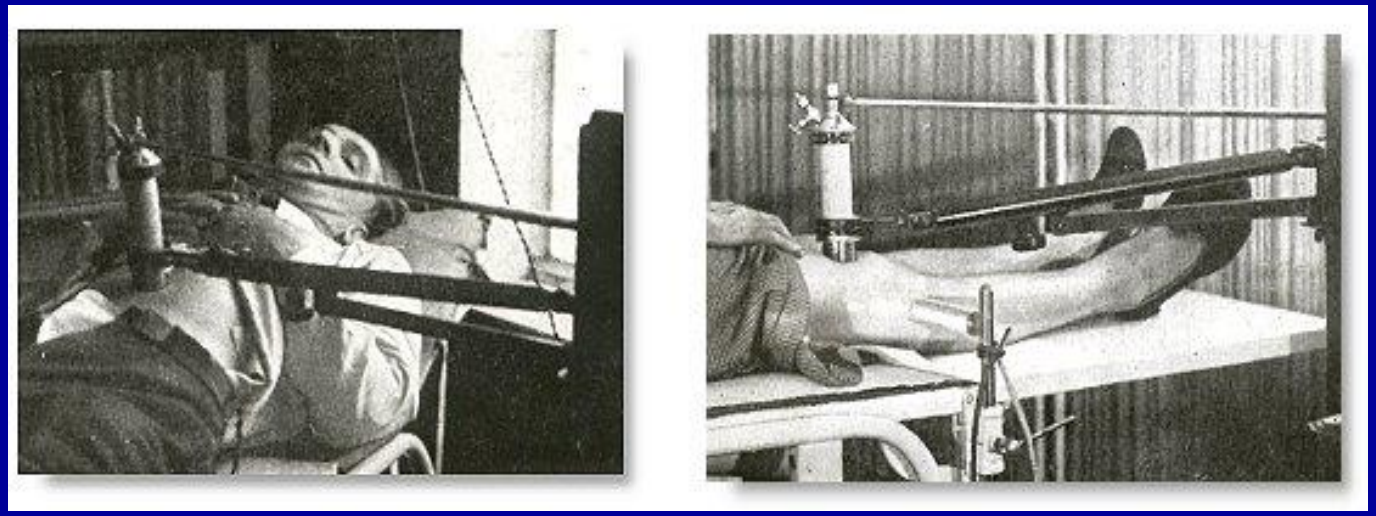
Point-of-Care Ultrasound

James H. Moak, MD, RDMS

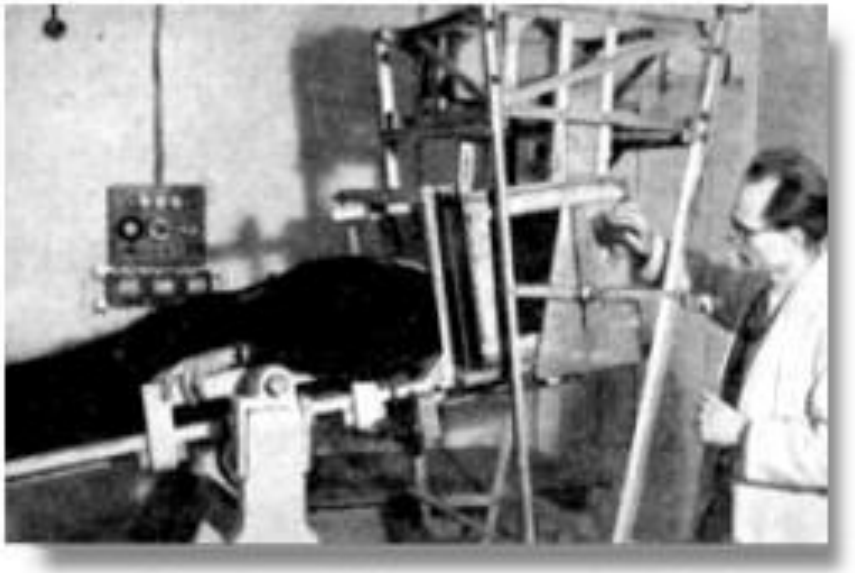
History of Ultrasound

Early use of ultrasound focused on therapy



Treatment of gastric ulcers (left) and arthritis (right) in the 1940s.

History of Ultrasound

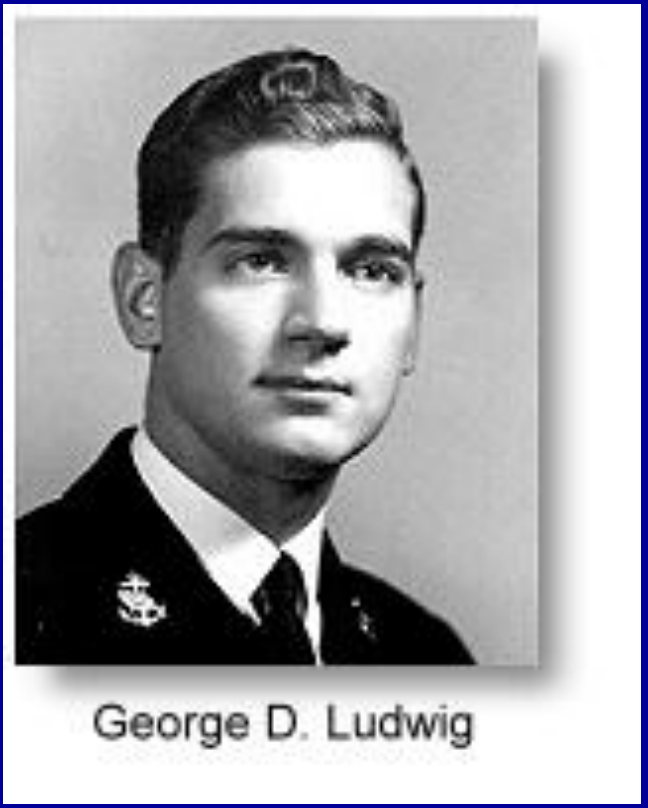


Dussik and his apparatus in 1946

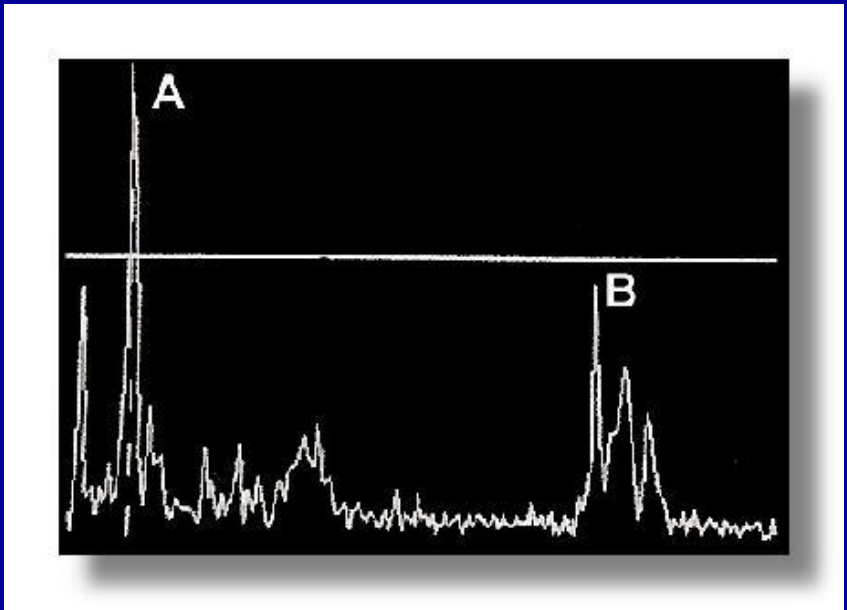
- Karl Dussik, 1946
  - University of Vienna in Austria
  - Cerebral ventricles

