Role of Combined Perfusion/Ventilation Scanning in Diagnosis of Pulmonary Embolism

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خـلاصــة

أجريت هذه الدراسة على 200 مريضاً باشتباه جلطة رئوية ممن تتراوح أعمارهم بين 9 إلى 74 عاماً بمتوسط 41,9 ± 14,6 عاماً .

وقد وجد أن صعوبة التنفس وألم الصدر والبصاق الدموي هي أكثر الأعراض المصاحبة شيوعاً بنسبة 67.5٪ و49,5٪ و14,5٪ على التوالي، في حين مثلت سرعة ضربات القلب أكثر العلامات المصاحبة بنسبة 64,5٪ يليها بقرقعة رئوية وتجمع مائي بالأطراف السفلى بنسبة 28,5٪ و 14٪ على التوالي .

هذا وقد كانت أمراض القلب تمثل أكثر عوامل الخطورة بنسبة 47٪ يليها جلطات أوردة الساقين والعمليات الجراحية وانسداد الشعب الهوائية بنسب 24٪ و10٪ و 9,5٪ على التوالي .

وقد أظهرت النتائج أن المسح الدموي كان طبيعياً في نسبة 27,5٪ بينما كانت احتماليات جلطات الرئة قليلة ومتوسطة وعالية في 7٪، و23,5٪، و42٪ كما أظهرها المسح على التوالي .

وقد غيّر المسح التنفسي من نتائج احتمالات نفس تدفق الدم بالمسح الدموي للرئة إلى 18,5٪، و19٪، و21,5٪ في الحالات القليلة والمتوسطة والعالية الإحتمالية على التوالي .

وبالإضافة إلى ذلك فقد تم تشخيص عدم حدوث جلطات في 3,5٪ من حالات نفس تدفق الدم كما أظهرها المسح الدموي .

وقد ثبت أن هناك علاقة ذات مغزى بين زيادة الأعراض والعلامات وبين الإحتمالية التشخيصية للجلطة بالمسح الرئوي بالنسبة للمجموعتين المتوسطة والعالية الإحتمالية .

كـمـا يبـدو أن نـسـبـة الجـلطـات الرئـوية فـي ازديـاد مـع زيـادة عـدد احتـمـالات الـخطـورة فـي المـجـمـوعـة الـعـالـيـة الإحـتـمـالـيـة الـتـشـخـيـصـيـة للجـلطة كما تـظـهر بـالمـسـح الرئـوي .

Abstract

This study was conducted on 200 patients with suspected pulmonary embolism. Their age ranged 9-74 years with a mean age of 41.9+14.6 years. The commonest symptoms were dyspnea; chest pain and haemoptysis in 67.5%, 49.5% and 14.5% respectively, whereas the main signs were tachycardia in 64.5% followed by rales and oedema of lower limbs in 28.5% and 14% respectively. Cardiac diseases were presenting the main risk factor in 47% followed by DVT, surgery, COLD in 24%, 10% and 9.5% respectively.

Perfusion lung scan was normal in 27.5%, whereas low, intennediate and high probability scans were seen in 7%, 23.5% and 42% respectively. The addition of ventilation scan, change probability of perfusion defects into 18.5%, 19% and 31.5% in low, intermediate and high probability scans respectively. In addition 3.5% of patient diagnosed as non-embolic disease. There was significant correlation with increase number of symptoms and signs in relation to scan probability in both whole group and high probability group. Also, the incidence of pulmonary embolism appear to be additive with increase number of risk factors in the group of high probability scans.

Introduction:

Pulmonary thromboembolism is a common and potentially serious condition whose clinical diagnosis is rather difficult. It is a leading cause of morbidity and mortality seen in an emergency situation with respiratory or cardiac complaints. It is not a disease per se, but it is a complication of venous thrombosis, right cardiac clots, bone fracture, pregnancy or malignant tumours. The deep veins of the lower extremities are dominant source of clinically significant pulmonary emboli. This fact has an important epidemiologic, diagnostic and therapeutic value (Touya et al., 1986; and Bomanji et al., 1992).

The introduction of perfusion lung scintigraphy in 1964 made it possible for the first time to assess objectively pulmonary circulation in

patients with clinically suspected pulmonary embolism. Subsequelltly with the implementation of ventilation scanning, 1970, the accuracy of lung scintigraphy is further imporved (Van Beek et al., 1993).

The aim of this study is to assess the value of ventilation / perfusion scintigraphy in the diagnosis of pulmonary embolism.

