

1: Sonography Principles & Instrumentation Registry Review

Hemodynamics Flow Rate Flow Characteristics- Laminar, Plug, Parabolic, Turbulent, Eddy current. Arterial Flow and Venous Flow Circulatory Pressure.

Front Back TVI is similar to peak velocity. However, TVI may be more accurate. May see peak velocity given on the boards. TVI is similar to peak velocity. How can you use echo to calculate cardiac output? In conjunction with this, the pressure drops in the stenosis How do you calculate the AV area using the continuity equation? How do you calculate the LVOT area? How is aortic stenosis graded? How is the aortic valve assessed by echo? Valve morphology Peak and mean gradients Aortic valve area Continuity equation and planimetry Dimensionless index What is dimensionless index? What are the pitfalls of assessing AS with echo? If it is not parallel to flow, it will underestimate the gradient LVOT Doppler When AS exists, there is a zone of acceleration just before the aortic valve When the pulsed Doppler sample volume is obtained within this zone when obtaining the LVOT velocity, it will be falsely elevated Normal LVOT TVI is cm Why should you not use the femoral sheath side arm as a surrogate for central aortic pressure? There is a temporal delay in the peripheral pressure. What is this tracing showing? In an invasive hemodynamic AS study, why should the mean gradient be used instead of the peak to peak gradient? The peak to peak gradient is not simultaneous and is therefore not physiologic. What is the Gorlin Formula? What is the simplified Gorlin formula? If there is co-existent regurgitation, the AVA will be underestimated. When non-invasive tests are adequate and concordant with clinical findings Asymptomatic pts Why does crossing the aortic valve in a pt with documented severe AS per TTE have a class III indication? How is the mitral valve area calculated based on Echo data? On the boards, sometimes, rather than providing the pressure half time, they will provide the deceleration time. How can the pressure half time be calculated? What is the pressure half time? How is mitral stenosis graded? What other very important piece of information in the setting of mitral stenosis can be obtained from echo? Peak RV systolic pressure. In the absence of pulmonic stenosis, this would be equivalent to PA systolic pressure How is RV systolic pressure obtained? If PCWP is used as a surrogate for LA pressure to obtain the transmitral gradient, this is not as accurate and echo results would be superior. There is a temporal delay in the wedge pressure when compared to simultaneous transeptal LA pressure readings. The V wave occurs later in the PCW tracing This can be corrected for in the lab by shifting the pressure tracing to occur earlier in the cycle. Also, the y descent is much shallower in the PCW tracing this cannot be corrected for. This is because the Doppler transducer can be well aligned with the mitral inflow. What is being shown in this pressure tracing? You are more likely to underestimate valve area and over estimate gradient. If you do not have a good Doppler gradient when assessing mitral stenosis, what should your next step be? A direct LA pressure measurement utilizing a transeptal puncture. What should be done when a pt has symptoms of severe MS, but findings consistent with non-severe MS? What findings do you look for in exercise stress echo in the evaluation of MS? Development of symptoms RV dysfunction and dilation with shifting of the interventricular septum. How can aortic stenosis be differentiated from HCM in the cath lab? Look at the aortic pulse pressure in a post-ectopic beat. There is increased contractility in a post-PVC beat which results in an increase in stroke volume. In AS, the obstruction is fixed. Therefore, more blood volume through a fixed obstruction will lead to an increase in stroke volume. As a result, the aortic pulse pressure will increase in the post-ectopic beat. In HCM, the increased contractility in the post-ectopic beat will lead to more obstruction. As a result, the pulse pressure will decrease because the stroke volume goes down. This is known as the Brockenhough response. When shown a post PVC tracing, look at the aortic pressure. Aortic pulse pressure that goes up with a post PVC beat. This is consistent with AS. Aortic pulse pressure that goes down with a post PVC beat. On exam, the carotid pulse will be bifid and more diminished on a post PVC beat, despite a loud increase in murmur. What are the factors that affect obstruction in HCM? Why is aortic pulse pressure decreased after a post PVC beat when this situation causes an increase in preload? In addition to the increase in pre-load, there is also an increase in contractility. When it comes to myocardial performance and stroke volume, the increase in contractility trumps the effect of increased preload, and results in increased obstruction and decreased stroke volume.

