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Post-instructional Examination - Volume Status/Mechanisms of Hypotension:

1. For the average adult patient the left ventricular end diastolic diameter that is most sensitive and specific for a hypovolemic state is:

- A. < 5cm
- B. < 4cm
- C. < 3.5cm
- D. < 2.5cm

2. The best position to obtain a long axis cross section of the IVC is

- A. apical four chamber view
- B. subcostal view with indicator marker at the 3 o'clock position
- C. Subcostal view with indicator marker at the 12 o'clock position
- D. apical long axis view

3. IVC diameter size of 1.5 cm with > 50% decrease with inspiration represent which CVP range:

- A. 0-5mmhg
- B. 5-10mmhg
- C. 10-15mmhg
- D. unable to be determined with information provided

4. One is able to determine hypovolemic vs. low systemic vascular resistance by which of the following ultrasound findings:

- A. Hyperdynamic left ventricle
- B. Left atrial size
- C. Left ventricle end diastolic diameter
- D. Papillary muscle contact during systole

5. Free fluid in the upper abdomen will accumulate in which region in the supine position.

- A. RUQ
- B. LUQ
- C. Subxiphoid
- D. pelvic pouch

6. Morrison's pouch relates to which of the following.
- A. Potential space between the liver and the kidney in RUQ view
 - B. Potential space between the spleen and the kidney in LUQ view
 - C. Potential space between inferior to the bladder
 - D. None of the above
7. The FAST abdominal exam reliably detects greater than how much of free fluid
- A. >500ml
 - B. >100ml
 - C. >200ml
 - D. >1000ml
8. Doppler ultrasonography to measure the area under the curve, termed velocity time integral (VTI), for structures that transmit the pulsatile systemic flow relates closest to which of the following variables:
- A. Stroke Volume
 - B. Systemic Vascular Resistance
 - C. Contractility
 - D. None of the Above
9. The best position to assess for pericardial tamponade is
- A. apical four chamber view
 - B. subcostal view with indicator marker at the 3 o'clock position
 - C. Subcostal view with indicator marker at the 12 o'clock position
 - D. apical long axis view
10. All of the following structures are retroperitoneal except
- A. Kidney
 - B. Pancreas
 - C. Spleen
 - D. Abdominal Aorta
11. The Diaphragm is higher on which side of the body
- A. Right
 - B. Left
 - C. Equal
12. One can often improve the image of the subxiphoid view to visualize more of the pericardium by doing what with the US probe

- A. Rising to a steeper angle with the body
- B. Lowering the angle with the body by lying it flat on the abdomen
- C. Using a flat linear probe
- D. None of the above

13. The following are true regarding ultrasound of LUQ for the FAST exam

- A. structures are often more superficial than the RUQ
- B. one usually needs to go to one higher rib space to scan the diaphragm
- C. The spleen/renal interface is often more anterior in the left side
- D. The spleen/renal interface is often more inferior in the left side

14. To optimize a view of Morrison's Pouch one should have the probe

- A. RUQ of abdomen mid-clavicular line
- B. LUQ of abdomen mid-clavicular line
- C. RUQ of abdomen axillary line
- D. LUQ of abdomen axillary line

15. Blood or Free fluid appears as what in the FAST exam

- A. anechoic (black) areas
- B. Hyperechoic (gray/white) areas
- C. Neither

16. One can assess VTI to determine SV (and therefore measure variation in SV) the best via sampling in which area

- A. Just below Mitral Valve at the Coaptation point
- B. 2 mm proximal to the aortic valve opening (Left Ventricle Outflow Tract)
- C. Just below Tricuspid Valve at the Coaptation point
- D. 2mm distal to the aortic valve

17. To optimize the subxiphoid view one should assess during

- A. inspiration
- B. expiration

18. Bladder volumes can be estimated by which formula:

- A. $0.7 \times (\text{supero-inferior diameter}) \times \text{TS (maximum transverse diameter)} \times \text{AP (maximum anteroposterior diameter)}$
- B. $0.5 \times (\text{supero-inferior diameter}) \times \text{TS (maximum transverse diameter)} \times \text{AP (maximum anteroposterior diameter)}$