Material And Methods:

The study included 200 patients with suspected pulmonary embolism (PE). All patients were asked about risk factors leading to PE to elicit the main risk factors in the studied group. Clinical examination with stress on important clinical signs as heart rate, respiratory rate, lower limb oedema, rales, crepitus and gallop.

Chest X-ray with 24 hours from the time of scanning is a must.

Ventilation/ Perfusion Scans:

Ventilation lung scan was done using radioaerosol delivery system (venticis II) (Fig.I). Aerosol size has a medium diameter of 0.92 um with a geometric standard deviation of 2.5. A dose of 740-1110 MBq (20-30mCi) ^{99m}Tc-DTPA in 2-3 ml were injected into the nebulizer through the external loading port, than the oxygen flow is turned on until 7-10 liter/min. The patient is asked to breathe through the mouth piece for 5-10 minutes after clamping his nose. By the end of the breathing time oxygen is turned off, nose clip is removed and the patient is given a mouth wash. The patient is taken into the gamma camera room and imaging was done in 6 projections (anterior, right lateral, left lateral, posterior, posterior right oblique and posterior left oblique), each for 150 k counts.

Perfusion lung scanning was done 4 hours later, in the same supine position using 111-185 MBq (3-5 mCi) of ^{99m}Tc-MAA through a wide caliber butterfly needle, taking into considration not to withdraw blood into the syringe. Duri··g injection, the patient is asked to take few deep breaths. The patient is then imaged on the same camera in the same position taking the same projections for 500 K counts.

Both ventilation and perfusion scans in association with recent chest-x ray were interpreted t v the nuclear medicine team in the department according to the criteria of Biello et al., (1979).

Digital subtraction angiography was done within 48 hours following scanning.
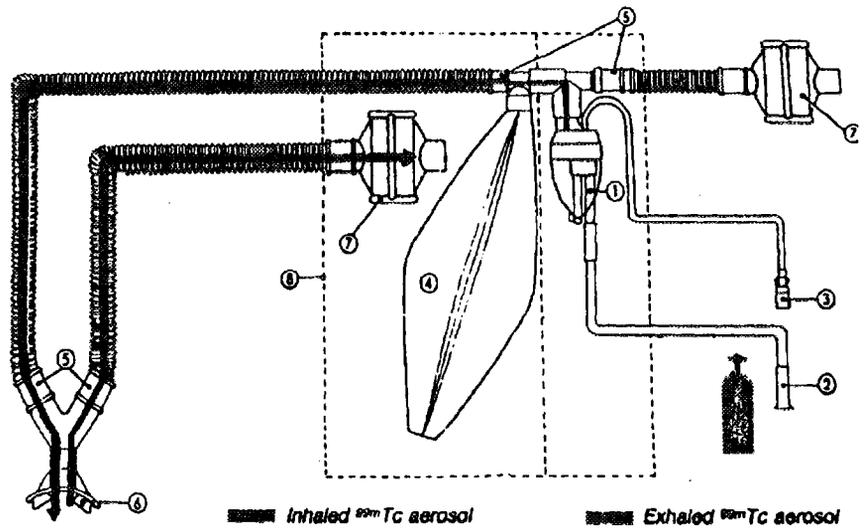
Fig. 1: Radioaerosol Delivery System 1. Nebulizer, 2. Air Supply Tubing, 3. External loader, 4. Reservoir bag, 5. Valves, 6. Mouth piece, 7. Filter trap, 8. Lead shielded box.

Results:

The 200 patients included in this study have an age ranged from 9 years to 74 years with a mean age of 41.9 ± 14.6 years.

The commonest first symptom was dyspnea in 67.5%, chest pain in 49.5% and haemoptysis in 14.5%. only 50 patients (25%) presented with one symptom, while the remaining 150 patients have more than one symptom (75%).

The commonest first sign was tachycardia in 64.5% followed by rales and oedema of lower limbs in 28.5% and 14% respectively.