Describe the Doppler envelopes of AS vs. The Doppler envelope in HCM dynamic obstruction is asymmetric, dagger shaped. Take home points when comparing AS vs. Dobutamine stress test echo or invasive When there is a pt with a low gradient and low EF, pseudo-stenosis needs to be ruled out. In pseudo-stenosis, with the administration of dobutamine, the stroke volume will increase as will the AVA. The gradient will not change that much. If there is true AS, with dobutamine, there will be an increase in SV and a concomitant increase in transvalvular gradient. There will not be much change in the calculated AVA. Describe what is happening in this figure: In functional AS, with dobutamine, the dimensionless index is 0. The calculation of the valve area in this setting would show a larger orifice, unmasking pseudo-stenosis. With administration of dobutamine, the TVI or peak velocities increase. The stroke volume increased disproportionately more than the mean gradient. The valve area calculation shows an increase in valve area. This is consistent with pseudostenosis. The AVA did not change and remained at 0. Should pts with low gradient, low EF severe AS undergo surgical intervention? However, if they survived, they did well with improved symptoms and improved EF. In addition to helping differentiate pseudo AS from low gradient, low EF severe AS, dobutamine stress studies can also help with what? Can help determine contractile reserve. These pts did better compared to those that were medically managed. However, in the population that had no contractile reserve, those that underwent valve replacement still did better than those that were medically managed although this was not statistically significant. What are the implications in pts with low gradient, low EF AS that do not have adequate contractile reserve? With AS, the ventricle can become hypertrophied and the LV cavity can become quite small. This results in a decreased stroke volume. If the SV is low, a high gradient across the aortic valve may not be able to be generated. What are the echo findings in pts with low flow, low gradient, normal EF AS? Limited valve mobility LV stroke volume is decreased Cardiac index is also decreased. This leads to a discordance: What is the prognosis in the pts with low flow, low gradient, normal EF AS? If these pts undergo surgery, they do just as well as regular AS pts If these pts do not undergo surgery, they do worse than regular AS pts What are some of the 2D echo findings in pts with constrictive pericarditis? With expiration, there is an exaggeration of the reversal in the hepatic vein diastolic flow white cursor. Diastolic reversal of hepatic vein flow during expiration is one of the key findings This is suggestive of constriction What is happening in this SVC doppler tracing? There is no variation in the forward flow velocities of the SVC This is suggestive of constriction This is an important finding. There are also variation in the SVC doppler in these pts. Note in the figure variation with COPD and no variation with constriction. What is happening in this tissue Doppler? In addition, under normal circumstances, the lateral annulus shows higher velocities than the medial annulus. In constriction, the medial annulus is higher. Describe the hemodynamics of constriction During inspiration, the lungs expand This results in increased blood flow to the right side of the heart and decreased blood flow to the left side of the heart The septum shifts from the RV to the LV Because of decreased blood flow to the left side of the heart the pulmonary vein velocities go down and the peak mitral velocities goes down. The tricuspid early velocities increase, and the hepatic reversals decrease.

