Ample Man Power Essential.

I have pointed out the chief essentials for the success of primary suture, but the application of this treatment must remain largely a question of man power from first to last.

First, it is only by having enough stretcher-bearers that we can get in the wounded who cannot walk, and, one must add, enough *strong* stretcher-bearers. If men are not brought in "soon" their wounds cannot be sutured, so it is really a race against time and against the microbic infection, which has got the start of both stretcher-bearers and surgeons. Difficulties exist which, though they might not be thought of by the inexperienced, explain why men may arrive too late without anyone being to blame. Both many and strong stretcher-bearers are required, and it is difficult to provide too many. It is not clear that delay in reaching a casualty clearing station may be unavoidable.

Need for More Surgeons.

In the second place, primary suture of wounds evidently requires surgeons in proportion to the numbers of the wounded. We have already been able to operate on almost all the most serious cases at the casualty clearing stations in recent battles, and one wounded man out of about every three wounded was passed through the theatre and operated upon under an anaesthetic. The remaining two-thirds were sent to the base, and many of them were in the class of the "lightly wounded."

In future, the wounds which have been excised but not sutured at the front, as well as probably some not yet excised, will be dealt with by hospitals placed further back than the casualty clearing stations, and thus, if there are enough surgeons, and if wounded are not too numerous, we hope to be able to ensure that a majority of all suturable wounds shall heal *per primam*. If our expectations are realized it is evident that patients will not be so long in hospital, and that there will be less strain on staffs at the bases both in France and in England. Much depends on the incidence of the wounded and on the supply of surgeons. It is at least evident that we shall need more operators than we have had previously.

I should like here to put in a special plea for plenty of medical officers in France. I hear from various surgeons at other seats of war, and amongst them men who have served in France, that the prevalence of gas gangrene is infinitely greater in France than elsewhere. It is the danger of this which makes early operation so necessary, and it is the number of these essential operations which calls for so many surgeons.

The accompanying figures, drawn from radiograms, illustrate some cases of fracture which were treated by "primary suture."

CONCLUSIONS.

Sufficient care has now been exercised, and sufficient experience gained, to allow the primary suture of wounds to be placed on a definite footing, and to permit the following conclusions to be drawn:

1. The most important treatment is the careful cleansing of every part of the wound, and the subsequent complete excision of all dead, badly damaged, or grossly infected tissue. It is never necessary or right to remove more than a very thin edge of skin.
2. Complete asepsis is of the highest importance, and experience at the front is essential in order to select suitable cases.
3. The wound may be sutured at once, or may be left unclosed for one, two, three, or four days. It can then be sutured, with results which are identical with those obtained by immediate suture.
4. If after operation the wound is not sutured it should be dressed in such a way that it need not be disturbed till the time for closure has come.
5. If the wound is sutured at the time of operation, the patient should be retained in hospital for not less than a week. If he cannot be retained then the wound must not be sutured.
6. It is seldom that, even after the most careful operation, the wound is sterile, and bacteria can generally be found in the secretion on the following day. The presence of a few bacteria, whether anaerobes or the ordinary pyogenic forms, does not prevent healing of the wound. Streptococci which can haemolyze blood constitute the most dangerous form of infection, and if they are detected the sutures should be at once removed.

7. No definite rule can be laid down as to the lapse of time after which *suture* should not be done, but the sooner the wound can be *operated* upon the greater is the probability of success. It can be sutured later.

8. If the wound edges are found on examination to be already indurated and inflamed, or if definite gas gangrene has already commenced, the wound must not be closed. Whenever there is any doubt at all it is best to leave the wound open, knowing that it can be equally well sutured in a day or two if this appears advisable.

REFERENCE.

¹ *Lancet*, October 27th, 1917.

GUNSHOT WOUNDS OF THE ABDOMEN AT A CASUALTY CLEARING STATION.

150 CONSECUTIVE OPERATIONS FOR PENETRATING
ABDOMINAL WOUNDS.

BY

CAPTAIN R. CHARLES, R.A.M.C.(T.C.).

SINCE November, 1914, I have had the opportunity of observing and treating a large number of gunshot wounds of the abdomen. I cannot lay claim to breaking fresh ground, yet in my series many of the cases present points of great interest, and illustrate the difficulties and the wide field of this type of surgery. It is not proposed to describe minutely or discuss either the various kinds of injuries produced by various missiles, or the signs and symptoms associated with the lesions of the different abdominal viscera.

DIAGNOSIS.

