THE ANNUAL ORATION, ON ABDOMINAL SECTION FOR THE TREAT- MENT OF INTRA-PERITONEAL INJURY.

Delivered before the Medical Society of London, May 2nd, 1887.

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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 the art of 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 conditions of the kid-

neys, intestine, stomach, uterus, and spleen, which indicate surgical intervention have 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 consider-

Fig. 1.—Small intestine sutured after Lambert's method. The patient survived the operation thirteen hours. 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.

able rent in it. There was fecal extravasation, and septic peritonitis had spread into the iliac, umbilical, and hypogastric regions. Enterorrhaphy 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 influ-

ence 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. 1) and the peritoneum was entirely free of 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. I would urge the propriety of a more frequent resort to abdominal section and exploration of the abdominal cavity and 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 American surgeons 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, Gely, 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 progress 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* Table II.)¹

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

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.)

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 fecal 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

¹ The tables will be published with the concluding portion of the Oration.

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 fecal 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."

Enterorrhaphy 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 fecal 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 then 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 fecal 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 this 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 fecal 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.

Fig. 3.—Jobert's suture. In this method the mucous membrane is included in the loop.

Fig. 4.—Diagram of the relations of the intestinal coats and sutures.—Jobert.

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.

Keybard, in 1827, sought a more exact apposition of the internal and external openings.

Ledran employed a looped suture. Bertrandi's stitch was practised by Chopart, Desault, and Bécillard.

The four masters in the 13th 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, 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. 3 and 4.) 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. 5)

Fig. 5.—Jobert's method of suture as modified by Madelung.

In place of passing the sutures, as advised by Jobert, 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.

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. 6 and 7.) 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 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 ovari-

otomy. 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.

Fig. 6.—Lembert's suture, in which the mucous membrane is excluded.

Fig. 7.—Manner of passing the sutures—Lembert's method.

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 everyone 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. Alexander relates a case occurring in the Crimea where the intestine was wounded in sixteen places by the same bullet. 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; 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 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 fecal matter in the parietal wound is no proof that the intestine is not perforated. In none of Professor Parkes's numerous experiments on dogs did any fecal 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 fecal 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 gunshot 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's 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 enterorrhaphy for wounded 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, the other, in which eight inches of intestine were cut away, 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 Kinspleh.

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 injury 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, fecal 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 slight 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, carefully examined, and 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, 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. 8), sometimes seriously interfering with the introduction

Fig. 8.—Illustrates the appearance of the resected bowel, with its edges much everted, previous to the introduction of the sutures. In the margins of the separated portion of mesentery four points of suture have been introduced after the vessels were secured by ligature.

of the sutures and the accurate approximation of the surfaces of the bowel. It should not 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. 9, 10, and 11), filled with connective tissue and blood-

Fig. 9.—Semi-diagrammatic section of the jejunum (natural size.) The muscular layer through which the sutures are passed is comparatively thick.

Fig. 10.—Section of ileum, from the same subject (natural size).

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

Fig. 11.—Enlarged view of the inter-serous space, diagrammatic.

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

¹ 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 laminae 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 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, 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 mus-

Three sutures should be first introduced at the mesenteric 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 order in the quadrantal intervals between. 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. 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. 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.

(To be concluded.)

AN ADDRESS

ON

MEDICAL AND SANITARY WORK IN SOUTHERN INDIA.

Delivered at the Annual Meeting of the South Indian Branch.

By GEORGE BIDIE, M.B., C.I.E., SURGEON-GENERAL,

President of the Branch; Sanitary Commissioner with the Government of Madras.

ON taking this chair for the first time I have to thank the members of the Branch for the honour which they have bestowed on me in electing me as their President. For a good many years I have been placed in positions that have prevented me from engaging in the executive duties of our common profession; but, although during that period my knowledge has been rather on the peace-list, I have not lost my interest in professional subjects, but have tried to keep myself acquainted with the numerous advances and discoveries in medical science.

Although this, the South Indian Branch of the Parent Society, is still in its infancy, it has, during the period of its existence, manifested considerable vigour, and I trust that during the year which has just begun it will be even more active and prosperous, extending the sphere of its action by the addition of new members resident in up-country stations, and making itself a name by contributing something new to our knowledge of disease and its relief, as also to vital statistics and ethnology.

Members.—At the close of 1885 there were sixty-nine members on the roll; and during the year that has just closed ten new members were enlisted, while six resigned, and one, Surgeon J. Heath, Medical Staff, was killed in Burmah while performing his duty with singular devotion and intrepidity. On January 1st, 1887, there were seventy-two members on the roll; but, as that number is less than half the strength of our department, I think some special effort should be made to secure recruits. The good that may be effected by a Society of this kind depends very largely on the extent of its membership. As the numbers multiply so do the observant eyes and busy brains at work, and thus by an increase of contributions the meetings are regular tuncs 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 fold left after suture of the intestine being 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 measurement. The difficulty and danger of enterorrhaphy will hence be greater the more remote the portion of intestine under operation is from the stomach.

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 surface of the mucous membrane. An inner row of stitches used in this manner would, in some cases, give increased security of union at the mesenteric border, and prevent channels of communication being opened between the peritoneal cavity and the lumen of the gut.