THE

SEQUELAE, MANAGEMENT, AND PREVENTION

OF

URINARY INFECTION

IN

RETROPUBIC PROSTATECTOMY

by

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EXPLANATORY NOTES

PRESENTATION

This thesis is presented in three volumes. The first two contain the text. The third contains the tables, graphs, and histograms applicable to the text.

NOMENCLATURE OF ORGANISMS

Organisms which were studied in compiling this thesis are named according to MEDICAL MICROBIOLOGY (1965) edited by Cruikshank et al and published by Livingstone, Edinburgh.

Organisms mentioned by other authors are named as in the original publications.

'STERILE' AND STERILE

The adjective sterile when used with reference to urine in this thesis is written thus - 'sterile' - since it is realised that in some of these patients organisms were present in the urine (see definition of 'sterile' urine on page 55 Vol I).

Sterile when used by other authors is written as in the original publications.

SECTION I

INTRODUCTION

HISTORY

INTRODUCTION

The influence of urinary infection present at the time of retropubic prostatectomy, on the complications which follow this operation, has not so far been detailed.Such urinary infection has not been related to other factors which might influence these post-operative complications.

Much more attention has been paid to mortality following operation and figures are quoted by Millin et al (1949), Jacobs (1951),Salvaris (1960), Stearns (1961), and others. Further series in which mortality rates are especially studied have been published by Lich (1953), Blue et al (1958), and Boreham (1964).

Other series consisting of patients having other forms of prostatectomy are also available for study and are mentioned below. (See Discussion on Mortality) A number of factors which might influence mortality have been discussed by these authors but urinary infection per se has not yet received special study.

The value of prophylactic antimicrobial agents in all forms of prostatectomy is still in doubt. (See Discussion on Antimicrobial Agents)

Bacteraemia as a complication of retropubic prostatectomy has already been documented by Marshall (1961) and Steyn et al (1962). Their results are conflicting and further work seemed indicated.

Millar et al (1958), Debenham (1960), and McKelvie (1962) have all used different methods to maintain urinary sterility during convalescence in patients who present for retropubic prostatectomy (or some other form of prostatectomy) with sterile urine. These methods, or modifications of these methods, have not been independently assessed and so far no one has considered the practical value, in terms of post-operative morbidity and mortality, of maintaining urinary sterility throughout a patient's hospital stay.

The Present Study

The present work was planned as a prospective study of a large number of consecutive patients undergoing retropubic prostatectomy. The investigation commenced on January 1st. 1954 and continued until December 31st. 1960. In all 761 patients were studied in this period.

Because of the work mentioned above on the maintenance of urinary sterility a second investigation was commenced on January 1st. 1963 and continued until June 30th. 1964, when 145 consecutive patients were studied in this period. From the data thus gathered the following points were explored -

I The detailed incidence of post-operative complications and mortality following retropubic prostatectomy. (Patients studied 1954-1960.)

II Factors which might influence morbidity and mortality were studied separately.

(a) in cases coming to operation with 'sterile' urine. (Patients studied 1954-1960.)

(b) in cases coming to operation with infected urine. (Patients studied 1954-1960.)

These factors were -

1 General

(a) Age

(b) State of cardio-vascular and respiratory system

(c) Condition of urinary tract at time of operation

(d) The existence of diabetes

(e) The duration of preliminary catheter drainage

(f) The source from which the patient was referred

2 Factors related to the prostate gland and its enucleation -

(a) Weight of gland

(b) The number of lobes

(c) The ease of enucleation

(d) The presence or absence of microscopic signs of infection.

(e) The effect of blood loss at operation

3 The value of prophylactic antimicrobial agents.

III Post-operative Bacteraemia was studied as a separate entity as regards -

(a) Its incidence

(b) The organisms responsible

(c) Its duration

(d) Its significance

(e) The value of antimicrobial drugs and pre-operative urinary drainage systems on its prevention (Patients studied 1954-1960, and 1963-1964).

IV The Elimination of Urinary Infection -

(a) A modification of the method described by McKelvie (1962) using Ureaphil was assessed as to its ability to maintain the urine 'sterile' throughout the stay in hospital of a patient having retropubic prostatectomy. (Patients studied 1963-1964.)

(b) The practical value of maintaining the urine 'sterile' throughout the hospital stay, in patients having retropubic prostatectomy, was assessed. (Patients studied 1963-1964.)

HISTORY

Although this present work is concerned with retropubic prostatectomy (Millin, 1945) it is worth while to review the problem of urinary infection as it is related to the various methods of prostatectomy which have previously been described. Briefly, infection has played a varied role. First, as an agent to which the weak succumbed in the days when catheterisation rather than prostatectomy was the treatment of the enlarged prostate. Later, at the time of the two-stage operations it was tolerated, since it appeared to give patients who had survived the first stage an immunity towards further infection which might occur at the second stage. Later still it was abhorred as a failure of surgical methods. In more recent years urinary infection and its possible sequelae are still regarded with great respect by Urological Surgeons. It is now looked upon as something which we can, perhaps, treat and certainly something which we can to a large extent prevent.

Since to give a purely chronological history would be tedious, for the purposes of this thesis I have divided the subject into the following sub-headings,

1 The problem of urinary infection as mentioned in the various outstanding publications on the subject of prostatectomy

2 The possible part played by urinary infection in other major series which have been published on the subject of prostatectomy but in which this infection has not been specifically assessed

3 History of the effect of medical conditions present at operation on post-operative morbidity and mortality

4 History of antimicrobial prophylactic agents in prostatectomy

5 History of bacteraemia as related to urethral instrumentation and to prostatectomy

6 History of the management of bladder drainage and irrigation

The Problem of Urinary Infection as Mentioned in the Various Outstanding Publications.

As stated above, in the late nineteenth century urinary infection consequent on months or years of intermittent catheterisation was a common cause of death in patients suffering from an enlarged prostate. In fact it must have acted as a means of natural selection for the earlier series of cases since patients coming to prostatectomy at this time had already withstood the onslaught of considerable infection, and had no doubt already acquired a certain degree of immunity.

It would appear that cases coming to operation in the earlier series were all infected, and in 1895 Fuller noted that sepsis along with haemorrhage and shock were the commonest causes of mortality following prostatectomy.

Thomson-Walker writing in 1927 put sepsis in first place as one of the "failures" of prostatectomy. He noted that in hospital practice 53% of cases presented with the bladder infected by the catheter. In considering post-operative infective complications in these infected cases he referred to Winsbury White's paper of 1922 in which the incidence of epididymitis was found to be 82%.

Thomson-Walker writing again in 1930 stated, "Sepsis in relation to the enlarged prostate and prostatectomy is a failure of surgical methods". He mentioned cystitis, epididymitis, pyelitis, and pyelonephritis as pre-operative complications secondary to an infected urine. In discussing the causes of death in 269 fatal cases he showed that 23.4% of this number died from definite infective complications. A further 24.9% died from renal failure, and no doubt infection played a great part in these deaths. He then went on to mention sepsis as one of the avoidable causes of serious haemorrhage after prostatectomy and discussed the role of infection as an "immuniser" in two-stage operations. Writing again in 1932 he mentioned dysuria, frequency, and calculus formation as sequelae due to sepsis.

In 1936 Morson wrote, "So far as hospital practice is concerned it is the exception rather than the rule for the urine to be sterile on admission of the patient for operation." He felt that when infection reached the kidney there was no certain remedy for its elimination.

Rees in 1947 found a mortality of 14.9% in 589 patients operated upon between 1939 and 1945. Of the 88 who died 64 had post mortem examination, and of these, severe sepsis was a cause of death, or a direct contributory factor in 38 (59%).

In 1949 Riches compared a series of patients who had had the retropubic operation with a further series in whom the Harris technique had been used. The mortality rates were 6.7% and 6.6% respectively and Riches noted that the cause of death was generally cardiac or pulmonary contrasting with the older figures, where uraemia, sepsis, and haemorrhage predominated. He described a number of post-operative infective complications but did not state if the urine was sterile at the time of operation. In contrast, Walters (1949) advocating immediate prostatectomy, noted that the chief cause of mortality at this time was still infection.

In the same year, Wells in discussing the problems of chronic urinary retention stated, "With very few exceptions the urine is sterile in chronic retention and in prostatics generally, unless there has been previous instrumentation." This author also pointed out that the control of infection was one of three cardinal points in the maintenance of good renal function in the presence of chronic prostatic obstruction.

Argument as to the part played by infection in the post-operative mortality following prostatectomy in general continued. Aitken (1953) describing 150 cases treated by immediate Wilson Hey prostatectomy considered infection, which accounted for most of his deaths (10% mortality), to be still the commonest complication of prostatectomy in spite of antibiotics. On the other hand, Dawson-Edwards (1956) showed that where sepsis was a direct contributory factor in 38 (59%) of the 64 deaths previously cited by Rees from the Urological Department in the Queen Elizabeth Hospital Birmingham, (1939-1945), only 5 (17%) of 29 cases in 1948-1953 were directly or indirectly attributable to urinary tract infection.

In a study of "Renal Function in Prostatism" published in 1957 by Olbrich et al infection was shown to diminish tubular function in elderly men just as chronic obstruction (in the absence of infection) reduces renal plasma flow and glomerular filtration rate. He quotes Lich who made similar studies in 1942, but did not mention the factor of infection.

As late as 1958 McEachern stated that in prostatic surgery sepsis was to be feared above all else - especially in the patient with poor renal function. Ross and Tinckler (1959) described "Some Common Complications after Prostatectomy". They studied 100 patients, 48% of whom were over 70 years of age and 33% of whom had infected urine at the time of operation. They noted the marked prevalence of urinary infection in the first 4 weeks after operation, in fact, 98.8% of their cases became infected in the first 4 weeks. Apart from urinary infection itself they noted epididymitis as a post-operative infective complication whose incidence in their series was 7%. Temporary incontinence, post-meatal stricture, and temporary supra-pubic leakage are mentioned as other complications of prostatectomy. They felt that temporary suprapubic leakage occurred particularly in aged and feeble patients with concomitant medical diseases, or chonic uraemia and secondary anaemia. They did not discuss the effect of urinary infection on the incidence of these complications.

In 1960 Salvaris evaluated 1200 retropubic prostatectomies. Of his patients 36% were aged 70 years or over and 40% had infected urine at the time of operation. He noted the incidence of several post-operative complications e.g. haemorrhage (8%), wound infection (10%), and epididymitis (3%). He also mentioned urethritis, rigors and pyrexia, and pyelonephritis as other post-operative infective complications. Suprapubic leakage, temporary incontinence, and general medical complications are also mentioned. Salvaris did not attempt to assess the influence of urinary infection at the time of operation on the incidence of these complications. In his series of 1200 patients the mortality was 4.2%. Of the 50 patients who died 7 had uraemia, 2 had retropubic abscess, and 3 had peritonitis following perforation of an abscess. These 12 cases would be classified in this thesis as infective deaths, i.e. nearly 25% of the deaths were from infective causes. Salvaris wondered why pre-operative infection should contribute so largely to increased mortality when all cases showed post-operative infection.

In recent years certain specific post-operative infective complications have been singled out for mention. Thus, in 1961, Grace referred to the high incidence of ascending pyelonephritis as a cause of death in a series of cases which he studied. In particular he quoted three cases all of whom showed a pre-operative blood urea of over 140 mgm. per 100 ml. and all three of whom died. Grace did not mention whether or not these patients had infected urine at operation.

<u>The Possible part played by urinary infection in other major series which have been published on the subject of prostatectomy but in which this infection has not been specifically assessed</u>.

At the end of the last century catheterisation rather than prostatectomy was the treatment for the enlarged prostate. It is almost certain, then, that all patients who came to prostatectomy at this time and early in this century had infected urine. McGill in 1889 described a very interesting series consisting of 24 patients, most, if not all, of whom must have been infected at operation, judging by the duration of "catheter life" which had been endured by many before operation, and the high incidence of bladder calculus at the time of operation. The author however mentions the presence of pyuria in only 4 cases. The average age (65.7 years) was rather lower than that in series published recently. In fact, only 7 of the 24 cases were aged 70 years or over. The main infective complication after operation would appear to have been wound infection, and the average time after operation for the wounds to heal was 41 days (data from 9 cases). All wounds were infected to some degree. Cystitis and bladder irritation are mentioned in 3 cases (12.5%).

There were 5 deaths in this series, a mortality of 20.8%. Of those 5 patients, one died from a chest infection, but it would appear from McGill's paper that infection of the urinary tract was the causal factor, or certainly a predisposing factor, in the other 4 deaths. Three of these 4 patients were very poor operative risks - 1 had a very high temperature and foetid urine, and the other 2 were noted to be in a deteriorating clinical condition.

In 1890 Belfield published a series of 85 patients who came to prostatectomy. The mortality was 17 (13.6%) and of these, 6 definitely died from infective causes (excluding chest infections). Four patients are noted as dying of shock, in some this may well have been bacteraemic shock although this was not then recognised as a clinical entity. Assuming then that only the fittest cases survived long enough to require operation, there was a mortality from infective causes of at least 7.1% and infective causes accounted for 52% of the deaths.

Freyer (1901) first brought firmly to light the value of complete adenectomy, and in this and the subsequent years until 1912 he published a large number of papers and several large series of cases. He published his first 53 cases which are of especial interest in the present context, and thereafter he published only certain selected cases. In analysing his first 53 cases, all of whom were infected, the average age was 67 years, the average time for wound healing was 25.8 days (data taken from 39 cases), and the average stay in hospital after operation was 38 days (data from 27 cases).

In these 53 consecutive cases there were 5 deaths, a mortality of 10%. It is difficult to say what part infection played as a cause of death in these cases. One patient is noted as having died of pneumonia, 2 appear to have had mental changes before death and these may well have been due to septic absorption. One patient died from "heat stroke" and another became drowsy and was quite possibly uraemic.

In 1912 Freyer published his major report on 1000 cases treated by his method of prostatectomy. The average age of his patients was 69 years and Freyer recorded that they were nearly all in broken health with cystitis, vesical calculus, pyelitis, kidney disease, diabetes, heart disease, thoracic aneurysm, chronic bronchitis, paralysis, and even, in a few cases, carcinoma of some other organ. The mortality for this series was 5.5%. Infection was a definite causal factor in at least 26 (47%) of the 55 deaths. Freyer noted that in many of his patients who died of cardiac or pulmonary disease primarily there was also present kidney disease, and this, I feel, was probably of infective origin in a great many cases. It is of interest that, although all cases were doubtless infected before operation, those who had bladder calculi at operation showed a mortality of 8.84% as against a mortality of 4.76% in the remainder of his series

In 1903 Hugh Young of Baltimore, published his paper on "Conservative Perineal Prostatectomy". In 15 cases he noted no post-operative complications apart from temporary incontinence and temporary fistulae. There were no deaths.

Harris (1934) published a 5 years experience of prostatectomy with bladder closure. A series of 371 cases was studied. He did not detail the post-operative infective complications but the mortality was 2.7%, i.e. there were 10 deaths. Only one of these deaths could definitely be attributed to sepsis. In his series he gave no details of age, the presence or absence of urinary infection at the time of operation, or the period of preliminary catheter drainage.

In 1941 Milner et al published a series of 700 patients (average age 67 years) having transurethral prostatic resection. Milner did not state how many of his patients were infected at operation but we know that over 60% had a complete urinary retention. It is probable that over 50% of his cases were, in fact, infected. The mortality rate was 3.4% and the authors noted, "Cardiac failure is responsible for most of the deaths at present."

The year 1945 saw the publication of two papers both of the utmost importance. Wilson-Hey described his technique in a paper entitled "Asepsis in Prostatectomy" and

Millin described his technique in a paper "Retropubic Prostatectomy". Wilson-Hey also described in his paper a series of 300 patients on whom he had carried out aseptic prostatectomy. The average stay in hospital after operation (excluding fatal cases) was 16.3 days, and the average mortality was 6.0%. He showed how the presence of marked systemic disease, poor renal function, and urinary infection, could increase the mortality rate, but he did not assess these factors separately.

In discussing other techniques Millin, in his paper, mentioned the relatively high incidence of post-operative infective complications which he felt occurred when these methods were used. He described a series of 20 cases treated by his own method (average age 68.1 years). The average post-operative stay in hospital was 19.9 days and he recorded secondary haemorrhage as a post-operative infective complication. This occurred in 10% of patients. Pyelonephritis was not noted. There were no deaths in this short series and at least 18 of the 20 patients would appear to have had a urinary infection at the time of operation.

Millin et al wrote again in 1947 and described a series of 757 patients. The part played by infection in this series was not detailed, however, but from the figures quoted, it would appear that perhaps about 60% of patients came to operation with sterile urine. Pelvic cellulitis, osteitis pubis, secondary haemorrhage, and funiculitis, are mentioned as infective complications. Their incidence is not cited, and the mortality due to infective causes is not stated.

In 1951 Jacobs published a series of 500 patients on whom retropubic prostatectomy had been carried out. He did not mention how many of these patients had infected urine at operation but he noted certain post-operative complications. In particular the incidence of secondary haemorrhage was between 6% and 8% and a few cases showed urinary leakage from the wound. The overall mortality in this series was 6% but the author noted that mortality increased as did the age of the patients operated upon, and in fact he stated that in 80 patients who were aged 75 to 87 years the mortality was 8.7%.

In 1961 Greig described a series of 197 patients with prostatic disease who were admitted to the surgical wards of a small provincial hospital. Their average age was 70.9 years and 70% of these patients had urinary retention. He mentioned a number of complications which occurred fairly soon after prostatectomy. Among these were epididymitis (4.8%) and osteitis pubis (1.8%). Urethral stricture and urinary incontinence were also mentioned among other complications, but again the influence of urinary infection at the time of operation upon the incidence of these complications was not noted. The mortality rate for those cases in Greig's series which were treated by prostatectomy was 11.6%. He noted, however, that the mortality of prostatectomy in patients having urinary retention was very much greater than the mortality in patients who did not have retention. His findings were 15.8% with retention and 9.8% without retention. In this series, cause of death is based purely on clinical findings. In 17 of the 22 patients who died following prostatectomy a cause of death is given. Of these 17 cases, 5 (29%) died from renal failure - probably of infective origin.

Stearns (1961) quoted a series of 500 retropubic prostatectomies carried out in U.S.A. The average age of his patients was 67 years and 36% had had pre-operative catheter drainage. We do not know the incidence of urinary infection at the time of operation but the incidence of post-operative infective complications was very low (7%). The mortality was only 0.6% and none of the deaths was from infective causes.

In 1962 Scorer and Knight published a detailed study of 200 cases of urinary retention treated between 1949 and 1952, and a further 200 cases treated between 1957 and 1960. All cases were due to prostatic enlargement. They gave full details of the age incidence of their patients, and of the duration of pre-operative catheter drainage.

They did not state specifically how many of the patients in each group were infected at the time of operation. It was noted that a mortality following prostatectomy of 15.5% between 1949 - 1952 fell to 6.2% in the 1957 - 1960 period. In the 1949 - 1952 series there were 20 deaths and 9 (4.5%) of these were from infective causes; in the 1957 - 1960 series there were 8 deaths and 2(25%) of these were from infective causes.

Thus far it will be seen that, ever since the first written description of retropubic prostatectomy, authors have been aware of the dangers of infection. Post-operative complications have been mentioned by many writers although none in this country has given a detailed account of the incidence of these complications and no one has compared the relative incidence of post-operative complications when the urine was (a) 'sterile' or (b) infected at the time of prostatectomy. Many authors have given fairly detailed accounts of the part played by infection in post-operative mortality. In the earlier writings infection generally accounted for between 50% and 80% of the deaths which occurred in any series. As recently as 1947 and 1953 authors noted that infection accounted for more than half of the deaths in different series of cases following prostatectomy. In the more recent series of cases described up until 1962 infection would still seem to have accounted for between 20% and

and 25% of the deaths following prostatectomy. There are one or two notable exceptions to these figures, namely Harris in 1934 who described a 10% mortality due to sepsis and Stearns (1961) who found no infective deaths in a series of 500 cases.

<u>History of the effect of medical conditions present at operation on post-operative morbidity and mortality</u>

For the purposes of this thesis it is necessary to review this subject briefly.

The influence of medical conditions present at operation on post-operative morbidity and mortality is studied later in this work. (see page 123)

It has long been realised that medical conditions present at the time of operation can adversely influence prognosis. Thus Freyer in his paper published in 1912 noted that many of his cases suffered from diabetes, heart disease, chest disease, or paralysis. Iversen (1955) studied the problem of prostatectomy in patients with heart disease. He attempted to assess the risk involved in carrying out prostatectomy on such patients. He concluded that there was an increase in post-operative complications in patients with heart disease. The complications he mentioned were, haemorrhage, paralytic ileus, phlebothrombosis, pulmonary embolism, pneumonia, and atelectasis. Iversen pointed out that not only was the incidence of post-operative complications increased in patients suffering from heart disease, but more important, the death rate from these complications was much higher. He found the mortality rate in a series of patients who had no heart disease to be 1.9% and in a series of patients with heart disease it was 6.7%. He did not mention the question of urinary infection at operation nor did he mention post-operative infective complications.

In 1958 Ellis and Leatherdale noted that the prognosis after prostatectomy was made worse by advancing age and by severely impaired cardiac, renal, or pulmonary function. They did not note however, the possible part which might be played by infection in worsening the prognosis.

Kass (1962) questioned the finding that pyelonephritis occurred more frequently in diabetes. He pointed out that these cases often required catheterisation because of neurological disease affecting bladder function and also that they often had degenerative vascular disease affecting the kidneys. He stated that a diabetic coming to prostatectomy need not have an infection of the kidneys. The diabetic, however, may be more likely than a normal individual to develop such an infection during his hospital stay.

Scorer and Knight (1962) in discussing the medical factor, i.e. the medical conditions existing at operation, and their relation to prostatectomy mortality stated, "If it may be said that the effective hazards of prostatectomy are being eliminated, there will always be a limit to what can be done in the medically unfit." These authors noted that patients with medical complications had a higher mortality rate than normal individuals. They also pointed out that patients with medical conditions who may have recovered completely from prostatectomy often succumbed very soon afterwards to that medical condition from which they suffered before operation.

History of Antimicrobial Prophylactic Agents in Prostatectomy

In 1938 Gaudin et al investigated the "Use of Sulfanilamide after Transurethral Prostatectomy". They studied 100 cases who were given this sulphonamide after operation along with 100 controls and concluded that there was no sound basis for the administration of sulfanilamide in routine post-operative management of these cases.

In 1942 Strom et al studied 100 patients given sulphathiazole and compared these with 100 controls. They concluded that this agent administered as a prophylactic in cases of transurethral prostatic resection lessened post-operative febrile reaction and lessened the number of infective complications.

In 1951 Merritt described a 10% incidence of bacterial endocarditis in patients with valvular heart lesions who underwent transurethral resection. He suggested that patients with valvular heart disease who required transurethral resection should be given Aureomycin as a prophylactic. Also in 1951 Jacobs, writing on his series of 500 cases who had had retropubic prostatectomy, said, "Urinary antiseptics, usually sulphonamide with penicillin or streptomycin, are routine".

In 1954 Greevy and Feeney published a thorough clinical investigation into "The Routine Use of Antibiotics in Transurethral Prostatic Resection". They showed that convalescence was smoother and the incidence of post-operative infective complications was less when certain broad spectrum antimicrobial substances were used as prophylactics over the period of operation. With these agents also mortality was greatly reduced. In their series, however, they did not state exactly the number of patients in whom the urine was infected at the time of operation.

In 1955 Jackson et al published evidence to show that, since the advent of the broad spectrum antibiotic agents, there had been an increase in infection with organisms which tended to be resistant to most antibiotics. The organisms cited were paracolon, aerogenes, pseudomonas, proteus, and str. faecalis. The authors felt that pyelonephritis clinically was not decreasing in incidence, but that antibiotic resistant organisms were relatively more frequent as aetiological agents in this disease. Thus an increasing awareness of the problem of theemergence of antibiotic resistant organisms as a result of the use of broad spectrum agents is here related by the authors to the problems of the urinary tract.

Antibiotic prophylaxis in transurethral prostatic resection formed the subject of a further paper in 1955 this time by Simon et al. Of 1118 patients 35% were infected at operation. The authors concluded that the routine use of prophylactic antibiotics was of definite value in both sterile and infected cases. They also discussed post-operative fever and suggested that generally this was not of bacterial origin. Fever occurring on removal of the urethral catheter, they considered, was of bacterial origin.

Appleton and Waisbren (1956) reported on the prophylactic use of chloramphenicol in transurethral resection. They noted that antimicrobial drugs may increase resistant strains of organisms and that toxic reactions had been reported from the use of these drugs. They found no advantage in the prophylactic use of chloramphenicol in transurethral resection. It is of interest that Ross and Tinckler (1959) observed that antibiotics given after operation were of no value in reducing the incidence of epidiymitis in the convalescent period.

In 1962 the Lancet discussed bacterial endocarditis. The value of prophylactic antimicrobials in cases with congenital heart disease or acquired valve lesions was pointed out, and the necessity for such prophylaxis before instrumentation or operation on the urogenital tract was stressed.

In addition to the emergence of resistant strains of organisms attention was drawn, about this time, to other dangers of the use of antibiotics. In particular the Lancet (1960) in considering the question of "Treatment of Infections in Hospital" pointed to the fact that "The antibiotic era has witnessed a change from pneumococcal to staphylococcal and coliform septicaemias". In 1961 the British Medical Journal mentioned the dangers of chloramphenicol administration. Several papers were quoted to show that the danger of aplastic anaemia following chloramphenicol administration might be much higher than had been supposed - even after small total dosage of the drug. In 1962 Cahill described a severe haemorrhagic reaction following the administration of chloramphenicol.

Loughbridge (1962) described peripheral neuropathy due to nitrofurantoin. It was suggested that this drug should not be used where there was significant renal failure. Ellis (1962) described acute polyneuritis after nitrofurantoin administration.

In 1962 the dangers of chloramphenicol were further emphasised by Hutchison and Pinkerton who described 3 cases of marrow depression following the administration of fairly large doses. Two of their cases were fatal. Chloramphenicol toxicity was again stressed by Sharp (1963) who analysed 40 cases of blood dyscrasia induced by this drug. The author felt that there was no justification for using chloramphenicol to treat post prostatectomy urinary infection unless it had been shown by careful bacteriological sensitivity tests that the offending organism was sensitive to no other antibiotic.

A further drug - tetracycline - sometimes used as a prophylactic agent in retropubic prostatectomy was mentioned in 1963 in the Lancet. It was pointed out that this drug used over a period was deposited in the nails and teeth. It would appear to have toxic effects which are more marked, however, in the foetus and children than in the elderly male.

Thus, in considering antimicrobial agents in general, it is seen that there is still a difference of opinion as to their value. Certain facts are agreed. First, antimicrobial substances are of value as prophylactics in patients with valvular heart disease who are to have instrumentation or operation on the urinary tract. Second, antimicrobial agents give rise to the emergence of resistant strains of organisms. Third, these agents all have toxic effects, some more serious than others.

History of Bacteraemia as Related to Urethral Instrumentation and to Prostatectomy

Blood stream infections in urology have excited interest for many years now, Hallé (1887) in a patient dying rapidly from an infective illness recovered from a renal abscess, and also from the urine and the blood, a short ovid organism which did not liquefy gelatine.

Moullin (1898) believed the cause of urinary fever to be virulent bacilli, or their toxic products, in the blood stream. Bertelsmann and Mau (1902) described 3 cases of urethral fever with positive blood cultures following instrumentation of the urethra. Crabtree (1916) also reported positive blood cultures in patients following urethral catheterisation, and in pyelonephritis.

Judd (1917) appears to have been the first author to describe a search for bacteraemia in relation to prostatectomy. He, however, failed to obtain positive cultures before, during or after operation, or at definite intervals following "chills". In 1929 Scott described 82 urological patients who had blood stream infections. A large number of these infections followed prostatectomy carried out either by the perineal, suprapubic, or transurethral route. In some cases the blood stream infection occurred immediately after operation and in others it was delayed, occurring from 6 days to 4 weeks after operation, either at the first voiding of urine or in the presence of some infective complication, such as wound infection, epididymitis, or pyelonephritis. Scott noted that 77% of the blood stream infections were bacillary and 23% coccal. He pointed out that most of these were much more common than true septicaemias.

Post-operative bacteraemia seems to have had little attention from then until 1954 when Creevy and Feeney published an account of bacteraemia following transurethral prostatic resection. They found that post-operative bacteraemia occurred in 10.8% of patients with a sterile urine, and in 57.5% of those whose urine was infected at operation. They felt that bacteraemia might be the cause of a severe illness characterised by circulatory collapse, or of bacterial endocarditis. Writing in the same year, however, Bulkley et al published 128 cases who had pre and post-operative blood cultures made. Their series included many infected cases most of whom received pre-operative antimicrobial medication. Only 3 patients had positive post-operative blood cultures (1.56%). They therefore considered that this post-operative bacteraemia was not of any apparent significance. Their patients all had transurethral resection.

Also writing in 1954 Spittel et al described 65 patients with bacteraemia due to Esch. coli but all cases were detected because of clinical symptoms. Of the 65 patients 14 had had previous urinary operative manipulations. The authors pointed out that these cases were often fatal, and required urgent antimicrobial treatment if they were to survive.

In 1955 Grey wrote on "The Incidence and Type of Bacteraemia at the Time of Various Prostatectomy Procedures". He found 45.4% positive blood cultures after transurethral resection and 5.8% positive cultures after enucleation of the prostate, either by the suprapubic, retropubic, or perineal route. He also found that with resection most of the organisms found in the blood were gram negative bacilli whereas with enucleation the majority of organisms found in the blood were gram positive cocci. He noted that there was no increased mortality or morbidity in patients with positive blood cultures.

Slade (1958) wrote about the presence of bacteraemia of a transitory nature at the time of removal of the indwelling catheter after prostatectomy. He believed that this was the portal of entry by which septicaemia could occur after urological operations. Gillespie et al (1960) noted the dangers of invasion of the blood stream by bacteria from an infected urinary tract, particularly septicaemia. This has been caused more often by urological infection than by the staphylococcal infection of wounds so frequently documented in recent years.

Talbot (1962) described 20 cases of "Septicaemia due to Gram Negative Bacilli". He pointed out that treatment must be urgent. In 6 cases the onset of the condition came a few hours after removing a catheter which had been left in situ following prostatectomy. In another case the onset was after the blockage of a catheter.

Steyn et al in 1962 published their experiences of "Bacteraemia Following Prostatectomy". They found a positive culture in 16.7% of infected cases. Bacteraemia persisted for 9 hours in one case and in another went on to become septicaemia with ultimate death. In their experience only B. Proteus and Str. faecalis were encountered in the blood stream. Since bacteraemia occurred only in patients who had been catheterised, a no-catheter technique was advised with prostatic cases (Debenham et al 1960).

Shubin et al (1963) described 692 patients with bacteraemia. Of these patients 169 were shocked, and of those shocked 40% had had recent manipulation of the urinary tract by catheter, sound or cystoscope. More than 80% of the shock group had had diseases relating directly or closely to the urinary tract. In those patients with urinary tract disease and bacteraemic shock the organisms recovered from the blood were generally the same as those found in the urine. The authors noted that bacteraemic shock was most common in patients with urinary infection, and that, excluding blood loss and myocardial infarction bacteraemia was the most common form of shock in the general hospital services.

History of the Management of Bladder Drainage and Irrigation

Around the turn of the century when prostatectomy became an established procedure bladder drainage before operation was carried out by rubber urethral catheters or by suprapubic tubes. Suprapubic tubes were often used to improve drainage and allow irrigation in grossly infected cases. For the next thirty odd years there were no marked advances in drainage methods and in 1932 Joly pointed to the fact that some surgeons preferred suprapubic drainage whereas others preferred catheter drainage of the bladder before prostatectomy. He himself preferred catheter drainage. Following operations at this time bladder drainage was instituted through both a urethral catheter and a suprapubic tube.

Harris revolutionised drainage procedures when in 1934 he published his own technique of prostatectomy with bladder closure. The important points of his communication were first, that the urethra should be irrigated with 1/5,000 Oxycyanid of mercury before passing the catheter. Second, catheters draining the bladder should be connected to drainage tubes which in turn were led below the level of antiseptic solution in the drainage bottles. Third, urinary antiseptics e.g. sodium benzoate, hexamine, or acid sodium phosphate were given during the period of catheterisation. Fourth, the bladder was washed out once or twice daily with potassium permanganate and silver nitrate.

Apart from the above, of course, the Harris technique did away with the suprapubic tube as a second means of bladder drainage in the post-operative period, since he advised closure of the bladder and drainage via a urethral catheter. The bladder was washed out as necessary after operation with antiseptic solutions if clotting was marked.

Some 6 years later Emmett (1940) described a closed drainage system using a bottle which was boiled before use. He also described a Y-tube method of closed bladder irrigation. This description, from U.S.A., does not appear to have received much notice in this country. It is interesting, nevertheless, to realise that before the advent of retropubic prostatectomy published accounts are available of the use of antiseptic substances to irrigate the urethra before catheterisation, of the use of antiseptics in drainage bottles, and of a method of closed drainage and irrigation.

After 1940 most patients with prostatic obstruction who required bladder drainage had this effected by means of a urethral catheter. In a number of cases, however, it was still thought best to carry out suprapubic drainage, and a number of surgeons still favoured this method for the majority of their patients. In 1949, Riches described his experiences of suprapubic bladder drainage using a small diameter self retaining rubber tube which was threaded on to a trochar pointed introducer and stabbed into the bladder through a very short skin incision. Riches found that he could reduce the mortality of suprapubic cystostomy quoted as 28% by Rees (1947) to 5.2%. None of Riches deaths in a series of 227 cases was due to urinary infection. He found that the bladder urine was often maintained sterile as long as 2 weeks by this method.

The fact that infecting organisms reached the urinary tract very easily in the presence of an indwelling catheter was well known. The paths used by these organisms were not ascertained until 1951 when Weyrauch and Bassett published their important experimental findings which showed that motile bacilli in an artificial urinary tract could ascend a slowly moving column of urine, but not a more rapidly flowing one. In a stagnant column of fluid non-motile cocci could ascend provided they were associated with motile bacilli. The critical downwards speed of flow of the urine in this artificial tract would appear to have been between 45 and 50 ccs. per hour. Here then we have proof of the fact already surmised, that many organisms can travel upwards inside the lumen of tubes and catheters if the urinary output is not brisk enough, or should there be a blockage of the drainage system.

Further bacteriological investigation of importance in relation to the management of bladder drainage systems was published in 1954 by Shackman and Messent in an article entitled "The Effect of an Indwelling Catheter on the Bacteriology of the Male Urethra and Bladder". They found that the saprophytic organisms of the virgin male urethra were staphylococci, Str. faecalis, diphtheroids, Bact. coli, Str. viridans and bacilli of the Proteus group. Before prostatectomy the commonest urethral organism when an indwelling catheter was retained, was Staph. albus, but after prostatectomy Bact. coli was found almost as frequently as Staph. albus.

In 1955 Pyrah et al showed the importance of the various routes of cross infection in a urological ward, and described the marked decrease in post-operative infection which resulted from an improved technique of catheterisation. They used either a "no-touch" technique, or handled the catheter with sterile mittens, and also introduced a closed bladder drainage system where hitherto drainage had been into an open bottle by the bedside. This work of Pyrah et al in 1955 was the first of a number of important communications which have continued to the present time on the subject of the management of bladder drainage and irrigation.

In 1956 the Lancet pointed to infection as being the main danger of mis-managed bladder drainage. In 1957 Dutton and Ralston again stressed the importance of cross infection in urological wards. They found little evidence of auto-infection in patients with indwelling catheters. In setting up mock bladder drainage systems they found that both staph. pyogenes and str. faecalis (but not gram negative bacilli) survived the routine chemical disinfection treatment given to Winchester bottles. The above organisms could ascend from these Winchester bottles along sterile tubing to the artificial bladder against a flow of sterile urine. The authors quoted numerous ward sources from which urinary infecting organisms could be isolated.

Kass and Schneiderman (1957), in a beautifully designed experiment, proved for the first time, the ability of organisms to ascend into the bladder alongside an indwelling urethral catheter in the male.

In 1958 McLeod followed up the work of Pyrah, and Dutton and Ralston. He pointed to the urine bottle and bedpan as reservoirs of infection by pyocyaneous and noted that carbolic acid as a 2% solution and Hibitane as a 0.2% solution were among the antiseptics suitable for the elimination of this organism. In the same year Millar et al in Bristol described their system of closed bladder drainage and irrigation following prostatectomy and proved its efficacy in keeping the urine sterile after this operation. Apart from a closed system of drainage and irrigation after operation they also suggested that each drainage bottle should contain 100 ml. of liquid formaldehyde B.P.C. These authors also noted, that in addition to the methods described, further lessening in the incidence of infection following prostatectomy could be obtained by an improved technique of sterilising cystoscopes, and in particular by sterilising these instruments in the vertical position. In the same work the authors showed that organisms could ascend drainage tubes in air bubbles as opposed to ascent in the fluid contained in the tubes, as described by other observers.

The importance of cross infection in the presence of an indwelling catheter had already been stressed on several occasions. In 1959 Liedberg found nosocomial urinary tract infections in the presence of an indwelling catheter and showed that nosocomial proteus infection was present in 75% to 80% of patients after 7 days on continuous catheter drainage.

In 1960 Millar and his colleagues reported further studies in the prevention of urinary infection after prostatectomy. They showed conclusively how several anti-infective measures when taken together, would maintain the sterility of the urine in patients whose urine was already sterile at the time of operation. The additional method which they described in this study was the irrigation of the urethra with a solution of 0.05% chlorhexidine in glycerol. By a combination of all the methods which they described they were able to maintain urinary sterility in 95% of patients throughout their hospital stay.

In 1960 Debenham et al described a series of cases undergoing retropubic prostatectomy in whom a no-catheter technique was used at operation, the patients being returned to the ward without an indwelling catheter. By these means they were able to maintain the urine sterile throughout the hospital stay in 18 (82%) of 22 cases.

In 1962 McKelvie described yet another technique for the pre and post-operative drainage of the bladder. Before operation he used the catheter described by Gibbon in 1958 draining into a Gamma-ray sterilised disposable plastic bag of 1500 ml. capacity. At operation a self-retaining balloon type of catheter made of plastic was placed in the bladder. The need for bladder irrigation following operation was obviated by the intravenous administration of 4% urea in 5% dextrose, "Ureaphil" (Abbott), given intravenously. Three thousand ml. were given each 24 hours for the first 72 hours following operation. The Ureaphil - which may also have had a bacteriostatic effect - acted as a diuretic and the increased urinary flow washed out blood before clotting could take place. Very few cases therefore required post-operative bladder irrigation and McKelvie was able to maintain urinary sterility in 81% of his patients throughout their hospital stay.

Perfection in methods of bladder drainage, particularly in those cases who require drainage for a long period, is still being sought. In 1962 McLeod described a method for use in such cases. This method was used in paraplegics but would be applicable to certain cases with prostatic retention particularly those with some medical condition who would require medical treatment before operation could be carried out. McLeod's method consisted of daily change of catheter and the use of Polybactrin. spray to prepare the external genitals before catheterisation. He also advocated irrigation of the anterior urethra with a solution containing 1.0% each of bacitracin and neomycin and 0.4% of polymyxin before inserting the catheter.

In 1965 Roberts et al described their technique when catheter drainage was undertaken for longer than 7 days. In this prolonged type of drainage they felt that the best results were obtained by the use of a plastic balloon catheter draining into a plastic bottle containing an adequate disinfectant (e.g. 100 ml. 40% formaldehyde). Changes of bottle were carried out at regular hours by senior nursing staff who were well aware of the danger of careless manipulations. In cases of accidental disconnection the bladder and catheter were irrigated with 60 ml. of 1/5000 aqueous chlorhexidine. Using this technique they had an infection rate of 21% in 29 cases.

SECTION II

DEFINITION OF TERMS

MATERIAL AND METHODS

DEFINITION OF TERMS

The following definitions are submitted in order to clarify the meaning of the terms used throughout this thesis.

Ascending Infection

Ascending infection was considered to exist

1 In patients who developed a temperature and who had pain and tenderness in one or both loins.

2 In those patients whose general health showed a deterioration over a period of a few days with a diminished urinary output and a rising blood urea; these patients often had no pyrexia and there was nothing in the way of loin pain or tenderness.

3 In patients who had a temperature of more than 99^{o} Fahrenheit on any 6 days of his convalescence. These patients had nothing whatsoever in the way of symptoms and there was no evidence of any chest infection. They all, however, had urinary infection. No overt localised infection became apparent in these patients as convalescence went on.

Cardio-vascular Complications

This group comprised patients with various degrees of myocardial ischaemia and patients with congestive cardiac failure.

Case - Infected

A patient in whom the urine is infected (see definition below) at the time of operation.

Case - 'Sterile'

A patient in whom the urine is 'sterile' (see definition below) at the time of operation.

Cerebral Complications

These consisted of either cerebral haemorrhage or cerebral thrombosis.

Cystitis

Cystitis was considered to exist when the patient complained of marked dysuria and frequency after the withdrawal of the catheter. Very often there was co-existant pyrexia.

Death - Infective

Death from pyelonephritis, septicaemia, or pyaemia.

Death - Medical

Under this heading have been grouped all other causes of death. The majority of deaths were from pulmonary, cardio-vascular, or cerebral causes. Deaths from pulmonary embolism, reticulosis, gastro-intestinal haemorrhage, and those during anaesthesia have also been included.

Epididymitis

Epididymitis was considered to exist when the epididymis on one or both sides were definitely swollen and tender. In many cases the testicle appeared to be involved. These patients had considerable pain and often marked pyrexia.

Funiculitis

Funiculitis was considered to exist when there was a brawny induration involving the spermatic cord and the skin of the upper part of the scrotum. There was generally no swelling of the epididymis or testicle.

Haemorrhage - Urinary Tract

This group includes only haemorrhages occurring on the 6th day after operation or later i.e. secondary haemorrhage. Severe haemorrhage at operation or reactionary haemorrhage - that is haemorrhage occurring very soon after operation - are not included.

Lower Urinary Tract Infective Complications

This group comprised funiculitis, epididymitis, and cystitis as defined in this section.

Medical Disease

These patients either had co-existant cardiac or respiratory disease as detected on clinical examination, or shown by electrocardiography, or X-ray of the chest, or a history of coronary artery disease, or a history of chronic respiratory disease.

Pelvic Cellulitis

This in fact was a deep wound infection. The patient had a marked pyrexia and lower abdominal pain. The wound appeared normal but eventually after about ten days some reddening became apparent and on probing a large quantity of pus was evacuated.

Poor Control

This was considered to exist if the patient was unable to control the urine after the catheter had been out for 7 days. Almost all these cases regained control over the next few weeks or months but they did act as complications in the period of convalescence.

Respiratory Complications

These consisted generally of exacerbations of bronchitis, the development of pneumonia, and in certain cases embolic phenomena. A number of patients with various degrees of pulmonary collapse are also included.

Suprapubic Leak

This consisted of a leak of urine either through the wound or through the stab wound in which the drain had been placed. This suprapubic leakage was sometimes, but not always, accompanied by wound infection.

Urinary Tract Disease

These patients, in the main, had a blood urea of over 50 mgm./100 ml. at the time of operation, or a fairly markedly abnormal I.V.P. e.g. one showing marked bilateral renal dilatation or one showing no renal function on one or both sides. A few of these patients had a history of previous transurethral prostatic resection or previous urinary tract infection. The presence of a solitary renal stone with no other renal abnormality on I.V.P. was not considered to constitute urinary tract disease. The presence of infected urine as defined below was not considered to constitute urinary tract disease.

Urine - Infected

1954-1960 Series

Urine was considered to be infected if -

(a) Pus, Pus+, or Pus++ was present and a moderate or good growth of organisms

or

(b) Pus+ or Pus++ with no growth or only a scanty growth of organisms.

1962-1964 Series

In the absence of antimicrobial therapy this was considered to exist if the bacterial count exceeded 100000 organisms/ml. on one or more days, with the exception of the day on which the catheter was removed after operation (see above). Infection was also considered to exist if the organism count remained between 50000/ml. and 100000/ml. for more than 3 successive days.

In the presence of antimicrobial therapy, infection was considered to exist if any organisms were cultured from the urine at any time.

Urine - 'Sterile'

1954-1960 Series

No pus was present or only a few pus cells reported. There was no growth or only a scanty growth of organisms on culture.

1962-1964 Series

In the majority of cases no pus was present and there was no gorwth of organisms on culture.

In the absence of antimicrobial therapy a bacterial count of below 10000 organisms/ml. was accepted as 'sterile' provided this did not persist for more than 3 days.

If the organisms count was more than 100000/ml. on the day on which the catheter was removed after operation, but on this day only, then the urine was considered to be 'sterile' (Gillespie et al, 1960).

Well at Operation

Patients considered to be well at operation had no history of past medical disease or urinary tract disease, the blood urea was below 50 mgm./100 ml., and the I.V.P. was normal. Their only abnormality in fact being prostatic enlargement.

Wound Infection

Wound infection was considered to exist if there was any induration at the margin of the wound, or if there was any discharge of pus from either the wound or the suture holes. In certain cases of wound infection there was some separation of the wound margins, in other cases there was none. Wound infection was not considered to exist in those cases which had some reddening around the stitch holes, but in which this reddening did not represent induration, and in which there was no discharge of pus.

MATERIAL AND METHODS

In the years 1954-1960 inclusive 761 patients underwent retropubic prostatectomy in the Urological Department of Glasgow Royal Infirmary. In the same period 32 patients were refused operation. Of these 16 were deemed unfit for anaesthesia by the physician and in 9 the urinary symptoms were found to be due to disease of the nervous system rather than prostatic enlargement. In 7 the symptoms were obviously improving markedly by the time the patient was admitted and operation was therefore considered to be unnecessary.

First Series 1954-1960

The 761 patients who had retropubic prostatectomy between January 1st. 1954 and December 31st. 1960 constituted the first series. A prospective study of these patients was made. A detailed history was obtained from each one and the presence of previous disease in the urinary tract, in the cardio-vascular system and in the respiratory system was particularly noted. A clinical examination was carried out with special reference to the presence of abnormalities in the urinary, cardio-vascular, respiratory, and central nervous systems.

If there was a history of cardio-vascular or respiratory abnormality electrocardiograms and chest x-rays were done and a physician's opinion was obtained as to suitability of the patient for operation. In all patients intravenous pyelography was carried out, blood urea estimations were made and urine cultures done as a routine before operation. Urine cultures were always repeated if necessary, one or two days before operation, or at the time of operation. Cultures were repeated at intervals of 3 days throughout the convalescence.

All urines were tested for sugar so that latent diabetes might be detected.

The source from which each patient was referred was checked and if catheter drainage had been instituted before operation then the duration and type of such drainage was noted where possible.

When each patient came to operation the surgeon was asked to record the weight of the prostate gland, the number of gland lobes, the ease or otherwise of enucleation, and the amount of blood loss measured by suction - as few swabs as possible being used. These records were not complete in all cases.

Note was made of any complications which occurred after operation. The highest temperature on each day of the convalescence was also recorded as was the duration of convalescence.

In patients who died following operation an attempt was always made to obtain permission for post mortem examination. Such permission was obtained in less than 50% of cases. In the cases where permission was not obtained cause of death was decided upon after considering the clinical course, the opinion of colleagues called into consultation, and the results of any special investigations done.

These 761 patients were not all managed similarly. All had retropubic prostatectomy carried out (for method see below), but management of bladder drainage, anti-microbial cover, and local antimicrobial application to the open wounds differed.

Management of Bladder Drainage Before and After Operation

This was of the "open" type (see diagram I) in the years 1954 and 1955. In 1956 a "closed" (diagram II) type of drainage was tried in a number of cases, and from January, 1957 until the end of 1960 this "closed" method was used routinely. (Diagrams pages 3-4 Volume III)

Rubber catheters were used from January, 1954 until the end of 1956 when plastic (Neoplex) catheters were substituted.

During the years 1957 to 1960 patients admitted from other units in Glasgow Royal Infirmary, or from some other hospital, with catheters indwelling were put on a closed system of drainage at once, if this had not already been instituted. During these years some other units were using closed drainage intermittently and often varying drainage from open to closed in a single case. It was thus not possible to assess accurately exactly what type of drainage system had previously been employed in patients being admitted to the Urological Department for some other unit or hospital with a catheter indwelling.

Technique of Prostatectomy

The abdomen was opened by a low transverse incision, the recti muscles were separated and the retropubic space opened up. The anterior aspect of the prostatic capsule was cleared of fat by blunt dissection and blood vessels coursing over this capsule were sealed by diathermy. Lateral packs were rarely used. The capsule was opened between stay sutures and long blunt pointed, curved scissors passed between adenoma and capsule to define a plane of cleavage. The scissors were then passed down in front of the adenoma, and the urethra at the apex of the adenoma was divided in whole or in part.

The adenoma was then enucleated with the finger and removed. In some cases it was finally removed from the bladder neck by cutting with scissors. In other cases, where enucleation was difficult, scissors or diathermy needle were used to dissect the adenomatous tissue from the capsule.

When the adenoma had been removed a wedge was cut from the bladder neck with scissors and 3 No. 0 plain catgut sutures placed, 2 in the postero-lateral aspects of the neck, and 1 centrally on the posterior aspect of the neck. These served to secure the bladder neck to the posterior prostatic capsule. They also exerted a haemostatic effect. A search was then made for prostatic tags, which were cut away with scissors. Finally any obvious bleeding points were diathermised.

A catheter was now passed along the whole length of the urethra, through the prostatic cavity, and into the bladder.

The prostatic capsule was closed with a continuous suture of No. 1 chromic catgut.

The abdominal wound was then closed in layers with a corrugated drain from the retropubic space emerging through a separate stab wound below the mid part of the main wound. The skin was sutured with black silk.

The vasa were then either crushed and ligated, or divided and ligated. The small wounds necessary to expose them were sutured with No. 0 plain catgut.

Post-operative Management

The drain in the retropubic space was removed on the third day after operation. The catheter was removed on the third day after operation provided the urine was clear of blood to the naked eye. Occasionally the catheter was left in situ for a day or two longer if the urine had been slow to clear of blood, or if there had been any difficulty in closing the prostatic capsule.

The patients were allowed up on the day following operation, they were encouraged to drink copious fluids and were given normal diet. An aperient was given on the second night after operation and a suppository or small enema on the third day if the bowels had not moved.

Alternate sutures were removed on the eighth day, the remainder being removed on the tenth day after operation.

Patients in whom the convalescence was normal were allowed home between the tenth and the fourteenth day.

Antimicrobial cover

In the years 1954 to 1956 inclusive most patients undergoing retropubic prostatectomy irrespective of whether the urine was 'sterile' or infected (see definition of terms) were given a 5 day course of penicillin (300000 units twice daily) and sulphatriad (2 gm. stat and 1 gm. 4 hourly).

If a patient had been on preliminary catheter drainage for 7 days or longer then streptomycin (gm. 1 b.d.) was given for 5 days. Treatment was sometimes commenced a day or so before operation, sometimes on the day of operation and sometimes a day or so after (see Page 5, Vol.III).

Once closed drainage had become routine in the Urological Department it was decided to select cases in order to assess the value of penicillin and sulphatriad or prophylactic agents. In view of the high incidence of bacteraemia following retropubic prostatectomy in infected cases (Marshall, 1961) it was decided that antimicrobial agents should be commenced 1 or 2 days before operation so that adequate blood and tissue levels of these drugs might be in existence before the enucleation of the gland.

Thus between the end of December, 1956 and the end of June, 1958, 100 consecutive patients were studied. Alternate cases were given a 5 days course of penicillin and sulphatriad in the above mentioned dosage, commencing 1 or 2 days before operation whether urinary infection was present or not. The other cases had no antimicrobial cover. Any patient showing clinical signs of infection during convalescence was placed on appropriate antimicrobial therapy after urine culture and sensitivity tests. At first patients who had been on preliminary catheter drainage for 7 days or longer were considered to be markedly infected. These were excluded from the above series of 100 and alternate patients in this markedly infected group were given streptomycin gm. 1 b.d., the others having penicillin and sulphatriad.

After only 17 patients with 7 days or more preliminary drainage had been studied as above it became clear that most of these cases were not grossly infected. This was probably due to the fact that all had a closed system of drainage. It was thus decided to alter the method. Sulphonamide and streptomycin therapy were no longer given. In their place alternate patients in this category were given an appropriate broad spectrum antimicrobial after sensitivity tests, the other patients having no cover.

