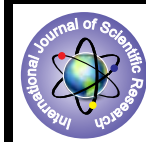


Colonic Barotrauma with Tension Pneumoperitoneum – Review of Literature and Report of A Successfully Treated Case



Medical Science

KEYWORDS : Compressed air, Colonic Barotrauma, Pneumatic rupture, Bowel perforation, Tension Pneumoperitoneum

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ABSTRACT

Iatrogenic [due to colonoscopy or barium enema], accidental [road traffic or industrial] or solid object [foreign body] inflicted colonic injuries are common .[1].

The colonic perforations due to Barotrauma are frequently related to therapeutic colonoscopies and do not result in tension pneumoperitoneum. They are commonly encountered in patients of advanced age with multiple co morbidities.

However, Barotrauma to bowel, from compressed air or liquid is of rare occurrence. It occurs in younger individuals and rapidly develops tension pneumoperitoneum. [2].

Pneumatic rupture of colon accompanied by tension pneumoperitoneum is a rare, unique and serious emergency that warrants prompt surgical intervention, else, it may prove fatal. We report a case of Colonic Barotrauma with tension pneumoperitoneum, treated with a favourable outcome.

Introduction:-

As the use of high pressure compressed air in industrial work has increased, so has the risk of associated pneumatic injuries from its improper use, which were practically unheard once upon a time.

These pressures usually over-exceed those used by medical applications such as colonoscopy and lead to extensive injuries of the bowel. Apart from perforative peritonitis, the resultant accumulation of free intra-abdominal air under pressure known as tension pneumoperitoneum, rapidly and adversely affects the cardiovascular and respiratory function and hence carries high mortality.

Historical :

In a classic review, Brown and Dwinelle noted that compressed air came into rather general use in industry at about the beginning of the twentieth century. [3].

In 1904, Stone reported a fatal case of rupture of bowel caused by compressed air introduced per rectum from a machine which was pumped by hand. [4].

In 1908, Petren wrote about a case of fatal rupture of the esophagus from accidental oral insufflation. [5].

In 1911, Andrews reported a case of pneumatic rupture of the sigmoid colon which recovered following resection of the injured loop. He also discussed the subject in details and recorded 15 other cases collected by correspondence and from law reports. [6].

The other cases recorded by Burt [7] are: Bendixen and Blything, one, with a collection of seven others; Fauquez and Jean of France, two each, and one each by Block and Weissman, Buchbinder, Cotton, Duval of France, Hailes of Australia, Hays, Houzel of France, Morris. [7].

Aetiology of tension pneumoperitoneum :

Upper or lower gastrointestinal endoscopy, ERCP or any other instrumentation of the gastrointestinal tract, abdominal trauma, or peptic ulcer are known to lead gastrointestinal perforation. [16]. Oesophageal perforation after instrumentation of the esophagus for stricture [17], ERCP resulting in perforation of the duodenum or biliary ducts [11] have also been noted.

A case of faulty nasal application of oxygen resulting in tension pneumoperitoneum due to stomach rupture has been reported. [18].

It can also be caused by Barotrauma in ventilated patients, particularly those ventilated with high inflation pressures and positive end-expiratory pressures. [19].

A few cases of tension pneumoperitoneum caused by gastrointestinal obstruction have been reported. [20].

Mechanism of injury and Pathophysiology of tension pneumoperitoneum

Andrews reported that 0.49 to 0.88 kg / sq cm pressure was required to rupture the normal intestine of ox or a dog. [6]. Burt found that under experimental conditions the human colon bursts with only about 4 lbs/sq inch pressure [0.29 kg / sq cm], and that the serosal and muscular coats tear first at about 3.5 lbs/sq inch pressure. [7].

Nowadays, compressed gases are used with increasing frequency in daily industrial work, in laboratories, and in gas stations, with increasing incidence of such injuries. The jets that are used in industry are usually said to have a pressure of 50 to 100 lbs. or more. Such an air jet enters the anus more readily than the examining finger or a proctoscope, as it passes through clothing and enters the bowel even when not accurately directed at the anus.

