On abdominal section for the treatment of intra-peritoneal injury / by Sir William Mac Cormac.


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TREATMENT OF INTRA-PERITONEAL INJURY

BY

SIR WILLIAM MAC CORMAC, F.R.C.S.

SURGEON TO, AND LECTURER ON SURGERY AT, ST. THOMAS'S HOSPITAL

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ABDOMINAL SECTION

FOR THE

TREATMENT OF INTRA-PERITONEAL INJURY.

MR. PRESIDENT AND GENTLEMEN,—The reason, I apprehend, why modern surgery occupies so foremost a position is because of its success in curing disease and in dealing with maladies hitherto regarded as beyond the reach of art.

Particular operative procedures are now distinguished by their boldness, completeness, and success. This greater success is based on sounder knowledge of the causes of disease and the principles of its treatment.

It cannot be gainsaid that great changes have taken place; that much is attempted now, and much successfully accomplished, which twenty years ago was never even dreamed of. All must admit the vastly enlarged powers which surgeons have recently acquired for the successful practice of their art, and this new development of their resources is based on a wider and more intimate scientific knowledge and experiment. "Medicine indeed," as Helmholtz says, "has become young again, and endowed with fresh and greatly enhanced powers of doing good by dipping in the youth-springs of the natural sciences."

History will, I believe, declare that nothing has done so much to further the progress of modern surgery as the work

of a man still living and active amongst us. He has laid down principles which, however they may be criticised, have revolutionised the art of surgery in every country in the world where scientific surgery is known.

It may well be said that many circumstances contribute to our modern success, but I am fully convinced of the efficacy of antiseptic measures. Whatever difference of opinion may exist as to the most effective manner of applying them, it must be admitted that the success attained by adopting the principles of treatment recommended by Professor Lister has been something quite unparalleled, and should be gratefully acknowledged.

Another important feature in the modern practice of medicine is the greater frequency with which the physician invites the surgeon to aid him in treating cases previously regarded as purely medical. Medicine in a sense has become more surgical, and surgery has penetrated the organism more deeply and has invaded territory previously reserved to internal medicine. The physician perhaps lays greater stress than the surgeon on the means of investigating the hidden causes of disease. He is apt to be more familiar with the stethoscope, microscope, thermometer, and the tests supplied by electricity ; but these are also subservient to the progress of surgery, and the surgeon must employ all the aids at his disposal in his search after the truth.

Medicine and surgery derive vitality from roots which nourish the same parent stem : resting, as surgery does, on the same scientific experience, it must in many things be correlative and equal with medicine, each helping the other. As Bacon truly urges when speaking of a wider field of human knowledge, natural phenomena cannot be studied alone. To be understood they must be considered in their relation to all nature.

Our anxiety as to the progress of the wound itself is now well-nigh altogether at an end, and to this we mainly owe the great possibilities of modern surgery—the possibility, for example, of safely performing many kinds of exploratory operations on the head, the chest, and abdomen. There are conditions of disease in which no certain knowledge can be attained by any other method of diagnosis. In many instances we cannot decide whether a serious operation is necessary by any means short of an incision into the affected parts. We lay open the abdominal cavity to ascertain the character of a tumour or to explore the nature of an injury, and only then may it be possible to decide on the propriety of removal of the diseased part, or the adoption of some other line of treatment.

Gentlemen, the subject of abdominal surgery is so wide that it may be said to possess a literature of its own. The condition of the kidneys, intestine, stomach, uterus, and spleen which indicates surgical intervention has been very fully considered, and lately the diseased states of the pancreas and liver. There is one class of cases, however, which has received less consideration than the rest, at any rate in the light of our newer knowledge and experience; and that is the treatment of penetrating abdominal wounds and visceral injury. My attention has been directed to the subject by the recent occurrence in my own practice of two cases of intra-peritoneal rupture of the bladder produced by external violence. In both of these the abdominal cavity was laid freely open, the rent in the bladder closed by suture, and the peritoneal cavity effectively purified. In each instance the patient completely recovered, and two men, the subjects of a heretofore fatal injury, were restored to perfect health. Another case of the same kind has been since successfully operated upon in a precisely similar manner by Mr. Walsham at St. Bartholomew's Hospital.

My colleague, Mr. Croft, has courteously placed at my disposal the record of a case which, if not in itself completely successful, points out how success is to be realised. It is so interesting that I shall quote a brief account of it.

G. W., aged 34, labourer, was admitted into St. Thomas's Hospital on Sunday, March 6th, at 2 o'clock. Seventeen hours previously he had received an injury to the abdomen in a public-house row. He stated that he had been jumped upon. He had no medical advice before reaching the hospital. During the night he was in great pain, and was sick two or three times. On admission the patient's temperature was 103°, and he was thought to have peritonitis. Mr. Croft was sent for. He decided at once to explore the abdomen by median laparotomy. The operation was performed eighteen and a half hours after the accident. Three lesions were discovered. The ileum had been ruptured transversely, to the extent of two-thirds of its circumference, at the junction of the lower and middle thirds; the lower surface of the mesentery in the same neighbourhood presented a laceration about an inch and a half in diameter; and the omentum, above the level of the umbilicus, had a considerable rent in it. There was fæcal extravasation, and septic peritonitis had spread into the iliac, umbilical, and hypogastric regions. Enteroraphy was debated, but was postponed, under the circumstances, in favour of artificial anus. The peritoneum was very carefully irrigated and rendered aseptic with a warm solution of boracic acid from 15 to 20 per cent. in strength. The edges of the ruptured intestine were closely attached to the parietal wound, and the rest of the incision was closed in the usual manner. The operation lasted an hour and a half, and the man was kept during this time under the influence of ether. He became much exhausted; the pulse was very feeble, and the hands and feet cold. He recovered satisfactorily. The

symptoms of peritonitis disappeared, but a sharp attack of bronchitis ensued. This yielded to treatment, but he did not gain strength or flesh, owing partly to the irrepressible escape of intestinal contents at the artificial anus, and partly to the local irritation established in the abdominal wall by the contact of the intestinal secretion.

At the end of four weeks Mr. Croft proceeded to close the artificial anus. The patient was prepared for the operation, which was performed on April 4th, by substituting rectal feeding for alimentation by the mouth, and by local irrigation of the intestine and all parts immediately concerned. The bowel was then separated from its parietal attachments, the injured portion resected, and the cut surfaces carefully united by twenty-six sutures of fine silk; twenty of these were in one row, after Lembert's manner of suturing. The operation lasted two hours and a quarter, and the patient was taking ether all the time, with the exception of a quarter of an hour, when his circulation became so feeble that the anæsthetic was discontinued, and a brandy enema was administered. He died on April 5th, thirteen hours after the operation. The lungs were found very congested and airless. The suturing had been perfect (fig. 27) and the peritoneum was entirely free from any recent exudation or inflammatory products. The figure shows the appearance of the sutured portion. Had the natural force of the man been a little greater, he might have made a good recovery.

Mr. Mackellar, in a case of gunshot injury of the sigmoid flexure, recently opened the abdominal cavity, but found it impracticable to apply Lembert's suture to the intestinal perforations caused by the bullet. The patient was in a state of impending collapse at the time of the operation, and died twelve hours afterwards.

Again, Mr. Croft nearly achieved success in a case of

rupture of the spleen. The patient, a young man, had been run over by a cab ; no effective assistance was rendered to him, and when brought to the hospital twelve hours afterwards, the abdominal cavity was full of blood. Laparotomy was performed, the ruptured spleen removed, and the peritoneal cavity cleared of blood and purified. But the patient never rallied from the state of collapse, and died the same evening.

Cases such as these are somewhat closely connected. They suggest many points of interest, and invite consideration to the large question of abdominal injury, more especially in regard to its treatment by operation. They seem to justify the propriety of a more frequent resort to abdominal section and exploration of the abdominal cavity and its contents in cases of injury than has been heretofore adopted.

I propose to consider :—

1. Incised and punctured wounds of the abdomen implicating the intestine or other viscera.

2. Abdominal gunshot wounds, chiefly as they affect the intestine.

3. Traumatic rupture of the intestine and viscera without external wound.

Of late years the subject has attracted an increasing attention, and surgeons in America in an especial manner have achieved some remarkable results. The foundation of a rational treatment was first laid down in that country by St. Croix, of the University of Pennsylvania, as early as 1805, when he performed a number of experiments upon dogs, with the view of ascertaining the best method of sewing up a wound of the bowel. Benjamin Travers, in 1812, published his treatise on the mode of repair of intestinal injuries, and the preparations illustrating his experiments are, by the courtesy of our Treasurer, upon the table. Early in the present century the French surgeons Jobert, Lembert, Gély,

and Amussat, experimented with various forms of intestinal suture on the lower animals.

In 1843, Professor Gross, of Philadelphia, published the results of a lengthened investigation to determine the manner of repair of intestinal wounds in dogs, and the best method of their treatment; and recently Professor Parkes of Chicago, Senn of Milwaukee, Dennis of New York, and several others, have published most valuable reports on the subject, more especially in regard to gunshot injury. (*Vide* Appendix.)

STAB WOUNDS OF THE ABDOMEN.

These may be either simple penetrating wounds without injury to any of the contained viscera, or accompanied by visceral injury. Simple penetrating wounds of the abdominal cavity, either by sharp or blunt weapons or by gunshot, are very rarely inflicted; there are upon record many apparent exceptions to this statement, but some of them may be explained by the circumstance that the weapon or projectile has evaded the abdominal cavity which it apparently enters, or, when traversing the cavity, has produced an injury susceptible of repair.

A sword-thrust may traverse the abdomen, and the bowel, subsequently prolapsed through the wound, be found uninjured. During the American war, an Apache Indian prisoner, attempting to escape, was transfixed by a bayonet and pinned with it to the ground. The weapon entered the left hypochondrium, passed directly backwards, and made its exit about two inches from the vertebral column. No bad symptom followed, and the wounds had healed on the fourth day. An instance is recorded where an iron-headed arrow (fig. 2) entered three inches to the right of the fifth lumbar spine, and emerged two inches to the right

of the ensiform cartilage. Circumscribed peritonitis ensued, but the patient recovered without other ill consequences.

Hennen records the recovery of a soldier shot through the abdomen with a ramrod at Badajos in 1812. During the American war, in 1863, a ramrod entered the left groin of Private Manypenny, and emerged through the left lumbar region. The surgeon records his diagnosis as "a ramrod driven plumb through the guts." There was no serious peritonitis, and the man returned to duty two months later.

Beck quotes seven cases of penetration of the abdomen by bullets, without any apparent visceral injury, occurring in soldiers of General Werder's Corps during the war of 1870–71. Five of these recovered. In one of the fatal cases the bullet entered anteriorly, and was found lying against the vertebral column ; the viscera were not wounded. In the other fatal case several coils of uninjured intestine protruded through a large wound caused by a mitrailleuse bullet. In the five cases which recovered there were secondary lesions, such as fæcal fistula, so that they can scarcely be considered conclusive.

Extraordinary instances of a similar kind are also reported by Paré, Wiseman, and many others. But such cases are very rare ; the viscera seldom wholly escape. Larrey, in his long career, only observed one instance in which a ball penetrated the abdominal cavity without producing immediately serious results, and in this case the intestine was afterwards found to have been contused.

PENETRATING WOUNDS WITH VISCERAL INJURY.

As I can only deal with a limited part of so comprehensive a subject, I shall chiefly refer to wounds of the small intestine, since, of all the complications of penetrating wounds

of the abdomen, injury of the small intestine is the most frequent and most fatal. Mr. Abernethy used to shake his head and say Nature would have nothing to do with these cases, but left them to their fate.

"In one short and general prognostic," says John Bell, "we announce them to be fatal." Fortunately this is not absolutely true, but, despite the exceptions, we may take it that such injuries are very rarely recovered from.

In time of war very few sword or bayonet wounds of the bowel are met with; these injuries occur for the most part in brawls where the knife or dagger is used. The intestine very rarely protrudes, and hence, probably, suture of the wounded bowel has been but seldom attempted; and although the result must depend to some extent on the empty or collapsed condition of the bowel at the time of injury, unless the puncture be very small there is no likelihood of recovery without suture. When extravasation occurs, peritonitis almost necessarily follows, although in a few instances a fortunate agglutination of adjacent coils may prevent it from spreading, and recovery ensue.

Diagnosis.—The diagnosis of wound of the bowel is of primary importance, as upon the speedy determination of this point, and prompt consequent action, must altogether depend the success of our treatment. When the injured intestine is prolapsed through the wound, or the contents of the tube escape externally, the diagnosis is clear, but these occurrences are the exception, and, in the early stage, the presence of a wound of the intestine must be often mere matter for conjecture. Tympanites, discharge of blood *per anum*, are valuable symptoms when present, but neither may appear directly after the injury. If the blood passed from the bowel be abundant, and shows itself soon after the injury, it is a very valuable symptom. Emphysema, when it occurs in the wound-neighbourhood, is said

to be pathognomonic. Shock and pain vary so much in degree as to afford no useful guidance. The amount of shock is very variable, and cannot be relied upon in any degree as diagnostic. It is often described as very trifling; at other times it may be severe. The amount of pain also offers no true criterion. The surgeon who sees the case immediately after the injury must often be in doubt as to whether the intestine is injured or not, and as to the extent of the internal damage.

Treatment.—Probing these wounds has been very universally condemned as useless for diagnostic purposes, and harmful to the sufferer, by possibly disturbing the parts and giving rise to fæcal effusion. But this view can scarcely meet with the same consideration now in the light of modern methods of treatment. If precautions be taken to exclude septic influences, the thorough examination of the wound by the probe may determine its direction and extent, and if this fail to clearly establish the fact or otherwise of penetration, the wound should be enlarged and explored to its termination either in the parietes or more deeply. The important point to speedily determine is, whether the wound penetrates the abdominal cavity, and this is perhaps the most effective manner of ascertaining it. After a short interval the occurrence of peritonitis will determine our diagnosis; tympanitic distension of the abdomen, agonising pain, ceaseless vomiting, tendency to collapse, thready pulse, and clammy surface make their appearance, and a fatal issue soon follows. When the diagnosis has been established in this way the services of the surgeon are no longer called for.

Should the abdominal cavity be penetrated, the question arises as to whether the intestine has been wounded or hæmorrhage has taken place. In that event the better treatment will be at once to make a median incision in the manner recommended for any other form of abdominal

section, and not to trust to enlargement of the existing wound. Of course where the bowel protrudes and no extravasation has taken place in the interior, it will be sufficient to suture the opening in the prolapsed portion, excise after ligature any damaged portion of omentum, and return the parts, if necessary enlarging the external wound for the purpose. Although the abdominal cavity has been traversed both by a bullet and sword without opening the intestine, which is presumably thrust aside, this condition of things is not to be relied upon to guide our treatment. The do-nothing system, Guthrie justly declared, is generally followed by death. In wounds of any magnitude of the small intestine an unequivocal recovery, either with or without an artificial anus, can scarcely be said to exist.

Benjamin Bell, "System of Surgery," 1783, long ago recommended suture of the bowel, although apparently he never practised it. He also advised the sutures to be cut short and the bowel returned to the abdominal cavity.

At the beginning of the century, however, John Bell stigmatised sutures as utterly useless and detrimental. When the intestine is wounded, he says, we must not pretend to search for it with the absurd intention of sewing it up, nor expect to fasten it to the external wound, but trust to adhesions forming. If the wounded intestine be protruding it were madness to let it go back into the abdomen. "I have ventured to say," he continues, "that if there be in all surgery a work of supererogation it is this operation of sewing up a wounded gut. It is a dangerous and puerile conceit." Indeed, he characterises Benjamin Bell's observations on the subject of abdominal injury as "unparalleled in all the books of surgery from the invention of printing down to the present day."

Enteroraphy is at the present time admittedly the best method of treatment for all punctured and incised wounds

attended by protrusion, unless the parts are so damaged that an artificial anus seems preferable. In cases of stabs and gunshot wounds, unattended by protrusion, the common practice heretofore has been to arrest the peristaltic movements with opium, and enjoin absolute rest, in the hope that adhesions may form to avert extravasation. Experience proves that in the vast majority of instances such hopes are illusory, ninety-nine times in a hundred extravasation occurs, hyper-acute peritonitis follows, and, after much suffering, death generally takes place within forty-eight hours.

Another proceeding commonly recommended is the formation of an artificial anus by attaching the margins of the wound in the gut to the skin, but where it is possible to avoid it this course is in the highest degree undesirable, and certainly unnecessary in those cases where the injury does not extend more than half-way around the calibre of the tube, or where the convexity of the bowel is wounded, and probably in all cases where the mesenteric attachment is intact; and the same may be said where the bowel is ruptured by external violence. This practice gives the surgeon a false sense of security; he thinks if his sutures give way the patient may still recover, but the evidence is very strong that the risk of fæcal extravasation is less when the wound in the bowel is completely closed, and the gut at once returned to the abdominal cavity. A different practice properly obtains in hernial or other forms of strangulation where the bowel is gangrenous. An artificial anus should in most instances be established in preference to immediate resection of the sphacelated portion of the bowel, with suture of the divided ends. In such cases the bowel is in an unhealthy condition. We do not exactly know the limits of the gangrenous action, nor of the zone of inflammatory infiltration beyond it, and therefore cannot precisely determine what amount of damaged bowel it is necessary to remove.

In cases of injury, however, we shall have but half accomplished our work if we form an artificial anus rather than at once attempt to restore the continuity of the intestine. Should the patient recover, a further operation will be required to close the fæcal fistula, and this procedure is often one of great difficulty and serious risk. Besides, should the original damage be in the upper portion of the small intestine, there is a considerable probability of the individual being either starved, or so weakened by the escape of nutriment that he becomes unfit to be submitted successfully to any operation whatever.

Should all wounds of the bowel be sutured? The older authorities—Dionis, Heister, Sabatier, Sharp, Boyer, and others—advised against it when the wound was under a quarter of an inch in length, the diameter of a goose-quill or penknife.

Benjamin Bell tells us emphatically that the opening, however small, should be securely closed, the suture in itself being harmless compared with the possibility of extravasation.

Gross settled the question in the affirmative by his experiments on dogs undertaken in 1843, for he found that even an opening two lines or one-sixth of an inch long, which was always blocked to some extent by intrusion of the mucous membrane, nevertheless permitted fæcal matter to escape, and we know the smallest quantity is sufficient to excite a fatal inflammation.

METHODS OF INTESTINAL SUTURE.

There are three conditions required to ensure successful suture of the intestine:

1. Two adequately broad and sufficiently wide surfaces of peritoneum must be brought into contact.

2. The mucous membrane must be excluded, for when the needle passes through the whole thickness of the gut, peritonitis generally ensues from leakage taking place along the line of the thread.

3. Rapidity of execution is of extreme importance, and that form of suture is the best which can be effectively applied in the shortest time.

In the earlier attempts to deal by operation with a wounded bowel, the surgeon generally connected the gut by one or two sutures to the external wound. This very imperfect method was approved by Scarpa, Richter, John Bell, Larrey, Lawrence, and other famous surgeons.

Rambdohr, in 1730, is said to have been the first to suture successfully a complete division of the intestine. Heister afterwards secured the preparation, and found the bowel quite united. The patient had died of pleurisy a year after the operation.

Reybard (fig. 40), in 1827, sought a more exact apposition of the internal and external openings.

Ledran employed a looped suture. Bertrandi's stitch (fig. 42) was practised by Chopart, Desault, and Béclard.

The four masters in the thirteenth century introduced a cylinder into the lumen of the intestine; and Duverger, in 1745, records a case of successful suture after this manner.

Denans, in 1838 (figs. 44, 45, 46, 47), combined inversion of the serous surfaces with the ancient plan of supporting the tube from within by a hollow cylinder of pewter or silver.

Jobert, in 1822, proposed a new method of treating wounds involving the entire circumference of the bowel. It consists in invaginating the upper into the lower end of the divided gut, and securing it there by suture after inverting the margins of the lower end, always a difficult matter to accomplish (figs. 49, 50, 51). The ends of the sutures are brought out through the abdominal wound and withdrawn,

by traction on the fourth or fifth day. Professor Madelung has recently revived and modified Jobert's suture (fig. 52).

In 1826, Lembert introduced a method of bringing the two adjacent serous surfaces into contact, avoiding penetration of the mucous coat. It is the preferable one to employ in all wounds of the bowel; sufficient inversion may be thus easily accomplished without causing obstruction of the lumen of the tube. When the wound is small or incised, the needle may be introduced a line and a half or two lines from the margin, and then brought out at the edge of the serous coat, the same being done on the opposite side (figs. 53, 54, 55). This will suffice in clean cut wounds; but where the edges are bruised, it is best to exclude them by entering the needle about three or three and a half lines from the margin, and carrying the suture through the bowel a line distant or more from the edge. The number of stitches must be sufficient to bring the parts everywhere into accurate contact, and care taken not to tie the sutures too tightly, as it may lead to gangrene and consequent failure to procure union. Experimentally, this has been found to be the most frequent cause of non-union. The ends of the sutures are cut short, and the intestine returned to the abdominal cavity. When the surfaces are drawn together sufficiently to bring them fairly into contact, the subsequent swelling will hold the parts firmly until the rapidly-formed adhesive material securely glues them together. When the omentum is much injured, it is probably best to excise the damaged parts after applying double ligatures.

The abdominal cavity must be perfectly cleansed of all blood and foreign matter. Irrigation with a 3 per cent. solution of boric acid, at a temperature of 100°, made with water previously boiled, is the best and gentlest method. The external wound is closed, as after ovariotomy. If the operation be done shortly after the accident, drainage may

be dispensed with. If some time have elapsed, or if peritoneal inflammation be present, it will be best to drain. The presence of a drainage-tube in the wound certainly enhances the risk run by the patient, and it is best therefore to dispense with it in all cases where it appears safe to do so.

Dr. Roberts, of Louisville, reports a case which shows how much may be done under unfavourable circumstances. It is, I believe, the first successful case of the kind in America, and well illustrates the practice we should adopt.

In August 1883, a fat man, of 54, received a knife-wound, three inches long, in the left side of the abdomen; the bowel protruded, and was ascertained to be wounded in two places, the openings being the size of a lead pencil, and two slits, each an inch long, were found in the mesentery. The patient had lost much blood, and the medical man who was first called in merely returned the intestine, and sutured the external wound. When Dr. Roberts saw the patient some hours later he reopened the wound, tied some still bleeding vessels in the mesentery, sutured the wounds in the gut, washed out the abdominal cavity with hot carbolic solution, and inserted a drainage-tube at the lower angle of the wound, which was then closed by deep sutures. The man made a rapid recovery.

A considerable number of successful cases of suture of the intestine when protruded through the abdominal wound are recorded in the tables.

GUNSHOT WOUNDS.

Gunshot wounds of the intestine are injuries of the most fatal description. They are of frequent occurrence in time of war, and far from being rare in civil practice, especially in America, where every one carries a revolver, and often uses it on small provocation.

About one-tenth of those slain in battle perish from abdominal injury, but only 3 to 4 per cent. of those who come under treatment are wounded in the abdomen. These wounds are almost invariably concealed, the gut being seldom protruded. Wounds of the duodenum are comparatively rare, and usually associated with other severe injury. The jejunum is more frequently wounded, but the ileum is the most frequent seat of gunshot injury; damage to other parts is often present, or a multiple wound of the intestine itself. Longmore relates the particulars of a case occurring in the Crimea where the intestine was wounded in sixteen places by the same bullet.[1] If this were common, operative surgery would prove of little avail; but it is rare that more than two convolutions are perforated, or that the intestine is wounded in more than four places. In a few instances the bullet may perforate and lodge in the bowel (fig. 18); this is proved by it being voided at stool shortly after, and this happens most frequently in wounds of the large intestine. When discharged *per anum* at an early period, the bullet has presumably penetrated the gut; when the missile is passed at a late period, it probably gained admission to the tube from some adjacent part by secondary ulceration or abscess.

