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"STUDY OF VARIATION OF ACUTE PHASE REACTANTS IN PATIENTS WITH SARS COVID-19 INFECTION"

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ABSTRACT:

Background: Research on COVID-19 acute phase reactants is still important today since it helps with early diagnosis, determining the severity of the illness, and assessing the efficacy of treatment. Critical information about the course and prognosis of the disease can be gained by analyzing the inflammatory response using acute phase reactants such as serum amyloid Acute phase proteins and C-reactive protein. Severe outcomes in COVID-19 individuals have been associated with higher acute phase reactants, lymphopenia, and neutrophil counts. By keeping an eye on these indicators, medical staff can enhance patient care, more efficiently use resources, and possibly even identify patients who are more likely to experience difficulties. All of these things can lead to better clinical outcomes and public health initiatives.

Method: The study analyzed data from 200 hospitalized COVID-19 patients at an academictertiary care hospital between August 2020 and June 2022. It focused on investigating various blood parameters, including C-reactive protein, ferritin, lactate dehydrogenase, erythrocyte sedimentation rate (ESR), procalcitonin, and albumin. Inclusion criteria comprised patients with positive COVID-19 RT-PCR results and complete lab records, while exclusion criteria included negative RT-PCR results, incomplete records, hospital stays less than one week, and patient transfers.

Result: In our study of 200 hospitalized COVID-19 patients, C-reactive protein (CRP)levels were

elevated in 179 (89.5%) patients, with 147 (90.74%) in wards and 32 (84.21%) in ICU. Procalcitonin levels were elevated in 51 (51.51%) patients overall, with 29 (40.85%) in wards and 22 (78.57%) in ICU. Ferritin levels were elevated in 94 (46.5%)

patients, with 65 (40.12%) in wards and 28 (73.69%) in ICU. Elevated lactate dehydrogenase (LDH) was found in 110 (55%) patients, with 83 (51.23%) in wards and 27 (71.05%) in ICU. Erythrocyte sedimentation rate (ESR) was high in 128 (64%) patients, with 102 (62.96%) in wards and 26 (68.42%) in ICU. Decreased albumin levels were observed in 44 patients, with 24 (14.82%) in wards and 20 (52.63%) in ICU.

Conclusion: Acute phase reactants like CRP, procalcitonin, ferritin, LDH, ESR, and albumin significantly influence COVID-19 progression, severity, and prognosis. Elevated CRP, procalcitonin, ferritin, LDH, ESR, and decreased albumin levels are strongly linked to disease severity and mortality. ICU patients exhibit more pronounced alterations in these markers compared to ward patients, aiding in severity prediction. Increased alterations in acute phase reactants are observed in deceased patients versus recovered ones, facilitating progression and prognosis prediction. Testing for these markers upon hospital admission in suspected or confirmed COVID-19 cases offers valuable prognostic insights. Utilizing acute phase reactants as predictive measures can enhance clinical management in COVID-19 patients.

Keywords: COVID 19; Acute phase reactants; ICU; C Reactive Protein; Ferritin; Procalcitonin; LDH; ESR

INTRODUCTION:

In December 2019, the city of Wuhan in China became the epicenter of an alarming health crisis when cases of pneumonia of unknown origin emerged.[1] Initially baffling, medical authorities swiftly identified the culprit in January 2020 as a highly contagious coronavirus, closely related to the severe acute respiratory syndrome coronavirus and the Middle East respiratory syndrome coronavirus.[2] Designated by the International Committeeon Taxonomy of Viruses as severe acute respiratory syndrome coronavirus 2 (SARS-CoV- 2), the World Health Organization (WHO) christened the disease caused by it as coronavirusdisease 2019 (COVID-19), promptly declaring it a public health emergency of international concern.[1]

SARS-CoV-2 spreads efficiently through various means, including respiratory droplets, aerosols, and contaminated surfaces, leading to a wide array of symptoms ranging from mild respiratory distress to severe pneumonia, acute respiratory distress syndrome (ARDS), multi-organ failure, and even death. The virus primarily targets the respiratory system, infiltrating cells by binding to angiotensin-converting enzyme 2 (ACE2) receptors, thereby disrupting their regulatory functions and inducing tissue damage, particularly in the lungs and heart.

The real-time reverse transcription polymerase chain reaction (RT-PCR) test is utilized to qualitatively identify SARS-CoV-2 nucleic acid in respiratory samples from both the upper and lower respiratory tract. This test serves as a definitive diagnostic tool for confirming the presence of COVID-19. Additionally, the human immune system is crucial in defending against harmful microorganisms, with the effectiveness of this defense system significantly impacting disease outcomes and prognosis. [3]

Understanding the immune response to SARS-CoV-2 is crucial in combating the disease. The acute phase response, a complex physiological reaction triggered by tissue injury, involves the release of cytokines such as interleukin-1, interleukin-6, tumor necrosis factor α, interferon-γ, and transforming growth factor β, which in turn prompt the liver to produce acute phase proteins. Among these proteins, C-reactive protein and serum amyloid A protein are pivotal markers of inflammation and disease severity in COVID-19 patients.

OBSERVATIONS AND RESULTS:

In the present study, 200 patients were evaluated for serum acute phase reactants over a period of 22 months.

Out of a total of 200 patients, 132(66%) were male patients and 68(34%) were female patients. Twenty nine (14.5%) patients are hypertensive and 46(23%) patients are diabetic.

These 200 patients range in age from 1 to 95 years old. Their age-wise distribution of these total patients is given in Table no.1

Table 1: Age group-wise distribution of patients

Age group	Number of Patients	% of Total Patients
18 to 35 years	26	13%
36 to 50 years	24	12%
51 to 65 years	80	40%
66 years above	70	35%
Total	**200**	**100%**

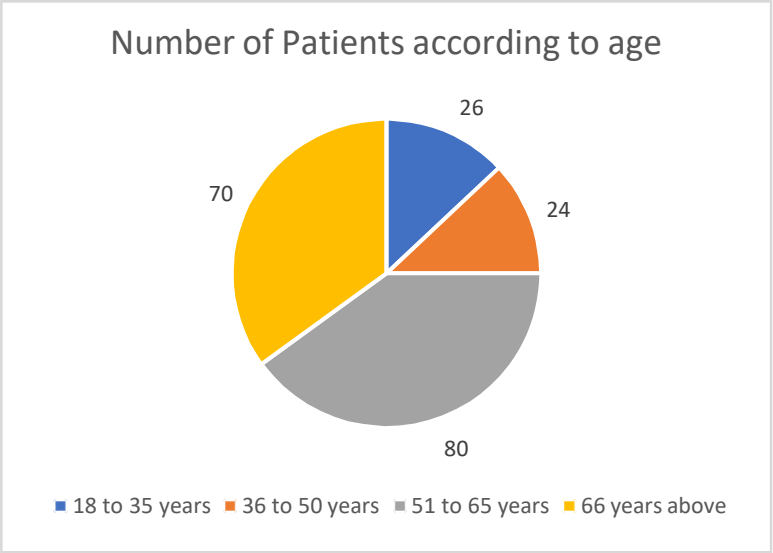

Figure 1: Number of patients according to age

The age group of 51 to 65 years had the highest number of patients, followedby the age group of age above 66 years, the age group of 18 to 35 years and the age group of 36 to 50 years had the lowest number of patients.

