CE 2.0 ANCC Contact Hours

Penetrating Knitting Needle Through the Mediastinum in a Child

Kelly Gettig, MSN, RN, CPNP-PC/AC ■ Karla A. Lawson, PhD ■ Nilda M. Garcia, MD ■ Kenneth A. Fox, MD

ABSTRACT

Thoracic injuries are second only to central nervous system injuries as the leading cause of traumatic death in patients of all ages. Penetrating chest injury is very uncommon in children, but it comes with significant morbidity and mortality. Presentation of penetrating thoracic injury in the child is unique with inherent opportunities for learning. The purpose of this case report was to disseminate information regarding rare thoracic trauma in the pediatric patient.

Key Words

Chest trauma, Mediastinum, Penetrating injury, Thoracic impalement, Thoracic trauma

INTRODUCTION/TOPIC

Thoracic injuries are second only to central nervous system injuries as the leading cause of traumatic death in patients of all ages.[1] Thoracic trauma is relatively uncommon and affects between 5% and 12% of injured children.[2,3] According to the National Pediatric Trauma Registry, blunt chest trauma accounts for 85% of thoracic injury with a mortality rate of 5% for isolated chest trauma. Penetrating chest injury is significantly more lethal with a mortality rate of 15% reported.

Chest trauma has been cited as a significant marker of morbidity and mortality with higher injury severity scores and trauma scores in children with chest injury as compared with those without.[1,4] Onat et al[5] cite an overall mortality rate of 10.8% in a retrospective review of 1123 adult patients admitted with penetrating thoracic trauma. The rate of thoracotomy in the first 24 hours was 14%. Rielly et al[6] reviewed the management and outcomes among 37 children with both blunt (65%) and penetrating (35%) chest trauma and cited a thoracotomy rate of 22% with 7 total deaths (19%).

Author Affiliations: Trauma Services (Ms Gettig and Drs Lawson and Garcia) and Pediatric Cardiothoracic Surgery (Dr Fox), Dell Children's Medical Center of Central Texas, Austin.

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Correspondence: Karla A. Lawson, PhD, Trauma Services Department, 4900 Mueller Blvd, Austin, TX 78723 (kalawson@seton.org).

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Penetrating chest injury in children is very uncommon and data are generally extracted from the adult literature where gunshot and stab wounds comprise the large majority of cases. In children, impalement with an object is a common mechanism of penetrating chest trauma, and there are isolated case reports of thoracic impalement in the literature.[7,8]

Regardless of mechanism, mortality is highest for children with injuries to the heart or intrathoracic blood vessels. Fortunately, thoracic vessel injury occurs infrequently in children compared with adults, due to increased vessel elasticity in children.[9] In a study comparing vascular injuries in children and adults over a 5-year period, the incidence of vascular injuries of the chest in children was reported at 13.2% versus 24.4% in adults.[10] This study found the incidence of pediatric thoracic aortic injuries to be 7-fold lower (0.03%) compared with adults (0.21%). Onan et al[11] reviewed 104 adult cases of cardiac and great vessel injuries over a 10-year period. This included both blunt and penetrating mechanisms with a mortality rate of 18.2% reported. Thoracotomy was performed in 89.5% of cases. This study reported a 2% incidence of cardiac or great vessel injury among patients with general chest trauma. O'Connor and Scalea[12] reviewed the surgical management of great vessel injuries in 36 patients aged 15 to 57 years over a 7-year period. Among those in shock, sternotomy was performed in 75% of cases, periclavicular in 20%, and thoracotomy in 5% (1 case). Among stable cases, a periclavicular approach was used in 56%, partial sternotomy in 32%, with 1 case each (6.5%) of sternotomy and thoracotomy.[12]

REVIEW OF CASE REPORT LITERATURE

In children, impalement with an object is a common mechanism of penetrating chest trauma, and there are isolated case reports of thoracic impalement in the literature. Massad et al[7] reported a 16-year-old male adolescent who presented with a retained segment of an ice pick that went unnoticed by the patient for 4 days. Computed tomographic (CT) scan identified the ice pick with the tip located in the right ventricular cavity. A left lateral thoracotomy was performed and a 14-cm segment of the ice pick was removed without complication.[7]

