

Retroperitoneal Rupture of the Duodenum Caused by Blunt Trauma with a Case Report*

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RETROPERITONEAL RUPTURE OF the duodenum caused by blunt trauma is being reported with increasing frequency. In few cases has the diagnosis been made early in the preoperative phase, and in several instances it has been unrecognized at laparotomy. The variability of symptoms and signs and the paucity or unreliability of roentgenologic findings in this condition have been stressed by many authors.

We did not make the correct diagnosis preoperatively in the case reported below. In view of what we have learned since, we feel that we should have suspected the true diagnosis on the basis of the history and physical findings (in spite of the inebriation of the patient), and a proper interpretation of the preoperative roentgenograms (Fig. 1) would have resulted in a correct diagnosis, almost to the exclusion of any other possibility (except for concomitant injury). We also feel, on the basis of case reports studied, that from a broad viewpoint the variable signs and symptoms tend to be grouped into a fairly definite pattern, and that roentgenologic studies are of more value than has been generally accepted in the past.

With the opportunities for such an injury increasing, familiarity with this complex in its various phases is essential if the mortality and morbidity is to be decreased (Tables I and II).

CASE REPORT

F. E. K. Register No. 47634, a 49-year-old white male farm laborer, was admitted to the

Wichita VA Hospital, Wichita, Kansas, at 1:00 A.M., April 16, 1954, with the history of having been perfectly well at approximately 3:00 P.M. the previous day, at which time he was fondling the front leg of a horse. The horse lunged, striking the patient on the abdomen and right chest with his shoulder. The patient regarded this as a trivial injury (as did his companion) since he was not knocked down, kicked or rolled on by the horse, and he continued with his normal activities. After a short period he began to have an increasing amount of pain located in the right upper and lower quadrants of the abdomen and the right flank. Ingestion of a pint of whisky failed to alleviate this pain. After vomiting twice and with the pain increasing in severity, he sought admission to the hospital 10 hours after the accident. The past history and system review were non-contributory.

Physical examination revealed an acutely ill, inebriated, white male. Temperature was 37.0° C.; pulse, 78 and regular; and blood pressure, 120/80. Examination of the head and neck revealed no remarkable findings. The lungs were clear on auscultation and percussion. Examination of the cardiovascular system revealed findings within normal limits. There was a small contused area in the left paraumbilical region. There was marked abdominal tenderness, maximum in the right lower quadrant, but also marked in the right upper quadrant. There was spasm of the right rectus abdominis muscle. Rebound tenderness was vaguely referred to the right side. There was a positive psoas sign on the right, and tenderness to light fist percussion at the right costovertebral angle. There were no palpable masses. Bowel sounds were absent. Rectal examination disclosed no abnormalities. The external genitalia were normal. There were multiple scratches on the arms.

Laboratory studies on admission revealed the following: RBC, 4.85 million; hemoglobin, 14.75 Gm.; WBC, 18,800, with neutrophils 93 per cent (including 34 per cent stab cells), lymphocytes 6 per cent, and monocytes 1 per cent. Routine urinalysis and serology were negative. Blood amylase

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TABLE I. Cases of Retroperitoneal Rupture of the Duodenum with Mortality Rates.

	Cases	Died	Mortality %
Schumacher 1910.....	24	22	91.7%
Miller 1916.....	22	19	86.4%
Johnson 1944.....	52	26	50.0%
Cohn et al 1952.....	24	5	20.8%
Cases since 1952 (Table II)...	6	0	0%

was 246 Somogyi units. Roentgenologic examination of the abdomen with the patient upright visualized the right kidney well against a background of translucency but with no free air under the diaphragm (Fig. 1). The initial chest roentgenogram was interpreted as being within normal limits.

Course in the hospital. Shortly after admission the patient was started on continuous gastric suction with a Levin tube and on intravenous fluids (5 per cent glucose in water) to which 500 mg. of oxytetracycline had been added. At 2:50 A.M. (approximately 12 hours after injury and 2 hours after admission) he was operated upon with a diagnosis of an acute high-lying appendicitis or possibly a ruptured intra-abdominal viscus. Spinal anesthetic (Pontocaine), supplemented by Pentothal Sodium and nitrous oxide-oxygen, was employed. A short right paramedian incision was made, and on entering the abdomen there was a slight increase in free fluid, which was brownish colored. Interstitial air could be palpated in the mesentery of the right colon, and in the right half of the transverse mesocolon. The incision was then extended upwards to the costal angle. The mesentery of the cecum, ascending colon and the right half of the transverse colon was infiltrated with interstitial air, as were the subperitoneal tissues of the right lateral wall of the abdomen. There was evidence of hemorrhage and fluid in the right mesocolon, and discrete, darkish "bile spots" were seen subserosally along the cecum and ascending colon. The spleen, liver, stomach, pancreas, (left) kidney, jejunum and ileum and left half of the colon were examined, with no evidence of injury being found. A diagnosis of retroperitoneal rupture of the bowel was then made.

