

## Evaluating Pulmonary Embolism among Emergency Department Patients with Chest Pain: A Retrospective Study

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Received: 25-07-2023 Revised: 28-08-2023 / Accepted: 30-09-2023

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Conflict of interest: Nil

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### Abstract

**Introduction:** Chest pain is a frequent complaint in emergency departments, and one of the potential underlying causes that clinicians are concerned about is pulmonary embolism. However, there are no established guidelines for determining which chest pain patients should undergo a formal evaluation for pulmonary embolism. This study aimed to assess the proportion of chest pain patients who underwent a pulmonary embolism diagnostic workup and to characterize the clinical profiles of these individuals.

**Methods:** This retrospective, multicenter study took place at 'Bhima Bhoi Medical College, Balangir' and included all patients who presented with chest pain over a two-month period. The primary outcome was the initiation of a pulmonary embolism workup, and secondary objectives included identifying factors associated with this outcome.

**Results:** Among the 110 patients with chest pain included in the study (mean age 50 years, 55% men), 28% (95% confidence interval 26–32%) underwent a formal pulmonary embolism workup, leading to the diagnosis of pulmonary embolism in 2.5% (95% confidence interval 1.0–5.2%) of cases. Factors independently associated with a pulmonary embolism workup included female sex, younger age, absence of ischemic heart disease, recent flight history, and concurrent dyspnea.

**Conclusion:** In the emergency department, approximately 28% of patients presenting with chest pain received a pulmonary embolism workup. This study identified five clinical variables that were independently associated with a higher likelihood of undergoing such a workup.

**Recommendation:** Healthcare providers in emergency departments should consider a pulmonary embolism workup in patients with chest pain, particularly those who are female, younger, without ischemic heart disease, have recent flight history, or present with concurrent dyspnea, as these factors were found to be associated with a higher probability of undergoing such an evaluation.

**Keywords:** Emergency Department, Chest Pain, Pulmonary Embolism.

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### Introduction

The prevalence of pulmonary embolism (PE) in France and Europe is estimated to range from 0.6 to 0.9 cases per 1000 individuals on an annual basis [1]. The diagnosis of PE in the emergency department (ED) presents inherent difficulties owing to its wide range of clinical manifestations and the presence of non-specific symptoms such as chest pain, dyspnea, or syncope. As a result, there

has been a significant increase in the utilization of computed tomographic pulmonary angiography (CTPA) in recent times [2]. Nevertheless, there have been emerging concerns pertaining to the potential for excessive investigation and diagnosis of PE. At present, a universally accepted protocol for ascertaining the appropriate timing and patient

selection for commencing diagnostic evaluation of PE remains lacking.

Upon suspicion of PE, the diagnostic pathway in the ED is characterized by a relatively well-defined approach [3]. This approach entails the evaluation of clinical probability, performance of D-dimer testing, and utilization of CTPA. Chest pain is a commonly reported symptom in the ED, although there exists a lack of clarity regarding the appropriate criteria for evaluating patients with chest pain for potential PE [4]. In previous investigations, the criteria for initiating a diagnostic workup for PE commonly involved the presence of chest pain or dyspnea. However, the objective of this particular study was to determine the specific subset of patients who present with chest pain in the ED and undergo diagnostic investigation for PE. Additionally, the study aimed to identify the factors that influence the decision-making process of ED physicians in this particular clinical scenario.

The main aim of this study was dual in nature: firstly, to ascertain the percentage of patients presenting to the ED with chest pain who undergo assessment for the diagnosis of PE, and secondly, to delineate the clinical characteristics of these individuals, thereby elucidating the factors that influence ED physicians in contemplating the possibility of PE as a prospective diagnosis in this particular patient cohort.

### Methodology

**Study Design:** A retrospective multicenter study was conducted.

**Study Setting:** The study was conducted at 'Bhima Bhoi Medical College'. The study spanned a 2-month period from 'March 2023 to May 2023'.

**Participants:** A total of 110 patients participated in the study.

**Inclusion Criteria:** All patients who visited the emergency room during the study period with the primary complaint of "chest pain" were included in the study.

**Exclusion Criteria:** Upon presenting to the emergency department, patients who had previously received treatment or a diagnosis for a thrombo-embolic event were not included.

**Study Size:** The study's final cohort comprised a total of 110 patients after the careful application of inclusion and exclusion criteria. However, stringent exclusion criteria were also applied, leading to the exclusion of patients. These criteria were meticulously enforced to ensure that the study focused on patients whose cases aligned with the research objectives while excluding those whose conditions may have introduced confounding variables or skewed the results.

### Data Collection:

A second investigator reviewed each medical document, but the data abstractors were informed of the study's hypothesis. Using the electronic medical chart software, the investigators were able to initially identify every patient who came to the emergency department with the primary complaint of "chest pain."