Difference of opinion sometimes arises as to whether a gunshot wound of the abdomen involves the peritoneal cavity or not; indeed it is sometimes impossible to tell without a laparotomy, for the signs and symptoms usually associated with these cases are not constant. Experience will usually settle the point in each particular case.

The following points taken collectively are important:

1. *Position of the Injury.*—It is first necessary to determine if possible the direction of the track. The entrance and exit wounds give an idea of the path of the missile and the structures likely to be involved. The absence of an exit wound does not necessarily mean that the foreign body is lodged in the abdomen. The possibility of its being buried in the parietes must be excluded.

2. *The facial expression* is usually one of anxiety.

3. *Pain* is not of great value, and may or may not be present. At first it is often diffuse, and afterwards becomes more localized, while the various reflected pains are occasionally complained of—a wound in the hepatic region accompanied with pain in the right shoulder; a wound in the lower costal region, with pain and rigidity in the epigastrium, and that often without any involvement of the abdominal cavity.

4. *Tenderness* is a very constant and reliable sign. I do not refer to the zone of hyperaesthesia of the skin in a certain segmented area corresponding to the deep-seated injury, but to the tenderness elicited on moderate pressure over the injured viscus. It is necessary to exclude the muscular tenderness along the path of the wound and the contused area in its immediate vicinity. This tenderness will indicate the seat of the injured viscus, thus giving some idea as to what incision will best meet the requirements of the case.

5. *Rigidity*, or the absence of it, is often most misleading. I have seen a flaccid abdominal wall in a case of multiple perforations of the bowel. On the other hand, board-like rigidity is frequently met with in a purely parietal wound.

6. *The pulse* varies in rate; it increases directly with the gravity of the intraperitoneal lesion, and gives an important basis for prognosis.

7. *Vomiting* is usually present, but not necessarily. Thirst is a most distressing symptom.

X-ray localization affords the most useful guide to the diagnosis of penetrating wounds of the abdomen. Without it there must often be a large element of doubt. I always advise the radiologist to curtail his examination as far as possible, even to the neglect of foreign bodies situated

elsewhere in multiple wounding; and every effort should be made to keep the patient warm throughout the examination.

TREATMENT.

The cases on their arrival at a casualty clearing station may be classified for the purpose of treatment, according to their general condition and irrespective of the class of wound, as follows:

1. In a dying condition, when nothing can be done except to relieve pain and thirst.
2. Showing varied degrees of collapse, but capable of resuscitation.
3. In good condition and operable.

Pre-operative Treatment.

This principally consists in treatment for shock. It is usually necessary to begin by raising the body heat, and for this purpose the radiant electric bath is the best. Saline, two pints, with brandy, is given subcutaneously prior to and not during operation, as formerly practised. For extreme cases intravenous saline with 3 per cent. sodium bicarbonate has lately been recommended, and is apparently more effective. If pain is present to any extent morphine is given; rest and absolute quietness are essential.

When to Operate.

In my opinion operation should not be undertaken before the patient has recovered from shock. Two arguments may be put forward in favour of immediate operation: (a) Internal haemorrhage; (b) danger of delay allowing peritonitis to supervene. Against these, however, it may be stated that almost every case of severe intraperitoneal haemorrhage, on its arrival at a casualty clearing station, is either in a dying condition or suffering from an extreme degree of collapse and has for the time being ceased to bleed. Except when there is only one perforation no serious infection of the peritoneum from the small intestines takes place until the lapse of about six hours from the time of being wounded. It is therefore in the best interests of the patient to delay operation pending his recovery from the initial shock before subjecting him to the further shock of operation. Indeed, in cases suffering from shock and haemorrhage I have often waited six hours or more, taking the risk of further haemorrhage, with results that have justified my delay.

Provided the patient is warm, operation is done at once. Saline is given on the table during the operation. The anaesthetic now used is warm ether and oxygen given by Shipway's apparatus.

OPERATION.

I attach great importance to the element of shock, and in operative manipulation endeavour in every way to avoid any aggravation of it. The first essential is speed; the prognosis of the case varies inversely as the length of the operation. If the operation is not completed inside one hour the prognosis is not good. To do this, very free access to the peritoneal cavity is necessary. Another difficult problem in war surgery is the maintenance of a constant warm temperature in the theatre. In winter the table should be kept warm, and draughts from doors opening direct to the open air must be avoided.

Incision.

