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Original Research Article

Paediatric blunt abdominal trauma with organ injury: a comprehensive analysis of cases at a tertiary hospital in Bangladesh

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ABSTRACT

Background: Pediatric blunt abdominal trauma with organ injuries is a critical issue in Bangladesh, lacking sufficient research. This study focuses on managing such cases in a tertiary hospital. Objectives were to assess clinical characteristics, injury patterns, and outcomes of pediatric patients with blunt abdominal trauma and organ injuries. It aims to identify causes, associated injuries, and hospital stay durations.
Methods: A prospective study of 142 pediatric patients aged 1-12 was conducted at Rajshahi medical college hospital study period January 2020 to December 2021. In addition, this study aimed to identify and grade solid organ injuries according to the American association for the surgery of trauma organ injury scale.
Results: Prevalence of hepatic injuries (76.8%), solid organ injuries (90.1%), road traffic accidents (71.8%), falls from height (25.4%). Most received conservative treatment, had short hospital stays, and a 7% mortality rate. Gender had no significant impact on organ injuries ($p>0.001$). Among the causes, 84.5% had hepatic injuries, 15.5% had spleen injuries due to road traffic accidents, and 58.3% had injuries from falls from height, with a highly significant cause-organ injury relationship ($p<0.001$).
Conclusions: pediatric blunt abdominal injuries in Bangladesh affect various organs, primarily in males and school-aged children, primarily due to road accidents. Timely surgical intervention and preventive measures are crucial for improved outcomes.

Keywords: Blunt trauma, Organ injury, Paediatric

INTRODUCTION

The major factor in childhood mortality is trauma. Every year, more than 20 million children suffer injuries, and unintentional injuries rank first among all causes of death for children over the age of one. After head and chest traumas, abdominal trauma is the third most common cause of death in this population. It is the most frequent cause of undetected injury-related mortality.[1] It is typically connected to bicycle, contact sport, and road traffic collision injuries.[2] Early and accurate management are required for the care of the injured youngster.[3] A thorough physical examination should be performed on trauma patients after evaluation and resuscitation. Serial physical examinations are necessary since a single physical examination is not sensitive.[4] Abdominal injury affects one-third of trauma patients worldwide, accounting for a significant portion of tragic fatalities, and continues to be a distressingly common cause of avoidable death.[5] Traditionally, abdominal injuries are either penetrating or blunt. The most frequent cause of mortality and disability in children is blunt traumatic injury. Injuries to the abdomen can happen alone or in conjunction with other traumas. Despite the fact that trauma has been a part of human history for millennia, the vast epidemic of childhood trauma is a relatively modern phenomena that

has grown in scope over the last three decades.[6] In low and middle-income countries (LMICs), trauma is growing in importance as nutrition and infection control have improved.[7]

Contrary to many overt injuries in other areas of the body, blunt abdominal injuries frequently present diagnostic and therapeutic challenges because the abdomen is a diagnostic "black box." To avoid morbidity and mortality in these disorders, early diagnosis and fast care are crucial. Although affluent nations have made significant strides in trauma management, there are concerns about resource shortages and a lack of knowledge regarding the epidemiology and demography of blunt abdominal injuries in many LMICS. More than 95% of all child injury deaths worldwide take place in LMICs.[8] Previous research has defined subtypes of children's blunt abdominal injuries, focusing mostly on solid organ or hollow viscus injuries. However, Treatment for these wounds does not rely on a single rather than the sum of the individual injuries. Studies considering all pediatric intra-abdominal injuries, encompassing both hollow viscus and solid organ injury, are confined.[9] The purpose of this study, then, was to document the therapeutic approaches and results of all pediatric patients with traumatic intra-abdominal injuries in our special devoted with a pediatric trauma surgeon, a pediatric trauma center. There has been limited research from low-resource countries examining the prevalence and types of injuries related to blunt abdominal trauma in pediatric individuals. To better understand the frequency and characteristics of pediatric blunt abdominal trauma, this study aimed to explore various factors that impact the occurrence of trauma and the nature of injuries observed in this population.

