

Cardiac Tamponade

Pericardial tamponade is the pathophysiologic consequence of fluid in the pericardial space (pericardial effusion) exerting pressure effects on cardiac function; the hemodynamic consequences can be mild to severe (potentially life threatening) depending on the volume and rate of accumulation of fluid and pericardial elastance; classic clinical findings including Beck's triad: hypotension, distended neck veins, muffled heart sounds.

ANESTHETIC CONSIDERATIONS:

- Potential Life Threatening Emergency
 - Risk of cardiovascular collapse / PEA
 - Induction of anesthesia may precipitate above
- Physiologic Consequences
 - Diastolic chamber pressure equalization
 - Impaired diastolic filling resulting in decreased SV
 - Heart rate dependent CO
- Etiologies / co-existing disease
 - Acute effusion → tamponade: post cardiac surgery, post cardiac catheterization, post CVC, trauma, aortic dissection
 - Chronic effusion → tamponade: infectious (viral), inflammatory (uremic), malignant, autoimmune (SLE), reactive (radiation)

ANESTHETIC GOALS:

1. If significant hemodynamic compromise, drain pericardium ASAP, prior to anesthesia / PPV
2. Avoid increases in intrathoracic pressure
 - Maintain spontaneous ventilation
 - Avoid coughing, straining
3. Cardiovascular: **fast, full and tight**
 - Preload: high (FULL)
 - Contractility: maintain / increase
 - Rate: maintain / increase
 - Rhythm: strict NSR
 - Afterload: maintain

HISTORY

- Symptoms: dyspnea, fatigue / lethargy, syncope, shock
 - Retrosternal chest pain, improved with leaning forward
- Onset & duration (dependent on etiology, postoperative, trauma, malignancy etc.)
- Treatment (prior pericardiocentesis)
- Co-morbidities
- Etiology:
 - Hemorrhagic pericarditis caused by:
 - Aortic dissection
 - Ventricular free wall rupture after myocardial infarction
 - Anticoagulant-induced hemopericardium
 - Trauma (stab wounds, central venous catheters)
 - Cardiac surgery
 - Uremic pericarditis
 - Neoplastic pericarditis (especially mesothelioma or lymphoma)
 - Serous pericarditis (rheumatoid disorders, irradiation, viral infection)

