Patterns, Management and Outcomes of Traumatic Pelvic Fracture: Insights from A Multicenter Study

Husham Abdelrahman
Hamad Medical Corporation

Ayman El-Menyar (aymanco65@yahoo.com)
Weill Cornell Medical College in Qatar https://orcid.org/0000-0003-2584-953X

Holger Keil
Heidelberg University

Abduljabbar Alhammoud
Hamad Medical Corporation

Syed Imran Ghouri
Hamad Medical Corporation

Elhadi Babikir
Hamad Medical Corporation

Mohammad Asim
Hamad Medical Corporation

Matthias Muenzberg
Heidelberg University

Hassan Al-Thani
Hamad Medical Corporation

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Abstract

Purpose we aimed to describe traumatic pelvic fracture in multinational level 1 trauma centers. Methods We conducted a retrospective analysis for all patients with traumatic pelvic fracture (TPF) between 2010 and 2016 at 2 trauma centers in Qatar and Germany. Results A total of 2112 patients presented with traumatic pelvic injuries of which 1814 (85.9%) sustained TPF, males dominated (76.5%) with a mean age of 41.2±21.1 years. Falls, motor vehicle crashes and pedestrians were the most frequent mechanisms involved. Chest (37.3%) was the most commonly associated injured region, with mean injury severity score (ISS) of 16.5±13.3. Hemodynamic instability was observed in 44%, blood was needed in a third, massive transfusion in a tenth and intensive care admission in a quarter of cases. Tile classification was possible in 1228 patients (type A in 60%, B in 30% and C in 10%). Patients with type C had higher rates of associated injuries, ISS, pelvis abbreviated injury score (AIS), more need for blood transfusion, massive transfusion protocol activation, prolonged hospital stay, higher rate for surgery, complications, and mortality ($p<0.001$). Two-thirds of patients were managed conservatively while a third needed surgical fixation. The median length of hospital and intensive care stay were 15 and 5 days, respectively. In-hospital complications were few and the overall mortality rate was 4.7% (86 patients). Conclusion pelvic fracture is a common injury. It needs a careful multidisciplinary and systematic approach to address the associated complexities and polytrauma nature in order to improve the associated outcomes both on a short and long-term basis.

Introduction

In polytrauma patients, pelvic injuries are commonly seen. It ranges from minor lacerations to major pelvic fractures that may be devastating and complex. Injury to pelvic region accounts for 10% of all the blunt trauma admissions [1]. Population-based studies reported average annual incidence rate of pelvic fractures to be 20 per 100,000 individuals [2, 3]. The clinical presentation and outcomes of pelvic fractures also depend on hemodynamic status. Thus it is considered challenging both from the diagnostic and therapeutic perspective especially in unstable patients. In spite of the trend toward initial selective imaging current recommendation favors routine pelvic X-ray (PXR) in blunt trauma as an initial screening tool to role out pelvic fractures [4]. Blunt traumatic injuries secondary to motor vehicle crashes (cars and motorcycles), pedestrian/bicycle injuries and falls from height are the main mechanisms of pelvic injuries. Usually, young men are more susceptible to the high-energy traumatic injuries [3]. Such high-energy mechanisms are most commonly associated with pelvic fractures but still, low-energy trauma may lead to a fracture in some patients; particularly among the elderly [5, 6]. Moreover, high-impact pelvic fractures may also present with other associated injuries, particularly peri-pelvic soft tissue, extremity fractures, abdominal solid organ injuries (SOIs) and injuries to the chest [1]. The severity of the pelvic injury also dictates the overall injury severity which might result in higher mortality [7]. The reported rate of in-hospital mortality in pelvic fracture usually ranges from 5%-20% but may go up to 50% in open compound fractures. This high mortality is mainly attributed to the hemodynamic instability resulted from exsanguinating hemorrhage. The various sources of hemodynamic instability include the disruption

of venous and arterial vessels near the fracture; the exposed fracture ends, the associated soft-tissue injury and SOIs [3, 7, 8]. Unstable patients with pelvic fractures represent a complex life-threatening scenario which necessitates early aggressive resuscitation and prompt surgical intervention [9]. Herein, the present study aims to describe the common patterns of pelvic fractures, hemodynamic status, management and clinical outcomes in patients with a traumatic pelvic fracture from two level-one trauma centers of different countries/continents.

