UNIVERSITY CLINIC FOR NUCLEAR MEDICINE, LJUBLJANA[1]
INSTITUTE OF ONCOLOGY, LJUBLJANA[2]

LUNG SCAN INTERPRETATION – COMPARISON OF DIFFERENT CRITERIA

Budihna N[1], Milčinski M[1], Šuštaršič J[2], Grmek M[1], Grošelj C[1], Porenta M[1]

Abastract – Authors reevaluated lung perfusion scans performed for suspected pulmonary embolism in 1988 and 1989 using new criteria proposed by international prospective study for pulmonary embolism diagnosis (PIOPED (5)).
The difference between the first reading and the reevaluation was found in 200 (25,35%) of patients examined by lung perfusion scaning using 99mTc–macro–aggregated albumin (99mTc–MAA). The probability of lung embolism increased in 185 (92,5%) of patients where the disagreement between the first and the second reading was found. The degree of discordance is low in the patients under 30 years of age (9,59%) and in the interpretation of normal lung perfusion scan (2,14%).
Ventilation lung scanning by 99mTc–diethylenetriaminepentaacetate aerosol (99mTc – DTPA), which was performed after perfusion lung scanning in 59 patients, influenced the diagnosis in 14 (23,72 %) of patients by lowering the predicted probability of lung embolism as assessed by perfusion scanning alone.
The systematic two–observer approach to lung perfusion scan analysis using PIOPED criteria is more sensitive for the diagnosis of pulmonary embolism than single–observer method. Ventilation scanning helps to avoid overdiagnosis of lung embolism specially in intermediate and high probability of pulmonary embolism.

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Introduction – Diagnosis of pulmonary embolism (PE) is difficult if only clinical and biochemical criteria are considered. Lung scintigraphy is one of the most important noninvasive imaging techniques. The interpretation of lung scans is liable to errors. As it has been proven with prospective studies, the systematic aproach is most succesful in the correct diagnosis of PE (1, 2, 3, 4). Since the systematic aproach has not been accepted in our laboratory before, we compared the results of nonsystematic lung scan interpretation to the aproach suggested by National Heart, Lung and Blood Institute in USA (5).

Patients and methods – Lung perfusion scanning was performed in 789 patients (pts) because of clinically suspected pulmonary embolism (PE) in the period of two years (from 1988 to 1989). The pts were from 10 to 90 years old, 448 (57,5%) were females.

Lung perfusion scanning was performed with a large view field gamma camera after intravenous application of 99mTc-human serum albumin macroaggregates (99mTc-MAA). During the injection the pts were supine, but the scans were taken in the sitting position whenever there were no serious contraindications. The scans were performed mostly in four projections: anterior, posterior, left and right posterior oblique. Few pts had scans taken only in anterior and both anterior oblique projections.

Ventilation lung scanning by 99mTc–diethylenetriaminepentaacetate aerosol (99mTc-DTPA) was performed after perfusion lung scanning in 59 patients in the same positions as perfusion scanning.

At the first diangnostic reading the scans were evaluated by several nuclear medicine physicians (sometimes they were less experienced) without strict criteria for lung scan interpretation. When ventilation lung scanning was not available, a recent thorax radiograph was compared to the lung scan serving as an estimation of the lung ventilation in the pts.

On reevaluation PIOPED criteria were used (Table 1). These are essentially modified Biello's criteria, known as PIOPED (prospective study of pulmonary embolism diagnosis (5)).According to them, the scans were assessed by two observers as normal, concordant with low, intermediate or high probability of lung embolism.

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Table 1 – PIOPED criteria for diagnostic reading of lung perfusion scans

PROBABILITY OF PE	PIOPED CRITERIA
NORMAL	NORMAL PERFUSION
LOW	(1) SMALL Q DEFECTS REGARDLESS OF NUMBER, V OR CXR FINDINGS (2) Q DEFECT SUBSTANTIALLY SMALLER THAN CXR DEFECT (V IRRELEVANT) (3) V-Q MATCH IN ≤ 50% ONE LUNG OR ≤ 75% OF ONE LUNG ZONE CXR NORMAL OR NEARLY NORMAL (4) SINGLE MODERATE Q WITH NORMAL CXR (V IRRELEVANT) (5) NONSEGMENTAL Q DEFECT
INTERMEDIATE	(1) ABNORMALITY THAT IS NOT DEFINED BY EITHER »HIGH« OR »LOW«
HIGH	(1) TWO OR MORE LARGE Q. V AND CXR NORMAL (2) TWO OR MORE LARGE Q IN WHICH Q IS SUBSTANTIALLY LARGER THAN EITHER MATCHING V OR CXR (3) TWO OR MORE MODERATE Q AND ONE LARGE Q. V AND CXR NORMAL (4) FOUR OR MORE MODERATE Q. V AND CXR NORMAL

Legend: Q = perfusion, V = ventilation, CXR = chest X ray (chest roentgenogram)

Table 2 – The degree of discordance between the first and the second interpretation of lung perfusion of lung perfusion scans according to the age of the patients

AGE (YEARS)	No OF PTS	No OF DISCORDANT INTERPRETATIONS	% OF DISCORDANCE
≤29	73	7	9.59
30 - 39	83	22	26.51
40 - 49	119	28	23.54
50 - 59	136	37	27.21
60 - 69	189	50	26.46
≥ 70	189	56	29.63
ALL	789	200	25.35