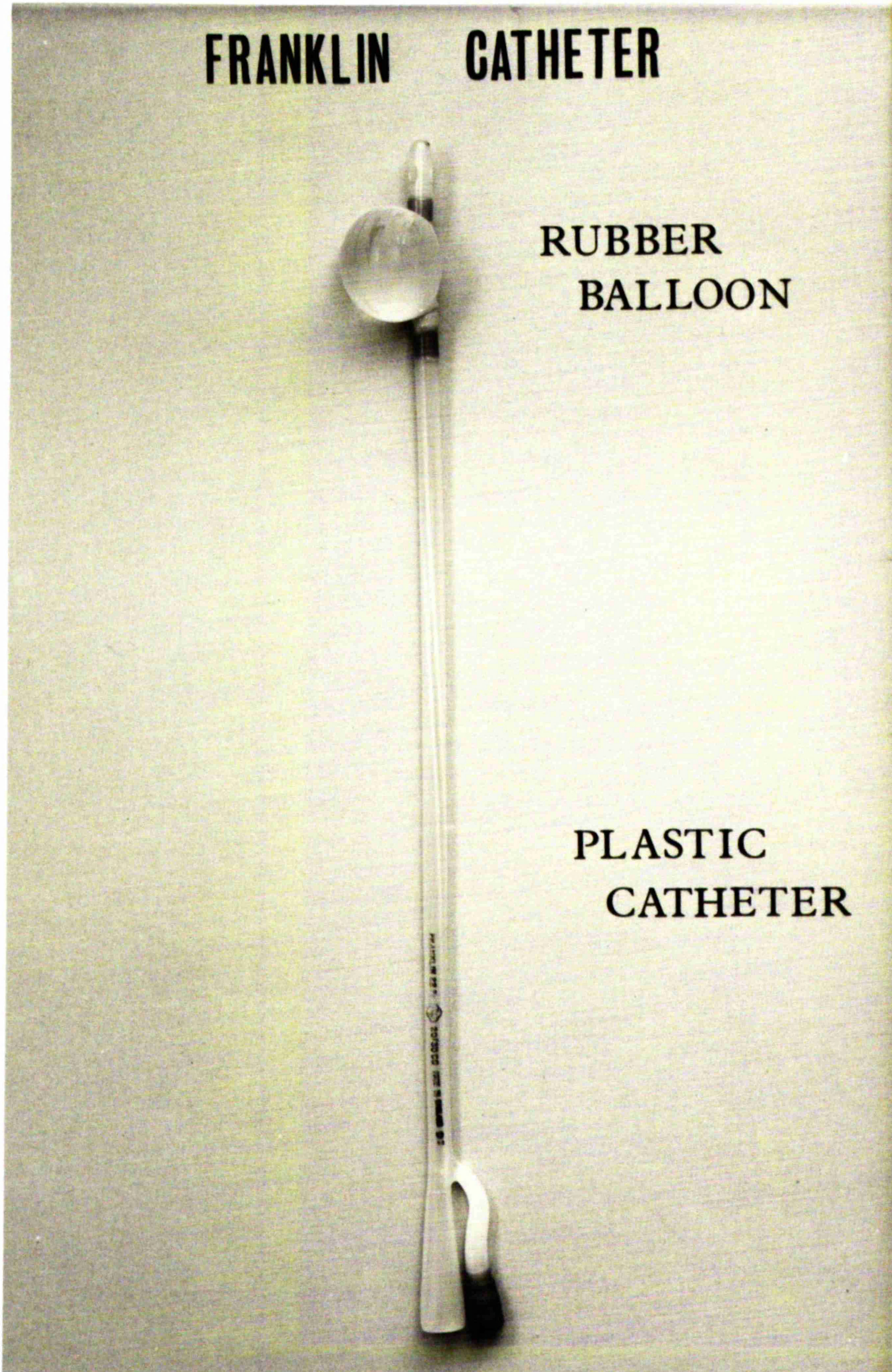
This procedure was continued in these cases having 7 days or more preliminary drainage until data had been collected from the 100 patients having penicillin and sulphatriad. Thereafter alternate patients with infected urine at operation, irrespective of duration of preliminary catheter drainage, were given appropriate antimicrobial cover. The others had no cover. Patients with 'sterile' urine at operation had no cover.

It had been hoped to continue this routine in infected cases until the end of the study. In fact, however, between

January 1st. and May 31st.1959, 40 consecutive patients with infected urine were given appropriate broad spectrum antimicrobials in order to gather material quickly for a communication on antimicrobial therapy and bacteraemia which the author wished to make to the British Association of Urological Surgeons in 1959.(Because of different nomenclature the results in this study of 1959 are not directly comparable with the results shown in this thesis. The conclusions, however, are similar.) In consequence the next 40 consecutive patients with infected urine were given no antimicrobial cover. The complications found in the 40 consecutive infected patients having appropriate cover, and in the 40 consecutive infected patients having no cover, did not differ appreciably in incidence from that found in other comparable groups. The routine of giving appropriate cover to alternate infected cases was then continued until the end of December, 1960.Appropriate agents were commenced 1or2 days before operation and continued for 5 days.

Blood Culture Studies

During the years 1956-1960 and 1963-1964 blood culture studies were carried out. Cases were selected for study only on the basis of there being time available to take the necessary blood samples at the chosen intervals.


FRANKLIN CATHETER
RUBBER BALLOON
PLASTIC CATHETER

Thus in the period 1955-1956, 50 patients were studied. In 34 the urine was infected at the time of operation and in 16 it was 'sterile'.

During 1957-1960, 122 patients were studied, 82 had infected urine and 40 had 'sterile' urine.

In the period 1963-1964 a further 24 studies were made - on 12 infected and 12 'sterile' cases.

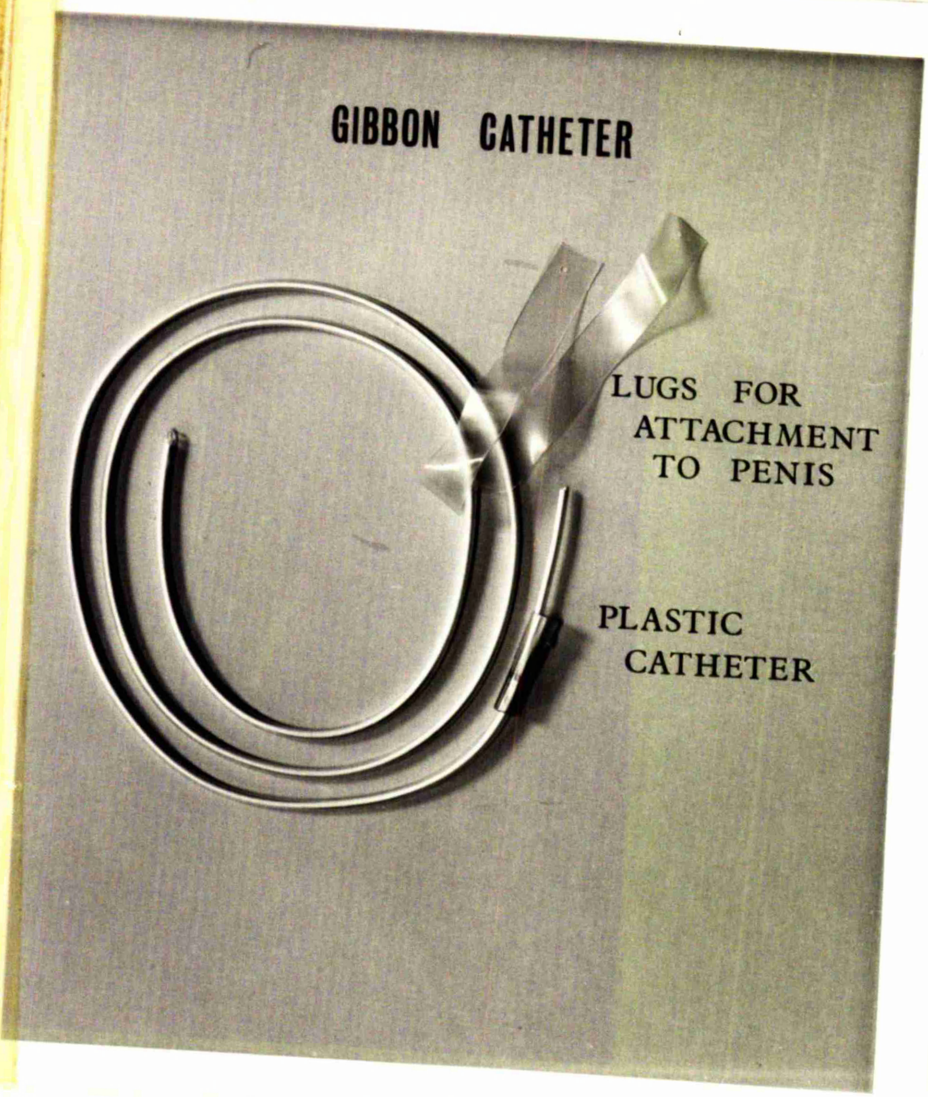
In 21 of the 50 patients studied in 1955-1956 blood was taken immediately before operation and immediately after enucleation of the gland. In all other cases in the three periods additional blood samples were taken 1 hour, and 2 hours after operation, and in some cases at additional intervals.

Blood (10 ml.) was taken from a suitable arm vein and immediately injected into 0.3 ml. of 1% Liquoid (Roche) in a small sterile bottle. Liquoid - an anticoagulant - destroys complement so that the blood is no longer bactericidal and becomes a culture medium (Stuart, 1948). The specimen was incubated at 37°C for 24 hours and then sub-cultures were made.

Second Series 1963 - 1964

In view of the work of McKelvie (1962) on the use of Ureaphil in prostatectomy a further study was carried out from January 1st. 1963 until June 30th. 1964.

In this period 145 consecutive patients having


GIBBON CATHETER
LUGS FOR ATTACHMENT TO PENIS
PLASTIC CATHETER

retropubic prostatectomy were studied. At this time the use of a closed system of bladder drainage had become universal in other units and many were now using a Gibbon (1957) catheter.

In the Urological Department of Glasgow Royal Infirmary during this period patients requiring preliminary catheter drainage had either a Gibbon, or a Franklin Simplastic Balloon catheter passed. Drainage was into a closed polythene Bardic bag (McKelvie, 1962).

In this group of 145 patients documentation was as in the previous series. All patients coming 'sterile' to operation were given 4 pints of Ureaphil intravenously commencing during and continuing for the 24 hours following operation. The infusion was commenced just after the patient was anaesthetised.

Patients coming to theatre with an indwelling catheter had this withdrawn. All patients after being anaesthetised had 10 ml. 1/2000 chlorhexidine in glycerol instilled into the urethra (Millar et al, 1960).

All patients in this series had Franklin Simplastic Balloon catheters inserted after removal of the prostate gland. Drainage was into a closed Bardic Drainage bag (McKelvie, 1962).

After operation documentation in this series was similar to that in the previous series with, in addition, the number of patients requiring bladder wash-out being noted. All patients had daily urine culture for the first 7 days following operation.

It was left to the surgeon's discretion whether or not to administer Ureaphil. All patients had blood urea and electrolyte studies carried out on the day following operation and on alternate days thereafter until the blood urea level fell below 40 mg. per cent.

Of the 145 patients 98 had a 'sterile' urine and of these 87 were given Ureaphil. It was withheld in the other 11 cases. In 5 instances because I.V.P. or blood urea findings suggested poor renal function. In the other 6 cases there was no obvious reason.

There were 47 patients with infected urine. Ureaphil was given in 33 of these. Of the 14 cases who did not have Ureaphil 6 were judged by I.V.P. and blood urea findings to have poor renal function, and 4 patients because of severe concomitant medical disease were judged as very poor risks. It was felt that a new method being assessed should not be used on these cases. In the remaining 4 patients there was no obvious reason for withholding Ureaphil.

Statistical Method

Yates modification of the χ^2 test, using a "Fourfold" table as described by Hill (1961) was used. Differences were considered to be significant if probability (P) in Fisher's Tables was less than 0.05. Differences were considered to be highly significant if probability (P) was less than 0.001.

SECTION III

MORBIDITY

RESULTS

GENERAL LAY OUT OF RESULTS

When in tabular form the post-operative complications are always represented in the same order. Wound infection, ascending infection, funiculitis, epididymitis, cystitis, and pelvic cellulitis are all straight-forward infective complications. These are therefore grouped together. Respiratory, cardio-vascular, and cerebral complications along with reticulosis are grouped together as "medical complications". Suprapubic leak and urinary tract haemorrhage are each placed separately. There is no doubt an infective element to these complications but they are probably not purely infective. The extent of the infective element in these two complications will be judged by reference to some of the ensuing tables.

Poor control and failure or difficulty in voiding are grouped together as upsets of micturition. The part which infection plays in these complications can also be judged by studying the following tables and will be mentioned later. Diarrhoea, rectal fistula, and rectal haemorrhage are grouped together as a final group of rather uncommon miscellaneous complications.

In each table the number of patients suffering from a complication is given along with the percentage incidence of that complication. More than one complication may be mentioned in each table for each patient, but only one complication is mentioned for each patient in each complication group (see first two paragraphs of this section).

Following the column of total incidence of complications is a second column showing the number of complications and their percentage which delayed convalescence, i.e. which caused the patient to be kept in hospital for more than 14 days after his operation. Any patient in hospital 14 days or less after operation was assumed to have a normal length of convalescence. In a few tables a third column appears which shows 'severe' complications i.e. those which delayed convalescence for 21 days or more.

Any complication which caused death is noted in the 'total incidence including deaths' column, and also in the next column, 'incidence of complications delaying convalescence or causing death', and also in the third column, 'severe + deaths', when this appears. Thus a complication causing death is included in all columns. The actual complications which caused death are detailed in Section IV - Mortality.

TABLE 1

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY

(761 CASES)

From this table it will be noted that infective complications form by far the largest group of complications following this operation even although no more than one such complication is cited for any one patient. Some 36.1% of patients had infective complications as against 11.2% of patients who had medical complications. If we count wound infection in a separate category, the incidence of infective complications other than wound infection (19.9%) shows these to be still the most numerous group of complications, wound infections (16.3%) coming second, and the medical group i.e. respiratory, cardio-vascular, cerebral, and reticulosis (11.2%) coming third.

With reference to those complications which delayed convalescence the findings are similar, i.e. infective complications (20.1%) form the largest group, with wound infections (10.5%) coming next, and lastly infective complications excluding wound infections (9.6%).

Cardio-vascular complications most commonly caused a delay in convalescence, 23 or 26 cases (88.4%). Next came suprapubic leakage, 42 of 50 cases (84%) having a delayed convalescence. The next most common complication which caused delay was epididymitis 13 of 18 cases (72.2%) and this was fairly closely followed by wound infection, 80 of 124 cases (65%).

TABLE 2

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY IN 'STERILE' CASES

(295 CASES)

TABLE 3

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY IN INFECTED CASES

(466 CASES)

These tables should be studied together for comparison.

Again in both tables it will be seen that infective complications form the largest group, not only so but infective complications excluding wound infections still for the largest group in the total column. In the column of those complications delaying convalescence wound infection forms the largest group and infective complications excluding wound infection in both tables form the second largest group.

It is interesting to note that in patients whose urine is 'sterile' at operation there is still a 23.9% incidence of total infective complications. In infected cases there is a 43.9% incidence of such complications. The difference is statistically highly significant (χ^2 = 29.52 $P < 0.001$).

In comparing the two tables it will be noted that the incidence of wound infection in infected cases is 20.5%

as against 9.8% in 'sterile' cases. The difference is again highly significant ($\chi^2 = 13.97$ $P < 0.001$). 14.2% of wound infections delayed convalescence in infected cases whereas only 4.8% delayed convalescence in 'sterile' cases. The difference is highly significant ($\chi^2 = 16.03$ $P < 0.001$). In infected cases, infective complications excluding wound infections total 23.4% as against 14.1% in 'sterile' cases. This difference is statistically significant ($\chi^2 = 8.928$ $P < 0.01$). When we consider those infective complications - excluding wound infection - which delayed convalescence we find that the incidence of these in infected cases is 12.8% as against only 4.2% in the 'sterile' cases. This difference is highly significant statistically ($\chi^2 = 12.69$ $P < 0.001$).

It is also interesting to note the greatly increased incidence of medical complications in infected cases when we compare these with the medical complications in 'sterile' cases, the figures being 15.4% in infected cases as against 4.8% in the 'sterile' group. Again a highly significant difference ($\chi^2 = 19.58$ $P < 0.001$). The medical complications which delayed convalescence in the infected group total 11.9% as against 2.3% in the 'sterile' group, a highly significant difference ($\chi^2 = 20.63$ $P < 0.001$).

In considering these figures however, it must be remembered that a great many patients who were originally admitted to hospital because of some medical illness developed a urinary retention when in hospital: they were catheterised and as a result of this they developed a urinary infection. Thus the infected group is loaded rather heavily with patients who already had some medical illness before operation.

The incidence of suprapubic leakage in the two groups is very interesting. Those with infected urine show a 9% incidence of suprapubic leak whereas those with 'sterile' urine show a 2.7% incidence. The difference is highly significant ($\chi^2 = 38.98$ $P < 0.001$). When we consider the suprapubic leaks which delayed convalescence the relevant figures are 7.7% for the infected group and 2.1% for the 'sterile' group. This difference is highly significant ($\chi^2 = 10.15$ $P < 0.001$). It would thus appear that infection plays a considerable part in post-operative suprapubic leakage. It can also be argued that in a number of cases difficulty or technical fault in closing the capsule were predisposing factors.

Urinary tract haemorrhage shows an almost equal incidence in both groups. This would suggest that urinary infection at the time of operation played no part in the incidence of this complication.

The upsets of micturition i.e. poor control and failure or difficulty in voiding show a greatly increased incidence in the infected group i,e. 10.1% as against 4.1% in the 'sterile' group. The difference is significant ($\chi^2 = 8.26$ $P < 0.01$). Urinary upsets which delayed convalescence show an incidence of 8.6% in the infected group as against 3% in the 'sterile' group. This difference is also significant ($\chi^2 = 8.83$ $P < 0.01$). Urinary infection before operation then would appear to be an obvious contributory factor in the onset of these upsets of micturition control which occur after operation.

The slightly increased incidence of diarrhoea in the infected cases may well be due to the increased use of antibiotic therapy in this group. The incidence of rectal fistula and rectal haemorrhage does not show any significant difference in the two groups.

TABLE 4

THE RELATIONSHIP OF AGE TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Four separate age groups have been studied. The number of cases who were aged 80 or over, however, in this particular table is small. All cases had 'sterile' urine at operation.

The incidence of wound infection remains fairly constant as age increases. Infective complications apart from wound infections, in fact, tend to diminish as age increases.

The medical complications in this 'sterile' group are slightly increased in patients of 70 years and over. Comparing the incidence of all medical complications in patients under 70 years and in those of 70 years or more the difference is not significant ($\chi^2 = 3.073$ $P < 0.1$).

Suprapubic leakage and urinary tract haemorrhage do not appear to be especially influenced by age in this group. The upsets of micturition, however, would appear to be more frequent in the older age groups but this is not a significant figure ($\chi^2 = 3.26$ $P < 0.1$).

TABLE 5

THE RELATIONSHIP OF AGE TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

The same four age groups have been studied.

In comparing the incidence of all infective complications arising in patients below 70 years with thosearising in patients who are 70 years or older we find that the younger age group has the greater number of complications. This increase is statistically significant (χ^2 = 5.678 $P < 0.02$).

Wound infections do not appear to be influenced by age since neither the total wound infections nor those causing delay in convalescence are increased as age progresses. Again in these infected cases the incidence of other infective complications excluding wound infections is not increased with age - neither in their total incidence nor in the incidence of those which caused delay in convalescence.

There is no difference in the incidence of medical complications when we compare patients under 70 years with those who are 70 years or over.

There would appear to be a definite increase in the incidence of medical complications in patients 80 years or over when compared with those below 80 years. This is statistically significant (χ^2 = 4.70 $P < 0.05$).

Suprapubic leakage and urinary tract haemorrhage are not increased with age in this group nor in fact are cases having upsets of urinary control.

TABLE 6

THE GENERAL CONDITION OF PATIENTS AT OPERATION AS RELATED TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

In the numbers available for study there is no obvious increase in total infective complications in patients with urinary tract disease or with medical disease when compared with those who were well at operation. This finding also applies to wound infection and to other infective complications, excluding wound infection, when studied separately. There is a definite increased incidence of post-operative medical disease in that group of patients who had medical disease at the time of operation or who had a history of medical disease when compared with those who were well at operation but this is not statistically significant ($\chi^2 = 2.725$ $P < 0.1$).

The other complications do not appear to be affected by the general condition of the patient at operation in this 'sterile' group of cases.

There is no significant difference when we compare those complications which delayed convalescence in each group.

TABLE 7

GENERAL CONDITION OF PATIENTS AT OPERATION AS RELATED TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

The patients have been divided into four groups as in the previous table and the definition of terms is similar. In comparing the total incidence of post-operative infective complications in those patients who were well at operation and in those who had urinary tract disease there is no statistical difference in the results. If we consider only those infective complications in the two groups which delayed convalescence then the increased incidence of these in patients with urinary tract disease is statistically significant ($\chi^2 = 6.616 \quad P < 0.01$).

There is some increase in wound infections which caused a delay in convalescence in the group of patients who had urinary tract disease, 18.4% as against 13% in the well patients. This is not statistically significant.

The increase in incidence of ascending infection which delayed convalescence in patients who had urinary tract disease is significantly higher than the incidence of ascending infection which delayed convalescence in those patients who were well at operation ($\chi^2 = 7.269 \quad P < 0.01$). It will be noted that patients who had medical disease or both medical and urinary tract disease showed a comparatively low incidence of upper urinary tract infective complications.

Patients with medical disease had a significantly higher incidence of post-operative medical complications than those who were well at operation ($\chi^2 = 5.828$ $P < 0.02$). In comparing medical complications which delayed convalescence in these two groups there was no significant difference.

Supra-pubic leak and urinary tract haemorrhage do not appear to be significantly increased in any of the groups.

The highest incidence of urinary upsets following operation is again noted in that group of patients who had urinary tract disease. Here both the total figure and the incidence of cases delaying convalescence is the highest of the 3 groups. These differences are not, however, of statistical significance.

THE EFFECT OF DIABETES ON POST-OPERATIVE COMPLICATIONS

There were only 16 patients with diabetes in this series of 761 patients. All 16 had infected urine at the time of operation. Four had urinary tract conditions and a further 6 had other medical conditions at the time of operation.

After operation 2 patients developed wound infections. These infections did not delay convalescence. One patient died from coronary thrombosis. This patient had a previous history of the condition.

TABLE 8

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1954-1955)

The sum of the total infective complications and also the sum of those infective complications delaying convalescence increases as does the duration of preliminary catheter drainage.

As the duration of catheter drainage increases the incidence of wound infection increases, both total wound infection and also wound infection delaying convalescence. The incidence of ascending infection is considerably greater in patients having catheter drainage than in those who had no preliminary catheter drainage, but this incidence does not increase as the duration of catheter drainage increases. The incidence of the other infective complications does not appear to be particularly related to the incidence of preliminary catheter drainage.

It is interesting to note that there is a very high incidence of medical complications in patients who have been on catheter drainage for 7 days or longer.

The incidence of suprapubic leakage increases as does the duration of preliminary catheter drainage, but the incidence of urinary tract haemorrhage does not appear to bear especial relation to preliminary catheter drainage in this group.

The incidences of total upsets of micturition and those upsets delaying convalescence increase as does the duration of preliminary catheter drainage. This is shown mainly in the case of poor control.

TABLE 9

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1956 - 1958)

The sum of the total infective complications increases with increase in duration of preliminary catheter drainage until 4 - 6 days, then there is a fall. The sum of infective complications delaying convalescence increases as does the duration of preliminary drainage apart from slight fall in the 1 - 3 day group.

The total incidence of wound infection in this period shows a rise as the duration of preliminary catheter drainage increases, but there is a levelling off after 4 to 6 days. Those cases of wound infection delaying convalescence show a general increase as the duration of preliminary catheter drainage increases.

Again the incidence of ascending infection increases with increased duration of preliminary catheter drainage save that there is a slight decrease in incidence with 7 or more days drainage. The other infective complications in this peripd do not appear to be especially related to the duration of catheter drainage.

As regards medical complications again these are most marked in patients who have had 7 or more days of preliminary catheter drainage but it is interesting to note that the incidence is fairly high in all cases in this period who had preliminary drainage when compared with those who had no preliminary drainage.

The incidence of suprapubic leakage again increases with increase in duration of preliminary drainage and in general urinary tract haemorrhages in this period tend to increase as preliminary drainage increases.

Upsets of micturition both total and those delaying convalescence do not show any definite relationship to the duration of preliminary catheter drainage.

TABLE 10

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1959 - 1960)

The sum of the total infective complications in this period is increased in those cases who had preliminary drainage as compared with those who had none. The actual duration of drainage has not influenced the sum of the total infective complications in each drainage group.

The sum of the infective complications delaying convalescence increases as does the duration of preliminary catheter drainage for the first 7 days. Thereafter there is a fall.

In this period the incidence of wound infection - both total and those delaying convalescence - increases as does catheter drainage up to 4 to 6 days. After this there is slight fall in incidence.

This plateauing effect is again noticeable when we consider ascending infection, the incidence of which reaches a peak in the 4 to 6 day period and then falls slightly in those cases drained 7 days or longer. When, however, we consider ascending infections which delay convalescence we find that these increase progressively as the duration of preliminary drainage increases. Again the other infective complications do not appear to be particularly related to the duration of drainage.

Once again the incidence of medical complications is markedly greater in patients who have had 7 or more days drainage. Medical complications which delayed convalescence increase as does the duration of preliminary drainage.

In this period the incidence of suprapubic leakage rises as the duration of preliminary catheter drainage increases again to the 4 to 6 day period, after which it falls slightly. This statement holds also for suprapubic leaks which delayed convalescence.

The incidence of urinary tract haemorrhage in this period is not particularly related to the duration of preliminary catheter drainage. Again, however, the incidence of upsets of micturition increases as does the incidence of preliminary drainage. This is true of the total incidence of upsets of micturition but there is a slight fall in those upsets which caused a delay in convalescence. This fall takes place in the cases drained for 4 to 6 days. In the main there is a rise in the incidence of poor control as the duration of drainage increases.

TABLE 11

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS.

(761 CASES)

In this table duration of catheter drainage has been broken into 5 different time intervals. The number of patients who had catheter drainage for these different times is indicated and in each section there are more than 60 cases.

Here the sum of the infective complications, both total and those delaying convalescence, increases as does the duration of preliminary drainage until the 7 - 13 day period, after which there is a fall.

The incidence of wound infection, both total and wound infection delaying convalescence, increases as does the duration of catheter drainage until we reach the 7 - 13 day period. Thereafter there is a fall both in total incidence and in the incidence of wound infection delaying convalescence.

The total incidence of ascending infection bears no particular relation to the duration of preliminary catheter drainage. The incidence of ascending infections which delayed convalescence is considerably higher in patients who did have preliminary catheter drainage than it is in patients who had no preliminary drainage. The highest incidence is in the 7 - 13 day period. The incidence of any of the other individual infective complications does not appear to be related to the duration of preliminary catheter drainage.

In this series the incidence of medical complications as a group rises as does the duration of preliminary catheter drainage. Both total medical complications and those delaying convalescence follow a similar course.

The incidence of suprapubic leakage is again considerably greater in patients having preliminary drainage than in those who have not. The incidence is most marked in patients who have had preliminary drainage for more than 4 days, this being true of both total incidence and incidence of leaks which delayed convalescence.

The incidence of urinary tract haemorrhage is not particularly related to the incidence of preliminary catheter drainage.

As regards upsets of micturition, these increase with the duration of preliminary catheter drainage until the 7 - 13 day group, when the incidence is highest, both total incidence and incidence of upsets which delayed convalescence. The incidence of urinary upsets in patients who had been drained for more than 14 days however, again shows a fall, both in total incidence and in the incidence of those upsets which delayed convalescence.

There is a highly significant difference in the incidence of total infective complications as a group when patients who had preliminary catheter drainage are compared with those who had no preliminary drainage. (χ^2 = 17.7 $P < 0.001$.) This increased incidence of total infective complications would appear, in the main, to be due to a highly significant increase in total wound infection in those cases having preliminary catheter drainage (χ^2 = 16.65 $P < 0.001$).

Total ascending infection shows some increase in those patients who had preliminary catheter drainage but this is not statistically significant. There is, however, a statistically significant increase in ascending infection which delayed convalescence in the group who had preliminary catheter drainage when compared with the group who had no such drainage (χ^2 = 7.966 $P < 0.01$).

GRAPH 1

PERCENTAGE OF ALL INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE AT TWO DIFFERENT PERIODS

In the period 1959 - 1960 the incidence of total infective complications as a group remains steady in those patients who have had preliminary catheter drainage, whereas in the earlier period this incidence shows a continuous rise.

GRAPH 2

PERCENTAGE OF INFECTIVE COMPLICATIONS DELAYING CONVALESCENCE GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE AT TWO DIFFERENT PERIODS.

Again in the 1959 - 1960 period the sum of those infective complications delaying convalescence does not increase appreciably as does the duration of preliminary catheter drainage. There are more infective complications delaying convalescence in those who had preliminary drainage than in those who had no preliminary drainage.

In the 1954 - 1955 period infective complications delaying convalescence show a general rise as the duration of preliminary catheter drainage increases.

GRAPH 3

PERCENTAGE OF VARIOUS INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE

(761 CASES)

In this graph wound infection shows a sustained rise until the 7 - 13 day period. Total ascending infection is slightly increased in those cases who had preliminary drainage. The other infective complications are rather less in those who had preliminary drainage of over 4 days.

Wound infection and ascending infection show a fall in incidence in the 14 or more day period when compared with shorter periods of catheter drainage.

The main fall here is in the incidence of wound infection, the other groups maintaining a fairly uniform incidence irrespective of the different durations of preliminary drainage which have been studied.

GRAPH 4

PERCENTAGE OF VARIOUS INFECTIVE COMPLICATIONS DELAYING CONVALESCENCE, GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE

(761 CASES)

Here again wound infection delaying convalescence rises in incidence until the 7 - 13 day period, after which there is a marked fall.

Ascending infections delaying convalescence shows a slight rise with the onset of catheter drainage but then its incidence remains fairly constant.

The incidence of the other infective complications delaying convalescence rises slightly at the 1 - 3 day period and then shows a level which remains lower than that of those who had no preliminary catheter drainage.

GRAPH 5

ALL INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE

(761 CASES)

In this graph the incidence of total infective complications and infective complications delaying convalescence rises until the 7-13 day period, after which they both show a fall.

TABLE 12

POST-OPERATIVE COMPLICATIONS IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROYAL INFIRMARY AND THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

These cases all had preliminary catheter drainage and were infected. The number of patients in each category is shown.

The total incidence of infective complications in either group shows no significant difference. It will be noted that the total incidence of wound infection is almost double in the patients who were referred from some other unit or hospital. This increase is just within the limits of statistical significance (Hill, 1961) ($\chi^2 = 4.613$ $P < 0.05$). There is no significant difference in the 2 groups as regards any of the other infective complications.

The incidence of medical complications is again not significantly different in either group. The incidence of suprapubic leakage is rather higher in the patients who were referred from some other unit or hospital but not significantly so. The incidence of urinary tract haemorrhage is the same in both groups.

Upsets of micturition would appear to be rather more frequent in patients admitted from some other unit or hospital, this is true both for the total incidence, and the incidence of those which delayed convalescence, but again the figures show no statistically significant difference.

TABLE 13

THE DURATION OF PRELIMINARY CATHETER DRAINAGE IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROYAL INFIRMARY COMPARED WITH THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

It will be seen from this table that of patients admitted direct to the Urological Department of Glasgow Royal Infirmary and requiring preliminary catheter drainage 73.9% had such drainage for a period of less than a week. Patients admitted from some other unit or hospital had preliminary drainage for less than a week in only 35.5% of cases.

TABLE 14

PROSTATE GLAND
RELATIONSHIP OF GLAND WEIGHT TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

There is no significant difference in the total incidence of all infective complications nor in the incidence of all those infective complications delaying convalescence. There is no significant difference in the incidence of any of the individual infective complications.

There is no significant difference in any other complication.

TABLE 15

PROSTATE GLAND
RELATIONSHIP OF GLAND WEIGHT TO POST-
OPERATIVE COMPLICATIONS IN INFECTED CASES

Here we have 234 patients whose glands weighed 50 grams or less compared with 138 patients whose glands weighed 51 grams or more.

When the total incidence of all infective complications in both groups is compared this is found to be higher in the group with large glands but the difference is not significant.

There is no significant difference in any of the individual infective complications in either group. In fact there is no significant difference in any of the other complications in either group. The incidence of upsets of micturition which delayed convalescence is again higher in patients with larger glands, but it is not significantly so.

TABLE 16

PROSTATE GLAND
RELATIONSHIP OF GLAND LOBES TO POST-
OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Here we have 92 patients with bilobed glands to compare with 88 patients whose glands were trilobed.

When total incidence of all infective complications in both groups is compared this is higher in the group with trilobed glands. This increase is statistically significant ($\chi^2 = 4.278$ $P < 0.05$). On comparing individual infective complications in these 2 groups there is no significant difference.

As regards all other complications there would not appear to be any significant difference apart from the case of urinary tract haemorrhage which shows a higher incidence in patients with bilobed glands, but this is not statistically significant.

TABLE 17

PROSTATE GLAND
RELATIONSHIP OF GLAND LOBES TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Here we have 165 cases with bilobed glands to compare with 144 patients whose glands were trilobed.

When we compare total infective complications collectively in both groups the incidence is 41.7% in those with trilobed glands as against 26.6% in those with bilobed glands. This difference is not significant ($\chi^2 = 0.3632$ $P < 0.7$). The incidence of each individual infective complication here is rather higher in the group whose glands were trilobed but the differences are not statistically significant. If we compare the incidence of infective complications excluding wound infection in both groups the total incidence is 27.2% in those with trilobed glands as against 15.2% in those with bilobed glands. This difference is not statistically significant. Infective complications, excluding wound infection, which delayed convalescence show an incidence of 16% in those with trilobed glands as against 8.5% in those with bilobed glands. Again, however, this difference is not statistically significant ($\chi^2 = 2.19$ $P < 0.2$).

There would not appear to be any significant difference in the incidence of any of the other complications in the 2 groups but it is of interest to note that the incidence of urinary tract haemorrhage appears to be higher in cases with bilobed glands, 4.8% as against 2.8% in those with trilobed glands. This difference in incidence shows up again when we compare urinary tract haemorrhage which delayed convalescence.

TABLE 18

PROSTATE GLAND
RELATIONSHIP BETWEEN EASE OF GLAND ENUCLEATION
AND POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Here we have 229 cases in whom enucleation was easy to compare with 50 cases in whom the enucleation was difficult. Allowing for the great difference in the numbers in each of the two groups there is no significant difference in any of the results. The percentage of patients with infective complications in the difficult group was rather greater than the percentage of patients with infective complications in the easy group, 28% as against 22.7%.

TABLE 19

PROSTATE GLAND
RELATIONSHIP BETWEEN EASE OF GLAND ENUCLEATION
AND POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Here we have 365 cases in whom enucleation was easy to compare with 76 cases who had a difficult enucleation.

Infective complications show no significant difference in the two groups either as regards the sum of the total infections or as regards the incidence of individual complications. In comparing the incidence of ascending infection which delayed convalescence in either group there is an increase in this complication in the group of patients in whom enucleation was difficult. This is statistically significant ($\chi^2 = 3.911 \quad P < 0.05$).

It is of interest to note that there is a very much higher incidence of medical complications in the group in whom the enucleation was difficult, this increase is statistically highly significant ($\chi^2 = 15.39 \quad P < 0.001$).

It is also perhaps worthy of note that neither suprapubic leakage nor urinary tract haemorrhage shows any significant difference in either group.

It is of note that there is a very much higher incidence of upsets of micturition - both total and also upsets delaying convalescence - in the group in whom enucleation was difficult. This increase is also significant ($\chi^2 = 5.315 \quad P < 0.02$).

In considering poor control alone 14 of 365 patients suffered from this in the group with easy enucleation, as against 9 of 76 with difficult enucleation. This shows a statistically significant increase in the incidence of poor control in those who had a difficult enucleation ($\chi^2 = 6.613$ $P < 0.01$).

TABLE 20

PROSTATE GLAND
THE RELATIONSHIP OF INFLAMMATION OF THE PROSTATE GLAND TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Here we have 207 patients in whom prostatic gland inflammation was absent to compare with 77 patients in whom inflammation was present.

The incidence of total infective complications as a whole was higher in the group who had inflammation of the prostate gland, i.e. 27% as against 21% when inflammation of the prostate gland was absent, but the difference is not statistically significant. In these groups there is a higher incidence of wound infection when inflammation of the prostate gland is absent. There is a higher incidence of ascending infection both total incidence and in the incidence of ascending infection delaying convalescence in the group in which prostatic gland inflammation is present. These differences are not significant, however, and there is no significant difference in the incidence of the other infective complications.

It is interesting to note that medical complications occurred more frequently in the group in which prostatic gland inflammation was absent, but the difference is not statistically significant. ($\chi^2 = 1.672$ $P < 0.2$.)
The incidence of the other post-operative complications did not appear to be significantly different in either group.

TABLE 21

PROSTATE GLAND
THE RELATIONSHIP OF INFLAMMATION OF THE PROSTATE GLAND TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Here we have 259 patients in whom prostatic gland inflammation was absent to compare with 201 in whom inflammation of the gland was present at the time of operation.

There is no significant difference in the incidence of total infective complications taken as a group nor of separate infective complications.

There is no significance in the difference in incidence of medical complications or suprapubic leakages, but it is interesting that suprapubic leak appeared to occur more commonly in patients in whom inflammation of the prostate gland was absent.

There is no difference in the incidence of urinary tract haemorrhage.

Upsets of micturition occurred more commonly in patients who had inflammation of the prostate gland, but the difference is not statistically significant.

TABLE 22

THE RELATIONSHIP OF URINARY INFECTING ORGANISM TO POST-OPERATIVE COMPLICATIONS

Only patients in whom the urine was infected with a single organism at the time of operation are considered here.

The incidence of total infective complications, taken as a group, is much higher in patients whose urine originally showed infection with Proteus species, or Klebsiella species, Staph. pyogenes, and Strep. faecalis when compared with those in whom the original infection was Esch. coli. This is a highly significant difference ($\chi^2 = 24.61$ $P < 0.001$). A similar trend is shown in those infective complications which delayed convalescence, the difference being even greater.

The incidence of wound infection is highest in the group of patients infected with either Ps. pyocyanea, Proteus species, or Klebsiella species but the difference is not significant when compared with the 88 patients infected with Staph. pyogenes or Strep. faecalis. It is a statistically significant increase when compared with the group infected with Esch. coli ($\chi^2 = 6.821$ $P < 0.01$). Patients infected with either Staph. pyogenes or Strep. faecalis show a higher incidence of ascending infection, but this again is not statistically significant when compared in the numbers available, with the incidence of ascending infection in the 52 patients infected with either Ps. Pyocyanea, Proteus species, or Klebsiella species. When the group infected with Staph. pyogenes or Strep. faecalis are compared with the group infected with Esch. coli. the difference is statistically significant ($\chi^2 = 7.578 \quad P < 0.01$).

It is also of interest to note that the patients infected with Esch. coli. show a much lower incidence of medical complications than do any of those infected with any of the other organisms.

When the incidence of suprapubic leaks in the above 52 patients is compared with that in the 220 patients infected with Esch. coli. the increased incidence in the former group is again statistically highly significant ($\chi^2 = 30.02 \quad P < 0.001$).

The incidence of urinary tract haemorrhage shows no significant increase in any group although it is greatest (7.7%) in the 52 patients infected with Ps. pyocyanea, Proteus species, or Klebsiella species.

Those patients in whom the original infecting organism was either a Staph. pyogenes or Strep. faecalis showed a higher incidence of upsets of micturition, but here the difference is not significant.

DISCUSSION

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY

The findings here show that the most common cause of morbidity following retropubic prostatectomy is infection of the wound, or of some part of the urinary tract or its immediate surroundings. Urinary infection as defined above following operation was present in 750 of 761 patients (98.6%). This was not recorded as a complication unless there were other symptoms present as defined above.

While infective complications form the largest group of post-operative complications the second largest group comprises the medical complications.

The other complications mentioned occur less frequently and their relation to infection, at this stage, is arguable.

If delay in convalescence is taken as a measure of severity of complications then the medical group were the more severe since 73.2% of such cases caused delayed convalescence as against 55.6% of the infective group.

Certain other authors have published their experiences of some of the complications of retropubic prostatectomy (see table 23). The results of this investigation lie within the quoted ranges of other authors, where comparison is possible, with the exception of the incidence of wound infection which is rather higher in this series. The incidence of pelvic cellulitis is rather lower than that found by Riches (1949). Taylor et al (1955) note that 25.3% of their cases had a temperature of over 102°F for 2 or more days. I have considered these cases as urinary infective complications in table 101, although, of course, some of the temperature rises may well have been due to other conditions e.g. chest infections. The series of Taylor et al (1955), Blue et al (1958), and Stearns (1961) were studied in North America.

Unfortunately no author sets out in detail the incidence of all the complications of retropubic prostatectomy.

It is of interest to see the present morbidity figures alongside those for prostatectomy carried out by some method other than retropubic. Several such series are shown in table 24. Apart from the incidence of ascending infection being higher in this series, the other findings are in the same range as those quoted for supra-pubic and immediate Wilson-Hey prostatectomy where comparison can be made.

The large series of perineal prostatectomies (Turner et al, 1957) and of transurethral resections (Holtgrewe et al, 1961) were studied in North America.

Where comparison can be made their incidence of complications is very much lower than that quoted here with the exception of epididymitis in both series and of poor control in the perineal series. These complications have occurred more frequently than they do in this present series of retropubic prostatectomies.

THE INFLUENCE OF URINARY INFECTION ON THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY

The Infective Complications.

In this series of 761 patients 466 (61.2%) had an infected urine at the time of operation. This urinary infection at the time of operation would appear to be a factor of major importance judging by the highly significant increase in the incidence and severity of the post-operative infective complications occurring in this group.

Wound Infection.

It has previously been noted that the total incidence of wound infection, and the incidence of those cases delaying convalescence, shows a highly significant increase in infected cases. Colebrook (1955) quotes Ives and Hirschfeld who indicated in 1938 that about 5% of clean wounds in Newhaven developed some signs of infection. Burnett et al (1958) in studying 211 clean wounds in the Western Infirmary of Glasgow found clinical infection in 7.6%.

A Report of the Public Health Laboratory Service on the 'Incidence of Surgical Wound Infection in England and Wales' (1960) describes wound sepsis rates (clinically manifest disease) in clean operations thus:- cholecystectomy (21%), breast operations (15%), orthopaedic operations (2%). It also found a wound sepsis rate of 7.3% in hernia operations and 6.9% in clean appendicectomies. On the other hand, abdominal operations with peritonitis showed a wound sepsis rate of 21.4%. Unfortunately infection after surgery of the lower urinary tract was excluded from this survey.

Loewenthal (1962) quotes B.P. Morgan who studied 764 clean surgical wounds in Sydney, Australia and found 8% showing clinical infection. The criteria of wound infection are not defined.

Ljungqvist (1964) studied 410 urological operations and found a wound infection rate of 14.9%. He considered a wound to be infected only if pus was present. He did not detail the different types of urological operations studied.

Our total incidence of wound infection in 761 cases at 16.3% is probably comparable with the findings of Ljungqvist - 14.9% for urological wounds (i.e. only those which showed pus).

Our wound sepsis rate of 9.8% for 295 clean retropubic prostatectomies is rather higher than the results quoted by the above authors for similar cases. In clean cases in the same region of the body these authors quoted 7.3% sepsis in hernia wounds and 6.9% sepsis in appendicectomy wounds.

The Report of the Public Health Laboratory Service (1960) and Ljungqvist (1964) both showed that wound sepsis increased with age and in fact the former report quoted an incidence of 18.1% sepsis in all wounds (excluding those with peritonitis) in patients 60 years of age and over. The rather older age group concerned in this present study could therefore explain our rather high incidence of infection in clean wounds. It must be noted however, that, in fact, we have no suitable series of wounds with which comparison can be made.

Our incidence of wound infection (20.5%) in infected cases, in this elderly group, compares favourably with the incidence (21.4%) reported by the Public Health Laboratory Service (1960) in abdominal operations with peritonitis. Again, however, there is no suitable series with which comparison can be made. Salvaris (1960) quoted a 10% incidence of wound infection in 1200 retropubic prostatectomies 40% of whom were infected. He did not however define his criteria of infection.

The Report by the Public Health Laboratory Service (1960) and Ljungqvist (1964) both showed that wound infection delays convalescence. The former report showed that this delay could vary from 0.538 to 10.389 days, depending upon the severity of the infection.

In this series almost 50% of the wound infections in sterile cases caused some delay in convalescence. Wound infection in infected cases, however, caused delay in convalescence in 69.5% of cases.

Ascending Infection

The total incidence of ascending infection is not markedly increased when we compare sterile with infected cases. On comparing 37 cases of ascending infection which delayed convalescence in 466 infected patients with 8 cases which delayed convalescence in 295 sterile patients we find a significant difference ($\chi^2 = 7.96$ $P < 0.01$).

Funiculitis and Epididymitis

The incidence of funiculitis and epididymitis is considerably increased in the infected cases - the difference however is not statistically significant in the numbers studied. In fact in one 'sterile' case and in two infected cases the vasa were not ligated. The incidence of epididymitis in cases who had vas ligation in this series is therefore 0.7% in 'sterile' cases and 2.8% in infected cases.

This figure of 0.7% is the lowest in any series which I have been able to find - but there is no other 'sterile' series available for comparison.

The figure of 2.8% in the 464 infected cases who had vas ligation is quite comparable with the figures of 2.7% (Riches, 1949) and of 3% (Salvaris, 1960). It is still much higher than that of 1.4% (Stearns, 1961). The number of infected cases in Riches' series is not known. Of the 1200 cases described by Salvaris (1960) 40% were infected and in Stearns (1961) series 35.6% were infected. When this fact is taken into account then our figure of 2.8% probably compares favourably even with Stearns (1961).

The incidence of epididymitis found in the infected cases in this series compares very well with the total figures found in series of patients having some other form of prostatectomy as shown in table 24. These series did not consist entirely of infected cases. It is not stated exactly what percentage of patients in them were infected.

Caine (1954) described a 7.6% incidence of epididymitis after various types of prostatectomy in patients who had vas ligation. This author was considering the late sequelae, however, whereas this thesis is concerned only with immediate complications.

Cystitis and Pelvic Cellulitis

These complications occur infrequently in the 'sterile' and the infected groups of patient. Riches (1949) quoted an incidence of 1.5% for pelvic dellulitis in his series. The incidence in this whole series of 761 cases was 0.1%. It may be that in our series some deep wound infections have been classified as wound infections when they might also have been classified as cases of pelvic cellulitis.

The Medical Complications

It has been noted above that medical complications show a highly significant increase in infected cases. This holds true for all medical complications and also those which were severe enough to delay convalescence or cause death. On the other hand the infected group of patients showed a significant increase in medical disease at the time of operation - 34% as against 26.1% ($\chi^2 = 5.388$ $P < 0.02$).

It is of interest to note, however, that almost 50% of the medical complications in either group were in patients who were apparently well at the time of operation.

These medical complications will be discussed further under "The Condition of the Patient at Operation".

Supra-pubic Leakage

The highly significant increase in the incidence of this complication in infected cases suggests that infection is the major factor in its production. Suprapubic leakage cannot be labelled purely as an infective complication, however, since a number of cases were known to be due to technical difficulty in closing the prostatic capsule.

The incidence of this complication in the infected cases (9%) is the same as that quoted by Salvaris (1960) in his total series of 1200 cases. The total figure for the 761 patients studied here was 6.6% and this is less than the figures quoted by Millen (1949), Aiken (1953) (Suprapubic Prostatectomy) and Taylor et al (1955) (Retropubic Prostatectomy).

Urinary Tract Haemorrhage (Secondary Haemorrhage)

The incidence of this complication was virtually the same in the 'sterile' and in the infected groups. Infection at the time of operation would thus not seem to play a part in its production.

This 4.5% total incidence of secondary haemorrhage is of the same order as that found by Stearns (1961) and is less than that reported by Millen (1949), Riches (1949), Jacobs (1951), and Taylor et al (1953). It is slightly higher than the figures shown in table 24 for the other types of prostatectomy. This is in agreement with the findings of Riches (1949) who showed that patients having retropubic prostatectomy had a higher incidence of secondary haemorrhage than did those having a Harris prostatectomy.

Upsets of Micturition

When poor control and failure or difficulty in voiding are considered together as upsets of micturition and compared in the 'sterile' and infected groups the increased incidence of these complications in the infected group is statistically significant ($\chi^2 = 8.26$ $P < 0.01$).

If we separate these 2 complications we find that, in the numbers studied, the difference is very much more marked in cases of poor control where $\chi^2 = 6.016$ $P < 0.02$ as against failure or difficulty in voiding where $\chi^2 = 1.752$ $P < 0.2$.

Even in the 'sterile' cases here the incidence of poor control (1.7%) is higher than the 1% quoted by Salvaris (1960) in his whole series. On the other hand the incidence of cases of poor control in the infected group in this series (5.6%) is less than the (5.9%) quoted by Turner et al (1952) in their series of 1964 perineal prostatectomies.

Miscellaneous Complications

As mentioned above the increased incidence of diarrhoea in the infected cases may be due to the increased use of antimicrobial drugs in this group of patients. The incidence of both rectal fistulae and rectal haemorrhage is of a similar order in each group and would not be expected to be influenced by the sterility or otherwise of the urine at operation.

THE INFLUENCE OF AGE

Infective complications

Reference to tables 4 and 5 shows that these complications, as a group, do not tend to increase with age either in 'sterile' or in infected cases. In fact total infective complications as a group were significantly commoner in infected patients under 70 years than in those over 70 years ($\chi^2 = 5.678 \quad P < 0.02$).

No individual infective complication has been found to increase with age. The Report of the Public Health Laboratory Service (1960) and Ljungqvist (1964) both show that wound sepsis increases with age. Stewart et al (1962) did not confirm this finding. None of these authors, however, studied prostatectomy wounds, and all considered the whole range of age from the first decade onwards.

This present study is, in the main, confined to patients of 60 years and over and shows that when this group is subdivided as to age and each group further subdivided into 'sterile' and infected cases, there is no increased incidence of wound infection as age increases.

Medical Complications

In both 'sterile' and infected groups of patients these complications occur more frequently in patients over 70 years than they do in patients who have not yet reached 70 years. The differences, however, are not statistically significant.

In infected cases the incidence of medical complications is considerably higher in patients of age 80 years or over. When these are compared with younger patients the increased incidence of medical complications is statistically significant ($\chi^2 = 4.70$ $p < 0.05$).

None of the other complications studied show appreciable increase with advancing age.

THE INFLUENCE OF PATIENTS' CONDITION AT OPERATION IN 'STERILE' PATIENTS (TABLE 6)

It is of note that when a patient's urine is 'sterile' at operation then the presence of urinary tract disease or medical disease at the time of operation does not significantly increase the incidence of any of the post-operative complications.

The greatest increase is in the incidence of medical complications in the group who had medical disease at operation or both urinary tract and medical disease. In the numbers available for study, however, this increase is not statistically significant ($\chi^2 = 2.728 \quad P < 0.1$).

THE INFLUENCE OF PATIENTS' CONDITION AT OPERATION IN INFECTED PATIENTS (TABLE 7)

Infective Complications

Total infective complications as a whole are increased in patients with urinary tract disease and diminished in patients with medical disease at the time of operation, when compared with patients who were well at operation, but the differences are not significant. Infective complications severe enough to delay convalescence or cause death, taken as a whole, are significantly higher when the group who had urinary tract disease plus the group who had both urinary tract and medical disease, is compared with the group who were well at operation ($\chi^2 = 7.018 \quad P < 0.01$).

Ascending infection severe enough to delay convalescence or cause death is significantly higher when groups are compared as in the above paragraph ($\chi^2 = 6.421 \quad P < 0.01$).

Thus infected patients with urinary tract disease at operation are more likely to have post-operative upper urinary tract infective complications. No other single infective complication shows significant change in the groups of patients examined.

When sterile and infected patients with urinary tract disease at operation are compared, the incidence of ascending infection severe enough to delay convalescence is significantly higher in the latter group ($\chi^2 = 6.179$ $P < 0.02$). The number of patients in this latter group who had preliminary catheter drainage (94 of 121) shows a highly significant increase over the number of sterile patients with urinary tract disease who had preliminary catheter drainage (19 of 43) ($\chi^2 = 15.09$ $P < 0.001$). It will be seen below (P 127 and also tables 25 and 26) that the fact of preliminary catheter drainage does not increase the incidence of ascending infection severe enough to delay convalescence provided the urine remains sterile. The importance of maintaining urinary sterility in patients who have urinary tract disease and who require preliminary catheter drainage is thus apparent.

Medical Complications

In these infected cases when we compare patients well at operation with those who had medical disease plus those who had both medical disease and urinary tract disease then the increase of medical complications in the sum of the latter two groups is statistically significant ($\chi^2 = 6.427 \quad P < 0.01$). The increase in the number of medical complications delaying convalescence in the sum of the latter two groups is not statistically significant when compared with patients who were well at operation.

Infected patients with medical disease at operation have a higher incidence of post-operative medical complications than those with medical disease at operation whose urine is 'sterile' at this time (tables 6 and 7). Iversen (1955) compared patients who had heart disease at prostatectomy with those who had no heart disease at this time. He noted that those who did have cardiac disease comprised a rather older age group.

In this present study 55% of all those patients who had cardiac disease were 70 years or older as compared with 46% who were well at operation. On the other hand 61% of those who had urinary tract disease were 70 years or older, and 75% of those who had both urinary tract and medical disease fell in this old age group.

Of the other post-operative complications studied no significant difference in incidence is noted with different conditions of the patient at operation.

It is interesting to note that the incidence of suprapubic leak, as is the incidence of total infective complications, is rather decreased in patients with medical disease at operation.

The Effect of Diabetes

As stated above, diabetes has not been found to affect the post-operative complications in the small group of patients available for study.

THE INFLUENCE OF THE DURATION OF PRELIMINARY CATHETER DRAINAGE

Infective complications

Table 11 and Graph 5 show that, as a group, these increase in incidence until the 7 - 13 day period after which the incidence falls. This may be due to an immunity to infecting organisms in patients who have been on catheter drainage for some time. That such an immunity arises has not been proved. Thomson Walker (1930) pointed out that such a process of immunity might take place in patients who had suprapubic tubes indwelling over a period.