Methods

Study Design: A retrospective cohort study was conducted for all patients who sustained traumatic pelvic injuries and were admitted at two trauma centers; Hamad Trauma Center (HTC); the level 1 national trauma center in the state of Qatar and BG Hospital Ludwigshafen, Germany (level 1 trauma center) between January 2010 and June 2016. We excluded patients presented with cardiac arrest on arrival at the hospital. The study was approved by the institutional review board (IRB) of the Medical Research Center at Hamad Medical Corporation [HMC IRB# 14175/14 & 16395/16; BG IRB# 837.500.17 (11334)] with a waiver of informed consent. In Qatar; data were retrospectively obtained from a prospectively maintained trauma registry database of the HTC. Our data repository with uniform data elements is contributing data to the National Trauma Data Bank (NTDB) and the Trauma Quality Improvement Program (TQIP) of the American College of Surgeons-Committee on Trauma (ACS-COT). The HTC is the only tertiary care facility in the country which admits around 1500-1700 trauma patients annually. Therefore, the data obtained from the trauma registry is nationally representative which covers approximately 2.6 million populations. The Germany center participates in the German Trauma (2018: 193 trauma room admissions, 125 patients injury severity score ((ISS)>16) as well as pelvic injury registry. The German center serves a population of about 1.5 million people in the metropolitan area Rhein-Neckar. The German data were retrospectively obtained from the clinic information system as well as from a prospectively maintained trauma database. The BG Trauma Center Ludwigshafen is a professional accident clinic in Ludwigshafen. The primary focus of this center includes trauma surgery and orthopedics, plastic and reconstructive surgery, as well as hand and tumor surgery. From 1997, the BG hospital has initiated academic research and teaching, and the management of patients with trauma, hand, plastic and burn surgery for the Ruprecht Karls University of Heidelberg and their respective university hospital.

Data collection: Data were retrieved for demographic characteristics (age and gender), mechanisms of injuries, associated injuries including head, chest, abdomen, spine, upper and lower extremity; injury characteristics such as Glasgow Coma Score at emergency department (ED), Abbreviated Injury Score (AIS), Injury Severity Score (ISS), and Revised Trauma Score (RTS), initial vitals at ED such as respiratory rate, oxygen saturation (SpO2), systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate and shock Index (SI), ED disposition, pelvic fracture pattern (Modified Tile's AO Müller classification), need for blood transfusion, number of blood units transfused, massive transfusion protocol (MTP), surgical intervention (open reduction and internal fixation, closed reduction and external fixation), in-hospital complications [pneumonia, sepsis, acute respiratory distress syndrome (ARDS), and acute kidney injury

(AKI), deep venous thrombosis (DVT), and pulmonary embolism (PE)], ventilator days, length of intensive care unit and hospital stay as well as in-hospital mortality. We excluded patients who brought in dead, and thoses who have non-fracture soft tissue pelvic injury or dislocation (Fig. 1).

The fracture patterns for the pelvis and acetabular fractures were classified according to the modified Tile AO Müller classification [10,11], which categorizes pelvic fractures into three main types based on stability and integrity of the posterior sacroiliac complex. It also takes into consideration the direction of the force involved. In Type A, the fracture does not involve the posterior arch. Type B fracture is a result of rotational forces that cause partial disruption of the posterior sacroiliac complex. Complete disruption of the posterior complex (including the sacrospinous and sacrotuberous ligaments) occurs in Type C fractures that are both rotationally and vertically unstable. Each of these basic types (A-C) has three subtypes. The pelvic fracture cases were identified from our trauma registry database according to the assigned ICD-10 code. Cases with difficult or overlapping classes were considered unclassified (almost one third of the cohort) and were not included in the final analysis.

SI was calculated as HR/SBP recorded at the time of presentation to the emergency department [12]. Hemodynamic stability was determined by either of three parameters (SBP $\leq$ 90 mmHg &/or HR $\geq$ 120 &/or SI $\geq$ 0.8).

Statistical analysis: Data were presented as proportions, medians, and range or mean ± standard deviation, as appropriate. Data were compared with respect to the pattern of pelvic fracture (Tile A vs. Tile B vs. Tile C) and hemodynamic status (stable versus unstable). Differences in categorical variables between respective groups were analyzed using the chi-square test. The continuous variables were analyzed using Student's t-test and one-way ANOVA, as appropriate. Yates' corrected chi-square was used for categorical variables if the expected cell frequencies were below 5. For skewed continuous data non-parametric Mann-Whitney test was performed. A two-tailed P value of <0.05 was considered to be statistically significant. Data analysis was carried out using the Statistical Package for the Social Sciences, version 18 (SPSS, Inc, Chicago, IL).

Results

During the study period, a total of 2112 patients sustained traumatic pelvic injuries of which 1814 (85.9%) had traumatic pelvic fractures (11.1%) of total trauma admissions in Qatar and 13% of Germany total trauma admissions. **Table 1** shows the demographic characteristics, mechanisms of injury, associated injuries, injury severity scores, clinical presentation, ED dispositions and clinical outcomes of pelvic fracture patients in the study cohort. The male to female ratio was 3:1 and the majority (76.5%) were males (88.2% in Qatar and 55.4% in Germany) and the mean age was 41.2±21.1 years (32.1±14.3 in Qatar and 57.4±21.6 in Germany). The most common mechanisms of pelvic fracture were traffic-related 59% [motor vehicle crashes (27.9%), pedestrian injury (28.0%), ATV (1.5%), 1.5% for motorcycles and bicycles), followed fall from height (32.8%), while fall of heavy objects was involved only in 6.6% cases. **Figure 1** shows the overall study design.

