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Original Research Article

SPECTRUM OF HEMATOLOGICAL ABNORMALITIES IN VARIOUS LIVER DISEASES: A CROSS SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Chronic liver disease (CLD) is characterized by progressive hepatic injury culminating in cirrhosis and hepatic decompensation. It is frequently associated with hematological abnormalities. Anemia occurs in about 75% of patients with chronic liver disease. The most common type of anemia seen in liver cirrhosis is normocytic normochromic anemia, due to the chronic inflammatory state, blood loss from esophageal and rectal varices. The purpose of this study was to observe the hematological manifestations and coagulation findings in cases with various liver diseases. **Objectives of study**: The objective of this study was to analyze the changes in complete blood count (CBC) parameters and spectrum of anemia in various liver diseases.

Materials and Methods: The study was conducted in the Department of Pathology, Shija Academy of Health Sciences, over a period of six months from July 2025 to December 2025. This study included 60 cases of clinically diagnosed liver disease. Hematological parameters including Hb, RBC count, HCT, MCV, MCH, MCHC, RDW, platelet count, TLC, and coagulation parameters including PT/INR data were collected and evaluated using SPSS software.

Results: The study was male-predominant (90%) and aged between 51 to 60 years. Alcoholic liver disease was the predominant etiology, followed by chronic hepatitis C virus infection. Anemia and thrombocytopenia were the most common hematological manifestations. Prolongation of prothrombin time and elevated INR was also noted.

Conclusion: Chronic liver disease patients are frequently associated with hematological and coagulation abnormalities, showing anemia, leucopenia, and thrombocytopenia along with prolonged prothrombin time and elevated INR. In our study, hematological parameters (Hb, RBC, HCT, MCHC, and platelet count) all were decreased except MCV, MCH, RDW and TLC, which were increased. Thus, routine hematological investigations provide essential insights in assessing CLD severity and outcome.

Keywords: Chronic liver disease, alcoholics, Anemia, hematological, thrombocytopenia.

INTRODUCTION

The liver is one of the largest internal organs of the body, located in the right upper quadrant of the abdomen. It weighs around 1-1.5 kg and it plays a central role in maintaining metabolic homeostasis and is essential for survival. The liver performs a wide range of functions, including metabolism of carbohydrates, proteins, and lipids; synthesis of plasma proteins such as albumin and clotting factors; detoxification of drugs, toxins, and metabolic byproducts, production and secretion of bile, which aids in digestion and absorption of fats. It also serves as a storage site for glycogen, vitamins, and minerals

and contributes to immune regulation. Given its diverse function, any impairment in liver activity, as seen in chronic liver disease, can lead to widespread systemic effects, including significant alterations in hematological parameters.[1] Chronic liver disease is a progressive condition characterized by sustained hepatic injury leading to fibrosis, cirrhosis, and eventual liver failure, resulting in widespread systemic manifestations. It can arise from a variety of causes, including viral hepatitis, alcohol use, non-alcoholic fatty liver disease, and autoimmune disorders.[2,3] Alcohol is one of the common causes of CLD, leading to direct bone marrow toxicity and anemia, often due to vitamin B12 and folate deficiency from secondary malnutrition and is usually attributed to spur cell anemia. This is related to abnormal cholesterol accumulation in the red blood cell membrane, leading to the formation of spiculated erythrocytes with reduced survival, known as acanthocytes.[4,5,6] Cytopenias are common in CLD, with the underlying mechanisms being varied and multifactorial. Among these, hematological abnormalities are commonly observed, with alterations in complete blood count, platelet count, and red cell indices.[7,8] These changes may arise due to mechanisms including hypersplenism, bone marrow suppression, nutritional deficiencies, chronic inflammation, and in some cases, a low level of erythropoietin.[9] The most common type of anemia seen in liver cirrhosis is normocytic normochromic anemia due to the chronic inflammatory state. Bleeding from esophageal varices, portal hypertensive gastropathy, and antral vascular ectasia can lead to iron-deficiency anemia, typically presenting as a microcytic hypochromic pattern [10]. Hypersplenism and hepcidin deficiency are also contributing factors to anemia in patients with CLD. Macrocytosis is a common hematological abnormality in this group, with multiple mechanisms implicated in its development. In patients with chronic hepatitis C, treatment with interferon and ribavirin can lead to anemia, primarily due to ribavirin-induced hemolysis.[11] Thrombocytopenia, also a common finding in patients with chronic liver disease, is associated with portal hypertension and splenomegaly, wherein platelets are trapped by the enlarged spleen.[12] As a simple, cost-effective and readily available investigation, complete blood count (CBC) can provide valuable insights into the severity and progression of liver dysfunction.

