

The Extended Focused Assessment with Sonography for Trauma

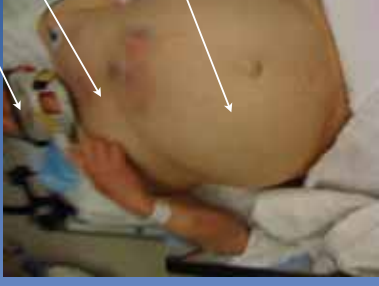


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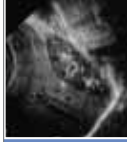
- Intracranial Hemorrhage
- Pneumothorax
- Hemothorax
- Cardiac Tamponade
- Cardiac/Lung Contusion
- Flail Chest
- Intra-peritoneal Hemorrhage
- Retroperitoneal Hemorrhage



- Intracranial Hemorrhage
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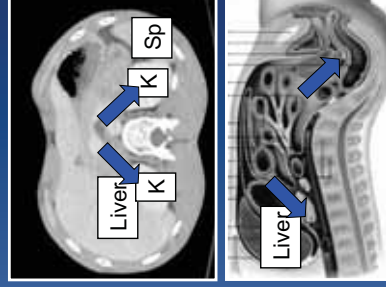
Role of Ultrasound



- most useful to rule in pathology in high risk patients
- may miss less severe injuries
 - Small pneumothoraces
 - <600cc of intraperitoneal hemorrhage
- rarely misses clinically important injuries
- FASTER than CT
- more information = better outcomes!!!

Anatomy

- Free fluid travels to dependent areas.
- 3 major areas in abdomen
 - Divided longitudinally by spine
 - Divided transversely by pelvic brim
 - Comprise the three "abdominal" regions of the FAST exam
 - Due to right paracolic gutter being more dependent fluid preferentially travels to the hepatorenal recess (Morrison's) in supine patients



FAST: Volume of FF

- Goldberg, 1970
 - right side down decubitus: consistently detected 100 ml FF in peritoneal dialysis patients
- Tilling 1990
 - 5 mm stripe in MP ≈ 500 cc FF
- Branney 1995
 - 50% have FF in MP after 600 cc
 - 97% have FF in MP after 1000 cc
 - The larger the amount of FF the more likely the need to go to the OR

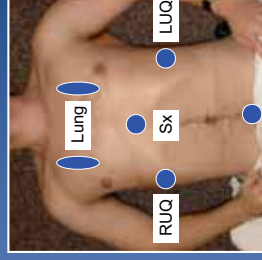
Overview

- Review the extended FAST
 - Required views
 - How to obtain
 - How to interpret
 - Pearls
 - Pitfalls

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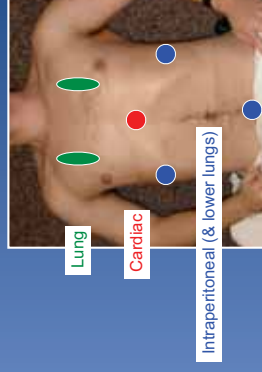
FAST 4 Views E-FAST 6 Views



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FAST 4 Views E-FAST 6 Views



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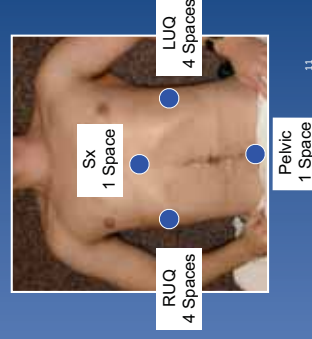
Performing the FAST exam: Choice of Transducer

- Small footprint probe helps for views between ribs
 - Can use “cardiac” phased array
 - Large footprint probe adequate
- 2 – 5 MHz probe



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FAST 4 Views 10 Spaces



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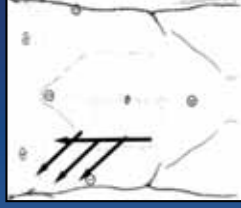
RUQ: Probe Placement



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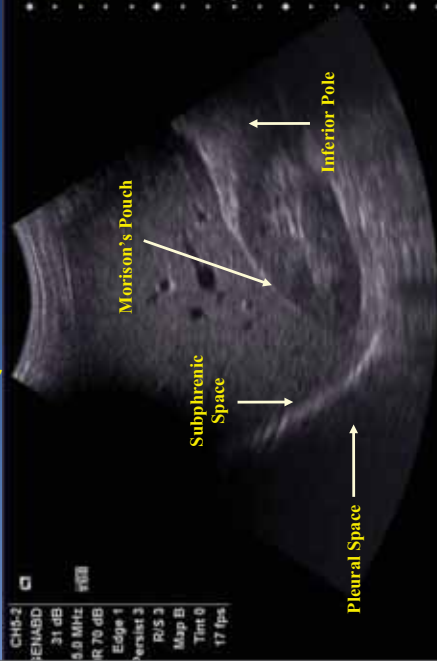
How to obtain



