THE AETIOLOGY, PATHOLOGY, DIAGNOSIS AND TREATMENT OF ACUTE PANCREATITIS

BY

R.A.RUSSELL TAYLOR B.Sc., M.B.Ch.B., F.R.C.S.,(Eng) M.R.C.O.G.

THE AETIOLOGY, PATHOLOGY, DIAGNOSIS AND TREATMENT OF ACUTE PANCREATITIS.

A REVIEW OF 110 CASES.

In the preparation of this thesis, only cases which were proved at operation, at post-mortem, or clinically with a raised urinary diastase or serum amylase, have been included.

In order to appreciate thoroughly the difficulties which face the surgeon in the diagnosis and treatment of acute pancreatitis, it is essential to give a resumé of the aetiology and pathology of this still obscure condition.

A E T I O L O G Y.

I am indebted to McWhorter (1932) for the following table giving the classification of the aetiology of acute pancreatitis and to which I have made a few additions :-

A. Non-infectious origin.

1. Obstruction.

Due to :-

1. Gall stones
2. Pancreatic calculi
3. Round worms
4. Tumours of the head of the pancreas
5. Aneurysms in the neighbouring vessels
6. Foreign bodies, e.g. a barley corn
7. Spasm of sphincter of Oddi
8. Proliferative metaplasia of the pancreatic duct epithelium

2. Chemical

Activation of ferments resulting from :-

1. Bile infected by bacteria.
2. Cell debris and degenerated duct contents
3. Duodenal contents
4. Enterokinase in the mucosa of the gall bladder
5. Autolysis

3. Trauma

1. Penetrating or non-penetrating abdominal wounds
2. During operations on stomach, duodenum, or lower end of common bile duct.

4. Degenerative changes in the pancreas

1. Ischaemia of pancreas
2. Vascular degeneration
3. Haemorrhage
4. Toxic changes following systemic disease
5. Secondary to malignant or benign tumours

B. Infectious origin.

1. Extension along the lymphatics to glandular group in region of head of pancreas
2. Blood stream - usually resulting from intestinal infection
3. Extension along the pancreatic ducts from the duodenum or bile tracts.
4. By direct extension from an infected focus.
5. Following activation by bacteria in the normal gland.

6. By bacterial permeability from adjacent lateral viscera.

7. By direct contiguity through the bile duct when it is embraced by the head of the pancreas.

C. Combination of two or more of the above factors.

First of all it must be pointed out that the relative frequency of different types of ductal arrangement, varies greatly according to the observers. Mann and Giordano (1923) stated that a common channel could be formed by the bile duct and the duct of Wirsung by obstruction at the ampulla of Vater in only 3·5% of subjects. Cameron and Noble (1924) prepared casts of the ducts and found that the bile and pancreatic ducts communicated in 75% of cases, whilst Howard and Jones (1947) observed that in over 50% of cases there is the anatomical possibility for the formation of this common channel. Popper et al (1948) state that there is a common channel in 89% of cases of pancreatic oedema, acute pancreatitis and pancreatic necrosis, but very few observations similar to the above have been done on definite cases of acute pancreatitis and extensive investigations on this most important point would be invaluable. Howard and Jones (1947) found that where there was an obstruction at the ampulla of Vater, fluid injected into the common bile duct refluxed into the duct of Wirsung in 54% of specimens. In cases where the duct of Santorini was present, the incidence of reflux rose to 82%. It is, therefore, at present justifiable to suggest that, other things being equal, that there might be a greater

incidence of acute pancreatitis in patients with a patent duct of Santorini. To pursue this further, it is also reasonable to assume that when there is an obstruction at the ampulla of Vater, the pressure in the pancreatic ducts is less than that in the biliary passages when there is a patent duct of Santorini, thus allowing a reflux of bile along the duct of Wirsung. That this is not the whole story is evident from the fact that cases of acute pancreatitis have also been described in which the ducts have opened separately into the duodenum, and rare cases in which the necrosis has been restricted to the region drained by the duct of Santorini.

In 50% of cases, it is said that the obstruction is caused by a gall-stone, but in less than 5% of cases is this stone found, as it may have passed into the intestine after producing oedema or necrosis of the pancreas. Other causes of obstruction may be pancreatic calculi, round worms, tumours of the head of the pancreas, aneurysms in the neighbouring vessels and in a case described by Forty (1939) a barley corn.

Obstruction which would allow reflux of bile along the pancreatic duct may also be produced by spasm of the sphincter of Oddi; the spasm is usually secondary to acute gastro-duodenitis which might be secondary to acute corrosive poisoning or occurs reflexly in the same way as pylorospasm in cases of acute cholecystitis.

In a large number of cases, there is a marked proliferative metaplasia of the pancreatic duct epithelium, which causes a certain degree of obstruction and stagnation of bile and pancreatic juice with a subsequent rise of

pressure and activation of the trypsinogen in the intraductal system.

Acute haemorrhagic pancreatitis has also been produced by injecting a large number of irritating fluids (not bland substances) into the pancreatic duct, but it was pointed out by Rich and Duff (1936) that the typical lesion is not produced unless the amount of fluid injected is sufficient to rupture the pancreatic acini and they conclude that the escape of trypsin into the interstitial tissues is the essential causative factor.

Pure bile appears to be incapable of activating trypsinogen to trypsin, but it has been proved that enterokinase in the mucosa of the gall bladder and bile infected by bacteria and cell debris may do so. If infected bile is forced along Wirsung's duct, the bile salts will activate the pancreatic zymogens, and there is digestion of the tissues which produces oedema, necrosis and haemorrhage.

Popper et al (1948) attempted to transform pancreatic oedema into pancreatic necrosis by the following methods, but all with negative results

1. Ligation of cisterna chyli in order to block the lymphatic drainage from the pancreas
2. Temporary clamping of the portal vein
3. Shock produced by trypsin
4. Gross trauma

They also showed that temporary occlusion of the gastro-duodenal artery applied for 30-40 minutes in a day, did not cause any marked microscopic changes in the pancreas, but the same experiment performed on an animal with pancreatic oedema led to the development of pancreatitis, the extent of which was determined by the previous degree of oedema. In cases of low grade oedema, only fat necrosis developed, but in cases with extensive oedema, all the pathological changes of acute pancreatitis were present. Wightman (1948) pointed out that the amount of damage produced, depended upon the volume of juice which has diffused into the connective tissue of the gland, the concentration of the enzymes in the juice, usually greatest in amount 2-3 hours after a meal, and the number of large blood vessels with which it came in contact.

The pancreas may also be infected from distant foci by the blood stream as is well illustrated in cases suffering from infective endocarditis, cholecystitis, ulcerative colitis, appendicitis, and pyaemia. Pancreatic abscesses may also result from retrograde thrombosis and suppurative pyelophlebitis.

Acute pancreatitis may also be observed as a complication of influenza, typhoid fever, small pox and mumps, but in the latter cases, suppuration or necrosis never occur; very rarely it has been attributed to tuberculosis and syphilis.

The frequent association of acute pancreatitis with infection of the biliary tract suggests that the lymphatic route is a possible connection between the inflamed gall-bladder

and the pancreas, but the experiments of Kaufmann (1927) on rabbits practically discounted this, but further investigations, however, on this point are definitely advisable.

Paxton and Payne (1948) found that 18% of their cases were admitted to hospital in an intoxicated condition, and that in 20% of cases, the pain came on immediately after a heavy meal. Cole (1938), however, found that the interval between a meal and the onset of pain was usually 2 - 3 hours.

Cases of acute pancreatitis have followed penetrating abdominal injuries. According to Naffziger and McCorkle (1943) it may also occur during the course of operation on the stomach, duodenum or lower end of the common bile duct, where the pancreas has been injured. Shallow and Wagner (1947) declare that these cases account for 2%- 4% of all recorded cases and that there is a definite latent period preceding the appearance of the symptoms.

Ackerman (1942) reported a case of acute pancreatitis which followed transfusion with incompatible blood, which at autopsy showed thrombosis of the pancreatic veins.

Pagel and Woolf (1948) recorded a case of aseptic necrosis of the pancreas due to arterial thrombosis occurring in malignant hypertension and concluded that neither the clinical nor the anatomical picture revealed any relationship to acute haemorrhagic pancreatitis and/or pancreatic fat necrosis.

P A T H O L O G Y.

Acute pancreatitis occurs most commonly about 40-60 years of age and with about equal frequency in the two sexes. There also seems to be a definite association with obesity, cholecystitis and cholelithiasis.

Pratt (1940) maintains that acute pancreatitis is not an infection but an intoxication by the pancreatic ferments. Nevertheless, the intensity of the primary destructive changes determines the extent of the pathological changes because this condition of auto-digestion may be self perpetuating and progressive even although the original stimulus has been removed. The progress of the disease may be continuous or intermittent and it may become arrested at any stage.

Appearances at Post Mortem.

The body is sometimes very obese and in approximately 50% of cases the patient is overweight. There may be local discolouration of the abdominal wall around the umbilicus (Cullen's sign) and in the loins (Grey Turner's sign). This discolouration is only seen in severe cases where the patient has lived for 2 - 3 days after the acute onset and must not be confused with post-mortem staining.

On opening the abdomen, it must be remembered that acute necrosis may be present and yet macroscopically the pancreas may appear normal. The mildest type of acute pancreatitis is that known clinically as "transient pancreatitis"

and recovery is common. Here we get oedema of the pancreas in which the intrapancreatic and peripancreatic oedema consists of pancreatic fluid which has escaped into the pancreatic interstitial tissues. This oedema does little or no harm and will disappear soon after the secretory stimulus has been discontinued. It is usually accompanied by catarrhal changes in the duodenum which extends up the pancreatic duct. The pancreas itself may be enlarged 2 - 3 times its normal size and is of varying consistence. It is indurated and small areas of fat necrosis may be present but haemorrhage is slight or absent. The changes may involve the whole organ or be localised to the head, body or tail, the usual percentage being, whole of pancreas 73·1%, body 19·2% and tail 7·7% Fallis(1939). The retroperitoneal tissues are also usually oedematous or infiltrated with blood.

The next stage, that of haemorrhagic pancreatitis, is seen if the arterial blood supply has been interrupted. The resistance of the acinar and interstitial cells has been weakened by this temporary ischaemia and they are attacked by the enzymatic action of the oedematous fluid in which the trypsinogen has been activated to trypsin by the bacteria and cellular debris.

In the most severe cases, the pancreas is seen as a large, dark, purplish, soft and friable mass on the posterior abdominal wall, shining through the peritoneum of the lesser sac. The peritoneal cavity may contain sanguinous or sero-sanguinous

fluid which is present in the greatest amount in the lesser sac. This fluid may, however, have a yellowish-green colour due to bile staining. It is invariably sterile, but later it may become infected, resulting in a localised or generalised peritonitis.

Gangrenous pancreatitis is generally regarded as a late stage of haemorrhagic pancreatitis and, therefore, occurs in cases which have survived the initial stages. The pancreas becomes softened, breaking up of the tissues with subsequent infection occurs, and a localised or generalised peritonitis results.

In suppurative pancreatitis there may be a considerable destruction of the gland due to one or more abscesses in the pancreas itself, a retroperitoneal abscess, or an abscess in the lesser sac. The infection may spread along the pancreatic ducts or directly from contact with the infected pancreatic tissues. The abscesses are usually sterile and contain thin pus or watery turbid fluid. Grey sloughs of pancreatic tissue or necrotic fatty tissue may subsequently liquify and give rise to pseudocysts of the pancreas.

In patients who survive, fibrosis occurs, which if extensive, results in a reduction of the glandular tissue, distortion of the ducts and the formation of pancreatic cysts, i.e. a similar picture to that found in cases of chronic pancreatitis.

In addition to the above, other pathological conditions are usually present :-

TABLE NO.1.

Associated Pathology	Lewison (1940)	Fallis & Palin (193
Chronic Cholecystitis	70%	57·7%
Acute Cholecystitis	2%	15.4%
Acute Cholelithiasis	80%	80%
Choledocholithiasis	9%	8%
Ampullary Stones	3%	-
Normal Gall-Bladder	20%	26·9%

In these cases, the gall-stones are invariably small and the bile is usually infected, dark in colour and may be blood stained.

In two of this series, one had a chronic gastric ulcer and the other a chronic duodenal ulcer.

Microscopic Appearances.

Three main pictures may be seen. In the first, the pancreas is seen to be uniformly haemorrhagic; secondly there is marked necrosis of the glandular and interstitial tissues with a varying amount of haemorrhage around the necrotic areas and in the areolar tissues, and thirdly the pancreas is mainly necrotic.

When haemorrhage is the outstanding feature, the whole glandular tissue is infiltrated with blood. The activated enzymes digest the blood vessel walls and the severity of the secondary haemorrhage in and around the pancreas depends to a certain extent on the size of the blood vessels involved.

Marked thrombosis of the blood vessels, which have hyaline degenerative changes in their walls, can also be seen.

Diffuse necrosis of acini may occur or the necrosis may affect the glandular and interstitial tissues with accompanying leucocytic infiltration. It is interesting to note that the inflammatory reaction is greatest in the less acute cases. The appearance of the parenchyma and the haemorrhage strongly suggest that the condition is due to some toxic agent, but, although bacteria, e.g. B.Coli and streptococci have been found in some cases in large numbers, there is not enough evidence to support the theory that this condition is the result of bacterial invasion.