Objective

1. To analyze the changes in CBC parameters in various liver diseases.
2. To analyze the spectrum of anemia in liver diseases.

MATERIALS AND METHODS

This is a hospital-based cross-sectional study carried out in the Department of Pathology at Shija Academy of Health Sciences (SAHS), Langol, Imphal, Manipur, over a period of 6 months (July 2025 to December 2025). CBC was analyzed by SYSMEX XN-350 and PT/INR was analyzed by Erba Mannheim ECL 105 coagulation analyzer.

Inclusion Criteria

1. All patients suffering from CLD (irrespective of etiology).
2. All patients of both genders and age > 18 years and irrespective of socioeconomic status were included.

Exclusion Criteria

1. Patients who were on treatment for anemia or had blood transfusions in the last 3 months.
2. Patients on drugs causing bone marrow suppression.
3. Patients who were known case of primary hepatocellular carcinoma or any other known malignancy.

Data collected

Patient's name, unique hospital identification number, age, gender, hemoglobin, RBC count, HCT, MCV, MCH, MCHC, RDW, TLC, platelet count, PT/INR, clinical diagnosis.

Study procedure

All the blood samples were collected under aseptic precautions and processed in the hospital's central laboratory using the automated 5 parts cell counter SYSMEXXN-350 and Erba Mannheim ECL 105 coagulation analyzer. The hematological profile included hemoglobin (Hb), total leukocyte count (TLC), platelet count, RBC count, hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), prothrombin time (PT), and International Normalisation Ratio (INR). Peripheral smears were prepared for all samples, and Leishman's stain was done. Anemia is categorized by WHO criteria as mild (10 gm/dl - 10.9gm/dl), moderate (7 gm/dl -9.9gm/dl) and severe (<7gm/dl) for pregnant women. For non-pregnant women- 11.0-11.9g/dl, 8-10.9 gm/dl and < 8g/dl respectively as mild, moderate and severe anemia. For men, 11.0- 11.9g/dl, 8.0- 10.9 g/dl and <8 gm/dl respectively as mild, moderate and severe anemia. Patients were diagnosed with thrombocytopenia if their platelet count was less than 150 x 10^{9}/L.

Ethical consideration

This was retrospective cross-sectional study in which no risk factors were identified. Patient data were obtained from laboratory requisition forms, and hematological as well as coagulation parameters were recorded accordingly. Ethical clearance was obtained from the Institutional Ethics Committee. The identities of the patients were kept confidential.

Statistical Analysis

All the data collected were entered in Excel for Microsoft Windows, and statistical analysis was performed by the Statistical Package for Social Sciences (SPSS). To investigate the distribution of a number of categorical (hematological parameters)

and mean± standard deviation, we used frequency (%) and mean± standard deviation.

RESULTS

A total of 60 patients of CLD were evaluated. Most of the patients belonged to the age group of 51-60 years (23.3%), followed by equal distribution of age groups of 41-50 years (21.7%) 61- 70 years (21.7%), 31-40 years (18.3%), >70 years (10%) and 18-30 years (5%). The mean age was 52.5±13.7.

Table 1: Distribution of patients according to age group

Age groups (Years)	Frequency	Percentage
18-30	3	5%
31-40	11	18.3%
41-50	13	21.7%
51-60	14	21.3%
61-70	13	21.7%
>70	6	10%

Table 1 shows two age peak i,e 41-50 years and 61-70 years.

Table 2: Distribution of patients according to gender

Gender	Frequency	Percentage
Male	54	90%
Female	6	10%

Above table shows that, out of 60 cases, 54 cases (90%) were males and 6 cases (10%) were non-pregnant females.

Table 3: Distribution of patients according to clinical diagnosis

Clinical diagnosis	Frequency	Percentage
Acute on chronic liver failure- alcohol induced	19	31.6%
Alcoholic chronic Liver Disease	12	20%
Decompensated CLD, alcohol induced	10	16.7%
Decompensated CLD, HCV induced	8	13.3%
Chronic hepatitis C virus infection	6	10%
Acute viral hepatitis	3	5%
CLD- Non-alcoholic steato-hepatitis (NASH) related	2	3.3%

The above table explains the distribution of cases according to clinical diagnosis. It was found that acute on chronic liver failure – alcohol-induced was the most commonly present in most of the cases, 19 (31.6%) followed by alcoholic chronic liver disease 12 (20%), decompensated CLD- alcohol induced 10 (16.7%), decompensated CLD- HCV induced 8 (13.3%), chronic hepatitis C virus infection 6 (10%), acute viral hepatitis 3 (5%) and CLD- non-alcoholic steatohepatitis (NASH) related-2 (3.3%).