Cardiac diseases were presenting the main risk factor in 47% followed by DVT, surgery and COLD in 24%,10% and 9.5% respectively.
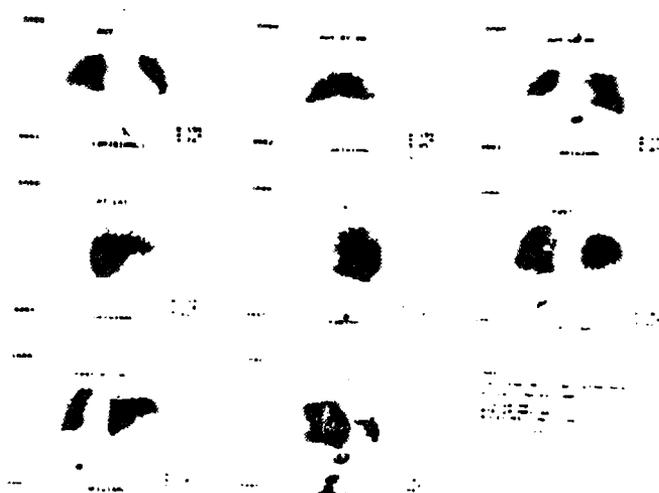
Perfusion/ Ventilation Lung Scan:

Fifty five patients of our group showed normal perfusion lung scan (17.5%), whereas the remaining 145 patients (27.5%) showed perfusion defect with low, intermediate and high probability scans in 7%, 23.5% and42% respectively (Table 1).

Table (1): The value of combined ventilation/ perfusion scanning versus perfusion scanning only in diagnosis of pulmonary embolism

Perfusion scans	No.	%	V/P Scans	No.	%
Nonnal	55	27.5	Nonnal	55	27.5
Low probability	14	7	Low probability	37	18.5
Intennediate probability	47	23.5	Intennediate probability	38	19
High probability	84	42	High probability	63	31 .5
Non-embolic event	-	-	Non-embolic event	7	3.5

The combined ventilation/perfision scintigraphy leadstochangeinthe scan results in those with perfusion defects with the incidence of low, intermediate and high probability scans in 18.5%, 19% and 31.5%. The incidence of normal scan was the same, with diagnosis of nonembolic pulmonary disorder in 7 patients (3.5%) (Table 1). So, the addition of ventilation to perfusion scans of pulmonary embolism in 58 patients (29%), change in diagnosis in 7 patients (3.5%), whereas the remaining 80 patients (40%) have the same diagnostic prrobability as well as the normal 55 patients (27.5%) (Fig.2A,B).

Fig.(IIA): Normal Ventilation lung scan
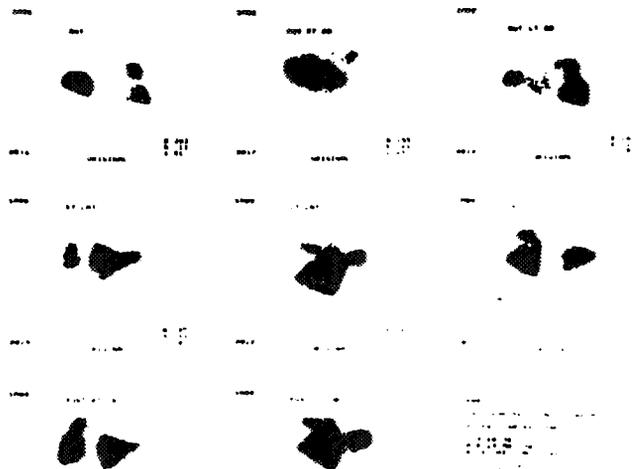
Fig.(IIB): Multiple bilateral mismatched perfusion defects (high probability)
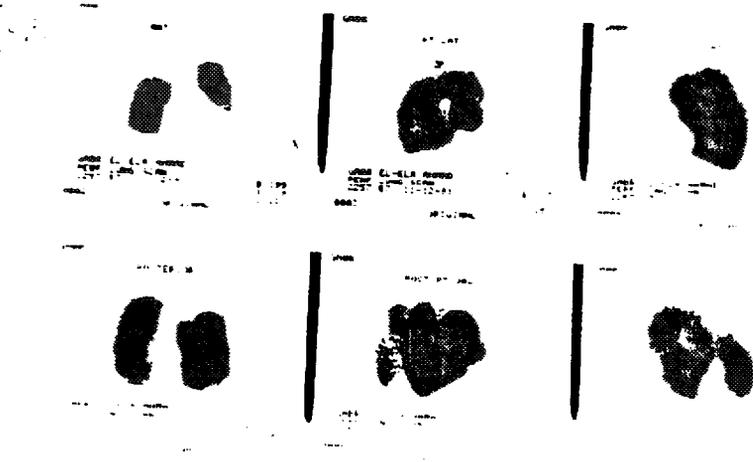
Digital subtraction angiography was done in 17 patients with intermediate or high probability group with concordant results in 11 patients, whereas one case was diagnosed as old embolic event and the other 5 cases were negative for pulmonary embolism (Fig.3A,B,C).
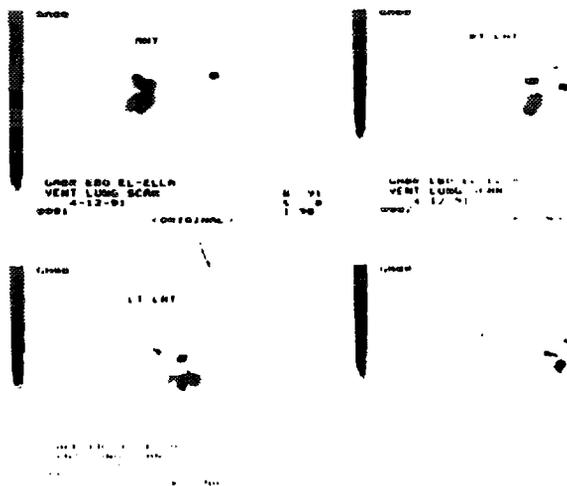
Fig. (IIIA) : Ventilation scan with multiple bilateral defects suggestive of chronic obstructive lung disease

