ORIGINAL ARTICLE

Correlation of pelvic fractures and associated injuries: An analysis of 471 pelvic trauma patients

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ABSTRACT

BACKGROUND: In most respects, the vast majority of pelvic injuries is not of a life-threatening status, but co-presence of other injuries needs to be diagnosed. This study aims to evaluate associated pelvic and extra-pelvic visceral organ injuries of the patients with closed pelvic fractures.

METHODS: This retrospective study was conducted with 471 adult patients who had been admitted to our Emergency Service with the diagnosis of pelvic fractures. Type of fractures, accompanying visceral organ injuries, the demographic data, type of operation, mortality rates were recorded and analysed statistically.

RESULTS: The rate of operations carried out by the general surgery clinic or other surgical clinics in each type of fracture according to AO classification did not differ (p=0.118). In patients with A2, A3 and B1 types of fractures, the operation rate of general surgery clinic did not show a significant difference. However, most of the patients who had extrapelvic surgery were in the mild severity pelvic trauma, such as AO A2 and A3. A total of 31 patients were ex-patients, 17 of whom had AO-A2 type of fractures. The findings showed that there was a significant difference between abdominal ultrasonography outcome that was normal and non-orthopedic surgery types (p<0.001). There was no significant difference between the types of surgery performed and Abdominal CT outcome, which was normal (p=0.215).

CONCLUSION: In the management of patients with pelvic fractures irrespective of its type or grade, the findings suggests that greater attention should be paid to not to overlook the associated injuries. Early blood and imaging tests are encouraged after the patient's hemodynamic status is stabilized.

Keywords: Associated injuries; pelvic fractures; trauma.

INTRODUCTION

The initial management of the pelvic injury is still challenging because of its blurred and heterogeneous nature. An immediate evaluation is crucial to avoid possible suffering from polytrauma. Pelvic fractures usually arise from high-kinetic-energy, such as motor vehicle accidents and falls from heights, in young population and as a consequence of associated injuries. The prognosis of pelvic trauma is likely to be related to the severity of these injuries.[1] In the elderly population with osteoporosis, they are usually caused by low-energy trauma, such as simple falls.

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The mortality rate varies from 4% to 15%.[2,3] The mortality rates and the associated complications, such as neurologic, thoracic and abdominal conditions, increase with associated trauma.[4,5] The present study aimed to evaluate pelvic fractures regarding their type and severity and also assess the possible correlation between the type of pelvic injuries and the associated injuries. Moreover, the present study demonstrated the analysis and comparison of various data, such as age, mechanism and type of injury AO/OTA (The American Orthopaedic Foundation and Orthopaedic Trauma Association), emergency interventions, imaging, definitive treatment by either orthopaedic and other disciplines, hospitalization time, and morbidity and mortality rates.

MATERIALS AND METHODS

This retrospective study was approved by Local Ethics Committee and was conducted between January 2012 and December 2017 with 471 adult patients (≥18) who were admitted to the University of Health Sciences, Emergency Service of Diskapi Education and Research Hospital because of the diagnosis of pelvic fractures with or without other injuries. Patients who had a pelvic fracture were identified with the use of the International Classification of Diseases, Ninth Revision (ICD-9) codes 806.6, 806.7, 808.2, 808.3, 808.4, and 808.5, which include all open and closed fractures of the sacrum, ischium, ilium, pubis, pelvic ring, and acetabular area. The age, sex, cause of injury (traffic accident, Industrial accident, fall from height, be trapped under wreckage, assault), type of treatments whether surgical or non-surgical, Abdominal CT (Computerized Tomography) and USG (Ultrasonography) findings, all of the interventions and operations, including orthopaedic and other clinics, e.g. general surgery, neurosurgery, urology, cardiothoracic surgery, additional organ injuries, surgery during the surgical procedure findings and patient survival results, hospitalization days were assessed and recorded. Patients under the age of 18 were excluded from this study. The pelvic fractures were reclassified by an experienced orthopedist with AO/OTA classification (Table 1, Table 2).

