Maximum Vasoactive Inotropic Score in the 48 Hours post-LVAD Implantation Predicts Early Severe Right Ventricular Failure

Salil Kumar, MD[1], Syed Muhammad Ibrahim Rashid, MD[1], Mohammad Hashim Mustehsan, MD[1], Thiru Chinnadurai, MD[1], Nitish Gupta, MD[1], Omar Saeed, MD[2], Snehal R. Patel, MD[2], Sandhya Murthy, MD[2], Jooyoung J. Shin, MD[2], Stephen Forest, MD[2], Sasha Vukelic, MD[2], Daniel J. Goldstein, MD[3], Ulrich P. Jorde, MD[2], Daniel B. Sims, MD[2].

1. Houston Methodist DeBakey Heart & Vascular Center, Houston, TX
2. Department of Medicine. Montefiore Medical Center/Albert Einstein College of Medicine. Bronx, New York 10467.
3. Division of Cardiology. Montefiore Medical Center/Albert Einstein College of Medicine. Bronx, New York 10467.
4. Division of Anesthesia. Montefiore Medical Center/Albert Einstein College of Medicine. Bronx, New York 10467.
5. Division of Cardiothoracic Surgery, Montefiore Medical Center/Albert Einstein College of Medicine. Bronx, New York 10467.

Montefiore THE UNIVERSITY HOSPITAL
Division of Cardiology
Department of Medicine

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY
Science at the heart of medicine

BACKGROUND

- Right ventricular failure (RVF) remains a significant source of post-LVAD implantation morbidity and mortality.
- The vasoactive inotropic score (VIS) is an emerging novel way to estimate total inotropic and vasotropic support, and we believe the post-operative VIS score could correlate with severe RVF post-LVAD implantation.

OBJECTIVE

- Determine if the post-operative VIS score correlates with severe early RVF.

METHODS

- Single-center retrospective study of 240 patients over the age of 18 who received a continuous-flow durable LVAD between Jan 1, 2006 and Dec 31, 2017.
- VIS score was calculated as: dobutamine (mcg/kg/min) + 10 x milrinone (mcg/kg/min) + dopamine (mcg/kg/min) + 100 x epinephrine (mcg/kg/min) + 100 x norepinephrine (mcg/kg/min) + 10,000 x vasopressin (units/kg/min).
- VIS score at 6, 24, and 48 hours postoperatively were abstracted and then the maximum VIS score within 48 hours after implantation for each patient was used to stratify the cohort into quartiles.
- Severe RVF was defined as meeting criteria for clinical RVF and having inotropes > 14 days after implant, inotropes re-started after 14 days of implant, RVAD placement during implant admission, or death from RVF during implant admission.
- A univariate and multivariate logistic regression was performed to evaluate for predictors of severe early RVF.

