Pediatric Thoracic Trauma

Recognition and Management

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KEYWORDS

• Pediatric • Thoracic trauma • Chest • Child

KEY POINTS

- Pulmonary contusions, pneumothoraces, hemothoraces, and rib fractures occur most commonly when children sustain thoracic trauma.
- The narrow trachea, compliant chest wall, lower functional residual capacity, and higher oxygen demand of children pose specific challenges in treating the unique injury patterns of thoracic trauma in children.
- Rib fractures occur less commonly in children even in association with cardiopulmonary resuscitation and should prompt consideration of nonaccidental trauma.
- Blunt cardiac injury should not increase the chance of arrhythmia or shock in children unless shock or arrhythmia are present at or before the emergency department presentation.
- Chest computed tomography may increase the detection of occult chest injuries but infrequently detects clinically significant occult injury, and chest radiograph provides a reasonable screening tool for most chest injuries in children.

INTRODUCTION

Thoracic injuries account for less than one-tenth of all pediatric trauma-related injuries but comprise 14% of pediatric trauma-related deaths.[1] Many affected patients die at the scene when injuries do occur. Thoracic trauma includes injuries to the lungs, heart, aorta and great vessels, tracheobronchial tree, and structures of the chest wall. Pulmonary contusions, pneumothoraces, hemothoraces, and rib fractures occur most commonly.[2]

During the first decade of life, most chest injuries result from falls or motor vehicle accidents.[1] Penetrating trauma occurs rarely. More than half of pediatric blunt thoracic trauma occurs in association with head, abdominal, and limb injuries.[1] The case-specific mortality for patients with thoracic trauma increases to 20% for patients with concomitant abdominal injuries and exceeds 30% for patients with associated head injuries. Isolated chest trauma occurs less frequently and with lower mortality rates.

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Certain unique anatomic features of the developing child provide a rationale for thoracic injury patterns. The trachea is narrow and easily compressed, and small changes in airway diameter produce respiratory distress.[3] Children less than 10 years of age have a lower functional residual capacity and a higher oxygen demand; thus, hypoxemia develops more quickly than in adults.[3] The mediastinum is not fixed in children, and there is more opportunity for visceral displacement leading to loss of preload and hypotension.[3] A child's short stature increases the incidence of improper restraint placement.[1] The pediatric chest wall is compliant, and the flexible ribs are unlikely to fracture; this can foster direct transmission of force to the lung parenchyma.[4] As a result, pulmonary contusions occur more commonly in the pediatric population. Rib fractures, when they do occur, herald more significant internal injuries in children. The chest wall seems to be fully developed by 13 years of age and responds to injury like the adult chest wall.[5]

The compliant chest wall of a child can also make the evaluation of patients more challenging, as there can be significant injury with little or no external signs of trauma. A thorough examination being mindful of risk factors for intrathoracic injury is imperative. These risk factors for thoracic trauma include a low systolic blood pressure, elevated age-adjusted respiratory rate, abnormal results on thoracic examination, abnormal chest auscultation, femur fracture, and Glasgow Coma Scale less than 15.[6] Clinicians should consider thoracic injury in pediatric patients with such risk factors, a suggestive examination, or radiographic findings of injury.

PNEUMOTHORAX AND HEMOTHORAX

Clinical Recognition

Tachypnea, decreased breath sounds, chest wall crepitus, and chest wall injury increase suspicion for pneumothoraces.[1] Decreased breath sounds on the left side may also occur in a right main stem intubation, and this should be considered when evaluating intubated patients with chest trauma.[3] Severe gastric distention from prolonged bagging can distort the left-sided lung examination as well.[3] An abnormal chest examination or work of breathing warrants further investigation for injury in pediatric trauma patients.

Tension pneumothorax occurs when air overfills the pleural space and causes displacement of the lung parenchyma and mediastinal structures. Diastolic filling of the heart is reduced by obstructed return of blood from the vena cava. This condition will progress to shock and cardiac arrest without decompression. Tension pneumothorax should be suspected with jugular venous distention, a displaced cardiac apex beat suggesting mediastinal shift, loss of breath sounds to one side, or contralateral tracheal deviation.[1] Decreasing end-tidal carbon dioxide levels and hyperresonance of the chest may also indicate tension pneumothoraces. These findings suggest potentially life-threatening injury, and the tension pneumothorax should be decompressed as quickly as possible.

Pneumomediastinum occurs in up to 10% of patients with blunt thoracic trauma.[7] Because pneumomediastinum may indicate aerodigestive injury, many patients received extended workups on this finding alone historically. However, in the absence of clinical symptoms, the workup of pneumomediastinum rarely yields findings of other injuries.[7] It has been postulated that benign pneumomediastinum may result from subclinical alveolar rupture.[7] Injuries of the tracheobronchial tree or esophagus warrant consideration with pneumomediastinum but are rarely present without other examination findings.