

**ORIGINAL ARTICLE****A Prospective Study of Blunt Trauma Abdomen in Pediatric Patients – Our Institutional Experience**

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**Abstract**

**Background** – Blunt trauma abdomen is a significant cause of morbidity and mortality in pediatric patients because of their peculiar body habitus and immature musculoskeletal system. We aimed to study clinical presentations and outcome analysis of blunt trauma abdomen in children.

**Method** - A prospective observational study from 16 October 2018 to 15 April 2020, carried out in our tertiary care teaching institute.

**Results** – A total of 121 patients of less than 16 year age were included in this study. Male to female ratio was 4.26: 1. Most common age group was 6 – 12 years. Most common mode of injury was RTA (41.32%) followed by fall from height (27.27%). Liver was most commonly involved solid organ in our study (25.61 %). One hundred five patients (86.77%) were managed successfully with conservative management. Surgery was done 16 (13.22%) patients. Out of these 16 patients emergency surgery was done in 14 patients (11.57%). While 2 (1.65%) patients were planned for conservative treatment but ultimately they required surgery.

**Conclusion-** Conservative treatment is an effective management modality in majority of pediatric blunt trauma abdomen patients without bowel perforation.

**Keywords:** Blunt trauma abdomen, Liver injury, Bowel injury, BTA, RTA

**1 | INTRODUCTION**

Trauma is a leading cause of morbidity and mortality in pediatric patients of older than 1 year.. Incidence of abdominal injury is approximately 25% with major trauma in children [1,

2]. Traditionally Abdominal trauma is classified as either blunt injury or penetrating injury [3]. Blunt trauma injury is the most common cause of disability and death in pediatric patients [4]. Spleen is the most common injured organ [5, 6] Blunt trauma abdomen in pediatric patients may be fatal due to either con-

tinuous bleeding from solid organ, injured vessel or peritonitis secondary to bowel injury [7]. In pediatric patients with BTA, there is increased risk of injury to intra-abdominal organs because of their body habitus and relatively immature musculoskeletal system. Intra-abdominal organs are proportionally larger and close proximity to each other in children as compared to adult. Relatively small size of the children, results in a greater degree of force per body surface area, which can lead to significant injury to intra-abdominal organs [8].

## 2 | AIMS AND OBJECTIVES

To study the various modes of injury, organ involvement, management strategy, and outcome analysis of blunt trauma abdomen.

## 3 | MATERIAL AND METHODS

This is a prospective study; conducted in the Department of Paediatric Surgery, in a tertiary care centre of India, over a period of 18 months from October, 2018 to April, 2020.

**Inclusion criteria—** All patients of blunt trauma abdomen up to 16 years of age included in this study.

**Exclusion criteria—** Patients above 16 years of age were not included in study.

**Supplementary information** The online version of this article (<https://doi.org/10.15520/ijmhs.v10i11.150>) contains supplementary material, which is available to authorized users.

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## 4 | RESULTS

During the period of 18 months, 121 pediatric patients with blunt trauma abdomen were hospitalized in the Department of Pediatric Surgery. There were 98 (80.99%) male and 23(19.01%) female. In our study we observed that majority of the patients of blunt trauma abdomen were aged between 6 to 12 years due (Table no. 1). Average age of affected children was  $7.65 \pm 3.70$  years.

All patients had complaint of pain abdomen with variable severity. Patients showed following sign and symptoms like, Abdomen (distension 68 patients, 56.20%), vomiting (48, 39.67%), hematuria (10, 8.26%), haematemesis (02, 1.65%) and anuria (01, 0.83%). Only six patients (4.96%) were presented with fever.

In our study, RTA was the most common mode of injury in pediatric blunt trauma abdomen patients. RTA observed in 50 patients (41.32%) followed by fall from height in 33 patients (27.27%). Other modes of blunt trauma abdomen were Cycle handle injury in 17 patients (14.05%), fall of heavy object over abdomen in 10 patients (8.26%), physical assault in 4 patients (3.31%) and 7 patients (5.79%) with other injuries (bull horn injury 2, injury by cricket ball 1, fall from swing 1, collision with brick wall 1, injury by electric motor of flour mill machine 1, injured during playing 1) (Table no. 2).