Symptoms and Diagnosis.—In gunshot injuries the first question to ascertain is if the bullet have penetrated the abdominal cavity. The external wound should be carefully probed, or it may be enlarged sufficiently to explore its whole length as it passes through the abdominal wall. This

[1] Sir Thomas Longmore explains this occurrence in the following manner:—"The man was shot, while in the act of defæcating on the exposed side of a trench before Sebastopol, by a bullet which entered near the umbilicus, and made its exit near the sacrum, and no doubt the compression together of the intestines by the diaphragm and the abdominal muscles at the time the bullet passed through his belly, and the oblique course it took, were the causes of so many duplicatures being perforated.

adds little to the gravity of the patient's condition, and will positively determine whether the wound is a penetrating one.

These injuries are attended with considerable hæmorrhage, great and prolonged shock, lowered temperature, feeble rapid pulse, restlessness, severe pain, great anxiety, rectal tenesmus, and there is always extravasation of fæces into the peritoneal cavity, although it is very rare for any sign of them to appear externally.

The absence of fæcal matter in the parietal wound is no proof that the intestine is not perforated. In none of Professor Parkes' numerous experiments on dogs did any fæcal matter emerge through the external wound, although in many instances large quantities were found in the peritoneal sac ; and Gross, as I have already mentioned, found that fæcal extravasation into the peritoneal cavity occurred in every instance. The mucous membrane never blocked the perforation produced by the smallest bullet so as to prevent it, a strong point in favour of active interference.

Air in the abdominal cavity causing tympanites, emphysema around the wound, a larger escape of blood than the injury to the parietes will account for, are among the symptoms which help to indicate intestinal injury.

The occurrence of bloody stools is usually a late symptom, and without practical importance in reference to operation. When they appear at an early period they signify intestinal damage. The amount of shock is partly dependent on idiosyncrasy, but prolonged initial shock indicates either general visceral involvement or a great loss of blood ; later on, the symptoms are those of hyper-acute peritonitis.

Shock accompanies all penetrating gunshot wounds to a greater or less extent. When it becomes more and more severe, with increasing exhaustion, jactitation, feeble pulse and respiration, we may conclude internal hæmorrhage is taking place. This is the most frequent cause of death after gun-

shot wound of the abdomen, and we usually find the cavity filled with blood quite out of proportion to the size of the vessels injured. Even in the case of small vessels there is but little tendency to spontaneous arrest of hæmorrhage, because of the laxity of the tissues and the absence of atmospheric influence in producing coagulation. As soon as air is freely admitted by abdominal section, the bleeding from the lesser arteries is speedily arrested. When a large vessel is injured the bleeding is always excessive, and a fatal result almost directly follows.

In Parkes' experiments no shock was observed apart from symptoms attributable to loss of blood, and whenever severe prostration occurred there was always extensive hæmorrhage to account for it; the transit of the bullet did not even alter the character of the pulse or respiration. If hæmorrhage, then, be so frequent a cause of symptoms usually attributed to shock, this condition, unless extreme, indicates laparotomy as the only means whereby the bleeding can be arrested, and life either saved or prolonged.

On the battlefield there is so much haste, confusion, dirt, and calls innumerable for the surgeon's aid, that immediate laparotomy can be very rarely feasible. Cases apparently suitable should be rapidly and gently transported to the nearest field-hospital, where an operation may possibly have a chance of success. We must recollect, however, that a rifle bullet inflicts a much more terrible injury than a revolver ball, the effects of which we commonly witness in civil practice.

After the military period which closed with Waterloo, the problem of enteroraphy for wound of the intestine remained unsolved. Guthrie regarded the proper management of gunshot wound of the intestine undetermined, and one to be settled by his successors. J. Thomson thought such cases should be left as much as possible to Nature. Astley

Cooper and Syme considered interference hopeless. But during the next quarter of a century the methods of suture were greatly improved, and during the military operations of the French in Algiers, occasion was found to practise intestinal suture. Baudens published two cases, one of which was completely successful ; in the other, in which eight inches of intestine were cut away, the patient died on the third day. Larrey, in a case of complete division of the ileum, attached the divided ends to the external wound ; the patient recovered.

Pirogoff, during the war in the Caucasus in 1849, was greatly impressed with the importance of this question, and regrets that he only once sutured the intestine for gunshot injury. The patient was reported as doing well on the fourth day, but his ultimate fate has not been recorded. All the others thus wounded he gave up as lost for want of time, and on account of the large numbers awaiting his help. In the Crimean war Legouest advised the proceeding, but it was not acted upon. In the American war the intestine was sutured by Bentley, Hudson, Gill, and Kinloch.

On the other hand, Dr. Hamilton ("Treatise on Military Surgery," 1865), speaking of gunshot wounds of the intestine, says : "Be assured the patient will have a better chance of life if we leave him entirely alone. It is surprising," he says, "that many good surgeons should think otherwise."

Treatment of Gunshot Perforation of the Intestine.—The experiments on dogs prove how futile it is to expect immunity from either intestinal perforation or extravasation of fæces after a bullet has traversed the abdomen. And the same is true in man ; the bowel is nearly always perforated, fæces are extravasated, and very frequently there is some other serious complication as well.

It will be more reasonable, then, to submit the patient to the less serious risk incurred by abdominal section than to leave him in deadly peril from the consequences of a

wounded intestine or a bleeding vessel, on the mere assumption that they may possibly have escaped injury. Some degree of doubt must always exist, on account of the necessary obscurity of the symptoms, except in the rare event of prolapse of the injured gut, fæcal extravasation appearing externally, or very free hæmorrhage from the wound. But although there may be uncertainty as to the extent of the lesion, it is surely better to solve the doubt by an exploratory abdominal section which may afford the only possible means of rescue.

If we await the outbreak of peritonitis, the patient's chances of recovery after operation will be greatly diminished. Operation is practically useless after twenty-four hours have elapsed, or when general peritonitis and great collapse have set in. A moderate amount of peritonitis, however, by no means contra-indicates operation.

If we are satisfied that laparotomy is the proper proceeding, and decide to explore the abdomen, the operation should be undertaken as soon as possible after the infliction of the injury, and performed with every antiseptic precaution. When it has been delayed, the condition of shock is so much aggravated by the necessarily prolonged operation, that it may be impossible to complete the thorough disinfection of the cavity.

The median incision must be sufficiently extensive to allow all parts of the abdomen to be explored. It should be large enough to admit the operator's hand, and none but his should ever be allowed to enter the peritoneal cavity. The mere enlargement of an existing wound is inadequate for the purpose of thorough exploration. The bullet wound in the abdominal wall should be explored when necessary for purposes of diagnosis, otherwise it ought simply to be disinfected and included under the general dressing. Abdominal section enables us to determine the extent of the injury and

the treatment which should be adopted. The entire cavity and its contents can be thoroughly examined. An injury is less liable to be overlooked, and the suture of the bowel is more readily accomplished.

The operation is incomplete unless the entire intestinal tract be examined, as well as the stomach and other viscera, which of course entails considerable manipulation. The intestines must be withdrawn and carefully examined, being protected as far as possible by warm cloths. The best way is to seek the cæcum first, and then trace the small intestine upwards for its entire length ; in this way we shall be least likely to fail to find the injury. All bleeding points must be secured and the clots swept away.

When several openings exist close together, it is better to resect the portion of intestine involved. In some instances, when the bowel wall is seriously compromised at one or more distant points, multiple resections have been made. Ingenious clamps, such as Rydygier's, Treves's (fig. 79), and others, have been suggested, but the fingers are probably the best form of instrument to prevent the escape of the intestinal contents after division of the tube.

The mesentery must be detached from the portion of the gut to be resected. When a large portion requires removal, a triangular piece of mesentery may have to be excised, taking care to secure separately every bleeding point. The mucous coat becomes much everted (fig. 72), sometimes seriously interfering with the introduction of the sutures and the accurate approximation of the surfaces of the bowel. It should never be excised, as it gives support, and supplies blood to the edges of the gut. In all the experiments where it was cut off by scissors the sutures gave way (Parkes). Care must be taken to insert the sutures at the mesenteric border sufficiently deep to ensure complete inversion of the intestine, and to bring the serous surfaces fairly into contact. There

is a triangular interval (figs. 33, 34, and 35), filled with connective tissue and blood-vessels between the layers of the peritoneal coat as it leaves the bowel to form the mesentery. At this place the needle must be passed deeply enough to include the muscular coat as well as the serous, otherwise extravasation will result.[1]

Three sutures should be first introduced at the mesenteric

[1] My colleague, Mr. Anderson, has kindly furnished me with the following interesting notes upon the surgical anatomy of the small intestine with reference to the operation of resection and suture :—

1. Owing to the divergence of the two layers of the mesentery as they approach the bowel, a portion of the circumference of the jejunum and ileum is left destitute of a serous investment. The separation of the mesenteric laminæ begins at a distance of about two-thirds or three-fourths of an inch from the intestine, and leaves a triangular space, the base of which, averaging about five-sixteenths of an inch in width, is formed by the uncovered muscular tunic. This interspace, extending along the whole of the mesenteric attachment, is occupied by fat in variable quantity, by the vessels and nerves of the gut, and by delicate fibres of connective tissue. Unless this disposition of the peritoneum be taken into consideration, it is obvious that a suture applied in the manner of Lembert might fail to bring into union the opposed portions of the true wall of the intestine at the mesenteric attachment, and a leakage from the interior of the tube might take place into the "inter-serous" triangle and peritoneal cavity.

2. The disposition of the arteries within the triangle is worthy of notice. The last row of anastomotic loops, from which arise the direct branches of supply, is placed much nearer to the intestinal wall in the lower than in the upper portion of the bowel, and, towards the termination of the ileum, commonly lies within a third of an inch of the canal. From these loops are given off at moderately regular intervals straight vessels (fig. A), which do not intercommunicate, but bifurcate and pass at once to the muscular floor of the triangle, to pierce it on either side near the lateral angles of the interspace. As each of these vessels has a fairly well-defined territory, it appears undesirable to interfere with the loops from which they spring for fear of causing obstruction in adjacent branches, and it is hence safer to divide the mesentery as near as possible to the part of the bowel to be resected (fig. A), the redundant portion left

border, in the manner insisted upon by Parkes. A suture had then better be placed at the convexity of the bowel, then one half-way down on each side, the others following in

after suture of the intestine being folded and the cut edges of the membrane united by a continuous suture of fine catgut (fig. B).

3. It is important to remember that the thickness of the muscular coat of the small intestine varies within rather wide limits in different subjects, and in all cases diminishes, together with the calibre of the tube, from the upper towards the lower extremity of the canal. The amount of the diminution is very considerable. Thus, in the jejunum, about two feet

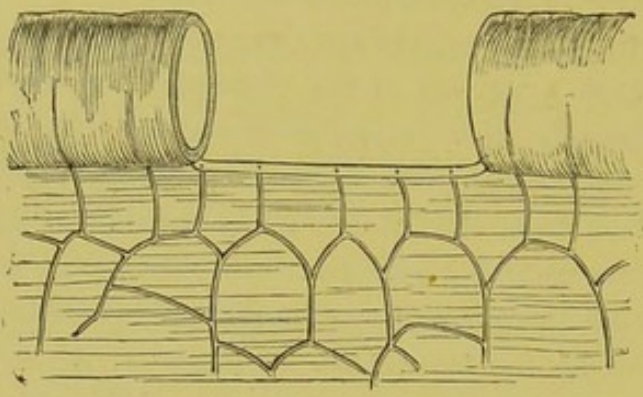

Fig. A represents the position and relations of the fold of mesentery after resection of the gut. The two layers of peritoneum are separated by fat. The manner of distribution of the blood-vessels is indicated. (Diagrammatic.)

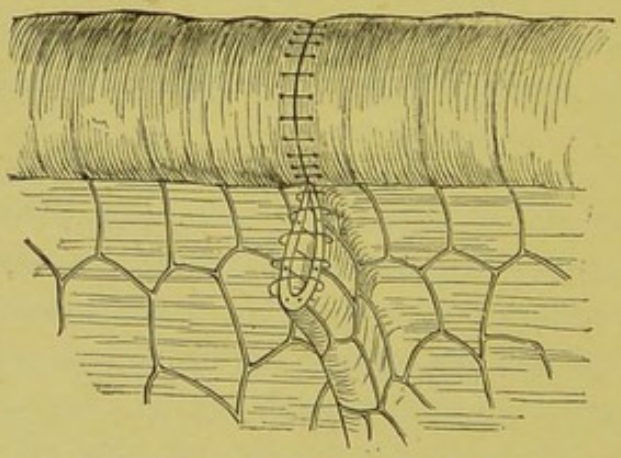

Fig. B.—The intestine has been sutured, and the mesentery appears as a redundant fold, whose edges have been united by a continuous suture. This method of dealing with the mesentery will obviate to a large extent the risk of gangrene of the divided edges of the bowel. (Diagrammatic.)

from its commencement, the depth of the tissue ranges from one-seventieth to one-fortieth of an inch, while at the lower part of the ileum, about two feet from the ileo-cæcal valve, it is reduced to about one-half or even

order in the quadrantal intervals between. It is more difficult to pass the sutures in succession, one after the other, all the way round ; the mucous membrane is in the way, and the sutures are apt to be uneven. In cases of complete resection of the bowel, it is best to include a considerable width of serous membrane. Each suture should be introduced not less than a third of an inch from the divided margins, brought out just free of the edge on one side, then re-introduced close to the opposite edge, and made to include about the same width of tissue. It should include only the serous and muscular layers. Fine silk is the best material to employ, and a moderately-curved needle. Czerny's double row is very tedious to apply, and, as it gives no better results than the single row including a sufficient width of tissue, it had better be abandoned, on account of the loss of time it entails ; or, if used at all, it can only be necessary along the mesenteric border. The condition of the solid viscera must be examined, and any injury found in them dealt with according to circumstances. This will, however, prove a very fatal complication.

one-third of this admeasurement. The difficulty and danger of enteroraphy of the small intestine will hence be greater in this respect the more remote the portion of bowel under operation is from the stomach, but, in compensation, the number of stitches required will be fewer. In the large intestine the risk of failure is greater than in the small, owing to the extreme tenacity of the muscular coat between the longitudinal bands, and to the larger number of sutures demanded by the increased circumference of the canal.

4. The submucous tissue of the small intestine has a considerable degree of toughness, and is usually strong enough to bear a fine suture applied after Lembert's manner without implicating the epithelial surface of the mucous membrane. An inner row of stitches of this description would give increased security of union without opening up any minute channels of communication between the lumen of the gut and the cellular interspaces beneath the muscular coat, such as are necessarily produced in the application of the Czerny suture.

WOUNDS OF THE PANCREAS.

Wounds of the pancreas are rarely isolated, and may be said to be otherwise inaccessible to surgical interference.

WOUNDS OF THE KIDNEYS.

Wounds of the kidneys are not necessarily mortal lesions; the majority are, however, complicated with other serious damage. The liver and right kidney are often wounded by the same ball. When the peritoneum is penetrated, urine escapes into its cavity and speedily excites fatal inflammation. In severe but uncomplicated damage the better course will be to excise the kidney. Twenty-six cases of alleged recovery after gunshot wound took place during the American war.

WOUNDS OF ARTERIES AND VEINS.

If the opportunity arise, an attempt should always be made to arrest severe bleeding from a wounded abdominal vessel, and instances are not wanting where the mesenteric, epiploic, gastric, and colic arteries have been successfully ligatured; but, if the vessel be large, the bleeding will usually occasion almost immediate death.

WOUNDS OF THE LARGE INTESTINE.

Taken as a group these injuries are much less fatal than wounds of the small intestine; the colon is only in part invested by peritoneum, and there seems therefore to be less liability to intraperitoneal extravasation (figs. 30, 31, 32).

Recovery after wound of the transverse colon is rare; after that of the cæcum or ascending colon it is more frequent; while wounds of the descending colon are least fatal. Injury

of the large intestine below the brim of the pelvis is very frequently recovered from ; these injuries are not so amenable to treatment by suture as are those of the small intestine. It is often a question of closing the intestinal fistula which forms after recovery by one of the various ingenious operations and instruments which have been devised for the purpose. (Figs. 75, 76, 77, 78).

WOUNDS OF THE STOMACH.

The principal signs are extreme shock, escape of the contents of the organ, and vomiting of blood (figs. 11, 12).

When the stomach is empty, as it often is in soldiers going into action, extravasation does not necessarily occur.

Extravasation of the contents into the abdomen is the rule in these cases. Hæmatemesis is usually an early but not constant symptom ; external hæmorrhage is seldom considerable, but the internal bleeding is often large in amount. Intense pain is felt in the epigastrium.

The position and direction of the external wound afford presumptive evidence of the stomach being wounded, but nothing short of a digital or ocular demonstration affords a positive proof ; the symptoms are very complex, and common to many other forms of abdominal injury.

This injury is occasionally, but very rarely, recovered from, and we may set down the mortality at 99 per cent.

Nineteen cases of gunshot wounds of the stomach are alleged to have recovered during the American war, but the reporter does not consider any one of them free from doubt as to the exact nature of the wound.

In an instance recorded by Fischer, I saw the stomach which had been removed from a man who died of cholera some two years after the receipt of the wound. The stomach had been traversed by a bullet, and the cicatrices on its anterior and posterior surfaces were quite distinct.

Larrey reports one unequivocal case of cure after sabre wound. A most extraordinary survival is that mentioned by Archer of South Carolina. A man was stabbed in the stomach shortly after taking a copious meal of cabbage and bacon with cider. The wound was two inches long, and the contents of the stomach escaped freely into the abdominal cavity. The patient nevertheless recovered, and some portions of cabbage were afterwards discovered in an abscess which formed in the groin.

Laroche, Carterat, Percy, Travers, and Ashby have also given us examples of successful suture of the stomach.

There is some difference of opinion as to whether it is better immediately to close a wound of the stomach or to form a gastric fistula by attaching its edges to the external opening.

In three recorded cases a gastric fistula spontaneously formed, but these subsequently proved fatal, one in four weeks, one in seven, one in eleven.

The celebrated case of St. Martin (figs. 28, 29) is referred to in the notes.

Baron Percy in 1794 records the only other known instance of recovery with a gastric fistula in a case which happened during the repulse of the French at Kaiserslautern, and here the fistula ultimately closed. Suture of the stomach was performed in all the cases which recovered, and where there is a fair presumption that a wound of the stomach has occurred, abdominal section should be performed, the opening in the stomach sutured and the external wound closed, a practice much to be preferred to attempting the formation of gastric fistula. Where the wound is on the anterior surface or at all accessible, and not complicated with otherwise fatal injury, it should be thus dealt with, as bleeding is arrested, extravasation prevented, and the abdominal cavity can be cleansed and disinfected.

OMENTUM.

If the omentum be seriously damaged, large portions, or even the entire mass, may require removal. It should be amputated in sections after ligature ; the peritoneal sac is then to be carefully cleansed by irrigation or repeated sponging ; the intestines are also to be carefully sponged, and, if uninjured, at once returned.

WOUNDS OF THE LIVER.

Traumatic lesions of the liver have but a small place in surgical literature. When deep they are usually considered necessarily fatal, on account of the resulting hæmorrhage, or the peritonitis which will most probably result.

Gunshot wounds of the liver are often associated with wounds of the ribs and spine, yet if hæmorrhage could be arrested—and some recent observations show that it may—these injuries might occasionally be benefited by an exploration, which could not materially aggravate the serious condition of the patient.

Penetrating wounds of the liver generally prove fatal from hæmorrhage, but occasionally they are recovered from, and Hennen's statement, that a deep wound of the liver is as fatal as that of the heart itself, is too absolute. If the patient escape the danger of hæmorrhage he is exposed to the hardly less serious risks of peritonitis.

If the liver surface be merely grooved or slightly lacerated, the peritoneal surfaces can often be brought together by continued suture ; the same may be done with advantage in laceration of the liver if not too extensive, as a comparatively slight amount of pressure will arrest the parenchymatous hæmorrhage, which can also be sometimes controlled by a light application of the actual cautery.

In spite of the friable nature of the liver, suturing is per-

fectly practicable, as experiments on animals have shown, but it is unlikely that any very deep wound of the hepatic parenchyma can be sutured with success, as it must involve some of the bile-ducts. When the liver tissue alone is sutured the bile will escape into the peritoneal cavity. In one case plugs of iodoform gauze were introduced into the wound with the object of arresting hæmorrhage and preventing the escape of bile.

In one reported case a deep stab wound produced a hæmorrhage sufficient to distend the abdominal cavity; laparotomy was performed, the peritoneal cavity cleansed, and sutures placed in the liver wound. The patient rallied from a state of profound shock and collapse, remained in an apparently good condition for about twelve hours, and then died suddenly. At the post-mortem the peritoneal cavity was found quite clean, the liver wound closed, and there were no signs of peritonitis.

In the Surgeon-General's report one case of recovery after bayonet perforation of the liver is recorded, and fourteen out of twenty-five cases are set down as indubitable instances of recovery from gunshot wound of this organ. In the other eleven the evidence is incomplete.

Burckardt ("Centralblatt für klinische Chirurgie," Jan. 1887, p. 88) considers that antiseptic agents can be sometimes directly applied to wounds of the liver, and that this will probably diminish in the future their high mortality.

He relates a case of great interest. In March 1886, a workman was stabbed by a knife, which entered the left epigastric region transversely, a little below the border of the ribs. After receiving temporary medical attention the man was taken to the Stuttgart Hospital. He was conscious on admission, but there were symptoms of considerable internal hæmorrhage. On a level with the free border of the ribs in the left mammary line there was a wound about one inch

long, in which two sutures had been placed; the belly was distended, and there was dulness in the lower abdominal region, but above the fifth rib on each side percussion was tympanitic. The patient was chloroformed, the wound re-opened and enlarged to nearly six inches, and search made for the origin of the hæmorrhage. When the peritoneal cavity was opened a large quantity of dark blood escaped, and several loops of intestine. It was believed the hæmorrhage had taken place from a large mesenteric artery, and the liver was not at first thought of, as no portion of the viscus was perceived. But on drawing the liver towards the wound an incision three centimètres long and five or six deep was found in the left lobe, from which blood was freely flowing. The state of the patient was now such that it was necessary to terminate the operation speedily. Six or eight tampons of iodoform gauze were pressed into the wound of the liver. The abdominal cavity was cleansed, the intestinal loops were carefully purified and replaced, and the external wound was sutured throughout except at its upper end, which was left open for the introduction of a drain and the subsequent removal of the gauze. A complete antiseptic dressing was then applied. The patient rallied well and finally recovered, in spite of some pneumonia. On the sixth day the tampons were removed and another drain introduced; after nine weeks a small fistulous tract only remained, kept open by a small piece of gauze. When this was removed recovery was soon complete. Burckhardt calls attention to the value of iodoform gauze tampons as a means of arresting hæmorrhage and preventing the escape of bile into the peritoneal cavity.

WOUNDS OF THE SPLEEN.

Extirpation of the spleen for injury is more successful than when performed for disease, a fact which would justify

exploration with a view to arrest an otherwise fatal hæmorrhage caused by injury to this organ (fig. 1). Had an earlier operation been possible in Mr. Croft's case, success would have probably ensued, as the patient, in point of fact, died from loss of blood.

ABDOMINAL INJURY WITHOUT EXTERNAL WOUND.

Violent contusion of the abdomen may result in rupture of any of its contained viscera, a condition, however, for which laparotomy has been but rarely performed.

