HEMORRHAGIC SHOCK AND ASSOCIATED INJURIES WITH MORTALITY RISK IN POLYTRAUMA PATIENTS WITH PELVIC FRACTURES

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Abstract: *The severe pelvic ring fractures with major hemorrhage are rare but these injuries increase the mortality rate in polytrauma patients. The aim of this retrospective study was to evaluate the results of the severe polytrauma cases including the severe pelvic fractures and major hemorrhage. Materials and methods: The present study evaluated 12.000 polytrauma patients admitted in Emergency Surgical Department in two Emergency Hospitals between 1978-2014, 200 cases with pelvic ring disruption and severe hemorrhage. The present study is addressed to the 200 cases with complicated pelvic ring fractures. All patients with unstable pelvic ring fractures were temporarily stabilized and those with ongoing hemorrhage underwent emergency laparotomy with or without extra peritoneal pelvic packing. In the present study the patients were including in early survivors (surviving the first 12 hours after admission) and deceased. We performed the statistics by Mann-Whitney test, with significance at p<0,05. Results: In the present study 64 (32%) patients with severe fractures and hemorrhagic shock passed away due to hemorrhagic shock. Commonly associated vascular injuries were the injuries of the venous plexus of the bladder, diffuse hemorrhage from the pelvic ring, hemorrhage from the retroperitoneal space. Other complications associated were the injuries of the urethra, bladder. The majority of the bladder injuries are extra peritoneal and result from shearing forces or direct laceration by bone splinters. In the present studies, the urethral disruption is complicated with stricture or incontinence. Overall mortality was 40%. Conclusions: Traumatic disruption of the pelvic ring is a major cause of life threatening hemorrhage, mainly due to extensive venous bleeding from the presacral venous plexus. The key elements in managing patients with pelvic fractures are swift and adequate resuscitation, reverse of shock and acidosis and rapid control of hemorrhage in order to facilitate survival of these patients.*

INTRODUCTION

Traumatic disruption of the pelvic ring is a major cause of life threatening hemorrhage and early recognition and assessment of the degree of hypo perfusion remains a challenge.(1,2,3)

The majority of severs pelvic fractures are marked by hemodynamic instability. The mortality rates from pelvic fractures have ranged from 18 to 40 %.(4,5)

In the majority of deaths within 24 hours after injury, the causes of this evolution is the persistent haemorrhage.(5,6,7,8)

A multidisciplinary approach is required for the proper management of hemodynamically unstable patients with pelvic fractures.(9,10,11)

Trauma still represents the "major killing factor" in young patients,<45 years of age in industrialized countries.(2,3)

Trauma related mortality has three major causes.(12)

1.the immediate mortality at the accident site(sudden death)due to lethal injuries such as aorta rupture with free bleeding, laceration of the brain stem or decapitation injuries.

2.early mortality within the first minutes to few hours (golden hour)due to compromise airways, tension pneumothorax, hemorrhage shock as a consequence of intraabdominal or intrathoracic bleeding and pelvic ring disruptions with massive retopeitoneal hemorrhage,ordue to severe traumatic brain injuries with acute cerebral edema or intracranial hematoma.

3.late mortality within days to weeks after trauma due to septic complications, multiple organ failure and due uncontrollable increased intracranial pressure associated with cerebral edema.

In the past decades the mortality was reduced from about 40% in the 1950 to around 10% in the 2010 in politrauma.(13,14,15)

The pelvic ring can include pubic symphisis, displaced pelvic rami fractures, and different forms of the fractures, or any combination of these injuries. Injuries associated with high severe pelvic fractures include intraperitoneal and retroperitoneal visceral ruptures, vascular disrupture and other fractures.(16,19)

PURPOSE

The aim of this study is to review the current management stereotypes in the evolution and management of patients with pelvic fractures, having experience with more then 12000 polytrauma cases and 200 severe pelvic ring fractures with vascular and other associated complications.

MATERIALS AND METHODS

From 1978 until 2014, 200 multiply injured patients with associated severe pelvic ring fractures were involved.

