

Paravalvular Leak Quantification PBLD

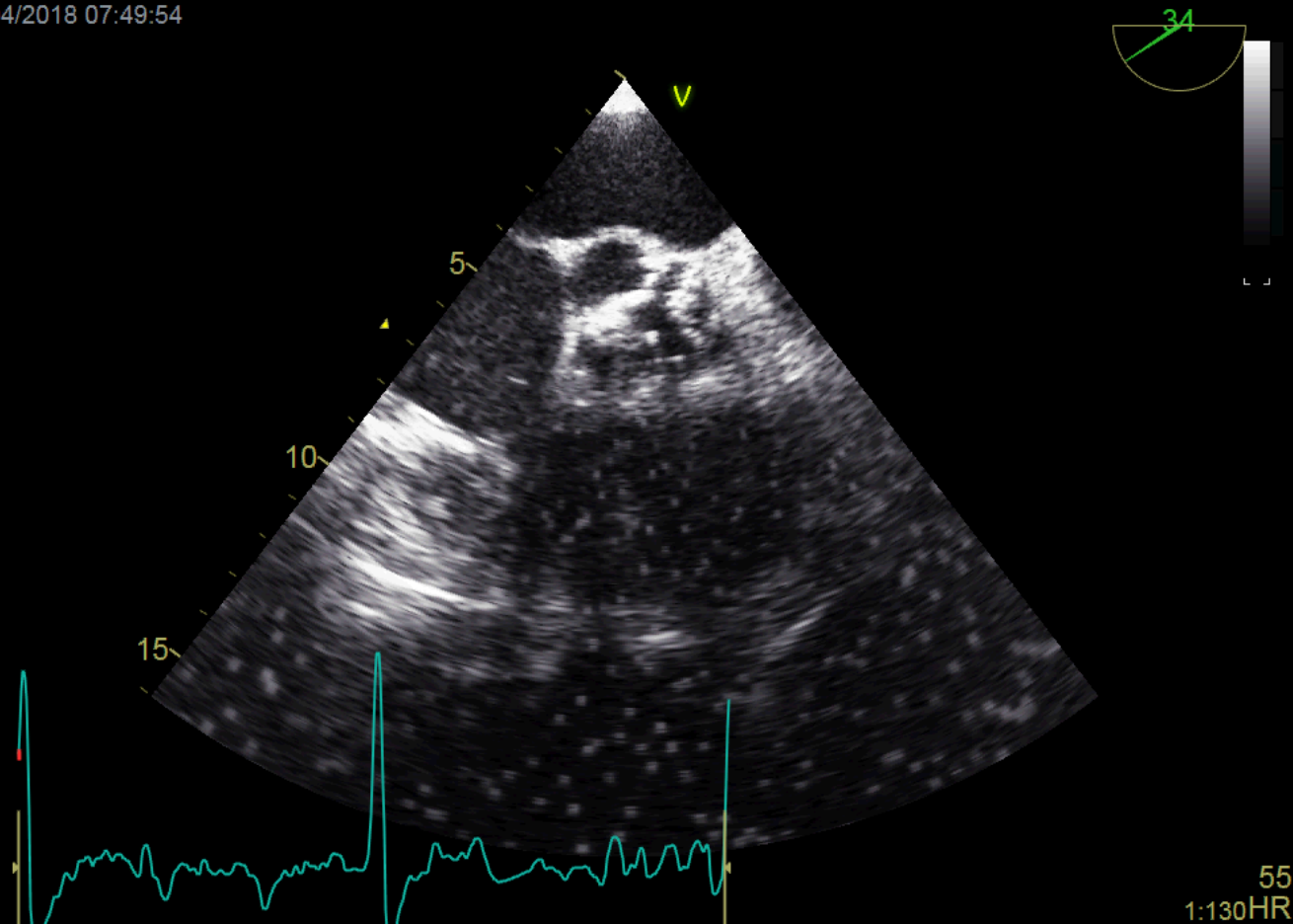
Summer Syed, MD, MSc, FRCPC
16th Annual Toronto TEE Symposium

Case 1 AVR

- 67 yo obese male for AVR
- HTN
- multivessel CAD
- Severe AS, mild-mod AI
- Hyperlipidemia
- GI bleed 2° H Pylori (remote)

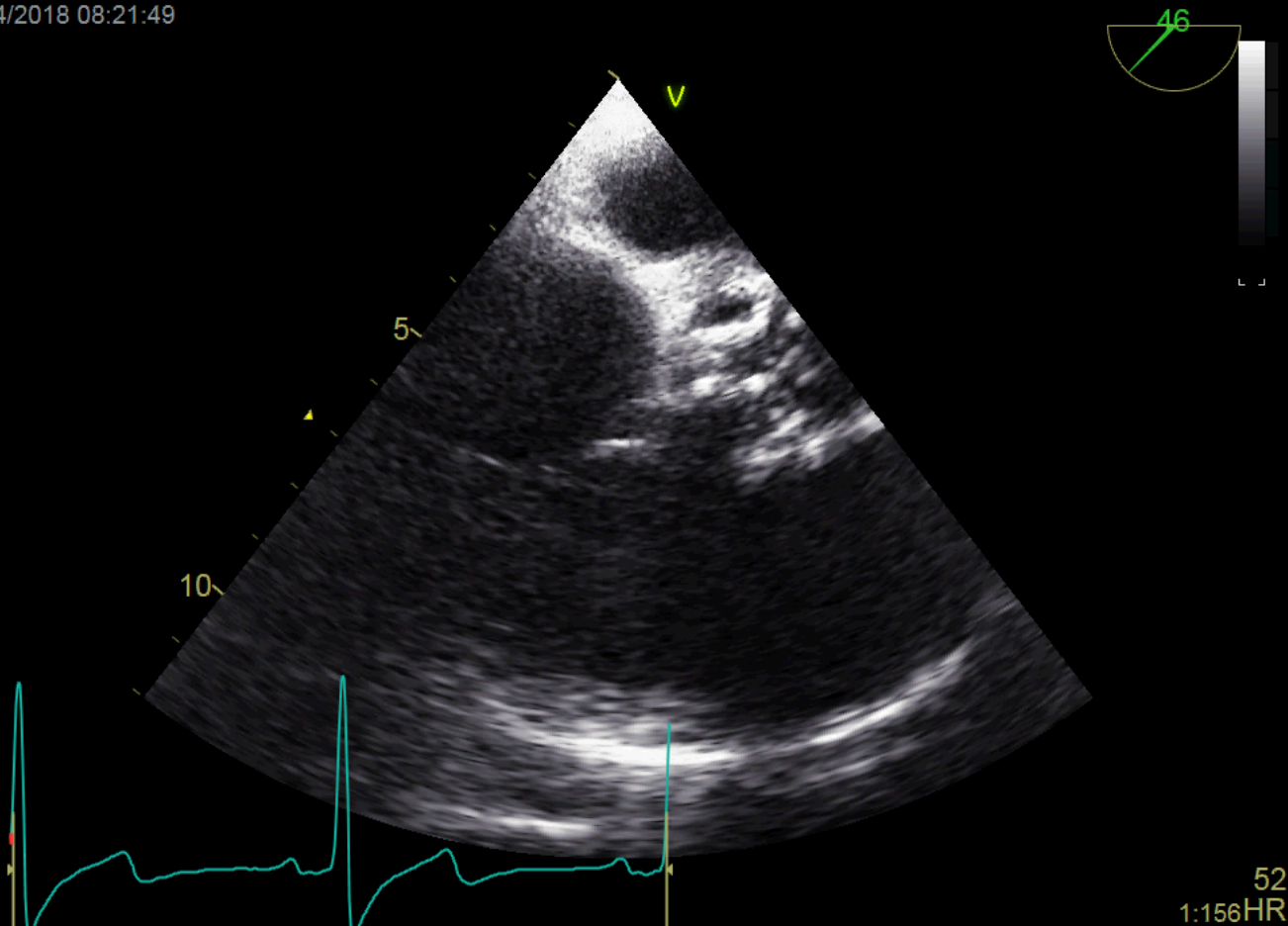
Case 1 AVR - pre

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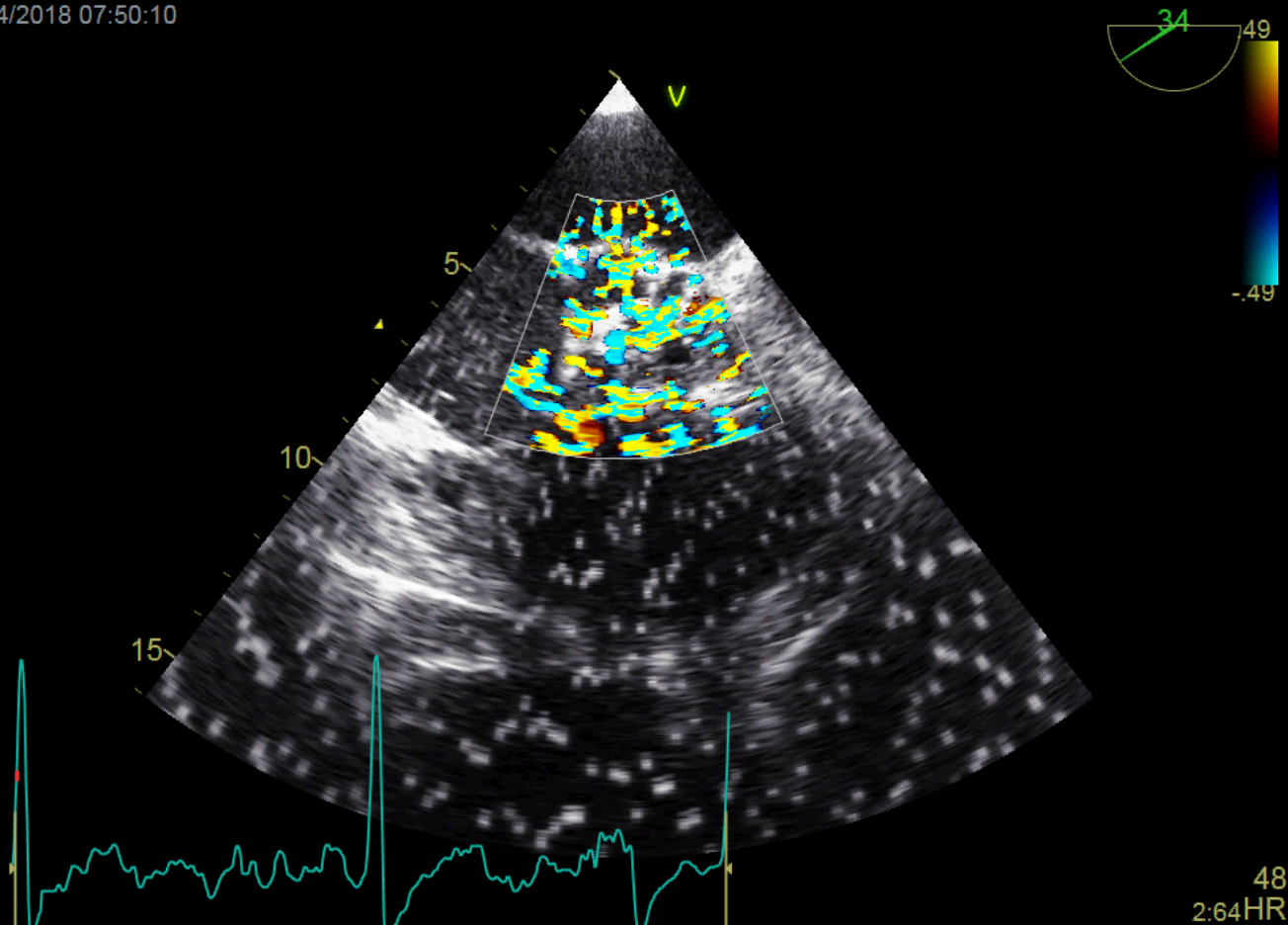
Case 1 AVR - pre

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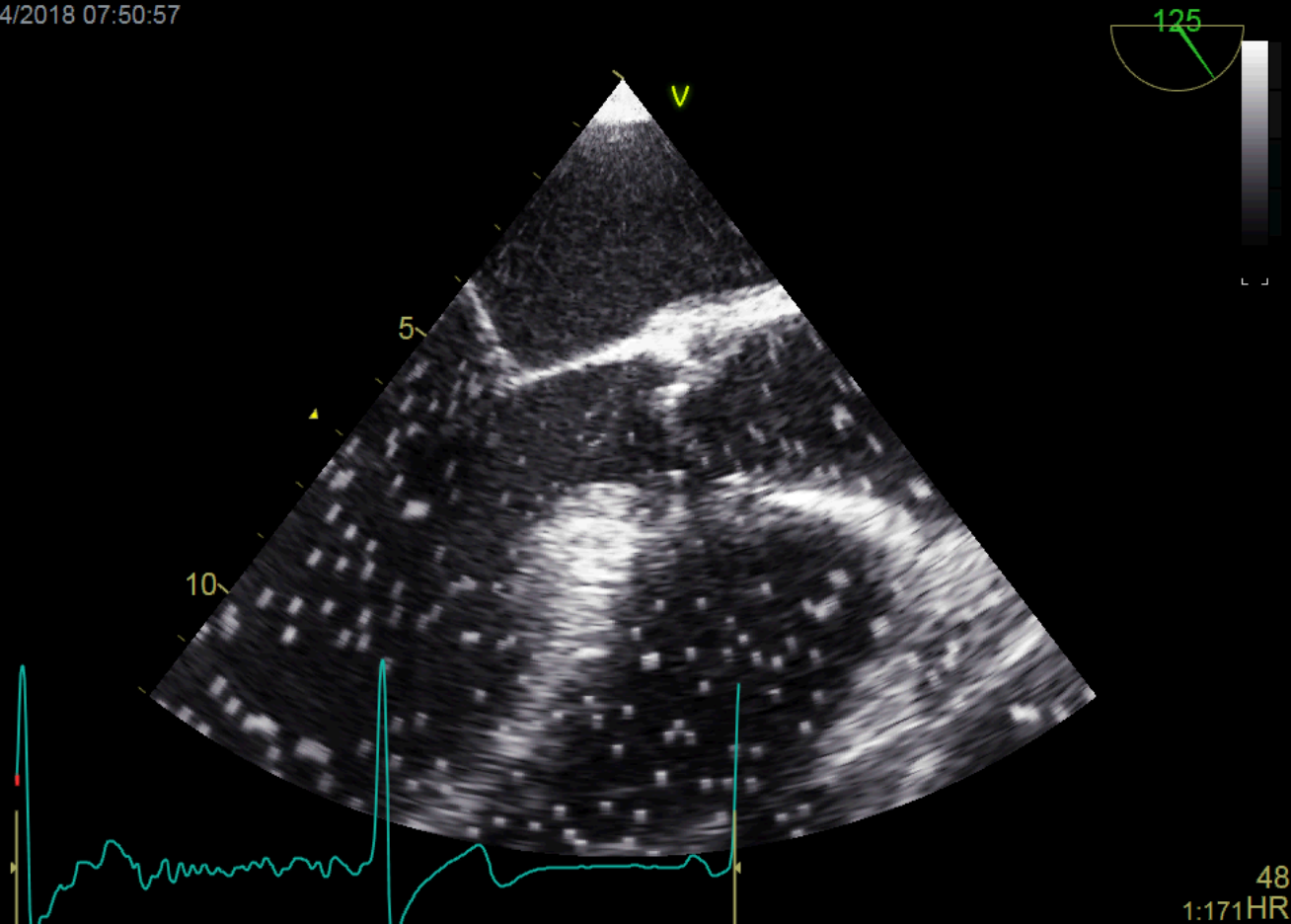
Case 1 AVR - pre

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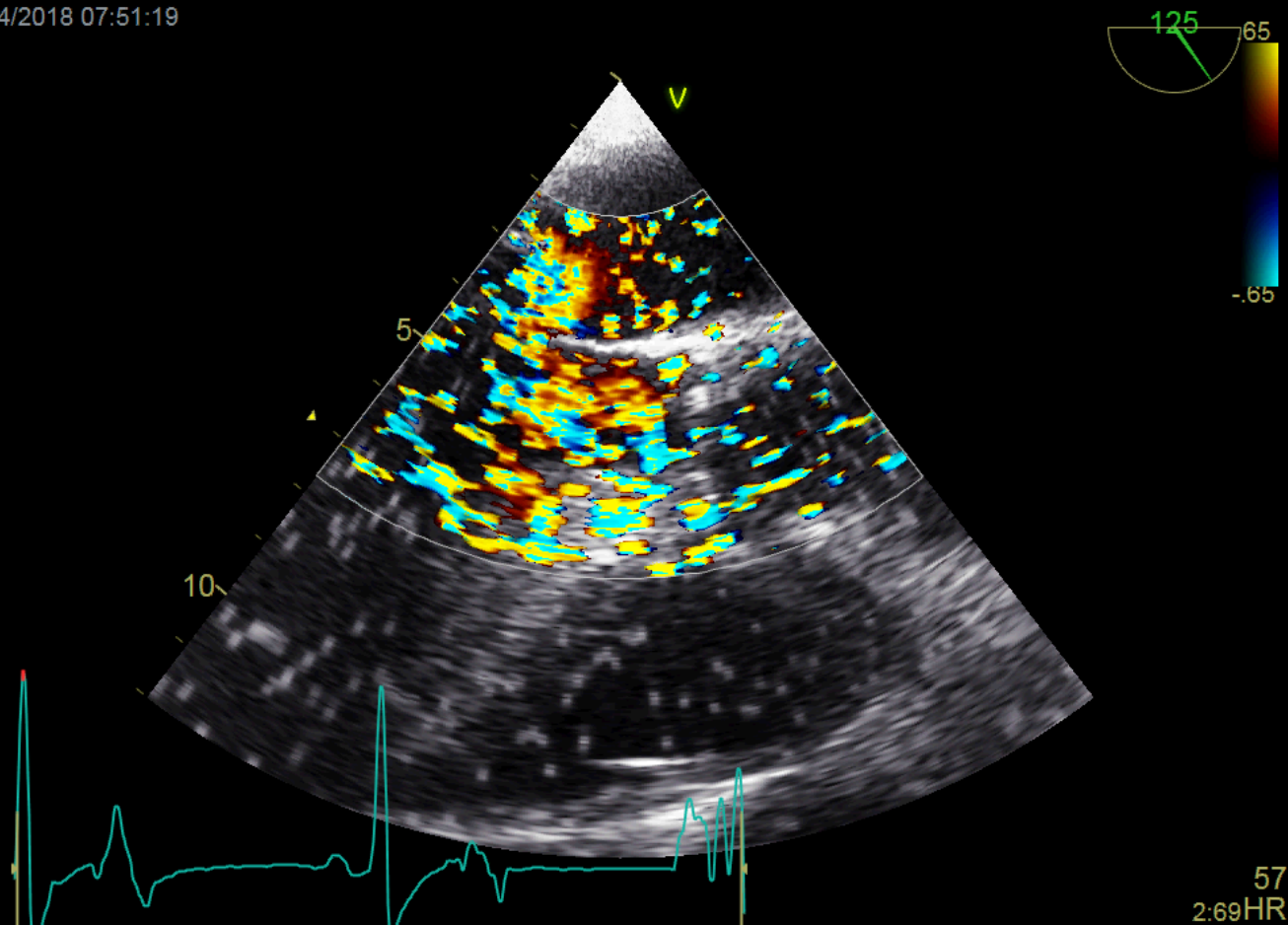
Case 1 AVR - preop