Rupture of the Intestine.—In these cases an exact diagnosis must always be very difficult, oftentimes quite impossible to arrive at, as the symptoms are obscure and common to several degrees and kind of injury. Serious hesitation must always occur when we are called upon to decide in the presence of each particular case what is the best line of treatment to adopt. Every surgeon, however, has seen cases of severe abdominal injury recover, while many others very speedily die.

Numerous instances may be cited to illustrate the fact that the most serious injury is sometimes unaccompanied by any definite diagnostic symptoms.

In a case which recently appeared at St. Thomas's, the man, apparently, had no serious complaint. He was a labourer, aged 24. On March 26th, 1887, about 8.30 p.m., he was knocked down while in a drunken condition by a tramcar, driving at the rate of four miles an hour, and wedged between the wheel-guard and the ground. He vomited repeatedly after the accident; when seen at the hospital one hour later he could not answer questions coherently, was restive and quarrelsome, the pulse full and quick, respiration hurried; there was no symptom of collapse, no distension or tenderness of the abdomen.

After being carefully examined, he was able, with some assistance, to put on his clothes, and, on being discharged, was taken to a police-cell. During the night he vomited frequently, and the bowels acted once; he was very noisy, but expressed himself as feeling "all right"; in the morning he complained of pain in the epigastrium, but was able to bail himself out, and walk away from the police-station. One hour later he became much worse with severe abdominal pain, and died of peritonitis the same evening, twenty-four hours after the accident. At the necropsy a rupture of the lower part of the duodenum, with extravasation of its contents, and a slight rupture of the liver, were found.

In 1872 a corpulent man walked a considerable distance to the London Hospital, after falling in a brewery some sixteen feet, and striking his belly in the fall. There were no symptoms throughout his illness referable to abdominal injury. He complained only of pain in the chest, and being considered fit to attend as an out-patient, was sent home Soon after he returned to the hospital, and died in about twenty hours. At the post-mortem examination a complete circular division of the bowel was found at the junction of the duodenum and jejunum, and a fracture of the sternum.

At the Leeds Infirmary, a man, aged 19, was admitted in 1881 in a drunken condition; the wheel of the cart he was driving had passed over his abdomen. There was no evidence of external injury, and the man had been able to remount his cart and drive a couple of miles into the town. There were no symptoms of collapse, and he vomited a few ounces of clear fluid, smelling of beer. On the following morning he said he felt "quite well." There was no abdominal tenderness, nor had any blood passed by the bowel. He was then given some bread and milk, and almost directly after, abdominal pain set in, and death occurred from peritonitis twenty-seven hours after admission. On post-mortem

examination, the jejunum was found completely divided transversely, exactly where it lay upon the vertebral column. It is not stated if extravasation took place.

Such cases—and others might easily be quoted—illustrate the fact that for some time nothing positively indicating a serious intestinal lesion may show itself. Nevertheless, the fatality of concealed lesions of the intestine is so great that since the beginning of this century the idea of intervention has occurred to many surgeons. In France, Jobert and Baudens urged interference as soon as symptoms of peritonitis were declared. Bouilly, in 1883, seems to have been the first to operate in a case of this kind. In the Appendix, twelve cases altogether are recorded in Table IV., including Mr. Croft's case, already detailed. These have proved fatal, unfortunately, in every instance.

Symptoms and Indications for Operation.—The chief indications for operative interference are afforded by the mode of action and severity of the injury. The presence of prolonged and profound shock—the duration of the shock is of greater importance than its intensity—a small and quick pulse, and hurried respiration, associated with acutely severe, persistent, and localised pain, increased on pressure, while the temperature remains either normal or subnormal, indicate the nature of the injury; bloody vomit or stool, rapid tympany, the evidence afforded by percussion, are inconstant signs, and help us but little.

The jejunum and ileum are the portions of intestine most frequently ruptured, and the rent will generally be found just behind the part of the abdomen which has been struck —a fact which can easily be verified by experiment. In about 15 per cent. of the cases more than one loop of intestine is damaged, and in these instances the injury generally occurs in superimposed coils.

It may be affirmed that there is no constant patho-

gnomonic sign of rupture of the intestine. It is difficult at first to distinguish the syncope induced by hæmorrhage from the shock caused by a ruptured intestine. In some cases, as we have seen, there appears to be little or no shock.

In the early period we shall have to arrive at a diagnosis from the nature and violence of the injury, and the general condition of the patient. When peritonitis is declared, an immediate operation is urgently indicated, as collapse comes on very quickly, sometimes very suddenly, and a few hours' delay may negative all prospect of recovery.

Treatment.—Chavasse, from a collection of 150 cases, estimates the mortality of rupture of the intestine without external wound at 96 per cent., a fatality probably below the mark, but one justifying at all events any operative proceeding affording even a moderate prospect of success. Chiefly, no doubt, on account of the obscurity and difficulty attending these cases, abdominal section has been very rarely performed. Absolute rest has hitherto been the chief indication for treatment. But cases do arise in which abdominal section should be practised, and an attempt made to discover and deal with the visceral wound, arrest the bleeding, and clear away the clots and extravasated blood.

We should interfere when we possess a reasonable belief that the intestine is ruptured. We may in some cases properly propose laparotomy as a means of diagnosis, and indeed, when intestinal rupture is suspected the operation should be performed at once, to afford a good prospect of success. Exploratory laparotomy has no very serious inconvenience, and should be adopted in those cases where there are sufficient grounds for believing the intestine has been damaged, as in no other way can effective assistance be rendered to the patient. At a later period we have not only the ruptured intestine to deal with, but a septic peri-

tonitis, which produces the most profound depression, and often necessitates an undue curtailment of some essential step in the operation, or occasions the death of the patient before its completion. Extreme collapse, a long interval from the time of the injury, or severe co-existing damage to the spleen, liver, or pancreas, of course contra-indicate operation.

The incision should be made in the middle line in all cases, and at the level which will afford readiest access to the seat of the injury. It is desirable to make it long enough to permit the surgeon to reach without difficulty every part of the interior. According to circumstances he may then decide to suture the intestinal wound, resect the injured portion of the bowel, or make an artificial anus. The same objections, I submit, hold in regard to the latter proceeding that obtain in respect of artificial anus after gunshot injury. Where it is at all practicable, I believe it best to finally close the opening in the intestine and also the external wound.

CONCLUSION.

For the purposes of this address, I have had to borrow many things from the records of military surgery, and I may therefore allude to the fact that in this branch of our profession the forward movement has been very decided. In this relation we should remember that our military brethren exercise no special vocation, but are an integral part of ourselves. Their surgery is but the application of general surgery under special and oftentimes most unfavourable conditions.

It is terrible to think of the sufferings formerly endured by an army in the field. The French troops in the Crimea lost one man in every three. Of 95,615 Frenchmen who

lost their lives there, only 10,240 perished at the hands of the enemy, as many more died in hospital from the effects of their wounds ; so that the remainder, amounting to 75,000 men or more, were sacrificed to diseases for the most part avoidable.

During the American war 97,000 men died from wounds, while just double the number—184,000—perished from diseases which modern knowledge declares to be mainly preventable. What a sea of blood and tears, what want of prevision and due care for the health of such great numbers of men massed together, do these figures suggest!

During the Franco-German war the losses on the German side in killed and wounded exceeded, for the first time in military history, those sacrificed by disease ; it was, in fact, more than double in amount, for while 17,572 received death at the hands of the enemy, and 10,710 succumbed to the effects of their injuries, the number of those who died from disease was only 12,253.

In all the older campaigns, blood-poisoning caused the most fatal consequences to the wounded. In the American war the number who died from this cause was enormous ; 2,818 cases of pyæmia following gunshot-wound are recorded in the Surgeon-General's report ; 2,747 of these died, 70 recovered, and this is probably a low estimate of the number, as the nature of septic poisoning was not so clearly recognised then as it is now.

At Sedan, among the French troops pyæmia was the uniform cause of death after operation, in gunshot fractures, and in many cases of simple flesh wound. Irrespective of the severity of the injury, the part of the body concerned, or the manner of treatment, the disease, once fairly developed, proved equally fatal.

We now possess means of checking this horrible malady, and in the campaign in Egypt in 1882 our surgeons were

furnished with the best antiseptic appliances, and the material in their hands was turned to such excellent account that not a single man died from pyæmia, septicæmia, erysipelas, or hospital gangrene—a result altogether unparalleled in the annals of war. The possibility of excluding infective diseases has been thus demonstrated for the first time, and in the next great European campaign, I believe results will be accomplished which may well surpass anything hitherto considered practicable. The military surgeon must principally strive to prevent disease by the establishment of sound hygienic conditions, and from year to year and from campaign to campaign this is more and more perfectly realised. Thus only can he in the fullest possible measure save life and hinder suffering, and give that aid to the wounded which it is his paramount duty to afford. Then, in the widest acceptation of the words, we may recall an old description:

> "Patent certantibus campi;
> Jam corpora procumbunt humi truncata,
> Membra late dispersa sternuntur; manat undique cruor;
> Salus una restat moribundis; vocant hominis amicum;
> Ecce chirurgus."

The science and art of surgery has been almost wholly reconstructed, and the wisdom of the great authorities even at the beginning of the present century possesses for us in some respects mainly an historic interest; but they were masters in their time, and in many ways their teaching is as fresh, as good, and as true at the present moment as it ever was.

Yet the last fifteen years have witnessed a complete revolution in the science and practice of surgery. The difference between the old surgery and the new is not more complete than the practice ridiculed by Le Sage differs from that of our modern physicians. Dr. Sangrado, we know, used to bleed freely, for he ordered the surgeon "to take six good porringers of blood, good master ones, and as

many more three hours hence; and to-morrow you will repeat the operation." "It is mere vulgar error," he says, "that the blood is of any use in the system; the faster you drain it off the better; and then, your Reverence, I do not despair of putting you on your legs again."

Baron Boyer, one of the most distinguished of French surgeons, said about seventy years ago that surgery had already completely, or almost completely, attained perfection. No statement could be more thoroughly falsified than this one has been by the subsequent progress of scientific surgery. Doubtless we incline to believe our own ways to be best, and that we have as nearly attained perfection as can well be; but there is surely no finality in surgery. It is very true that we have made great advances beyond the knowledge of our predecessors; but our successors, we may feel quite sure, will in their turn surpass us. Decennium follows decennium, and the sum of knowledge constantly increases; new schools arise, each one possessing better methods and more effective appliances for investigation that its predecessors; the number of things possible increases; our diagnosis and treatment rest their foundation on sound pathological knowledge; our prognosis is fortified by trustworthy statistics. But, after all, if we would obtain the real measure of our progress, we must rather weigh our results than merely count them.

APPENDIX.

TABLES OF CASES

IN WHICH LAPAROTOMY HAS BEEN PERFORMED FOR THE RELIEF OF INTRA-PERITONEAL ABDOMINAL INJURY.

For many of the following cases I am indebted to the courtesy of Dr. THOMAS K. MORTON of Philadelphia, and in my search for others have been much aided by Mr. LANGLEY and Mr. MIDDLETON. The record is, I believe, very complete.

TABLE I.--CASES OF ABDOMINAL SECTION FOR STAB WOUNDS: IN SOME INSTANCES THE ABDOMEN WAS EXPLORED AFTER ENLARGEMENT OF THE EXISTING WOUND.

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Lesions found.	Treatment of Intra-peritoneal Wounds.	Result.	Remarks and Post-mortem.
1	J. AVERY. Med. Age, 1885, iii. 412.	Adult	7 hours.	Much shock.	2 wounds of small intestine, 1 of mesentery.	Laparotomy; edges resected, and Glover's suture introduced.	Recovered.	No visceral injury was found; no shock after operation; rapid recovery.
2	A. E. J. BARKER. Lancet, 1886, i. 347.	F. 14	1½ hour.	Wound by carving-knife one inch long close to margin of left ribs; no shock.	Some clots; no visceral injury.	Abdominal wound enlarged to three inches; viscera drawn out; examination of stomach, colon, and omentum; abdomen carefully sponged.	Recovered.	
3	BAUDENS. Annals of Surg. May 1886, p. 392.	...	...	.....	2 perforations of intestine.	Opening much enlarged.	Died.	Peritonitis. Post-mortem: another perforation found in cæcum.
4	J. G. BROOKS. Med. Herald, 1886, viii. 134.	11	A few hours.	Great shock; abdomen tense and dull.	Great quantity of blood; cut and bleeding mesentery.	Laparotomy; vessels ligated.	Recovered.	
5	J. B. DEAVER. (Unpublished.)	Adult	...	Much blood in peritoneal cavity; great shock.	Wound of spleen.	Excision of spleen.	Died.	Post-mortem: wound of kidney, &c.
6	F. S. DENNIS. Med. News, 1886, xlviii. 225-253.	22	...	Stabbed with a knife; intestines protruded.	2 incised wounds of small intestine—one divided the whole thickness, the other only the serous and muscular coats of the intestine.	Abdominal wound enlarged; intestine drawn out and examined for further injury; cavity irrigated with bichloride solution; Czerny-Lembert suture.	Recovered.	

TABLE I.—*Continued.*

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Lesions found.	Treatment of Intra-peritoneal Wounds.	Result.	Remarks and Post-mortem.
7	F. S. DENNIS. Med. News, 1886, xlviii. 225–253.	57	3 hours.	Shock moderate; stab wound four inches above and three inches to the left of umbilicus; omentum protruded.	No wound of any viscus found.	Laparotomy; abdominal contents examined. The whole length of the small intestine, also the stomach and colon, were carefully examined. The incision was extensive. The viscera which protruded were constantly irrigated with bichloride solution.	Recovered.	In this case there was a very rapid recovery.
8	F. S. DENNIS. Med. News, 1886, xlviii. 225-253.	25	Next day.	Had been stabbed in a hernia; hernia reduced; peritonitic symptoms next day.	2 large wounds of small intestine.	Wound enlarged so as to give easy access to cavity of abdomen; resection of gut, including the two wounds; continued suture of divided ends; fæcal extravasation very large; cavity washed with bichloride solution.	Died in a few hours.	Post-mortem: no leakage at resected portion; no other wounds.
	F. S. DENNIS. Med. News, 1886, xlviii. 225–253.	22	Immediately.	Considerable hæmorrhage from external wound just above crest of ilium.	5 wounds of small intestine; much fæcal extravasation.	Laparotomy; Czerny-Lembert suture: cavity sponged.	Died in 40 hrs.	Post-mortem: wounds in good condition; no other wounds; bloody serum in cavity.
10	JOBERT. Günther, Operationslehre.	23	...	Protrusion of intestine.	2 wounds of intestine.	Abdominal wound considerably enlarged; wounds sutured.	Died in 38 hours.	Post-mortem: another perforation found.
11	KWIECINSKI. Pregl. lik. Krakow, 1885, xxiv. 71.	20	At once.	Great pain; vomiting.	3 wounds of small intestine.	Laparotomy; suture.	Recovered.	
12	T. G. MORTON. (Unpublished.)	30	9 hours.	Increasing pain about wound; also emphysema; no shock.	Wound of omentum, 1½ inch.	Laparotomy; suture of omentum; ligature of bleeding omental artery.	Recovered.	
13	J. B. ROBERTS, Philadelphia. Polyclinic, 1886, iii. 93.	19	2 hours.	Great shock; vomiting; violent pain.	2 wounds of small intestine.	Laparotomy; Lembert's suture.	Died in 2 days.	Post-mortem: purulent peritonitis; one wound overlooked.
14	J. B. ROBERTS, Philadelphia. (Unpublished)	40	¾ hour.	Violent abdominal pain; prolapse small knuckle intestine; free hæmorrhage.	4 wounds of small intestine; 1 of colon; mesentery transfixed.	Laparotomy; wounds all closed with Lembert's suture.	Recovered.	

15	W. O. Roberts, Kentucky. Am. Pract. 1884, xxix. 13.	54	A few hours.	Considerable hæmorrhage from wound.	2 wounds of small intestine; 2 of mesentery.	Abdominal wound extensively enlarged; viscera examined; wounds sutured in intestine and mesentery.	Recovered.	
16	G. Tiling. St. Petersburger Med. Woch. 1848, No. 24.	19	Soon.	Vomited much blood.	Much blood; 1½ in. wound of gut, and also in curvature of stomach; wound of omentum.	Laparotomy; Lembert's suture.	Recovered.	
17	W. S. Trkmaine. Med. News, 1886, xlix. 601.	18	10 hours.	Free bleeding from wound; opium poisoning also.	Incised wound 3⅓ inches long of abdominal wall below umbilicus, dividing the rectus and cutting the deep epigastric artery. Intestines protruding into the wound. No visceral wound. The medical man who first saw the patient introduced a few points of suture in the skin only.	Laparotomy; 1½ pint of clotted blood removed; peritoneum stitched, then the abdominal wound sewn up and a drainage-tube placed in the wound.	Died.	Had been given 8 grains of opium before admission, and was deeply under its influence till death.
18	Wunderlich. N. Y. Med. Journ. 1887, i. 68. (Reported by A. H. Buckmaster.)	19	4½ hours.	Shoemaker's knife entered eighth intercostal space two inches to left of mamma, wounding diaphragm and stomach; great thirst; milk passed through the wound.	¾ in. wound of great curvature of stomach near the pyloric end. The mucous membrane protruded; abdomen full of intensely acid and dark-coloured fluid; and wound of diaphragm.	Laparotomy; Lembert's suture; abdominal cavity washed out; patient became much collapsed, and the wound in the diaphragm was left unclosed.	Died in 1 hour.	Post-mortem: wound in stomach securely closed; some dark coloured fluid found in peritoneal and pleural cavities; a coil of intestine had passed through the diaphragmatic wound.

TWO CASES IN WHICH THE ABDOMEN WAS TORN OPEN BY GORING.

1	Davids. Günther's Operationslehre, Abtheilung iv. 163.	...	...	Gored by an ox.	Protrusion of intestine, with two wounds of bowel.	Abdominal wound extensively enlarged; gut sutured.	Recovered.	A hernia subsequently formed in the scar.
2	Gal. Centralblatt f. Chirurgie, 1886, p. 686.	45	9 hours.	Gored by a cow.	Protrusion of intestine.	Opening considerably enlarged; abdominal contents carefully examined, cleansed, and returned.	Recovered.	No rupture of intestine found.

TABLE II.—CASES OF ABDOMINAL SECTION PERFORMED ON ACCOUNT OF GUNSHOT WOUND.

No.	Operator and Reference.	Age.	Time after Injury	Special Symptoms.	Intra-peritoneal Injuries, &c., found.	Treatment of Intra-peritoneal Injuries.	Result.	Remarks and Post-mortem.
1	ABBE. Med.News, 1886, xlix. 554.	53	5½ hours.	Slight shock; vomiting; rapid and increasing abdominal pain; tympany.	4 wounds of small intestine; 3 of mesentery; wound between bladder and rectum, perforating bladder; much sub-peritoneal extravasation.	Laparotomy; a pint of greenish serum containing extravasated fæces; wounds in small intestine sutured by Lembert's method and also the wound in the bladder; abdomen drained.	Died in 9 hrs.	Walked two squares after injury. Post-mortem purulent peritonitis ball found in bladder.
2	W. E. ANDREWS. Journ. Am. Med. As. 1885, p. 177.	Adult.	16 hours.	Vomited much blood; moderate shock; diffused tenderness of abdomen.	1 quart of bloody serum.	Laparotomy; bloody serum sponged out; organs examined and wound closed.	Recovered.	Operation asted 2 hours.
3	T. ANNANDALE. Lancet, 1885, i. 740.	15	1 hour.	General shock; slight pain in abdomen and pelvis.	Considerable hæmorrhage; 5 wounds of small intestine, 2 in colon, 2 in rectum; wound of mesentery.	Laparotomy; all closed with Lembert sutures.	Died in 24 hrs.	Walked 100 yards after injury. Post-mortem: all sutured portions were water-tight except the uppermost wound of the small intestine, where 3 openings were situated close together; wounds firm; no others found.
4	BAUDENS. Plaies d'Armes à Feu, 1836.	...	...	Wound of entrance at umbilicus; exit through quadratus lumborum.	2 wounds of intestine, 1 completely destroying portion of intestine.	Abdominal wound considerably enlarged; 8 in. of bowel resected; Lembert's suture.	Died 3rd day.	Post-mortem: wound of cæcum found with fæcal extravasation.
5	BAUDENS. Günther, Operationslehre, Abtheilung iv.	...	...	.....	Fæcal extravasation; wound of transverse colon.	Abdominal wound enlarged; intestine sutured.	Recovered.	
6	BRIDDON. N. Y. Med. Journ. 1887, xlv. 75.	...	12 hours	Vomited large quantity of blood; no urgent symptoms.	2 slits in great curvature of stomach.	Laparotomy; Lembert's suture.	Died.	Post-mortem: 4 other wounds, all within 3 in., previously escaped notice.

7	T. Billroth. Prof. Billroth's Klinik, 1886. (R. von Hacker reporter.)	F. 63	32 hours.	Collapse; great pallor; small pulse; vomited blood; belly swollen and tender.	Bullet entered beneath left nipple through seventh intercostal space; traversed the stomach near greater curvature.	Laparotomy; transverse wound 6 in. long from linea alba to sixth rib; ends of seventh and eighth ribs resected; contused margin of stomach wound excised. 29 Lembert's sutures used to close exit wound. 3 sutures sufficed to close entrance wound. Bullet not discovered. Abdomen cleared of coagula, and drained.	Death following evening.	Peritonitis and pleuritis; bullet had wounded liver and aorta, and lodged in the right kidney. Vomiting was continuous; gradual loss of strength.
8	Wm. T. Bull. Med. News, 1885, i. 171.	22	17 hours.	Vomiting; pain; rectal tenesmus; involuntary micturition.	Abdomen full of bloody serum, but no fæces; 6 perforating wounds of small intestine; 1 wound of sigmoid flexure.	Laparotomy; bullet wound enlarged afterwards; 27 Lembert's sutures to small intestine, 3 to sigmoid flexure. The larger wounds close together had their edges resected, and all wounds were dusted with iodoform; laparotomy wound was closed entirely, but drainage-tube was placed in the bullet wound.	Recovered.	The ball was found lodged in the peritoneum at the edge of sigmoid flexure and protruding into its lumen.
9	Wm. T. Bull. Med. News, 1886, xlix. 601.	24	6 hours.	Severe abdominal pain; shock; vomiting; diminished liver dulness; fluid in abdominal cavity.	Bullet entered behind, and lodged in abdominal wall near umbilicus; 2 wounds of small intestine, and 2 of transverse colon; extravasation into mesocolon.	Laparotomy; incision in abdominal wall and bullet removed; escape of bloody serum and gas. Abdominal section in central line, incision 11 inches; 2 pints of bloody serum removed; 2 wounds of jejunum and 2 of transverse colon sutured by Lembert's method; abdomen washed out.	Died in 8 hrs.	Post-mortem: wounds firmly closed, no other injury found.