Table 3 – The degree of discordance between the first and the second interpretation of lung perfusion scans according to the scintigraphic probability of pulmonary embolism

SCAN RESULT	No OF PTS	No OF DISCORDANT INTERPRETATIONS	PER CENT DISCORDANCE
NORMAL SCAN	140	3	2.14 %
LOW PROBABILITY OF PE	213	35	16.43 %
INTERMEDIATE PRO-BIBILITY OF PE	181	92	50.83 %
HIGH PROBABILITY OF PE	255	70	27.45 %
ALL	789	200	25.35 %

Results – The disagreement between the first interpretation of lung perfusion scans and the reevaluation by two observers was found in 200 (25,35%) dof 789 patients. The probability of lung embolism increased in 185 (92,5%) of patients where the disagreement between the first and the second reading was found. The degree of discordance is low in the patients under 30 years of age (9,59% (Table 2)) and in the interpretation of normal lung perfusion scan (2,14%), (Table 3).

Ventilation lung scanning by 99mTc-diethylenetriaminepentaacetate aerosol (99mTc-DTPA), which was performed after perfusion lung scanning in 59 patients, influenced the diagnosis in 14 (23,72%) of patients by lowering the predicted probability of lung embolism as assessed by perfusion scanning alone.

Discussion – Disagreement in repeated readings of diagnostic pictues was first studied in radiology. According to Smith (7), following double reading of 300 consecutive radiologic examinations, diagnostic disagreements occur in about one-third of all filmreadings and about two-thirds of all errors are found by modified dual-reading techniques.

In our study, lung scintigrams performed in last two years were reevaluated by two experienced nuclear medicine physicians using PIOPED criteria and compared to the results of random aproach of several individual, sometimes less experienced, nuclear medicine physicians who were not strictly using special criteria for lung scan interpretation. The percent of discordance between the first and the second reading of the scans in our study was comparable to the results published by Smith. An important difference was found in some of the patients in whom repeated reading increased the probability of lung embolism from low to intermediate or from intermediate to high. In the latter group, the disagreement was partly due to illdefining of larger than segmental defects composed of several juxtaposed segments thus overlaying the anatomic borders. Further, problems have arisen as already noted by Sullivan (6), in the definition of the size of the subsegmental defects. The multiobserver aproach is of great value in these cases.

In our pts the ventilation scans mostly decreased the probability of lung embolism estimated on the basis of perfusion scans only. Unfortunately they were not performed frequently enough in all patients.

We conclude that the systematic applying of PIOPED criteria, especially with multiobserver aproach, surpasses the nonsystematic scan analysis particularly in the borderline scans. Substantial experience is necessary for interpreters. Ventilation scan is peremptory in the cases of intermediate and high probability of lung embolism estimated on the base of perfusion scan, to avoid the scintigraphic overdiagnosis of high probability of lung embolism.

Povzetek

PONOVNA OCENA SCINTIGRAMOV PLJUČ BOLNIKOV S SUMOM NA PLJUČNO EMBOLIJO

Avtorji poročajo o ponovni oceni scintigramov pljuč pri 789 bolnikih, ki so jih preiskovali v letih 1988 in 1989 zaradi kliničnega suma na pljučno embolijo. Pri vseh bolnikih je bila izvedena perfuzijska scintigrafija pljuč z 99mTc–albuminskim makroagregatom (99mTc-MAA). Ventilacijsko scintigrafijo pljuč z aerosolom (99m Tc-dietilentriaminopentaacetata (99mTc-DTPA) so izvedli po perfuzijski scintigrafiji 59 bolnikom.

Pri ponovnem ocenjevanju scintigramov avtorji uporabljajo merila priporočena v mednarodni prospektivni študiji za diagnostiko pljučnih embolizmov (PIOPED (5)).

Pri 200 (25,35%) bolnikih od 789 se razlikujejo rezultati prvega in drugega odčitanja perfuzijskih scintigramov pljuč. Stopnja neskladja je najmanjša pri bolnikih mlajših od 30 let (9,59%) in pri normalnih scintigramih pljuč (2,14%). Z uporabo kriterijev PIOPED se pri 185 (92, 5%) bolnikih od 200 poveča verjetnost pljučnih embolizmov.

Pri 14 (23,72%) bolnikih od 59 rezultat dodatne ventilacijske scintigrafije pljuč zmanjša verjetnost obstoja pljučnih embolizmov.

Interpretacija scintigramov pljuč z dvema odčitovalcema,ki uporabljata merila PIOPED, poveča občutljivost (in s tem možnost lažno patoloških rezultatov) perfuzijske scintigrafije v diagnostiki pljučnih embolizmov v primerjavi s tehniko z enim odčitovalcem. Ventilacijska scintigrafija pljuč, ki sledi perfuzijski scintigrafiji, zmanjša število lažno patoloških rezultatov perfuzijske scintigrafije, posebno tistih, ki kažejo srednjo in visoko verjetnost pljučnih embolizmov.

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Author's address: Dr Nataša Budihna, Univerzitetna klinika za nuklearno medicino, Zaloška 7, Ljubljana