Prognostic Factors for Paediatric Abdominal Trauma at Tertiary Care Center

Mohammed Abdul Baseer[1], Nandkishor Dhanvantrao Shinde[1*], Ravindra G Devani[2], Manjunath J[3]

[1] Associate Professor of Department of Paediatric Surgery, Khaja Banda Nawaz University, Faculty of Medical Sciences, Kalaburagi. Karnataka, India

[2] Professor of Department of Paediatric Surgery, Khaja Banda Nawaz University, Faculty of Medical Sciences, Kalaburagi. Karnataka, India

[3] Resident of Department of Paediatric Surgery, Khaja Banda Nawaz University, Faculty of Medical Sciences, Kalaburagi. Karnataka, India

***Address for Corresponder:** Dr. Nandkishor Dhanvantrao Shinde, Department of Paediatric Surgery, Khaja Banda Nawaz University, Faculty of Medical Sciences, Kalaburagi. Karnataka, India (email: drnandkishorshinde@gmail.com)

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Abstract

Introduction: Pediatric abdominal trauma incidence is increasing due to rising population, industrialization, modernization, increase in the motor vehicle accidents, terrorist activities and riots. This study is done to know the prognostic factors in pediatric abdominal trauma which help in decreasing morbidity and mortality.

Materials and Methods: This retrospective study was conducted at a tertiary care centre, since May 2016 till April 2022. Records of paediatric patients with a history of abdominal trauma were analysed Retrospectively. Demographic data, mode of injury, mechanism of injury,

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nature of the injury, definitive treatment and outcome of patients were analysed.

Results: There were 110 pediatric abdominal trauma patients. Road traffic accidents were the most common mode of trauma, seen in 70% of cases, followed by falling which comprises 25.5% cases. Twenty-five (22.7%) cases were hemodynamically unstable at presentation. Seventy (63.6%) cases required transfusion of blood or blood products. Penetrating abdominal trauma and blunt trauma were seen in 19 (17.3%) cases and in 91 (82.7%) cases, respectively. Most common solid organ of injury was spleen in 46 (41.8%) cases. Surgical interventions were required in 29(26.4%) cases, however 81(73.6%) cases were managed conservatively. All patients with traumatic bowel perforation required surgical intervention. Nine (08.1%) patients were succumbed to death. Among the factors leading to mortality, delayed presentation (78%), hemodynamic instability (89%), requirement of transfusion (100%), penetrating abdominal trauma (78%), higher grades of injury (67%), and surgical interventions (89%) were commonly identified as poor prognostic factors.

Conclusion: Delayed presentation, hemodynamic instability, penetrating abdominal trauma, higher grade of injury, and surgical intervention are the poor prognostic factors. Site of injury, mechanism and the mode of injury are other factors contributed to the prognosis in pediatric abdominal trauma.

Keywords

- abdominal trauma
- pediatrics
- spleen injury
- bowel injury
- road traffic accidents

Introduction

In paediatric age group, trauma is the main cause of morbidity and mortality.[1] In children, abdomen is the third common region after the head and extremities to be injured.[2] Paediatric abdominal trauma accounts for approximately 25% of major

trauma in children and is the main contributing factor for unidentified fatal injuries in the children.[1,2]

Common mechanisms for paediatric abdominal trauma are motor vehicle accidents, pedestrian injuries, fallings, assaults and sports-related injuries. Penetrating abdominal trauma is less common in children.[3,4] Blunt trauma accounts for the majority of abdominal injuries in children. Blunt abdominal trauma leads to compression, deceleration, or crushing forces exerted in the abdominal cavity causing serious injuries.[5] Paediatric trauma incidence is increasing due to rising population, industrialization, modernization, increase in the vehicular traffic, terrorist activities and riots.[2,6]

Children have unique anatomy and physiology, has less adipose tissue, connective tissue and muscle mass. Bones are more pliable. Intra-abdominal organs are closely situated to each other.[7] Children have smaller blood vessels with good vasoconstrictive response, which help in controlling bleeding associated with solid organ trauma. As a result, most of the paediatric abdominal trauma can be successfully managed nonoperatively.[8] Abdominal ultrasonography (USG), Focused Assessment with Sonography for Trauma (FAST), computed tomography scans, laparoscopy, and diagnostic peritoneal lavage (DPL) are the tools for the diagnosis of the children with abdominal trauma.[4,9] Management of paediatric abdominal trauma has undergone a major shift to non-operative management in recent years. The reason may be the more accurate evaluation with the aid of improved imagining of the abdomen and improved critical care management in children.[1,10] Paediatric penetrating abdominal trauma are less common and often require surgical intervention.[1,10] Paediatric abdominal trauma has significant morbidity and has mortality as high as 8.5% .[2,5]

