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Blunt Injuries of the Abdomen

*Chester C. Guy**

MANAGEMENT OF CLOSED abdominal injuries, produced by blunt violence, is one of the most challenging problems that the surgeon has to meet. It is usually made difficult by presence of associated injuries of the head, chest, or extremities, and the obvious severity of these may largely or completely mask the early evidences of abdominal visceral injury. It should be emphasized that, in general, injuries of the head and chest take precedence over those of the abdomen, and it is in the "multiple-injury" cases that intra-abdominal injuries are most frequently overlooked or undertreated. Blows to the abdomen received in sports or industrial accidents are promptly recognized and the patient carefully observed. It is those sustained in a serious automobile crash, a fall from a height, or a blast that present the diagnostic problem.

The Diagnostic Problem

Observations from autopsy, as well as experience in military and civilian practice, permit asserting some basic principles underlying diagnosis and treatment of these injuries. The first is that even if there is no early clue to its presence, abdominal injury should be suspected in all victims of an accident which might have produced it. A minimum requirement is that the patient be hospitalized and examined at frequent intervals during the first 12-24 hours, particularly if he is under the influence of alcohol.

History should include the time of the most recent meal, bowel movement, and urination, and information concerning tetanus immunization, sensitivities to penicillin or other drugs, allergies, malaria, and bleeding tendencies.

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[Note: This is a digest by the Editors of this Law Review, of a medical article by the author in the Oct. 1962 issue of the *Journal of Occupational Medicine*, as approved by the author and the latter, and with permission. It has been simplified, for use by attorneys.]

Symptoms and Signs: Pain

Pain is perhaps the most reliable single symptom of abdominal injury.¹ It comes largely from an insult to the parietal peritoneum² since the visceral peritoneum³ is insensitive to pain unless it is inflamed. Therefore, pain developing or increasing several hours after injury suggests peritoneal inflammation, which usually indicates a perforated viscus⁴ demanding exploration. A rupture of the small bowel may be temporarily sealed off by the omentum⁵ or by eversion of the mucosa and muscular contractions of the bowel wall. The immediate pain then may be minimal. Hours later leakage occurs, producing peritonitis⁶ and severe pain; therefore, frequent examinations are necessary. Abdominal injuries producing shock may be relatively painless until shock is overcome.

Persistent, increasing pain, localized or spreading, is an indication for exploration, as is an immediate pain which disappears and then recurs. Shifting pains can be watched. Referred pains to the shoulders mean diaphragmatic irritation; if on the left side, splenic damage is possible. Severe referred pain to the loin and testicle suggests kidney damage that can be treated expectantly.

Very important questions have never been answered to the satisfaction of all: Of itself, does hemorrhage into the peritoneal cavity cause pain? If so, how much blood is required to produce pain? Must it be clotted? Brady,⁷ writing on ectopic pregnancy,⁸ states that the pain is due to escape of blood. But after the initial pain (which may be due to tubal rupture or contractions),⁹ many women have comparatively little pain even when the abdomen contains much blood. The pain of ovulation may last

¹ Guy, Diagnostic Value of Pain in Nonpenetrating Abdominal Injuries, *Illinois Med. J.* 107 (Feb. 1955).

² Lining of the abdominal walls (peritoneum—the smooth transparent serous membranes that line the cavity containing the digestive organs and other viscera).

³ The same membrane which encloses these viscera.

⁴ Internal hollow organ—such as stomach or bowel.

⁵ The fatty apron which covers the small intestines.

⁶ Inflammation of the peritoneum.

⁷ II Brady and Anderson, *Ectopic Pregnancy*, in *Lewis' Practice of Surgery*, 18, 21 (Hagerstown, Md.; W. F. Prior, curr. ed.).

⁸ Pregnancy occurring in the fallopian tubes.

