Sonographer Assessment Study Guide

Review basic safety and infection control information, including:

- Use of patient identifiers. Patient identifiers refer to ways the patient can be identified not the source of the information. Therefore, another person is not an acceptable identifier. Identifiers are unique to the patient, such as a birthdate, social security number, medical record identification number, or some other information unique to a particular patient. Use at least two patient identifiers – neither can be the patient’s room number.

- Infection control procedures such as preventing spread of infection by washing your hands before and after working with each individual patient.

- Managing oxygen when a patient who is receiving oxygen and using a portable tank arrives for an ultrasound examination. Leave the oxygen in place and observe the patient’s respiratory status during the examination. Oxygen will not interfere with ultrasound examination and poses no safety risks. Since the patient is receiving oxygen it is important to observe for any evidence of difficulty breathing which might require a change of position, temporarily interrupting the exam, or increasing the flow of oxygen.

Review documentation guidelines, including:

- Correcting an error in handwritten documentation by drawing a line through the error, initialing it and documenting the correct information.

Review common terms, practices, systems, and equipment in use for ultrasound examinations, such as:

- Attenuation. The ultrasound signal decreases in strength (attenuation) as distance from the source increases.

- Nyquist Limit. The maximum frequency shift that can be measured by a pulsed Doppler system. Pulsed-Doppler instruments are sampling instruments. Each emitted pulse yields a sample of the desired Doppler shift. There is an upper limit (the Nyquist limit) to Doppler shift that can be detected properly by pulsed instruments. If the Doppler shift frequency exceeds ½ the PRF (Pulse Repetition Frequency, which is normally in the 5 to 30 kHz range), temporal aliasing occurs.

- Ultrasound frequencies used for medical imaging are generally in the range of 1 – 13 MHz. Higher frequencies have a correspondingly smaller wavelength, and can be used to make sonograms with smaller details. However, the attenuation of the sound wave is increased at higher frequencies, so in order to have better penetration of deeper tissues, a lower frequency (3-5 MHz) is used.

- The Picture Archiving & Communication System (PACS) which simultaneously integrates from all imaging sources: Computer Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound and conventional digital imaging. The data is saved as
permanent legal medical documents for each patient. Radiographs are considered legal documents. It is important that the technologist understands all the intricacies of this system and how to properly QC the data.

- Trauma radiography. The priority: to work as quickly as possible without further injury to the patient. The job of the radiographer in a trauma situation is to obtain diagnostic radiographs without interfering with the Emergency Department doctor or staff. Many life-threatening situations require x-rays to diagnose the problem. It is the radiographer’s responsibility to understand how, when, where, and why x-rays are to be taken in a trauma situation.

- Contrast microbubble technology: importance of the MI setting. The Most Important Setting: Mechanical index (MI)
  - Determines ultrasound acoustic power produced and delivered to the patient
    - Displayed as MI (or thermal index)
    - Measured in watts/sq cm
  - Higher MI = faster bubble destruction

Review terminology, technique, and findings related to general diagnostic examinations, such as:

- Examination of the thyroid gland, position the patient with neck hyperextended.

- Assisting with an ultrasound-assisted needle biopsy and locating the needle tip.

  Hints on Finding the Needle Tip
  - Choose appropriate transducer type and frequency
  - Optimize focal zone
  - Optimize image depth
  - Use echogenic needles
  - Move the needle or stylet up and down
  - Slowly sweep the probe superior and inferior
  - Check needle and transducer alignment especially with freehand techniques

- Findings in commonly encountered diagnoses, including:
  - Testicular microlithiasis, associated with testicular cancer or benign conditions, has the sonographic appearance of starry sky. Microlithiasis throughout the testicular parenchyma gives the appearance of numerous brightly echogenic foci throughout the testes.
  - Acute cholecystitis. Sonographic criteria include: Gallbladder wall thickened over 3 mm with edema. If the patient has acute tenderness over the area of the gallbladder this indicates a positive sonographic Murphy’s sign. Principle criteria of acute cholecystitis include the visualization or nonvisualization of the gallbladder and the presence or absence of stones. The additional sonographic
criteria are a thickened gallbladder wall (over 3mm) with edema. This edema is characterized by a diffuse striated hyperreflective wall thickening, hazy wall delineation, and gallbladder distension. In addition, there is a lucent layer within the thickened gallbladder wall that represents edema and necrosis. The gallbladder may be distended with or without sludge or evidence of cholelithiasis (stones obstructing the cystic duct are present in over 80% of patients). The shape of the gallbladder becomes rounded and tense appearing with the transverse diameter larger than the transverse kidney (or greater than 5cm). If the wall has perforated, an irregular collection of hypoechoic echoes will surround the area of the gallbladder that indicates abscess.

