Comparison of chest multiple detector computed tomography and perfusion scintigraphy in pulmonary embolism diagnosis

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ABSTRACT

Objectives: Pulmonary embolism (PE) occurs most commonly as a complication of deep vein thrombosis (DVT) and emboli, where thrombus leads to blockage of the pulmonary artery. Chest multiple detector computed tomography (MDCT) and lung perfusion scintigraphy are diagnostic modalities that are of immense importance in the diagnosis of PE. The aim of this study was to compare chest MDCT and lung perfusion scintigraphy in the PE diagnosis and to determine which modality is superior in the diagnosis of PE.

Materials and methods: This was a cross sectional study. Based on recorded predisposing factors, symptoms, laboratory findings and clinical presentation patients with clinically suspected PE were screened for the study. Chest MDCT and lung perfusion scintigraphy were used for PE detection.

Results: In total 57 patients without significant difference in gender were enrolled in the study. Chest MDCT detected PE in 49.1% of patients while in 50.9% of patients PE was not proven. By means of lung perfusion scintigraphy, PE was listed as a diagnosis for 59.6% of patients while for 40.4% of patients there were no scintigraphy signs of PE. Segmental PE was more frequently demonstrated than massive PE. Chest MDCT in the diagnosis of PE showed a sensitivity of 100%, specificity of 100%, positive predictive value (PPV) of 100% and negative predictive value (NPV) of 100%. Perfusion scintigraphy showed a sensitivity of 83.35%, specificity of 73.91%, PPV of 82.35% and NPV of 73.91%. Perfusion scintigraphy showed false positive findings in 17.6% of patients in the diagnosis of PE.

Conclusion: Chest MDCT is superior diagnostic modality in the diagnosis of PE compared to lung perfusion scintigraphy because it allows direct visualization of the thrombus in the pulmonary arteries and visualization of sub segmental branches of the pulmonary artery, and display of lung parenchyma and mediastinal structures.

Keywords: Pulmonary embolism, chest multiple detector computed tomography, lung perfusion scintigraphy.

Original article

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INTRODUCTION

Pulmonary embolism (PE) is not a disease itself, but represents a complication of another pathological condition, the most commonly of deep vein thrombosis (DVT) and emboli, where thrombus leads to blockage of one or both pulmonary arteries with consequent obstruction of blood flow in the lung tissue and is common cause of death. Virchow’s Triassic: venous stasis, blood vessels endothelial damage and blood hypercoagulability usually cause DVT. Also, DVT can be caused by other provoking factors such as longer immobilization, local obstruction, obstructive pulmonary diseases, congestive heart failure and pregnancy [1-4].

The pulmonary artery (truncus pulmonalis) exits the right ventricle, directed cranially and backwards, where are branches into two main branches: into the right and the left pulmonary artery. The mentioned arteries are divided into lobar, segmental and sub segmental branches which, together with pulmonary vein branches, follow the appropriate bronchial branches. Early diagnosis of PE and adequate treatment reduces the time and cost of treatment, as well as the incidence of complications and mortality rates [5,6]. The diagnosis of PE is made based on the clinical status, laboratory results and diagnostic procedures, of which the most commonly used are chest X-ray, pulmonary angiography, perfusion lung scintigraphy, single photon emission computed tomography (SPECT), magnetic resonance imaging/magnetic resonance angiography (MRI/MRA) of pulmonary arteries and chest multiple detector computed tomography MDCT (7,8).

