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Original Research Article

# Assessment of Hematological Parameters and Their Significance in Cirrhotic Patients at a Tertiary Care Center in Gujarat

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**Abstract:**

**Introduction:** Cirrhosis of the liver is a complex and multifaceted condition characterized by the progressive replacement of healthy liver tissue with fibrous scar tissue, resulting in impaired liver function and a myriad of clinical complications. Among these complications, hematological abnormalities play a crucial role in influencing the course and prognosis of the disease. Our study aims to investigate the diverse spectrum of these abnormalities, shedding light on their implications for patient care and management strategies.

**Material and Method:** The study was conducted as a prospective observational cross-sectional analysis at our Department of Surgery in a tertiary care center in Gujarat, India, over a period from June 2022 to May 2023, following ethical approval and participants' consent. We enrolled 70 cirrhotic liver patients admitted to the in-patient ward, aged 18 years or older, diagnosed with cirrhosis attributed to various etiologies. Using structured data collection, patient information, including hematological parameters, was documented and statistical analysis was performed using SPSS to assess significance among anemia categories.

**Results:** The results revealed distinct demographic patterns among cirrhotic patients, with the majority aged 41-50 years. Gender distribution showed a higher prevalence among males, comprising 61.42% of the cohort. In terms of anemia, macrocytic normochromic anemia was the most prevalent type, followed by microcytic normochromic anemia. Significant variations were observed across hematological parameters among different types of anemia, highlighting differences in red blood cell count, hemoglobin levels, mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC). Notably, thrombocytopenia was prevalent in 55.71% of cases, while leukocyte abnormalities varied, with leucopenia and lymphocytosis being the most common.

**Conclusion:** Our study highlights normocytic normochromic anemia as the most prevalent type in cirrhotic patients, with microcytic anemia more common in men. Leucocytosis, lymphopenia, and significant decreases in RBC count and hemoglobin levels were also observed, emphasizing the need for vigilant monitoring and intervention to prevent adverse outcomes.

**Keywords:** Cirrhosis, Hematological Abnormalities, Liver Disease.



## Introduction

Cirrhosis of the liver is a chronic and progressive condition characterized by the replacement of healthy liver tissue with scar tissue, ultimately leading to impaired liver function. [1] While the most common etiologies of cirrhosis include chronic alcoholism, viral hepatitis, and non-alcoholic fatty liver disease (NAFLD), the disease manifests through a spectrum of complications affecting various organ systems. [2,3] Among these complications, haematological abnormalities stand out as significant contributors to morbidity and mortality in patients with cirrhosis. [4]

The relationship between liver dysfunction and haematological abnormalities in cirrhosis is multifaceted. The liver plays a crucial role in the synthesis of various blood components, including clotting factors, albumin, and bile acids, which are essential for maintaining haemostasis and overall homeostasis. [5] As cirrhosis progresses, liver synthetic function becomes compromised, leading to alterations in the haematological profile. These abnormalities range from alterations in platelet count, coagulation factors, and erythropoiesis to the development of portal hypertension-related complications such as variceal bleeding and hypersplenism. [6]

Anemia, a common hematological complication of cirrhosis, is often accompanied by alterations in other blood parameters such as white blood cell (WBC) count and platelet levels. [7] While thrombocytopenia is a recognized hallmark of cirrhosis, anemia also significantly impacts the

disease's progression and severity. [8] The etiology of anemia in cirrhosis is multifactorial, influenced by factors such as decreased erythropoietin production, nutritional deficiencies, and chronic inflammation. [9] Concurrently, abnormalities in WBC count and platelet levels further contribute to the complexity of cirrhotic patients' hematological profiles. Understanding the interplay between these hematological abnormalities is essential for optimizing patient management and prognosis. In this study, we aim to comprehensively explore the haematological abnormalities associated with cirrhosis of the liver.

## Material and Methods

The prospective observational cross-sectional study was carried out at our Department of Surgery in a tertiary care center in Gujarat, India, from June 2022 to May 2023 with Ethical approval and participant's content prior to recruitment. The study enrolled 70 patients diagnosed with cirrhosis of the liver admitted to the in-patient ward of our hospital. Eligible participants were aged 18 years or older, of any gender, with cirrhosis attributed to chronic hepatitis-C, chronic hepatitis-B, non-alcoholic steatohepatitis (NASH), primary biliary cirrhosis, autoimmune hepatitis, Wilson's disease, or haemochromatosis. Exclusion criteria included acute hepatitis, drug-induced acute hepatic injury, fulminant hepatic failure, malignancy at presentation, and jaundice associated with seasonal viral infections.

