

PRACTICE GUIDELINES: PELVIC FRACTURES

OBJECTIVES:

1. To prevent and treat life-threatening hemorrhage as a result of pelvic ring injuries.
2. To establish early pelvic stability to assist in obtaining early hemodynamic stability
3. To establish early involvement of the orthopedic trauma service to help facilitate care of the trauma patient with pelvic fractures.

DEFINITIONS:

Instability: Unstable pelvic ring disruption may be rotationally and/or vertically unstable. Instability can be a result of fractures of the sacrum, ilium, and pubis. Instability can also result from ligamentous disruption of the pelvic ring at the iliosacral joints and the pubic symphysis.

Open fracture: Associated soft tissue injury allowing contamination of the fracture. Increase in mortality has been associated in markedly increased mortality rates. Open fracture in the pelvis include lacerations in the skin, perineum, vagina, and rectum.

GUIDELINES:

1. Follow the ABC's per ATLS protocol
2. Perform physical exam. If pelvic ring fracture suspected or if patient presents with a high energy mechanism of injury (MVC, Motorcycle, Fall from height, etc) obtain AP Pelvis x-ray ASAP as standard trauma work up in addition to the standard CXR.
3. If pelvic ring injury is present, early consult to orthopedic surgery to address the pelvic ring injury in the trauma bay.
4. Appropriate placement of a pelvic binder and/or traction in patients with pelvic ring injury and hemodynamic instability.
Majority of intra-pelvic bleeding with pelvic ring injuries is venous and can be stabilized with appropriate trauma bay management to limit fracture movement and allow the bleeding to tamponade.
5. Perform CT scans after appropriate resuscitative modalities have been applied.
6. If patient remains hemodynamically unstable consider other treatments in the OR with possible placement of an external fixator, exploratory laparotomy, or interventional radiology for selective arterial embolization.

REFERENCES:

1. DiGiacomo JG, Bonadies JA, Cole FJ. Practice management guidelines for hemorrhage in pelvic fracture [EAST Website], 2001. Available at:<http://www.east.org/tpp/pelvis.pdf>. Accessed October 1, 2009.
2. ^ Eastern Association for the Surgery of Trauma. *Practice Management Guidelines for Trauma East Ad Hoc Committee on Guideline Development*. Chicago, IL: EAST; 1998.
3. ^ abc def Baque P, Trojani C, Deloche J, et al. Anatomical consequences of “open-book” pelvic ring disruption: a cadaver experimental study. *Surg Radiol Anat*. 2005;27:487–490.
4. ^ ab Stover MD, Summers HD, Ghanayem AJ, Wilber JH. Three-dimensional analysis of pelvic volume in an unstable pelvic fracture. *J Trauma*. 2006;61:905–908.
5. ^ Grimm MR, Vrahas MS, Thomas KA. Pressure-volume characteristics of the intact and disrupted pelvic retroperitoneum. *J Trauma*. 1998;44:454–459.
6. ^ Flint LM, Brown A, Richardson JD, Polk HC. Definitive control of bleeding from severe pelvic fractures. *Ann Surg*. 1979;189:709–716.
7. ^ abc Moreno C, Moore EE, Rosenberger A, Cleveland HC. Hemorrhage associated with major pelvic fracture: a multispecialty challenge. *J Trauma*. 1986;26:987–994.
8. ^ Batalden DJ, Wickstrom PH, Ruiz E, Gustilo RB. Value of the G suit in patients with severe pelvic fracture. Controlling hemorrhagic shock. *Arch Surg*. 1974;109:326–328.
9. ^ Ali J, Qi W. Fluid and electrolyte deficit with prolonged pneumatic anti-shock garment application. *J Trauma*. 1995;38:612–615.
10. ^ Chang FC, Harrison PB, Beech RR, Helmer SD. PASG: does it help in the management of traumatic shock? *J Trauma*. 1995;39:453–456.
11. ^ ab Sadri H, Nguyen-Tang T, Stern R, Hoffmeyer P, Peter R. Control of severe hemorrhage using C-clamp and arterial embolization in hemodynamically unstable patients with pelvic ring disruption. *Arch Orthop Trauma Surg*. 2005;125:443–447.