History of Ultrasound

- Diagnostic ultrasound
  - George Ludwig, 1940s
  - Classified experiments with the Navy
  - Gall stones

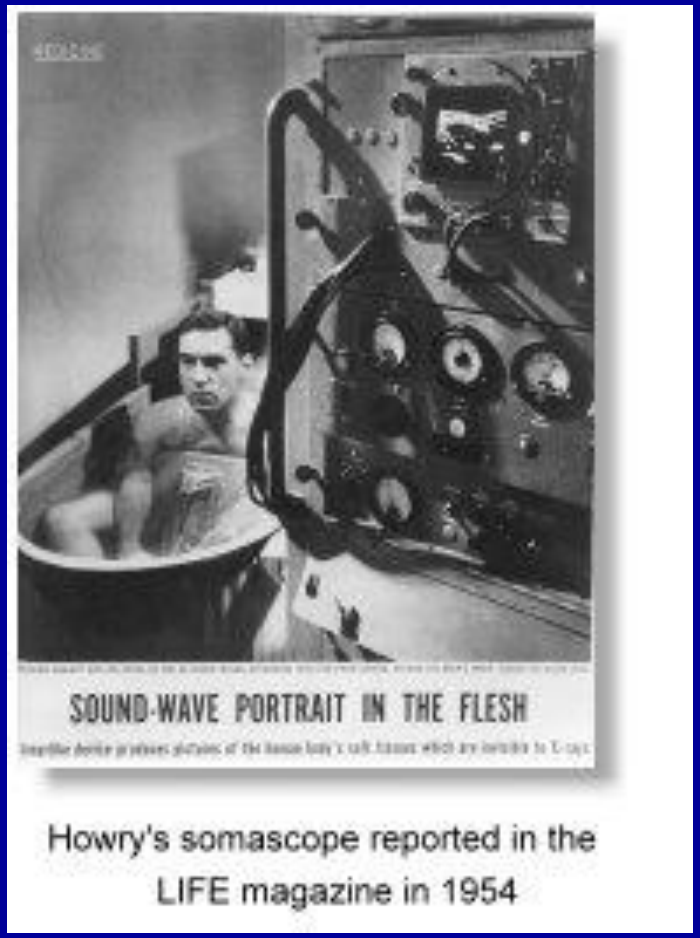


A-mode



- A-mode ultrasound
- A = amplitude

History of Ultrasound



Howry's somascope reported in the LIFE magazine in 1954

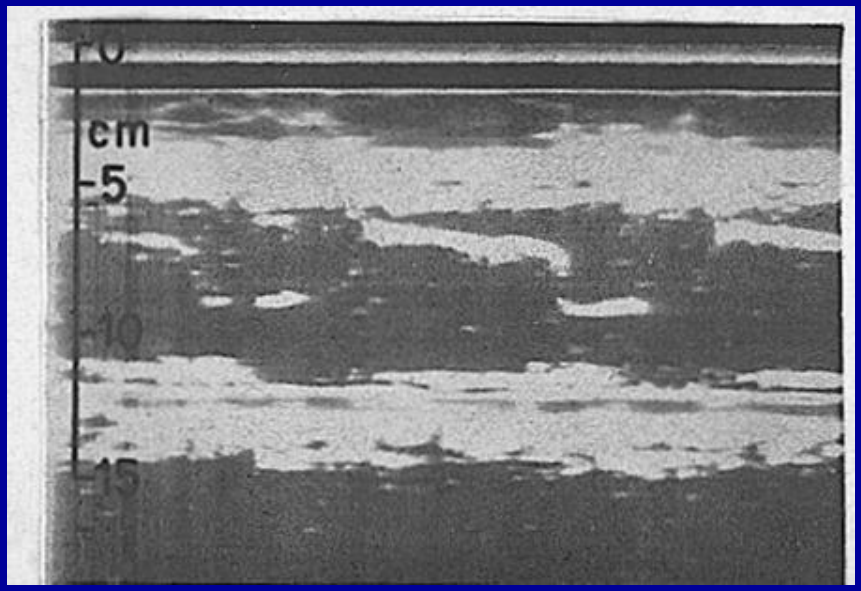
- Howry's somascope
- 2-D images called "somagrams"

B-mode

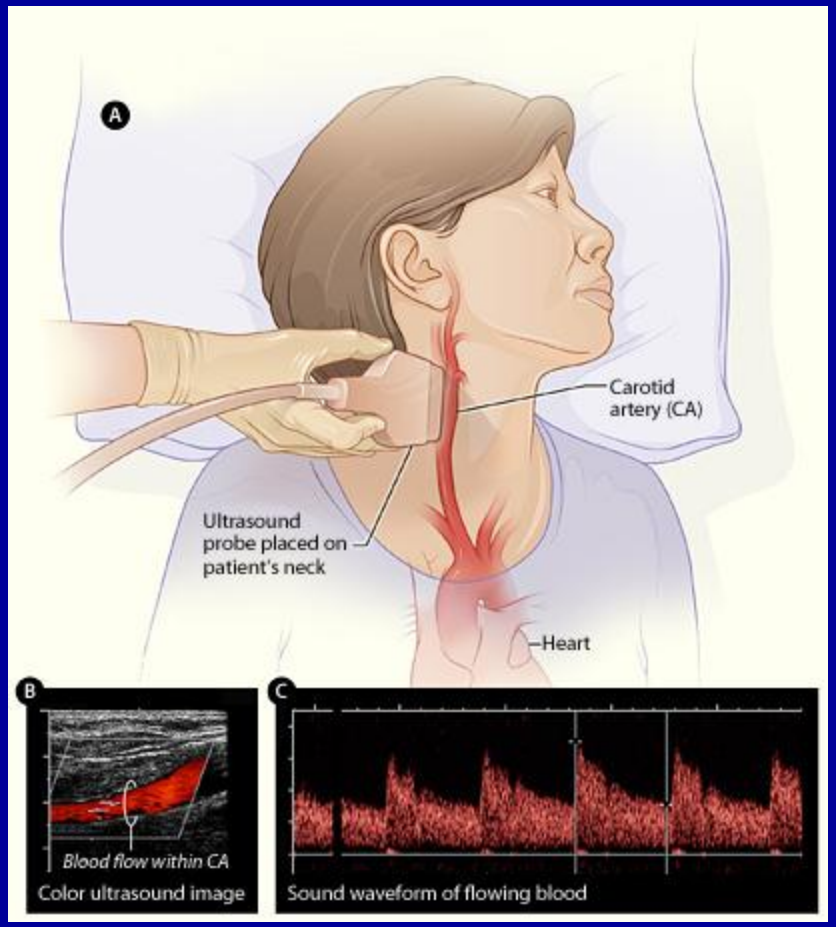
- B-mode ultrasound
- B = brightness
- Intensity of echoes in grey scale