TABLE II.—*Continued.*

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Injuries, &c., found.	Treatment of Intra-peritoneal Injuries.	Result.	Remarks and Post-mortem.
10	WM. T. BULL. Med. News, 1886, xlix. 524.	57	12½ hours.	Shock; vomiting; scarcely any pain.	Large amount of blood; left lobe of liver almost divided.	Laparotomy: incision from 1 in. below ensiform cartilage to 3 in. above the pubes; abdomen sponged out. Patient died before the operation could be completed.	Died on table.	Post-mortem: no other wounds found.
11	WM. T. BULL. Med. News, 1886, xlix. 524.	25	2½ hours.	Nausea; abdomen appeared normal; only vicinity of wound tender.	2 wounds of small intestine; 3 tears of peritoneum; omentum torn.	Wound explored by incision 3 inches long. Laparotomy; incision from umbilicus to pubes; abdomen full of bloody serum, which was sponged out; 2 wounds of small intestine were sutured by 9 Lembert's sutures. Iodoform dusted on them. Wound of serous coat of sigmoid flexure was sutured with 4 Lembert's sutures; vessel bleeding in meso-colon was tied; portion of great omentum ligatured and cut off; laparotomy wound sewn up; bullet wound stuffed with iodoform gauze.	Recovered.	
12	F. S. DENNIS. Med. News, 1886, xlviii. 225–253.	23	...	Shock.	Much blood; wound of liver and its great vessels.	Laparotomy; contents of abdomen completely examined; clots of blood carefully removed; abdomen rapidly closed, and pressure applied.	Died in 48 hrs.	Post-mortem: bullet passed through left lobe of liver, injured portal vein, and lodged in right lobe.
13	F. S. DENNIS. Med. News, 1886, xlviii. 225–253.	F. 26	...	Slight shock and pain; pain increased during respiration.	Abdomen full of venous blood; 7 wounds of intestine and 1 of mesentery; uncontrollable hæmorrhage from iliac vein; fæcal extravasation.	Laparotomy; wounds in intestine sutured; abdomen cleared of blood.	Died in 48 hrs.	Post-mortem: abdominal cavity filled with blood; wounds in intestines all water-tight; iliac vein wounded.

14	J. McF. Gaston, M.D. Med. & Surg. Rep. June 12, 1886, p. 739.	M. 30	4 days.	Very prostrate, almost pulseless; extreme shock, which continued for 3 days, treatment being employed to overcome it.	No peritoneal wound found beyond the one made by bullet in anterior abdominal wall; considerable serosanguinary effusion undergoing decomposition.	Laparotomy in median line; colon punctured with trocar and cannula to allow of escape of gas; small intestine also punctured 6 times; each puncture sewn up by crucial stitch. Abdomen cleansed by sponging. Wound closed; drainage-tube introduced.	Death.	Post-mortem; no wound of intestines found, nor could the bullet be discovered. Operation performed too late.
15	J. B. Hamilton. Journ. Am. Med. As. 1885, ii. 202.	19	2½ hours.	Considerable shock.	11 wounds of small intestine, 2 of colon; omentum and mesentery wounded; abdomen full of blood.	Arteries tied; blood removed; Lembert's suture to intestine; wounds of the omentum ligatured, and the injured portion removed.	Recovered.	Pelvic suppuration; hæmatocele evacuated through rectum on twelfth day.
16	C. A. Jersey. Med. Record, Oct. 16, 1886.	44	20 hours.	Much shock; pain and tenderness of abdomen.	4 wounds of small intestine; 2 perforations of mesentery; abrasion of mesentery.	All wounds, except the abrasion, stitched with Lembert sutures.	Died in 19 hrs.	Post-mortem: mesenteric wounds sloughing, and bathed with pus.
17	W. W. Keen, Med. News, May 14, 1887.	18	8½ hours.	Shot by pistol-bullet in right hypochondrium, fracturing ninth rib. Pale and weak; tenderness of abdomen; had vomited some clear blood.	No extravasated blood or fæces. Bullet wound of pylorus; 2nd wound posteriorly. Wound of the superior mesenteric vein; considerable extravasation in mesentery. Anterior part of the liver was "scalloped" by the ball. Wound of the small intestine 1½ in. long in the long axis of the gut. Left kidney was considerably lacerated.	Laparotomy. Incision in median line above the umbilicus 8 in. long; anterior wound in the stomach closed by 4 Lembert's sutures and posterior by 3 Lembert's sutures. Superior mesenteric vein ligatured, as well as a small mesenteric artery. 10 Lembert's sutures were employed to close the wound in the small intestine. Left kidney was entirely removed, abdomen washed out, and wound carefully closed by 9 silver sutures and 8 silk ones. The wound of entrance was closed by 3 stitches, and that of exit by 2.	Died 14 days after operation.	Slight albuminuria after the operation. Vomiting and rigors. Abdomen partially re-opened 12 days after the operation. Post-mortem revealed general peritonitis, but no fluid pus. Wound in the liver was healed. Anterior wound in the stomach was healed. The wound in the small intestine was healed. Some gangrene of the small intestine opposite the wound; also gangrene of part of the mesentery. Slight suppuration of the mesentery and wounded intestine.

TABLE II.—*Continued.*

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Injuries, &c., found.	Treatment of Intra-peritoneal Injuries.	Result.	Remarks and Post-mortem.
18	R. A. KINLOCH.* North Car. Med. Journ. 1882, x. 1.	Adult.	11 hours.	Slight shock; general abdominal pain; pain in sacral region; hole in rectum.	Much blood and fæces; 5 perforations of intestine, 2 of mesentery.	Laparotomy; edges resected and sutured with Lembert's stitch; drainage.	Died in 16 hrs.	Post-mortem: another wound of the intestine was found.
19	R. A. KINLOCH, American Surgical Society's Proceedings, May 1887.	27	2 hours.	Ball entered 1½ inches to left of umbilicus; slight shock.	Jejunum wounded in 4 places; ileum in 2. Mesentery was perforated in 2 places, and also was torn. Mesenteric branch bleeding freely.	Laparotomy; all wounds closed by Lembert's sutures. The bleeding vessel tied and the abdomen cleaned out; abdominal wound closed by silver wire sutures, and a drainage tube introduced.	Died 15 hours.	Vomiting supervened; laparotomy wound of abdominal wall re-opened; knuckle of intestine protruded; all intestinal wounds were firm. No fæcal extravasation.
20	KOCHER. Correspond. für Schweitzer Aertze, 1883, No. 23.	14	3 hours.	Collapse; signs of peritonitis. Pistol bullet perforated near navel; severe abdominal pain; hiccough; vomiting; pallor; collapse; tympanites.	Much blood; circular wound 1½ centimètre, of large curvature and fundus of stomach on anterior surface; no exit wound; bullet not found.	2 interrupted sutures, then 3 Lembert's sutures of silk.	Recovered.	Abscess followed in track of wound, and somewhat delayed recovery.
21	JORDAN LLOYD. Brit. Med. Journ. 1883, i. 560.	F. 19	72 hours.	Little shock; no vomiting; later constant vomiting; pain and peritonitis.	Much stinking brown fluid; ragged wound of small intestine ¾ in. in diameter.	Laparotomy; intestine stitched to wound.	Died in 2 hrs.	Post-mortem: mesentery perforated; contusion of bladder not recognized during life.
22	F. J. LUTZ. Weekly Med. Rev. 1886, p. 514.	21	...	Right side of abdomen tympanitic; left side dull.	7 wounds of small intestine, 4 wounds of mesentery.	Laparotomy; Lembert's suture; ligature of a mesenteric artery.	Died in 3 days.	Post-mortem: purulent peritonitis; intestinal wounds in good condition.
23	A. O. MACKELLAR. Dec. 25, 1886. (Unpublished.) Noticed, Lancet, 1887, i. 37.	22	33 hours.	Collapse; vomiting; pain; no blood appeared in urine till 12 hours after injury.	Entrance wound to left, and a little below umbilicus; two perforations of sigmoid flexure; contused wound of small intestine.	Laparotomy; 2 perforations secured by ligatures.	Died in 12 hrs.	Never recovered from shock of operation. Post-mortem: bullet lodged in posterior wall of bladder; small wound of anterior part of rectum; some fæcal matter and blood clots in abdominal cavity.
24	T. G. MORTON, Philadelphia. (Unpublished.)	36	1½ hour.	Some pain; no shock; vomited blood copiously.	4 wounds of stomach, 1 of transverse colon; omentum much lacerated.	Laparotomy; Lembert's suture to all.	Died in 6 hrs.	Post-mortem: wounds and abdominal cavity all right; large hæmorrhage (1½ pint) into left pleura from cut intercostal artery.

* Kinloch, Amer. Jour. Med. Sci., July 1867, eight months after the injury, successfully resected and sutured the divided ends of the small intestine in a case of fæcal fistula following gunshot wound traversing the abdomen. Kinloch's case is of great interest by proving the possibility of recovery after gunshot wound of the intestine. It may be described as a case of secondary Laparotomy for gunshot injury.

25	C. B. Nancrede. Phila. Acad. of Surg. 1886.	...	...	At first little pain or shock, later copious bloody vomiting.	Perforation of anterior and posterior wall of stomach; 2 large perforations of duodenum.	Laparotomy; Lembert's suture; "cleansing."	Died in 3 days.	No post-mortem.
26	Newall, New Brunswick. Brit. Med. Journ. Feb. 25, 1882, p. 260.	Adult.	Next day.	Accidentally shot himself with shot-gun in the median line.	Perforation of intestine by shot; 29 shots passed per anum following day.	Laparotomy; gun-wad and pieces of clothing removed from the abdominal cavity.	Recovered.	3 shots made their exit 1½ in. above crest of ilium and 3½ in. from spine.
27	A. V. Parkes. Chicago Med. Journ. and Examiner, 1885, li. 412.	16	22 hours.	Abdomen tympanitic; no liver dulness.	Great quantity of blood: ½ in. perforation, also groove wound, in small intestine.	Laparotomy; Lembert's suture to groove and perforation.	Died in 15 hrs.	Post-mortem: few clots; peritonitis; contused wound of rectum and sigmoid flexure.
28	Pirogoff. Langenbeck's Archiv, xxvii. 278.	Adult.	...	Wound near umbilicus; protrusion of intestine.	4 perforations of small intestine.	4 in. resected, also piece of mesentery; 10 Lembert's sutures.	?	Progressed favourably for 4 days, patient was then lost sight of.
29	Pozzi. Revue de Chirurgie, 1887, i. 78.	13	8 hours.	Vomiting; bloody urine.	Infiltration of urine; 3 perforations and 3 contused wounds of intestine; wound of bladder.	Laparotomy; 29 sutures were employed; partial resection of gut; drainage.	Died in 52 hrs.	Post-mortem: sutures did not yield to injection of water. The symptoms due to the vesical injury were those which chiefly indicated the necessity for operation.
30	A. C. L. Ramsay. Northwestern Lancet, 1885, iv. 377.	7	6 hours.	Great pain; much vomiting.	Much blood; extensive wound of duodenum; contusion of colon.	Laparotomy; excision of gut including wound; Lembert's suture.	Died in 1 hour.	
31	T. G. Richardson. N. O. Med. and Surg. Journ. 1886, xiii. 867.	Adult	9 hours.	Great shock; vomiting; signs of incipient peritonitis.	3 lacerations of intestine, 1 of mesentery.	Laparotomy; all the wounds sutured.	Died in 14 hrs.	
32	W. Watkins Seymour. N. Y. Med. Journ. 1886, xliv. 209.	16	13 hours.	Collapse; vomited; some pain down left sciatic nerve.	Acute peritonitis; one quart of bloody fluid in abdomen; 2 wounds in transverse colon, a nick in the duodenum, and 2 wounds of meso-colon.	Laparotomy; incision 7 inches; abdomen washed out clean, 2½ inches of colon resected; the ends joined with Lembert's suture; nick in duodenum closed by 3 Lembert's sutures; glass drainage-tube.	Died in 18 hrs.	Post-mortem: no other wound found. No fluid in abdomen; wounds of intestine firmly closed; did not yield to injection of water. Seymour is of opinion that an earlier operation would have been successful.

TABLE III.—CASES OF ABDOMINAL SECTION FOR RUPTURE OF THE URINARY BLADDER.

No.	Operator and Reference.	Age.	Time oper. after Injury.	Special Symptoms.	Intra-peritoneal Lesions.	Treatment of Intra-peritoneal Lesions.	Result.	Remarks and Post-mortem.
1	WILLIAM T. BULL. Ann. of Surgery, 1885, i. 67.	46	13 hours.	Great shock; bloody urine; dulness half way to umbilicus; catheter went beyond bladder.	3¾ in. rent of posterior wall of bladder.	Laparotomy; 7 Lembert sutures.	Died in 7 hrs.	Also had fractured pelvis; catheter tied in.
2	J. DUNCAN. Lancet, 1886, ii. 399.	38	22 hours.	Shock; desire to urinate, but no power; bloody urine; peritonitis; vomiting.	Blood and urine; 2½ in. rupture of posterior vesical wall.	Perineal cystotomy failed to discover the rent; subsequently abdominal section was performed; the bladder wound was not sutured; glass drain introduced into bladder.	Died in 55 hrs.	Suppression of urine.
3	Jos. M. FOX. (Unpublished.)	38	19 hours.	Great pain about bladder, and desire to micturate; bloody urine; great shock.	Much blood and urine; 2½ in. triangular rent in anterior wall of bladder.	Laparotomy; 15 Lembert sutures.	Died in 42 hrs.	No abdominal drain; soft catheter in urethra. Post-mortem: bladder wound firm.
4	C. HEATH. Med. Chir. Trans. vol. lxii.	Adult.	40 hours.	Tense belly; bloody urine by catheter; water injected felt through abdomen by patient.	Extensive rent of bladder.	Laparotomy; continuous suture.	Died in 6 dys.	Post-mortem: suture had given way.
5	HOFMOKL. Wiener Med. Presse, 1886.	Adult.	...	Principally those of extra-peritoneal rupture.	Intra- and extra-peritoneal rupture of bladder; great infiltration of tissues with blood.	Laparotomy; partial suture of the bladder; upper portion left open, and drained.	Recovered.	It is not clear from the report that the injury was primarily an int. a-peritoneal one.
6	WILLIAM MAC CORMAC. Lancet, 1886, ii. 1118.	33	19 hours.	No shock; 95 oz. of blood-tinged urine withdrawn by catheter. Had walked one mile to the hospital day after injury. Great pain; vesical tenesmus.	Median vertical rent of posterior wall of the bladder, 4 inches long.	Laparotomy; 16 Lembert sutures; peritoneum divided at sides to relax bladder walls.	Rapid recovery.	Catheter passed at intervals of 4 hours; abdominal drainage-tube.
7	WILLIAM MAC CORMAC. Lancet, 1886, ii. 1118.	37	27 hours.	No shock or symptoms of intra-peritoneal injury; patient directed to attend as out-patient; returned following day. Fluid present in abdomen; vesical tenesmus; signs of incipient peritonitis; nausea.	Large amount of bloody fluid in abdomen; 3 in. rent upper portion of posterior bladder wall.	Laparotomy; 12 Lembert sutures inserted in the bladder.	Rapid recovery.	Urine passed voluntarily from first; no catheterism; no abdominal drainage.
8	A. F. MCGILL. Lancet, 1886, xxi. 972.	54	68 hours.	Insensible for time; pain; bloody urine; could not urinate, though had desire; incipient peritonitis.	Pint of urine; 4 in. rent of apex and fundus of bladder.	9 chromic gut sutures.	Died in 17 hrs.	Post-mortem: bladder wound firm; no fluid in peritoneum.

9	A. W. Mayo Robson. (Unpublished.)	68	3 hours.	Frequent desire to micturate with inability to pass water; on passing catheter, 3 ozs. of bloody urine (chiefly blood) drawn off. Fracture of right side of pelvis diagnosed; patient conscious, but pulse feeble.	None were found.	Membranous urethra opened and tube introduced into the bladder. Laparotomy in median line, but as no urine or rupture into peritoneal cavity was found, the external wound was closed.	Died from shock a few hours after wounds.	Fracture of the pelvis was diagnosed by finger passed along the incision in membranous urethra; the muscles and fascia were found infiltrated with urine above the pubes, which had sustained a comminuted fracture; and one of the fragments had penetrated the anterior wall of the bladder.
10	Socin and Keser. Annals of Surgery, Feb. 1887.	20	...	Retention of urine; bloody fluid drawn off; hiccough; pain above pubes.	Rent in front of bladder, admitted tip of index-finger (extra-peritoneal).	Laparotomy; wound stitched to abdominal wall; drainage-tube 9 days.	Recovered.	It is doubtful from the report of this case whether the peritoneal cavity was opened or not.
11	Sonnenburg. Centralblatt für Chirurgie, 1885, p. 838.	...	2 days.	Peritonitis did not appear for 24 hours; 1000 gr. clear urine drawn off.	Rent from vertex to neck along posterior wall of bladder.	Laparotomy; no sutures; drainage-tube.	Died 4th day.	Infiltration of urine and intense peritonitis.
12	Charters J. Symonds. (As yet unpublished.)	F. 7	7 hours.	Partially insensible; very collapsed; pale; small pulse; great pain in epigastric region, no pain in hypogastric region; vomited blood-streaked contents of stomach; dulness on percussion up to umbilicus; seven hours after the injury complained of pain over bladder; had passed no urine; catheter passed and drew off nearly pure blood in considerable quantity.	Y-shaped rent in top of bladder, partly intra- and partly extra-peritoneal; pelvic cavity full of blood and urine.	Laparotomy; incision 3 inches long between umbilicus and pubes; about 2 pints of blood and urine sponged out; the rent was sewn up by 12 Lembert's sutures, and abdomen closed.	Died in 7 days.	Post-mortem: suppurative peritonitis; wound firmly united in all but one small spot, where there was a leakage of urine; no other visceral damage observed; one of the sacro-iliac synchondroses was separated. Two days subsequent to the operation, in consequence of symptoms of peritonitis, the abdominal wound was re-opened with a view of irrigating the abdomen; a considerable quantity of urine escaped, and continued to escape until death. The patient did not pass any urine for 12 hours after the first operation.

TABLE III.—*Continued.*

No.	Operator and Reference.	Age.	Time oper. after Injury.	Special Symptoms.	Intra-peritoneal Lesions.	Treatment of Intra-peritoneal Lesions.	Result.	Remarks and Post-mortem.
13	T. PRIDGIN TEALE, Leeds. (Unpublished.)	25	2 hours.	Had been kicked in the abdomen and perineum during a quarrel. Pain in hypogastrium; inability to pass urine; abdominal muscles tense; absence of shock; subsequently tympanites, and dulness on percussion in both flanks appeared.	Intestines found floating in a large quantity of pale straw-coloured fluid. Vertical rent of fundus of the bladder an inch in length.	Perineum opened in median line and drainage-tube inserted into the bladder. Laparotomy; abdomen cleared of urine, &c., and the slit in the bladder closed by fine catgut sutures, so inserted as to bring the peritoneal surfaces into contact without perforating the mucous surface; abdominal wound closed.	Died 19 hours after operation.	Considerable secondary hæmorrhage occurred from perineal wound in spite of careful plugging. Post-mortem showed the rent in the bladder to be water-tight, and no peritonitis existed.
14	W. J. WALSHAM. (Unpublished.)	21	13 hours.	Little or no shock.	Rent of bladder 1½ in.	Laparotomy; 9 Lembert sutures.	Recovered.	Urine passed voluntarily every four hours after first day; no abdominal drainage.
15	WALTERS, of Pittsburg.	22	10 hours.	Signs of active peritonitis.	Much blood and urine; extensive tear at base of bladder.	Laparotomy; removal of extravasated fluid; drainage-tube; no sutures introduced into bladder.	Recovered.	Catheter in bladder also.
16	A. WILLETT. St. Barth. Hosp. Rep. 1876, p. 209.	48	29 hours.	Shock and pain; bloody urine by catheter later, symptom of peritonitis.	3½ in. rent across fundus of bladder.	Laparotomy; interrupted sutures.	Died in 23 hrs.	Post-mortem: portion of bladder wound found open.

TABLE IV.—CASES OF ABDOMINAL SECTION PERFORMED FOR SUPPOSED TRAUMATIC RUPTURE OR CONTUSION OF THE INTESTINE AND OTHER ABDOMINAL VISCERA, WITHOUT ANY EXTERNAL WOUND.

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Lesions found.	Treatment of Intra-peritoneal Wounds.	Result.	Remarks and Post-mortem.
1	BOUILLY. Bull. et Mém. Soc. de Chir. 1883, p. 690.	29	23 hours.	Signs of incipient peritonitis; fæcal vomiting.	3-inch rupture of small intestine; also severe bruise of intestine above the rupture.	Laparotomy; resection of 5 inches of the small intestine.	Died in 10 dys.	Post-mortem: contused portion had given way after manipulation.
2	M. CHAUVEL. Le Progrès Médical. Mar. 7, 1885, p. 193.	...	3 days.	Had been kicked in abdomen by a horse; 3 days afterwards, signs of general peritonitis.	Transverse meso-colon and right half of pancreas contused; no wound of intestine.	Laparotomy.	Died 7 days after injury.	The case is very shortly noticed. The details of the laparotomy are not given. The injuries described were only found post-mortem.
3	CHAVASSE. Bull. et Mém. Soc. de Chir. 1885, p. 123.	23	...	Kicked by horse. Abdomen retracted. Shock from the first, then peritonitis, constipation, and vomiting.	Colon badly contused in two places; intestine and meso-colon infiltrated with blood.	Laparotomy; no suture required; peritoneal cavity cleansed and drained.	Died in 6 dys	Pancreas contused.
4	J. CROFT. St. Thomas's (unpublished).	34	24 hours.	Jumped upon by companions. Shock; peritonitis; no sign of external injury.	Extravasation of fæces; rupture of lower part of ileum extending through ¾ of circumference.	I. Laparotomy; wound of ileum sutured to abd. wound; cavity washed out. Operation 1½ hour.	...	Recovered from first operation.
						II. Second operation 4 weeks later; bowel detached from abd. wall; divided margins resected, and united by Lembert's suture. Operation 2¼ hours.	Died in 26 hrs.	Post-mortem: lungs collapsed; no peritonitis; no fluid in abdomen; sutured intestine firmly united; did not yield on injection of water.
5	J. CROFT. Mar. 4, 1887. (Unpublished.)	25	13 hours.	Run over by cab. Pain; shock; distension; evidence of loss of blood; pallor; fluid in flanks.	Ruptured spleen; fractured ribs (8th and 9th).	Laparotomy; 1½ to 2 pts. of blood in cavity; spleen excised.	Died same evening.	Never recovered from shock. Post-mortem: no blood in abdominal cavity; no sign of peritonitis; clots in renal vessels.
6	DEMONS. Cong. Fr. de Chirurg. 1885.	Male Adult.	...	Crushed between a cart wheel and the wall.	Circular rupture of intestine diagnosed previous to operation.	Laparotomy; Lembert's suture; cavity purified.	Died.	Post-mortem: another wound of intestine found.

TABLE IV.—*Continued.*

No.	Operator and Reference.	Age.	Time after Injury.	Special Symptoms.	Intra-peritoneal Lesions found.	Treatment of Intra-peritoneal Wounds.	Result.	Remarks and Post-mortem.
7	FITZGERALD. Australian Medical Journ. 1883, p. 264.	58	20 hours.	All the signs of strangulated hernia. (His truss had been pressed violently against a descended hernia.)	Ruptured small intestine.	Laparotomy; wound sutured.	Died in 8 hrs.	Author advises abdominal incision to be long enough to afford ready access to all parts of the cavity.
8	T. M. GIRDLESTONE. Australian Medical Journ. 1883.	22	4th day.	Shock, which was followed by development of peritonitis; vomiting.	Almost complete rupture of ileum; lacerations of omentum.	Laparotomy; excision and suture of wounded bowel.	Died in 1½ hr.	
9	Dr. GREGORY. St. Louis, 1876 (unpublished).	...	...	.....	Rupture of ileum.	Laparotomy; suture.	Died in 6 hrs.	Operation not undertaken till hope was almost gone.
10	A. O. MACKELLAR. Mar. 21, 1887. (Unpublished.)	57	29 hours.	Struck by shaft of cart. Collapse; pain; pallor; distension; dulness in both flanks.	Ruptured spleen; fractured rib.	Laparotomy performed after peritonitis had set in; dark blood in cavity; irrigation; glass drainage-tube.	Died 3rd day.	Post-mortem: ruptured spleen, extra-peritoneal rupture of kidney, not into hilus, with infiltration of blood around those organs.
11	EDMUND OWEN. Lancet, 1885, ii.	Adult.	41 hours.	Fell, while drunk, across a board placed edgeways. Shock; peritonitis; tympanites.	Rent 1 inch in ileum.	Laparotomy; Intestine clamped and left outside to form an artificial anus.	Died 6 hours after.	No post-mortem.
12	E. A. WAGGONER. St. Louis Cour. of Med. 1886, xvi. 204.	8	27 hours.	Walked 400 yards. Great shock; violent peritonitis soon followed.	Rupture of intestine 2½ feet above the ileo-cæcal valve; much fæces in abdominal cavity.	Laparotomy; wound sutured.	Died in 2 hrs.	
13	ALFRED WILLETT. (Unpublished.)	32	Soon.	While drunk he fell on his back from a van. Acute pain in the epigastrium immediately followed; much collapsed; bowels acted freely; vomiting constant; abdomen quickly became distended; emphysematous crackling around umbilicus.	Peritoneal cavity full of blood; several pints drawn away; rupture of right lobe of the liver extending from the hilus.	Laparotomy; abdomen cleared of blood, and wound in abdominal wall subsequently closed.	Died 4 days after the injury.	Post-mortem: a transverse rent of under-surface of right lobe of liver was found; one large branch of the portal vein was torn; peritonitis was found only around the neighbourhood of the rupture.

