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QPATH E

For EVERY exam (including incomplete & educational exams)

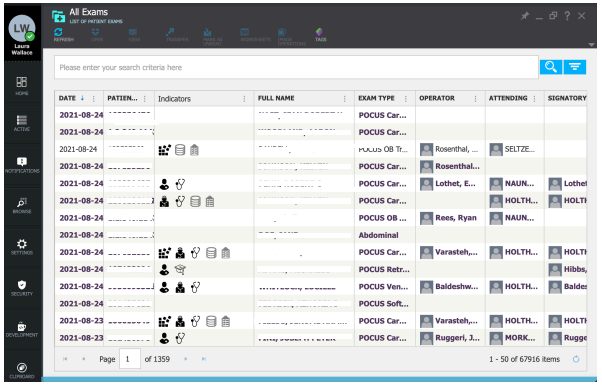
- Write a note in QPATH E
- Show the saved images/clips to an attending so they can attest to the exam

At the US Machine

- END the exam
- Exams will archive to QPATH automatically if machine is charged.
- You can check to see if your scan archived under Review: Patient List. Look for the file cabinet icon

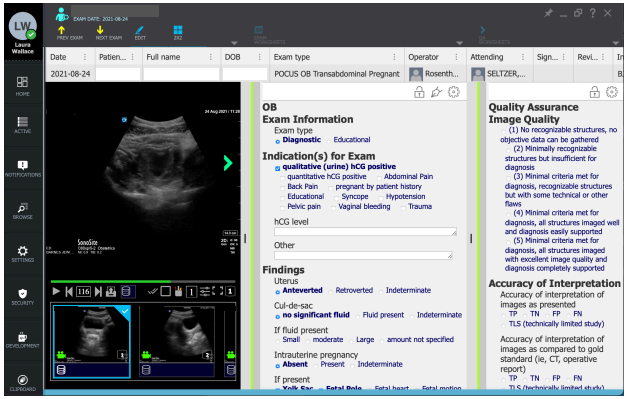
bjc.qpath.cloud

- Login with WUSTLKey
- Select the exam
- EDIT: Check exam info
- EDIT: Select Exam Type
- IMAGE OPERATIONS: split exam or export



Writing a note

- EDIT: Select Exam Type
- Note is the center column
- SELECT Diagnostic or Education
- SIGN at the bottom



Other

- Off service notes must be written by attending
- In QPath, exams can be merged with the EPIC chart using EDIT: Change Patient
- For procedures
  - EDIT: Exam Type Procedural Guidance
  - Mark Diagnostic
  - Sign the note
  - Fill out procedure note in EPIC

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Sonosite X-porte

For EVERY exam (including incomplete & educational exams)

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Entering Patient Information

PATIENT: Select New/End

- WORKLIST

OR

- Type Name & DOB

Reading=Resident
WustlKey

Referring=Attending
WustlKey

PROBE & EXAM TYPE

Other Buttons

ZOOM

MORE CONTROLS:

Label, Calcs, etc

Improving Image Quality

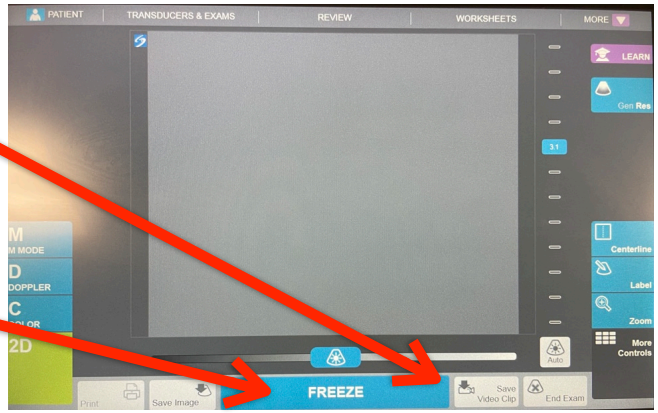
DEPTH

LABEL

GAIN

Saving Images

- Save Video Clip
- Freeze->Save to save a still image



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Sonosite LX

For EVERY exam (including incomplete & educational exams)

- Write a note in QPATH E
- Show the saved images/clips to an attending so they can attest to the exam

Entering Patient Information

PATIENT

- Type Name, DOB)

OR

- WORKLIST: Select Patient

Reading=Resident WustlKey

Referring=Attending WustlKey

Other Buttons

PROBE

CALCS

Improving Image Quality

LABEL (ABC)

DEPTH

GAIN

Saving Images

VIDEO

PHOTO

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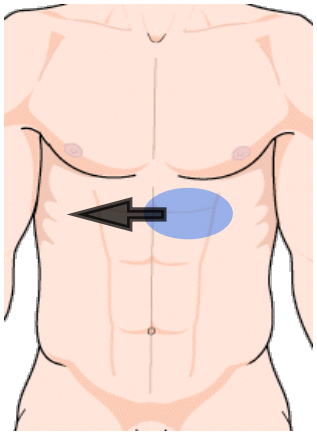
FAST Exam

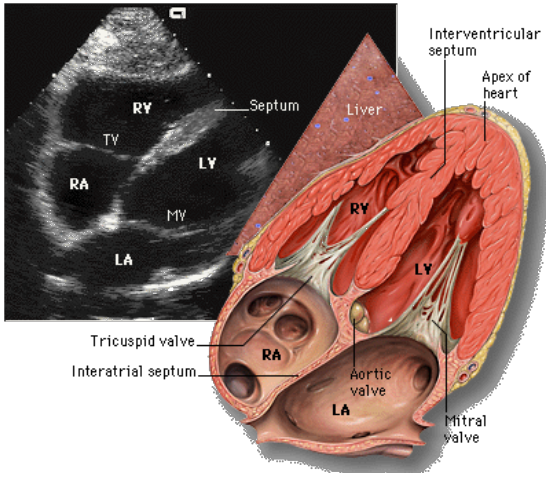
Images: https://www.yale.edu/imaging/echo_atlas/contents/index.html

- Curvilinear probe
- Abdominal exam preset
- Obtain 4 views below
- May need multiple clips of each view for complete exam

- Objectives
  - Rule out effusion/tamponade
  - Rule out free peritoneal fluid
  - Very sensitive if all views adequately obtained

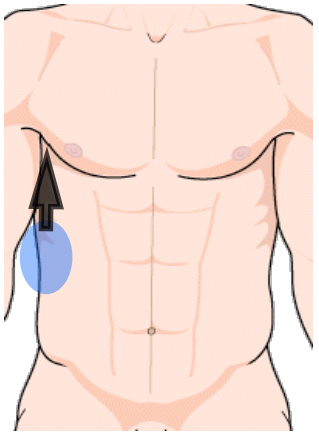
Subxiphoid

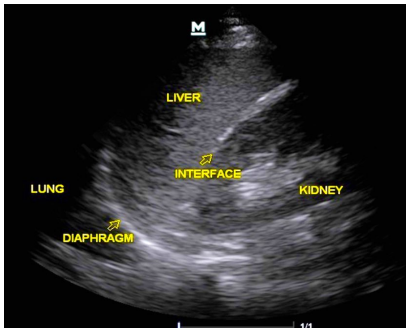




- Subxiphoid view usually easiest for effusion
- Can use any cardiac view

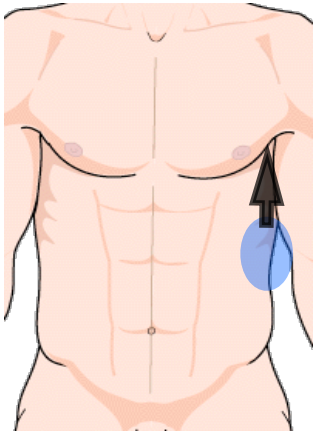
Right Upper Quadrant

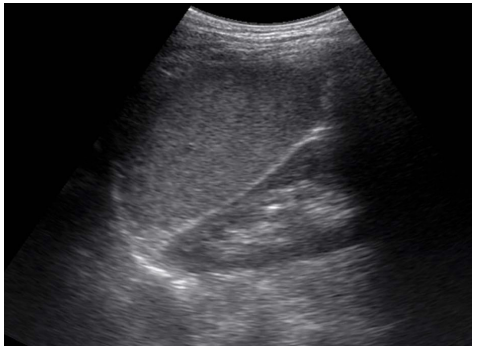




- Eval for free fluid in three places
  - Above/below diaphragm
  - Morrison's pouch
  - Inferior pole of R kidney

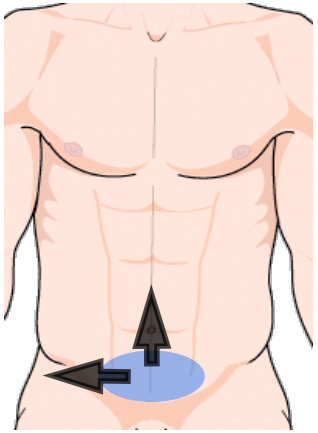
Left Upper Quadrant

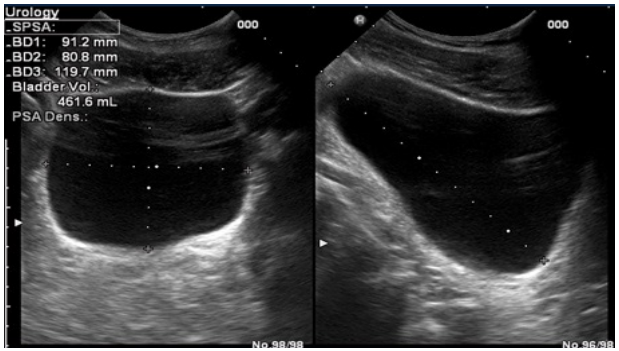




- Eval for free fluid in three places
  - Above/below diaphragm
  - Splenorenal interface space
  - Inferior pole of L kidney

Pelvis





- Save clips fanning in both directions
- Look all around bladder for free fluid

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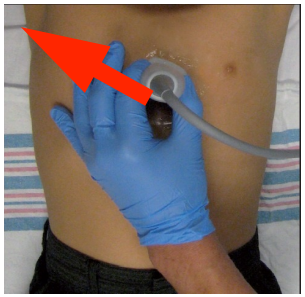
Basic Echo

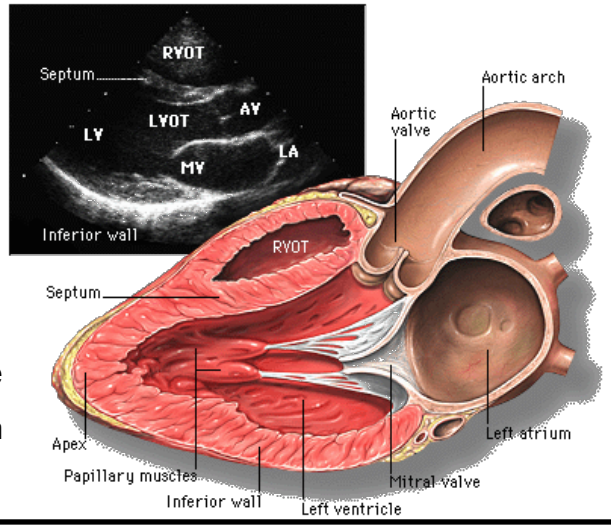
Images: https://www.yale.edu/imaging/echo_atlas/contents/index.html

- Phased array (square probe)
- Cardiac exam preset
- Obtain 4 views below
- IVC view/compressibility optional

- Objectives
  - ID effusion/tamponade
  - Eval cardiac activity in arrest
  - Eval LV function

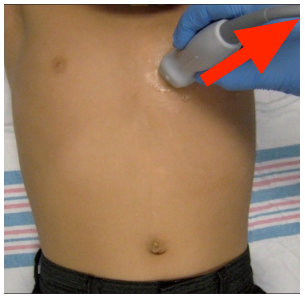
Parasternal Long

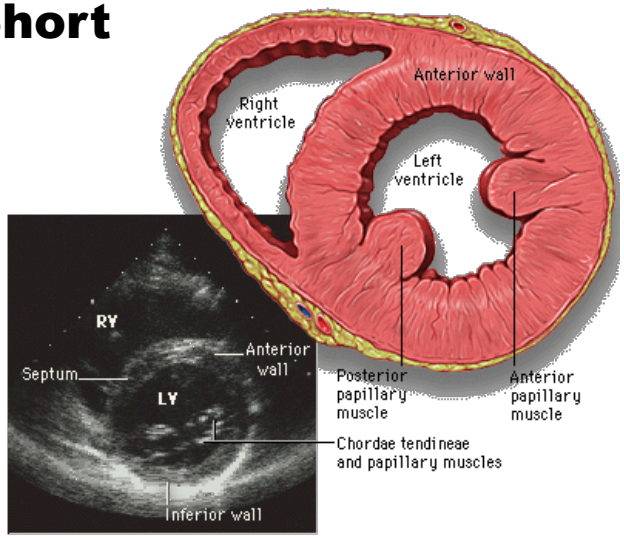




- Evaluate MV, View AV
- Compare RVOT, AV, LA size
- Eval global systolic function
  - Measure EPSS

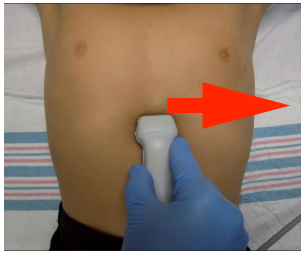
Parasternal Short

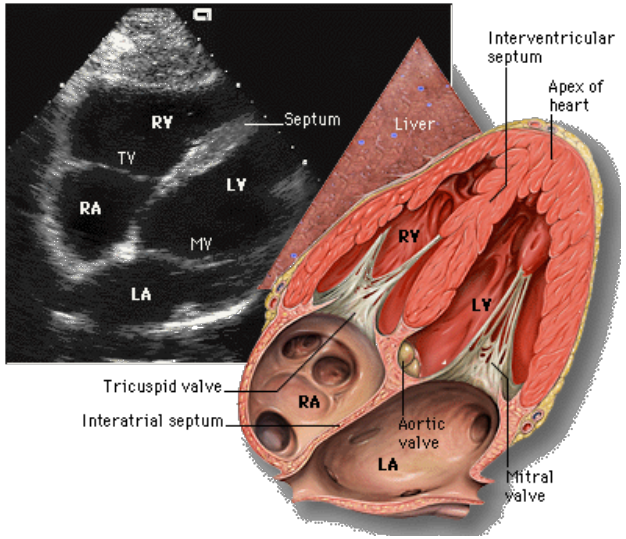




- Evaluate septum for signs of RV strain
- Look for focal wall motion abnormality

