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CT Pulmonary Angiography in COVID-19 Pneumonia: A Retrospective Study of Relationship between Pulmonary Embolism and Disease Severity

Research Article

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Abstract

Introduction: Coagulopathy has been commonly reported in patients with COVID positive status. We conducted this study relationship between pulmonary embolism and covid 19 disease severity. clear understanding of rate of embolism, correlation with D dimer levels and the degree of involvement of thrombosis can be of great help in management of COVID positive patients

Study design and methods: In this observational retrospective study, conducted over a period of 2 months, all the suspected COVID patients referred to our institute with complaints of breathlessness and suspected to be having thromboembolism were included. These patients were first subjected to HRCT chest and were followed up for CTPA after patient's symptoms worsened and were assessed the presence or absence of arterial thrombosis

Results: Out of the evaluated 34 patients, none of them were seen to have pulmonary thromboembolism in main pulmonary trunk, while 14 patients were found to have thrombosis involving right and left pulmonary arteries and their ascending and descending branches and all 34 patients were found to have thrombosis in segmental and subsegmental branches.

Interpretation: Thromboembolism, including pulmonary embolism is one of the known and frequent complication in COVID patients. In cases with sudden clinical worsening CT Pulmonary angiography should be done to confirm pulmonary embolism which is a life threatening but potentially treatable condition.

Keywords: COVID 19; Pneumonia; Pulmonary Embolism; CTAngiography

Abbreviations

COVID-19, HRCT, CTPA

Introduction

The novel Corona virus disease began to take its course in December 2019 and by March 2020 reaching the pandemic levels [1]. According to the current guidelines RTPCR (reverse transcriptase polymerase chain reaction) is considered confirmatory for COVID testing. How-ever those with negative test having positive findings on CT are considered to have lung involvement which is analysed in the form of CT severity classification system. How-ever CT can be falsely negative early in the disease but HRCT reserved for evaluation of complications in patients with COVID positive status [2].

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Coagulopathy has been commonly reported in patients with COVID positive status and has been associated with increased mortality with lab findings of elevated D-dimer levels[3]. It was found that patients who were empirically treated with low molecular weight heparin had a lower morbidity and mortality as compared to those that were not treated with LMWH [4,5]. A significance of embolism is thus associated with worst clinical outcome in COVID-19 patients.

How-ever this seems to be challenging in evaluation of terminally ill patients and possibly acute kidney injury as both the risk of nephrotoxicity from IV contrast administration and potential benefit of diagnosing pulmonary thromboembolism needs to be considered [6]. Thus, clear understanding of rate of embolism, correlation with D dimer levels and the degree of involvement of thrombosis can be of great help in management of COVID positive patients.

It is necessary to look for embolism in main pulmonary artery, its right or left main branches, the lobar branches and even the proceeding segmental and sub segmental branches [7]. We conducted this study relationship between pulmonary embolism and covid 19 disease severity.

CT pulmonary angiography not only can assess the presence of pulmonary embolus but also can assess the severity of the embolus as well as heart function and strain on the right ventricle. Thus, we can predict the need for ICU admission and patient outcome [8].

Material and Methods

In this retrospective study all the suspected COVID patients referred to the department of radiology at government medical college, Surat with complaints of breathlessness and suspected to be having thromboembolism were included. The study was conducted over a period of 2 months from including April and May 2021. These patients were first subjected to HRCT chest and were followed up for CTPA after patient's symptoms worsened.

Written and informed consent of the patient taken with risk factors explained to the relatives. Patient then were taken for CTPA with all the necessary precautions as per the protocols and guidelines on Philips's brilliance 256 slice CT machine dedicated for Covid patients at the department.

We assessed the presence or absence of arterial thrombosis i.e., filling defect in the form of is Odense to hypodense content within pulmonary vasculature and reported presence, extent and location of thrombus if any. The presence of thrombus was described in terms of unilateral vs bilateral involvement, lobar, segmental or subsegmental involvement.