⁹ Cope, *The Early Diagnosis of the Acute Abdomen*, 136, 179 (London; Oxford, 11th Ed., 1957).

only a few hours, but days later considerable blood may be found in the pelvis at operation. I am quite convinced that uncontaminated liquid blood in the abdomen does not of itself cause continued pain. Of course, I am not referring to such lesions as a localized perisplenic hematoma¹⁰ with its painful pressure effects in the left upper quadrant.

Abdominal Examination

Abdominal examination closely follows pain in diagnostic importance. It cannot be done hurriedly or with a cold hand. Bruises and abrasions are to be noted. Inconsistent or contradictory findings indicate re-examination in an hour. Chest injuries, diaphragmatic pleurisy, and even coronary thrombosis are all known to produce abdominal findings. The character of the respiratory excursions may be helpful: if the breathing is all thoracic in type, an abdominal injury is suspected; if the abdominal wall heaves with each respiration, a thoracic injury is likely, especially if there is cough and hemoptysis.¹¹ In differentiating between thoracic and upper abdominal injuries, the following observation described by Cope is helpful. If the patient complains of pain in the left upper quadrant, the examiner can palpate the right upper quadrant and push to the left. If this increases the pain, there is probably an abdominal injury. The same is true with right-sided pain. If the patient is not in severe pain but is restless and frequently changing his position, spreading peritonitis is unlikely, but intra-abdominal hemorrhage is very possible. It is dangerous to attribute restlessness to alcoholism.

Rigidity of the abdominal muscles has probably caused more mistaken diagnoses than any other single finding. True involuntary abdominal rigidity is never localized. Right lower quadrant rigidity is voluntary rigidity or "guarding." Sudden pressure with a cold hand may cause a reflex muscle spasm, especially if it produces pain. Rovsing's test or sign and so-called "rebound pain" can be misleading. An inflammatory mass near the anterior abdominal wall may produce guarding on pressure over it, but gentle simultaneous pressure with both hands in both lower quadrants may reveal that the abdomen is soft. Gentleness and the patient's confidence that he will not be hurt are

¹⁰ Type of blood clot.

¹¹ Coughing of blood.

requisites too often overlooked. Injuries limited to the abdominal wall only, such as a ruptured rectus muscle,¹² may produce rigidity suggesting an intra-abdominal insult. A true diffuse rigidity, the "boardlike" abdomen of a ruptured peptic ulcer, means a diffuse peritoneal insult, and when found in a traumatized abdomen, it means a ruptured hollow viscus until proved otherwise. In overwhelming peritonitis of considerable duration, especially in old or debilitated patients, the peritoneal nerve reflex mechanism may be paralyzed, and the abdomen may be perfectly soft with no particular tenderness. In these cases the surgeon is surprised and embarrassed to be shown an abdomen full of pus by the pathologist at autopsy.

Abdominal distention¹³ has various meanings after injury. Seldom is there enough free air, fluid, or blood in the cavity to distend it. Fluid or blood can only be diagnosed by noting a shifting dullness with changes of position, or by abdominal or cul de sac needle-puncture. Abdominal distention is almost always due to dilatation of the gastrointestinal tract by fluid or gas or both. This results from ileus¹⁴ due to paralysis of the peristaltic mechanism. It may be purely reflex in nature, as with spine injuries, or it may be due to peritonitis. With the former, there may be no particular pain or tenderness. If due to peritonitis both tenderness and pain are part of the picture. Regardless of the cause, the abdomen in ileus is silent or almost so. Splashing noises should not be confused with the sounds of true peristaltic contraction.

Auscultation¹⁵ of active high-pitched peristaltic sounds in a distended abdomen indicates organic obstruction, and this is not seen early after abdominal injuries. Hemoperitoneum¹⁶ per se does not abolish peristalsis,¹⁷ as anyone managing ruptured ectopic pregnancies knows. In fact, hemoperitoneum may stimulate peristalsis, an observation not generally recognized,¹⁸ and it may produce a palpable friction rub or crepitus that is very

¹² Straight vertical muscle of abdominal wall.

¹³ The condition of being expanded by pressure from within.

¹⁴ Paralysis of the bowel.