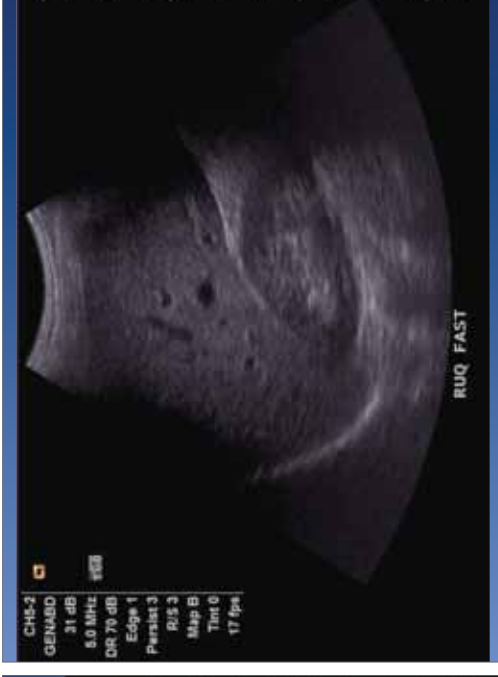
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RUQ: View



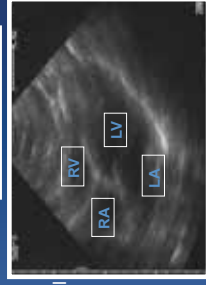
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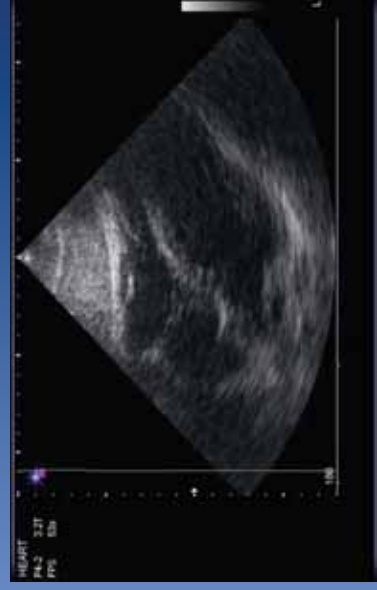
Subxyphoid View

- Place probe immediately below xiphoid
 - maximize hepatic window
 - "Take a deep breath and hold"
- Aim probe toward left shoulder
- Heart is immediately beneath / behind sternum
 - Plane of probe parallel to abdominal wall
 - Hand on top of probe to depress abdomen
 - Pointer to "9 o'clock"



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Region 2: the Subxyphoid 4-chamber view



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Alternate to Subxyphoid

- In some cases pericardium may not be well visualized due to patient body habitus, bowel gas, or abdominal injuries
- Use parasternal view as backup



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LUQ View

- Technically the most challenging view
- Angle the probe parallel to the ribs (2 o'clock)
- Probe position usually *more posterior* and *more cephalad* than expected



Region 3: LUQ

- Usually need to image between several ribs to identify all potential spaces

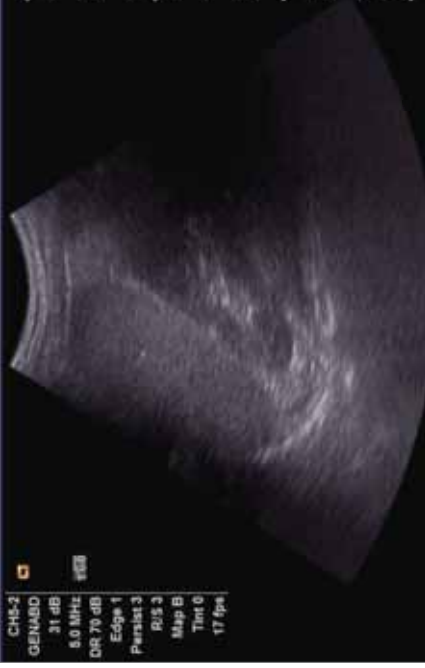
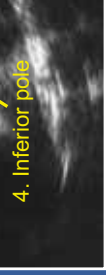
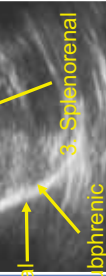
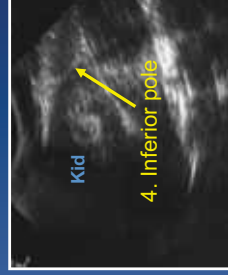
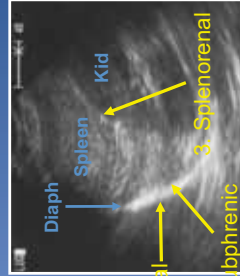


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Region 3: LUQ - Check 4 potential spaces



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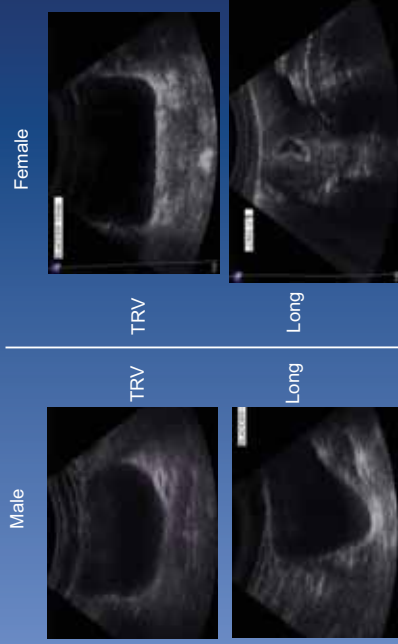
Suprapubic View

- Probe immediately cephalad to pubic symphysis
 - (Maximize bladder window)
- Angle probe caudad
- Scan before Foley
- Free fluid may be behind or above or anterior to bladder
 - Look for pockets of FF between loops of bowel

