

A Study of Haematological Parameters in Patients Suffering from COVID-19 in a Tertiary Care Centre, Chennai

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ABSTRACT

COVID-19 is a viral infectious disease caused by the novel severe acute respiratory syndrome Corona virus SARS-CoV-2. COVID-19 first case was reported in Wuhan, China in December 2019 and since then emerged into a global pandemic causing innumerable loss of lives around the world. One of the earliest research findings done across China by Guan, et al. showed that lymphocytopenia, thrombocytopenia, and leukopenia were the common haematological manifestations among COVID-19 patients. A single centre prospective observational study of 291 COVID-19 patients with laboratory confirmed infection and admitted to sree balaji medical college and hospital. In this study, among COVID-19 patient's pancytopenia was 2.40%. 15.80% of patients had leukopenia, while 15.80% and 9.96% of patients had anaemia and thrombocytopenia. 15.46% of patients had lymphocytopenia where as 3.78% presented with leucocytosis and 8.59% had neutrophil a respectively. The lymphocyte neutrophil ratio was raised more than 3.5 in 16.84%. Thrombocytopenia and leucocytosis with sex, leukopenia with age group, anaemia with age group and sex amongst COVID-19 were the statistically significant findings present in our study. Constant analysis of COVID haematological parameters along with other investigations and clinical assessment is essential to find the changes made by the different strains of COVID-19 to guide the patients to a proper care and reduce the death rates in these patients.

Key words: Lymphocytopenia, Thrombocytopenia, Leukopenia, Neutrophilia, Haematological

HOW TO CITE THIS ARTICLE: Kaushika, Sai Sudha, Vinutha, Mary Lilly, A Study of Haematological Parameters in Patients Suffering From COVID-19 in a Tertiary Care Centre, Chennai, J Res Med Dent Sci, 2022, 10 (12): 031-037.

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Received: 01-Sep-2022, Manuscript No. JRMDS-22-75751;

Editor assigned: 05-Sep-2022, PreQC No. JRMDS-22-75751 (PQ);

Reviewed: 19-Sep-2022, QC No. JRMDS-22-75751;

Revised: 21-Nov-2022, Manuscript No. JRMDS-22-75751 (R);

Published: 01-Dec-2022

INTRODUCTION

COVID-19 is caused by the menacing Severe Acute Respiratory Syndrome Corona Virus (SARS-CoV-2) with the first few cases reported in Wuhan, China in December 2019 and later it has emerged into a global pandemic causing innumerable fatality around the world [1]. As of March 23, 2022, there have been 474,776,979 confirmed cases and 6,123,010 deaths globally and 43,012,749 confirmed cases and 516,636 deaths in India [2].

Corona virus disease spreads from an infected individual through respiratory droplets by coughing or sneezing [3]. The clinical manifestations of the COVID-19 varied from severe acute respiratory distress, in some cases causing death, to mild non-specific symptoms [4].

It is a systemic infection with haematological, pulmonary, cardiovascular, gastrointestinal and other clinical presentations [5]. One of the earliest research findings done across China by Guan, et al, reported that

lymphocytopenia was present in 83.2% of the patients, thrombocytopenia and leukopenia in 36.2% and 33.7% of the patients [6]. Other studies have also indicated that lymphocytopenia, leucocytosis, neutrophilia and thrombocytopenia were associated with severity and progression of the disease [7].

Assessing the abnormal haematological parameters in COVID-19 patients will be helpful in earlier risk stratification and improving the prognosis of the patients.

MATERIALS AND METHODS

Study design and setting

The present study is a prospective and observational type conducted for three months. It includes 291 patients with laboratory confirmed COVID-19 infection and admitted to sree balaji medical college and hospital. The diagnosis of COVID-19 was made according to the guidelines of the Ministry of Health and Family Welfare (MOHFW) Government of India (GOI). The disease is confirmed by RTPCR test performed on nasopharyngeal swab samples of the patient. All adult and paediatric cases were included in our study. Patients with malignancy on medication, chronic lung diseases, liver impairment and

haematological disorders were excluded from the study since it might alter the haematological parameters.

