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Original Research Article

Prognostic Significance of Hematological Parameters and Coagulation Indices in Assessing COVID-19 Disease Severity: A Single Centre Tertiary Care Covid Hospital Study

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Abstract

Introduction: The new coronavirus that triggered the COVID-19 pandemic began to spread quickly over the world in December of 2019. When the epidemic first started, clinical attention was focused on the symptoms and epidemiology in addition to the patients' computed tomography images. A positive nucleotide amplification result would then be used to make the diagnosis.

Aims: The aims to determine the correlation of COVID-19 patients by systematically analyzing the baseline haematological characteristics and laboratory indices.

Materials and Method: This is a hospital based; observational cross-sectional study was conducted in the department of pathology Medical College Kolkata in collaboration with the department of chest medicine. The study period was one year. 382 patients were included in this study.

Result: Lymphocyte counts significantly decrease as disease severe ($p<0.0001$), while NLR shows a dramatic rise in severe cases [8.8328mean±7.1585] ($p<0.0001$). In Moderate, the mean ESR [70.2299± 30.6405] and In Severe, the mean ESR [70.8662± 30.7169], Distribution of mean ESR with Severity was statistically significant ($p=0.0001$). Mean CRP was significantly higher in severe severity [108.0000± 68.9692] than mild severity [28.1538± 25.1832] and moderate severity [77.5709± 51.0397] ($p<0.0001$). Mean Platelet shows significantly higher trends in severe cases [277459.7701± 103473.3765] than mild [232060.5634 ± 84759.5239] ($p=0.0004$).

Conclusion: In conclusion, the association shown in COVID-19 patients between hematological traits and disease severity highlight the significance of blood profile monitoring as a critical instrument for determining the prognosis of a patient. The severity of COVID-19 has been observed to substantially correlate with hematological indicators, including lymphopenia, high neutrophil-to-lymphocyte ratio (NLR), elevated ESR, CRP, increased platelets with elevated INR and D dimer levels. According to these results dynamic alterations in blood components may function as prognostic markers of the course of a disease, allowing prompt intervention and treatment techniques that enhance patient outcomes.

Keywords: COVID-19, Disease Severity, Risk Factors and Hematological Characteristics.

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Introduction

The coronavirus disease-2019 (COVID-19) was identified in Wuhan, China, in December 2019 and has a 10% fatality risk. [1]. The cause of this illness is an infection with the Severe Acute Respiratory Syndrome Coronavirus 2 (SARSCoV-2), a newly discovered zoonotic virus.[2] These enclosed positive-strand RNA coronaviruses, which are isolated from bats, may spread from one animal to another, from one person to another.[3] The disease's symptoms, which include fever, coughing, shortness of breath, and weariness, might start to show up in the first five to six days and last up to fourteen days in milder forms [4]. After that, pneumonia and dyspnea are two major symptoms that certain patients may have. These patients need to be managed in intensive care units to prevent life-threatening respiratory complications. [5] The coronavirus disease 2019 (COVID 19) pandemic caused by the novel coronavirus broke out in December of 2019 and has spread rapidly worldwide.[6] When the epidemic first started, clinical attention was focused on the symptoms and epidemiology in addition to the patients' computed tomography imaging [7]. A positive nucleotide amplification result would then be used to make the diagnosis. Later on, nevertheless, a variety of pathological impairments were discovered in numerous organs. [8] Growing data suggests that

COVID-19 has quite complicated pathophysiological alterations, including immune system hyperreaction and multi-organ damage from the viral infection. Serum and lung alveolar have been shown to contain elevated levels of cytokines and inflammatory reactive proteins, while individuals with severe illness were discovered to have lymphocytopenia and aberrant T-cell subsets. In clinical practice, the neutrophil to lymphocyte ratio has been shown to be a helpful signal in distinguishing between mild and moderate progression. On the other hand, there are no specific symptoms to diagnose COVID-19, accurate testing depends on Reverse transcription-polymerase chain reaction (RT-PCR) analysis of viral genome. COVID-19 is not limited to it's country of origin, spread all over the world, however there is no sufficient data to analyse the disease in eastern India so the aim is to determine the correlation of COVID-19 patients by systematically analyzing the baseline haematological characteristics and laboratory indices.