The associated injury by region frequently involved chest (37.3%) followed by the spine (31.6%), abdomen (27.4%) and extremities (lower 26%, upper 27%); while the head injury was associated in 18.2% cases.

Figure 2 demonstrates the distribution of associated injuries with pelvic fracture. The chest injuries such as rib fractures (27%), lung contusion (22%), pneumothorax (13%), hemothorax (7%) and hemopneumothorax (5%) were most commonly associated followed by SOI (22%), bowel/mesenteric injuries (4.3%), and hematomas (8.7%).

The mean ISS was 16.5±13.3 (15.8±10.6 in Qatar and 17.7±16.9 in Germany), RTS was 7.23±1.38; the Head AIS was 3.3± 1.3. The majority were presented with blood pressure and oxygen saturation within the normal range but with a high mean heart rate (96 b/min) and respiratory rate of 20 breath per minute. Positive FAST was seen in 11%, blood transfusion was needed in 34.5% (38.1% in Qatar and 27.8% in Germany) and in 10.6% it reached the massive transfusion limit of 10 units over 24 hours. The majority of the fractures (65%) were treated conservatively while 35% underwent surgical treatment (reduction and fixation open or closed external fixation).

With regard to ED disposition; more than half of patients were admitted to regular trauma ward and a quarter needed trauma ICU admission; the majority were treated initially conservatively while 19% needed immediate transfer to Operation Theater for life-saving interventions. The common in-hospital complications were pneumonia (6.5%), sepsis (3.2%), ARDS (3.0%), and AKI (2.4%). The frequency of other complications such as DVT (0.8%), PE (0.5%) and multi-organ failure (0.7%) was very low. The median length of mechanical ventilation and ICU stay was 5 days and the median hospital stay was 15 days. Eighty-six patients died with an overall in-hospital mortality of 4.7% (5.0% in Qatar and 4.3% in Germany).

Table 2 shows the clinical characteristics and outcomes by types of pelvic fractures. The pelvic fracture pattern based on Tiles classification was available in 1228 (67.7%). Tile A (60%) was most frequently observed followed by Tile B (30%) and Tile C (10%). There were 284 patients having acetabular fractures; of which 273 were isolated acetabular fractures and hip dislocation in 8 patients. Falls was the most common mechanism in all pelvic ring fracture types followed by pedestrian mostly had type A and MVC in type B while fall of heavy objects was more common in tiles C (P=0.001 for all). The associated injuries mainly chest, spine and abdomen showed significant association with type C (P=0.001). Also, patients with Tile C were more likely to have higher ISS, pelvis AIS, chest AIS, abdomen AIS and lower GCS ED ($p<0.001$ for all); in comparison to Tile A and B.

Elevated shock index (≥ 0.8) was found in 61.5% of tile C compared to 47% in tile B and 38.5% in Tile A (p=0.001). The need for blood transfusion (P=0.001), MTP (P=0.001), intubation (P=0.001) and surgical intervention (P=0.001) were also greater in patients with Tile C.

With respect to in-hospital complications, patients with Tile B showed a higher association with pneumonia (P=0.01) whereas, the rate of sepsis, ARDS, AKI and DVT (P=0.001 for all) were significantly

higher in Tile C group. Also, patients with Tile C had prolonged hospital stay (P=0.001) with the highest in-hospital mortality (13%) as compared to Tile A (3.2%) and Tile B (4.7%; p=0.001).

Table 3 compares the clinical characteristics and outcomes of pelvic fracture patients by hemodynamic status. Hemodynamically unstable patients tended to be younger in age, sustain more associated injuries, severely injured (higher ISS, higher AIS, lower GCS, and lower RTS (P=0.001 for all) as compared to stable patients. Also, unstable patients were more likely to have unstable pelvic fractures i.e. Tile B and C and had a higher rate of intubation, positive FAST, in-hospital complications, greater need for blood transfusion, and MTP (p=0.001) and had prolonged mechanical ventilation, ICU and hospital stay (p=0.001) than the stable group. On the other hand, stable patients were more likely to be male, frequently had Tile A (p=0.001) and acetabular fracture (p=0.004) as compared to the unstable group. The rate of mortality was significantly higher in the hemodynamically unstable group (9.1% vs. 1.4%; p=0.001) (82.4% males and 17.6% females) as compared to the stable group (90% males and 10% females).

