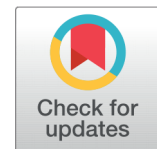


COMPUTED TOMOGRAPHY ANGIOGRAMS PERFORMED FOR PATIENTS WITH SUSPECTED PULMONARY EMBOLISM: THE PREVALENCE OF PULMONARY EMBOLISM AND NON-EMBOLIC FINDINGS IN A TERTIARY CARE HOSPITAL IN SAUDI ARABIA



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ABSTRACT

Objective

This study aims to estimate the prevalence of pulmonary embolism and non-embolic findings in patients who underwent CT pulmonary angiography for suspected pulmonary embolism.

Methods

In this cross-sectional study, we retrospectively analyzed consecutive 158 CTPA images and reports performed for suspected pulmonary embolism at a Saudi tertiary care hospital. The non-embolic findings were classified based on their location.

Results

The prevalence of pulmonary embolism was 26.6%. No statistically significant difference was found between the diagnosis of pulmonary embolism with respect to gender and age. The prevalence of non-embolic findings in the whole study was 86.7%. Pulmonary findings represented 45.2% of all non-embolic findings, followed by pleural findings in 18.3%. Lung opacification and pleural effusion were the most commonly occurring findings.

Conclusion

Relative to other studies, our center has a reasonable prevalence of CTPA studies being positive for pulmonary embolism. However, we encourage balancing the potential benefits and harms by following a well-structured clinical approach to improving healthcare quality and safety.

المخلص

الهدف: دراسة معدل انتشار الجلطات الرئوية والملاحظات الغير تجلطية لدى الأشخاص المشتبه اصابتهم بجلطة رئوية والذين خضعوا لتصوير الأوعية الرئوية بالفحص المقطعي المحوسب.

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منهجية البحث: دراسة رجعية مقطعية مستعرضة قمنا فيها بتحليل الصور والتقارير لعدد ١٥٨ فحص مقطعي لمرضى مشتبه إصابتهم بجلطة رئوية في مستشفى رعاية طرفي في المدينة المنورة. تم تصنيف الملاحظات الغير تجلطية حسب موقعها.

النتائج: معدل انتشار الجلطات الرئوية ٢٦.٦٪. لا يوجد فروق ذات دلالة إحصائية بين الإصابة بالجلطة وعلاقتها بالعمر والجنس. معدل انتشار الملاحظات الغير تجلطية في كل الفحوص المشمولة ٨٦.٧٪. شككت الملاحظات الرئوية ٤٥.٢٪ من كل الملاحظات الغير تجلطية متبوعة بالملاحظات البلورية. عتامة الرئة و الانصباب البلوري كانت اكثر الملاحظات حدوثاً.

الخلاصة: مقارنة بالدراسات السابقة وجدنا أن معدل الحالات المؤكد إصابتها بجلطة رئوية باستخدام الفحص المقطعي المحوسب في مركزنا معتدل مع التأكيد على ضرورة تحقيق التوازن بين الفوائد والأضرار المحتملة باتباع فحص سريري منظم لتحسين جودة وسلامة الرعاية الصحية.

Keywords: Pulmonary embolism, Computed tomography, Saudi Arabia

1. INTRODUCTION

Pulmonary embolism is a leading cause of death with high mortality and morbidity rates [1]. Early diagnosis of this condition helps improve the outcomes, but the nonspecific clinical presentation can be challenging [2]

Computed tomography pulmonary angiography (CTPA) is a minimally invasive, rapid and reliable test with a sensitivity of 83% and specificity of 96% [3]. It examines the pulmonary vasculature in addition to pulmonary and extrapulmonary structures; therefore, it has a great advantage in providing the appropriate diagnosis; however, some of the nonsignificant findings can be a source of confusion and may lead to unnecessary investigations [4]. Other disadvantages of CTPA include the risk of contrast-induced nephropathy [5], additional costs [6] and exposure to ionizing radiation [7]. Particularly in young women, little but the discernible carcinogenic risk has been documented [8, 9].