Table V.—EDLER'S TABLE OF CASES OF INJURY TO THE SOLID VISCERA OF THE ABDOMEN.

Langenbeck's "Archiv," vol. 34.

Injury to the Solid Viscera.	Liver and Gall Bladder.								Spleen.							
	Total Number of Cases.	Uncomplicated Cases.	Recoveries.		Deaths.		Mortality per cent.		Total Number of Cases.	Uncomplicated Cases.	Recoveries.		Deaths.		Mortality per cent.	
			Total.	Uncomplicated.	Total.	Uncomplicated.	Total.	Uncomplicated.			Total.	Uncomplicated.	Total.	Uncomplicated.	Total.	Uncomplicated.
Subcutaneous Ruptures . .	189	96	27	21	162	75	85.8	78.2	83	62	11	11	72	51	86.7	82.3
Gunshot Wounds . . .	289	110	130	67	159	43	55.0	39.1	42	20	7	7	35	13	83.3	65.0
Incised and Punctured Wounds .	65	32	23	20	42	12	64.6	37.5	35	9	29	6	6	3	17.1	33.3
Totals . . .	543	238	180	108	363	130	66.8	54.3	160	91	47	24	113	67	70.6	73.8

Injury to the Solid Viscera.	Pancreas.				Kidneys.								General Totals.			
	Total Number of Cases.	Recoveries.	Deaths.	Mortality per cent.	Total Number of Cases.	Uncomplicated Cases.	Recoveries.		Deaths.		Mortality per cent.		Total Number of Cases.	Recoveries.	Deaths.	Mortality per cent.
							Total.	Uncomplicated.	Total.	Uncomplicated.	Total.	Uncomplicated.				
Subcutaneous Ruptures . .	3	1	2	66.6	90	55	45	36	45	19	50.0	34.5	365	84	281	77.0
Gunshot Wounds . . .	6	1	5	83.3	50	20	28	15	22	5	44.0	25.0	387	166	221	57.0
Incised and Punctured Wounds .	4	4	...	...	12	7	7	6	5	1	41.6	14.2	116	63	53	45.6
Totals . . .	13	6	7	53.8	152	82	80	57	72	25	47.3	30.4	868	313	555	63.9

ANALYSIS OF CASES OF LAPAROTOMY AND ABDOMINAL EXPLORATION FOR:—

I. STAB WOUNDS PENETRATING THE ABDOMINAL CAVITY.

Successful	10
Fatal	8
	18

II. GUNSHOT WOUNDS PENETRATING THE ABDOMINAL CAVITY.

Successful	7
Fatal	24
Doubtful (Pirogoff) . .	1
	32

III. RUPTURE OF THE URINARY BLADDER.

Successful	6
Fatal	10
	16

IV. RUPTURE AND CONTUSION OF THE INTESTINE OR OTHER ABDOMINAL VISCUS WITHOUT EXTERNAL INJURY.

Successful	0
Fatal	13
	13

Cases where the small intestine was sutured for punctured or incised wounds, with or without enlargement of abdominal opening ("History of the War of the Rebellion," Günther, and other sources):—

Successful	42
Fatal	14
	56

Of 4 cases of stab wounds of large intestine recorded in "History of the War of the Rebellion" which were treated by suture, the wound having first been enlarged:—

Recovered	3
Fatal	1
	4

In "History of the War of the Rebellion," pp. 42, 43, 44, are recorded 11 cases where the stomach was sutured for punctured or incised wounds, with or without enlargement of abdominal opening; of these:—

Recovered	10
Fatal	1
	11

Günther, "Operationslehre," mentions 4 other cases where the coats of the stomach were stitched to the abdominal wall, and recovery obtained in each case.

Nussbaum states that in nineteen recoveries, which followed in seventy-nine cases of gunshot injury supposed to be of the stomach, only one of the nineteen can be regarded as having certainly involved the perforation of the stomach.

Kocher believes that recovery is only possible when laparotomy, followed by suture of the wound in the stomach, is immediately performed.

In the Surgeon-general's Report, nineteen cases of alleged gunshot wound of the stomach are stated to have been followed by recovery, but the reporter does not consider that any one of them was free from doubt as to the exact nature of the injury.

In 2 cases where the abdomen was torn open by goring:—

Recovered	2
Fatal	0
	2

Of 3 cases of gunshot wound of liver, where the abdominal wound was enlarged, 2 recovered.

Of 15 cases of partial or complete removal of spleen after injury, all recovered.—Otis—"Surgical History of the War of the Rebellion."

Of 8 cases of wound of intestine occurring during surgical operations, 7 were sutured, with 1 fatal result. The bowel was returned to the abdominal cavity; in 1 case where the bowel was returned without suturing an uninterrupted recovery followed.

A considerable number of cases have been recorded in which the bladder has been accidentally wounded or torn during ovariotomy and other abdominal operations, and in several of these the bladder has been successfully sutured.

ILLUSTRATIONS OF INJURY TO THE ABDOMINAL VISCERA, AND METHODS OF INTESTINAL SUTURE.*

FIG. 1.—Rupture of the spleen, occasioned by a blow of the fist. Next to the liver the spleen is most frequently ruptured. An extensive rent commonly gives rise to fatal hæmorrhage. Recovery does, however, occur. The patient from whom the preparation represented in the woodcut was taken, only survived the injury one quarter of an hour.

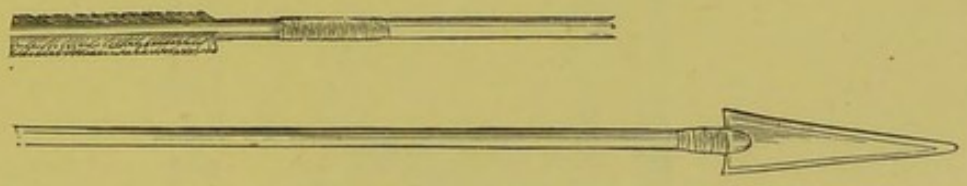

FIG. 2.—Kiowa arrow. The shaft has been divided in order to withdraw the barbed and feathered extremities from a man's body. The arrow, twenty-six inches in length, entered three inches to the right of the fifth lumbar vertebra and emerged two inches to the right of the ensiform cartilage. Circumscribed peritonitis ensued, but the patient recovered without other ill consequences. (One-fourth natural size.)

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* A considerable number of these woodcuts are derived from the "Surgical History of the War of the American Rebellion."

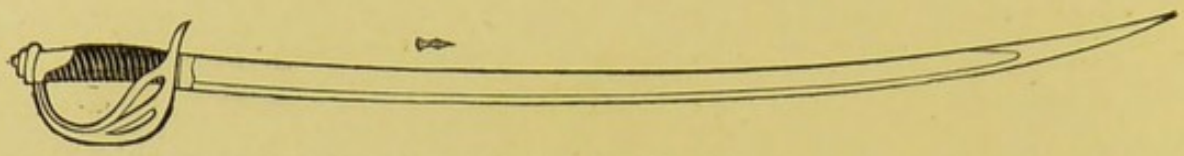


FIG. 3.—U.S. Cavalry sabre.

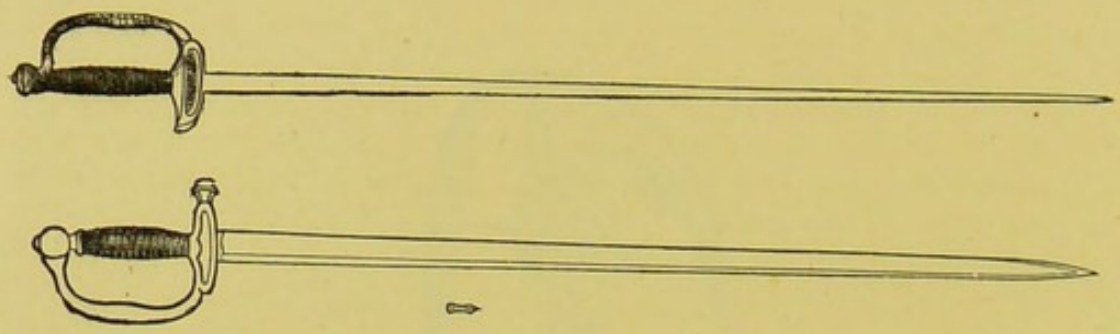


FIG. 4.—U.S. Officers' swords.

FIG. 5.—U.S. Springfield rifle bayonet.

FIG. 6.—U.S. Lance.

The steel offensive weapons used during the American War as represented in the above woodcuts (Figs. 3–6) are on a scale of one-tenth. The size of the wound they are calculated to inflict is represented in transverse section.

FIG. 7.—Conical musket-ball voided at stool. Private B. B. was wounded at Petersburg, March 25, 1865. The ball lodged over the transverse colon. He suffered from moderate traumatic peritonitis. There was no indication that the bowel was perforated until April 29. An attack of tenesmus then came on, and the bullet was passed during defecation. The patient completely recovered.

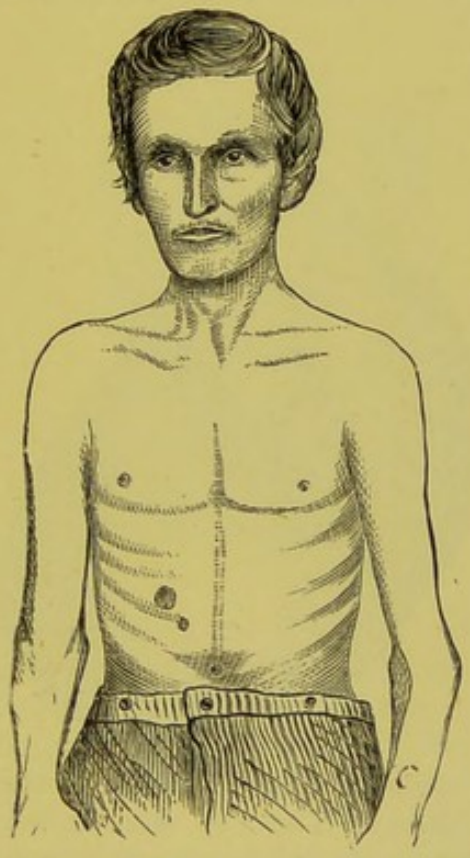


FIG. 8.—Cicatrix of a wound made by the ball Fig. 7. From a photograph taken seven years after the injury.

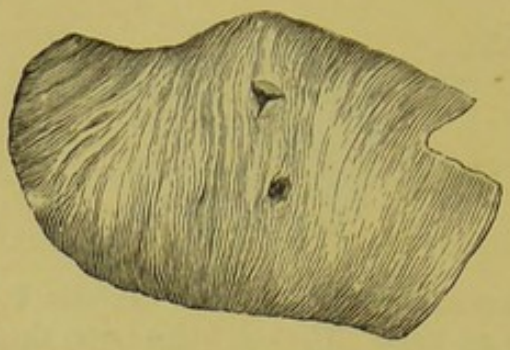


FIG. 9.—Portion of the stomach inverted to show a bayonet puncture near the cardiac extremity. The bayonet entered at a point corresponding to the extremity of the ninth rib on the left side. There was very little bleeding or vomiting. On the day following the man was fairly comfortable. On the next day, however, he suffered excruciating pain and vomiting. Tympanites and all the symptoms of acute peritonitis set in, and he soon died with bloody vomit and bloody stools. *P.M.*—The jejunum was also punctured, and blood, fæces, and an *ascaris lumbricoides* were found in the abdominal cavity.

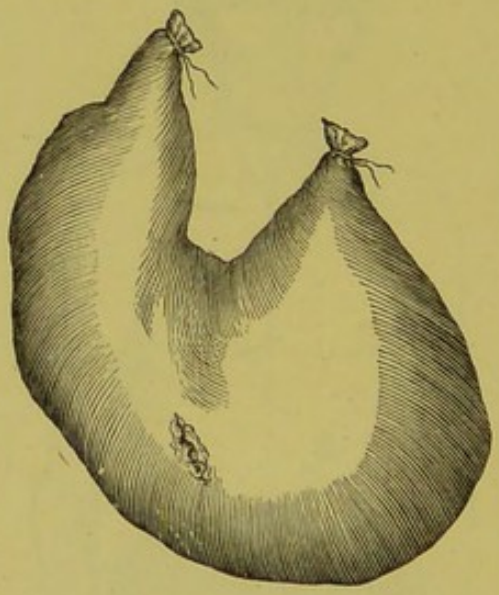


FIG. 10.—Stomach showing a bayonet perforation in the middle of its anterior wall (reduced one-fourth). The man survived the bayonet wound in his stomach thirty-six hours. It was drawn out through the abdominal wound, and the incision in its walls closed by interrupted suture; the viscera were then replaced, and the external wound united in the same manner. He complained of excruciating pain and excessive thirst. The stomach was full when the injury was inflicted.

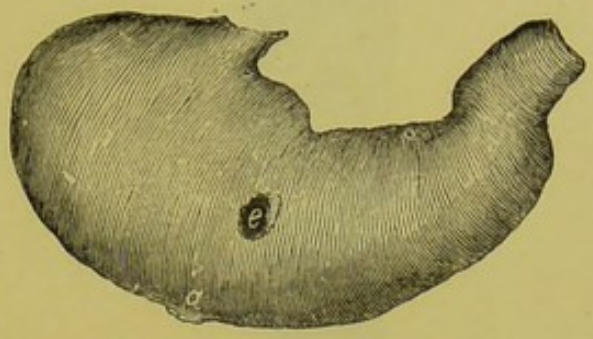


FIG. 11.—Posterior view of a stomach perforated by a musket ball. *a*. Entrance wound. *e*. Exit wound. (Reduction one-fourth.) J. B., æt. 28, was wounded in front of Nashville, 1864. A conoidal bullet entered the chest at the cartilaginous junctions of the eighth and ninth ribs. Great shock ; intense pain in chest and abdomen ; collapse quickly supervened ; death took place the day following. *P.M.*—The diaphragm and transverse colon were also perforated ; intense peritonitis ; a large quantity of blood and fæces was found in the abdominal cavity.

FIG. 12.—Inner surface of the cardiac extremity of the stomach perforated by a pistol bullet at short range (reduction one-fourth). J. D. was shot by a Colt's revolver from a distance of ten feet, the bullet entering four inches below, and a little to the right of the left nipple. Severe shock and prostration followed immediately. An hour later the patient began to vomit blood. The vomiting was spasmodic and painless. The thirst was intense. Perfectly conscious till the last moment, he died eight hours after the infliction of the wound. *P.M.*—The ball had entered between the seventh and eighth ribs, wounding the pleura and diaphragm, thence it passed through the greater curvature of the stomach and the body of the second lumbar vertebra.

FIG. 13.—Bayonet perforation of the jejunum. The patient was stabbed in a brawl; the stomach also was perforated; the incised form of the wound is to be clearly seen; fæcal extravasation was promptly followed by fatal peritonitis.

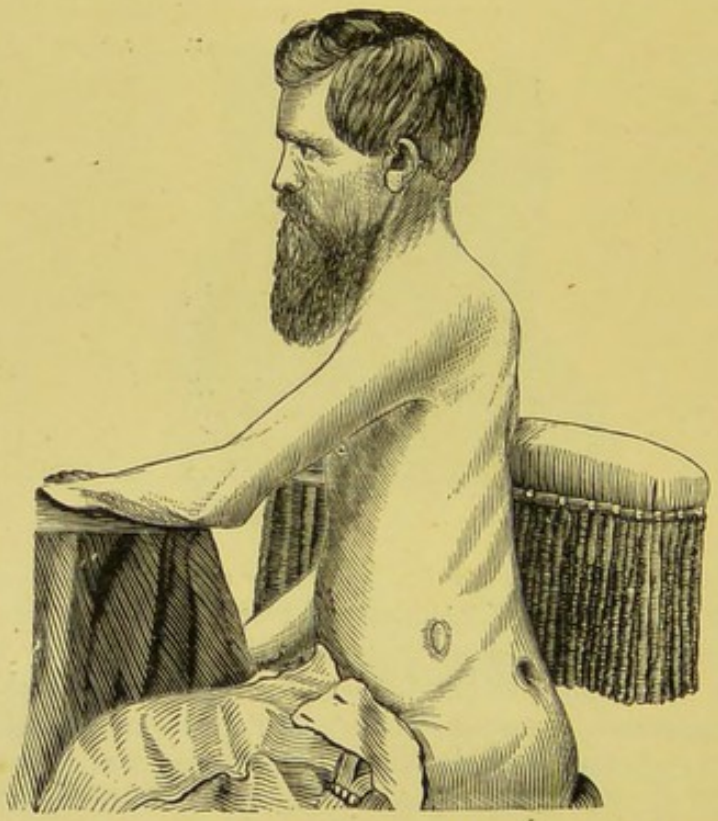


FIG. 14.—Cicatrices of a shot wound involving the intestine. J. B., æt. 40; bullet entered on the left side near tip of last rib, passed through the left ilium, and lodged in the gluteal muscles; thin fluid, like bile, escaped, and some round worms. The nature of the discharge suggested a wound of the small intestine, but the position of the wound is what one might expect were the descending colon the seat of injury.

FIG. 15.—Gunshot perforation of the duodenum. Death ensued in a few hours from hæmorrhage from the liver. The ball in this instance entered the right side of the epigastrium and emerged through the right buttock. Fæces escaped by both wounds. Wounds of this portion of the intestine are infrequent, and usually accompanied by mortal injury to adjacent parts. It is possible for the duodenum to be wounded without extravasation of its contents into the peritoneal cavity if the portion uncovered by peritoneum be injured. In one case of this kind the survival was six days, although the liver was also wounded. In another, death did not occur for twenty-four days.

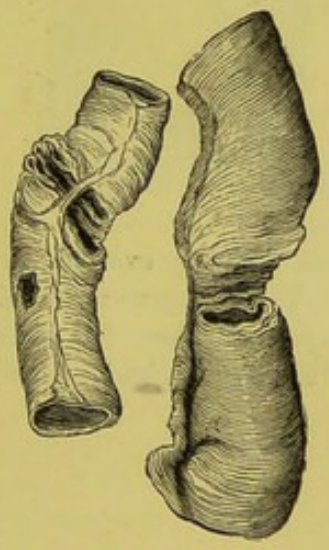


FIG. 16.—Two portions of ileum traversed and nearly divided by a conoidal carbine ball. The bullet entered just above the left iliac crest and emerged at the opposite side of the abdomen. The man immediately felt intense pain, and died after great agony in three days. *P.M.*—Intense peritonitis. The openings in the bowel were ragged, and a number of lumbricoid worms had crawled from them into the abdominal cavity, which also contained much fæcal matter. An empty condition of the intestines, although it may hinder extravasation, does not secure the patient from the intrusion of entozoa into the peritoneal cavity.

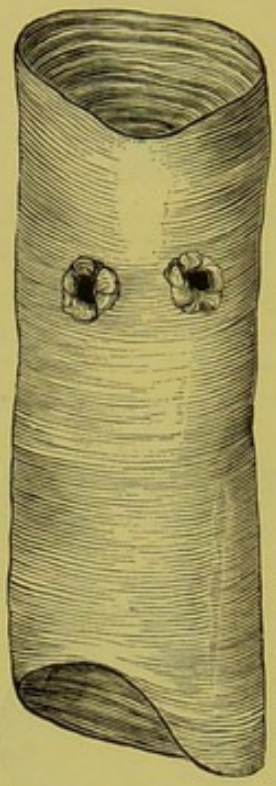


FIG. 17.—Section of the ileum, showing everted mucous membrane at the two orifices of a stab wound. The injury was caused by a stab in the groin with a butcher's knife. The patient lived for six days. The wound presents very similar appearances to those produced by a pistol bullet. *Vide* Fig. 18.

FIG. 18.—Portion of the jejunum perforated at one point by a round pistol ball. The mucous membrane is much everted at the orifice. There was fæcal extravasation, immediate peritonitis, great depression, and shock, and death took place on the following day. It is difficult to suppose, Assistant-Surgeon Woodhall remarks, that closing of the opening by interrupted suture could have accelerated the fatal issue. Musket balls usually divide a large portion of the intestinal tube; pistol balls traverse it, making two perforations, and occasionally, as in the present instance, lodge within the gut, making one opening only. It will be seen that the mucous coat is everted in precisely the same manner as in Fig. 17, where the openings were of a punctured or incised character.

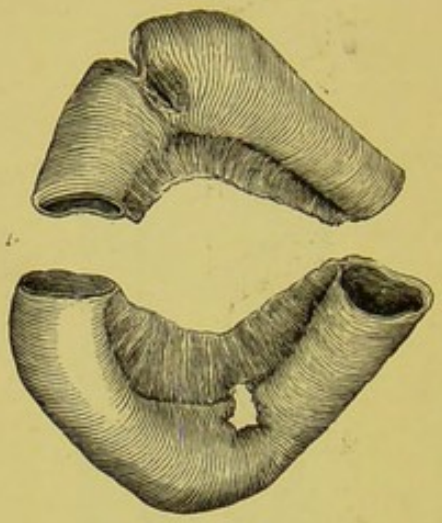


FIG. 19.—Two loops of the ileum, with gunshot perforation (reduced one-half). C. B., æt. 23, was shot in the abdomen with the carbine bullet (Fig. 20), which entered in the median line, five inches above the pubes. He died the following day. *P.M.*—The intestines were greatly distended; a large clot and an *ascaris* were found in the peritoneal cavity. The small intestine was wounded in two places. The bullet was found free in the peritoneal cavity, lying near the bladder on the right side.

FIG. 20.—Carbine ball (natural size) removed in the preceding case from the abdominal cavity after death.

FIG. 21.—Section of the ileum slit open to show the appearance of the suture from the interior, as employed to close a gunshot wound. (Reduced one-fourth.)

FIG. 22.—Another portion of the same ileum, with the gunshot perforation closed by suture. (Reduced one-fourth.)

W. W. was shot in the abdomen, May 23, 1865. The bullet entered just below the crest of the right ilium, about five inches behind the anterior spine, and emerged near the umbilicus. On admission to l'Ouverture Hospital three feet of bowel protruded, in which two small wounds and one large one were discovered. Surgeon Bentley closed them by means of a Glover's suture. The patient survived twenty-four hours. *P.M.*—Serum, coagula, and fluid blood were found in the abdominal cavity. In the ascending colon there was a large rent, a perforating wound with everted edges half an inch in diameter in the ileum, and another eighteen inches from this, almost severing the tube, which had been sewn up, and also two smaller ones. There had been no plastic exudation, and the continued sutures had not satisfactorily approximated nor inverted the serous membrane, and a space near the middle of the suture was patulous.

