

# Western Trauma Association Critical Decisions in Trauma: Management of Pelvic Fracture With Hemodynamic Instability

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The management of patients with hemodynamic instability from pelvic fracture is challenging and controversial. Mortality rates have ranged from 18% to 40% in reported series<sup>1–4</sup> and death within the first 24 hours of injury was most often a result of acute blood loss.<sup>2</sup> Significant decreases in mortality rates have been shown with adoption of algorithms for management of these injuries.<sup>5–7</sup>

The key issues in management are identifying the site(s) of hemorrhage and then controlling the bleeding. Bleeding from pelvic fractures occurs from three major sources; arterial, venous, and cancellous bone. A seminal study from 1973 identified extravasation of contrast from the hypogastric arteries in 23 of 27 autopsy cases. Bleeding sources were bilateral in 63%, and 61% had more than one bleeding site identified. Careful dissection revealed lesions to main arteries in only three specimens, and the authors noted that bleeding from cancellous bone and from vessels in adjacent soft tissue hampered identification of arterial injuries. They also stressed the significance of hemorrhage from the fracture sites.<sup>8</sup> A more recent study reported that over 70% of unstable patients with pelvic fractures will have arterial bleeding.<sup>9</sup>

Furthermore, blunt force injury severe enough to fracture the pelvic ring can cause concomitant intra-abdominal injuries. The frequency of abdominal injury, in association with pelvic fracture can range from 16% to 55%.<sup>10–12</sup> Appropriate evaluation of the abdomen for associated intra-abdominal injuries cannot be overstressed.

Management of hemodynamically unstable patients with pelvic fracture requires a multidisciplinary team. In addition to the general trauma surgeon, an experienced orthopedic surgeon and a skilled interventional radiologist are needed for optimal care.

## ALGORITHM TEXT

The issues addressed in this management algorithm are diagnostic evaluation, indications for noninvasive pelvic stabilization, abdominal evaluation and the critical decisions concerning surgical options and angiography. Those determinations are greatly influenced by the availability of resources; a surgical team immediately available with a surgeon familiar with the principles of damage control and preperitoneal packing or an angiography suite with a skilled radiologist for urgent embolization. For example, if angiography is not available, then preperitoneal packing may be the first option in some circumstances.

- A. As part of the initial trauma evaluation, an anteroposterior pelvis radiograph should be obtained. Evaluation of the abdomen can be done rapidly with a focused abdominal sonogram for trauma (FAST). If ultrasonography is not available, a diagnostic peritoneal aspirate (DPA) can be performed from the supra-umbilical site.
- B. Hemodynamic instability in blunt trauma victim with a pelvic fracture can be defined by hypotension (blood pressure  $\leq 90$  mm Hg), significant transfusion requirement (4–6 units packed red blood cells [PRBC]) or significant base deficit ( $\leq -6$ ) or both.<sup>13</sup> Resuscitation should be on-going, with attention given to correction of coagulopathy, acidosis and maintenance of normothermia. Consideration should be given to the early use of a massive transfusion protocol.<sup>14</sup> Every institution should evaluate and adopt their own protocol, but recent studies have supported a 1:1 ratio of PRBC to fresh frozen plasma and a pheresis platelet pack per 5 to 10 units PRBC as a starting point.<sup>15–17</sup> The effectiveness of the resuscitation needs to be monitored, with attention to not just the blood pressure and heart rate, but the correction of the metabolic status as well, using base deficit,<sup>18</sup> lactate,<sup>19</sup> tissue hemoglobin oxygen saturation (StO<sub>2</sub>),<sup>20</sup> or other parameters.<sup>21</sup>