METHODS

Study design

This hospital-based study employed a prospective observational approach to assess the effectiveness of clinical examination and other influential factors in ruling out significant intra-abdominal organ injury among pediatric patients presenting with blunt abdominal trauma (BAT). Additionally, it examined aspects of management, including major causes, organ injuries, associated complications, and patient outcomes. The study enrolled pediatric patients aged 1 to 12 years who presented at the emergency department of Rajshahi Medical College Hospital with a diagnosis of blunt abdominal trauma (BAT) and underwent evaluation for intra-abdominal organ injury. Patients with penetrating abdominal trauma or incomplete medical records, as well as those with blunt abdominal trauma (BAT) but without organ injury, were excluded from the analysis. The sampling technique employed was purposive sampling. Information was extracted from the hospital's electronic medical records system, encompassing patient demographics, injury mechanisms, clinical observations, associated complications, management strategies, and outcomes regarding the severity of organ injuries. To create a master sheet, the recorded data were imported into Microsoft Excel version 2019 and given unique alphanumeric codes. SPSS version 23 was then used to analyze the data. Frequency and percentage were used to characterize categorical variables (gender, method of injury, organ implicated, kind of treatment, and result. Chi-square test was used to investigate differences in injury mechanisms between sexes, among age groups and patterns of injuries, kinds of treatment, and their outcomes. According to the American Association for the Surgery of Trauma's suggested organ injury scale, solid organ injuries were rated in this study. The grading system offered criteria for choosing whether surgical or nonsurgical treatment was necessary in cases of solid organ damage. Informed consent from guardians, assuring patient confidentiality, and prioritizing the well-being of pediatric subjects was ensured. Additionally, all procedures followed established ethical standards and legal requirements, safeguarding the rights and safety of the participants.

RESULTS

This study focused on 142 pediatric patients aged 1 to 12 admitted to Rajshahi medical college hospital, Bangladesh, from January 2020 to December 2021 for blunt abdominal injuries.

Table 1: Distribution of cases according to age (n=142).

Age of the patients (years)	N	%
1 to <3	18	12.7
3≤ to <6	38	26.8
6≤ to ≤12	86	60.6
Total	142	100

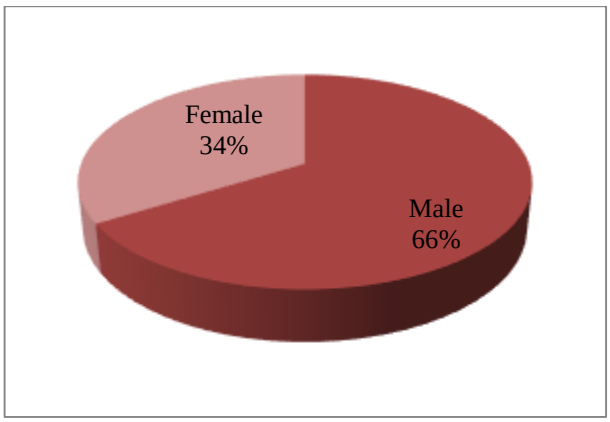

Figure 1: Distribution of cases of blunt abdominal trauma (BAT) by gender (n=142).

Most cases (60.6%) fell within the 6 to 12 age group, with Road Traffic Accidents (71.8%) and falls from height (25.4%) as the primary causes. Among these patients, 66.2% were male. The most frequently observed injuries were to the liver (76.8%), followed by spleen injuries

(16.2%). Common diagnostic methods included ultrasonography (23.2%) and computed tomography (76.8%).

Table 2: Distribution of cases of BAT based on types of organ injury (n=142).

