

## Research Article

# A study of factors affecting outcome in pediatric polytrauma

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### ABSTRACT

**Background:** Trauma is a leading cause of morbidity and mortality in children. Polytrauma affects the prognosis due to multisystem involvement.

**Methods:** A retrospective observational study was conducted from January 2012 to December 2015. All cases of polytrauma below 12 years of age were included in the study. The data was analyzed in terms of age, sex, mode of injury, time of presentation, ISS scoring at presentation, USG, CT/MRI findings, analysis of type and severity of injuries in individual systems, associated system injuries, management, outcome and mortality.

**Results:** 75 cases of polytrauma were included in the study. 48 (64%) were males and 27 (36%) were females. The commonest age group affected was 3-8 years. The most common mode of injury was road traffic injury (80%). The average time of presentation to the hospital was 4-7 hours. The most common injury was extremity injury (52%). The most common systemic injury was head trauma (40%). The commonly associated injuries with head trauma were extremity injuries followed by chest trauma. All five cases with pelvic trauma had genitourinary tract involvement. 18 patients required minor surgical interventional procedures. 3 patients required laparotomy, 3 required neurointervention for evacuation of large hematomas and 5 patients required surgery for perineal injuries. There were 5 deaths in the series.

**Conclusions:** Pediatric polytrauma is a significant cause of morbidity in children. Head injury is the most common injury and also the prime determinant of prognosis. Solid organ injury in children seldom requires operative intervention. Management of polytrauma requires active interdepartmental co-ordination. The prognosis in most cases is excellent.

**Keywords:** Children, Polytrauma, Head injury

## INTRODUCTION

Trauma is the most common cause of mortality in children.<sup>1</sup> Polytrauma is defined as simultaneous injuries of two or more systems as a result of a single or combination of several injuries. There is a debate on the exact definition of polytrauma, however patients with injury severity score (ISS score) of 16 and above are grouped in the category of polytrauma.<sup>2</sup> The aim of this study is to evaluate factors affecting outcome of polytrauma in children.

## METHODS

This was a retrospective observational study including 75 patients of pediatric polytrauma admitted to a tertiary health care centre from January 2012 to December 2015. All cases of polytrauma below 12 years of age were included in this study. Patients with isolated single system injuries were not included. On admission, all patients were assessed with primary attention to airway, breathing and circulation. Pediatric injury severity scoring (ISS) was calculated by deriving their Abbreviated injury scale (AIS).

All patients were immobilized till spinal injury was ruled out. Blood was cross matched for all patients. All patients were administered intravenous fluids, antibiotics and analgesics. In all cases, complete blood count, radiography of chest, abdomen, spine and extremities were done. USG abdomen and pelvis was done for all patients. CT scan and MRI were done as indicated.

Glasgow coma scale (GCS) was assessed for all patients after stabilization. CT brain and skull were performed in all patients with head injury. CT spine was performed in suspected cases of vertebral fractures or subluxation. Patients with linear fractures, small cerebral contusions or haemorrhages and small extradural or subdural haematomas without midline shift were managed conservatively. All patients with large subdural or extradural haematomas were taken up for immediate evacuation. Contused lacerated wounds on the scalp were cleaned and sutured. Plastic surgical opinion was sought for all cases of facial injuries with or without mandibular fractures.

Intercostal drain tube was inserted in cases of pneumothorax and hemothorax. Patients with persistent respiratory distress or direct trauma to the chest were subject to CT scan chest to assess parenchymal injuries, contusions, pneumothorax, hemothorax, vascular injuries. Rib fractures were managed conservatively by splinting and analgesics. Thoracic exploration was considered for tracheobronchial injuries involving more than one fourth of the diameter, cardiac tamponade, massive air leaks or haemorrhage from the thoracostomy tubes.

CT abdomen and pelvis was done for solid organ injuries, retroperitoneal injuries, suspected hollow viscous injuries and pelvic fractures. MRCP was considered for biliary and pancreatic trauma. Conservative management with supportive care in the form of blood and blood products was instituted for all patients with solid organ injuries. Emergency laparotomy was performed for pneumoperitoneum and penetrating injury to the abdomen.

## RESULTS

The data of all 75 patients was analysed in terms of age, sex, mode of injury, time of presentation, ISS scoring at presentation, USG, CT/ MRI findings, and associated system injuries, analysis of type and severity of injuries in individual systems, management, outcome and mortality.

The most commonly affected age group was 3-8 years (66.4%), youngest patient being 6 months of age. Playschool and primary school children were the most affected. 48 patients (64%) were male and 27 (36%) were female.

The causes of pediatric polytrauma were road traffic accidents, fall from height, penetrating trauma and blast

injury. Road traffic accidents were the most common cause of injury (80%). Majority of these were pedestrian injuries (50/60) and the others (10/60) were passenger injuries-children travelling pillion with an adult. 12 out of 75 cases (16%) were fall from height - 'malya' (local for mezzanine floor in hutment colonies) or staircase. 3 injuries were sustained during unsupervised playtime due to penetrating injuries and battery explosion.

