Echocardiographic Assessment of Shock Using Right Ventricular–Pulmonary Artery Uncoupling in Acute Pulmonary Embolism

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Introduction

Right ventricular–pulmonary arterial (RV–PA) coupling refers to the relationship between right ventricular contractility and its afterload. This relationship can be noninvasively estimated using tricuspid annular plane systolic excursion (TAPSE) to pulmonary arterial systolic pressure (PASP) ratio.

A study by Yurditsy et al. demonstrated that in patients with acute pulmonary embolism (APE) undergoing mechanical thrombectomy, the TAPSE/PASP ratio was a strong predictor of normotensive shock.

This study aimed to explore further the relationship between TAPSE/PASP and shock, with particular attention to those classified as low-risk, submassive, or massive PE. By using noninvasive echocardiographic measurements to assess hemodynamics, this approach may offer valuable insights for enhanced PE risk stratification.

Hypothesis

We predict that the TAPSE/PASP ratio will be a strong predictor for shock in patients with APE.

Methods

This retrospective analysis examined 83 patients with low-risk, intermediate-risk, or high-risk APE.

The patients were stratified into shock (CI <2.2) versus no-shock (CI >2.2) groups based on right heart catheterization measurements.

Univariate testing was performed between the two shock groups with Student's t-test for continuous variables and chi-squared testing for categorical variables.

Results

	Shock (CI < 2.2)	No Shock (CI > 2.2)	P-Value
Age	61±13	60±11	0.71190
Female	21 (49%)	20 (50%)	0.91568
Race			0.01106
White	22 (51%)	19 (48%)	
Black	0 (0%)	3 (7.5%)	
Hispanic	9 (21%)	1 (2.5%)	
Other	12 (28%)	17 (43%)	
PE Severity			0.02611
Low Risk	0 (0%)	2 (5%)	
Submassive	30 (69%)	34 (85%)	
Massive	13 (30%)	4 (10%)	
Catheter-Directed Thrombolysis	34 (79%)	28 (70%)	0.34225

Table 1: Demographic data stratified by shock (CI <2.2) vs no shock (CI >2.2)
Invasive hemodynamics identified 43 (52%) of our patients with cardiogenic shock. The age, gender, and race were evenly distributed among the shock and no-shock groups

	Shock (CI < 2.2)	No Shock (CI > 2.2)	P-Value
TAPSE (mm)	13.9 ± 4	16.2 ± 4	0.0176
PASP (mmHg)	59 ± 18	46 ± 11	0.0001
TAPSE/PASP (mm/mmHg)	0.25 ± 0.09	0.39 ± 0.2	0.0002
Cardiac Index (L/min/m2)	1.8 ± 0.3	2.8 ± 0.5	0
Cardiac Output (L/min)	3.8 ± 0.9	5.9 ± 1.4	0

Table 2: Echocardiographic and invasive hemodynamic measurements
Patients classified in the shock group had a significantly lower TAPSE/PASP ratio compared to the no-shock group

	TAPSE/PASP	TAPSE
Threshold	0.306	13.25
Sensitivity	0.790	0.558
Specificity	0.625	0.775
True positive	34	24
False positive	15	9
True negative	25	31
False negative	9	19
PPV	0.693	0.727
NPV	0.735	0.620

Table 3: Comparison of TAPSE/PASP vs only TAPSE as a predictor of shock
The TAPSE/PASP ratio yielded an area under the curve (AUC) of 0.76, with a sensitivity of 0.79, specificity of 0.63, positive predictive value of 0.69, and negative predictive value of 0.74