Types of organ injury	N	%
Hepatic injury	109	76.8
Spleen injury	23	16.2
Large gut perforation	5	3.5
Bile duct injury	2	1.4
Small gut perforation	3	2.1
Total	142	100

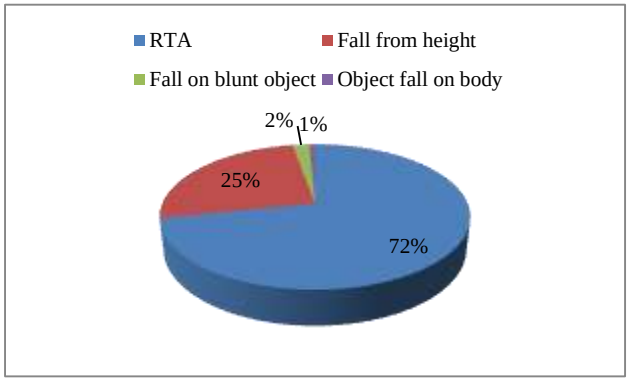

Figure 2: Distribution according to most common causes of BAT.

In terms of treatment, 80.3% of patients received conservative care, while 19.7% underwent surgery. The majority of patients had hospital stays lasting less than 7 days (84.5%), with a mortality rate of 7%.

Table 3: Distribution of cases of BAT based on types of treatment (n=154).

Types of treatment	N	%
Conservative	114	80.3
Laparotomy and colostomy	4	2.8
Laparotomy and ileostomy	1	0.7
Laparotomy and peritoneal lavage	2	1.4
Laparotomy and repair of perforation	5	3.5
Tube Thoracotomy	14	9.9
Suprapubic cystostomy	2	1.4
Total	142	100

Among the injuries, 90.1% were solid organ injuries, with grade III injuries being the most prevalent (46.1%). In the context of gender, 67.9% of males and 32.1% of females experienced hepatic injuries, and there was no significant relationship between gender and organ injury (p>0.001). Furthermore, the analysis revealed that 84.5% of patients had hepatic injuries, 15.5% had spleen injuries due to Road Traffic Accidents, and 58.3% sustained injuries from falls from height. This relationship between the cause of injury and the affected organ was highly significant (p<0.001).

Concerning age, children aged 6 to 12 had a prevalence of 69.8% for hepatic injuries, while those aged 3 to 6 had a prevalence of 94.7% (p<0.001). Lastly, grade III injuries were treated conservatively in 53.6% of cases, while 72.2% of grade IV injuries underwent operative treatment, with a highly significant relationship (p<0.001). The (Table 1) reveals that the most common age group is between 6 to 12 years (60.6%).

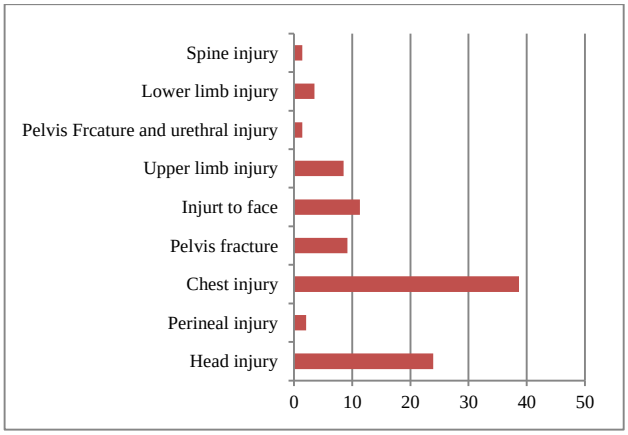

Figure 3: Distribution of cases of BAT according to associated injury (n=142).

The (Figure 1) shows that male patients (66.2%) are more sufferer than females (33.8%). The (Table 2) shows that regarding organ injury hepatic injury (76.8%) is most common, second highest injury is spleen injury (16.2%). The (Figure 2) denotes that the most common cause of BAT is RTA (71.8%). Fall from height 25.4%, fall on blunt object 2.1% and object fall on body is 0.7% respectively.

