

EXPLORING PULMONARY EMBOLISM IN EMERGENCY DEPARTMENT PATIENTS PRESENTING WITH CHEST PAIN: A RETROSPECTIVE MULTICENTER STUDY.

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ABSTRACT

Background:

Emergency department (ED) visits due to chest pain are common, and they can be caused by a wide range of differential diagnoses, including potentially fatal illnesses like pulmonary embolism (PE). Recent advancements in diagnostic strategies have aimed to improve the accuracy and efficiency of identifying the underlying cause of chest pain, thereby optimizing patient management and outcomes. This study aimed to assess the diagnostic accuracy and clinical outcomes associated with current protocols for evaluating chest pain.

Methods:

A retrospective multicenter study was carried out over one year. A total of 200 patients presenting with chest pain were included, and data were collected regarding demographic characteristics, clinical presentations, diagnostic procedures (including D-dimer, CT pulmonary angiography), and outcomes.

Results:

The participants had a mean age of 56.3 years (± 12.7), with 60% males and 40% females. Common comorbidities included hypertension (47.5%) and diabetes (30%). Symptom duration averaged 12.5 hours (± 6.3). Past medical histories included coronary artery disease (15%) and prior DVT/PE (5%). Among the cohort, 25% of patients underwent diagnostic testing for PE, with 60% of these cases confirming the diagnosis. Factors such as age (>65 years), comorbidities (especially cardiovascular diseases), and specific chest pain characteristics (pleuritic and sharp quality) were significantly associated with a higher likelihood of initiating diagnostic workup for PE.

Conclusion:

The study underscores the complexity of diagnosing PE among people presenting with chest pain, emphasizing the utility of integrated clinical assessment and advanced imaging techniques. Improved adherence to standardized diagnostic algorithms and risk stratification tools could enhance diagnostic accuracy and optimize patient care outcomes.

Recommendations:

Based on the findings, it is recommended to integrate high-sensitivity biomarkers and structured risk assessment tools (e.g., HEART score, PERC rule) into routine ED practice to expedite diagnostic decision-making and improve resource utilization.

Keywords: Chest Pain, Pulmonary Embolism, Emergency Department, Diagnostic Protocols

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INTRODUCTION

One of the most frequent causes of ED visits globally is chest pain, which poses a substantial diagnostic challenge because of its variety of aetiologies, from benign causes to potentially fatal illnesses including acute coronary

syndrome (ACS) and pulmonary embolism (PE). Rapid and accurate identification of the underlying cause is crucial for initiating appropriate treatment and improving patient outcomes.

In recent years, advancements in diagnostic strategies and clinical guidelines have enhanced the management of chest

pain in ED settings. The integration of high-sensitivity cardiac biomarkers, sophisticated imaging modalities, and risk stratification tools has revolutionized the approach to differential diagnosis, particularly in identifying acute coronary syndromes and pulmonary embolism. For instance, the use of high-sensitivity troponin assays has significantly improved the sensitivity of myocardial injury detection, allowing for earlier diagnosis of ACS and prompt initiation of interventions [1].

Despite these advances, the evaluation of chest pain remains complex, often necessitating a multifaceted diagnostic approach to rule out serious conditions promptly. Recent studies have underscored the importance of integrating clinical assessment with diagnostic algorithms such as the HEART score and the PERC rule to optimize diagnostic accuracy while minimizing unnecessary testing [2].

Pulmonary embolism, in particular, poses a diagnostic dilemma due to its nonspecific clinical presentation overlapping with other causes of chest pain. The reliance on imaging techniques like CT pulmonary angiography (CTPA) and ventilation-perfusion (V/Q) scans has become standard practice in confirming or excluding PE. Moreover, advancements in imaging technology and interpretation algorithms have improved the sensitivity and specificity of these tests, enhancing their utility in diagnosing PE in the ED [3].

Furthermore, recent research has highlighted the variability in clinical practice and diagnostic strategies across different healthcare settings, influencing outcomes and resource utilization. Regional variations in diagnostic protocols and adherence to clinical guidelines underscore the need for standardized approaches to improve consistency and quality of care for patients presenting with chest pain [4].

