A STUDY OF SURGICAL COMPLICATIONS OF OVARIOHYSTERECTOMY AND PYOMETRA IN THE BITCH AND CAT

BY

Abdel Rahman H. Altarifi

Dissertation for M.V.M. submitted in conjunction with written and practical examination in Abdominal Surgery in Small Animals

Department of Surgery
Faculty of Veterinary Medicine
University of Glasgow

May 1980

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

ACKNOWLEDGEMENT

I wish to record my appreciation for all the help and encouragement I have received during the course of this work.

I am particularly grateful to Professor Donald D. Lawson, under whose supervision this work was carried out, and to Dr. A. D. Weaver for his constant help and support during the past year.

I am indebted to the following members of staff of the Department of Veterinary Surgery - Dr. Jean P. Renton for her valuable help and advice, Dr. G. J. Baker for his encouragement and Mr. N. H. Dodman for his assistance.

My thanks also go to the staff in the Departments of Pathology and Clinical Biochemistry for their skilled technical assistance, and to Mrs. M. MacDonald, Mrs. H. Rodrick and Mrs. A. Nuttall for typing the manuscript.

C O N T E N T S

SUMMARY

Surgical Complications of ovariohysterectomy and pyometra in the dog and cat

The literature on surgical complications of ovariohysterectomy and pyometra in the dog and cat is reviewed by considering first the aetiopathogenesis of pyometra, its diagnosis and different types of treatment, followed by the immediate and delayed complications which may develop during and after surgery. The role of suture materials in post-operative complications is also reviewed.

The causes of death in pyometra cases admitted to Glasgow University Veterinary Hospital during the last eight years were studied. These causes in 23 of 124 bitches were uraemia (7), peritonitis (2), septicaemia (3), haemorrhage (2), uterine stump infection (3) and euthanasia (6). Blood urea in the uraemic fatalities ranged from 20 to 102.4 mmol/l. The average age of the dead and recovered cases was respectively 11.5 $\pm$ 4.1 years and 8.8 $\pm$ 3.3 years. In 12 cats with pyometra, 9 survived and 3 died after the operation. The causes of death in these cats were pyelonephritis, peritonitis and septicaemia. The incidence of pyometra in relation to the breed indicated that the highest incidence was in mongrel dogs, followed by Labrador, Cairn Terrier and Miniature Poodle. The results of complete blood cell count and blood urea showed that the total white cell count ranged from 8 - 108 x 10^3 per cu mm (mean 47 $\pm$ 10). Blood urea ranged from 5-102.9 with a mean and SD of 25.6 $\pm$ 12 mmol/l. PCV ranged from 34% to 55% (mean 47.1 $\pm$ 3.3). The types of bacteria isolated from the uterus of 70 cases of canine pyometra were E. coli

(57.5%), Staphylococci (16.1%), Streptococci (13.8%), proteus spp. (3.4%), klebsiella (2.3%) and no bacterial growth was found in 5.7%.

In 35 dogs and 2 cats which were admitted in the period October 1978 to October 1979 for the treatment of pyometra and different post-operative complications, an investigation was carried out on the operative and post-operative complications of ovario-hysterectomy.

Surgical complications included haemorrhage in 2 and anaesthetic problems in 8 cases.

A post-operative follow-up study revealed that among 37 animals, 13 had complications after discharge from the hospital and these included delayed healing, incision swelling and drainage in 5, wound disruption and herniation in 1, vaginal discharge in 3, urinary incontinence in 1, weight gain in 1 and change in behaviour in 3.

Laboratory investigation and radiography were evaluated in all cases of pyometra as an aid to diagnosis as well as to assess the condition of the patient before and after surgery. Abnormal laboratory results were found as follows: raised blood urea ($>$ 9 mmol/l) in 3, low plasma chloride ($<$95 mmol/l) in 2, low plasma sodium ($<$136 mmol/l) in 2, lowered packed cell volume ($<$37%) in 1 and increased ($>$ 55%) in 6 and raised white blood cell count ($>$18000/cu mm) in 13 cases. Use of laboratory tests aids the recognition of the most suitable treatment for pyometra cases before and after the operation. Fluid therapy was used when necessary to improve renal function and to correct hypovolaemia. Dextrose saline was administered in 4 cases and Lactated Ringer's in another 4. One case needed whole blood transfusion (500 ml).

Radiography was used in all the cases of pyometra both to confirm the diagnosis and to assess the degree of uterine enlargement.

In 12 cases the uterus was grossly enlarged and this was easily detected on radiography. In 8 other cases the uterus was only slightly enlarged at laparotomy, but it was not detected as enlarged on radiography.

Cultural examinations were carried out on the uterine content of 19 dogs and 1 cat which underwent ovariohysterectomy for pyometra. The examinations revealed a pure culture of E. coli in 12 dogs, a mixed growth of E. coli and S. aureus in 1 and a mixture of E. coli and B-haemolytic, group G streptococci from another. No bacterial growth was found in 5 dogs. Bacteriology of the abdominal cavity during pyometra operation was evaluated in 19 dogs and 1 cat by examination of bacterial swabs which were taken from the abdominal cavity before and after removal of the uterus, from the uterine stump and both ovarian pedicles. Bacterial growth was found only in 3 cases where a mixture of anaerobic bacteria, Haemophilus canis and E. coli was isolated from the uterine stump. No bacterial growth was found from the other swabs. A pure culture of E. coli was isolated from the uterine content of one cat.

In the majority of pyometra cases wound problems were the most common complication. In dogs with pyometra, care should be taken to correct fluid and electrolyte loss in dehydrated cases, and in animals with a high blood urea, surgery is not recommended until it returns to normal. Post-operative care is important following pyometra surgery; the animal should be kept warm and fluid therapy such as dextrose saline, plasma, or blood transfusion in anaemic cases should be given if necessary. The routine ovariohysterectomy operation is contra-indicated in bitches in oestrus. Chromic catgut suture material should be used for ovarian pedicle and uterine body ligatures. Care should be taken in ligating the ovarian and

uterine vessels to prevent haemorrhage.

GENERAL INTRODUCTION

Pyometra is a common disease of the mature bitch. This study discusses the surgical complications which might occur during or following ovariohysterectomy for the treatment of pyometra, or as a routine spaying. These complications were investigated retrospectively in animals which were admitted during the last 8 years in Glasgow University Veterinary Hospital and secondly in cases investigated personally during the period 1978 to 1979. Post-operative assessment for complications was carried out on these cases by daily examination during hospitalisation and by a follow-up survey after discharge.

It is not the scope of this study to investigate the aetiological factors and pathogenesis of pyometra which are merely reviewed. An attempt has been made to relate personal observations to the published results of other workers.

REVIEW OF THE LITERATURE

PYOMETRA

1. Definition

During the last four decades pyometra has been defined and described many times depending on the alleged aetiology and pathogenesis.

The term chronic endometritis was applied until 'cystic hyperplasia - pyometra complex in the bitch' was introduced by Dow (1957; 1958; 1959a), pyometra endometritis complex used by Rieck (1959) and 'an acute or chronic polysystemic metoestral disease of the mature bitch' by Hardy and Osborne (1974).

2. Aetiology

Pyometra may be associated with a wide variety of clinical and pathological manifestations related to both genital and extragenital lesions (Bloom 1946; Lettow 1960; Pallaske 1961; Schalm 1973; Hardy and Osborne 1974).

Recent work on the aetiology of genital lesions shows general agreement that pyometra is caused by a combination of hormonal and bacterial factors (Asheim 1965; Grindlay, Renton and Ramsay 1973; Hardy and Osborne 1974).

a) Hormonal Factors

Pyometra is a metoestral disease and since circulating progesterone levels are highest during this phase of the oestral cycle, excessive release of progesterone from retained or cystic corpora lutea is considered to be a major factor in the pathogenesis (McEntee 1970; Hardy and Osborne 1974). The direct action of progesterone on the endometrial glands increases their secretory activity (Roberts 1971).

It also inhibits the relaxation of the cervix and myometrial contractility, thus preventing adequate drainage of uterine secretion.

The importance of progesterone in the development of pyometra is indicated by a number of clinical observations which are related to progesterone compounds given to suppress or delay oestrus (Anderson, Gilmore, and Schnelle 1965; Brodey and Fidler 1966; Withers and Whitney 1967; Brodey 1968). There are various reports about the pathological changes in the uterus induced by progestagens. Withers and Whitney (1967) stated that among 86 bitches given medroxy progesterone acetate to control oestrus, one bitch developed chronic endometritis and two developed cystic hyperplasia of the endometrium. This agrees with the observation of Brodey (1968) that cystic glandular hyperplasia and pyometra could develop after the use of long-acting synthetic progesterone compounds. In clinical studies in which 700 bitches received megestral acetate (Ovaban, Schering Corp.) the incidence of pyometra was 0.6 per cent (Wildt and Seager 1977). On the other hand proligestone (Delvosteron, Mycofarm Ltd.) was claimed to be safe in comparison with other progestagens (Van Os and Oldenkamp 1978). They also stated that the percentage of uterine disorders among 776 bitches treated with proligestone alone was 0.3%, or 3.6% in the case of 307 bitches previously treated with other progestagens. According to Dow (1959b)lesions identical to those observed in naturally occurring pyometra were produced experimentally by the administration of progesterone to ovariectomized bitches. Teunissen (1952), Dow (1959b)and Knecht (1966) agreed that a prolonged influence of progesterone seems necessary to produce pyometra and that the process is enhanced by the presence of oestrogen. This seems to agree with recent reports about clinical cases of

pyometra which have been under oestrogen therapy. Dürr (1975) and Borresen (1979) have reported that among 406 and 119 cases of pyometra 28.5% and 14% respectively had been under oestrogen therapy.

b) Bacteria

It is generally accepted that endocrine disturbances are the primary factors responsible for pyometra and bacteria, usually E. coli, are secondary invaders of the uterus (Teunissen 1952; Dow 1959a, Brodey and Fidler 1966). The bacterium most frequently isolated from the uterus in canine pyometra is E. coli (Asheim 1965; Grindlay et al 1973). Less frequently isolated bacteria include staphylococci, streptococci, proteus spp, klebsiella spp, and salmonella spp (Hardy and Osborne 1974). As the variety of bacteria isolated increased, it became apparent that no aetiological specificity could be given to any of them (Dow 1957). Dow also stated that failure of experimental bacterial production of pyometra was considered final proof that bacteria were not the only factors involved in the genesis of the disease.

3. Pathogenesis

a) Ovarian Lesions

Lesbouyries and Berthelon (1936) and DeVita (1952) observed that an ovariectomised bitch will not develop pyometra. On the other hand one or more corpora lutea were found in the majority of naturally occurring pyometra cases (Dow 1957; Rieck 1959). The hypothesis was put forward that the development of cystic corpora lutea is related to insufficient release of luteinising hormone from the adenohypophysis during oestrus (McEntee 1970).

Hyperoestrogenism was considered by Erichsen (1952) as the cause for development of the disease. He also stated that in aged bitches with partial inhibition of ovulation both cystic follicles

and fresh corpora lutea were found. Christie, Bell and Parkes (1972) have found that the progesterone levels in pregnant, cycling and pyometra bitches are similar.

b) Pathogenesis of Uterine Lesions

Cystic endometrial hyperplasia is characterised grossly by the presence of a thickened endometrium with many cystic, irregular elevations covering the endometrial surface (Smith and Jones 1973). Cystic endometrial hyperplasia was produced experimentally in ovariectomised bitches by the administration of progesterone (Dow 1959b). These lesions developed more rapidly in bitches which were pretreated with oestrogen. Dow also stated that by increasing the dose of progesterone, acute inflammatory lesions were superimposed on cystic endometrial hyperplasia. Dow (1957, 1958, 1959b)concluded that empyema of the uterus is not an isolated condition but only one stage in a series of pathological changes. He divided the development of pyometra into four stages. Type 1 is a cystic hyperplasia of the endometrium without superimposed inflammatory reaction. Type II has a diffuse plasma cell infiltration superimposed on the cystic hyperplasia of the endometrium. Type III shows an acute endometritis superimposed on the cystic hyperplasia. Type IV animals present a chronic endometritis with atrophied endometrium in cases with a patent cervix showing a chronic vulvar discharge (open cases) and a paper-thin uterine wall in cases with no vulvar discharge and extensive pus accumulation within the uterus (closed cases).

Type I

The haemogram is usually normal in these dogs, and radiographic evidence of uterine enlargement is evident only following induction of pneumoperitonium during oestrus or metoestrus.

Type II

Vaginal discharge is the only consistent clinical sign. Lesions usually develop approximately 40 to 70 days following oestrus. Haemogram reveals a mild neutrophilia.

Type III

Dogs are clinically ill showing vaginal discharge, occasional vomiting and abdominal distension. Such cases are usually examined between 15 and 45 days after oestrus. Haemogram in such cases shows moderate to severe immature leucocytosis.

Type IV

The magnitude of systemic clinical signs depends on the degree of cervical patency. Dogs with a closed cervix are extremely toxic. White blood cell counts generally are between 20,000 and 70,000/cumm, or sometimes even higher. Dogs with this type of pyometra are usually examined between 55 and 90 days post-oestrus.

4. Clinical Presentation

Animals are usually over six years of age and have not been in good health since the last oestrus (Low 1954; Dow 1957; Ewald 1961; Roberts 1971). The usual signs of illness are depression, anorexia, vaginal discharge, vomiting, diarrhoea, polydypsia and polyuria (Walker 1965; Sumner-Smith 1966; Hardy and Osborne 1974). Animals with closed pyometra show a more severe clinical picture such as a distended abdomen, marked depression with anorexia, vomiting, increased thirst and polyuria and are sometimes severely dehydrated and anaemic (Fowler 1964; Asheim 1965; Whitney 1969). Pyometra is less common in cats, which can remain asymptomatic for long periods (Merck 1979). Cases of true pyometra in the cat at times show very little beyond distension of the abdomen and marked loss of hair coat (Sumner-Smith 1965). He also stated that

symptoms of pyometra are cyclical and there is often a discharge for 2-3 weeks, the distension subsides and little else is observed until the next cycle.

5. Diagnosis

A diagnosis of pyometra can usually be established on the basis of history, physical examination, clinical signs, laboratory data and radiology.

a) History

The history of the patient is extremely important in arriving at a diagnosis (Low 1954). There is usually a history of oestrus several weeks to two months before the onset of clinical signs.

b) Physical examination

A number of abnormal findings are commonly detected by physical examination.

i) Vaginal Discharge

The vaginal discharge varies considerably in nature from thin mucoid and cream coloured to greenish-chocolate coloured containing small clots of blood, while some discharges are foetid (Whitney 1956; Sumner-Smith 1965). The condition of these dogs varies from apparent good health to a variable degree of depression (Walker 1965).

ii) Dehydration

The percentage of dehydration can be approximately determined by relating the percentage of body water deficit to total body weight (Osborne, Low and Finco 1972) and classified into four grades.

iii) An enlarged uterus may be detected by careful abdominal palpation to avoid uterine rupture (Whitney 1956; Ewing, Schechter, Whitney and Wind 1970). Palpation is greatly facilitated by prior emptying of the bladder and colon (Sumner-Smith 1965). According

to Wright (1950) rectal palpation with the patient's fore quarters raised makes the uterus more accessible.

iv) Temperature

Temperature records in cases of pyometra are of little prognostic value due to the fact that thermal reaction is extremely variable but subnormal temperature indicates a guarded prognosis (Whitney 1956) and was invariably observed in severely toxic animals (Hardy and Osborne 1974).

c)Laboratory Findings

The clinical laboratory findings with their coverage of haematology, blood biochemistry, urinalysis and bacteriology can contribute much in clinical study of pyometra (Rehfeld 1954).

i) Haematology

The examination of blood samples is of considerable value since there is a marked leucocytosis (Whitney 1956; Schalm 1973).

According to Bloom (1944) the total white blood count in 5 cases of pyometra averaged 99.480/cumm, with range of 48,800 to 166,400/cumm. In contrast, another series of 20 cases had an average of 27,560/cumm with a range of 10,500 to 101,00 (Lacroix 1952). The total white cell count depends on the presence or absence of secondary bacterial infection and an open or closed cervix, but the usual range for all types is from 20,000 to 100,000/cumm (Smith 1965: Brodey 1968). A shift to the left, toxic changes and disturbed maturation levels of neutrophilic cells are considered as characteristic features in pyometra of the dog and cat (Bloom 1954; Schalm 1965).

The packed cell volume (PCV) helps to asses the haemodynamic status of the animal (Walker 1965). If the normal range is taken as 40-45%, then a PCV of 55% is an indication of haemoconcentration.

ii) Blood Biochemistry

. Blood Urea Level

The estimation of blood urea is a simple test for the evaluation of renal function and a guide to the prognosis (Renton, Douglas and Watts, 1971; Osborne and Hardy 1974).

iii) Urinalysis

Accurate evaluation of fluid requirement is dependent on the patient's renal function capacity (Osborne, Low and Finco 1972). This could be determined by estimation of blood urea and complete urinalysis -

1. Low specific gravity (1.001 to 1.006)
2. Mild to moderate proteinuria
3. Mild haematuria

iv) Radiography

Diagnosis of pyometra cannnot be based only on radiography which is a valuable aid in conjunction with other clinical evidence (Smith 1965). Pyometra is evidenced radiographically by the presence of an enlarged uterus (Kealy 1979). It is seen in the caudal abdomen as a large coiled mass that displaces the small intestine cranially. According to Kealy (1979) it is usually not possible to distinguish enlargement due to pregnancy from that due to pyometra unlessfoetal ossification has taken place. Pressure applied to the caudal abdomen by means of a wooden spoon or other radiolucent implement may improve visualisation of the uterus by displacing the small intestine and the bladder from it (Walker 1965; Hardy and Osborne 1974; Kealy 1979).

v) Recently two new laboratory tests using serum were suggested by Kivisto, Vasenius and Sandholm (1977) to be of value for diagnosing pyometra. Their aim is to estimate the total serum γ-globulin

as well as specific antibodies against a common E. coli antigen. It is known that enteric E. coli bacteria give rise neither to high levels of circulating antibody nor to a urinary tract infection. On the other hand elevated E. coli antibodies have been observed as a result of pyometra (Asheim 1965). This was confirmed by the detection of precipitating antibody against E. coli from the serum of pyometra-infected bitches (Asheim 1965). E. coli strains associated with pyometra belong to different serotypes (Wilkinson 1974) but a thermolabile antigenic factor was detected recently by Sandholm, Vasenius and Kivisto (1975) and shown to be common to all the E. coli strains isolated from the uterine content. In this respect the glutaraldehyde test was used for the detection of γ-globulin. Immunological techniques were also employed for the detection of specific E. coli antibody (Sandholm and Kivisto 1975).

6. Treatment of Pyometra

a) Medical Treatment

Four different methods have been tried:

1. In open cases daily oral treatment with ergot alkaloids with antibiotics has been given in order to promote the expulsion of exudate from the uterine lumen and prevent further infection (Hardy and Osborne, 1974).

2. An initial injection of oestrogen followed by parenteral administration of oxytocin and antibiotics for several days with the same purpose as in (1), is also limited to open cases (Cseh and Horvath, 1957; Mathews 1962; Mowdy 1963; Fidler, Brodey, Howson and Cohen 1966). Reports as to the effect of this regime vary and even successful cases often need repeated treatment periods to cure the disease.

3. Testosterone propionate, given intramuscularly twice a week until symptoms have disappeared, gave acceptable results in both open and closed cases of pyometra (Spy 1966). Improvement occurred in seven of ten cases but follow-up studies indicated a high recurrence rate and a low incidence of return to normal breeding.

4. Intravenous administration of Malucidin, a yeast extract which is believed to suppress bacterial toxin production, has been tried in 23 bitches (Linde 1966). The extract also has a direct effect on the uterus, dilating the cervix and stimulating uterine contractions. Of the 15 bitches that did not require subsequent surgery, the majority recovered and several subsequently produced healthy litters.

b) Medico-Surgical Treatment consists of removing the corpora lutea, replacing the ovaries in the bursae, emptying the pus-filled

uterus and giving antibiotic treatment post-operatively (Ewing, Schechter, Whitney and Wind 1970). Of three reported cases, complete recovery was seen in one case.

c) Surgical Treatment

Ovariohysterectomy seems to be the most common therapy of canine pyometra (Tufvesson 1953; Hardy and Osborne 1974). When performed in conjunction with adequate fluid therapy, the method is considered safe and efficient. Marsupialisation or creation of utero-abdominal fistula can be a useful operation for the relief of pyometra under certain emergency conditions. According to Williams (1947) this operation may be performed quickly and easily under local anaesthesia with or without premedication. The uterus is drained through the fistula and usually clears itself completely within three or four days. The patient is relieved from the urgency of radical operation and time is gained to overcome dehydration, toxaemia or shock before completing hysterectomy at a later date. Adhesions between the uterus and the abdominal wall may present some difficulty, being considered a disadvantage of this operation (Williams 1947).

Operative Technique

1. Preparation of Operative Field

Skin preparation has been described (Shuttleworth and Smythe, 1960; Archibald, 1965; Hickman and Walker, 1973) and involves clipping, scrubbing and skin disinfection with cationic detergent and bactericidal compounds (e.g. Cetavlon I.C.I.). After positioning for surgery a 2% iodine alcohol or 1% chlorhexidine gluconate in spirit solution is applied.

2. Draping

Sterile cloths or disposable drapes are usually applied

around the operative field.

3. Surgical Approach

There are five basic approaches available 1) midline through the linea alba, 2) paramedian through the rectus sheaths and muscle, 3) pararectus through the rectus sheath only, 4) transverse across muscle fibres of rectus muscles and 5) sublumbar flank incision.

Each approach has advantages and disadvantages in so far as approach to the abdominal organs and facility of wound closure and good healing are concerned.

In canine patients the midline is preferred because there is less tissue to cut through, less haemorrhage and healing is very rapid, providing septic infection does not occur (Hobday 1953; Armistead 1954). It is however claimed that this incision favours wound disruption and prolapse of the intestine (Dollar 1950).

