where fluid was found in the pelvis, that part of the abdomen was drained through a stab wound. The drains were all dispensed with in from two to four days, unless secondary abscesses developed.

Complications. The most common complication found was peritonitis. This was given as the cause of death in 14 of the 21 cases.

Occasionally it resulted in a localized abscess in the pelvis, right lower quadrant, or subphrenic region.

Post-operative hemorrhage and shock were given as the cause of death in three instances. Pneumonia occurred six times, with four deaths.

The other complications recorded were pleurisy with effusion, and abscess of the lung, with recovery in each case.

Results. In the above series of cases, there were 57 recoveries and 21 deaths, a mortality of 26.9%. This is considerably lower than the mortality usually attributed to this condition. As we have stated above, the individuals were, for the most part, poor operative risks. Add to this the fact that the average duration of the perforation was 25.9 hours. Of those who recovered, the average duration of the perforation was 14.5 hours, and of those who died 37.3 hours. Seventeen were operated upon during the first four hours, and all recovered. Of those operated upon from 5 to 12 hours after perforation, the mortality was 17.9%; of those operated on from 13 to 24 hours, 47.6%; and of those from 25 to 48 hours, 66.2%. Ten were operated upon after 48 hours, with 5 deaths and 5 recoveries. Of those who recovered, it should be said that each had a walled-off abscess, and not a generalized peritonitis, thus accounting for the recoveries.

It would appear from the analysis of these cases, as well as from those of other writers, that a high mortality can generally be attributed, not to the technic of operation, but rather to the unpardonable mistake of allowing such cases to wait hours before surgical advice is sought. A certain number of patients are themselves responsible for the error of not having sought in time medical advice for chronic ulcer of the stomach and duodenum, and later for the symptoms of acute perforation. However, a goodly number of others are themselves blameless, having been rather indifferently treated for indigestion, stomach trouble, or even ulcer, without having the importance of following up the treatment and the danger of the existing lesion impressed upon them.

CONCLUSIONS.

1. The history of disturbance of the stomach or duodenum should always be sought for in cases of suspected perforation.
2. Sudden, severe epigastric pain is the most constant symptom in the diagnosis of this condition.
3. Shock is an inconstant symptom.

4. The value of the absence of liver dulness as a sign of perforation of the stomach or duodenum has probably been overestimated.

5. Simple closure of the perforation, with drainage of the peritoneal cavity is the safest procedure in the majority of cases.

6. The mortality can be diminished by greater care in the diagnosis and in the treatment of chronic lesions referable to the stomach and duodenum, so that but few are allowed to reach the stage of perforation, and even those, given the benefit of surgical measures while the chances of recovery from operation are still good.

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III.

CONCERNING TRAUMATIC RUPTURE OF THE DUODENUM AND DUODENAL FISTULA. WITH THE REPORT OF A CASE.*

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THE comparative rarity of rupture of the duodenum, due to injury, and more particularly of cases of recovery from this condition, justify the reporting of a single case and a discussion of the principles involved in its treatment, which are not confined in their application to this particular trouble.

The patient, R. J. S., a schoolboy fifteen years of age, on January 6, 1914, tried to cross the street in front of a slowly moving automobile, but slipped on the ice and fell down in front of it. Witnesses stated that one front wheel ran over his body. The accident occurred at 1.30 p.m. He was able to extricate himself from under the car, and walk to the sidewalk, whence he was taken home, and his physician called, who found him in a condition of shock and suffering a good deal of abdominal pain. He was brought to the Peter Bent Brigham Hospital, about one and a half hours after the injury.

Examination showed a well developed boy in a condition of slight shock; pulse 50, blood pressure 110, respiration somewhat rapid, temperature normal. Except for a slight abrasion on the left thigh, there was no external sign of injury. The abdomen was slightly tender and spastic generally, but there were no localizing signs, and, with the exception of slight dulness in either flank, which did not change on change of position, was practically negative. At this time the points of maximum tenderness were on either side about the level of the umbilicus. The objective signs did not seem to justify intervention at this time, especially as the testimony of witnesses differed as to whether or not the boy had actually been run over or simply thrown to the ground and stunned. When seen again, about three hours later, he looked more sick, had begun to complain of abdominal pain, and showed fairly well-marked

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tenderness in the right iliac region,—scarcely any tenderness in the epigastric region. During examination at this time the patient vomited a small amount for the first time. Pulse was 84. Diagnosis of probable rupture of a viscus was made. An operation was advised, and later accepted.

