Aim: The aim is to prospectively study 125 trauma patients admitted in the pediatric surgery ward in our institute.

Materials and Methods: Pediatric patients admitted in the ward after initial resuscitation in the triage room were included. Isolated neurosurgical and orthopedic injuries were excluded. X-ray cervical spine, hip, and chest and a focused assessment with sonography in trauma ultrasound were done for all patients. Computed tomography of the abdomen or chest was done where relevant. Injury profile and surgical intervention when needed were analyzed.

Results: Road traffic accidents and fall from height caused 73.6% of the injuries. School-going children were most commonly affected (60.8%). Distinctive injuries were noted such as abdominal wall hernias and delayed bladder perforation. All solid organ injury irrespective of grade treated conservatively. Forty percent of the children required surgical intervention. Five patients after laparotomy were found to have surgical conditions unrelated to trauma, whereas another 14 required delayed surgery. Five patients had injuries secondary to sexual abuse. All except two patients were discharged in a satisfactory condition and are doing well in the follow-up.

Conclusion: In spite of extensive injuries and the need for multiple surgeries, children with trauma have a good prognosis. Close observation during admission and also in follow-up are essential, as many patients may require delayed surgery ≥1 week from injury.

Keywords: Delayed surgery, injury, pediatric trauma, surgical intervention

INTRODUCTION

Trauma is a leading cause of mortality and morbidity in children and is largely preventable. The WHO estimates that injuries are a cause of death in 1 million children per year.[1] In India, injuries make up one-fourth of all hospital admissions and 15% of childhood mortality.[2] On studying the “years of potential life lost,” it has been shown that, injury is the second most common cause of death in a child in India, after 5 years of age.[3] We aimed to study the injury profile, the need for intervention, type of surgery, and outcome of the patients who were admitted to the pediatric surgery ward. Certain peculiarities of pediatric trauma related to the cause and type of injury and in the surgical intervention came to the fore, which we would like to emphasize in this article. We would also like to highlight these differences from the adult population so as to benefit the treating pediatricians or surgeons.

Materials and Methods

All trauma patients, who required admission in the pediatric surgical ward from April 2014 to June 2016, were prospectively studied. Isolated neurosurgical or orthopedic injuries and patients who did not require admission were excluded from the study. All patients were received in the triage room, where they were resuscitated and stabilized. X-ray spine, X-ray pelvis, and a chest X-ray along with a focused assessment with sonography in trauma (FAST) ultrasound (USG) were done for all patients. If the FAST was positive and the patient was hemodynamically stable, a chest X-ray was done to look for any other injury.

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contrast-enhanced computed tomography (CT) abdomen was done. CT chest was done if the chest X-ray was suggestive of contusion, bronchial injury, or multiple rib fractures. CT head and other relevant limb X-rays were done for associated neurosurgical or orthopedic injuries, respectively. After the child was stabilized, he/she was shifted to the pediatric surgery ward for further management. Patients were studied with respect to their demographic data, mode and type of injury, associated injuries, time taken to present to triage after trauma, and days of admission. Other parameters such as need for surgery, requirement of intensive care with or without ventilation, and mortality were also assessed.

**RESULTS**

A total of 125 patients met the criteria for the study. Male-to-female ratio was 4:1. Maximum number of children (76) was in the age group of 6–12 years. Forty-six (36.8%) of them were aged 1–5 years, whereas only three patients were < 1 year of age. The mode of injury in 51.2% of patients was due to road traffic accidents (RTAs) followed by fall from height in 22.4% [Figure 1]. Most of the patients (80%) presented within 24 h of trauma, while one patient presented as late as 2 months. Solid organ injury was the most common type of injury encountered with the liver being the most common organ affected (35.2%), followed by the spleen (12%) and then the kidney (9.6%), duodenal and pancreatic injury made-up 8% of the patients. Remaining injuries included perineal injuries, urethral injuries, and bronchial injuries. [Figure 2]. Associated injury was most commonly an orthopedic injury in the form of fracture of the long bones or pelvis, seen in 15 patients. Eleven (8.8%) patients had two or more solid organs involved. Surgical intervention was required in 40% of the patients, and the most common indication was for perineal injury [Figure 3]. Five patients who underwent exploratory laparotomy were found to have a surgical abdomen unrelated to the history of trauma. Out of the 50 patients who underwent surgery, 14 underwent surgery 1 week after the trauma event. About 14.4% (18/125) of patients required intensive care and 8.8% required ventilator support. The majority (56.8%) were discharged within a week of hospital stay. There were two children who succumbed to polytrauma.

