remarkable experiences offer valuable insights and can help streamline the algorithm for MCS management strategy in this group of SV patients. They should be applauded for their contributions.

References

- Pearce FB, Kirklin JK, Holman WL, Barrett CS, Romp RL, Lau YR. Successful cardiac transplant after Berlin Heart bridge in a single ventricle heart: use of aortopulmonary shunt as a supplementary source of pulmonary blood flow. *J Thorac Cardiovasc Surg.* 2009;137:e40-2.
- Weinstein S, Bello S, Pizarro C, Fynn-Thompson F, Kirklin J, Guleserian K, et al. The use of the Berlin Heart EXCOR in patients with functional single ventricle. *J Thorac Cardiovasc Surg.* 2014;147:697-704; discussion 704-5.
- Philip J, Powers E, Machado D, Lopez Colon D, Gupta D, Shih R, et al. Pulsatile ventricular assist device as a bridge to transplant for the early high-risk single-ventricle physiology. *J Thorac Cardiovasc Surg.* 2021;162:405-13.e4.
- Adachi I. Ventricular assist device support for complex congenital heart disease: inspiration from history of surgical evolution. *J Heart Lung Transplant.* 2019;38:431-2.
- Rutledge JM, Chakravarti S, Massicotte MP, Buchholz H, Ross DB, Joashi U. Antithrombotic strategies in children receiving long-term Berlin Heart EXCOR ventricular assist device therapy. *J Heart Lung Transplant.* 2013;32:569-73.
- VanderPluym CJ, Cantor RS, Machado D, Boyle G, May L, Griffiths E, et al. Utilization and outcomes of children treated with direct thrombin inhibitors on paracorporeal ventricular assist device support. *ASAIO J.* November 20, 2019 [E-pub ahead of print].
- Rosenthal DN, Lancaster CA, McElhinney DB, Chen S, Stein ML, Lin A, et al. Impact of a modified anti-thrombotic guideline on stroke in children supported with a pediatric ventricular assist device. *J Heart Lung Transplant.* 2017;36:1250-7.
- Ungerleider RM, Shen I, Yeh T, Schultz J, Butler R, Silberbach M, et al. Routine mechanical ventricular assist following the Norwood procedure—improved neurologic outcome and excellent hospital survival. *Ann Thorac Surg.* 2004;77:18-22.
- Buck ML. Bivalirudin as an alternative to heparin for anticoagulation in infants and children. *J Pediatr Pharmacol Ther.* 2015;20:408-17.

See Article page 405.

Commentary: Promise with pulsatility? Early bridging of high-risk patients with single-ventricle physiology with a ventricular assist device

Tanya Perry, DO,^a and
David Luís Simón Morales, MD^b

The outcomes for use of the Berlin Heart Excor (The Woodlands, Tex) in patients after stage 1 palliation have been dismal. In previous studies, no single-ventricle (SV) patient

Tanya Perry, DO, and David Luís Simón Morales, MD

CENTRAL MESSAGE

Successful outcomes are possible using a Berlin Heart Excor ventricular assist device as a bridge to transplant in high-risk patients with single ventricle physiology, yet outcomes after Norwood remain uncertain.

weighing ≤ 7 kg could successfully be bridged to transplantation.^{1,2} However, the current article describes a more promising experience with the Excor ventricular assist device (VAD) in 9 patients with single ventricle physiology, before ($n = 6$) or after ($n = 3$) the first stage of palliation.³ Overall, hospital survival was 66% (6 out of 9 patients), which represents a major improvement in survival in comparison with previous reports. Notably, only 1 patient had a VAD placed after Norwood and that patient survived but had a major neurological injury.

The authors should be congratulated for quickly identifying before palliation or soon after a failed palliation,

From the Departments of ^aCardiology and ^bCardiothoracic Surgery, Cincinnati Children's Hospital Medical Center, the University of Cincinnati College of Medicine, Cincinnati, Ohio.

Disclosures: Dr Morales is a consultant, instructor, and advisor to Berlin Heart; a proctor, consultant, instructor, and national principal investigator for the 50/50 trial for SynCardia; a consultant within the HeartWare Division of Medtronic; and a consultant within the Thoratec Division of Abbott. Dr Perry reported no conflicts of interest.

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

Received for publication Sept 16, 2020; revisions received Sept 16, 2020; accepted for publication Sept 17, 2020; available ahead of print Sept 29, 2020.

