Central Line Insertion & Pneumothorax

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83 y.o. Male presents for a TAVR
What is a TAVR you ask?
TAVR: Transcatheter Aortic Valve Replacement
A minimally invasive approach for implanting an artificial valve inside a stenotic aortic valve, performed under fluoroscopy.
TAVR: Too unstable for traditional valve replacement surgery
History of Presenting Illness

- 83 y.o.
- Aortic Stenosis
- NKDA
- Height: 180.3 cm
- Weight: 75.3 kg
Past Medical History

- Aortic Valve Stenosis
- Cardiomyopathy
- CAD
- Hyperlipidemia
- Anemia
- HTN

- CKD
- Bladder neoplasm
- Diverticulosis
- GERD
Aortic Valve Stenosis

- **AS causes an increased preload**
  - LV Concentric Hypertrophy
  - Increased LV diastolic function
    - Increased risk for ischemia
- **Reliance on atrial “kick”**
  - Maintain NSR
- **Sensitivity to changes in SVR**
  - Decreased perfusion and CO
- **Sensitivity to volume changes**
  - Hypovolemia → decreased preload → decreased CO
- **Sensitivity to rate changes**
  - Tachycardia → decreased ejection time → decreased myocardial perfusion
### AS VS AR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AS</th>
<th>AR</th>
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<tbody>
<tr>
<td>LV preload</td>
<td>Increased</td>
<td>Normal to increased</td>
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<tr>
<td>HR</td>
<td>Normal to slow</td>
<td>Modest increase</td>
</tr>
<tr>
<td>Rhythm</td>
<td>SR</td>
<td>SR</td>
</tr>
<tr>
<td>Contractility</td>
<td>Maintain</td>
<td>Maintain</td>
</tr>
<tr>
<td>SVR</td>
<td>Modest increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>PVR</td>
<td>Maintain</td>
<td>Maintain</td>
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</tbody>
</table>
Medications

- Aspirin
- Lovastatin
- Metoprolol
- Keflex
- Coenzyme Q
- Vitamin B12
- Iron
Labs

- K: 4.2
- BUN: 24
- Cr: 1.1
- Glucose: 117
- eGFR: >60
- Hgb: 10.9
- Hct: 34.3
- APTT: 32
- PT: 13.4
- INR: 1.03
Diagnostic Studies

- 12 Lead EKG, ECHO, Cardiac Cath
- 12 Lead EKG shows NSR
- “Severe Aortic Stenosis” with an aortic valve area $0.8 \text{ cm}^2$
  - Nagelhaut defines severe as $<0.5 \text{ cm}^2$ and moderate as $0.7-0.9 \text{ cm}^2$
- EF 30%
- Moderate MR
- Trace TR
The Plan

- Preinduction Art Line
- Fentanyl, Versed, Etomidate, Vecuronium induction
- Intubate with 8.0 Oral ETT
- Sevoflurane
- Right IJ CVC with PA Catheter
- Extubate and transfer to CIUC
When they told me I would be doing the art line and then intubating,

LET’S DO THIS.
Post-Induction Picture

- HR: 70-80’s
- BP: 130s/90s
- SPO2: 99%
- ETCO: 33-36 mmHg
- Vent Settings: VC // VT 550 // RR 10 // PEEP 5
- Sevo 1.5%
Then they said I would be getting sterile to place the CVC
And they told me I would do fine
What could possibly go wrong?

