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Commentary: No one-size-fits-all approach to extracorporeal membrane oxygenation

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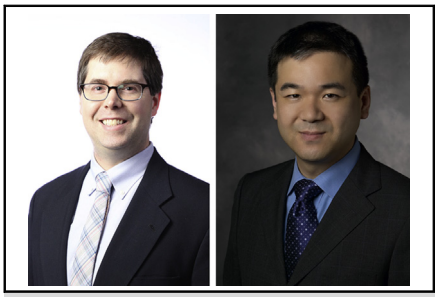

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CENTRAL MESSAGE

Supporting a child with right heart failure due to severe pulmonary hypertension is challenging. An approach should be determined based on a careful assessment of RV and pulmonary function.

Supporting children with complex congenital heart disease by mechanical circulatory support requires innovative approaches. When coupled with pulmonary hypertension (PH), mortality can exceed 50%.[1] In this issue of the *Journal*, Stephens and colleagues[2] described a novel approach for central venoarterial extracorporeal membrane oxygenation (ECMO) cannulation in a child with d-transposition of the great arteries who had undergone an arterial switch procedure with the Lecompte maneuver.[2] The patient was in right heart failure due to severe PH. Cannulation was performed via the right pulmonary artery (PA) and ascending aorta via a short tube graft using Berlin EXCOR cannulae. We commend the authors for successfully supporting this patient to lung transplant, and, more importantly, sharing their thoughtful approach to mechanical support in PH with right ventricle (RV) failure.

To support decompensating patients with PH, 4 classic approaches can be considered, taking into account a careful assessment of RV and pulmonary function. For complete RV and lung support, standard venoarterial ECMO strategies may be employed to unload the RV and successfully bridge to transplant and/or recovery.[3] For lung support with reasonable RV function, venovenous ECMO with or without atrial septal defect creation should be considered. To support a failing RV with relatively good lung function, a Potts shunt with PA-to-descending aorta connection with or without one-way valve may be a better option.[4] For lung support with depressed RV function, a PA-to-left-atrium shunt with artificial membrane decreases RV afterload and supports oxygenation.[5]

The new approach by Stephens and colleagues[2] can also decrease the PA pressure, with a theoretical benefit of afterload reduction to the decompressed RV. This benefit needs to be confirmed in future reports/research. In addition, the described use of ventricular assist device (VAD)-style central cannulation improves stability, allowing for increased mobility and rehabilitation while on support. If aiming for extubated and mobile ECMO, the child's developmental state and temperament should be taken into account in choosing a cannulation strategy.

This report also highlights the complications that unusual anatomy—in this case, severe right ventricular dilation and anterior draping of the pulmonary arteries over the aorta—pose in central cannulation for ECMO. Berlin cannula offer technical advantages in unusual cardiac anatomy. We have frequently added short interposition grafts, as done here, to allow for better geometry or access to distant structures (eg, left atrium via a trans-right atrial graft to an enlarged patent foramen ovale) when placing VADs. Unlike the range of devices available for adult-sized patients with 2-ventricle circulation, small children are limited to a single Food and Drug Administration–approved device, the Berlin EXCOR VAD. With the recent removal of the HeartWare HVAD from the market, the ability to implant a durable and dischargeable device in a medium-sized child has

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disappeared. Given the anatomic variety we work with, there will never be a "one-size-fits-all" approach. Consequently, innovative surgical strategies for both ECMO and VAD support are required, as novel methods in one form of mechanical circulatory support will inform new, iterative approaches in the other, and vice versa.

References

1. Morell E, Rajagopal SK, Oishi P, Thiagarajan RR, Fineman JR, Steurer MA. Extracorporeal membrane oxygenation in pediatric pulmonary hypertension. *Pediatr Crit Care Med*. 2020;21:256-66.
2. Stephens NA, McKenzie ED, Heinle J, Melicoff-Portillo E, Gazzaneo C, Coleman R, et al. Central extracorporeal membrane oxygenation to lung transplantation after remote arterial switch operation. *J Thorac Cardiovasc Surg Tech*. 2021;10:452-5.
3. Rosenzweig EB, Brodie D, Abrams DC, Agerstrand CL, Bacchetta M. Extracorporeal membrane oxygenation as a novel bridging strategy for acute right heart failure in group 1 pulmonary arterial hypertension. *ASAIO J*. 2014;60:129-33.
4. Machuca TN, de Perrot M. Mechanical support for the failing right ventricle in patients with precapillary pulmonary hypertension. *Circulation*. 2015;132:526-36.
5. Weinberg A, Mongero L, Armstrong B. ECMO cannulation strategy for pulmonary hypertension: an alternative approach to traditional veno-arterial ECMO. *Perfusion*. 2016;31:614-7.