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Curriculum on the Use of Bedside Ultrasonography in Critical Care

Introduction and overview

Plan

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1-) Introduction: Bedside ultrasound in the ICU.

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1-) Introduction: Bedside ultrasound in the ICU.
2-) Indications for bedside U/S in the ICU

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1-) Introduction: Bedside ultrasound in the ICU.
2-) Indications for bedside U/S in the ICU
3-) Technical aspects and safety

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4-) Impact of bedside ultrasound in the ICU

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5-) Hand-carried ultrasound (HCU) in the ICU

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- Introduction -

Bedside ultrasound in the ICU

- Constantly evolving technology with expanding diagnostic applications at the bedside.
- Rapid, accurate and non-invasive technique.
- Can be used with success by non-cardiologist (anesthesio-logists,intensivists, ER physicians,…) with proper training.
- Hand-carried devices enhance bedside application.

- Introduction -

Potential uses of bedside ultrasonography in the ICU by the intensivist

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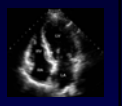
Potential uses of bedside ultrasonography in the ICU by the intensivist

- Assessment of cardiac anatomy and function



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- Assessment of cardiac anatomy and function
- Assessment of pleural effusions and intra-abdominal fluid collection

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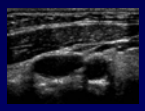
- Assessment of great vessels



- Introduction -

Potential uses of bedside ultrasonography in the ICU by the intensivist

- Assessment of cardiac anatomy and function
- Assessment of pleural effusions and intra-abdominal fluid collection
- Assessment of great vessels
- Assessment of the urinary bladder

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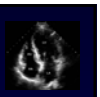
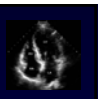
General indications for performance of an echocardiographic examination in the ICU

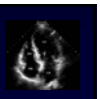


General indications for performance of an echocardiographic examination in the ICU



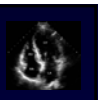
1. Hemodynamic instability

General indications for performance of an echocardiographic examination in the ICU



1. Hemodynamic instability
   a. Ventricular failure
   b. Hypovolemia
   c. Pulmonary embolism
   d. Acute valvular dysfunction
   e. Cardiac tamponade
   f. Complications after cardiothoracic surgery

General indications for performance of an echocardiographic examination in the ICU



1. Hemodynamic instability
   a. Ventricular failure
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2. Infective endocarditis

General indications for performance of an echocardiographic examination in the ICU

3. Aortic dissection and rupture

General indications for performance of an echocardiographic examination in the ICU

3. Aortic dissection and rupture

4. Unexplained hypoxemia

General indications for performance of an echocardiographic examination in the ICU

3. Aortic dissection and rupture

4. Unexplained hypoxemia

5. Source of embolus

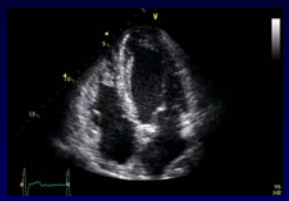
Hemodynamic instability
- ventricular failure -

Parasternal long-axis

Hemodynamic instability
- ventricular failure -

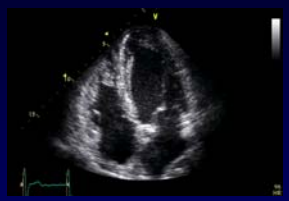
Parasternal long-axis

Hemodynamic instability
- pulmonary embolism + RV failure -



Apical 4-chamber

Hemodynamic instability
- pulmonary embolism + RV failure -



Apical 4-chamber

Hemodynamic instability
- pulmonary embolism + RV failure -

Apical 4-chamber

Hemodynamic instability
- pulmonary embolism + RV failure –
" McConnell sign" in acute PE

Hemodynamic instability
- pulmonary embolism + RV failure –
" McConnell sign" in acute PE

Before thrombolysis

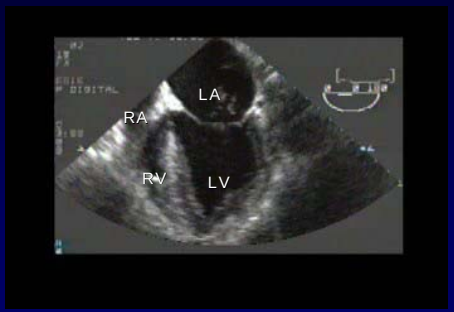
After thrombolysis

Apical 4-chamber view

Hemodynamic instability
- acute valvular dysfunction –
Ruptured posterolateral papillary muscle with acute inferior MI

TEE views

Hemodynamic instability
- acute valvular dysfunction –
Ruptured posterolateral papillary muscle with acute inferior MI

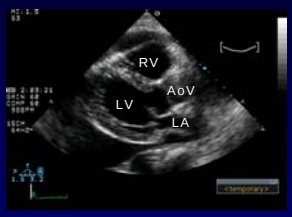


TEE views

Hemodynamic instability
- cardiac tamponade -

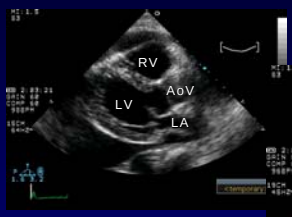
Parasternal long-axis view

Hemodynamic instability
- cardiac tamponade -

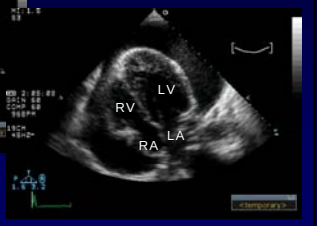


Parasternal long-axis view

Hemodynamic instability
- cardiac tamponade -



Parasternal long-axis view



Apical 4-chamber view

Other indications for use of bedside ultrasonography by the intensivist

Other indications for use of bedside ultrasonography by the intensivist

1. Central line placement

Other indications for use of bedside ultrasonography by the intensivist

1. Central line placement
2. Assessment of pleural effusions and intra-abdominal fluid collections

Other indications for use of bedside ultrasonography by the intensivist

1. Central line placement
2. Assessment of pleural effusions and intra-abdominal fluid collections
3. Urinary bladder scan