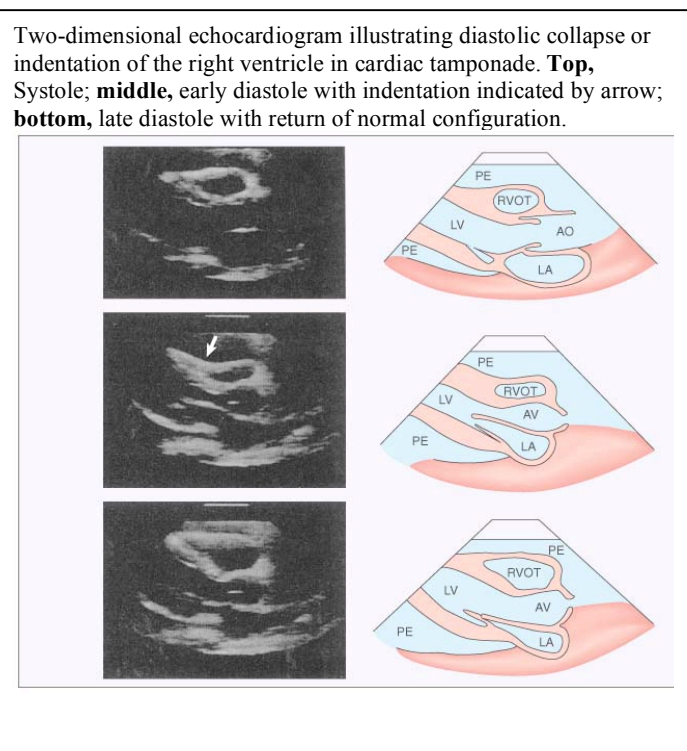
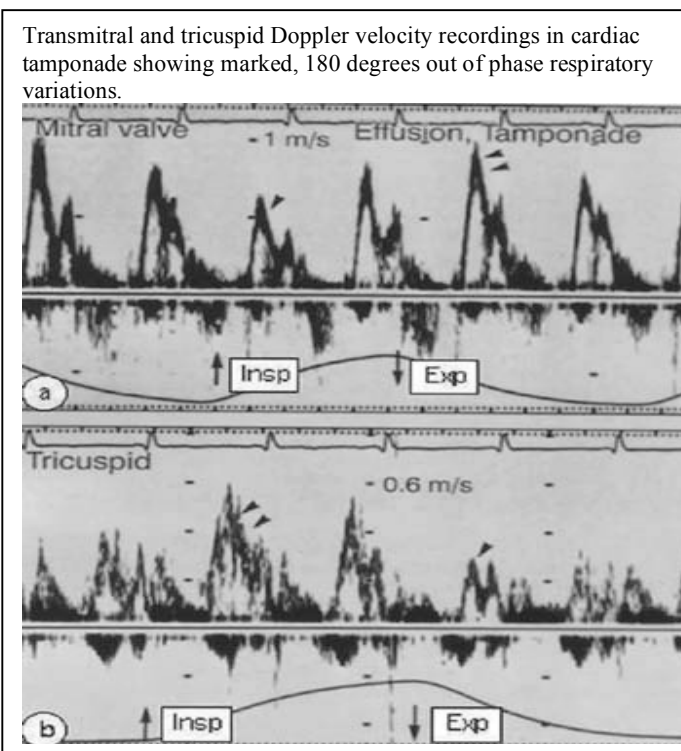
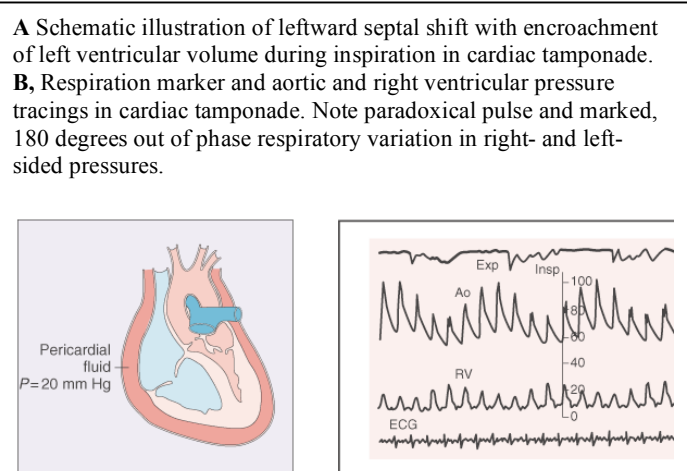
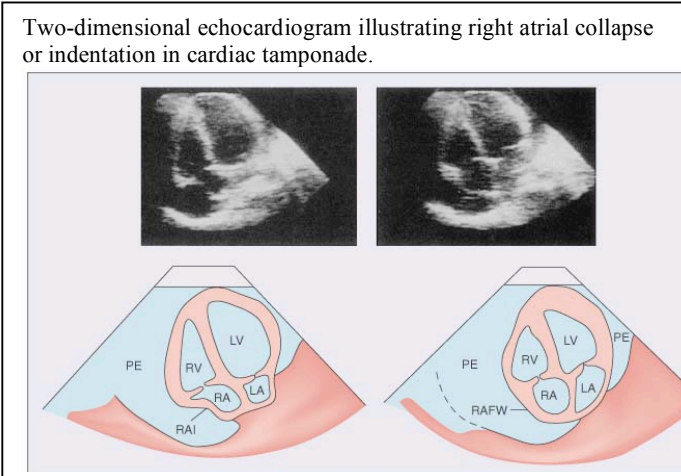
PHYSICAL

- **Beck's Triad** – hypotension, distended neck veins, muffled heart sounds
- **GENERAL**
 - Vitals – tachycardia, tachypnea, hypotension, +/- elevated temperature
- **HEENT**
 - Airway exam for ease of intubation
- **RESP**
- **CVS**
 - Elevated JVP
 - Hepatic congestion / pulsatile liver
 - Muffled heart sounds, presence of rub, murmur of AI if aortic dissection
 - Narrow pulse pressure
 - Pulsus paradoxus
 - Hypotension / shock

INVESTIGATIONS

- **Labs**
 - CBC, Lytes, BUN, Cr, INR, PTT, Crossmatch (looking for anemia, coagulopathy, renal insufficiency)
- **Imaging**
 - **12 lead ECG** (expect sinus tachycardia, low voltage, non-specific ST-T changes, electrical alternans)
 - **CXR**: Enlarged cardiac thoracic index, globular pericardial silhouette
 - **ECHO**:
 - Pericardial effusion,
 - Right atrial compression or inversion (sensitivity 94%, specificity 100%),

