

## TRAUMATIC APPENDICITIS

BY RICHARD J. BEHAN, M.D.

OF PITTSBURGH, PA.

MOOREHEAD, in his book on "Traumatic Surgery," states: "It seems highly improbable that any sort of violence could produce a lesion of such deep-seated, movable and well-protected tiny piece of intestine as is the appendix, and yet do no damage to surrounding intestine nearer the source of violence and far more vulnerable."

In view of this statement let us first consider the anatomic fact, that the appendix is not always as freely movable as Doctor Moorehead would have us believe. Very frequently it is changed by past diseases so that either the walls are sclerosed by a prior inflammation or an inflammatory process had spread into the meso-appendix, so that it became thick and unyielding. As a consequence of this thickening the free border of the meso-appendix is shortened and the appendix is curved on itself or is slightly angulated, so that in the latter instance, when the intra-luminary pressure in the appendix is increased, the mucosa is stretched and a tear may occur with extravasation of some of the intestinal contents (fæces with associated bacteria) into the submucous layer and there is produced either a progressive and active or a slumbering inflammation.

The intra-luminary appendicular pressure may be increased by any force which decreases the intra-abdominal space. This force, however, must be suddenly exerted, for instance, a squeeze of the abdomen not severe enough to bring about a rupture of a viscus or a sudden blow upon the abdomen (the blow not necessarily being over the area of the appendix). The force must be of sufficient violence to produce a rupture of the mucosa with resulting infiltration and inflammation. If the blow is over the appendix and the abdominal muscles are caught in a state of relaxation, even a bruising of the appendix might possibly occur. However, what most likely takes place is that by the blow, the abdominal muscles are thrown into a state of violent contraction and press forcibly upon the intestinal viscera.

If the colon and cæcum are filled with fecal matter or with gas, the lumen of the appendix is forced open and some of the contents of the cæcum are pushed in. If there is a constriction of the lumen of the appendix, the mucosa is torn and if in addition an enterolith is present, the rebound of the fecal mass from the increased intra-luminary pressure may close the opening entirely. An accumulation of fluid occurs in the lumen. The increase of the intra-luminary pressure causes pressure on the veins, so that congestion and œdema of the walls of the appendix follow. The follicles and crypts are opened. There may be minute traumatisms (Zwalenburg, p. 443).

If the obstructed lumen of the appendix is now forced open, the inflammation recedes. Should the obstruction be continued, the inflammation

becomes more and more violent and distention, gangrene and perforation of the appendix results. If the lumen contains no concretions and is not constricted, then when the appendix is suddenly distended by gas forced into its lumen from the cæcum the appendiceal valve is stretched and the appendix is suddenly straightened out and rupture of the mucosa is produced; as a rule, either at the base or near to the tip. On examination of such an appendix it is frequently found that the mucosa lies more or less free in the lumen; the pus has apparently dissected it free from the muscularis. If the process is very advanced the mucosa may be entirely destroyed and the appendix becomes totally gangrenous.

However, if the progress has advanced gradually, the inflammatory area surrounding the appendix may be walled off and a localized abscess results. If, however, the course of the disease is rapid and no peri-appendicular adhesions have taken place, there is a sudden and stormy appendicitis.

Traumatic appendicitis may also be the result of injury to the appendix mucosa by foreign bodies, such as pins, seeds, grapes or enteroliths. Injury to the mucosa of itself is not dangerous as long as there is no obstruction of the lumen, which of itself is a potent cause of appendicitis, and it is the most important cause of the disease. Obstruction by kinks, twists, block the circulation and may produce gangrene.

If a sudden contraction, either of the musculature of the cæcum, or of the abdominal wall such as a protective contraction against a blow, or if the abdomen is squeezed, intestinal contents may be pressed into the appendix and the lumen will be dilated. If an enterolith or foreign body is present in the appendiceal lumen, it may be forced into the narrow communicating opening between the appendix and the cæcum and thus close the opening with somewhat the same action as a ball valve and so obstruction results.

