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Commentary: Challenges associated with Long-term Implantable Ventricular Assist Device Support in Children

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Conflicts of Interest: None

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Central Message (192/200 characters with spaces):
The need exists for ongoing research to develop new and improved options for implantable VAD support in smaller children, including those with CHD and functionally univentricular circulation.

Central Picture Legend (86/90 characters with spaces):
Mark S. Bleiweis, MD, Joseph Philip, MD, Giles J. Peek, MD, and Jeffrey P. Jacobs, MD.

Commentary text:

We congratulate the mechanical circulatory support program at Texas Children’s Hospital directed by Iki Adachi, MD for their manuscript by Junsang Cho and colleagues titled “Long-term Implantable Ventricular Assist Device Support in Children”. The authors conducted a single-institution retrospective review of 100 consecutive patients supported with implantable continuous-flow ventricular assist device (VAD) at their institution between 2008-2022, including 67 (67%) HeartWare HVAD (Medtronic; Minneapolis, MN, USA), 17 (17%) HeartMate II (Abbott; Chicago, IL, USA), and 16 (16%) HeartMate 3 (Abbott; Chicago, IL, USA). Median (range) age, weight, and body surface area at implantation were 14.1 (3.0-56.5) years, 54.8 (13.3-140) kilograms, and 1.6 (0.6-2.6) meter², respectively. Diagnoses included cardiomyopathy (58; 58%) and congenital heart disease (37; 37%, including 13 functionally univentricular hearts). At 6 months of VAD support, 94 (94%) encounters achieved positive outcomes: ongoing support (59; 59%), transplant (33; 33%), and cardiac recovery (2; 2%).
Eighty-two encounters (82%) resulted in home discharge with ongoing VAD support, including 38 (46%, out of 82) requiring readmission and 7 (9%, out of 82) resulting in death. Overall, 86 encounters (86%) reached positive end-points at the latest follow-up (64 transplant, 15 ongoing support, and 7 recovery). Top causes of negative outcome were infection (29%; 4 of 14) cerebrovascular accident (21%; 3 of 14), and unresolved frailty (21%; 3 of 14). Estimated overall survival at 1, 2, 5 years was 90%, 86%, 77%, 89 respectively.

These findings and results reported by the team from Texas Children's Hospital are notable, important, and outstanding. The authors and team are to be congratulated. We recently reviewed our single institutional outcomes in 82 consecutive children supported with the Berlin Heart pulsatile paracorporeal VAD (Berlin EXCOR [Berlin Heart, Inc., Berlin, Germany]) (Age: median = 1.4 years, range = 17 days-17.7 years; Weight [kilograms]: median = 9.4, range = 3.1-112, dates of cannulation between September 29, 2006 and March 17, 2022).[2,3] One-year survival after VAD insertion was 88.6% (95% CI = 78.8%-99.8%) in acquired heart disease and 59.9% (95% CI = 46.7%-76.7%) in congenital heart disease, P=0.0004.[3] Five-year survival after VAD insertion was 85.3% (95% CI = 74.0%-98.2%) in acquired heart disease and 55.4% (95% CI = 40.8%-75.2%) in congenital heart disease, P=0.002.[3] One-year survival after VAD insertion was 82.7% (95% CI = 72.4-94.4%) in biventricular patients and 59.7% (95% CI = 44.9-79.5%) in univentricular patients, P=0.026[2]. Five-year survival after VAD insertion was 79.7% (95% CI = 68.6-92.6%) in biventricular patients and 50.5% (95% CI = 35.0-73.0%) in univentricular patients, P=0.010.[2] Importantly, 49/82 = 59.76% weighed less than 10 kg at the time of VAD insertion and 36/82 = 43.90% weighed less than 5 kg at the time of VAD insertion.
[4,5] During the period of analysis, we also placed 3 HeartWare HVAD in children, and after this period of analysis, we began placing HeartMate 3 in children.[2,3]

A recent analysis of the Advanced Cardiac Therapies Improving Outcomes Network (ACTION) titled: “Outcomes of Intracorporeal Continuous and Paracorporeal Pulsatile Ventricular Assist Devices in Pediatric Patients, 10-30 kg” included data about patients supported with VAD between June 2018 and September 2021. This analysis included 41 patients in the intracorporeal VAD group, including HeartWare HVAD (31/41; 76%) and HeartMate 3 (10/41, 24%). Only four of these 41 patients (9.8%) with intracorporeal VAD were discharged on VAD.

It is a fact that significant challenges exist with the use of implantable VAD in children less than 30 kilograms. These challenges are even greater in patients with congenital heart disease and especially those with functionally univentricular circulation. Furthermore, in both the analysis at Texas Children’s Hospital and the analysis of children in ACTION weighing less than 30 kilograms, the most common type of implantable VAD used was the HeartWare HVAD. However, in June 2021, distribution of the HeartWare HVAD System was ceased due to observational data demonstrating increased mortality and neurological events compared to other available left ventricular assist devices.[6] Consequently, in the current era. HeartMate 3 is the implantable VAD of choice and is certainly suitable for many larger children. We congratulate the mechanical circulatory support program at Texas Children’s Hospital directed by Iki Adachi, MD for sharing their excellent results with long-term implantable VAD in children. These data support the need for ongoing research to develop new and improved options for implantable
VAD support in smaller children, including those with congenital heart disease and functionally univentricular circulation.[1]
Reference:


Bleiweis MS, Sharaf OM, Philip J, Peek GJ, Stukov Y, Janelle GM, Pitkin AD, Sullivan KJ, Nixon CS, Neal D, Jacobs JP. A Single-Institutional Experience with 36 Children Smaller Than 5 Kilograms Supported with the Berlin Heart Ventricular Assist Device (VAD) over 12 Years: Comparison of Patients with Congenital Heart Disease versus Acquired Heart Disease. Cardiology in the Young. Accepted for publication. In Press.
