ULTRASOUND IN CRITICAL CARE

Assessment and Management - Update

SADIK GİRİŞGİN, MD, EP, Assoc. Prof of EM

Necmettin Erbakan Uni. Meram Medicine School KONYA
Taksim Gaziosmanpasa E&R Hospital ISTANBUL

Education

- American College of Radiology (ACR)
- American Institute of Ultrasound in Medicine (AIUM)
- Ultrasound Imaging by Emergency Physicians: ACEP Policy Statement

Why can we use US in ICU?

- Portable
- Probe variety
- Real time imaging
- Cost effective
- No radiation
- Repeatable
- ……

US suitable for ICU patients

- Bedridden
- Diagnosis variety
- Real time treatment
- Costly, expensive
- Weak immunity
- Nonstable condition
- ……

Ultrasonography

- How can we use US in ICU?

What is the ICU US?

- **Abdominal & Retroperitoneal Ultrasound**

- Abdominal vasculature,
- Bladder,
- Spleen,
- Liver
- Kidney

(Left kidney longitudinal view with splenorenal space, Right kidney longitudinal view with hepatorenal recess, Abdominal aorta longitudinal view, Bladder transverse view)

What is the ICU US?

- **Pulmonary /Pleural Ultrasound**

- Pleural effusion (any size)
- Pneumothorax (Sliding lung)
- Infiltrates with ultrasound (Consolidation)

- **Cardiac Ultrasound**

- Parasternal long axis view
- Parasternal short axis view
- Apical four-chamber view
- Subcostal long axis view
- Inferior vena cava longitudinal view
  - to find a pericardial effusion.

What is the ICU US?

- **Ultrasound Guided Procedures**

- This topic covers how to use ultrasound to assist the performance of multiple procedures, from central lines to thoracentesis…

What is the ICU US?

- **DVT Evaluation**

- This topic covers how to use ultrasound to assess your patients for life threatening DVT's

  (common femoral vein, saphenous intake, superficial femoral vein, popliteal vein with compression)

What is the ICU US?

- **Ultrasound Guided Resuscitation**
  - How to use all the information you gain with ultrasound to guide your management of the critically ill patient.
  - This topic helps you put the whole picture together and is full of great case examples to help solidify your understanding.

What is the ICU US?

- **Ultrasound-Guided Vascular Access**
  - An overview of how to use ultrasound to help guide central venous access and peripheral venous access.

What is the ICU US?

- **Critical Care Echocardiography**
  - Integrating general critical care ultrasonography with bedside echocardiography.

Advanced US

- Advanced Hemodynamic Measurements
- Advanced Evaluation of Left Ventricular and Right Ventricular Systolic Function
- Pulmonary Edema
- Pneumonia

Advanced US

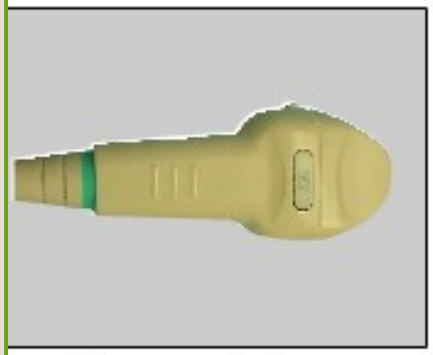
- Valvular Assessment in the Critically Ill
- Focused Echocardiography Evaluation in Life Support (FEEL Algorithm)
- Pitfalls and Limitations of Echocardiography in the ICU

Advanced US

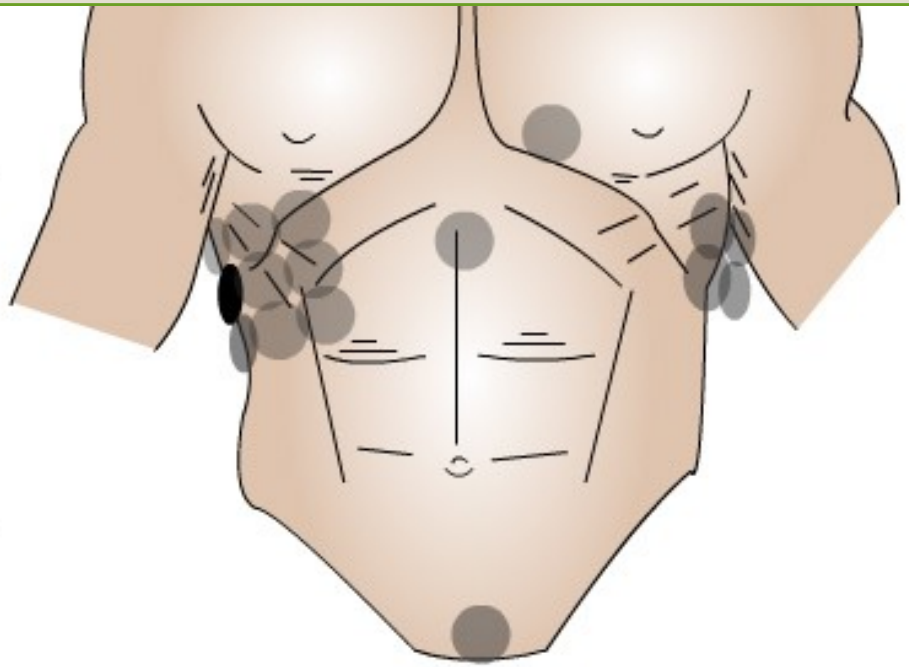
Abdominal evaluation with US for ICU patient

