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Successful Percutaneous Management of Traumatic Abdominal Compartment Syndrome in a Child

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ABSTRACT

Posttraumatic abdominal compartment syndrome (ACS) is an unusual and potentially lethal entity in pediatric patients. Early recognition and/or prevention of the syndrome, as well as prompt treatment of ACS, can reduce its associated morbidity and mortality but has traditionally required a laparotomy. Herein, we describe a case of posttraumatic ACS successfully treated percutaneously.

Key Words

Blunt abdominal trauma, Compartment syndrome, Intra-abdominal hypertension, Pediatric trauma, Percutaneous

Abdominal compartment syndrome (ACS) occurs when sustained intra-abdominal pressure results in impaired intra-abdominal organ function and may lead to multisystem organ failure and death if not properly diagnosed and managed.[1] Abdominal compartment syndrome may result from a variety of clinical scenarios such as trauma, ascites, and sepsis. In posttraumatic ACS, excessive fluid resuscitation and intestinal edema are common causes. Trauma continues to be the leading cause of morbidity and mortality in children,[2] and ACS has been reported to occur in injured children. We report the successful, percutaneous management of trauma-related ACS in an adolescent.

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CASE REPORT

A 13-year-old girl, who was restrained in the front seat, passenger side of the family car going approximately 40 miles per hour, was involved in a motor vehicle crash when the driver fell asleep and collided head on into a tree. At the scene, the patient was confused with an unknown loss of consciousness. Emergency medical services placed her in full spinal immobilization, started peripheral intravenous access, and transported her to a local hospital by ambulance. En-route, the patient complained of abdominal pain with documented hypotension. Outside the hospital, the patient was found to be alert with appropriate mental status, normotensive but tachycardic with an initial hematocrit of 29%.

On the basis of mechanism of injury and continued complaints of abdominal pain, a computed topography of chest, abdomen, and pelvis was done. These studies revealed a right rib fracture, a small right pneumothorax, bilateral pulmonary contusions, a grade IV liver laceration, grade III spleen laceration, and a transection of the mid pancreas. On examination, abrasions and ecchymotic areas were noted on right mid chest, left breast, and across the upper abdomen correlating with diffuse tenderness on palpation. Aggressive fluid resuscitation with crystalloid then blood was administered because of episodes of hypotension with increasing tachycardia. A left closed ankle fracture was splinted, intravenous pain medication was given, and the patient was transported to Boston Children's Hospital's emergency department. Prior to arrival to our emergency department, a total of 10 L of crystalloid and 5 units of packed red blood cells were given.

On arrival, the patient was normotensive, tachycardic, and mentating normally with a normal urine output. She was ventilating normally and was not intubated despite the large volume resuscitation. She was found to be without peritoneal signs, and her examination findings at the outside hospital were confirmed. A period of nonoperative observation was chosen given her relative stability and the combination of organ injuries, and she was admitted to the intensive care unit. Over the next 36 hours, her abdomen became increasingly distended, firm, and tender without peritoneal signs. Her urine output decreased, and

she developed impaired gas exchange and an oxygen requirement. With these clinical findings, the diagnosis of ACS was considered.

Because of the high risk of a laparotomy in the setting of her multiple intra-abdominal injuries, a lesser intervention was chosen. A repeat abdominal computed topography was performed, which showed 4 to 5 L of peritoneal fluid without active extravasation of contrast from her injured solid organs. A percutaneous peritoneal drain was placed in the right upper quadrant in the intensive care unit, at the bedside, under local anesthesia. With placement of the peritoneal drain, more than 2 L of blood-tinged fluid drained over a 1-hour period. Her hemodynamic status and urine output improved promptly, but her hematocrit dropped from 31.1% to 26.2%. Over the next few days, the abdominal drain was intermittently opened, draining 250 to 500 mL aliquots of fluid, depending on her abdominal physical examination. These smaller fluid amounts were well tolerated with no further decrease in her hematocrit. This strategy was continued until her abdomen was no longer palpably tense and the drain was removed.