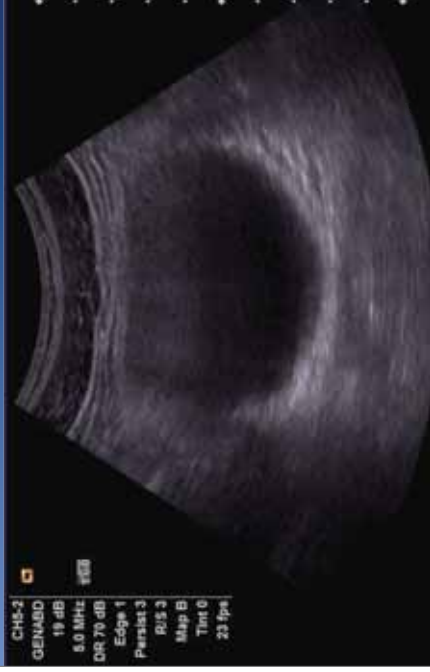


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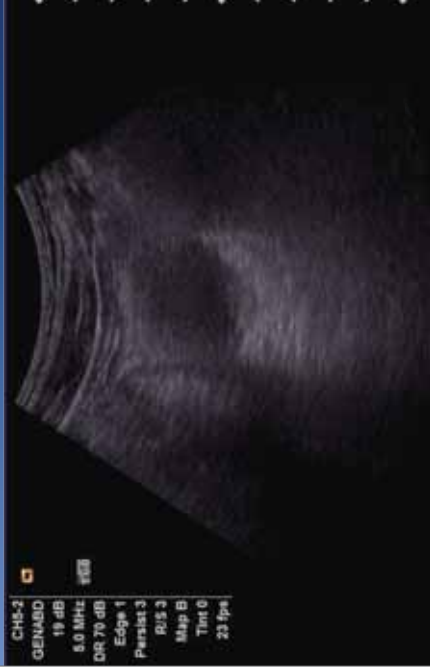
Normal suprapubic view



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“Extended” FAST



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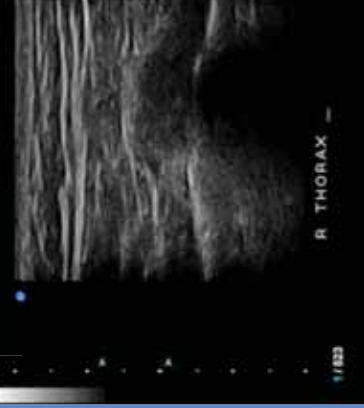
Negative PTX Study



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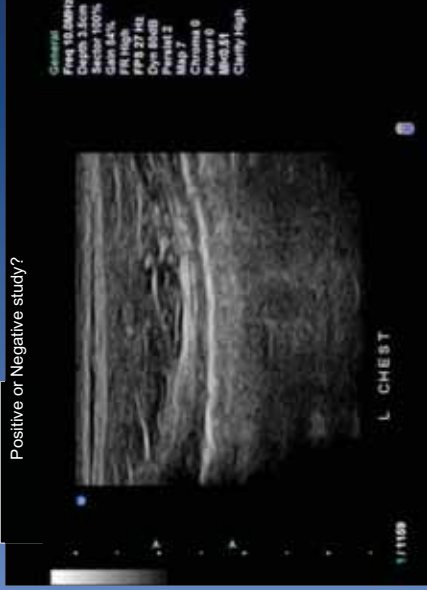
Great sliding



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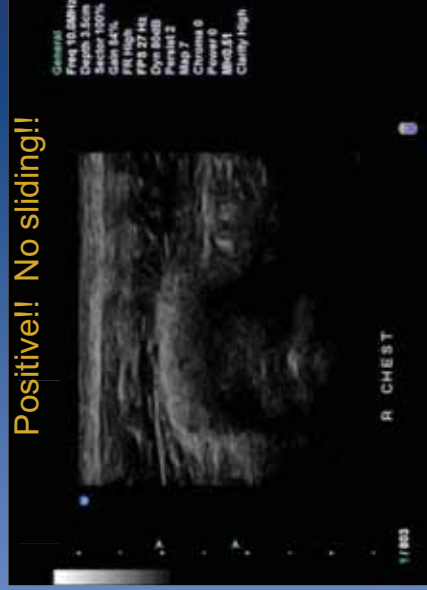
Positive or Negative study?



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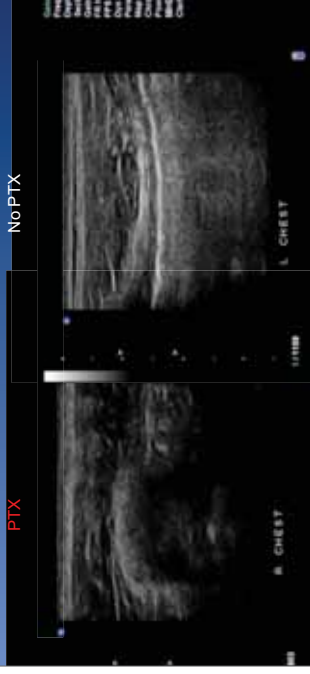
Positive!! No sliding!!