In this retrospective study, are presented 1,51% of all 12000 polytrauma cases ,that were treated in this period.

For these cases inclusive criteria were score of>/=17

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points and unstable pelvic ring fracture according to the AO classification.(20)

All patients were clinically examined, further assessments included plain X ray of the chest and pelvis, abdominal ultrasounds. After 1989 the concomitant chest, abdominal, brain injuries were examined and evaluated by CT-scan in hemodynamic stable patients. In 86(43%) of these patients CT scan could not be performed before emergency treatment because the presence of severe hemorrhage shock at presentation in emergency room.

To the patients with persistent hemodynamic instability due to ongoing hemorrhage, the immediate control of the bleeding was the major objective, with or without stabilization of the pelvic ring wall.

In other patients with persistent hemodynamic instability due to ongoing hemorrhage we performed intra or extra peritoneal packing or even resuscitative thoracotomy with additional therapy.

All surviving patients in the first 12 hours after admission were considered as early survivors and no survivors when the patient died within 12 hours of admission.

For statistics, the groups of patients were compared using the chi-square test or Fisher's exact test and Mann-Whitney test for continuous variable. Significant differences were at $p<0.05$.The SPSS soft ware package SPSS 13.0, SPSS Inc.

RESULTS

During 1978-2014 (36 years period), 200 patients, who met the predefined inclusive criteria were included in present study. Industry accident was the most common mechanism of trauma between 1978-1986, 140 (70%) and after 1996 traffic accident was the dominant cause of trauma, 160 (80%).Overall mortality was 40% (80) for the analyzed period. In the first 12hours after admission in surgery or ICU, 68% of the admitted patients survived (early survivors).From these patients 4 died at11+/- 8 days after trauma due to multiple organ failure (MSOF), or severe head ,thorax injury. Within 12 hours of admission 32% of the patients died because hemorrhage or head injury.

In hemorrhage the individual compensatory mechanism can maintain a normal blood pressure for a limited time even in a critical hypovolemic situation. In our experience, these situation were observed in young patients with hemorrhagic shock. In this regard, in case of an acute blood loss up to 30% (ex. Equivalent to 1,5 l blood loss for a 70 kg patient), the systolic pressure were in normal range in 8% of the patients with severe hemorrhage, because the increasing of the peripheral resistance that was "masking" the stage of shock.

The parameters of early survivors and no survivors of the two groups are presented in tables no. 1 and 2.

Table no. 1. Dates of early survivors and no survivors patients with pelvic ring fractures and severe hemorrhage

	All patients N=200	**Early survivors N=120**	**No survivors N=80**	**P value**
IS abdomen >/=3	75%	71%	88%	0,29
IS chest >/= 3	63%	57%	77%	0,22
IS head >/=3	39%	33%	51,5%	0,36
IS extremity >/=3	61%	59%	64%	1,00
ISS >/=25	91%	86%	100%	0,15
GCS	22,1%	18,2%	30%	<0,002

IS= injury score GCS=Glasgow Coma Score

Dates from this table showed that in patient with IS abdomen >/= 3 the majority of the cases were no survivors 88%, in IS chest >/= 3 the 77% were no survivors. All patients with IS >/=25 were no survivors (100%)

Table no. 2. Fluids administration in patients with severe hemorrhage and pelvic fractures

	All patients N=200	Early survivors N=120	No survivors N=80	P value
BP at admission (Hg mm)	105	115	85	0,003
P.T %	55,2	67	33	<0,002
Ht % on admission	22	26	15	<0,002
Hgb % on admission	7,5	8,7	4,6	<0.002
Mean arterial pressure on admission	76	84	59	0,002
Heart rhythm on admission	105	120	110	0,02
Plasma until 1 hour(units)	1,4	4,0	1,2	0,2
Crystalloid solution administrated until 1 hour after admission(l)	3,0	2,8	3,5	0.42
Colloid solution until 1 hour(l)	2,7	2,0	3,8	0,002
Red blood cells until 1 hour (units)	4,8	2,8	9,0	<0,002

Table no. 2 showed the difference between survivors and no survivors in fluid administration. The results from these table show that the survivors were majority with collapse, anemia, hypovolemia and with tachycardia.

