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Predictors of mortality after pelvic fractures: a retrospective cohort study from a level one trauma centre in Upper Egypt

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Abstract

Purpose The primary objective was to identify the predictors of in-hospital mortality after pelvic ring injuries. Secondary objectives were to analyze the differences between adults and children and to analyze the causes and timing of death.

Methods A retrospective cohort study from the pelvic registry of Assiut University Trauma Unit (AUTU), a level 1 trauma centre in Upper Egypt, was carried out. A total of 1188 consecutive patients with pelvic ring fractures treated from January 2010 to December 2013 were eligible for analysis. Potential predictors were identified using standard statistical tests: univariable and multivariable regression analysis.

Results Nine hundred fifty-one were adults (above 16 years) and 237 were children. According to Tile's classification, fractures type A, B, and C were 31.8%, 25.1%, and 43.1%, respectively. About a third of patients had fractures with soft tissue injury. Abdominopelvic collection as diagnosed by Focused Assessment with Sonography for Trauma (FAST) was positive in 11%. Associated injuries were present in 67.3% with abdominal-urogenital injuries being the most prevalent (66.3%). Median hospital stay was five days. Fifty-two patients (4.4%) were admitted to the ICU. One hundred three patients died (8.7%) within two peaks: first 24 hours and between 48 hours and one week. Multivariable logistic regression analysis identified increasing age, fractures with soft tissue injury, associated head injury, positive FAST examination, and admission to an ICU as significant predictors of in-hospital mortality.

Conclusions The first 24 hours were confirmed to be critical for survival in pelvic fracture patients. Advancing age, associated soft tissue injury, associated head injury, admission to ICU, and positive FAST examination can serve as reliable predictors for an elevated mortality risk in such patients.

Keywords Pelvic fractures · Mortality · Predictors · Trauma registry

Introduction

Pelvic fractures have a reported incidence of 3–8% among all fractures [1–3], which increases in poly-trauma patients up to 25% [3–6]. Substantial morbidity and mortality have been reported to result from pelvic fractures [7–9]. Analyzing the mortality rate and its causes after pelvic fracture serves two main purposes: First, it helps to identify patients at high risk, which is crucial to guide the initial management of these patients, usually done by first respondents and trauma residents. Identifying "red flags" can help address issues or apply preventive measures more efficiently. Secondly, in-hospital mortality, apart from being an indicator for injury severity, mainly reflects the standards of care in a given trauma centre. This is particularly important for decision makers when auditing their protocols of injury management and comparing their figures with the regional and international standards of care.

Literature about the demographics of pelvic fractures in the Middle East is currently scarce. Analyzing the causes of mortality from pelvic fractures in this region would provide the missing information and help to evaluate the standards of care

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of this serious injury in Middle Eastern countries. Unlike pelvic fractures in adults, paediatric pelvic fractures are not well documented in the literature [10–12].

We analyzed a large cohort of pelvic ring fractures within our Pelvic Injury Registry with the primary objective to identify the predictors of in-hospital mortality. Our secondary objectives were to analyze the differences between adults and children and to analyze the causes and timing of death.

Methods

Study design

A retrospective cohort study was carried out for all pelvic fracture patients admitted to Assiut University Trauma Unit (AUTU), a level 1 trauma centre in Upper Egypt. Our unit provides trauma healthcare to over 30,000 patients per year. In 2010, a Pelvic Injury Registry was developed to document treatment and outcomes in a standardized manner. All patients admitted to AUTU sign an informed consent form to permit using their data for research purposes. Patients' data were prospectively collected and stored in a local database specifically designed for this purpose. The study was approved by the Ethical Committee Board of the Faculty of Medicine of Assiut University.

Selection of patients

A total of 1773 consecutive patients with pelvic ring fractures treated from January 2010 to December 2013 were identified. To determine the predictors of mortality due to pelvic fractures, patients with penetrating injuries, with firearm injuries, and with isolated acetabular fractures were excluded. Only patients who were first-time admissions and patients whose treatment was completed at our hospital were included because only for these patients, the discharge status was unequivocally known. Patients who decided to self-discharge against the medical advice, or whose treatment was continued at another hospital, or who were re-admitted were excluded. In total, 585 cases were excluded: 20 firearm injuries, 204 with missing final discharge status due to hospital transfer or voluntary discharge, and 361 with isolated acetabular fractures. Finally, 1188 patients were considered eligible for analysis. These were further divided into an adult cohort with an age above 16 years (951 patients) and a pediatric cohort (237 patients). Figure 1 shows a flowchart of patient selection.

