

Research Article

Pattern of Presentation and Outcomes of Pediatric Blunt Abdominal Trauma: A Cross-Sectional Single Centre Study

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Abstract: Background: Blunt abdominal trauma (BAT) is a major reason of morbidity and mortality worldwide in pediatric age group. Injury patterns, mechanisms, and outcomes vary across regions, necessitating local data to guide management strategies.

Objective: The study aims to evaluate the epidemiology, clinical presentation patterns, and outcomes of pediatric patients with blunt abdominal trauma.

Materials and Methods: This prospective descriptive cross sectional study was conducted in the Department of Pediatric Surgery, Mayo Hospital Lahore, from 1st December 2024 to 30th June 2025 (Ref. No. 764/RC/KEMU), dated: 20th November 2024. Children aged 0–13 years presenting with blunt abdominal trauma were included. Data regarding demographics, mechanism of injury, solid organ and hollow viscus injuries, management strategies, associated injuries, intensive care unit (ICU) admissions, blood transfusion requirements, length of hospital stay and outcomes were collected and analysis was done using SPSS version 26.

Results: Seventy-three patients were included in the study. The most affected age group was 6–9 years (54.8%), and males constituted 76.7% of the cohort. Falls were the leading mechanism of injury (57.5%), followed by road traffic accidents (37.0%). Liver injuries were the most common solid organ injury (39.7%), followed by splenic injuries (23.3%), renal injuries (13.7%) and hollow viscus injuries (8.2%). Blood transfusion was required in 53.4% of patients, while 42.5% required ICU admission. Non-operative management was successful in most patients, with only 15.1% requiring surgical intervention. The median hospital stay was 7 days. Overall recovery was achieved in 94.5% of patients, while mortality was 5.5%.

Conclusion: Pediatric blunt abdominal trauma predominantly affects school-aged boys. Fall was the most noted mechanism of injury in our setting. Most cases were successfully managed non-operatively, with favorable outcomes. Strengthening injury-prevention programs and ensuring timely multidisciplinary trauma care may further improve outcomes.

Keywords: Pediatric trauma, Abdominal trauma, Liver injury, Splenic injury, Non-operative management, Outcomes.

INTRODUCTION

Blunt abdominal trauma (BAT) represents as a major cause of morbidity and mortality in pediatric populations worldwide [1]. Trauma in children makes up approximately 14% of the global trauma. That is a leading cause of death in kids above the age of one year. Preceded by the head and extremities, abdomen is the third most frequently injured anatomical region. It accounts for approximately one quarter of major trauma [2]. Abdominal trauma is due to blunt and penetrating etiology in 90% and 10% respectively [3]. 6%–12% of children evaluated in emergency departments for blunt abdominal trauma have intra-abdominal injury. Among the solid organ inju-

ries, half comprise of the liver and spleen [4]. 10 – 12 % cases of blunt abdominal trauma include bowel and mesenteric injuries [5]. Although, pediatric trauma care has advanced with the gradual establishment of specialized trauma centers worldwide, trauma continues to be a major cause of mortality. Over 95% of deaths related to trauma occur in low- and middle-income countries. Even in high income nations, trauma mortality can approach 40% in certain settings, underscoring the ongoing need for improved education, continued research, effective injury prevention strategies [6].

Diverse nature of injuries sustained and varying clinical presentations necessitate a nuanced understanding of this complex condition. While several studies have explored the management and outcomes of BAT in

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adults, the pediatric population poses unique challenges due to anatomical differences, developmental considerations, and differing injury patterns. This cross-sectional single-center study aims to comprehensively assess the epidemiology, pattern of presentation and outcomes of pediatric blunt abdominal trauma. By analyzing a cohort of patients presenting with blunt abdominal trauma over a defined period, we seek to elucidate common mechanisms of injury, clinical manifestations, and therapeutic interventions employed. Furthermore, the study endeavors to evaluate short-term outcomes including complications, length of hospital stay, and mortality rates among affected children.

To reduce the morbidity and mortality associated with pediatric abdominal trauma, it is important to follow evidence-based management protocols for children with abdominal injuries. At the same time, effective child injury prevention strategies are essential to decrease the number of such injuries. Studying the specific characteristics and outcomes of pediatric blunt abdominal trauma is crucial for optimizing management strategies and improving clinical outcomes in this vulnerable group of patients. This study not only adds to the existing body of literature but also informs clinical practice guidelines aimed at enhancing the care and prognosis of pediatric patients suffering from blunt abdominal trauma.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board King Edward Medical University, Lahore RefNo: 764/RC/KEMU dated: 20th November, 2024. A prospective, descriptive, cross-sectional study was conducted involving all children aged 0-13 years who presented with blunt abdominal trauma to Pediatric Surgery Department Mayo Hospital Lahore from 1st December 2024 till 30th June 2025. Patients with penetrating injuries to the chest or abdomen, with major central nervous system (CNS) or thoracic injuries and those with suspected physical abuse were excluded. The required sample size was calculated to be 73 patients based on 95% confidence interval, 10% absolute precision with expected percentage of blunt abdominal trauma as 25% based on the previously published literature [2, 7]. Non probability consecutive sampling was employed and all patients fulfilling the pre-defined inclusion criteria were included in the data.