- Chronic pancreatitis: heterogeneous irregular areas of increased echogenicity throughout the pancreas often with shadowing from calcification. Chronic pancreatitis is due to repeated bouts of acute inflammation with progressive pancreatic destruction. This disease is much more common in males than in females. Fibrosis and calcification produce heterogeneous irregular areas of increased echogenicity throughout the gland often with shadowing from calcification.

Review terminology, technique, and findings related to vascular examinations, such as:

- External carotid artery: the arterial vessel in the neck which is typically located medially, has a smaller circumference, and contains multiple branches.

- Correcting lung interference in a contrast-enhanced echocardiographic examination by changing the patient’s position. Change the patient’s position by either physically moving him or by coaching him with his breathing pattern (lateral/anterior walls especially).

- Optimal angle for a vascular probe when evaluating an underlying vessel: 60 degrees or less. When using a vascular probe to detect vessel flow, place the probe of your Doppler over the underlying vessel using sufficient coupling gel. It is not necessary to press hard! Broad beam 5 MHz probes should be held flat against the skin, while smaller tipped probes should be held at an angle of 45 to 60 degrees. The correct amount of pressure and the angle of the transducer affect the quality of the signal. These techniques can be easily mastered in a short period of time. The optimal angle for evaluating a vessel is 60-degrees or less to the vessel wall.

- Pseudoaneurysm: True aneurysms contain all three layers of the normal arterial wall; pseudo-aneurysms contain only an inner endothelial layer and an outer layer formed by surrounding inflammatory reaction. These false aneurysms may result from perforation through the arterial wall with the formation of a hematoma in the surrounding tissue. Pseudoaneurysm is a complication that can develop from arterial catheterization.

- Findings in commonly encountered diagnoses, including:
  - Subclavian steal suggested by monophasic subclavian artery flow. A clot or stenosis in the subclavian or SVC (superior vena cava) will dampen the phasicity of the venous flow distally. Subclavian steal produces symptoms of cerebral
vascular insufficiency (not enough blood to the brain) when the patient exercises an arm, due to obstruction of the subclavian artery before the origin (the takeoff) of the vertebral artery. Exercising the arm causes the blood flow to reverse and the subclavian artery "steals" blood from the vertebral artery. The subclavian normally supplies blood to the arm while the vertebral artery conveys blood to the brain, so what is happening in the subclavian steal is that blood meant for the brain is stolen by the arm.

- Portal vein thrombosis. Demonstrated on an ultrasound of the liver and portal vascular system by decreased blood flow in the portal vein. PVT is recognized with increasing frequency on US images. Reduced portal blood flow resulting from hepatic parenchymal disease and abdominal sepsis are the primary causes. Transient PVT is also recognized with increasing frequency, in part because of the large increase in the use of US in evaluating patients with abdominal inflammation, such as appendicitis. Tumor within the portal vein may appear identical to thrombosis, but it is far less common. Tumor within the portal vein is most frequently related to a hepatocellular carcinoma, which gives rise to serpiginous filling defects in the portal venous luminal flow, but it usually persists around the tumor without complete occlusion.

- Possible deep vein thrombosis (DVT): Non-compressible vessel. Duplex ultrasonography (or real-time B-mode ultrasonography with color Doppler). In adults, duplex ally when diagnosing DVT of the lower extremities. It is being used more often as the primary diagnostic tool to confirm the diagnosis of thrombosis in adults and children. In vessels with thrombosis, Doppler signals are absent, and the lumen cannot be compressed with direct pressure. US compares favorably with contrast venography.

