Original Research Article

WHITE BLOOD CELL PARAMETERS IN PATIENTS DIAGNOSED WITH COVID-19

ABSTRACT:

Aim: The SARS-CoV-2 virus has been a major health concern in recent times, causing a large number of deaths globally. It primarily effects the respiratory and immune system. In the present study the effect of this virus on the white blood cell (WBC) parameters was analysed.

Study Design: Retrospective record-based study

Place and duration of study: The study was conducted at Lok Nayak Hospital, Delhi. It was one of the largest COVID designated hospitals in India. A total of 200 patients admitted to Lok Nayak Hospital during the COVID wave in April-May 2021 and the COVID wave in January-February 2022 were randomly included in the study.

Methodology: The cases were grouped into intensive care unit (ICU) patients and non-ICU patients to compare the association of severity of disease with the WBC parameters.

Results:Patients infected with COVID-19 requiring hospital admission showed leukocytosis in the present study. It was noted that the patients requiring critical care had a significantly higher total leucocyte count (TLC), absolute neutrophil count (ANC), neutrophil lymphocyte ratio (NLR) and neutrophil monocyte ratio (NMR). Though no statistically significant association was noted between absolute lymphocyte count (ALC) and the severity of infection, the ALC was markedly reduced in ICU patients as compared to non-ICU patients (p-value= 0.057).

Conclusion:WBC parameters could help in assessing the severity of COVID-19 infection.

KEY WORDS: COVID-19, neutrophil count, neutrophil-lymphocyte ratio, neutrophil-monocyte ratio

INTRODUCTION:

The novel SARS-CoV-2 or COVID-19 is an enveloped RNA virus. Patients infected with COVID-19 present with fever, dry cough and fatigue. Patients with severe illness may require intensive care. These patients may develop acute respiratory distress syndrome and septic shock as described in a study by Zhu B et al. [1]. According to WHO, over 4 lakh deaths have been reported due to COVID-19 in India till date [2]. The hematological profile of patients infected with this virus is known to change with the severity of infection. In a study by Anurag et al, most patients with severe disease showed leukocytosis. Early defense against the COVID infection commonly involves neutrophils. As the severity of infection increases, there is excessive degranulation of neutrophils leading to a cytokine storm [3]. In a study by Mardani et al, lymphopenia was noted in patients diagnosed with COVID-19 requiring critical care [4].

The present study was conducted at Lok Nayak Hospital, Delhi. The aim of the study was to evaluate the use of commonly used haematology parameters in assessing the severity of the disease in COVID infection.

MATERIALS AND METHODS:

Patients diagnosed with COVID-19, admitted to a tertiary care hospital in Delhi during the period of study from 15 April to 15 May 2021 and from 4 January to 4 February 2022 were included in the study. Hundred cases were selected randomly from each COVID wave and were included in the two groups.

Patients were categorized into two groups, ICU and non-ICU cases. The peripheral blood samples of these patients had been sent to the Department of Clinical Pathology during their course of hospital stay. All safety precautions had been taken during phlebotomy, sample processing and proper disposal of blood samples. The white blood cell parameters of patients with severe illness requiring intensive care were compared to the patients admitted in the ward with moderate illness. White blood cell parameters included from automated haematology analyser Mindray BC-6200 and Sysmex XT-2000i were total leucocyte count, percentage and absolute counts of neutrophils, lymphocytes, eosinophils, and basophils. The highest absolute neutrophil count was considered for each patient during their period of hospital admission. Neutrophil lymphocyte ratio (NLR) and neutrophil monocyte

ratio (NMR) were calculated from the data collected. Data was compiled in Excel and analysed in SPSS version 25 software. Statistical analysis of quantitative variables was done using student's t-test. p values < 0.05 were considered statistically significant.

Ethical Clearance was taken from the institutional ethics committee (F.1/IEC/MAMC/90/02/2022/No.127).

RESULTS:

A total of 200 patients diagnosed with COVID were randomly selected and included in the study. The total cases included in the present study were divided into ICU and non-ICU groups(Table 1).