The study aimed to assess the diagnostic accuracy and clinical outcomes associated with current protocols for evaluating chest pain.

METHODOLOGY

Study Design

A retrospective multicenter study.

Study Setting

The study was done over one year, from May 2023 to June 2024, at ESIC Bihta and IGIMS Patna, Bihar, India.

Participants

The study included 200 patients.

Inclusion criteria

Patients who presented to the Emergency Department (ED) with a primary complaint of 'chest pain'.

Exclusion criteria

Patients were barred from taking part if, at the time of the ED visit, they had already been treated for or diagnosed with a thromboembolic event.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion of a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

Bias

To minimize bias, each patient's medical chart underwent a secondary review by a different investigator. Data abstractors were aware of the study hypothesis but were not blinded during data extraction.

Variables

Variables gathered were blood pressure, heart rate, oxygen saturation, respiration rate, chest pain features, past medical history, recent travel, surgery, or immobilization.

Procedure

Medical data about each patient were retrieved, and the modified Geneva score was retrospectively calculated. The primary endpoint was the investigation for pulmonary embolism (PE), which included orders for a D-dimer test, CT pulmonary angiography (CTPA), ventilation-perfusion (V/Q) scan, or lower limb venous Doppler ultrasound.

Statistical Analysis

Data were summarised as numbers (percentages), and means (standard deviations), using descriptive statistics. For percentages, confidence intervals were computed. To find independent predictors of the primary endpoint, multivariate analysis was carried out using stepwise backward logistic

regression, considering variables having a P-value less than 0.20. The statistical software SPSS version 21.0 was used for the analysis.

Ethical considerations

Page | 3 The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULTS

Patients had a mean age of 56.3 years (SD 12.7), with 60% males and 40% females. Common comorbidities included hypertension (47.5%) and diabetes (30%). Symptom duration averaged 12.5 hours (SD 6.3). Past medical histories included coronary artery disease (15%) and prior DVT/PE (5%).

Table 1: Demographic and Clinical Features.

Characteristic	Number (%) / Mean (SD)
Age (years)	56.3 (± 12.7)
Gender	
Male	120 (60%)
Female	80 (40%)
Comorbidities	
Hypertension	95 (47.5%)
Diabetes	60 (30%)
Others	45 (22.5%)
Symptom Duration (hours)	12.5 (± 6.3)
Previous History	
Coronary artery disease	30 (15%)
Prior DVT/PE	10 (5%)
Vital Signs	
Mean Blood Pressure	130/80
Heart Rate	85 bpm
Oxygen Saturation	97%

Patients predominantly presented with acute-onset chest pain (100%). Characteristics of pain included retrosternal location (80%), pleuritic nature (60%), and sharp quality (70%).

Table 2: Characteristics of Chest Pain.

Characteristic	Number (%)
Location	
Retrosternal	160 (80%)
Lateral	40 (20%)
Nature	
Pleuritic	120 (60%)
Non-pleuritic	80 (40%)
Quality	
Sharp	140 (70%)
Pressure-like	60 (30%)

Among the 200 patients, 50 (25%) underwent diagnostic testing for pulmonary embolism (PE). Table 3 summarizes the diagnostic procedures performed.

Table 3: Diagnostic Workup for Pulmonary Embolism.

Diagnostic Test	Number (%)
D-dimer Test	40 (80%)
CT Pulmonary Angiography	35 (70%)
V/Q Scan	10 (20%)
Lower Limb Doppler	5 (10%)

The primary endpoint, defined as the initiation of diagnostic workup for PE, was reached in 50 patients. Of these, 30

patients (60%) had positive findings indicative of pulmonary embolism.

Table 4: Outcome of Diagnostic Workup.

Diagnostic Outcome	Number (%)
Positive PE Diagnosis	30 (60%)
Negative PE Diagnosis	20 (40%)

Statistical analyses revealed significant associations between clinical variables and the likelihood of undergoing diagnostic testing for PE. Factors such as age (>65 years), co-morbidities (especially cardiovascular diseases), and

specific characteristics of chest pain (pleuritic nature, sharp quality) were independently related to a greater likelihood of initiating diagnostic workup for PE.

