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# Role of Imaging in Evaluation of Deep Venous Thrombosis and Pulmonary Embolism in COVID-19 Patients

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## Abstract

*Background: As of June 30, 2020, COVID-19, the coronavirus illness, continues to pose a hazard to public health worldwide, accounting for over 500,000 deaths and over 10 million cases.*

*Objective: To characterize the imaging results of COVID-19-positive patients who had acute venous thromboembolic events in the pulmonary or lower limb venous circulation and ascertain the frequency of thromboembolic consequences in COVID-19-positive patients.*

*Patients and Methods: This prospective study involved 30 patients with proven COVID-19 infection who first developed thromboembolic symptoms at Dar-Elshfaa Specialty Hospital. Six months were dedicated to the research.*

*Results: In the present investigation, the mean BMI of the 19 (63.3%) male and 11 (36.7%) female cases ranged in age from 31 to 85 years (mean 61.20 years). According to our analysis, 22 (73.3%) of the cases had co-morbidities, including 21 instances with HTN, 3 cases with COPD, 2 cases with IHD, 2 cases with CKD, and 1 case with cystic fibrosis. 12 (40.0%) cases were unilateral, and 18 (60.0%) were bilateral, according to distribution.*

*Conclusion: DVT is very common and has a negative correlation with hospitalized COVID-19 patients' prognosis. According to our findings, COVID-19 is most likely an extra risk factor for DVT in hospitalized patients. PE in our study's COVID-19 participants may mostly impact the bilateral lung.*

**Keywords:** Deep Venous Thrombosis, Pulmonary Embolism, COVID-19

## 1. Introduction

The coronavirus disease 2019 (COVID-19), which has caused over 500,000 fatalities and over 10 million illnesses globally as of June 30, 2020, is still a hazard to public health.<sup>1</sup>

Pulmonary embolism (PE) is the primary cause of thromboembolic events among COVID-19; however, the relationship between PE and deep vein thrombosis (DVT) in these patients remains unclear.<sup>2</sup>

This research aimed to determine the prevalence of thromboembolic effects in COVID-19-positive individuals, thereby improving the understanding of the imaging results of patients who suffered acute venous thromboembolic events in the pulmonary or lower limb venous circulation.

## 2. Patients and methods

This prospective study involved 30 COVID-19 patients treated for six months at Dar-Elshfaa Specialized Hospital Ministry of Health. The project was submitted to the ethics committee for approval. Before participant recruitment, a written agreement was obtained from each after the procedures and goals of the study were explained.

Patients with chronic thromboembolic events and those with thromboembolic symptoms but no proven COVID-19-positive status were excluded.

Every patient underwent a thorough history taking that included information about their characteristics, symptoms, date of onset, RT-PCR results, general and local examinations, and laboratory investigations such as lactate, D-dimer, troponin, fibrinogen, interleukin-6, C-reactive protein, differential blood count, and LDH.

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3. Results

Table 1. Distribution of the studied cases according to age, sex, BMI and co-morbidities

NO. = 30		
AGE	Mean ± SD	61.20 ± 13.84
	Range	31 – 85
SEX	Female	11 (36.7%)
	Male	19 (63.3%)
BMI	Mean ± SD	25.20 ± 2.04
	Range	20 – 29

	NO.	%
CO-MORBIDITIES	22	73.3%
HTN	21	95.5%
COPD	3	13.6%
IHD	2	9.1%
CKD	2	9.1%
CIRRHOTIC	1	4.5%

The table displays that there were 19 cases with a mean age of 61.20 years, 11 cases with a gender distribution, and a mean BMI of 25.20 ± 2.04. The cases' ages varied from 31 to 85 years. Twenty-one cases (73.3%) had co-morbidities, including 21 cases with hypertension, three cases with COPD, two cases with IHD, two cases with CKD, and one case with cystic fibrosis.

Table 2: Distribution of the studied cases, according to CT chest findings and PCR result

	NO.	%
CT. CHEST FINDINGS	CORAD 5	30 100.0%
PCR RESULT		30 100.0%

This table shows that CT chest findings results where all cases were Corad 5 and positive PCR result.