In transverse incision, more haemorrhage is encountered and more tension is exerted upon sutures following closure of the wound (Archibald 1965). On the other hand, a transverse incision heals considerably stronger than the midline incision (Wianko et al 1961).

After a flank incision the incidence of herniation is low, but is still possible, though unlikely to be catastrophic (Hickman and Walker 1973). In the flank it is preferable to use a blunt technique for separation of the muscles to avoid haemorrhage and in addition the muscle fibres fall back for suturing when the retraction tension is released (Archibald 1965). In a paramedian incision (as shown in Fig. 1b) there is less likelihood of wound breakdown if the operation is done with minimal tissue contusion. However it is accompanied by profuse bleeding (Berge and Westhues 1966).

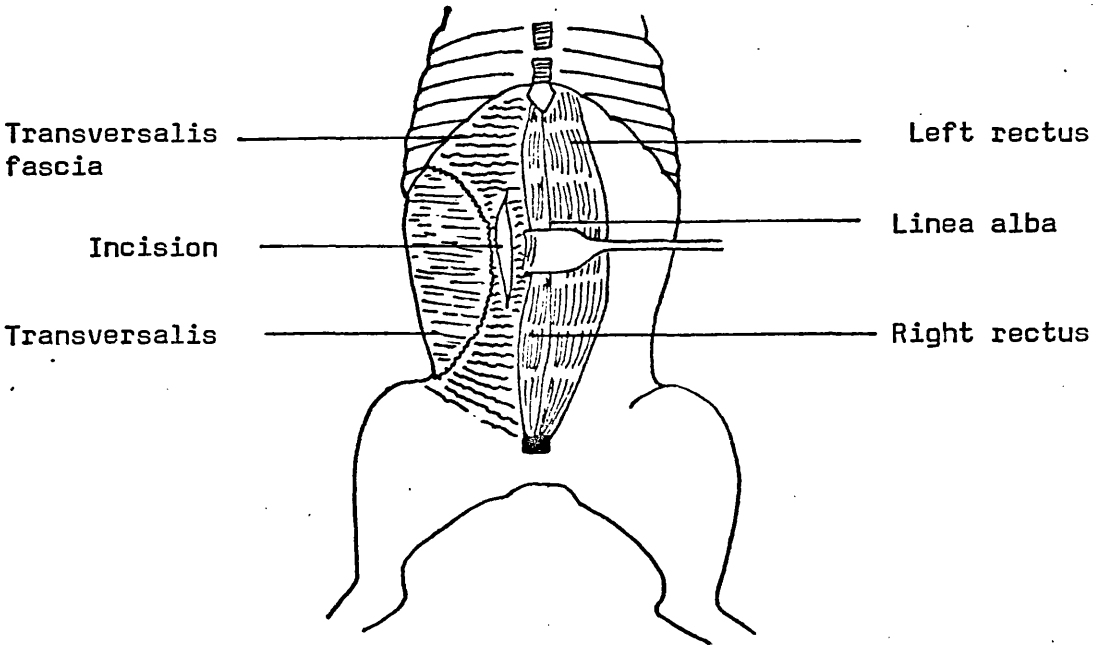


Fig. 1a Abdominal section, pararectal incision

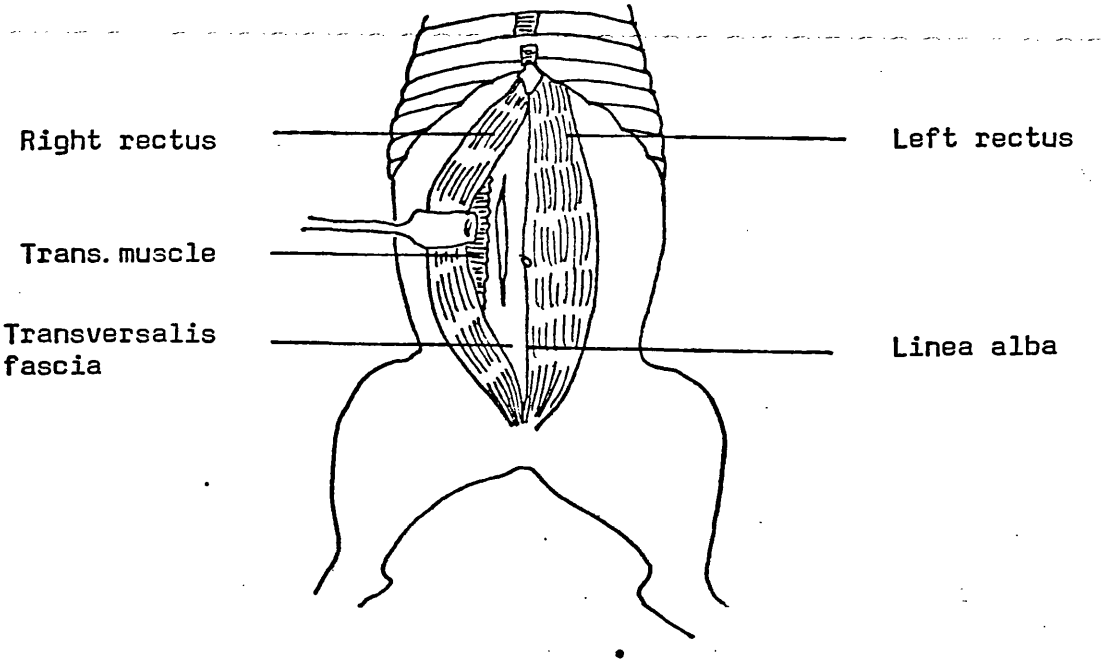


Fig. 1b Abdominal section, paramedian incision

In the cat, flank incision is frequently used but in cases of pregnancy or pyometra a midline incision is preferred (Shuttleworth and Smythe 1960).

Ovariohysterectomy

Ovariohysterectomy is the surgical removal of the ovaries and the uterus (Hobday, 1953; Archibald, 1965).

A. Removal of Ovaries

1. The ovary is resected between two ligatures, one including the utero-ovarian artery and vein. The second is tied round the proximal end of the uterine horn and the middle uterine artery (Berge and Westhues, 1966).

2. Three Forceps Tie

In this technique the ovary is resected between the middle and the distal forceps (Archibald, 1965). The proximal forceps, nearest to the patient, forms a groove for the ligature, the middle forceps serves to hold the stump for ligation and the distal forceps prevents back-flow of blood from the severed vessels, as shown in Fig. 2.

B. Removal of the Uterus

1. Site of Transection

In the case of pyometra and caesarean hysterectomy, transection is made caudal to the cervix (Merillat 1931; Smythe 1931; McCunn, 1932; Wright, 1933).

Transection according to Hobday (1953) is made around the body or the cervix of the uterus just below the junction of the two horns.

2. Ligation of the Uterine Vessels

Separate ligation of the uterine vessels on each side of the

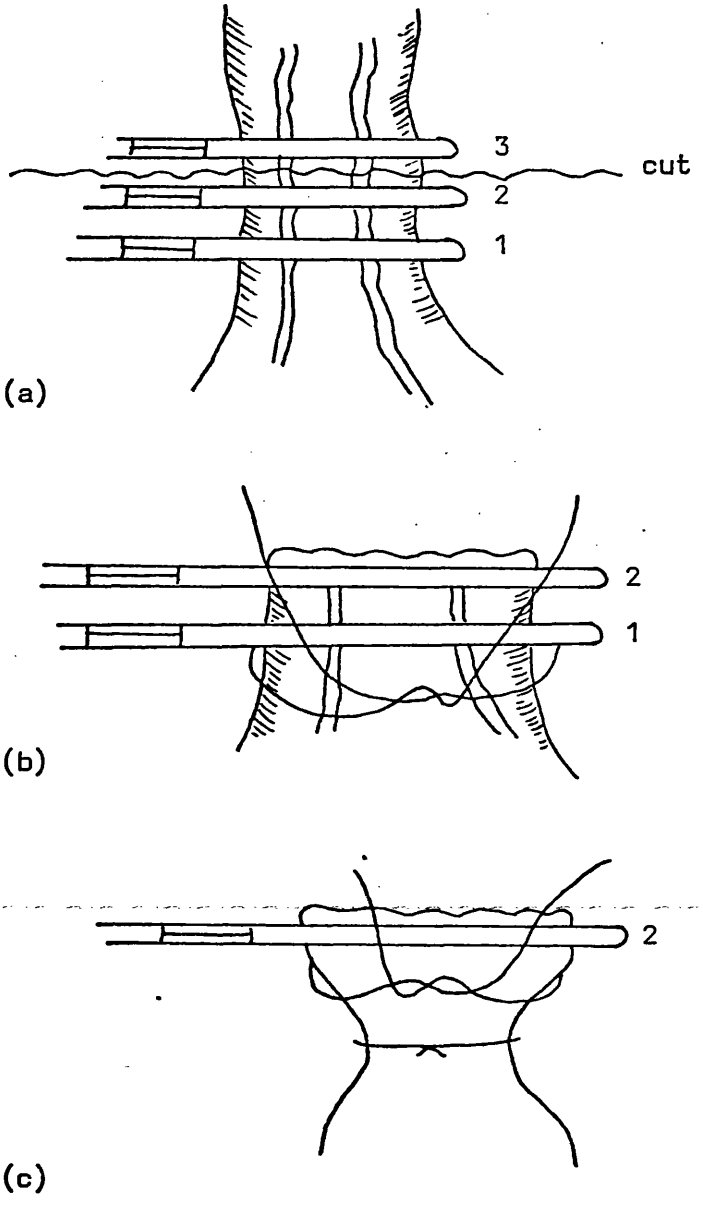


Fig. 2 Three forceps method of ligating ovarian pedicle

vaginal stump is more reliable (Pearson, 1973). He found that a slack transfixing ligature will not prevent bleeding and has the added disadvantage, especially in cases of pyometra or gravid hysterectomy, of possibly becoming contaminated in the vaginal lumen.

C. Closure of the Uterine Stump

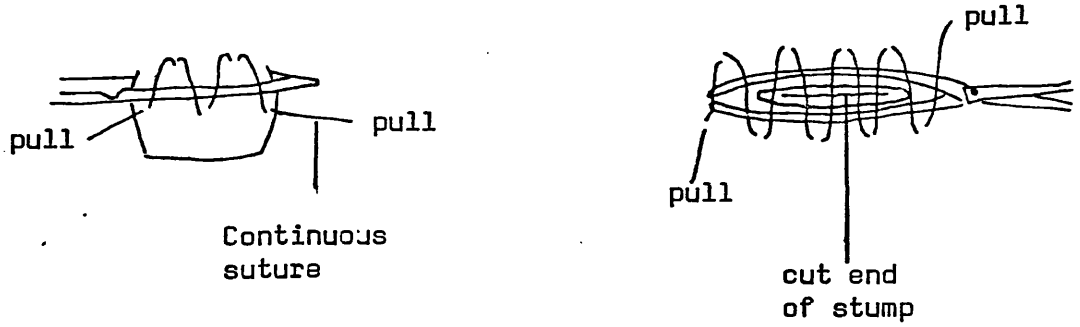
Merillat (1931) described several techniques for dealing with the uterine stump: mortification, cauterisation, invagination, peritonisation, disinfection and marsupialisation.

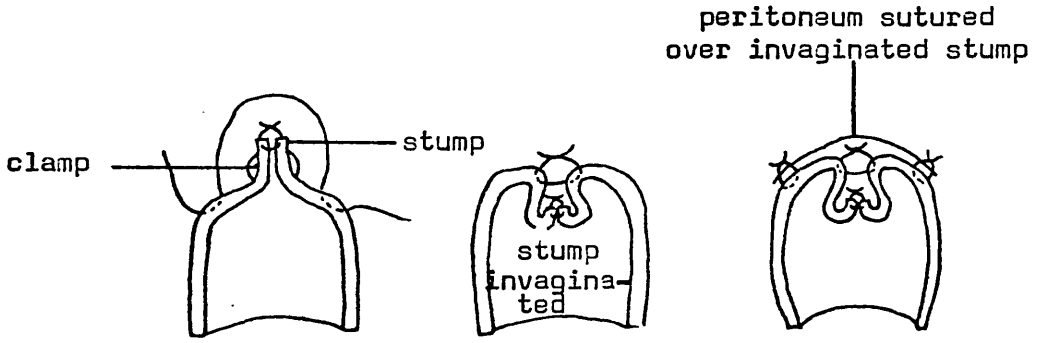
These techniques were criticised by Wright (1933). He stated that marsupialisation causes wound problems and delays healing, while cauterisation and mortification of the stump are followed by sloughing and leave undesirable dead tissue inside the abdomen.

A flap technique is used by Wright (1933) for closure of the uterine stump. The point of section is made by dorsal and ventral flaps through the anterior vagina immediately behind the cervix. To close the stumps three or four sutures are inserted through the serous and muscular layers. This technique allows the removal of the uterus as a sealed sac and reduces the risk of peritoneal contamination to a minimum.

Different techniques were used by Smyth (1931) for invagination of the stump, as shown in Fig. 3.

In one, a ligature was applied around the vagina and a constricting suture was passed through serosa and muscular layer midway between serosa and mucosa, then passing through the vaginal lumen to be inserted in a similar manner on the other side (i.e. muscular and then serous layer). When these sutures were drawn tight and firmly tied, the lateral serous surfaces were brought into apposition. This was followed by simple interrupted Lembert sutures, including the serous and muscular layers only.





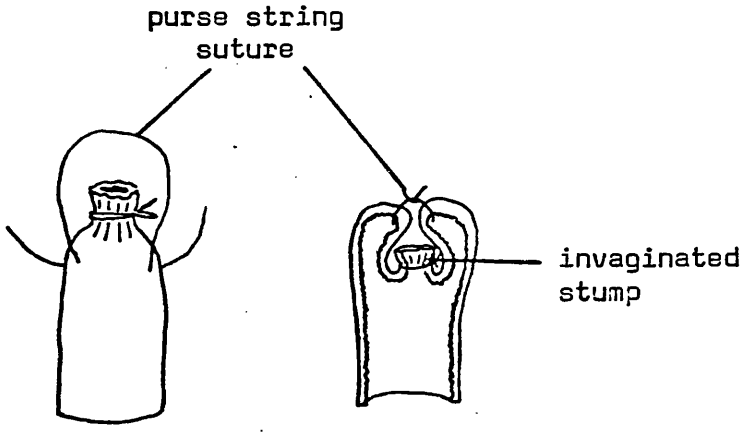


Fig. 3 Methods of invaginating a uterine stump

McCunn (1932) did the same, but used a clamp on the stump and over-stitched it. Marsupialisation, or pouching of the uterine stump is another technique described by Merillat (1931). In this technique the uterine stump is fixed into the abdominal wall by threading each end of the uterine ligature into a needle and drawn from within outward through the cutaneous edges of the wound.

As a final stage the stump can be sealed by using peritoneum or omentum (Hobday, 1953). Archibald (1965) stated that closure of the stump can be done by using an inverting Cushing type catgut suture while a Crile clamp is applied on the stump.

Complications of Ovariohysterectomy

Complications of ovariohysterectomy are classified into two groups: immediate and delayed.

A. Immediate

1. Anaesthesia

Anaesthetic problems are more likely to occur in patients with uraemia, dehydration or anaemia (Armistead, 1954).

2. Haemorrhage

Haemorrhage is caused by improper ligation of the ovarian and uterine vessels (Dorn and Swist, 1977). These authors found that haemorrhage during ovariohysterectomy was encountered in 4.1% of bitches.

3. Shock

Surgical shock is a severe risk in ovariohysterectomy for pyometra and Armistead (1954) recommended careful pre-operative treatment of toxaemia, dehydration and anaemia. Hardy and Osborne (1974) found that this supportive pre-operative treatment was frequently life-saving.

4. Peritonitis

Peritonitis associated with pyometra is primarily related to leakage of the uterine content into the peritoneal cavity when the uterine body is excised or as a result of inadvertent rupture of the

abnormal uterine wall (Smith 1965; Hardy and Osborne 1974).

5. Incisional Hernia

Henderson (1952) reported two cases of disrupted surgical wounds causing herniation of the abdominal contents following hysterectomy for pyometra.

The incidence of abdominal wound disruption is approximately 0.5% with a mortality rate of 25-40% (Archibald, 1965).

B. Delayed Complications

1. Adhesions

Madsen (1953) stated that some suture materials constantly produced a very marked and prolonged exudation and therefore are liable to cause wound suppuration and intraperitoneal adhesions.

Pearson (1973) found that intestinal and peritoneal adhesions had an incidence of 5.5% among 72 referred cases with different complications.

2. Flank Sinuses

Cawley and Archibald (1958) described a series of five animals with eight discharging sinuses in the paravertebral fossa. All these sinuses contained some form of non-absorbable suture material. Their cases were claimed to have resulted from contamination of the suture before or during the surgical procedure.

In 20 cases of ovarian and uterine ligature sinuses Pearson (1970) found that these sinuses had resulted from suppuration caused by tissue reaction to non-absorbable suture material.

3. Urinary Incontinence

In a follow-up examination of 209 cases of pyometra which were treated surgically, Tufvesson (1953) found urinary incontinence in 3 cases among 9 animals with different post-operative complications. The attribution of this symptom to ovario-hysterectomy is somewhat controversial (Joshua 1965). According to

Bloom (1954) urinary incontinence following ovariohysterectomy could be attributed to hormonal imbalance, or the involvement of the urinary bladder in adhesions as a result of chronic peritonitis, due to ligation of the uterine stump with silk. The exact mechanism responsible for urinary incontinence has not beenestablished. However oral administration of 0.1 to 1.0 mg per day of diethylstilbestrol for 3 to 5 days, followed by a maintenance dosage of 1.0 mg per week usually results in remission of the incontinence (Osborne 1971; Oliver and Brodley 1974).

4. Recurrent Oestrus

Post-operative oestrus in the bitch is always due to functional ovarian tissue which remains after incomplete removal of the ovaries (Archibald, 1965; Brodey and Harvey, 1971). These authors recommended surgical removal of the remaining ovarian tissue as the only satisfactory treatment.

Suture Materials

Several authors have investigated the various complications commonly associated with surgical closure of wounds and most of them attributed them to the suture material and the suture technique (Wianko, Kling and Mackenzie, 1961; Alexander, Kaplan and Altemeier, 1967; Ludewig, Rudolf and Wangensteen, 1971).

Sutures are made of both absorbable and non-absorbable materials.

A. Absorbable Materials

Madsen (1953) investigated the reaction of the tissue to various suture materials and the retained tensile strength in loops of suture fascia, and reported a clinical analysis of wound complications in 1211 human patients after closure with plain catgut, chromic catgut and perlon. He found that plain catgut produced a marked exudative tissue reaction with a wide reaction zone

and delayed formation of collagen. This reaction to plain catgut decreased the tensile strength of the wound, the tensile strength of the suture diminished rapidly due to suture absorption and the knots tended to slip. These findings agreed with the results previously obtained by Localio, Casale and Hinton (1943).

Postlethwait, Schauble, Dillon and Morgan (1959) studied the effect of different suture materials on the rabbit and agreed with the results reported by Madsen (1953) and Localio et al (1943). In addition, they reported that teflon caused a little tissue reaction and maintained its tensile strength well, but a tendency for the knot to slip and untie was a disadvantage.

Wianko, Kling and Mackenzie (1961) also reported that plain catgut was totally unreliable as it caused a marked tissue reaction and was absorbed long before wound tensile strength was adequate to prevent dehiscence or herniation. They found also that infection and peritoneal adhesions were frequent when catgut was used.

Alexander et al (1967) studied the different suture materials in relation to wound infection. They found that between types of catgut both chromic and iodised catgut resisted infection better than did plain catgut. The frequency of occurrence of wound complications in connection with plain catgut, chromic catgut and braided nylon was recorded by Munksgaard (1952) and is shown in the following table.

TABLE 1

Complications	Plain catgut	Chromic catgut	Braided nylon
Exudate	25.0	17.7	7.8
Disruption and herniation of the wound	3.1	3.5	1.0
Cicatricial pain	19.8	10.9	9.5
Unsightly scars	5.0	3.6	2.1
Extrusion of the suture	4.2	6.1	10.5

Frequency of Occurrence of Wound Complications (%)

Polyglycolic acid suture material was studied by Echeverria and Jimenez (1970) who found that this non-toxic, non-collagen product is flexible and can be handled like silk. They found also that this suture material is stronger than a similar gauge of catgut and the total absorption time was found to be as long as approximately 60 days. This suture material causes less tissue reaction but loses its tensile strength much more rapidly than chromic catgut, and the knot tends to slip and untie (Knecht, Welser, Allen, Williams and Harris, 1975).

B. Non-Absorbable Materials

These materials are not absorbed or digested by the tissues. To demonstrate the advantages of non-absorbable suture materials in comparison to absorbable materials Madsen (1953), in a series of experiments, inserted monofilament nylon and 3 different types of catgut into fascial wounds in rats, rabbits, and pigs. He found that non-absorbable sutures stimulated slight exudation, a small reaction

zone and rapid formation of collagen. Accordingly, the strength of the tissue was not much impaired, the suture retained its tensile strength and the knots were safe (except with monofilament synthetic fibres).

Narat, Cangelosi and Belmonte (1956) found the tensile strength and frictional coefficient of dacron to be superior to that of cotton and silk. In addition dacron did not fray, was not affected by repeated autoclaving and was well tolerated by the tissues.

Usher and Wallace (1958) reported that teflon and dacron showed less foreign body reaction than nylon, orlon and marlex when placed in the peritoneum of dogs. According to Postlethwait et al (1959) the major disadvantages of synthetic sutures were the tendency for knots to slip and the untying of the sutures in the tissues.

These synthetic materials should not be used for suturing mucous membranes (Gierloff, 1973). Chromic catgut should be used for suturing the gastro-intestinal tract, urinary bladder, whereas for contaminated and accidental wounds, polypropylene and stainless steel, or monofilament nylon is preferred (Madsen, 1950; Usher, Allen, Crostwait and Cogan, 1962).

