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EDITORIAL COMMENT

Expanding the Tools for Transcatheter Tricuspid Valve Intervention

Transcatheter Tricuspid Valve Repair*

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Transcatheter tricuspid valve intervention (TTVI) is emerging as a promising therapeutic option to treat high-risk patients affected by severe tricuspid regurgitation (TR), who have been a therapeutically neglected population for too long (1,2).

Different devices are currently available, with 3 of them approved for commercial use in Europe (PASCAL, TriClip, and Cardioband). Repair devices can be grouped according to the therapeutic target into leaflet devices and annuloplasty devices.

Although direct comparisons between the 2 approaches are not available so far, a leaflet repair is usually preferred when valve tethering is the predominant pathophysiological component or in the rare case of degenerative TR, whereas tricuspid annuloplasty, which mimics the surgical gold standard technique to address functional TR, is the preferred treatment in the case of predominant annular dilatation. Catheter-based replacement of the tricuspid valve has been reported as well, and it will most likely become a complementary tool for patients who are not amenable to optimal repair strategy.

At the present early stage, TTVI presents specific challenges, which are currently the subject of extensive investigation, and which make TTVI a demanding intervention from a technical standpoint.

These challenges include the following (**Figure 1**).

- The tricuspid valve is a complex structure, with a 3-leaflet configuration, fragile tissue components, large annulus, and short distance from the inferior vena cava orifice, and it is surrounded by vital structures that can be impaired during any intervention (right coronary artery, atrioventricular node, aortic valve, the free wall of the right ventricle, and so on).
- Anatomic patient selection: Which device performs better in each specific anatomy? Which approach should be used, leaflet versus annuloplasty? What are the benefits of repair versus replacement? What are the predictors of failure?
- Clinical patient selection: What is the optimal interventional timing? Should we really wait for symptoms of right heart failure? What are the contraindications to TTVI? Which patients could benefit most from TTVI?
- Imaging: As the most anterior heart valve, the tricuspid is difficult to visualize with transesophageal echocardiography. How should TR be quantified before and after the TTVI? How should RV function be assessed in patients with severe TR?
- Definition: there are no standardized TVARC (Tricuspid Valve Academic Research Consortium) definitions for the tricuspid valve so far.

The case reported by Arikan et al. (3) describes a TTVI case performed with the PASCAL device as a compassionate use in the tricuspid valve (3). The patient treated represents the typical clinical profile of patients who are treated in real-world clinical practice (outside the feasibility trial), referred with a

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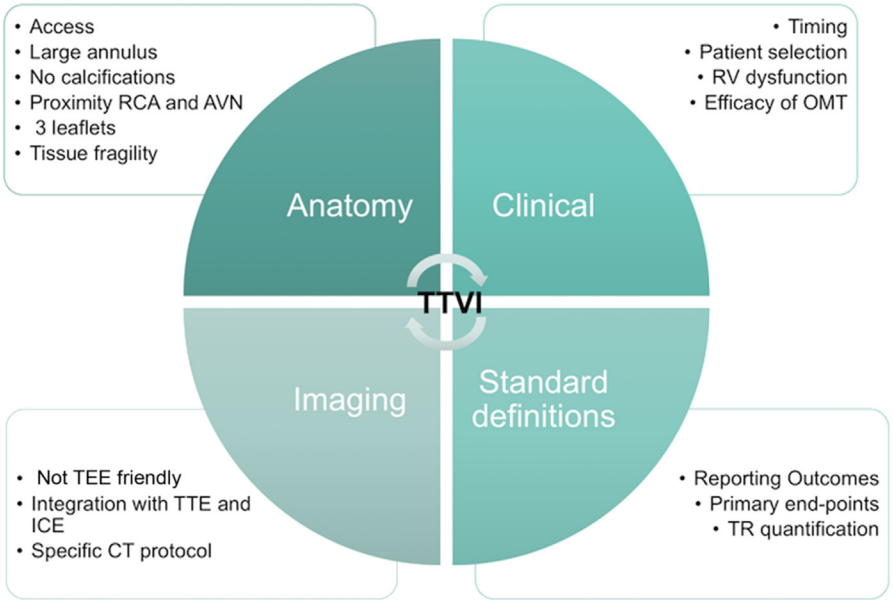
FIGURE 1 Open Challenges Associated With Transcatheter Tricuspid Valve Intervention



AVN = atrioventricular node; CT = computed tomography; ICE = intracardiac echocardiography; OMT = optimal medical therapy; RCA = right coronary artery; RV = right ventricle; TEE = transesophageal echo cardiography; TR = tricuspid regurgitation; TTE = transthoracic echo cardiography; TTVI = transcatheter tricuspid valve intervention.

(too?) late indication: severely enlarged tricuspid annulus, severe pulmonary hypertension, RV dysfunction, large coaptation gap (8 mm is twice the value considered as the cutoff for criteria in the TRILUMINATE study), and severe symptoms.

The promising results of TTVI observed in the TriValve Registry showed that to achieve a prognostic benefit, it is fundamental to obtain a consistent TR reduction (procedural success) (4). All of the predictors of procedural failure and late mortality are related to a too-late indication (severe valve tethering, severe gap, severe pulmonary hypertension), suggesting that an earlier indication would be advisable (5). Moreover, the safety profile of the different devices has been proven to be excellent, considering the high-risk profile of the patients.

The feasibility of TTVI with PASCAL has been recently reported in 28 compassionate high-risk patients with severe TR (6). The unique feature of independent grasping of the PASCAL (which is present in MitraClip Gen 4 as well and will be implemented soon in the TriClip) allows the operator to capture the leaflet in an easier way, especially in the presence of advanced tethering of the septal leaflet.

Performing the procedure with deep sedation rather than general anesthesia could represent a potential advantage in terms of invasiveness in selected cases, but it does not represent a dramatic improvement in that sense. The feasibility of tricuspid clipping with intracardiac echocardiography (ICE) alone has been reported (7). However, although ICE can be extremely useful in annuloplasty procedures (because it allows a careful visualization of the annular hinge point in most of the case), it presents several limitations in leaflet visualization and, therefore, in leaflet procedures, as with the PASCAL or TriClip devices. The new generation 3-dimensional ICE probe will most likely allow the operators to perform TTVI with local anesthesia, without using TEE.

In conclusion, the case described here represents a real-world intervention with a late indication, where procedural success was achieved thanks to the specific features of the PASCAL device. Better devices, better and less invasive imaging guidance, and a more careful definition and patient selection process will help the community improve the overall results of TTVI.

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