Surgical management with emergency indication

The pelvic fractures were classified: 8 cases Type B and 42 cases Type C fractures according to the AO Classification.

Type B, 16% in all 200 cases, with more then 30% in no survivor patients.

Type C, 85% in all 200 cases, with 70,1% in no survivors.

The pelvic fractures were associated in many cases with other injuries, included head injuries (57%), chest injuries 64%.Intrabdominal injuries 80%, extremity injuries in 29%. The most commonly associated intrabdominal injured organs were the liver (25%), the spleen (19%), bladder (15%), and urethra (81%).

In the present study 59% (118) of the patients were in severe hemorrhage with shock and 49% (82) of the patients had mild or moderate hemorrhage shock.

The patients with unstable pelvic ring fractures were stabilized with pubic osteosinthesys or peritoneal pelvis packing and in the 10 years with C-clamp.

In 83% (166) patients, the persistent shock with hemodynamic instability, additional emergency laparotomy was indicated, associated in 75% of these cases with pelvic packing intra or/and extra peritoneal. Also intra or extra peritoneal urogenital organs lesions were associated with severe fractures in 45%of cases and were operated with emergency indications. In all operated cases, 15% of the patients required additional resuscitative thoracotomy.

In hemodynamic instable patients, external pelvic

stabilization were benefic, in first 6-12 hours after admission .In the last decade we use C-clamp for stabilization of posterior pelvic ring providing efficient tamponade. In our experience, the C-clamp was not indicated in ilium fractures or in transiliac dislocation, because of the risk of secondary severe injury in sacral fractures and the risk of pelvic organ perforation with septic shock.

Preperitoneal pelvic packing was on alternative option in unstable patients with refractory hemorrhage shock. The potential volume of the retroperitoneal space is approximately 4 liters, therefore the adequate tamponade of this potential space is absolutely necessary. For these patients we performed the packing by evacuation of the hematoma anteriorly, with lateral retraction of the bladder and carefully dissected the pelvic brim. A carefully dissection is necessary to avoid avulsion of the vascular convection between the iliac and obturator vessels.

Also, it is very important to place the packs posterior and as deep as it possible, after the laparotomy.

In our experience, we placed the first pack (sponge) below the sacroiliac joint, the second one anterior to the first sponge and the other sponge in the retropubic space deep in Retzius space but lateral to the bladder after symphisis osteosynthesis. We do not have experience with angioplasty and therapeutic embolisation.

In some cases with persistent hypotension and acidosis or having a persistent transfusion (4-6 units of blood) and are hemodynamic instable the management strategies were difficult. In our experience, the most important were the correction of acidosis, coagulopaty and ensuring the normal temperature. In cases that needed massive transfusion we used 1:1 ratio with fresh frozen plasma.

In our experience, pain on palpation of the pelvic ring was important finding in the alert, aware patients. In the unconscious patients, we applied the anterior-posterior compression and lateral- medial compression over the anterior-superior iliac crest to assess the abnormal mobility of the pelvis. Rectal digital examination was necessary to assess rectal tore, prostate and the presence of blood in Douglas or in the rectal vault.

The initial goal in the management of patients with unstable fractures was to stop further blood loss by realigned the fractures surfaces or disrupted joints .In more than 90% of these cases , reduction of the fractures site and the stabilization of the pelvic ring ,released pain and helped in management of shock therapy.

In the present study, 60% of the bladder ruptures were extra peritoneal, 10% were combined intra and extra peritoneal.

In the presence of intra peritoneal bladder injuries, the surgical exploration was the standard in all cases, with two layers suture with resorbable sutures and Foley catheter are used for 10 to 14 days with clear urine. In intra peritoneal bladder injuries the majority of our patients healed with Foley catheter drainage only (88% by 10-14 days) and the remaining 12% healed by prolonged urinary diversion up to 1 month.