¹⁵ The use of hearing for signs of changes in the body.

¹⁶ Effusion of blood into the peritoneal cavity.

¹⁷ Vermiform movement of the intestine or other tubular structure.

¹⁸ Farrell, Nonpenetrating Abdominal Trauma, 43 Florida M. A. 1104 (1957).

typical. The effect of morphine in abolishing peristaltic activity must be remembered.

Vomiting after abdominal injuries means very little unless there is hematemesis¹⁹ which speaks of course for injuries to the stomach, duodenum, pancreas, and sometimes to the spleen. Acute gastric dilatation is common after thoracic or abdominal trauma; this may be serious.

The pulse rate may be slow at first even with extensive intra-abdominal hemorrhage. Later a rising rate suggests hemorrhage or peritonitis or both. The same may be said for falling blood pressure after immediate shock is treated. Increasing intracranial pressure after head injury produces a rising blood pressure and a slowing pulse, the opposite of that found in shock. Therefore, when a patient with a head injury shows evidence of shock, intrathoracic or intra-abdominal hemorrhage must be seriously considered, as it must be when adequate treatment for shock does not result in improvement. Shock due to spreading peritonitis may be resistant to blood transfusions, and excessive intravenous blood and fluids in such cases may cause pulmonary edema.²⁰

The temperature (rectal, of course) is usually subnormal at first. A rapidly rising temperature to 102° or higher suggests thoracic or kidney injuries.

Rectal examination may reveal cul-de-sac tenderness which is present with hemoperitoneum and pelvic peritonitis. Blood in the rectum is found in cases of sigmoid or rectal perforation.

Surgical and Laboratory Procedures

Abdominal puncture is relatively safe and may be of great value if it reveals free blood, bile, gastrointestinal contents, or exudate. It can be done in all 4 quadrants if inconclusive in the first 3. Strickler²¹ has described the technique well. He uses local anesthesia and a 4-in. styletted 14-gauge needle, through which is passed 5-7 in. of polyethylene tube. After the needle is removed, aspiration is done through the tubing. The danger of bowel puncture has been exaggerated, and the procedure may be repeated if early attempts were not diagnostic. It may be of

¹⁹ Vomiting of blood.

²⁰ Accumulation of excessive watery fluid in the lungs.

²¹ Struckler, Erwin, and Rice, 77 A. M. A., Arch. Surg. 859 (1958).

particular value in the comatose²² patient. Byrne²³ found it positive in 78 of 82 patients with intra-abdominal injuries proved at operation.

Blood counts and hematocrit²⁴ readings usually have to be repeated. Intra-abdominal hemorrhage usually raises the white blood count to 12,000 or higher. The meanings of other alterations in these test results are fairly well known.

Urinalysis, usually by indwelling catheter drainage, is essential to determine hematuria and to measure output during therapy.

X-ray studies of the abdomen are almost always essential in closed injuries. The usual "flat plate" is of little value. The lateral view may reveal retroperitoneal emphysema²⁵ or pneumoperitoneum²⁶ and the upright view free air under the diaphragm. With an upright patient a plate of the chest takes only a few additional moments. Interpretation of "portable" films is often difficult and misleading. If a patient is sick enough to be considered for emergency abdominal surgery, he is usually well enough to warrant X-ray study. It can even be done en route to the operating room.

Special Intra-abdominal Injuries

Rupture of the diaphragm results from severe crushing injuries of the lower chest wall.

Splenic rupture is always to be suspected in left upper quadrant abdominal blows, and in fractures of the left tenth to twelfth ribs. It is to be considered if left upper quadrant pain radiates to the left shoulder, if there is displacement of the gastric air bubble to the right (on X-ray), and if there is shifting abdominal dullness, increased splenic dullness, and a falling hematocrit, with or without pulse and blood pressure changes. If splenic injury is suspected and the patient improves, he should be kept under observation for at least 2 weeks, because secondary splenic hemorrhages are as serious and fatal as primary ones.²⁷

²² In a state of coma.