Data collection and outcome measures

Data collection to identify potential predictors for mortality included age, gender, mechanism of injury, fracture classification according to Tile into types A (stable), B, and C (unstable) [13], location of associated injuries, presence of pelvic ring soft tissue injury at admission, admission to an intensive care unit (ICU), the dates of admission and discharge to calculate the length of hospital stay, and presence of abdominopelvic collection as diagnosed by Focused Assessment with Sonography for Trauma (FAST) at admission. FAST could either be negative or positive. Mild/moderate or marked collection were classified as positive.

The primary outcome measure was in-hospital mortality among patients who had sustained a pelvic fracture. In-hospital mortality was defined as death during the hospital stay after the first admission for a pelvic fracture.
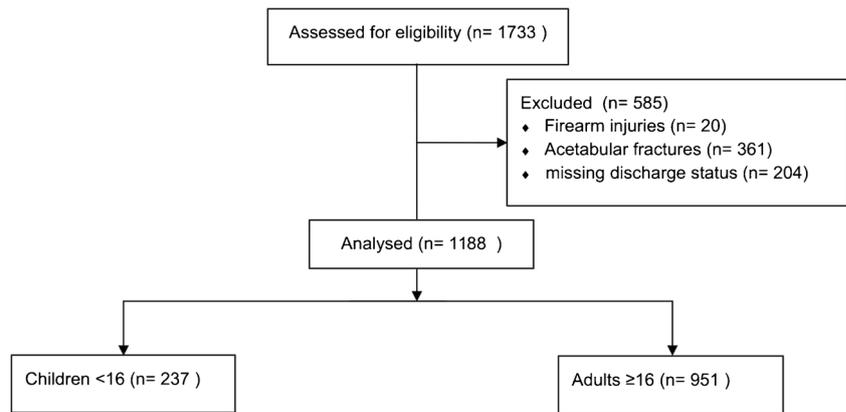
Statistical analysis

Demographic-, injury-, and treatment-related data are presented with the use of standard descriptive statistics (mean and standard deviation for normally distributed continuous variables; median and interquartile range (Q1; Q3) for non-normally distributed continuous variables; absolute numbers and percentages for categorical variables). In order to investigate possible associations of patient characteristics with in-hospital mortality after pelvic injury, univariable analyses using Student's t test, Fisher's exact test, chi-squared test, and Mann-Whitney test were performed as appropriate, in the cohorts of adult and paediatric patients as well as in the overall population. Subsequently, multivariable logistic regression analysis was performed to identify possible predictors of in-hospital mortality. Due to the relatively low number of deaths in the paediatric population, the logistic regression model was developed in the overall population instead of the individual cohorts. The multivariable model included all variables of the univariable analysis except for mechanism of injury and pelvic ring fracture type (A, B, or C); the reason for this exclusion was the presence of substantive collinearity. Of the associated injuries, only the three most frequent types (abdominal-urogenital, head, and chest) were included. The significance level was set at $p < 0.05$. The statistical analysis was conducted using the statistical software Stata version 13 (Stata Corporation, College Station, TX, USA).

Results

Patient characteristics

Demographic, injury, and treatment characteristics are presented in detail in Table 1.

According to Tile's classification, the overall percentages of fractures type A, B, and C were 31.8%, 25.1%, and 43.1%, respectively. However, the paediatric group showed a slightly higher incidence of type C and lower incidence of type B

Fig. 1 Flowchart of patient selection

Assessed for eligibility (n= 1733)

Excluded (n= 585)
- Firearm injuries (n= 20)
- Acetabular fractures (n= 361)
- missing discharge status (n= 204)

Analysed (n= 1188)

Children <16 (n= 237)

Adults ≥16 (n= 951)

fractures compared to adults. Nearly a third (31.8%) of all patients had a stable fracture, with no striking differences between the two groups.