Table 1. The revised AO/OTA classification (2018)

Stable ring	
61-A1	Innominate bone, avulsion
61-A2	Innominate bone, direct blow
61-A3	Transverse sacrum/coccyx
Partially stable ring	
61-B1	Open book
61-B2	Lateral compression injury
61-B3	Bilateral partial posterior arch
Unstable ring	
61-C1	Unilateral complete posterior disruption
61-C2	C1 with contralateral B injury
61-C3	Bilateral C1 injuries

AO/OTA: The American Orthopaedic Foundation and Orthopaedic Trauma Association.

Table 2. Acetabular fractures (AO classification) 62

The AO system incorporates the concepts of the Letournel classification	
Type A	Partial articular, involving only one of two colums
	A1: Posterior wall fracture
	A2: Posterior column fracture
	A3: Anterior wall or column fracture
Type B	Partial articular, involving a transverse component
	B1: Pure transverse fractures
	B2: T-Shaped fractures
	B3: Anterior column and posterior hemitransverse
Type C	Complete articular fravtures, both columns
	C1: High variety, extending to the iliac crest
	C2: Low variety, extendirg to the anterior border of the ilium
	C3: Extension into the sacroiliac joint

AO: The American Orthopaedic Foundation.

After classification, the correlation and the co-occurrence between severity of pelvic trauma and extrapelvic associated injuries and the correlation between pelvic trauma and mortality were analyzed. Moreover, the analysis was performed to find out whether mortality arose from pelvic trauma or associated trauma. The correlation between the results of imaging techniques, whether positive or negative and rates of operation was also analyzed.

Statistical Analysis

Distribution of the numerical variables was evaluated using the Shapiro-Wilk test. The median and minimum and maximum values were used to represent the variables determined to have non-Gaussian distribution, as well as the descriptive statistics of discrete variables. The percentage values and number (n) were given for categorical variables.

Pearson's chi-square test was used to compare the distribution of the results of USG, CT, and operation types according to fracture classification type. Spearman's rho correlation coefficient was used to examine the relationship between USG, CT, and the day of admission and classification. In the case of meaningful correlation, when the correlation coefficient was between the range of 0.00–0.19, it was determined as "no relationship", values between range of 0.20–0.39 was determined as "low relationship", values between range of 0.40–0.69 was determined as "intermediate relationship", val-

ues between range of 0.70–0.89 was determined as "high relationship", and finally values between range of 0.90–1.0 was determined as "very strong relationship".

IBM SPSS Statistics for Windows version 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp) and MS-Excel 2007 (Microsoft Corporation, Redmond, WA, USA) were used for statistical analysis and calculations. P<0.05 was considered as statistically significant.

RESULTS

In the analysis of the patient files, 50.3% (n=237) of the patients included in this study were male and 49.7% (n=234) were female (Table 3). The most common cause of trauma was traffic accidents (66.8%, n=314) and the second common cause was fall from height (24.6%, n=116) (Table 3). There were 47 (10.0%) patients with AO-A1, 246 (52.2%) with AO-A2 and 88 patients (18.6%) with acetabulum (Table 3). The median age of the patients aged between 18 and 94 years was found to be 48 (IQR=40) (Table 3). There were 464 patients known to be hospitalized. A total of 217 patients were hospitalized at least one day. There was no relationship between the AO OTA classification type and the day of hospitalization (p=0.118).

One hundred fifty-five (32.9%) of the patients underwent surgery (Table 4). The major part of the patients with AO-A1 type fracture (87.2%) was not operated. Four of AO-A1 (8.5%) patients underwent an orthopaedic surgery, and two of them (4.3%) had a neurosurgery (Table 5). Distribution of the type of surgery according to classification was statistically significant (χ^2=95.717; p<0.001).

Significant differences were found in the distributions of the patients with orthopeadic surgery in the classifications (χ^2=78.368; p<0.001), but no significant difference was found in the distribution of other operations (χ^2=15.622; p=0.075). As a result of the bilateral comparisons, the proportion of the patients who had only orthopedic surgery in the class of acetabulum (40.9%) was higher than the patients who had orthopedic surgery at type AO-A1 and AO-A2. The proportion of patients with orthopedic surgery in the AO-A1 type was lower than the patients with orthopedic surgery in the AO-B1, AO-B3, AO-C1, AO-C2 types. Type of surgical treatments was summarized in Table 6.

