surgeons may also limit the adoption of this technique at the current time.

The authors state that the most challenging technical segment of rAVR was the aortotomy closure. There are certainly solutions to this problem, but it is clear this is an important consideration in performing this procedure. Although not reported in this paper, challenges related to inadequate robotic instrumentation necessary for debridement of heavily calcified leaflets[3,4] have been described. The authors found that this potential concern was not a significant problem.

Innovation is critical to the evolution of our specialty. As noted in Joseph Bavaria's 2017 Presidential Address to the Society of Thoracic Surgeons, the cardiac surgical community cannot shirk its responsibility to continually advance practice with new devices, approaches, and indications for treatment.[8] The authors are to be commended for their ingenuity and the ability to bring rAVR to patients.

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Commentary: Robotic aortic valve replacement—fad or future?

J. James Edelman, MD, PhD,[a] and
Vinod H. Thourani, MD[b]

J. James Edelman, MD, PhD, and Vinod H. Thourani, MD

CENTRAL MESSAGE

TAVR is now a viable alternative to surgery as the standard treatment of aortic stenosis. Minimally invasive approaches to SAVR are essential for innovation to surgery.

In this issue of the *Journal*, Badhwar and colleagues[1] report their initial experience with robotic aortic valve replacement. Twenty patients underwent surgical aortic valve replacement (SAVR) using a lateral thoracotomy approach, similar to that used for robotic mitral valve surgery. On cardiopulmonary bypass (CPB) and using aortic crossclamping (XC), calcified valve leaflets were resected and a stented bioprosthesis or mechanical valves were secured using conventional techniques and a suture fastening device. The patient population was relatively low risk (Society of Thoracic Surgeons predicted risk of mortality 1.6%), but did include patients with comorbidities such as severe lung disease, moderate-severe pulmonary hypertension, radiation valvulopathy with a calcified aortic root, and urgent cases. The duration of CPB and XC were long at

From the [a]Department of Cardiothoracic Surgery and Transplantation, Fiona Stanley Hospital, University of Western Australia, Perth, Australia; and [b]Department of Cardiovascular Surgery, Marcus Valve Center, Piedmont Heart Institute, Atlanta, Ga.

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Address for reprints: Vinod H. Thourani, MD, Department of Cardiovascular Surgery, Piedmont Heart Institute, 95 Collier Rd, Suite 5015, Atlanta, GA 30308 (E-mail: vinod.thourani@piedmont.org).

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159 minutes and 109 minutes for the isolated aortic valve replacement groups, respectively. However, this was an early experience and did improve throughout the series. The median valve size was 23 mm, and 1 patient had a root enlargement with an autologous pericardial patch. There were no deaths, strokes, or significant acute kidney injury, and all patients but 1 were discharged. The median length of stay was 4.5 days.

Badhwar and colleagues[1] are to be congratulated for this significant technical advance in surgical technique and corresponding outstanding results. The video is evidence of the excellent visualization of valve that the robotic technique offers. Many will argue that minimally invasive techniques compromise the standard of aortic valve replacement. Although the XC and CPB times are predictably longer using the robotic aortic valve replacement technique, the early clinical results presented by this group appear not to have been compromised and satisfactory valve sizes were placed.

With the approval of transcatheter aortic valve replacement (TAVR) for all risk groups in the United States in August 2019, SAVR is being challenged in low- and intermediate-risk surgical cohorts. The early results of TAVR compared with SAVR in the PARTNER 3, Low Risk Evolut trials, and 5-year results of the NOTION trial suggest excellent results for TAVR.[2-4] However, there are certain groups of patients in whom surgery remains the standard of care, although these anatomic scenarios are increasingly being challenged by TAVR: bicuspid aortic valves (especially those that are heavily calcified), young patients (aged <65 years), or those with concomitant coronary disease or valvular pathology. It is for these patients that SAVR must continually be improved. However, it is essential that minimally invasive approaches maintain the ability to place adequately sized valves to minimize the risk of patient–prosthesis mismatch and provide minimal to no paravalvular regurgitation. This remains important because an implanted valve size of less than 23 mm has the strongest risk for long-term mortality in TAVR valve-in-valve procedures. As more younger patients are undergoing bioprosthesis implantation during their initial surgery, it becomes imperative for the lifelong planning for patients with aortic valve disease, which includes planning for the second or third bioprosthesis.[5,6]

Patients are keen to avoid sternotomy, and most will pursue a minimally invasive approach if available. Low-risk patients undergoing TAVR are willing to accept the uncertainty about its long-term results to minimize recovery time, and payers are encouraged by the cost-effectiveness and decreased length of stay of TAVR compared with SAVR in low-risk cohorts.[7] The advance of minimally invasive approaches to SAVR that minimize recovery is to be encouraged, and it remains essential if SAVR is to compete with TAVR in low-risk cohorts. We congratulate Badhwar and colleagues[1] on continuing to push the envelope on novel surgical techniques.

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