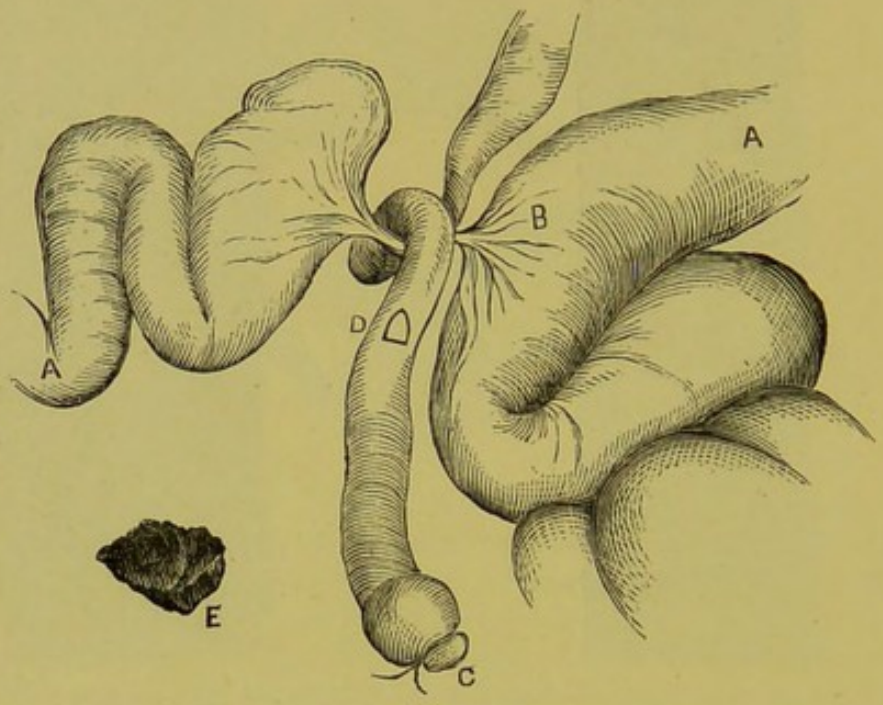


FIG. 23.—Sketch of a strangulation of the ileum caused by an adventitious fibrous band due to the irritation produced by a bullet. A, A, Coils of the intestine united by the fibrous band, B, around which the gut, C, became entangled. D, Bullet lying loose in the canal. E, Size and shape of the bullet. This injury occurred to an officer of the Royal Artillery in 1858, seven and a half years before death. The bullet entered the abdomen two inches above and one inch to the right of the umbilicus. At first but little hope was entertained of the patient's recovery, but the wound healed in about five weeks, and he regained health and strength. In 1865 he suddenly experienced sickness, severe abdominal pain, constant vomit of dark fœtid fluid, and in a few hours became collapsed, and died with cold skin and imperceptible pulse.

FIG. 24.—Ruptured small intestine, with great eversion of the mucous membrane and effusion of adhesive lymph on the peritoneum.—*St. Thomas's Hospital Museum.*

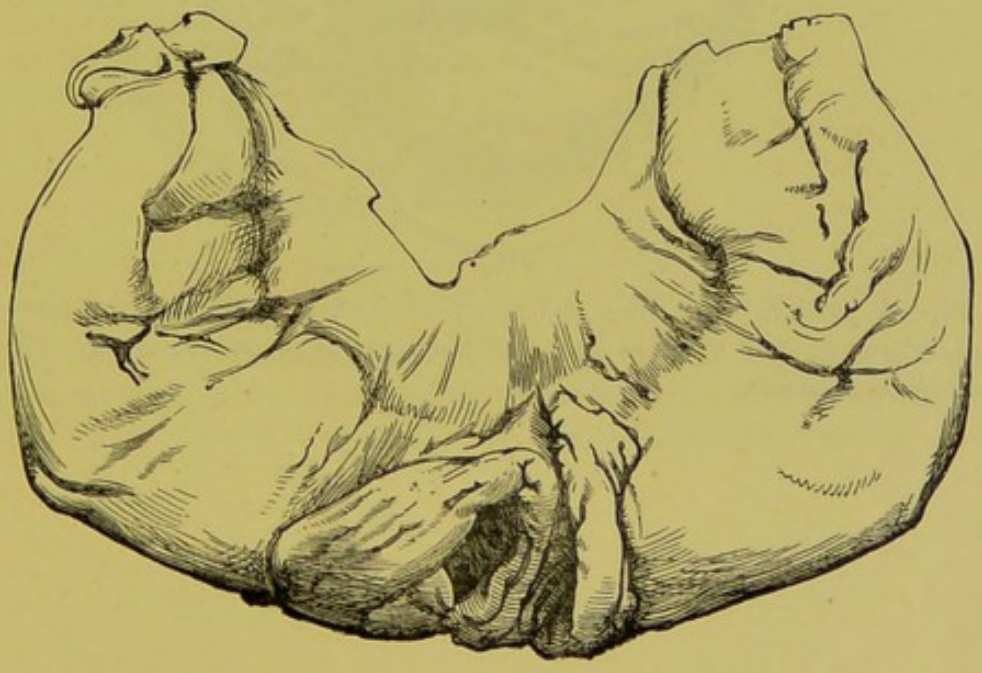


FIG. 25.—A portion of completely ruptured intestine, with adhesive matter on the peritoneum, and eversion of the mucous membrane.—*St. Thomas's Hospital Museum.*

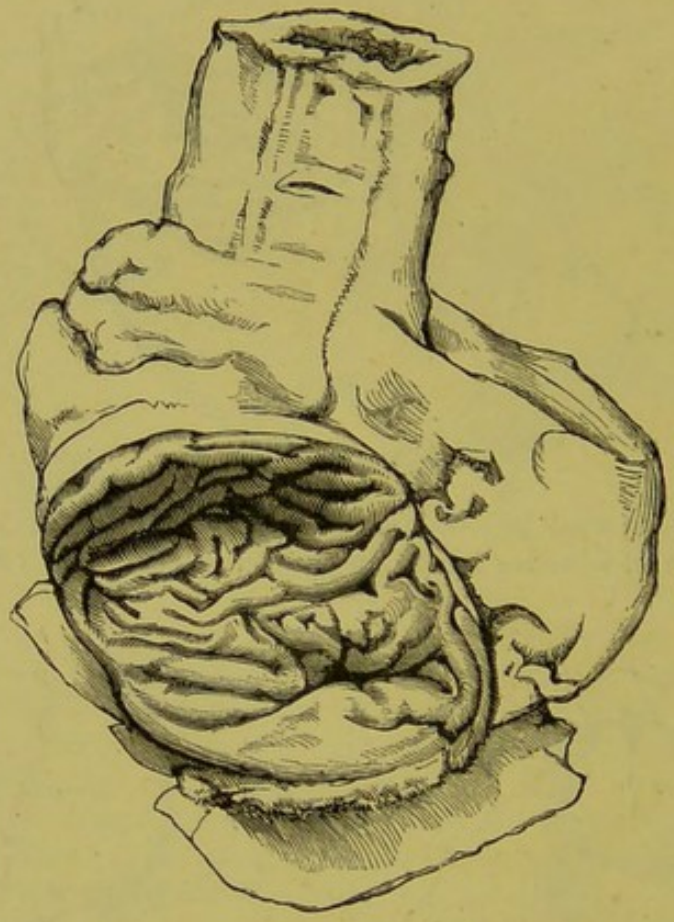


FIG. 26.—A portion of intestine wounded by a bullet; there is considerable loss of substance and great eversion of the mucous membrane.—*St. Thomas's Hospital Museum.*

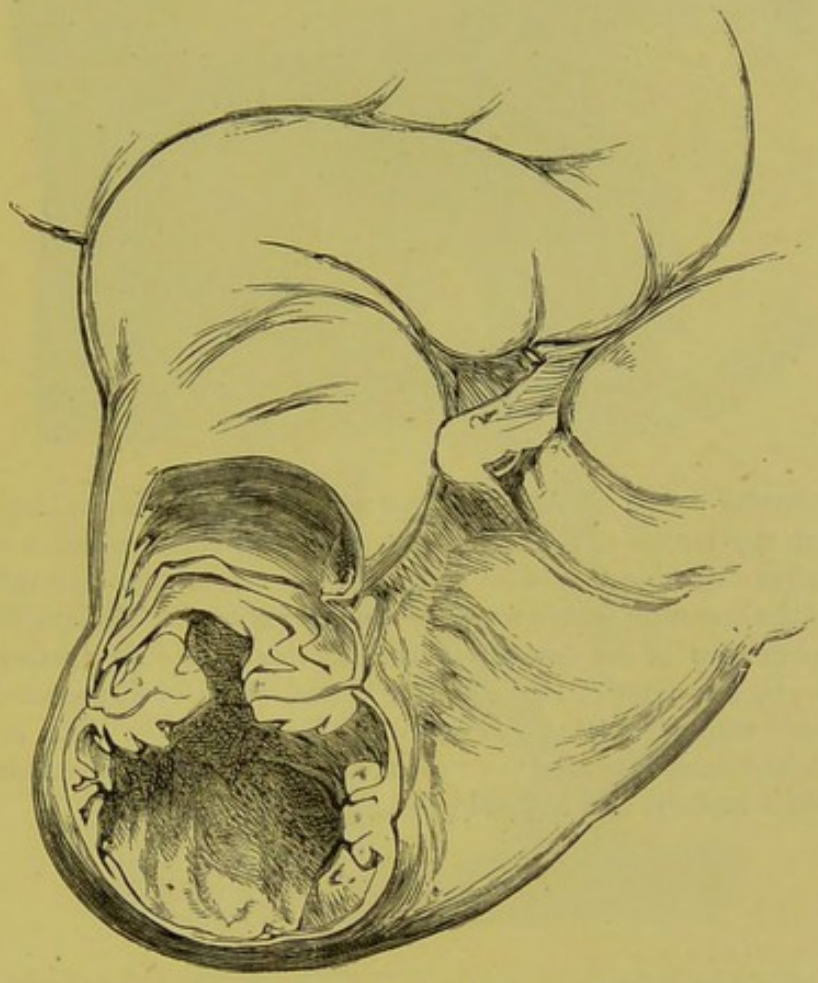


FIG. 27.—Small intestine sutured after Lembert's method. The patient survived the operation twenty-four hours. (Mr. Croft, p. 6.)

The wound is soundly closed and quite water-tight. A window has been cut in the bowel wall to show the complete inversion of the adjacent serous surfaces produced by this manner of suturing.—*St. Thomas's Hospital Museum.*

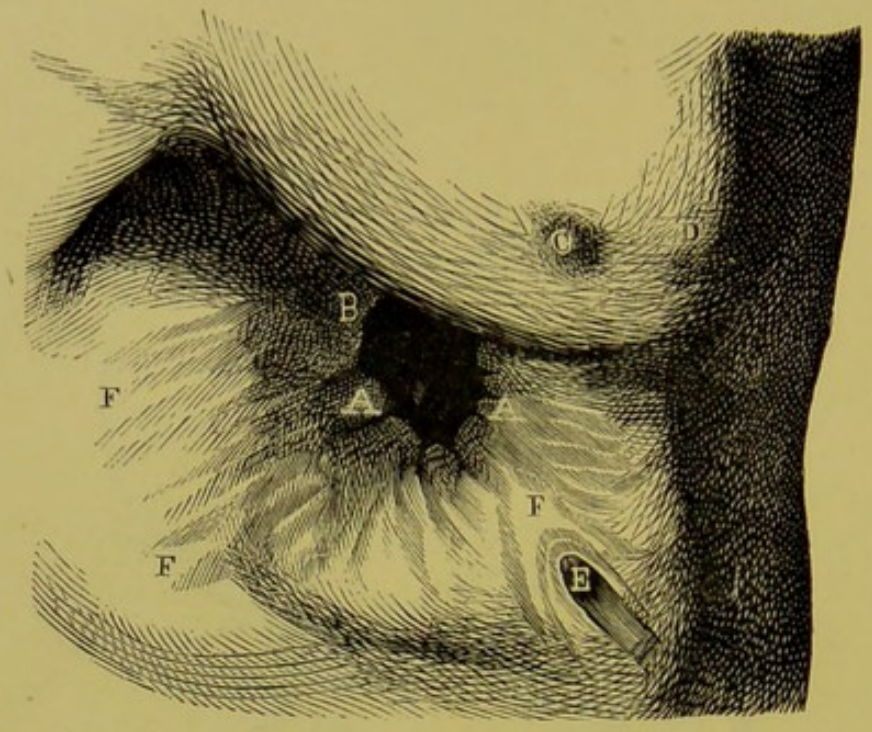


FIG. 28.—Gastric fistula of Alexis St. Martin. The engraving represents the ordinary appearance of the left breast and side; the aperture is filled with a valve when the subject is in an erect position. A, A, The circumference and edge of the aperture, within which is seen the valve. B, The attachment of the valvular portion of the stomach to the superior part of the aperture. C, The nipple. D, The anterior portion of the breast. E, The scar where an opening was made with a scalpel and necrosed cartilage taken out. F, F, F, Cicatrix of the original wound around the aperture. St. Martin survived his injury for over half a century, and enjoyed good health.

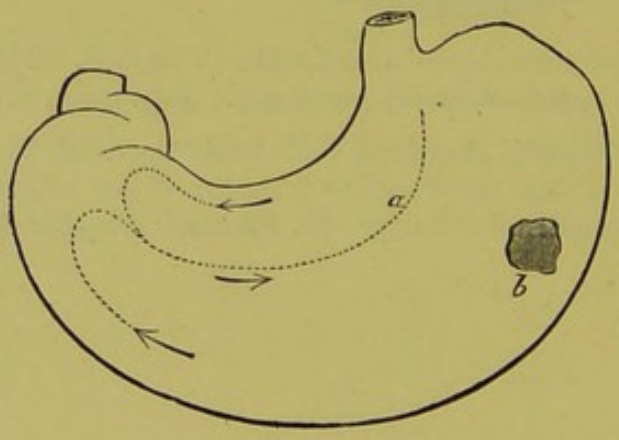


FIG. 29.—Diagram to show the situation of the abdominal opening *b*, in St. Martin's case, and the general direction *a* of the movement imposed upon the semi-fluid food in the digesting stomach.

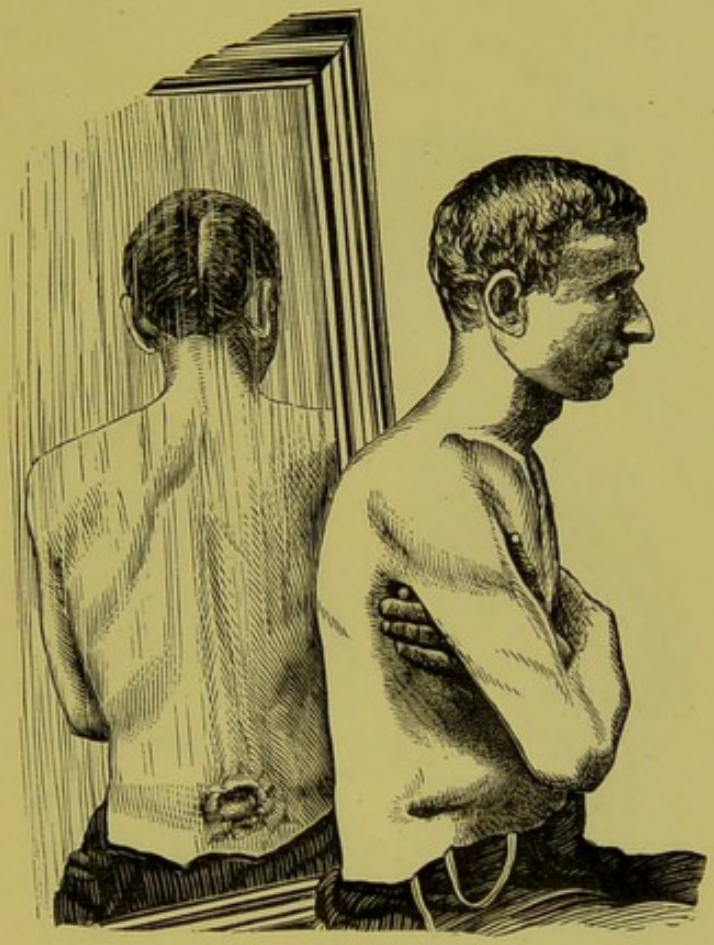


FIG. 30.—Cicatrices in a case of gunshot wound of the ascending colon. (From a photograph taken five months after the injury.) Ball entered right iliac region, and emerged a little to the left of last dorsal vertebra; fæcal discharge from both openings; peritonitis; great exhaustion. A large piece of sphacelated omentum came away from the anterior wound. The first fæcal discharge *per anum* took place one month after the injury. Finally the patient made a good recovery.

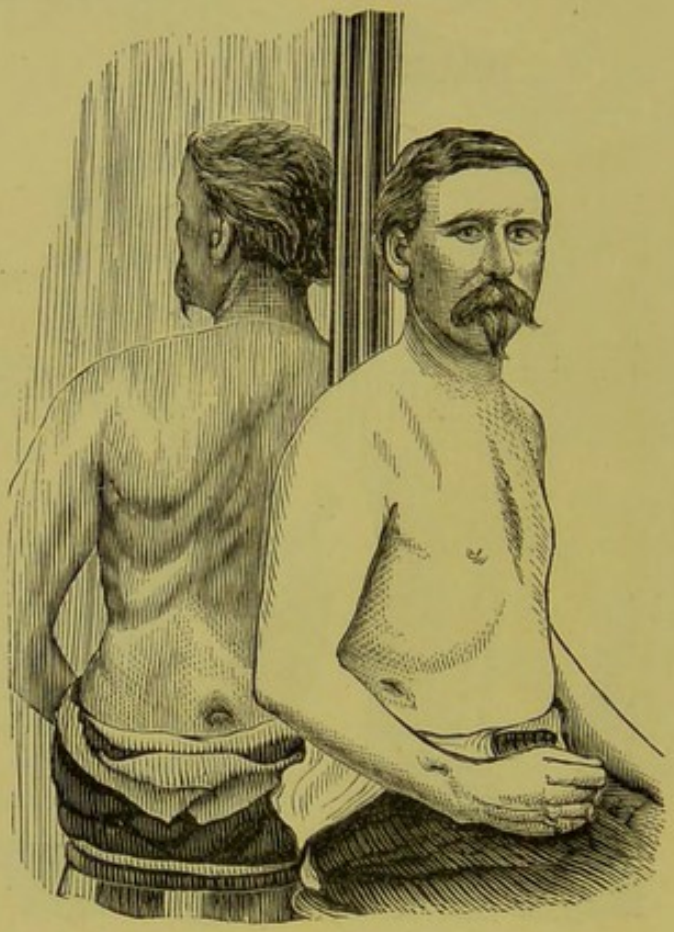


FIG. 31.—Cicatrices after gunshot perforation of the ascending colon and forearm. Col. W. H. was wounded at Antietam, 1862. He lay on the field for twenty-four hours. The ball entered the abdomen three inches above the middle of the right iliac crest, on a level with the umbilicus, traversed the ascending colon, and emerged close to the spine. Fæcal discharge took place and serious peritonitis. In a few weeks the dejections resumed their natural channel, the fistulæ closed, and the patient recovered perfectly.

FIG. 32.—Cicatrices after gunshot perforation of the colon. Capt. C. was shot at Cross Keys, Va., 1862. The bullet entered about two inches to the left of the umbilicus, and, after traversing the abdomen, emerged a little to the left of the spine. Discharge of fæces through both wounds. Recovery did not take place for several months.

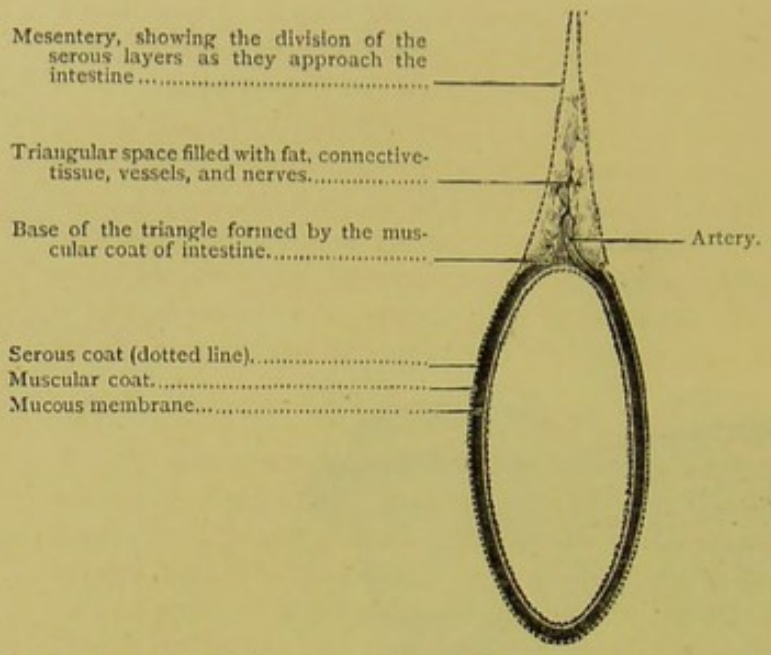


FIG. 33.—Semi-diagrammatic section of the jejunum. (Natural size.) The muscular layer through which the sutures are passed is comparatively thick.

FIG. 34.—Section of ileum, from the same subject. (Natural size.)

The figures illustrate the comparative thickness of the wall and the size of the tube in these two portions of the intestine, and show how thin the muscular layer is in the ileum.

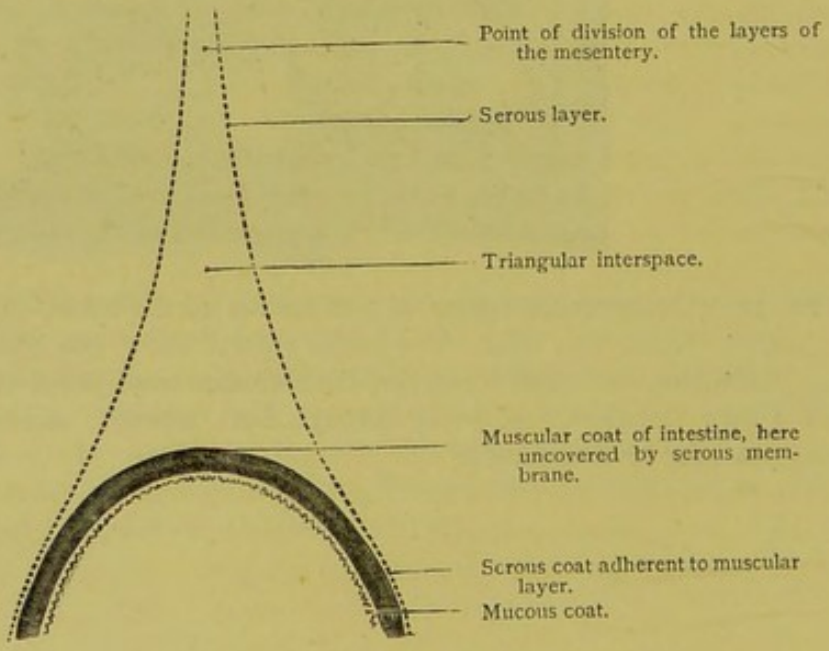


FIG. 35.—Enlarged view of interserous space, diagrammatic.

Mr. W. Anderson's note upon the surgical anatomy of the small intestine with reference to the operation of resection and suture:—

1. Owing to the divergence of the two layers of the mesentery as they approach the bowel, a portion of the circumference of the jejunum and ileum is destitute of

a serous investment. The separation of the laminæ of the mesentery begins at a distance of about two-thirds or three-fourths of an inch from the intestine, and leaves a triangular space, the base of which, averaging about five-sixteenths of an inch in width, is formed by the uncovered muscular tunic. This interspace, extending along the whole of the mesenteric attachment, is occupied by fat in variable quantity, by the vessels and nerves of the gut, and by delicate fibres of connective tissue. Unless this disposition of the peritoneum be taken into account, it is obvious that a suture applied in the manner of Lembert might fail to bring into contact the true wall of the intestine at the mesenteric attachment, and a leakage from the interior of the tube might take place into the interserous triangle and peritoneal cavity.

