This excellent clinical report is very encouraging for all of us who treat this critically ill patient cohort. The report emphasizes that early technical success leads to excellent early and late outcomes. I am particularly encouraged by the fact that all patients who needed mechanical support postoperatively were able to be weaned. Only 1 subgroup is missing from this report: The group with significant mitral valve disease, who remain a high-risk group with less-optimal options and outcomes.

See Article page 365.

Commentary: Ross procedure in neonates and infants: Withstanding the litmus test of time

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More than 50 years after Donald Nixon Ross developed his eponymous procedure of replacing a diseased aortic valve with pulmonary autograft, the technique has become an established surgical option for aortic valve replacement.¹ The Ross procedure offers superior hemodynamic parameters in comparison to alternative means for aortic valve replacement, avoidance of anticoagulation therapy, and growth potential for patients at younger ages. In the pediatric population, it is the sole option if valve repair is not feasible or fails. The main disadvantages of the Ross procedure are autograft failure primarily in the form of neo-aortic root dilatation and an almost definite need for reintervention on both valves down the line.

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CENTRAL MESSAGE

Ross procedure in infants and neonates entails high initial morbidity. However, the long-term outcomes are good, with an acceptable, but definite risk of reintervention(s).

Luxford and colleagues² have shared their excellent results of the Ross/Ross-Konno procedure in patients younger than age 1 year. We congratulate the authors for their outstanding results that should encourage us to utilize the technique more often in pediatric populations. In other series, the average early mortality of the Ross procedure in infants varies from 7% to 27%.³⁻⁶ In this retrospective analysis of 35 patients, there was no surgical mortality. Therefore, we have the privilege to comment on a study with among the best early surgical results for Ross/Ross-Konno in infants and neonates. Strikingly, 60% of all patients underwent emergency procedures; all of the 13 neonates had an emergency repair. Morbidity was high: use of extracorporeal membrane oxygenation (17%), delayed sternal closure (70%), and incidence of low cardiac output (60%). There are other notable aspects of this study. Compared with previous studies, fewer patients

had an earlier attempt at valve repair (2 out of 35) or a Norwood (1 out of 35) hybrid-type palliation as a bridge to Ross. This can be attributed to conscious decision making as explained in their management algorithm, wherein there appears to be a low threshold of referring patients with failed balloon aortic valvuloplasty directly for the Ross procedure. Also, fewer patients in this study had concomitant arch or mitral repairs; factors traditionally known to increase mortality of Ross procedure. These minor confounding variables and high morbidity in no way eclipse excellent survival. These results stand testimony to excellent operative technique and postoperative care in this challenging patient group.

This study also reports an acceptable risk of reintervention. There was a comparable rate for right ventricle–pulmonary artery conduit reinterventions and no intervention on the aortic autograft itself at a median follow-up of 4 years (62% 10-year freedom from reintervention). The echocardiographic follow-up showed a lack of concerning autograft dilatation although they did not employ any root-supporting technique. However, the duration of follow-up did not extend into the second decade of life. This finding along with recent studies demonstrating stable autograft function in patients who underwent Ross as infants at follow-up challenges the dogma that Ross in younger patients increases the rate of autograft failure.⁷⁻⁹

The Ross procedure is an inevitable tool in the armamentarium of every congenital cardiac surgeon. Not rarely, it appears to be the procedure of choice notwithstanding its inherent risks of mortality and reintervention. The 2 main reasons why Ross procedure has not been considered ideal procedure by some of our colleagues: firstly, it converts a single valve disease into double-valve disease; and secondly, the fate of autograft in the long term may be unpredictable. The mechanisms and risks factors for autograft dilatation and subsequent failure, and why some roots dilate, and others do not is still poorly understood. Although not reported by the authors, several other groups have reported a non-negligible risk of autograft dilatation, failure, and reintervention particularly as the cohort enters the second decade.¹⁰⁻¹² Various techniques to reinforce/stabilize the autograft have been described.^{13,14}

The Ross procedure is also a good alternative in cases of aortic valve endocarditis because it avoids implanting prosthetic material in the aortic position.¹⁵ Successful

application of Ross procedure in a patient with aortic root abscess in this study substantiates this fact.

The Ross procedure seems to have withstood the test of time over the past 5 decades and, as demonstrated by the authors, can be performed with excellent outcomes in neonates and infants with severe aortic valve disease. We once again congratulate the authors for their exemplary work.

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