12. ^ Richard MJ, Tornetta P. Emergent management of APC-2 pelvic ring injuries with an anteriorly placed C-Clamp. *J Orthop Trauma*. 2009;23:322–326.
13. ^ abc Tiemann AH, Bohme J, Josten C. Emergency treatment of multiply injured patients with unstable disruption of the posterior pelvic ring by using the “C-clamp”: analysis of 28 consecutive cases. *Eur J Trauma*. 2005;31:244–251.
14. ^ abcde Krieg JC, Mohr M, Ellis TJ, Simpson TS, Maday SM, Bottlang M. Emergent stabilization of pelvic ring injuries by controlled circumferential compression: a clinical trial. *J Trauma*. 2005;59:659–664.
15. ^ Galois L, Pfeffer F, Mainard D, Delagoutte JP. The value of external fixation for unstable pelvic ring injuries. *Acta Orthop Belg*. 2003;69:321–327.
16. ^ abc Stephen DJG, Kreder HJ, Day AC, et al. Early detection of arterial bleeding in acute pelvic trauma. *J Trauma*. 1999;47:638–642.
17. ^ abcd Totterman A, Dormagen J, Madsen JE, Klow NE, Skaga NO, Roise O. A protocol for angiographic embolization in exsanguinating pelvic trauma: a report on 31 patients. *Acta Orthop*. 2006;77:462–468.
18. ^ abcd Miller PR, Moore PS, Mansell E, Meredith JW, Chang MC. External fixation or arteriogram in bleeding pelvic fracture: initial therapy guided by markers of arterial hemorrhage. *J Trauma*. 2003;54:437–443.
19. ^ abc Cook RE, Keating JF, Gillespie I. The role of angiography in the management of haemorrhage from major fractures of the pelvis. *J Bone Joint Surg*. 2002;84:178–182.
20. ^ abc Fangio P, Asehnoune K, Edouard A, Smail N, Benhamou D. Early embolization and vasopressor administration for management of life-threatening hemorrhage from pelvic fracture. *J Trauma*. 2005;58:978–984.
21. ^ abcde Starr AJ, Griffin DR, Reinert CM, et al. Pelvic ring disruptions: prediction of associated injuries, transfusion requirement, pelvic arteriography, complications, and mortality. *J Orthop Trauma*. 2002;16:553–561.
22. ^ abcd Gourlay D, Hoffer E, Routt M, Bulger E. Pelvic angiography for recurrent traumatic pelvic arterial hemorrhage. *J Trauma*. 2005;59:1168–1173.
23. ^ abc Fang JF, Shih LY, Wong YC, Lin BC, Hsu YP. Repeat transcatheter arterial embolization for the management of pelvic arterial hemorrhage. *J Trauma*. 2009;66:429–435.
24. ^ abcd Niwa T, Takebayashi S, Igari H, et al. The value of plain radiographs in the prediction of outcome in pelvic fractures treated with embolisation therapy. *Br J Radiol*. 2000;73:945–950.
25. ^ ab Wong YC, Wang LJ, Ng CJ, Tseng IC, See LC. Mortality after successful transcatheter arterial embolization in patients with unstable pelvic fractures: rate of blood transfusion as a predictive factor. *J Trauma*. 2000;49:71–75.
26. ^ ab Hagiwara A, Minakawa K, Matsuda T, Murata A, Masuda H, Shimazaki S. Predictors of death in patients with life-threatening pelvic hemorrhage after successful transcatheter arterial embolization. *J Trauma*. 2003;55:696–703.
27. ^ abc Kimbrel BJ, Velmahos GC, Chan LS, Demetriades D. Angiographic embolization for pelvic fractures in older patients. *Arch Surg*. 2004;139:728–732.