2. The disposition of the arteries within the triangle is worthy of notice. The last row of anastomotic loops, from which arise the direct branches of supply, is placed much nearer to the intestinal wall in the lower than in the upper portion of the bowel, and towards the termination of the ileum commonly lies within a third of an inch of the canal. From these loops are given off at moderately regular intervals straight vessels, which do not intercommunicate, but pass at once to the muscular floor of the triangle either to pierce it on each side near the lateral angles of the interspace, or to run for a short distance between the serous and muscular tunics before entering the latter. As each of these vessels has a fairly well defined territory, it appears undesirable to interfere with the loops from which they spring, and it is hence safer to divide the mesentery as close as possible to the portion of bowel to be resected, the cut edges of the redundant part left after suture of the intestine being folded and the edges united by fine catgut stitches.

3. It is important to remember that the thickness of the muscular coat of the small intestine varies within rather wide limits in different subjects, and in all cases diminishes, together with the calibre of the tube, from the upper towards the lower extremity of the canal. The amount of the diminution is very considerable. Thus, in the jejunum, about two feet from its commencement, the depth of the tissue ranges from one-seventieth to one-fortieth of an inch, while at the lower part of the ileum, about two feet from the ileo-cæcal valve, the thickness is reduced to about one-half or even one-third of this admeasurement. The difficulty and danger of enteroraphy will hence be greater the more remote the portion of intestine under operation is from the stomach, but fewer sutures will be needed.

4. The submucous tissue has a considerable degree of toughness, and is usually thick enough to bear a fine suture applied after Lembert's manner without implicating the epithelial surface of the mucous membrane. An inner row of stitches used in this manner would, in some cases, give increased security of union without opening up any minute channels of communication between the lumen of the gut and the cellulary interspaces beneath the muscular coat.

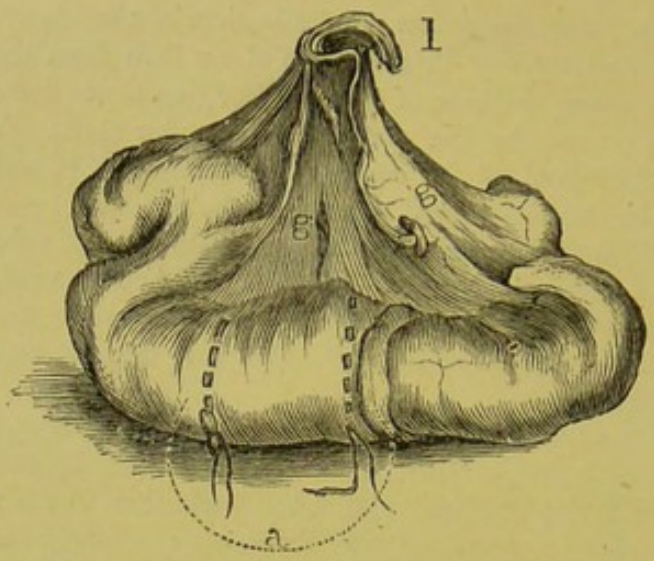


FIG. 36.—Method of intestinal suture as recommended by Benjamin Bell. *a* indicates the space which must mortify, according to J. Bell. *g*, Mesentery.

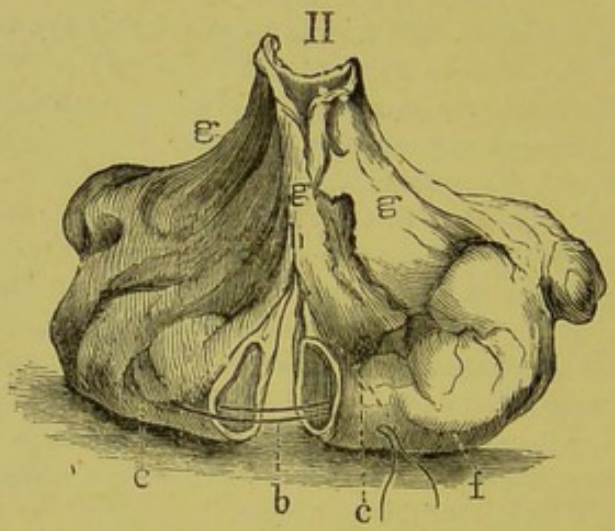


FIG. 37.—John Bell's manner of dealing with wounded intestine. *b*, Single stitch by which the two portions of bowel are held close together and to the external wound. *c*, Dotted line marks the position of the portion, *e*, invaginated by the stitch, and lying within the portion *f*. *g*, Mesentery. This proceeding is as unpractical as it is untrustworthy.

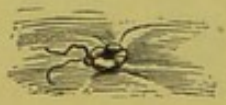


FIG. 38.—Ligature applied around a pinched up puncture in the serous membrane. In small wounds of the stomach Astley Cooper recommended the opening to be pinched up in a forceps and a thread thrown round it—a practice adopted successfully by Travers. When the wound is larger, interrupted sutures should be employed.

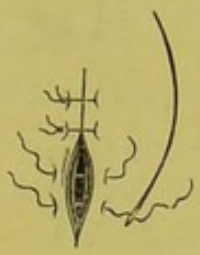


FIG. 39.—Interrupted suture in wound of the stomach, as recommended by Travers.

FIG. 40.—Reybard's disc. Reybard proposed this method in 1827. The object is to maintain the injured bowel in strict relation with the abdominal wall, and the author sought also to temporarily occlude the wound in the gut by a disc of ivory or wood introduced into the interior. The disc is traversed by a fine thread, to each end of which a fine needle is attached, and the disc fastened within the gut by passing the needles through the lips of the wound from within outwards; the needles are then removed, the threads twisted together, and passed by means of a larger needle through the abdominal wall; the ends are then untwisted and fastened securely over a compress. After a couple of days the thread is divided and removed, and the disc passes onward in the bowel. The plan proved successful on the lower animals, but has not been tried on man.

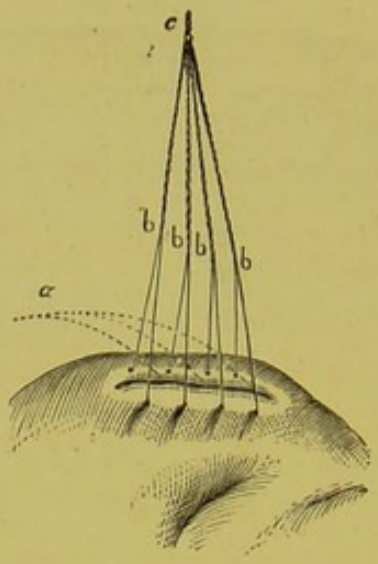


FIG. 41.—Twisted suture of Velpeau. Wound of the ileum united by the looped suture. The edges (*a*) are inverted. Each suture (*b*) is twisted separately, and then all are twisted together to form a cord, which is secured externally.

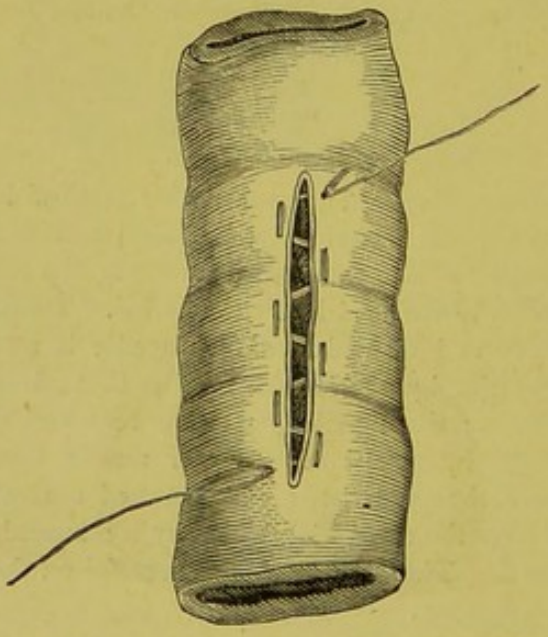


FIG. 42.—Bertrandi's suture, as applied to a wound in the intestine (*vide* Fig. 43).

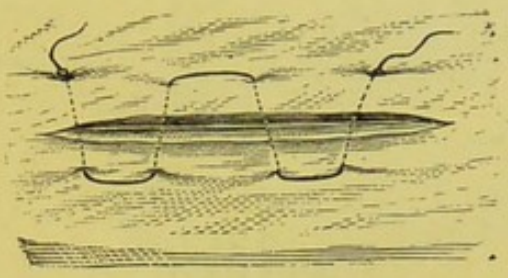


FIG. 43.—Bertrandi's suture *à points passées*, or basting stitch—*sutura transgressiva* of Petit, advocated by Sabatier, Desault, and Boyer (*vide* Fig. 42).

FIG. 44.—Ferules employed in Denans' method.

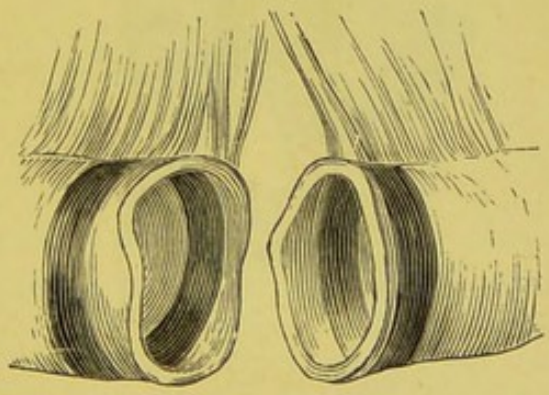


FIG. 45.—Two of the ferules introduced into the extremities of the divided intestine, according to the method of Denans.

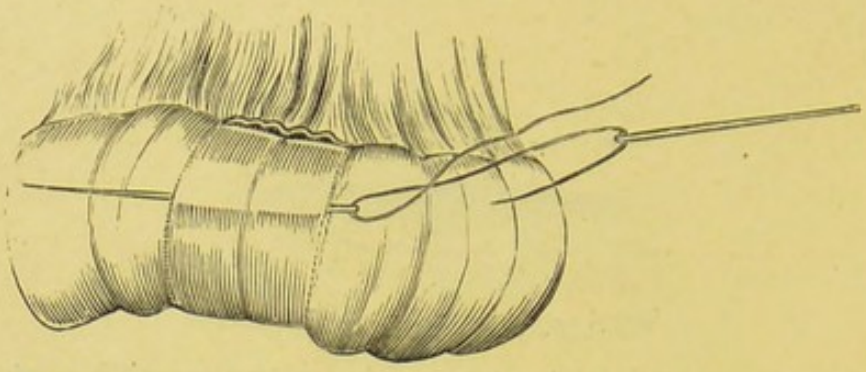


FIG. 46.—Mode of fastening the ferules by a thread in the method of Denans.

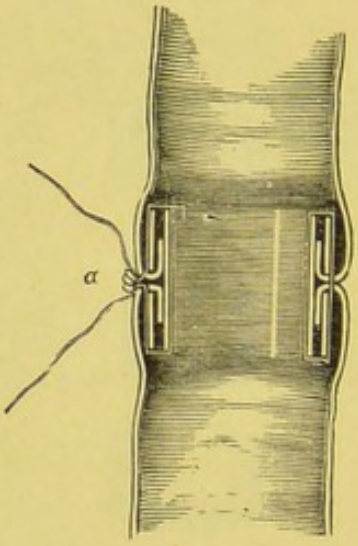


FIG. 47.—Diagram of a section of divided intestine, with the ferules in place, the inverted serous surfaces in apposition, and the apparatus secured by a stitch after Denans' method.

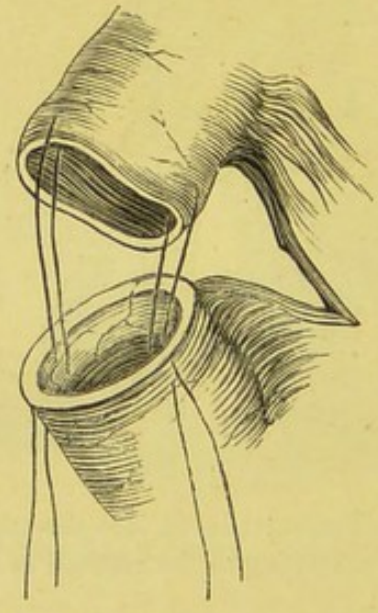


FIG. 48.—Sutures placed preparatory to invagination.—*Jobert.*

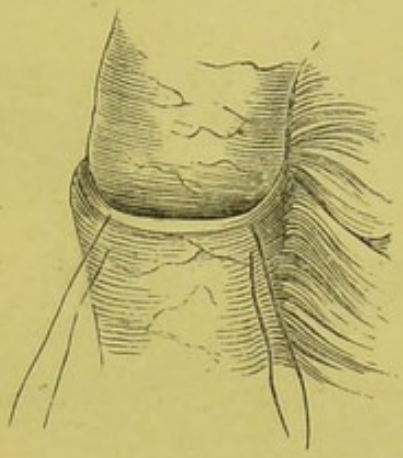


FIG. 49.—The upper extremity of the bowel invaginated within the inverted lip of the lower.—*Jobert.*

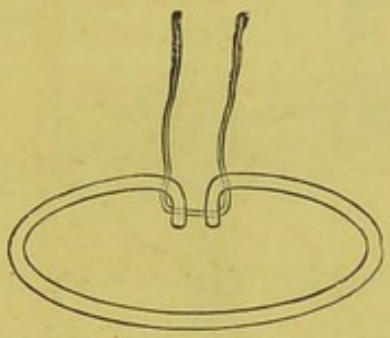


FIG. 50.—Jobert's suture. In this method the mucous membrane is included in the loop.

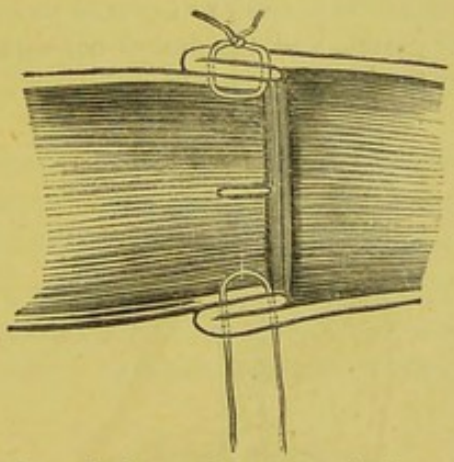


FIG. 51.—Diagram of the relations of the intestinal coats and sutures.—*Jobert.*

Jobert's method of suture was proposed in 1822. The upper and lower ends of the gut being identified. Jobert dissects away the mesentery for one-third of an inch from each end. One suture is inserted one-third of an inch from the divided margins of the upper extremity of the bowel. A second suture is similarly introduced at the mesenteric border of the bowel (Fig. 48). The edges of the lower cut end are to be invaginated (always very difficult to do); and the upper portion of bowel is then invaginated within the lower, and secured (Figs. 49, 51). The ends of the sutures are brought out of the external wound, and withdrawn by traction on the fourth or fifth day.

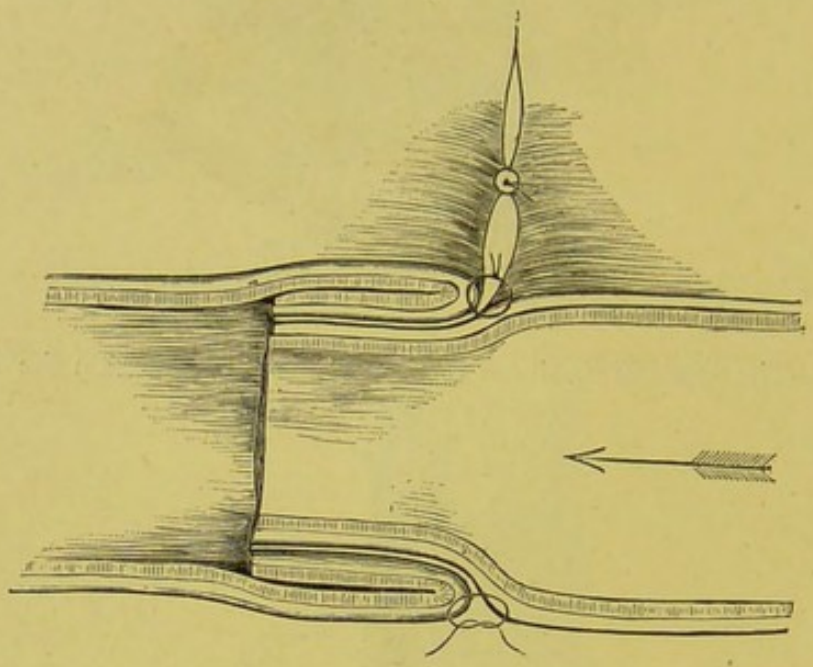


FIG. 52.—Jobert's method of suture as modified by Madelung.

In place of passing the sutures, as advised by Jobert (Fig. 51), through the whole thickness of the invaginated intestine, which would include three layers of gut, Madelung sutures the serous layers together around the line at which the invagination begins. The invaginated portion will thus be directed valve-like whichever way the intestinal current passes, and the danger consequent upon mistaking the upper for the lower end of the bowel is avoided.

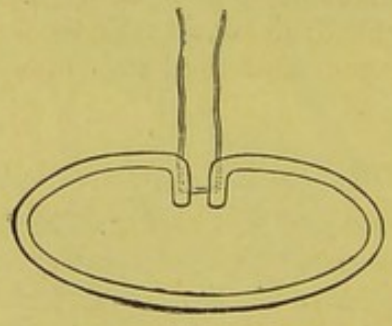


FIG. 53.—Lembert's suture. In this method the mucous membrane is excluded.

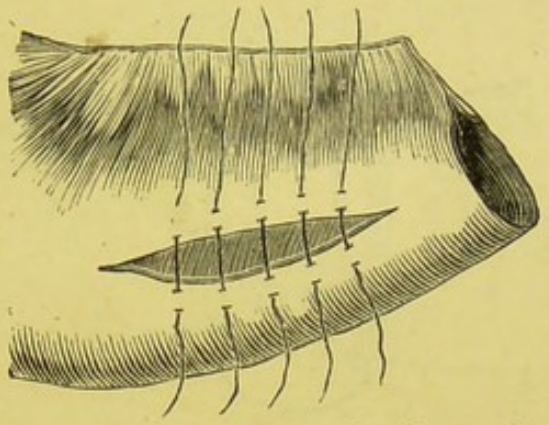


FIG. 54.—Five interrupted sutures introduced according to Lembert.

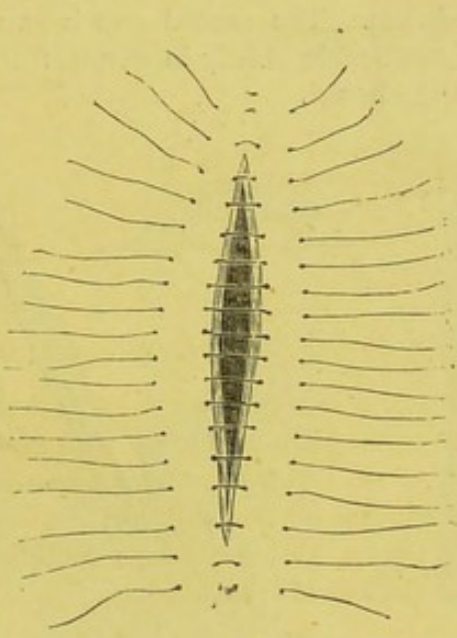


FIG. 55.—Manner of suturing the bladder after Lembert adopted in two cases of intra-peritoneal rupture. Both patients made an excellent recovery. Sutures have been purposely introduced beyond each extremity of the rent.

Lembert proposed his admirable form of suture in 1827. It is the one most generally adopted, is applicable to almost all varieties of intestinal wound, and best capable of maintaining the serous surfaces in a condition of exact coaptation.

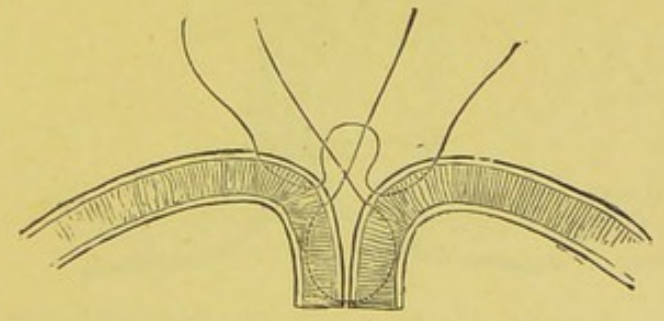


FIG. 56.—Double row of sutures adopted for suturing the bladder, stomach, or intestine, in some cases of intra-peritoneal rupture.

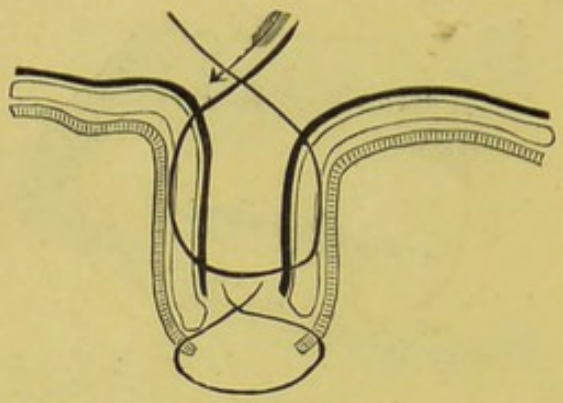


FIG. 57.—Czerny's double row of sutures. The first row approximates the edges of the mucous membrane. The second row is passed after the manner of Lembert's suture. Applicable chiefly in cases of wound of intestine to the mesenteric border of the bowel.

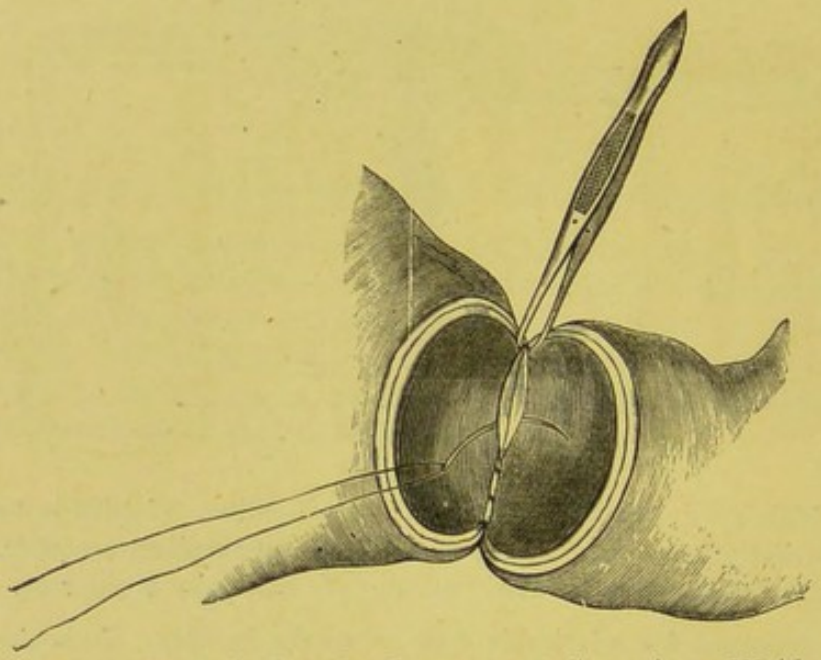


FIG. 58.—Manner of introducing the first row of Czerny's or Wölfler's sutures, which includes mucous membrane only.

