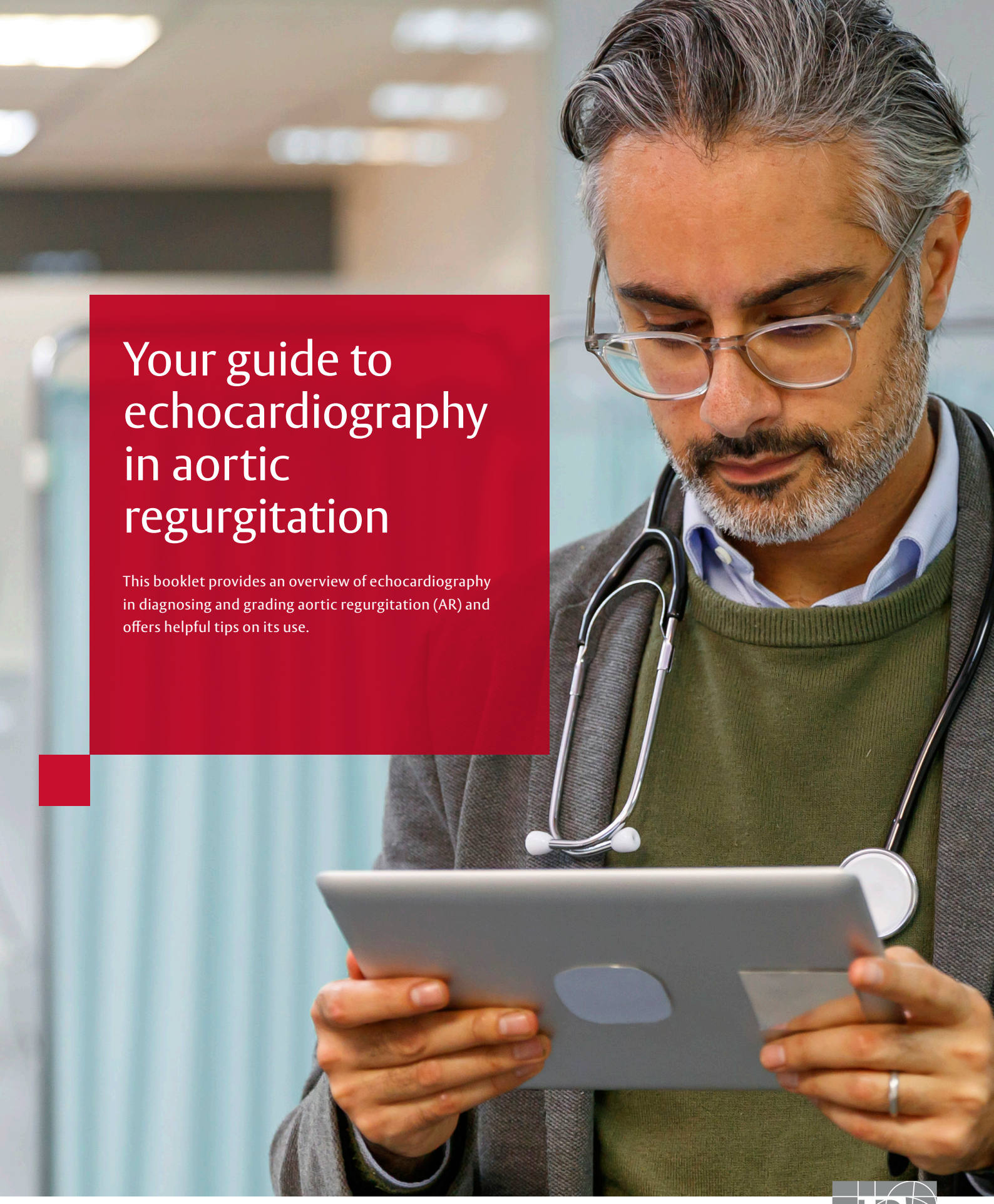


Your guide to echocardiography in aortic regurgitation

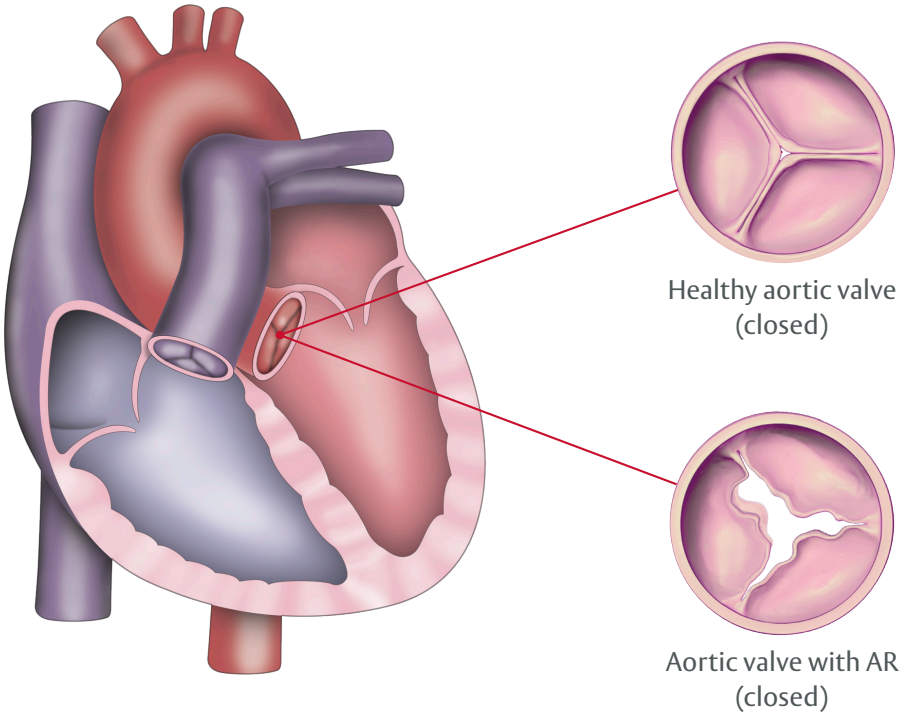
This booklet provides an overview of echocardiography in diagnosing and grading aortic regurgitation (AR) and offers helpful tips on its use.

Edwards

The challenges of AR management

AR is the third most common valvular heart pathology.[1] If treated conservatively, patients can experience a rapid decline in functional cardiovascular health and high mortality.[2,3]

The 2021 ESC/EACTS guidelines recommend surgery for symptomatic patients, regardless of left ventricle (LV) function and for asymptomatic patients with left ventricular end-systolic diameter (LVESD) >50mm (>25 mm/m^2 body surface area) or left ventricular ejection fraction (LVEF) ≤50%.[4] These guidelines also underscore the importance for timely referral to the Heart Team before irreversible damage occurs.[4]



Several studies have demonstrated how early surgical intervention can improve survival outcomes.[5,6] The latest ESC/EACTS guidelines introduced an additional Class IIb recommendation that patients at low-risk for surgery may be considered for surgery earlier in their disease progression when LVEF ≤55%, emphasising the need for earlier intervention.[4] Despite this, referral of patients with VHDs to the Heart Team is sometimes delayed due to underestimation of patients' severity and symptoms.[7]

Echocardiography is the key modality for imaging VHD and holds significant influence over clinical decision-making.[8] However, its success can be influenced by limitations of commonly used parameters that are inherent to the technique itself[8] and the experience of the operator.[9,10] It's important to recognise these constraints to avoid common sources of error so that AR patients can be monitored and referred for surgery in a timely manner.

