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Original Research Paper

Radio-Diagnosis

ROLE OF COMPUTED TOMOGRAPHY ANGIOGRAPHY IN PULMONARY EMBOLISM AND ITS COMPARATIVE EVALUATION WITH CONVENTIONAL RADIOGRAPHY

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ABSTRACT

1. Objective: A. To evaluate the diagnostic value of CT pulmonary angiography as compared to conventional radiography in Pulmonary embolism patients.

B. To perfectly diagnose Pulmonary embolism (acute and chronic).

2. Materials and Methods: In this cross-sectional study, CTPA and CXR of 65 patients was done which were hemodynamically stable patients of various ages with clinical diagnosis of pulmonary embolism . On CTPA, out of 65 patients, Pulmonary embolism was diagnosed in 55 patients with no Pulmonary embolism like imaging findings evident in 10 patients. On CXR out of 65 patients, Pulmonary embolism was diagnosed in 9 patients with no Pulmonary embolism like imaging findings evident in 56 patients. Correlation between CXR and CTPA finding was looked for.

3. Results: 43(66.15%) out of 65 patients were male. Majority - 35 (53.84%) belonged to age group between 30-60 years. Sickle cell disease and recent surgery were the most common comorbid condition seen in 30 (46.15%) patients in both. The most common lobe involved was right lower lobe seen in 20 patients(30.76%).The most common artery involved was right pulmonary artery in 30 patients(46.15%). The most common etiological factor was DVT followed by SCD.

4. Conclusion: To conclude CTPA, when readily available should be used as first line of investigation in suspected cases of pulmonary embolism for their prompt and accurate diagnosis that can help in precise management of the underlying cause. CTPA is a very important non-invasive imaging tool in pulmonary embolism Management as it has the potential to positively affect the outcome, morbidity in these patients.

KEYWORDS : CTPA, SCD, CXR, DVT

INTRODUCTION:

Pulmonary embolism (PE) is potentially threatening disease which results from detachment of thrombus from leg vessels in 70-80 and from pelvic vessels in 10-15 of cases(1). The complaint poses an individual dilemma because of non-specific signs with symptoms.

Up to the 1990s, chest X-ray, ventilation/ perfusion (V/ Q) lung scan, and pulmonary angiography were applied classically to diagnose PE. In general, it should be mentioned that every modality has different advantages and disadvantages with different perceptivity and particularity rates (2). In the former decade, several advancements have been made in the opinion of PE with minimally invasive modalities similar as spiral CT and MR imaging. Multitudinous studies have studied about the effectiveness of spiral CT angiography (CTA) in the opinion of acute PE. At the present time, pulmonary CTA is used in suspected cases of PE as the first-line individual approach(3).

Usually, the clinical diagnosis of PE in suspected patients isn't made accurately. Consistent with autopsy results, the prevalence of PE in hospitalized individuals is 15% - 26%. Although one-third of PEs have contributed to the death of patients, quite 70% of this number has not been clinically suspected before (2, 4). Moreover, about 10% of patients with PE don't survive after the primary embolic occasion. If PE remains neglected, it results in death in up to 30%of patients, but this high level is often lowered right down to 2% -10% if PE is diagnosed and managed timely with anticoagulants(5).

Pulmonary angiography remains the reference standard for PE diagnosis; however, it's invasive, expensive, and infrequently challenging to assess. Non-invasive diagnostic modalities are accepted and different combination of clinical assessment, lower extremity colour ultrasonography, D-dimer measurement, V/Q lung scintigraphy and, recently, CT are considered to eliminate the necessity for pulmonary angiography.

The above-mentioned technical difficulties and limitations have led researchers to consider CT pulmonary angiography as a reliable alternative to other non-invasive techniques for the correct diagnosis and severity of pulmonary embolism.

MATERIALS AND METHODS:

1. Ethics

The study was discussed with the ethical committee of our institution and as it is a Cross sectional study, the ethical approval was waived off.