Thus, a Barotrauma injury can occur without inserting the air hose into the anus. [3]. The anatomical configuration of the buttocks and perineum is like a funnel; it allows easy delivery of compressed air in the anal orifice. Cloths do not alter the effect of compressed air. In several cases reported in the literature, the air hose was "fired" through clothes at a distance from the anus. [2, 4, 6, 8].

Rupture of the intestine perhaps depends more upon the suddenness of the pressure than upon its amount, for the bowel will expand enormously if given time to relax. Duval - quoted by Burt [7] - observed great dilatation of the colon in a deranged patient who inflated himself by means of a hand bicycle pump. Operation was performed in error, with a diagnosis of megacolon, and no abnormality was found. [3, 7]. Although the air pressure can vary in different situations, it takes only 1 or 2 seconds to deliver enough pressurized air to cause major damage. [22].

Apparently the muscularis mucosa adapts itself more readily to sudden changes in tension than the outer muscular coats of the bowel. In serious injuries, rents in the muscle, usually along one of the longitudinal bands, with the underlying mucosa intact,

have been observed in many cases. When there are multiple seromuscular lacerations, complete rupture through all the layers is usually found in only a few, perhaps in only one of them, as in our case. [3].

A tear along the taenia coli with full thickness solitary perforation with stripping of the serosa and muscularis and bulging of mucosa at multiple places can occur [as noted in our case]. The most common location of injury is anti-mesenteric surface of sigmoid colon and rectosigmoid junction is the commonest site of perforation. [2, 3]. In such cases, tension pneumoperitoneum is the characteristic presentation. [2, 9, 10].

The difference between simple pneumoperitoneum and tension pneumoperitoneum is the presence of enormous tension in the peritoneal space, which can have fatal haemodynamic and respiratory consequences. Decreased venous return to the heart due to compression of the inferior vena cava and splanchnic circulation results in hypotension and can lead to shock. Elevation of the diaphragm due to pressure from below, which decreases lung volumes, compromises ventilation. Unless promptly treated, death ensues due to acute air embolism, acute fat embolism, acute respiratory insufficiency due to high intra-abdominal pressure and chest compression, acute heart failure due to insufficient preload and peritoneal shock, hyper acute abdominal compartment syndrome. [9]

Tension pneumoperitoneum can result in compression of the aorta, inferior vena cava, and mesenteric vessels, which can cause ischemia of the bowel or, very rarely, ischemia or venous congestion of the lower extremities. [11]. Massive tension pneumoperitoneum can even result in aortic occlusion. [12]. Severe circulatory failure can also cause rhabdomyolysis.

Management :

Unless timely intervened, tension pneumoperitoneum carries high mortality.

In the past, the overall mortality of pneumatic rupture of the bowel was 65%. If the acute shock was not immediately fatal, the survival was depending upon further treatment. Surgery reduced mortality to 42%. [3].

An emergency ceiotomy was the mainstay, and this rule still holds good. An apt description given by Wainwright [as quoted by "Ide"] [21] - "When the peritoneum was opened there was a loud escape of gas under high pressure, almost as loud as the report of a small automobile tire," emphasizes upon the urgent need to convert "tension pneumoperitoneum" into "open pneumoperitoneum" akin to "tension pneumothorax."

Paracentesis of the peritoneal cavity with the needle or trocar is a simple, quick and useful method that ensures remarkable improvement by alleviating the respiratory distress. [8, 13].

Urgent Percutaneous decompression of the tension pneumoperitoneum can be accomplished by inserting a canula or a Veress needle into the abdomen for relief of the pressure. [14]. Sixteen-gauge angiocath can be inserted percutaneously in the right upper quadrant of the abdomen for decompression with alleviation of respiratory and hemodynamic problems. [15]. This should be followed by emergency laparotomy to tackle the traumatized bowel.