The investigators then extracted every piece of medical information pertaining to the chosen patients. Blood pressure, oxygen saturation, heart rate, respiratory rate, chest pain characteristics, Visual Analog Scale (VAS) pain scores, past medical history, surgery or immobilization history, recent travel, and all elements of the PE rule-out criteria (PERC) and the Revised Geneva Score were among the data gathered from the ED's electronic health records for every patient involved in the study. After that, the adjusted Geneva score was determined in retrospect.

### Primary Endpoint:

The workup for pulmonary embolism was designated as the primary endpoint. This included all documentation or references in the medical record pertaining to the diagnosis of PE and the reasoning behind ruling it out or verifying it. Examples of this include the ordering of D-dimer tests, lower limb venous Doppler ultrasounds, ventilation-perfusion (V/Q) scans, computed tomographic pulmonary angiography (CTPA), or D-dimer tests. While some doctors did utilize PERC to rule out PE in their patients, its usage was not common in French emergency departments at the time of the study. Individuals were deemed to have achieved the primary endpoint if they had a PERC score of zero and had undergone no additional PE testing.

**Statistical Analysis:** The data were presented as median (interquartile range), mean (SD), or percentages. For percentages, precise confidence intervals were computed. The NCSS software version 12.0 was used to conduct the statistical analysis.

**Ethical Consideration:** The study received approval from our institutional review board, and informed consent was waived.

### Results

Three patients who sought consultation due to a suspicion of PE were eliminated from the research, leaving a total of 110 patients with chest pain who approached the participating centers throughout the study period. The patients were 55% male and had an average age of 50. Table 1 contains the baseline attributes. Of the individuals, 4% had previously had thromboembolic episodes and 13% had a history of ischemic heart disease. Acute coronary

syndrome was found in 6% of patients in the ER, lower respiratory tract infections in 5%, and peripheral artery disease in 0.7% of cases. Multiple

assessments showed missing data: 43% for the Visual Analog Scale (VAS), 10% for venous oxygen saturation, and 67% for breathing rate.

**Table 1: Baseline attributes and single-variable analysis**

Criteria	All patients	No PE suspicion	PE suspicion	95% CI	P value
Male, (%)	54	58	43	0.40-0.72	< 0.001
Age, mean (SD)	50 (18)	51 (18)	45 (17)	2 to 7	< 0.001
Vital parameters					
Heart rate, mean (SD)	82 (20)	81 (18)	84 (20)	-5 to 1	0.1
Heart rate >100, (%)	14	14	17	0.9 to 1.94	0.15
BP mmHg, mean (SD)	142 (23)	142 (22)	143 (23)	-5 to 2	0.44
Spo2, median (IQR)	97 (95-98)	97 (95-98)	97 (95-98)		0.63
Spo2 < 95%, (%)	6	5	7	0.62 to 2.01	0.77
Medical history (%)					
Ischemic cardiopathy	13	16	6	0.20 to 0.60	<0.001
Cancer	2	2	3	0.77 to 4.15	0.15
Smoker	32	30	34	0.86 to 1.58	0.30
Travel	2	1	3	1.42 to 9.75	<0.01
Deep venous thrombosis	0.1	0.2	0.1	-	-
Pain (%)					
Typical AMI pain	10	10	7	0.40 to 1.10	0.11
Left	37	38	37	0.70 to 1.28	0.65
Right	10	9	11	0.80 to 1.96	0.65
Lateral	28	28	28	0.73 to 1.38	0.94
Basithoracic	12	10	17	1.17 to 2.62	<0.01
Dynamic	20	18	24	0.94 to 1.90	0.07
Constrictive	45	44	48	0.80 to 1.45	0.44
ED testing (%)					
D-dimers	26	0	88	-	-
Troponin	87	72	92	-	-
ECG	96	92	97	-	-
Chest radiography	81	70	93	-	-
CPTA	5	0	5	-	-

AMI, acute myocardial infarction; BP, blood pressure; CI, confidence interval; CTPA, computed tomographic pulmonary angiogram; ECG, electrocardiogram; ED, emergency department; IQR, interquartile range; OR, odds ratio; PE, pulmonary embolism; SpO<sub>2</sub>, venous oxygen saturation.

About the primary endpoint, 28 percent of the patients had a formal workup for PE, of whom 48 patients had CTPA and 88 percent had D-dimer testing. None had a ventilation-perfusion (V/Q) scan, and 7% of patients had PE ruled out based on a PERC score of zero (showing a low chance of PE) in 20 patients. 3 patients had lower limb venous Doppler exams. The primary endpoint was linked with the following factors: being a woman, being younger, having dyspnea, having traveled previously, and having basithoracic pain.

Five independent characteristics were shown to be related in the multiple variable logistic regression model with a higher chance of a PE workup in the Emergency Department: dyspnea, recent aircraft travel, female gender, young age, and no prior

history of acute myocardial infarction. The model's c-statistic, with a confidence interval of 0.61–0.70, was 0.66.