Table 4: Distribution of cases of BAT according to duration of hospital stay (n=142).

Duration of hospital stay (days)	N	%
1 to 7	120	84.5
8 to 14	16	11.3
15 to 21	1	0.7
22 to 30	4	2.8
31 and above	1	0.7
Total	142	100

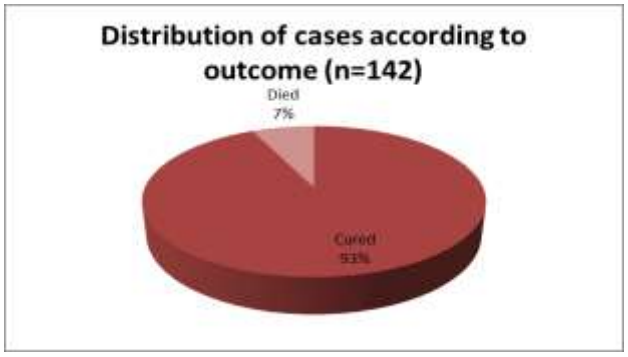

Figure 4: Distribution of cases of BAT according to outcome (n=142).

The (Table 3) shows that conservative treatment (80.3%) was the most common treatment option. The second common treatment option was tube thoracotomy (9.9%). Chest injuries were the highest at approximately 38.7%, while head injuries ranked second 23.9% (Figure 3). Regarding hospital stay table 4 reveals that out of 142 patients most of the patients (84.5%) were stayed in hospital less than 7 days. The longest duration of hospital stay was more than 31days (0.7%).

Table 5: Classification of solid organ injury cases based on American association for the surgery of trauma organ injury scale.

Grading	N	%
Grade-I	18	14.1
Grade-II	26	20.3
Grade-III	59	46.1
Grade-IV	17	13.3
Grade-V	8	6.3
Total	128	100

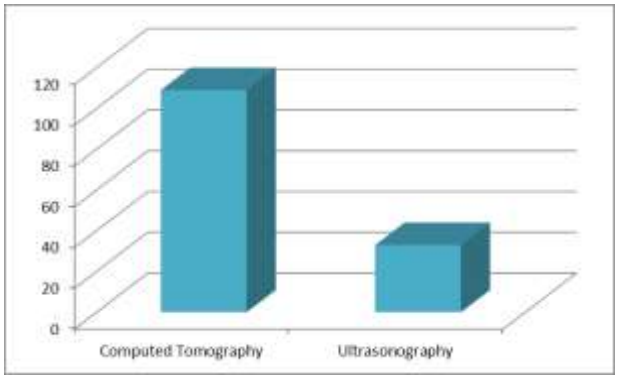

Figure 5: Distribution of cases according to diagnostic tests used (n=142).

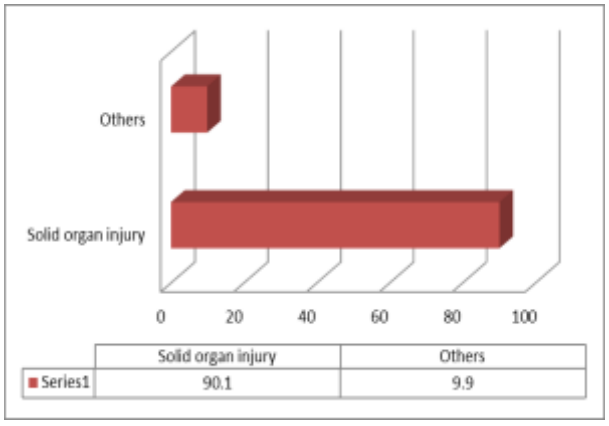

Figure 6: Distribution of cases according to solid organ injury (n=142).

