Ultrasound in Hospital Medicine

Joshua D. Lenchus, DO, RPh, FACP, SFHM
Regional Medical Officer
Broward Health Medical Center, Ft. Lauderdale, FL
Adjunct Associate Professor of Medicine
Nova Southeastern University Kiran C. Patel College of Osteopathic Medicine
Disclosure

None
Basics

- No radiation
- Echolocation / sonar
- Physics
A Sound Wave:

wavelength ($\lambda$)

period = time of one cycle (wavelength) above: one second from crest to crest

frequency = number of cycles/second above: 1 cycle/sec = 1 Hertz (Hz)

reflected wave

sender/receiver

original wave

distance $r$
Handhelds
Tablets
Screenshot overview

- Depth marker
- Superficial to deep
- Laterality

- Optimizing the image location and quality
Transducer selection

- Structure location
- Frequency: high vs low
“Back in my day...”

- No radiation vs CXR or CT
- Portable
- Ability for real-time imaging
- More potential areas
- Increased proper site selection
- Decrease performance time
- Visual confirmation
- Increased successful completion rates
- Decrease complications
- Increase confidence
Diagnostic & therapeutic apps

- Thoracentesis
- Paracentesis
- Lumbar puncture
- Vascular access
- Musculoskeletal
Thoracentesis

[Image of an ultrasound showing a lung, pleural effusion, and diaphragm]
Paracentesis

BOWEL / ASCITES
Lumbar puncture
Vascular access
Musculoskeletal
Diagnostic applications

- Carotid artery – intima media thickness
- Thyroid – masses, nodules
- Cardiac – infarction, effusion/tamponade
- Inferior vena cava – intravascular volume
- Abdominal aortic aneurysm – diameter
- Pleural – pneumothorax, effusion, consolidation
- Intraocular – lens dislocation, retinal detachment
- Optic nerve – retinal injury, intracranial pressure
- Deep vein thrombosis
- Trauma – FAST exam
Carotid artery

Carotid Intima Media Thickness (CIMT)

Interior of Carotid Artery

Intima Media Layer of Arterial Wall

PHILIPS
18/07/2008 01:31:00 PM Ti:50.2 MI 0.6

Right Prox ICA

P5V -73.9 cm/s
EDV -36.0 cm/s
Focused cardiac ultrasound (FOCUS)
Focused cardiac ultrasonography (FCU)

- Views
  - Parasternal long axis (PLAX)
  - Parasternal short axis (PSAX)
  - Apical four chamber (A4C)
  - Subcostal four chamber (S4C)
  - Subcostal inferior vena cava
Parasternal long axis

Assess

- LV size and function
- RV size
- Mitral valve
- Aortic valve
- Left pleural effusion
- Pericardial effusion
- Aortic dissection

http://pie.med.utoronto.ca/TTE/TTE_content/assets/applications/FOCUS/index.htm
Position the TTE transducer:
- in the 3rd or 4th intercostal space
- at the left parasternal border
- with the index marker pointing towards the right shoulder (11 o'clock)

Adjust the sector depth to:
- 10-16cm to see the descending aorta in SAX
- increase to 20cm to assess for a left pleural effusion
Parasternal short axis

Assess

- LV size and function
- RV size and function
- Pericardial effusion
Position the TTE transducer:
- in the 3rd or 4th intercostal space
- at the left parasternal border
- with the index marker pointing towards the left shoulder (2 o'clock)
- this view can be easily obtained by rotating the probe 90 degrees clockwise from the Parasternal LAX view and tilting the probe downwards

Adjust the sector depth to:
- 10-16cm to see the entire LV
Apical four chamber view

Assess

- LV size and function
- RV size and function
- Mitral valve
- Tricuspid valve
- RA and LA size
- Pericardial effusion

http://pie.med.utoronto.ca/TTE/TTE_content/assets/applications/FOCUS/index.htm
Position the TTE transducer:
- in the 4th or 5th intercostal space
- in the midclavicular line or at the point of apical pulsation
- with the index marker pointing towards the left (3 o'clock)

Adjust the sector depth to:
- 14-18cm to image the atria
- 6-10cm to assess the LV apex
Subcostal four chamber view

