

THE HERNIAL SAC IN ITS RELATION TO CONCEALED INTESTINAL INJURIES.

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CONCEALED or subcutaneous injuries of the intestine, exhibiting lesions of more or less severity yet unassociated with a visible destruction of the intervening structures, while not frequent, nevertheless are far from unknown. Barring the minority of such accidents, based upon the dislodgement of and injury to the mesentery and its blood-vessels, leading to secondary dissolution of the intestinal wall, the greater portion of such cases is due to the sudden application of excessive pressure to the muscular walls of the abdomen, which in turn transmit this force to the underlying structures and thence to the opposite wall.

However, we are occasionally confronted with the picture of concealed intestinal injuries, where pressure, in lieu of being applied to the abdominal walls, has been exerted upon the tissues overlying an inguinal hernia.

There are factors, both as regards the relation of intestine to abdominal walls and to hernial sac and as regards the intestinal condition *per se*, which have a definite bearing, not only on the final outcome of the applied pressure, but also upon the methods by which this force may be applied.

Weakening of the intestinal walls, not only by disease but also by circulatory interference due to mesenteric trauma, is especially important in determining rupture, while intestinal distention, with which we are more frequently confronted, is a factor no less important. Probably the abnormal intestinal conditions are of greater frequency in injuries of herniated bowel, owing to the greater possibilities for interference with the vessels supplying intestine so located.

To a certain extent similar in their relation to the en-

veloped intestine, yet the abdomen and sac display anatomical and physical peculiarities quite different from one another, in so far as the reception and defence of pressure is concerned. The former is in part protected by a skeletal wall and in part by muscles fully capable of protecting the underlying intestine from ordinary pressure. The sac, which may be considered as a pyriform prolongation of the peritoneal cavity, consists of a neck or upper portion and a body. The former, generally speaking, is hemmed in by integument and a sparse muscular and aponeurotic covering and the pubic ramus. The body is enveloped on all sides by the elastic scrotal wall, and hence but poorly protected.

The methods by which pressure is applied varies. Crushing accidents, blows, horse kicks, falls, are responsible for the majority of concealed intra-abdominal intestinal injuries, while to these may be added, in the case of intrasacal injuries, manual trauma, a product of the pernicious habit of the forcible reduction of herniæ.

The direct cause of such injuries has been a fruitful source of discussion, and generally speaking one must bear in mind the difference in the resisting power of the various walls—of the skeletal and muscular walls of the abdomen—of the muscular and integumental coverings of the sac, and of the skeletal bridge which underlies it.

Depending upon its direction and application, abdominal pressure may either be broken on the skeleton, may force muscular wall to rigid skeleton, or may approximate muscular wall to muscular wall. In the former case it is extremely unlikely that, without external evidences of injury or fracture, harm could be done the intestines or mesentery to any great degree. What changes occur when muscular wall is forced against the vertebral column, or the sacral promontory, or other points of the bony framework? The abdominal cavity is directly encroached upon and the intra-abdominal pressure greatly increased, due to the marked diminution of the size of its cavity; while the intestines, in great part, are driven from the immediate region of the greatest extra-

abdominal pressure into areas free from this force, where they are temporarily fixed. The extra-intestinal pressure is focussed upon those sections "caught" between the opposing walls. The intra-intestinal pressure is greatly increased, not only in those imprisoned sections but also in the sections immediately adjoining these, as the gas and fluid are rapidly displaced from the former into the latter.

The action of the diaphragm in relieving intra-abdominal pressure as it is driven upward is neutralized, to all intents and purposes, by the reflex contraction of the other muscular boundaries of the abdomen. While the increased abdominal pressure is hardly in itself responsible for direct intestinal injury yet, by fixing the intestines, it is probable that the latter are more susceptible to synchronous blows with different points of application, and also to the injuries sometimes ascribed to muscular action alone, and to the possibility of the extrusion of a part of the tense wall, distended with gas and fluid, through the neck of a hernial sac.

The local increase in extra-intestinal pressure focussed upon bowel imprisoned between opposing walls is no doubt the greatest single factor in concealed intestinal injuries. The bowel wall, delicate as compared with the parietes, is ground, bruised, torn, and crushed against the bony skeleton, while the abdominal wall shows little or no evidences of the pressure.

Finally, the increased intra-intestinal pressure, due to the expressing of gas and fluid rapidly from one section of bowel to another, is occasionally the cause of an "explosive" rupture, when the increase in intra-intestinal pressure overcomes the resistance of the intestinal wall.

