pathology, and those with more comorbidity are more likely to be referred and/or accepted for sternotomy compared with the robotic approach. Patients with MAC are, no doubt, complex, so what would be the expected benefit of the robotic over sternotomy approach in such cases? How do we counsel the patients? It is worth mentioning that there have been no consistently demonstrable benefits of robotic mitral valve repair in standard cases, other than better cosmesis, and possibly quicker early recovery. There is certainly no evidence that robotic repairs are superior to sternotomy in terms of safety, effectiveness, or durability—indeed, there may be indirect pointers that the opposite may be the case. These are important considerations, as the greater the risk and complexity of a procedure, the more that safety and effectiveness, as opposed to cosmesis and short-term recovery, should be the driving factors in choice of procedure. At least in majority of surgeons' hands (including most robotic surgeons), the sternotomy should, therefore, remain the default for the patient with MAC. This is truly a remarkable series demonstrating advanced surgical management by a highly focused 2-surgeon team working together on every case. Do watch the video and marvel at a demonstration that tests the extremes of technology, surgical skill, and surgical courage—but please don't try this one at home!

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See Article page 80.

Commentary: Lessons from 1000 robotic mitral repairs

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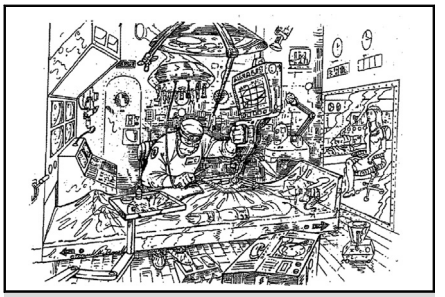

Robotic mitral valve repair as illustrated by Alain Carpentier.

CENTRAL MESSAGE

Robotic mitral repair is reproducible, safe, and effective, but requires great care when navigating the learning curve.

In their analysis of 500 patients who underwent robotic mitral repair between 2011 and 2017, Loulmet and colleagues[1] encountered significant mitral annular calcification (MAC) in 54 patients (12%), which they addressed, largely successfully, with an aggressive strategy involving resections that necessitated atrioventricular groove repair in one-third of cases. Their findings demonstrate that MAC is common in patients with degenerative mitral regurgitation, significantly increases operative risk, and that extensive experience is essential to perform robotic mitral repair safely in this population. Our Cedars-Sinai team has learned similar lessons over the course of more than

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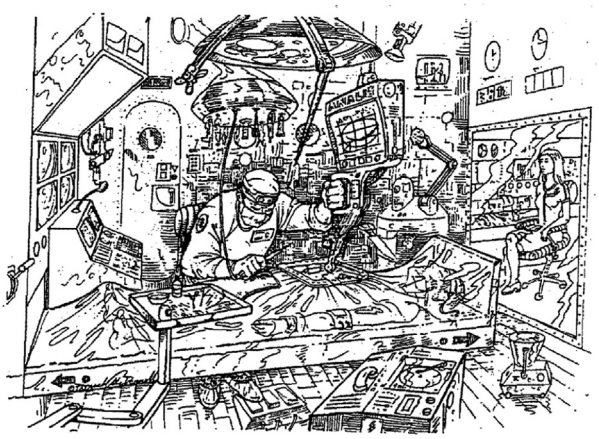

FIGURE 1. Robotic mitral valve repair with enhanced 3-dimensional imaging as illustrated by Alain Carpentier.[7]

1000 robotic mitral repairs, and offers 3 take-homes to mitral surgeons in 2020:

- Despite an excellent, reproducible track record of safety, durability, and patient satisfaction with sternotomy approaches, it is prime time for minithoracotomy mitral repair. Patient aversion to sternotomy and demand for transcatheter therapy are powerful practice drivers, especially while comparative data are limited to short-term, noninferiority studies.[2] Experienced centers and surgeons have developed minithoracotomy approaches delivering excellent mitral repair rates, durability, and safety.[1,3-5] If mitral surgery is to survive the next transcatheter tsunami, it is time to stop debating incisions and move on.
- The learning curve with mitral repair is weaponized when combined with learning curves for peripheral cardiopulmonary bypass, thoracoscopic cardiac surgery, and robots. Intuitive Surgical Inc (Sunnyvale, Calif) the group that supplies and supports the robots, has the only truly comprehensive insight into unsuccessful attempts to adopt this platform, because program failures are rarely publicized. The best strategy is leveraging the learning curve of the most expert, high-volume team available, spending as much time possible scrubbed with them, and recruiting experienced help, remembering that the Leipzig group defined the minimally invasive mitral repair learning curve as 100 cases.[5]
- The robot mandates an economy of movement that requires deep knowledge of mitral repair. However, the act of sewing with a robot is the least challenging piece of the equation. The visualization needs to be experienced to be believed, beating anything you can see through loupes and allowing surgery with a precision that is remarkable, relatively easy, and enjoyable to develop. It is the same precision with which every other piece of the operation needs to be planned and performed that presents the challenge. Without an expert team—particularly an experienced bedside surgeon and scrub team—minor obstacles become major hurdles, and major ones become catastrophic.

As far as MAC goes, the spectrum ranges from inoperable to irrelevant. Based on our inconsistent long-term outcomes with aggressive decalcification, at Cedars-Sinai we adopted a more conservative approach: for MAC limited to P2 we resect the calcium bar without patch reconstruction.[6] For advanced calcification restricting P1, we perform an edge-to-edge repair to A1. For the types of advanced MAC that the authors excluded from their robotic series, we have found conventional surgical, hybrid, and transcatheter approaches to be equally unreliable, and believe there is a need for a better solution. We wholeheartedly agree with the authors' premise that MAC is not a contraindication to robotic repair and congratulate the team for consistently and safely delivering a Carpentier repair via the platform he predicted would eventually become the norm (Figure 1).[7]

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