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Diagnosis and Management of Blunt Abdominal Trauma in Children: Experience from a Newly Established Facility

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Abstract

Background: Trauma is the leading cause of death in children in developed countries. In developing countries accidents are shown to be as numerous as in developed countries and it remains the major cause of blunt abdominal trauma in children. It is irony that thousands of children saved from nutritional and infectious diseases were killed or maimed by injuries. The management of these unfortunate children remains a challenge in developing countries where the advanced facilities and expertise are localized to only few centers, catering a vast population. The present study shares our experience in managing children with blunt abdominal trauma. Causes of blunt abdominal trauma in children, their mode of presentation and subsequent challenges met in the management is discussed. *Materials and Methods:* All Patients with diagnosis of blunt abdominal trauma admitted to the Department of pediatric surgery, Government Medical College, Srinagar, Kashmir, India, from June 2011 to January 2018 were retrospectively analyzed. Individual case records were analyzed regarding mode of injury; presentation, associated injuries and treatment offered were studied. The data sheets were analyzed for the investigations ordered and the operative management if offered to the patients. The postoperative recovery and complications if any were recorded. *Results:* A total of 251 children with a diagnosis of blunt abdominal trauma were admitted in the study period. There were 192 (76.4%) male patients and 59 (23.5%) were females. Road traffic accident was the commonest cause of trauma (62%) followed by fall (29%), sports (3%) and animal violence related injuries (4%). Operative management was indicated in a total of 105 patients (41%). 80 patients with signs of pneumoperitoneum. 16 patients with solid organs injury needed operative intervention, while 9 patients with bladder and urethral injuries were operated. Rests of the patients were managed conservatively. Associated non-abdominal injuries were found in 67 (26.6%) patients. The mortality in the study was 7.5%. Those who expired had delayed presentation with low general condition at the time of presentation or had associated grievous injuries. *Conclusion:* Trauma is increasing rapidly as a cause of child mortality in developing countries, both in absolute numbers and in terms of populations. Children are more prone to blunt abdominal injuries due to various social factors. Anatomic differences and variations in body habitus seen in children may account for significant internal abdominal injuries in the absence of obvious external signs. Most of the pediatric abdominal injuries can be managed conservatively. Those who need operative intervention are those having viscus perforations or multiple organ injuries. Mortality was related to delayed presentation and associated non-abdominal grievous injuries.

Keywords: Blunt Abdominal Trauma; Children; Management; Developing Country.

Introduction

The management of blunt trauma abdomen (BTA) has been shifted from essential operative intervention to more conservative approach especially in pediatric patients. Simpson in 1968 first published his report on successful conservative treatment of splenic injury in children and it revolutionized the management of splenic injury [1]. An increased awareness of the anatomic pattern and physiological response characteristics of pediatric trauma has resulted in

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successful non-operative management of most solid organ injuries. Improvement in radiology and ICU care has a big impact on increasing survival in trauma victims. High resolution contrast tomography, MRI and focused abdominal sonography for trauma (FAST) helps in early and accurate assessment of damage to abdominal viscera and more focused management to involved organ system [2].

As a developing country with limited resources the investigations advised to be weighed against their need and cost effectiveness and this is the area where clinical skill of the trauma surgeon matters. The present paper shares the experience gained in management of cases of pediatric trauma admitted to a tertiary center in India. The various causes of abdominal trauma, pattern of injury and management with subsequent outcome is discussed. The unique conditions of this region of the world, leading to trauma in children are also discussed.

Patients and Methods

Patients presented to the Department of Pediatric surgery, Government Medical College, Srinagar, India, from June 2011 to January 2018 with a diagnosis of blunt trauma abdomen formed the basis of this study. These patients were retrospectively analyzed and individual case records were looked for mode of injury; presentation, associated injuries and treatment offered were studied. The data sheets were analyzed for the investigations ordered and the operative management, if offered, to the patients. The postoperative recovery and complications if any were recorded. The poly trauma patients with associated abdominal injuries were also included.

All the patients after initial resuscitation and maintenance of airway, breathing and circulation were subjected to thorough clinical evaluation to assess the severity of injury. Chest and abdominal X-rays were done in all patients. The patients, in whom abdominal injury was suspected either on the basis of history (mode of injury) or clinical examination, were subjected to an abdominal ultrasound. An abdominal contrast CT was advised in patients where the ultrasound findings were either inconclusive or clearly suggestive of solid organ injuries. The patients in whom the indication for surgery was obvious (peritonitis, pneumoperitoneum or uncontrolled hemoperitoneum) were subjected to laparotomy. The data was stratified according to the mode of injury, the organs involved, the management done, the final outcome of the patients and analyzed accordingly.