The cecum, the ascending colon, and hepatic flexure were mobilized, in turn revealing a large retroperitoneal collection of thin, black fluid but no loss of integrity of the bowel. Mobilization of the colon was then continued medially, and a gaping hole in the inferior part of the second portion of the duodenum was found. This ran diagonally (more transversely than longitudinally) and extended downward and medially for about 6 cm. The edges were everted and edematous, sug-

gesting a blow-out type of mechanism. When the lateral margin of the duodenum was further mobilized the lesion appeared to involve approximately three-fourths of the circumference of the duodenum. Mobilization of the duodenum was then continued, to permit good control of the extremities of the laceration, and the opening was closed in two layers. The retroperitoneal area exposed by the mobilization was then thoroughly irrigated with 0.9 per cent NaCl solution. Three Penrose drains were placed in the depths of the wound, being brought out through a stab wound in the right flank. The incision was closed in layers.

Postoperative course. The patient was given penicillin and intravenous oxytetracycline for 4 days. The gastric suction was continued for 2 days, and clear fluids by mouth were started the fourth postoperative day. Ambulation was begun the first postoperative day. The wound healed by primary intention. Shortening of the drains was begun on the sixth postoperative day, and removal was completed on the tenth postoperative day. The patient ran a low grade fever for 18 days postoperatively. During the investigation of this, additional roentgenologic examinations of the chest revealed fractures of the third through the seventh ribs on the right, with a small (3 cm.) extrapleural hematoma. These inconvenienced the patient only slightly. He was discharged on the twenty-third hospital day.

Gastro-intestinal roentgenologic examinations on June 11, 1954, and February 11, 1955, revealed slight deformity of the second portion of the duodenum but no evidence of obstruction. He has been working at his usual occupation.

Counseller and McCormack⁴ found in reviewing 17 series of cases of subcutaneous ruptures of the intestines totalling 1183 cases that the large intestine was involved in approximately 10 per cent of the cases, the duodenum in 10 per cent, and the remainder of the small bowel in 80 per cent. Of duodenal injuries, 25 per cent¹² to 33 per cent⁵ have been reported as being retroperitoneal.

There have been several reviews of the literature. Among the best of these, in our opinion, are those of Shumacher (1910),¹² Miller (1916),¹⁰ Johnson (1944),⁸ and Cohn, Hawthorne, and Frobese (1952).³ Each of these after Shumacher has referred to the work of his predecessor(s) in this listing, and has collected only the reported cases appearing after the publication by the

RETROPERITONEAL RUPTURE OF DUODENUM

TABLE II. Cases of Retroperitoneal Rupture of the Duodenum Caused by Blunt Trauma Reported Since Review in 1952 by Cohn, Hawthorne and Froese.³
(Authors' case included)

