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Original Research Article

Role of Complete Blood Count (CBC) Parameters as A Prognostic Assister in Management of Hospitalised COVID-19 Patients: Study from A Tertiary Health CareCentre

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Abstract

Background: Complete blood count (CBC) parameters has always been a very important and informative assessor in the diagnosis and management of infectious diseases. It is also a rapid, cheap and simple procedure without much inconvenience to patients. CBC parameters of COVID-19 patients recently have shown variations from normal CBC parameters as well as some new variations in comparison to other viral infections. The aim of our study is to observe the various CBC parameters of COVID-19 patients and assess them in the diagnosis and prognosis of disease. We also aimed to compare CBC parameters of ICU and non-ICU patients in order to assess the severity of the disease by an early and cost-effective method in order to handle the huge surge of COVID patients during the pandemic waves.

Materials and Methods: CBC reports of around 500 hospitalised COVID-19 patients were examined which also included ICU patients from April 2021 to December 2022 that also included the huge second and a mild third wave also. Different parameters like TLC, DC, Platelet count, neutrophil to lymphocyte ratio (NLR) and platelet to lymphocytes ratio (PLR) were observed and correlated with severity. Various CBC parameters were studied and comparison was done between COVID ward cases and ICU cases.

Results: Total 500 CBCs were examined and correlated with normal range in CBC. Most (92%) of the patients showed neutrophilia along with lymphopenia. Eosinopenia was observed in 76% of patients. NLR was also higher in 92% of COVID-19 patients. Platelet count was lower in ICU patients (29%) as comparedto ward patients (11%). PLR was also significantly high in ICU patients.

Conclusion: Various CBC parameters can help in diagnosing COVID-19 patients and also can be adopted as a prognostic marker during management. Pandemicwaves of COVID-19 brings a surge of patients with constraints in time and economy as well as for bed and ICU availabilities Hence, CBC parameters have a crucial role along with other inflammatory markers in assessing

severity of COVID19 patients and imply early interventions to bring down the death rates.
Keywords: CBC, COVID-19, NLR, PLR.