The abdomen is opened by a paramedian or, in some cases, a transverse incision. The skin is covered with tetra towels wrung out of hot saline, and over these a sheet of oiled silk is placed. On opening the peritoneum, owing to the sudden relief of tension, in many cases bleeding commences again. It is therefore necessary to mop up any blood quickly, and to attend to the bleeding point first. A large abdominal swab is next placed into the pouch of Douglas, and a systematic search made for injuries; by this means alone maximum speed and efficiency are secured. The small intestine is examined first, and any perforation covered with gauze, clamped, and left outside the abdomen; uninjured gut is returned immediately, as far as possible. Wounds of the colon are then looked for and dealt with, or packed off and dealt with later through a separate incision if free access cannot be obtained by the original opening. In wounds of the stomach the anterior and posterior walls are examined, while those of the solid viscera can be felt.

TREATMENT OF HOLLOW VISCERA.

I have very little to add to what has already been written on this subject. When wounds of both the small and large gut are present I deal, if possible, with the large bowel first, and always discard soiled instruments and gloves before proceeding to repair the small gut. With regard to the respective advantages of the lateral and end-to-end anastomosis, I have experienced so few recoveries in these cases that I am not in a position to express a definite opinion. End-to-end union takes less time if done by a single invaginating suture, and this method obviates the need for a second layer, involving a further reduction of the lumen of the bowel.

Injuries of the colon do best if operated upon at the earliest possible moment, and as these cases are usually admitted in good condition, delay is seldom necessary for the treatment of shock. X-ray localization is invaluable as a guide both to diagnosis and to the subsequent transverse incision. This gives direct approach, and if the colon injury is uncomplicated the field of operation is localized; moreover, there is little handling of the small bowel or unnecessary soiling of the peritoneum, and a retroperitoneal wound can be dealt with at the same time. Colon wounds are always closed by suture if possible, and I usually risk the faecal fistula which occasionally follows suture and drainage, in preference to making an artificial anus.

WOUNDS OF THE SOLID VISCERA.

Owing to the inability of the solid organs in the abdomen to overcome sepsis, the question arises whether wounds of them ought to be treated by excision of the infected tissue and suture.

Liver.

In many of my cases the treatment has been conservative. Sometimes laparotomy has been done for progressive haemorrhage, and packing the wound with gauze. In a few cases where the missile was retained sepsis has supervened, causing death. If the missile is moderately large and when accessible, it is now removed by resecting a rib above the costal margin, usually including the wound of entrance, thereby obtaining direct approach. Certain superficial wounds allow of excision of the track, removal of the foreign body, and suture. Failing this, a thorough mechanical cleansing of the wound is carried out; a packing of gauze is inserted to stop fresh haemorrhage, and removed within twenty-four to forty-eight hours; the peritoneal cavity by this time is shut off, and Carrel-Dakin treatment is substituted.

Pancreas.

Wounds of this organ often occur with other abdominal injuries, so that the pancreatic wound is overlooked. In two cases I removed the missile from the body along with lacerated tissue, and sutured it up. Drainage was obtained through the transverse mesocolon, which had been previously anchored to the anterior abdominal wall. In another case good drainage was obtained through a wound of exit directly behind.

Kidney.

For exposure, the transverse kidney incision is used. If it is found necessary to deal with an intraperitoneal lesion as well, the line of incision is extended towards the middle line in front. Complete removal of the kidney is only done for gross destruction or torn vessels. Previously, in less severe cases, where an operation was warranted either for a retained foreign body or for haemorrhage, operative procedure was confined to removal of the missile and arrest of the bleeding by packing with gauze. Lately, with a view to minimizing sepsis, I have tried a more thorough operation, where only the body of the kidney was involved. Infected and damaged kidney was excised and the renal wound sutured, with drainage down to it. This has proved more satisfactory and can be carried out in the majority of the cases, the renal vessels being compressed by a rubber-guarded clamp throughout.

CLOSURE OF THE ABDOMEN.

Having dealt with the various intraperitoneal injuries the operation is completed by removing swabs and mopping up any fluid in the abdominal cavity with gauze wrung out of hot saline. Finally the incision is closed in layers.

The question of drainage is often raised. Should it be practised at all, and if so, what are the indications? I favour drainage in certain cases. The factors which influence my decision in any particular case are, primarily, the relative infectivity of the parts injured, and secondarily, the time which has elapsed since the wound was inflicted. In wounds of the small intestine operated on within twelve hours the abdomen may be closed with safety. As regards colon wounds, whenever possible I supply free drainage, usually by rubber dam, direct to the site of suture; in my series the majority were treated in this way. Retro-peritoneal wounds of the colon are always very freely drained.

The superficial wound is excised according to indications, no attempt having been made to enter the abdomen by enlarging it, a practice I avoid if possible. When the wound is in the back it is dealt with previous to performing laparotomy, as recommended by Marshall.