In our study 105 patients of BTA (blunt trauma abdomen) treated with conservative management. Remaining 16 patients (13.22%) were operated. Out of these 16 patients 14 (11.57%) were treated by emergency operation while 2 patients (1.65%) were planned for conservative management but they could not be managed by conservative treatment and required surgery.

Among 14 patients (11.57%) who required emergency surgery 10 patients (8.26%) were operated for hollow viscus perforation (jejunal perforation in 5 patients, ileal perforation in 3 patients, duodenum and ileal perforation with liver injury grade V in 1 patient, multiple sigmoid perforations in 1 patient). In two patients (1.65%) we found appendicitis after BTA. One case of BTA presented with abdominal wall laceration without breaching peritonium, ab-

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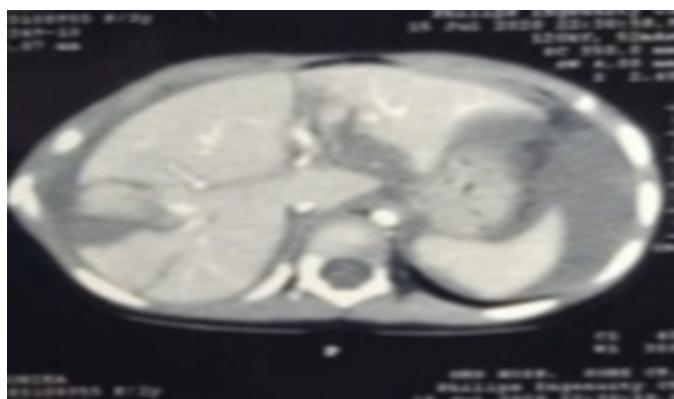
domen wall repair was done. One case of BTA, presented with cellulitis of abdominal wall and scrotum. That was managed by incision and drainage.

Gas under diaphragm was present in 10 (8.26 %) patients at the time of admission (5 jejunal perforation in 4, ileal perforation in 4, multiple sigmoid perforation in 1, and duodenal and ileal perforation with grade 5 liver injury in 1 patient). One patient showed jejunal perforation intra operatively without gas under diaphragm at the time of admission (Table no.4).

Out of total 121 patients overall mortality was 4 (3.31%) in our institution. Among these 4 patients, 2 patients (1.65%) died due to fall from height, 1 patient (0.82%) due to RTA and 1 patient (0.82%) due to fall of heavy object over abdomen in this study. All these patients had hollow viscus perforation with peritonitis.

Average duration of hospital stay was  $8.31 \pm 3.54$  days. Associated injuries were chest injury in 3 patient, radial bone fracture in 1 patient, wrist fracture in 1 patient, shoulder dislocation in 1 patient, femur bone fracture in 2 patients and pelvic bone fracture in 4 more common in RTA patients than fall from height. Associated injuries are common in patients of RTA and fall from height.

Among 121 patients, FAST (Focused Assessment with Sonography in Trauma) was done in 111 patients (91.73%) and CT scan was done 90 patients (74.38%).



**FIGURE 1:**



**FIGURE 2: coronal section of CT scan showing liver laceration with contusion and hemoperitoneum**

## 5 | DISCUSSION

Trauma produced by two main mechanisms either direct blow to abdomen or high-energy mechanisms but latter is associated with higher mortality [9, 10]. The most common organs injured are spleen, liver and kidney. Spleen is the most frequent cause of intra abdominal bleeding. Although renal injuries are much less common than splenic or liver injuries in BTA, but children are more susceptible to renal injuries than adults because of anatomical aspects [11]. Various modes of Blunt trauma abdomen are road traffic accidents (RTA), fall from height, sports-related injuries, or others. These can cause substantial mortality from solid organ or hollow viscus injury [12]. For the identification and quantification of BTA computed tomography (CT) is the investigation of choice. It gives excellent analysis of solid organ injuries but low sensitivity in hollow viscus lesions. High level suspicion and careful analysis of images by radiologist is very important for hollow viscus injuries [13]. Conservative management is the “gold standard” in most of clinically stable pediatric blunt trauma abdomen patients. It can be carried out only in haemodynamically stable children with continuous monitoring in the intensive care unit for at least first 48 hours, and with an experienced multidisciplinary team should be available for intervention if necessary [14].

