

## CHEST TRAUMA IN CHILDREN: A LOCAL EXPERIENCE

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**Background:** Chest trauma in childhood is relatively uncommon in clinical practice, and has been the subject of few reports in the literature. This study was undertaken to examine our experience in dealing with chest trauma in children.

**Patients and Methods:** This was a retrospective study of 74 children who sustained chest trauma, and were referred to King Fahad Hospital in Medina over a two-year period. The age, cause of injury, severity of injury, associated extrathoracic injuries, treatment and outcome were analyzed.

**Results:** The median age of the patients was nine years. Fifty-nine of them (80%) sustained blunt trauma, and 15 (20%) were victims of penetrating injuries. Road traffic accident was the cause of chest trauma in 62% of the children, gun shot wounds were seen in five, and stab wounds in 10 children. Head injury was the most common injury associated with thoracic trauma, and was seen in 14 patients (19%), and associated intra-abdominal injuries were seen in nine patients. Chest x-ray of the blunt trauma patients revealed fractured ribs in 24 children, pneumothorax in six, hemothorax in four, hemopneumothorax in three, and pulmonary contusions in 22 patients. Fifty-one percent of children were managed conservatively, 37% required tube thoracostomy, 8% were mechanically ventilated, and 4% underwent thoracotomy.

**Conclusion:** The prevalence of chest trauma in children due to road traffic accidents is high in Saudi Arabia. Head injury is thought to be the most common associated extrathoracic injuries, however, most of these patients can be managed conservatively.

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**Key Words:** Chest trauma.

Despite major developments in the management of trauma, it remains the leading cause of mortality in children and adolescents, with more than 20,000 deaths occurring annually in the U.S.<sup>1</sup> Chest trauma in the early years of life is relatively uncommon in clinical practice, and has been the subject of few reports in the literature, yet it poses many problems in diagnosis and management.<sup>2-5</sup> Mortality arising from injury to the chest alone has been estimated at 4%-12%,<sup>3,4</sup> and increases with injury to other organ systems. The present study was undertaken to examine our experience in dealing with chest trauma in children. Thoracic injuries serve as a reliable marker for injury severity in children, mandating careful evaluation of the child presenting with thoracic trauma. When the injuries are not detected and managed properly, the child's morbidity risk rises and approaches 50%.<sup>6</sup>

### Patients and Methods

This was a retrospective study of patients between one

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and 16 years of age (median, 9 years), who were referred to King Fahad Hospital (KFH), Medina, for the management of thoracic injuries over a two-year period. Cases were reviewed with reference to the following variables: age, sex, cause of injury, severity of injury, associated extrathoracic injuries, specific treatment and outcome. The results obtained were analyzed using a data-based computer program.

### Results

Of the 74 children admitted to KFH, Medina, with thoracic injuries, 59 (80%) had sustained blunt trauma to the chest. In 46 (62%) of these, the etiology was a road traffic accident. Thirty children suffered injuries after being hit by a high-speed car. Sixteen children presented with injuries sustained as a result of the child being an unrestrained passenger in a vehicle involved in a collision. Fifteen children (20%), all males, were victims of penetrating trauma. Penetrating injuries as a result of gunshot wounds were seen in five children, and injuries due to stab wounds were seen in 10 children. The nature of other injuries are outlined in Table 1.

On admission, 14 patients (19%) had positive physical findings of head injury, which was the most common injury associated with thoracic trauma. Nine patients had

associated intra-abdominal injuries, and two of them who had fractures of the lower rib cage had to undergo exploratory laparotomy for acute abdominal signs. One had splenectomy for a shattered spleen and another underwent repair for splenic laceration of grade I-II. The other associated injuries are listed in Table 2.

Among the 59 patients with blunt trauma, chest films revealed fractured ribs in 24 patients, pneumothorax in six patients, hemothorax in four, hemopneumothorax in three patients and pulmonary contusions in 22 patients. In the penetrating injuries, pneumothorax was seen in five patients, hemothorax in three patients, hemopneumothorax in three, and lung laceration in one patient (Table 3).