All the patients were studied for C-reactive protein (CRP), procalcitonin, lactate dehydrogenase (LDH), ESR, ferritin and albumin.

1) C- reactive protein

The CRP level was normal in 33(16.5%) patients and elevated in 167(83.5%) patients out of 200(100%) patients.

Patients in the 51 to 65-years-old age group had the highest percentage of patients with elevated CRP level (90%), followed by the 18 to 35 years age group (84.62%), the 66- plus age group(78.57%), and lastly, the 36 to 50 years age group(75%).

Table 2 : Age group wise result of CRP

Age group	Mean	Normal CRP	Elevated CRP	Total
18 to 35 years	23.37	4(15.38%)	22(84.62%)	26
36 to 50 years	40.63	6(25%)	18(75%)	24
51 to 65 years	33.26	8(10%)	72(90%)	80
66 years above	238.04	15(21.43%)	55(78.57%)	70
Total		33(16.5%)	167(83.5%)	200

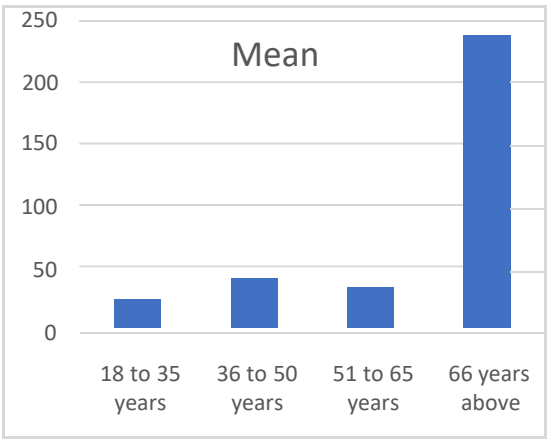

Figure 2: Age group wise mean of CRP

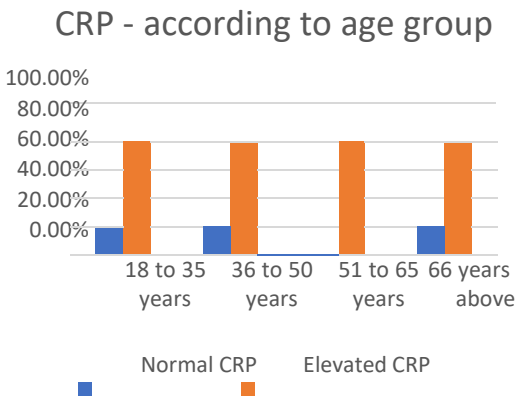

Figure 3: Age group wise CRP

Out of 132 males,elevated CRP level.

12 (9.09%) had normal CRP and 120(90.91%) had an

Nine (13.2%) of the 68 females had normal CRP levels, while 59(86.8%) had elevated CRP levels.

Table 3 : Gender wise result of CRP

Group	Patients number	Mean CRP (mg/dl)	Number and % of patients with normal CRP level	Number and % of patients with elevated CRP level
Total patient	200	34.51	21(10.5%)	179(89.5%)
Male	132(66%)	35.59	12(9.09%)	120(90.91%)
Female	68(34%)	32.42	9(13.2%)	59(86.8%)

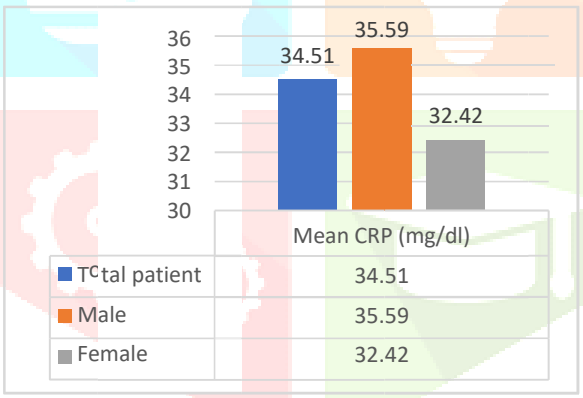

Figure 4 : Gender wise mean of CRP

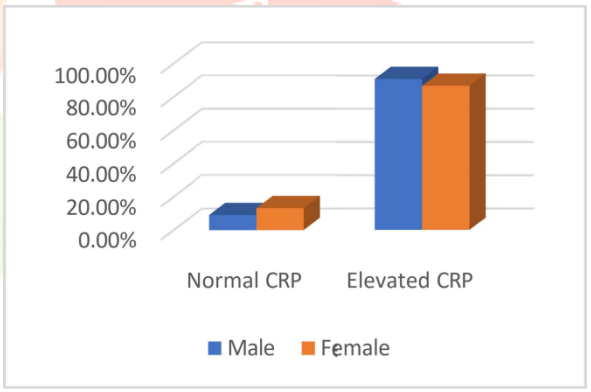

Figure 5: Gender wise result of CRP

In our study, 162 (81%) of the 200 patients were admitted to the ward, while 38(19%) were in ICU. ICU Patients had higher CRP levels than ward patients. In the ICU patients, 2 patients (5.26%) had a normal CRP level and 36 (94.74%) had an elevated CRP level, whereas 15 patients (9.26% of the total) had a normal CRP level and 147 (90.74%) had an elevated CRP level in ward patients. Statistically significant difference is seen between ICU and ward patient's CRP levels (p value< 0.014).

Table 4: Hospital stay type wise result of CRP

Group	Patients number	Mean CRP (mg/dl)	Number and % of patients with normal CRP level	Number and % of patients with elevated CRP level
Total patient	200	34.51	21(10.5%)	179(89.5%)
ward	162(81%)	32.56	15(9.26%)	147(90.74%)
ICU	38(19%)	130.92	6(21.42%)	32(84.21%)

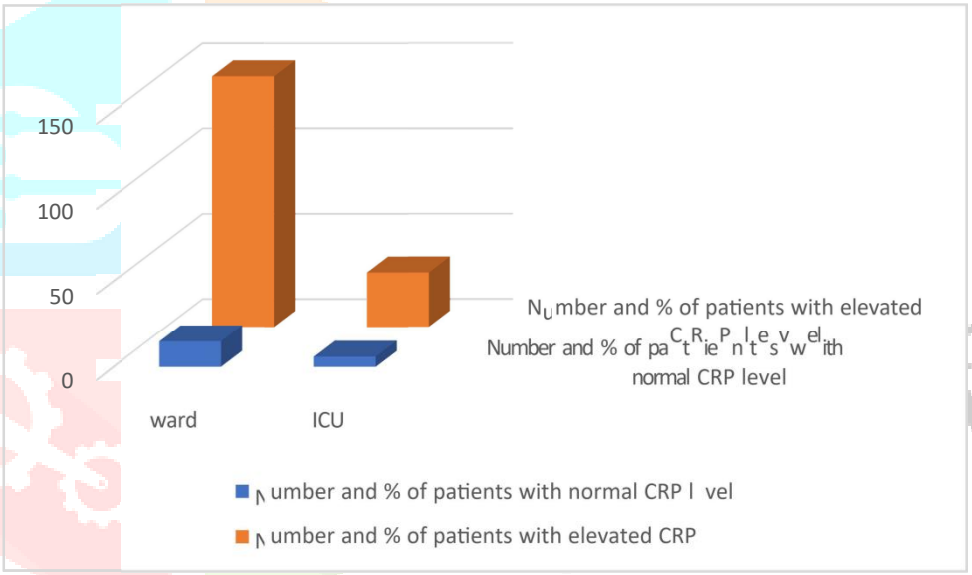

Figure 6: Hospital stay type wise result of CRP

Table 5 : prognosis wise result of CRP

Group	Patients number	Mean CRP (mg/dl)	Number and % of patients with normal CRP level	Number and % of patients with elevated CRP level
Total patient	200	34.51	21(10.5%)	179(89.5%)
Survivor	156(78%)	34.42	19(12.18%)	137(87.82%)
Non-survivor	44(22%)	133.02	2(4.54%)	42(95.56%)

