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Appropriateness of pulmonary CT angiography testing request in patients suspected with pulmonary embolism in Hai'l Region, Northern Saudi Arabia

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ABSTRACT

Objective: The present study aimed to evaluate the appropriateness of pulmonary CT angiography testing requests in patients suspected of pulmonary embolism in the Hai'l Region, Northern Saudi Arabia. *Methodology:* This study involved data obtained from 133 patients presented with suspected pulmonary embolism (PE) (from Feb. 2019 to Feb. 2020). All available variables were attained from the intensive care unit (ICU) at King Khalid Hospital, Hail, Northern Saudi Arabia. *Results:* CTPA was performed on 133 patients suspected with PE, 70(52.6%) males, and 63(47.4%) females, aged 15 to 95 years with a mean age of 48.3 years. CTPA testing was positive in 47/133(35.3%) patients and non-indicative in 86/133(65%). Out of the 45 confirmed patients with PE, CAPA was positive in 35/45(77.8%). The probability of true CAPA positive (sensitivity) was 77.78%, whereas, the probability of true CAPA negative (specificity) was 86.36%. *Conclusion:* CTPA is appropriately used in Northern Saudi Arabia with fewer overdiagnosis escapes, perhaps due to the adoption of existing guidelines for the management of PE. The use of multifarious diagnostic methods for the diagnosis of PE is deemed important.

Keywords: Pulmonary embolism, CT angiography, D-dimer, blood coagulation, Saudi Arabia

1. INTRODUCTION

Pulmonary embolism (PE) is a serious health problem resulting in venous thromboembolism and leading to high morbidity and mortality (Bagga et al. 2020). PE has complicated overall management due to challenging diagnoses. As both inherited and acquired etiological factors are implicated in susceptibility to PE, precise assessment is deemed important for accurate diagnosis and subsequent treatment. The challenging non-specific and variable presentation of PA necessitates the efficient evaluation in suspected PE patients (Giordano et al., 2017).

The diagnosis of PE varies greatly due to non-specific clinical presentation. Symptoms can interfere with other cardiopulmonary diseases, particularly in the absence of risk factors. Different diagnostic approaches are always tried including clinical susceptibility, blood testing, and lung imaging. Misuse of diagnostic testing can result in serious harm; careful, evidenced-based management is needed (Ishaaya et al., 2020). A combination of a low clinical pretest probability and a D-dimer can be useful in the risk evaluation of PE (Xiong, 2020; Kearon et al., 2019). Computed tomography (CT) angiography testing for PE is useful for including or excluding PE, thus CT pulmonary angiography (CAPA) is of choice imaging method in patients suspected of PE. However, the CAPA is tended to be overused because of its availability and less invasiveness. Accurate employment of clinical choice guidelines in diagnostic checkup for PE expands suitable usage of CT (Doğan et al., 2015; Grillet et al., 2020).

Although there is a lack of literature regarding the epidemiology of PE in Saud Arabia, many patients are frequently admitted to intensive care units with suspected PE. Although there is strict guidelines (Al-Hameed et al., 2015) for the management of PE, overuse of CTPA is expected. Therefore, the present study aimed to evaluate the appropriateness of pulmonary CT angiography testing requests in patients suspected of pulmonary embolism in the Hai'l Region, Northern Saudi Arabia.

2. MATERIALS AND METHODS

This study involved data obtained from 133 patients presented with suspected pulmonary embolism (PE) (from Feb. 2019 to Feb. 2020). All available variables were attained from the intensive care unit (ICU) at King Khalid Hospital, Hail, Northern Saudi Arabia. For test valuation, patients confirmed as having PE with different diagnostic approaches were further ascertained as the gold standard for validation of the CTPA testing results. Besides the clinical presentations, the diagnosis of PE was based on computed tomography (CT) angiography testing, Coagulation testing, and another necessary testing for a particular situation of the distinct patients including D-dimer, and clinical pretest probability.

Data analysis

Data analysis was performed using computer software Statistical Package for Social Sciences (SPSS). Frequencies, percentages, cross-tabulations, relative risk (RR), and chi-square test were obtained. A P-value of less than 0.05 reflecting a significant statistical difference.