2. Selection And Description Of Participants

Our cross-sectional study deals with 65 patients who were referred to our department with clinical diagnosis of DVT and pulmonary embolism. They were evaluated and 40(61.53%) patients were found with symptoms related to DVT. However , all the 65 patients were referred to the Radiology department for CTPA and CXR. On CTPA, out of 65 patients, Pulmonary embolism was diagnosed in 56 patients (86.15%) with no Pulmonary embolism like imaging findings evident in 10(13.80%) patients. On CXR out of 65 patients, Pulmonary embolism was diagnosed in 9 patients(13.80%) with no Pulmonary embolism like imaging findings evident in 56 patients(86.15%)(**FIGURE 5**).

We also evaluated the potential risk factors of the patients SCD, recent surgery prolonged bed rest and h/o coagulopathies etc.

3. Technical Information:

CTPA study was done using Philips 256 slice Spiral CT

machine. Contrast used was Inj. Iohexol 350mgI/ml.

4. Ct Features

We evaluated the patients radiologically in detailed manner with respect to laterality, lobe and arterial territory involved.

5. Statistics

Collected data was entered into Microsoft Excel software and coded. Charts and tables were prepared using Microsoft word and excel software. Descriptive data was presented in frequency and percentage. The correlation between CTPA findings and CXR was performed. P value <0.05 was considered as statistically significant and statistical software STATA version 14.2 was used for data analysis.

RESULTS:

1. Demographic And Clinical Data Of Entire Cohort

43(66.15%) out of 65 patients were male. Majority - 35 (53.84%) belonged to age group between 30-60 years (**FIGURE 1**). Sickle cell disease and recent surgery were the most common comorbid condition seen in 30 (46.15%) patients in both (**TABLE 1**). Most frequent complain of patient was clinical signs of DVT in 40 (61.53%) cases(**TABLE 2**).

2. Radiological Findings

Most frequent lobe to be involved was right lower lobe in 20 patients(30.76%)(**TABLE 4**).

Most frequent artery involved was right pulmonary artery in 30 patients (46.15%) (**FIGURE 3**).Most common etiological factor was DVT in 25 patients (38.46%) followed by SCD in 20 patients(30.76%)(**FIGURE 4**).

3. Follow-up: On CTPA, 56 patients were diagnosed as pulmonary embolism, 1 thrombus was missed in a patient of pulmonary AV malformation i.e., one false negative **(FIGURE 7),** 1 lesion that was diagnosed as a thrombus was in fact a partial volume averaging artifact i.e., another false negative. In one other patient, a lesion that later on proved to be an artifact was incorrectly diagnosed as a thrombus on CTPA i.e., a false positive **(TABLE 6, TABLE 7).**

On CXR, 9 patients were diagnosed as pulmonary embolism. On CXR, 56 pulmonary embolism patients were missed i.e., 56 false negative. None of the patient, was incorrectly diagnosed as pulmonary embolism on CXR i.e., 0 false positive **(TABLE 9 TABLE 10)**.

DISCUSSION:

Pulmonary embolism (PE) refers to embolic occlusion of the pulmonary arterial system. The most of cases affects from thrombotic occlusion, and therefore the condition is constantly nominated "pulmonary thromboembolism" which is what this composition mainly covers. Acute PE is a common cause of acute onset chest pain presenting in the emergency room with as many as 1–2 per 1,000 patients potentially affected by VTE (6). The risk of VTE is increased with inherited thrombophilias with 5–8% of US population having one of these high-risk conditions. Recurrence is seen in up to a third of patients with VTE within 10 years, and half may develop long term post-thrombotic syndrome (6). The clinical presentation of acute PE is variable. Up to two-thirds of patients may be asymptomatic, or sudden death may be the first presentation. Common clinical presentations of acute PE include chest pain, tachycardia, hypotension, dyspnoea, cough, and haemoptysis. Massive PE presents with hypotension, shock, or cardiac arrest. electrocardiography (EKG) changes of S1Q3 pattern, S1Q3T3 pattern, notched S wave in lead V1, inverted T waves, and right bundle branch block may be seen in patients with right heart strain(7). Signs and symptoms of proximal deep vein thrombosis (DVT) include lower extremity swelling, edema, erythema, and pain.

