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Original Article

Assessment of Hematological Parameters in Patients with Viral Hepatitis: A Cross-Sectional Study.

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ABSTRACT

Background: Viral hepatitis, particularly Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections, remains a major global health concern. The liver plays a crucial role in the metabolism and regulation of blood cells; therefore, hepatic dysfunction may influence hematological parameters. Assessment of these parameters can provide valuable insights into the systemic effects of viral hepatitis.

Objective: To assess and compare hematological parameters among patients with HBV infection, HCV infection, and healthy controls.

Methods: A cross-sectional study was conducted among 50 participants at A.C.S. Hospital, Chennai, comprising 20 HBV-positive patients, 20 HCV-positive patients, and 10 healthy controls. Venous blood samples were collected and analyzed using the SYSMEX XN-100 automated hematology analyzer. Hematological parameters including hemoglobin (Hb), red blood cell count (RBC), total white blood cell count (WBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) were evaluated. Statistical analysis was performed using one-way ANOVA.

Results: Healthy controls exhibited comparatively higher values of Hb, RBC, PCV, MCV, MCH, and MCHC than hepatitis-infected patients. No statistically significant differences were observed among the study groups ($p > 0.05$). However, greater variability in MCV and PCV values was observed among HCV-positive patients.

Conclusion: Viral hepatitis was associated with minor variations in hematological parameters; however, these differences were not statistically significant. Larger studies are warranted to further investigate hematological alterations associated with HBV and HCV infections.

Keywords: Hepatitis B, Hepatitis C, Hematological Parameters, Viral Hepatitis.

Introduction:

Hepatitis is an inflammatory disorder of the liver caused by various etiological factors, including viral infections, alcohol abuse, drug toxicity, autoimmune diseases, and metabolic disorders. Viral hepatitis remains a major global health concern due to its high prevalence, chronic disease burden, and potential progression to cirrhosis and hepatocellular carcinoma [1,2]. Among the different types of viral hepatitis, Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections are responsible for significant morbidity and mortality worldwide [3].

The liver plays an essential role in hematopoiesis during fetal life and continues to regulate the metabolism and clearance of blood cells throughout adulthood. Consequently, hepatic dysfunction may lead to alterations in hematological parameters such as hemoglobin concentration, red blood cell count, white blood cell count, platelet count, and red cell indices [4,5]. These hematological changes may arise from impaired liver function, chronic inflammation, immune-mediated mechanisms, nutritional deficiencies, or bone marrow suppression associated with viral hepatitis [6].

Globally, HBV infection affects approximately 296 million individuals, with nearly 1.5 million new infections reported annually [7]. Similarly, HCV infection continues to pose a substantial healthcare challenge, particularly in developing countries, where delayed diagnosis and limited access to treatment contribute to disease progression [8]. Several studies have demonstrated that patients with chronic HBV and HCV infections may exhibit hematological abnormalities, including anemia, leukopenia, thrombocytopenia, microcytosis, and alterations in red blood cell indices [9–12]. Previous investigations have evaluated the relationship between viral hepatitis and hematological parameters. Dar et al. reported significant variations in hematological indices among HBV- and HCV-infected patients when compared with healthy controls [13]. Similar findings have been reported by Samanci and Kosker, who observed alterations in neutrophil-to-lymphocyte ratio and mean platelet volume among patients with chronic HBV infection [14]. Studies conducted in different populations have also suggested that hematological parameters may serve as useful indicators of disease severity and prognosis in viral hepatitis [15–17]. Despite numerous studies evaluating hematological changes in viral hepatitis, the findings remain inconsistent across different populations and clinical settings [18,19].

Therefore, assessment of hematological parameters in HBV- and HCV-infected individuals may provide valuable information regarding the systemic effects of these infections and their potential impact on patient health. Hence, the present study was undertaken to assess and compare hematological parameters among patients with Hepatitis B infection, Hepatitis C infection, and healthy controls attending a tertiary care hospital.

Materials and Methods:

Study Design and Setting: A hospital-based cross-sectional descriptive study was conducted among patients diagnosed with Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infection attending A.C.S. Hospital, Chennai. The study was carried out to evaluate and compare hematological parameters among HBV-positive patients, HCV-positive patients, and healthy controls.

Study Population: The study population consisted of adult patients with confirmed HBV or HCV infection. A sampling framework of accessible patients with known hepatitis infection was obtained from the hospital infection clinic.

Inclusion Criteria:

1. Adult patients diagnosed with Hepatitis B infection.
2. Adult patients diagnosed with Hepatitis C infection.
3. EDTA blood samples collected from confirmed hepatitis patients.