Table 1: White blood cell parameters in the ward and ICU patients

Parameter	ICU/Ward	Sample Size	Mean	Standard Deviation	P-value
TLC	ICU	97	13409.814	11842.722	0.013
	Ward	103	10139.876	5606.651	
P %	ICU	97	88.027	10.740	0.000
	Ward	103	82.673	10.249	
L%	ICU	97	8.885	7.602	0.000
	Ward	103	14.028	8.818	
M%	ICU	97	1.776	1.640	0.004
	Ward	103	2.452	1.624	
E%	ICU	97	0.748	1.931	0.850
	Ward	103	0.794	1.452	
ANC	ICU	97	11989.241	10902.980	0.005

	Ward	103	8587.024	5223.508	
ALC	ICU	97	975.970	1168.565	0.057
	Ward	103	1264.969	958.084	
AMC	ICU	97	196.801	219.213	0.341
	Ward	103	223.535	175.838	
AEC	ICU	97	58.621	142.893	0.913
	Ward	103	60.492	97.249	
NLR	ICU	97	19.916	19.236	0.000
	Ward	103	10.253	9.724	
NMR	ICU	97	122.089	143.725	0.000
	Ward	103	57.056	57.784	

Out of a total of 200 cases included in the study, it was found that 119 patients (59.5%) were males and 81 were females (40.5%). Of the 103 patients in the ward, 56 (54%) were males. However, among the patients requiring critical care, 63 patients (65%) were males. Thus, a higher percentage of patients requiring critical care were males. (Figure 1, 2)