When muscular wall is forced against muscular wall there is no doubt but that the intra-abdominal conditions are altered very much, but there is great doubt whether only a rare case will show rupture or injured intestines under these conditions, so greatly is the shock ameliorated by the elasticity of the opposing muscular wall which acts as a buffer to the blow.

Similar principles may be applied under different conditions to the hernia sac and its contents. In its upper part, with its rigid background of pubic ramus and its thin unprotecting covering, conditions are ideal for a crushing injury, such as truss injuries, kicks, blows, etc. Unlike this the lower portion has no bony border, but is completely enveloped in thin elastic scrotal wall and yields readily to pressure; and the lack of support affords heightened susceptibility to explosive and crushing ruptures, to direct injuries, and to manipulative trauma, the latter so frequently associated in this location with bowel whose resistance has been lowered by constriction.

The fixation of the scrotum, the distention and amount of bowel in the sac, its condition and fixation, and the elasticity of the scrotum—all are important determining factors in such injuries and involve definite physical principles which make it possible to explain the outcome of the pressure.

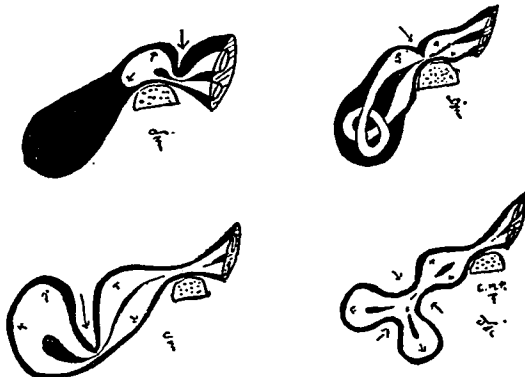
The following cases which have been operated on by the writer for this condition are interesting in that they represent nearly all the different forms of concealed intestinal injuries with which one meets in the hernial sac.

CASE I.—S. M. W., aged 27. Right inguinal hernia "caught down" 24 hours before admission. *Forcible reduction applied.* Condition persistently became worse. Is restless, toxic, shocked. Pulse 120, temperature 99.2°, white blood-cells 35,000. Abdomen: Marked distention. C. M. obliterated. R. M. everywhere limited. No visible peristalsis. No masses seen. Distinct bulging in flanks. Slight general tenderness of entire abdomen, but walls fairly soft. Tympany everywhere except in right flank, where there is slight movable dulness. Liver dulness 4 cm. above C. M. In right inguinal region there is a bulging which reaches from internal ring into scrotum, forming an oval swelling about 6 × 4 cm. Percussion note flat. Fairly soft. Skin movable over swelling. Slightly tender. Rectal examination: Marked bulging in anterior wall. Testes and epididymes normal.

Operation (Dr. Remsen): Under cocaine, skin and external oblique aponeurosis divided; the ilioinguinal and iliohypogastric

nerves blocked and divided and a congenital sac filled with bloody fluid and strangulated omentum found. Digital examination revealed, higher up, what appeared to be a hernia reduced *en masse*. Abdominal exploration revealed the following: omentum and small intestine running through internal ring and into hernial sac, the "ring" having been displaced inward so that the swollen omentum had completely hidden the bowel in the sac. Divulsion of the ring and excision of the omentum allowed reduction of the bowel into the protected general cavity. The wall everywhere

FIG. 1.



Hernial sacs seen in cross section representing, schematically, intestinal compression and dilatation due to pressure applied above the ramus (Case IV); over the ramus (Case V); to the scrotum (Case II); and manipulative pressure applied to the scrotum (Cases I and III).

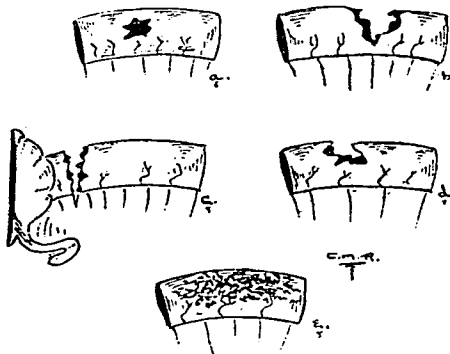
was in good condition even where compressed by the ring except for two ruptures, one completely through the circumference of the wall (Fig. 2, c) the other partially through (Fig. 2, d). General condition called for a quick enterostomy and tubes were inserted into both openings. A partial operation for hernia was performed quickly. Patient never rallied. Death in 24 hours.

