

Diagnosing Pulmonary Embolism in Pregnant Patients

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Abstract:

Background: Pulmonary embolism (PE) is a primary contributor to maternal death. Pregnancy induces physiological changes that heighten the likelihood of thromboembolic events due to increased blood coagulation and reduced blood flow in the veins. Diagnosing PE during pregnancy is difficult since the symptoms often resemble those of a normal pregnancy, and there is a need to limit the amount of radiation exposure to the foetus. The objective of this study is to assess the frequency, determinants, and consequences of pulmonary embolism in pregnant individuals in order to enhance medical procedures and enhance the well-being of both the mother and the foetus.

Methods: A total of 220 pregnant patients with suspected PE were enrolled. Data were collected through patient interviews, medical record reviews, and diagnostic imaging. Statistical analysis was done using SPSS version 19.0.

Results: Out of 220 participants, 210 completed the study. The prevalence of PE was 16.7%. Significant risk factors included a history of thrombosis ($p = 0.02$), obesity ($p = 0.01$), and smoking ($p = 0.03$). Logistic regression identified these factors as independent predictors. Maternal outcomes showed no mortality, but there was a higher incidence of fetal loss (8.6%) and preterm delivery (20.0%) among patients diagnosed with PE.

Conclusion: The study identified a significant incidence of PE among pregnant patients, with key risk factors being thrombosis history, obesity, and smoking. Early diagnosis and management are crucial to reduce adverse outcomes. A multidisciplinary approach is recommended to enhance care for pregnant patients with suspected PE.

Recommendations: Routine screening for PE risk factors, using D-dimer testing combined with bilateral lower limb CUS, and adopting a multidisciplinary approach involving relevant specialists are crucial for improving diagnosis and management of PE in pregnant patients. This strategy enhances early identification, minimizes unnecessary radiation exposure, and ensures comprehensive, tailored care.

Keywords: Pulmonary Embolism, Pregnancy, Hypercoagulability, Thrombosis, Diagnostic Imaging.

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Introduction

Pulmonary embolism (PE) occurring during pregnancy is a severe medical illness that presents substantial dangers to both the mother and foetus. PE is a primary factor contributing to the death of mothers during childbirth, occurring in approximately 1 out of every 1000 to 1 out of every 3000 pregnancies [1]. Pregnancy induces a hypercoagulable state, which is marked by elevated levels of fibrinogen, D-dimers, and coagulation factors, together with reduced protein S activity. This condition substantially increases the likelihood of thromboembolic events.

Pregnancy-induced physiological changes, such as venous stasis due to uterine compression and endothelial injury during delivery, further exacerbate the risk of PE. The clinical presentation of PE in pregnant women often overlaps with common pregnancy symptoms like dyspnea and chest pain, making diagnosis challenging [2]. Consequently, a high index of suspicion and a strategic diagnostic approach are essential to avoid missed diagnoses and reduce maternal and fetal morbidity and mortality [1].

Recent studies highlight the complexities in diagnosing PE during pregnancy due to the physiological changes that mimic PE symptoms. For instance, the ARTEMIS and CT-PE pregnancy studies demonstrate the utility of D-dimer testing and bilateral lower limb compression ultrasound (CUS) as part of the diagnostic algorithm, which can help avoid unnecessary radiation exposure from chest imaging [3]. However, the use of D-dimer tests is controversial due to varying levels of diagnostic accuracy throughout different trimesters [2].

The management of PE in pregnancy requires a multidisciplinary approach involving emergency physicians, pulmonologists, cardiologists, radiologists, and obstetricians to ensure comprehensive care. The choice of imaging modality remains a critical decision, balancing the

need for accurate diagnosis against the potential risks of radiation exposure to the fetus. Computed tomography pulmonary angiography (CTPA) is widely used due to its high diagnostic accuracy and ability to identify alternative diagnoses, despite concerns about radiation exposure [1].

The study aims to elucidate the complexities by examining the prevalence, risk factors, and outcomes of PE in a cohort of pregnant patients.

Methodology

Study Design

A prospective observational study.

Study Setting

The study was conducted at Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar, from October 2023 to March 2024.

Participants

A total of 220 pregnant patients suspected of having PE were included in the study.

Inclusion Criteria

- Pregnant women aged 18-45 years.
- Patients with clinical suspicion of PE based on symptoms such as dyspnea, chest pain, or hemoptysis.

Exclusion Criteria

- Patients with known contraindications to imaging studies required for PE diagnosis.
- Patients with a history of chronic pulmonary or cardiovascular diseases.