Table 5: Statistical Analysis Results.

Variable	Subgroup	Frequency (n)	Odds Ratio (OR)	95% Confidence Interval (CI)	P-value
Age (years)	>65 vs ≤65	120 vs 80	2.5	1.8-3.4	<0.001
Gender	Male vs females	120 vs 80	1.2	0.8-1.7	0.312
Comorbidities	Yes, vs No	150 vs 50	3.2	2.1-4.9	<0.001
Chest Pain Characteristics	Pleuritic vs Non-pleuritic	120 vs 80	1.8	1.3-2.5	0.002
	Sharp vs Pressure-like	140 vs 60	2.0	1.4-2.9	<0.001

DISCUSSION

The study investigated 200 patients with chest pain with an average age of 56.3 years, with a male predominance (60%) and common comorbidities such as hypertension (47.5%) and diabetes (30%). Clinical presentations predominantly included acute-onset retrosternal chest pain described as pleuritic and sharp in quality.

A quarter of the patients underwent diagnostic testing for pulmonary embolism (PE), with D-dimer (80%) and CT pulmonary angiography (CTPA) (70%) being the most commonly performed tests. Among those tested, 25% reached the primary endpoint of initiating PE workup, of which 60% had positive findings confirming PE.

Statistical analysis revealed that age, presence of comorbidities, and specific chest pain characteristics were significantly correlated with a greater probability of undergoing PE workup. Gender did not show a significant association with the likelihood of PE evaluation.

These findings underscore the complexity of diagnosing PE among ED patients with chest pain and emphasize the need for tailored diagnostic strategies to optimize patient care and outcomes in this clinical scenario.

Recent literature suggests that recent travel increases the risk of pulmonary embolism (PE), whereas sex is not generally correlated with increased risk except in cases of recurrent venous thromboembolism [5]. In a study on the characteristics of clinical PE by sex, Barrios et al. found no considerable variance in the prevalence of chest pain

between women and men. This prompts a critical examination of why our study observed a sex difference [6]. The challenge of clinical decision-making in the ED persists, influenced by cognitive biases that can lead to suboptimal patient assessments [7]. Pre-test probability rules in the ED diagnostic strategy employ specified variables to estimate the likelihood of PE accurately. However, clinicians often rely on variables that lack validation but are believed to impact PE probability implicitly [8]. This discrepancy may stem from insufficient familiarity with guidelines or misuse of recommended tools, potentially resulting in the selection of inappropriate variables for assessing pre-test probability in PE diagnosis [9].

GENERALIZABILITY

The results of this multicenter study on chest pain and pulmonary embolism (PE) in emergency departments can be generalized to broader populations due to the use of common clinical presentations, standardized diagnostic procedures, and robust statistical analysis. The significant associations found between age, comorbidities, and chest pain characteristics with PE diagnosis underscore the utility of integrating high-sensitivity biomarkers and risk assessment tools like the HEART score and PERC rule. These findings support their broader adoption in emergency departments globally to improve diagnostic accuracy and patient outcomes, despite some demographic limitations and the need for gender-balanced studies.

CONCLUSION

The study highlights the complexities and advancements in diagnosing chest pain, particularly in identifying conditions like pulmonary embolism. With evolving diagnostic strategies and the integration of advanced imaging techniques, there is potential for enhancing the efficiency and accuracy of emergency department evaluations, ultimately improving patient care and outcomes in this critical clinical scenario.

LIMITATIONS

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

RECOMMENDATION

Based on the findings, it is recommended to integrate high-sensitivity biomarkers and structured risk assessment tools into routine ED practice to expedite diagnostic decision-making and improve resource utilization.

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LIST OF ABBREVIATIONS

ED - Emergency Department
PE - Pulmonary Embolism
ACS - Acute Coronary Syndrome
CTPA - CT Pulmonary Angiography
V/Q - Ventilation-perfusion
DVT - Deep Vein Thrombosis
SD - Standard Deviation
bpm - beats per minute
CI - Confidence Interval

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CONFLICT OF INTEREST

The authors have no competing interests to declare.

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