Original Article

CT Obstructive Index and Systolic Blood Pressure at the Time of Diagnosis of Pulmonary Thromboembolism

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Abstract

Background: Recognition of imaging findings in pulmonary emboli and their association with homodynamic factors is important for prompt diagnosis, treatment, and reduction of its morbidity. The main objective in current study was to determine the correlation between CT obstructive index in pulmonary thromboembolism and systolic blood pressure at the time of diagnosis.

Materials and Methods: In this observational cross-sectional comparative study, 70 consecutive patients with pulmonary emboli admitted in Modarress Hospital (Tehran, Iran) among 2013-17 were enrolled and correlation between CT obstructive index on pulmonary CT angiography and systolic blood pressure at the time of diagnosis was determined.

Results: The correlation between CT index and hypotension (systolic blood pressure≤90) in our studied patients was significant (P=0.0001) and the mean CT index in hypotensive and normotensive patients was 56.4% and 27.5%, respectively. The CT obstructive index cut-off point of 53.75% resulted in sensitivity and specificity of 87.5% and 96.3%, for hypotension prediction.

Conclusion: According to the obtained results it may be concluded that there is significant correlation between CT obstructive Index in patients with pulmonary thromboembolic and systolic blood pressure at the time of diagnosis and be calculating the CT obstructive index the possibility of hypotension related to massive emboli could be predicted.

Keywords: Systolic blood pressure, Pulmonary emboli, CT index

Introduction

Pulmonary thromboemboli (PTE) is mainly due to migration of blood clots from deep calf veins or other body regions in to the pulmonary arterial circulation. It causes multiple problems in patients related to main pulmonary arteries or their branches obstruction[1]. The definite prevalence rate has not been cleared yet but there is an increasing trend. Regarding the role of pulmonary thromboemboli in sudden cardiac death, therefore it needs to prompt diagnosis and treatment[2]. In some world regions, it has been reported that prevalence rate has been increased up to sevenfold resulting in mortality rate of 10.8 per 100000 cases[3]. Despite brief reduction in total thromboemboli prevalence since 2004, it is yet a prominent cause of mortality and morbidity[4]. However, the mortality rate due to pulmonary thromboemboli could be decreased between 46 to 54 percent with utilization of preventive strategies[5]. Use

of more definite diagnostic methods would result in reduced mortality and morbidity rate and imaging techniques are important diagnostic tools[6-10]. One of the approved sign for thrombolytic therapy in PTE patients is acute homodynamic instability characterized by systolic blood pressure less than 90 mmHg and/or decrease of systolic blood pressure to 40 mmHg. Recognition of CT obstructive index, which can be predictive for systolic blood pressure less than 90 mmHg, can be helpful for prompt thrombolytic therapy[11-16]. Hence, the main objective in current study was to determine the correlation between CT obstructive index in pulmonary thromboemboli and systolic blood pressure at the time of diagnosis of pulmonary thromboemboli.

Methods

In this observational cross-sectional comparative study, 70 consecutive patients who were admitted with pulmonary emboli in Modarress Hospital (Tehran, Iran) with diagnosis of PTE in 2013-2017. The inclusion criterion was pulmonary emboli. The exclusion criteria were history of hypotension, cardiac background disorders resulting in hypotension, inferior myocardial infarction, severe bradycardia, septicemia, and endocrine problems such as hypoglycemia. Pulmonary CT angiography was performed by Briliance64, Philips Medical system, Cleveland, OH CT scan machine with administration of 80-100cc contrast agent and with collimation of 64*0.625mm, slice thickness of 1mm, slice increment of 0.5mm, pitch of 1.08, rotation time of 0.5sec, voltage of 140kv and current of 308mA. For calculation of CT-PAOI we use Qanadli method that CT- PAOI is equal to $\sum$ i*n. The coefficient "i" is one in partial pulmonary obstruction and two in complete pulmonary obstruction. "n" is the number of segmental branches which are supplied by involved pulmonary arterial branch[7].

