External Validation and Comparison of the EUROMACS and the Right Ventricular Failure Risk Score for Right Ventricular Failure Prediction After Left Ventricular Assist Device

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I will not discuss off label use and/or investigational use of drugs/devices.

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Background:

- Prediction of right ventricular failure (RVF) after left ventricular assist device (LVAD) implant is crucial to improve patient selection and patient outcomes.

- To date, most of the scores derived for RVF prediction lack external validation.

- The aim of our study was to validate the EUROMACS Right-Sided Heart Failure (EUROMACS-RHF) risk score and compare to the right ventricular failure risk score (RVFRS).

Hypothesis

- EUROMACS- RHF risk score outperforms the RVFRS in predicting early RVF after LVAD implantation

Methods

- A retrospective review of 268 continuous-flow LVADs implanted at Montefiore's Medical center between 1/2007 and 12/2017

- Calculated the EUROMACS-RHF risk score and RVFRS and assessed their predictive performance for early RVF

- Early RVF definition: short- or long-term right-sided circulatory support, continuous inotropic support for ≥14 days, or nitric oxide ventilation for ≥48 hours post-operatively.

Risk Score Definitions

- EUROMACS RHF Risk Score
  - RA/PCWP > 0.54 (1 point)
  - Hg ≤ 10 g/dL (1.5 points)
  - Multiple Inotropes (2 points)
  - INTERMACS 1-3 (2 points)
  - Severe RV Dysfx by TTE (1 point)
  - CPB > 100 min (1 point)

- RVFRS
  - Vasopressor requirement (4 points)
  - AST ≥ 80 UI/L (2 points)
  - Cr ≥ 2.3 mg/dL (3 points)
  - Bilirubin ≥ 2 mg/dL (2.5 points)

Results: Patient Characteristics

Variables	Total (n=268)	RVF (n=100, 37%)	Non-RVF (n=168, 63%)	p-value
Demographics				
INTERMACS class				0.005
1	42 (16%)	23 (23%)	19 (11%)	
2	60 (22%)	29 (29%)	31 (19%)	
3	144 (54%)	43 (43%)	101 (60%)	
≥4	22 (8%)	5 (5%)	17 (10%)	
Laboratory values				
Creatinine, mg/dL	1.4 (1.1-1.9)	1.5 (1.1-2)	1.4 (1.1-1.8)	0.184
AST, UI/L	32 (22-53)	37 (24-63)	30 (21-49)	0.019
Total bilirubin, mg/dL	1.2 (0.8-1.8)	1.5 (1-2.4)	1.1 (0.7-1.6)	<0.001
Albumin, g/dL	3.5 (3.2-3.8)	3.5 (3.1-3.8)	3.6 (3.3-3.9)	0.022
BUN, mg/dL	30 (20-44)	32 (23-45)	29 (19-42)	0.150
Hemoglobin, g/dL	10.7 (9.5-12.2)	10.5 (9-11.7)	11.1 (9.8-12.6)	<0.001

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Results: Patient Characteristics

Variables	Total (n=268)	RVF (n=100, 37%)	Non-RVF (n=168, 63%)	p-value
Hemodynamic				
RA pressure, mmHg	12 (7-16)	12 (10-18)	11 (6-15)	<0.001
PCWP, mmHg	24 (20-30)	24 (21-30)	24 (18-30)	0.335
Mean PAP, mmHg	35 (29-40)	36 (33-41)	35 (27-40)	0.056
Systolic PAP, mmHg	52 (42-60)	52 (46-61)	51 (40-60)	0.069
PAPi	2.2 (1.5-3.6)	2.0 (1.4-2.8)	2.4 (1.7-4.6)	0.002
Cardiac index, L/min/m^2	2.0 (1.6-2.3)	2.0 (1.5-2.2)	2.0 (1.7-2.4)	0.100
RA/PCWP	0.50 (0.33-0.63)	0.50 (0.39-0.70)	0.46 (0.29-0.59)	0.001
RVSWI, g/m2 per beat	7.0 (5.1-9.1)	6.9 (4.8-7.9)	7.0 (5.3-9.5)	0.039
Echocardiographic findings				
Severe RV dysfunction	65 (25%)	33 (33%)	32 (19%)	0.042
Moderate to severe TR	133 (50%)	51 (51%)	82 (49%)	0.678
Moderate to severe MR	168 (64%)	60 (60%)	108 (65%)	0.790