M-mode

- Early echocardiogram
  - 1953 Edler & Hertz
- M = Motion



D-mode



- D = Doppler
- Satomura, 1956
  - freq returning echoes ≈ velocity of flow
- Moving RBCs create a Doppler shift

History of Ultrasound

- 1960s – Commercial machines available
- 1970s – Grey scale becomes common
- 1980s – Use in trauma in Europe & Japan
- 1990s – Introduced into EM curriculum

Emergency Medicine

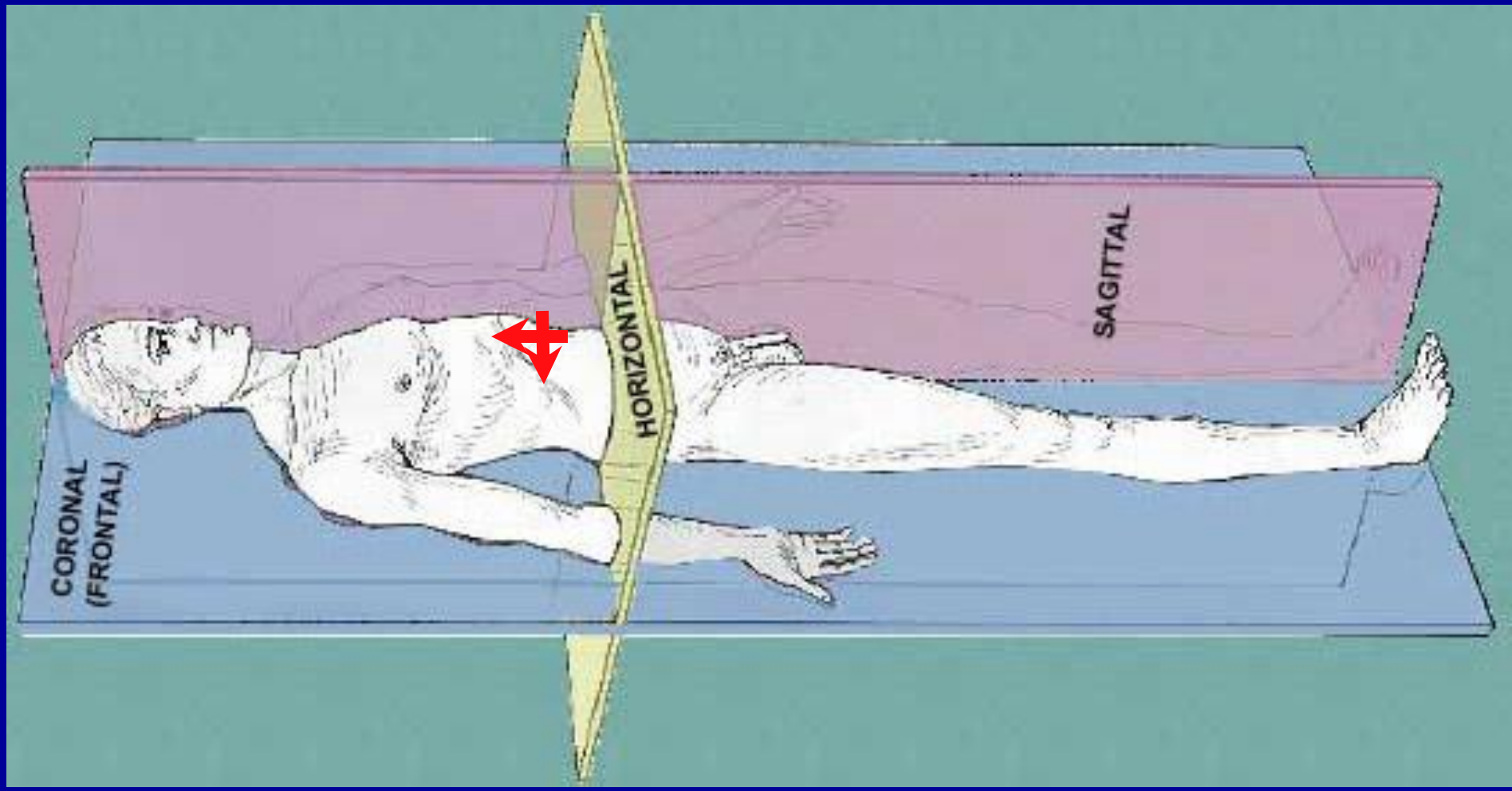
Mateer J et al. 1994

- Goal-oriented
- Core applications
  - Trauma (FAST)
  - Renal
  - Cardiac
  - Biliary (RUQ)
  - Aorta
  - Early pregnancy

Additional applications

- Diagnostic
  - DVT
  - Soft tissue (abscess)
  - Ocular
  - Testicular
  - Long bone fractures
  - Lung (thoracic)
  - Joint effusions
  - Bladder volume
  - IVC diameter
- Procedural
  - Vascular access
  - Thoracentesis
  - Paracentesis
  - Arthrocentesis
  - Nerve blockade
  - Foreign body removal
  - Lumbar puncture