Grading AR severity with echocardiography requires a multiparametric assessment

Effects caused by severe AR may be irreversible.[11] That's why accurate assessment and grading of AR severity is crucial for clinical decision-making, risk prediction and to assess the optimal time for surgery.[11,12]

Echocardiography requires a multiparametric integrative assessment to determine the severity of AR[11,13]

	Moderate		Severe
	Mild to moderate	Moderate to severe	
Qualitative parameters			
Aortic valve morphology	Normal/abnormal	Abnormal/prolapse/ moderate coaptation defect	Abnormal/flail/large coaptation defect
Colour flow regurgitant jet width‡	Intermediate	Large in central jets, variable in eccentric jets	Large in central jets, variable in eccentric jets
Colour flow convergence	Intermediate	Intermediate	Large
CW signal of regurgitant jet	Dense	Dense	Dense
Diastolic flow reversal in the descending aorta	Intermediate	Holodiastolic flow reversal (EDV 10 to <20 cm/s)	Holodiastolic flow reversal in descending aorta (EDV >20 cm/s)
Diastolic flow reversal in the abdominal aorta	Absent	Present	Present
Semiquantitative parameters			
VC width (mm)	3–6	3–6	>6
Jet width/LVOT diameter (%)	25–45	46–64	≥65
Jet CSA/LVOT CSA (%)	5–20	21–59	≥60
Pressure half-time (ms)	Intermediate, 500–200	Intermediate, 500–200	<200
Quantitative parameters			
EROA (mm^2)	10–19	20–29	≥30
Regurgitant volume (mL)	30–44	45–59	≥60
Regurgitant fraction (%)	30–39	40–49	≥50
Structural parameters			
Size of left ventricle§	Normal or dilated	Usually dilated	Usually dilated

