

Pelvic fractures as a marker of injury severity in trauma patients

Fratura de pelve: um marcador de gravidade em trauma

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A B S T R A C T

Objective: To assess whether the presence of a pelvic fracture is associated with greater severity and worse prognosis in victims of blunt trauma. **Methods:** A retrospective analysis of protocols and records of victims of blunt trauma admitted from June 2008 to March 2009 was separated into two groups: those with pelvic fracture (Group I) and those without it (Group II). Data were collected from pre-hospital admission rates of trauma, laboratory tests, diagnosed lesions, treatment and outcome. We used the Student t test, Fisher's exact test and chi-square test for statistical analysis, considering $p < 0.05$ as significant. **Results:** During the study period, 2019 individuals had multiple trauma protocols completed, of which 43 (2.1%) had pelvic fractures. Patients in Group I had significantly lower average blood pressure, higher mean heart rate, lower mean Glasgow Coma Scale, the highest average AIS in the segments head, chest, abdomen and extremities, as well as higher mean ISS and lower mean TRISS and RTS on admission. Group I more frequently presented with traumatic subarachnoid hemorrhage (7% vs. 1.6%), spinal cord injury (9% vs. 1%), thoracic and abdominal injuries, as well as need for laparotomy (21% vs. 1%), chest drainage (32% vs. 2%) and damage control (9% vs. 0%). Complications were more frequent in group I: ARDS (9% vs. 0%), persistent shock (30% vs. 1%), coagulopathy (23% vs. 1%), acute renal failure (21% vs. 0%) and death (28% vs. 2%). **Conclusion:** The presence of a pelvic fracture is a marker of greater severity and worse prognosis in victims of blunt trauma.

Key words: Fractures, bone. Pelvis. Shock, traumatic. Hemorrhage. Mortality.

INTRODUCTION

Pelvic fractures usually result from high energy trauma and in approximately 90% of cases there are associated injuries^{1,2}. At least a frontal impact of 50 km / h or a side impact of 40 km / h is needed to compromise the integrity of the pelvic ring⁴. In about 72% of cases fractures occur in compact vehicles, increasingly common in congested urban areas^{5,6}. Considering all traumatic fractures, the bones of the pelvis are affected in only 3% of the time⁷. About 10% of pelvic fractures can be classified as "complex", characterized by mechanical and/or hemodynamic instability and lesions on other body segments⁷.

The incidence of pelvic fracture in large urban centers is approximately 23 per 100,000 and mortality varies from 4 to 23%⁸⁻¹³. In some studies, it is observed that up to 60% of deaths occur in the actual crash site¹⁴. It is believed that retroperitoneal bleeding associated with pelvic fracture is responsible for 7-33% of deaths^{8,9,10,15}. When there is an association of complex fractures and severe in-

juries in other body segments, such as the skull and abdomen, the fatality rate can reach 50%^{1,10,16}.

Advances in prehospital care, together with the development of a multidisciplinary approach to trauma with pelvic fractures, are responsible for the decreased morbidity and mortality seen in recent years¹⁷⁻¹⁹. The rapid control of retroperitoneal hemorrhage by early external fixation and angiography with embolization, associated with the development of protocols for transfusion and damage control, are some of the most important aspects in the care of these patients^{7,11,14-25}.

With these advances, we found that deaths caused by retroperitoneal hemorrhage alone became less frequent and that many deaths are caused by concomitant injuries, especially to the head^{2,26}. This is especially true in patients with stable fractures of the pelvis. Thus, one wonders to what extent the presence of a pelvic fracture determines a poorer prognosis in trauma.

The objective of this study is to evaluate if the presence of a pelvic fracture is associated with greater

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severity and a worse prognosis in victims of blunt trauma.

METHODS

This study was approved by the Ethics Committee of the Brotherhood of Santa Casa de Misericórdia de São Paulo (ISCMSP) (Project 024/10).

