prolonged period of hypoglycaemia maintained by slow absorption.

The results also suggest that advantage might be taken of this method to utilize crude insulin extracts. At the present time the cost of isolating the drug in a pure and active state for the purposes of hypodermic medication is such as to restrict seriously its application on a large scale. It is possible that more liberal use of cruder materials might with advantage be made by means of inunction.

I have to thank Mr. Orr for performing the analyses of the blood.

The work was done under the Medical Research Council.

A Clinical Lecture

ON

SUBCUTANEOUS RUPTURE OF THE INTESTINE.

GIVEN AT GUY'S HOSPITAL ON MARCH 7TH, 1923,

BY

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CONTUSIONS, unlike bullet and other penetrating wounds, do not often cause multiple injuries of the bowel, but the individual lacerations of the intestine and mesentery are generally more severe. For instance, the small intestine is sometimes completely divided. Therefore it is clear that the hope of recovery without operation is more remote, but the operation itself is likely to be less tedious and troublesome.

CAUSE.

The bowel is most frequently ruptured by a wheel passing over the abdomen, by a squeeze or a crush, a blow or a kick. It may be crushed against the spine or torn from its mesenteric attachments, especially at the junction of movable and fixed parts, such as the duodeno-jejunal junction. Sometimes the reduction of a strangulated hernia has led to rupture of the bowel; a man was admitted to Guy's Hospital recently who had ruptured his own intestine in this way. In the large majority of cases, as pointed out by Massie, the contusion is below the umbilicus; there may be, however, no sign of injury on the surface of the abdomen at first, but a bruise may appear some days later.

SITE OF RUPTURE.

In an examination of 381 cases, published and unpublished, the site of rupture was as follows:

Duodenum	...	...	...	23 cases.
Jejunum	...	...	...	157 "
Ileum	...	...	...	158 "
Colon	...	...	...	43 "

In one-tenth of the cases there was more than one rupture; sometimes the large as well as the small intestine was torn.

NATURE OF DAMAGE.

As a rule the laceration runs for less than an inch across the axis of the bowel, but occasionally the latter is completely divided or severely bruised. The mucous membrane always pouts; the bowel dilates above and below the rupture, and rapidly becomes inflamed and oedematous. In nearly one-tenth of the cases there are complications, such as rupture of the mesentery or of one or more of the other abdominal viscera. In one-quarter of the cases there is fracture of the spine or pelvis, and sometimes severe injuries to other parts, such as the chest and head. The frequency and severity of these complications contribute very largely to the mortality.

SYMPTOMS AND SIGNS.

1. *Pain* is the most striking symptom. As a rule it comes on early and is very severe, being described by patients as "agonizing."

2. *Tenderness*.—This is at first local, near the site of the injury, but later it becomes general, as a result of peritonitis.

3. *Shock*.—This is nearly always severe. It occurs, and may even be fatal, very soon after the accident. In some cases it passes comparatively quickly.

4. *Vomiting* is almost always present, often constant and most persistent.

5. *Pulse and Temperature*.—The former is at first slow and weak from shock, then normal and deceptive; later increasingly rapid and weak as a result of peritonitis. Similarly the temperature is at first subnormal, then normal, and later raised.

6. *Rigidity*.—At first this may be local, but it soon becomes general. The abdomen may be flat at first, or even retracted, but later it becomes distended as a result of peritonitis, with effusion and tympanites.

7. *Dullness*.—There is usually shifting dullness in the flanks as a result of effusion. The liver dullness is often greatly diminished from free gas in the peritoneum.

8. *Transmission of Heart and Breath Sounds*.—The heart and breath sounds may be transmitted, through the gas and fluid, over the abdomen, far beyond the natural limits.

9. *Signs of Internal Haemorrhage*.—In many cases the patient is pale and restless as the result of haemorrhage, and examination of the blood confirms the evidence of this grave complication. The face is usually anxious, pale, cold and sweating, and is, in fact, a typical "abdominal facies."

Emphysema of the abdominal wall or of the loin generally implies rupture of the bowel in its extraperitoneal part. When it affects the right loin the ascending colon or duodenum is ruptured; on the left side, the descending colon. Later on, in such cases, a faecal abscess may form in the loin.

As a rule the minds of these patients are unusually active, and they often have a premonition of impending death.

DIAGNOSIS.

The diagnosis depends a great deal upon an accurate history of a severe abdominal injury. Anyone who has sustained such an injury should be kept under direct observation for a few days, for although there may be no bad signs at first these may rapidly develop. It is of the gravest importance to admit such a case into hospital at once.

Severe pain, tenderness, rigidity, and persistent vomiting following an abdominal injury should make us open the abdomen without delay, although the pulse and temperature and general condition of the patient may be good. It is by operating in the early stages that the appalling mortality of these catastrophes can be reduced.

It is often difficult to distinguish this condition from rupture of the spleen, liver, or mesentery, in which signs of internal haemorrhage and shock are the most prominent. Presence of free gas in the peritoneum, as shown by a tympanitic note, diminution of the liver dullness, and rapid onset of peritonitis, are strong indications in favour of rupture of the bowel; but accurate diagnosis is not so important as a realization of the presence of grave intra-abdominal injury and the urgent need of an operation to set it right.