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Technical aspects

A. Acoustic window in the critically ill patients

Technical aspects

A. Acoustic window in the critically ill patients

- Sub-optimal imaging may result as a consequence of:

Technical aspects

A. Acoustic window in the critically ill patients

- Sub-optimal imaging may result as a consequence of:

- Air distribution (mechanical ventilation, pneumothorax, s/c air)
- Inadequate positioning
- Surgical wound and dressings, tapes, tubing, chest tubes
- Obesity, COPD, anasarca
- Lack of patient's cooperation

Technical aspects

A. Acoustic window in the critically ill patients

Failure rate of TTE may be up to 15-30% of patients in the ICU

Technical aspects

A. Acoustic window in the critically ill patients

Failure rate of TTE may be up to 15-30% of patients in the ICU

➡ Important pathologies can be missed if no further imaging studies are ordered (eg. TEE, CT scan,…)

Potential pittfalls of TTE in the ICU
Suboptimal imaging
24 year-old patient with left chest tube after trauma

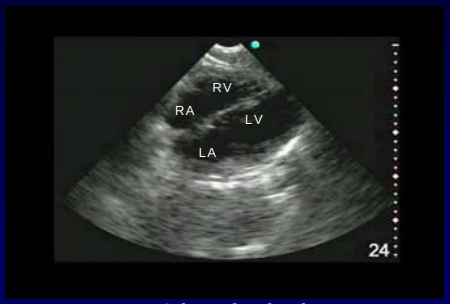
Potential pittfalls of TTE in the ICU
Suboptimal imaging
24 year-old patient with left chest tube after trauma

Apical view

Potential pittfalls of TTE in the ICU
Suboptimal imaging
24 year-old patient with left chest tube after trauma

Subcostal 4-chamber

Potential pittfalls of TTE in the ICU
Suboptimal imaging
24 year-old patient with left chest tube after trauma



Subcostal 4-chamber

Potential pittfalls of TTE in the ICU
Technically difficult transthoracic exam

Use of contrast agents

Potential pittfalls of TTE in the ICU
Technically difficult transthoracic exam

Use of contrast agents

- Agents capable of producing left ventricular cavity opacification from a venous injection.

Potential pittfalls of TTE in the ICU
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Use of contrast agents

- Agents capable of producing left ventricular cavity opacification from a venous injection.
- Contain albumin microspheres filled with perfluorocarbon gas, allowing for the passage of contrast through the lungs with appearance of contrast in the LV.

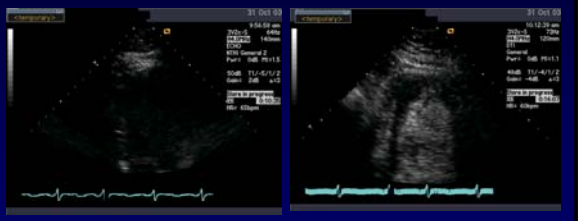
Potential pittfalls of TTE in the ICU
Technically difficult transthoracic exam

Use of contrast agents

- Agents capable of producing left ventricular cavity opacification from a venous injection.
- Contain albumin microspheres filled with perfluorocarbon gas, allowing for the passage of contrast through the lungs with appearance of contrast in the LV.
- The LV thus becomes opacified by the contrast agent, within 1 minute of administration, and allows improved endocardial border detection.

Potential pittfalls of TTE in the ICU
Technically difficult transthoracic exam

Use of contrast agent



No contrast | With contrast

Apical 4-chamber view

Potential pittfalls of TTE in the ICU
Technically difficult transthoracic exam

In critically ill patients with sub-optimal transthoracic image quality, contrast echocardiography is a non-invasive, rapid, safe and simple technique that can be performed at the bedside with positive impacts on interpretation of global and segmental LV function.

Yong Y, Wu D, Fernandes V, et al: Diagnostic accuracy and cost-effectiveness of contrast echocardiography on evaluation of cardiac function in technically very difficult patients in the intensive care unit. Am J Cardiol 2002 Mar;89(6) :711-8.

Reilly JP, Tunick PA, Timmermans RJ, et al: Contrast echocardiography clarifies uninterpretable wall motion in intensive care unit patients. J Am Coll Cardiol 2000 Feb;35(2):491-2.

Safety

- Very safe in general

Safety

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Performance of the ultrasound exam in the ICU allows procedures that previously required transport to the radiology suite to be performed at the bedside

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- Very safe in general

Performance of the ultrasound exam in the ICU allows procedures that previously required transport to the radiology suite to be performed at the bedside

→ *May prevent many of the potential complications known to occur during patient transport out of the ICU .*

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Impact of bedside echocardiography in the ICU

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- Potential to offer superior insight for determination of cardiac performance and filling status compared to the pulmonary artery catheter (PAC).

Impact of bedside echocardiography in the ICU

- Often provides unexpected diagnosis in critically ill patients.
- Potential to offer superior insight for determination of cardiac performance and filling status compared to the pulmonary artery catheter (PAC).
- TEE may provide different or additional information compared to TTE in critically ill patients.

Impact of bedside echocardiography in the ICU

- Changes in clinical management following echo in 30-60% of patients (leading to surgical intervention in 7-30% of cases):

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  Medical: Fluids, vasopressors or inotropic agents anticoagulants, antibiotics,…

Impact of bedside echocardiography in the ICU

- Changes in clinical management following echo in 30-60% of patients (leading to surgical intervention in 7-30% of cases):

  Medical: Fluids, vasopressors or inotropic agents anticoagulants, antibiotics,…

  Surgical (or interventionnal): Drainage of tamponade, aortic surgery,valvular surgery…

Impact of bedside echocardiography in the ICU

Benefit of bedside echocardiography especially important with:

- Unexplained hemodynamic instability

- In the post-cardiac surgical setting

Impact of bedside echocardiography in the ICU

Persistent hemodynamic instability and hypoxemia 3 days post-bowel surgery in a patient with a large pneumothorax.

