SUBJECT: Acute Pelvic Fracture Management Guideline **PAGE:** 1 of 7
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PURPOSE:

To provide an evidence-based approach to acute management and hemorrhage control of these complex injuries. These guidelines would apply to any patient presenting with an acute pelvic injury (excluding femoral neck but including acetabular fractures) that disrupts the pelvic ring.

BACKGROUND:

There are varied approaches to the acute management of trauma patients with pelvic fractures. Properly caring for these complex injuries is multidisciplinary and often dependent on local resources. Two key factors must be recognized early: patients can bleed to death from acute arterial or venous retroperitoneal bleeding, and the impact required to incur pelvic ring injury leads to a high likelihood of associated life-threatening injuries. Some related injuries may have competing therapeutic priorities (e.g., TBI, SCI) and present a particular challenge to trauma teams. Mortality from pelvic ring injury remains as high as 40%[1].

Early recognition of pelvic trauma, prompt cessation of hemorrhage, and aggressive resuscitation are critical to reducing mortality and limiting the sequelae of hemorrhagic shock, such as delayed multi-organ failure.

This guideline is designed to be used immediately upon the arrival of a trauma patient in the ED. The guideline prioritizes rapid cessation of bleeding, early recognition of associated abdominal trauma, and balanced resuscitation. Patients are evaluated in the trauma bay and then, depending on their condition and the presence of other injuries, are transferred rapidly to either the Operating Room (OR), Interventional Radiology Suite (IR), or CT scanner, followed by admission to the Surgical Intensive Care Unit (SICU).

This guideline is meant to encompass all patients with pelvic fractures because fracture pattern on X-ray does not predict mortality, hemorrhage, or the need for IR[2,3,4]. This guideline includes acetabular fractures because these patients are just as likely to require hemorrhage control[2] but does not pertain to patients with isolated femoral neck fractures.

GUIDELINE

EVALUATION:

The evaluation of potential pelvic trauma patients begins with pre-hospital history. Providers should anticipate and prepare accordingly for a pelvic fracture under the following circumstances:

1. Blunt trauma with hemodynamic instability
2. Fall from significant height
3. Pedestrian/Cyclist struck by a vehicle
4. High-speed MVC
5. Moderate-speed MCC
6. MVC/ATV/MCC ejection
7. Unable to ambulate at the scene
8. Obviously unstable pelvis or leg length discrepancy
9. Bruising of the pelvis or perineum
10. Bowel/bladder incontinence
11. Rectal or vaginal hemorrhage
12. Blood at the meatus of the penis
13. Pelvis pain

If pelvic ring disruption is suspected:

