

# THE BLUNT ABDOMINAL TRAUMA AND PELVIC FRACTURES WITH HEMODYNAMIC INSTABILITY

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**Abstract:** The management of patients with hemodynamic instability related to pelvic fractures is a multidisciplinary challenge. The trauma surgeon, orthopedic surgeon and radiologist all have important roles to play in caring for these patients. Trauma patients with pelvic fractures and hemodynamic instability managed in the County Emergency Hospital Petroșani and Clinical County Emergency Hospital of Sibiu from 1990- 2013 were selectively analyzed. In this period, there were more than 1 2000 trauma admissions and 350 patients with pelvic fractures admitted with hemodynamic instability. If clinical and conventional X-ray examinations do not reveal any pathological findings, a major trauma can be excluded and further diagnostic measures postponed. After stabilization of the patients and if there is any suspicion, CT examination of the pelvis must be performed and also an abdominal ultrasound. Identifying the sites of hemorrhage and controlling the bleeding are key elements in managing pelvic fractures. Bleeding occurs from arteries, veins and cancellous bone. Rapid resuscitation, reversal of the acidosis and shock, with rapid control if possible of the hemorrhage are the key elements. External pelvic stabilization when appropriate, can be a useful adjuvant.

## INTRODUCTION

The management of patients with hemodynamic instability related to pelvic fractures is a multidisciplinary challenge having a mortality between 10% and sometimes more than 40%.(1-5) The high mortality is related to severe and uncontrolled pelvic bleeding with or within retroperitoneal hematoma in more than 40% of the cases.(6-8) Pelvic fractures can produce venous and arterial injury. Whereas arterial hemorrhage accounts for only 10% of all traumatic pelvic bleeding, it is more frequently associated with the hemodynamic instability than venous hemorrhage.(9) Pelvic hemorrhage associated with traumatic pelvic fractures can lead to life threatening bleeding with mortality of up to 20%.(10,11)

In addition as a result of the large force required to cause pelvic fractures, thoracoabdominal and skeletal injuries frequently occur and can also lead to significant hemorrhage.(11,12) Death within 24 hours of injury is most often due to hemorrhage.(12) Centres where algorithms of these injuries have been adopted, mortality has decreased.(13,14,15)

The trauma surgeon, orthopedic surgeon and radiologist have important roles to play in caring for these patients.

## MATERIALS AND METHODS

Trauma patients with pelvic fractures and hemodynamic instability managed in County Emergency Hospital Petroșani and Clinical County Emergency Hospital of Sibiu from 1990- 2013 were selectively analyzed. In this period there were more than 12000 trauma admissions and 350 pelvic fractures patients admitted, with hemodynamic instability.

The inclusive criteria in this selective study were the presence of hemorrhagic shock with injury severity score (ISS)>15. To include in this study patients with hemorrhagic shock, the presence of shock was defined by base deficit higher than 6mEq/l, more than 64 units of red blood cells transfused

during the first 12 hours. From this study, there were excluded all trauma patients with Glasgow Coma Scale <9 and those with uncontrolled extrapelvic bleeding.

In this study, there were isolated patients whose hemodynamic instability was related to pelvic bleeding only.

Retrospectively, there were 350 patients that were subjects to abdominal US examination for suggested blunt abdominal trauma associated with pelvic fractures. The US examination was performed within the first 30 min of the patient arrival to the emergency room.

The areas that were checked for free peritoneal fluid were bilateral: subdiaphragmatic, subphrenic, perisplenic, bilateral paracolic and pelvic area.

In addition the liver and spleen were checked for possible injury.

The examination was classified as positive in the case of free peritoneal fluid or obvious parenchyma injury of solid intraabdominal organs.

On the other hand, the exam was considered negative when the above signs were absent.

The exam was declared unclear when equivocal signs or technical limitations were present. In general, patients with hemodynamic instability and a positive US test were treated surgically.

In this study, we analyse the management of acute hemorrhage in pelvic trauma, the complex open pelvic fracture, the soft tissue trauma in pelvic fractures and the risk of infection for mortality in pelvic fractures.

## RESULTS

Simultaneous palpation and careful mobilization of both pelvic crests confirms vertical and /or rotational instability. Perineal hemorrhage is a direct indicator of severe pelvic lesions. Because all patients from this selective study were with hemorrhagic shock, the conventional X-ray was the most

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## CLINICAL ASPECTS

important imaging procedure.

If clinical and conventional X-ray examinations do not reveal any pathological findings, a major trauma can be excluded and further diagnostic measures postponed. After stabilization of the patients if exists any further suspicion, Computed Tomography (CT) examination of the pelvis must be performed.

CT images and conventional X-rays of good quality were allowed for exact classification of the pelvic lesion. We used classification of Tile (16), a distinction is made between stable (type A), rotationally unstable (type B), as well vertically and rotationally unstable lesions (type C) and classification of Burgess (17,18), with antero-posterior compression, lateral compression, shear and complex vertical injuries.