Impact of bedside echocardiography in the ICU

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Impact of bedside echocardiography in the ICU

Persistent hemodynamic instability and hypoxemia 3 days post-bowel surgery in a patient with a large pneumothorax.

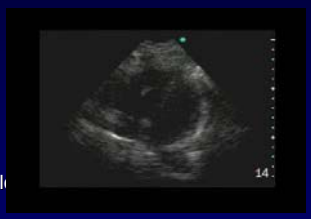
- Despite insertion of 2 chest tubes, patient remained in profound shock with severe hypoxemia.

- An EKG and bedside cardiac ultrasound were then obtained.

Impact of bedside echocardiography in the ICU

Persistent hemodynamic instability and hypoxemia 3 days post-bowel surgery in a patient with a large pneumothorax.

Parasternal l



Apical 4-chamber

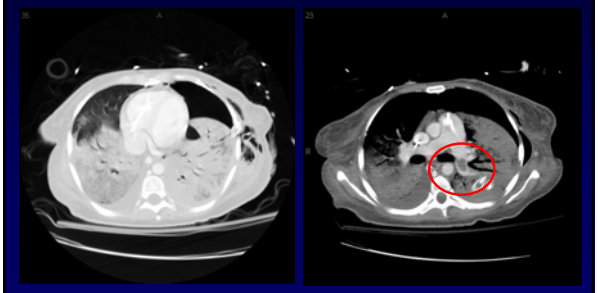
Impact of bedside echocardiography in the ICU

Persistent hemodynamic instability and hypoxemia 3 days post-bowel surgery in a patient with a large pneumothorax.

Based on the EKG *(RAD, RBBB, RV strain)* and bedside echo findings *(McConnell sign, preserved LV function)* in the clinical context of a post-op refractory shock and hypoxemia, a spiral CT scan of the chest with contrast was obtained to R/O PE.

Impact of bedside echocardiography in the ICU

Persistent hemodynamic instability and hypoxemia 3 days post-bowel surgery in a patient with a large pneumothorax.



Impact of bedside echocardiography in the ICU

Unexpected diagnosis

Impact of bedside echocardiography in the ICU

Unexpected diagnosis

- Patient with unexplained fever many days post liver transplant.

Impact of bedside echocardiography in the ICU

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- Patient with unexplained fever many days post liver transplant.
- Bedside cardiac ultrasound to look at valves to R/O vegetations

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Unexpected diagnosis

- Patient with unexplained fever many days post liver transplant.
- Bedside cardiac ultrasound to look at valves to R/O vegetations
- Had difficult insertion of two central lines (right IJ and left SC) two days prior

Impact of bedside echocardiography in the ICU

Unexpected diagnosis

- Patient with unexplained fever many days post liver transplant.
- Bedside cardiac ultrasound to look at valves to R/O vegetations
- Had difficult insertion of two central lines (right IJ and left SC) two days prior
- Was mildly hypotensive with good response to fluids.

Impact of bedside echocardiography in the ICU

Unexpected diagnosis

Parasternal long-axis

Subcostal 4-chamber

Impact of bedside echocardiography in the ICU

Unexpected diagnosis

Parasternal long-axis

Subcostal 4-chamber

Impact of bedside echocardiography in the ICU

Unexpected diagnosis

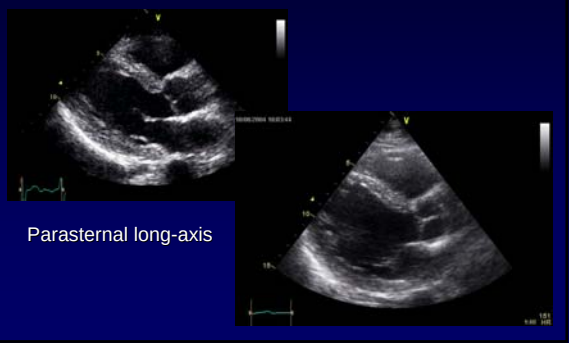
Parasternal long-axis

Subcostal 4-chamber

Impact of bedside echocardiography in the ICU
Unexpected diagnosis

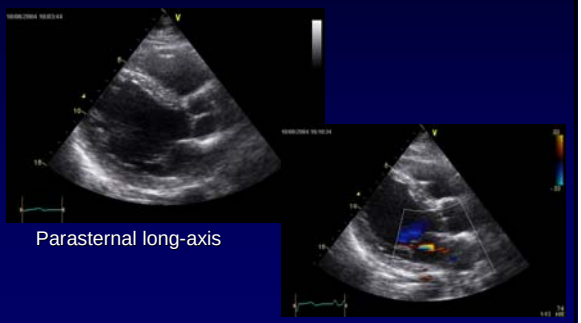
- 52 y.o male
- Dyspnea, fever, cough
- Sat = 84% (RA)
- BP = 120/70, HR = 90
- T°= 38.8 °C

Impact of bedside echocardiography in the ICU
Unexpected diagnosis



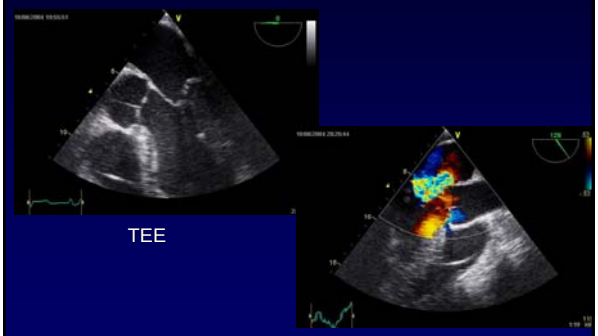
Parasternal long-axis

Impact of bedside echocardiography in the ICU
Unexpected diagnosis



Parasternal long-axis

Impact of bedside echocardiography in the ICU
Unexpected diagnosis



TEE

Impact of other uses of bedside ultrasonography in the ICU

A. Central line placement

Impact of other uses of bedside ultrasonography in the ICU

A. Central line placement

- The use of ultrasound guidance during central venous catheterization has been well demonstrated to reduce the risk of complications, mostly so for the internal jugular route.