- C. 1.2 x (supero-inferior diameter) x TS (maximum transverse diameter) x AP (maximum anteroposterior diameter)
- D. None of the above

19. IVC diameter should be measured when and where

- A. should be measured on end expiration (spont breathing patient) and 1cm distal to the IVC-hepatic vein junction where the anterior and posterior walls are clearly visualized.
- B. should be measured on end inspiration (spont breathing patient) and 1cm distal to the IVC-hepatic vein junction where the anterior and posterior walls are clearly visualized.
- C. should be measured on end expiration (spont breathing patient) and 1cm proximal to the IVC-hepatic vein junction where the anterior and posterior walls are clearly visualized.
- D. None of the above

20. Hematoma and lacerations of the liver or spleen would look like

- A. Linear and poorly defined irregularly shaped hypoechoic regions (compared to adjacent organ tissue)
- B. Linear and poorly defined irregularly shaped hyperechoic regions (compared to adjacent organ tissue)

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Post-instructional Examination - Cardiac

1. One should place the probe for a left parasternal short axis view at
 - A. 3rd to 4th rib space with probe indicator pointed at the 10 o'clock position
 - B. 5th to 6th rib space with probe indicator pointed at the 10 o'clock position
 - C. 3rd to 4th rib space with probe indicator pointed at the 2 o'clock position
 - D. 5th to 6th rib space with probe indicator pointed at the 2 o'clock position

2. One is able to best assess the major and minor dimensions of the left ventricle in the
 - A. L parasternal long axis view
 - B. Apical four-chamber view
 - C. subcostal view
 - D. None of the above

3. Regarding the patient position for cardiac ultrasound in apical views the ideal position is:
 - A. Left side down with L arm stretched out
 - B. Supine
 - C. Right side down with R arm stretched out
 - D. Doesn't matter

4. Appropriate position to obtain an apical four chamber view include all of the following except:
 - A. at the point of maximal impulse
 - B. inferolateral to the nipple
 - C. the probe indicator directed towards the 3 o'clock position
 - D. the probe indicator directed towards the 9 o'clock position

5. One is trying to acquire a L parasternal LAX view but the heart is seen in right of the screen, assuming appropriate indicator/probe position the best adjustment to make to optimize the image is:
 - A. tilt probe to the left
 - B. tilt probe to the right
 - C. change the angle anteriorly
 - D. Change the angle posteriorly

6. To achieve the 5 chamber apical view from the 4 chamber view one needs to:

- A. change the angle of the probe posteriorly by increasing the angle between the probe and the chest
- B. change the angle of the probe anteriorly by decreasing the angle between the probe and the chest
- C. change the angle of the probe posteriorly by decreasing the angle between the probe and the chest
- D. change the angle of the probe anteriorly by increasing the angle between the probe and the chest

7. To assess valve regurgitation one should use color flow Doppler via:

- A. parasternal long axis view with blood flow perpendicular to the ultrasound image
- B. apical four chamber view with blood flow parallel to the ultrasound image
- C. apical four chamber view with blood flow perpendicular to the ultrasound image
- D. all of the above

8. To assess right ventricular function one can:

- A. assess peak tricuspid annulus systolic (TA Sa) velocities of the lateral border in the four chamber apical view
- B. assess peak tricuspid annulus systolic (TA Sa) velocities of the lateral border in the two chamber apical view
- C. assess peak tricuspid annulus systolic (TA Sa) velocities of the lateral border in the parasternal long axis view
- D. None of the above

