Validating the Composite Pulmonary Embolism Shock Score for Predicting Normotensive Shock in Intermediate-Risk Pulmonary Embolism

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Normotensive shock in patients with acute myocardial infarction is associated with unfavorable outcomes. In a recent analysis from the FLASH registry (FlowTriever All-Comer Registry for Patient Safety and Hemodynamics), Bangalore et al1 showed that one-third of patients with intermediate-risk pulmonary embolism (PE) present with normotensive shock. A composite pulmonary embolism shock (CPES) score that incorporates markers of right ventricular function/ischemia (elevated troponin/brain natriuretic peptide, moderately/severely reduced right ventricular function), central thrombus burden (saddle PE), potential for additional thrombus embolization (residual deep vein thrombosis), and cardiovascular compensation (tachycardia) was able to predict patients with normotensive shock confirmed by invasive hemodynamics.[1] The objective of this study was to validate the CPES score in a cohort of intermediate-risk PE who received mechanical thrombectomy (MT).

Patients who underwent MT between August 2020 and March 2023 with intermediate-risk PE were included in the study. All patients undergoing MT underwent invasive hemodynamic evaluation. Normotensive shock was defined as systolic blood pressure ≥90 mm Hg in the absence of vasopressor support with preprocedural invasive measures of CI ≤2.2 L/min per m2 and clinical evidence of hypoperfusion (ie, elevated lactate, oliguria). The study was approved by the New York University institutional review board, and the procedures followed were in accordance with institutional guidelines. The data that support the findings of this study are available from the corresponding author upon reasonable request. The decision to proceed with MT was at the recommendation of the PE response team. MT was performed using the FlowTriever device (Inari Medical). A CPES score was calculated for each patient.1 Univariable logistic regression was used to assess the predictive value of the CPES score. Discrimination was assessed using the C statistic with a value >0.75 considered to represent good discrimination. Wilcoxon signed-rank test was used to compare paired continuous variables, and categorical variables were compared using the Fisher exact test.

A P<0.05 was considered significant. All analyses were performed using Stata 17 software (StataCorp LP, College Station, TX).

A total of 49 patients met inclusion criteria for the study. Four patients had incomplete invasive hemodynamic data, resulting in a final cohort of 45 patients (mean age, 57±13 years; 43% female). The prevalence of normotensive shock was 62%. Patients with normotensive shock had lower rates of hypertension (36% versus 71%; P=0.023), higher heart rate (117 versus 97 bpm; P<0.001), higher rates of elevated lactate (96% versus 47%; P<0.001), and higher CPES score (5 [IQR, 4–5] versus 3 [IQR, 3–4]; P=0.002) but similar simplified pulmonary embolism severity index (sPESI) score (1 [IQR, 1–2] versus 2 [IQR, 1–2]; P=0.15) and hemoglobin (12.4 versus 12.7 g/dL; P=0.78), when compared with the no shock group. No patients with a score of 1 or 2 had normotensive shock whereas the prevalence of normotensive shock was 100% in those with a score of 6 (Figure [A]). For every 1-point increase in the CPES score, there were 2.7-

fold higher odds of normotensive shock ([95% CI, 1.3–5.6]; P=0.004). The CPES score demonstrated good discrimination (area under the curve, 0.76 [95% CI, 0.62–0.90]). Post-thrombectomy, there was a significant reduction in the mean pulmonary artery pressure (both shock and no shock group) and improvement in CI (shock group), with 15/24 (62.5%) achieving a CI >2.2 L/min per m2 immediately post-procedure (Figure [B]). There were no deaths during the 30-day follow-up.

Identifying intermediate-risk PE patients at risk of decompensation and requiring advanced therapies remains a challenge. The in-hospital mortality rates vary from 3% to 15% despite contemporary treatments.2 In our cohort of intermediate-risk PE patients, the prevalence of normotensive shock was high (62%). This rate is higher than that in the FLASH registry (34%), suggesting perhaps selection of a higher risk cohort by the local PE response team to undergo MT. The CPES score effectively identified patients with normotensive shock, with a prevalence greatest in those with the highest CPES scores (CPES score 6: 58% in FLASH and 100% in our cohort). Despite this high-risk cohort, the in-hospital and 30-day mortality was zero similar to the low mortality observed in the analysis from FLASH.[1]

Of note, both our and the FLASH cohort showed that the routinely used sPESI to risk stratify patients failed to identify normotensive shock patients. External validation of the CPES model has the potential to assist clinicians in identifying patients who necessitate closer monitoring and advanced therapies including MT, as well as, the possible need for extracorporeal membrane oxygenation on standby. Given the limitations of our small sample size, further research is warranted to evaluate the predictive capacity of this model for outcomes in this patient populations.

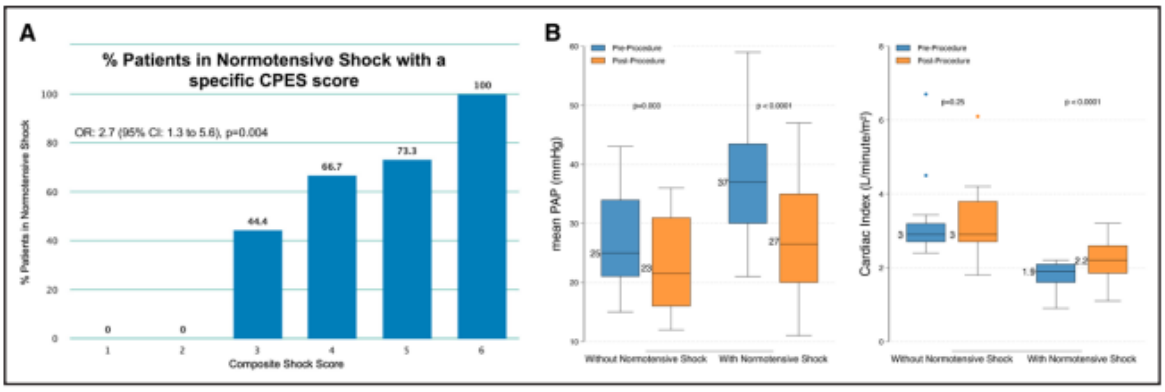

Figure. Proportion of patients with normotensive shock by composite pulmonary embolism shock (CPES) score and hemodynamic changes after thrombectomy.
A, The bars in the graph represent the proportion of patients with normotensive shock among patients with a specific CPES score. **B**, Invasive hemodynamic measurements pre-thrombectomy and immediately post-thrombectomy are shown, separated by those with and without normotensive shock. Boxes represent the IQR with median indicated by the line. PAP indicates pulmonary artery pressure.

REFERENCES

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