About eight hours after the original injury, under ether anesthesia, the abdomen was opened in the middle line below the umbilicus, since the evidence seemed to point more to an injury in the lower abdomen than elsewhere, and in the writer's experience the lower part of the ileum had been the most frequent seat of traumatic rupture. Free gas and a large amount of bloody, brownish fluid was found, and sponged out of the pelvis and either iliac fossa. The small intestine was now examined from the ileo-cecal valve without finding any injury. It was not until a sponge was thrust upward toward the region of the gall-bladder that the first correct clew as to the seat of the lesion was found in the appearance of a green staining, evidently due to bile. Another incision was at once made through the right rectus from the costal border downward, and, after considerable difficulty, due to the infiltration of all omental tissues by the extravasating fluid, a laceration admitting a thumb was found on the posterior aspect of the first part of the duodenum about 3 cm. distal to the pylorus. It was circumferential to the long axis of the gut, and its edges were pouting as though it had been caused by a bursting force. Its situation was such that it was in part extra- and in part intra-peritoneal, which made closure difficult, but a fairly good repair was made with chromic cat-gut. The abdomen, all of which showed traces of extravasated fluid, was thoroughly washed out with salt solution, and drains carried down to the injured duodenum and to the bottom of the pelvis. The patient left the table in rather poor condition.

The immediate after-treatment consisted of the Fowler position, proctoclysis, and appropriate stimulation. For the first three days, he showed marked toxemia and seemed to be going down hill, but then began to improve. On the fifth day after the operation, a suspicious discharge appeared in the upper wound, together with evidence of tissue digestion and skin irritation. Soon after, a profuse, bile-stained, extremely irritating discharge became established, which caused the wound to re-open throughout its length, undermining the skin and rapidly digesting the skin edges and the tissues of the abdominal wall. Whatever food was ingested appeared in a few minutes afterward in the discharge, and it seemed unlikely that any material portion passed onward. The boy's general condition was now very poor, showing more prostration and exhaustion than would be expected merely from the lack of nutrition and the amount of obvious infection, since there was no evidence of a general peritonitis. It was evident that, unless the discharge could be stopped, a fatal issue must come. Accordingly, a small rubber tube was carried down to the bottom of the wound, and held in place by appropriate means, and a continuous irrigation of the sinus with sterile water inaugurated,—the overflow being conducted into receptacles by means of a bank of rubber tissue, which was made to adhere to the skin about the wound by means of chloroform. By this means the digestive juices were kept highly diluted, and immediate cessation of the destructive process was noted, together with an improvement in the patient's general condition. This continuous

irrigation was continued for five days and nights, requiring the presence of an attendant constantly by the bedside. On the fifth day, it was omitted in part, because the secretion had markedly diminished, and no more food was appearing, and on the sixth day it was discontinued, and from that time there appeared no more leakage from the fistula, and the wound began to heal satisfactorily. No more trouble was experienced from this source, but the rest of the convalescence was stormy, requiring three subsequent laparotomies in the course of the next month for the drainage of large residual abscesses in the lesser peritoneal cavity, in the right iliac fossa, and in the pelvis, respectively.

He was finally discharged fifty-eight days after his admission, and has since made a complete convalescence, and presents no symptoms referable to this illness.

Ruptures of the intestines by trauma are relatively common lesions, and of these the duodenum, by virtue of its fixed position against the spine, yields its share. Berry and Giuseppi's¹ analysis of 132 lacerations of the intestinal tract gives the following figures:—

Large intestine.....	10
Duodenum	23
Duodeno-jejunal flexure.....	3
Jejunum	32
Ileum	32
"Small intestine" (not further specified).....	25
Large and small intestine together.....	4
Incomplete rupture.....	3

Hertle's² figures in 122 cases are not essentially different:—

Large intestine.....	10
"Small intestine" (not further specified).....	31
Jejunum.....	29
Ileum	40
Duodenum	12

Combining these figures the conclusion is reached that 13.7% of all intestinal ruptures (excluding lacerations due to instrumental perforation of the abdominal wall) involve the duodenum, or nearly twice as many as involve the large intestine (7.8%).

Traumatic rupture, wherever localized in the intestinal tract, is notoriously fatal. Combining the figures of three large series of cases, those of Berry and Giuseppi, Hertle and Travaststjerna,³ we find a general mortality of over 80%. Yet even more striking are the figures for rupture of the duodenum, 92.6%; or, including 4 cases reported in the last year, 93.1%. Several obvious factors contribute to this mortality,—the largely retroperitoneal situation of the duodenum permits the rupture and extravasation to be extra-peritoneal where its evidence is masked until too late, or where it is actually overlooked during exploratory laparotomy. Thus Meerwein,⁴ writing in 1907, states that of 28 cases of extra-peritoneal rupture operated on, in six the lesion was not found until autopsy. The rapid and extensive diffusion of the infiltration is favored by the loose areolar tissues of the pos-

terior abdominal wall, so that huge phlegmons are frequent. The deep-seated and inaccessible tear presents technical difficulties in operative closure. Finally, the noxious character of the contents of the duodenum, whether merely intensely irritating and digestive in their action, or possessed of a specific toxic action, must be reckoned with.