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Introduction

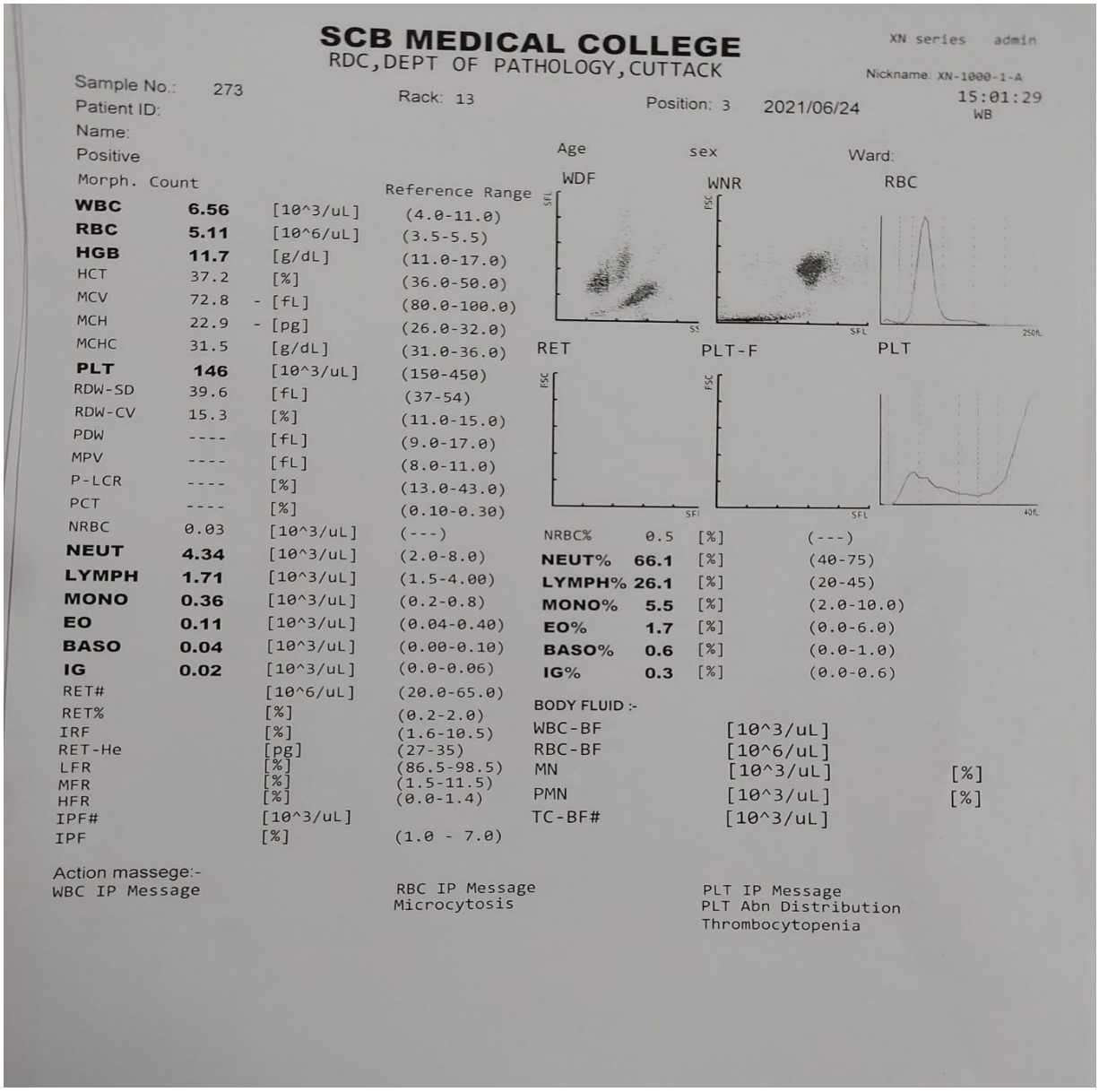
The Novel Corona virus caused COVID-19 pandemic which was responsible for causing a wide range of symptoms and spread like wild fire in spite of the lock down, shut down and all other precautionary measures. After causing deaths and panic it was learned that corona virus causes common cold like symptoms to serious illness like pneumonia, severe acute respiratory syndrome, coagulopathy or septic shock. The virus was recognized by the WHO on 12 January 2020 and subsequently spreaded to different parts of the world.[1] In India the first case was reported on 30 January 2020. The pandemic had a peak on mid-September w with over 90,000 cases reported per day, dropping to 15,000 cases per day by January 2021. A second wave started on March 2021 that was more devastating than the first one. By late April, India led the world in new active cases with over 4 lacs new cases per day. In Odisha, the first reported case was on 16 March 2020. The first wave occured during September 2020. A second peak occured during April 2021 to July 2021 which was more severe than the first peak. SCB medical college was a referal centre for COVID patients from all parts of Odisha ,especially receiving a lot of patients from costal Odisha. The COVID OPD catered to about 300 patients per day. During April 2021 to December 2022 around more than 10,000 cases have been admitted to COVID ward and COVID ICU. All COVID positive admitted patients were subjected for various haematological and biochemical parameters that included RT-PCR, CBC, CRP, LDH, AST, ALT, IL-6, Serum Ferritin, Sr D-dimer, blood sugar , alkaline phosphate etc. that reflected the severity of the disease as well as the prognosis to some extent. We studied the CBC reports of around 500 COVID patients both from COVID ward and COVID ICU. Various CBC parameters like TLC (total leucocyte count), DC (differential counts) of Neutrophil, lymphocyte, eosinophil, monocyte, and platelet count was analysed. Also the NLR (neutrophil lymphocyte ratio) and PLR (platelet lymphocyte ratio) was calculated and studied for each patients. We also did a peripheral smear for each case and looked for the presence of toxic granules in neutrophils, granules in lymphocytes or presence of any atypical lymphocytes. We did a comparison with normal CBC as well as comparison between CBC of COVID ward and COVID ICU patients.

