

## Mitral valve edge-to-edge repair under scrutiny: what can we learn from transoesophageal echocardiographic follow-up?

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Mitral valve transcatheter edge-to-edge repair (M-TEER) has emerged as a safe and effective guideline-recommended treatment approach for patients with primary (PMR) and secondary mitral regurgitation (SMR)<sup>1</sup>. As demonstrated by several randomised clinical trials<sup>2,3</sup> and data from large real-world registries<sup>4</sup>, procedural mitral regurgitation (MR) reduction to  $\leq 2+$  can be achieved in 80% to 95% of patients, depending on MR aetiology and M-TEER experience of the implanting centre. Regular follow-up visits after MR treatment are key to monitoring long-term therapeutic success and enabling early intervention in case of relevant MR recurrence. Possible mechanisms for relevant MR after M-TEER are, among others, single leaflet device attachment (SLDA) and recurrent or newly developing structural defects of the valvular apparatus (e.g., prolapse or flail). Whether follow-up assessments which are nowadays usually performed using transthoracic echocardiography (TTE) can detect all relevant changes or whether regular transoesophageal echocardiography (TOE) might provide additional benefits in detecting recurrent MR is currently unclear. In this issue of EuroIntervention, the study by Bartkowiak and colleagues helps to fill the respective knowledge gap<sup>5</sup>. In their study, elective TOE follow-up was performed in 128 out of 373 (34.4%) patients who underwent M-TEER at a single heart valve centre in Switzerland. The study covers several important aspects including (1) detection of relevant MR recurrence after M-TEER and the underlying mechanism, (2) TOE assessment of mitral valve inflow gradients and its impact on prognosis, and (3) changes in mitral valve (MV) geometry after M-TEER.

Article, see page e1298

Even though the present analysis might be subject to a certain selection bias (65% of patients had no TOE follow-up), the study is probably the largest available with TOE follow-up 6 months after M-TEER.

Six months after M-TEER, 53 patients (41%) experienced worsening of MR by at least 1 degree. Among those, 16 patients progressed to severe MR. The majority of cases with severe recurrent MR were observed in patients with PMR. The main reasons for MR recurrence were SLDA (in 6 patients) and recurrent prolapse or flail (in 5 patients). Despite TOE imaging, the exact mechanism of recurrent MR could not be determined in 5 patients. This once again emphasises the complexity of M-TEER and current imaging limitations even using TOE. The grading of residual MR after M-TEER is extremely challenging, since conventional parameters of MR quantification are subject to several limitations in the presence of implanted M-TEER devices<sup>6</sup>. To overcome those limitations as best as possible, the authors applied a multiparametric approach which itself was not further specified. Comparison of discharge and 6-month follow-up MR might further have been complicated by the fact that discharge MR was quantified using TTE. It would have been of considerable interest to compare MR grading using identical echocardiographic techniques, e.g., postprocedural TOE with 6-month TOE or discharge TTE with 6-month TTE, to rule out an imaging bias. Furthermore, a comparison of 6-month TOE over 6-month TTE would have been of interest to evaluate the precise additive value of TOE over TTE for follow-up studies.

As stated by the authors, the majority of patients were treated using first- or second-generation devices (62% vs 38%). The application of recent device generations with specific features like independent grasping and an expanded range of device sizes might further improve outcomes, especially in challenging PMR anatomies. The newer PASCAL system (Edwards Lifesciences) was used only in a small group of patients in this registry, but it is intriguing to see that no MR recurrence or SLDA cases were observed in these patients. Of course, an increased M-TEER experience over time and differences between the devices as well as chance

might have triggered this observation. In line with previous literature, the present study reported a strong association of residual MR at 6 months with a combined endpoint of 2-year mortality and heart failure hospitalisation<sup>5,7</sup>.

Until today, the prognostic value of mitral valve inflow gradients (MVG) after M-TEER remains controversial. In a study with >400 PMR patients, postprocedural MVG was not associated with a composite endpoint consisting of all-cause mortality, heart failure hospitalisation and MV reinterventions<sup>8</sup>. Similar results were recently reported by the PRIME-MR registry<sup>9</sup>. In the present study by Bartkowiak and colleagues, TOE-measured MVG  $\geq 5$  mmHg at 6-month follow-up was associated with higher risk of the above-mentioned combined clinical endpoint. Interestingly, MVG at 6-month follow-up was higher compared to TOE-derived measurements after device implantation but lower compared to those reported by discharge TTE. This once again emphasises the fact that measuring MVG is subject to several limitations (heart rate, imaging modality, haemodynamic alterations in sedated patients, volume status). Further studies adjusting for all those potential confounders are urgently needed to shed further light onto the discussion about the prognostic value of MVG after M-TEER. Finally, it would be interesting to know which patient and valve characteristics as well as procedural factors will trigger an increase in MVG during follow-up and if such procedural factors can be modified to improve long-term outcomes.

Using a subset of patients (n=55) with available three-dimensional (3D) datasets of the MV, the study provides unique insights into geometric changes over the course of follow-up after M-TEER. From 3D MV evaluation immediately after the procedure to 6-month follow-up, an increase in MV area and MV perimeter as well as anteroposterior and mediolateral diameters were observed. Even though the respective changes were statistically significant, absolute changes were relatively small, which was emphasised by the authors at several points throughout the paper. Even though M-TEER is known to be associated with a certain annuloplasty effect<sup>10</sup>, the present study hints at the fact that the latter might diminish over time. However, larger studies are needed to further investigate a potential relationship of progressive MV dilation and recurrent MR.

Using TOE follow-up after M-TEER, Bartkowiak and colleagues provide unique insights into long-term results after percutaneous MV repair. Severe residual MR and elevated MVG at 6 months were associated with adverse 2-year outcomes. Ultimately, TTE will remain the standard method for follow-up after M-TEER due to its lower invasiveness. However, in patients in whom MR quantification is challenging or the mechanism of MR recurrence is unclear by TTE, TOE should be liberally performed, since it provides helpful additional information which might allow for targeted repeat interventions in selected patients to further improve long-term outcomes after M-TEER.

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## Conflict of interest statement

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