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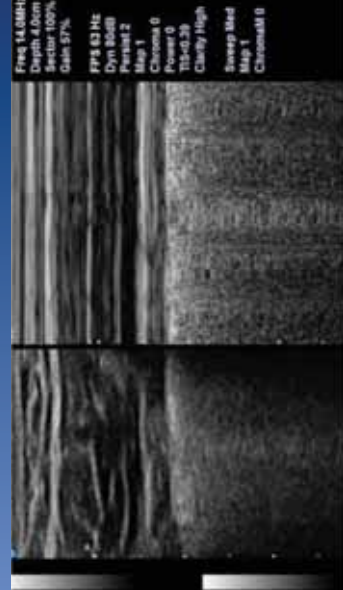
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Which is which?



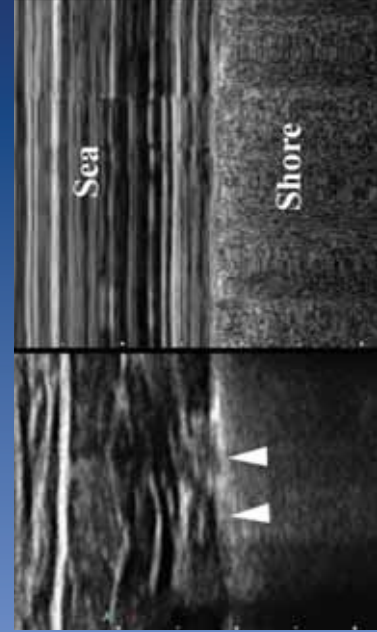
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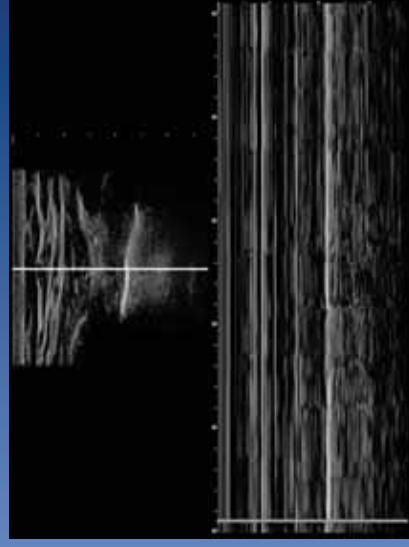
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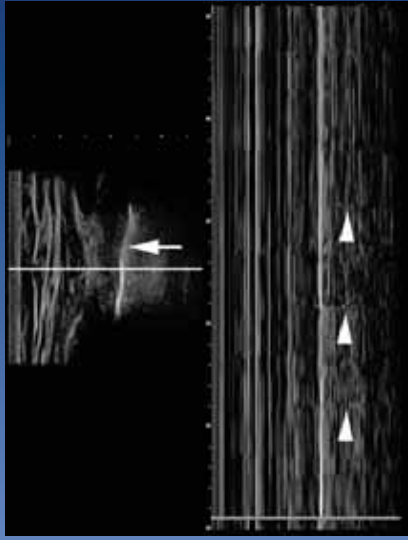
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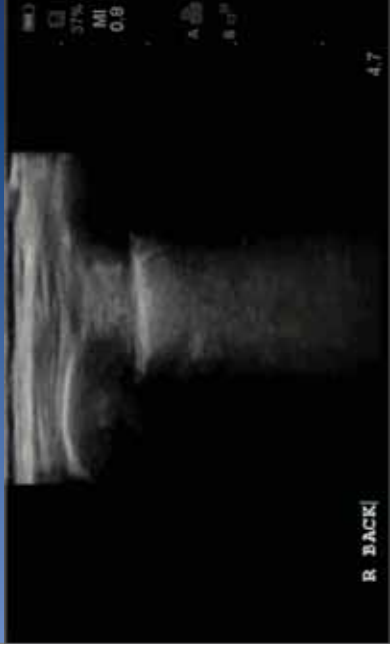
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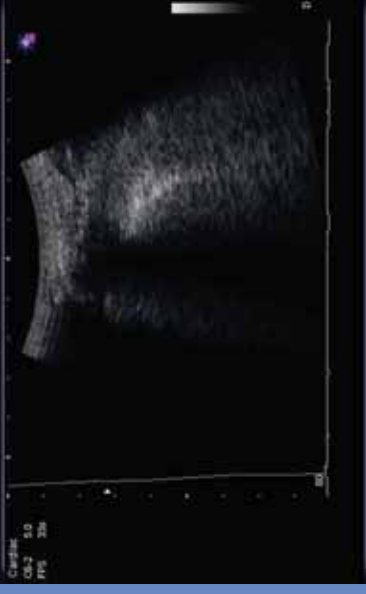
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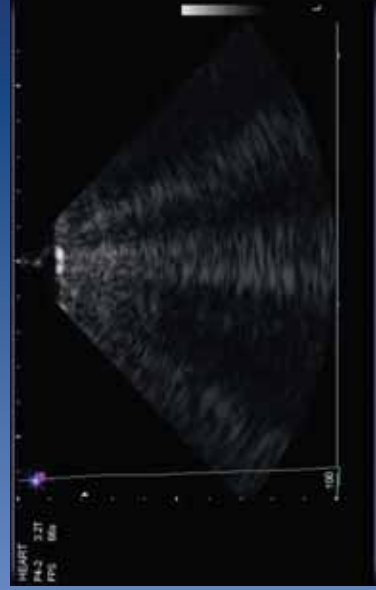
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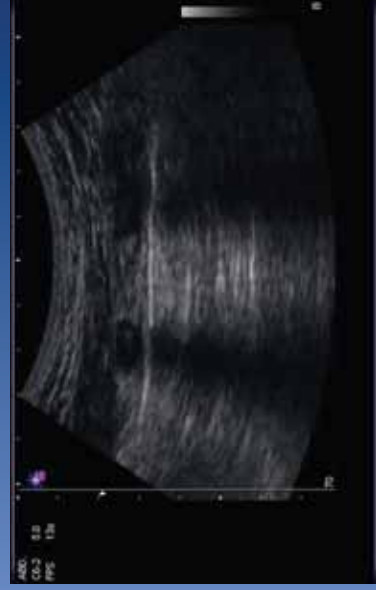
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Let's put it all together