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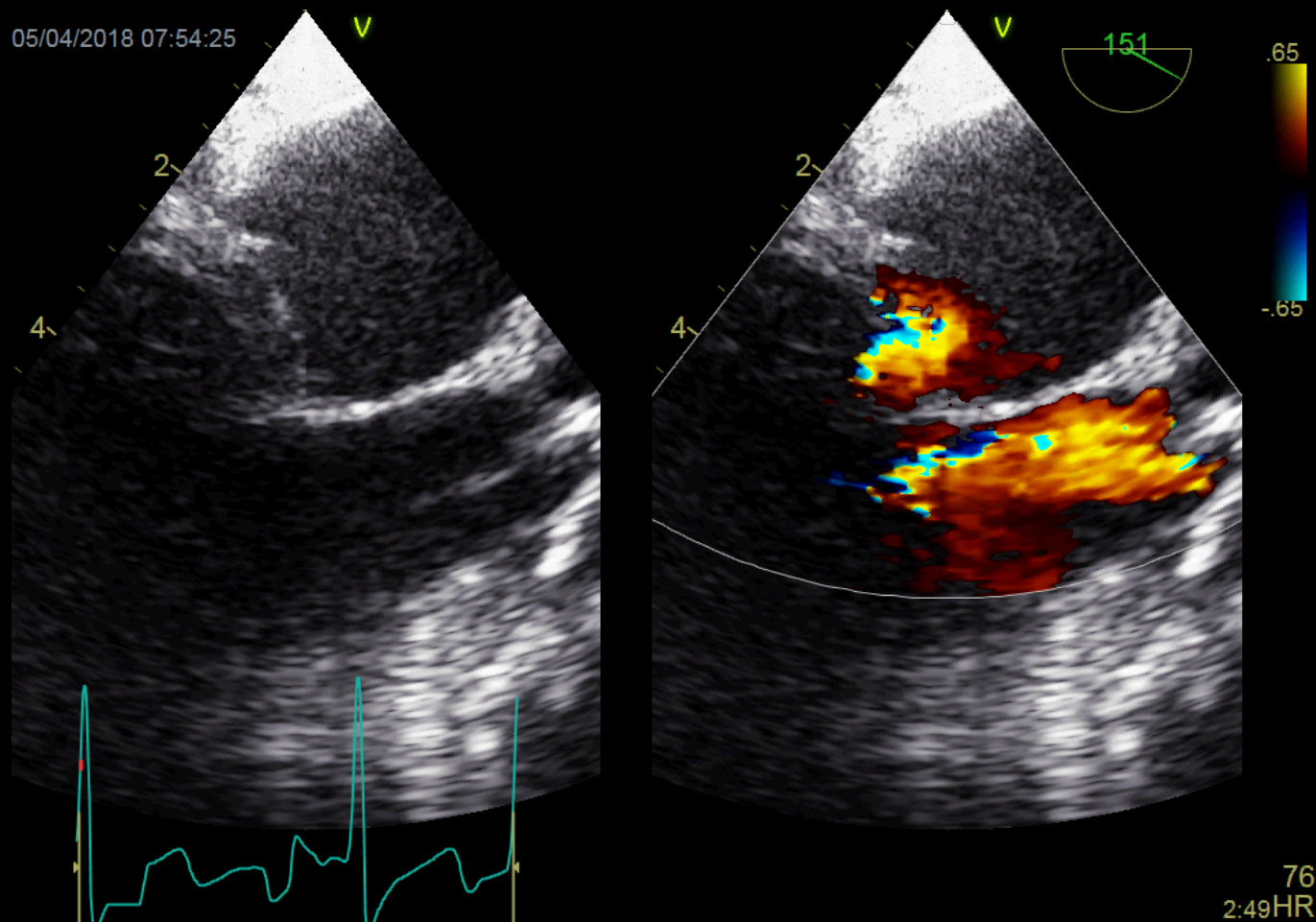


Case 1 AVR - preop

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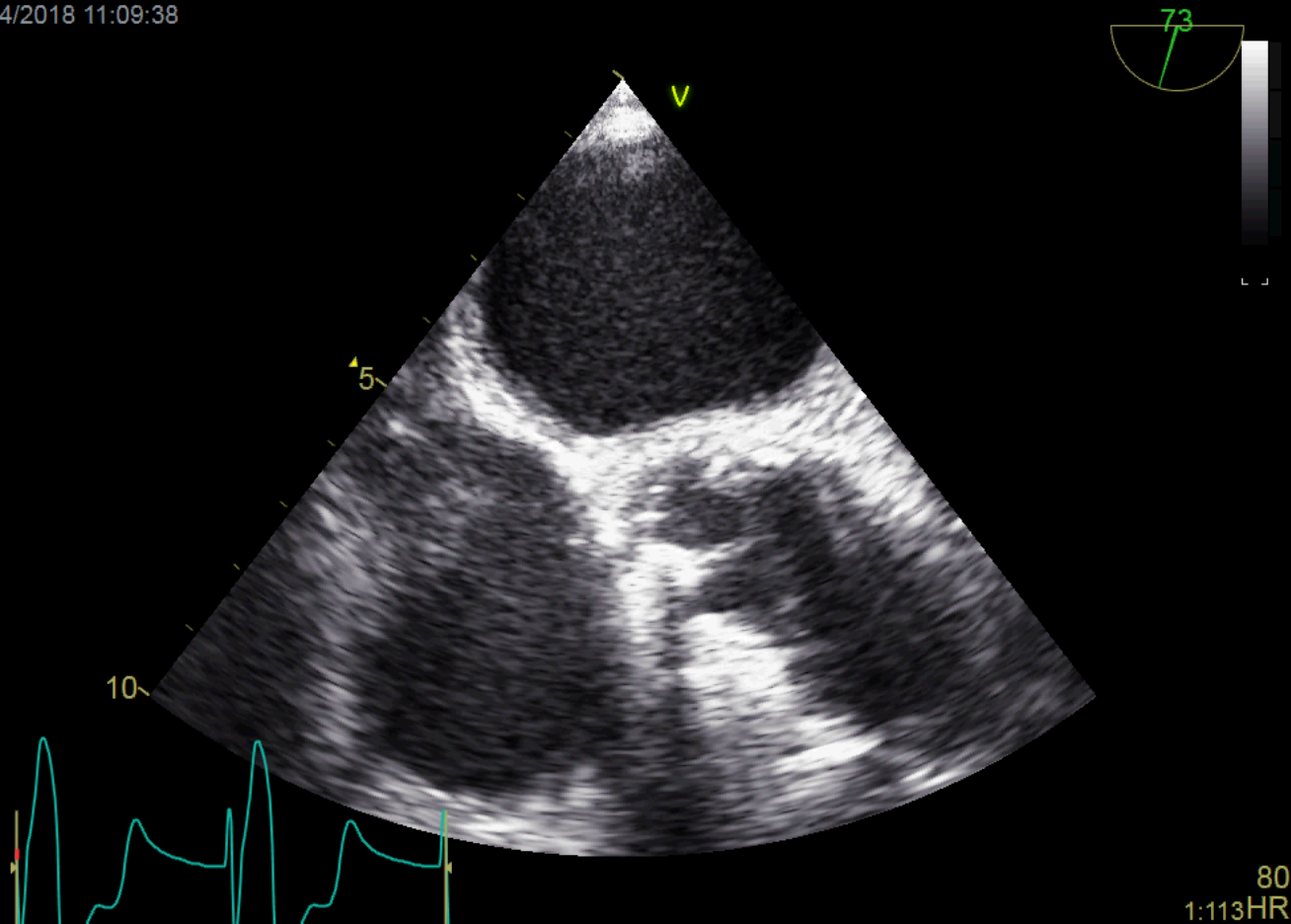


Case 1 AVR - preop



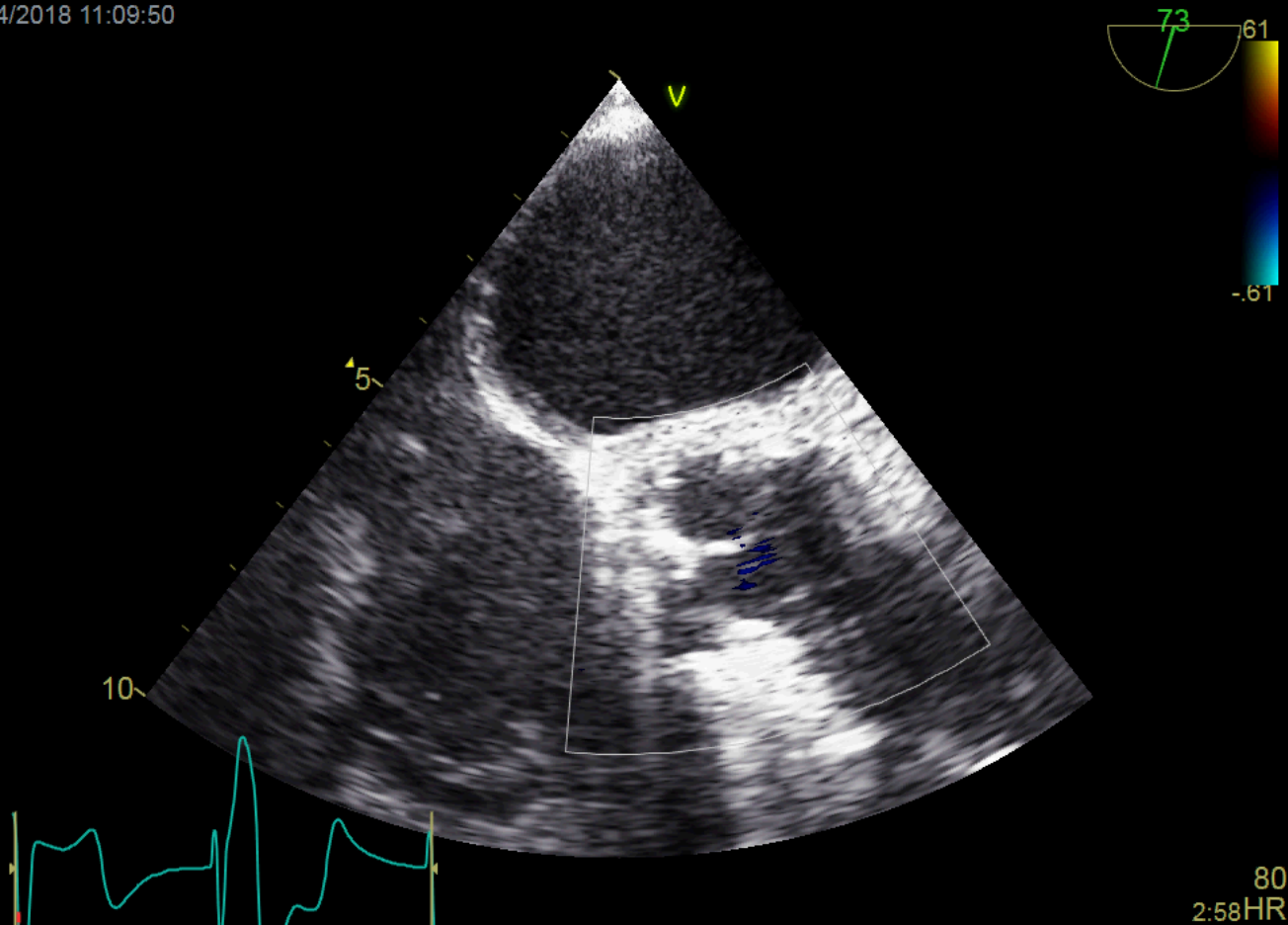
Case 1 AVR – post

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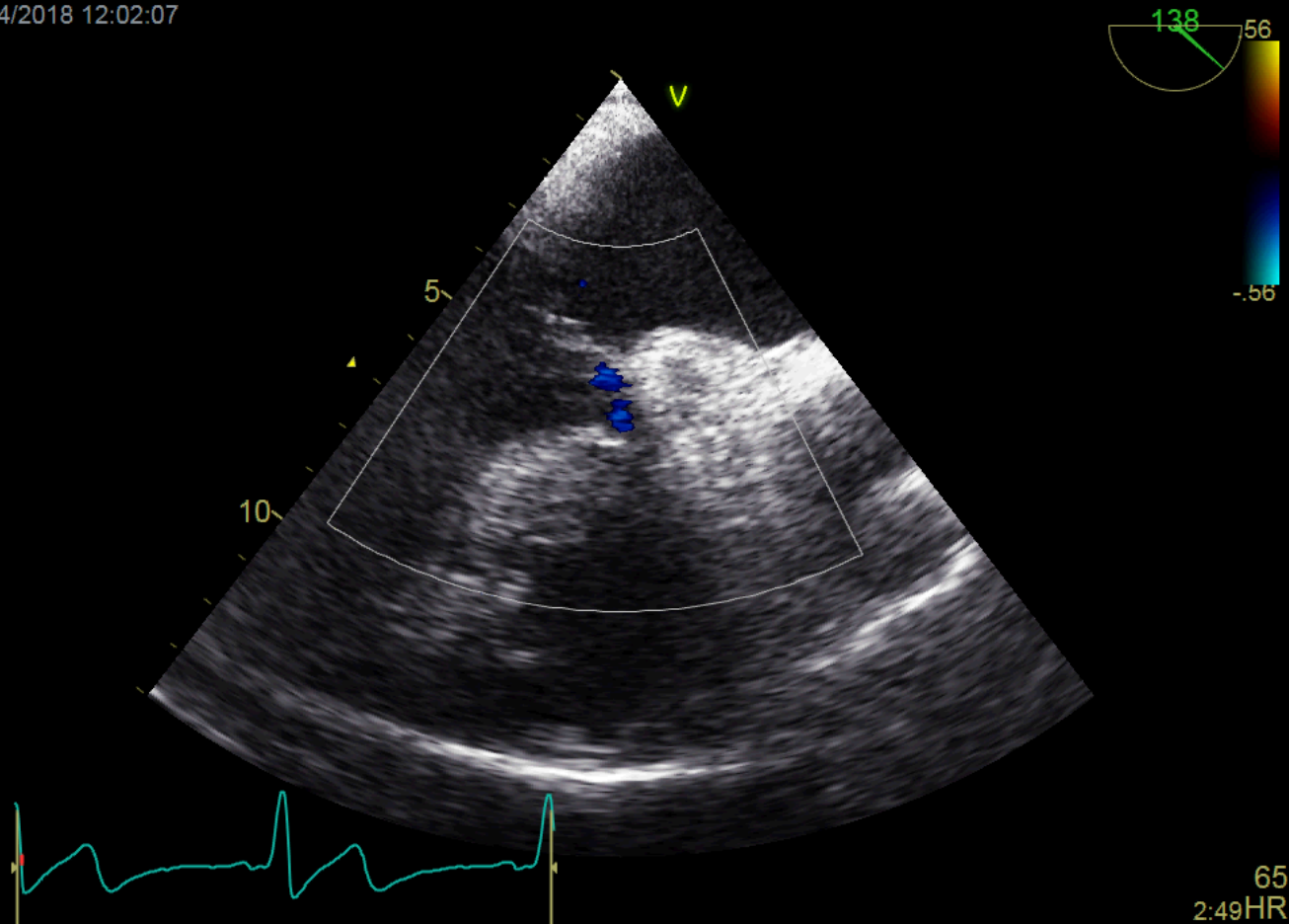
Case 1 AVR – post