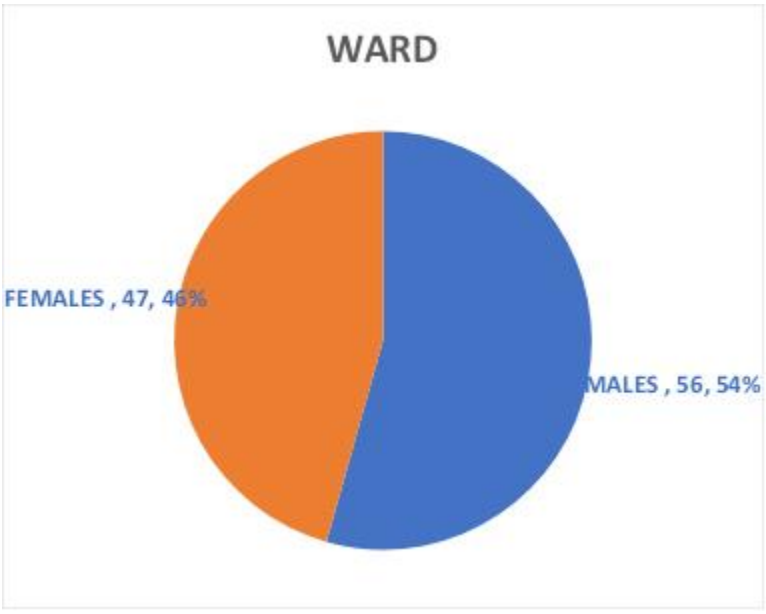

Figure 1: Gender distribution in ward patients

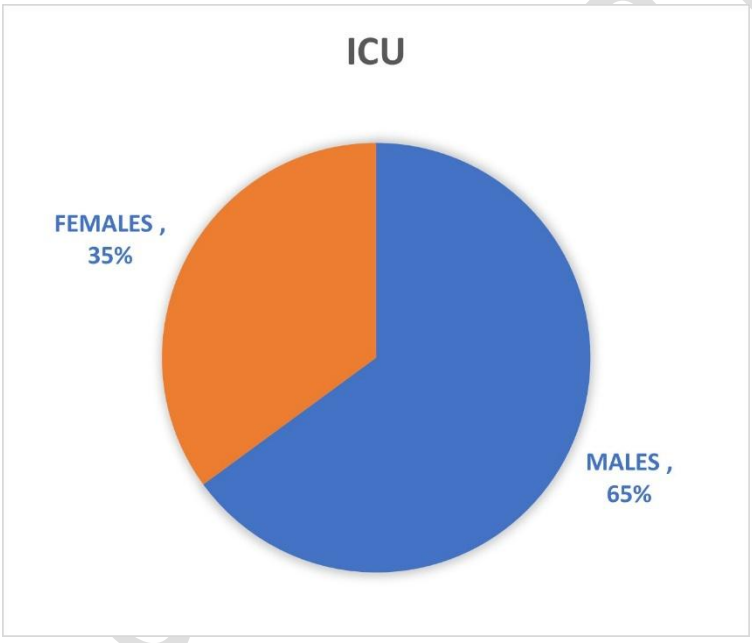

Figure 2: Gender distribution in ICU patients

The mean TLC was found to be higher than the normal range followed in our laboratory (4000-10,000 cells/mm^3) [5].The TLC was compared in the two groups. It was found to be significantly higher in the ICU patients(p=0.013) (Figure 3).

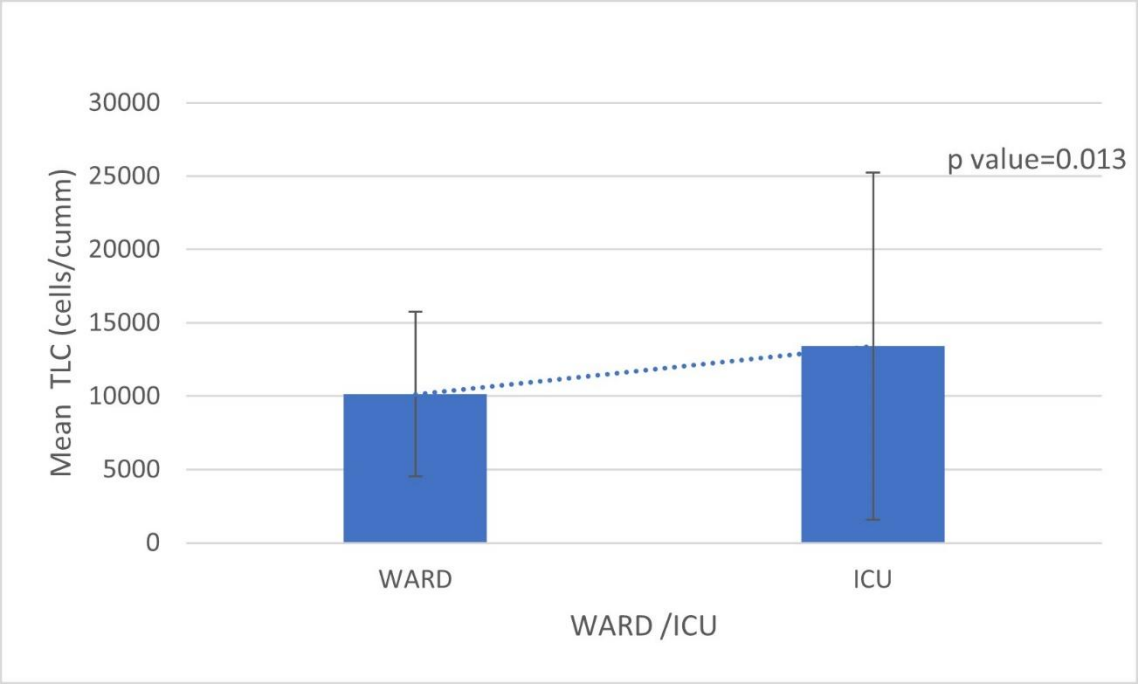

Figure 3: Mean TLC in ward and ICU patients

The mean P% was found to be higher than the normal range of percentage of neutrophils (40-80%) [5]. The mean P% was compared in the two groups. It was found to be significantly higher in the ICU patients(p=0.000) (Figure 4).