ABDOMINO-THORACIC INJURIES.

It is generally accepted that gunshot wounds including both the chest and abdomen have proved fatal in the large majority of cases. This state of affairs was not improved by the active surgical treatment undertaken earlier in the war; nor did treatment on conservative lines tend to give any better results. Recently, however, a different type of operation has yielded results which have encouraged me to persist in it.

Respiratory distress is the outstanding feature on admission. It is often so severe that immediate operation is out of the question. The patient is placed in a recumbent position, morphine is given for pain and restlessness, and, when the wound in the thorax is a blowing one, a few temporary skin sutures often bring a marked relief to the breathing. Time is allowed for shock to pass off and dyspnoea to diminish before operating.

Abdomino-thoracic wounds may be classified for the purpose of treatment into four types, as follows:

(1) *Where there are separate entrance wounds in the chest and abdomen.*

Provided the chest wound is not a blowing one, the abdomen is dealt with first, and only if the condition of the patient permits is the chest wound attended to.

(2) *On the left side with the entrance wound about the level of the sixth to the eighth rib, with a high up abdominal lesion.*

A few cases of this class do well on conservative treatment, especially where a rifle bullet has gone clean through antero-posteriorly or vice versa. What probably happens is that omentum protrudes through one or two small holes in the diaphragm and, becoming adherent, acts as a plug. Unfortunately the damage is often more extensive, and some idea of this may be gauged by considering the nature and position of the missile as shown by x rays and the appearance of the chest wound. If the metal has travelled down into the lower part of the abdomen it is treated as in (1). More often, however, the abdominal injury is limited to the upper abdomen, and it is for this type of case that I use a purely transdiaphragmatic route, because (a) it saves time; (b) access to the upper abdomen is much easier than by laparotomy; and (c) it avoids the combined laparotomy and thoracotomy, which is highly fatal.

Operation.—The chest wound, with all infected tissue, is completely excised and enlarged backwards and forwards until about five inches of the affected rib has been removed altogether. With fresh instruments the pleura is opened widely, the haemothorax swabbed dry, and the chest cavity protected by large abdominal swabs. Having placed a self-retaining retractor in the wound, the rent in the diaphragm is found and enlarged up to four or five inches. The abdominal injury is reached in this way, and, when it has been dealt with, gloves and soiled instruments are changed, and closure of the diaphragm is accomplished by a continuous suture of chromic gut. Next, the lung is examined, and, where necessary, treated according to present-day methods. Suture of the parietal pleura may present difficulty. When it cannot be sutured completely and a large gap is left, the lung is brought up and fixed by suture to the edges of the hole. This gives an airtight closure to the cavity, and also acts as a barrier to any superficial sepsis which may subsequently develop. Closure of the wound in layers completes the operation.

(3) *On the left side, with the wound of entrance below the eighth rib.*

In this type the abdominal condition is often much more serious. Frequently the chest escapes altogether, or is so slightly injured that it can be left out of consideration, in which case the abdomen is dealt with by laparotomy. When, however, both chest and abdomen require attention, the following operation can often be employed, bearing in mind the position of the missile: The chest is opened as described under (2), and the incision carried forward on to the abdominal wall. By prolonging the wound in the diaphragm the parietal peritoneum may be opened to any required extent. The chest condition is dealt with, and the pleural cavity shut off by suture of the diaphragm to the chest wall just above the wound. The intraperitoneal injury can then be treated and the incision closed.

(4) *When the Entrance Wound is on the Right Side.*

It is usually found that the metal having penetrated the diaphragm is lodged in the liver. If operation is indicated by the condition and size of the chest wound or the retention of a large foreign body, it is practically the same as for the left side. Having opened the pleural cavity the rent in the diaphragm is then sought for and the metal removed from the liver by passing a forceps down the track. When, as frequently happens, the diaphragm is pierced near its attachment, the operation is to suture the edges of the hole in the diaphragm to the parietal pleura, and so effect direct drainage of the liver track with a completely closed pleural cavity. If injury to the abdominal viscera is suspected it is treated as in (1).

Post-operative Complications and Treatment.

Shock is the commonest and one of the most serious complications that may follow operation for penetrating abdominal wounds, and the means usually adopted to combat it are as described under pre-operative treatment, with the additional use of rectal saline, or brandy and coffee when the degree of collapse is not extreme; cases with severe shock derive very little benefit from this method as it is seldom absorbed. Much more useful is the intravenous injection of a solution of 4 per cent. sodium bicarbonate or a 2 per cent. solution of gum acacia in normal salt solution. But where the loss of blood has been severe blood transfusion is the best remedy.

