<u>#ASEchoJC</u> Twitter Chat Tuesday, January 19, 2021 – 8 PM ET

- 1. <u>Etiology and Relevance of the Figure-of-Eight Artifact on Echocardiography after</u> Percutaneous Left Atrial Appendage Closure with the Amplatzer Cardiac Plug
- 2. Color Doppler Splay: A Clue to the Presence of Significant Mitral Regurgitation

Introduction & Welcome: Ritu Thamman (@iamritu) with moderators Vincent Sorrell, Edward Gill and Rajesh Janardhanan: @VLSorrellImages @rajdoc2005 @edwardgill @iamritu

Co-Authors: @Ph_Bertrand @Phil_Wiener

Welcome everyone to #ASEchoJC with @VLSorrellImages @rajdoc2005 @edwardagill co moderating with me & special guest @Ph_Bertrand (in Belgium) whose article we will discuss along w @Phil_Wiener's article on artifacts!

Tweetorial: https://twitter.com/iamritu/status/1351407300582498305?s=20

Q1: What is a splay artifact? How is this splay a helpful clue to the presence of severe MR?

A1 Notable Responses:

@iamritu: A1.Splay~ focal flow MR jet with high backscattered Doppler power reflects low-energy Doppler pulses in side lobes toward the transducer and cause a color Doppler side-lobe artifact. this leads to a linear arc-like artifact on both sides of vena contracta #ASEchoJC

https://twitter.com/i/status/1351696713678000131

@EGarciaSayan: #ASEchoJC: Diamond suitThe presence of splay as a result of a side-lobe artifact affecting the color Doppler signal suggests hemodynamically significant MR according to the study by @Phil_Wiener et al.



@EGarciaSayan: #ASEchoJC splay artifact in color Doppler can be a clue to hemodynamically significant MR

@DocStrom: Why does beam-width artifact look like an arc? 2D image is created by scan-lines that are produced in a radial fashion (from one side of the sector to other). Thus, side lobes appear as an arc with a fixed radial distance from the probe. #ASEchoJC

@iamritu: This is a key \P finding by *@Phil_Wiener!* Splay can be another qualitative finding to help us determine if MR is truly severe: splay artifact in 28 of 30 patients with wall-hugging jets, suggests role of splay in eccentric MR, acting as a strong Doppler reflector #ASEchoJC

@rajdoc2005: This is a critical finding especially on those "wall-hugging" jets of MR! So dont miss this finding - coz we may "under-estimate" the MR!! @ASE360 #ASEchoJC

@rajdoc2005: Hey! We have a new marker for significant MR!! Who knew!! @ASE360 #ASEchoJC @iamritu @VLSorrellImages

@EGarciaSayan: #ASEchoJC very useful finding indeed! But authors caution against reliance on this single parameter, and must still be used along with multi-parametric approach recommended by @ASE360 guidelines.

@LilyLeiZhang1: This color Doppler pattern is very important to recognize as eccentric jets due to flail leaflets are wall-hugging and produce little to no color jet area within the left atrium and faint spectral Doppler signals , as demonstrated below

@LilyLeiZhang1: #ASEchoJC top was same patient a few years ago with intact MV function, bottom with bee likely severe MR



Q2: How does splay change with transducer frequency and color gain?

A2 Notable Responses:

@iamritu: A2. Backscattered Doppler power is not solely related to MR severity but is modulated by color Doppler gain: Upwards arrow color gain Upwards arrow the splay signal & Upwards arrow transducer frequency (which Upwards arrow ultrasound attenuation & Downwards arrow backscattered power) Downwards arrow splay signal @ASE360 #ASEchoJC

@EGarciaSayan: #ASEchoJC:

- Splay increases w color gain and decreases w frequency.
- Therefore it may not be seen in TEE.



@DocStrom: This is a really important limitation of this as a marker of MR severity. It is specific but not sensitive. #ASEchoJC

Q3: How to differentiate MR splay from an eccentric out-of- plane jet that appears truncated (though in both cases, the MR may be more significant than it would appear on first impression)?