The rate of "general surgery and other surgical clinics" operations in each type of fracture according to AO classification did not differ (χ^2=12.833; p=0.118). In AO-A2, AO-A3 and AO-B1 types, the rate of application of general surgery was similar. 6.9% (n=17) of the patients with AO-A2 who died. Five (7.7%) of the AO-A2 patients who had surgery, and 12 (6.6%) of the AO-A2 patients who did not have surgery died. There was no statistical relationship between the classification and the mortality rates between nor survival and having

Table 3. Distribution of the individuals in specified variable groups

Variables	n	%	Variables	n	%
Gender (n=471)			AO classification (n=471)		
Male	237	50.3	Acetabulum	88	18.6
Female	234	49.7	A1	47	10.0
Type of trauma (n=471)			A2	246	52.2
Industrial accident	35	7.4	A3	22	4.7
Traffic accident	314	66.8	B1	13	2.8
Fall from height	116	24.6	B2	38	8.1
Industrial accident/fall from height	1	0.2	B3	3	0.6
Be trapped under wreckage	2	0.4	C1	8	1.7
Assault	3	0.6	C2	5	1.1
Abdominal USG (n=471)			C3	1	0.2
Normal	233	49.5	Abdominal CT (n=471)		
Free fluid	51	10.8	Normal	114	24.2
Organ injury	2	0.4	Free fluid	46	9.8
Free fluid with organ injury	9	1.9	Organ injury	24	5.1
Not applied	176	37.4	Free fluid with organ injury	33	7.0
			Not applied	254	53.7
			Age (n=471), median (min-max)	48 (18–94)	

AO: The American Orthopaedic Foundation; USG: Ultrasonography; CT: Computerized tomoghrapy.

Table 4. Operation and survival distribution of the patients

Variables	n	%	Variables	n	%
Operation			1,3: (orthopeadic surgery+urology)	5	1.1
None	316	67.1	1,3,4: (orthopeadic+plastic surgery+urology)	1	0.2
Present	155	32.9	1,5: (orthopeadic+neurosurgery)	2	0.4
Type of operation			1,6: (orthopeadic+cardiovascular surgery)	1	0.2
0: Absent	316	67.1	2,3: (general surgery+urology)	1	0.2
1: Orthopaedic surgery only	117	24.8	2,3,6: (general surgery+urology+ cardiovascular surgery)	1	0.2
2: General surgery only	4	0.8	None	316	67.1
3: Urologyonly	2	0.4	Orthopaedic surgery only	117	24.8
5: Neurosurgery only	6	1.3	General surgery with or without other clinics	21	4.5
4: Plastic surgery only	0	0	Orthopaedic surgery with other clinics	9	1.9
6: Cardiovascularsurgery only	0	0	Urology	2	0.4
1,2: (orthopeadic+general surgery)	11	2.3	Neurosurgery	6	1.3
1,2,3: (orthopeadic+general surgery+urology)	2	0.4	Survival		
1,2,3,6: (orthopeadic+general surgery+ urology+cardiovascular surgery)	1	0.2	Yes	440	93.4
1,2,4: (orthopeadic+general surgery+ plastic surgery)	1	0.2	Exitus	31	6.6

Table 5. Distribution of type of surgery according to AO/ATO

Classification	Surgery					
	None	Orthopaedic	General surgery and the others	Orthopaedic and the others	Urology	Neurosurgery
Acetabulum	46 (52.3)	36 (40.9)	2 (2.3)	3 (3.4)	–	1 (1.1)
A1	41 (87.2)	4 (8.5)	–	–	–	2 (4.3)
A2	181 (73.6)	46 (18.7)	12 (4.9)	3 (1.2)	2 (0.8)	2 (0.8)
A3	19 (86.4)	–	3 (13.6)	–	–	–
B1	4 (30.8)	7 (53.8)	2 (15.4)	–	–	–
B2	24 (65.8)	9 (23.7)	1 (2.6)	3 (7.9)	–	–
B3	–	3 (100.0)	–	–	–	–
C1	–	7 (87.5)	–	–	–	1 (12.5)
C2	–	5 (100.0)	–	–	–	–
C3	–	–	1 (100.0)	–	–	–

AO/OTA: The American Orthopaedic Foundation and Orthopaedic Trauma Association.

operated (Table 7). Ten of the 31 patients who died due to multi-trauma were operated by the other surgical branches plus with the orthopaedic department. All of the patients who could not be operated were unable to survive because of the severe head and neck and thoracic pathologies.