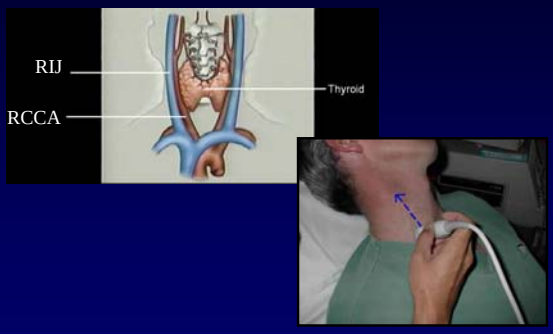
Impact of other uses of bedside ultrasonography in the ICU

A. Central line placement

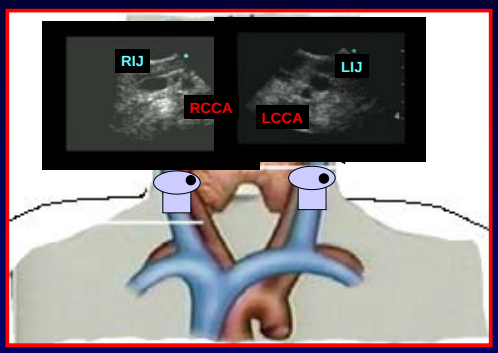
Compared to the standard surface landmark technique, placement of catheter under ultrasound guidance significantly decreases placement failure by 64%, decreases related complications by 78%, and decreases the need for multiple placement attempts by 40% *.

* Randolph AG, Cook DJ, Gonzales CA, et al: Ultrasound guidance for placement of centralvenous catheters: A meta-analysis of the literature. Crit Care Med 1996 Dec;24(12): 2053-8

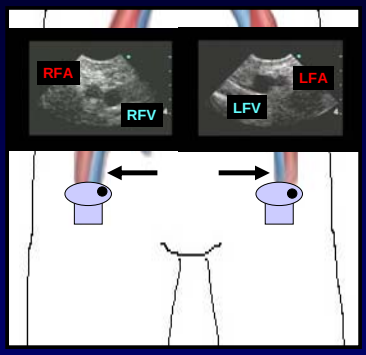
Determination of anatomy



Determination of neck vessels anatomy
Internal jugular vein and carotid



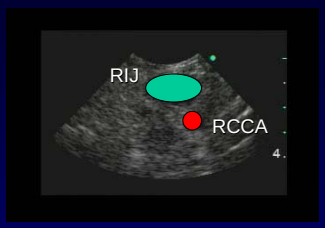
Determination of femoral vessels



Determination of anatomy
- Pathologic right neck vessels -

Dilated RIJ vein

Determination of anatomy
- Pathologic right neck vessels -



Dilated RIJ vein

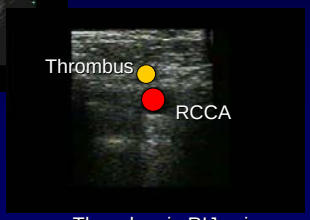
Determination of anatomy
- Pathologic right neck vessels -

Dilated RIJ vein

Thrombus in RIJ vein

Determination of anatomy
- Pathologic right neck vessels -

Dilated RIJ vein



Thrombus in RIJ vein

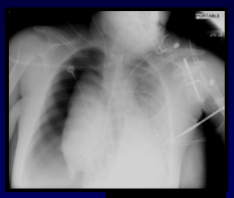
Variation in left IJ vein size with respiration and position

Left internal jugular vein assessment before placement of a central catheter

Assessment of the great vessels for central line placement

- Complications related to central venous line placement are most often:

a) mechanical
- arterial puncture
- local hematoma
- hemothorax
- pneumothorax



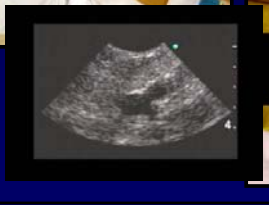
Right-pneumothorax

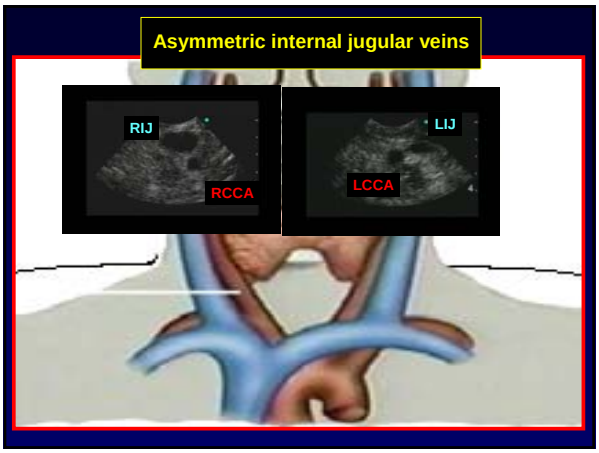
b) infectious
- catheter colonization and related blood-stream infection

c) thrombotic

Assessment of the great vessels for central line placement
Difficult central venous access

Determination of femoral vessels anatomy
Ultrasound examination





Central line placement

Real-time two-dimensional US guidance

Central line placement

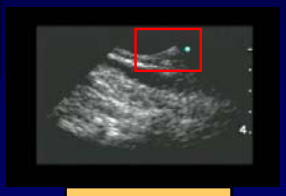
Real-time two-dimensional US guidance

Technique

Central line placement

Real-time two-dimensional US guidance

Technique



Longitudinal view

Impact of other uses of bedside ultrasonography in the ICU

B. Assessment and drainage of pleural effusion

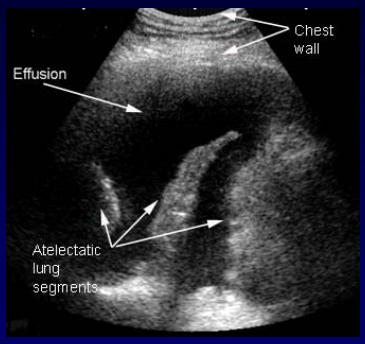
Impact of other uses of bedside ultrasonography in the ICU

B. Assessment and drainage of pleural effusion

→ especially valuable in guiding drainage of loculated or very small effusions and in the mechanically ventilated patient * when the patient is on a high level of PEEP .

