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Correlation of Oxygen Saturation on Pulse Oximeter With Chest CT Severity Score in Young Adult Covid-19 Patients

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ABSTRACT

Objective: To assess the association between Computerized Tomography severity score and oxygen saturation by pulse oximeter in patients of COVID-19.

Study Design: Cross sectional study.

Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jan to Apr 2021.

Methodology: CT severity score was calculated for all patients who had undergone Chest CT scan. The oxygen saturation by pulse oximeter was noted at admission. Spearman rank correlation was calculated between the CT severity score and oxygen saturation on pulse oximeter.

Results: There were 203 patients in this study. Among them, 124(61.1%) were male and 74(38.9%) females. The greater proportion of the patients, 138(68%) were between 36-55 years old, and 65(32%) were between 18-35 years old. There were 130(64%) patients who had low CT severity score, 73(36%) had high CT severity score. Among 73 patients who had high CT severity score, 67(91.7%) had shortness of breath (p-value<0.001), 48(66%) had fever (p-value=0.021), and 53(72.6%) belonged to the older age group of patients (p-value=0.0294). Statistically significant negative correlation between Computerized Tomography severity score and oxygen saturation was noted (ρ rho=−0.264, p= 0.01).

Conclusions: Our study provided evidence that there is a negative correlation between the Computerized Tomography severity score and oxygen saturation by pulse oximeter.

Keywords: COVID-19, Computed tomography, CT severity score, Hypoxia, pulse oximetry

How to Cite This Article: *Khalid B, Saleem T, Naseer U, Hashmat A, Uttra KM, Khan NU. Correlation of Oxygen Saturation on Pulse Oximeter with Chest CT Severity Score in Young Adult Covid-19 Patients. Pak Armed Forces Med J 2024; 74(3): 708-711. DOI: https://doi.org/10.51253/pafmj.v74i3.6951*

INTRODUCTION

In December of 2019, a new outbreak was first reported in China; it was the Corona Virus Disease (COVID-19).[1] The characteristic radiographic image of chest involvement in COVID -19 patients is parenchymal damage seen as consolidation and ground-glass opacities.[2] Corona virus, is a family of viruses that includes the common cold virus and the virus of Severe Acute Respiratory Syndrome (SARS).[3,4] Acute respiratory failure may be a consequence of COVID-19 infection and may present with severe hypoxemia.[5,6] Evidence shows that the expression of the disease varies in people, however the primary characteristics include upper respiratory tract inflammation, myalgia, cough, Acute Respiratory Distress Syndrome (ARDS), reduced blood oxygen saturation levels and lung involvement on imaging.[7] Literature shows pulmonary involvement as most significant prognostic factor when treating COVID-19 patients.[8] Additionally, numerous studies indicate CT has superior sensitivity (86%-98%) and lesser false negative rates compared to Reverse transcription polymerase chain reaction (RT-PCR).[9] Chest CT scan remains an essential modality in the diagnosis of lung irregularities. This has a pivotal part in assessment of COVID -19 patients.[10] When physicians use CT scan as choice of imaging, it can easily be used for follow-up of patients. Literature is well documented for imaging changes of pulmonary involvement caused by Coronavirus infection.[2]

Hence, it is of value to explore whether there is a statistically significant correlation between the chest CT severity score and oxygen saturation by pulse oximeter.

METHODOLOGY

The cross-sectional study conducted at Pak Emirates Military Hospital, Rawalpindi, Pakistan from January to April 2021 after permission from the Ethical Review Committee (ERC) (A/28/EC/243/2021).

Inclusion Criteria: Patients aged 18-55 years of age, of either gender, presented with a confirmed diagnosis

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Received: 28 Jun 2021, revision received: 22 Mar 2023; accepted: 24 Mar 2023

of COVID-19 by RT-PCR for SARS-CoV-2 were included.

Exclusion Criteria: Patients with pulmonary tuberculosis, pulmonary embolism, asthma, chronic renal failure, heart failure, chronic liver disease, stroke, recent history of cardiothoracic surgery, chronic obstructive pulmonary disease (COPD), interstitial lung disease, immunosuppression and a history of pulmonary hemorrhage were excluded from the study.