The distribution of USG results according to AO classification was given in Table 8. There was no statistically significant correlation between USG, abdominal CT results and AO/ATO classification (p=0.514 and p=0.313, respectively). Eight (21.1%) of abdominal USG outcomes were normal in patients undergoing non-orthopedic surgery. It was determined that there was a significant difference between abdominal USG outcome, which was normal and non-orthopedic surgery types (χ^2=16.505; p<0.001). There was no significant difference between the types of surgery performed and abdominal CT outcome which was normal (χ^2=3.079; p=0.215). The distribution of surgeries which were performed according to the results of

Table 6. Type of surgical treatment

Surgery	n	%	Surgery	n	%
Pelvic surgery only	68	14.4	Liver surgery+non-operative orthopedic treatment	3	0.6
Extremity surgery only	5	1.1	Liver+renal surgery+non-operative	1	0.2
Pelvic+extremity surgery	32	6.8	orthopedic treatment		
Extremity+non-operative orthopedic treatment	12	2.5	Colorectal+pelvic surgery	2	0.4
Spleen+pelvic+extremity surgery	1	0.2	Spleen+renal+pelvic+extremity surgery	1	0.2
Negative laparatomy+pelvic+extremity surgery	1	0.2	Spleen+pelvic surgery	2	0.4
Negative laparatomy+extremity surgery	1	0.2	Spleen+pelvic+extremity surgery	2	0.4
Liver+bladder+major vascular+pelvic surg	1	0.2	Spleen surgery+non-operative orthopedic treatment	1	0.2
Liver+major vascular+pelvic+extremity surgery	1	0.2	Diaphragm+extremity surgery+non-operative	1	0.2
Liver+spleen+bladder	1	0.2	orthopedic treatment		
Liver+spleen+renal surgery+non-operative	1	0.2	Bladder+pelvic surgery	5	1.1
orthopedic treatment			Bladder+pelvic+extremity surgery	1	0.2
Liver+diaphragm surgery+non-operative	2	0.4	Bladder surgery+non-operative orthopedic	2	0.4
orthopedic treatment			treatment		
Liver+pelvic surgery	1	0.2	Renal+extremity surgery+non-operative	1	0.2
Liver+spleensurgery+non-operative	2	0.4	orthopedic treatment		
orthopedic treatment			Orthopaedical nonoperative treatment	320	67.9

Table 7. Exitus rates according to classification and surgery

Classification	Non-operative treatment		Operative treatment		Total	
	Survival	Exitus	Survival	Exitus	Survival	Exitus
Acetabulum	45 (97.8)	1 (2.2)	40 (95.2)	2 (4.8)	85 (96.6)	3 (3.4)
A1	41 (100.0)	–	6 (100.0)	–	47 (100.0)	–
A2	169 (93.4)	12 (6.6)	60 (92.3)	5 (7.7)	229 (93.1)	17 (6.9)
A3	19 (100.0)	–	–	3 (100.0)	19 (86.4)	3 (13.6)
B1	4 (100.0)	–	8 (88.9)	1 (11.1)	12 (92.3)	1 (7.7)
B2	19 (76.0)	6 (24.0)	12 (92.3)	1 (7.7)	31 (81.6)	7 (18.4)
B3	–	–	3 (100.0)	–	3 (100.0)	–
C1	–	–	8 (100.0)	–	8 (100.0)	–
C2	–	–	5 (100.0)	–	5 (100.0)	–
C3	–	–	1 (100.0)	–	1 (100.0)	–
Total	297 (94.0)	19 (6.0)	143 (92.3)	12 (7.7)	440 (93.4)	31 (6.6)

the abdominal CT and ultrasonography are detailed in Table 9. The distribution of the abdominal CT scan is given in Table 8.