Case report :

Presentation

A young male was admitted, with a grossly distended, rigid abdomen which was tympanic and hyper-resonant to percussion and with obliteration of the liver dullness, had severe abdominal pain with respiratory distress. Preliminary history revealed that, he was a victim of a prank played upon him by his friends - release of compressed air through a nozzle held in apposition to his anus. Diagnosis of the pneumatic colonic injury was obvious and was further confirmed by a radiograph of abdomen that showed a huge pneumoperitoneum. [Fig 1]. Severe respiratory distress required immediate relief by emergency decompression

of acute abdominal compartment syndrome.

Management

1 : Peritoneocentesis using number 16 F trocar canula preceded surgical intervention. As soon as a small opening was made in the peritoneum, the air whistled out and the distended abdomen deflated like a pin-pricked balloon. The anaesthetist reported instant remarkable improvement in the respiration and cardio-vascular status of the patient.

2 : Patient was haemodynamically stable, hence, was explored immediately under general anaesthesia. A midline abdominal incision long enough to give access to entire viscera revealed the pathology.

Operative findings: A two cm diameter perforation in transverse colon near the hepatic flexure resulting in faecal contamination of the peritoneal cavity and viscera, was noted. Entire Colon had multiple seromuscular tears [Fig 2] and petechiae, with gross dark bluish discoloration and patchy devitalization, predominantly affecting the transverse colon. Colon also revealed torn, bifurcated and splayed taenia coli. [Fig 3].

Surgical procedure

Transverse colonic resection with colo-colic anastomosis was performed. Seromuscular tears were repaired by 3/0 interrupted silk sutures, abdominal cavity irrigation was performed using copious amount of normal saline. The Caecum was extraperitonealized and partially exteriorized in the area where it had suffered seromuscular tear. The incision was closed in layers with a corrugated drain at the site of anastomosis. "Lord's anal dilatation" procedure was performed towards the end. Caecum was opened 24 hours later as a caecostomy; it started functioning after 48 hours. [Fig 4].

Patient had uneventful recovery and a formal caecostomy closure was performed after 8 weeks

Conclusion

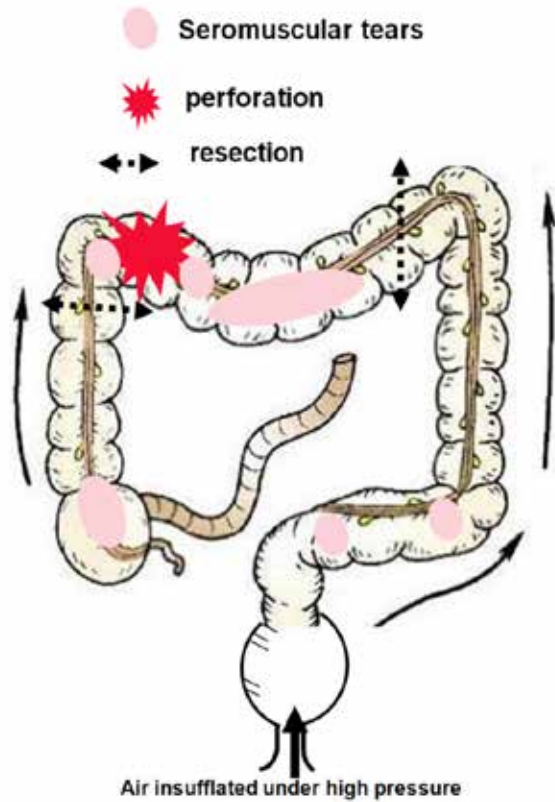
Colonic Barotrauma due to compressed air resulting into tension pneumoperitoneum is an unusual, serious surgical emergency carrying high mortality.

Immediate release of hyper acute abdominal compartment syndrome by using a trochar- canula followed by definitive surgery can salvage the patient. Resection anastomosis of the devitalized portion of the bowel is preferably protected by a proximal enterostomy.

[Fig 1]



[Fig 2]



[Fig 4]



[Fig 3]

Pointers indicate torn bifurcated taenia coli



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