On postinjury day 9, once it was determined that the patient was stable, she underwent an open reduction and internal fixation of her left ankle fracture. There was continued improvement with decreased abdominal distention, controlled pain, and strength. Repeat imaging revealed a $5.8 \times 3.5 \times 2.5$ cm^3 pancreatic pseudocyst, managed with nothing by mouth, parenteral nutrition (PN) through a percutaneously inserted central catheter and Octreotide. She was discharged home 31 days after presentation on home PN. At follow-up imaging, her liver, spleen, and pancreas injuries had all healed nonoperatively and the pancreatic pseudocyst was fully resolved. She tolerated a regular diet without difficulty and months afterward her only complaint was ankle pain while playing basketball for her school team.

DISCUSSION

Herein, we describe the successful use of percutaneous drainage for decompression of ACS in an adolescent patient. The multiple high-grade solid organ injuries and the sequelae of her necessary large volume resuscitation were the major contributors to the development of ACS in this case. The use of percutaneous drainage allowed the ACS to be addressed while avoiding laparotomy, which would likely have resulted in operative intervention for her various organ injuries and increased short- and long-term morbidity.

Abdominal compartment syndrome may result in long-term morbidity or mortality if not promptly diagnosed and treated.[3] Compartment syndromes such as ACS may occur in any of several body spaces including the head, chest, extremities, and the abdomen.[4] Common denominators are as follows: (1) a limited "potential space"; (2) an increased pressure in a confined space relative to systemic blood pressure; leading to (3) an inability to perfuse vital tissues; and, (4) resulting sequelae leading to potential morbidities and overt mortality. The numerical definition of ACS relates to the inability to perfuse vital organs and is graded I to IV; grade IV often mandates surgical intervention.[4]

Abdominal compartment syndrome, or intra-abdominal hypertension (IAH), is not new; being first described in 1863 by Marey and in 1870 by Burt.[5,6] Similar to these previous descriptions, Heinricus, in 1890, and Emerson in 1911, described the relationship between IAH and respiratory failure in animal models.[5-7] Thorington and Schmidt[8] further described the relationship between IAH and renal morbidity; intra-abdominal pressures over 30 mL of mercury (Hg) causing oliguria or anuria.[9]

Abdominal compartment syndrome, or IAH, may be diagnosed through a combination of clinical indicators, as well as serial measurements. The most common clinical scenario includes the presence of refractory hypotension, oliguria and/or anuria, and a "tense" abdomen.[10] This entity may or may not have a rapid onset and may develop over several days; thus, an ongoing high clinical suspicion is warranted. Invasive or noninvasive tools may be used to ascertain the "compartment pressure."[10] The most commonly used tool is the bladder pressure monitor; however, this may be limited by high intraobserver and interobserver variability.[11]

Once ACS has been diagnosed, the intra-abdominal pressure must be promptly relieved to avoid complications. Traditionally, open decompression is the treatment of choice with or without associated delayed closure of the abdominal wall.[12] Yet, this treatment, in itself, may be fraught with complications and morbidities including and not limited to (1) extended hospital length of stay; (2) extended ventilator requirements and/or neuromuscular sedation; (3) bowel ischemia and long-term ileus; (4) entero-entero or enterocutaneous fistulae; and (5) postoperative abdominal wall hernias.

In this particular case, the use of intermittent release of peritoneal fluid using a percutaneous peritoneal drain resulted in resolution of ACS sequelae without laparotomy, similar to one other report in the literature.[13] However, this technique was not without complexities, as too rapid a decompression released the tamponade effect the peritoneal fluid pressure was having on her solid organ injuries, resulting in a hematocrit drop and tachycardia. A more judicious release of smaller aliquots of fluid subsequently prevented this complication.

CONCLUSION

Abdominal compartment syndrome is a potentially lethal entity for pediatric and adolescent patients. Early recognition and prompt treatment of ACS reduces its associated morbidity and mortality. Herein, we describe a case of

posttraumatic ACS successfully treated with percutaneous drainage in a child. This allowed the ACS to be addressed without laparotomy.

Key Points

- Abdominal compartment syndrome is a potentially lethal entity for pediatric and adolescent patients.
- The early recognition and prompt treatment of ACS reduces its associated morbidity and mortality.
- Treatment with percutaneous drainage in a child can be successful eliminating the need for laparotomy in some cases.

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