Traumatic appendicitis is more apt to occur in those patients who have a thin abdominal wall in which there is either a lack of fatty tissues or a deficiency of muscular tone (weakness of the muscles or defective development). If, as Warbasse says, a blow on the abdomen can cause injury to the bowel, why can it not cause an injury to the appendix?

Traumatic appendicitis may be of special significance in a medico-legal way. If such a pathological entity is generally accepted, there will be a great increase in the number of suits following upon and induced by an accident. If appendicitis is claimed to be the result of an accident, there should be good corroborative evidence that there has been a more or less continuous train of symptoms from the date of the accident to the time of the acute appendiceal attack. These symptoms should be associated and accompanied by intra-abdominal pain from the time of the trauma to that of the onset of the acute appendiceal attack. This pain is not necessarily in the area of the abdomen where the trauma was received.

If an appendix which is kinked by adhesions is suddenly straightened, there is probably some reflex change which normally is interpreted as pain,

## TRAUMATIC APPENDICITIS

but which is shunted out of consciousness by the more immediate and greater local pain caused by the trauma.

In traumatic appendicitis vomiting is very frequent. It may occur shortly after the trauma and is a sign of intra-abdominal shock. If it persists, it is an indication of acute peritoneal irritation, such as may result from the rupture of a viscus. However, I have never seen a case in which the vomiting came on and persisted without an intermission between the primary vomiting due to reflex intra-abdominal trauma and the secondary vomiting due to peritoneal inflammatory change. The pulse may go up rapidly for a short time, then it returns to, or almost to, normal, and may remain low until the inflammation has progressed to the point where the appendix ruptures. During all this time there is vague uneasy feeling in the abdomen and on sudden or severe exertion the patient may have pain. During this time also the patient complains of pain on palpation and the pain is localized to the appendiceal area. There may also be mapped out in some cases a dulness over the side of the appendix and the rectus is rigid over this area. After peritonitis has begun there is, of course, a marked rigidity and great tenderness. Tympany may not be excessive, though later when paralysis of the bowel occurs, it is most marked. The symptoms are now those of acute appendicitis.

If the appendix ruptures there is a sudden change. The pulse becomes very rapid and the temperature which has been normal or slightly above normal becomes very high and the patient presents a very sick appearance, for he has a peritonitis which is rapidly becoming generalized. Another symptom group immediately intrudes, namely, the symptom group of ileus. Vomiting becomes persistent and the patient rapidly passes into a state of extreme toxæmia.

*Treatment.*—Appendicitis, wherever and whenever it occurs, if the surroundings are suitable, should always be operated, using the regulation technic. If rupture and peritonitis is present, drainage with a provision for enterostomy should be made. Care must be taken that interference of too severe a character is not undertaken.

In one of my cases, there is no doubt of the relationship between trauma and the resulting appendicitis with resulting peritonitis. In a second case the sequence is not as definite.

The history of the first patient is as follows:

H. R., American, shipping clerk, twenty-eight years old, on entering the hospital complained of pain in the abdomen diffuse in character, nausea, weakness and general malaise. The onset was sudden. On September 9, 1917, Sunday morning after breakfast, the patient was seized suddenly with severe cramps in the lower abdomen. The pain gradually increased in severity. He says he did not vomit but felt weak. That same evening the patient went out to look for a doctor, found one, who gave him electric treatments. That night the patient was very restless, unable to sleep, fussed the whole night. Monday morning, September 10, 1917, the family physician was called. Medications were given. No relief all day Monday; the patient felt miserable. Tuesday morning the patient became worse. The same physician was called in in the afternoon in consultation with another doctor and the parents were advised to rush their son to the hospital. Tuesday night patient entered the hospital.

## RICHARD J. BEHAN

The patient dates his illness to three weeks ago, when he fell over a tomato patch, landing on a sewer crock, inflicting a bruise on the left side of the abdomen. From this time he had severe pains in the abdomen which were more or less constant. After the first severe onset the tendency was for the pain to be localized in the right side. During this entire time the right lower iliac fossa was very tender to the touch.

