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Original Article

Surgery Section

Management Strategies and Outcomes of Paediatric Blunt Abdominal Trauma at a Tertiary Care Centre in South Kerala: A Retrospective Observational Study

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ABSTRACT

Introduction: Blunt abdominal trauma is a leading cause of injury in paediatric population. The management of paediatric abdominal injury has shifted from Operative Management (OM) to Non Operative Management (NOM) over years. NOM is the standard treatment for clinically stable patients with blunt trauma abdomen.

Aim: To describe retrospectively the management strategies and outcomes of paediatric patients with blunt abdominal trauma in a tertiary care centre.

Materials and Methods: This was a retrospective observational record-based study that included 96 medical records of children admitted in Government Medical College, Thiruvananthapuram, Kerala, India, with blunt trauma abdomen from January 2018 to December 2022. Patients were characterised according to the treatment they received as- NOM and OM. Ultrasound Focused Assessment with Sonography in Trauma (USG FAST) and Contrast Enhanced Computed Tomography (CECT) abdomen were done in all the patients. The factors recorded were- age, gender, mechanism of injury, concomitant injury, tachycardia, hypotension, respiratory rate, blood transfusion requirement, injuries (American Association of Surgery of Trauma (AAST) organ injury scale), length of Intensive Care Unit (ICU) and hospital stay and mortality. Univariate analysis of the clinical features were done using Chi-square test using Statistical Package for the Social Sciences (SPSS) 27.0 statistical software. The p-value <0.05 was considered statistically significant.

Results: About 83 patients (86.46%) were in NOM group while 13 patients (13.54%) were in OM group. The most common age group involved was 6-12 years with male predominance. Median age was 9.2 years. The most common mechanism of injury was road traffic accident 31 (32.29%). Among 84 patients with isolated solid organ injury, only 5 (5.9%) required surgical intervention. Among nine patients with isolated hollow viscous injury, 5 (55.5%) required surgical intervention. All 3 (100%) patients with both hollow viscous and solid organ injury required surgery. Hypotension and blood transfusion requirement were statistically significant factors in the OM group p<0.05. Complications, length of hospital and ICU stay were more in operatively managed group with mortality rate of 1.04%.

Conclusion: The success of NOM of blunt trauma abdomen depends on proper selection of the patient. Patients who are haemodynamically stable can be safely managed non operatively with adequate monitoring in a tertiary care centre.

Keywords: Child, Conservative treatment, Injuries, Laparotomy, Trauma centre

INTRODUCTION

Blunt abdominal trauma is a leading cause of injury in paediatric population. Though less frequent than isolated head and limb injuries, it is often the cause of morbidity and mortality in paediatric trauma patients [1]. It is usually associated with road traffic accidents, fall from height, bicycle and contact sport injuries [2]. Care of the injured child needs early and precise management [3]. After initial assessment, resuscitation, and stabilisation of trauma patients, USG FAST is done to detect presence of free fluid suggestive of intraabdominal injury. CECT abdomen is the gold standard to identify intra abdominal injury [4]. The management of paediatric abdominal injury has shifted from OM to NOM over the years. Until recently, the grade of abdominal organ injury was the key factor in deciding the management protocol. Arizona-Texas-Oklahoma-Memphis-Arkansas Consortium (ATOMAC) guidelines in 2012 emphasised haemodynamic status as main factor in decision-making in paediatric blunt abdominal trauma [5]. NOM is the standard treatment for clinically stable patients with blunt abdominal trauma [6]. Presence of free intraperitoneal air suggesting a hollow viscus injury and haemodynamic instability despite maximum resuscitative efforts are indications for OM [4]. Conservative management requires continuous monitoring with an experienced multidisciplinary team, that is ready for intervention if necessary [1]. Angiographic embolisation is a useful addition in treatment protocol [7]. Criteria for admission in ICU for blunt abdomen trauma should not be guided only by CT grading of the injury. Shock index and haematocrit are decisive factors for admission to ICU [8]. Length of hospital stay for children would also depend on these factors [9].

There are very few studies from developing countries discussing the management strategy and outcomes of blunt abdominal trauma in paediatric population [10-12]. Knowledge about paediatric abdominal trauma is essential for planning and implementing preventive measures. This will also help in effective utilisation of hospital resources and manpower [13,14]. The aim of this study was to describe the management strategies and outcomes of paediatric patients with blunt trauma abdomen.