The Fowler position is adopted as soon as the patient has got over the shock of operation, and for twenty-four to forty-eight hours rectal saline with glucose is given. Bland fluid is the only thing given by the mouth for the first few days. Early in the war I prescribed a purgative almost immediately after operation, but I discontinued that in favour of a glycerin enema with pituitrin hypodermically on the third day.

Dilatation of the Stomach.

This occurred in several cases; the chief symptoms were a feeling of tightness in the epigastrium, restlessness, and, in the beginning, the vomiting of a small quantity of dark brownish fluid. Relief is afforded if a stomach wash of sodium bicarbonate is done early.

Paralytic Ileus.

This condition may arise in two ways: (1) It may be nervous in origin—that is, there has been primary inhibition of the nervous mechanism in the bowel due to trauma (see Case 1 below); or (2) it may be secondary to peritonitis. The symptoms are almost identical, whatever the cause, and simulate those of progressive peritonitis.

In my earlier cases operations were done to prevent or alleviate this complication. In every instance quoted there was present some degree of peritonitis, and paralytic ileus seemed imminent. In two cases, having dealt with severe wounds of the lower part of the ileum by suture, a prophylactic anastomosis was made between the parts of the bowel above the injured area and the transverse colon. Both patients were suffering from shock at the end of the operation, and neither of them recovered. It is obvious that the operation was prolonged by the anastomosis, and in view of this delay I doubt whether I was well advised, but the prognosis in both cases was not good from the start.

In one case only, occurring in December, 1915, where the upper part of the ileum had to be sutured in nine places

over a length of three feet, a short circuit above and below the injured area was done. This case did remarkably well until the twelfth day, when peritonitis became marked in the short-circuited portion, and the patient subsequently died from general peritonitis. In deciding to perform this operation I was influenced by a desire to avoid the risk of resection.

In six others, comprising perforations sutured at various levels of the small intestine, ileostomy was performed—a large catheter or half-inch tubing was inserted several inches above the first perforation either at the original operation or secondary to it. This met with little success. I experienced great difficulty in getting the catheter to act, and when once started the intestinal drainage was very limited. Consequently the peritonitis was not stayed. Possibly the addition of a second catheter inserted below the last intestinal perforation would have given more encouraging results. Latterly, however, several bad cases of paralytic ileus have recovered, the treatment consisting of frequent gastric lavage, intramuscular injections of pituitrin, appropriate saline, and the administration of enemata as required. Morphine was not withheld.

Gas Gangrene.

In this series one case developed gas infection of the anterior abdominal wall in which the deep epigastric artery had been severed. As a precautionary measure, where the wound of the abdominal wall was extensive and had to be freely excised, the peritoneum alone was sutured and a few tension stitches of strong silk, protected by capillary tubing, were inserted. I am unable to state accurately the number of cases in which retroperitoneal sepsis—gaseous or non-gaseous—became a prominent feature, but in most of them it proved fatal. One bad case, however, recovered. In this case the gas had extended from one side to the other, lifting the peritoneum from the posterior abdominal wall. A very large incision was made, resembling that employed for exposing the ureter; infected and gangrenous muscle was removed; Carrel's tubes were placed in all directions and hourly injections of Dakin's solution given.

The following are notes on a few interesting cases.

CASE I.

Lieut.-Cpl. S.; admitted February 12th, 1916. The missile had entered from behind at close range, explosive in action, carrying away a portion of the right rectus below the umbilicus; two feet of intestine lying on the abdominal wall. Bowel outside showed evidence of plastic peritonitis; four large holes in it and the mesentery torn; general condition fair. Laparotomy: Abdomen full of blood; no further bowel injury discovered; resection of two and a half feet with lateral anastomosis; abdomen closed without drainage; pulse 120. Twenty-four hours later: vomited a large amount of blackish fluid; under local anaesthesia a large catheter was inserted high up in the jejunum; stomach washed out. Second day, evening: About 5 oz. of yellowish odourless fluid came away. Third day: Catheter acting well after being syringed and siphoned with saline; patient felt and looked ever so much better. Fourth day, early morning: Catheter not draining, patient very ill indeed, looking moribund; catheter syringed out and siphoned; large quantity of foul-smelling fluid came away; improved beyond all expectation—pulse returned with good volume. This carried him through to the fourth night and he died in the morning. If the catheter was not siphoned every few hours he vomited, though very little. *Post mortem*: No evidence of peritonitis, serosa shiny, no adhesions even in pelvis or over anastomosis, bowel at and below the union collapsed—for two feet it contained a little fluid, while the last fourteen inches of the ileum was absolutely collapsed.

