Traumatic rupture of the aorta in an 11-year-old patient: Surgical considerations in the technique of repair

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We describe an 11-year-old child who presented with a traumatic aortic transection. This is an extremely rare occurrence in this age group. In managing the injury the future growth of the child must be considered. Primary repair is ideal when possible, but in choosing a graft, the choice of size and material should take cognisance of the risk of a coarctation-like syndrome in the future

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CASE REPORT

An 11-year-old boy was the unrestrained backseat passenger in a frontal impact, single vehicle, high speed road traffic accident. Two other occupants died at the scene. On transfer to the local trauma centre he was found to have a left humerus midshaft fracture, a fracture dislocation of his left elbow, a left midshaft femur fracture, right second and third rib fractures and a left radial nerve palsy. A chest radiograph suggested a widened mediastinum. Subsequent contrast computerised tomography (CT) identified a poorly defined aortic arch, hypodense periaortic collection with bilateral effusions, and a small amount of air in the left posterior mediastinum and paraspinal region. A single cut identified an intraluminal lucency thought to represent an intimal flap (Figure 1). Transfer to the national paediatric cardiothoracic surgery centre was expedited. He was haemodynamically stable throughout.

On arrival 11 hours following the injury, he underwent a contrast aortogram which identified an aortic tear with a false aneurysm at the juxtaductal region confirming transection of the aorta (Figure 2). In addition, he had a left haemo-pneumothorax and a right pleural effusion. Left posterolateral thoracotomy was performed at the level of the fourth intercostal space. A haematoma was noted at the isthmus. He was placed on partial cardiopulmonary bypass from the pulmonary artery to the distal aorta having being anti-coagulated with 3mg/kg of heparin. The clamp was placed distal to the origin of the left subclavian artery and at the distal aorta, at the level of the sixth thoracic vertebra. A complete transection was noted just distal to the isthmus and the edge of the aorta resected and primary repair, with an end-to-end anastomosis, performed using a continuous 4/0 polypropylene suture. The total cardiopulmonary bypass time was 21 minutes and the aortic cross clamp time was 20 minutes at a temperature of 34ºC. His orthopaedic injuries were dealt with the following day. Post-operatively, his management was complicated by hypertension, which required pharmacological management with propranolol. He was discharged from intensive care after four days, well and neurologically competent. Six months after the event he was well on follow-up.

DISCUSSION

Traumatic thoracic aorta injuries in childhood are extremely rare. In a review of 213, 118 traumatic thoracic injuries, there were no aortic disruptions in those aged 10 years and under, although this age group made up 12,382 of the study total.[1] However, from the limited number

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that have been reported, we know that childhood injury differs from adult trauma because of differences in mechanisms of injury, development and anatomy. Thoracic injuries in children are predominantly due to blunt trauma (97%), compared with adults who are more likely to be involved in stabbings and gunshot wounds.[2] Male children predominate in childhood thoracic trauma, accounting for 78% of injuries and 50% are secondary to road traffic accidents, where 80% of children are unrestrained as in this case report.[2] In traumatic injuries in children, the energies may be distributed more widely over the entire body than in adults.[3] Differences between adult and children thoracic cage compliance, due to the lower mineral content of the ribs of younger children, makes them more pliable, and may contribute to the different pattern of tissue damage in childhood. However, a less rigid thoracic cage may increase the likelihood of damage to internal thoracic organs. This may account for the high rate of pulmonary contusions in children with chest trauma.[2] Emergency surgical intervention is rarely required however, and is only performed in 6% of cases.[2] The 0-4 year age group has the highest mortality rate (12-23%) from chest injury.[2,4]

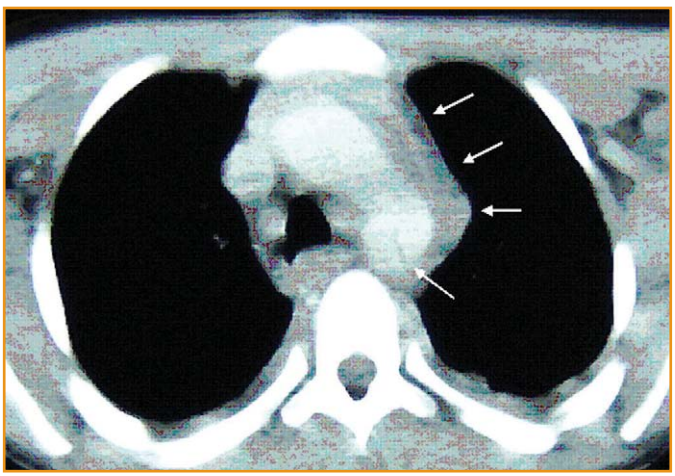

Figure 1: This CT thorax with contrast shows an intimal flap in the descending aorta with a periaortic fluid collection.

