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Is Thrombus Laterality More Important Than Clot Burden for Pulmonary Embolism Severity?



To the Editor:

The management of patients with pulmonary embolism, particularly those classified as intermediate-high and high risk, along with the identification and treatment of low-risk patients eligible for outpatient follow-up, are critical aspects of care. We commend Casey et al¹ for their outstanding study, which we deem highly significant. To augment the study's value, we wish to highlight a few key points.

Although bilateral pulmonary embolism is not currently a criterion in risk-scoring systems, it is often used by clinicians as a determinant for hospital admission. Moreover, the impact of thrombus localization, whether proximal or distal, on this decision is limited. However, we posit that these classifications require further refinement. For instance, the management of bilateral subsegmental pulmonary emboli differs significantly from that of thrombi located in bilateral main interlobar arteries. To address this, we suggest a shift toward evaluating scoring systems such as the Qanadli and Mastora scores, which quantify total thrombus burden, for more objective outcomes.

It is well acknowledged that evaluating right ventricular dysfunction is essential, even in low-risk patients. Although the 2019 European Society of Cardiology Pulmonary

Embolism Guidelines indicate that right ventricular dysfunction can be assessed using echocardiography or thoracic computed tomography in identifying low-risk patients, a recent meta-analysis by Becattini et al² reported that the evaluation of right ventricular dysfunction with thoracic computed tomography for predicting early mortality was insufficient (odds ratio=2.03 [95% confidence interval 0.51 to 8.10]).³ Therefore, despite physicians predominantly utilizing thoracic computed tomography for right ventricular evaluation in admission decisions, current evidence suggests that echocardiographic evaluation or assessment of cardiac biomarkers may be more crucial. Moreover, providing information on the proportion of rehospitalizations or deaths among patients who are decided for outpatient follow-up, if known, would contribute valuable insights to the literature.

Finally, in the conducted multivariate logistic regression analysis, some variables may exhibit high correlations with each other. We believe that it is important to assess correlations among these parameters before including them in the model. To prevent multicollinearity from parameters with high correlation, we suggest excluding the clinically less significant parameter.

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In reply:



We appreciate Dr. Satici's correspondence and agree with the conjecture that clot burden is likely being used informally to guide disposition decisionmaking for patients with acute pulmonary embolism despite a lack of evidence.¹ Although bilateral emboli do not consistently produce higher computed tomography (CT) obstruction indices than those produced by a unilateral embolism, our work suggests that physicians may perceive a patient with bilateral emboli to be at higher risk, prompting the hospitalization of an otherwise low-risk patient.² Qanadli's CT obstruction index is derived from the number of affected lung segments (1 to 20) as well as the severity of arterial obstruction. Based on Qanadli's methods, a unilateral embolus has a maximum CT obstruction index of 20 (a unilateral main pulmonary artery embolus), whereas a bilateral embolus can theoretically produce the maximal CT obstruction index of 40 (a saddle pulmonary embolism).

We further agree that clot burden may have future utility in acute pulmonary embolism risk assessment. A recent report by Gotta et al³ detailed a unique radiomics approach to clot burden assessment using dual energy CT and demonstrated an association between thrombus volume and likelihood of hospitalization for acute pulmonary embolism. Although these results are interesting, the clot burden's effect on the patient (eg, right ventricular strain, vital signs, and symptoms) is currently much more useful for clinical decisionmaking.

Pulse rate appeared only as a categorical variable in our model to investigate the effect of pulse rate cut offs other than the ≥ 110 beats per minute criterion suggested by the Pulmonary Embolism Severity Index on a physician's decisions to hospitalize a low-risk patient. Pulse rate did not appear simultaneously as a continuous variable in our model.

Lastly, we agree with Dr. Satici's assessment of the prognostic limitations of CT-demonstrated right ventricular dilatation. Our study identified this variable as a statistically significant predictor of physicians' decisions to hospitalize a low-risk patient. However, RV dilatation on CT imaging was found by Becattini et al⁴ to be poorly predictive of mortality

and by Lyhne et al⁵ to have very low specificity (4% [95% CI 2–8%]) for echocardiographic RV strain. Physicians may be using right ventricular dilatation on CT imaging as a surrogate for echocardiographic right ventricular strain, resulting in hospitalization of patients who could otherwise be managed as outpatients. Implementation as well as deimplementation initiatives aimed at changing physician behavior may increase rates of safe outpatient management and should be pursued.

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