It must not be forgotten, however, that haemorrhage into the pancreas may also occur in blood diseases, sepsis and poisoning, especially in fat people.

Fat Necrosis

This is the most distinctive feature of acute pancreatitis, and is seen as dull opaque, yellowish white areas suggestive of drops of tallow, but they are not raised above the surface. Their size varies from that of a pin head to about $\frac{1}{4}$" in diameter and they are most abundant in the vicinity of the pancreas, but the retroperitoneal tissues, omentum, mesentery, mediastinum pericardium, pleura and anterior abdominal wall, may also be involved. It is invariably attributed to the action

of lipase following its liberation due to damage to the gland tissue by infection, abscess formation or mechanical injury. The lipase has travelled along the lymphatics or by the blood stream and this theory explains its patchy nature and also the occurrence of distant foci in the bone marrow, etc. Pancreatic lipase splits up the fatty molecule into glycerine and fatty acid and the latter combines with calcium to form an insoluble soap. If the patient survives, these deposits are absorbed in a matter of weeks.

Microscopically the necrosed fat cells are seen to be wholly, or partly, opaque and the whole area surrounded by a ring of leucocytes.

Fat necrosis is not, however, pathognomonic of acute pancreatitis as it may occur with perforation of an ulcer of the second part of the duodenum. Also it is necessary to distinguish between fat necrosis in acute pancreatitis and post-mortem fat necrosis. In the latter condition, only scattered white spots in and around the pancreas itself are seen, with no haemorrhage, vascular congestion, or leucocytic infiltration.

SIGNS AND SYMPTOMS.

In the preparation of this thesis, I have been greatly impressed by the marked diversity of the signs and symptoms occurring in this disease, but by presenting them in a series of tables, it is hoped to demonstrate more clearly the predominant features. Critical and careful study of these will, it is hoped, enable a correct diagnosis to be made in the majority of cases, thus resulting in the appropriate treatment being instituted at the earliest possible moment.

Number of cases.

The following table shows the number of cases in each year under review but apart from the period 1938-1941, the numbers appear to be fairly constant, although there is no doubt that this condition is being more accurately diagnosed clinically.

TABLE NO.2.

Year.	Number of Cases.	Year.	Number of Cases.
1933	5	1940	16
1934	4	1941	15
1935	9	1942	7
1936	2	1943	6
1937	4	1944	3
1938	20	1945	1
1939	14	1946	1
		1947	3
Total			110

Seasonal Incidence.

Certain diseases are known to have a definite seasonal incidence, and with this in mind, the following table was compiled, but the facts observed are quite inconclusive.

TABLE NO. 3.

Season	Number of cases.
January - March	19
April - June	34
July - September	25
October - December	32
Total	110

Age.

It is usually stated that 50% of all cases are between 40 to 60 years of age, (Fallis (1939)), and that the average age is approximately 42 years (McWhorter (1932) and Abell (1938)); Lewison (1940), however, stated that 60% of all his cases were aged between 30 and 50 years.

In the series under review, the largest age groups lie between 40 and 70 years of age, the youngest being a girl of 10 years and the oldest patient being 85 years of age.

TABLE NO.4.

Age.	Number of patients.	Percentage.
10 - 19	1	.9%
20 - 29	3	2.7%
30 - 39	7	6.4%
40 - 49	22	20.0%
50 - 59	29	26.4%
60 - 69	31	28.2%
70 - 79	16	14.5%
80 - 89	1	.9%
Total	110	100.0%

Sex

McWhorter (1932) and Abell (1938) found that the sexes were equally affected, but my own figures show a large preponderance of females over males.

TABLE NO.5.

Sex.	Number of cases.	Percentage.
Males	37	33.6%
Females	73	66.4%
Total	110	100.0%

Obesity.

In a number of cases obesity has been pronounced, but this is by no means general, and in only 16 cases (14.5%) was the obesity considered sufficient to be commented upon. It is, however, significant that 51 cases (46.3%) were overweight. c.f. Morton (1940), Morton and Widger (1940), McWhorter (1932), and Fallis (1939)).

Temperature, Pulse and Respiration.

The following table may be of definite clinical interest as it shows the temperature, pulse and respiration, of the patient on admission to hospital.

TABLE NO. 6.

Temperature	No. of Patients	Percentage	Pulse	No. of Patients	Percentage.
96° - 98.4°	71	64.5%	60-70	5	4.6 %
98.6° - 100°	27	24.6 %	70-80	14	12.7%
100.2° - 101°	11	10.0%	80-90	27	24.5%
101.2° - 102°	1	.9%	90-100	31	28.2%
Total	110	100.0%	100-110	11	10.0%
			110-120	12	10.9%
			120+	10	9.1%
			Total	110	100.0%

Respiration	No. of Patients	Percentage.
16-24	83	75.5%
25-32	25	22.7%
33-40	2	1.8%
Total	110	100.0%

It will be noted that in 64·5% of cases, the temperature was normal or subnormal and that in 89·1% the temperature was not above 100°F.

Fallis and Plain (1939) found that 7·7% of all their cases had a temperature over 102°F. and was below 100°F. in 57·5% of cases. Fallis (1939) also states that the temperature is rarely over 102°F. whilst McWhorter (1932) stated that only in 3 cases was the temperature over 103°F. On the other hand, the pulse was definitely accelerated in 82·7% of cases and was of poor volume and tension. Quick (1932) states that the pulse rate was frequently below 90/min., but we were unable to verify this. Morton and Widger (1940) and Morton (1940) found the pulse to be rapid and Fallis and Plain (1939) observed that in 23·1% of the cases, the pulse rate was over 120/min. Of course these figures must be viewed in relationahip to all the other clinical signs, the duration of the illness, the presence or absence of shock, etc., etc., to be of any real value. The absence of fever combined with a rapid pulse and a high white cell count is significant.

Previous Illnesses.

Although the attack may commence in apparently healthy subjects, careful questioning will frequently elicit the fact that attacks of similar, but less severe pain, have occurred in the past, suggesting peptic ulcer or gall bladder disease. The figures obtained from the literature relating to healthy subjects are most misleading, as they range from 17% to 40% . Also biliary disease reported as associated with pain varies from

20% - 95% in all the published literature Smead (1940). It must be noted in passing that quite a large proportion of patients have had previous biliary infection which presented no physical signs.

Morton (1940) found a normal gall bladder in 27.3% of cases, but Connell (1941) found gall-stones in 92.3% of cases. The general opinion, however, appears to be that the gall-bladder is diseased in approximately 60% of cases and that gall-stones are present in 50% of cases, of which 5% are found in the common bile duct.

McWhorter (1932) found acute inflammation of the gall-bladder in 22% of cases in which stones were present in 12%.

A review of the previous illnesses of these 110 patients is shown in the following table and it will be seen that they are all connected with the gastro-intestinal tract.

TABLE NO.7.

Previous Illnesses	No. of Patients	Percentage.
1. Gastric disturbances	29	26.4%
2. Gall-Bladder Disease	43	39.1%
3. Gall-Stones	4	3.6%
4. Appendicitis	11	10.0%
5. Gastro-Enterostomy	1	.9%
6. Previous Acute Pancreatitis	1	.9%
Total	89	80.9%

It must be clearly understood that this table was compiled from information obtained from hospital records, family doctors' notes, and the patients' own statements. There is little doubt in my mind that in quite a definite proportion of these cases, the correct diagnosis should have been "mild attack of acute pancreatitis or oedema of the pancreas".

Morton and Widger (1940) describe a case in which the patient had a cholecystectomy 7 years previously. This is interesting, because most authorities state definitely that a cholecystectomy saves the patient from a possible attack of acute pancreatitis, yet two of my patients H.H. and M.S. had a cholecystectomy performed 2 and 8 years previously. Another patient G.W. had had a laparotomy for acute pancreatitis 13 years previously and had had a sub-acute attack in 1939. 24 patients (21·8% were x-rayed during their stay in hospital and the following results were obtained :-

Gall-Bladder disease	8 cases	(33·3%)
Gall-Bladder disease with stones	10 cases	(41·7%)
No evidence of Gall-Bladder disease	6 cases	(25%)

"Indigestion" was complained of by 20% - 40% of the cases described in the literature, Lewison (1940) and Morton (1940), my own figure being 32 cases, i.e. 29%.

Pain.

The onset of the pain is invariably sudden and this initial pain may be due to one or more of the following causes :-

1) Associated biliary pathology, e.g. acute cholecystitis, cholelithiasis, biliary colic, etc.
2) Rapid inflammatory swelling of the pancreas with stimulation of the nerves in the coeliac plexus and post-parietal peritoneum.
3) Early and copious toxic exudate into the peritoneal cavity producing marked irritation of the parietal peritoneum.
4) Raised intraductal pressure.
5) Trauma.

A) Situation.

The site of the pain varies greatly, and the varying figures quoted in the literature are quite understandable when the following facts are considered :-

1) The time between the onset of the disease and admission to Hospital, e.g. pain may be primarily epigastric, but soon becomes generalised.
2) The extent of involvement of the pancreas, e.g. whole head, body, or tail.
3) Presence and amount of free fluid in peritoneal cavity.
4) Pain in the right iliac fossa due to secretion leaking through the foramen of Winslow down the right paracolic gutter.

5) Patient being nursed in Fowler's position may result in lower abdominal pain but with marked epigastric tenderness.

Lewison (1940) found that 90% of his cases had upper abdominal pain including 50% with epigastric pain, and 20% with pain in the right upper quadrant. Fallis and Plain (1939) put the incidence of epigastric pain at 88·5% whilst McWhorter (1932) puts it at 40%.

In this series of cases, the pain was localised to the upper abdomen in 91 cases (82·7%), being primarily epigastric in 60 cases (54·5%) and becoming generalised in 48 cases (43·6%) by the time of admission. In 15 cases (13·6%) the pain was generalised from the onset and the patient was unable to demonstrate the point of maximum intensity. In only 18 cases (16·4%) did the patient complain of pain over the gall-bladder, whilst in 2 cases (1·8%) pain was localised to the left hypochondriac region. Umbilical pain was primarily present in 5 cases (4·5%), in the right iliac fossa in 3 cases (2.7%), and in the left iliac fossa in 1 case (·9%). Praecordial pain was also complained of in 1 case (·9%).

Another very important feature of this pain is its tendency to radiate to other parts of the abdomen and to more distant foci. Broadly speaking, radiation occurs in 74% of all cases and the usual sites are, costo-vertebral angles 25% - 60% (Eliason (1930) and Lewison (1940) respectively) umbilical 2·9%, right shoulder 8·6%, Scapula 8·6%, left shoulder 2·9% (Lewison (1940)).

Severe backache in the lower thoracic region was a marked feature in only 38 cases (34·5%). This backache may be in the midline or in one or other costo-vertebral angle; the left being by far the most significant.

A less frequent, but equally important symptom, is the presence of pain radiating upwards to the shoulder, especially the left. This, however, occurred in only 12 cases (10·9%) of the series.

In studying pain, Loe (1941) came to the following conclusion that if a patient gives a history of gall-bladder disease and has pain in the right hypochondriac region, which is followed by severe pain in the left hypochondriac region, acute pancreatitis should be suspected. In other words, pain radiating across the epigastric region from right to left is practically pathognomonic of this disease.

The next question is this, "Is the site of the pain determined by the portion of the pancreas affected " ?. A categorical answer cannot be given because of the numerous factors involved, but this can almost certainly be said 'that where the whole pancreas is involved, the pain usually extends right across the abdomen, but if the head or tail is chiefly affected, other things being equal, the pain is situated in the right hypochondriac and right costo-vertebral regions or the left hypochondriac and left costo-vertebral regions respectively'. The referred pains are merely an indication of the irritation of the peritoneal and diaphragmatic areas by the serous exudate.

B. Severity.

In most of the literature, pain which is present in 100% of cases, is described as sudden, severe, agonising, prostrating, unbearable, excruciating, persistent, colicky or stabbing, but whilst this is true in some cases, it would be most misleading to expect this in every case. In this series, the pain was of intense severity in 24 cases (21·8%) and in 3 of these, it was so severe as to awaken the patients from sleep.

Ogilvie (1941) classifies the severity of abdominal pain in the following order :-

1) Perforated peptic ulcer.
2) Gall-stone colic.
3) Renal colic.
4) Acute pancreatitis.

In the remaining 86 cases (78.2 %), the pain, although severe, did not appear to be unbearable, and in a few of these cases was actually of a gnawing and burning character.

Mallorey (1941) states that his patients obtained considerable relief from morphia, but Pratt (1940) and Morton (1940) found that either morphia did not control it, or it had to be given in very large doses. I, personally, have abandoned the use of morphine in this disease as it either did not control the pain or it had, as stated above, to be given in very large doses.

From a close study of this series, I have come to the conclusion that the severity of the pain depends upon one or more of the following factors :-

1) the degree of obstruction at the ampulla of Vater
2) the extent of the pancreatic involvement
3) the amount of pancreatic haemorrhage
4) the amount of the serous exudate
5) the extent of the involvement of the retro-peritoneal tissues
6) concommitant biliary pathology especially if 'acute'
7) presence of local or general peritonitis

Type.