**DISCUSSION**

Trauma was the 9th leading burden of disease in 1990. It is steadily rising in incidence and as per the projection by the WHO, it will climb up to the third place by 2020. Trauma in children is especially devastating for the family, and any associated morbidity will be carried into adulthood. Our study brought to fore certain peculiarities that are seen with pediatric trauma and how they are managed differently from adult patients.

As in other studies, boys were more affected than girls and the most common age group affected were the school-going children. We found that RTA was the leading cause of trauma causing injury to more than half the patients which is far higher than previously published reports [Table 1]. Children are especially vulnerable to RTA, as they lack safety measures such as helmets and seatbelts, especially in developing nations. Playing along the roadside makes them a regular candidate in a
hit and run. The next most common cause of injury was fall from a height which accounted for nearly one-fourth of the cases. Curiosity, coupled with imagination and lack of parental supervision, can cause serious injury to a child immersed in play on a balcony. One of our patients was practicing his jumping on the terrace (to catch the enemy), and another child was practicing walking backward in school, only to fall down a flight of stairs. Similar case reports have been published, where the fall has been due to the child deeply engrossed in role play.\cite{14}

In our series, we found that the liver to be the most common organ affected which goes against the classic teaching of the spleen being the most common organ injured after blunt trauma abdomen. However, they have been previously published reports of the liver being the most common organ affected.\cite{15} As per literature, the success rate of nonoperative treatment of the liver is 85%–90% and spleen is 90%–98%.\cite{16,17} All (100%) of our solid organ injury were treated successfully with conservative management, irrespective of grade of injury and are thriving well in the follow-up with normal liver function tests. All solid organ injury patients were monitored closely, especially in the initial 24–48 h with respect to vitals, abdominal girth, and input-output charting. Blood or blood products were transfused when necessary, and packed cell volume (PCV) was repeated 6-h post admission. This conservative management was continued if there was no deterioration in clinical or laboratory parameters.

Two patients with active bleed from a branch of the hepatic artery in liver injuries were treated successfully with digital subtraction angiographic embolization and avoided a major laparotomy.

Forty percent of our patients required surgical intervention. All patients were operated within 24–48 h of arrival and could be discharged in satisfactory condition. Ten (20%) of them had perineal injuries which required primary repair. Two patients with extensive injuries close to the anal sphincter required debridement with a colostomy for fecal diversion. Sixteen percent had bowel perforations, which were mainly proximal jejunal (4/8). Three patients had duodenal (D1 and D2) perforations, and they underwent primary repair with triple diversion. All our patients with hollow viscus perforations were operated within 8 h of arrival, so as to decrease the septic complications which are reported more in cases of delay in diagnosis or surgery.\cite{18} Ten percent had penetrating injury abdomen which required exploratory laparotomy, and another 10% needed suprapubic catheter insertion for urethral injury. Major bronchial lacerations made up 5% of the cases. Two of them involved the right main bronchus and one the left main bronchus. All three patients underwent thoracotomy and primary repair of the bronchus within 24 h of injury. Fifteen cases had other thoracic injuries such as lung contusions and rib fractures, out of which six required intercostal tube drainage for associated hemopneumothorax.

Of special interest was that in five patients, the abdomen was opened suspecting perforation peritonitis secondary to trauma, but on laparotomy, the abdominal pathology was found to be unrelated to trauma. One patient had worm infestation with ileal perforation, two had appendicitis, one had Meckel’s diverticulitis, and another had a tubercular abdomen. On retrospectively analyzing these cases, it was clear that the trauma history was incidental and that pain abdomen was attributed to a recent trivial fall or RTA by the parents.