- Infection (5-26%)
- Pneumothorax (30%)
- Hemothorax
- Hematoma (2-26%)
- Arterial insertion (4.2-9.3%)
- The inexperienced student with 3 “coaches” on the sidelines
The Setup

- Patient will be fully draped from head to toe
- Exposed skin will be prepped with Chlorhexidine
  - The most efficacious antiseptic
- Clinician’s hair will be covered and a mask will be worn
- Clinician will don sterile gown and gloves
How to Don a Sterile Gown
How it felt when I was donning the sterile gown
The Position

- Right side IJ CVC insertion
- 10-15° Trendelenburg
  - Allows gravity to enhance central venous filling
  - Creates a larger target and smaller risk of air embolism
- Head rotated to the left
- Physical landmarks
- Insert the needle at a 30-40° angle
  - Caudally toward the ipsilateral nipple
What a view

Positioned for right IJ CVC insertion
Actual footage of me at the head of the bed while sterile
USE THE ULTRASOUND, KATE.
The Kit
The Insertion

• Insert the introducer needle at a 30-40° angle
  ○ Caudally toward the ipsilateral nipple
  ○ Aspirate the whole time
• Remove the syringe and needle from the introducer catheter
• Attach the pressure transducing tubing
  ○ Confirm venous placement
  ○ Remove
• Insert guidewire
  ○ Be cognizant of the distance, never lose visualization of the guidewire
• Remove Introducer catheter
• Use scalpel to dilate insertion site
• Insert Central venous access device with gentle pressure, do not force it
• Aspirate all air and then flush and cap
• Suture into place
Seldinger Technique

Insertion of a catheter into an artery or vein by inserting narrow bore needle and then advancing a guidewire through the existing catheter, then a larger catheter may be placed over the guidewire.
How it feels preparing and inserting a PA Catheter for the first time
PA Catheter Insertion

Pressure

Length of Catheter Advanced

0-10

15-30/0-8

15-30/5-15

5-15

PCWP
PA Catheter Insertion

- IJ to SVC
- IJ to RA
- IJ to RV
- IJ to PA
- IJ to PCW

- 15 cm
- 15-25 cm
- 25-35 cm
- 35-45 cm
- 40-50 cm
Post Insertion Picture

- HR: 70-80’s
- BP: 130s/90s
- SPO2: 99%
- ETCO: 30-35 mmHg
- CVP 11 // PAP 29/17
- Vent Settings: VC // VT 550 // RR 10 // PEEP 5
- Sevo 1.5%
About 10 minutes later...
ETCO2 is 16 mmHg with a dampened waveform
What do you want to do?
What do you want to do?

- Troubleshoot
  - Manually ventilate
  - Check all connections
  - Check ETCO2 tubing
  - Check water trap
  - Auscultate

- Lower MV
  - Drop VT to 500 and RR to 8
ETCO2 is holding steady at 14-16 mmHg, PCO2 28. Everything is connected, vital signs are stable, the patient is easy to manually ventilate, and had no change in ETCO2 when lowering MV.
Hypocarbia Causes

- Increased Carbon Dioxide Elimination
- Decreased Pulmonary Perfusion
- Decreased Carbon Dioxide Production
- Airway/Equipment Problems
Hypocarbia Complications

- Decreased myocardial oxygen supply
- Increased coronary vascular resistance
- Increased risk of coronary artery vasospasm
- Increased coronary microvascular leakage
- Increased myocardial oxygen demand
- Decreased cerebral blood flow
- Decreased cerebral oxygen delivery
Differential Diagnosis

- Hyperventilation
- Decreased CO
- Pulmonary Embolism
- Pneumothorax
- Esophageal Intubation
- Extubation
- Deep Anesthetic
Pneumothorax
Pneumothorax

- Respiratory distress
- Hypoxia
- Tachypnea
- Absent or distant lung sounds
- Tachycardia
- Pulsus paradoxus
- We did not have a normal presentation
Pneumothorax

- One of the most common complications of CVC insertion
  - Incidence between 1-6.6%
  - Represents 30% of all CVC complications
- More likely to occur with
  - Emergent situations, large catheters, increased number of needle passes, SC vs IJ, inexperience
What went wrong?

- Inexperience
- Clinician inserting was not the one to drape
- Feeling rushed so as not to upset the surgeon
- “Through and Through”
Resolution

- Right sided chest tube was placed by the surgeon
- The pneumothorax was caught early and did not worsen with positive pressure ventilation
- Serial ABGs
- Extubated and transferred to CICU without complication


