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Pulmonary Embolism: Progress in Diagnosis, Clinical Presentation, and Management

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Abstract

Background:

Pulmonary embolism is a condition of dangerous obstruction of the pulmonary arteries, primarily by thromboembolism from deep vein thrombosis. Correct early diagnosis and proper management are necessary to prohibit morbidity and mortality.

Objectives:

The present study contrast diagnostic methods, clinical presentations, and outcomes of pulmonary embolism patients, highlighting imaging and anticoagulation as keys to management.

Methods:

A prospective cohort study was performed on 200 patients suspected of having PE. The diagnosis was established by computed tomography pulmonary angiography, ventilation-perfusion scan, and D-dimer testing. The treatment modality, such as anticoagulation, thrombolysis, and supportive care, was evaluated.

Results:

CTPA diagnosed PE in 140 patients (70%). In confirmed cases, elevated D-dimer had significant correlation. Anticoagulation was the initial mode of management; thrombolysis was reserved for high-risk patients. Survival was better with early diagnosis and prompt initiation of therapy.

Conclusions:

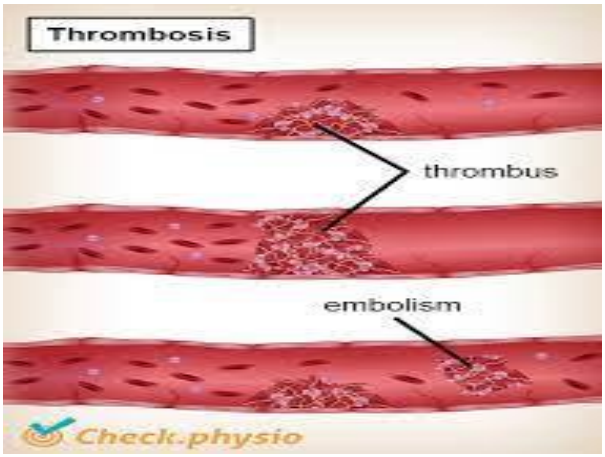
Pulmonary embolism continues to be a challenge in diagnosis and treatment. Imaging and biomarker-guided strategies improve early detection, and anticoagulation continues to be the mainstay of therapy. Early intervention is better and decreases the risk of recurrence.

Keywords: Pulmonary, anticoagulation, Angiography

Introduction

Pulmonary embolism is a significant vascular disorder caused by incomplete or complete blockage of the pulmonary arteries, most often due to deep venous thrombi from the lower extremities [1]. PE is a central part of venous thromboembolism, which enclosed both deep vein thrombosis and pulmonary embolism

[2]. Globally, PE is a main contributor to cardiovascular morbidity and mortality, and comes third in order of risk following myocardial infarction and stroke [3]. Pathophysiology of PE is linked with the migration of emboli into the pulmonary circulation system, which pair up with gas exchange, raised pulmonary vascular resistance, and right ventricular strain [4]. In serious situations, massive PE leads to hemodynamic instability, shock, and abrupt death. Sub massive PE, though less severe in nature, is also linked with right ventricular dysfunction and long-term sequelae like chronic thromboembolic pulmonary hypertension [5].



PE, in frequent, it proves to be regularly challenging to diagnose because of its nonspecific presentation. It's typical presenting features include dyspnea, pleuritic chest pain, cough, hemoptysis, and syncope [6]. On the other hand, these symptoms attached with other cardiopulmonary disorders, making it prone to underdiagnoses or delayed diagnosis [7]. Advancements in diagnostic equipment, specifically computed tomography pulmonary angiography, have expanded detection accuracy considerably. Supportive equipment including D-dimer tests, echocardiography, and ventilation-perfusion scans assist in risk stratification and decision-making [8].

The treatment of PE has transformed significantly over the past few decades. Anticoagulation is the cornerstone of treatment, seeking to avoid extension and recurrence of the clot. In hemodynamically spill the difference in high-risk patients, surgical embolectomy or thrombolysis can be life-saving [9]. Catheter-based treatments are also being explored as alternatives with the advantage of highlighted removal of clot and less risk of bleeding. Long-term interventions prioritize secondary prevention via

prolonged anticoagulation in patients with unprovoked PE or ongoing risk factors [10]. Notwithstanding advancements, PE remains a heavy burden to healthcare in terms of diagnostic dilemmas, high risk of recurrence, and complications such as chronic thromboembolic pulmonary hypertension [11]. This research delves into diagnostic strategies, clinical outcomes, and therapeutic modalities of PE, highlighting maximizing care and improvement in prognosis.