Right Upper – Perihepatic

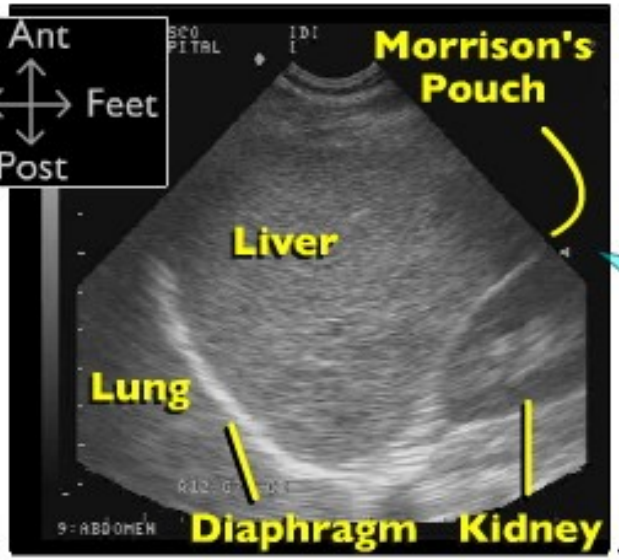
Probe Orientation



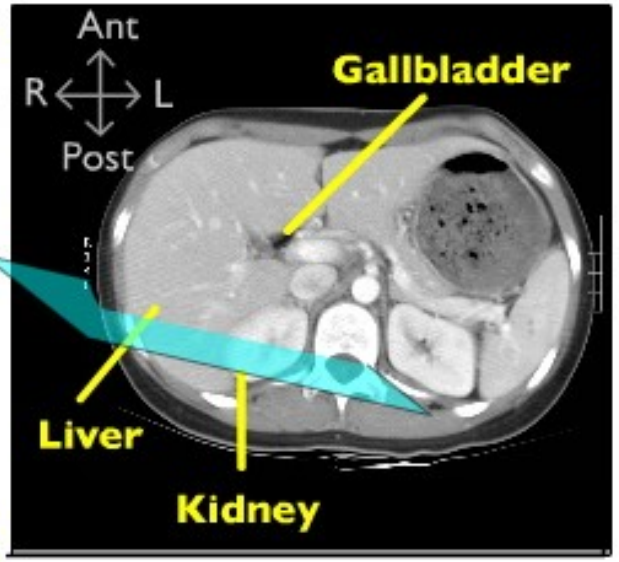
Coronal view



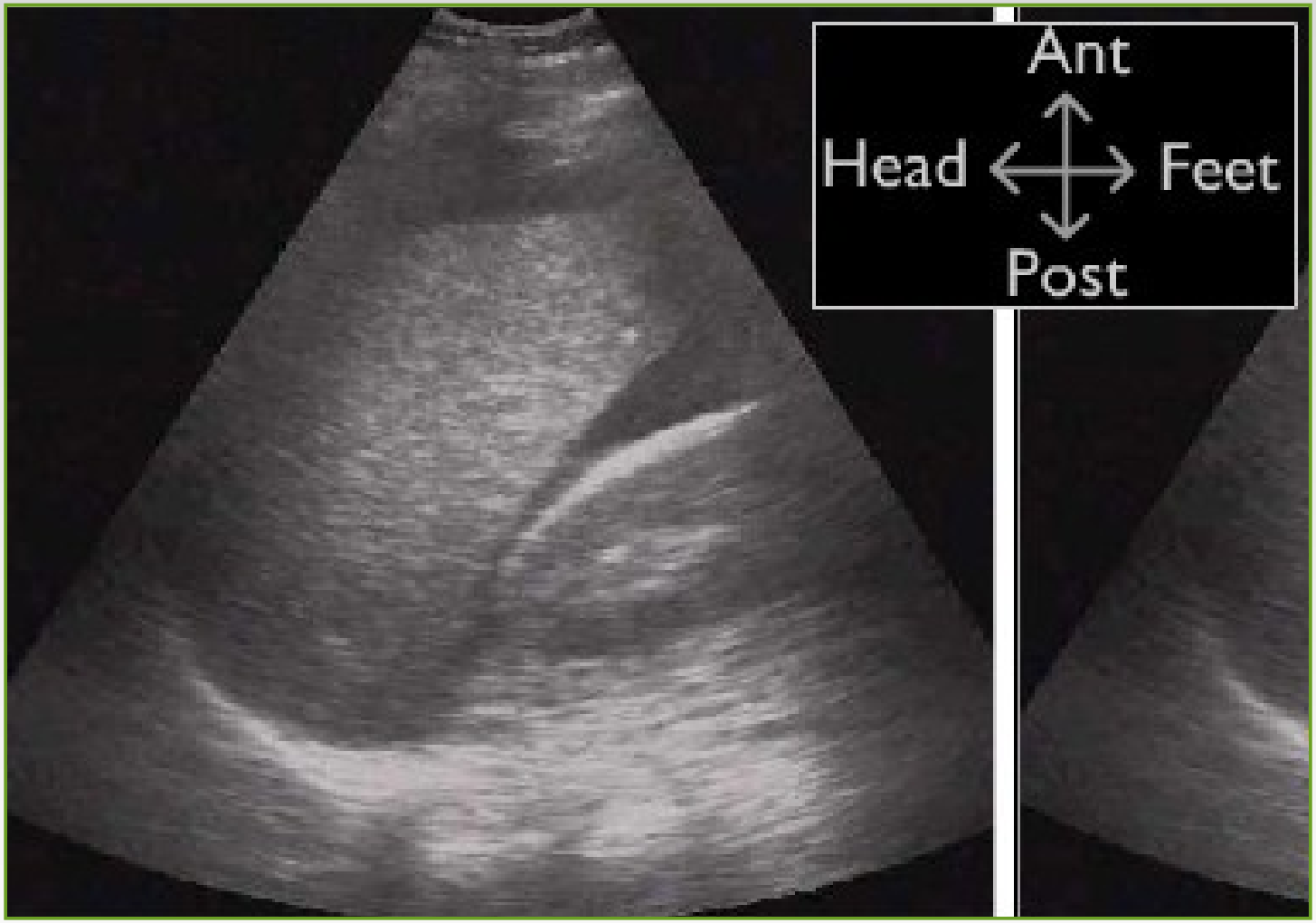
Actual ultrasound image



Labeled ultrasound image

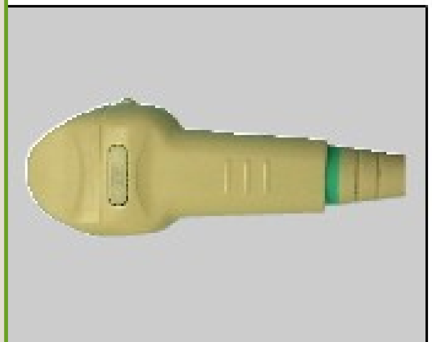


Cross-sectional CT anatomy

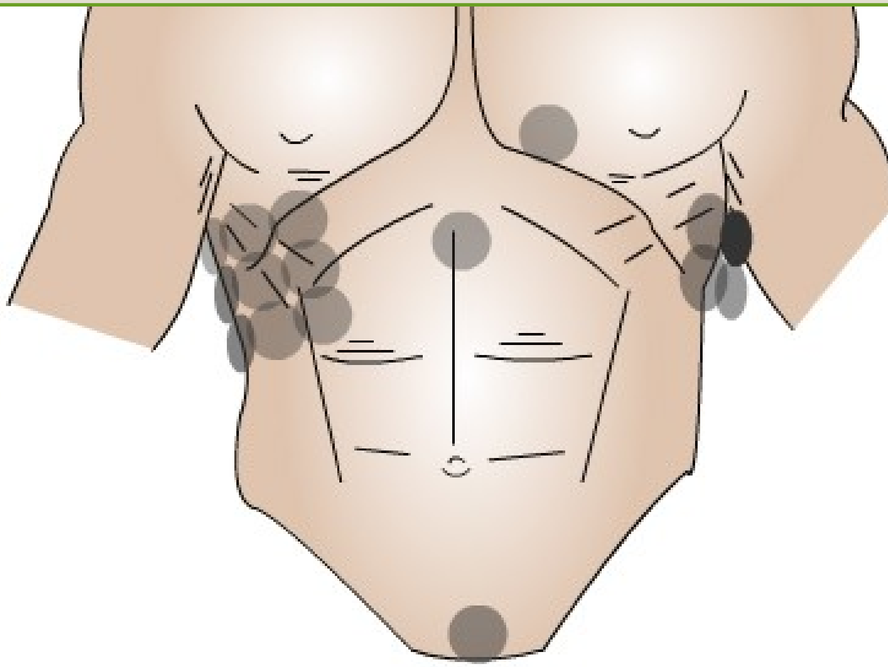

Ant
Head
Feet
Post

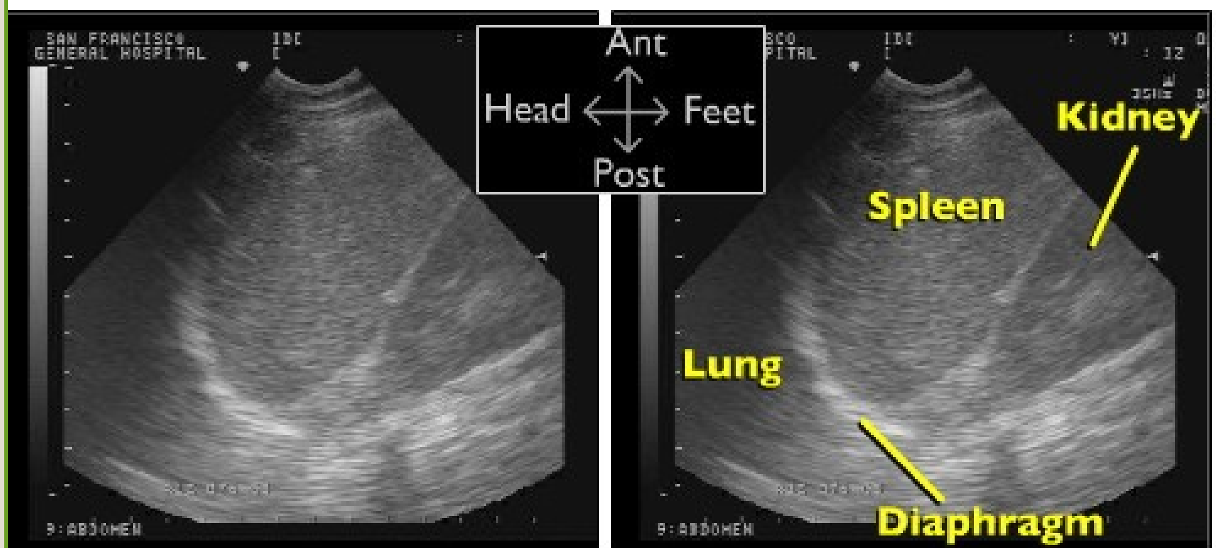
Left Upper - Perisplenic

Probe Orientation



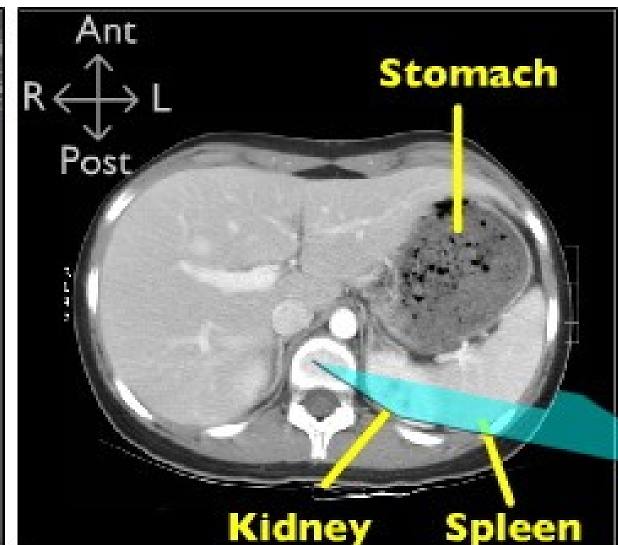
Coronal view



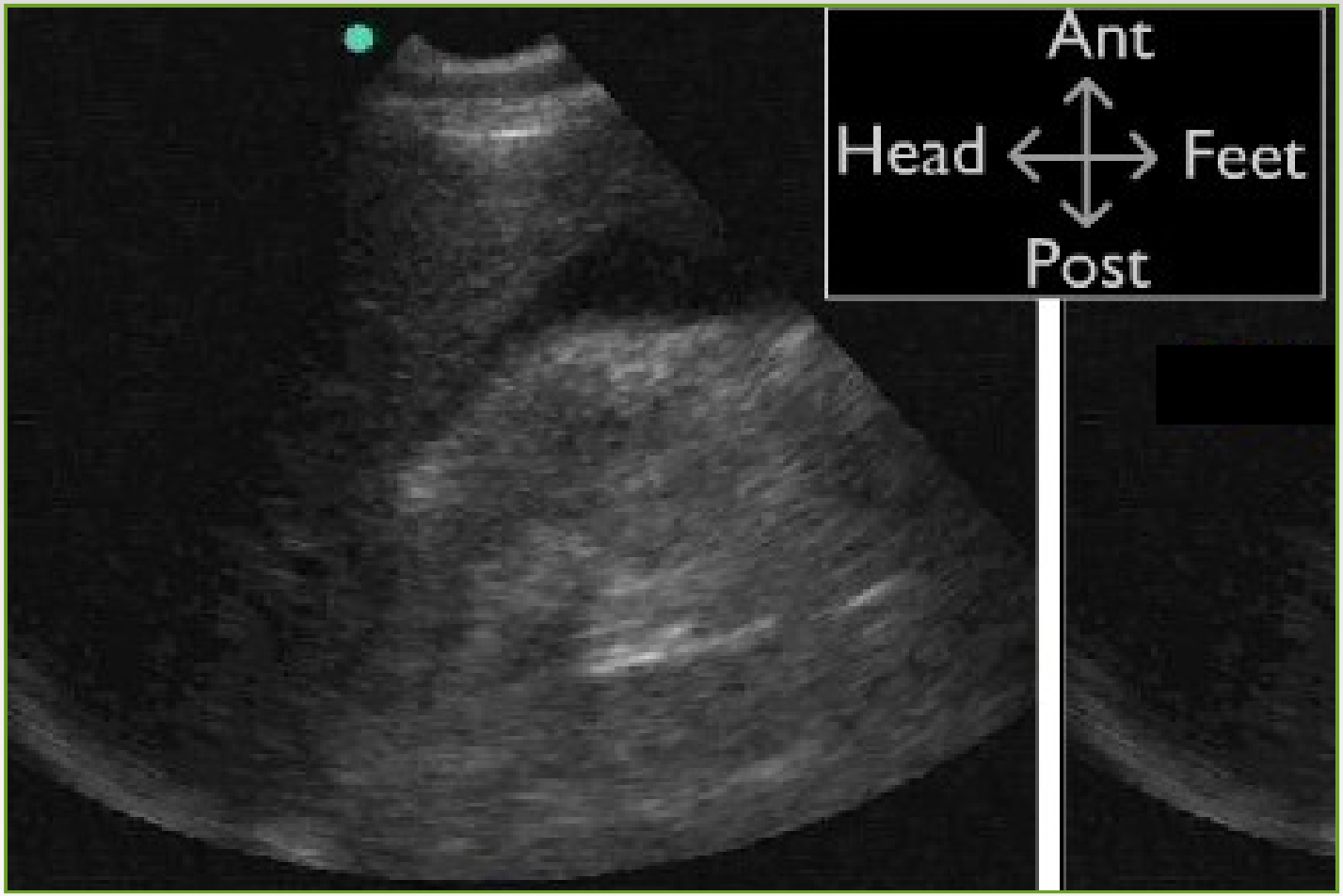


Actual ultrasound image

Labeled ultrasound image

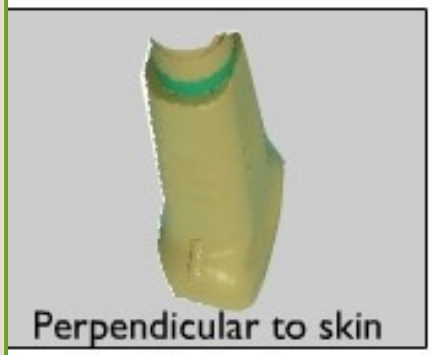


Cross-sectional CT anatomy

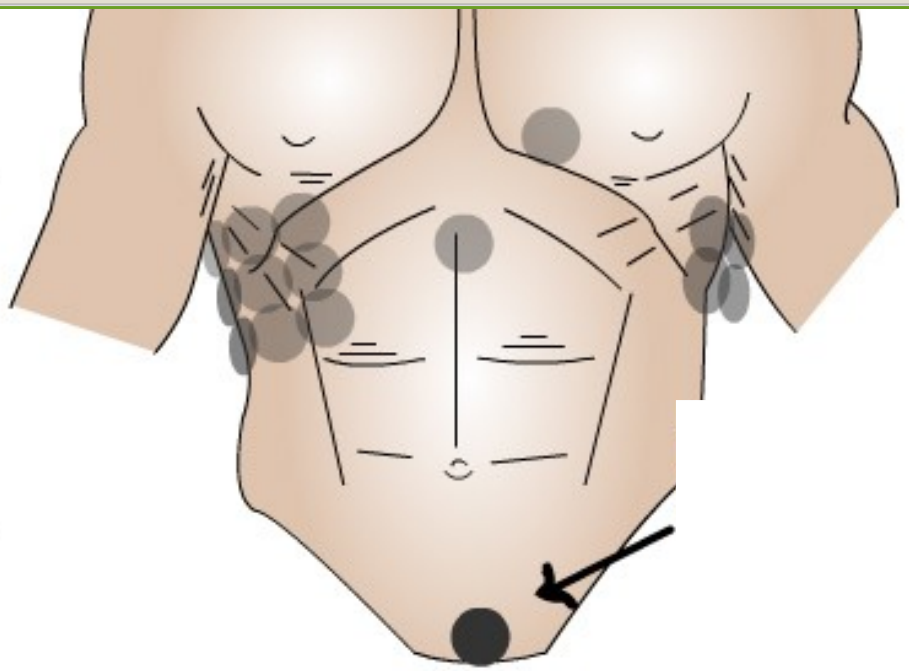

Ant
Head
Feet
Post

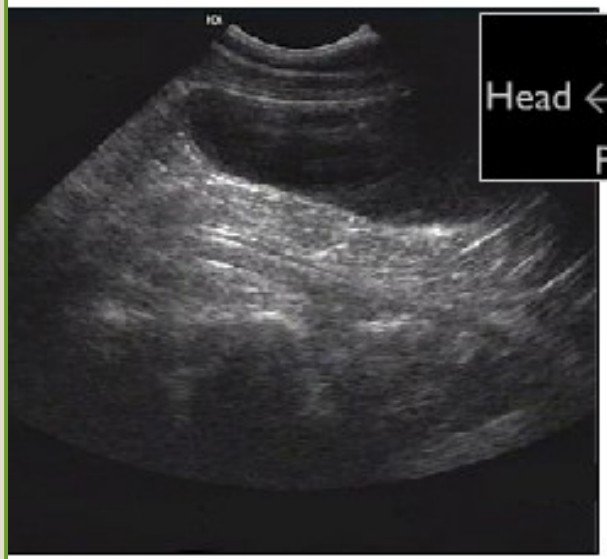
Pelvic - Suprapubic

Probe Orientation

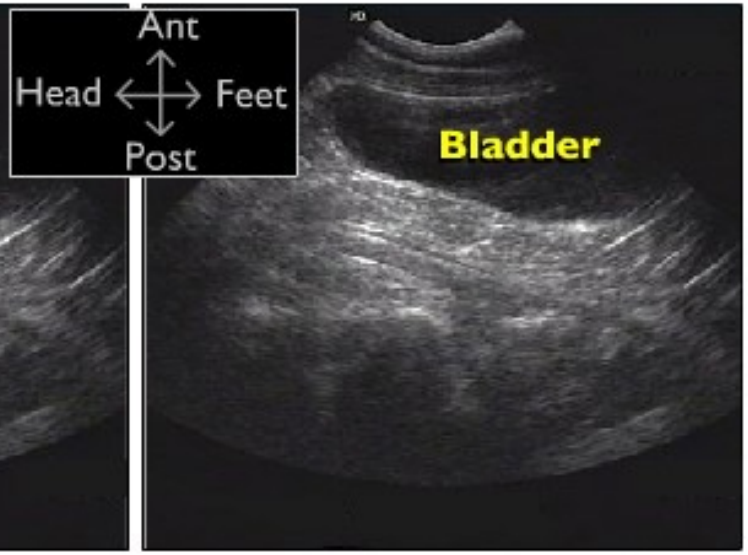


Sagittal view

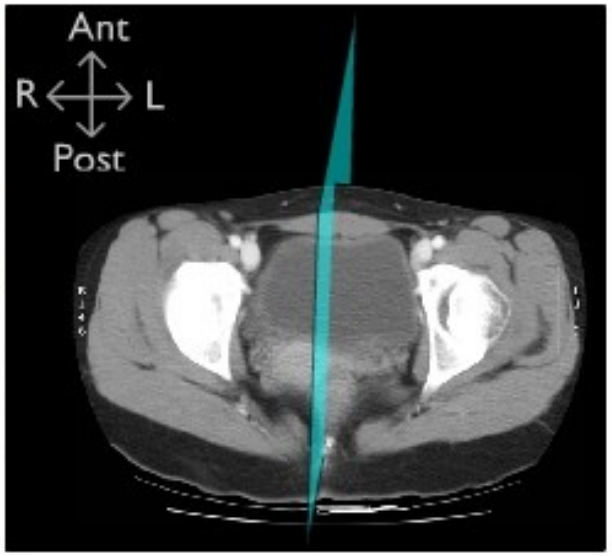