Results: Surgical Management

Variables	Total (n=268)	RVF (n=100, 37%)	Non-RVF (n=168, 63%)	p-value
LVAD strategy				
DT	160 (60%)	54 (54%)	106 (63%)	0.279
BTT	67 (25%)	27 (27%)	40 (24%)	
Possible BTT	41 (15%)	19 (19%)	22 (13%)	
Type of VAD				
Heart Mate II	203 (76%)	81 (81%)	122 (73%)	0.186
Heart Mate 3	27 (10%)	6 (6%)	21 (12%)	
Heart Ware	38 (14%)	13 (13%)	25 (15%)	
Surgery				
CPB time, min	90 (74-112)	100 (80-124)	87 (73-108)	0.005
RBC transfusion	0 (0-2)	2 (0-4)	0 (0-2)	<0.001
FFP units	0 (0-2)	2 (0-3)	0 (0-1)	<0.001
Platelets transfusion	0 (0-2)	2 (0-2)	0 (0-2)	<0.001

Results: Postoperative Management

Variables	Total (n=268)	RVF (n=100, 37%)	Non-RVF (n=168, 63%)	p-value
Duration inotropic support, days	6 (4-10)	11 (7-17)	5 (4-7)	<0.001
RVAD implant	37 (14%)	37 (37%)	0	<0.001
iNO 48 post implant	65 (24%)	65 (65%)	0	<0.001
Length of stay, days	34 (25-52)	46 (33-64)	30 (22-45)	<0.001
Intra-hospital death	29 (11%)	22 (22%)	7 (4%)	<0.001