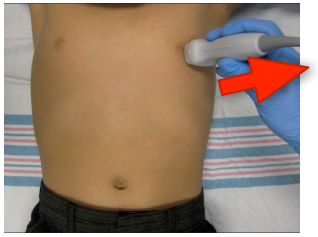
Subxiphoid

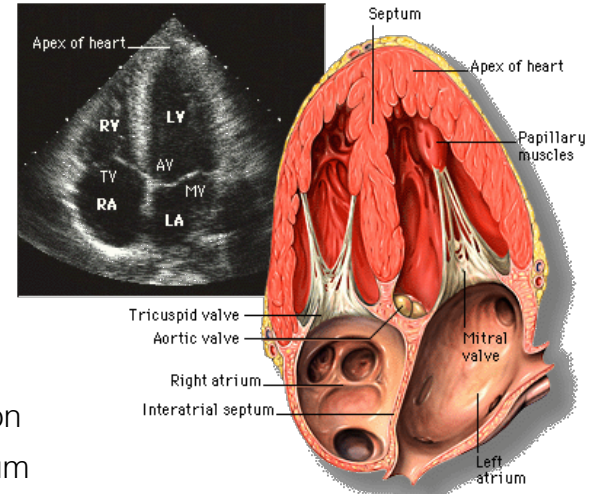




- Put hand on top of probe
- Pericardial effusion
- Good in cardiac arrest

Apical 4-Chamber





- Compare LV:RV size
  - Normal ratio is 1:0.6
- View MV, TV
- Eval apical free wall motion
- Eval interventricular septum

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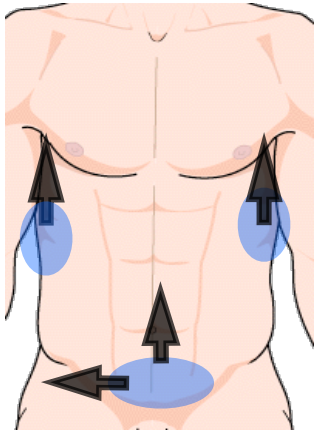
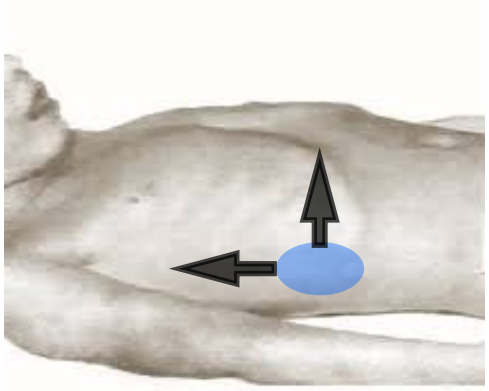
Renal

- Curvilinear probe
- Abdominal Exam preset
- Obtain long & short axis scans of both kidneys
- Obtain sagittal and transverse scans of bladder

- Objectives
  - Evaluate for hydronephrosis/obstruction
  - Calculate bladder volume
  - Note any other findings (eg.stones, cysts)

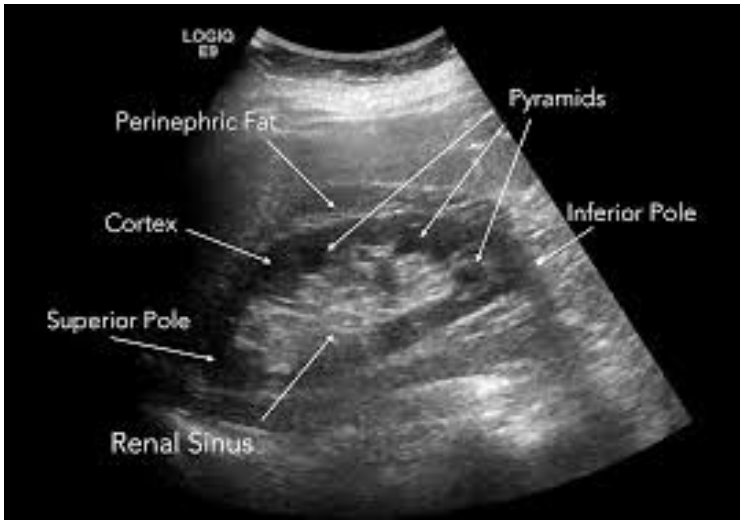
Orientation



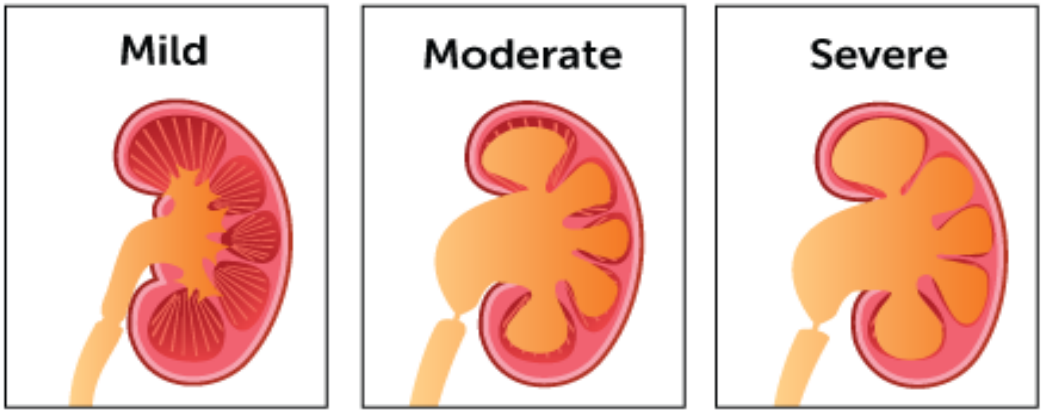


- Clips of both kidneys in short and long axis
- Indicator anterior for short axis
- Indicator to head for long axis
- Clips of bladder in long and short axis

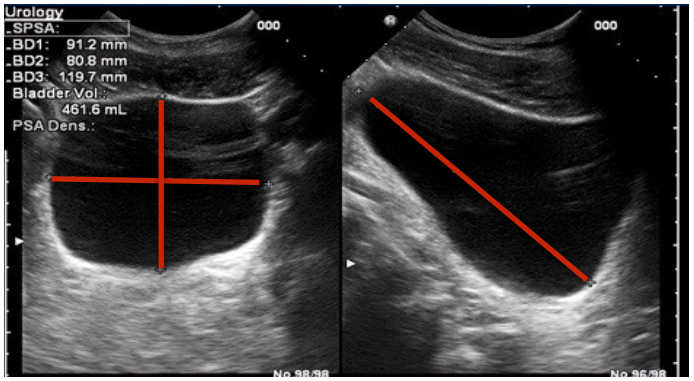
Renal Anatomy



Hydronephrosis classification



Bladder volume



- Measure AP and width in transverse axis.
- Measure longest height in sagittal axis

Volume = Length x width x height x 0.72

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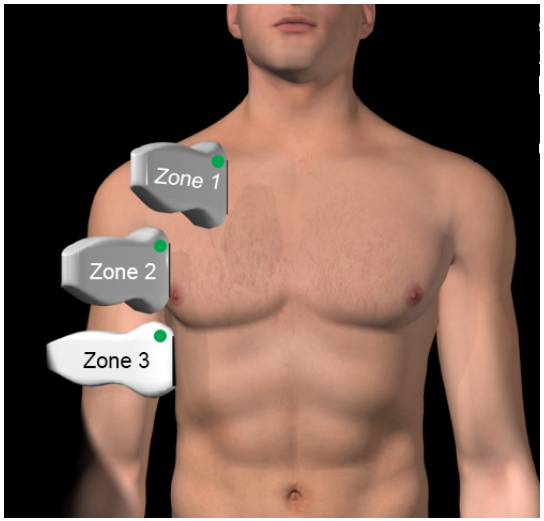
Lung

- Linear (sliding) and/or curvilinear (b-lines) probe
- Lung preset
- Obtain clips in multiple locations (see below)
  - Make sure to label left and right!

- Objectives
  - Rule out pneumothorax (high sensitivity)
  - Evaluate for b-lines, consolidation, effusion
  - Can be part of extended FAST exam

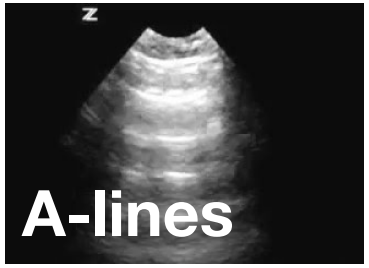
Locations

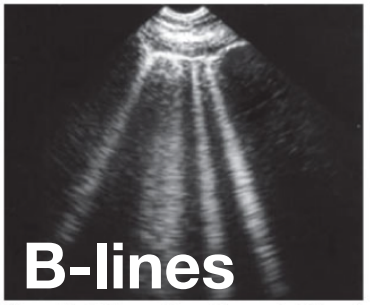


- Indicator towards head
- Scan in multiple locations
  - Mid-clavicular line
  - Mid axillary line
  - Lung base (diaphragm)
  - Multiple rib spaces in each location
- Superficial/linear
  - Lung sliding
- Deep/curvilinear
  - B-lines, effusion

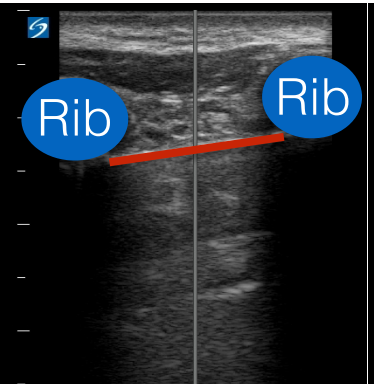
Curvilinear probe: Deeper lung fields

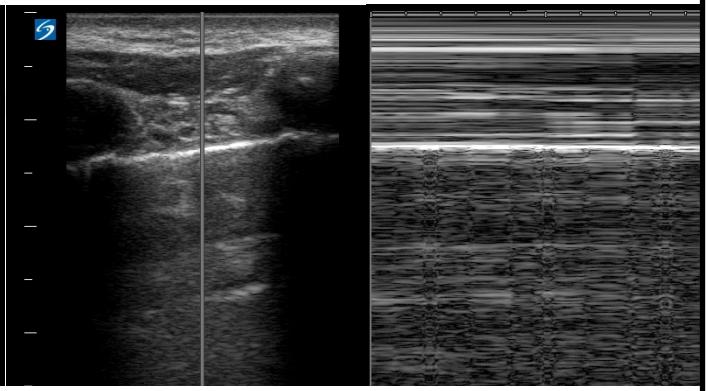
- A-lines-Parallel to pleural line
  - Normal reverb artifact
- B-lines=start at pleural line, extend through entire lung field (15-18cm)
  - Obliterate A-lines
  - >3/rib space=Interstitial fluid (Usually pulmonary edema)





Linear probe: Pleural line

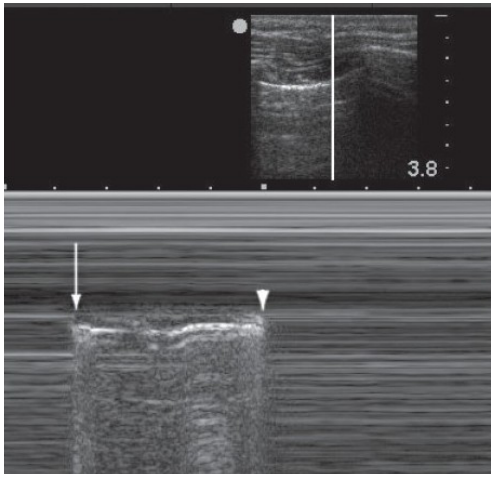




- +lung sliding=no PTX (very sensitive)

- M-mode: graphing 1 line of b-mode over time
- Should see motion in lung (sandy beach sign)

Transition point=pneumothorax



- Point where lung sliding comes in and out of view
- Very sensitive and specific for ptx

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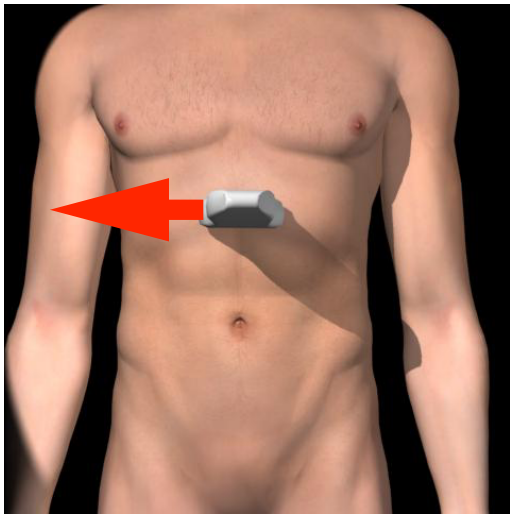
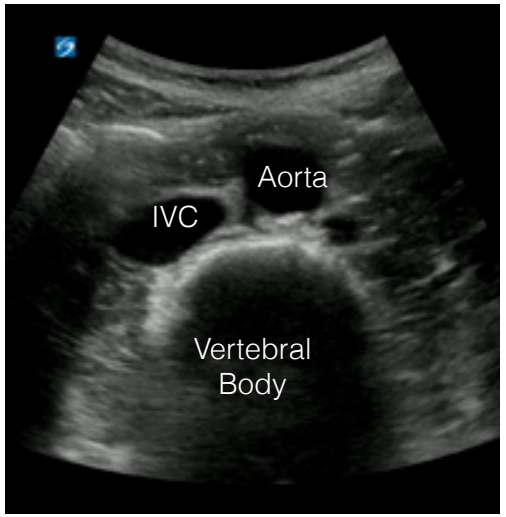
Aorta

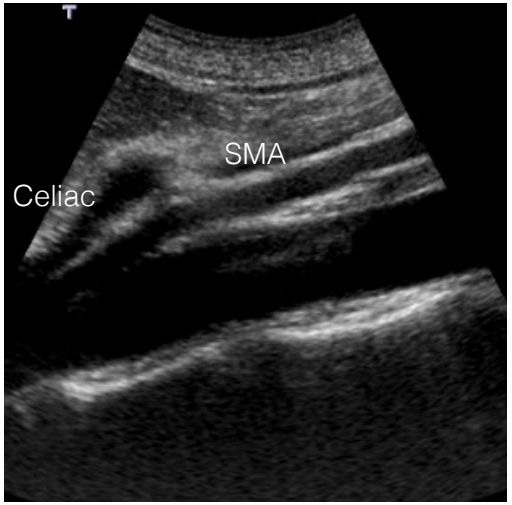
- Curvilinear probe
- Abdominal preset
- Measure proximal, mid and distal aorta in short axis
- Obtain clip through bifurcation into iliac arteries
- Must visualize entire aorta!

