

## CASE AND COMMENTARY: PEER-REVIEWED ARTICLE

### Should Physicians Offer a Ventricular Assist Device to a Pediatric Oncology Patient With a Poor Prognosis?

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#### Abstract

A case is presented of a 10-year-old girl with refractory leukemia with poor prognosis and chemotherapy-induced heart failure. She is evaluated for a ventricular assist device (VAD), but the pediatric heart failure team views VAD as clinically inappropriate due to her active oncologic problems. This article examines ethical concerns that arise in deciding whether to offer and use this technology.

#### Case

BJ is a 25 kg, 10-year-old with acute myeloid leukemia who underwent 4 cycles of chemotherapy and a total of 350mg/m<sup>2</sup> of anthracyclines. She attained remission but relapsed within 2 months. The oncology team felt that her probability of cure was extremely low. They estimated her chance of recovery at less than 25% but acknowledged uncertainty. If remission were achieved, it would then be followed by stem cell transplantation necessary for the high-dose chemotherapy to improve the chance of remission.

BJ's cardiac function was normal prior to chemotherapy. However, after chemotherapy she had moderately depressed left ventricular function (30% ejection fraction). She is on submaximal heart failure medications, as increases are limited by symptomatic hypotension. She has had frequent hospital admissions for hemodynamically significant infections. Between these episodes, she has had New York Heart Association Class I and II symptoms.

BJ's family and her oncology team want her "to have every chance." They have heard there are "heart pumps, and that some kids get heart transplants after chemotherapy has hurt their heart." BJ is fearful of all medical interventions but defers to her parents

for decision making. Her family expressly desires that all medical avenues be explored to maximize BJ's life expectancy. The pediatric heart failure team is consulted about BJ's candidacy for placement of a ventricular assist device (VAD) and, in her case specifically, a left ventricular assist device (LVAD).

In BJ's case, the heart failure team has concerns about the success of VAD support at each phase of her care. There is a higher probability of VAD-related, life-threatening complications (eg, wound-healing problems, infection, bleeding, stroke) while undergoing the intensive chemotherapy regimen and subsequent stem cell transplantation. Given the paucity of data on and experience in pediatric destination therapy, combined with BJ's increased risk for complications, the heart failure team decides that she is not a candidate for chronic LVAD therapy. VAD support as bridge to transplant candidacy would similarly require long-term VAD support, with a minimum 1-year disease-free period after treatment in order to be considered for a heart transplant. Due to these concerns, the heart failure team members decide that they are not comfortable offering an LVAD. They acknowledge that this decision is informed by BJ's less-than-25% probability of cancer-free survival. They also acknowledge that they might offer device therapy (as a bridge to either recovery or heart transplantation) to a patient with a higher probability of oncologic cure. While the majority of the medical professionals agree with the heart failure team's assessment in the case, the family expresses dissent and enmity.

### **Commentary**

A VAD is a form of mechanical circulatory support for the failing heart, most commonly the left ventricle. LVADs are implanted in patients with end-stage heart failure as (1) a bridge to heart transplant, (2) destination therapy when patients are not heart transplant candidates, (3) a bridge to myocardial recovery, or (4) a bridge to decision when transplant candidacy has not yet been determined. More than 2500 LVADs are implanted in adults annually, of which almost 50% are for destination therapy.<sup>1</sup>

Adult LVADs are used off label in teenagers and young children, with 174 such implantations reported to a national registry from 42 hospitals between 2012 and 2016.<sup>2</sup> These primarily serve as a bridge to transplant, with only 8 in the registry reported as destination therapy and 23 as a bridge to recovery.<sup>2</sup> Complications are common, with 55% of pediatric patients experiencing at least 1 adverse event—most commonly infection, bleeding, neurologic dysfunction (including stroke), and device malfunction.<sup>3</sup> Chronic VAD therapy or destination therapy in children is an emerging area of interest, but it is currently limited in practice to case series and reports such as palliative implantation in those with muscular dystrophy.<sup>4,5</sup>

In pediatric oncology patients, there are reports of LVADs being used as a bridge to candidacy or recovery for anthracycline-induced cardiomyopathy, but there is no

literature on pediatric VAD destination therapy.<sup>6-9</sup> Adult VAD guidelines state that oncology patients with a “reasonable life-expectancy” may be considered for VAD implantation as destination therapy, but it should not be considered in patients with a life expectancy of less than 2 years.<sup>10</sup> In pediatrics, however, there are no accepted guidelines or criteria for VAD support, and experience with destination therapy remains limited and controversial. This article examines ethical concerns that arise in deciding whether to offer and use this technology.