Out of 121 pediatric patients there were 98 (80.99%) male and 23(19.01%) female with male to female ratio of 4.26:1 in our study. Kumar Abdul Rashid

**TABLE 1: Age wise distribution of cases**

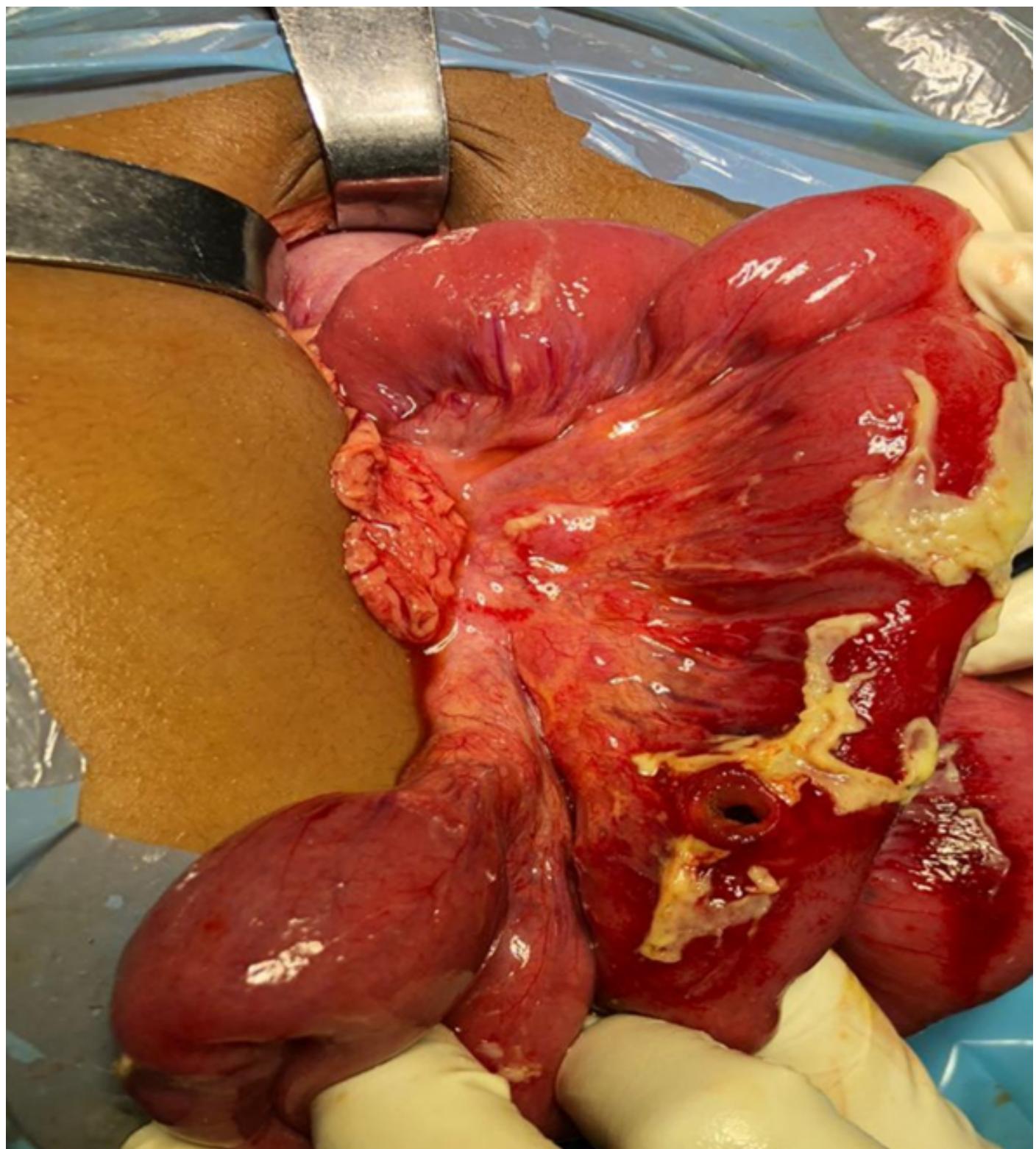
Age (in years)	Male	Female	Total (%)
0 to 3	15 (12.39%)	7(5.78%)	22(18.18%)
>3 to 6	17(14.05%)	8(6.61%)	25(20.66%)
>6 to 12	49(40.49%)	8(6.61%)	57(47.10 %)
>12	17(14.05%)	0	17(14.05%)
Total	98 (80.99%)	23(19.01%)	121

