Improving the prognostic value of blunt abdominal trauma scoring systems in children

Mohammad G. Khirallah[a] and Elsayed I. Elsayed[b]

Purpose **Blunt abdominal trauma (BAT) is a frequent reason for hospital admission and a significant cause of death in children older than 2 years of age. Mechanisms causing abdominal injuries are predominantly motor vehicle accidents, falls, and intentional injuries. Blunt trauma accounts for 90% of pediatric injuries. There are many scoring systems that are designed to monitor victims of BAT and to predict victims who may require conservative management and those who may require surgical intervention. None of these scoring systems is perfect and fulfill the data for accurate prediction of the prognosis of these victims. We assessed three different clinical scoring systems and their prognostic properties alone and after their modification by adding a plain, erect, abdominal radiographic film to improve their prognostic values.**

Patients and methods **We included all patients presenting with BAT older than 2 years and younger than 18 years. All children were subjected to three different trauma scoring systems. We evaluated all children using Pediatric Trauma Score, Clinical Abdominal Score System, and Blunt Abdominal Trauma in Children. We then added plain, erect, abdominal radiographic films to these systems.**

Results **A total of 250 children with BAT were subjected to three different scoring systems. Among them, 58% were boys and 42% were girls. The cause for BAT in two hundred and two cases was car accidents, falling from heights in seven, and kicks and abuse in 41 cases. The mean time until hospital arrival was 2 h. The mean age was 15 years. The mean time for every scoring system was 5 min. Radiographic imaging showed positive signs of trauma (air under diaphragm, elevated copula of diaphragm) in 45 patients.**

Conclusion **Adding a simple radiographic film in the erect position of the abdomen and lower chest markedly improved the prognostic value of the different scoring systems included. *Ann Pediatr Surg* 13:65–68 © 2017 Annals of Pediatric Surgery.**

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[a]Pediatric Surgery Department, Faculty of Medicine and [b]Tanta University Hospitals, Tanta, Egypt

Correspondence to Mohammad G. Khirallah, MD, PhD, Pediatric Surgery Department, Tanta University Hospitals, El Geish Street, Tanta, El Gharbeya 31111, Egypt
Tel: +20 100 354 6853; e-mail: mohamed.khirallah@med.tanta.edu.eg

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Introduction

Blunt abdominal trauma (BAT) in the pediatric age group is still one of the major causes of disability and even deaths among children [1,2].

BAT may be caused by several mechanisms of injury, including road traffic accidents, sporting injuries, abuse (abdominal kicks), or falling from heights [3,4].

The presence of multiple scoring systems for the assessment of injured children helps in categorizing BAT, and such scoring systems have made it easy to predict patients who need rapid intervention [5].

Because of already-existing multiple scoring systems, their complexity of calculation, and the presence of financial burden at times, especially in developing countries, we tried to revise some of them and improve their prognostic value to save lives of our patients. We mainly used the Pediatric Trauma Score (PTS), the Clinical Abdominal Scoring System (CASS), and the Blunt Abdominal Trauma in Children (BATiCh) system.

Patients and methods

This study included 250 children who presented with a history of BAT during the period between December 2013 and December 2015. Cases with chest or neurological injuries and cases with major fractures that required any intervention were excluded from the study. Patients were assessed with regard to demographic data, mechanism of injury, and mean time of hospital arrival. All patients were evaluated using three different scoring systems (Tables 1–3).

Plain, erect radiographic of the abdomen was requested for all children, and data were recorded according to the findings.

Informed consent was obtained from parents, ethical committee approval was obtained.

Statistical analysis

All data were analyzed according to SPSS program, and a P value less than 0.05 was considered statistically significant. For multiple variants, we used analysis of variance system.