In the present study, open book injuries, vertically unstable lesions, complex and open pelvic injuries are the most dangerous as, they are combined with soft tissue disruption and retroperitoneal bleeding.

Open book lesions are the result of antero-posterior compression. In this cases we have rupture with diastases of the symphysis pubis and in case that is more then 2 cm, the ventral sacroiliac ligaments, the sacrospinal and sacrotuberal ligaments are also torn and blood loss may be active and continuous.(19,20)

We defined complex pelvic injuries as pelvic lesions in combinations with severe damage of the surrounding soft tissue lesions of the urogenital tract or neurovascular compromise of one of the lower extremities and open pelvic injuries was defined as pelvic fracture with a direct communication with a ruptured skin, vagina or rectum.

In concordance with other (21-25) if the complex lesions are recognized early, adequate management has to be started because all from these lesions have in common that there may be severe and ongoing blood loosening inside and outside the pelvic ring witch endangers the patient's survival.

Pelvic fractures can lead to extensive blood loss, notorious is retroperitoneal hematoma, which can hold up to 6 liters.(26)

In this study the risk for extensive blood loss is highest in roll-over trauma and open pelvic fractures and C type fractures has the highest risk .In this cases we used in initial therapy the compression on the fracture sites and tamponade of the intrapelvic bleeding with (20-30 meters) mesh and accomplished occasionally with external binder.

The most common soft tissue lesions accompanying a pelvic fracture is a bladder lesion, this complication we found it in 35%.Housechild (27) found in 36% of cases with soft tissue injuries, a bladder rupture .

In patients who have motorcycle accidents, the mechanism separates both iliac pelvic bones and widely tears the pelvic floor open (figure no. 1).

**Figure no. 1. Ecchymosed scrotum and perineum**



In the severe pelvic trauma patients, the Morel-Lavalle

injury is a severe degloving of the skin and subcutaneous tissue, mostly associated with a role over trauma. These lesions are not easy to treat and the infection is highly present.

In most cases, unstable pelvic ring fractures are associated with injuries in other areas of the body, respectively many patients with pelvic fracture have polytrauma (figure no. 2).

**Figure no. 2. Severe crush trauma of the pelvic ring in a 36-year-old male. Initial hemodynamic instability**



The average age of patients with pelvic fractures was  $45,4 \pm 12,2$  years, medium 44 years. Demographics statistics from 350 pelvic fractures with hemodynamic instability showed in table1. The results showed, that the pubic rami and symphyses were the most common pelvic fracture site (33,7%) and the acetabulum was the second most common (20%). The comorbidities were frequent identified, with 6.1% diabetes and 5.8% cardiovascular disease. The pelvic fractures were associated in polytrauma with blood vessels injuries in 18,7 %,abdominal injuries in 12,4%,and in 10,9% with chest injuries. Male victims were younger but spent more money than female victims in average (table no. 2).

**Table no. 1. Demographics statistics in “%” from 350 cases**

Injury mechanism	%
Automobile accidents	53.40
Pedestrian hit by automobile	3.60
Motorcycle accidents	25.00
<b>Fracture sites</b>	
Acetabulum	20.00
Pubic bone	33.70
Ischion	3.80
Ilium	10.50
Multiples sites	1.80
<b>Fracture types</b>	
Open pelvic fractures	2.10
Sacrococigeal fractures	1.80
Massive transfusions required	38.00
<b>Public fracture and related injuries</b>	
Head injuries	18.70
Chest injuries	11.00
Abdominal injuries	12,50
<b>Comorbidites</b>	
Diabetes	6.10
Hypertensions	5.80

**Table no. 2. Differences in pelvic fractures by gender (% p)**

Constants	Male %	Female %	P value
<b>Injury mechanism</b>			
Automobile accidents	51.40	55.80	0.001
Motorbike	26,10	23,40	< 0.001
<b>Comorbidites</b>			
Diabetes	4.80	7.80	< 0.001
Hypertension	4.10	7.50	< 0.001

## CLINICAL ASPECTS

Fracture sites			
Acetabulum	27.70	13.30	< 0.001
Pubic bone	23.60	42.70	< 0.001
Ilium	15.30	6.01	< 0.001
Ischion	3.00	4.60	< 0.001
Multiple lesions	1.90	1.90	< 0.880
Pubic fractures			
Head injuries	19.00	19.10	0.846
Chest injuries	12.50	8.30	< 0.001
Abdominal injuries	15.30	9.90	< 0.001
Fracture type			
Open	4.00	1.60	< 0.001
Sacrococcygeal	1.80	1.80	0.601
Blood transfusions requirement	35.00	34.00	0.266