* Lichtenstein D, Hulot JS, Rabiller A, et al: Feasibility and safety of ultrasound-aided thoracentesis in mechanically ventilated patients. Intensive Care Med 1999;25:955-8.

Right-sided pleural effusion



Assessment and drainage of pleural effusion

Case 1

- 34 y.o. patient, ICU Day # 1
- Day # 1 post small bowel Tx
- Severe hypoxemia (O2 sat = 86-90%)

Assessment and drainage of pleural effusion

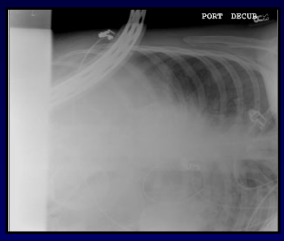
Case 1

- 34 y.o. patient, ICU Day # 1
- Day # 1 post small bowel Tx
- Severe hypoxemia (O2 sat = 86-90%)
- Vent settings:
  - A/C 650 x 16
  - FiO2 = 100%
  - PEEP =10

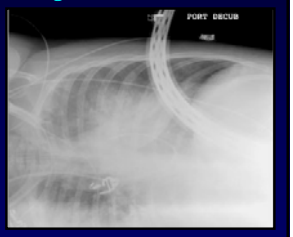
Assessment and drainage of pleural effusion

Case 1

Left lateral decubitus

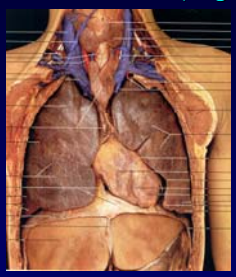


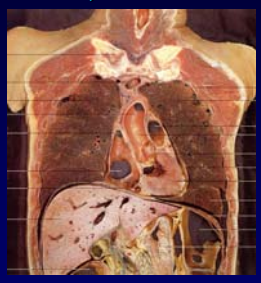
Right lateral decubitus



Right pleural space

Anatomical orientation
(longitudinal cut)





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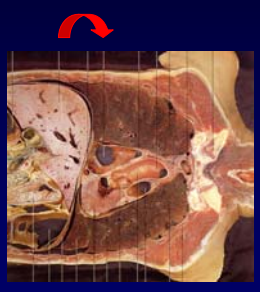
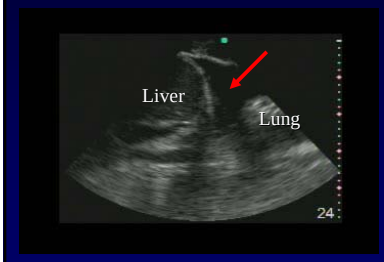


Bedside ultrasonographic right pleural space assessment



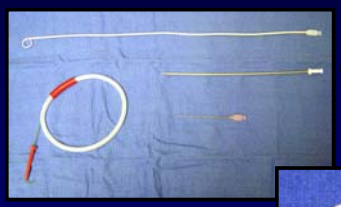
Longitudinal view

Assessment of the pleural space for effusion

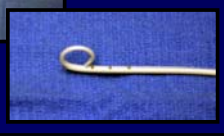
Ultrasound examination - Thoracentesis

Curriculum for the intensivist

Pig-tail catheter



8.3 FRENCH (12 GA.)



Right pleural pig tail catheter inserted

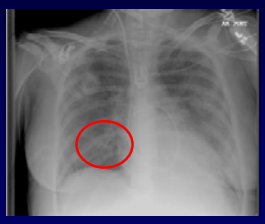
Case 1

Right pleural pig tail catheter inserted

Case 1

Pre-drainage

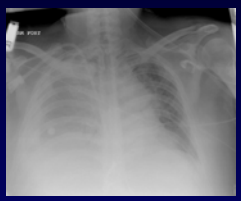
Post Drainage



Right pleural space assessment

Case 2

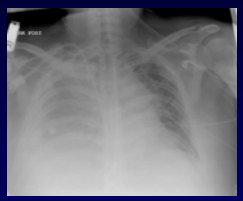
- 56 y.o. patient, ICU Day # 8
- Liver failure post liver Tx



Right pleural space assessment

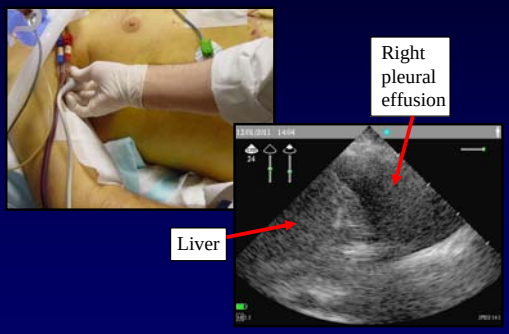
Case 2

- 56 y.o. patient, ICU Day # 8
- Liver failure post liver Tx
- Moderate hypoxemia (O2 sat 93%)
  - – Vent settings:
    A/C 700 x 16
    FiO2= 65%
    PEEP=10