- Objectives
  - Rule out aneurysm (very sensitive)
    - Normal aorta width <3cm
  - Can sometimes find clot or dissection

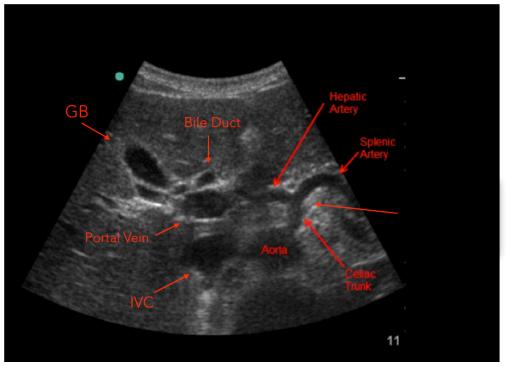




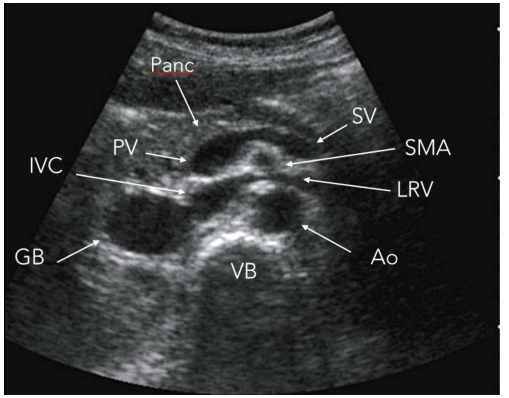
- Find aorta, IVC and vertebral body in upper abdomen
- Use slow gentle pressure to push bowel gas aside
- Differentiate IVC and aorta with color/doppler
- Sometimes long axis view can help as well
- Landmarks include celiac, SMA, bifurcation



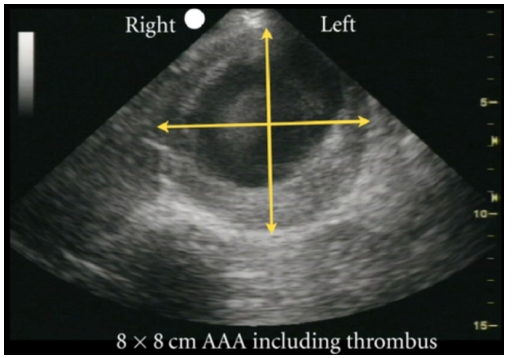
- Level of celiac
- AKA seagull sign
- Good proximal measurement



- Level of SMA
- Good mid measurement
- Look for landmarks to differentiate SMA from Aorta



- Measure aorta in 3 different places in SHORT axis
- Try to measure in both axes BUT-
- Always measure A-P, outer wall to outer wall



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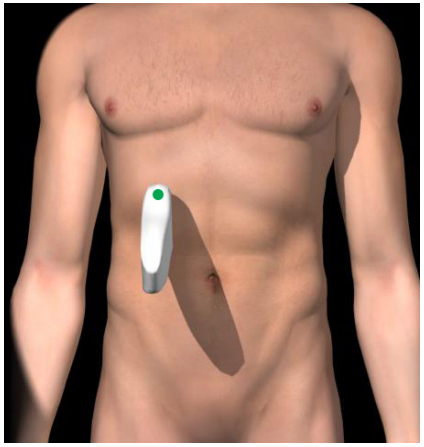
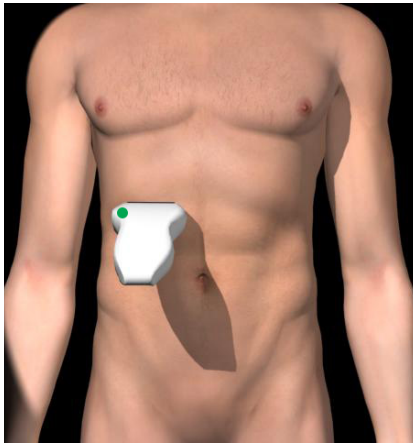
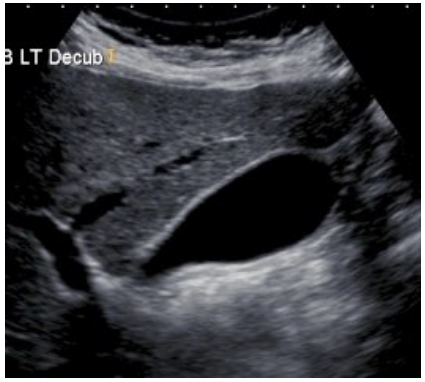
RUQ

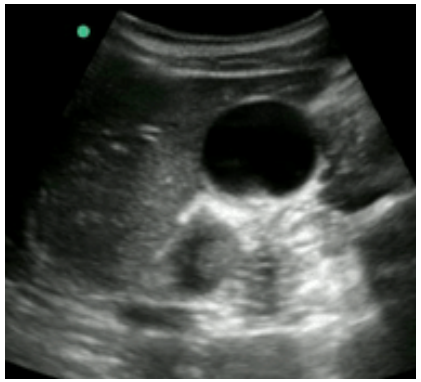
- Curvilinear probe
- Abdominal preset
- Obtain transverse and long axis scans through gall bladder
- Obtain anterior wall measurement and CBD diameter measurement

- Objectives
  - Identify cholelithiasis
  - Evaluate for cholecystitis (see below)



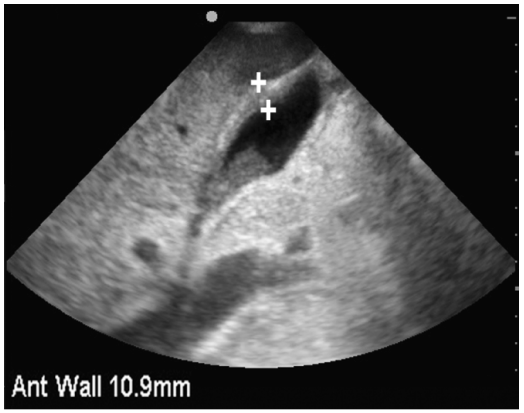


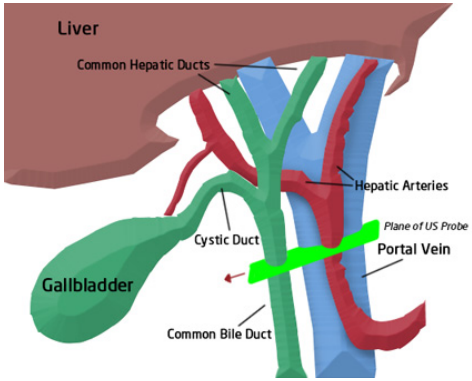




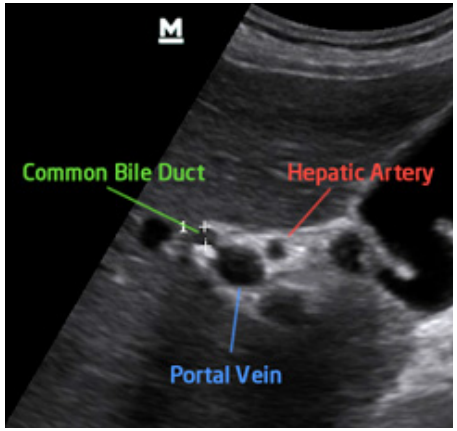
To help find gallbladder
- Place patient in LL decubitus
- Scan along inferior liver edge
- Can try cardiac probe over ribs
- Have patient hold a deep breath

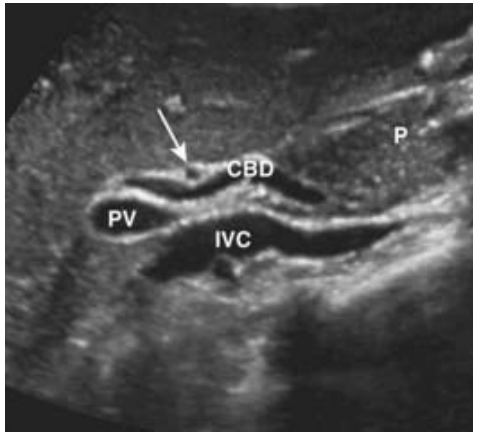
Concerning for cholecystitis:
- pericholecystic fluid
- +Murphy's sign
- +gallstones
- gallbladder distention >5cm
- anterior GBW>0.4cm





- Measure anterior GBW: freeze, zoom in and measure
- Note portal triad anatomy deep to gall bladder





- Fan through CBD horizontally and longitudinally
- Put color/doppler on image to differentiate vessels
- Borderline common bile duct diameter: 6mm (inner to inner wall)

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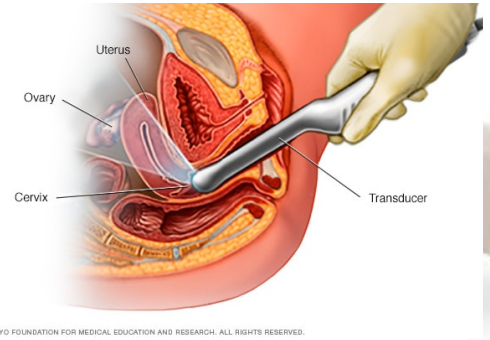
OB

- Curvilinear and Endocavitary probes
- OB exam preset
- Obtain scans of uterus in 2 directions **and** both adnexa to identify all structures in pelvis (and free fluid)
- Obtain stills of uterus for GS, YS, and use m-mode for FHR

- Objectives
  - Confirm IUP/live IUP
  - Rule out free fluid/ectopic
  - Calculate FHR

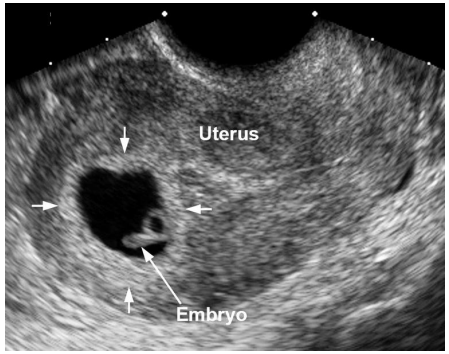
Orientation

Always transabdominal before transvaginal!



- Transabdominal: Indicator to pt's right and then pt's head
- Transvaginal: Indicator to pt's right and then towards ceiling (anterior)

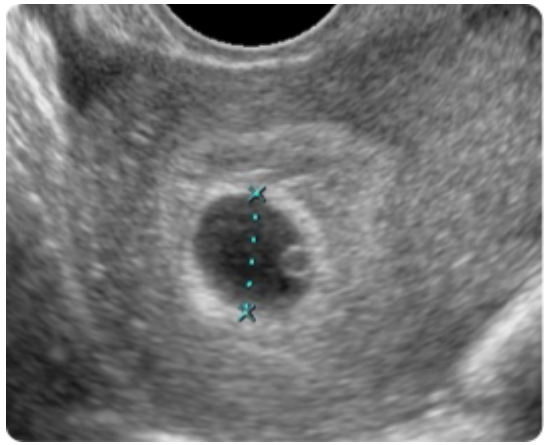
Anatomy



- Transabdominal: Indicator to pt's right and then pt's head
- Transvaginal: Indicator to pt's right and then towards ceiling (anterior)

IUP Definition (for our purposes)

- IUP is
  - In the uterus
  - with yolk sac and/or fetal pole
  - **GS alone is NOT IUP**
- If fetal pole >7 mm, FHR should be visible
- Any concerns=consult OB