Actual ultrasound image



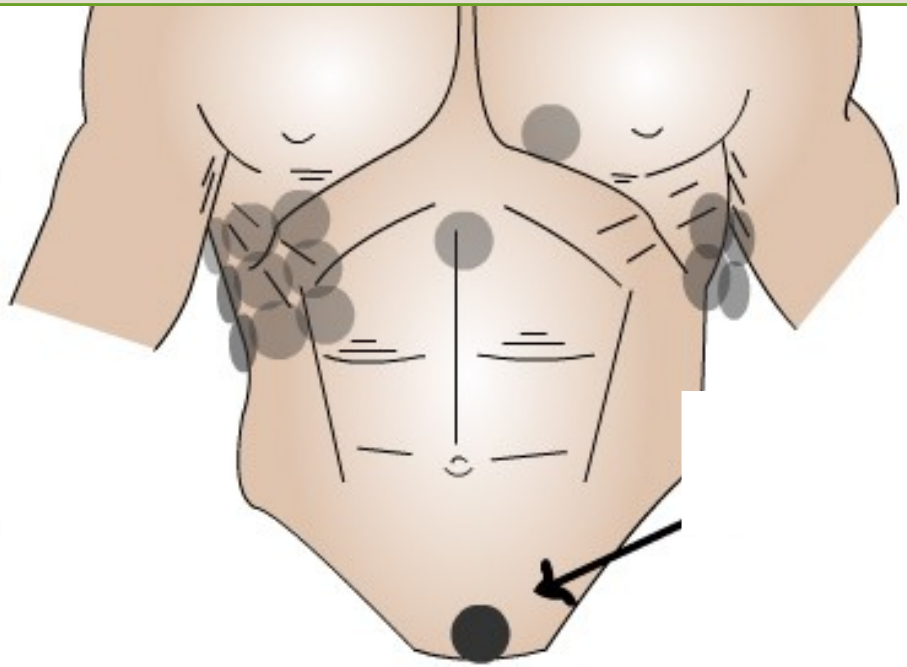
Labeled ultrasound image

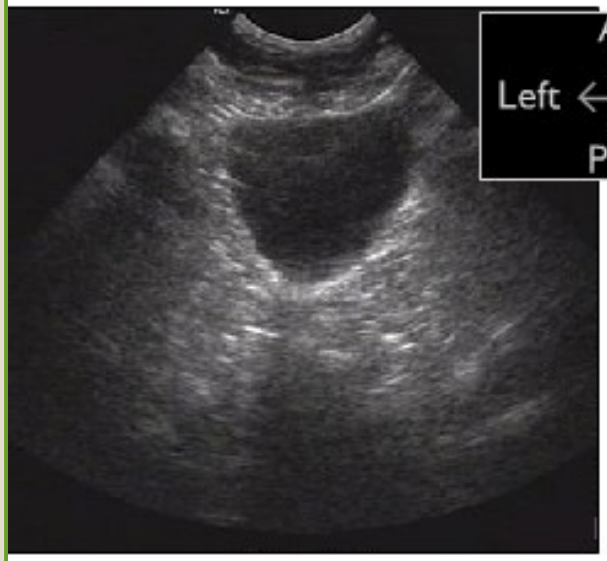


Cross-sectional CT anatomy

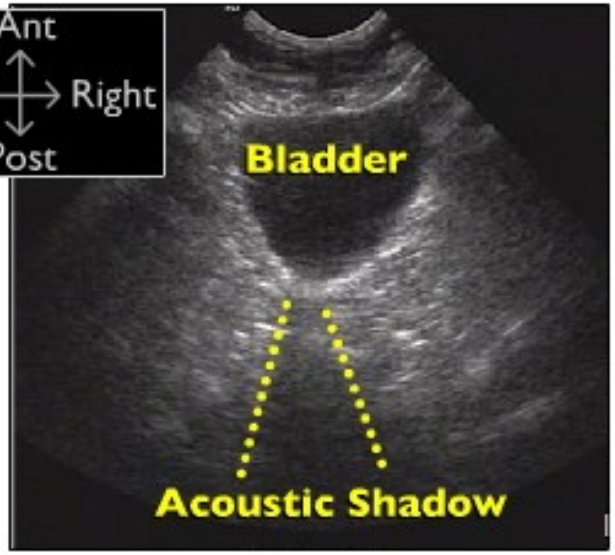
Probe Orientation

Transverse view

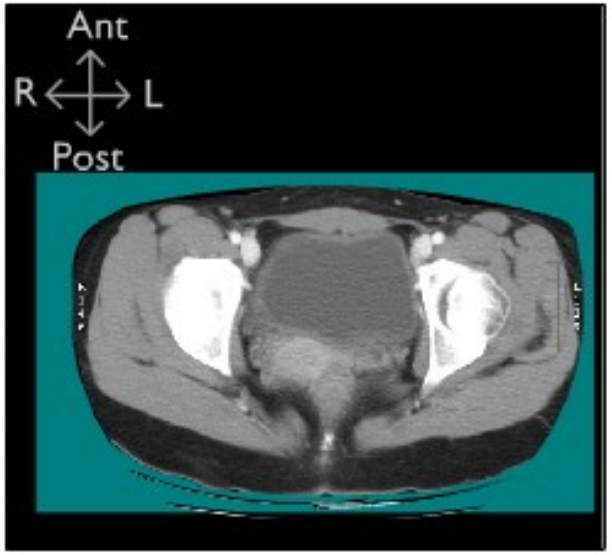




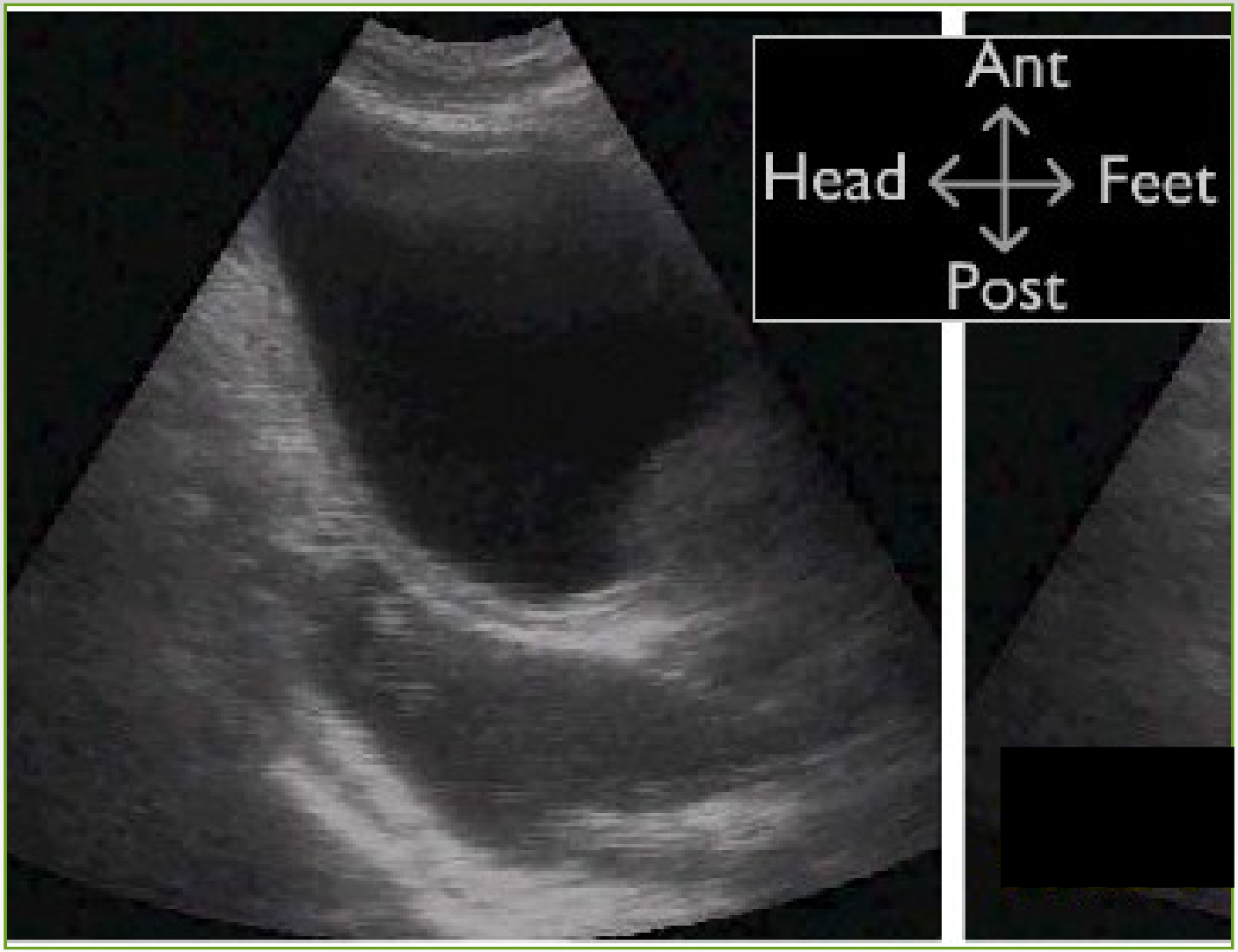
Actual ultrasound image



Labeled ultrasound image



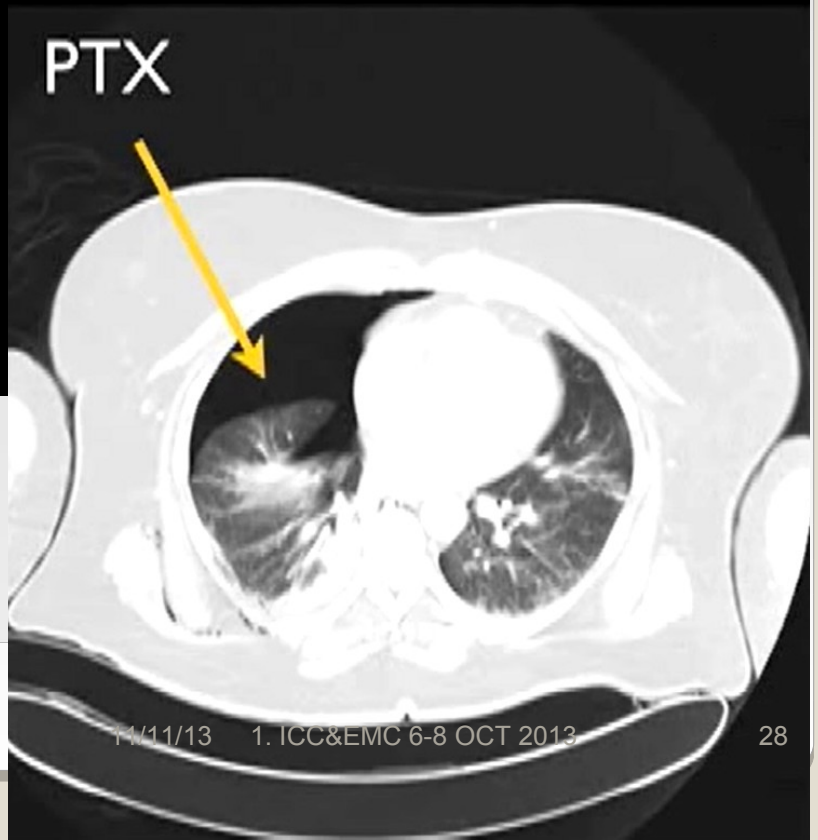
Cross-sectional CT anatomy


Ant
Head
Feet
Post

Pulmonary evaluation with US for ICU patient

CXR-Radiology Reading: PTX Negative

CT-Large Right PTX

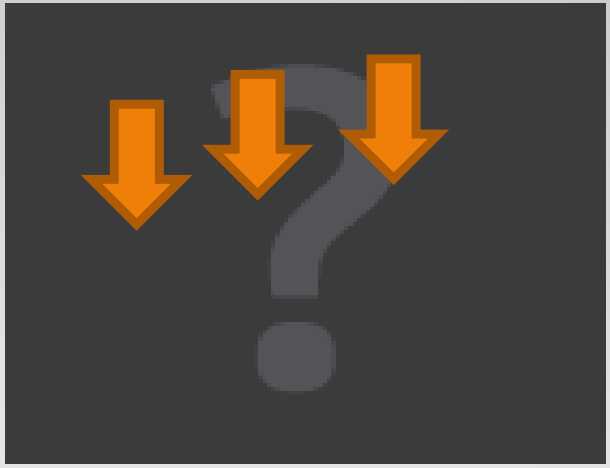


- Direct graphy specificity for pneumothorax %53
- Gold standart is "**CT**"

- Lung is not suitable for US
- Thoraks US pnomothorax sensitivity (relative CT) %92
- US has some technical superiority
- 4-12 MHz probe

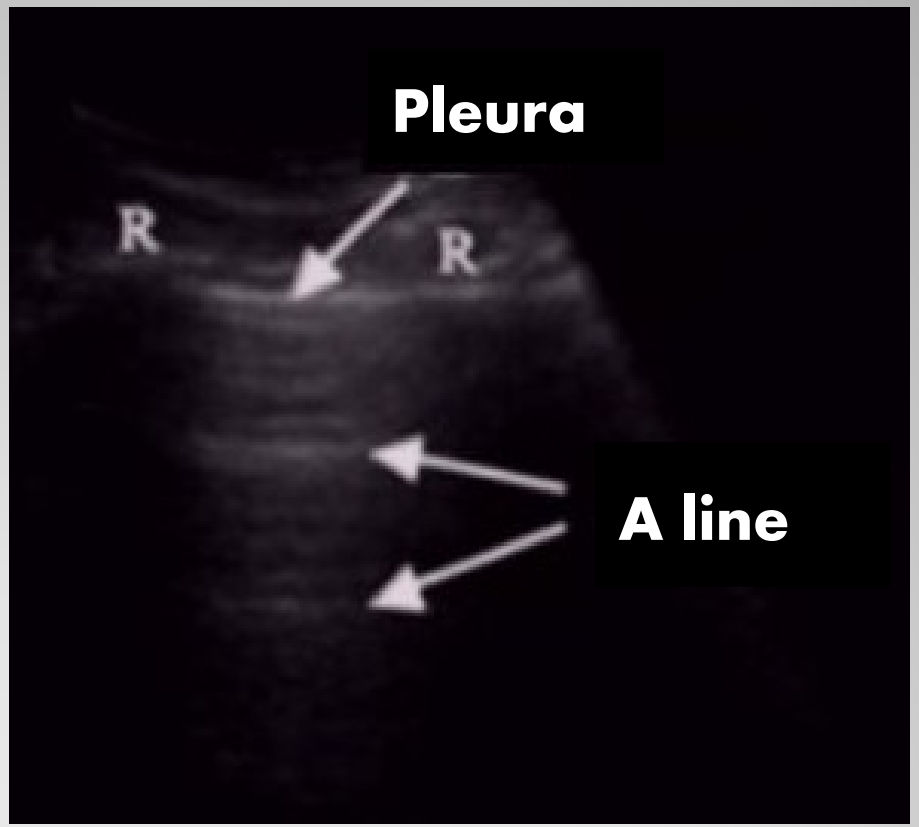
SLS (Sliding Lung Sign)