Materials and Methods

Study design / Experiment design: Hospital based, observational cross-sectional study.

Study setting and timelines: The study was conducted in the department of pathology Medical college Kolkata in collaboration with the department of chest medicine dedicated as COVID hospital.

Place of study: Medical College, Kolkata.

Period of study: One year.

Study Populations: Diagnosed patients with COVID-19 by RT-PCR (ICMR approved).

Sample size / design: As it is a pandemic disease, so we expect 382 cases to assess within the period of data collection fulfilling the inclusion and exclusion criteria.

Inclusion Criteria

1. Diagnosed patient with COVID 19 by real time polymerase chain reaction (ICMR approved centres)
2. Admitted to the covid ward Medical College and hospital Kolkata.
3. Admitted patient who has gone through all the laboratory tests which are included in this study.

Exclusion Criteria

1. Patients with negative COVID-19 RT-PCR test.
2. Previously critically ill patients.
3. Vaccinated individuals.
4. Foreign nationals.
5. Travellers from foreign countries within 1 month of tier 4 lockdown.
6. Patients suspected of new/ future strains of COVID-19.
7. Those who do not give consent.

Study Tools: Questionnaire, Upper respiratory throat swab samples at admission to detect the COVID-19 by RT-PCR, c-reactive protein (CRP) by immunoturbidimetry method, (PCT) by electrochemiluminescence method. Erythrocyte sedimentation rate (ESR) by Westergren's international standard method. Other Laboratory techniques for complete hemogram (Hemoglobin, Total leucocyte count, platelet count, neutrophil count, lymphocyte count, NLR), coagulation profile (prothrombin time, D- dimer), inflammatory parameters (Procalcitonin, ferritin, LDH, lL6), biochemical parameters (Aspartate amino transferase, alanine aminotransferase, total bilirubin, Albumin)

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests, which compare the means of independent or unpaired samples, were used to assess differences between groups. Paired t-tests, which account for the correlation between paired observations, offer greater power than unpaired tests. Chi- square tests (χ^2 tests) were employed to evaluate hypotheses where the sampling distribution of the test statistic follows a chi-squared distribution under the null hypothesis; Pearson's chi-squared test is often referred to simply as the chi-squared test. For comparisons of unpaired proportions, either the chi-square test or Fisher's exact test was used, depending on the context. To perform t-tests, the relevant formulae for test statistics, which either exactly follow or closely approximate a t-distribution under the null hypothesis, were applied, with specific degrees of freedom indicated for each test. P- values were determined from Student's t-distribution tables. A p-value ≤ 0.05 was considered statistically significant, leading to the rejection of the null hypothesis in favour of the alternative hypothesis.

Result

Table 1: Distribution of mean Lymphocyte count, NLR and ESR: Severity (n=382)

		Number	Mean	SD	Minimum	Maximum	Median	p-value
L	Mild	152	21.9605	8.5303	5.0000	43.0000	20.0000	<0.0001
	Moderate	142	17.0775	7.1964	5.0000	38.0000	16.0000	
	Severe	88	13.6322	7.6266	2.0000	32.0000	11.0000	
NLR	Mild	152	4.3964	2.6455	1.1860	18.6000	3.8500	<0.0001
	Moderate	142	5.8473	3.5628	1.5526	19.6000	5.0313	
	Severe	88	8.8328	7.1585	2.0938	45.5000	7.7273	
ESR	Mild	152	57.1908	26.7759	10.0000	110.0000	54.5000	
	Moderate	142	70.2299	30.6405	18.0000	130.0000	70.0000	<0.0001
	Severe	88	70.8662	30.7169	8.0000	110.0000	80.0000	

Table 2: Distribution of mean TLC, Neutrophils count and CRP: Severity (n=382)

		Number	Mean	SD	Minimum	Maximum	Median	p value
TLC	MILD	152	6287.49	2597.356	1700	15600	6000	<0.0001
	MODE RATE	142	6866.91	2737.4659	19000	151000	66500	
	SEVERE	88	9706.27	9262.7828	1300	65400	7800	
N	MILD	152	73.9737	9.227	50	93	75	<0.0001
	MODE RATE	142	78.9577	7.9251	50	98	80	
	SEVERE	88	81.8276	8.604	60	92	85	
CRP	MILD	152	28.1538	25.1832	1	136.9	25.2	<0.0001
	MODE RATE	142	77.5709	51.0397	0.38	236.1	75.5	
	SEVERE	88	108	68.9692	10.3	331.8	105.7	

