

When not to reintervene: three-dimensional echocardiography guiding conservative management in frail octogenarian with post-TEER tricuspid regurgitation

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The management of severe tricuspid regurgitation (TR) in elderly patients has been transformed by transcatheter edge-to-edge repair (TEER), now a cornerstone for those at prohibitive surgical risk.^[1] However, with increasing procedural volumes, recurrent TR after TEER is emerging as a relevant clinical challenge.^[2] Although three-dimensional (3D) echocardiography provides superior characterization of complex post-procedural orifices, its role in guiding the difficult decision between redo intervention and conservative management in octogenarians remains insufficiently defined.^[3,4]

We report the case of an 80-year-old woman admitted to our cardiac rehabilitation unit for acute decompensated heart failure. Her clinical background was complex, including chronic cor pulmonale, permanent atrial fibrillation, and prior tricuspid TEER performed two years earlier with two TriClip devices. She presented with features consistent with advanced geriatric frailty and reduced physiological reserve, manifesting as hemodynamic instability (systolic blood pressure 90–100 mmHg, paced heart rate 55 beats/min), along with signs of venous congestion, including lower-limb edema and mild jugular venous distension. Her condition was further complicated by multiple comorbidities, including hyperthyroidism requiring careful methimazole titration, chronic gastritis, recent urinary tract infection, mild thrombocytopenia, and dependence on a permanent VVI pacemaker. Functional assessment revealed impairment in activities of daily living (ADL: 4/6 lost), supporting the presence of frailty. Laboratory tests showed

serum creatinine of 1.38 mg/dL and N-terminal pro-B-type natriuretic peptide (NT-proBNP) of 1610 pg/mL. Initial two-dimensional (2D) transthoracic echocardiography demonstrated moderate-to-severe TR, right ventricular (RV) dilation (49 mm), pulmonary hypertension (systolic pulmonary artery pressure 50 mmHg), and moderately reduced RV systolic function (tricuspid annular plane systolic excursion: 14 mm).

A comprehensive offline 3D echocardiographic analysis (Philips EPIQ 7) proved crucial in clarifying the mechanism of recurrent TR. Importantly, 3D imaging was not only diagnostic but also decisional, as it identified anatomical features associated with a very low likelihood of procedural success. While tricuspid tethering height was similar between 2D and 3D (1.1 vs. 1.2 cm), the regurgitant burden was markedly underestimated by 2D imaging (Figure 1). Vena contracta measured 0.35 cm on 2D versus 0.71 cm on 3D multiplanar reconstruction, and the 3D-derived jet area was more than twice the 2D estimate (11 vs. 5 cm²). Quantitative volumetric analysis confirmed this discrepancy, with an effective regurgitant orifice area (EROA) of 0.263 cm² on 2D versus 0.366 cm² on 3D. Crucially, 3D imaging revealed a highly irregular and extensive regurgitant orifice, with a vena contracta area (VCA) of 0.521 cm². Due to acoustic shadowing from the clips, VCA was derived using an ellipsoidal approximation from orthogonal diameters, as commonly adopted in complex post-TEER geometries (Figure 2). Retrospective 3D assessment of the index procedure demonstrated suboptimal anterior leaflet capture, multiple residual gaps, and severe systolic tethering

