Minimally invasive, robotic-assisted approach for mitral valve replacement in a pediatric congenital patient with severe mitral regurgitation

Madonna E. Lee, MD,[a] Andrea Amabile, MD,[a] Michael LaLonde, MHA, PA-C,[b] Markus Krane, MD,[a,b] Arnar Geirsson, MD,[a] and Peter J. Gruber, MD, PhD,[a] New Haven, Conn, and Munich, Germany

From the [a]Division of Cardiac Surgery, Department of Surgery, Yale School of Medicine, New Haven, Conn; and [b]Department of Cardiovascular Surgery, Institute Insure, German Heart Center Munich, Technical University of Munich, Munich, Germany.

Drs Lee and Amabile contributed equally to this article.

Read at The American Association for Thoracic Surgery Mitral Conclave Workshop, New York, New York, May 4-5, 2023.

Received for publication June 16, 2023; revisions received Sept 10, 2023; accepted for publication Sept 16, 2023; available ahead of print Sept 22, 2023.

Address for reprints: Arnar Geirsson, MD, Division of Cardiac Surgery, Yale School of Medicine, 330 Cedar St, New Haven, CT 06510 (E-mail: ag4877@cumc.columbia.edu); or Peter J. Gruber, MD, PhD, Division of Pediatric Cardiac Surgery, Yale School of Medicine, 330 Cedar St, New Haven, CT 06510 (E-mail: peter.gruber@yale.edu).

JTCVS Techniques 2023;22:94-5

2666-2507

https://doi.org/10.1016/j.xjtc.2023.09.019

Robotic mitral valve replacement in a pediatric congenital patient: Final cosmetic result.

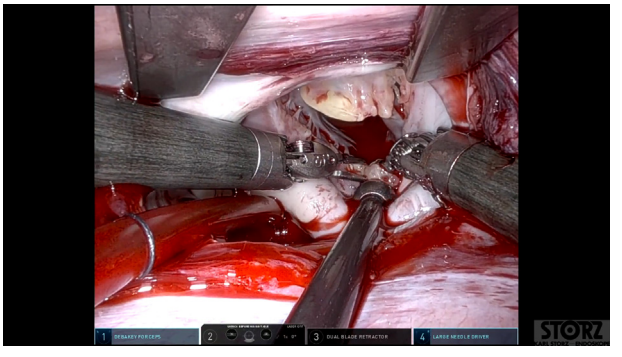
CENTRAL MESSAGE

This case video highlights technical details of a mitral valve replacement in a pediatric congenital patient with rheumatic heart disease using a minimally invasive robotic approach.

Video clip is available online.

CASE VIDEO

The adoption of robotic-assisted techniques for mitral valve surgery in the adult population is increasing.[1,2] However, reports on minimally invasive robotic-assisted mitral valve procedures in pediatric patients remain scant. A 7-year-old, 20 kg girl with history of rheumatic heart disease was admitted for significant shortness of breath (institutional review board No. 2000032417, March 4, 2023; informed written consent was obtained for publication of study data). On echocardiography, the patient had severe mitral regurgitation, significant left atrial dilation, and preserved left ventricular function. She was unable to tolerate an oral diuretic regimen. Thus, the recommendation was to proceed with surgery. There was no absolute contraindication for a robotic approach, so after discussion with the family, the decision was made to proceed to the operating room for possible valve repair versus replacement. The patient was brought to the operating room and general anesthesia was induced. The right neck vessels were exposed for peripheral cannulation using a surgical cut-down technique while being careful to avoid injury to adjacent structures within the carotid sheath (Video 1). A 19-Fr cannula was inserted into the right internal jugular vein, and a 14-Fr arterial cannula was cannula placed in the right carotid artery. One camera port, 2 robotic arm ports, and 1 retractor port were inserted into right intercostal spaces. The pericardium was entered. A cardioplegia needle was placed in the ascending aorta and a transthoracic



VIDEO 1. Narrated case video. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00365-6/fulltext.

