

PELVIC FRACTURES – MEDICAL-SURGICAL EMERGENCY

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Abstract: The management of patients with pelvic fractures, in special cases with hemodynamic instability related to pelvic fracture is a major challenge, with high morbidity and mortality. Severe pelvic fractures pose a great challenge for physicians. The purpose of this review is to highlight recent changes in the management of patients with pelvic fractures. In this review, the current stains of pelvic fracture management is presented including an evaluation of roles of angioembolization and preperitoneal packing, recently proposed algorithm for management. In present study, the bilateral iliac artery ligation as a salvage surgery is reviewed and the early (<24h) pelvic fracture operative fixation. The key elements in pelvic fractures management are the adequate resuscitation, reverse acidosis and shock and the early, definitive control of hemorrhage. A multidisciplinary approach has been shown to reduce the mortality rates.

Cuvinte cheie: reducerea și imobilizarea focarelor de fractură și meșarea spațiului preperitoneal

Rezumat: Managementul pacienților cu fracturi de bazin, în special cei cu instabilitate hemodinamică reprezintă o mare provocare pentru medici, în același timp având și o morbiditate și mortalitate înaltă. Scopul acestei retrospective este de a sublinia cele mai recente modificări aduse protocoalelor în ceea ce privește managementul fracturilor de bazin. În această retrospectivă sunt prezentate metodele curente de management ale fracturilor de bazin incluzând evaluarea rolului angioembolizării și a împachetărilor (meșării) preperitoneale. În acest studiu este reanalizată legătura arterelor iliace bilaterale ca și metodă de supraviețuire primară și reducerea și fixarea focarelor de fractură în primele 24 de ore. Elementele cheie în managementul fracturilor de bazin sunt resuscitarea adecvată, reversibilitatea șocului și a acidozei precum și controlul imediat și definitiv al hemoragiei. O abordare multidisciplinară s-a dovedit a fi cea mai eficientă pentru a reduce rata mortalității.

The management of patients with pelvic fractures can be challenging. The mortality rates from pelvic fractures have been ranged from 18-40%.(1-4) The mortality in the early phase after trauma, within 24 hours of injury is most often due to hemorrhage.(2) The management of patients with hemodynamic instability related to pelvic fracture is a multidisciplinary challenge with mortality between 10-42%(5-9), and in uncontrolled pelvic bleeding the mortality is more than 40% of the cases.(10-12)

In centres where the algorithms for the management of these cases have been adopted, mortality has decreased.(13-15)

A multidisciplinary approach is essential for the proper therapy of hemodynamically unstable patients with pelvic fractures, the trauma surgeon, orthopedic surgeon and interventional radiologist have important roles to play. This study aims to review the current management stereotypes in the evaluation and management of patients with pelvic fractures.

The pelvic girdle is the largest and strongest entity of the musculo-skeletal system, and large forces are needed to disrupt the pelvic ring of a healthy person.

Recognizing the severity of the lesion

Many cases with the pelvic ring lesion are severely injured.

The examination of the pelvic girdle is performed clinically and radiological.

The presence of the traumatic lesions, or open wounds of the back, on the buttocks, or in the perineum are direct signs

of the amount of traumatic force.

In every severely injured patient, the pelvic overview has to be completed with thorax x-ray, and cervical spine x-ray.(16) In case of any suspicion, CT examination of the pelvis must be performed. X-Rays and CT images allow for exact classification of the pelvic lesions.

Tile (17) distinctness stable (type A), rotationally unstable(type B), as well as vertically and rotationally unstable lesions (type C).

In the classification of Burges, lateral compression, antero-posterior compression, vertical shear and complex injuries are distinguished.(18,19) Between these, the vertically unstable lesions, open pelvic injuries and complex lesions are the most dangerous, as they are associated with retroperitoneal bleeding and soft tissue destructions. In pelvic fractures blood loss may be active and continues (20,21), because self tamponade is less likely than in “open book” lesions. In pelvic fractures lesions of the urethra, bladder, nerves or vessels are more frequent.(22)

Complex pelvic injuries are defined as pelvic lesions with severe damage of soft tissues urogenital, neurovascular lesions.(23,24)

All lesions of pelvic fractures have in common that there may be severe and ongoing blood loss inside and outside the pelvic ring, with risks of patient’s survival.(25,26)

