

Role of CT Pulmonary Angiography in Evaluation of COVID-19 Patients

Nikita Mantri¹, P.S. Mishrikotkar², D.B. Dahiphale³, Kavita Makasare⁴

¹Resident, ²Professor, ³Professor and HOD, ⁴Assistant Professor, Department of Radiology, MGM Medical College, Aurangabad, India

Corresponding author: Dr Nikita Mantri, Resident, Department of Radiology, MGM Medical College, Aurangabad, India

DOI: <http://dx.doi.org/10.21276/ijcmsr.2020.5.4.22>

How to cite this article: Nikita Mantri, P.S. Mishrikotkar, D.B. Dahiphale, Kavita Makasare. Role of CT pulmonary angiography in evaluation of COVID-19 patients. *International Journal of Contemporary Medicine Surgery and Radiology*. 2020;5(4):D92-D95.

A B S T R A C T

Introduction: Pulmonary thromboembolism is a pathophysiological syndrome resulting from obstruction of pulmonary artery and its branches from the emboli arising from venous system or heart resulting in dysfunction of pulmonary circulation thereby causing respiratory failure. Since pulmonary embolism is one of the known complications in COVID patients it is necessary to rule out this condition particularly in patients in whom there is sudden unexplained deterioration of clinical condition or in whom there is deranged D-Dimer levels. We conducted this study to study the prevalence of pulmonary embolism in COVID patients and the factors associated with severity.

Material and Methods: In this retrospective study all the COVID positive patients referred to the department of radiology at MGM medical college Aurangabad with complaints of breathlessness and suspected to be having thromboembolism were included on the basis of a predefined inclusion and exclusion criteria. All the recent lab parameters were recorded on a sheet of paper that included D-Dimer levels, ESR, C-reactive protein, coagulation markers like PT/INR and platelet counts. The D-Dimer levels closest to CTPA study and imaging diagnosis were taken into account. Patients were then taken for CTPA with all the necessary precautions as per the protocols and guidelines on CT machine 128 slice dedicated for COVID patients at the department.

Results: A total of 30 cases were included in this study. Out of 30 cases there were 21 males and 9 females with a M:F ratio of 1:0.42. Amongst 10 patients who had pulmonary embolism all were found to have D-Dimer levels elevated above 0.5. Among the 10 patients with thromboembolism about 3 (30%) patients had thrombus in right main pulmonary artery extending to its lobar branches. 4 (40%) had findings in right interlobar artery extending to its lower lobe branches. 1 (10%) had thrombus in left main pulmonary artery extending into its lower lobar branches and 2 (20%) patients had embolism in the segmental branches of right lower lobe.

Conclusion: Pulmonary embolism is a serious condition seen in COVID patients. It must be ruled out in all patients of COVID having elevated D-Dimer levels of sudden unexplained deterioration of clinical condition.

Keywords: COVID-19, Pulmonary Thromboembolism, D-Dimer, CT Pulmonary Angiography.

INTRODUCTION

The novel Corona virus disease began to take its course in December 2019 and by March 2020 reaching India reached the pandemic levels.¹ According to the current guidelines RTPCR (reverse transcriptase polymerase chain reaction) is considered confirmatory for COVID testing. However 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. However CT can be falsely negative early in the disease but HRCT reserved for evaluation of complications in patients with COVID positive status.²

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.

However 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 preceding segmental and sub-segmental branches.⁷

We conducted this study to study the prevalence of

pulmonary embolism in COVID patients and the factors associated with severity.

MATERIAL AND METHODS

In this retrospective study all the COVID positive patients referred to the department of radiology at MGM medical college Aurangabad with complaints of breathlessness and suspected to be having thromboembolism were included on the basis of a predefined inclusion and exclusion criteria. The study was conducted over a period of 8 months from April-November 2020. These patients were first evaluated clinically. Gender, age, indication and presence of co-morbidities such as diabetes, hypertension as well as history and duration of smoking were recorded in all cases. Information regarding duration of illness, its progress and severity was noted. All the recent lab parameters were recorded on a sheet of paper that included D-Dimer levels, ESR, C-reactive protein, coagulation markers like PT/INR and platelet counts. The D Dimer levels closest to CTPA study and imaging diagnosis was taken into account.

The use of any prophylactic anticoagulation as that of clexane or subcutaneous heparin was recorded. The clinical outcomes were judged and taken into account as well as per the medical record review. Any venous ultrasound examinations to evaluate for DVT in addition to ECG was assessed for positive patients. 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 CT machine 128 slice dedicated for Covid patients at the department.

Imaging results were reviewed by same senior radiologist. The examiner was blinded to the patients clinical status. The examining radiologist assessed the presence or absence of arterial thromboembolism in pulmonary vasculature. The examining radiologist 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.