Probe Orientation

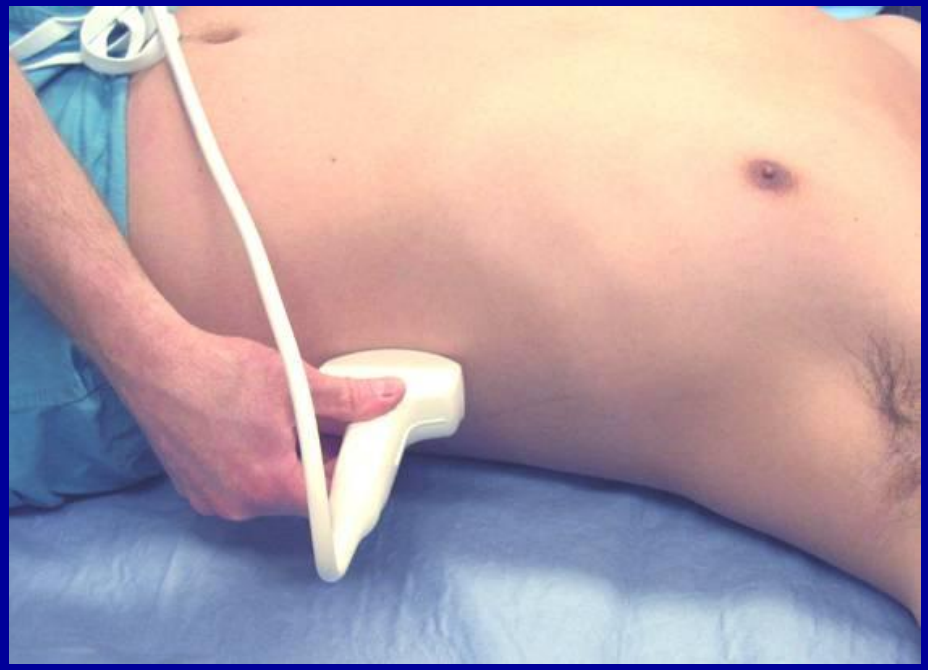


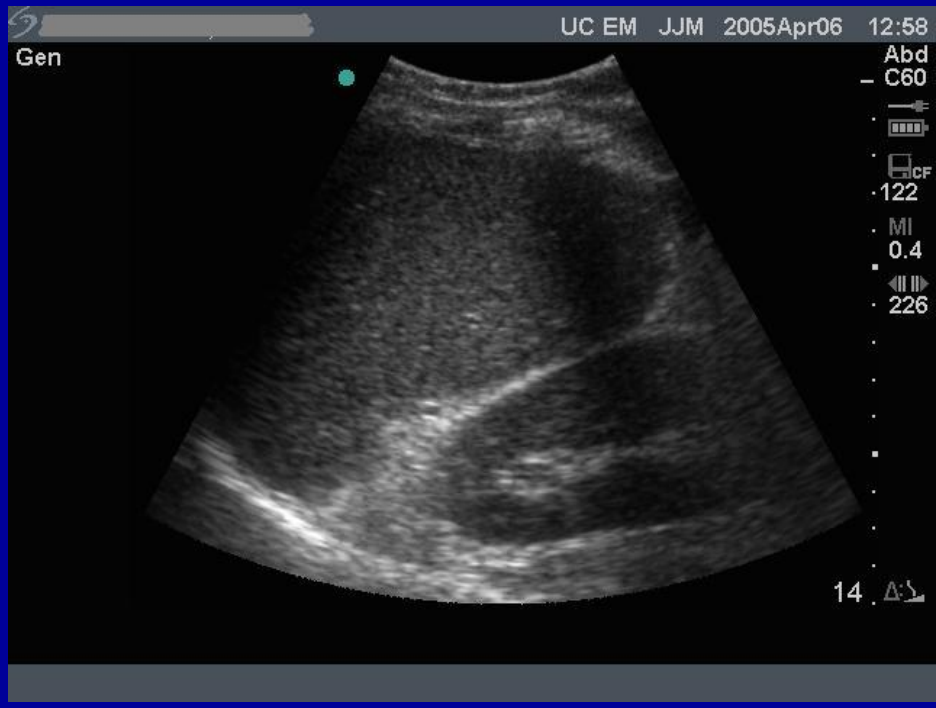
FAST

- Right flank

FAST

- Left flank





FAST

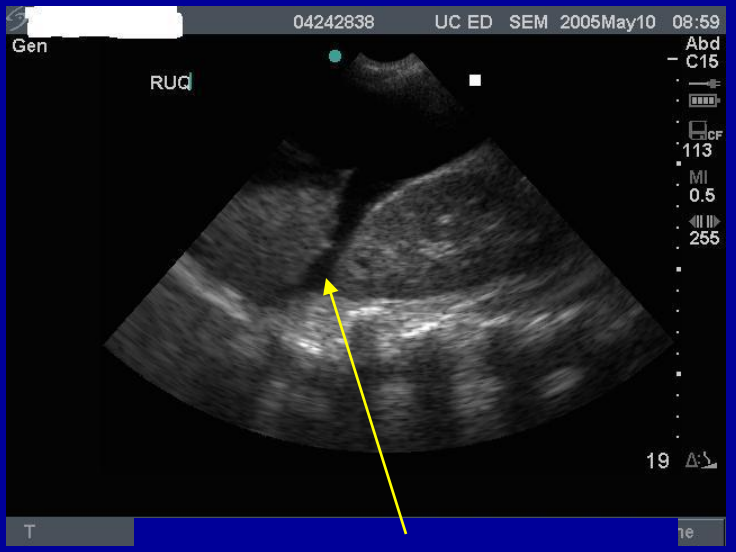
- Cardiac

FAST

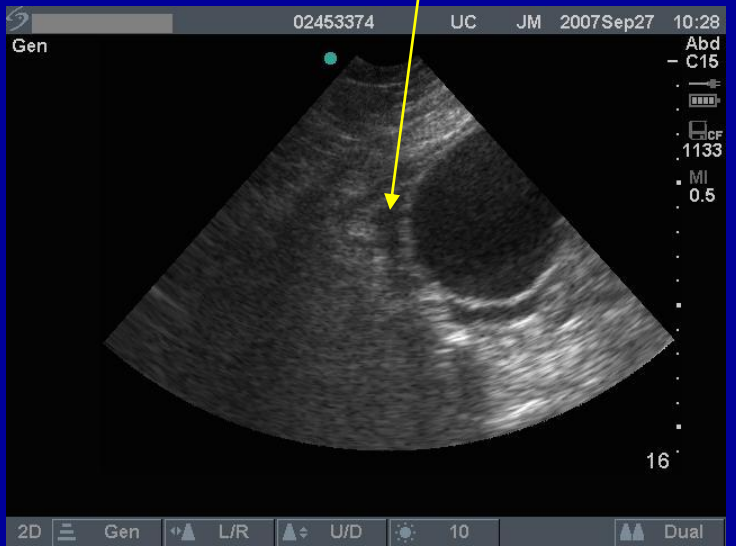
- Bladder

FAST

Hemopericardium

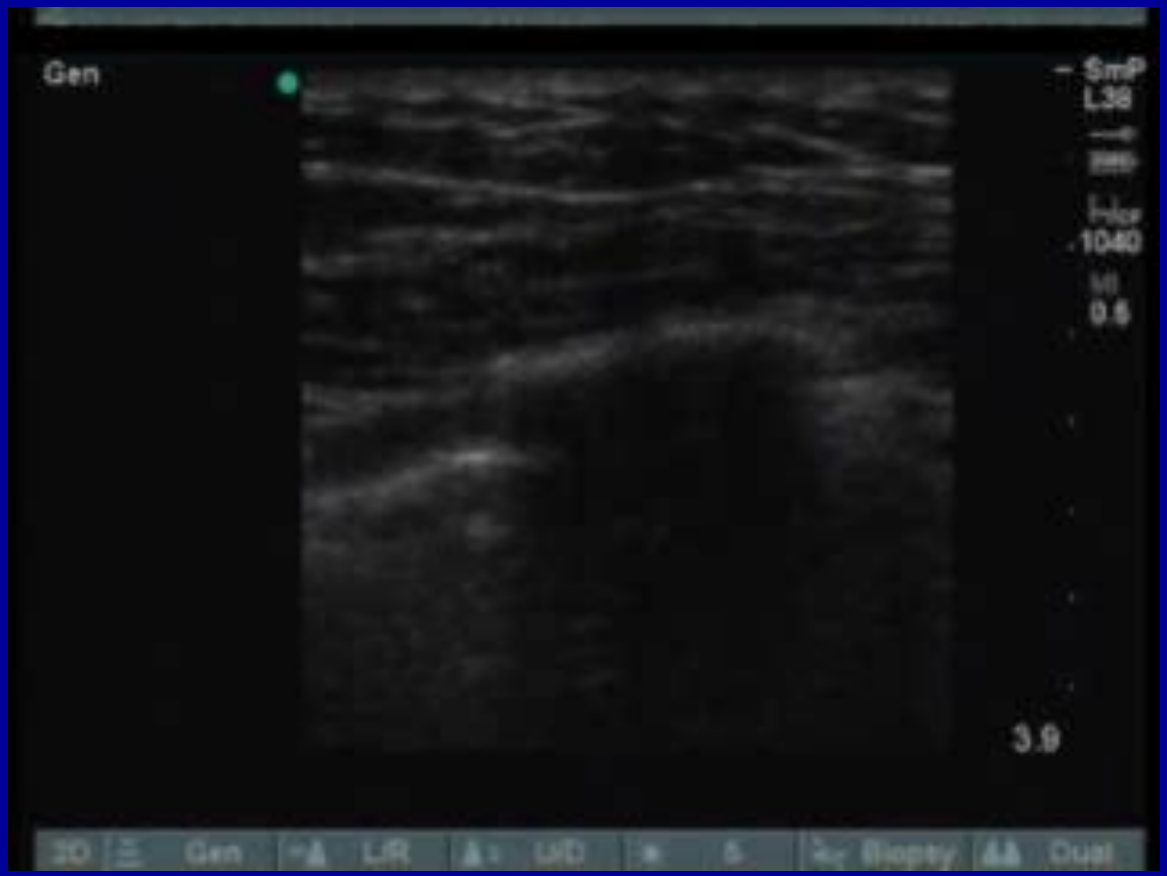


Free fluid



Extended FAST

(with pleural view)

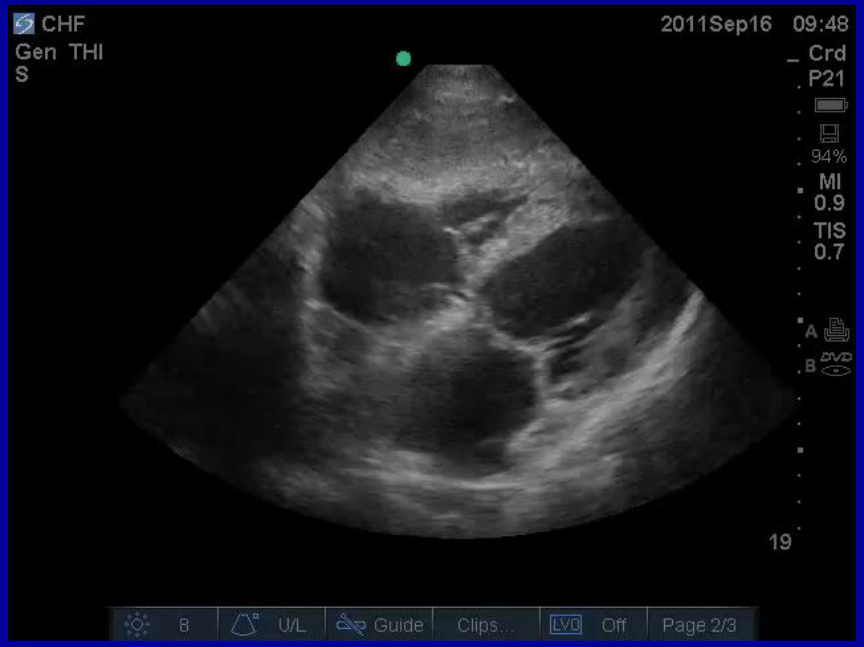


Cardiac

- Ejection fraction
  - Normal or poor?