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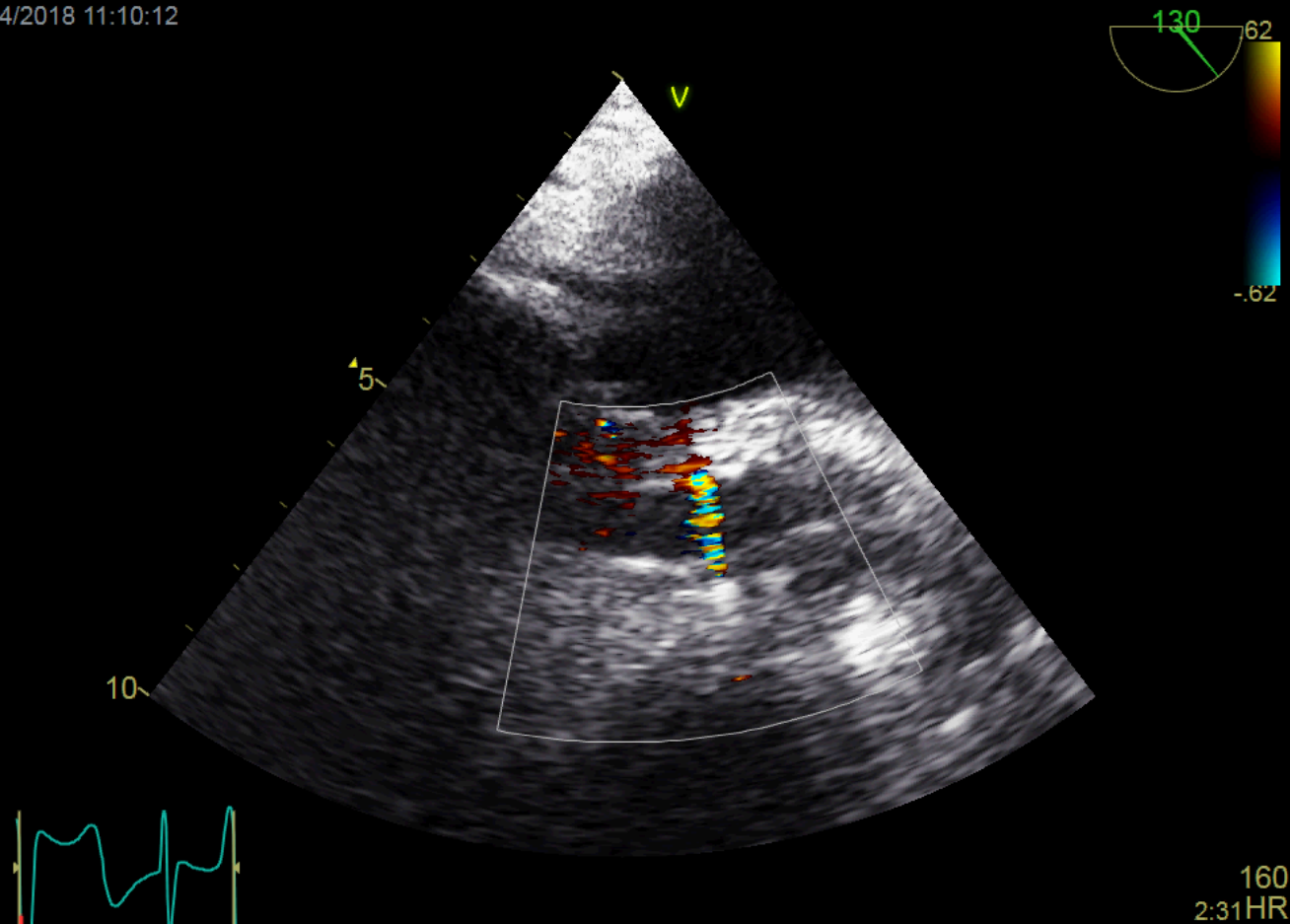
Case 1 AVR – post

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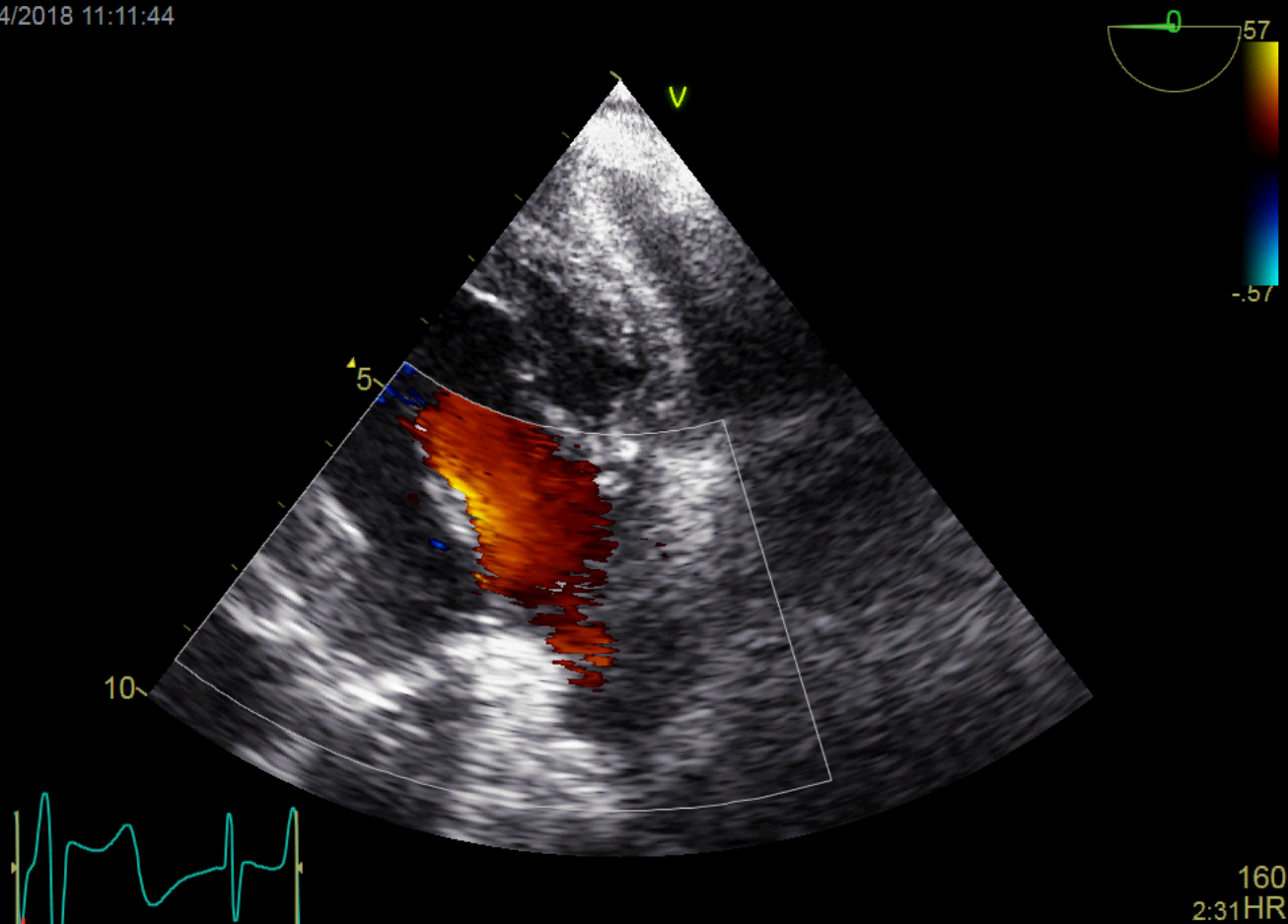
Case 1 AVR – post

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Case 1 AVR – post

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Case 1 AVR - Conclusions

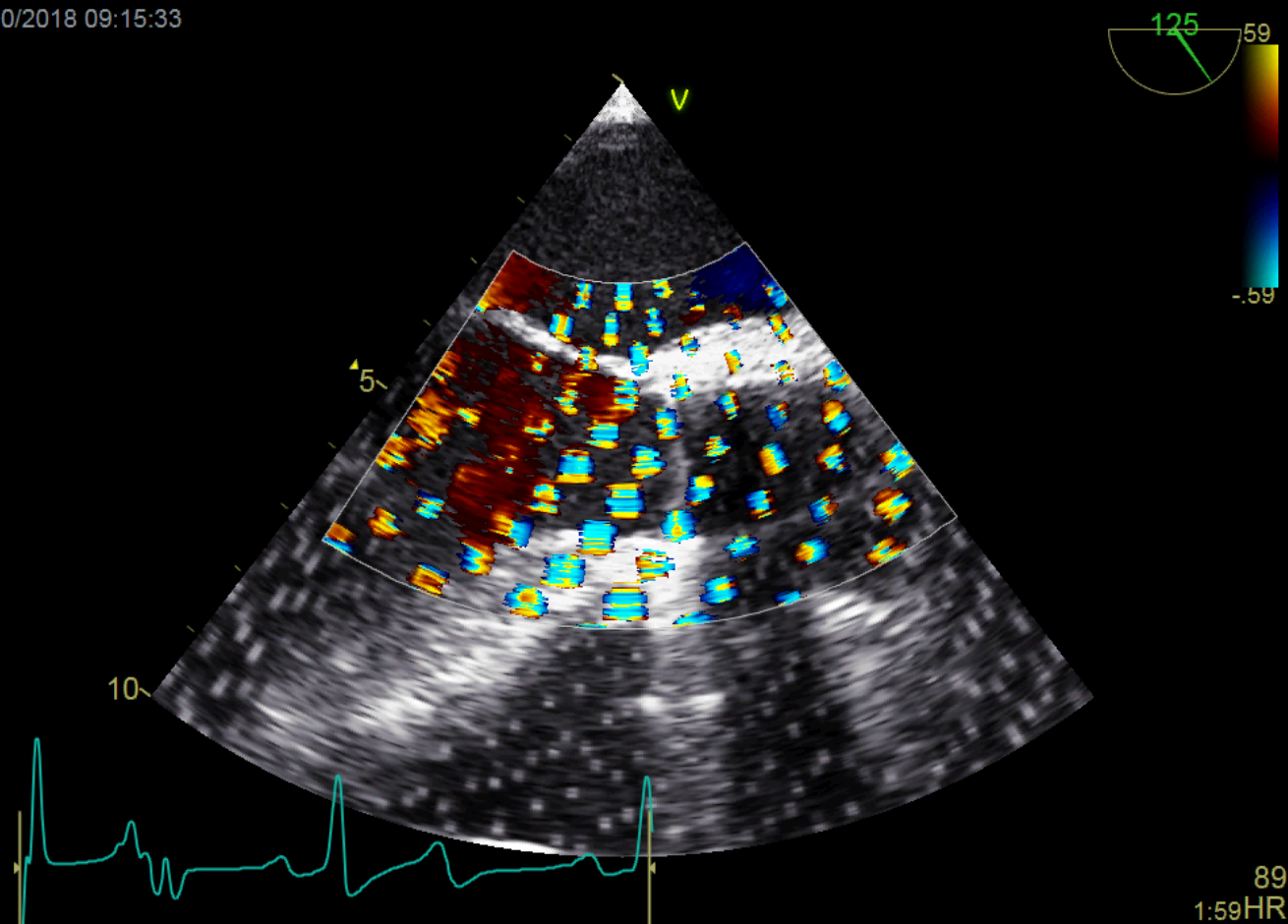
- Severe paravalvular leak exists – takes up entire annulus of AoV
- Back on pump, tried to repair - pledgeted sutures placed – no change in leak
- Pt to ICU – increased inotropes, CHF, hemolysis
- Back to OR
- Leak in 3D thought to be in LVOT (sorry no images available)

Case 2 ROSS

- 48 yo male
- AVR at age 18 for bicuspid valve with severe AS
- Re-Do Bentall with mechanical AoV 4y ago
- Recurrent strokes from inadequate anticoagulation on warfarin (MCA/visual field defects/seizures post infarcts)

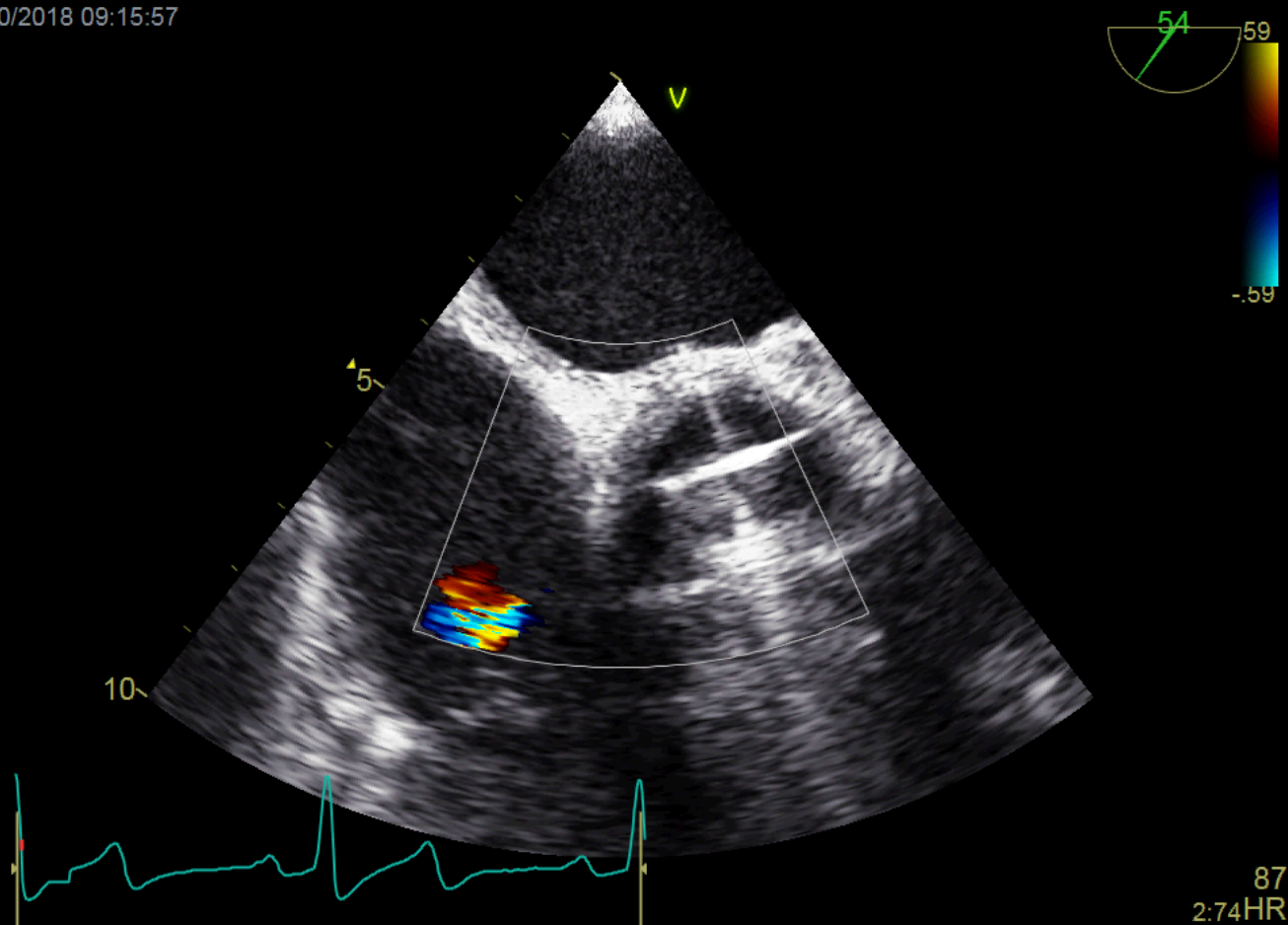
Case 2 ROSS - pre

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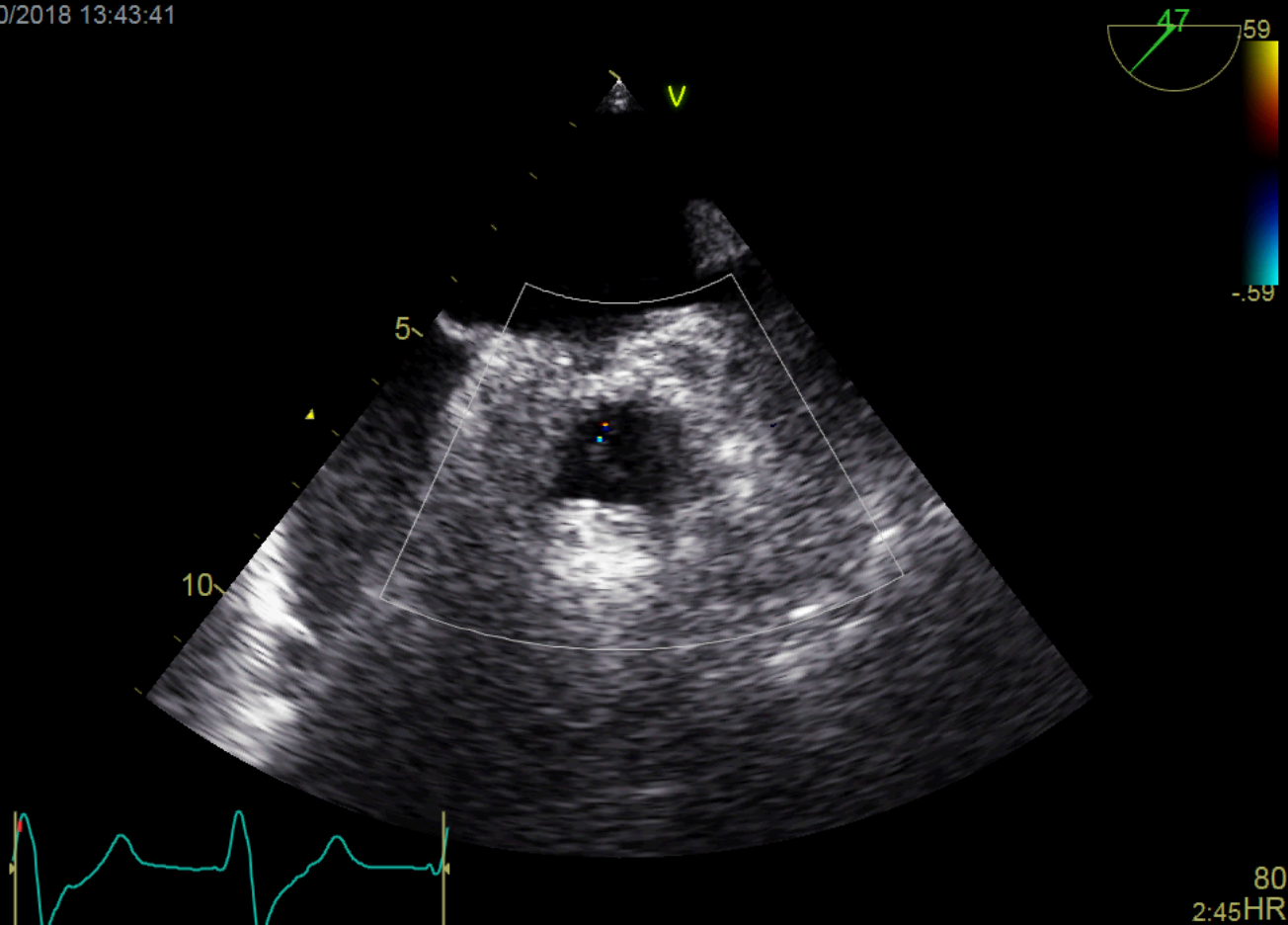
Case 2 ROSS - pre