In comparing total infective complications as a group in patients who had catheter drainage and in those who did not have catheter drainage the increase in infective complications in those having drainage is highly significant ($\chi^2 = 17.7 \quad P < 0.001$). In the case of those infective complications which were severe enough to delay convalescence or to cause death a similar finding obtains. It is to be noted that when all infective complications are compared in sterile and infective cases the difference is even more highly significant ($\chi^2 = 29.52$ $P < 0.001$).

Graph 1 shows that the percentage of total infective complications as a group rises continuously as the duration of catheter drainage increases in the period 1954 - 1955. In this period all drainage was of the open type. In the period 1959 - 1960 the percentage of total infective complications as a group increased when drainage was established. This trend did not continue with prolongation of preliminary catheter drainage. In this latter period all preliminary drainage was of the closed type. Thus closed preliminary drainage would appear to lessen the overall incidence of post-operative infective complications. Pyrah et al (1955) found a similar reduction in morbidity after introducing closed drainage among other measures.

Graph 3 shows that the main rise in the incidence of total infective complications as a group is, in fact, due purely to a great rise in the incidence of total wound infections at this period. The rise in the incidence of infective complications as a group which delayed convalescence, most marked again in the 7 - 13 day period, is due to a marked rise in wound infections delaying convalescence along with a lesser rise in the incidence of ascending infection delaying convalescence.

Further study of the influence of preliminary catheter drainage is made in tables 25, 26, 27 and 28. From tables 25 and 26 in 'sterile' cases there is no statistically significant difference in the incidence of total infective complications as a group, or of infective complications as a group which delayed convalescence, or of any of the individual infective complications, when those who had no preliminary drainage are compared with those who had.

From tables 27 and 28 the incidence of total infective complications as a group in infected cases who had catheter drainage shows a highly significant increase when compared with the group of total infective complications in those infected cases who had no catheter drainage ($\chi^2 = 14.41$ $P < 0.001$). In comparing the group of infective complications which delayed convalescence in infected patients who had had preliminary catheter drainage, with the similar group in infected patients who did not have preliminary catheter drainage, the difference is not statistically significant. The incidence of infective complications as a group which delayed convalescence is higher in those infected cases who had had a period of preliminary catheter drainage.

Infected patients who had had preliminary catheter drainage show a significantly higher incidence of total wound infection when compared with those who had no preliminary drainage ($\chi^2 = 7.199$ $P < 0.01$). They also show a higher incidence of wound infection which delayed convalescence but this difference is not statistically significant.

Infected patients with preliminary drainage show a significantly higher incidence of total ascending infection when compared with infected cases who had no preliminary drainage ($\chi^2 = 7.921$ $P < 0.01$). They also show a higher incidence of ascending infection which delayed convalescence, but this difference is not statistically significant.

Infected patients who had had catheter drainage show a slightly lessened total incidence of the other individual infective complications but the difference is not significant.

Thus, as regards post-operative infective complications the fact of preliminary catheter drainage would not appear to be of any significance so long as the patients remain 'sterile'. In infected patients the fact of preliminary catheter drainage is of the utmost significance. In the majority of these patients the catheter was probably the route of entry of the infection in the first place (Lancet 1956, Lancet 1958). Also it is seen that in this group of patients the incidence of post-operative infective complications as a group is significantly increased.

That such infection takes place along the catheter lumen was shown by Dutton and Ralston (1957). That such infection can travel upward in the urethral lumen outside the catheter was shown by Kass and Schneiderman (1957). Beeson (1958) also described infection resulting from catheterisation.

Liedberg (1959) showed that nosocomial infection of the urinary tract occurred in 75% - 80% of cases after 7 days continuous catheter drainage. The clinical findings in this investigation, namely that the incidence of infective complications which delayed convalescence is greatest in those patients who have been drained for 7 - 13 days would suggest that this nosocomial infection might be of considerable importance.

That cross infection is often responsible for post-operative urinary infection has been shown by Orskov (1952, 1954), Kass (1955), Pyrah et al (1955), Dutton and Ralston (1957), and Miller et al (1958). Such newly acquired infecting organisms may more readily find their way into the blood stream (Miller et al, 1958).

This investigation suggests that organisms gaining entrance to the body because of catheterisation may cause a very high incidence of specific infective complications of a relatively severe degree.

Medical Complications

As noted above the incidence of medical complications considered as a group increases with increase in the duration of preliminary catheter drainage. This holds good for both total complications and also those delaying convalescence. In a number of cases who had fairly prolonged preliminary drainage this was necessitated because some medical condition required treatment before the patient could be brought to operation.

Suprapubic Leakage

This occurs much more frequently in patients who have had preliminary catheter drainage but the increase is not statistically significant ($\chi^2 = 2.654$ $P < 0.1$). The fact that the incidence of this complication remains uniformly high in patients who have had more than 4 days of preliminary catheter drainage again points to infection as being a major factor in its production.

Haemorrhage - Urinary Tract (Secondary Haemorrhage)

It is of interest that there is no increase in this complication with increase in duration of preliminary drainage. This would suggest that infection acquired as a result of preliminary catheter drainage plays little part in its production.

Upsets of Micturition

The incidence of poor control follows the course of the infective complications and reaches a peak in the 7 - 13 day preliminary drainage period. Failure or difficulty in voiding shows a maximum incidence in the 4 - 6 day period, but the variations of these complications in the different drainage periods are slight.

Because of its incidence here with a peak at the 7 - 13 day period poor control is probably more closely related to urinary infection than is difficulty or failure in voiding.

Miscellaneous Complications

These are few in number and again show no specific trends.

THE INFLUENCE OF PATIENTS' SOURCE OF ADMISSION

Some patients were admitted direct to the Urological Department of Glasgow Royal Infirmary. Others were admitted to the Urological Department from some other unit, either general medical or general surgical, in Glasgow Royal Infirmary, and others still from some other hospital altogether.

Patients who were not admitted direct to the Urological Department had a rather longer period of preliminary catheter drainage on the average (see Table 13). In particular 41.3% of the latter group were drained for 7 - 13 days as against only 20.7% of the former. The difference in the 2 groups as regards catheter drainage is only reflected in the difference in incidence of total wound infections and in wound infections delaying convalescence. Even here however as regards total wound infections the difference is just significant ($\chi^2 = 4.613$ $P < 0.05$). As regards wound infections delaying convalescence the difference is not statistically significant. When all other complications are compared in both groups there is very little difference.

THE INFLUENCE OF THE PROSTATE GLAND

The part, if any, played by the weight, the number of lobes, the ease of enucleation or the presence of infection in the gland itself in individual patients has received little attention in previous work. Lich et al (1949) in comparing a series of 65 retropubic with 65 perineal prostatectomies concluded that the number of lobes in the glands removed in each group did not affect the post-operative results.

The results here suggest that in certain instances the characteristics of the prostate gland may play some part in influencing post-operative complications.

Gland weight appears to play no part in the presence of 'sterile' urine but in infected cases there is a significant increase in the incidence of lower urinary tract infective complications (i.e. funiculitis, epididymitis, and cystitis) in patients whose gland weighs 51 gm. or more when compared with those in whom the gland weighs 50 gm. or less ($\chi^2 = 8.314$ $P < 0.01$). (Tables 14 and 15.)

In considering again the group of lower tract infective complications these are significantly increased in patients with trilobed glands when compared with those having bilobed glands, when the urine is 'sterile'. In infected cases there is a considerable increase in lower urinary tract infective complications in patients with trilobed glands but the difference is not statistically significant in the numbers studied (Tables 16 and 17).

Lower urinary tract infective complications bear no relation to the ease of gland enucleation in either 'sterile' or infected cases. In infected cases they appear to be much more numerous in those patients in whom the enucleation was easy. The difference, however, is not statistically significant ($\chi^2 = 1.963 \quad P < 0.2$).

In 'sterile' patients the incidence of poor control after operation was not increased in patients in whom enucleation was difficult, in fact, these latter showed a rather lower incidence of poor control than did those in whom enucleation was easy. In infected cases in whom enucleation was difficult the incidence of poor control after operation is significantly higher than in infected patients in whom the enucleation was easy ($\chi^2 = 6.613 \quad P < 0.01$).

It is of interest to note that the group of infected patients in whom enucleation was difficult showed a highly significant increase in the incidence of post-operative medical complications ($\chi^2 = 15.39 \quad P < 0.001$). In practice, however, there is probably no relation between ease of prostatic enucleation and post-operative medical complications (Tables 18 and 19).

When we take into account the presence of microscopic signs of inflammation of the prostate gland as described in the pathological reports we find in 'sterile' patients an increase in the incidence of lower urinary tract infective complications when signs of prostatic inflammation are present when compared with patients in whom such signs are absent. This increase is statistically significant ($\chi^2 = 5.017$ $P < 0.05$). In the presence of an infected urine again the incidence of lower urinary tract infective complications is slightly higher in patients with microscopic signs of prostatic inflammation. The difference, however, is not significant (Tables 20 and 21).

THE INFLUENCE OF THE URINARY INFECTING ORGANISM

The effect of the urinary infecting organism on post-operative morbidity has not been accurately assessed before.

That Esch. coli is the most common infecting organism in uncomplicated urinary tract infections is well known. After the passage of cystoscope and catheters resistant strains of Esch. coli and other organisms e.g. Ps. pyocyanea, Klebsiella species and Proteus species are found. The literature appertaining to these findings is reviewed in the Lancet 1962. 1. 789.

Table 22 of this present study relates morbidity to urinary infecting organisms in those cases where only one such organism was grown on culture at the time of operation.

It has been noted that infective complications as a group are significantly more numerous in patients whose original infecting organism was other than Esch. coli.

The incidence of wound infections is significantly higher in the group infected by Ps. pyocyanea, Proteus species, Klebsiella species, Staph. pyogenes or Strep. faecalis when compared with the group infected primarily by Esch. coli ($\chi^2 = 5.707$ $P < 0.02$). If the same groups are compared as regards ascending infections the former again shows a higher incidence. This is statistically significant ($\chi^2 = 4.056$ $P < 0.05$). In the case of lower tract infections also the former group shows a significantly higher incidence ($\chi^2 = 10.49$ $P < 0.01$).

This group of organisms, then, would appear to be significantly more pathogenic than Esch. coli as regards post-operative infective morbidity.

Patients infected with Ps. pyocyanea, Proteus species, Klebsiella species, Staph. pyogenes or Strep. faecalis show a significantly higher proportion of post-operative medical complications when compared with those infected with Esch. coli ($\chi^2 = 10.58 \quad P < 0.01$). This may well be explained by the fact that a large number of patients with pre-operative medical complications had a period of preliminary catheter drainage in hospital with resulting infection or re-infection by one or other of these organisms.

This former group of patients also showed a highly significant increase in post-operative suprapubic leaks when compared with those infected with Esch. coli ($\chi^2 = 10.95 \quad P < 0.001$) again showing that this complication behaves in the main, as the other infective complications. It must be noted however, that the highest incidence of total suprapubic leaks, as did the highest incidence of total wound infections, occurred in those patients in whom the infecting organism at operation was either Ps. pyocyanea, Proteus species, or Klebsiella species.

The nature of the infecting organism at operation did not appear to affect significantly the incidence of any of the other post-operative complications.

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY

CONCLUSIONS

GENERAL

1 Post-operative complications are common following retropubic prostatectomy.

2 The most common complication is wound infection. This occurred in 16.3% of 761 patients.

3 Infective complications (defined above) formed the largest group of post-operative complications. (36.2% of 761 patients)

4 Medical complications (defined above) formed the second largest group (11.2% of 761 patients).

5 The percentage of medical complications severe enough to delay convalescence was higher than the percentage of infective complications which caused a similar delay.

6 The incidence of complications following retropubic prostatectomy found in this study is similar to that noted by other authors, where comparison can be made.

THE INFLUENCE OF URINARY INFECTION

1 Urinary infection present at operation causes a highly significant increase in the incidence and severity of infective complications considered as a group, when compared with the incidence and severity of these complications in the presence of 'sterile' urine.

2 Patients with urinary infection at operation show a highly significant increase in the incidence and severity of wound infection when compared with patients whose urine is 'sterile' at this time.

3 Patients with urinary infection at operation show a highly significant increase in the incidence and severity of medical complications when compared with patients whose urine is 'sterile' at this time. Many of these patients already have some medical illness at the time of operation.

4 The incidence and severity of suprapubic leakage shows a highly significant increase in infected cases when these are compared with 'sterile' ones. The commonest aetiological factor in suprapubic leakage would seem to be infection.

5 The presence of urinary infection at operation does not appear to increase the incidence of secondary haemorrhage.

6 Upsets of micturition after operation (defined above) show a significant increase when those whose urine is infected at operation are compared with those whose urine is 'sterile'.

THE INFLUENCE OF AGE

1 The complications of retropubic prostatectomy do not appear to increase with age, apart from medical complications which are considerably higher in patients over 80 years of age than they are in patients who are younger than this.

THE INFLUENCE OF PATIENTS' CONDITION AT OPERATION

1 The general condition of the patient at the time of operation does not influence significantly the incidence of any of the post-operative complications provided the urine is 'sterile'.

2 If the urine is infected at the time of operation then patients with urinary tract disease (defined above) have a significantly higher incidence of infective complications as a whole, which are severe enough to delay convalescence, when compared

with infected patients who are otherwise well at operation.

3 Ascending infection severe enough to delay convalescence in infected cases is significantly higher when urinary tract disease (defined above) is already present at the time of operation.

4 When 'sterile' and infected patients with urinary tract disease at operation are compared, the incidence of ascending infection severe enough to delay convalescence is significantly higher in the infected group. Every effort should be made to maintain urinary 'sterility' before operation in patients with urinary tract disease.

5 Infected patients with medical disease at operation have a significantly higher incidence of post-operative medical complications than do those infected patients who are well at operation.

THE INFLUENCE OF THE DURATION OF PRELIMINARY CATHETER DRAINAGE

1 Evidence from both morbidity and mortality findings under this heading suggests that patients who have been on preliminary catheter drainage for two weeks or longer may develop some degree of immunity to

their urinary infecting organisms. That such an immunity does develop has not been proved.

2 The total incidence of infective complications as a group and also the incidence of those infective complications which were severe enough to delay convalescence shows a highly significant increase when we compare patients who have had preliminary catheter drainage with those who did not. This increase in infective complications as a group is in fact due mainly to an increased incidence of wound infection.

3 If catheter drainage is of the open type the incidence of infective complications as a whole tend to increase with the duration of such drainage. If catheter drainage is of the closed type then the incidence of infective complications as a whole remains relatively constant despite increase of duration of such drainage.

4 In 'sterile' cases infective complications considered as a group do not increase when preliminary catheter drainage has been used. There is no increase in any individual infective complication in these circumstances.

5 In infected cases infective complications considered as a group show a highly significant increase when preliminary catheter drainage has been used. In these circumstances both wound infection and ascending infection show a statistically significant increase.

6 The incidence of secondary haemorrhage is not increased in patients who have had preliminary catheter drainage.

THE INFLUENCE OF PATIENTS' SOURCE OF ADMISSION

1 The incidence of wound infection shows an increase which is statistically significant when patients referred from some other unit or hospital are compared with those referred direct to the Urological Department of Glasgow Royal Infirmary.

THE INFLUENCE OF THE PROSTATE GLAND

1 In the presence of a 'sterile' urine at operation increase in gland weight is not of significance. In the presence of infected urine at operation patients whose glands weigh more than 50 gm. have a significantly higher incidence of lower urinary tract complications.

2 In the presence of 'sterile' urine patients with trilobed glands show an increase in lower urinary tract infective complications which is statistically significant when compared with those who have bilobed glands. A similar increase in lower urinary tract infective complications is noted in patients with infected urine who have trilobed glands. This increase is not of statistical significance.

3 The ease or otherwise of gland enucleation does not affect the incidence of any of the post-operative complications in 'sterile' patients.

4 In infected patients in whom gland enucleation is difficult the incidence of poor urinary control after operation is significantly higher than it is in those infected patients in whom gland enucleation has been easy.

5 In 'sterile' patients there is a significantly higher incidence of lower urinary tract infective complications when the pathologist reports signs of inflammation in the prostate gland. Infected patients in the same circumstances show an increase in lower urinary tract infective complications but this is not of statistical significance.

THE INFLUENCE OF THE URINARY INFECTING ORGANISM

1 Infective complications as a group are significantly increased in incidence in patients whose urine is infected at operation by organisms other than Esch.coli.

2 The incidence of wound infection is significantly higher in patients whose urine is infected at operation by an organism other than Esch.coli.

3 The incidence of ascending infection shows an increase which is just within the limits of statistical significance when the urine is infected at operation by an organism other than Esch.coli.

4 The incidence of lower urinary tract infective complications (defined above) is significantly increased when the urine is infected at operation by an organism other than Esch.coli.

5 Medical complications are significantly increased in patients whose urine is infected at operation by an organism other than Esch.coli. This is probably due to the fact that many patients who suffered from medical conditions before operation had a prolonged period of preliminary catheter drainage with

resultant infection, or reinfection, with an organism other than Esch. coli.

6 The incidence of suprapubic leak shows a highly significant increase in patients whose urine at operation is infected by an organism other than Esch. coli.

7 The highest incidence of wound infection and of suprapubic leak occurred in those patients whose urine at operation was infected by either Ps. pyocyanea, Proteus species, or Klebsiella species.

THE SEQUELAE, MANAGEMENT, AND PREVENTION OF URINARY INFECTION IN RETROPUBIC PROSTATECTOMY

by

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A thesis presented
to
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for
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VOLUME II

SECTION IV

MORTALITY

RESULTS

TABLE 29

THE CAUSE OF DEATH IN 45 FATAL CASES

The presumed causes of death in 45 fatal cases are enumerated. Post mortem examination was carried out in 21 of these cases.

TABLE 30

MORTALITY FOLLOWING RETROPUBIC PROSTATECTOMY (761 CASES)

This table shows a total mortality of 5.9%. The operability rate was 97.2%. It will be noted that the mortality in infected cases was more than double that in 'sterile' cases. This difference is statistically significant ($\chi^2 = 6.291$ $P < 0.02$).

TABLE 31

ANALYSIS OF CAUSES OF DEATH IN 'STERILE' AND INFECTED CASES

It is of interest to note that in infected cases the incidence of death from infective causes is much higher than in 'sterile' cases, i.e. 2.5% as against 0.7%.

Death from cardiac disease was twice as frequent in cases with infected urine, while death from cerebral causes was rather more frequent in patients in whom the urine was 'sterile' at operation.

Death from pulmonary embolism was slightly more frequent in infected cases.

None of the above differences between the 'sterile' and the infected group is of statistical significance.

TABLE 32

THE INCIDENCE OF DIFFERENT CAUSES OF DEATH IN 45 FATAL CASES

This table shows the causes of death in patients in which it was verified at post mortem examination and also in all 45 patients. Reading from either column it is seen that infective causes were responsible for about 30% of the deaths.

TABLE 33

MORTALITY IN EACH YEAR INVESTIGATED

It will be seen that the highest total mortality occurred in the years 1955, 1958, and 1959. Mortality from infective causes was highest in 1955, 1957, and 1958.

TABLE 34

AGE AND MORTALITY IN 'STERILE' CASES

In this group of 'sterile' cases the only deaths from infective causes occurred in patients below the age of 70. When infective deaths are compared in those patients below 70 and in those of 70 years and over, the difference is not statistically significant ($\chi^2 = 0.336 \quad P < 0.7$).

In the age group below 70 there were no deaths from medical causes. Such deaths showed an incidence of over 4% in patients who were 70 years of age or over. This difference is statistically significant ($\chi^2 = 6.501$ $P < 0.01$).

In comparing total mortality in 'sterile' patients below 70 years and in those 70 years and over the difference is not statistically significant ($\chi^2 = 2.964 < P \quad 0.1$).

TABLE 35

AGE AND MORTALITY IN INFECTED CASES

In this table it will be seen that deaths from all causes are considerably higher in patients 70 years and over than in those under 70 years. When we compare total deaths in each age group the difference is statistically significant ($\chi^2 = 6.317 \quad P < 0.2$).

A comparison of infective deaths in each age group and of medical deaths in each age group shows no statistically significant difference.

TABLE 36

AGE AND MORTALITY

This table summarises the findings in the previous two tables and shows again that in both 'sterile' and infected cases total mortality increases with age.

It is again evident that in sterile cases infective mortality does not appear to increase with age although iniinfected cases infective mortality does increase with age.

Medical mortality increases with age in both 'sterile' and infected cases.

GRAPH 6

MORTALITY OF DIFFERENT AGE GROUPS

GRAPH 7

INFECTIVE MORTALITY OF DIFFERENT AGE GROUPS

GRAPH 8

MEDICAL MORTALITY OF DIFFERENT AGE GROUPS

These show in graphical form the figures shown in Table 36.

TABLE 37

MORTALITY IN RELATION TO AGE GROUPS

It is interesting to note that in 'sterile' cases 7 of the 9 patients who died were aged 70 or over, i.e. 87.7% of the deaths occurred in patients of 70 or over. In infected cases 28 of the 36 patients who died were 70 or over, that is again 87.7% of the deaths occurred in patients of 70 or over.

TABLE 38

MORTALITY AND CONDITION OF PATIENTS AT OPERATION IN STERILE CASES

Here it has been seen that the highest mortality occurred in that group of patients who had some medical condition at the time of operation or who had a history of some medical condition as defined above.

TABLE 39

MORTALITY AND CONDITION OF PATIENTS AT OPERATION IN INFECTED PATIENTS

Here it will be seen that total mortality is increased considerably in those patients who had urinary tract disease (defined above) at the time of operation.

When infective mortality in those with urinary tract disease and in those who were well at operation is compared the difference is highly significant ($\chi^2 = 11.69$ $P < 0.001$). Deaths from medical causes are naturally higher in those patients who had medical disease, but they are not significantly higher than in those who were well at the time of operation.

Accurate interpretation of the results in these patients who had both urinary tract and medical disease is difficult. In this group 2 of the patients dying from medical causes had, in addition, advanced pyelonephritis, so a large infective element was also present (See table 29). Because of this, comparison of infective mortality in well patients and in those having urinary tract disease plus those having both urinary tract and medical disease, has not been made.

TABLE 40

MORTALITY AND DURATION OF PRELIMINARY CATHETER DRAINAGE

Here it will be seen that deaths from infective causes increase as does the duration of catheter drainage to reach a maximum in the period 7 - 13 days. Beyond this deaths from infective causes seem to fall slightly.

Deaths from medical causes rise as does the duration of catheter drainage to the 4 - 6 day period, thereafter there is a slight fall in the 7 - 13 day period, Deaths from medical causes reach much their highest figure in that group of patients who have preliminary catheter drainage for 14 days or more.

When total mortality in patients who had no catheter drainage is compared with total mortality in patients who did have preliminary catheter drainage the difference is highly significant ($\chi^2 = 11.33 \quad P < 0.001$).

When the same groups are compared as regards infective mortality the difference is not statistically significant ($\chi^2 = 2.382 \quad P < 0.2$). Medical mortality on the other hand is significantly increased in patients who did have preliminary catheter drainage when compared with those who did not ($\chi^2 = 7.345 \quad P < 0.01$). Factors which might account for this are mentioned in the Discussion Section.

TABLE 41

MORTALITY AND DURATION OF PRELIMINARY CATHETER DRAINAGE

This is a summary of the previous table.

TABLE 42

MORTALITY IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROYAL INFIRMARY AND THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

Here it will be seen that deaths from infective causes are slightly more frequent in patients admitted from some other unit or hospital than they are in those patients who were admitted direct to the Urological Department of Glasgow Royal Infirmary. Deaths from other causes show no great difference in either group of patients.

The results are not statistically significant.

TABLE 43

MORTALITY AND WEIGHT OF PROSTATE GLAND

The mortality does not seem to be related to the weight of the prostate gland in either 'sterile' or infected cases.

TABLE 44

MORTALITY AND GLAND LOBES

The number of gland lobes does not appear to affect either the total, the infective, or the medical mortality.

TABLE 45

MORTALITY AND GLAND ENUCLEATION

Here it is interesting to note the higher mortality in those patients with infected urine in whom the gland enucleation was difficult. The difference is statistically significant ($\chi^2 = 4.699$ $P < 0.05$).

TABLE 46

MORTALITY AND GLAND ENUCLEATION IN INFECTED CASES

This breaks down further some of the findings of the previous table. We see that those patients in whom the enucleation was difficult showed much the same age incidence, and much the same incidence of urinary tract and medical disease as did the patients in whom enucleation was easy. Nevertheless mortality in this group with difficult enucleation was higher. This is noted both in the medical mortality 10.6% as against 4.4% and also in the infective mortality 2.6% as against 1.1%.

TABLE 47

MORTALITY AND GLAND INFLAMMATION

In both 'sterile' and infected groups total mortality showed very little difference whether or not the gland was infected.

It is of interest to note that in 'sterile' patients here the only death from infective causes occurred in a patient who had inflammation of the prostate gland. In the infected group on the other hand, patients in whom the inflammation of the prostate gland was absent showed a much higher mortality from infective causes than did those in whom inflammation of the prostate gland was present.

TABLE 48

MORTALITY AND BLOOD LOSS AT OPERATION

Although both infective and medical mortality is somewhat higher in infected patients with a blood loss of less than 500 ml. the results are not of statistical significance.

TABLE 49

MORTALITY AND URINARY INFECTING ORGANISM

Total mortality is greater in those patients whose urine was infected with an organism other than Esch. coli. The increase is not statistically significant ($\chi^2 = 3.171$ $P < 0.1$). Both infective and medical mortality was higher in this group but the results were not statistically significant.

TABLE 50

MORTALITY AND URINARY INFECTING ORGANISMS

This table summarises the findings of the previous table.

DISCUSSION

THE CAUSE OF DEATH FOLLOWING PROSTATECTOMY

Mortality figures in prostatectomy have been much more accurately documented than have morbidity figures. The present study confirms a number of previous findings and brings out several additional points of interest.

In the present series of 761 patients 52.2% were aged 70 years or over, 54.7% had suffered from acute or chronic urinary retention and 61.2% of the patients had an infected urine at the time of operation. In addition to the 761 patients 22 were not operated upon, being deemed unfit because of some medical condition in 21 and on advanced gastric carcinoma in 1. The operability rate is thus 97.2%.

Whatever the main cause of death from prostatic disease there is no doubt that mortality is falling steadily in the population as a whole (Lee 1957).

Opinions differ as to whether infection or medical disease is the main cause of death. In 1930 Thomson Walker analysing the cause of death in 269 fatal cases found that 48% of these were due to renal failure or some septic complication. Such cases would have been classified as infective deaths in this thesis.

Milner et al (1941) discussing deaths following transurethral resection came to the conclusion that most deaths were due to cardiac disease. Also in 1949 Riches pointed out that the cause of death following prostatectomy was generally cardiac or pulmonary contrasting with older figures where uraemia, sepsis and haemorrhage predominated.

Dawson Edwards (1956) noted a great drop in the incidence of urinary sepsis as a cause of death in a series of patients treated between 1948 and 1953 when compared with another series who had been treated between 1939 and 1945.

In a series of 1200 patients described by Salvaris (1960) there were 50 deaths. Of these 12 (24%) would appear to have been of infective origin.

Barrett (1962) described a series of 433 prostatectomies of which 126 were done by the retropubic route. There were 29 deaths, 7 (24.1%) of these being of infective origin. Another 5 (17.2%) are noted as being due to renal failure without infection. This author stated that the two chief killers after prostatectomy were still haemorrhage and infection.

On the other hand, Scorerand Knight (1962) compared the mortality in 200 cases of urinary retention treated in 1949-1952 with that in a series of equal number treated in 1957-1960. They noted a great fall in mortality in the second series and pointed out that this was apparently due to a much reduced incidence of severe urinary infection and secondary haemorrhage. Nevertheless 2 (25%) of the 8 deaths in the latter series were due to pyelonephritis.

There would thus appear to be a majority who feel that sepsis is lessening as a cause of death after prostatectomy. In Freyer's series (1912) there were 55 deaths and of these 26 (47.3%) were due to infective causes. Of the deaths examined by Thomson Walker (1930) 48% were of infective origin, if we consider deaths from renal failure to fall into this category. In the series of Harris (1934) only 1 (10%) of 10 deaths was of infective origin. Rees (1947) showed that of 64 post mortems, after various forms of prostatectomy, death was of infective origin in 38 (59.4%).

In a series of 678 retropubic prostatectomies published by Lich (1953) in North America 2 (18.2%) of 11 were of infective origin. In the series of 1000 retropubic cases published by Blue et al (1958) in North America 3 (12.5%) of 24 deaths were infective.

Boreham (1964) described 150 retropubic prostatectomies. There were 10 deaths. One of these was from pyelonephritis, another from pelvic cellulitis and a third from uraemia. Thus 30% of these deaths were probably of infective origin.

So, while sepsis may be lessening as a cause of death, it is still a very important factor. In the first 30 years of this Century sepsis accounted for about half the deaths following prostatectomy, today it still accounts for from 10% to 30% of deaths in different reports.

In this series there were 45 deaths and 14 (31.1%) were judged to be of infective origin. The problem of infection and its relation to prostatectomy is thus still well worthy of study.

THE INFLUENCE OF INFECTION

Per se, the influence of urinary infection present at operation on post-operative mortality following retropubic prostatectomy is not nearly so marked as its influence on post-operative morbidity. Total mortality in infected cases is, however, considerably higher than in 'sterile' cases and this increase is statistically significant ($\chi^2 = 6.29$ $P < 0.02$). No statistically significant difference is obtained on comparing mortality from medical causes or mortality from infective causes in the 'sterile' and the infected groups of patients.

THE INFLUENCE OF AGE

It has been noted several times before that mortality in retropubic prostatectomy increases with age (Millin, 1949; Jacobs, 1951; Shepperd, 1961; Scorer and Knight, 1962). A similar trend has also been noted in prostatectomy carried out by other methods (Hey, 1945; Holtgrewe et al. 1961; Lane et al. 1961; Bodman, 1964).

The present study brings out the fact that this increase in mortality with age is very much less marked if the patients' urine is 'sterile' at operation. Up until the age of 79 the mortality rate in infected cases is more than double the mortality rate in sterile cases (Graph 6). There were only 20 'sterile cases who were aged 80 years or more so that the 10% mortality indicated for this group in Graph 6 has little significance.

It has previously been noted, but is worth further mention, that in both sterile and infected groups 87.7% of the deaths occurred in patients who were aged 70 years or over.

THE INFLUENCE OF PATIENT'S CONDITION AT OPERATION

In 1912 Freyer noted that a mortality of 4.8% was increased to 8.8% if patients suffered from bladder calculi. Hey (1945) divided patients into 4 groups with increasingly severe defects in renal function and in the cardiovascular system. He pointed out that mortality increased markedly in those patients with poor renal function and marked cardio-vascular disease. Taylor et al. (1955) pointed out that "Associated medical, surgical and urological pathological changes frequently found in patients with prostatic hypertrophy may be a deciding factor in mortality".

Grace (1961) noted a much higher mortality from cardio-vascular causes in patients who had a history of, or who had concomitant, cardio-vascular disease. Bodman (1964) divided patients having open prostatectomy into 4 worsening medical groups. He found that mortality increased as the medical condition of the patients worsened.

The above findings are confirmed in this study. From tables 38 and 39 it is seen that medical mortality was highest in both sterile and infected cases in patients who had a history of, or who suffered from some medical condition (defined above) at the time of operation.

Medical mortality in the infected group who had medical disease is higher, but not very much higher, than it is in the 'sterile' group who had medical disease.

Mortality from infective causes is remarkably high in those patients with urinary tract disease or a history of such disease, provided the urine is infected. In infected patients this infective mortality in the urinary tract disease group shows a statistically highly significant increase when compared with those infected cases who were well at the time of operation.

Of infected patients in the urinary tract disease group 61% were 70 years or over, however, as compared with 53% of infected patients in the well group. This age difference could to some extent explain the high mortality in the urinary tract disease group.

The age incidence of sterile patients with urinary tract disease was comparable to that of infected patients with urinary tract disease. There was no infective mortality in the 'sterile' cases with urinary tract disease. The numbers are not sufficient, however, to make the difference in infective mortality in these 2 groups of statistical significance, but the findings are highly suggestive. The medical mortality in this 'sterile' group with urinary tract disease, was similar to that in the infected group with urinary tract disease.

THE INFLUENCE OF THE DURATION OF PRELIMINARY CATHETER DRAINAGE

It has been noted that the increase in mortality in those patients in this series who had preliminary catheter drainage is highly significant when compared with those patients who did not have preliminary catheter drainage (Tables 40 and 41). Allowance, however, must be made for the fact that only 42% of those without preliminary drainage were aged 70 years or over while 63% of those who did have drainage were in the older age-group. Not only so but only 10% of the no drainage group had a blood urea of 50mgm./100ml. or more at the time of operation whereas 26% of those who did have drainage showed a blood urea over 50mgm./100ml. or more at the time of operation.

The series of patients who required drainage were thus old, many had impaired renal function, many had medical comditions, and a great many became infected due to the drainage. All those factors tend, of course, to increase mortality rate in any series.

It will be recalled that there was a significant diffemence in mortality when we compared 'sterile' cases with infected cases. Here however, the age difference is less marked 45% of the 'sterile' group being 70 years or over while 56% of the infected cases fall in this older age group. The state of the upper urinary tract as judged by raised blood urea levels is again more comparable in these 2 groups - 17% of the 'sterile' group and 21% of the infected group had blood ureas of 50 mgm./100 ml. or more at the time of operation.

There is thus still doubt as to whether urinary infection at the time of operation is as accurate a measure as the fact of preliminary catheter drainage in forecasting possible differences in mortality when comparing different series of cases.

Again in considering infective mortality and the duration of preliminary catheter drainage it is interesting to note that infective mortality increases until the 7 - 13 day period after which there is a fall in the incidence of deaths from infective causes. This fall in infective mortality in patients drained for 14 days or longer compares with the similar fall in the incidence of infective complications in patients so drained. This again suggests that patients who have catheter drainage for 14 days or longer before operation may develop some immunity to their urinary infecting organisms.

Catheter drainage thus appears to play a significant part in mortality following prostatectomy. This is probably due in large part to the infection which catheter drainage produces. It must also be remembered that a large number of the bad risk patients require preliminary catheter drainage because of a urinary retention which has occurred during the course of some other illness.

THE INFLUENCE OF EASE OF GLAND ENUCLEATION

The increase in mortality in infected cases in whom gland enucleation was difficult is noteworthy. This increase is present in both medical and infective mortality but is more marked in the latter (Table 45). The difference in total mortality, when infected cases in whom enucleation was easy are compared with infected cases in whom enucleation was difficult, is statistically significant ($\chi^2 = 4.699$, $P < 0.05$).

Table 46 shows that the above increase in mortality is due neither to age nor to the state of the upper urinary tract at the time of operation.

It might thus be wiser, in the present state of our knowledge to use knife or diathermy needle in infected cases especially when enucleation becomes at all difficult.

THE INFLUENCE OF THE URINARY INFECTING ORGANISM

In cases infected by organisms other than Esch. coli mortality is increased, although the differences are not statistically significant. This is in keeping with the finding that there is a significant increase in both infective and in medical complications in this group.

GENERAL REMARKS

Several of the assessments recorded under Results have not been mentioned in this part of the discussion since they were shown to have no significance as regards mortality.

The main factor in post-operative mortality would appear to be age. The steep increase in mortality as age advances is shown to be much less marked if patients can be maintained 'sterile'. Even in 'sterile' cases there is an unavoidable increase in mortality from medical causes with increasing age but mortality from infective causes does not increase with increasing age in these 'sterile' cases (Graph 7). Urinary infection at the time of operation is thus also a most important factor as regards post-operative mortality. Another noticeable factor is the state of the patient at operation with particular reference to urinary tract or medical disease. In infected cases the presence of urinary tract disease, as defined above, causes a significant increase in mortality from infective causes.

The catheter has been condemned many times (Beeson, 1958) and obviously plays a great part as a factor in the production of mortality - probably mainly because of the infection which it produces. In this series 82% of patients who had preliminary catheter drainage were infected at operation, while 36% of patients not so drained were infected.

Thus in comparing mortality in different series of patients who have had some form of prostatectomy it is necessary to know the incidence of all the above mentioned factors before adequate comparison can be made.

More attention must be given to the one factor which can be prevented, namely infection. This aspect of the problem will be further discussed. (Section VII)

As regards comparison of different series, table 51 shows several series published by authors in Great Britain and Ireland. This table takes into account most of the factors mentioned above and also includes the operability rate where this is mentioned. The state of the patient at operation is mentioned by a number of authors but because of differences in definition of conditions e.g. hypertension and uraemia, accurate comparison is not possible and this factor has therefore not been included. It will be noted however that when allowance is made for the factors included then the mortality following retropubic prostatectomy differs little in different centres. Thus in this table series with a high proportion of patients 70 years or over show a high mortality and vice versa. Similarly series with a high percentage of urinary retention and consequent catheter drainage have a high mortality.

The mortality of 5.9% quoted in this series thus compares favourably with that of 4.2% quoted by Salvaris in a series of younger age, which included fewer patients with urinary retention and in whom 40% of the patients were infected at operation compared with 61.2% of the patients in this series.

Table 52 shows several series of retropubic prostatectomies published in North America. The mortality in these, with one exception, is much lower than in any series from Great Britain and Ireland. Where quoted the age incidence, the incidence of urinary retention and infection are comparable with the series in table 51. I cannot explain this almost universal low incidence of mortality except to say that a larger number of the American patients may be of "private patient" physical status.

Table 53 shows a number of representative series of different types of prostatectomy from this country. The lowest mortality is obtained by Stewart with trans-urethral resection. His series shows a lower incidence of urinary retention and a lower operability rate than the present one, however.

CONCLUSIONS

MORTALITY

When all factors are considered the mortality rate following retropubic prostatectomy found in this study is comparable with the mortality rates quoted for other such studies in this country. The mortality rates obtained in several published series from North America are very much lower. There is no apparent explanation for this.

THE INFLUENCE OF INFECTION

Mortality following retropubic prostatectomy is significantly higher in infected cases than it is in 'sterile' cases.

THE INFLUENCE OF AGE

1 Mortality following retropubic prostatectomy increases with increasing age in all cases. This increase in mortality is much less marked in 'sterile' cases than it is in infected cases.

2 In both 'sterile' and infected cases almost 90% of the deaths occurred in patients who were 70 years or older.

THE INFLUENCE OF PATIENT'S CONDITION AT OPERATION

1 In both 'sterile' and infected cases medical mortality is highest in those who have medical disease (defined above) at the time of operation.

2 The incidence of death from medical causes shows little difference when sterile and infected cases are compared.

3 In 'sterile' cases infective mortality is minimal.

4 In infected cases infective mortality is very high in patients who have urinary tract disease (defined above) at the time of operation. In these infected cases with urinary tract disease the incidence of infective mortality shows a highly significant increase when compared with the incidence of infective mortality in those who were well at operation. This increase is partly due to the increased age incidence of the former group.

5 The incidence of mortality from infective causes is very much higher in infected patients with urinary tract disease than in 'sterile' patients with urinary tract disease. In the numbers available for study the difference is not of statistical significance. In these 2 groups the age incidence is similar.

THE INFLUENCE OF THE DURATION OF PRELIMINARY CATHETER DRAINAGE

1 Total mortality following retropubic prostatectomy shows a highly significant increase in patients who

have had preliminary catheter drainage when compared with those who have had no such drainage. This findings is modified by the fact that the group who had preliminary catheter drainage comprised firstly a higher percentage of patients who were 70 years or over, second a higher percentage of patients with poor renal function, and third a higher percentage of patients who already had medical disease (defined above) at operation.

In the numbers studied the incidence of infective mortality is higher (but not significantly so) in those who had preliminary catheter drainage when compared with those who did not.

2 When all factors are considered there is still doubt as to whether urinary infection at the time of operation is as accurate a measure as the fact of preliminary catheter drainage in forecasting possible differences in mortality when comparing different series of cases.

THE INFLUENCE OF EASE OF GLAND ENUCLEATION

1 The increase in total mortality, when infected cases in whom enucleation was difficult are compared with infected cases in whom the enucleation was easy is just within the limits of statistical significance. (Hill, 1961) The age incidence and the state of

renal function in the 2 groups compared did not appear to play any part in the increased mortality in the former group.

2 Diathermy needle or knife should be used to effect removal of prostatic tissue when digital enucleation becomes difficult.

THE INFLUENCE OF THE URINARY INFECTING ORGANISM

There is no statistically significant increase in mortality in patients whose urine is infected at operation by organisms other than Esch. coli.

SECTION V

ANTIMICROBIAL COVER

RESULTS

ANTIMICROBIAL COVER

'STERILE' CASES

In all, 192 patients with 'sterile' urine had retropubic prostatectomy in the 4 year period 1957 - 1960 (Table 54). The 'sterile' cases are presented for study thus:-

Of the 100 cases in the trial to assess the value of penicillin and sulphatriad as a prophylactic agent in retropubic prostatectomy 52 cases were sterile. Of these 22 had no cover and no antimicrobials in the first 3 days after operation, and 30 had penicillin and sulphatriad.

Of the remaining 140 patients (Table 54) 92 had no antimicrobial cover and no antimicrobial drugs were given during the first 3 days after operation. No prophylactic cover was given to 33 patients but broad spectrum antimicrobial agents were given during the first 3 days after operation, generally because of a sudden rise in temperature with no clinical signs.

Experience has shown that a temperature rise to $101^{\circ} - 102^{\circ}$F during the first 3 days after operation is generally a very transitory affair and settles over 12-24 hours without treatment. Such episodes of pyrexia have not been included as infective complications in this thesis. A few patients did however have clinical signs of chest infection.

It was felt that effects caused by antimicrobials given shortly after operation might influence the interpretation of results in patients who had no prophylactic cover over the period of operation. These cases were therefore excluded in assessing results in 'sterile' cases who had no prophylactic cover.

A further 15 patients with sterile urine were given broad spectrum antimicrobial cover. In 9 of these chest signs had been elicited before operation and the other 6 were put on broad spectrum cover before the result of the urine culture was to hand on the mistaken assumption that the urine was infected.

INFECTED CASES

271 patients with infected urine had retropubic prostatectomy in this 4 year period (Table 55); 48 of these are included in the study of penicillin and sulphatriad, 28 having no cover, and no antimicrobial therapy in the first 3 days after operation and 20 having penicillin and sulphatriad.

As previously mentioned 17 patients, who had been on preliminary catheter drainage for 7 days or longer were excluded from the above study. Of these 8 had streptomycin but the urinary infecting organisms were found to be insensitive to this agent. The other 9 had penicillin and sulphatriad. These 9 patients are tabulated along with the 20 infected patients in the study of penicillin and sulphatriad since, with closed drainage, the urine was not considered to be grossly infected (Table 55). The 8 patients having streptomycin are tabulated with a number of other cases in whom the antimicrobial cover was inappropriate as judged by the urine sensitivity tests.

Excluding the above 65 patients 206 patients remain. These comprise the series which were studied in order to assess the value of appropriate broad spectrum antimicrobial drugs (after sensitivity tests) as prophylactic agents over the period of operation in infected patients.

The plan had been to give 103 patients appropriate broad spectrum agents commencing 1 or 2 days before operation and continuing for 5 days in all. In actual fact, because of a mistake in selection, 104 patients were given such treatment. In 8 of these however, the drug given was found to be inappropriate when the results of urine culture and sensitivity tests came to hand. These 8 cases were studied in a separate small group along with the 8 cases having streptomycin - 96 infected patients having appropriate broad spectrum prophylactic agents thus remain for study (Table 55).

102 infected patients (instead of 103) had no cover over the period of operation. Of these, however, 20 were given broad spectrum agents (appropriate to the urinary infecting organisms at operation) within the first 3 days of operation, again because of some sudden rise in temperature after operation often without clinical signs. These 20 cases were excluded from the group having no cover for the reasons stated above in describing the 'sterile' cases. This leaves 82 patients with infected urine who had no antimicrobial cover and no antimicrobial therapy within the first 3 days after operation, to compare with 96 infected patients who had appropriate broad spectrum antimicrobial therapy. The agents used in these cases were mainly tetracycline (250 mgm. 6 hourly), chloramphenicol (250 mgm. 6 hourly), and nitrofurantoin (100 mgm. Q.I.D.).

LOCAL ANTIMICROBIAL APPLICATION TO WOUNDS

Before commencing suture of the abdominal wall and after closing the prostatic capsule the wound was insufflated with antimicrobial powder. From January, 1954 until December, 1957 penicillin and sulphonamide powder was used. From January, 1958 until December, 1960 Polybactrin Spray was used.

There was no significant reduction in the incidence of wound infection as a result of using Polybactrin Spray (Graphs 9 and 10).

TABLE 56

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957 - 1960

This table shows the results in 4 small series of cases studied between 1957 and 1960. All had closed drainage. It will be noted that the results as regards infective complications are very much the same in each group.

There is no statistically significant difference as regards medical complications, suprapubic leak, urinary tract haemorrhage, or upsets of micturition in any of these small groups. The group who had the broad spectrum cover in the first few days show a higher incidence of medical complications, but again this is not statistically significant.

TABLE 57

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957 - 1960

This table shows the results of 92 'sterile' cases studied between 1957 and 1960. No antimicrobial cover was given over the period of operation and none of these patients had antimicrobial agents given during the first 3 days after operation.

25% of these patients had some form of infective illness following operation and in 12% this infective illness delayed convalescence.

In this group infective illness was by far the greatest cause of post-operative morbidity; 25.1% had infective complications comparing with 6.6% who had medical complications.

TABLE 58

ANTIMICROBIAL COVER IN 'STERILE' CASES

ALL 'STERILE' CASES 1957 - 1960

MORBIDITY

This table compares post-operative complications in 114 'sterile' patients who had no antimicrobial cover over the period of operation with 78 sterile patients who had some form of antimicrobial cover over operation, or within the first 3 days of operation. (See Table 54 above and also Discussion).

The incidence of total infective complications was 28.3% in those who had some form of antimicrobial therapy while in those who had no cover it was 25.5%. There is little difference in the incidence of any of the individual complications. This in fact, is also true for the medical complications, suprapubic leak, urinary tract haemorrhage, and upsets of micturition.

TABLE 59

ANTIMICROBIAL COVER IN 'STERILE' CASES

ALL 'STERILE' CASES 1957 - 1960

MORTALITY

This shows the mortality in the same series of patients as in Table 58. There is no statistically significant difference in the results although it is of interest that deaths from infective causes occur only in that group of patients who had no antimicrobial cover over the period of operation.

TABLE 60

ANTIMICROBIAL COVER IN 'STERILE' CASES

ALL 'STERILE' CASES 1957 - 1960

AGE AND DURATION OF PRELIMINARY CATHETER DRAINAGE

This table shows that of those patients who had no antimicrobial cover 38.6% were 70 years or older while of those who had some form of cover, or antimicrobial therapy within 3 days of operation, 48.7% were 70 years or older.

Of those who had no cover only 11.4% had had preliminary catheter drainage while of those who had antimicrobials over, or just after, operation 34.6% had had preliminary drainage.

TABLE 61

ANTIMICROBIAL COVER IN INFECTED CASES
1957 - 1960

This table shows four small series of infected cases studied in the period 1957 - 1960. There is no statistically significant difference between the 4 groups in regard to total infective complications as a whole or in regard to any of the individual infective complications. There is no statistically significant difference in the incidence of any of the other complications.

TABLE 62

ANTIMICROBIAL COVER IN INFECTED CASES

1957 - 1960

This table compares 82 infected patients who had no antimicrobial cover over the period of operation with 96 infected patients who had appropriate antimicrobial cover over the period of operation. These patients were all on closed catheter drainage and apart from the antimicrobials mentioned above no others were given in the first 3 days following operation.

Cases who had appropriate cover show a 17% decrease in the incidence of total infective complications as a group. They also show a decrease of 12.9% in those infective complications which delayed convalescence. There is some decrease in this group in all the individual infective complications apart from wound infection and funiculitis. This decrease is most marked in the case of ascending infection where it is statistically significant ($\chi^2 = 5.744 \quad P < 0.02$). There is no difference in the incidence of medical complications in these 2 groups. Suprapubic leakage, urinary tract haemorrhage, and upsets of micturition are all less in the group who had antimicrobial cover but the decrease is not statistically significant.

TABLE 63

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES 1957 - 1960

MORBIDITY

This table compares post-operative complications in 96 infected patients who had appropriate broad spectrum antimicrobial cover over the period of operation with 110 infected patients who had no cover over operation and with 65 patients who had inappropriate antimicrobials (as judged by urine culture and sensitivity tests) given as cover over the period of operation or appropriate agents within the first 3 days after operation (see Table 55 and Discussion).

There is no statistically significant difference in the sum of the total infective complications or in the sum of those infective complications which delayed convalescence in any of the 3 groups of patients studied.

The incidence of individual infective complications shows no statistically significant difference in any group, with the exception of ascending infection. When the incidence of this complication is compared in the group of 96 patients who had approrpiate cover and in the group of 110 who had no cover then its increased incidence in the latter group is statistically significant ($\chi^2 = 5.832 \quad P < 0.02$).

When the increased incidence of ascending infection in the 65 patients who had inappropriate cover over the period of operation, or appropriate cover given within the first 3 days after operation is compared with the incidence of ascending infection in those 96 patients who had appropriate antimicrobial cover this increase is again statistically significant (Hill, 1961), ($\chi^2 = 4.638$ $P < 0.05$).

If the incidence of ascending infection in 96 patients with appropriate cover is compared with its incidence in all other infected patients (i.e. 110 + 65 = 175) having no cover, inappropriate cover, or appropriate antimicrobials given after operation then the increased incidence of this complication in these latter groups is again statistically significant ($\chi^2 = 6.707$ $P < 0.01$).

The incidence of medical complications differs little in the 3 groups shown, being highest in the group of 65 with inappropriate cover or appropriate cover given after operation.

The incidence of suprapubic leak, urinary tract haemorrhage and upsets of micturition are all lowest in the group of 96 patients who had appropriate cover. The differences are not, however, statistically significant.

There is nothing of special note about the miscellaneous complications.

TABLES 64 AND 65

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES 1957 - 1960

AGE AND DURATION OF PRELIMINARY CATHETER DRAINAGE

These tables show the age incidence and the duration of preliminary catheter drainage in the 3 groups of patients studied in Table 63. Of the 96 patients who had appropriate cover 54.2% were 70 years or older. Of the 110 who had no cover 50.9% were 70 years or older and of the 65 who had inappropriate cover, or appropriate agents given after operation 61.6% were 70 years or over.

Of the group of 96, 90.6% had had preliminary catheter drainage. 82.7% of the group of 110 and 84.6% of the group of 65 had had such drainage.

TABLE 66

ANTIMICROBIAL COVER IN INFECTED CASES

1957 - 1960

TRIAL OF PENICILLIN AND SULPHATRIAD

MORTALITY

In the small numbers available for study there is no statistically significant difference in their results.

TABLE 67

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES 1957 - 1960

CONDITION OF PATIENT AT OPERATION AND MORTALITY

The 96 patients who had appropriate cover over operation had a higher incidence of urinary tract disease and a higher incidence of patients of 70 years or over with a blood urea of 50 mgm./100 ml. or over, than the group of 110 who had no cover. The former group had a lower incidence of medical disease at operation than the latter group.

The 96 patients who had appropriate cover had a much lower total mortality than the 110 patients who had no cover. While medical mortality was almost equal in the 2 groups, infective mortality in those with appropriate cover was nil as against 4.5% in those with no cover. This difference is not statistically significant in the numbers studied.

It will be seen that the group of 65 patients who had inappropriate cover or appropriate agents given within the first 3 days of operation has the highest incidence of urinary tract disease and of medical disease at operation. This group also has the highest incidence of patients who are 70 years or over with a blood urea over 50 mgm./100 ml. It also has the highest total mortality and the highest infective mortality. The medical mortality is slightly lower than it is in the other 2 groups.

When infective mortality is compared in the 96 patients who had appropriate cover and in the sum of the other 2 groups (i.e. 175 patients) then the difference is statistically significant (Hill, 1961) ($\chi^2 = 4.197$ $P < 0.05$).

TABLE 68

ANTIMICROBIAL COVER IN INFECTED CASES

1957 - 1960

PATIENTS OVER 70 YEARS WITH BLOOD UREA OVER

50 MG./100 ML.

These cases are few in number but all 5 who were given appropriate antimicrobial cover had a normal convalescence. Of the 6 who had no antimicrobial cover 2 died of pyelonephritis and 1 had a very severe infective illness which greatly prolonged his convalescence.

DISCUSSION

ANTIMICROBIAL COVER IN PROSTATECTOMY

The use of sulphonamide, penicillin and most of the broad spectrum antibiotics as prophylactic agents in prostatectomy has been studied by various workers. In general, but not always, the studies have been made on patients undergoing transurethral prostatic resection.

Studies have also been made of prophylactic antibiotics in other operative procedures.

Opinions as to the efficiency of these agents differ. Gaudin et al. (1938) could not demonstrate a sound basis for the administration of sulfanilimide in the routine management of patients having transurethral prostatic resection. In this series, however, the drug was administered after operation. Appleton et al. (1956) failed to demonstrate any advantage in the prophylactic use of chlormphenicol in transurethral resection.