9. Normal values for peak tricuspid annulus systolic (TA Sa) velocities are

- A. >10cm/sec
- B. >5cm/sec
- C. >20cm/sec
- D. <10cm/sec

10. Fractional Area Change correlates with Ejection Fraction and can be measured by:

- A. $(\text{Area of Chamber (RV or LV) in Diastole} - \text{Area of Chamber (RV or LV) in Systole}) / \text{Area of Chamber (RV or LV) in Diastole} \times 100$
- B. $(\text{Area of Chamber (RV or LV) in Diastole} - \text{Area of Chamber (RV or LV) in Systole}) / \text{Area of Chamber (RV or LV) in Systole} \times 100$
- C. $(\text{Area of Chamber (RV or LV) in Systole} - \text{Area of Chamber (RV or LV) in Diastole}) / \text{Area of Chamber (RV or LV) in Systole} \times 100$
- D. None of Above

11. Regarding the Left Ventricle the anterior wall receives primarily oxygenated blood from which vessel

- A. Left Anterior Descending (LAD)
- B. Left Circumflex
- C. Right Coronary Artery

12. Regarding the Left Ventricle the lateral wall receives primarily oxygenated blood from which vessel

- A. Left Anterior Descending (LAD)
- B. Left Circumflex
- C. Right Coronary Artery

13. Regarding Diastolic Function, one can assess normal E (passive diastolic filling) to A (atrial contraction in late diastolic) ratio via which ultrasound technique

- A. Parasternal Long Axis just below the coaptation point of the mitral valve since blood flow is perpendicular to the pulse wave doppler single
- B. Four Chamber Apical View just below the coaptation point of the mitral valve since blood flow is parallel to the pulse wave doppler single
- C. Four Chamber Apical View just below the coaptation point of the mitral valve since blood flow is perpendicular to the pulse wave doppler single
- D. None of Above

14. One can tell normal Diastolic function vs. a Restricted Pattern by which pattern on Mitral Inflow?

- A. Normal Diastology has E/A >1 but <2 with a deceleration time >150ms while a restricted pattern has E/A >2 with a deceleration time <150ms
- B. Normal Diastology has E/A >2 with a deceleration time <150ms while a restricted pattern has E/A <2 with a deceleration time >150ms
- C. Normal Diastology has E/A >1 but <2 with a deceleration time <150ms while a restricted pattern has E/A >2 with a deceleration time >150ms
- D. None of the above

15. The ideal indicator of myocardial contractility should not be affected by preload or afterload. Ejection fraction (an indicator of contractility) is less dependent of loading conditions as compared to SV.

- A. True
- B. False

16. The different methods commonly used in the echocardiographic assessment of LV systolic function include all of the following except:

- A. Ejection fraction - M-mode LV dimensional method
- B. Simpsons method

- C. Visual gestalt
- D. dP/dT of the mitral regurgitant jet
- E. Doppler measurement of stroke volume...and therefore cardiac output
- F. all of the above are valid methods

17. When assessing the endocardial border those parts that are parallel to the ultrasound beam will show how on the screen

- A. Hypoechoic
- B. Hyperechoic

18. Which of the following values is most important in determining aortic valve area?

- (A) Ejection fraction
- (B) Left ventricular end-diastolic pressure
- (C) Mean gradient
- (D) Pulmonary artery pressures

19. How can one assess pulmonary systolic pressures using ultrasound?

- A. By measuring the peak regurgitate velocity of mitral regurgitation (via Continuous Doppler) and using Bernoulli equation to translated this to a pressure and then add the estimated RA pressure
- B. By measuring the peak regurgitate velocity of the tricuspid regurgitation (via Continuous Doppler) and using Bernoulli equation to translated this to a pressure and then add the estimated RA pressure
- C. By measuring the peak regurgitate velocity of the pulmonic regurgitation (via Continuous Doppler) and using Bernoulli equation to translated this to a pressure and then add the estimated RA pressure
- D. None of the above

20. Assuming ones Nyquist limit is appropriately set (50-60cm/sec) one can define severe mitral regurgitation has having a regurgitate jet area of what?