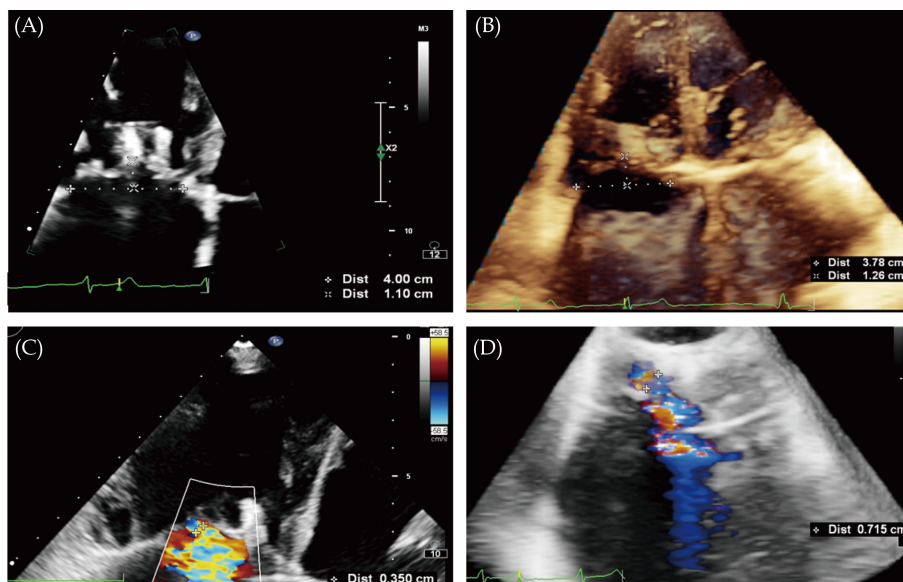


Figure 1 Comparison of 2D and 3D echocardiographic parameters for the evaluation of recurrent tricuspid regurgitation post-TEER. (A): Two-dimensional transthoracic imaging demonstrating severe systolic tethering with a tethering height of 1.10 cm, indicating unfavorable right ventricular remodeling; (B): Three-dimensional reconstruction demonstrating consistent findings of severe systolic tethering with a tethering height of 1.26 cm; (C): Two-dimensional color Doppler assessment significantly underestimating the regurgitant jet burden, with a vena contracta measurement of 0.350 cm; (D): Three-dimensional multiplanar reconstruction revealing a much larger and clinically representative vena contracta of 0.715 cm along the major axis of the asymmetric orifice, confirming the presence of truly severe tricuspid regurgitation and highlighting the inherent limitations of two-dimensional imaging in post-procedural complex geometries.

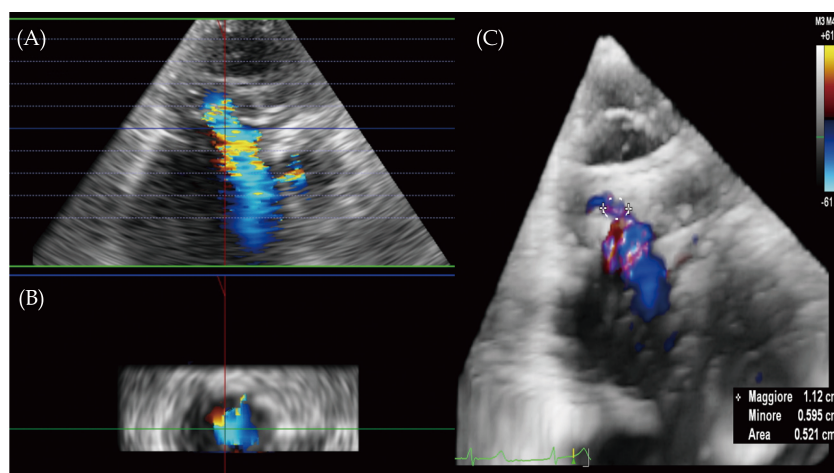


Figure 2 Advanced 3D multiplanar reconstruction and area quantification of recurrent tricuspid regurgitation. (A): Multiplanar reconstruction showing the orthogonal plane used to correctly align the eccentric regurgitant jet, to ensure accurate alignment and measurement of the narrowest cross-sectional area; (B): the used orthogonal plane demonstrates a highly irregular orifice morphology; (C): Quantitative three-dimensional assessment of vena contracta area (VCA). Due to acoustic shadowing from previously implanted devices, an ellipsoidal approximation was applied using a major axis of 1.12 cm and a minor axis of 0.595 cm, yielding a final 3D VCA of 0.521 cm² that confirms severe tricuspid regurgitation and supports Heart Team decision-making by highlighting the low likelihood of a successful redo intervention.