A fine single strand of nylon or polypropylene is preferred in cases involving very thin skin such as laparotomy in cats (Gierloff, 1973).

Fisfis (1967) used stainless steel wire (32-34 gauge) in the deep tissue and in the skin for closing the abdomen after ovariohysterectomy for pyometra. He found that there were few problems with dehiscence, licking of the incision, or tearing out of the stitches. Stainless steel is a desirable suture material because it does not provoke a tissue reaction according to Cowley (1967), who found that multistrands were preferred for clean wounds, but not

for infected wounds. Monofilament wire has no capillary attraction and Cowley found it superior for contaminated wounds.

MATERIAL AND METHODS

1. RETROSPECTIVE CASE INVESTIGATION

One hundred and thirty six cases of pyometra were referred to Glasgow University Veterinary Hospital during the period of 1972 to 1979. Information collected from these cases was tabulated. Different laboratory examinations were carried out before surgery. Post-operative complications including fatalities were assessed.

2. CLINICAL CASES

Twenty cases of pyometra (19 dogs and 1 cat) were admitted for surgical treatment during the period October 1978 to October 1979. The following examinations were carried out:-

a) Bacteriology

Swabs were taken for bacteriological examination from the abdominal cavity and the uterine content.

Methods

1. Aerobic culture on sheep blood agar or MacConkey agar for pus on swab.

2. Swabs from peritoneal cavity, vagina, uterine stump.

a) If material was obvious on the swab a Gram smear was made.

b) Anaerobic culture on blood agar, or aerobic culture on horse blood or MacConkey agar.

c) Bacteria were identified by colonial morphology and appearance on relevant media and confirmed by methods of Cowan and Steel (1974).

b) Pathology

The uterus and both ovaries underwent gross and microscopic pathological examination.

c) Haematology

Blood samples from each case were examined for:

1. Leucocyte count, total and differential

2. Haemoglobin (Hb)

3. Packed cell volume (PCV)

d) Blood Biochemistry

Biochemical analysis was made for the estimation of blood urea, electrolytes and total protein.

1. Blood urea : Technicon, method AA11-1;

2. Electrolytes : Flame photometry Carning 920;

3. Total protein : Technicon, method AA11-14.

e) Radiological Examination was carried out using the lateral view of the abdomen (equipment : Hellophos, Siemens).

3. CURRENT STANDARD TECHNIQUE FOR PYOMETRA

a) General Anaesthesia

Seventeen dogs were premedicated by Acepromazine (Acepromazine maleate, C-Vet Ltd.), dose 0.1 mg/kg. Atropine sulphate (Atropine Sulphate v Bimeda) was used in one dog and one cat. Premedication was not used in one dog. In 15 dogs anaesthesia was induced by thiopentone sodium (Intraval sodium, May & Baker), dose 25 mg/kg. Saffan, (Glaxo) was used in one cat, dose 9 mg/kg. A mask induction was used in four dogs. After intubation, anaesthesia was maintained with halothane (Fluothane I.C.I.) and oxygen in 14 dogs and 1 cat, and with halothane, nitrous oxide and oxygen in 5 dogs via a semi-closed circle absorber or a to- and-fro system depending on body weight.

b) Preparation of the Operative Field

The hair was removed by clipper blade and the clipped area was cleansed with surgical scrubbing agent.

c) Surgical Technique

A midline abdominal incision was used in all cases. Where the uterus was greatly distended, the incision extended from the umbilicus to the brim of the pubis. After opening the abdomen and exteriorising the uterus the three forceps tie method (3 pairs of Spencer-Wells artery forceps), was used to remove the ovaries by cutting the ovarian ligament between the second and the third forceps. Chromic catgut 2/0 was then placed around the ovarian ligament and vessels proximal to the first and the second forceps as shown in Figure 4a . While the first forceps was being loosened this ligature was tied.

After the ovaries were removed the broad ligament was severed with scissors, and both horns were reflected backwards to expose the cervix. After separately ligating the middle uterine vessels two Spencer-Wells artery forceps were placed on the anterior vagina and the uterus was removed by cutting between the forceps, as shown in Fig. 4c, d.

The uterine stump was closed with an inverting Cushing catgut suture. Before replacing the uterine stump inside the abdomen it was checked for bleeding, as shown in Fig. 4e, f.

Closure of the abdominal wall was made with simple interrupted sutures using 2/0 blue nylon for peritoneum and linea alba, simple continuous sutures for subcutaneous tissues and sub cutis using 2/0 chromic catgut and simple interrupted suture with armofil for the skin.

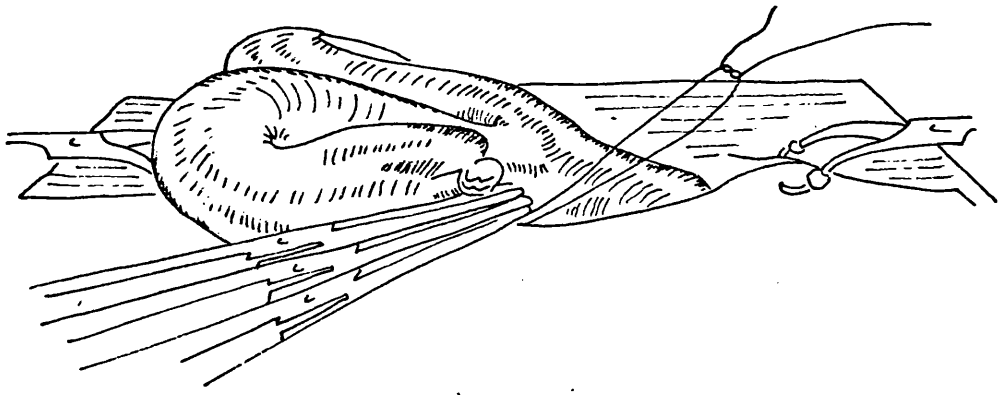


Fig. 4a Placing ligature

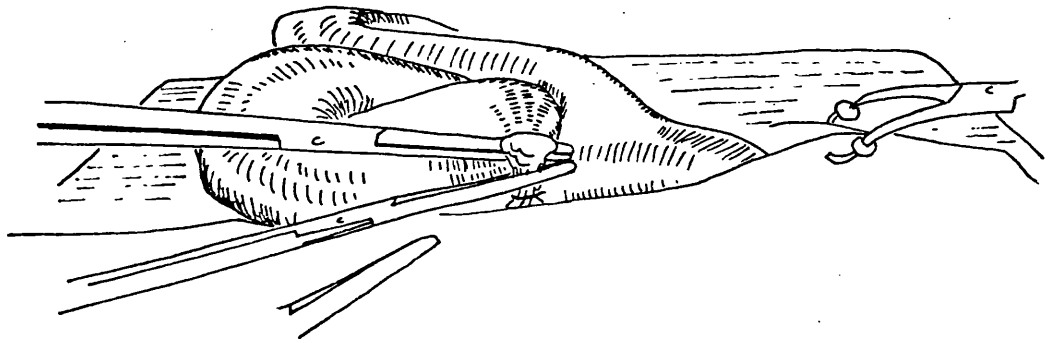


Fig. 4b Ligature above has been tied

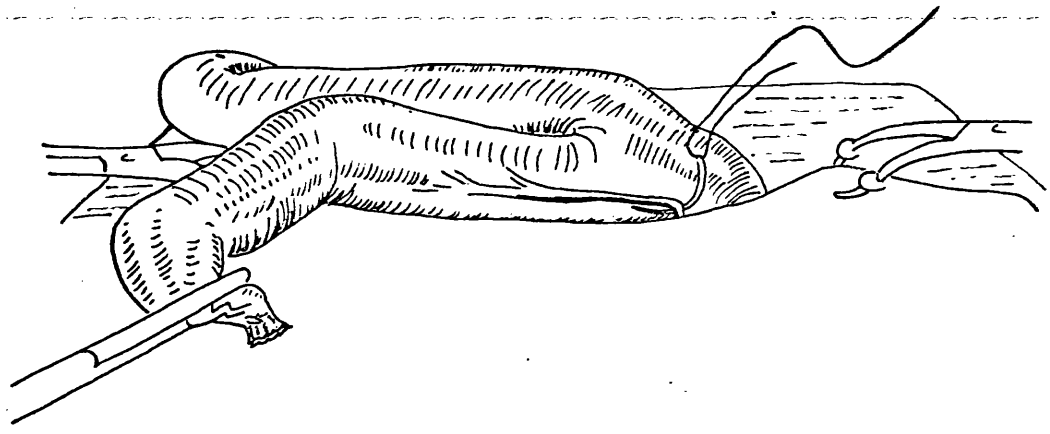


Fig. 4c Ligating uterine vessels

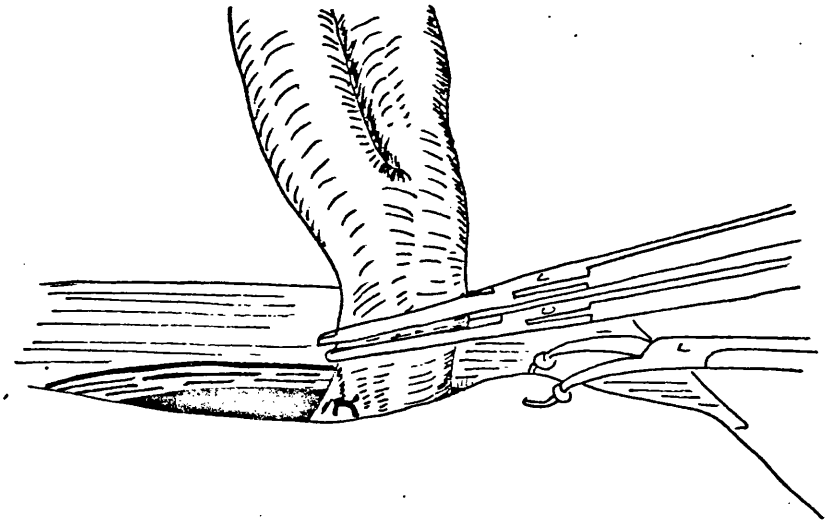


Fig. 4d After ligation of uterine vessels, the body of the uterus is divided between forceps

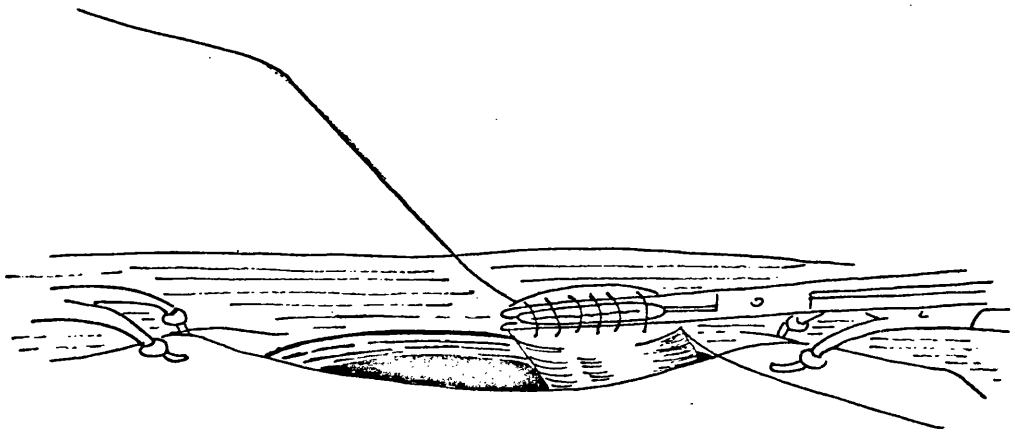


Fig. 4e Cushing sutures for inverting uterine stump

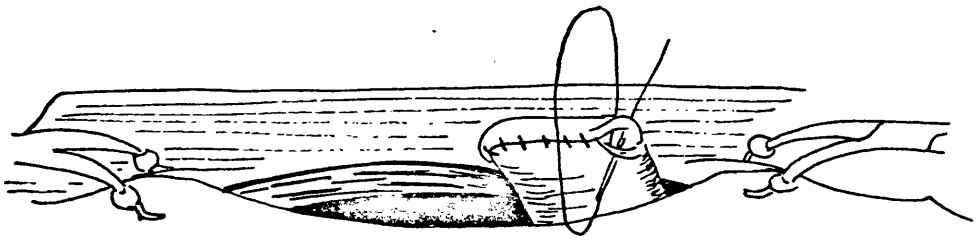


Fig. 4f Completing the inversion of the uterine stump

4. METHODS OF POST-OPERATIVE ASSESSMENT

The patients were checked daily during their post-operative recovery in the hospital which lasted from two to seven days. Subsequent to discharge a post-operative follow-up of cases was done. The owners were contacted by mail or telephone.

5. SURGICAL EXERCISES

a) Materials

1. 15 recently killed dogs.
2. Surgical instruments -

Bard-Parker scalpel handle and blades

Spencer-Wells artery forceps

Mayo scissors

Allis tissue forceps

Mayo - Hegar needle-holder

Mayo - half-curved, cutting edge needles

Mayo - half curved, round body needle

b) Methods

Two techniques were used -

a) Midline incision was used on ten dogs. The ovaries and the uterus were removed as described above.

b) Flank incision was used on five dogs. Two methods were carried out for entering the abdomen through the flank.

1. Using a Bard-Parker scalpel for cutting through the muscles, firstly the external and internal oblique and secondly through the transverse muscle and peritoneum (3 cases), as shown in Fig. 5
2. In this method with Mayo scissors blunt separation of the muscles was carried out (2 cases), as shown in Fig.6a, b.

In both methods the ovaries and the uterus were removed in the manner already mentioned.

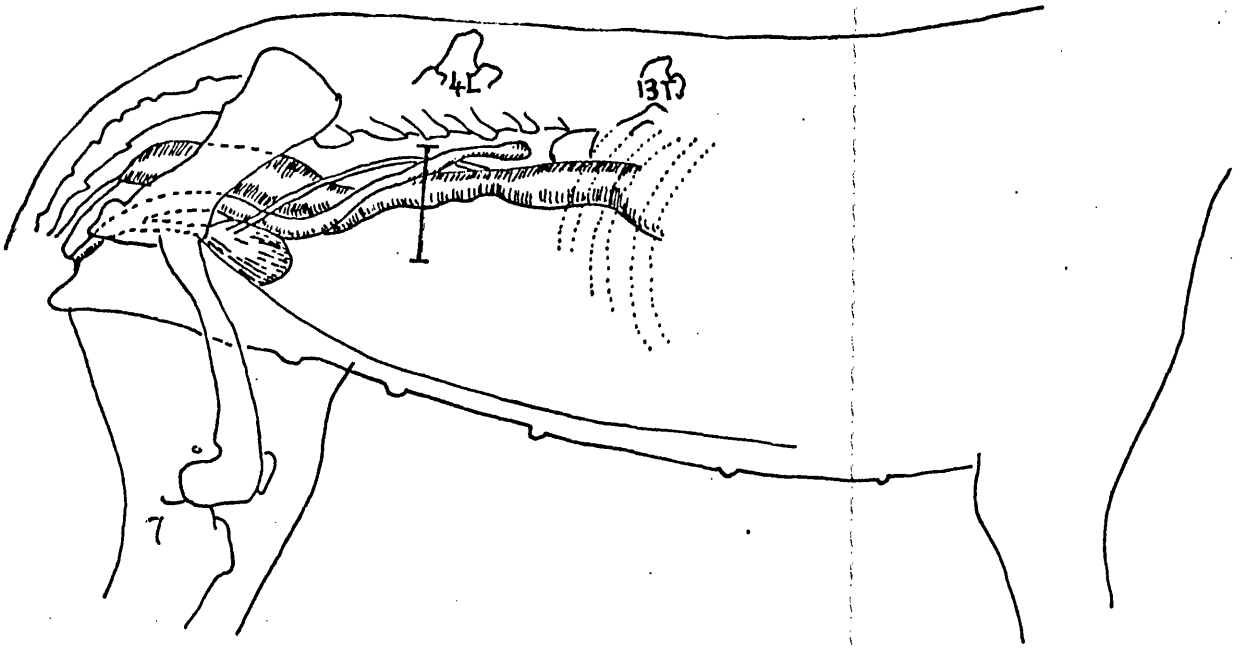


Fig. 5 Position of flank incision for ovariohysterectomy in the bitch

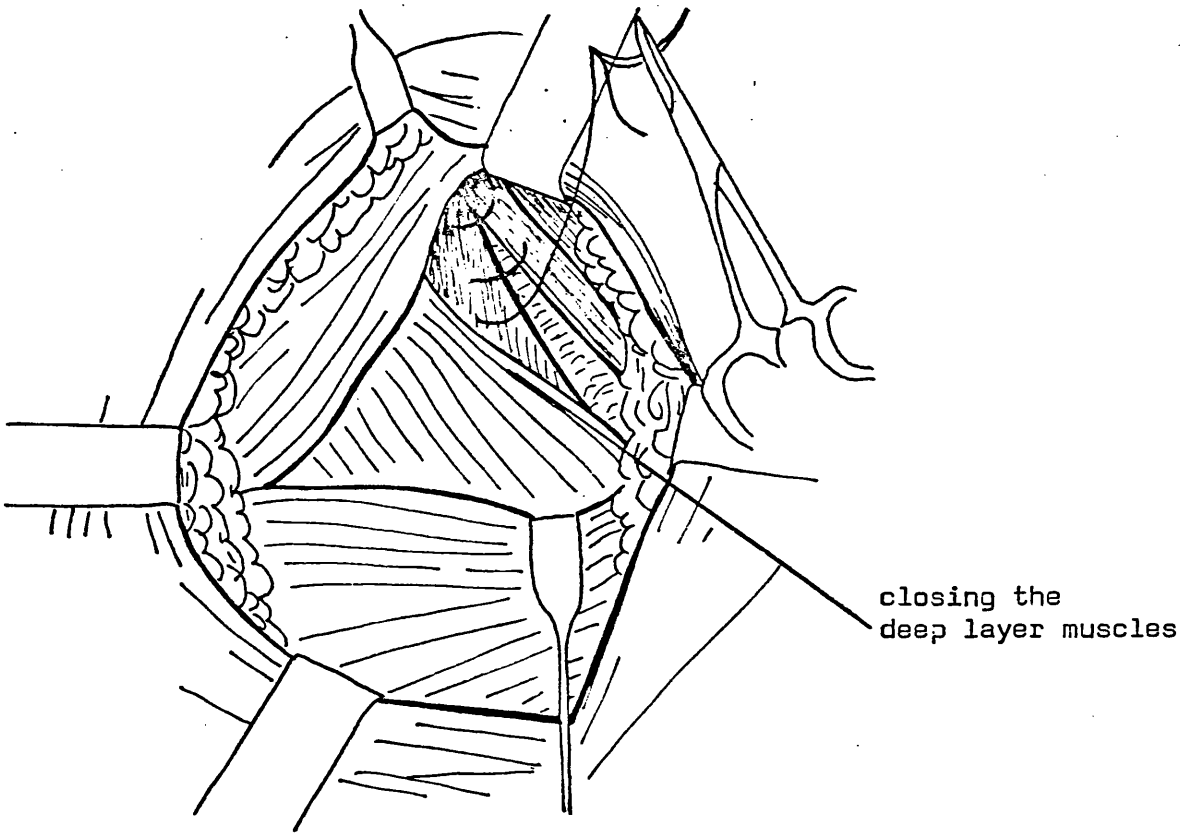


Fig. 6a Closing an incision in the flank. The transverse abdominal muscle and its attached peritoneum are being closed

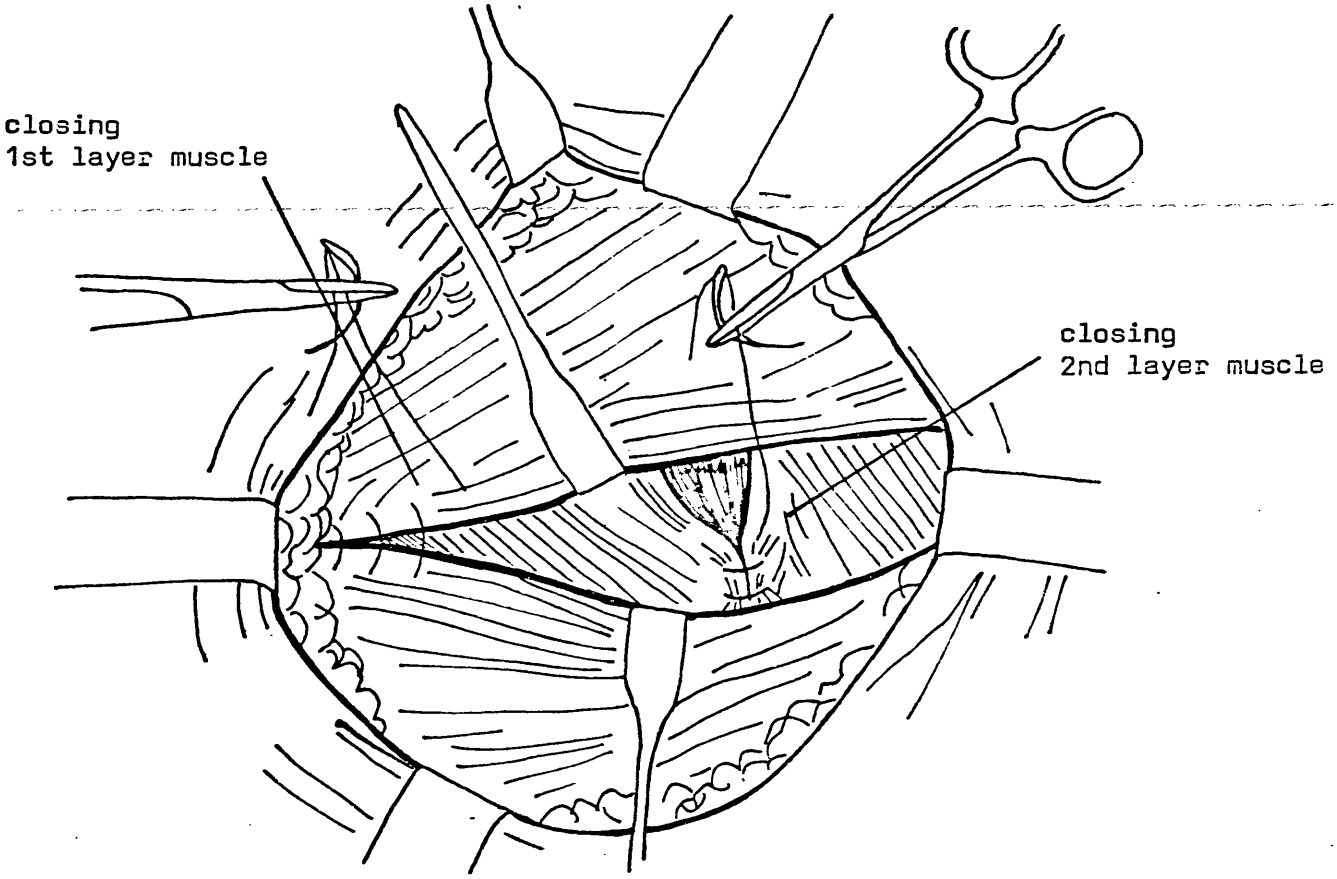


Fig. 6b Closing an incision in the flank. The internal abdominal oblique muscles are being closed

RESULTS

RETROSPECTIVE CASE INVESTIGATION

During a seven year period from 1972 to 1979, 15,193 dogs and cats were seen at the Surgery Department, University of Glasgow Veterinary Hospital. Of those animals, 124 dogs and 12 cats were treated surgically for pyometra.