Utilizing a structured data collection form, patient information, including various haematological parameters, was recorded. Patients diagnosed with cirrhosis of the liver in both the outpatient department (OPD) and inpatient department (IPD) of the Department of Surgery were included if they met the predefined criteria. Cirrhosis diagnosis was contingent upon stability criteria, excluding patients in shock, sepsis, or fulminant hepatic failure. Anaemia severity was classified as mild (13 g/dL to 10 g/dL), moderate (7 g/dL to 10 g/dL), and severe (below 7 g/dL).[10]

Data entry was performed using Excel for Microsoft Windows, with statistical analysis conducted using the Statistical Package for Social Sciences (SPSS). Descriptive statistical analysis summarized categorical and quantitative variables, presenting frequency (%) and mean ± standard deviation. One-way Analysis of Variance (ANOVA) assessed statistical significance among anaemia categories, with a p-value less than 0.05 considered significant.

## Results

The majority of cirrhotic patients at our center are aged 41-50 (45.71%), followed by those aged 51-60 (24.28%). Notably, 20% of patients are over 60 years old, highlighting the prevalence of cirrhosis in older individuals. Patients aged 31-40 and ≤30 years represent 8.57% and 1.42% of the cohort, respectively. Furthermore, the incidence of cirrhosis varies across genders, with males comprising 61.42% of the cohort compared to females at 38.57%.

Our study on the type of anemia in patients with cirrhosis of the liver presents intriguing findings. Among the observed cases, macrocytic, normochromic anemia emerged as the most prevalent type, accounting for 61.43% of cases, followed by microcytic, normochromic anemia at 45.71%. Surprisingly, dimorphic anemia was also noted in a significant proportion, representing 38.57% of cases. Meanwhile, normocytic normochromic anemia was observed in 24.29% of patients.

Our study on hematological parameters in patients with cirrhosis of the liver revealed significant differences across various parameters among different types of anemia, as indicated by the p-values. ($p<0.05$) For instance, hemoglobin levels were notably higher in cases of macrocytic normochromic anemia compared to other types, while microcytic normochromic anemia exhibited the lowest red blood cell count. Additionally, significant variations in mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and prothrombin time were observed among the different types of anemia ($p<0.05$). However, some parameters such as platelet count and neutrophils did not show significant differences ($p>0.05$). (Table 1)

**Table 1: Haematological abnormalities (mean±SD) and types of anemia**

| Hematological parameters | Dimorphic | Macrocytic Normochromic | Microcytic, Normochromic | Normocytic Normochromic | P val-ue |
|---|---|---|---|---|---|
| RBC count | 3.12 | 3.70±0.38 | 3.28±0.37 | 3.36±0.43 | 0.012 |
| Hb | 9.50 | 12.00±1.60 | 8.70±0.90 | 10.20±1.60 | <0.001 |
| PCV | 28.5 | 36.50±3.50 | 24.00±2.60 | 30.00±4.60 | <0.001 |
| MCV | 87.5 | 99.00±3.50 | 71.50±1.20 | 89.00±4.00 | <0.001 |
| MCHC | 33.00 | 32.40±1.70 | 34.90±2.80 | 34.00±1.90 | 0.010 |
| WBC | 10450 | 7875.0±3050.0 | 7750.0±3450.0 | 9450.0±2400.0 | 0.123 |
| Platelet count (permicroliter) | 86.38 ± 7.16 | 70.78 ± 2.61 | 64.10 ± 8.50 | 63.67 ± 7.42 | 0.11 |

| | | | | | |
|---|---|---|---|---|---|
| Prothrombin time (sec) | 18.48 ± 4.25 | 15.53 ± 3.59 | 17.18 ± 4.50 | 18.80 ± 5.49 | 0.07 |
| Neutrophils | 80 | 69.50±9.50 | 67.00±6.50 | 64.50±14.00 | 0.129 |
| Lymphocytes | 14 | 25.00±10.50 | 28.50±7.50 | 28.50±12.50 | 0.157 |
| Eosinophils | 6 | 5.75±1.75 | 4.25±2.00 | 5.50±2.50 | 0.532 |
| Monocytes | 0 | 0 | 0.10±0.35 | 0 | 0.086 |

Figure 1 shows a notable predominance of Class C Child-Pugh Score, with 44 patients (45.71%), indicating severe liver dysfunction among the cirrhotic patients. This observation underscores the advanced stage of liver disease in the majority of cases, emphasizing the importance of early identification and intervention for improved treatment outcomes.