Table 3: Distribution of mean PLATELET and INR: Severity (n=382)

		Number	Mean	SD	Minimum	Maximum	Median	p- value
Platelet	Mild	152	232060.56	84759.5239	100000	569000	220000	0.0004
	Moderate	142	256592.15	71597.2304	60000	450000	240000	
	Severe	88	277459.77	1034730.377	60000	480000	270000	
INR	Mild	152	1.1369	0.3152	0.9	2.08	1.2	<0.0001
	Moderate	142	1.18669	0.1443	0.89	1.66	1.22	
	Severe	88	1.519	0.2721	0.86	2.04	1.67	

In Mild, the mean L (mean± s.d.) of patients was 21.9605± 8.5303. In Moderate, the mean L (mean± s.d.) of patients was 17.0775± 7.1964. In Severe, the mean L (mean± s.d.) of patients was 13.6322± 7.6266. Distribution of mean L with Severity was statistically significant (p<0.0001). In Mild, the mean NLR (mean± s.d.) of patients was 4.3964± 2.6455. In Moderate, the mean NLR (mean± s.d.) of patients was 5.8473± 3.5628. In Severe, the mean NLR (mean± s.d.) of patients was 8.8328± 7.1585. Distribution of mean NLR with Severity was statistically significant (p<0.0001). In Mild, the mean ESR (mean± s.d.) of patients was 57.1908± 26.7759. In Moderate, the mean ESR (mean± s.d.) of patients was 70.2299± 30.6405. In Severe, the mean ESR (mean± s.d.) of patients was 70.8662± 30.7169. Distribution of mean ESR with Severity was statistically significant (p=0.0001). In Mild, the mean N (mean± s.d.) of patients was 73.9737± 9.2270. In Moderate, the mean N (mean± s.d.) of patients was 78.9577± 7.9251. In Severe, the mean N (mean± s.d.) of patients was 81.8276± 8.6040. Distribution of mean N with Severity was statistically significant (p<0.0001). In Mild, the mean TLC (mean± s.d.) of patients was 6287.4934± 2597.3056. In Moderate, the mean TLC (mean± s.d.) of patients was 6866.9014± 2737.4659. In Severe, the mean TLC (mean± s.d.) of patients was 9706.2069± 9262.7828. Distribution of mean TLC with Severity was statistically significant (p<0.0001). In Mild, the mean CRP (mean± s.d.) of patients was 28.1538± 25.1832. In Moderate, the mean CRP (mean± s.d.) of patients was 77.5709± 51.0397. In Severe, the mean CRP (mean± s.d.) of patients was 108.0000± 68.9692. Distribution of mean CRP with Severity was statistically significant (p<0.0001). In Mild, the mean Platelet (mean± s.d.) of patients was 232060.5634 ± 84759.5239. In Moderate, the mean Platelet (mean± s.d.) of patients was 256592.1053 ± 71597.230. In Severe, the mean Platelet (mean± s.d.) of patients was 277459.7701± 103473.3765. Distribution of mean Platelet with Severity was statistically significant (p=0.0004). In Mild, the mean INR (mean± s.d.) of patients was 1.13690± .3152. In Moderate, the mean INR (mean± s.d.) of patients was 1.18669±0.1443. In Severe, the mean INR (mean± s.d.) of patients was 1.51900± .2721. Distribution of mean INR with Severity was statistically significant (p<0.0001).

Discussion

In our study, mean TLC was significantly higher in severe cases [9706.2069± 9262.7828] compared to moderate [6866.9014± 2737.4659] and mild cases [6287.4934± 2597.3056](p<0.0001). We found that mean Lymphocyte count (%) was significantly lower in severe cases [13.6322± 7.6266] compared to moderate [17.0775± 7.1964] and mild cases [21.9605±8.5303] (p<0.0001).

We observed that mean Neutrophill count (%) was significantly higher in severe cases [81.8276± 8.6040] compared to moderate [78.9577±7.9251] and mild cases [73.9737±9.2270] (p<0.0001).