Yates Bell (1947) on the other hand, after study, recommended the use of penicillin for any period of indwelling catheter drainage in prostatic surgery. Jacobs (1949) pointed out that to operate with patients under an antibiotic umbrella was an important safety factor, especially in the aged. His opinion was based on patients having either transurethral resection or retropubic prostatectomy. Strom et al. (1942), Creevy et al. (1954) and Simon et al. (1955) studied between them, a wide range of antimicrobial agents in patients having transurethral resection. All concluded that prophylactic antimicrobials were of value in patients having transurethral resection, since these agents reduced the incidence of pyrexia, especially after removal of the urethral catheter. Creevy et al. (1954) found that with broad spectrum antibiotics in transurethral resection, convalescence was smoother and mortality, especially from infective causes, less.

Pulaski (1957) reviewed reports showing that, after operations on the biliary tract, subtotal gastrectomy, or resection of the colon, post-operative complications were as common in those who received prophylactic antibiotics as in those who did not. He also mentioned reports which showed that the incidence of wound infections after appendicectomy for acute suppurative and acute gangrenous appendicitis were not reduced by parenteral tetracycline therapy.

Thulbourne et al. (1962) showed that the use of penicillin prophylactically in a wide range of surgical procedures did not reduce the incidence of post-operative chest infection.

Shubin et al. (1963) felt that antibiotics in relation to the surgery of urinary tract obstruction tended to reduce the natural defences when given prophylactically.

Although opinions as to the value of prophylactic antimicrobials differ all who mention the subject are agreed that in the presence of congenital heart disease or acquired heart valve abnormality prophylactic antimicrobials should be given before operation on the urinary tract lest bacterial endocarditis follow (Merritt 1951; Appleton et al. 1956; Toh et al. 1960; Lancet, 1962).

Apart from the merits or otherwise of antimicrobial substances used as prophylactics in prostatectomy other factors have also been discussed. Thus Band (1949) warned against the use of antibiotics without appropriate sensitivity tests. He noted that over-enthusiastic use of antibiotics without proper bacteriological control lead to alterations in the nature of bacterial invaders and alterations in the sensitivity of different strains.

Jackson et al. (1955) pointed to an increased incidence of paracolon, A. aerogenes, Pseudomonas, proteus and Strep. faecalis species in the urine in patients with pyelonephritis treated with chloromycetin, Aureomycin, and Terramycin in 1949 - 1954. In 1960 the British Medical Journal referred to the work of Finland et al. showing the increased incidence of bacteraemia and meningitis due to Staphylococcus aureus and the coliform group since the general use of broad spectrum antibiotics. In 1963 the Lancet pointed out that there was a correlation between the amount of cross infection in wards and the proportion of the patients who received antibiotics.

Apart from their effect on the types of organisms to be found in a given environment and on the resistance of these organisms the antibiotics themselves all have toxic effects on the patient. The toxic reactions of penicillin and sulphonamide were reviewed by Kutscher et al. 1954. The toxicity of antimicrobial agents was also mentioned by Appleton et al. (1956). The subject of aplastic anaemia following chloromphenicol therapy (generally unnecessary) is reviewed in the British Medical Journal (1961). Hutcheson et al. (1962) reported a further 3 cases of marrow aplasia due to chloramphenicol, and Cahill (1962) reviewed the literature as regards the haematological complications of chloramphenicol therapy and described 1 patient who had a severe haemorrhagic reaction to the drug. Sharp (1963) described another 40 cases of blood dyscrasia following chloroamphenicol.

Nitrofurantoin is itself toxic as pointed out by Loughridge (1962), and Ellis (1962).

A review of the toxic reactions of tetracycline is given in the Lancet (1963).

PRESENT STUDY

In view of the above mentioned differences of opinion as to their efficacy in prostatectomy, and as to their effects on both infecting organisms and human hosts another attempt to assess the value of anti-microbials as prophylactics would appear to be well worthwhile.

In this study all patients had retropubic prostatectomy over a selected 4 year period. A closed system of catheter drainage was used in all cases. The selection of patients for trial and control is imperfect but compares favourably with the methods of selection used in most of the above series. The method of selection in this series is detailed in the chapter on 'Material and Methods'.

'STERILE' PATIENTS

In the small series of 'sterile' cases studied separately in Table 56 it is obvious that the giving of penicillin and sulphatriad, or broad spectrum cover over the period of operation, or in fact the giving of broad spectrum agents within the first 3 days after operation did not appreciably affect the incidence of any of the post-operative complications compared with the small group of 'sterile' patients who had no antimicrobial cover.

The complications in the small group of 'sterile' patients who had no cover in Table 56 show only a slight increase in the sum of the total infective complications and in the sum of these infective complications which delayed convalescence when compared with the large series of 92 'sterile' patients shown in Table 57 who also had no cover. The series shown in Table 57 had a slightly higher incidence of medical complications.

In view of the minimal differences between these 2 'sterile' series, it was felt that they could be studied together as 1 series of 114 patients who had no cover over operation and no antimicrobial agents within the first 3 days of operation. These can now be compared (Table 58) with the 78 patients shown as 3 separate groups in Table 56. Each of these 78 patients had cover either by penicillin and sulphonamide or a broad spectrum antimicrobial, or they had a broad spectrum agent given within the first 3 days after operation. Again the post-operative complications in the 3 shorter series shown in Table 56, which are combined to give the larger series of 78 cases shown in Table 58, show only insignificant differences in the incidence of post-operative complications.

From Table 58 it is seen that the giving of antimicrobials to these larger series of 'sterile' patients either over operation or after operation has not altered the incidence of any of the post-operative complications to any statistically significant degree. The sum of the total infective complications is slightly higher in those patients who did have cover. The sum of those infective complications which delayed convalescence is slightly higher in the group of 114 patients who had no cover.

Of the group of 78 who had antimicrobials over or just after operation 38% had a period of preliminary catheter drainage as against 11% of the 114 patients who had no cover. Of those who had antimicrobials 49% were aged 70 years or over as against 39% of those who had no antimicrobials (Table 60).

It has been shown above that age does not influence the incidence of post-operative complications. Preliminary catheter drainage does, however, influence the incidence of some of these complications and so the group of 78 patients, 35% of whom did have such drainage, might well have had a higher incidence of post-operative complications and especially of infective complications had it not been for the administration of antimicrobials.

Nevertheless from the above findings one cannot conclude that the giving of antimicrobial cover over operation, or in the first 3 days following operation in 'sterile' cases, is of any particular value.

Mortality in the trial of penicillin and sulphatriad in sterile cases showed no significant difference when the group on penicillin and sulphatriad was compared with the group who had no cover. There was 1 death from medical causes in each group.

In the series of 78 patients having antimicrobials there were 4 deaths (5.1%). There was no infective mortality in this series. In the group of 114 who had no antimicrobials over, or in the first 3 days following operation, there were also 5 deaths (4.4%). See Table 59. In this group however 2 of the deaths were from infective causes (1.8%). Both of the patients who died were under 70 years. Neither had had preliminary catheter drainage. Post mortem examination in 1 showed death from staphylococcal pyaemia. In this patient the presence of a prostatic abscess was reported by the pathologist who sectioned the gland. There was, however, no clinical sign of this and the urine, of course, was 'sterile' at the time of operation. In the other patient post mortem examination confirmed the cause of death as pyelonephritis. He had a marked wound infection in addition. These 2 patients might have been saved by a broad spectrum antimicrobial given over the period of operation.

INFECTED PATIENTS

The 4 small series of infected cases shown in Table 61 show no marked difference in the incidence of any individual complication or any group of complications whether they had no antimicrobial cover over the period of operation, or penicillin and sulphatriad, or appropriate cover on 1 of the first 3 days after operation, or inappropriate broad spectrum cover.

Those who had no cover (see Table 61) show an incidence of post-operative complications comparable with those found in the 82 infected patients who had no cover studied in Table 62. These 2 groups who had no cover have thus been combined since they were all studied in the same 4 year period. We therefore have 82 + 28 = 110 infected patients without antimicrobial cover to compare first with 96 infected patients who had appropriate antimicrobial cover and second with 65 infected patients (Table 63) who had penicillin and sulphatriad, or inappropriate broad spectrum cover over the period of operation or who had appropriate broad spectrum agents given on 1 of the first 3 days <u>after</u> operation.

From Tables 64 and 65 it will be seen that of the 96 infected patients who had appropriate cover 54.2% were 70 years or over; of the 110 who had no cover 50.9% were 70 years or over and of the 65 who had inappropriate cover over operation or appropriate cover after operation 61.6% were 70 years or over. The percentage of each of these 3 groups who had catheter drainage was 90.6% of 96, 82.7% of 110 and 84.6% of 65.

Table 67 shows the pre-operative state in these 3 groups of patients - 26% of 96 with appropriate cover, 21.8% of 110 with no cover and 32% of 65 with inappropriate cover or appropriate cover during the first 3 days after operation had urinary tract disease. The incidence of medical disease was as follows - 30.2% of 96, 34.6% of 110 and 38.5% of 65.

With these facts in mind attention can be turned to Table 63. The sum of the total infective complications is similar in the 110 patients with no cover and in the 65 patients with either inappropriate cover or appropriate cover given on the first 3 days after operation, being 46% in each group. The sum of the infective complications delaying convalescence is 30% in the 110 with no cover and 27.6% in the 65 with inappropriate cover or appropriate cover given after operation.

These figures are all higher - but not significantly so - than the sum of the total infective complications (35.4%) and the sum of the infective complications delaying convalescence (18.7%) in the 96 patients who had appropriate cover. In studying individual infective complications the incidence of total wound infections in all 3 groups is similar. The incidence of wound infections which were severe enough to delay convalescence is slightly less in the group who had appropriate anti-microbial therapy but the difference is not statistically significant.

The incidence of total ascending infection is considerably lower in the group who had appropriate cover. If we compare their incidence in the group with no cover and in the group with appropriate cover then the difference in incidence is statistically significant ($\chi^2 = 5.832$ $P < 0.02$). When the incidence of ascending infection in the 96 patients having appropriate cover is compared with the incidence of ascending infection in the 65 patients having inappropriate cover or appropriate cover in the first 3 days after operation, then the increased incidence in the latter group is within the limits of statistical significance ($\chi^2 = 4.638$ $P < 0.05$). If we compare the incidence of this complication in the group who had no cover plus the group who had inappropriate cover or appropriate cover in the first 3 days after operation with its incidence in the group who had appropriate cover then the decrease in incidence is even more significant ($\chi^2 = 6.707 \quad P < 0.01$).

The incidence of ascending infection which delayed convalescence is also much less in the group who had appropriate antimicrobial cover. In the numbers available for study, however, this difference is not statistically significant.

The incidence of funiculitis, epididymitis, cystitis, and pelvic cellulitis shows no significant difference either individually or as a summation in either of the 3 groups studied.

The difference in the incidence of infective complications in the 3 groups then is due entirely to the difference in the incidence of ascending infection. This difference is statistically significant and important since it is upper urinary tract infection which sometimes leads to death.

The different incidences of medical complications in the 3 groups are interesting and reflect to some degree the incidence of medical disease which was present in the groups at the time of operation. These differences are, however, small and of no statistical significance.

The incidence of total supra-pubic leak, total secondary haemorrhage and total upsets of micturition are lower in the group who had appropriate cover than in either of the other 2 groups. The incidence of these complications which delayed convalescence is also lower in the group who had appropriate cover with the exception of supra-pubic leaks. The incidence of this complication severe enough to cause delay in convalescence was slightly lower in the group who had inappropriate cover or appropriate cover in the first 3 days after operation. These differences, although showing a trend, are not statistically significant.

Diarrhoea, rectal fistula, and rectal haemorrhage all occurred very infrequently and no comparisons can be made.

There was no significant difference in mortality in infected cases whether they were given penicillin and sulphatriad or whether they had no cover over the period of operation (Table 66).

Table 67 compares the 3 infected series as regards mortality. It is reasonable that the highest mortality is found in the series of 65 patients who had inappropriate antimicrobial therapy or appropriate therapy on the first 3 days after operation since this group contained the highest proportion of patients of 70 years or over. It also had the highest percentage of patients with urinary tract disease and medical disease at the time of operation.

While medical mortality is fairly constant in the 3 groups it is notable that infective mortality occurred only in the 2 groups who had no appropriate antimicrobial cover. Of those latter 2 groups, the group of 65 patients who had inappropriate cover or appropriate cover in the first 3 days after operation had the greatest incidence of urinary tract disease at operation (32%) and thus the greatest infective mortality (7.7%).

If the incidence of infective mortality in the group who had appropriate antimicrobial cover is compared with that in the other 2 groups then we have 96 patients 26% of whom had urinary tract disease at operation to compare with 175 patients and again 26% of this number had urinary tract disease at the time of operation. 54% of those with appropriate antimicrobials were 70 years or over as against 55% in the other 2 groups combined.

There were no infective deaths in the 96 patients who had appropriate antimicrobials and 10 infective deaths in the 175 patients who comprised the other 2 groups. The difference is just statistically significant ($\chi^2 = 4.197$ $P < 0.05$).

It would thus appear that in the numbers studied no advantage was gained in 'sterile' patients by administering penicillin and sulphatriad or broad spectrum antibiotics over the period of operation. In infected cases, however, ascending infection showed a statistically significant decline when appropriate broad spectrum antibiotics were given over the period of operation. These should commence one or two days before, but not after operation - see Table 61. The infective syndromes defined above as constituting ascending infection probably all signify the presence of pyelonephritis, a complication which can give rise to death. It is thus of interest to note that mortality from ascending infection in infected cases having appropriate antimicrobial cover was reduced when compared with infected patients having penicillin and sulphatriad, inappropriate cover, or appropriate antimicrobials after operation. This reduction was statistically significant (Hill, 1961).

It is possible that the results of appropriate antimicrobial therapy might be bettered if the drugs were withheld until a few hours before operation (Garrod et al. 1962). This, however, must form the subject of further study.

CONCLUSIONS

ANTIMICROBIAL COVER

1 In sterile cases the giving of any antimicrobial drugs over the period of operation or during the first 3 days after operation has not been shown to be of benefit in diminishing post-operative morbidity or mortality.

2 In infected cases the giving of appropriate broad spectrum antimicrobials (after urine culture and sensitivity tests) causes a significant reduction in the incidence of post-operative ascending infection, but not in any of the other post-operative complications, when compared with-

- a patients who have no antimicrobial cover over the period of operation and no antimicrobial therapy within the first 3 days after operation or/
- b patients having inappropriate cover over operation or appropriate cover within the first 3 days after operation or/
- c when compared with both the above groups combined.

3 The incidence of infective mortality in those

infected patients having no cover plus those having inappropriate cover over operation or appropriate cover in the first 3 days after operation, is higher than in those infected patients having appropriate antimicrobial cover (after urine culture and sensitivity tests). This difference is statistically significant.

4 In infected patients appropriate broad spectrum antimicrobial therapy (after urine culture and sensitivity tests) should be commenced before and not after operation if beneficial results are to be obtained.

SECTION VI

POST-OPERATIVE BACTERAEMIA

RESULTS

TABLES 69, 70, 71, and 72

ORGANISMS GROWN FROM BLOOD

These show the organisms grown from the blood immediately after enucleation of the gland and 2 hours after enucleation.

All organisms isolated immediately after enucleation have appeared 2 hours afterwards, but with a much decreased frequency.

Thus all the urinary infecting organisms have appeared in the blood and all are capable of remaining in the blood stream for 2 hours or longer - that is bacteraemia may be protracted.

TABLE 73

TOTAL ORGANISMS GROWN FROM BLOOD EXCLUDING PATIENTS HAVING APPROPRIATE BROAD SPECTRUM ANTIMICROBIAL THERAPY

(63 POSITIVE CULTURES)

Here, with the influence of appropriate broad spectrum antimicrobials removed, the incidence of organisms found in the blood 2 hours after enucleation is increased on the whole, apart from the case of Coliform (unspecified) and Esch. coli. Thus of the total of 89 organisms found in the blood immediately after prostatic gland enucleation 22 (24.7%) were also found to be present 2 hours after enucleation (Table 72). Of the 64 organisms found in the blood immediately after enucleation in patients who did not have appropriate broad spectrum antimicrobial therapy 19 (29.7%) were still present 2 hours later.

TABLE 74

ORGANISMS IN URINE COMPARED WITH ORGANISMS RECOVERED FROM BLOOD - EXCLUDING PATIENTS HAVING APPROPRIATE BROAD SPECTRUM ANTIMICROBIALS

It will be seen that Klebsiella species and paracolon bacillus in the urine gave rise to the recovery of a coliform organism of some kind, but generally not the actual urinary infecting organism, in 100% of cases.

A urinary infection with Strep. faecalis or Staph. pyogenes produced a bacteraemia due to these respective organisms in a high proportion of cases.

Urinary infection with coliform organisms (unspecified) or with Esch. coli gave rise to a relatively high incidence (over 50%) of bacteraemia with a variety of coliform organisms.

The presence of Str. viridans in the blood in 2 cases may be due to contamination.

TABLES 75, 76, 77, AND 78

BLOOD CULTURE IN 'STERILE' CASES

These show individual complications in 'sterile' cases in the 3 groups studied in 1955-1956, 1957-1960, and 1963-1964.

The total of these three tables is represented in Table 78.

The number of 'sterile' patients with a positive culture is too small for any statistical comparison.

TABLES 79, 80, 81, AND 82

BLOOD CULTURE IN INFECTED CASES

PATIENTS WITHOUT ANTIMICROBIAL COVER

These show individual complications in 3 series of infected cases who had no appropriate antimicrobial cover over the period of operation.

Table 82 shows the total figures. The main difference is the decrease in the incidence of ascending infection and especially in the incidence of this complication which delayed convalescence in the cases having a negative blood culture. These differences are not, however, statistically significant.

TABLES 83 AND 84

BLOOD CULTURE IN INFECTED PATIENTS HAVING APPROPRIATE ANTIMICROBIAL COVER

These show individual complications in the infected cases in the 1957-1960 series, and in the 1963-1964 series who had appropriate antimicrobial cover over the period of operation.

There is no significant difference in either group when those who had positive blood cultures are compared with those who had negative blood cultures.

TABLE 85

BLOOD CULTURE IN INFECTED CASES

ALL INFECTED CASES

This table shows the individual complications in all infected cases studied 1955-1963, irrespective of antimicrobial cover.

When we compare ascending infection which delayed convalescence in the group with positive blood culture and in the group with negative blood culture then the difference is statistically significant ($\chi^2 = 4.74$ $P < 0.05$).

The difference in any of the other complications individually, or in groups, is not statistically significant.

TABLES 86 AND 87

PROTRACTED BACTERAEMIA

These tables show the individual complications in infected cases in whom post-operative bacteraemia was protracted i.e. in whom it persisted for 2 hours or longer. Table 86 details the findings in all 20 patients in whom bacteraemia was protracted. Table 87 details the findings in 16 such patients who had no broad spectrum antimicrobial cover.

In both groups the infective complications delaying convalescence and especially the severe infective complications, i.e. those delaying convalescence for 21 days or longer, remain at a very high level.

No medical complications were noted in this small group of patients.

TABLES 88 AND 89

BLOOD CULTURE IN INFECTED CASES

MORBIDITY IN THE PRESENCE OF TRANSITORY AND PROTRACTED BACTERAEMIA

Table 88 compares individual complications in all infected patients who had a transitory bacteraemia with the individual complications in those infected cases who had a protracted bacteraemia.

There is a much lower incidence of ascending infection, total, delaying convalescence, and severe, in those patients who had transitory bacteraemia. The difference is statistically highly significant as regards the severe cases ($\chi^2 = 10.86 \quad P < 0.001$).

Table 89 gives the same comparison as above except that, in this case, the patients exclude those who had appropriate broad spectrum cover.

The incidence of total ascending infection in each group shows no statistical difference when the groups are compared.

In comparing the incidence of ascending infection in each group, where this complication delayed convalescence, then the difference is statistically significant ($\chi^2 = 3.95 \quad P < 0.05$).

When the incidence of severe ascending infection in both groups is compared the difference is highly significant ($\chi^2 = 12.73 \quad P < 0.001$).

The incidence of any of the other complications in the 2 groups shows no significant difference.

TABLE 90

PROTRACTED BACTERAEMIA IN RELATION TO
PRELIMINARY CATHETER DRAINAGE

It will be seen that 80% of these patients who had protracted bacteraemia had had preliminary catheter drainage. In 55% of the patients preliminary catheter drainage had lasted for 7 days or longer.

The numbers are too small for any comparison of the incidence of infective complications.

TABLE 91

GENERAL DETAILS OF 20 CASES WITH
PROTRACTED BACTERAEMIA

It will be seen that the 2 patients who died were both over 70 years of age and had pre-operative blood urea levels of over 100 mg./100 ml.

Of the other 4 patients with severe post-operative infective complications 1 had a pre-operative urea level of 56 mg./100 ml. In the other 3 the urea levels were all below 40 mg./100 ml.

All patients who died or who had severe post-operative infective complications, as defined above, were over 70 years of age. Of these patients with protracted bacteraemia 65% were 70 years of age or older.

TABLE 92

BACTERAEMIA AND BLOOD UREA LEVEL

The proportion of patients without bacteraemia, with transitory bacteraemia and with protracted bacteraemia in whom the blood urea was over 50 mg./100 ml. at the time of operation is similar in each group.

A rather higher proportion of those with protracted bacteraemia had a blood urea level of over 100 mg./100 ml. but this is not statistically significant.

TABLE 93

RELATION OF BACTERAEMIA TO EASE OF PROSTATIC ENUCLEATION IN INFECTED CASES

This table shows that infected cases in whom prostatic enucleation proved difficult showed no increase in the incidence of post-operative bacteraemia when compared with patients in whom the prostatic enucleation had been easy.

TABLES 94, 95, AND 96

POST-OPERATIVE BACTERAEMIA

MORTALITY

These show the mortality in infected patients who had post-operative bacteraemia compared with infected patients in whom the blood culture was negative. The total numbers in each group are studied in Table 94. Table 95 shows the comparison when patients who had broad spectrum antimicrobial cover are left out.

There is no statistical difference in the results shown in either of these tables.

Table 96 also considers the question of patients having protracted bacteraemia. Here it is seen again (patients who had had appropriate antimicrobial cover being excluded) that the infective deaths took place in that small group who had protracted bacteraemia and also in whom the pre-operative blood urea level was over 100 mg./100 ml.

TABLE 97

THE EFFECT OF APPROPRIATE ANTIMICROBIAL COVER IN REDUCING BACTERAEMIA (INFECTED CASES) 1955 - 1964

The reduction in transitory bacteraemia when appropriate antimicrobial therapy is given is statistically significant ($\chi^2 = 9.118$ $P < 0.01$).

In similar circumstances the reduction in protracted bacteraemia shows a significance level thus ($\chi^2 = 5.195$ $P < 0.05$).

TABLE 98

BACTERAEMIA IN INFECTED CASES

This table shows that the incidence of post-operative bacteraemia decreased steadily from 1955-1964 even when no antimicrobial cover was given over the period of operation.

DISCUSSION

POST-OPERATIVE BACTERAEMIA

The study of blood stream infection in Urology has taken place in 2 different sets of circumstances. First are those workers who studied blood stream infection in the presence of overt symptoms, e.g. 'chills' and pyrexia, or in the presence of overt disease, e.g. bacterial endocarditis. Second are those who studied blood stream infections after operation in the absence of any specific objective symptoms and signs.

BLOOD STREAM INFECTION IN THE PRESENCE OF SYMPTOMS

In the first category probably the earliest documentation occurred in the late nineteenth century. Hallé (1887) found organisms in urine, blood, and renal abscesses in a patient with marked pyrexia, who died very quckly. Moullin (1898) expressed the opinion that the reactions found in urinary fever were due to virulent bacilli or their toxic products. He could not prove this, however. Bertelsmann and Mau (1902) described a case of staphylococcal endocarditis following urethral dilatations for stricture. This case was fatal.

Positive blood cultures in the presence of chills and pyrexia were noted by Crabtree (1917) and by Scott (1929). Most of these blood stream infections followed operation or manipulation of the urinary tract. Scott (1929) noted that 77% of these infections were bacillary and 23% coccal.

Spittel et al (1954 and 1956) studied bacteraemia due to gram-negative bacilli as seen in a general hospital. They noted that 33% of cases followed operations on the urinary tract and mentioned the presence of Esch. coli, A. aerogenes, Proteus species, and Ps. aeruginosa in the blood stream. These authors discussed the symptoms of this form of bacteraemia and mentioned several other series all of which showed a high mortality rate. Their mortality varied from 12.8% to 15% according to the organism present in the blood. The authors stated that the prognosis depended on the age of the patient, the presence or absence of debilitating disease, the site of the primary focus, the virulence of the infecting organisms and their sensitivity to the various antibiotics.

Beeson (1955) noted that urethral instrumentation produced a transient bacteraemia. He felt that this probably represented one of the ways in which infection was transferred from lower to upper urinary tract.

Ezzo et al. (1957) discussed bacterial shock. They mentioned the organisms found by Spittel et al. (1954 and 1956) as invaders of the blood stream and added the enterococcus. These workers again noted that the patients who died had either very marked inflammatory reactions at the portal of entry, or severe complicating disease, or were otherwise poor risks.

Slaney et al. (1958) described several cases of septicaemia. Most of their patients had had cortisone therapy and the lesions were unrelated to the urinary tract. In 1 patient, however, the septicaemia complicated prostatitis with upper urinary tract infection. The organism in this case, Staph. pyogenes, was sensitive to chloramphenicol and erythromycin in vitro, but little response to these agents was obtained in vivo and the patient died.

Hassall et al. (1959) described 86 cases of staphylococcal septicaemia but the urinary tract was not mentioned as a portal entry. The mortality rate was 58%. Smith et al. (1960) described 358 cases of staphylococcal septicaemia. Open removal or trans-urethral resection of the prostate were noted as originating factors in some cases. The death rate from staphylococcal septicaemia in males was found to increase with age. The incidence of such a septicaemia was high in the 6th, 7th and 8th decades. They pointed out that control of infection must be more stringent in debilitated old people.

Aldridge (1960) noted the presence of severe hypotension in 2 patients with septicaemia following operation on the lower urinary tract. Both patients survived. In one the infecting organism was Proteus morgani and in the other Esch. coli.

Faber et al. (1960) reported on 201 cases of staphylococcal bacteraemia studied in Copenhagen. Again prostatectomy and urethral catheterisation were among the initiating factors. The mortality rate in hospital acquired infections was 55%. Powell (1961) described 49 cases of staphylococcal septicaemia in a general hospital. Prostatectomy was not a factor in the origin of any of these cases but the author noted that in a pathological study of the fatal cases non-suppurative renal lesions were found to be extensive and severe. This author noted that staphylococcal septicaemia, especially when contracted subsequent to hospital admission, had become or was becoming as lethal a hazard as it was prior to the advent of antibiotics.

Talbot (1962) detailed 20 cases of septicaemia due to gram-negative bacilli and again pointed out the necessity of preventing added infection even in already infected urological cases since Gillespie et al. (1960) had shown that the recently acquired infections tended to be the most dangerous.

Wilson (1963) found staphylococci and gram negative bacilli much more commonly than streptococcus viridans and pneumococcus in fatal cases of endocarditis since the advent of antibiotics.

Shubin et al. (1963) in a most detailed account of bacterial shock found that more than 80% of their cases had diseases relating directly or closely to the urinary tract. The organisms recovered from the blood were generally the same as those found in the urine and nearly 90% of those organisms were sensitive to chloramphenicol. These authors were against the use of prophylactic antibiotics. They felt that the organisms responsible for bacterial shock were normal inhabitants of the human intestine. These initially had a low order of pathogenicity, but the giving of antibiotic prophylaxis broke down natural defences and did away with the normal symbiotic relationship between organism and host. The mortality rate in their patients who had bacteraemic shock was 82%.

The British Medical Journal (1964) commenting on the work of Shubin et al. (1963) pointed out that bacteraemia was better prevented than cured. "This is not to say that systemic chemoprophylaxis should never be employed, but it should be restricted to cases with special indications and based on full knowledge of the bacteriology of the urine".

BLOOD STREAM INFECTION WITHOUT SYMPTOMS

Barrington and Wright (1930) were the first in this country to investigate blood stream infections after urological operations, but in the absence of any overt symptoms. After operation or dilatation for urethral stricture they found a positive culture in 13 of 23 patients (56.5%). These workers noted that the organisms disappeared very quickly from the blood and suggested that cultures be made soon after operation. In this series the urine was infected in all cases in which it was cultured.

Bulkley et al. (1954) sought the presence of blood stream infection after transurethral prostatic resection in 128 cases. They obtained only 2 positive cultures in this group of patients (1.56%). In both cases the urine was infected before operation and both had high temperatures after operation. These authors considered that a positive blood culture after operation was not of any apparent significance.

The first major study of post-operative bacteraemia was made in 1954 by Creevy and Feeney. Again the operation considered was transurethral resection. They found post-operative bacteraemia in 10.8% of 102 patients in whom the urine was sterile at operation and in 57.5% of 254 patients in whom the urine was infected at operation. They showed that broad spectrum anti-microbials given prophylactically reduced the incidence of this bacteraemia. They noted that post-operative bacteraemia may give rise to bacterial endocarditis or circulatory collapse.

In an interesting study Grey (1955) found that the incidence of post-operative bacteraemia was much higher after transurethral resection (45.4%) than after any of the open forms of treatment (5.8%). He did not state how many of his patients were infected at operation although the majority had an indwelling catheter. All cases had Aureomycin given prophylactically over the period of operation.

Slade (1958) pointed out that bacteraemia could also occur after the removal of a catheter which had been left indwelling at the time of prostatectomy. He believed that this was the mechanism and portal of entry by which septicaemia could occur after urological operations. Slade noted that the organisms had disappeared from the blood stream within 15 minutes.

The present author in 1961 published an account of bacteraemia following retropubic prostatectomy. In this study the incidence of post-operative bacteraemia in the presence of a sterile urine was 12.8% and in the presence of an infected urine it was 82%. In this particular study it was pointed out that bacteraemia was not necessarily a transitory incident. The blood stream infection could last for several hours. One culture remained positive for at least 5 hours.

Steyn et al. (1962) studied post-operative bacteraemia in a series of patients who had either retropubic or transvesical prostatectomy. They found a bacteraemia of 16.7% in 36 infected patients. No bacteraemia was noted in the presence of sterile urine. In this series the bacteraemia persisted for 48 hours in 1 patient, becoming a septicaemia with ultimate death. In 2 other patients the bacteraemia persisted for 9 hours. These authors felt that there was a high incidence of wound infection in patients who had bacteraemia. In this series B. proteus and Str. Faecalis were the only 2 organisms grown from the blood stream.

Mitchell et al. (1962) studied bacteraemia after urethral instrumentation. They found an incidence of 39% bacteraemia in 28 infected patients after instrumentation and 75% bacteraemia in 12 infected patients at the first voiding after instrumentation. Several local methods by which this high incidence of bacteraemia might be significantly reduced are described.

PRESENT STUDY

This present study confirms the fact that all the organisms previously mentioned by those who have studied blood stream infection with or without symptoms can, in fact, cause blood stream infection after retropubic prostatectomy. Not only so, but any of those organisms can remain in the blood stream for several hours.

The organisms recovered from the blood in these cases of retropubic prostatectomy were generally, although not always, the same as the organisms infecting the urine. If the urine was infected with Staph.pyogenes then this organism was obtained in the blood in 91% of cases. A urinary infection with Strep.faecalis corresponded to a blood infection with this organism in 75% of cases, while a urinary infection with 1 of the coliform organisms corresponded to a blood infection with a coliform organism (but not necessarily the same coliform) in 70% of cases. (Table 74)

As stated above Slade (1958) felt that bacteraemia following the withdrawal of a catheter left in at prostatectomy might be a portal of entry by which septicaemia could occur after this operation. Steyn et al. (1962) pointed to 1 patient in whom post-operative bacteraemia persisted for a total of 48 hours "becoming a septicaemia". Creevy and Feeney (1954) felt that bacteraemia might be the cause of a severe illness characterised by circulatory collapse or bacterial endocarditis. On the other hand Bulkley et al. (1954) felt that bacteraemia following transurethral prostatic resection was not of any apparent significance.

No one has attempted to correlate the presence of bacteraemia with individual post-operative complications. One of the objects of this study was to assess the clinical significance of this post-operative bacteraemia. As regards both 'sterile' (Table 78) and infected patients with, or infected patients without appropriate anti-microbial cover (Tables 82, 83, 84) there is no statistically significant difference in the total incidence of any of the post-operative complications in those who had post-operative bacteraemia when compared with those in whom the blood cultures taken after operation were 'sterile'.

When, however, all infected patients are grouped together whether or not they had appropriate antimicrobial cover then the incidence of ascending infections is significantly higher in those patients who had post-operative bacteraemia ($\chi^2 = 4.74 \quad P < 0.05$) (Table 85). As opposed to the findings of Steyn et al. the incidence of wound infections in infected patients with bacteraemia was no higher (in fact it was slightly lower) than in those who had no bacteraemia.

If bacteraemia is protracted and patients are studied who did not have appropriate broad spectrum antimicrobial cover over operation (Table 89), then the incidence of ascending infection which caused delay in convalescence or death, is significantly higher in the group who had protracted bacteraemia when compared with those in whom the bacteraemia was transitory. ($\chi^2 = 3.95$ $P < 0.05$.) If we consider the incidence of ascending infection severe enough to delay convalescence by 21 days or more or cause death, then the difference in incidence in these 2 groups becomes highly significant ($\chi^2 = 12.73$ $P < 0.001$).

Steyn et al. (1962) remarked that all patients in whom they found a positive blood culture after operation had had a period of preliminary catheter drainage. Histogram 1, 2, and 3 of this study show that preliminary catheter drainage greatly increases the incidence of both transitory and protracted bacteraemia after operation. On the other hand bacteraemia occurred in 25% of those who had no preliminary drainage.

Histogram 4 shows the decreasing incidence of bacteraemia in cases having closed drainage, appropriate antibiotics and especially in cases drained by the plastic Gibbon or Franklin catheters. The 28 cases so drained, in fact, had an incidence of bacteraemia of 18% which is directly comparable with the incidence of 17% found by Steyn et al. (1962) in patients drained by Gibbon catheter.

It must be noted that bacteraemia also occurs, although infrequently, following retropubic prostatectomy in patients with 'sterile' urine (Histogram 5). The findings in this study approximate closely to those of Creevy and Feeney as regards 'sterile' cases.

Several of the workers who studied blood stream infections in the presence of symptoms noted a high mortality in old debilitated patients.

It was thus of interest to consider the relationship of age to bacteraemia in the present series. In fact, in patients with infected urines in whom blood culture studies were made it was found that 56% of the patients who had a negative blood culture were aged 70 years or over while 57% of those who had a positive culture were in the same age group. But in infected patients without antimicrobial cover we find that 37% of those with negative cultures were 70 years or older while 57% of those with positive cultures were 70 years or over. In the numbers available for study, however, these results are not statistically significant, but they tend to confirm previous work.

Table 92 shows that bacteraemia is not related to the blood urea level and Table 93 that bacteraemia in infected patients is not related to the ease or difficulty of prostatic enucleation.

In the numbers available for study both total and infective mortality have been shown to be increased in patients with infected urine at operation who also have a post-operative bacteraemia (Tables 94 and 95). This increase is not, however, statistically significant. Death from infective causes in fact occurred in only 2 patients both of whom had protracted bacteraemia. These 2 patients also had blood urea levels of over 100 mg./100 ml. when operation took place.

In this context it is of interest that there were 2 infected patients with blood urea over 100 mg./100 ml. (160 mgm./100 ml. and 120 mgm./100 ml.) neither of whom had antimicrobial cover over operation. Both had protracted bacteraemia and both died from infective causes. One was 74 years old, the other 76. A further 2 infected patients with blood urea at operation over 100 mgm./100 ml. (120 mgm./100 ml. and 106 mgm./100 ml.) had appropriate antimicrobial cover. Neither had post-operative bacteraemia and neither had post-operative complications. One was aged 76 and the other 65 years.

Table 97 shows the reduction in post-operative bacteraemia in infected patients which is obtained by using appropriate antimicrobial cover. This reduction is statistically significant.

Bacteraemia would thus appear to be a complication of retropubic prostatectomy. This complication can itself give rise to an increase of some significance in upper urinary tract infection during convalescence. Fortunately bacteraemia can be significantly decreased by the use of appropriate broad spectrum antimicrobials to cover the period of operation in infected cases.

From this study of patients who have been subjected to retropubic prostatectomy at different time intervals the incidence of bacteraemia in each series is inversely proportional to the general care taken with bladder drainage and irrigation (table 98).

Miller et al. (1958) suggest that bacteraemia is more likely with recently acquired, than with long standing, infection. The results shown in Table 99 however derived from 16 patients in this series in whom the duration of infection was accurately known support the suggestion of Miller et al. (1958) in only 50% of cases. In the other 50% a long standing infection produced bacteraemia.

CONCLUSIONS

POST-OPERATIVE BACTERAEMIA

1 All urinary infecting organisms can invade the blood stream.

2 These organisms can all persist in the blood stream for severeal hours.

3 The organisms obtained from the blood after retropubic prostatectomy in infected cases are generally, but not always, the same as the organisms infecting the urine.

4 Urinary infecting organisms both recently acquired and long-standing, show an equal ability to invade the blood stream.

5 There is a definite, but low, incidence of bacteraemia in patients who come to operation with a 'sterile' urine.

6 Where preliminary drainage is carried out by other than a Gibbon or Franklin catheter then the incidence of both transitory and protracted bacteraemia is considerably increased.

7 Post-operative bacteraemia is lessened when closed drainage is employed using either a Gibbon

or Franklin catheter.

8 Post-operative bacteraemia is significantly reduced when appropriate broad spectrum anti-microbials (after urine culture and sensitivity tests) are given over the period of operation in infected patients.

9 Infected patients of 70 years or older are more likely to have post-operative bacteraemia than are younger men. In the numbers studied the difference is not significant.

10 Post-operative bacteraemia is not related to blood urea level.

11 Post-operative bacteraemia is not related to the ease or difficulty of prostatic enucleation.

12 In infected patients (excluding those who have had appropriate antimicrobial therapy which might influence post-operative morbidity and mortality) the presence of post-operative bacteraemia is not associated with a significant difference in any of the post-operative complications of retropubic prostatectomy, in the numbers studied.

13 Infected patients who have protracted post-

operative bacteraemia (excluding patients having appropriate antimicrobial cover) have a highly significant increase in the incidence of ascending infection which is severe enough to delay convalescence to 21 days or more or to cause death, when compared with infected patients in whom post-operative bacteraemia is only transitory. There is no significant difference in any of the other post-operative complications when these 2 groups are compared.

14 Allowing for the effect of appropriate broad spectrum antimicrobials mortality in infected patients is higher in those with a transitory bacteraemia than it is in those with no bacteraemia. Mortality is higher still in patients in whom bacteraemia is protracted. The differences are not statistically significant in the numbers studied.

SECTION VII

THE ELIMINATION OF URINARY INFECTION.

TABLE 100

PATIENTS MAINTAINED STERILE THROUGHOUT
HOSPITAL STAY (1963 - 1964)

54 CASES

It will be seen that infective complications are absent apart from the presence of wound infection (5.6%). Medical complications, suprapubic leaks, urinary tract haemorrhage, and upsets of micturition are minimal.

TABLE 101

POST-OPERATIVE COMPLICATIONS
(1963-1964)

This table shows 5 different series of cases which were studied in the above period. It will be noted that patients who remained 'sterile' throughout having had Ureaphil did much better than any of the other groups as regards infective complications. There is no obvious difference as regards medical complications, suprapubic leaks, or urinary haemorrhage between this and the other groups, but again the sterile group with the Ureaphil appear to have done considerably better as regards upsets of micturition.

It is also of interest to compare patients who were infected both before and after operation; one group had Ureaphil and the other group had no Ureaphil. In actual fact there is no difference between the 2 groups.

In comparing the total infective complications in the 54 patients remaining 'sterile' throughout their hospital stay with the total infective complications in the 44 patients who were 'sterile' before, but became infected after, operation we find a significant difference ($\chi^2 = 5.982 \quad P < 0.02$).

TABLE 102

PATIENTS HAVING UREAPHIL (1963-1964)

This table compares the complications encountered in the group of patients who were maintained 'sterile' throughout their hospital stay with the complications obtained in a group who became infected after operation and also with another group who were infected before and after operation. These groups were all studied at the same time and all had closed catheter drainage. None of the patients whose urines were 'sterile' at the time of operation had antimicrobial cover.

It will be seen that the group maintained 'sterile' throughout the length of the hospital stay has rather a higher percentage of patients who were over 70 with a urea over 50 mgm./100 ml. The total infective complications and the infective complications delaying convalescence are all very much less in the group of patients who were maintained 'sterile' throughout their hospital stay.

The total and infective complications obtained in the group who became infected after operation compares reasonably with the group of 92 'sterile' cases who had no antimicrobial cover which was studied in the 1957 - 1960 series.

There were no infective deaths in either the patients who remained 'sterile' throughout their hospital stay or in the group who remained sterile until the time of operation. One infective death is noted in a patient whose urine was infected before operation.

Total infective complications in 54 patients who remained 'sterile' throughout compared with those in 33 who became infected after operation shows a significant difference ($\chi^2 = 4.877 \quad P < 0.05$).

Of those patients having Ureaphil who were 'sterile' before operation 62.1% remained sterile throughout their hospital stay.

When we compare the 92 'sterile' patients with no antimicrobial cover in the 1957 - 1960 series with the 54 patients in this series who remained 'sterile' throughout, as regards the incidence of post-operative infective complications, then the decrease in incidence of these complications in the 54 patients who remained 'sterile' throughout is significant ($\chi^2 = 7.503 \quad P < 0.01$).

HISTOGRAM 6

AGE INCIDENCE (1963-1964)

The histogram shows the age incidence of this particular series. In actual fact 53.5% of the patients were under the age of 70.

TABLES 103 AND 104

AGE INCIDENCE (1963-1964)

It is of interest to note that in the group who remained 'sterile' throughout 35 (64.8%) of patients were below the age of 70. In the 2 groups who were 'sterile' before operation but became infected after operation 23 (52.3%) were under the age of 70, while in the 2 groups who were infected before operation 20 (42.5%) of the patients were under the age of 70.

It would appear, then, that it is easier to keep younger patients sterile for the whole of their hospital stay.

TABLES 105, 106, AND 107

PROSTATE GLAND WEIGHT, NUMBER OF LOBES, EASE OF ENUCLEATION, PRESENCE OF GLAND INFLAMMATION, AND BLOOD LOSS AT OPERATION

From these tables it will be seen that in those cases who remained 'sterile' throughout the incidence of large glands, of trilobed glands, of difficult enucleation, of gland inflammation and of high blood loss at operation was the lowest of any of the 3 groups.

The incidence of large gland and of gland inflammation increases steadily as we read down from those cases who were 'sterile' throughout to those who were infected throughout.

TABLES 108 AND 109

MORTALITY (1963-1964)

These 2 tables show the cause of death and the distribution of deaths in the 3 series studied.

There was no mortality in the group whose urine remained 'sterile' throughout and it is interesting to note that the only death from infective causes occurred in the group whose urine was infected at operation.

In the whole series of 145 patients there were 5 deaths. A mortality rate of 3.4%.

TABLES 110 AND 111

INFECTED CASES

ANTIMICROBIAL COVER 1963-1964

The post-operative complications are related to antimicrobial cover in both these tables. The total infective complications in infected patients having Ureaphil, but no antimicrobial cover, 11 of 23 (48%) is comparable to the incidence of total infective complications in the 1957-1960 series of infected cases with no antimicrobial cover but, in these cases, no Ureaphil (Table 63).

Otherwise the numbers are too small for comparisons to be made.

In the 33 infected cases who had Ureaphil there were 2 deaths. One from pyelonephritis occurred on the 5th day, in a patient who had an inappropriate antimicrobial agent over the period of operation. The other, from uraemia and pulmonary embolism on the 12th day, occurred in a patient who had an appropriate antimicrobial cover. These deaths are detailed further below.

TABLE 112

PATIENTS MAINTAINED 'STERILE' THROUGHOUT HOSPITAL STAY (1963-1964)

This table relates the general condition of the patient at the time of operation to post-operative complications. The numbers are very small, however, and no definite conclusions can be drawn.

TABLES 113 AND 114

PATIENTS 'STERILE' BEFORE, INFECTED AFTER, OPERATION (1963-1964)

These tables relate the condition of the patient at operation to post-operative complications. The number of patients for study in each group is small and no conclusions can be drawn. It should be noted that a rather higher proportion of patients without Ureaphil had urinary tract disease than did those who had Ureaphil.

TABLES 115 AND 116

PATIENTS INFECTED THROUGHOUT (1963-1964)

The condition of the patient at operation is related to post-operative complications. The numbers studied are small but a very much higher proportion of the patients without urea had urinary tract disease.

TABLE 117

DURATION OF PRELIMINARY CATHETER DRAINAGE
(1963-1964)

This table shows the different groups studied in this period in relation to the duration of preliminary catheter drainage. It will be noted that patients who remained 'sterile' throughout their hospital stay comprised many (66.7%) who had no drainage at all. Of those who became infected after operation 40.9% had no preliminary drainage while of those infected before operation only 10.6% had no preliminary drainage.

It is of interest to note in this series of 145 cases that while 86 (59.3%) did have preliminary catheter drainage only 42 (48.8%) of this number came to operation with an infected urine. Of this 42, 19 (45.2%) had drainage by a catheter other than a Gibbon or a Franklin. Of the 44 patients who came to operation 'sterile' following a period of preliminary drainage 11 (25%) had drainage by other than a Gibbon or a Franklin catheter.

If we consider patients who had Ureaphil and who came to operation 'sterile' we find that of the 54 cases who remained 'sterile' throughout, 18 had preliminary drainage. Of these 18, 6 (33%) were drained by other than a Gibbon or Franklin catheter. Of the 44 who came to operation 'sterile' but who became infected after operation 26 had preliminary catheter drainage and of this 26, 5 (19.2%) had drainage by other than Gibbon or Franklin catheter.

Of 49 patients with no preliminary catheter drainage who came 'sterile' to operation and had Ureaphil, 36 (73.5%) remained 'sterile' throughout their hospital stay. Of 38 patients who had had preliminary catheter drainage who came 'sterile' to operation and had Ureaphil, 20 (47.4%) remained 'sterile' throughout.

DISCUSSION

THE ELIMINATION OF URINARY INFECTION

Previous discussion has centred on the effect of urinary infection at the time of operation on morbidity and mortality following retropubic prostatectomy. A number of other factors which might influence post-operative morbidity and mortality in 'sterile' and in infected cases have also been discussed.

With the above mentioned definitions and data in mind the next logical step in this study is undoubtedly an assessment of the results obtained when urinary infection is eliminated entirely throughout the stay in hospital of patients having retropubic prostatectomy.

Studies and methods by which this infection may be eliminated have already been mentioned (Miller et al, 1958 and 1960; Debenham et al, 1960; and McKelvie, 1962).

Cameron (1963) described a method of managing urinary retention without catheterisation as a further step in the maintenance of a 'sterile' urine during the patients' stay in hospital.

THE PRESENT SERIES

In any system of bladder drainage through an indwelling catheter it is known that organisms may ascend within the lumen of the catheter and drainage tubing in the presence of a static or slowly downward moving column of fluid (Weyrauch et al. 1951; Dutton and Ralston 1957). Organisms can also ascend the tubing in air-bubbles (Miller et al 1958). There is evidence also that organisms may ascend the urethra in the space between its mucosa and the outside wall of the catheter (Kass et al. 1957).

In view of these facts it is evident that any drainage system must be of the closed type (Pyrah et al. 1955).

Intravenous Ureaphil (Abbott) can produce a diuresis so that the downward column of fluid runs at a good pace and ascent of infection can be prevented or minimised. Not only so but blood clotting in this marked flow of urine in response to diuresis will be minimal and thus the necessity of breaking the drainage system to wash out the bladder with resulting risk of infection will arise infrequently. Schlegel et al. (1961) have shown that urea in 4% concentration (Ureaphil) is bacteriostatic to the common organisms causing urinary infection. Because of these facts it was decided to use a modification of the method advocated by McKelvie (1962) who used Ureaphil to eliminate urinary infection.

The importance of eliminating urinary infection altogether and this modified method (See pages 66 and 271) have both been assessed.

The results above (Table 102) show a very marked decrease in total infective complications and also in infective complications delaying convalescence when we compare patients in whom the urine has been maintained 'sterile' throughout their hospital stay, with patients in whom the urine, although 'sterile' at operation, became infected afterwards.

The series of 33 patients (Table 102) in whom the urine became infected after operation are almost exactly comparable as regards age and incidence of infective complications with 92 'sterile' patients previously studied under the heading of Antimicrobial Cover (Table 57). In comparing the incidence of infective complications in this latter series of 92 'sterile' patients with the decreased incidence of infective complications in the group of 54 patients who were maintained 'sterile' throughout the difference is significant ($\chi^2 = 7.503$ $P < 0.01$). These series were studied at different times, however.

Table 101 compares complications in the 54 patients (column 1) who were maintained sterile throughout with those in a further 44 patients (columns 2 and 3), studied over the same period of time, who became infected after operation. If we consider infective complications in these 2 groups, these are again markedly reduced in the 54 patients who were maintained 'sterile'. This reduction is statistically significant ($\chi^2 = 5.982$ $P < 0.02$).

The maintainance of urinary 'sterility' throughout hospital stay thus produces a significant fall in the incidence of post-operative infective complications. It is of interest to note that the only complication found in the 54 patients maintained 'sterile' throughout was wound infection. This occurred in only 3 cases and delayed convalescence in 1.

POST-OPERATIVE PYREXIA (Studies on 1963-1964 series)

Simon et al. (1955) conclude that most fevers occurring in the first few days after operation are not of bacterial origin. They base this statement on the fact that they found a similar incidence of fever in patients with and without pre-operative infection of the urinary tract.

Miller et al. (1958) noted that a pyrexia higher than 100°F. was obtained from the 3rd post-operative day onward in only 5 of 79 patients (6%) whose urine remained sterile while it occurred in 42 of 76 patients (55%) whose urine became infected after operation.

In the present study 13 of 54 patients (24.1%) who remained 'sterile' throughout had pyrexia of 100°F. or higher at one time or another from the 3rd post-operative day onwards. 23 of 44 patients (52.3%) whose urine became infected after operation had a similar pyrexia. When the 2 groups are compared the difference in the incidence of post-operative pyrexia is significant ($\chi^2 = 7.125$ $P < 0.01$).

If however we consider each day from the 3rd to the 10th inclusive after operation, then each patient has 7 days in which the temperature could rise over 100°F. In the 54 patients who remained 'sterile' we could therefore have 54 x 7 = 378 days in which this could happen. In actual fact it only happened on 13 occasions, i.e. 13 of 378 (3.4%). A similar calculation as regards patients whose urine became infected after operation shows the incidence of similar pyrexia to be 54 times in 44 x 7 = 308 possible occasions (17.5%). When these 2 groups are compared in this way then the difference is highly significant ($\chi^2 = 36.63$ $P < 0.001$). The above findings, then, confirm those of Miller et al. (1958).

When we consider the incidence of pyrexia of 100°F. or higher on the day of operation and the 2 succeeding days then in patients who had a 'sterile' urine at operation (98 cases) this pyrexia was noted to occur on one or more occasions in 39 (40%). In patients whose urine was infected at operation (47 cases) the pyrexia occurred on one or more occasions in 28 (60%). When these 2 groups are compared the difference is just within the limits of significance ($\chi^2 = 4.23 \quad P < 0.05$).

On the other hand when the total number of days on which the temperature might have risen above 100°F. (considering the day of operation and the succeeding 2 days in each case) is calculated, along with the actual number of days on which it did so, then as regards 'sterile' cases out of 294 possible days the temperature rose above 100°F. on 49 (16.7%). For infected cases the figure was 42 out of a possible 141 (29.8%). When these figures are compared then the difference is significant ($\chi^2 = 9.141 \quad P < 0.01$). These findings thus fail to confirm those of Simon et al. (1955).

When patients whose urine remained 'sterile' throughout are compared with those in whom the urine became infected after operation there is no significant increase in pyrexia of 100°F. or higher on the day of operation and the 2 succeeding days ($\chi^2 = 0.989$ $P < 0.5$).

AGE INCIDENCE

The age incidence of the whole series of 145 patients studied from 1963-1964 is shown in the Histogram 6. This, then, is a relatively young series of patients. Table 104 reveals an increase in the age incidence as we proceed from patients who remained 'sterile' throughout, to those who became infected after operation and finally to those who were infected throughout. It may be that in young patients the urine is more easily maintained 'sterile'. The figures are not statistically significant.

THE CONDITION OF THE PATIENTS AT OPERATION

This is shown in Tables 112 - 116 inclusive. There is no significant difference in any of these groups as regards the number who were well at operation or who had either urinary tract or medical disease.

From the very small numbers available in each sub-group no assessment can be made of the effects of urinary tract or medical disease on the post-operative course.

PRELIMINARY CATHETER DRAINAGE

Reference to table 117 shows that of the 54 patients who remained 'sterile' throughout their hospital stay only 18 (33%) had had preliminary drainage. Of the 44 patients who became infected after operation 26 (59%) had had preliminary drainage, while of the 47 patients who were infected before operation 42 (89%) had had preliminary drainage.

Of the 98 patients who came to operation with a 'sterile' urine 44 (45%) had preliminary drainage. Of these 44 patients, 33 (75%) had drainage by either a Gibbon (1958) or Franklin (McKelvie, 1962) catheter.