Cardiac

- Effusion
  - present or absent
- Ejection fraction
  - Normal or poor

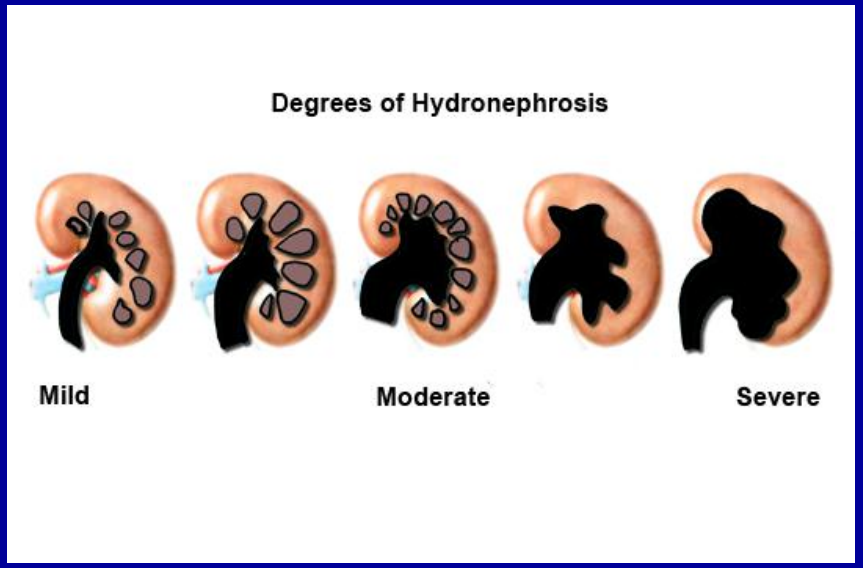


Renal

- Ureterolithiasis
  - Flank pain, N/V
  - Hematuria
- Options
  - KUB, CT, U/S, IVP
  - No imaging?
- Ultrasound
  - Hydronephrosis
  - Sensitive for large stones

Renal

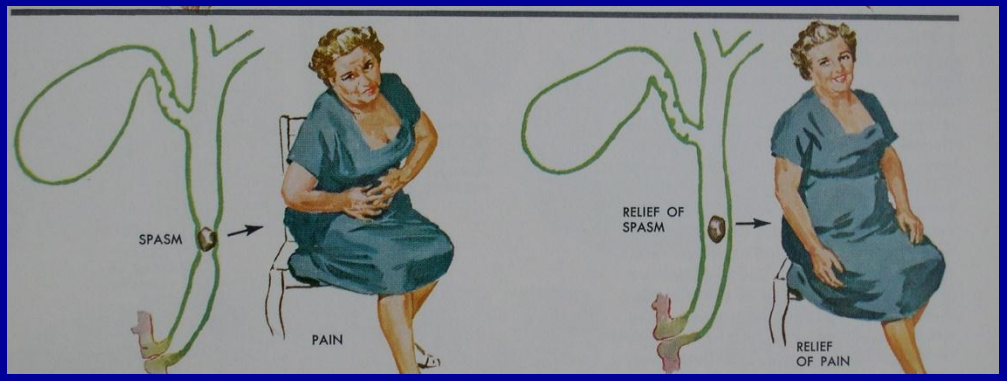
- Hydronephrosis



Renal

- Moderate hydro

Biliary



Ultrasound

Stones?
Wall thickening? (>3mm)
Fluid around wall?
CBD dilated?