The past, personal and family history is negative.

Examination by Doctor Behan on evening of entrance to the hospital.—Patient is apathetic. Tongue slightly coated and moist. Chest, right side, dullness lower lobe; vocal resonance increased; breath sound diminished. Left side negative. Heart negative; abdomen distended; very sensitive to touch. Respiration movement of the abdomen is absent. On palpation resistance is increased probably more on the right than on the left side. The patient is tender over the entire abdomen. The slightest touch causes severe pain; deep pressure is not so painful. The patient localizes his greatest tenderness to the abdomen below the umbilicus. When told to localize it with one hand, he indicated the right iliac fossa. Dullness is present in the right iliac fossa. Peristalsis is not marked, but is present on both sides. The small waves are most numerous on the left side—the large waves also. On the right side the small waves are entirely absent. Hyperalgesic areas are not well defined. Pulse, 120. Blood examination showed white blood-cells, 17,400; polymorphonuclears, 84 per cent.; lymphocytes, 16 per cent. Blood-pressure, 88 over 58.

*Diagnosis.*—Generalized suppurating peritonitis primary from the appendix.

*Operation.*—10.45 P.M., September 11, 1917.—Spinal anaesthesia—tropococaine one amp. and local anaesthesia novocaine one-half per cent., 75 c.c. Right rectus incision. The peritoneum was thickened. On opening the peritoneum a considerable quantity of dark, foul liquid exuded. The drainage apparatus was connected and about 400 c.c. of the fluid was collected in the aspirating flask. The intestines were dark in color and considerably distended. The caecum was bound down to the lateral peritoneal wall and around it were fibrin deposits. An attempt was made to separate the adhesions, but because of their resistance was not persisted. A tube was inserted down into the pelvis. A cigarette drain through a counter opening in the lowest part of the right lower iliac region. Gauze drains were inserted through the operative incision down to the appendix area. The wound was closed. On the left side in the iliac area another opening was made under local anaesthesia into the abdomen. The muscles being split, the same character of fluid was found on opening the abdomen. A cigarette drain was inserted in the direction of the pelvis. About one ounce of foul liquid was obtained by suction. Wound was partially closed. Operating time—about one hour and twenty-five minutes from beginning of injection to the end of operation. Patient left the table in fair condition. Pulse 135. He had hypodermoclysis submammary of 500 c.c. of sodium bicarbonate 2 per cent. and glucose 5 per cent.

September 13, 1917.—Blood-pressure was 108 over 65. Patient was dressed. The dressings were saturated. Patient complains when pulling is made on the drains. Abdomen is not distended. Tongue is dry. The patient talks rationally. General condition much improved during the past twenty-four hours. Last night a great deal of distention. At 1.30 A.M. the stomach tube was used. Gas of a foul odor was evacuated. Later the abdomen was distended. The rectal tube was ordered and the condition was relieved.

September 17, 1917.—Patient has been restless all night; slept about three and one-half hours off and on. Complains a great deal and wants his bed changed to a Fowler's position. Tongue is still dry. Lips very dry and scaly and fissured. Incision clean. Two iodoform gauze drains. One gauze drain reinserted for drainage. Otherwise clean and very little discharge. Abdomen still somewhat distended.

September 18, 1917.—Patient has been dressed this morning. Very little discharge present. Drains inserted. Opening drawn together with adhesive plaster. Abdomen greatly distended. Enema ordered; eyes brighter; color better. General condition improved.

## TRAUMATIC APPENDICITIS

October 3, 1917.—Wound looked good. Right side almost healed. Left side entirely healed. Abdomen flat. Patient discharged.

One year later. Patient still in good health, although he complains at times of pulling and dragging in the abdomen.

*Reports of Cases from Literature.*—Borchardt-Moritz (Die Behandlung der Appendicitis mit aus dem Grenzegebieten der Medizin und Chirurgie, Bd. xi, p. 305) found three cases of traumatism in 150 cases of appendicitis.