Improper car seat use was the issue in a 15-month-old female status-post motor vehicle crash with ejection.[8]

Riggle et al[8] report the case of a toddler impaled with a knitting needle, which was protruding from her right chest and stabilized by first responders. The patient was hemodynamically stable on arrival with the needle penetrating the third right intercostal space at the midclavicular line. The CT scan demonstrated that the knitting needle had penetrated the right lung with a hematoma along the needle and possible transection of pulmonary artery branches. An anterior right thoracotomy was performed to gain control of the pulmonary artery prior to needle removal. A Roummel tourniquet was placed around the trunk of the right pulmonary artery to obtain proximal vascular control and the needle was removed successfully. A chest tube was placed and there were no complications in the postoperative course.

CASE REPORT

We describe an uncommon case of a young child who was impaled with a knitting needle through her mediastinum, requiring urgent surgery. A 4-year-old previously healthy female fell off the arm of a couch onto her mother's knitting bag. The parents noted an impalement with a large aluminum knitting needle and called emergency services. The first responders found her in no distress with 12 inches of exposed knitting needle emanating from her right posterior axilla. When compared with its partner, the needle was estimated to have 4 to 5 inches inside the chest. The needle was stabilized with rolled gauze and she was transported in the side-lying position to our hospital.

The patient arrived hemodynamically stable with a Glasgow Coma Scale score of 15. She was transferred to the stretcher into prone position with the needle protruding from her right posterior axilla. She was talking very calmly and was clearly not in any distress. Breath sounds were noted to be diminished on the right; 100% oxygen via nonrebreather was applied and a normal saline bolus was given. Chest roentgenogram showed the needle crossing the mediastinum with concern for major vascular or airway injury (Figure 1). No free air was noted.

The patient remained stable and the decision was made to evaluate further with CT angiogram (Figure 2). On the CT scan, an 8-mm needle was seen penetrating the right posterior thorax, appearing to nick the scapula. It passed into the lung through the fourth rib interspace and into the mediastinum. Hematoma was noted along the tract through the right lung with no evidence of pneumothorax or effusion. The needle passed between the carina and esophagus with a small amount of free air, most likely related to the lung injury. The tip crossed midline and ran between the right and left subclavian arteries and along the wall of the left common carotid. There was no extravasation or hematoma, but

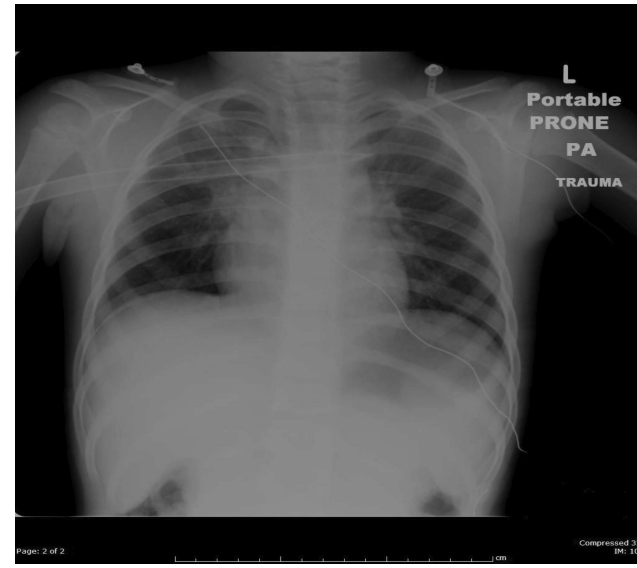

Figure 1. Initial chest roentgenogram showing the needle traversing the mediastinum.

injury could not be entirely ruled out. The tip terminated near the brachiocephalic vein and there was concern for venous injury near the junction of the subclavian and internal jugular.

The patient was taken directly to the operating room where rigid esophagoscopy and bronchoscopy demonstrated no injury. Based on the path of the needle, it was felt that a median sternotomy offered the most options for

Figure 2. Preoperative computed tomography showing the needle tip crossing midline with hematoma noted along the tract through the right lung.

repair of potential vascular injury throughout the thorax as well as good exposure for bypass if needed. The tip of the needle was found adjacent to the aortic arch, having displaced the trachea. The path of the needle was traced back, revealing close association with, but no injuries to the pulmonary hilum, the superior vena cava, the esophagus, the trachea and the aortic arch. The needle was removed uneventfully. A through and through injury to the right lung was found and the lateral aspect was stapled over. Drains were left in the mediastinum and right pleural space. The entry site was managed with local wound care. The patient had a remarkably uneventful postoperative course. Tubes were pulled on postoperative day 2 and she was discharged home the following morning. She has done well in outpatient follow-up.