As stated before, the pain is invariably of sudden onset and in this series, the duration varied between half an hour and 3 days before admission to hospital; most patients were, however, admitted within 6 hours of its onset. On careful questioning, the patient frequently admits to similar, but milder attacks, in some cases over a period of years. In my youngest case (a female aged 10) she had had 4 severe attacks over a period of 5 months, which lasted for half an hour and made the child scream with pain. Frequently there is also a previous history of gall-stone colic which may be accompanied by intermittent jaundice.

In 99 cases (90%) the pain, whether epigastric, upper abdominal, or generalised, continued without intermission, but in 11 cases (10%) from time to time paroxysms of still

more severe pain were felt. Of these 11 cases, 8 definitely had gall-stones, whilst the remaining 3 showed definite evidence of gall-bladder disease. In one case which complained of severe paroxysmal pain, a stone was found in the ampulla of Vater at post-mortem. These paroxysms of pain may well be due to an attempt to pass a gall-stone from the ampulla of Vater into the duodenum, and should this be successful, the paroxysm will cease and the stone will, therefore, not be found at operation or post mortem. Another cause of this paroxysmal pain may be further haemorrhage into the pancreas and peripancreatic tissues from the blood vessels whose walls have been digested.

Importance of the type of Pain in Differential Diagnosis.

1) Acute Cholecystitis.

In this disease, there is also acute epigastric pain and backache, but the pain is usually confined to the right hypochondriac area and frequently radiates to the right scapula or to the right shoulder tip. This latter feature is unusual in acute pancreatitis and shoulder pain, when present, may affect the left side. Also, we frequently get a history of recurrent biliary colic with intermittent jaundice.

2) Acute Intestinal Obstruction.

The spasmodic pain of acute intestinal obstruction does not occur in acute pancreatitis, but the pain may be continuous and be referred to the region of the umbilicus. As the toxaemia of intestinal obstruction progresses, the pain diminishes, but the vomiting continues. Pain in the back is felt only very rarely in intestinal obstruction.

3) Perforated Peptic Ulcer.

The striking features of the pain in perforated peptic ulcer are :-

i) the severity, which doubles the patient up and is increased by movement.

ii) pain referred to the supraspinous fossa or summit of the shoulder

iii) partial relief of pain in the "second stage"

4) Aneurysm.

In differentiating the pain due to abdominal aneurysm, or dissecting aneurysm of the abdominal aorta, it is to be noted that this pain is neuralgic in character or may simulate renal colic.

5) Acute Coronary Artery Occlusion.

Substernal pain or pain radiating to the neck or left arm is strongly suggestive of this condition.

Shock.

It is generally accepted that the severe pain is almost invariably accompanied by shock or collapse which may be so profound as to prove fatal in a matter of hours. The cause of this rapid collapse is not clear, but it may be due to the pressure of blood on the semilunar ganglia and coeliac plexus, the absorption of toxins derived from the protein digestion in the abnormal pancreas, reflex disturbance mediated through the nerves of the region, the severity of the haemorrhage, or the stripping of the parietal peritoneum off the posterior abdominal wall.

Fallis (1939), Abell (1938), and Fallis and Plain (1939), state that shock is rare, whilst Cole (1938) found that it was very marked, and in Finney's (1933) cases it was found in 28 out of 32 cases.

15 cases (13·6% of this series were suffering from profound shock when admitted to hospital. This small percentage may be accounted for by the fact that most of the patients were not admitted to hospital until 6-9 hours after the acute onset, thus enabling them to recover somewhat from the primary shock. It must, however, be observed that in those patients suffering from repeated paroxysms of pain, spontaneous recovery from the primary shock is unlikely to occur and may even be increased.

Nausea and Vomiting.

Lewison (1940) puts the incidence of nausea as high as 70% and Mallorey (1941) refers to persistent nausea and anorexia. Vomiting occurs early and is usually unaccompanied by nausea. It is repeated at frequent intervals and is forcible in character, the amount varying greatly. Morton and Widger (1940), Lewison (1940), and Morton (1940) state that the vomiting occurred in 75%, 71% and 75% of cases respectively. It consists at first of gastric contents, later of bile, and occasionally it contains a trace of blood, but it is never faecal.

It has been pointed out the absence of bile in the vomit may be an additional finding of great value in the diagnosis of the presence of ampullar obstruction. If the patient has not vomited, aspiration of the duodenal contents is a relatively easy procedure and may serve as a means of determining the patency of the common bile duct.

Vomiting was a pronounced feature in 89 cases (80·9%) but blood was present in only 1 case, Paxton and Payne (1948) found haematemesis in 10 out of 307 cases. This blood in the vomit may be due to blood passing from the pancreatic duct into the duodenum, or from an intensely inflamed stomach or duodenum, or from a co-existing peptic ulcer. In cases with haematemesis, the prognosis appears to be worse, as shown by McWhorter (1932) with a mortality of 100% in the 3 cases described. Another important point is that the vomiting gradually tends to subside in contrast to the vomiting of acute intestinal obstruction, which becomes more marked and eventually stercoraceous. In contrast to this, the patient with a perforated ulcer may vomit once or twice, but no more. In thrombosis and embolism of the superior mesenteric artery, vomiting is early and severe, the vomitus sometimes containing blood and it is followed by melaena.

Flatulence.

Flatulence was present im 22 cases (20%) and was expelled by the mouth and per rectum. Although it was present in such a small percentage of cases, it was a most distressing symptom, and caused the patients most acute discomfort.

Bowels.

Morton (1940) and Quick (1932) found that constipation was present in the majority of their cases, but Fallis and Plain (1939) found only 1 case out of 26; in this series it was noted in 24 cases (21·8%). Absolute constipation is the rule in acute intestinal obstruction. Diarrhoea may be an unusual symptom, being present in 7·7% of Fallis and Plain's (1939) cases, and in 4·6% of Paxton and Payne's (1948) cases. In 4 cases (3·6%) of this series, the patient complained of diarrhoea. Melaena was not observed in any of this series, although it has been mentioned by others, e.g. Paxton and Payne (1948), 24 out of 307 cases.

Jaundice.

Slight jaundice is said to occur in approximately 20% of cases, but it may be as high as 43% Lewison (1940), or as low as 10%. Abell (1938); the number in this series was 13, giving a percentage of 11·8%. This symptom is usually attributed to an obstruction at the ampulla of Vater, or pressure of the swollen pancreas on the common bile duct. As Grey and Probstein (1941) point out, jaundice per se does not change the level of the blood diastase.

Cyanosis and skin discolouration.

There may be only slight cyanosis of the lips and ears or it may be widely distributed over the abdomen and limbs. This has been attributed to shallow breathing because of the painful abdominal lesion, to marked shock and cardiac failure, or to toxaemia. Occasionally, there is local discolouration of the abdominal wall around the umbilicus and in the loins. It is only seen in cases of some 2-3 days standing, and the patches have the appearance of the skin in late extravasation of urine, gas gangrene, or virulent influenzal pneumonia. The discoloured areas are slightly oedematous, and the oedema fades away into the surrounding tissue. Their size varies greatly, and in one case described by Blauvelt (1946) it was 5 cms. in diameter. They are usually attributed to the direct action of the pancreatic juice which escapes via the retroperitoneal tissues and passes by the most direct route to the surface, or to the action of the pancreatic lipase carried by the blood stream.

Cyanosis and skin discolouration occur only in very acute cases and, therefore, the prognosis is bad. The mortality may be as high as 85%, Eliason (1930). Cyanosis of the lips and ears was present in 6 cases (5·5%), and discolouration of the flanks in 1 case (·9%). Another sign described by Loeffler and Esselver (1946) is redness of the face in 50% of cases, but it may also occur in patients recovering from diabetic coma.

In acute coronary occlusion, cyanosis is usually present but the main distinguishing features are irregular pulse and praecordial distress.

(a) Abdomen.

Inspection.

Examination of the abdomen shows that the movements are definitely limited and, therefore, the breathing is mainly thoracic. In cases with severe epigastric pain the abdomen may be immobile above the umbilicus. In the early stages, the contour of the abdomen is that which is normal for the individual, but it soon becomes distended. This abdominal distension was a feature in 29 cases (26·4%), and was most evident in the epigastric region. It is due to the transverse colon being paralysed and distended with gas, and also to an incomplete ileus. In acute intestinal obstruction, the distension is usually more marked and generalised, but it is not present until the very late stages of perforated peptic ulcer.

(b) Palpation.

Abdominal palpation demonstrated the presence of extreme local tenderness in 35 cases (31·8%), and generalised tenderness in 47 cases (42·7%). A milder type of tenderness was present in the other 28 cases (25·5%), but there is no direct relationship between the degree of tenderness and the type of pancreatic lesion.

Lewison (1940) gives the distribution of the tenderness as :-

Epigastric region 40% cases.

Upper region 31·24% cases.

Rt. upper quadrant 20% cases.

Very careful palpation may determine that there is deep tenderness over the whole of the pancreas, whilst in other cases it may be more marked on the left side of the epigastrium. If the tenderness is chiefly on the right side, then the possibility of co-existing gall-bladder disease must be considered, The most important sign, however, is tenderness in the costo- vertebral angles, especially if this is on the left side. Recoil tenderness is invariably present and is often very marked, especially in the region of the upper abdomen.

In the early stages, the abdominal wall is flaccid. Muscular rigidity is either absent, or only occurs to a very mild degree. This mild degree of rigidity was present in 59 cases (53·6%) being generalised in 33 cases (30%) and localised to the epigastrium in 26 cases (23·6%). In approximately half the cases, the point of maximum tenderness corresponds to the point of maximum muscle spasm.

In the later stages of this disease, the rigidity may be generalised and severe, but was only found in 3 out of 26 cases, Fallis and Plain (1939). Obviously the extent and degree of rigidity must be correlated with the whole of the clinical picture in order to be of value. It is the combination of extreme tenderness and the lack of definite

muscular rigidity which is so characteristic; the rigidity which may develop later is due to peritonitis secondary to pancreatic infection.

In acute cholecystitis, muscular rigidity is usually marked in the upper half of the right rectus muscle and in both upper quadrants or even generalised in perforated peptic ulcer.

No tumour is likely to be felt in the epigastric region until the third day (Krote's sign) and even then the pancreas may not be palpable. The percentage of cases with a definite palpable swelling varies between 8·5%, Mallorey (1941) and 33·3%, Abell (1938). This mass may be felt either in the epigastrium or left loin and was present in 17 cases (15.4%) in this series. The swelling moves little on respiration, and often transmits a non-expansile pulsation from the underlying aorta. It may be separated from the liver and spleen by areas of resonance.

In acute cholecystitis, the gall-bladder may be palpable. A small rounded swelling with an expansile pulsation situated usually to the left of the mid-line is present in abdominal aneurysm, and a vague mass in dissecting aneurysm of the abdominal aorta.

Dinsmore and Nosik (1939) suggest that areas of hyperaesthesia on the left side corresponding to the segments of T. 8 - 10, possiblyeven higher, would be found

if sought for, but although I have been unable to confirm this in more than 3 cases (2·7%), it is of definite significance.

Percussion.

There is no alteration in the area of hepatic dullness in acute pancreatitis, but it may be diminished or absent in perforated peptic ulcer. The presence of free fluid may be demonstrated in the peritoneal cavity and may be of such an amount as to give rise to 'shifting' dullness. This was present in 8 cases (7·2 %). Morton (1940) and Fallis (1939) have withdrawn this fluid by abdominal paracentesis, the former reporting on a characteristic prune juice fluid and the latter finding blood-stained fluid. Personally, I am of the opinion that this method of investigation is quite unjustified.

Auscultation.

Intestinal sounds in acute pancreatitis disappear almost immediately, but in acute intestinal obstruction the sounds are easily heard and only disappear at a late stage.

Rectal Examination.

This may yield no definite information, but it is extremely tender when there is free irritant fluid in the peritoneal cavity and when peritonitis has developed in the later stages.

Urine.

Changes in the urine are not constant, but nevertheless may be important when taken with the other signs and symptoms. The following table shows the abnormalities which occurred in this series :-

TABLE No. 8.

	No. of Cases.	Percentage.
Albumen	27	24.5%
Blood	4	3.6%
Bile	12	10.8%
Sugar	14	12.7%
Acetone Bodies	6	5.4%
Increased Urinary Diastase	15	13.6%
Dysuria	7	6.3%
Oliguria	1	.9%

Albuminuria was present in 25% of cases and in the vast majority of cases was only transient. It could be due to one of the following causes namely, cardiac failure, shock, toxaemia, fever, renal damage or simply from pressure of the oedematous pancreas on the renal veins :-

Haematuria only occurred in 3.6% of cases and is probably due to an accompanying nephritis or to severe renal congestion, again due to pressure on the renal veins.

As mentioned above, jaundice was present in 13 cases and in 12 of these, bile was detected in the urine.

If glycosuria is found, it tends to confirm the diagnosis, but this finding is said to be uncommon, probably because death

occurs too rapidly (Proof:- In animals, even total removal of the pancreas is not followed by glycosuria for several days). Its presence undoubtedly demonstrates destruction or temporary non-functioning of the Islets of Langerhans, and as mentioned later, the patient may develop diabetes mellitus, but no such case occurred in this series.