A3 Notable Responses:

@EGarciaSayn: #ASEchoJC:

- The splay artifact in mitral regurgitation can be confused with truncated eccentric jets, but the Key is to appreciate its arc shape at the same distance from the probe.
- However either of these situations may hint more significant MR than immediately apparent

@EGarciaSayan: #ASEchoJC: How can we differentiate a color Doppler splay artifact from a truncated eccentric regurgitant jet?

@iamritu: A3. Key features of splay it occurs in an arc splay does not respect anatomic boundaries, main lobe (the point at which the MR jet emerges into the atrium) is usually a bit rounder & thicker with the side lobes wing-like but can be tough to see vena contracta #ASEchoJC

exact vena contracta width is difficult to delineate because of the side-lobe artifact.



@EdwardAGill: #ASEchoJC SPLAY jets tend to be more central than eccentric wall hugging jets. Hence the name of eccentric jets. Multiple views very useful to sort out

@DocStrom: Very important to recognize the difference. Splay appears in an arc formation at an equal distance from the probe. This can be a clue that this is splay vs. eccentric MR, though both may be indicators of more severe MR; @ASE360 #EchoFirst #ASEchoJC

Q4: How does Figure 8 artifact of an Amplatzer septal occlude occur?

A4 Notable Responses:

@iamritu: A4. U/s machine assumes echoes travel along a straight path But in figure 8 artifact U/s waves falling on device are deflected in many DIRECTIONS because mesh fiber orientation heterogeneity Only those waves reflected t/w probe make u/s image #ASEchoJC

Ultrasound system assumptions Pulses and echoes travel along a straight path Echoes return to the transducer after a single reflection Echoes originate from the main beam Echoes travel at a uniform speed (1540 m/s) Pulses and echoes are attenuated uniformly by all tissues (at 0.5 dB/ cm/MHz)

ECHOCARDIOGRAPHY IN LA APPENDAGE CLOSURE

Etiology and Relevance of the Figure-of-Eight Artifact on Echocardiography after Percutaneous Left Atrial Appendage Closure with the Amplatzer Cardiac Plug

Philippe B. Bertrand, MD, MSc, Lars Grieten, MSc, PhD, Pieter De Meester, MD, Frederik H. Verbrugge, MD, Wilfried Mullens, MD, PhD, David Verhaert, MD, Maximo Rivero-Ayerza, MD, PhD, Werner Budts, MD, PhD, and Pieter M. Vandervoort, MD, *Genk, Haselt, and Leuven, Belgium*

@iamritu: planar mesh structure of device ~ epitrochoid curve mesh points at which tangent vector of mesh is perpendicular to direction of u/s beam very reflective When emphasizing only those curve points with a tangent vector perpendicular to a vertical u/s beam, Eyes symmetric figure-of-8



@Mariovar55: wonderful and complicated explanation of 8 artifact, physics of ultrasound always surprise

Q5: What is the impact of distance to the probe on the shape of the Figure 8 artifact?

A5 Notable Responses:

@iamritu: A5. morphology of fig 8 artifact depends on imaging depth, w more asymmetric fig-of-8 morphology smaller upper part & wide lower part at smaller probe-to-device distance(more asymmetric artifact on TEE Squared vs TTE) Epitrochoid creation using mathematical model by @avainrib1 #ASEchoJC

https://twitter.com/i/status/1351704750253867008

@iamritu: Also Fig 8 artifact seen 5-chamber 94% or 3-chamber 24% never in 2-chamber when tilting imaging plane laterally toward anterior commissure (off-axis 3-chamber) one can Eyes coronal view of device standard 5-chamber offers "near-coronal" view of front of ACP device #ASEchoJC

when tilting the imaging plane laterally toward the anterior commissure (off-axis three-chamber view, bottom left) one can expect a coronal view of the ACP device.