28. ^ abc Metz CM, Hak DJ, Goulet JA, Williams D. Pelvic fracture patterns and their corresponding angiographic sources of hemorrhage. *Orthop Clin North Am*. 2004;35:431–437.
29. ^ abc Velmahos GC, Toutouzas KG, Vassiliu A, et al. A prospective study on the safety and efficacy of angiographic embolization for pelvic and visceral injuries. *J Trauma*. 2002;53:303–308.
30. ^ abc Shapiro M, McDonald AA, Knight D, Johannigman JA, Cuschieri J. The role of repeat angiography in the management of pelvic fractures. *J Trauma*. 2005;58:227–231.
31. ^ ab Velmahos GC, Chahwan S, Falabella A, Hanks SE, Demetriades D. Angiographic embolization for intraperitoneal and retroperitoneal injuries. *World J Surg*. 2000;24:539–545.
32. ^ ab Takahira N, Shindo M, Tanaka K, Nishimaki H, Ohwada T, Itoman M. Gluteal muscle necrosis following transcatheter angiographic embolisation for retroperitoneal haemorrhage associated with pelvic fracture. *Injury*. 2001;32:27–32.
33. ^ ab Yasumura K, Ikegami K, Kamohara T, Nohara Y. High incidence of ischemic necrosis of the gluteal muscle after transcatheter angiographic embolization for severe pelvic fracture. *J Trauma*. 2005;58:985–990.
34. ^ Ramirez JI, Velmahos GC, Best CR, Chan LS, Demetriades D. Male sexual function after bilateral internal Iliac artery embolization for pelvic fracture. *J Trauma*. 2004;56:734–739.
35. ^ Panetta T, Scalfani SGA, Goldstein AS, Phillips TF, Shaftan GW. Percutaneous transcatheter embolization for massive bleeding from pelvic fractures. *J Trauma*. 1985;25:1021–1029.
36. ^ ab Evers BM, Cryer HM, Miller FB. Pelvic fracture hemorrhage. *Arch Surg*. 1989;124:422–424.
37. ^ Flint L, Babikian G, Anders M, Rodriguez J, Steinberg S. Definitive control of mortality from severe pelvic fracture. *Ann Surg*. 1990;211:703–706.
38. ^ Branney SW, Moore EE, Cantrill SV, Burch JM, Terry SJ. Ultrasound based key clinical pathway reduces the use of hospital resources for the evaluation of blunt abdominal trauma. *J Trauma*. 1997;42:1086–1090.
39. ^ Healey MA, Simons RK, Winchell RJ, et al. A prospective evaluation of abdominal ultrasound in blunt trauma: is it useful? *J Trauma*. 1996;40:875–883.
40. ^ Glaser K, Tschmelitsch J, Klingler P, Wetscher G, Bodner E. Ultrasonography in the management of blunt abdominal and thoracic trauma. *Arch Surg*. 1994;129:743–747.
41. ^ Liu M, Lee CH, Peng FK. Prospective comparison of diagnostic peritoneal lavage, computed tomographic scanning, and ultrasonography for the diagnosis of blunt abdominal trauma. *J Trauma*. 1993;35:267–270.
42. ^ Boulanger BR, McLellan BA, Brenneman FD, et al. Emergent abdominal sonography as a screening test in a new diagnostic algorithm for blunt trauma. *J Trauma*. 1996;40:867–874.
43. ^ Eastridge BJ, Burgess AR. Pedestrian pelvic fractures; 5-year experience of a major urban trauma center. *J Trauma*. 1997;42:695–700.
44. ^ Allen CF, Goslar PW, Barry M, Christiansen T. Management guidelines for hypotensive pelvic fracture patients. *Am Surg*. 2000;66:735–738.
45. ^ abc Ruchholtz S, Waydhas C, Lewan U, et al. Free abdominal fluid on ultrasound in unstable pelvic ring fracture: is laparotomy always necessary? *J Trauma*. 2004;57:278–285.