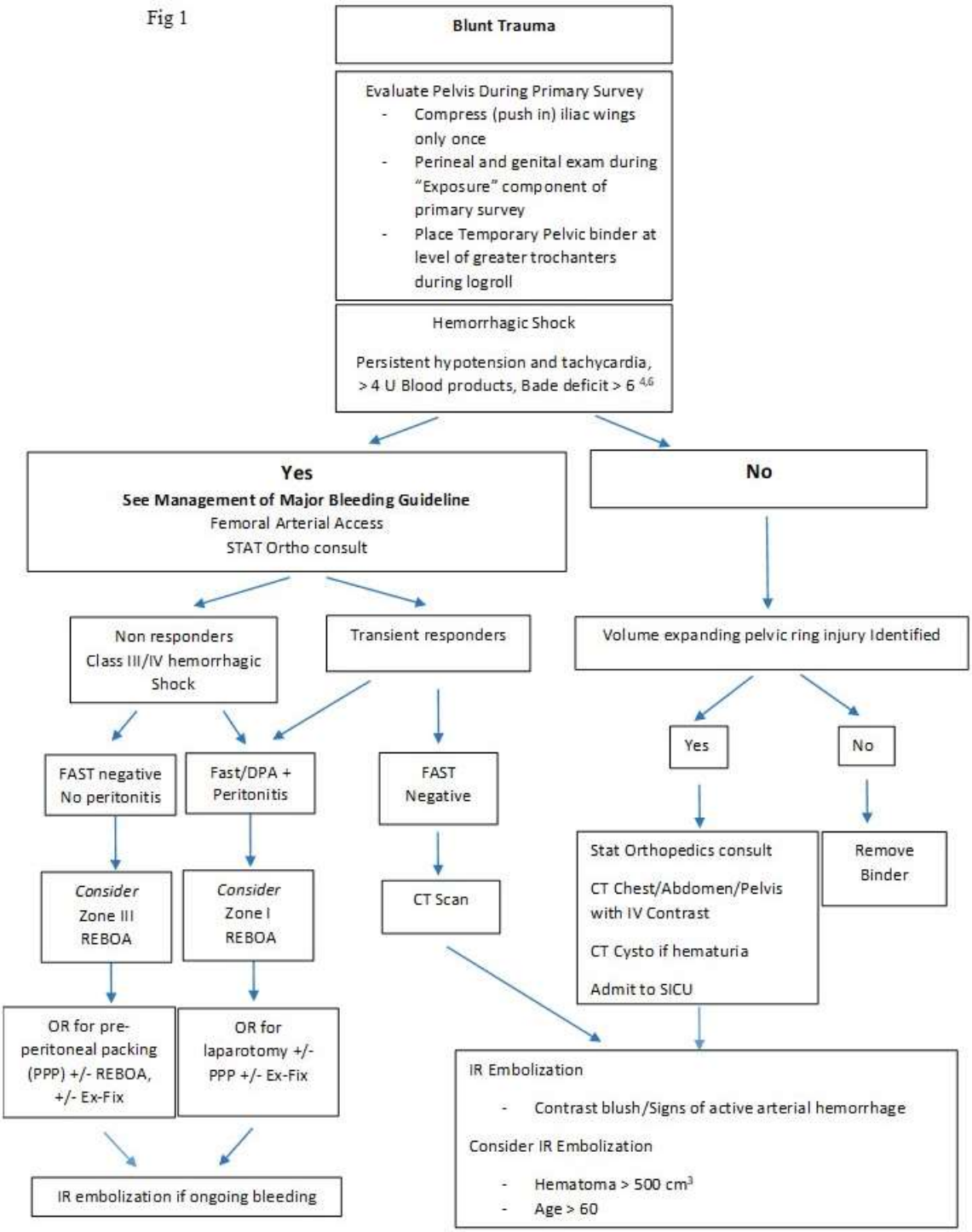
- Evaluate for unstable pelvis during the primary survey.
    - Compress bilateral iliac wings together (if it moves inward, place a binder before relaxing)
    - Evaluate if the pubic tubercle is wider than two fingerbreadths
    - Examine only once
- Place Temporary Binder (TPB) as soon as possible after the perineal exam.[1,4,7]
    - Place cautiously in pregnant and elderly patients[1]
    - TPB can be placed regardless of fracture pattern if severe bleeding suspected
        - TPP may be less effective for vertical shear fractures but has not been shown to exacerbate bleeding[1,4,7]
- Place TPB at the level of greater trochanters
    - 40% of binders are placed too high[5].
- Bind the knees and/or feet
- Repeat pelvic x-ray after pelvic binder placement to confirm proper pubic symphysis reapproximation
- To facilitate femoral venous and/or arterial access or genital exam, do not remove the binder; cut a "wedge" out of the material to expose vascular access puncture sites or genitals. Alternatively, consider placing a second, lower binder that would allow for access to femoral vessels.