SCHOTTMULLER reports two cases of children receiving severe blows on the abdomen with immediate signs of peritoneal injury, which later proved to be due to appendicitis.

Schottmuller explains the course of the appendicular inflammatory process as follows:

1. Fecal concretion is present in the lumen.

2. Through pressure at the point where the stone lodges a necrosis and ulceration of the inner wall of the appendix results. This is not dangerous and produces no symptoms. However, if now there is a sudden trauma, the thin-intact outer wall is torn or will be destroyed. The infectious contents are now forced out into the free peritoneal cavity and peritonitis results. The sudden rupture and the overwhelming of the peritoneal cavity by the infection explains why in these cases we have no adhesions.

BLOCK, in the *Denver Medical Times*, states that out of 129 cases of appendicitis, traumatism was quite positive in three cases. The first case fell; symptoms with severe abdominal pain; developed six hours after falling from a bicycle. The second case was kicked by a pony; over and just to right of umbilicus. Pain severe in abdomen, most marked over gastric region. Third case, lifting heavy furniture; four hours later severe pain in right side of abdomen.

SMALL reasons that trauma is instrumental in causing the increase in appendicitis over former years. He says that 75 per cent. to 80 per cent. in young adults, of appendicitis, is caused from trauma. Seventy-five per cent. are under thirty years of age. He cites the case of a boy nine years old who had pain come on while he was pushing a heavy cart; the tongue of the cart was pressing against his abdomen. On operation, five days later, pus was found in the abdomen. The appendix had sloughed away.

SOUTHAM, in the *Lancet*, reports four cases of traumatic appendicitis. He believes that severe strain may cause sudden and forcible contraction of the abdominal muscles and so separate or break down adhesions between the appendix and the abdominal wall and cause an extravasation of blood, either into or around the appendix.

In one case, in a boy nine years of age, there was no history of any previous pain. He had been struck on the abdomen. There was pain in the right iliac area. The next day he was confined to bed. He vomited constantly; on the fourth day temperature was 100, pulse 120. Operation, appendix inflamed, almost perforated in one spot. Contained a concretion. Numerous recent adhesions around the appendix. Pus was diffused throughout the peritoneal cavity.

In cases of traumatic appendicitis it is usually claimed that the pain generally comes on immediately after the trauma and is frequently though not absolutely localized to the right side. In three out of the four cases of Southam, it was not at first localized, but gradually became so.

LADUSKI reports one case of a boy, eleven and one-half years, who had some slight cramps in the abdomen prior to a fall on the abdomen while sliding down a banister. Immediately after the fall he had pain in abdomen, nausea and vomiting. On operation the abdomen was found filled with blood and a rent of about one and one-half inches was present at the end of the meso-appendix. In this there were several small bleeding vessels. The patient recovered.

WARBASSE, *New York Medical Journal*, vol. iii, No. 8, pp. 411-413, believes that as a rule there is some pain present in the abdomen at the time of the traumatism. This

RICHARD J. BEHAN

may entirely disappear and no unusual symptoms be present for one or two days; then the pain recurs in the right side and a well-defined appendicitis becomes evident.

DEAVER says that in a previously healthy appendix, he has never seen appendicitis produced by a blow or traumatism.

WARBASSE further states that traumatism may be due to the following:

1. Abrasion of mucosa by foreign matter.
2. Lowering of the vitality of the mucous membrane cells by retained secretions.
3. Distention of follicles by retained bacteriological products.
4. Presence of an excess of ptomaines retained in the appendix against the pressure of the contents of a distended cæcum. If traumatism can cause injury to the bowel, why not, as Warbasse says, cannot it cause injury to the appendix?

SAVAGE, in *Medical Record*, reports a case, sixty-one days old, where the appendix and colon were down in a scrotal right inguinal hernia. For one week efforts at reduction by taxis were made. Operated; caput-coli in sac; appendix inflamed and perforated. Death in two days.