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TENSION PNEUMOPERITONEUM LEADING TO ABDOMINAL COMPARTMENT SYNDROME: CASE SERIES AND REVIEW OF LITERATURE

General Surgery

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ABSTRACT

Abdominal compartment syndrome is a rare but lethal entity which leads to death of a patient if not treated immediately. Here we have discussed six case of abdominal compartment syndrome who came to emergency department. We have operated all cases and discussed here cause, pathogenesis and various method to manage abdominal compartment syndrome

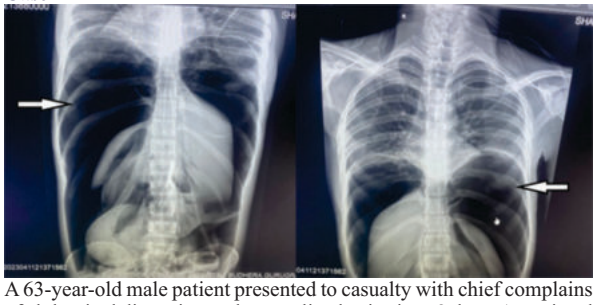
KEYWORDS

INTRODUCTION

Compartment syndrome is well known in the extremities, where increased pressure within a closed fascial space depresses capillary perfusion pressure to a level that cannot maintain tissue viability. The effects of elevated intraabdominal pressure are less well recognized. Normally, the abdominal pressure is about 5 mm Hg. The intraabdominal pressure may increase with acute and substantial accumulation of fluid within the abdomen. "Abdominal compartment syndrome" is defined as intraabdominal pressure of at least 20 mm Hg with dysfunction of at least one thoracoabdominal organ [1]. In nearly all cases, there is some amelioration of organ function after decompressive laparotomy. Primary abdominal compartment syndrome results from injury or disease in the abdominopelvic region, such as after liver transplantation or pelvic fractures [2]. Secondary abdominal compartment syndrome occurs from disease originating from outside the abdomen, such as from major burns or sepsis. There are virtually no radiology reports of abdominal compartment syndrome [3]. One reason for this may be that CT is not ordered for the diagnosis of abdominal compartment syndrome. The diagnosis is usually rapidly performed at the bedside with intravesical pressure measurements. However, radiologists should understand this entity because it is likely that many of these patients, especially those with trauma or pancreatitis, will undergo CT studies for determining the severity of the illness and for identifying potential complications. In this case series, we discuss the pathogenesis, clinical features, radiologic findings, and treatment of abdominal compartment syndrome. [4]

METHODOLOGY

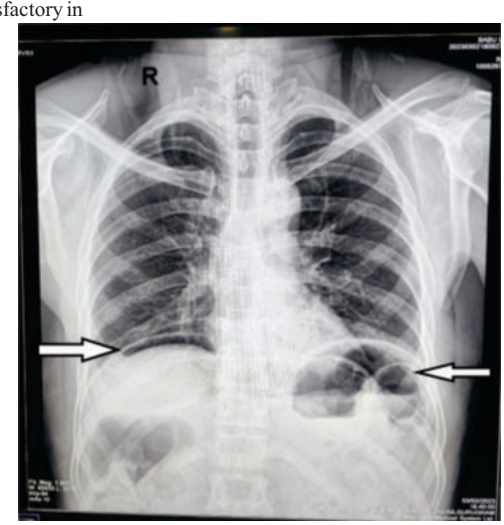
Case 1



A 63-year-old male patient presented to casualty with chief complains of abdominal distention and generalized pain since 2 days. Associated with bilious vomiting, fever and constipation since 2 days. The patient had generalized guarding and tenderness all over the abdomen. The patient was sent for Xray abdomen erect which showed massive pneumoperitoneum. Large amount of air was found under the diaphragm. (Fig 5) The patient was posted for emergency laparotomy which showed multiple perforations in the jejunum. The peritoneal cavity was filled with leak from the jejunum which was aspirated and the peritoneal wash given. The jejunal perforations were sutured primarily and the midline incision closed. The patient was stable post operatively and discharged uneventfully on the post op day 6.

Case 2

A 56-year-old male came to emergency with chief complaint of pain in abdomen for two days and not passing stool and flatus for two days. Patient was having tachycardia and hypotension. His BP was 106/60 mmHg, Pulse was 112/min. On per abdomen examination abdomen was distended, generalised tenderness was present. Patient was given fluid resuscitation. All routine blood investigation like CBC, LFT, KFT, PT-INR, viral markers and Xray abdomen was done which was showing gas under diaphragm (Fig.2). Patient was taken for emergency decompressive laparotomy. In operation it was found that patient had gastric perforation and graham's patch repair done. Patient was kept in post operative icu and antibiotics, analgesic, antacids given. No post operative complication was noted. Patient discharged satisfactory in



(Fig. 2) Xray Abdomen Erect- showing b/l gas under diaphragm.