In an interesting paper, Kanavel⁵ reports two cases of traumatic rupture of the duodenum, following the kick of a horse and a blow by a wagon pole, respectively, operated on 52 hours and 34 hours after the injury and presenting a rupture of the retro-peritoneal portion of the duodenum in each instance, and in addition, in the first case, a laceration of the root of the mesentery, which allowed the extravasation to enter the abdominal cavity. Both patients died,—one 6 hours and the other 50 hours after the operation; in both instances it seemed that death was more speedy and apparently the result of a much graver toxemia than would be expected from the degree of peritonitis, or of local injury, existing.

Reasoning from his observation of this peculiar toxemia, and from the well-known fatal course of high intestinal obstruction, both experimental and clinical, in which the secretions of the duodenum undoubtedly play an important rôle, Kanavel ascribes a specific toxicity to the extravasated material. In most of the recorded cases no especial stress is laid by writers upon this point. Sometimes, indeed, the fatal progress of the disease is comparatively slow, as in Maddock's⁶ patient, who was seen six weeks after a severe blow in the right abdomen, when an extensive subphrenic and retroperitoneal phlegmon was incised, followed by death in seven days. Autopsy showed a rupture of the second part of the duodenum. In comparatively few instances has fat necrosis been reported. On the whole, while a specific toxicity may well be suspected, it cannot yet with certainty be ascribed to the duodenal contents, in the absence of changes wrought by stasis and circulatory strangulation incident to obstruction of the gut. Kanavel reviews briefly the literature of this subject to date, including 94 cases which show a mortality with or without operation of 92.6%. Since his paper, a brief review of the literature discloses four additional cases, all operated on and all fatal.

The mechanism of traumatic rupture of the intestinal tract in general is usually described under three heads: a rupture due to (1) a crushing force, (2) a bursting force, and (3) a tear due to sudden traction. In the first group, the intestine must be compressed between the impacting force and a part of the skeleton, as the spinal column or the pelvis. Evidently the third portion of the duodenum, fixed across the lumbar spine, is ideally situated for this lesion, and it is in fact the part of the duodenum most frequently injured. Keller⁷ considers that the bursting rupture is very rare, since it is sup-

posed to require that the loop be full of liquid whose means of egress is obstructed, and since the duodenum is rarely full he believes that its traumatism is not of this character. To the writer, however, it seems probable that the present case belongs to this class, since the automobile wheel mounting upon the abdomen from the right side would naturally drive the gaseous and liquid contents of the second part of the duodenum against the closed pylorus, thus effectually producing a bursting pressure. Moreover, it is difficult to conceive how the first part of the duodenum, retreating from the convexity of the lumbar spine, could be subjected to a direct crushing force sufficient to produce rupture.

The symptomatology of this condition needs no extended comment. Local pain, muscle spasm, tenderness, increasing pulse rate, later vomiting, perhaps shifting dullness in the flanks, leucocytosis, unless the toxemia be overwhelming, constitute the familiar picture of a severe abdominal lesion. A word of warning may be uttered, however. If the rupture be retroperitoneal, the condition may at first be masked, but soon a tender tumor, not shifting, in the right hypochondrium and umbilical region, with evidence of physical shock will give the clue. If intra-peritoneal, the effusion may cause pain not so marked at the point of rupture as in the more dependent portions of the abdomen,—the iliac fossae or the pelvis, due apparently to the intense irritation of the peritoneum by the gravitated contents. In the present case this was the cause of an ill-placed primary incision and loss of time. Absence of liver dullness, a sign handed down from text-book to text-book as pathognomonic of rupture of a hollow viscus, is in reality a hollow mockery. Rarely demonstrable in the early and curable stages of a perforative peritonitis, when found it gives assurance of the correctness of the diagnosis and of the hopelessness of intervention.

