



## Tricuspid regurgitation: remembering ‘the forgotten valve’

R. J. de Winter

Accepted: 19 July 2022 / Published online: 3 August 2022  
© The Author(s) 2022

The tricuspid valve, separating the right atrium from the right ventricle, is a complex structure with its fibrous saddle-shaped annulus, three leaflets, two papillary muscles and chordae tendineae, and is sometimes referred to as ‘the forgotten valve’. In recent years, the tricuspid valve has been rediscovered and tricuspid regurgitation (TR) is now recognised as a not uncommon cause of dyspnoea on exertion and progressive fluid retention. It is estimated that clinically significant TR is present in 4% of subjects over 75 years of age [1, 2]. Primary causes of TR occur in 25% of cases and include rheumatic disease, endocarditis, carcinoid disease, Ebstein anomaly, trauma and iatrogenic causes, e.g. pacemaker leads. Secondary causes account for the remaining 75% and include TR due to pulmonary hypertension as a consequence of left heart disease (left ventricular dysfunction, valve disease), pulmonary hypertension in the setting of lung disease, chronic pulmonary embolism or right ventricular dysfunction, e.g. due to ischaemia/infarction. TR results in volume overload of the right ventricle and annular dilatation with worsening of regurgitation, resulting in atrial enlargement with atrial fibrillation. This vicious circle leads to progressive heart failure and eventually significant morbidity.

Treatment of TR includes intensive use of diuretics, in cases of atrial fibrillation rate or rhythm control, precapillary pulmonary hypertension medication and addressing left heart disease with coronary revascularisation and treatment of valve disease where appropriate. Surgical treatment for isolated TR has been associated with high mortality (8.8–9.7%) [3, 4], although this may partly be related to the timing of surgery,

with better results with less sick, younger patients [5, 6].

Transcatheter treatment options for severe TR have recently been shown to hold great promise, with most experience being reported with tricuspid transcatheter edge-to-edge repair (T-TEER). Other transcatheter techniques are being explored (annuloplasty, e.g. Cardioband, Millipede; valve implantation, e.g. Intripid, Cardiovalve, bicaval valves, e.g. TricValve, Tricento) but fall outside the scope of this editorial. Several considerations in the application of edge-to-edge repair deserve careful evaluation in planning and executing such procedures. It has become apparent that there is an optimal time window for patient selection, with patients having progressive symptoms but presenting not too late in the course of the disease. By the time severe right ventricular dysfunction occurs, irreversible liver cirrhosis, severely impaired renal function or irreversible precapillary and postcapillary pulmonary hypertension, transcatheter treatment will yield disappointing results. In addition, assessment of tricuspid valve anatomy is crucial because large variation in morphology exists with additional leaflets or leaflet scallops in the septal, posterior and anterior part of the valve [7]. Moreover, due to disease advancement and progressive annular dilatation, the leaflet coaptation gap will become too large and edge-to-edge repair becomes difficult. Imaging with transoesophageal echocardiography is the key to success and requires the presence of adequate echo windows in order to assess the anatomy, the origin of the regurgitant jet(s), the optimal positioning of the clips and the efficacy of the grasping of the leaflets. Obviously, this requires experience and great skills of the interventional imaging cardiologist and seamless collaboration among the interventional operators.

---

R. J. de Winter (✉)  
Department of Cardiology, Amsterdam University Medical  
Centers, Amsterdam, The Netherlands  
[r.j.dewinter@amsterdamumc.nl](mailto:r.j.dewinter@amsterdamumc.nl)

In this issue of the *Netherlands Heart Journal*, Krikken and colleagues from the University Medical Centre in Groningen provide an excellent and concise overview of the current state of transcatheter treatment of TR, covering patient selection, imaging, and the specifics of the procedure [8]. With regard to imaging, they recommend a transoesophageal echocardiogram prior to the procedure to confirm adequate echo windows. They also report their initial experience with the TriClip T-TEER device (Abbott) in their first 17 patients. They demonstrate that the procedure was safe and resulted in a reduction to TR grade 2 or less in 70% of patients which was accompanied by an improvement in symptoms. There is a learning curve, but this is modest in centres with ample experience with MitraClip (Abbott). The authors summarise that more studies are needed to document the clinical value of T-TEER in patients with severe TR and emphasise that we should take action to be able to offer this treatment to our patients in the Netherlands.

