Alternatives to PumpKIN: The ongoing development of ventricular assist devices for infants

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Central Message

Ongoing development of infant ventricular assist devices suggests that further opportunities exist to provide mechanical support to the smallest children.

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The availability and use of mechanical circulatory support devices in children has been expanding rapidly. There is still no option, however, for safe, durable, and dischargeable support in infants and small children weighing less than 15 to 20 kg. The development of extracorporeal centrifugal and paracorporeal pulsatile devices intended for use in children has resulted in a dramatic improvement in outcomes in these complex cases.¹ Challenges remain, however, and outcomes are far from ideal.

In adults, the transition to intracorporeal continuous-flow pumps resulted in dramatic improvements in risk profile and survival.² Similar improvements in the management of adolescents have been achieved with the use of adult pumps in progressively smaller children.³ The article by Olia and colleagues⁴ in this issue of the *Journal* describes the ongoing effort to extend these improvements to the smallest children.

Olia and colleagues⁴ have been developing a continuous-flow ventricular assist device intended for intracorporeal insertion into infants as small as 3 kg. Although the article describes preliminary animal work, it is encouraging. The largest barrier to the miniaturization of ventricular assist devices has been the propensity for hemolysis, as has been seen with the infant Jarvik 2000 pumps (Jarvik Heart, Inc, New York, NY). Researchers solved that problem by modifications that included an increase in the inflow cannula from 11 mm to 15 mm, resulting in an increase in the lower end of the indicated weight range to 8 kg.⁵ In contrast, the PF4 prototype has an inflow cannula that is 5 mm in diameter, and it is intended for support of children as small as 5 kg.

In the reported studies, there was very little hemolysis in animals with support times of more than 2 weeks when the device was run at speeds and flows appropriate for infant support. This is contrast to the early studies of the original infant Jarvik 2000, which had significant hemolysis and

damage to end organs during sheep support.⁶ Thus, although it is not a part of the current PumpKIN trial plan, this device has the potential to expand further the population of patients supported by intracorporeal devices. Olia and colleagues⁴ are to be congratulated on their persistence and their progressive improvements in pump design.

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