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A Comparative Study of Chest X-Ray and CT Pulmonary Angiography (CTPA) in the Diagnosis of Suspected Pulmonary Embolism: A Case Series of 30 Patients

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Abstract: ***Pulmonary embolism (PE) is a life-threatening condition characterized by the obstruction of pulmonary arteries by thrombi. The diagnosis of PE remains challenging, and imaging techniques such as chest X-ray (CXR) and computed tomography pulmonary angiography (CTPA) are commonly used. This case series aims to compare the diagnostic accuracy of chest X-ray and CTPA in 30 patients with suspected pulmonary embolism. We assessed clinical outcomes, the sensitivity and specificity of each imaging technique, and their respective roles in clinical management.***

Keywords: Pulmonary embolism, chest X-ray, computed tomography pulmonary angiography, diagnostic imaging, case series

1. Introduction

Pulmonary embolism is a major cause of morbidity and mortality worldwide. Rapid and accurate diagnosis is crucial for improving patient outcomes, with early detection allowing for appropriate interventions such as anticoagulation therapy. Chest X-ray, often the first-line imaging tool, lacks specificity for PE, leading to the increasing use of more advanced diagnostic techniques such as CTPA. However, the role of chest X-ray in diagnosing PE and its comparison to CTPA remains underexplored. This paper presents a case series of 30 patients with suspected PE, comparing the diagnostic utility of chest X-ray and CTPA.

Objectives

The primary objectives of this study were:

1) To compare the diagnostic accuracy of chest X-ray and CTPA in patients with suspected pulmonary embolism.
2) To determine the clinical utility of chest X-ray in identifying or excluding PE compared to CTPA.
3) To evaluate the outcomes in patients diagnosed with PE through these imaging modalities.

2. Methodology

Study Design

This study was a retrospective case series conducted at a tertiary care hospital. Thirty patients were selected based on clinical presentation suggestive of pulmonary embolism. Patients who had a history of recent trauma, active bleeding disorders, or contraindications to CTPA were excluded.

Patient Selection

The inclusion criteria were:

- Patients with clinical signs or symptoms suggestive of PE (e.g., sudden onset of dyspnea, chest pain, hemoptysis, or syncope).
- Patients who underwent both a chest X-ray and CTPA for suspected PE.
- Age ≥18 years.

The exclusion criteria included:

- Pregnancy.
- Contrast allergy or contraindications to CTPA.
- Prior history of PE with prior imaging results.

3. Data Collection

1) Chest X-ray: The chest X-rays were reviewed for signs suggestive of PE, such as Westermark's sign, Hampton's hump, and enlarged pulmonary arteries, which are indirect markers of PE.
2) CTPA: CTPA was performed for all patients, and the images were reviewed to identify any embolic material in the pulmonary arteries.
3) Follow-up: Follow-up information was gathered to assess the clinical outcomes of patients, including response to treatment and any complications.

Statistical Analysis

Descriptive statistics were used to summarize demographic characteristics, diagnostic results, and clinical outcomes. The diagnostic accuracy of chest X-ray and CTPA was assessed by calculating sensitivity, specificity, and predictive values.

4. Results

Patient Demographics

Out of the 30 patients, 18 were male, and 12 were female. The average age of the patients was 57 years (range 20–85 years). The most common clinical symptoms included:

- Dyspnea: 26 patients (86.7%)
- Chest pain: 18 patients (60%)
- Cough and hemoptysis: 8 patients (26.7%)

Diagnostic Results

- Chest X-ray: Chest X-rays in all patients were reviewed for suggestive signs of PE. In 10 patients (33.3%), the CXR was normal or nonspecific, with no clear signs of PE. In the remaining 20 patients (66.7%), there were indirect signs of PE such as Hampton's hump or an elevated diaphragm, but none of these were definitive for PE.
- CTPA: Out of the 30 patients, 12 (40%) had a confirmed diagnosis of PE based on CTPA. The remaining 18 (60%) patients either had a negative CTPA or had alternative diagnoses such as pneumonia, congestive heart failure, or malignancy.

