Robotic mitral valve surgery: the future is now

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The fundamental principle in the management of patients with primary degenerative mitral regurgitation (MR) must always be to prioritize the safe and effective pathoanatomically optimal solution at durable mitral valve (MV) repair. This must hold for any approach, be it sternotomy, minimal access, robotic, or transcatheter. Surgeons have become skilled at surgically treating primary MR with repair rates of over 90% and nearly no operative mortality in low-risk patients (1). Striking the right balance between maximum durability and minimal invasiveness has been the directional evolution of our specialty for the last two decades. While direct vision repair with traditional or shafted surgical instruments has enjoyed excellent outcomes and durability, the ubiquitous access to safe transcatheter edge-to-edge applications has patients frequently seeking this negligibly traumatic alternative, albeit with incomplete longer-term evidence. Robotic-assisted MV repair provides the least invasive surgical opportunity to provide durability at the equivalency of open surgery, yet with the ability to enhance offerings of complexity (2-7).

No longer relegated to expert zealotry or a "future" consideration, robotic MV repair is now an accepted and increasingly common approach for the successful management of primary degenerative MR (3). Growing from 11% of all isolated MV repair cases in 2015, to 15% in 2021, and currently surpassing one fifth of all cases performed in the USA, robotic repair is accessible in most major USA centers and being increasingly applied for all levels of MV pathoanatomy with durable 1-year outcomes (2-4). Of course, for robotic cardiac surgery to become a mainstream offering on a global scale, it will be necessary to improve access to the technology and unify training principles by focusing on surgeon and system reproducibility (6). Providing additional hope that this important goal of global access and reproducibility will be achievable in the near term, a multinational effort is currently underway to enhance standardization of robotic cardiac training as we also witness the emergence of more robotic companies and a refocusing on cardiac applications.

Informing the selection of a robotic approach must be the continued focus of providing the most comprehensive care to our patients with primary MR. The well-known benefits of pain and blood product need notwithstanding, this must not be the only goal, as one must provide the same robotic operation one would perform open, particularly when concomitant pathologies exist. Patients with MR may often have associated atrial fibrillation, tricuspid regurgitation, or even aortic valve disease. Management of the patient and their pathology must always guide the approach. Never should the approach short-change a patient on a clinically indicated and/or guideline-supported treatment of coexistent pathology. This noted, the current era of robotic cardiac surgery is well prepared to not only provide high precision MV repair, but also facilitate thorough treatment of multiple concomitant pathologies (7-10). Robotic double valve and concomitant tricuspid valve repair can be readily and accurately achieved using the same or similar instruments and access (7,8). The performance of robotically assisted full biatrial Cox Maze III with cryoablation is not only feasible and safe, but it can facilitate a high degree of lesion precision with avoidance of tissue gaps and lead to longitudinal rhythm efficacy that is among the highest in the literature (9). The transaxillary 4th intercostal space access commonly used for robotic

MV repair can now also be used for robotic aortic valve surgery with increasing multicenter reproducibility, making this a possible unifying platform to perform multiple valve operations (10).

As we await the results of prospective trials between transcatheter and surgical repair in non-prohibitive risk patients with primary MR, we must continue to innovate minimally invasive options without sacrificing quality. Like in the trials, where the bar of long-term efficacy has been set at mild or less residual MR, so should this be the case for any innovative MV repair therapy. As programs increasingly adopt robotic technology for MV repair, we must be vigilant that this enhance the precision and quality of the result. It is encouraged that programs follow all patients with pre-dismissal or 30-day echocardiograms following robotic MV repair and extend this to 1-year clinical and echocardiographic follow-up to provide assurances that innovation matches quality. It will be through this commitment to longer-term outcomes that the robotic platform will maintain its role as a precise, durable, and adaptable approach to MV repair and coexistent pathologies at all levels of complexity.

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