- Normal

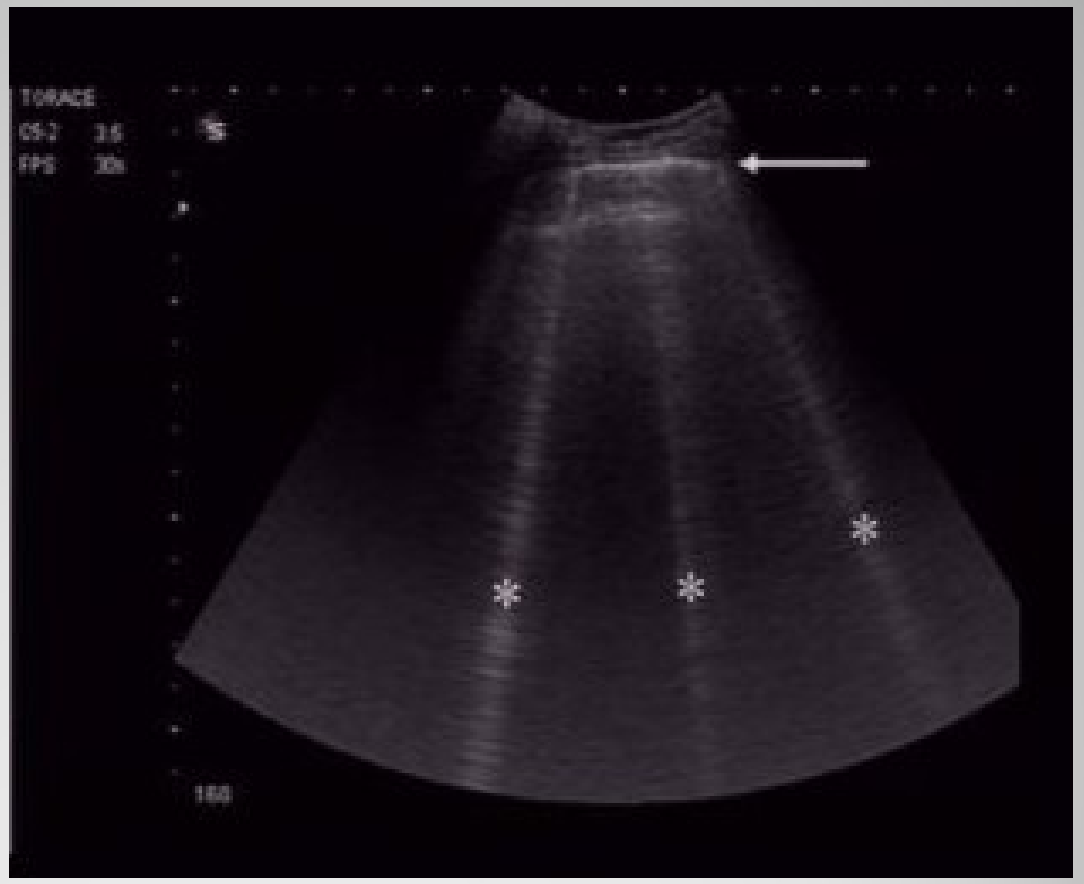


- Pnomothorax?

A line

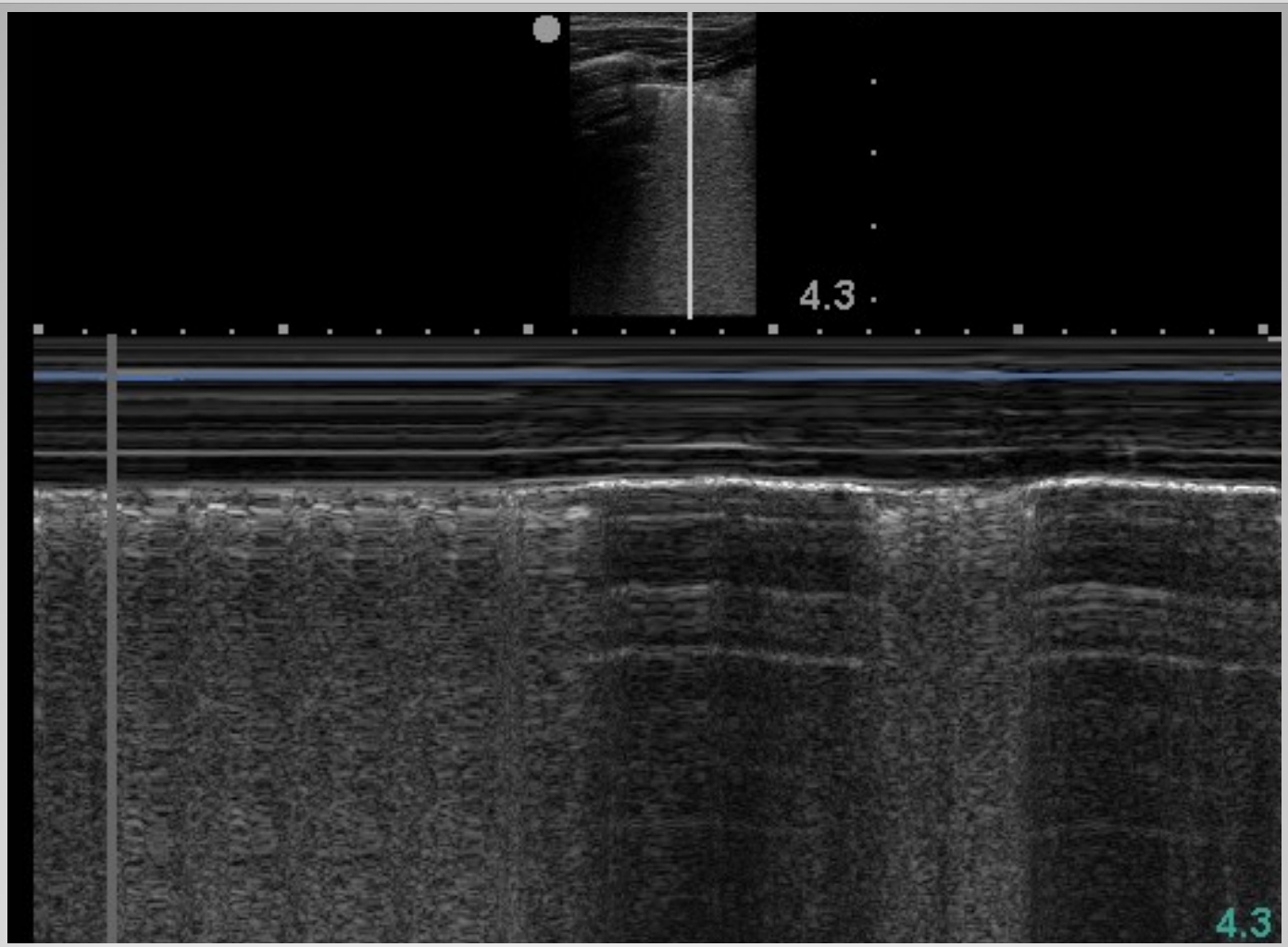


- Normal

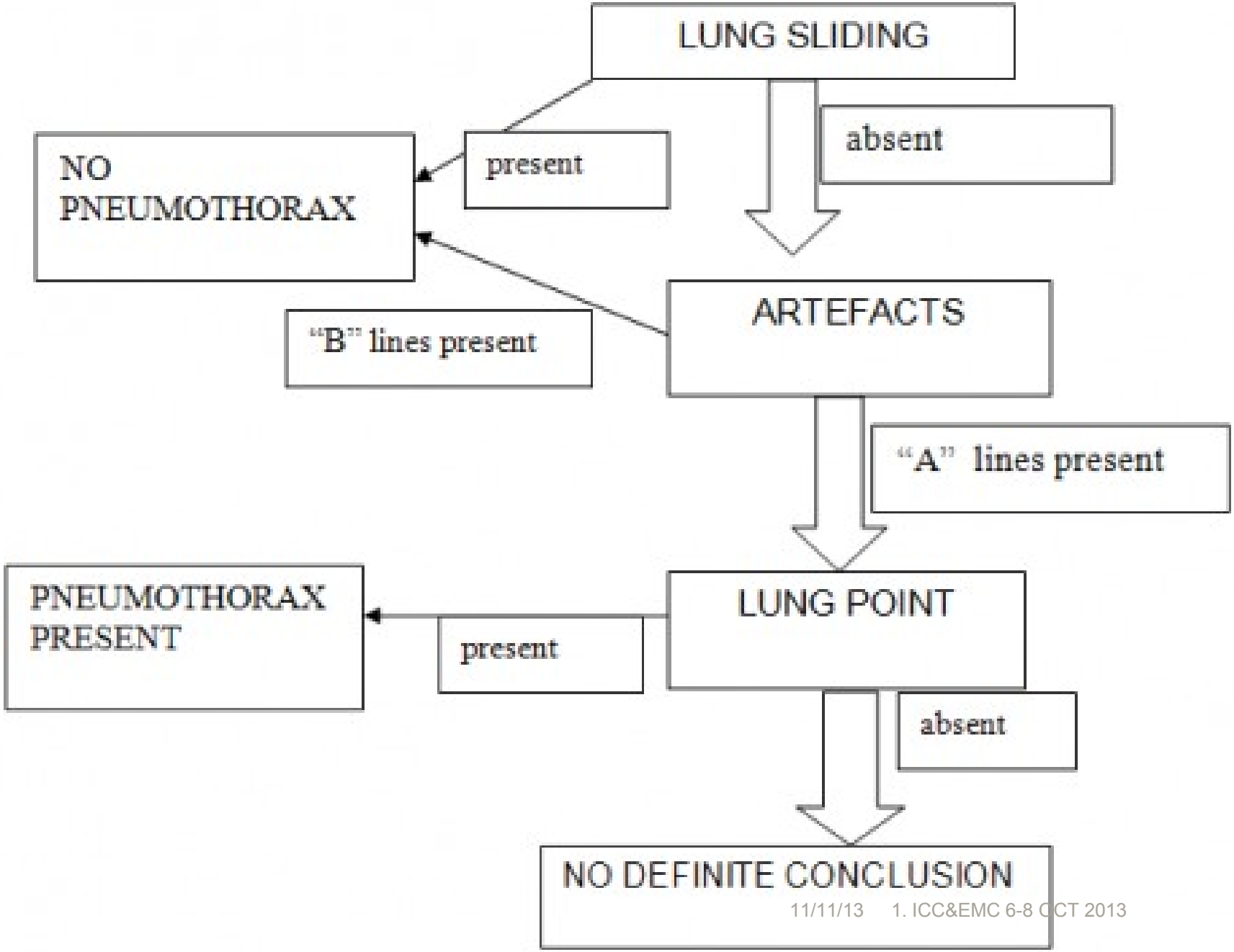


B line (comet tail – rocket sign)