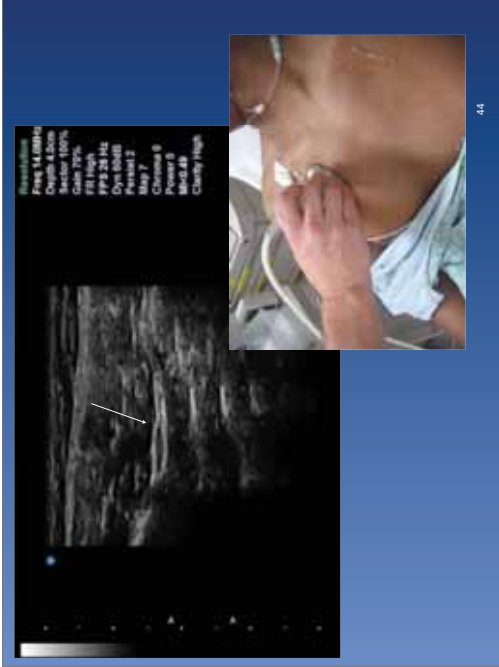
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FAST-Plus: Summary

1. Pleural sliding = NO pneumothorax
2. Comet tail artifact = NO pneumothorax
3. False positives: COPD or other chronic lung disease, atelectasis, pleural adhesions, etc.
4. False negatives: small, loculated PTX
5. Seashore vs Barcode sign

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The **FAST**: what's abnormal and how does it look?

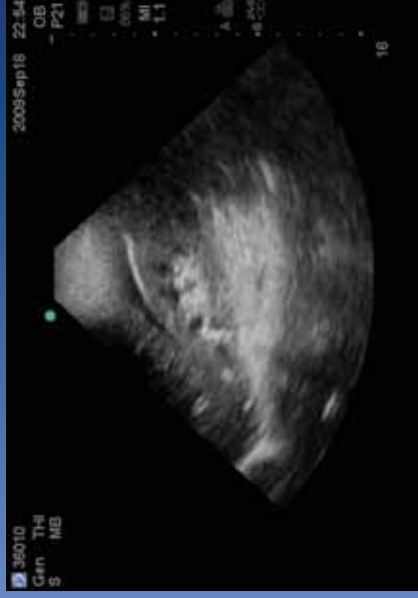


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Region 1: RUQ - hemothorax

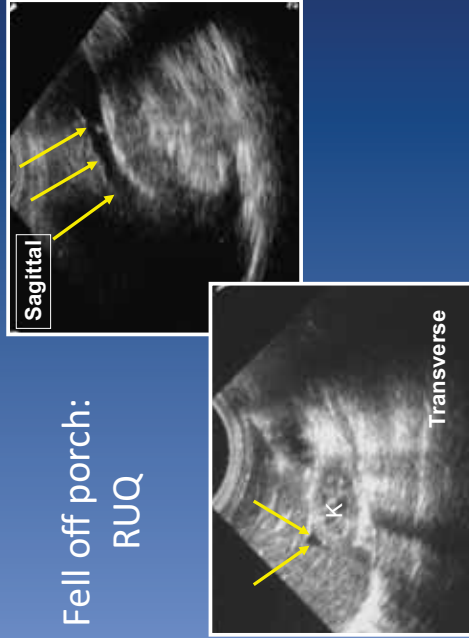


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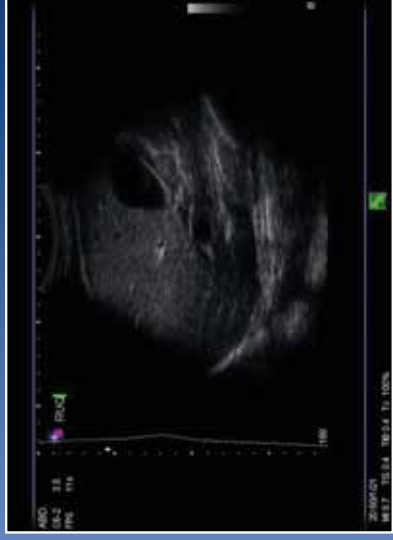
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Fell off porch:
RUQ



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RUQ: 25 min s/p MVC



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Region 2: subxiphoid



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Classification of pericardial fluid collections

- 2 kinds of effusion in trauma
 1. **Unrelated to trauma**
 - Usually small, often adjacent to R atrium
 2. **Related to trauma**
 - Any size can rapidly expand
 - Risk of tamponade with any circumferential effusion
 - Beck's triad are LATE and INCONSTANT findings
- If unsure ...**
... frequent (q 5 min) serial exams!

