

Blunt Trauma in Paediatric Patients – Experience from a Small Centre

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ABSTRACT

Objective: Despite great prevention efforts, blunt abdominal trauma still remains a leading cause of injury, especially in the paediatric population. Abdominal trauma is the main culprit of serious children's injury and the most common area of initially missed diagnosis with a fatal outcome.

Aim: The purpose of this study was to determine the incidence, aetiology, grades of abdominal organ injuries, diagnosis, management and outcome of blunt abdominal trauma in a paediatric population.

Method: This is a retrospective study of 31 patients with isolated parenchymatous abdominal organs, treated in a single centre. Stable patients with no signs of peritonitis and insignificant changes in laboratory findings were managed conservatively. Unstable patients received surgery.

Results: The leading cause of injuries were traffic accidents (64.5%), followed by fall from a height (22.5%), bicycle handlebar injuries (6.45%), contact sport and child abuse (3.22% each). The majority of injured children (90.32%) were managed conservatively. Only three patients (9.68%) were operated on due to complete avulsion and organ smash, or devascularization of the injured organs. Diagnostic computed tomography (CT) scan examination was performed on 93.5% of patients. Few patients had grade I and grade V injuries, while the largest proportion of patients had grade III and IV injuries. The most frequently injured organs were the spleen and kidney. There was no mortality.

Conclusion: The results emphasize that conservative treatment was appropriate for all stable patients with blunt abdominal trauma regardless of organ injury grade. The success of non-operative management depends upon proper patient selection. The choice of non-operative treatment should be based predominantly on physiological response, rather than grade injury on CT scan.

Keywords: Blunt abdominal trauma, children

Trauma Contuso en Pacientes Pediátricos: Experiencia de un Pequeño Centro

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RESUMEN

Objetivo: A pesar de los grandes esfuerzos por su prevención, el traumatismo abdominal contuso (TAC), sigue siendo la principal causa de lesiones, especialmente en la población pediátrica. El trauma abdominal es el principal responsable de las lesiones graves de los niños, y el área más común en la que el diagnóstico se pasa inicialmente por alto, con resultado fatal.

Objetivo: El propósito de este estudio fue determinar la incidencia, etiología, grados de lesión de los órganos abdominales, diagnóstico, tratamiento, y resultado del trauma abdominal contuso en una población pediátrica.

Método: Se trata de un estudio retrospectivo de 31 pacientes con órganos abdominales parenquimatosos aislados, tratados en un solo centro. Pacientes estables sin signos de peritonitis y cambios insignificantes en los resultados del laboratorio fueron tratados de manera conservadora. Los pacientes inestables recibieron cirugía.

Resultados: La principal causa de las lesiones fueron accidentes de tráfico (64.5%), seguidos por la caída desde una altura (22.5%), lesiones con el manubrio de la bicicleta (6.45%), deporte de contacto, y abuso infantil (3.22%). La mayoría de los niños heridos (90.32%) recibieron tratamiento conservador. Solamente tres pacientes (9.68%) fueron operados debido a la avulsión completa y destrucción de un órgano, o la revascularización de los órganos lesionados. Se hizo un examen diagnóstico mediante tomo-

grafía computarizada (TC) en el 93.5% de los pacientes. Pocos pacientes presentaban lesiones de grado I y grado V, en tanto que la mayor parte de los pacientes tenían lesiones de grado III y IV. Los órganos más frecuentemente lesionados fueron el bazo y el riñón. No hubo mortalidad.

Conclusión: *Los resultados señalan que el tratamiento conservador fue apropiado para todos los pacientes estables con TAC, independientemente del grado de lesión del órgano. El éxito del manejo no quirúrgico depende de que se haga una adecuada selección del paciente. La elección del tratamiento no quirúrgico debe basarse predominantemente en la respuesta fisiológica, en lugar del grado de la lesión en la TC.*

Palabras claves: Trauma abdominal contuso, niños

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INTRODUCTION

Despite great prevention efforts, blunt abdominal trauma (BAT) still remains a leading cause of injury especially in the paediatric population. Although BAT is less frequent compared to isolated head injury and penetrating trauma, it is still the leading cause of morbidity, permanent disability and mortality in children. Blunt abdominal trauma is usually associated with a traffic accident 75–80% (1). Injuries from falling from a height, bicycle handlebar injuries, pedestrians motor vehicle violations, injuries in contact sports or due to abuse [battered child] (2, 3) are other causes of BAT.

Abdominal trauma is the main cause of serious children's injury and the most common area of initially missed diagnosis with a fatal outcome. The most commonly injured organs are the spleen (over 60%), liver, pancreas, kidneys, and, less frequently, small bowel and bladder.

Care of the injured child requires special knowledge, precise treatment and focus on attention to details. Non-operative (conservative) treatment is the "gold standard" in most clinically stable children with blunt abdominal injury. This approach was started in children, but as time went by it was accepted for the treatment of adult patients.

Conservative treatment can be carried out only in haemodynamically stable patients with continuous monitoring in the intensive therapy unit for at least 48 hours, and with an experienced multidisciplinary team that is ready for intervention if necessary.