Hemodynamic and Time goals:

- Maintain permissive hypotension when able.
    - SBP < 90 so long as the patient is mentating, making urine, and does not have other signs of end-organ hypoperfusion (cold, mottled extremities, decreased LOC, rising base deficit/lactate).
    - Contraindications to permissive hypotension: TBI and SCI.
- Trauma bay to CT scan → 15 min
- Trauma bay to OR → 20 min

- Trauma bay to IR → 60 min (IR consult to puncture time)
- Surgical fixation within 24 hours.
- VTE chemoprophylaxis (Enoxaparin BID) within 6 hours of injury, if hemostasis is achieved.
- Remove the pelvic binder as soon as possible (almost always within 24 hours).

Fig 1



Pre-Peritoneal Packing versus IR Embolization

Angioembolization

- Angioembolization is a safe and effective technique to control pelvic hemorrhage. However, the source of hemodynamic instability in patients with pelvic ring disruptions is venous 80-90% of the time[1].
- When arterial bleeding is identified, angioembolization effectively controls the hemorrhage 85-97% of the time.[4] However, some patients will still bleed because the likelihood of concomitant venous bleeding is nearly 100%[1].
- The safety of angioembolization is well established. Femoral artery injury or renal artery embolization is very rare. Bilateral internal iliac artery embolization is safe, with minimal reports of gluteal muscle ischemia.[4] Sexual function in males does not seem to be affected by bilateral internal iliac embolization.[15] Other complications such as nerve injury, bowel injury, claudication, and deep space infections have been reported.[16]
- Retrospective evidence has suggested that angioembolization of a pelvic artery is associated with a significant risk of deep surgical site infection requiring operative management (58% vs. 14%, $p < 0.05$) in patients with acetabular fractures. [17] Newer, larger retrospective studies have demonstrated that concerns for higher infection rates after pelvic embolization are not substantiated. [18] This remains an area of ongoing investigation.
- Large hematomas (> 500 cc^3) may increase the risk of arterial injury requiring angioembolization.[4]
- Elderly patients have been shown to require angioembolization more frequently, regardless of hemodynamics and fracture pattern. Therefore, angiography should be considered in these patients even if suspicion of- arterial bleeding is low.[1]

Pre-Peritoneal Packing

- Studies have reported that only 5-15% of hemodynamically unstable patients with pelvic fractures have a target to embolize, [1,4,9,10] Therefore, angioembolization does not address potentially lethal bleeding in 85-95% of patients hemorrhaging from their pelvic fracture
- PPP is an effective measure for early hemorrhage control in hypotensive patients with bleeding secondary to pelvic ring disruptions.[1,4,8,10,11]
- PPP can be done in less than 20 minutes and is effective in APC, LC, and VS-type fractures.[9,11]
- Some studies have shown no difference in mortality or ICU length of stay between PPP and angioembolization. However, there is an overall increased delay to hemostatic therapy and hemorrhage control with angioembolization, especially when an interventional radiologist is not immediately available.[1,8,9,10]
- Some evidence for increased survival with PPP + external fixation compared to angioembolization.[11]
- Some evidence suggests that outcomes with PPP are optimized when combined with emergent External Fixation.[12] PPP has been identified as an independent predictor of 24-hour survival when combined with external fixation.[13]
- The typical incisions for anterior pelvic ring plating is approximately 2cm above the pubic tubercles through a Pfannenstiel-type horizontal incision. If access to the pelvis for PPP is gained through an extension of a vertical midline incision, consider utilizing separate or interrupted closure of the extra-peritoneal space to facilitate independent repair of the pelvic injuries and avoiding re-opening the extensile laparotomy incision.

Choosing between PPP and Angioembolization

- Both approaches are reasonable first-line hemorrhage management strategies in patients with pelvic fractures.
- PPP in the operating room provides the advantage of extending to other cavities if required and is easy, fast, and at least as effective at controlling bleeding.
- If a patient continues to bleed after one strategy is used, it is reasonable to try the other.
- WEST Trauma Association recommends either PPP or angioembolization in hemodynamically unstable patients with pelvic trauma.[14]
- Eastern Association of Trauma, Western Trauma Association, and World Society of Emergency Surgery all advocate PPP as an effective tool.
- Angioembolization is associated with less morbidity, including subsequent infection and DVT, so it should be used preferentially over PPP.

