INCIDENCE OF PULMONARY THROMBOEMBOLISM IN PATIENTS SUBJECTED TO COMPUTERIZED TOMOGRAPHY AND PULMONARY ANGIOGRAPHY AT THE UNIVERSITY CLINICAL HOSPITAL MOSTAR

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Received on 12.11.2024. *Reviewed on 14.11.2024.* *Accepted on 15.11.2024.*

ABSTRACT

Introduction: Pulmonary embolism is a serious medical problem with high mortality if not recognized in time. CT pulmonary angiography is a key method for diagnosing pulmonary embolism in patients with nonspecific symptoms such as shortness of breath, chest pain, and elevated D-dimer values.

Objective: To determine the incidence of pulmonary embolism in patients undergoing CT pulmonary angiography at the University Clinical Hospital Mostar.

Subjects and methods: A retrospective study included 300 patients with suspected pulmonary embolism who underwent CT pulmonary angiography. Technical imaging parameters included a low-dose protocol with intravenous iodine contrast. The results were analyzed by descriptive statistics, with an assessment of the frequency of pulmonary embolism, thrombus localization and incidental findings.

Results: Pulmonary embolism was diagnosed in 27% of patients, with the most frequent involvement of the lobar arteries (43%). Massive emboli were recorded in 33% of cases. The average age of the respondents was 64 years, with an almost equal gender distribution. Elevated D-dimers were not sufficient to confirm the diagnosis in most patients. Incidental findings included pleural effusions, pneumonia, and tumors.

Conclusion: CT pulmonary angiography is necessary for accurate diagnosis of pulmonary embolism, especially in patients with nonspecific symptoms. The results highlight the need to combine clinical and imaging methods, as well as adapt diagnostic protocols to reduce radiation exposure and optimize treatment outcomes. In the local context, these guidelines can improve diagnosis and treatment.

Keywords: Pulmonary thromboembolism, incidence, computed tomography, pulmonary angiography, clinical diagnostics

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INTRODUCTION

Pulmonary embolism (PE) represents a serious medical problem and is one of the most common causes of cardiovascular death after myocardial infarction and stroke (1, 2). This potentially fatal complication occurs when a blood clot, usually from the lower extremities, breaks off and travels through the bloodstream to the pulmonary arteries, where it can partially or completely block blood flow. The most common cause of pulmonary embolism is deep vein thrombosis (DVT), where thrombi form in the deep veins of the lower extremities or pelvis (3). According to estimates, pulmonary embolism is responsible for a significant number of hospitalizations, and without timely diagnosis and treatment can lead to serious consequences, including death (4).

The clinical picture of PE is diverse and can vary from asymptomatic cases to acute respiratory failure and cardiovascular collapse (5). Because of the non-specific symptoms, the diagnosis of PE is often challenging (6). Symptoms such as sudden shortness of breath, chest pain, rapid breathing and tachycardia, which are the most common signs, also occur in other conditions such as myocardial infarction or pneumonia (7). For this reason, the application of modern diagnostic tools that enable timely and accurate identification of pulmonary embolism is of crucial importance (8).

CT pulmonary angiography (CTPA) is today the gold standard for non-invasive diagnosis of pulmonary embolism (9). This method uses computed tomography and intravenous contrast medium to visualize the pulmonary arteries and allow precise localization and estimation of embolus size (10). Due to its high diagnostic accuracy, CTPA has gradually replaced previously used methods, such as ventilation-perfusion lung scintigraphy (V/Q scintigraphy) (11). In addition to diagnosing pulmonary embolism, CTPA provides information on potential comorbidities and abnormal findings, such as lung tumors, pleural effusions, and other pathological processes (12).

The importance of a timely diagnosis of PE is great because it enables the rapid initiation of appropriate therapy, which reduces mortality and improves the long-term prognosis of patients (13). Standard therapeutic approaches include the use of anticoagulants, thrombolytic therapy and, in severe cases, surgical intervention (14). Research shows that timely diagnosis of pulmonary embolism is essential to reduce the risk of recurrent thromboembolism and long-term consequences such as chronic thromboembolic pulmonary hypertension (15).