Exclusion Criteria

1. Individuals without hepatitis infection.
2. Clotted EDTA blood samples.
3. Hemolyzed serum samples.
4. Mislabeled or mismatched samples.
5. Improperly transported specimens.
6. Samples with insufficient volume for analysis.

Sample Size: A total of 50 participants were included in the study. Among them, 20 patients were positive for HBV infection, 20 patients were positive for HCV infection, and 10 healthy individuals served as controls.

Sample Collection: Venous blood samples were collected using standard phlebotomy procedures. Patients were identified using two unique identifiers, and test requisition forms were verified before sample collection. The venipuncture site was selected and disinfected with 70% alcohol. Following adequate drying of the site, blood was collected using a sterile Vacutainer system. The collected samples were transferred into appropriate collection tubes according to laboratory protocols. For EDTA samples, the tubes were gently inverted to ensure proper mixing of blood with the anticoagulant. Red-top tubes were allowed to clot naturally without inversion. After collection, all samples were labeled appropriately and transported to the laboratory for further processing.

Sample Processing

1. **Rapid Card Testing:** Blood samples collected in red-top tubes were allowed to clot for approximately 30 minutes and subsequently centrifuged at 3500 rpm for 15 minutes to separate the serum. The separated serum was transferred into labeled Eppendorf tubes for serological testing. For the detection of Hepatitis C virus infection, a Tri-Dot Immunofiltration Fourth-Generation Assay was used to identify anti-HCV antibodies (IgG, IgM, and IgA). Hepatitis B virus infection was detected using a lateral flow immunochromatographic assay for the qualitative detection of Hepatitis B surface antigen (HBsAg). All test kits were brought to room temperature before use. Appropriate volumes of serum and buffer were added to the designated sample and buffer wells according to the manufacturer's instructions. Results were interpreted within the recommended time frame. The appearance of a control line alone was considered a negative result, while the presence of both control and test lines indicated a positive result. Tests lacking a control line were considered invalid and repeated.

2. Complete Blood Count Analysis

For hematological analysis, approximately 2.5 mL of venous blood was collected into lavender-top tubes containing dipotassium ethylenediaminetetraacetic acid (K_2EDTA). EDTA prevents coagulation by chelating calcium ions present in the blood sample. Prior to analysis, samples were mixed thoroughly using a blood mixer to ensure uniform distribution of cellular components. Hematological parameters were analyzed using the SYSMEX XN-100 automated hematology analyzer. The analyzer provides a seven-part differential count and measures various hematological parameters, including: Hemoglobin concentration (Hb), Red blood cell count (RBC), Total white blood cell count (WBC), Differential leukocyte count, Platelet count, Red blood cell indices, Platelet indices. The SYSMEX XN-100 operates using a combination of electrical impedance (Coulter principle), flow cytometry, spectrophotometry, and fluorescence-based technologies, ensuring accurate and reliable hematological measurements.

Statistical Analysis

Data obtained from the study were entered into a spreadsheet and analyzed statistically. Descriptive statistics were used to summarize the hematological parameters of the study participants. Results were expressed as mean ± standard deviation (SD). Comparisons among HBV-positive patients, HCV-positive patients, and healthy controls were performed using one-way Analysis of Variance (ANOVA). A p-value of less than 0.05 was considered statistically significant.

Results

Baseline Characteristics of Study Population: A total of 50 participants were included in the study, comprising 20 patients with Hepatitis B virus (HBV) infection, 20 patients with Hepatitis C virus (HCV) infection, and 10 healthy controls. Hematological parameters including hemoglobin (Hb), red blood cell count (RBC), total white blood cell count (WBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) were analyzed and compared among the three groups (Table-1).

Parameter	HBV	HCV	Control
Hb (g/dL)	11.81	12.48	13.85
RBC (×10⁶/µL)	4.30	4.55	4.84
Total WBC (×10³/µL)	12.39	9.56	8.42
PCV (%)	37.30	40.35	42.22
MCV (fL)	84.08	81.34	87.95
MCH (pg)	25.61	27.30	28.84
MCHC (g/dL)	31.55	31.94	32.80
RDW (%)	14.55	14.23	12.96

Table 1. Mean Hematological Parameters among Study Groups

Healthy controls demonstrated comparatively higher values for Hb, RBC count, PCV, MCV, MCH, and MCHC than HBV- and HCV-infected patients. Conversely, total WBC counts were higher among HBV-positive patients.