In Qatar, during the study period, the angiography and subsequent angioembolization were performed in 65 patients. The most commonly involved vessel was the internal iliac artery (50 cases), while the other embolized vessels were the pudendal, sacral and other unnamed arteries with immediate satisfactory results and a smooth course. Data on arterial embolization is not available at the German institution. If needed, it can be transferred to a cooperating hospital and sent back after intervention but this is not the daily routine.

Discussion

This is a large multicenter study that describes the epidemiology, clinical presentation, complications and mortality in patients with pelvic fractures in two trauma centers, the first in the state of Qatar and the second in Germany. Pelvic fracture is not uncommon and is nearly reported in 10% of admitted patients and tends to affect the younger males in our cohort (11% in Qatar and 13% in Germany). Pelvic fracture caused by traffic-related injuries and falls suggested a high energy impact and work-related trauma. Polytrauma is the norm, with an average ISS of 16. Chest injuries outnumbered all other anatomical injuries in nearly 40% of cases in our cohort.

Also, the frequency of pelvic fracture in our cohort is high which represents the complex nature of trauma in this young population as stated before in other countries like the UK, Sweden and Germany [13-15]. The observed male predominance and gender difference are not the same when compared to another study based on a national database that demonstrated more elder (average age was >60) patients population and predominance of female gender [6]. The high incidence figure may represent an overestimation as the denominator of admitted cases to trauma service rather than all ED cases; where an incidence of 3% is reported by Arvieux et al [16], Magnone et al [17] and others [2, 3, 6,15,18]. It seems that there is great variability in different regions as the German data reflects higher age and slight male predominance in comparison to the Qatar cases.

Prior data advocated the crucial impact of age on the outcomes in trauma patients as advanced age alters the physiologic status resulting in a suboptimal recovery [19]. However, in the current study, the mean age of patients was 41 years; a unique finding. It can represent the national census as the majority of the population are young expatriate males working in Qatar; this may also explain the work-related injury pattern noticed in this cohort as well as the relatively better clinical outcomes in terms of in-hospital complications rates and mortality. The majority had high energy impacts; whether traffic-related or falls. Studies have already shown that high-energy impacts such as road traffic collisions and a pedestrian hit by vehicles are the primary mechanisms of injuries leading to pelvic fracture [15,20,21]. Furthermore, males were more likely to experience pelvic fractures as they are more vulnerable to these high energy mechanisms (road traffic-related trauma and work-related falls).

Hemodynamic instability on-admission predicts the requirement of massive blood transfusion in pelvic trauma, injury severity, associated injuries, fracture stability, in-hospital complications, and mortality. A higher proportion of our patients was hemodynamically stable; admitted to the regular trauma ward and managed conservatively without blood transfusion and had a lower rate of complications and mortality similar to data from the US and Europe. [6,13-15].

An earlier study demonstrated a higher mortality rate in trauma patients with hemodynamic instability. The reported mortality rates vary quite widely which could be as high as 30% [22-25]. In this cohort the overall mortality was low 4.7%, but correlates well with reported cases from previous studies in Germany (4%) and united states (3.5%); this may reflect the maturation of our trauma system and improved post-traumatic care with availability of specialized team, MTP activation, immediate access to operative room and interventional radiology as well as subsequent critical care [18,26-29].

Higher mortality was observed in unstable fracture patterns (i.e. Tile C; 13%) as compared to Tile A (3.2%) and B (4.7%). In hemodynamically stable patients, the mortality reached 1.4% in comparison to 9.1% in unstable patients.

Tile A classification of pelvic fracture was the commonest type of pelvic fracture in the present cohort which is similar to some of the studies that reported stable fractures as the most frequent fracture type [30]. On the other hand, an earlier study from the Netherlands reported Tile B fractures to be predominantly followed by Tile C and Tile A fractures [31].

Agri et al [32] reported that Tile C fractures are significantly associated with more blood transfusion and a higher rate of mortality as compared to Tile A or B fractures. Unstable fracture is really the most serious skeletal injury due to complexity and high-energy related to other anatomical injuries [33].

Limitations: We acknowledge the limitations of our study. The retrospective study design and possible bias due to missing information or coding errors are among the most important limitations. Moreover, trauma patients who died before hospital arrival were not included as well as those who were not admitted and discharged home. The higher frequency of associated significant injuries makes it impossible to effectively separate the mortality caused by pelvic fracture per se. The MTP activation

documentation was not complete; so we used blood unit ≥10 for the identification of cases that had a massive transfusion. We lack information for arterial embolization from the German institution. Also, our database is lacking results of functional outcomes and other chronic sequel such as pain, impotence, disabilities. This may urge the need to conduct further studies using isolated pelvic fractures only to determine pelvic fracture related-mortality and other underreported complications of this important injury to strengthen our findings and to set the optimal time and type of management approaches for the new cases.