About a third of patients had fractures with soft tissue injury, regardless of the population group. Among all patients, 131 (11.0%) had a positive FAST examination for abdominopelvic collection. This was more than twice as high in children compared with adults (19.4% versus 8.9%).

Associated injuries were present in 64.9% and 77.2% of adults and children, respectively. Abdominal-urogenital injuries were the most prevalent (66.3%), while face (3.2%) and external (1.2%) injuries were least common. Chest and head injuries occurred in 15.7% and 14.1% of patients, respectively. Median hospital stay was five days in the total sample of 1188 patients, with a maximum value of 214 and 192 days in adults and children, respectively. Fifty-two patients (4.4%) were admitted to the trauma unit ICU; of these, 25 patients (48% of ICU admissions) were admitted to the ICU because of associated head injury with GCS scale less than or equal to 10. All adult patients with pelvic fractures in our institute had received thromboprophylaxis in the form of subcutaneous low molecular weight heparin. Accordingly, no cases of in-hospital DVT were reported.

Patterns of in-hospital mortality: Univariable analysis

Table 2 presents the distribution of patient characteristics between survivors and non-survivors in each study population.

In adults, the in-hospital mortality was associated with age ($p < 0.001$), stable pelvic fractures ($p = 0.011$), soft tissue injury ($p < 0.001$), associated injuries ($p < 0.001$), a positive FAST examination ($p < 0.001$), and ICU admission ($p < 0.001$).

In children, in-hospital mortality was significantly associated with pelvic ring soft tissue injury ($p = 0.004$), a positive FAST examination ($p = 0.007$), and ICU admission ($p < 0.001$).

Predictors of in-hospital mortality: multivariable analysis

Increased age, fractures with soft tissue injury, positive FAST examination, associated head injury, and ICU admission were identified as predictors of in-hospital mortality (Table 3). The risk of in-hospital mortality was found to increase by 17% for a five year increase in age (OR = 1.17; 95%CI 1.10–1.25; $p < 0.001$). Patients with soft tissue injury compared to patients without such injuries and patients with a positive FAST examination, compared to those with a negative FAST examination, were almost 2.5 times more likely to die during hospitalization. The risk to die was dramatically increased (12.8-fold) in patients who had been admitted to intensive care (OR = 12.89; 95%CI 6.31–26.33; $p < 0.001$). Regarding the major associated injuries, abdominal-urogenital and chest injuries were not found to be associated with in-hospital mortality; however, head injury was identified as a predictor, leading to a five fold increase in risk of in-hospital mortality (OR = 4.94; 95%CI 6.31–26.33; $p < 0.001$).

Time to death

Figure 2 depicts the time to death during the hospital stay. Among the 103 patients who died, 79 (76.7%) died within the first week following hospital admission. Thirty-four (33.0%) patients died within the first 24 hours, 14 (13.6%) between 24 and 48 hours, 31 (30.1%) between 48 hours and one week after admission, 14 (13.6%) during the second week of hospital stay, and the remaining 10 (9.7%) died at a later time point.

Discussion

Predictors of mortality

The present study analyzed data from our Pelvic Injury Registry with the main aim of identifying predictors of in-hospital mortality after pelvic ring fractures.

Table 1 Demographic, injury, and treatment-related characteristics of pelvic ring injuries in adult and pediatric patients admitted to AUTU, 2010–2013