Urinary Diastase.

As pointed out by Mushin (1932) and Loeffler and Esseluer (1946), estimation of the urinary diastase in acute pancreatitis is of the greatest value in diagnosis. In the healthy subject, the concentration of diastase in the urine is usually between 2 and 50 units, but there are marked variations in the figures obtained at different times of the day owing to polyuria or oliguria.

The daily output of diastase is estimated by multiplying the volume in ccs. of a 24 hour specimen of urine by the diastase index. The figure normally lies between 8,000 and 30,000 units. In all cases, except those of acute pancreatitis, the estimations should be made on a 24 hour specimen of urine. In acute pancreatitis, the first specimen available is taken and in the majority of definite cases, it usually contains 100 or more units/cc; lesser concentrations being of little or no significance. It is generally true to say that the highest figures are obtained if the test is performed within a few hours of the acute onset of the disease, but the urinary diastase only rises from 6-24 hours after the rise in blood amylase. This increase of diastase in the urine may

be due to obstruction to the pancreatic duct, e.g. stone at the ampulla of Vater, or increased permeability of the pancreatic cells due to inflammation.

In some cases of acute pancreatitis, proved at operation or at autopsy, there is no increase in urinary diastase, especially if the test is performed 14 days after the acute onset. This is almost invariably found in the following types of cases :-

1) Pancreatic oedema and mild cases of acute haemorrhagic pancreatitis.
2) Cases seen late and in which there is a certain recovery of function.
3) Widespread and apparently total glandular destruction.

In 10 out of 25 established cases in which this test was employed, the results were within normal limits. In one of these cases in which it was increased, the diastase index was 600 units/cc (Wohlgemuth's method) representing a daily output of diastase of 336,000 units.

An increased urinary diastase is, however, not pathognomonic of acute pancreatitis because, although it never reaches very high figures, it may rise to 200 units/cc in carcinoma of the head of the pancreas - due to obstruction of the ducts, and toxaemia of pregnancy - due to increased permeability of the kidneys.

Oliguria.

This occurs only in very severe cases and may even amount to a definite anuria. It is usually attributed to a low blood pressure causing impaired renal circulation, or pressure of the pancreas on the renal veins causing marked renal congestion.

Blood changes.

a) Blood Diastase.

Wightman (1948) pointed out that experimental obstruction of the pancreatic duct causes a rise in the blood amylase and lipase content within a few hours and that it may fall to normal within 24-48 hours.

The height of the rise is said to be directly proportional to the functional alterations in the acinar cells which are secondary to the degree of occlusion of the pancreatic ducts or the extent of the parenchyma involved in the inflammatory processes. Ellman (1942) does not concur with this view and states that the type of pancreatic disease and the degree of severity must be decided on the history and clinical findings. The ferment soon appears in increased amounts in the urine, and there is greatly diminished diastase content in the faeces, or it may be completely absent.

The blood diastase level in any one person is practically constant, but it varies markedly in different persons and has no relationship between age and sex. The range of normal levels is usually given as 60-200 units of

diastase / cc of serum. There is now no doubt that a rise in serum amylase is almost invariably associated with pancreatic disease and if it is over 1,000 units /cc the prognosis is said to be bad. I do not support this point regarding the prognosis, unless the level remains persistently high over a period of 24-72 hours. The highest figures are usually found within 12 hours of the acute attack and the vast majority have returned to normal by the 6th-10th day. Vastly different figures may be obtained for cases which clinically are of equal severity and this has been attributed by Wohlgemuth to the proximity of the lesions to the main pancreatic duct. Ellman (1937) suggested serial estimation of the blood diastase at short intervals in patients suffering from severe upper abdominal pain from the very onset of the attack The subsequent figures may follow one of three courses :-

1) They may fall rapidly probably indicating a sub-acute pancreatitis.
2) They may fall slowly indicating usually a widespread pancreatic destruction.
3) They may fall fairly rapidly and reach a sub-normal level just before death.

In the later cases, this sub-normal level can be explained at autopsy by the pancreatic necrosis.

It must not be forgotten, however, that a definite case of acute pancreatitis may have a normal blood diastase. This usually indicates, if the clinical condition is satisfactory, that the pancreatitis is subsiding or has subsided.

As mentioned under aetiology, acute pancreatitis appears to be common in chronic alcoholics and it is worthy of note that in a series of estimations carried out by Domzalski and Wedge (1947) there was a definite rise of serum amylase in 24% of such cases compared with only 2% of the controls.

In this series of cases, the blood diastase was estimated in 23 cases (20·9%) at times varying from 4 hours to 8 days after the onset of symptoms. In 14 cases (12·7%) the highest figures, i.e. 1,000 units/cc and over, (maximum 5,000 units/cc) all occurred within 4 days of onset, and all except one had returned to normal within 5 days. All the cases in which the serum amylase remained elevated over 5 days died. In 5 cases (4·5%) there was no rise in serum amylase. As Polowe (1946) and McCorkle and Goldwin (1942) concluded, an increase in blood diastase is almost always associated with pancreatic disease, but a normal figure almost excludes pancreatitis.

Other conditions which may give rise to increased blood diastase are :-

1) Parotitis.
2) Renal Disease
3) Trauma to Pancreatic gland.
4) Pancreatic Cysts.
5) Carcinoma of Head of Pancreas
6) Chronic Venous Congestion
7) Diabetes Mellitus (rarely)

And experimentally by :-

1) Ligature of main pancreatic ducts.
2) Forced injection of chemical irritants into duct.

It will be noted that only 2 acute surgical conditions, namely acute pancreatitis and trauma to the pancreatic gland are accompanied by an increased blood or urinary diastase and, therefore, this factor in conjunction with the foregoing signs and symptoms is of definite diagnostic value, but a normal diastase does not exclude pancreatitis.

b) Hyperglycaemia.

In these cases, preceding diabetes mellitus must be excluded as far as possible. Provided this has been done, we may obtain some idea of the amount of destruction of the pancreas and especially the Islet of Langerhan's. This is not a common symptom and in 11 of the cases in this series no increase in the blood sugar was detected. Loe (1941) found that there was a marked variation in the blood sugar from hour to hour depending on the amount of pancreatic destruction and states that if the blood sugar is over 300 mgms.% the outcome is usually fatal. Pratt (1940) on the other hand found hypoglycaemia in 50% of cases.

Shumacker (1940) found that diabetes mellitus may develop during acute pancreatitis. It may terminate rapidly in coma or the patient may survive with a more or less severe diabetes. He concludes that at least 2% of all patients with severe acute pancreatitis acquire diabetes mellitus and of those surviving the acute illness from 3-10% become subjects of diabetes mellitus. This fact has also been commented upon by Cole (1938).

c) Blood Counts.

1) Anaemia.

It is well worth mentioning here that secondary megalocytic anaemia may occur in acute pancreatitis, but it is extremely rare.

2) White Blood Count.

There seems to be no unanimity of opinion regarding the presence or absence of leucocytosis. This is not to be wondered at, because on reviewing the literature, there is very little attempt to correlate the clinical findings at various stages of the disease with the figures quoted. In this series, the maximum recorded count was 38,000/cmm., and this was in a case of marked pancreatic necrosis. The vast majority of other cases had a count ranging from 6,000-15,000/cmm. Observations of other authors may be of interest and are recorded on the following table.

TABLE NO.9.

Author.	
Lewison (1940)	35% cases W.B.C. over 15,000/cmm.
McWhorter (1932)	54·7% cases W.B.C. over 20,000/cmm.
Fallis and Plain (1939)	65% cases 15,000 - 30,000/cmm.

The percentage of polymorphs varies from 69% - 97%.

d) Blood Calcium.

Edmondson and Berne (1944) reported that in 72% of cases the serum calcium was below 9 milligrams per 100 cubic

centimetres between the 2nd and 15th day of the disease, and that the average serum calcium value was the lowest on the 6th day. If the serum calcium level was below 7 milligrams per 100 cubic centimetres of blood, the prognosis was invariably fatal. At these low levels, it is necessary to keep a careful watch for the onset of tetany and to treat it vigorously.

e) Plasma Protein and Prothrombin.

Lowering of the protein and prothrombin content of the blood during an attack of acute pancreatitis is said to occur, but further investigation is necessary before any definite conclusions can be drawn.

Loewi's Test.

This is an extremely simple test and is well worth doing provided that its limitations are remembered. It must, however, be carried out correctly as follows :- The pupils are examined and a drop of Adrenalin Hydrochloride 1:1,000 is put in one conjunctival sac and any dilatation of the pupil noted. After an interval of 15 minutes, another drop is added and if there is a further dilatation within half an hour the test is positive and suggestive of acute pancreatitis. In positive cases, the pupil is frequently ovoid and the dilatation eccentric but in the normal subject there is no effect on the pupil.

Mushin (1932) found it to be positive in 4 out of 32 cases, i.e. 13%, whilst in 150 other cases (not pancreatitis) it was positive in 10 cases, i.e. 7%.

In my own series, the test was negative in 9 out of 14 definitely established cases of acute pancreatitis, whilst being positive in a case of gangrenous cholecystitis.

Other conditions in which the test has been reported positive are :-

1) Hyperthyroidism.
2) Disease of the gall-bladder.
3) Diseases of the biliary tract.
4) Diabetes Mellitus (very rare).

Cammidge's Pancreatic Reaction.

This is not pathognomonic of acute pancreatitis and is now regarded as so unreliable as to be useless.

Radiography.

My own experience with the use of radiography in acute pancreatitis in differential diagnosis is to exclude the presence of free air in perforated peptic ulcers, or the presence of dilated intestinal loops and fluid levels in acute intestinal obstruction. It is, however, important to realise that this method of investigation may be extremely valuable, but also extremely dangerous.

A straight radiogram of the abdomen should be carefully examined to determine any abnormality or deformity of the outlines of normal structures. The opaque medium is then administered and any unusual irregularities of size, shape, position and function of their structures are noted.

The usual findings according to Glenn and Baylin (1947) and Metheny et al (1944) are :-

1) Stomach - elevated and flattened - due to pressure from swollen pancreas.

2) Duodenum - increase in size of duodenal loop - due to loss of tone and ileus.

- transverse position also elevated.

3) Distension of upper loop of jejunum and defects in shadow contours in region of the duodeno-jejunal flexure.

4) Distension of transverse Colon - due to localised ileus.

5) If the patient lies supine and a straight film taken, a large proportion of the cases show collections of gas at the cardiac orifice and duodenal bulb.

6) Tenderness of pancreatic area.

7) Limitations of diaphragmatic movements.

8) Pleural effusion.

9) Ill defined left psoas shadow.

10) Indistinct shadows in region of pancreas.

Lastly, a word of warning about cholecystography. If a stone is suspected to be impacted in the common bile duct and more especially if jaundice is present, it is most unwise to attempt cholecystography, because the opaque fluid may flow into the pancreatic duct and produce a fulminating pancreatitis.

Late Cases.

If the patient is seen at a later stage, the clinical picture is slightly different. The temperature is subnormal or slightly raised, but if suppuration has occurred, it may be markedly raised. The pulse rate is normal or slightly increased and the volume and tension has improved. Dittler abd McGavack (1938) reported on a case of acute pancreatitis complicated by impure auricular fibrillation and flutter, but at autopsy, no organic lesion could be found. They, therefore, concluded that the cardiac condition was due to reflexes from the abdomen. Drummond (1934) also reported on a case with auricular fibrillation. Acute pericarditis has also been found in several cases(Loeffler and Esseluer (1946)) Dyspnoea occasionally occurs and may even amount to air hunger. Hiccup may be present and if persistent, generally indicates a grave prognosis. 2 patients (1.8%) in this series found this a most distressing symptom and both died.

Shifting dullness, uncommon in the early stages, can usually be elicited at this juncture. In some cases, after the acute onset, the symptoms subside, but the pulse rate remains high and a mass develops in the epigastric region. This is followed by localised suppuration or sloughing of the gland. In the suppurative form, the pus may collect in the substance of the pancreas, fill up the lesser sac and bulge beneath the left vault of the diaphragm, or present in the left lumbar region and simulate perinephric abscess.

In the later stages, when there is no localisation, there are signs of diffuse peritonitis with free fluid or retroperitoneal cellulitis.

The symptoms of sepsis usually develop after 7-10 days, and ultimate recovery after prolonged illness may follow rupture of an abscess into the bowel. Perforation into the peritoneal cavity, stomach or duodenum may occur, or there may be the formation of a perinephric abscess. Temporary improvement may end in late death in 4-6 weeks after operation from pancreatic insufficiency. The symptoms then are malnutrition, wasting, profound weakness, hypotension, hypoproteinaemia, glossitis, vitamin D and vitamin K deficiency, fatty diarrhoea, and uncontrolled vomiting of small amounts.

The best criterion of excessive fat loss is the demonstration that the daily total excretion of fat exceeds 10% of dietary intake.

Death may also be due to haemorrhage from neighbouring vessels or to septic absorption.