CT Technique

Patients' preparation: Patients were required to fast for 6-8 h, and normal kidney function was needed using serum creatinine as a reference. Adequate hydration was instructed before and after the procedure. An 18–20-gauge cannula was inserted into the antecubital vein.

CT Machine: Philips's brilliance 256 slice

CT machine**.** The infection control parameters wereapplied under the guidance of the hospital infection control unit.

The patients were scanned in a supine position with the arm above the head. A breath-hold was requested from the patients trying to avoid respiratory motion artifact. A region over interest was drawn on the main pulmonary artery. Bolus IV injection of non-ionic contrast medium **1.2 ml/kg** was used at rate 4 ml/s using injector pump followed by 40 ml saline at rate 4 ml/s.

CT parameters: The scan area extended from diaphragm to lung apex with scan time used = 10 s. The tube voltage was 140/80 KVP and tube current: 51/213 mAs. Rotation time was 0.33 s, 0.75mm thickness, 0.7 reconstruction increment (mm), and 0.7 Pitch.

Image processing and interpretation: The images were transferred to the workstation where the axial cuts and multi-planar reformation were examined.

The following items were fulfilled: Positive pulmonary embolism, site if unilateral or bilateral and extent if segmental, lobar, or main arterial.

Based on percentage of lung involvement on HRCT for changes of covid pneumonitis, patients were divided as follows:

Category	% of Lung Involvement
1. Mild	0-25 %
2. Moderate	26-50 %
3. Severe	51-75 %
4. Very Severe	76-100 %

Presence or absence of CT progression comparing the CTPA with the last available study regarding the parenchymal involvement.

Result

A total of 34 cases were included in this study. Out of 34 cases there were 26 males and 8 females with a M:F ratio of **3.25:1**.

The mean age of the patients was 51.3 ± 16.9 years with age range 20–75.

From the above mentioned table:

Out of the evaluated 34 patients with pulmonary thromboembolism, one patient each fell under mild and moderate category respectively.

14 (41%) patients out of 34 fell under severe category and 18 (52.9 %) patients under very severe category.

Of the 14 patients with severe lung involvement, 10 (71 %) patients showed changes of pulmonary thromboembolism in bilateral lungs; 3 (22 %) patients in right lung and 1 (7%) patient in left lung.

Among patients in severe category, irrespective of the laterality of lung involvement, total of 24 each upper and lower lobe were evaluated. The changes of thromboembolism were seen in 15 (62 %) upper lobes and 19 (79 %) lower lobes.

Of the 18 patients with very severe lung involvement, 11 (61%) patients showed changes of pulmonary thromboembolism in bilateral lungs; 4 (22%) patients in right lung and 3 (17 %) patients in left lung.

Among patients in very severe category, irrespective of the laterality of lung involvement, total of 29 each upper and lower lobe

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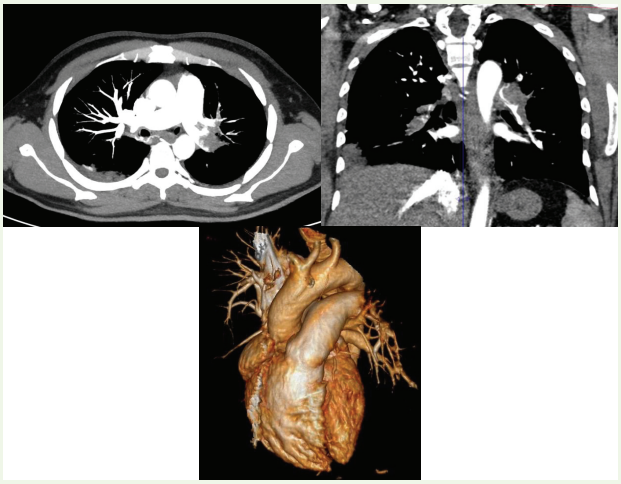