Potential Strength: This is one of the largest databases available, the sample is somewhat homogenous with no wide age variation and the Qatari center is the national center for trauma care so it is national representing data (cover 2.6 million) while Germany covers approximately 1.5 million populations.

Accurate and prompt assessment of the patient and injury, physiologic and anatomic classification and multidisciplinary management approach with priority are essential components for effective management, improved outcomes, and future studies and audits.

Conclusions

This study reveals that pelvic fracture is a common injury and needs a careful multidisciplinary and systematic approach to address the complexities and multi-trauma nature. A high index of suspicion and prompt recognition of instability both hemodynamic and fracture-related mechanical pattern are of paramount importance for predicting significant hemorrhage, activation of the trauma team and massive transfusion to expedite appropriate care thereby improving the clinical outcomes.

Abbreviations

ISS: injury severity score

AIS: abbreviated injury score

MTP: massive transfusion protocol

SI: shock index

ED: emergency department

GCS: Glasgow coma scale

Declarations

Ethics approval and consent to participate: This observational study has received an expedited review and was approved by the Institutional Review Board (HMC IRB# 14175/14 & 16395/16) & BG IRB# 837.500.17 (11334).

Consent for publication: was approved by the Institutional Review Board (HMC IRB# 14175/14 & 16395/16) & BG IRB# 837.500.17 (11334).

Availability of data and material: not applicable

Competing interests: The authors declare no conflict of interest.

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Tables

Table 1: Overall demographics characteristics, clinical presentation and outcome of patients with pelvic fracture (n=1814)

Variables	Value	Variables	Value
Mean age in years	41.2±21.1	**Pulse rate at ED** (n=1306)	95.8±23.1
Males	1387 (76.5%)	**Oxygen saturation at ED** (n=1282)	97.7±6.3
Females	426 (23.5%)	**Respiratory rate at ED** (n=1208)	19.5±4.5
Mechanism of injury		**Hemodynamic instability**	562 (44.0%)
Fall from height	595 (32.8%)	**ED disposition** (n=1806)	
Motor vehicle crashes	506 (27.9%)	Intensive care unit	398 (22.0%)
Pedestrian	508 (28.0%)	Operating room	342 (18.9%)
All-Terrain Vehicle	28 (1.5%)	Floor	1061 (58.7%)
Motor Cycle Crashes	16 (0.9%)	High dependency unit	5 (0.3%)
Bicycle	11 (0.6%)	**Number of blood units (median)**	6 (1-122)
Hit by falling object	119 (6.6%)	**Blood transfusion**	625 (34.5%)
Self-inflicted	10 (0.6%)	**Massive transfusion (n=885)**	94 (10.6%)
Other	21 (1.2%)	**Intubated ETT (n=885)**	203 (22.9%)
Associated injuries		**FAST positive (n=833)**	92 (11.0%)
Chest	677 (37.3%)	**Management (n=1829)**	
Spine	573 (31.6%)	Conservative management	1172 (64.6%)
Abdomen	497 (27.4%)	Surgical intervention*	642 (35.4%)
Head	330 (18.2%)	**In-hospital complications**	
Lower extremity	462 (25.5%)	Pneumonia	118 (6.5%)
Upper extremity	487 (26.8%)	Sepsis	57 (3.2%)
Glasgow Coma Score ED (n=1466)	13.0±2.0	Acute Respiratory Distress Syndrome (ARDS)	54 (3.0%)
Injury Severity Score (mean ± SD)	16.5±13.3	Acute Kidney Injury (AKI)	44 (2.4%)
Revised Trauma Score (n=1200)	7.23±1.38	Deep Vein Thrombosis (n=885)	7 (0.8%)
Pelvis AIS	2.4±0.7	Pulmonary embolism (n=885)	4 (0.5%)
Head AIS	3.3±1.3	Multiorgan failure (n=885)	6 (0.7%)
Chest AIS	2.8±0.8	**Ventilatory days**	5 (1-63)
Abdomen AIS	2.7±1.1	**ICU length of stay**	5 (1-74)
SBP at ED (n=1295)	120.2±21.7	**Hospital length of stay**	15 (1-505)

DBP at ED (n=1221)	73.1±15.8	Mortality	86 (4.7%)

* Open Reduction and Internal Fixation, closed reduction and external fixation; ED: emergency department , SBP: systolic blood pressure; DBP: Diastolic Blood Pressure