In the Emergency Department of ISCMSP prospective data are collected on all trauma cases admitted to the emergency room since June 2008. This protocol is initially filled by residents of surgery at the admission of the patient and later by the Assistant Physicians of the end Service, until discharge. Data is collected for identification, mechanism of trauma, pre-hospital data, vital signs at admission, rates of trauma, complementary tests, diseases, injuries diagnosed and treated.

In this study, we conducted a retrospective analysis of protocols collected from October 6th, 2008 to October 3rd, 2009. We included all blunt trauma victims older than 13 years of age. For analysis, We considered all variables recorded in more than 90% of the protocols. Stratification of gravity of the sample was performed by trauma indices Glasgow Coma Scale (GCS)²⁷, Revised Trauma Score (RTS)²⁸, Abbreviated Injury Scale (AIS)²⁹, Injury Severity Score (ISS)³⁰ and TRISS³¹. We considered as "severe" the injuries with AIS score greater than or equal to three. We used the Key and Conwell classification modified by Kane for the evaluation of pelvic fractures: grade I, fractures without involvement of the pelvic ring; grade II, with solution of the pelvic ring at one point; grade III, with solution at more than one point; and grade IV, acetabular fractures³².

The traumatized were separated into two groups: those with pelvic fractures (Group I) and the other (Group II). Patients with isolated fractures of the acetabulum were allocated to group II. To evaluate the severity of patients with pelvic fractures, the variables were compared between groups. For statistical analysis, we used the Statistical

Package for Social Sciences 16.0, with application of the Student t, chi-square and Fisher tests for comparison between groups, considering the value of $p < 0.05$ as significant.

RESULTS

During the study period, 2019 trauma protocols were completed, of which 43 (2.1%) recorded pelvic fractures (Group I). The overall mean age was 37.8 ± 16.1 years; 1537 were men and 482 women. In Group I, mean age was 39.2 ± 15.6 years, comprising 31 men and 12 women.

Mechanism of trauma

In patients in Group I, the most common trauma mechanism was running over, followed by falls from height, accidents with drivers or passengers of motorcycles, accidents with car drivers or passengers and fall of one's own height. In Group II, the most frequent mechanism was an accident with a motorcycle drivers or passengers, followed by running over, falling from one's own height, falls from height, physical assault and motor vehicle accident (Table 1).

Condition on admission, rates of trauma and fracture classification

As for the parameters evaluated at admission, patients with pelvic fractures had significantly lower mean systolic blood pressure, higher mean heart rate and lower average Glasgow coma scale than the traumatized without this type of injury. We also noticed that the traumatized group I received a larger volume of crystalloid and packed red blood cells at admission (Table 2).

The assessment of trauma indices showed that those with pelvic fractures had significantly higher mean AIS in the head, chest, abdomen and extremities, as well as higher average ISS. They also showed lower mean RTS and lower mean probability of survival (TRISS) (Table 3).

Of the 43 patients with fractures, 41 were classified according to Key and Conwell modified by Kane,

Table 1 - Mechanism of trauma in patients with (Group I) and without fracture of the pelvis (Group II).

Mechanism	Group I n (%)	Group II n (%)
Automobile	2 (4.7%)	182 (9.2%)
Running over	17 (39.5%)	439 (22.1%)
Motorcycle	11 (25.6%)	537 (27.2%)
Fall	12 (27.9%)	245 (12.4%)
Fall from own's height	1 (2.3%)	296 (15.1%)
Assault	0	212 (10.5%)
Unclassified	0	65 (3.3%)
Total	43 (100%)	1976 (100%)

$p = 0.001$ in comparison between groups I and II.

as follows: 21 as grade I, 10 as grade II and 10 as grade III (Table 4).

Associated Injuries

Group I had significantly higher frequency of traumatic subdural hemorrhage, spinal cord injury, hemothorax, pneumothorax, rib fractures, pulmonary contusion and lesions of the spleen, liver, kidney and bladder (Table 5).

Treatment

Patients in group I were more often subjected to non-operative treatment of injuries of abdominal parenchymal organs (liver, spleen and kidney) and angiography diagnosis / therapy. Some surgical procedures were also more frequent in patients with pelvic fractures trauma, such as thoracic drainage (32.6% vs. 1.9%), laparotomy and damage control (9% vs. 1%) (Table 6).

