



Resurgence of the Ross procedure

Robert O. Bonow

Bluhm Cardiovascular Institute, Northwestern Memorial Hospital, Northwestern University Feinberg School of Medicine, Chicago, IL, USA

Correspondence to: Robert O. Bonow, MD, MS. Department of Medicine, Northwestern University Feinberg School of Medicine, 676 North St. Clair Street, Suite 600, Chicago, IL 60611, USA. Email: r-bonow@northwestern.edu.



Submitted Sep 10, 2020. Accepted for publication Dec 23, 2020.

doi: 10.21037/acs-2020-rp-196

View this article at: <http://dx.doi.org/10.21037/acs-2020-rp-196>

Innovation in transcatheter aortic valve replacement (TAVR), which has virtually transformed the care of patients with aortic stenosis (AS), has fueled an intense interest in the management of patients with aortic valve disease. Indications for TAVR have expanded to low-risk symptomatic patients with AS, and clinical trials are currently in progress for asymptomatic patients with severe AS, testing the strategy of pre-emptive TAVR versus waiting for symptom onset or other indications for valve replacement.

However, expanding the eligibility for TAVR to lower risk, less symptomatic patients goes against the uncertainties regarding durability of transcatheter biologic valves, as such patients are generally much younger than those at higher surgical risk, for whom TAVR was initially targeted towards (1). The high rate of pacemaker requirement after TAVR is another limitation that must be acknowledged when TAVR is considered in younger low-risk populations. Thus, the vast majority of patients with AS under the age of 60 requiring aortic valve replacement (AVR) remain within the realm of surgical intervention. In addition, there is no expectation in the near future of a transcatheter solution for patients with aortic regurgitation, who tend to be younger when AVR is warranted than patients with AS. Similarly, although there is emerging data on successful TAVR in patients of suitable age with AS and bicuspid aortic valves, many, if not most patients with bicuspid valves who require AVR fall under the age threshold below which surgery remains the best option.

In the midst of the excitement and din generated by TAVR, discussions concerning the most appropriate surgical valve substitute for those under the age of 60 years, has essentially been sidelined—yet this has been a debatable topic for decades. While it is clear that most cardiologists

and cardiac surgeons shy away from recommending bioprosthetic heterografts and homografts for young adults in the 20–40 years age range due to accelerated structural valve deterioration, the long-term consequences of life-long anticoagulant therapy with a vitamin K antagonist in patients with mechanical prostheses is equally daunting. These same issues carry over to patients in ages 40–60 years. There is no perfect valve substitute for young and middle-aged patients with aortic valve disease. Against this continuing conundrum, the time is ripe for discussions on broadening the use of the Ross operation as a preferred option for selected young individuals who require AVR (2).

Following initial reports of success of the Ross operation, the procedure was adopted by many centers in the United States in the 1980s and 1990s. The initial enthusiasm was ultimately dampened by the procedure's technical demands, lengthy cardiopulmonary bypass times and, in some centers, poor long-term outcomes with deterioration of either the aortic autograft or the pulmonic replacement valve (heterograft or homograft) or both, and therefore, the need for complex repeat operations. Currently, there are vanishingly few expert centers remaining in the United States, resulting in limited training opportunities for junior surgeons, and the Ross procedure has thus virtually disappeared from the surgical armamentarium. It receives limited or absent endorsement in current societal guidelines, with a class IIb recommendation in the American College of Cardiology (ACC)/American Heart Association (AHA) guidelines for valvular heart disease only for young patients in whom anticoagulation is undesirable or contraindicated and is performed only at a comprehensive valve center by surgeons experienced in this procedure (3). Additionally, there is no mention in the European Society of Cardiology (ESC)/European Association for Cardio-Thoracic Surgery

(EACTS) guidelines for valvular heart disease (4), and only passing mention with no specific recommendation in the updated ESC guidelines for adult congenital heart disease (5). It is likely that few practicing cardiologists in the United States can identify a Ross center of excellence for referral of patients, and the Ross procedure is thus beyond the bandwidth of most. The result is lack of access for suitable patients who would otherwise be excellent candidates for the only AVR operation that offers the patient a living aortic valve substitute. This represents a major lost opportunity (6).

