

Development of the Echocardiographic Severity Index of Pulmonary Embolism as a Potential Reperfusion Criterion and Treatment Target During Viscoelastometry-Guided Low-Dose Prolonged Thrombolysis

Authors: Máté Berczi MD¹; Anna Párkányi MD¹; Zsófia Imre²; János Domonkos Stubnya MD^{1,3}; Hanna Dóra Szász MD⁴; Györgyi Csósza MD, PhD⁵; Tamás Böhm MD¹; János Gál MD, PhD¹; János Fazakas MD, PhD¹; András Kállai MD, PhD¹

1: Semmelweis University, Department of Anaesthesiology and Intensive Therapy, Budapest, Hungary

2: Semmelweis University, Faculty of Medicine, Budapest, Hungary

3: Semmelweis University, Pediatric Centre, Division of Neonatology, Budapest, Hungary

4: St. John's Central Hospital of North Buda, Department of Central Anesthesiology and Intensive Therapy, Budapest, Hungary

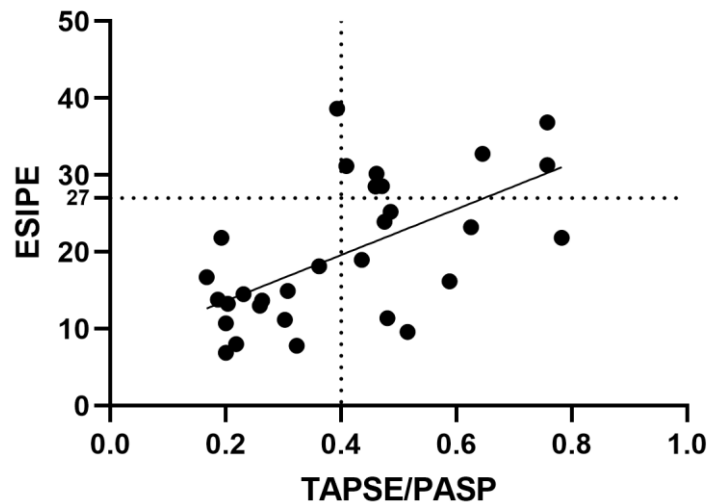
5: Semmelweis University, Department of Pulmonology, Budapest, Hungary

Background: Echocardiographic monitoring may allow thrombolysis to be individualised in acute pulmonary embolism (PE), but quantitative criteria for initiating and terminating treatment are lacking. We developed the Echocardiographic Severity Index of Pulmonary Embolism (ESIPE), integrating forward flow and right ventricular pressure overload, and compared it with TAPSE/PASP, an established marker of right ventricular–pulmonary arterial coupling.

Methods: Patients received either conventional thrombolysis (100 mg rtPA over 2 h) or viscoelastometry-guided low-dose prolonged thrombolysis. In the latter group, serial echocardiography was performed and treatment discontinued upon resolution of the D-sign.¹ In this post hoc analysis, measurements before and at completion of thrombolysis were compared between groups. ESIPE was calculated as stroke volume index divided by systolic eccentricity index (SVI/SEI). A physiologically derived threshold of 27 was proposed based on an SVI of 30 mL/m² and an upper normal SEI of 1.1. Changes in ESIPE and TAPSE/PASP were assessed using mixed-effects models and their association using Spearman correlation.

Results: ESIPE and TAPSE/PASP both increased markedly during thrombolysis (Time $P < 0.001$), without significant Group or Group×Time effects. ESIPE correlated moderately with TAPSE/PASP (Spearman $r = 0.551$, 95% CI 0.228–0.765; $P = 0.0016$). Using ESIPE < 27 as the proposed threshold for haemodynamic impairment, TAPSE/PASP < 0.4 showed 65.2% sensitivity (95% CI 44.9–81.2%) and 87.5% specificity (95% CI 52.9–99.4%); notably, 34.8% of measurements with ESIPE < 27 had TAPSE/PASP ≥ 0.4 .

Conclusions: ESIPE provides a quantitative measure of haemodynamic recovery during thrombolysis while incorporating complementary physiological information beyond TAPSE/PASP. ESIPE ≥ 27 may represent a treatment target for echocardiography-controlled thrombolysis, whereas ESIPE < 27 warrants prospective investigation as a potential reperfusion criterion. By integrating forward flow and septal deformation, ESIPE may identify persistent haemodynamic impairment despite TAPSE/PASP ≥ 0.4 . Unlike TAPSE/PASP, it does not require a measurable tricuspid regurgitation signal, facilitating serial assessment during reperfusion therapy.



Association between TAPSE/PASP and the Echocardiographic Severity Index of Pulmonary Embolism (ESIPE). ESIPE showed a moderate positive correlation with TAPSE/PASP (Spearman $r=0.551$, 95% CI 0.228–0.765; $P=0.0016$). Using ESIPE <27 as the proposed threshold for haemodynamic impairment, TAPSE/PASP <0.4 showed a sensitivity of 65.2% (95% CI 44.9–81.2%) and specificity of 87.5% (95% CI 52.9–99.4%). Notably, 8/23 (34.8%) measurements with ESIPE <27 had TAPSE/PASP ≥ 0.4 , corresponding to the lower-right quadrant. Dotted lines indicate the established TAPSE/PASP threshold of 0.4 and the proposed ESIPE threshold of 27. The solid line represents the linear regression fit.

Reference:

1. Kállai A, Párkányi A, Berczi M, Skultéti D, Stubnya JD, Szász HD, et al. Personalised viscoelastometry-guided systemic thrombolysis for high- and intermediate-high-risk acute pulmonary embolism in the ICU: a single-centre randomised controlled interventional feasibility trial. *Intensive Care Medicine Experimental* 2026;**14**:57.
doi: <https://doi.org/10.1186/s40635-026-00903-7>