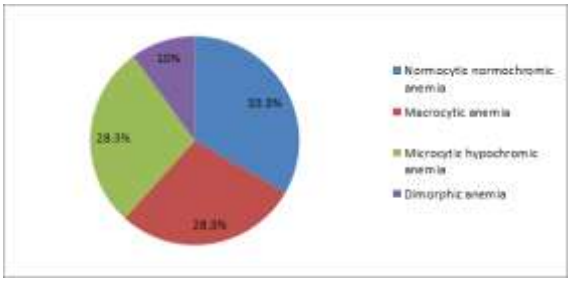

Figure 1: Pie chart showing distribution of cases according to types of anemia in various liver diseases

Figure 1 presents the distribution of patients based on hematological profile. The majority of the patients showed normocytic normochromic anemia (33.3%), followed by macrocytic anemia (28.3%), microcytic hypochromic anemia (28.3%) and dimorphic anemia (28.3%).

Table 4: Mean score (SD) of RBC, Hb, HCT, MCV, MCH, MCHC, RDW, TLC, Platelet Count, PT/INR

Parameters		Mean ±SD	Frequency	Percentage
Hb (g/dl)	>12	9.51±2.68	13	21.7%
	10-11.9		08	13.3%
	7-11		33	55%
	<7		06	10%
RBC count (million cell/mcL)	<4.5	3.32±1.01	53	88.4%
	4.5-5.5		05	8.3%
	>5.5		02	3.3%
MCV (fl)	<80	91.70±11.65	10	16.7%
	80-100		33	55%

	>100		17	28.3%
MCH (pg)	<27	29.33±4.51	21	35%
	27-32		27	45%
	>32		12	20%
MCHC (g/dl)	<32	31.90±1.80	30	50%
	32-36		28	46.7%
	>36		02	3.3%
HCT (%)	<40	29.75±8.45	54	90%
	40-50		05	8.3%
	>50		01	1.7%
RDW SD (%)	<11	17.75±2.77	00	0%
	11-15		18	30%
	>15		42	70%
Platelet count (thou/cumm)	<1.5	160.8±143.17	40	66.7%
	1.5-4.5		18	30.0%
	>4.5		02	3.3%
TLC (cells/cumm)	<4.0	10.21±6.83	02	3.3%
	4.0-10.0		35	58.4%
	>10		23	38.3%
PT (seconds)	10-14	19.29±9.51	23	38.3%
	>14		37	61.7%
INR (International Normalization Ratio)	0.8-1.1	1.72±0.93	22	36.7%
	>1.1		38	63.3%

Table 5: Comparison of Mean score (SD) for Hb, RBC, HCT, MCV, MCH, MCHC & Platelet count

Mean values	Berad & Chand et al[19]	Rappai M et al[18]	Das SK et al[20]	Precious IC et al [21]	Present study
Hb	9.31±2.31	9.71±2.92	15.0±1.45	16.5±2.5	9.51±2.68
RBC	3.11±0.68	2.95±0.69	5.03±0.5	6.57±1.3	3.32±1.01
HCT	28.16±6.02	27.52±10.37	43.2±4.49	55.6±4.12	29.75±8.45
MCV	93.42±11.62	89.62±11.55	85.9±4.83	87.7±4.68	91.70±11.65
MCH	24.86±1.64	31.56±5.40	29.9±2.08	25.5±1.6	29.33±4.51
MCHC	30.26±1.46	30.68±4.77	34.8±1.57	30.1±1.98	31.90±1.80
Platelet count	146.0±58.0	132.22±90.88	142.2±73.80	199.0±60.2	160.8±143.17

Author, Year	Mean TLC value
Das S K et al, 2011 [20]	7.8±4.0
Kaur J et al, 2021[14]	11.44±8.59
Joshi et al, 2023 [22]	9.59±3.96
Present study, 2025	10.21±6.83