Materials And Methods

This study is a cross-sectional observational study conducted at SCB Medical College Cuttack, a tertiary health care centre that receives COVID patients from different parts of Odisha, especially costal Odisha. Study was conducted from April 2021 to December 2022.

Inclusion criteria: All hospitalised COVID-19 positive patients diagnosed by Real time PCR. Exclusion criteria was hospitalised patients with negative RT-PCR and patients with any haematological malignancies. The study was approved by the Departmental Scientific Committee and Institutional Ethical Committee. CBC reports of around 400 COVID ward patients and around 100 COVID ICU patients were included in our study. There was no significant differences in underlying co-morbidities like diabetes, hypertension, cardiovascular diseases or respiratory diseases among COVID ward patients and COVID ICU patients. Routine CBC was

performed within a day or two upon admission to the COVID hospital. An automated six part differential WBC included Total leucocyte count, differential count, absolute count of neutrophils, lymphocytes, eosinophil, monocyte and basophil. We also noted the platelet count, neutrophil lymphocyte ratio NLR, platelet lymphocyte ratio PLR and compared them with normal values as well as comparisons between ICU and non ICU patients. A peripheral blood smear was examined for each case to look for any morphological changes in WBC. The morphological change for neutrophil included presence of toxic granules or shift to left and morphological change for lymphocyte included presence of cytoplasmic granules and presence of atypical lymphocytes.



SCB MEDICAL COLLEGE
RDC, DEPT OF PATHOLOGY, CUTTACK

XN series admin
Nickname: XN-1000-1-A
15:01:29
WB

Sample No.: 273
Patient ID:
Name:
Positive
Morph. Count

Rack: 13 Position: 3 2021/06/24

Age sex Ward:

			Reference Range
WBC	**6.56**	[10^3/uL]	(4.0-11.0)
RBC	**5.11**	[10^6/uL]	(3.5-5.5)
HGB	**11.7**	[g/dL]	(11.0-17.0)
HCT	37.2	[%]	(36.0-50.0)
MCV	72.8	- [fL]	(80.0-100.0)
MCH	22.9	- [pg]	(26.0-32.0)
MCHC	31.5	[g/dL]	(31.0-36.0)
PLT	**146**	[10^3/uL]	(150-450)
RDW-SD	39.6	[fL]	(37-54)
RDW-CV	15.3	[%]	(11.0-15.0)
PDW	----	[fL]	(9.0-17.0)
MPV	----	[fL]	(8.0-11.0)
P-LCR	----	[%]	(13.0-43.0)
PCT	----	[%]	(0.10-0.30)
NRBC	0.03	[10^3/uL]	(---)
NEUT	**4.34**	[10^3/uL]	(2.0-8.0)
LYMPH	**1.71**	[10^3/uL]	(1.5-4.00)
MONO	**0.36**	[10^3/uL]	(0.2-0.8)
EO	**0.11**	[10^3/uL]	(0.04-0.40)
BASO	**0.04**	[10^3/uL]	(0.00-0.10)
IG	**0.02**	[10^3/uL]	(0.0-0.06)
RET#		[10^6/uL]	(20.0-65.0)
RET%		[%]	(0.2-2.0)
IRF		[%]	(1.6-10.5)
RET-He		[pg]	(27-35)
LFR		[%]	(86.5-98.5)
MFR		[%]	(1.5-11.5)
HFR		[%]	(0.0-1.4)
IPF#		[10^3/uL]	
IPF		[%]	(1.0 - 7.0)