The ability of CTPA to show non-embolic findings makes some physicians overuse this test even when clinical suspicion of pulmonary thromboembolic disease is unlikely [10, 11]. Recently, considerable literature has grown around the issue of overutilization of CTPA, with a subsequent decline in the positive diagnostic yield. Over the past two decades, studies have shown a wide range of pulmonary embolisms by positive CTPA (5% - 51%) [4, 6] [10–29]. The different study populations and settings may explain this variability; however, there is little literature in our country. Therefore, we conducted this study to investigate the positive diagnostic yield of CTPA in the Saudi population and estimate the prevalence of non-embolic findings to help support the clinical decision-making process and provide safe and high-quality patient care.

2. MATERIALS AND METHODS

2.1. Study design

This cross-sectional study reviewed CTPA images and reports performed at the tertiary care centre, King Fahad hospital, in Almadinah Almunawarah, Saudi Arabia. The local institutional review board approved this retrospective study and waived the informed consent requirement (IRB 22-032).

2.2. Data collection

Picture archiving and communication system (PACS) was used to search for the performed CT pulmonary angiograms between June and August 2020. CTPA studies performed for patients with suspected pulmonary embolism were included with no age or sex limitation. We excluded CTPA scans requested for non-embolic causes (e.g., pulmonary hypertension, evaluation of pulmonary artery aneurysm). Examinations were acquired via GE Healthcare Discovery CT750 HD system. Scan parameters were collimation 64 x 0.6 mm with 120 kV, 430 mA and pitch of 1.375. Images were reconstructed at slice thickness of 0.625 mm. Automatic CT injector was used to administer intravenous contrast media at flow rate of 5 ml/s with bolus-tracking software with a region of interest placed at the level of the pulmonary trunk.

The researcher radiologists reviewed and analyzed the reports and images of the included CTPA studies and collected the observed radiological findings in the data collection sheet. A Microsoft Excel spreadsheet was designed for data collection. CTPA studies were classified as positive, negative, or equivocal. The data included the age and gender of patients in addition to the observed non-embolic findings, which were then classified based on their location.

2.3. Statistical analyses

Statistical analysis was performed through descriptive and comparative analysis. Descriptive analysis was carried out through counts and percentages, while comparative analysis was carried out through chi-square testing for categorical variables at a level of significance p -value <0.05 . SPSS Statistics (Version 26.0. Armonk, NY: IBM Corp) was utilized for statistical analysis.

3. RESULTS

One hundred and fifty-eight CTPA studies performed for suspected pulmonary embolism were included. All descriptive and comparative analyses are described below.

3.1. Demographic information and the prevalence of pulmonary embolism

Out of 158 patients, females were predominant and represented 55.7%. The mean age was 55.05±18.7 years. Diagnosis of pulmonary embolism was made through CTPA as positive, negative, or equivocal. The prevalence of pulmonary embolism by CTPA was 26.6%, while 64.6% were negative, as shown in Figure 1. There is no statistically significant relationship between the diagnosis of pulmonary embolism with respect to gender and age (P-value > 0.05) (Table 1).

Table 1 Comparison of CTPA results for pulmonary embolism in relation to gender and age.

		Pulmonary embolism			Total	P-value
		Positive	Negative	Equivocal		
Gender	Male	17	47	6	70 (44.3%)	0.822
	Female	25	55	8	88 (55.7%)	
Age	15-30	1	15	0	16 (10.1%)	
	30-45	10	19	3	32 (20.3%)	
	45-60	13	25	6	44 (27.9%)	
	60-75	14	24	3	41 (25.9%)	
	75-95	4	19	2	25 (15.8%)	
Total		42	102	14	158	