Gangrenous pancreatitis may follow :-

1) Haemorrhagic infiltration of pancreas.
2) Suppurative infiltration of pancreas (rare).
3) Trauma.
4) Perforated gastric ulcer.

The symptoms of haemorrhagic pancreatitis may precede or be associated with it, and death usually occurs in 10-20 days. Necrotic portions of the pancreas have been known to be discharged per rectum with recovery.

DIFFERENTIAL DIAGNOSIS.

Acute pancreatitis is one of many acute abdominal conditions which present very similar symptoms and the following table shows the widely varying diagnosis made by the general practitioner. It is at once noted that 43 cases (39 1%) were sent into hospital with a diagnosis of "acute abdominal pain" without any further attempt at diagnosis, apparently due to the fact that the features presented did not suggest any one of the more common catastrophies.

TABLE NO. 10.

Diagnosis by General Practitioner.	No. of Cases.	Pecentage.
1) Acute abdominal pain	43	39.1%
2) Acute cholecystitis	23	20.9%
3) Acute intestinal obstruction	14	12.7%
4) Perforated peptic ulcer	8	7.3%
5) Peritonitis	6	5.5%
6) Coronary thrombosis	5	4.5%
7) Acute appendicitis	5	4.5%
8) Acute gastritis	2	1.8%
9) Acute pancreatitis.	4	3.6%
	110	99.9%

A diagnosis of acute cholecystitis in 23 cases (20.9%) was probably due to the fact that these cases exhibited a history of gall-bladder disease whilst 13 cases (11.8%) showed some degree of jaundice.

A history of recent constipation and the presence of repeated vomiting has undoubtedly played a part in arriving at a diagnosis of acute intestinal obstruction which was given in 14 cases (12·7%) of this series.

A correct diagnosis was made in only 4 of the series (3·6%). On admission to hospital, the surgeon made a correct diagnosis in only 46 cases (41·8%) whilst the other possible diagnoses are tabulated below :-

TABLE NO.11.

Surgeon's Diagnosis	No. of Cases.	Percentage.
1) Acute pancreatitis	46	41·8%
2) Acute cholecystitis.	32	29·1%
3) Acute intestinal obstruction.	13	11·8%
4) Perforated peptic ulcer.	16	14·5%
5) Acute appendicitis with peritonitis.	2	1·8%
6) Coronary thrombosis.	1	·9%
	110	99·9%

Other observers made the following observations.

Author	A.P.	G.B.D.	Appendicitis.	P.P.U.	A.I.O.	M.T.	C.T.
Morton and Widger (1940)	17%						
Lewison (1940)	13%	70%	10%				
Morton (1940)	17%	43%	5%	27%	8%	5%	5%
Fallis (1939)	30·8%						
Abell (1938)	12%						

A.P. = Acute pancreatitis
G.B.D. = Gall bladder disease
P.P.U. = Perforated peptic ulcer
M.T. = Mesenteric thrombosis
I.O. = Intestinal obstruction
C.T. = Coronary thrombosis.

Other conditions which must also be considered are :-

1) Pneumonia, but routine examination of the chest would obviate this mistake.

2) Acute Nephritis - A raised blood pressure, oliguria, albuminuria, haematuria, and urinary casts are usually present in this condition. In acute pancreatitis, oedema is absent and the blood urea is normal unless there has been excessive vomiting and dehydration. A raised blood urea due to these causes was present in 2 cases (1·8%).

3) Ruptured ectopic pregnancy. This can be excluded by a careful history and gynaecological examination.

From the foregoing signs and symptoms, and tables, it will be seen that the differential diagnosis lies mainly between the following conditions :-

i) Acute cholecystitis.

ii) Acute intestinal obstruction.

iii) Perforated peptic ulcer.

iv) Mesenteric thrombosis.

v) Abdominal aneurysm.

vi) Acute coronary artery occlusion.

For completeness, it is necessary to include a very rare condition, namely spontaneous rupture of the common bile duct. It is due to the ulceration of a gall-stone through its wall. At operation, there is intense infiltration of bile between the layers of the lesser omentum, along the greater curvature of the stomach, into the base of the transverse mesocolon and around the pancreas.

T R E A T M E N T.

1. Prophylactic.

As Cole (1938) pointed out, gall-bladder disease is far too common and acute pancreatitis too uncommon to justify cholecystectomy merely in the endeavour to prevent acute pancreatitis. Chronic alcoholism, obesity and any disease of the biliary tract should be treated.

Before proceeding to the conservative and operative treatment, it is right to mention that in common with other acute abdominal conditions, a certain proportion of patients admitted with acute pancreatitis are so severely ill that the termination is inevitably fatal whatever the form of treatment. This in early cases, is due to the fact that they do not recover from the initial shock, but if cases recover from this initial shock, they may still die from toxaemia. This toxaemia may be due to absorption of the products of protein destruction in and around the pancreas, intestinal paralysis and secondary infection of the necrosed gland.

2) Conservative.

Modern treatment tends to be conservative and certainly the figures published of cases so treated show a definite decrease in the mortality rate. Evidence of old fat necrosis discovered at a later operation as well as the biochemical tests mentioned above, definitely prove that conservative treatment has been successful. In acute pancreatitis due to mumps, operation is never indicated and recovery is usually complete within a week. If conservative treatment is decided upon, frequent and detailed clinical

examination of the patient is essential with hourly recordings of the pulse rate and blood pressure.

41 of this series (37·3%) were treated by conservative methods. Of these, 30 cases (73·2%) made an uninterrupted recovery whilst 11 cases (26·8%) died. Post mortem examination was performed on each of these 11 patients and the diagnosis was confirmed. Of these 11 patients, 3 died within 24 hours of admission, whilst 4 more died within 5 days. The post-mortem findings were interesting and are detailed below :-

In 3 cases, the gall-bladder and bile ducts were found to be perfectly healthy, whilst in 8 cases, chronic cholecystitis was present; 4 of these also having gall-stones. In 2 of the cases with cholelithiasis, a stone was found in the ampulla of Vater. In 1 case, the peritoneal cavity contained 1 pint of straw coloured fluid and the upper part of the duodenum was markedly dilated. 5 cases showed fat necrosis and 2 cases had thrombosis of the splenic vein.

1) Shock.

Shock may be very profound after any acute abdominal catastrophy and its treatment in all cases is of primary importance. This is not the appropriate place to describe the classical signs of shock, but a few points on its treatment as related to this disease are worth recording as primary shock is increased by inadequate respiration, pain, and loss of fluid.

1) Warmth. The patient is kept warm by hot blankets, bottles or electric crade, but care must be taken that this is

not carried to excess. The four main reasons for this are :-

i) Profuse sweating causes further loss of body fluids.

ii) Warming causes vasodilatation of the superficial vessels and diverts blood from more vital functions.

iii) Increases metabolism of skin and muscles.

iv) May promote autolysis of damaged tissue and absorption of autolytic products.

2) Transfusion and Infusion.

The great fall of blood pressure is counteracted by the administration of whole blood or plasma. As the patient is suffering purely from shock and not from internal or external haemorrhage, blood plasma is the ideal transfusion forthe following reasons. A diminution of the blood volume caused by plasma loss is more dangerous than the same amount due to haemorrhage. This causes an increased viscosity and results in a further reduction in the tissue circulation in addition to that caused by the fall in blood pressure and vasoconstriction. The height of the systolic blood pressure is the most reliable indication of the degree of shock and the response of the patient to the transfusion. Early and adequate transfusion must be given because if advanced shock waited for, the blood vessels and central nervous system will be irreversibly damaged. If signs of shock are present, especially if the pulse rate is over 100 beats/minute, the shock must be treated immediately even if the blood pressure is over 100 mm mercury, as the slightest intensification

of shock will result in a very rapid fall in the blood pressure. It will usually be found that from 1-2 pints of plasma is quite sufficient to restore the blood pressure to 100 mm mercury or over. The first 500 cc of plasma should be given fairly rapidly and the remainder at a rate of 100 drops/minute. As pointed out by Jensen (1946) the plasma given by transfusion may pass into the serous cavities irritated by the pancreatic secretions and may, therefore, account for the cyanosis and shock with haemoconcentration. In certain cases, transfusion of whole blood is indicated to counteract that lost during the haemorrhagic phase.

The estimation of haemoconcentration of the blood is of little or no value in these cases, as it is only altered in shock due to extensive burns and severe crushing injuries.

If the patient is dehydrated from repeated vomiting, intravenous saline with 5% glucose should be administered. It is an established fact that intravenous saline and glucose will only transiently relieve shock as the fluids rapidly pass into the body tissues. It is, therefore, of paramount importance to treat the shock efficiently before intravenous saline and glucose is administered. However, if the dehydration is extreme, there is no contra-indication to administering fluids subcutaneously or per rectum. A word of warning must be given here because large doses of intravenous glucose may be dangerous. Experimentally it has been shown that an elevation of the blood sugar level causes an increased flow of pancreatic juices rich in ferments. This may be counteracted in humans to a certain extent by giving one unit

of insulin for each 4 grams of glucose. Intravenous therapy may be continued for several days if necessary, provided that a fluid intake and output chart is kept.

It is essential that the intake of fluids and the output of urine should be approximately equal unless there is much sweating or diarrhoea, otherwise the fluids will remain in the tissues and lungs, with the danger of hypostatic pneumonia. If the rate of transfusion is kept at 30-40 drops/minute, this danger is greatly diminished; also the amount of saline should be restricted to 6 pints a day.

3) Drugs.

Is is usually stated that morphia is of the greatest value in the treatment of shock, and should be given in large doses ($\frac{1}{4}$-$\frac{1}{3}$ grain). This may be repeated if necessary because it is essential to relieve pain and to promote sleep.

As stated previously, I do not advocate the use of morphia for the relief of pain in acute pancreatitis, because although it will do so, in full doses, by its action on the central nervous system, at the same time it causes further spasm, or at least increases the tone of the smooth muscle. This would cause a contraction of the sphincter of Oddi with a resulting rise in the biliary and pancreatic pressures and possibly further damage to the liver and pancreas.

I, therefore, advise the administration of anti-spasmodics

because not only is the pain diminished or abolished, but a stone or plug of mucus in the ampulla of Vater, if present, can be passed into the duodenum by the relaxation of the sphincter whilst it also produces a fall in the intraductal pressure.

Immediate, although only very temporary relief can be obtained by giving inhalations of amyl nitrate, but a better method is to give tablets of nitroglycerine to suck or chew.

Papaverine or Eupaverin give more prolonged effects, and ephedrine either alone or in combination with atropin and papaverine, is excellent.

Papaverine may also be of value for its vaso-dilator effect because the extent of local vasoconstriction may determine the type and degree of pancreatitis.

Atropin Sulphate given in as large doses as gr. 1/50, 6 hourly for 24 hours, acts as an excellent antispasmodic and proportionately small doses may be given later. This drug is also extremely useful if there is excessive sweating.

According to Smead (1940) small doses of ephedrine, 4 hourly, are also useful if vascular collapse present.

Popper (1933) described 3 cases in which he relieved pain by the paravertebral injection of the 8th-10th dorsal nerves with novocaine, and Popper et al (1948) partly ascribed their good results to the local vasodilatation produced by blocking the sympathetic innervation to the pancreas.

Considerable quantities of calcium may be present in the lesions in cases of acute pancreatic necrosis, and it is logical to assume that a plentiful supply of available calcium is desirable in order to facilitate the formation of calcium soap in situ without undue depletion of serum calcium, and the possible onset of tetany. This may be given in the form of a 10% solution of calcium gluconate intravenously in 10 cc doses. Lastly, chemotherapy and penicillin therapy should be employed in full doses to prevent local infection of the necrotic pancreatic tissues and in an attempt to prevent infection spreading into the peritoneal cavity.

4) Oxygen Therapy.

If cyanosis is present, oxygen is beneficial, especially if administered by the B.L.B.mask, which is well tolerated by most patients, or in an oxygen tent.

This type of therapy is also very helpful in the treatment of shock, but there are considerable fluctuations of the blood pressure during its administration, and there is also a rapid fall when it is discontinued if shock is present. A lack of response usually indicates severe toxaemia, or the onset of uraemia.

Recently, surgeons have claimed that oxygen therapy is also beneficial in cases of ileus paralyticus, if the oxygen is given in concentration of 90-95% for short periods. As the abdominal distension of acute pancreatitis is due to paralysis of the transverse colon, it may be benefited by oxygen therapy.

II. Gastric Aspiration and Duodenal Suction.

Aspiration of the gastric contents may be instituted to try to prevent intestinal atony.

If vomiting is severe and abdominal distension is marked, a Ryle's or Miller Abbott's tube is passed and continuous suction carried out. If this is not practicable, the duodenal contents should be aspirated every hour.

III. Diet.

It is essential that intravenous therapy should be continued for 3-4 days, and that nothing be given by mouth in an attempt to inhibit the activity of the pancreas. The intake of food must be resumed very carefully and easily assimilable carbohydrates are given, e.g. milk, milk puddings, orange juice, glucose, honey, carrots, white of egg, etc. Fat is not permissible for several weeks, and meat is forbidden as the protein intake must be limited.

Length of stay in Hospital.

The following table shows the length of stay in hospital of 30 patients treated successfully by conservative methods :-

TABLE NO. 12.

