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Cohort Study

The relationship between CT severity infections and oxygen saturation in patients infected with COVID-19, a cohort study

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A B S T R A C T

Keywords: COVID-19, SARS-CoV-2, CT scan, Pneumonia, Blood oxygen saturation

Introduction: Thin-section chest computed tomography is an important diagnostic test and utilized to determine the severity of lung involvement in COVID-19 pneumonia. The goal of this study is to examine the relationship between CT severity and the oxygen saturation level of individuals with COVID-19.

Method: This is a single-center retrospective study of COVID-19 patients that were admitted at a COVID-19 hospital. Patients confirming COVID-19 with PCR testing, patients undergoing lung CT-scan and measures of capillary oxygen saturation using pulse oximetry at the time of admission were all included.

Result: The total number of the cases were 105. The age was classified into four age groups, with the majority of them falling into the fourth to sixth decade of life (42, 40%). Diabetes was the most common comorbidity disease (29, 27.6%). Pulse oximetry showed hypoxemia in 87 (82.9%) cases. The most common CT finding was ground glass opacities (GGO) (45, 42.9%). The data showed a significant positive correlation between oxygen saturation and CT severity in patients infected with covid-19.

Conclusion: These findings support the importance of using pulse oximetry to monitor COVID-19 patients in order to evaluate or even estimate their clinical situations.

1. Introduction

Coronavirus disease 2019 (COVID-19) has evolved as severe acute respiratory illness coronavirus 2 (SARS-CoV2) [1]. The disease has spread rapidly all over the world, resulting in a significant mortality and putting excessive pressure on healthcare systems. Most individuals with COVID-19 have no or very minor symptoms, such as fever and a dry cough, but in extreme cases, particularly with older age and the presence of comorbidities, the likelihood of more severe disease increases [2]. Although COVID-19 is largely a respiratory illness with lung parenchymal damage, multiple reports have shown that severe forms are linked with a pro-inflammatory cytokine storm that leads to systemic inflammation and sepsis, with subsequent involvement of several other organs [3]. Early detection of serious illnesses is crucial for early categorization and improvement of patients’ prognosis [4]. The real time polymerase chain reaction (RT-PCR) of respiratory specimens is typically used to identify SARS-CoV-2 nucleic acid. Although this test is very specific, swabs of the upper respiratory tract may be insensitive when the illness is restricted to the lower airways [5]. Changes in the number of lymphocytes, C-reactive protein (CRP), and erythrocyte sedimentation rates (ESR) have previously been described in COVID-19 patients, but their relationship with disease severity is unknown [4]. Medical imaging modalities play a key role in the early diagnosis and management of individuals infected with SARS-CoV-2. Chest X-rays have the potential to be effective in detecting the existence of lung disease [6]. Thin-section chest computed tomography (CT) is more effective than chest radiography in detecting abnormal changes in the pulmonary parenchyma early in progression of the disease [7]. CT scan is an important diagnostic test and utilized to determine the severity of lung involvement in COVID-19 pneumonia [8]. Pulse oximetry might be...
utilized as a warning sign to detect “silent hypoxemia” in COVID-19 patients [9]. Finding out if there’s a relationship between CT severity and oxygen saturation is important.

The goal of this study is to examine and investigate the relationship between CT severity and the blood oxygen saturation level of individuals infected with COVID-19.

2. Method

2.1. Study design

This is a single-center retrospective study of COVID-19 patients that are admitted in Qala hospital in Garman region from April 4th, 2020 to March 5th, 2021. The study has been written in line with STROCSS guidelines [10].

**Registration:** The research was registered in Research Registry. The registration number is researchregistry7505. The link is https://www.researchregistry.com/register-now#home/registrationdetails/61d174097c4f04001e1eaec27/

2.2. Inclusion criteria

Patients confirming COVID-19 infection with PCR testing, patients undergoing lung CT-scan and measures of capillary oxygen saturation using pulse oximetry at the time of admission were all included.

2.3. Exclusion criteria

Patient with incomplete data in the patient’s documents and unusual CT scans of the lung for COVID-19 infection were all excluded.

2.4. Data analysis

Data of the present study was analyzed through application of statistical package for social sciences (SPSS) version 23.

3. Result

The total number of cases were 105. The age was classified into four age groups, with the majority of them falling into the fourth to sixth decade of life (42, 40%). The vast majority of the cases were male (63, 60%). The most common comorbidity disease (29, 27.6%) and followed by diabetes mellitus was the most common comorbid disease (29, 27.6%) and followed by hypertension (27, 25.7%). Pulse oximetry showed hypoxemia in the majority of the cases (82%). The CT scan showed mild disease in 42 (38.1%) cases and moderate infection in 42 (40%) cases. The most common CT finding was ground glass opacities (GGO) (45, 42.9%). Table 1 summarizes the cases’ details. Table 2 shows the relationship of CT severity score with the degree of hypoxia.

Hypoxia was seen in the majority of the cases (82%). In covid-19 patients, there was a statistically significant association between oxygen level and CT-scan severity score. (p-value = .001). Table 4.

Table 3 reveals that there is no statistically significant relationship between age and CT-scan severity score in patients with covid-19.

Table 4 reveals that there is a strong significant positive correlation between oxygen saturation and CT severity in patients infected with COVID-19.