Table 3: Distribution of the studied cases according to CT sign

CT SIGN	NO.	%
GGO	15	50.0%
CRAZY PAVING	15	50.0%
ROUND SHAPE OF OPACIFICATION	14	46.7%
BRONCHIAL DILATATION	13	43.3%
PERIPHERAL VESSEL ENLARGEMENT	11	36.7%
PLEURAL EFFUSION	11	36.7%
CONSOLIDATION	11	36.7%
SHARP MARGIN OF OPACIFICATION	10	33.3%
CAVITATION	10	33.3%
AIR BRONCHOGRAM	9	30.0%
CURVILINEAR/ BANDLIKE OPACIFICATION	8	26.7%
LYMPHADENOPATHY	6	20.0%

This table reveals that 15 (50.0%) of the cases were GGO, 15 (50.0%) were CRAZY PAVING, 14 (46.7%) were round shape of opacification, 13

(43.3%) were bronchial dilatation, 11 (36.7%) were peripheral vessel enlargement, 11 (36.7%) were pleural effusion, 11 (36.7%) were consolidation, 10 (33.3%) were sharp margin of opacification, 10 (33.3%) were Cavitation, 9 (30.0%) were air bronchogram, 8 (26.7%) were curvilinear/band like opacification, and 6 (20.0%) were lymphadenopathy.

Table 4: Distribution of the studied cases according to distribution

DISTRIBUTION	NO.	%
BILATERAL	18	60.0%
UNILATERAL	12	40.0%

This table shows that there were 18 (60.0%) of the cases were Bilateral and 12 (40.0%) of the Cases were Unilateral.

Table 7. Distribution of the studied

	NO.	%
RIGHT UPPER LOBE	14	46.7%
RIGHT MIDDLE LOBE	8	26.7%
RIGHT LOWER LOBE	8	26.7%
LEFT LOWER LOBE	8	26.7%
LEFT UPPER LOBE	5	16.7%

Table 1 shows that there were 14 (46.7%) of the Cases were Right Upper lobe, 8 (26.7%) of the Cases were Right Middle lobe, 8 (26.7%) of the Cases were Right Lower lobe, 8 (26.7%) of the Cases were Left Lower lobe and 5 (16.7%) of the Cases were Left Upper lobe.

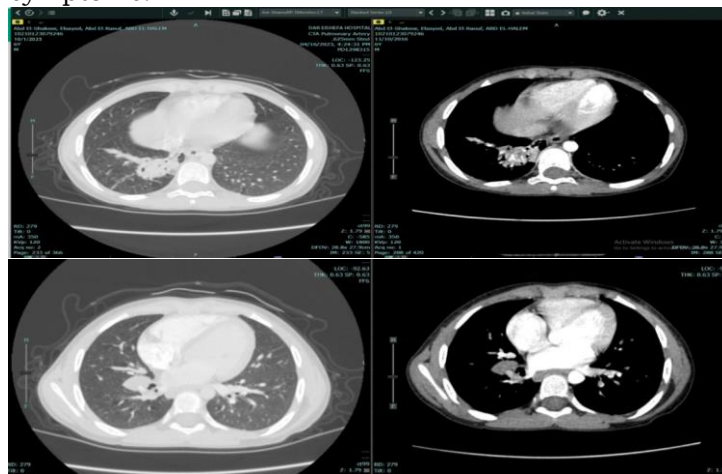
Table 6. Distribution of the studied

EXTENT	NO.	%
MILD	4	13.3%
MODERATE	5	16.7%
SEVERE	21	70.0%

Table 2 shows there were 4 (13.3%) of the Cases were Mild Extent, 5 (16.7%) of the Cases were Moderate Extent and 21 (70.0%) of the Cases were Severe Extent.

ILLUSTRATIVE CASE

Patient history: 56 years old male patient presented to the ER with history of cough with expectoration & dyspnea of 6 days duration. CT chest was done on the 6th day after onset of symptoms.



