Objective: Demonstrate basic operation of an ultrasound machine to obtain an image of the thyroid and structures in the neck.

Prior to session review the following resources:


Instructions:

1. Press “Preset” and select the linear probe, select “SMP,” then “Thyroid” preset. Exit.
2. Apply US coupling gel to the probe footprint and position the probe on the patient’s neck (right side) for a transverse scan of the thyroid gland (Figure 1). It may be helpful to begin in the midline over the trachea, scan superiorly and inferiorly to find the isthmus, then move the probe to the right and focus on the right lobe.
3. Locate and ID: thyroid isthmus and right lobe, trachea, strap muscles, right common carotid artery and right internal jugular vein. (Figures 2-4). Do you see a mirror image artifact? What can you do to improve view of internal jugular vein? (Valsalva maneuver, have pt lie down)
4. Freeze image of the transverse scan containing right lobe and isthmus.
5. Figure 5 shows an example of measuring the area of the right lobe of thyroid. If you want to measure the area of the thyroid, draw lines as the crosshairs and press enter key. (Figure 5)
6. Swap roles and repeat steps 2-5.
7. Clean probe with a wipe and properly replace.
Figure 1. Ultrasound probe position.

Figure 2. Ultrasound image of thyroid with anatomical outline.
Figure 3. Ultrasound image of thyroid.

Figure 4. Cross-section of neck at the level of thyroid.
Figure 5. Ultrasound image for measurements of thyroid.
Objective: Demonstrate basic operation of an ultrasound machine to obtain an image of the musculoskeletal and vascular structures of the wrist.

Prior to session review the following resources:

- Learning modules (Physics, (7 modules) and Instrumentation, (1 module)) at SUSME site http://www.susme.org/learning-modules/
- Sonosite instructional video http://www.sonosite.com/education/learning-center/59/1394 - Wrist Exam

1. Press “Preset” and select the linear probe, then “MSK,” then “wrist” preset. Exit. Confirm that the TGC controls are set in the middle range.
2. Apply US coupling gel to the probe footprint and do a finger test on the marker side of the probe. Which side of the screen responds?
3. Position probe on your partner’s right wrist in a transverse plane over the carpal tunnel with the marker pointed to the right. (Figure 1)
4. Locate and ID: median nerve, flexor tendons, radial and ulnar arteries. (Figures 2, 3)
5. Freeze image.
6. Switch with another group member and repeat steps 2–5.
7. Clean probe with a wipe and properly replace.

Figure 1. Ultrasound probe position outlined by red box. Marker is indicated by red dot in figures.
Figure 2. Ultrasound image of carpal tunnel with outline of structures

Figure 3. Ultrasound image of wrist
Objectives: Demonstrate basic operation of ultrasound to obtain images of the musculoskeletal structures of the wrist and shoulder under the guidance of a professional sonographer.

Prior to session review the basic concepts for ultrasound imaging at the following resource:

Learning modules (Physics, (7 modules) and Instrumentation, (1 module)) at SUSME site http://www.susme.org/learning-modules/

Sonosite Videos:

1. Press “Preset” and select the linear probe, then “MSK,” then “shoulder”. Exit. Confirm that TGC controls are all set in the middle range.
2. Have the patient position right arm with elbow flexed, palm up, and arm slightly medially rotated.
3. Apply US gel to anterior surface of right shoulder and position probe as indicated by the marker (Figure 1A). Locate and ID: tendon of the long head of biceps, greater (GT) and lesser (LT) tuberosities, or tubercles (Figure 1B). Externally rotate the arm and identify the attachment of the subscapularis tendon to the lesser tuberosity (Figure 1C and 1D).
4. Have the patient position right arm with arm extended posteriorly and medially rotated as if reaching into their back pocket. This should bring the supraspinatus tendon and its attachment to the greater tuberosity into view from the anterior position (Figure 2A-C).
5. Have the patient return to the original position with the right arm, palm up and arm fully medially rotated with elbow flexed.
6. Apply US gel to posterior surface of right shoulder and position probe as indicated by the marker (Figure 3A and 3B). Locate and ID: combined tendon attachments of the infraspinatus to the greater tuberosity (Figure 3B). Also try to find the teres minor tendon attachment to the greater tuberosity just inferior to the infraspinatus attachment.
7. Switch with partner and repeat.
8. Clean probe with a wipe and properly replace.
Figure 1. Position of probe for LHB tendon (A). LHB Tendon (B). Position of probe for short axis view of Subscapularis (C). Subscapularis ultrasound image (D).
Figure 2. Position of probe for visualization of supraspinatus. Arm is extended, medially rotated (A and B). Supraspinatus tendon long axis view (C).
Figure 3. Position of probe for Infraspinatus and Teres Minor visualization in a short axis view. Arm is medially rotated and elbow is flexed (A). Long axis view of infraspinatus tendon and its attachment to the Greater Tubercle (B). (This requires transverse orientation of probe not shown in Figure 3A).
Learning Objectives
The objective of this exercise is to introduce the learner to musculoskeletal (MSK) ultrasound using the knee as an example.

