Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/vxcym008

HAEMATOLOGICAL ABNORMALITIES IN DECOMPENSATED CHRONIC LIVER DISEASE

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Abstract
Decompensated chronic liver disease (DCLD) is frequently associated with hematological abnormalities such as anemia, thrombocytopenia, and coagulation dysfunction, all of which significantly impact disease progression and clinical outcomes. Anemia in DCLD may result from chronic gastrointestinal bleeding, nutritional deficiencies, or hypersplenism. Thrombocytopenia is often due to portal hypertension and reduced thrombopoietin production, while coagulation disorders arise from impaired hepatic synthesis of clotting factors. This prospective observational study was conducted between 2023 and 2024 at the Department of General Medicine, Meenakshi Medical College Hospital and Research Institute. Fifty patients with DCLD were enrolled based on defined inclusion and exclusion criteria. Investigations included complete blood count, peripheral smear, serum iron profile, folate levels, liver function tests, and coagulation studies. Data analysis was performed using SPSS version 21.0, with $p < 0.05$ considered statistically significant. Anemia was present in 96% of patients, with normocytic anemia being the most common (58.3%), followed by microcytic (29.2%) and macrocytic anemia (12.5%). Thrombocytopenia was observed in 70%, and 17.1% had platelet counts <50,000/μL. Prolonged prothrombin time and elevated international normalized ratio were observed in 66% and 76% of patients, respectively. Gastrointestinal bleeding was significantly associated with both thrombocytopenia ($p = 0.045$) and coagulation abnormalities ($p = 0.011$ for PT, $p = 0.01$ for INR). These findings underscore the high prevalence of hematological complications in DCLD. Early detection and management of anemia, thrombocytopenia, and coagulation disorders are essential to reduce morbidity and improve patient care outcomes.

Keywords: Chronic Liver Disease; Hematological abnormalities; Thrombocytopenia; Prothrombin time; Hypersplenism

Introduction

Chronic liver disease (CLD) represents a significant global health challenge, contributing to substantial morbidity and mortality worldwide [1]. The progression of CLD to decompensated chronic liver disease (DCLD) is characterized by complications such as ascites, hepatic

encephalopathy, variceal bleeding, and jaundice—hallmarks of advanced hepatic dysfunction [2–4]. Cirrhosis, the end stage of chronic liver disease, involves hepatocellular degeneration, necrosis, fibrosis, and the replacement of normal liver architecture with regenerative nodules, ultimately impairing hepatic function [5]. Liver cirrhosis remains among the leading causes of global mortality, affecting an estimated 160 million people and accounting for approximately 800,000 deaths annually [6].

Hematological abnormalities are commonly observed in DCLD and are often multifactorial. These include anemia, leukopenia, thrombocytopenia, and coagulation disturbances, each of which can further complicate disease management. Thrombocytopenia is the most prevalent hematologic abnormality, affecting approximately 64% to 84% of individuals with cirrhosis or hepatic fibrosis [7–9]. Leukopenia is also frequently encountered, primarily due to hypersplenism, portal hypertension, and bone marrow suppression. Anemia in cirrhotic patients arises through mechanisms such as chronic gastrointestinal blood loss, nutritional deficiencies (e.g., iron, vitamin B12, folate), bone marrow suppression, and hemolysis. Normocytic normochromic anemia has been identified as the most common morphological subtype in these individuals [10–12].

Thrombocytopenia in cirrhosis results from multiple mechanisms, including decreased hepatic thrombopoietin (TPO) production, increased splenic sequestration, and immune-mediated platelet destruction [13,14]. TPO, predominantly produced by hepatocytes and sinusoidal endothelial cells, plays a key role in regulating platelet production. As liver fibrosis progresses, reduced TPO synthesis exacerbates thrombocytopenia [15]. Moreover, coagulation abnormalities are intrinsic to hepatic dysfunction, with diminished synthesis of clotting factors leading to prolonged prothrombin time (PT) and elevated international normalized ratio (INR). However, recent research indicates that the bleeding diathesis in cirrhotic patients may be influenced more by sepsis, hypotension, hepatorenal syndrome, and endothelial dysfunction than by hepatic dysfunction alone. Notably, despite elevated PT and INR values, patients with cirrhosis are not inherently protected from thromboembolic events; in fact, those with Child-Pugh Class C disease are at the highest risk of venous thromboembolism.