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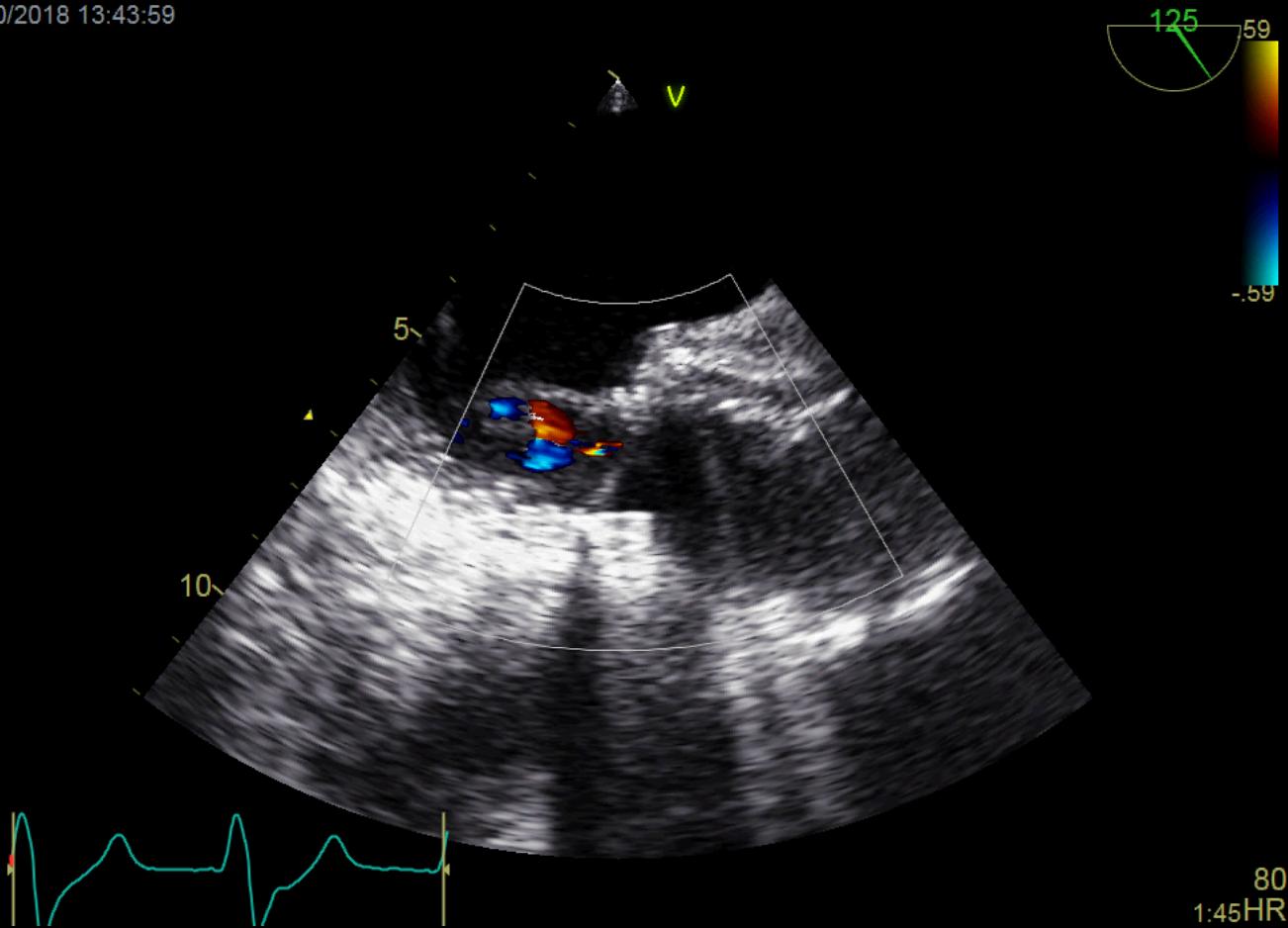
Case 2 ROSS post

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Case 2 ROSS - post

17/10/2018 13:43:59



Case 2 ROSS - Conclusions

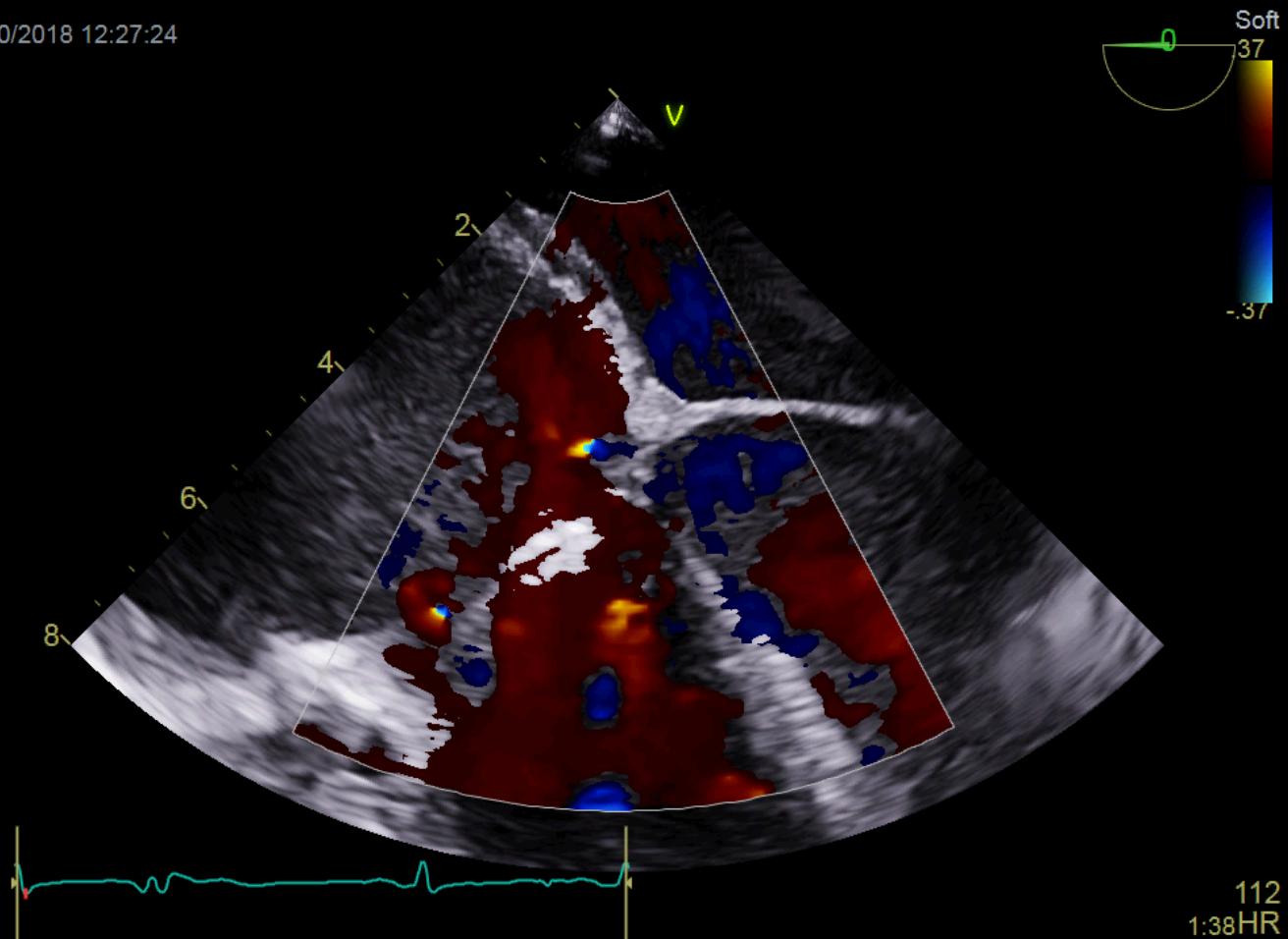
- Perfectly functioning AVR with normal washing jets
- Unfortunately due to poor anticoagulation management and recurrent strokes required re-operation for AVR
- ROSS procedure successful with mild AI from PV in AoV position
- Well functioning homograft in pulmonic position

Case 3 TVR

- 23 yo female IVDU, Hep C +
- Mini-TV replacement May 2018 for native valve endocarditis (R mini-thoracotomy)
- Left hospital AMA with PICC in situ
- Found ↓LOC with frank pus draining from PICC (4 months later)
- Recurrent endocarditis of bioprosthetic TV
- Antibiotics x 6 weeks, increasing CHF, O₂ required and RV dysfunction

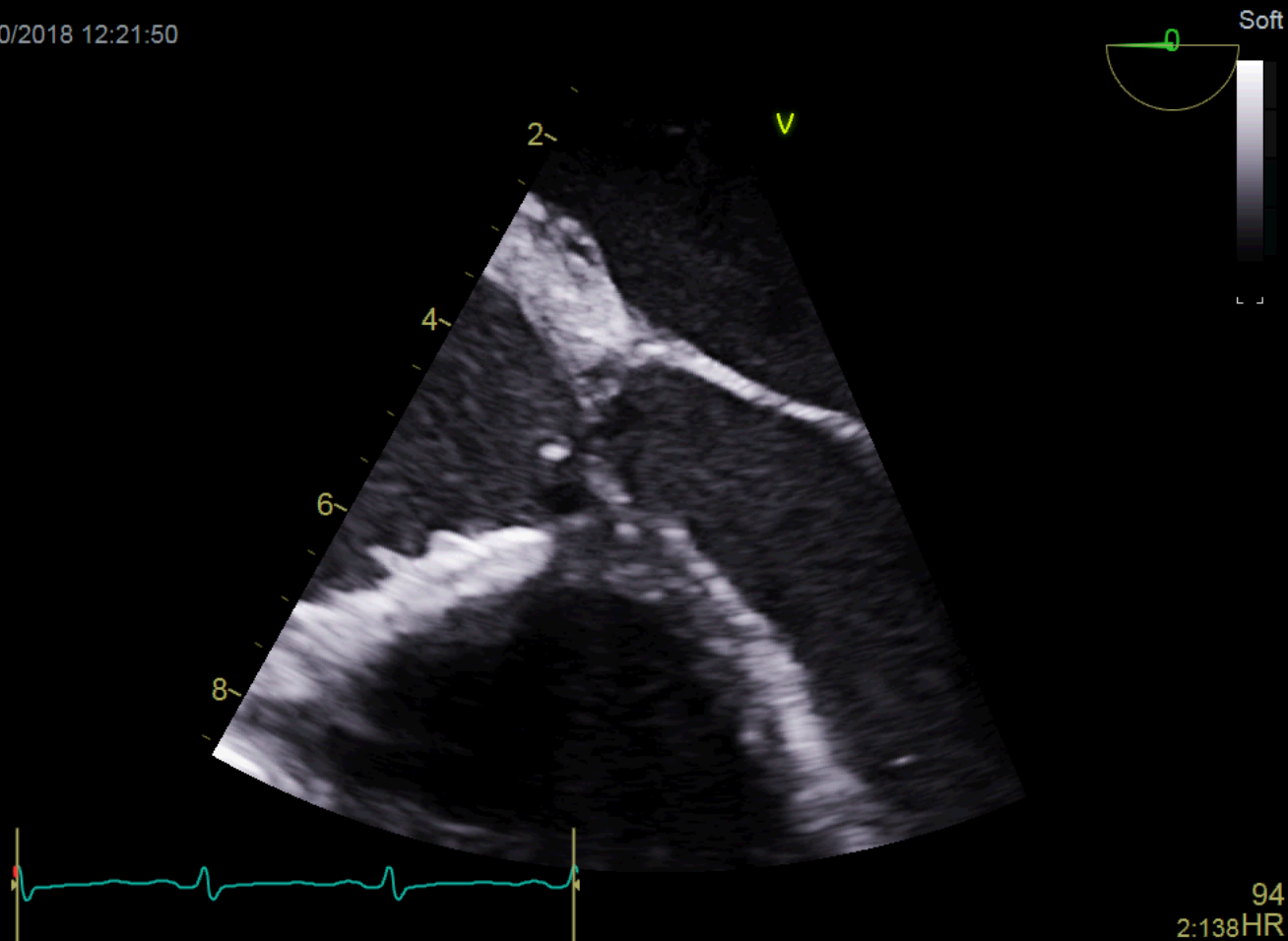
Case 3 TVR - pre

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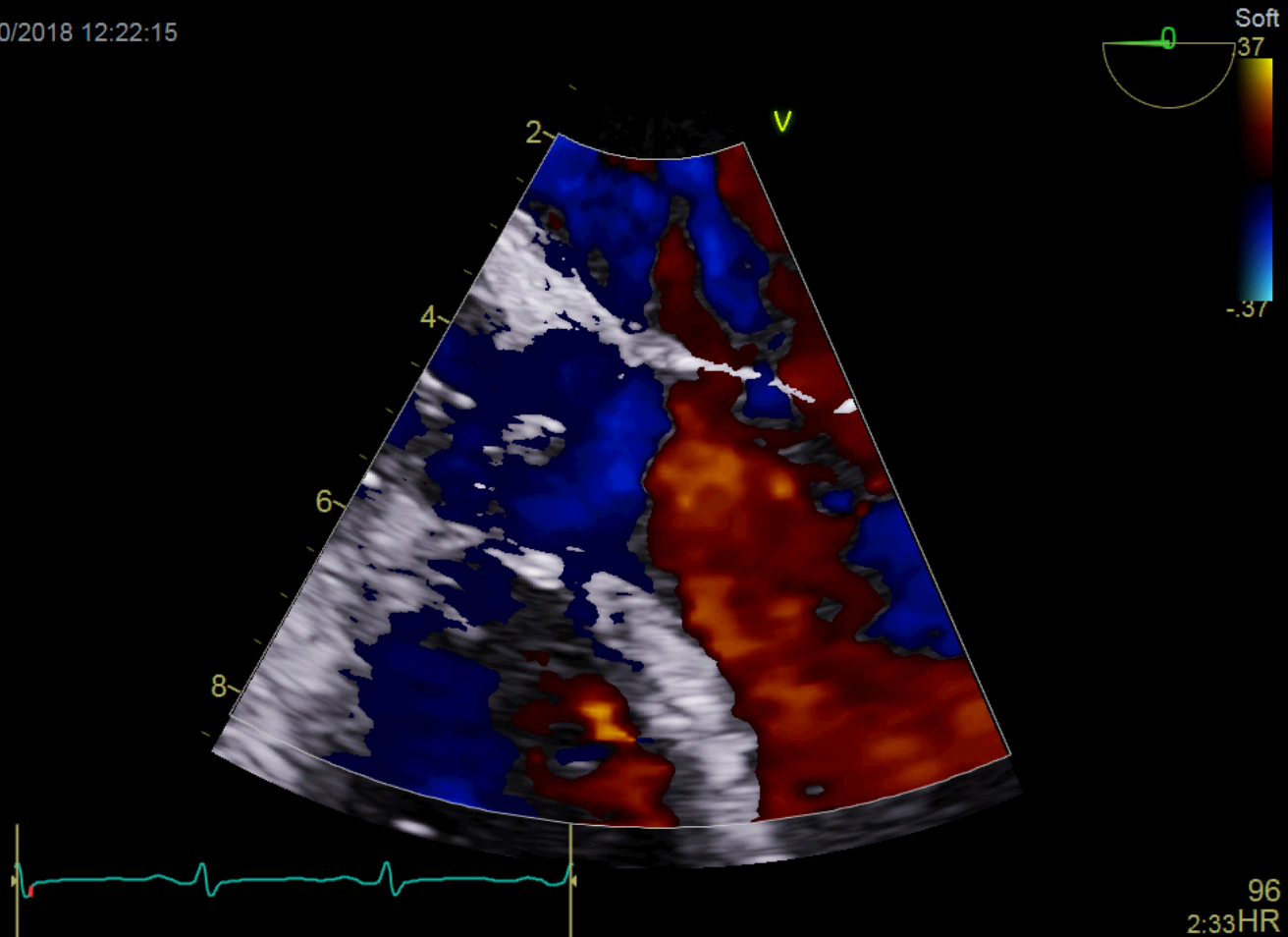
Case 3 TVR - pre