Sources of hemorrhage

A classic study of autopsy specimens demonstrates a

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contrast extravasations from the hypo gastric arteries in 85%, with bilateral sources of hemorrhage in 63% and more than one bleeding site identified in 61%, and from the fracture sites as well.(27)

Another study from Miller and Al has shown bleeding in over 70% of hemodynamically unstable with pelvic fractures.(28) Pubic rami fractures are associated with obturator vessel trauma, sacroiliac joint separation correlates with severe bleeding, as well as hemorrhage from gluteal and hipogastric branches.(29,30)

Early management

Primary treatment must be focused on the hemodynamic situation of the patient. The cause of hemodynamic instability is blood loss out of the fracture fragments especially of the dorsal pelvic ring.

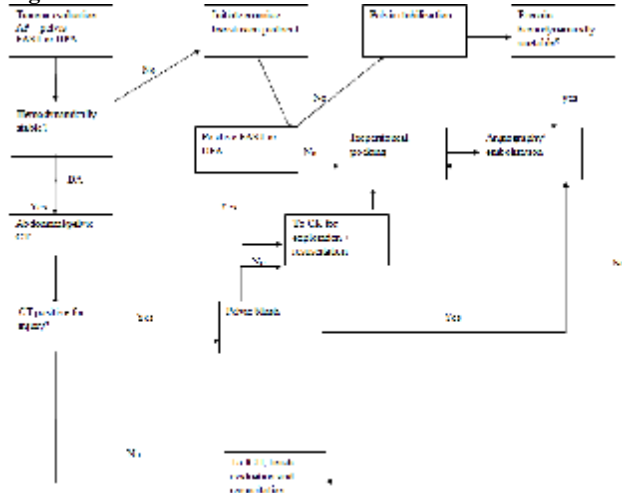
Slates and company presented a series of 27 postmortem angiographies and dissection after pelvic trauma, and they found that leakage from the fractured cancellous bone was the major source of bleeding.(31)

If larger vessels such as iliac arteries are ruptured, there is massive blood loss, with hemodynamic disorders.

The management algorithm of pelvic ruptures should include adequate diagnosis, pelvic stabilization modality, abdominal evaluation, surgical options and angiography.

The algorithm referred here was developed by the Western Trauma Association.(32)

Figure no. 1.



DPA=diagnostic peritoneal aspirate; FAST=focused assessment with sonography for trauma; OR=operating room

External fixation

External fixation of the broken pelvis has been a well accepted technique of provisional or definitive stabilization for decades.(33-37)

In patients with hemodynamic instability, external fixation with pelvic stabilization may be indicated, this stabilization can reduce pelvic volume by 10%.(38,39)

A retrospective study by Numm et al.(40) demonstrated an increase in SBP by 40mmHg with a use of external pelvic stabilization for open book fractures or pubic symphysis diastasis is indicated, in lateral compression fractures or pubi rami fractures may exacerbate hemorrhage.(41-45)

C-clamp

This anti-shock pelvic clamp was introduced in 1991.(46)

In 1996, Hevic et al published a first series of 30 cases. This application was hemodynamically effective in 10 out of 18 cases with an acute unstable hemodynamic situation, there

were no complications related to the C-clamp application (47)

An external fixator or posterior C-clamp may be used for pelvic stabilization as well.(47,48) The pelvic C-clamp provides direct and improved stabilization of the posterior pelvic ring providing tamponade.

However the C-clamp should not be used with fractures of the ilium or with transiliac wing fracture – dislocation.

After C-clamp application, the possible complications are the injury to the gluteal neurovascular structures, risk of secondary nerve injury in patients with posterior sacroiliac fractures. In recent studies, pin tract infections and pelvic organ perforation have been also reported.(41)

Pelvic Packing

In some European Trauma Centres, pelvic packing have been advocated as an additional salvage control procedure in posttraumatic pelvic bleeding.(50,51,52)

The goal is to control bleeding which originates from broken cancellous bone, from the dorsal venous plexus and from the smaller arteries. Packing can be done with intra or extra peritoneal approach and in absence of any abdominal lesions, a laparotomy is not needed.

In pelvic packing, through a incision above the symphysis pubis, the middle forml layer, between both rectus abdominal muscles is transected and the peritoneum is not opened.