DISCUSSION

Many trauma victims sustaining pelvic fractures are treated conservatively, although the pelvic injury is generally a description of severe injury, mandating a comprehensive investigation for the existence of associated injuries, mainly intra-abdominal injuries. However, the correlation between the severity of pelvic fractures and the incidence of associated abdominal injuries is not clear.[6] In our study, the presentation of the extrapelvic injuries was not correlated with the AO classification, which measures pelvic trauma severity. Most of the patients in this study were in class A2, and the majority of the mortalities with any type of surgery performed were in this class. Nevertheless, AO-A2 may be named as a moderate injury type according to AO classification. Under normal circumstances, we would expect to find more surgery and mortality rates in the upper-level injuries before this study had been formed.

Table 8. The Distribution of USG and CT results according to the AO/ATO classification

	AO/ATO Classification									
	Acetabulum	**A1**	**A2**	**A3**	**B1**	**B2**	**B3**	**C1**	**C2**	**C3**
Abdominal USG (n=471), n (%)										
Normal	43 (18.5)	25 (10.7)	117 (50.2)	13 (5.6)	4 (1.7)	23 (9.9)	–	4 (1.7)	4 (1.7)	–
Free fluid	9 (17.6)	–	26 (51.0)	4 (7.8)	4 (7.8)	6 (11.8)	2 (3.9)	–	–	–
Organ injury	1 (50.0)	–	–	–	1 (50.0)	–	–	–	–	–
Free fluid+organ injury	1 (11.1)	–	2 (22.2)	1 (11.1)	–	1 (11.1)	1 (11.1)	1 (11.1)	1 (11.1)	1 (11.1)
n/a	34 (19.3)	22 (12.5)	101 (57.4)	4 (2.3)	4 (2.3)	8 (4.5)	–	3 (1.7)	–	–
Abdominal CT (n=470), n (%)										
Normal	21 (18.4)	12 (10.5)	58 (50.9)	4 (3.5)	3 (2.6)	10 (8.8)	1 (0.9)	2 (1.8)	3 (2.6)	–
Free fluid	5 (10.9)	2 (2.2)	27 (58.7)	2 (4.3)	2 (4.3)	6 (13.0)	1 (2.2)	2 (4.3)	–	–
Organ injury	6 (25.0)	–	8 (33.3)	1 (4.2)	4 (16.7)	2 (8.3)	1 (4.2)	1 (4.2)	1 (4.2)	–
Free fluid+organ injury	4 (12.1)	–	19 (57.6)	4 (12.1)	2 (6.1)	2 (6.1)	–	1 (3.0)	–	1 (3.0)
n/a	51 (20.2)	34 (13.4)	134 (53.0)	11 (4.3)	2 (0.8)	18 (7.1)	–	2 (0.8)	1 (0.4)	–

AO/OTA: The American Orthopaedic Foundation and Orthopaedic Trauma Association; USG: Ultrasonography; CT: Computerized tomoghrapy.

Table 9. The distribution of surgeries performed according to results of the abdominal CT and abdominal ultrasonography

	Operation					
	None	**Orthopaedic**	**General surgery and the other clinics**	**Orthopaedic and the other clinics**	**Urology**	**Neurosurgery**
Abdominal USG						
Negative	156 (67.0)	69 (29.6)	1 (0.4)	3 (1.3)	–	4 (1.7)
Positive	160 (67.2)	48 (20.2)	20 (8.4)	6 (2.5)	2 (0.8)	2 (0.8)
Abdominal CT						
Negative	72 (63.2)	35 (30.7)	1 (0.9)	2 (1.8)	–	4 (3.5)
Positive	243 (68.3)	82 (23.0)	20 (5.6)	7 (2.0)	2 (0.6)	2 (0.6)

USG: Ultrasonography; CT: Computerized tomoghrapy.

The most common mechanism of injury leading to pelvic fractures is a motor vehicle accident (MVA) and fall from heights.[7,8] The rising incidence of road traffic crashes is the most important public health problem in civil society. The two most common causes of trauma in our study were these two mechanisms, which were around 90%. Depending on the position of a pedestrian or fallen person, the pelvis, hip, thighs or legs were usually affected at the first contact, and the extrapelvic structures, mostly intraabdominal solid organs, are affected by the real-time blast effect.