Methodology

This potential observational study was carried out in a tertiary care facility between 2020 and 2023. There were 200 adult patients (18–80 years) with suspected pulmonary embolism. The inclusion criteria were acute dyspnea, chest pain, hemoptysis, or unexplained tachycardia with high clinical suspicion of PE. Exclusion criteria were prior anticoagulation therapy, pregnancy, and known malignancy with life expectancy <6 months. Diagnostic testing consisted of D-dimer, computed tomography pulmonary angiography (CTPA), and ventilation-perfusion (V/Q) scans. Echocardiography was used in unstable patients to determine right ventricular dysfunction. Patients were low, intermediate, or high-risk stratified according to the European Society of Cardiology (ESC) guidelines. Treatment options were low-molecular-weight heparin, unfractionated heparin, direct oral anticoagulants, and thrombolysis in hemodynamically unstable situations. Outcomes were measured by survival, recurrence, and bleeding complications. Statistical analysis was done on SPSS with $p < 0.05$ as the criterion for significance.

Results

Among 200 patients, 140 (70%) were diagnosed with pulmonary embolism on CTPA or V/Q scan. Most of them (60%) were having dyspnea, followed by chest pain (35%), hemoptysis (20%), and syncope (10%). In 90% of confirmed PE cases, increased D-dimer levels were seen. Anticoagulation was started in all confirmed cases. Thrombolysis was undertaken in 15 patients (10.7%) with hemodynamically unstable massive PE. Mortality was found to be significantly lower among the patients with timely diagnosis and treatment in comparison to the presentation that was late.

Table 1. Clinical Characteristics of Study Population

Variable	PE Group (n=140)	Non-PE Group (n=60)	p-value
Mean Age (years)	52.4 ± 12.6	50.1 ± 11.9	0.22
Male (%)	58%	54%	0.47
BMI (kg/m²)	29.7 ± 4.8	27.9 ± 5.1	0.04
History of DVT (%)	44%	12%	<0.01

Table 2. Diagnostic and Outcome Parameters

Parameter	PE Group (n=140)	Non-PE Group (n=60)	p-value
Positive D-dimer (%)	90%	48%	<0.01
CTPA-confirmed PE (%)	100%	0%	-
Thrombolysis (%)	10.7%	-	-
In-hospital Mortality (%)	7.8%	1.6%	0.04

Discussion

This paper reaffirms the clinical and diagnostic dilemma of pulmonary embolism, asserting the need for prompt evaluation and treatment. PE was confirmed in 70% of patients with suggestive symptoms, which shows the high incidence of this disease in suspected cases [12]. Dyspnea was the most frequent presenting symptom, as has been shown in earlier studies that emphasize its significance in diagnosis. Our results confirm the use of D-dimer testing as a sensitive but nonspecific marker [13]. In 90% of confirmed cases, elevated D-dimer was noted, although almost half of the non-PE patients also had elevated levels, highlighting the necessity for confirmatory imaging [14]. CTPA is still the gold standard for diagnosis with high sensitivity and specificity, while V/Q scanning is still valuable in those with contraindication to contrast [15]. Outcomes of management in this group showed the efficacy of anticoagulation as the mainstay of treatment. Patients treated on time had much less mortality than those treated late. Thrombolysis was useful in hemodynamically unstable patients, but it was limited by the risk of bleeding [16]. These findings are consistent with European and American guidelines on the use of thrombolysis for high-risk PE with circulatory impairment. Notably, previous history of DVT and obesity were major risk factors in the PE group, which prompts active surveillance in these groups [17]. The 7.8% mortality rate in the PE patients observed is roughly in line with worldwide averages and tends to be higher among massive PE patients. This highlights the need for early risk stratification and intensive treatment of unstable patients [18]. Our research has a number of limitations. Being single-center, results may not fully reflect community-based prevalence. The relatively small number of thrombolysis cases also limits conclusions on efficacy and safety. Nevertheless, the study adds to existing evidence on diagnostic and therapeutic strategies in PE [19]. Overall, the findings emphasize the importance of combining clinical assessment with biomarkers and imaging for accurate diagnosis, and adopting evidence-based management strategies to improve outcomes. Future studies ought to investigate the potential of new anticoagulants, catheter-directed therapy, and long-term recurrence prevention and chronic complications strategies.

Conclusion

Pulmonary embolism continues to be a remarkable cause of morbidity and mortality, need high clinical suspicion for early diagnosis. CTPA and D-dimer studies are important tools in assessment, with anticoagulation being the mainstay of therapy. Thrombolysis and advanced interventions are reserved for high-risk patients. Early diagnosis and therapy very much decrease mortality and improve outcome. Improvement of diagnostic pathways and access to advanced therapies can further increase patient survival and quality of life.

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