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ORIGINAL ARTICLE

INTERPRETATION OF EMERGENCY COMPUTED TOMOGRAPHY PULMONARY ANGIOGRAM

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ABSTRACT

Background: Computed tomography pulmonary angiogram (CTPA) is the recommended diagnostic method for individuals suspected of having pulmonary embolism (PE). The objective of this study was to determine the degree of concordance and discordance of CTPA interpretations for diagnosis of PE between the resident and consultant radiologist at Rehman Medical Institute, Peshawar.

Materials & Methods: This was a cross sectional study conducted between 1st January 2022 and 30th June 2022 at radiology department of the Rehman Medical Institute in Peshawar. A consultant radiologist's report was contrasted to the first interpretation of the on-call radiology resident. For pulmonary embolism, studies were categorized as positive, negative, or equivocal. Inter-rater agreement was examined using an unweighted Kappa coefficient with a 95% confidence range. SPSS version 26 was used for data analysis.

Results: Fifty successive CTPA tests were examined. The results showed that consultant interprets 43 (86%) of the studies as negative for PE. Residents, on the other hand, interpret 40 (80%) of them negatives. The concordance rate was 88%, with moderate statistical agreement, kappa = 0.597: 95% CI, 0.187- 0.765. The discordance rate was 12%. Regarding cardiac chambers, the consultant reported 10 (20%) with cardiomegaly. However, residents interpreted only 2 (4%) of them cardiomegaly. Overall concordance rate was 82%, with weak kappa = 0.350: 95% CI, 0.00- 0.688. In 18% of the cases, there was discordance.

Conclusion: Resident radiologist can provide high level of interpretation of CTPA for PE, achieving moderate concordance with consultant radiologist.

KEY WORDS: Pulmonary embolism; CTPA; Contrast; Radiologist; Residents.

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INTRODUCTION

Pulmonary embolism (PE) is an emergency and is a potentially fatal illness linked with substantial mortality and morbidity that is generally underdiagnosed.[1] It is the third most common kind of cardiovascular disease.[2] The incidence of PE varies from 39 to 115 per 100,000 persons per year, and the rapid recognition of PE remains difficult.[3]

CTPA with several detectors is the recommended diagnostic method for individuals suspected of having PE. It provides precise imaging at the subsegment level of the pulmonary arteries.[4] For the diagnosis of PE; it has a sensitivity of 83% and a specificity of 96%. For urgent diagnosis of PE, imaging investigations are often performed during on-call hours, when radiology residents act as the first interpreters. In most of academic institutions, radiology residents continue to offer early interpretations for studies ordered during several hours of their duties on weekends. Afterwards, a consultant radiologist evaluates the study. Several studies have shown a high degree of agreement between resident and consultant of on-call studies,[5,6] but few studies have addressed resident interpretation of CTPA.[7-9]

On a regular basis, radiology residents are available to analyze CTPAs to diagnose pulmonary embolism, and based on their interpretation treatment decisions are made. As PE therapy is associated with morbidity and mortality, it is of the highest clinical relevance for clinicians examining CTPAs for the existence of PE to make correct findings. The objective of this study was to determine the concordance and discordance of CTPA reports between residents and consultants in our setting.

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MATERIALS AND METHODS

This was a descriptive cross-sectional study. From 1st January 2022 and 30th June 2022, we prospectively analyzed 50 consecutive CT pulmonary angiograms conducted at the radiology department of Rehman Medical Institute, Peshawar. The designated on-call hours were 9 p.m. to 8 a.m., Monday through Saturday, and the full day on Sunday. In-patients, out-patients, and emergency room patients were recruited. All included individuals were suspected clinically to have an acute PE. After receiving approval from RMI's research department and ethics committee, patients were included in the study. Each patient provided informed consent, assuring confidentiality and the absence of any danger to the patient throughout participation in this research. On a questionnaire specifically prepared for this purpose, patient data such as demographics and clinical examination were collected.

The computed tomography scans were obtained with a 128-Row multi-detector CT machine. During the procedure, initial chest imaging consisted of a non-contrast-enhanced spiral CT with which a time–density curve was then generated with 20 ml of noniodinated contrast material at a flow rate of 4–5 ml per second using an automated injector. Then, craniocaudal pattern was followed for CT angiography at 3 mm collimation, 400 mA, and 120 kV with 4-5ml/kg of nonionic contrast material.

Before analysis, patient data and information were de-identified and anonymized. The radiology resident's tentative interpretation was compared to the consultant final report the following day. Initial attention was given to three potential results: positive, negative and equivocal. We determined inter-rater agreement using an unweighted Kappa coefficient and a 95% confidence range (CI). The Kappa values were interpreted as follows: <0.20 indicated poor performance; 0.21 - 0.40 indicated fair performance; 0.41 - 0.60 indicated moderate performance; 0.61 - 0.80 indicated good performance; and 0.81 - 1.0 indicated very good performance.

SPSS version 26 (Armonk, NY: IBM Corp.) for Windows was utilized for data storage and analysis. For categorical variables, frequency and percentage were computed, while mean and standard deviation were determined for continuous variables.

RESULTS

During study period total of 50 cases were performed. Regarding consultant interpretation of CTPA, 43(86%) were reported as negative, 4(8%) as positive for PE, and 3(6%) as equivocal. Moreover, radiology residents interpreted 40(80%) as negative, 4(8%) equivocal, and 6(12%) positive for PE. Overall, concordance rate was 88%, with moderate agreement, kappa of (k = 0.597: 95% CI, 0.187- 0.765). The discordance rate was 12%.