The (Figure 4) shows that regarding distribution of cases of BAT according to outcome approximately 93% were cured and 7% died. The (Figure 5) reveals that computed tomography (76.8%) and ultrasonography (23.2%) were found effective in diagnosis of injury. The (Figure 6) demonstrates that in terms of solid organ injury, approximately 90.1% of patients, or 128 individuals, presented with solid organ injuries, while 9.9% (14 cases) were diagnosed with other types of injuries. In (Table 5), among 128 cases of solid organ injury, grade III injuries were most prevalent at 46.1%, followed by grade II (20.3%) and grade V injuries (6.3%), based on the American Association for the Surgery of Trauma Organ Injury Scale. The (Figure 7) depicts that among 142 BAT cases, 114 (80.3%) underwent conservative treatment, while 28 (19.7%) required surgical procedures.

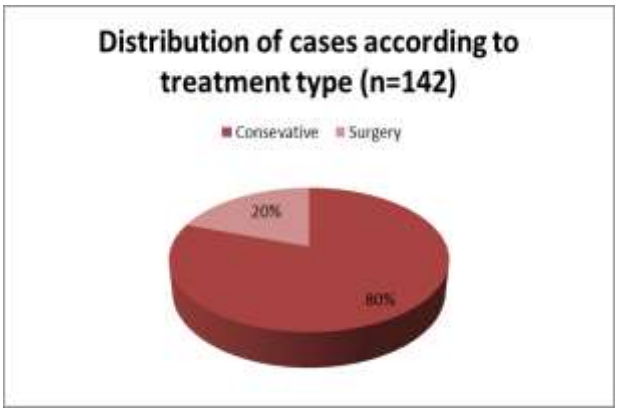

Figure 7: Distribution of cases according to treatment type (n=142).

In (Table 6), 67.9% of male patients and 32.1% of female patients had hepatic injuries. The gender-organ injury relationship was statistically non-significant (p>0.001). The (Table 6) further demonstrates the association between the cause and organ injuries in BAT patients. Out of 142 patients, 87 (84.5%) experienced hepatic injuries, 16 (15.5%) had spleen injuries due to road traffic accidents (RTA), and 21 (58.3%) sustained injuries from falls from height. The statistical analysis revealed a statistically significant relationship between the cause and organ injury (p<0.001). Children aged 6 to 12 years had a higher prevalence of hepatic injury (69.8%), followed by those aged 3 to 6 years (94.7%). This age-organ injury relationship was statistically significant (p<0.001). The (Table 7) reveals that 59 (53.6%) patients with grade III injuries received conservative treatment, while 13 (72.2%) patients of grade- IV received operative treatment. The relationship is highly significant, with p<0.001.

DISCUSSION

Given their frequent occurrence in polytrauma situations, the potential for various visceral injuries, the diverse range of presentations, and the severity of intra-abdominal damage, pediatric abdomino-pelvic trauma, both penetrating and blunt, presents a significant diagnostic and therapeutic challenge for attending surgeons. The primary aim of this study was to investigate clinical manifestations, assess the effectiveness of an investigation protocol, promptly analyze treatment outcomes, and explore the

viability of non-operative management for solid visceral injuries in a healthcare setting without access to angiography and an advanced pediatric intensive care unit.In this study the common age group of children was found 6 to 12 years (60.6%).

Table 6: Relationship of various patient factors with organ injuries in BAT patients (n=142).

Variables	Organ injury				P value
Gender	**Hepatic injury**	**Splenic injury**	**Others**	**Total**	
Male	74 (67.9)	13 (56.5)	7 (70)	94 (66.2)	>0.001
Female	35 (32.1)	10 (43.5)	3 (30)	48 (33.8)	
Total	109 (100)	23 (16.2)	10 (7)	142 (100)	
Cause of injury					
RTA	87 (84.5)	16 (15.5)	0 (0)	103 (100)	<0.001
Fall from height	21 (58.3)	7 (19.4)	8 (22.2)	36 (100)	
Fall on object	1 (33.3)	0 (0)	2 (66.7)	3 (100)	
Total	109 (76.8)	23 (16.2)	10 (7)	142 (100)	
Age of the patients (years)					
1 to <3	13 (72.2)	5 (27.8)	0 (0)	18 (100)	<0.001
3 to ≤6	36 (94.7)	2 (5.3)	0 (0)	38 (100)	
>6 to 12	60 (69.85)	16 (18.6)	10 (11.6)	86 (100)	
Total	109 (76.8)	22 (16.2)	10 (7)	142 (100)	

Table 7: Relationship between various grading of organ injuries in BAT patients and treatment type (n=142).