CASE II.

Pte. S.; admitted August 31st, 1916. Wound of entrance only, left groin; severe shock, pulse thready and of poor volume. Operation: Left paramedian incision; found twelve holes in the ileum and two in caecum, with considerable plastic peritonitis; resection of five feet with lateral anastomosis; holes in caecum sutured; foreign body removed and abdomen closed without drainage. Recovery. Base September 10th.

CASE III.

Pte. C.; admitted May 25th, 1916. Wound of entrance only, to the left and at the level of the umbilicus, omentum protruding. Operation: Right paramedian incision; enormous quantity of blood; eight holes in upper ileum, four of them necessitating a resection with end-to-end union; remainder sutured, abdomen swabbed dry and closed. Recovery. Base June 18th.

CASE IV.

Pte. F.; wounded March 7th, 1916. 11.30 p.m.; admitted March 8th, 8 a.m. A rifle bullet entered in the epigastric region and emerged at a corresponding point behind. Patient

cold, collapsed, and pulseless; abdomen distended, rigid, and motionless. At the end of seven hours' rest and treatment he began to rally. 5 p.m.: Pulse 150. Operation, 5.30 p.m.: Left median incision—abdomen full of blood; two holes in the liver and two in stomach, the missile having then passed through the tail of the pancreas and emerged as stated. Visceral wounds sutured, abdomen swabbed dry and closed. Exit wound enlarged and the pancreas drained from behind. March 9th, developed bronchitis. March 12th, death—acute bronchitis.

CASE V.

Private S.; wounded September 10th, 11 p.m. Cause, bayonet. Admitted 6.30 a.m. Wound of entrance only, in the left groin, deep to Poupart's ligament. Patient collapsed, pulse thready and irregular; abdomen distended, but very little rigidity or pain. After four hours' rest and warmth he improved wonderfully. Operation, 10.30 a.m.: Left paramedian incision—abdomen full of blood, external iliac vein severed, two holes in the ileum. Ligation of vein, perforations sutured, abdomen swabbed dry and closed. Recovery. Evacuated to base September 19th.

CASE VI.

Pte. A.; admitted April 10th, 1917. Entrance wound right buttock, exit below and to the left of the umbilicus. Operation: Right paramedian incision; fourteen holes in the ileum, two in caecum; eleven of them treated by suture, remainder necessitating a resection of fourteen inches with lateral anastomosis; peritonitis present; abdomen swabbed dry and closed. Recovery. Base April 22nd, 1917.

CASE VII.

Lieut.-Cpl. B.; admitted March 31st, 1917. A large piece of shell fragment hit the abdominal wall, carrying away portion of the oblique muscles. Several feet of intestine lying on the abdominal wall with many perforations; a small amount of mucoid and faecal material stained the serosa of the bowel. General condition very bad, but responded well to treatment. After five hours' rest, operation. Original opening enlarged; plastic peritonitis and perforations confined to the prolapsed portion of bowel. Resection of three feet; end-to-end union by a single invaginating layer; peritoneum only closed, using a few tension stitches for the skin. Developed pneumonia. Recovery. Base April 24th, 1917.

CASE VIII.

Pte. S.; admitted April 28th, 1917. Wound of entrance only, left buttock; signs of much shock and loss of blood; pulse 130; rigidity and tenderness confined to the lower abdomen. After three and a half hours' rest, marked improvement. Operation: Left paramedian incision—abdomen full of blood; internal iliac vein perforated—clamped with forceps; one hole in ileum sutured; patient became very collapsed, so the abdomen was closed, with forceps left in position. Transfusion of blood by the sodium citrate method; left the table much improved. Four days later forceps removed. Recovery. Evacuated to base May 18th, 1917.

CASE IX.

This is one of interest, as it is the only case of recovery I have had with an abdominal patient admitted pulseless who remained so for many hours. Pte. H., wounded July 21st, 1917, 12 midnight. Shell fragment. Admitted July 22nd, 7 a.m. Entrance wound only, mid-abdomen. Complications: Penetrating wound of chest and multiple wounds of both legs. 10 a.m.: Intravenous saline with 4 per cent. sodium bicarbonate and glucose given. 1 p.m.: Pulse for the first time felt at wrist. 4 p.m.: Warmer, and much improved generally; pulse 150. 5 p.m.: Pulse of fair volume. Operation, 5.30 p.m.: Right paramedian incision—abdomen full of muco-purulent fluid; one perforation in ileum with missile lodged there; removed and hole closed; abdomen swabbed clean, and a pint of warm euol left in it, with drainage down to pelvis; the incision closed in one layer. Subsequent treatment: Repeated stomach lavage, saline, pituitrin, etc. August 1st, second operation: Resection of rib for septic haemothorax. Evacuated to the base August 10th, in good general condition.