²⁷ standard five-chamber view offers a "nearcoronal" view of the front of the ACP device



@EGarciaSayan: #ASEchoJC figure of 8 artifact w/ Amplatzer device seen predominantly in coronal plane, hence most commonly seen in apical 5 and 3-chamber views on TTE.

Q6: What is the difference between a reverberation artifact and a mirror artifact?

A6 Notable Responses:

@iamritu: A6.Both have Upwards arrow distance determined by time it takes for the sound to return reverberation-parallel motion Squared vs mirror opposite motion both intense reflector(calcified stuff, pericardium) reflects US waves back to probe but only after ricocheting https://bit.ly/3iuuGHA #ASEchoJC

@DocStrom: Reverberations are caused by reflections between closely spaced highly specular reflectors, resulting in a step-ladder or comet-tail appearance (see below for reverb from discs of MVR) @ASE360 #EchoFirst #ASEchoJC

@LucySafi: Metallic prosthesis may act as an acoustic mirror The timing of the color in the LA matches that in the LVOT Proximal flow acceleration is absent Flow is separated from the prosthesis Look subcostal, no MR



Q7: Are there 3D artifacts?

A7 Notable Responses:

@iamritu: A7. In 3D can get dropout artifact:ie Fossa ovalis Since FO is thinner than power of resolution of u/s beam &FO is not perpendicular to beam, it's more parallel/oblique which produces scatter/ weak signals -> During acquisition overset gain -> Use color Doppler(ASD Squared vs FO) #ASEchoJC

https://twitter.com/i/status/1351708385490710530

@EgacriaSayan: #ASEchoJC figure of 8 artifact w Amplatzer device can also be seen in 3D (depending on the orientation of the ultrasound beam). Other common 3D artifacts may include apparent tissue deficiencies (valvular clefts or perforations, ASDs) as a result of undergaining.

Q8: What are the most common steps to correct a suspected 2D artifact and confirm this is not pathology?

A8 Notable Responses:

@EGarciaSayan: #ASEchoJC how to avoid misdiagnosing artifacts as pathology:

- Be aware of artifacts and understand the physics
- Change the ultrasound angle
- Adjust gain & focus
- Utilize color Doppler and PWD for suspicious vascular structures Diamond suitHarmonic imaging (side-lobe)
- Use UEAs

@DavidWienerMD: #ASEchoJC And look for the artifact in another view or window

@iamritu: A8. If you understand the cause/physics behind it , then try & resolve by confirming log it's present in multiple views(more likely to be pathology), change depth, use #UEA , change probe frequency harmonics Squared vs fundamentals 2d Squared vs 3D #ASEchoJC

@Ph_Bertrand: Great points @EGarciaSayan! Adding:

M-mode echocardiography as a simple yet powerful tool to confirm reverberation artifacts: showing identical motion with stronger reflector in the near field.



Example of reverberation in Ascending Aorta, confirmed by M-mode. #ASEchoJC

@LucySafi: Artifacts:

Are often linear, lack well-demarcated borders May appear to pass through other solid structures Motion identical to a real structure (mirror) May not be reproduced in an orthogonal view Color flow Doppler not affected by it Do not have clear attachments #ASEchoJC

Q9: Can artifacts ever be a good thing?

A9 Notable Responses:

@EGarciaSayan: #ASEchoJC: #EchoFirst artifacts are not all bad! These two articles from @JournalASEcho highlight that artifacts can serve to recognize a specific type of device, or hemodynamically significant MR. A perfect example of use of echo artifacts for diagnosis is the PISA calculation.

@EdwardAGill: The newer wider and MitraClips create more artifact, can be advantage in seeing demonstrating their position, but a disadvantage in terms of seeing the MR jet

@SeeWithSound: Yes, I love to see reverberation artifact (A-pattern on lung ultrasound) in my patients.

@drsmitamishra: Lung Ultrasound

Additional Images and Discussions:

@VLSorrellImages: SIDE-LOBE artifacts: derive from 'nearby' strong reflectors 'outside' the main beam (misinterpreted as deriving from 'within' main beam).