65 patients were admitted to the hospital within 4 to 7 hours of injury. 10 patients were referrals from primary or secondary health centres and presented 7 hours after the injury. First few hours after trauma are critical for resuscitation and medical management, but unfortunately were lost in referral and patient transit.

All cases of polytrauma were subject to abdominal and pelvic ultrasound to look for any abdomino-pelvic injuries. All patients of craniofacial trauma, chest and abdominal trauma underwent specific CT scan to determine the extent of the injury and rule out other injuries. MRCP was done in 3 cases of pancreatic injuries.

Majority of the patients (62/75) had injuries involving two systems. 10 patients had three system injuries. Only 3 patients had involvement of four or more systems. All three had grave prognosis with severe head injury and ISS score between 65 and 75. The commonest associated injuries were head trauma with extremity injury followed by chest trauma and gastrointestinal tract. All cases of pelvic trauma had associated lower genitourinary tract injury.

37 patients had extremity injuries (49.3%) out of which 17 had long bone fractures requiring orthopedic intervention. The others had lacerated or contused wounds or trauma to the muscles and ligaments.

Head injuries were seen in 30 patients (40%) in our series. Patients with contusions, small subdural and epidural hematomas on CT scan were managed with anticonvulsants and anti edema measures. Three patients required emergency craniotomy to evacuate large haematomas with severe midline shift and cerebral edema. Most of these patients had associated soft tissue injury of the face, nasal bone fractures or mandibular fractures and ear or eye injuries.

Abdominal Injuries were present in 27 patients (36%). 8 had grade 1 to grade 3 liver injury. 9 patients had grade 1 to grade 3 splenic lacerations. Four had both liver and splenic injury. Solid organ injuries were treated conservatively by serial clinical examinations and haematocrit monitoring. 3 cases of hollow viscous injuries underwent immediate operative intervention. 3 children with direct injuries over the abdomen had pancreatic parenchymal injuries. One patient had pancreatic duct trauma requiring ultrasound guided

external drain placement for the peripancreatic fluid collection and pancreatic duct stenting by ERCP.

25 patients (33%) had associated chest trauma. 8 patients had lung contusions, 2 had rib fracture with lung contusion, 9 had pneumothorax and 6 had hemothorax. No patient had major airway injuries. 15 patients had clavicular fracture and received immobilization with figure of 8 brace. 8 of these patients had associated lung injuries.

In our series, 15 (20%) cases had genitourinary system involvement. 10 patients had grade 2 to grade 4 renal trauma. Grade 1 bladder injury with contusion and intramural hematoma was seen in 2 children. 2 patients had grade II anterior urethral injuries and 1 had complete urethral transection requiring staged urethroplasty. 5 patients had pelvic fracture associated with lower urogenital system injuries. 5 patients had direct perineal injuries. Three patients with grade 2/3 injuries were primarily sutured. Two patients had grade 4 injuries requiring diverting colostomy followed by staged definitive repair.

In our series, 2 out of 75 cases had spinal injuries. One child had traumatic fracture of transverse process of the L2, L3, L4 vertebrae with lower limb paraesthesia. The other child had grade 3 stable fracture of the body of C3 and C4 cervical vertebrae which was managed by immobilization. This child had massive hemothorax which required intercostal drainage.

18 patients required minor interventional procedures like chest tube drainage, percutaneous external drainage of peripancreatic collections, ERCP, suprapubic cystostomies. 11 patients required surgery in the form of craniotomies, laparotomy, perineal reconstruction or diverting colostomy. Rest 46 patients were treated conservatively.

ISS scoring system correlates linearly with morbidity and mortality. In our series of 75 cases, 57 patients had ISS score between 16-50 (76%) and had complete recovery. 13 had ISS score between 50- 65 and were discharged with home care instructions. 5 with ISS score ranging between 65- 75 expired within the first 24 hours of injury. The average duration of stay in the hospital was 6 days. The prognosis in these cases of polytrauma was excellent with 70 cases (93%) being discharged. 13 patients required home care in the form of stoma and wound care. There were 5 mortalities in the series. They had severe head injuries with associated chest or abdominal and pelvic trauma, associated with extremity injuries at admission. All these patients presented 7 hours after injury and succumbed within 24 hours.