The incidence of pyometra among dogs and cats in relation to the total number of either species admitted was 0.9% and 0.7% respectively, as shown in table 2.

TABLE 2

	Dogs	Cats	Total no. of Dogs and Cats
Total cases admitted	13,420	1,773	15,193
Total surgical treatment for pyometra	124	12	136
Proportion treated for pyometra (%)	0.9	0.7	-

Incidence of pyometra in total number of dogs and cats admitted during period 1972-1979 at Glasgow University Veterinary Hospital.

One hundred and one dogs (81.5%) survived surgery and were discharged. 23 cases (18.5%) died before discharge from hospital.

Of the cats, 9 survived and 3 cases died after the operation as shown in Figure 7. The mean age of surviving dogs was 8.8 $\pm$ 3.3 years and 11.5 $\pm$ 4.1 years in the dead cases (Figure 8.). Figure 9 shows that the causes of death in 23 dogs were uraemia, destruction, septicaemia, peritonitis, uterine stump infection and haemorrhage. The causes of death in cats were pyelonephritis, peritonitis and septicaemia (one case each).

Time of death in relation to surgery is given in Table 3 which

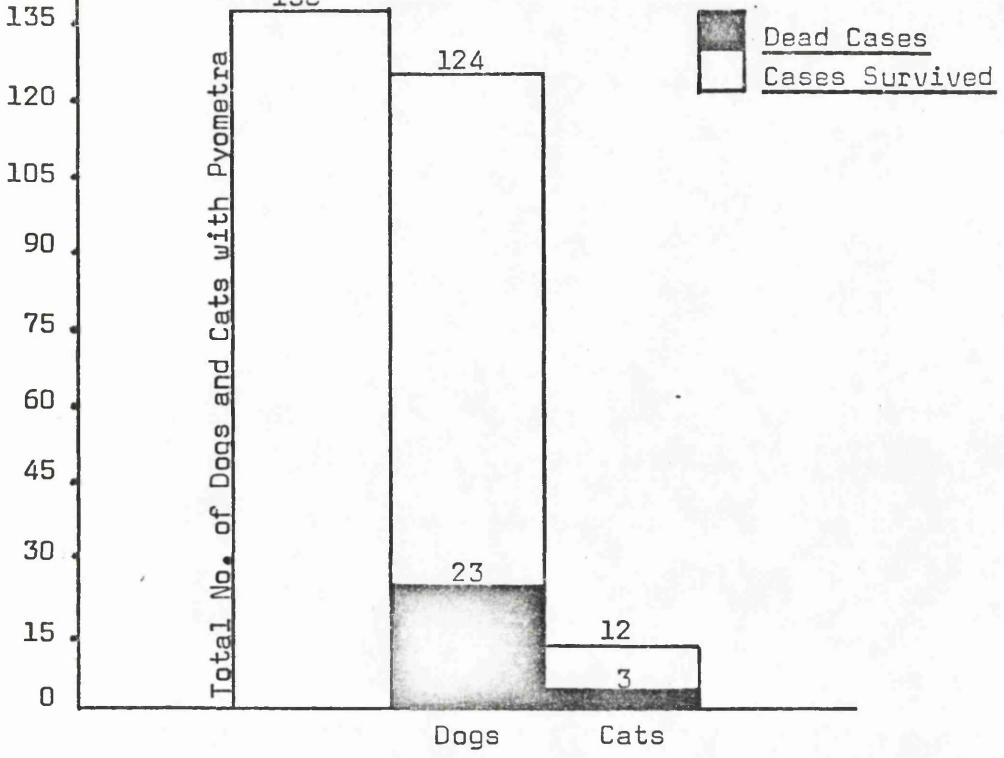


Fig.7 Number of deaths in dogs and cats

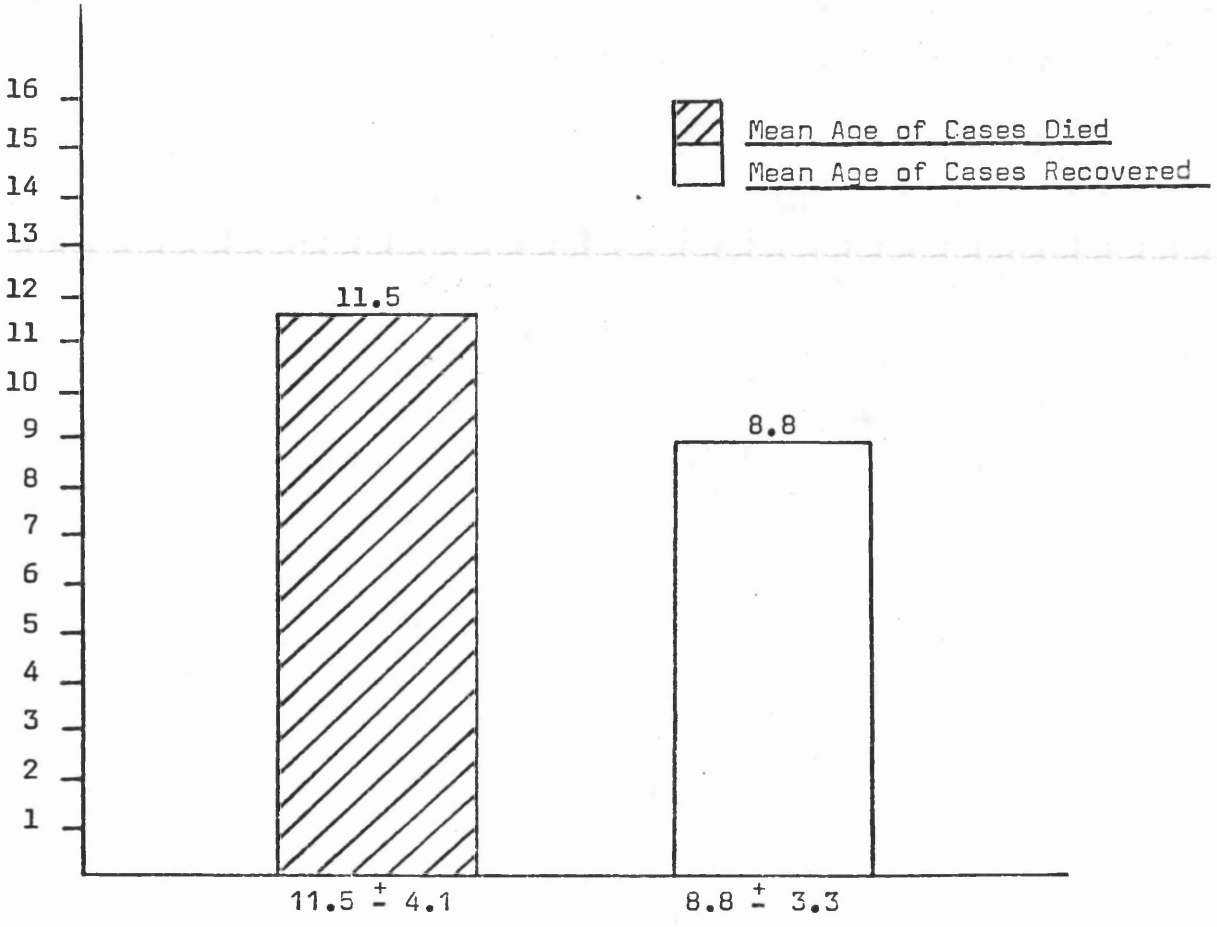


Fig. 8 Mean ages and standard deviation of dead and recovered cases.

shows that 5 dogs died on the operation day, 5 dogs died one day post-operatively (P.O.), 3 dogs died 2 days P.O. and 10 dogs died 3-7 days P.O.

TABLE 3

Number	Animals* Condition Before Surgery	Post-operative death							
		Same Day	1	2	3	4	5	6	7
5	Very poor	+							
5	Poor		+						
3	Poor			+					
2	Poor				+				
2	Poor					+			
2	Fair								+
4	Poor						+		
* Assessed by anaesthetist immediately before induction									

Condition of dog and day of post-operative death in 23 cases subjected to ovariohysterectomy for pyometra

The incidence of pyometra in relation to the breed is given in Table 4 which shows that the highest incidence of pyometra was in mongrel dogs, followed by Labrador, Cairn, Poodle, Alsatian and Border Collie. The other pure breeds were represented by four dogs each (Retriever, Beagle, W.H.W.T. and Sheltie), followed by Stafford Bull Terrier, Cocker Spaniel, Basset, Keeshund and Wire Haired Fox Terrier.

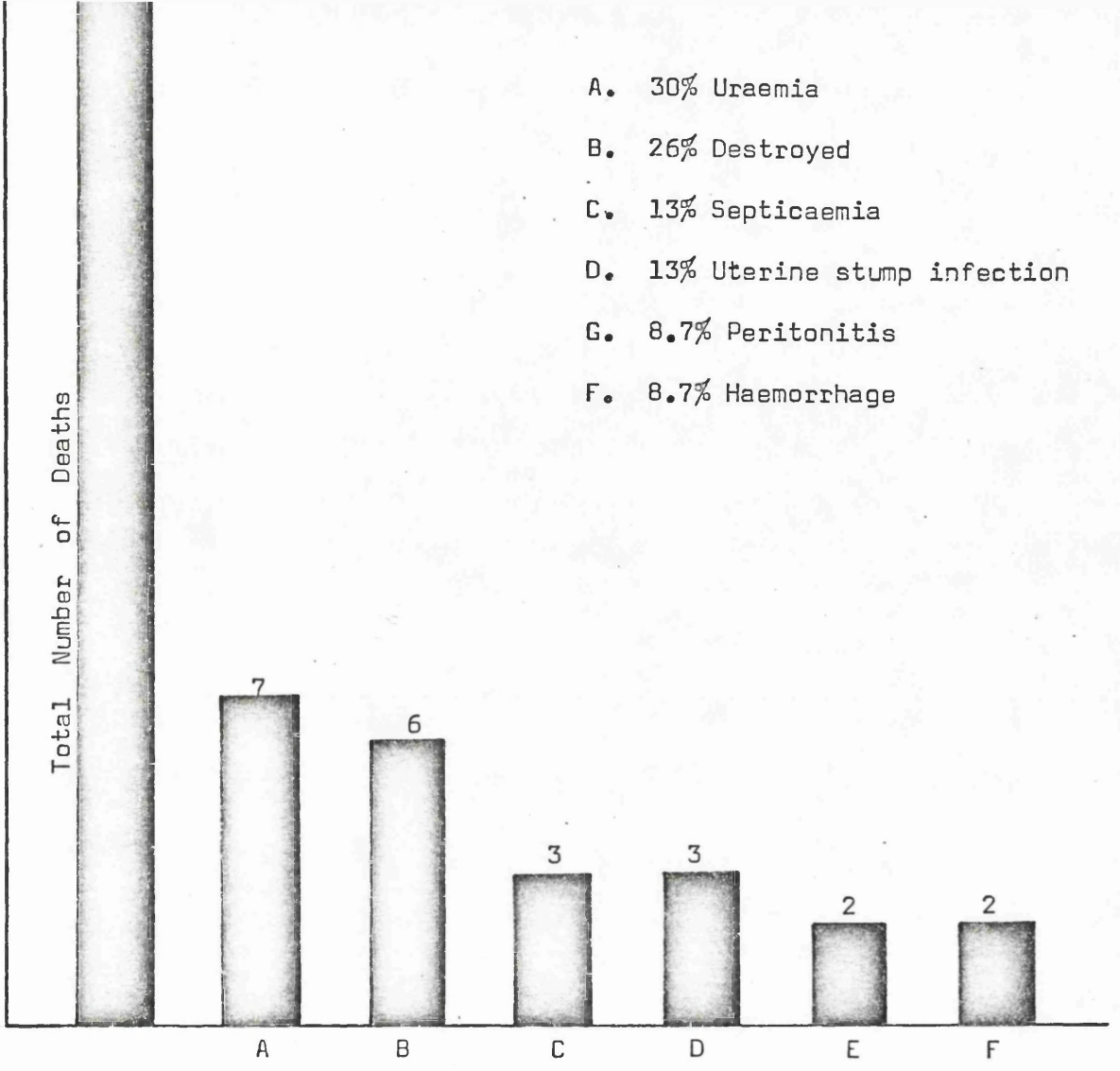


Fig. 9 Causes of deaths of 23 dogs

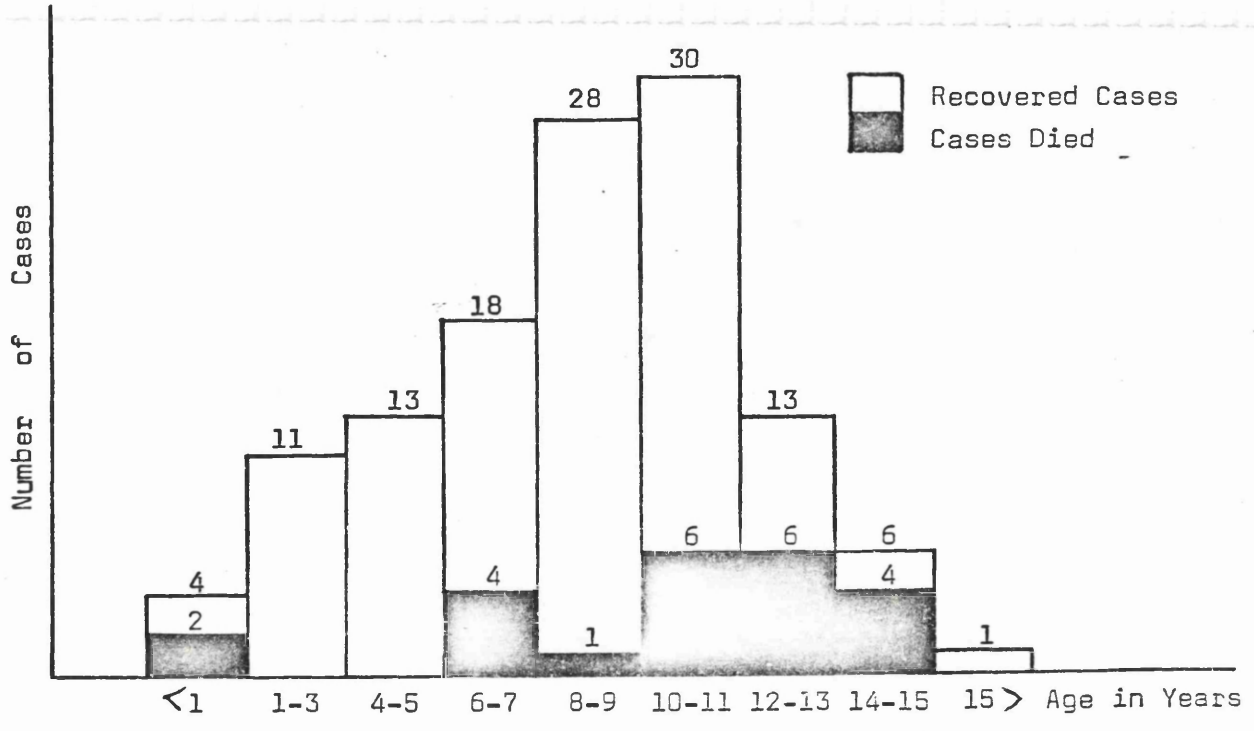


Fig. 10 Age groups of dead and recovered cases

TABLE 4

Breed	Number	Percent
1. Border Collie	8	6.4
2. Retriever	4	3.2
3. Stafford Bull Terr.	3	2.4
4. Mongrel	34	27.4
5. Poodle	9	7.3
6. Labrador	19	15.3
7. King Charles Spaniel	2	1.6
8. Beagle	4	3.2
9. Alsatian	8	6.4
10. Cocker Spaniel	3	2.4
11. Basset	3	2.4
12. Keeshund	3	2.4
13. Sheltie	4	3.2
14. Wire Haired Fox Terr.	3	2.4
15. Westie (W.H.W.T.)	4	3.2
16. Cairn	9	7.3
17. Other breeds - one for each	4	3.2

Incidence of Pyometra in relation to breed.

The age range was from 8 months to 17 years (Figure 10). This figure shows the different age groups and the proportion which died.

The urea level in the fatalities recorded as 'uraemia' is given in Table 5, which shows that it varied from 20 mmol/1 to 102.9 mmol/1 (mean and S.D. 53.47 $\pm$ 25.67).

TABLE 5

No.	Age (Yrs.)	Urea mmol/l	Post-operative Death
1	15	58.8	Destroyed
2	10½	102.9	Died on 3rd day
3	13	57.3	Died on 3rd day
4	10	52.3	Died after 24 hours
5	12	36	Died after Operation
6	15	47	Died on 4th day
7	10½	20	Died after 1 week

Blood urea level in 7 dogs which died due to uraemia.

The results of complete blood cell count and blood urea are given in Table 6 which shows the PCV. ranges from 34%-55% (mean 47.1 $\pm$ 3.3). The total white cell count ranges from 8-108 x 10^3 per cu. mm. (mean 47 $\pm$ 10). Blood urea ranges from 5-102.9 with a mean and S.D. 25.6 $\pm$ 12 mmol/l.

TABLE 6

	PCV %	Urea mmol/l	Total White Cell Count per cmm.
Mean	47.1	25.6	47 x 10^3
Range	34-55	5-102.9	8-108 x 10^3
S.D.	3.3	12	10

Total white cell count, PCV and blood urea in 23 cases which died after surgery at Glasgow University Veterinary Hospital from 1972 to 1979.

The type and frequency of bacteria which were isolated by culture from the uterus of 70 cases of canine pyometra are shown in Table 7.

TABLE 7

Organism	Cases Affected *	% of Isolates as % of 70 cases
E. coli	50	57.5
Staphylococci	14	16.1
Streptococci	12	13.8
Proteus spp	3	3.4
Klebsiella	2	2.3
Pasteurella	1	1.1
No Growth	5	5.7

* Of 124 cases evaluated, a positive bacterial culture was obtained from 70.

* Total does not equal 70 since mixed population of bacteria was detected in 12 cases

Type of bacteria isolated by culture from the uterus of 70 cases of canine pyometra at Glasgow University Veterinary Hospital.

POST-OPERATIVE ASSESSMENT

Follow-up was carried out on 37 animals. The indications for surgery are shown in Table 8.

TABLE 8

No. of dogs and cats	Indication for surgery
19 dogs 1 cat	Pyometra
7 dogs	Routine ovariohysterectomy
9 dogs 1 cat	With post-operative complications following ovariohysterectomy

Indications for surgery in 35 dogs and 2 cats at Glasgow University Veterinary Hospital.

This indicates that 19 dogs and 1 cat underwent surgery for treatment of pyometra. Routine ovariohysterectomy was performed in 7 dogs. Exploratory laparotomy was done in 6 dogs and 1 cat, for the removal of a retained ovary in 3 dogs and 1 cat, abdominal adhesions in 1 dog, incisional hernia in 1 dog and suspected uterine stump infection in the last dog. Wound exploration was carried out on 3 dogs.

The incidence rate of complications among the different breeds is given in Table 9.

TABLE 9

Breed	Number in Population	Percent of total Population	Number with complications by breed	Percent with complications by breed
Mixed	11	29.7	8	61.5
Alsatian	4	10.8	2	15.4
Labrador	3	8.1	2	15.4
Boxer	3	8.1		
Other Pure Breeds	14	37.8	1	7.7
Short Hair Domestic Cat	2	5.4	-	
Total	37	100.0	13	100.0

Incidence of complication in relation to breed

This table shows that among the 37 cases which were treated surgically and discharged from the hospital, 13 cases developed complications. Eight were mongrels (61.5%), 2 were Alsatians (15.38%), 2 were Labradors (15.38%) and one from other pure breed (7.7%).

Ages ranged from 10 months to 15 years. The proportion of complications in relation to age is given in Figure 11.

Post-operative complications involving 13 dogs are given in Table 10.