Results

Total 251 pediatric patients with a diagnosis of blunt abdominal trauma were admitted during the study period. There were 192 males and 59 females, age ranging from 26 days to 14 years (Table 1).

Age and Sex: Majority of the patients in the study were between 6 to 12 years of age (52%). There was a single neonate, who unfortunately fell from the mother's lap while travelling and sustained liver contusion and head injury. Males outnumbered females with a ratio of 3.2:1 in the study.

Mechanism of injury: Road traffic accident (RTA) was the commonest cause of blunt abdominal injury (n=154), Followed by fall from height (n=72). There were 36 children, who fell from the rooftops especially during flying kites. 27 children had history of fall from the roof of construction sites or abandoned places, 6 from the moving trolleys, while remaining 2 patients had history of falling into dry wells. Eight patients acquired injury during sports. Eleven patients were hit by various animals.

Diagnosis

The diagnosis was established clinically in most of the patients. Abdominal pain, tenderness and distension was present in majority of patients. Fifteen (6%) patients had anemia and shock at the time of presentation. Signs of pneumoperitoneum were found in 69 (27.4%) patients at the time of admission. 10 (4%) patients developed pneumoperitoneum during the course of conservative management. After initial resuscitation plain x-rays of abdomen and chest were done. Besides giving information regarding free abdominal gas and associated thoracic injuries, x-rays were not helpful in the diagnosis of solid organ injuries.

Table 1: Age and sex distribution

Age range	Male	Female
0-1 years	5	1
1-3 years	16	5
3-6 years	25	19
6-9 years	38	11
9-12 years	68	13
12-14 years	41	10
Total	192	59

The USG was performed in most of the cases without pneumoperitoneum. It showed localization of the injury along with evidence of hemoperitoneum. Computed tomography was done in selected patients when USG was inconclusive or there was definitive organ involvement.

Organ involvement and treatment

There were total 251 patients admitted with abdominal trauma, 116 patients (46.2%) had isolated injuries involving liver (n=74), spleen (n=26) and kidneys (n=16). 30 (11.9%) patients had multiple organs involvement (Table 2).

Liver

A total of 74 (29.4%) patients presented with isolated injuries of liver of varying grades. The injury to the liver was diagnosed by ultrasonography with variable amount of hemoperitoneum. CT scan was done in select patients for grading and to rule out associated solid organ injuries.

Table 2: Pattern of organ involvement

Organ involved	No. of patients	%
Hollow viscera injury	63	25.0
Liver (isolated)	74	29.4
Spleen(isolated)	26	10.3
Kidneys	16	6.3
Mesenteric injury	20	7.9
Pancreas	4	1.59
Bladder	6	2.3
Urethra	12	4.7
Multiple organ involvement	30	11.9
Total	251	100

Out of total 74 patients, operative intervention was needed in 8 patients, rest of the patients were managed conservatively. Among those requiring exploration, deterioration in the general condition and increasing hemoperitoneum was the cause. Liver suturing was done in 6 patients. In 1 patient left auto segmentectomy was found with no active bleeding at the time of exploration. Liver packing and splenectomy was done in 1 patient, who subsequently expired.

Spleen

The spleen was injured in 42 children (22%), and in 26 patients was the only organ involved. The injury was grade 2/3 in 4 patients and was managed by splenorraphy or partial splenectomy. Six patients had grade 4 and 5 injuries needing splenectomy. Rest of the patients were diagnosed milder grades of injury on USG and were managed conservatively. Only one patient expired who had associated liver injury and massive hemoperitoneum in whom liver packing was done.

Gastrointestinal Injuries

The GI tract was involved in 83 (33.0%) patients. Bowel perforations were found in 63 (25%) patients while the mesentery was teared in 20 (7.9%) patients. There were 17 gastric perforations which were repaired in two layers.Jejunal perforations were found in 31 patients, which were repaired by primary closure in 6 patients and resection anastomosis (RA) was done in 25 patients. Fourteen patients had perforations in the ileum and were repaired by primary closure in 10 patients while RA was done in four patients with delayed presentation with associated contusion and doubtful viability.

Six patients had colonic perforations which were closed in single layer in two patients, while closure with proximal colostomy was done in 4 patients. One patient had sigmoid colonic perforation in which closure of the perforation with right transverse colostomy was done. Two patients had contusion of jejunum and ileocecal region respectively. Ileosto-colostomy was done after resection of the ileocecal region due to questionable viability in the second patient. Jejunal contusion was managed conservatively. Mesenteric tear was found isolated in 11 patients, where repair was performed. 8 patients had associated bowel injury and in one patient associated intra peritoneal rupture of the bladder were found.