Author & Year	Age & Sex	Type of Injury	Initial Symptoms and Signs	Time of Injury to Hospital Operation	Lesion	Associated Lesion	Operation	Result
Pirkle 1953 (11)	26 M	Crushing injury Automobile accident	Vomited small amount of blood Severe pain RUQ generalized abdominal tenderness and voluntary spasm of musculature	6 hr. Immediate	Complete tear obliquely across 2nd portion of duodenum just distal to Ampulla of Vater	None	Closed both ends of duodenum. Cholecystostomy Anterior gastroenterostomy Drainage	About 70 days P.O. large posterior wall abscess explored and drained. Recovery.
Keith & Burch 1954 (9)	23 M	Automobile accident Upper abdomen struck by steering wheel	Repeated vomiting, moderately severe mid-abdominal pain	7 hr. 18 hr.	Laceration posterior distal section of third portion of duodenum involving about 1/2 of circumference	None	2 layer closure, Stamm type jejunostomy	Uneventful recovery
Keith & Burch 1954 (9)	31 M	Automobile accident Upper abdomen struck by steering wheel	Unconscious 6 hrs. nausea, progressive weakness, LLQ pain and hematemeses began 4 days after accident	6 mo.	On basis of x-ray studies rupture at duodenojejunal angle	Rt. Colles fract. Lacerated scalp Mult. Contusions	Extraperitoneal drainage of retroperitoneal abscess on 11th hospital day	Discharged 25th hospital day—has returned to work
Strode & Gilbert 1955 (14)	13 M	Fell while running striking abdomen against curb	Minimal symptoms initially but with abdominal pain of increasing severity	20 hr. Immediate	Perforation posterior wall 3rd portion of duodenum	None	Closure of perforation drains	Recovered Discharged on 15th P.O. day
Strode & Gilbert 1955 (14)	39 M	Compression injury across upper abdomen (truck accident)	Moderate abdominal pain, acute tenderness in epigastrium	3 hr. Immediate	Rent in duodenum below ampulla of Vater with extensive trauma above and below this opening	Almost complete severance of head of pancreas	Removal of traumatized duodenum, Jejunoduodenostomy with implantation of common duct. Head of pancreas oversewn	Recovery after stormy convalescence of about 60 days complicated by pancreatic fistula
Rothchild & Hinshaw	49 M	Struck on chest and abdomen by lunging horse	Minimal symptoms initially, increasing abdominal pain, vomited twice	10 hr. 12 hr.	Rupture of 2nd portion involving 3/4 of circumference	Rib fractures?	Closure Drains	Recovered

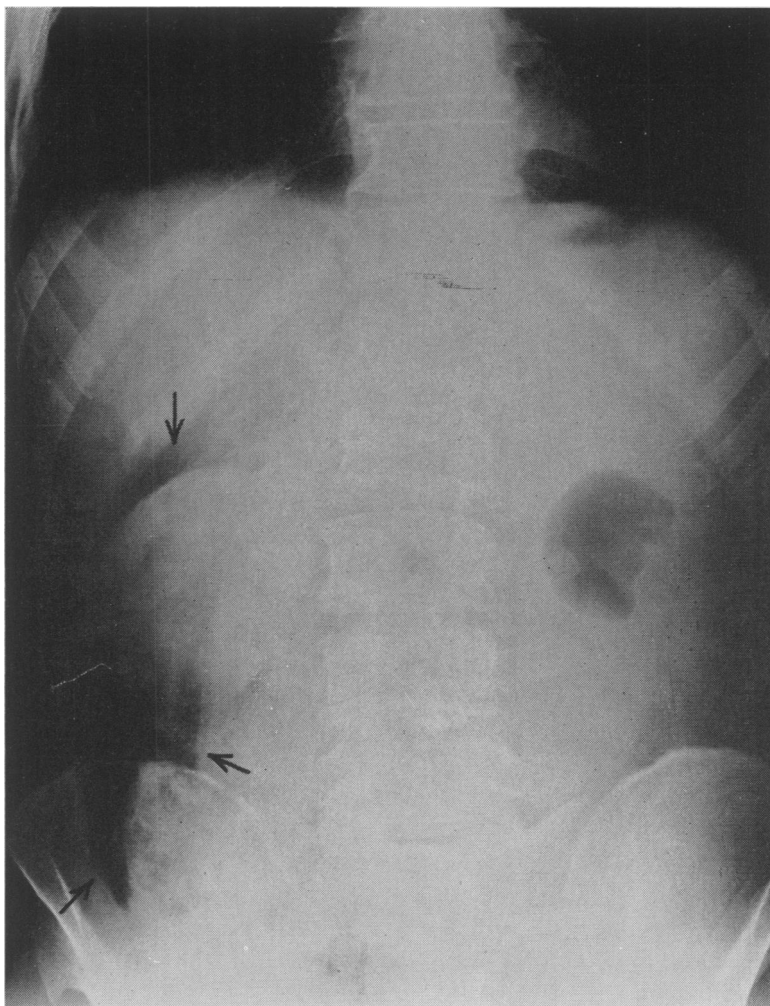


FIG. 1. Upright roentgenogram of abdomen 10 hours after injury. The legend employed by Sperling and Rigler,¹⁸ with Figure 1 of their case report is applicable here. Gas collected about right kidney, right psoas muscle, and retrocecal region is shown (arrows). Note bubble-like character of shadows, characteristic of emphysema of tissues rather than free gas.

immediate predecessor. Thus, in addition to being meritorious articles when considered separately, collectively they give a comprehensive picture of the problem as it existed into 1952. Table I shows the cases reported by each of these authors, and the mortality rates in each series. In this table we have included the six cases of Table II.