Biliary

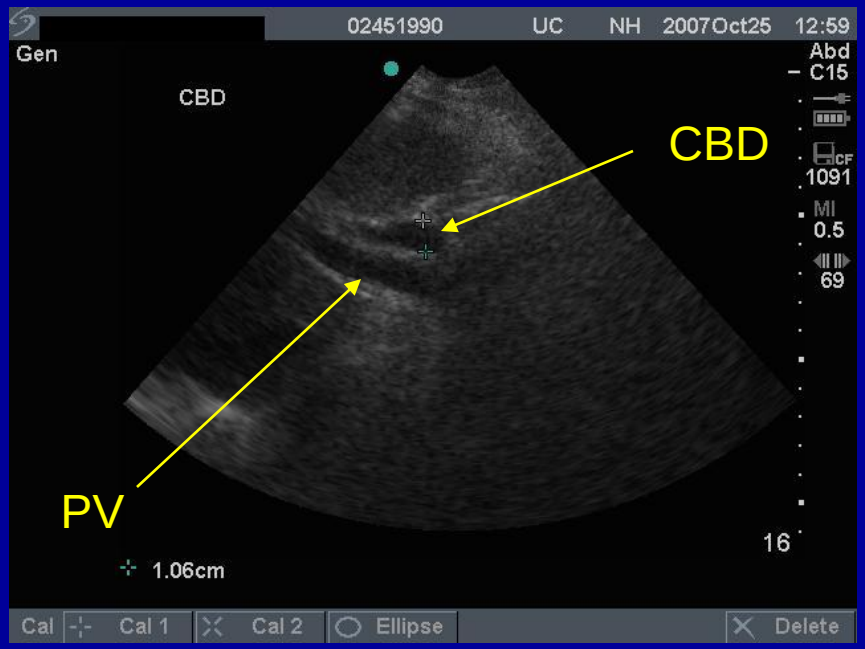
- Transverse view

- Longitudinal view

Biliary

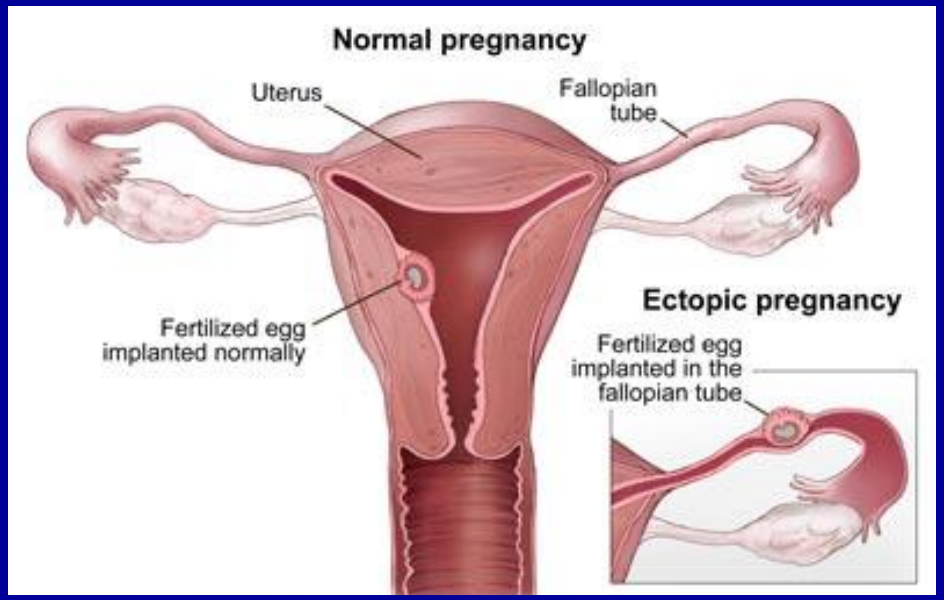
- Thickened wall
- Pericholecystic fluid

- Portal vein and dilated CBD

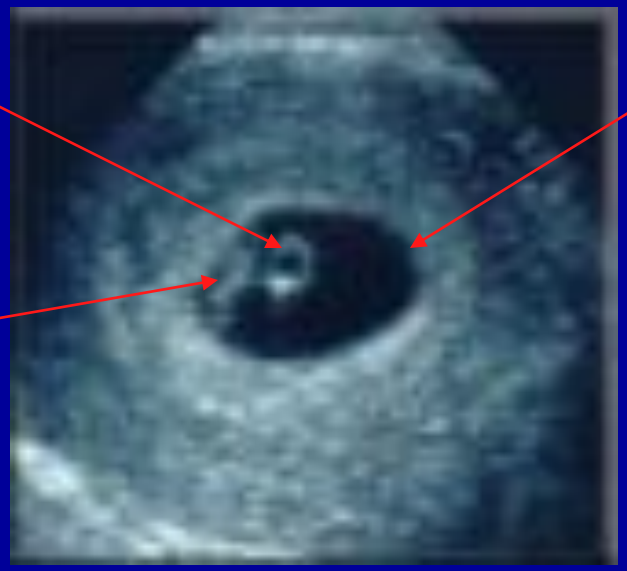


Early Pregnancy

- Ectopic pregnancy
  - 2% incidence
  - Abdominal pain
  - Bleeding
- Goal
  - Identify IUP



Early IUP (6 wks)