TREATMENT.

Death is almost inevitable without early operation, therefore it should be carried out at the earliest possible moment, for mortality increases with delay. The following figures, taken from 376 operation cases collected by Siegel, illustrate this point:

Operation	Mortality.
within 4 hours	15.2 per cent.
" from 5 to 8 hours	44.4 "
" from 9 to 12 hours	63.6 "
" later	70.0 "

The mortality of this series was 51.6 per cent., and is very misleading, because fatalities are so often forgotten and not published.

Operation.

While preparing for the operation every endeavour must be made to combat shock by warmth, saline or subcutaneous infusions, or, in some cases, by transfusion of blood. Whenever possible spinal anaesthesia or gas and oxygen is chosen.

The abdomen is opened in the middle line, preferably by displacement of the right rectus outwards. The jejunum, being the most likely part to be affected, is at once examined and the small intestine traced downwards to the caecum. In many cases, however, the injured coil comes forwards into the wound directly the abdomen is opened, and gas and liquid escape. If no perforation is found in the jejunum or ileum the duodenum is most carefully examined; in many cases lacerations of the duodenum have been overlooked at the time of operation and have only been found *post mortem*. Lastly, the caecum and colon are examined.

Unless a loop of intestine has been very severely damaged it is not necessary to resect. It is far safer to pare the edges of the laceration and to close it with two continuous sutures of fine linen thread. Linen thread closes wounds in these damaged tissues more effectively and permanently than fine catgut and does no harm. While the surgeon is closing the perforation gauze rolls are passed into the pelvis and flanks to absorb the effusion in these areas. This is a quicker and better method than washing out, and the peritoneum is left dry and less damaged. In late cases a stab wound is made about two inches above the pubis and a tube is inserted to drain the pelvis, but in early cases the peritoneum is completely closed.

MORTALITY.

The mortality of this condition is appalling, and is chiefly due to delay and errors of diagnosis. James Berry and Giuseppe¹ have done good service by collecting and analysing 132 cases of rupture of the intestine from contusion, from the records of ten London hospitals, previous to 1908. Of Berry's collection, 84 patients were operated upon, with 67 deaths—a mortality of 80 per cent.; but in 15 the ruptures were not found at the operation; 7 of these were in the duodenum. The surgical registrars of twelve London hospitals collected 44 cases occurring between 1908 and 1912.² In 12 of these there was no operation. Of 32 operated upon, 23 died (72 per cent.). Taking these two series together, there were 176 cases, with 116 operations, and a mortality of 77 per cent. It is interesting to note that 60 (or over one-third) of the patients were not submitted to operation. This was chiefly due to their grave condition on admission, owing to delay or the presence of complications.

It is certain that the best results are obtained by quick decision, early operation, and accurate and rapid work at the operation, followed by careful after-treatment.

CASE I.

Mrs. T. H., aged 43, had been up to London, and was walking from the station to her home, at 4 p.m. on September 4th, 1922. She was carrying a heavy suitcase, which had hard protected corners, when she was run into from behind by a cyclist. She was thrown violently forwards and doubled up over the case, one of the corners of which injured her in the right hypochondrium, and the cyclist fell on top of her. She crawled to the side of the road in terrible agony and scarcely able to breathe or speak. A doctor was fetched who, however, did not think anything very serious had occurred, and he took her home (four miles) in a taxi. She almost fainted before entering the taxi, but took some sal volatile which made her feel better. She could not sit up or lean back, and especially could not bear to be touched on the abdomen or trunk. Arrived at home she crawled upstairs on her hands and feet, holding her body rigid but shaking all over. She was given a cup of tea, but vomited at once. Dr. G.-J. was called in late that night and found her with a rigid abdomen and very tender in the right flank. Pulse and temperature were normal. She was vomiting a little, but brought up no blood. A diagnosis was made of "bruised ribs and abdominal wall." As the pain was still very great he, at the urgent request of the husband, gave an injection of morphine (1/4 grain), but the following morning it was as bad as ever, and, as he was unhappy about the patient, Dr. G.-J. got me to see her at noon. Although the abdomen did not move well on respiration, I did not think there was sufficient cause for operation, but by 8 p.m. she was much worse. The pulse was 124, and temperature 102°; the abdomen was getting more distended and she was very flushed; the liver dullness had almost disappeared, and the pain was so intense that the patient welcomed the idea of an anaesthetic as she longed for unconsciousness. A diagnosis was made of "ruptured viscus, bowel, or gall bladder," and an operation advised and carried out at once. From the moment of the accident the patient had an acute sense of impending death and the brain was more than usually active throughout, in spite of the pain suffered.