The mechanism of the rupture may be one of four types; (1) crushing of the duodenum as it is fixed rigidly against the vertebral bodies; (2) tearing by a tangential force applied to the rigid and fixed retro-

peritoneal attachments; (3) bursting or blow-out caused by the application of a sudden increased pressure on the duodenum while it is functionally closed at both ends by the pylorus and superior mesenteric artery; and (4) a hydraulic type blow-out, with gastric contents being propelled under pressure through an open pylorus and striking the wall of the duodenum with great force. Of these four types, the third, or "blow-out" type, is probably the most common, since the tears are usually quite long, and since the duodenal edges at the time of

operation usually show only edema of the mucosa rather than the diffuse changes that would be anticipated with a crushing type of trauma. The force required to rupture the small intestine was experimentally determined by Andrews¹ to be as little as six to ten pounds.

These injuries have occurred in males in 94 per cent of the cases, and have been caused by kicks from horses, crushing blows from steering wheels, "kneeing" in athletic contests, falls, *etc.* In many instances only trauma of a slight degree is recorded, and in several cases no history of antecedent trauma could be obtained.

Even with a reliable history of trauma the diagnosis in the immediate post-traumatic period may be difficult for several reasons. There may be a relatively symptom-free period described by several authors,^{3, 8} lasting on occasion up to 12 hours. This period is most frequently seen in cases having only a small rupture, or a small retroperitoneal leak, and its duration varies with the size of the rupture, the secretory activity at the time of the accident, the contents of the stomach, the degree of associated ileus, and the patient's tolerance to pain. During such a time the physical findings are minimal, and the roentgenologic findings (which will be discussed in more detail below) are often negative. Pain, with or without slight muscle spasm or distention, often is the only clue to the correct diagnosis, and in the early stages frequently unaccompanied by shock, fever, muscle spasm, or other evidences of peritoneal irritation. This pain is usually high in the right upper quadrant, although occasionally lower, at which time the picture may simulate appendicitis. Flank pain and pain in the right chest are common. A "board-like" abdomen is rare in the early stages and, when seen at this time is usually associated with other intra-abdominal injuries. Testicular pain and priapism have both been reported (Butler and Carlson²) as probably being due to

irritation of the sympathetic nerves retroperitoneally. Both are rare.

The leucocyte count usually ranges from 15,000 to 30,000, and the differential shows a marked shift to the left. Anemia is rare in the absence of an associated injury, since bleeding into the gut or retroperitoneal tissues is usually minimal. Blood may be found in the urine due to trauma of the kidney.

Roentgenologic findings vary from no abnormalities to findings that are almost pathognomonic.

In 1937 Sperl and Rigler¹³ in reporting their case pointed out that the presence of gas in the retroperitoneal tissues could occur in only three ways: by artificial introduction, by infection with a gas-forming organism, and by rupture of a hollow viscus which had a retroperitoneal course. In their case it was unnecessary to consider the first, and the absence of an external wound made the second extremely unlikely. The presence of gas on the right side in the position in which the second portion of the duodenum extended retroperitoneally strongly suggested rupture of this portion of the bowel, although rupture of a retroperitoneal portion of the ascending colon could not be positively excluded.

In 1944 Jacobs, Culver and Koenig⁶ again reviewed the problem of diagnosis in rupture of the retroperitoneal duodenum by means of roentgenograms, and concluded that the high mortality in this injury was largely due to errors in diagnosis and procrastination in treatment, both of which could be obviated if an early roentgenologic diagnosis were made. These authors pointed out that it was estimated that emphysema should be present in over 80 per cent of these cases, and yet prior to the time of their report only three cases had been diagnosed preoperatively by roentgenogram. They postulated that extravasated material (including gas) escaping from the retroperitoneal duodenum will tend to extend along one or several of the following courses:

(1) along the root of the transverse mesocolon, (2) along the root of the mesentery of the small bowel, (3) along both and in the intervening space, (4) over the right (rarely the left) kidney, (5) downward along the route of the mesentery of the ascending colon and cecum, (6) downward along the psoas muscle to the brim of the bony pelvis or to Poupart's ligament, and (7) along the great vessels through the diaphragm into the inferior mediastinum.