46. ^{abc} Tayal V, Nielsen A, Jones AE, Thomason MH, Kellam J, Norton HJ. Accuracy of trauma ultrasound in major pelvic injury. *J Trauma*. 2006;61:1453–1457.
47. ^{abc} Friese RS, Malekzadeh S, Shafi S, Gentilello LM, Starr A. Abdominal ultrasound is an unreliable modality for the detection of hemoperitoneum in patients with pelvic fracture. *J Trauma*. 2007;63:97–102.
48. ^{abc} Ballard RB, Rozyczki GS, Newman PG, et al. An algorithm to reduce the incidence of false-negative FAST examinations in patients at high risk for occult injury. Focused assessment for the sonographic examination of the trauma patient. *J Am Coll Surg*. 1999;189:145–150; discussion 150–151.
49. ^a Young JWR, Burgess AR. Radiologic Management Of Pelvic Ring Fractures in Systematic Radiographic Diagnosis. Baltimore: Urban and Schwarzenberg; 1987.
50. ^{abc} Eastridge BJ, Starr A, Minei JP, O'Keefe GE, Scalea TM. The importance of fracture pattern in guiding therapeutic decision-making in patients with hemorrhagic shock and pelvic ring disruptions. *J Trauma*. 2002;53:446–450.
51. ^{ab} Hamill J, Holden A, Civil I. Pelvic fracture pattern predicts pelvic arterial haemorrhage. *Aust N Z J Surg*. 2000;70:338–343.
52. ^a Fu CY, Wu SC, Chen RJ, et al. Evaluation of pelvic fracture stability and the need for angioembolization: pelvic instabilities on a plain film have an increased probability of requiring angioembolization. *Am J Emerg Med*. 2009;27:792–796.
53. ^{ab} Magnussen RA, Tressler MA, Obremskey WT, Kregor PJ. Predicting blood loss in isolated pelvic and acetabular high-energy trauma. *J Orthop Trauma*. 2007;21:603–607.
54. ^{ab} 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;62:687–691.
55. Blackmore CC, Cummings P, Jurkovich GJ, Linnauf KF, Hoffer EK, Rivara FP. Predicting major hemorrhage in patients with pelvic fracture. *J Trauma*. 2006;61:346–352.
56. ^{ab} Sarin EL, Moore JB, Moore EE, et al. Pelvic fracture pattern does not always predict the need for urgent embolization. *J Trauma*. 2005;58:973–977.
57. ^{ab} Smith W, Williams A, Agudelo J, et al. Early predictors of mortality in hemodynamically unstable pelvis fractures. *J Orthop Trauma*. 2007;21:31–37.
58. ^{abc} Pereira SJ, O'Brien DP, Luchette FA, et al. Dynamic helical computed tomography scan accurately detects hemorrhage in patients with pelvic fracture. *Surgery*. 2000;128:678–685.
59. ^{abc} Ryan MF, Hamilton PA, Chu P, Hanaghan J. Active extravasation of arterial contrast agent on post-traumatic abdominal computed tomography. *Can Assoc Radiol J*. 2004;55:160–169.
60. ^{ab} Evers BM, Cryer HM, Miller FB. Pelvic fracture hemorrhage: priorities in management. *Arch Surg*. 1989;124:422–424.
61. ^{abc} Brasel KJ, K. Pham, Yang H, Christensen R, Weigelt JA. Significance of contrast extravasation in patients with pelvic fracture. *J Trauma*. 2007;62:1149–1152.
62. ^{ab} Brown CVR, Kasotakis G, Wilcox A, Rhee P, Salim A, Demetriades D. Does pelvic hematoma on admission computed tomography predict active bleeding at angiography for pelvic fracture? *Am Surg*. 2005;71:759–762.
63. ^a Brandes S, Borrelli J. Pelvic fracture and associated urologic injuries. *World J Surg*. 2001;25:1578–1587.
64. ^{ab} Netto FA, Hamilton P, Kodama R, et al. Retrograde urethrocystography impairs computed tomography diagnosis of pelvic arterial hemorrhage in the presence of a lower urologic tract injury. *J Am Coll Surg*. 2008;206:322–327.
