Anesthesia POCUS Pocket Reference

Cardiovascular POCUS

- **CWD (Continuous Wave Doppler)**
  - Measures highest velocity along path

- **2D (Two-Dimensional Imaging)**
  - Gross anatomy, ventricular and valvular movement, positioning for M-mode
  - **4-chamber view**: RV inflow/outflow, RVOT
  - **5-chamber view**: CWD

- **Color doppler**
  - Gross assessment for TR, PR, VSD

- **M-mode**
  - LV and aortic root measurements, LA dimensions
  - Mitral valve leaflets: in systole, diastole
  - LV diastolic function

- **Doppler**
  - LV pressure overload

- **Echo Modes**
  - **2D**
    - Gross anatomy, valvular, and valvular movement, positioning for M-mode and Doppler
  - **M-mode**
    - Movement along long axis, parasternal view, left shoulder
  - **PND (Pulsed N-Doppler)**
    - Measure velocity at one point
  - **CWD (Continuous Wave Doppler)**
    - Velocity of flow in shunts

- **Valves**
  - Mitral valve: epigastrium, left arm above head
  - Aortic valve: left anterior chest
  - Pulmonic valve: right arm, head down
  - Tricuspid valve: sub-costal

- **Dimensions**
  - **LV** SER: 40/50/55, vol: 20/40/50
  - **LVOT** diameter: 25/30/35
  - **RVOT** diameter: 9/10/11
  - **PA** diameter: 20/25/30

- **péricardial effusion**
  - Fluid between epicardium and descending aorta

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- **Position**
  - **Left lateral**
    - View of the heart from the left side
  - **Right lateral**
    - View of the heart from the right side

- **Ventricular function**
  - **LV**: diameter, thickness, echogenicity
  - **RV**: size, shape, trabeculations

- **Echocardiography**
  - **Standard PLAX**: Center MV and AV leaflets in the middle of the screen
  - **Aortic valve level**: Short-axis view
  - **Pulmonary valve level**: Short-axis view

- **Parasternal Long Axis (PLAX) views**
  - **B.**
    - RV inflow: from PLAX view, tilt transducer to aim toward patient's right shoulder
  - **C.**
    - RV outflow: from PLAX view, aim transducer toward patient's left shoulder (look up), may see PV leaflets

- **Doppler**
  - Standard PLAX
    - Standard PLAX: Center MV and AV leaflets in the middle of the screen

- **Disease**
  - **RV overload and dilation**
    - Dilated RV, flattening of interventricular septum
  - **LV overload**
    - LV size, wall thickness
  - **Mitral stenosis**
    - Decreased mitral valve area

- **Probe types**
  - **Linear**
    - 9 cm
  - **Curvilinear**
    - 1-5 MHz, 5-8 MHz

- **Transducer Types**
  - **PLAX**
    - Aorta
  - **PSAX**
    - RVOT
  - **Apical**
    - SVS, IVC
  - **Subcostal**
    - LA, RA, RV, LV, PV, PA

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- **Photographic images**
  - Courtesy of Dr. Atif Qasim: echocardiographer.org

- **Lung ultrasound images**
  - Courtesy of: Picano et al. "Lung Ultrasound for the cardiologist", JACC

- **Cardiac illustrations**
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- **Echocardiography**
  - **Standard PLAX**
    - Center MV and AV leaflets in the middle of the screen

- **Echo Modes**
  - **2D**
    - Gross appearance of RA, TV, AV, PA, RVOT + RV apex

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Position
Patient: left lateral decubitus, left arm up, gentle inspiratory hold
Transducer: probe placed on the sternal notch, if not clear, use palpation
Apical 4 chamber (A4C)
A) 4 chamber: place transducer at the base of the heart, with landmark
toward the left shoulder
B) 5 chamber: with probe placed medially, toward the right shoulder

Subcostal
Patient: supine, legs bent to relax abdomen, deep end-inspiratory hold
Transducer: probe placed below the xiphoid and flat on the abdomen

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Aortic regurgitation
Disease
Aortic regurgitation: CWD across AV to measure jet deceleration rate
(Msec)
Mild: >500, Moderate: 500-200, Severe: <200
Aortic stenosis: CWD across AV to measure Vmax
Bernoulli equation: peak gradient (mmHg) ΔP = 4(Vmax
Mild: <20, Moderate: 20-40, Severe: >40
Continuity equation: use velocity time integral (VTI) and LVOT diameter (D) to measure aortic valve area
AVA = (0.785 * D
Mild: >1.5, Moderate: 1.0-1.5, Severe: <1.0

Annular Plane Systolic Excursion
Mitral inflow: evaluating LV diastolic function

Doppler
Color Doppler: assessment for MR, TR, ASD, VSD
PWD: hepatic vein systolic flow reversal >0.3-0.4m/s suggestive of RV pressure/volume overload

Suprasternal
Position
Patient: supine, head tilted to the left, deep and prolonged hold
Transducer: probe placed in right sternal notch, with indicator placed at 14:00
Disease
Aortic arch dissection: gross visualization
Pulmonary hypertension: if RPA is smaller than aorta, filling pressures likely normal

