Pediatric aortoiliac injury following blunt abdominal trauma: A case report

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**A B S T R A C T**

**INTRODUCTION:** The most common mechanism of aortic injury involves motor vehicle collisions resulting in aortic disruptions, occurring almost exclusively in the chest. Injury to the abdominal aorta following blunt trauma is nearly twenty times less likely to occur than the thoracic aorta. Because of the low incidence, there are few reports regarding the presentation and repair of these particular injuries, especially in the pediatric population.

**PRESENTATION OF CASE:** We present a case of a 7-year-old boy involved in a high speed motor vehicle accident with an abdominal aorta transection at the aortic bifurcation extending into the left iliac artery. The injury was repaired using bovine pericardium with the adventitia and intima of the vessel approximated over the bovine bridge.

**DISCUSSION:** Primary repair of thoracic aortic injury has been thoroughly described in the literature with good outcomes yet, abdominal aortic repair remains ambiguous. Few techniques and materials have been described with even less data surrounding the long-term outcomes.

**CONCLUSION:** Bovine pericardium is a strong and stable acellular collagenous material with the potential to accelerate endothelialization and tissue regeneration. This remains an interesting field of research as stenosis and pseudo-coarctation data have yet to be determined.

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**1. Introduction**

Although trauma and unintentional injury are the primary cause of mortality in children from ages one to twenty-one, pediatric vascular and aortic injuries are extremely rare. The most common mechanism of aortic injury reported is motor vehicle collisions with aortic disruptions occurring almost exclusively in the chest (95–99%) [1,2]. Abdominal aortic injury following blunt trauma is almost twenty times less likely than the thoracic aorta, making its repair even that more challenging.

Since the incidence is low, there are few reports regarding pediatric abdominal aortic injury from blunt trauma or its repair. The clinical presentation and repair of the aorta varies depending upon the mechanism, ranging from ATV accidents to soccer injuries [3,4].

We present a case in which a 7-year-old boy was involved in a high speed head on collision. He suffered an abdominal aortic intimal transection measuring about 2 cm starting at the aortic bifurcation extending into the left iliac artery. We describe the use of bovine pericardium in the setting of pediatric abdominal aortic injury with positive results, avoiding the use of synthetic graft material or autologous vein.

**2. Case report**

Patient is a 7-year-old boy who was involved in a motor vehicle accident, head on collision, at highway speeds. The patient was the rear passenger and was restrained with just a lap seat belt. On scene, he was hemodynamically stable and conscious. He presented to a nearby hospital where he was worked up with a CT scan of the abdomen and pelvis with contrast. He was transferred to our hospital three and a half hours after the incident with abdominal pain and CT findings of pneumoperitoneum, a distal aortic tear, and a chance fracture of the L3 vertebra (Figs. 1 and 2). On arrival to our facility, he was tachycardic with an initial heart rate of 130. He had a blood pressure of 133/81 and had a respiratory rate of 18, saturating 95% on room air.

He was taken emergently to the operating room for an exploratory laparotomy. He was found to have a cecal perforation for which the pediatric surgery team performed an ileoectomy with a primary anastomosis. He also had deserosalization of the sigmoid colon for which repair and a diverting sigmoid colostomy was performed. The intra-peritoneal portion of the case was performed prior to evaluation of the aorta. Due to the gross contamination

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of the abdomen and the hemodynamic stability of the patient, a thorough washout was performed prior to evaluation of the aorta. With the possibility of contamination of the vascular repair, the abdomen was cleaned prior to any considerations for repair. Once completed, the cardiovascular team was called into the operating room to evaluate the transection.

A left sided distal aortic transection was found on exposure of the retroperitoneum. Upon evaluation, a bulging area of circumferential adventitia was identified where the intima had been transected and retracted proximally and distally. After opening the aorta longitudinally, a complete transection of the intimal layer for 2 cm was observed. A rectangular strip of bovine pericardium was placed at the base of the defect, reconstituting the proximal iliac and distal aorta at the bifurcation. The bovine pericardium was used as a bridge that reconstituted the posterior and lateral walls of the aorta. This was wrapped 270° leaving an elliptical opening on the anterior wall. An elliptical patch of bovine pericardium was then sutured into place at this site (Fig. 3). Once the vascular portion of the case was completed the neurosurgery team performed a posterior spinal fusion for his L3 chance fracture. Following the procedure the patient had palpable distal pulses.