TABLE 10

Complication	14 yrs 1	8yrs 2	11 yrs 3	6 yrs 4	1½ yrs 5	13 yrs 6	6 yrs 7	10 yrs 8	1 yr 9	1½ yrs 10	10 yrs 11	3 yrs 12	7 yrs 13
Delayed healing, incision swelling and drainage	+ve	+ve			+ve	+ve				+ve			
Wound disruption and herniation			+ve										
Vaginitis													+ve
Incontinence	+ve												
Vaginal discharge	+ve							+ve			+ve		
Haematuria							+ve						
Change in behaviour			+ve		+ve				+ve				
Weight gain												+ve	
Euthanasia				+ve*					+ve**				+ve***

* Chronic diarrhoea unrelated to surgical procedure
** Dog became vicious and aggressive
*** Corneal ulcer in both eyes

Results of post-operative follow-up for 35 dogs and 2 cats.

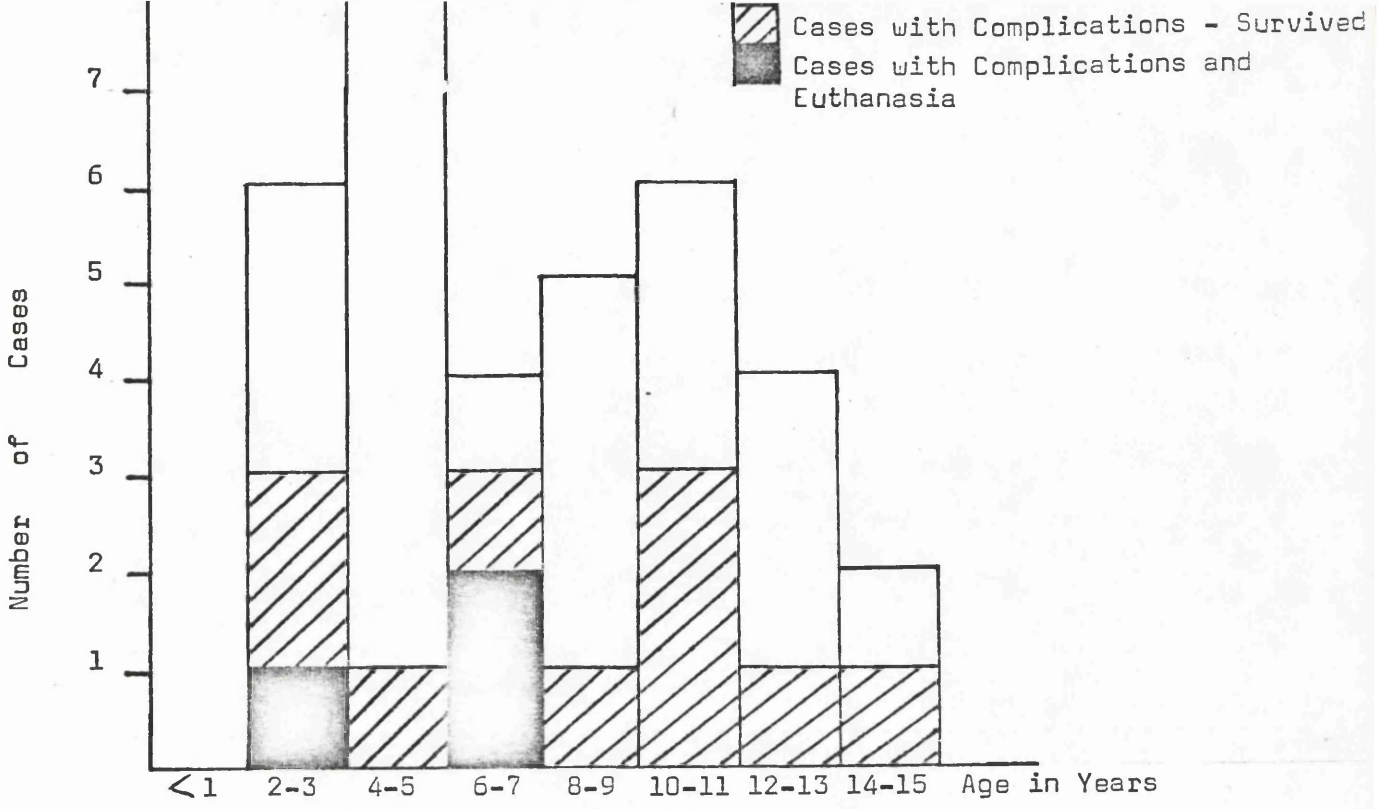


Fig. 11 Results of follow-up in 37 animals

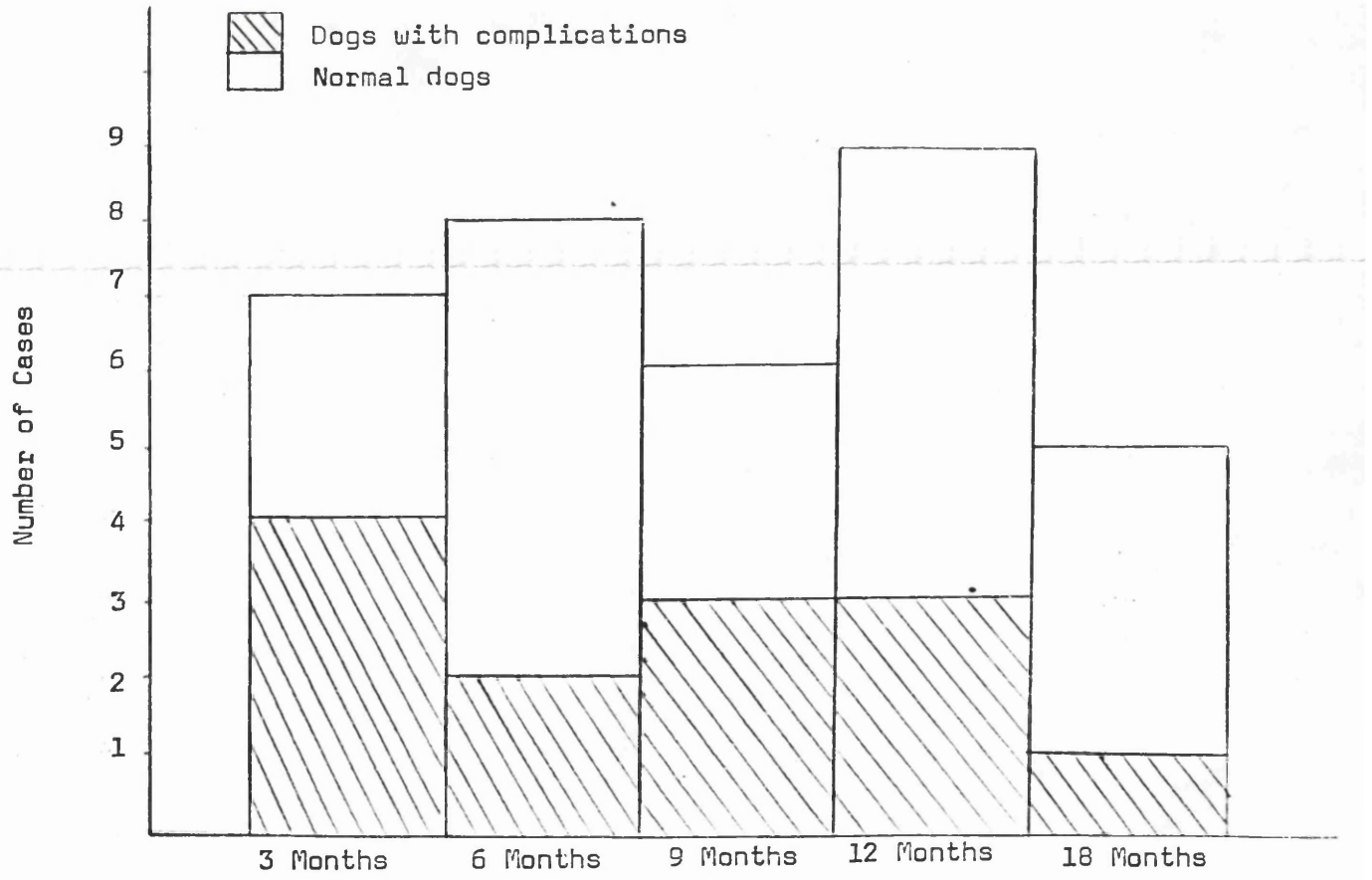


Fig. 12 Various periods of follow-up.according to the initial date of surgery in 37 animals.

These complications were delayed healing, incision swelling and drainage, wound disruption, incontinence, vaginal discharge, haematuria, change in behaviour and weight gain.

Thirty five dogs were divided into 5 groups according to the date of the initial surgery as shown in Figure 12.

The incidence rate of complications in relation to the surgical procedure is given in Table 11.

Table 11

Reason	Number	Percent	Numbers with Complications	Percent with Complications
Pyometra	20	54.1	10	50%
Routine O.V.H.	7	18.9	2	28.6%
Post-operative wound problem	3	8.1	-	-
Retained ovary	4	10.8	1	25%
Suspected uterine stump infection	1	2.7		
Abdominal adhesions	1	2.7	-	-
Incisional hernia	1	2.7	-	-
Total	37	100.0	13	

Indication for surgery and complication rate in 35 dogs and 2 cats.

This shows that among 20 cases which underwent surgery for treatment of pyometra 10 cases had complications (50%) and in the 7 cases which were operated on for routine ovariohysterectomy 2 cases had complications (28.6%).

Complications which occurred during surgery are shown in Table 12.

TABLE 12

Complications	Number	Percent %
Anaesthetic problems	8	21.62
Haemorrhage	2	5.40
Total	10	
Normal	27	73

Surgical complications in 35 dogs and 2 cats during ovariohysterectomy at Glasgow University Veterinary Hospital

These were anaesthetic problems in 8 cases (21.62%) and haemorrhage in 2 cases (5.4%).

Surgical complications following ovariohysterectomy in Glasgow University Veterinary Hospital are shown in Table 13.

TABLE 13

Complications	Number of animals affected	Percent
Wound Swelling	6	16.21%
Wound drainage	4	10.81%
Self inflicted trauma	3	8.10%
Wound breakdown	2	5.40%
Delayed recovery from anaesthesia	1	2.70%
Total number	16	43.22%
Normal	21	56.76%

Surgical complications in 35 dogs and 2 cats following ovariohysterectomy in Glasgow University Veterinary Hospital in period June 1978 to June 1979.

These were wound swelling and drainage, self inflicted trauma and delayed anaesthetic recovery and wound breakdown.

BACTERIOLOGICAL RESULTS

Cultural examinations were carried out on the uterine content of 19 dogs and 1 cat which underwent ovariohysterectomy for pyometra at Glasgow University Veterinary Hospital. The examinations revealed a pure culture of E. coli in 12 dogs, a mixed growth of E. coli and staphylococcus aureus from 1 dog and a mixture of E. coli and β-haemolytic, group G streptococci from another. No bacterial growth was found in 5 dogs.

Examinations of the vaginal discharge of 11 cases revealed a pure growth of E. coli in 4 cases and a mixed culture in 3 cases. A pure growth of E. coli was obtained from the uterine content of 1 cat.

Bacterial swabs were taken from the abdominal cavity before and after removal of the uterus from the uterine stump and from both ovarian pedicles from 20 cases (19 dogs and 1 cat). In three cases a mixture of anaerobic bacteria, Haemophilus canis and E. coli were isolated. In these cases bacteria were actually obtained from the uterine stump. A pure culture of E. coli was isolated from the abdominal cavity and the uterine stump in 1 dog.

No bacterial growth was obtained from the abdominal cavity of the 7 cases which underwent routine ovariohysterectomy as shown in Table 14.

TABLE 14

Organism	Total No. of Isolates	Vagina	Uterus	Abdominal Cavity during surgery	
				Pyometra	Routine OVH *
E. coli	24	7	15	2	-ve
Streptococci	6	5	1	-ve	-ve
Staphylococci	3	2	1	-ve	-ve
Haemophilus canis	1	-ve	-ve	1	-ve
Anaerobic bacteria	2	-ve	-ve	2	-ve
Mycoplasma	1	1	-ve	-ve	-ve
Total no. of isolates examined	37	15	17	5	-
Pyometra	20				
Routine OVH *	7				

* OVH - ovariohysterectomy

Bateriological examination for 26 dogs and 1 cat admitted at Glasgow University Veterinary Hospital for treatment of pyometra (in 20 cases) and routine OVH in 7 cases.

The results of laboratory examinations which were carried out on 21 dogs and 2 cats admitted for treatment of pyometra and post-operative complications of ovariohysterectomy are given in Table 15.

Abnormalities were found in a few cases, as follows:

a) raised blood urea ($>$ 9mmol/l) in 3 cases

b) low plasma Cl ($<$ 95mmol/l) in 2 cases

c) low plasma Na ($<$ 136mmol/l) in 2 cases

d) raised plasma protein ($>$ 65g/l) in 5 cases and
lowered plasma protein ($<$ 65g/l) in 6 cases

e) low PCV ($<$ 37%) in 1 case and
high PCV ($>$ 55%) in 6 cases

f) leucocytosis ($>$ 18000/cu mm) in 13 cases.

TABLE 15

No.	Urea mmol/l	Na	K meq/litre	Cl	Total Protein g/l	PCV %	Total WBC 10^3cmm	Neut. %
1	15.1	121	3.5	97	53	43	92000	91
2	4.7	138	4.0	108	43	40	8000	73
3	39.1	139	6.8	84	59	33	79000	80
4	4.5	145	3.8	103	88	39	42000	84
5	1.9	141	3.5	99	66	37	8000	69
6	5.8	150	4.7	104	70	40	22000	59
7	9.2	140	3.6	113	78	40	95000	86
8	3.0	141	3.5	89	65	56	39000	71
9	4.5	138	3.9	109	61	57	11000	77
10	3.4	151	3.6	111	63	38	15000	80
11	3.3	141	3.9	97	80	59	39000	70
12	6.2	158	3.9	108	66	47	46000	80
13	1.8	145	3.9	111	63	4 8	43000	90
14	6.4	133	3.5	108	75	54	56000	68
15	4.8	155	4.6	109	57	42	18000	76
16	3.3	148	4.6	104	80	37	55000	88
17	3.5	150	3.9	109	60	55	10000	77
18	3.1	139	3.7	114	67	37	16000	79
19	5.5	146	5.2	107	63	40	21000	65
20	5	138	3.4	105	64	50	14000	73
21	6.2	140	4.3	104	70	60	9000	63
22	5.4	149	4.6	104	51	55	14000	73
23	3.4	157	4.2	108	72	58	11000	84
Mean	6.80	142.9	4.1	104.5	64.6	46.2	32.2	75.1
S.D.	7.9	8.3	0.8	7.8	10.3	8.9	27.2	8.0
Range	1.8-39.1	121-158	3.4-6.8	84-114	43-88	33-60	8-95 x 10^3	59-91

Laboratory results from 21 dogs and 2 cats admitted for surgical treatment of pyometra and post-operative complications of ovariohysterectomy at Glasgow University Veterinary Hospital in period October 1978 to October 1979.

1. Case No. 74178

Subject:

$7\frac{1}{2}$ year old Boxer bitch weight 23 kg.

History:

An ovariohysterectomy was performed but the bitch came into heat again.

Blood Results:

These were within normal limits.

Anaesthesia and Surgery:

4 mg Acepromazine were given for premedication and 10 ml. 2.5% thiopentone sodium were given to induce anaesthesia. Halothane was used to maintain anaesthesia. The animal was prepared for surgery and exploratory laparotomy was performed. The retained right ovary was located but many adhesions were present involving the bodywall, kidney and gut. Adhesions were broken down, the ovary was clamped, a double ligature was applied ('0' chromic gut) before the ovary was transected. The abdominal wall closure was done as mentioned before. Penicillin and streptomycin (P/S) was given for 5 days as post-operative treatment. The animal made an uneventful recovery and was discharged 4 days after the operation.

Follow-up after 3 months: dog was in a good condition.

2. Case No. 76554

Subject:

$1\frac{1}{2}$ year old Alsatian bitch weight 35 kg.

History:

An ovariohysterectomy was performed but the bitch came into heat again.

Blood Results:

W.B.C. 11.900 per cmm.

Differential Count:

Neutrophils	84%
Lymphocytes	14%
Eosinophils	2%
PCV	58%

The rest of the results were within normal limits.

A vaginal smear was taken and microscopical examination was carried out. Diagnosis of oestrus was confirmed by the presence of large numbers of cornified epithelial cells in the smear.

Anaesthesia and Surgery:

The animal was anaesthetised and prepared for surgery. After the abdomen was opened the right ovary was located and was found adherent to the omentum which probably was included with the ligature. The adhesion was broken down and the ovary was removed as mentioned before. P/S was given as post-operative treatment for 5 days. The animal made an uneventful recovery.

3. Case No. 74334

Subject:

10½ month old Miniature Dachshund bitch weight 3½ kg.

History:

The bitch was spayed when she was 9 months old. Two weeks after the operation she was off her food and drink, had pain on passing urine and was not passing faeces. Liquid paraffin was given. Appetite improved but still no faeces, vomiting every 2nd or 3rd day. Palpation revealed a large mass in the ventral abdomen. There was no abdominal pain.

X-Ray Reports:

There is fairly marked distension of a segment of bowel situated

ventrally, there is no evidence of any food material passing to the colon or rectum.

A barium meal with spot films taken after 3 hours demonstrates that barium has passed through the small intestine and can be seen within the descending colon and rectum. A dilated segment of bowel is situated ventral to the colon and this may be due to a low grade of obstructive lesion in the small intestine.

Blood Results:

W.B.C.	19.800	per cmm	PCV	55%
Alk. Phos.	265	i.u./l	Diff. Count:	
As. T.	44	i.u./l	Neutrophils	73%
AL. T	701	i.u./l	Lymphocytes	27%

Anaesthesia and Surgery:

The dog was premedicated with 0.25 mg ACP intramuscularly, induction of anaesthesia was with 2 ml. 2.5% thiopentone sodium. Halothane was used to maintain anaesthesia. The dog was prepared for surgery and exploratory laparotomy was carried out. Surgical findings were as follows:-

1. Left ovarian stump was normal.

2. The site of the right ovarian stump and the tip of the tail of the pancreas were adherent to the mesoduodenum and on attempting to breakdown the adhesion, a small portion of mid-jejunum was found to be connected with them at the adhesion site. There was considerable distension of the proximal portion of the mid-jejunum. The adhesion was broken down and no suture material was found, as shown in Fig. 13.

The uterine stump was adherent to the dorsal surface of the urinary bladder. After the stump had been released the abdomen was flushed with crystapen and was closed as mentioned before. As

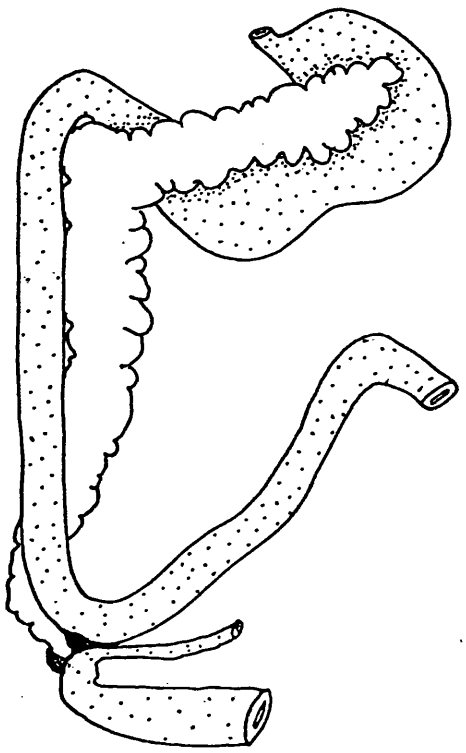


Fig. 13 – Showing site of adhesion of right ovary, tip of pancreas mesoduodenum and small portion of jejunum

post-operative treatment, the dog was given 100 ml. lactated Ringer's and was kept on chloramphenicol (Chloromycetin palmitate, Parke-Davis) for 4 days. Post-operative recovery was uneventful. The dog was checked after 3 months and was in good condition.

4. Case No. 74100

Subject:

$3\frac{1}{2}$ year old Labrador bitch weight $18\frac{1}{2}$ kg.

History:

Ovariohysterectomy was performed but the bitch came to heat again.

X-Ray Report:

On lateral view of the abdomen following vaginography the contrast material can be seen inside the vagina and there is no evidence of any abnormality in the uterine stump.

Blood Results:

Progesterone 5 nmol/l

Oestrogen 85 P mol/l

PCV 60%

Vaginal smear was taken and examined microscopically for cornified epithelium which was not abundant.

Anaesthesia and Surgery:

The dog was premedicated with 1.5 mg ACP, anaesthesia was induced with 7 ml. 2.5% thiopentone sodium and maintained on halothane. The dog underwent surgery. A small portion of ovarian tissue measuring 4 x 3 x 3 mm was present on the right side and it was adherent to the omentum. The adhesion was broken down and the ovarian remnant was removed. The dog was kept on P/S for 5 days. The dog made an uneventful recovery. The dog was checked after 3 months and was found to be in good condition.

5. Case No. 76945

Subject:

$2\frac{1}{2}$ year old short haired domestic cat weight 3 kg.

History:

Ovariohysterectomy was performed but the cat was still attractive to males.

Surgery:

The cat was anaesthetised and underwent exploratory laparotomy through a midline incision. The ovary was located on the right side; it was adherent to the urinary bladder. Adhesions were extensive and after they were broken down the ovary was removed. The abdomen was flushed with crystapen wash and routine closure was carried out.

Follow-up after 6 months: The cat was in good condition and had not been in season again.

6. Case No. 76220

Subject:

3 year old Bulldog bitch weight $17\frac{1}{2}$ kg., Fig. 14.