In this study, we have come across various presentations of pulmonary embolism ranging from clinical signs of DVT , breathlessness, tachycardia, chest pain, etc. . From the current cross-sectional study of 65 patients, certain inferences were drawn. Sensitivity and specificity of CTPA in diagnosing pulmonary embolism and differentiating it from pulmonary embolism mimics was 96.36% and 90% respectively while its positive and negative predictive value were 98.14% and 81.81% respectively. The overall accuracy of CTPA in diagnosing pulmonary embolism was 95.38%(**TABLE 8**).Sensitivity and specificity of CXR in diagnosing pulmonary embolism and differentiating it from pulmonary embolism mimics was 12.36% and 100% respectively. While its positive and negative predictive value were 100% and 1.75% respectively. The overall accuracy of CXR in diagnosing pulmonary embolism was 13.84%(**TABLE 11).** The exact role of a radiologist is to correctly diagnose the pulmonary embolism as early as possible. This will help the treating physician to take early decision and reduce further risk and complications of pulmonary embolism.

CONCLUSION:

Morbidity and mortality associated with pulmonary embolism is responsible for its severity. The widespread use of CTPA for diagnosing pulmonary embolism may lead to the early treatment and decrease in associated morbidity and mortality. Healthcare professionals should act promptly when there is suspicion of Pulmonary embolism. A multidisciplinary approach should include the prompt diagnosis and treatment with anticoagulants, antiplatelets and fibrinolytics and surgical management whichever needs.

Tables And Figures

Table 1: Co-morbidities Of The Patients

Risk Factors	Frequency (n=65)	Percentage (%)
H/o SCD	30	46.15
Recent Surgery	30	46.15
Prolonged bed rest/immobility	20	30.76
H/o Coagulopathies	15	23.07
H/o TB Contact	14	21.53
H/o other Anaemia	14	21.53
Malignancy: Including multiple Myeloma	10	15.38
HIV	8	12.30
COVID19	8	12.30
oral contraceptive use	5	7.69
Pregnancy	5	7.69
Known or previous DVT	4	6.15
H/O Heart Disease	3	4.61
H/S/o Dehydration	2	3.07

Table 2: Clinical Features Of The Patients

PRESENTING COMPLAINTS AND CLINICAL HISTORY	Frequency (n=65)	Percentage (%)
Clinical signs of deep venous thrombosis (DVT)	40	61.53
Asymmetric pitting lower extremity edema	30	46.15
Prominent superficial collateral vessels	20	30.76
Tenderness to palpation along the deep venous system	20	30.76
Breathlessness	20	30.76
Tachycardia	15	23.07
Pleuritic chest pain	15	23.07
Hemoptysis	5	7.69
Elevated D-Dimer	5	7.69
CXR findings	5	7.69
Immobilization for 3 or more consecutive days or surgery in the previous 4 weeks	2	3.07

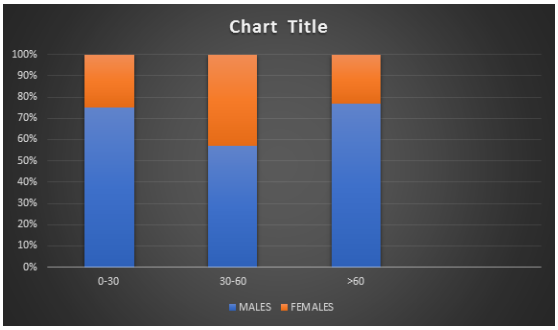


Figure 1: Bar Diagram Showing Age And Sex Distribution.