3. Discussion

Due to the low incidence of traumatic aortic injuries, repair remains a challenge. Even in the setting of blunt abdominal trauma, abdominal aortic injury is over twenty times less likely to occur than thoracic aortic injury [5]. This is because the abdominal aorta is located in the retroperitoneum, making it relatively protected. The most common site of abdominal aortic injury at the is in zone III, described as inferior to the renal vessels to the level of the iliac bifurcation. This was described in the Journal of Vascular Surgery in a retrospective review of patients with blunt abdominal trauma between 1996–2010 with over 200 patients evaluated. In the patient described, this is the location of the aortic injury, extending into the left iliac from the bifurcation. The retrospective study also describes non-operative management using beta blockade with intimal tears with minimal thrombus formation. In our described case, it is unlikely that, given the size of the intimal tear, the patient would have had a favorable outcome without operative intervention [6].

In the literature regarding abdominal aortic transections and dissections, most repairs were performed with Dacron, PTFE, or primary repair alone [7]. The severity of the trauma for the patient described led to concomitant injuries including ileocecal perforation and sigmoid deserosalization. Gross contamination of the abdomen puts a prosthetic graft at risk for infection. Synthetic graft such as PTFE or Dacron also puts a pediatric patient at risk for pseudo-coarctation or pseudoaneurysm over time. The learning points taken away from this specific case include, in the setting of gross contamination, an innovative material for repair. The literature thus far has not included complete reconstruction using bovine
pericardium in the pediatric population. Due to the specific properties of the material, the idea is that it will grow with the child overtime preventing any of the sequelae of a prosthetic material.

Endovascular repair for zone 3 abdominal aortic injuries has also been described in the literature. Injuries that have been treated in such a way have been described as large intimal flaps, pseudoeurysms, and free rupture. It has also been described in cases where primary repair subsequently causes recoarction. In the setting of gross contamination or polytrauma, newer endovascular repair does appear to be a more attractive option. Pseudoaneurysm formation after trauma has especially been successful with this therapeutic modality. In the described injury, with the concomitant catastrophic injuries to the gastrointestinal tract, requiring a diverting colostomy, an open approach was mandated. An additional concern with endovascular techniques in the pediatric population is the fixed diameter of endovascular stents in comparison to the increasing diameter of the vasculature in children due to normal growth [8].

Pediatric aortic trauma is a complicated and challenging repair due to the prospective growth of the child over time. Even though primary repair of aortic transections has shown positive long term results [9], there are instances where the anatomy of the injury does not lend itself to this type of repair (such as the aortoiliac bifurcation as presented in our case). Another option for repair that has been described is autologous vein, including greater saphenous vein. The vein can be used in situ or reversed, and there has been mixed results and complications described. There were reservations regarding its use in the pediatric population, and late aneurysmal degeneration occasionally occurred in preadolescent children. In one study with all children having autologous vein grafts, over 50% experienced some sort of vascular dilation whether that be aneurysmal or non-aneurysmal dilation. This is due to the high pressures of the arterial system affecting the vein wall [10, 11]. In the described case, the patient’s young age and emergent nature of the surgery, a vein conduit was a less attractive option. Bovine pericardium is a material that has been used in vascular surgery for things such as patch closures in carotid endarterectomy. It has elastic properties due to the high amount of structured, layered proteins as well as a coating to help prevent calcification. It is available quickly in the operating room without the need to harvest autologous tissue, which also increases the risk of infection. This there decreases operative time which was beneficial in our case due to the contamination as well as the longer ischemic time due to evaluation at an outside hospital prior to transfer. Complete reconstruction using bovine pericardium has not been previously described in literature. The use of this in the pediatric population is also very limited, making the long term data regarding patency, pseudo-aneurysm, and coaction limited. Further long term studies are further required.

4. Conclusion

Pediatric aortic injury is challenging, especially in the setting of blunt abdominal trauma. In the setting of the patient described, a bovine pericardium patch with bridging and reconstruction was the best option. Long term patency rates for reconstruction with bovine pericardium is limited and more data is needed regarding complications in the pediatric population.

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Authors contribution
Edward Daniele M.D. – written, edited.
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