History:

Caesarean section was performed. Six weeks later an incisional hernia had developed. The dog underwent surgery for ovariohysterectomy and hernial repair. After cutting through the skin a great deal of adhesion involving the subcutaneous tissue and fibrous bands were found passing across the area. The adhesion was broken down and the fibrous tissues were removed. After the linea alba was exposed and the abdominal cavity was opened, the uterus and the ovaries were removed. The technique was mentioned earlier and before the abdomen was closed the ends of the incision were cleaned of all the necrotic and fibrous tissues. Then the abdomen was closed with 2/0 simple interrupted blue nylon sutures for linea alba and peritoneum,

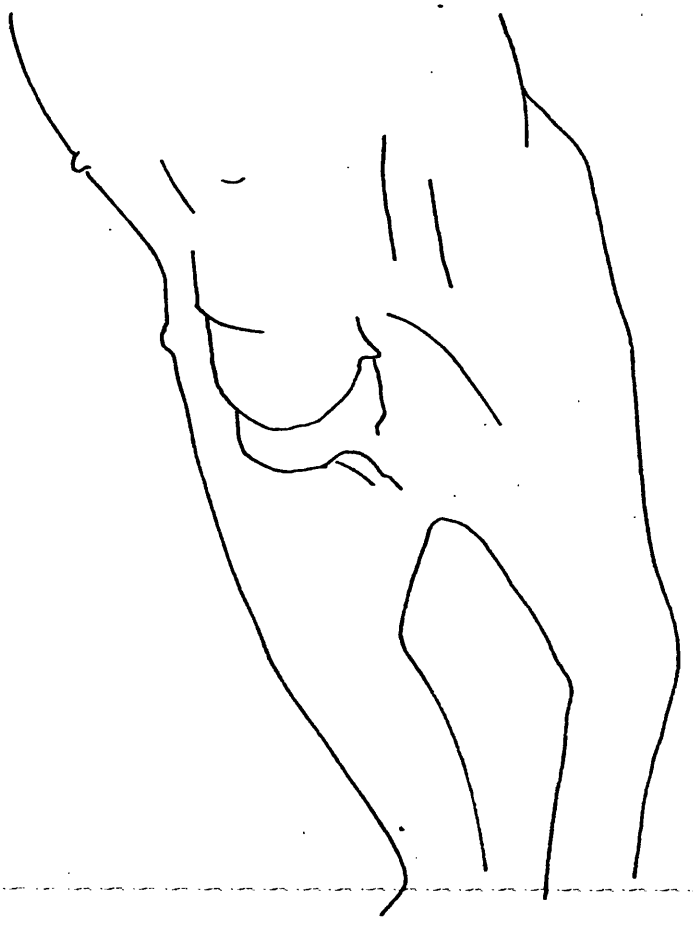


Fig. 14 Incisional hernia as a sequel to Caesarean Section

2/0 chromic catgut continuous sutures for subcutaneous layer and 2/0 chromic continuous sutures for subcuticular tissues. The skin was closed with armofil using simple interrupted sutures. Post-operatively the dog was given P/S for 5 days.

Two weeks later a swelling developed involving the caudal portion of the wound. The dog was re-admitted after 3 weeks.

Surgical Findings:

A 10 x 4 cm sac, filled with yellowish fluid, was found adherent to the skin and subcutaneous tissue. The sac was dissected from the adhesion. The abdominal wall was intact after the sac was removed. The wound was closed and the sac with its content was sent for pathological and bacteriological examination.

Pathology Report:

The sac was composed of connective tissue, foci of necrosis and an infiltration by lymphocytes and plasma cells was present. This would appear to be a dermoid cyst which may have arisen by implantation during previous surgery.

Bacteriology Report:

Bacteria were seen in a film prepared from the sample. From 2-5 coccal colonies per plate, which were found in aerobic and anaerobic cultures, were possibly formed by contaminants.

Post-operatively the dog was kept on P/S for 3 days. Recovery was uneventful. Follow-up was done after 6 months and the dog was found to be in good condition.

7. Case No. 66247

Subject:

7 year old female Peke weight 5 kg.

History:

Smelly vaginal discharge; developed vaginitis a few months after pyometra operation, corneal ulcer in both eyes, dermatitis abdomen and heels.

X-Ray Report:

Lateral views of the abdomen on a plain film and following intravenous urography show normal uterine stumps. Conray (May & Baker Ltd.) was used as positive contrast material.

Blood Results:

Were within normal limits.

Anaesthesia and Surgery:

The dog was premedicated with ACP and mask induction was carried out. Anaesthesia was maintained by halothane, nitrous oxide and oxygen. Exploratory laparotomy was performed. There was no evidence of uterine stump abnormality and both ovarian pedicles were normal. Dog also was operated on for corneal ulcer repair. Conjunctival flap was done.

Bacteriological Results:

Cultural examination of urine sample and vaginal swab produced numerous colonies of S. aureus.

Pathological Results:

Histological examination of biopsy specimen from uterine stump revealed the tissue to be composed of inactive connective tissue. Small amounts of glandular tissue present, no signs of infiltration by inflammatory cells.

Treatment and Results:

The dog was kept on antibiotics after the operation and due to the co-existing corneal ulcer in both eyes the dog underwent surgery twice. The dog was operated on again for cunjunctival flap breakdown. The dog was destroyed as requested by the owner.

8. Case No. 76148

Subject:

4½ year old W.H.W.T. bitch weight 9 kg.

History:

Spayed at six months. Lump appeared on the abdomen, remained for one year then started to enlarge, eventually burst and dicharged serous fluid, was explored, nothing found and healed. Later a sinus reopened, as shown in Fig. 15.

Blood Results:

PCV 50% T.W.B.C. 14,000/cmm.

Differential Count:

Neutrophils	73%
Lymphocytes	27%

Bacteriological Results:

Cultural examination of swab from the sinus produced S. aureus.

Surgery:

The dog was anaesthetised and prepared for surgery. The sinus was just lateral to the first incision (surgical technique of practitioner was paramedian incision). An incision extending cranially and caudally from the sinus was made, the subcutaneous tissue was explored and the fibrous tissue removed but no foreign body was found. Exploration extended deeply through rectus muscle and a fibrous tract was found leading through the muscle, but the internal rectus sheath and peritoneum were intact. Two nylon sutures were removed from the wound but these were not associated with the sinus tract. The peritoneum was incised and the abdomen was explored; nothing abnormal was found. The abdomen was closed with 2/0 monofilament nylon, simple interrupted sutures for peritoneum. 2/0 chromic

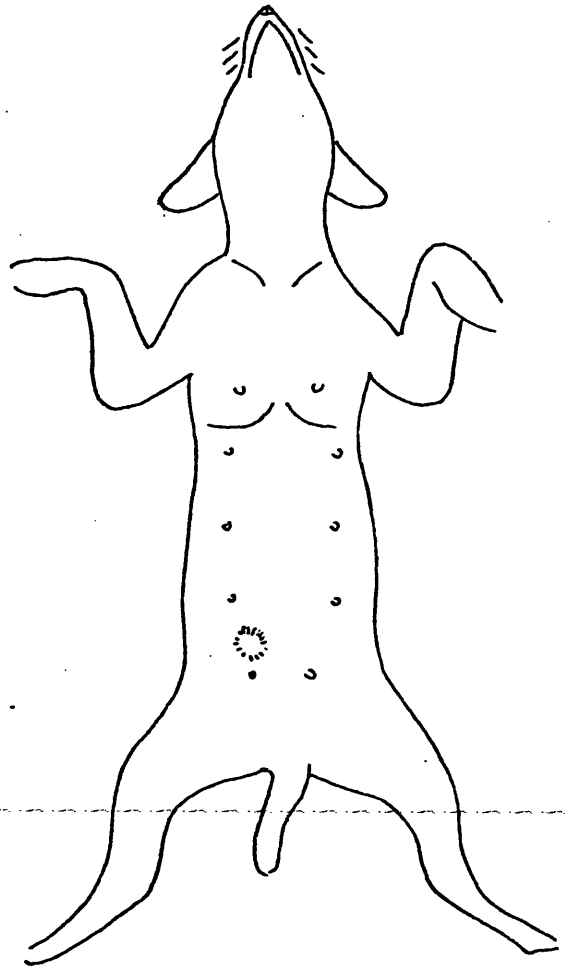


Fig. 15 Abdominal sinus as sequel to ovariohysterectomy through paramedian incision

catgut simple continuous sutures closed the muscle and the sheath and subcutaneous tissue. Simple interrupted sutures with armofil were used for the skin.

Post-Operative Treatment:

Dog was given ampicillin 50 mg b.i.d. for 5 days. Dog made uneventful recovery and was discharged.

Follow-up after 5 months: Dog was in good condition with no recurrence.

9. Case No. 77251

Subject:

7 month old Labrador bitch weight 23½ kb.

History:

Two days after spay operation through the left flank,wound became swollen and discharged for seven days. Swelling became bigger, then was re-opened by practitioner and referred to hospital.

X-Ray Report:

The VD view shows most of the intestine is to the right of the midline. The colon is located more medially than normal. An area of soft tissue density is observed below the distal pole of the left kidney, continues posteriorly and curves into the pelvic cavity. Further radiographs following positive contrast administration show a normal colon and distended bladder.

Blood Results:

T.W.B.C.	21.800/cu.mm

Differential Count:

Neutrophils	65%
Lymphocytes	33%
Monocytes	2%

The rest of the results were within normal limits.

Bacteriological Examination of Swab from Sinus:

No bacteria were isolated.

Anaesthesia and Surgery:

The dog was anaesthetised and prepared for surgery. The left flank wound was opened. The whole area of the wound was explored. Much necrotic and fibrous tissue was found involving the subcutaneous tissue and the external oblique abdominis muscle. The abdominal wall was intact, the adhesion between subcutaneous layer and the muscle was broken down and the wound was cleaned of all the necrotic and fibrous tissue. The wound was flushed thoroughly with crystapen. 2/0 chromic catgut continuous sutures were used for ext. oblique muscle, 2/0 chromic catgut continuous sutures for subcutaneous tissue and the skin was closed with simple interrupted armofil sutures and a drainage tube was placed before closing the wound.

Post-operative Treatment:

The wound was cleaned with crystapen and saline for three days and the dog was give P/S for 5 days post-operatively. The dog made an uneventful recovery and was discharged. One week later the dog was checked again, sutures were removed, the swelling was found to be reduced and the dog needed no further treatment.

Pathological Examination:

Histological examination of samples from the wound revealed only active, fibroblastic granulation tissue with scattered areas of haemorrhage, oedema and necrosis. No suture material could be i dentified.

PYOMETRA CASES

1978 - 1979

CASES

1. Case No. 74151

Subject:

20 month old female Labrador weight 25 kg.

History:

Polyuria and polydypsia associated with vaginal discharge started 5 weeks after the last oestrus.

X-ray Report:

Fluid-filled uterus lying in the ventral posterior abdomen ventral to the colon.

Blood Results:

T.W.B.C. 39.900/cmm, 70% neutrophils, PCV 59%. The rest of the results were within normal limits.

Anaesthesia:

The dog was premedicated with ACP and induction of anaesthesia was with thiopentone sodium and maintenance with halothane and oxygen.

Surgery:

An ovariohysterectomy was carried out with the same technique as described before (p. 15). P/S was given after the operation for 3 days.

Pathology Report:

Each uterine horn measured 40 cm long x 3 cm in diameter and was filled with dark brown thick fluid. Histological examination confirmed the presence of corpora lutea in both ovaries. The uterine glands were cystic and contained polymorphs. Polymorphs and plasma cells were present in the lamina propria.

Bacteriological Results:

Bacteriological examination of a swab from the uterus produced a mixture of haemolytic and non-haemolytic E. coli.

The dog was discharged after recovery. Three months later the dog was in good condition.

2. Case No. 73620

Subject:

10 year old O.E.S. X bitch weight 27 kg.

History:

Anorexia, polydypsia, with vaginal discharge.

Blood Results:

T.W.B.C. 46,600/cmm. PCV 47%, blood biochemistry and urine analysis were within normal limits.

Bacteriological Examination:

E. coli was isolated from a vaginal swab and a few colonies of bacteria were isolated from urine samples; both were sensitive to oxytetracycline and ampicillin.

Anaesthesia and Surgery:

The dog was anaesthetised and prepared for surgery as described before. The uterus and ovaries were removed. Ampicillin (Penbritin, Beecham) was given as post-operative treatment for 5 days.

Post-Operative Complications:

Wound disruption developed 7 days after surgery and as a result omentum prolapsed through the abdominal wound. Before the wound was resutured the abdominal cavity was flushed with penicillin (Crystapen, Glaxo Ltd.), P/S was given for 5 days. The dog was checked two weeks later and the wound was fine.

3. Case No. 74075

Subject:

10 month old female Yorkie, weight 4½ kg.

History:

Vaginal discharge, increased water intake 8 weeks after the last oestrus.

X-Ray Report:

Following positive contrast cystography the bladder is well outlined and a shadow of enlarged uterine horns can be seen anterior to the bladder.

Blood Results:

Within normal limits.

Anaesthesia and Surgery:

The dog was premedicated with ACP. Anaesthesia was induced with thiopentone sodium and maintained on halothane and oxygen. Operative field was prepared and the dog underwent surgery for removal of the uterus and ovaries. 120 ml. lactated Ringer's solution was given during the operation. Post-operative treatment with Penbritin. The dog was discharged 5 days after the operation.

Pathology Report:

Each uterine horn measured 20 cm long x $2\frac{1}{2}$ cm in diameter and was filled with yellowish grey thick fluid. Corpora lutea were confirmed on histological examination. Cystic endometrial glands with polymorphs. Lamina propria was infiltrated with plasma cells and polymorphs. On bacteriological examination haemolytic lactose-fermenting coliforms were identified.

4. Case No. 75232

Subject:

8 year old R. Collie bitch, weight 30 kg.

History:

4 weeks after oestrus animal restless, licking the hind quarters, abdomen tender and vaginal discharge was noticed.

Blood Results:

Normal

X-Ray Reports:

Soft tissue shadow lying between the colon and the bladder and runs cranially and ventrally on the anterior surface of the bladder. This is probably a slightly enlarged uterus.

Anaesthesia and Surgery:

The animal was anaesthetised and prepared for surgery. The ovaries and the uterus were removed and the animal was given 1 litre Ringer's lactate during the operation. The dog was checked 6 months later and was in good condition.

Pathology Report:

Each uterine horn measured 25 cm long x 2 cm in diameter. The uterine content was haemorrhagic and rather tenacious with some thickening and toughening of the endometrium. Microscopical examination confirmed the presence of corpora lutea in the ovaries and revealed cystic endometrial hyperplasia characterised by haemorrhage, large numbers of polymorphs and scattered mononuclear cells in the endometrium. Bacteriological examination of the uterine content yielded a profuse growth of haemolytic E. coli.

5. Case No. 77632

Subject:

5 year old Chow bitch weight 23½ kg.

History:

Wetting the floor at night, thirsty and urination taking a long time.

X-Ray Reports:

Several coils of a soft tissue mass are observed in the ventral and posterior portion of the abdominal cavity. The intestines are displaced to the cranial part of the abdomen. These features

are consistent with enlarged uterus.

Blood Results:

Urea	9.2 mmol/l
T.W.B.C.	95.200 per cmm.
Alk. Phos.	423 i.u./l

The rest of the blood results are within normal limits.

Anaesthesia and Surgery:

The dog was premedicated with ACP and anaesthesia was induced by thiopentone sodium and maintained with halothane and nitrous oxide. The dog was prepared for surgery and the uterus with the ovaries were removed. Dextrose saline was administered during the operation and continued afterwards (800 ml.). 'Tribrissen 80' was given as post-operative treatment. 6 months later the dog was found in good condition.

Pathology Report:

The uterine horns were distended to about 5 cm in diameter by creamy brown fluid.

Bacteriological examination of swab of fluid from the uterus yielded a profuse growth of non-haemolytic E. coli. Microscopy confirmed the presence of corpora lutea in both ovaries. The uterus showed cystic hyperplasia of endometrial glands which contained large quantities of dead and dying polymorphs. Numerous plasma cells were scattered throughout the endometrium.

6. Case No. 72404

Subject:

12 year old Springer Spaniel weight 21 kg.

History:

4 weeks after last oestrus excess thirst with vaginal discharge.

X-Ray Report:

Soft tissue shadow is observed on the dorso-cranial part of the bladder, suggestive of an enlarged uterus.

Blood Results:

Normal

Anaesthesia and Surgery:

The dog was premedicated with ACP and anaesthesia was induced through a mask using gas mixture. Surgical field was prepared and the animal underwent surgery for removal of both uterus and ovaries. Post-operative treatment was with "Tribrissen 80" for 5 days. 3 months later the owners reported a slight vaginal discharge.

Pathology Report:

Both ovaries measured approximately 2.5 cm in diameter. One contained corpora lutea while the other contained several rounded masses of softer red tissue. Histological examination revealed an ovarian tumour composed of cuboidal cells forming finger-like projections and acini. The uterus showed hyperplasia of endometrial glands.

7. Case No. 74925

Subject:

11 year old mongrel bitch weighing 18 kg.

History:

6 weeks after the last oestrus, off food and excessive thirst.

X-Ray Report:

There is evidence of distended coils of uterus lying in the ventral posterior abdomen.

Blood Results:

T.W.B.C.	42.100/cmm
Alk. Phos	230 i.u./l

Anaesthesia and Surgery:

Premedication was with ACP. A mask induction was carried out using a mixture of nitrous oxide, cyclopropane, carbon dioxide and oxygen. Anaesthesia was maintained with halothane. The dog was prepared for surgery and both uterus and ovaries were removed. 450 ml dextrose saline was given before and during the operation. The dog was given 'Penbritin' for 5 days. 9 months later the dog was in good health.

Pathology Report:

The uterus was grossly enlarged. The horns were approximately 23cm long by 5cm in diameter; the lumen contained a thick, reddish-brown mucopurulent exudate. Histological examination confirmed the presence of cystic endometrial hyperplasia. Corpora lutea were present in both ovaries. A mixture of haemolytic and non-haemolytic E. coli was obtained from culture of uterine pus.

8. Case No. 76711

Subject:

~~11 year old Labrador bitch weight 25 kg.~~

History:

Off food, vomiting and smelly vaginal discharge.

X-Ray Report:

Marked degree of uterine distension. The uterus was occupying most of the posterior and ventral parts of the abdominal cavity.

Blood Results:

Before Opeartion -

Urea 25.5 mmol/l

T.W.B.C. 57.100/cmm

Differential Count:

Non-lobulated neutrophils	90%
Lymphocytes	8%
Monocytes	2%

After Operation -

Urea 29.1 mmol/l 2 days post-operatively

Alk. Phos. 656 i.u./l

T.W.B.C. 79.1 x 10^3/cmm

Differential Count:

Neutrophils	80%
Lymphocytes	17%
Monocytes	3%

Urea 29.3 mmol/l 5 days post-operatively

Alk. Phos. 2160 i.u./l

Urea 3.8 mmol/l 16 days post-operatively

Alk. Phos. 948 i.u./l

Anaesthesia and Surgery:

The animal was premedicated with ACP and anaesthesia was induced using thiopentone sodium and maintained by halothane. The animal underwent surgery. During the operation 800 ml. of lactated Ringer and 250 ml. Haemaccel (Hoechst) were given. Fluid therapy was continued post-operatively in addition to P/S. 9 months later the dog was found in good condition.

9. Case No. 76402

Subject:

12 year old mongrel bitch weight 15½ kg.

History:

Off food, vomiting and increased water intake.

X-Ray Report:

Dorsal and anterior to the bladder there is a shadow of fluid-filled uterus extending into the mid-ventral abdomen and suggestive of pyometra.

Blood Results: - Before Operation

T.W.B.C.	7.300/cmm
Urea	20 mmol/1

After Operation -

T.W.B.C.	39.600/cmm
Differential Count:	
Neutrophils	71%
Eosinophils	1%
Lymphocytes	26%
Monocytes	2%
Urea	10 mmol/1.

Anaesthesia and Operation:

Was induced with thiopentone sodium and maintained by gas mixture halothane, nitrous oxide and oxygen. Atropine was given after intubation. 600 ml. Ringer lactate was administered during the operation. P/S was given for 5 days post-operatively. The dog was found in good condition 6 months later.

Bacteriological Examination:

Haemolytic E. coli and S. aureus were isolated from pus from the vagina. Both bacteria were sensitive to streptomycin, septrin and ampicillin.

10. Case No. 77343

Subject:

13 year old Alsatian bitch weight 36 kg.

History:

Vaginal discharge, dull, polydypsic, lumps in mammary glands.

X-Ray Report:

Several coils of soft tissue organ are seen craniodorsal to the bladder. It is not possible to state whether these are due to uterine shadows especially as the space between the colon and the bladder is not wide.

Blood Results:

T.W.B.C. 92.300/cmm R.B.C. 4.09×10^6 cmm.

Differential Count:

Neutrophils	91%
Lymphocytes	8%
Monocytes	1%

Urea 15.1 mmol/l

Anaesthesia and Surgery:

Premedication - ACP

Induction - Thiopentone sodium.

Halothane was used to maintain anaesthesia. The animal underwent surgery for removal of both uterus and ovaries. Two mammary tumours involving the cranial thoracic and vaginal mammary glands were also removed. During surgery fluid therapy was given, 500 ml. Haemaccel, 1000 ml. sodium lactate. Recovery was uneventful.

Post-operative treatment P/S was given for 5 days. After one week, a couple of sutures were lost from the wound, the wound was cleaned and resutured, later no wound problem was reported and healing was fine. 3 months after the dog was in good condition.

11. Case No. 77007

Subject:

10 year old Mongrel bitch weight 9½ kg.

History:

Vomiting and polydypsic, no vaginal discharge, very dull and complete anorexia.

X-Ray Report:

The bladder was full and clearly visualised and there was obvious uterine distension with the enlarged uterus overlying the dorsal anterior aspect of thebladder.

Blood Results:

T.W.B.C.	56.300/cmm.
Differential Count:	
Neutrophils	68%
Lymphocytes	30%
Monocytes	2%
PCV	54%

The other blood results were within normal limits.

Anaesthesia:

ACP was used for premedication and multigas through a mask was used for induction and for maintaining anaesthesia. The surgical field was prepared and the animal underwent surgery. 600 ml. Dextrose saline intravenous drip was given before and was continued after the operation.

Post-operative P/S was given for 5 days.