Figure 1: Axial and coronal sections and 3D pulmonary angiogram showing filling defect (thrombosis) in left pulmonary artery extending into the branches

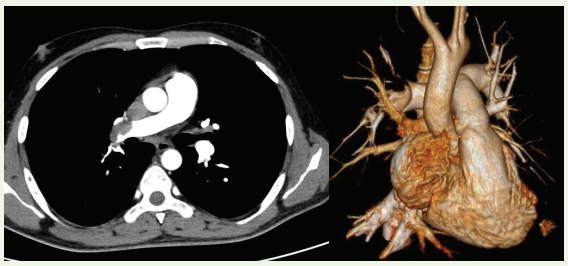


Figure 2: Axial section and 3D pulmonary angiogram showing filling defect (thrombosis) in right pulmonary artery

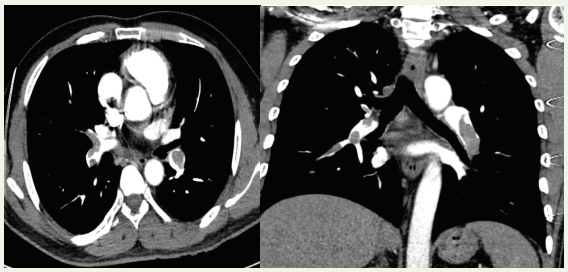


Figure 3: Axial and coronal sections showing thrombosis in right and left pulmonary arteries extending into the branches

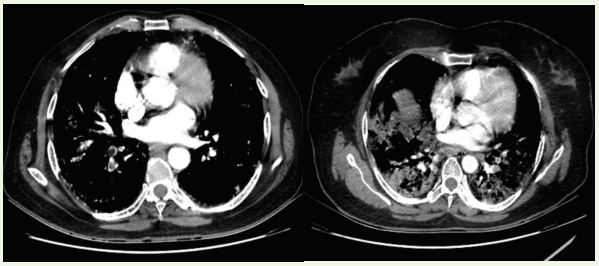
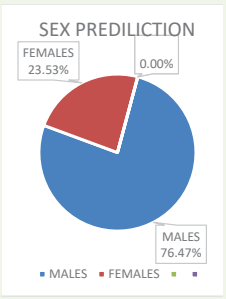
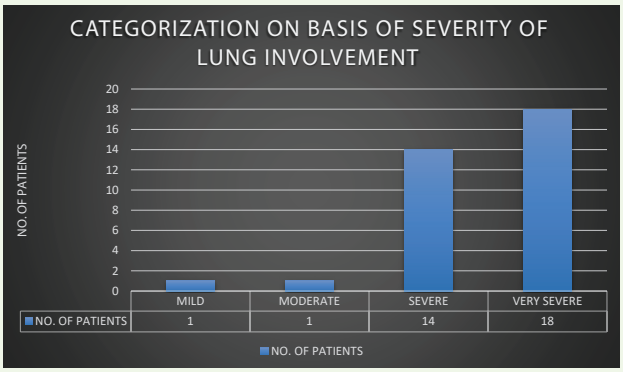


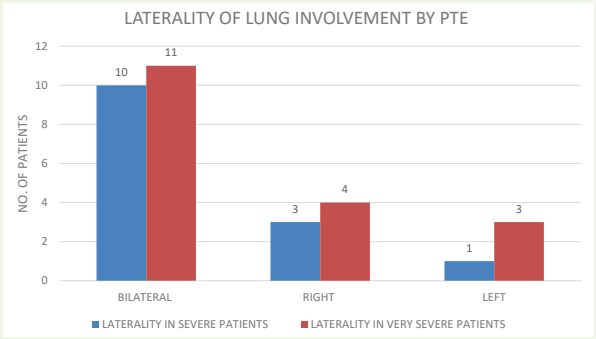
Figure 4: Axial section of CTPA showing thrombosis in subsegmental branches of bilateral lower lobes