The aim of our research was to compare chest MDCT and lung perfusion scintigraphy in the PE diagnosis and to determine which modality is superior in the diagnosis of PE.
Patients and methods
The cross-sectional clinical study was conducted from January 2015 to December 2015 at the Clinical Center University of Sarajevo, Bosnia and Herzegovina. The study was approved by the Ethics Committee of Clinical Center University of Sarajevo.
Patients with clinically suspected PE based on recorded predisposing factors, symptoms, laboratory findings and clinical presentation were screened for the study. Inclusion criteria for enrollment in the study were dyspnea, chest pain, cough, hemoptysis, increased levels of D-dimer, post-operative status, conditions after fractures, malignant diseases, positive history of the existence of DVT and PE, and a positive family history of the existence of DVT and PE. Exclusion criteria were the lack of apnea, the inability of patients to take appropriate (lying down) position for the examination, increased blood levels of urea and creatinine, high fever and pregnancy.
Chest MDCT and lung perfusion scintigraphy were used as diagnostic modalities in PE detection. We performed chest MDCT examination using the unit GE Lightspeed VCT 64 Slice, which technical features includes X-ray tube rotation time of 0.5 s, a voltage of 120 KV and a layer thickness of 0.6 mm with the application of 80-100 ml intravenous iodine contrast media. Pathognomonic sign of PE is filling defect in pulmonary artery. Lung perfusion scintigraphy was performed in the supine position with the intravenous administration of technetium macroaggregate albumin (MAA TC 99). Lung perfusion deficit suggested PE, but it is also seen in other conditions such as lung tumors infiltrating pulmonary arteries, pneumonia, pulmonary artery hypoplasia or aplasia. Radiation dose was significantly higher in MDCT than in lung perfusion scintigraphy.

Results
The total number of patients with clinically suspected PE was 57 and average age 57. Figure 1 shows the incidence of PE using chest MDCT, while Figure 2 shows the incidence of PE using lung perfusion scintigraphy. Table 1 shows the comparative numerical and percentage relationships of neat and pathological findings of MDCT and perfusion scintigraphy, while Table 2 shows the analysis of the accuracy of MDCT and perfusion scintigraphy in diagnosis of PE. Based on the analysis of accuracy the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated.

Discussion
In total 57 patients, average age 57 and without significant difference in gender, for 28 patients (49.1%; 31.6% with segmental PE and 17.5% with massive PE) PE was demonstrated by chest MDCT while for 29 patients (50.9%) PE has not been proven (X2=1.445; p=0.4855). For 34 patients (59.6%; 39.0% with segmental PE and 21.0% with massive

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PE) PE was demonstrated by lung perfusion scintigraphy while for 23 patients (40.4%) PE has not been proven (X2=1.402; p=0.4962). MDCT in the diagnosis of PE shows a sensitivity of 100% and specificity of 100%, PPV of 100% and NPV of 100.0% while perfusion scintigraphy shows a sensitivity of 82.35% and specificity of 73.91%, PPV of 82.35% and NPV of 73.91%. For the 16 Slice MDCT in the PE diagnosis for sub segmental branches of pulmonary arteries Sostman et al. [9] reported the sensitivity of 86.0% and specificity of 100% [9].

Regarding MDCT, pathognomonic sign of PE is filling defect in the pulmonary artery. Superiority of MDCT is morphological structure analysis and possibility of clearly visualization of lung parenchyma, mediastinal soft tissues and vascular structures. MDCT in our study diagnosed a tumor that infiltrates the pulmonary artery (in three patients), pneumonia (in two patients) and severe hypoplasia of the pulmonary artery (in one patient). Our results also showed that the segmental PE is more frequently proved than the massive PE.

In the diagnosis of PE, lung perfusion scintigraphy showed false positive findings in 6 patients (17.6%). Pathological findings in those patients suggested PE because of lung perfusion deficit, but this sign is also seen in other conditions such as lung tumors infiltrating pulmonary arteries, pneumonia, pulmonary artery hypoplasia and aplasia. Negative lung perfusion scintigraphy finding with almost 100% certainty excluded the PE. Cross et al. [10] reported that the sensitivity of 85.1%, specificity of 82.5%, PPV of 88.1% and NPV of 82.5% indicate that the perfusion scintigraphy is an important and reliable diagnostic modality in the diagnosis of PE [10]. In addition, radiation doses in perfusion scintigraphy of 0.28 to 0.9 mSv, are significantly lower compared to doses in chest MDCT, lung radiation doses in perfusion scintigraphy are significantly lower compared to doses in chest MDCT, lung perfusion scintigraphy should be diagnostic method of choice for pregnant and breastfeeding women.

**CONFLICT OF INTEREST**
The authors declare no conflict of interest.

**References**