Urinary tract

Traumatic involvement of the urinary tract was found in the 34 (13.5%) patients. Sixteen patients had isolated renal injuries, while bladder injury was present in 6 patients. Twelve patients had urethral injuries. All patients with renal injuries were managed conservatively. Ten patients were diagnosed as minor injuries on CT scan, while 4 patients had grade 3 and 4 injuries. Patients with gross hematuria were placed at bed rest with close monitoring of the vital signs and serial physical examinations and blood cell counts.Ambulation was begun once the patient was fully resuscitated and hemodynamically stable and gross hematuria resolved. One patient needed bladder irrigation from the Foley's catheter for clot retention. All patients were subsequently discharged.

Bladder contusion was found in 2 patients associated with pelvic hematoma. Both improved conservatively. Intraperitoneal dome rupture was found in 3 patients needing repair by lower midline approach. One patient had associated mesenteric injury. Extraperitoneal rupture was found in 1 patient and was managed by transurethral catheter drainage.

Urethral injuries were found in 12 (4.7%) patients. RTA was the chief cause involving 8 patients; three patients had history of fall, while one had straddle injury. Three patients had minor contusiontreated by catheterization alone. Six patients had posterior urethral injury while 3 had anterior urethral injury. Supra pubic cystostomy was done in all of these cases for a later urethral repair.

Other injuries

There were four pancreatic injuries that occurred in association with gastric and bowel injuries. The patients were diagnosed on USG as bulky pancreas and mainly in the form of contusions. These patients were managed conservatively. Three patients had associated perineal injuries in association with abdominal trauma. Diverting colostomy was done in two patients while primary repair was done in one patient. One patient had associated eventration of the diaphragm which

was repaired. Retroperitoneal hematoma was found in six patients which was left undisturbed.

Extra-Abdominal Injuries

There were 67(26.6%) extra-abdominal injuries (Table 3). Limb fractures were found in 19 patients, while six patients had pelvic fractures. There were 12 patients who had isolated head injuries, while combined chest and head injury was present in 7 patients. Twenty-three patients had isolated chest injuries. Sixteen had rib fractures alone, while 4 patients had underlying lung contusions as well. Three patients had severe hemo-pneumothorax with midline shift and subsequent respiratory compromise needing intercostal chest drainage. Head injury was present in 12 patients and included 5 fractures, two contusions and one extradural hemorrhage. Four patients had multiple injuries including depressed fractures and contusions with poor Glasgow score on admission.

Table 3: Associated injuries with blunt abdominal trauma

Organ involved	No. of patients	%
Thoracic injury	23	9.16
Orthopaedic injuries	25	9.9
Head injury	12	4.1
Head and chest injury	7	2.7
Total	67	26.6

Mortality

Overall, 19 (7.5%) patients expired following traumatic blunt abdominal injuries. Among expired, 9 patients had bowel perforation with delayed presentation and low general condition on presentation. Six patients had isolated bowel perforations while 3 had associated thoracic injuries. Four patients who had associated head injuries and low GCS expired during resuscitation. Three patients who had suspected severe liver injuries with massive ascites clinically and were in severe shock at the time of presentation, also expired. Three patients had multiple organs involvement at the time of presentation and had respiratory compromise. They were intubated and resuscitated and prepared for surgery, however they expired before being taken up for surgery.

Discussion

Injuries constitute a variable epidemic. Injuries are responsible for approximately 9.1% of all causes of deaths in the world and about 16% of the disabilities are reported due to injuries [3].

Anatomical differences in children make them more vulnerable to major abdominal injuries with very minor forces [4]. In children, the abdomen begins at the level of the nipple. Children's small, pliable rib cages and undeveloped abdominal muscles provide little protection of major organs. Solid organs (eg, spleen, liver, kidneys) are vulnerable to injury. Due to patientsize and mechanisms of injury, blunt abdominal trauma in children occurs most often in association with other injuries. Motor vehicle accidents and falls continue to account for the majority of abdominal injuries seen in this population [4]. Overall, up to 8% of children sustaining trauma by blunt mechanisms will have injuries to the abdomen, primarily involving the solid viscera [5]. Despite the high frequency of associated injuries, most solid abdominal visceral injuries can be managed non-operatively. Overall, the outcome for children sustaining abdominal injury is good with mortality typically determined by the severity of the associated injuries [5]. Accidents are definitely on an increase in India. Increasing mechanization in agriculture and industry, induction of semiskilled and unskilled workers in various operations and rapid increase in vehicular traffic have resulted in an increase in morbidity and mortality due to accidents. Overcrowding, lack of awareness and poor implementation of essential safety precautions result in an increasing number of accidents. Road traffic accidents remained the number one cause of un-natural deaths in our country and the reported numbers of accidental deaths are increasing [6].

