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Radiographic Patterns in Patients Diagnosed with Acute Pulmonary Embolism

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ABSTRACT

Background: *Pulmonary embolism (PE) results in significant morbidity and mortality. Due to lack of awareness among physicians in this regard or non-availability of objective tests the diagnosis of PE is difficult. Clinical features are nonspecific and all diagnostic tests have certain limitations. The purpose of this study was to evaluate chest radiographic findings in diagnosed cases of acute pulmonary embolism.*

Materials and Methods: *We conducted a retrospective, chart review study on chest radiographs of all patients admitted to Masih Daneshvari Hospital in Tehran, Iran with a diagnosis of acute PE from April 2005 to February 2006. Fifty-one consecutive patients were diagnosed with acute pulmonary embolism by single detection CT scan, perfusion scan and echocardiography. Three radiologists interpreted the chest radiographs.*

Results: *We found only 2 normal chest radiographs (4%) and the other 48 (96%) were abnormal. The most common abnormalities were pleural effusion (60%), pulmonary artery enlargement (56%), and parenchymal pulmonary infiltration (54%).*

Conclusion: *Although chest radiography cannot be used for diagnosing or excluding PE, it contributes to non-invasive diagnostic assessment of PE through the exclusion of diseases that may mimic PE.* ***(Tanaffos 2008; 7(4): 19-23)***

Key words: *Pulmonary embolism, Chest radiography, Accuracy*

INTRODUCTION

Pulmonary embolism (PE) has been described as the most preventable and under-diagnosed cause of hospital deaths (1). Unsuspected or undiagnosed pulmonary embolism, first recognized at autopsy, remains an important problem (2-5). Two studies have suggested that undiagnosed acute pulmonary embolism contributes to the death of approximately 5% of patients who undergo autopsies. (3, 4). The majority of preventable deaths associated with PE can be ascribed to a missed diagnosis rather than to the failure of existing therapies. Estimatedly, 600,000 cases of PE occur per year in the United States resulting in 50,000-100,000 fatalities, and 5-10 % of hospital deaths (6, 7). Performing special tests for diagnosis of acute pulmonary embolism is not

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possible unless the patients refer to a specialized center to obtain diagnosis accurately.

Pulmonary embolism (PE) results in significant morbidity and mortality (1). Lack of awareness among physicians and non-availability of objective tests render diagnosis of PE difficult because clinical features are nonspecific and all diagnostic tests have certain limitations (1, 8, 9).

Pulmonary angiogram is the 'gold standard' for PE diagnosis but is invasive, impractical or unavailable in most clinical settings (10).

Chest radiography is a fundamental test for initial evaluation of cardiopulmonary diseases and has the advantage of being non-invasive (11). Chest radiographic observations are integral to the clinician's formulation of the probability of acute pulmonary embolism underlying cardiopulmonary symptoms (11) or resulting in cardiopulmonary complications. Interpretations influence both the decision regarding performing additional diagnostic tests for PE (12) and the likelihood that pulmonary embolism has caused an abnormal lung scan pattern (6, 13). Chest radiography is not a diagnostic test for PE but is extremely helpful in evaluation of other common cardio-respiratory diseases that mimic PE, like congestive heart failure (CHF), pneumonia and pneumothorax (1).

Data describing chest radiographic findings associated with the diagnosis of pulmonary embolism are limited (14).

In an effort by Greenspan et al. (15) to determine the sensitivity and specificity of the chest roentgenogram for the diagnosis of pulmonary embolism, 152 suspected cases were studied. Using positive pulmonary angiogram, 108 patients were proven to have pulmonary embolism. The interpreters were requested to report the presence or absence of pulmonary embolism and non-sufficiency of the roentgenogram. Average true-positive ratio (sensitivity) was 0.7, with a range of 0.52 to 0.88. Average true-negative ratio (specificity) was 0.59 and false-positive and false-negative ratios were 0.21 and 0.41, respectively. In his study, a predictive index reflecting the overall accuracy of diagnoses was calculated for the entire group which was 0.40, with a range of 0.17 to 0.57 (15).

According to his study, plain chest radiography does not have strong sensitivity and specificity to determine and confirm the diagnosis of PE, but it has a potential reliability to indicate abnormal findings in order to make a presumption of the presence of PE. On the other hand, this can help clinicians to make decisions for doing more evaluations through more specific tests to diagnose PE or other diseases that mimic PE pattern.

In another review article by Riedel (16), clinical assessment alone was considered unreliable to confirm the diagnosis of PE and the author believes that since the consequences of misdiagnosis are serious, objective testing such as chest radiography and pulmonary angiography is necessary. His article also indicates that no single test has ideal characteristics (100% sensitivity and specificity, no risk, and low cost). Some tests are good for confirming and some for excluding embolisms; those able to do both are often non-diagnostic.

The purpose of our study was to evaluate chest radiographic findings in diagnosed cases of acute pulmonary embolism and assess the value of the mentioned diagnostic test.

MATERIALS AND METHODS

We conducted a retrospective, chart review study on chest radiographs of all patients admitted to Masih Daneshvari Hospital in Tehran, Iran with a diagnosis of acute PE from April 2005 to February 2006.

