

ACUTE APPENDICITIS FOLLOWING MOTOR VEHICLE ACCIDENT

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This paper concerns a 21 year old male, weighing 115 pounds and 5 feet 5 inches in height who was driving his car when he was involved in a minor accident on December 10, 1970. The patient's car which had stopped at an intersection was struck in the rear by a truck. On impact the patient was thrown forward and suffered a whiplash sort of injury to his neck, a contusion to his forehead and a steering wheel injury to his abdomen in the right lower quadrant. The patient received emergency treatment at a hospital where his head and neck were X-rayed and was discharged the same day to be treated by his family physician.

Next day this patient was seen in his doctor's office. The presenting complaints and symptomatology referred again only to a contusion to his forehead, and to his stiff neck; there was some right lower quadrant minor abdominal pain. Outwardly there was no evidence of contusion or any skin markings on the lower abdomen.

Over the weekend the patient had epigastric pain and nausea and vomiting. He had coffee grounds vomit which at the time he attributed to some virus infection.

On the Monday the patient went to the Emergency Department of another hospital, complaining of severe abdominal pain. The diagnosis of acute appendicitis was considered very likely. However, the patient's pupils were noticed to be unequal and a minor strabismus was noted in one eye. A neurological consultation was requested. The neurologist ascertained that the neurological findings were unrelated to the abdominal findings and the acute abdomen had to be treated on its own merits. His temperature was 36°.7C. White count was 16,200. His abdomen was very tender in the right lower quadrant at McBurney's point with rebound tenderness.

Next day the patient was operated for

acute appendicitis. There was no free fluid in the peritoneal cavity but the omentum occluded the operative field completely. The caecum and the area of the appendix were covered with dense, thickened, fibrinous, oedematous adhesions. The appendix was retrocaecal and retroperitoneal in position and was kinked on itself. A point of perforation was noted at the site where the appendix was folded on itself. The appendix was removed in a standard fashion. The patient tolerated the procedure well.

The post-operative course in the first twenty-four hours became tempestuous. The patient went into haemorrhagic shock. The haemoglobin went down to 7 grams. He had a tense abdomen. Exploratory laparotomy showed gross intraperitoneal haemorrhage. The source of bleeding was not clearly determined, in spite of the fact that a second midline upper abdominal incision was made to exclude any bleeding from the spleen or liver. The only finding was a small amount of sanguinous ooze from the region of the appendicular stump. At the time it was thought that this might have been the site from which the haemorrhage originated. Blood transfusion was given. Recovery was subsequently uneventful and the patient was discharged from hospital on the 29th December.

Pathology Report. The specimen consisted of an appendix measuring 6.5 x 0.6 cms. The appendix was dilated. The external serosa showed fibrous exudate. The lumen contained a large quantity of purulent and blood tinged material. The mucosa was necrotic in the midportion. The rest of the mucosa was congested.

Diagnosis. Acute suppurative appendicitis.

Cases of Acute Appendicitis as a Result of Blunt Injury to the Abdomen

In looking through the medical

literature there was not one case of acute appendicitis recorded resulting from blunt trauma to the abdomen.

Blunt Injuries to the Abdomen

Blunt injuries to the abdomen are becoming quite prominent due to the increasing number of motor vehicle accidents. All structures forming the abdominal wall and its organs can be affected in these blunt injuries, such as fractures of the vertebral column with or without paraplegia; injuries to the abdominal aorta; injuries to the liver and spleen; injuries to the pancreas and common bile duct; injuries to the gastrointestinal tract such as the stomach, duodenum, small intestine, large bowel; or injuries to the kidneys and genitourinary tract. Some of these injuries are well known while others are not so common. Here are some of the more unusual cases recorded in medical literature classified as to type of organ injured.

1 — Aorta

A 54 year old woman was involved in a head-on motor vehicle accident, at a moderate speed, suffering a steering wheel injury to the abdomen. On exploration she was found to be suffering from a partial disruption of the abdominal aorta which was causing a subintimal dissection of the abdominal aorta with partial and subsequently total occlusion of the superior mesenteric artery and the left renal artery resulting in gangrene of the terminal ileum and of the left kidney. There were normal femoral pulses in both limbs. In spite of a total abdominal colectomy and resection of the gangrenous terminal ileum followed by ileosigmoidostomy the patient died on the second postoperative day from anuria.