## DISCUSSION

Both in developed and developing countries, polytrauma is a major cause of pediatric morbidity and mortality.<sup>1</sup>

School-going children (3-8 years) were most affected in our study, with males more commonly affected than females (48 males and 27 females). This trend is seen in another Indian study in which 6-12 year children were involved with males more than female.<sup>3</sup> Road traffic accidents have been widely accepted as a leading cause of polytrauma in children.<sup>4</sup>

Polytrauma or multiple traumas is a medical term describing the condition of a person who has been subjected to multiple traumatic injuries. An ISS score of more than 16 is considered as polytrauma. ISS score is derived from Abbreviated injury score. The Abbreviated Injury Scale (AIS) is an anatomical scoring system first introduced in 1969. Injuries are ranked on a scale of 1 to 6, with 1 being minor, 5 severe and 6 a nonsurvivable injury. This represents the 'threat to life' associated with an injury and is not meant to represent a comprehensive measure of severity as given in Table 1.<sup>2</sup>

**Table 1: Abbreviated injury score.**

Injury	AIS Score
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurvivable

Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned AIS and is allocated to one of six body regions (head, face, chest, abdomen, extremities (including pelvis), and external). Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. The ISS score takes the values from 0 to 75.<sup>2</sup>

Imaging Modalities include a focused assessment sonography in trauma (FAST).<sup>5</sup> This is performed for the primary evaluation of the injured child. The sensitivity of FAST examination in children following polytrauma is 30-88% and the specificity is 42-100% in pediatric trauma patients.<sup>6</sup> Whole body CT scan is preferred in patients who are hemodynamically stable.<sup>7</sup> Extremity fracture has been reported to have 76% incidence with polytrauma.<sup>3</sup> Closed fractures require casting, open fractures require operative intervention with external fixation.

Pediatric patients are more susceptible to traumatic brain injury, because of thinner and immature skull and large head size. The subarachnoid space is small; hence it offers less of protection. Reported incidence of head injuries in polytrauma cases is 17% in western countries.<sup>8</sup>

The reported incidence of chest trauma in the literature is 5 to 12 %.<sup>9</sup> The cartilage content of pediatric thorax is

greater and ossification of ribs is incomplete hence isolated rib fracture are less common. Amongst the common chest injuries are pulmonary contusions, hemothorax and/or Pneumothorax or mediastinal injuries. In more than 50% of children with thoracic trauma multisystem involvement is reported and has a worse prognosis. Mortality is 5% for isolated thoracic trauma, goes up to 20% in patients with concomitant abdominal injuries, and exceeds 30% in patients with concomitant head injuries.<sup>10</sup>

The incidence of abdominal injuries in the literature is 8-27%.<sup>8</sup> Children are more vulnerable to major abdominal injuries because of anatomical differences compared to adults. Firstly the child intra-abdominal organs are proportionately larger and are close to each other. Secondly the underdeveloped abdominal musculature does not provide protection. Splenic injury is the most common, followed by hepatic, renal, intestinal and pancreatic<sup>11</sup> as also documented in our series. 90% of solid organ injuries do not require surgical intervention.<sup>11</sup> but requires observation in intensive care under pediatric surgeons. Indications for laparotomy are pneumoperitoneum, penetrating injuries of abdomen, Grade 5 solid organ injuries. The reported incidence of pancreatic injuries in the literature is less than 5%.<sup>3</sup> Early E.R.C.P. with duct stenting is essential in cases of pancreatic duct injuries.<sup>12</sup> Peripancreatic fluid collections are managed with endoscopic drainage, percutaneous catheter drainage or surgical drainage. In extensive pancreatic injuries is partial resection indicated.<sup>13</sup>

Pediatric patients are at increased risk for genitourinary trauma due to unique anatomical differences between children and adults. The kidneys are large relative to the size of body and positioned lower in abdomen, less protected because of decreased perirenal fat and weak abdominal wall musculature. Soft tissue injuries are also common. The immature pelvis is more elastic at the symphysis and sacroiliac joint, hence high energy force is required to cause fractures. Consequently pediatric pelvic fractures accompany multiple abdominal and retroperitoneal injuries.<sup>14</sup>

Spine injuries are very rare due to plasticity of the pediatric spine. Vertebral bodies of children are wedged anteriorly; flat facet joint, flexible interspinous ligament makes their spine mobile. Reported incidence in literature is 1-2%.<sup>15</sup> Unstable fractures with neurological deficits need operative management requiring laminectomy and internal fixation. 50% of cases of unstable fracture of spine are associated with severe chest, abdominal or retroperitoneal injuries.<sup>3</sup>

Resuscitation of the pediatric trauma patients requires that the practitioner must understand the anatomy and pathophysiology of children, which includes smaller body size, less fat, less connective tissue, larger head size and bones highly elastic. Children have a better prognosis than adults with similar injuries.

## CONCLUSION

The degree of recovery in pediatric polytrauma is excellent due to the unique anatomy and pathophysiology in the pediatric population. However the other factors determining prognosis are availability of prompt and appropriate first aid by paramedical personnel at the site of trauma and during transit and coordinated and accurate assessment at the treating hospital. Management involves team effort involving trauma surgeons, pediatricians, pediatric surgeons, orthopaedic Surgeons and anaesthesiologist. Severity of head injury and multisystem involvement is a prime determinant influencing prognosis in cases of polytrauma. Public education as regards adult supervision of young children at all times can significantly reduce the incidence of these events. Strict adherence to road safety measures and adequate precautions for passengers on two wheelers cannot be overemphasized.

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