Characteristic	Population group		
	Adult ($N = 951$)	Pediatric ($N = 237$)	Total ($N = 1188$)
Age (years)	36.6 ± 15.9	9.9 ± 4.6	31.2 ± 17.9
Gender			
Male	695 (73.1)	155 (65.4)	850 (71.5)
Female	256 (26.9)	82 (34.6)	338 (28.5)
Mechanism of injury[a]			
Motor car/motorcycle accident	535 (56.3)	123 (51.9)	658 (55.4)
Fall from a height	244 (25.7)	67 (28.3)	311 (26.2)
Ground-level fall	81 (8.5)	23 (9.7)	104 (8.7)
Train accident	5 (0.5)	1 (0.4)	6 (0.5)
Other	86 (9.0)	23 (9.7)	109 (9.2)
Tile's pelvic fracture type			
A	294 (30.9)	84 (35.4)	378 (31.8)
B	261 (27.4)	37 (15.6)	298 (25.1)
C	396 (41.6)	116 (49.0)	512 (43.1)
Fracture stability			
Stable (type A)	294 (30.9)	84 (35.4)	378 (31.8)
Unstable (type B and C)	657 (69.1)	153 (64.6)	810 (68.2)
Pelvic ring soft tissue status			
Without soft tissue injury	639 (67.2)	166 (70.0)	805 (67.8)
With soft tissue injury	312 (32.8)	71 (30.0)	383 (32.2)
Positive FAST examination			
No	866 (91.1)	191 (80.6)	1057 (89.0)
Yes (mild/moderate/marked)	85 (8.9)	46 (19.4)	131 (11.0)
Associated injuries			
No	334 (35.1)	54 (22.8)	388 (32.7)
Yes[b]	617 (64.9)	183 (77.2)	800 (67.3)
Abdominal-urogenital	606 (63.7)	182 (76.8)	788 (66.3)
Chest	157 (16.5)	30 (12.7)	187 (15.7)
Face	32 (3.4)	6 (2.5)	38 (3.2)
Head	126 (13.2)	41 (17.3)	167 (14.1)
External	11 (1.2)	3 (1.3)	14 (1.2)
Length of hospital stay (days)	5 (2; 10)	4 (2; 9)	5 (2; 10)
Stay in intensive care unit			
No	913 (96.0)	223 (94.1)	1136 (95.6)
Yes	38 (4.0)	14 (5.9)	52 (4.4)
Condition at discharge			
Survived	865 (91.0)	220 (92.8)	1085 (91.3)
Not survived	86 (9.0)	17 (7.2)	103 (8.7)

Data are presented as mean ± SD, N (%), or median (Q1; Q3)

[a] "Other" consists of patients whose trauma was due to assault ($n = 26$), heavy object ($n = 72$), animal attack ($n = 5$), and unspecified reason ($n = 6$)

[b] The same patient can contribute to more than one category

The multiple logistic regression analysis was performed for the complete population and identified increasing age, fractures with soft tissue injury, associated head injury, positive FAST examination, and admission to an ICU as highly significant predictors of in-hospital mortality. Age, soft tissue injury, and concomitant injuries have also been reported as risk factors for death in pelvic fracture patients by other researchers [4, 14, 15]. In an attempt to understand which type of associated injury had the worst prognosis, we divided them into different subtypes. The three most frequent subtypes were

Table 2 Demographic, injury, and treatment-related characteristics, according to in-hospital mortality after pelvic ring injuries in adult and paediatric patients admitted to AUTU, 2010–2013