Given the significant clinical implications of hematological abnormalities in DCLD—including their effects on prognosis and morbidity—early recognition and appropriate management are essential for improving patient outcomes [16]. This study aims to evaluate the prevalence, patterns, and potential pathophysiological mechanisms underlying hematological abnormalities in patients with DCLD. The findings are expected to offer critical insights into disease progression and guide targeted therapeutic strategies.

Materials and Methods

This study was conducted in the Department of General Medicine at Meenakshi Medical College Hospital and Research Institute between 2023 and 2024. The study included patients diagnosed with decompensated chronic liver disease (DCLD) admitted to the inpatient ward. The study aimed to assess the prevalence and patterns of hematological abnormalities in these patients.

The study population consisted of all patients diagnosed with decompensated chronic liver disease who were admitted to the General Medicine Department during the study period. Patients were selected based on predefined inclusion and exclusion criteria.

Patients aged 18 years or older with a confirmed diagnosis of decompensated chronic liver disease persisting for more than six months were included. Cases of alcoholic cirrhosis, post-necrotic cirrhosis, and metabolic liver diseases were considered eligible for inclusion. Patients with known primary hepatocellular carcinoma, malignancies, acute hepatic failure, primary coagulation disorders, or primary abnormalities in hemostatic function were excluded. Additionally, individuals with pre-existing anemia due to other non-hepatic causes and those with end-stage medical conditions such as chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), coronary artery disease, or cardiac failure were not included in the study.

A total of 50 patients meeting the eligibility criteria were included in the study. The census sampling method was employed, whereby all eligible patients admitted during the study period were recruited for analysis.

Patient data were recorded using a structured case proforma, which included demographic details such as name, age, sex, address, occupation, and contact information. A detailed clinical history was obtained, covering presenting complaints, duration of symptoms, prior treatment history, associated comorbidities, and medication use. A thorough general and systemic examination was conducted, and vital signs were documented.

All enrolled patients underwent laboratory investigations after providing written informed consent. The tests performed included complete blood count (CBC), peripheral smear analysis, serum iron profile, serum folate levels, liver function tests (LFT), and coagulation parameters such as prothrombin time (PT) and international normalized ratio (INR). These investigations were performed to assess the hematological profile and coagulation status of patients with decompensated chronic liver disease.

Ethical Considerations

The study was conducted after obtaining ethical approval from the Institutional Ethics Committee (IEC) of Meenakshi Medical College Hospital and Research Institute. Written informed consent was obtained from all participants before enrollment, ensuring that ethical principles were adhered to throughout the study.

Statistical Analysis

Data were recorded, entered, and analyzed using SPSS software version 21.0. Categorical variables were expressed as percentages and analyzed using the Chi-square test, while continuous variables were presented as mean ± standard deviation (SD) and analyzed using the Student's t-test. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 50 patients diagnosed with decompensated chronic liver disease (DCLD) were included in the study. Among them, 42 (84%) were male and 8 (16%) were female.The predominant etiology of DCLD was alcohol-related liver disease, accounting for 33 patients (66%). Non-alcoholic steatohepatitis (NASH) was identified in 11 patients (22%). Hepatitis B virus (HBV) infection was the cause in 3 patients (6%), and hepatitis C virus (HCV) infection in 2 patients (4%). Wilson's disease and autoimmune hepatitis were each diagnosed in 1 patient (2%). This distribution highlights alcohol as the leading cause of DCLD in the study population, followed by NASH and viral hepatitis.

Prevalence and Severity of Anemia

Anemia was present in 48 of the 50 patients (96%) with DCLD. Based on hemoglobin levels, anemia was categorized as follows:

Anemia Severity	Number of Patients (n)	Percentage (%)
Mild (Hb 10–11.9 g/dL)	10	20.8%
Moderate (Hb 7–9.9 g/dL)	24	50.0%
Severe (Hb <7 g/dL)	14	29.2%

Table 1. Severity of Anemia in DCLD Patients

Moderate anemia was the most frequently observed type. These results indicate a high prevalence of anemia in DCLD, with most patients exhibiting moderate severity.