Case 3

A 30-year-old male came to emergency with chief complains of severe pain in abdomen and distension in the last three days. Not passing flatus or stools in the last three days. Not associated with fever or vomiting. On per abdominal examination generalized tenderness was present. Bowel sounds were absent. Immediately x ray abdomen was done which showed air under diaphragm on both the sides with elevation of diaphragm. (Fig 3) All routine blood investigations were sent. The blood investigations were within normal limit. Patient was taken up for emergency decompressive laparotomy. Intraoperative findings showed a duodenal perforation in the first part 2cm from the antrum. Grahams patch repair was done. Patient was kept in post operative ICU, and given Intravenous antibiotics analgesics and antacids. No post operative complication was found and patient was discharged on post operative day seven.

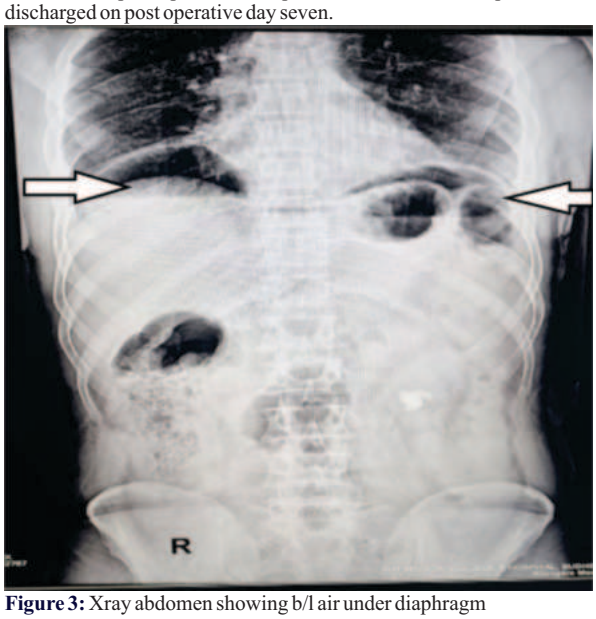


Figure 3: Xray abdomen showing b/l air under diaphragm

Case 4

A 54-year male presented to the casualty with chief complains of generalized pain in the abdomen and distention since three days. Associated with obstipation since three days. The x ray abdomen (erect and supine) showed multiple air fluid levels. (Fig. 4) The patient was taken up for exploratory laparotomy which showed diffuse peritonitis with 2 small perforations approximately six and twelve cms from the ileocecal junction. Segmental resection of affected segment done with end-to-end anastomosis of the healthy ileal segment was done. The post operative course was uneventful and the patient was discharged on 6th post operative day.

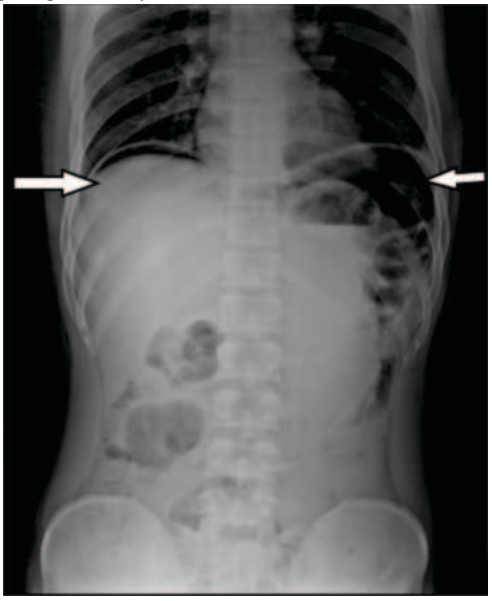
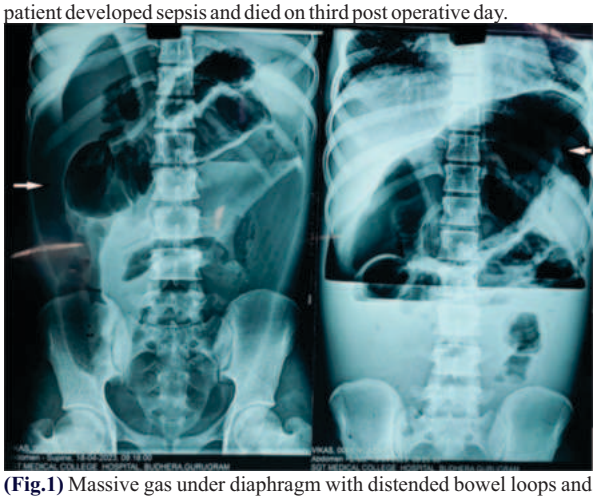