Adapted from Lancellotti *et al.* 2022.[14]

‡At a Nyquist limit of 50–60 cm/s. §In acute severe AR, the LV size is often normal.
CSA, cross-sectional area; CW, continuous wave; EDV, end-diastolic velocity; EROA, effective regurgitant orifice area; VC, vena contracta; LVOT, left ventricular outflow tract.

Tips and tricks from an echocardiography specialist[15]

Leading cardiologist **Dr. Marta Sitges** shares useful insights from decades of experience in the field of echocardiography and heart valve disease.

Dr. Sitges is the Director of the Cardiovascular Institute at Hospital Clinic, Barcelona, Spain and holds the position of Professor of Medicine at the University of Barcelona. Dr. Sitges has a notable publication record in these fields and actively participates in prominent national and international conferences.

Do not rely on a single parameter

All parameters have their advantages and pitfalls so it's best to use a multi-parametric approach to avoid over- or under-estimation of AR severity, for example:

- Eccentric jets can affect measurements such as the width of the regurgitant flow or the proximal isovelocity surface area (PISA)

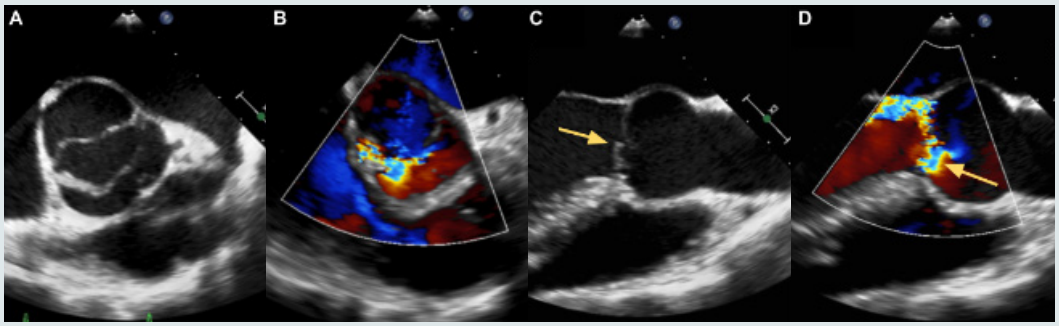


Figure of a patient with a bicuspid aortic valve. Short-axis view of the aortic valve **(A)** and colour flow doppler demonstrating eccentric AR **(B)**. Also shown the parasternal long-axis view where the prolapse of the cusp is visible as indicated by the yellow arrow **(C)** along with the eccentric jets **(D)**.

Figure 1: Figure supplied by Dr. M. Sitges

- Relying solely on structural parameters may affect the assessment as some patients may have conditions that cause LV remodelling or dilatation, such as ischaemic cardiomyopathy or hypertension

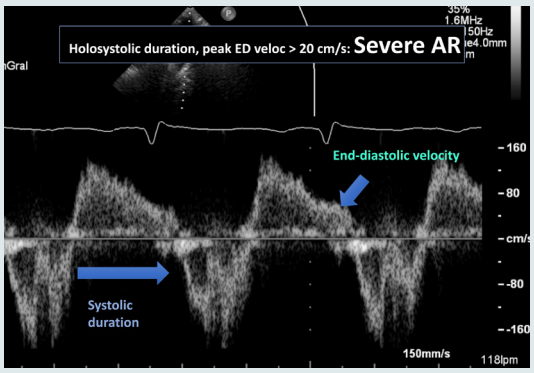
Remember that acute and chronic AR present differently

The haemodynamics of acute and chronic AR differ so 'classic' AR findings, in particular left ventricular remodelling and dilatation, are not present in acute AR.[1]