Among abdominal injuries in pelvic trauma patients liver is the most commonly injured organ as reported in the literature.[9,10] In patients with complex pelvic fractures, the spleen is found to be the second most frequently injured solid organ followed by the liver.[11,12] In our study, the incidence of liver and splenic injuries were in accordance with the literature, which followed by kidney and bladder injury. Contrary to our work, among adults with pelvic fractures and associated intraabdominal solid organ injuries, there was a clear correlation between the severity of pelvic fractures and the grade of the splenic or hepatic injuries according to most of the studies in the literature. Higher pelvic fracture mostly argues a more severe injury, possibly explaining the higher grade of the associated abdominal organ injuries. A study that included 126 patients with severe pelvic trauma (AO classification type B or C) revealed that the most common extrapelvic lesions were thoracic injuries in 56.4% and severe head injuries (GCS <8) in 33.3%.[13] However, among children, such a correlation was not observed.

In our study, no relationship was found between AO classifications and abdominal CT outcomes. There was a significant false-negative rate in abdominal USG outcomes. However, USG is still the imaging modality of choice for the detection of blunt abdominal trauma, and positive ultrasonographic findings can be used as a risc factor when planning new algorithms in the management of the patient although it has shortcomings in the demonstration of hollow viscus injury.[14,15] On the other hand, given that USG is an operator-dependent imaging modality, and in emergency conditions where the patient cooperation is not expected, it may have low sensitivity rates, especially when performed by the physician other than radiologists. Therefore, in suspected cases, if the condition stabilizes, it is absolutely necessary to evaluate the patient with abdominal CT. Initial assessment of trauma patients using CT has resulted in shorter triage times and intensive care unit stays, as well as an overall reduction in ventilation requirements and organ failure rates.[16] Abdominopelvic CT is considered the optimal imaging examination in polytrauma patients.[17] The drawbacks of the modality could be the utilization of ionizing-radiation and the potentially nephrotoxic contrast agents. It is important to use CT always with the right indications.[18] A small percentage of traumatic injuries may not be identified or fail to be manifest in the initial CT, resulting in delayed manifestations of abdominal trauma. This may lead to subsequent readmission, delayed management, and more severe medical complications. Investigating the frequency, cause, and type of delayed abdominal injuries helps raise the awareness of radiologists and emergency physicians to traumatic injuries that may indicate delayed presentation.[19]

Several publications showed the mortality rates after pelvic fracture and associated injuries, and the mortality rates ranged from 7.6% to 19%.[20,21] In our study, the mortality rate was 6.6%. The strategies aimed to decrease the risk of death after pelvic fracture were described in many studies in the literature.[22,23] Although there was no correlation between death rates and pelvic fracture severity and types of operations in our study, almost all of the patients who died had multi-trauma. In this case, the literature confirms that the most common cause of death after pelvic fracture was associated injuries. For example, although there were patients in the literature who died due to intrapelvic hemorrhage after pelvic fracture, our patients usually died due to intracranial hemorrhage and additional multiorgan trauma.

Severe pelvic trauma management often requires a strategy different than regular approaches like removing an organ or tightening a vessel. Some specific interventions, such as reapproximation of bony structures, damage control resuscitation, assessment for associated injuries, and triage of investigations, as well as multimodality hemorrhage control (external fixation, preperitoneal packing, angioembolization, REBOA [resuscitative endovascular balloon occlusion of the aorta]) by multidisciplinary trauma specialists (general surgeons, orthopedic surgeons, endovascular surgeons/interventional radiologists) can be lifesaving.[24]

Our work has some limitations. First of all, we could not reach the Injury Severity Score (ISS) data. We may have reached more effective results if we could have examined the associated traumas in the presence of these scores with the AO classification. However, when a patient with pelvic trauma arrives, we should be alerted not to overlook the underlying problem, even if the condition is stable and pelvic injury is moderate. Another limitation of our study is the patient population, which includes only adult patients. Thus, we should highlight that when various published studies are reviewed, it is emphasized that the clinical condition of children with pelvic trauma may be different with blurred findings compared to the adults.[25]

Conclusion

Mortality and morbidity rates are mainly affected by associated injuries, rather than the severity of the pelvic fracture itself according to this study. Recent guidelines confirm that further chest and abdominal evaluation for referring pelvic fractures is recommended, regardless of the pelvic fracture severity. In the management of patients with pelvic fractures, greater attention should be paid to the associated injuries. Early CT imaging is suggested after the patient is hemodynamically stabilized.