Figure 4 Xray abdomen showing b/l elevated diaphragm

Case 5

A 21-year-old male patient came to emergency with chief complaint of severe pain in abdomen, abdominal distension and fever for 2 days. Patient had not passed stool and flatus for 3 days. On per abdomen examination generalised tenderness was present. Blood pressure was 100/64 mmHg, Pulse- 110/min, RR- 34/min. Xray abdomen was done (Fig.1) and routine blood investigation like CBC, LFT, KFT, PT-INR, Viral markers done. TLC was 22000/mm^3. Patient was taken for exploratory laparotomy. In operation it was found that patient had multiple ileal perforation starting from IC junction up to 40 cm dis. Resection of distal part of ileum was done (up to 10 cm proximal from IC junction) which had 4 different perforation and for rest of the perforation primary repair with ileostomy done. Patient was kept in surgical ICU with mechanical ventilation. Patient was given antibiotics, analgesics, antacids, and kept nil per oral. Post surgery patient's condition hemodynamically didn't improve much. Eventually patient developed sepsis and died on third post operative day.



(Fig.1) Massive gas under diaphragm with distended bowel loops and multiple air fluid level.

Case 6

A 63-year-old female came to the emergency with chief complains of abdominal distention and bilious vomiting since three days. It was associated with fever and nausea since three days. The patient was sent for immediate x ray which showed air under diaphragm.(Fig. 6) The patient had a Total leucocyte count of 22000 and other blood tests were normal. The patient was posted for an exploratory laparotomy. Intra op findings showed a terminal ileum perforation which was primarily sutured. The patient was continued on Intravenous antibiotics which were continued for 5 days. The patient was discharged on the post operative day 8 after the TLC settled down and the patient was vitally stable.

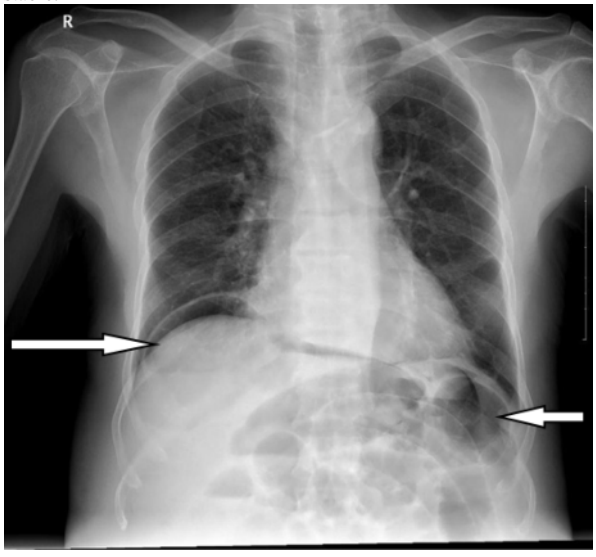


Figure 6 Xray abdomen showing b/l gas under diaphragm

Causes Of Abdominal Compartment Syndrome

Hollow viscus perforation

Hemoperitoneum
Penetrating trauma
Repair of large incisional hernia
Haemorrhagic pancreatitis
Large amount of pancreatic ascites
Trauma Grade 5 liver injury
Liver transplantation
Abdominal surgery in obese patients
Massive fluid resuscitation > 5 L within 25 hours
Iatrogenic perforation- following laparoscopy, endoscopy, colonoscopy