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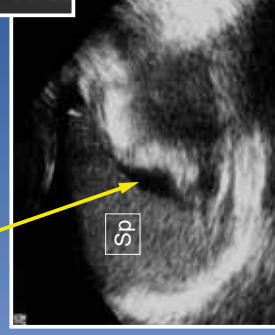
High speed MVC, unrestrained driver



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Region 3: LUQ

Splenorenal space

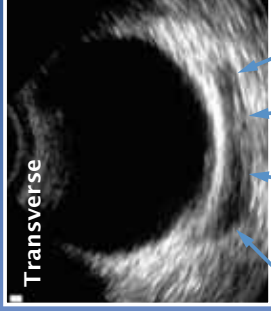


Hemothorax

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Region 4: suprapubic

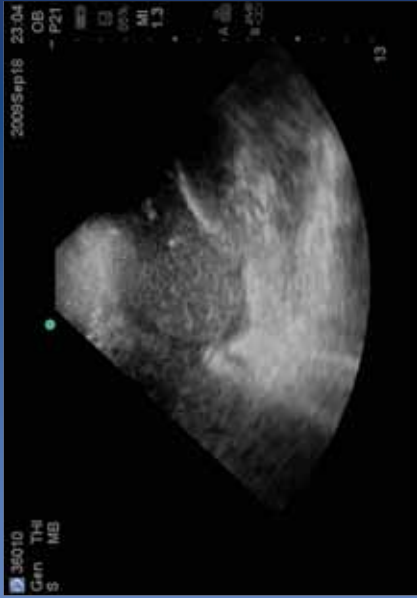
"Bow-tie sign": small amounts of free fluid appear as a black triangles on either side of the rectum



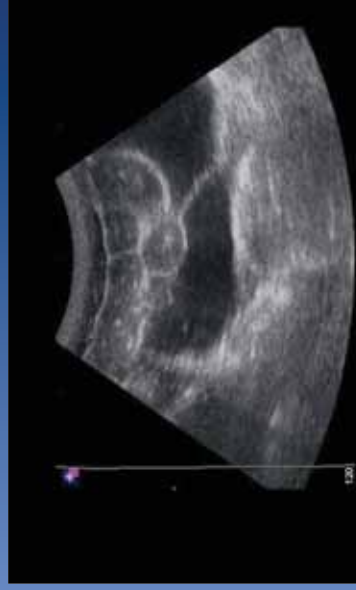
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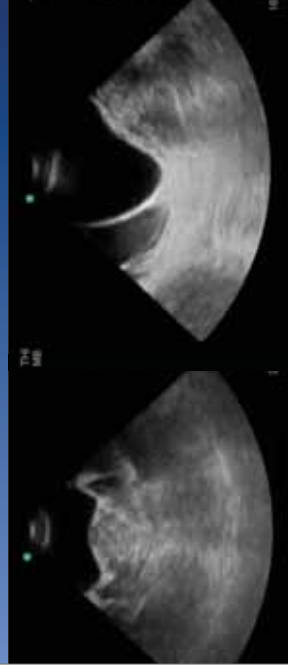
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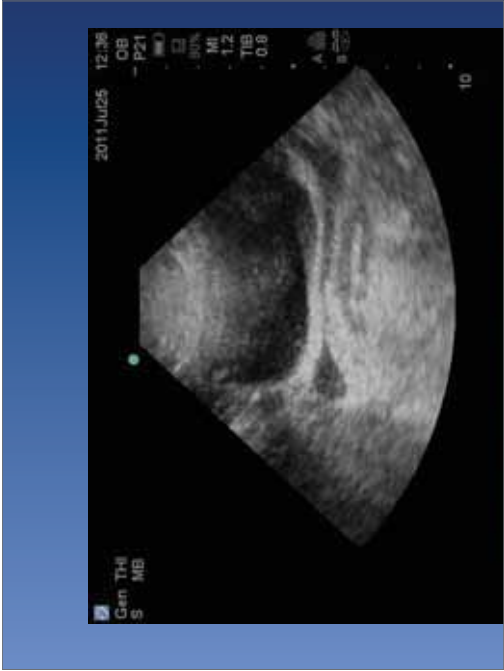
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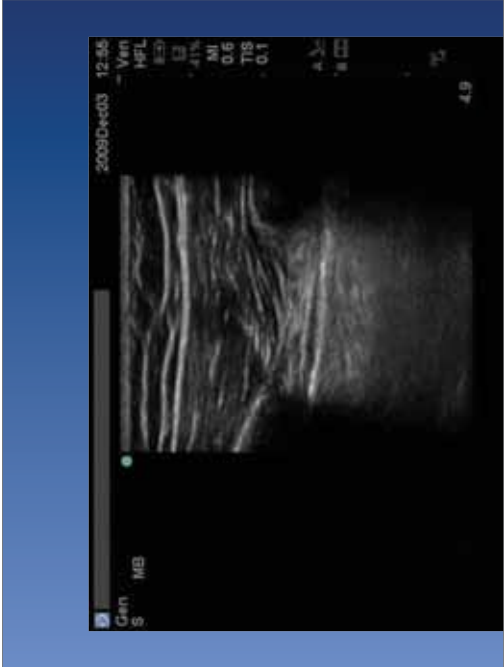
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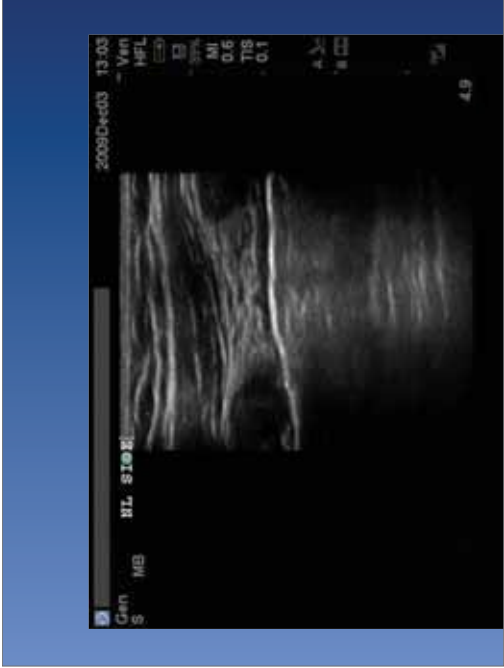
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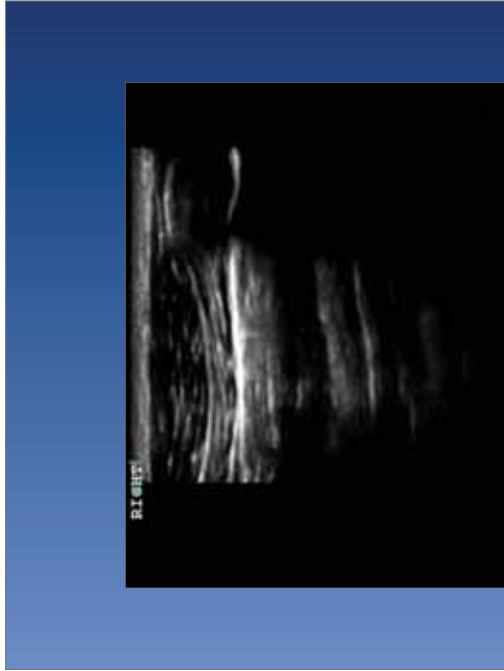
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RUQ pearl: Patient positioning