Ethical consent

The protocol of this study was approved by the Research Ethics committee (REC) at the University of Ha'il, Saudi Arabia. Approval number: Nr13675/5/42. The study followed the ethical standards of the 1964 Helsinki declaration and its subsequent modifications or analogous ethical standards.

3. RESULTS

CTPA was performed on 133 patients suspected with PE, 70(52.6%) males, and 63(47.4%) females, aged 15 to 95 years with a mean age of 48.3 years. CTPA testing was positive in 47/133(35.3%) patients and non-indicative in 86/133(65%). Out of the 45 confirmed patients with PE, CAPA was positive in 35/45(77.8%). The probability of true CAPA positive (sensitivity) was 77.78%, whereas, the probability of true CAPA negative (specificity) was 86.36%. The probability of true/false CAPA positive (positive likelihood ratio) was 5.7%, whereas, the probability of true/false CAPA negative (negative likelihood ratio) was 0.26%. The probability of CAPA positive- disease is present (Positive predictive value) was 74.47%, whereas, the probability of true CAPA negative- the disease is absent (Negative predictive value) was 88.37%. The overall probability that each patient was accurately diagnosed by CTPA was 83.46%, as shown in Table 1.

Low international normalized ratio (INR) levels were detected in only one patient with CTPA-negative. High INR was detected in 5/17(29.4%) and 6/34(17.6%) of the CTPA-positive, and CTPA-negative patients, respectively. Low prothrombin time (PT) levels were demonstrated in 3/20(15%), CTPA-positive, and 12/41(29.3%) CTPA-negative. High PT levels were found in 10/20(50%), CTPA-positive, and 18/41(44%) CTPA-negative.

Table 1. CTPA statistics measures

Statistics	CTPA	
	Value	95% CI
Sensitivity	77.78%	62.91% to 88.80%
Specificity	86.36%	77.39% to 92.75%
Positive likelihood ratio	5.70	3.30 to 9.87
Negative likelihood ratio	0.26	0.15 to 0.45
Disease prevalence	33.83%	25.86% to 42.54%
Positive predictive value	74.47%	62.76% to 83.47%
Negative predictive value	88.37%	81.39% to 92.96%
Accuracy	83.46%	76.03% to 89.33%

Low & high partial thromboplastin time (PTT) levels were measured in 5/22(22.7%) & 5/22(22.7%) CTPA-positive, and 14/38(36.8%) & 9/38(23.7%) CTPA-negative. Only high platelets count levels were seen in 3/6(50%) CTPA-positive, hence, only one (8.3%) with low platelets count level was seen in CTPA-negative, as indicated in Table 2, Fig 1.

Table 2. Distribution of the CTPA test status by coagulation parameters

Category		CTPA-positive	CTPA-negative	Total
Pulmonary Embolism				
	Positive	35	10	45
	Negative	12	76	88
	Total	47	86	133
INR				
	Low	0	1	1
	Normal	12	27	39
	High	5	6	11
	Total	17	34	51
PT				
	Low	3	12	15
	Normal	7	11	18
	High	10	18	28
	Total	20	41	61
PTT				
	Low	5	14	19
	Normal	12	15	27
	High	5	9	14
	Total	22	38	60
Platelets				
	Low	0	1	1
	Normal	3	11	14
	High	3	0	3
	Total	6	12	18