65. ^a Routt ML Jr, Falicov A, Woodhouse E, Schildhauer TA. Circumferential pelvic antishock sheeting: a temporary resuscitation aid. *J Orthop Trauma*. 2006;20:S3–S6.
66. ^a Simpson T, Krieg JC, Heuer F, Bottlang M. Stabilization of pelvic ring disruptions with a circumferential sheet. *J Trauma*. 2002;52:158–161.
67. ^a Warne WJ, Todd MS. The circumferential antishock sheet. *Mil Med*. 2002;167:438–441.
68. ^{abc} Ghaeemmaghami V, Sperry J, Gunst M, et al. Effects of early use of external pelvic compression on transfusion requirements and mortality in pelvic fractures. *Am J Surg*. 2007;194:720–723; discussion 723.
69. ^{abc} Croce MA, Magnotti LJ, Savage SA, Wood GW II, Fabian TC. Emergent pelvic fixation in patients with exsanguinating pelvic fractures. *J Am Coll Surg*. 2007;204:935–939; discussion 940–942.
70. ^{abc} Bottlang M, Krieg JC, Mohr M, Simpson TS, Madey SM. Emergent management of pelvic ring fractures with use of circumferential compression. *J Bone Joint Surg Am*. 2002;84:43–47.
71. ^{abc} Bottlang M, Simpson T, Sigg J, Krieg JC, Madey SM, Long WB. Noninvasive reduction of open-book pelvic fractures by circumferential compression. *J Orthop Trauma*. 2002;16:367–373.
72. ^{abc} Jowett AJL, Bowyer GW. Pressure characteristics of pelvic binders. *Injury*. 2007;38:118–121.
73. ^a Pohleman T, Ganssen A, Hufner T, Tscherne H. Extraperitoneal packing at laparotomy. Presented at: *OTA-AAST Annual Meeting*, October 12–14, 2000, San Antonio, Texas.
74. ^a Ertel W, Karim E, Keel M, Trentz O. Therapeutic strategies and outcome of polytraumatized patients with pelvic injuries. *Eur J Trauma*. 2000;26:278–286.
75. ^a Ertel W, Keel M, Eid K, Platz A, Trentz O. 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.
76. ^a Giannoudis PV, Pape HC. Damage control orthopaedics in unstable pelvic ring injuries. *Injury*. 2004;35:671–677.
77. ^{ab} Totterman A, Madsen JE, Skaga NO, Roise O. Extraperitoneal pelvic packing: a salvage procedure to control massive traumatic pelvic hemorrhage. *J Trauma*. 2007;62:843–852.
78. ^{abc} Cothren CC, Osborn PM, Moore EE, Morgan SJ, Johnson JL, Smith WR. Preperitoneal pelvic packing for hemodynamically unstable pelvic fractures: a paradigm shift. *J Trauma*. 2007;62:834–839; discussion 839–842.
79. ^a Bach A, Bendix J, Hougaard K, Christensen EF. Retroperitoneal packing as part of damage control surgery in a Danish trauma centre—fast, effective, and cost-effective. *Scand J Trauma Resusc Emerg Med*. 2008;16:4.

80. ^{abc} Smith WR, Moore EE, Osborn P, et al. Retroperitoneal packing as a resuscitation technique for hemodynamically unstable patients with pelvic fractures: report of two representative cases and a description of technique. *J Trauma*. 2005;59:1510–1514.
81. ^{abc} Osborn PM, Smith WR, Moore EE, et al. Direct retroperitoneal packing versus pelvic angiography: a comparison of two management protocols for hemodynamically unstable pelvic fractures. *Injury*. 2009;40:54–60.
82. ^{abc} 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;233:843–850.
83. ^{ab} 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.
84. ^a Jeske HC, Larndorfer R, Krappinger D, et al. Management of hemorrhage in severe pelvic injuries. *J Trauma*. 2010;68:415–420.
85. ^a 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;138:504–509.
86. ^a Kataoka Y, Maekawa K, Nishimaki H, Yamamoto S, Soma K. Iliac vein injuries in hemodynamically unstable patients with pelvic fractures caused by blunt trauma. *J Trauma*. 2005;58:704–710.