Management of Haemodynamically Unstable Patients with Pelvic Injury

This guideline focuses on the assessment of haemodynamic instability related to haemorrhage associated with a pelvic injury; it assumes other sources of hypotension have been excluded such as tension pneumothorax or pericardial tamponade and that the patient is not responding to fluid resuscitation.

Major, typically blunt, force is required to disrupt the pelvis and pelvic fractures are frequently associated with other significant injuries. All patients with pelvic fractures have some degree of haemorrhage; this can arise from the highly vascular cancellous bone surfaces, the pre-sacral venous plexus and/or iliac arterial or venous branches. Arterial bleeding occurs in 10% of pelvic fractures overall but in the persistently haemodynamically unstable patient, where no alternative source is found, the incidence may be as high as 60-75%. In the haemodynamically unstable trauma patient there are five potential sites of major blood loss: externally, long bones, the chest, the abdomen and the pelvic retroperitoneum. Evaluating the source of haemorrhage in the first three instances is relatively straightforward. Of the remaining two the presence of an unstable pelvic fracture increases the chance that this is the bleeding source but in approximately one third to one half of occasions the unstable patient with a pelvic fracture will have co-existent intraperitoneal bleeding. Recognition, coordinating and prioritising management in this situation is of paramount importance in this group of patients who have a predicted mortality of 30-50%. A systematic multidisciplinary approach to these injuries, directed initially only at haemorrhage control, can lead to significant improvements in survival.

**Key Steps**
1. Recognition of potential unstable pelvis, unstable patient scenario
2. Early pelvic mechanical stabilisation (usually pelvic binder)
3. Anticipate major bleeding – activate Major Haemorrhage Protocol
4. Request consultant orthopaedic surgeon and general surgeon prompt attendance.
5. Determine & prioritise need for:
   - a. Theatre: Damage control laparotomy/external haemorrhage control
   - b. Interventional Radiology: Angio-embolisation

**Diagnosis of Major Pelvic Injury**
Clinical examination is unhelpful and attempts to test for instability may lead to haemodynamic instability as clot is dislodged and vascular injuries exacerbated. If a pelvic injury is suspected place a binder pending the result of imaging. The pelvis must not be “sprung” by anyone unless under the direction of a consultant orthopaedic surgeon.

**AP Pelvis X-Ray**
Anterior injuries (pubic rami diastasis/fractures) are more easily identified than those affecting posterior structures, which may be missed in up to 22% of cases. Overall, AP films of the pelvis have a sensitivity of only 78% for identification of pelvic fractures in the acute trauma patient. Approximately 50% of patients with significant pelvic arterial hemorrhage have relatively minor appearing nondisplaced fractures at the time of pelvic x-ray. Aside for making the diagnosis the AP pelvic X-ray remains useful (in addition to CT) in assisting the orthopaedic surgeon in determining a treatment strategy and if time permits should be taken before/after CT. It should not delay WBCT.
Whole Body CT
CT scan is the best imaging study for evaluation of pelvic anatomy and degree of pelvic, retroperitoneal and intraperitoneal bleeding4.

Specific but not sensitive indicators on WBCT of a likely need for angiography are:
- Contrast blush suggestive of arterial extravasion
- High volume pelvic haematoma (>600ml)

The absence of these findings does not exclude arterial bleeding and even these patients may benefit from angiography5.

Treatment of Pelvic Injury Related Haemodynamic Instability
Where a patient has haemodynamic instability that is thought to be related to a pelvic fracture a consultant orthopaedic and general surgeon should be contacted immediately.

Mechanical Stabilisation
This aims to reduce bleeding principally by compressing and stabilising the fractured cancellous bone edges. To a lesser extent it also limits pelvic volume which may bring about earlier tamponade of a bleeding point.

Non Invasive Pelvic Stabilisation Using a Pelvic Binder
The application of a pelvic binder should be considered first line in the haemodynamically unstable patient with a suspected pelvic fracture6. They may be used in all fracture types but are of most benefit in rotationally unstable fracture patterns7. They should be applied so as to apply pressure to the greater trochanters of the femur rather than the iliac wings. Pelvic reduction will be facilitated by ensuring the knees are internally rotated by tying them together with a bed sheet to prevent external rotation of the hips.

6 Bottlang M, Krieg JC, Mohr M, Simpson TS, Madey SM: Emergent management of pelvic ring fractures with use of

Once the pelvic binder is on it should be left on until significant pelvic injury is either excluded radiologically or haemorrhage control is achieved, the patient fully is resuscitated, the coagulopathy corrected and alternative methods of stabilisation are in place. Patient movement, log-rolls etc should be kept to an absolute minimum to avoid displacement of the pelvic fracture and haemostatic clot. A satisfactory response to pelvic volume reduction is signalled by stabilisation of blood pressure and heart rate and improvement of acidosis. If these do not occur within 30 minutes of device placement alternative approaches are indicated.