WDF WNR RBC
RET PLT-F PLT

NRBC%	0.5	[%]	(---)
NEUT%	**66.1**	[%]	(40-75)
LYMPH%	**26.1**	[%]	(20-45)
MONO%	**5.5**	[%]	(2.0-10.0)
EO%	**1.7**	[%]	(0.0-6.0)
BASO%	**0.6**	[%]	(0.0-1.0)
IG%	**0.3**	[%]	(0.0-0.6)

BODY FLUID :-

WBC-BF	[10^3/uL]	
RBC-BF	[10^6/uL]	
MN	[10^3/uL]	[%]
PMN	[10^3/uL]	[%]
TC-BF#	[10^3/uL]	

Action massege:-
WBC IP Message
RBC IP Message
Microcytosis
PLT IP Message
PLT Abn Distribution
Thrombocytopenia

Normal CBC

Group Statistics

	patient code	N	Mean	Std. Deviation	Std. Error Mean
TLC(10^3/ul)	Covid ward patient	400	13.0108	6.07500	.30375
	Covid ICU Patient	100	12.6556	5.59469	.55947
Hemoglobin(g/dl)	Covid ward patient	400	11.3773	1.87672	.09384
	Covid ICU Patient	100	11.4390	1.59297	.15930
Platelet(10^3/ul)	Covid ward patient	400	255.80	97.271	4.864
	Covid ICU Patient	100	211.92	94.314	9.431
Neutrophill	Covid ward patient	400	85.664	9.0273	.4514
	Covid ICU Patient	100	84.200	8.6865	.8686
Lymphocytes	Covid ward patient	400	11.080	7.5176	.3759
	Covid ICU Patient	100	12.700	7.5297	.7530
Eosinophill	Covid ward patient	400	.778	1.5241	.0762
	Covid ICU Patient	100	.930	1.2733	.1273
Monocytes	Covid ward patient	400	2.339	1.4941	.0747
	Covid ICU Patient	100	2.150	1.0481	.1048
N:L ratio	Covid ward patient	400	12.605725000000001	10.610594552912230	.530529727645612
	Covid ICU Patient	100	8.791999999999996	4.696047768758814	.469604776875881
P:L ratio	Covid ward patient	400	35.727399999999996	33.490342373896425	1.674517118694821
	Covid ICU Patient	100	20.385500000000008	12.264670240618420	1.226467024061842

Figure 1

Test Statistics[a]

	TLC(10^3/ul)	Hemoglobin(g/dl)	Platelet(10^3/ul)	Neutrophill	Lymphocytes	Eosinophill	Monocytes	N:L ratio	P:L ratio
Mann-Whitney U	19768.500	19789.500	14873.000	17100.000	16480.500	17541.500	19866.500	16572.000	13820.500
Wilcoxon W	24818.500	99989.500	19923.000	22150.000	96680.500	97741.500	24916.500	21622.000	18870.500
Z	-.179	-.164	-3.968	-2.247	-2.729	-2.255	-.107	-2.653	-4.782
Asymp. Sig. (2-tailed)	.858	.870	.000	.025	.006	.024	.915	.008	.000