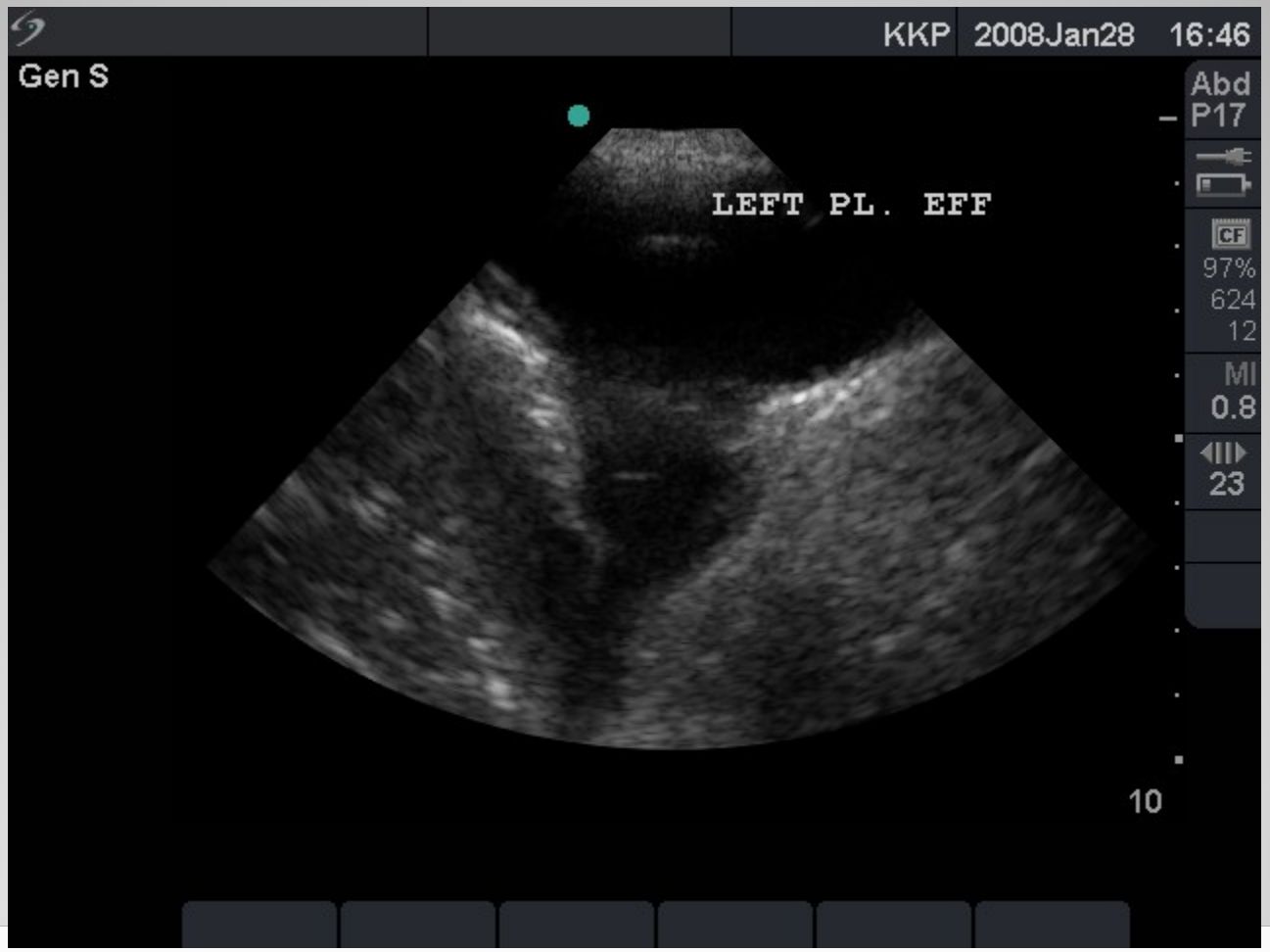
Lung point



Dynamic changes

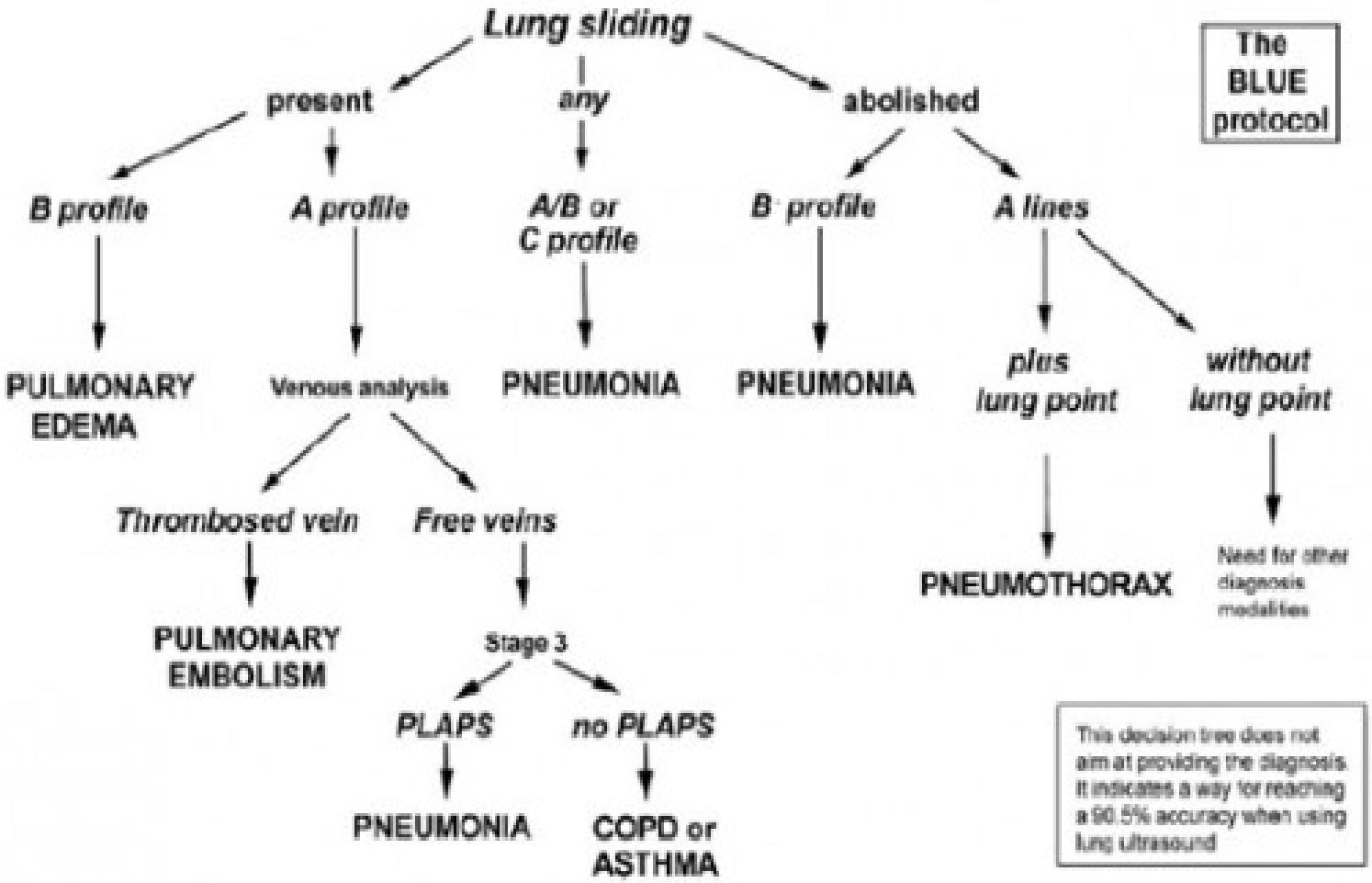

LUNG SLIDING
present
absent
NO PNEUMOTHORAX
"B" lines present
ARTEFACTS
"A" lines present
PNEUMOTHORAX PRESENT
present
LUNG POINT
absent
NO DEFINITE CONCLUSION

Pleural Effusion



BLUE

(Bedside Lung Ultrasound in Emergency)



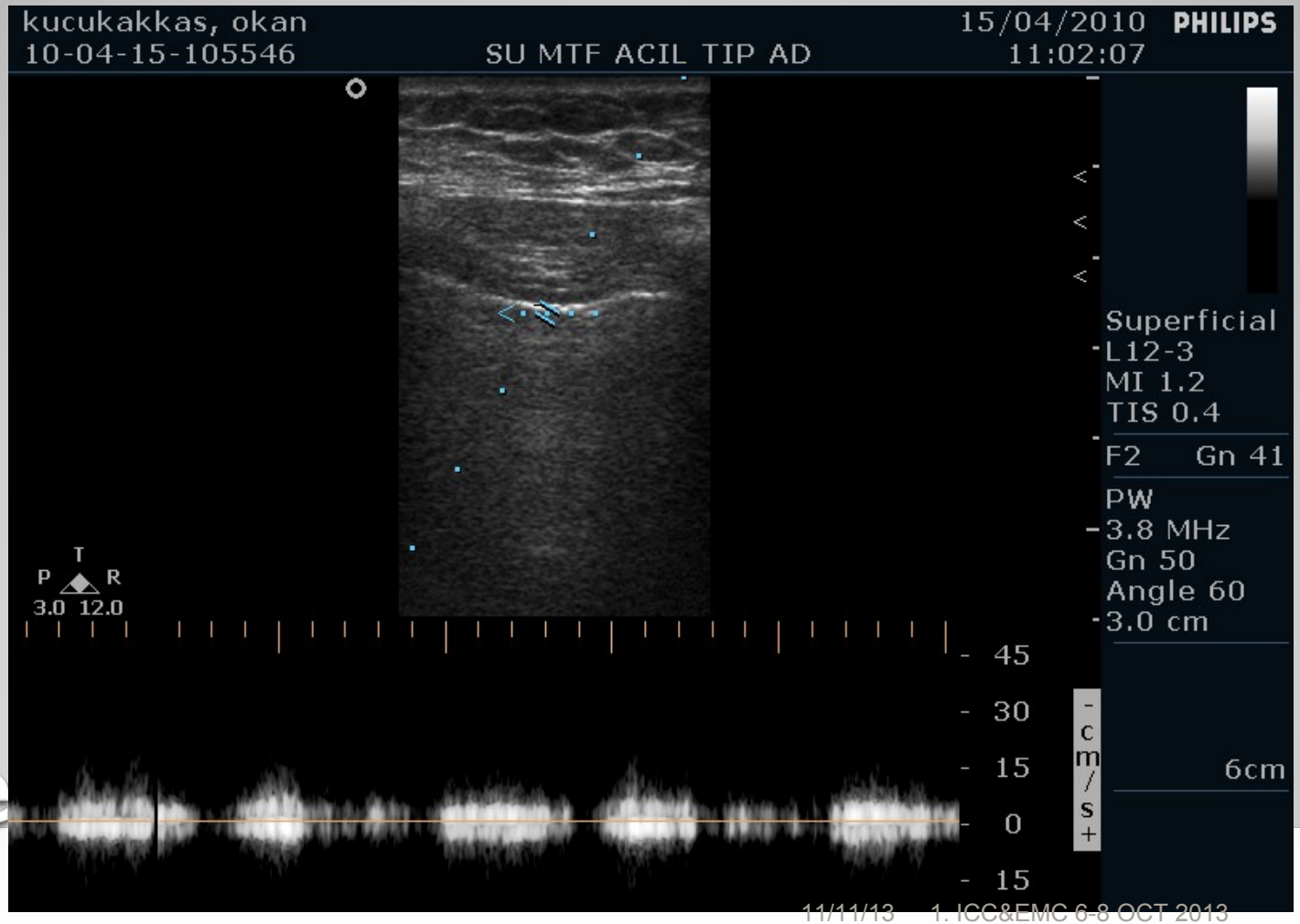
A profile means predominantly A lines
B profile means predominantly multiple anterior diffuse B lines
A / B profile means predominant A lines on one side and predominant B lines on the other side.
C profile means anterior alveolar consolidation(s)
PLAPS means ***posterolateral alveolar and/or pleural syndrome*** detected on a lateral sub-posterior sonological examination.

PAKISTAN JOURNAL OF
MEDICAL SCIENCES
QUARTERLY

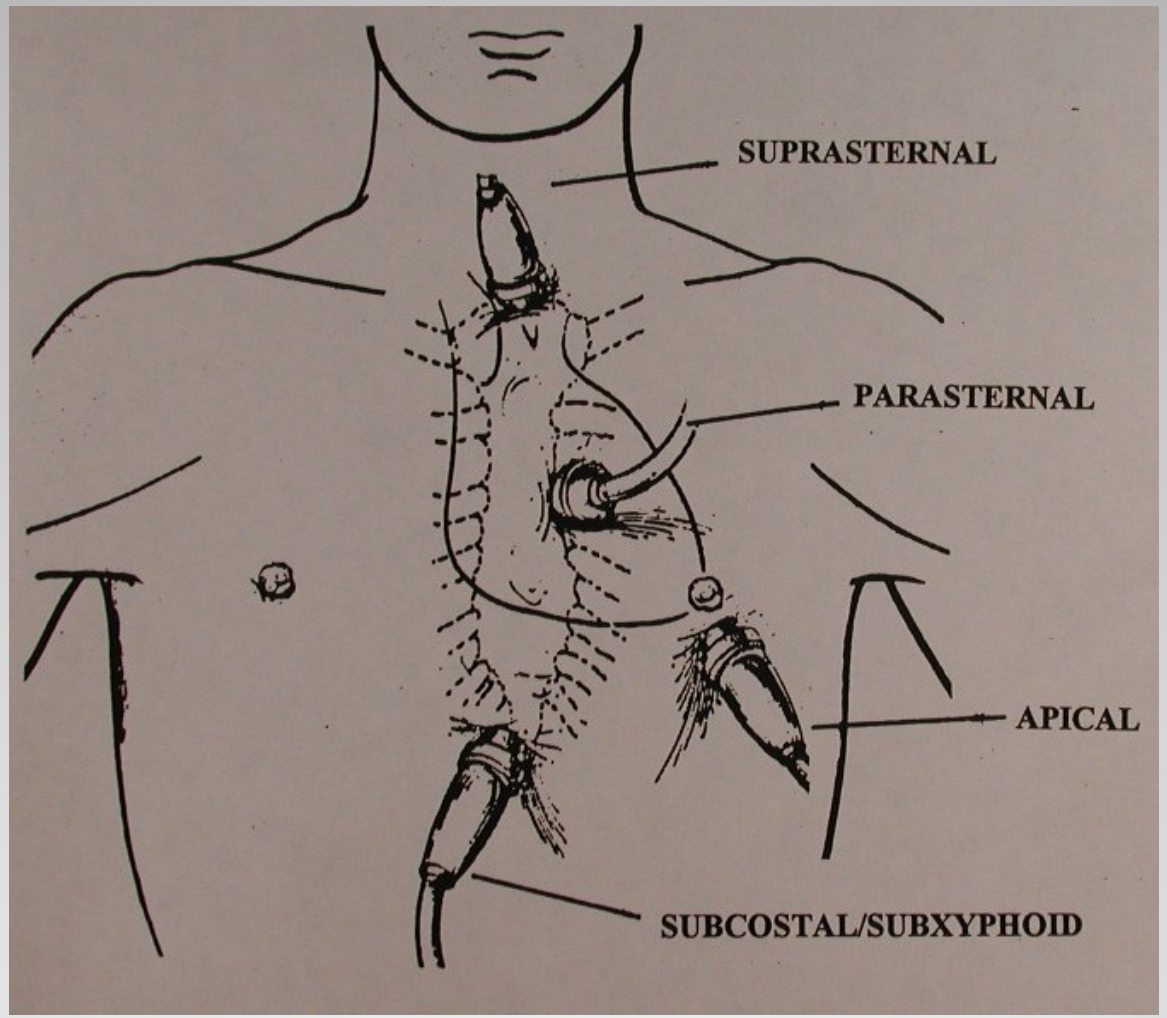
A new development in emergency department ultrasonography: Pleural Sliding Sound (PSS)