Of the 47 patients who were infected before operation 42 (89.4%) had preliminary drainage. Of these 42 patients 23 (55%) had drainage by either Gibbon or Franklin catheter. The number of patients in this group who were already infected before drainage was instituted is not known. It would seem, however, that a fairly high percentage of these patients who became infected because of preliminary catheter drainage were drained by either a Gibbon or Franklin catheter. Thus, the use of these catheters, although helpful, is only one factor in the maintainance of urinary 'sterility'. The maintainance of 'sterility' depends on attention to a number of factors (Miller et al. 1960) and the benefits to be obtained from one factor alone are not generally of significant degree.

It is of interest that by the use of Ureaphil 74% of patients who had not had preliminary catheter drainage were maintained 'sterile' while only 47% of those who did have preliminary drainage remained 'sterile'. The adverse role played by preliminary drainage even although in 75% of patients this was carried out by means of Gibbon or Franklin catheter, should be noted.

PROSTATE GLAND

From tables 105 and 106 the group of patients who remained 'sterile' had fewer large glands, fewer trilobed glands, fewer difficult enucleations and fewer inflamed glands when compared with the patients who became infected after operation. The differences when studied separately are not of statistical significance, however. It is interesting to note that the incidence of prostatic gland inflammation as reported by the pathologist was only slightly less in those who remained 'sterile' throughout than in those who became infected after operation. Hidden inflammatory foci in the prostate gland might well have been a cause of post-operative infection in the 'sterile' cases. Such foci were obviously not a factor in this series.

MORTALITY

In this series of 145 patients the age incidence is fairly low and 67% of the patients were 'sterile' at operation. The mortality rate is correspondingly low. There were 5 deaths (3.4%). In 98 'sterile' cases there were 3 deaths (3.1%) and in 47 infected cases 2 deaths (4.3%). The numbers available are too small for statistical comparison. It is of interest, however, that the only infective death occurred in a patient whose urine was infected at the time of operation.

Table 108 shows the causes of death in the individual patients. All deaths occurred in patients who were over 70 years. The 3 deaths in the 'sterile' cases were all from obvious medical causes.

One infected patient aged 72 years had a blood urea of 90 mgm./100 ml. before operation. This remained over 300 mgm./100 ml. after the giving of Ureaphil and finally rose to 475 mgm./100 ml. before death on the 12th post-operative day. At post-mortem examination the renal parenchyma showed only moderate congestion and the pelvis and calyces were normal. There was thrombo-embolism of the right pulmonary artery, broncho-pneumonia and early right empyema.

Another infected patient aged 71 years had a normal blood urea (25 mgm./100 ml.) before operation. He died on the 5th post-operative day having had temperatures rising over 102°F. on the 3 preceding days. At post mortem examination acute, superimposed on chronic pyelonephritis was diagnosed.

It is of interest to note that there were 10 'sterile' patients aged 70 or over who at operation had blood urea levels of 50 mgm./100 ml. or more. One of these patients died from coronary thrombosis. There was no infective mortality.

There were 3 infected patients aged 70 years or more with blood urea, at operation, of 50 mgm./100 ml. or more. One of these died having marked uraemia at the time of death - perhaps accentuated by Ureaphil. This is the patient of 72 years described above who had pulmonary embolism, pneumonia and empyema.

ASSESSMENT OF UREAPHIL AS A MEANS OF ELIMINATING URINARY INFECTION

McKelvie (1962) discussed the rationale of using urea as a 4% solution in 5% dextrose as a means of overcoming the anti-diuresis following surgery.

In patients coming 'sterile' to operation McKelvie found that over 93% remained 'sterile' throughout. Of 23 patients who had preliminary catheter drainage and who came to operation 'sterile', all remained 'sterile' throughout their hospital stay. Of these 23 patients, however, only 3 had been on preliminary drainage for more than 2 days.

McKelvie used 6 pints of Ureaphil in 24 hours continuing at first for 72 hours but later for only 48 hours.

In this present study 4 pints only of Ureaphil were used and then only over the first 24 hours. The results shown here are not so good as those quoted by McKelvie. This may well be explained by the lower dosage and shorter period of administration of Ureaphil.

In all, 62% of patients who came to operation with a 'sterile' urine remained 'sterile' throughout their hospital stay (74% of those who had no preliminary drainage and 47% of those who did have preliminary drainage). Of the 47 who had preliminary drainage 30 had such drainage for 3 days or longer in contrast to the 23 cases of McKelvie only 3 of whom had had preliminary drainage for longer than 2 days.

Despite the fact that the results quoted here are not so good as those of McKelvie they nevertheless represent a great advance on any previous results from this department where, before, almost all cases had become infected after operation (cf. Salvaris, 1960).

Of the 98 patients in this series who came to operation 'sterile' 87 had Ureaphil. Of these 54 remained 'sterile' throughout. Of the 11 patients who did not have Ureaphil all became infected. On comparing the incidence of post-operative urinary infection in the group of 87 (Ureaphil) and the group of 11 (no Ureaphil) the difference is highly statistically significant ($\chi^2 = 12.8$ $P < 0.001$).

Side effects of Ureaphil

One patient with infected urine following 9 days preliminary catheter drainage and a pre-operative blood urea of 90 mgm./100 ml. had a rise of blood urea to 380 mgm./100 ml. following 4 pints of Ureaphil. Over the next 5 days the blood urea level dropped to 310 mgm./100 ml. but then rose gradually until it reached 475 mgm./100 ml. With the blood urea at this level the patient died on the 12th post-operative day after an illness lasting 5 days. Post mortem showed the cause of death to be uraemia with pneumonia, thrombo-embolism of the right pulmonary artery, and right empyema.

Resultant uraemia accentuated by the Ureaphil was certainly an obvious predisposing factor in this death.

Effect of Ureaphil on Post-operative Blood Urea

McKelvie found that following administration of Ureaphil daily blood urea estimations revealed 4 distinct patterns of behaviour.

Type I. The blood urea normal or near normal on admission, rising to 80-120 mgm. for the 2-3 days they are given urea and then falling to normal on the 5th or 6th post-operative day.

Type II. Where the blood urea is normal or near normal it rises to a higher level than was expected and takes longer to fall.

Type III. Where the blood urea is high at operation it may become very high (250-400 mgm./100 ml.) before falling to normal between the 8th and the 12th day.

Type IV. Those presenting with a high blood urea which rises higher and falls slowly to the previous high estimation.

The composite Graphs 11, 12 and 13 perhaps throw further light on the different behaviour of the blood urea in different patients.

In Graph 11 all patients were 'sterile' at operation and remained 'sterile' throughout their hospital stay. It will be noted that the blood urea had fallen to normal in all cases by the 7th post-operative day.

The patients referred to in Graph 12 were 'sterile' at operation but became infected later. Of these only 81.8% had a normal blood urea on the 7th post-operative day.

Graph 13 shows the findings in patients who were infected at the time of operation. Only 75.8% of these had a normal blood urea on the 7th post-operative day.

The increased duration of blood urea elevation as we read from Graph 11 to Graph 13 must be due to increased incidence of patients with poor renal function. Again reading from Graph 11 to Graph 13 the percentage of patients of 70 years and over increases and the presence of urinary infection becomes more marked in each group. These facts would support an increased incidence of patients with poor renal function in the group shown in Graph 13 when compared with that shown in Graph 12. The group shown in Graph 11 should have the lowest incidence of patients with poor renal function.

In actual fact when using pre-operative intravenous pyelography and blood urea levels as tests of renal function the group shown in Graph 11 contained 17% of patients with impaired function, that shown in Graph 12 had 6% of patients with impaired function and that shown in Graph 13 had 12% of patients with impaired function.

In studying the clearance of urea from the blood in a series such as this it may well be that pre-operative blood urea level and intravenous pyelogram represent tests of renal function which are too crude. In future studies separate tests of tubular and glomerular function and the use of the isotope renogram will be required.

Effects of Ureaphil on Blood Electrolytes

McKelvie did not note any significant change in the levels of serum sodium, potassium, and chloride during or immediately after the administration of Ureaphil.

Blood electrolytes in this series of patients were estimated on the day after operation, i.e. after the Ureaphil had been given. The findings here agree with those of McKelvie in that there was no significant change in the level of the serum electrolytes as a result of giving Ureaphil.

Bladder Wash-out

McKelvie using Ureaphil had to employ bladder wash-out in only 7 of 161 cases (4.3%).

In this series wash-out was employed more frequently. How much this contributed to infection in this series, however, is difficult to state. Of the 54 patients who were 'sterile' at operation and who remained 'sterile' throughout their hospital stay 10 required bladder wash-out (18.5%). Of the 33 patients who had Ureaphil but who became infected after operation 7 had bladder wash-out (21.2%). It would thus appear that bladder wash-out when employed in this series has not increased to any extent the incidence of post-operative infection. It may be that bladder wash-out was employed more frequently in each individual case who became infected after operation. This point will require further investigation.

Diuretic Effect of Ureaphil

Giving 6 pints of Ureaphil in 24 hours over a period of 48 to 72 hours McKelvie obtained an output of 3,000 ml. in the first 24 hours in 146 of 161 cases. All had outputs in excess of 3000 ml. in the second and third 24 hours.

In the dosage of 4 pints only in the first 24 hours given here in the Urological Department of Glasgow Royal Infirmary the average output in patients who remained 'sterile' throughout was 1500 ml. on the day of operation (this of course is not equivalent to McKelvie's first 24 hours). The average output on the next two 24 hour periods was 3120 ml. and 2610 ml. respectively.

When one considers that operation took place and Ureaphil was started about the middle of the "day of operation" then the average output of 1500 ml. on this day, although lower than that obtained by McKelvie, is probably not so different as might appear. In this series urinary outputs were calculated from 12 midnight till 12 midnight. The outputs in the next two 24 hour periods are very comparable to those obtained by McKelvie.

Of considerable interest in this context is the average urinary output of the 25 patients in this series who did not have Ureaphil. Here the average output on the day of operation was 1260 ml. and in the 2 succeeding 24 hour periods it was 2850 and 2760 ml. respectively. Thus the diuresis produced by 4 pints of Ureaphil in 24 hours would not appear to be much greater than it is in cases in whom this agent is not used. On the other hand it must be remembered that Ureaphil was not used in a number of these cases because of an elevated blood urea which itself might have had a diuretic effect. Allowing for this, and taking the average output of these 11 patients who had no Ureaphil and in whom the pre-operative blood urea was not elevated, we find an average output of 1200 ml. on the day of operation and of 2790 ml. and 2895 ml. respectively on the 2 following days. Thus there was a 20% decrease in diuresis on the 'day of operation' (i.e. from 1500 ml. - 1200 ml.) when Ureaphil was not given.

One further point should be noted. In the 'sterile' patients with Ureaphil the average output of 1500 ml. obtained on the day of theatre corresponded to an average intake of 2580 ml; the average output of 1260 ml. on the day of theatre in those who did not have Ureaphil corresponded to an intake on that day of 1980ml.while the average output of 1200 ml. in those who had no Ureaphil and in whom the blood urea was not elevated corresponded to an intake of 1890 ml. This latter is a decrease in intake of 23% when compared with those having Ureaphil.

In these cases then, the giving of Ureaphil would appear to allow the handling of a higher fluid load on the day of operation without signs of water intoxication. There was no evidence of water intoxication in any of the patients who had Ureaphil.

General Remarks

The giving of Ureaphil among other factors leads to a significant lessening of post-operative urinary infection.This action may be due partly to the fact that diuresis is increased in the immediate post-operative period since a higher fluid load can be given over this period. There is no conclusive evidence that bladder wash-outs are required less frequently.

Shlegal et al. (1961) showed that urea in 4% concentration is bacteriostatic to the common urinary infecting organisms. No evidence was found of this in the present investigation. Thus there was no reduction in post-operative urinary infection in those patients who came to operation infected and who had Ureaphil. This group showed the same incidence of post-operative infective complications as any other infected group of patients who did not have Ureaphil.

The incidence of infective complications in those patients who came 'sterile' to operation but who became infected later having had Ureaphil was of the same order as in any other group of patients coming 'sterile' to operation but becoming infected later. These facts would suggest that the bacteriostatic effect of Ureaphil is not marked.

One must conclude in this series that urinary 'sterility' was maintained because of a number of factors. These were:-

(i) instillation into the urethra of 1/1000 chlorhexidine in glycerol before catheterisation,

(ii) the use of plastic catheters,

(iii) a strict system of closed drainage using "Bardic" bags,

(iv) the use of Ureaphil which allowed increased fluid load and marked diuresis. That this diuresis lessened the number of bladder wash-outs required and that Ureaphil exerts a bacteriostatic action has not been proved.

Ureaphil is expensive and a search should be made for a cheaper substitute.

The patients in this series who have had Ureaphil have given little trouble as regards urinary drainage in the immediate post-operative period. As stated above a number have required a bladder wash-out, but this has generally only had to be done once. The medical and nursing time spent on supervision, milking of drainage tubes and dealing with clot retentions has been greatly reduced. The patients' general post-operative condition and comfort has been much improved.

CONCLUSIONS

THE ELIMINATION OF URINARY INFECTION

1. Post-operative infective complications as a group are significantly reduced in patients whose urine is maintained 'sterile' throughout their hospital stay, when compared with those in whom the urine, although 'sterile' before, becomes infected after operation.

2. Patients whose urine is maintained 'sterile' throughout show a highly significant decrease in the incidence of pyrexia of 100°F. or over from the third post-operative day onwards, when compared with those in whom the urine becomes infected after operation.

3. There is a significant increase in the incidence of pyrexia of 100°F. or over on the day of operation and the subsequent 2 days in patients whose urine is infected at operation, when compared with those in whom the urine is 'sterile' at this time.

4. The urine is more easily maintained 'sterile' in young patients.

5. The urine is more easily maintained 'sterile' in patients who have not had preliminary catheter drainage.

6 The maintainance of urinary 'sterility' depends on attention to a number of factors none of which alone is sufficient.

7 By using 4 pints of Ureaphil intravenously in 'sterile' patients commencing during operation and continuing for 24 hours thereafter there is a highly significant decrease in the incidence of post-operative urinary infection when compared with 'sterile' patients who did not have Ureaphil.

8 Ureaphil can accentuate uraemia in a patient with poor renal function.

9 The time taken for clearance of urea from the blood is shortest in patients whose urine is maintained 'sterile'. The time taken for the clearance of urea from the blood is shorter, in the main, in patients whose urine is infected after operation, than in patients whose urine is infected before operation.

10 There is no significant change in the level of serum sodium, potassium, or chloride, or in the level of the alkali reserve as a result of giving Ureaphil.

11 The giving of 4 pints of Ureaphil commencing during operation and continuing for 24 hours allows the

handling of a higher fluid load (27% average increase) without water intoxication, and produces a 23% average increase in diuresis on the day of operation.

12 The number of patients requiring bladder wash-outs after operation was not significantly decreased in the group who remained 'sterile' throughout when compared with the group who became infected after operation.

SECTION VIII

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THE
SEQUELAE, MANAGEMENT, AND PREVENTION
OF
URINARY INFECTION
IN
RETROPUBIC PROSTATECTOMY

by

Alexander Marshall

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to
The University of Glasgow
for
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VOLUME III

DIAGRAM I

OPEN DRAINAGE

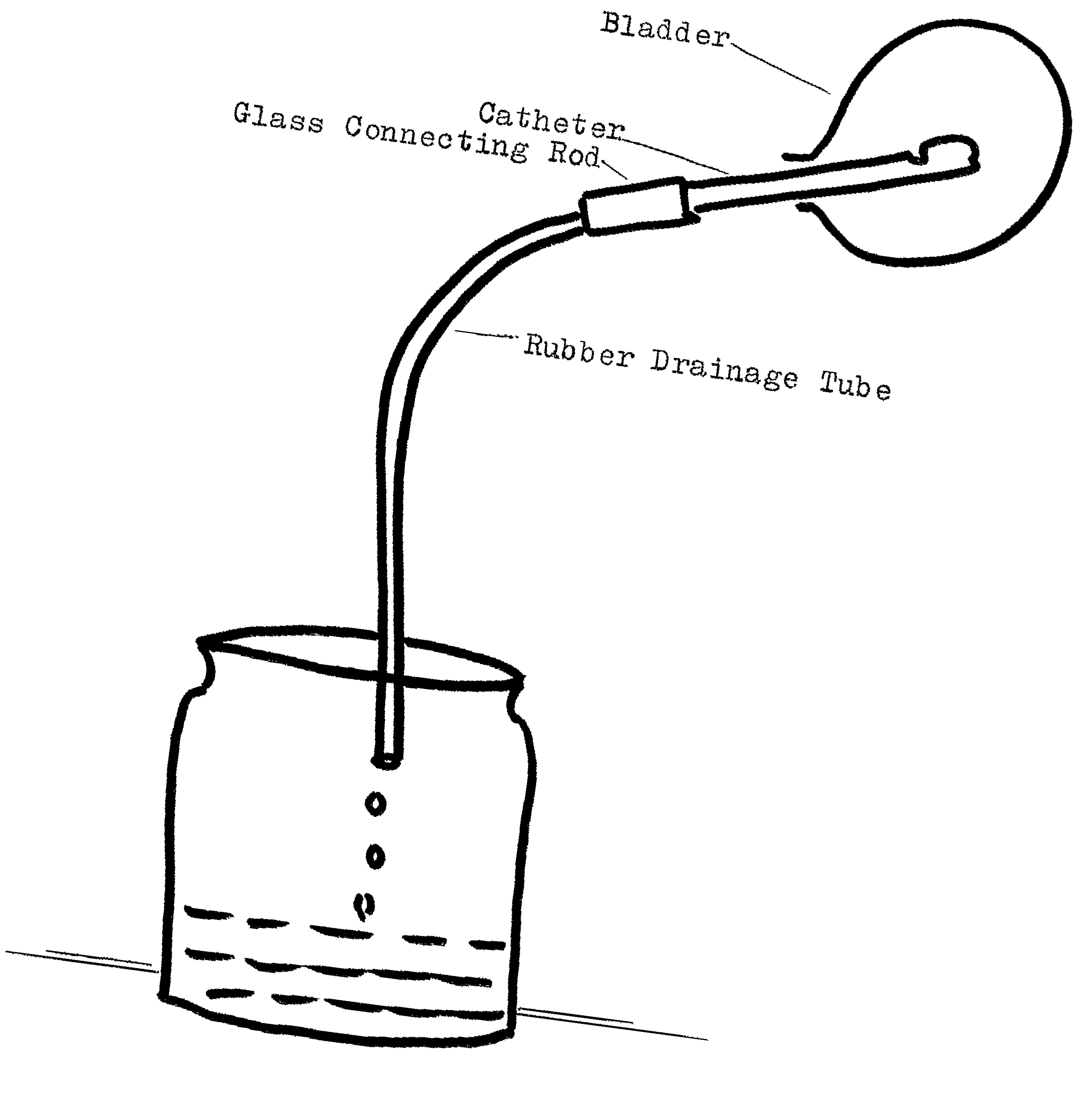
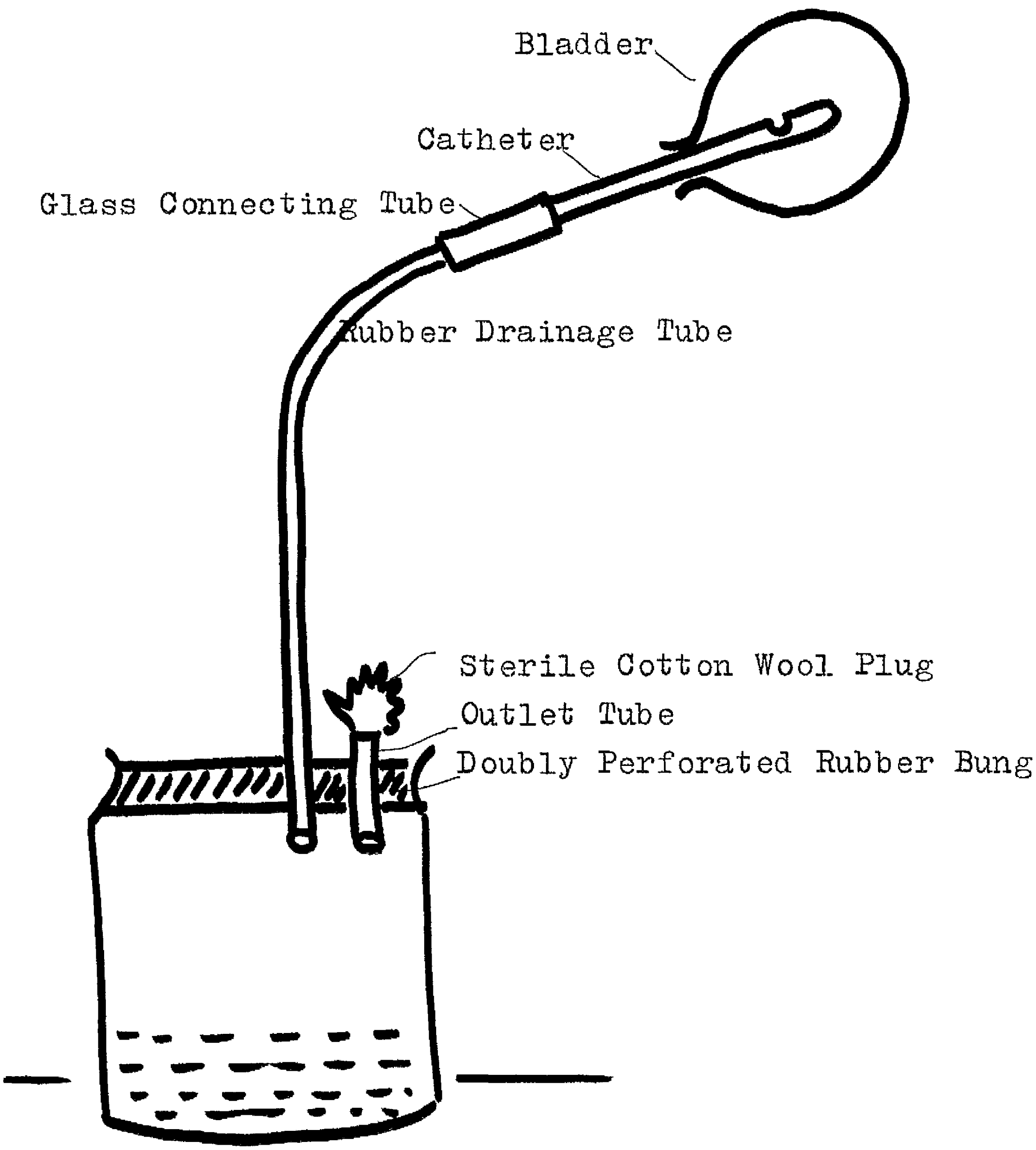


DIAGRAM II

CLOSED DRAINAGE



DEVELOPMENT OF STUDY

ANTIMICROBIAL COVER

This plan outlines the development of study which commenced at the end of December, 1956 and continued until the end of December, 1960. Minor alterations were made to these plans as time went on. The reasons for and the extent of these alterations are described in the text in this chapter and in the chapter Antimicrobial Cover - Results.

OPEN DRAINAGE	CLOSED DRAINAGE	
1954 - 1956	End of December, 1956 - End of June, 1958	July, 1958 - End of December, 1960
No routine antimicrobial prophylactic policy	I 100 consecutive cases alternately treated with penicillin and sulphatriad or no prophylactic cover. The presence or absence of urinary infection at operation disregarded. 2 Patients having 7 days or more preliminary drainage given alternately- a streptomycin or penicillin and sulphatriad, and later- b appropriate broad spectrum antimicrobials or nothing.	Infected cases given appropriate broad spectrum cover or nothing. (The cases treated alternately except for 40 consecutive cases having appropriate broad spectrum cover following by 40 consecutive cases having no cover during part of 1959).

DEVELOPMENT OF STUDY

(ANTIMICROBIAL COVER)

TABLE 1

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY

(761 CASES)

Complication Group	Complication	Total + Deaths		Delay in Convalescence + Deaths	
Infective	Wound infection	124	(16.3%)	80	(10.5%)
	Ascending infection	107	(14.1%)	45	(5.9%)
	Funiculitis	19	(2.5%)	8	(1.1%)
	Epididymitis	18	(2.4%)	13	(1.7%)
	Cystitis	6	(0.8%)	6	(0.8%)
	Pelvic cellulitis	1	(0.1%)	1	(0.1%)
Medical	Respiratory	46	(6.0%)	28	(3.6%)
	Cardio-vascular	26	(3.4%)	23	(3.0%)
	Cerebral	13	(1.7%)	11	(1.5%)
	Reticulosis	1	(0.1%)	1	(0.1%)
-	Supra-pubic leak	50	(6.6%)	42	(5.5%)
-	Haemorrhage (Urinary tract)	34	(4.5%)	20	(2.6%)
Upsets of Micturition	Poor control	31	(4.1%)	23	(3.1%)
	Failure or difficulty in voiding	28	(3.7%)	26	(3.5%)
Miscellaneous	Diarrhoea	7	(0.9%)	2	(0.3%)
	Rectal fistula	2	(0.3%)	2	(0.3%)
	Rectal haemorrhage	3	(0.4%)	3	(0.4%)

TABLE 1

TABLE 2

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY IN 'STERILE' CASES
(295 CASES)

Complication Group	Complications	Total + Deaths		Delay in Convalescence + deaths	
Infective	Wound infection	29	(9.8%)	14	(4.8%)
	Ascending infection	32	(10.8%)	8	(2.7%)
	Funiculitis	5	(1.7%)	2	(0.6%)
	Epididymitis	3	(1.0%)	1	(0.3%)
	Cystitis	1	(0.3%)	1	(0.3%)
	Pelvic cellulitis	1	(0.3%)	1	(0.3%)
Medical	Respiratory	7	(2.4%)	1	(0.3%)
	Cardio-vascular	4	(1.4%)	3	(1.0%)
	Cerebral	3	(1.0%)	3	(1.0%)
	Reticulosis	0		0	
-	Supra-pubic leak	8	(2.7%)	6	(2.1%)
-	Haemorrhage (Urinary tract)	13	(4.4%)	8	(2.7%)
Upsets of Micturition	Poor control	5	(1.7%)	3	(1.0%)
	Failure or difficulty in voiding	7	(2.4%)	6	(2.0%)
Miscellaneous	Diarrhoea	2	(0.7%)	0	
	Rectal fistula	1	(0.3%)	1	(0.3%)
	Rectal haemorrhage	1	(0.3%)	1	(0.3%)

TABLE 3

THE COMPLICATIONS OF RETROPUBIC PROSTATECTOMY IN INFECTED CASES

(466 CASES)

Complication Group	Complications	Total + Deaths		Delay in convalescence + deaths	
Infective	Wound infection	95	(20.5%)	66	(14.2%)
	Ascending infection	75	(16.1%)	37	(7.9%)
	Funiculitis	14	(3.0%)	6	(1.3%)
	Epididymitis	15	(3.2%)	12	(2.5%)
	Cystitis	5	(1.1%)	5	(1.1%)
	Pelvic cellulitis	0		0	
Medical	Respiratory	39	(8.4%)	27	(5.8%)
	Cardio-vascular	22	(4.7%)	20	(4.2%)
	Cerebral	10	(2.1%)	8	(1.7%)
	Reticulosis	1	(0.2%)	1	(0.2%)
-	Supra-pubic leak	42	(9.0%)	36	(7.7%)
-	Haemorrhage (Urinary tract)	21	(4.5%)	12	(2.6%)
Upsets of Micturition	Poor control	26	(5.6%)	20	(4.3%)
	Failure or difficulty in voiding	21	(4.5%)	20	(4.3%)
Miscellaneous	Diarrhoea	5	(1.1%)	2	(0.4%)
	Rectal fistula	1	(0.2%)	1	(0.2%)
	Rectal haemorrhage	2	(0.4%)	2	(0.4%)

TABLE 4

THE RELATIONSHIP OF AGE TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complications Group	Complication	50-59 years 46 CASES		60-69 years 115 CASES		70-79 years 114 CASES		80 years or over 20 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	5(10.9%)	2(4.4%)	12(10.4%)	5(4.3%)	10(8.8%)	5(4.4%)	2(10%)	2(10%)
	Ascending infection	6(13.0%)	1(2.2%)	12(10.4%)	4(3.4%)	13(11.4%)	3(2.6%)	1(4.0%)	0
	Funiculitis	1(2.2%)	0	4(3.4%)	2(1.7%)	0	0	0	0
	Epididymitis	2(4.3%)	0	1(0.9%)	1(0.9%)	0	0	0	0
	Cystitis	0	0	1(0.9%)	1(0.9%)	0	0	0	0
	Pelvic cellulitis	0	0	1(0.9%)	1(0.9%)	0	0	0	0
Medical	Respiratory	1(2.2%)	0	0	0	3(2.6%)	2(1.8%)	0	0
	Cardio-vascular	1(2.2%)	0	0	0	3(2.6%)	3(2.6%)	0	0
	Cerebral	0	0	1(0.9%)	0	1(0.9%)	1(0.9%)	1(5.0%)	1(5.0%)
	Reticulosis	0	0	0	0	0	0	0	0
-	Supra-pubic leak	0	0	4(3.4%)	2(1.7%)	3(2.6%)	3(2.6%)	1(5.0%)	1(5.0%)
-	Haemorrhage (Urinary tract)	3(6.5%)	2(4.3%)	7(6.1%)	4(3.4%)	3(2.6%)	2(1.8%)	0	0
Upsets of Micturition	Poor control	1(2.2%)	0	0	0	3(2.6%)	2(1.8%)	1(5.0%)	1(5.0%)
	Failure or difficulty in voiding	1(2.2%)	0	1(0.9%)	1(0.9%)	4(3.5%)	4(3.5%)	1(5.0%)	1(5.0%)
Miscellaneous	Diarrhoea	0	0	0	0	2(1.8%)	0	0	0
	Rectal fistula	0	0	0	0	1(0.9%)	1(0.9%)	0	0
	Rectal haemorrhage	0	0	0	0	1(0.9%)	1(0.9%)	0	0

TABLE 5

THE RELATIONSHIP OF AGE TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complication	50-59 years 46 CASES Total+ Deaths	Delay in conval-escence + deaths	60-69 years 157 CASES Total + Deaths	Delay in conval-escence + deaths	70-79 years 203 CASES Total + Deaths	Delay in conval-escence + deaths	80 years or over 60 CASES Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	9(19.6%)	7(15.2%)	36(22.6%)	24(15%)	39(19.2%)	27(13.3%)	11(18.3%)	8(13.3%)
	Ascending infection	9(19.6%)	3(6.5%)	28(17.8%)	12(7.6%)	28(13.8%)	16(7.9%)	10(16.7%)	6(10.0%)
	Funiculitis	3(6.5%)	1(2.2%)	6(3.8%)	4(2.6%)	5(2.4%)	1(0.5%)	0	0
	Epididymitis	4(8.7%)	4(8,7%)	5(3.1%)	4(2.6%)	4(1.9%)	4(1.9%)	2(3.3%)	0
	Cystitis	1(2.2%)	1(2.2%)	1(0.6%)	1(0.6%)	2(0.9%)	2(0.9%)	1(1.7%)	1(1.7%)
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	4(8.7%)	1(2.2%)	14(8.8%)	8(5.0%)	13(6.2%)	11(5.3%)	8(13.3%)	7(11.6%)
	Cardio-vascular	1(2.2%)	0	8(5.0%)	7(4.4%)	9(4.4%)	9(4.4%)	4(6.6%)	4(6.6%)
	Cerebral	0	0	2(1.3%)	1(0.6%)	5(2.4%)	4(1.9%)	3(5.0%)	3(5.0%)
	Reticulosis	0	0	0	0	1(0.5%)	1(0.5%)	0	0
-	Supra-pubic leak	5(10.9%)	4(8.6%)	13(8.3%)	11(7.0%)	18(8.7%)	16(7.8%)	6(10.0%)	5(8.3%)
-	Haemorrhage (Urinary tract)	3(6.5%)	2(4.3%)	8(5.0%)	6(3.8%)	8(3.9%)	3(1.5%)	2(3.3%)	1(1.7%)
Upsets of Micturition	Poor control	3(6.5%)	2(4.3%)	7(4.4%)	5(3.1%)	12(5.7%)	10(4.9%)	4(6.6%)	3(5.0%)
	Failure or difficulty in voiding	3(6.5%)	3(6.5%)	4(2.6%)	3(1.9%)	10(4.9%)	10(4.9%)	4(6.6%)	4(6.6%)
Miscellaneous	Diarrhoea	0	0	1(0.6%)	0	3(1.5%)	1(0.5%)	1(1.7%)	1(1.7%)
	Rectal fistula	0	0	1(0.6%)	1(0.6%)	0	0	0	0
	Rectal haemorrhage	0	0	1(0.6%)	1(0.6%)	1(0.5%)	1(0.5%)	0	0

TABLE 5

TABLE 6

THE GENERAL CONDITION OF PATIENTS AT OPERATION AS RELATED TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complication Group	Complications	Well 183 CASES		Urinary tract disease 35 CASES		Medical disease 69 CASES		Both urinary tract and Medical disease 8 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	19(10.4%)	9(4.9%)	4(11.4%)	2(5.7%)	3(4.3%)	3(4.3%)	0	0
	Ascending infection	16(8.7%)	5(2.7%)	5(14.3%)	0	9(13.0%)	2(2.9%)	1(12.5%)	0
	Funiculitis	3(1.6%)	0	2(5.7%)	2(5.7%)	0	0	0	0
	Epididymitis	0	0	0	0	2(2.9%)	0	0	0
	Cystitis	1(0.5%)	1(0.5%)	0	0	0	0	0	0
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	4(2.2%)	0	0	0	2(2.9%)	1(1.4%)	1(12.5%)	0
	Cardiovascular	1(0.5%)	1(0.5%)	0	0	3(4.3%)	2(2.9%)	0	0
	Cerebral	1(0.5%)	1(0.5%)	1(2.9%)	1(2.9%)	1(1.4%)	1(1.4%)	0	0
	Reticulosis	0	0	0	0	0	0	0	0
-	Supra-pubic leak	5(2.7%)	4(2.2%)	1(2.9%)	1(2.9%)	1(1.4%)	1(1.4%)	0	0
-	Haemorrhage (Urinary tract	7(3.8%)	4(2.2%)	2(5.7%)	0	3(4.3%)	3(4.3%)	1(12.5%)	1(12.5%)
Upsets of Micturition	Poor control	3(1.6%)	2(1.1%)	0	0	1(1.4%)	1(1.4%)	0	0
	Failure or difficulty in voiding	5(2.7%)	4(2.2%)	0	0	1(1.4%)	1(1.4%)	0	0
Miscellaneous	Diarrhoea	1(0.5%)	0	0	0	0	0	0	0
	Rectal fistula	1(0.5%)	1(0.5%)	0	0	0	0	0	0
	Rectal haemorrhage	1(0.5%)	1(0.5%)	0	0	0	0	0	0

TABLE 7

THE GENERAL CONDITION OF PATIENTS AT OPERATION AS RELATED TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complications	Well 230 CASES		Urinary tract disease 76 CASES		Medical disease 115 CASES		Both urinary tract and Medical disease 45 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence +deaths
Infective	Wound infection	45(19.6%)	30(13.0%)	18(23.7%)	14(18.4%)	20(17.4%)	13(11.3%)	11(24.4%)	6(13.3%)
	Ascending infection	40(17.4%)	16(7.0%)	18(23.7%)	16(21.1%)	10(8.7%)	4(3.5%)	8(17.8%)	3(6.7%)
	Funiculitis	5(2.2%)	3(1.3%)	2(2.6%)	0	3(2.6%)	1(0.9%)	1(2.2%)	0
	Epididymitis	7(3.0%)	5(2.2%)	2(2.6%)	2(2.6%)	4(3.5%)	3(2.6%)	2(4.4%)	2(4.4%)
	Cystitis	1(0.4%)	1(0.4%)	1(1.3%)	1(1.3%)	0	0	2(4.4%)	2(4.4%)
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	15(6.5%)	13(5.7%)	6(7.9%)	2(2.6%)	12(10.4%)	7(6.1%)	5(11.1%)	4(8.8%)
	Cardio-vascular	5(2.2%)	5(2.2%)	4(1.7%)	2(2.6%)	12(10.4%)	10(8.7%)	3(6.7%)	3(6.7%)
	Cerebral	5(2.2%)	4(1.7%)	0	0	1(0.9%)	1(0.9%)	1(2.2%)	1(2.2%)
	Reticulosis	1(0.4%)	1(0.4%)	0	0	0	0	0	0
-	Supra-pubic leak	21(9.1%)	19(8.3%)	9(11.8%)	8(10.5%)	5(4.3%)	4(3.5%)	5(11.1%)	5(11.1%)
-	Haemorrhage (Urinary tract	9(3.9%)	5(2.2%)	4(5.3%)	3(3.9%)	5(4.3%)	2(1.7%)	2(4.4%)	1(2.2%)
Upsets of Micturition	Poor control	14(6.1%)	11(4.8%)	4(5.3%)	4(5.3%)	3(2.6%)	2(1.7%)	1(2.2%)	1(2.2%)
	Failure or difficulty in voiding	9(3.9%)	9(3.9%)	7(9.2%)	6(7.9%)	1(0.9%)	1(0.9%)	2(4.4%)	2(4.4%)
Miscellaneous	Diarrhoea	4(1.7%)	2(0.9%)	0	0	1(0.9%)	0	0	0
	Rectal fistula	0	0	0	0	1(0.9%)	1(0.9%)	0	0
	Rectal haemorrhage	0	0	1(1.3%)	1(1.3%)	1(0.9%)	1(0.9%)	0	0

TABLE 8

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1954-1955)

Complication Group	Complications	Nil 90 CASES		1-3 days 40 CASES		4-6 days 40 CASES		7 or more days 21 DASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	7(7.7%)	3(3.3%)	4(10%)	3(7.5%)	11(27.5%)	5(12.5%)	7(33.3%)	4(19%)
	Ascending infection	9(10%)	5(5.6%)	8(20%)	5(12.5%)	7(17.5%)	6(15%)	4(19%)	4(19%)
	Funiculitis	3(3.3%)	1(1.1%)	0	0	0	0	0	0
	Epididymitis	4(4.4%)	3(3.3%)	3(7.5%)	3(7.5%)	1(2.5%)	1(2.5%)	1(4.8%)	1(4.8%)
	Cystitis	0	0	1(2.5%)	1(2.5%)	0	0	0	0
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	3(3.3%)	2(2.2%)	0	0	2(5.0%)	2(5.0%)	2(9.5%)	2(9.5%)
	Cardio-vascular	0	0	0	0	1(2.5%)	1(2.5%)	3(14.3%)	3(14.3%)
	Cerebral	2(2.2%)	1(1.1%)	0	0	0	0	1(4.8%)	1(4.8%)
	Reticulosis	1(1.1%)	1(1.1%)	0	0	0	0	0	0
-	Supra-pubic leak	3(3.3%)	1(1.1%)	4(10%)	4(10%)	6(15%)	6(15%)	4(19%)	4(19%)
-	Haemorrhage (Urinary tract)	5(5.5%)	3(3.3%)	2(5.0%)	2(5.0%)	0	0	2(9.5%)	2(9.5%)
Upsets of Micturition	Poor control	1(1.1%)	1(1.1%)	1(2.5%)	1(2.5%)	1(2.5%)	1(2.5%)	2(9.5%)	2(9.5%)
	Failure or difficulty in voiding	4(4.4%)	4(4.4%)	2(5.0%)	2(5.0%)	3(7.5%)	3(7.5%)	1(4.8%)	1(4.8%)
Miscellaneous	Diarrhoea	0	0	1(2.5%)	1(2.5%)	0	0	0	0
	Rectal fistula	1(1.1%)	1(1.1%)	0	0	1(2.5%)	1(2.5%)	0	0
	Rectal haemorrhage	1(1.1%)	1(1.1%)	0	0	0	0	0	0

TABLE 9

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1956-1958)

Complication Group	Complications	Nil 134 CASES		1-3 days 47 CASES		4-6 days 60 CASES		7 or more days 69 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	12(9.0%)	8(6.0%)	6(12.7%)	2(4.2%)	11(18.4%)	7(11.7%)	12(17.4%)	12(17.4%)
	Ascending infection	15(11.2%)	4(3.0%)	7(14.9%)	2(4.2%)	13(21.7%)	2(3.4%)	12(17.4%)	7(10.1%)
	Funiculitis	5(3.6%)	2(1.5%)	0	0	1(1.7%)	1(1.7%)	3(4.3%)	1(1.4%)
	Epididymitis	0	0	1(2.1%)	1(2.1%)	2(3.4%)	1(1.7%)	1(1.4%)	0
	Cystitis	3(2.2%)	3(2.2%)	0	0	1(1.7%)	1(1.7%)	0	0
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	5(3.6%)	4(2.9%)	4(8.6%)	2(4.2%)	6(10.0%)	4(6.7%)	7(10.1%)	5(7.2%)
	Cardio-vascular	2(1.5%)	2(1.5%)	4(8.6%)	4(8.6%)	2(3.3%)	2(3.3%)	4(5.8%)	3(4.3%)
	Cerebral	1(0.7%)	1(0.7%)	0	0	2(3.3%)	2(3.3%)	5(7.1%)	4(5.8%)
	Reticulosis	0	0	0	0	0	0	0	0
-	Supra-pubic leak	3(2.2%)	3(2.2%)	3(6.4%)	3(6.4%)	5(8.3%)	4(6.6%)	8(11.5%)	7(10.1%)
-	Haemorrhage (Urinary tract)	3(2.2%)	2(1.5%)	2(4.2%)	1(2.1%)	2(3.3%)	2(3.3%)	4(5.8%)	3(4.3%)
Upsets of Micturition	Poor control	7(5.2%)	5(3.6%)	2(4.2%)	2(4.2%)	3(5.0%)	2(3.3%)	5(7.1%)	3(4.3%)
	Failure or difficulty in voiding	5(3.6%)	4(2.9%)	2(4.2%)	2(4.2%)	2(3.3%)	2(3.3%)	4(5.8%)	4(5.8%)
Miscellaneous	Diarrhoea	0	0	1(2.1%)	0	0	0	1(1.4%)	0
	Rectal fistula	0	0	0	0	0	0	0	0
	Rectal haemorrhage	0	0	0	0	0	0	2(2.8%)	2(2.8%)

TABLE 10

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS (1959-1960)

Complication Group	Complications	Nil 121 CASES		1-3 days 23 CASES		4-6 days 28 CASES		7 or more days 72 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	13(10.7%)	8(6.6%)	5(21.7%)	3(13.0%)	7(25.0%)	6(21.4%)	17(23.6%)	8(11.1%)
	Ascending infection	12(9.9%)	1(0.8%)	2(8.6%)	1(4.3%)	4(14.3%)	2(7.1%)	10(13.9%)	6(8.4%)
	Funiculitis	1(0.8%)	1(0.8%)	3(13.0%)	1(4.3%)	0	0	3(4.2%)	1(1.4%)
	Epididymitis	4(3.4%)	2(1.7%)	0	0	0	0	1(1.4%)	1(1.4%)
	Cystitis	1(0.8%)	1(0.8%)	0	0	0	0	0	0
	Pelvic cellulitis	1(0.8%)	1(0.8%)	0	0	0	0	0	0
Medical	Respiratory	7(5.8%)	2(1.7%)	0	0	1(3.6%)	1(3.6%)	9(12.6%)	5(7.0%)
	Cardio-vascular	2(1.7%)	1(0.8%)	1(4.3%)	1(4.3%)	1(3.6%)	1(3.6%)	4(5.6%)	3(4.2%)
	Cerebral	0	0	0	0	0	0	1(1.4%)	1(1.4%)
	Reticulosis	0	0	0	0	0	0	0	0
-	Supra-pubic leak	3(2.5%)	2(1.7%)	1(4.3%)	1(4.3%)	3(10.8%)	2(7.1%)	5(7.0%)	3(4.2%)
-	Haemorrhage (Urinary tract)	7(5.8%)	3(2.5%)	1(4.3%)	1(4.3%)	2(7.1%)	1(3.6%)	2(2.8%)	1(1.4%)
Upsets of Micturition	Poor control	0	0	1(4.3%)	1(4.3%)	1(3.6%)	0	7(9.8%)	5(7.0%)
	Failure or difficulty in voiding	2(1.7%)	1(0.8%)	0	0	1(3.6%)	1(3.6%)	2(2.8%)	2(2.8%)
Miscellaneous	Diarrhoea	1(0.8%)	0	1(4.3%)	1(4.3%)	1(3.6%)	0	1(1.4%)	0
	Rectal fistula	0	0	0	0	0	0	0	0
	Rectal haemorrhage	0	0	0	0	0	0	0	0

TABLE 11

THE DURATION OF PRELIMINARY CATHETER DRAINAGE RELATED TO POST-OPERATIVE COMPLICATIONS
(761 CASES)

1954 - 1960

Complication Group	Complications	Nil 345 CASES Total + Deaths	Delay in convalescence + deaths	1-3 days 110 CASES Total + Deaths	Delay in convalescence + deaths	4-6 days 132 CASES Total + Deaths	Delay in convalescence + deaths	7-13 days 112 CASES Total + Deaths	Delay in convalescence + deaths	14 or more days 62 CASES Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	34(10.2%)	22(6.4%)	16(14.6%)	9(8.2%)	31(23.5%)	19(14.4%)	33(29.5%)	26(23.2%)	9(14.5%)	5(8.1%)
	Ascending infection	40(11.6%)	11(3.2%)	18(16.4%)	9(8.2%)	24(18.2%)	10(7.6%)	17(15.2%)	11(9.8%)	9(14.5%)4	5(8.1%)
	Funiculitis	9(2.6%)	4(1.2%)	3(2.7%)	1(0.9%)	1(0.8%)	1(0.8%)	6(5.4%)	2(1.8%)	0	0
	Epididymitis	8(2.3%)	5(1.4%)	4(3.6%)	4(3.6%)	3(2.4%)	2(1.5%)	0	0	3(4.8%)	2(3.2%)
	Cystitis	4(1.2%)	4(1.2%)	1(0.9%)	1(0.9%)	1(0.8%)	1(0.8%)	0	0	0	0
	Pelvic cellulitis	1(0.3%)	1(0.3%)	0	0	0	0	0	0	0	0
Medical	Respiratory	15(4.4%)	8(2.3%)	4(3.6%)	2(1.8%)	9(6.8%)	7(5.3%)	11(9.9%)	8(7.2%)	7(11.2%)	4(6.4%)
	Cardio-vascular	5(1.5%)	4(1.2%)	5(4.5%)	5(4.5%)	5(3.8%)	5(3.8%)	5(4.5%)	3(2.7%)	6(9.7%)	6(9.7%)
	Cerebral	2(0.6%)	1(0.3%)	0	0	3(2.3%)	3(2.3%)	7(6.3%)	6(5.4%)	3(4.8%)	2(3.2%)
	Reticulosis	1(0.3%)	1(0.3%)	0	0	0	0	0	0	0	0
-	Supra-pubic leak	9(2.6%)	6(1.8%)	8(7.2%)	8(7.2%)	15(11.4%)	13(9.9%)	11(9.9%)	10(9.0%)	7(11.2%)	5(8.1%)
-	Haemorrhage (Urinary tract)	18(5.2%)	8(2.3%)	5(4.5%)	4(3.6%)	4(3.1%)	3(2.3%)	6(5.4%)	4(3.6%)	2(3.2%)	1(1.6%)
Upsets of Micturition	Poor control	8(2.3%)	6(1.8%)	4(3.6%)	4(3.6%)	5(3.8%)	3(2.3%)	12(1018%)	9(3.1%)	2(3.2%)	1(1.6%)
	Failure or difficulty in voiding	11(3.2%)	9(2.6%)	4(3.6%)	4(3.6%)	7(5.3%)	7(5.3%)	3(2.7%)	3(2.7%)	3(4.8%)	3(4.8%)
Miscellaneous	Diarrhoea	1(0.3%)	0	3(2.7%)	2(1.8%)	1(0.8%)	1(0.8%)	1(0.9%)	0	1(1.6%)	0
	Rectal fistula	1(0.3%)	1(0.3%)	0	0	1(018%)	1(0.8%)	0	0	0	0
	Rectal haemorrhage	1(0.3%)	1(0.3%)	0	0	0	0	2(1.8%)	4 2(1.8%)	0	0

TABLE 12

POST-OPERATIVE COMPLICATIONS IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROYAL INFIRMARY AND COMPARED WITH THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

Complication Group	Complications	Urological Dept. direct 169 CASES		Some other unit or hospital 155 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	20 (11.8%)	13 (7.7%)	33 (21.3%)	23 (14.8%)
	Ascending infection	22 (13.0%)	14 (8.3%)	22 (14.2%)	9 (5.8%)
	Funiculitis	6 (3.6%)	4 (2.4%)	6 (3.9%)	3 (1.9%)
	Epididymitis	2 (1.2%)	1 (0.6%)	0	0
	Cystitis	0	0	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	9 (5.3%)	6 (3.6%)	12 (7.7%)	10 (6.5%)
	Cardio-vascular	9 (5.3%)	7 (4.1%)	4 (2.6%)	4 (2.6%)
	Cerebral	0	0	1 (0.6%)	1 (0.6%)
	Reticulosis	0	0	0	0
-	Supra-pubic leak	10 (5.9%)	9 (5.3%)	15 (9.7%)	12 (7.7%)
-	Haemorrhage (Urinary tract)	4 (2.4%)	2 (1.2%)	4 (2.6%)	3 (1.9%)
Upsets of Micturition	Poor control	5 (2.9%)	4 (2.4%)	7 (3.5%)	6 (3.9%)
	Failure or difficulty in voiding	2 (1.2%)	2 (1.2%)	3 (1.9%)	3 (1.9%)
Miscellaneous	Diarrhoea	1 (0.6%)	0	0	0
	Rectal fistula	0	0	0	0
	Rectal haemorrhage	0	0	1 (0.6%)	1 (0.6%)

TABLE 12

TABLE 13

THE DURATION OF PRELIMINARY CATHETER DRAINAGE IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROYAL INFIRMARY COMPARED WITH THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

Days on Drainage	Urological Department direct	Some other unit or hospital
1 - 6	73.9%	35.5%
7 - 13	20.7%	41.3%
14 - 27	3.6%	14.2%
28+	1.8%	9.0%

TABLE 13

TABLE 14

PROSTATE GLAND
RELATIONSHIP OF GLAND WEIGHT TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complication Group	Complications	50 gm. or less 153 CASES *		51 gm. or more 69 CASES *	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	11 (7.3%)	6 (4.0%)	5 (7.2%)	1 (1.4%)
	Ascending infection	18 (11.7%)	5 (3.3%)	10 (14.5%)	4 (5.7%)
	Funiculitis	3 (2.0%)	1 (0.7%)	1 (1.4%)	1 (1.4%)
	Epididymitis	2 (1.3%)	0	1 (1.4%)	1 (1.4%)
	Cystitis	1 (0.7%)	1 (0.7%)	0	0
	Pelvic cellulitis	1 (0.7%)	1 (0.7%)	0	0
Medical	Respiratory	2 (1.3%)	1 (0.7%)	3 (4.3%)	0
	Cardio-vascular	5 (3.3%)	4 (2.6%)	1 (1.4%)	1 (1.4%)
	Cerebral	2 (1.3%)	2 (1.3%)	0	0
	Reticulosis	0	0	0	0
-	Supra-pubic leak	6 (4.0%)	4 (2.6%)	1 (1.4%)	1 (1.4%)
-	Haemorrhage (Urinary tract)	5 (3.3%)	1 (0.7%)	2 (2.8%)	2 (2.8%)
Upsets of Micturition	Poor control	2 (1.3%)	1 (0.7%)	2 (2.8%)	2 (2.8%)
	Failure or difficulty in voiding	2 (1.3%)	2 (1.3%)	2 (2.8%)	2 (2.8%)
Miscellaneous	Diarrhoea	1 (0.7%)	0	1 (1.4%)	0
	Rectal fistula	1 (0.7%)	1 (0.7%)	0	0
	Rectal haemorrhage	0	0	0	0

* All cases not documented.