(1.1–1.2 cm). A coaptation gap > 0.7 cm, together with the risk of steric interaction with existing clips and the pacing lead, indicated a very low probability of success for redo TEER.

Surgical re-intervention was excluded due to prohibitive operative risk (EuroSCORE II 12.4%) and advanced frailty. The case was therefore discussed by a multidisciplinary Heart Team including cardiologists, geri-

atricians, a psychologist, a physiotherapist, and specialized rehabilitation nurses. Based on the integrated clinical and imaging assessment, a comprehensive conservative strategy was pursued. Pharmacological therapy was optimized through careful titration of loop diuretics (furosemide 100 mg/day), with close monitoring of electrolytes and renal function. The patient subsequently underwent a 20-day tailored cardiac rehabilitation program. Nursing care focused on medication adherence, education on fluid management and daily weight monitoring, and support with ADL adapted to her hemodynamic fragility. A physiotherapist implemented a progressive mobilization program emphasizing energy conservation and frailty-adapted resistance training. Psychological evaluation confirmed preserved cognition (Mini-Mental State Examination > 24/30) and adequate emotional resilience.

The clinical course was favorable. Following initial stabilization and diuretic optimization, symptoms improved from New York Heart Association (NYHA) class IV to III within one week, with resolution of peripheral edema and jugular venous distension. Completion of the rehabilitation program led to further improvement to NYHA class II at discharge. This was accompanied by right heart reverse remodeling (RV basal diameter 49 → 43 mm) and reduction in systemic venous congestion (inferior vena cava diameter 20 → 17 mm). Renal function improved markedly, with serum creatinine decreasing from 1.38 to 0.86 mg/dL. At one-month follow-up, clinical and hemodynamic stability were maintained, with preserved functional independence and stable pulmonary pressures. NT-proBNP further decreased to 1429 pg/mL, supporting a favorable neurohormonal response.

This case highlights several points of particular relevance in geriatric cardiology. First, it confirms that 2D PISA systematically underestimates TR severity in post-TEER settings, a well-recognized limitation. Conventional 2D measurements fail to capture the complex, often elliptical and fragmented geometry of residual regurgitant orifices created by clips.^[5] In this context, 3D-derived EROA and VCA provide a more accurate assessment of regurgitant burden, in line with current recommendations supporting 3D multiplanar reconstruction as the reference standard for complex valvular lesions.^[6] Such precision is essential to identify patients unlikely to benefit from further intervention.

Second, the marked improvement in renal function

underscores the central role of venous congestion in the cardiorenal axis in elderly patients. In advanced TR, elevated central venous pressure may impair renal perfusion more significantly than reduced cardiac output.^[7] Relief of congestion likely restored the transrenal perfusion gradient, suggesting that targeting venous pressure may be more effective than high-risk structural intervention in selected older patients.^[8]

Furthermore, while TEER aims to reduce volume overload, its long-term effects on RV–pulmonary artery coupling remain uncertain, particularly in the presence of myocardial fibrosis or pacing-induced dyssynchrony.^[9] The observed reverse remodeling supports the potential contribution of structured rehabilitation in improving RV–pulmonary vascular coupling, even in the persistence of significant TR.^[10,11]

In conclusion, this case underscores the importance of integrating advanced 3D imaging with frailty assessment to define the boundaries of clinical futility. In octogenarians, therapeutic goals often shift from achieving complete valve competence to preserving functional independence and minimizing hospitalizations.^[12] When 3D imaging reveals unfavorable anatomy, a combined strategy of optimized medical therapy and structured rehabilitation may represent the most appropriate and ethically sound approach. Although limited by short-term follow-up, this report supports a physiology-driven conservative strategy in selected frail patients. In advanced age, stabilizing hemodynamics and preserving autonomy may be more meaningful than pursuing anatomical correction through high-risk reintervention. In such cases, the value of advanced imaging lies not in guiding intervention, but in supporting the decision to safely avoid it.^[13–15]

CONFLICT OF INTERESTS

None.