- Right ventricular diastolic collapse (sensitivity 60%-90%, specificity 85%-100%)
- Reciprocal respiratory changes in the right and left ventricular filling, and inferior vena cava plethora (sensitivity 97%, specificity 40%)
- **Special**
 - **CVP:**
 - Elevated CVP
 - Loss of y descent
 - Loss of the y descent has been explained on the basis of the concept that total heart volume is fixed in severe tamponade
 - Consequently, blood can enter the heart only when blood is simultaneously leaving
 - The right atrial y descent begins when the tricuspid valve opens, i.e., when blood is not leaving the heart
 - Thus, no blood can enter the heart and the y descent is lost
 - **PAC:**
 - Diastolic pressure equalization (usually 15-20mmHG; corresponding to pericardial pressure)



OPTIMIZATION

- Is the pericardial tamponade hemodynamically significant?
- If yes, try to drain prior to induction if at all possible:
 - Pericardiocentesis
 - Subcostal incision with pericardial widow (can be done under LA), pre-treat with atropine to avoid reflex bradycardia with pericardial manipulation, can use ketamine for mild sedation / analgesia
- If unable to drain prior to incision, have patient prepped and surgeon present in room prior to induction
- Adequate IV access, fluid bolus prior to PPV

- Consider A-line, CVP / PAC monitoring

ANESTHETIC OPTIONS

- Local vs. GA: decision should be based on patient / surgical approach / urgency
- Local
 - Advantages: maintain spontaneous ventilation
 - Disadvantage: limited surgical approach, risk of cough, straining, unsecured airway in case of cardiac arrest
- GA
 - Advantages: controlled airway, allows sternotomy / thoracotomy approaches
 - Disadvantages: risk of cardiac arrest on induction, PPV further compromises preload / filling

ANESTHETIC SETUP

- **Drugs**
 - Standard Emergency drugs (prepare to manage both hypo and hypertension)
 - Epinephrine is the inotrope of choice due to inotropic, chronotropic and pressor effects
- **Equipment**
 - CAS + 5 lead ECG
 - A-line (do not delay drainage if hemodynamically unstable)
 - CVP / PAC (do not delay drainage if hemodynamically unstable), useful for monitoring / inotropic support

MANAGEMENT OF ANESTHESIA

- **Induction**
 - Once again, attempt to drain pericardial collection prior to induction
 - May use Ketamine during this procedure
 - Once pericardial fluid drained, institute GA and PPV for definitive management
 - If unable to drain prior to GA
 - Have surgeon available in room and have chest prepped
 - Attempt awake intubation / maintain spontaneous ventilation: but coughing, straining, hypoxemia, respiratory acidosis can all lead to detrimental hemodynamic compromise
 - If need to ventilate, use high frequency and low volume
 - Induction drugs: any but carefully titrated (Ketamine has advantages of sympathomimetic properties)
 - Good drugs: Ketamine, midazolam, small dose opioids, muscle relaxants, atropine (maintain fast HR and antisialogogue if ketamine used)
 - Be prepared for hypertension post decompression → treatment with NTG
- **Maintenance**
 - Ketamine, low-dose volatile, narcotic balanced anesthesia
- **Emergence**
 - Extubated only if hemodynamically stable

DISPOSITION & MONITORING

- Postoperative disposition: high dependency unit
- Postoperative pain management: if thoracotomy, consider thoracic epidural post-op vs. PCA

COMPLICATIONS

- Post-induction hypotension / PEA (Treatment: fluid, epinephrine and rapid pericardiocentesis / surgical drainage)
- Postoperative pericardial evacuation hypertension (Treatment: IV NTG, labetalol, etc)

PATHOPHYSIOLOGY

- High sympathetic state:
 - Acute tamponade vs. chronic constrictive pericarditis (“surgical” vs. “medical”)
 - Accumulation of fluid or blood in the closed pericardial space
 - Urgency determined by rate and degree of accumulation
 - Impaired diastolic filling → ↓ SV & CO
 - Compensatory tachycardia, arterial & venous vasoconstriction
 - Myocardial ischemia through tachycardia, ↑ LVEDP, epicardial vasoconstriction
 - Eventually equalization of RA / EDPA / PCWP pressures
 - Decompensation: cardiogenic shock

REFERENCES

- Miller: Miller’s Anesthesia, 6th ed. 1967-1968
- Morgan: Clinical Anesthesiology: 3rd ed. 388-395
- Zipes: Braunwald’s Heart Disease: A Textbook of Cardiovascular Medicine, 7th ed (see attached chapter of pathophysiology)