3.2. The prevalence of the non-embolic findings

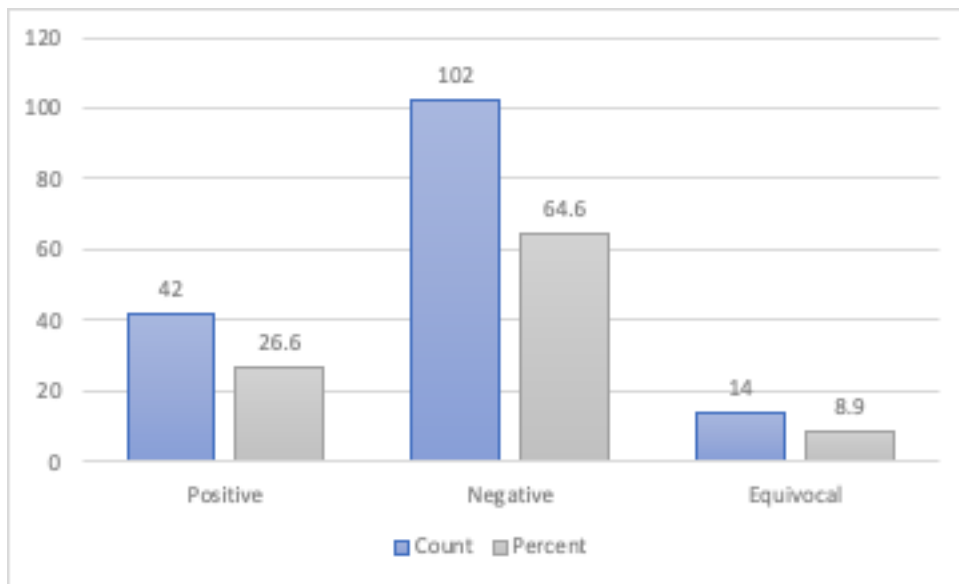


Figure 1 Diagnosis of pulmonary embolism.

Fourteen patients (8.8%) had normal studies without pulmonary embolism or non-embolic findings, while 86.7% of all the included CTPA studies had non-embolic findings. Out of 42 CTPA scans that confirmed pulmonary embolism, 83.3% had abnormal

findings other than an embolic disease, while 87.3% of the negative studies had non-embolic findings. Figure 3 shows the frequency of the non-embolic findings among positive, negative and equivocal CTPA studies for pulmonary embolism.

Most non-embolic findings were pulmonary and represented 45.2%, while pleural findings were the second most prevalent and represented 18.3%, as shown in Figure 3.

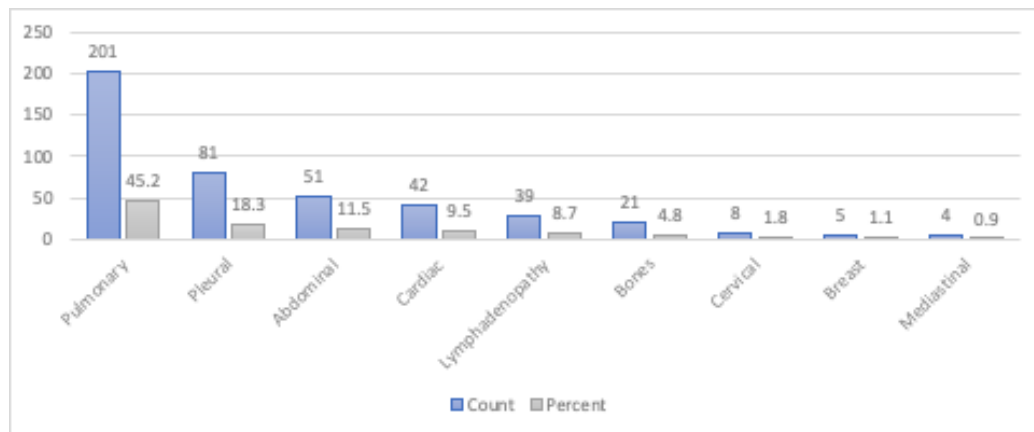


Figure 2 The prevalence of non-embolic findings based on their location

The most common pulmonary abnormality was lung opacification (consolidation and ground-glass opacities), while pleural effusion was found in 71 patients. Other observed findings are detailed in Table 2.

3.3. Comparison of non-embolic findings by location among positive and negative CTPA studies for pulmonary embolism.

Using the chi-square test, the different non-embolic findings were compared over different CTPA results for pulmonary embolism. Although none of the sites had a statistically significant occurrence among patients with a positive diagnosis of pulmonary embolism, there were more common non-embolic findings in different locations in patients with a negative pulmonary embolism result, as described in Table 3.

4. DISCUSSION

Considering the largely varied prevalence of confirmed pulmonary embolism by CTPA in the literature, 26.6% is within the European average (15-51%) (12,14,18,21,26,27) while the prevalence in North American literature is lower (5-14%) [6, 10, 11, 13, 15, 16, 19, 20, 25].