Complications and mortality

Twenty-two (51.2%) patients in group I required intensive care beds, compared with 69 in group II (3.5%). Group I had significantly higher incidence of complications:

acute respiratory distress syndrome (ARDS) (9.3% vs. 0.6%), persistent shock (30.2% vs. 0.7%), coagulopathy (23.3% vs. 0.8%), failure of multiple organs and systems (16.3% vs. 0.3%), acute renal failure (20.9% vs. 0.4%) and sepsis (20.9% vs. 1.6%). The mortality rate was 27.9% in group I, compared to only 1.8% in group II.

DISCUSSION

Pelvic fractures usually result from trauma and high kinetic energy, often associated with injuries in other body segments. In our study about 2.1% of blunt trauma victims had fractures of the pelvis, which coincides with that observed in another study, the incidence approaching 3%⁷. When evaluating only the patients with pelvic fractures, we note that severe associated injuries are more frequent than hemodynamic instability by retroperitoneal hemorrhage. However, the mortality of trauma patients with complex pelvic fractures admitted in shock is high. Thus, the severe and potentially fatal bleeding associated with pelvic fractures persist as a serious problem, although less frequent.

Table 2 - Parameters of patients with (Group I) and without (Group II) fracture of the pelvis at admission.

Variables	Group I N=43 mean ± SD		Group II N=1976 mean ± SD		p
	SBP admission	107.9 ±	48 mmHg	128.1 ±	
HR admission	101 ±	21.6 bpm	82.5 ±	13.2 bpm	0.000
RF admission	18 ±	9.4 ipm	17.1 ±	3.8 ipm	0.524
Glasgow admission	12.1 ±	4.3	14.3 ±	2.1	0.002
Hb saturation admission (Oximeter)	90.9 ±	12.3 %	96.3 ±	3.4 %	0.034
Crystalloids admission	2.980.7 ±	1.769 ml	1.405.7 ±	1.153.4 ml	0.000
CH admission	251.1 ±	523.4 ml	2.7 ±	39.2 ml	0.003

SD: standard deviation; SBP: systolic blood pressure; HR: heart rate; RF: respiratory frequency; Hb: hemoglobin; CH: concentrated red blood cells. bpm: beats per minute; ipm: respirations per minute.

Table 3 - Indexes in patients with trauma (Group I) and without fracture of the pelvis (Group II).

Variables	Group I N=43 mean ± SD		Group II N=1976 mean ± SD		p
	AIS head	1.58 ±	1.8	0.58 ±	
AIS chest	1.41 ±	1.6	0.14 ±	0.6	<0.001
AIS abdomen	1.13 ±	1.6	0.08 ±	0.5	<0.001
AIS extremities	3.37 ±	1.6	0.95 ±	1.2	<0.001
ISS	26.72 ±	14.6	4.57 ±	7.4	<0.001
RTS	6.72 ±	2.11	7.70 ±	0.77	0.012
TRISS	0.80 ±	0.32	0.98 ±	0.07	0.007

SD: standard deviation; AIS: Abbreviated Injury Scale; ISS: Injury Severity Score; RTS: Revised Trauma Score; TRISS: Trauma and Injury Severity Score

Table 4 - Classification of patients with fractures of the pelvis (Group I) according to Key and Conwell³² modified by Kane.

Degree of fracture	n	%
I	21	48.8%
II	10	23.2%
III	10	23.2%
Unclassified	2	4.6%

In 2007, Lunsjo *et al.*¹⁶, published a study of 100 patients with pelvic fractures consecutively admitted to two trauma centers in the United Arab Emirates. In their analysis, the majority (77%) was related to traffic collisions, which is also described in other samples^{5,6}. In our study, the most frequent mechanisms of trauma were running overs (39.5%), falls (27.9%) and accidents involving motorcycle drives and passengers (25.6%). In previous studies, we noted that running overs were also frequent, which is not found in studies from developed countries⁹. The mechanisms of

Table 5 - Associated Injuries in patients with and without fracture of the pelvis.