When the abdomen has been opened and the lesion identified, what course shall be pursued? Repair of the rupture by suture, resection of the bruised bowel with gastro-jejunostomy and duodeno-jejunostomy, closure of the proximal limb and gastro-jejunostomy, leaving the duodenal contents to find their way through the pylorus and thus into the intestine, have all been successfully practised. It is no time, however, for elaborate procedures. The evidence is overwhelmingly in favor of promptness, simplicity and speed. A simple repair of the laceration by suture, washing out the extravasated material, and the institution of proper drainage are the indications, reserving resections and anastomoses for the rare cases where local repair is impossible. If the patient survives the immediate effects of trauma, the operation for repair of the lacerated bowel, the threat of peritonitis and of a primary retro-peritoneal cellulitis, a complication of gravest portent may be introduced by the failure of the repair and the establishment

of a duodenal fistula. Such a fistula never heals unaided, and if not healed is invariably fatal. Pannett,⁸ writing in 1914, reports a case of recovery from a duodenal fistula, and says but three other cases are to be found in the literature of the previous ten years, and indeed one of these, that of Berg, should scarcely be included, since, although a duodenal fistula following a cholecystenterostomy ceased discharging, the patient died 17 days after operation! W. J. Mayo,⁹ writing in 1914, reports 3 cases due to injury to the duodenum by a clamp placed on the kidney pedicle during a right nephrectomy, all fatal. Subsequently,¹⁰ in 1915, he reports an additional case where he exposed the laceration by transperitoneal mobilization of the duodenum and repaired it, with recovery. Probably further reports will show many recoveries from duodenal fistula, but of its gravity there can be no question. The methods of combating these fistulae are of vital interest to the surgeon confronted by one. The secretion evidently is composed of the gastric juice with whatever food has been taken, the bile, pancreatic juice and succus entericus, or secretion of the duodenum itself. Of these substances, by far the most important is the pancreatic juice with its tissue-digesting enzymes and its alleged specific toxicity incidental to auto-digestion or its own absorption into the blood stream. Another invariable feature of these fistulae is the loss of practically all nutriment taken into the stomach, with consequent rapid failure of nutrition and vital resistance. Efforts then should be directed toward neutralizing or removing the pancreatic juice and increasing the nutrition by rectal feeding, or even by jejunostomy. There is no agent which wholly stops the secretion of the pancreas. So far as is known, it is increased by the presence of food in the stomach, which inaugurates nervous impulses through the splanchnic nerves, causing a secretion rich in the pancreatic ferments, but poor in the alkaline elements. This action may be in part inhibited by atropin. In addition it is believed that the acid gastric juice acting on the duodenal mucous membrane forms a hormone (secretin) which, having been absorbed by the blood, is carried to the pancreatic cells and there stimulates a secretion which is said to be rich in the alkalies and poor in ferments. Reasoning from these premises, it would seem proper to withhold all food from the stomach, or give only that which, like milk, does not excite gastric secretion, to give an alkali to further insure against gastric acidity, and to keep the patient under the influence of atropin. The chief dependence should undoubtedly be placed, however, on the dilution or mechanical removal of the secretion as fast as it appears, either by constant irrigation, as employed in the case reported today, or by some appropriate suction apparatus, as employed recently by Jones¹¹ and Williams,¹² or even, perhaps, by immersion of the patient in the constant bath. It may be noted in this connection

that the pancreatic juice, if removed soon after its entrance into the duodenum, is comparatively harmless since its most important ferment, trypsinogen, is relatively inert until activated by the succus entericus of the duodenum.

Before this audience, it is superfluous to insist on early operation, but it must be urged on those whose experience with abdominal traumas is only occasional. Hertle tells the story in his analysis of 109 cases of intestinal rupture: Of those operated on in the first 6 hours, 48% died; during the 7th to 12th hour inclusive, 54% died; during the 13th to 24th hour, 79% died; during the 24th to 48th hour, 93% died. Later than 48 hours, 80% died (in 16 cases the time of operation is not given). The abdomen should be opened on well-grounded suspicion,—when the diagnosis is sure the golden moment may have passed. The writer's experience has convinced him that in case of a pedestrian struck by an automobile, a concussion of the brain must be regarded as a fractured skull or brain laceration, and a contusion of the abdomen as a rupture of a viscus until proved otherwise, and that the reliable story of the passage of an automobile wheel over the abdomen justifies, or even demands, intervention.

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IV.

CHOLELITHIASIS. AN ARGUMENT FOR EARLY OPERATION.*

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AFTER the symposium on cholelithiasis at the meeting last year there is little to be said on the subject. There is, however, one point I wish to emphasize in this paper. The facts to prove it I shall not deduce from many statistics compiled from many sources, but from the records of one institution only, both autopsy and clinical. The general statement is this, that as soon as the diagnosis of gall-stones is made it is the duty of the doctor in charge, subject to possible complications, to advise operation. The

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