**TABLE 2: Distribution of cases according to age and mode of injury**

S. No.	Mode of injury	0- 3yrs		>3- 6yrs		>6- 12yrs		>12yrs	
		M	F	M	F	M	F	M	F
		(20)	(23)	(59)	(19)				
1	RTA n=50	9	4	10	2	18	3	3	1
2	Fall from height n=33	4	1	2	1	14	4	7	0
3	Cycle buckle handle injury n=17	0	0	0	1	10	0	6	0
4	Due to fall of heavy object over abdomen n=10	0	1	3	1	3	1	1	0
5	Physical assault n=4	0	0	1	0	2	0	1	0
6	Others n=7	0	1	0	2	4	0	0	0
Total male +female (n =121)		13	7	16	7	51	8	18	1

**TABLE 3: Treatment modalities in pediatric patients of blunt trauma abdomen according mode of injury**

S. No.	Mode of injury	No. of patients	Conservative management	Conservative followed by Surgery	Surgical management
1	RTA n=50	50 (41.32 %) )	44 (36.36 %)	1 (0.82 %)	5 (4.13 %)
2	Fall from height n=33	33 (27.27%)	27 (22.31 %)	0	5 (4.13 %)
3	Cycle buckle handle injury n=17	17 (14.05%)	17 (14.04 %)	0	1 (0.82 %)
4	Due to fall of heavy object over abdomen n=10	10 (8.26%)	9 (7.5 %)	1 (0.82 %)	0
5	Physical assault n=4	4 (3.31%)	3 (2.47 %)	0	1 (0.82 %)
6	Others n=7	7 (5.79%)	5 (4.13 %)	0	2 (1.66 %)
Total n =121		121 (100%)	105 (86.77%)	2 (1.66 %)	14 (11.57 %)



**FIGURE 3: Blunt trauma abdomen with jejunal perforation**

**TABLE 4: Incidence of bowel injury in various mode of blunt trauma abdomen**

S. No.	Mode of injury	Bowel injury
1	RTA (n=50)	4 (3.31%)
2	Fall from height (n=33)	4(3.31%)
3	Cycle buckle handle injury (n=17)	1(0.82%)
4	Due to fall of heavy object over abdomen (n=10)	1(0.82%)
5	Physical assault (n=4)	0
6	Others (n=7)	1(0.82%)
	Total (n =121)	11(9.09%)

**TABLE 5: Table showing grading of solid organ injuries**

Injured organ	Conservative management	Percentage	Surgical management	Percentage
<b>Liver(31)</b>				
Grade 1/2	21	67.74 %	0	0
Grade 3	6	19.35 %	0	0
Grade 4	2	6.45 %	0	0
Grade 5	1	3.22 %	1	3.22 %
<b>Spleen (20)</b>				
Grade 1/2	15	75 %	0	0
Grade 3	4	20 %	0	0
Grade 4	1	5 %	0	0
Grade 5	0	0	0	0
<b>Kidney(12)</b>				
Grade $\frac{1}{2}$	9	75 %	1	8.33%
Grade 3	1	8.33%	0	0
Grade 4	1	8.33%	0	0
Grade 5	0	0	0	0
<b>Pancreas(11)</b>				
Grade 1/2	5	45.45%	0	0
Grade 3	6	54.54%	0	0
Grade 4	0	0	0	0
Grade 5	0	0	0	0

et al had similar study in pediatric patients and also found male predominance (192 males and 59 females) [15]. Majority of the patients (47.10 %) were aged between 6 to 12 years suggesting that school-going children are most commonly injured due blunt trauma abdomen. In Kumar Abdul Rashid et al study also most commonly involved group was aged between 6 to 12 years. They found 52 % children in this group [15]. Average age of affected children was  $7.65 \pm 3.70$  years.

Most common complaint was pain abdomen which was [present in all patients followed by Abdomen distension present 68 patients (56.20%). Other pre-

senting complaints were vomiting (39.67%), hematuria (8.26%), fever (4.96%) haematemesis (1.65%) and anuria (0.83%).