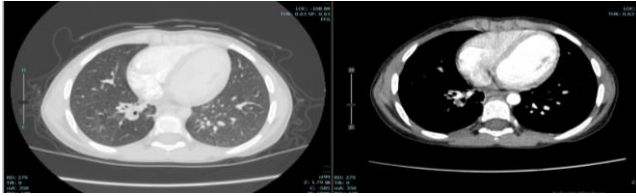


Figure 1. Segmental non-occlusive filling defect is seen at one of the branches of the right lower lobar pulmonary artery. Associated posterior segment right lower lobar consolidative patch with air bronchogram.

#### 4. Discussion

T Severe COVID-19 regimens often result in acute respiratory distress syndrome and multi-organ failure. Furthermore, there is an increased chance of thromboembolic complications for the patients, the most common of which is venous thromboembolism (VTE).<sup>3,4</sup>

According to international recommendations for imaging in COVID-19, the standard of care is low-dose chest CT without the use of a contrast agent.<sup>5</sup>

Therefore, pulmonary embolism may not show up on CT. In the meanwhile, we must learn that VTE more often complicates COVID-19 than other pneumonias.<sup>6</sup>

Many studies assessed the predictive utility of CT in COVID-19 for the overall prognosis of patients; however, none particularly examined the relationship between VTE and the CT characteristics of COVID-19 pneumonia.<sup>7</sup>

This is consistent with the findings of Franco-Moreno et al.<sup>8</sup>, who said that the sample's median age was 60 years (interquartile range: 54–73 years) and that fifteen patients (57.7%) were male.

Furthermore, Zhang et al.<sup>9</sup> found that 74 (51.7%) patients were men, and the mean age was 63±14 years.

Our study showed that 22 (73.3%) Cases were suffering from Comorbidities, including 21 cases suffering from HTN, 3 cases of COPD, 2 cases of IHD, 2 cases of CKD, and 1 case of Cirrhosis.

Mumoli et al.<sup>10</sup> found that forty-one (58.7%) patients had hypertension, twenty-five (22.5%) patients had diabetes, thirty (11.8%) patients had COPD and nine (3.5%) patients had previously experienced a cerebrovascular incident. Of the patients included, the majority (97.28%) had at least one comorbidity.

In the current study, 14 (46.7%) of the Cases were in the Right Upper lobe, 8 (26.7%) were in the Right Middle lobe, 8 (26.7%) were in the Right Lower lobe, 8 (26.7%) were in the Left Lower lobe, and 5 (16.7%) were in the Left Upper lobe.

Meiler et al.<sup>11</sup>, in their cohort of 50 patients with RT-PCR-confirmed COVID-19, found that 28% of the patients had VTE detectable by CT,

which falls within the range of data previously published.<sup>1,6,12</sup>

According to Suh et al.'s meta-analysis,<sup>13</sup> patients with coronavirus disease 2019 (COVID-19) had pooled incidence rates of 16.5% and 14.8% for pulmonary embolism (PE) and deep vein thrombosis (DVT), respectively.

According to Longchamp et al.,<sup>14</sup> there was a 9% incidence of serious VTE. The incidence of PE was 8%, while the incidence of proximal lower limb DVT was 3%.

Porfidia et al.<sup>15</sup> included upper extremity and distal lower limb DVT in their overall incidence of VTE (26%, 95% CI 1–75%).

Nopp et al.<sup>16</sup> could not differentiate between upper and lower limb DVT or distal/proximal DVT. Still, they did estimate an overall VTE risk of 14.1% (95%CI 11.6–16.9%).

Other previous meta-analyses may have overestimated the risk of VTE since they did not limit the events to VTE that were objectively identified.<sup>17,18</sup>

#### 4. Conclusion

I DVT is very common and has a negative correlation with hospitalized COVID-19 patients' prognosis. According to our findings, COVID-19 is most likely an extra risk factor for DVT in hospitalized patients. PE in our study's COVID-19 participants may mostly impact the bilateral lung.

#### Disclosure

The authors have no financial interest to declare in relation to the content of this article.

#### Authorship

All authors have a substantial contribution to the article

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#### Conflicts of interest

There are no conflicts of interest.

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