Transducer/Probe Selection/Preset
For most musculoskeletal ultrasound examinations, a high frequency (5.0-13.0 MHz) linear array transducer is most appropriate. For deeper structures such as the hip, a lower frequency transducer (2.0-5.0 MHz) may be more appropriate. Use MSK preset if available.

MSK Terminology
Anisotropy refers to decreased echogenicity of tissue when the transducer is not perpendicular to multiple linear interfaces of tissue such as in tendons and ligaments. This artifact can result in misinterpretation of a hypoechoic region as a pathological disruption or tear of the tendon or ligament. A slight change in the angle of the transducer can eliminate the hypoechoic region and confirm structures are fully intact (Figure 1).

Fibrillar pattern refers to the ultrasound appearance of a structure that has multiple layers of discrete parallel fibers or tissue as with the collagen fibers in tendons and ligaments.

Figure 1. As the quadriceps tendon (fibrillar pattern) approaches the patella, the angle of the tendon is no longer perpendicular to the surface and an area of hypoechoic anisotropy can appear (X). A slight change in transducer angle eliminates area of hypoechogenicity as seen in the figure on the right.

Sonosite Video instructions
http://www.sonosite.com/education/learning-center/59/11607 - Knee Quadriceps Tendon Exam
http://www.sonosite.com/education/learning-center/59/1387 - Patellar Tendon Exam
http://www.sonosite.com/education/learning-center/59/1388 - Medial Meniscus, MCL
Anterior Longitudinal Suprapatellar View
The suprapatellar bursa communicates with the knee joint and as fluid accumulates in the knee due to trauma, infection, or gout, it will begin to fill the suprapatellar bursa. The bursa normally contains just a few CCs of anechoic fluid at most and may not be seen on US.

With probe marker pointed proximally, place the probe over the proximal part of the patella and identify the following:
- patella
- quadriceps tendon
- femur
Suprapatellar Transverse or Short Axis Flexed Knee

Place the probe in the transverse position with probe marker to the patient's right side on the distal femur (landmark). Slide the probe distally to obtain a good image of the condyles of the femur. Identify and assess the following:

- transverse quadriceps tendon
- femoral condyle
Infrapatellar Longitudinal

With the probe marker pointed proximally, place the probe over the distal part of the patella and track the patella ligament to the tibia, identify the:

- patella
- patella tendon
- tibia
Infrapatellar Transverse Short Axis View
With the probe marker pointed to the patient’s right side, place the probe over the distal part of the patella and track the patella ligament to the tibia, identify the:

- patella tendon
- tibia
Liver Ultrasound exercise
Geoffrey Guttmann Ph.D., UNTHSC, Colin Vokes D.O., UNTHSC
Based on the work of Vaughn Lee, TTUHSC

Prior to session review the following resources:
Learning modules (Abdomen-Liver and Gallbladder modules) at SUSME site
http://www.susme.org/learning-modules/

Liver Ultrasound video at http://www.youtube.com/watch?v=7Y6wFXfmuvg&feature=related

Sonosite Videos:
http://www.sonosite.com/education/learning-center/58/1448 - GB US 1
http://www.sonosite.com/education/learning-center/59/1420 - CBD Measurements

Instructions:

1. Press “Preset” and select the curvilinear probe, “Abdomen” application and “Abdomen” preset. Exit.

2. Apply US coupling gel to RUQ in the subxyphoid region at the midline and right subcostal region and the probe footprint. (Figure 1)

3. Scan with probe marker pointing cephalad in the midline of the subxyphoid region and right subcostal region and identify liver. Slightly adjust direction of the probe and briefly explore longitudinal views of liver. Ask the patient to take a deep breath and hold it briefly to help bring liver and IVC into clear view.

4. Scan the left lobe angling probe side to side until you obtain a view of the left lobe, caudate lobe, IVC, ligamentum venosum, and hepatic vein (Figure 2, 3).

5. “Freeze” and save image to USB drive or SD card. Press “Freeze” to release.

6. Gall Bladder: Scan the subcostal region on the right side approximately 7cm from the midline. Marker should be pointed toward the patient’s right shoulder for a longitudinal view of the gall bladder (Figure 3 - 4). Visualization of the gall bladder requires distention which is normally facilitated by having the patient fast. This will vary in the non-fasted patient, i.e. the standardized patient. See if you can locate the cystic duct (Figure 4)

7. Repeat steps 2-6 with each student.
Figure 1 Surface anatomy, location of probe outlined in red, marker pointed cephalad

Figure 2 Cross section of liver and US image of liver
Figure 3. US image of GB and IVC

Figure 4 US Image of GB and Cystic Duct