Results

A total of 250 children who presented with BAT to the emergency department of Tanta University Hospital during the period between December 2013 and December 2015 were included in this study. Road traffic accidents represented 202 cases (80.8%), of whom 110 were boys and 92 were girls (i.e. boys represented 54.45% of all road traffic victims). Falling from heights occurred in seven cases (2.8%), and five of them were males (71.4% of falling victims). Direct abdominal impact by kicks (abuse and fighting sports) was present in 41 cases

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Table 1 Pediatric trauma scoring system

	Scores		
Parameters	+2	+1	−1
Weight (kg)	>20	10–20	<10
Airway	Normal	Simple adjunct	ET tube/surgical
Systolic blood pressure (mmHg)	>90	50–90	<50
Conscious level	Alert	Decreased/loss of consciousness	Coma
Open wounds	None	Minor	Major/penetrating
Fractures	None	Minor	Open/multiple

Table 2 Clinical Abdominal Score System

Items	Scores
Time of presentation after trauma (h)	
<2	1
2–6	2
>6	3
Pulse rate (beats/min)	
<90	1
90–110	2
>110	3
Systolic blood pressure (mmHg)	
>120	1
90–120	2
<90	3
Glasgow coma score	
13–15	1
9–12	2
<9	3
Abdominal clinical findings	
Pain	1
Guarding	2
Tenderness and rigidity	3

Table 3 Blunt Abdominal Trauma in Children

Positive FAST examination	4
Abdominal pain	2
Signs of peritoneal irritation	2
Hemodynamic instability	2
AST>60 IU/l	2
ALT>25 IU/l	2
WBC count>9.5 g/l	1
LDH>330 IU/l	1
Lipase>30 IU/l	1
Creatinine<50 mg/dl	1

ALT; alanine aminotransferase; AST, aspartate aminotransferase; FAST, focused assessment with sonography for trauma; LDH, lactate dehydrogenase; WBC, white blood cells.

(16.4%), and among them 30 were males (73.17% of all direct trauma). The age of the patients ranged from 2 to 18 years with a mean age of 10.14 years. In all, 145 boys (58%) and 105 girls (42%) were affected by BAT. Therefore, road traffic accidents represented the main cause of BAT in children in our series (Table 4).

According to PTS, the mean average of scoring was 10.37 with a standard deviation of 2.28. No intervention was required in 200 cases (80%), whereas 50 cases (20%) required admission under conservative measures.

According to CASS, the mean average was 8.01 with a SD of 1.5. Three cases (1.2%) had increased liability for exploration. Ninety cases (36%) were in need of further investigations, and 157 cases (62.8%) did not require further investigations.

According to BATiCH, the mean average was 9.79 with a SD of 3.32. There were 70 patients (28%) with increased tendency for exploration, 120 cases (48%) needed further investigations, and 60 cases (24%) required no investigations (Table 5).

These results show the prognostic value of BATiCH in relation to the other two scores.

After adding plain radiograph in the erect position of the abdomen, we found that 45 patients (18%) needed immediate intervention because of either rupture of the diaphragm in nine cases or air under the diaphragm in 36 cases (Table 6).

Discussion

Although there is great improvement in therapeutic approaches and improved facilities in intensive care units, BAT still represents more than half of deaths among children aged 1–14 years and is also the second leading cause of emergency department visits preceded only by infections [6].

Several institutions have tried to define an accurate system that can predict the severity of injury and possible outcomes, and hence many scoring systems have been developed for stratifying trauma in patients. Yet, all these scoring systems have some limitations in predicting the prognosis of an injured child [7–9].

According to this study and rules that guided our management of pediatric trauma, we depended on three different major scoring systems – BATiCH, PTS, and CASS – to evaluate children admitted with BAT. We chose these systems because of their easy applicability. However, on the other hand, we were faced with certain problems such as difficulty in calculating values and the need for available laboratory investigations that may take time before defining the score of the child.

Kondo *et al.* [5] highlighted some problems while using the scoring systems: difficulty in calculating, unreliability when used by paramedics, and the possibility of some elements being affected by other factors other than trauma, such as age and respiratory rates.

In the current study, we tried to depend on more objective items to detect intra-abdominal injuries and improve outcomes. One of these objective measures was plain, erect radiograph of the abdomen and lower chest.

According to CASS, it depended mainly on the clinical sense and good examination of the child who presented

with BAT. It required good cooperation from the child, especially when examining the abdomen, and frequent attempts of examination to monitor the progress of every case. False interpretation may lead to false scoring.

In the same context, Ciftci and colleagues found that normal or very minimal changes were present in up to 46% of patients in their series, and this figure was consistent with similar studies in which false-negative abdominal findings occurred with an incidence of 10–45% in BAT [10,11].