12. Case No. 45707

Subject:

12 year old Collie X bitch weight 27 kg.

History:/

History:

Dull, polydypsic with a history of frequent pseudopregnancies.

X-Ray Report:

Coils of enlarged uterine horns can be seen lying over the dorsal surface of the bladder and extending cranially and ventrally in the mid posterior abdomen.

Blood Results:

T.W.B.C.	43.600/cmm
Alk. Phos.	405 i.u./l

Other results were within normal limits.

Anaesthesia:

The dog was premedicated with ACP and anaesthesia was induced with thiopentone and was maintained by halothane and oxygen. 600 ml. Ringer lactate was given before the operation. During the operation haemaccel was given due to considerable blood loss from the ovarian and uterine vessels. Post-operatively the animal was very pale. Blood transfusion was carried out and a total of 500 ml. whole blood was given. The dog also received 1 ml. Betsolan (Glaxo) and 1 ml. neo-cytamen (Glaxo). Later the animal was slightly improved. The dog died overnight.

Post Mortem Report:

Fluid and clotted blood was present in the abdomen. The largest clot of blood was attached to the uterine stump, small clots being present at the sites of removal of the ovaries. The uterine horns measured approximately 20 x 5 cm. in diameter and contained thick, cloudy, brown fluid. Histological examination of sections of uterus revealed infiltration by polymorphs, lymphocytes and plasma cells between distended endometrial glands. Posterior abdominal mammary tissue was prominent and fleshy.

13. Case No. 73610

Subject:

3 year old Doberman bitch weight 30 kg.

History:

Irregular oestrus cycle, pseudopregnancy and long history of polydypsia.

X-Ray Report:

A small visceral shadow overlying the dorsocranial aspect of the bladder possibly representative of a minor degree of uterine enlargement.

Blood Results:

Were within normal limits.

Anaesthesia and Surgery:

The animal was premedicated with ACP. Intraval sodium was used for induction of anaesthesia which was maintained by halothane and oxygen. Surgical field was prepared and the animal underwent surgery for ovariohysterectomy. 700 ml. Dextrose saline was used during the operation P/S was given for 5 days as post-operative treatment. Ten months later no problem was reported by the owner.

Pathology Report:

Several corpora lutea were present in both ovaries. Attached to each ovary was a 10 cm length of uterine horn. Histological examination confirmed the presence of corpora lutea, an increase in the cellularity and vascularity of lamina propria, small subepithelial haemorrhages, supepithelial haemosiderin deposits, vacuolation of luminal epithelial cells and the presence of occasional polymorphs in capillaries in the lamina propria. These changes indicate a mild endometritis.

14. Case No. 73737

Subject:

5 year old short haired domestic cat weight $3\frac{1}{2}$ kg.

History:

Vaginal discharge, increased water intake and abdominal enlargement.

X-Ray Report:

Not available.

Blood Results:

Normal.

Anaesthesia and Surgery:

The cat was premedicated with atropine and anaesthesia was induced with Saffan. Halothane was used to maintain anaesthesia. After the removal of both uterus and ovaries the cat was given 'Penbritin' for 5 days. Recovery was uneventful.

Pathology Report:

The uterine horns were dilated and filled with a thin grey pus. The uterine walls were thin and cysts were noted on the surface. Microscopic examination revealed a few lymphocytes and plasma cells were noted in lamina propria. Pure growth of non-haemolytic E. coli was obtained from the uterine pus.

DISCUSSION

1. Introduction

Pyometra is usually a disease of older bitches which are generally toxic and consequently require careful preoperative and postoperative attention. In this section evaluation of the different types of complication which might occur during and after ovariohysterectomy for treatment of pyometra or as routine speying will be discussed.

2. Old Cases Investigation

a) Incidence

The incidence of pyometra in the Glasgow material in relation to the total number of cases admitted was 0.9%. Ewald (1961) found that among the 2150 bitches which were admitted at the Animal Medical Center (U.S.A.), 18.4% were affected with pyometra. This much higher figure could be attributed to a bias towards surgical material in the A.M.C.

b) Age

The mean age of Glasgow discharged cases (8.8 $\pm$ 3.3 years) was similar to an earlier Glasgow study (Dow 1959a, 8.5 $\pm$ 2.8 years) and rather older than a group of Pennsylvania (U.S.A.) bitches (Fidler, Brodey, Howson and Cohen 1966, 7.8 years). These series indicate that pyometra usually occurs in dogs over six years old, but in Glasgow cases 22.6% were under six years (Fig. 10).

c) Breed

Table 4 shows the various breeds which were affected with pyometra. It indicates a similar prevalence among the different breeds, except that higher numbers were found in mixed breeds, and also

the Collie had a higher prevalence. It could be possible to conclude from these results that mixed breeds, Labradors and Cairns are perhaps more susceptible than other breeds, but I believe that the number of dogs and the variety of breeds were too limited to draw such a conclusion. The mixed breeds account for over 19% of all admissions to this hospital.

d) Fatality and Causes of Death

The incidence of fatality in the Glasgow material (18.5%) suggests that pyometra surgery is a common cause of death in older bitches where the prognosis is guarded to poor.

The mean age in the 23 Glasgow fatalities (11.5 $\pm$ 4.1 years) was almost 3 years older than the mean affected age (Fig. 8).

In an earlier Glasgow series of pyometra cases the percentage fatality was 12.5% (Renton, Douglas and Watts, 1971). They found that in 12 cases blood urea was above normal before surgery, in 2 of which the value returned to normal within 24 - 48 hours after the operation. In 6 the high level persisted postoperatively, while in 4 animals, which subsequently died, the blood urea concentration rose steadily after the operation. In the current series only in 7 dogs could death be attributed to uraemia (Table 5). In these 7 bitches the higher blood urea level was attributed to chronic interstitial nephritis.

Renal failure may be precipitated by acute or chronic reversible or irreversible, prerenal, post renal or primary renal disease (Osborne, Low and Finco, 1972). The faulty elimination of urea in urine is associated with many factors which may be classified as a) prerenal and b) renal.

The prerenal factors lead to the lowering of the glomerular filtration rate and impair the efficiency of the kidneys. Such factors

include haemoconcentration or low blood pressure. The renal factors involved may be nephritis (found in older dogs) and in particular, the lesion described by Obel, Nicander and Asheim, (1964), which involved the glomeruli and which is characterised by varying degrees of thickening of the glomerular capillary walls. In some cases, thickening of glomerular capillary walls reduces the size of the capillary lumen, with moderate swelling and proliferation of glomerular capillary endothelial cells and preglomerular fibrosis associated with swelling and proliferation of capsular parietal epithelium.

Tufvesson (1953) found that the percentage fatality among 273 bitches which were treated surgically for pyometra was 13.9% (38) but nephritis with uraemia was claimed to be the cause of death in 8 of them. In these cases of fatal uraemia, renal failure was irreversible and it implies that three quarters or more of the functional capacity of the nephrons of both kidneys has been eliminated.

Tufvesson (1953) found that in 23 dogs in which autopsy was done the causes of death were toxaemia (5), nephritis with uraemia (8), haemorrhage (3) and sepsis (2). Freudiger (1961) recorded the causes of death in 17 bitches of 104 following ovariohysterectomy for pyometra, as uraemia (3), wound disruption and herniation (3), peritonitis (3), haemorrhage from uterine stump (2), while death in the remaining cases was unrelated to pyometra. The Glasgow cases similarly had a high proportion of deaths attributed to uraemia, with a variety of minor groups (Fig. 9). These findings confirm that the common causes of death in pyometra are uraemia, peritonitis, uterine stump infection and haemorrhage.

Particular mention should be made of the consequences of lesions of the uterine stump because the symptoms may relate to either the urinary or digestive systems or both, pain at defaecation, vomiting

due to bowel obstruction and urinary incontinence (Pearson 1973).

In one case with uterine stump infection clinical symptoms included difficulty in passing urine, vomiting and diarrhoea. Palpation revealed a large mass in the posterior abdomen. This suggests that lesions of the uterine stump usually involve the bladder, with possible extension to one or both ureters, descending colon and often the mesentery and small bowel, accompanied by peritonitis and adhesions (Pearson 1973). One case in this series indicated that a uterine stump lesion is a serious sequel to ovariohysterectomy if non-absorbable multifilament suture materials are used as ovarian or uterine stump ligatures as already stated by Pearson (1973).

Multifilament suture materials facilitate the transport and propagation of bacteria due to their capillarity properties which cause infection (Blomstedt, Osterberg and Bergstrand 1977). Previously others (Elek and Conen 1957, James and Macleod 1961, Ewerett 1970) found that suture materials increase the susceptibility to bacterial infection in surgical wounds.

The results of experimental studies which were carried out on rats by Blomstedt et al (1977) indicated that immobile bacteria can be transported inside multifilament suture materials, and that the capillary and fluid absorption properties are of significance for the spread of bacteria.

In the majority of cases with uterine or ovarian stump infection, Pearson (1970) stated that multifilament nylon or terylene, strong linen, or multifilament nylon surrounded by plastic was responsible. The high incidence of ovarian and uterine stump lesions shows the dangerous and serious sequelae of using non-absorbable multifilament materials. No ligature sinuses were recorded with the use of chromic catgut (Pearson 1970).

Catgut for closure of an abdominal wound increased the incidence of herniation (Freudiger 1961; Pearson 1970). Freudiger (1961) reported that 6 out of 25 bitches had wound disruption for this reason, but when nylon was used the incidence decreased to only 7 out of 70 bitches.

In the 136 dogs and cats in Glasgow treated for pyometra a mid-line abdominal incision was used in all cases. It is the preferred surgical approach for ovariohysterectomy in dogs with pyometra (Engle 1940; Armistead 1954; Archibald 1965 and Hoffer, 1977). This technique is basically similar to any standard ovariohysterectomy (Hoffer 1977), but a slight variation is to oversew the uterine stump to prevent any possible leakage of pus resulting in contamination of the abdominal cavity (Engle 1940; Arthur 1964). Oversewing the uterine stump was carried out on every case of the Glasgow series of pyometra cases. The technique involved overstitching a clamp with 2/0 chromic catgut Cushing's sutures. In some cases of closed pyometra where the cervix was markedly firm, invagination of the stump was accomplished only after a portion of the mucosa was removed.

Armistead (1954) stated that rupture of the grossly enlarged uterus resulting in peritonitis and surgical shock is the important danger occurring during pyometra surgery. He described a technique for entering the abdomen, without damaging the friable uterus, at the point immediately adjacent to the umbilicus where the fatty umbilical fold and ligament provide an additional margin of safety between the abdominal wall and the uterus. In my opinion damage to the uterine horns could be caused by undue handling of the grossly enlarged uterus while removing it from the abdominal cavity. In our pyometra series uterine damage during surgery was not encountered.

In two cases out of 23 (Fig. 9), death was due to peritonitis which could have been caused by abdominal contamination from the uterine content. In neither case did the uterus rupture intra-abdominally. In one of these cases peritoneal lavage was carried out but the dog eventually died a few days after the operation. Both Archibald (1965) and Hoffer (1972) emphasise that among the different causes of peritonitis is direct contamination of the abdomen from septic abdominal contents.

Hoffer (1972) described a technique for peritoneal lavage using an intra-abdominal silastic drainage tube. Ringer's solution with 500 mg oxytetracycline hydrochloride (Liquamycin, Pfizer).is infused through the tube one to three times daily. In cases with renal failure Inperson 1.5% (Inperson, Abbott) may be used in place of Ringer's solution to initiate peritoneal dialysis. Freudiger (1961) found that peritonitis developed in 13 out of 104 bitches after pyometra surgery and only three animals died, indicating that this complication can be successfully treated in many cases. In the cat which died due to pyelonephritis, haemolytic E. coli was isolated from both uterine content and the left kidney. Asheim (1964) associated the presence of E. coli in the uterus of pyometra cases with a renal lesion.

Bloom (1954) reported that in the cat purulent peritonitis may occur secondary to pyometra, while in the dog a perimetritis, parametritis or peritonitis may occasionally occur.

e) Analysis of Laboratory results

The frequency of leucocytosis in pyometra agrees with the observations by others (Smith 1965; Brodey 1968). The usual range for pyometra is from 20×10^3 to 100×10^3/cmm (Smith 1965; Brodey 1968). The normal range of leucocyte counts according to Bruner and

Wakerlin (1937) is 5600 - 19200 with a mean 8.2.

Leucocytosis is attributed to an increased number of immature neutrophils as a result of bone marrow hyperplasia and the release of immature forms of neutrophils into the peripheral circulation (Bloom 1944; Coles 1967; Schalm 1973).

Hardy and Osborne (1974) found that among 101 bitches with pyometra PCV was less than 36% in 26 bitches, indicating a mild to severe anaemia. This observation agrees with Schalm (1973) who stated that variable degrees of anaemia occur in a significant number of pyometra cases. in the Glasgow series, only three bitches' PCV was less than 36% (Table 6).

In a smaller group of pyometra cases admitted and treated at the Glasgow University Veterinary Hospital during the period from October 1978 to October 1979 (Table 15), PCV was below 36% in one and over 54% in three cases. This indicates that in the majority of our cases of pyometra PCV was within the normal range. In those cases with a high PCV fluid therapy was administered before, during and was maintained after surgery until PCV returned to normal. A high PCV level was attributed to vomition in two cases, and persisting polyuria in another.

Eng and Stahl (1971) stated that inadequate perfusion of normal glomeruli with blood is attributed to dehydration or shock. Poor perfusion can be corrected by parenteral administration of fluids (Osborne 1972). The primary renal disease, responsible for the increase in blood urea, has been attributed to immune complexes (Obel, Nicander and Asheim 1964). However generalised renal diseases unrelated to pyometra, such as renal calculi, pyelonephritis and chronic generalised nephritis have been observed in dogs with pyometra (Hardy and Osborne, 1974). This agrees with the Glasgow

pathological results which were carried out on seven bitches which died due to uraemia.

In the smaller Glasgow series (1978-1979) analysis of the laboratory results shows that in the majority of cases the white cell count was over 19 x 10^3 per cumm. This could be attributed to the inflammatory process in the uterus and the continuous demand for neutrophils from the bone marrow. Marked neutrophilia was found in 4 cases and was caused by immature neutrophils. Sodium (Na) values under 135 meq/l were found in 2 cases, but in the rest Na was within the normal limits (135 to 160 meq/l).

According to Foster (1970) a depletion of sodium may arise from a) severe uncontrolled diarrhoea, where sodium loss is accompanied by additional depletion of chloride, potassium and water, as well as b) Primary renal disease where the loss of sodium through the tubules into the urine is not compensated by that quantity ingested.

In the Glasgow cases of pyometra no case had diarrhoea, but in one bitch (Case 1, Table 15) a high blood urea level 15.1 mmol/l was accompanied by a low sodium level.

A high potassium level was found in one (case 3, Table 15) accompanied by a high urea level. Coles (1967) stated that the potassium level may be increased in animals with renal dysfunction, since excretion of potassium is in part controlled by the kidneys. In one case high blood urea was not associated with a high potassium and this could be due to the fact that the high blood urea developed due to haemoconcentration but the PCV in this case was normal.

A low plasma chloride found in three cases was occasionally accompanied by a high blood urea (casel, 3 Table 15). Coles (1967) and Foster (1970) claim that a low chloride is caused by severe loss due to emesis or chronic renal disease where tubular damage

does not permit normal sodium and chloride ion resorption. In our series of pyometra cases chloride loss was attributed to emesis.

Hyperproteinaemia has been attributed to dehydration and shock (Coles 1967). However although in three cases values were high, even these cases can be considered to be within the normal limits. The frequent recovery of E. coli on bacteriological culture of uterine contents (Table 7) agrees with observations by Renton et al (1971), Hardy and Osborne (1974) and Osbaldiston (1978). These bacteria which include E. coli, Staphylococci, Streptococci, Proteus spp., Klebsiella were not only isolated from pyometra cases but also could be found in the vagina and cervix of healthy bitches. Osbaldiston (1978) found that the vagina and cervix of the bitch had a resident bacterial flora which varies from animal to animal and was primarily composed of enteric organisms.

The results of bacteriological examination have shown that bacteria were isolated from the swabs which were taken from the uterine stump, while none of the swabs which were taken from the abdominal cavity before and after the removal of the uterus, or from the ovarian pedicles, revealed any bacterial growth. These results indicate that the uterine stump after ovariohysterectomy for pyometra could be considered as a source of contamination and suggest that it is important to seal the uterine stump to avoid contamination. Several methods involving oversewing the stump and the application of antiseptics or antibiotics have been described (Archibald, 1965; Roberts 1971; Hoffer 1977).

3. Complications

In this limited study the main interest has been the possible complications which might occur during or after ovariohysterectomy. Thirty five dogs and two cats were evaluated for surgical complications

in three categories:

a) Complications during surgery;

b) Complications following surgery during hospitalisation;

c) Complications following discharge from the hospital (carried out initially by a questionaire sent to the owner).

a) Complications during surgery (Table 12) were associated in the majority of dogs with anaesthesia and included technical difficulties in performing the intravenous induction of anaesthesia and achieving sufficient depth. Where intravenous induction was particularly difficult, mask induction using halothane, nitrous oxide and oxygen was used. Anaesthetic problems of this nature were encountered in eight dogs. According to Dorn and Swist (1977) the complications which occurred during surgery were due to anaesthetic problems in three dogs out of 23 (13. %) from the total number of 73 bitches. The authors did not comment on these cases and why they developed.

Haemorrhage occurred in two dogs and was attributed to the surgeons inexperience and the heavy weight of the animals. Haemorrhage occurred in three dogs during surgery out of 23 dogs with different types of complications recorded by Dorn and Swist (1977) who attributed the cause of haemorrhage to the breaking of the ovarian pedicle or improper ligation. They also stated that this haemorrhage occurred only on cases where final-year students performed the surgery.

In my opinon haemorrhage can be avoided by careful handling of the ovarian and uterine vessels, and their proper ligation. On the other hand exteriorising the ovary can be facilitated by lowering the edge of the abdominal wound to a level below the ovary instead of cutting the suspensory ligament. During ovariohysterectomy for the treatment of pyometra the ovaries could be exteriorised more easily than in cases of routine ovariohysterectomy, but due to the fact that

the ovarian and uterine vessels are dilated and fragile undue traction could then result in haemorrhage. The three forceps tie method is considered safer for the removal of the ovaries. In all our cases of pyometra the uterine vessels were ligated separately and the uterine stumps were sealed by an inverting Cushing's suture. This agrees with Pearson (1973) who stated that the risk of haemorrhage from the uterine vessels is entirely overcome by separate ligation of these vessels on either side of the vaginal stump close to the main encircling ligature.

b) Complications following surgery during hospitalisation. These complications are given in Table 13. The post-operative wound swelling was not in fact marked and could be attributed to the inflammatory reaction usually accompanying the process of healing, because the swelling subsided later.

The wound discharge was marked in one case. It was clear and slight in the rest of the dogs, and ceased before the animals were discharged from hospital. This probably is attributed to the exudative reaction arising from the suture material inserted in the tissue or improper suture technique which fails to close the dead space between the tissue layers. Closing a surgical wound with excessive tissue damage and free blood in the field can double the infection rate (Polk and Lopez-Mayer 1969).

The category of self-inflicted trauma involved one dog in which a few stitches were pulled out, and in the remainder moderate inflammation was noticed around the wound due to continuous licking attributed to the irritation caused by either disinfectants or to tight wound sutures. In the last dog delayed recovery from anaesthesia was alleged to be due to hypothermia.

These complications were not serious problems which required

further treatment, and could have happened after any routine surgery. One more serious case, with a clear wound discharge, was readmitted three days after discharge with a disrupted wound (see below).

Dorn and Swist (1977) found that of the 73 bitches undergoing ovariohysterectomy 23 (31.5%) developed complications during or immediately following surgery. Ten of the 23 manifested some type of healing delay which was attributed to serous drainage. They also found that suture abscess and infection developed in two dogs, self-inflicted trauma and chewing sutures in one, haematuria in one, and coughing in one. The authors found these complications to be commonly associated with any abdominal surgery.

c) Complications following discharge from the hospital. The long-term complications following ovariohysterectomy were surveyed by mail. In this group of dogs with complications, surgical treatment was required only in one case which developed wound disruption a few days after discharge. Dehiscence was due to the tearing off and untying of the nylon sutures from half the length of the abdominal wound. This bitch was an Old English Sheepdog weighing over 30 kg. Herniation of the omentum occurred as a result of wound disruption.

Nayman (1966) studied the relationship between uraemia induced in dogs and wound disruption. He found that in five dogs where uraemia was induced during the first five days of wound healing, wound disruption occurred in all cases. However blood urea was normal in the Glasgow case with wound disruption. In my opinion this complication occurred due to improper suture technique and could be attributed also to the heavy weight of the animal. Insecurely tied knots, improper suture size, excessive ligation of tissue and tissue trauma can also be responsible for this complication. According to Henderson (1952) wound disruption which occurred in two bitches with

pyometra was attributed to heavy weight and the use of chromic catgut for closure of the abdominal wound. Other factors which may be concerned (Christopher 1949; Archibald 1965) include malnutrition, chronic anaemia and wound contamination and infection. It seems that the best way to avoid this complication is to use a proper aseptic technique and suitable suture material. Dehoff, Greene and Greiner (1972) stated that to prevent wound disruption in pyometra cases monofilament stainless steel wire is suitable for closure of the abdominal incision.

In the results of long-term follow up two and a half years after ovariohysterectomy in 73 bitches, Dorn and Swist (1977) found that the most common sequelae were increase in weight which involved 11 bitches, attractiveness to male dogs (4), behavioural changes (3) and vaginal discharge (1).

Another follow up was carried out by Tufvesson (1953) on 209 bitches after ovariohysterectomy for pyometra. He found that among 209 bitches, 163 were considered perfectly well. Of the remaining 46 bitches complications were found only in 9, and involved hind limb paralysis (3), urinary incontinence (3), hernia (2) and harmorrhagic vulval discharge (1). In the remaining dogs of this group the symptoms were more likely due to advanced age of the animals or to factors not connected with pyometra.