2 — Complete Transection of the Common Bile Duct

A 25 year old man was admitted to hospital three hours after an automobile accident in which he had been forcibly thrown against the steering wheel. Initially it was thought that he was uninjured. Three hours later, however, he developed acute pain in the upper abdomen for

which he was subsequently operated. A rupture of the common bile duct with no other associated abdominal injuries, was found. The tear was repaired and the patient made a complete recovery.

3 — Rupture of the Duodenum

The largest published statistics indicate that duodenal rupture occurs once in 100 cases of internal injury resulting from blunt trauma to the abdomen. Out of 101 surveyed cases of rupture of the duodenum caused by blunt trauma to the abdomen, 23 were victims of automobile accidents (of whom 13 were steering wheel type of injuries to a driver not protected by a seat belt), 11 were victims of other transportation agents (such as train, streetcar, bicycle and motorcycle), 19 were injured in falling from a height or when hitting the abdomen against an edged object, 20 sustained a blow to the abdomen (such as by a fist, a foot, a horse's hoof), 17 were crushed between a moving and an immobile object (usually between a truck and a platform or wall), in 11 the cause of injury was not reported, not determined or different from those above.

4—Intramural Haematoma of the Jejunum

Until 1966 less than 75 cases of symptomatic duodenal haematoma had been recorded in medical literature. Most cases were reported to have been caused by a blow with a blunt object with rare mention of seat belt. There is one case report of a 12 year old girl who was involved in an automobile accident. She was seated in the back seat with her seat belt placed over her abdomen. She presented to the Emergency Department with ecchymoses and pain in the back over the upper lumbar and lower thoracic vertebrae and a seat belt mark over her upper abdomen. Thirty-one hours after admission the patient developed symptoms of acute upper gastrointestinal obstruction for which she was operated. On the fourth hospital day laparotomy revealed a large hematoma in the wall of the jejunum. The hematoma was between the muscle layers and was very adherent to the inner layers of the jejunal wall.

5 — Gangrene and Slough of Small Bowel

A 56-year old woman suffered a steering wheel injury in her right flank. There was no evidence of external trauma. The vital signs were within normal limits. Supine and upright X-rays did not demonstrate any free air but there was moderate "diffuse ileus". Over the following three days she had temperature elevations to 103°F. Her abdomen was distended and tender and she began to pass tarry stools for which she was given three units of blood. On subsequent laparotomy she was found to have a free segment of gangrenous bowel completely devoid of mesenteric attachments with intraperitoneal free faecal material. To avoid further peritoneal contamination, exploration of the cavity was limited and the free ends of the bowel were not identified. Multiple drains were inserted in the cavity with a Chaffin tube and the wound was packed open. On the eighth post-operative day a laparotomy was performed and an ileo-transverse colostomy was made. The patient was discharged ten days later having been in hospital for thirty days.

6 — Abdominal Aortic Rupture

Rupture of the abdominal aorta was described in a 31 year old man who survived the injury caused by blunt trauma in a motor vehicle accident and was admitted to hospital in no acute distress. Due to alteration of his vital signs he was operated upon twenty-four hours later and a tear was found at the aortic bifurcation which was repaired, the patient proceeding to complete recovery.

Mechanism of Blunt Traumas to the Abdomen

Blunt injuries to the abdomen may cause trauma to the abdominal organs in one or more of the following ways:

1 — A crushing force. A viscus or organ may be crushed against the spine or pelvic bones by a violent, direct external force applied to the abdominal wall such as by a steering wheel or a seat belt. Such a direct blow may cause a contusion or a tear to the wall of the organ or to its blood supply or to both. The areas of the

gastrointestinal tract that are likely to be injured by such a force are the parts that are relatively fixed such as the duodenojejunal junction and the ileo-caecal junction as well as any adherent loop of bowel.

2 — Blow-out injury. Compression of the abdomen by sudden deceleration may cause a blow-out injury to a viscus that contains fluid if the viscus is sealed at both ends and presents as an airtight compartment. The sudden compression may cause an explosive force within the viscus to tear the wall of that organ.

3 — Shearing force. This kind of injury may occur when there are two fairly large organs at opposite ends which move in opposite directions while attached together to a relatively fixed centre. Such a shearing force may cause a tear of the relatively fixed duodenum when the stomach and the liver on its one side and the intestinal mass on the other side move rapidly in opposite directions. A similar injury may occur at the ileo-caecal junction which is relatively fixed, having the mobile large bowel on the one side and the small bowel on the other side.