Aim

The purpose of this study was to determine the incidence, aetiology, grades of abdominal organ injuries, diagnosis, management and outcome of blunt abdominal trauma in children at a single centre.

SUBJECTS AND METHODS

Paediatric Surgery Clinic, Niš, is a trauma referral centre for the region of southeast Serbia. This is a retrospective study of 31 patients with isolated parenchymatous abdominal organ injuries in children that were consecutively admitted and managed over the interval of four years (January 2010 – December 2013) in our clinic. Patients with associated fractures and cerebral trauma were excluded in order to eliminate chances in the

management plan and outcome. Children were evaluated for conservative management or urgent laparotomy depending on initial physiologic parameters to life support management protocols established for the treatment of paediatric BAT. Initially, Ringer's lactate solution was administered in all patients, with boluses of crystalloid solution and blood transfusion in persisting circulation dysfunction. Focussed assessment with sonography for trauma (FAST) has been used as the first tool to look for presence or absence of "free fluid" and associated solid organ injury. All haemodynamically stable patients who responded to resuscitative efforts were examined with computed tomography (CT) scan, with intravenous contrast. All parenchymatous organ injuries were graded according to the American Association for the Surgery of Trauma.

Data were collected depending on gender, age, grades of injury, mechanism of trauma, management and outcome. Urine and blood samples were sent for analysis investigations, grouping and cross matching. Patients with stable blood pressure and adequate urine output, with no signs of peritonitis and insignificant changes in laboratory findings were managed conservatively.

All haemodynamically stable patients that were treated non-operatively were on a strict bed rest programme, with continuous 24-hour monitoring and serial haemoglobin analyses. In all patients, controlled ultrasounds were performed during the third or fourth day of hospitalization. If the patient's condition was stable, they were transferred to the regular ward department within a few days for further observation. Unstable patients with massive haemoperitoneum were operated on. Follow-up CT scans were performed in three to six month intervals depending on injury grade.

RESULTS

During the period of four years, 31 children with isolated abdominal organ injuries were hospitalized in the Pediatric Surgery Clinic in Niš. Patients were between 15 months and 15 years, with male to female ratio about 3:1 (23 boys (74.2%) and 8 girls (25.8%)). The leading causes of injuries were traffic accidents in 20 patients (64.51%), followed by fall from a height in seven children (22.58%), bicycle handlebar injuries in two (6.45%), contact sport and child abuse in one patient each (3.22%) [Tables 1, 2].

Table 1: Age of patients (separated in three major groups) and incidence of injuries in different age category

Age	Number of patients	Percentage
0–5 years	4	12.90
6–10 years	15	48.38
11–15 years	12	38.70
Total	31	100

tervals in all patients. Except scarring changes that were detected, other pathological malformations which would require further surgery were not presented.

DISCUSSION

The leading cause of injuries in paediatric patients, especially in young males, is road traffic accidents, causing blunt organ injuries predominantly to the spleen, liver and kidney, followed by pancreatic and liver injuries. Incidence of solid abdominal

Table 2: Mechanism and incidence of injuries in different age categories

Mechanism of injury	Age (years)			Total
	0–5	6–10	11–15	
Traffic accident	1 (3.22%)	11 (35.48%)	8 (25.80%)	20 (64.51%)
Fall from height (blunt organ trauma)	2 (6.45%)	2 (6.45%)	3 (9.67%)	7 (22.58%)
Bicycle handlebar injury	–	2 (6.45%)	–	2 (6.45%)
Contact sport injury	–	–	1 (3.22%)	1 (3.22%)
Child abuse	1 (32.22%)	–	–	1 (3.22%)
Total	4	15	12	31

The highest percentage of children with isolated parenchymal organ injuries was in the age range of 6–10 years. Older children of 11–15 years followed. Patients from both groups had injuries as a consequence of traffic accidents and falls from a height. In the younger group, injury was recorded due to abuse (Table 2). Twenty-eight (90.32%) of the total number of injured children were managed conservatively.

Only three patients (9.68%) had surgery due to complete avulsion and organ smash, or devascularization of the injured organs. Diagnostic CT scan examination was performed in 29 (93.5%) patients. As expected, only a few patients had grade I and grade V injuries, while the largest proportion of patients had grades III and IV injuries. The most frequently injured organs were the spleen and kidney. Computed tomography grading of injured organs is shown in Table 3.

All patients who had surgery had grade V injuries. Fortunately, there was no mortality. Average time in intensive care unit for injured patients was 8.4 ± 2.3 days. They were discharged from hospital after an average of 18.9 ± 3.5 days. Controlled CT scans were performed at three to six-month in-

organ injuries is almost uniform in the series described in the literature (4–6). Management of BAT in children has evolved with conservative management as a strategy and mainstream practice.