Pujani M et al [14] (2021) examined that COVID-19 is a systemic viral infection with a significant impact on the hematopoietic system, hemostasis as well as immune system. There were statistically significant differences in neutrophil-lymphocyte ratio (NLR) covid cases vs controls. among the clinical subgroups and among the survivors and non-survivors. There was a significant strong positive correlation between various parameters, that is, NLR and MLR (r: 0.852, P=0), NLR (AUC: 0.676, P=0) was the best single parameter.

Taj S et al [15] (2021) examined that COVID-19 virus involves respiratory as well as other body systems including cardiovascular, gastrointestinal, neurological, immunological and hematopoietic system. Median (IQR) values of NLR (p-value 0.001) were significantly increased in patients with critical disease.

Leulseged TW et al [18] (2021) found that to identify laboratory biomarkers that predict disease severity and outcome among COVID-19 patients admitted to the Millennium COVID-19 Care Center in Ethiopia. Neutrophil to Lymphocyte ratio (NLR) (ARR = 4.769, 95%CI = 2.419–9.402 p-value <0.0001), Assessing and monitoring the laboratory markers of NLR at the earliest stage of the disease could have a considerable role in halting disease progression and death.

We showed that mean NLR was significantly higher in severe cases [8.8328± 7.1585] compared to moderate [5.8473± 3.5628] and mild cases [5.8473± 3.5628] (p<0.0001).

Israfil SM et al [16] (2021) examined that clinical characteristics are essential for the correct diagnosis of diseases. The prominent laboratory findings were ESR 72.99. Our study showed that, mean ESR was significantly higher in severe severity [70.8662±30.7169] compared to moderate severity [70.2299± 30.6405] and mild severity [57.1908±26.7759] (p<0.0001).

Taj S et al [15] (2021) examined that COVID-19 virus involves respiratory as well as other body systems including cardiovascular, gastrointestinal, neurological, immunological and hematopoietic system. Median (IQR) values of CRP (p- value 0.0001) were suggestively higher in patients with severe disease. The study concluded that CRP are associated with severity of covid-19 disease.

We found that, mean CRP was significantly higher in severe severity [108.0000± 68.9692] compared to moderate severity [77.5709± 51.0397] and mild severity [28.1538± 25.1832] and statistically significant. (p<0.0001).

Li Q et al [20] (2020) found that we studied admission and dynamic demographic, hematological and biochemical co-variates in 1449 hospitalized subjects with coronavirus infectious disease-2019 (COVID-19) in five hospitals in Wuhan, Hubei province, China. They also found dynamic changes in platelets (OR = 0.95 [0.90–0.99]; P = 0.029), The potential risk factors of platelets could help clinicians to identify and treat subjects with poor prognosis.

Our study showed that, mean Platelet was significantly higher in severe severity [277459.7701± 103473.3765] compared to mild severity [232060.5634± 84759.5239] and moderate severity [256592.1053± 71597.230] (p=0.0004).

We showed that, mean INR was significantly slightly higher in severe severity [1.5190±.3152] compared to mild severity [1.13690± .2721] and moderate severity [1.18669± .1443] (p<0.0001).

Conclusion

In conclusion, this study has shown significant association between hematological traits and disease severity highlights the significance of blood profile monitoring as a critical instrument for determining the prognosis of a patient. The severity of COVID-19 has been observed to substantially correlate with lymphopenia, high neutrophil-to-lymphocyte ratio (NLR), elevated ESR and CRP.

While literature shows thrombocytopenia as a marker of disease severity but in our study exhibits statistically significant upward trend in mean platelet count in moderate to severe patients. We hypothes that this reflects a reactive thrombocytosis driven by immune system during inflammation which is evidenced by increased CRP and ESR. Furthermore, we observed prolongation of INR suggest an early-stage disruption of coagulation cascade, together these markers indicate a state of hyper inflammatory coagulopathy while there is bone marrow compensatory megakaryopoeisis.