The agreement on positive cases was 66.66% (4/6), by residents, and for negative cases it was 97.5% (39/40), and 25% (1/4) for studies interpreted as equivocal by residents. (Table 1- 2)

Regarding cardiac chambers, the consultant identified 10 (20%) cases of cardiomegaly, 2 (4%) cases of thrombus, and 38 (76%) cases of normality. Nonetheless, residents assessed 2(4%) as having cardiomegaly, 1(2%) as having thrombosis, and 47(94%) as being normal. Overall agreement was 82% with a modest Kappa coefficient (k = 0.350: 95% confidence interval, 0.00-0.688). There was 82% agreement (38/47) for studies interpreted by residents as normal, 100% agreement (2/2) for studies evaluated by residents as cardiomegaly, and 100% agreement (1/1) for studies interpreted by

Table 1: CT Pulmonary Angiograms (CTPA) by Radiology Residents and Consultant for diagnosis of Pulmonary Embolism. (n=50)

Negative		Consultant			Total
		Positive	Equivocal		
Residents	Negative	39	0	1	40
	Positive	1	4	1	6
	Equivocal	3	0	1	4
Total		43	4	3	50

Table 2: Kappa for CTPA for resident

			95% Confidence Interval	
			Lower	Upper
Measure of Agreement for PE	Kappa	0.597	0.187	0.765

Table 3: Cardiac chambers by radiology residents and consultant

Normal		Consultants			Total
		Cardiomegaly	Thrombus		
Residents	Normal	38	8	1	47
	Cardiomegaly	0	2	0	2
	Thrombus	0	0	1	1
Total		38	10	2	50

Table 4: Kappa for Cardiac chambers by residents

			95% Confidence Interval	
			Lower	Upper
Measure of Agreement for Cardiac Chambers	Kappa	0.350	0.000	0.688

residents as thrombus. In 18% of the cases (9/50), there discordance. (Table 3, 4)

DISCUSSION

Computed tomography pulmonary angiogram (CTPA) is the method of choice for patients with a suspected pulmonary embolism (PE). To minimize mortality and morbidity, a timely diagnosis is necessary. At many teaching institutions, resident radiologist is the first to evaluate the CT examination and CTPA for the diagnosis of PE during off-call hours. This on-call obligation is an integral part of postgraduate training, but it is essential to analyze the frequency of inconsistent on-call interpretations on a periodic basis. Initial management choice is contingent upon the initial CPTA report. This study examines the concordance and discordance between the initial PE diagnoses provided by residents and consultants.

In our study, 88% of resident radiologists agreed on the diagnosis of pulmonary embolism (kappa: 0.597). Earlier research revealed no variance between residents' and consultants' interpretations of CT scans. [10, 11] In research by Ginsberg et al. [12]comparing CTPA reports between a resident radiologist and a consultant, overall agreement was 93%. (Kappa: 0.80). Shaham et al. [13]demonstrated a strong connection with a kappa value of 0.70. Our findings were nearly identical to those of Mayo et al., who showed an 83% interobserver agreement. In addition, Safriel et al.[14] assessed the accuracy of four residents in assessing 25 consecutive CT pulmonary angiograms retrospectively. They discovered a strong correlation between emboli in the major pulmonary arteries (kappa; 0.61).

Our data revealed a moderate level of concordance (kappa = 0.597) between the residents and consultant radiologist, with all disputes being to false positive instances identified by the residents. Respiratory motion artifacts are the most prevalent cause of an ambiguous CTPA and can lead to an incorrect diagnosis of pulmonary embolism. When a patient is suspected of having PE, the radiologist must first evaluate the CTPA's quality, as the researchers stated. According to Jones et al.[15] motion artifacts account for 74% of indeterminate CTPAs. It is crucial that consultant and residents realize how different technical aspects might alter the accuracy of an otherwise effective diagnostic instrument.

We found a large number of individuals without PE who had other relevant findings that adequately explained their presenting symptoms. One of the primary reasons CTPA imaging has supplanted traditional pulmonary angiography as the gold standard test for imaging suspected PE is its ability to give an alternate diagnosis. In our study, 10 patients had cardiomegaly which were reported by consultants. The overall concordance rate between residents and consultant was 82% and discordance rate was 12%. It is vital to note that some more discoveries will be purely coincidental but will require further investigation.

Limitation of our study is that we have small number of patients. In addition, no follow-up or investigations were conducted to validate the interpretations and the radiologist who validated the findings were not blinded to the reports of the residents, which raises the risk of reporting bias.

However CTPA is diagnostic of PE and on call radiologist should be able to give on spot diagnosis. Resident curriculums should encourage reporting CTPA in early years, so that they are fully able to do so in the later years of residency.

CONCLUSION

Our study concludes that residents had a moderate degree of agreement with the final consultant report in the emergency diagnosis of PE via CTPA. Our findings indicate that a system of independent

assessment by the radiology resident, along with rapid consultant assessment, offers a superior level of care and prompt assistance to physicians who are treating patients with pulmonary embolism.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	ZS, MA
Acquisition, Analysis or Interpretation of Data:	ZS, MA, AA, SY, RA
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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.