In a survey conducted by the Australian College for Emergency Medicine, the respondents supposed that 10% - 25% is the ideal range for CTPA yield [30]. An American study had a 5% CTPA yield in a population younger than 45 years [13]. In our study, there is no

Table 2 The frequency of non-embolic findings on CT pulmonary angiograms

Category	CT finding	Category	CT finding	Category	CT finding	Category	CT finding
Pleural (N=81)	Pleural Effusion (N=71), Pneumothorax (N=6), Pleural thickening (N=4), Lung opacification (N=88), Atelectasis (N=55)	Mediastinal (N=4)	Mediastinal mass (N=2), Mediastinitis (N=1), Mediastinitis (N=1), Pneumomediastinum (N=1), Mediastinal (N=23)	Cardiac (N=42)	Cardiomegaly (N=35), Pericardial effusion (N=6)	Cervical (N=8)	Thyroid nodule (N=7), Cervical abscess (N=1)
						Abdominal (N=51)	Ventricular thrombus (N=1), Liver lesions (N=19), Ascites (N=12), Hiatal hernia (N=5), Splenic lesions (N=5), Renal stones, (N=4), Gallbladder stones (N=3), Adrenal lesions (N=2), Pneumoperitoneum (N=1)
Pulmonary (N=201)	Nodules (N=22), Bronchiectasis (N=12), Emphysema (N=9), Axillary (N=8), Abdominal (N=2)	Breast (N=5)	Breast mass (N=5)	Bones (N=21)	Traumatic bone lesions (N=11), Neoplastic bone lesions (N=10)	Lymphadenopathy (N=39)	Subpectoral (N=2), Supraclavicular (N=2), Jugular (N=1).
							-

Table 3 Diagnosis of Pulmonary Embolism

	Positive	Negative	Equivocal	P-value
Pleural	23.9%	67.6%	8.5%	0.760
Pulmonary	27.4%	64.3%	8.3%	0.951
Mediastinal	0.0%	100.0%	0.0%	0.324
Lymphadenopathy	20.7%	75.9%	3.4%	0.310
Cardiac	28.9%	63.2%	7.9%	0.917
Breast	20.0%	80.0%	0.0%	0.693
Cervical	25.0%	75.0%	0.0%	0.639
Abdominal	28.6%	66.7%	4.8%	0.546
Bones	20.0%	70.0%	10.0%	0.774

significant difference between the diagnosis of pulmonary embolism with respect to age and gender (P-value > 0.05) in agreement with other studies [4, 12, 22] . The prevalence of non-embolic findings in all included CTPA studies was 86.7%, while the prevalence among negative CTPA scans was 87.3%. A similar result was obtained by Perelas et al., who reported that 80.1% of negative CTPA scans had non-embolic findings [16].

Pulmonary findings were found in 45.2% of patients, followed by pleural findings in 18.3%. In line with various studies, pulmonary findings were the most frequently noted [13, 16, 20, 25] , while other studies had pleural effusion as the most common finding [15, 17, 23] . It is important to look for findings other than pulmonary embolism as they may help explain the patient's symptoms. Moreover, the patient may require later imaging thus, having a well-reported CT scan for future comparison is helpful. On the other hand, it should be remembered that CTPA is a diagnostic tool, and its ability to add more information does not justify using it as a screening tool. Guidelines have been established to assist physicians in effectively allocating resources. Imaging is reserved for individuals at intermediate or high risk for pulmonary embolism, according to the PIOPED II and European Society of Cardiology guidelines [31, 32] . Therefore, an integrated clinical examination using a validated predictive workup is the best solution to avoid confusion and unnecessary exposure to CTPA hazards [2, 6, 28].

As previously stated, lung opacification and pleural effusion are the most frequent findings; therefore, an initial chest X-ray should always be considered, especially when pulmonary embolism is low. Being a retrospective study, this might have affected the accuracy of the collected data. Also, the data was collected from a single centre and focused only on CT findings without correlating them to clinical information. Hence, prospective and multicenter studies with larger sample sizes are endorsed.

5. CONCLUSION

CTPA was positive for pulmonary embolism in 26.6% of cases. The majority of CTPA studies detected non-embolic findings; most of them were pulmonary and pleural. Some of these non-embolic findings might explain the patient's symptoms. However, it is important to benefit from this advantageous test in a carefully selected population to provide safe and high-quality services.

CONFLICT OF INTEREST

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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N/A

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