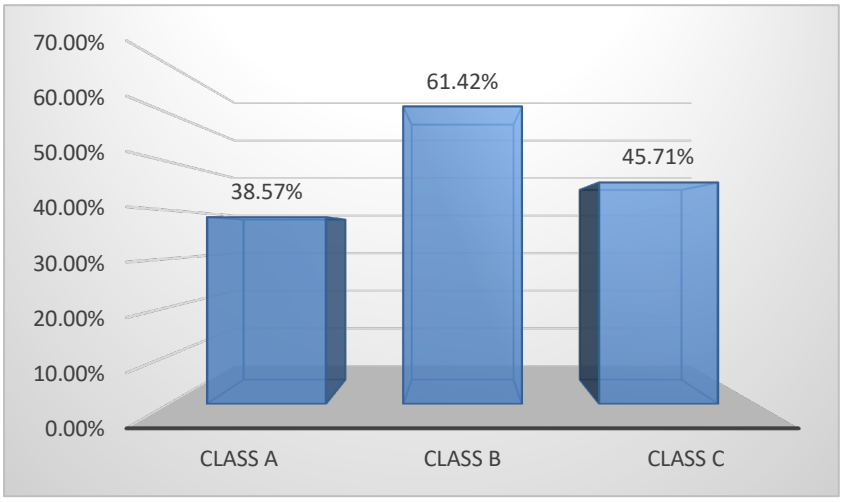


**Figure 1: Cirrhosis of Liver patients per the Child-Pugh Score**

The study delves into the intricate hematological profile of cirrhosis patients, uncovering a range of abnormalities including leukocyte and platelet disorders. Notably, thrombocytopenia was prevalent in 55.71% of cases, while thrombocytosis was observed in 5.71% of patients. Additionally, 38.57% exhibited normal platelet counts. Regarding leukocyte abnormalities among cirrhosis patients, revealing varying incidences: leucopenia in 61.43%, lymphopenia in 24.29%, leucocytosis in 38.57%, and lymphocytosis in 45.71%. Additionally, 20% exhibited normal leukocyte counts.

**Discussion**

This study explored the hematological profile in cirrhotic patients, considering the diverse clinical presentations of liver cirrhosis across different regions. Davidson, Sherlock, and Turner provided insights into the differing behaviors of cirrhosis between Europe and America, where alcoholism is identified as a common underlying factor. [11] Typically, the onset of cirrhosis occurs above 35 years of age, with males being more prevalent. [12] While ascites and jaundice commonly characterize its presentation, history of previous hepatitis is infrequent. Common manifestations include parotid enlargement, gynecomastia, and anaemia, often accompanied by hepatomegaly and palpable splenomegaly in a quarter of cases. [13] In contrast, non-alcoholic cirrhosis, more prevalent in England, demonstrates a female predominance without a specific age incidence. History of previous hepatitis is evident in about 30% of cases, with portal hypertension being a common complication. [14] Coexisting peptic ulcer has been reported, and serum albumin levels tend to be low in decompensated liver conditions. [15] Hematological abnormalities are commonly observed in cirrhosis, stemming from various contributing factors. [16] Emerging research indicates that the presence of hematological cytopenias is linked to a dismal prognosis in cirrhosis, underscoring the significance of these abnormalities in disease progression. [17]

Our study revealed that the majority of cirrhotic patients at our centre fell within the age range of 41-50 years (45.71%), with 24.28% aged between 51 and 60 years. Our findings regarding disease prevalence align with previous studies conducted by Kumar et al. [18] and Anand et al. [19], indicating consistency within the Indian context. Additionally, our study highlighted an increasing trend in alcohol-related cirrhosis over time, stabilizing at approximately 60% during the latter three years of our observation period. This observation echoes similar trends reported by Ray [20], who noted a rise in alcohol-related chronic liver disease (CLD) from 22% in 2003 to 42% in

2011. Furthermore, Thomson et al. [21] from England reported increasing hospital admissions and mortality from CLD, with alcohol-induced liver disease playing a significant role. This escalating trend in alcohol-related cirrhosis has been attributed to factors such as an earlier onset of alcoholism, rising per capita alcohol consumption, and increasing prevalence of "at-risk" drinking behaviors. [22]