Data gathering: Haematological parameters were assessed by collecting the blood samples from COVID-19 patients. The data accorded by BC5380 automatic blood analyser including haemoglobin, total RBC count, total leucocyte count (WBC), and platelet count done on the blood samples were collected. During laboratory analysis of these blood samples, quality control and standard operational procedures and protocols were stringently followed.

Statistical analysis: Data on RBC, WBC and platelet levels of RT-PCR positive patients were assessed.

Microsoft professional plus excel software was used to evaluate the data. Age and sex correlation with haematological abnormalities were also analysed.

RESULTS

Demographic variables of study population

The present study population comprised 291 hospital admitted COVID-19 patients. Majority of the patients were male (58.76%). Most of them were of 30-39 age groups (27.49%) (Table 1).

Table 1: Demographic variables of the study population (n=291).

Variable	Frequency (n=291)	Percentage
Sex		
Male	171	58.76%
Female	120	41.23%
Age		
0-19	10	3.43%
20-29	58	19.93%
30-39	80	27.49%
40-49	45	15.46%
50-59	48	16.49%
60-69	35	12.02%
>70	15	5.15%

Analysis of haematological abnormalities

In the study, patients having pancytopenia were 2.40%. Regarding cytopenia, anaemia (15.80%) and leukopenia (15.80%) were relatively more common. Whereas, 3.78% of patients had leucocytosis and 8.59% had neutrophilia.

Lymphopenia was also one of the most common haematological abnormalities among COVID-19 patients (15.46%) (Table 2).

Table 2: The analysis of haematological abnormalities among COVID-19 patients (n=291).

Haematological abnormalities	Frequency (%)
Any cytopenias	
Anemia	46 (15.80%)
Leukopenia	46 (15.80%)
Thrombocytopenia	29 (9.96%)
Bi-cytopenia	
leukopenia and anemia	10 (3.43%)
Leukopenia and thrombocytopenia	11 (3.78%)
Thrombocytopenia and anemia	8 (2.74%)
Pancytopenia	7 (2.40%)
Leukocytosis	14 (3.78%)
Neutrophilia	25 (8.59%)
Lymphopenia (DC)	45 (15.46%)

Significance of white blood cells

Leukocytosis was seen in 3.78% patients only and it was more common in females (8.33%) and among 60-69 years age group (8.57%). The p-value is .018667. Hence

there is a statistical significant relationship between gender and leucocytosis in COVID 19 patients (Table 3).

Table 3: Study of leucocytosis in relation to the age and sex of COVID-19 patients.

Variables	No leucocytosis	Leucocytosis present n (%)	P value
	N=277 (95.18%)	N=14 (3.78%)	
Sex			The p-value is .018667.
Male	167 (87.43%)	4 (2.33%)	

Female	110 (91.66%)	10 (8.33%)	The P-Value is .505703.
Age group (in yrs)			
0-19	9 (90%)	1 (10%)	
20-29	54 (93.10%)	4 (6.89%)	
30-39	76 (95%)	4 (5%)	
40-49	45 (100%)	0	
50-59	46 (95.83%)	2 (4.16%)	
60-69	32 (91.42%)	3 (8.57%)	
>70	15 (100%)	0	

Leukopenia was seen in 15.80% of the COVID positive patients and more commonly in males (18.12%). There is statistical (Table 4). leukopenia was seen in 15.80% of the COVID positive patients and more commonly in males (18.12%). There is statistical (Table 4).

Table 4: Study of leukopenia in correlation to age and sex of COVID-19 patients.