Solid organ injury with grading	Treatment types		Total
	Conservative	**Operative treatment**	
Grade- I	18 (16.4)	0 (0)	18 (14.15)
Grade- II	26 (23.6)	0 (0)	26 (20.3)
Grade- III	59 (53.6)	0 (0)	59 (46.1)
Grade- IV	4 (3.6)	13 (72.25)	17 (13.3)
Grade- V	3 (2.7)	5 (27.8)	8 (6.3)
Total	110 (100)	18 (100)	128 (100)

$\chi 2=87$, df=4, $p<0.001$

According to a study by Djordjevic et al children between the ages of 6 and 10 were most likely to sustain injuries, with a male:female ratio of 3:1.[10] We have found male patients (66.2%) are more sufferer than female children(33.8%). In similar study, the most prevalent age range was 5 to 9 years, with a predominance of males. Boys in this age group's restlessness and playfulness may be the cause of this. In a research by Spijkerman et al the spleen was the organ most frequently affected (48.7%).[2] But in this study the most common organ injury was found hepatic injury(76.8%). Spleen injury was found about 16.2%. The easy susceptibility of the spleen and liver to trauma in youngsters may be due to the partial protection provided by malleable ribs, less overlaying fat, and weaker abdominal musculature. Road traffic accidents were the most frequent cause of injury (72.5%). The most frequent mechanism of damage in the study by Kundal et al was falling (58.08%).[11] Unsafe road infrastructure, dangerous vehicles, speeding, not using seat belts, kid restraints driving while distracted, driving while intoxicated, inadequate post-crash care, and insufficient traffic law enforcement are some of the main risk factors. Involvement of multiple systems is typical in youngsters. Polytrauma involves the involvement of two or more organ systems. The amount of crushing, deforming, stretching, and shearing forces that cause blunt injuries depends on the rate of acceleration and deceleration as well as the direction of impact.[12] In the current investigation, chest injury was more frequently related (37.0%). This is not similar to other research done by Kulshrestha et al where thoracic injury was predominant.[13] According to our study, 80.3% of kids receiving conservative care experienced resolution. The majority of blunt abdominal injuries can be managed conservatively, according to other studies. However, in a study, surgical intervention was required for 50% of splenic injuries, 44% of liver injuries, 25% of pancreatic injuries, and 23% of renal injuries. This is higher than numerous findings, such as those by Ghosh et al.[14] About 6% of patients had gastrointestinal (GI) perforations, and 25% of patients required surgical intervention. In similar study large gut perforation was found in 3.5% of cases, bile duct injury (1.4%) and small gut perforation (2.1%). FAST is crucial in the early assessment of traumatized children. According to Wegner et al investigation into the application of ultrasonography (USG) (FAST) in trauma, A youngster with a positive USG and stable hemodynamics should perform a CT.[15] Due to its easy accessibility and great sensitivity in diagnosing IAI, CT has become the method of choice for evaluating injured youngsters. According to Ellison et al