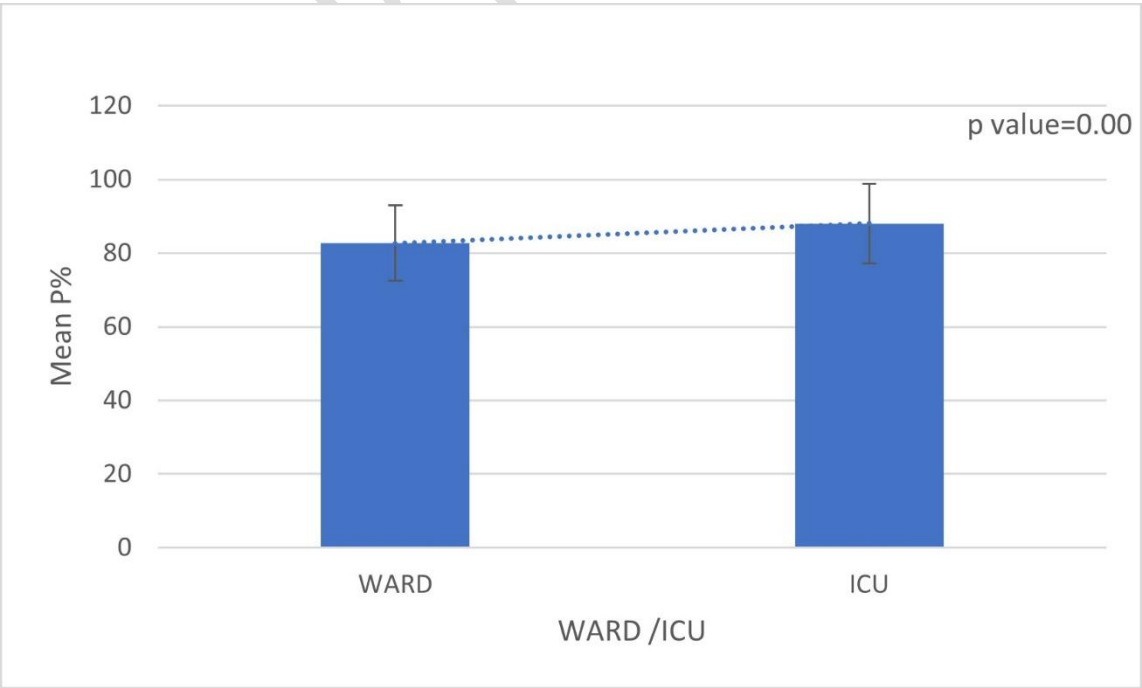

Figure 4: Mean P% in ward and ICU patients

The mean ANC of the two groups was analysed. It was found to be higher than the normal range of ANC (2000-7000 cells/mm^3) [5].The ANC was compared in the two groups and was found to be significantly higher in the ICU patients (p=0.005). (Figure 5)