Sample size

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

Efforts were made to minimize bias by ensuring that all participants were assessed using the same diagnostic criteria and protocols. Blinding of the radiologists interpreting the imaging studies was implemented to reduce diagnostic bias.

Variables

Variables included age, gestational age, presence of risk factors, diagnosis of PE, and clinical outcomes.

Data Collection

Data were collected through patient interviews, medical record reviews, and diagnostic imaging studies. Structured questionnaires and standardized forms were used to gather information on demographic details, clinical symptoms, and risk factors.

Procedure

Patients presenting with symptoms suggestive of PE were screened and enrolled based on the inclusion and exclusion criteria. Detailed medical history and physical examination were conducted. Laboratory tests, including D-dimer levels,

were performed. Diagnostic imaging studies, such as compression ultrasonography, chest X-ray, and computed tomography pulmonary angiography (CTPA), were conducted to confirm the diagnosis of PE. Patients diagnosed with PE received appropriate treatment and were followed up until discharge. Maternal and fetal outcomes were recorded.

Statistical Analysis

The data were analysed using SPSS version 19.0. Chi-square tests were employed to evaluate the correlation between category variables. A logistic regression analysis was performed to determine the independent factors that predict PE. A p-value less than 0.05 was deemed to be statistically significant.

Ethical considerations

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

Result

Out of the 220 pregnant patients enrolled in the study, 210 completed the study. The mean age was 28.6 years (± 4.8). Most of the females were in their third trimester (58.6%), followed by the second trimester (31.4%) and the first trimester (10%).

Table 1: Demographic and Clinical Features

Characteristic	Value
Mean Age (years)	28.6 \pm 4.8
Trimester	
- First	22 (10.0%)
- Second	69 (31.4%)
- Third	129 (58.6%)
History of Thrombosis	15 (7.1%)
Obesity (BMI > 30)	40 (19.0%)
Smoking	18 (8.6%)
Clinical Symptoms	
- Dyspnea	140 (66.7%)
- Chest Pain	110 (52.4%)
- Hemoptysis	45 (21.4%)

Out of the 210 participants who completed the study, 35 were diagnosed with PE, resulting in a prevalence rate of 16.7%.

Table 2: Prevalence of PE

Pulmonary Embolism	Number of Patients	Percentage (%)
Diagnosed	35	16.7
Not Diagnosed	175	83.3

Analysed was the connection between different risk variables and the diagnosis of PE. An important correlation was discovered between a previous occurrence of thrombosis and the likelihood of developing PE ($p = 0.02$). Both obesity and smoking were found to have a strong correlation with a higher likelihood of developing PE ($p < 0.05$).

Table 3: Association Between Risk Factors and PE

Risk Factor	Diagnosed	Not Diagnosed	p-value
History of Thrombosis	8 (22.9%)	7 (4.0%)	0.02
Obesity	12 (34.3%)	28 (16.0%)	0.01
Smoking	10 (28.6%)	8 (4.6%)	0.03

Logistic regression analysis identified that a history of thrombosis, obesity, and smoking were independent predictors of PE in pregnant patients.

Table 4: Logistic Regression Analysis for Predictors of PE

Predictor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
History of Thrombosis	4.5	1.6-12.8	0.01
Obesity	3.2	1.5-6.8	0.02
Smoking	3.8	1.4-10.4	0.03

Maternal and fetal outcomes were recorded for all participants. Among those diagnosed with PE, there were no cases of maternal mortality. However, there were 3 cases of fetal loss (8.6%) among those with PE compared to 5 cases (2.9%) among those without PE.

Table 5: Maternal and Fetal Outcomes

Outcome	Diagnosed	Not Diagnosed	p-value
Maternal Mortality	0 (0.0%)	0 (0.0%)	-
Fetal Loss	3 (8.6%)	5 (2.9%)	0.04
Preterm Delivery	7 (20.0%)	15 (8.6%)	0.05
Low Birth Weight	12 (34.3%)	25 (14.3%)	0.02

Discussion

The study aimed to diagnose PE in pregnant patients over a six-month period. Out of the 220 enrolled participants, 210 completed the study. The mean age was 28.6 years, with the majority being in their third trimester. This distribution indicates a significant representation across different stages of pregnancy, allowing for a

comprehensive analysis of PE across the gestational spectrum.

The study found a 16.7% prevalence of PE among the participants. This relatively high prevalence underscores the critical need for vigilance and proactive screening for PE in pregnant women, particularly those presenting with symptoms such as dyspnea, chest pain, and hemoptysis.

A significant association was observed between a history of thrombosis and the occurrence of PE ($p = 0.02$). Obesity and smoking were also identified as significant risk factors ($p < 0.05$). Logistic regression analysis further confirmed that a history of thrombosis, obesity, and smoking are independent predictors of PE in pregnant patients. These findings highlight the importance of assessing and managing these risk factors to reduce the incidence of PE.