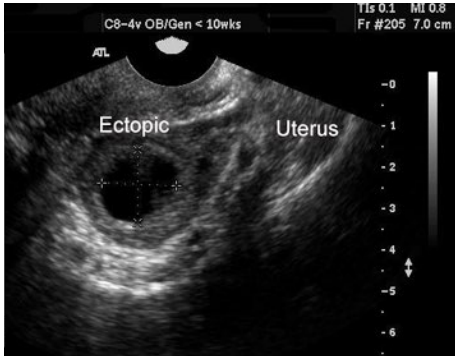
Abnormals

Pseudosac mistaken for IUP

- If no yolk sac->no IUP

Ectopic mistaken for IUP

- Scan through entire pelvis first to ID all structures



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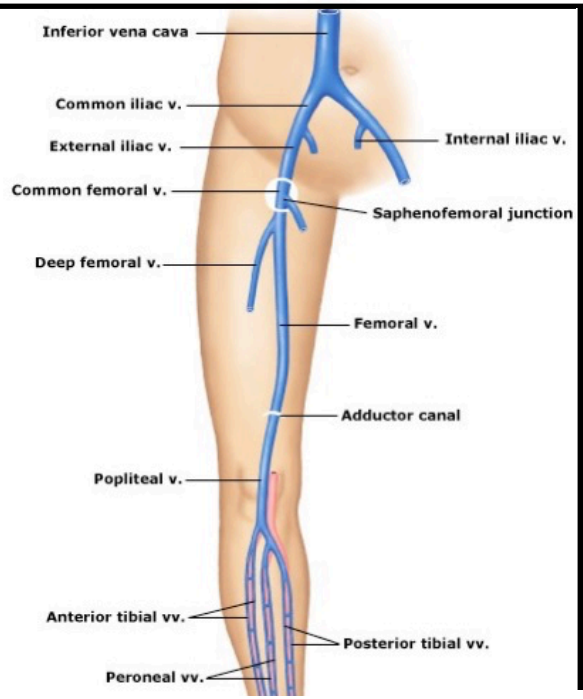
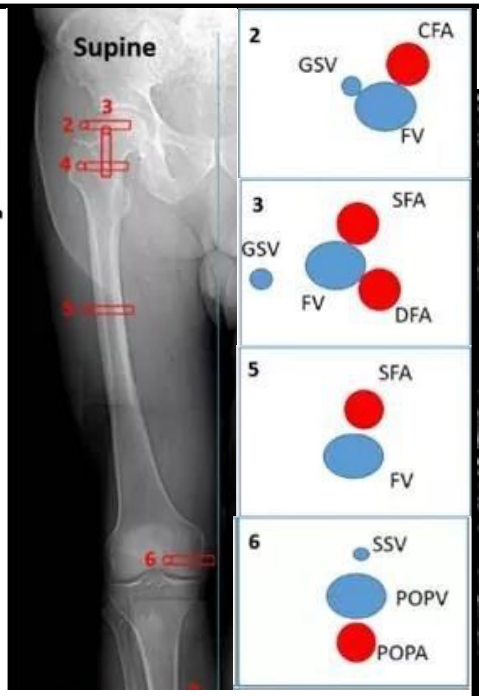
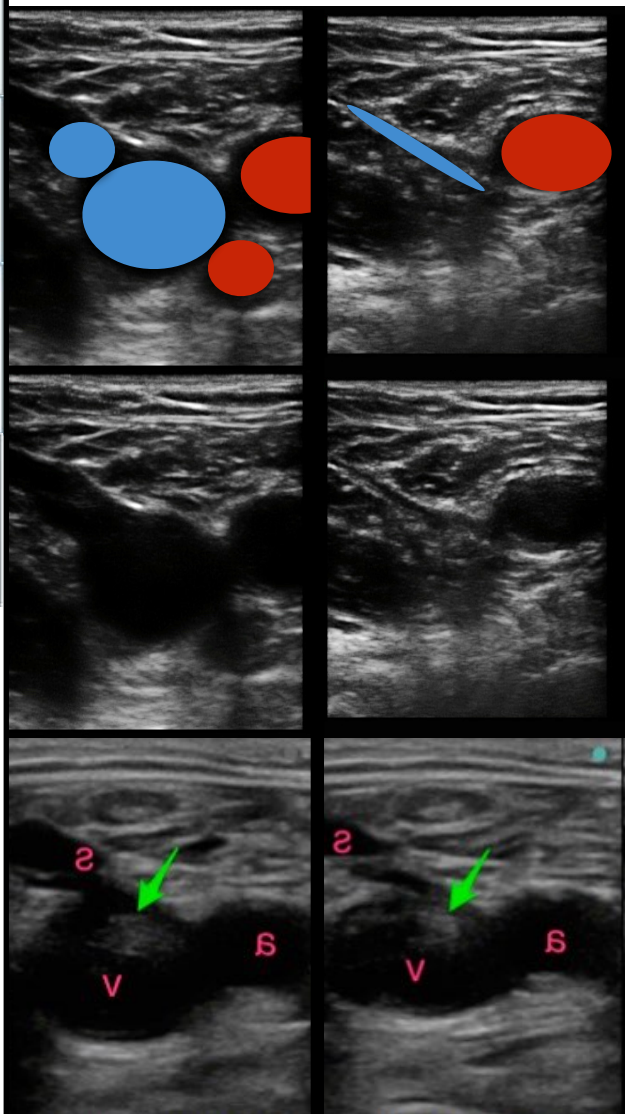
DVT

- Linear probe (or curvilinear if necessary)
- Venous/vascular preset
- Obtain short axis scans of compression of bilateral femoral and popliteal veins as described below
- Be sure to label!

- Objectives
  - Identify acute proximal DVT in lower extremities
- Limited in patients with prior DVTs







Femoral anatomy

- Start proximal at saphenofemoral junction (#2 above)
- Scan through deep femoral vein takeoff, at least 2cm distal (#5)
- Compress every 1 cm along path and evaluate branch points

Popliteal anatomy

- Vein is *usually* superficial to artery but can anywhere nearby
- Start approximately 12cm proximal to popliteal crease
- Scan through trifurcation (5-7cm distal to popliteal crease)
- Compress every 1 cm along path and evaluate branch points

<u>Normal</u>

- Compress until **complete** collapse of vein
- Compress q1cm along vein
- Save a clip of EVERY compression

<u>Thrombus</u>

- Non-compressible
- Can be hyperechoic

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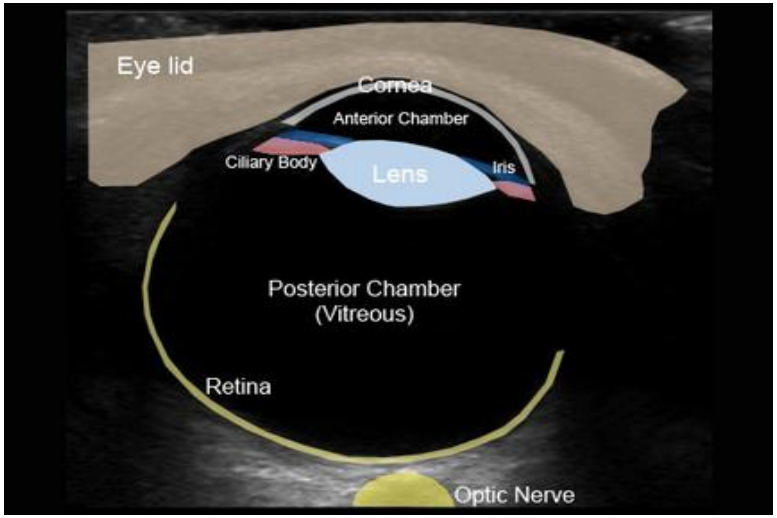
Ocular

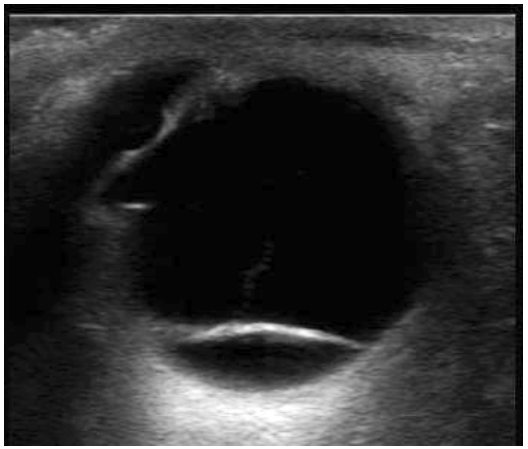
- Linear probe
- Ocular or small parts exam preset
- Obtain scans of globe in 2 axes
- Measure optic nerve sheath diameter (ONSD)

- Objectives
  - ID abnormalities in the posterior chamber
  - Evaluate for increased ICP with ONSD
- Contraindicated in globe rupture

Normal Anatomy (in transverse plane)

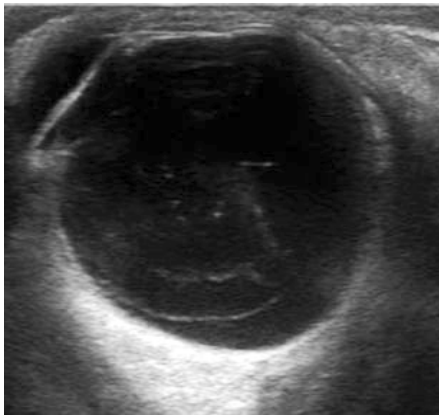


Retinal Detachment



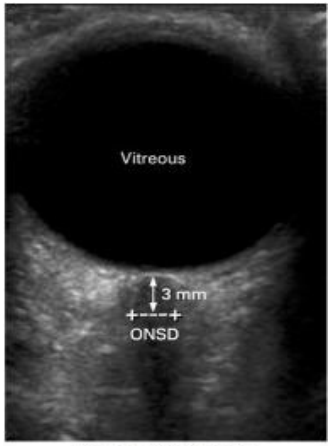
- "Worm-like" line of retina in posterior chamber
- Will not cross optic nerve
- does not move w/ ocular movement
- Difficult to differentiate from vitreous detachment with ultrasound alone

Vitreous detachment/hemorrhage



- Floating material in posterior chamber
- Usually moves when eye moves
- Difficult to differentiate from retinal detachment with ultrasound alone

Measure ONSD



From Emergency Medicine Journal

- Freeze image of optic nerve deep to globe
- Measure 3 mm posterior to retina
- Measure across optic nerve
- Normal ONSD≤5mm

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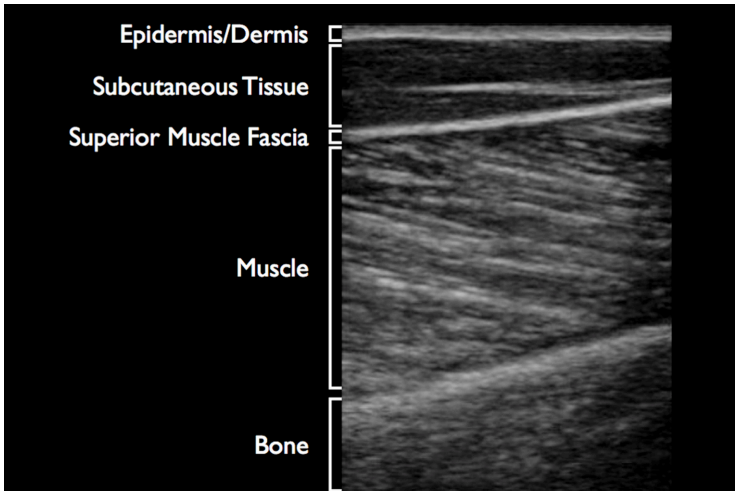
Superficial

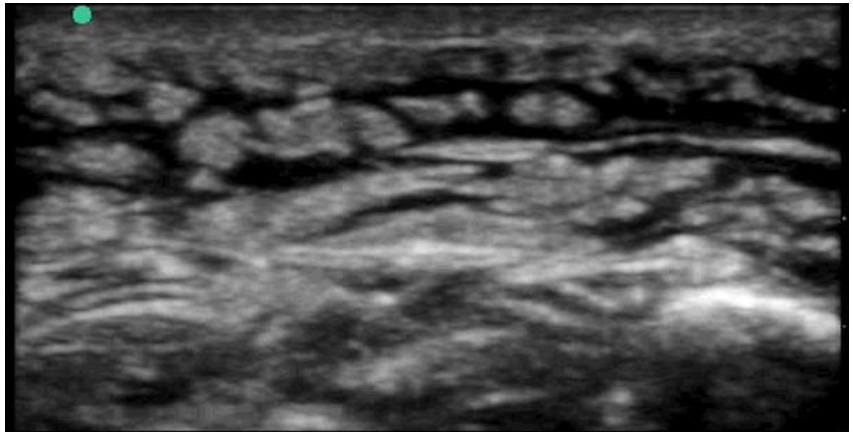
- Linear probe
- Soft tissue/superficial preset
- Obtain scans in sagittal and transverse
- Label area of body and laterality

- Objectives
  - ID foreign body
  - Differentiate abscess from cellulitis

Normal Skin and Soft Tissue



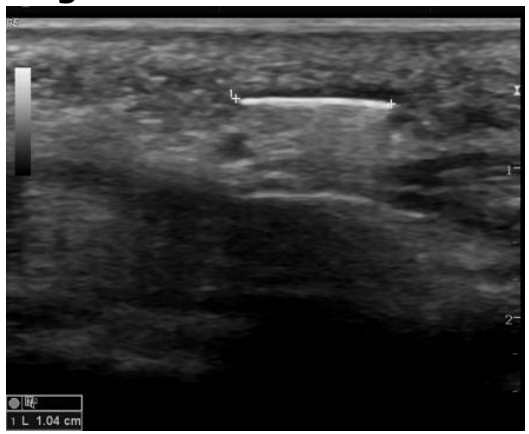
Tissue edema (often cellulitis)



Cobblestoning=fluid in tissue (edema, pus)

Abscess/foreign body

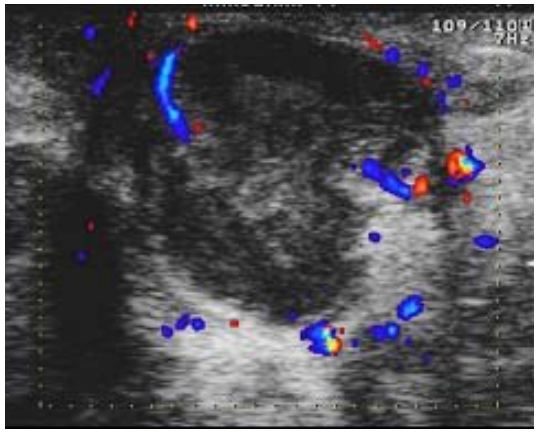
Compress for fluctuance



Note shadowing deep to FB

Tips

- Use color doppler to help differentiate abscess from lymph nodes
- Evaluate for depth and extension below SF tissue
- "Swirl Sign": Compress with probe to see fluctuance of pus



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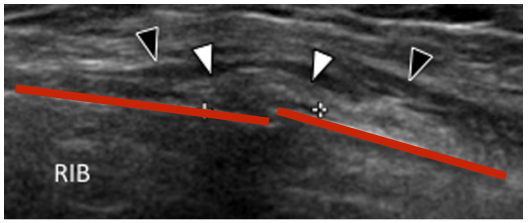
Bone/Joint