Types of Anemia

Among the 48 patients with anemia, normocytic anemia was the most common morphological subtype, observed in 28 patients (58.3%). Microcytic anemia was found in 14 patients (29.2%), and macrocytic anemia in 6 patients (12.5%). These findings suggest a predominance of normocytic anemia among individuals with DCLD.

Platelet Count and Gastrointestinal (GI) Bleeding

Thrombocytopenia (platelet count <150,000/μL) was present in 35 patients (70%), while 15 patients (30%) had normal platelet counts. The distribution among those with thrombocytopenia was as follows:

- Platelet count <50,000/μL: 6 patients (17.1%)
- Platelet count 50,000–100,000/μL: 17 patients (48.6%)
- Platelet count 100,000–150,000/μL: 12 patients (34.3%)

GI bleeding occurred more frequently among patients with thrombocytopenia. Among the 35 patients with low platelet counts, 21 (60%) experienced GI bleeding, compared to 6 (40%) of the 15 patients with normal platelet counts. This association between low platelet count and GI bleeding was statistically significant (p = 0.045).

Table 2. Association Between GI Bleeding and Platelet Count

Platelet Count (μL)	GI Bleeding – Yes	GI Bleeding – No	*p*-value
<150,000 (Thrombocytopenia)	21	14	0.045
150,000–450,000 (Normal)	6	9	

Coagulation Parameters and GI Bleeding

Elevated prothrombin time (PT) and international normalized ratio (INR) were frequently observed. Prolonged PT was noted in 33 patients (66%), while 38 patients (76%) had elevated INR levels.

Patients with GI bleeding showed significantly higher coagulation derangements. The mean PT among bleeding patients was 18.6 ± 5.0 seconds, compared to 10.2 ± 1.5 seconds in those without bleeding (p = 0.011). Similarly, the mean INR in patients with GI bleeding was 2.53 ± 0.3, significantly higher than 1.6 ± 0.11 in those without bleeding (p = 0.01).

Table 3. Relationship Between GI Bleeding and Coagulation Parameters

Coagulation Parameter	GI Bleeding – Yes (Mean ± SD)	GI Bleeding – No (Mean ± SD)	*p*-value
Prothrombin Time (PT)	18.6 ± 5.0 seconds	10.2 ± 1.5 seconds	0.011
INR	2.53 ± 0.3	1.6 ± 0.11	0.01

These findings demonstrate a significant association between coagulation abnormalities and the risk of GI bleeding in patients with DCLD.

Discussion

Decompensated chronic liver disease (DCLD) is commonly associated with hematological abnormalities such as anemia, thrombocytopenia, and coagulation dysfunction. These abnormalities contribute significantly to patient morbidity, particularly through complications like gastrointestinal (GI) bleeding. The present study evaluated the prevalence and patterns of these hematologic changes in patients with DCLD and compared the findings with previously published data.

In the current study, anemia was observed in 96% of patients, with 20.8% having mild anemia, 50% moderate, and 29.2% severe. The mean hemoglobin level was 8.2 ± 1.8 g/dL, underscoring anemia as a major hematological issue in DCLD. These findings align with those of Joeimon J et al. [16], who reported a 90% prevalence of anemia, including 14% with severe anemia (Hb <6 g/dL). Frijo J et al. [17] similarly reported anemia in 86.8% of cirrhotic patients, with normocytic normochromic anemia being the predominant type (39.4%).

In our study, normocytic anemia was the most prevalent morphological subtype (58.3%), followed by microcytic (29.2%) and macrocytic anemia (12.5%). These results contrast with the findings of Krithiga E et al. [18], who reported macrocytic anemia in 40% of patients, likely due to regional variations in nutritional deficiencies such as vitamin B12 and folate. In line with our results, Anbazhagan G et al. [19] also reported a high prevalence of normocytic anemia (80%) in DCLD patients. Similarly, Kumar EH et al. [20] observed moderate anemia in 41% of patients, predominantly normochromic, supporting our study findings.