Characteristic	Condition at discharge								
	Adult population ($N = 951$)			Paediatric population ($N = 237$)			Total ($N = 1188$)		
	Survived ($N = 865$)	Not survived ($N = 86$)	p value	Survived ($N = 220$)	Not survived ($N = 17$)	p value	Survived ($N = 1085$)	Not survived ($N = 103$)	p value
Age (years)	35.8 ± 15.7	44.2 ± 16.3	< 0.001[*]	10.0 ± 4.6	8.9 ± 4.8	0.367[*]	30.6 ± 17.5	38.4 ± 20.0	< 0.001[*]
Gender			0.584[†]			0.794[††]			0.450[†]
Male	630 (72.8)	65 (75.6)		143 (65.0)	12 (70.6)		773 (71.2)	77 (74.8)	
Female	235 (27.2)	21 (24.4)		77 (35.0)	5 (29.4)		312 (28.8)	26 (25.2)	
Mechanism of injury[a]			0.328[††]			0.395[††]			0.149[††]
Motor car/motorcycle accident	479 (55.4)	56 (65.2)		111 (50.5)	12 (70.5)		590 (54.4)	68 (66.0)	
Fall from a height	227 (26.2)	17 (19.8)		65 (29.5)	2 (11.8)		292 (26.9)	19 (18.4)	
Ground-level fall	75 (8.7)	6 (7.0)		22 (10.0)	1 (5.9)		97 (8.9)	7 (6.8)	
Train accident	4 (0.5)	1 (1.2)		1 (0.5)	0 (0.0)		5 (0.5)	1 (1.0)	
Other	80 (9.2)	6 (7.0)		21 (9.5)	2 (11.8)		101 (9.3)	8 (7.8)	
Fracture pelvic ring			0.012[†]			0.217[††]			0.025[†]
A	257 (29.7)	37 (43.0)		80 (36.4)	4 (23.5)		337 (31.1)	41 (39.8)	
B	247 (28.6)	14 (16.3)		36 (16.4)	1 (5.9)		283 (26.1)	15 (14.6)	
C	361 (41.7)	35 (40.7)		104 (47.2)	12 (70.6)		465 (42.8)	47 (45.6)	
Fracture stability			0.011[†]			0.431[††]			0.069[†]
Stable (type A)	257 (29.7)	37 (43.0)		80 (36.4)	4 (23.5)		337 (31.1)	41 (39.8)	
Unstable (type B and C)	608 (70.3)	49 (57.0)		140 (63.6)	13 (76.5)		748 (68.9)	62 (60.2)	
Pelvic ring soft tissue status			< 0.001[†]			0.004[††]			< 0.001[†]
Without soft tissue injury	596 (68.9)	43 (50.0)		160 (72.7)	6 (35.3)		756 (69.7)	49 (47.6)	
With soft tissue injury	269 (31.1)	43 (50.0)		60 (27.3)	11 (64.7)		329 (30.3)	54 (52.4)	
Positive FAST examination			< 0.001[†]			0.007[††]			< 0.001[†]
No	798 (92.3)	68 (79.1)		182 (82.7)	9 (52.9)		980 (90.3)	77 (74.8)	
Yes (mild/moderate/-marked)	67 (7.7)	18 (20.9)		38 (17.3)	8 (47.1)		105 (9.7)	26 (25.2)	
Associated injuries			< 0.001[†]			0.769[††]			< 0.001[†]
No	322 (37.2)	12 (14.0)		51 (23.2)	3 (17.6)		373 (34.4)	15 (14.6)	
Yes[b]	543 (62.8)	74 (86.0)		169 (76.8)	14 (82.4)		712 (65.6)	88 (85.4)	
Abdominal-urogenital	535 (61.8)	71 (82.6)		169 (76.8)	13 (76.5)		704 (64.9)	84 (81.6)	
Chest	121 (14.0)	36 (41.9)		28 (12.7)	2 (11.8)		149 (13.7)	38 (36.9)	
Face	25 (2.9)	7 (8.1)		4 (1.8)	2 (11.8)		29 (2.7)	9 (8.7)	
Head	88 (10.2)	38 (44.2)		32 (14.5)	9 (52.9)		120 (11.1)	47 (45.6)	
External	10 (1.2)	1 (1.2)		3 (1.4)	0 (0.0)		13 (1.2)	1 (1.0)	
Length of hospital stay (days)	5 (2; 10)	3 (1; 7)	0.001[$]	4 (2; 9)	2 (1; 7)	0.139[$]	5 (2; 10)	3 (1; 7)	< 0.001[$]
Stay in intensive care unit			< 0.001[†]			< 0.001[††]			< 0.001[†]
No	853 (98.6)	60 (69.8)		213 (96.8)	10 (58.8)		1066 (98.2)	70 (68.0)	
Yes	12 (1.4)	26 (30.2)		7 (3.2)	7 (41.2)		19 (1.8)	33 (32.0)	

Data are presented as mean ± SD, N (%), or median (Q1; Q3)

[a] "Other" consists of patients whose trauma was due to assault ($n = 26$), heavy object ($n = 72$), animal attack ($n = 5$), and unspecified reason ($n = 6$)

[b] The same patient can contribute to more than one category

p values were calculated using [*] Student's t test; [†] Chi-squared test; [††] Fisher's exact test; [$] Mann-Whitney test

Table 3 Results of multivariable logistic regression analysis evaluating the effect of demographic, injury, and treatment-related characteristics to in-hospital mortality after pelvic injury in patients admitted to AUTU, 2010–2013, using the overall sample of 1188 study patients