We had obtained informed consent from all patients, after full disclosure of risk and benefits of the study. In case patient was critically ill and unable to provide informed consent, then consent was taken from their attendants. Confidentiality of data was maintained throughout the study.

We had collected data about patient history, clinical features either from the patients or their relatives, or from the medical records. Data regarding patient's gender, age, history of diabetes mellitus, hypertension, dyslipidemia, smoking, obesity, anemia, fever, cough, shortness of breath, chest pain, CT severity score, and oxygen saturation were noted. Covariates cut off were described in the following manner in our study. Diabetes mellitus (DM) was labeled in patients with confirmed diagnosis of DM using anti-diabetic medication for at least 6 months. Hypertension (HTN) was labeled in patients with confirmed diagnosis of HTN on anti-hypertensive medication for at least 6 months, with Systolic Blood Pressure <130 mmHg and DBP <90 mmHg. Dyslipidemia was labeled in patients with history dyslipidemia on anti-hyperlipidemic medication for at least 6 months.[11] Height of patients was measured with a wall mounted scale, weight was approximated closest kilogram using calibrated weighing machines and BMI (Height/Weight2[kg/m2]) was calculated at the time of inclusion in the study. Patients with BMI ≥27.5 kg/m2 were labelled obese. Pulse oximetry was done and oxygen saturation percentage (SPO2) of patients was noted within 24 hours of admission before the chest CT scan. Three readings of oxygen saturation were taken with a gap of 30 seconds between each reading. The mean readings of three observations was calculated and noted. High resolution CT scan was performed for known COVID-19 cases. The image was reviewed on the Picture Archiving Computerised System (PACS). An experienced radiologist did the reporting of the scan. In this study our team had calculated the CT severity score of the initial admitting scan. Severity of COVID-19 disease was estimated in each pulmonary lobe. Severity grading was carried according to following suggested CT severity score system (CT-SS).[12,13] Each lung lobe with disease was scored as (a) 0% involvement was coded 0, (b) <50% lung involvement was coded 1 and (c) >50% lung involvement coded as 2. Max score for one lobe was 2 and hence max score for all lobes was 10. CT score of 0 to 7 was graded low severity score of COVID-19, whereas CT score of 8-10 was graded as high COVID-19 severity score.[14]

Statistical Package for Social Sciences Software SPSS-25 was used for analysis of data. Quantitative data was described by their mean along with standard deviation (SD) and qualitative data was calculated as frequency and percentage. Student t-test was performed to compare groups. Spearman rank's correlation was run to assess the relationship between the CT severity score and oxygen saturation on pulse oximeter. The *p* value of ≤0.05 was considered statistically significant.

RESULTS

There were 203 patients in this study. Table-I shows the statistics of this study.

Table-I: Patient Characteristics the Study (n=203)

Variables	Categories	n (%)
Age in years	18-35	65(32)
	36-55	138(68)
Gender	Male	124(61.1)
	Female	74(38.9)
Diabetes Mellitus	Yes	65(32)
	No	138(68)
Hypertension	Yes	64(31.5)
	No	139(68.5)
Dyslipidemia	Yes	54(26.6)
	No	149(73.4)
Smoking Status	Yes	92(45.3)
	No	111(54.7)
Obesity (BMI≥ 27.5)	Yes	86(42.4)
	No	117(57.6)
Anemia	Yes	46(22.7)
	No	157(77.3)
Fever	Yes	126(62.1)
	No	77(37.9)
Cough	Yes	82(40.4)
	No	121(59.6)
Shortness of Breath	Yes	123(60.6)
	No	80(39.4)
Chest pain	Yes	67(33)
	No	136(67)
CT severity Score	Low	130(64)
	High	73(36)

The Mean±SD oxygen saturation was 88.41%±9.25. There were 130(64%) patients who had lower CT severity scores and 73(36%) had a higher CT severity scores. Table-II shows association of age and gender according to CT severity score.