Pathogenesis Of Abdominal Compartment Syndrome

As intraabdominal pressure rises, progressive organ failure occurs. The kidneys and lungs are the most affected. With abdominal pressure of 15–20 mm Hg, the urinary output is reduced. When the pressure exceeds 30 mm Hg, anuria occurs. Renal failure is caused by external pressure on the renal vasculature and parenchyma [5]. Ureteric obstruction is not thought to be a cause. Mesenteric blood flow reduces to 70% of normal when intraabdominal pressure is about 20 mm Hg and falls to 30% of normal at 40 mm Hg. Intestinal oxygenation is impaired above a pressure of 15 mm Hg. Bowel mucosal hypoxia results in impaired gut–mucosal barrier function, allowing bacterial translocation and sepsis [6]. In abdominal compartment syndrome, the diaphragm is elevated with reduced excursion. The thoracic volume and compliance are reduced. The ensuing compressive atelectasis and ventilatory perfusion mismatch leads to hypercarbia and respiratory acidosis [7]. Oxygen delivery decreases with increasing abdominal pressure. Hypoxia is found in 20% of patients with abdominal pressure above 15 mm Hg and in all patients when the pressure exceeds 35 mm Hg. Decompression usually results in prompt reversal of respiratory failure. Increased abdominal pressure reduces venous return from the inferior vena cava and increases systolic arterial pressure in abdominal arteries. Increased thoracic pressure reduces cardiac output. Elevated intracranial pressure may occur and has been shown to decline after decompression surgery for abdominal compartment syndrome [8].

Clinical Diagnosis

The rapid accumulation of abdominal fluid in some conditions may cause organ dysfunction. In contrast, a more gradual rise in abdominal pressure, such as in normal pregnancy or in ascitic accumulation in liver disease or ovarian cancer, does not normally result in abdominal compartment syndrome [9-11]. Laparoscopy with pneumoperitoneum may cause elevated intraabdominal pressure, but the effect is transient and not to the degree required to cause abdominal compartment syndrome. Findings suggestive of abdominal compartment syndrome include a tensely distended abdomen; increased peak airway pressure; difficulty in maintaining ventilation, with hypoxia and hypercarbia; increasing creatinine; and oliguria [12]. Increased gastric acidity is also a recognized finding of abdominal compartment syndrome. However, most patients with abdominal compartment syndrome are in intensive care units, and clinical examination is usually not sensitive for diagnosing this entity.

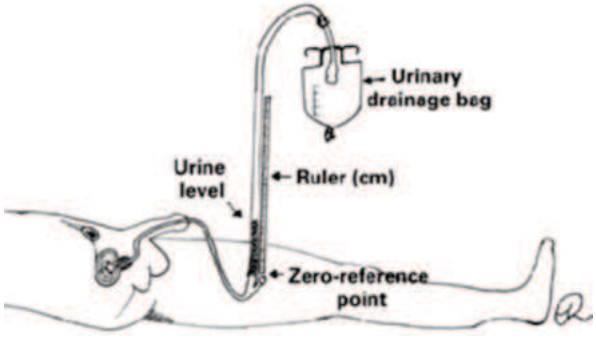
Diagnosis of abdominal compartment syndrome is complicated by the fact that these patients have many other explanations for renal or pulmonary failure. Sepsis, acute respiratory distress syndrome, hypovolemic shock, and multiorgan failure syndrome are frequently seen in patients who are also at risk of abdominal compartment syndrome. In some patients, these diverse and potentially lethal conditions may coexist [13-14]. Unlike in pure hypovolemic shock, the mean arterial pressure is normal in abdominal compartment syndrome. Central venous and pulmonary wedge pressures are poor indicators of volume depletion in abdominal compartment syndrome because they are artificially elevated due to the increased thoracic pressure. In contrast to hypovolemic shock, it is unusual for renal failure to occur in patients with abdominal compartment syndrome without concomitant respiratory failure [15]. However, rapid IV resuscitation of a patient in hypovolemic shock may precipitate abdominal compartment syndrome [16]. In general, abdominal compartment syndrome should be suspected in any patient with the appropriate clinical antecedents whose organ dysfunction worsens or does not improve in the face of adequate supportive therapy [17-18]. Measurement of intraabdominal pressure is required in such patients and is best assessed by a transurethral probe inserted in the urinary bladder. However, intravesical pressure measurements may not accurately reflect intraabdominal pressure if there is a neurogenic or contracted bladder, abdominal packing, or abdominal adhesions [19].