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Scan pattern in relation to symptoms:

In the high probability group, higher incidence of main symptoms of dyspnea, chest pain and haemoptysis was evident in 28.3%, 8.7% and 8.7% respectively.

Fig. (IIIB) : Perfusion scan with right apical segmental perfusion defect.
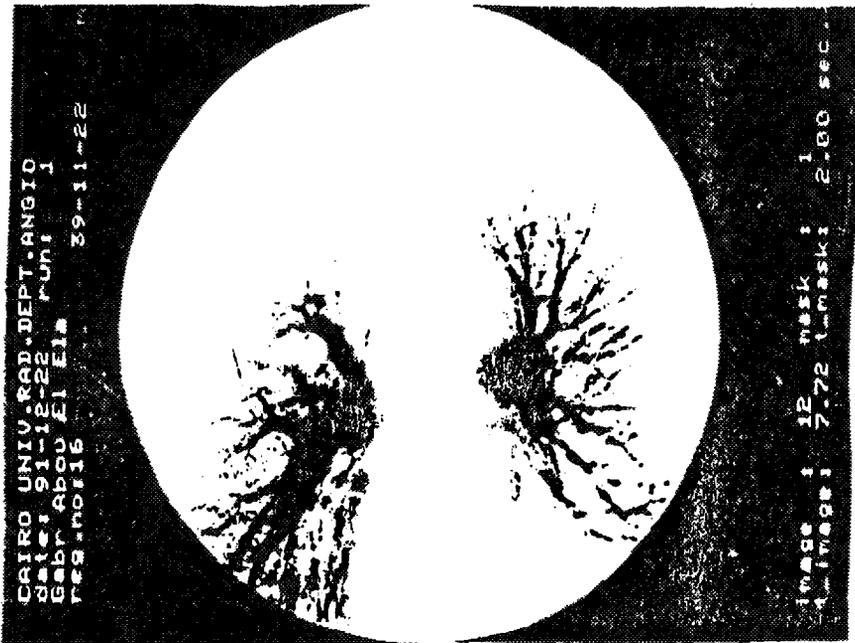
Fig (IIIC) : Normal digital subtraction angiography

Also, the incidence of commonest symptoms dyspnea in high, intermediate and low probability group, were 28.3%, 21.7% and 1 9.5% with no significant difference between the three groups. However, the total incidence of positive pulmonary scanning with one symptoms was 16.7% as compared to 83.3% with more than one complaint with statistical significant difference between both groups (P<0.001). Furthermore, an associated increase in the incidence of high probability scans with more than one complaint in 39.8% versus 5.8% in those with one complaint with significallt difference between both groups (P<0.001) (Table 2,3).

Table (2): Correlation Between main symptoms, signs and risk factors with V/P scans:

	Low Probability		Intermediate probality		High Probability	
	No.	%	No.	%	No.	%
Main Symptom:						
Dyspnea	27	19.5	30	21.7	39	28.3
Chest pain	6	4.4	4	2.9	12	8.7
Haemoptysis	4	2.9	4	2.9	12	8.7
Main Sign :						
Tachycardia	21	15.3	27	19.5	47	34.1
Tachypnea	8	5.8	3	2.2	9	6.5
Cyanosis	5	3.6	8	5.8	4	2.9
Rales	1	0.7	-	-	-	-
Main Risk Factor:						
Heart disease	22	16	21	15.2	29	21
DVT	3	2.1	7	5.1	19	13.8
COLD	11	8	8	5.8	-	-
Surgery	1	0.7	1	0.7	13	9.5

Scan Pattern in relation to risk factor:

The incidence of positive pulmonary scintigraphy in relation to commonest risk factors were 52.2%, 21%, 13.8% and 10.9% for heart

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diseases, DVT, COPD and surgery respectively. The majority of surgical group were in the high probability group, whereas no single case of COLD was seen in high probability group (Table 2). The incidence of positive V/P scans for one risk factor 49.1% versus 50.9% in those with more than on risk factor with no significant difference between both groups. While in the high probability group, the incidence for one risk factor was 13% compared to 32.6% for more than one risk factor with significant difference between both groups (P<0.05) (Table3).