- **Right side down most sensitive**
 - As little as 100cc identified in models
 - » Goldberg 1970
- **Trendelenberg**
 - Volume reliably detected 660 mL → 440 mL
 - » Abrams 1999



On arrival



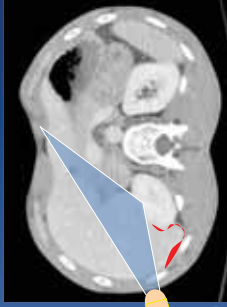
Trendelenberg

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The FAST: Pearls and Pitfalls

RUQ pitfall: probe position

- Beware of horizontal scanning plane (coronal plane) in mid-axillary line
- Solution:
 - systematic real-time scanning through all tissue planes ...



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RUQ pitfall: probe position

- Beware of horizontal scanning plane (coronal plane) in mid-axillary line

• Solution:

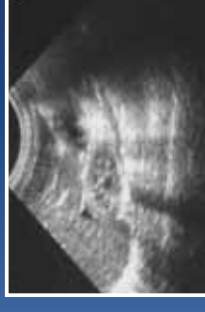
1. Systematic real-time scanning through all tissue planes
2. Try to scan from as anteriorly as possible



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RUQ pitfall: probe position

- Beware of horizontal scanning plane (coronal plane) in mid-axillary line
- Solution:
 1. Systematic real-time scanning through all tissue planes
 2. Try to scan from as anteriorly as possible
- 3. Use TRV plane. Scan from top to bottom of kidney



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RUQ and LUQ pearls: Hemothorax

- Ma 1997: Sensitivity 96%, specificity 100%: identical to that of CXR
- Röthlin 1993: sensitivity only 79%
 - half of false (-) due to “forgot to look”
 - half because hemothorax developed after 24 hours
- Differentiation from pleural effusion similar to ascites

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Pitfalls: subxiphoid view

- Difficulty with
 - Obesity
 - Protuberant abdomen
 - Abdominal wall injury / tenderness
- Increase depth and gain settings after RUQ
- Pleural fluid can be mistaken for pericardial fluid, and vice-versa



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LUQ pitfall

- Do not expect to identify splenic hematoma
 - Parenchymal injury not primary focus of FAST



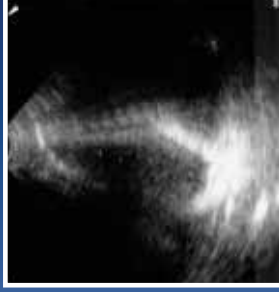
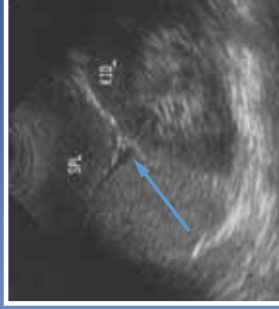
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LUQ: Parenchymal injury not primary focus of FAST



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LUQ pitfalls: splenic hilum and fluid filled stomach



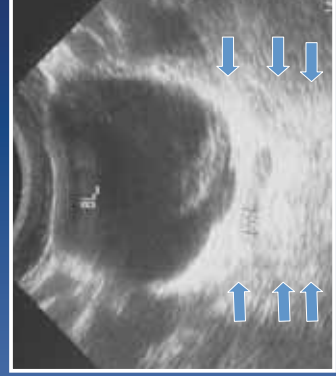
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LUQ pitfalls: fluid filled stomach



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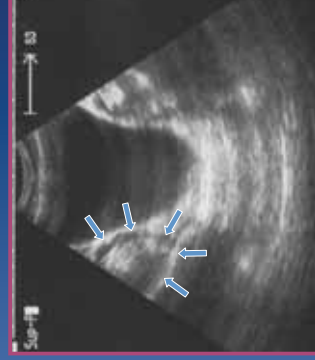
Pitfalls: suprapubic view