In patients with abdominal exploration for other associated injuries, we repaired at the same times all extra peritoneal bladder ruptures.

DISCUSSIONS

The management of these patients is a therapeutic challenge for every trauma team.

For these patients early aggressive resuscitations efforts with surgical control of the persistent bleeding represents the centre piece of treatment.(1,25)

Identifying the site(s) of hemorrhage and controlling the bleeding are key elements in managing pelvic fracture.(20,26,27)

A classic study of autopsy specimens demonstrates contrast extravasations from the hypogastric arteries in 85% cases, with bilateral sources of hemorrhage in 63% and more than one bleeding site indentified in 61% cases.(22,28,29)

Another study noted arterial bleeding in over 70% of hemodynamic unstable patients with pelvic fracture.

In our experience, blunt force trauma, severe enough to fracture the pelvic ring, can also cause significant intra abdominal injuries with retro peritoneal hematoma, urogenital injuries, or vascular and visceral injuries. In the literature the frequency of abdominal injuries ranges is from 16 to 55%.

The management of pelvic fractures it is addressed to the evaluation of the positive diagnosis, of the mortality for noninvasive pelvic stabilization, abdominal evaluation and control of hemorrhage.

The external stabilization in hemodynamic instability can reduce pelvic volume by 10% and increase the systolic blood pressure by 40 mmHg .In four cases we observed an exacerbate hemorrhage after external stabilization devices for lateral compression fractures.

In unstable patients with refractory shock, the preperitoneal pelvic packing were an alternative option, especially if interventional radiology with embolization is not available.(22) The current controversy centers on angiography versus pelvic packing.

Some authors consider that catheter embolization is the best choice with 73 to 90% success rate.

Other authors strongly advocate for pelvic packing as the initial therapy in controlling pelvic haemorrhage.(21)

In our experience, venous injuries, especially those from Retzius venous plexus are significant sources of hemorrhage. The preperitoneal packing using the suprapubic way can be performed very quick and efficient. This observation is in accord with others authors opinions too.(23,24,26)

A pelvic fracture is nearly always associated with extra peritoneal bladder injuries. In our experience bladder rupture were in 60% of cases extra peritoneal, 30% intra peritoneal and 10% mixed injuries and these results were in concordance with other publication.

Mortality rates, in patients with pelvic disruption and intra peritoneal bladder ruptures associating hemorrhagic shock, are high and typically due to multiple organs associated injuries and hemorrhage.

The pelvic fracture is associated with injury of the posterior urethra and intraabdominal injuries including injuries of the spleen (8-21%), liver and bowels.

CONCLUSIONS

Patients with hemodynamic instability and pelvic fractures provide a significant challenge to the trauma surgeon. Rapid resuscitation, reversal of shock with quick control of hemorrhage are the key elements for the patients.

REFERENCES

1. Moreno C, Moore EE, Rosenberger A, Cleveland HC. Hemorrhage associated with major pelvic fracture: a multidisciplinary challenge. J Trauma; 1986.
2. Smith W, Williams, Agudelo J, et al. Early predictions of mortality in hemodynamicaly unstable pelvis fractures. J Orthop Trauma; 2007.
3. Cothren CC, Osborn PM, Moore EE, Morgan SJ, et al. Preperitoneal pelvic packing for hemodynamically unstable pelvic fractures: a paradigm shift. J Trauma; 2007.
4. Gilliland MD, Ward RE, Barton RM, Miller PW, et al.Factors affecting mortality in pelvic fractures. J Trauma;