Traumatic aortic transection is thought to result from a deceleration mechanism. Disruption occurs at a point between the relatively fixed descending aorta and the mobile arch where the combination of deceleration and shear forces are concentrated. The ageing process is accompanied by an increasing stiffness of the aorta and this is most pronounced in the thoracic aorta.[4,5] The media of the aorta is responsible for its physical properties of elasticity and compliance. Progressive loss of elasticity and compliance occurs from birth to old age, with a precipitous decrease beyond 20 years.[6] The increase in stiffness in the aorta is mainly due to increased thickness of the vessel wall with growth.[6] Paediatric thoracic aortic injury is rare, occurring in only 0.064% of all chest trauma under 20 years of age, although it is extremely rare below the age of 10 years.[1] Blunt trauma is the major aetiological factor and almost all are due to road traffic accidents.[7,8] Most cases of aortic transection in children result in rapid death at the scene. Across all age groups only 15% of aortic transections survive to hospital admission.[1] However, while adult mortality is in the range of 60%, mortality in the paediatric population, who survive to the operating theatre, is 34%.[9]

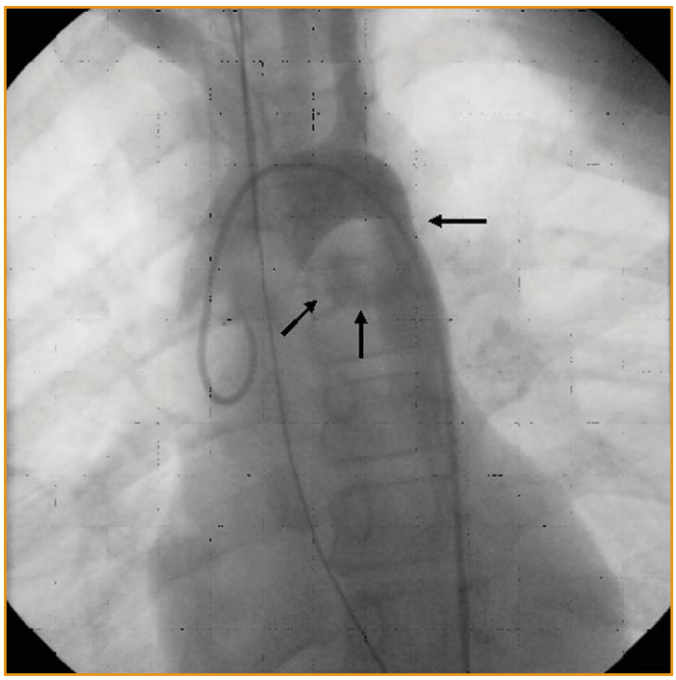

Figure 2: This frame from the aortagram shows contrast leaking at the site of transection.

Whenever a child is involved in a traumatic chest injury, aortic injury should be suspected. Aortic injuries are still present in 50% of cases with no obvious external thoracic injury and an erect chest radiograph should be performed. The most common findings are a left apical cap, pulmonary contusion, aortic obscuration and mediastinal widening.[8] Associated injuries occur in 68% and include pulmonary contusion (100%), pelvic/long bone fractures (50%), visceral laceration (50%), neurological injury (33%), paraplegia (17%) and myocardial contusion (17%).[10] Flail chest is a rare occurrence in this age group and this may explain the low ventilation requirements of this group where only 21% will require ventilation for a short duration. Predictors of mortality include a presentation systolic blood pressure <90mmHg and the presence of central nervous system injuries or haemorrhage, rather than respiratory insufficiency.[2,9,11] Hypertension, however, should be avoided as this can disrupt any local peri-aortic tissue or mediastinal pleura that has contained the transection. Predictors of prolonged hospital stay include the presence of associated injuries, intubation, pneumothorax and haemothorax.[2]

This case was repaired utilising partial cardiopulmonary bypass. Anticoagulation was employed in this polytrauma case, as there was no evidence of head injury. Strategies employed to protect the spinal cord included a mild systemic hypothermia and short cross clamp time of 20 minutes. There

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