

Saddle vs Nonsaddle Pulmonary Embolism: Clinical Presentation, Hemodynamics, Management, and Outcomes

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Abstract

Objective: To understand the clinical significance, hemodynamic presentation, management, and outcomes of patients presenting with saddle pulmonary embolism (PE).

Methods: All patients with saddle PE diagnosed at Mayo Clinic in Rochester, Minnesota, from January 1, 1999, through December 31, 2014, were included in this study. These patients were age and simplified Pulmonary Embolism Severity Index (sPESI) matched (1:1) to a nonsaddle PE cohort. Both groups were then classified into massive, submassive, and low-risk PE based on established criteria and compared for clinical presentation, management, and outcomes.

Results: A total of 187 consecutive patients with saddle PE were identified. The saddle PE group presented more frequently with massive PE (31% vs 20%) and submassive PE (49% vs 32%), whereas low-risk PE was more common in the nonsaddle PE group (48% vs 20%). Systemic thrombolysis was used more frequently in the saddle PE group on admission (10% vs 4%; $P=.04$) and later during hospitalization (3.2% vs 0%; $P=.03$). Late major adverse events were similar in both groups except for mechanical ventilation (6% in saddle PE vs 1% in nonsaddle PE; $P=.02$). Overall in-hospital mortality did not differ between the 2 groups (4.3% in saddle PE vs 5.4% in nonsaddle PE; $P=.81$).

Conclusion: Although patients with saddle PE presented with higher rates of hemodynamic compromise and need for thrombolysis and mechanical ventilation, we found no difference in short-term outcomes compared with an age- and severity-matched nonsaddle PE cohort. Overall, in-hospital mortality was low in both groups.

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Acute pulmonary embolism (PE) is a potentially life-threatening disease and remains a leading cause of cardiovascular morbidity and mortality. Clinical outcomes differ widely depending on initial clinical presentation and presence of comorbidities, with mortality ranging from 2% to 11% in treated PE and up to 30% in untreated patients.¹⁻⁸ Often, PE is classified radiologically based on the most central extent of the clot burden.

Saddle PE is a radiologic definition and refers to thrombus that straddles the bifurcation of the pulmonary artery trunk often with extension into both the right and left main pulmonary arteries.⁹ Saddle PE is found in 2.6% to 5.4% of patients with PE.^{10,11} The large central clot burden seen in saddle PE often alarms clinicians, who often refer to

saddle PE as massive PE and admit these patients to the intensive care unit (ICU). However, the term *massive PE* is actually a hemodynamic definition and refers to any PE that presents with shock and hemodynamic collapse.¹² Thus, it is incorrect to refer to patients with saddle PE as having massive PE because every clinician has encountered patients with saddle PE who present with stable hemodynamic values and a very benign clinical picture. Thus, saddle PE is a diverse entity with variable clinical features and eventual outcomes. There are relatively sparse data to guide clinicians on how to manage patients with saddle PE in general. A few small studies have shown that saddle PE does not confer an unfavorable clinical outcome, with mortality between 4.5% and 16%.^{11,13} Only 1 study showed higher 1-year mortality rates in

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patients with saddle PE.¹⁴ The wide variations in outcomes reflect the small sample sizes of these studies.

The aim of the present study was to better define the clinical presentation and outcomes of a large cohort of patients with saddle PE. Furthermore, we compared the clinical presentation and outcomes of patients with saddle PE with those of a matched nonsaddle PE cohort.

METHODS

The study was approved by the Mayo Clinic Institutional Review Board. We included all patients from January 1, 1999, through December 31, 2014, who had authorized the use of their medical records for research purposes. Data were obtained manually and from the Mayo Clinic Life Science Services and the Data Discovery and Query Builder, structured search software that interfaces with the Mayo Enterprise Data Trust and allows for detailed search results for all available data from the electronic medical record. Full technical details and other aspects of this tool are available elsewhere.¹⁵⁻¹⁷ Relevant clinical information extracted from the electronic medical record included vital signs, demographic characteristics, comorbidities, risk factors for PE, treatment on hospital admission (anticoagulation, thrombolytics, catheter-directed thrombectomy, surgical thrombectomy), laboratory data, echocardiographic and radiographic findings, and hospital course and outcomes.

We identified all consecutive patients with saddle PE diagnosed at Mayo Clinic in Rochester, Minnesota, from January 1, 1999, through December 31, 2014, using a well-validated, customized, in-house search tool called the Data Discovery and Query Builder. We confirmed the presence of saddle PE by reviewing the contrast-enhanced chest computed tomographic (CT) scans and the associated radiology report for each patient. A saddle PE was defined as any PE with a filling defect involving the bifurcation of the main pulmonary artery on chest CT.

Matching With the Nonsaddle PE Cohort

Each patient with saddle PE was matched in a 1:1 manner with a control (nonsaddle PE) diagnosed during the same period (January

1, 1999, through December 31, 2014). Nonsaddle PE was defined as any PE diagnosed by chest CT that did not involve the main pulmonary artery bifurcation area and included lobar, segmental, and subsegmental PE cases. Matching was based on age and the simplified Pulmonary Embolism Severity Index (sPESI). The sPESI is a validated bedside clinical score that allows for risk stratification of patients with PE into low- and high-risk groups in a binary manner.^{18,19}

Hemodynamic Stratification of Patients With Saddle PE and Nonsaddle PE

Both cases (saddle PE) and controls (nonsaddle PE) were stratified as per initial clinical presentation into 1 of the following 3 hemodynamic categories:

1. Massive PE, defined as any PE requiring intubation or chest compressions/cardio-pulmonary resuscitation (CPR) or presenting with persistent hypotension with systolic blood pressure less than 90 mm Hg for at least 15 minutes or requiring inotropic support, not due to another cause such as arrhythmia, hypovolemia, sepsis, or left ventricular dysfunction.¹²
2. Submassive PE, defined as any PE presenting without hypotension but with signs of either right ventricular (RV) dilatation/dysfunction on the echocardiogram or myocardial injury as indicated by an elevated cardiac troponin level AND not meeting the criteria for massive PE.²⁰
3. Low-risk PE, defined as any PE not meeting the criteria for massive or submassive PE.

Outcomes Studied

We compared demographic characteristics, comorbidities, PE risk factors, hemodynamic values at presentation, echocardiographic results, and outcomes such as admission to the ICU, ICU length of stay (LOS), hospital LOS, and in-hospital mortality between the 2 groups. The RV dilation and dysfunction was graded as per the official echocardiography report. We also studied PE-related hospital complications and treatment decisions in both groups, including shock requiring inotropic support, respiratory failure requiring mechanical ventilation, hemodynamic collapse requiring CPR, and treatments such as

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