In 1951 Jacobson and Carter⁷ reviewed the subject of small intestinal rupture due to non-penetrating abdominal injury and included three cases of retroperitoneal rupture of the duodenum. These, they felt, demonstrated most of the various roentgen manifestations which may be encountered. These are: (1) no evidence of either retroperitoneal air or fluid; (2) retroperitoneal air about the right kidney extending to the paravertebral region and then upwards along the crus of the diaphragm; and (3) obliteration of the right kidney and psoas shadows associated with scoliosis of the spine due to retroperitoneal extravasation of duodenal juices. They point out that just as air has been described as extending to the left, there is no reason to suppose that obliteration of the left renal and psoas shadows could not occur. They also point out that trauma to the kidney or a retroperitoneal hematoma may also produce obliteration of the renal and psoas shadows.

If the possibility of retroperitoneal enteric rupture is considered the patient should be hospitalized. In such a case any of the following may be of significance: an increase in abdominal pain possibly associated with psoas spasm or abdominal muscle spasm; a rise in pulse rate; an elevation of body temperature; an increase in the white count, with a shift to the left of the differential. At this period, re-examination by roentgenograms may reveal significant findings not present at an earlier examination.

Although a few cases have been successfully treated by more conservative methods,

surgical intervention is the only method to be recommended, and consists of mobilization of the duodenum, closure of the rupture, and adequate drainage of the retroperitoneal space, preferably through a stab wound or muscle splitting wound in the flank. Cases of complete and nearly complete severance of the duodenum have been successfully treated by end-to-end anastomosis. In other cases of this type short circuiting procedures have been done in conjunction with duodenal repair or closure because of the fear of subsequent duodenal obstruction.

The surgical program should include (1) early operation; (2) recognition of the defect; (3) mobilization of the involved area of the duodenum; (4) meticulous repair of the defect; and (5) adequate retroperitoneal drainage.

Mobilization of the second portion of the duodenum may be done by the method of Kocher, incising the avascular peritoneum to the right of the duodenal curve, and reflecting the duodenum medially. Good exposure to the third and fourth portions is achieved by retracting the colon cephalically and incising the mesocolon, taking care to avoid the superior mesenteric and midcolic arteries.

The complications reported include retroperitoneal cellulitis and peritonitis (which are the two commonest causes of death in this condition), duodenal fistula, local abscess, subphrenic abscess, subhepatic abscess, duodenal stenosis, pulmonary infections, wound infections, and wound dehiscence. Stenosis of the bile ducts or ampulla as the result of repair has been postulated.

Several factors which are felt to have contributed to the high mortality have previously been mentioned. These include: (1) history of relatively minor trauma with no signs of injury to the abdominal wall; (2) examination during a latent period, the mild and non-specific variations of normal findings present on examination, and the absence of abnormal roentgenologic findings

or the incorrect interpretation of abnormal findings when present. To these may be added the failure of the surgeon to discover the lesion at operation. In the two series reported by Schumacher¹² and by Miller,¹⁰ laparotomy was performed in 37 cases, with the lesion being unrecognized 14 times, the correct diagnosis in these being established at the postmortem examination. In the cases collected by Johnson⁸ the exact nature of the lesion was not ascertained in nine cases, of which seven terminated fatally. This failure to recognize the lesion may be due to two reasons; first, the presence of only minimal findings, *i.e.*, only localized retroperitoneal edema; and second, severe concomitant pathologic findings which hold the surgeon's attention to the point of precluding recognition of the retroperitoneal duodenal rupture.

Laceration of the liver has been the most frequently observed severe concomitant injury.⁸ Other concomitant injuries reported include those to kidney, stomach, pancreas, and other portions of the intestines, as well as fractures and head injuries. Multiple and simultaneous intraperitoneal and retroperitoneal injuries to the duodenum have been found.

SUMMARY

Rupture of the retroperitoneal duodenum caused by blunt trauma and the causes of its high mortality are discussed. Attention is called to the significant radiologic findings which may be present, and to the ease with which they may be overlooked.

Attention is also called to the ease with which the correct diagnosis may be missed at operation.

A case is presented.

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