Apical 4 Chamber (A4C) Advanced
2D: LV/RV size and gross systolic function
M-mode: MAPSE (lateral):
<12mm = LVEF reduced
<6mm = LVEF <30%
A)  M-mode TAPSE: <17mm = reduced RV systolic fxn
Disease
Pulmonary hypertension: if RPA is smaller than aorta, filling pressures likely normal

Subcostal Advanced
2D: similar to other 4-chamber views; only available view during CPR
M-mode: IVC view assess intravascular volume status during spontaneous breathing
RAP 0-5mmHg: <2.1cm + collapses >50% w/ sniff
RAP 10-20mmHg: >2.1cm + collapses <50% w/ sniff

Subcostal Expert
Doppler
Color doppler: assessment for MR, TR, ASD, VSD
PWD: hepatic vein systolic flow reversal >0.3-0.4m/s suggestive of RV pressure/volume overload

Suprasternal Expert
Disease
Aortic arch dissection: gross visualization
Pulmonary hypertension: if RPA is smaller than aorta, filling pressures likely normal

Annular Plane Systolic Excursion:
Mitral inflow: evaluating LV diastolic function

Tricuspid Regurgitation: estimating PASP

Aorta
### Pulmonary Ultrasound

**Phlebography:** High frequency; better for superficial evaluation (groin and clavicular heads/brachial)

Low frequency: better for deep structure evaluation (contralateral, popliteal)

**Probe position:** In a conical angle with notch toward head, probe perpendicular to skin, evaluated multiple depths in both anterior and dependent areas.

**Imaging Findings**

- **Pleural line:** static equally spaced horizontal lines. No pleural effusion.
- **B. A-lines (repetition artifacts):** static vertical lines, do not originate at pleural line, move with lung sliding, usually <1cm. Normal lung finding, help rule out PTX.
- **A. Comet tails (artifact):** thin anechoic horizontal lines, move with respiration (rare artifact).

**Tips**

- **Probe Selection:** Linear/vascular probe

- **Probe Positing**
  - **C. Probe selection:** High frequency: better for superficial evaluation (pleura and lung). Low frequency: better for deep structure evaluation (consolidation, pleural effusion).

- **Probe position:** Point in a cranial-caudal axis with notch toward head, probe perpendicular to skin, evaluated multiple depths in both anterior and dependent areas.

### Pulmonary Edema

**ALVEOLAR EDEMA**

- B. A-line (repetition artifacts): static vertical lines, do not originate at pleural line, move with lung sliding, usually <1cm. Normal lung finding, help rule out PTX.

**INTERSTITIAL EDEMA**

- **B-line:** A static horizontal line 1-2mm wide, terminates at a pleural line, move with lung sliding, do not obliterate A lines; Do not move with lung sliding, do not obliterate A lines.

**Lung Sliding**

- **Increased lung sliding** = no pleural effusion

- **Normal Lung**

### FAST

**Uses**

- Rapidly, clearly, semiquantively assess free fluid in pericardial, free fluid, as well as pleural fluid or pleural effusion or part of the "hemopericardium" (HPE)

- First validated for blunt thoracic trauma adult patient.

**Tips**

- **Probe Selection:** Use frequency sufficient or phased "tonguing" (tongue), probe. Consider that frequency changes for surface and deep structures.

- **Probe position:** Point in a cranial-caudal axis with notch toward head, probe perpendicular to skin, evaluated multiple depths in both anterior and dependent areas.

- **Use of COMPRESS Compression technique:** Hold the transducer in a transverse position, perpendicular to the fluid line.

### FAST Views

- **B. Transverse**

- **A. Longitudinal**

- **Tips**

- **Labeling:** Complete with a line directly linked to the label. Evaluate popliteal with compression is applied behind the knee in prone/decubitus position.

### FAST Views

- **A. Longitudinal**

- **B. Transverse**

### Normal CFV w/ COMPRESSION

**Features**

- **Arrow** = Free fluid around spleen. In patients with splenic trauma, only see the spleen and not the free fluid.

- **Arrow** = Free fluid in Morrison’s pouch, a space normally occupied by the liver and the myocardium.

- **Arrow** = Free fluid around bladder. This appears as an anechoic stripe between the diaphragm and the bladder. Always evaluate the tip of the spleen and kidney. It is also important to also evaluate the tip of the liver between liver and kidney. Always include evaluation of the tip of the liver and the myocardium.

**Labels for Evaluation**

- **Arrow** = Free fluid in Morrison’s pouch, a space normally occupied by the liver and the myocardium.

- **Arrow** = Free fluid around bladder. This appears as an anechoic stripe between the diaphragm and the bladder. Always evaluate the tip of the spleen and kidney. It is also important to also evaluate the tip of the liver between liver and kidney. Always include evaluation of the tip of the liver and the myocardium.

**Class**

- **C. | DVT**

**Probable**

- **CTE or DVT**

**Possible**

- **Pelvis**

**Able to rule out**

- **Pelvis**

**Femoral vein** (FV) has also been referred to as "the superficial femoral vein." Clots in the FV are considered deep vein thromboses.

- **Supraclavicular fossa (SCF)**

- **High frequency:** better for superficial evaluation (neck and axilla). Low frequency: better for deep structure evaluation (contralateral).

**Probe position:** In a conical angle with notch toward head, probe perpendicular to skin, evaluated multiple depths in both anterior and dependent areas.