- The bladder allows intense "through transmission" = "Posterior acoustic enhancement"
- **Gain artifact obscures free fluid**

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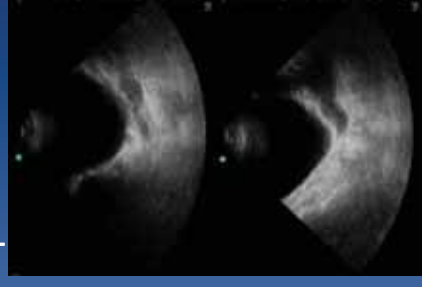
Pitfalls: suprapubic view



- Iliopsoas adjacent to bladder can look like FF
 - Look like "kidneys"

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Pitfalls: suprapubic view



- Seminal vesicles
 - dark and located in same area as FF
 - more "rounded", symmetrical, and adherent to bladder

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Pitfalls: suprapubic view

- Scanning too low in the pelvis
 - Male:
 - Prostate below pelvic peritoneal reflection
 - Seminal vesicles at or below peritoneal reflection
 - Female
 - Cervix at level of peritoneal reflection

Scanning in these planes will miss pelvic FF!



Courtesy: Gray's anatomy



Courtesy: Wikipedia

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Pearls of Technique

- Avoid temptation to rush
 - "FAST should be SLOW (systematic look for Occult Hemorrhage)"
- Maintain "peripheral vision"
 - (Like CXR)
 - Note incidental findings
- "Hand-held CT scanner"
 - ... systematic
 - ... real-time scanning
 - ... through all tissue planes

http://www.4u6981-2.2000

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"Free Fluid" vs. Physiologic fluid:

- FF tends to be "pointy"
 - Fluid in physiologic locations has "rounded" contours
- FF slips between loops of bowel and viscera



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Ascites vs. blood

- Ascites more sonolucent
- Ascites more homogeneous
- Ascites usually more extensive
- Clinical setting
- Sonographic appearance of liver



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Caveat: Clotted blood

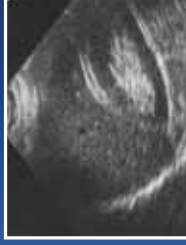
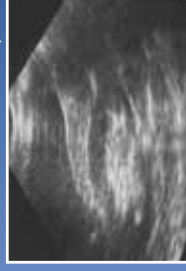
- Hemorrhage: sonographic evolution
 - Fresh blood: initially **sonolucent** (black), starts to clot within minutes
 - Clot
 - may be **hyperechoic**
 - may be difficult to distinguish from bowel and abdominal organs
 - After fibrinolysis: (12 – 48 hours) again **sonolucent**



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Caveats: perinephric fat

- Can look like organizing hematoma
 - Tends to be of even thickness (not pointy)
 - Compare with opposite kidney
 - If possible roll patient
 - Characteristic echodensity of fat
 - Correlate with patient habitus



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False negative FAST

- Review of 10 peer-reviewed articles (N = 5959)
- 98 *clinically significant* (operative repair needed) false (-) exams reported
 - 34% hollow viscus
 - 23% spleen
 - 14% liver
 - 11% diaphragm
 - 10% hemothorax
- Most evolved > 24 hours after injury
 - Initial FAST truly negative for FF
- Most clinically identifiable
 - Patient unstable
 - Diagnosed by repeat US

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False positive FAST

- Retroperitoneal / pelvic hematoma
- Ascites and pleural effusions
- False + usually clinically identifiable
 - Patient stable

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Pearls: Repeat FAST exams

- Repeat as often as necessary for unstable patients
- Repeat at 6 hours for stable patients with initially negative FAST
- Porter 1997
 - 0/105 pts with negative repeat FAST needed lap
 - A + repeat FAST leads to lap in 40% of patients with initially negative exam
- Glaser 1994
 - Correctly dx'd 7/7 delayed splenic ruptures out of 49 pts being followed conservatively for splenic hematoma

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FAST: Integration with the Trauma evaluation



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FAST: integration with the trauma evaluation

- Do FAST after the primary survey
 - If the patient is in shock, concurrent with “C” of “ABC”
- Prior to insertion of Foley
 - “Hemoperitoneum is a more common and more dangerous condition than hematuria” (Rozycki 1993, 1995)
- If “inconclusive” or “possible” free fluid
 - Repeat FAST in 15 minutes and observe for clinical deterioration

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FAST: the integrated trauma evaluation

- FAST should put the patient in one of 3 diagnostic categories:
 - “Yes” ... **“Positive”** for free fluid
 - “No” ... **“Negative”** for free fluid
 - “I don’t know” ... **“Indeterminate”** for FF
- ... This + clinical condition determines the next step:
 - Either **O.R. stat**
 - ... or **neither (clinical management)**
 - ... or **CT/DPL**

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Integration

- EFAST = FAST information
- Not a replacement for CT, but yields important information
- **Unstable patient** with
 - PTX --> Tube Thoracostomy
 - Significant Pericardial Effusion --> Drainage
 - Intraperitoneal Fluid --> OR
- **Stable patient** with
 - PTX --> CXR, CT, Chest Tube
 - Pericardial Effusion --> Serial Exams, Close Monitoring
 - Intraperitoneal Fluid --> CT

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