Cardiac Tamponade

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Injury Disease and Demographics

- Cardiac tamponade occurs when fluid in the pericardial sac causes an obstruction to filling of the heart chambers.
- To tamponade the heart, the contents of the pericardial sac must:
    - Fill the pericardial reserve volume
    - Fill at a rate exceeding pericardial stretch
    - Equalization of intra-pericardial and mean diastolic pressures in the cardiac chambers.
- Cardiac tamponade following trauma is more commonly seen in penetrating mechanisms.
- Up to 80% of myocardial stab wounds may develop cardiac tamponade.
- In order to have cardiac tamponade the hole in the pericardial sac cannot be so large as to allow the cardiac blood to egress/decompress into the pleural cavity. For example, either a long pericardial laceration or a blunt pericardial rupture can cause a combined pericardial and cardiac injury resulting in bleeding in the pericardium and through the pericardial defect without resultant tamponade physiology.
- GSWs are less likely to develop tamponade because it is more difficult for the pericardium to seal the defect (larger, more irregular shape of the pericardial injury).

Clinical Presentation

- Patients typically present with cardiogenic/obstructive shock, and symptoms include shortness of breath, weakness, lightheadedness, and cough.
- Diagnosis may be suspected based on hypotension, jugular venous distension, and muffled heart sounds; these components are defined as Beck's triad.
- Clinical signs such as Beck's triad may be absent in nearly 80% of cases
- Patients with wounds in the "cardiac box" are at risk of cardiac tamponade; the "box" refers to the chest area bounded by sternal notch, xiphoid, and nipple both anteriorly and posteriorly.
- In cases where there is a cardiac injury decompressing into the pleural space, the patient may present with hypovolemic shock not tamponade, and have evidence of a massive hemothorax.

Diagnostics

- The diagnosis can be confirmed by ultrasound evaluation of the heart during the Focused Assessment with Sonography in Trauma (FAST).
    - Cardiac tamponade can be visualized in the subxyphoid window.
    - Blood often will be dependent but can clot acutely; the entire cardiac structure needs to be visualized in order to completely rule out blood in the pericardial space.
    - The right side of the heart includes the structures closest to the liver. Right atrial collapse during systole is a sign of tamponade.
    - Right ventricle collapse can be seen in more severe cases.

- Pitfalls of FAST include:
    - The presence of pleural effusion blurring the diagnosis.
    - A large defect in the pericardium allowing egress of blood into the pleural space, creating a potential false negative pericardial FAST.
    - Pneumothorax limiting visualization of the pericardial space.
- If the diagnosis is highly suspected and not confirmed by FAST a pericardial window is very sensitive to identify blood in the pericardium. Alternate modalities include pericardiocentesis and/or the measurement of the central venous pressure after placement of a central venous line; elevated CVP suggests tamponade.
- In cardiac tamponade there will be equalization of pressures: the central venous pressure, end diastolic pressures in the right ventricle left ventricle as well as a pulmonary wedge pressure will be on a similar range.

Operative Techniques/Intraoperative Considerations

- **Diagnosis with pericardial window:**
    - Involves incision of the pericardium for diagnosis.
    - The pericardotomy is done via a small subxiphoid incision

- **Subxiphoid window technique**
    - Position the patient supine. Ask anesthesia to provide reverse Trendelenburg this will lower the heart and help with access to the pericardium.
    - Perform a small incision in the midline over the xiphoid process extending inferiorly.
    - The xiphoid process should be retracted superiorly with army navy retractors superiorly; if necessary the xyphoid process can be resected with curved Mayo scissors to improve visualization.
    - Feel the heart beating and dissect towards the impulse. If the pericardium is full of blood it is hard to grasp with pickups. Two options exist: 1) use 2 Allis clamps to obtain a good grasp and cut between the clamps, or 2) use a scalpel to make an incision in the pericardium (the blood in the pericardium sac will prevent a laceration of the heart).
    - Preform an incision measuring approximately 1-3 cm in the pericardium sharply with Metzenbaum scissors; care is taken not to injure the heart.
    - This window is only negative if clear fluid comes out. If there is no fluid, it is possible that clot is sitting behind the heart. Consider then placing a posterior drain to make the diagnosis. If blood is visualized and is persistently bleeding, one should proceed with median sternotomy and cardiac repair.

- **Via thoracotomy**
    - If a patient is in need of a resuscitative thoracotomy, the first step should be to open the pericardium.
    - After opening the chest and placing the rib spreader the most anterior structure will be the pericardial sac and its contents.

- Visualize and preserve the phrenic nerve. Incise the pericardium in a craniocaudal direction.
- This approach allows you to deliver the heart and repair cardiac injuries as indicated

Complications

- Death is the obvious complication from cardiac tamponade.
- This can occur as a consequence of the obstructive shock if not treated or as a consequence of exsanguination from the cardiac injury.
- Intubate the patient in a recumbent position if possible. Intubation drugs may induce vasodilation and precipitate cardiovascular collapse.
- Be ready to perform a resuscitative thoracotomy in case pulses are lost.

Suggested Readings

- Anderson JE, Salcedo ES, Rounds KM, Galante JM. Getting a better look: outcomes of laparoscopic versus trans-diaphragmatic pericardial window for penetrating thoracoabdominal trauma at a level I trauma center. J Trauma Acute Care. 2016 [Epub ahead of print].
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- Zengin S, Yavuz E, Al B, et al. Benefits of cardiac sonography performed by a non-expert sonographer in patients with non-traumatic cardiopulmonary arrest. Resuscitation. 2016;102:105-9.