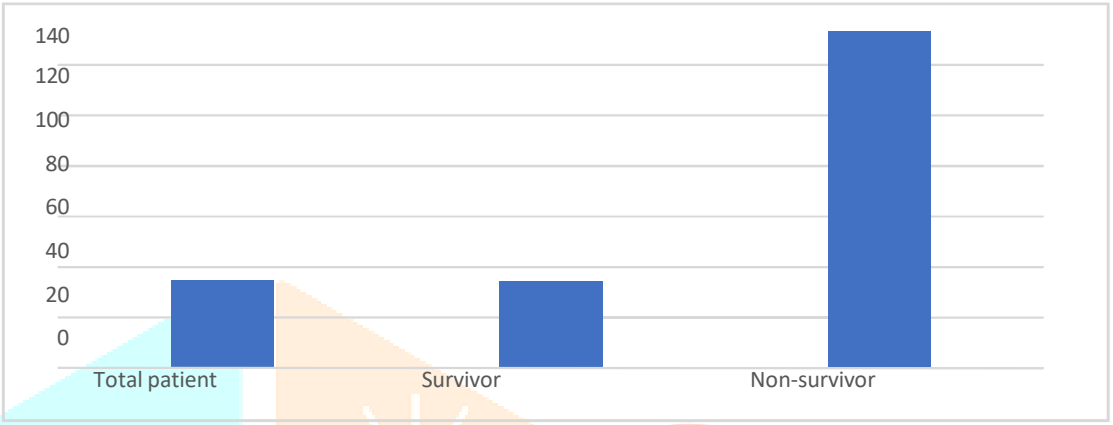

Figure 7: Prognosis wise mean of CRP

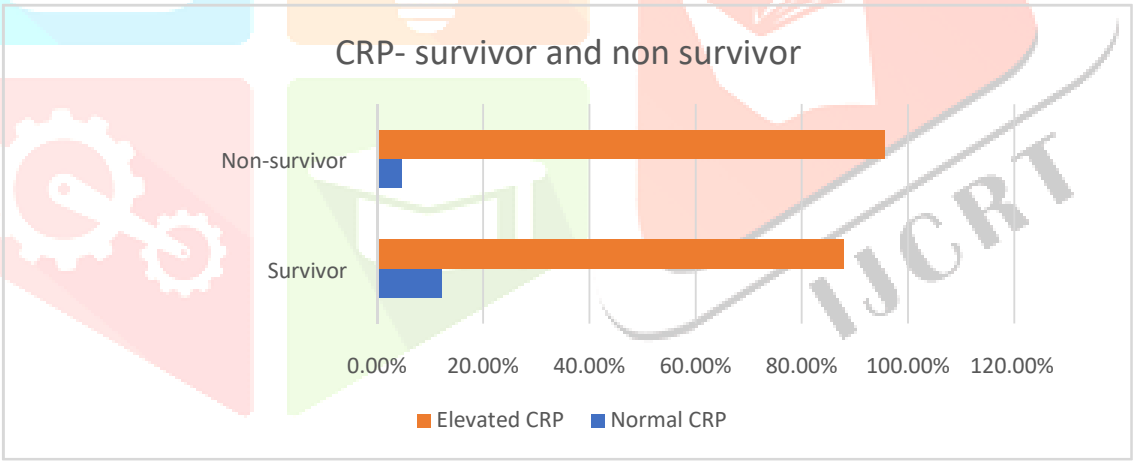

Figure 8: Prognosis wise result of CRP

19 (12.18%) of the 156 Survivor patients had normal CRP levels, while 137 (87.82%) had high CRP levels. Two patients (5.26%) had normal CRP levels, while 36 (94.74%) of the non-survivor patients had increased levels.

2) Procalcitonin

Out of 200 patients, 99 were tested for procalcitonin levels. Procalcitonin levelswere

normal in 48(48.48%) patients but elevated in 51 (51.52%).

Table 6: Age group wise result of procalcitonin

Age group	Mean	Normal procalcitonin	Elevated procalcitonin	Total
18 to 35 years	0.25	04(44.44%)	05(55.56%)	09
36 to 50 years	0.087	06(75%)	02(25%)	08
51 to 65 years	0.36	20(52.63%)	18(47.37%)	38
66 years above	0.69	20(45.45%)	24(54.55%)	44
Total		50(50.51%)	49(49.49%)	99

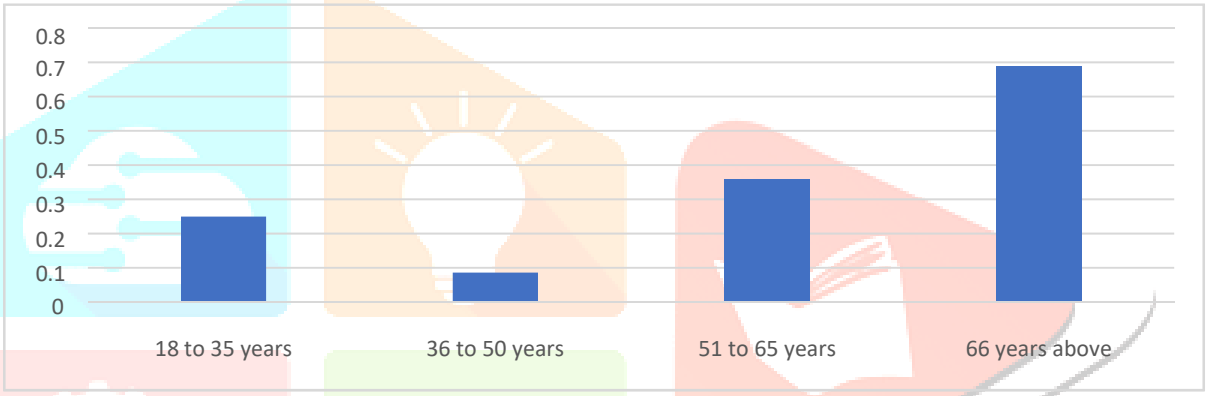

Figure 9: Age group wise mean of procalcitonin

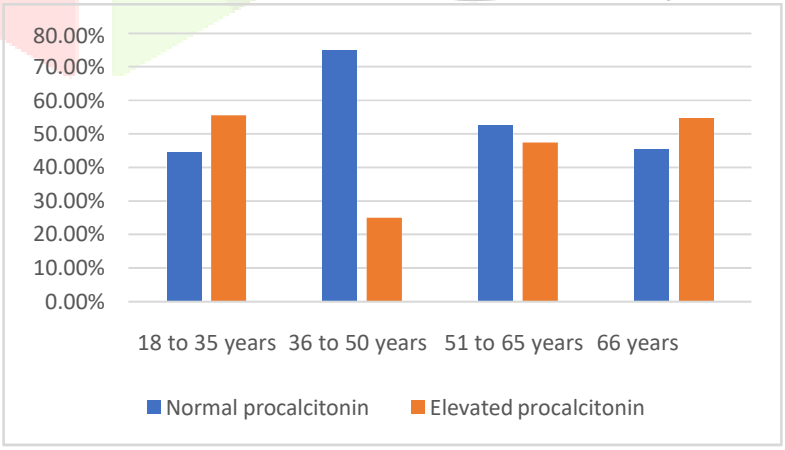

Figure 10: Age group wise result of procalcitonin

Patients in the 18 to 35 year age group had the highest percentage of patients with elevated procalcitonin level (55.56%), followed by the 66 and older age group(54.55%), the

51 to 65 year age group(47.37%) and lastly in 36 to 50 year age group(25%).