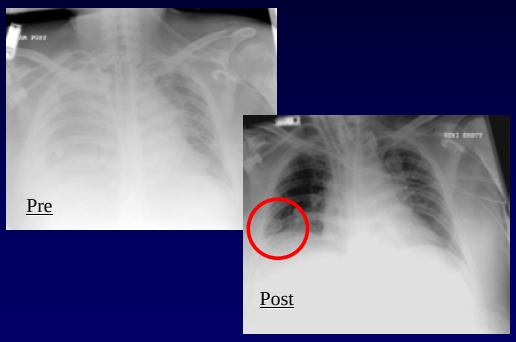
Right pleural space assessment
Case 2

Right pleural space assessment
Case 2

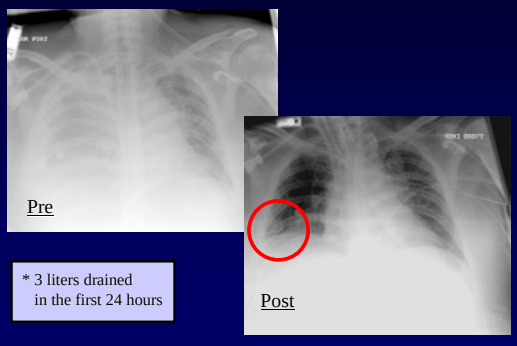


Right pleural space assessment
Case 2

Right pleural space assessment
Case 2



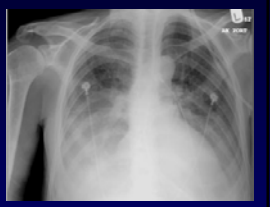
Right pleural space assessment
Case 2



* 3 liters drained in the first 24 hours

Right pleural space assessment
Case 3

- 62 y.o. patient,
- Day # 7 post liver Tx
- Transferred out of the ICU 2 days previously.



Right pleural space assessment

Case 3

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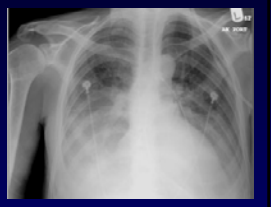
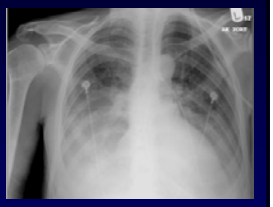
- Transferred out of the ICU 2 days previously.
- Now presents respiratory distress with moderate hypoxemia.



Right pleural space assessment

Case 3

- 62 y.o. patient,
- Day # 7 post liver Tx
- Transferred out of the ICU 2 days previously.
- Now presents respiratory distress with moderate hypoxemia.
- Transferred back to the ICU and required re-intubation



Right pleural space assessment

Case 3

Decubitus CXRs obtained 2 days previously

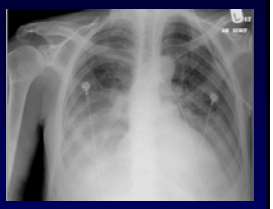
Right lateral decubitus

Left lateral decubitus

Right pleural space assessment

Case 3

- Based on the decubitus films and the clinical state, a significant right pleural effusion was suspected.



Right pleural space assessment

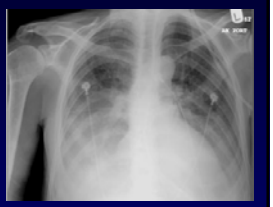
Case 3

- Based on the decubitus films and the clinical state, a significant right pleural effusion was suspected.
- Blind right thoracentesis attempted

Right pleural space assessment

Case 3

- Based on the decubitus films and the clinical state, a significant right pleural effusion was suspected.
- Blind right thoracentesis attempted
  → Unsuccessful (“dry tap”)



Right pleural space assessment
Case 3

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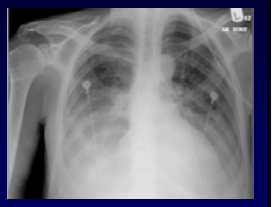


- Blind right thoracentesis attempted
  → Unsuccessful ("dry tap")

- No immediate complications

Right pleural space assessment
Case 3
Bedside ultrasound obtained the next morning to assess the pleural space

Longitudinal view

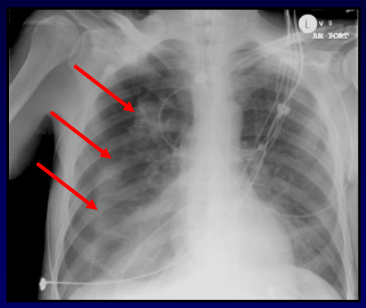
Right pleural space assessment
Case 3
Bedside ultrasound obtained the next morning to assess the pleural space

Longitudinal view

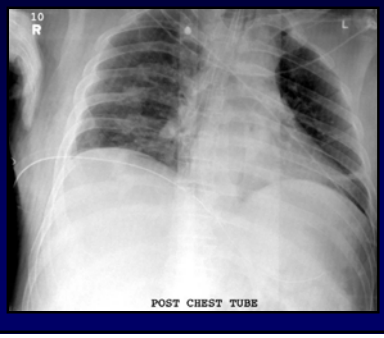
Right pleural space assessment
Case 3
Bedside ultrasound obtained the next morning to assess the pleural space

Longitudinal view

Right pleural space assessment
Case 3
Delayed pneumothorax 36 hours post-tap



Pleural space assessment
Case 4
Chest tube inserted in the abdomen



Pleural space assessment
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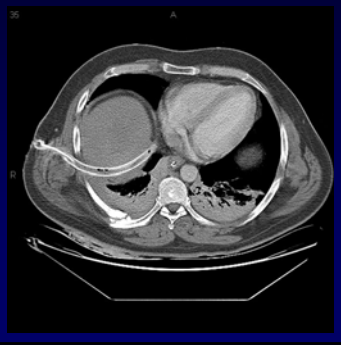
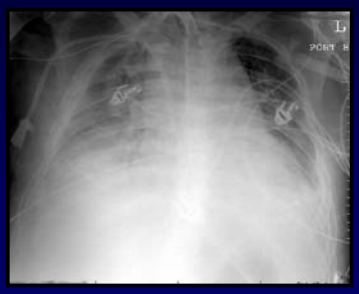
Chest tube inserted in the abdomen