Fourteen children required delayed surgery, at least 1 week after the injury. Of note were that these patients were all discharged from hospital, either at our center or elsewhere, after primary management and then needed readmission for surgery. Two patients needed adhesiolysis for posttraumatic perforation repair done elsewhere. One patient with mesenteric injury underwent laparotomy and was discharged but was readmitted after 2 days with delayed perforation in the small bowel. One child with Grade 3 liver and splenic injury was discharged after conservative management and readmitted with abdominal pain and distension. A delayed intraperitoneal bladder rupture was diagnosed which required laparotomy and bladder repair. Delayed traumatic bladder rupture is rare, and only five cases have been previously reported.\cite{19,20} Three patients needed cystogastrostomy for pseudocyst of pancreas secondary to trauma. Two patients were referred with complications of duodenal perforation repair. One presented with anastomotic leak 10 days after the first surgery, and another was referred 2 months later with a duodenal fistula. Other surgeries done after at least 1 week of injury include urethral dilatations, stoma closures, and skin grafts.

### Table 1: Comparison of the incidence of road traffic accidents in previous publications

| Article     | Year | Place    | Incidence of RTA |
|-------------|------|----------|------------------|
| Amin        | 2003 | Kashmir  | 26%              |
| Manish      | 2006 | Wardha   | 28.9%            |
| Mukesh      | 2009 | Indore   | 24.2%            |
| Oboirien    | 2010 | Nigeria  | 44.8%            |
| Sharma      | 2014 | Rewa     | 32.15%           |
| Present Study | 2016 | Chandigarh | 51.2%         |
Another injury seen distinctively in pediatric trauma is abdominal wall hernia. In children, the skin being more elastic remains intact, while tangential forces disrupt the underlying fascia and muscles. We had two such patients presenting after RTA with the hernia present adjacent to the lateral border of the rectus muscle and minor abrasions on the overlying skin. FAST was negative, and both children underwent laparotomy with abdominal wall repair. Pediatric traumatic hernias are also unique because of the absence of internal injuries, and this was true for both our cases.[19]

Four of our patients had hospital stay more than a month for their injuries requiring intensive care unit (ICU) stay and ventilation. In spite of extensive injuries, prolonged hospital stay, and multiple surgeries, children show remarkable resilience and survival. One of them was run over by a tractor and presented with the complete evisceration of the bowel, multiple pelvic fractures, and extensive left femoral vessel injury necessitating hip disarticulation. He could be discharged after 2 months with a tracheostomy, external fixator for the hip, suprapubic catheterization (SPC), and a colostomy. Three months later, he underwent restoration of bowel continuity and is continent. He is able to walk with assisted devices and is now awaiting surgery for urethral stricture. Two patients in our study who succumbed to their illness had three or more internal organ injury with associated long bone fractures and died due to multiple organ failure. This finding is in concordance with other studies that show polytrauma to have an adverse effect on the outcome.[13]

An alarming trend of sexual abuse in children was seen, with five cases needing surgical intervention. The ease with which a child can be overpowered or carried away makes them vulnerable to sexual predators. The implicit trust that children have in their caregivers coupled with their inability to accuse make them a soft target. Four girls (6 months–6 years of age) presented with perineal tears and underwent primary suturing. Regional issues of female oppression and penis envy contributed in another case, where a 2-month-old boy underwent a perineal urethrostomy. The distressing entity of child abuse is becoming increasingly visible in India. Five patients out of 25 patients of suspected sexual assault required surgery in a study by Sham et al. and in another study by Verma et al., 3.5% of children were recognized to suffer from sexual abuse.[8,21]

Majority of the patients could be managed in the ward with only 15% requiring admission into an ICU. More than half (56.8%) were discharged within a week of hospital stay.

The anatomical and physiological differences in a child with respect to trauma compared to adults are well known such as smaller and more anteriorly placed airways, compliant chest and abdominal walls giving less protection to internal organs, and larger volume of viscera with less fat. The purpose of this article is to highlight other important features that we have observed in our pediatric trauma patients, which could help improve their management in the future.

**Conclusion**

RTAs and fall from height cause majority of childhood injury. RTA, in particular, has shown a steep rise in incidence. Conservative management for solid organ injury irrespective of grade is usually successful. Nonsolid organ injury patients may require surgical intervention, and early surgery has a good prognosis. Close observation during admission and also in follow-up is essential, as many patients may require delayed surgery ≥1 week from injury. Trauma history may be incidental and attributed for other causes of surgical abdomen. Sexual abuse should be strongly suspected in children, including infants, with perineal injury. Presence of polytrauma increases the chances of mortality.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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