Data were collected using a structured proforma and included demographic characteristics (age and sex),

mechanism of trauma, associated minor injuries, treatment instituted, requirement for blood transfusions, grade of injury of the affected organ according to the American Association for the Surgery of Trauma (AAST) guidelines, referrals to any specialty, duration of stay, readmissions if any, and final outcomes including mortality.

Injuries were classified according to the American Association for Surgery of Trauma organ injury grading scales. American Pediatric Surgical Association (APSA) and the American Association for the Surgery of Trauma (AAST) guidelines were followed in managing the patients [8]. All patients were managed according to institutional trauma protocols and received multidisciplinary care when indicated. The participants were enrolled after obtaining written informed consent from their parents or legal guardians.

STATISTICAL ANALYSIS

Data were entered and analyzed using SPSS version 26.0. Continuous variables were assessed for normality and summarized as mean $\pm$ standard deviation or median with interquartile range (IQR) as appropriate. Categorical variables, including gender, mechanism of injury, type of management, associated injuries, and outcomes were summarized as frequencies and percentages. Results were presented in tabular and graphical formats for clear visualization. No inferential comparative analysis was performed as this was a descriptive observational study. Data visualization was performed using bar charts and pie charts to enhance interpretability.

RESULTS

A total of 73 pediatric trauma patients who met the inclusion criteria were recruited for the study. The most commonly affected age group was 6–9 years ($n = 40$, 54.8%), followed by 10–13 years ($n = 21$, 28.8%) and 2–5 years ($n = 12$, 16.4%). Most patients were male ($n = 56$, 76.7%), while females accounted for ($n = 17$, 23.3%).

Falls were the leading mechanism of injury, observed in 42 patients (57.5%), and followed by road traffic accidents in 27 patients (37.0%). Sports-related injuries were reported in 2 patients (2.7%). Unusual mechanisms included one patient (1.4%) who was kicked by a sibling and another (1.4%) who sustained injury due to a wall collapse (Table 1).

Table 1. Demographic Characteristics and Mechanism of Injury.

Variable	Frequency	Percentage
Age 2-5 years	12	16.4%
Age 6-9 years	40	54.8%
Age 10-13 years	21	28.8%
Male	56	76.7%
Female	17	23.3%
Falls	42	57.5%
RTA	27	37.0%
Sports related	2	2.7%
Others	2	2.7%

31 of the 73 patients (42.5%) required admission to the intensive care unit (ICU), while 42 patients (57.5%) were managed in the general ward. Blood transfusion was required in 39 patients (53.4%).

The majority of patients were managed non-operatively while surgical intervention was performed in 11 patients (15.1%). Exploratory laparotomy was carried out in all 6 patients with hollow viscus injuries (n=1 perforation of stomach, n= 2 perforations of ileum, n= 1 perforation of duodenum, n=1 perforation of transverse colon, n = 1 perforation of cecum) and in 5 patients with liver injuries who had indications for operative interventions.

The median hospital length of stay was 7.0 days (inter-quartile range: 4.0–8.0; range: 2.0–21.0 days).

Among patients with documented solid organ injuries, liver injuries were recorded in 29 patients (39.7%). Of these, Grade III injuries were most common (41.4%), followed by Grade II (20.7%), Grade IV (17.2%), Grade I (13.8%), and Grade V (6.9%).

Splenic injuries were documented in 17 patients (23.3%), with Grade IV injuries being the most frequent (35.3%), followed by Grades II and III (23.5% each) and Grade I (17.6%).

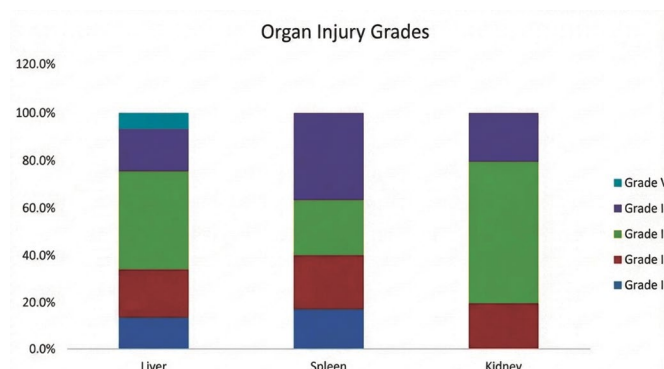
Renal injuries were recorded in 10 patients (13.7%), with Grade III injuries predominating (60.0%), followed by Grades II and IV (20.0% each).