Knowledge of the factors like nature of injury, mode of injury, mechanisms of injury, and type of injury in children is important for the diagnosis and prognosis of specific injurie. Hence, this study is done to evaluate the prognostic factors in paediatric abdominal trauma which help in decreasing morbidity and mortality.

Materials and Methods

This retrospective study was conducted at a tertiary care centre, over the period of six years since May 2016 till April 2022. Local ethics committee approval was granted for this study. Retrospectively, records of all the paediatric patients <12 years of age with a history of abdominal trauma were analysed from the medical record section between May 2016 and April 2022. Exclusion criteria included associated paediatric head and spine injuries, paediatric limb injuries, thoracic injuries, burns, and drowning patients.

Demographic data, mode of injury, mechanism of injury, nature of the injury, presentation to the hospital, hemodynamic stability, investigations (USG and CT scan reports), definitive treatment required, whether conservative or surgical and the outcome of patients were recorded from case files.

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented as Mean ± SD (Min-Max) and results on categorical measurements are presented in percentile. The Statistical software IBM SPSS 24.0.(IBM, Armonk, NY, USA) were used for the analysis of the data.[11]

Result

There were 110 paediatric abdominal trauma patients <12 years of age fulfilling inclusion criteria. There were 83(75.5%) males and 27(24.5%) females with Male: Female ratio of 3.1:1. Age ranging from 6 months to 12 years with mean age of 6 ± 4.5 years.

Road traffic accidents was the most common mode of trauma seen in 77 (70%) of cases, followed by fall which comprises 28(25.5%) cases, followed by assaults which was seen in 5 (4.5%). Among road traffic accidents **(Table 1)** four-wheeler accidents were most commonly seen, in 45(58.5%) cases, followed by two-wheeler accidents seen in 14 (18.2%) cases.

Table 1: Type of vehicle-Frequency distribution of patients studied.

Type of vehicle	Number of persons	Percentage
Bus	06	07.7%
2-wheeler	14	18.2%
3-wheeler	09	11.7%
4-wheeler	45	58.5%
Pedestrian	03	03.9%

Eighty (72.7%) cases reached hospital within 1 hour, 23 (20.9%) cases reached hospital between 1hour to 6 hours, 7 (6.4%) cases reached hospital6 hours after abdominal injury.85 (77.3%) cases were hemodynamically stable and 25 (22.7%) cases were hemodynamically unstable on presentation to the hospital. Seventy (63.6%) cases required transfusion of blood or blood products **(Table 2).**

Table 2: Transfusion- Frequency distribution of patients studied.

Transfusion	Number of patients	percentage
FFP		
• 1-2	19	17.3%
• 2-4	02	01.8%
• >4	01	0.9%
PRBC		
• 1-2	26	23.6%
• 2-4	05	04.5%
• >4	03	02.7%
Whole Blood		
• 1-2	13	11.8%
• 2-4	01	0.9%
• >4	00	00

In paediatric abdominal trauma, penetrating abdominal trauma was seen in 19 (17.3%) cases, while blunt trauma was seen in 91 (82.7%) cases. In paediatric abdominal trauma, most common solid organ of injury was spleen, seen in 46 (41.8%) cases, followed by liver trauma which was seen in31 (28.2%) patients and among hollow viscous injuries, bowel injuries were most common and seen in18 (16.4%) cases **(Table 3).**

Table 3: Organ injury frequency in paediatric abdominal trauma

Organ injured	Number	Percentage
Spleen	46	41.8%
Liver	31	28.2%
Kidney	12	10.9%
Pancreas	02	01.8%
Bowel perforation	18	16.4%
Urinary bladder injury	01	0.9%

Ultrasound abdomen was done in all 110 (100%) cases, while CECT abdomen was done in 106 (96.4%) cases.