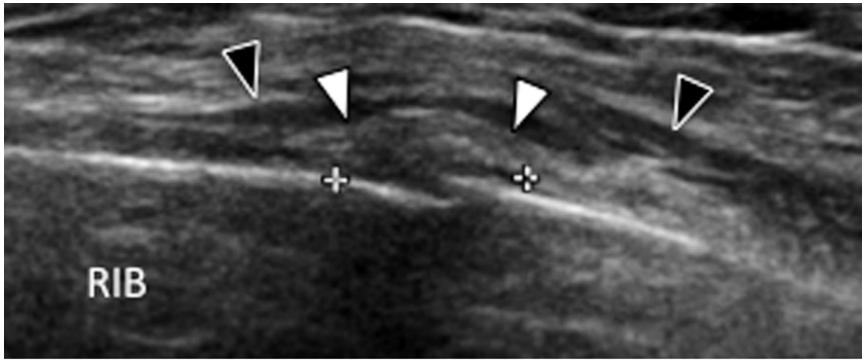
- Linear probe/curvilinear probe
- Soft tissue/superficial preset
- Obtain scans in sagittal and transverse
- Label area of body and laterality

- Objectives
  - ID fracture, tendon/ligament injury
  - Diagnose tenosynovitis

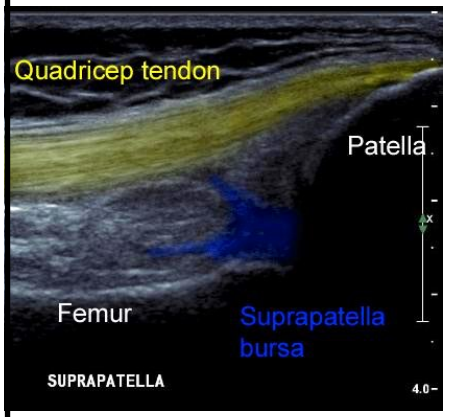
Bone

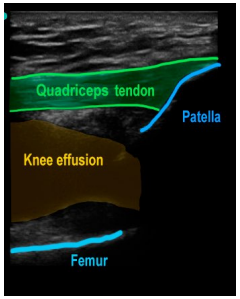
- White line w/ shadowing
- Fracture=break in line
- Very specific for fracture





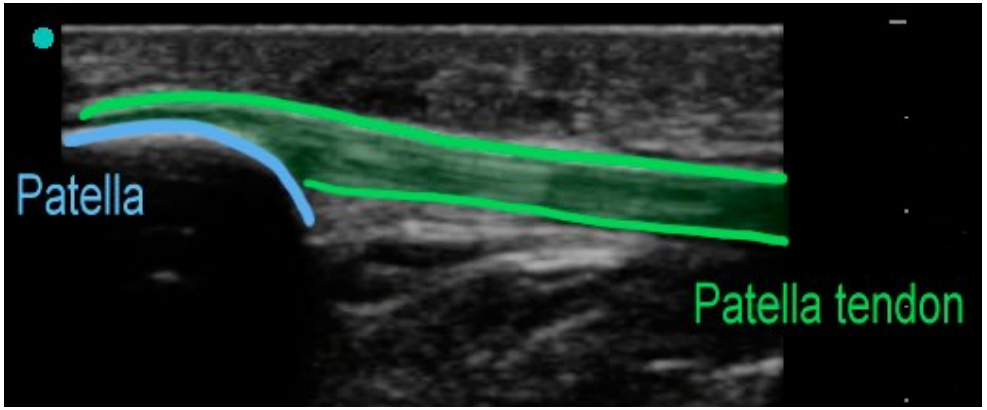
Joint Effusion





- Compare to normal side
- >2mm difference in size=effusion

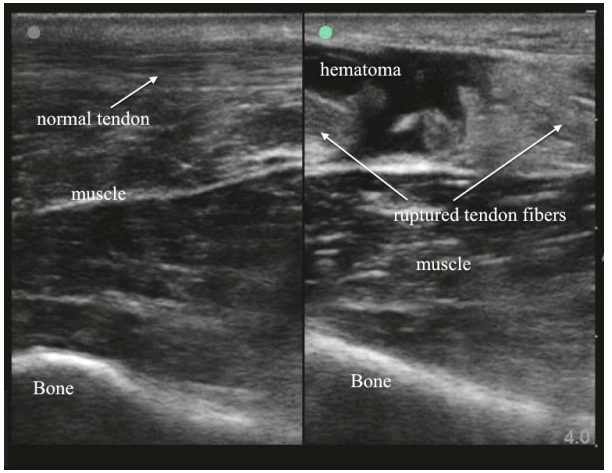
Ligament/Tendon



Anisotropy: parallel fibers of tendon best visible at 90˚

Ligament/Tendon Injury

- Disruption in fibers
- More notable when ranging joint
- Must differentiate from anisotropy



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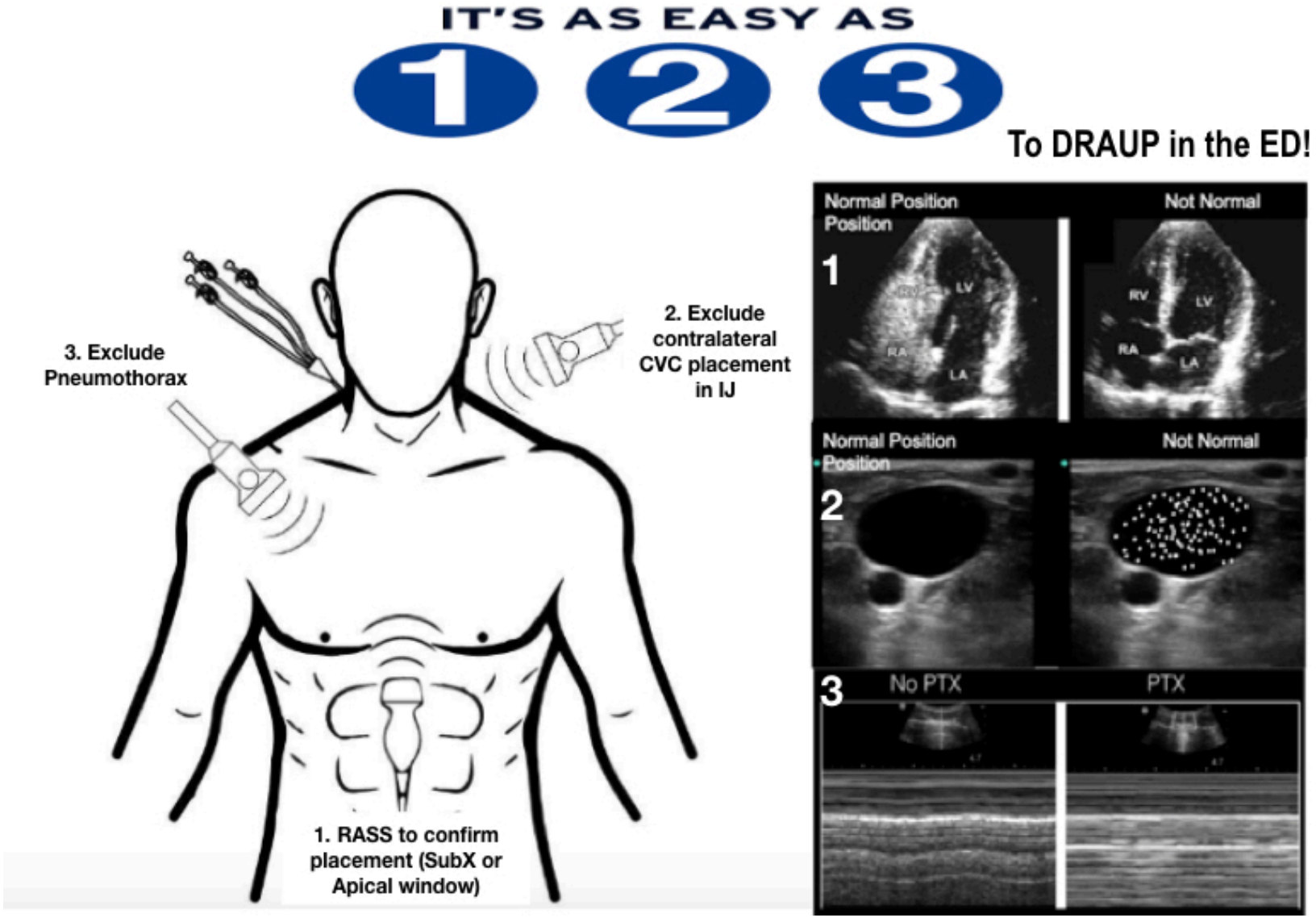
DRAUP Protocol

It's Faster!
It's just as good as chest X-ray! (evidence based)
It reduces wasted minutes, wasted resources!



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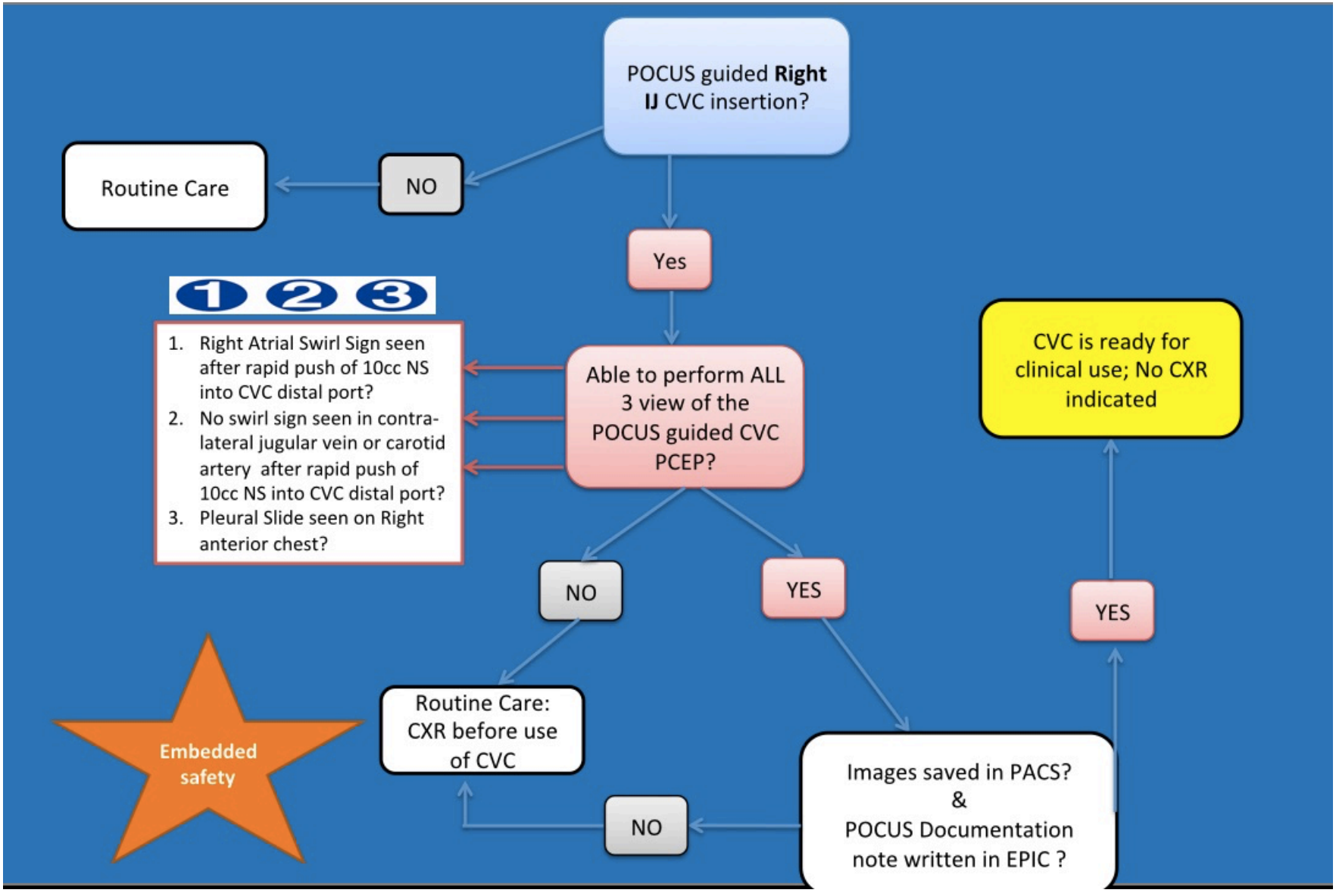

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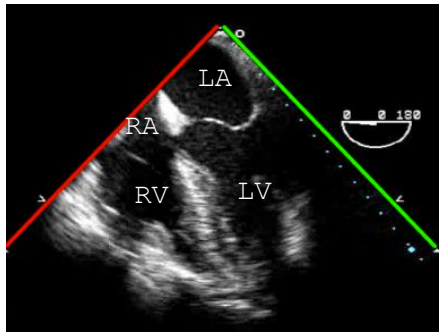
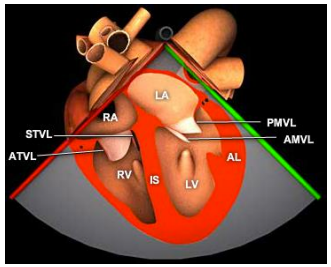
ME 4/5 Chamber

Omniplane: 0°
Rotation: None
Structures: LA, IAS, RA, TV, RV, IVS, LV, MV
Tip: Retroflex to optimize LV apex view

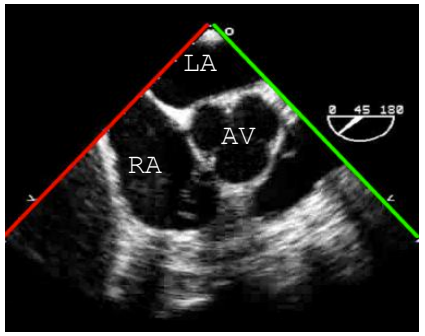


Diagnostic Issues:
- Dilated RV
- Decreased LV systolic function
- MV regurgitation
- Pericardial effusion

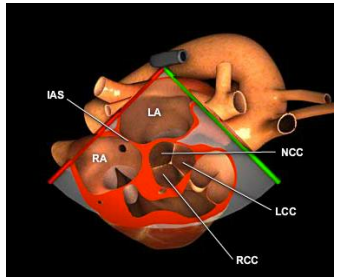


ME AV SAX

Omniplane: 30-45°
Rotation: R
Structures: LA, IAS, RA, AV
Tip: Aim to make 3 aortic valve cusps symmetric