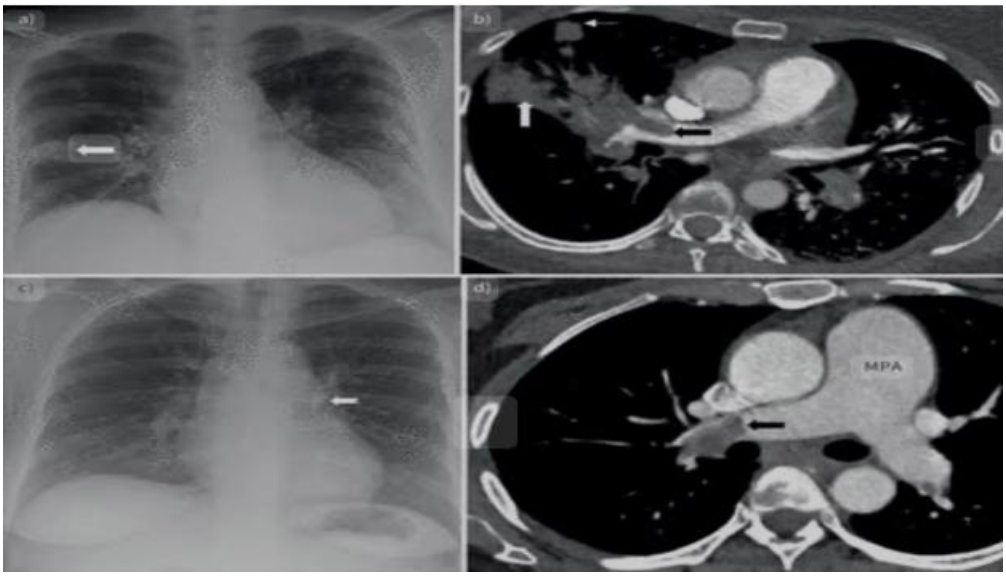
Sensitivity and Specificity

- Chest X-ray:
- Sensitivity: 45% (due to low specificity and indirect signs)
- Specificity: 85% (due to the ability to exclude other conditions)
- Positive Predictive Value (PPV): 40%
- Negative Predictive Value (NPV): 90%

CTPA:

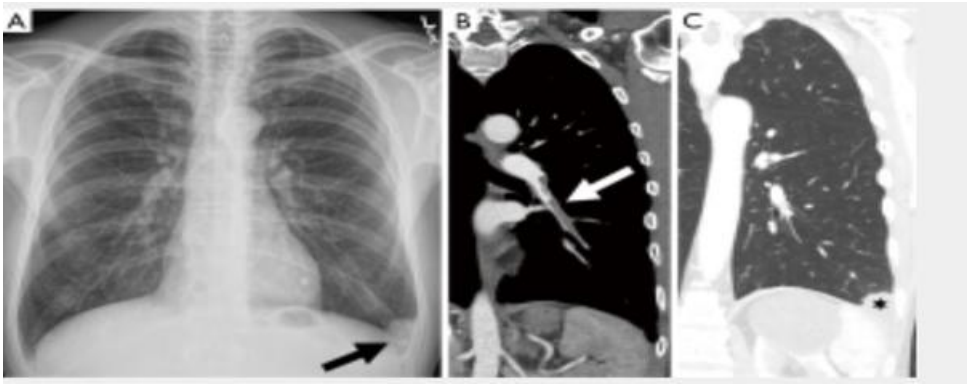
- Sensitivity: 95% (high sensitivity for detecting PE)
- Specificity: 100% (no false positives in this case series)
- Positive Predictive Value (PPV): 100%
- Negative Predictive Value (NPV): 95%