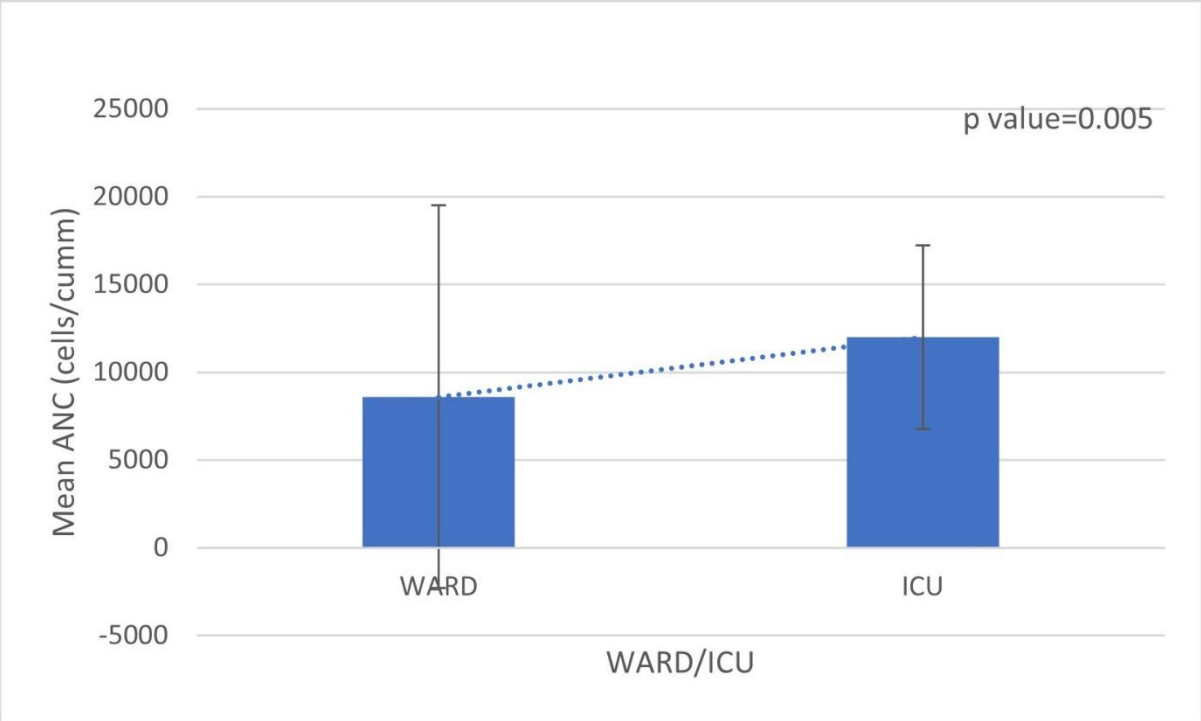

Figure 5: Mean ANC in ward and ICU patients

The mean ALC of the two groups was analysed. It was compared in the two groups. The ALC was found to be markedly reduced in ICU patients as compared to the non-ICU patients. (p-value= 0.057).

The mean NLR was found to be higher than normal range of neutrophil lymphocyte ratio (NLR) (1.6-3.5) [6].The NLR was compared in the two groups. It was found to be significantly higher in the ICU patients(p=0.000). (Figure 6)