Potential complications of pelvic binders are the development of pressure ulceration, skin necrosis, or slough. These can be avoided by limiting application to 36 hours. Another disadvantage is these devices may compromise access for laparotomy or pelvic packing as well as prevent monitoring of the skin around the pelvis.

**External Fixation (“Ex-Fix”)**

Although pelvic binders are less rigid than external fixators and fracture reduction is more tenuous there is very little evidence, if any, of haemodynamic benefit from their removal only to be replaced by an external fixator. They may have a role in acute haemodynamic stabilisation where they can facilitate pelvic packing, laparotomy or angiography access which may be hindered by a binder.

The anterior external fixator may be used as definitive management of a rotationally unstable fracture as it is more comfortable for the patient and less prone to causing pressure related problems. In some cases, after careful specialist consultation they may be used as a bridge to definitive internal fixation where this is not readily available.

The external fixator can be placed with the pins in the iliac crest or in the supra-acetabular region. The latter benefits from slightly better biomechanics but takes longer and there is no evidence of survival benefit. In the case of a vertically unstable fracture pattern supplemental femoral pin traction is necessary on the affected side. The disadvantage of conventional anterior fixation is that it does not provide posterior stability and can potentially increase displacement of the vertically unstable pelvis.

Application of an external fixator should occur in theatre and caution should be exercised to ensure the bridging bars are angled inferiorly over the groin to avoid limiting access for laparotomy or impeding abdominal distension.

**Cessation of Arterial Bleeding**

**Pelvic Angiography**

Only about 10% of pelvic fractures have significant arterial bleeding but in the patient who remains haemodynamically unstable or has an ongoing transfusion requirement (> 4 units) despite exclusion of other major bleeding sources and pelvic mechanical stabilisation the incidence of arterial bleeding is 57-64%. Early angiography has been shown to improve survival rates and these patients should proceed to pelvic angiography and embolisation within 60 minutes of admission or as soon as possible after the


9 Guthrie HC, Owens R, Bircher MD. British Editorial Society of Bone and Joint Surgery 2010 (Online)

http://www.jbjs.org.uk/media/29777/focuson_pelvic.pdf


abdomen has been excluded as a source of haemorrhage. Haemodynamic instability is the main indication for angiography, there appears to be no indication for arterial embolisation in cases of haemodynamic stability.

Angiography allows both selective embolisation of bleeding arteries and non-selective embolisation of bilateral internal iliac arteries. It is important to ensure the pelvis remains stabilised; a femoral approach is usually preferred and this can be done with the T-Pod binder but may be awkward, alternatively the left brachial route may be chosen or an external fixator applied to facilitate access.

Any sites of contrast extravasation, false aneurysm or occlusion (“cut off”) of the mainstem internal iliac artery warrant embolisation. A pelvis flush should reveal sites of arterial extravasation but may not always due to temporary spasm of the vessel. In cases of major haemodynamic instability that persist despite failure to identify any arterial lesion, nonselective, bilateral embolization of the internal iliac arteries with steal coils12. Successful embolisation rates for arterial injuries have been reported to be 85–100% success has been defined as cessation of angiographically identified bleeding and not stabilisation of hypotension13.

Recurrent arterial haemorrhage occurs in approximately 5% after successful embolisation or after normal initial angiogram as evidenced by continued transfusion needs14. This is more likely in patients who have multiple arterial injuries on initial angiogram (and therefore larger insult) and may be the result of release of vessels from vasospasm during further resuscitation and warming. Alternatively, it may be caused by dislodgement of the embolisation material. Recurrence is associated with significant increases in morbidity and mortality and patients at high risk should have an arterial sheath left in place for 48–72 h to be restudied if signs of haemorrhage recur. If the patient remains haemodynamically unstable despite this this implies venous bleeding or missed injury, in which case urgent laparotomy with pelvic packing should be performed.

Fewer than 5% of pelvic embolization patients suffer complications and non-selective bilateral embolization does not seem to be associated with greater complications. Necrosis and ischemia of tissues due to embolisation of internal iliac arteries have been reported in various types of tissues, such as sacral skin, bladder wall, uterus, femoral head, gluteal muscle, and colon with complications including paresis of the lower extremity, acute ischemia of the lower extremity, impotence, and rectal stenosis.

Other options to consider:

Aortic Balloon Occlusion
In cases of extremis or inability to access the IR suite a balloon catheter may be used to allow resuscitation to achieve sufficient stability for transfer for angiography15.