Variable	Category or increment	Odds ratio	95%CI	p value
Age	5-year increase	1.17	1.10–1.25	< 0.001
Gender	Males	Baseline		
	Females	1.00	0.59–1.72	0.988
Fracture stability	Stable	Baseline		
	Unstable	0.71	0.43–1.16	0.172
Pelvic ring soft tissue status	Without soft tissue injury	Baseline		
	With soft tissue injury	2.33	1.44–3.76	0.001
Collection on FAST examination	No	Baseline		
	Yes (mild/moderate/marked)	2.54	1.31–4.94	0.006
Abdominal-urogenital injury	No	Baseline		
	Yes	0.94	0.50–1.79	0.857
Chest injury	No	Baseline		
	Yes	1.56	0.89–2.74	0.118
Head injury	No	Baseline		
	Yes	4.94	2.88–8.46	< 0.001
Stay in intensive care unit	No	Baseline		
	Yes	12.89	6.31–26.33	< 0.001

The overall sample included in the model was 1188 study patients

included in the multivariable regression analysis, and only head injury was statistically significant predictor. Our results further show that the risk to die is significantly increased in patients with a positive FAST examination or who have been admitted to an ICU, namely 2.5- and 12.8-fold, respectively. In our population, the leading indication to ICU admission was the associated head injury (48% of ICU admissions), which is a significant risk factor for their death. These factors could thus serve as simple, rapid, and yet reliable prognostic factors in the setting of poly-trauma patients with pelvic fractures. Focused resuscitation protocols should be set, and trauma team activation are required to manage such vulnerable patients.
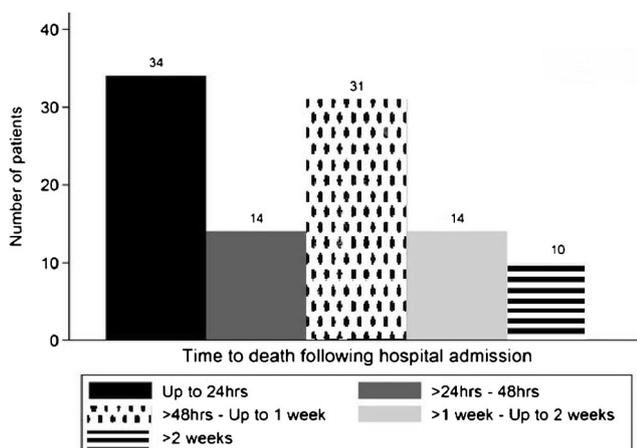

Fig. 2 Timing of in-hospital mortality. Distribution of the 103 deaths in relation to different time periods after hospital admission

On the other hand, we found no significant association between in-hospital mortality and gender, fracture pattern (classified as stable or unstable), and abdominal-urogenital or chest injuries. Gender has been studied as a predictor of mortality after pelvic injury with contrasting results [16–19], and fracture patterns are still under debate [4], as some studies have found a correlation between fracture patterns and risk of death [7, 15, 20, 21] but others have not [4, 22]. We attribute these apparently contradictory findings to differences in the respective patient populations, e.g., concerning severity of injury at presentation or inclusion of solely open-type injuries or elderly population, which make valid comparisons challenging.

The short hospital stay could be explained by the fact that about a third (31.8%) of our patients had type A fractures, which, together with most of paediatric injuries, were treated conservatively. This might have affected the results, giving an overall short hospital stay.

Only 52 patients were admitted to the trauma ICU for management of serious associated injuries such as severe head trauma and chest injuries. All other patients with haemodynamic instability were managed in an intermediate care service equipped for resuscitation of critically injured patients in the reception area with the same equipment of ICU except mechanical ventilation.

Timing of death

The first 24 hours after admission of a patient with a pelvic fracture are critical and have been used as the threshold to

distinguish between early and late mortality [7, 15, 16, 22–24]. This distinction is important because a considerable number of patients die within the first 24 hours mostly due to hemorrhagic events [7, 24, 25], whereas late mortality is more related to complications or comorbidities [24]. The reported rate of early mortality ranges from 30 up to 80%, depending on the patient population studied [7, 15, 16, 22–24, 26, 27]. In our setting, one third of all deaths occurred in the first 24 hours of admission with a second peak between 48 hours and the first week. These two peaks coincide with the pattern described in the treatment of polytrauma patients in the literature [28]. The first peak (within first hours) is related to shock events, and the second peak (2–5 days) coincides with the "second hit" that is related to surgical complications and associated with the release of inflammatory mediators.