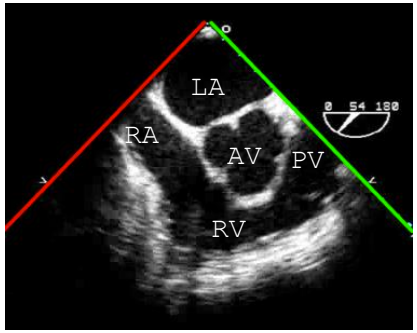


Diagnostic Issues:
- Aortic valve disease
- Coronary artery pathology
- CPR Quality – Opening of aortic valve

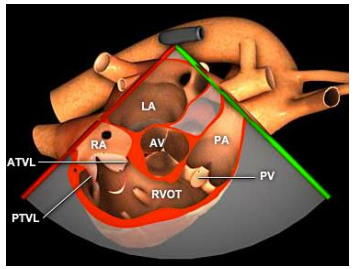


ME RV In-Out

Omniplane: 60-75°
Rotation: R
Structures: LA, RA, TV, RV, RVOT, PV, PA, AV
Tip: Δ omniplane from ME AV SAX and to get view

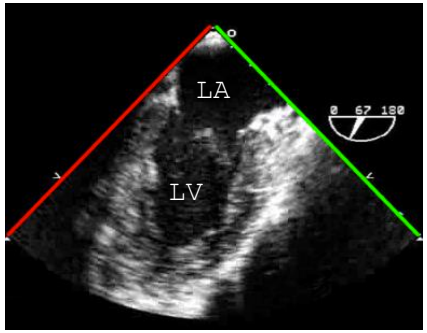


Diagnostic Issues:
- Decreased RV systolic function
- RV thrombus
- RV dilation

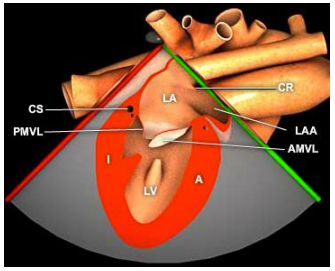


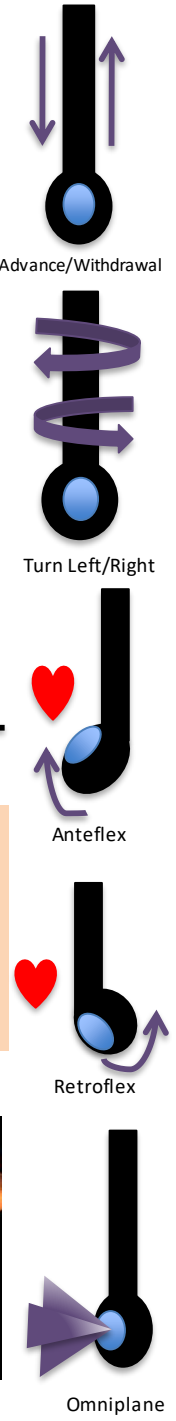
ME 2 Chamber/LAA

Omniplane: 80-100°
Rotation: None
Structures: LA, MV, LV, coronary sinus, LAA
Tip: Retroflex to optimize LV apex view



Diagnostic Issues:
- LA appendage mass/thrombus
- LV size and function
- MV disease





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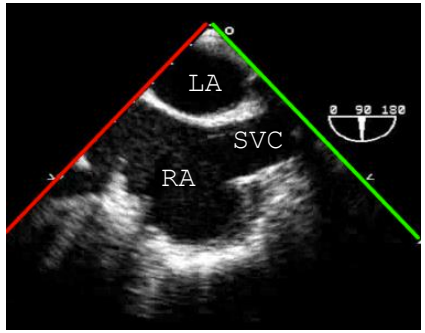
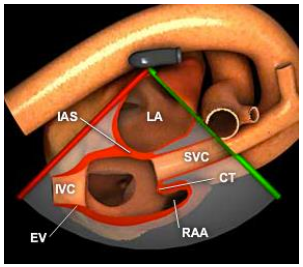
ME Bicaval

Omniplane: 100°
Rotation: R
Structures: LA, RA, SVC, IAS, IVC
Tip: Rotate probe right from ME 2 chamber

Diagnostic Issues:
- Procedural guidance to confirm catheter placement
- Atrial pathology
- PFO

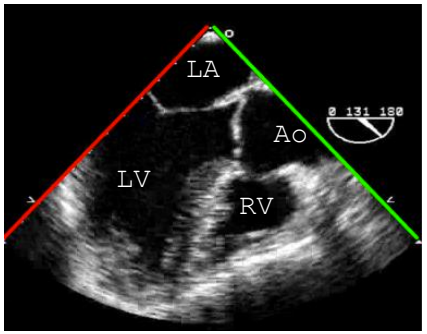


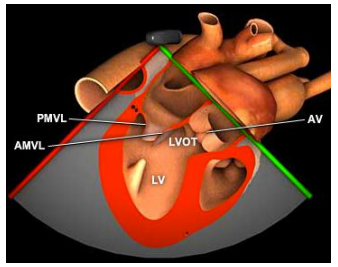


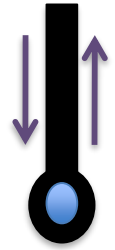
ME LAX

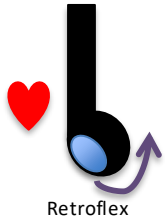
Omniplane: 120-130°
Rotation: None
Structures: LA, LV, LVOT, AV, MV, RV
Tip: Similar to parasternal long axis

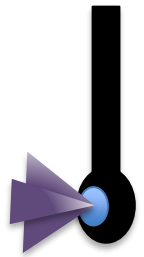
Diagnostic Issues:
- LV function
- MV/AV disease
- Aortic root disease
- CPR Quality – Opening of aortic valve







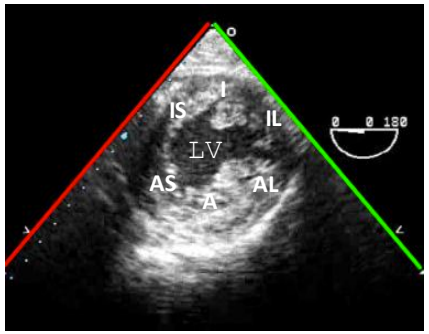


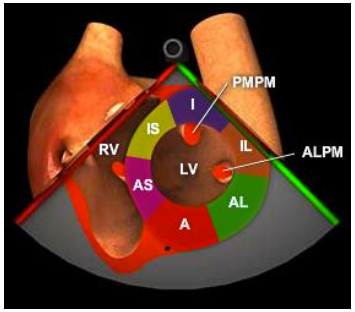


TG Mid SAX

Advance probe to stomach
Omniplane: 0° ; Anteflex
Rotation: None
Structures: LV, Papillary muscles, RV, liver
Tip: Similar to parasternal short axis

Diagnostic Issues:
- Ventricular wall motion abnormalities
- LV size and function
- Pericardial effusion

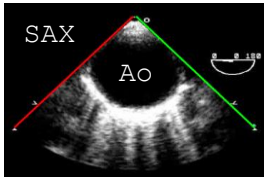


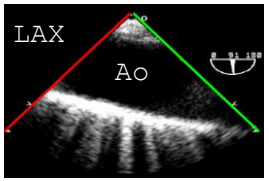


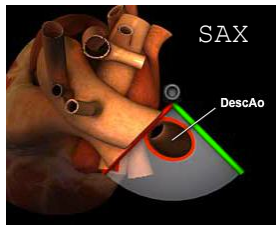
ME Dec/Asc Aorta LAX/SAX

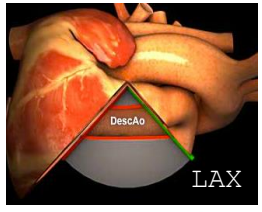
Pull back to esophagus
Omniplane: SAX = 0°
Omniplane: LAX = 90°
Rotation: L
Structures: DescAo

Diagnostic Issues:
- Aortic pathology
- Aortic dissection
- Device placement (REBOA)









Rapid US in Shock & Hypotension

H I VC
M pouch A orta P TX
2016 Hormberg/Ablordeppy

Cardiac US

♥ In each of 4 main views: ask is view adequate & 5 Q's:

❶Beating? ❷Effusion? ❸LV size/fill/fxn? ❹RV size/fill/fxn? ❺Valves, etc.?

♥ Decide therapeutic mgmt after all 4 views— **are they LIV'N?**

1. PSL- Parasternal Long

L parasternal border, probe indicator to R shoulder (11 o'clock), drag 2nd → 5th ICS until

♥ **adequate view**:

□ See MV, AV, RV, longitudinal LV chamber.

□ Depth: desc. aorta, post. pericardium

□ LV chamber axis ~ horizontal, not foreshorten

♥ TIP: *try rotating probe indicator ~20° → R humerus or chin*

♥ **5 Q's**:

❶Beating?

❷Effusion? Look anterior & posterior: if yes, RV diastolic collapse?

M mode: EPSS- RV size @ MV opening (peak of E wave)

❸LV size/fill/fxn?

Global fxn: look *or use M mode.* nl EF is:

1. EPSS: anterior (top) MV leaflet almost hits septum
   M mode: thru distal ant. MV leaflet (<0.6cm)
   EPSS 2cm ≈EF 30%
2. LV chamber fractional shortening > 30%
   M mode: just beyond MV leaflets

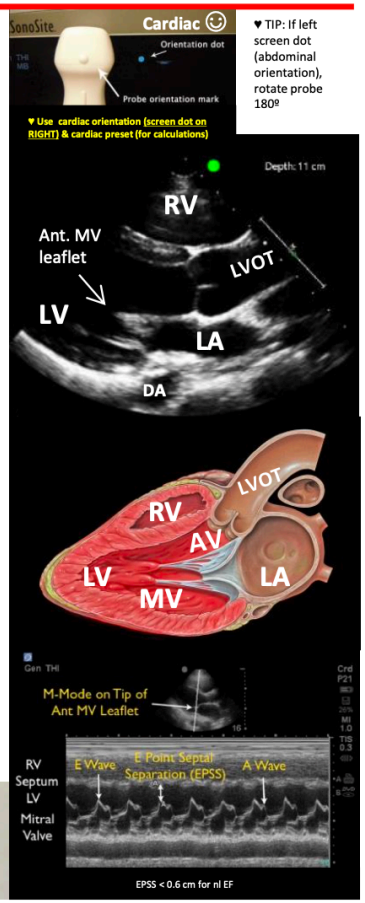
Regional wall motion abnormality:
"SALI": Septal- Anterior-Lateral-Inferior

❹RV size/fill/fxn?

nl size = ⅓ RV, ⅓ LVOT, ⅓ LA

❺Valves, etc.? Obvious valve pathology, intra-cardiac clots…

♥ TRICKY! *RV has trabeculae & moderator band*



2. PSS – Parasternal short

Rotate probe 90º to left from PSL

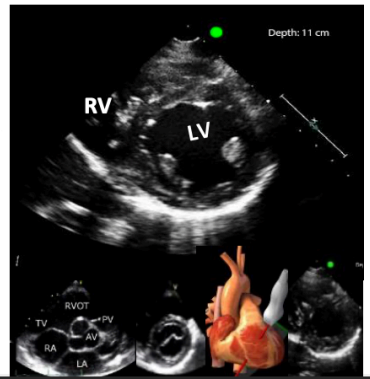
♥ **Adequacy:** □ mid papillary level: *mushroom*

❶? ❷? ❸LV—nl EF >30% Δ in mushroom size

Regional wall motion abnormality: SALI

❹RV- √ for septal flattening ("D") or bowing in

❺Tilt probe down to scan from base (AV) → MV (fish mouth) → mid pap → apex (√ for clot)



3. Apical 4 View

in 4th -5th ICS, indicator to L (3 o' clock)

Start laterally → ant chest wall, @ PMI

♥ **Adequacy:**

□ septum is straight-ish

□ see LV inner wall

❶? ❷? ❸LV size/fill/fxn?

LV vs. RV?
- LVOT → LV
- Desc. aorta on L
- Medial TV annulus closer to apex

Look at LV inner wall movement—

If can't see but outer wall ok, inner wall probably ok

❹RV size/fill/fxn?

1) nl RV size: ⅓ RV, ⅔ LV

measure above open valves in diastole

2) RV fxn: look *or M mode:* lateral TV annulus moves ↑↓ 2 cm (TAPSE) . TAPSE <1 cm = bad RV

❺?

4. Sub-xiphoid

Long: indicator to L, flatten

♥ **adequacy:** □ see LV, RV, post. pericardium & ideally MV, TV

❶Beating? ❷Effusion? ❸LV size/fill/fxn?

❹RV size/fill/fxn? ❺Valves, etc.?

Short: indicator → head, fan to L

♥ **adequacy:** □ mid pap (but sideways!)

