Pelvic Vascular Injuries

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Injury/ Disease Demographics

- Pelvic vascular injuries occur following penetrating or blunt trauma.
- Iliac vessel injuries have mortality rates ranging from 24 to 40% - with higher rates for common or external injuries compared to internal iliac artery injuries.
- Penetrating injury:
    - can result in iliac vessel partial or complete transection.
    - can result in an arterial pseudoaneurysm.
- Blunt injury:
    - can result in vessel damage, resulting in occlusion of the vessel or frank bleeding.
    - in the setting of pelvic fractures, most hemorrhage in this setting is venous in origin.

Clinical Presentation

- Patients may present in hemorrhagic shock and/or with loss of pulses to the extremity.
- Blunt trauma with pelvic fracture and associated hemorrhage should heighten the concern for associated pelvic vascular injury. Any fracture pattern may cause pelvic hemorrhage resulting in hemodynamic instability.
- In blunt pelvic fractures, severe hemorrhage is most commonly associated with type II/III anteroposterior compression or lateral compression and vertical sheer fracture patterns

Evaluation/Diagnostics/Imaging

- Pulse exam for bilateral femoral arteries, and distal pulses should be documented.
- Patients with penetrating injury to the abdomen and pelvis should undergo chest, abdomen and pelvic x-rays to evaluate trajectory of the projectile.
- Patients with pelvic fractures and hemodynamic instability should undergo pelvic binding to reduce pelvic volume. Proper placement of the pelvic binder is critical; the binder should be placed to provide compression at the level of the greater trochanters, not at the level of the iliac crest.
- Patients with hemodynamic instability may need to go to the operating room for pelvic packing if they do not respond to the placement of a pelvic binder and the initiation of hemostatic resuscitation.
- Hemodynamically stable patients should be evaluated with CT scan. Blunt injuries causing pelvic fracture are high in energy and have high risk for associated injury.
- In the face of unstable pelvic fractures causing hemorrhage, central venous catheters in the groin should be avoided.
- Associated injuries in blunt or penetrating mechanisms include small bowel, colon, urinary bladder, and ureter.

Role of Nonoperative Management and Associated Considerations

- In the hemodynamically stable patient sustaining pelvic venous injury which is contained in the retroperitoneum on CT scan, patients can be managed expectantly.
- Hemodynamically stable patients with active arterial contrast extravasation may be treated with selective angioembolization. It has been suggested that those patients with "blush" on CT with hypotension on admission and a large pool of IV contrast extravasation (>1.5cm) may benefit from therapeutic embolization.
- Immediate endovascular intervention to facilitate limb perfusion in the setting of blunt iliac arterial injury has been described and may have a greater role in the future.

Indications for Operative Intervention

- Hemodynamic instability after penetrating injury causing pelvic vascular injury is an indication for operative intervention.
- Loss of pulses following pelvic vascular injury is an indication for surgery.
- Hemodynamic instability after blunt injury causing pelvic vascular injury may be an indication for operative intervention.

Preoperative Preparation

- If available in the hemodynamically stable patient, need for on table angiography should be anticipated. Both lower extremities should be prepped down to the feet.
- Patients should be prepped and draped in standard trauma fashion – from the chin down to the mid thighs/knees and laterally down to the table.
- Resuscitative endovascular balloon occlusion of the aorta (REBOA) has been advocated as a temporizing measure to control pelvic hemorrhage in patients who are in shock.

Operative Techniques / Intraoperative Considerations

Penetrating Injuries

- Access to the iliac vasculature is obtained by rotating the bowel to the opposite side from the injury; mobilizing the colon may also be necessary.
- Before entering the hematoma, proximal control of the infrarenal aorta should be obtained; rotating the bowel to right upper quadrant may be helpful for exposure.
- With extensive hematomas, distal control can be established by controlling the common femoral artery in the groin. Once the hematoma is opened, further control may be established by controlling the internal iliac artery either directly or with balloon occlusion.
- In a damage control situation, temporary arterial shunting may be used to restore flow to the lower extremity. This results in lower risk of subsequent amputation. The largest shunt possible should be used (14 French Argyle). Other shunt options include the Pruitt-Inahara or Javid shunts, or a small caliber chest tube can be used.

- In damage control shunts, systemic anticoagulation is not needed. Shunt patency can be monitored by examination of distal pulses and Doppler studies.
- Internal iliac ligation may have minimal consequences, but limb loss or late sepsis can result from common or external iliac ligation. Shunting and/or repair/reconstruction is preferred.
- Iliac arterial injuries can be primarily repaired if one is able to do this without tension; alternatively an interposition graft of Dacron or PTFE can be performed to re-establish arterial flow.
- The internal iliac artery can be rotated to serve as a replacement arterial graft.
- Penetrating venous injury can be repaired via lateral venorrhaphy or more commonly via venous suture or clip ligation.
- For patients in extremis, the external iliac vein may be ligated. In this situation, one needs to be prepared to manage subsequent extremity swelling and/or lower extremity compartment syndrome.

Blunt Injuries

- Blunt trauma resulting in iliac arterial injury may result in vessel damage and occlusion requiring interposition grafting to prevent limb loss.
- For blunt pelvic trauma with hypotension and a hematoma, preperitoneal pelvic packing can be employed. This is accomplished through a lower midline/suprapubic incision. As many lap pads are placed in the preperitoneal space as needed to accomplish a tight packing; typically 6-8 pads are placed for adult trauma patients.
- Regarding pelvic hematomas discovered at time of "blunt trauma laparotomy," – in the absence of hard signs of bleeding or expanding hematoma, these collections should not be routinely explored.
- Patients with combined arterial/venous iliac system injuries should undergo empiric fasciotomy.
- Patients undergoing vascular repair intraoperatively should undergo completion angiography to document adequate limb runoff.
- When possible, the ureter should be identified and preserved. The ureter crosses the pelvic brim at the bifurcation of the internal and external iliac vessels.

Postoperative Management / Complications

- The patient's vascular exam should be closely monitored in the post-operative period.
- When iliac vein ligation or repair is used, patient should be considered for immediate calf fasciotomy, appropriate fluid resuscitation, use of elastic compression wraps or TED hose to both lower extremities, and elevation of both lower extremities.
- In blunt trauma, after pre-peritoneal packing is employed, if there is a high clinical suspicion of ongoing arterial hemorrhage, patients should go for angiographic embolization of arterial bleeding.
- Air embolism is a potential complication from major venous injuries.
- Patients with iliac vessel injury should undergo surveillance with duplex ultrasound to monitor for the development of deep venous thrombosis. Despite aggressive

revascularization blunt common and external iliac vessel injuries have high rates of amputation and hemipelvectomy, in one series approaching 67%, showing the importance of management of concurrent extremity injuries.

Considerations for Special Populations

- Pediatric population may have smaller vessels making angiography problematic and potentially making them more prone to vasospasm.
- Elderly patients may have atherosclerotic vessels rendering angiography problematic

Suggested Readings

- Harris DG, Drucker CB, Brenner ML, et al. Management and outcomes of blunt common and external iliac arterial injuries. J Vasc Surg. 2014;59:180-5.
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