CASE II.—J. L., aged forty-seven. Seven hours previous, while running for a street car, patient tripped and fell, striking a rather large inguinal hernia upon a cobble stone. Intense abdominal pain, nausea, and vomiting followed. Patient restless at examination. Pulse strong, slow, regular. Abdomen scaphoid; entire absence of respiratory movements; C. M. well marked; no

distention. No masses nor visible peristalsis. General tenderness not localized. An extreme degree of abdominal rigidity existed. Submural palpation impossible. There is a small swelling in the inguinal region, tympanitic, very soft, compressible and tender and increased in size on coughing.

Operation (Dr. Remsen): Inguinal swelling explored first. A hernial sac filled with fecal matter and containing no bowel was exposed. Fecal material was seen escaping from abdominal cavity through inguinal canal into sac. Immediate abdominal exploration revealed a ruptured ileum (Fig. 2, a) and a peritoneal

FIG. 2.



Concealed intestinal injuries occurring in the hernial sacs (viz. text).

cavity soiled with intestinal contents. Suture of rupture and careful toilet of the peritoneal cavity and slight drainage completed the abdominal operation. Sac treated by drainage owing to soiling with the intestinal contents. Recovery with only slight recurrence of hernia.

CASE III.—M. B., aged twenty-two. Hernia two years. "Caught down" 48 hours before admission, with nausea and vomiting. *Forced manipulative reduction* 36 hours ago with disappearance of the mass and cessation of vomiting but with increase in pain which now extended to abdomen. Pulse slow and soft. White blood-cells 22,000. Pupils small. (Patient has been given large amounts of morphia.) Face anxious. Patient thirsty. Abdomen markedly distended. Moderately tender over

lower portion. Respiratory movements diminished. No elevation of liver dulness. No shifting dulness. Large patent external (right) abdominal ring. No bowel in sac. Bowels moved once since onset. Owing to the masking of symptoms by prophia it seemed advisable to explore immediately.

Operation: Abdominal section revealed a section of bowel about 50 cm. in length limited by two indented circumferential impressions due to the pressure of the ring. In one portion of this section of bowel there was a definite bruising and reddening not at all resembling the bowel seen in a strangulated hernia (Fig. 2, e). This was viable, and active peristalsis occurred after artificial stimulus. The abdomen was closed and radical cure of the hernia followed. Recovery.

CASE IV.—I. M., aged forty-nine. Fall from scaffold four hours previous, *striking his abdomen (left inguinal region) across projecting board*. At present lies on back moaning with pain, thighs flexed, cautious respiratory movements. Markedly shocked. Very large left inguinal hernia exists. Palpation reveals intense abdominal rigidity. Submural palpation impossible. Abdominal tenderness general. Hernial sac very tender, and even gentle manipulative measures cause great pain. Liver dulness at six R. No shifting dulness. Increased abdominal tenderness in L. I. F. Slight general distention of abdomen. Marked shock. Blood-pressure 65.

Operation: Left rectus incision. On opening peritoneal cavity there was an escape of gas and bloody fluid. Search revealed a ruptured ileum (Fig. 2, b) in close proximity to the internal ring (left) and some intestinal contents extruding from sac into abdominal cavity through the ring. Very small amount of intestinal contents seen in the abdominal cavity itself. From these findings it seemed that the rupture had occurred in the sac itself rather than in bowel that was in the abdominal cavity at the time of the accident. Resection and lateral anastomosis. Patient never rallied. Death in two hours.

CASE V.—C. M., aged twenty-seven. Left inguinal hernia "caught down" several years ago and reduced successfully. Has been wearing truss for some time. Thirty-six hours ago *patient fell and compressed truss against pubic ramus, the hernia having been extruded during the fall*. Following this patient had severe abdominal pain, which, however, has diminished in the last 12

hours. Nausea but no vomiting. Abdomen now shows slightly diminished respiratory movements on left side. General condition normal. There is slight tenderness in left iliac fossa, well localized and corresponding to the area of abdominal tenderness. Hernial sac negative. General condition excellent and the local signs so mild and showing improvement so markedly that operation was postponed. Local conditions improved and patient discharged in three days with no abnormal symptoms.

Suggestive, then, is the history of trauma applied to a hernial sac, followed by acute abdominal signs and symptoms; the tense rigidity of the abdominal walls, as emphasized by Moynihan, in concealed abdominal ruptures; and the soft, tender, fluctuant and bulging hernial sac, an evidence of the escape of intestinal contents into this latter cavity. When coupled with the shock and general symptoms and signs which one would expect with such an injury, there is formed a group almost positively indicating a concealed injury or rupture of bowel contained, at least at the time of the accident, in the sac which has suffered the trauma.

I wish to acknowledge my thanks to Dr. William S. Halsted for his kindness in allowing me to report the four cases of this series that occurred while I was in his service at the Johns Hopkins Hospital.