

COMPARATIVE ANALYSIS OF OXYGEN SATURATION LEVELS WITH CLINICAL AND LABORATORY PARAMETERS IN COVID-19 PATIENTS

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ABSTRACT

Objective: The main objective of the current study was to identify clinical and laboratory parameters associated with hypoxemia in patients with coronavirus disease 2019 (COVID-19).

Materials and Methods: This retrospective study was carried out in Farooq Hospital, West Wood, Lahore. A total of 188 COVID-19 positive patients admitted to the corona unit of our hospital were enrolled in this study. The diagnosis of COVID-19 was confirmed either by Reverse transcriptase-polymerase chain reaction (RT-PCR) or clinical and imaging studies. Detailed demographic, clinical, laboratory and x-ray chest findings were recorded for each of these patients.

Results: Age, number of days in the hospital, and hypertension were found to be significant. Lymphocytes, neutrophil counts, urea, and C- Reactive Protein (CRP) were significantly associated with oxygen saturation levels, less than 92% in COVID-19 patients.

Conclusion: In this study, it was observed that hypoxemia was independently associated with clinical parameters and serum biomarkers. These may help/ guide in the clinical management of patients presenting with hypoxemia, particularly in a limited resource setting.

Keywords: Oxygen saturation, Covid-19, Laboratory parameters, Hypoxemia

INTRODUCTION

Studies on the 2019 novel coronavirus disease (COVID-19) have generally been limited to the description of the epidemiology and initial clinical characteristics.

Since its emergence in China, due to its highly infectious nature, COVID-19 has become a worldwide pandemic. On June 30th, 2020, WHO announced that “10,185,374 cases of COVID-19” had been reported globally with “503,862 deaths”. Pakistan reported “209,337 confirmed cases with 4,304 deaths.”¹ The unprecedented number of new cases has placed an undue burden on health facilities across the globe. This is especially true in a low-resource county like Pakistan.

According to a study, an undue delay in diagnosis will aggravate the symptoms in Covid-19 patients and may give rise to deadly acute respiratory distress syndrome (ARDS).² Currently, critically ill COVID-19 patients require respiratory support as part of their treatment. In some independent studies, the range for oxygen support was from 32³ to 78%⁴.

Clinically, 14% of the total COVID-19 infected patients present with severe disease, and 5% of patients with oxygen saturation below 92%, may require respiratory support for their survival. However, the continuous rise in the number of critical cases, especially in settings with a limited capacity of intensive care units are further adding to the graveness of the situation.⁵

The role of clinical judgment is crucial in the early identification of infected cases. The timely identification of infected cases would thus guide the clinicians towards prompt and precise treatment

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strategies. The patient's detailed history, blood, and biochemical profile and x-ray findings, all these parameters collectively form the basis for clinical judgment.⁶

The common signs and symptoms in COVID-19 positive patients usually include pyrexia, flu, cough, and congestion. There is a considerable difference in laboratory values of patients with mild and severe disease. A recent study has reported that high LDH (Lactate Dehydrogenase), low lymphocyte, monocyte counts and raised haemoglobin with elevated levels of Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) in serious patients.⁷ Similarly, raised CRP, low lymphocyte count, leukopenia, and high ALT count had also been observed in yet another study conducted on severe acute respiratory syndrome (SARS) patients a few years back.⁸

The main objective of the current study was to assess the level of significance in terms of clinical, laboratory, and chest X-ray findings in COVID-19 cases and to compare and correlate these values with their oxygen saturation levels.

MATERIALS AND METHODS

This retrospective study was carried out in Farooq Hospital, West Wood, Lahore. A total of 188 COVID-19 positive patients admitted in Corona Unite of our hospital were enrolled in this study. The diagnosis of COVID-19 was confirmed either by RT-PCR or clinical and imaging studies. The requirement for getting informed consent from patients was waived by the "Institution's Ethical Board" of the hospital. This was attributed to the emerging situation of highly infective COVID-19. However, oral consent for enrollment was obtained from all the patients or their attendants.

All COVID-19 positive cases admitted to the hospital were categorized into two major groups. Group one comprised of patients with oxygen saturation levels above 92% and group two comprised of those patients with oxygen saturation levels less than 92% and required intensive care.⁹ Group one patients had oxygen saturation levels above 92%, and group two patients were critically ill with oxygen saturation levels below 92%.¹⁰ Detailed demographic, clinical, laboratory and x-ray chest findings were recorded for each of these patients. All the information was

recorded on a predesigned proforma. Statistical analysis was done using SPSS 24.0. For comparative analysis, the mean and standard deviations were calculated for oxygen saturation levels in both groups. The data were analyzed using an independent sample t-test between the two groups.