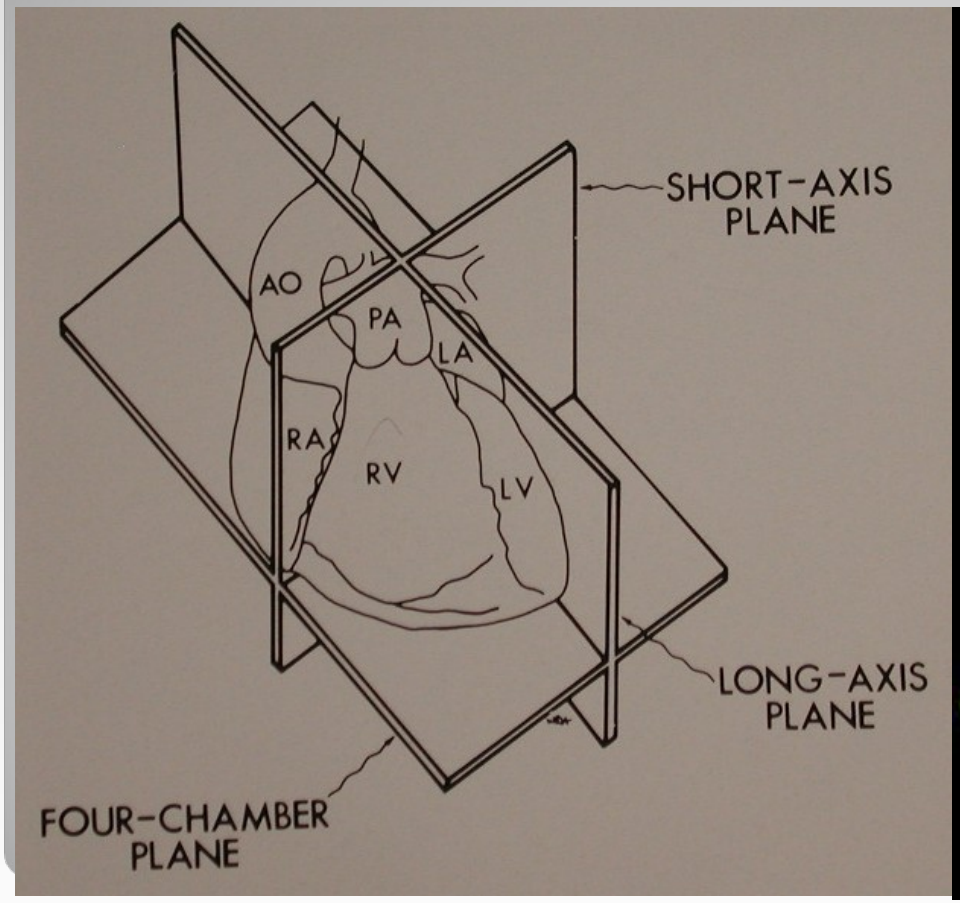
Sadik Abdullah Girisgin, Osman Karaoglan, Goknil Calik, Mehmet Ergin, Sedat Kocak, Basar Cander

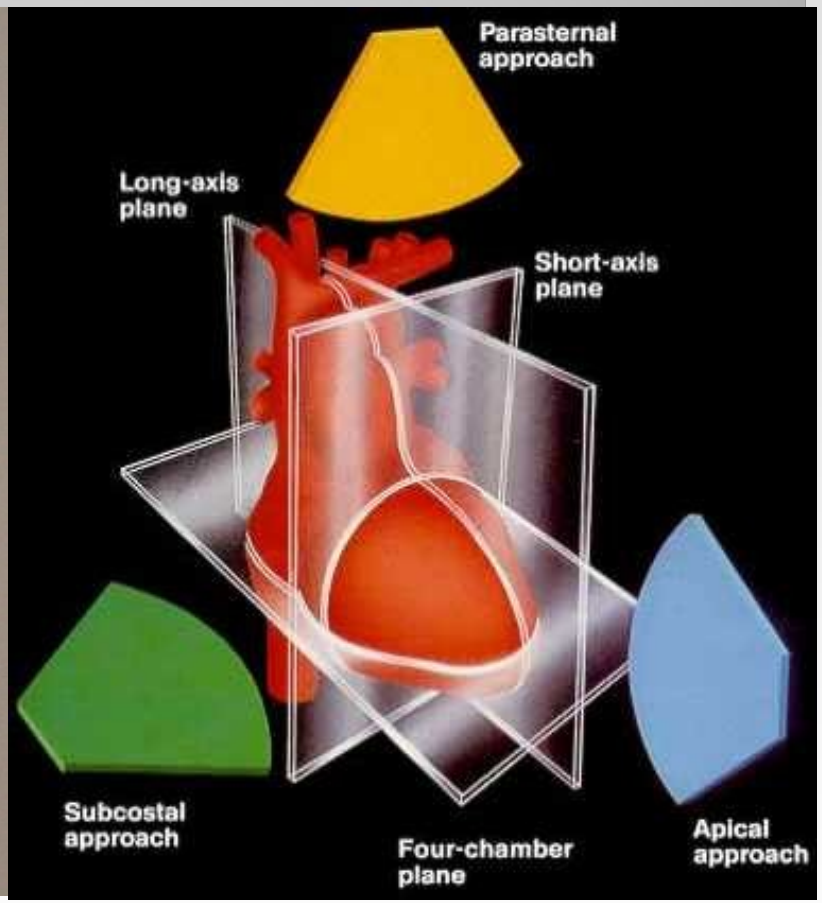
Ple


kucukakkas, okan
10-04-15-105546
SU MTF ACIL TIP AD
15/04/2010
11:02:07
PHILIPS
Superficial
L12-3
MI 1.2
TIS 0.4
F2 Gn 41
PW
3.8 MHz
Gn 50
Angle 60
3.0 cm
6cm
T
P R
3.0 12.0
45
30
15
0
15
cm/s

Cardiac evaluation details with US for ICU patient


SUPRASTERNAL
PARASTERNAL
APICAL
SUBCOSTAL/SUBXYPHOID


SHORT-AXIS
PLANE
AO
PA
LA
RA
RV
LV
LONG-AXIS
PLANE
FOUR-CHAMBER
PLANE

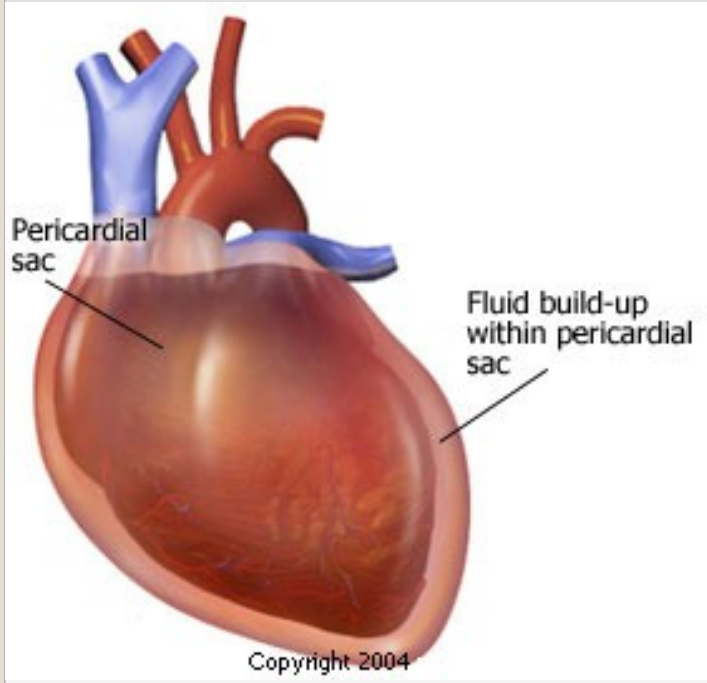

Parasternal
approach
Long-axis
plane
Short-axis
plane
Subcostal
approach
Four-chamber
plane
Apical
approach

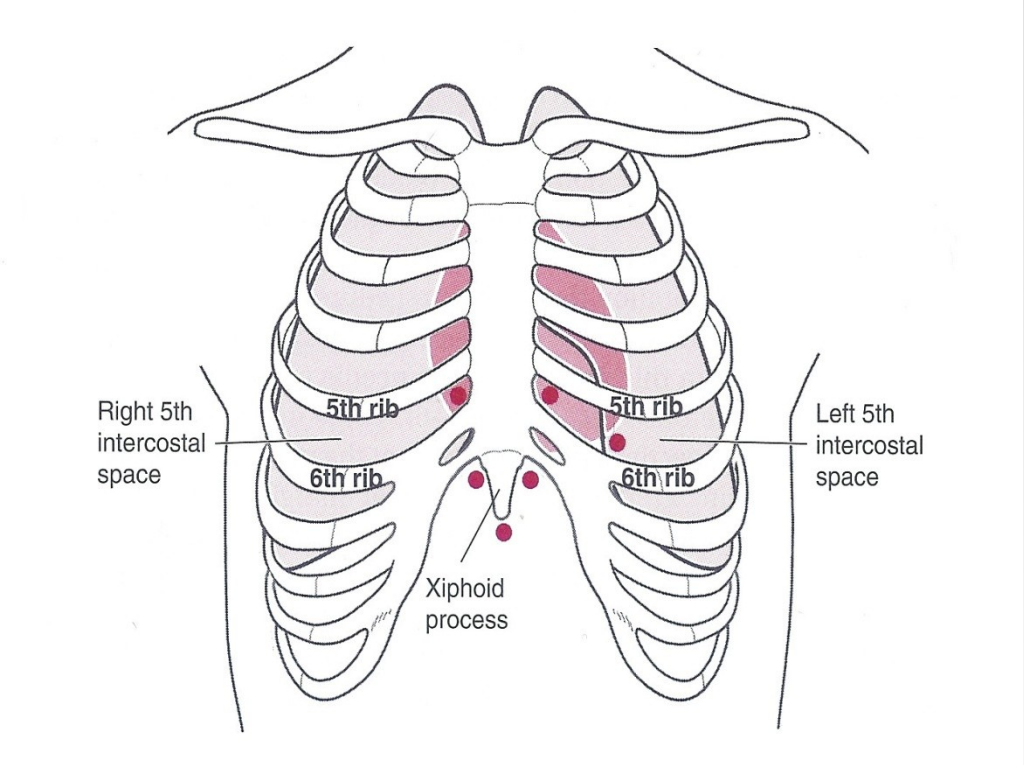
ULTRASOUND GUIDED PROCEDURES

- Intravenous lines
  - Internal jugular
  - Femoral
  - Deep brachial
- Paracentesis
- Thoracentesis
- Bladder aspiration
- Transvenous pacemaker
- Abscess drainage
- Lumbar punction
- Artrocentesis

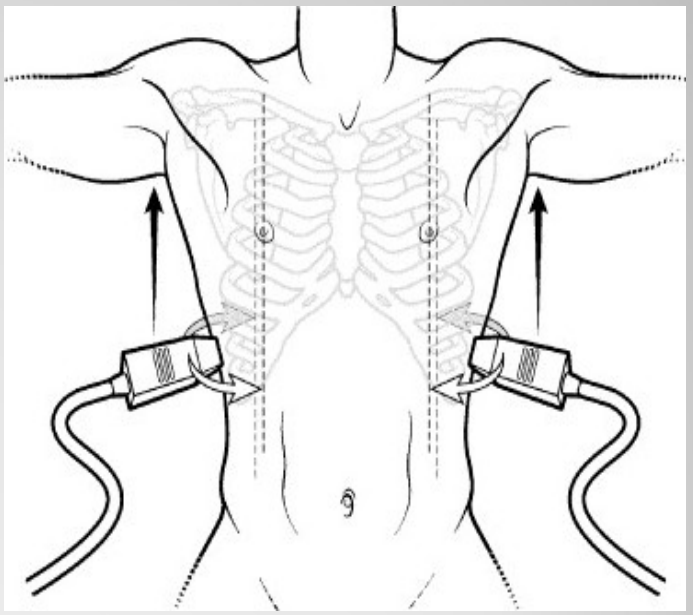
Procedural

Pericardiosynthesis





Pleural fluid and thorasynthecis



PROTOCOLS

RUSH

(Rapid Ultrasound for Shock and Hypotension)

- **Bedside**
  - **H**eart
  - **I**nferior Vena Cava
  - **M**orison's/FAST, lower thorax (or abdominal thorax window)
  - **A**orta
  - **P**neumothorax
- **These components can be recalled with the mnemonic: HI-MAP**

RUSH

Heart in RUSH

- Pericardial effusion/tamponade;
- Right ventriculer failure (pulmonary embolism)
- Left ventriculer function (parasternal long axis and the four chamber view)

Heart

Inferior Vena Cava

- **Estimate fluid necessesity**
  - **IVC diameter of <1.5 cm (complete inspiratory)**

low CVP (<5)

  - **IVC diameter of >2.5 cm (no inspiratory collapse)**

high CVP (> 20) and fluid loading.

