

## Assessment of the pulmonary artery diameter in different severity of COVID-19: A retrospective Study in Indonesia

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### ABSTRACT

*COVID-19, caused by SARS-CoV-2, has been associated with numerous pulmonary complications alongside pulmonary arterial systolic pressure and vascular remodeling. The main objective of this paper was to analyze the pulmonary artery diameter (PAD) in patients suffering from the varying degrees of COVID-19 and seek if it can act as predictor. This was undertaken as a retrospective study on 300 COVID-19 diagnosed individuals in Indonesia. Participants were classified into mild, moderate or severe cases based on their clinical characteristics. The use of CT scans aids in determining a patient's pad level. The mean pad for mild, moderate and severe cases turned out to be ascertainably different. A significant ease increase in pad levels was noted with the severity of the disease. While these trends may require further validation, our initial findings suggest that PAD may be reliable as an imaging marker in the assessment of the severity of the COVID -19 disease and its further management.*

**Keywords:** COVID-19, pulmonary artery diameter, severity, CT imaging, Indonesia

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## 1. INTRODUCTION

COVID-19 due to SARS-CoV-2 has greatly impacted humanity leading to a great loss of life and overall incapacity. While the illness is mainly restricted to the lungs but more insight about this disease has revealed that it may be affecting multiple organs of the body<sup>1</sup>. Pulmonary hypertension among other issues has and is still being reported as a form of extra-pulmonary issues faced while the cardiovascular system's thromboembolic events are of a concern <sup>2</sup>. It is widely accepted that COVID has a lot of amputations such as endocrine dysfunctions and vascular restructuring with a few being severe (3). The pulmonary artery diameter (PAD) constitutes a well-established imaging biomarker for pulmonary hypertension and right ventricular dysfunction (4). In the case of COVID-19, an increased PAD has been reported in patients with more severe disease, which may be related to increased resistance and pressure in the pulmonary vascular bed (5). On the other hand, how PAD correlates with COVID-19 severity has not been extensively investigated, especially in lower- and middle- income countries such as Indonesia, where COVID-19 burden was high (6). Aims of this study is to measure the PAD of varying severity of patients suffering from COVID-19 and also determine its usability as a prognostic indicator. This research intends to blend into the current literature regarding the pathophysiology of the COVID-19 infection by examining the vascular alterations which are brought about by the COVID-19 and help clinicians in their management. Same as SARS-CoV and MERS-CoV, COVID-19 bears many pulmonary and cardiovascular sequelae including ARDS, pulmonary embolism and pulmonary hypertension (7). These complications arise from various mechanisms such as direct viral infection, immune modulation and endovascular injury (8). In Malaysia, there has been increasing reports of pulmonary vascular changes (increased size and pressure of pulmonary arteries) among severe Covid-19 patients that resulted into negative clinical outcomes. (9). The non-invasive imaging biomarker Pulmonary artery diameter has gained traction among researches in regards to diagnosing and monitoring pulmonary hypertension. The normal pad is in between the 24-28mm range which can easily be calculated through CT scans (10). But the most important use to this measurement is that it helps identifying covid-19 related sickness. Multiple researches have shown that the severe the case is, the higher the PAD is, such as Li

et al. (11) reported in their study where PAD was significantly higher in severe covid-19 patients. Another prominent study by Lang et al. (12) revealed that high mortality in covid-19 patients directly correlated with high PAD measurements.

Researchers are still trying to understand the reason why covid-19 APD increased but It is hypothesized to be caused due to inflammation, thrombosis or even mild hypoxia (13). These problems are known to cause right ventricular dysfunction and worsen the clinical cases making it harder for the individual to recuperate (14). However, if APD is identified at an early stage, it can easily be treated with preventive measures especially in places where it is hard to obtain advanced diagnostic tools (15).

There is a gap in the data on PAD in COVID-19 patients residing in low- and middle-income countries, despite the evidence, they bear the greatest brunt(coutinho) This study focuses on bridging this gap by conducting a thorough evaluation of PAD in a subset of COVID-19 patients in Indonesia.