RESULTS

The present study analyzed a sample of 188 patients, of which 55 patients had Oxygen saturation (SO₂) levels less than the optimum (see Figure 1). As the assumptions of normality and homogeneity of variances were not met, independent samples, the median test was used to compare demographic, clinical, and laboratory parameters between COVID-19 patients with below normal and normal SO₂ levels. The results are presented as the median and interquartile range (between brackets) in Tables 1 and 2. The analysis revealed that there was a significant median difference with respect to age between patients with oxygen saturation levels below 92% and above this optimum saturation levels ($p < 0.05$). A significant median difference ($p < 0.05$) was also observed between patients below and above 92% SO₂ as far as the days since the patients were admitted. There was also a statistically significant difference of systolic ($p < 0.05$) and diastolic blood pressure ($p < 0.05$) between patients with below normal and normal SO₂ levels.

With respect to laboratory parameters, the analysis found that there was a significant median difference with respect to total leukocyte count ($p < 0.05$) between patients with below normal and normal SO₂ levels. It can be seen in Table 2 that there was a significant difference in Neutrophils and Lymphocytes count as the p-values in both cases were less than 0.05. Another significant finding of the study was that the median of ALT and AST were higher in patients with below-normal SO₂ levels ($p < 0.05$) as compared to those with normal SO₂ levels. The median of serum albumin was greater in patients with normal SO₂ levels as compared to those with below-normal SO₂ levels ($p < 0.05$). Alternatively, the median serum urea level was greater in patients with below-normal SO₂ levels ($p < 0.05$) when compared to those with normal SO₂ levels. Likewise, the median C. reactive protein was much higher in patients with below-normal SO₂ levels as compared to those with normal SO₂ levels ($p < 0.05$).

Table: 1 Clinical and demographic characteristics of corona virus disease 2019 (COVID-19) patients with below normal and normal SO₂ levels

Clinical & demographic characteristics	SO ₂ <92 (n=55)	SO ₂ ≥92 (n=133)	p-value
Age	60 (48-68)	50 (40-60)	0.002*
Total days of admission	10 (6-14)	8 (5-12)	0.03*
Temperature	98 (98-98.60)	98 (98-98.60)	0.42
Blood pressure systolic	130 (110-137)	120 (110-130)	0.008*
Blood pressure diastolic	80 (70-90)	80 (70-80)	<0.001*
Respiratory rate	20 (18-22)	18 (16-22)	0.05
Reversr transcriptase poly-merase chain reaction			
Negative	9 (16.4%)	20 (15%)	
Postive	46 (83.6%)	113 (85%)	

Table: 2 Comparison of laboratory parameters between coronavirus disease 2019 (COVID-19) patients with below normal and normal SO₂ levels

Parameters	SO ₂ <92 (n=55)	SO ₂ ≥92 (n=133)	p-value
Haemoglobin	13.80 (11.70 – 14.50)	13.50 (12.30 – 14.65)	0.48
Total Leucocyte Count	9.30 (7.60 – 13.10)	8 (6.00 – 10.60)	0.02*
Platelets Count	250 (176 – 327)	230 (177.50 – 293.50)	0.33
Neutrophils	80 (75 – 85)	70 (60 – 78)	< 0.001*
Lymphocytes	15 (10 – 20)	24 (16 – 32)	< 0.001*
Bilirubin	0.70 (0.60 – 1.00)	0.70 (0.50 – 0.80)	0.22
SGPT (ALT)	40 (25 – 72)	29 (25 – 48.50)	0.02*
SGOT (AST)	47 (30 – 62)	28 (18 – 48)	< 0.001*
Alkaline Phosphate	235 (193 – 281)	210 (166.50 – 264)	0.11
Total Protein	6.30 (6.00 – 6.50)	6.40 (6.00 – 7.00)	0.20
Albumin (Serum)	3.40 (3.20 – 3.80)	4.00 (3.50 – 4.30)	< 0.001*
RFT/Urea	45 (26 – 65)	30 (25 – 42.50)	0.002*
Creatinine	1.10 (1.00 – 1.30)	1.00 (0.90 – 1.20)	0.13
CRP (C. Reactive Protein)	90.20 (24.30 – 114)	35 (7.25 – 88.35)	0.001*
FDPS (D. Dimer)	1.05 (0.54 – 6.86)	1.00 (0.51 – 24.50)	0.68
Ferritin	460 (225 – 975.70)	280 (103.7 – 675.1)	0.05
Procalcitonin	0.52 (0.19 – 1.20)	0.238 (0.058 - 0.750)	0.05
Chest X-ray	11 (5 – 14)	9 (2 – 13)	0.06

Results are shown as the median and interquartile range (between brackets). The parameters were compared using the independent samples median test; *, p < 0.05.