Variables	Group I n=43 n (%)	Group II n=1976 n (%)	p
Subdural hematoma	2 (4.7)	22 (1.1)	0.091
Traumatic ASH	3 (7.0)	31 (1.6)	0.034
Diffuse axonal injury	2 (4.7)	16 (0.8)	0.055
Skull base fracture	3 (7.0)	37 (1.9)	0.051
Spinal injury	4 (9.3)	22 (1.1)	0.002
Hemothorax	13 (30.2)	24 (1.2)	< 0.001
Pneumothorax	10 (23.3)	34 (1.7)	< 0.001
Rib fracture	14 (32.6)	61 (3.1)	< 0.001
Flail chest	2 (4.7)	20 (1.0)	0.078
Pulmonary contusion	10 (23.3)	28 (1.4)	< 0.001
Thoracic drainage	14 (32.6)	37 (1.9)	< 0.001
Liver injury	3 (6.9)	20 (1.0)	< 0.001
Splenic injury	6 (13.9)	20 (1.0)	< 0.001
Renal injury	2 (4.7)	8 (0.4)	< 0.001
Bladder lesion	2 (4.7)	0 (0)	< 0.001
Fracture of upper limbs	8 (18.6)	90 (4.6)	0.001
Fracture of lower limbs	6 (14.0)	97 (4.9)	0.020
Exposed fracture of upper limbs	4 (9.3)	20 (1.0)	0.001
Exposed fracture of lower limbs	6 (14.0)	65 (3.3)	0.003

ASH: Acute subdural hemorrhage.

Table 6 - Procedures carried out in patients with (Group I) and without (Group II) fracture of the pelvis.

Variables	Group I n=43 n (%)	Group II n=1976 n (%)	p
Thoracotomy	1 (2.3)	3 (0.2)	0.083
Non-operative treatment of injury to abdominal organs	9 (20.9)	26 (1.3)	< 0.001
Arteriography	5 (11.6)	4 (0.2)	< 0.001
Laparotomy	9 (20.9)	23 (1.2)	< 0.001
Non-therapeutic laparotomy	7 (16.3)	11 (0.6)	< 0.001
Pelvic external fixation	9 (20.9)	0 (0)	< 0.001

injury associated with pelvic fractures depends on several factors and we believe that, by regional characteristics, the care of victims of pedestrian accidents have been more frequent in our service.

The severity of the trauma with fractures of the pelvis is evident already at admission. We observed a lower mean systolic blood pressure, higher mean heart rate and lower average RTS and Glasgow coma scale. In other studies, it was observed that 30-46% of pelvic fractures in trauma patients require blood transfusions³³. Approximately 70% of patients will receive up to four units of packed red blood cells and, in unstable fractures with open book type, 40% receive at least 10 packed red blood cells.

In our study, there was significant difference between groups when evaluating rates of trauma (ISS, RTS, AIS head, AIS chest, AIS abdomen and AIS extremities) and the frequency of specific injuries, such as traumatic subdural hemorrhage, spinal cord injuries, chest injuries and abdominal injuries. This makes it clear that the presence of a fractured pelvis identifies a traumatized of worse prognosis. We do not believe that the fracture of the pelvis is responsible for worse outcome in all cases, but its presence is associated with a large power dissipation and concomitant injuries, which determine a worse prognosis. Other studies have reported that the associated lesions may be the main prognostic factor in these patients^{2,10,16}. We believe that this is true in traumatized with stable fractures of the pelvis. On the other hand, in patients with unstable pelvic fractures, the severity of the fracture is apparently associated with the volume of retroperitoneal bleeding and prognosis¹³.

