

EDITORIAL COMMENT

Hybrid Mitral Valve Replacement

An Emerging Option for Nonsurgical Candidates With Complex Mitral Valve Disease*



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Hybrid mitral valve surgery has emerged as a treatment option for mitral valve disease in patients unsuitable for standard mitral valve replacement (MVR) due to severe mitral annular calcification (MAC). It is an open surgical approach where a transcatheter valve system is implanted in the mitral position. The first published report was in 2012 of a successful open transcatheter mitral valve replacement (TMVR) using a SAPIEN XT valve (Abbott Laboratories, Abbott Park, Illinois) in a patient with severe MAC (1).

MAC is a degenerative process of the fibrous base of the mitral valve with atherosclerosis and abnormal calcium-phosphorous metabolism contributing to the damage (2). The prevalence is between 8% and 15% but increases with age, cardiovascular risk factors, and severe renal impairment (2). Decades ago, Dr. Alain Carpentier outlined surgical approaches in patients with MAC (3). Surgeons have since striven to decrease rates of complications associated with severe MAC, including cardiac rupture at the atrioventricular junction, rupture of the left ventricular free wall, injury to the circumflex artery, calcific embolism, and conversion from valve repair to replacement (2-4). Hybrid procedures aim to reduce complications and shorten surgical duration (4). Patients previously considered nonsurgical candidates due to severe MAC and high surgical risk are now potential candidates for a hybrid procedure (5).

Guerrero et al. (6) in 2016 described the first multicenter global registry in TMVR in 64 patients

with severe MAC (6). These were mostly SAPIEN XT or SAPIEN 3 aortic valves in the mitral position inserted through either an open or a percutaneous approach (6). An open transatrial access was used in 15.6% (10 of 64) patients in 2016 (6), but by 2018 this method had increased to 19.8% (23 of 116) in the registry of patients (5).

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In this issue of *JACC: Case Reports*, Castillo et al. (7) add to the growing body of literature on hybrid transatrial procedures in cases of severe MAC. They report a case of a patient with severe mitral stenosis and relatively low surgical risk who was found intraoperatively to have extensive MAC (7). After a ministernotomy was performed, they discovered the needles would not pass through the annulus. An urgent heart team discussion took place, and a hybrid approach was chosen using a SAPIEN 3 Ultra valve (Abbott Laboratories). The patient had a successful outcome (7). The case illustrates a good outcome in a patient with very severe MAC and a well-functioning heart team. The importance of an organized heart team approach in preprocedural planning supports successful outcomes (4).

There are advantages to a hybrid surgical approach compared to a minimally invasive approach. Hybrid transatrial surgery can be performed in patients with contraindications to transseptal approaches such as high risk of left ventricular outflow tract obstruction (LVOTO), concomitant multivalvular disease, or coronary artery disease, noncircumferential annular calcification, and extensive calcification of the subvalvular apparatus (8). As illustrated by Castillo et al. (7), a hybrid surgical approach can be a helpful bailout option.

Outcome data for the hybrid procedure show feasibility, but there are concerns with morbidity and mortality. Guerrero et al. (7) reported that the

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transatrial approach had higher technical success (88.9%) than transapical (71.4%) and transseptal approaches (65.4%) (6). The 30-day mortality was 20% in transatrial hybrid approach versus 32.1% in the transapical and 30.7% in the transseptal approach (6). Outcomes of this registry at 1 year showed the 30-day mortality in the open transatrial approach was 21.7% and 1-year mortality was 35% (5). The driver of these poor outcomes is likely multifactorial, generally related to the higher risk patient population and procedural complications involving paravalvular leakage, LVOTO, and valve migration (5). LVOTO is an independent predictor of mortality after TMVR (5). Heart teams have attempted to address these issues over time. Lee et al. (9) described a novel modification of a SAPIEN XT valve with soft felt secured around the valve to be successfully placed in a patient with mitral stenosis and severe MAC. This decreased paravalvular leakage and valve migration (9).

Heart teams have had inconsistent experiences. For example, El Sabbagh et al. (10) described a retrospective case series of 6 high-risk surgical patients with severe MAC who underwent open transatrial implantation of a SAPIEN XT or S3 valve. Although there was no LVOTO, paravalvular leakage was severe in 3 of 6 patients and moderate-to-severe in 1 of 6 patients (10). In-hospital mortality occurred in 3 of 6 patients (50%) (10). Slightly better outcomes were reported by Praz et al. (8) in a prospective study of 26 patients with severe MAC undergoing hybrid transatrial surgery with SAPIEN XT or S3 valves due to risk of LVOTO based on cardiac imaging. All patients met technical success, but 30-day mortality was high at 27% (7 of 26) patients and acute renal failure requiring temporary dialysis at 15% (4 of 26) patients (8). Risk factors included patients with chronic kidney disease requiring multiple valve surgery (8).

A more successful outcome was seen by Russel et al. (4). They described 8 patients who underwent hybrid surgery with transatrial TMVR using SAPIEN 3

heart valves (4). They had 100% technical success, zero 30-day mortality, and minimal paravalvular leak (4). They attribute their success to a deliberately planned surgery, rather than a bailout procedure (4). They emphasize careful pre-operative planning with cardiac imaging and avoided LVOTO by resecting the anterior mitral leaflet (4). The addition of the polytetrafluoroethylene felt strip around the valve helped reduce paravalvular leak (4). However, the numbers in this study were small.

Cardiac imaging plays an important role in pre-operative evaluation. Computed tomography (CT) scanning can evaluate distribution of MAC, simulate valve implantation, and assess for LVOTO (5). For example, Praz et al. (8) outlined an algorithm for successful pre-procedural planning for valve selection based on simulation by CT scanning of 21 patients with severe MAC who underwent hybrid transatrial TMVR (11).

Limitations of studies so far include small numbers of patients and lack of randomization. The next step will be to replicate successful studies in larger numbers of patients. Longer follow-up times are necessary, and safety profiles must be better evaluated. Future studies should use dedicated mitral valve apparatus rather than aortic valve systems.

While hybrid transatrial TMVR remains in the developmental stage, recent results are promising. Collaborative heart teams continue to refine their techniques with careful patient selection and pre-operative evaluation. Increased experience and advances in cardiac imaging technologies will also help. In the interim, we thank heart teams such as those described by Castillo et al. (7) in helping to expand our understanding of this procedure and make it safer.

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