Preperitoneal pelvic packing is alternative option in unstable patients with refractory hemorrhage shock and packing may be the only options for the experienced surgical team if the interventional radiology is not available.

Before packing is provide, the procedure of preperitoneal packing is performed by evacuation of the hematoma anteriorly. After the bladder retraction laterally and carefully dissection of the pelvic brim, cautions dissection is carried out to avoid avulsion of the vascular connections between the iliac and obturator vassels. Deep to the pelvic brim must be placed three laparotomy packs, the first sponge is placed below the sacroiliac joint, the second sponge is place anterior to the first, and the third sponge is placed in the retropubic space, deep and lateral to the bladder.(54)

Bilateral iliac artery ligation

A recent study was investigated using bilateral iliac artery ligation and pelvic packing as an adjuvant to hemorrhage control in patients with expanding retroperitoneal hematoma.

In recent study from Dubose et al (50), the mortality rates was 64% in expanding retroperitoneal hematoma with hemodynamic instability and at least some of the survivals went on to angioembolisation for hemorrhage control.

The hemodynamically unstable patients

Clinical pathways were developed and published during the last 20 years for management of hemodynamically unstable patients. Criteria for this are SBP<90 mmhg, acidosis with base deficit <-6 or have a persistent transfusion requirement, represent a group in whom there is controversy in management.(51-54,55)

The current controversies centres on angiography versus pelvic packing

Some authors believe that rather embolisation is the last choice.(28,30,56-58)

Miller et al (28) stratified patients with pelvic fractures and hypotension.

Others authors strongly advocate for pelvic packing as the initial manoeuvre in controlling pelvic hemorrhage.(49)

Conclusions:

In patients with hemodynamic instability rapid resuscitation with appropriate component therapy, reverse of the

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shock and acidosis and rapid control of the hemorrhage are the key elements.

External pelvic fixation, when appropriate, can be a useful adjuvant.