4 — Sudden and extensive hyperextension of the lumbar spine may also cause a tear of the aorta or the duodenum.

5 — Perforation of a wall of an organ may be caused by a "jetstream" ejection of fluid through a small aperture in a viscus such as the stomach, gallbladder or the caecum. Sudden abdominal compression by ejecting the fluid contents through a narrow outlet in a viscus such as the pylorus or cystic duct may cause a tear in the wall of the duodenum or the cystic duct, if the force of the stream is sufficiently great.

6 — Rapid deceleration by causing sudden compression of the abdomen followed by a sudden decompression may cause a special type of shearing force injury which has been described as a "whiplash" abdominal injury. The importance of such an injury lies in the fact that no direct contact with the abdominal wall is necessary. The mechanism of action producing this type of injury is the same as that resulting from the cracking of a whip or a whiplash injury of the neck. The organs most susceptible to this kind of in-

jury are those which are relatively mobile and attached by a mesentery such as the small bowel. The point of fixation is represented by the root of the mesentery and the shearing force is transmitted along the somewhat radially arranged arteries. A wave-like motion is transmitted through the mesentery to the bowel. When the force is of major proportions a rupture of the primary mesenteric artery or a detachment of the mesentery from the bowel wall or its root may result.

Anatomical Considerations

The appendix is not immune to intra-abdominal injuries.

These are some of the anatomical considerations which make the vermiform appendix susceptible to inflammation following injury:

1 — The narrow lumen and serosal covering of the appendix. Trauma to the appendix stimulates immediate hyperplasia of the lymphoid tissue in the submucosa. This could block the lumen of the appendix with accumulation of secretions causing passive congestion and edema in the appendiceal wall resulting in obstruction to the circulation with secondary infection.

2 — The appendix lacks a true mesentery which would help to absorb any congestion or edema of the appendicular wall.

3 — The arterial blood supply is an end artery arrangement lacking arterial anastomosis. Any blockage of the arterial blood supply would therefore result in gangrene of the appendicular wall.

4 — The position and size of the vermiform appendix may vary from patient to patient and each injury has to be taken on its own merits.

Mechanism of Blunt Trauma to the Appendix

1 — A crushing injury to the abdomen may compress the appendix between the external abdominal force and the pelvic bone. The result of such an injury may be a contusion, a laceration or a transection of the appendix depending on the type of blunt trauma and the position of the appendix.

2 — A sudden compression-decompression abdominal injury may cause kinking of the body of the appendix resulting in obstruction to the lumen with subsequent obstruction to the blood supply.

3 — A crushing injury to the abdominal aorta or to the superior mesenteric artery or to its ileo-colic branch may similarly cause vascular injury in the form of arterial spasm, laceration or transection of the artery, thrombosis or embolism resulting in acute appendicitis.

Discussion

In this case the driver was a very lean individual. He was not expecting a collision. His abdominal muscles would therefore be in a relaxed position. He was thrown forward across the steering wheel suffering a crushing abdominal injury in the right lower quadrant. The vermiform appendix was retro-caecal in position, and therefore relatively trapped behind the caecum. The haematemesis and post-operative intraperitoneal haemorrhage were inexplicable and it is quite possible that there was a concomitant vascular injury to the abdominal aorta or to the superior mesenteric artery. The symptomatology developing on the second and third day after the accident was referable to the appendicitis. On the fourth day the clinical diagnosis of acute appendicitis was made. On the fifth day an acute suppurative appendicitis with an area of perforation was determined at surgery. Acute appendicitis is a common occurrence in young people, 21 years of age or younger and the cause is not always very clear. Many writers at one time or another have suggested trauma as a very likely cause of acute appendicitis in this most active and violent age group.

Conclusion

There are many recorded cases in the medical literature where it has been determined that blunt injury to the abdomen may injure any organ or structure within the abdomen. There were, however, no recorded cases of acute appendicitis resulting from blunt abdominal trauma.

The vermiform appendix is not immune to blunt abdominal trauma. As a

matter of fact, by its anatomy and position, it is a very vulnerable structure.

This is one case recorded in this paper where acute appendicitis has followed a steering wheel injury. It is hoped that this incident will draw attention to similar cases considering the great frequency of motor vehicle accidents.

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