Time.	No. of patients.	Percentages.
Less than 1 week	2	6.6%
1 - 2 weeks	13	43.3%
2 - 3 weeks	9	30.0%
3 - 4 weeks	4	13.3%
4 - 8 weeks	1	3.3%
8 - 12 weeks	1	3.3%
	30	99.8%

It will be noted that with conservative treatment 24,(80%) of the 30 cases which survived, were discharged from hospital within 3 weeks, and to date no patient has returned with recurrent symptoms.

Before turning to the discussion of operative treatment, it should be emphasised that it is unwise to give or to proceed with conservative treatment if the following conditions are present, and early operation should be advised.

1) Persistent fever or development of fever along with other abdominal signs.
2) Spreading peritonitis.
3) Pancreatic necrosis.
4) Distension of lesser peritoneal cavity.
5) Enlargement of the gall-bladder.
6) Jaundice.
7) No response to conservative treatment.

Operative Treatment.

There is still a great diversity of opinion amongst some observers as to the advisability of operation in all cases of acute pancreatitis, but my own conviction is that operation is only indicated under certain circumstanes, which will be detailed later.

Operation was previously advised in cases of acute pancreatitis for the following reasons :-

1) To remove the cause, e.g. gall-stones, and to drain the bile passages.

2) To relieve the tension about the pancreas by incising its peritoneal covering.

3) To remove the fluid from the greater and lesser sacs.

4) To provide drainage from neighbourhood of gland.

As will be seen from the aetiology, the cause of acute pancreatitis is not definitely known, and even if gall-stones are present, they may not be the determining factor. Provided that there is no stone in the ampulla of Vater, drainage of the biliary tract and pancreatic ducts can be stimulated by duodenal suction.

Incision of the peritoneal covering of the pancreas does not relieve the tension completely, because the acini have their own fibrous capsule and it is impossible to operate on them individually. The removal of the haemorrhagic fluid from the peritoneal cavity also seems to be unnecessary. Ireneus (1941) found that the haemorrhagic exudate in animals with acute haemorrhagic pancreatitis was not toxic on the intra-peritoneal injection of 2-3 cc into white mice, or on intravenous injection into dogs. Smead (1936) attributes this to the toxic substances being so diluted and neutralised by blood and peritoneal exudate, that they are no longer harmful and the fluid need not, therefore, be removed from the patient.

Laparotomy as a Diagnostic Procedure.

If a definite diagnosis cannot be made from any acute abdominal condition requiring an emergency laparotomy, this must be performed. If oedema of the pancreas or an acute haemorrhagic pancreatitis is observed, then the abdomen should be quickly, but very carefully, closed and conservative treatment instituted as detailed above.

Sometimes at laparotomy and before the peritoneum is incised, areas of fat necrosis may be seen in the extraperitoneal fat or, if the peritoneum is very thin, on the omentum.

Details of Operative Procedure.

In 69 cases (62·7%) operation was performed and of these 28 died, giving a mortality rate of 40.6%.

Anaestheic used.

TABLE No. 13.

Anaesthetic.	No. of patients.	Percentage.	Deaths.	Mortality
Gas Oxygen and Ether	51	73·9%	21	41·1%
Open Ether	14	20·3%	5	9·8%
Spinal	4	5·8%	2	50·0%
Total	69	100·0%	28	99·9%

It is quite obvious that interesting though this table may be, it gives no indication of the clinical picture of the patient when submitted to operation. There is , however, no doubt in my mind that these cases should have their anaesthetic administered by a consultant anaesthetist and that the practice of House Surgeons giving the anaesthetic to emergency cases should be whole heartedly condemned.

Various types of operations have been performed in acute pancreatitis and those employed in this series are detailed in the following tables :-

TABLE No. 14.

Type of Operation.	No. of Cases.	Deaths.	Mortality.
1) Laparotomy.	28	8	28·6%
2) Laparotomy with suprapubic drainage.	4	1	25%
3) Laparotomy with drainage of lesser sac	8	5	62·5%
4) Laparotomy with drainage of lesser sac and suprapubic drainage	2	1	50%
5) Laparotomy with cholecystostomy	7	4	56·3%
6) Laparotomy with cholecystostomy and suprapubic drainage.	2	1	50%
7) Laparotomy with cholecystostomy and drainage of lesser sac.	10	6	60%
8) Laparotomy with cholecystostomy and drainage of Rutherford Morrison's pouch.	2	nil	nil
9) Laparotomy with drainage of posterior abdominal wall.	1	1	100%
10) Laparotomy with cholecystectomy	4	1	25%
11) Laparotomy with cholecystectomy and choledochostomy.	1	nil	nil

Making allowances for the small number of cases reported upon and also the fact that half of the cholecystectomy operations were done after conservative treatment, it will be noted that laparotomy and laparotomy with suprapubic drainage have the lowest mortality, namely 28%. In cases in which the gall-bladder was also operated upon, and also when the lesser sac was opened, the mortality rose to 50% or over. In the 3 cases which recovered after drainage of the lesser sac, the duration of the symptoms had been longer than 24 hours.

Fallis and Plain (1939) found that drainage alone gave a mortality rate of 27·7%, drainage and cholecystectomy 50%, and drainage and cholecystostomy 61·8%. The pancreas is an extraperitoneal organ and, therefore, if the lesser sac is opened and the peritoneal covering of the pancreas incised, the pancreatic secretions and products of protein metabolism are allowed to escape into the general peritoneal cavity. Some of course may escape along a drainage tube placed down to the pancreas, but one cannot prevent some of it passing into the general peritoneal cavity. The great absorptive powers of the peritoneum are well known and, therefore, the dangers of profound toxaemia are greatly increased by this interference. The obvious conclusion to come to is that it is advisable to interfere operatively as little as possible if a laparotomy has been performed, because of the uncertainty of the diagnosis and an acute haemorrhagic pancreatitis found. Certain features, however, may make it essential to proceed:-

Marked distension and inflammation of the gall-bladder which may go on to rupture and cause biliary peritonitis. In these cases cholecystostomy is indicated.

Jaundice, because it is of the obstructive type, is also an indication for cholecystostomy. Only in rare cases should choledochostomy be performed in order to remove a stone in the ampulla of Vater or common bile duct. This should be attempted if the patient's general condition is good and the common bile duct much distended and easily accessible. Should choledochostomy appear difficult, a rapid cholecystostomy will suffice to decompress the biliary system. Cholecystectomy should be avoided if possible, because cholecystenterostomy may be necessary later, and also it is accompanied by a great deal of shock in an already ill patient. Later there is also the danger of an increased biliary pressure.

In the absence of gall-stones or jaundice, dilatation or thickening of the duct, one is rarely justified in exploring the common bile duct, but should this be necessary, the following points made by McWhorter (1932) are very useful in determining the subsequent treatment :-

(1) If the outlet of the common bile duct is dilated prolonged drainage is unnecessary.

(2) If the outlet is partially or completely obstructed due to local congestion, do NOT dilate because of the danger of increased swelling. If possible a tube should be inserted into the common bile duct, through the sphincter of Oddi into the duodenum.

This prevents a further reflex of bile into the pancreatic duct.

Pancreatic necrosis or suppuration ia another indication for drainage and may be best done through the loin or costo-vertebral angle. Drainage of fluid in the lesser sac is advisable as it may prevent the development of a pseudocyst and may be carried out through the gastro-colic or gastro-hepatic omentum.

If a retroperitoneal involvement is present as indicated by surface discolouration, incisions are made into the loin. In very rare cases, pancreatic lithiasis is present and it is necessary to remove the stone by a transduodenal incision exposing the ampulla of Vater, which is split, and the stone removed with forceps.

Pancreas.

Various parts of the pancreas were seen at operation to be the site of the initial lesion, but in only 33 cases (47·8%) was the whole of the organ involved. In only 2 cases (2·9%) was the disease confined to the tail, whilst the remainder were about equally divided between the head, the head and body, the body, head and tail, and the body and tail.

Fat Necrosis.

Fat necrosis was found in 55 cases (79·7%) and was invariably extensive over the omentum, mesentery and parietal peritoneum. Morton and Widger (1940), McWhorter (1932), Fallis and Plain (1939), and Finney (1933), give their instances of fat necrosis as 60%, 83%, 61·5% and 76% respectively.

Free Fluid.

Free fluid was found in 13 cases (10·8%) mainly in the lesser sac and around the gall-bladder. This fluid was chocolate coloured in 5 cases (7·1%), blood stained in 7 cases (10·1%), and serous in 1 case (1·4%). McWhorter (1932) found free fluid in 60% of his cases, the majority being blood stained.

Gall Bladder.

The gall-bladder appeared normal in 20 cases (29%), but was diseased in the remaining 49 cases (71%). the degree of involvement being shown in the following table :-

TABLE NO.15.

State of Gall-bladder.	No. of patients.	Deaths.	Mortality
1) Apparently healthy gall-bladder	20	8	40%
2) Apparently healthy gall-bladder with gall-stones	13	4	30·8%
3) Acute cholecystitis	13	5	38·5%
4) Acute cholecystitis with gall-stones	3	3	100%
5) Chronic cholecystitis	5	4	80%
6) Chronic cholecystitis with gall-stones	13	4	30·8%
7) Empyema of gall-bladder with gall-stones	2	nil	nil
Total	69	28	

From the previous table, it will be seen that gall-stones were present in 31 cases (44·9%) and in only 1 case was a stone found in the ampulla of Vater at operation.

If there is no contra-indication to operation, all cases in which gall-stones are demonstrated should be treated surgically as their removal may prevent a further attack. This operation should be performed preferably 3 months after all the acute symptoms have subsided.

Other findings at operation were marked oedema of the posterior abdominal wall in 5 cases, 3 of which died at the following times post-operatively, within 24 hours, 6 days, and 1 month. In 1 case a chronic gastric ulcer was present, in another a duodenal ulcer.

The following tables are included because they give the details of the cases much better than any lengthy description; the main points, however, being embodied in the text.

Abbreviations used in Table No. 16 and Table No. 17.

G.O.E. = Gas, oxygen and ether
N = Apparently normal.
+ = Present.
- = Absent.
P.I. = Portion only of pancreas involved.
A.P.I. = All pancreas involved.
A.of V. = Ampulla of Vater.
E. = Emergency operation.
C.B.G. = Chronic gall-bladder disease.
A.C. = Acute cholecystitis.
O. of P. = Oedema of pancreas.
A.H.P. = Acute haemorrhagic pancreatitis.
G.P. = Gangrenous pancreatitis.
S.P. = Suppurative pancreatitis.

TABLE No. 16

OPERATION CASES. CASES WHICH RECOVERED.

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall Stones	Fat Necrosis	Pancreas	Length of stay in Hospital.
1	A.W.	43	F	3-4 days	4 days	G.O.E.	Laparotomy and drainage of lesser sac.	N	+	+	A.P.I	4 weeks
2	S.S.	10	F	7 hours	E	Ether	Laparotomy and chole-cystostomy and drainage of Rutherford Morrison's pouch	A.C.	-	+	A.P.I. O. of P.	4 weeks
3	M.C.	68	F	1-2 days	E	Spinal.	Laparotomy	C.G.B.	+	+	P.I.	16 days
4	G.W.	37	M	6 hours	E	G.O.E.	Laparotomy	N.	-	+	A.P.I. A.H.P.	4 weeks
5	J.K.	68	F	2-3 days	E	Spinal	Laparotomy Drainage of lesser sac, suprapubic drainage.	A.C.	-	+	P.I.	21 day
6	P.D.	20	F	2-3 days	18 days	Spinal	Cholecystectomy and Chole-dochotomy.	C.G.B.	+ AofV	-	P.I.	5 week

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall stones	Fat Necrosis	Pancreas	Length of stay in Hospital.
7	A.S.	57	F	0-1 days	5 days	G.O.E	Laparotomy	N	-	+	P.I.	14 days
8	A.B.	38	F	3 days	9 days	G.O.E.	Laparotomy and drainage of lesser sac.	C.G.D.	-	+	A.P.I. A.H.P.	8 weeks.
9	M.F.	24	F	3-4 days	9 days	G.O.E.	Laparotomy	N	-	-	A.P.I.	21 days
10	E.R.	50	F	3 days	5 weeks	G.O.E.	Laparotomy and Cholecystectomy	C.G.D. Empyema	+	+	A.P.I A.H.P	3 months
11	E.H.	46	F	7 days	2 days	G.O.E.	Laparotomy	C.G.D.	++	+	A.H.P	3 weeks.
12	D.E.	41	F	0-1 days	E	G.O.E.	Laparotomy and Cholecystostomy	C.G.B. ++	+	+	A.P.I.	21 days
13	M.S.	57	F	0-1 days	E	Ether	Laparotomy.	C.G.B.	+	+	A.P.I.	5 weeks
14	A.I.	25	F.	6-7 days	E	G.O.E.	Laparotomy and suprapubic drainage.	N	-	+	P.I.	4 weeks

CASES WHICH RECOVERED.