Assess

- LV size and function
- RV size and function
- Mitral valve
- Tricuspid valve
- RA and LA size
- Pericardial effusion
- Cardiac monitoring during code blue

http://pie.med.utoronto.ca/TTE/TTE_content/assets/applications/FOCUS/index.htm
Position the TTE transducer:
- in the subxiphoid region of the abdomen
- flat and push down with a slight tilt to the patient’s right
- with the index marker pointing towards the left (3 o’clock)

Adjust the sector depth to:
- 16-24cm to image the entire LA and LV
Subcostal inferior vena cava view

Assess

- IVC size (measure in mm or cm)
- Change in IVC size with respiration (use M-mode)
Position the TTE transducer:
- in the subxiphoid region of the abdomen
- tilt to the patient’s left
- with the index marker pointing towards the head (12 o’clock)
- this view can be easily obtained by rotating the probe 90 degrees counterclockwise from the subcostal 4C view

Adjust the sector depth to:
- 16-24cm to image the entire IVC

http://pie.med.utoronto.ca/TTE/TTE_content/assets/applications/FOCUS/index.htm
### IVC size (cm)

<table>
<thead>
<tr>
<th>IVC size (cm)</th>
<th>Inspiration affect</th>
<th>Estimated mean RAP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small &lt;1.5</td>
<td>collapse</td>
<td>0 - 5</td>
</tr>
<tr>
<td>Normal 1.5 - 2.5</td>
<td>↓ ≥ 50%</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Normal 1.5 - 2.5</td>
<td>↓ ≤ 50%</td>
<td>10 - 15</td>
</tr>
<tr>
<td>Dilated &gt;2.5</td>
<td>↓ ≤ 50%</td>
<td>15 - 20</td>
</tr>
<tr>
<td>Dilated + Hepatic veins</td>
<td>no collapse</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

*From Otto CM. and Pearlman AS: Textbook of Clinical Echocardiography*
Abdominal Aortic Aneurysm
Point of care lung ultrasound
8 probe positions

- Anterior zones
- Posterior zones
- All zones
How to Obtain this View

- Probe is positioned in the 2nd-3rd intercostal space along the mid-clavicular line.
- The probe marker is pointing towards the patient’s head.
- Probe depth is set at 4-6 cm.

Tips:
- Slide the probe up and down to visualize two ribs.
- Rotate the probe to bring the ribs as close as possible.
- Keep the probe perpendicular to the chest wall.
# Lung ultrasound signs

<table>
<thead>
<tr>
<th>Bat sign</th>
<th>Lung sliding sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seashore sign</td>
<td>Lung pulse</td>
</tr>
<tr>
<td>Lung point</td>
<td>Stratosphere / barcode sign</td>
</tr>
<tr>
<td>Quad sign</td>
<td>Sinusoid sign</td>
</tr>
<tr>
<td>Jellyfish sign</td>
<td>A-line</td>
</tr>
<tr>
<td>B-line</td>
<td>Tissue-like sign</td>
</tr>
<tr>
<td>Shred / fractal sign</td>
<td>Curtain sign</td>
</tr>
</tbody>
</table>
Pleural effusion
Shred sign

pleural effusion

atelectatic lung

THE SHRED LINE

diaphragm

B-lines
B – lines
Intraocular
Optic nerve sheath diameter
Deep Vein Thrombosis
AIUM Practice Guideline for the Performance of the Focused Assessment With Sonography for Trauma (FAST) Examination
- Perihepatic
- Pericardial
- Perisplenic
- Pelvic
Diastole

Interventricular septum
Anterior leaflet (mitral valve)
Postero-medial papillary muscle
Posterior wall (left ventricle)
Pericardium
Coronary sinus

Right ventricular free wall
Membranous septum
Right coronary cusp
Ascending aorta
Descending thoracic aorta
Non-coronary cusp
LVGT

LA

Parasternal long-axis view (PLAX)
Thank you

Joshua D. Lenchus, DO, RPh, FACP, SFHM
jlenchus@browardhealth.org
954-355-5603 (off)
954-817-5684 (cel)