Thrombocytopenia was present in 70% of patients, with 17.1% having platelet counts below 50,000/μL. These results are consistent with findings by Shetty V et al. [21], who reported thrombocytopenia in 56.6% of patients. The etiology of thrombocytopenia in DCLD is multifactorial, primarily due to hypersplenism secondary to portal hypertension, decreased thrombopoietin production, and bone marrow suppression. Qamar AA et al. [22] also confirmed a high prevalence of thrombocytopenia in chronic liver disease, supporting our observations.

Coagulation abnormalities were also prevalent in our cohort, with 66% of patients having prolonged prothrombin time (PT) and 76% demonstrating elevated international normalized ratio (INR). These findings are consistent with Sharma A et al. [23] and Solomon RT et al. [24], who reported prolonged PT in a majority of DCLD patients. Bhatia G et al. [25] found prolonged PT in 62% of patients, while Patil AY et al. [26] observed prolonged PT and aPTT in 63% and 55% of patients, respectively. In our study, 65.8% of patients with prolonged PT had at least one episode of hematemesis, reaffirming the strong association between coagulation dysfunction and GI bleeding. Similar results were noted by Selvamani S et al. [27], who reported prolonged PT in 46% of patients.

A statistically significant association was identified between GI bleeding and thrombocytopenia, with 60% of patients with low platelet counts (<150,000/μL) experiencing GI bleeding, compared to 40% in the non-thrombocytopenic group. These findings align with Nagarajaiah RB et al. [28], who found that acute GI bleeding was the most common presentation in DCLD. Additionally, in our study, both PT and INR were significantly higher in patients with GI bleeding ($p = 0.011$ and $p = 0.000$, respectively), highlighting the predictive role of coagulation parameters in bleeding risk.

Regarding etiology, hepatitis B virus (HBV) was present in 6% and hepatitis C virus (HCV) in 4% of patients in our study. These values are consistent with data from Bhattacharyya M et al. [29], who reported an HBV prevalence of 8.9% and HCV prevalence of 3.2% in CLD patients. Ahmed S et al. [30] similarly reported that 11% of DCLD cases were attributable to HBV and HCV, emphasizing the importance of routine viral screening to mitigate disease progression.

The most frequent presenting features in our cohort included jaundice, abdominal distension, and bleeding manifestations. Consistent with our observations, Nagarajaiah RB et al. [28] also reported acute GI bleeding as the most common presentation in patients with DCLD. GI hemorrhage is a recognized complication in advanced liver disease, often linked to coagulopathy and portal hypertension.

Conclusion

This study underscores the high prevalence of hematological abnormalities—namely anemia, thrombocytopenia, and coagulation disturbances—in patients with decompensated chronic liver disease (DCLD). These abnormalities contribute significantly to the clinical burden and are closely associated with complications such as gastrointestinal bleeding. The findings are in alignment with existing literature and reinforce the necessity for routine hematological evaluation and early identification of at-risk individuals. Timely and targeted interventions addressing these hematological derangements may play a pivotal role in improving clinical outcomes, minimizing complications, and enhancing the overall management of DCLD.

Limitation:

This study is limited by its small sample size, single-center design, and cross-sectional approach, restricting generalisability and long-term assessment. Potential confounders like nutritional deficiencies and medication effects may have influenced results. The absence of advanced coagulation markers and bone marrow evaluation limits a comprehensive hematological analysis. Despite these limitations, the study provides valuable insights into hematological abnormalities in DCLD.

Conflict of Interest

None.

Source of Funding
None.

Authorship Contribution Statement
Karrolla Shyam Sundhar Reddy: experimentation and Writing-original draft, , Jubeida Aafreen: Review and editing, Neelavathi Gopalakrishnan: Review and editing, Anbarasu Duraisamy: Conceptualization and supervision

Acknowledgement
The author would like to thank Meenakshi Medical College Hospital and Research Institute, Meenakshi Academy of Higher Education and Research (Deemed to be University), for providing a research facility to carry out our research work.

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