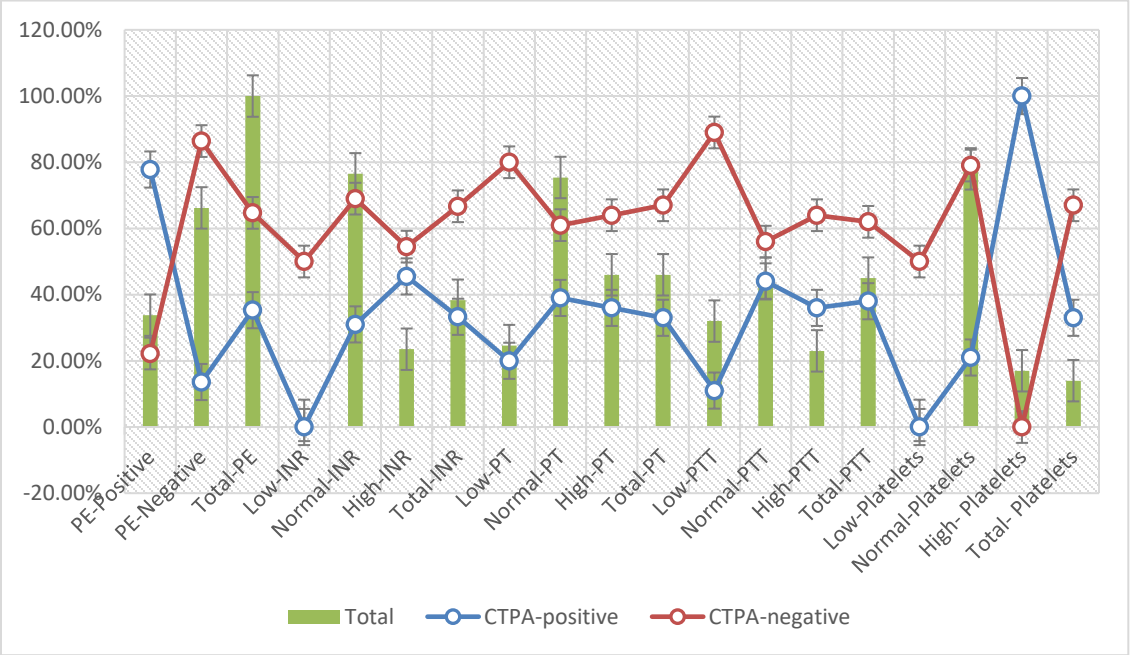

Figure 1. CTPA testing by blood coagulation testing

High >6, Intermediate 2-6, and Low 0-1 of clinical probability of PE were identified in 16/47(34%), 30/47(64%), and 1/47(2%) of the CTPA-positive, respectively. D-dimer was requested in 62/133(47%) of whom 27/62(44%) were CTPA-positive. Of the 62 tested for D-dimer, positive findings were reported in 25/34(74%), as indicated in Table 3, Fig 2.

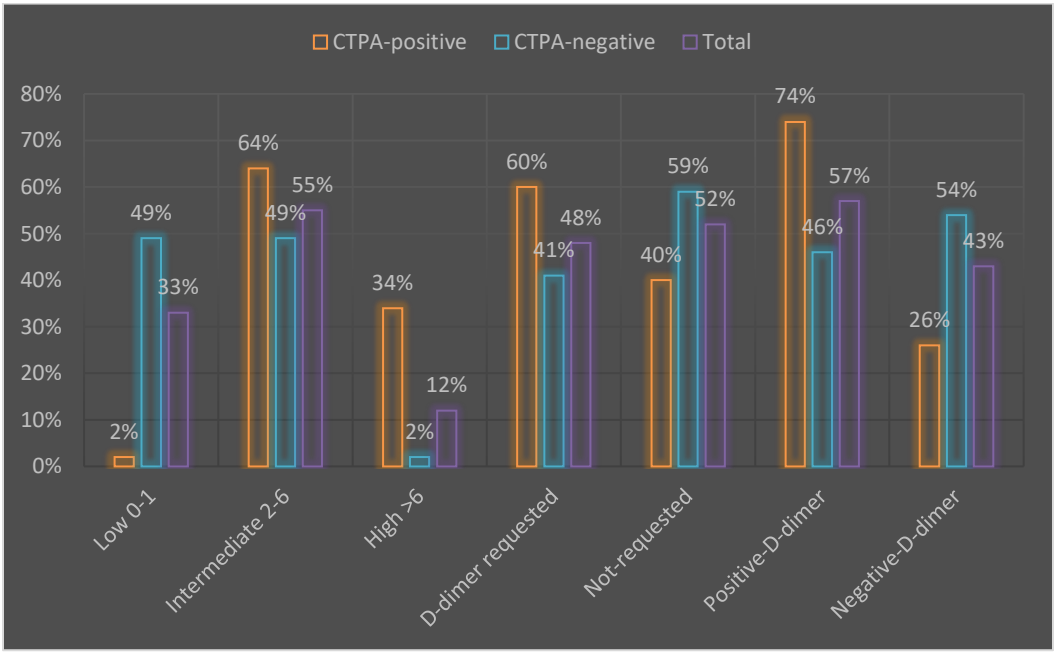

Figure 2. Description of CTPA test status by the clinical probability of PE and D-dimer proportions