[1]In acute AR the LV is unable to adapt to the sudden volume increase, leading to diastolic mitral regurgitation and pulmonary oedema. In contrast, patients with chronic AR may be asymptomatic for years due to LV remodelling, which if left untreated can progress to heart failure.[2]

Certain parameters are particularly helpful in defining severity of AR

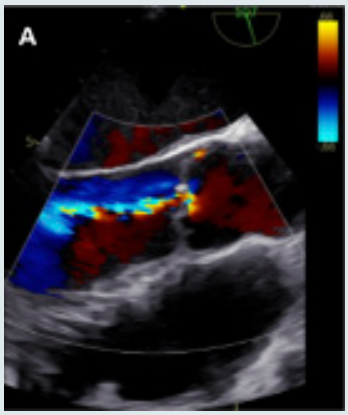
- Don't forget to image the aortic arch and descending thoracic aorta as presence of flow reversal is a clear indicator of severe AR



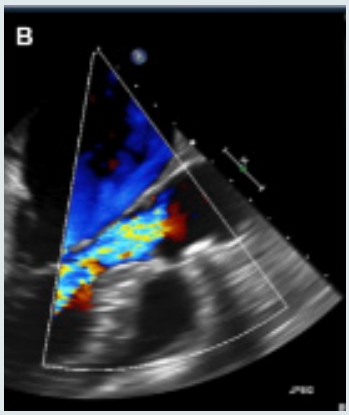
A pulsed-Doppler recording of a patient with severe AR with flow reversal during diastole within the descending aorta. With a worsening degree of regurgitation, the duration and the velocity of the reversal flow increases. An end-diastolic flow velocity >20 cm/s in the proximal descending aorta just beneath the aortic isthmus is indicative of severe AR.[14]

Figure 2: Figure supplied by Dr. M. Sitges

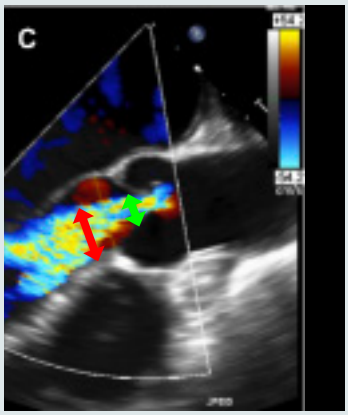
- Presence of LV dilatation unexplained by other causes, suggests chronic severe AR
- Do not rely on the area of the regurgitant flow in colour Doppler mode as it can be influenced by loading conditions. Instead, focus on the width of the regurgitant jet at its origin in the parasternal or three chambers apical views, and not at the expansion of the jet within the left ventricle, as that may overestimate the degree of AR
- The percentage width of the regurgitant jet vs the left ventricular outflow tract (LVOT) diameter (jet width/LVOT diameter [%]), which if greater than 65% is associated with severe AR



A) Mild-moderate AR: jet/LVOT width ratio 5-20%



B) Severe AR: jet/LVOT width ratio >65%

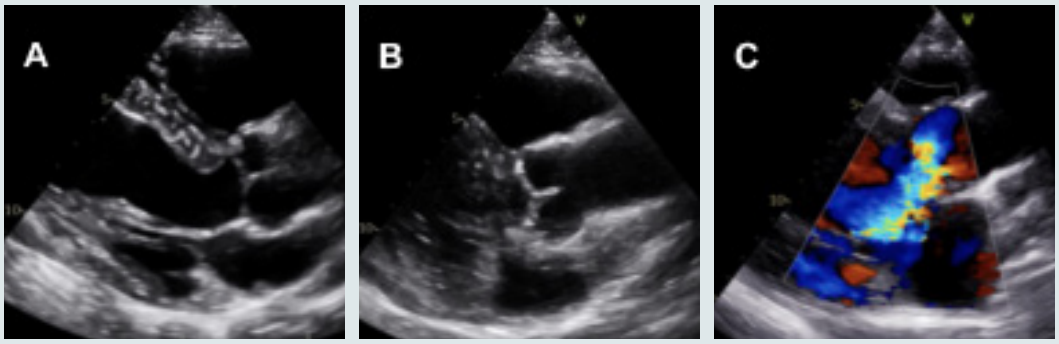


C) Important note: The jet/LVOT width ratio should be based on the width of the AR jet measured immediately below the aortic valve (green line). If the jet width is measured deeper in the left ventricle (red line), this may lead to overestimation of AR.