1982.
5. Balogh Z, Caldwell E, Heetweld M, et al. Institutional practice guidelines on management of pelvic fracture – related hemodynamic instability:do they make a diference? J Trauma; 2005.
6. Biffl WL, Smith WR, Moore EE, et al. Evolution of a multidisciplinary clinical pathway for the management of unstable patients with pelvic fractures. Ann Surg ;2001.
7. Pohlemann T, Bosh A, Gannslen A, Tscherne H. The Hannover experience in management of pelvic fractures.Clin Orthop Relat Res; 1994.
8. Huittinen VM, Slatis P. Postmortem angiography and dissection of the hypogastric artery in pelvic fractures. Surgery; 1973.
9. Miller PR, Moore PS, Mansell E, et al. External fixation or arteriogram in bleeding pelvic fractures: initial therapy guided by marckers of arterial hemorrhage. J Trauma; 2003.
10. Melz CM, Hak DJ, Goulet JA, Williams D.Pelvic fractures patterns and their corresponding angiographic sources of hemorrhage. Orthop VClin Noth Am; 2004.
11. Hak D. The role of pelvic angiography in evaluation and management of pelvic trauma. Orthop Clin North Am; 2004.
12. Ben-Menachem Y, Coldwell DM, Young JW, Burgess AR. Hemorrhage associated with pelvic fractures: causes, diagnosis and emergent management. AJR AM J Roentgenol; 1991.
13. Cryer HM, Miller FB, Evers BM, et al. Pelvic fractures classification:correlation with hemorrhage.J Trauma; 1988.
14. Murr PC, Moore EE, Lipscomb R, Johnston RM. Abdominal trauma associated with pelvic fractures. J Trauma; 1980.
15. Davis JW, Moore FA, McIntyre RC, Cocanour CS, et al. Western Trauma Association critical decisions in trauma: management of pelvic fractures with hemodynamic instability. J Trauma; 2008.
16. Botllang M, Simpson T, Sigg J, et al. Noninvasive reduction of open-book pelvic fractures by circumferential compression. J Orthop Trauma; 2002.
17. Krieg JC, Mohr M, Ellis TJ,et al.Emergent stabilization of pelvic ring injuries by controlled circumferential compression:a clinical trial. J Trauma; 2005.
18. Nunn T, Cosker T, Bose D, et al .Immediate application of improvised pelvic binder as firest step in extended resuscitation from life-threatening hypovolemic shock in conscioun patients with pelvic injuries. Injury; 2007.
19. Jowett AJ, Bowyer GW. Pressure characteristics of pelvic binders. Injury; 2007.
20. Ertel W, Keel M, Eid K, et al. Control of severe hemorrhage using C-clamp and pelvic packing in multiply injured patients with pelvic ring disruption. J Orthop Trauma; 2001.
21. Archdeacon MT, Hiratzka J. The trochanteric C-clamp for provisional pelvic stability. J Orthop Trauma; 2006.
22. Gansslen A, Giannoudis P, Pape HC. Hemorrhage in pelvic fractures:who needs angiography? Curr Opin Crit Care; 2003
23. Davis JW, Kaups KL, Parks SN. Base deficit is superior to pH in evaluating clearance of acidosis after traumatic shock. J Trauma; 1998.
24. Omert LA, Sayler D, Dunham CM, et al. Implications of the contrast blush finding on CT scan of the spleen in truma. J Trauma; 2001.
25. Velmahos GC, Chahwan S, Hanks SE, et al. Angiographic embolization of bilateral internal iliac arteries to control life–threatening hemorrhage after blunt trauma to pelvis.Am Surg; 2000.
26. Panetta T, Sclafani SJ, Goldstein AS, et al. Percutaneous transcatheter embolization for massive bleeding from pelvic fractures. J Trauma; 1985.
27. Velmahos GC, Toutouzas KG, Vassiliu P, et al. A prospective study on the safety and efficaty of angiographic embolizationfor pelvic and visceral injuries. J Trauma; 2002.
28. Dubose J, Inaba K, Barmparas G, et al. Bilateral iliac artery ligation as a damage control approach in massive retroperitoneal bleeding after fractures of pelvic ring. J Trauma 2010.
29. Dente CJ, Shaz BH, Nicholas JM, et al. Improvements in early mortality and coagulopathy are sustained better in patients with blunt trauma after institution of a massive transfusion protocol in a civilian level I trauma center. J Trauma; 2009.