- **Like FAST**
  - **right upper quadrant,**
  - **left upper quadrant,**
  - **suprapubic area**

- **ectopic pregnancy,**
- **massive ascites,**
- **ruptured viscus,**
- **spontaneous intraabdominal bleeding,**
- **intraperitoneal rupture of an AAA, etc.**

Morison's and The FAST Exam Views With Hemothorax Windows

Aorta

AAA 4 level (Xiphoid to umblicus)

- **Near heart**
- **Suprarenal**
- **Infrarenal**
- **Above iliac bifurcation**

- **Aorta diameter >5 cm (+ hypotension =AAA)**

Pneumothorax

Think tension pnx

- **Central line**
- **Pacemaker placement**
- **Thoracentesis**

- **Bi-hemithorax anterior 3. intercostal space (begin)**
- **high frequency probe**
- **M-mode**
  - **ocean/beach or seashore – no pneumothorax**
  - **continuous ocean or stratosphere sign pneumothorax**

OTHERS

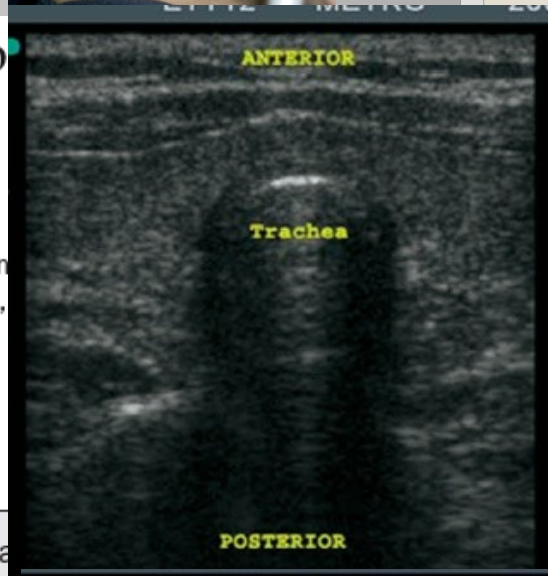
Pilot Study to Evaluate the Accuracy of Ultrasonograp in Confirming Endotracheal Tube Placement

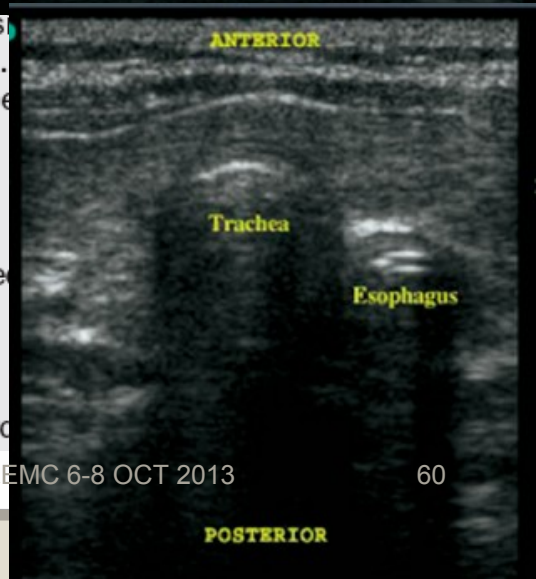
lra L. Werner, MD, RDMS
les E. Smith, MD
ica R. Goldstein, MD
ert A. Jones, DO, RDMS
K. Cydulka, MD, MS

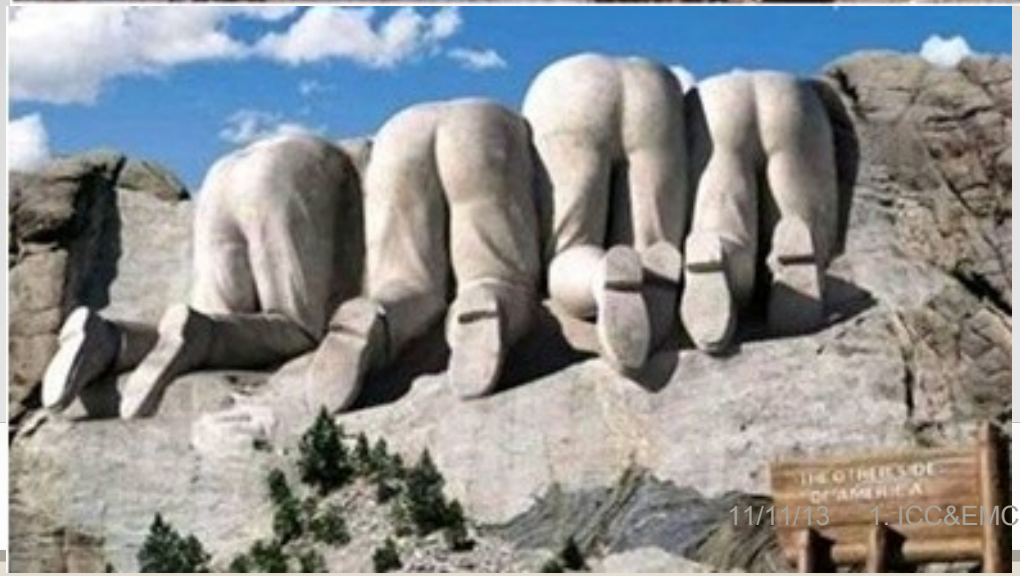
From the Department of Emergency Medicine, MetroHealth Medical Center/Clevelan Foundation (Werner, Goldstein, Jones, Cydulka), and the Department of Anesthesia, Medical Center (Smith), Cleveland, OH.

Study objective: Visualization of the vocal cords and end-tidal capnography are the usual standa in confirming endotracheal tube placement. Vocal cord visualization is, however, not always poss and capnography is not 100% reliable and requires ventilation of the lungs to confirm placement. goal of this study is to determine the accuracy of ultrasonography for detecting endotracheal tube placement into the trachea and esophagus in real time.

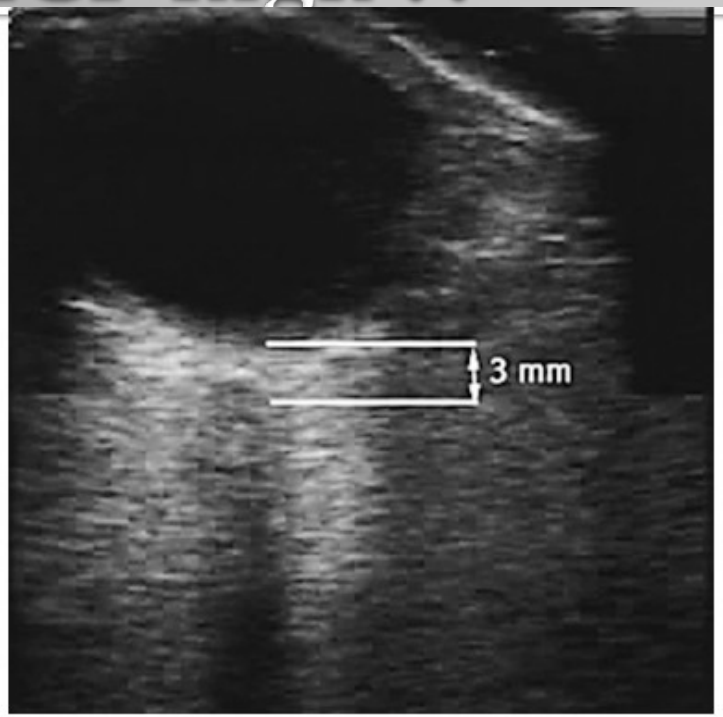
Methods: This was a prospective, randomized, controlled study. Eligible patients were adults undergoing elective surgery requiring intubation. Exclusion criteria were a history of difficult intubation, abnormal airway anatomy, aspiration risk factors, and esophageal disease. Thirty-three patients were enrolled. After induction of anesthesia and neuromuscular blockade, the anesthesiologist placed the endotracheal tube in the trachea and esophagus in random order with direct laryngoscopy. During the intubations, a high-frequency, linear transducer was placed transversely on the neck at the suprasternal notch. Two emergency physicians, blinded to the orc

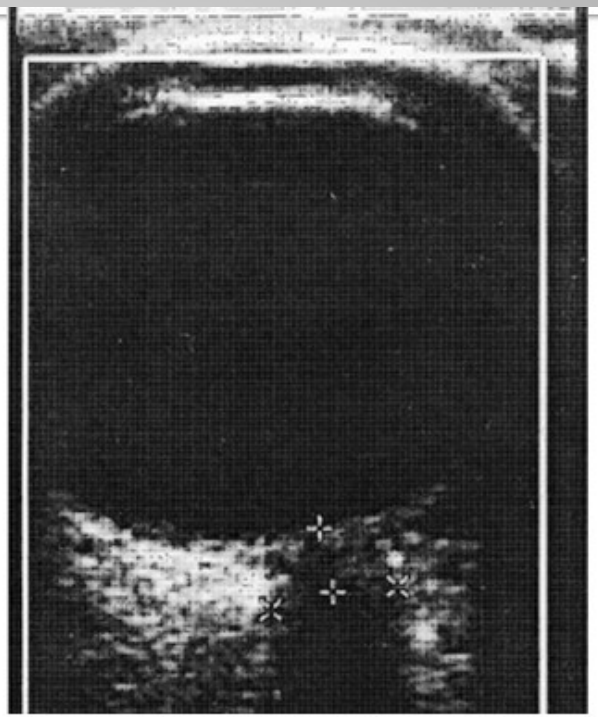






ICP high ??





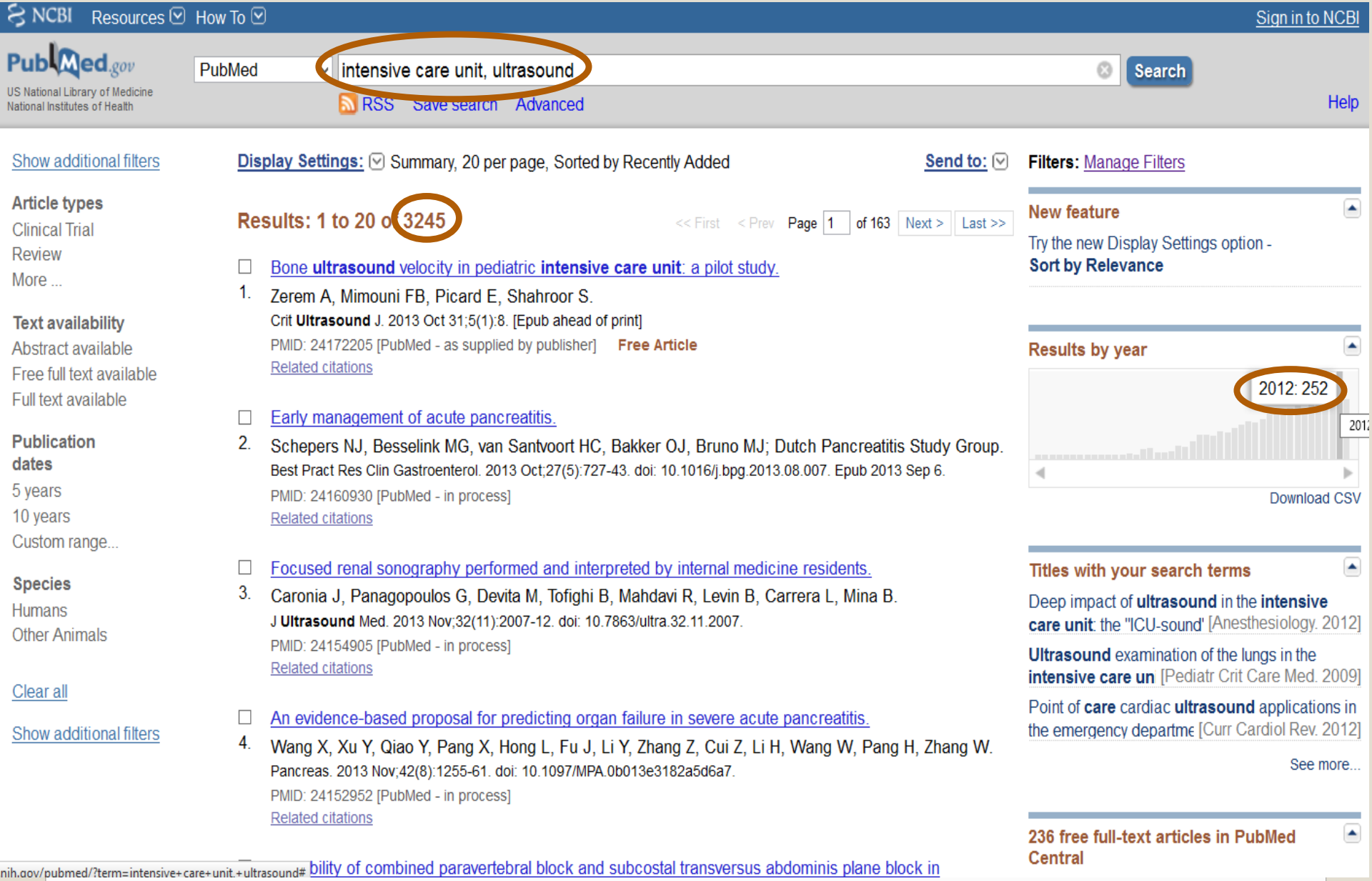
The role of optic nerve ultrasonography in the diagnosis of elevated intracranial pressure

Abdullah Sadik Girisgin, Erdal Kalkan, Sedat Kocak, Basar Cander, Mehmet Gul, Mustafa Semiz

Emerg Med J 2007;**24**:251–254. doi: 10.1136/emj.2006.040931

Objective: To evaluate the convenience and utility of optic nerve ultrasonography (ONUS) in the evaluation of emergency patients with elevated intracranial pressure (EICP) due to traumatic or non-traumatic causes.
Methods: This study was conducted between May 2005 and December 2005 in the emergency department of


A
A
B


NCBI Resources How To
Sign in to NCBI
PubMed.gov
US National Library of Medicine
National Institutes of Health
PubMed
intensive care unit, ultrasound
Search
RSS Save search Advanced
Help
Show additional filters
Article types
Clinical Trial
Review
More ...
Text availability
Abstract available
Free full text available
Full text available
Publication dates
5 years
10 years
Custom range...
Species
Humans
Other Animals
Clear all
Show additional filters
Display Settings: Summary, 20 per page, Sorted by Recently Added
Send to:
Results: 1 to 20 of 3245
<< First < Prev Page 1 of 163 Next > Last >>
Bone ultrasound velocity in pediatric intensive care unit: a pilot study.
1. Zerem A, Mimouni FB, Picard E, Shahroor S.
Crit Ultrasound J. 2013 Oct 31;5(1):8. [Epub ahead of print]
PMID: 24172205 [PubMed - as supplied by publisher] Free Article
Related citations
Early management of acute pancreatitis.
2. Schepers NJ, Besselink MG, van Santvoort HC, Bakker OJ, Bruno MJ; Dutch Pancreatitis Study Group.
Best Pract Res Clin Gastroenterol. 2013 Oct;27(5):727-43. doi: 10.1016/j.bpg.2013.08.007. Epub 2013 Sep 6.
PMID: 24160930 [PubMed - in process]
Related citations
Focused renal sonography performed and interpreted by internal medicine residents.
3. Caronia J, Panagopoulos G, Devita M, Tofighi B, Mahdavi R, Levin B, Carrera L, Mina B.
J Ultrasound Med. 2013 Nov;32(11):2007-12. doi: 10.7863/ultra.32.11.2007.
PMID: 24154905 [PubMed - in process]
Related citations
An evidence-based proposal for predicting organ failure in severe acute pancreatitis.
4. Wang X, Xu Y, Qiao Y, Pang X, Hong L, Fu J, Li Y, Zhang Z, Cui Z, Li H, Wang W, Pang H, Zhang W.
Pancreas. 2013 Nov;42(8):1255-61. doi: 10.1097/MPA.0b013e3182a5d6a7.
PMID: 24152952 [PubMed - in process]
Related citations
bility of combined paravertebral block and subcostal transversus abdominis plane block in
Filters: Manage Filters
New feature
Try the new Display Settings option - Sort by Relevance
Results by year
2012: 252
Download CSV
Titles with your search terms
Deep impact of ultrasound in the intensive care unit: the "ICU-sound' [Anesthesiology. 2012]
Ultrasound examination of the lungs in the intensive care un [Pediatr Crit Care Med. 2009]
Point of care cardiac ultrasound applications in the emergency departme [Curr Cardiol Rev. 2012]
See more...
236 free full-text articles in PubMed Central

WHAT IS THE NEW?