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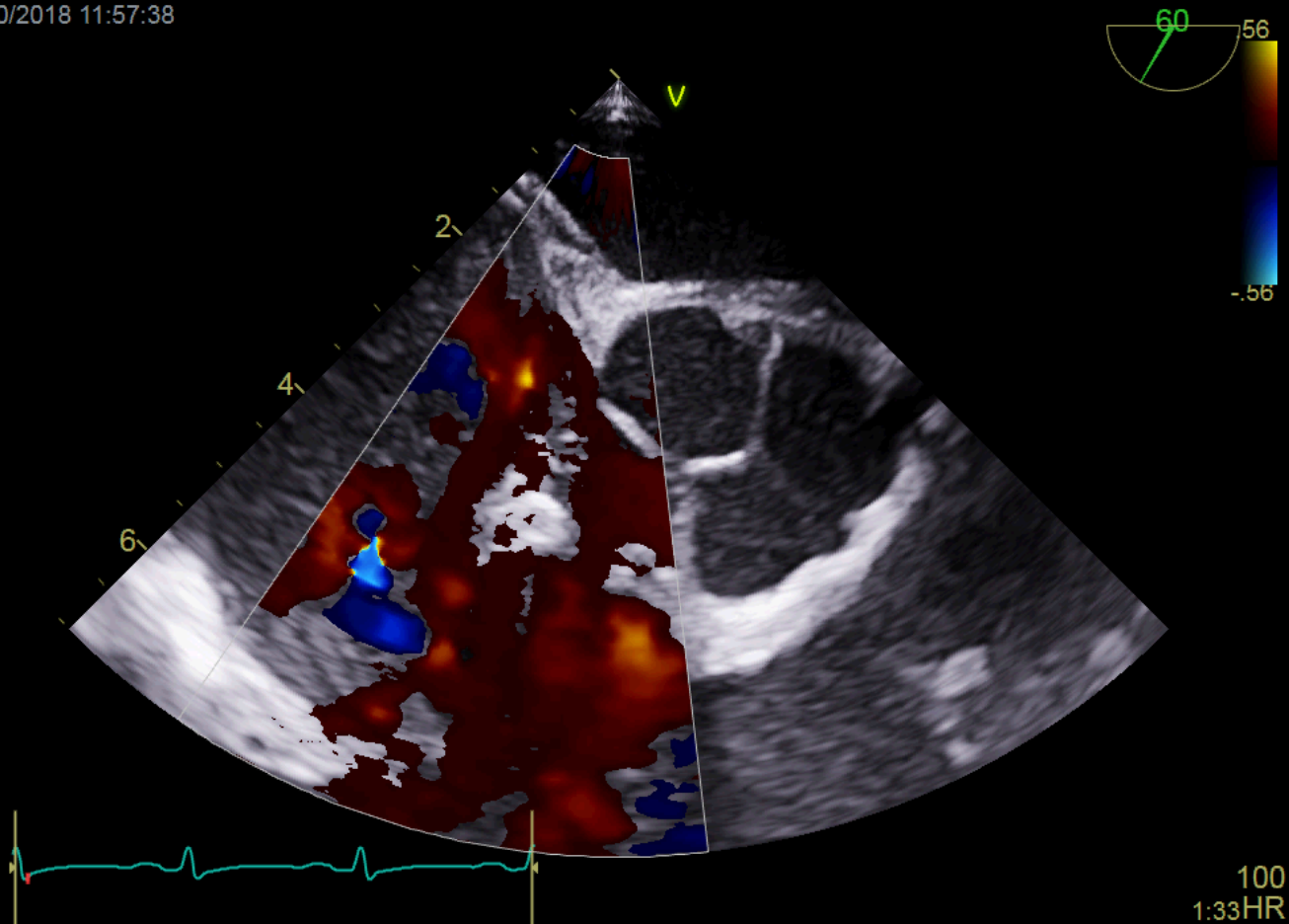
Case 3 TVR - pre

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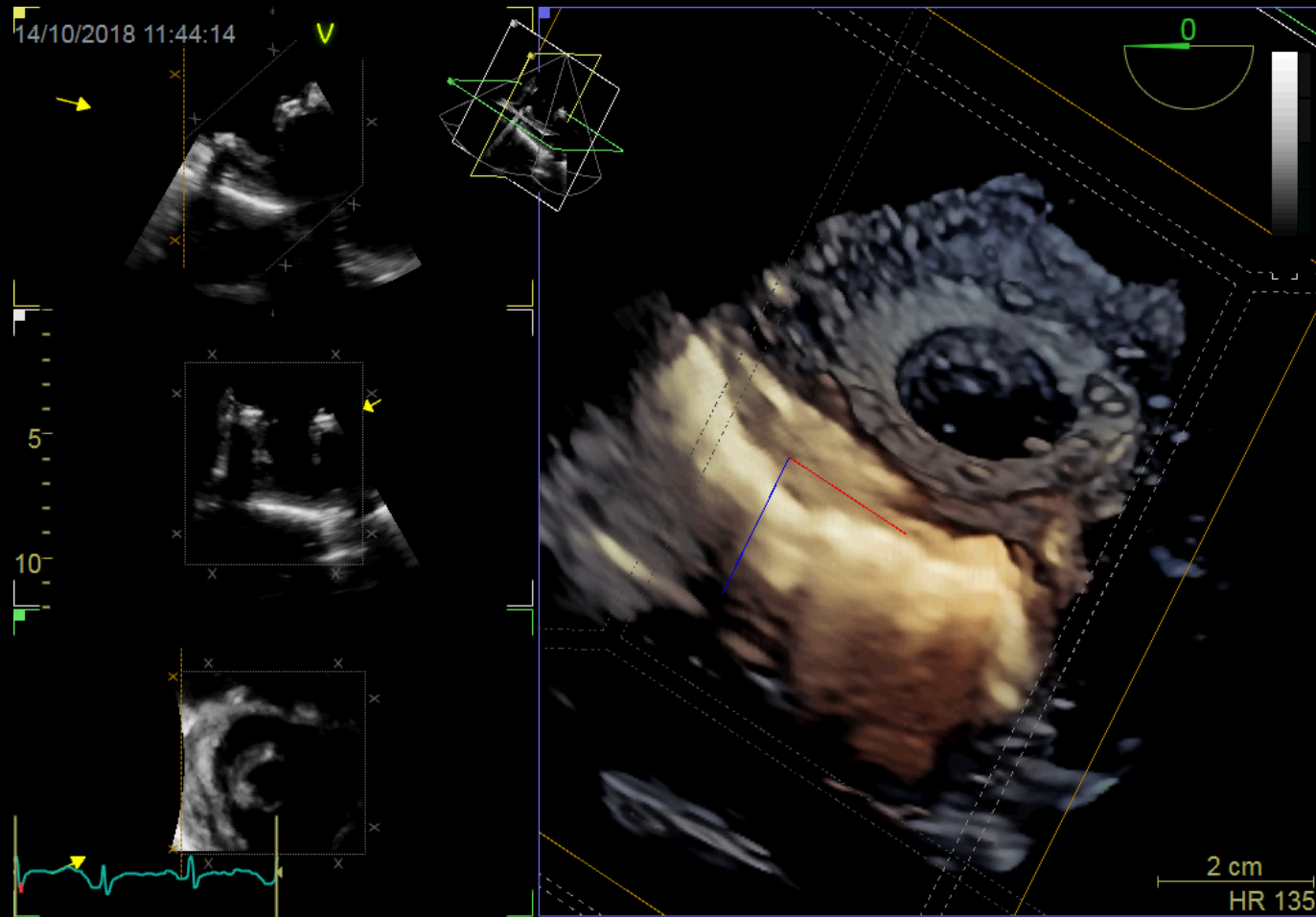


Case 3 TVR - pre

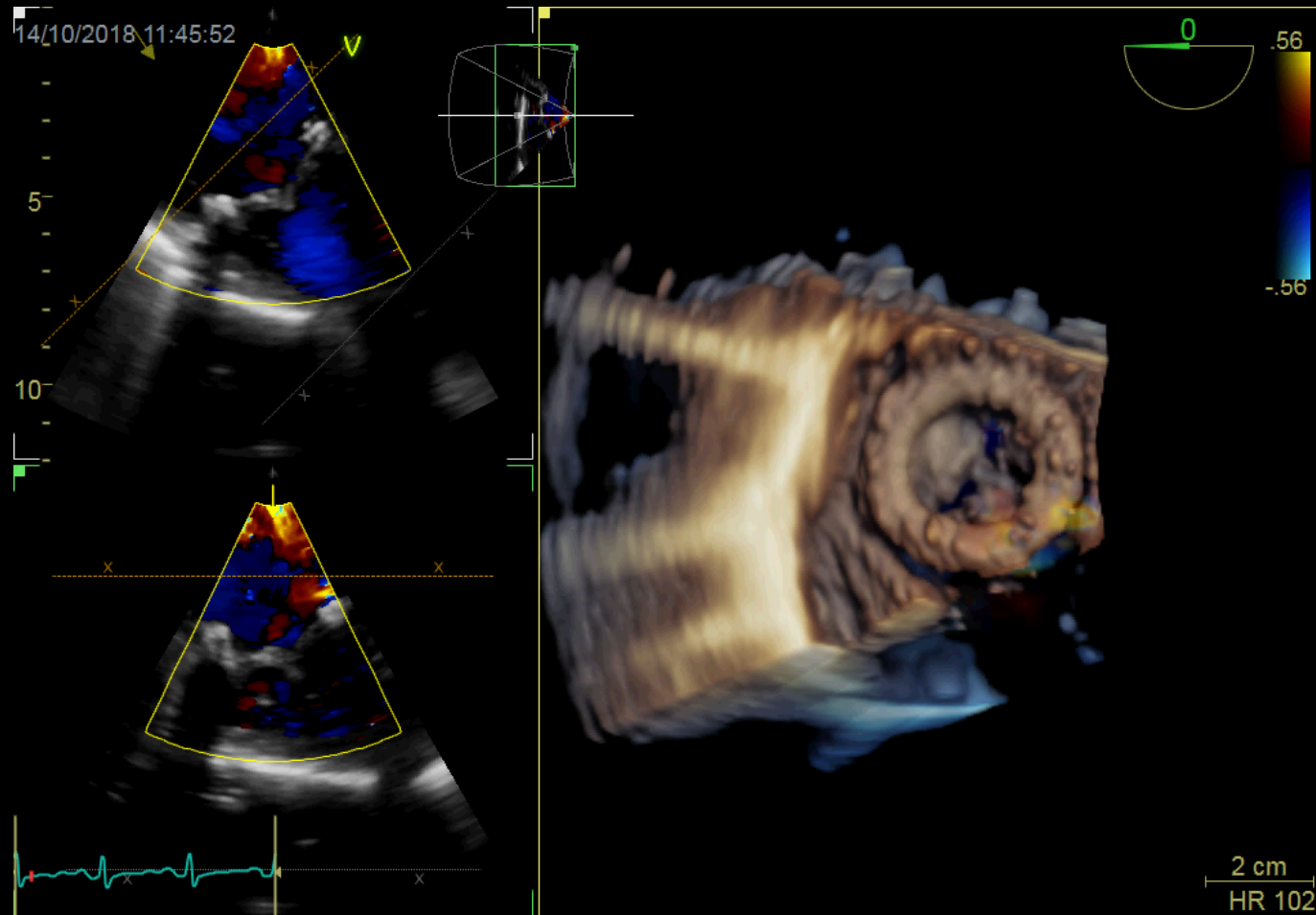
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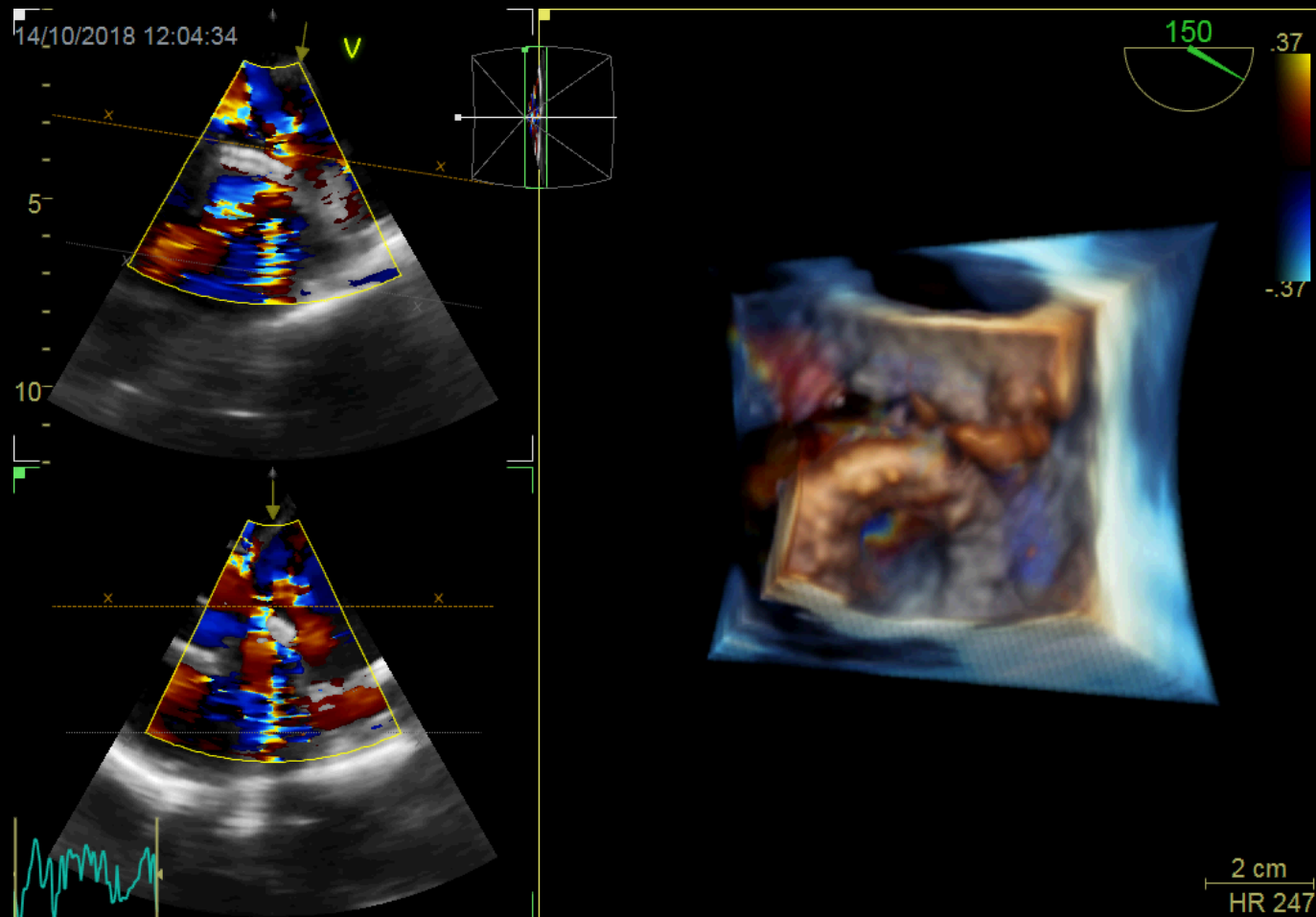
Case 3 TVR - pre