2: Physics-Sonography Principles & Instrumentation Registry Review

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Master synchronizer- Contains the beam former; as well as keeps all components ready to operate at the same time. Beam Former- Gives direction, steering, dynamic focusing and apodization to the transducer. May also work with returning signals depending on pre processing functions. Transducer- Converts electrical energy to mechanical sound energy and vice versa. The voltage applied to the crystal is in the range of volts and lasts for as little as us. Where the action originates. Alerts memory and receiver that action originated. PRF ranges from 4- 10 kHz. High PRF for display at a rapid rate. To avoid echo ambiguity misplacement, all echoes must be received before the next one is sent out. Must follow the following formula: The five major functions on the receiver are: Linear, which the signal is amplified directly in proportion to its size upon entering the receiver. Logarithmic, which weak echoes are strengthened more than strong ones, which narrows the dynamic range of amplitudes. Typically have dB of gain. Gain controls are used to compensate for this disparity. Typically compensate for about 60 dB of attenuation. Compensates according to go return time. Also called threshold, or suppression. Dynamic Range- Ratio of the largest to smallest power that a system can handle. Increases the contrast by reducing the range of intensity of displayed signals. It has two components: Changes frequency from radio to video form. Rectification turns all of the negative voltages into positive ones. Smoothing consists of putting an envelope around the bumps to smooth out the rough edges. Only one of the 5 Receiver functions that is not operator adjustable. Analog to digital converter - ADC converter - converts all signals from analog form to digital form before memory. A scan converter takes information in one format RF format and converts it into another format video display , that results in a two dimensional, sonographic, or color Doppler image. Can be in analog, but more recent systems are in digital format. Multiple frames are stored per second. Digital systems are much less sensitive to noise and display the signals more accurately, and also its values are discrete and well defined. Digital is made up of a matrix board. Common matrix board consists of x , or x Common memory devices have bits or more in memory. Prior to display signals go through a DAC converter - signals are changed from digital to analog to be sent to display. Most systems use digital display - so go through a ADC converter to be sent to digital display. Can be bi-stable - store only two shades -black or white - on or off - one bit system. Gray scale stores multiple shades - more bits per pixel. Low in contrast - smooth images. Pixels - relate to image resolution - image detail - spatial resolution. Bits - relate to computer memory per pixel - number of gray shades - contrast resolution. Typical matrices contain x pixels. LCD - liquid crystal displays. DLP - digital light processing. A Modeâ€” Amplitude Mode. Shows amplitudes of echoes. It is a depth vs. Temporal resolution in M and A mode is equal to pulse repetition period, because each pulse produces a new line of echo information on the displays. The beam is stationary. M Modeâ€” Motion Mode. Shows motion of cardiac structures. Presents depth vertical axis , vs. Can be in either 2D or 3D forms. Relate to spatial resolution- where the signal memory is stored in memory and in display. Pixel density- number of picture elements per inch. Represents the number of gray shades that can be displayed per pixel. Values are in multiples of 2. A byte is a group of 8 bits. Word- 16 bits two bytes. DACâ€” Digital to analog converter. Converts the digital data received from the image memory to analog voltages that are fed into the display to determine the echo brightness displayed. ADC- Analog to digital converter. Cathode Ray Tubeâ€” Cathode ray tube. Generates a display with an electron beam that painted the image in horizontal lines, each corresponding to a row of echo information in the image memory. Contrast Resolution- The ability of a gray scale image to distinguish between echoes of slightly different amplitudes or intensities. Increasing number of bits per pixel will improve contrast resolution. Range of dynamic range will determine how great a difference is needed. There is overall gain and depth selective gain. Overall gain increases all of the signals equally, like the knob of the volume. Pre Processing- The manipulation of the scan data before it is stored in the scan data scan converter. Includes any manipulation of that data. Log Compression- Using a log transformation of the signal levels, certain values from the possible

shades of gray can be eliminated, resulting in a cleaner image ideally suited for eliminating low level noise, or fill in cystic structures. Overall, reduces the dynamic range of the displayed image, that is less gray shades are displayed. Image Updating- Using algorithms to alter the rate at which new data is displayed, to avoid missing information to be displayed causing a grainy image. Write Zoom- Also called regional zoom is applied during data collection. It increases an ROI to be displayed on more pixels, thereby increasing the spatial resolution. Freeze Frame- It allows the user to select an image of interest for prolonged viewing. Persistence- Averages the frames for smoother images, reduces noise, when randoms are averaged it reduces speckle and noise, improves DR, improves CR and reduces frame rate. It is also called filtering. Post Processing- Its operations enable the sonographer to manipulate the image data after it has been stored on the scan converter but before it is sent to the video to display. Gray Scale Assignment- Allowing pixels with similar values over a narrow range to be displayed with different brightness levels, allowing them to be distinguished differently on the display. Read Zoom- Display magnification technique applied to the scan converter after collection. It is performed on a frozen image. Contains the same number of scan lines and pixels, pixels are larger. Does not improve resolution as with write zoom. Black-and-White Inversion- It is a technique that reverses white and black in the displayed image. Panoramic Imaging- C- Scape - Expands image beyond normal field of view. Echoes from previous frame are retained and new ones are added. B - Color- Improves contrast resolution by assigning colors rather than shades of gray. Cine - Loop- Allows backtracking of stored frames. Contrast Enhancement- Changes association between signal values and gray levels. Similar values can be displayed in different grays. KNOBS Amplification " Increases the brightness on the whole image, by amplifying the strength of the echo voltages from the transducer. Power " Increases the intensity on the image by increasing the power of the beam going out of the transducer. TGC " Allows tech to adjust the attenuation effects on the image by increasing the voltages on the further echoes thereby making them equally as bright as nearer echoes with the same IRC. Near gain, delay, slope, knee and far gain. Compression " Reduces the dynamic range making the image appear with more contrast. Focal or Transmit Zone " It makes the image on the area with the focal zone appear more clear by decreasing its lateral resolution, ie. Freeze " It is a constant display of one of the frames.