Among 73 patients who had high severity score, 67(91.7%) had shortness of breath (*p* value <0.001), 48(66%) had fever (*p*-value=0.021), and 53(72.6%) belonged to the older age group of patients (*p* value = 0.0294). There was a statistically significant correlation between the CT severity score and oxygen saturation as shown in Table-III. Among the patients with more severe COVID-19, the signs and symptoms present in greater than 50% proportion were shortness of breath, fever, cough and comorbidities like diabetes mellitus, hypertension, dyslipidemia and obesity. We noted that severe COVID-19 was affecting women less than men.

Table-II: Association of Age and Gender according to CT Severity Score (n=203)

Variables	Covariate n (%)	COVID-19 High Severity (%) n=73(36)	COVID-19 Low Severity (%) n=130(64)	*p*-value
Age in years				
18-35 years 36-55 years	65(32) 138(68)	30.76 38.4	69.25 61.59	0.029
Gender				
Male Female	124(61.1) 79(38.9)	48.3 16.4	51.6 83.5	<0.001

from Canada.[2] Our study also showed that fever and cough were the predominant symptoms, which was in concurrence with the findings of a study conducted at Wuhan, China.[14] This further emphasizes the fact that pulse oximeter readings can be used effectively and non-invasively in resource-scarce settings.Our study also showed that severity of COVID-19 infection was more in patients with comorbidities, which was in agreement with a study from China.[15]

Literature shows that 17–29% of COVID-19 patients who are hospitalized with pneumonitis on chest CT clinically progress to Acute Respiratory Distress Syndrome (ARDS).[16] The COVID-19 virus first infects upper airway cells, and then causes a slight inflammatory reaction. Subsequently, it spreads to lower respiratory tracts and immune response becomes stronger with more severe disease manifestations. There is consequently an inflammatory response within the human body.[17] COVID-19 commonly presents with a bronchocentric distribution. In our study, the more severe COVID-19 disease was found in patients between 36 and 55 years of age. Similar results among the same age group were found in a study conducted by Saeed *et al*. in 2021 and in another one by Mallapaty *et al*. in 2021.[18,19] There were more complication in patients with comorbidities such as Diabetes Mellitus, Hypertension, dyslipidemia and anemia in our study. This is comparable to other published research where it is suggested that presence of comorbidities lead to a poor prognosis among COVID-19 patients.[20,21] In our study 43(59%) of severe

Table-III: Correlation between CT Severity Score and Oxygen Saturation on Pulse Oximeter (n=203)

		Oxygen Saturation				*p*-value
		Above 95 % n(%)	90-95 % n(%)	85-89 % n(%)	less than 85 % n(%)	
CT severity Score	Low	49(42.6%)	48(41.7%)	8(7.0%)	10(8.7%)	0.002
	High	12(13.6%)	10(11.4%)	22(25.0%)	44(50.0%)	

DISCUSSION

In this research we studied 203 COVID-19 patients to determine whether a correlation existed between the CT severity score and oxygen saturation percentage (SPO2). We found that hypoxia suggests a greater severity of COVID-19 infection. Sabri *et al*, in a study conducted at Iran found that mortality associated with COVID-19 infection was higher in patients with low oxygen saturation levels.[11] In our study we found that among 73 patients who had severe disease on chest CT, there were 67(91.78%) patients who had shortness of breath which is comparable to a study

COVID-19 patients suffered from shortness of breath. This may represent pulmonary tissue damage in the lungs of the COVID-19 patient. A study conducted by Yang *et al*., in China has recommended that CT severity score can be utilized to see extent of Corona-virus infection and subsequent pneumonia in the patient's lungs and it might be utilized to assess patient's clinical status.[22]

CONCLUSION

CT severity score (CTSS) is statistically significantly correlated with saturation levels of oxygen in patients of Coronavirus disease (COVID-19). However, further research is required to elucidate the value of correlation between

oximetry and pulmonary CTSS for prognostication in COVID-19, including its association with patient outcomes.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

BK & TS: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

UN & AH: Data acquisition, data analysis, approval of the final version to be published.

KMU & NUK: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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