❶? ❷? ❸LV—nl EF >30% Δ in mushroom size

Regional wall motion abnormality: SALI

❹RV—- √ for septal flattening ("D") or bowing in ♥ TRICKY!: may see RVOT

❺ fan R→L

IVC US

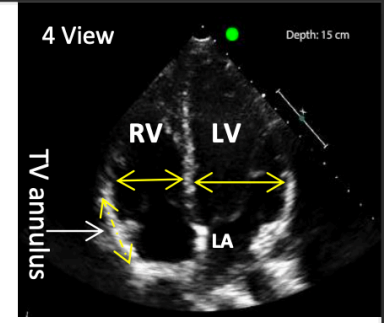
♥ Sub-xiphoid, indicator to head

♥ **Adequacy:** □ see hepatic vein, RA inlet

□ rotate probe to R (confirm not aorta)

♥ Measure IVC size just after hepatic vein or about 2 cm from RA inlet

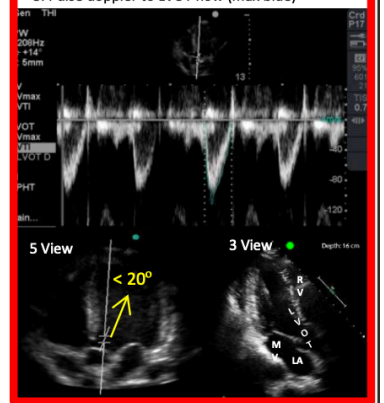
IVC size (mm)	Collapsibility index	RA pressure
<17	50%	5
>17	>50%	10
	<50%	15
	No collapse	20

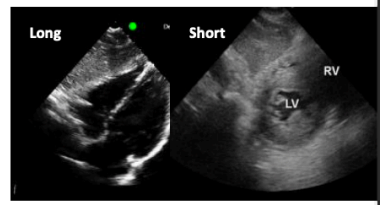


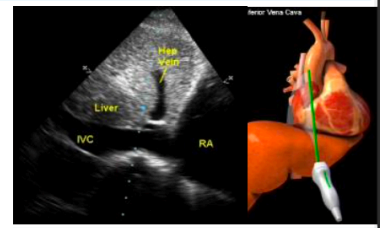
SIDEBAR: Velocity Time Integral

VTI: 18-30 cm = CO of ~5L

1. From 4v., tilt probe up → 5 v.
   Or rotate indicator toward L shoulder/head 3 v.
   □ in 5v., US beam & LVOT flow must be < 20°
2. Add color doppler
3. Pulse doppler to LVOT flow (max blue)







♥ IVC correlates w/ RAP/CVP.
Caution use in isolation as surrogate for LV preload—look also at LV function

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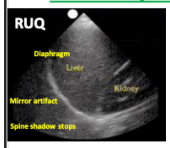
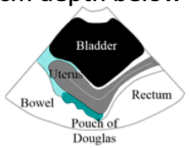
H²I^VC
M^pouch A^orta P^TX
2016 Hormberg/Ablordeppy

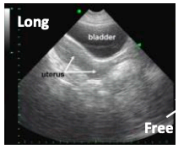
Morrison's Pouch (FAST)

• Abdominal orientation (left screen dot) • Probe indicator toward head or to L
• is there free fluid?
1. RUQ □ Diaphragm, liver, sup. & inf. pole of kidney
2. LUQ □ diaphragm, splenic angle, entire kidney
3. Bladder, Transv.& Long. □ ~5 cm depth below bladder □ fan thru entire bladder

Pleural effusion if 1) loss mirror artifact & 2) spine shadow continues beyond diaphragm

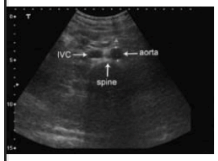


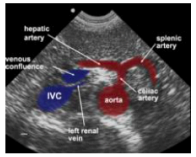


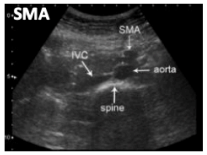


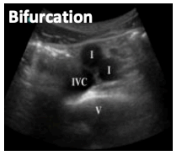
Aorta

• Abdominal orientation (left screen dot) • Probe indicator to left
• Start below xiphoid process. Apply steady, firm pressure
• **Adequacy:** □ Aorta anterior to spinal shadow
• Scan from proximal aorta to illiac bifurcation
• Transv: measure aortic diameter from outer wall to outer wall (nl < 3 cm)



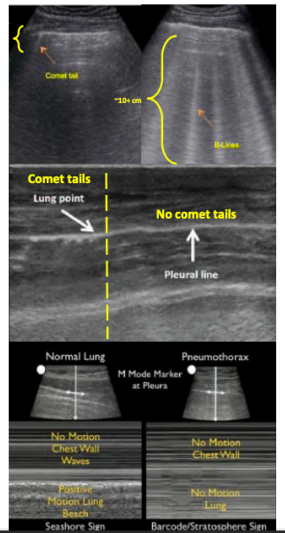






Pneumothorax

• **Adequacy:** □ see rib shadow & pleura
□ ~5 cm depth linear probe □ ~10 cm depth ab probe
R & L Apical Views: • TIP! Turn gain down
• Probe indicator to head
• Ant. mid-clavicular line, 2nd-3rd ICS
Look for
1. **Lung slide** (comet tails = z lines) w/ each breath
2. **B lines** = line extending down ~10 cm depth.
Multiple B lines suggestive of lung pathology- edema, pneumonia, DAH, etc. (1 or 2 ok)
3. **Lung pulse** = shimmering pleura w/ ea heart beat
If 0/3 present, POSSIBLE PTX but…
If see **lung point sign,** likely PTX
• TIP! Unsure? Use linear probe, apply m-mode
• A lines = horizontal lines have NO significance
RUQ, LUQ views: *ab probe, same as FAST*



Are they LIV'N?

Symptomatic hypotension?
MAP = HR x SVR x SV
1. Start IVF bolus
2. Shock tachy/Pace brady arrhythmias
3. Vasopressors

How to use **LIV'N:**
Must first fix HR & SVR.
Then US to determine type of shock & LIV'N intervention→ do you *now* lyse, add ionotropy to vasopressors, give more volume, or needle decompress?

SV = k x preload x afterload

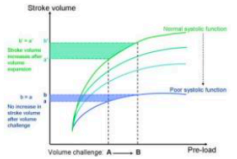
Lytic **I**onotopy **V**olume **'N**eedle

Contractility (k)	Ionotropy
Preload	Volume or Needle
RV "afterload"	Lyse PE

♥ ♥ ♥ Use clinical context/pretest probability. Reassess after intervention ♥ ♥ ♥

1. Is LV fxn nl or hyperdynamic (EF>70%)?
YES → Not cardiogenic shock, cont. to step 2.
NO → If decreased EF, consider cardiogenic shock & Stopping IVF, adding ionotropy *(after vasopressors!)*
Difficult to cont & assess for RV strain (PE) if chronic CHF (LV may not be hyperdynamic because baseline poor function)

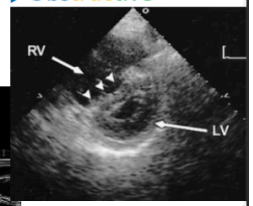
♥Cardiogenic



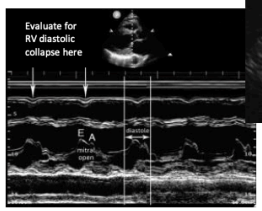
2. Is LV hyperdynamic?
YES → cont IVF → step 3

3. Is RV big? Is there septal wall flattening ("D") or bowing?
YES → consider PE if acute
NO → RV is nl or small, cont. to step 4

♥Obstructive



4. Is there RV diastolic collapse?
YES → Is there pericardial effusion?
YES → consider tamponade
NO → consider PTX
NO → cont to step 5



5. If small/nl RV & hyperdynamic LV, then either hypovolemic or distributive shock & cont IVF, vasopressors
♥ Consider where pt is on Frank-Starling Curve
♥ May use ΔSV = ΔVTI to quantify resuscitation

♥Hypovolemic
♥Distributive

Diastolic Dysfunction Made EASY!

Pocus101.com

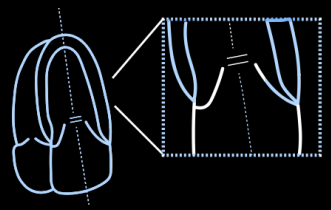
INTERPRETATION:

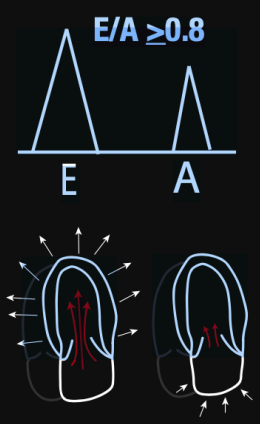
Grade 0 (Normal)	Grade 1 (Impaired Relaxation)	Grade 2 (Pseudonormal)	Grade 3 (Restrictive)
E/A ≥0.8	E/A <0.8	E/A ≥0.8	E/A ≥2
e' ≥ 8 cm/s	e' < 8 cm/s	e' < 8 cm/s	e' << 8 cm/s
E/e' < 8	E/e' < 8	E/e' 8 - 15	E/e' > 15

MITRAL INFLOW

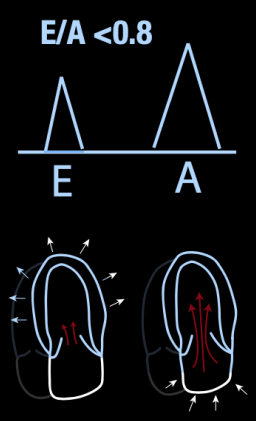
Measures **BLOOD FLOW** coming into the Left Ventricle

PULSE Wave gate at Mitral Valve Tips

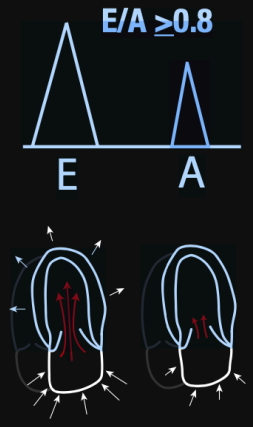




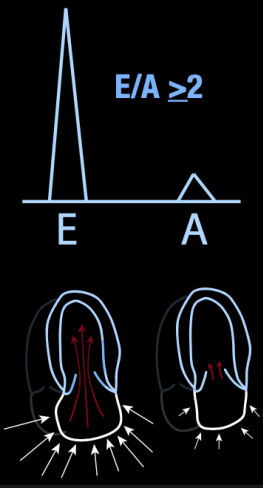
Impaired Relaxation & Decreased LV Compliance



Increase in LAP causing more "Push" from LA during Early Filling

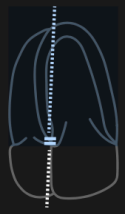


Severe increase in LAP causing more "Push" from LA during Early Filling. Also LA enlargement



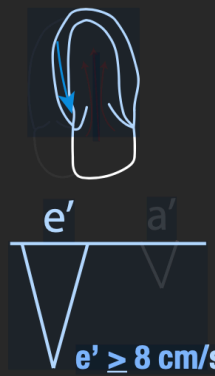
TISSUE DOPPLER

Measures **MUSCLE MOVEMENT** of the Left Ventricle AWAY from probe during Diastole

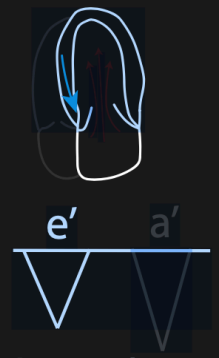


Tissue Doppler gate at Septal Annulus

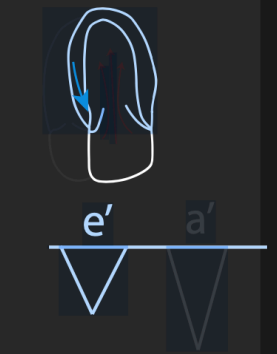
POCUS 101



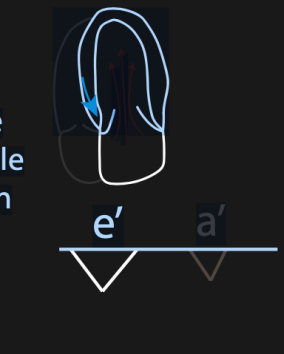
Mild Decrease in LV Muscle Relaxation Speed



Moderate Decrease in LV Muscle Relaxation Speed



Severe Decrease in LV Muscle Relaxation Speed



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Nerve Blocks

- Lidocaine: Use for short procedures (Laceration repair, abscess I&D, reductions)
- Lido w/ Epi: NOT used for nerve blocks. Use on superficial wounds when bleeding is a concern
- Bupivacaine: Use when longer pain control is needed. Contraindicated in pregnancy

Dosing & Pharmacokinetics

		Lidocaine			Lido w/ Epi		Bupivacaine		
Onset		2-5 mins			2-5 mins		15-30 mins		
Duration		30-90 mins			1-3 hrs		4-8 hrs		
Max Dose		4.5 mg/kg			7 mg/kg		2.5 mg/kg		
Concentration		0.5%	1%	2%		1%		0.25%	0.5%
Body Weight	*Max Dose*	5 mg/mL	10 mg/mL	20 mg/mL		10 mg/mL		2.5 mg/mL	5 mg/mL
10 kg	*45 mg*	9 mL	4.5 mL	2 mL	*70 mg*	7 mL	*25 mg*	10 mL	5 mL
20 kg	*90 mg*	18 mL	9 mL	4.5 mL	*140 mg*	14 mL	*50 mg*	20 mL	10 mL
30 kg	*135 mg*	27 mL	13.5 mL	6.5 mL	*210 mg*	21 mL	*75 mg*	30 mL	15 mL
40 kg	*180 mg*	36 mL	18 mL	9 mL	*280 mg*	28 mL	*100 mg*	40 mL	20 mL
50 kg	*225 mg*	45 mL	22.5 mL	11 mL	*350 mg*	35 mL	*125 mg*	50 mL	25 mL
60 kg	*270 mg*	54 mL	27 mL	13.5 mL	*420 mg*	42 mL	*150 mg*	60 mL	30 mL
70 kg	*315 mg*	63 mL	31.5 mL	15.5 mL	*490 mg*	49 mL	*175 mg*	70 mL	35 mL

- Volumes listed above represent maximum safe doses for a given local anesthetic and patient body weight. Patients >70kg should be treated as 70kg when calculating maximum safe doses.
- Doses are cumulative when performing multiple procedures.
  (e.g. A 60kg person could safely be given 135mg of Lidocaine for 30kg of body weight and 75mg of Bupivacaine for the remaining 30kg)

- Nebulized Lidocaine: 5mL of 4% solution (200mg or max for ~45kg of body weight).
- Dental blocks: 1.8mL of Bupivacaine 0.5% with Epi. (9mg or max for ~3kg of body weight).
- LET Viscous solution: Lido 4%, Epi 0.05%, and Tetracaine 0.5% (variable absorption).