In addition, certain dilemma was still present when dealing with the BATiCH score, especially during the early periods after trauma, and positive ultrasound findings represented a major factor when calculating the score. Moreover, when intra-abdominal injury could not be detected, computed tomography (CT) was indicated [12].

Holmes *et al*. [13] showed that isolated free fluid in the peritoneal cavity was found in 8% of children with BAT, and the likelihood of associated intra-abdominal injury increased with increased intra-abdominal free fluid.

However, Christiano found free peritoneal fluid in 14% of children with BAT and only 3% required surgery because of the development of peritonitis [14].

Table 4 Mode of trauma in relation to age and sex

	Type of trauma [*n* (%)]				
Variables	Road traffic accidents	Falling from a height	Direct abdominal trauma	Total	*P*
Age (years) (mean)					
10.14	202 (80.8)	7 (2.8)	41 (16.4)	250	0.010*
Sex					
Males	110 (54.45)	5 (71.4)	30 (73.17)	145	0.870
Females	92 (45.55)	2 (28.6)	11 (26.83)	105	

Table 5 Results of applying scores to BAT patients

	n (%)		
	PTS	BATiCH	CASS
No need	200 (80)	60 (24)	157 (62.8)
Conservative	50 (20)	120 (48)	90 (63)
Increased liability of laparotomy	0 (0)	70 (28)	3 (1.2)
Mean ± SD	10.37 ± 1.2	9.790 ± 3.328	8.01 ± 1.567
P value		0.0001*	

BATiCh, Blunt Abdominal Trauma in Children System; CASS, Clinical Abdominal Scoring System; PTS, Pediatric Trauma Score.
*Significant relations.

Therefore, even with availability of ultrasound and CT, many cases with BAT will be discharged without any intervention, but a small percentage of victims require frequent follow-up and serial examination in selected cases.

Moreover, intestinal perforations due to BAT might cause minimal fluid collection and can be missed during ultrasound examination together with free air [15].

PTS is a simple and quick anatomical and physiological scoring system, but it is concerned mainly with the survival of injured children [16].

Pokota and colleagues, discussed the drawbacks of PTS while evaluating injured children. They assumed that the description of an open wound is not clear, and therefore a small contused wound may not affect the victim as a large open wound to the same extent and subsequently affect the score of the patient [17].

Although these scoring systems play a role in identifying injuries and prognosis of children with BAT, they could not achieve good prognosis in such children.

When we started to include radiographic films in the erect position to scoring systems for the prognosis of children with BAT, we found a marked change in the prognosis. These findings will save time and resources when dealing with a trauma victim. It may also show the presence of a ruptured gut or diaphragm easily.

The importance of diagnosis of a ruptured gut in BAT children arises from the fact that there is incidence of such a problem in 1–14% of all blunt trauma cases, and the delay in diagnosis significantly increases morbidity in these victims [15].

The hazardous effect of damage caused by CT may necessitate careful use of such investigation in a traumatized child. The role of CT in predicting injury in the pediatric group is still a matter of debate. The overall estimated risk of lifetime cancer development due to exposure of children to radiation during the procedure was two per 10 000 patients. Moreover, this examination is expensive and may necessitate general anesthesia or at least sedation of the child to avoid movement while it is being performed [18,19].

This made us re-evaluate the importance of different scoring systems in children suffering from BAT.

Conclusion

We believed that BAT in children is a time-sensitive problem that needs rapid and accurate assessment. None

Table 6 Results after adding erect, abdominal radiographic films

	PTS		BATiCH		CASS	
	Without radiograph	With radiograph	Without radiograph	With radiograph	Without radiograph	With radiograph
No need	200	172	60	45	157	142
Conservative	50	33	120	100	90	63
Increased liability for laparotomy	0	0	70	60	3	3
Laparotomy	45		45		45	
P value	0.045*		0.001*		0.0001*	

BATiCh, Blunt Abdominal Trauma in Children System; CASS, Clinical Abdominal Scoring System; PTS, Pediatric Trauma Score.
*Significant relations.

of the available scoring systems is sufficient alone to predict the prognosis and decrease morbidity and mortality. However, modifying these scoring systems by adding a simple, plain, erect, abdominal radiographic film may greatly improve the prognostic values of these systems and help in decreasing morbidity and mortality in children due BAT.

Conflicts of interest

There are no conflicts of interest.

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