

Predicting Right Ventricular Failure in Chronic Heart Failure Patients Receiving Left Ventricular Assist Device

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Background

- Placement of a left ventricular assist device (LVAD) can serve as a temporary solution for advanced heart failure (HF) patients awaiting a donor organ or as a destination therapy in those ineligible for a transplant.
- While LVADs improve the morbidity and mortality in patients with end-stage HF, right ventricular failure (RVF) following device implantation is a frequent complication associated with decreased survival rates.
- Identification of which patients are more likely to develop RVF remains relatively unknown.
- Recent changes in the UNOS heart allocation criteria has led to prolonged wait times for patients bridged to transplant with LVADs. Thus, improved selection of patients susceptible to RVF is of increasing importance.

Objectives

1. To identify clinical, hemodynamic, and laboratory parameters predictive of RVF in the early post-LVAD period.
2. To create a reliable RVF clinical model that incorporates several independent risk factors.

Methods

From 2008 to 2019, end-stage HF patients supported with continuous-flow LVADs were stratified based on presence or absence of RVF within 30 days of LVAD implantation. RVF was defined as the need for intravenous inotropes for >14 days and/or the placement of a right ventricular assist device (RVAD).

The student's t-test was used to determine significance of baseline characteristics. Multivariable logistic regression was used to create an RVF risk model and subsequently a risk score was created by assigning weighted points to the multivariable predictors based on their β -regression coefficient.

Results

Variables	RVF Group N=77	No-RVF Group N=401	p-value
Age, years	56±2	56±1	0.84
Male sex, n (%)	65 (84)	336 (84)	0.93
Body Mass Index, kg/m2	27±1	28±0	0.13
Medical History			
Hx of smoking, n (%)	32 (42)	205 (52)	0.09
Hx of hypertension, n (%)	46 (60)	182 (46)	0.03
Diabetes mellitus, n (%)	28 (36)	144 (37)	0.98
Previous thoracotomy, n (%)	18 (23)	98 (25)	0.83
Pre-operative supportive therapies			
Inotrope dependency, n (%)	63 (82)	272 (70)	0.03
Intra-aortic balloon pump, n (%)	15 (19)	26 (7)	<0.001
Short-term mechanical circulatory support, n (%)	19 (25)	20 (5)	<0.001
Mechanical ventilation, n (%)	9 (12)	33 (9)	0.32
New York Heart Association class			0.68
III, n (%)	19 (26)	108 (28)	
IV, n (%)	55 (74)	277 (72)	
INTERMACS Profile			
1, n (%)	16 (22)	30 (8)	
2, n (%)	16 (22)	65 (17)	
3, n (%)	28 (39)	169 (44)	
≥4, n (%)	12 (17)	118 (31)	
Laboratory values			
Sodium, mEq/L	132±1	134±0	0.007
Platelet Count, ×103/μL	195±11	219±4	0.03
Hemodynamic Measurements			
Mean right atrial pressure, mmHg	14±1	11±0	0.002
Systolic pulmonary artery pressure (PAP), mmHg	49±1	52±1	0.04
Cardiac index, L/min/m2	1.9±0.1	1.8±0.0	0.34
RA/PCWP ratio	0.58±0.03	0.48±0.01	0.0004
Pulmonary artery pulsatility index (PAPi)	2.4±0.2	3.4±0.2	0.04

Table 1. Comparison of pre-LVAD characteristics between patients who developed RVF and those who did not. Values represented as either mean ± standard error or n (%).

The model (AUC=0.77; p<0.0001) predicted RVF using 7 factors:

- ✓ History of systemic hypertension
- ✓ IABP support
- ✓ PLT < 100 x 10³ μl
- ✓ Na < 135 mEq/L
- ✓ Systolic PAP < 60 mmHg
- ✓ RA/PCWP ≥ 0.66
- ✓ PAPi < 1.44

Protocol for Prevention and Treatment of RVF

Score	Predicted Probability	Observed Probability
0	0.02	0.00
1	0.04	0.04
2	0.09	0.10
3	0.20	0.20
4	0.36	0.35
5	0.57	0.56
6	0.76	0.75
7	0.88	>0.99

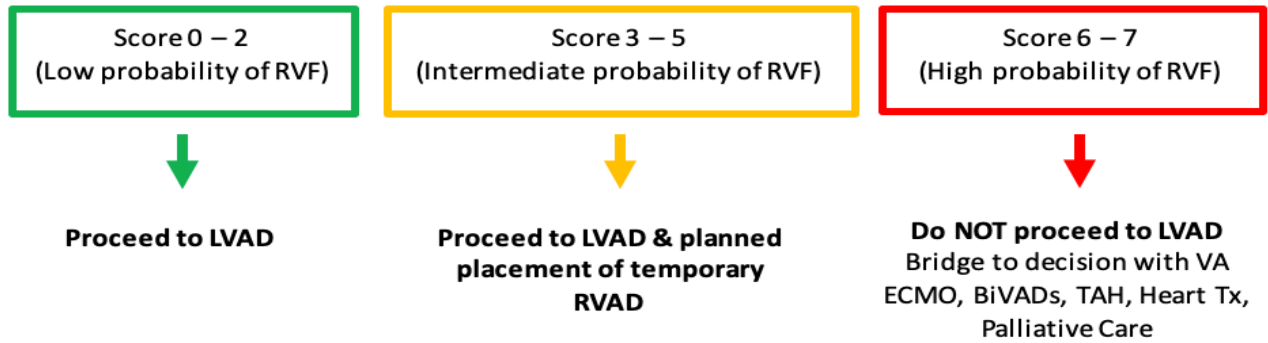


Figure 1. RVF risk score groupings and corresponding treatment strategies. Presence of each risk factor adds one point for a score range of 0-7.

Conclusions

- Our clinical model appears capable of discerning patients susceptible to RVF following LVAD placement based on seven pre-implant parameters.
- Incorporation of this model into LVAD decision-making can allow for planned biventricular support in intermediate-risk patients. Early introduction of therapeutic measures has the potential to alleviate the burden of late RVF.
- Future directions include external risk score validation and incorporation of biological risk factors such as those found in cardiac biopsies.

Disclosures

Stavros Drakos, MD, PhD: Consultant for Abbott Laboratories. None of the other authors have any relationship to disclose.
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