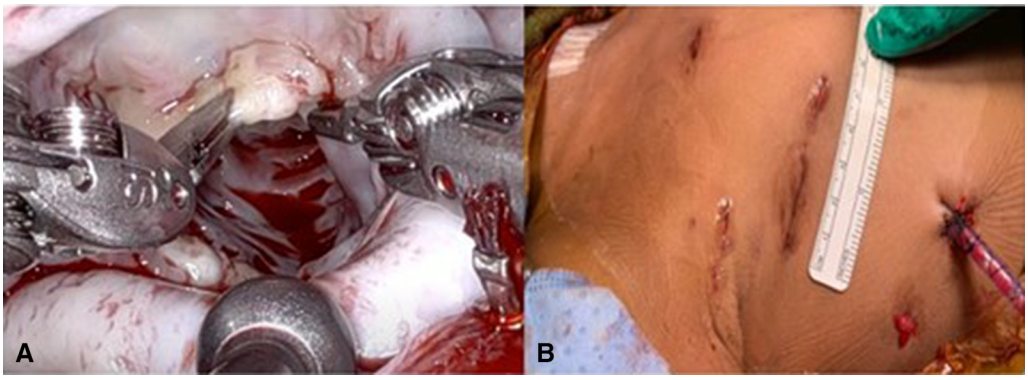


FIGURE 1. A, Intraoperative surgical view of the rheumatic mitral valve demonstrating thickened anterior leaflet. B, Postoperative incisions showing port placement with the largest being 3 cm.

aortic crossclamp was applied. Prompt cardioplegic arrest was obtained, then the left atrium was accessed through the interatrial groove. Utilization of DaVinci Xi Long Tip Forceps (Intuitive Surgical) as a retractor, due to the narrow antero/posterior diameter, provided excellent exposure of the mitral valve, demonstrating rheumatic changes (see Figure 1, *A*). The valve was severely dysplastic and deemed not repairable by the surgeons' judgment. Due to the patient's admission for heart failure, a prolonged bypass time for an attempt at repair with a questionable result was also not advisable. Thus, a mechanical mitral valve replacement was performed with a 25-mm St Jude Medical mechanical prosthesis. After placement of Ti-Cron valve sutures (Medtronic), using the Cor-Knot device (LSI Solutions), the sewing ring was secured in place to the mitral valve annulus. Total cardiopulmonary bypass and cross-clamp times were 167 minutes and 88 minutes, respectively. Postoperative transesophageal echocardiography demonstrated a functioning and well-seated mitral valve prosthesis, with no regurgitation and good leaflet motion. Surgical incisions demonstrated an improved cosmetic result (see Figure 1, *B*).

Postoperatively, the patient had an unremarkable course. She was extubated on postoperative day 1. For anticoagulation, warfarin was started with heparin bridge. She was discharged on postoperative day 9 with transthoracic echocardiography demonstrating a properly functioning mechanical mitral valve, with no pericardial effusion. At 3-month follow-up, this patient was still doing well with good function of the mechanical valve.

CONCLUSIONS

Using a minimally invasive, robotic-assisted approach with cervical cannulation is feasible in smaller patients and should be considered when treating pediatric congenital mitral valve disease.

Conflict of Interest Statement

Dr Amabile receives consulting fees from JOMDD/Sanamedi. Mr LaLonde receives consulting fees from Edwards Lifesciences and Intuitive Surgical. Dr Krane is a physician proctor and a member of the medical advisory board for JOMDD/Sanamedi, a physician proctor for Peter Duschek, a medical consultant for EVOTEC and Moderna, and has received speakers' honoraria from Medtronic and Terumo. Dr Geirsson receives consulting fees for being a member of the Medtronic Strategic Surgical Advisory Board and from Edwards Lifesciences. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

References

1. Bonatti J, Kiaii B, Alhan C, Cerny S, Torregrossa G, Bisleri G, et al. The role of robotic technology in minimally invasive surgery for mitral valve disease. *Expert Rev Med Devices*. 2021;18:955-70.
2. Cerny S, Oosterlinck W, Onan B, Singh S, Segers P, Bolcal C, et al. Robotic cardiac surgery in Europe: status 2020. *Front Cardiovasc Med*. 2022;8:827515.