# Results: ROC Curves for Risk Scores
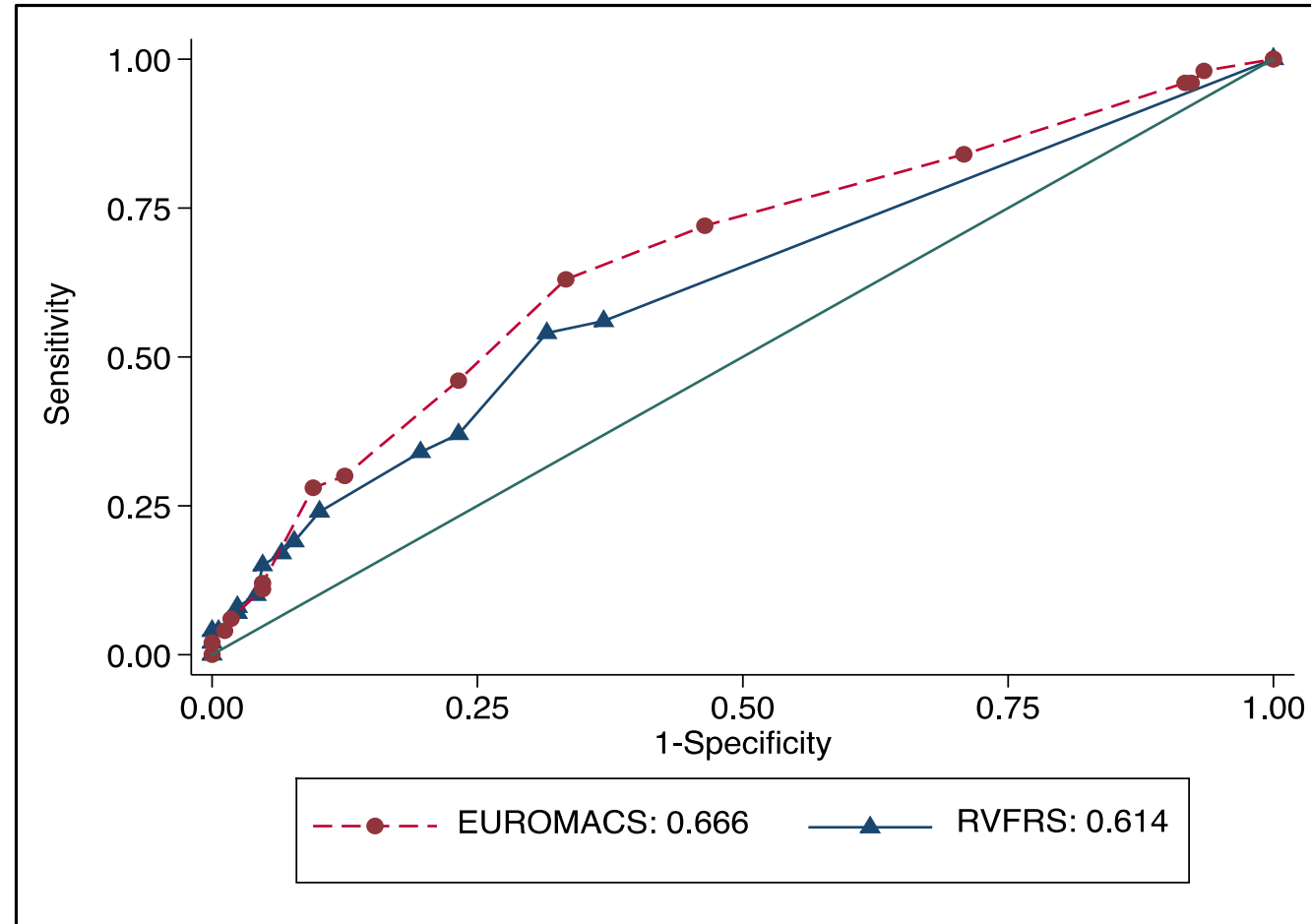
Results: Decision curve analysis
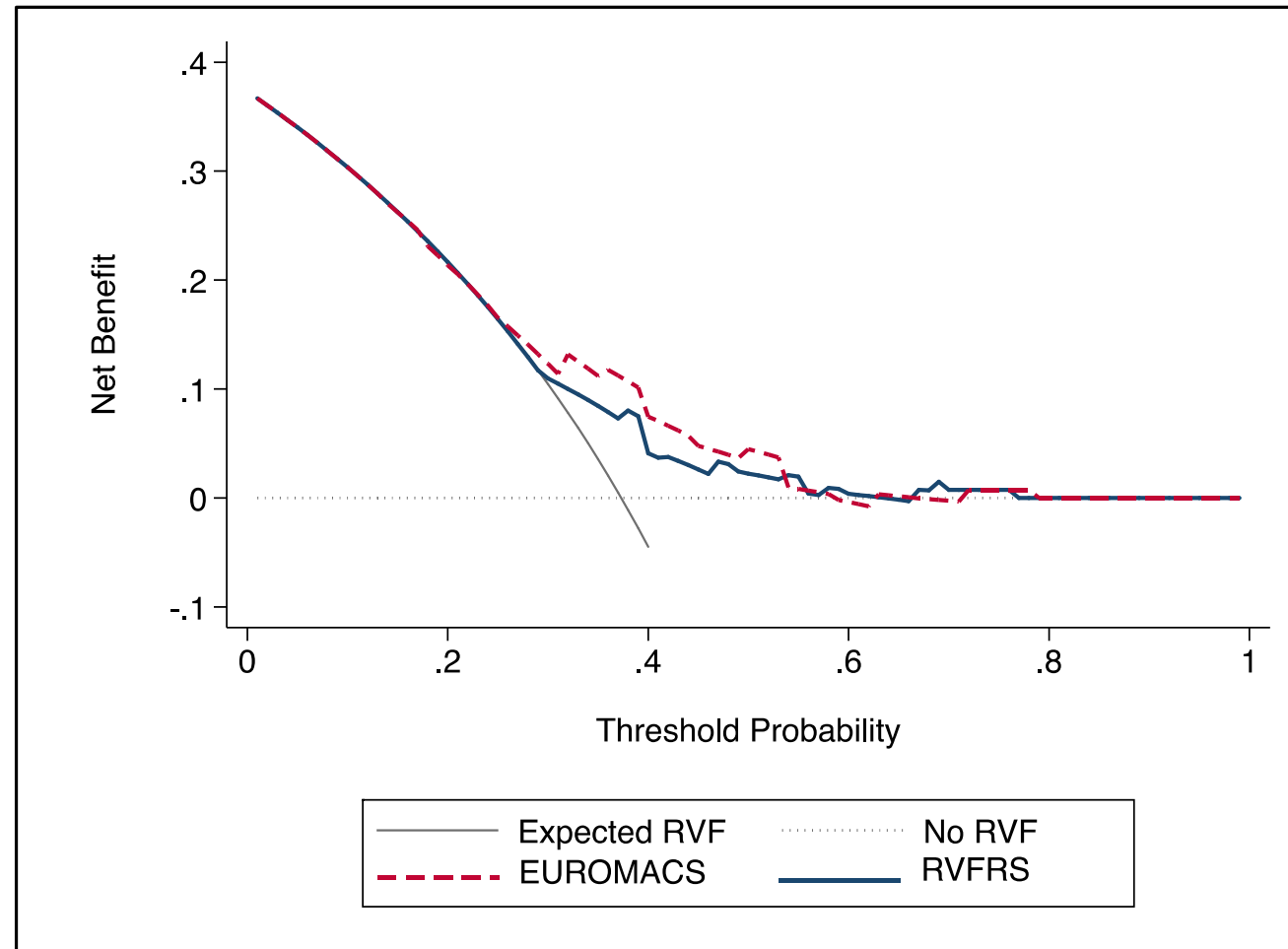
Conclusion

- In an external validation cohort, both the EUROMACS and RVFRS can predict RVF after LVAD.

- EUROMACS RHF score trended towards having higher discriminatory power than the RVFRS.

- Overall, the clinical utility of these scores are both limited.

Limitations

- Single Center
- Retrospective study
- Scores in patients declined from VAD unknown

Thank you

Questions?
Feel free to email!
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