a. Grouping Variable: patient code

Figure 2

Percentiles

		patient code	Percentiles 5	10	25	50	75	90	95
Weighted Average(Definition 1)	TLC(10^3/ul)	Covid ward patient	5.6025	6.6000	8.8000	11.9000	16.1500	21.3600	25.7200
		Covid ICU Patient	5.0500	7.0000	9.2000	12.0000	14.0000	20.1800	26.7750
	Hemoglobin(g/dl)	Covid ward patient	8.0000	9.0000	10.0000	11.6000	12.9750	13.6000	14.0000
		Covid ICU Patient	8.5150	9.6200	10.0000	12.0000	12.6000	13.9000	14.0000
	Platelet(10^3/ul)	Covid ward patient	112.00	146.00	187.25	240.00	320.00	386.40	442.00
		Covid ICU Patient	78.00	94.40	134.75	216.00	262.00	327.80	400.40
	Neutrophill	Covid ward patient	67.05	75.00	82.10	87.00	92.00	95.00	96.00
		Covid ICU Patient	65.15	75.20	82.00	85.00	91.00	92.00	92.00
	Lymphocytes	Covid ward patient	3.000	4.000	6.000	10.000	14.000	21.000	26.000
		Covid ICU Patient	5.050	6.000	7.250	11.000	15.000	22.000	28.900
	Eosinophill	Covid ward patient	.00	.00	.00	.00	1.00	3.00	3.00
		Covid ICU Patient	.00	.00	.00	.00	2.00	3.00	4.00
	Monocytes	Covid ward patient	.000	1.000	1.000	2.000	3.000	4.000	5.000
		Covid ICU Patient	.000	1.000	2.000	2.000	3.000	3.000	4.000
	N:L ratio	Covid ward patient	2.5000	3.4000	5.9000	9.0000	15.2000	24.0000	32.3000
		Covid ICU Patient	2.2150	3.4100	5.4000	7.8000	12.2250	15.2000	18.1400
	P:L ratio	Covid ward patient	5.8000	10.2400	16.0500	24.7000	43.8750	76.7000	109.6950
		Covid ICU Patient	5.8100	7.3100	10.3250	17.3500	26.3500	37.8500	46.4850

Figure 3

Observations

CBC parameters of 500 COVID cases (400 ward patients and 100 ICU cases) were studied and subjected for statistical analysis. All categorical laboratory data were expressed in number (%) and also by mean (inter quartile range). Chi square analysis was done to compare proportions of COVID patients (both ward and ICU) having normal, increased and decreased levels of haematological parameters than the standard CBC cut off values. All quantitative data were tested for normality using KOLMOGROV-SMIRNOV test (Figure 1). However, none of the parameters were distributed normally. So, to compare the quantitative data between ICU and ward cases, the Mann Whitney U test was done (Figure 2). P value of less than 0.005 was considered statistically significant. All hypothesis tests were 2 tailed. SPSS Software version 25.0 was used to perform the analysis.

CBC parameters of 400 COVID ward patients and 100 ICU patients were studied and compared with normal CBC values (Figure 3). The following changes were seen.

Total Leucocyte Count (TLC)

About 165(41.3%) ward patients and 38(38%) ICU patients had a TLC count within normal range. 230 (57.5%) COVID ward patients and 62(62%) ICU patients had a higher TLC count.

Incidence of increased TLC count was more in ICU cases as compared to ward cases with a significant p value (0.858).

Neutrophil Count

Increased neutrophil count was found in 373 (93%) of COVID ward patients as well as 93(93%) of ICU cases.

Incidence of neutrophilia was remarkable in both ward and ICU cases and almost similar when compared between ICU and ward cases with a p value of 0.025.

Lymphocyte Count

A significant number of ward patients 316 (79%) showed lymphopenia and about

71(71%) ICU cases showed lymphopenia. Comparing ward and ICU patients, lymphopenia was slightly higher in ward cases than ICU cases with a p value of 0.006.

Eosinophil Count

Eosinophil count was decreased in 308 (77%) ward cases and 76(%) ICU cases. Incidence of Eosinopenia was significant in both ward and ICU patients with a p value 0.024

Platelet

45(11%) of COVID ward patients showed thrombocytopenia wherea s 29 (29%) of COVID ICU cases showed thrombocytopenia. So, incidence of thrombocytopenia in ICU patients was significantly higher as compared to ward cases with a p value 0.00.

Neutrophil Lymphocyte Ratio (NLR)

NLR was found to be increased in 372 (93%) ward cases and 92(92%) ICU cases. This high incidence of NLR in COVID cases was found to be significant with a p value of 0.008.

Platelet Lymphocyte Ratio (PLR)

PLR was increased in 9(2.3%) of ward cases and 9(9%) of ICU cases PERIPHERAL SMEAR EXAMINATION

Atypical lymphocytes was seen in the peripheral smear of about 3% of cases. Differential count of COVID cases didn't show any significant changes in monocyte count or basophil count.

