Case Report

Traumatic Abdominal Wall Hernias Following High-Velocity Trauma in Children

Rakesh Quinn, Susan Jehangir, Michael Collin, S. V. S. Soundappan

Department of Surgery, The Children's Hospital at Westmead, Sydney, Australia

Received: 24 February, 2019. Revised: 05 March, 2019. Accepted: 20 April, 2019. Published: 11 April, 2020.

ABSTRACT

Traumatic abdominal wall hernias following blunt high-velocity trauma are uncommon in children and can result in concurrent abdominal visceral injuries. We present one such case of a 9-year-old boy requiring a trauma laparotomy to repair visceral injuries following a motor vehicle accident. He was an improperly restrained, back seat passenger. He presented complaining of abdominal pain. On arrival, he was hemodynamically stable, with a Glasgow Coma Scale of 15. A seatbelt sign was identified across his lower abdomen. There was a tender fullness in the left flank, but it was difficult to decipher a clear mass or defect due to his high body mass index (>30). There was a laceration over his forehead extending to the hairline. The remainder of the examination was unremarkable.

The plain abdominal radiograph showed an unusual gas shadow in the left lower quadrant. A focused abdominal sonography for trauma was positive with free fluid in Morrison's pouch and the rectovesical pouch. The diagnosis of TAWH was made by abdominal computed tomography (CT), which revealed a large left lower lateral abdominal wall muscle defect, spanning 120 mm anteroposteriorly and 70 mm craniocaudally [Figure 1]. Small bowel, mesentery, and a small portion of the distal transverse colon were herniating through the defect, with associated fat stranding in the mesenteric root. Free fluid in the left subphrenic and hepatorenal space was identified.

An emergency trauma laparotomy was performed. He required resection of a segment of ischemic sigmoid bowel with primary anastomosis and repair of jejunal vehicle accident. He was an improperly restrained, back seat passenger. He presented complaining of abdominal pain. On arrival, he was hemodynamically stable, with a Glasgow Coma Scale of 15. A seatbelt sign was identified across his lower abdomen. There was a tender fullness in the left flank, but it was difficult to decipher a clear mass or defect due to his high body mass index (>30). There was a laceration over his forehead extending to the hairline. The remainder of the examination was unremarkable.

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INTRODUCTION

Traumatic abdominal wall hernias (TAWH), first described by Shelby in 1906, are described as a localized injury with herniation of bowel through a disrupted abdominal wall musculature and fascia without skin penetration due to a blunt force.[1] The force from the impact does not penetrate the skin due to its elasticity but is transferred through the abdominal wall. The combination of raised intra-abdominal pressure due to patients bracing for impact and a localized blunt force causes disruption of the musculature and fascia of the abdominal wall.[2] Shear forces applied to the bony prominences result in muscular attachments being avulsed off the pelvis and thoracic cage.[3]

TAWH are further described based on mechanism of injury into three categories.[2] Type I hernias commonly occur in children and are referred to as “handlebar” hernias.[4] They are low energy injuries associated with small defects and a low risk of associated visceral injury. Type II hernias following high-energy injuries, associated with larger defects, are associated with coexisting intra-abdominal injuries. Type III injuries are intra-abdominal hernias following deceleration injuries. High-velocity injuries (Type II and III) are extremely rare in children and management is thus not well established. Herein, we describe an additional case of a high-velocity TAWH and review the available literature on diagnosis, management, and treatment.

CASE REPORT

A 9-year-old boy was brought in by ambulance to the Children’s Hospital at Westmead following a motor

Address for correspondence: Dr. Rakesh Quinn, Department of Surgery, Westmead Hospital, Cnr Hawksbury Rd and Darcy Rd, Westmead, Sydney 2145, NSW, Australia. E-mail: rakesh.quinn@health.nsw.gov.au

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How to cite this article: Quinn R, Jehangir S, Collin M, Soundappan SV. Traumatic abdominal wall hernias following high-velocity trauma in children. J Indian Assoc Pediatr Surg 2020;25;169-71.
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serosal tear and a large jejunal mesenteric defect. The large abdominal wall defect was closed in layers with PDS and a permacol patch secured to reinforce the defect.

His postoperative course was complicated by persistent fevers. An abdominal ultrasound revealed a 48 mL cutaneous collection in the left flank. Incision and drainage of the collection occurred on postoperative day 12. Intraoperatively, fecal material was identified in the left flank collection, and we proceeded to laparotomy. It was identified on laparotomy that necrosis of the psoas muscle had led to a posterior abdominal wall breakdown and herniation of the sigmoid colon anastomosis which subsequently leaked. The anastomosis was revised and the hernia repaired. He subsequently required incision, drainage, and washout of anterior and posterior wall collections 4 days later. His postoperative course was slow, and he was discharged home 33 days after the trauma. At a 4-month follow-up appointment, he was recovering well with no evidence of recurrence.