Reference

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020;395(10223):497–506.
2. Rodiguez-Morales AJ, Cardona-Ospina JA,

Gutieffez-Ocampo E, Villamizar-Pefla R, Holguin- Rivera Y,et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. Travel medicine and infectious disease. 2020 Mar 13:101623.
3. Rodriguez-Morales AJ, Bonilla-Aldana DK, Balbin-Ramon GJ, Rabaan AA, Sah R, Paniz-MondofiA,et al. History is repeating itself:.Probable zoonotic spillove. as the cause of the 2019 novel Coronavirus Epidemic. lnfez Med. 2020 Mar 1;28(1):3-5.
4. Chen T, Wu D, Chen H, Ya. W Yang D, Chen G, Ma K, Xu D, Yu H, Wang H, Wang T. Clinical characteristics of '113 deceased patients with coronavirus disease 2019t retrospective study- Bmj. 2020 [4ar26;368.
5. Udugama B, Kadhiresan P, Kozlowski HN, LlalekjahaniA, Osborne M, Lr VY, Chen H, Mubareka S, Gubbay J, Chan WC. Diagnosing COVID"19: The Disease and Tools for Detection ACS Nano.
6. Ackermann M, Verleden SE, Kuehnel M, et al. Pulmonary vascular endothelialitis, thrombosis, and angiogenesis in Covid 19. N Engl J Med. 2020;383(2):120 128.
7. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395:507 513.
8. Mehta P, McAuley DF, Brown M, Sanchez E, Tattersall RS, Manson JJ. COVID 19: consider cytokine storm syndromes and immunosuppression. Lancet. 2020;395:1033 1034.
9. Duman TT, Aktas G, Atak BM, Kocak MZ, Erkus E, Savli H. Neutrophil to lymphocyte ratio as an indicator of diabetic control level in type 2 diabetes mellitus. African Health Sci. 2019;19:1602 1606.
10. Pagano L, Salmanton-García J, Marchesi F, Corradini P, Hoenigl M, Klimko N, et al. COVID-19 infection in adult patients with hematological malignancies: a European Hematology Association Survey (EPICOVIDEHA). Journal of hematology & oncology. 2021 Dec;14(1):1-5.
11. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet. 2020;395(10223):507. doi: 10.1016/s0140-6736(20)30211- 7.
12. Algahtani FD, Elabbasy MT, Alshammari F, Atta A, El-Fateh AM, Ghoniem ME. Evolving Risk of Acute Kidney Injury in COVID-19 Hospitalized Patients: A Single Center Retrospective Study. Medicina. 2022 Mar 18;58(3):443.
13. Cai Q, Huang D, Ou P, Yu H, Zhu Z, Xia Z, et al. COVID 19 in a designated infectious diseases hospital outside Hubei Province, China. Allergy. 2020 Jul;75(7):1742-52.
14. Pujani M, Raychaudhuri S, Verma N, Kaur H, Agarwal S, Singh M, et al. Association of Hematologic biomarkers and their combinations with disease severity and mortality in COVID-19- an Indian perspective. American journal of blood research. 2021;11(2):180.
15. De-Madaria E, Siau K, Cárdenas-Jaén K. Increased amylase and lipase in patients with COVID-19 pneumonia: Don t blame the pancreas just yet! 2020.
16. Varghese GM, John R, Manesh A, Karthik R, Abraham OC. Clinical management of COVID-19. The Indian journal of medical research. 2020 May;151(5):401.
17. Xie Y, Wang Z, Liao H, Marley G, Wu D, Tang W,et al. Epidemiologic, clinical, and laboratory findings of the COVID-19 in the current pandemic: systematic review and meta-analysis. BMC infectious diseases. 2020 Dec;20(1):1-2.
18. Leulseged TW, Hassen IS, AyeleBT, Tsegay YG, Abebe DS, Edo MG, et al. Laboratory biomarkers of COVID-19 disease severity and outcome: Findings from a developing country. PloS one. 2021 Mar 15;16(3):e0246087.
19. Qiu P, Zhou Y, Wang F, Wang H, Zhang M, Pan X, et al. Clinical characteristics, laboratory outcome characteristics, comorbidities, and complications of related COVID-19 deceased: a systematic review and meta-analysis. Aging clinical and experimental research. 2020 Sep;32(9):1869-78.
20. Li Q, Cao Y, Chen L, Wu D, Yu J, Wang H, et al. Hematological features of persons with COVID-19. Leukemia. 2020 Aug;34(8):2163-72.