Parameter	HCV (Mean ± SD)	HBV (Mean ± SD)	Control (Mean ± SD)	p-value
Hb	12.48 ± 2.85	11.81 ± 2.90	13.85 ± 2.20	0.172
RBC	4.55 ± 0.84	4.30 ± 0.93	4.84 ± 0.94	0.298
Total WBC	9.56 ± 4.24	12.39 ± 8.36	8.42 ± 2.99	0.180
PCV	40.35 ± 11.58	37.30 ± 8.95	42.22 ± 6.67	0.386
MCV	81.34 ± 18.19	84.08 ± 6.40	87.95 ± 6.56	0.401
MCH	27.30 ± 3.50	25.61 ± 4.97	28.84 ± 2.06	0.106
MCHC	31.94 ± 2.24	31.55 ± 2.46	32.80 ± 0.48	0.321
RDW	14.23 ± 2.30	14.55 ± 3.78	12.96 ± 0.80	0.347

Table 2. Comparison of Hematological Parameters among HBV, HCV, and Healthy Controls

One-way ANOVA analysis revealed no statistically significant differences among the three groups for any of the evaluated hematological parameters ($p > 0.05$). However, greater variability was observed among HCV-positive patients, particularly in MCV (81.34 ± 18.19) and PCV (40.35 ± 11.58), as evidenced by their higher standard deviation values.

DISCUSSION

The present study evaluated hematological parameters among patients with HBV infection, HCV infection, and healthy controls. Although differences in mean values were observed among the study groups, statistical analysis demonstrated that these differences were not significant ($p > 0.05$). Nevertheless, variations in several hematological indices were evident, particularly among HCV-infected patients. The liver serves as an important hematopoietic organ during fetal development and contributes to the maintenance of hematological homeostasis throughout life. Liver dysfunction resulting from viral hepatitis may influence blood cell production, survival, and metabolism, thereby affecting hematological parameters [20]. Previous studies have reported varying degrees of anemia, leukopenia, thrombocytopenia, and red cell abnormalities among patients with chronic viral hepatitis [9,10,18].

In the present study, healthy controls exhibited comparatively higher mean values of hemoglobin concentration, red blood cell count, packed cell volume, mean corpuscular volume, and mean corpuscular hemoglobin than HBV- and HCV-infected patients. Similar observations were reported by Dar et al. and Ahsan et al., who found reduced hematological indices among hepatitis-infected individuals compared with healthy controls [4,13]. The total white blood cell count was relatively higher among HBV-positive patients compared with HCV-positive patients and controls. Although the difference was not statistically significant, this finding may reflect an ongoing inflammatory or immune response associated with HBV infection [5,21]. Similar trends have been described in studies investigating the hematological manifestations of chronic hepatitis [11,22]. An important observation in the present study was the greater variability in MCV and PCV values among HCV-infected patients. The larger standard deviations observed for these parameters may indicate heterogeneity in disease progression, nutritional status, or individual host responses to infection [8,15].

Ain et al. reported comparable findings, demonstrating significant fluctuations in hematological indices among HCV-infected individuals [18]. Fasola et al. reported that marked anemia is relatively uncommon in acute viral hepatitis and that hematocrit values may fluctuate during the early phase of infection due to transient bone marrow suppression and autoimmune hemolytic mechanisms [19]. Likewise, Lin et al. and Akarsu et al. documented hematological abnormalities in acute viral hepatitis, although these changes were often temporary and resolved with clinical recovery [23,24].

The absence of statistically significant differences in the current study may be attributed to the relatively small sample size and the cross-sectional nature of the study. In addition, the study did not evaluate viral load, liver enzyme levels, disease severity, or duration of infection, all of which may influence hematological findings [16,17,25]. Overall, the findings of the present study suggest that routine hematological parameters alone may have limited utility in distinguishing HBV- and HCV-infected patients from healthy individuals. However, these parameters remain valuable as part of a comprehensive clinical and laboratory assessment of patients with viral hepatitis.

CONCLUSION

The present study evaluated hematological parameters among patients with Hepatitis B infection, Hepatitis C infection, and healthy controls. Although minor variations were observed in parameters such as hemoglobin concentration, red blood cell count, total white blood cell count, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and red cell distribution width, these differences were not statistically significant.

HCV-positive patients exhibited greater variability in MCV and PCV values compared with HBV-positive patients and healthy controls. However, the overall findings suggest that routine hematological parameters alone may not be sufficient to differentiate HBV and HCV infections from healthy individuals. Further studies involving larger sample sizes, longitudinal follow-up, and additional hematological and biochemical biomarkers are recommended to better understand the hematological manifestations of viral hepatitis and their clinical significance.

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