Pelvic Packing


15 Martinelli T. et al. Intra-Aortic Balloon Occlusion to Salvage Patients With Life-Threatening Hemorrhagic Shocks From Pelvic Fractures J Trauma. 2010 Apr;68(4):942-8
The aim of this is to tamponade the bleeding pelvis, in addition to reducing venous bleeding it may reduce the need or urgency for angiography and is an option to consider when ready access to angiography is not possible (eg when in theatre.)

A controlled, retroperitoneal method has been described. This technique can facilitate control of retroperitoneal bleeding through a small incision which does not violate the intraperitoneal space and leaves the peritoneum intact. First a simple external fixator is placed to stabilise the ring for packing. Then, using an 8-cm midline incision of the lower abdomen, direct access to the bleeding retroperitoneal space is possible, and the presacral area and paravesicle region is packed with surgical lap packs (usually 3 per side in adults). The key to this manoeuvre is packing of the true pelvis, below the pelvic brim and not the false pelvis, above the pelvic brim. The packing is changed or removed 24–48 h after the injury.

Making the Decision: Angiography Suite or Operating Theatre?
Haemorrhage from branches of the internal iliac artery are best managed by endovascular techniques such as angiographic embolisation or coil placement. Immediate transfer of the patients to an endovascular suite is therefore the ideal for these patients. The Royal College of Radiologists stipulate that this should happen within 60 minutes of patient arrival or within 30 minutes of referral.16 However in the following situations, patients must be transferred immediately to the operating theatre prior to angiography:

1. The patient has co-existant major thoracic or abdominal haemorrhage.
   Thoracic haemorrhage is usually readily identified following chest examination, chest X-ray and chest tube drainage. Major intraperitoneal haemorrhage must be excluded before transfer for angio-embolization. WBCT or FAST should be used to exclude major intraperitoneal haemorrhage of significant volume to account for the degree of cardiovascular derangement. A small amount of intraperitoneal fluid is likely in patients with massive retroperitoneal haematoma. Thus a FAST may be positive, but not ‘positive enough’ to warrant a laparotomy prior to embolisation. If there is any doubt, the operating theatre is a safer bet than the angiography suite for initial haemorrhage control manoeuvres.

2. The patient is exsanguinating from an open pelvic fracture.
   Patients with open pelvic fractures that are bleeding externally should be taken to the operating room for packing of the external haemorrhage as well as extraperitoneal pelvic packing.

3. Angio-embolisation is not immediately available.
   Where angioembolization is not available within an appropriate timeframe (30 minutes of referral is suggested by the RCR), patients should be transferred to the operating room for immediate haemorrhage control manoeuvres.

For all of the above 3 situations, patients will usually be transferred to the angiography suite for embolisation after surgery for definitive control of intra-pelvic arterial haemorrhage. Angiographic resources should therefore be mobilised while the patient is in the operating room to avoid further delays after surgery.

Operating Theatre Procedures
The following sequences are suggestions for the management of these injuries. There is no evidence base from which to draw on here.

Some form of mechanical stabilisation should remain in place throughout as the tension band effect of the anterior abdominal wall on the iliac wings is lost during laparotomy which could potentially increase pelvic volume17 (a pelvic binder will usually suffice but a decision will need to made at the time between the general and orthopaedic surgeon). All procedures should be performed on a damage control only basis

16 Royal College of Radiologists. Standards of Practice and Guidance for Trauma Radiology in Severely Injured Patients 2010 (Online) http://www.rcr.ac.uk/docs/radiology/pdf/BFCR%2811%293_trauma.pdf
which achieves hemorrhage control by organ resection (spleen, kidney) or packing, if resection not feasible (liver). Any pelvic packing manoeuvres will not work without some form of external stabilization in place.

1. Pack any open wounds that are exsanguinating.
2. Extraperitoneal packing through a lower midline incision
3. Extension of the incision upwards and damage control laparotomy.

Intraperitoneal packing is a less satisfactory procedure as the packs are placed against clot and it is difficult to achieve effective compression of vessels against the bony pelvis.

Where angiography is not available at all, or where the patient is in extremis, attempts to reduce inflow to the pelvic vascular beds may be of value, including aortic balloon occlusion, distal aortic compression (at the bifurcation) and/or ligation of the internal iliac arteries. If the patient becomes haemodynamically normal after pelvic packing and laparotomy, and the pelvic injury is rotationally unstable only (open-book), consideration can be made to place an external fixator or symphyseal plate at this time. If the patient has not yet stabilised and there is continued evidence of active bleeding, angio-embolization is the priority.

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