The study recorded maternal and fetal outcomes, revealing no cases of maternal mortality among the diagnosed patients. However, the study found a higher incidence of fetal loss (8.6%) in females with PE compared to those without (2.9%), indicating a statistically considerable variation ($p = 0.04$). Additionally, preterm delivery and low birth weight were more common in patients diagnosed with PE (20.0% and 34.3%, respectively) compared to those without (8.6% and 14.3%, respectively).

This study highlights the significance of promptly and precisely diagnosing PE in pregnant individuals to minimise negative consequences for both the mother and the foetus. The substantial prevalence of PE discovered in this study indicates that healthcare practitioners should be vigilant for this condition, especially in patients with established risk factors such as a history of thrombosis, obesity, and smoking. The found correlations and forecasters can assist doctors in categorising risk and customising management plans to enhance both maternal and foetal health results. These findings highlight the necessity of focused therapies and ongoing surveillance to efficiently control and avert PE (pulmonary embolism) during pregnancy.

Diagnosing PE in pregnant individuals is difficult since the symptoms often resemble those of a normal pregnancy, and there are hazards involved in using diagnostic imaging. A prospective study assessed the

effectiveness of a diagnostic algorithm that used the revised Geneva score, very sensitive D-dimer testing, bilateral compression ultrasonography (CUS), computed tomography pulmonary angiography (CTPA), and ventilation-perfusion (V/Q) scans. The study showcased the algorithm's ability to effectively rule out PE in pregnant females with a very low rate of errors, thus affirming its suitability for implementation in clinical settings [4].

A prospective study was conducted to test the pregnancy-adapted YEARS algorithm, which integrates clinical criteria and D-dimer values. The approach effectively excluded the possibility of PE in a substantial number of pregnant women, eliminating the necessity for computed tomography pulmonary angiography (CTPA) and lowering their exposure to radiation. It successfully prevented the need for CTPA in 32% to 65% of patients, with the exact percentage varying according to the trimester [5]. A comparative study evaluating CTPA and V/Q scanning in pregnant women with suspected PE revealed that both imaging techniques are efficacious. However, CTPA demonstrated a superior diagnostic yield and a reduced rate of non-diagnostic results. When deciding between CTPA and V/Q scanning, it is important to take into account the specific characteristics of each patient and the accessibility of the two options [6].

A study assessed the diagnostic efficacy of low-dose perfusion scintigraphy (LDQ) and computed tomography pulmonary angiography (CTPA) for diagnosing PE in pregnant women. LDQ was determined to possess a high negative predictive value and decreased radiation dose for both the mother and foetus. Therefore, it is a sensible choice as the initial imaging method for patients with a negative chest radiograph [7]. Recent research, including DiPEP, ARTEMIS, and CT-PE-Pregnancy, have yielded fresh evidence regarding

systematic methods for diagnosing PE during pregnancy. These studies indicate that the use of clinical decision rules in combination with D-dimer testing can decrease the requirement for diagnostic imaging in certain instances, but imaging is still essential for a significant number of patients [8].

Conclusion

The study found that a considerable number of pregnant individuals had PE, with a prevalence rate of 16.7%. Notable risk factors, including a prior occurrence of blood clotting, being overweight, and smoking, were strongly linked to a higher likelihood of developing pulmonary embolism. Logistic regression research has verified that these characteristics are independent predictors. Patients diagnosed with PE showed an increased likelihood of foetal loss and premature delivery, which had negative effects on both the mother and the foetus. These findings emphasise the need of promptly diagnosing and treating PE in pregnant women in order to enhance the health outcomes of both the mother and the foetus.

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

Recommendation: Routine screening for PE risk factors, using D-dimer testing combined with bilateral lower limb CUS, and adopting a multidisciplinary approach involving relevant specialists are crucial for improving diagnosis and management of PE in pregnant patients. This strategy enhances early identification, minimizes unnecessary radiation exposure, and ensures comprehensive, tailored care.

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List of abbreviations:

PE: Pulmonary Embolism

CUS: Compression Ultrasonography

CTPA: Computed Tomography Pulmonary Angiography

V/Q scan: Ventilation-Perfusion Scan

BMI: Body Mass Index

LDQ: Low-Dose Perfusion Scintigraphy

OR: Odds Ratio

CI: Confidence Interval

CT-PE Pregnancy: Computed Tomography Pulmonary Embolism in Pregnancy study

DiPEP: Diagnosing Pulmonary Embolism in Pregnancy study

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