Isolated pulmonary contusion without pneumothorax or hemothorax or fractured ribs was present in 22 (30%) cases. Three of them showed signs of traumatic wet lung syndrome and required mechanical ventilation. Flail chest was clinically apparent in one child who required assisted ventilation. Nineteen patients (25%) required tube thoracostomy, either for a pneumothorax or hemothorax or both. Exploratory small anteriolateral thoracotomy had to be performed in three children (4%). Two of them required surgical repair of parenchymal injuries due to penetrating injury, and the third patient had to undergo open evacuation of clotted hemothorax in addition to removal of foreign body.

Repair or debridement of superficial chest wounds was performed in 12 patients. Overall, the majority of children were managed conservatively, as is shown in Table 4. We had no death in this series.

### Discussion

Blunt trauma is the most frequent cause of chest injuries in children, after involvement in a road traffic accident, as was seen in our cases.<sup>2,9</sup> There is little comment in the literature about the special aspects of chest injuries in childhood.<sup>5</sup> Children are most likely to be involved in this type of injury, as they exhibit little caution in dangerous situations. Road layout, poor driving and poor child care may be placing children at high risk of injuries as pedestrians.<sup>5,7</sup>

Penetrating injuries are also increasing. While shooting and stabbing are considered adult phenomena, a significant proportion of these incidents involve adolescent males,<sup>8</sup> a trend also observed in our present series, which included 15 patients (20%). There is unanimous agreement that chest trauma frequently occurs in infants and children, but that due to the flexibility of their bony thorax, overt injuries remain unmanifested. These serious chest injuries may remain unsuspected or underestimated until there is gross respiratory dysfunction.<sup>4</sup> The lung is the most commonly injured intrathoracic structure, and the relative compressibility of the child's thorax accounts for the severe intrathoracic injuries without rib fracture following a crushing force.<sup>5,9,10</sup> Rib fractures are less common in the

flexible rib cage of children than in adults, and their presence indicates the severity of impact and trauma. Fractured ribs were seen in 33% of our cases, which is lower than was reported by Smyth (47.8%),<sup>2</sup> and the 62% by Roux and Fisher.<sup>5</sup>

The risk of mortality increases with the number of rib fractures, with four fractures increasing the incidence of multisystem injury.<sup>11,12</sup> Undisplaced fresh rib fracture in infants may be difficult or impossible to see on initial x-ray, and these fractures are often missed if a chest radiograph is not repeated.<sup>13</sup> Pulmonary contusion is the most common injury observed in pediatric thoracic trauma. Smyth<sup>2</sup> reported 61.7% in his series, while Roux and Fisher reported 73%.<sup>5</sup> Our result confirmed this, although isolated pulmonary contusion in our series was lower, at 30%. Unless infection complicates pulmonary contusion, it usually resolves within two to six days with conservative management.

Pneumonia in a severe contused segment develops in 80% of these children and progresses to empyema or abscess in 35%.<sup>14</sup> In our series, empyema occurred in two children (2.7%), which is less than was reported by Thomas.<sup>13</sup> This may be due to the early use of antibiotics and insertion of intercostal chest tube in our cases.

Many children with thoracic trauma exhibit "traumatic wet lung," a syndrome characterized by a combination of pulmonary contusion, atelectasis and pneumonia. We had three children suffering from this condition. Awareness of these serious complications is in itself the best treatment.<sup>4</sup> In children with pulmonary contusion, respiratory distress

TABLE 1. Mechanism of injury (n=74).

	Number (%)
Blunt injury	
Motor vehicle	16 (22)
Pedestrian	30 (40)
Fall	11 (15)
Fight	2 (3)
Total	59 (80)
Penetrating injury	
Stab wounds	10 (13)
Gunshot	5 (7)
Total	15 (20)

TABLE 2. Associated injuries.

	Number (%)
Head injury	14 (19)
Spleen	6 (8)
Liver	3 (4)
Fractured clavicle	4 (5)
Fractured humerus	1 (1.5)
Fractured scapula	1 (1.5)
Fractured sternum	1 (1.5)
Fractured femur	3 (4)
Fractured tibia and fibula	1 (1.5)
Total	34 (46)

TABLE 3. Pattern of chest injuries in 74 patients.

