



A comparison study of pelvic fractures and associated abdominal injuries between pediatric and adult blunt trauma patients



Forat Swaid ^{a,*}, Kobi Peleg ^{b,c}, Ricardo Alfici ^d, Oded Olsha ^e, Adi Givon ^b, Boris Kessel ^f Israel Trauma Group ¹

^a General Surgery Department, Bnai-Zion Medical Center, Haifa, Israel

^b National Center for Trauma and Emergency Medicine Research, Gertner Institute for Epidemiology and Health Policy Research, Tel Hashomer, Israel

^c Disaster Medicine Department, School of Public Health, Tel-Aviv University, Israel

^d Surgical Division, Hillel Yaffe Medical Center, Hadera, Israel

^e Surgery Department, Shaare Zedek Medical Center, Jerusalem, Israel

^f Trauma Unit, Hillel Yaffe Medical Center, Hadera, Israel

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ABSTRACT

Purpose: Pelvic fractures are a marker of severe injury, mandating a thorough investigation for the presence of associated injuries. Anatomical and physiological differences between adults and children may lead to a different impact of pelvic fractures on these populations. The purpose of this study is to compare pelvic fractures between pediatric and adult blunt trauma victims, mainly regarding their severity and associated intraabdominal injuries. **Methods:** A retrospective study involving blunt trauma patients suffering pelvic fractures, according to the records of the Israeli National Trauma Registry. Patients included children, aged 0–14 years, and adults between 15 and 64 years. The presence and severity of associated injuries were assessed.

Results: Overall, 7621 patients aged 0–64 years were identified with pelvic fractures following blunt trauma. The incidence of pelvic fractures in children was (0.8%), as compared to 4.3% in adults, $p < 0.0001$. The most common mechanism of injury was motor vehicle accident (MVA) in adults, and pedestrian hit by car (PHBC) in children. About a quarter of the patients in both groups had an ISS > 25 . Adults sustained significantly more moderate to severe pelvic fractures (AIS ≥ 3) than children (26.7% vs. 17.4%, $p < 0.0001$). The overall mortality rate was similar among the two groups (5.4% in adults, 5.2% in children, $p = 0.7554$). The only associated injury with statistically significant difference in incidence among the two groups was rectal injury (1.2% among children, 0.2% among adults, $p < 0.0001$). Among adult patients, there was a clear correlation between the severity of pelvic fractures and the severity of concomitant splenic and hepatic injuries ($p = 0.026$, $p = 0.0004$, respectively). Among children, a similar correlation was not demonstrated.

Conclusions: Adults involved in blunt trauma are more likely to sustain pelvic fractures, and these are generally more severe fractures, as compared to children suffering from blunt trauma. Nonetheless, mortality rates were found similar in both groups. The only associated injury with statistically significant difference in incidence among the two groups was rectal injury. In adults, but not in children, higher grade pelvic fractures correlated with more severe concomitant splenic or hepatic injuries.

Level of evidence: The level of evidence for this study is III (3).

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Pelvic fractures resulting from blunt trauma comprise a complex and sometimes life threatening type of injury, with trauma surgeons, orthopedic surgeons, and invasive radiologists commonly involved simultaneously in treating such patients. Pelvic fractures in children are less studied than in adults, and little literature exists comparing these

injuries among pediatric and adult populations. The pelvis in children consists of a higher cartilaginous volume, and the bony components are more elastic, thus providing increased energy absorption and a lower tendency to fracture [1,2]. We assumed that such differences may account for a different impact of pelvic fractures between the two groups, possibly affecting the incidence and severity of associated injuries differently. As the pelvis in children requires more energy to fracture, the significance of a pelvic fracture is assumed to be greater in children as compared to adults. The purpose of this study is to compare pelvic fractures between pediatric and adult blunt trauma victims, mainly regarding their severity and associated intraabdominal injuries. In addition, as blunt hepatic and splenic injuries are among the most common intraabdominal organs injured during blunt trauma, we also

* Corresponding author at: General Surgery Department, Bnai-Zion Medical Center, Affiliated to Rappoport Medical School, Technion, Golomb 47, Haifa, Israel 31048. Tel.: +972 4 8359136 (Work), +972 503352305 (Home).

E-mail address: foratola@gmail.com (F. Swaid).

¹ Israel Trauma Group includes: H. Bahouth, A. Becker, A. Hadary, I. Jeroukhimov, M. Karawani, Y. Klein, G. Lin, O. Merin, B. Miklosh, Y. Mnouskin, A. Rivkind, G. Shaked, D. Simon, G. Sivak, D. Soffer, M. Stein and M. Weiss.

examined whether there is a correlation between the severity of pelvic fractures and the grade of the concomitant hepatic or splenic injuries.

1. Methods

We performed a retrospective cohort study involving all blunt trauma patients suffering pelvic fractures, between the years 1998 and 2013, according to the records of the Israeli National Trauma Registry.

Data collected in the registry include age, gender, mechanism of injury, severity of pelvic fractures according to the Abbreviated Injury Scale (AIS) score, Injury Severity Score (ISS), mortality, severity of concomitant splenic or hepatic injuries, and other associated injuries. Traumatic brain injury (TBI) was defined as the presence of any kind of intracranial bleeding (epidural hematoma, subdural hematoma, subarachnoid hemorrhage, intraparenchymal hemorrhage, and brain edema). The severity of TBI was stratified according to AIS; an AIS of 1 or 2 was defined as mild, AIS of 3 or 4 was defined as moderate, and AIS of 5–6 was defined as severe brain injury. All trauma victims, including children, were treated in the general trauma centers, since we have no specialized pediatric trauma units over the country.