²³ Byrne, Nonpenetrating Wounds of the Abdomen, 74 A. M. A., Arch. Surg. 786 (1957).

²⁴ Separating of the cells and other particulate elements of the blood from the plasma.

²⁵ Inflation by air of the cellular tissue behind the peritoneum.

²⁶ The presence of air or gas in the peritoneal cavity.

²⁷ Guy, Ruptured Spleen, Illinois M. J. (Nov. 1938).

Secondary hemorrhages seldom occur later than 2 weeks after injury.

It is to be remembered that an enlarged spleen may be ruptured by minor trauma. It is said that a popular method of assassination in some malarial countries is to strike an enemy in the splenic area.

Kidney injuries cause hematuria, flank pains and masses, fever, nonvisualization with intravenous pyelograms,²⁸ and extravasated²⁹ dye with retrograde pyelograms.

Liver injuries occur with fractures of the right lower ribs and crushing trauma. When lacerations are severe, death from hemorrhage usually occurs rapidly. When they are minor, they will heal without treatment and are usually unrecognized. In my experience hemorrhage is usually either too severe to be treated successfully or too minimal to be important. The major dangers in liver lacerations are the escape of bile and the secondary infection of devitalized liver fragments.

Ruptures of the small bowel and left colon may not give early signs of severe peritonitis, because of reflex contraction of the small bowel and the formed nature of the colon stool content. Several hours later the signs of leakage and peritonitis become apparent.

Ruptures of the right colon cause immediate leakage of liquid feces and rapidly appearing peritonitis.

Ruptures of the stomach and duodenum may cause hematemesis and early peritonitis. Retroperitoneal duodenal ruptures cause severe pain radiating to the back or loin³⁰ and probably are the injuries most commonly overlooked during surgical exploration.

Pancreatic injuries are seldom single. An early elevation of blood amylase and the formation of a mass later may be diagnostic. The mass is the so-called pseudocyst of the pancreas and consists of fluid in the lesser peritoneal cavity.

Ruptures of the urinary bladder are usually caused by penetrations of bone fragments after a fracture of the pelvis. Occasionally a kick or blow will rupture a distended bladder; persons drunk and in a fight are particularly liable. Inability to pass

²⁸ X-ray of the kidneys.

²⁹ Pass out of a vessel into the tissue.

³⁰ Frost and Guy, Multiple Duodenal Perforations, 37 *Am. J. Surg.* 319 (1937).

a catheter may be due to a ruptured urethra or to an old stricture. If blood only is obtained, a severe injury is almost certain; if a large amount of blood-tinged urine is obtained, a simple bruise only is probable. When in doubt, 200 cc. of a sterile opaque solution may be instilled and an X-ray made if less than 200 cc. can be withdrawn.

Treatment

Conservative

Conservative (nonoperative) measures are justified in several situations: if the patient is moribund; if diagnosis is impossible because of other serious injuries (to head and chest) or because the patient is intoxicated, comatose, or completely uncooperative; if the injuries occurred 24-48 hours earlier and the patient is obviously improving; if kidney injury alone is probable; if liver injury alone is probable and the patient has minimal symptoms or is improving; or if chest or head injuries requiring emergency operation take precedence over those of the abdomen.

Emergency and Preoperative

The measures taken prior to operation include:

1. Intra-gastric suction to empty the stomach and prevent gastric dilatation
2. Insertion of a Foley catheter in the bladder
3. Administration of intravenous fluids (5% dextrose in water) running in one or more large (No. 15) needles (A cut-down should be done if there is any question.)
4. Securing of blood substitutes (Dextran or plasma) while typing and crossmatching is being done for transfusions
5. Use of endotracheal anaesthesia if there are associated head or chest injuries or if trauma of the upper gastrointestinal tract is suspected (Spinal anaesthesia is unwise if the patient is in shock.)
6. Making available a tracheostomy set if any associated chest injury is suspected

Operative

[Discussion of surgical exploration procedures, at some length, is omitted from this digest.]