Last year, the 1-year results of the TRILUMINATE trial were published [9]. This was an international, prospective, single-arm, multicentre study ( $n=85$ ) investigating safety and performance of the TriClip tricuspid valve repair system in patients with moderate or more severe TR. At 1 year, TR was reduced to moderate or less severe in 71% of subjects compared with 8% at baseline. Patients experienced significant clinical improvements in New York Heart Association functional class I/II (31% to 83%) 6-min walk test ( $272.3 \pm 15.6$  to  $303.2 \pm 15.6$  m) and Kansas City Cardiomyopathy Questionnaire score (improvement of  $20 \pm 2.61$  points). Significant reverse right ventricular remodelling was observed in terms of size and function. The overall major adverse event rate and all-cause mortality were both 7.1% at 1 year. Several randomised studies comparing T-TEER with optimal medical therapy are underway (TRILUMINATE pivotal trial (NCT03904147,  $n=700$ ), CLASP II TR trial (NCT04097145,  $n=825$ ), TRI-FR trial (NCT04646811,  $n=300$ )) and more results are expected in the near future. European guidelines on the management of valvular heart disease include a class IIb recommendation for transcatheter treatment of symptomatic secondary severe TR in inoperable patients at a heart valve centre with experience in the treatment of tricuspid valve disease [10]. At present, T-TEER is not reimbursed in the Netherlands, limiting widespread application. By June 2022, approximately 80 procedures with TriClip had been performed in the Netherlands. The multicentre TRACE-NL study, comparing T-TEER with optimal medical therapy, will be started soon with Dr. Martin Swaans as lead investigator. Endpoints will be major cardiovascular events, hospitalisation and quality of life at 12 months, and the

analysis will include safety and cost-effectiveness. Let us hope that results will become available soon and let us also not forget either the valve or the patients who may benefit from this important and innovative transcatheter treatment.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

1. Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2014;63:e57–e185.
2. Topilsky Y, Maltais S, Inojosa MJ, et al. Burden of tricuspid regurgitation in patients diagnosed in the community setting. *JACC Cardiovasc Imaging*. 2019;12:433–42.
3. Zack CJ, Fender EA, Chandrashekar P, et al. National trends and outcomes in isolated tricuspid valve surgery. *J Am Coll Cardiol*. 2017;70:2953–60.
4. Dhoble A, Zhao Y, Vejpongsa P, et al. National 10-year trends and outcomes of isolated and concomitant tricuspid valve surgery. *J Cardiovasc Surg*. 2019;60:119–27.
5. Hamandi M, Smith RL, Ryan WH, et al. Outcomes of isolated tricuspid valve surgery have improved in the modern era. *Ann Thorac Surg*. 2019;108:11–5.
6. Kadri AN, Menon V, Sammour YM, et al. Outcomes of patients with severe tricuspid regurgitation and congestive heart failure. *Heart*. 2019;105:1813–7.
7. Hahn RT, Weckbach LT, Noack T, et al. Proposal for a standard echocardiographic tricuspid valve nomenclature. *JACC Cardiovasc Imaging*. 2021;14:1299–305.
8. Krikken JA, van den Heuvel AFM, Willemsen HM, Voors AA, Lipsic E. Transcatheter edge-to-edge repair of tricuspid regurgitation in the Netherlands: state of the art and future perspectives. *Neth Heart J*. 2022; <https://doi.org/10.1007/s12471-022-01673-z>.
9. TRILUMINATE Investigators, Lurz P, von Bardeleben SR, Weber M, et al. Transcatheter edge-to-edge repair for treatment of tricuspid regurgitation. *J Am Coll Cardiol*. 2021;77:229–39.
10. Vahanian A, Beyersdorf F, Praz F, et al. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. Developed by the Task Force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J*. 2021;43:561–632.