Table 3. CTPA testing by the clinical probability of PE and D-dimer

Category	CTPA-positive	CTPA-negative	Total
clinical probability of PE			
Low 0-1	1	42	43
Intermediate 2-6	30	42	72
High >6	16	1	17

	Total	47	85	132
D-dimer request				
	Yes	27	35	62
	No	18	50	68
	Total	45	85	130
D-dimer results				
	Positive	25	26	51
	Negative	9	30	39
	Total	34	56	90

4. DISCUSSION

One of the most challenging in medical practice is the accurate and effective diagnosis and management of patients with PE. As misdiagnosis has fatal effects, similarly overuse of some diagnostic testing can result in a harmful consequence, particularly in a health setting with high testing availability. Saudi Arabia has a colossal health infrastructure and raised the question of whether that setup is appropriately utilized.

In the present study, we evaluated the appropriateness of pulmonary CT angiography testing request in patients suspected of pulmonary embolism. PE was confirmed (using combined means of diagnosis) in 45/133(33.8%) of the patients suspected as having PE. Applying CTPA testing, PE was ascertained in 47/133(35.3%) of the patients of whom 12/133(9%) couldn't be ascertained by overall means of diagnosis according to the followed guidelines in Saudi Arabia (Al-Hameed et al., 2015). This means that overdiagnosis of CTPA testing was done for a group of patients, which might result in unwilling harmful consequences. CTPA overuse was previously reported in several studies (Dobler, 2019; Osman et al., 2019). However, overuse of CTPA for patients having only a low pretest probability of PE has received an important previous consideration. Overdiagnosis, which means the true positive diagnosis of PE, but without any accompanying detriment, necessitates the clinical practice of respiratory specialists, who evaluate the situation, whether the use of some treatment (anticoagulants) is necessary or not (Dobler, 2019).

Taking into account all diagnostic measures, CTPA revealed high acceptable specificity and specificity measures. Such measures can decrease misdiagnosis as well as, overdiagnosis. A previous systemic analysis of CTPA involved about 12 studies identified a relatively similar specificity (89.5%) and sensitivity (74.1%) with specificity and sensitivity ranges of 68-100% and 57-100%, correspondingly, for diagnosis of pulmonary embolism (Safriel et al., 2002). Consequently, CTPA is gradually becoming the method of choice as it can recognize patients who may benefit from thrombectomy. New CT measurements such as distensibility and subtraction procedures may additionally improve diagnosis and prognosis for better patient care (Doğan et al., 2015).

In the present study coagulation factors, measurements showed variable values when compared to the CTPA testing. In most instances, the pulmonary thromboembolism occurs in association with disturbances of coagulation parameters (Tian et al., 2012).

Most patients with CTPA positive testing showed intermediate or high clinical probability (CP) score. CP for PE is regularly used in emergency units, as it is a dominant step in the diagnosis of PE. It was reported that CP had a suboptimal diagnostic presentation, possibly emphasizing the necessity of more optimum assessment particularly with acute PE (Esiéné et al., 2019).

D-dimer positive findings were found associated with a great majority of CTPA positive tested patients. The D-dimer is released when the blood clot fragmented and its level can be measured in the blood, which has great indications in cases of thromboembolism and pulmonary thromboembolism. D-dimer testing has a high sensitivity but low specificity for identifying PE or DVT, particularly in populations with low risk (Bounds et al., 2020).

5. CONCLUSION

CTPA is appropriately used in Northern Saudi Arabia with fewer overdiagnosis escapes, perhaps due to the adoption of existing guidelines for the management of PE. The use of multifarious diagnostic methods for the diagnosis of PE is deemed important.

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This study has not received any external funding.

Conflict of interest

The authors declare that there are no conflicts of interests.

Ethical approval

All procedures performed in studies involving human participants were following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards (ethical approval number Approval number: Nr13675/5/42.

Informed consent

Informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

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Data and materials Availability

All data associated with this study are present in the paper.

Peer-review

External peer-review was done through double-blind method.

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