Figures

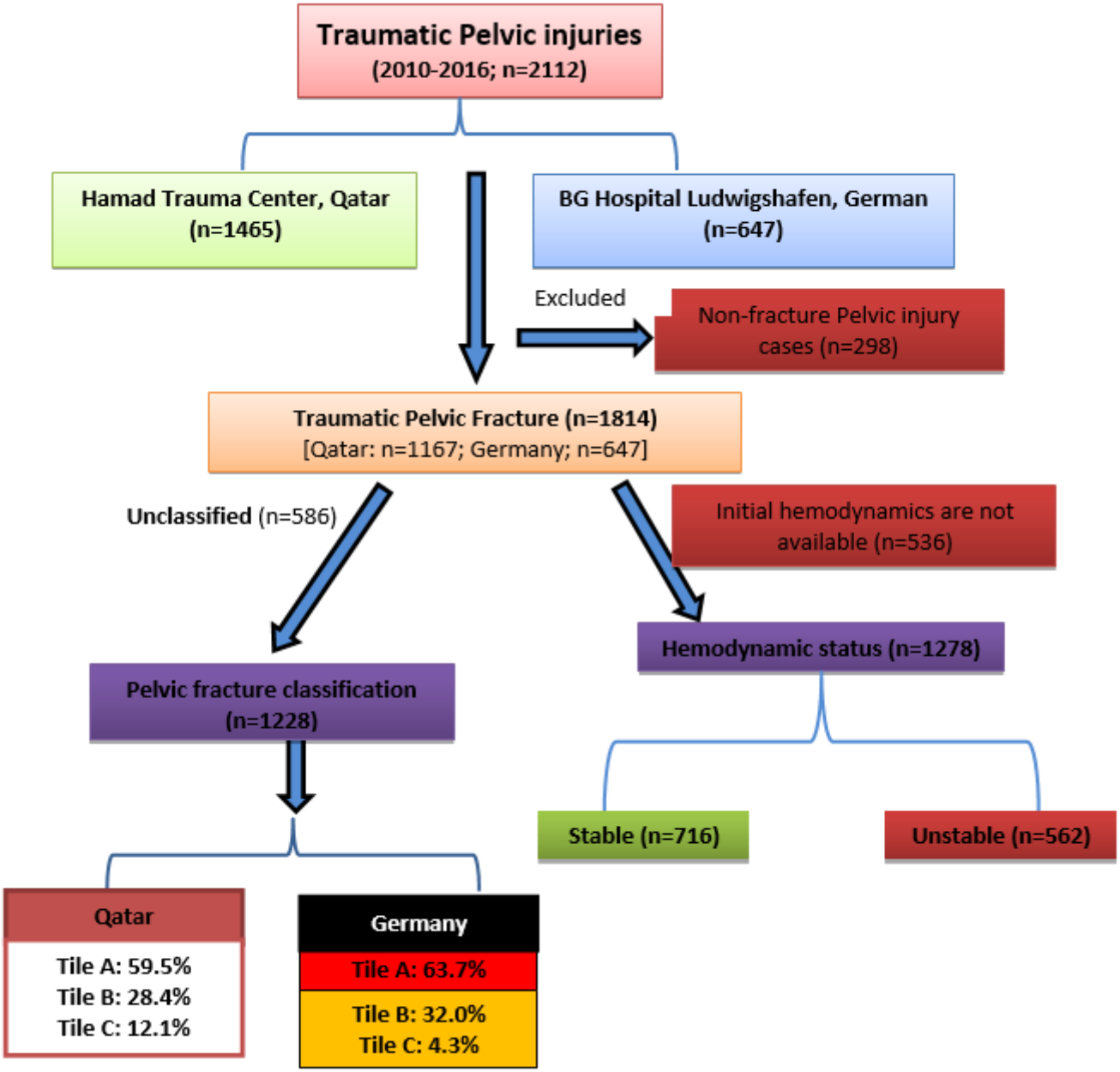

Figure 1

Table 2: Clinical characteristics and outcome by types of pelvic fractures (Tiles classification; n=1228)