Table 7: Gender wise result of procalcitonin

Group	Patients number	Mean procalcitonin	Number and % of patients with normal procalcitonin level	Number and % of patients with elevated procalcitonin level
Total patient	99	0.48	48(48.48%)	51(51.52%)
Male	63(63.64%)	0.45	28(44.44%)	35(55.56%)
Female	36(36.36%)	0.51	20(55.56%)	16(44.44%)

Out of 63 males, 28(44.44%) had a normal procalcitonin level, and 35(55.56%)had an elevated procalcitonin level.

Twenty (55.56%) of the 36 females had normal procalcitonin level, while16(44.44%) had an elevated procalcitonin level.

Table 8: Hospital stay type wise result of procalcitonin

Group	Patients number	Mean procalcitonin	Number and % of patients with normal procalcitonin level	Number and % of patients with elevated procalcitonin level
Total patient	99	0.48	48(48.48%)	51(51.52%)
ward	71(71.72%)	0.41	42(59.15%)	29(40.85%)
ICU	28(28.28%)	0.64	6(21.42%)	22(78.57%)

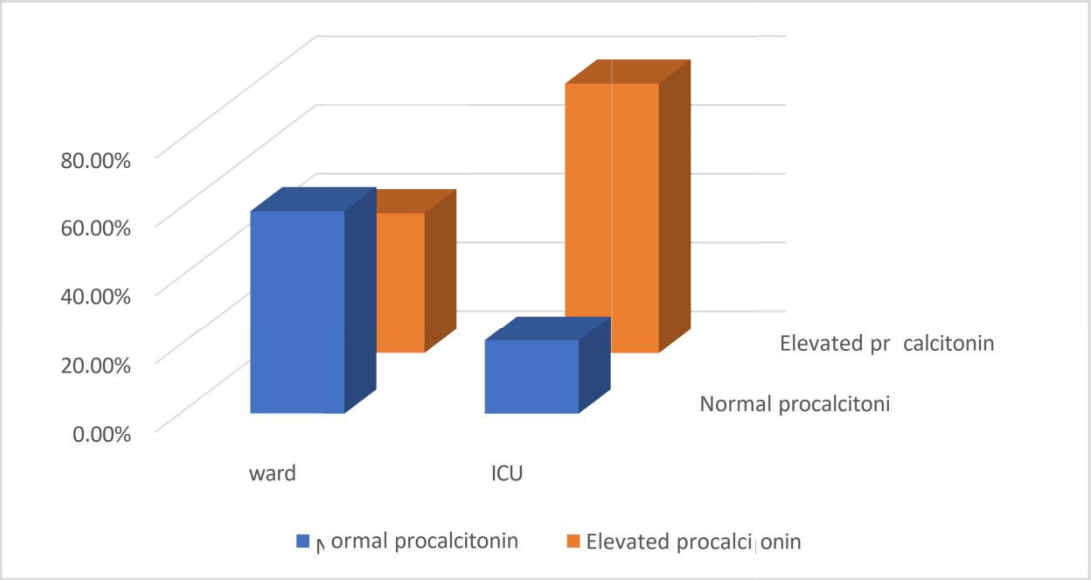

Figure 11: Hospital stay wise result of procalcitonin

ICU patients had a higher prolactin level than ward patients. Out of 71 ward patients, 42(59.15%) had normal procalcitonin level and 29(40.85%) had an elevated procalcitonin level, whereas 6(21.42%) patients had a normal procalcitonin level and 22(78.57%) had an elevated procalcitonin level in ICU patients.

Table 9: Prognosis wise result of procalcitonin

Group	Patients number	Mean procalcitonin	Number and % of patients with normal procalcitonin level	Number and % of patients with elevated procalcitonin level
Total patient	99	0.48	48(48.48%)	51(51.52%)
Survivor	62(62.63%)	0.18	42(67.74%)	20(32.26%)
Non-survivor	37(37.37%)	1.08	6(16.22%)	31(83.78%)

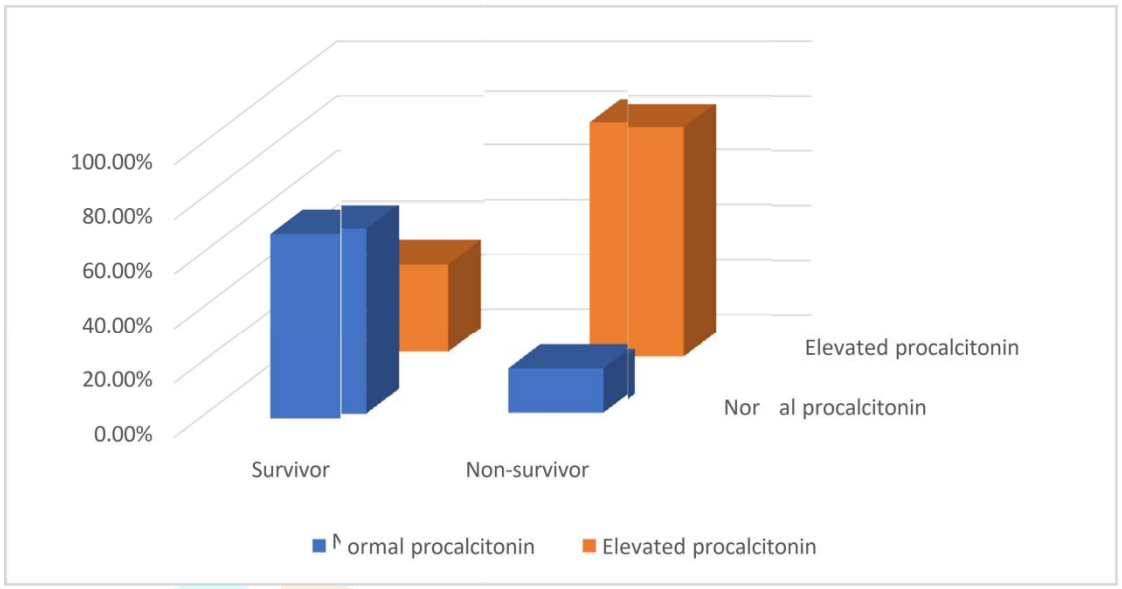

Figure 12 : Prognosis wise result of procalcitonin

42 (67.74%) of the 62 Survivor patients had normal procalcitonin levels, while 20 (32.26%) had high procalcitonin levels. Six patients (16.22%) had normal procalcitonin levels, while 31 (83.78%) of th non-survivor patients had increased levels.

