Commentary: Challenges associated with long-term implantable ventricular assist device support in children

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We congratulate the mechanical circulatory support program at Texas Children’s Hospital, directed by Iki Adachi, MD, for their article by 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 an implantable continuous-flow ventricular assist device (VAD) at their institution between 2008 and 2022, including 67 (67%) with HeartWare HVAD (Medtronic), 17 (17%) with HeartMate II (Abbott), and 16 (16%) with HeartMate 3 (Abbott). Median (range) age, weight, and body surface area at implantation were 14.1 (3.0-56.5) years, 54.8 (13.3-140) kg, and 1.6 (0.6-2.6) m², respectively. Age distribution consisted of children (aged 3-12 years; 42%), adolescents (aged 13-17 years; 45%), and adult congenital heart disease patients (aged ≥18 years; 13%). Diagnoses included cardiomyopathy (58%; 58%) and congenital heart disease (37%; 37%, including 13 functionally univentricular hearts). At 6 months after VAD implantation, 94 (94%) encounters achieved a positive outcome: 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%, of 82) requiring readmission and 7 (9%, of 82) resulting in death. Overall, 86 encounters (86%) reached a positive end-point at the latest follow-up (64 transplant, 15 ongoing support, and 7 recovery). Top causes of a 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, and 5 years was 90%, 86%, and 77%, 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]) (age: median = 1.4 years, range = 17 days-17.7 years; weight [kg]: median = 9.4, range = 3.1-112; dates of cannulation between September 29, 2006, and March 17, 2022). One-year survival after VAD insertion was 88.6% (95% confidence interval [CI], 78.8%-99.8%) in acquired heart disease and 59.9% (95% CI, 46.7%-76.7%) in congenital heart disease, P = .0004. 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 = .002. 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 = .026. 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 = .010. Importantly, 49 of 82 patients, or 59.76%, weighed less than 10 kg at the time of VAD insertion and 36 of 82 patients, or 43.90%, weighed less than 5 kg at the time of VAD insertion. During the period of analysis, we also placed 3 HeartWare HVADs in

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children, and after this period of analysis, we began placing HeartMate 3 in children.\textsuperscript{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 of 41; 76\%) and HeartMate 3 (10 of 41, 24\%). Only 4 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 kg. These challenges are even greater in patients with congenital heart disease and especially in 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 kg, 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 neurologic events compared with other available left VADs.\textsuperscript{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.\textsuperscript{1}

Conflict of Interest Statement

The authors reported no conflicts of interest.

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