

A novel pediatric treatment intensity score: development and feasibility in heart failure patients with ventricular assist devices



Lindsay J. May, MD,^{a,*} Michelle Ploutz, MD,^{c,*} Seth A. Hollander, MD,^a Olaf Reinhartz, MD,^b Christopher S. Almond, MD,^a Sharon Chen, MD,^a Katsuhide Maeda, MD,^b Beth D. Kaufman, MD,^a Justin Yeh, MD,^a and David N. Rosenthal, MD^a

From the ^aDivision of Pediatric Cardiology, Department of Pediatrics; ^bDivision of Pediatric Cardiac Surgery, Department of Cardiothoracic Surgery, Stanford University, Palo Alto, California; and ^cDivision of Pediatric Cardiology, Department of Pediatrics, Children's National Health System, Washington, DC.

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BACKGROUND: The evolution of pharmacologic therapies and mechanical support including ventricular assist devices (VADs) has broadened the scope of care available to children with advanced heart failure. At the present time, there are only limited means of quantifying disease severity or the concomitant morbidity for this population. This study describes the development of a novel pediatric treatment intensity score (TIS), designed to quantify the burden of illness and clinical trajectory in children on VAD support.

METHODS: There were 5 clinical domains assessed: nutrition, respiratory support, activity level, cardiovascular medications, and care environment. A scale was developed through expert consensus. Higher scores indicate greater morbidity as reflected by intensity of medical management. To evaluate feasibility and face validity, the TIS was applied retrospectively to a subset of pediatric inpatients with VADs. The Bland-Altman method was used to assess limits of agreement.

RESULTS: The study comprised 39 patients with 42 implantations. Bland-Altman interobserver and intraobserver comparisons showed good agreement (mean differences in scores of 0.02, limits of agreement ± 0.12). Trends in TIS were concordant with the overall clinical impression of improvement. Scores remained ≥ 0.6 preceding VAD implantation and peaked at 0.71 3 days after VAD implantation.

CONCLUSIONS: We describe a pediatric VAD scoring tool, to assess global patient morbidity and clinical recovery. We demonstrate feasibility of using this TIS in a test population of inpatients on VAD support. *J Heart Lung Transplant* 2015;34:509–515

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In both adult and pediatric cardiovascular disease and critical care, there are models designed to predict disease-related or treatment-related outcomes with a focus on mortality.^{1–5}

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These scales have applicability in selecting patients for intervention and can serve as benchmarks for program performance. However, in many disease states, as mortality improves, data on morbidity assume increasing importance in understanding the disease trajectory. Although quality of life offers a framework for assessing

*These authors have contributed equally to this article.

Reprint requests: Lindsay J. May, MD, Division of Pediatric Cardiology, 750 Welch Road, Suite # 325, Palo Alto, CA 94304. Telephone: 650-839-3111. Fax: 650-724-4922.

E-mail address: ljmay@stanford.edu

disease morbidity, it is not ideal for pediatric inpatients. For instance, the Health-Related Quality of Life Measures were developed for outpatients at least 12 years old.⁶ Similarly, existing heart failure scoring systems, such as the New York Heart Association or Ross classification, are most applicable to outpatients.⁷⁻⁹ We aimed to develop a scoring tool suitable for pediatric inpatients with severe heart failure and supported on ventricular assist devices (VADs), focusing the tool on morbidity as captured by treatment intensity. This study describes the development and feasibility of a novel pediatric treatment intensity score (TIS), designed to provide insight into the degree of recovery and burden of illness during VAD support for heart failure. We sought to develop a metric that was relevant to measuring morbidity in children hospitalized with heart failure. We then performed preliminary feasibility testing of this novel index in a cohort of inpatient children supported with VADs.