Ultrasound Findings

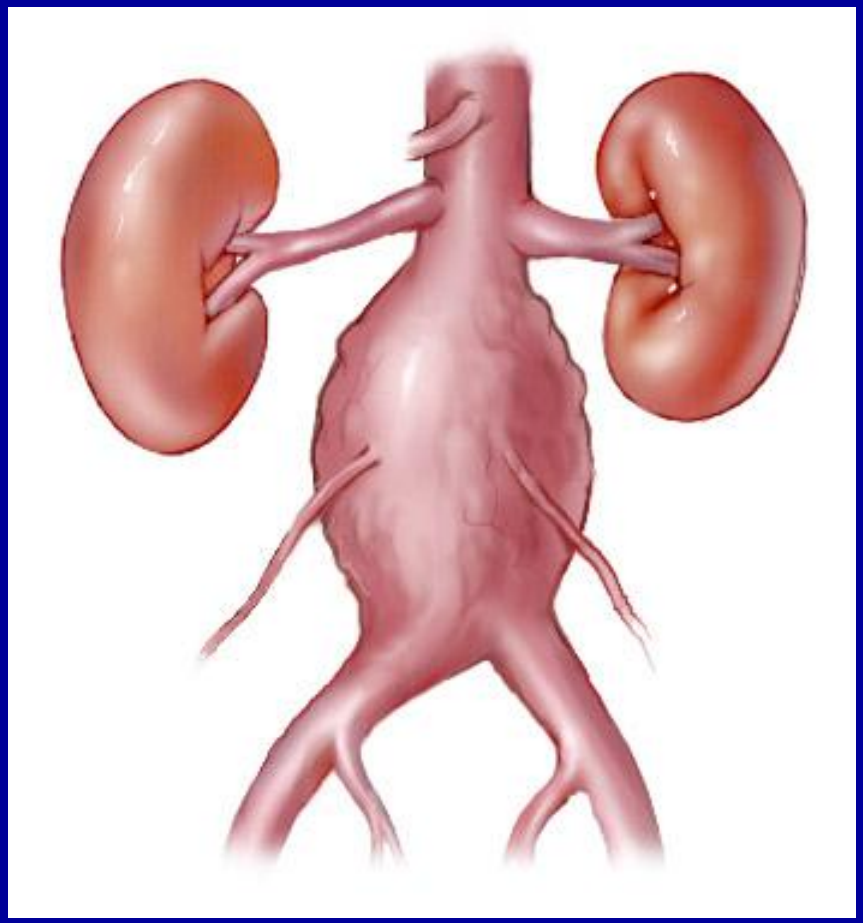
Variations in hCG occur

	hCG (mIU/mL)
• Gestational sac	
– 4-5 weeks TVS	1000
• Fetal pole	
– 6 weeks TVS	2000
• Cardiac activity	
– 7 weeks TVS	10,000

Early Pregnancy

- Gestational sac
- Yolk sac
- Fetal pole

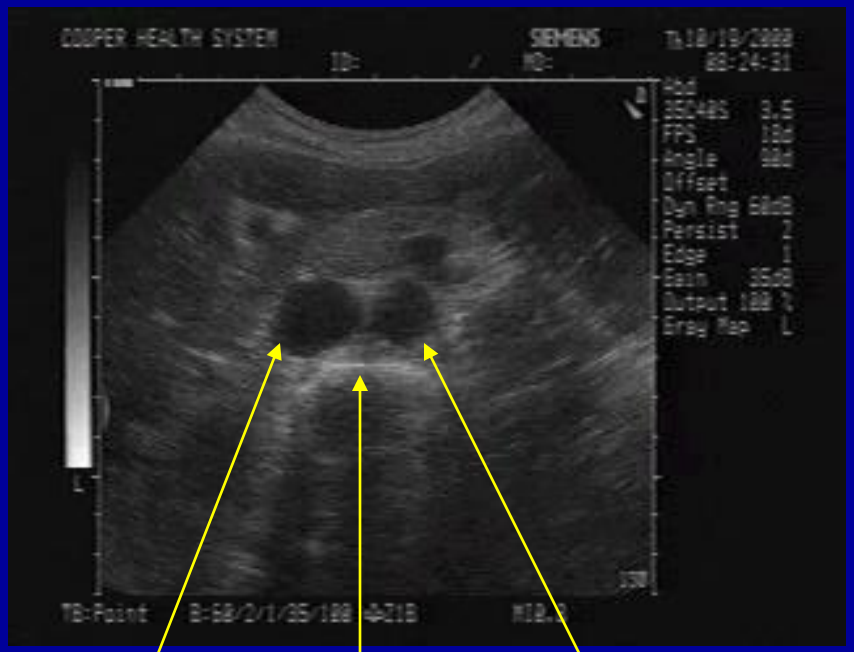
Aorta



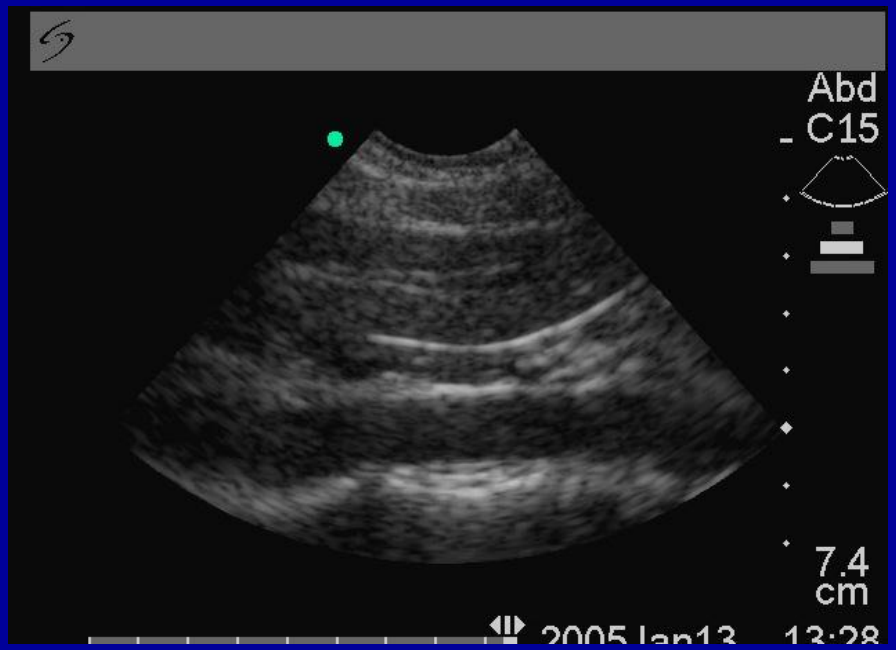
- AAA
  - 2-4% of population >50
  - 10,000 deaths/yr
  - Rupture: 80% mortality

Aorta

- Normal transverse



- Normal longitudinal



Aorta

- AAA transverse

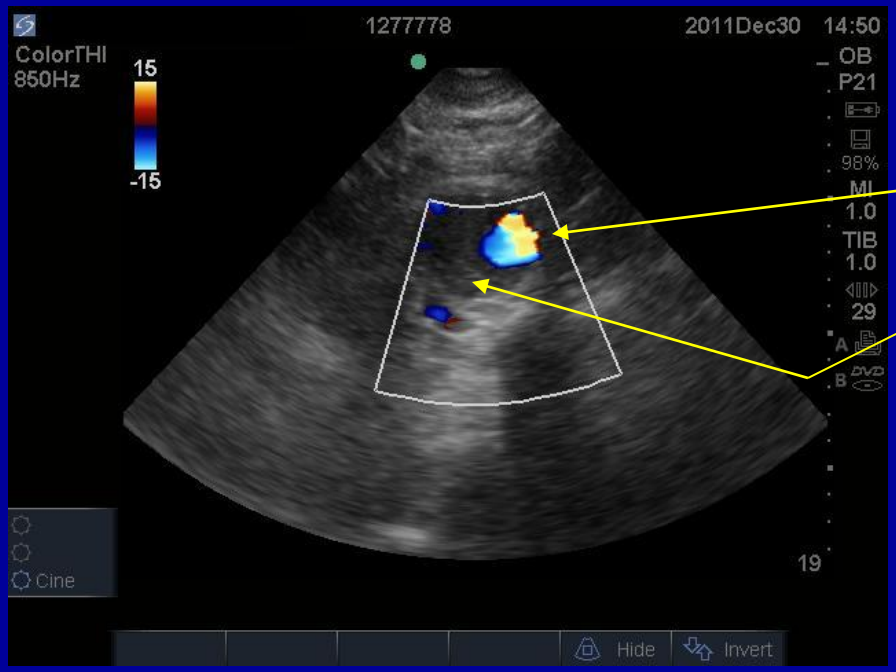
- AAA longitudinal

Aorta


1277778
2011Dec30 14:44
Gen THI
S MB
OB
P21
98%
MI
1.1
TIB
0.8
96
A
B
DVD
A
Cine
A 5.78cm
19
Ellipse
Manual
Delete