- A. $>4\text{cm}^2$
- B. $>10\text{cm}^2$
- c. $>20\text{cm}^2$
- D. One cannot use regurgitate jet area to define severity

21. Another way to asses severity of regurgitation is by vena contracta (the point in a regurgitate jet that originates from the fluid stream where the diameter of the stream is the least) of the tricuspid and mitral valves. Which of the following is the correct ranges of vena contracta?

- A. $<7\text{mm}$ =mild and $>14\text{mm}$ =severe
- B. <20 =mild and $>40\text{mm}$ =severe
- C. $<3\text{mm}$ = mild and $>7\text{mm}$ =severe
- D. None of the Above

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Post-instructional Examination - Pulmonary

1. Thoracic Ultrasound is more sensitive for the detection of which of the following compared to chest radiograph

- A. Pneumothorax
- B. Pleural Fluid
- C. Pulmonary Consolidation
- D. All of the above

2. When scanning for pneumothorax in the supine position the probe should be placed

- A. perpendicular with the ribs with the indicator marker pointing cephalad
- B. perpendicular with the ribs with the indicator marker pointing caudad
- C. parallel with the ribs with the indicator marker pointing cephalad
- D. parallel with the ribs with the indicator marker pointing caudad

3. When scanning for pleural fluid the ideal patient position

- A. in the sitting position with the arms by the patient's side
- B. In the sitting position with the arms raised to the level of the axilla
- C. supine
- D. R lateral decubitus position

4. Generally the diaphragm is typically caudad to the _ rib

- A. 8th
- B. 9th
- C. 10th
- D. 11th

5. Regarding Lung Ultrasound the following is true about B lines except

- A. They arise between border between aerated and compressed lung
- B. They are ray-like echogenic horizontal lines
- C. They extend from the pleural line to the lower edge of the screen
- D. They move synchronously with the lung respiration always

6. Key features of pneumothorax by lung ultrasound include

- A. Presence of lung sliding
- B. Absence of B lines
- C. Absence of lung sliding

D. Presence of B lines

7. Which of the following is correct regarding horizontal lines in the lung parenchyma by ultrasound?

A. they represent hyper echogenic lines representing reverberations of the pleural line.

B they represent areas of poor aeration of lung tissue

C. They are artifacts from ribs

D. The artifact pattern is improved with a deep breath.

8. An increase in B lines is associated with all of the following except:

A. worsening pulmonary edema

B. worsening pneumonia

C. worsening ARDS

D. worsening pneumothorax

9. One can differentiate pneumonia from bilateral pulmonary edema/air-space disease by:

A. Comparing presence/number of A lines between the two lungs

B. Observing for an increase in B lines in the diseased lungs

C. Observing for an decrease in B lines in the disease lungs

D. None of the above

10. Which artifact of lung ultrasound is defined as horizontal regular spaced hyperechogenic lines representing reverberations of the pleural line.

A. A Lines

B. B Lines

C. Z lines

D. E lines

11. Short broad, ill defined, vertical comet tail artifacts arising from the pleural line but not reaching the distal edge of the screen are NOT B lines but rather are

a. E lines and are artifact

b. Z lines and are artifact

c. B lines and are artifact

d. None of the above

12. Reverberations occur when there is a large difference in acoustic impedance

a. True

b. False

13. If the distance between the lung and posterior chest wall at the lung base is greater than 5 cm one can predict how much pleural fluid can be drained.