Case 5
? Significant right pleural effusions



Case 5
? Significant right pleural effusions

CXR at 5 am

CXR at 9 am

Impact of other uses of bedside ultrasonography in the ICU

C. Assessment and drainage of intra-abdominal fluid collection

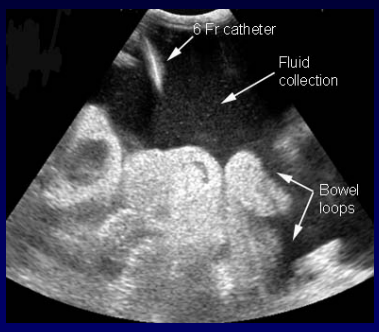
Impact of other uses of bedside ultrasonography in the ICU

C. Assessment and drainage of intra-abdominal fluid collection

- Very useful for assessment of fluid in regions around the liver and gallbladder, spleen, kidneys and lateral retroperitoneal areas, lateral gutter and pelvis around the uterus and bladder *.

* Lee SY, Frankel HL: Ultrasound and other imaging technologies in the intensive care unit. Surg Clin North Am 2000 Jun;80(3):975-1003.

Intra-abdominal fluid collection



Intra-abdominal fluid collection

Bedside ultrasonographic evaluation of intra-abdominal fluid

Impact of other uses of bedside ultrasonography in the ICU

D. Assessment of the urinary bladder

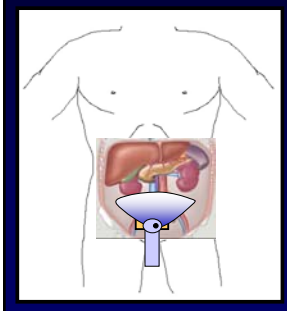
Impact of other uses of bedside ultrasonography in the ICU

D. Assessment of the urinary bladder

- Can provide a measurement of urine volume in the bladder and thus avoids bladder overdistension and reduce the need for unnecessary catheterization * .

* Anton HA, Chambers K, Clifton J, et al: Clinical utility of a portable ultrasound device in intermittent catheterization. Arch Phys Med Rehab 1998 Feb;79(2):172-5.

Assessment of the urinary bladder
Ultrasonographic diagnosis



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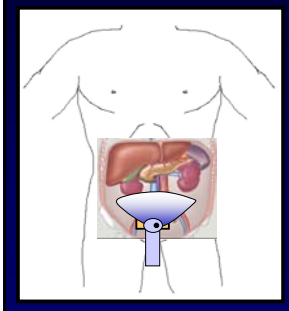

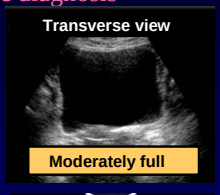

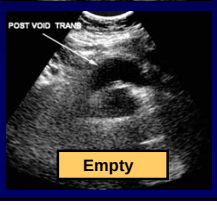

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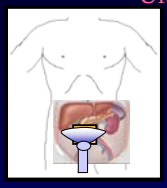
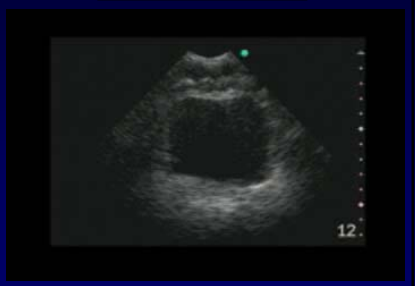
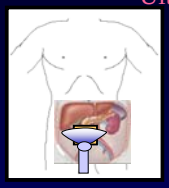
Ultrasonographic diagnosis



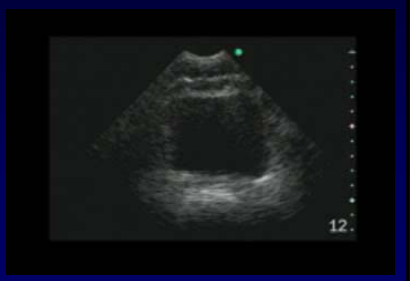
Moderately full bladder (male)



Assessment of the urinary bladder
Ultrasonographic diagnosis



Moderately full bladder pre + post-void



Curriculum on the Use of Bedside Ultrasonography in Critical Care

Introduction and overview

Plan

1-) Introduction: Bedside ultrasound in the ICU.
2-) Indications for bedside U/S in the ICU
3-) Technical aspects and safety
4-) Impact of bedside ultrasound in the ICU
5-) Hand-carried ultrasound (HCU) in the ICU
6-) Performance of bedside U/S by the intensivist
7-) Curriculum plan
8-) Conclusion

Hand-carried ultrasound (HCU)

- New generation of portable HCU
  - light weight (6-10 lbs)
  - battery powered
  - less expansive (<$ 15,000)

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- New generation of portable HCU
  - light weight (6-10 lbs)
  - battery powered
  - less expansive (<$ 15,000)
- Limitations
  - Small screen (4-6”)
  - Inferior transducers on some HCU models
  - Inferior Doppler capabilities

Different HCU models

Optigo

Phillips Medical Systems, Andover, MA

Different HCU models

Sonoheart

Sonosite Inc, Bothell,WA

HCU

Accuracy of images created by the devices

- In general, agreement between standard echocardiogram machines and HCU for 2-D findings seems to be adequate:

HCU

Accuracy of images created by the devices

- In general, agreement between standard echocardiogram machines and HCU for 2-D findings seems to be adequate:

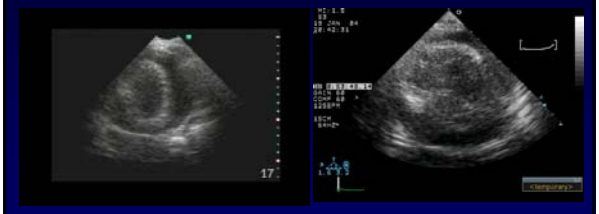
→ HCU sensitivity for finding abnormal LV function ranges from 76-96%

→ Lower sensitivity for color Doppler assessment of valvular regurgitation (52-96%)

HCU

Accuracy of images created by the devices

HCU Standard machine



Tamponade
(Parasternal short-axis view)

HCU

Skill and training of the operator

HCU

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- Both the acquisition and interpretation of images are highly dependent upon the operator.