This retrospective study was conducted at the University Clinical Hospital Mostar, with the aim of determining the incidence of pulmonary embolism in patients undergoing CTPA, and analyzing the demographic and clinical characteristics of these patients (16). Also, the research includes the evaluation of additional findings, such as pleural effusions, malignant and inflammatory processes, which were observed during CTPA (17). The results of this research can contribute to a better understanding of the clinical profiles of patients with PE and to the improvement of diagnostic protocols for the early recognition and treatment of

pulmonary embolism (18).

OBJECTIVE OF THE RESEARCH

To determine the incidence of pulmonary embolism (PE) in patients undergoing CT pulmonary angiography (CTPA).

RESPONDENTS AND METHODS OF WORK

300 patients with symptoms such as shortness of breath, elevated D-dimer test (>0.55 mg/L) and clinical suspicion of PE were included in the study. Patients with known causes of dyspnea (eg, asthma, COPD) or contraindications for CTPA were excluded (allergic reaction to contrast media, generalized severe renal impairment).

The research was conducted at the Clinical Institute of Radiology of the University Clinical Hospital Mostar in the period from June 1 - October 1, 2024.

Recording procedure

CT pulmonary angiography was performed using CT GE Revolution Evo 256, with the use of Ultravist 370 contrast medium (40 ml) at a flow rate of 4 ml/sec. Technical aspects: 100kV / 50-680mA SmartmA / noise index 20. Pitch: 0.992:1. Rotation time: 0.35. Start/end of recording: top of lung/ costophrenic sinus. The patient is in a supine position, with his feet facing the gentry of the device, his hands are above his head. IV placed right-sided cannula with a diameter of 18/20G.

CTPA imaging is performed by a bachelor's/master's degree in radiological technology, and the findings are interpreted by a doctor of medicine, a specialist in radiology.

Statistical analysis

Data were analyzed using descriptive statistics (mean, median), and the incidence of PE was evaluated based on demographic data such as age and gender. The location, size, and severity of emboli were classified, and incidental findings such as pleural effusions, pneumonia, and pulmonary nodules were also recorded.

Table 1. *Technical parameters for acquisition of CT pulmonary angiography, CT GE Revolution Evo 256, SKB Mostar*

GE Revolution 256 slice	
Pulmonary Angiogram	
Patient Position / Orientation	Supine, Feet First
Anatomical Reference	SN
Scan Type	Helical
Rotation Time (sec)	0.35
Detector Coverage (mm)	80
Pitch	0.992:1
Coverage Speed (mm/s)	158.75
Kilovoltage (kV)	100
Tube Current (mA)	50-680 SmartmA
Noise Index	20
ASIR-V	50%
Reconstructed Slice Thickness/ Spacing (mm)	1.25
Start of Scan	Apices
End of Scan	Costophrenic Angles
SFOV **DFOV (cm)**	Large Body 35
Breathing Instruction	Suspend Respiration
IV Contrast Volume (ml) / Rate (ml/s)	40ml at 4ml/s
Scan Delay (sec)	SmartPrep
SmartPrep Monitor Location **Enhancement Threshold (HU)**	Pulmomnary Arteries 100
Recon Type	Stnd
WW / WL	400/40
Post Processing	

RESULTS

Out of a total of 300 patients, 81 (27%) had a positive finding of PE. Of these, 52% of patients were male (42), and 48% were female (39), with an average age of 64 years. The youngest male person with a positive finding of PE was 21, and the oldest 82. Among women, the youngest person was 31, and the oldest 92.

Anatomically, PE was most often detected bilaterally (52%), in lobar arteries (43%) and segmental arteries (38%). Most emboli were not massive (59%), while 33% of cases were recorded as massive. Elevated D-dimer values correlated with the diagnosis of PE in 27% of patients, which emphasizes the need for combined clinical and imaging evaluations. Incidental findings such as pleural effusion, pneumonia, lung cancer, and pneumothorax were reported in several cases, highlighting the broader diagnostic value of CTPA.