REFERENCES

- [1] Esser R, Harboun M, Esteban M, *et al.* Transcatheter tricuspid edge-to-edge repair in frail older adults: a cardiogeriatric framework for integrated care. *Aging Clin Exp Res* 2025; 38: 34.
- [2] Stabile F, Jaramillo S, Hakkeem B, *et al.* Tricuspid transcatheter edge-to-edge repair for severe symptomatic tricuspid regurgitation: a systematic review and meta-analysis. *J Cardiovasc Med (Hagerstown)* 2025; 26: 519–526.
- [3] Shimoda TM, Ueyama HA, Miyamoto Y, *et al.* Comparison of transcatheter versus surgical tricuspid repair among



- patients with tricuspid regurgitation: two-year results. *Circ Cardiovasc Interv* 2025; 18: e014825.
- [4] Passaniti G, Safi LM, Granot YN, *et al*. The use of 3D-echo in edge-to-edge percutaneous tricuspid valve repair. *J Clin Med* 2025; 14: 684.
 - [5] Tomaselli M, Badano LP, Menè R, *et al*. Impact of correcting the 2D PISA method on the quantification of functional tricuspid regurgitation severity. *Eur Heart J Cardiovasc Imaging* 2022; 23: 1459–1470.
 - [6] Lancellotti P, Pibarot P, Chambers J, *et al*; Scientific Document Committee of the European Association of Cardiovascular Imaging. Multi-modality imaging assessment of native valvular regurgitation: an EACVI and ESC council of valvular heart disease position paper. *Eur Heart J Cardiovasc Imaging* 2022; 23: e171–e232.
 - [7] Forado-Benatar I, Caravaca-Pérez P, Rodríguez-Espinosa D, *et al*. Tricuspid regurgitation, right ventricular function, and renal congestion: a cardiorenal triangle. *Front Cardiovasc Med* 2023; 10: 1255503.
 - [8] Salter B, Tang GHL, Hahn RT, *et al*. A contemporary look at the landscape of treatment of tricuspid regurgitation: a review. *JAMA Cardiol* 2026; 11: 98–106.
 - [9] Theofilis P, Vlachakis PK, Karakasis P, *et al*. Right ventricular-pulmonary arterial coupling in transcatheter structural heart interventions. *Cardiovasc Revasc Med* 2025; 78: 113–119.
 - [10] Kusunose K, Seno H, Yamada H, *et al*. Right ventricular function and beneficial effects of cardiac rehabilitation in patients with systolic chronic heart failure. *Can J Cardiol* 2018; 34: 1307–1315.
 - [11] Zoroufian A, Taherian A, Hosseini SK, *et al*. Effects of cardiac rehabilitation program on right ventricular function after coronary artery bypass graft surgery. *J Tehran Heart Cent* 2012; 7: 25–29.
 - [12] Pozzi M, Mariani S, Scanziani M, *et al*. The frail patient undergoing cardiac surgery: lessons learned and future perspectives. *Front Cardiovasc Med* 2023; 10: 1295108.
 - [13] Coisne A, L'Official G, Dreyfus J, *et al*. Echocardiographic outcomes after transcatheter edge-to-edge repair in patients with isolated tricuspid regurgitation: the Tri. *Fr Tri-al. JACC Cardiovasc Imaging* 2026; 19: 297–307.
 - [14] Zhang R, Lan X, Huang P, *et al*. Exercise rehabilitation for patients undergoing interventional treatment for heart valve disease: a scoping review and evidence summary. *BMC Nurs* 2025; 24: 950.
 - [15] Goldwater D, Wenger NK. Patient-centered care in geriatric cardiology. *Trends Cardiovasc Med* 2023; 33: 13–20.

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