TABLE 15

PROSTATE GLAND
RELATIONSHIP OF GLAND WEIGHT TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complications	50 gm. or less 234 CASES *		51 gm. or more 138 CASES *	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence ÷ deaths
Infective	Wound infection	45 (19.2%)	30 (12.8%)	29 (21.1%)	18 (13.1%)
	Ascending infection	33 (14.1%)	20 (8.6%)	21 (15.2%)	11 (7.9%)
	Funiculitis	4 (1.7%)	2 (0.8%)	7 (5.1%)	2 (1.4%)
	Epididymitis	5 (2.1%)	4 (1.7%)	7 (5.1%)	6 (4.3%)
	Cystitis	0	0	3 (2.1%)	2 (1.4%)
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	18 (7.6%)	13 (5.5%)	9 (6.5%)	6 (4.3%)
	Cardio-vascular	7 (3.0%)	7 (3.0%)	5 (3.6%)	4 (2.9%)
	Cerebral	6 (2.6%)	4 (1.7%)	2 (1.4%)	2 (1.4%)
	Reticulosis	0	0	0	0
-	Supra-pubic leak	25 (10.7%)	22 (9.4%)	16 (11.5%)	14 (10.1%)
-	Haemorrhage (Urinary tract)	11 (4.7%)	8 (3.4%)	5 (3.6%)	2 (1.4%)
Upsets of Micturition	Poor control	18 (7.6%)	14 (6.0%)	6 (4.3%)	6 (4.3%)
	Failure or difficulty in voiding	4 (1.7%)	4 (1.7%)	8 (5.8%)	8 (5.8%)
Miscellaneous	Diarrhoea	1 (0.4%)	0	2 (1.4%)	1 (0.7%)
	Rectal fistula	0	0	0	0
	Rectal haemorrhage	0	0	1 (0.7%)	1 (0.7%)

* All cases not documented

TABLE 16

PROSTATE GLAND
RELATIONSHIP OF GLAND LOBES TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complication Group	Complications	Bilobed 92 CASES *		Trilobed 88 CASES *	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	4 (4.3%)	3 (3.3%)	6 (6.8%)	2 (2.3%)
	Ascending infection	6 (6.5%)	2 (2.2%)	10 (11.4%)	2 (2.3%)
	Funiculitis	1 (1.1%)	1 (1.1%)	2 (2.3%)	0
	Epididymitis	0	0	4 (4.5%)	2 (2.3%)
	Cystitis	0	0	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	3 (3.3%)	0	3 (3.4%)	2 (2.3%)
	Cardio-vascular	1 (1.1%)	1 (1.1%)	1 (1.1%)	1 (1.1%)
	Cerebral	0	0	1 (1.1%)	1 (1.1%)
	Reticulosis	0	0	0	0
-	Supra-pubic leak	2 (2.2%)	0	1 (1.1%)	1 (1.1%)
-	Haemorrhage (Urinary tract)	5 (5.4%)	3 (3.3%)	1 (1.1%)	1 (1.1%)
Upsets of Micturition	Poor control	1 (1.1%)	1 (1.1%)	0	0
	Failure or difficulty in voiding	3 (3.3%)	2 (2.2%)	4 (4.5%)	4 (4.5%)
Miscellaneous	Diarrhoea	0	0	0	0
	Rectal fistula	0	0	0	0
	Rectal haemorrhage	0	0	1 (1.1%)	1 (1.1%)

* All cases not documented

TABLE 17

PROSTATE GLAND
RELATIONSHIP OF GLAND LOBES TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complications	Bilobed 165 CASES * Total + Deaths	Bilobed 165 CASES * Delay in convalescence + deaths	Trilobed 144 CASES * Total + Deaths	Trilobed 144 CASES * Delay in convalescence + deaths
Infective	Wound infection	19 (11.5%)	13 (7.9%)	21 (14.6%)	13 (9.0%)
	Ascending infection	18 (10.9%)	10 (6.1%)	26 (18.1%)	16 (11.1%)
	Funiculitis	3 (1.8%)	1 (0.6%)	6 (4.2%)	1 (0.7%)
	Epididymitis	4 (2.4%)	3 (1.8%)	6 (4.2%)	5 (3.5%)
	Cystitis	0	0	1 (0.7%)	1 (0.7%)
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	9 (5.5%)	7 (4.2%)	10 (6.9%)	10 (6.9%)
	Cardio-vascular	9 (5.5%)	8 (4.8%)	4 (2.8%)	4 (2.8%)
	Cerebral	2 (1.2%)	1 (0.6%)	1 (0.7%)	1 (0.7%)
	Reticulosis	1 (0.6%)	1 (0.6%)	0	0
-	Supra-pubic leak	17 (10.3%)	15 (9.1%)	15 (10.4%)	15 (10.4%)
-	Haemorrhage (Urinary tract)	8 (4.8%)	5 (3.0%)	4 (2.8%)	2 (1.4%)
Upsets of Micturition	Poor control	7 (4.2%)	6 (3.6%)	7 (4.9%)	6 (4.2%)
	Failure or difficulty in voiding	6 (3.6%)	6 (3.6%)	3 (2.1%)	3 (2.1%)
Miscellaneous	Diarrhoea	0	0	1 (0.7%)	1 (0.7%)
	Rectal fistula	0	0	0	0
	Rectal haemorrhage	0	0	1 (0.7%)	1 (0.7%)

* All cases not documented

TABLE 18

PROSTATE GLAND
RELATIONSHIP BETWEEN EASE OF GLAND ENUCLEATION AND POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complication Group	Complications	EASY 229 CASES *		DIFFICULT 50 CASES *	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	16 (7.0%)	8 (3.5%)	6 (12.0%)	4 (8.0%)
	Ascending infection	30 (13.1%)	9 (3.9%)	6 (12.0%)	3 (6.0%)
	Funiculitis	4 (1.7%)	2 (0.9%)	1 (2.0%)	0
	Epididymitis	2 (0.9%)	0	1 (2.0%)	1 (2.0%)
	Cystitis	0	0	0	0
	Pelvic cellulitis	1 (0.4%)	1 (0.4%)	0	0
Medical	Respiratory	7 (3.1%)	2 (0.9%)	0	0
	Cardio-vascular	6 (2.6%)	5 (2.2%)		
	Cerebral	1 (0.4%)	1 (0.4%)	2 (4.0%)	2 (4.0%)
	Reticulosis	0	0	0	0
-	Supra-pubic leak	5 (2.2%)	4 (1.7%)	4 (8.0%)	3 (6.0%)
-	Haemorrhage (Urinary tract)	10 (4.3%)	6 (2.6%)	1 (2.0%)	1 (2.0%)
Upsets of Micturition	Poor control	6 (2.5%)	5 (2.1%)	1 (2.0%)	0
	Failure or difficulty in voiding	7 (3.1%)	6 (2.6%)	1 (2.0%)	0
Miscellaneous	Diarrhoea	3 (1.3%)	0	0	0
	Rectal fistula	0	0	1 (2.0%)	1 (2.0%)
	Rectal haemorrhage	1 (0.4%)	1 (0.4%)	0	0

* All cases not documented

TABLE 18

TABLE 19

PROSTATE GLAND

RELATIONSHIP BETWEEN EASE OF GLAND ENUCLEATION AND POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complications	EASY 365 CASES *		DIFFICULT 76 CASES *	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	68 (18.7%)	45 (12.4%)	14 (18.5%)	10 (13.2%)
	Ascending infection	52 (14.2%)	25 (6.8%)	16 (21.1%)	11 (14.5%)
	Funiculitis	12 (3.4%)	5 (1.4%)	1 (1.3%)	1 (1.3%)
	Epididymitis	12 (3.4%)	9 (2.5%)	1 (1.3%)	1 (1.3%)
	Cystitis	5 (1.4%)	5 (1.4%)	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	20 (5.4%)	13 (3.6%)	10 (13.2%)	7 (9.2%)
	Cardio-vascular	12 (3.4%)	10 (2.7%)	9 (11.8%)	9 (11.8%)
	Cerebral	7 (1.9%)	5 (1.4%)	3 (3.9%)	3 (3.9%)
	Reticulosis	1 (0.3%)	1 (0.3%)	0	0
-	Supra-pubic leak	42 (11.5%)	37 (10.1%)	10 (13.2%)	8 (10.6%)
-	Haemorrhage (Urinary tract)	19 (5.2%)	11 (3.0%)	5 (6.5%)	4 (5.2%)
Upsets of Micturition	Poor control	14 (3.8%)	8 (2.2%)	9 (11.8%)	9 (11.8%
	Failure or difficulty in voiding	15 (4.1%)	15 (3.8%)	2 (2.6%)	2 (2.6%)
Miscellaneous	Diarrhoea	2 (0.6%)	1 (0.3%)	0	0
	Rectal fistula	0	0	0	0
	Rectal haemorrhage	1 (0,3%)	1 (0.3%)	0	0

* All cases not documented

TABLE 19

TABLE 20

PROSTATE GLAND
RELATIONSHIP OF INFLAMMATION OF THE PROSTATE GLAND TO POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES

Complications Group	Complications	Inflammation absent 207 CASES * Total + Deaths	Inflammation absent 207 CASES * Delay in convalescence + deaths	Inflammation present 77 CASES * Total + Deaths	Inflammation present 77 CASES * Delay in convalescence + deaths
Infective	Wound infection	19 (9.2%)	12 (5.8%)	6 (7.8%)	2 (2.6%)
	Ascending infection	23 (11.1%)	5 (2.4%)	10 (13.0%)	4 (5.2%)
	Funiculitis	2 (1.0%)	1 (0.5%)	2 (2.6%)	0
	Epididymitis	0	0	2 (2.6%)	0
	Cystitis	0	0	1 (1.3%)	1 (1.3%)
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	7 (3.4%)	2 (0.9%)	0	0
	Cardio-vascular	3 (1.4%)	3 (1.4%)	1 (1.3%)	1 (1.3%)
	Cerebral	2 (0.9%)	2 (0.9%)	0	0
	Reticulosis	0	0	0	0
-	Supra-pubic leak	5 (2.4%)	3 (1.4%)	2 (2.6%)	2 (2.6%)
-	Haemorrhage (Urinary tract)	9 (4.3%)	5 (2.4%)	4 (5.2%)	3 (3.9%)
Upsets of Micturition	Poor control	2 (1.0%)	2 (1.0%)	2 (2.6%)	2 (2.6%)
	Failure or difficulty in voiding	5 (2.3%)	5 (2.3%)	1 (1.3%)	1 (1.3%)
Miscellaneous	Diarrhoea	0	0	1 (1.3%)	0
	Rectal fistula	1 (0.5%)	1 (0.5%)	0	0
	Rectal haemorrhage	0	0	0	0

* All cases not documented

TABLE 20

TABLE 21

PROSTATE GLAND
RELATIONSHIP OF INFLAMMATION OF THE PROSTATE GLAND TO POST-OPERATIVE COMPLICATIONS IN INFECTED CASES

Complication Group	Complications	Inflammation absent 259 CASES *		Inflammation present 201 CASES *	
		Total + Deaths	Delay in conval- escence + deaths	Total + Deaths	Delay in conval- escence + deaths
Infective	Wound infection	44 (17.0%)	32 (12.4%)	44 (21.9%)	36 (17.9%)
	Ascending infection	39 (15.1%)	20 (7.7%)	24 (11.9%)	16 (7.9%)
	Funiculitis	9 (3.5%)	3 (1.2%)	5 (2.5%)	2 (0.9%)
	Epididymitis	3 (1.2%)	2 (0.8%)	11 (5.5%)	9 (4.5%)
	Cystitis	2 (0.8%)	2 (0.8%)	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	23 (8.9%)	14 (5.4%)	14 (6.9%)	10 (4.9%)
	Cardio-vascular	10 (3.9%)	8 (3.1%)	6 (2.9%)	6 (2.9%)
	Cerebral	3 (1.2%)	2 (0.8%)	1 (0.5%)	1 (0.5%)
	Reticulosis	1 (0.4%)	1 (0.4%)	0	0
-	Supra-pubic leak	31 (12.0%)	28 (10.8%)	16 (7.9%)	15 (7.5%)
-	Haemorrhage (Urinary tract)	13 (5.0%)	8 (3.1%)	11 (5.5%)	6 (2.9%)
Upsets of Micturition	Poor control	11 (4.2%)	7 (2.7%)	12 (5.9%)	9 (4.5%)
	Failure or difficulty in voiding	8 (3.1%)	8 (3.1%)	8 (3.9%)	8 (3.9%)
Miscellaneous	Diarrhoea	3 (1.2%)	1 (0.4%)	3 (1.5%)	1 (0.5%)
	Rectal fistula	0	0	2 (0.9%)	2 (0.9%)
	Rectal haemorrhage3	0	0	0	0

* All cases not documented

TABLE 21

TABLE 22

THE RELATIONSHIP OF URINARY INFECTING ORGANISM TO POST-OPERATIVE COMPLICATIONS

Complication Group	Complications	Esch. coli 220 CASES		Ps. pyocyanea, Proteus species, Klebsiella species. 52 CASES		Staph. pyogenes 35 CASES		Strep. faecalis 53 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	17(7.7%)	10(4.5%)	11(21.2%)	7(13.5%)	4(11.4%)	2(5.7%)	8(15.1%)	7(13.2%)
	Ascending infection	9(4.1%)	8(3.6%)	2(3.8%)	2(3.8%)	5(14.3%)	4(11.4%)	7(13.2%)	4(7.5%)
	Funiculitis	2(0.9%)	1(0.5%)	2(3.8%)	1(1.8%)	2(5.7%)	2(5.7%)	4(7.5%)	1(1.9%)
	Epididymitis	3(1.4%)	2(0.9%)	3(5.8%)	3(5.8%)	1(2.9%)	0	3(5.7%)	3(5.7%)
	Cystitis	2(0.9%)	2(0.9%)	0	0	1(2.9%)	1(2.9%)	1(1.9%)	1(1.9%)
	Pelvic cellulitis	0	0	0	0	0	0	0	0
Medical	Respiratory	11(5.0%)	9(4.1%)	3 (5.8%)	3(5.8%)	6(17.1%)	4(11.4%)	3(5.7%)	1(1.9%)
	Cardio-vascular	2(0.9%)	2(0.9%)	3(5.8%)	3(5.8%)	1(2.9%)	1(2.9%)	5(9.4%)	5(9.4%)
	Cerebral	2(0.9%)	2(0.9%)	1(1.9%)	1(1.9%)	2(5.7%)	1(2.9%)	1(1.9%)	1(1.9%)
	Reticulosis	0	0	1(1.9%)	1(1.9%)	0	0	0	0
-	Supra-pubic leak	7(3.2%)	6(2.7%)	14(26.9%)	12(23.9%)	2(5.7%)	2(5.7%)	2(3.8%)	1(1.9%)
-	Haemorrhage (Urinary tract)	7(3.2%)	6(2.7%)	4(7.7%)	2(3.8%)	1(2.9%)	1(2.9%)	2(3.8%)	1(1.9%)
Upsets of Micturition	Poor control	8(3.6%)	7(3.2%)	3(5.8%)	2(3.8%)	2(5.7%)	1(2.9%)	2(3.8%)	1(1.9%)
	Failure or difficulty in voiding	1(0.5%)	1(0.5%)	0	0	3(8.6%)	3(8.6%)	2(3.8%)	2(3.8%)
Miscellaneous	Diarrhoea	2(0.9%)	1(0.5%)	0	0	1(2.9%)	1(2.9%)	1(1.9%)	0
	Rectal fistula	0	0	0	0	0	0	0	0
	Rectal haemorrhage	0	0	0	0	0	0	0	0

TABLE 23

RETROPUBIC PROSTATECTOMY - OTHER PUBLISHED SERIES

Complication Group	Complication	Millin et al 1949 757	Riches 1949 313	Jacobs 1951 500	Taylor et al 1955 150	Blue et al 1958 1000	Salvaris 1960 1200	Stearns 1961 500	Present Series 761
Infective	Wound infection				Temperature rise over 102°F. for 2 or more days in 25.3% of cases		10%	0.8%	16.3%
	Ascending infection						*Found at most post mortems -	4.0%	14.1%
	Funiculitis	In a proportion of cases						0.8%	2.5%
	Epididymitis		2.7%				3%	1.4%	2.4%
	Cystitis								0.8%
	Pelvic cellulitis		1.5%						0.1%
Medical	Respiratory	1.5% pulmonary embolism	1.5% pumonary embolism				7.0%		6.0%
	Cardio-vascular						5.8%	2.4%	3.4%
	Cerebral								1.7%
	Reticulosis								0.1%
-	Supra-pubic leak	7.5% of 600		4% of 50			9.0%		6.6%
-	Haemorrhage (Urinary tract)	8% of 200	6%	6% - 8%				4.2%	4.5%
Upsets of Micturition	Poor control					In some cases	1.0%		4.1%
	Failure or difficulty in voiding								3.7%
Miscellaneous	Diarrhoea								0.9%
	Rectal fistula								0.3%
	Rectal haemorrhage								0.4%

* Refers to ascending infection only

TABLE 24

MORBIDITY IN DIFFERENT TYPE OF PROSTATECTOMY

		Riches 1949 149 CASES Harris	Bulkley et al 1952 142 CASES Supra-pubic	Aiken 1953 150 CASES Immediate Wilson-Hey	Turner et al 1957 1694 CASES Perineal	Holt Grewe et al 1961 2015 CASES Trans urethral Resection	Present Series 1965 761 CASES Retropubic
Infective	Wound infection				1.43%		16.3%
	Ascending infection		2.8%		0.31%	1.85%	14.1%
	Funiculitis						2.5%
	Epididymitis	2.6%	2.1%	3.5%	5.3%	6.0%	2.4%
	Cystitis						0.8%
	Pelvic cellulitis	1.3%				1.1%	0.1%
Medical	Respiratory	2% Pulmonary Embolism	6.3%			1.6%	6.0%
	Cardio-vascular		3.5%			0.9%	3.4%
	Cerebral					0.2%	1.7%
	Reticulosis						0.1%
-	Supra-pubic leak			7.0%			6.6%
-	Haemorrhage (Urinary tract)	1.3%	3.5%	4.0%	2.98%		4.5%
Upsets of Micturition	Poor control		1.4%	Common	5.9%		4.1%
	Failure or difficulty in voiding				0.25%		3.7%
Miscellaneous	Diarrhoea						0.9%
	Rectal fistula						0.3%
	Rectal haemorrhage					0.2%	0.4%

TABLE 25

POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES
NO PRELIMINARY CATHETER DRAINAGE
223 CASES

Complication Group	Complications	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	22 (9.9%)	11 (4.9%)
	Ascending infection	23 (10.3%)	7 (3.1%)
	Funiculitis	3 (1.3%)	2 (0.9%)
	Epididymitis	3 (1.3%)	1 (0.4%)
	Cystitis	1 (0.4%)	1 (0.4%)
	Pelvic cellulitis	1 (0.4%)	1 (0.4%)
Medical	Respiratory	3 (1.3%)	0
	Cardio-vascular	0	0
	Cerebral	1 (0.4%)	1 (0.4%)
	Reticulosis		
-	Supra-pubic leak	5 (2.2%)	3 (1.3%)
-	Haemorrhage (Urinary tract)	10 (4.5%)	5 (2.2%)
Upsets of Micturition	Poor control	0	0
	Failure of difficulty in voiding	5 (2.2%)	4 (1.8%)
Miscellaneous	Diarrhoea	0	0
	Rectal fistula	1 (0.4%)	1 (0.4%)
	Rectal haemorrhage	1 (0.4%)	1 (0.4%)

TABLE 25

TABLE 26

POST-OPERATIVE COMPLICATIONS IN 'STERILE' CASES
PRELIMINARY CATHETER DRAINAGE NECESSARY
72 CASES

Complication Group	Complications	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	7 (9.7%)	3 (4.2%)
	Ascending infection	9 (12.5%)	1 (1.4%)
	Funiculitis	2 (2.8%)	
	Epididymitis		
	Cystitis		
	Pelvic cellulitis		
Medical	Respiratory	4 (5.6%)	2 (2.8%)
	Cardio-vascular	4 (5.6%)	3 (4.2%)
	Cerebral	2 (2.8%)	
	Reticulosis		
-	Supra-pubic leak	3 (4.2%)	3 (4.2%)
-	Haemorrhage (Urinary tract)	3 (4.2%)	3 (4.2%)
Upsets of Micturition	Poor control	5 (6.9%)	3 (4.2%)
	Failure or difficulty in voiding	2 (2.8%)	3 (4.2%)
Miscellaneous	Diarrhoea	2 (2.8%)	
	Rectal fistula		
	Rectal haemorrhage		

TABLE 27

POST-OPERATIVE COMPLICATIONS IN INFECTED CASES
NO PRELIMINARY CATHETER DRAINAGE
127 CASES

Complication Group	Complications	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	15 (11.8%)	12 (9.4%)
	Ascending infection	10 (7.9%)	6 (4.7%)
	Funiculitis	5 (3.9%)	2 (1.6%)
	Epididymitis	5 (3.9%)	4 (3.1%)
	Cystitis	2 (1.6%)	2 (1.6%)
	Pelvic cellulitis		
Medical	Respiratory	9 (7.1%)	6 (4.7%)
	Cardio-vascular	2 (1.6%)	2 (1.6%)
	Cerebral	1 (0.8%)	1 (0.8%)
	Reticulosis	1 (0.8%)	1 (0.8%)
-	Supra-pubic leak	6 (4.7%)	5 (3.9%)
-	Haemorrhage (Urinary tract)	8 (6.3%)	3 (2.4%)
Upsets of Micturition	Poor control	4 (3.1%)	3 (2.4%)
	Failure or difficulty in voiding	5 (3.9%)	4 (3.1%)
Miscellaneous	Diarrhoea	1 (0.8%)	
	Rectal fistula		
	Rectal haemorrhage		

TABLE 27

TABLE 28

POST-OPERATIVE COMPLICATIONS IN INFECTED CASES
PRELIMINARY CATHETER DRAINAGE NECESSARY
339 CASES

Complication Group	Complications	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	80 (23.6%)	54 (15.9%)
	Ascending infection	65 (19.2%)	31 (9.1%)
	Funiculitis	9 (2.7%)	4 (1.2%)
	Epididymitis	10 (2.9%)	8 (2.4%)
	Cystitis	3 (0.9%)	3 (0.9%)
	Pelvic cellulitis		
Medical	Respiratory	30 (8.8%)	21 (6.2%)
	Cardio-vascular	20 (5.9%)	18 (5.3%)
	Cerebral	9 (2.7%)	7 (2.1%)
	Reticulosis	0	0
-	Supra-pubic leak	36 (10.6%)	31 (9.1%)
-	Haemorrhage (Urinary tract)	13 (3.8%)	9 (2.7%)
Upsets of Micturition	Poor control	22 (6.5%)	17 (5.0%)
	Failure or difficulty in voiding	16 (4.7%)	16 (4.7%)
Miscellaneous	Diarrhoea	4 (1.2%)	2 (0.6%)
	Rectal fistula	1 (0.3%)	1 (0.3%)
	Rectal haemorrhage	2 (0.6%)	2 (0.6%)

TABLE 29

THE CAUSE OF DEATH IN 45 FATAL CASES

Age	'Sterile' or Infected	Presumed cause of death	Whether or not post mortem carried out
69	Infected	Coronary thrombosis	Yes
83	Infected	Pulmonary embolism	Yes
76	Infected	Reticulosis	Yes
64	Infected	Coronary thrombosis	No
69	'Sterile'	Staphylococcal pyaemia	Yes
71	Infected	Pyelonephritis Uraemia	Yes
77	'Sterile'	Cerebral haemorrhage	Yes
73	Infected	Cerebral haemorrhage	No
78	Infected	Post-operative shock (Cardiac failure)	No
72	Infected	Pulmonary embolism	Yes
74	Infected	Pyelonephritis Uraemia	Yes
66	Infected	Coronary thrombosis	No
73	Infected	Broncho-pneumonia	Yes
82	'Sterile'	Cerebral thrombosis	No
79	'Sterile'	Coronary thrombosis	Yes
71	Infected	Chronic duodenal ulcer haemorrhage (rectal)	Yes
80	'Sterile'	Cerebral haemorrhage	No
79	Infected	Pyelonephritis uraemia	No
75	Infected	Pyelonephritis	No
79	Infected	Pyelonephritis	No
75	'Sterile'	Pulmonary embolism	No
84	Infected	Broncho-pneumonia	Yes
63	Infected	Pyelonephritis	Yes
78	Infected	Broncho-pneumonia (chronic pyelonephritis)	Yes
76	Infected	Coronary thrombosis	No
76	Infected	Coronary thrombosis	No

TABLE 29 (continued)

THE CAUSE OF DEATH IN 45 FATAL CASES

Age	'Sterile' or Infected	Presumed cause of death	Whether or not post mortem carried out
77	Infected	Cardiac arrest anaesthetic death	Yes
79	Infected	Bacteraemic shock	No
75	'Sterile'	Coronary thrombosis	Yes
83	Infected	Pyelonephritis	No
82	Infected	Pyelonephritis	No
65	Infected	Coronary thrombosis	No
69	Infected	Congest. cardiac failure (had pyelonephritis)	No
79	Infected	Coronary thrombosis	Yes
71	Infected	Coronary thrombosis	Yes
75	Infected	Coronary thrombosis	No
81	Infected	Pyelonephritis	No
68	'Sterile'	Pyelonephritis	Yes
84	Infected	Pneumonia	No
70	'Sterile'	Congestive cardiac failure	No
69	Infected	Staphylococcal septicaemia	Yes
76	Infected	Pyelonephritis	No
82	Infected	Broncho-pneumonia	No
74	Infected	Coronary thrombosis	No
67	Infected	Pulmonary embolism	Yes

TABLE 30

MORTALITY FOLLOWING RETROPUBIC PROSTATECTOMY

(761 CASES)

	No. of Cases	No. of Deaths	% Mortality
Total	761	45	5.9
'Sterile' Cases only	295	9	3.1
Infected Cases only	466	36	7.7

TABLE 31

ANALYSIS OF CAUSES OF DEATH IN 'STERILE' AND INFECTED CASES

Cause of Death	'Sterile' 295 CASES	Infected 466 CASES
Pyelonephritis	0	10 (2.1%)
Pyaemia or Septicaemia	2 (0.7%)	2 (0.4%)
Cardiac disease	3 (1.1%)	11 (2.4%)
Bronchitis or Pneumonia	0	5 (1.1%)
Cerebral	3 (1.1%)	1 (0.2%)
Pulmonary embolism	1 (0.3%)	3 (0.6%)
Post-operative shock	0	2 (0.4%)
Gastro-intestinal haemorrhage	0	1 (0.2%)
Reticulosis	0	1 (0.2%)

TABLE 32

THE INCIDENCE OF DIFFERENT CAUSES OF DEATH IN
45 FATAL CASES

Causes of Death	20 Cases having P.M.		All 45 Cases	
	No.	%	No.	%
Pyelonephritis	3	15	10	22.2
Pyaemia or Septicaemia	3	15	4	8.9
Cardiac disease	5	25	14	31.1
Bronchitis or pneumonia	3	15	5	11.1
Cerebral	1	5	4	8.9
Pulmonary embolism	3	15	4	8.9
Post-operative shock	0	0	2	4.4
Gastro-intestinal haemorrhage	1	5	1	2.2
Reticulosis	1	5	1	2.2

TABLE 33

MORTALITY IN EACH YEAR INVESTIGATED

Cause of Death	1954 96 CASES	1955 107 CASES	1956 95 CASES	1957 93 CASES	1958 126 CASES	1959 106 CASES	1960 138 CASES
Pyelonephritis		2 (1.9%)		3 (3.3%)	3 (2.4%)	1 (0.9%)	1 (0.7%)
Pyaemia or Septicaemia		1 (0.9%)			1 (0.8%)	1 (0.9%)	1 (0.7%)
Cardiac disease	2 (2.1%)		2 (2.1%)		4 (3.2%)	4 (3.8%)	2 (1.4%)
Bronchitis or pneumonia			1 (1.1%)		2 (1.6%)	1 (0.9%)	1 (0.7%)
Cerebral		2 (1.9%)	1 (1.1%)	1 (1.1%)			
Pulmonary embolism	1 (1.0%)	1 (0.9%)		1 (1.1%)			1 (0.7%)
Post-operative shock		1 (0.9%)			1 (0.8%)		
Gastro-intestinal haemorrhage			1 (1.1%)				
Reticulosis	1 (1.0%)						
TOTAL MORTALITY	4 (4.2%)	7 (6.5%)	5 (5.3%)	5 (5.4%)	11 (8.7%)	7 (6.6%)	6 (4.3%)

TABLE 33

TABLE 34

AGE AND MORTALITY IN 'STERILE' CASES

Cause of death	AGE 50-59 46 CASES	60-69 115 CASES	70-79 114 CASES	80 or more 20 CASES
Pyelonephritis				
Pyaemia or septicaemia		2 (1.7%)		
Cardiac disease			3 (2.3%)	
Bronchitis or pneumonia				
Cerebral			1 (0.9%)	2 (10%)
Pulmonary embolism			1 (0.9%)	
Post-operative shock				
Gastro-intestinal haemorrhage				
Reticulosis				

TABLE 35

AGE AND MORTALITY IN INFECTED CASES

Cause of death	AGE 50-59 46 CASES	60-69 157 CASES	70-79 203 CASES	80 or more 60 CASES
Pyelonephritis		1 (0.6%)	6 (2.9%)	3 (5.0%)
Pyaemia or septicaemia		1 (0.6%)	1 (0.5%)	
Cardiac disease		5 (3.2%)	5 (2.5%)	1 (1.7%)
Bronchitis or pneumonia			3 (1.5%)	2 (3.3%)
Cerebral			1 (0.5%)	
Pulmonary embolism		1 (0.6%)	1 (0.5%)	1 (1.7%)
Post-operative shock			2 (0.9%)	
Gastro-intestinal haemorrhage			1 (0.5%)	
Reticulosis			1 (0.5%)	

TABLE 36

AGE AND MORTALITY

	Age in years	50-59	60-69	70-79	80+
Whole Series (761 Patients)	No. of Patients	92	272	317	80
	Total Mortality	0	10 (3.7%)	26 (8.2%)	9 (11.3%)
	Infective Mortality		4 (1.5%)	7 (2.2%)	3 (3.8%)
	Medical Mortality	0	6 (2.2%)	19 (6.0%)	6 (7.5%)
'Sterile' Cases (295 Patients)	No. of Patients	46	115	114	20
	Total Mortality	0	2 (1.7%)	5 (4.4%)	2 (10%)
	Infective Mortality	0	2 (1.7%)	0	0
	Medical Mortality	0	0	5 (4.4%)	2 (10%)
Infected Cases (466 Patients)	No. of Patients	46	157	203	60
	Total Mortality	0	8 (5.1%)	21 (10.3%)	7 (11.7%)
	Infective Mortality	0	2 (1.3%)	7 (3.4%)	3 (5.0%)
	Medical Mortality	0	6 (3.8%)	14 (6.9%)	4 (6.7%)

TABLE 36

TABLE 37

MORTALITY IN RELATION TO AGE GROUPS

Pre-op. Urine	No. of Cases	50-59 years	60-69 years	70-79 years	80 years or over
'STERILE'	295	0	2	5	2
INFECTED	466	0	8	21	7

TABLE 38

MORTALITY AND CONDITION OF PATIENTS AT OPERATION IN 'STERILE' CASES

	Well	Urinary Tract Disease	Medical Disease	Both Urinary Tract and Medical Disease
Number of Cases	183 cases	35 cases	69 cases	8 cases
Total Mortality	4(2.2%)	1(2.9%)	4(5.8%)	0
Infective Mortality	2 (1.1%)	0	0	0
Medical Mortality	2(1.1%)	1(2.9%)	4(5.8%)	0

TABLE 39

MORTALITY AND CONDITION OF PATIENTS AT OPERATION IN INFECTED CASES

	Well	Urinary Tract Disease	Medical Disease	Both Urinary Tract and Medical Disease
Number of Cases	230 cases	76 cases	115 cases	45 cases
Total Mortality	14(6.1%)	11(14.5%)	8(7.0%)	3(6.7%)
Infective Mortality	5(2.2%)	9(11.8%)	0	0
Medical Mortality	9(3.9%)	2(2.7%)	8(7.0%)	3(6.7%)

TABLE 40

MORTALITY AND DURATION OF PRELIMINARY CATHETER DRAINAGE

Cause of Death	DURATION OF DRAINAGE (DAYS)				
	0 345 CASES	1-3 110 CASES	4-6 132 CASES	7-13 112 CASES	14+ 62 CASES
Pyelonephritis	0	1 (0.9%)	1 (0.8%)	6 (5.4%)	2 (3.2%)
Pyaemia or septicaemia	3 (0.9%)	0	1 (0.8%)	0	0
Cardiac disease	3 (0.9%)	2 (1.8%)	2 (1.5%)	1 (0.9%)	6 (9.7%)
Bronchitis or pneumonia	1 (0.3%)	1 (0.9%)	1 (0.8%)	0	2 (3.2%)
Cerebral	1 (0.3%)	0	2 (1.5%)	0	1 (1.6%)
Pulmonary embolism	0	1 (0.9%)	1 (0.8%)	2 (1.8%)	0
Post-operative shock	0	1 (0.9%)	0	1 (0.9%)	0
Gastro-intestinal haemorrhage	0	0	0	1 (0.9%)	0
Reticulosis	1 (0.3%)	0	0	0	0

TABLE 40

TABLE 41

MORTALITY AND DURATION OF PRELIMINARY CATHETER DRAINAGE

Duration of Preliminary Drainage (Days)	0	1 - 3	4 - 6	7 - 13	14+
No. of Cases	345	110	132	112	62
Total Mortality	9 (2.6%)	6 (5.5%)	8 (6.1%)	11 (9.8%)	11 (17.7%)
Infective Mortality	3 (0.9%)	1 (0.9%)	2 (1.5%)	6 (5.4%)	2 (3.2%)
Medical Mortality	6 (1.8%)	5 (4.5%)	6 (4.6%)	5 (4.5%)	9 (14.5%)

TABLE 41

TABLE 42

MORTALITY IN PATIENTS ADMITTED DIRECT TO THE UROLOGICAL DEPARTMENT OF GLASGOW ROMAL INFIRMARY AND THOSE ADMITTED FROM SOME OTHER UNIT OR HOSPITAL

Cause of Death	Urological Dept. direct (155 CASES)	Some other unit or hospital (169 CASES)
Infective	5 (3.2%)	8 (4.7%)
Chest	4 (2.6%)	2 (1.2%)
Cardiac	4 (2.6%)	6 (3.6%)
Cerebral	1 (0.6%)	0
Post-operative shock	0	2 (1.2%)
TOTAL	14 (9.0%)	18 (10.7%)

TABLE 43

MORTALITY AND WEIGHT OF PROSTATE GLAND

	No. Cases*	Gland Weight	Total Mortality	Infected Mortality	Medical Mortality
Urine	153	Less than 50 Gm.	5 (3.3%)	1 (0.7%)	4 (2.6%)
'Sterile'	69	51 Gm. or more	3 (4.3%)	1 (1.4%)	2 (2.9%)
Urine	234	Less than 50 Gm.	16 (6.8%)	5 (2.1%)	11 (4.7%)
Infected	138	51 Gm. or more	9 (6.5%)	1 (0.7%)	8 (5.8%)

* All cases not documented

TABLE 44

MORTALITY AND GLAND LOBES

	Lobes	No. of cases *	Total Mortality	Infective Mortality	Medical Mortality
'Sterile'	Bilobed	92	2 (2.2%)	1 (1.1%)	1 (1.1%)
	Trilobed	88	3 (3.4%)	0	3 (3.4%)
Infected	Bilobed	165	9 (5.5%)	4 (2.4%)	5 (3.1%)
	Trilobed	144	13 (9.0%)	3 (2.1%)	10 (6.9%)

* All cases not documented

TABLE 45

MORTALITY AND GLAND ENUCLEATION

	No. of Cases *	Enucleation	Total Mortality	Infective Mortality	Medical Mortality
'Sterile'	229	Easy	7 (3.1%)	4 (1.8%)	3 (1.3%)
	50	Difficult	2 (4.0%)	1 (2.0%)	1 (2.0%)
Infected	365	Easy	20(5.5%)	4 (1.1%)	16(4.4%)
	76	Difficult	10(13.2%)	2 (2.6%)	8 (10.6%)

* All cases not documented

TABLE 46

MORTALITY AND GLAND ENUCLEATION IN INFECTED CASES

Enucleation	No. of Cases *	Patients 70 or over	Pre-op. Urinary Tract Disease	Pre-op. Medical Disease	Infective Mortality	Medioal Mortality
Easy	365	56.9%	91(24.9%)	30.4%	4 (1.1%)	16 (4.4%)
Difficult	76	56.6%	20(26.3%)	32.9%)	2 (2.6%)	8 (10.6%)

* All cases not documented

TABLE 47

MORTALITY AND GLAND INFLAMMATION

	No. of Cases*	Inflammation	Total Mortality	Infective Mortality	Medical Mortality
Sterile	207	Absent	7 (3.4%)	0	7 (3.4%)
	77	Present	2 (2.6%)	1 (1.3%)	1 (1.3%)
Infected	259	Absent	18(6.9%)	10(3.9%)	8 (3.0%)
	201	Present	13(6.5%)	3 (1.5%)	10(5.0%)

* All cases not documented

TABLE 48

MORTALITY AND BLOOD LOSS AT OPERATION

	No. of Cases*	Blood Loss	Total Mortality	Infective Mortality	Medical Mortality
Sterile	170	Below 500 ml.	6 (3.5%)	1 (0.6%)	5 (2.9%)
	31	500 ml. or more	1 (3.2%)	0	1 (3.2%)
Infected	255	Below 500 ml.	22(8.6%)	6(2.4%)	16(6.2%)
	67	500 ml. or more	2(3.0%)	0	2 (3.0%)

* All cases not documented

TABLE 49

MORTALITY AND URINARY INFECTING ORGANISM

Cause of Death	Esch. coli 320 CASES	Ps.pyocyanea Proteus species Klebsiella species 52 CASES	Staph. pyogenes 35 CASES	Strep. faecalis 53 CASES
Pyelonephritis	2 (0.9%)	0	0	1 (1.9%)
Pyaemia or septicaemia	0	0	1 (2.9%)	0
Cardiac disease	1 (0.5%)	2 (3.8%)	1 (2.9%)	3 (5.7%)
Bronchitis or pneumonia	3 (1.4%)	0	1 (2.9%)	0
Cerebral	0	0	0	1 (1.9%)
Pulmonary embolism	2 (0.9%)	0	1 (2.9%)	0
Post-operative shock	1 (0.5%)	1 (1.9%)	0	0
Gastro-intestinal haemorrhage	0	1 (1.9%)	0	0
Reticulosis	0	0	0	0

TABLE 49

TABLE 50

MORTALITY AND URINARY INFECTING ORGANISM

Infecting Organism	Esch. coli	Ps.pyocyanea Proteus species Klebsiella species	Staph.pyogenes	Strep.faecalis
Number of cases	220	52	35	53
Total Mortality	9(4.1%)	4(7.7%)	4(11.4%)	5(9.4%)
Infective Mortality	2(0.9%)	0	1(2.9%)	1(1.9%)
Medical Mortality	7(3.2%)	4(7.7%)	3(8.5%)	4(7.5%)

TABLE 50

TABLE 51

MORTALITY IN RETROPUBIC PROSTATECTOMY (GREAT BRITAIN AND IRELAND)

AUTHOR	DATE	NO. OF CASES	MORTALITY	% OF PATIENTS 70 YRS. OR OVER	% OF PATIENTS IN URINARY RETENTION	% OF PATIENTS WITH INFECTED URINE	OPERABILITY RATE
Millin et al.	1949	757	33 (4.6%)	37.6	39 of 200	?	?
Riches	1949	313	21 (6.7%)	?	?	?	?
Jacobs	1951	500	30 (6.0%)	16 (75 or over)			97.6
Dawson-Edwards	1956	317	9 (2.8%)	-	-	-	89.5%
Jacobs	1956	100	3 (3.0%)	79	?	?	?
Salvaris	1960	1200	50 (4.2%)	36.3	25	40	-
Lane et al.	1961	173	4 (2.3%)	47.8	-	-	-
Shepperd	1961	167	11 (6.6%)	61	-	-	-
		184	23 (12.5%)	61	No preliminary drainage	-	-
Greig	1961	720	52 (7.2%)	62	-	-	-
Scorer et al.	1962	75	9 (12%)	51.9	100	-	)
		94	7 (7.4%)	50	100	-	) 64.5%
Greig	1961	127	13 (10.2%)	Average age 70.9 yrs.	68.5	-	96.4%
Barrett	1962	126	8 (6.3%)	-	73.9	-	89.0%
Baker	1964	665 345 elect. 320 retent.	42 (6.4%) 8 (2.4%) 34 (10.6%)	-	48.1	-	-
Boreham	1964	150	10 (6.6%)	60+	45.3	-	-
Glaser	1964	108	8 (7.4%)		54		
Present series	1965	761	45 (5.9%)	52.2	54.7	61.2	97.2%

TABLE 52

MORTALITY IN RETROPUBIC PROSTATECTOMY (NORTH AMERICA)

AUTHOR	DATE	NO. OF CASES	MORTALITY	% OF PATIENTS 70 YRS. OR OVER	% OF PATIENTS IN URINARY RETENTION	% OF PATIENTS WITH INFECTED URINE	OPERABILITY RATE
Bacon	1949	102	7 (6.8%)	52.9	75	88	0 -
Lich	1953	678	11 (1.6%)	-	-	-	-
Taylor	1955	150	1 (0.7%)	49.3	58.7	48.6	-
Blue et al	1958	1000	24 (2.4%)	25.8% 75 or over	-	-	-
Stearns	1961	500	3 (0.6%)	Average 67 years	35.6	-	-

TABLE 53

MORTALITY IN DIFFERENT TYPES OF PROSTATECTOMY (GREAT BRITAIN)

AUTHOR	DATE	TYPE OF OPERATION	NO. OF CASES	MORTALITY	% OF PATIENTS 70 YRS. OR OVER	% OF PATIENTS IN URINARY RETENTION	% OF PATIENTS WITH INFECTED URINE	OPERABILITY RATE
Freyer	1912	Freyer	1000	55 (5.5%)	73 cases 79 yrs. or over	-	-	-
Hey	1945	Wilson Hey	300	18 (6.0%)	-	-	-	-
Riches	1949	Harris	149	10 (6.6%)	-	-	-	-
Stewart	1949	T.U.R.	1347	41 (3.04%)	-	37.8+	-	89.4%
Dawson-Edwards	1956	Perineal	66	6 (9.1%)	-	-	-	-
Present series	1965	Retropubic	761	45 (5.9%)	52.2	54.7	61.2	97.2%

TABLE 54

1957 - 1960 SERIES

ANTIMICROBIAL COVER IN 'STERILE' CASES

	No Cover	Penicillin and Sulphatriad	No cover broad spectrum in first 3 days	Broad spectrum cover	Total
From study of penicillin and sulphatriad	22	30			52
Remaining sterile cases	92		33	15	33 15 92
Totals	114		78		192

TABLE 54

TABLE 55

1957 - 1960 SERIES

ANTIMICROBIAL COVER IN INFECTED CASES

	No cover	Penicillin and sulphatriad	No cover - Appropriate broad spectrum cover commenced in first 3 days	Inapprop-riate cover	Appropriate cover	Total
Study of Penicillin and Sulphatriad	28	20				48
17 cases on catheter drain 7 days or longer		9		8		17
104 cases selected for appropriate cover				8	96	104
102 cases selected for "no cover"	82		20			82 20
Totals	110		65		96	271

TABLE 56

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957 - 1960

Complication Group	Complications	No cover 22 CASES Total + Deaths	No cover 22 CASES Delay in convalescence + deaths	Penicillin and Sulphatriad 30 CASES Total + Deaths	Penicillin and Sulphatriad 30 CASES Delay in convalescence + deaths	No cover - Broad spectrum in first 3 days 33 CASES Total + Deaths	No cover - Broad spectrum in first 3 days 33 CASES Delay in convalescence + deaths	Broad spectrum cover 15 CASES Total + Deaths	Broad spectrum cover 15 CASES Delay in convalescence + deaths
Infective	Wound infection	3(13.6%)	1(4.5%)	3(10%)	2(6.7%)	3(9.1%)	1(3.3%)	2(13.3%)	1(6.7%)
	Ascending infection	1(4.5%)	1(4.5%)	2(6.7%)	1(3.3%)	5(15.2%)	0	1(6.7%)	0
	Funiculitis	2(9.1%)	0	1(3.3%)	0	1(3.3%)	1(3.3%)	0	0
	Epididymitis	1(4.5%)	1(4.5%)	2(6.7%)	1(3.3%)			1(6.7%)	0
	Cystitis			1(3.3%)	1(3.3%)				
	Pelvic cellulitis								
Medical	Respiratory	1(4.5%)	1(4.5%)			3(9.1%)	0		
	Cardio-vascular					1(3.3%)	1(3.3%)		
	Cerebral								
	Reticulosis								
-	Supra-pubic leak			2(6.7%)	2(6.7%)	1(3.3%)	1(3.3%)		
-	Haemorrhage (Urinary tract)	1(4.5%)	1(4.5%)			1(3.3%)	0	1(6.7%)	1(6.7%)
Upsets of Micturition	Poor control			1(3.3%)	0	1(3.3%)	1(3.3%)	1(6.7%)	0
	Failure or difficulty invvoiding	1(4.5%)	1(4.5%)	2(6.7%)	0	1(3.3%)	1(3.3%)		
Miscellaneous	Diarrhoea							1(6.7%)	
	Rectal fistula								
	Rectal haemorrhage								

TABLE 57

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957-1960

Complication Group	Complications	92 CASES Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	9 (9.8%)	6 (6.5%)
	Ascending infection	12 (13.0%)	3 (3.3%)
	Funiculitis		
	Epididymitis		
	Cystitis	1 (1.1%)	1 (1.1%)
	Pelvic cellulitis	1 (1.1%)	1 (1.1%)
Medical	Respiratory	2 (2.2%)	0
	Cardio-vascular	3 (3.3%)	2 (2.2%)
	Cerebral	1 (1.1%)	1 (1.1%)
	Reticulosis		
-	Supra-pubic leak	4 (4.3%)	3 (3.3%)
-	Haemorrhage (Urinary tract)	5 (5.4%)	3 (3.3%)
Upsets of Micturition	Poor control	2 (2.2%)	2 (2.2%)
	Failure or difficulty in voiding	2 (2.2%)	2 (2.2%)
Miscellaneous	Diarrhoea		
	Rectal fistula		
	Rectal haemorrhage		

TABLE 58

ANTIMICROBIAL COVER IN 'STERILE' CASES - 1957-1960

MORBIDITY

Complication Group	Complications	Cover over operation or within first 3 days 78 CASES		No cover 114 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	9 (10.3%)	4 (5.1%)	12 (10.5%)	7 (6.1%)
	Ascending infection	8 (10.3%)	1 (1.3%)	13 (11.4%)	4 (3.5%)
	Funiculitis	2 (2.6%)	1 (1.3%)		
	Epididymitis	3 (3.8%)	1 (1.3%)	2 (1.8%)	0
	Cystitis	1 (1.3%)	1 (1.3%)	1 (0.9%)	1 (0.9%)
	Pelvic cellulitis			1 (0.9%)	1 (0.9%)
Medical	Respiratory	3 (3.8%)	0	3 (2.6%)	1 (0.9%)
	Cardio-vascular	1 (1.3%)	1 (1.3%)	3 (2.6%)	2 (1.8%)
	Cerebral			1 (0.9%)	1 (0.9%)
	Reticulosis				
-	Supra-pubic leak	3 (3.8%)	3 (3.8%)	4 (3.5%)	3 (2.6%)
-	Haemorrhage (Urinary tract)	2 (2.6%)	1 (1.3%)	6 (5.3%)	4 (3.5%)
Upsets of Micturition	Poor control	3 (3.8%)	1 (1.3%)	2 (1.8%)	2 (1.8%)
	Failure or difficulty in voiding	3 (3.8%)	1 (1.3%)	3 (2.6%)	3 (2.6%)
Miscellaneous	Diarrhoea	1 (1.3%)			
	Rectal fistula				
	Rectal haemorrhage				

TABLE 59

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957 - 1960

MORTALITY

	Cover over operation or within first 3 days 78 CASES	No cover 114 CASES
Total mortality	4 (5.1%)	5 (4.4%)
Infective mortality	0	2 (1.8%)
Medical mortality	4 (5.1%)	3 (2.6%)

TRIAL OF PENICILLIN AND SULPHATRIAD

	Penicillin and sulphatriad 30 CASES	No cover 22 CASES
Total mortality	1 (3.3%)	1 (4.5%)
Medical mortality	1 (3.3%)	1 (4.5%)

ANTIMICROBIAL COVER IN 'STERILE' CASES

1957 - 1960

Number of patients	Antimicrobial Cover or antimicrobials given within first 3 days	AGE 50-59 years	60-69 years	70-79 years	80 years and over
114	Nil	14(12.3%)	56(49.1%)	35(30.7%)	9(7.9%)
78	Various	12(15.4%)	28(35.9%)	33(42.3%)	5(6.4%)

DURATION OF PRELIMINARY CATHETER DRAINAGE

Number of Patients	Antimicrobial Cover or antimicrobials given within first 3 days	DAYS 0	1-3	4-6	7 +
114	Nil	101(88.6%)	12(10.5%)	1(0.9%)	0
78	Various	51(65.4%)	23(29.5%)	4(5.1%)	0

TABLE 60

TABLE 61

ANTIMICROBIAL COVER IN INFECTED CASES
1957 - 1960

Complication Group	Complications	No cover 28 CASES Total + Deaths	No cover 28 CASES Delay in convalescence + deaths	Penicillin and Sulphatriad 29 CASES Total + Deaths	Penicillin and Sulphatriad 29 CASES Delay in convalescence + deaths	No cover - Broad spectrum (appropriate) in first 3 days 20 CASES Total + Deaths	No cover - Broad spectrum (appropriate) in first 3 days 20 CASES Delay in convalescence + deaths	Inappropriate Broad spectrum 16 CASES Total + Deaths	Inappropriate Broad spectrum 16 CASES Delay in convalescence + deaths
Infective	Wound infection	5(17.9%)	3(10.7%)	5(17.2%)	5(17.2%)	4(20%)	3(15%)	4(25%)	3(18.8%)
	Ascending infection	5(17.9%)	3(10.7%)	6(20.7%)	2(6.8%)	4(20%)	2(10%)	3(18.8%)	1(6.3%)
	Funiculitis	1(3.6%)	1(3.6%)	0	0	0	0	0	0
	Epididymitis	2(7.1%)	1(3.6%)	2(6.9%)	1(3.4%)	1(5%)	0		
	Cystitis							1(6.3%)	1(6.3%)
	Pelvic cellulitis								
Medical	Respiratory	1(3.6%)	1(3.6%)	5(17.2%)	3(10.3%)	3(15%)	1(5%)	2(12.5%)	1(6.3%)
	Cardio-vascular	2(7.1%)	1(3.6%)	1(3.4%)	1(3.4%)	1(5%)	1(5%)		
	Cerebral	1(3.6%)	1(3.6%)	1(3.4%)	1(3.4%)			1(6.3%)	1(6.3%)
	Reticulosis								
-	Supra-pubic leak	2(7.1%)	2(7.1%)	3(10.3%)	1(3.4%)	1(5%)	0	2(12.5%)	1(6.3%)
-	Haemorrhage (Urinary tract)	1(3.6%)	1(3.6%)	2(6.9%)4	2(6.9%)	1(5%)	0		
Upsets of Micturition	Poor control	1(3.6%)	1(3.6%)	2(6.9%)	2(6.9%)	1(5%)	1(5%)	1(6.3%)	1(6.3%)
	Failure or difficulty in voiding	1(3.6%)	1(3.6%)	2(6.9%)	2(6.9%)	1(5%)	1(5%)	1(6.3%)	0
Miscellaneous	Diarrhoea								
	Rectal fistula								
	Rectal haemorrhage	1(3.6%)	1(3.6%)						

TABLE 62

ANTIMICROBIAL COVER IN INFECTED CASES

1957 - 1960

Complication Group	Complications	No cover 82 CASES Total + Death	No cover 82 CASES Delay in convalescence + deaths	Appropriate cover 96 CASES Total + Death	Appropriate cover 96 CASES Delay in convalescence + deaths
Infective	Wound infection	17(20.7%)	13(15.9%)	20(20.8%)	11(11.5%)
	Ascending infection	17(20.7%)	7(8.5%)	7(7.3%)	3(3.1%)
	Funiculitis	4(4.9%)	2(2.4%)	6(6.3%)	3(3.1%)
	Epididymitis	4(4.9%)	3(3.6%)	1(1.0%)	1(1.0%)
	Cystitis	1(1.2%)	1(1.2%)	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	7(8.5%)	6(7.3%)	9(9.4%)	6(6.3%)
	Cardio-vascular	5(6.1%)	4(4.9%)	4(4.1%)	4(4.1%)
	Cerebral	2(2.4%)	2(3.4%)	3(2.7%)	2(2.1%)
	Reticulosis	0	0	0	0
-	Supra-pubic leak	6(7.3%)	5(6.1%)	4(4.1%)	4(4.1%)
-	Haemorrhage (Urinary tract)	6(7.3%)	3(3.7%)	2(2.1%)	0
Upsets of Micturition	Poor control	7(8.5%)	3(3.7%)	5(5.2%)	2(3.1%)
	Failure or difficulty in voiding	4(4.9%)	4(4.9%)	2(2.1%)	2(2.1%)
Miscellaneous	Diarrhoea	1(1.2%)	0	3(3.1%)	1(1.0%)
	Rectal fistula				
	Rectal haemorrhage				

TABLE 63

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES

(1957 - 1960)

MORBIDITY

Complication Group	Complications	APPROPRIATE COVER 96 CASES		NO COVER 110 CASES		INAPPROPRIATE COVER OVER OPERATION OR APPROPRIATE COVER IN FIRST 3 DAYS 65 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	20(20.8%)	11(11.5%)	22(20%)	17(15.5%)	13(20%)	11(16.9%)
	Ascending infection	7(7.3%)	3(3.1%)	22(20%)	11(10%)	13(20%)	5(7.7%)
	Funiculitis	6(6.3%)	3(3.1%)	4(3.6%)	2(1.8%)		
	Epididymitis	1(1.0%)	1(1.0%)	2(1.8%)	2(1.8%)	3(4.6%)	1(1.5%)
	Cystitis	0	0	1(0.9%)	1(0.9%)	1(1.5%)	1(1.5%)
	Pelvic cellulitis	0	0	0	0	0	0
Medical	Respiratory	9(9.4%)	6(6.3%)	8(7.3%)	7(6.4%)	10(15.4%)	5(7.7%)
	Cardio-vascular	4(4.1%)	4(4.1%)	7(6.4%)	5(4.5%)	2(3.1%)	2(3.1%)
	Cerebral	3(2.7%)	2(2.1%)	3(2.7%)	3(2.7%)	2(3.1%)	2(3.1%)
	Reticulosis	0	0	0	0	0	0
-	Supra-pubic leak	4(4.1%)	4(4.1%)	8(7.3%)	7(6.4%)	6(9.2%)	2(3.1%)
-	Haemorrhage (Urinary tract)	2(2.1%)	0	7(6.4%)	4(3.6%)	3(4.6%)	2(3.1%)
Upsets of Micturition	Poor control	5(5.2%)	3(3.1%)	8(7.3%)	4(3.6%)	4(6.1%)	4(6.1%)
	Failure or difficulty in voiding	2(2.1%)	2(2.1%)	5(4.5%)	5(4.5%)	4(6.1%)	3(4.6%)
Miscellaneous	Diarrhoea	3(3.1%)	1(1.0%)	1(0.9%)	0	0	0
	Rectal fistula	0	0	0	0	0	0
	Rectal haemorrhage	0	0	1(0.9%)	1(0.9%)	0	0

TABLE 63

TABLE 64

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES

(1957 - 1960)

	Antimicrobial cover	No. of Patients	50-59 years	60-69 years	70-79 years	80 years or over
Infected cases	Appropriate	96	17(17.7%)	27(28.1%)	40(41.7%)	12(12.5%)
Infected cases	Nil	110	10(9.1%)	44(40%)	43(39.1%)	13(11.8%)
Infected cases	Inappropriate or appropriate in first 3 days after operation	65	5(7.7%)	20(30.8%)	30(46.2%)	10(15.4%)

TABLE 65

ANTIMICROBIAL COVER IN INFECTED CASES

ALL INFECTED CASES

(1957 - 1960)

DURATION OF PRELIMINARY CATHETER DRAINAGE

Preliminary Catheter Drainage (DAYS)	Appropriate cover (96 CASES)	No cover (110 CASES)	Inappropriate or appropriate in first 3 days after operation (65 CASES)
0	9 (9.4%)	19 (17.3%)	10 (15.4%)
1-6	32 (33.3%)	40 (36.4%)	28 (43.1%)
7-28	45 (46.9%)	45 (40.9%)	26 (40%)
28 +	10 (10.4%)	6 (5.5%)	1 (1.5%)

TABLE 66

ANTIMICROBIAL COVER IN INFECTED CASES
(1957 - 1960)

TRIAL OF PENICILLIN AND SULPHATRIAD

MORTALITY

	Penicillin and Sulphatriad 29 CASES	No cover 28 CASES
Total Mortality	2 (6.9%)	1 (3.6%)
Infective Mortality	1 (3.4%)	1 (3.6%)
Medical Mortality	1 (3.4%)	0

TABLE 67

ANTIMICROBIAL COVER IN INFECTED CASES
ALL PATIENTS
(1957 - 1960)
MORTALITY

CONDITION OF PATIENT AT OPERATION AND MORTALITY

No. of Cases	Antimicrobial cover	Urinary tract disease at operation	Medical Disease at operation	Patients 70 years or over Urea over 50 mg./100ml.	Total Mortality	Infective Mortality	Medical Mortality
96	Appropriate	25 (26%)	29 (30.2%)	16 (16.7%)	5 (5.2%)	0	5 (5.2%)
110	Nil	24 (21.8%)	38 (34.6%)	9 (8.2%)	11 (10%)	5 (4.5%)	6 (5.5%)
65	Inappropriate or appropriate in first 3 days after operation	21 (32%)	25 (38.5%)	14 (21.5%)	8 (12.3%)	5 (7.7%)	3 (4.6%)

TABLE 68

ANTIMICROBIAL COVER IN INFECTED CASES

(1957 - 1960)

PATIENTS OVER 70 YEARS
WITH BLOOD UREA OVER 50MG./100ML.