3) Ferritin:

The ferritin level was normal in 107(53.5%) patients and elevated in 93(45%) patients out of 200(100%) patients.

Patients in the 66 years and older age group had the highest percentage of patient with high ferritin levels (55.71%), followed by the 51 to 65 year age group (55%), the 36 to 50 year age group (29.17%), and lastly the 18 to 35 years age group (11.54%).

Table 10: Age group wise result of ferritin

Age group	Mean	Normal level of ferritin	Elevated level of ferritin	Total
18 to 35 years	153.92	23(88.46%)	03(11.54%)	26
36 to 50 years	263.09	17(70.83%)	07(29.17%)	24
51 to 65 years	451.89	36(45%)	44(55%)	80
66 years above	799.96	31(44.29%)	39(55.71%)	70
Total		**107(53.5%)**	**93(45%)**	**200**

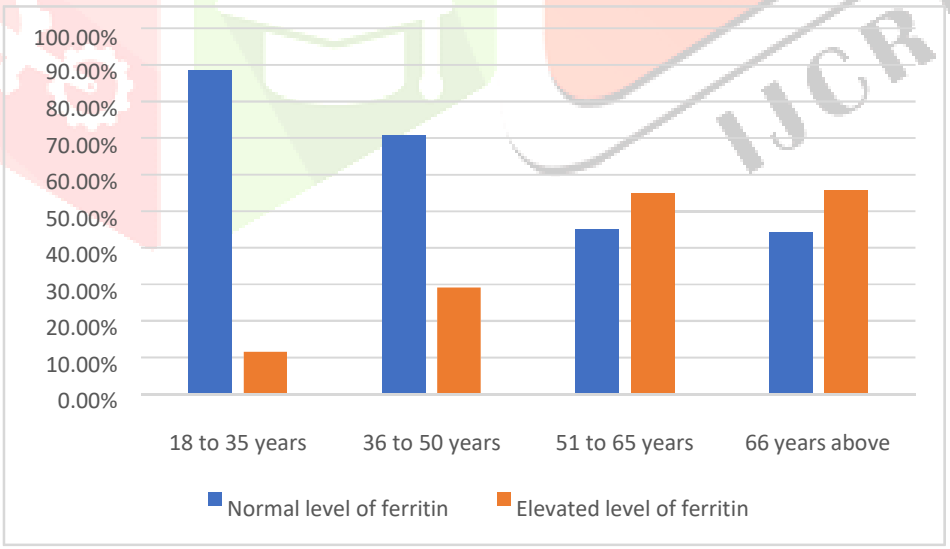

Figure 13: Age group wise result of ferritin

Table 11: Gender wise result of ferritin

Group	Patients number	Mean	Number and % of patients with normal level of ferritin	Number and % of patients with elevated level of ferritin
Total patient	200	512.19	107(53.5%)	93(46.5%)
Male	132(66%)	483.76	66(50%)	66(50%)
Female	68(34%)	567.37	41(60.3%)	27(39.7%)

Out of 132 males, 66(50%) have normal ferritin and 66(50%) have an elevated ferritin level.

Forty-one (60.3%) of the 68 females had normal ferritin levels, while 27(39.7%) had elevated ferritin levels.

Table 12: Hospital stay type wise result of ferritin

Group	Patients number	Mean	Number and % of patients with normal level of ferritin	Number and % of patients with elevated level of ferritin
Total patient	200	512.19	107(53.5%)	93(46.5%)
Ward	162(81%)	351.07	97(59.88%)	65(40.12%)
ICU	38(19%)	1199.07	10(26.31%)	28(73.69%)

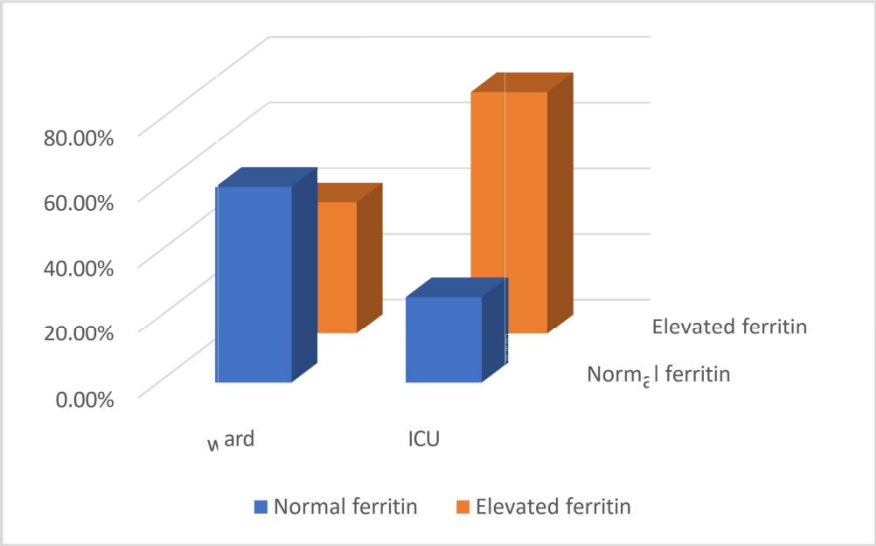

Figure 14: Hospital stay type wise result of ferritin

In our study, ICU patients had higher ferritin levels than ward patients. In the group of ward patients, 97 patients (59.88%) had a normal ferritin level and65(40.12%) had an elevated ferritin level, whereas 10 patients (26.31%) had a normal ferritin level and 28(73.69%) had an elevated ferritin level in ICU patients.

Table 13: Prognosis wise result of ferritin

Group	Patients number	Mean	Number and % of patients with normal level of ferritin	Number and % of patients with elevated level of ferritin
Total patient	200	512.19	107(53.5%)	93(46.5%)
Survivor	156(78%)	260.55	100(64.1%)	56(35.9%)
Non-survivor	44(22%)	1224.7	07(15.91%)	37(84.09%)

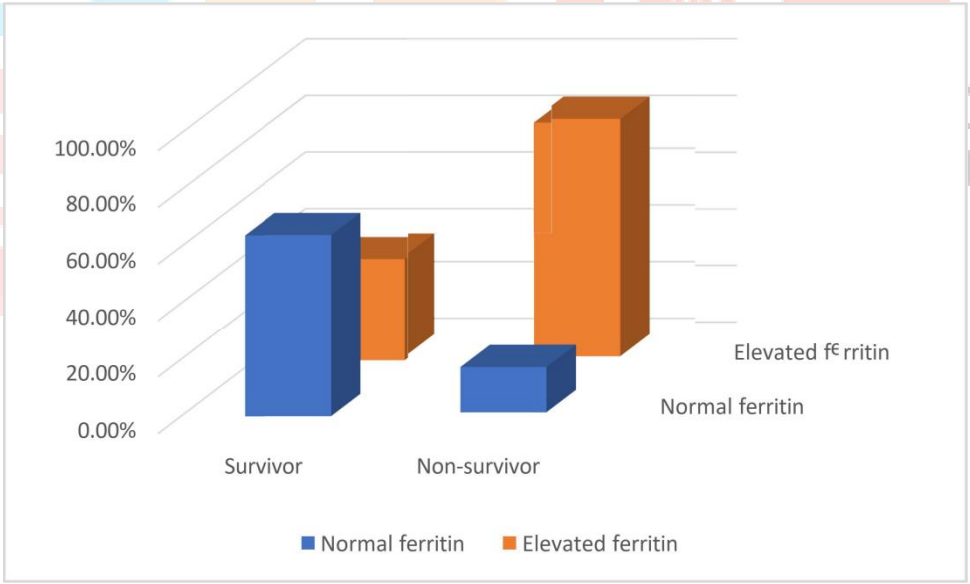

Figure 15: Prognosis wise result of ferritin

100(64.1%) of the 156 Survivor patients had normal ferritin levels, while 56 (35.9%) had increased ferritin levels. Seven (15.91%) had normal ferritin levels, while37(84.09%) of the non-survivor patients had increased levels.

