Vena Cava Injuries

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Injury Disease / Demographics

- Overall incidence is rare.
- Most common mechanism is penetrating; and also carries highest mortality rate.
- One-third of patients with this injury do not survive the first 24 hours of treatment secondary to hemorrhage or associated injuries.
- If associated with aortic injury, mortality approaches 100% secondary to exsanguination.

Clinical Presentation / Role of Conservative Management

- In blunt vena cava injuries:
    - The patient can present in a stable fashion since it is a low pressure system and may tamponade in the retroperitoneum.
    - The patient may demonstrate hemodynamic instability; the diagnosis is made in the operating room with high frequency of concomitant injuries to the liver and surrounding structures.
- Non-operative treatment should only be attempted in patients who are completely stable with a retrohepatic inferior vena cava injury or suprahepatic vena cava injury.
- Certain retrohepatic caval injuries may be amenable to the placement of an endovascular stent.

Evaluation/Diagnostics

- Penetrating injuries are diagnosed upon exploration and are often associated with other organ injuries, such as colon, duodenum, liver, kidney, and pancreas.
- The evaluation depends on the clinical presentation. If the patient is hemodynamically unstable; there is no role for preoperative diagnostic imaging. These patients should go to the operating room immediately.
- In blunt trauma patients, this injury may be incidentally found on CT imaging.

Operative Techniques / Intraoperative Considerations

Infrahepatic Vena Cava (I-IVC) Injuries

- This injury should be suspected when a zone 1 hematoma is encountered. The most effective method to identify this injury is through determination of trajectory and exposure of the penetrating wound tract of the injury. Penetrating injuries to the duodenum and head of the pancreas are likely to continue posteriorly and involve the IVC.
- Most IVC injuries are “hidden” in a hematoma, less commonly, it will present with free intra-peritoneal hemorrhage.
- To fully expose an IVC injury, perform a right medial visceral rotation (Cattell Brasch maneuver). Begin the mobilization of the right colon at the pelvic brim and work

cephalad toward the hepatic flexure. It is best not to begin the exploration with an isolated Kocher maneuver.

- Immediate control of the bleeding IVC can be achieved with direct digital pressure; a side biting Satinsky or sponge stick on either side of the injury will provide enough hemostasis to enable identification of the injury.
- Once the injury is visualized; confirm there is no posterior injury. If the injury involves only the anterior wall, a Satinsky clamp can be applied to the injury and a Prolene suture used to repair it. Alternatively Allis clamps can be used to hold the injury closed and remove them slowly as your suture advances.
- Posterior caval injuries are best approached from a endoluminal approach. Lateral injuries can be repaired directly following mobilization of the cava.
- If your patient physiologically cannot tolerate repair or the injury is too destructive to repair, other options include ligation of the vessel or placing a temporizing shunt.

Retro-hepatic Inferior Vena Cava (RIVC) Injuries

- Retro-hepatic IVC injuries carry a **very high** mortality rate.
- If the patient is stable, and this injury is identified on a CT scan, select patients can be managed non-operatively. Close hemodynamic monitoring and avoiding hypertension and hypervolemia is pivotal in the care of these patients.
- During laparotomy, an RIVC injury usually presents with dark blood emanating from behind the liver that fails to halt with manual compression and a Pringle maneuver. Compression of the liver down to the spine can help with hemorrhage control.
- Do not let the incision to be an obstacle. Extending the laparotomy into a right anterolateral thoracotomy often improves visualization. If it is beneficial to make a T or a cross to be able to see- a larger incision and future wound problems are better than losing a life.

Suprahepatic Vena Cava Injuries

- Management of the short segment that is the supra-hepatic IVC is almost identical to that described for the retrohepatic IVC.
- Intra-pericardial vena caval injuries can present as pericardial tamponade, pericardial fluid visualized on FAST exam or during a pericardial window.
- When controlling and repairing intra-thoracic IVC injuries, it is pivotal that there is clear communication with anesthesia since elevation of the heart may be required. This maneuver alone can result in the demise of the patient since it may induce a complete cardiac obstruction or the potential for air embolism.

Complications

- The most common complications of venous injuries especially in the setting of post-repair narrowing or with complete ligation, is lower extremity swelling and deep venous thrombosis.
- Even in the occurrence of complete ligation there is risk of clot formation superior to the ligation and risk of pulmonary emboli; therefore DVT prophylaxis should be started as soon as this is safe.

- Risk for lower leg compartment syndrome exists and is higher when accompanied by other concomitant arterial injuries.
- Judicious compartment monitoring, avoiding fluid overload as well as considering fasciotomy is important in the post-operative stage.

Suggested Readings

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