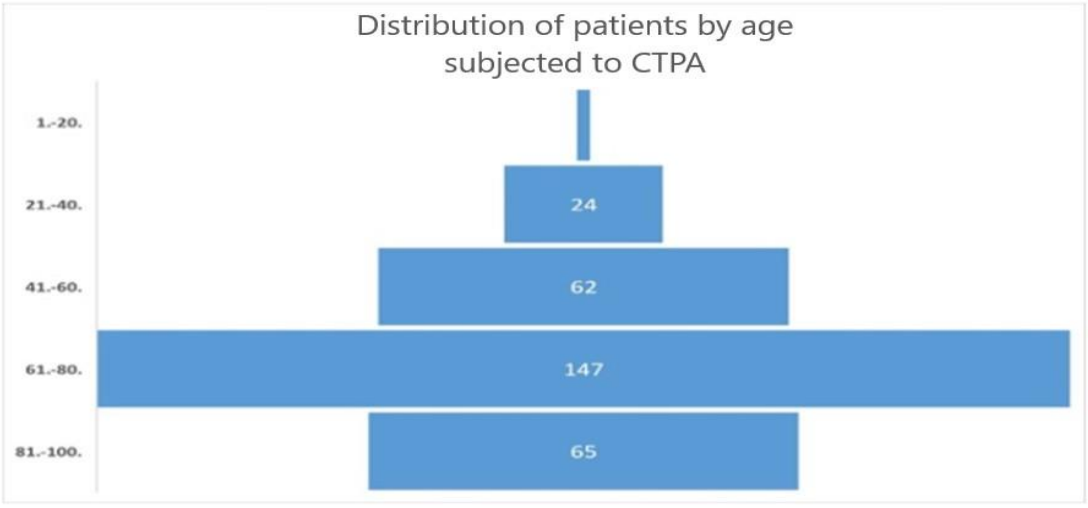

Figure 1. *Distribution of patients by age undergoing CTPA*

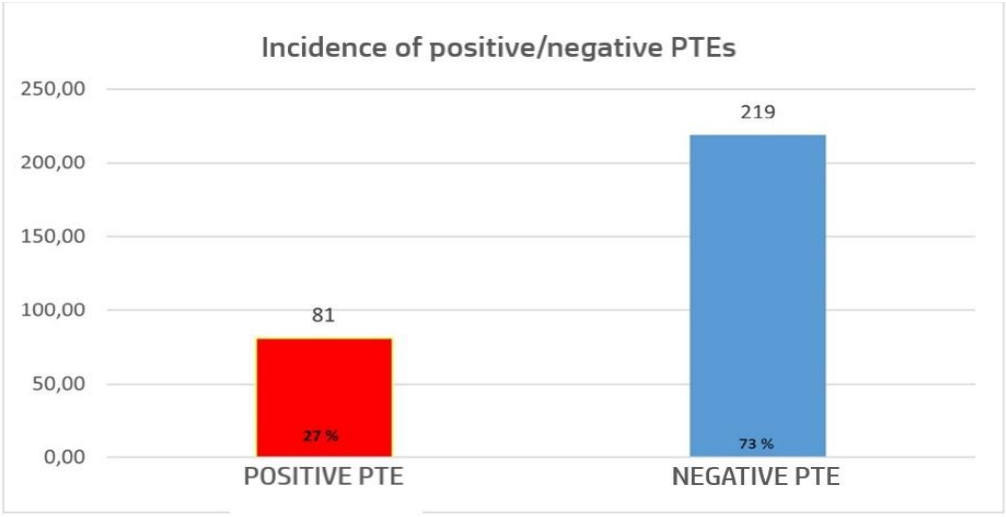

Figure 2. *Incidence of positive/negative PTE findings*

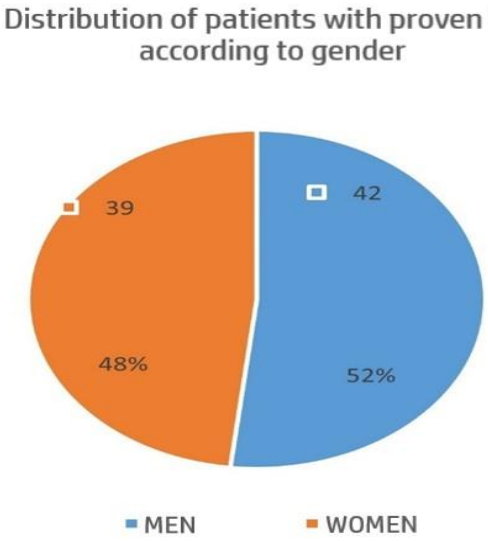

Figure 3. *Distribution of patients with proven PTE according to gender*

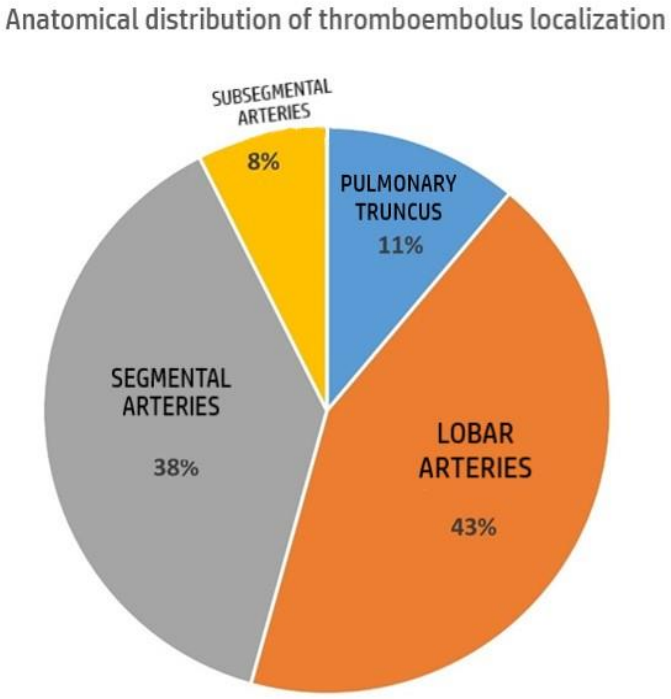

Figure 4. *Anatomical distribution of thromboembolus localization*

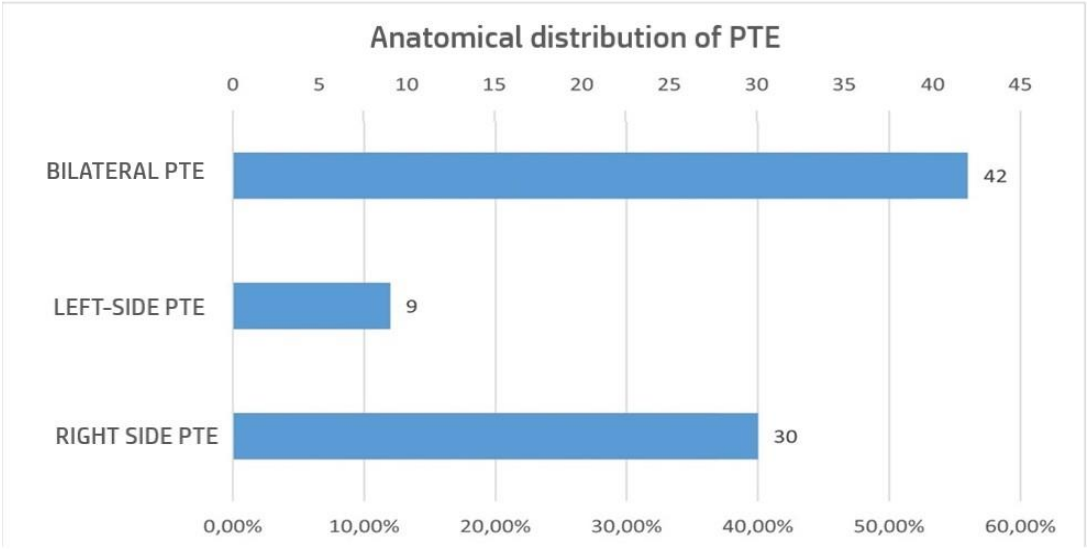

Figure 5. *Anatomical distribution of pulmonary thromboembolism (PTE)*

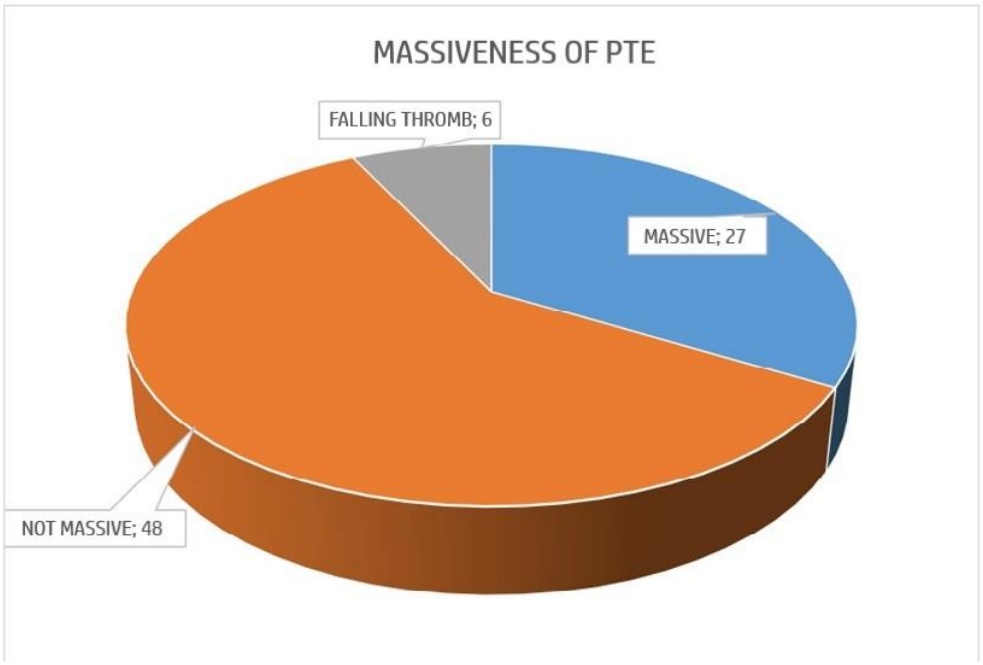

Figure 6. *Pulmonary thromboembolism massiveness*

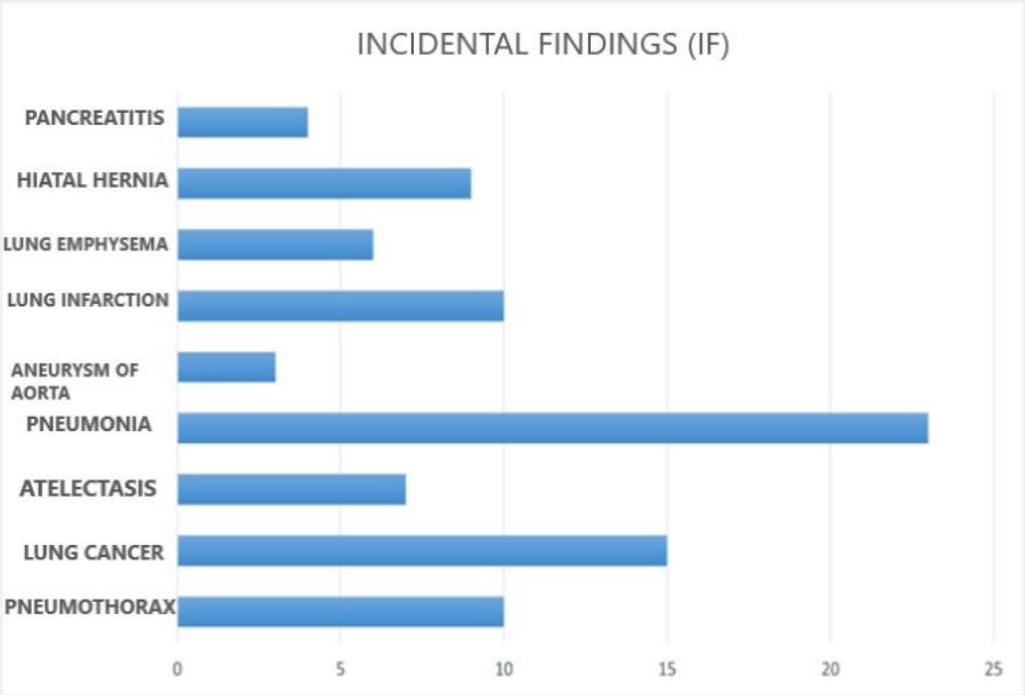

Figure 7. *Results of incidental findings*

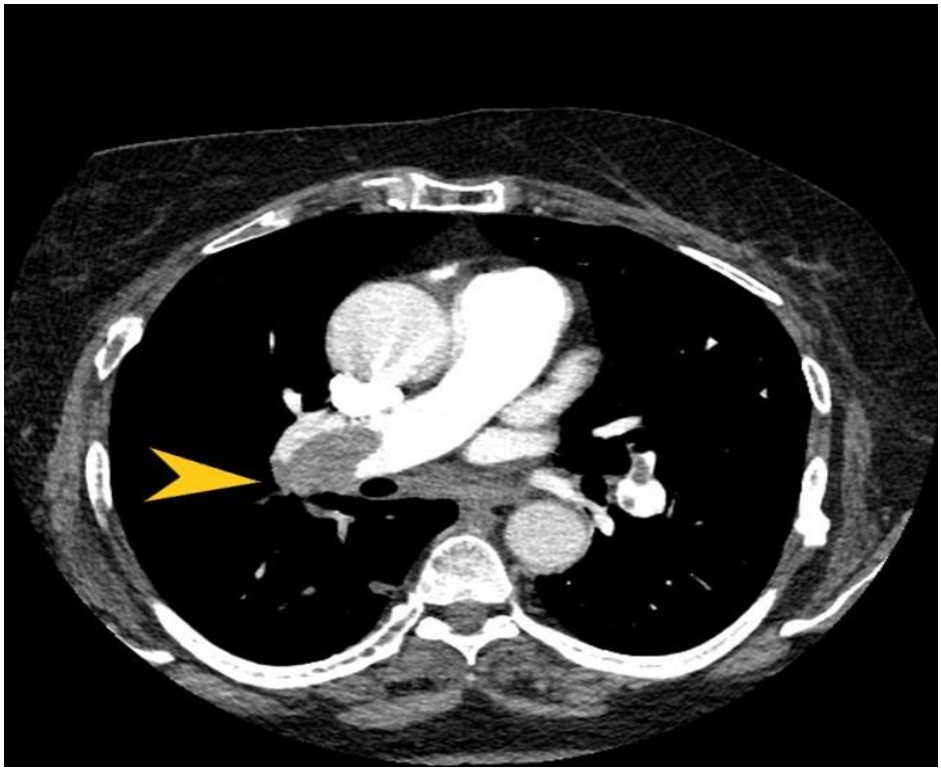

Figure 8. *Thromboembolus in the right main pulmonary artery*

DISCUSSION

The results of this study show that pulmonary embolism (PE) was diagnosed in 27% of patients undergoing CT pulmonary angiography (CTPA), which is a slightly higher