Non-operative treatment is the “gold standard treatment” in the majority of children with blunt parenchymal organ injury that are clinically stable. Children have smaller blood vessels with more prominent vasoconstrictive response. Splenic capsule and vessel injury usually stop bleeding spontaneously regardless of injury grade. Consequently, most patients will respond to non-operative treatment. Our personal results support the principle of conservative treatment in all haemodynamically stable patients, with overall efficacy rate more than 91%, as was reported in modern literature (7, 8).

Specific splenic organization and segmental vascularization enables preservation of splenic tissue in more than 95% of cases, supporting the conservative treatment as a feasible choice and eliminating the need for splenectomy and consequent postsplenectomy sepsis.

Table 3: Incidence of solid abdominal organs injuries, graded on computed tomography (CT) scan*

Injury grade	Liver injuries	Splenic injuries	Renal injuries	Pancreatic injuries	Total
I	–	1	1	–	2
II	2	2	1	–	5
III	2	3	3	1	9
IV	–	4	3	2	9
V	–	2	2	2	6
Total (%)	4 (12.9%)	12 (38.7%)	10 (32.25%)	5 (16.12%)	31 (100%)

*According to the American Association for the Surgery of Trauma

Meta-analyses indicate 97% success in conservative treatment of blunt splenic injuries (9). Later meta-analyses showed that hepatic blunt injuries may be treated with the same approach and success in children (10, 11). This therapeutic approach to kidney and pancreas injuries showed equally good results. Stylianou found that only 1% of patients with grade I–IV hepatic or splenic injury required laparotomy (12). Croce *et al* published a 90% success rate of conservative management of hepatic injuries in properly selected children in the United States of America [USA] (13). In more recent series, failure of conservative management was less than 4%, predominantly due to haemodynamic instability and hepatic abscess (14). Most renal and pancreatic injuries related to abdominal trauma can be successfully and safely managed conservatively. Haemodynamic stability, a prompt clinical diagnosis and CT grading are necessary for successful implementation of conservative treatment.

Focused assessment with sonography for trauma, first introduced by Rozycki, is a modality of choice for prompt verification of haemoperitoneum in BAT, with high sensitivity and specificity of 95–100% (15). Focused assessment with sonography for trauma is a crucial and important screening diagnostic tool for accurate triage of the assessment with unstable trauma patient, determining who requires urgent lifesaving laparotomy (16). Serial FAST examinations of all injured children are mandatory in order not to underestimate injuries. Initially, altered sensorium in children may mislead the surgeon in the wrong direction, which increases the possibility of an initially missed diagnosis.

Focused assessment with sonography for trauma is not a replacement for CT. But, in haemodynamically unstable patients, FAST is feasible, and positive FAST findings can determine patients for urgent laparotomy. In FAST positive, but haemodynamically stable patients, additional CT scans must be done for better injury differentiation. In our study, our rule was that a haemodynamically stable child with a positive FAST examination should immediately undergo abdominal CT scanning.

Double contrast CT scan is standard for the evaluation of abdominal trauma in the haemodynamically stable child (17). Although some authors stated that acute extravasation of contrast is a sign of acute haemorrhage (18), intravenous contrast still remains essential for evaluating the accuracy of grades in solid abdominal organ injuries. It is sensitive (97%) and specific [98%] (19) with the ability to detect arterial extravasation, and to present haemoperitoneum, as CT revealed in 29 (93.5%) of our patients. In two haemodynamically unstable children with refractory hypotension, CT was not done, and laparotomy was done just after bedside FAST that suggested huge haemoperitoneum and complete avascularization and organ avulsion. Computed tomography scanning often provides the most detailed images of traumatic pathology and may assist in determination of operative intervention.

In our study, ultrasound examination was done on all stable patients after the initial injury and then sequentially re-

peated every two to three days (in shorter periods in specific cases) until the general condition stabilized.

In the present study, only three patients had surgery due to conservative treatment failure. In fact, the reason for surgical intervention was a completely devascularized spleen (in one patient), and complete avulsion and organ smash of kidney (in two patients).

These patients maintained refractory hypotension, not responding to 40 mL/kg of fluids during the first few hours in the presence of haemoperitoneum.

On the other side, blood transfusions should be reduced to a reasonable level, as their implementation significantly increases the risk of blood-borne diseases. More than 65% of our patients received blood transfusions, although it has been proven that children can tolerate even lower haematocrit levels (7 g/dL).

During stay in the intensive care unit, all patients were on continuous monitoring, which included vital signs monitoring and serial ultrasound examinations (every three to four days). All patients had at least two control ultrasound examinations before transfer to a general department. The length of hospitalization depended on the injury grade.

CONCLUSION

The results of this study emphasize that conservative treatment was a favourable option for all stable patients with BAT regardless of grade of organ injury. The success of non-operative management depends upon proper selection of the patient. Focused assessment with sonography for trauma is a screening tool for accurate triage of unstable patients that require laparotomy. The availability of FAST and CT have definitely improved the management and outcome of BAT.

The choice of non-operative treatment should be based predominantly on physiological response of the child, rather than injury grade on CT scan.

Assessment of haemodynamic stability is the most important initial concern in the evaluation of a patient with BAT.

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