- A. 100ml
- B. 200ml
- C. 500ml
- D. 10000ml

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Post-instructional Examination – Ultrasound Physics

1. All of the following are true regarding a convex sector design 3.5-5MHZ transducer except.

- A. It provides a higher resolution image for near structures than a linear transducer
- B. Its design has a small footprint allowing scanning between rib interspaces
- C. Near field artifact is unavoidable
- D. It provides lower resolution than a linear probe but is able to have greater tissue penetration

2. All sound waves are characterized by the following except:

- A. frequency (f)
- B. wavelength (λ),
- C. speed (s),
- D. amplitude (A)
- E. strength (S)

3. Higher frequency transducer provides better resolution, but it has a shallower depth of penetration.

- A. True
- B. False

4. When the needle is inserted in the short axis all are the following are true except:

- A. a cross-sectional view of the needle will be obtained
- B. This is known as the out-of-plane technique.
- C. this technique results in the needle being imaged on cross-section that appears as a small dot, which can be difficult to see in real time.
- D. the needle will cross the ultrasound beam only once.
- E. all of the above are true

5. When the needle is inserted in the long-axis view all of the following are true except:

- A. the entire needle can be visualized.

- B. the operator loses the lateral-medial perspective.
- C. this technique affords visualization of the entire needle
- D. all of the above are true

6. Interaction of ultrasound wave with tissues

- A. Attenuation
- B. Reflection
- C. Scattering
- D. Absorption

7. The relative amount of ultrasound beam that is reflected depends on:

- A. the difference in Acoustic impedance between the mediums
- B. the power of the transducer
- C. the insonation angle of the probe
- D. none of the above

8. Axial Resolution is the minimum separation between structures the ultrasound beam can distinguish _____ to its path.

- A. parallel
- B. perpendicular

9. Lateral Resolution is the minimum separation between structures the ultrasound beam can distinguish _____ to its path.

- A. parallel
- B. perpendicular

10. Drawbacks of high frequency transducers

- A. More scatter by insignificant inhomogeneity
- B. More attenuation
- C. Limited depth of penetration
- D. All of the above

11. All of the following are true regarding M-mode except:

- A. It displays as a diagram that shows how the positions of the structures along the path of the beam change over time

B. Strength of the returning echoes are shown vertically and temporal variation horizontally

C. Strength of the returning echoes are shown horizontally and temporal variation vertically

D. Provides quantitative measurements of size , distance & velocity and has great temporal resolution

12. All of the following are true of resolution except:

A. It is separated as spatial and temporal

B. Spatial resolution is further divided as axial and lateral

C. Both axial and lateral resolution increase with increase frequency

D. All of the above are true

13. Facts of the Doppler ultrasound technique of Continuous Wave Doppler include all of the following except

A. Can measure high velocity flows

B. offers depth discrimination

C. Involves continuous generation of ultrasound waves coupled with continuous ultrasound reception using a two crystal transducer