In a previous study of our service, we evaluated 224 patients with fractures of the pelvis and its relationship to abdominal injuries²⁶. The most affected organs were bladder (11%), spleen (8%), liver (7%), urethra (6%) and kidneys (3%). In our present study, the major abdominal / pelvic organs injured were the spleen (13.9%), liver (6.9%), kidney (4.7%) and bladder (4.6%). Hauschild *et al.*¹⁰, analyzing 386 trauma victims with fractures of the pelvis, observed the following: retroperitoneal hematoma (38%), injuries of bladder (36%), urethra (18%), unilateral (18%) or bilateral sacral plexus (5%), pelvic vessels (13%), intestines (12%) and

perineum (12%). Those with associated lesions had significantly higher mortality (21.7% vs. 3.6%). We did not find variables that could justify the lower incidence of bladder injury in our study.

In our analysis, there was significant difference between groups as for complications. The traumatized by pelvic fractures had a higher frequency of ARDS, persistent shock, coagulopathy, multiple organ and systems failure, acute renal failure and sepsis. Some studies evaluated the prognostic factors in trauma with fractures of the pelvis and in them the severity of the fracture was not considered a significant factor^{2,10,16}. Probably the frequency of unstable pelvic fractures with active bleeding was not as high as the presence of severe injuries to other body segments. Therefore, when considering all traumatized by pelvic fractures, the severity of the fracture may not have reached statistical significance. However, the severity of a patient with a complex fracture and hemodynamic instability can not be overstated, since it is a situation which is highly lethal and still one of the biggest challenges in this area.

In the literature, we found reports of mortality in this group of patients ranging from 4% to 50%^{8,10}. This wide variation is secondary to the several different possible presentations of trauma patients with pelvic fractures. Rarely a traumatized with a stable pelvic fracture and without associated lesions will not progress well, while the combination of unstable fracture, shock and severe neurological injuries are highly lethal. In our study, the mortality found in patients with pelvic fractures was 27.9%, which is significantly greater than that observed in previous studies of our service. However, the probability of survival in this group was 0.80. We believe that this increase in mortality is related to the greater complexity of the attended traumatized, and also with the higher frequency of complex fractures in this study.

In summary, the presence of a pelvic fracture can be considered as a marker of severity of trauma. Its simple diagnosis leads us to actively investigate associated lesions, suppose the presence of retroperitoneal bleeding and, when facing hemodynamic instability, take immediate steps for the transfusion of blood products, identification of hemorrhagic focus and control.

R E S U M O

Objetivo: avaliar se a presença de fratura de pelve é associada à maior gravidade e pior prognóstico em vítimas de trauma fechado.

Métodos: análise retrospectiva dos protocolos e prontuários das vítimas de trauma fechado admitidas de 10/06/2008 a 10/03/2009, separadas em dois grupos: com fratura de pelve (Grupo I) e os demais (Grupo II). Foram avaliados dados do pré-hospitalar e admissão, índices de trauma, exames complementares, lesões diagnosticadas, tratamento e evolução. Utilizamos os testes t de Student, Fisher e qui-quadrado na análise estatística, considerando $p < 0,05$ como significativo. **Resultados:** No período de estudo, 2019 politraumatizados tiveram protocolos preenchidos, sendo que 43 (2,1%) apresentaram fratura de pelve. Os doentes do grupo I apresentaram, significativamente, menor média de pressão arterial sistêmica à admissão, maior média de frequência cardíaca à admissão, menor média da escala de coma de Glasgow, maior média nos AIS em segmentos cefálico, torácico, abdominal e extremidades, bem como, maior média do ISS e menor média de RTS e TRISS. O grupo I apresentou, com maior frequência, hemorragia subaracnoidea traumática (7% vs. 1,6%), trauma raquimedular (9% vs. 1%), lesões torácicas e abdominais, bem como

necessidade de laparotomias (21% vs. 1%), drenagem de tórax (32% vs. 2%) e controle de danos (9% vs. 0%). As complicações foram mais frequentes no grupo I: SARA (9% vs. 0%), choque persistente (30% vs. 1%), coagulopatia (23% vs. 1%), insuficiência renal aguda (21% vs. 0%) e óbito (28% vs. 2%). **Conclusão:** a presença de fratura de pelve é um marcador de maior gravidade e pior prognóstico em vítimas de trauma fechado.

Descritores: Fraturas ósseas. Pelve. Choque traumático. Hemorragia. Mortalidade.

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