	Tile A (n=745; 60.7%)	Tile B (n=361; 29.4%)	Tile C (n=122; 9.9%)	P value
Age	41.5±21.7	38.8±19.6	36.1±14.9	0.009
Males	553 (74.3%)	270 (74.8%)	100 (82.0%)	0.18
Mechanism of injury				
Fall from height	250 (33.6%)	118 (32.7%)	40 (32.8%)	0.001 for all
Motor vehicle crashes	192 (25.8%)	104 (28.8%)	31 (25.4%)	
Pedestrian	248 (33.3%)	92 (25.5%)	27 (22.1%)	
Fall of heavy object	32 (4.3%)	39 (10.8%)	21 (17.2%)	
Others	23 (3.1%)	8 (2.2%)	3 (2.5%)	
Associated injuries				
Chest	249 (33.4%)	130 (36.0%)	55 (45.1%)	0.04
Spine	236 (31.7%)	115 (31.9%)	64 (52.5%)	0.001
Abdomen	182 (24.4%)	134 (37.1%)	68 (55.7%)	0.001
Head	131 (17.6%)	70 (19.4%)	26 (21.3%)	0.53
Lower extremity	207 (27.8%)	91 (25.2%)	36 (29.5%)	0.55
Upper extremity	170 (22.8%)	93 (25.8%)	39 (32.0%)	0.07
Injury severity score	13.7±10.7	16.9±11.6	23.7±15.3	0.001
GCS ED (n=1017)	13.0±2.0	13.0±2.0	12.0±3.0	0.01
Revised Trauma Score (n=874)	7.4±1.2	7.2±1.4	6.9±1.7	0.004
Pelvis AIS	2.1±0.4	2.5±0.7	2.9±1.0	0.001
Chest AIS (n=434)	2.7±0.8	2.8±0.8	3.0±0.9	0.04
Abdomen AIS (n=384)	2.5±1.1	2.4±0.8	2.7±1.0	0.30
Blood Transfusion	187 (25.1%)	146 (40.4%)	88 (72.1%)	0.001
Blood Units	4 (1-83)	6 (1-48)	8 (1-55)	0.008
MTP blood units >10 (n=629)	33 (7.5%)	19 (16.4%)	26 (35.6%)	0.001
Intubation (n=629)	85 (19.3%)	37 (31.9%)	32 (43.8%)	0.001
FAST positive (n=591)	44 (10.8%)	19 (16.7%)	13 (19.1%)	0.06
Shock Index (n=913)				
<0.8	326 (61.5%)	145 (52.9%)	42 (38.5%)	0.001 for all
≥0.8	204 (38.5%)	129 (47.1%)	67 (61.5%)	
Management				
Conservative	573 (76.9%)	259 (71.7%)	65 (53.3%)	0.001 for all
Surgical intervention	172 (23.1%)	102 (28.3%)	57 (46.7%)	
In-hospital Complications				
Pneumonia	35 (4.7%)	34 (9.4%)	9 (7.4%)	0.01
Sepsis	13 (1.7%)	18 (5.0%)	7 (5.7%)	0.003
ARDS	8 (1.1%)	8 (2.2%)	9 (7.4%)	0.001
Acute kidney injury	9 (1.2%)	6 (1.7%)	11 (9.0%)	0.001
Deep vein thrombosis (n=629)	3 (0.7%)	0 (0.0%)	3 (4.1%)	0.01
Pulmonary embolism (n=629)	2 (0.5%)	0 (0.0%)	1 (1.4%)	0.40
Organ failure (n=629)	1 (0.2%)	1 (0.9%)	2 (2.7%)	0.04
Ventilatory days	6 (1-53)	5.5 (1-63)	8 (1-49)	0.91
ICU length of stay	4 (1-71)	5 (1-74)	5 (1-61)	0.62

Hospital length of stay	11 (1-505)	18 (1-257)	28 (1-165)	0.001
Mortality	24 (3.2%)	17 (4.7%)	16 (13.1%)	0.001

Table 3: comparison of clinical characteristics and outcome by hemodynamic status of pelvic fracture patients (n=1278)

	Stable (n=716; 56.0%)	**Unstable (n=562; 44.0%)**	**P value**
Age	37.1±15.5	30.9±16.3	0.001
Males	637 (89.0%)	455 (81.0%)	0.001
Associated injuries			
Chest	247 (34.5%)	300 (53.4%)	0.001
Spine	237 (33.1%)	240 (42.7%)	0.001
Abdomen	194 (27.1%)	251 (44.7%)	0.001
Head	106 (14.8%)	151 (26.9%)	0.001
Injury severity score	13.9±10.1	21.8±14.2	0.001
GCS ED (n=1017)	14.0±1.0	12.0±3.0	0.001
Revised Trauma Score (n=874)	7.6±0.9	6.9±1.6	0.001
Pelvis AIS	2.3±0.5	2.5±0.8	0.001
Chest AIS (n=434)	2.7±0.8	2.8±0.8	0.02
Abdomen AIS (n=384)	2.4±1.0	2.7±1.0	0.01
TILE AO Müller Classification (n=913)			
Tile A	322 (64.0%)	208 (50.7%)	0.001 for all
Tile B	141 (28.0%)	133 (32.4%)	
Tile C	40 (8.0%)	69 (16.8%)	
Acetabulum fracture	160 (22.3%)	89 (15.8%)	0.004
Blood Transfusion	176 (24.6%)	354 (63.0%)	0.001
Blood Units	3 (1-38)	6 (1-83)	0.001
MTP blood units >10 (n=861)	4 (0.9%)	77 (19.6%)	0.001
Intubation (n=861)	41 (8.7%)	147 (37.5%)	0.001
FAST positive (n=812)	26 (5.9%)	62 (16.8%)	0.001
Management (n=1293)			
Conservative	449 (62.7%)	342 (60.9%)	0.49 for all
Surgical intervention	267 (37.3%)	220 (39.1%)	
In-hospital Complications			
Pneumonia	25 (3.5%)	80 (14.2%)	0.001
Sepsis	9 (1.3%)	37 (6.6%)	0.001
ARDS	10 (1.4%)	28 (5.0%)	0.001
Acute kidney injury	6 (0.8%)	26 (4.6%)	0.001
Deep vein thrombosis (n=861)	2 (0.4%)	4 (1.0%)	0.29
Pulmonary embolism (n=861)	2 (0.4%)	2 (0.5%)	0.85
Organ failure (n=861)	1 (0.2%)	4 (1.0%)	0.12
Ventilatory days	4 (1-49)	7 (1-63)	0.008
ICU length of stay	4 (1-71)	6 (1-74)	0.001
Hospital length of stay	13 (1-125)	21 (1-505)	0.001
Mortality	10 (1.4%)	51 (9.1%)	0.001