MATERIALS AND METHODS

The present retrospective observational study was conducted at Department of Paediatric Surgery, Government Medical College, Thiruvananthapuram, Kerala, India on paediatric cases of blunt abdominal injury admitted between January 2018 and December 2022. The data analysis was done in January 2023. This study was approved by Institutional Research and Human Ethics committee review board (HEC NO: 10/05/2022/MCT).

Inclusion criteria: All children ≤12 years of age who were admitted in Department of Paediatric Surgery between January 2018 and

December 2022 with blunt trauma abdomen were included in this study.

Exclusion criteria: Children who could not be evaluated with USG FAST and CECT abdomen, children with concomitant penetrating trauma abdomen and children who were discharged against medical advice during treatment period and in whom information on condition of child was unavailable were excluded from the study.

Blunt injury abdomen was considered as any injury to one of the following structures: spleen, liver, kidney, mesentery, duodenum, jejunum, ileum, colon, adrenal, pancreas, major intra-abdominal vascular structure, bladder, ureter, gallbladder, or abdominal wall fascial disruption. Injuries included in the analysis were diagnosed on abdominal CT scan or identified during surgery. Solid organ injury was defined as injury to the spleen, liver, kidney, adrenal, or pancreas. Hollow viscous injury was defined as injury to the duodenum, jejunum, ileum, colon, or small bowel or colonic mesentery or urinary bladder [15].

Study Procedure

All patient charts were reviewed. Patient and trauma characteristics were documented. These included age, gender, mechanism of injury, concomitant injury, pulse rate (beats/minute), blood pressure (mm of mercury), respiratory rate (breaths/minute), Glasgow coma scale, haemoglobin (gm/dL), blood transfusion requirement, length of ICU and hospital stay and mortality [16]. USG FAST and CECT abdomen were done in all the patients. Organs injured were identified based on CECT report. The injuries ranged from haematoma, parenchymal laceration to devascularisation. The injuries were graded according to on AAST Organ injury scale by radiologist. Severity Grade-I to V indicated increasing complexity and severity of organ injury [17].

Patients were characterised according to the treatment they received as- NOM and OM. NOM was defined as non surgical management strategy of intra-abdominal injury which usually consists of observation with close monitoring and resuscitation. OM group of patients are those who underwent treatment with laparotomy, laparoscopy or interventional radiological procedures [18]. Patients with haemodynamic instability despite maximum resuscitative efforts or suspected hollow viscus injury were operated.

STATISTICAL ANALYSIS

Qualitative variables were summarised as numbers and percentages and quantitative variables in mean and standard deviation. Data was analysed using SPSS 27.0 statistical software. Univariate analysis was analysed with Chi-square test. The p-value <0.05 was considered statistically significant.

RESULTS

There were 98 paediatric cases of blunt abdominal injury admitted between January 2018 and December 2022. Of these, 2 patients with polytrauma who succumbed to death within 12 hours due to traumatic brain injury and whose abdominal imaging could not be performed were excluded from the study. Thus, a total of 96 patients were included in this study.

Children were categorised into two groups depending upon the type of management provided- (a) NOM group; and (b) OM group. More than four fifths of the children (86.46%) were successfully managed using non operative methods, and only n=13 (13.54%) of the children required surgical therapy. Baseline characteristics are shown in [Table/Fig-1].

The study group consisted of 78 (81.25%) males and 18 (18.75%) females, with a median age of 9.2 years. The most common mechanism of injury was road traffic accident 31 (32.29%). There were concomitant injuries in 46 children (47.9%). There were no statistically significant differences found in mechanism of injury or presence of concomitant injuries between the two study groups [Table/Fig-1]. Among the clinical parameters, hypotension and blood transfusion requirement showed a statistically significant difference between the two groups [Table/Fig-2].