- Normal response to the provocative maneuver of distal compression/augmentation in Color Doppler Imaging (CDI) to evaluate venous flow: an increase in flow volume and velocity during maneuver. Provocative maneuvers (proximal and distal compression/augmentation) are performed to assess direction of flow during maneuver and after release of compression. Valsalva maneuver and “sniff” can be used but the effectiveness of these techniques are more dependent on patient compliance and ability to perform the maneuver without effecting movement of the leg being examined.

  - Distal compression (augmentation): Normal response is an increase flow volume and velocity in during maneuver; no flow reversal upon release of compression. Significant flow reversal (> 1 seconds in duration) upon release indicates “spontaneous regurgitation” a finding consistent with deep venous insufficiency or valvular incompetence.

  - Proximal compression: No flow reversal is seen in normal vessels during compression. Flow reversal (>0.5 seconds in duration) is consistent with deep venous insufficiency.
Patent dialysis access graft including increased velocity that has continuous forward diastolic flow and spectral broadening. The velocities will be slightly lower moving toward the venous limb of the graft. Peak systolic velocities are usually in the range of 200 cm/sec or higher. Decreases in peak velocities are suspicious for development of a problem – usually an outflow stenosis. No Doppler signals and intraluminal echoes are evidence for occlusion of the graft.

Poststenotic turbulence. Bidirectional turbulent blood flow patterns distal to a stenosis. Poststenotic disturbances distal to the stenosis will be demonstrated by bidirectional turbulent blood flow patterns (spectral broadening). Additionally there will be a mottled color pattern consisting of aliasing and multiple directions of blood flow. Multiple diagnostic criteria have been suggested for degrees of internal carotid artery (ICA) narrowing, including: peak-systolic velocity, end-diastolic velocity, and ICA/common carotid artery (CCA) ratios.

Review terminology, technique, and findings related to obstetrics and gynecology examinations, such as:

- Transabdominal (TA) technique to examine the female pelvis. Best results will be obtained if the patient has a distended urinary bladder. TA scans typically use the distended urinary bladder as a "sonic window" to identify the uterus and adnexa. TA may be limited with patients who are obese, unable to fill their urinary bladders have a retroverted uterus.

- Findings in commonly encountered diagnoses, including:
  
  - Torsed ovary: Enlarged ovary and decreased blood flow. An ovary that has torsed will increase in size and lose blood flow.
  
  - The first recognizable structure seen on ultrasound in an early pregnancy is the gestational sac. The gestational sac is the first recognizable structure seen in pregnancy. Early Ultrasound appearance: The earliest visible gestational sac is seen at 4.5 weeks as an echogenic ring, with a tiny central hypo echoic area. The nearly horizontal line beneath the sac is the endometrial cavity. Note the gestational sac lies outside the cavity, embedded in the decidua (lining). This eccentric position is called the intra-decidual sign, seen in intrauterine implantations, and different from fluid collections in the endometrial cavity which can be seen in both intrauterine and ectopic pregnancies. The presence of fluid in the canal in ectopic gestation carries the risk of misidentification as an intrauterine pregnancy, and is referred to as a pseudo gestational sac. Pseudo sacs never show the intra-decidual sign however.

  - The presence of the fetal pole allows for measurement of the crown-rump Length (CRL). This allows for more accurate pregnancy dating. The fetal pole, mass of fetal cells, separate from the yolk sac, first becomes apparent on transvaginal ultrasound just after the 6th week of gestation. The fetal pole grows at a rate of about 1 mm a day, starting at the 6th week of gestational age. Thus, a simple way
to "date" an early pregnancy is to add the length of the fetus (in mm) to 6 weeks. Using this method, a fetal pole measuring 5 mm would have a gestational age of 6 weeks and 5 days. CRL is a universally recognized term, very useful for measuring early pregnancies. The CRL is highly reproducible and is the single most accurate measure of gestational age. After 12 weeks, the accuracy of CRL in predicting gestational age diminishes and is replaced by measurement of the fetal biparietal diameter.

- Uterine fibroid: a concentric, solid, hypoechoic mass.