In the first 24 hours, focused resuscitation, close monitoring, proper decision making by a senior trauma team leader, and implementing damage control policies might reduce the risk of death during the first peak. Alleviating the second peak effect could be achieved by minimizing the magnitude of surgical intervention that can aggravate the second hit in polytrauma patients.

Children compared to adults

Pelvic fractures in children are rare, with an estimated incidence of 2.7–4.6% [20, 29, 30] and have been less studied than in adults [10, 11, 27]. Defining the upper age limit to distinguish between pediatric and adult pelvic fractures remains a controversial issue. A recent review identified that the upper age limit to classify pelvic trauma as "paediatric" ranged between 14 and 20 years in the currently available literature [20]. Similar to other studies [30, 31], we considered the cut-off age for the paediatric group as 16 years and we provide a comprehensive comparison between the adult and the paediatric cohorts. Our study population consisted of 80% adults and 20% children with similar mortalities. Children had a lower incidence of type B fractures, nearly twice the chance of a positive FAST examination, and more associated injuries than adults. Due to the low number of deaths in children it was not possible to perform a multivariate analysis in this age group. The univariate analysis was performed separately for each age group and identified the presence of soft tissue injury, a positive FAST, and admission to an ICU as significant predictors of mortality in children compared with age, fracture stability, soft tissue injury, associated injuries, length of hospital stay, and admission to an ICU for adults.

Impact of the study

Pelvic fractures are typically the result of high-energy trauma and are often caused by road traffic accidents. The Middle East was reported to be a hot zone of road traffic accidents [32]. This is the largest series reporting pelvic fractures from the Middle East to date. Notably, more than half of our cases, both in adults and in children, were due to road traffic accidents, a preventable aetiology with great impact on morbidity and mortality. In addition, our patient population consisted mainly of males with a mean age of 31.2 years; the youngest population when compared to UK, Germany, USA, and Taiwan [4, 15, 18, 33], and which from an economic perspective would be expected to have a greater impact on productivity. In the first four years of our registry, we had an average patient load of 297 pelvic fractures per year. In the light of our results, enforcing policies and preventive measures destined to increase road traffic safety seems to be of paramount importance in our country.

Strengths and limitations

Strengths of this study include the large number of patients treated in the same centre by a dedicated team. A single dedicated team is expected to employ a uniform standard of care and hence provide more reliable results. A second strength is that this is the largest report of pelvic injuries from the Middle East.

The limitations of our work are the retrospective nature of the study (Level III, Prognostic study), the lack of blood transfusion data, and the exclusion of many patients for whom the discharge status was unknown. Although our study was not prospective, it is based on a prospective data collection from a database that comprises all patients admitted to our hospital, thereby reliably generating a consecutive patient series with a well-defined indication. This set-up minimized potential bias that is otherwise common in retrospective studies. The lack of blood transfusion data is another important limitation, because this parameter has been identified as a significant mortality predictor in previous studies [18, 34]. Since some of our patients were transferred from distant areas with unclear data about the blood products they were given, it was impossible to have reliable transfusion data. In order to avoid confounding, we chose not to include the transfusion data into the analysis.

Regarding the exclusion of patients whose discharge status was unclear because their treatment was not completed in our hospital, the reason for this was that by comparing the mortality rates of our study to other registries, we aimed at determining the quality of our level of care. Including patients who did not complete their treatment at our hospital would have confounded the results. So, we deemed it more important to gain an understanding of the level of care we can provide at the expense of including a larger patient population, albeit with less reliable endpoint data.

Likewise, we did not include any information about the cause of death, because this can only be unequivocally

determined by an autopsy and this is not done on a routine basis in our hospital.

Conclusion

This study represents the largest series of pelvic ring fractures reported from the Middle East and provides comparisons with registries from different countries. Despite the high patient load, the reported mortality rate in this series falls within an acceptable range compared with figures from registries of developed countries.

The first 24 hours was confirmed to be critical for survival in pelvic fracture patients, so this should warrant more attention in the resuscitation and assessment phase of management. Advancing age, associated soft tissue injury, associated head injury, positive FAST examination, and admission to ICU can serve as reliable predictors for an elevated mortality risk in pelvic fracture patients.

Compliance with ethical standards

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