Discussion

The present study included careful observations of different CBC parameters of COVID ward patients and COVID ICU patients as well as comparison of different parameters between COVID ward and ICU cases.

TLC count was found to be within normal range in 41.3% of ward cases and 57.5% had leucocytosis. Similarly, among ICU cases 38% had normal TLC and 62% had leucocytosis. Leucopenia was observed in 2% of ICU cases. Comparing them, incidence of leucocytosis was higher in ICU patients than in ward cases.

Neutrophil count was increased in about 93% COVID patients, both ward and ICU cases. Lymphopenia was observed in 71 % ward patients but in 79% of ICU cases Comparing between ward and ICU cases, incidence of lymphopenia was more among ICU patients which was statistically significant with a p value 0.006. A research at Jin Yin Tan Hospital [1] showed lymphopenia in 63 % COVID patients along with Neutrophilia. Similarly, Zhongnan Hospital of Wuhan University reported Neutrophilia along with lymphopenia in 70.3% of COVID patients [2]. Hence high Neutrophil count along with Lymphopenia occurs with onset of activation of Neutrophils, possibly generating an immune response to fight against the virus and contribute to the cytokine storm. So, Neutrophil and Lymphocyte count can act as a predictive parameter for the severity of COVID infection. Eosinopenia was noted among COVID ward and ICU cases. Comparing between ward and ICU cases, eosinopenia was more marked in ward cases than in ICU cases that was statistically significant (p value 0.025).

Platelet count was reduced in 11% ward cases and 29% of ICU cases. Incidence of thrombocytopenia was more in ICU patients and was found to be statistically significant, p value 0.001. Incidence of thrombocytopenia was also noted in other studies like Huang CL et al 1 and Chen NS et al [3] who found thrombocytopenia in 5% and 12% of COVID cases respectively. Similarly, higher incidence of thrombocytopenia among COVID patients with serious complications was found in another study by Guan WJ et al [6].

NLR showed a significantly increased value among COVID ward as well as ICU cases. It was statistically significant with a

p value 0.008. Severe inflammatory status in COVID 19 cases with high level of cytokines mostly occurs due to the imbalance of immune responses and weak immunity status of the patients [4,8]. Various CBC parameters, especially TLC count, Neutrophil count, NLR and PLR can be used as a quick representative of the degree of inflammation and immune status of the patient. They can be very cost effective also in potentially predicting the severity of the disease [5]. Yang et al also have considered increased NLR as an independent parameter in assessing the disease severity of COVID-19 patients [9]. Another study by Jingyan Lieu et al [7] used NLR as a prognostic marker in COVID cases and did the management of the patient basing upon the NLR value. NLR < 3.13 had a mild disease course and a better outcome whereasNLR >3.13 had a moderate chance of progressing into critical illness. Hence NLR can be used in early shifting of COVID cases into the ICU and thus reduce the death rates due to COVID 19.

PLR value was increased in about 9 % of COVID cases which was found to be statistically significant.

Conclusion

The present study included the CBC parameters of around 500 COVID cases from ward as well as ICU. Increased total leucocyte count and increased Neutrophil was seen among COVID patients, the incidence being more in ICU patients than COVID ward patients. Hence Leucocytosis and Neutrophilia may be associated with disease severity. Lymphopenia and Eosinopenia was also noted remarkablyin COVID patients, being more severe in ICU patients. High NLR was also noted among COVID patients that was statistically significant. Thrombocytopenia was more marked in ICU patients.

Hence these CBC parameters can be used as an assister in predicting the severity of the disease. By doing a CBC count we can assess the severity of the disease within few hours along with other serological markers. During COVID waves with a rush for bed and ICU facilities in our thickly populated country, CBC parameters are a quick method for early prediction of disease severity. A quick assessment of CBC parameters like platelet count or NLR etc along with other serological markers can surely help in reducing the rush in ICU as well as the death rate due to the novel corona virus COVID19.

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