Surgical interventions were required in 29(26.4%) cases; however, 81(73.6%) paediatric abdominal traumas were managed conservatively. All 18 patients of traumatic bowel perforation required surgical intervention. Out of the total of 18 cases of bowel perforation, two had stomach, six had jejunal, five had ileal, two had caecal, three had splenic flexure of the colon perforation. Surgical intervention in bowel consisted of simple closure of perforation in 8 patients, resection and anastomosis in 7 patients and stoma in 3 patients in view of contamination and delayed presentation. Re-exploration required in two patients of closure of perforation among which one was of jejunal perforation which underwent resection and anastomosis and the other was of ileal perforation which underwent ileostomy. One patient who underwent

resection and anastomosis of ileum developed anastomotic leak which later underwent ileostomy after relaparotomy.

Out of the total of 46 patients of splenic trauma (Table 4), only five (10.8 %) patients of injury above grade 4 required surgical intervention in which two patients required partial splenectomy and three patient required splenectomy. Only 4 (12.9%) of patients of liver injury required surgical exploration in view of persistent hemodynamic instability and underwent repair of liver laceration all injuries were above grade 3. One patient of grade 5 renal injury **(Table 4)** underwent nephrectomy. Repair of urinary bladder injury was required in one patient. None of our cases of pancreatic injury cases were required surgical intervention.

Table 4: Grades of Solid Organ Injuries

Abdominal Solid organ injury Grades	Number of patients	Percentage
Spleen		
• 1	12	26.1%
• 2	20	43.5%
• 3	09	19.6%
• 4	03	06.5%
• 5	02	04.3%
Liver		
• 1	11	35.6%
• 2	16	51.6%
• 3	02	06.4%
• 4	02	06.4%
Kidneys		
• 1	03	25%
• 2	06	50%
• 3	02	16.7%
• 4	00	00
• 5	01	08.3%

Nine (08.1%) patients with paediatric abdominal trauma succumbed to death. **(Table 5)** Among the factors leading to mortality, delayed presentation and management was seen in 7(78%) patients, hemodynamic instability was seen in 8(89%) patients, requirement of transfusion was seen in 9(100%), penetrating abdominal trauma was seen in 7(78%) patients, higher grade of solid organ injury was seen in 6(67%) patients and surgical intervention was required in 8(89%) patients and these factors were identified as poor prognostic factors increasing mortality. Site and mechanism of injury are the other factors contributing and deciding prognosis in paediatric abdominal trauma.

Table 5: Mortality due to paediatric abdominal trauma

Mortality due to	Number	Percentage
Bowel trauma	04	3.6%
Spleen trauma	02	1.8%
Liver trauma	02	1.8%
Kidney trauma	01	0.9%
Total	09	08.1%

Discussion

Globally, Paediatric trauma is the leading cause of mortality and morbidity and cause for a burden on developing countries with limited resources.[12,13] In children aged between 1–12 years, paediatric trauma causes more than half of the deaths and are the 2nd leading cause of emergency hospital visits after infections.[4,12] The male to female ratio was3.1:1with male predominance in our study, which is similar to the 1.5:1 to 3.5:1 ratio reported in the other studies.[4,13,14,15]

In this study, road traffic accident was the most common mode of trauma seen in 70%of cases, followed by fall which comprises 25.5% cases. Similar findings seen in other studies.[4,14] In our study, 72.7% cases reached hospital within 1 hour and 6.4%cases reached hospital 6 hours after abdominal injury.22.7% patients were

hemodynamically unstable on presentation.63.6% patients required transfusion of blood or blood products during treatment. The initial management involves stabilizing the patient ensuring a patent airway, breathing, adequate oxygenation, circulation, IV fluid resuscitation and identifying other injuries. Resuscitation is done with crystalloid fluids and transfusion of blood or blood products when required. Ongoing monitoring with vital signs, abdominal examinations and urine output measurements are important which is also emphasized in other similar studies.[14,15,16]

In our study, ultrasound abdomen was done in all 100% cases. Ultrasonography has been used mainly for the detection of intraperitoneal blood or fluid from a visceral injury in trauma patients.[9] However, the detection of hemoperitoneum in the hemodynamically stable child requires continuous monitoring and further imaging for decisions in management. In hemodynamically unstable patients, Focused Assessment with Sonography for Trauma (FAST) evaluation in emergency department help in detection of intraperitoneal blood or fluid.[9,17,18] In hemodynamically stable children, CECT abdomen is the imaging of choice in the evaluation of paediatric abdominal trauma. CECT imaging help in accurate detection and quantification of injury to viscera. Stabilisation is required in hemodynamically unstable patients before CECT or before direct surgery.[17,18] However, in this study CECT abdomen was done in 96.4% cases after stabilisation of patients.