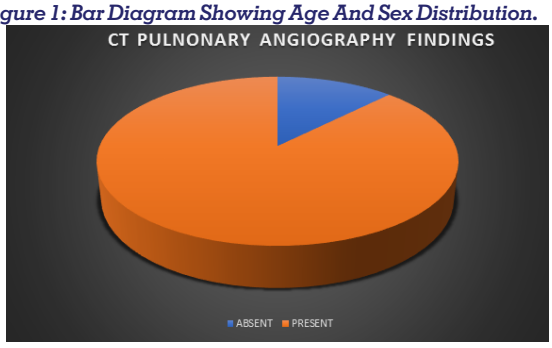


Figure 2: Distribution Of Cases According To Positive Findings On Ctpa

Table 3: Distribution Of Cases According To Positive Findings On Cxr

FINDINGS ON CHEST X RAY	Frequency (n=65)	Percentage (%)
PRESENT	56	86.15
ABSENT	9	13.80

Table 4: Distribution Of Cases According To Lobe Of Lung Involved

LOBE OF LUNG INVOLVED	Frequency (n=65)		
	PULMONARY INFARCT	**No PULMONARY INFARCT**	**TOTAL**
RUL	5	7	12
RML	10	3	13
RLL	20	3	23
LUL	3	3	6
LLL	7	4	11
TOTAL	45	20	65

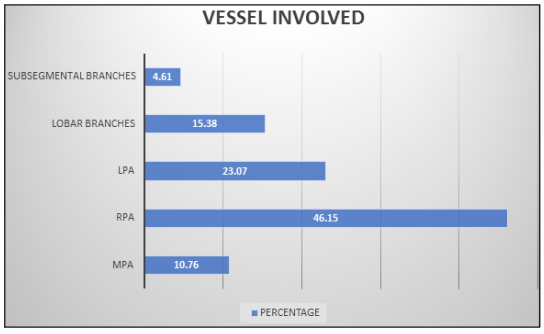


Figure 3: Bar Chart Showing Distribution Of Pulmonary Embolism Cases According To Vessel Involvement.

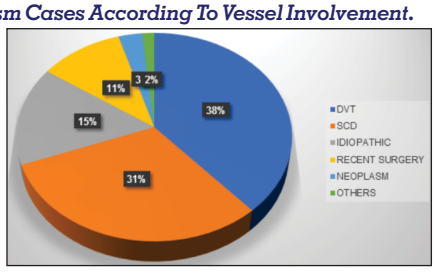


Figure 4: Pie Chart Showing Distribution Of Pulmonary Embolism Cases According To Etiology.

Table 5: Distribution Of Cases According To Final Diagnosis

Final Diagnosis	Frequency (n=65)	Percentage (%)
PULMONARY EMBOLISM	53	81.53
Not PULMONARY EMBOLISM / PULMONARY EMBOLISM Mimic	12	18.46

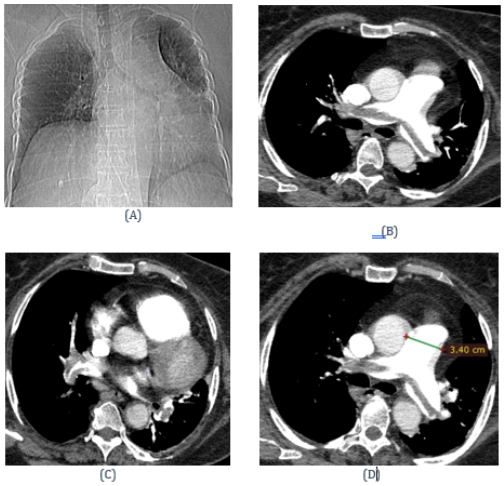


Figure 5: A)cxr Shows No Significant Abnormality;(b) Ctpa Axial Image Showing Saddle Thrombus;(c) Shows Extension Of Thrombus Into Right Descending Interlobar Artery ;(d) Shows Dilated Mpa Consistent With Pulmonary Arterial Hypertension. This Was A Case Of Saddle Thrombus In Mpa With Extension Into Rpa.