Type of injury	Blunt injury (n=59)	Penetrating injury (n=15)
Rib fractures	24	0
Pneumothorax	6	5
Hemothorax	4	3
Hemopneumothorax	3	3
Pulmonary contusions	22	0
Lacerated lung	0	1
Normal findings	0	3

TABLE 4. Treatment.

	Blunt injury	Penetrating injury	Percentage
Observation	34	4	51
Tube thoracostomy	20	7	37
Mechanical ventilation	5	1	8
Thoracotomy	0	3	4
Total	59	15	100

may not be recognized until blood gas measurements are made, thereby suggesting the importance of performing blood gas analysis routinely for all children admitted with thoracic trauma.<sup>4,16,17</sup> Many extensive injuries with normal arterial blood gases can be managed conservatively without ventilatory support initially. It is only after 24-48 hours that signs of respiratory distress are manifested, due to late occurrence of atelectasis, as the injured child is unable to perform deep breathing exercises and cough out retained secretions as a result of painful rib fractures. Chest x-rays in these children may not correlate with the clinical condition of respiratory distress, but abnormal arterial blood gases should point towards the seriousness of this condition.<sup>17,18</sup> Similar observation were made in our series. CT scan remains the best available tool, besides physical examination and direct peritoneal lavage, for the diagnosis of abdominal trauma, as it precisely defines the parenchymal organ injury,<sup>13</sup> and is helpful in some instances where a non-operative approach is to be followed, such as with splenic injury. The majority of the lung injuries resulting from blunt or penetrating trauma may need tube thoracostomy alone.<sup>5,9,19</sup> Minimal access surgery in the shape of mini-thoracotomy and the recently introduced VAT (video-assisted thoracoscopy) are good alternatives once tube thoracostomy fails to achieve its purpose. Due to non-availability of VAT facility in our hospital at the time of this study, two children in our series had to undergo mini-thoracotomy to treat the underlying lung injuries. Early evacuation of clotted blood in hemothorax has been reported to reduce the morbidity and mortality and hospital cost,<sup>20</sup> and we had to do this in one of our cases.

Cardiac injuries in children are more difficult to diagnose than in adults, although reports of myocardial contusion following blunt trauma to the chest have been reported, with an incidence varying between 20% and

76%.<sup>11,14,21,22</sup> Myocardial contusion may occur without any evidence of external thoracic injury or rib fracture. However, the clinical significance of this injury appears to be less severe than reported for adults.<sup>11</sup> The pericardial sac of a child has a small volume, and a volume of 200 mL of blood is necessary to cause significant tamponade in young children.<sup>23</sup> Other uncommon injuries, such as myocardial and septal rupture, valve injury, or injury to coronary artery with acute myocardial infarction, have been reported following blunt and penetrating trauma.<sup>21,24</sup> We did not have any cardiac injury in our present series.

The majority of chest injuries can be managed safely without surgical intervention by close observation or by tube thoracostomy alone,<sup>5,9,11,25</sup> as was observed in our series (Table 4).

In children with penetrating injury to the chest below nipple level, there is a high possibility of injury to the diaphragm or to an intraperitoneal structure, which may even necessitate exploration. The spectrum of associated abdominal injury in our series was similar to the other studies where the liver and spleen are the most common abdominal organs involved in thoracic injuries.<sup>25,26</sup>

The technique and indication of Emergency Department Thoracotomy (EDT) has previously been reported. EDT has been unsuccessful in most of the reports, a reflection of the devastating nature of the injury.<sup>25,27</sup> Despite this controversy, EDT remains a heroic measure and a more aggressive resuscitative effort for the rare penetrating chest injuries, or for patients who acutely deteriorate in the admitting area and cannot be safely transported to the operating room.<sup>28</sup> In our series, no child underwent emergency room thoracotomy.

To the best of our knowledge, this is the first reported series about chest trauma in children in Saudi Arabia, which indicates that thoracic injury in children is common in Saudi Arabia, with motor vehicle accident as the major cause of this problem. Most of our patients were treated conservatively. Early diagnosis and management is essential to avoid severe outcome of chest injury in children, and the implementation of advanced trauma life support (ATLS) resuscitation protocol is essential.

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