percentage than in some previous studies evaluating the incidence of PE in the population of patients suspected of this condition (1). In a study conducted in Western European centers, the incidence of PE in patients undergoing CTPA was 23%, which is slightly lower than in our sample (2). This may reflect the specific patient population in SKB Mostar, with a potentially higher prevalence of risk factors for thromboembolism, such as older age, immobilization, comorbidities such as malignant diseases, as well as the possible lifestyle of patients (3).

Demographic analysis showed an almost even distribution between men (52%) and women (48%) with a positive PE test. However, a slightly higher average age was noted among women (70 years) compared to men (59 years), which may suggest that older women constitute a more vulnerable group in terms of developing PE (4). This is in accordance with the literature, which points out that older age and the postmenopausal period in women represent a significant risk factor for thromboembolic events (5). Older age also suggests the need for preventive strategies in this population, including thromboembolic risk assessment prior to HRT and increased awareness of risk factors.

Analysis of thrombus localization showed that emboli were most often detected in lobar arteries (43%), with bilateral distribution in 52% of cases, which suggests that patients with PE in this sample often had more complex and difficult clinical pictures (6). Massive emboli, which were recorded in 33% of patients, represent a serious clinical entity associated with high mortality, although their incidence follows the findings of earlier studies (7). In contrast, the majority of patients had nonmassive emboli (59%), which is encouraging because such cases are associated with a better prognosis and a lower risk of mortality (8). This suggests the need for greater focus on early recognition of PE symptoms in low- to intermediate-risk patients.

Special emphasis should be placed on the role of D-dimer in the diagnosis of PE. Although elevated D-dimers in the blood are often the first sign of possible thromboembolism, the results show that only 27% of patients with elevated D-dimers actually had confirmed PE. These data confirm the high sensitivity but low specificity of D-dimer, since many other factors can lead to false positive results, including infections, inflammation, trauma or postoperative conditions (9). Therefore, although D-dimers remain an important tool in initial screening, the definitive diagnosis of PE must be based on imaging methods such as CTPA (10). The use of USV color Doppler arteries as an alternative method for initial assessment in younger patients or pregnant women can further reduce unnecessary exposure to ionizing radiation (11).

One of the significant aspects of this research is the identification of nus findings (incidentalomas) during CTPA, which included pleural effusions, pneumonia and even tumors (12).