@VLSorrellImages: DOPPLER has largely the same potential artifacts as 2D

https://doi.org/10.1016/j.echo.2016.01.009



Notable Responses:

@docstrom: This image is from a GREAT article by **@Ph_Bertrand @JournalASEcho on #EchoFirst** artifacts - a must read for aspiring imagers.

@VLSorrellImages: BEAM WIDTH artifacts:

- -SAX view with TWO distinct AV's
- - overlap of MR & AR CWD A5C view
- -pacer wires appears in LA



@VLSorrellImages: SIDE-LOBE artifacts: this is another cause for the reduced SPECIFICITY of TEE to exclude aortic dissection.



Notable Responses:

@rajdoc2005: THIS is so important to be aware - and not "over-call" aortic dissection!!! Also wear your "thinking cap" when you see these artifacts!

@VLSorrellImages: Reverberation artifacts arise from an unexpected reflector (e.g. transducer) but, also consider the aorta, calcified structures, or devices.



Notable Responses:

@EdwardAGill: In this case note that the reverberation position is 2xd— a very important concept but the rules are not always followed

@lamRitu: Not always as mathematically precise #ASEchoJC

Reverberation		
d		
First Echo	d ₁ First Reverb	
d = v*t/2	d ₁ = v*(2t)/2 = 2d	d ₂
		d ₂ = v*(3t)/2 = 3d

@VLSorrellimages: NEAR FIELD CLUTTER - TGIH

- High amplitude oscillations from transducer
- A common cause for "cannot exclude LV clot" before Harmonics



@VLSorrellImages: What about UEA? Do they cause artifacts too? Of course...

Far field attenuation (too much / too fast) is simply a reverberation artifact!



@VLSorellImages: To Quote Harvey F:

"TEE gives you great images of rare findings; Stress Echo gives you lousy images of a common deadly disease!"



@VLSorellImages: If you can't exclude LV apical clot':

- highest freq probe

- narrow ur sector
- CFD = PMC (Poor Man's Contrast)
- Use UEA
- Apical sweeps



@VLSorrellimages: REFRACTION (e.g. beam width or side lobe): Violates the assumption that ALL US travels in a straight line. NO - the pencil is NOT broke!



VLSorrellImages: Ever wonder why you can see the mitral valve apparatus in the lung? Here's why! Bertrand PB et al. JASE 2016 DOI: 10.1016/j.echo.2016.01.009



@VLSorrellImages: I hope you don't think that TEE is vaccinated against artifacts - its not! Bertrand PB et al. JASE 2016 DOI: 10.1016/j.echo.2016.01.009



Notable Responses:

@iamritu: These are always the hardest cases:



@docstrom: Agreed -very tough cases. Reverb artifact is faint, can cross anatomic borders, is seen only in certain views, and occurs at 2X distance from posterior Ao wall in this case.

@EdwardAGill: Yes the classic doubling artifact

@VLSorrellImages: Hmmmmm... whats up with this? Severe AR?

... I don't THINK so!



Notable Responses:

@cianmcdermott: Looks like a perfect mirror image, both in systole?

@AnjaliSharmaHH: Carotid flow?

@DrBrijPatel: Carotid flow? It is in systole. Bidirectional may because of high gain or power **@XufangBai:** U mean the spectrum above the baseline? It is from brachiocephalic artery.

@VLSorrellImages: IATROGENIC: MVR clicks / reverb can be used to assess normal vs abnormal valve function (see normal v fixed leaflet?).



Notable Responses:

@rajdoc2005: Artifacts in general are super annoying - but there are situations it can be super helpful!! Now This is one situation we can all say "Thank God for the artifact" - to help differentiate a "stuck valve" vs "normal leaflet motion" !!

@VLSorrellImages: #ASEchoJC ARTIFACTS JAN 19, 2021

IATROGENIC (e.g. unshielded electrical device): Cauterization artifacts are common in OR.

Q. Best way to mitigate? A. Ask surgeon to STOP.