Hollow viscus injury was seen in 6 (8.2%) patients. All of them underwent exploratory laparotomies. The small bowel was the most commonly involved hollow viscera (n=3) 11 patients (15.1%) had multi organ injuries (Table 2).

Table 2. Organ Injury Pattern.

Organ Injured	Frequency (n)	Percentage (%)
Liver	29	39.7%
Spleen	17	23.3%
Kidney	10	13.7%
Hollow Viscus	6	8.2%
Multi organ Injury	11	15.1%

Percentages may exceed 100% because patients with multi organ injuries were counted in more than one injury category.

**Fig. (1).** Grades of Organ Injury.

A total of 13 patients (17.8%) required referral to other specialties, including 11 referrals to orthopedics and 2 patients were referred to neurosurgery.

Associated injuries included scalp lacerations (n=2), facial laceration (n=1), linear fracture of frontal bone (n=1), linear fracture of temporal bone (n=1), perineal laceration (n=1), thigh lacerations (n=2), pelvic fractures (n=3), femur fractures (n=2), radius and ulna fractures (n=2), humerus fracture (n=1), Bennett fracture (n=1), and tibial fractures (n=2).

Overall outcomes were favorable, with 69 patients (94.5%) achieving full recovery. No readmissions were recorded during the study period.

Overall mortality was 5.5% (4 patients). 3 deaths occurred in patients with grade IV liver injuries while one patient with gastric perforation succumbed despite operative management. All deaths occurred in patients with severe injuries requiring operative intervention. All these patients presented with severe shock on admission and remained hemodynamically unstable despite repeated fluid resuscitation and required operative intervention.

The demographic characteristics, mechanism of injuries, outcomes and grades of injuries are summarized in tables and illustrated in figures (Tables 1, 2, Figs. 1, 2).

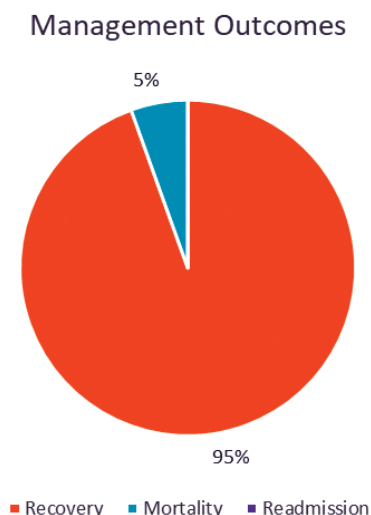


Fig. (2). Management Outcomes.

DISCUSSION

Pediatric blunt abdominal trauma is a major burden to healthcare worldwide and knowledge regarding its demographics as well as the patterns of injury and timing of presentation are instrumental in the judicious use of available resources. [1,9,10]. In our study, children aged 6-9 years were most commonly affected with a clear male predominance (76.7%). Bašković *et al.* stated that abdominal injuries are seen in the age group of 5 to nine years most often, twice more in boys [6]. These findings are consistent with our study and are supported by previously published data.

Falls were the leading mechanism of injury in our cohort (57.5%) followed by road traffic accidents (37.0%). This finding differs from many published pediatric trauma series in which road traffic accidents predominated. Sabounji *et al.* reported 54.3% of abdominal trauma was caused by road traffic accidents [2]. Chaudhari *et al.*, Staab *et al.*, Spijkerman *et al.* and Yancovich *et al.* all reported road traffic accidents as the leading cause of pediatric blunt abdominal trauma [4, 5, 11, 12]. The observed predominance of falls in our study may signify regional differences in patterns of presentation, environmental and socioeconomic factors, and child supervision practices. These findings emphasize the need for locally centered fall prevention strategies in children.

In our study, 15.1% of patients underwent surgical intervention while majority were successfully managed conservatively [13]. This finding is consistent with existing pediatric trauma literature, which advocates for conser-

vative treatment as the standard of care in hemodynamically stable patients with solid organ injuries. The earliest report supporting conservative management of blunt abdominal trauma was published in Toronto between 1956 and 1965, involving 12 children with splenic injuries who were successfully managed non-operatively. Subsequent reviews of published studies indicated that internal organ injuries occur in approximately 8–12% of children with blunt abdominal trauma, with survival exceeding 90% [14]. Lyttle *et al.* reported that 96.5% of pediatric blunt abdominal trauma was successfully managed conservatively [15]. Similarly, Evans *et al.* reported non-surgical treatment as the standard of care with only 0.4% of patients requiring laparotomy [16]. Similar findings were also reported by Spijkerman *et al.* [11]. Reid *et al.* further demonstrated that although laparotomy remains necessary in selected patients, its overall requirement has significantly decreased due to the adherence to non-operative strategies [17].