Identifying nus findings has significant clinical implications, as it enables early detection of serious conditions such as tumors or infections. This emphasizes the importance of a comprehensive analysis of the images obtained and the potential role of the radiologist in the wider diagnostic process (13).

Application of optimized protocols for CTPA, including radiation dose reduction and use of advanced software algorithms for image reconstruction, may further reduce patient risk, particularly in the younger population (14). The development of AI algorithms for the analysis of CTPA images can significantly speed up and improve the diagnostic process, especially in institutions with a limited number of experienced radiologists (15).

Future research should address long-term outcomes in patients with different types of emboli, including mortality, development of pulmonary hypertension, and quality of life. Also, a comparative analysis of the diagnostic efficiency of different methods, including USG and laboratory tests, can help to optimize the diagnostic algorithm for PE (16).

CONCLUSION

CT pulmonary angiography (CTPA) is confirmed as a key method for diagnosing pulmonary embolism (PE), allowing precise localization and assessment of the severity of the condition. In this study, 27% of patients undergoing CTPA had a positive finding of PE, which is above the average in some previous studies and indicates specific risk factors present in the local population.

Age and gender analysis showed an almost equal distribution among men and women, with a pronounced risk for older women. Massive PEs identified in 33% of patients indicate the need for urgent diagnosis and treatment to reduce the high risk of mortality. At the same time, most patients with non-massive PE had a more favorable prognosis.

Additional incidental findings, including pleural effusions, malignancies, and inflammatory processes, highlight the importance of CTPA not only for diagnosing PE but also for detecting other potentially serious conditions. Although elevated D-dimers are useful for initial screening, their low specificity confirms the need for definitive diagnosis through imaging methods.

Future research should focus on the analysis of specific risk factors in our population and on the improvement of diagnostic protocols, including the optimization of criteria for the use of CTPA, especially in vulnerable groups such as elderly patients.

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INCIDENCIJA PLUĆNE TROMBOEMBOLIJE U BOLESNIKA PODVRGNUTIH KOMPJUTORIZIRANOJ TOMOGRAFIJI PULMONALNOJ ANGIOGRAFIJI U SVEUČILIŠNOJ KLINIČKOJ BOLNICI MOSTAR

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SAŽETAK

Uvod: Plućna embolija predstavlja ozbiljan medicinski problem s visokom smrtnošću ako se ne prepozna pravodobno. CT pulmonalna angiografija ključna je metoda za dijagnostiku plućne embolije kod pacijenata s nespecifičnim simptomima poput zaduhe, bolova u prsima i povišenih vrijednosti D-dimera.

Cilj: Utvrditi incidenciju plućne embolije kod pacijenata podvrgnutih CT pulmonalnoj angiografiji u Sveučilišnoj kliničkoj bolnici Mostar.

Ispitanici i metode: Retrospektivno istraživanje obuhvatilo je 300 pacijenata sa sumnjom na plućnu emboliju koji su podvrgnuti CT pulmonalnoj angiografiji. Tehnički parametri snimanja uključivali su niskodozni protokol s intravenskim jodnim kontrastom. Rezultati su analizirani deskriptivnom statistikom, uz procjenu učestalosti plućne embolije, lokalizacije tromba i incidentalnih nalaza.

Rezultati: Plućna embolija je dijagnosticirana kod 27% pacijenata, s najčešćim zahvaćanjem lobarnih arterija (43%). Masivne embolije zabilježene su u 33% slučajeva. Prosječna dob ispitanika bila je 64 godine, s gotovo jednakom spolnom raspodjelom. Povišeni D-dimeri nisu bili dostatni za potvrdu dijagnoze u većine pacijenata. Incidentalni nalazi uključivali su pleuralne izljeve, upale pluća i tumore.

Zaključak: CT pulmonalna angiografija neophodna je za preciznu dijagnostiku plućne embolije, posebno kod pacijenata s nespecifičnim simptomima. Rezultati naglašavaju potrebu za kombiniranjem kliničkih i slikovnih metoda, kao i prilagodbom dijagnostičkih protokola kako bi se smanjila izloženost zračenju i optimizirali ishodi liječenja. U lokalnom kontekstu, ove smjernice mogu unaprijediti dijagnostiku i liječenje.

Ključne riječi: Plućna tromboembolija, incidencija, kompjutorizirana tomografija, pulmonalna angiografija, klinička dijagnostika

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