There were 150 patients with PE impression. After excluding diseases that may imitate the radiographic pattern of PE such as pneumonia, COPD, lung cancer, and other underlying diseases,

we included 51 patients in our study. These 51 consecutive patients were diagnosed with acute pulmonary embolism by CT-scan (Simens Emotion single Detector). Echocardiography was also performed in one case.

Records were reviewed and three radiologists interpreted the chest radiographs. To avoid any bias, radiologists were blinded regarding the patients' diagnoses. Controversies encountered throughout the process were debated. Radiographs were characterized as normal or abnormal. When abnormal, we looked for other abnormal features like local or general oligemia, pulmonary artery enlargement or change in vessel size of pulmonary branches, loss of lung volume, tapering of pulmonary artery branches, consolidation, Hampton's hump, cavitations, pleural effusion or pneumothorax, cardiac enlargement, linear atelectasis, cephalization, mediastinal shift and etc (8). Descriptive statistics were analyzed using SPSS Ver.15.

RESULTS

There were 51 patients (31 males, 20 females) in the study out of which 32(62.7%) were ≤60 and the remaining were > 60 years old.

The diagnosis of acute pulmonary embolism was confirmed using methods summarized in Table 1.

Table1. Methods used to diagnose acute pulmonary embolism in 51 patients.

Methods	No. of patients (%)
HPQ *	3(5.9)
Single-slice spiral CT	36(62.7)
Echocardiogram	1 (2)
NVQ-DVT **	6 (11.8)
Other tests	5(17.6)

* HPQ = High-probability perfusion lung scan

** NVQ-DVT = Non-diagnostic ventilation and perfusion lung scan and deep vein thrombosis confirmed by compression ultra-sonography.

One of the 51 patients had some missing data. Among the remaining we found 48 (96%) abnormal chest radiographs. The most common abnormalities were pleural effusion (60%) and pulmonary artery enlargement (56%) in addition to parenchymal pulmonary infiltration (54%). Table 2 describes the chest radiographic findings.

We did not find any significant difference between the two age groups (Table 3) for frequency of radiographic findings.

Table 2. Chest radiographic abnormalities associated with acute pulmonary embolism.

Abnormalities	Patients (%)
Pleural effusion	30 (60)
Pulmonary artery enlargement	28 (56)
Parenchymal pulmonary infiltration	27 (54)
Tapering of pulmonary artery branches	14 (28)
Cardiac enlargement	9 (18)
Atelectasis	7 (14)
Oligemia	5 (10)
Hampton's hump	3 (6)
Cavitations	3 (6)
Mediastinal shift	3 (6)
Cephalization	3 (6)
Pneumothorax	1(2)
Loss of lung volume	1(2)

Table 3. Chest radiograph interpretations relative to age (<60 and ≥ 60 yrs.OH).

Interpretations	Age > 60 years	Age ≤60 years
Normal	none	2 (4%)
Oligemia	1 (2%)	4(8%)
Pulmonary artery enlargement	12(24%)	16(32%)
Loss of lung volume	1(2%)	none
Cardiomegaly	4 (8%)	5 (10%)
Tapering of pulmonary artery branches	4 (8%)	10 (20%)
Linear atelectasis	2(4%)	5 (10%)
Infiltrate	11(22%)	16(32%)
Hampton's hump	-	3(6%)
Cavitation	1(2%)	2(4%)
Pleural effusion	13(26%)	17(34%)
Pneumothorax	1(2%)	-
Cephalization	2(4%)	1(2%)
Mediastinal shift	2(4%)	-

DISCUSSION

Although chest radiographic abnormality provides a clue for diagnosis of patients who are unable to communicate (6), investigators have not described ante mortem chest radiographic findings when pulmonary embolism was first recognized postmortem.

We classify chest radiography in the last group of tests mentioned by Riedel in his study, because chest x-ray can show abnormal findings for PE as an average test for sensitivity and it hints to suspect pulmonary embolism, although it cannot exclude PE. Riedel pointed that standardized clinical estimates can be used to give a pre-test probability to assess, after appropriate objective testing, the post-test probability of embolism (16).

One of the few prospective studies that evaluated the reliability of chest radiography in diagnosis of PE has shown that chest radiography alone is a notoriously poor indicator of this diagnosis (1). Plain chest radiograph cannot be used per se to diagnose or exclude PE, but it may rule out other potentially life-threatening conditions such as pneumothorax (17).

It is not rare for PE to occur from other diseases, and physicians may misdiagnose it because of the attention to the primary illness. The most important issue is the concept that physician can get from the radiographs.

Finding sensitivity and specificity of radiographs in PE diagnosis was not the main purpose of this study. According to previous studies as well as this present study although chest radiography is not a reliable and valid test for diagnosis of PE, it can be used as a cost-effective and available technique to show several patterns that mimic pulmonary embolism aside more prominent diseases. Our observation, that pleural effusion was the most common chest radiographic abnormality associated with acute pulmonary embolism may reflect the propensity of acute pulmonary embolism to occur in the setting of underlying respiratory disease.

CONCLUSION

Although chest radiograph cannot be used to diagnose or exclude PE, it contributes to the non-invasive diagnostic assessment of PE through the exclusion of diseases that may mimic PE.

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