additional barrier in the form of the visceral pleura, which has to be penetrated by pieces of intrapleural calcium before they can reach the bronchi.

Coughing produces a steep rise in intrapleural pressure. It may even reach 200 mm. Hg (Bell *et al.*, 1965). Any loose pieces of intrapleural calcium with jagged edges may penetrate the visceral pleura as a result of this sudden increase of intrapleural pressure. In this patient the cough accompanying pulmonary tuberculosis may have been the precipitating factor in the production of broncholithiasis.

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Perforation of the Intestine due to Muscular Violence

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Edshage (1961) credited Aristotle with the first references to perforation of the intestine associated with direct blunt trauma to the abdomen, and numerous cases have since been recorded. These perforations occur near fixed points in the bowel—for example, near the duodenojejunal or ileocaecal junctions—or are due to splitting of the bowel by pressure against the vertebral column. Damage to bowel in the sac of an inguinal hernia has also been reported (Aird, 1937).

An intraperitoneal rupture of bowel in the presence of an empty inguinal hernial sac was reported by Bunge (1905). He postulated that the bowel loop was suddenly projected into the empty inguinal hernial sac by increased intra-abdominal pressure, and perforation in the affected loop occurred because the hernial sac was the only weak point in the abdominal wall that was otherwise subjected to equal pressure in all directions.

Aird (1937) regarded the perforation of bowel occurring in association with an empty hernial sac as being due to distraction of a segment of bowel lying between a fixed ileocaecal junction and a hernial sac, but conceded that Bunge's theory could apply if it were known that the hernial sac had previously been empty.

Christopher (1944) traced 50 cases of subparietal rupture of the intestine due to muscular violence and described one case in which increased intra-abdominal pressure in association with an inguinal hernia had resulted in rupture of intestine. He acknowledged a similar case quoted by Berman and Rosner (1942) in which the patient had previously had bilateral inguinal hernial repair carried out and in whom a ventral hernia was also present. Berman and Rosner stressed the possible relation of the perforation to injury at work. They suggested that increased intra-abdominal pressure produced by spinal hyperextension due to the lifting of heavy weights might result in a perforation of small bowel which could subsequently prove fatal.

More recently, Linden and Rydell (1962) reviewed the world literature and stressed that spontaneous perforation might be associated with pre-existing disease of the bowel wall. They advised that a biopsy of the area of perforation should be performed.

CASE REPORT

A stout 72-year-old man slipped on ice and fell on his back. Almost immediately he experienced severe lower abdominal pain and was unable to pass urine. On arrival at hospital two hours later he was found to have a distended bladder and lower abdominal tenderness. No prostatic enlargement was found on rectal examination and an x-ray film of the pelvis showed no fracture. Catheterization

yielded clear urine followed by some blood, and a small bladder washout was completely returned. The presence of a small, empty right inguinal hernial sac was noted, but the patient had previously been unaware of this. Lower abdominal tenderness and rigidity persisted, and, as he appeared to have a pelvic peritonitis, laparotomy was undertaken.

At operation the antimesenteric surface of the ileum was perforated about 4 ft. (1.2 m.) from the ileocaecal junction and a fibrinous exudate was present. The orifice of an empty right inguinal hernial sac was seen. No other injuries were found and the perforation was closed after biopsy of its margin. Subsequent histology showed that the entire thickness of bowel wall was necrotic, with infiltration of acute inflammatory cells.

His postoperative course was complicated by paralytic ileus and bronchopneumonia, and he died seven days later. Post-mortem examination showed peritonitis with distension of bowel, and there was an abscess in the region of the splenic flexure. The sutured bowel was soundly healed. Severe cirrhosis of the liver, which was also found, might have contributed to his death.

COMMENT

This case of traumatic perforation of the ileum can be satisfactorily explained by invoking the theory ascribed to Bunge. The fact that the patient had not previously been aware of a swelling in the inguinal region would tend to support the presumption that the hernial sac had been empty before the accident. Increased intra-abdominal pressure due to spinal hyperextension at the time of his fall could have resulted in the sudden propulsion of gut into the empty sac, and, according to Bunge, perforation of bowel could be caused by the gradient in pressure between the abdominal cavity and the hernial sac. Aird's alternative explanation (that the bowel could be ruptured between two fixed points) is simpler but assumes that at the moment of injury the bowel would have to be caught by the neck of the inguinal sac and stretched between that and the ileocaecal junction. This, however, would be more likely to occur in the presence of an existing inguinal hernia, of which there was no record in the present instance.

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