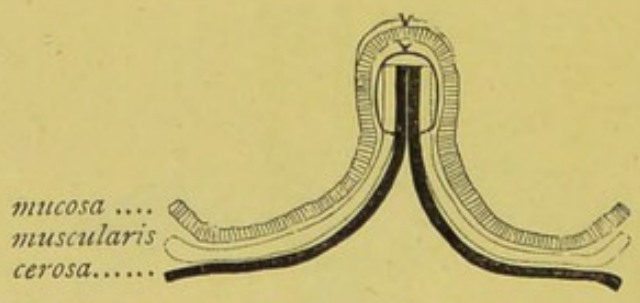


FIG. 59.—Wölfler's modification of Czerny's suture. The loops are drawn tight, and knotted.

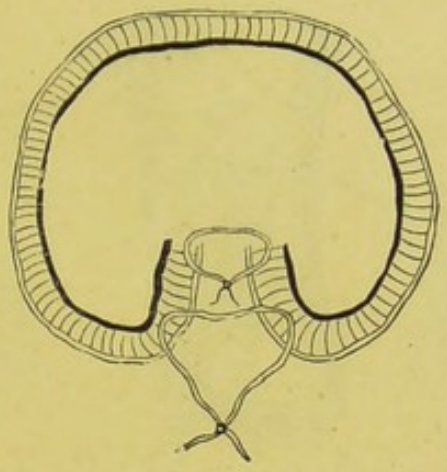
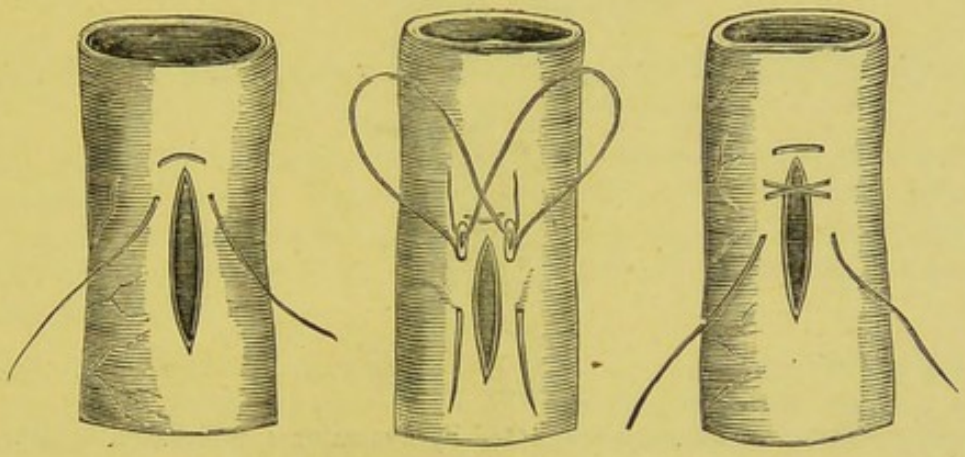


FIG. 60.—Diagram representing a modification of Czerny's suture.



FIGS. 61, 62, 63.—First, second, and third steps of the application of Gély's suture to a longitudinal wound of the intestine.

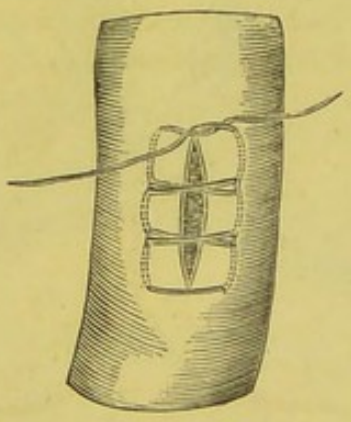


FIG. 64.—Four points of suture placed ready to be tightened.—*Gély*.

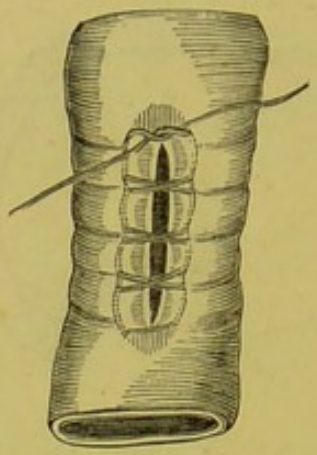


FIG. 65.—Five points of Gély's suture introduced to close a longitudinal wound of the ileum, and ready to be tightened.

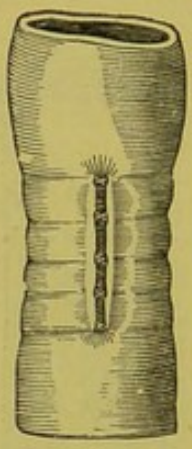


FIG. 66.—Serous surfaces approximated by five sutures, which are tightened, tied, and the ends cut short.—*Gély.*

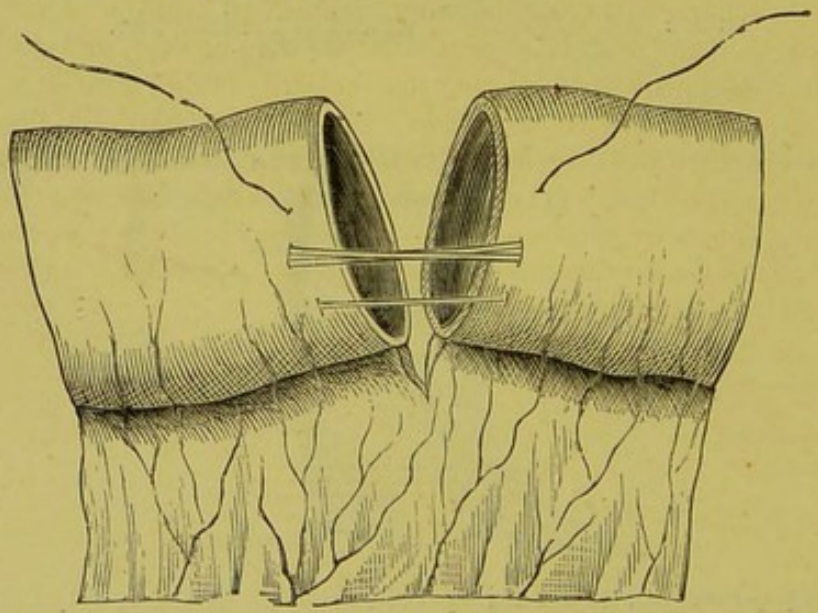


FIG. 67.—Application of Gély's suture to a complete division of the bowel.

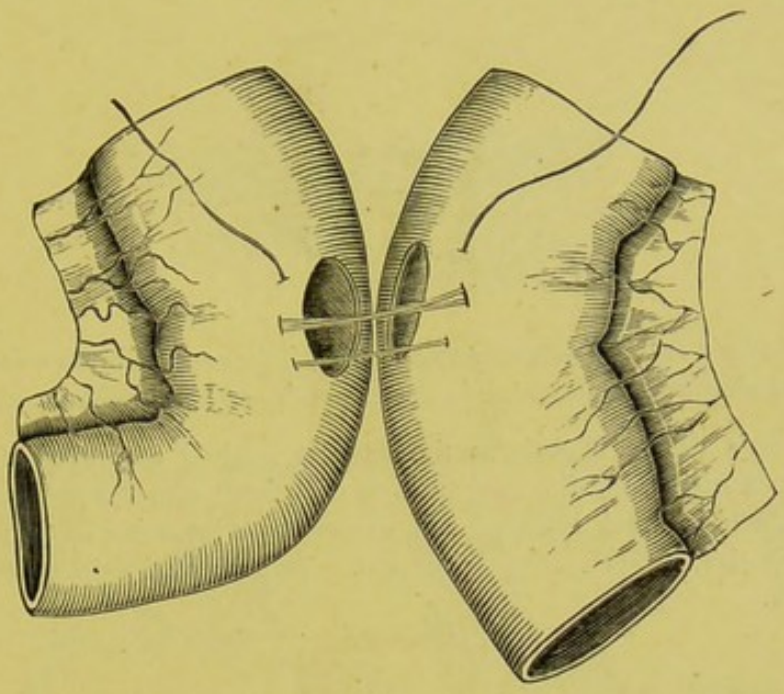


FIG. 68.—Suture together of contiguous wounds in two knuckles of bowel after loss of substance.—*Gély*.

Gély claims for his method, first proposed in 1844, a greater security against extravasation. The thread is armed with a needle at each extremity, introduced as in Fig. 61 ; the needles are crossed over as in Fig. 62, again traversing the bowel parallel to its margins. In Figs. 64 and 65 the thread is passed, but not drawn tight, as it has been in Fig. 66.

Gély's method is a modification of Lembert's plan, but it is not nearly so effective nor so simple in application. The thread is armed with a needle at each end. One needle is introduced parallel to the edge of the wound, 4 to 5 mm. behind one of its extremities, and brought out after traversing the bowel for a similar distance. The same is done with the other needle on the opposite margin of the wound. The needles are then crossed, and similar stitches taken on the opposite sides, re-entering the needle by the aperture of exit ; and this is repeated as often as may be necessary. In order to close the wound, the loops of thread are tightened successively at each crossing, the edges of the gut being depressed at the same time. The opposed serous surfaces are thus brought into close contact. The author claims as an advantage over Lembert's interrupted suture that his is a continuous one, more securely closes the wound, and enables the bowel to be safely returned without fear of leakage.

FIG. 69.—The continued suture (*suture à surjet*), spiral suture.

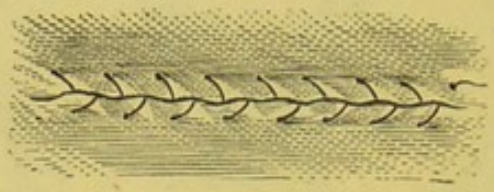


FIG. 70.—Glover's suture (*sutura pellionum*). The earliest known form of suture for sewing up the intestine is the Glover's, or herring-bone, stitch.

The Glover's suture is perhaps the earliest method employed of closing the wound in the intestine, but the modification of it, known as the ordinary continued or basting suture, is much better, for it causes some inversion of the edges of the wound, which the Glover's stitch prevents. Velpeau and others obtained good results with it.

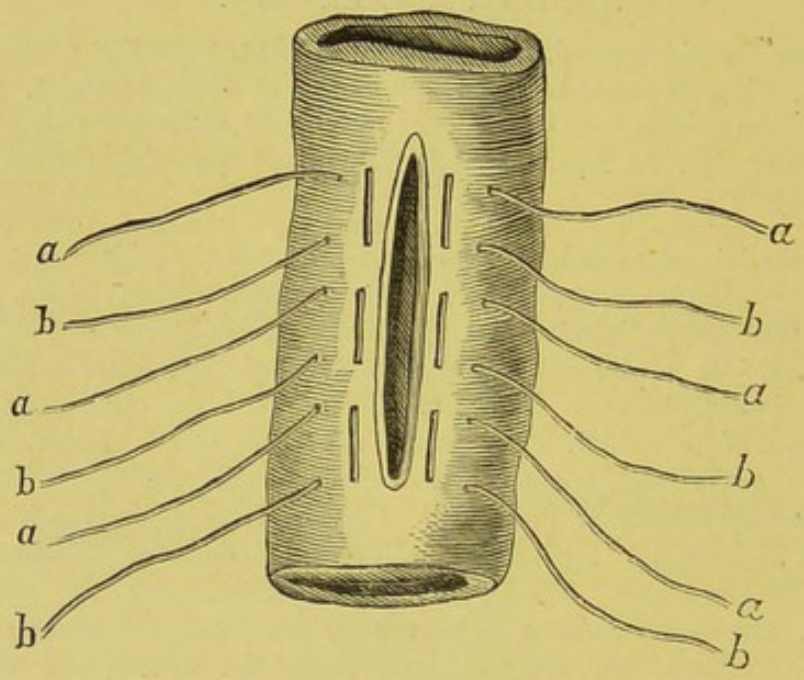


FIG. 71.—Emmert's suture. Each thread is armed with two needles; as many loops as the size of the wound may require are introduced, and the corresponding ends, *a a*, *b b*, of the ligatures tied together. Emmert of Bern proposed this plan in 1862. It is a combination of Lembert's suture with the loop of Ledran and the darning point of Bertrandi. It is ingenious, but not superior to Lembert's. Plans have also been proposed for tying the knots in the interior of the bowel, but this is quite unnecessary.

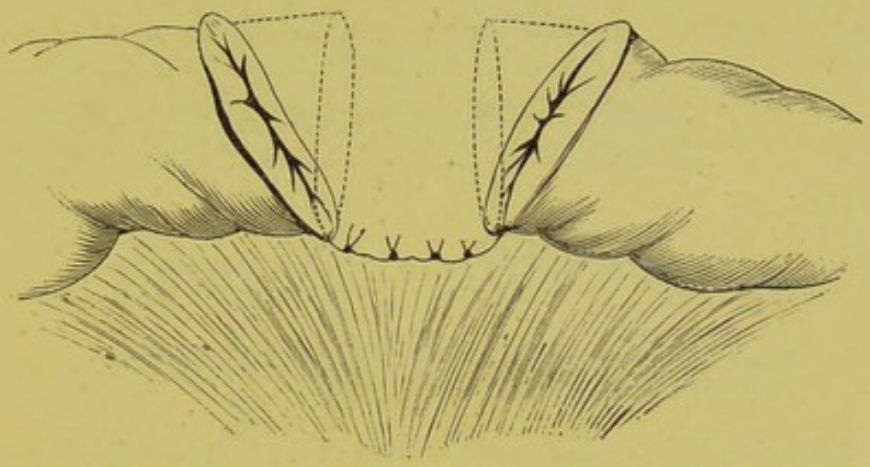


FIG. 72 illustrates the appearance of the completely resected bowel with its edges much everted previous to the introduction of the sutures. In the margins of the separated portion of the mesentery four points of suture have been introduced after the vessels were secured by ligature.

When a complete resection of the bowel is performed, the margins of the opening in the gut should be divided in a slightly radiating or oblique manner, so as to remove rather more on the convex than the concave or mesenteric border. When the Lembert's suture is tied, the channel of the united portion of the bowel will thus be straighter, and there is less liability to any interference with the free passage of its contents at the point necessarily narrowed by the suture. The mesentery should be cut through as close as possible to the intestine, and after all bleeding has been arrested the two cut edges are sutured together.

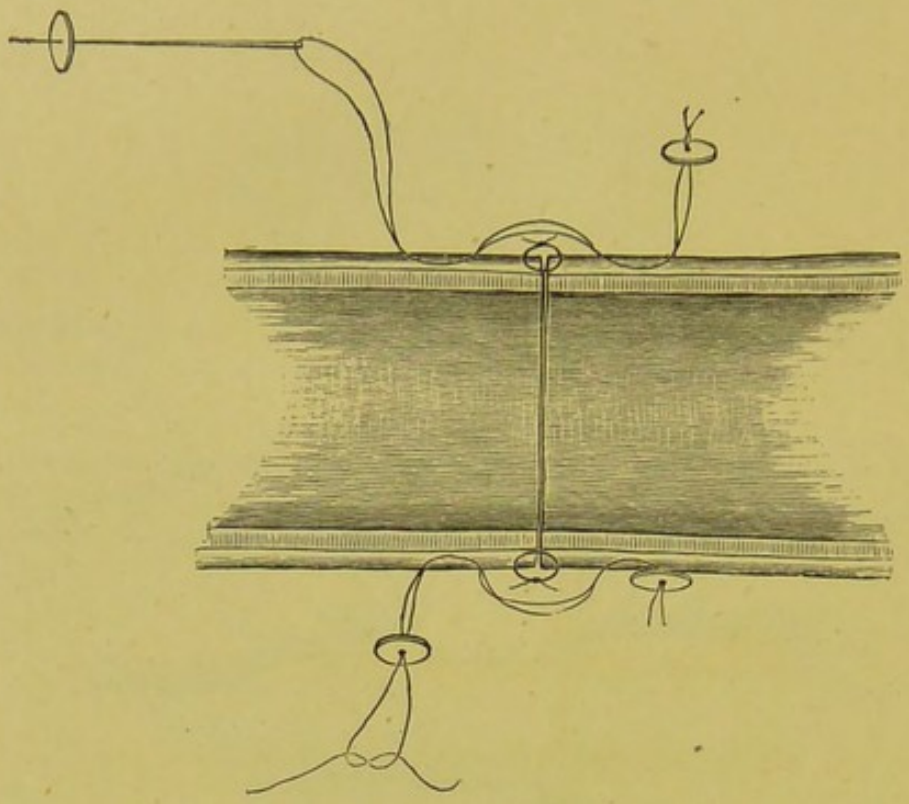


FIG. 73.—Madelung has devised an application of the button or Bozemann suture. The buttons are made of thin slices of cartilage, with a small central opening. The edges of the wound are first united, as shown in the woodcut, and then a Lembert's suture introduced, each extremity of the thread carrying one of the small plates. An important advantage claimed for this modification is that a fewer number of sutures are required.

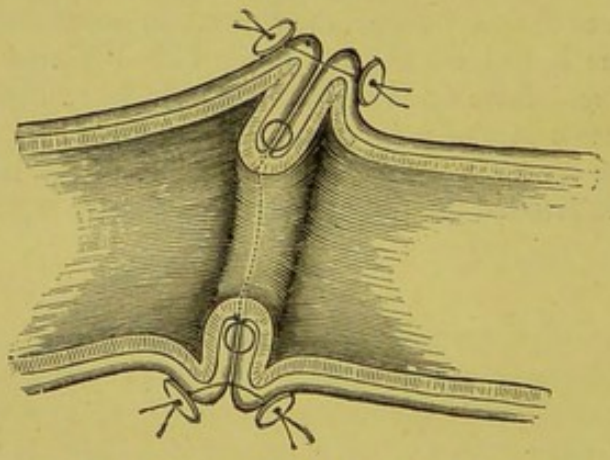


FIG. 74.—Appearance of the parts in Madelung's button suture when the suture is drawn tight. The pressure is distributed over a considerable surface, and there is no risk of the thread cutting the tissues.

Madelung adopted this method in nine cases of complete resection of the intestinal tube in animals; a thoroughly satisfactory result ensued.

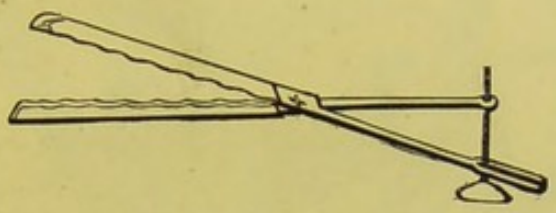


FIG. 75.—Dupuytren's enterotome for dividing the septum in cases of artificial anus, and restoring the continuity of the bowel. (One-fourth size.)

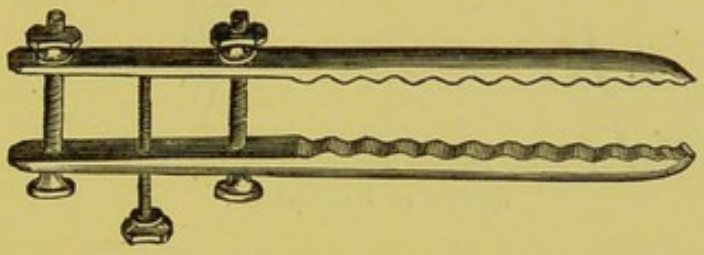


FIG. 76.—Blasius's intestine forceps, or *Darmscheere*. The blades are parallel, thus obviating an objection to the use of Dupuytren's instrument, which divides the parts nearest the intersection of the blade sooner than the more distant portions.

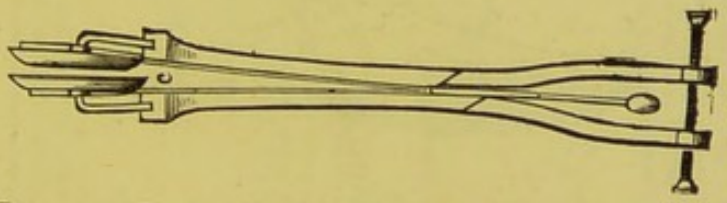


FIG. 77.—Reybard's clamp for the operation to cure a preternatural anus.

Many other forms of instrument have been devised, and the knife, caustic, and gradual tightening of a ligature have been all suggested as means for dividing the *éperon*.

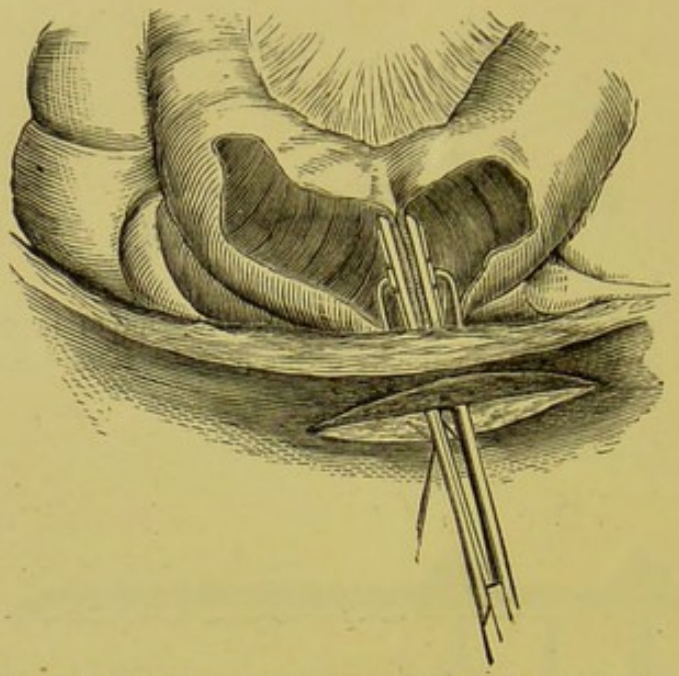


FIG. 78.—Reybard's instrument applied for the division of the *éperon* of Dupuytren.

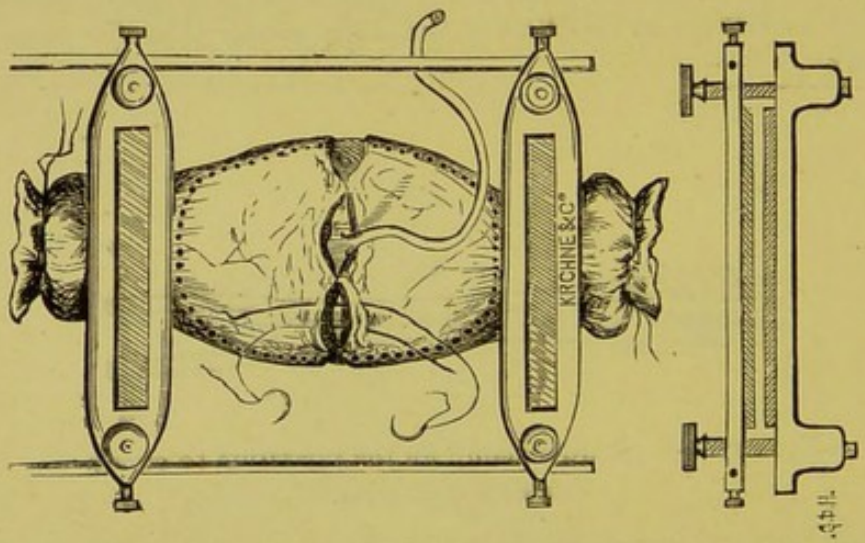


FIG. 79.—Treves' apparatus for suture of the intestine after resection of the bowel.

An india-rubber tampon is employed to distend the bowel and thus facilitate the introduction of the sutures, the air being allowed to escape and the india-rubber bag to collapse before the opening is finally closed. The clamps prevent the passage of any fæcal matter. The apparatus appears likely to involve too much interference with the bowel and mesentery.