Operation.—On opening the abdomen through the right rectus gas at once escaped, also foul, bile-stained pus, of which there was a large amount in Morison's pouch. There was a large collection of thinner sero-pus in the pelvis. This was mopped away, and two rents, large enough to admit the tip of the finger, were found in front at the junction of the first and second parts of the duodenum. There was a narrow bridge between the two rents which I divided. There was no induration of the duodenum nor any evidence of chronic ulceration. Moreover, the mucous membrane pouted, which it never does for a perforated ulcer, because it is adherent at the edge of the ulcer. The large opening was then closed with fine linen thread in two layers, the line of suture being transverse to the duodenum, so that the lumen would not be narrowed. The omentum, above and below the duodenum, was then brought over the suture line. A tube was left in a stab wound just above the pubis and another in the abdominal wall just above the wound. The patient vomited a good deal during the next forty-eight hours, bringing up black vomit; the temperature kept up for a week, and there was considerable suppuration in the abdominal wound and some cystitis. She slowly regained strength, however, and made a complete recovery.

CASE II.

A man, aged about 21, in the Officers' Training Corps, at 9 p.m. on December 29th, 1915, was struck in the abdomen by the handle of a handcart. It hurt him very much, but he did not fall and later went home to Woolwich. He did not sleep at all that night, having dreadful pain in the abdomen and vomiting frequently. He was seen by Dr. Baird, who sent him up to Guy's Hospital the following day. On admission he looked ill and anxious; temperature 100°, pulse 110.

Operation (December 30th, 5 p.m.).—The abdomen was flat, completely fixed, and exquisitely tender, but it was quite resonant over the liver and in the flanks. He was unable to pass urine, but the bladder was not fully distended, only 6 ounces of clear, high-coloured urine being removed with a catheter. A diagnosis of ruptured small intestine was made, for the signs of peritonitis were much too severe for anything else. Pallor was not very marked. A very long incision was made to the right of the middle line. Pus and gas at once escaped, followed by brownish, very offensive fluid. There was lymph on the coils of small intestine, which I withdrew in order to find the perforation without delay. Ultimately I found a very large laceration, 2½ in. long, across the dilated, oedematous jejunum, high up. The perforation was lying far back in the left flank, near the spleen. I withdrew it, after separating some adhesions, pared the edges, and closed the opening with two continuous fine black threads. Meanwhile, gauze rolls had been draining away the fluid from the flanks and pelvis. There was general peritonitis. A tube containing a wick of gauze was inserted in the pelvis, through a stab wound above the pubis. The main wound was closed completely in layers. The patient was infused throughout the operation. He made a complete recovery.

REFERENCES.

¹ *Lancet*, 1908, vol. ii, p. 1143. ² *Trans. Roy. Soc. Med.*, 1914, vii, 3, p. 96.

A CASE OF INTESTINAL STASIS.

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THE CASE I am about to describe seems to warrant publication more by the multiplicity than by the rarity of the abnormal features it presented. The patient was referred to me by Dr. Cowardin of Guildford with the provisional diagnosis of "colon disease," which was, perhaps, the happiest term that could have been chosen, for the whole of the colon was in a pathological state.

Mrs. W., aged 46, had always been an active woman, and gave a life history free from any abdominal trouble, inflammatory or otherwise, until about five years ago, when she began to be troubled with chronic constipation and colicky pain, which gradually became more persistent; for two years she had had constantly to resort to the use of laxatives, but was often quite constipated for periods of four or five days, generally followed by a few days of diarrhoea. Pain of a colicky nature had for a year been almost constantly present on the left side; it was most severe for about two hours prior to the morning evacuation, which was becoming more difficult.

Considerable quantities of mucus had been passed with the stools for two years, and for some time the stools had taken the form of small, hard, rounded nodules; tenesmus had become a marked feature. She was never sick or visibly distended and melaena had never been noticed. A barium enema was administered and its passage through the colon examined with the fluoroscopic screen. There was no noticeable delay at any point, the opaque material passing round to the caecum in the normal five minutes without any massaging, but there was noticed a very severe kinking of the ascending colon at a point about on the level with the iliac crest; at this point the column of barium was thinned out and, for a time, broken. The splenic flexure appeared in good position, but the hepatic was unusually low. A week later the patient entered a nursing home and a barium meal was administered by the mouth. Four hours later the stomach had emptied and the opaque meal was all collected in the terminal ileum; at eight hours the caecum had begun to fill; at twelve hours the whole of the opaque substance had passed into the caecum and ascending colon.

Fluoroscopic examination showed that the caecum was unusually large and that the ileo-caecal junction was well below the level of the brim of the true pelvis. The ascending colon appeared very short, the hepatic flexure being about the level of the iliac crest.

At twenty-six hours the bulk of the barium was still in the caecum and ascending colon; only a few small pellets of barium were seen in the transverse and upper part of the descending colon down to the level of the kink noticed on giving the opaque enema; but as these all threw small separate shadows, no definite evidence of obstruction at this point could be demonstrated.

The marked general stasis and proptosis of the caecum and ascending colon decided us to advise operation. Through a large paramedian incision the whole colon was explored, working from below upwards. The rectum was normal. The pelvic colon was greatly elongated (about two feet) and lay loose in the cavity of the true pelvis, to the walls of which it was attached by a long loose mesentery which allowed of its being withdrawn freely from the pelvic hollow. The kink seen in the first radiographic examination was a typical "Lane's last kink," being caused by a dense