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- Rigorous training is needed if goal of the exam is doing a complete echocardiography study (minimum of Level 2)

- A lower degree of training was shown to be feasible to achieve adequate performance and interpretation of a focused exam (used as an extension to the physical examination).

HCU used as an extension to the physical examination

HCU used as an extension to the physical examination

"The role of the HCU in non-cardiologist's hands is not to replace or detract from a complete echo-cardiogram performed on a standard "high-end" machine, but to elevate and augment the physical exam to standards established during the "golden age" of cardiology" *.

Duvalll WL, et al: Can hand-carried ultrasound devices be extended for use by the non-cardiology medical community ? Echocardiography July 2003;20(5):471-6.

HCU used as an extension to the physical examination

"The challenge is to provide practical training programs to assure competency in performing point-of-care echocardiograms"* .

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- Can provide immediate information on LV / RV function and volume status…..NO DELAYS
- Can monitor response to therapy by doing repetitive bedside evaluations
- Can improve safety when performing invasive procedures
- Important learning and teaching tool at the bedside to better understand patients physiology

Performance of bedside ultrasound by the intensivist

- Successful performance of bedside echocardiography by non-cardiologist intensivists has been well demonstrated in the literature.

Colreavy FB, Donovan K, Lee KY et al: Transesophageal echocardiography in critically ill patients. Crit Care Med 2002;30:989-996.

Benjamin E, Griffin K, Leibowitz AB, et al: Goal-directed transesophageal echocardiography performed by intensivists to assess left ventricular function: comparison with pulmonary artery catheterization. J Cardiothorac Vasc Anesth 1998;12:10-15.

Performance of bedside ultrasound by the intensivist

- HCU (OptiGo, Philips Medical systems) vs conventional TTE (used as a gold standard) in a population of 106 critically ill patients on mechanical ventilation.

Vignon et al; Diagnostic ability of hand-held echo in the critically ill patient. Critical Care Medicine 2003; vol 7 (5).

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- HCU and TTE had a similar therapeutic impact in 45 and 47 patients, respectively (44% vs 46%, p=0.9).

Vignon et al; Diagnostic ability of hand-held echo in the critically ill patient. Critical Care Medicine 2003; vol 7 (5).

Performance of bedside ultrasound by the intensivist

- The safety and utility of performance of bedside ultrasound by the intensivist for various other purposes in the ICU (*central venous canulation, thoracentesis, paracentesis*) have also been well demonstrated

Denys BG, Uretsky BF, Reddy PS: Ultrasound-assisted cannulation of the internal jugular vein. A prospective comparison to the external landmark-guided technique. Circulation 1993;5: 1557-62.

Troianos CA, Jobes DR, Ellison N: Ultrasound-guided cannulation of the internal jugular vein. A prospective, randomized study. Anesth Analg 1991;72: 823-6.

Lichtenstein D, Hulot JS, Rabiller A, et al: Feasibility and safety of ultrasound-aided thoracentesis in mechanically ventilated patients. Intensive Care Med 1999;25:955-8.

Performance of bedside ultrasound by the intensivist

- Inappropriate interpretation or application of data gained by a poorly skilled user may result in adverse medical, ethical and social consequences. To avoid misusing the technology, adequate training is essential.

Curriculum on the Use of Bedside Ultrasonography in Critical Care

Introduction and overview

Plan

1-) Introduction: Bedside ultrasound in the ICU.
2-) Indications for bedside U/S in the ICU
3-) Technical aspects and safety
4-) Impact of bedside ultrasound in the ICU
5-) Hand-carried ultrasound (HCU) in the ICU
6-) Performance of bedside U/S by the intensivist
7-) Curriculum plan
8-) Conclusion

Curriculum plan

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A. Introduction (1 hour)

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B. Ultrasound + echocardiography basics and instrumentation (2 hours)

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C. Echocardiography (8 hours)

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2. Assessment of global and regional LV size and function (1 hour)
3. Assessment of RV size and function and estimation of volume status (1 hour)
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D. Assessment of the pleural and abdominal spaces for fluid (2 hours)

E. Assessment of central vessels + urinary bladder (2 hours)

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Conclusion

- Performance of bedside TTE and other non-invasive US exams is safe and not associated with significant risks to the patient.
- Often provides unexpected diagnosis in critically ill patients.
- Potential to offer superior insight for determination of cardiac performance and filling status compared to the pulmonary artery catheter (PAC).

Conclusion

- Performance of bedside ultrasound for central venous catheterization, diagnosis and drainage of pleural effusions and intra-abdominal fluid collections, and assessment of the urinary bladder is relatively easy, improves safety, improves patient`s comfort, decreases the risk of complications, saves time, and saves unnecessary trips out of the ICU

Conclusion

- Use of HCU may facilitate the full clinical potential of ultrasound imaging, with true portability, ease of use and low cost and can be especially powerful *as an adjunct to physical examination* .

Conclusion

- The role of the HCU in non-cardiologist's hands is not to replace or detract from a complete echocardiogram performed on a standard "high-end" machine, but to elevate and augment the physical examination

Conclusion

- Inappropriate interpretation or application of data gained by a poorly skilled user may result in adverse medical, ethical and social consequences. To avoid misusing the technology, adequate training is essential.

Conclusion

The era of a technology-extended physical examination appears to have arrived and there appears to be a role for a user-specific, focused ultrasound examination

Yanick Beaulieu
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QUESTIONS ???