No. of Cases	Antibiotic Cover
5	Appropriate
6	Nil

TABLE 69

ORGANISMS GROWN FROM BLOOD
(30 POSITIVE CULTURES)

(1955 - 1956)

ORGANISM GROWN	IMMEDIATELY AFTER ENUCLEATION	TWO HOURS AFTER ENUCLEATION
Coliform (unspecified)	8	2
Esch. coli	2	1
Ps. pyocyanea	5	1
Proteus species	3	1
Klebsiella species	2	1
Paracolon bacillus	0	0
Strep. faecalis	11	3
Staph. pyogenes	1	1
Strep. viridans	1	0

TABLE 70

ORGANISMS GROWN FROM BLOOD
(47 POSITIVE CULTURES)
(1957 - 1960)

ORGANISM GROWN	IMMEDIATELY AFTER ENUCLEATION	TWO HOURS AFTER ENUCLEATION
Coliform (unspecified)	1	
Esch. coli	12	5
Ps. pyocyanea	4	
Proteus species	6	
Klebsiella species	0	1
Paracolon bacillus	5	3
Staph. pyogenes	14	3
Str. viridans	1	

TABLE 71

ORGANISMS GROWN FROM BLOOD
(7 POSITIVE CULTURES)
(1963 - 1964)

ORGANISM GROWN	IMMEDIATELY AFTER ENUCLEATION	TWO HOURS AFTER ENUCLEATION
Coliform (unspecified)		
Esch. coli	3	
Ps. pyocyanea	1	
Proteus species	1	
Klebsiella species		
Paracolon bacillus		
Strep. faecalis		
Staph. pyogenes	2	
Strep. viridans		

TABLE 72

TOTAL ORGANISMS GROWN FROM BLOOD
(84 POSITIVE CULTURES)

ORGANISM GROWN	IMMEDIATELY AFTER ENUCLEATION	TWO HOURS AFTER ENUCLEATION
Coliform (unspecified)	9	2
Esch. coli	17	6
Ps. pyocyanea	10	1
Proteus species	10	1
Klebsiella species	2	2
Paracolon bacillus	5	3
Strep. faecalis	17	3
Staph. pyogenes	17	4
Str. viridans	2	0
Total	89	22

TABLE 73

TOTAL ORGANISMS GROWN FROM BLOOD
EXCLUDING PATIENTS HAVING APPROPRIATE BROAD
SPECTRUM ANTIMICROBIAL THERAPY
(63 POSITIVE CULTURES)

ORGANISM GROWN	IMMEDIATELY AFTER OPERATION	TWO HOURS AFTER OPERATION
Coliform (unspecified)	8	1
Esch. coli	12	4
Ps. pyocyanea	6	1
Proteus species	6	1
Klebsiella species	2	2
Paracolon bacillus	3	3
Strep. faecalis	15	3
Staph. pyogenes	10	4
Str. viridans	2	0
Total	64	19

TABLE 74

ORGANISMS IN URINE COMPARED WITH ORGANISMS RECOVERED FROM BLOOD (EXCLUDING PATIENTS HAVING BROAD SPECTRUM ANTIMICROBIALS)

ORGANISM IN URINE	NO. OF CASES	ORGANISMS IN BLOOD								
		Coliform (unspecified)	Esch. coli	Ps.pyocyanea	Proteus species	Klebsiella species	Paracolon bacillus	Strep. faecalis	Staph. pyogenes	Str.viridans
Coliform (unspecified	8	1	1	1						
Esch. coli	24	5	9	1						1
Ps. pyocyanea	0									
Proteus species	10				5					1
Klebsiella species	7	2		3	1	2				
Paracolon bacillus	5		2	1			2			
Strep. faecalis	20							15		
Staph. pyogenes	11						1		10	
Str. viridans	0									
Total organisms in blood		8	12	6	6	2	3	15	10	2

64

TABLE 75

BLOOD CULTURE IN 'STERILE' CASES
(1955 - 1956)

Complication Group	Complications	Positive 2 CASES Total + Deaths	Delay in convalescence + deaths	Severe +deaths	Negative 14 CASES Total + Deaths	Delay in convalescence + deaths	Severe +deaths
Infective	Wound infection				1	1	
	Ascending infection	1	0	0	3	0	0
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory				1	0	0
	Cardio-vascular						
	Cerebral				1	1	1
	Reticulosis						
-	Supra-pubic leak						
-	Haemorrhage (Urinary tract)				1	1	0
Upsets of Micturition	Poor control						
	Failure or difficulty in voiding						
Miscellaneous	Diarrhoea						
	Rectal fistula						
	Rectal haemorrhage						

TABLE 76

BLOOD CULTURE IN 'STERILE' CASES
(1957 - 1960)

Complication Group	Complications	Positive 4 CASES Total + Deaths	Delay in conval-escence + deaths	Severe +deaths	Negative 36 CASES Total + Deaths	Delay in conval-escence + deaths	Severe +deaths
Infective	Wound infection				4	1	0
	Ascending infection	1	0	0	2(5.6%)	0	0
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory				2	1	1
	Cardio-vascular	1	0	0	1	1	1
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	1	0	0	1	0	0
-	Haemorrhage (Urinary tract)				1	0	0
Upsets of Micturition	Poor control						
	Failure or difficulty in voiding						
Miscellaneous	Diarrhoea						
	Rectal fistula						
	Rectal haemorrhage						

TABLE 77

BLOOD CULTURE IN 'STERILE' CASES
(1963 - 1964)

Complication Group	Complications	Positive 2 CASES Total + Deaths	Positive 2 CASES Delay in conval-escence + deaths	Negative 10 CASES Total + Deaths	Negative 10 CASES Delay in conval-escence + deaths
Infective	Wound infection			1	0
	Ascending infection				
	Funiculitis				
	Epididymitis				
	Cystitis				
	Pelvic cellulitis				
Medical	Respiratory				
	Cardio-vascular				
	Cerebral			1	1
	Reticulosis				
-	Supra-pubic leak				
-	Haemorrhage (Urinary tract)			2	1
Upsets of Micturition	Poor control				
	Failure or difficulty in voiding			1	1
Miscellaneous	Diarrhoea				
	Rectal fistula				
	Rectal haemorrhage				

TABLE 78

BLOOD CULTURE IN 'STERILE' CASES

ALL 'STERILE' CASES

Complication Group	Complications	Positive 8 CASES Total + Deaths	Delay in convalescence + deaths	Negative 60 CASES Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	1(12.5%)	0	6(10%)	2(3.3%)
	Ascending infection	2(25%)	0	5(8.3%)	0
	Funiculitis				
	Epididymitis				
	Cystitis				
	Pelvic cellulitis				
Medical	Respiratory			3(5%)	1(1.7%)
	Cardio-vascular	1(12.5%)	0	1(1.7%)	1(1.7%)
	Cerebral			2(3.3%)	2(3.3%)
	Reticulosis				
-	Supra-pubic leak	1(12.5%)	0	1(1.7%)	0
-	Haemorrhage (Urinary tract)			4(6.7%)	2(1.7%)
Upsets of Micturition	Poor control				
	Failure or difficulty in voiding			1(1.7%)	1(1.7%)
Miscellaneous	Diarrhoea				
	Rectal fistula				
	Rectal haemorrhage				

TABLE 79

BLOOD CULTURE IN INFECTED CASES
(1955 - 1956)
PATIENTS WITHOUT ANTIMICROBIAL COVER

Complication Group	Complications	Positive 28 CASES			Negative 6 CASES		
		Total + Deaths	Delay in conval-escence + deaths	Severe + deaths	Total + Deaths	Delay in conval-escence + deaths	Severe +deaths
Infective	Wound infection	2(7.1%)	2(7.1%)	1(3.6%)	2(33.3%)	2(33.3%)	0
	Ascending infection4	10(34.7%)	9(32.1%)	5(17.9%)	1(16.7%)	1(16.7%)	0
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	1(3.6%)	1(3.6%)	0	2(33.3%)	0	0
	Cardio-vascular	1(3.6%)	1(3.6%)	1(3.6%)	0	0	0
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	7(25%)	7(25%)	5(17.9%)	2(33.3%)	1(16.7%)	0
-	Haemorrhage (Urinary tract)						
Upsets of Micturition	Poor control	1(3.6%)	1(3.6%)	1(3.6%)	1(16.7%)	1(16.7%)	0
	Failure or difficulty in voiding	1(3.6%)	1(3.6%)	1(3.6%)	0	0	0
Miscellaneous	Diarrhoea	1(3.6%)	1(3.6%)	0			
	Rectal fistula						
	Rectal haemorrhage						

TABLE 80

BLOOD CULTURE IN INFECTED CASES
(1957 - 1960)
PATIENTS WITHOUT ANTIMICROBIAL COVER

Complications Group	Complications	Positive 22 CASES Total + Deaths	Delay in convalescence + deaths	Severe + deaths	Negative 13 CASES Total + Deaths	Delay in convalescence + deaths	Severe + deaths
Infective	Wound infection	6(27.3%)	4(18.2%)	0	4(30.8%)	4(30.8%)	1(7.7%)
	Ascending infection	5(22.7%)	2(9.1%)	1(4.5%)	1(7.7%)	0	0
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	2(9.1%)	1(4.5%)	0			
	Cardio-vascular	1(4.5%)	1(4.5%)	1(4.5%)			
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	1(4.5%)	1(4.5%)	0	2(15.4%)	2(15.4%)	0
-	Haemorrhage (Urinary tract)	1(4.5%)	0	0			
Upsets in Micturition	Poor control				1(7.7%)	0	0
	Failure or difficulty in voiding				1(7.7%)	1(7.7%)	0
	Diarrhoea	1(4.5%)	1(4.5%)	0			
	Rectal fistula						
	Rectal haemorrhage						

TABLE 81

BLOOD CULTURE IN INFECTED CASES

(1963 - 1964)

PATIENTS WITHOUT ANTIMICROBIAL COVER

Complication Group	Complications	Positive 5 CASES		Negative 4 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	2	2	1	1
	Ascending infection	1	1	1	0
	Funiculitis				
	Epididymitis				
	Cystitis				
	Pelvic cellulitis				
Medical	Respiratory				
	Cardio-vascular				
	Cerebral				
	Reticulosis				
-	Supra-pubic leak			2	2
-	Haemorrhage (Urinary tract)				
Upsets of Micturition	Poor control	2	2		
	Failure or difficulty in voiding			1	1
Miscellaneous	Diarrhoea				
	Rectal fistula				
	Rectal haemorrhage				

TABLE 82

BLOOD CULTURE IN INFECTED CASES
TOTAL
PATIENTS WITHOUT ANTIMICROBIAL COVER

Complication Group	Complications	Positive 55 CASES Total + Deaths	Positive 55 CASES Delay in conval-escence + deaths	Positive 55 CASES Severe ÷deaths	Negative 23 CASES Total + Deaths	Negative 23 CASES Delay in conval-escence + deaths	Negative 23 CASES Severe +deaths
Infective	Wound infection	10(18.2%)	8(14.5%)	1(1.8%)	7(30.4%)	7(31.4%)	1(4.3%)
	Ascending infection	16(29.0%)	12(21.8%)	6(10.9%	3(13.0%)	1(4.3%)	0
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	3(5.5%)	2(3.6%)		2(10.5%)	0	
	Cardio-vasoular	2(3.6%)	2(3.6%)	2(3.6%)	0	0	0
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	8(14.5%)	8(14.5%)	5(9.1%)	4(17.4%)	3(13.0%)	0
-	Haemorrhage (Urinary tract)	1(1.8%)	0		0	0	
Upsets of Micturition	Poor control	3(5.5%)	3(5.5%)	1(1.8%)	2(8.7%)	1(4.3%)	0
	Failure or difficulty in voiding	1(1.8%)	1(1.8%)	1(1.8%)	1(4.3%)	1(4.3%)	0
Miscellaneous	Diarrhoea	2(3.6%)	2(3.6%)		0	0	
	Rectal fistula						
	Rectal haemorrhage						

TABLE 83

BLOOD CULTURE IN INFECTED CASES
(1957 - 1960)
PATIENTS HAVING APPROPRIATE ANTIMICROBIAL COVER

Complication Group	Complications	Positive 21 CASES Total + Deaths	Positive 21 CASES Delay in convalescence + deaths	Positive 21 CASES Severe + deaths	Negative 26 CASES Total + Deaths	Negative 26 CASES Delay in convalescence + deaths	Negative 26 CASES Severe + deaths
Infective	Wound infection	5(23.8%)	2(9.5%)	0	4(15.4%)	4(15.4%)	1(3.8%)
	Ascending infection	2(9.5%)	2(9.5%)	1(4.8%)	2(7.7%)	1(3.8%)	0
	Funiculitis	0	0	0	1(3.8%)	0	0
	Epididymitis	1(4.8%)	1(4.8%)	0	0	0	0
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	1(4.8%)	1(4.8%)	1(4.8%)	3(11.5%)	2(7.7%)	0
	Cardio-vascular	2(9.5%)	1(4.8%)	1(4.8%)	1(3.8%)	1(3.8%)	1(3.8%)
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	1(4.8%)	1(4.8%)	0	2(7.7%)	2(7.7%)	1(3.8%)
-	Haemorrhage (Urinary tract)	0	0	0	1(3.8%)	0	0
Upsets of Micturition	Poor control	2(9.5%)	2(9.5%)	0	1(3.8%)	1(3.8%)	1(3.8%)
	Failure or difficulty in voiding	0	0	0	1(3.8%)	1(3.8%)	0
Miscellaneous	Diarrhoea	0	0	0	3(11.5%)	0	0
	Rectal fistula						
	Rectal haemorrhage						

TABLE 84

BLOOD CULTURE IN INFECTED CASES

(1963 - 1964)

PATIENTS HAVING APPROPRIATE ANTIMICROBIAL COVER

Complication Group	Complications	Positive 0 CASES		Negative 3 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection				
	Ascending infection			1	1
	Funiculitis				
	Epididymitis				
	Cystitis				
	Pelvic cellulitis				
Medical	Respiratory			1	1
	Cardio-vascular				
	Cerebral				
	Reticulosis				
-	Supra-pubic leak				
-	Haemorrhage (Urinary tract)				
Upsets of Micturition	Poor control				
	Failure or difficulty in voiding				
Miscellaneous	Diarrhoea				
	Rectal fistula				
	Rectal haemorrhage				

TABLE 85

BLOOD CULTURE IN INFECTED CASES

ALL INFECTED CASES

Complication Group	Complications	Positive 76 CASES		Negative 52 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	15(19.7%)	10(13.2%)	12(23.1%)	12(23.1%)
	Ascending infection	18(23.7%)	14(18.4%)	5(9.6%)	2(3.8%)
	Funiculitis	0	0	1(1.9%)	0
	Epididymitis	1(1.3%)	1(1.3%)	0	0
	Cystitis	0	0	0	0
	Pelvic cellulitis	0	0	0	0
Medical	Respiratory	4(5.3%)	3(3.9%)	6(11.5%)	3(5.8%)
	Cardio-vascular	4(5.3%)	3(3.9%)	1(1.9%)	1(1.9%)
	Cerebral	0	0	0	0
	Reticulosis	0	0	0	0
-	Supra-pubic leak	9(11.8%)	9(11.8%)	8(15.4%)	7(13.5%)
-	Haemorrhage (Urinary tract)	1(1.4%)	0	1(1.9%)	0
Upsets of Micturition	Poor control	4(5.3%)	4(5.3%)	3(5.8%)	2(3.8%)
	Failure or difficulty in voiding	1(1.3%)	1(1.3%)	3(5.8%)	3(5.8%)
Miscellaneous	Diarrhoea	2(2.6%)	2(2.6%)	3(5.8%)	0
	Rectal fistula4	0	0	0	0
	Rectal haemorrhage	0	0	0	0

TABLE 86
20 CASES WITH PROTRACTED BACTERAEMIA
ALL INFECTED
(1955 - 1964)

Complication Group	Complication	Total + Deaths	Delay in convalescence + deaths	Severe + deaths
Infective	Wound infection	2(10%)	0	0
	Ascending infection	8(40%)	6(30%)	6(30%)
	Funiculitis			
	Epididymitis			
	Cystitis			
	Pelvic cellulitis			
Medical	Respiratory			
	Cardio-vascular			
	Cerebral			
	Reticulosis			
-	Supra-pubic leak			
-	Haemorrhage (Urinary tract)			
Upsets of Micturition	Poor control	1(5%)	1(5%)	0
	Failure or difficulty in voiding	1(5%)	1(5%)	1(5%)
Miscellaneous	Diarrhoea	2(10%)	2(10%)	0
	Rectal fistula			
	Rectal haemorrhage			

TABLE 87

16 CASES WITH PROTRACTED BACTERAEMIA
NO BROAD SPECTRUM COVER
ALL INFECTED
(1955 - 1964)

Complication Group	Complications	Total + Deaths	Delay in convalescence + deaths	Severe + deaths
Infective	Wound infection	1(6.3%)	0	0
	Ascending infection	8(50%)	6(37.5%)	6(37.5%)
	Funiculitis			
	Epididymitis			
	Cystitis			
	Pelvic cellulitis			
Medical	Respiratory			
	Cardio-vascular			
	Cerebral			
	Reticulosis			
-	Supra-pubic leak			
-	Haemorrhage (Urinary tract)			
Upsets of Micturition	Poor control			
	Failure or difficulty in voiding	1(6.3%)	1(6.3%)	1(6.3%)
Miscellaneous	Diarrhoea	2(12.5%)	2(12.5%)	0
	Rectal fistula			
	Rectal haemorrhage			

TABLE 88

BLOOD CULTURE IN INFECTED CASES

1955 - 1964

MORBIDITY IN THE PRESENCE OF TRANSITORY AND PROTRACTED BACTERAEMIA

Complication Group	Complications	Transitory 56 CASES Total + Deaths	Delay in convalescence + deaths	Severe + deaths	Protracted 20 CASES Total + Deaths	Delay in convalescence + deaths	Severe +deaths
Infective	Wound infection	13(23.2%)	10(17.9%)	1(1.8%)	3(15%)	0	0
	Ascending infection	10(17.9%)	8(14.3%)	1(1.8%)	8(40%)	6(30%)	6(30%)
	Funiculitis						
	Epididymitis	1(1.8%)	1(1.8%)				
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	4(7.1%)	3(5.4%)	1(1.8%)			
	Cardio-vascular	4(7.1%)	3(5.4%)	3(5.4%)			
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	9(16.1%)	9(16.1%)	5(8.9%)			
-	Haemorrhage (Urinary tract)	1(1.8%)	0	0			
Upsets of Micturition	Poor control	3(5.4%)	3(5.4%)	1(1.8%)	1(5%)	1(5%)	0
	Failure or difficulty in voiding	0	0	0	1(5%)	1(5%)	1(5%)
Miscellaneous	Diarrhoea	0	0	0	2(10%)	2(10%)	0
	Rectal fistula						
	Rectal haemorrhage						

TABLE 89

BLOOD CULTURE IN INFECTED CASES

1955 - 1964

THE MORBIDITY IN THE PRESENCE OF TRANSITORY AND PROTRACTED BACTERAEMIA

(EXCLUDING PATIENTS ON APPROPRIATE ANTIMICROBIAL COVER)

Complication Group	Complications	Transitory 39 CASES Total + Deaths	Transitory 39 CASES Delay in convalescence + deaths	Transitory 39 CASES Severe + deaths	Protracted 16 CASES Total + Deaths	Protracted 16 CASES Delay in convalescence + deaths	Protracted 16 CASES Severe + deaths
Infective	Wound infection	9(23.1%)	8(20.5%)	1(2.6%)	3(18.9%)	0	0
	Ascending infection	6(15.4%)	4(10.3%)	0	6(37.5%)	6(37.5%)	6(37.5%)
	Funiculitis						
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	3(7.7%)	2(5.1%)	0			
	Cardio-vascular	2(5.1%)	2(5.1%)	2(5.1%)			
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	8(20.5%)	8(20.5%)	5(12.8%)			
-	Haemorrhage (Urinary tract)	1(2.6%)	0	0			
Upsets of Micturition	Poor control	2(5.1%)	2(5.1%)	1(2.6%)			
	Failure or difficulty in voiding	0	0	0	1(6.3%)	1(6.3%)	1(6.3%)
Miscellaneous	Diarrhoea	0	0	0	2(12.5%)	2(12.5%)	0
	Rectal fistula						
	Rectal haemorrhage						

TABLE 90

PROTRACTED BACTERAEMIA IN RELATION TO PRELIMINARY CATHETER DRAINAGE

ALL CASES INFECTED

Duration of Drainage (days)	No. of Cases	No infective complications	Infective complications		
			Total + Deaths	Delay in conval-escence + deaths	Severe
0	4	2	2	0	0
1-6	5	3	2	2	2
7 or over	11	4	7	5	4

TABLE 91

GENERAL DETAILS OF 20 CASES WITH PROTRACTED BACTERAEMIA

Age	Preliminary Drainage (DAYS)	Antimicrobial Cover	Blood Urea mg./100 ml.	I.V.P.	Complications
78	12	Appropriate Broad Spectrum	59	R.*dilatation. *L. no function	Mild wound
80	11	Appropriate Broad Spectrum	46	L. faint R. no function	Nil
68	4	No cover	47	N.A.D.	Nil
70	Intermittent	No cover	38	N.A.D.	Ascending infection (severe)
56	0	No cover	22	N.A.D.	Nil
76	0	No cover	44	Faint both sides	Nil
82	12	No cover	56	R. Nil L. faint	Wound. Ascending infection (severe)
66	9	No cover	234-33	L. Dilatation. R. N.A.D.	Ascending infection (mild)
72	7	Appropriate broad Spectrum	38	N.A.D.	Nil
78	110	Appropriate Broad Spectrum	16	N.A.D.	Ascending infection (moderate)
66	16	No cover	35	N.A.D.	Nil
84	2	No cover	35	N.A.D.	Nil
74	16	No cover	23	N.A.D.	Nil
69	0	No cover	30	N.A.D.	Ascending infection (mild)
76	14	No cover	194-123	Faint both sides	Died pyelonephritis (No P.M.)
74	10	No cover	165	No function	Died pyelonephritis
57	5	Sulphatriad	35	N.A.D.	Nil
75	2	Sulphatriad	28	N.A.D.	Ascending infection (severe)
62	0	No cover	47	N.A.D.	Wound (mild)
81	15	No cover	37	N.A.D.	Ascending infection (severe). Suprapubic leak

* R = right *L = left

TABLE 92

BACTERAEMIA AND BLOOD UREA LEVEL
1955 - 1960

Bacteraemia	No. of Cases	Urea Level (mg./100 ml.) Below 50	51-99	100+
Not present	95	77(81.1%)	16(16.8%)	2(2.1%)
Transitory	57	50(87.7%)	6(8.8%)	1(1.8%)
Protracted	20	16(80%)	2(10%)	2(10%)

TABLE 93

RELATION OF BACTERAEMIA TO EASE OF PROSTATIC ENUCLEATION IN INFECTED CASES

1959-60 cases	Easy enucleation	53.2%	positive culture (62 cases)
	Difficult enucleation	50%	positive culture (20 cases)

TABLE 94

POST-OPERATIVE BACTERAEMIA

MORTALITY

INFECTED CASES

ALL CASES

BLOOD CULTURE	POSITIVE	NEGATIVE
No. of Cases	76	52
Total mortality	6 (7.9%)	1 (1.9%)
Infective mortality	2 (2.6%)	0

TABLE 95

POST-OPERATIVE BACTERAEMIA

MORTALITY

INFECTED CASES

EXCLUDING CASES HAVING APPROPRIATE BROAD SPECTRUM ANTIBIOTIC COVER

BLOOD CULTURE	POSITIVE	NEGATIVE
No. of cases	55	23
Total mortality	4 (7.3%)	0
Infective mortality	2 (3.6%)	0

TABLE 96

POST-OPERATIVE BACTERAEMIA

MORTALITY

INFECTED CASES

EXCLUDING PATIENTS HAVING APPROPRIATE BROAD SPECTRUM ANTIMICROBIAL COVER

BACTERAEMIA	PROTRACTED	TRANSITORY	ABSENT
No. of cases	16	39	23
Total mortality	2 (12.5%)	2 (5.1%)	0
Infective mortality	2 (21.5%)	0	0

TABLE 97

THE EFFECT OF APPROPRIATE ANTIMICROBIAL COVER IN REDUCING BACTERAEMIA (INFECTED CASES)

1955 - 1964

NO. OF CASES	ANTIMICROBIAL COVER	BACTERAEMIA PRESENT	BACTERAEMIA PROTRACTED
78	Nil	55 (70.5%)	16/60 (27%)
50	Appropriate	21 (42%)	4 (8%)

TABLE 98

BACTERAEMIA IN INFECTED CASES

	ALL INFECTED CASES		INFECTED CASES (NO COVER)	
1955 - 1956	$(\frac{28}{34})$	82%	$(\frac{28}{34})$	82%
1959 - 1960	$(\frac{43}{82})$	52%	$(\frac{22}{35})$	63%
1963 - 1964	$(\frac{5}{12})$	42%	$(\frac{4}{8})$	50%

TABLE 99

1st zUrine Culture		Urine at Operation		Duration of Infection at Operation	Blood Culture	Remarks
No growth	12.12.55	Coliform	15.12.55	4 days	Coliform	For Bristol
No growth	1.11.55	Esch. coli	3.11.55	2 days	Esch. coli	do.
Esch. coli	19.5.56	Esch. coli Strep. faecalis	24.4.56	3 days	Strep. faecalis	do.
No growth	18.6.56	Coliform Strep. faecalis	25.6.56	6 days	Strep. faecalis	do.
No growth	28.11.60	Staph. pyogenes Strep. faecalis	2.12.60	4 days	Staph. pyogenes	do.
Esch. coli	20.10.60	Paracolon bacillus	25.10.60	4 days	Paracolon bacillus	do.
Strep. faecalis	29.8.60	Staph. pyogenes	5.9.60	6 days	Staph. pyogenes	do.
Strep. faecalis	22.6.60	Esch. coli	28.6.60	5 days	Esch. coli	do.
Strep. faecalis	22.10.55	Strep. faecalis	31.10.55	9 days	Strep. faecalis	Against Bristol
Staph. pyogenes	10.2.56	Staph. pyogenes	19.3.56	37 days	Staph. pyogenes	do.
Proteus species Staph. pyogenes	28.3.59	Proteus species Staph. pyogenes	10.4.59	13 days	Staph. pyogenes	do.
Staph. pyogenes	5.1.59	Staph. pyogenes	9.1.59	No instrumentation (Long standing)	Staph. pyogenes	do.
Proteus species	19.1.59	Proteus species	2.2.59	14 days	Proteus species	do.
Proteus species	12.6.60	Proteus species	21.6.60	9+ days	Proteus species	do.
Esch. coli	20.1.61	Esch. coli	30.1.61	Months-Years (stricture case)	Esch. coli	do.
Esch. coli	7.1.60	Esch. coli	16.1.60	9+ days	Esch. coli	do.

TABLE 100

PATIENTS MAINTAINED 'STERILE' THROUGHOUT HOSPITAL STAY

(1963 - 1964)

54 CASES

Complication Group	Complications	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection Ascending infection Funiculitis Epididymitis Cystitis Pelvic cellulitis	3 (5.6%)	1 (1.9%)
Medical	Respiratory Cardio-vascular Cerebral Reticulosis	2 (3.7%)	0
-	Supra-pubic leak	2 (3.7%)	2 (3.7%)
-	Haemorrhage (Urinary tract)	2 (3.7%)	1 (1.9%)
Upsets of Micturition	Poor control Failure or difficulty in voiding	1 (1.9%)	0
Miscellaneous	Diarrhoea Rectal fistula Rectal haemorrhage		

TABLE 101

POST-OPERATIVE COMPLICATIONS

(1963 - 1964)

Complication Group	Complications	'STERILE' THROUGHOUT (Urea) 54 CASES		'STERILE' BEFORE INFECTED AFTER OPERATION (Urea) 33 CASES		'STERILE' BEFORE INFECTED AFTER OPERATION (No urea) 11 CASES		INFECTED THROUGHOUT (Urea) 33 CASES		INFECTED THROUGHOUT (No urea) 14 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection	3(5.6%)	1(1.9%)	3(9.1%)	0	1(9.1%)	1(9.1%)	10(30.3%)	7(21.2%)	4(28.6%)	2(14.3%)
	Ascending infection			1(3.0%)	1(3.0%)	1(9.1%)	0	4(12.2%)	2(6.1%)		
	Funiculitis			2(6.1%)	0			1(3.0%)	0		
	Epididymitis			1(3.0%)	1(3.0%)	1(9.1%)	0			2(14.3%)	1(7.1%)
	Cystitis	1(3.0%)	1(3.0%)								
	Pelvic cellulitis										
Medical	Respiratory	2(3.7%)		1(3.0%)	0			3(9.1%)	2(6.1%)		
	Cardio-vascular			1(3.0%)	1(3.0%)	1(9.1%)	1(9.1%)			1(7.1%)	1(7.1%)
	Cerebral			1(3.0%)	1(3.0%)	1(9.1%)	1(9.1%)				
	Reticulosis										
-	Supra-pubic leak	2(3.7%)	2(3.7%)			1(9.1%)	1(9.1%)	3(9.1%)	3(9.1%)	1(7.1%)	1(7.1%)
-	Haemorrhage (Urinary tract)	2(3.7%)	1(3.7%)	2(6.1%)	1(3.0%)	1(9.1%)	1(9.1%)				
Upsets of Micturition	Poor control	1(1.9%)						1(3.0%)	0		
	Failure or difficulty in voiding			3(9.1%)	3(9.1%)			2(6.1%)	2(6.1%)	2(14.3%)	2(14.3%)
Miscellaneous	Diarrhoea										
	Rectal fistula										
	Rectal haemorrhage			1(3.0%)	1(3.0%)						

TABLE 102

PATIENTS HAVING UREAPHIL

(1963 - 1964)

When Infected	No. of Cases	Patients over 70 with urea over 50 mgm./ 100 ml.	Total Complications	Infective Complications	Infective Complications Delaying Convalescence	Total Deaths	Infective Deaths
Not Infected	54	5 (9.3%)	10 (18.5%)	3 (5.6%)	1 (1.9%)	0	0
After Operation	33	1 (3.0%)	17 (51.5%)	8 (24.2%)	3 (9.1%)	2 (6.1%)	0
Before Operation	33	1 (3.0%)	24 (72.7%)	15 (45.5%)	9 (27.3%)	2 (6.1%)	1 (3.0%)

TABLE 103

AGE INCIDENCE

(1963 - 1964)

1963 - 1964	No. of Cases	AGE 50-59	60-69	70-79	80 or over
'Sterile' throughout (Ureaphil)	54	12 (22.2%)	23 (42.6%)	15 (27.8%)	4 (7.4%)
'Sterile' before, infected after, operation (Ureaphil)	33	7 (21.2%)	12 (36.4%)	12 (36.4%)	2 (6.1%)
'Sterile' before, infected after, operation (no Ureaphil)	11	1 (9.1%)	3 (27.3%)	5 (45.5%)	2 (18.2%)
Infected before and after operation (Ureaphil)	33	4 (12.1%)	9 (27.3%)	15 (45.5%)	5 (15.2%)
Infected before and after operation (No Ureaphil)	14	0	7 (50%)	6 (42.9%)	1 (7.1%)
TOTALS	145	24	54	53	14

TABLE 104

AGE INCIDENCE

(1963 - 1964)

1963 - 1964	No. of Cases	AGE 50-59	60-69	70-79	80 or over
'Sterile' throughout	54	12 (22.2%)	23 (42.6%)	15 (27.8%)	4 (7.4%)
'Sterile' before, infected after, operation	44	8 (18.2%)	15 (34.1%)	17 (38.6%)	4 (9.1%)
Infected before and after operation	47	4 (8.5%)	16 (34.0%)	21 (44.7%)	6 (12.8%)

TABLE 105

PROSTATE GLAND - WEIGHT AND NUMBER OF GLAND LOBES
(1963 - 1964)

	Number of Patients (Total)	GLAND WEIGHT			NUMBER OF LOBES		
		Number of Cases Documented	50 gm. or less	51 gm. or more	Number of Cases Documented	Bilobed	Trilobed
'Sterile' throughout	54	47	32 (68%)	15 (32%)	43	24 (55.8%)	19 (44.2%)
'Sterile' before, infected after, operation	44	40	24 (60%)	26 (40%)	39	15 (38.5%)	24 (61.4%)
Infected throughout	47	43	25 (58%)	18 (42%)	40	22 (55%)	18 (45%)

TABLE 106

PROSTATE GLAND - EASE OF ENUCLEATION AND PRESENCE OF GLAND INFLAMMATION
(1963 - 1964)

	Number of Patients (Total)	EASE OF ENUCLEATION			INFLAMMATION		
		Number of Cases Documented	Easy	Difficult	Number of Cases Documented	Absent	Present
'Sterile' throughout	54	49	46 (93.9%)	3 (6.1%)	54	46 (85.2%)	8 (14.8%)
'Sterile' before, infected after, operation	44	41	33 (80.5%)	8 (19.5%)	44	37 (84.1%)	7 (15.9%)
Infected throughout	47	41	33 (80.5%)	8 (19.5%)	47	37 (78.7%)	10 (21.3%)

TABLE 106

TABLE 107

BLOOD LOSS AT OPERATION

	Number of Patients (Total)	Number of Cases Documented	500 ml. or less	501 ml. or more
'Sterile'	54	47	37 (79%)	10 (21%)
'Sterile' before, infected after, operation	44	40	27 (67%)	13 (33%)
Infected throughout	47	42	31 (74%)	11 (26%)

TABLE 108

MORTALITY 1963 - 1964

Patients with 'sterile' urine at operation which became infected later

AGE	CAUSE OF DEATH	WHETHER OR NOT P.M. CARRIED OUT
79	Cerebral	Yes
85	Coronary thrombosis	Yes
86	Coronary thrombosis	No

Patients whose urine was infected throughout

AGE	CAUSE OF DEATH	WHETHER OR NOT P.M. CARRIED OUT
72	Uraemia. Pulmonary embolism. Bronchopneumonia. Early Right empyema.	Yes
71	Acute superimposed on chronic pyelonephritis	Yes

TABLE 109

MORTALITY

(1963 - 1964)

	No. of Cases	Patients over 70 with urea over 50 mg./100 ml.	Total Mortality	Infective Mortality
'Sterile' throughout	54	5 (9.3%)	0	0
'Sterile' before, infected after, operation	44	5 (11.4%)	3 (6.8%)	0
Infected throughout	47	3 (6.4%)	2 (4.3%)	1 (2.1%)

TABLE 110

INFECTED CASES - ANTIMICROBIAL COVER
(1963 - 1964)
UREAPHIL (33 CASES)

Complication Group	Complications	NO COVER 23 CASES		APPROPRIATE COVER 6 CASES		INAPPROPRIATE COVER 4 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	7	6	3	1		
	Ascending infection	3	1			1	1
	Funiculitis	1					
	Epididymitis						
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory	1	1	1	1	1	1
	Cardio-vascular						
	Cerebral						
	Reticulosis						
-	Supra-pubic leak	3	3				
-	Haemorrhage (Urinary tract)						
Upsets of Micturition	Poor control	1					
	Failure or difficulty in voiding	2	2				
Miscellaneous	Diarrhoea						
	Rectal fistula						
	Rectal haemorrhage						

TABLE 111

INFECTED CASES - ANTIMICROBIAL COVER
(1963 - 1964)

NO UREAPHIL (14 CASES)

Complication Group	Complications	NO COVER 6 CASES		APPROPRIATE COVER 3 CASES		INAPPROPRIATE COVER 5 CASES	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	2	1			2	1
	Ascending infection						
	Funiculitis						
	Epididymitis	1	1			1	
	Cystitis						
	Pelvic cellulitis						
Medical	Respiratory						
	Cardio-vascular					1	1
	Cerebral						
	Reticulosis						
-	Supra-pubic leak					1	1
-	Haemorrhage (Urinary tract)						
Upsets of Micturition	Poor control						
	Failure or difficulty in voiding	1	1			1	1
Miscellaneous	Diarrhoea						
	Rectal fistula						
	Rectal haemorrhage						

TABLE 111

TABLE 112

PATIENTS MAINTAINED STERILE THROUGHOUT HOSPITAL STAY

(1963 - 1964)

CONDITION OF PATIENT AT OPERATION

ALL PATIENTS HAD UREAPHIL

Complication Group	Complications	WELL 31 CASES		URINARY TRACT DISEASE 9 CASES		MEDICAL DISEASE 11 CASES		BOTH URINARY TRACT AND MEDICAL DISEASE 3 CASES	
		Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection Ascending infection Funiculitis Epididymitis Cystitis Pelvic cellulitis	1(3.2%)		1(11.1%)	1(11.1%)			1(33.3%)	1(33.3%)
Medical	Respiratory Cardio-vascular Cerebral Reticulosis	1(2.7%)				1(9.1%)			
-	Supra-pubic leak	1(3.2%)	1(3.2%)	1(11.1%)	1(11.1%)				
-	Haemorrhage (Urinary tract)	2(6.5%)	1(3.2%)						
Upsets of Micturition	Poor control Failure or difficulty in voiding	1(3.2%)							
Miscellaneous	Diarrhoea Rectal fistula Rectal haemorrhage								

TABLE 113

PATIENTS STERILE BEFORE, INFECTED AFTER, OPERATION

(1963 - 1964)

CONDITION OF PATIENT AT OPERATION

UREAPHIL - 33 CASES

Complication Group	Complications	WELL 21 CASES		URINARY TRACT DISEASE 4 CASES		MEDICAL DISEASE 8 CASES		BOTH URINARY TRACT AND MEDICAL DISEASE 0 CASES	
		Total + Deaths	Delay in Conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths	Total + Deaths	Delay in conval-escence + deaths
Infective	Wound infection			2 2		1	0		
	Ascending infection			1	1				
	Infective illness			0	0				
	Funiculitis	1(4.8%)				1	0		
	Epididymitis	1(4.8%)	1(4.8%)						
	Cystitis	1(4.8%)	1(4.8%)						
	Pelvic cellulitis								
Medical	Respiratory	0	0			1			
	Cardio-vascular			1	1				
	Cerebral					1	1		
	Reticulosis								
-	Supra-pubic leak								
-	Haemorrhage (Urinary tract)	1(4.8%)	1(4.8%)			1			
Upsets of Micturition	Poor control								
	Failure or difficulty in voiding	2(9.5%)	2(9.5%)			1	1		
Miscellaneous	Diarrhoea								
	Rectal fistula								
	Rectal haemorrhage	1(4.8%)	1(4.8%)						

TABLE 114

PATIENTS STERILE BEFORE, INFECTED AFTER, OPERATION
(1963 - 1964)
CONDITION OF PATIENT AT OPERATION
NO UREAPHIL - 11 CASES

Complication Group	Complications	WELL 5 CASES		URINARY TRACT DISEASE 4 CASES		MEDICAL DISEASE 1 CASE		BOTH URINARY TRACT AND MEDICAL DISEASE 1 CASE	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection			1	1				
	Ascending infection								
	Infective illness							1	1
	Funiculitis								
	Epididymitis	1							
	Cystitis								
	Pelvic cellulitis								
Medical	Respiratory								
	Cardio-vascular			1	1				
	Cerebral			1	1				
	Reticulosis								
-	Supra-pubic leak			1	1				
-	Haemorrhage (Urinary tract)	1	1						
Upsets of Micturition	Poor control								
	Failure or difficulty in voiding								
Miscellaneous	Diarrhoea								
	Rectal fistula								
	Rectal haemorrhage								

TABLE 115

PATIENTS INFECTED THROUGHOUT
(1963 - 1964)
CONDITION OF PATIENT AT OPERATION
UREAPHIL - 33 CASES

Complication Group	Complications	WELL 25 CASES		URINARY TRACT DISEASE 2 CASES		MEDICAL DISEASE 6 CASES		BOTH URINARY TRACT AND MEDICAL DISEASE -	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	9	7	1					
	Ascending infection			1	1				
	Infective illness	2	0			1	1		
	Funiculitis	1							
	Epididymitis								
	Cystitis								
	Pelvic cellulitis								
Medical	Respiratory	1		1	1	1	1		
	Cardio-vascular								
	Cerebral								
	Reticulosis								
-	Supra-pubic leak	3	3						
-	Haemorrhage (Urinary tract)								
Upsets of Micturition	Poor control	1							
	Failure or difficulty in voiding	1	1			1	1		
Miscellaneous	Diarrhoea								
	Rectal fistula								
	Rectal haemorrhage								

TABLE 116

PATIENTS INFECTED THROUGHOUT
(1963 - 1964)
CONDITION OF PATIENT AT OPERATION
WITHOUT UREAPHIL - 14 CASES

Complication Group	Complications	WELL 6 CASES		URINARY TRACT DISEASE 2 CASES		MEDICAL DISEASE 6 CASES		BOTH URINARY TRACT AND MEDICAL DISEASE -	
		Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths	Total + Deaths	Delay in convalescence + deaths
Infective	Wound infection	2		1	1	1	1		
	Ascending infection								
	Infective illness								
	Funiculitis								
	Epididymitis	1	1	1					
	Cystitis								
	Pelvic cellulitis								
Medical	Respiratory								
	Cardio-vascular	1	1						
	Cerebral								
	Reticulosis								
-	Supra-pubic leak			1	1				
-	Haemorrhage (Urinary tract)								
Upsets of Micturition	Poor control								
	Failure or difficulty in voiding			1	1	1	1		
Miscellaneous	Diarrhoea								
	Rectal fistula								
	Rectal haemorrhage								

TABLE 117

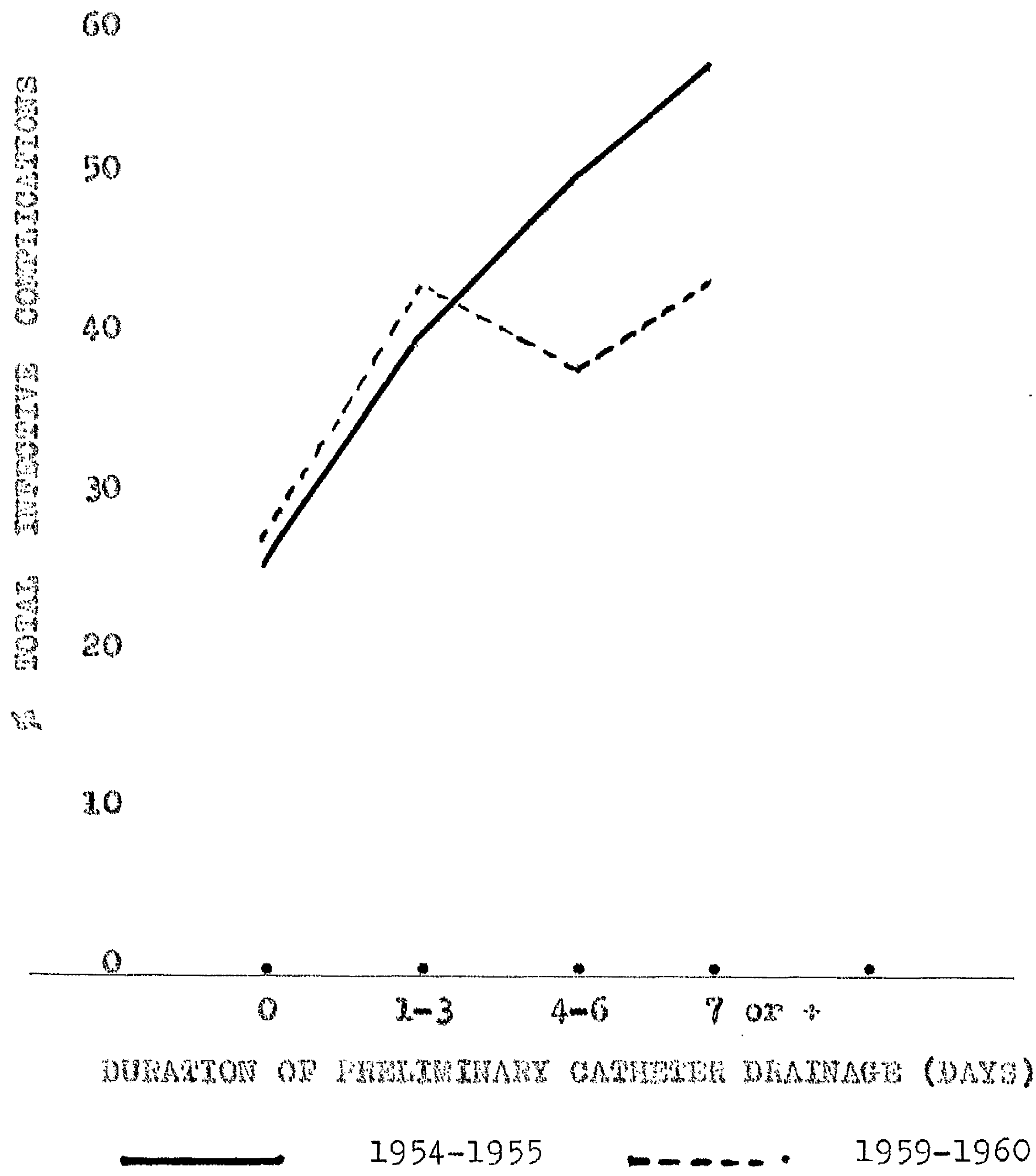
DURATION OF CATHETER DRAINAGE

	NO. OF CASES	DRAINAGE						
		NIL	1-6 DAYS		7-28 DAYS		28 OR MORE DAYS	
			GIBBON OR FRANKLIN	OTHER	GIBBON OR FRANKLIN	OTHER	GIBBON OR FRANKLIN	OTHER
'Sterile' throughout (urea)	54	36(66.7%)	9(16.7%)	0	2(3.7%)	6(11.1%)	1(1.9%)	0
'Sterile' before, infected after, operation (urea)	33	13(38.5%)	2(27.3%)	0	7(22.2%)	4(12.2%)	0	0
'Sterile' before, infected after, operation (no urea)	11	5(45.5%)	1(9.1%)	1(9.1%)	4(36.4%)	0	0	0
Infected before and after operation (urea)	33	4(12.1%)	5(15.2%)	2(6.1%)	11(33.3%)	8(24.2%)	0	3(9.1%)
Infected before and after operation (no urea)	14	1(7.1%)	1(7.1%)	2(14.3%)	6(42.9%)	4(28.6%)	0	0
TOTALS	145	25	5	30	22		1	3

TABLE 117

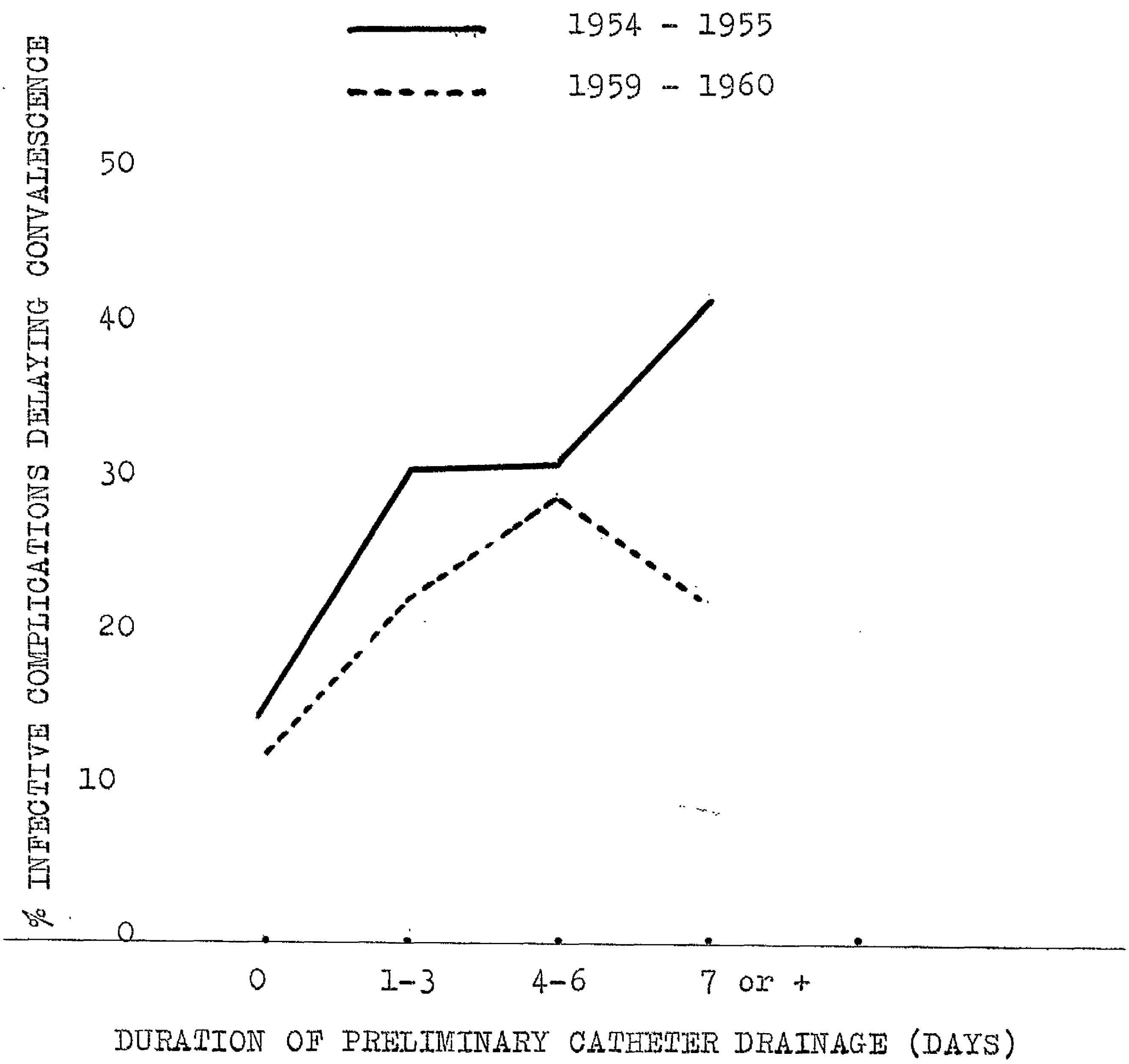
GRAPH 1

PERCENTAGE OF ALL INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE AT TWO DIFFERENT PERIODS



GRAPH 2

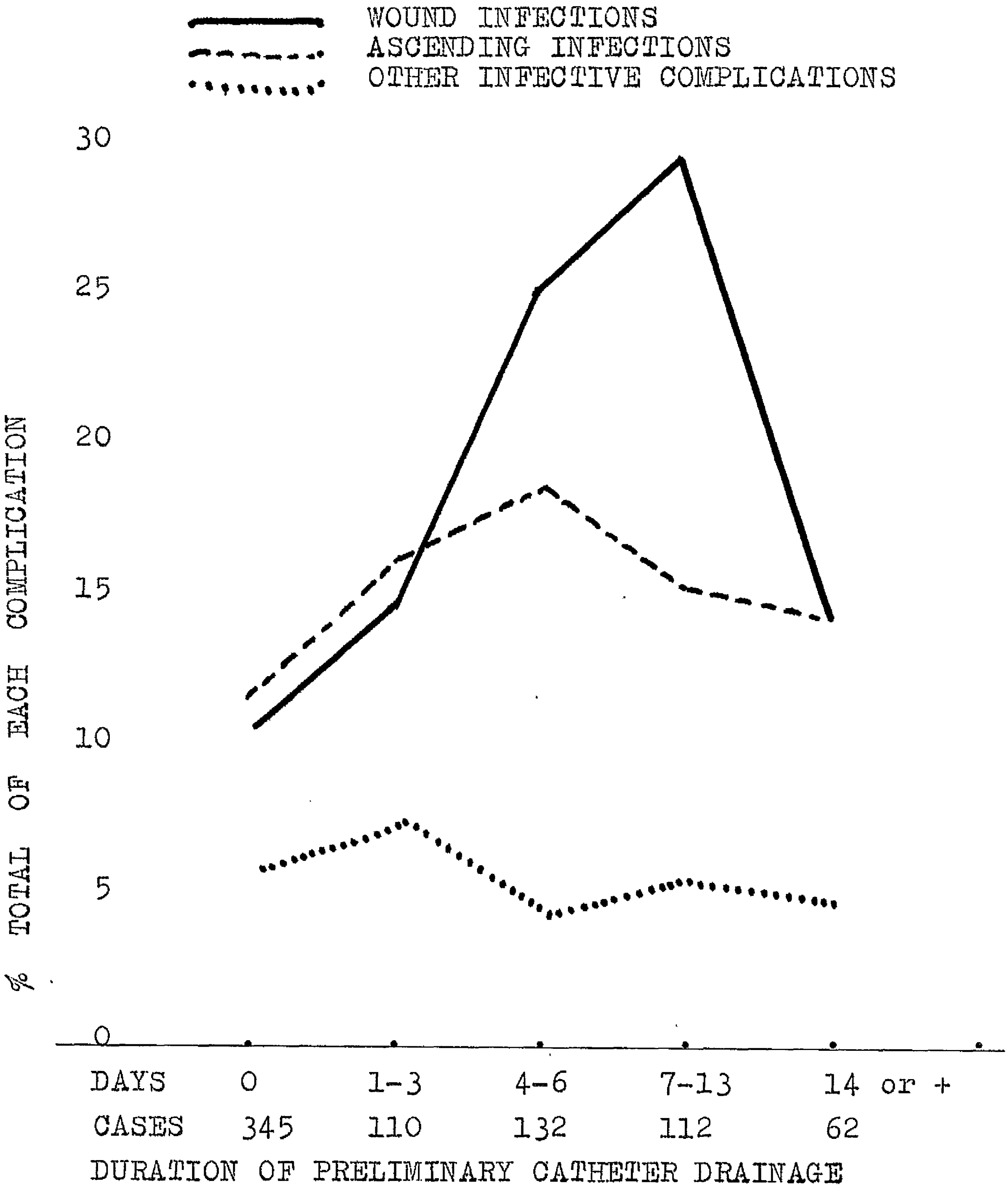
PERCENTAGE OF ALL INFECTIVE COMPLICATIONS DELAYING CONVALESCENCE GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE AT TWO DIFFERENT PERIODS



