Assessing AI, Clinical Tools, and Biomarkers in Predicting Outcomes of Moderate to High-Risk Pulmonary Embolisms

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Purpose

This retrospective study aims to evaluate the independent predictive capabilities of artificial intelligence (AI)-assisted right ventricle/left ventricle (RV/LV) analysis software, pulmonary embolism severity index (PESI) scoring, and biomarkers in predicting the need for extracorporeal membrane oxygenation (ECMO) after endovascular thrombectomy (ET) in intermediate-high to high risk PE patients.

PE Classification

ESC European Society of Cardiology

LOW RISK PE	INTERMEDIATE-LOW RISK PE	INTERMEDIATE-HIGH RISK PE	HIGH RISK PE
• Hemodynamically stable • No evidence of RV dysfunction or elevation of cardiac biomarkers	• Hemodynamically stable • Abnormal RV on Imaging OR elevated troponin	• Hemodynamically stable • Abnormal RV on Imaging AND elevated cardiac biomarkers	• Hemodynamically unstable • Abnormal RV on Imaging AND elevated cardiac biomarkers

Figure 1. European Society of Cardiology Guidelines for PE Classification

PESI Scoring Guidelines

Age (base value)
Sex (M = +10)
History
- Cancer (+30)
- Heart Failure (+10)
- Chronic Lung Disease (+10)

Vital Signs
- HR ≥ 110 (+20)
- SBP < 100 mmHg (+30)
- RR ≥ 30 (+20)
- Temp < 36°C (+20)
- AMS (+60)
- O2 Sat < 90% (+20)

PESI Score	Class	30-day Mortality Risk
0-65	I	0.0-1.6%
66-85	II	1.7-3.5%
86-105	III	3.2-7.1%
106-125	IV	4.0-11.4%
≥ 125	V	10-24.5%

Figure 2. PESI Risk Stratification Scoring

Inari FlowTreiver® ET

INARI MEDICAL

Triever Aspiration Catheter
Large lumen catheter used as guide for FlowTreiver Catheter or to perform suction thrombectomy

FlowTriever Catheter
Composed of 3 self expanding nitinol mesh disks for mechanical clot capture and retrieval

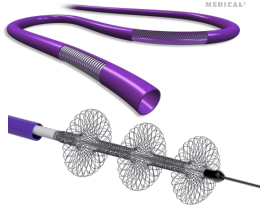

Figure 3. All patients in this study underwent an endovascular thrombectomy using the Inari Flowtriever® system.

Methods

Retrospective review of all consecutively admitted PE patients who underwent ET using Inari FlowTriever® between 12/2018 – 03/2022
n = 62

- ECMO therapy group n = 24
- Standard (Non-ECMO) therapy group n = 38

RV/LV Analysis*
Abnormal pre-procedural CPTA:
RV/LV ratio > 0.9
imbio
*if pre- and post-procedural CTPA are available

Clinical Data Analysis
Clinical Analysis Tools: PESI Scoring
Lab Values: Troponin (ng/mL) and Lactate (mmol/L) levels
Clinical success: improvement of RV/LV ratio and no VTE or ET related complications

clinical success was observed in 83.3% (20 of 24) of patients on ECMO and 97.4% (37 of 38) of patients not on ECMO

Results

Table 1. Baseline Patient Demographics and Assessment Using Predictive Tools

		ECMO (n=24)	Non-ECMO (n=38)	P-Value
Age (y)	Mean ± SD	56 ± 16	60 ± 13	0.435
	Range	27-78	34-86	
Biomarkers	Troponin (ng/mL)	0.933 ± 2.560	0.451 ± 0.485	0.117
	Lactate	**5.281 ± 0.046**	**2.397 ± 2.630**	**<0.0001**
Clinical Analysis	**PESI Score**	**131.92 ± 40.74**	**100.95 ± 15.49**	**0.0133**
AI-Guided RV/LV Ratio	Available Pre- and Post-CTPA (%)	54.2 (13/24)	50.0 (19/38)	
	Pre-ET RV/LV Ratio	**1.942 ± 0.376**	**1.480 ± 0.312**	**0.000528**
	Post-ET RV/LV Ratio	1.031 ± 0.193	1.072 ± 0.226	0.383
	Change in RV/LV Ratio	**0.911 ± 0.412**	**0.430 ± 0.273**	**0.00103**
	Clinical Success (%)	83.3 (20/24)	97.4 (37/38)	

Figure 5. RV strain and improvement after treatment shown on echocardiogram

(top) Normal

(middle) Pre-ET and ECMO echocardiogram shows severe RV strain

(bottom) Post-ET and ECMO echocardiogram shows improvement in RV strain as compared to referenced normal

Example RV/LV Analysis Output

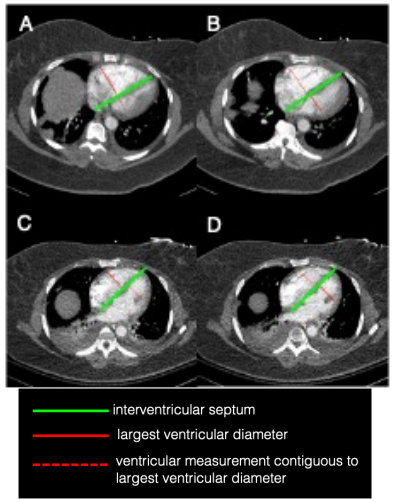

Figure 4. Images correlate to (A) largest pre-procedural right ventricle and (B) left ventricle diameter measurement and largest post-procedural (C) right ventricle and (D) left ventricle diameter measurement.

Take Home Points

- Inari FlowTriever® ET is an effective therapy for patients with intermediate-high and high risk PE
- AI-guided RV/LV analysis paired with PESI scoring can improve risk stratification and shorten time to appropriate treatment initiation
- Future research to determine the value of AI-based thrombus burden detection and efficacy of ET therapy for patients with intermediate-low risk PE

Proposed PE Response Paradigm

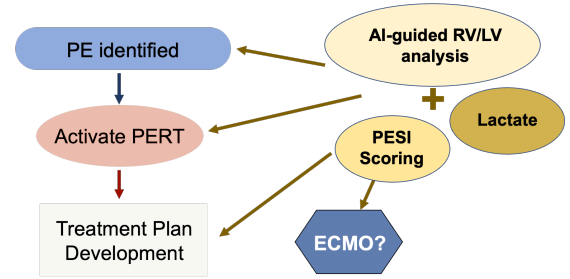

Figure 7. Working model of integrating AI-guided RV/LV analysis, biomarkers, and PESI scoring in PE identification and response workflow.

References

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