Right now, the general approach worldwide leans toward managing blunt abdominal trauma in children conservatively rather than through surgery [18- 21]. This usually means keeping the child in the hospital longer, closely monitoring their vital signs, and relying heavily on imaging techniques to track how they're recovering [19, 21, 22]. Kids are actually more prone to having multiple injuries at once when it comes to abdominal trauma. This is because their ribs are more flexible, their abdominal wall is thinner, their abdomen is smaller overall, and their internal organs take up a larger proportion of that space compared to adults [23]. On the flip side, children's organs also tend to have a thicker, more resilient outer capsule, which means bleeding often stops on its own more frequently than it would in adults. This is actually a good thing, since it makes non-surgical treatment a more realistic and effective option for these injuries [24].

In our study, liver injuries (39.7%) were more common than splenic injuries (23.3%) followed by renal injuries (13.7%). This is consistent with the existing literature. Lyttle *et al.* reported 44% liver injuries followed by spleen (32%) and kidneys (18%) [15]. Similar findings were also reported by Cunha *et al.* and Baseer *et al.* [24,25]. Hollow viscus injury was seen in 6 (8.22%) patients with small bowel as the most commonly involved in our cohort. Staab *et al.* revealed < 10% cases of bowel perforation and small bowel as the most frequently injured site [5].

Associated injuries were predominantly orthopedic, including pelvic and long bone fractures, necessitating

multidisciplinary management. A significant proportion of patients required referral to orthopedics and neurosurgery, emphasizing that pediatric trauma is often multi-system in nature. Sabounji *et al.* documented associated injuries in 40% of trauma patients with thoracic injuries being the most common followed by neurosurgical and orthopedic injuries [2]. These findings correlate with our study.

The overall outcome in our cohort was favorable, with a recovery rate of 94.5% and mortality of 5.5%. Comparable studies like Lyttle *et al.* Cunha *et al.* and Baseer *et al.* have reported similarly favorable outcomes, particularly with early resuscitation, adherence to trauma protocols, and increasing reliance on non-operative strategies [15, 24, 25].

Our study reinforces the current evidence supporting non-operative management as the cornerstone of treatment in pediatric BAT.

LIMITATIONS

This was a single-center study with relatively small sample size, potentially limiting the generalizability of the results. Second, the study only focused on in-hospital outcomes and did not cover long term morbidity or quality of life. As a descriptive study, causal relationships between injury characteristics, management strategies and outcomes cannot be established.

CONCLUSION

In our study, pediatric blunt abdominal trauma emerged as a major cause of illness and complications, with falls being the leading cause of injury. Successfully managing these cases without surgery depends heavily on choosing the right patients for this approach. Importantly, non-operative management only works well when a full clinical care team, including pediatric surgeons, anesthesiologists, radiologists, and pediatric intensivists, is available around the clock to catch and manage any complications that might arise. Our findings also point to the need for stronger prevention efforts, especially around fall safety and road safety, to help lower the overall burden of trauma in children in our region.

AUTHORS' CONTRIBUTIONS

Zuha Zafar: Conceptualization, study design, methodology, data analysis and interpretation, drafting the manuscript, critical review and revision of the manuscript, and final approval of the version to be published.

Batool Fatima: Methodology, data analysis and interpretation, drafting the manuscript, critical review and revision of the manuscript, and final approval of the version to be published.

Muhammad Kashif Bashir: Study design, critical review and revision of the manuscript, and final approval of the version to be published.

Muhammad Rehman Waheed, Syed Salman Hussain Zaidi, and Mahwish Noor ul Haq: Methodology, data analysis and interpretation, and drafting the manuscript.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Declared none.

ETHICAL DECLARATIONS

Data Availability

The data supporting the findings of this study are included in the article. Further inquiries regarding the data may be directed to the corresponding author, subject to applicable ethical, privacy, and institutional requirements.

Ethical Approval

This study was approved by the Institutional Review Board of King Edward Medical University, Lahore, Pakistan (Ref. No. 764/RC/KEMU; dated: 20th November 2024).

Consent to Participate

Written informed consent was obtained from all patients before their participation in the study.

Consent for Publication

Written informed consent for publication was obtained from patients whose individual information, clinical details, images, or other potentially identifiable material are included in this article, where applicable.

Declaration of Competing Interest

The authors declare that they have no known financial or

non-financial competing interests that could have influenced the work reported in this study.

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Use of AI-Assisted Technology

The authors used Claude (Anthropic) as artificial intelligence (AI)-assisted language tools to assist with improving the language, grammar, readability, and formatting of the manuscript. AI was not used for data collection, data analysis, interpretation of results, or generation of scientific conclusions. All AI-assisted output was critically reviewed, revised, and approved by the authors, who take full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

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