Acute Pulmonary Embolism: Investigation and diagnosis in the Covid-19 pandemic

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Introduction

Pulmonary embolism (PE) has emerged as an important complication of COVID-19 infection with several studies suggesting an increase thromboembolic burden among hospitalised COVID-19 patients[1]. COVID-19-associated PE may exhibit significant overlap with the signs and symptoms of disease in which no evidence of PE is found, thereby creating a difficult clinical dilemma when prioritising patients for further assessment with CT pulmonary angiography (CTPA).

In this study we examine the clinical characteristics and predictors of (i) COVID-19 patients undergoing CTPA for suspected acute PE and (ii) those ultimately diagnosed with PE on CTPA.

Methodology

Patients confirmed to have COVID-19 by polymerase chain reaction (PCR) and admitted to the Mater Misericordiae University Hospital between 10th March and 19th of May 2020 were retrospectively analysed. Data regarding patient demographics, clinical characteristics, and in-hospital outcomes - including diagnosis with PE - were collected.

Between-group comparison was made between those who underwent CTPA and those who did not, and again between those diagnosed with PE and those not, using Mann Whitney U and Chi square testing (SPSS vers27). Regression analysis was used to assess predictors of PE diagnosis. Data are reported as median (IQR) unless otherwise stated.

Results

300 patients with COVID-19 were included in the analysis. Mean age was 60 (44, 76) years, 47% female, and 14% were healthcare workers.

32 (10.7%) patients underwent CTPA for suspected acute PE. When compared to COVID-19 patients who did not undergo CTPA, c-reactive protein (CRP), ferritin, and d-dimer levels were found to be higher in the CTPA group. Blood oxygenation ($Sp0_2$) and respiratory rate (RR) were significantly lower in the CTPA group, also. Critical care patients made up a greater proportion of the CTPA group than the non-CTPA (see table 1 for figures).

Among patients who had undergone CTPA, 5/32 (15.6%) had evidence of PE. CRP, d-dimer, neutrophil count and troponin levels were higher among those with a diagnosis of PE compared to those without. SpO_2 was significantly lower in those with PE but respiratory rate did not significantly differ between the two groups. Critical care patients accounted for a larger proportion of those with a confirmed diagnosis of PE while the number of in-hospital deaths were higher in this group (table 1).

	CTPA (n = 32)	No CTPA (n = 268)	P value	PE (n = 5)	No PE (n = 27)	P value
Critical Care n (%)	**10 (31.3)**	**25 (9.3)**	**0.000***	**4 (80)**	**6 (22.2)**	**0.010***
Length of Stay (days)	**25 (11, 37)**	**10 (6, 19)**	**0.001***	29 (20,32)	22 (8, 38)	0.448
Death n (%)	7 (21.9)	34 (12.7)	0.153	**3 (60)**	**4 (14.8)**	**0.025***
$Sp0_2$ (%)	**93 (82, 96)**	**96 (94, 98)**	**0.003***	**65 (51, 81)**	**94 (90, 97)**	**0.011***
RR (breaths per minute)	**20 (18, 26)**	**20 (18, 22)**	**0.034***	30 (22, 36)	20 (18, 25)	0.108
SBP (mmHg)	132 (120, 152)	130 (119, 145)	0.546	142 (122, 158)	132 (120, 152)	0.576
HR (bpm)	93 (78, 107)	89 (78, 102)	0.475	104 (90, 111)	91 (77, 101)	0.298
Neutrophil count (10^9/L)	4.6 (2.9, 9.0)	4.2 (3.0, 6.4)	0.359	**9.9 (9.6, 17.1)**	**4.2 (2.4, 6.7)**	**0.000***
Lymphocyte count (10^9/L)	1.0 (0.7, 1.3)	1.1 (0.8, 1.5)	0.229	1.3 (0.7, 1.4)	1.0 (0.7, 1.2)	0.511
C-reactive protein (mg/L)	**69 (40, 131)**	**42 (14, 113)**	**0.048***	**202 (116, 246)**	**57 (17, 122)**	**0.040***
HS-cTroponin (ng/L)	13 (0, 27)	8 (0, 23)	0.334	**39 (31, 71)**	**10 (0, 20)**	**0.023***
Ferritin (mg/L)	**769 (385, 2350)**	**428 (181, 1021)**	**0.004***	2100 (737, 2232)	721 (354, 2430)	0.530
D-dimer (mcg/mL)	**1.5 (0.9, 3.3)**	**0.6 (0.4, 1.1)**	**0.000***	**7.1 (2.0, 7.2)**	**1.1 (0.7, 2.6)**	**0.015***

Table 1. Between-group comparisons; CTPA vs. non-CTPA and PE vs. no PE on CTPA

Results continued

The strongest predictors of PE diagnosis in this cohort were critical care admission [OR 14.0 (95% CI 1.3, 150.0) p=0.03], raised CRP [OR 1.01 (95% CI 1.0, 1.03) p=0.05] and D-Dimer [OR 1.25 (95% CI 0.98, 1.6) p=0.06]. Higher SpO_2 on admission was seen to be protective [OR 0.92 (95% CI 0.86, 0.99) p=0.03].

Conclusion

In COVID-19 infected individuals, people with higher inflammatory markers were more likely to undergo CTPA imaging, with critical care admission and raised CRP most associated with PE diagnosis. This reflects the significant risk of the hyperinflammatory phenotype for PE diagnosis in Covid-19 infection.

This study gives further support to the assertion that a higher d-dimer cut-off may be considered for the exclusion of PE in moderate to severe COVID-19 disease.

Acknowledgements

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References

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