3: Instrumentation/ Harmonics/ Doppler/ Hemodynamics - Sam's Ultrasound Program

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Upon completion of this activity the learner should be able to: State the elementary principles of ultrasound including definition of ultrasound, basic properties and units of measure. Describe the fundamental principles of sound and the propagation of sound in soft-tissue. Cite the different types of transducers, focusing, sound beam formation and the various types of resolution including: Differentiate imaging artifacts by their cause and characteristic appearance Apply statistical test correlation and test validation using CHI Square principles regarding sensitivity, specificity and overall test accuracy. Outline safety, quality control, quality assurance and bioeffects concerns regarding operation and maintenance of ultrasound equipment. Daily continental breakfast and afternoon snack will also be provided. The Regular Registration Tuition is applied to registrations submitted between days in advance of the course. The Late Registration Tuition is strictly enforced and is applied to ALL registrations submitted within two weeks 14 days of the start of the course. No relevant financial relationships to disclose. Speakers will disclose any relevant commercial relationships prior to the start of the educational activity. Content Validation All presentations for this CME activity were reviewed and approved by members of the GUI CME Review Committee to determine content validity and to ensure that no conflicts of interest exist prior to the activity commencement or material compilation. Disclosure of Individuals in Control of Content In addition to the faculty listed the following individuals are recognized by GUI as being in control of content of this program: No relevant financial relationships to disclose show less The Gulfcoast Ultrasound Institute designates this live activity for a maximum of 7. Physicians should claim only the credit commensurate with the extent of their participation in the activity. Successful completion of this CME activity enables the participant to earn up to 7. While offering the CME credit hours noted above, activities are not intended to provide extensive training or certification for exam performance or interpretation. Special discounted room rates are available at most of the beach-front and downtown properties when booked through us. Call us at

4: Ultrasound Physics Test

a misrepresentation of the Doppler shift in a negative direction occurring when the pulse repetition frequency is set too low. arterioles smallest arteries in the circulatory system controlling the needs of organs and tissues.

Presents brief history of sonography profession, code of ethics, scope of practice, and technical standards. Admission to DMS program. Lecture 1 hour per week. Satisfactory completion of all previous sonography courses with a grade of "C" or better. Lecture 3 hours per week. Laboratory 3 hours per week. Total 6 hours per week. Focuses on anatomy, physiology, pathology, and vascular recognition with real-time 2-D and Doppler imaging. Complete all previous sonography courses with a "C" or higher. May be repeated for credit. Lecture hours per week. Total hours per week. Emphasis will be placed on abdominopelvic organs and vasculature. Lecture 2 hours per week. Focuses on the use of pulse-echo principles as applied to diagnostic sonography. Presents the physics of sound-tissue interactions and explores ultrasound instrumentation controls and functions. Explores Doppler principles and applications and basic types of equipment. Includes laboratory sessions on basic scanning techniques and protocols. Includes topics of discussion on normal and abnormal sonographic patterns, related clinical symptoms and associated laboratory tests. Includes laboratory sessions on basic scanning techniques. Laboratory 2 hours per week. Total 2 hours per week. Provides hands-on practice through vascular scanning in a laboratory setting. May include experiences in abdominal, pelvic, obstetrical, and small parts scanning, as well as echocardiography and vascular sonography. Laboratory hours per week. Laboratory 20 hours per week. Total 4 hours per week. Presents anatomy in transverse, sagittal and coronal planes. All previous sonography classes must be completed with a "C" or better. Completion of all prior Sonography courses with a "C" or better. Completion of all prior sonography courses with a "C" or better. Completion of all previous sonography courses with a "C" or better. Lecture 3 hours. Completion of all previous Sonography courses with a "C" or better. May be used also for special honors courses. View each individual course description and schedule across Virginia. Find the colleges which offer the course as well as when and where the course is offered.

5: Northern Virginia Community College: Diagnostic Medical Sonography (DMS)

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7: Hemodynamics Flashcards by ProProfs

Doppler shifts are also sent through a spectrum analyzer to a spectral display to show positive & negative Doppler shifts above and below the display baseline, which represents zero Doppler shift for observation and evaluation.

8: Doppler Instrumentation - Ultrasound Physics

Positive Doppler shift indicates a reflector that is moving toward the receiver and a negative Doppler shift indicates moving away from the receiver. The angle is factored into the equation for the Doppler shift frequency by using its Cosine values.

9: Cardiac Hemodynamics Products - Pegasus Lectures

For example, fetal Doppler echocardiography requires advanced duplex ultrasound instrumentation, which combines the capabilities of high-resolution two-dimensional imaging with the PW Doppler mode and an acoustic power output appropriate for fetal application.

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