Results

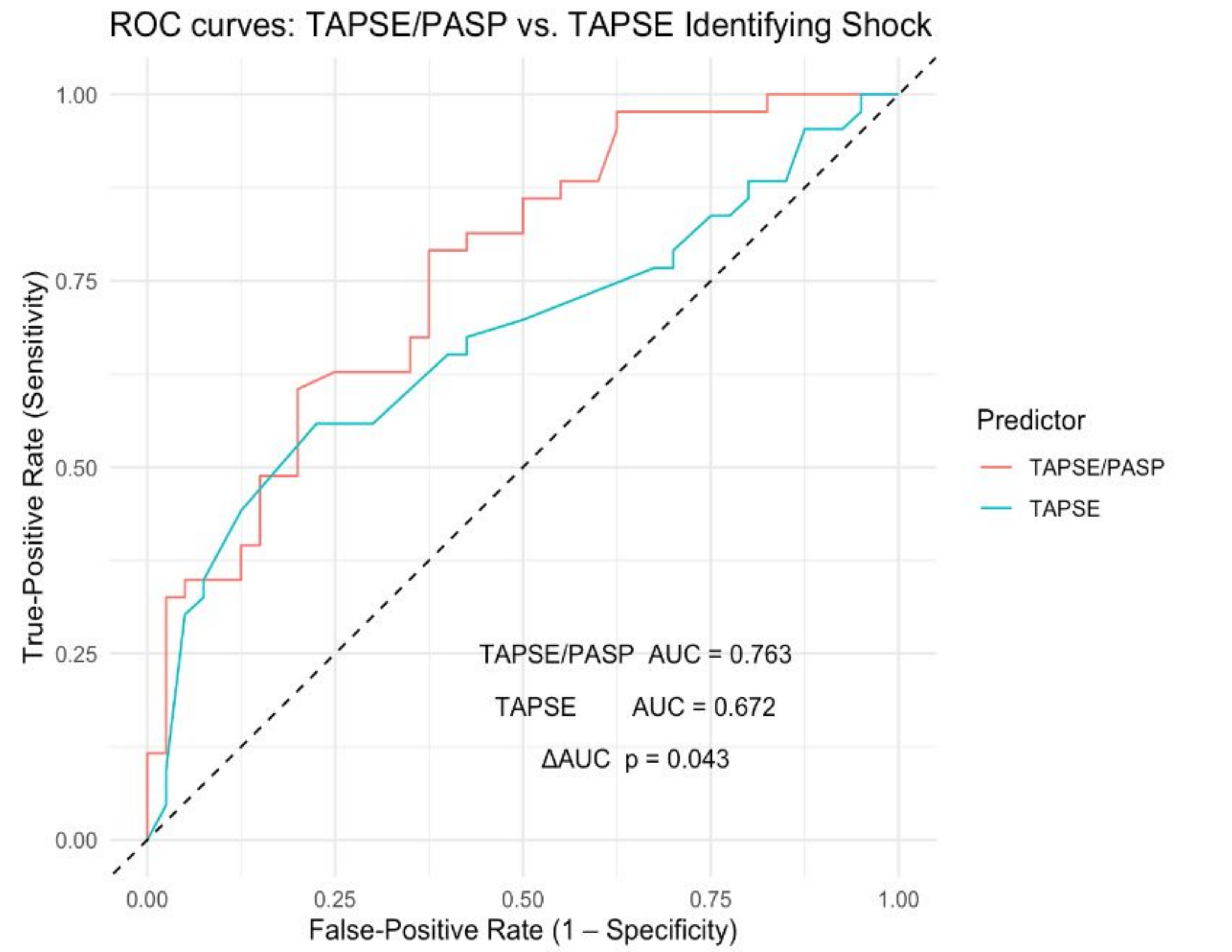

Figure 1: Area under the curve comparing TAPSE/PASP vs only TAPSE as a predictor of shock
Notably, the TAPSE/PASP ratio had a significantly higher AUC for predicting shock compared to TAPSE alone

Conclusion

In conclusion, the TAPSE/PASP ratio can be a useful non-invasive measurement in predicting shock in patients presenting with APE. The measurement can be used to quickly assess hemodynamics to further risk-stratify patients with an APE.

References

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