Table 3 : Correlation between number of complaint, signs and risk factors with V/P scans

	Low Probability		Intermediat probality		High Probability		Total (L)	
	No.	%	No.	%	No.	%	No.	%
One Symptom	8	5.8	7	5.1	8	5.8*	23	16.7*
More than one symptom	29	21	31	22.4	55	39.9	115	83.8*
No or one sign	5	3.5	1	0.7	3	2.2*	9	6.4*
More than one sign	32	23.3	37	26.8	60	43.5*	129	93.6*
One risk factor	32	23.1	18	13	18	13**	68	49.1
More than one risk factor	5	3.7	20	14.6	45	32.6**	70	50.1

* P<0.001   ** P<0.05

Scan Pattern in Relation to Clinical Sign:

In those with high probability scan for PE, the commonest sign was tachycardia in 34.1% as compared to 19.5 and 15.3% in those with intermediate and low probability groups, with no significant difference between the three groups. It was found that with increase number of clinical signs, the incidence of positive pulmonary scans for PE was 93.6% versus 6.4% in those with no or one clinical signs with significant difference between both groups (P < 0.0001). Similarly, the incidence of high probability scans was 43.6% and 2.2% for both groups with P value < 0.001 (Table 2,3).

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Discussion :

Perfusion lung scanning has been utilized frequently to evaluate patients with suspected PE, such procedure is simple, safe and sensitive to define the status of pulmonary flow, but it lacks specificity. In urokinase/streptokinase PE trail 906 patients with perfusion scans suggestive of PE and all had angiography and 734 (83%) pulmonary angiography did not diagnose pulmonary embolism (Bell et al., 1974).

In this study, only 55 patients (27.5%) showed normal perfusion lung scan, with the incidence of positive perfusion scan as high as 72.5%. To overcome the problem of nonspecificity of perfusion scan, the addition of ventilation scintigraphy has been suggested. In this work, the addition of ventilation scan exclude the diagnosis of PE in 3.5% of patients whereas there was no change in incidence of normal perfusion scans. Ventilation imaging change the diagnosis of probability in 65 patients (32.5%) with more increase in low probability to 18.5% with reduction of intermediate and high probability groups to 19% and 31.5% respectively. Such figures with highest incidence in high probability group is similar to these reported by Hull et al., (1985), whereas PIOPED group (1990) showed an incidence of 14%, 34% and 13% in the normal, low, intermediate and high probability scans. An other different study reported by Bomanji et al., (1992) with an incidence of 37%, 27%, 14% and 22% in the same scan groups respectively. Such divergence in incidence between various groups reflects differences in patient population, selection criteria and clinical threshold for obtaining pulmonary scintigraphy.

The classic symptoms for PE such as pleuritic chest pain and haemoptysis were found more frequent with submassive emboli (Hirsh et al., 1981). Also, the PIOPED study in 1990 demonstrated a correlation between the size of pulmonary embolism with frequency of main symptoms including dyspnea, chest pain, cough and haemoptysis in 79%, 58%, 44% and 16% respectively. Comparable results as regards symptomatology were found in this work with dyspnea representing the main symptoms for the whole group with an incidence of 67.5 %, with lower incidence of chest pain and haemoptysis in 18% and 14.5% respectively. Also, a statistically significant difference was found between the number of complaints and scan finding for the whole group and for those with high probability scans for PE.

Similarly, the role of clinical signs was identified in our study by the statistically significant correlation between the number of signs and the scan results for the whole group and high probability group, denoting increased number of clinical signs in association with scan abnormality and with pulmonary embolic events.

The risk of pulmonary embolism appear to be additive with increase risk factors (Conn, 1976 and Moser, 1990). This was proved only in high probability group, in this work with an incidence of 13%, 32.6% for one risk factor and multiple risk factors with significant difference between both groups.

It should be accepted that the combined V/P scans are more sensitive for detection of PE in correlation with clinical symptoms, signs and risk factors, such prospective study may lead to better diagnostic and therapeutic strategies.

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