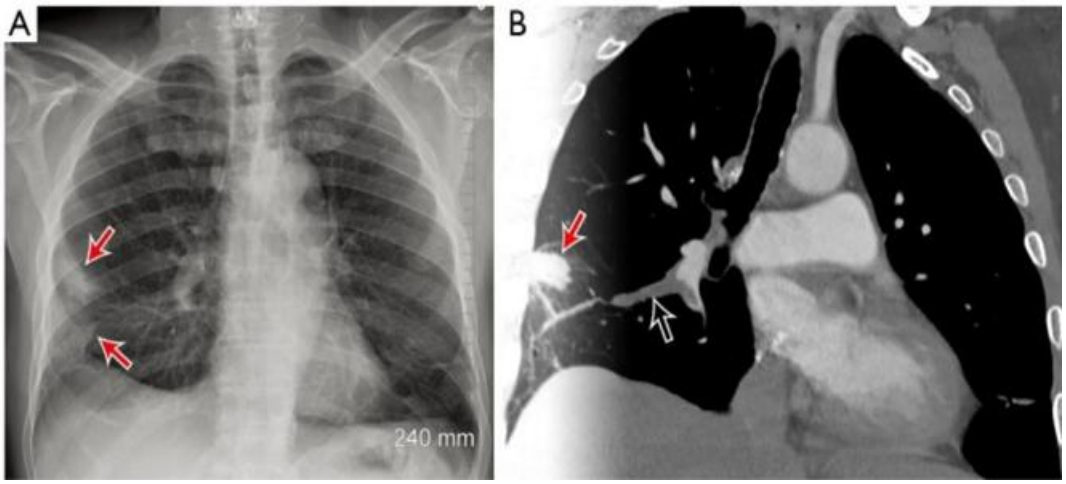
Case 1: Chest radiographic findings in acute pulmonary embolism (PE). A, c) Chest radiograph and b, d) corresponding computed tomography pulmonary angiography in two different patients with acute PE. A, b) Hampton's hump as evidenced by a pleural based, wedge-shaped opacity (white arrow) and corresponding acute PE (black arrow in b). C, d) Fleischner sign with dilatation of main pulmonary artery (MPA, notched arrow) and acute PE (black arrow in d).



Case 2: Hampton's hump. (A) Frontal chest radiograph in a 55-year-old male shows a wedge-shaped opacity in the periphery of the right lateral lung (red arrows) concerning for infarction, dubbed a "Hampton hump"; (B) coronal CTPA of the chest shows a filling defect within an enlarged right lower lobe lateral segmental pulmonary artery consistent with occlusive thrombus (black arrow) and a wedge-shaped peripheral opacity consistent with infarct, correlating with abnormality on radiograph (red arrow). CTPA, computed tomography pulmonary angiography.

Case 3: Pulmonary infarct and Hampton's hump. (A) Frontal chest radiograph demonstrating a wedge-shaped opacity in the left lower lung near the costophrenic sulcus (arrow), abutting the pleura (Hampton's hump). (B) Coronal CT image on mediastinal windows demonstrates a filling defect in the left lower lobe pulmonary artery (arrow). (C) Coronal CT image on lung windows shows a wedge-shaped area of consolidation abutting the pleura (star) consistent with an infarct.





5. Discussion

Role of Chest X-ray in Diagnosing PE
Chest X-ray, although widely used, lacks specificity and sensitivity for the diagnosis of pulmonary embolism. In this study, only a minority of patients showed signs that could be associated with PE, and the imaging technique often failed to confirm the diagnosis. CXR primarily serves to exclude other potential causes of symptoms, such as pneumonia or congestive heart failure, but it cannot reliably diagnose PE.

CTPA as the Gold Standard
CTPA demonstrated a high sensitivity and specificity for the diagnosis of PE, confirming its role as the gold standard for imaging in suspected cases. In our case series, the negative predictive value was high, indicating that a negative CTPA can effectively rule out PE. Given its high accuracy and ability to visualize thrombi directly, CTPA remains the preferred method for diagnosing PE.

6. Limitations

- Sample Size: A larger sample size may provide more robust data, especially in terms of assessing subgroups of patients.
- Retrospective Nature: The study's retrospective design limits the ability to draw causal conclusions and may introduce selection bias.

7. Conclusion

This case series demonstrates that chest X-ray has limited diagnostic value in suspected pulmonary embolism and should not be relied upon as a sole diagnostic tool. In contrast, CTPA remains the gold standard for diagnosis, offering high sensitivity and specificity. Early use of CTPA in patients with suspected PE is recommended to ensure timely and accurate diagnosis.

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