CASE X.

Spr. F.; admitted April 30th, 1917. Entrance wound epigastric region, no exit; in fair condition; pulse 120. Operation: Left paramedian incision—abdomen full of blood; two holes in the liver; two in stomach; coronary artery severed. Visceral wounds treated by suture, artery ligatured; foreign body removed from the body of the pancreas, lacerated tissue removed, wound sutured and drained through the transverse mesocolon; abdomen swabbed dry and closed. Developed a pancreatic fistula, which gradually got less daily. Evacuated to base May 16th, 1917.

CASE XI.

Pte. H.; admitted October 1st, 1917. Shell fragment entering left side over sixth rib in mid-axillary line, penetrating abdomen; large haemothorax; severe dyspnoea; general condition good. Operation: Trans-diaphragmatic route; five inches of rib resected after excision of wound; pleural opening enlarged and cavity swabbed dry; omentum seen protruding through rent in diaphragm—this opening freely enlarged and abdominal viscera examined. The only visceral wound was a hole in anterior stomach wall with foreign body embedded in it; treated. Diaphragm closed, wound of lung sutured, and incision closed. Recovery. Base October 12th, 1917.

CASE XII.

Pte. D.; admitted October 10th, 1917. Shell fragment; entrance wound only, over eighth rib, left side; abdomen penetrated; general condition good; severe dyspnoea. Operation: Trans-diaphragmatic route—rib resected and blood swabbed from thorax; omentum found protruding through a wound in the diaphragm, size of a half a crown—enlarged this opening and found injury to spleen and kidney; foreign body removed from kidney, the wound being excised and sutured—no treatment of spleen; diaphragm closed; sudden cardiac failure then necessitated massage of the heart, which responded immediately; operation completed. Recovery uneventful. Base October 20th.

CASE XIII.

Lie.-Cpl. W.; admitted October 15th, 1917. Entrance wound close to spine, with exit wound at tenth rib in mid-axillary line, from which omentum protruded; patient badly shocked, but apparently had not lost much blood. After four hours' rest and treatment, operation: wound of exit (with omentum) excised and enlarged forwards and backwards; rib resected; wound laid widely open; rent in diaphragm sutured to chest wall above the wound; spleen found severely lacerated and therefore removed; no other visceral lesion present; wound closed. Died suddenly twenty-six hours later, when apparently doing well.

CASE XIV.

Gnr. G.; wounded October 26th, 1917. Shell fragment. On admission same day a large blowing wound in the chest wall at the level of the ninth rib, right side; x rays showed a very large foreign body in the liver. Operation: Trans-diaphragmatic route—rib resected, including excision of entrance wound; pleural opening further enlarged; blood removed from pleural cavity; foreign body removed from the liver through the rent in the diaphragm; edges of rent sutured to parietal pleura; wound of liver packed with gauze surrounded with rubber dam; rest of the wound carefully stitched. Following day, gauze removed and replaced by Carrel's tube. Dakin's solution used. Recovery. Base fourteen days later.

The table shows the results of 150 consecutive operations for penetrating wounds of the abdomen. As regards mortality, shock played the largest part, peritonitis was next in importance, and pulmonary complications accounted for several deaths.

Viscus Injured.	No. of Cases.	Recoveries.	Deaths.
Small intestine only: sutured ...	28	17	11
Small intestine only: resection ...	13	4	9
Small intestine and colon (2 resections of small intestine, 1 died)	28	16	12
Small intestine, colon, and stomach	1	0	1
Small intestine, colon, and liver (1 resection)	2	0	2
Small intestine, colon, and kidney...	1	0	1
Small intestine, colon, and bladder	1	0	1
Stomach	3	0	3
Stomach and liver	6	3	3
Stomach, liver, and pancreas ...	3	1	2
Stomach, colon, and kidney	1	0	1
Colon	10	5	5
Liver	14	6	8
Liver and colon	5	1	4
Spleen (2 splenectomies; both died)	6	3	3
Spleen and diaphragm	2	1	1
Spleen and kidney	1	1	0
<i>Abdomino-thoracic Wounds.</i>			
Thorax and diaphragm (missile in lesser sac, no visceral lesion)	1	0	1
Thorax, diaphragm, and stomach ...	2	2	0
Thorax, diaphragm, and spleen ...	1	0	1
Thorax, diaphragm, spleen, and kidney	1	1	0
Thorax, diaphragm, and liver (lung in two cases)	4	3	1
Kidney (3 nephrectomies, 1 death) ...	9	8	1
Intraperitoneal lesion, no viscus injured	5	4	1
Total	150	76	74