Recommendations for Pre-Peritoneal Packing

- Consider emergent PPP in hemodynamically unstable patients with pelvic fractures.
- Consider PPP in patients who continue to bleed after angioembolization.
- The pelvic binder should remain during and after PPP. Consider discussing with Orthopaedic surgeons a concurrent external fixation or traction pin placement.
- Remove pelvic packing within 24 hours after physiologic restoration, including correction of hypothermia, coagulopathy, and acidosis.
- Avoid re-packing the pelvis for ongoing bleeding due to pelvic space infection risk. If continued bleeding occurs after coagulopathy is corrected, proceed to angioembolization.
- Bleeding is likely to occur along fractures in “lateral compression” type patterns from direct injury to arterial or venous structures (typically superior glueteal, pudendal, obturator, or anastomosis between these systems). Bleeding also can occur along tension-based failures of the above vessels, particularly in “open book” type injuries. Without CT angio or angiography, these injuries are still most likely to be identified as areas of concern based on AP pelvis plain radiography. These injuries are typically deep in the true pelvis, below the pelvic brim, and as far posterior as the sacroiliac joints. Bleeding that is occurring directly from fractured bone ends (which can also be life-threatening) is unlikely to respond to packing. Surgical fixation and stabilization of the fracture is most likely to achieve control of bleeding.

Recommendations for REBOA Placement

- A REBOA can be considered as a bridge to definitive treatment in the following circumstances:
    - Patients with pelvic fractures as the source of hemorrhagic shock and who are non-responders to blood products
    - Zone I placement can be considered an alternative to Aortic Cross clamping for patients with massive intra-abdominal hemorrhage and pelvic fracture.
    - Consider intermittent REBOA to limit ischemia-reperfusion time.
    - Consider re-deploying a Zone I REBOA to Zone III if no massive abdominal hemorrhage or intra-abdominal bleeding is controlled.
- Common Femoral Arterial access for the REBOA should be obtained under US guidance or cut down by an attending, fellow, or senior surgery resident (PGY 4/5).

Admission to SICU Criteria

- Any patient with hemodynamic instability, metabolic acidosis, or coagulopathy
- Post-op or post-IR procedure for hemorrhage control
- Vascular compromise
- Unstable pelvic fractures: LC 2, 3, APC 2,3, and VS fractures.

Additional Management Recommendations

- Perineal, digital rectal exam (DRE), and genitalia exams are mandatory in patients with pelvic trauma.
- Double glove when performing DRE as bone fragments can be sharp
- If blood or bony fragments are identified on DRE, proceed with rigid or flex sigmoidoscopy when the patient stabilizes.
- If suspected open pelvic fracture, administer Ceftriaxone 2 grams and Metronidazole 500 mg within 30 min.

- If blood is identified at the urethral meatus, do not insert Foley. Instead, perform a Retrograde Urethrogram (RUG) using the following steps. (*after* CT scan, if applicable):
    - Insert the tip of the Foley catheter 1-2 cm into the urethra
    - Inflate Foley balloon with 2 cm of sterile NS
    - Inject 60 ml of water-soluble contrast
    - Immediately obtain KUB X-ray in both the AP and Lateral positions
    - If there is evidence of urethral disruptions, emergently consult urology.
- If a Foley is placed and hematuria is seen, obtain a CT Cystogram if the patient is going to the scanner.
- If patient presents with an EMS-placed TPP, remove the binder to facilitate the pelvis and perineal examination. If there is evidence of pelvic ring disruption, immediately reapply the binder.
- Do not “rock” or push down on the iliac crests if there is concern for an open-book pelvic fracture as this can worsen the injury and result in more bleeding.

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