Address for reprints: David Luís Simón Morales, MD, Department of Surgery, Cincinnati Children's Hospital Medical Center, The University of Cincinnati College of Medicine, 3333 Burnet Ave, MLC 2004, Cincinnati, OH 45229 (E-mail: david.morales@cchmc.org).

J Thorac Cardiovasc Surg 2021;162:415-20
0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery
<https://doi.org/10.1016/j.jtcvs.2020.09.079>

children who were going to do poorly with SV palliation and changing their strategy toward transplantation. We often persist in our SV strategy until a patient is so ill that even VAD support cannot resuscitate him or her. The authors' improved results with SV palliation is because they moved to VAD support early—before the children were on extracorporeal membrane oxygenation. In all but 2 patients, the surgeons avoided the common scenario of failed neonatal palliation resulting in extracorporeal membrane oxygenation and then VAD support and salvage VAD, the results of which are dismal: <20% survival.⁴ This series is an important report for our field because it is the first to describe elective VAD therapy as a bridge to transplant in a series of SV patients before any palliation using the Excor device. Despite size, device, or diagnosis, good patient selection and timing of support can result in acceptable results even in infants with SV physiology.

This study is limited by its small sample size and further study is needed, especially because multiple reports have demonstrated that support of neonates/infants with SV physiology has been improving with the use of

paracorporeal continuous flow devices.⁵ However, there may be advantages to pulsatility in this cohort.^{5,6} This series is a promising step to improving survival in this high-risk patient population, begging the question: Have we again found promise with pulsatility?

References

1. Weinstein S, Bello R, Pizarro C, Fynn-Thompson F, Kirklin J, Guleserian K, et al. The use of the Berlin Heart EXCOR in patients with functional single ventricle. *J Thorac Cardiovasc Surg*. 2014;147:697-704.
2. Conway J, St Louis J, Morales DLS, Law S, Tjossem C, Humpl T. Delineating survival outcomes in children <10 kg bridged to transplant or recovery with the Berlin Heart EXCOR ventricular assist device. *JACC Heart Fail*. 2015;3:70-7.
3. Philip J, Powers E, Machado D, Colon DL, Gupta D, Shih R, et al. Pulsatile ventricular assist device as a bridge to transplant for the early high-risk single-ventricle physiology. *J Thorac Cardiovasc Surg*. 2021;162:405-13.e4.
4. Morales DL, Zafar F, Rossano JW, Salazar JD, Jefferies JL, Graves DE, et al. Use of ventricular assist devices in children across the United States: analysis of 7.5 million pediatric hospitalizations. *Ann Thorac Surg*. 2010;90:1313-8.
5. Gazit AZ, Petrucci O, Manning P, Shepard M, Baltagi S, Simpson K, et al. A novel surgical approach to mechanical circulatory support in univentricular infants. *Ann Thorac Surg*. 2017;104:1630-6.
6. Philip J, Reyes K, Ebraheem M, Gupta D, Fudge JC, Bleiweis MS. Hybrid procedure with pulsatile ventricular assist device for hypoplastic left heart syndrome awaiting transplantation. *J Thorac Cardiovasc Surg*. 2019;158:e59-61.

See Article page 405.

Commentary: Ventricular assist device support in an early infancy with single ventricle: Transformation from salvage to elective

Jiyong Moon, MD, and Iki Adachi, MD

Jiyong Moon, MD, and Iki Adachi, MD

CENTRAL MESSAGE

Mechanical circulatory support for stage I single-ventricle patients is most challenging. The unique strategy Philip and colleagues reported may be a game-changing solution for this population.

Recent Pedimacs (Pediatric Interagency Registry for Mechanical Circulatory Support) data showed significant outcome differences in ventricular assist device (VAD)

From Congenital Heart Surgery, Michael E. DeBakey Department of Surgery, Texas Children's Hospital, Baylor College of Medicine, Houston, Tex.

Disclosures: Dr Adachi reported consultant/proctor for Berlin Heart, Inc, Medtronic, Inc, Jarvik Inc, BiVACOR Inc, and Sony-Olympus Medical Solutions, Inc. Dr Moon reported no conflicts of interest.

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

Received for publication Oct 11, 2020; revisions received Oct 11, 2020; accepted for publication Oct 14, 2020; available ahead of print Oct 17, 2020.

Address for reprints: Iki Adachi, MD, Mechanical Circulatory Support, Congenital Heart Surgery, Texas Children's Hospital, 6651 Main St, Houston, TX 77030 (E-mail: iadachi@bcm.edu).

J Thorac Cardiovasc Surg 2021;162:416-7

0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery

<https://doi.org/10.1016/j.jtcvs.2020.10.045>