D. is not affected by image depth.

14. Axial resolution depends on all of the following except:

A. wavelength (smaller the better)

B. pulse length (shorter the train of cycles the greater the resolution)

C. the ability to separate structures parallel to the ultrasound beam

D. it decreases with increase in frequency

15. Lateral resolution depends on all of the following except:

A. beam width (smaller the better)

B. Depth

C. Gain

D. All of the above affect lateral resolution

16. The Doppler Frequency Shift states that

A. Higher returned frequency if RBCs are moving towards the probe and lower if the cells are moving away

B. Lower returned frequency if RBCs are moving towards the probe and higher if

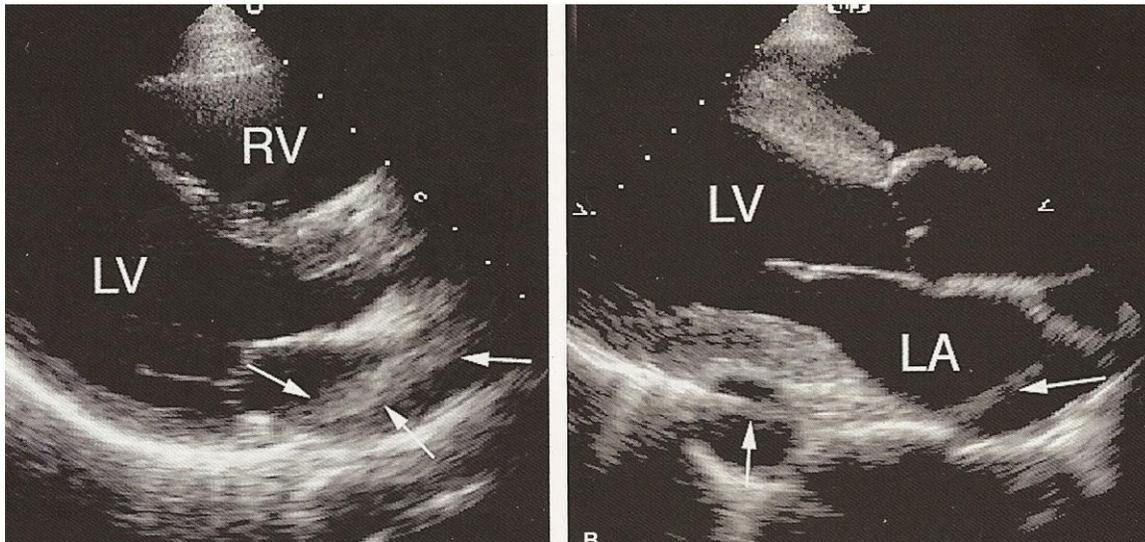
the cells are moving away

17. Blood flow velocity can be measured most accurately when a beam is
- A. parallel
 - B. perpendicular
18. 2 D images, which is collection of B lines will show the best images of structures that are
- A. parallel
 - B. perpendicular
19. Pulsed Wave Doppler involves all of the following except:
- A. provides depth discrimination
 - B. offers measurement of high flow velocities
 - C. is limited by depth
 - D. offers measurement of significantly lower flow velocities than continuous Doppler but offers depth discrimination
20. Aliasing occurs if the frequency of the sample volume is more than the Nyquist limit
- A. True
 - B. False
21. All of the following of Color Flow Doppler with a 2 –D image are true except:
- A. Displays flow data on 2-D Echocardiographic image
 - B. Displays real-time blood flow within the heart as colors while showing 2D images in gray scale
 - C. Allows estimation of velocity, direction and pattern of blood flow
 - D. Blue indicates blood moving away from the transducer
 - E. Red indicates blood moving towards the transducer
 - F. It provides higher frame rates than standard 2-D imaging.
 - G. Faster the velocity – more intense is the color

22. Similarly all of the following of Color Flow Doppler are also true except

- A. Eccentric jets appear smaller than equivalently sized central jets – Coanda Effect
- B. High pressure jet will appear larger than a low-pressure jet for the same amount of flow
- C. As gain increases, jet appears larger
- D. As ultrasound output power increases, jet area increases
- E. Lowering the pulse repetition frequency (Nyquist limit) makes the jet larger
- F. All of the above are true

23. The below image is an example of what type of artifact?



- A. Reverberations
- B. Side Lobe Artifact
- C. Shadowing
- D. Near Field Clutter

Post-instructional Examination - Volume Status/Mechanisms of Hypotension:

Answer key

1. C
2. C
3. B
4. C
5. A
6. A
7. C
8. A
9. B
10. C
11. A
12. B
13. D
14. C
15. A
16. B
17. A
18. A
19. A
20. A

Post-instructional Examination – Cardiac

Answers:

1. C
2. B
3. A
4. D
5. A
6. B
7. B
8. A
9. A
10. A
11. A
12. B
13. B
14. A
15. B
16. F
17. A
18. C
19. B

20. B

21. C

Post-instructional Examination - Pulmonary

Answer Key:

1. D
2. A
3. B
4. B
5. B
6. C
7. A / C
8. D
9. B
10. A
11. B
12. A
13. C

Ultrasound Physics

Answer Key:

1. A
2. E
3. A
4. E
5. D
6. A
7. A
8. A
9. B
10. D
11. C
12. D
13. B
14. D
15. D
16. A
17. A
18. B
19. B
20. A
21. F
22. D BUT ACCEPT ALL ANSWERS
23. B