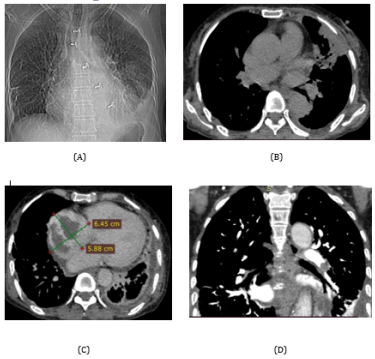
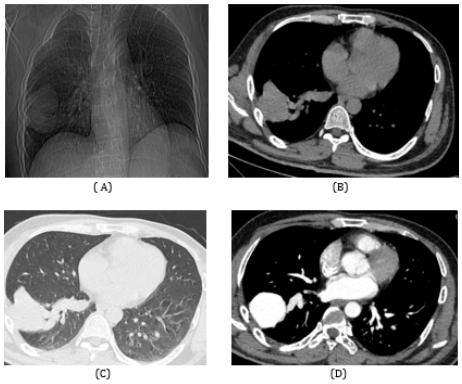
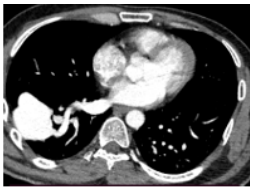


Figure 6: (a)cxr Consolidation Seen Involving Left Lower Zone (b) Mediastinal Window Ct Thorax Revealed Consolidation With Air Bronchogram In Anterior Segment Of Left Lower Lobe (c) Ctpa Study Axial Images Revealed Large Thrombus In Right Atrium With Right Atrial Enlargement (d) Ctpa Study Coronal Image Shows Thrombus In Lpa And Subsegmental Branchces.this Was A Case Of Right Atrial And Lpa Thrombosis With Left Lower Lobe Pulmonary Infarct.





(E)

Figure 7: (a) Cxr Revealed Large Well Defined Intraparenchymal Opaque Lesion In Right Lower Zone; (b)mediastinal &(c) Lung Window Ct Thorax Axial Images Revealed Well Defined Lobulated Soft Tissue Hyperdense Lesion In Superior Segment Of Right Lower Lobe With "feeding Vessel Sign"; On Ctpa Study (d)axial And (e)coronal Images, The Lesion Is Seen Supplied By Rpa And Is Drained By Inferior Pulmonary Vein. This Was A Case Of Pulmonary Arteriovenous Malformation (type A).

Table 6: Table Of Number Of Cases With Final Diagnosis Vs Ctpa Diagnosis Of Pulmonary Embolism

	PULMONARY EMBOLISM	No PULMONARY EMBOLISM / PULMONARY EMBOLISM Mimic	TOTAL
CTPA Diagnosis	56	09	65
Final Diagnosis	53	12	65

Table 7: 2 X 2 Table Of Final Diagnosis Vs Ctpa Diagnosis In Pulmonary Embolism

Final Diagnosis → / CTPA Diagnosis ↓	PULMONARY EMBOLISM	**NO-PULMONARY EMBOLISM**	
PULMONARY EMBOLISM	53(TP)	1 (FP)	54
NON-PULMONARY EMBOLISM	2 (FN)	9(TN)	11
TOTAL	55	10	65

Table 8: Statistics Of Ctpa In Diagnosis Of Pulmonary Embolism

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
Formula:	TP/ TP+FN *100	TN/ FP+TN *100	TP/TP+FP *100	TN/TN+FN *100	TP+TN/ TP+TN+ FP+FN *100
RESULT	96.36%	90%	98.14%	81.81%	95.38%

Table 9: Table Of Number Of Cases With Final Diagnosis Vs Cxr Diagnosis Of Pulmonary Embolism

	PULMONARY EMBOLISM	**No PULMONARY EMBOLISM / PULMONARY EMBOLISM Mimic**	**TOTAL**
CXR Diagnosis	09	56	65
Final Diagnosis	53	12	65

Table 10: 2 X 2 Table Of Final Diagnosis Vs Cxr Diagnosis In Pulmonary Embolism

Final Diagnosis → / CXR Diagnosis ↓	PULMONARY EMBOLISM	NO-PULMONARY EMBOLISM	
PULMONARY EMBOLISM	08(TP)	0 (FP)	08
NON-PULMONARY EMBOLISM	56 (FN)	1(TN)	57
TOTAL	64	1	**65**

Table 11: Statistics Of Cxr In Diagnosis Of Pulmonary Embolism

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
Formula:	TP/ TP+FN *100	TN/ FP+TN *100	TP/TP+FP *100	TN/TN+FN *100	TP+TN/ TP+TN+ FP+FN *100
RESULT	12.36%	100%	100%	1.75%	13.84%

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