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Nerve Blocks

- Linear Probe
- Nerve setting

- Localize nerve and appropriate landmarks
- In-plane (or long-axis) needle approach
- Instill local anesthetic in fascial plane or around nerve

Basic Setup

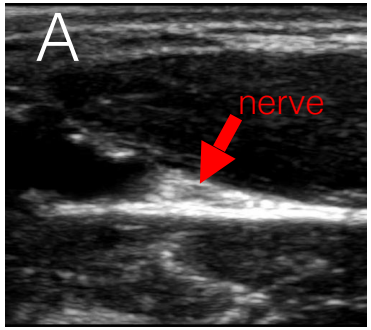
Clean vs Sterile Technique:
- Chloraprep a wide area
- Superficial sites: Tegaderm probe cover, sterile gel & gloves
- Deeper sites: Sterile probe cover, gel & gloves

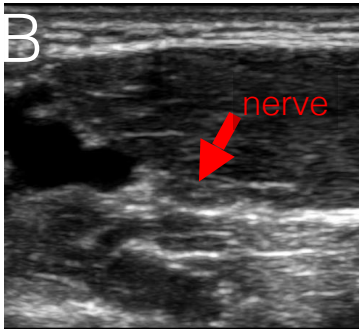
Equipment:
Superficial sites (A)
- 30mL Syringe
- 27g Needle

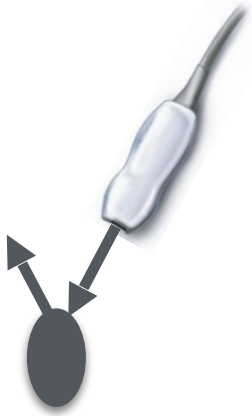
Deeper sites (B)
- 30mL Syringe
- 3-Way Stopcock
- J-Loop or Extension Tubing
- 22g Spinal Needle

- Extension tubing/J-loop helps keep needle stable but requires a second person

- Anisotropy: The echogenicity of the nerve is relative to the angle of the probe.
  - Always keep the probe at a 90° angle to the nerve







LAST

(Local Anesthetic Systemic Toxicity)

Neuro: first with lidocaine
Early: tongue & perioral paresthesia, dizziness, tinnitus, restlessness.
Then: Muscle twitching heralds the onset of seizures.
Last: decreased LOC & apnea.

Cardiac: first with bupivicaine
Early: Hypertension & tachycardia.
Then: Conduction delays, hypotension, bradycardia.
Last: Cardiac arrest.

Treatment:
- Intubation if needed
- Supplemental oxygen, hyperventilation
- IV fluids & pressors if needed
  - Bicarb for severe acidosis.
  - Benzos for seizures.
- Lipid Emulsion Therapy (20% Intralipid):
  - **lipidrescue.org**
  - Bolus: 1-1.5 mL/kg over 1 min
  - Infusion: 0.25 mL/kg/min over 30-60 mins
- Long-acting agents may require more aggressive support, CPR, or even ECMO.

- Allergic reaction: treatment same as any allergen

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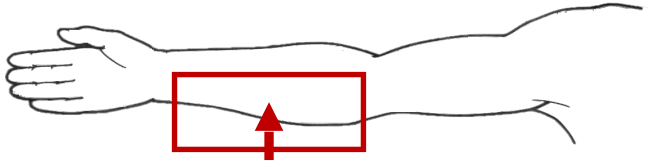
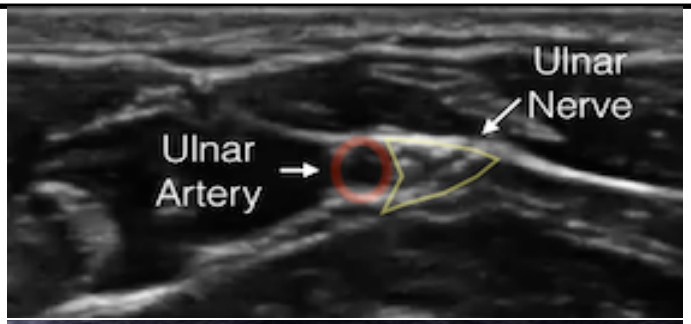
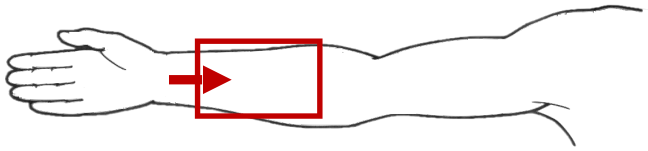
Nerve Blocks: Upper Extremity

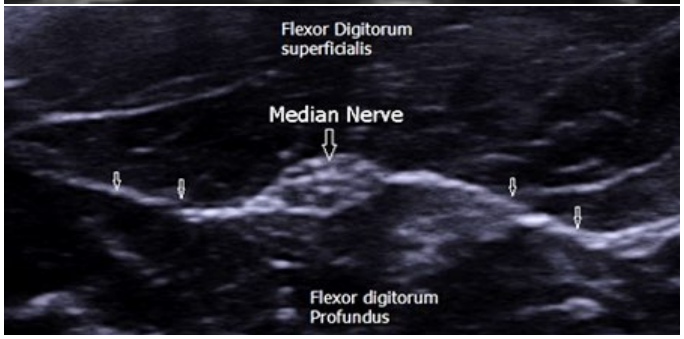
Ulnar Nerve Block:
- Position: Palm up, ulnar aspect of forearm
- Approach: In-plane, from ulnar side
- Landmark: Ulnar aspect of ulnar artery



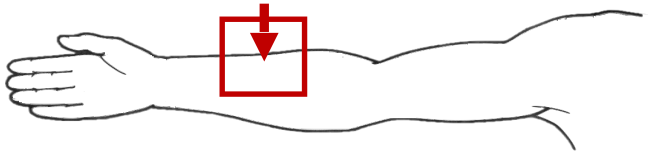


Median Nerve Block:
- Position: Palm up, mid-forearm
- Approach: Out-of-plane, mid-forearm
- Landmark: Fascia between FDS & FDP muscles

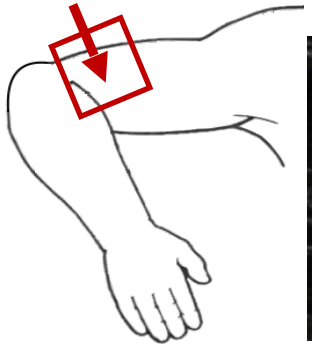


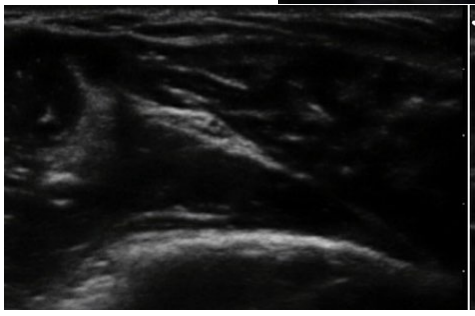


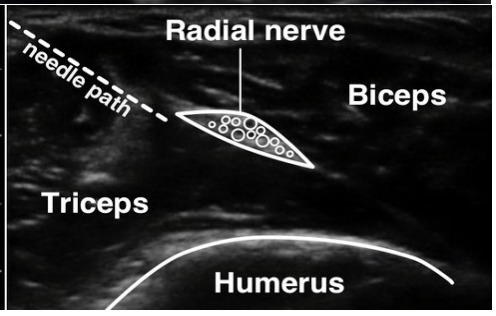
Distal Radial Nerve Block:
- Position: Palm up, radial aspect of forearm
- Approach: In-plane, from radial side
- Landmark: Radial aspect of radial artery



Proximal Radial Nerve Block:
- Position: Palm down, lateral aspect just above elbow
- Approach: In-plane, from posterior side
- Landmark: Adjacent to humerus between biceps & triceps







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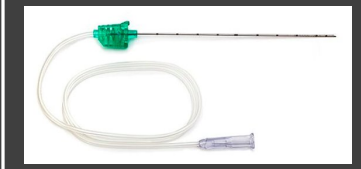
FASCIA ILIACA BLOCK

- HIP AND FEMUR FRACTURES
- Ant/lat/med thigh lacerations

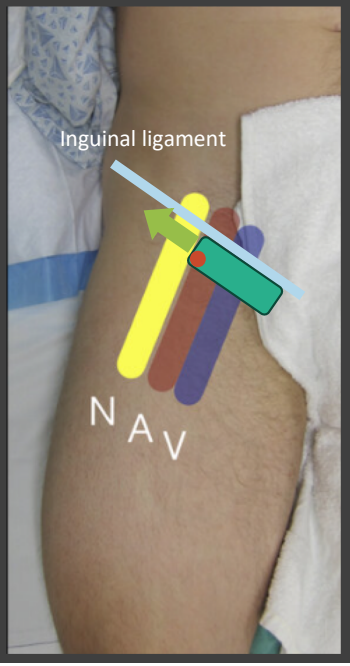
Bupivacaine 0.5% →
Weight →
Comorbidities →

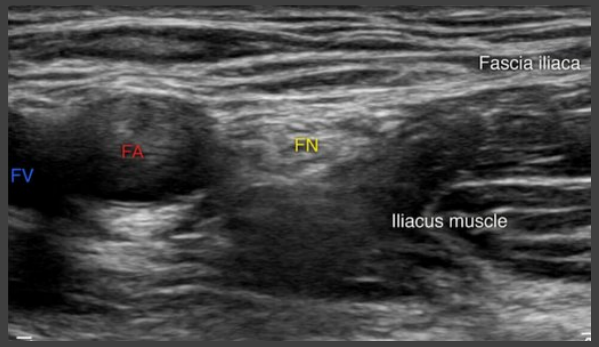
→ Max safe dose

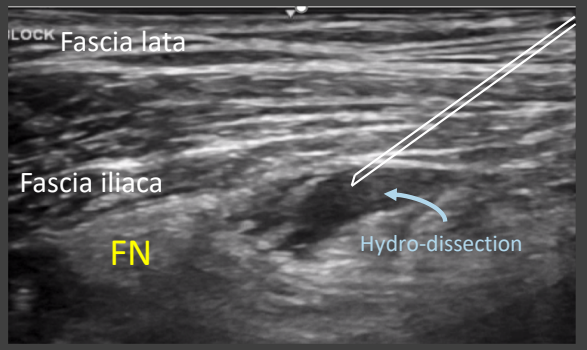
At bedside:
Semi-sterile technique: gloves, probe cover

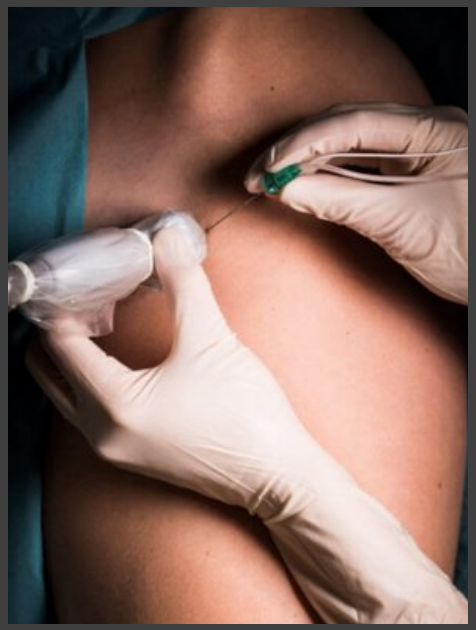


A friend!









STEPS:

- Advance needle UNDER fascia iliaca plane
- 10cc flush hydro-dissection, watch plane separate
- Correct location: UNDER fascia iliaca and ABOVE iliacus muscle
- Bupivacaine ~ Vmax 20-40 cc
- 10cc flush

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ERECTOR SPINAE BLOCK

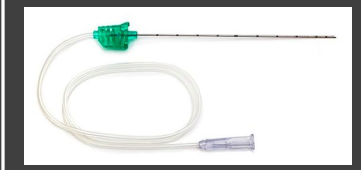
- 2+ RIB FRACTURES
- Thoracic/abdominal zoster, PHN
- Appy/renal colic/chole/pancreatitis

Bupivacaine 0.5% →
Weight →
Comorbidities →

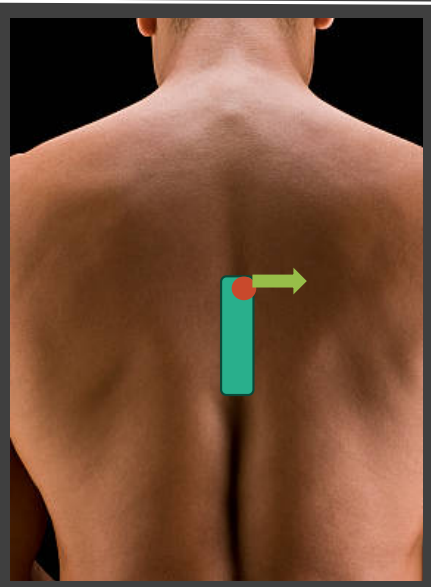
→ Max safe dose

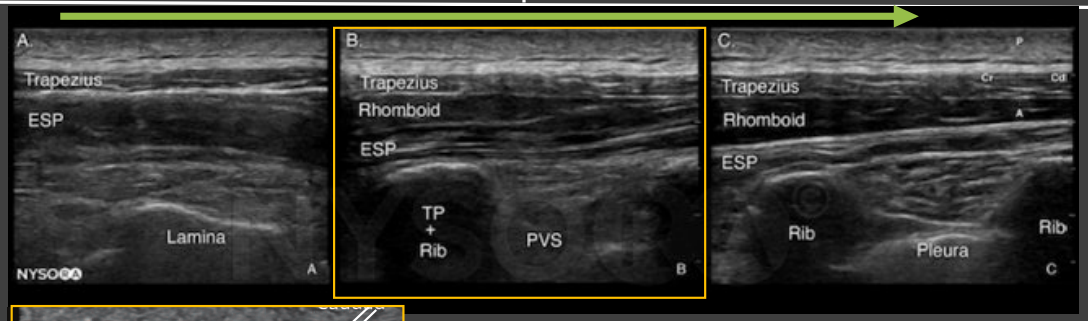
At bedside:

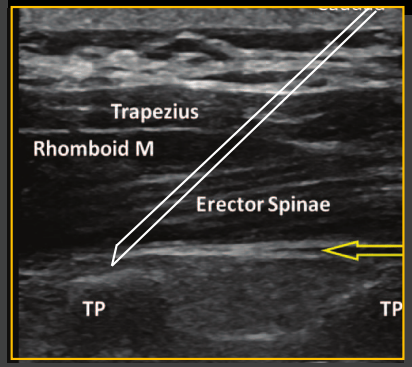
Semi-sterile technique: gloves, probe cover



A friend!







STEPS:

- Saline flush spinal needle first
- Advance needle until touches bone
- 10cc flush hydro-dissection
- Watch fascial plane separate, confirm location
- Bupivacaine ~ Vmax 30-60cc
- 10cc flush