I take this opportunity to express my gratitude to Surgeon-General Sir Anthony Bowlby, K.C.M.G., for his encouragement and advice throughout this period. My best thanks are due to

Surgeon-General Cuthbert Wallace, C.M.G., and to Lieut.-Colonel H. Rogers, D.S.O., and Lieut.-Colonel W. D. Kelly, D.S.O., for permission to publish these cases.

REFERENCES.

¹ Sampson Handley, *British Journal of Surgery*, 1916. ² Bonney, *BRITISH MEDICAL JOURNAL*, 1916.

SHELL WOUND OF THE PANCREAS CAUSING PANCREATIC PSEUDO-CYST.

BY

JOHN MORLEY, CH.M., F.R.C.S., CAPTAIN R.A.M.C.(T.),
HONORARY SURGEON, ANCOATS HOSPITAL AND MANCHESTER
CHILDREN'S HOSPITAL; LECTURER IN CLINICAL
ANATOMY, MANCHESTER UNIVERSITY.

GUNSHOT wounds of the pancreas are less frequent, or less frequently recognized, than those of any other of the abdominal viscera, hollow or solid. The relations of the pancreas with the aorta and inferior vena cava, to say nothing of such vessels as the splenic artery and vein, are so intimate that perforation of the gland by a projectile involves the gravest risk of an immediate and fatal intraperitoneal haemorrhage, and but few cases are likely to survive the first few hours. Should a case escape this primary danger, peritonitis resulting from coincident perforation of the stomach or intestines will usually supervene, and will naturally tend to monopolize the surgeon's attention, should a laparotomy be performed.

The extensive literature concerning penetrating gunshot wounds of the abdomen that has arisen during the present war is remarkable for the rarity of cases of authenticated wounds of the pancreas. Thus Surgeon-General Cuthbert Wallace, in a total of 935 penetrating abdominal wounds, collected only 5 cases of wounds of the pancreas.¹ He remarks that there are no distinctive symptoms of these wounds, and mentions that the formation of Jordan Lloyd's pseudo-cysts, so frequent after civil confusions of the pancreas, has not been seen. Surgeon-General Sir G. H. Makins² states that wounds of the pancreas found during the performance of operations for intestinal injuries have usually proved fatal, while in the few cases in which apparent wounds of the pancreas have been seen at base hospitals it is difficult to exclude the possibility of a wound of the second or third part of the duodenum. He mentions one case, fatal on the eleventh day, in which *post mortem* a wound of the pancreas was found with fat necrosis of the omentum and mesentery, and two other probable cases which recovered but were not established as pancreatic lesions beyond doubt. Fraser and Drummond,³ in a series of 300 cases of perforating wounds of the abdomen, met with one case only involving the pancreas—a rifle bullet wound through the body of the gland, where recovery followed exploration and drainage.

The case described below, in which a penetrating shell fragment gave rise to a large collection of pancreatic juice in the lesser sac of the peritoneum, is not unique, for I have been able to find one reference to a similar case, which is reported in a Hungarian journal that is not accessible.⁴

Pte. M. was admitted to High Street Military Hospital, Manchester, under my care on August 14th, 1916, with the following history: He was hit in the back by a shell fragment on July 24th, three weeks before he came under my observation. Some aching pain in the epigastrium resulted, but there were no symptoms of peritonitis, and he was evacuated rapidly to England. After six days in a central hospital in Manchester he was considered well enough to be sent to an auxiliary hospital in the country. While in that hospital the aching pain in the epigastrium persisted, and a week before he came under my care it was noticed that a swelling had appeared in the epigastrium, and that he was rapidly losing flesh.

Condition on Admission.

He was thin and pale and the tongue was foul. The temperature was 99.4° F. and the pulse 100. There was an unhealed wound of entry in the back 1 in. to the right of the eleventh dorsal spine, and no wound of exit. In the centre of the epigastrium was an obvious swelling. It was large, tense, and rounded, and extended back to the left loin. It was dull on percussion and only moderately tender.

Operation.

The case was regarded as one of subphrenic abscess involving the lesser sac of peritoneum. Accordingly, under ether, a small vertical exploratory incision was made through the left rectus below the costal margin. On opening the peritoneum