REFERENCES

1. Moreno C, Moore EE, Rosenberger A, Cleveland HC. Hemorrhage associated with major pelvic fracture: a multispecialty challenge. *J Trauma* 1986;26:987-994.
2. Smith W, Williams A, Agudelo J, et al. Early predictors of mortality in hemodynamically unstable pelvis fractures. *J Orthop Trauma* 2007;21:31-37.
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;62:834-839; discussion 839-842.
4. Gilliland MD, Ward RE, Barton RM, Miller PW, et al. Factors affecting mortality in pelvic fractures. *J Trauma* 1982;22:691-693.
5. Naam NH, Brown WH, Hurd R, Burdge RE, Kaminski DL. Major pelvic fracture. *Arch Surg* 1983;118:610-616.
6. Evers BM, Cryer HM, Miller FB. Pelvic fracture hemorrhage. *Arch Surg* 1989;124:422-424.
7. Poole GV, Ward EF. Causes of mortality in patients with pelvic fracture. *Orthopedics* 1994;17:691-696.
8. Gilliland MD, Ward RE, Barton RM, Miller PW, Duke JH. Factors affecting mortality in pelvic fracture. *J Trauma* 1982;22:691-693.
9. Dalal SA, Burges AR, Siegel JH, et al. Pelvic fracture in multiple trauma: classification by mechanism is key to pattern of organ injury, resuscitative requirements and outcome. *J Trauma*. 1989;29:981-1002
10. McMurtry R, Walton D, Dickenson D, Kellam J, Tile M. Pelvic disruption in the polytraumatized patient. *Clin Orthop* 1980;151:22-30.
11. Poole GV, Ward EF. Causes of mortality in patients with pelvic fracture. *Orthopedics* 1994;17:691-696.
12. Balogh Z, Caldwell E, Heetveld M, et al. Institutional practice guidelines on management of pelvic fracture-related hemodynamic instability: do they make a difference? *J Trauma* 2005;58:778-782.
13. Balogh Z, Caldwell E, Heetveld M, et al. Institutional practice guidelines on management of pelvic fracture-related hemodynamic instability: do they make a difference? *J Trauma* 2005;58:778-782.
14. Biffl WL, Smith WR, Moore EE, et al. Evolution of multidisciplinary clinical pathway for the management of unstable patients with pelvic fractures. *Ann Surg* 2001;233:843-850.
15. Pohlemann T, Bosch U, Gansslen A, Tscherne H. The Hannover experience in management of pelvic fractures. *Clin Orthop Relat Res* 1994;(305):69-80.
16. Tile M. Pelvic ring fractures: should they be fixed? *J Bone Joint Surg Br* 1988;70:1-12.
17. Burgess AR, Eastridge BJ, Young JW, Ellison TS, Ellison PS Jr, Poka A, Bathon GH, Brumback RJ. Pelvic ring disruption: effective classification system and treatment protocols. *J Trauma* 1990;30:848-56.
18. Dalal SA, Burges AR, Siegel JH, Young JW, Brumback RJ, Poka A, Dunham CM, Gens D, Bathon H. Pelvic fracture in multiple trauma: classification by mechanism is key to pattern of organ injury, resuscitative requirements and outcome. *J Trauma*. 1989;29:981-1000.
19. Moss MC, Bircher MD. Volume changes within the true pelvis during disruption of the pelvic ring—where does the hemorrhage go? *Injury* 1996;27:5-A21-3.
20. Grimm MR, Vrahas MS, Thomas KA. Pressure-volume characteristics of the intact and disrupted pelvic retroperitoneum. *J Trauma* 1998;44:454-9.
21. Dyer GSM, Vrahas MS. Review of the pathophysiology and acute management of hemorrhage in pelvic fracture. *Injury* 2006;37:602-13.
22. Pohlemann T, Gansslen A, Stief CH. Complex injuries of the pelvis and acetabulum. *Orthopaed* 1998;27:32-44.
23. Bosh U, Pohlemann T, Haas N, Tscherne H. Classification and management of complex pelvic trauma. *Umfallchirurg* 1992;95:189-96.
24. Jones AL, Powell JN, Kellam JF, McCormack RG, Dust W, Wimmer P. Open pelvic fracture. A multicentre retrospective analysis. *Orthop Clin North Am* 1997;28:345-50.
25. Grotz MR, Allami MK, Harwood P, Pape HC, Krettek C, Gianoudis PV. Open pelvic fractures: epidemiology, current concepts of management and outcome. *Injury* 2005;36:1-3
26. Holting T, Burh HJ, Richter GM, Roeren T, Friedl W, Herfarth C. Diagnosis and treatment of retroperitoneal hematoma in multiple trauma patients. *Arch Orthop Trauma Surg* 1992;111:323-6.
27. Huittinen VM, Slatis P. Postmortem angiography and dissection of the hypogastric artery in pelvic fractures. *Surgery* 1973;73:454-462.
28. Miller PR, Moore PS, Mansell E, et al. External fixation or arteriogram in bleeding fracture: initial therapy guided by markers of arterial hemorrhage. *J Trauma* 2003;54:437-443.
29. Metz CM, Hak DJ, Gouler JA, Williams D. Pelvic fracture patterns and their corresponding angiographic sources of hemorrhage. *Orthop Clin North Am* 2004;35:431-437.
30. Hak D. The role of pelvic angiography in evaluation and management of pelvic trauma. *Orthop Clin North Am* 2004;35:439-443.
31. Sathy AK, Starr AJ, Smith WR, Elliot A, Agudelo J, Reinert CM, Minei JP. The effect of pelvic fracture on mortality after trauma: an analysis of 63,000 trauma patients. *J Bone Surg Am* 2009;91:2803-10.
32. Davis JW, Moore FA, McIntyre RC, Cocanour CS, et al. Western Trauma Association critical decisions in trauma: management of pelvic fracture with hemodynamic instability. *J Trauma* 2008;65:1012-1015.
33. Rommens PM, Hessman MH. Staged reconstruction of pelvic ring disruption: differences in morbidity, mortality, radiologic results and functional outcomes between B1, B2/B3 and C-type lesions. *J Orthop Trauma* 2002;16:92-8.
34. Brandes S, Borrelli J Jr. Pelvic fractures and associated urologic injuries. *World J Surg* 2001;25:1578-87.
35. Anger JT, Sherman ND, Dielubanza E, Webster GD, Hegarty PK. Erectile function after posterior urethroplasty for pelvic fracture-urethral distraction defect injuries. *BJU Int* 2009;104:1126-9.
36. Chiodo A. Neurologic injury associated with pelvic trauma: radiology and electrodiagnosis evaluation and their relationships to pain and gait outcome. *Arch Phys Med Rehabil* 2007;88:1171-6.
37. Ben-Menachem Y, Coldwell DM, Young JV, Burgess AR. Hemorrhage associated with pelvic fracture: causes, diagnosis, and management and emergent management. *AJR Am J Roentgenol* 1991;157:1005-1014.
38. Bottlang M, Siimpson T, Sigg J, et al. Noninvasive reduction of open-book pelvic fractures by circumferential compression. *J Orthop Trauma* 2002;16:367-373.
39. Krieg JC, Mohr M, Ellis TJ, et al. Emergent stabilization of