DISCUSSION

The current study reveals risk factors related to clinical and laboratory parameters with reference to hypoxemia. This study was conducted on severe and critically ill COVID-19 patients. The mean age for COVID-19 patients with SO₂ below 92% were found to be statistically significant. This finding was in ac-

cordance with a study by Xie et al.¹¹ Another study also reflected similar findings. Age was significantly associated with the outcome of COVID-19 patients. Elderly patients of 60 and up had higher chances of becoming critically ill with COVID-19 infection and thus higher chances of mortality.¹²

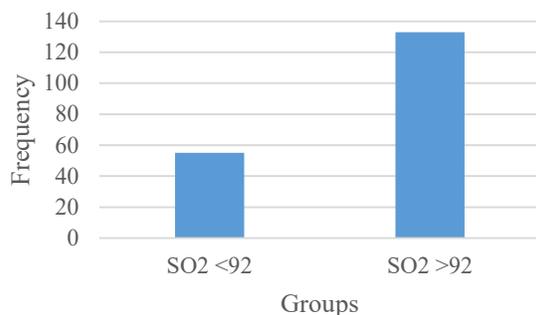


Fig 1: Bar chart of frequency of COVID-19 patients with respect to SO₂ levels

The current study has a low leukocyte count in patients with low oxygen saturation levels. This finding was in well accordance with numerous studies, for example, Xie et al.¹³ They reported an overall significant reduction of lymphocyte counts in patients with severe respiratory problems. Another study by Tan et al.¹⁴ showed that lymphocyte count reflects as one of the significant indicators for disease severity among COVID-19 patients. Their study also reported low lymphocyte count in critically ill patients.

In our study, a majority of COVID-19 patients presented with severe disease were also hypertensive. This finding was found to be in well concordance with other studies. Huang and his colleagues demonstrated that the risk of hypertension increases with the deteriorating circulatory status of the patient.¹⁵ Similarly, other studies also had this trend. Those who presented with comorbidities like hypertension and other associated diseases had higher chances of becoming seriously ill of Covid-19 infection when compared to those who had none.¹⁶

Total leukocyte was found to be raised in critically ill patients in whom oxygen saturation was below 92%. This finding was well coordinated with a study by Shi et al.¹⁷ The neutrophil count was significantly raised in critically ill patients in our research, and this was well in accordance with a recently published study by Zhang and his colleague. They reported that neutrophil count increases with the severity of the disease.¹⁸

Lymphopenia is a potential indicator that directly correlates with the progression and seriousness of the disease. As the lymphocyte count drops, the risk for bacterial co-infection increases. Covid-19 is believed to alter T lymphocyte function, and thus immune response becomes ineffective in combating

infections. Qin and his friends also reported that a drop in lymphocyte count is induced by inflammatory mediators such as IL 2, IL 6, IL 8, and TNF- α .¹⁹ Another recently published study by Tabata et al. stated that lymphopenia is a strong prognostic indicator for the severity of the COVID-19 infection.²⁰ These studies are well coordinated with our findings of lymphopenia.

Abnormal liver function tests (LFTs) are a well-documented feature in COVID-19 patients. ALT and AST represent liver function tests, which indicate the extent of liver injury. The worsening of liver function is typically depicted by elevation in AST and ALT levels. A study by Wang and his co-workers showed that about 26.9% of patients with severe illness had much higher levels of ALT & AST when compared with those who had mild disease.²¹ Similarly, Zhang et al. also reported elevated levels of ALT and AST in severe COVID-19 patients.²²

A study was recently conducted to look for the exact cause of hypoalbuminemia Covid19 patients specifically. They correlated their findings of low albumin levels with clinical characteristics and overall outcome. They suggested that basically, it is the cytokine storm-generated in response to COVID-19 infection, which leads to liver toxicity, which in turn causes low serum albumin levels.²³ Aziz and his coworkers did a systematic review and meta-analysis in which they indicated that low serum albumin levels reflect the severity of symptoms in COVID-19 disease.²⁴ All these studies support the findings of this study.

Elevated levels of urea and creatinine cause acute kidney damage. Our study reported significantly elevated levels of urea, but creatinine was not significant in COVID-19 patients in our setting. This finding was in accordance with a study by Cheng et al. They reported that both the levels of serum creatinine (14.4 %) and blood urea nitrogen (13.1%) were found to be raised in COVID-19 patients with progressing disease.²⁵

CRP is a prognostic indicator of the inflammatory process. Being an important component of inflammation, it also mediates an immune response against foreign pathogens.

A group of scientists conducted a study in Wuhan, the epicentre of COVID-19. They recorded

CRP levels in critically ill patients before death and found these levels to be elevated in 85% of these patients. This finding suggests that the inflammatory process was severe in those critical patients, which lead to damage to their organs.²⁶ Similarly, the levels of CRP were reported to be higher in critically ill patients when compared to those with relatively milder disease.²⁷

CONCLUSION

In this study, it was seen that hypoxemia was independently associated with clinical parameters and serum biomarkers. These may help/ guide in the clinical management of patients presenting with hypoxemia, particularly in a limited resource setting.

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