Methods

This investigation was approved by the Human Subjects Research and Institutional Review Board at Stanford University. The pediatric TIS was developed based on expert opinion among a

multidisciplinary team and the available literature. The components of the TIS are shown in Table 1. There were 5 clinical domains assessed: nutrition, respiratory support, activity level, cardiovascular medications, and care environment. The scale was designed such that higher scores represent heightened treatment intensity.

Raw scores for each domain were calculated based on the preceding 24-hour period. For each domain except for cardiovascular medications and physical activity, a score was assigned based on the highest score or level of care provided during that period. The respiratory score was based on the most severe status, and care level was defined as the highest care level required in the assessment period. Nutrition scores were based on enteral intake, mode of feeding, and composition of parenteral nutrition. Whenever possible, this information was confirmed with recent documentation by a registered dietitian. Daily caloric requirements were defined per the Institute of Medicine recommendations.¹⁰ "Adequate" nutrition was defined as meeting these recommended caloric goals. Nutritional scores were based on the poorest level of nutrition (the highest score) achieved in the scoring period.

In the domain for cardiovascular medications, points were added for each class of medication used (e.g., a patient receiving 2 intravenous inotropes is awarded 1 point, whereas a patient treated with an inotropic medication and an enteral diuretic receives 2 points). A physical activity score was applied only for

Table 1 Scoring System for the Treatment Intensity Score of Children With Ventricular Assist Devices.

Component	Level achieved	Score	Detailed definition
Nutrition	Inadequate nutrition	4	Not meeting 50% of daily caloric requirements ^a
	Partial nutrition	3	Meeting 51%–80% of daily caloric requirements, including TPN and/or tube feeds
	Adequate nutrition	2	Exceeding 80% of daily caloric requirements, including both TPN and tube feeds
	Adequate enteral nutrition, tube delivery	1	Exceeding 80% of daily caloric and/or fluid requirements enterally, with tube feeds but no TPN
	Adequate oral nutrition	0	Exceeding 80% of daily caloric and/or fluid requirements exclusively via oral intake
Respiratory	Mechanical ventilation	3	Invasive positive pressure ventilation
	Non-invasive positive pressure	2	CPAP or BiPAP
	Oxygen	1	Oxygen cannula including high-flow systems
	Room air	0	No respiratory support
Activity ^b	Bed	4	In bed, supine or upright
	Standing or chair	3	In a chair or standing with support at least once per 24 hours
	Ambulating	2	Walking with support at least once per 24 hours
	Attending activities	1	Visits to school, playroom, or equivalent within hospital
	Excursions	0	Excursion outside of hospital
	Not applicable	N/A	Age ≤ 5 years
Medications	IV vasoconstrictors	2	Vasopressin, norepinephrine, phenylephrine, epinephrine
	IV inotropes	1	Dopamine, dobutamine
	IV vasodilators	1	Milrinone, nitroprusside, fenoldopam, prazosin
	Pulmonary vasodilators	1	Nitric oxide, prostacyclins, phosphodiesterase inhibitors, endothelin receptor antagonists
	IV diuretics	1	At least 1 dose of IV diuretic per 24 hours
	Enteral diuretics	1	At least 1 dose of enteral diuretic per 24 hours
Care level	ICU	3	ICU level care
	Acute care	2	Non-ICU inpatient care
	Transitional care facility	1	Rehabilitation facility, long-term care facility or residence near hospital
	Home	0	—

Raw scores for each domain are calculated based on the preceding 24-hour period. For cardiovascular medications, 1 point is added for each class of medication used. A physical activity score is applied only for patients >5 years old and reflects the patients' best activity status (lowest score) in the 24-hour period. The respiratory, care level, and nutrition scores were based on the most intensive support (highest score) in the assessment period. BiPAP, bi-level positive airway pressure; CPAP, continuous positive airway pressure; ICU, intensive care unit; IV, intravenous; TPN, total parenteral nutrition.

^aAs defined by the Institute of Medicine.⁹ "Adequate" nutrition was defined as meeting these recommended caloric goals.

^bPatients > 5 years old.

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