Unfortunately, given the few number of pediatric trauma centers, most injured children receive their initial care in lower level trauma centers, which are less experienced with the evaluation and management of the pediatric patients. The situation is graver in developing countries like ours, where the catchment area of a tertiary center capable of handling such cases is very big (more than 10 million in most of the cases) and very often overburdened. Often the abdominal injuries can be missed under the shadow of more grievous looking orthopedic and head injuries. A careful examination is needed in all cases of pediatric trauma for assessment of abdominal injuries. In addition, alterations in mental status, common to the child with multi trauma, make the assessment of the abdomen less reliable.

Road traffic accident remained the most common cause of abdominal trauma in our study (62%) and is comparable to other studies from the same country [7]. The causes may be attributed to increasing population and migration of parents towards bigger cities in search of jobs. The children due to scarcity of open places usually tend to play on the streets and are most vulnerable for fatal accidents. Domestic accidents like fall from height remained the second most common cause of trauma in our study (29%). Falls are responsible for large number of hospital visits for non-fatal or fatal injuries especially for children and young adults. Falls from rooftops, balconies, windows and stair cases are common. Factors specific to developing countries, are

falls from trees of children picking fruits ornuts, tapping toddy, children falling from rooftops while flying kites. Minor number of patients had trauma following sports and straddle injuries. One peculiar type of trauma noted in our study was the animal related injuries. Four per cent of the children presented with such kind of injuries. The cause of such injuries in our country is attributed to the involvement of the children in rearing of the animals. They sometimes get violent making childrenvulnerable. Another reason is the involvement of animals in various festivals and sports. These animals may get uncontrolled due to crowd and children may get injured thereafter. Male outnumbered females in sustaining abdominal trauma with a ratio of 3.2:1 in the present study and is comparable to contemporary studies. The majority of these patients were managed conservatively in the present study and it goes well along the contemporary dictum [8].

Operative intervention was needed in only 105 patients (41%), out of 251 patients. Those requiring operative management were the patients who had signs of hollow viscus perforations or ongoing bleed with deterioration in the general condition or bladder or urethral injuries. The overall mortality in the study was 7.5%, which is less than a similar study by EA Ameh et al. [9].

The patients, who died had low general condition on presentation secondary to delayed presentation or severe associated injuries were present. Two patients had post-operative burst abdomen which was repaired. One patient had fecal discharge from the drain and from the wound site on the fifth postoperative day. The patient was re-operated and double barrel ileostomy was performed following resection of the gangrenous segment. The mortality percentage in our study may not be the real reflection of the traumatic burden in our society, as most of the patients living in the far-off regions could not reach a trauma facility.

Problems in management: The traditional view of injury as an accident has resulted in the neglect of this aspect of public health. The problem is further compounded by the availability ofexpertise to manage an injured child, mainly concentrated in tertiary centers and they usually cater vast populations. Children with serious injuries usually die before they can reach such centers or unnecessarily operated and then referred to us with various complications. Developing countries are very uniquely different from the industrialized countries with regard to the environment and the mix of vehicles in the traffic stream [10].

The following are the major differences:

1. Low driving standards.
2. Widespread disregard to traffic rules.
3. Large number of pedestrians (especially children) and animals share the road way with fast moving wheeled traffic.
4. No segregation of pedestrians from wheeled traffic.
5. Unusual behavior of men and animals.

Conclusion

To conclude, we suggest that, accidents are not the prerogative of developed nations. In developing countries accidents are shown to be as numerous as in developed countries. It is increasing rapidly as a cause of death in absolute numbers and in terms of populations. Children are more prone to blunt abdominal injuries due to various social factors. Anatomic differences and variations in body habitus seen in children may account for significant internal abdominal injuries in the absence of obvious external signs. Most of the pediatric abdominal injuries can be managed conservatively. Those who need operative intervention are those having viscus perforations or multiple organ injuries. Mortality was related to delayed presentation and associated non-abdominal grievous injuries.We also propose that there should be a basic reporting system of all pediatric accidents. The national data should be supplemented by special surveys and in-depth studies. Safety education must begin with school children; they should be educated regarding risk factors, traffic rules and safety precautions.

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