Variables	Non Operative Management (NOM) n (%)	Operative Management (OM) n (%)	p-value
Age (years)			
<3	7 (8.4)	1 (7.7)	0.3076
3-6	25 (30.1)	3 (23.1)	
>6	51 (61.5)	9 (69.2)	
Gender			
Male	67 (80.7)	11 (84.7)	0.7381
Female	16 (19.3)	2 (15.3)	
Mechanism of injury			
Road traffic accident	26 (31.3)	5 (38.4)	0.6088
Fall from height >1 metre	6 (7.2)	2 (15.4)	0.3225
Fall from height <1 metre	11 (13.3)	1 (7.7)	0.3178
Bicycle injury	21 (25.3)	4 (30.8)	0.6761
Heavy object injury	15 (18.1)	1 (7.7)	0.3504
Others	4 (4.8)	0	1.0000
Concomitant injury			
Head injury	12 (14.5)	2 (15.4)	0.9298
Thorax injury	8 (9.6)	3 (23.1)	0.1572
Extremity injury	19 (22.9)	2 (15.4)	0.5426

[Table/Fig-1]: Baseline characteristics of patients.

Variables	Non Operative Management (NOM) n (%)	Operative Management (OM) n (%)	p-value
GCS†			
<14	4 (4.8)	0	1.0000
>14	79 (95.2)	13 (100)	
Tachycardia‡	73 (87.9)	13 (100)	0.2068
Hypotension‡	27 (32.5)	9 (69.2)	0.0110*
Hypotension after fluids and blood transfusion†	0	8 (61.5)	<0.001**
Tachypnoea‡	67 (80.7)	13 (100)	0.1167
Hb <10 gm/dL‡	29 (34.9)	8 (61.5)	0.0669
Blood transfusion required (%)‡	20 (24.1)	12 (92.3)	<0.001**

[Table/Fig-2]: Based on clinical and laboratory parameters.
{GCS: Glasgow coma scale, *p<0.05-statistically significant, **p<0.001-statistically highly significant, †Fisher-exact test, ‡Chi-square test}

An overview of the abdominal injuries is shown in [Table/Fig-3]. Among the 96 patients, 84 (87.5%) patients had isolated solid organ injury, 9 (9.4%) patients had isolated hollow viscous injury and 3 (3.1%) patients had solid organ along with hollow viscous injury. The most common solid organ injured was spleen and hollow viscous injured was duodenum. Among 13 patients in OM group, three underwent resection anastomosis of bowel, two underwent primary closure of bowel, three underwent splenectomy, one underwent liver suturing, three underwent resection anastomosis of bowel along with liver suturing and one underwent liver suturing along with splenorraphy.

Variables	Non Operative Management (NOM) n (%)	Operative Management (OM) n (%)
Spleen only		
Grade I/II	9 (10.8)	0
Grade III	18 (21.7)	0
Grade IV	6 (7.2)	2 (15.4)
Grade V	0	1 (7.7)

Liver only		
Grade I/II	2 (2.4)	0
Grade III	9 (10.8)	0
Grade IV	6 (7.2)	1 (7.7)
Grade V	0	0
Liver+Spleen	4 (4.8)	1 (7.7)
Liver+Bowel	0	3 (23.1)
Kidney		
Grade I/II	2 (2.4)	0
Grade III	6 (7.2)	0
Grade IV	3 (3.6)	0
Grade V	3 (3.6)	0
Bowel		
Duodenum	1 (1.2)	3 (23.1)
Jejunum	0	1 (7.7)
Ileum	0	1 (7.7)
Pancreas	8 (9.6)	0
Retroperitoneum+Solid organ	3 (3.6)	0
Urinary bladder	3 (3.6)	0

[Table/Fig-3]: Abdominal solid organ injury/hollow viscus injury.

Both abdominal and non abdominal complications were higher in operatively managed group and was statistically significant [Table/Fig-4]. One patient in operatively managed group died on postoperative day seven due to septicaemia.