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall Stones	Fat Necrosis	Pancreas	Length of stay in Hospital.
5	E.N.	47	F	6 hours	E	G.O.E.	Laparotomy and Cholecystectomy	A.C.	-	+	A.P.I. O.of P.	4 weeks.
6	M.S.	56	F	4 days	E	G.O.E.	Laparotomy	N.	-	-	A.P.I. A.H.P.	7 weeks.
7	O.S.	48	F	3 days	14 days	G.O.E.	Laparotomy	N.	+	-	A.P.I. A.H.P.	4 weeks.
8	L.P.	74	M.	0-1 days	E	G.O.E.	Laparotomy cholycystostomy and suprapubic drainage.	A.C.	-	+	A.P.I.	4 weeks.
9	L.S.	64	F	3-4 days	4 weeks	G.O.E.	Laparotomy and cholecystostomy	N.	+	+	P.I.	6 weeks.
0	A.L.	34	F.	12 hours	E.	Ether	Laparotomy Cholecystectomy + drainage of lesser sac.	C.G.D.	++	+	A.P.I. A.H.P.	8 weeks.
21	J.G.	63	M	3 days	E	G.O.E.	Laparotomy Cholecystostomy	Empyema of G.B.	++	+	P.I. A.H.P.	4 weeks.

CASES WHICH RECOVERED

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall Stones	Fat necrosis	Pancreas	Length of stay in hospital.
22	G.W.	36	M	3 hours	E	G.O.E.	Laparotomy	N	-	+	A.P.I. A.H.P.	3 wee
23	E.L.	56	M	21 hours	10 days	Ether	Laparotomy	N	-	++	A.P.I. O.of P.	3 wee
24	E.S.	47	F	2-3 days	8 days	G.O.E.	Laparotomy and Suprapubic drainage.	N	-	+	A.P.I.	2 wee
25	H.P.	60	M	12 hours	2 days	G.O.E.	Laparotomy and cholecystectomy.	C.G.D.	++	++	A.P.I. A.H.P.	4 wee
26	L.F.	36	F	2-3 days	E	G.O.E.	Laparotomy and cholecystostomy drainage of lesser sac.	C.G.D.	+	+	A.P.I	24 days
27	F.M.	56	F	3 hours	E	G.O.E.	Laparotomy	N	+	-	A.P.I. O.of P.	8 week
28	L.S.	56	F	2-3 days	13 days	G.O.E.	Laparotomy	N	-	+	A.P.I.	4 week
29	M.D.	76	F	24 hours	E	G.O.E.	Laparotomy Drainage of lesser sac.	A.C.	-	+	P.I. G.P.	6 week

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall stones	Fat necrosis	Pancreas	Length of sts in hospital.
30	M.E.	48	F.	4 hours	E	G.O.E.	Laparotomy	N	+	+	A.H.I.	8 wee
31	A.S.	66	M.	1 day	E	G.O.E.	Laparotomy	N	-	-	P.I.	16 we
32	P.E.	70	M.	2 days	6 days	Ether	Laparotomy and cholecystostomy and drainage of lesser sac.	A.C.	-	+	A.P.I.	5 wee
33	M.G.	47	F.	1-2 days	2 weeks	G.O.E.	Laparotomy	C.G.B.	+	+	P.I.	4 wee
34	E.D.	63	F.	0-1 days	E	Ether	Laparotomy	N	+	+	A.P.I.	15 day
35	D.S.	63	F.	8 hours	E	Ether	Laparotomy with Cholecystostomy Drainage of lesser sac.	A.C.	-	+	A.P.I.	6 week
36	J.M.	46	M.	2-3 days	5 days	G.O.E.	Laparotomy	N.	-	+	P.I.	18 day
37	F.H.	50	F.	0-1 days	E	G.O.E.	Laparotomy	N.	-	+	P.I.	16 day

TABLE No. 16 (Contd.) CASES WHICH RECOVERED.

CASES WHICH RECOVERED.

	NAME	Age	Sex	Duration of symptoms before operation.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall stones	Fat Necrosis	Pancreas	Length of stay in hospital.
8	A.K.	52	F.	1day	5th day	Ether	Laparotomy with supra-pubic drainage.	N	+	-	Head and body	18 day
9	R.A.	45	F.	6 hours	21 days	G.O.E.	Laparotomy with cholecystostomy and drainage of Rutherford Morrison's Pouch.	A.C.	-	-	A.P.I.	4 week
0	B.N.	49	F	2 days	21 days	G.O.E.	Laparotomy	N	+	-	A.P.I.	15 days
1	A.F.	49	M	9 hours	E	Ether	Laparotomy	N	+	+	Body and tail	18 days

TABLE No. 17 CASES WHICH DIED

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospt. before operation	Anaesth.	Operation	Gall Bladder	Gall stones	Fat Necrosis	Pan-Creas	Days of life after operation.
1	M.L.	75	F	o-1 days	E	G.O.E.	Laparotomy drainage of lesser sac.	N	-	+	P.I.	5
2	S.L.	63	F	6-7 days	2 days	Ether	Laparotomy.	N	+	+	P.I.	I
3	E.S.	43	F	0-1 days	E	Ether	Laparotomy Cholecystostomy Drainage of lesser sac.	C.G.B.	+ AofV	+	P.I.	18
4	G.W.	40	M	24 hours	E	Ether	Laparotomy and drainage of post. abd. wall.	N	-	+	A.P.I S.P.	32
5	H.M.	67	M	2-3 days	E	G.O.E.	Laparotomy Cholecystostomy Drainage of lesser sac.	C.G.B.	+ AofV	+	P.I.	18
6	E.M.	59	M	12 hours	6 days	G.O.E.	Laparotomy.	N	-	-	P.I A.H.P.	11

CASES WHICH DIED.

TABLE No. 17 Cont.

CASES WHICH DIED

	Name	Age	Sex	Duration of symptoms before admission.	Days in Hospt. before operation.	Anaesth.	Operation.	Gall Bladder	Gall stones	Fat Necrosis	Pancreas	Days of life after operation.
7	L.W.	51	F	0-1 days	14 days	G.O.E.	Laparotomy drainage of lesser sac.	N.	-	-	P.I.	1
8	W.W.	59	M	24 hours	E	G.O.E.	Laparotomy	A.C.	-	++	A.P.I. S.P.	27
9	E.B.	51	F	0-1 days	E	G.O.E.	Laparotomy Cholecystostomy	N.	+	+	P.I.	10
10	J.L.	66	M	12 hours	E	G.O.E.	Laparotomy and drainage of lesser sac.	A.C.	-	+	P.I. S.P.	6
11	W.G.	53	M	0-1 days	E	G.O.E.	Laparotomy Cholecystostomy	C.G.B.	-	+	P.I.	2
12	A.H.	57	M	6 hours	E.	Ether	Laparotomy	.A.C.	+	-	head & body A.H.P.	23
13	F.E.	67	F	0-1 days	E.	G.O.E.	Laparotomy Cholecystostomy Suprapubic Drainage	N.	+	+	A.P.I.	4

CASES WHICH DIED.

TABLE No. 17. Cont. CASES WHICH DIED

	Name	age	Sex	Duration of symptoms before admission.	Days in Hospital before operation	Anaesth.	Operation	Gall Bladder	Gall Stones	Fat Necrosis	Pancreas	Days of life after operation
4	R.G.	46	M	28 hours	E	G.O.E.	Laparotomy Cholecystostomy and lesser sac drained.	A.C.	+	++	A.P.I. O.ofP.	1
5	R.T.	59	F	0-1 days	E	G.O.E.	Laparotomy	N.	-	+	P.I.	1
6	F.L.	74	M	4 hours	E	G.O.E.	Laparotomy with suprapubic drainage.	A.C.	-	++	P.I. A.H.P.	21
7	W.S.	55	F	0-1 days	E	G.O.E.	Laparotomy drainage of lesser sac suprapubic drainage.	A.C.	-	+	P.I.	1
8	C.M.	61	F	8 hours	E	Ether	Laparotomy and drainage of lesser sac.	N.	-	+	P.I. A.H.P.	Died same day.
9	J.G.	72	M	1-2 days	E	G.O.E.	Laparotomy Cholecystostomy Drainage of lesser sac.	C.G.B.	+	-	A.P.I.	8
0	J.P.	70	M	3 days	E	Spinal	Laparotomy Cholecystectomy	C.G.D.	-	+++	P.I. A.H.P.	1
1	T.B.	50	M	0-1 days	E	G.O.E.	Laparotomy Cholecystostomy Drainage of lesser sac.	A.C.	+	+	P.I.	10

TABLE No. 17. Cont. CASES WHICH DIED

	Name	Age	Sex	Duration of symptoms before admission.	Days in hospital before operation.	Anaesth.	Operation	Gall Bladder	Gall Stones	Fat Necrosis	Pancreas	Days of life after operation
2	C.R.	61	M	12 hours	1 day	G.O.E.	Laparotomy.	N	-	+++	body & tail S.P.	10 days
3	J.F.	60	F	0-1 days	E	G.O.E.	Laparotomy drainage of lesser sac.	A.C.	-	+	P.I.	4 weeks
4	H.B.	45	M	2 days	16 days	G.O.E.	Laparotomy + Cholecystostomy + lower sac.	C.G.D.	X-ray ? in Common bile duct	++	A.P.I A.M.P.	59 days
5	T.T.	42	M	2-3 days	E	Spinal	Laparotomy.	N	+	+	P.I.	1 day
6	G.T.	54	F	1 day	E	G.O.E.	Laparotomy	N	-	++	head & body A.M.P.	6 days
7	E.S.	65	F	2-3 days	21 days	G.O.E.	Laparotomy Cholecystostomy	C.G.B.	-	-	P.I.	10 days
8	R.Q.	63	F	2-3 days	3 days	G.O.E.	Laparotomy Cholecystostomy	C.G.B.	-	+	A.P.I.	2 days

Post-Operative Treatment.

When the patient returns from theatre, he should be given the usual treatment for post-operative shock, and this should be followed by the strict régime laid down under conservative treatment.

Post-Operative Complications.

1) Burst Abdomen.

As I mentioned above, special care must be taken in the closure of the laparotomy wound, because the pancreatic juice will digest the catgut sutures and the abdominal wall and, therefore, "burst abdomen" is a very likely complication. This may be guarded against to a certain extent by perfect peritoneal apposition, the use of non absorbable sutures, with interrupted sutures for the muscles, and the supporting of the wound by means of laparotomy corsets. Should the ferments escape on to the surface, the skin may become digested, and this is best guarded against by applying paraffin molle ointment containing 2% hydrochloric acid, paint daily with Whitehead's varnish, or Lanolin ointment containing 1% Acetic Acid applied liberally.

2) Sepsis.

Apart from the usual aseptic surgical technique, little can be done as a prophylactic, except the administration of one of the sulphanilamide group of drugs or penicillin.

Should sepsis occur in the form of a subphrenic abscess, retro-peritoneal abscess, perinephric abscess, etc., the usual treatment is given and drainage obtained by the most appropriate route. If a retroperitoneal abscess is not drained it may rupture into the stomach, duodenum, or general peritoneal cavity.

Pancreatic sloughs must be removed when clinical signs point to their presence.

3) Haemorrhage.

About the 13th - 15th day post-operatively, the surgeon must be on the alert for secondary haemorrhage which if not instantly and energetically treated is invariably fatal.

4) Thrombosis of Splenic and Mesenteric Veins.

Very little can be done for this complication, except the administration of heparin, or dicumerol and penicillin to counteract sepsis. The outcome is invariably fatal.

5) Pancreatic Insufficiency.

This is treated by blood transfusion and pancreatic extracts. Pancreatinum may be given orally in doses of 3 - 5 grains, 2 - 3 hours after a meal. This is to prevent its destruction by the acid in the gastric juice. This white or buff coloured powder contains the enzymes, trypsin, lipase and amylase. Peptonised foods in the form of peptonised milk, beef tea and Benger's food may also be given. Pancreatinum may also be given in the form of an enema in 4 oz. doses in equal parts of milk and beef tea. Other proprietary preparations are:- dipantrin, panacoids, panteric tablets, and zymine. These extracts may have to be continued for several months and

estimations of serum amylase and lipase give some guide as to the extent and progress of the deficiency.

6) Diabetes Mellitus.

May also follow acute pancreatitis and is treated on the usual lines.

7) Biliary Disease.

Before discharge from hospital, all patients who have had an attack of acute pancreatitis should have a cholecystogram. If this shows the presence of gall-stones and/or a non-functioning gall-bladder, then cholecystectomy is the treatment of choice. A dilated or thickened common bile duct should be explored, especially if jaundice present, and it should be drained for several weeks. The time for removal of the drain can best be judged by clamping an increasing amount each day.

8) Pseudocyst of Pancreas.

Aldis (1946) describes 3 cases of pseudopancreatic cysts following acute pancreatitis. This condition may also arise after an injury to the pancreas 2 - 3 weeks previously and usually results from the occlusion of the foramen of Winslow.

This is usually dealt with by drainage and a counter-incision in the left loin.

9) Pancreatic Fistulae.

These may arise following an operation for acute pancreatitis or from a pseudopancreatic cyst. They usually close spontaneously, but may take several months to do so. Bufalini (1947) describes an operation for a persistent fistula by which he converts it into an internal drainage

by using the fistulous track and anastomosing the cutaneous opening with an abdominal viscus. Persistent cases may be cured by the insertion of radium into the track.