## **2. METHODOLOGY**

**Study Design and Population:** This retrospective study encompassed 300 stricken patients with COVID-19 who were admitted to a tertiary care hospital situated in Indonesia in the period of March 2020 to December 2021. The stratification of the severity of the disease into mild, moderate, or severe was done following the predetermined clinical guidelines issued by the World Health Organization(WHO) (17). Individuals diagnosed with certain pre-existing conditions such as pulmonary or affecting cardiovascular diseases were filtered out.

**Data Collection:** Using the electronic medical records, requisite demographic and clinical data such as age, sex, pre-existing conditions, and lab results were extracted. On contrast enhanced CT scans of the levels of pulmonary artery bifurcation CMD were captured and later analyzed using cross-sectional axial images of the CT scans. Measurements were taken independently by two different radiologists and the average was used to collate the data.

**Statistical Analysis:** The information was processed in SPSS version 25. Continuous variables were presented as mean  $\pm$  standard deviation (SD) and categorical variables as numbers and percentages. Differences in PAD among the severity groups were analyzed using one-way ANOVA and post-hoc Tukey tests for pair comparisons afterwards. A p-value of  $<0.05$  was considered statistically significant.

### 3. RESULTS

A total of 300 COVID-19 patients (55% male, 45% female) were enrolled in this study at a mean age of 52.3 years. The mean PAD for the mild cases were 24.5 mm, 27.8 mm and 31.2 mm for the moderate and severe cases respectively. The differences in PAD among the severity groups were statistically significant with  $p < 0.001$ .

**Table 1: Demographic and Clinical Characteristics**

Characteristic	Mild (n=100)	Moderate (n=100)	Severe (n=100)	p-value
Age (years)	48.2 ± 12.3	52.5 ± 11.8	56.4 ± 10.9	<0.05
Male sex (%)	54	56	55	>0.05
Comorbidities (%)	30	45	60	<0.01
PAD (mm)	24.5 ± 1.8	27.8 ± 2.1	31.2 ± 2.5	<0.001

**Table 2: Comparison of PAD Between Severity Groups**

Comparison	Mean Difference (mm)	p-value
Mild vs. Moderate	3.3	<0.001
Moderate vs. Severe	3.4	<0.001
Mild vs. Severe	6.7	<0.001

### 4. DISCUSSION

This study indicates that the increased severity of COVID-19 is associated with higher PAD as previously demonstrated (11, 12). The mean values of PAD in severe cases were quite large at 31.2 mm and considering how increased PAD values were expected in moderate and mild cases, the values were significantly greater in severe cases, there is reason to expect that PAD would be appropriate for clinical use as an imaging PCM. These results follow Li et al. (11), for example ARDS in patients with COVID-19 were associated with increased PAD.

Covid-19's contribution to inflating the levels of PAD can be attributed to multiple factors such as thrombus formation, vasoconstriction due to hypoxia, and inflammation (13). Furthermore, this triad can also lead to an elevation in pulmonary vascular pressure, and in

turn, result in the poor function of the right ventricle (14). Our research highlighted the correlation between enhanced PAD and the severity of the disease, which emphasises the need to mitigate pulmonary vascular complications in patients with covid-19 as early as possible.

This study sheds light on PAD as a supplementary tool in measuring the severity of the vascular disease and aiding clinical practices, especially in a resource scarce scenario like Indonesia. The CT scan however, does not require advanced clinical management and oversight which makes it a non - conspicuous addition to routine practices (18).

The design of this study was retrospective, and was conducted in a single clinic in Indonesia which inherently limits the generalizability of the observations. Furthermore, the absence of follow up data limits the assessment of the long term PAD levels in patients who have covid - 19. Further clinical studies need to be done in order to verify the findings and to measure the prognostic strength of PAD in such patients.

## 5. CONCLUSIONS

We concluded that incidence of PAD was significantly increases with severity of COVID-19. Therefore, PAD can be used as a promising biomarker to predict the severity of the disease and for management plan

### **Ethical Approval:**

All ethical issues were approved by the author. Data collection and patients' enrollment were in accordance with Declaration of Helsinki of World Medical Association, 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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