Variables	Non Operative Management (NOM) n (%)	Operative Management (OM) n (%)	p-value
Abdominal			
Rebleed	2 (2.4)	0	<0.001**
Infected haematoma	1 (1.2)	1 (7.7)	
Biloma	0	1 (7.7)	
Wound Infection	0	4 (30.8)	
Non abdominal			
Pneumonia	4 (4.8)	2 (15.4)	<0.001**
Pleural effusion/Empyema	1 (1.2)	1 (7.7.)	
Septicaemia	2 (2.4)	3 (23.1)	
Mean length of ICU stay (days) (M±SD)	2.6±1.3	6±1.9	<0.001**
Mean length of hospital stay (days) (M±SD)	5.5±1.8	12.69±2.8	<0.001**
Mortality	0	1 (7.7)	0.1354

[Table/Fig-4]: Outcome measurements and complications.
(**p<0.001-statistically highly significant)

DISCUSSION

The management strategy of blunt abdominal injury has changed from mandatory surgical exploration to selective conservative approach. The management depends on clinical and haemodynamic stability of the patient. Non operative treatment is now considered as the standard of care for the treatment of blunt injury abdomen; with a success rate of 80-90% [19,20]. In this study, 86.46% patients were successfully managed by non operative treatment. In study by Sabounji SM et al., success rate for non operative treatment was as high as 93.3% [21]. The advantage of NOM in solid organ injury is lowered risk of non therapeutic laparotomy with preserved organ function [22].

In this study, the management and outcomes of blunt trauma abdomen in children were investigated. The most common mechanism of injury was road traffic accidents (32.29%). In study by Kundal VK et al., the most common mechanism of injury was fall (58.08%) [13]. In this study, males predominated and most common age group being 6-12 years. In study by Djordjevic I et al., injuries were most common in children with 6-10 years age group and male:female ratio was 3:1 [1]. In study by Nimanya SA et al., the most common age group was 5-9 years with male preponderance [23]. Restlessness and playfulness of boys in this age group could be reason for the same. In this study, most common isolated organ injured was spleen (37.5%) followed by liver (18.8%). In study by Spijkerman R et al., most common organ involved was spleen (48.7%) [2]. Partial protection by pliable ribs, less overlying fat and weaker abdominal musculature may be the reason for the easy vulnerability of spleen and liver to trauma in children.

A 13.54% of all children with blunt trauma abdomen required surgical interventions. Among 84 patients with isolated solid organ injury, only 5 (5.9%) required surgical intervention. Among nine patients with isolated hollow viscous injury, 5 (55.5%) required surgical intervention. All 3 (100%) patients with both hollow viscous and solid organ injury required surgery. These findings were in line with other paediatric studies [2,15]. Patients with hollow viscous injury are more likely to undergo surgery than those with solid organ injury and account for most of the patients requiring operation.

In this study, hypotension (69.2%) and requirement of blood transfusions (92.3%) (markers of haemodynamic instability) was more common and statistically significant in the OM group. This was in concurrence with the study by Echavarria Medina A et al., where, hypotension (55.5%) and blood transfusion (66.7%) were associated with the failure in NOM [24]. Abnormal haemodynamics suggests ongoing haemorrhage in the trauma patients, which may necessitate intervention.

In this study, the most common concomitant injury was extremity injury (21.9%) followed by head injury (14.6%). The most common abdominal complication was wound infection (4.2%) and non abdominal complication was pneumonia (6.3%). In the study by Spijkerman R et al., the most common concomitant injury was thoracic injury (31.4%) followed by extremity injury (27%) and the most common abdominal and non abdominal complications were bile leak (1.7%) and pneumonia (5.8%), respectively [2]. Mean length of hospital stay and ICU stay was more in the operative managed group and was statistically significant. This was similar in the study by Spijkerman R et al., [2]. The use of haemodynamic parameters and CT findings for observing stable patients with isolated abdominal organ injuries will reduce the need for ICU care.

Mortality rate in this study was 1.04%. This was in concurrence with other studies by Spijkerman R et al., (1%), Arbra CA et al., (less than 1%) [2,15]. This was nil in the study by Sabounji SM et al., [21]. The clinical outcome and prognosis of children with isolated blunt abdominal trauma are favourable if managed appropriately.

Limitation(s)

The greatest limitation of the present study was the retrospective design. Conclusions were based on observation from a single study centre. Thus, a prospective multicentre study is required.

CONCLUSION(S)

Non operative treatment in blunt trauma abdomen is safe and effective. Assessment of haemodynamic stability is the most important concern in initial evaluation of a child with blunt trauma abdomen. Haemodynamically stable patients can be safely managed non operatively with adequate monitoring in a tertiary care centre.

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