DISCUSSION

Chronic Liver Disease (CLD) refers to diseases of the liver, which last for more than six months and involve progressive destruction and regeneration of liver parenchyma, leading to fibrosis and cirrhosis. The most common cause of CLD is chronic alcoholism.[13]

Several studies have reported alterations in hematological parameters among patients with various liver diseases. In our study, 54 (90%) out of the 60 patients were males and 6 (10%) cases were females [Table 2], which was comparable to a study done by Kaur J et al,[14] in which 86.6% were males and 13.3% were females. The mean age of the study population in this study was 52.53 ± 13.79, with 23.3% cases belonging to 51-60 years of age, 21.7% cases each belonging to 41-50 years of age and 61-70 years, and 18.3%, 10% & 5% patients belonging to 31-40, >70 & 18-30 years of age, respectively [Table 1]. Our study was similar to the study done by Eduru Ranjhita et al.,who reported a similar age profile.[15]

In our study, the majority of the liver disease cases were alcohol-induced, followed by chronic hepatitis C virus infection, acute viral hepatitis and NASH-related [Table 3]. This finding suggests that alcohol consumption remains a major etiological factor contributing to liver disease. In patients with alcoholic liver disease, the iron is not incorporated into the hemoglobin molecules. Instead, it is converted into the storage form, i.e., ferritin, which can accumulate in RBC precursors, forming granules around the nucleus, resulting in the production of functionally immature red blood cells.[16] Alcoholics often have reduced red blood cell folate levels, primarily due to poor dietary intake, which is further worsened by alcohol-induced impairment of folate absorption.[17]

Mean MCV and MCH were 91.7 fl and 29.3 pg, respectively. The most common anemia observed in this study was normocytic normochromic anemia (33.38%); 28.3% had macrocytic anemia, 28.3% had microcytic hypochromic anemia, and 10% had a dimorphic blood picture [Figure 1]. This was comparable to a study done by Rappai M. et al. in which the most common anemia observed was normocytic normochromic (25.8%), macrocytic anemia in 22.5%, microcytic anemia in 16.1%, and 12.9% in dimorphic anemia.[18] This indicates multifactorial etiology: chronic disease, nutritional deficiency, alcoholism, and iron deficiency. Low hemoglobin values were associated with decreased

hematocrit and RBC counts in most cases. The mean hematocrit was 29.75%, and the mean RBC count was 3.32 million/cumm, comparable to the findings by Rappai M et al,[18] and Berad & Chand et al.[19] This may be attributed to reduced erythropoiesis or increased destruction of red blood cells due to hypersplenism secondary to portal hypertension. Thrombocytopenia was seen in 66.7% cases with a mean of 160.8±143.17 and was comparable with studies done by Kaur J et al,[14] and Shakyawat et al,[23] where the mean platelet count was 151.90±87.77 and 182.8±72.7, respectively. In our study, leukocytosis was observed in 38.33% of cases with a mean score of 10.21±6.83, which was comparable with the study done by Joshi et al,[22] where the mean score was 9.59±3.96, and the study by Kaur J et al,[14] where the mean was 11.44±8.59.

A deranged coagulation system is very common in chronic liver disease. In our study, prolongation of prothrombin time was observed in 61.7% with a mean score of 19.29±9.51. The mean INR was 1.72, which was comparable with studies done by Kaur J et al,[14] and Hemang Suthar et al,[24] where the mean INR was 1.40 and 1.92, respectively.

CONCLUSION

Alterations in hematological parameters are frequently associated with various liver diseases, showing anemia, leucopenia, and thrombocytopenia along with prolongation of prothrombin time and elevated INR. In our study, hematological parameters (Hb, RBC, HCT, MCHC and platelet count) were decreased except MCV, MCH, RDW and TLC, which were increased. The majority of the cases had normocytic normochromic anemia followed by macrocytic anemia and microcytic hypochromic anemia. Thrombocytopenia was present in 66.7% cases. Alcoholism was the most common cause of liver disease in our study. Early detection of anemia in alcoholics can help to prevent the future complication of anemia and reduce mortality. The predominance of alcohol-related liver disease calls for targeted preventive strategies. Our findings substantiate the importance of the assessment of hematological parameters and coagulation parameters in patients with various liver diseases.

Additional Information

Author Contribution

Dr. Bijoya Debnath: Have written the manuscript

Dr. Purnika Tongbram: Data collection

Dr. Vaskerjeet Konsam: Supervision of the study

Dr. Kaushik Debnath: Critical review

Disclosures

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