Variables	No leukopenia N=245 (84.19%)	Leukopenia present n (%) N=46 (15.80%)	P value
Sex			The p-value is .195106.
Male	140 (81.87%)	31 (18.12%)	
Female	105 (87.5%)	15 (12.5%)	
Age group (in years)			The P-value is .004925.
0-19	5 (50%)	5 (50%)	
20-29	51 (87.93%)	7 (12.06%)	
30-39	60 (75%)	20 (25%)	
40-49	41 (91.11%)	4 (8.88%)	
50-59	43 (89.58%)	5 (10.41%)	
60-69	32 (91.42%)	3 (8.57%)	
>70	13 (86.66%)	2 (13.33%)	

The magnitude of lymphocytopenia was 15.46% and was relatively higher among males (15.78%) with P value 0.8545 and in the age group of 60-69 age group (25.71%) with p value 0.37008 (Table 5).

Table 5: Study of lymphopenia in relation to age and sex of COVID-19 patients.

Variables	No lymphocytopenia N= 246 (84.53%)	Lymphocytopenia N = 45 (15.46%)	P value
Sex			The p-value is .854517
Male	144 (84.21%)	27 (15.78%)	
Female	102 (85%)	18 (15%)	
Age group (in years)			The p-value is .37008.
0-19	8 (80%)	2 (20%)	
20-29	53 (91.37%)	5 (8.62%)	
30-39	69 (86.25%)	11 (13.75%)	
40-49	39 (86.66%)	6 (13.33%)	
50-59	38 (79.16%)	10 (20.83%)	
60-69	26 (74.28)	9 (25.71%)	
>70	13 (86.66%)	2 (13.33%)	

Neutrophilia: Neutrophilia was seen in 8.59% of the patients and was more common amongst males (9.35%) with p value of 0.577 and amongst the 60-69 age groups (17.14%) with p value of 0.5253. There was no statistically significant relationship between gender and

the age group with neutrophilia among COVID-19 patients (Table 6).

Table 6: Study of neutrophilia in relation to age and sex of COVID-19 patients.

Variables	NO	Present n (%)	
	N=266 (91.40 %)	N=25 (8.59%)	
Sex			The p-value is .577951.
Male	155 (90.64%)	16 (9.35%)	
Female	111 (92.5%)	9 (7.5%)	
Age group (in years)			The p-value is .525361
0-19	9 (90%)	1 (10%)	
20-29	55 (94.82%)	3 (5.17%)	
30-39	75 (93.75%)	5 (6.25%)	
40-49	40 (88.88%)	5 (11.11%)	
50-59	44 (91.66%)	4 (8.33%)	
60-69	29 (82.85%)	6 (17.14%)	
>70	14 (93.33%)	1 (6.66%)	

Neutrophil Lymphocyte Ratio (NLR): NLR is calculated by the formula: Absolute number of neutrophils/absolute number of lymphocytes. 83.16% of the patients had neutrophil lymphocyte ratio less than 3.5 and 16.84% patients had an elevated N:L ratio. The p value for gender

with N:L ratio was 0.9476 and age group was 0.5845 which was statistically significant (Table 7).

Table 7: Study of neutrophil: Lymphocyte ratio in relation to age and sex of COVID-19 patients.

Variables	<3.5 n=242 (83.16%)	3.5-7 n=36 (12.37%)	7.1-10.5 n=7(2.40%)	>10.5 n=6 (2.06%)	P value
Sex					The p-value is .947684.
Male	142 (83.04%)	20 (11.69%)	6 (3.5%)	3 (17.54%)	
Female	100 (83.33%)	16 (13.33%)	1 (0.83%)	3 (2.5%)	
Age group (in years)					The P-Value is .584537.
0-19	8 (80%)	1 (10%)	1 (10%)	0	
20-29	52 (89.65%)	4 (6.89%)	1 (1.72%)	1 (1.72%)	
30-39	68 (85%)	9 (11.25%)	2 (2.5%)	1 (1.25%)	
40-49	38 (84.44%)	6 (13.33%)	1 (2.22%)	0	
50-59	38 (79.16%)	7 (14.58%)	1 (2.08%)	2 (4.16%)	
60-69	26 (74.28%)	7 (20%)	0	2 (5.71%)	
>70	12 (80%)	2 (13.33%)	1 (6.66%)	0	