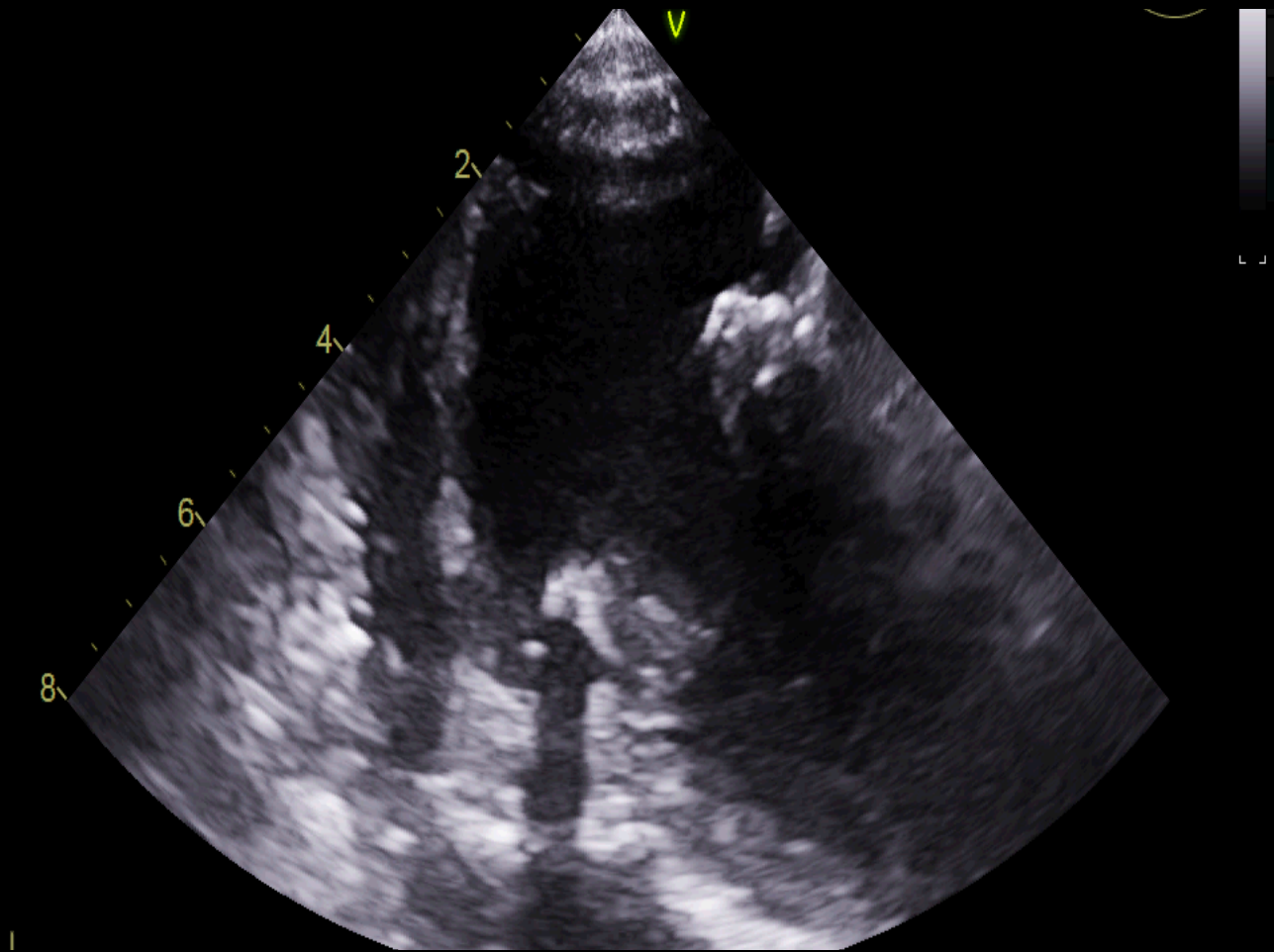
Case 3 TVR - pre



Case 3 TVR - pre

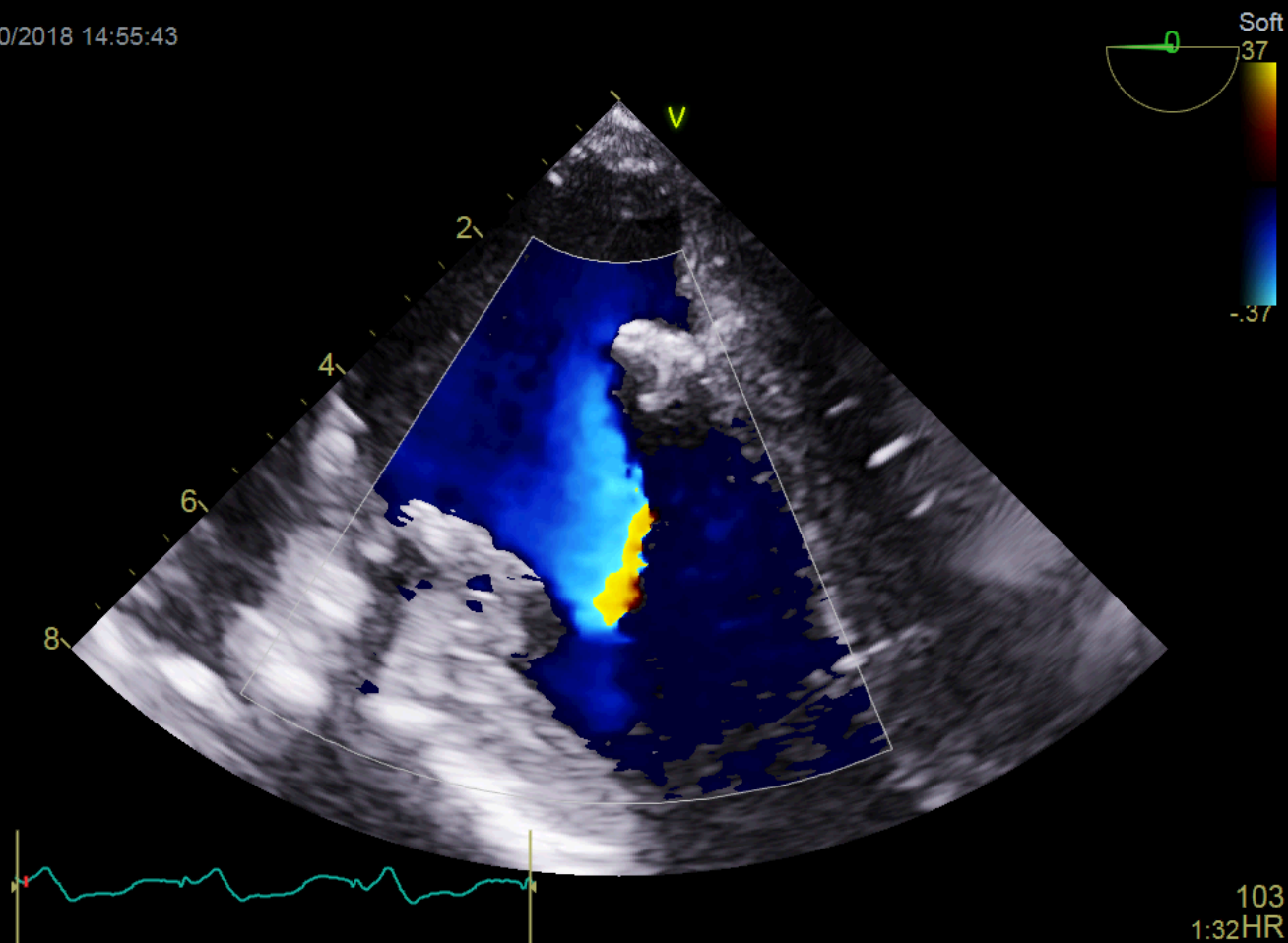


Case 3 TVR - post

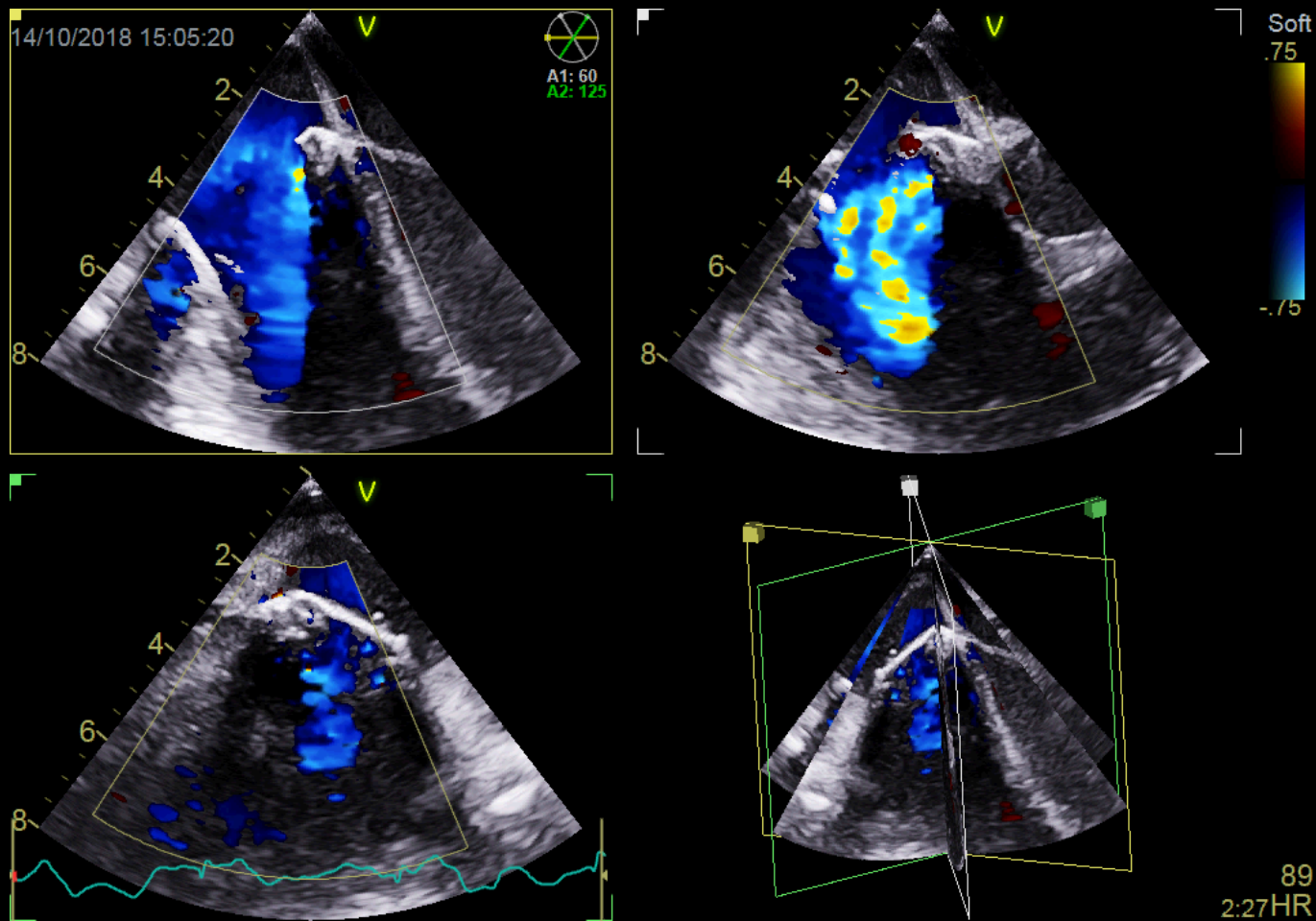


Case 3 TVR - post

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Case 3 TVR - post



Case 3 TVR - Summary

- Endocarditis of bioprosthetic valve (mini-TVR)
- Sternotomy for valve replacement and repair leak....
- 2 leaks – ‘Gerbode’ defect (repaired with mattress sutures LV-RA) + PVL – TVR (33 Magna Ease with pledgeted sutures)
- Post op – open chest due to coagulopathy, closed POD2
- Complete heart block requiring PPM

Gerbode Defect

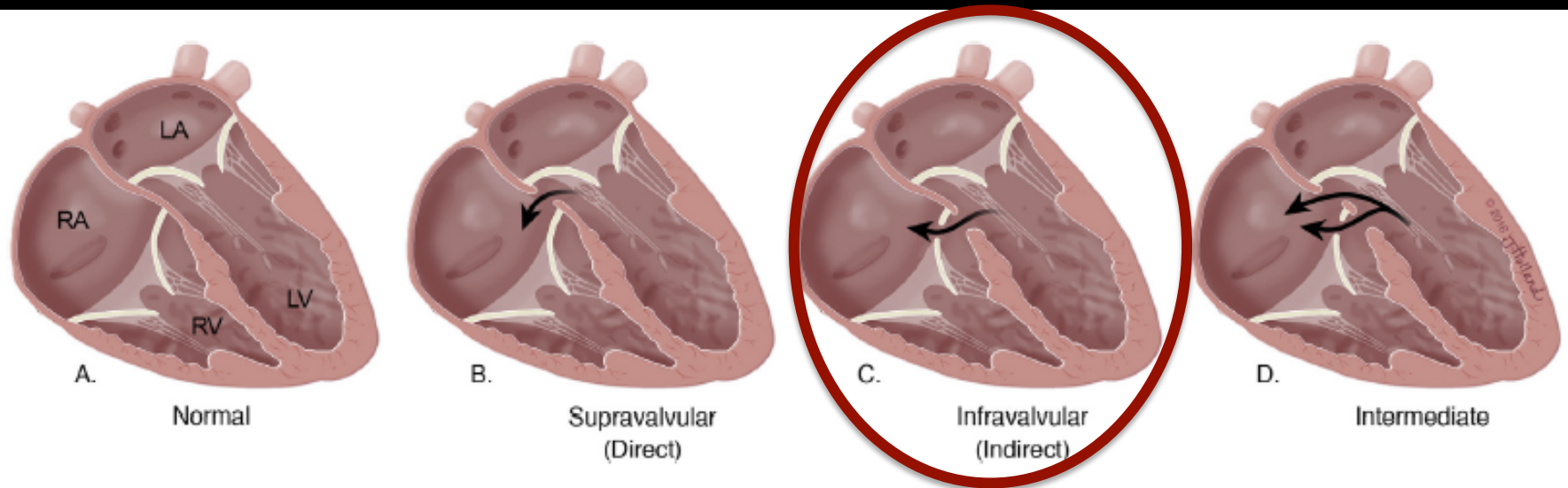


Figure 2. Comparison of normal heart to hearts with Gerbode defect. (A) Normal heart, (B) Supraventricular defect involving membranous portion of septal wall, superior to the septal leaflet of the tricuspid valve. (C) Intraventricular defect involving membranous portion of septal wall, below the septal leaflet. (D) Both supraventricular and intraventricular defect with septal leaflet of tricuspid valve. (Illustration by Jessica Holland ©2016, provided under CC-BY-NC-ND 4.0.)

Definition of PVL

- Characterised by a gap between the prosthetic valve and the native annular tissue
- Results in regurgitation of blood from downstream to upstream chamber

Risk Factors

SAVR

(2-10% AVR, 7-17% MVR)

- Frailty
- Endocarditis
- Corticosteroid use
- Severe annular calcification
- Previous valve replacement

TAVR

(5-24%)

- Malapposition of lower stent frame in aortic annulus
- Annular calcification
- Prosthesis annulus mismatch
- Prosthesis undersizing
- Prosthesis underexpansion

Figure 1: Location and Sizing of Aortic Paravalvular Leaks

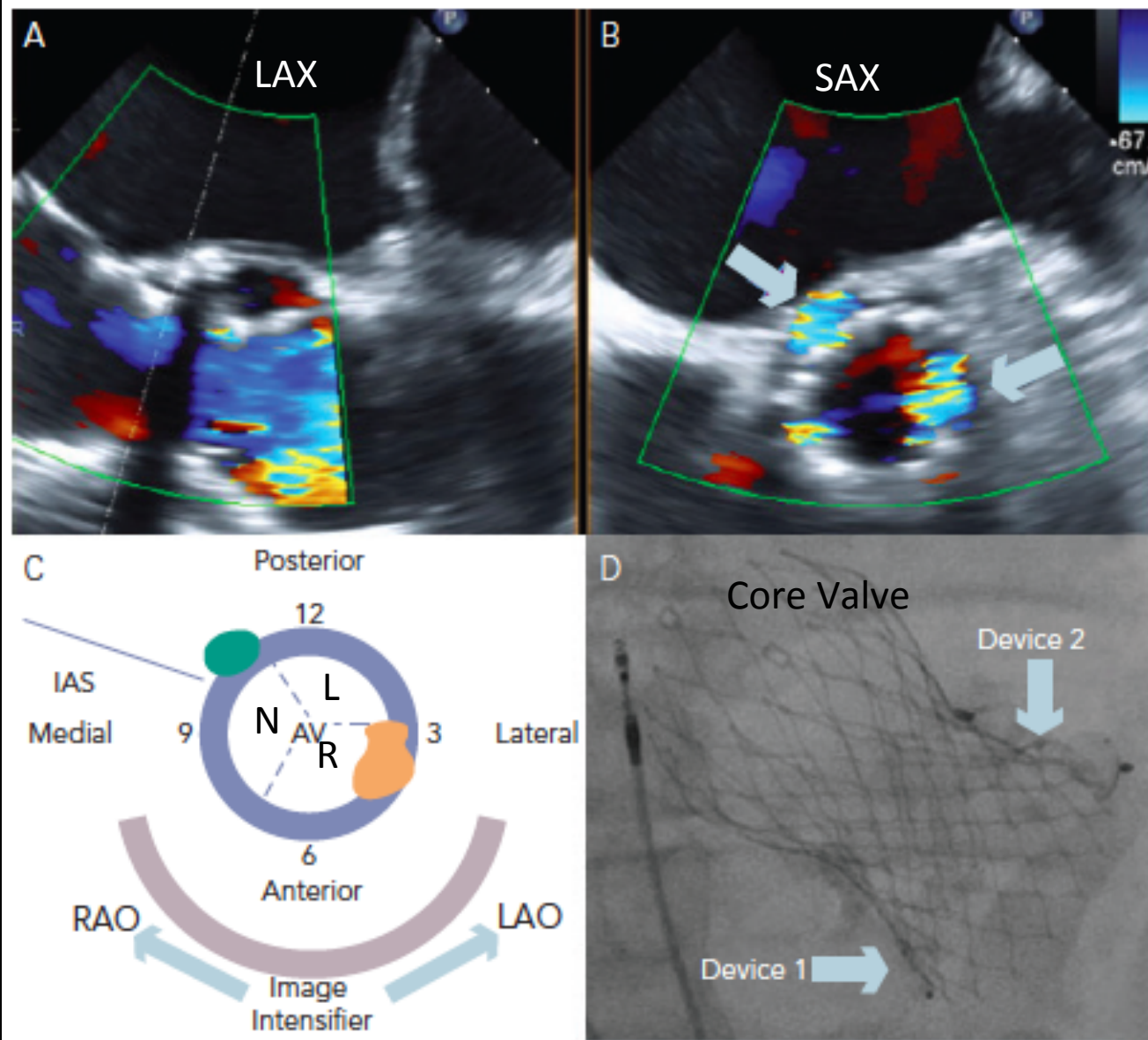
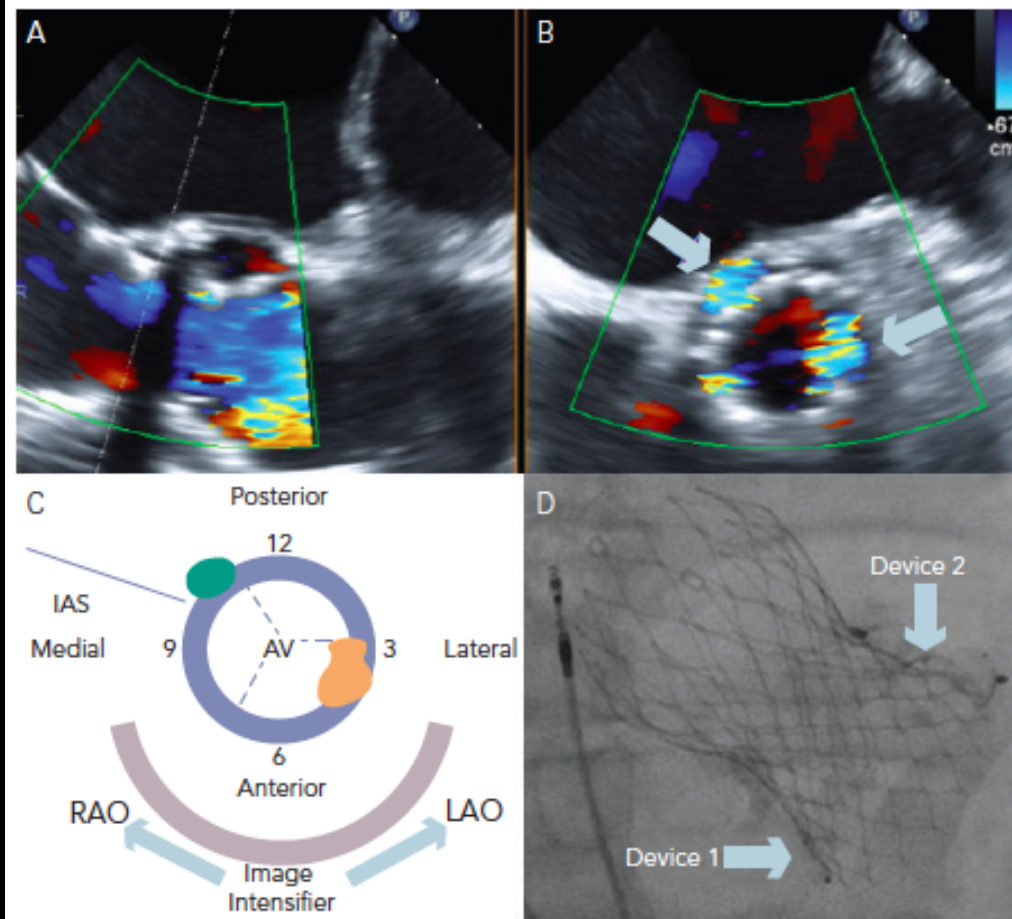


Figure 1: Location and Sizing of Aortic Paravalvular Leaks



Aortic paravalvular leak in patient after CoreValve transcatheter aortic valve implantation. Here we see one aortic valve in 120 degree view (A) that on biplane view (B) has at least two areas of major leak (blue arrows). A schematic of part B is shown in C, where the leaks are shown in relation to the IAS and the AV. One leak, which is green, is located near the IAS at the 10-11 o'clock position on the clock face, which is also posterior and medial. This would be in the region of the noncoronary cusp of the original AV. The other leak (in orange) is located near 4 o'clock on the clock face, and is mostly lateral and located in the region of the original right coronary cusp. The bottom of panel C shows how the image intensifier would visualise the lesion. An extreme left anterior oblique (LAO) angulation would overlap the orange and green paravalvular leak above each other. However an right anterior oblique (RAO) angulation would allow both to be seen adjacent to the valve. In D, we see a post-procedure RAO angulation on fluoroscopy, with two devices in each of the major paravalvular leaks on each side of the CoreValve. AV = aortic valve; IAS = interatrial septum.