4. Discussion

COVID-19 is extremely contagious and has spread globally. Strategies for the disease prevention and patient management rely primarily on the disease diagnosis [11]. CT scan is an essential and effective approach for diagnosing and assessing the severity of COVID-19 [12]. Although RT-PCR testing of respiratory secretions or blood samples is the definitive diagnostic test for COVID-19, the possibility of false negative instances has made chest CT-scan one of the most essential procedures for the relatively early detection of COVID-19 pneumonia. As a result, although positive RT-PCR testing can be used to confirm COVID-19, a negative swab test cannot be used to exclude the condition [13]. Fang et al. compared CT severity score findings to RT-PCR results in 51 individuals with COVID-19 infection. They discovered that chest CT had a higher sensitivity than RT-PCR (98% vs 71%) [14]. The major CT findings in individuals with COVID-19 are patchy, rounded,
segmental or subsegmental GGO and consolidation, which are related to the course and severity of the illness [15]. Lesions are numerous and asymmetrically distributed, and they are more frequent towards the periphery [16]. The most common CT findings of this study were GGO in 45 cases, GGO with crazy paving appearance in 38 cases, and consolidation in 11 cases. Dai et al. reported that clinical assessment had significant role in COVID-19 diagnosis, while high resolution CT (HRCT) demonstrated the location, shape, attenuation, and amount of lung lesions, as well as some of the typical CT signs of COVID-19 pneumonia [17].

It is critical to understand that COVID-19 infection often exhibits slow radiological progression characteristics, peaking in the second week after the beginning of the symptoms. The second week of the illness course is the most crucial, with the highest CT severity score, the largest frequency of complications, and the lowest oxygen saturation level. This is followed by a gradual regression in the third week. Furthermore, CT indicators of severity and poor prognosis include consolidation, mixed attenuation with a predominant consolidation pattern, and a high CT severity score [18]. The relationship between the radiological features and the period from the onset of early symptoms to CT-scan imaging demonstrates that in the “early phase” of the disease, the GGO is the dominant imaging finding, whereas as the disease progresses to the intermediate and late phases, the intensity of the GGO decreases and the appearance of consolidation and crazy paving pattern increases. It has also been found that the consolidation alone, without GGO, appears more frequently in the late-stage of the illness [19].

Yang et al. in China analyzed chest CT scan indicators and their associations with patients’ clinical states. They examined the CT scan findings of 102 individuals with COVID-19 infection and discovered that the total CT severity score was considerably greater in patients with severe COVID-19 infections compared to mild cases. They also recommended that a CT severity score can be used to assess the severity of lung involvement [11]. Zhao et al. conducted another study and revealed that GGO or mixed GGO, as well as consolidation and vascular enlargement, were the most common in severe COVID-19 patients. They proposed that a CT severity score can aid in determining the severity of the illness [20]. Fang et al. reported similar findings that patients with higher CT severity score had more severe infection [14]. Xiong et al. have observed that COVID-19 infection is characterized by GGO in lung CT scans, which is associated with increased CRP, ESR, and lactate dehydrogenase levels. In contrast to other studies, they were unable to associate any clinical characteristic with the severity of CT scan findings [21]. Cheng et al. also stated that they’re unable to determine if there are any relationships between such CT scan findings and the clinical characteristics of patients [22].

According to these findings, a higher CT severity score associated with more severe clinical problems in COVID-19 patients. Researchers further suggest that associations between greater CT severity score and hypoxia might help to justify this problem [23]. According to certain studies in the literature, individuals with oxygen saturation levels of less than 93% should have undergone imaging modalities. UK guidelines suggest that pulse oximetry be used for the examination and monitoring of breathless, ill, or high-risk individuals with suspected COVID-19 [24]. It is suggested that the oxygen saturation level alone is neither an exclusive nor a decisive factor in deciding whether to consider a chest CT-scan imaging. The patient’s overall clinical condition and all symptoms should be considered more carefully when deciding whether to perform chest CT-scan and other diagnostic procedures [25]. However, this finding suggests that oxygen saturation should be used as an adjunctive factor when considering a chest CT scan as it showed a significant relationship, but it should not be used as an exclusive mean of diagnosis.

It’s critical to discover if there’s a relationship between CT severity and oxygen saturation. Aalinezhad et al. observed a significant correlation between oxygen saturation and CT severity [23]. Komatlapalli et al. discovered that individuals with higher CT scores require more oxygen throughout their disease course and revealed that oxygen saturation values fall as CT severity scores rise [13]. Similar, to the previous studies, the current study found a significant correlation between CT severity and oxygen saturation level, indicating that as CT severity increases, oxygen saturation level decreased. Another study by Qaseemya et al. found a direct association between the degree of pulmonary involvement and low oxygen saturation. However, this relationship was not found in those aged 20–40 years. This discovery is significant because it demonstrates that younger individuals with almost normal oxygen saturation can have substantial lung involvement [19].

In conclusion, the current study found that individuals with hypoxia have considerably higher CT severity. Researchers observed a substantial inverse association between CT severity and oxygen saturation, which has important therapeutic implications. These findings support the importance of using pulse oximetry to monitor patients having COVID-19 in order to evaluate or even estimate their clinical situations.

Ethical Approval

The manuscript was approved by ethical committee of the Ksclen Organization.

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Author contribution

Faraidoon I. Qadir: Major contribution to the idea, follow up of the cases, and final approval of the manuscript. Fahmi H.Kakamad, Razhan K. A: literature review, writing the manuscript, final approval. Ismael Y. Abdullah, Berwn A. Abdulla, Shvan H. Mohammed, Rawezh Q. Salih, Abdulwahid M. Salh: literature review and final approval of the manuscript.

Consent

Consent has been taken from the patients and the family of the patients.

Registration of Research Studies

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Guarantor

Fahmi Hussein Kakamad is Guarantor of this submission.

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Declaration of competing interest

There is no conflict to be declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103439.
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