Inclusion Criteria

1. Covid positive patients (by RTPCR) referred to us for Imaging.
2. Age above 18 years.
3. Informed written consent obtained.

Exclusion Criteria

1. Those who refused consent.
2. Age below 18 years.
3. Patients with known allergy to contrast agents, hepatic or renal dysfunction.
4. CT images with artifacts.

For Statistical purposes SSPS 21.0 software was used and p value less than 0.05 was taken as statistically significant.

RESULT

A total of 30 cases were included in this study. Out of 30 cases there were 21 males and 9 females with a M:F ratio of 1:0.42 (Figure 1).

The analysis of patients to find out presence of risk factors for thromboembolism showed that out of 30 patients 10

(33.33%) patients had type II diabetes whereas hypertension and smoking was seen in 12 (40%) and 10 (33.33%) patients respectively (Figure 2).

About 10 patients out of the evaluated 30 were seen to have pulmonary thromboembolism in main pulmonary artery, lobar and segmental branches. D dimer levels were found to be raised with a mean of about 10 microgram/ml. Incidence of pulmonary embolism was found to be comparable in males as well as females with no statistically significant difference (P=1.00) (Table 1)

Amongst 10 patients who had pulmonary embolism all were found to have D-Dimer levels elevated above 0.5. D-Dimer levels were found to be high in patients with pulmonary thromboembolism on CT as compared to those patients who didn't have pulmonary thromboembolism and the difference was found to be statistically highly significant (P<0.0001) (Table 2)

Amongst the 10 patients who had pulmonary embolism on imaging 4 (40%) were successfully discharged, 3 became critical and needed mechanical ventilation. 03 patients needed oxygen supplementation and were improving. All patients received anticoagulant therapy. (Table 3)

Among the 10 patients with thromboembolism about 3 (30%) patients had thrombus in right main pulmonary artery extending to its lobar branches. 4 (40%) had findings in right interlobar artery extending to its lower lobe branches. 1(10%) had thrombus in left main pulmonary artery extending into its lower lobar branches and 2 (20%) patients had embolism in the segmental branches of right lower lobe (Figure 3-6).

Discussion:

In this study of 30 patients 10 were found to have positive findings suggestive of pulmonary embolism. D-Dimer significantly differed between the patients who had positive findings and those with negative CTPA exams. Thus, this study supported the knowledge regarding the relationship between COVID 19 and hypercoagulable states including DIC. This association has also been indicated by an ultrasound study by Cui et al which reported peripheral DVT in 25% of patients with severe COVID 19.⁸

Additionally a brief clinical report by Llitilos et al further reinforced the association of COVID 19 and pulmonary embolism and venous thromboembolism (VTE). The authors reported that despite anticoagulation overall rate of VTE in patients was 69%. On the other hands 6 (23.07%) patients were diagnosed to be having pulmonary thromboembolism.⁹ In our study among the 10 patients with thromboembolism about 3 (30%) patients had thrombus in right main pulmonary artery extending to its lobar branches. 4 (40%) had findings in right interlobar artery extending to its lower lobe branches. Bompard F et al conducted a retrospective study of 137 patients with confirmed SARS-Cov-2 infection and COVID-19 pneumonia. 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. An interesting point

reported by the authors in this study was that prophylactic anticoagulation did not avoid the occurrence of Pulmonary embolism in studied cases.¹⁰

In another review study by Moores et al it was found that COVID 19 positive patients treated with anticoagulation therapy like low molecular weight prophylactically has comparatively better outcome than that of non treated patients¹¹. Various studied concluded that though the anticoagulation may not significantly reduce the incidence of pulmonary thromboembolism it can improve the ultimate outcome. In a review of patients with COVID 19 Salah HM et al reported that mortality rate in patients who were taking

anticoagulation was 17.4%, whereas it was 20.9% in patients who were not taking anticoagulants.¹²

Alonso-Fernández A et al 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

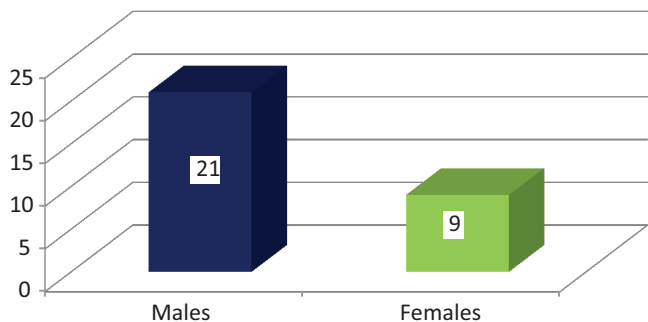


Figure-1: Gender Distribution of the studied cases.