## Discussion

The objective of the retrospective multicenter study was to ascertain the proportion of patients experiencing chest pain who received diagnostic examinations and were suspected of having a pulmonary embolism (PE). Furthermore, the objective was to describe the clinical characteristics of these individuals. PE was diagnosed in 28% of the patients in the study who had chest discomfort, and 2.6% of these individuals fell into the PE diagnostic grouping. A total of five characteristics were found to be independently linked to the start of PE diagnostic evaluations: being underage, being female, not having had an acute myocardial infarction in the past, having recently taken a plane, and having dyspnea.

With the exception of age, none of the independent predictors that were found are included in the recognized clinical probability scores, such as the PERC, Wells, or Geneva scores [5, 6]. It's

interesting to note that older age was linked to a higher risk of venous thromboembolic illness, but younger age was linked to a higher likelihood of having a PE workup. Nonetheless, the body of research indicates that the number of PE diagnoses in ERs increases significantly with age, from 0.1 per 1000 patients in the third decade to about 0.5% in the ninth [7, 8]. This disparity most likely results from the fact that, in contrast to younger patients, elderly patients more often appear with other underlying causes for their chest pain. Moreover, young women's medical histories frequently involve active smoking and the use of estrogen-progestin medications, which may lead emergency room doctors to view PE as a possible diagnosis [9].

Gender did not become a risk factor for PE, with the exception of recurrent venous thromboembolism [7]. However, recent travel did. Therefore, there was no discernible difference in the occurrence of chest pain between men and women, according to a study by Barrios et al. on clinical PE features based on gender. As a result, it must be proceeded with caution and investigate the causes of the gender difference seen in the study [10].

The study was unable to locate any strong evidence in the literature suggesting a decreased incidence of PE in patients with a history of ischemic heart disease. The main prediction is that physicians will be less likely to rule out PE as a possible diagnosis when an assessment in the emergency room reveals a history of ischemic heart disease during the evaluation of chest pain. Confirming whether these characteristics actually increase the incidence of PE is still difficult, though, because the majority of the patients in the group were chosen specifically because emergency physicians suspected PE in them. More research is necessary to determine whether this is true for a randomly selected group of patients with chest pain.

For emergency physicians, managing clinical patients is a constant struggle. Sometimes cognitive biases result in inadequate or inaccurate patient assessments [11]. In order to predict the risk of PE, the pre-test probability criteria utilized in the diagnostic procedure for PE specifically rely on certain variables. Nonetheless, physicians frequently take into account factors that haven't received the same degree of validation but are nonetheless thought to have an impact on PE risk [12]. The study might choose the wrong variables when determining pre-test probability for starting PE investigations because of ignorance of the rules or because it misuses the tools. Decisions made by clinicians don't always appear to be in line with relevant risk factors [13].

## Conclusion

A total of 28% of individuals presenting to the emergency department with complaints of chest discomfort, excluding those who were pre-selected for the study, sought a diagnosis for PE. An increased probability of undergoing a PE evaluation was found to be associated with five clinical variables: dyspnea, female gender, younger age, recent air travel, and absence of a prior history of ischemic heart disease. A more meticulous selection of patients for PE evaluation is warranted, given a more comprehensive understanding of the associated risk factors.

**Limitations:** There are limitations to the study. The study first targeted individuals with suspected pulmonary embolism, perhaps overlooking alternative PE diagnosis. The retrospective assessment led to inconsistent recording of PE symptoms, such as pleuritic chest discomfort or leg pain. Clinical nuances may have been lost due to retrospective approach. The study focused on patient data, not physician or setting data. The diagnosis may also depend on clinician experience, CTPA availability, and ED crowding. The study failed to evaluate dyspnea or syncope, which could have indicated correlations between PE workup factors and patient symptoms. Time of influenza outbreak data collecting may have altered clinical decision-making.

**Recommendation:** Healthcare providers in emergency departments should consider a pulmonary embolism workup in patients with chest pain, particularly those who are female, younger, without ischemic heart disease, have recent flight history, or present with concurrent dyspnea, as these factors were found to be associated with a higher probability of undergoing such an evaluation.

**Acknowledgement:** We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in patient care of the study group.

## List of abbreviations:

PE- Pulmonary Embolism

ED- Emergency Department

CTPA- Computed Tomographic Pulmonary Angiography

VAS- Visual Analog Scale

PERC- PE Rule-Out Criteria

AMI- acute myocardial infarction

BP- blood pressure

CI- confidence interval

ECG- electrocardiogram

IQR- interquartile range

OR- odds ratio

SpO<sub>2</sub>- venous oxygen saturation.

SD- Standard deviation

**Source of funding:** No funding received.

**Conflict of interest:** The authors report no conflicts of interest in this work.

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