Most common mode of injury in pediatric blunt trauma abdomen patients was RTA observed in 41.32% patients, followed by fall from height (27.27%). Other modes of blunt trauma abdomen were Cycle handle injury in 14.05% patients, fall of heavy object over abdomen patients in 8.26% patients, physical assault in 3.31% patients and 5.79% patients with other injuries (bull horn injury 2, injury by cricket ball 1, fall from swing 1, collision with brick wall 1, injury by electric motor of flour

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mill machine 1, injured during playing 1) (Table no. 2). Similarly in study of Kumar Abdul Rashid et al showed Road traffic accident (RTA) was the commonest cause of blunt abdominal injury (154 out of 251), followed by fall from height (72) [15].

In our study 86.77% (105) patients of blunt trauma abdomen treated successfully with conservative management. Remaining 13.22% (16) patients were operated. Out of these 16 patients 14 (11.57%) were treated by emergency operation while 2 patients (1.65%) were planned for conservative management but they could not be managed by conservative treatment and required surgery.

Among 14 patients (11.57%) who required emergency surgery 10 patients (8.26%) were operated for hollow viscus perforation with gas under diaphragm (jejunal perforation in 5 patients, ileal perforation in 3 patients, duodenum and ileal perforation with liver injury grade V in 1 patient and multiple sigmoid perforations in 1 patient). Blunt trauma abdomen may cause appendicitis in pediatric patient. In our study two patients (1.65%) we found appendicitis after BTA. Singh AP et al also described about post traumatic appendicitis in their study of Blunt trauma abdomen-induced jejunal perforation with appendicitis in 2018 [16]. One case of BTA presented with abdominal wall laceration without breaching peritonium, abdomen wall repair was done. One case of BTA, presented with cellulitis of abdominal wall and scrotum. That was managed by incision and drainage.

Two patients (1.65%) those were planned for conservative management but they could not be managed by conservative treatment, one had ileal perforation and other developed urinoma. Ileal perforation was diagnosed during exploratory laparotomy only as patient not showed gas under diaphragm at the time of admission. Cystoscopy and double J stenting was done in urinoma patient. D-J stent was removed after 1 month.

Overall study suggested that conservative management is effective and satisfactory protocol for hemodynamically stable patients after primary resuscitation excluding hollow viscus perforation. Similar results were observed in study done by Garg D et al [17].

The overall mortality was 3.31% (4 patients) in pediatric blunt trauma abdomen patients at our study. 1.65% (2 patients) mortality was due to fall from height and 0.82% (1 patient) due to RTA and 0.82% (1 patient) due to fall of heavy object over abdomen in this study. All these patients had hollow viscus perforation with peritonitis.

Average duration of hospital stay was  $8.31 \pm 3.54$  days. Associated injuries were chest injury in 3 patient, radial bone fracture in 1 patient, wrist fracture in 1 patient, shoulder dislocation in 1 patient, femur bone fracture in 2 patients and pelvic bone fracture in 4 more common in RTA patients than fall from height. Associated injuries are common in patients of RTA and fall from height. Treatment of associated injuries done by involving respective departments.

Most common injured solid organ was liver (31 patients) followed by spleen (20 patients) in our study. An another study of north India done by garg D et al also found that liver is the most common solid organ get injured in BTA in pediatric patients [17]. But Borse N et al, Gaines BA et al, Grazino KD et al, Qadri AI et al, reported that splenic injury is the most common solid organ involved in pediatric blunt trauma patients [5, 6, 11, and 18].

Renal injury was present in 12 patients. Urinoma was present in one patient which treated by DJ stenting right side. Pancreatic injury diagnosed in 11 patients (9.09%) and all they were managed conservatively. One of them developed pancreatic pseudocyst after 3 month and referred to gastro-surgery department for further management.

Among 121 patients, FAST (Focused Assessment with Sonography in Trauma) was done in 111 patients (91.73%) and CT scan was done 90 patients (74.38 %). Similar findings were found in both USG and CT scan. Serial USG was done in admitted patients who were managing conservatively. USG is as better as CT scan tool for regular monitoring and access minimal fluid collection in pelvic cavity due to its easy availability and economically affordability [19].

## Conclusions

Blunt trauma abdomen is a leading cause of morbidity and mortality in pediatric patients. School going children are most commonly affected age group. There is male predominance in our study. Road traffic accident is the most common mode of injury for blunt trauma abdomen in pediatric patients. Liver is the most common solid organ injured in BTA, followed by spleen. Conservative management is the successful and satisfactory management modality in pediatric patients. Operative intervention is required in few patients, specifically in bowel perforation or a hemodynamically unstable patient who does not respond with resuscitative measures.

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