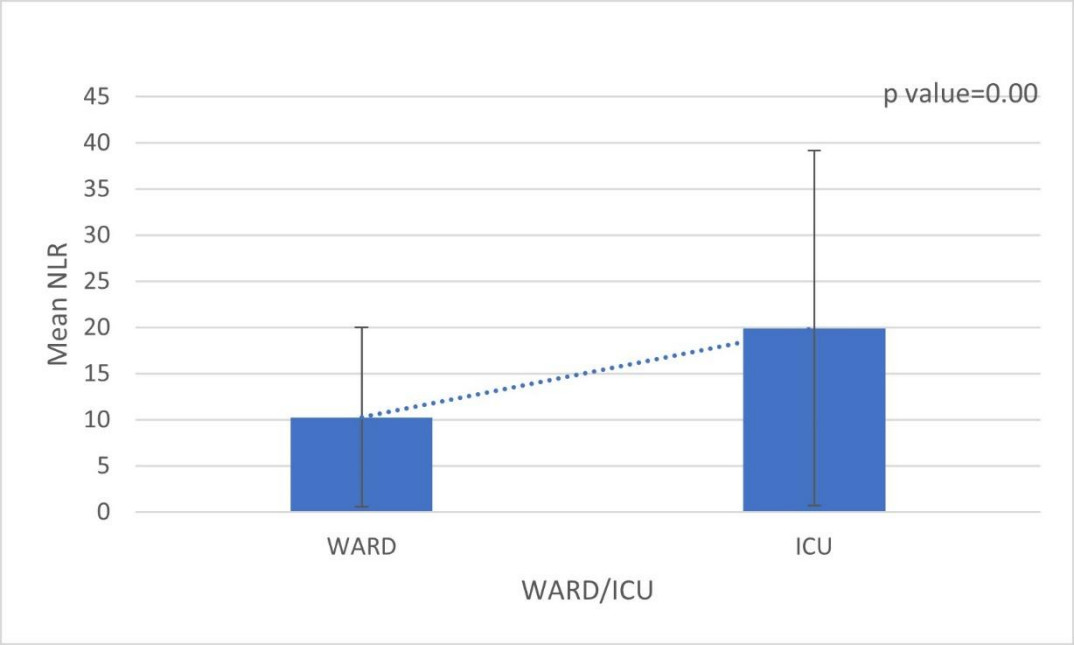

Figure 6: Mean NLR in ward and ICU patients

The mean NMR was found to be higher than normal range of neutrophil lymphocyte ratio (NMR) (NMR≥17.75)[7].The NMR was compared in the two groups. It was found to be significantly higher in the ICU patients(p=0.000). (Figure 7)

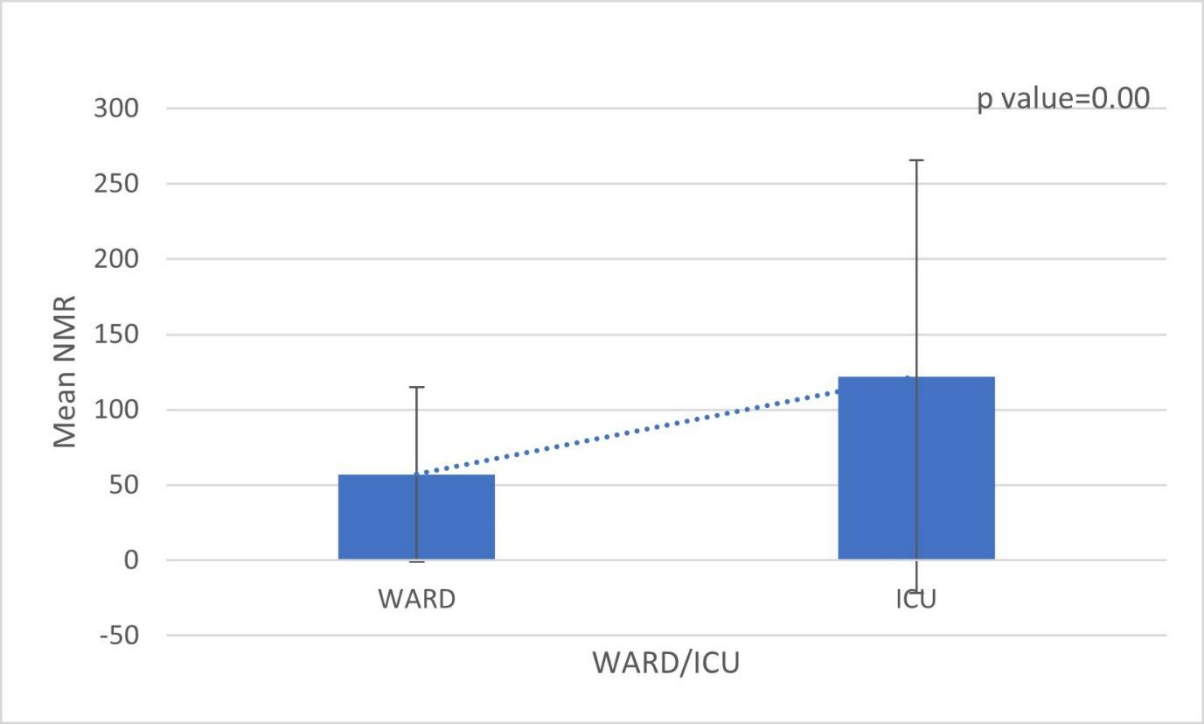

Figure 7: Mean NMR in ward and ICU patients

No other significant association was noted on comparing the WBC parameters between the ICU and non-ICU group.

DISCUSSION:

COVID -19 had emerged in December 2019 in Wuhan, China as an outbreak of pneumonia[8]. Theimmune response curbs the viral replication in mild cases and limits the disease. However, uncontrolled inflammation may cause viral sepsis with immunologic impairment in severe cases[9].