Conflict of interest: None declared.

REFERENCES

1. Cordts Filho Rde M, Parreira JG, Perlingeiro JA, Soldá SC, Campos Td, Assef JC. Pelvic fractures as a marker of injury severity in trauma patients. [Article in English, Portuguese]. Rev Col Bras Cir 2011;38:310–6. [CrossRef]
2. Arvieux C, Thony F, Broux C, Ageron FX, Rancurel E, Abba J, et al. Current management of severe pelvic and perineal trauma. J Visc Surg 2012;149:e227–38. [CrossRef]
3. Cullinane DC, Schiller HJ, Zielinski MD, Bilaniuk JW, Collier BR, Como J, et al. Eastern Association for the Surgery of Trauma practice management guidelines for hemorrhage in pelvic fracture--update and systematic review. J Trauma 2011;71:1850–68. [CrossRef]
4. Demetriades D, Karaiskakis M, Toutouzas K, Alo K, Velmahos G, Chan L. Pelvic fractures: epidemiology and predictors of associated abdominal injuries and outcomes. J Am Coll Surg 2002;195:1–10. [CrossRef]
5. Eastridge BJ, Burgess AR. Pedestrian pelvic fractures: 5-year experience of a major urban traumacenter. J Trauma 1997;42:695–700. [CrossRef]
6. Holden CP, Holman J, Herman MJ. Pediatric pelvic fractures. J Am Acad Orthop Surg 2007;15:172–7. [CrossRef]
7. Demetriades D, Karaiskakis M, Velmahos GC, Alo K, Murray J, Chan L. Pelvic fractures in pediatric and adult trauma patients: are they differentinjuries? J Trauma 2003;54:1146–51. [CrossRef]
8. Leonard M, Ibrahim M, Mckenna P, Boran S, McCormack D. Paediatric pelvic ring fractures and associated injuries. Injury 2011;42:1027–30.
9. Shweiki E, Klena J, Wood GC, Indeck M. Assessing the true risk of abdominal solid organ injury in hospitalized ribfracture patients. J Trauma 2001;50:684–8. [CrossRef]

10. Demetriades D, Karaiskakis M, Toutouzas K, Alo K, Velmahos G, Chan L. Pelvic fractures: epidemiology and predictors of associated abdominal injuries and outcomes. J Am Coll Surg 2002;195:1–10. [CrossRef]
11. Pajenda GS, Seitz H, Mousavi M, Vécsei V. Concomitant intra-abdominal injuries in pelvic trauma. [Article in German]. Wien Klin Wochenschr 1998;110:834–40.
12. Lunsjo K, Tadros A, Hauggaard A, Blomgren R, Kopke J, Abu-Zidan FM. Associated injuries and not fracture instability predict mortality in pelvic fractures: a prospective study of 100 patients. J Trauma 2007;62:687–91.
13. Siegmeth A, Müllner T, Kukla C, Vécsei V. Associated injuries in severe pelvic trauma. [Article in German]. Unfallchirurg 2000;103:572–81.
14. Shojaee M, Faridaalaee G, Yousefifard M, Yaseri M, Arhami Dolatabadi A, Sabzghabaei A, et al. New scoring system for intra-abdominal injury diagnosis after blunt trauma. Chin J Traumatol 2014;17:19–24.
15. Güneş Tatar İ, Yılmaz KB, Ergun O, Balas Ş, Akıncı M, Deryol R, et al. The effect of clinical, laboratory and radiologic results on treatment decision and surgical results in patients admitted to the emergency department with blunt abdominal trauma due to traffic accident. [Article in Turkish]. Ulus Travma Acil Cerrahi Derg 2015;21:256–60. [CrossRef]
16. Wurmb TE, Frühwald P, Hopfner W, Keil T, Kredel M, Brederlau J, et al. Whole-body multislice computed tomography as the first line diagnostic tool in patients with multiple injuries: the focus on time. J Trauma 2009;66:658–65. [CrossRef]
17. Soto JA, Anderson SW. Multidetector CT of blunt abdominal trauma. Radiology 2012;265:678–93. [CrossRef]
18. Gunes Tatar I, Aydin H, Kizilgoz V, Yilmaz KB, Hekimoglu B. Appropriateness of selection criteria for CT examinations performed at an emergency department. Emerg Radiol 2014;21:583–8. [CrossRef]
19. Elbanna KY, Mohammed MF, Huang SC, Mak D, Dawe JP, Joos E, et al. Delayed manifestations of abdominal trauma: follow-up abdominopelvic CTin posttraumatic patients. Abdom Radiol (NY)k 2018;43:1642–55.
20. Blackmore CC, Jurkovich GJ, Linnau KF, Cummings P, Hoffer EK, Rivara FP. Assessment of volume of hemorrhage and outcome from pelvic fracture. Arch Surg 2003;138:504–8. [CrossRef]
21. Starr AJ, Griffin DR, Reinert CM, Frawley WH, Walker J, Whitlock SN, et al. Pelvic ring disruptions: prediction of associated injuries, transfusion requirement, pelvic arteriography, complications, and mortality. J Orthop Trauma 2002;16:553–61. [CrossRef]
22. Agolini SF, Shah K, Jaffe J, Newcomb J, Rhodes M, Reed JF 3rd. Arterial embolization is a rapid and effective technique for controlling pelvic fracture hemorrhage. J Trauma 1997;43:395–9. [CrossRef]
23. Smith W, Williams A, Agudelo J, Shannon M, Morgan S, Stahel P, et al. Early predictors of mortality in hemodynamically unstable pelvis fractures. J Orthop Trauma 2007;21:31–7. [CrossRef]
24. Skitch S, Engels PT. Acute Management of the Traumatically Injured Pelvis. Emerg Med Clin North Am 2018;36:161–79. [CrossRef]
25. Swaid F, Peleg K, Alfici R, Olsha O, Givon A, Kessel B; Israel Trauma Group. A comparison study of pelvic fractures and associated abdominal injuriesbetween pediatric and adult blunt trauma patients. J Pediatr Surg 2017;52:386–9. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZET*