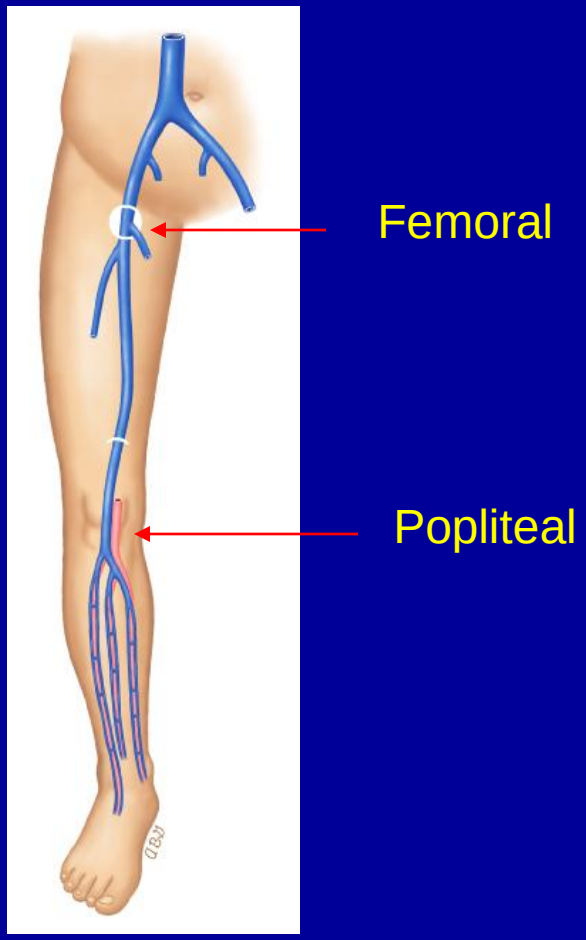
- AAA

Aorta



- AAA
  - True lumen
  - Mural thrombus

Rule out DVT



- Two-site compression
  - ≈ formal ultrasound
  - Misses calf DVTs
  - Follow up in 5-7 days

Normal study

DVT


DVT
Res
S MB
2011Dec16 09:23
Ven
L25
97%
MI
0.7
TIS
0.2
A
B
5.1
Res
Guide
MB On
Dual
Page 1/2

DVT


DVT
Res
S MB
2011Dec16 09:26
Ven
L25
95%
MI
0.7
TIS
0.2
A
B
5.1
Res
0
Guide
MB On
Dual
Page 1/2

Ocular

- Retinal detachment

Ocular

- Vitreous hemorrhage

Ocular

- Nerve sheath diameter

Ocular

- Nerve sheath diameter

Procedural Ultrasound

- Standard of care for IJ vein catheterization

Procedural Ultrasound

- Standard of care for IJ vein catheterization

Point-of-Care Ultrasonography

Christopher L. Moore, M.D., and Joshua A. Copel, M.D.

The NEW ENGLAND JOURNAL of MEDICINE

Table 1. Selected Applications of Point-of-Care Ultrasonography, According to Medical Specialty.*

Specialty	Ultrasound Applications
Anesthesia	Guidance for vascular access, regional anesthesia, intraoperative monitoring of fluid status and cardiac function
Cardiology	Echocardiography, intracardiac assessment
Critical care medicine	Procedural guidance, pulmonary assessment, focused echocardiography
Dermatology	Assessment of skin lesions and tumors
Emergency medicine	FAST, focused emergency assessment, procedural guidance
Endocrinology and endocrine surgery	Assessment of thyroid and parathyroid, procedural guidance
General surgery	Ultrasonography of the breast, procedural guidance, intraoperative assessment
Gynecology	Assessment of cervix, uterus, and adnexa; procedural guidance
Obstetrics and maternal–fetal medicine	Assessment of pregnancy, detection of fetal abnormalities, procedural guidance
Neonatology	Cranial and pulmonary assessments
Nephrology	Vascular access for dialysis
Neurology	Transcranial Doppler, peripheral-nerve evaluation
Ophthalmology	Corneal and retinal assessment
Orthopedic surgery	Musculoskeletal applications
Otolaryngology	Assessment of thyroid, parathyroid, and neck masses; procedural guidance
Pediatrics	Assessment of bladder, procedural guidance
Pulmonary medicine	Transthoracic pulmonary assessment, endobronchial assessment, procedural guidance
Radiology and interventional radiology	Ultrasonography taken to the patient with interpretation at the bedside, procedural guidance
Rheumatology	Monitoring of synovitis, procedural guidance
Trauma surgery	FAST, procedural guidance
Urology	Renal, bladder, and prostate assessment; procedural guidance
Vascular surgery	Carotid, arterial, and venous assessment; procedural assessment

Future Directions

- Hand-held ultrasound

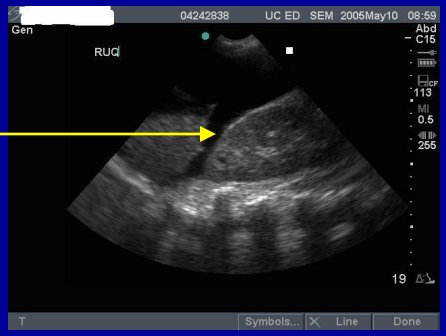
- Vscan (GE)
  - $7000-$8000
  - One probe

Future Directions

- MobiUS (Mobisante)
  - Connects to cell phone
  - $7000-$8000
- Hand-held ultrasound

Conclusion

- Probe indicator → head or right
- Free fluid is hypoechoic
- Standard of care for IJ lines
- Numerous applications
  - EM: FAST, Cardiac, Renal, Biliary, Aorta, IUP, DVT, Ocular
- Hand-held devices coming soon…



References

- Mateer J, Plummer D, et al. Model curriculum for physician training in emergency ultrasonography. Ann Emerg Med 1994; 23(1):95-102.
- Moore CL, Copel JA. Point-of-Care Ultrasonography. *NEJM* 2011; 364(8):749-757.
- Roelandt JRTC. Seeing the invisible. A short history of cardiac ultrasound. *Eur J Echocardiography* 2000; 1(1):8-11.
- Sigel B. A brief history of Doppler ultrasound in the diagnosis of peripheral vascular disease. Ultrasound in Med and Biol 1998; 24(2):169-176.
- Walcott BM. Mapping the literature of diagnostic medical sonography. Bull Med Libr Assoc 1999; 87(3):287-291.
- Woo JSK. A short history of the development of ultrasound in obstetrics and gynecology. www.ob-ultrasound.net/history1.html. Accessed Jan. 6, 2012.