Discussion

High-velocity TAWH are rare in children. The tangential shearing stresses associated with a sudden elevation in intra-abdominal pressure are thought to be responsible for the rupture of the abdominal wall muscle with intact skin. The defect may not be clinically apparent on initial assessment. There may be a muscle spasm due to pain or related anxiety in children surrounding a high impact trauma. Further, as in our case, a high body mass index (BMI) may contribute to a difficult assessment. The mechanism of injury should raise clinical suspicion of the presence of an abdominal wall disruption. Overlying skin changes or a seat belt sign is often reported in the literature. There may also be a palpable reducible or nonreducible swelling.

Plain abdominal films can show gas-filled loops outside the contour of the abdominal cavity, raising suspicion as in our case. CT imaging has been proven to be efficacious in the evaluation of hemodynamically stable children with high-speed impact trauma and abdominal signs and appears to be the best modality to identify TAWH. A pediatric case series on both low and high-velocity TAWH reported 37.5% use of CT for diagnosis. The frequency of the use of CT scans increased over time, with 77% of cases utilizing CT imaging in the past 10 years. Dennis et al. have described grades of abdominal wall injuries based on CT findings, from abdominal wall contusions (Grade 1) to complete disruption of the abdominal wall with evisceration (Grade 5). Interestingly, the incidence of associated injuries was consistent across Grade 1–4. Further, TAWH have been reported to be associated with other injuries, with a frequency of 39%–100% of cases in published adult series. In the adult population, pelvic fractures, thoracolumbar fractures, bowel perforation, and mesenteric injuries are the most commonly associated injuries with TAWH. Bony injuries are less common in children in comparison, but both bowel and mesenteric injuries are often associated.

The optimal timing of repair for TAWH is debatable. Many patients require urgent laparotomy for nonhernia-related pathology, and the hernia is subsequently managed during the same procedure. Those without identified concurrent abdominal injuries pose the dilemma of when to operate. There is 8%–25% reported risk of strangulation and incarceration if repair is delayed. Further, if there is a missed bowel injury, it could have disastrous consequences. However, there is a reported 8.3%–50% recurrence rate when the hernia is repaired in the acute setting. Like in our case, this could be attributed to the lack of demarcation at the outset and ongoing necrosis and breakdown of traumatized muscle tissue. Conversely, there are reports of good outcomes with delayed management in uncomplicated cases. Concurrent intra-abdominal injuries were radiologically reported in 45%–50% of TAWH. However, CT scans can often be negative in the setting of bowel and mesenteric injuries, with a reported sensitivity of 55% for identifying hollow viscus

Figure 1: Computed tomography abdomen-pelvis, axial, and coronal view
The signs can often be subtle such as bowel wall thickening and mesenteric stranding. Although ideal, a standard protocol is difficult to define in these circumstances. Each case must be examined on its own merit.

Once a decision to operate is made, a variety of methods may be employed depending on the clinical scenario. Both laparoscopic and open approaches have been documented in the literature; however, most cases in pediatric series were managed with an open approach. Diagnostic laparoscopy is appropriate for patients who are hemodynamically stable and for surgeons with sufficient skills to explore the entirety of bowel to exclude injuries in the acute setting. Depending on the size and location of the TAWH, the placement of laparoscopic ports may be restricted, affecting the surgeon’s ability to examine all the viscera adequately and repair the hernia. We performed a midline laparotomy considering the BMI of our patient as it provided adequate exposure to the entire abdomen, to assess and repair injuries. Conversely, an incision over the defect has also been employed with success in many cases. The management principles are the same for any approach: adequate visualization, satisfactory debridement, and decontamination, removal of hematoma, and tension-free repair. Primary repair is appropriate where possible; in large defects, a mesh may be required. The use of a synthetic mesh may not be advisable in a contaminated field; however, biologic mesh is a good alternative. Biologic mesh has been shown to have similar recurrence rates to synthetic mesh, with the benefit of less potential for bowel adherence and infective complications.

There was a paucity of follow-up data in the literature. Most children seem to recover quickly after repair of the abdominal wall defect and other associated injuries. However, our patient had a prolonged hospitalization and slow recovery. Although no recurrences (except our patient) have been reported in pediatric patients, it has been known to occur in adults where the experience is more extensive.

TAWH are uncommon following blunt abdominal trauma in children. It requires a high degree of suspicion to diagnose and must be suspected, especially in the presence of skin changes over the abdomen. Preoperative CT is recommended in stable patients to decipher the extent of the associated visceral injury and localize the defect. An individualized approach is required considering the various injuries in the child. Primary closure of the hernia is recommended where possible. The use of mesh should be restricted to large defects not amenable for primary closure. Recovery may be slow, but outcomes are good.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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