4) Lactate dehydrogenase (LDH):

The LDH level was normal in 90(45%) patients and elevated in 110(55%) patients out of 200(100%) patients.

Patients in the 66 years and older age group had the highest percentage of patient with an elevated LDH level (65.71%), followed by the 51to 65 year age group (52.5%%), the 18 to 35 year age group (50%%), and lastly in 36 to 50 year age group (37.5%).

Table 14: Prognosis wise result of ferritin

Age group	Mean	Normal level of LDH	Elevated level of LDH	Total
18 to 35 years	299.35	13(50%)	13(50%)	26
36 to 50 years	332.54	15(62.5%)	09(37.5%)	24
51 to 65 years	314.74	38(47.5%)	42(52.5%)	80
66 years above	374.44	24(34.29%)	46(65.71%)	70
Total		**90(45%)**	**110(55%)**	**200**

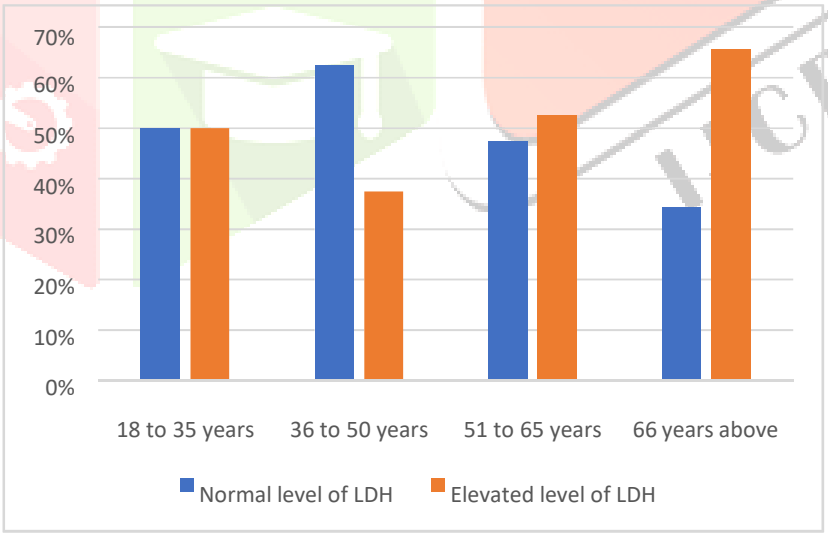

Figure 16: Prognosis wise result of ferritin

Table 15: Gender wise result of DH

Group	Number of patients	Mean	Number and % of patients with normal level of LDH	Number and % of patients with elevated level of LDH
Total patient	200	335.77	90(45%)	110(55%)
Male	132(66%)	331.21	57(43.18%)	75(56.82%)
Female	68(34%)	344.61	33(48.52%)	35(51.48%)

Table 16: Hospital stay type wise result of LDH

Group	Number of patients	Mean	Number and % of patients with normal level of LDH	Number and % of patients with elevated level of LDH
Total patient	200	335.77	90(45%)	110(55%)
Ward	162(81%)	300.12	79(48.77%)	83(51.23%)
ICU	38(19%)	487.73	11(28.95%)	27(71.05%)

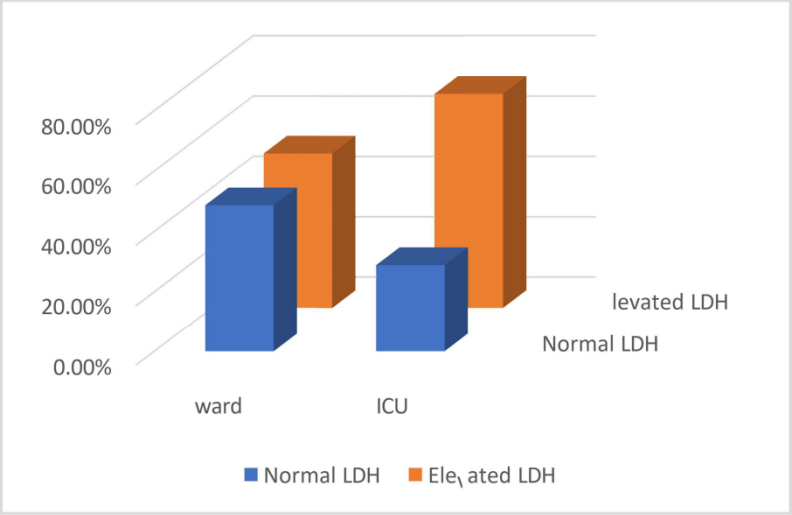

Figure 17: Hospital stay type wise result of LDH

In our study, ICU patients had higher LDH levels than ward patients. In thegroup of ward patients, 79(48.77%) had a normal LDH level and 83(51.23%) had an elevated LDH level, whereas 11 patients (28.95%) had a normal LDH level and 27(71.05%) had an elevated LDH level in ICU patients.

Table 17: Prognosis wise result of LDH

Group	Number of patients	Mean	Number and % of patients with normal level of LDH	Number and % of patients with elevated level of LDH
Total patient	200	335.77	90(45%)	110(55%)
Survivor	156(78%)	280.14	82(52.56%)	74(47.44%)
Non-survivor	44(22%)	532.29	08(18.18%)	36(81.82%)

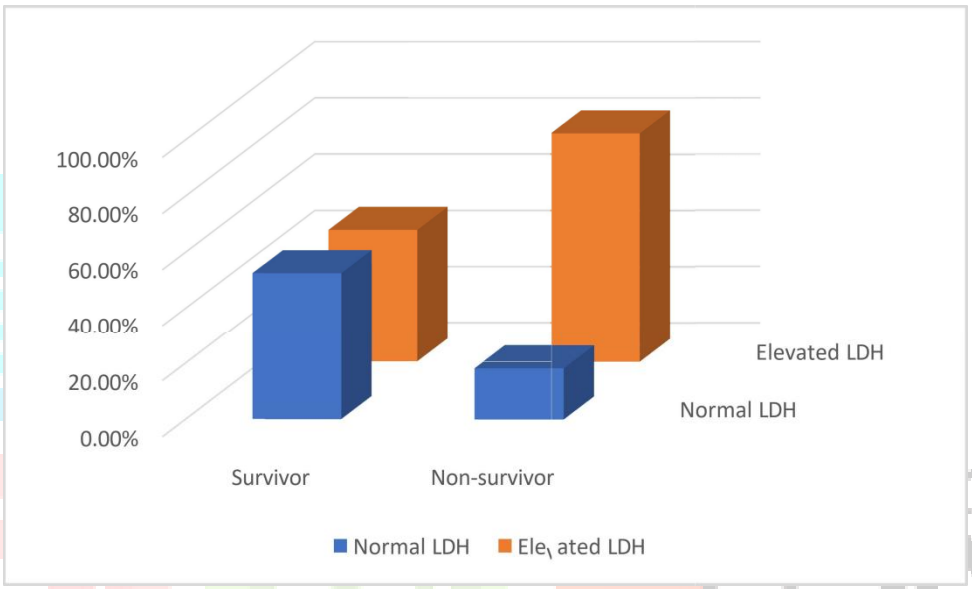

Figure 18: Prognosis wise result of LDH

82 (52.56%) of the 156 Survivor patients had normal LDH levels, while 74 (47.44%) had high LDH levels. Eight (18.18%) had normal LDH levels, while 36 (81.82%) of the non-survivor patients had increased levels.