Our study revealed a higher proportion of male patients (61.42%) diagnosed with cirrhosis of the liver compared to females (38.57%). This aligns with existing literature indicating a greater incidence of alcohol-related cirrhosis among males, with an annual incidence of 0.2% compared to 0.03% in females, as reported by Mitra et al. [23]. Furthermore, research suggests that women may have a higher relative risk of alcohol-related liver disease (ALD) for any given alcohol intake. Studies such as Rogers et al. [24] have indicated that men are generally twice as likely to succumb to chronic liver disease and cirrhosis compared to women. Additionally, analysis of age-standardized death rates due to cirrhosis of the liver between 1990 and 2017 demonstrated consistent higher rates among males compared to females across all super-regions, as reported by Sepanlou et al. [25]

Our study on anemia in cirrhotic patients unveils intriguing findings. Macrocytic, normochromic anemia predominated (61.43%), followed by microcytic, normochromic anemia (45.71%). Dimorphic anemia was notable (38.57%), while normocytic normochromic anemia was observed in 24.29% of cases. Anemia commonly accompanies cirrhosis, primarily due to hemodilution and reduced erythropoietin levels. [26] Interestingly, Yang et al. [27] found higher plasma erythropoietin levels in cirrhotic patients compared to controls, particularly in those with anemia. Inflammatory cytokines, along with deficiencies in folic acid, vitamin B12, and iron, often contribute to the development of severe anemia in cirrhotic individuals. This condition, stemming from various causes, affects approximately 75% of patients with chronic liver disease, as noted by McHutchison et al. [28] Normochromic and normocytic anemia are the most prevalent types observed in cirrhotic patients, according to Fan et al. [29] Additionally, previous studies have linked macrocytic anemia, particularly in alcoholics, to the direct toxic effects of alcohol on erythrocyte precursors in the bone marrow. [18]

Our study on cirrhotic patients found significant differences in hematological parameters among anemia types ($p<0.05$). Hemoglobin levels were higher in macrocytic normochromic anemia, while microcytic normochromic anemia had the lowest red blood cell count. Variations in MCV, MCHC, and prothrombin time were noted ($p<0.05$), but platelet count and neutrophils showed no significant differences ($p>0.05$). These findings corroborate with previous studies by Bruno et al. [30], Gheno et al. [31], Manrai et al.7, Qamar and Grace [16], and Yang et al. [32], Yoon et al. [33], highlighting the complex hematological alterations in cirrhosis and their potential clinical implications.

Our study highlighted significant abnormalities in platelet and leukocyte levels among cirrhotic patients, indicating potential hematological complications in this population. The findings from various studies shed light on the complex hematological dynamics in cirrhotic patients. [34] Notably, a range of factors contribute to leukocyte abnormalities and platelet disorders in this population. While some investigations highlight the role of chronic inflammatory cytokines and alcohol-induced bone marrow suppression, others delve into the potential therapeutic implications of factors like granulocyte colony-stimulating factor (G-CSF) and granulocyte macrophage colony-stimulating factor (GM-CSF) in managing leukopenia. [16,35] Moreover, studies by Gurakar et al. [35] demonstrate the efficacy of GM-CSF treatment in increasing white blood cell counts without spleen-related complications. Concurrently, observations by Jha et al. [34] underscore the significance of altered prothrombin time and activated partial thromboplastin time (APTT) in cirrhosis patients. Additionally, studies by Acharya et al. [36] and Joshi et al. [37] elucidate the association between specific hematological parameters and alcohol-related liver diseases. These findings collectively contribute to a deeper understanding of the hematological intricacies in cirrhotic patients, complementing our study's observations on the prevalence of thrombocytopenia, thrombocytosis, and leukocyte abnormalities in this population.

Limitations of our study include its single-center design, modest sample size, and observational nature, which may restrict generalizability and causal inference.

## Conclusion

In our study, normocytic normochromic anemia emerged as the predominant type among cirrhotic patients, with microcytic anemia exhibiting a higher prevalence in men compared to women. Leucocytosis and lymphopenia were commonly observed in this patient population. Additionally, significant decreases in RBC count, Hb level, PCV, MCV, and MCHC were noted. These findings underscore the importance of closely monitoring hematological parameters in cirrhotic patients to mitigate risks associated with anemia, infections, sepsis, and hemorrhagic shock, thereby improving patient outcomes.

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