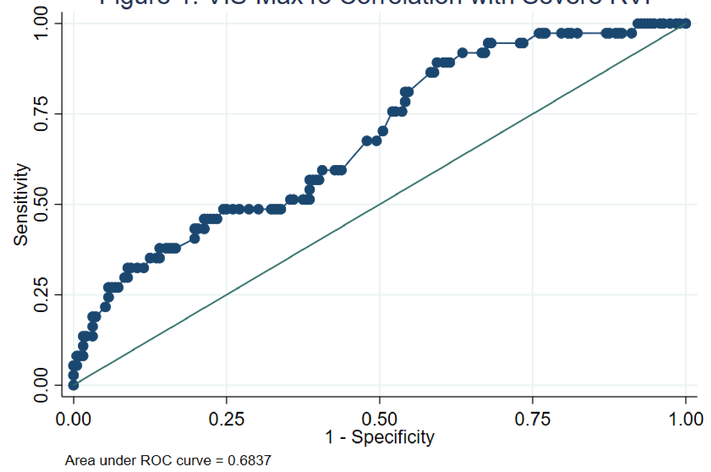
TABLE 1: PATIENT CHARACTERISTICS

	All Patients (n = 240)	VIS 0 - 10 (n = 72)	VIS 11 - 15 (n = 50)	VIS 16 - 22 (n = 61)	VIS 23 - 87 (n = 57)	P value
Mean VIS Score	18 ± 12	7 ± 2	13 ± 2	19 ± 2	33 ± 12	
Age, year	56 ± 13	53 ± 13	56 ± 14	54 ± 12	60 ± 11	0.01
BMI, m2/kg	27 ± 7	27 ±8	28 ± 6	28 ± 7	27 ± 7	0.83
Gender						0.12
Female	56 (23)	23 (32)	7 (14)	12 (20)	14 (25)	
Male	184 (77)	49 (68)	43 (86)	49 (80)	43 (75)	
INTERMACS Level						0.03
1	33	5	12	6	10	
2	48	8	11	15	14	
3	139	52	21	35	31	
4	19	7	5	5	2	
LVAD Indication						0.32
Destination	148 (62)	41 (57)	30 (60)	35 (57)	42 (74)	
Bridge to transplant	58 (24)	22 (31)	12 (24)	17 (28)	7 (12)	
Possible bridge to transplant	34 (14)	9 (12)	8 (16)	9 (15)	8 (14)	
Heart Failure Etiology						0.42
Nonischemic	145 (60)	48 (67)	29 (58)	38 (62)	30 (53)	
Ischemic	95 (40)	24 (33)	21 (42)	23 (38)	27 (47)	
LVAD Type						0.24
HeartMate 2	180 (75)	50 (69)	37 (74)	45 (74)	48 (84)	
HeartMate 3	26 (11)	10 (14)	8 (16)	4 (7)	4 (7)	
HeartWare	34 (14)	12 (17)	5 (10)	12 (19)	5 (9)	
Total bilirubin, mg/dL	1.5 ± 1.1	1.2 ± 0.8	1.8 ± 1.3	1.5 ± 1.2	1.5 ± 1.2	0.05
Creatinine, mg/dL	1.5 ± 0.6	1.4 ± 0.5	1.5 ± 0.6	1.6 ± 0.7	1.6 ± 0.5	0.11
Pre-operative hemodynamics						
Mean RA pressure (mmHg)	12 ± 7	10 ± 7	12 ± 7	13 ± 7	14 ± 7	0.02
Mean PA pressure (mmHg)	36 ± 10	34 ± 11	36 ± 7	36 ± 11	36 ± 10	0.67
PAPi	3.8 ± 4.3	4.3 ± 4.8	3.7 ± 4.7	3.4 ± 3.6	3.6 ± 4.2	0.72
PCWP (mmHg)	24 ± 9	23 ± 10	26 ± 8	26 ± 10	24 ± 8	0.31
Fick CI (L/min/m2)	2.0 ± 0.6	2.0 ± 0.7	2.0 ± 0.6	2.1 ± 0.7	2.1 ±0.6	0.76

RESULTS

- The VIS quartiles groups were 0-10, 11-15, 16-22, and 23-87.
- Patients in quartile 4 were older, had a higher preoperative CVP and INTERMACS level (Table 1).
- In our univariate analysis, VIS quartile 4 was associated with severe RVF (OR 3.62, CI [1.37-9.56], p = 0.009).
- The multivariable model (which included age, INTERMACS level, total bilirubin over 2.5 mg/dL, RV dysfunction on echocardiogram, and gender) found that VIS quartile 4 independently correlated with severe RVF (OR 3.04, CI [1.5 - 8.83], p = 0.04).
- The ROC-curve for this model had an AUC of 0.68 (Figure 1).

Figure 1: VIS-Max48 Correlation with Severe RVF



CONCLUSION

- Our results demonstrate that the highest VIS score within the first 48 hours after LVAD implantation correlates with severe RVF.
- This correlation could imply that higher vasoinotropic support may be part of what precipitates severe RVF in these patients who have less RV reserve.
- Further work is needed to confirm this relationship.

- Drs. Jorde and Goldstein report serving as non-paid consultants for Abbott.
- Dr. Saeed is supported by the NIH/NHLBI (HL145140).