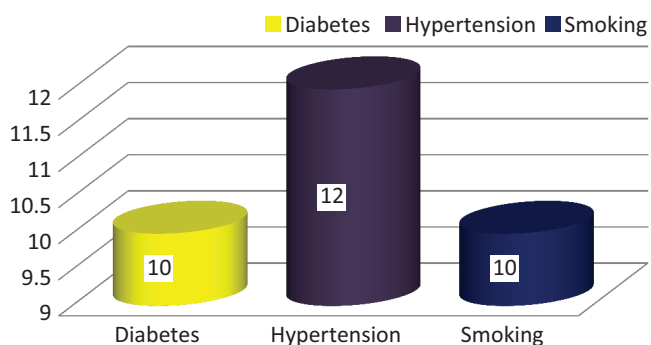


Figure-2: Risk Factors for thromboembolism in studied cases.

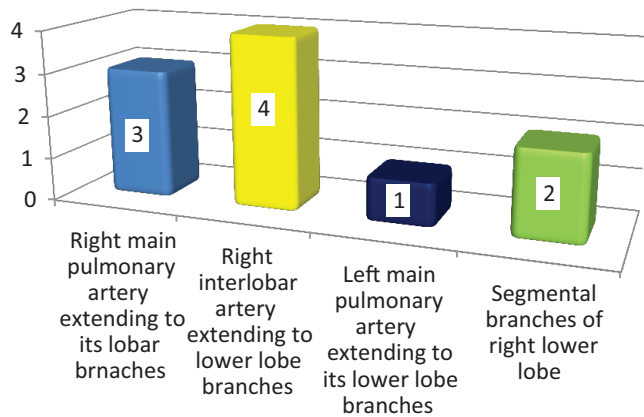


Figure-3: Involvement of pulmonary arteries and their branches.

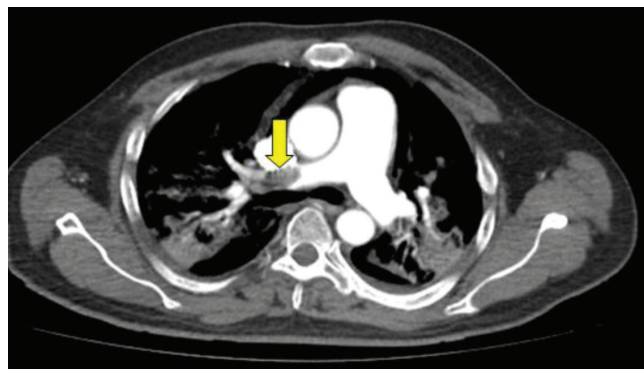


Figure-4: Filling defect seen in right branch of pulmonary artery s/o pulmonary embolism.

	Pulmonary-embolism on CT	No Pulmonary-embolism on CT	P value
Male	7 (23.33%)	14 (46.66)	P = 1.00 Not significant
Females	3 (10%)	6 (20%)	
Total	10 (33.33%)	20 (66.66%)	

Table-1: Incidence of pulmonary embolism and its gender distribution.

	Pulmonary-embolism on CT	No Pulmonary-embolism on CT	P value
Mean	0.77	0.19	P = P < 0.0001 Highly significant
Std Deviation	0.19	0.08	

Table-2: Comparison of D-Dimer level in patients with and without Pulmonary thromboembolism

Clinical Course	No of patients	Percentage
Patients that worsened and needed mechanical ventilation	03	30%
Discharged	04	40%
Improved	03	30%
Total	10	100%

Table-3: Clinical Outcome of the studied cases.

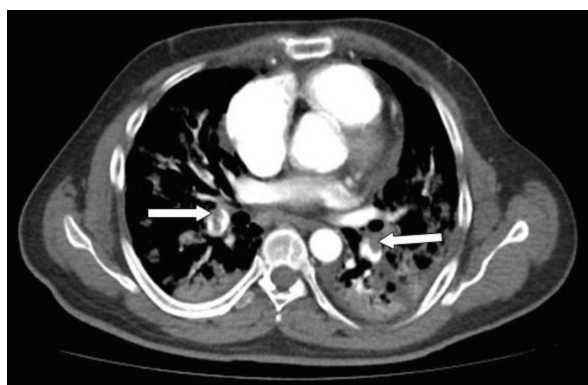


Figure-5: Loss of contrast opacification in both lower lobar arteries..