that the routine use of oral contrast is unnecessary is shown in their study and it extends the time needed for angiographic and CT scans. Only intravenous contrast is sufficient, according to research.[16] Diagnostic methods, including ultrasonography (23.2%) and computed tomography (76.8%), proved effective in identifying organ injuries. None of the patients who were observed needed intensive care unit care; instead, they only had an average hospital stay of one to three days and returned to their regular activities in one to two weeks. The average hospital stay for patients who had intra-abdominal injuries and were managed non-operatively was 7 to 14 days. None of them required ICU care, and it took them an average of 2 to 3 weeks to resume their regular activities. The average hospital stay for those who underwent surgery was longer 14 to 28 days; one of them required an ICU stay; and it took them an average of 3 to 6 weeks to return to their normal activities. Those who underwent surgery had longer hospital stays and took longer to resume normal activities than those who were handled non-operatively. Navascues et al. found similar results.[17] It was discovered that approximately 84.5% of the patients had hospital stays lasting less than 7 days. Moreover, 10.4% of the patients had hospital stays up to 14 days, 1.9% up to 21 days, and a minority (0.6%) had stays lasting 31 days or more. The study reported an overall mortality rate of 7.8%, with all fatalities occurring in the surgical treatment group; no deaths were observed among patients treated conservatively. Notably, liver injuries were identified as the sole contributing factor to the overall mortality, accounting for 12 cases.[18] In this study, it was observed that approximately 90.1% of the patients, totaling 128 individuals, suffered from solid organ injuries, while the remaining 9.9% (14 cases) presented with different types of injuries. The most frequent solid organ damage caused by BAT are liver and splenic, while renal and pancreatic lesions are less frequent. The liver is the organ that experiences injuries the second most commonly, with an incidence of injury ranging from 1% to 8%, but it also accounts for the majority of BAT mortality. Hepatic lacerations can be shallow (grades I-II, 3 cm deep) or deep (grades III-V, 3 cm deep). Branched hypoattenuation zones or irregularly linear lacerations can be seen on contrast-enhanced CT scans. Parenchymal Hematomas may show up as hepatic low-attenuation areas with fuzzy edges on a contrast-enhanced CT scan. However, a subcapsular hematoma appears. a low-attenuation elliptic blood collection between the liver capsule and the hepatic parenchyma.[19] Among the injuries, 90.1% were solid organ injuries, with grade III injuries being the most prevalent (46.1%). In the context of gender, 67.9% of males and 32.1% of females experienced hepatic injuries, and there was no significant relationship between gender and organ injury ($p>0.001$).Furthermore, the analysis revealed that 84.5% of patients had hepatic injuries, 15.5% had spleen injuries due to Road Traffic Accidents, and 58.3% sustained injuries from falls from height. This relationship between the cause of injury and the affected organ was highly significant ($p<0.001$). Concerning age, children aged 6 to 12 had a prevalence of 69.8% for hepatic injuries, while those aged 3 to 6 had a prevalence of 94.7% ($p<0.001$). Lastly, grade III injuries were treated conservatively in 53.6% of cases, while 72.2% of grade IV injuries underwent operative treatment, with a highly significant relationship ($p<0.001$).

Limitations

This study has limitations worth noting. It's a single-center study, so its findings might not fully represent the broader population in Bangladesh. The study's limited timeframe and sample size (142 patients) could affect its ability to capture long-term trends and generalize the results. Data collection from medical records may introduce bias, and missing or incomplete data could impact the analysis. The study's focus on a tertiary hospital might introduce selection bias toward more severe cases. Its observational design lacks the control of experimental studies, and its scope primarily covers descriptive aspects, without delving into interventions or long-term outcomes. Lastly, the findings may not be directly applicable to regions or countries with different healthcare systems and demographics.

CONCLUSION

The age group 6 to 12 years is most affected, revealing insights into pediatric trauma epidemiology. Road traffic accidents and falls from heights are the primary causes, often resulting in hepatic or splenic injuries. Most pediatric injuries are preventable, differing from adult patterns. This study highlights the significant impact of pediatric blunt abdominal trauma in Bangladesh, emphasizing the importance of swift diagnosis, effective diagnostics, and timely surgery. Raising road safety awareness can reduce trauma rates. Further research is needed to improve prevention and management protocols, ultimately saving lives and enhancing pediatric patient outcomes.

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