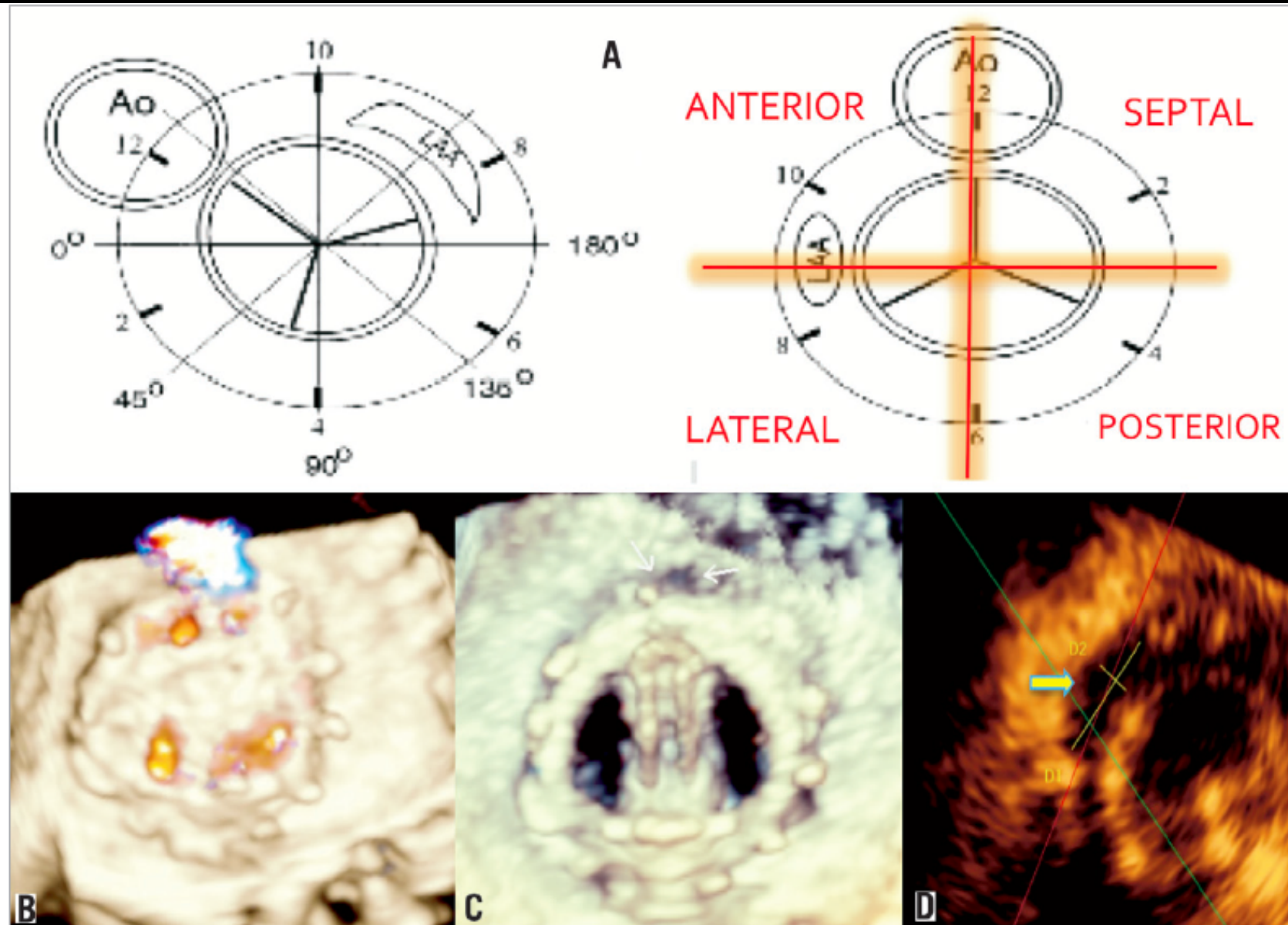


Figure 1. Mitral valve prosthetics, echocardiographic description of locations. A) Localisation of leaks, defects related to the aorta and left atrial appendage³¹. B) and C) show 3-D TEE of a mitral prosthetic valve as well as leaks in the anterior-septal position 0°. D) Estimating the leak size.

Figure 2: Location and Sizing of Mitral Paravalvular Leaks

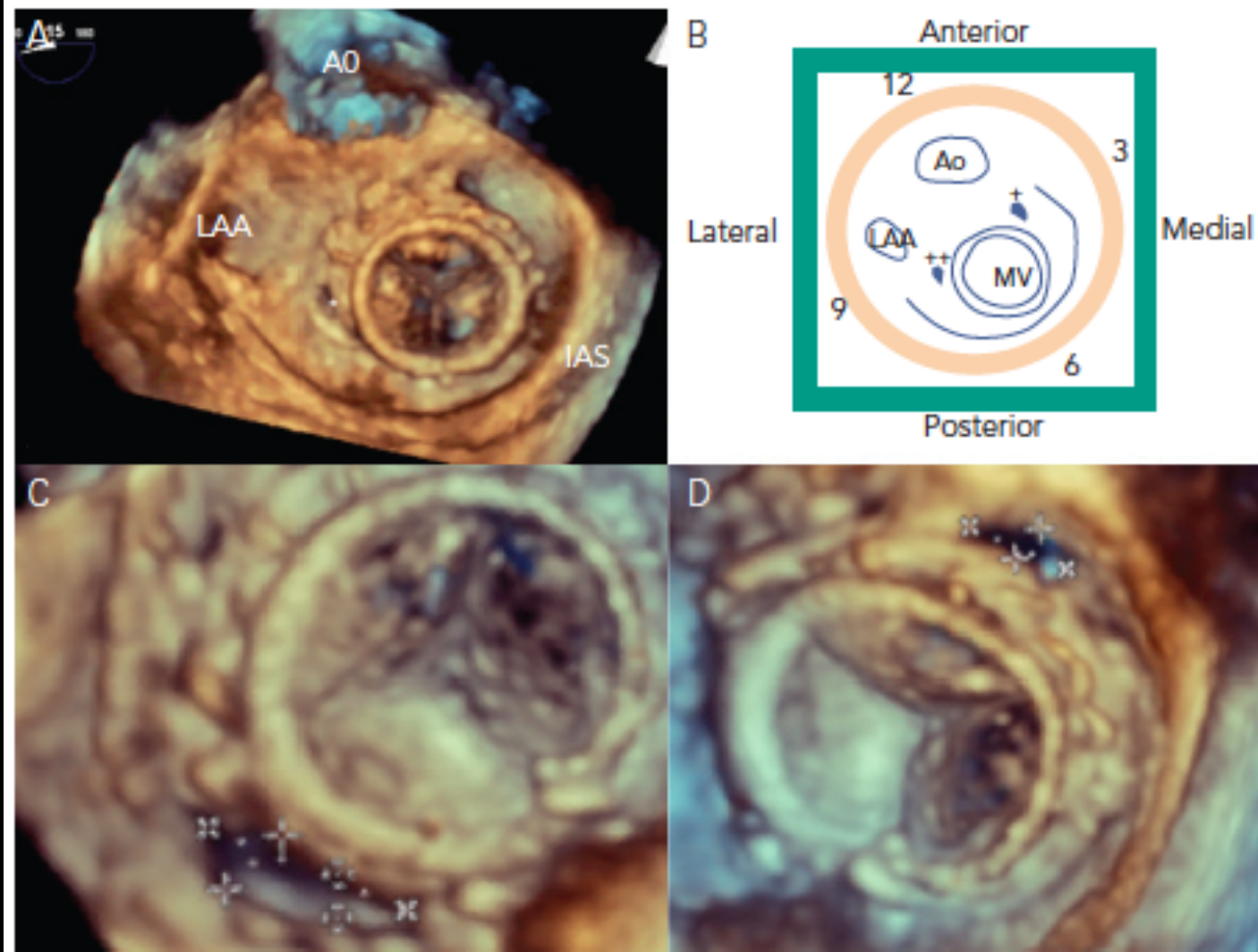
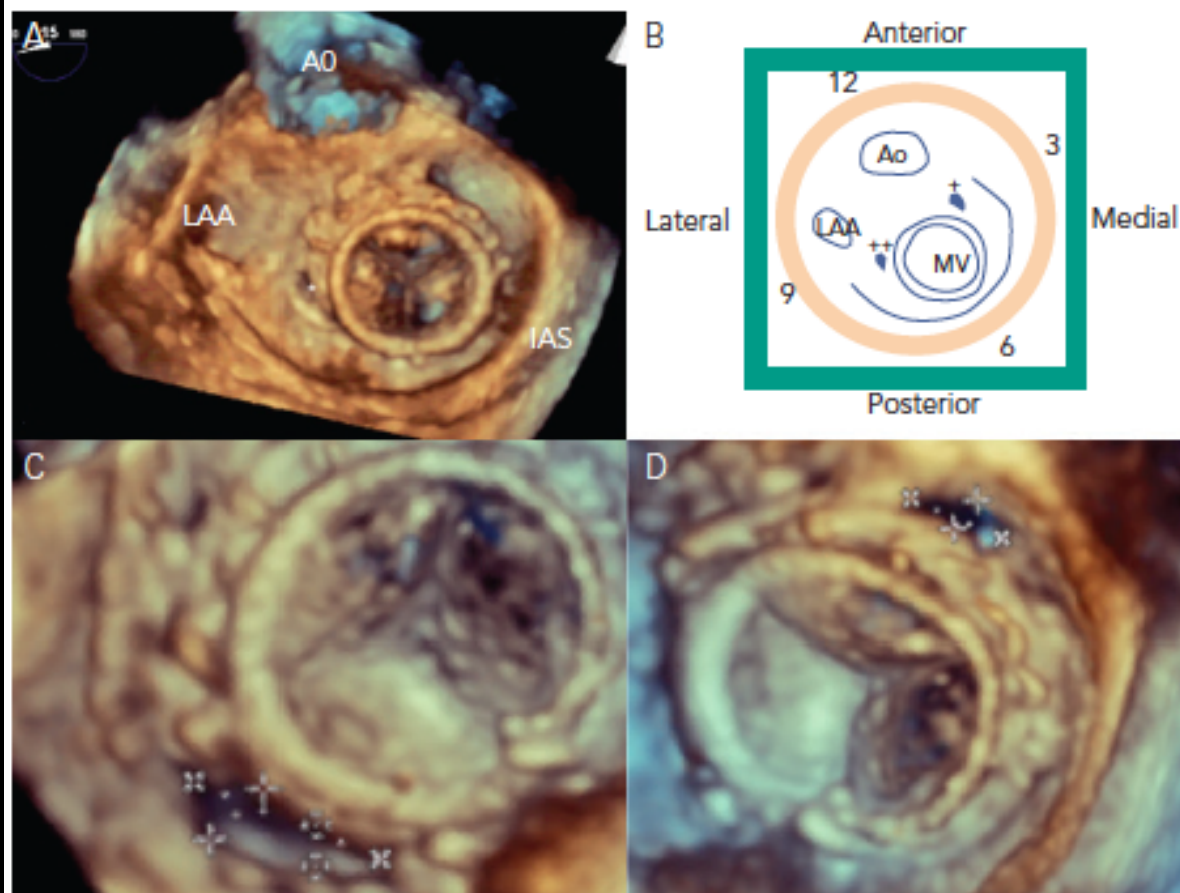
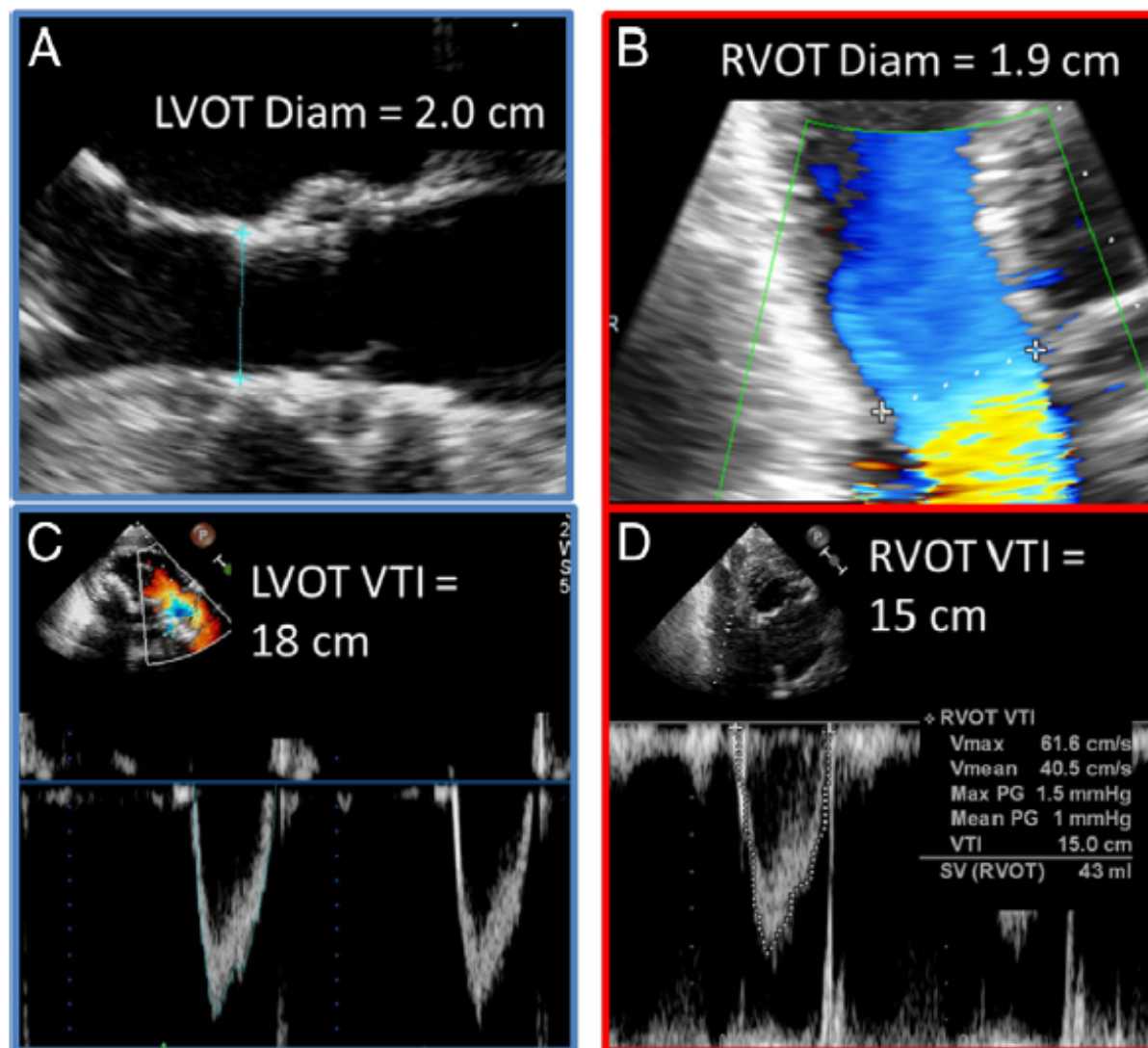


Figure 2: Location and Sizing of Mitral Paravalvular Leaks



Images for patient with two mitral paravalvular leaks (asterisk) at various locations in relation to the Ao, LAA and IAS (A). In the schematic shown in B, one can see that the anatomy is distorted, with the MV being more medial compared with normal anatomy. The two leaks are seen as well. On the clock face (orange disc) with the aortic valve as the 12 o'clock position, one leak is at the 2 o'clock position (one asterisk) and another leak is at the 9 o'clock position (two asterisks). In relation to spatial position, one leak is anterior and medial (one asterisk) and the other leak is lateral (two asterisks). This illustrates the difficulty of using one naming system, especially in distorted valve anatomy after replacement. The lateral leak is shown in C as a large crescentic leak, with measurements of 16 x 6 mm. The anteromedial leak is shown in D, with a measurement of 9 x 3 mm. Ao = aorta; IAS = interatrial septum; LAA = left atrial appendage; MV = mitral valve.



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Figure 3 Quantitative Doppler Echocardiography Can Be Used to Calculate the Regurgitant Orifice and Volume

(A) Post-transcatheter heart valve (THV) left ventricular outflow tract (LVOT) diameter (just apical to the THV stent). **(B)** Right ventricular outflow tract (RVOT) diameter. **(C)** LVOT Doppler with sample volume located just apical to the THV stent aligned in the short-axis view of the LVOT pulsed Doppler signal just below the THV stent. Stroke volume (SV) across the THV = LVOT area \times LVOT velocity time integral (VTI) = 56 ml. **(D)** RVOT VTI yields an SV across the RVOT of 43 ml. The regurgitant volume = LVOT SV - RVOT SV = 13 ml. AR = aortic regurgitation; PG = pressure gradient.