5) Erythrocyte sedimentation rate (ESR):

The ESR was normal in 72 (36%) patients and elevated in 128 (64%) patientsout of 200 (100%) patients.

Table 18: Hospital stay wise result of ESR

Group	Number of patients	Mean	Number and % of patients with normal ESR	Number and % of patients with elevated ESR
Total patient	200	37.24	72(36%)	128(64%)
Ward	162(81%)	34.90	60(37.04%)	102(62.96%)
ICU	38(19%)	47.19	12(31.58%)	26(68.42%)

In our study, ICU patients had a higher ESR than ward patients. In the group of ward patients, 66 (40.74%) had a normal ESR and 96 (59.26%) had an elevated ESR, whereas 11 patients (28.95%) had a normal ESR and 27 (71.05%) had an elevated ESR in ICU patients.

Table 19: Prognosis wise result of ESR

Group	Number of patient	Mean	Number and % of patients with normal ESR	Number and % of patients with elevated ESR
Total patient	200	37.24	72(36%)	128(64%)
Survivor	156(78%)	34.13	60(38.46%)	96(61.54%)
Non-survivor	44(22%)	48.24	12(27.27%)	32(72.73%)

60 (38.46%) of the 156 Survivor patients had normal ESR, while 96 (61.54%) hadhigh ESR. Twelve (27.27%) had normal ESR, while 32 (72.73%) of the non-survivor patients had increased levels.

6) Albumin:

The albumin level was normal in 150 (75%) patients and decreased in 44 (22%) patients out of 200 (100%) patients.

Patients in the 66 years and older age group had the highest decreased in albumin levels (34.29%), followed by the 51to 65 year age group (18.75%), the 36 to 50 year age group (16.67%), and lastly the 18 to 35 year age group(3.85%).

Table 20 : Age group wise result of albumin

Age group	Mean	Normal level of Albumin	Decreased level of Albumin	Increased level of albumin	Total
18 to 35 years	4.16	23(88.46%)	01(3.85%)	02(7.69%)	26
36 to 50 years	4.15	18(75%)	04(16.67%)	02(8.33%)	24
51 to 65 years	3.84	63(78.75%)	15(18.75%)	02(2.50)	80
66 years above	3.37	46(65.71%)	24(34.29%)	00	70
Total		150(75%)	44(22%)	06(3.0%)	200

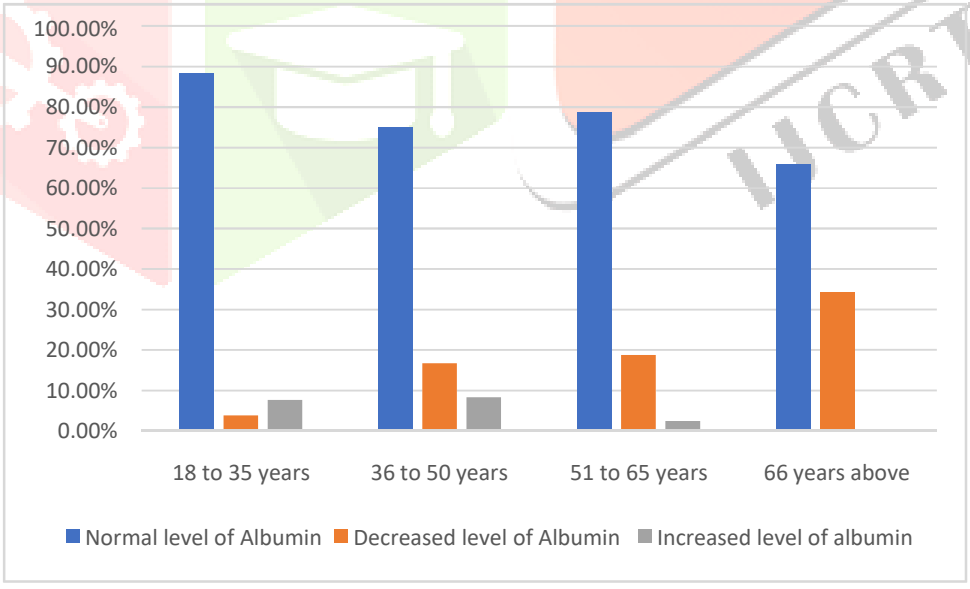

Figure 19 : Age group wise result of albumin

Table 21: Gender wise result of albumin

Group	Patients number	Mean	Number and % of patients with normallevel of Albumin	Number and % of patients with decreased level of Albumin	Number and % of patients with increased level of Albumin
Total patient	200	3.75	150(75%)	44(22%)	06(3%)
Male	132(66%)	3.76	100(75.76%)	28(3.03%)	04(21.21%)
Female	68(34%)	3.74	50(73.53%)	16(23.53%)	02(2.94%)

Table 22: Hospital stay type wise result of albumin

Group	Patients number	Mean	Number and % of patients with normal level of Albumin	Number and % of patients with decreased level of Albumin	Number and % of patients with increased level of Albumin
Total patient	200	3.75	150(75%)	44(22%)	06(3%)
ward	162(81%)	3.91	132(81.48%)	24(14.82%)	06(3.7%)
ICU	38(19%)	3.06	18(47.37%)	20(52.63%)	00