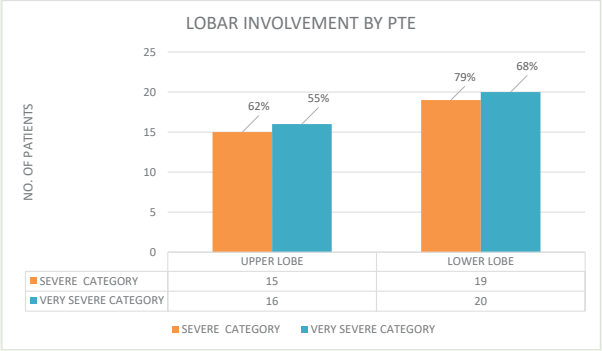
Graph 1



Graph 2



Graph 3



Graph 4

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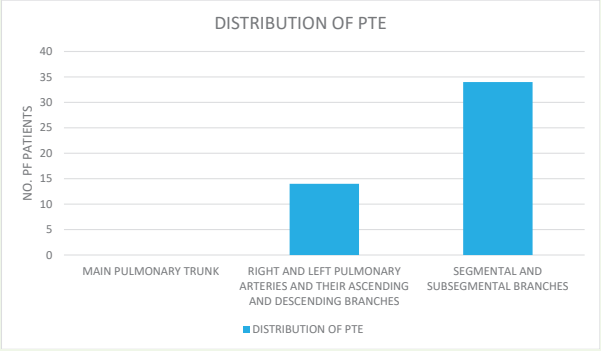

Graph 5

were evaluated. The changes of thromboembolism were seen in 16 (55 %) upper lobes and 20 (68%) lower lobes.

None of the patients out of the evaluated 34 were seen to have pulmonary thromboembolism in main pulmonary trunk, while 14 patients were found to have thrombosis involving right and left pulmonary arteries and their ascending and descending branches and all 34 patients were found to have thrombosis in segmental and subsegmental branches.

Discussion

Our study of 34 patients with changes of pulmonary thromboembolism shows that the embolism was predominantly involving segmental and sub segmental branches of pulmonary artery and more so in bilateral lung fields which correlates with studies of Bompard F et al who conducted a retrospective study of 137 patients with confirmed SARS-Cov-2 infection and COVID-19 pneumonia[9]. All these patients underwent computerized tomographic angiography. In this study a total of 32 Pulmonary embolism cases were identified resulting in a 24%incidence. Out of these 32 cases there were 10 proximal pulmonary embolism cases and 22 peripheral Pulmonary embolism cases 18 of which were involved segmental pulmonary arteries and 4 were involved in multiple subsegmental pulmonary arteries.

Alonso-Fernández A et al also conducted a study in which 30 consecutive confirmed cases of COVID-19 pneumonia with D-dimer >1 µg/mL underwent computed tomography pulmonary angiography (CTPA) to find out presence of pulmonary embolism, the authors found that out of 30 studied cases 15 had pulmonary embolism on CTPA resulting in the incidence of 50%.[10] The authors reported that embolism was found predominantly In peripheral and bilateral (60%) distribution, affecting mainly segmental and subsegmental arteries. Similar finding were also reported by the authors such Desai R as et al [11] and Shi L et al. [12].

A major limitation in our study was relatively small sample size. Additionally due to retrospective study many patients lacked laboratory testing of coagulation and inflammatory markers during their workup. Future investigation with larger number of sample size may aid in further evaluation of the influencing factors for pulmonary embolism.

Another interesting fact to be noted was that as the percentage of lung involvement on HRCT for changes of covid pneumonitis increases, there is an increase in incidence of thromboembolic events.

Conclusion

Thromboembolism, including pulmonary embolism is one of the known and frequent complication in COVID patients. In cases with sudden clinical worsening CT Pulmonary angiography should be done to confirm pulmonary embolism which is a life threatening but potentially treatable condition.

Ethical Statement:"The study was conducted in accordance with the declaration of Helsinki, and the protocol was approved by the Human Research Ethics committee of Government college, Surat"

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