In the present study, it was found that 119 (59.5%) patients were males and 81(40.5%) were females. This was similar to the findings in other studies where a higher percentage of COVID positive hospital admissions were males. In a study by Anurag A. et al, 58.8% patients were males and 41.2% patients were females [3].In a study by Tong X et al., 52.6% of the patients infected with COVID included in the study were males while 48.3% were females[9].

In the present study, on comparing the TLC, between the ICU and non-ICU patients, TLC was significantly higher in ICU patients. On comparing the percentage of neutrophils in the differential count and ANC between ICU and non-ICU patients, ANC was significantly higher in ICU patients. These findings were similar to the findings by Anurag A. et al. in their study where they noted an increase in the total leukocyte count and differential neutrophil count in patients with severe COVID-19 infection[3]. Yuan et al. noted similar haematological findings in their study with higher TLC and ANC in the severe group as compared to the moderate group of patients[10].

COVID-19 infection causes an exaggerated inflammatory response causing a cytokine storm. Cytokine storm may be accompanied with neutrophilia (absolute neutrophil count above 7.5×10^9 /L)[8].

The mean ALC was found to be within the normal range in the present study. The ALC was found to be markedly reduced in ICU patients as compared to the non-ICU patients. (p-value= 0.057). In a study by Liu et al., they observed that 72.3% (99/137) of the patients had

lymphocytopenia[11].Pozdnyakova O et al. in their study also noted lymphopenia in severe COVID-19 cases[12].

The NLR was found to be significantly higher in the ICU patients on comparing the mean NLR of ICU and non-ICU patients (p=0.000). Liu J et al. found NLR to be an early predictor of patients with COVID-19 who are likely to develop critical illness[6]. These findings were similar to the findings by Anurag A et al. where they found increase in NLR with increase in severity of the disease[3].

The mean NMR was found to be higher than normal range of neutrophil monocyte ratio (NMR) (NMR≥17.75)[7]. The NMR was compared in the two groups. It was found to be significantly higher in the ICU patients (p=0.000). These findings were similar to the findings by Rizo-Téllez S et al. where they found a two-fold increase in NMR in non-survivors than survivors and found the NMR to be a reliable predictor of severity of COVID-19[7].

Palladino et al. analysed the effect of COVID-19 on the white blood cell count. They noted lymphocytopenia to be the most common haematological abnormality in COVID-19 infection, seen in almost 85% of cases. The severity of lymphopenia was noted to increase with increase in severity of the disease. Virus attachment or immune injuries from inflammatory mediators may be responsible for lymphocytopenia in COVID-19. Lymphocytopenia could also be due to exudation of circulating lymphocytes into inflammatory lung tissues.Severe COVID-19 infection has been found to be associated with a hyperinflammatory state and cytokine storm. Neutrophilia with enhanced degranulation of neutrophils plays a major role in inducing a hyperinflammatory state. Palladino et al. noted neutrophilia to be associated with poorer outcomes in COVID-19 infection[13].

Xue G et al. analysed the role ofnovel inflammatory markers to predict the disease severity in COVID-19. They found the neutrophil lymphocyte ratio to be elevated in the severe disease group as compared to patients with mild to moderate COVID-19 disease[14].

Myari A et al. found the WBC count, neutrophil count and neutrophil lymphocyte ratio to be the best indicators of critical disease in COVID-19 cases whereas lymphocytopenia was found to be an early predictor of severe disease[15].

The present study showed results similar to those reported in other studies. However, there was no follow up of patients after they were discharged from the hospital as the health system was already overburdened during the pandemic.

CONCLUSION:

The present study showed that the critical patients requiring ICU admission were shown to have a significantly higher TLC, ANC, NMR and NLR as compared to the non-ICU patients. Though no statistically significant difference was noted in the ALC of ICU and non-ICU patients, the ALC was found to be markedly reduced in ICU patients (p-value= 0.057). Thus, WBC parameters could help in assessing the severity of COVID-19 infection.

Various studies from across the globe have shown white blood cell count, neutrophil count, lymphocyte count and neutrophil lymphocyte ratio as important predictors of severity of COVID-19 disease[13]. The findings of the present study support the findings of previous studies.

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