These two follow ups (Tufvesson 1953; Dorn and Swist 1977) show that none of the dogs had complications involving either the ovarian or the uterine stump in connection with the use of non absorbable multifilament suture materials as recorded by others (Cawley and Archibald 1958; Pearson 1970).

In the Glasgow survey none of the 13 dogs with complications had recurrent oestrus but weight gain was found in one dog and

vaginal discharge in three dogs. Behavioural change was found in three dogs, in one of which it was enough to justify euthanasia because the dog became vicious and aggressive. Euthanasia was performed in two further dogs due to chronic diarrhoea and bilateral corneal ulcer.

The rather random distribution of complications in different age groups (Fig. 11) shows that it is not possible to reach any conclusion due to the limited numbers.

In that complications were most commonly found in mixed breeds the data of Table 9 agree with the observations of Dorn and Swist (1977) who found that mixed breeds were represented by 30 of 80 bitches which underwent ovariohysterectomy.

The indications for surgery (Table 11) show that the highest incidence of complications was among the bitches in which ovariohysterectomy was performed for treatment of pyometra, as opposed to routine ovariohysterectomy(spey). This indicated that bitches with pyometra are more susceptible to develop complications. Roberts (1971) recognised the severity of pyometra surgery and recommended that aftercare should consist of dextrose and saline solution and plasma or blood given intravenously if necessary with heat for hypothermic dogs, and close observation to prevent shock and death. In our cases fluid therapy was usually given before, during and after surgery depending on the animal's condition .

4) Complications not Encountered in our Series

1) Postoperative bleeding:

This usually occurs within three weeks of surgery and if persistent indicates uterine stump infection, when removal of the stump should be considered.

2) Recurrent oestrus:

This is an indication of incomplete removal of the ovaries.

The best treatment of this condition is removal of the ovarian tissue. In our series, three bitches and one cat were referred to the hospital for treatment of postoperative oestrus. In these cases it was noticed during exploratory laparotomy that all the retained ovaries in these dogs were on the right side. This is probably due to the shortness of the ovarian ligament so that exteriorisation of the ovary out of the abdominal incision is not as easy as on the other side. These animals were discharged after surgery and a follow up was made after 3 months when none of these animals had returned to heat.

3) Urinary Incontinence:

In as much as the disease is seen principally in bitches after ovariohysterectomy, the cause is thought to be hypoestrinism (Merck 1979). The animal may unconsciously dribble urine when walking. Apart from this intermittent incontinence the animal will urinate normally. As treatment, diethylstilbestrol dipropionate is administered at the rate of 0.1 to 1.0 mg daily. Treatment will require to be maintained indefinitely and in a few instances the dosage required to control incontinence may be great enough to produce oestrus. In such cases, combining stilbestrol with testosterone may control the incontinence and suppress the signs of oestrus (Merck 1979).

4) Uterine and ovarian stump ligature sinuses:

These sinuses are caused by granulomatous reactions following the use of non-absorbable multifilament suture material. The site of these sinuses depends on whether they are from ovarian or uterine stump ligatures. In cases of ovarian stump ligature, they often develop in the angle between the last rib and the lumbar transverse processes, but may appear anywhere in the flank. The uterine stump

ligature sinuses usually affect the precrural fold, the inner aspect of the thigh, or the inguinal region. To avoid the development of these sinuses chromic catgut ligatures should be used.

Conclusion

1) In the majority of cases, wound problems are the most common complication. To avoid these complications: a) an aseptic surgical technique should be applied; b) suitable suture materials and techniques are necessary.

2) In dogs with pyometra, care should be taken to correct fluid loss and electrolyte loss in dehydrated cases. In cases with a high blood urea surgery is not recommended, until blood urea returns to normal.

3) Postoperative care is important following pyometra surgery. The animal should be kept warm and fluid therapy such as dextrose saline, plasma, or blood transfusion in anaemic cases should be given if necessary.

4) On performing routine ovariohysterectomy: a) operation should not be performed on bitches in oestrus; b) care should be taken in ligating the ovarian and uterine vessels to prevent haemorrhage; c) chromic catgut ligatures for ovarian and uterine stump should be used.

5) Further investigations are needed to evaluate the preoperative, and postoperative complications associated with pyometra in the dog and cat.

REFERENCES

Alexander, J.W., Kaplan, J.Z. and Altemeier, W.A. (1967) Role of suture materials in the development of wound infection. Ann. Surg., 192, 165.

Anderson, R.K., Gilmore, C.E. and Schnelle, G.G. (1965) Utero-ovarian disorder associated with the use of medroxyprogesterone in dogs. J.A.V.M.A., 146, 1131.

Archibald, J. (1965) Canine Surgery, 1st Ed., Chap.5, p. 107, Chap. 20, p.468, Chap.27, p.662-665. American Veterinary Publications, Santa Barbara, California.

Armistead, W.W. (1954) Some surgical considerations in pyometra. Vet. Med., 49, 533.

Arthur, G.H. (1964) Wright's Veterinary Obstetrics, including diseases of reproduction, 3rd Ed., Chap.23, p.364. Bailliere, Tindall and Cox, London.

Asheim, A. (1964) Renal function in dogs with pyometra. 8 Uterine infection and the pathogenesis of the renal dysfunction. Acta. path. Microbiol. Scand., 60, 99.

Asheim, A. (1965) Pathogenesis of renal damage and polydipsia in dogs with pyometra. J.A.V.M.A., 147, 736.

Berge, E. and Westhues, M. (1966) Veterinary Operative Surgery, Chap.F, p.314. Medical Book Company Copenhagen, Denmark.

Blomstedt, B., Osterberg, B. and Bergstrand, A. (1977) Suture material and bacterial transport. Acta. Chir., Scand., 143, 71-73.

Bloom, F. (1944) The blood and bone marrow in pyometra. N.Am.Vet., 25, 483.

BLOOM, F. (1946) The extra genital lesions of canine pyometra. Cornell Vet., 36, 324.

system, with clinical considerations' Chap. 3. p. 362, American Veterinary Publication Inc., Evanston, Illinois.

Borre sen, B. (1979) Pyometra in the dog. A pathophysiological investigation II Anamnestic Clinical and Reproductive Aspecte. Nord. Vet. Med.,31, 251.

Brodey, R.S. (1968) Pyometra in 'Current Veterinary Therapy III'. Ed. Kirk, R.W., W.B. Saunders & Co., Philadelphia.

Brodey, R.S. and Harvey, C. (1971) Letter to the Editor, J. small Anim. Pract., 12, 699.

Brodey, R.S. and Fidler, I.J. (1966) Clinical and pathological findings in bitches treated with progestational compounds. J.A.V.M.A., 149, 1406.

Bruner, H.D. and Wakerlin, G.E. (1937) The blood picture of the normal dog. Proc. Soc. Exp. Biol. Med., 36, 667.

Cawley, A.J. and Archibald, J. (1958) Sinus tracts resulting from suture material. Can. J. Comp. Med., 22, 59-62.

Christie, D.W., Bell, E.T., and Parkes, M.F. (1972) Plasma progesterone levels in canine uterine disease. Vet. Rec., 90, 704.

Christopher, F. (1949) A Text Book of Surgery, 5th Ed., p.1466. W.B. Saunders & Co., Philadelphia.

Coles, E.H. (1967) Veterinary Clinical Pathology, Chap.3, p.62, Chap.5, p.131-148. W.B. Saunders Company, Philadelphia and London.

Cowan, S.T. (1974) Cowan and Steel's Manual for the Identification of Medical Bacteria, 2nd.Ed., revised by S.T. Cowan, London, Cambridge U.P.

Cowley, L.L. (1967) Braided vs. monofilament wire sutures. Am. J. Surg., 113, 472-474.

Cseh, S. and Horvath, Gy. (1957) Treatment with oestrogens of cystic glandular hyperplasia of endometrium in the bitch. Acta. vet. Acad. Sci., Hung., 7, 139-145.

Dehoff, W.D., Greene, R.W. and Greiner, T.P. (1972) Surgical Management of abdominal emergencies. The Veterinary Clinics of North America, 2, p. 301., W.B. Saunders Co., Philadelphia.

De Vita, J. (1952) 'Canine Surgery' 3rd Ed., p. 424. Evanston, American Veterinary Publications.

Dollar's Veterinary Surgery (1950) 4th Ed., Chap. 2, p.345-346. Ed. O'Connor, J.J. Bailliere, Tindall and Cox, London.

Dorn, A.S. and Swist, R.A. (1977) Complications of canine ovariohysterectomy. J.A.A.H.A., 13, 720.

Dow, C. (1957) The cystic hyperplasia pyometra complex in the bitch. Vet. Rec., 69, 1409.

Dow, C. (1958) The cystic hyperplasia pyometra complex in the bitch. Vet. Rec., 70, 1102.

Dow, C. (1959a) The cystic hyperplasia pyometra complex in the bitch. J. Comp. Path., 69, 237.

Dow, C. (1959b) Experimental reproduction of the cystic hyperplasia pyometra complex in the bitch. J. Path. Bact., 78, 267.

Dürr, A. (1975) Pyometra nach Östrogen Behandlung (Jatrogene Metropathien). Pyometra after treatment with oestrogen (Jatrogenic metropathies). Schweiz. Arch. Tierheilk., 117, 349.

Echeverria, E.A. and Jimenez, J. (1970). Evaluation of an absorbable synthetic suture material. Surg. Gyn.Obst., 131, 1.

Elek, S.D. and Conen, P.E. (1957) The virulence of Staphylococcus pyogenes for man. A study of problems of wound infection. Br. J. exper. pathol., 38, 573.

Eng, K. and Stahl, W. (1971) Correction of the renal haemodynamic changes produced by surgical trauma. Ann. Surg., 174, 19.

Engle, J.B. (1940) Pyometra. N. Am. Vet., 21, 358.

Erichsen, S. (1952) Follicular cysts, hyperestrogenism and the pathogenesis of pyometra in dog. Nord. Vet. Med., 4, 1088.

Ewald, B.H. (1961) A survey of the cystic hyperplasia - pyometra complex in the bitch. J. small Anim. Clin., 1, 383.

Ewerett, W.G. (1970) Suture materials in general surgery. Prog. Surg., 8, 14-37.

Ewing, G.O., Schechter, R.D., Whitney, R.C. and Wind, A.P. (1970) Therapy of canine pyometra. J.A.A.H.A., 6, 218-227.

Fidler, I.J., Brodey, R.S., Howson, A.E. and Cohen, D. (1966) Relationship of estrous irregularity, pseudopregnancy and pregnancy to canine pyometra. J.A.V.M.A., 149, 1043.

Fisfis, N.H. (1967) Diagnosis and surgical treatment of pyometra. Mod. vet. Pract., 48, 50.

Foster, S.J. (1970) Some aspects of fluid therapy in practice. J. small Anim. Pract., 11, 337-357.

Fowler, N.G. (1964) The diagnosis of closed pyometra in the bitch. Vet. Rec., 76, 1206.

Freudiger, U. (1961) Komplikationen nach Endometritis Operationen. Kleintier-prax., 6, 101-105.

Gierloff, B. Chr. Hassel (1973) A manual of suture techniques. Stougaards forlag Kobenhavn, p.10.

Grindlay, M., Renton, J.P. and Ramsay, D.H. (1973) O-groups of Escherichia coli associated with canine pyometra. Res. Vet. Sci., 14, 75.

Hardy, R.M. and Osborne, C.A. (1974) Canine pyometra pathogenesis, diagnosis and treatment of uterine and extra-uterine lesions. J.A.A.H.A., 10, 245.

Henderson, W. (1952) Post-operative hernia in the dog. The problem of suturing. Vet. Rec., 64, 441.

Hickman, J. and Walker, R.G. (1973) An atlas of veterinary surgery. Chap.1, p.9, Chap.111, p.62. Oliver and Boyd. Edinburgh.

Hobday's Surgical Disease of the Dog and Cat (1953) 6th Ed., Chap.13,p.194, Chap. 20, p.342-343, Ed. McCunn, J., Bailliere Tindall and Cox, London.

Hoffer, R.E. (1972) Peritonitis.Veterinary Clinics of North America, 2, No.1, p.189. W.B. Saunders Co., Philadelphia.

Hoffer, R.E. (1977) Atlas of small animal surgery: thoracic, abdominal and soft tissue technique. St. Louis, Mosby.

James, R.C. and Macleod, C.J. (1961) Induction of Staphylococcal infection in mice. Br. J. Exper. Pathol., 42, 266.

Joshua, J.O. (1965) The spaying of bitches. Vet. Rec., 77, 642.

Kealy, J.K. (1979) Diagnostic Radiology of the Dog and Cat, Chap.2, p.134, Philadelphia, London : Saunders.

Kivisto, A.K., Vasenius, H. and Sandholm, M. (1977) Laboratory diagnosis of canine pyometra. Acta Vet. Scand., 18, 308.

Knecht, C.D. (1966) A brief survey of progestogen involvement in utero-ovarian disorders. Illinois Vet., 9, 3.

Knecht, C.D., Welser, J.R., Allen, A.R., Williams, F.J. and Harris, M.N. (1975) Fundamental Techniques in Veterinary Surgery, Chap. 2, p.22. W.B. Saunders Company, Philadelphia, London, Toronto.

Lacroix, J.V. (1952) Canine Surgery, 3rd Ed., Evanston, III, American Veterinary Publication, p.427.

Lesbouyries, G. and Berthelon, G. (1936) Pathogenie et traitement de l'endometrite chronique de la chienne et de la chatte

LETTOW, E. (1960) Liver function tests in bitches with uterine disease of hormonal origin. Zbl. Vet.-Med., 8, 353.

Linde, N.N. (1966) Treatment of pyometra with yeast extract. Mod. vet. Pract., 47, 79.

Localio, S.A., Casale, W. and Hinton, J.W. (1943) Wound healing - experimental and statistical study. I Historical, II Sutures and ligatures. Surg. Gynec. Obst. Internat. Abstr. Surg., 77, 369-375 and 437-469.

Low, D.G. (1954) Pyometra in the bitch. Vet. Med., 49, 527.

Ludewig, R.M., Rudolf, L.E. and Wangensteen, S.L. (1971) Reduction of experimental wound infection with iodized gut sutures. Surg. Gynec. Obst., 133, 946.

Madsen, E.T. (1950) Nylon som kirurgisk Suturmateriale. Ugeskr Laeg., 112, 1191.

Madsen, E.T. (1953) An experimental and clinical evaluation of surgical suture materials. Surg. Gynec. Obst., 97, 73.

Mathews, G.P. (1962) Clinical aspects of non-surgical treatment of pyometra in the bitch. Auburn Vet., 25, 8-13 and 27-30.

Merck Veterinary Manual (1979) Reproductive and urinary systems, p.873-877, 5th Ed. , Merck & Co., Inc. Rahway, N.J., U.S.A.

Merillat, L.A. (1931) Handling the stump in supravaginal hysterectomy in dogs. Vet. Rec., 11, 890.

Mowdy, T.M. (1963) Pyometra treated. Vet. Med., 58, 497.

Munksgaard, E. (1952) Kirurgiske suturmaterialer og deres relation til sarhelingen. Thesis, Kobenhavn.

McCunn, J. (1932) Some surgical conditions, problems and methods encountered in canine practice. Vet. Rec., 12, 509.

McEntee, K.J. (1970) The Female Genital System in Jubb, K.V.F., Kennedy, P.C. (2. ed). Pathology of Domestic Animals, eds. N.Y. Academic Press, Vol. 1.

Narat, J.K., Cangelosi, J.P. and Belmonte, J.V. (1956) Evaluation of dacron suture material for general surgery. Surgical Forum: Clinical Congress, VII, 176-178.

Nayman, J. (1966) Effect of renal failure on wound healing. Ann. Surg., 164, (2), 227-235.

Obél, A.L., Nicander, L. and Asheim, A. (1964) Light and electron microscopic studies of the renal lesions in dogs with pyometra. Acta. vet. Scand., 5, 146.

Oliver, J.E. and Bradley, W.E. (1974) Treatment of Urinary Incontinence in 'Current Veterinary Therapy V' Ed. Kirk, R.W., p.906 W.B. Saunders & Co., Philadelphia.

Osbaldiston, G.W. (1978) Bacteriological studies of reproduction disorders of bitches. J.A.A.H.A., 14, 363-367.

Osborne, C.A. (1971) Urinary Incontinence in 'Current Veterinary Therapy IV'. Ed. Kirk, R.W., p.687 W.B. Saunders & Co., Philadelphia.

Osborne, C.A. (1972) Surgery of the urinary system - pre-operative and post-operative consideration. Scientific presentation and seminar synopses of 39th Annual Meeting of the A.A.H.A.

Osborne, C.A., Low, D.G. and Finco, D.R. (1972) Canine and feline urology. Chap.12, p.126, W.B. Saunders Co., Philadelphia.

PALLASKE, G. (1961) Effect of pyometra in the organism as a whole from pathological and anatomical points of view. Berl. Münch. Tierarztl. Wschr., 4, 74.
bitch. J. small Anim. Pract., 14, 257-266.

Polk, H.C. and Lopez-Mayer, J.F. (1969) Post-operative wound infection: a prospective study of determinant factors and prevention. Surgery, 66, 97.

Postlethwait, R.W. Schauble, J.F., Dillon, M.L. and Morgan, J. (1959) Evaluation of surgical suture materials. Surg. Gynec. Obst., 108, 555.

Rehfeld, C.E. (1954) Clinical laboratory diagnosis of pyometra in the bitch. Vet. Med., 49, 531.

Renton, J.P., Douglas, T.A. and Watts, C. (1971) Pyometra in the bitch. J. small Anim. Pract., 12, 252.

Rieck, G.W. (1959) Studien zur pathologischen Histologie, Pathogenese und Ätiologie des Pyometra-endometritis Komplexes der Hündin, IV Die Ätiologie, Abl. Vet.-Med., 6, 575.

Roberts, S.J. (1971) Veterinary Obstetrics and Genital Diseases, (Theriogenology), Chap. 17, 585-600. Published by the author Ithaca, New York.

Sandholm, M. and Kivisto, A.K. (1975) Determination of γ-globulin in dog serum by glutaraldehyde. J. small Anim. Pract., 16, 201.

Sandholm, M., Vasenius, H. and Kivisto, A.K. (1975) Pathogenesis of canine pyometra. J.A.V.M.A., 16, 1006.

Schalm, O.W. (1965) Veterinary Haematology, 2nd Ed., Bailliere, Tindall & Cassell, p. 559.

Schalm, O.W. (1973) Pyometra in the dog. Calif. Vet., 27, 19.

Shuttleworth, A.C. and Smythe, R.H. (1960) Clinical Surgery Operative Procedure, Vol. 2, Chap. 3, p.79, Chap.10, p.284. Crosby Lockwood and Son Ltd., London.

Smith, K.W. (1965) Female genital tract in Canine Surgery, Chap. 27, p.641-676. Ed. Archibald, J., Wheaton, III American Veterinary Publications, Inc.

Smith, H.A. and Jones, T.C. (1973) Veterinary Pathology, Ed. 3, Philadelphia, Pa., Lea and Febiger, P.91, 1039.

Smythe, R.H. (1931) Handling the stump in supravaginal hysterectomy in the dog. Vet. Rec., 11, 1018.

Spy, G.M. (1966) The results of testosterone propionate treatment in ten cases of pyometra. Vet. Rec., 79, 281.

Sumner-Smith, G. (1966) The diagnosis of 'open' and 'closed' pyometra in the dog and cat. I: Clinical aspects and differential diagnosis. J. small Anim. Pract., 6,429.

Teunissen, G.H.B. (1952) The development of endometritis in the dog and the effect of oestradiol and progesterone on the uterus. Acta Endocr. (KbH), 9, 407.

Tufvesson, A.G. (1953) Operative treatment of pyometra in the dog. Nord. Vet. Med., 5, 273-288.

Usher, F.C. and Wallace, S.A. (1958) Tissue reaction to plastics. Arch. Surg., 76, 997-999.

Usher, F.C., Allen, J.C., Crostwait, R.W. and Cogan, H.E. (1962) Polypropylene monofilament - a new biologically inert suture for closing contaminated wounds. J. Am. Med. Ass., 179, 780.

Van Os, J.L. and Oldenkamp, E.P. (1978) Oestrus control in bitches with proligestone, a new progestational steroid. J. small Anim. Pract., 19, 521.

Walker, R.G. (1965) The diagnosis of 'open' and 'closed' pyometra in the dog and cat - II: Diagnosis and Clinical Assessment of Closed Pyometritis in the Bitch. J. small. Anim. Pract., 6, 437.

Whitney, J.C. (1956) Pyometra in the bitch (with special reference to the pathology of the condition). Br. vet. J., 112, 25.

Whitney, J.C. (1969) Polydipsia in the dog - symposium : 2. Polydipsia and its relationship to pyometra. J. small Anim. Pract., 10, 485.

Wianko, K.B., Kling, S. and Mackenzie, W.C. (1961) Wound healing, incisions and suturing. Can. Med. Ass. J., 84, 254.

Wildt, D.E. and Seager, S.W.J. (1977) Reproduction control in dogs. The Veterinary Clinics of North America, 7, 775. W.B. Saunders Co., Philadelphia.

Wilkinson, G.T. (1974) O-groups of E. coli in the vagina and alimentary tract of the dog. Vet. Rec., 94, 105.

Williams, R.E. (1947) Marsupialisation for acute pyometra in the bitch. Vet. Rec., 59, 226.

Withers, A.R. and Whitney, J.C. (1967) The response of the bitch to treatment with Medroxyprogesterone Acetate. J. small Anim. Pract., 8, 265.

Wright, J.G. (1933) Everyday surgery in small animal practice. Vet. Rec., 51, 1331.

Wright, J.G. (1950) Veterinary Obstetrics - Benesch and Wright. Bailliere, Tindall and Cox, London, p.446.