methodological deficiency in this field. Perhaps the closest we come is in the comparison of Fontan patients with 2 ventricles versus those who have undergone major surgery to achieve 2 ventricles.⁷ Length of follow-up is too short to make a fair comparison, but it would be surprising if there was a major divergence in survival over time.

In the wake of this major contribution, we are left with a more nuanced maxim focused on a subset of people with a Fontan circulation: *A not-so-bad 2-ventricle circulation is better than a bad Fontan.* For the patients in this series who underwent staged recruitment of their systemic ventricle, there was substantial mortality and ongoing morbidity in replacement of mitral valves, Ross-Konno procedures, and pacemakers. Thirty-six percent were left with important elevations of pulmonary arterial pressure and 2 were functionally 1.5-ventricle circulations. Although it is reasoned that this will be well tolerated in the future, survival benefit compared with chronic Fontan failure or transplantation is yet to be established.

We have learned much from this experience, not the least of which is a list of key acceptable parameters for left ventricular end diastolic pressure and volume associated with successful biventricular conversion. As we move forward,

we should work toward acquiring and validating data points with relevant comparators and perhaps less on the maxim of the day.

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Commentary: Biventricular conversion: A decade of data delivers more debate

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Doulamis and colleagues¹ report a retrospective report of 23 patients who underwent biventricular conversion (BiVC)

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CENTRAL MESSAGE

Despite a decade of data regarding biventricular conversion, the debate about the wisdom of this strategy compared with single ventricle palliation or transplantation continues.

following Fontan completion at their center over a 13-year period. This report builds on previously published excellent data from this center, and is an important contribution to our collective understanding regarding the selection and management of these challenging patients.

This article also provides valuable data to further inform the question articulated by Karamlou and colleagues²: “If you force a borderline candidate down a biventricular pathway and achieve survival, what are the implications in terms of functional health status and quality of life?”

Unfortunately, there is no clear answer given the design of this study, but let’s inspect the data more closely to see what can be gleaned. Of the 23 BiVC patients included, 8 were elective conversions and the remaining 15 underwent conversion for failing Fontan physiology. Median follow-up for the entire cohort was short, at 1.1 years. The mortality rate was not insignificant: 5 patients (22%) over the course of the study period. There was 1 (4%) early and 4 late (17%) deaths, with no deaths in patients who underwent elective takedown. Reintervention was required in 13%, including multiple valve replacements and a Ross procedure. Almost half required recatheterization for reintervention on outflow tracts, pulmonary arteries, valves, septal defects, and coronary arteries. What about other metrics of the health of the biventricular circulation? Thirty-six percent of patients had some degree of right ventricular systolic dysfunction with right ventricular pressures $>2/3$ systemic pressure and the median left ventricular (LV) end-diastolic pressure in the cohort was 15 mm Hg, which might disqualify him/her from transplantation.

A premise of this therapy is that BiVC is superior to continuing single ventricle palliation. I recognize that the majority of the included patients were failing single ventricle circulations and therefore delineating a sufficiently sized control group is difficult. Ideally, the authors would report longitudinal outcomes in a matched cohort of group of less symptomatic patients with ongoing single ventricle palliation in the face of similar hemodynamic or physiologic issues. These data would be critical to ascertain whether the comparatively higher mortality and reintervention rates among BiVC are justified. Moreover, heart transplantation outcomes, which are comparably excellent and may be preferable in certain circumstances, could be presented to provide additional balance to the conversation.

The group from Boston has been a leader in defining an approach to BiVC. One major knowledge gap in this arena

is patient selection, which is critical not only for centers that undertake BiVC, but perhaps also even more important data to elucidate for physicians and centers considering referring patients for BiVC. To this end, I would have liked additional clarity provided on this issue by Doulamis and colleagues,¹ or at least the development of a defined protocol that could be prospectively investigated either as a single-center initiative or as a multicenter study. That only patients who eventuated in a successful BiVC were included in the present report is problematic because this obviates the ability to learn from failures of staged recruitment. Further, additional data about cadence and selection for staging would have been highly relevant given that staging toward anticipatory BiVC is advocated by this group. Our group has also found value in a preemptive staged approach (preferably at younger ages) in our experience with the ventricular switch, in which the borderline morphologic left ventricle is recruited as a subpulmonary ventricle.³ These caveats notwithstanding, Doulamis and colleagues¹ provide some thoughtful criteria that can be leveraged in decision making: a preference toward a staged approach in those whose LV end-diastolic and LV end-systolic volumes are $<62.5 \text{ mL/m}^2$ and 17.5 mL/m^2 , respectively, LV end-diastolic volume $>30 \text{ mL/m}^2$ considered adequate in the absence of endocardial fibroelastosis, LV end-diastolic volume $>45 \text{ mL/m}^2$ considered adequate in the presence of endocardial fibroelastosis.

Since the first report by Emami and colleagues in 2012 describing BiVC,⁴ we have all learned a tremendous amount from the courage and innovation of this group. I cannot help but be a bit deflated that after nearly 10 years, the summative inference from this present study reads, “At present it is unclear if this treatment strategy is superior to conventional single ventricle palliation or preferable to transplantation in failing Fontan patients.”¹

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