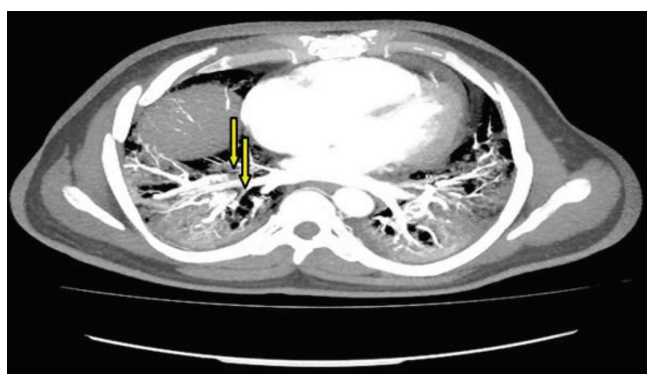


Figure-6: partial lumen occluding thrombus in lower lobe segmental branches of right interlobar artery.

30 studied cases 15 had pulmonary embolism on CTPA resulting in the incidence of 50%.¹³ 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 al¹⁴ and Shi L et al.¹⁵

A major limitation in our study was relatively small sample size. Another limitation being the COVID suspect patients who do not undergo D-dimer study and thus remained out of discussion. Additionally due to retrospective study many patients lacked laboratory testing of coagulation, inflammatory markers during their workup, ECG and even understanding for ordering of CTPA. Future investigation with larger Cohort may elucidate influencing factors for pulmonary embolism.

CONCLUSION

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

REFERENCES

1. Bialek S, Boundy E, Bowen V, Chow N, Cohn A, Dowling N, Ellington S, Gierke R, Hall A, MacNeil J, Patel P, Peacock G, Pilishvili T, Razzaghi H, Reed N, Ritchey M, Sauber-Schatz E. Severe Outcomes Among Patients with Coronavirus Disease 2019

(COVID-19)— United States, February 12–March 16, 2020. *MMWR Morbidity and Mortality Weekly Report* 2020; 69(12):343-346.

2. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, Diao K, Lin B, Zhu X, Li K, Li S, Shan H, Jacobi A, Chung M. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. *Radiology* 2020;20(1):0463.
3. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, Xiang J, Wang Y, Song B, Gu X, Guan L, Wei Y, Li H, Wu X, Xu J, Tu S, Zhang Y, Chen H, Cao B. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020;673(3):66-3
4. Tang N, Bai H, Chen X, Gong J, Li D, Sun Z. Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy. *J Thromb Headmost* 2020;4(5):45-49.
5. Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. *J Thromb Haemost* 2020;18(4):844-847.
6. Xie Y, Wang X, Yang P, Zhang S. COVID-19 Complicated by Acute Pulmonary Embolism. *Radiology: Cardiothoracic Imaging* 2020;2(2):e200067.
7. Danzi GB, Loffi M, Galeazzi G, Gherbesi E. Acute pulmonary embolism and COVID-19 pneumonia: a random association? *Eur Heart J* 2020;23(2):34-39.
8. Cui S, Chen S, Li X, Liu S, Wang F. Prevalence of venous thromboembolism in patients with severe novel coronavirus pneumonia. *J Thromb Haemost* 2020;23(4):39-44
9. Llitjos JF, Leclerc M, Chochois C, Monsallier JM, Ramakers M, Auvray M, Merouani K. High incidence of venous thromboembolic events in anticoagulated severe COVID-19 patients. *J Thromb Haemost* 2020;34(6):45-49.
10. Bompard F, Monnier H, Saab I, et al. Pulmonary embolism in patients with COVID-19 pneumonia. *Eur Respir J.* 2020;56(1):2001365.
11. Moores LK, Tritschler T, Brosnahan S, et al. Prevention, Diagnosis, and Treatment of VTE in Patients With Coronavirus Disease 2019: CHEST Guideline and Expert Panel Report. *Chest.* 2020;158(3):1143-1163.
12. Salah HM, Naser JA, Calcaterra G, Bassareo PP, Mehta JL. The Effect of Anticoagulation Use on Mortality in COVID-19 Infection. *Am J Cardiol.* 2020;134(5):155-157.
13. Alonso-Fernández A, Toledo-Pons N, Cosío BG, et al. Prevalence of pulmonary embolism in patients with COVID-19 pneumonia and high D-dimer values: A prospective study. *PLoS One.* 2020;15(8):e0238216.
14. Desai R, Gandhi Z, Singh S, Sachdeva S, Manaktala P, Savani S, Desai V, Sachdeva R, Kumar G. Prevalence of Pulmonary Embolism in COVID-19: a Pooled Analysis. *SN Compr Clin Med.* 2020;28(2):1-4.
15. Shi L, Xu J, Duan G, Yang H, Wang Y. The pooled prevalence of pulmonary embolism in patients with COVID-19. *Intensive Care Med.* 2020;46(11):2089-2091.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 06-10-2020; **Accepted:** 02-11-2020; **Published online:** 31-12-2020