DISCUSSION/CONCLUSION

Penetrating chest injury in children is very uncommon but the associated morbidity and mortality are significant.[1,6] Injury to the great vessels brings the highest risk of mortality and is fortunately much less common in children than in adults.[10,11] Data regarding penetrating thoracic injury are generally extracted from the adult literature and sparse case study presentations in the pediatric literature. For this reason, presentation of penetrating injury to the chest in a young child is unique and merits discussion.

Our case study, as well as the cases from the literature presented in this article, illustrates similarities in presentation and management with inherent opportunities for learning and for future studies. First, there were no significant great vessel injuries identified. This is in alignment with accepted differences in pediatric physiology including increased vessel elasticity,[9] and by limited data that cite a decrease in thoracic pediatric vascular injury, specifically a 7-fold decreased incidence of aortic vessel injury in children compared with adults.[10]

The role of CT scan and particularly CT angiogram for hemodynamically stable patients has been shown to be an integral part of diagnostic evaluation.[7,8] In all 3 cases (2 previously reported cases as well as the case presented here), the patients were stable with no clinical urgencies for operative care. Following plain chest film, CT angiogram was chosen as a viable means to determine location and risk of injury and to facilitate operative planning.

Thoracotomy as the operative approach is described and cited in the literature for both blunt and penetrating chest trauma with thoracotomy performed in 89.5% of cases of adult cardiac and vessel injury.[11] O'Connor and Scalea[12] reviewed the surgical management of great vessel injuries in 36 adult patients and reported that sternotomy was performed in 75% of unstable cases. In stable cases, the approach was periclavicular (56%), partial sternotomy (32%), with one case each (6.5%) of sternotomy and thoracotomy.[12] Clearly there is limited data on this topic and even less information regarding surgical approach to penetrating chest trauma in children. The 2 pediatric cases from the literature each describe thoracotomy as the chosen surgical approach. A left lateral thoracotomy was performed to remove the ice pick from the right ventricle in the stable teen. In the toddler, an anterior right thoracotomy was performed to gain control of the needle in the right lung with potential pulmonary artery injury. In our uncommon case of the knitting needle transecting the mediastinum, a median sternotomy was felt to be the best approach to repair potential vascular injury throughout the thorax and offer good exposure for bypass if needed. All 3 cases were successful in stabilizing and removing the object with no significant vessel injury or complications.

The nurse professional is an integral member of the trauma clinical team and should be aware of these rare injuries and their mechanisms. Because we rarely see penetrating chest trauma in children, refreshers of the ABCs of trauma care are imperative to proper assessment and treatment of these patients. Stable patients should be taken to the CT scanner to identify injuries to major thoracic structures and for surgical planning. Exploratory surgery is often required and consultation with the surgical team should be initiated early in presentation. Other disciplines, such as injury prevention professions, should take note of the seriousness and work to prevent these injuries from occurring by studying the case reports presented here and their diverse mechanisms. Children should be protected in car seats and extraneous items should not be loose within the confines of the car, as during a motor vehicle collision, sharp items can impale children. Information gleaned from this case study point to the need for education to parents who have knitting equipment in their homes. These items may need special storage and care to avoid injury in children.

There is very little research to direct the trauma team the evaluation and treatment of penetrating trauma to the chest, and even pediatric case study presentation in the literature is rare. The utility of CT has been shown to be instrumental in the management of stable head and abdominal injuries, and while further studies are needed, the literature suggests that it is a reliable noninvasive method to define penetrating thoracic injury in the stable child. Because cardiac and great vessel injuries in children are extremely rare the trauma and operating room teams have limited experience in the exploration and operative management of these life-threatening injuries. Additional, multicenter studies are warranted to guide initial management and nursing care as well as surgical decision-making and operative approach in children with penetrating thoracic trauma.

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