### **Guidelines for Shared Decision Making About New Technology Use**

Parents and health professionals sometimes disagree about health decisions for children. Overriding parents’ decisions is particularly fraught with conflict as new treatments and technologies are introduced for diagnoses that are inherently uncertain and complex.<sup>11-14</sup> Pediatric ethical principles and guiding frameworks, though sometimes conflicting, can be applied to various clinical scenarios with young patients of various ages.<sup>15,16</sup> These include various formulations of the best interest standard, avoiding harm, constrained parental autonomy, shared family-centered decision making, clinically reasonable alternatives, responsible thinking, and rational decision making.<sup>17-22</sup> While these principles and frameworks have historically served as a guide for parental refusals of therapy, as technology advances and parental requests for therapies arise that a clinical team might consider inappropriate, these models will need to be repurposed to address parental requests.<sup>17</sup>

Examples of conflict involving innovative technology exist in pediatrics, such as with extracorporeal membrane oxygenation (ECMO). Unlike VADs, ECMO has typically been viewed as a short-term therapy for reversible processes or as a bridge to durable support.<sup>23</sup> Utilization of ECMO has resulted in ethical debates about [autonomy](#), nonmaleficence, informed consent, resource allocation, and the advancement of medicine.<sup>24,25</sup> ECMO now has an expanded role including—at times—for patients with active malignancies who need short-term support to recovery, but this role can necessitate discussions of withdrawal of ECMO support if there is no clinical improvement.<sup>26,27</sup>

A central ethical question in BJ’s case is how to express regard for the [child’s best interest](#) using emerging technology amidst disagreement between clinical team members and parental decision makers. The parents seem to be appropriate surrogate decision makers for BJ who are motivated by love and believe that maximizing life expectancy is in BJ’s best interest. However, the proposed treatment of implanting an LVAD has little chance of achieving the family’s goal of BJ’s long-term survival given BJ’s ongoing chemotherapy and underlying poor prognosis. As mentioned previously, for pediatric patients implanted with a VAD, the risk of complications from device infection, bleeding, and stroke are higher. The heart failure team is weighing the potential of

extending BJ's life against the higher-than-usual burdens of harm posed by therapy with little prospect of benefit.

In the United States, physicians are generally expected to share decision making. In this case, then, the parents' views of what is best for BJ needs to be considered as the clinical team defines goals and offers recommendations. Life prolongation is the overarching goal for BJ's parents. However, BJ's physicians believe placement of the VAD for the purpose of life prolongation to be a probable source of harm and that the VAD would require long-term management during BJ's chemotherapy and stem cell transplant. They believe the probability of harm outweighs the minimal chance of benefit. They further argue that a VAD could hasten BJ's death if there are complications.

In cases such as this, several principles and frameworks, as mentioned above, can be helpful for guiding decision making.<sup>15</sup> One approach entails constraining or limiting parental decisional autonomy. While acknowledging that parents are almost always acting in their child's best interest, as in BJ's case, physicians must occasionally weigh whether harms outweigh potential benefits of an emerging technology when considering whether to present that technology as an option. If a chance of cancer-free survival from use of an emerging technology is high, physicians would likely be justified in offering it more freely to parents as a treatment option to consider. We must also acknowledge that a decision to not offer a VAD in BJ's case could be seen by some as setting a precedent that could limit other patients' access to this technology.

Finally, given that off-label and emerging treatments are being considered, BJ's team has an obligation to effectively communicate this information to BJ's parents and other caregivers. It is incumbent on the team to take responsibility for leading thoughtful, compassionate discussions about [palliative care](#) as an alternative to LVAD placement.

### **Conclusion**

As VAD technology continues to evolve—and as VAD outcomes improve and complications diminish—its use as a chronic care option or destination therapy might become more commonplace in select pediatric patients. In BJ's case, a poor prognosis and the significant possibility of severe complications given her underlying acute myeloid leukemia should directly inform the physicians' consideration of whether to offer LVAD. If BJ's disease had a higher rate of cure with potential for disease-free status—such that she could be a heart transplant candidate—LVAD implantation as a bridge to transplant candidacy or recovery could be viewed as more compelling. As debate over appropriate uses of VAD technologies continue, thoughtful analysis and conversations are needed among clinicians, families, and patients.

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