CLINICAL ASPECTS

- pelvic ring injuries by controlled circumferential compression: a clinical trial. *J Orthop Trauma* 2002;55:659-664.
40. Nunn T, Cosker T, Bose D, et al. Immediate application of improvised pelvic binder as first step in extended resuscitation from life-threatening hypovolemic shock in conscious patients with unstable pelvic injuries. *Injury* 2007;38:125-128.
 41. Jowett AJ, Bowyer GW. Pressure characteristics of pelvic binders. *Injury* 2007;38:118-121.
 42. Davis JW, Kaups KL, Parks SN. Base deficit is superior to pH in evaluating clearance of acidosis after traumatic shock. *J Trauma* 1998;44:114-118.
 43. Jowett AJ, Bowyer GW. Pressure characteristics of pelvic binders. *Injury* 2007;38:118-121.
 44. Geeraerts T, Chhor V, Cheisson G, et al. Clinical review: initial management of blunt pelvic trauma patients with hemodynamic instability. *Crit Care* 2007;11:204.
 45. Ertel W, Keel M, Eid K, et al. Control of severe hemorrhage using C-clamp and packing in multiply injured patients with pelvic ring disruption. *J Orthop Trauma* 2001;15:468-474.
 46. Archdeacon MT, Hiratzka J. The trochanteric C-clamp for provisional pelvic stability. *J Orthop Trauma* 2006;20:47-51.
 47. Grimm MR, Vrahas MS, Thomas KA. Pressure-volume characteristics of the intact and disrupted pelvic retroperitoneum. *J Trauma* 1998;44:454-9.
 48. 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;15:468-474.
 49. Archdeacon MT, Hiratzka J. The trochanteric C-clamp for provisional pelvic stability. *J Orthop Trauma* 2006;20:47-51.
 50. Gansslen A, Giannoudis P, Pape HC. Hemorrhage in pelvic fracture: who needs angiography? *Curr Opin Crit Care* 2003;9:515-523.
 51. Dubose J, Inaba K, Barmparas G, et al. Bilateral iliac artery ligation as a damage control approach in massive retroperitoneal bleeding after pelvic fracture. *J Trauma* 2010.
 52. Bosh U, Pohlemann T, Haas N, Tscherne H. Classification and management of complex pelvic trauma. *Umfallchirurg* 1992;95:189-96.
 53. Grotz MR, Allami MK, Harwood P, Pape HC, Krettek C, Giannoudis PV. Openpelvic fractures: epidemiology, current concepts of management and outcome. *Injury* 2005;36:1-3.
 54. Anger JT, Sherman ND, Dielubanza E, Webster GD, Hegarty PK. Erectile function after posterior urethroplasty for pelvic fracture-urethral distraction defect injuries. *BJU Int* 2009;104:1126-9.
 55. Ertel W, Keel M, Eid K, et al. Control of severe hemorrhage using C-clamp and packing in multiply injured patients with pelvic ring disruption. *J Orthop Trauma* 2001;15:468-474.
 56. 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;66:1616-1624.
 57. Velmahos GC, Chahwan S, Hanks SE, et al. Angiographic embolization of bilateral internal iliac arteries to control life threatening hemorrhage after blunt trauma to the pelvis. *Am Surg* 2000;66:858-862.
 58. Panetta T, Sclafani SJ, Goldstein AS, et al. Percutaneous transcatheter embolization for massive bleeding from pelvic fractures. *J Trauma* 1985;25:1021-1029.
 59. Velmahos GC, Toutouzas KG, Vassiliu P, et al. A prospective study on the safety and efficacy of angiographic embolization for pelvic and visceral injuries. *J Trauma* 2002;53:303-308; discussion 308.