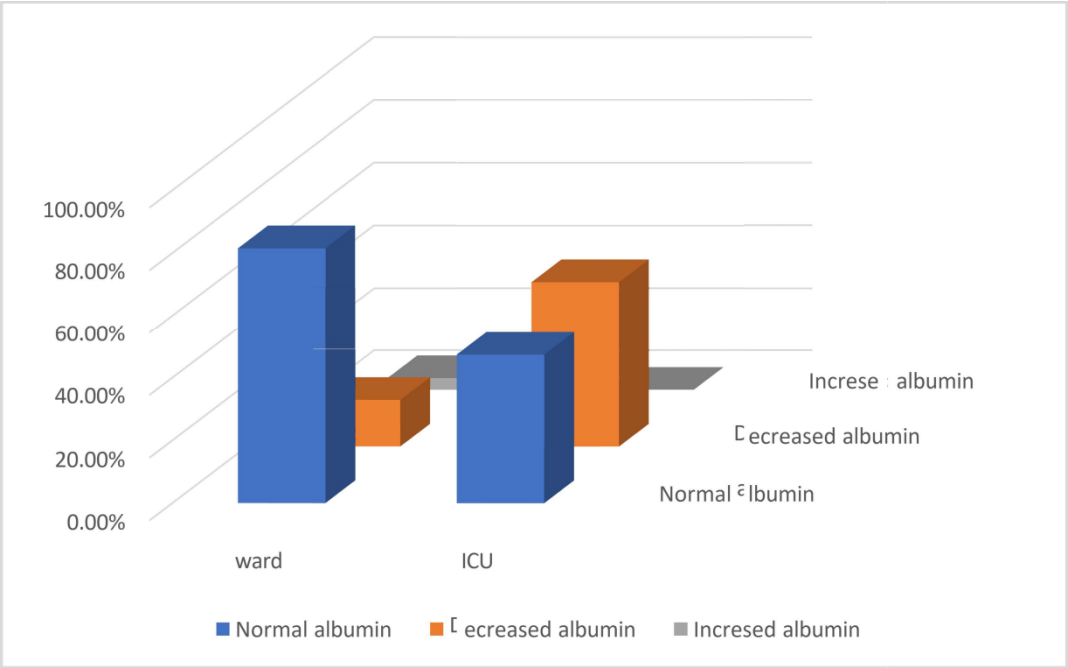

Figure 20: Hospital stay type wise result of albumin

In our study, ICU patients had lower albumin levels than ward patients. In the group of ward patients, 132 (81.48%) had a normal albumin level and 24 (14.82%) had a decreased albumin level, whereas 18 patients (47.37%) had a normal albumin level and 20 patients (52.63%) had a decreased albumin level in ICU patients.

Table 23: Prognosis wise result of albumin

Group	Patients number	Mean	Number and % of patients with normallevel of Albumin	Number and % of patients with decreased level of Albumin	Number and % of patients with increased level of Albumin
Total patient	200	3.75	150(75%)	44(22%)	06(3%)
Survivor	156(78%)	3.95	130(83.33%)	20(12.82%)	06(3.85%)
Non-survivor	44(22%)	3.06	20(45.45%)	24(54.55%)	00

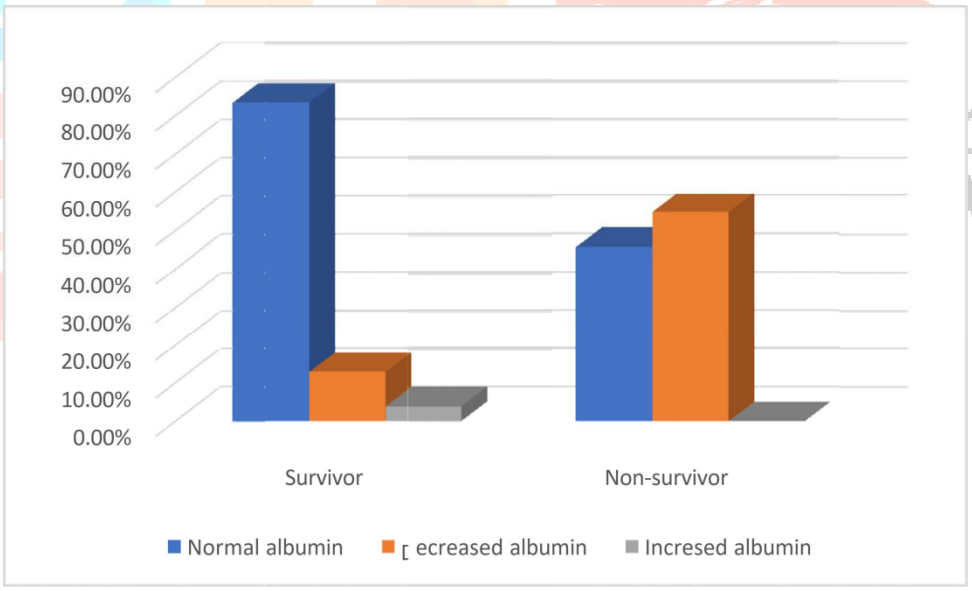

Figure 21: Prognosis wise result of albumin

130 (83.33%) of the 156 Survivors had normal albumin levels, while 20 (12.82%) had decreased albumin levels. Twenty (45.45%) had normal albumin levels, while 24 (54.55%) of the non-survivor patients had decreased levels.

These acute phase reactants, along with other laboratory parameters like high neutrophil count, lymphopenia, and elevated lactate dehydrogenase, serve as critical predictors of mortality and disease progression. Monitoring these biomarkers aids in early diagnosis, distinguishing infectious from non-infectious diseases, and assessing treatment responses.

In summary, studying acute phase reactants and how the immune system responds to COVID-19 is critical for figuring out how the disease progresses, enhancing clinical care, and developing public health strategies. Through disentangling the complex interactions between the virus and the host immune system, we can create more potent approaches to tackle this worldwide health emergency.[4]

DISCUSSION:

SARS-CoV-2, though often causing mild respiratory illness, can lead to severe pneumonia, acute respiratory distress syndrome (ARDS), and even death. Mortality rates vary but have been reported as high as 14.6%, with comorbidities exacerbating severity. Symptoms commonly include fever, cough, fatigue, and dyspnea, with RT-PCR as the recommended diagnostic test, though false negatives can occur. Acute phase reactants (APRs) such as CRP, procalcitonin, ferritin, LDH, ESR, and albumin play crucial roles in diagnosing, monitoring, and predicting COVID-19 progression.

Elevated levels of CRP, procalcitonin, ferritin, LDH, ESR, and decreased albumin areassociated with disease severity and mortality. Our study, conducted on 200 COVID-19 patients, found significant correlations between high APR levels and severity, ICU admission, and mortality, emphasizing their prognostic value. For instance, CRP levels were markedly higher in ICU patients compared to ward patients, and deceased patients had significantly higher CRP levels than survivors. Similarly, procalcitonin, ferritin, LDH, ESR, and albumin levels showed consistent trends, with elevated levels indicating a poorer prognosis.

These findings underscore the importance of monitoring APRs in COVID-19 patientsfor timely intervention and improved outcomes. Specifically, high levels of CRP, procalcitonin, ferritin, LDH, and ESR can serve as early indicators of disease severity and the need for ICU admission. Conversely, decreased albumin levels are associated with increased mortality risk. Therefore, regular assessment of APRs can aid clinicians in risk stratification, treatment decision-making, and prognosis estimation. Overall, understanding the role of APRs in COVID-19 pathogenesis and utilizing them in clinical practice can help optimize patient care and mitigate adverse outcomes.

CONCLUSION:

1. Acute phase reactants, including CRP, procalcitonin, ferritin, LDH, ESR, and albumin, significantly influence disease progression, severity, and prognosis in COVID-19 patients. Elevated levels of these markers and decreased levels of albumin are strongly correlated with disease severity and poor prognosis leading to mortality.

2. ICU patients exhibit more pronounced alterations in acute phase reactants compared to ward patients, suggesting the potential for using these parameters to predict the severity of COVID-19 infection.

3. Deceased patients display more alterations in acute phase reactants than recovered patients, indicating their utility in predicting disease progression and prognosis.

4. It is recommended to perform acute phase reactant tests such as CRP, ESR, ferritin, procalcitonin, LDH, and albumin at the hospital admission stage for suspected or confirmed COVID-19 cases to provide valuable prognostic information.

5. The increase in acute phase reactants could serve as an effective measure for predicting and enhancing the clinical management of COVID-19 patients, emphasizing the importanceof monitoring these markers for timely intervention and improved patient outcomes.

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