Flow diagram showing study design

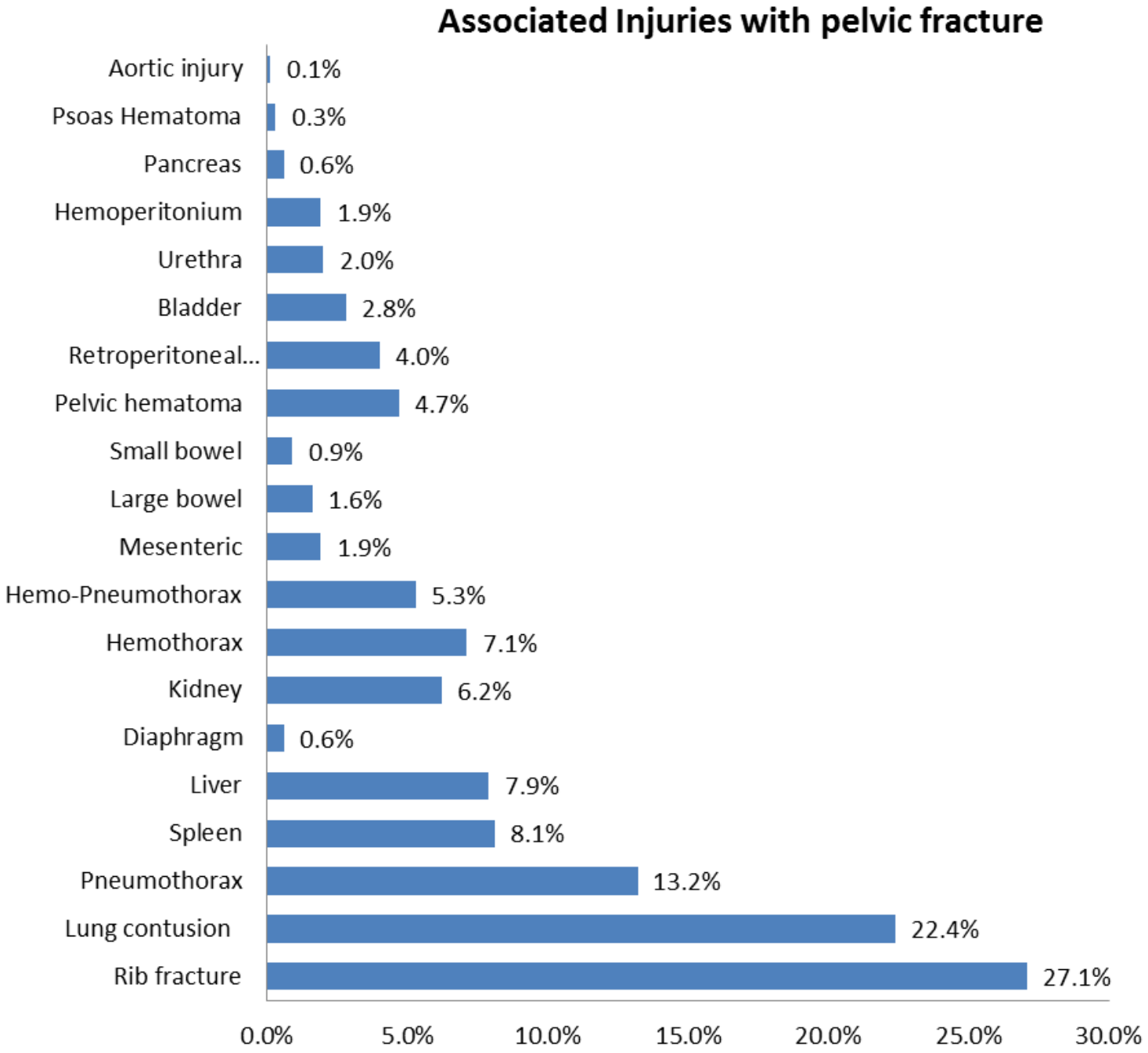

Figure 2

distribution of associated Injuries with pelvic fracture (n=885)