Figure 3: Figures supplied by Dr. M. Sitges

If you don't get the best image quality, experiment with moving the probe in different positions

When imaging the aortic valve, aortic root or origin of the jet in the parasternal view, it's common to scan from the second or third parasternal intercostal space as the patient lies in the left lateral decubitus position. However, if this does not produce the best quality image, move the probe one space higher in the intercostal space to adequately see the origin of the jet. This will also allow the aortic root and ascending aorta to be scanned adequately.



A) View from third left intercostal space.

B) View from second left intercostal space.

C) Scanning from an upper parasternal view allows visualisation of the whole ascending aorta. The alignment with the regurgitant jet enables the real origin of the AR jet to be seen

Figure 4: Figures supplied by Dr. M. Sitges

While transthoracic echocardiography is effective in the majority of cases, if the acoustic window is still suboptimal, complement the assessment with other imaging modalities

If you are looking to image the aortic valve, ascending aorta, or the aortic root, switching to transoesophageal echocariography can help with image quality.

However, in some instances, echocardiography is insufficient for assessing AR severity. Problematic cases, like suspected aortic disease, are challenging to image; transoesophageal echocardiography is poor at visualising the aortic arch and the emergency situation of the patient may not allow for it.

In such instances, complementing with other imaging modalities, such as cardiac computed tomography (CT) in the acute setting or cardiac magnetic resonance (CMR) for non-acute cases, is beneficial.

Improving your echocardiography skills can unlock opportunities for timely surgical referral in AR

Delayed referrals for surgery can reduce survival of AR patients.[3,16] A 2.7-fold increased risk of mortality has been associated with patients diagnosed with severe AR who do not undergo surgery within one year.[16] Therefore, being able to accurately assess, grade, and refer your AR patients to the Heart Team without delay is crucial.

Take your echocardiographic assessment to the next level for timely referrals and improved outcomes.

Abbreviations

AR, aortic regurgitation; CSA, cross sectional area; CW, continuous wave; EACTS, European Association for Cardio-Thoracic Surgery; EROA, effective regurgitant orifice area; ESC, European Society of Cardiology; LV, left ventricle; LVEF, left ventricular ejection fraction; LVESD, left ventricular end systolic diameter; LVOT, left ventricular outflow tract; PISA, proximal isovelocity surface area; US, United States; VC, vena contracta; VHD, valvular heart disease.

References

1. Galusko V, *et al. Eur Heart J Qual Care Clin Outcomes.* 2022;8(2):113–26.
2. Akinseye OA, *et al. Curr Probl Cardiol.* 2018;43:315–34.
3. Dujardin KS, *et al. Circulation.* 1999;99(14):1851–7.
4. Vahanian A, *et al. Eur Heart J.* 2022; 43(7): 561–632.
5. De Meester C, *et al. JACC Cardiovasc Imaging.* 2019;12(11 Pt 1):2126–38.
6. Yang L, *et al. J Am Coll Cardiol.* 2019;73(14):1741–52.
7. Lung B, *et al. Circulation.* 2019;140:1156–69.
8. Seoudy H. *e-Journal of Cardiology Practice.* 2020;18:17. Available at: https://www.escardio.org/Journals/E-Journal-of-Cardiology-Practice/Volume-18/limitations-of-echocardiography-in-the-assessment-of-aortic-valve-disease. Accessed January 2024.
9. Dieden A, *et al. BMC Med Educ.* 2019;19(1):212.
10. Quiñones MA, *et al. J Am Coll Cardiol.* 2003;41(4):687–708.
11. Siani A, *et al. J Clin Ultrasound.* 2022;50(8):1041–50.
12. Truedsson F, *et al. Int J Cardiovasc Imaging.* 2021;37(12):3561–72.
13. Flint N, *et al. Curr Cardiol Rep.* 2019;21(7):65.
14. Lancellotti P, *et al. Eur Heart J Cardiovasc Imaging.* 2022;23(5):e171–e232.
15. Sitges M. Edwards Education Aortic Regurgitation podcast: Echocardiography. Available at: https://edwardseducation.com/aorticregurgitation/resources/index.html. Accessed January 2024.
16. Thourani V, *et al. Struct Heart.* 2021;5(6):608–18.

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