Patients included were originally divided into three groups: children, aged 0–14 years, adults between 15 and 64 years, and patients older than 65 years. We decided to concentrate our analysis on patients up to 64 years old because patients older than 65 years have a higher prevalence of osteoporosis leading to fractures following even minor injuries. Hence, most comparisons in the study are between children and adults aged 15–64 years. We are presenting some data about elderly patients, mainly for illustrative purposes, and in order to stress the fact that this group is completely distinct because of severe bone fragility.

Statistical analysis was performed using SAS software version 9.2 (SAS, Cary, NC) and GraphPadInStat® version 3.10 (GraphPad Software Inc., San Diego, CA). Statistical tests performed included chi-square test, two-sided Fisher's exact probability test and Mantel–Haenszel test for trend. A *p*-value of less than 0.05 was considered statistically significant.

2. Results

Overall, 7621 patients aged 0–64 years, and 4448 patients aged 65 years or more, were identified with pelvic fractures following blunt trauma in the years 1998–2013. The incidence of pelvic fractures differed significantly between children and adults. Of 99,579 children registered with blunt trauma, 812 (0.8%) sustained pelvic fractures, as compared to 4.3% in the adult group aged 15–64 years (6809 of 159,597 patients), *p* < 0.0001. The higher incidence of pelvic fractures with higher age was even demonstrated when further analyzing the children group itself (ages of 0–14 years); those children who sustained pelvic fractures had a median age of 8 years (interquartile range 5–12 years), while blunt trauma children without pelvic fractures had a median age of 6 years (interquartile range 2–10 years) (*p* < 0.0001).

In adults aged 15–64 years, sex distribution between patients with and without pelvic fractures was similar (67% of adults with pelvic fractures were males, and 66.5% of adults without pelvic fractures were males, *p* = 0.93). Similarly, sex distribution was similar between children with and without pelvic fractures (67.7% of children with pelvic fractures were males, and 67.9% of children without pelvic fractures were males, *p* = 0.93).

Injury mechanisms leading to pelvic fractures in adults and children are presented in Table 1. In adults aged 15–64 years, the most common mechanism of injury was motor vehicle accident (MVA) (47.3%), while in children the most common mechanism of injury was pedestrian hit by car (PHBC) (51.5%). In patients older than 65 years, the most common mechanism of injury was falls, accounting for 74.3% of all pelvic fractures.

Injury Severity Score (ISS) distribution is shown in Table 2. In both children and adults aged 15–64 years, the majority of patients had an ISS of ≤14 (56.1% in adults, and 59.5% in children, *p* = 0.0675). For

Table 1
Injury mechanism leading to pelvic fractures in children and adults.

Mechanism of injury	Age group (years)		>65	P value
	0–14	15–64		
PHBC*	418 51.5%	1052 15.5%	759 17.1%	<0.0001
MVA**	170 20.9%	3222 47.3%	307 6.9%	<0.0001
Fall	178 21.9%	1892 27.8%	3305 74.3%	0.0004
Other	46 5.7%	643 9.4%	77 1.7%	0.0004
Total	812	6809	4448	

* PHBC – pedestrian hit by car.

** MVA – driver or passenger in motor vehicle accident.

illustrative purposes, Table 2 also shows the ISS distribution among patients older than 65 years, which is distinctly different, with 68.5% of patients having an ISS of 1–8.

The overall ISS is lower in the pediatric group as compared to adults aged 15–64 years, but an analysis of stratified ISS shows that this is true only in the patients with an ISS of 14 or less; among patients with higher ISS, the overall ISS was not significantly different between children and adults aged 15–64 years. In both groups, there was a statistically significant positive correlation between the ISS and the incidence of pelvic fractures: patients with pelvic fractures had higher ISS scores than patients without pelvic fractures (*p* < 0.001 in both groups). For example, 24.4% of adults with pelvic fractures had an ISS of 25 or higher, as compared to only 1.7% of adults without pelvic fractures. Similarly, 27.1% of children with pelvic fractures had an ISS of 25 or higher, as compared to only 4.2% of children without pelvic fractures (full data not shown in tables).

The distribution of the severity of pelvic fractures according to the AIS score in both populations is shown in Table 3. Adults sustained significantly more moderate to severe pelvic fractures (AIS ≥ 3) than children (26.7% vs. 17.4%, *p* < 0.0001).

The overall mortality rate was similar among the two groups (5.4% in adults, 5.2% in children, *p* = 0.7554). In both groups, patients with pelvic fractures had significantly higher mortality rates than patients without pelvic fractures [in children, 5.2% vs. 0.3%, respectively (*p* < 0.0001), and in adults, 5.4% vs. 1%, respectively (*p* < 0.0001)]. In both groups, concomitant severe TBI (with AIS of 5 or higher) was found to be the most common cause of death, followed by massive bleeding and multiple organ failure. Thirty out of 42 expired children (71.43%) suffered from concomitant severe TBI, compared to 162 out of 370 expired adults (43.78%) (*p* = 0.007). Regarding the timing of death, 59.5% of adults and 54.8% of children died on admission day (*p* < 0.005).

Table 2
Injury Severity Score in children and adults with pelvic fractures.

ISS	Age group (years)		>65	P value (children vs. adults 15–64 years old)
	0–14	15–64		
1–8	309 38.1%	2108 31.0%	3047 68.5%	<0.0001
9–14	174 21.4%	1713 25.1%	706 15.9%	0.02
16–24	131 16.1%	1143 16.8%	278 6.3%	0.6371
25–75	198 24.4%	1845 27.1%	417 9.4%	0.0991
Total	812	6809	4448	

P = 0.0005.

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