Thrombocytopenia: Thrombocytopenia was seen in 9.96% of the patients. It was more common amongst men (12.86%) with p value of 0.0486. Hence there is statistical significant difference between sex and thrombocytopenia in COVID-19 patients. Thrombocytopenia was highest in patients above 70 years of age (26.66%). However

p value was 0.1075 and therefore no statistical significance was seen between age group and thrombocytopenia in COVID-19 patients (Table 8).

Table 8: Study of thrombocytopenia in relation to age and sex of COVID-19 patients.

Variables	No thrombocytopenia N= 262 (90.03%)	Thrombocytopenia present n = 29 (9.96%)	
Sex			The p-value is .048678.
Male	149 (87.13%)	22 (12.86%)	
Female	113 (94.16%)	7 (5.83%)	
Age group (in years)			The p-value is .107599.
0-19	10 (100%)	0	
20-29	56 (96.55%)	2 (3.44%)	
30-39	69 (86.25%)	11 (13.75%)	
40-49	42 (93.33%)	3 (6.66%)	
50-59	43 (89.58%)	5 (10.41%)	
60-69	31 (88.57%)	4 (11.42%)	
>70	11 (73.33%)	4 (26.66%)	

Anaemia: Anaemia was more common amongst females (36.66%) with p value less than 0.00001 and hence statistical significant difference was present between sex and anaemia in COVID 19 patients. Anemia was seen in 60% of patients aged above 70 years. There is a

significant statistical correlation between anemia and age group with p value of 0.00011 (Table 9).

Table 9: Study of anemia in correlation with age and sex of COVID-19 patients.

Variables	No N=245 (84.19%)	Present N=46 (15.80%)	
Sex			The P-value is <0.00001.
Male	147 (85.96%)	24 (14.03%)	
Female	76 (63.33%)	44 (36.66%)	
Age group (in years)			P-value is .000111.
0-19	7 (70%)	3 (30%)	
20-29	44 (75.86%)	14 (24.13%)	
30-39	73 (91.25%)	7 (8.25%)	
40-49	37 (82.22%)	8 (17.77%)	
50-59	35 (72.91%)	13 (27.08%)	
60-69	21 (60%)	14 (40%)	
>70	6 (40%)	9 (60%)	

DISCUSSION

The need to understand the pathogenesis and evolution of COVID-19 which has caused a global alarm is essential. The aim of the study is to assess the extent of various haematological abnormalities in COVID-19 patients. Haematological parameters obtained from routine CBC could prove to be a relatively cost friendly and vital test for monitoring and prognostic risk categorization of patients when used with other molecular diagnostic tests such as RT-PCR.

In this study, pancytopenia was observed in 2.40% of the study population. 15.80% and 9.96% of patients had anemia and thrombocytopenia. 15.80% of patients had leukopenia. 15.46% of patients had lymphocytopenia whereas 8.59% had neutrophilia and 3.78% presented with leukocytosis, respectively. The lymphocyte neutrophil ratio was raised more than 3.5 in 16.84%.

Coronavirus and total white blood cells level

Study conducted by ding and colleagues observed leukopenia in more than 25% of hospital admitted COVID-19 patients [8]. Another study done to investigate the level of WBCs in hospitalized COVID-19 patients reported 20% of the COVID-19 patients developed leukopenia [9]. Only 5.4% of patients had leukopenia in a study conducted in Addis Ababa, Ethiopia.

We were able to see similar observations of leukopenia in our study (15.80%). In our study, the magnitude of leukopenia was highest in bimodal extremes of age at 0-19 years as well as above 70 years of age. It was more prevalent in males (18.12%).