Local ethical committee approved the study. The extracted data were recorded in checklists. In addition, the correlation between CT pulmonary artery obstructive index (CT-PAQI) in pulmonary thromboembolic at the time of diagnosis and systolic blood pressure at diagnosis time was determined.

Data analysis was performed among 70 subjects by SPSS software (version 24.0) [Statistical Procedures for Social Sciences; Chicago, Illinois, USA]. Independent-Sample-T, Pearson, and ROC tests were used and were considered statistically significant at P values less than 0.05.

Results

Participants mean age was 57.99±17.2 years. Among them 50% were male. The cause of pulmonary emboli was DVT/immobility, surgery/fracture, cancer, OCP use and others in 18.6%, 27.1%, 14.3%, 4.3%, and 35.7%, respectively. Hypotension (systolic blood pressure less than 90 mmHg) was seen in 22.9%. The mean CT-PAQI in patients was 34.07±21.9 percent. The CT-PAQI was not related to age and gender (p>0.05). The CT PAQI was not related to cause of pulmonary emboli (Table 1).

Presence of hypotension (systolic blood pressure less than 90 mmHg) was not related to age and cause of emboli (p>0.05). As shown in Table 2 the hypotension was significantly more common in male subjects (p=0.023).

The correlation between CT-PAQI and hypotension in patients was significant (p=0.0001) and the mean CT PAQI in hypotensive (systolic blood pressure less than 90 mmHg) and normotensive patients was 56.4% and 27.5%, respectively. The CT-PAQI cut-off point of 53.75% has sensitivity and specificity of 87.5% and 96.3%, respectively for prediction of systolic blood pressure below 90 mmHg.

Table 1: Association of CT PAQI and cause of pulmonary emboli.

Cause of pulmonary emboli	Mean	Standard Deviation
DVT/immobility	32.7	18.9
Surgery/fracture	38.3	24.6
Cancer	26.5	20.4
OCP Use	54.2	5.2
Others	32.2	22.3

Table 2: Association of hypotension and gender.

Gender	Hypotension	Without Hypotension
Male	4 (11.4%)	31 (88.6%)
Female	12 (34.3%)	23 (65.7%)

Table 3: Association of CT PAQI and hypotension (systolic blood pressure less than 90 mmHg).

Cause of pulmonary emboli	Mean	Standard Deviation
Hypotension	56.4	13.7
Without Hypotension	27.4	19.4

Discussion

In this study significant association was found between hypotension (systolic blood pressure than 90 mmHg), CT-PAQI index in patients with acute PTE was assessed and significant association was found between two variables. The mean CT-PAQI index was higher in hypotensive patients (less than 90 mmHg for systolic blood pressure). The CT-PAQI cut-off point for prediction of hypotension was 53.75% leading to sensitivity and specificity of 87.5 and 96.3 percent, respectively. The study by John *et al.*, revealed that contrast reflux to hepatic veins, proximal location of emboli, and right-to-left short-axis ventricular diameter had significant association with CTpPAQI index[13]. Also Qanadli et al. reported that patients with higher CT-PAQI index more than 40% had right ventricular dilatation[15-16].

Ghuysen *et al.*[14] assessed 82 patients with pulmonary emboli and reported that pulmonary hypertension and CT pulmonary artery obstruction index had no effect on pulmonary emboli but the SBP, HR, right ventricular strain, and diameter of azygous vein were related to outcomes[14]. Wong et al reported that higher Miller score was related to higher RV decompensation. The Miller score Cut off point was 12 for RV decompression[15].

Conclusion

Totally, according to the obtained results it may be concluded that there is significant correlation between CT-PAQI index in pulmonary thromboembolism and systolic blood pressure at the time of diagnosis. According to CT-PAQI index, systolic blood pressure under 90 mmHg may be predictable value for thromboembolism.

Acknowledgment

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