Int J Nephrol Renovasc Dis. 2013 Oct 14;6:215-21. doi: 10.2147/IJNRD.S46788.

Hemodialysis catheter implantation in the axillary vein by ultrasound guidance versus palpation or anatomical reference.

Valencia CA, Villa CA, Cardona JA.

Internal Medicine, Nephrology, Caldas University, Manizales, Colombia.

Ann Card Anaesth. 2013 Oct-Dec;16(4):296-8. doi: 10.4103/0971-9784.119185.

Use of optimized ultrasound axis along with marked introducer needle to prevent mechanical complications of internal jugular vein catheterization.

Ghatak T, Singh RK, Baronia AK.

Department of Critical Care Medicine, SGPGIMS, Lucknow, Uttar Pradesh, India.

J Vasc Access. 2013 Oct 7;0(0):0. doi: 10.5301/jva.5000190. [Epub ahead of print]

The role of ultrasound as an adjunct to arterial catheterization in critically ill surgical and intensive care unit patients.

Zochios VA, Wilkinson J, Dasgupta K.

1 Cardiac Intensive Care Unit, Papworth Hospital NHS Trust, Papworth Everard, Cambridge - UK.

Abstract

<sec id="st1"><title>ABSTRACT</title> <bold><italic>Objective:</italic> To review the evidence behind Ultrasound (US) guided placement of arterial cannulae and its use in the critically ill population.</bold> <bold><italic>Data sources:</italic> We performed a computer-aided literature search using set search terms and electronic data bases of PubMed and EMBASE from their commencement date through the end of July 2013.</bold> <bold><italic>Summary of review:</italic> Insertion of intra-arterial catheters is a commonly performed invasive procedure in the peri-operative and intensive care setting that facilitates invasive blood pressure and cardiac output monitoring as well as frequent blood sampling. Arterial catheterization can be particularly challenging in critically ill and high-risk surgical patients with circulatory collapse, low cardiac output state and peripheral edema, all of which can limit the ability to successfully palpate and cannulate the artery. There is a convincing body of evidence suggesting a decrease in complication rate and first-pass success rate in US guided central venous catheter (CVC) insertion compared with the landmark technique. While most intensivists and peri-operative physicians are familiar with US guided CVC placement, fewer use US to guide arterial access.</bold> <bold><italic>Conclusions:</italic></bold> Most studies have demonstrated a higher success rate when using US guidance for arterial cannulation. Moreover, the technique permits more rapid access and establishment compared with the conventional palpation technique. However, there is evidence opposing the routine use of US to guide arterial cannula insertion. Further studies are required to ascertain the benefits and cost effectiveness of US guided arterial catheterization in

Crit Care. 2013 Aug 23;17(4):449. [Epub ahead of print]

Contrast-enhanced ultrasound: a new vision of microcirculation in the intensive care unit.

Harrois A, Duranteau J.

AP-HP, Service d'Anesthésie-Réanimation, Hôpitaux Universitaires Paris-Sud, Université Paris-Sud, Hôpital de Bicêtre, Le Kremlin-Bicêtre 94275, France.
jacques.duranteau@bct.aphp.fr.

Abstract

To gain new insights into renal perfusion and pathogenesis of acute kidney injury in intensive care unit (ICU) patients, we need new
evaluate renal microcirculation. In addition, a bedside technique applicable in the ICU could be extremely useful for physicians to a
therapeutic/preventive modalities for kidney perfusion in each patient. Contrast-enhanced ultrasound (CEUS) has been validated t
quantify the microcirculation up to capillary perfusion in several organs. In a recent issue, Schneider and colleagues suggest that C
tolerated and able to quantify cortical renal microcirculation in patients undergoing cardiac surgery. In addition, CEUS derived-para
decrease in renal perfusion occurring within 24hours of surgery in patients at risk of acute kidney injury. This study opens up new p

Crit Care. 2013 Sep 13;17(5):237. [Epub ahead of print]

Clinical review: The role of ultrasound in estimating extra-vascular lung water.

Shyamsundar M, Attwood B, Keating L, Walden AP.

Intensive Care Unit, Royal Berkshire Hospital, London Road, Reading, Berkshire, RG1 5AN, United Kingdom. andrew.walden@nhs.net.

Abstract

The estimation of extra-vascular lung water (EVLW) is an essential component in the assessment of critically ill pat
associated with mortality and its manipulation has been shown to improve outcome. Accurate assessment of lung
imaging but these are impractical for real-time measurement in sick patients and have been superseded by single
useful, single thermo-dilution requires repeated calibration and is prone to error, suggesting a need for other monit
was not thought amenable to ultrasound examination owing to the high acoustic impedance of air; however, the ide
lung has led to increased use of ultrasound as a point of care investigation for both diagnosis and to monitor respo

Neurochirurgie. 2013 Apr;59(2):55-9. doi: 10.1016/j.neuchi.2013.02.001. Epub 2013 Mar 21.

[Interest of optic nerve sheath diameter ultrasonography in dectecting non-invasively raised intracranial pressure].

[Article in French]

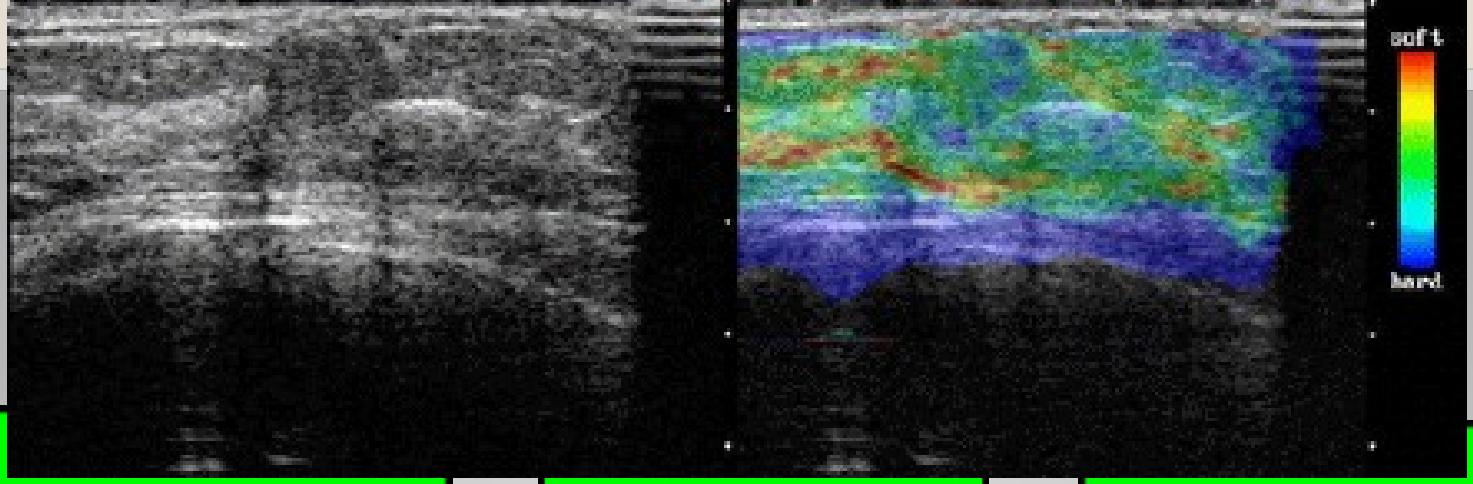
Messerer M, Berhouma M, Messerer R, Dubourg J.

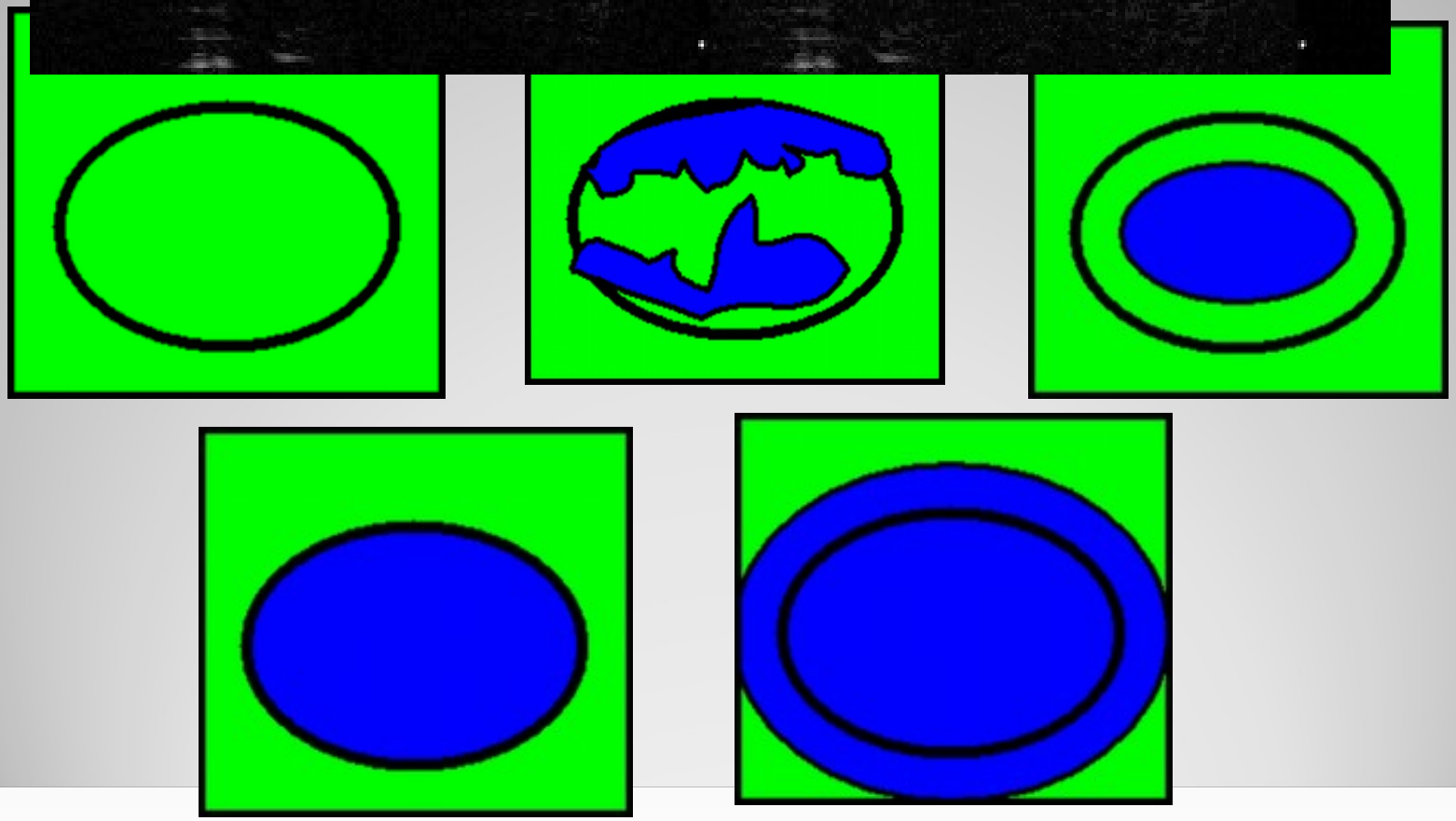
Service de neurochirurgie, département des neurosciences cliniques, centre hospitalier universitaire Vaudois, Lausanne, Suisse.

Abstract

Intracranial hypertension is an emergency suspected from clinical symptoms, imaging data and ophthalomologic signs. Intracranial hypertensi confirmed by invasive intracranial monitoring, which is the gold standard technique to measure intracranial pressure (ICP). Because of compli hemorrhage or infection, non-invasive methods have been developed such as neuroimaging, transcranial Doppler sonography and optic nerv diameter (ONSD) ultrasonography. We have reviewed ONSD technique that detects intracranial hypertension related volume variations of subarachnoid space along the retro bulbar segment of the optic nerve. Technique, indications and prospects are discussed.

US Elastography





Elasticity Score

- IF YOU ASK ME “WHICH SOUND IS BEST IN THE ICU”
- I SAY “ULTRASOUND”


Would you like milk for your coffee
No thanks….
THANKS FOR LISTENING
sgirisgin@yahoo.com