However, several centers of excellence in Europe, Canada, and Australia have kept the flame alive and devoted the necessary time, resources and personnel to achieve exceptional expertise in perfecting the Ross operation, with long-term survival rates exceeding those of conventional AVR and with durability of both replacement valves, therefore yielding low rates of re-operation. A decade ago, a randomized clinical trial demonstrated superior ten-year survival with the Ross operation, as compared to a homograft AVR (7). While this is the only prospective randomized trial, more recent observational studies have reported higher long-term (15–20 years) survival rates in patients undergoing AVR with the Ross operation than with mechanical prosthetic valves (8–11) and, as anticipated, it presents lower risks of thromboembolic and bleeding complications related to chronic anticoagulation. Although the data is limited, the Ross operation also appears to provide superior survival and durability compared to AVR using a bioprosthetic heterograft (8,12). Additional prospective randomized trials are needed to validate these observational data, but it is apparent that the Ross operation is the only AVR procedure that results in long-term survival equivalent to that of an age and sex matched normal population (7,8,12,13).

These recent long-term outcome data has stimulated renewed interest in the Ross operation (2,14). The published data indicate what can be achieved when surgical teams operate in centers devoted to perfecting this procedure in appropriately selected patients. This experience is currently not generalizable. Whether these results can be broadened beyond this small network of specialized centers to other academic institutions and ultimately to larger community hospitals remains to be determined. There are a number of obstacles that need to be surmounted to achieve this potential. First and foremost is the need for educational and training opportunities for both cardiologists and cardiac surgeons, including surgical

proctoring and hands-on experience. In the United States and other countries, regulatory issues and barriers related to insurance and reimbursement may limit the referral of patients from one hospital system to another in a more distant region. Further investigation is required to enhance longevity of the autograft and pulmonary homograft, such as strategies for optimal post-operative blood pressure control and optimal anti-inflammatory management. A limited supply of homografts may also slow progress in expanding access to the Ross operation; whether this can be overcome with biologically engineered human valves is yet to be determined (14). There are thus a number of technical, clinical, educational and regulatory challenges. There is great potential, but much more work needs to be done to realize a true Ross resurgence.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: No relationships to disclosed other than Editor in Chief, JAMA Cardiology.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

1. Otto CM. Informed Shared Decisions for Patients with Aortic Stenosis. *N Engl J Med* 2019;380:1769-70.
2. Mazine A, El-Hamamsy I, Verma S, et al. Ross Procedure in Adults for Cardiologists and Cardiac Surgeons: JACC State-of-the-Art Review. *J Am Coll Cardiol* 2018;72:2761-77.
3. Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol* 2020.

- doi: 10.1016/j.jacc.2020.11.018.
4. Baumgartner H, Falk V, Bax JJ, et al. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur Heart J* 2017;38:2739-91.
 5. Baumgartner H, De Backer J, Babu-Narayan SV, et al. 2020 ESC Guidelines for the management of adult congenital heart disease. *Eur Heart J* 2021;42:563-645.
 6. Yacoub MH, El-Hamamsy I, Sievers HH, et al. Underuse of the Ross operation--a lost opportunity. *Lancet* 2014;384:559-60.
 7. El-Hamamsy I, Eryigit Z, Stevens LM, et al. Long-term outcomes after autograft versus homograft aortic root replacement in adults with aortic valve disease: a randomised controlled trial. *Lancet* 2010;376:524-31.
 8. Sharabiani MT, Dorobantu DM, Mahani AS, et al. Aortic Valve Replacement and the Ross Operation in Children and Young Adults. *J Am Coll Cardiol* 2016;67:2858-70.
 9. Mazine A, David TE, Rao V, et al. Long-Term Outcomes of the Ross Procedure Versus Mechanical Aortic Valve Replacement: Propensity-Matched Cohort Study. *Circulation* 2016;134:576-85.
 10. Buratto E, Shi WY, Wynne R, et al. Improved Survival After the Ross Procedure Compared With Mechanical Aortic Valve Replacement. *J Am Coll Cardiol* 2018;71:1337-44.
 11. Mazine A, Rocha RV, El-Hamamsy I, et al. Ross Procedure vs Mechanical Aortic Valve Replacement in Adults: A Systematic Review and Meta-analysis. *JAMA Cardiol* 2018;3:978-87.
 12. Sievers HH, Stierle U, Charitos EI, et al. A multicentre evaluation of the autograft procedure for young patients undergoing aortic valve replacement: update on the German Ross Registry†. *Eur J Cardiothorac Surg* 2016;49:212-8.
 13. David TE, David C, Woo A, et al. The Ross procedure: outcomes at 20 years. *J Thorac Cardiovasc Surg* 2014;147:85-93.
 14. Yacoub M. The Ross Operation Comes of Age. *JAMA Cardiol* 2018;3:988.

Cite this article as: Bonow RO. Resurgence of the Ross procedure. *Ann Cardiothorac Surg* 2021;10(4):512-514. doi: 10.21037/acs-2020-rp-196