GRAPH 3

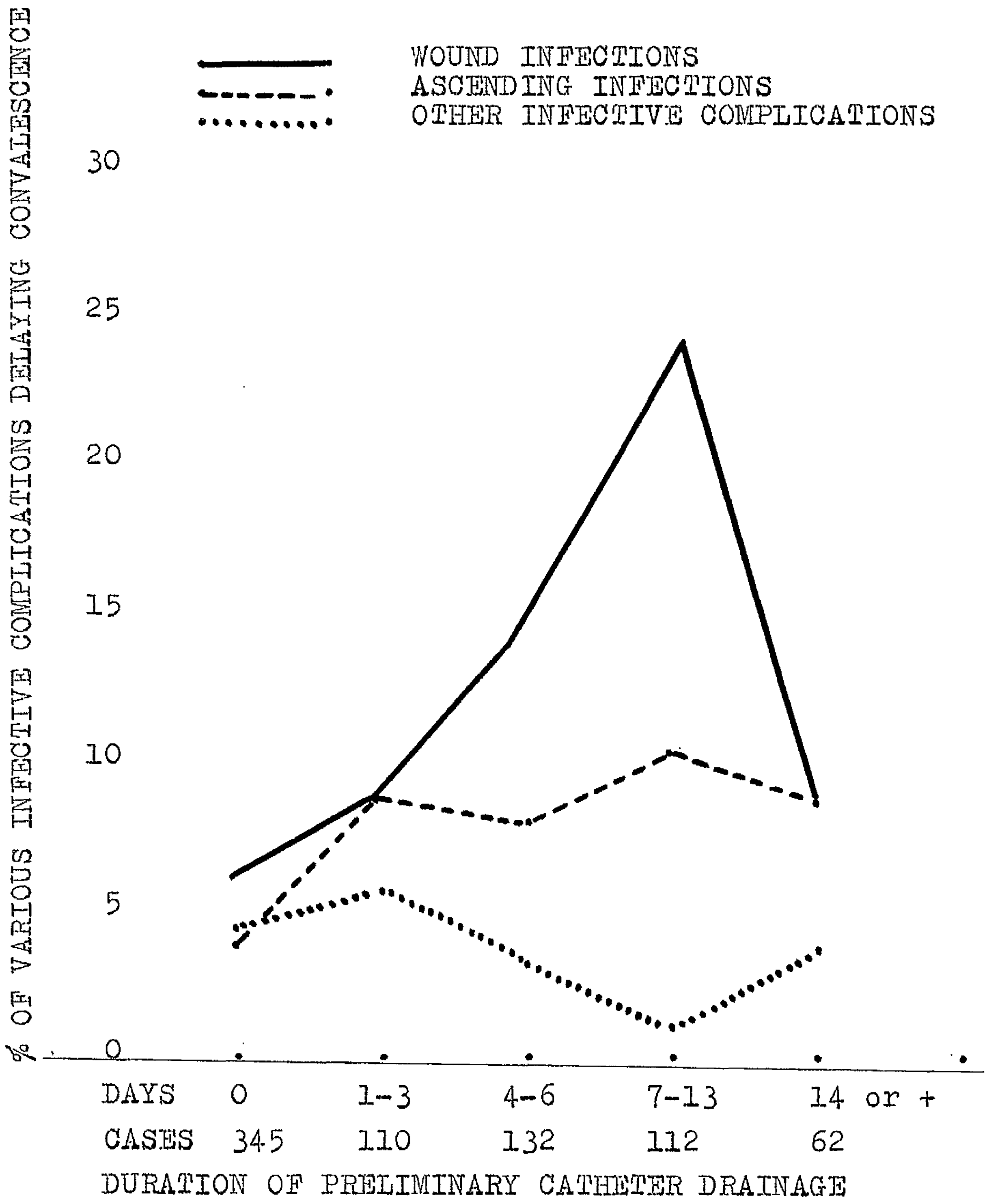
PERCENTAGE OF VARIOUS INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE

(761 CASES)



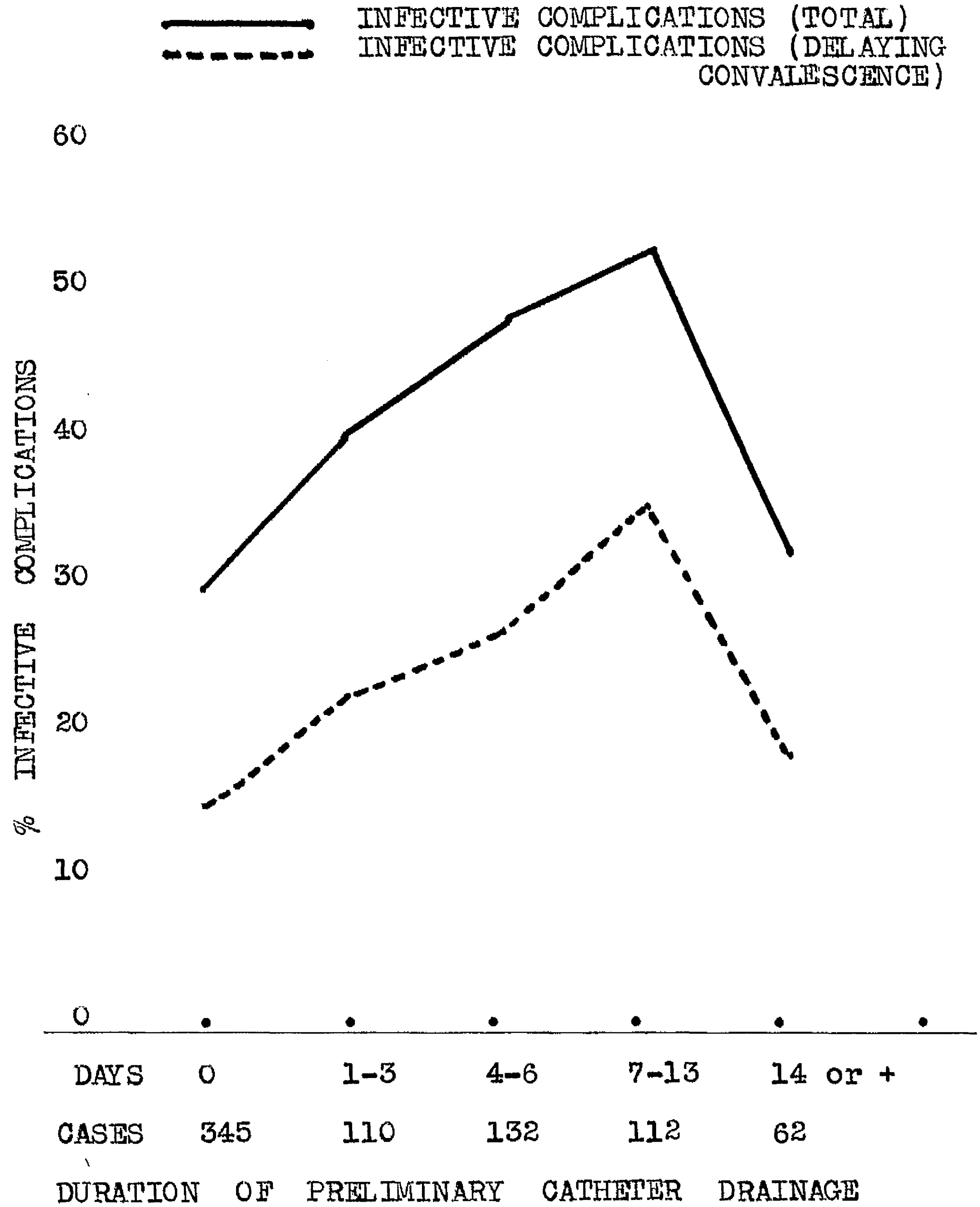
GRAPH 4

PERCENTAGE OF VARIOUS INFECTIVE COMPLICATIONS DELAYING CONVALESCENCE GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE
(761 CASES)



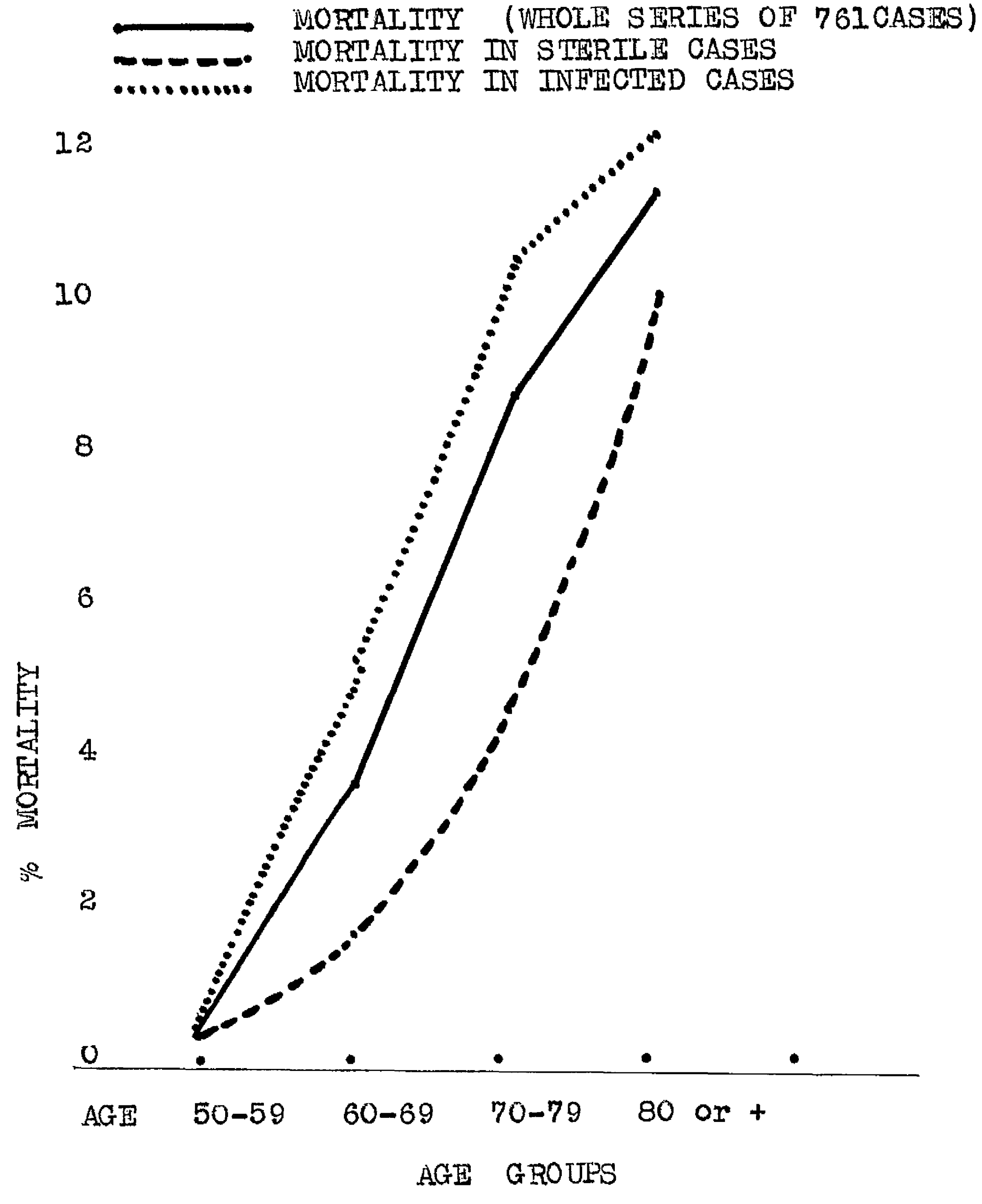
GRAPH 5

ALL INFECTIVE COMPLICATIONS GRAPHED AGAINST DURATION OF PRELIMINARY CATHETER DRAINAGE
(761 CASES)



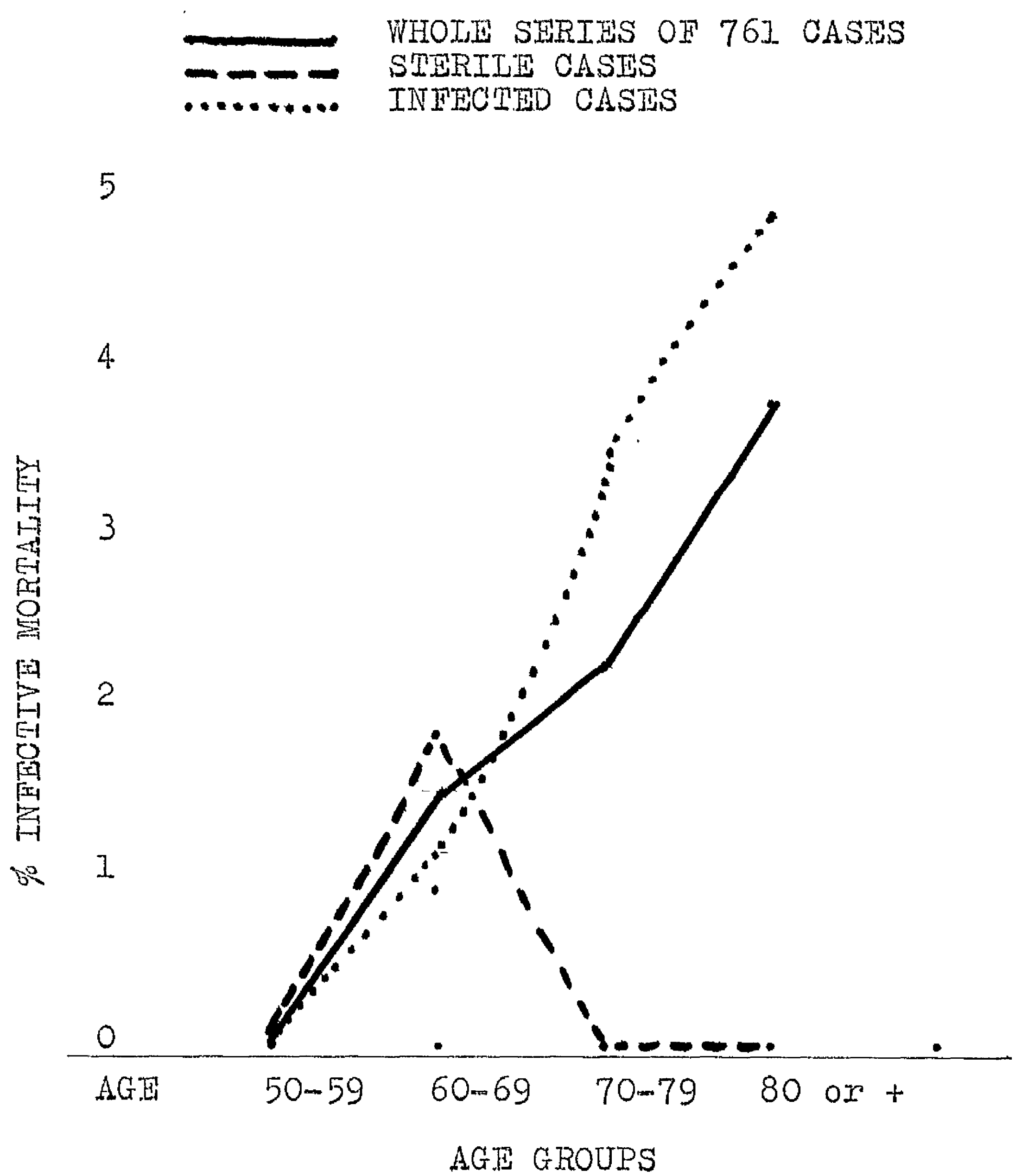
GRAPH 6

TOTAL MORTALITY OF DIFFERENT AGE GROUPS



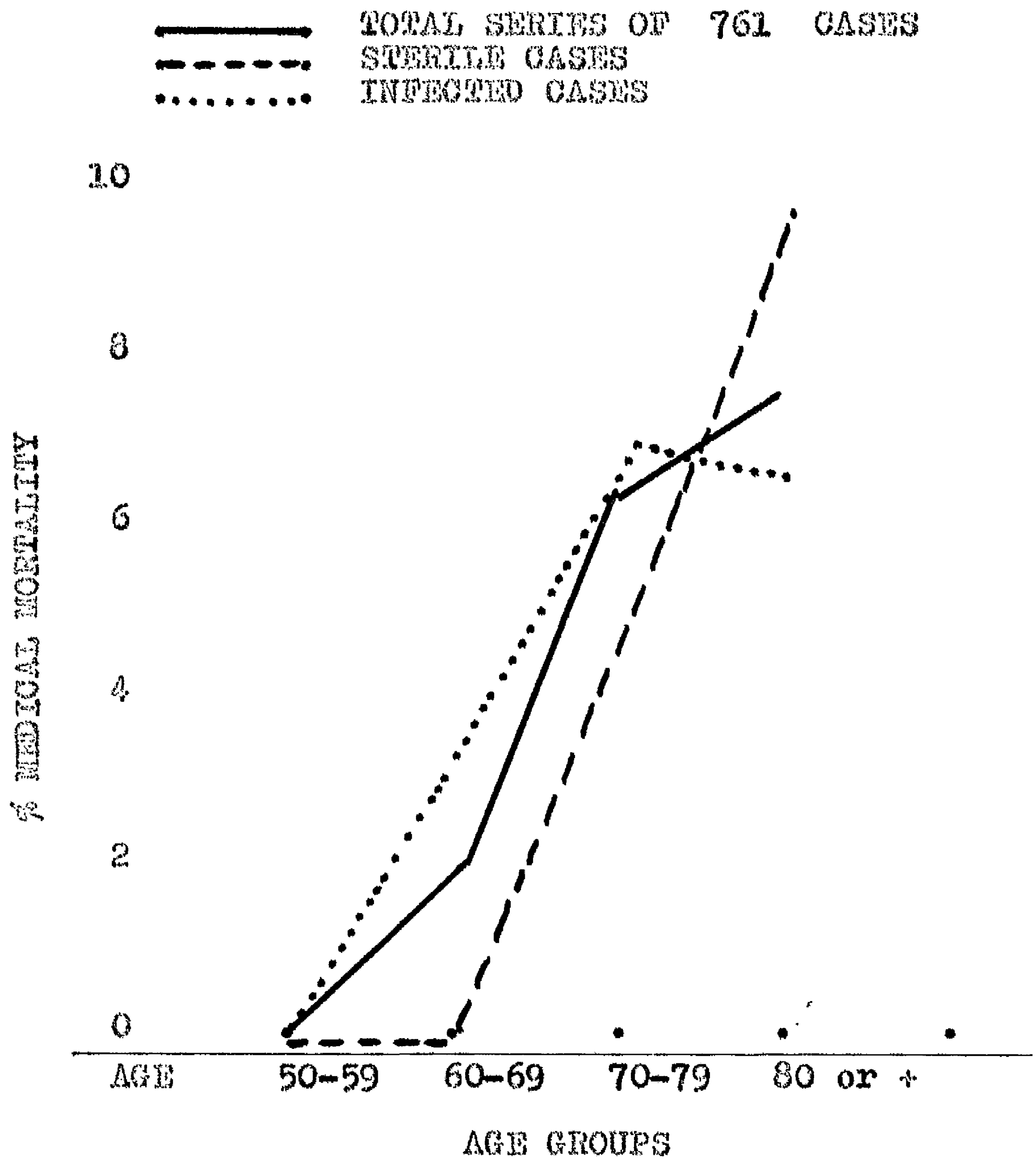
GRAPH 7

INFECTIVE MORTALITY OF DIFFERENT AGE GROUPS



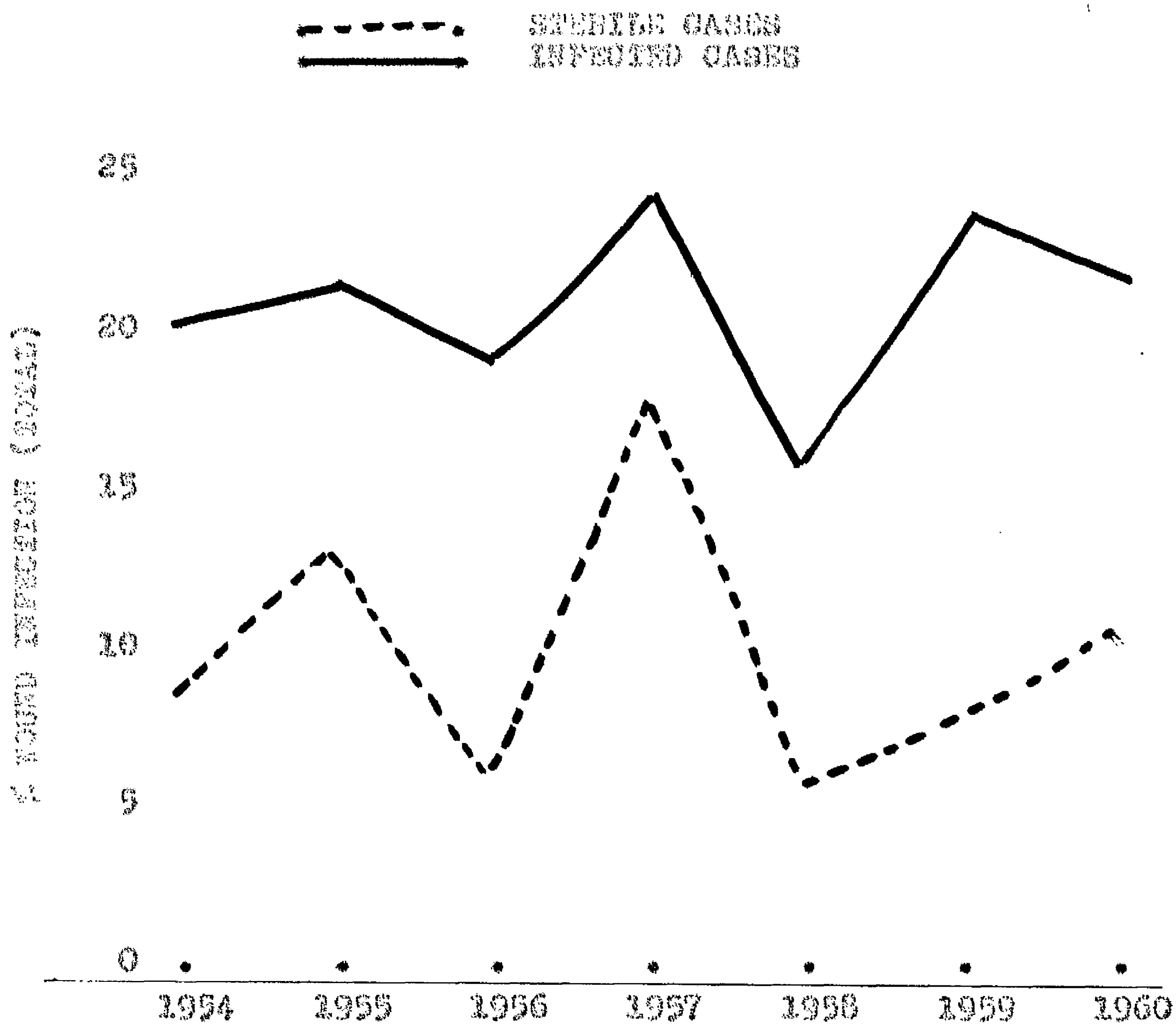
GRAPH 8

MEDICAL MORTALITY OF DIFFERENT AGE GROUPS



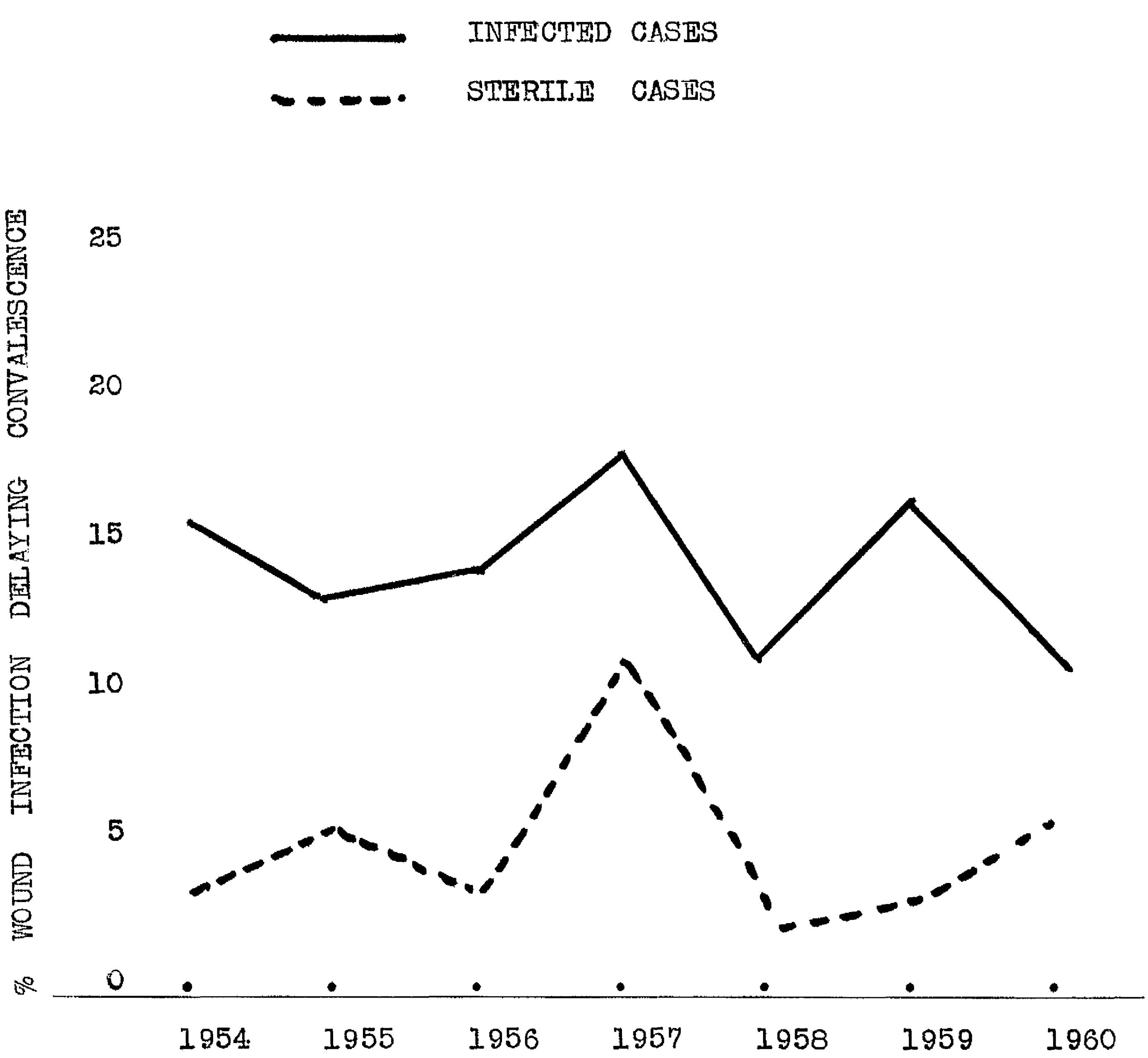
GRAPH 9

INCIDENCE OF TOTAL WOUND INFECTION IN EACH YEAR STUDIED



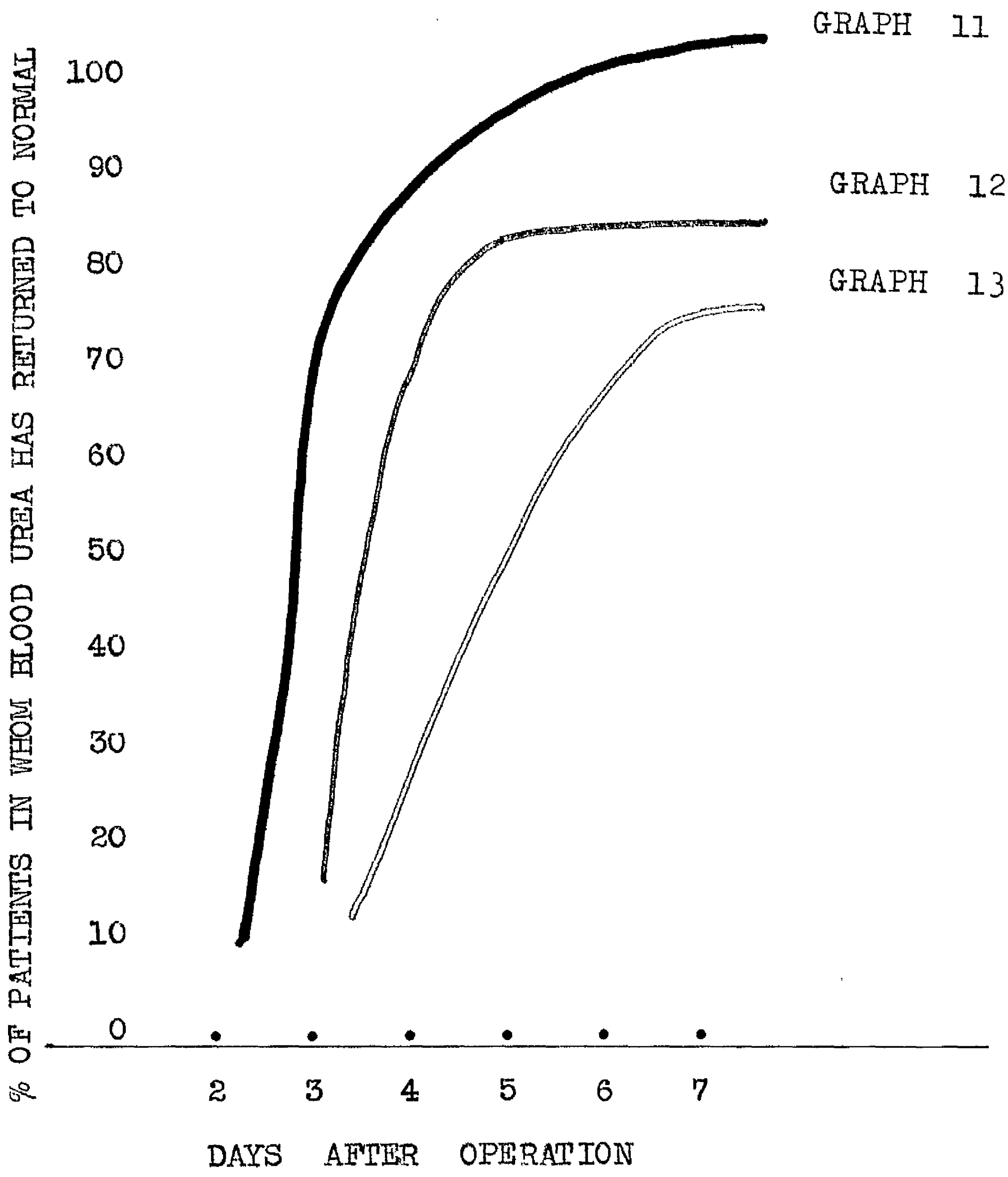
GRAPH 10

INCIDENCE OF WOUND INFECTION DELAYING CONVALESCENCE IN EACH YEAR STUDIED



GRAPHS 11 - 13

TIME TAKEN FOR UREA TO FALL TO NORMAL AFTER GIVING UREAPHIL

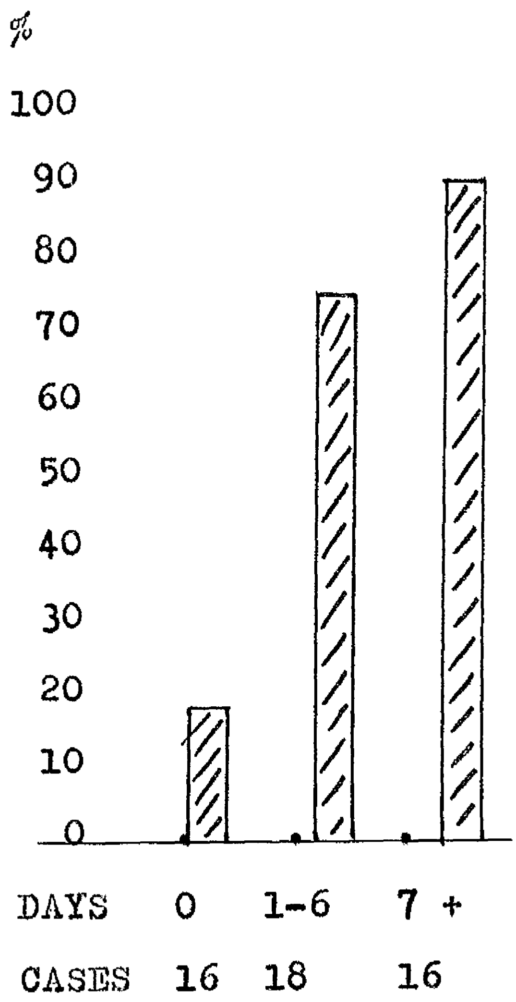


HISTOGRAM 1

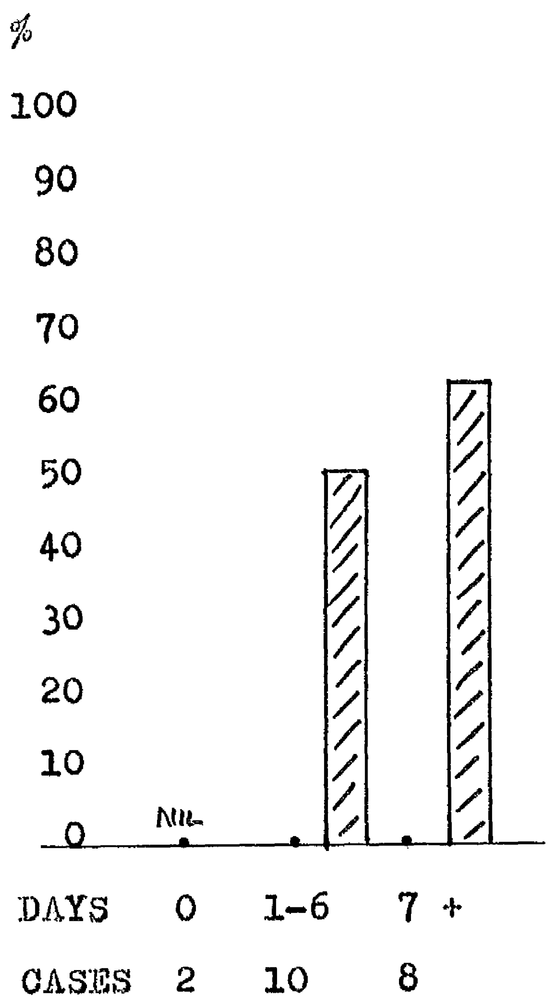
RELATION OF POST-OPERATIVE BACTERAEMIA TO DURATION OF PRELIMINARY CATHETER DRAINAGE

1955 - 1956

TRANSITORY



PROTRACTED

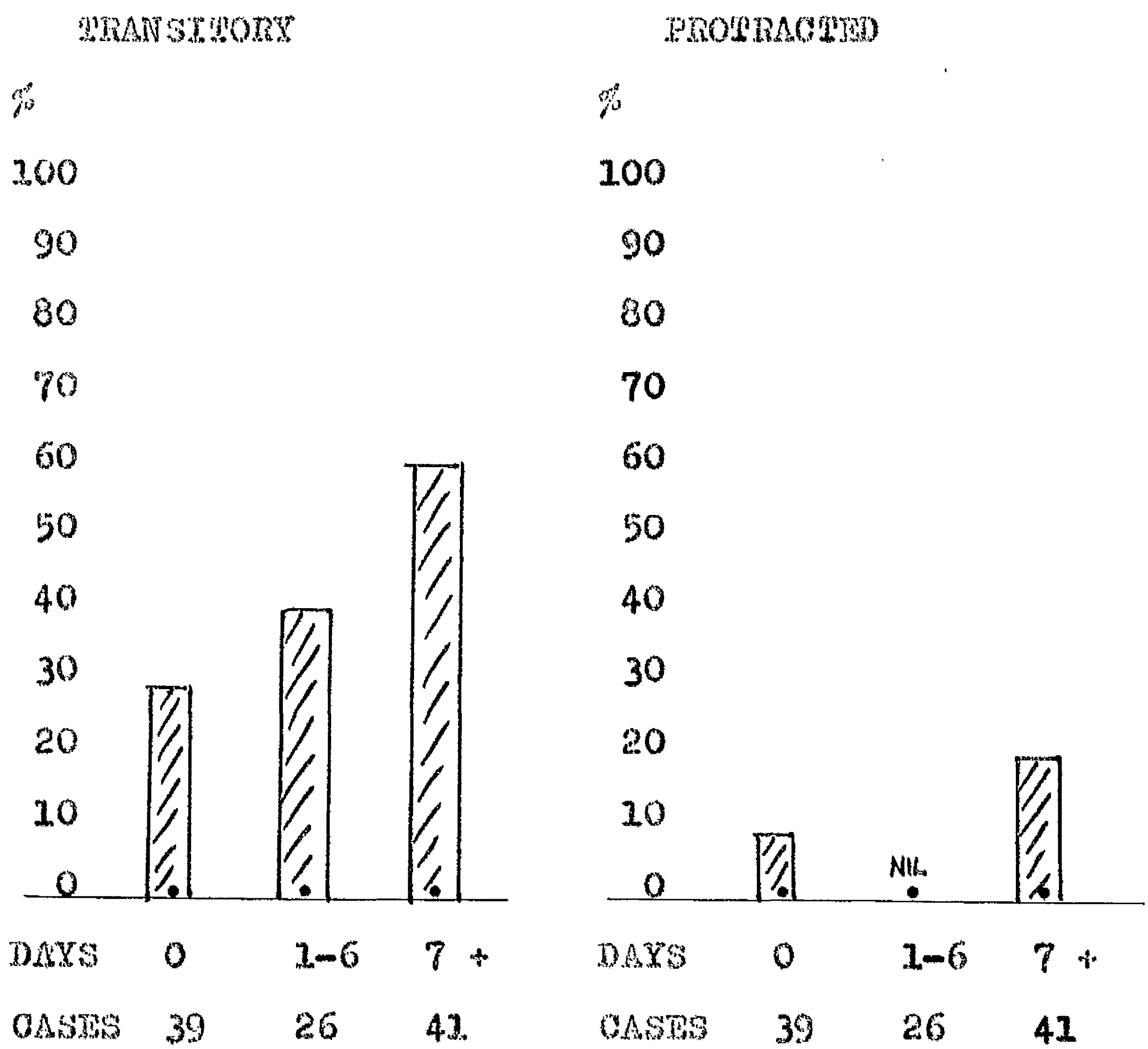


HISTOGRAM 2

RELATION OF POST-OPERATIVE BACTERAEMIA TO DURATION OF PRELIMINARY CATHETER DRAINAGE

1957 – 1960

EXCLUDING CASES WHERE A GIBBON CATHETER WAS USED



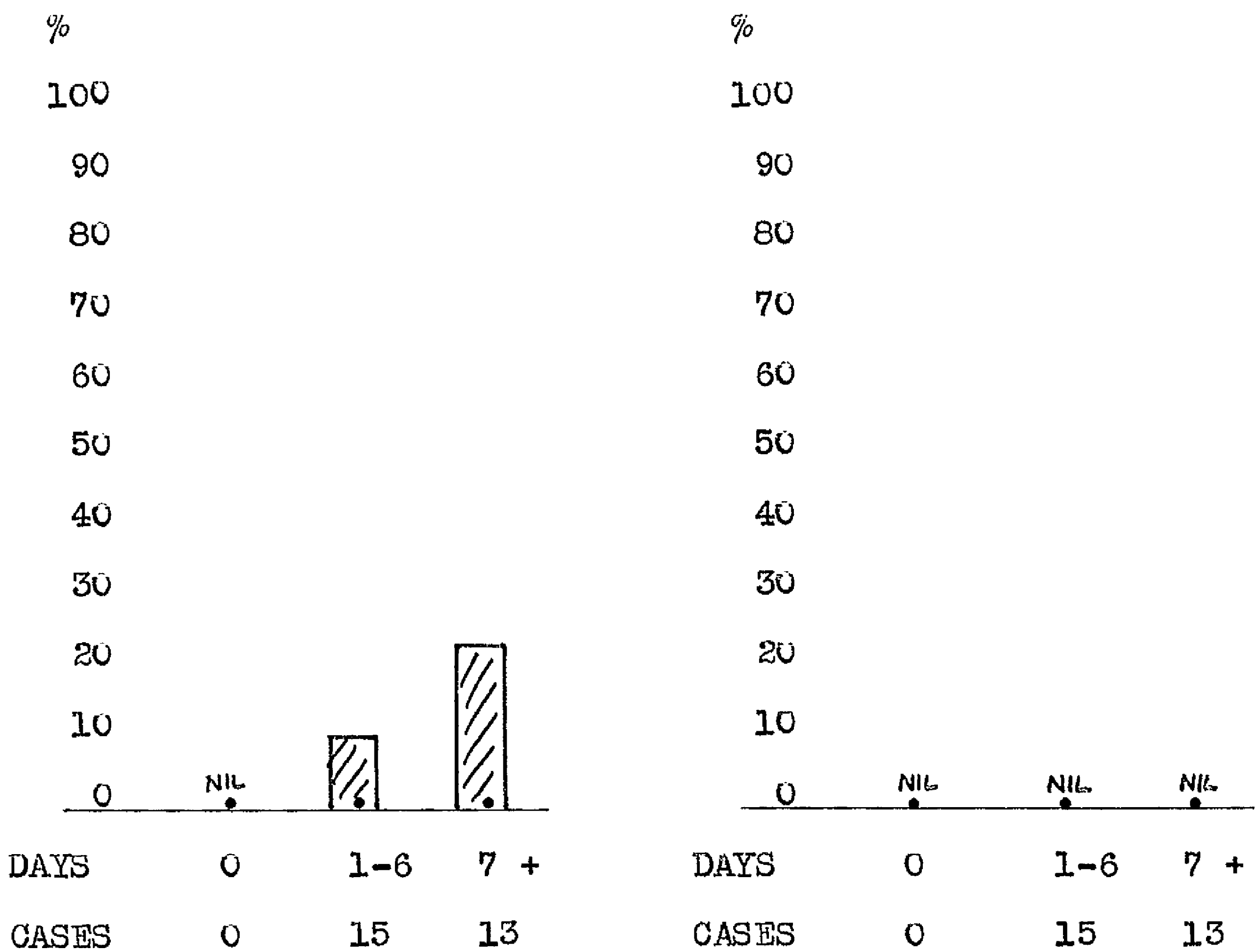
HISTOGRAM 3

RELATION OF POST-OPERATIVE BACTERAEMIA TO DURATION OF PRELIMINARY CATHETER DRAINAGE

1957 - 1960

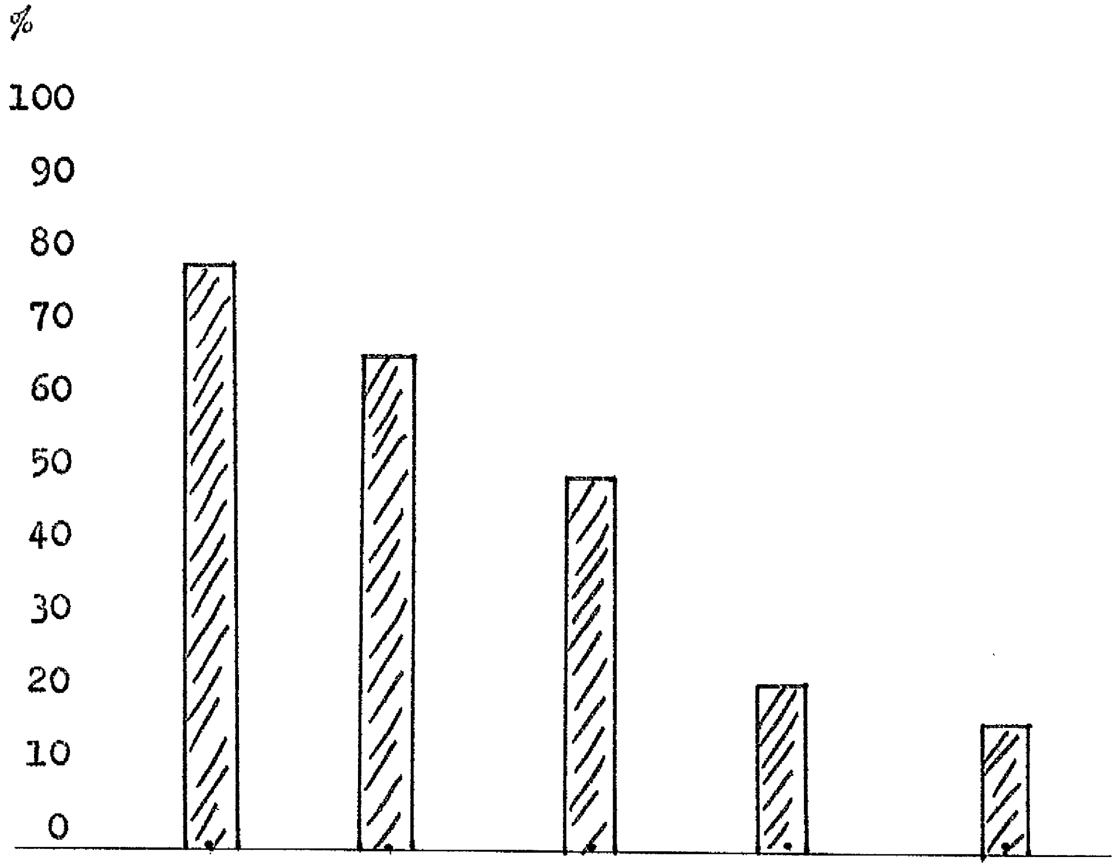
CASES ON GIBBON OR FRANKLIN CATHETER DRAINAGE

TRANSITORY PROTRACTED



HISTOGRAM 4

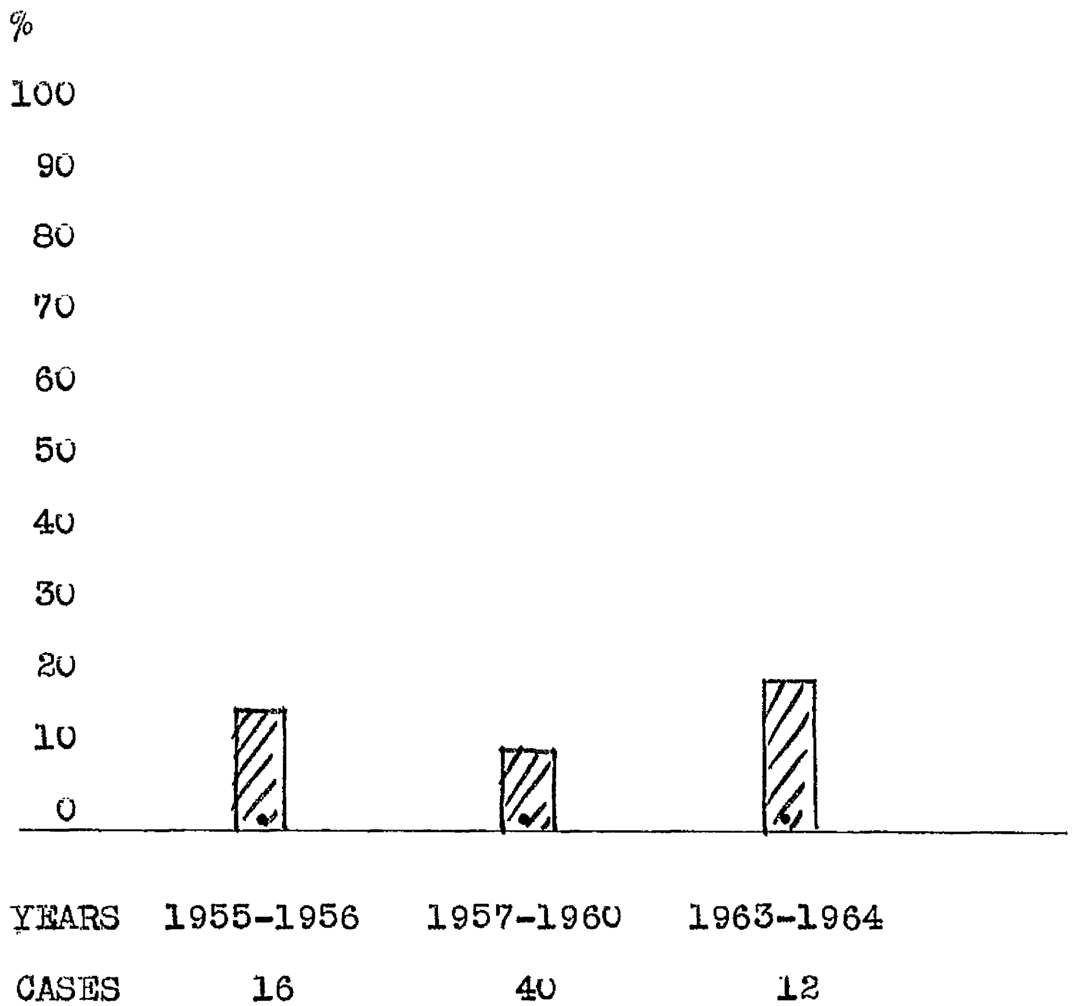
INCIDENCE OF BACTERAEMIA RELATED TO THE TYPE OF PRELIMINARY CATHETER DRAINAGE



NO. OF CASES	31	29	42	14	14
DRAINAGE	OPEN	CLOSED	CLOSED	CLOSED GIBBON OR FRANKLIN	CLOSED GIBBON OR FRANKLIN
ANTI-MICROBIAL COVER	NIL	NIL	APPROP-RIATE	NIL	APPROP-RIATE

HISTOGRAM 5

THE INCIDENCE OF BACTERAEMIA IN STERILE CASES



NO INCIDENCE OF PROTRACTED BACTERAEMIA

HISTOGRAM 6

AGE INCIDENCE

1963-1964 SERIES