Radiological Findings seen on CECT of Abdominal Compartment Syndrome

Elevated diaphragm
Rounded configuration of abdominal wall (anteroposterior-to-lateral girth ratio > 0.8)
Increase in ascites (serial scans)
Hemoperitoneum
Flattened inferior vena cava
Flattened renal veins
Mosaic liver perfusion
Increased bowel enhancement
Increased gastric wall enhancement
Gastric distention
Reduced diastolic flow in portal, hepatic, or renal veins on sonography [12]

Measurement of Intra-Abdominal Pressure (IAP)

Contemporary measurement of IAP outside of the laboratory is accomplished by a variety of means. These include direct measurement of IAP by means of an intra-peritoneal catheter, as is done during laparoscopy. Bedside measurement of IAP has been accomplished by transduction of pressures from indwelling femoral vein, rectal, gastric, and urinary bladder catheters. Of these methods, measurement of urinary bladder and gastric pressures are the most common clinical applications [20-21]. In 1984 Kron *et al* reported a method by which to measure IAP at the bedside with the use of an indwelling Foley catheter Sterile saline (50–100 ml) is injected into the empty bladder through the indwelling Foley catheter. The sterile tubing of the urinary drainage bag is cross-clamped just distal to the culture aspiration port. The end of the drainage bag tubing is connected to the Foley catheter. The clamp is released just enough to allow the tubing proximal to the clamp to flow fluid from the bladder, then reapplied. A 16-gauge needle is then used to Y-connect a manometer or pressure transducer through the culture aspiration port of the tubing of the drainage bag. Finally, the top of the symphysis pubic bone is used as the zero point with the patient supine. An alternative bedside technique has been described in which intragastric pressure measurements are taken from an indwelling nasogastric tube. This method has been validated and found to vary within 1.8mmHg of urinary bladder pressures. Of these techniques, measurement of urinary bladder pressure appears to have gained widest clinical acceptance and application. [22]



DISCUSSION

Abdominal Compartment Syndrome is a very aggressive and deadly emergency condition, which need proper and immediate intervention by a surgeon. Diagnosis can be made by clinical examination with radiological evidence either by plain x ray or CT scan abdomen. For clinical examination, we should see weather patient is hemodynamically stable or not or having any signs of organ failure. The mortality rate associated with abdominal compartment syndrome is significant, ranging between 60% and 70% [23,24]. The poor outcome relates not only to abdominal compartment syndrome itself but also to concomitant injury and haemorrhagic shock. Treatment of the shock with large-volume resuscitation may worsen abdominal compartment syndrome by causing reperfusion bowel oedema. The currently accepted treatment for abdominal compartment syndrome is decompressive laparotomy. However, decompressive laparotomy does not prevent death in abdominal compartment syndrome. A metanalysis of 250 patients who had decompressive laparotomy for abdominal compartment syndrome found a mortality rate of 49%. Other methods of reducing intraabdominal pressure include drainage of fluid collections and muscle relaxation [28]. There are multiple ways to close the laparotomy wound in abdominal compartment

syndrome. Some prefers to keep Bogota bag for three days followed by closure of abdomen. Many techniques have been described for temporarily covering the abdomen after decompression laparotomy using mesh, opened sterile saline bags, plastic, or silicone [25-27]. Some surgeons have used skin clips to achieve skin closure while leaving the muscle and fascial layer open. The complications of leaving the abdomen open include delayed bowel fistula and ventral hernia, which occur in up to two thirds of patients treated with an open abdomen. A less common but more serious complication is a potentially lethal reperfusion syndrome with persistent haemorrhage. Nevertheless, most surgeons would prefer to leave the abdomen open in those who are at high risk of abdominal compartment syndrome [28]. A retrospective study of five patients with tension pneumoperitoneum who underwent endoscopy came with abdominal distension and fullness in abdomen was managed with 16G/14G needle decompression. Where needle was placed at midline 2 centimetres below umbilicus. Needle decompression is not a definitive treatment but can be done in emergency in hemodynamically unstable patient. Another method of non-invasive decompression is CT guided 14G pigtail catheter insertion [29,30] Though caecal perforation is thought to be a rare cause of tension pneumoperitoneum, four cases were noted of tension pneumoperitoneum following caecal perforation. Out of these four cases, three patient was managed with primary closure of caecal perforation and one patient was managed by caecostomy [31].

CONCLUSION

This case series illustrates number of important things about management of Abdominal compartment syndrome. The surgeon should be aware of all presenting symptoms of abdominal compartment syndrome and should evaluate patient accordingly, timely intervention is very important. The main object of management is to provide immediate decompression. Radiologic input into the diagnosis of this entity has been minimal in the past. Individual CT signs such as elevated hemidiaphragm, flattened inferior vena cava and renal veins, and increased bowel wall enhancement and Xray abdomen signs of gas under diaphragm, massive dilated bowel loops are neither sensitive nor likely specific for abdominal compartment syndrome. However, when a combination of these findings is present with the appropriate clinical setting or if the signs are seen to worsen on sequential imaging studies, the radiologist should raise the possibility of abdominal compartment syndrome.

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