10) Acute pericarditis, pleurisy and bronchopneumonia are liable to occur as also is acute intestinal obstruction and the other common complications following abdominal operations. They are treated on recognised lines.

M O R T A L I T Y.

Death is usually due to one or more of the following causes :-

1) Shock due to severe haemorrhage or pressure on coeliac axis.
2) Toxaemia from protein autolysis of the pancreatic tissues.
3) Compression of the portal vein from the pancreatic swelling; the latter can be diagnosed clinically by the distension of the umbilical veins and the marbling of the skin of the abdominal wall.

The mortality of operative cases must always remain high because it is frequently the most serious cases which are operated upon. This may be due to two factors - one is because of a mistaken pre-operative diagnosis, and secondly in an attempt to save the patient's life when conservative treatment has failed. The post-operative duration of life suggests that operative treatment has accelerated the fatal issue.

In this series, 25 males were operated upon and 15 died, giving a mortality of 60%; and of 44 females 13 died, giving a mortality of 29·5%, i.e. a total mortality of 40·6%. This compares favourably with other observers as seen on the following table :-

TABLE No. 18.

Mortality.

Author.	Operative Treatment.	Conservative Treatment.
Fallis (1939)	42·6%	6·3%
Pratt (1940)	54%	25%
Lewison (1940)	50% (E)	
Morton (1940)	49·03%	
Eliason (1930)	80% (E)	
Finney (1933)	37%	

(E = Emergency Operation.)

TABLE No. 19.

Mortality relating to age.

Age.	No. of cases.	No. of cases treated operatively.	No. of cases who died.	Percentage.
10 - 19	1	1	-	-
20 - 29	3	3	-	-
30 - 39	7	5	-	-
40 - 49	22	18	5	27·7%
50 - 59	29	19	10	52·6%
60 - 69	31	16	9	56·2%
70 - 79	16	7	4	57·1%
80 - 89	1	-	-	-
Total	110	69	28	

It may also be noted that no patient under 40 years of age died.

Of the 42 cases which were operated upon as emergency cases, 21 died and 21 recovered, and of the 19 cases which were not treated as emergencies but later operated upon, only 7 died.

Of the 38 cases operated upon with symptoms of less than 24 hours duration, 17 died, and of these 12 were subjected to a more extensive operation than a simple laparotomy. 21 of these cases recovered and these were submitted to the following operations-

Simple laparotomy.	11
Laparotomy and cholecystostomy	4
Cholecystostomy	2
Laparotomy, cholecystostomy and drainage of lesser sac.	2
Laparotomy and drainage of lesser sac.	1
Laparotomy with suprapubic drainage	1

Of the patients whose symptoms had been present for 1 - 4 days, 19 recovered and 8 died, but it will be noted that only one of these 8 fatal cases had a simple laparotomy.

In this series, the overall mortality was 35.5%.

CONCLUSIONS.

Aetiology.

It is extremely difficult to demonstrate the pancreatic and bile ducts in cases of haemorrhagic and suppurative pancreatitis due to the disintegration of the pancreatic tissues and I have only been able to demonstrate a common channel in 3 of my own cases at post mortem. As mentioned previously, it is most desirable that full details of all post mortem examinations should be published in this still fairly rare condition. It is obvious that the presence, or the possible formation of a common channel for the pancreatic duct and common bile duct is not in itself a determining factor in causing the onset of an attack of acute pancreatitis, but that other conditions previously mentioned may be additional predisposing factors. Popper et al (1948). made observations which were most enlightening on this point and further investigations on these lines should be energetically pursued.

Further, I strongly suggest that a patent duct of Santorini should always be sought for at post mortem for the reasons stated above and I am definitely of the opinion that acute pancreatitis is much commoner in patients with a patent duct of Santorini.

Obviously, as these are anatomical points nothing prophylactically can be done surgically, but they are certainly very important from a pathological point of view.

In 2 of my cases, the patient was seen to have a peptic ulcer and this may have been the determining factor by causing spasm of the sphincter of Oddi.

As mentioned above (Paxton and Payne, 1948) 18% of cases were admitted to hospital in an intoxicated condition and in one case in this series the pain occurred immediately after swallowing a large quantity of whisky. This could be attributed to spasm of the sphincter of Oddi due to acute gastro-duodenitis.

Aseptic necrosis of the pancreas occurring in malignant hypertension has also been reported and I am at present collecting a series of cases to show the appearances of the pancreas at post mortem in chronic alcoholics and hypertensives.

It must reluctantly be admitted that in spite of all the present available evidence, not one of the current theories of the genesis of acute haemorrhagic pancreatitis adequately explains the mechanism of its production. As Smyth (1940) pointed out, the solution of this problem is more likely to be found in the experimental studies in which the earliest stages of the disease can be investigated, rather than by examining the materials obtained at autopsy.

Pathology.

It will be observed that in common with other observers I consider that the different types of acute pancreatitis described in the literature are really different stages of the same disease, the stages depending on the predominence of one or more of the aetiological factors. The progression from oedema of the pancreas to haemorrhagic pancreatitis is definitely due to ischaemia of the gland which may progress to gangrenous

pancreatitis. Suppurative pancreatitis occurs when infection is superimposed.

It will be noted that the associated pathology is invariably confined to the biliary and gastro-intestinal tracts. Haemorrhage into the pancreas and fat necrosis are not pathognomonic of this disease.

Signs and symptoms.

The large preponderance of females over males is to be expected because of the much higher proportion of diseases of the biliary tract in females.

It is not surprising that such a large percentage of cases had a normal or sub-normal temperature and a rapid pulse of poor volume and tension because most of these cases are admitted as surgical emergencies and are often in a state of shock on admission. Also a high temperature is usually only found in late cases which have reached the suppurative stage.

Mild attacks of acute pancreatitis are in my opinion frequently mis-diagnosed as gall bladder disease, peptic ulcer, acute appendicitis, etc. and I am satisfied that this is mainly due to an inadequate clinical examination and a failure to avail oneself of the biochemical methods at one's disposal. Pathological facilities for estimating blood diastase, serum calcium levels, etc. should be available during the whole 24 hours, because a positive finding may be a most important sign and save the patient an unnecessary operation.

It will be noted that of the 24 cases which were x-rayed

in hospital, only 25% had no evidence of gall bladder disease.

I have found that severe backache and pain in the costo-vertical angles, especially the left, are most important signs, but radiation of the pain from right to left in the upper abdomen is so significant as to be almost pathognomonic.

It is usually stated that the pain of perforated peptic ulcer is the only pain which is so severe as to awaken the patient from sleep, but this occurred in 3 of my cases. This is however unusual, and all degrees of pain can be encountered in this disease.

Paracentesis abdominis is definitely unjustified as a method of investigation because not only is the procedure not devoid of danger, but the information obtained is minimal.

The early disappearance of the intestinal sounds in this disease is obviously due to the early onset of paralytic ileus.

Differential diagnosis.

If a stoutish elderly patient of either sex, with a previous history of indigestion, has an acute attack of severe upper abdominal pain, marked epigastric tenderness without muscular rigidity, upper abdominal distension, distressing flatulence, frequent vomiting, a rapid pulse of extremely poor volume and tension, increased urinary diastase and a fall in serum calcium level, acute pancreatitis should be suspected. One should, however, be cautious in diagnosing acute pancreatitis if the patient already has a laparotomy scar.

Treatment.

In common with other observers, there is no doubt in my own mind that conservative treatment is definitely preferable, but I suggest that the following are definite indications for surgical intervention:-

1) Uncertainty of diagnosis.
2) Failure to respond to conservative treatment as shown by failing circulation and evidence of renal damage.
3) Traumatic pancreatitis with involvement of other organs.
4) Evidence of spreading peritonitis; - biliary or suppurative.
5) Deterioration of the patient's condition which could be attributed to necrosis or suppuration of the pancreas.
6) Jaundice.
7) Associated biliary tract disease.
8) Retroperitoneal involvement as shown by discolouration in the loins.
9) Distension of lesser peritoneal cavity or pseudocyst of the pancreas.
10) Pancreatic fistula - after prolonged conservative treatment has failed.

Finally, I would point out, that a high serum amylase, whilst indicating severe pancreatic disease, is not in itself, an indication for operation, because the decision to operate must be based on purely clinical grounds.

REFERENCES.

ABELL, I. (1938) Surg. Gyn. & Obst. 66, 348.

ACKERMAN, L.V. (1942) Arch. Path. 34, 6, 1065.

ALDIS, A.S. (1946) Surg. Gyn. & Obst. 83, 181.

BLAUVELT, H. (1946) Brit. J. Surg. 34, 134, 207.

BUFALINI, (1947) Arch. Ital. Chir. 69, 441.

CAMERON, L. and NOBLE, J.F. (1924) Proc. R.S.M. 82, 1410

COLE, W.H. (1938) Amer. J. Surg. 40, 145.

COLE , W.H. (1938) Inter. Abst. Surg. 67, 31.

CONNELL, F.G. (1941) Am. J. Digestive Diseases 8, 9, 327.

DINSMORE, R.S. and NOSIK, W.A. (1939) Surg. Clin. N. Amer. 19, 120.

DITTLER, E.L. and McGAVACK, (1938) Amer. Heart J. 16, 354.

DOMZALSKI, L.A., and WEDGE, B.N., (1947) Amer. J. Clin. Path. 18, 1, 43.

DRUMMOND, J. (1934) S. Afr. Med. J. 8, 520.

EDMONDSON, H.A. and BERNE, C.J. (1944) Surg. Gyn. and Obst. 72,240

ELIASON, E.L. (1930) Surg. Gyn. & Obst. 51, 183.

ELLMAN, R. (1937) Annals of Surg. 105, 379.

ELLMAN, R. (1942) J. of Am. Med. 118, 15, 1265.

FALLIS, L.S. (1939) Am. J. Surg. 46, 593.

FALLIS, L.S., and PLAIN, G. (1939) Am. J. of Surg. 5, 358.

FINNEY, J.M.T. (1933) Annals of Surg. 98, 750.

FORTY, F. (1939) Lancet 2, 370.

GLENN, J.C., and BAYLIN, G.J., Am. J. Roent. 57, 604.

GREY, S.H., PROBSTEIN, J.G., HERFETZ, C.J. (1941). Arch. Inter. Med. 67, 805.

HOWARD, J., and JONES, R. (1947) Am. J. Med. Sc: 214, 6, 617.

IRENEUS, C. (1941) Arch. Surg. 42, 126.

REFERENCES Cont.

JENSENN, K. (1946) Minnisota Med. 29, 10, 1047.

KAUFMANN, N. (1927) Surg. Gyn. & Obst. 44, 15.

LEWISON, E.F. (1940) Arch. of Surg. 41, 4, 1008.

LOE, R.H. (1941) North West Med. 40, 127.

LOEFFLER, W. and ESSELUER, A. (1946) Gastroenterologia, 71, 257.

MALLOREY, TRACY, B. (Editor) (1941) New Engl. J. of Med. 224, 4, 1165.

MALLOREY, TRACY, B. (Editor) (1941) IBID. 225, 22, 881.

METHENY, D., ROBERTS, E.W., & STRANAHAN, A. (1944) Surg. Obst. & Gyn. 79, 504.

MANN, F.C., and GIORDANO, A.S. (1922) Arch. Surg. 6, 1.

MORTON, J.J. (1940) New York State J. of Med. 40, 4, 255.

MORTON, J.J., and WIDGER, S. (1940) Annals of Surg. Jan. - June P.851.

MUSHIN, M.(1932) Austr. & N. Zealand J. of Surg. 2, 133.

McCORKLE, H., and GOLDWIN, L. (1942) Surg. Gyn. & Obst. 74, 439.

McWHORTER, G.L. (1932) Arch. Surg. 25, 958.

NAFFZIGER , H.C., and McCORKLE H. (1943) Ann: Surg. 118, 4, 594.

OGILVIE, W.H. (1941) Med. J. of Austr. 11, 26, 743.

PAGAL, W., & WOOLF, A.L. (1948) B.M.J. No. 4528, p. 242.

PAXTON, J.R., and PAYNE, J.H. (1948) Surg. Gyn. & Obst. Chicago, 86, 1, 69.

POLOWE, D., (1946) Surg. Gyn. & Obst. 82, 115.

POPPER, H.L. (1933) Zentralb. J. Chir. 60, 2050.

POPPER H.L. et al (1948) Surg. Gyn. & Obst. 87, 79.

PRATT, J.H. (1940) New. Eng. J. of Med. 222, 47.

REFERENCES Cont.

QUICK, B. (1932) Austr. & New. Zealand J. of Surg. 2, 114.

RICH, A.R., and DUFF, G.L. (1936) Bull John Hopkins Hospital, 58, 212.

SHALLOW, Th. A., and WAGNER, F.B. (1947) Ann. Surg. 125, 1, 66.

SHUMACKER, H.B. (1940) Ann. Surg. 112, 117.

SMEAD, L.F. (1936) Am. J. Surg. 32, 487.

SMEAD, L.F. (1940) J. of Inter. Coll. of Surg. 3, 138.

SMYTH, C.J. (1940) Arch. Path. 30, 651.

WIGHTMAN, K.J.R. (1948) Med. Clin. N. Amer. 32, 518.