Quantification of PVL

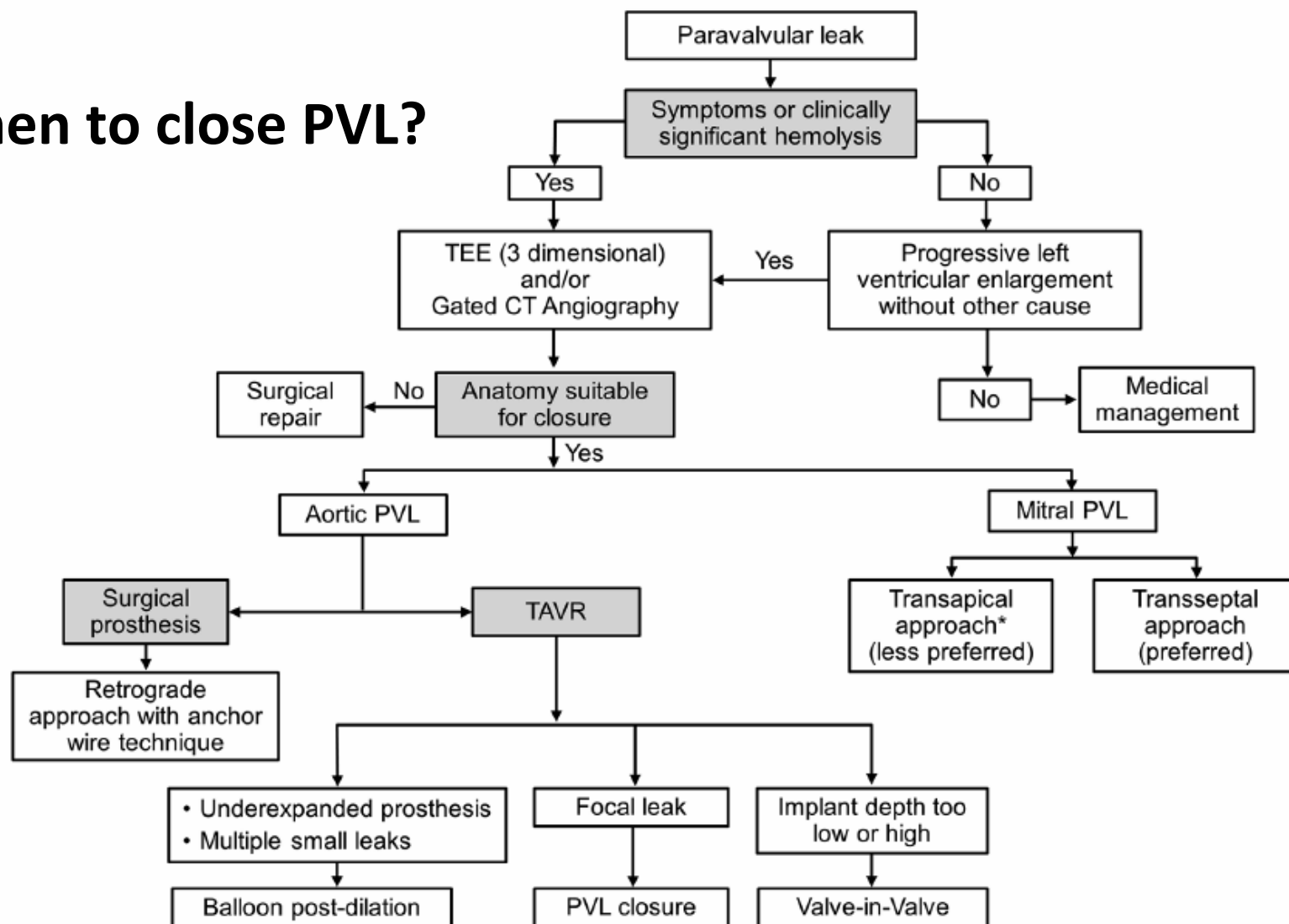
Table 4 VARC II Recommendations for Evaluation of Aortic and/or Paravalvular Regurgitation After TAVR

	Mild	Moderate	Severe
Semiquantitative parameters			
Diastolic flow reversal in the descending aorta—pulsed wave	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
Circumferential extent of prosthetic valve paravalvular regurgitation (%) [*]	<10	10-29	≥30
Quantitative parameters [†]			
Regurgitant volume (ml/beat)	<30	30-59	≥60
Regurgitant fraction (%)	<30	30-49	≥50
Effective regurgitant orifice area (cm ²)	0.10	0.10-0.29	≥0.30

^{*}Not well validated and may overestimate severity compared with quantitative Doppler. [†]For LVOT >2.5 cm, significant stenosis criteria is <0.20. Adapted with permission from Kappetein et al. (66).

VARC = Valve Academic Research Consortium; other abbreviations as in Table 1.

When to close PVL?



*For unfavorable atrial septum or AV rail in a patient with aortic mechanical prosthesis

Figure 1 Paravalvular leak closure (PVL) algorithm. Paravalvular leak closure is indicated for patients with heart failure or haemolytic anaemia due to paravalvular leak with suitable anatomy at centres with expertise in interventional and imaging techniques required for percutaneous closure. TAVR, transcatheter aortic valve replacement; TEE, transoesophageal echocardiography.

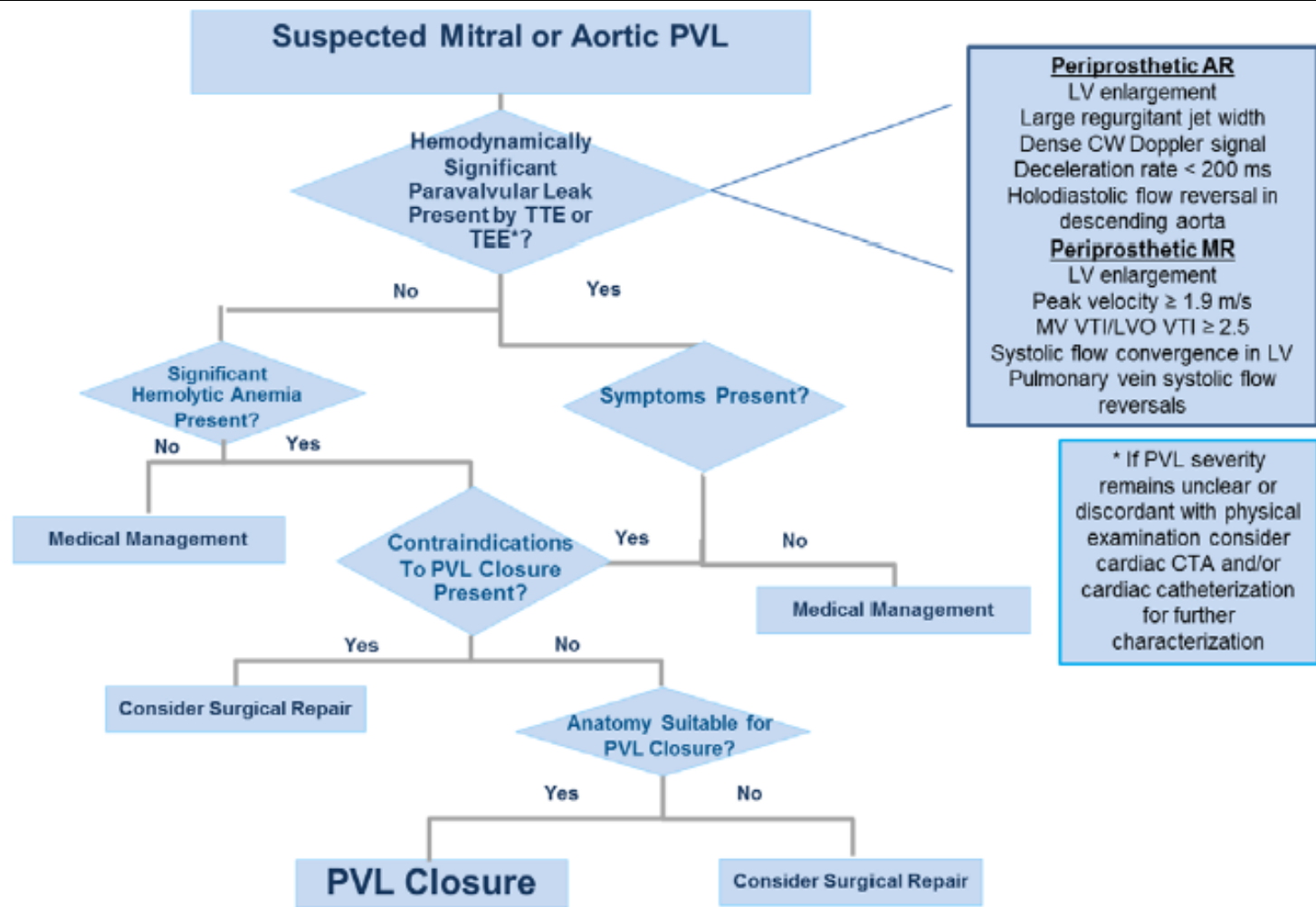
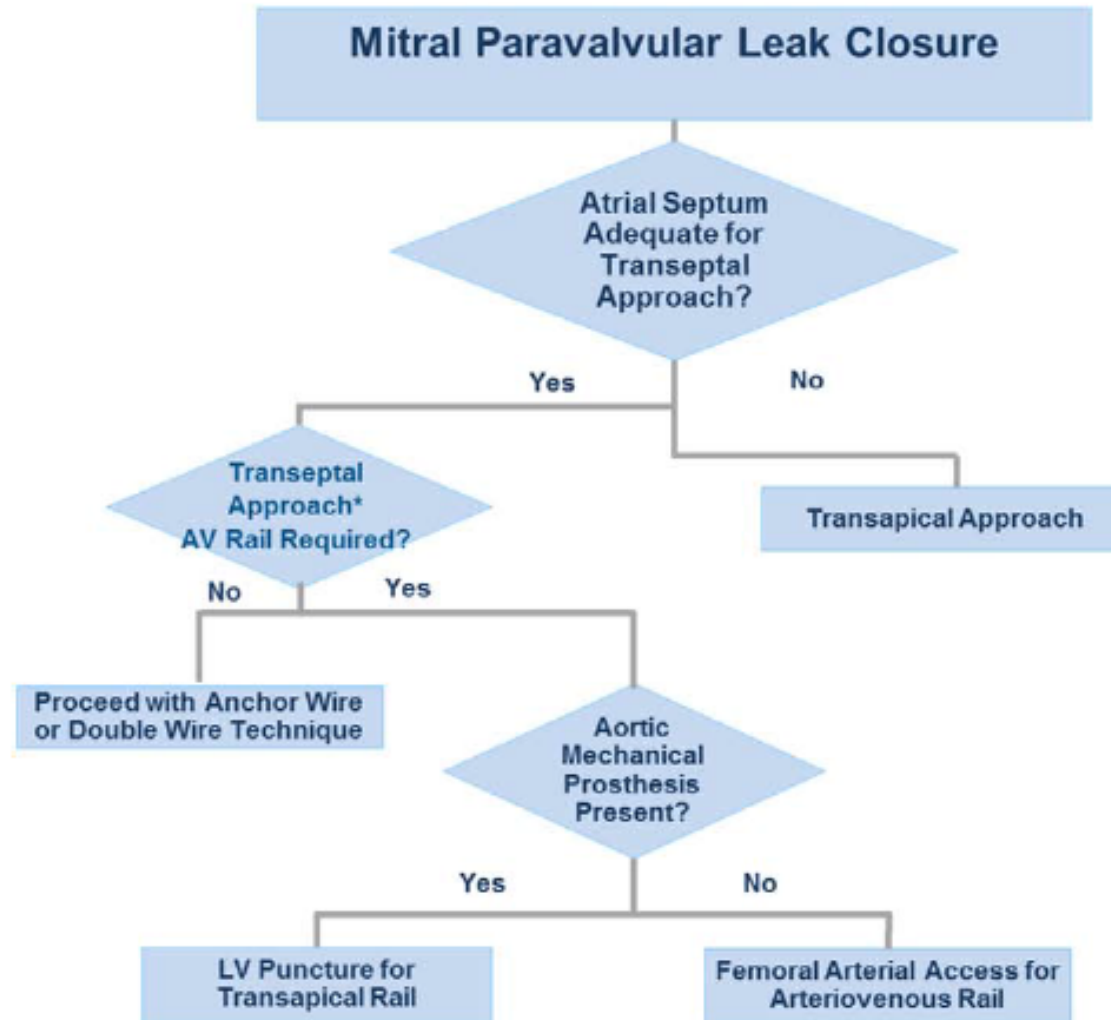


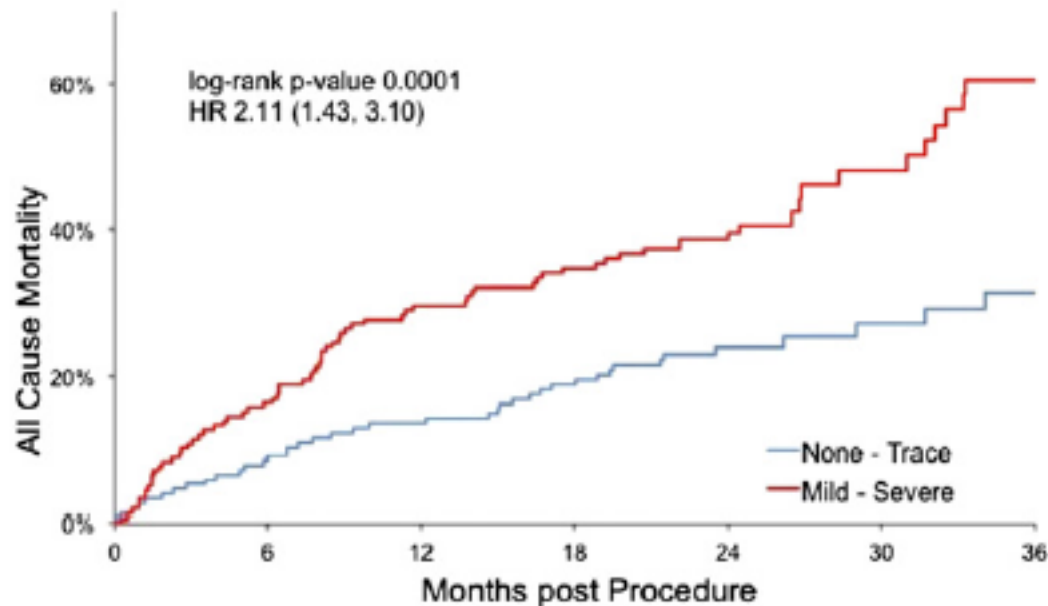
Figure 3. Decision algorithm for diagnosis and treatment of paravalvular leak (PVL). AR indicates aortic regurgitation; CTA, computed tomography angiography; LV, left ventricular; LVO VTI, left ventricular outflow velocity time integral; MR, mitral regurgitation; MV VTI, mitral valve velocity time integral; TEE, transesophageal echocardiogram; and TTE, transthoracic echocardiography.



* Location of transeptal access is based upon the defect location around the mitral prosthesis; e.g. anterior/lateral mitral defects require a more superior transeptal puncture.

Figure 4. Mitral paravalvular leak procedural planning algorithm. AV indicates arteriovenous; and LV, left ventricular.

Why bother to close PVL?



None-Tr	158	142	134	121	84	39	15
Mild-Sev	160	134	112	101	64	26	12

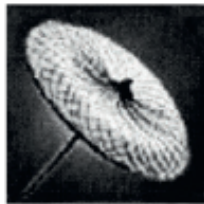
Figure 2 Impact of Paravalvular Leak on 2-Year All-Cause Mortality

Reprinted with permission from Kodali et al. (8). HR = hazard ratio.

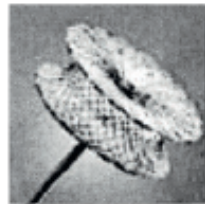
Kodali SK, Williams MR, Smith CR, et al. Two-year outcomes after transcatheter or surgical aortic-valve replacement. *N Engl J Med* 2012;366:1686–95.

Current devices used for percutaneous closure of PVL (off label)

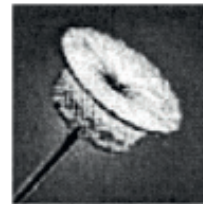
Comparison of current devices most commonly used in transcatheter PVL closure.



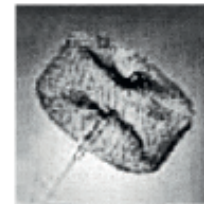
Amplatzer Septal Occluder



Amplatzer Muscular VSD Occluder



Amplatzer Duct Occluder



Amplatzer Vascular Plug



Vascular Coil

Low profile	+	++	+++	+++	+++
Stability	+++	++	+	+	+
Resistance to haemolysis	+	+++	+++	+	+
Clinical experience	+++	+++	+++	+	+
Delivery approach	Anterograde or retrograde	Anterograde or retrograde	Anterograde only	Anterograde or retrograde	Anterograde or retrograde
+++ very favourable; ++ moderately favourable; + least favourable					

Figure 7. Several devices used in the early PVL closure experiences.

Summary

- ▶ Paravalvular regurgitation is a common and underdiagnosed condition.
- ▶ Detailed imaging modalities including transoesophageal echocardiography and/or cardiac CT are usually required for the assessment of the presence and extent of paravalvular leak.
- ▶ Indications for percutaneous paravalvular leak closure include the presence of heart failure or haemolytic anaemia attributed to paravalvular leak.
- ▶ Percutaneous paravalvular leak closure requires specialised interventional and imaging techniques to accomplish successfully.
- ▶ Successful paravalvular leak closure (defined as mild or less residual regurgitation) is associated with a reduction in heart failure symptoms and improved survival.

Eleid M. *Heart* 2018;**0**:1–6. doi:10.1136/heartjnl-2017-312454

Questions?