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- C. If the FAST or DPA are positive, the patient should go to the operating room for exploration. A positive DPA is aspiration of greater than 10 mL of gross blood.<sup>22,23</sup>
- D. If the patient remains unstable and has a negative FAST or DPA, in selected circumstances, external pelvis stabilization may be beneficial. If the pelvis is clinically unstable to manual compression or the radiograph shows widening of the posterior pelvic ring or pubic symphysis diastasis, noninvasive pelvic stabilization should be done. Level II evidence demonstrates that external compression of the pelvis can reduce the volume by 10%.<sup>24,25</sup> There is some Level III data suggesting clinical and hemodynamic benefit in these patients.<sup>26,27</sup> If there is no widening of the pelvic ring, or pubic symphysis diastasis (i.e., lateral compression type injuries, or pubic rami fractures), external pelvic stabilization is not likely to be helpful, and may exacerbate the injury. The pelvis can be stabilized with a tightly wrapped sheet, secured with towel clips or with a proprietary device (T-pod; Bio Cybernetics, La Verne, CA). The device (or sheet) should be centered over the greater trochanters, covering the buttocks in most patients. The device should not be left in place longer than 24 to 36 hours as skin necrosis can occur over injured areas and bony prominences.<sup>28</sup>
- E. Patients with hemodynamic instability and unstable pelvic fracture being transported to the operating room for intra-abdominal injury may benefit from more sophisticated skeletal stabilization with an anterior pelvic fixator or posterior pelvic C clamp.<sup>29,30</sup> The abdominal bleeding sources should be rapidly identified and controlled. Damage control principles should be observed. If the patient stabilizes after laparotomy (with pelvic external fixator placement if appropriate); the patient should be transported to an intensive care setting for continued resuscitation.
- F. In patients with hemodynamic instability and refractory hemorrhagic shock, an alternative option, is direct transport to the operating room for preperitoneal packing. This approach should be used if the surgical team has the appropriate knowledge and experience to perform preperitoneal packing as described.<sup>3</sup> If the pelvic hematoma is expanding or the patient remains unstable, exploration and preperitoneal packing should be rapidly performed.<sup>3,31</sup> Preperitoneal packing is performed by opening the retroperitoneal hematoma anteriorly, and evacuating the blood and clot. The bladder is retracted laterally with a malleable retractor and the pelvic brim is carefully palpated and manually dissected. Care should be taken to avoid avulsing any vascular connections between the iliac and obturator vessels. After the pelvic brim is palpated as posteriorly as the surgeon can reach (it is not visualized), three laparotomy packs are placed sequentially deep to the pelvic brim. The first is placed posteriorly just below the sacro-iliac joint, the second sponge is placed anteriorly to the first (in the middle of the pelvic brim), and the third sponge is placed in the retropubic space, deep, and lateral to the bladder. When one side is completed, the bladder is retracted laterally toward that side and the other side is packed.<sup>31</sup> If there is continued bright red hemorrhage indicative of arterial bleeding, emergency angiography with embolization should be performed. Removal or exchange of the packs (if bleeding persists after pack removal) should be performed in 24 to 48 hours.
- G. If the patient remains unstable after packing, urgent pelvic angiography with angio-embolization should be performed. In one report of 18 patients who underwent emergency preperitoneal packing, 80% who had subsequent angiography had positive findings for arterial injury and underwent therapeutic embolization.<sup>32</sup>
- H. If the abdominal evaluation is negative for free fluid and the patient remains unstable, urgent angiography and embolization should be performed. Miller et al. stratified patients with pelvic fracture and hypotension by response to resuscitation. Adequate response was defined by sustained improvement in blood pressure after transfusion of two units of PRBC or less. Those that did not respond to this level of resuscitation had positive angiography findings in 73%.<sup>9</sup>
- I. In the setting of pelvic fracture related hemorrhage, an aortogram with bilateral runoff is followed by selective injections into both iliac systems. If extravasation of contrast is seen, documenting arterial bleeding, selective embolization with coils or foam should be performed. Evidence of vessel spasm, or abrupt cutoff of named vessels are also signs of injury and strong consideration should be given to embolization in those circumstances. This approach is reported successful in 87% in one study.<sup>33</sup> A prospective study of angiography and embolization reports an 80% rate of embolization with pelvic and visceral angiography, with 95% effectiveness.<sup>34</sup> If the patient stabilizes after angio-embolization, the patient should then get completion of the trauma evaluation including computed tomography (CT) scans and any needed plain radiographs.
- J. In patients that stabilize after angioembolization, the trauma evaluation should be completed including CT scans and any needed plain radiographs in the intensive care unit.
- K. If the patient remains unstable after angiography (particularly if there has not been therapeutic embolization), consideration should be given to urgent transport to the operating room and preperitoneal packing as described above for those patients that have not been to the operating room (F).
- L. A stable patient with a negative FAST or DPA or one that stabilizes with minimal resuscitation (sustained systolic blood pressure above 100 mm Hg, normalizing base deficit,<sup>18</sup> decreased fluid requirement) can undergo CT scanning. If the CT reveals injury to the liver or spleen, nonoperative management protocols can be followed, if appropriate.



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