Delayed presentation and delayed treatment may cause peritonitis, specifically in bowel perforations.[19] Repeated clinical evaluations are necessity to decide for surgical intervention. Increasing abdominal tenderness with signs of peritonitis, tachycardia, decrease in the blood pressure with decreasing haematocrit even after resuscitative attempts are the indications for surgical intervention. Surgical intervention is necessary for peritonitis or uncontrolled intraperitoneal bleed or shock and for penetrating injuries. Surgical intervention is also necessary to repair the injured organs and to control bleeding.[16,19] Delayed presentation and management are the poor prognostic factors in pediatric abdominal trauma.[16,19]

Pediatric abdominal trauma could be blunt or penetrating. In our study, penetrating abdominal trauma was seen in 17.3%

patients, leading to hollow viscus perforation, penetrating trauma is less frequent in children when compared to adults.[22,23] Among the penetrating abdominal trauma,100% patients of traumatic bowel perforation and one case of urinary bladder perforation underwent surgical intervention in this study which further increases the mortality due to peritonitis from spillage of the content and due to surgical stress. Hence, penetrating abdominal trauma with hollow viscous injury and surgical intervention are the poor prognostic factor.

In our study, blunt abdominal trauma was seen in 82.7% cases. Blunt abdominal trauma causing hollow viscus injury has incidence of 1% to 8.5% in different studies.[20,21,22] The most common solid organ of injury was spleen seen in 41.8% cases followed by liver trauma in 28.2% cases. Other studies in the literature also reports spleen to be the most common organ of injury followed by liver.[24] In paediatric abdominal trauma, renal trauma was found in 10% to 20% of cases and majority were treated conservatively. However, cases with hemodynamic instability and higher-grade renal injury requires surgical interventions.[25,26] In our study, renal injury was seen in 10.9% cases in which one case of grade 5 injury required surgical intervention. Most cases of solid organ injuries in children are minor grades of 1 or 2, with only few injuries of grades 3 and above, involving major parenchymal or vascular disruptions. 10.8 % patients of splenic injury above grade 4 required surgical intervention.12.9% of patients with liver injury above grade 3 and one patient of grade 5 renal injury required surgical intervention in our study. Hence, higher grade of solid organ injury is the poor prognostic factor which increases operative morbidity and mortality.

The management of paediatric patients with solid organ injuries has shifted towards nonoperative management. But the management of high-grade injuries depends on other factors like grade of injuries, haemodynamic stability. This nonoperative management of solid organ injury reduces the operative and postoperative complications for patients and also reduces the cost.[27,28] Nonoperative management is the gold standard with >96% success.[16,29]

In our study, 08.1% deaths of paediatric abdominal trauma reported. The incidence of mortality due to abdominal trauma in children varied from 2.2% to14% in various studies.[14,15] Mortality was higher in

males. These results are similar to those of the studies done in developing countries.[1,2,4,14]

From the observations in this study and the review of the literature about paediatric abdominal trauma[1-4,16-21], we found out that delayed presentation and delayed management, hemodynamic instability, penetrating abdominal trauma with hollow viscous injury, higher grade of solid organ injury and surgical intervention are poor prognostic factors for outcome of pediatric abdominal trauma. Site and mechanism of injury are the other factors contributing and deciding prognosis in paediatric abdominal trauma.

We recommend education about road safety, law enforcement about strict traffic rules and the use of safety devices to reduce road accidents and paediatric trauma.

Conclusion

Delayed presentation and management, hemodynamic instability, penetrating abdominal trauma, higher grade of solid organ injury and surgical intervention are the poor prognostic factors. Site and mechanism of injury are the other factors contributing and deciding prognosis in paediatric abdominal trauma.

Ethical Consideration

This study was approved by Office of the INSTITUTIONAL ETHICS COMMITTEE KBN UNIVERSITY-FACULTY OF MEDICAL SCIENCES with the code number: "KBNU-FM/IEC", date:05/04/2022.

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Conflict of interests

There is no conflict of interest

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