The acetabulum was more commonly injured in male (27.7%) and the pubis in female (47.7%). In severe trauma, head injury was fairly even in both genders, but the chest and abdominal injuries were more frequent in males (12.3 vs. 8.2%; 15.3 vs. 9.9%). Open fractures and mortality were higher in males. We analyzed the relative mortality risks of these variables using logistic regression. We found no association between gender, sacrococcygeal fracture status and mortality. Motor vehicles accidents were the injury mechanism that increased the risk of very highly mortality. There was a strong correlation between pelvic fracture related injuries and the risk of death regardless of whether it was a head injury (odds ratio – OR 7.1, 95%; confidence interval - CI: 5.6-8.9) chest injury (OR: 3.1, 95%; CI: 2.4-4.0) or abdominal injury (OR: 2.2, 95%; CI: 1.9-3.2). All of the fractures sites were associated with a lower risk of death, except concurrent sacrococcygeal fracture, but the association was not significant (OR 1.4, 95%; CI: 0.6 - 3.2) instead an open fracture of the pelvis was significantly associated with a higher risk of death. In this study, at the first period, 1990-2000, in open pelvic fracture the mortality rate was around 50%, after this period the mortality rate was lower but still higher than 30%. Early death from uncontrolled hemorrhage, head injury and associated mediastinal rupture occurs within the first few hours. There is a second peak some weeks later when patients are overwhelmed with Multi System and Organ Failure (MSOF) or (Multi Organ Dysfunction System) MODS and sepsis, severe sepsis and septic shock. In present study we observed that the early mortality rate is unusually high when the transportation times are much longer to an emergency trauma centre.

### DISCUSSIONS

#### *The management of pelvic fractures*

Identifying the sites of hemorrhage and controlling the bleeding are key elements in managing pelvic fractures. Bleeding occurs from arteries, veins and cancellous bone. A classic study of autopsy specimens demonstrate contrast substance extravasation from the hypogastric arteries in 85%, with bilateral sources of hemorrhage in 63% and more than one bleeding site identified in 61%. Significant bleeding was rated from the fracture sites as well.(28) Another study rated arterial bleeding in over 70% of hemodynamically unstable patients with pelvic fractures.(29) Additionally, some fractures are more commonly associated with vessel injury. In present material and in other study, pubic rami fractures are associated with obturator vessel injury, sacroiliac joint separation correlates with a shear type injury and venous bleeding, as well a hemorrhage from gluteal and hypogastric branches.(30,31-36) The blunt force trauma, severe enough to fracture the pelvic ring, can also cause significant intraabdominal injuries, the frequency of abdominal injury ranges from 16 to 55% (40,41), and that evidence the importance of clinical examination of the patients in emergency

trauma room.(37,38,39) In patients with hemodynamic instability, external pelvic stabilization may be beneficial, from this approach may benefit patients with certain fractures types such as open book fractures or pubic symphysis diastasis. Patients who are hemodynamically stable after injury or are rapidly stabilized can undergo CT scanning.(42) In patients with refractory hemorrhagic shock, preperitoneal (Retzius space) pelvic packing is an alternative option. In present conditions in our opinion packing may be the only options for an experience surgical team if interventional radiology is not available. The potential volume of the retroperitoneum is approximately 4 liters, therefore preperitoneal packing can provide adequate tamponade of this potential space.(43,44,45) In the present study, the best results with pelvic hemorrhage we have when the procedure of preperitoneal packing was performed by evacuation of the hematoma anteriorly and after symphysis osteosynthesis. In present experience, the bladder was retracted laterally and the pelvic brim was carefully dissected. Cautions dissection is then carried out to avoid avulsion of the vascular convections between the iliac and obturator vessels. In most cases three laparotomy packs are placed posterior and deep to the pelvic brim: the first sponge is placed below the sacroiliac joint, the second sponge is placed anterior to the first and the third sponge is placed in the retropubic space, deep and lateral to the bladder.

Patients with pelvic fractures who remain hypotensive (systolic blood pressure - SBP<90 mmHg) and acidotic (base deficit <-6) and /or have persistent transfusion requirement (4-6 units of red blood cells) are hemodynamically unstable and represent a group in management stereotypes. Ongoing resuscitation should be carried out that is focused upon correction of coagulopathy, acidosis and maintenance of normal temperature. On the basis of more than 12 000 polytrauma patients treatment we consider that if massive transfusion is necessary, the use a 1:1 ratio of red cell to fresh frozen plasma is acceptable.

### CONCLUSIONS

Patients with hemodynamic instability and pelvic fractures provide a significant challenge to the trauma surgeon. Rapid resuscitation, reversal of the acidosis and shock, with rapid control if possible of the hemorrhage are the key elements. External pelvic stabilization, when appropriate, can be a useful adjuvant. A multidisciplinary approach has been shown to be beneficial for patients' outcome.

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