Pelvik kırıklar ve bağlantılı yaralanmaların ilişkisi: Pelvik travmalı 471 hastanın istatistiksel analizi

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[w]AMAÇ: Pelvik yaralanmaların büyük çoğunluğu yaşamı tehdit etmemesine rağmen, ilişkili yaralanmaların heterojen doğası sebebiyle, açıklığa kavuşmasına ihtiyaç vardır. Bu çalışmanın amacı, kapalı pelvik travmalı hastalarda ilişkili pelvik ve ekstra pelvik organ yaralanmalarını araştırmaktır.

GEREÇ VE YÖNTEM: Bu geriye dönük çalışma, acil servise pelvik kırık tanısı ile başvuran 471 erişkin hasta ile yapıldı. Kırık tipi, eşlik eden viseral organ yaralanmaları, demografik veriler, operasyon şekli, mortalite oranları kaydedildi ve istatistiksel olarak analiz edildi.

BULGULAR: AO sınıflamasına göre genel cerrahi kliniği veya diğer cerrahi klinikler tarafından yapılan operasyonların oranı istatistiksel olarak farklılık göstermemiştir (p=0.118). A0-A2, A3 ve B1 kırık tiplerinde, genel cerrahi kliniğinin operasyon oranı anlamlı bir farklılık göstermemiştir. Bununla birlikte, ekstrapelvik cerrahi geçiren hastaların çoğu AO A2 ve A3 gibi hafif şiddetteki pelvik travmalı hastalardı. Toplamda 31 hasta hayatını kaybetti, bunların 17'si AO-A2 tipi kırığı olan hastalardı. Ortopedi dışı ameliyat olanlar ile normal abdominal ultrasonografi sonuçları arasında anlamlı bir fark olduğu saptandı (p<0.001). Yapılan tüm tip ameliyatlar ve normal abdominal bilgisayarlı tomografi sonuçları arasında (p=0.215) anlamlı bir fark yoktu.

TARTIŞMA: Pelvis kırığı olan hastaların yönetiminde, türüne ya da evresine bakılmaksızın, ilişkili yaralanmaların gözden kaçırılmamasına dikkat edilmelidir. Hastanın hemodinamik durumu stabilize edildikten sonra erken kan ve görüntüleme testleri yapılmalıdır.

Anahtar sözcükler: İlişkili yaralanmalar; pelvik kırıklar; travma.

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