Coronavirus and platelet level

Three mechanisms were reported by Xu and colleagues which were possibly causing thrombocytopenia. Direct bone marrow cells infection by the virus and impairment of platelet synthesis is the first mechanism. Also

indirectly, lung injury causes the decrease of platelet synthesis. The second mechanism is mediated through the host immune system. The third hypothesized mechanism is micro thrombi formation and platelet consumption due to platelet aggregation in the lungs [10].

Thrombocytopenia was observed in COVID-19 patients on admission and among ICU patients in around 552 hospitals in 30 different areas in China [11]. In our study, thrombocytopenia was observed in 9.96% of patients. The study conducted in Ethiopia reported that thrombocytopenia was more common among females (24.6%) and 18-35 years aged group COVID-19 patients (23.9%). However, in our study males (12.86%) had a higher prevalence of thrombocytopenia. Patients more than 70 years showed higher incidence of low platelet counts (26.66%).

Coronavirus: Neutrophils and lymphocytes level

Lymphopenia is hypothesized to result from defective immune response to the virus. In addition, SARS-CoV-2 causes lymphopenia by inhibiting bone marrow haematopoiesis [12].

Lymphopenia was noted in 83.2% of hospital admitted patients in one study [13]. Huang, et al. specifically mentioned neutrophilia in patients with COVID-19 who is admitted in ICU [14]. Similar studies showed lymphopenia among hospital admitted COVID-19 patients, 83% in Singapore [15] and 83.2% in China. In our study, neutrophilia and lymphocytopenia were observed in 8.59% and 15.46% of the patients respectively.

Lymphopenia was highest in the elderly (≥ 56 years) age group, 78.7% in one study [16]. In our study, males had a slightly higher prevalence (15.78%) than females (15%). Patients in the 60-69 years age group had the highest prevalence (25.71%) [16].

Due to the lack of specificity of lymphopenia, which is also a common haematological abnormality in the elderly individuals, the predictive value of lymphopenia can be improved if in combination with other parameters like neutrophilia and high neutrophil lymphocyte ratio

[17,18]. A higher NLR at hospital patients, especially an NLR of >4 was associated with admission to the ICU [19]. In our study, the neutrophil lymphocyte ratio is less than 3.5 in 83.16% and 12.37% for 3.5 to 7 and 4.46% for more than >7.5 (Table 10) [20].

Table 10: Comparison of various values with other institutions.

Comparison of various values with other similar studies conducted in other institutions	Patients in millennium COVID-19 referral treatment centre, Addis Ababa, Ethiopia	Our study: A study of haematological parameters in patients suffering from COVID-19 in a tertiary care centre, Chennai	Study of haematological parameters in patients with Coronavirus disease 2019 in Basra	Clinical characteristics of Coronavirus disease 2019 in China
N	334	291	112	1099
Pancytopenia	1.80%	2.40%		
Anemia	24.90%	15.80%		
Leukopenia	5.40%	15.80%	5.40%	33.70%
Leukocytosis	29.60%	3.78%	9.82%	
Lymphopenia	72.20%	15.46%	5.40%	83.20%
Neutrophilia	8.70%	8.59%	14.28%	
Thrombocytopenia	21.60%	9.96%	5.36%	36.20%

CONCLUSION

COVID-19 is a novel virus which has been causing destruction and havoc in a global scale causing mortality and morbidity of millions of people. The continuous analysis of haematological parameters could provide prognostic variations and help in the short term treatment and long term management protocol of COVID-19 patients.

Thrombocytopenia with sex, leukopenia with age group, leucocytosis with sex, anemia with age group and sex amongst COVID-19 were the statistically significant correlations present in our study. Further constant analysis of COVID haematological parameters is essential to find the changes made by the different strains of COVID-19 to guide the patients to a proper care and reduce the mortality rate in these patients. However, furthermore studies are needed to confirm the efficiency of these haematological parameters for predicting the clinical outcome and the ideal therapeutic management.

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