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Hematological Alterations in Patients Infected with Hepatitis B Virus: A Retrospective Study from Libreville, Gabon

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Abstract

Background: Hepatitis B virus (HBV) infection remains a major global public health concern, particularly in sub-Saharan Africa. Although primarily associated with liver disease, HBV infection may also influence hematological parameters. **Objective:** This study aimed to assess variations in selected hematological parameters among HBV-infected patients compared with uninfected individuals at the Mother and Child University Hospital Center—Jeanne Ebori Foundation (CHUME-FJE), Libreville, Gabon. **Methods:** We conducted a retrospective study including 150 patients who underwent both hepatitis B surface antigen (HBsAg) testing and complete blood count (CBC) analysis between January 2019 and December 2021. Patients were classified into two groups: HBsAg-positive (n = 75) and HBsAg-negative controls (n = 75). Hematological parameters were analyzed and compared between groups. **Results:** The study population consisted predominantly of women (72%) with a mean age of 31 years. The highest proportion of HBV-infected patients was found in the 32 - 43-year age group. Compared with controls, a higher proportion of HBV-infected individuals had leukopenia (11% vs. 3%), neutropenia (15% vs. 8%), lymphopenia (20% vs. 8%), and thrombocytopenia (29% vs. 19%). Hemoglobin levels, mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC) did not differ significantly between groups. **Conclusion:** HBV infection appears to affect hematological parameters, particularly leukocyte and platelet counts, potentially reflecting immune alterations and hematopoietic dysfunction associated with chronic infection. Further studies examining inflammatory markers, including the

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neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), as well as possible bone marrow involvement, are warranted.

Keywords

Hepatitis B Virus, Hematological Parameters, Thrombocytopenia, Leukopenia, Gabon

1. Introduction

Viral hepatitis refers to liver inflammation caused by five distinct viruses (hepatitis A, B, C, D, and E), each characterized by different modes of transmission and disease outcomes [1]. Among them, hepatitis B virus (HBV) infection represents a major global public health concern [2]. It is estimated that approximately 2 billion people worldwide have been infected with HBV at some point in their lives, and about 296 million are living with chronic HBV infection. Each year, 1.5 million new infections occur, and without appropriate treatment, chronically infected individuals remain at high risk of developing severe liver complications such as cirrhosis and hepatocellular carcinoma (HCC) [3] [4].

An individual is considered infected with HBV when the virus is demonstrably present in the body, either through the detection of hepatitis B surface antigen (HBsAg) or through the direct identification of HBV DNA in the bloodstream (viral load), regardless of whether the infection is acute, chronic, occult, or mutant. In addition, during the course of infection, biochemical and hematological parameters must also be assessed to ensure optimal patient monitoring.

Sub-Saharan Africa is classified as a region of high endemicity, with an estimated 65 million chronic carriers and approximately 56,000 HBV-related deaths annually [5] [6]. The burden is particularly high among young adults, many of whom acquire the infection perinatally or during early childhood, leading to a high likelihood of chronicity [7].

The liver plays a central role in systemic homeostasis through the activity of hepatocytes, which synthesize most plasma proteins, including albumin, hemoglobin-associated globins, immunoglobulins, and clotting factors [8]. It is also one of the main detoxifying organs, protecting bone marrow function by eliminating toxic byproducts [9]. Consequently, hepatic dysfunction due to viral infections may lead to alterations in hematological parameters, including red blood cell indices, leukocyte counts, and platelet levels [10] [11].

Despite this potential link, the impact of HBV infection on hematological indices remains insufficiently explored, particularly in African settings where HBV prevalence is high. Previous studies have reported varying degrees of anemia, leukopenia, neutropenia, lymphopenia, and thrombocytopenia in HBV-infected individuals, but findings remain inconsistent across populations [12]-[14].

Liver dysfunction associated with HBV infection can lead to hematological alterations through several well-established mechanisms. Impaired hepatic function

reduces the production of key regulatory factors such as thrombopoietin, resulting in decreased platelet synthesis. In addition, progressive liver injury may lead to portal hypertension, which in turn causes splenomegaly and hypersplenism, promoting increased sequestration and destruction of blood cells. These pathophysiological processes provide a strong biological rationale for investigating hematological parameters in HBV-infected patients.

The present study was therefore designed to evaluate hematological parameters in patients with HBV infection compared with HBsAg-negative controls at the Mother and Child University Hospital—Jeanne Ebori Foundation in Libreville, Gabon. Specifically, the study aimed to characterize hematological parameters in HBV-infected and non-infected individuals and to compare variations in key hematological indices between the two groups.

2. Materials and Methods

2.1. Study Setting

This study was conducted in Libreville, Gabon, at the laboratory of the Mother and Child University Hospital Center—Jeanne Ebori Foundation (CHUME-FJE), located in Montée de Louis. This hospital specializes in maternal and child healthcare. Operational since December 28, 2018, the institution was completely rebuilt on the site of the former foundation.

2.2. Study Design

We conducted a retrospective study covering a three-year period, from January 1, 2019, to December 31, 2021.

2.3. Study Population

The study population consisted of patients who underwent both hepatitis B surface antigen (HBsAg) testing and complete blood count (CBC) analysis. During the study period (January 1, 2019 to December 31, 2021), samples were selected based on their HBsAg status—either positive or negative (control group).

2.4. Inclusion Criteria

Patients were included if they:

- Consulted during the study period;
- Had complete information for all study variables;
- Underwent CBC testing, whether HBsAg-positive or HBsAg-negative.

2.5. Exclusion Criteria

Patients were excluded if they:

- Were outside the study period,
- Had incomplete study variables,
- Did not undergo CBC testing, or
- Had known comorbidities likely to affect hematological parameters (e.g., HIV

infection, malaria, pregnancy, other liver diseases, or hematological disorders).

2.6. Data Collection

Data were retrieved from the laboratory registers of the immuno-serology and hematology units of CHUME-FJE.

2.7. Sampling

A semi-random sampling technique was used. HBsAg-positive individuals were first selected according to the inclusion and exclusion criteria. Subsequently, HBsAg-negative individuals were randomly selected in proportion to the number of infected individuals, following the same criteria.

The final sample size was 150 patients.

2.8. Diagnostic Procedures

The analyses performed in this study included CBC and HBsAg testing. Venous blood samples were collected from the antecubital vein into pre-labeled collection tubes. Sampling was performed using a scalp vein set or a vacuum system connected to a pump body. Prior to puncture, the site was disinfected with 70% alcohol, applied from the center outward or from top to bottom. After collection, a cotton swab and bandage were applied to prevent bleeding.

2.9. Complete Blood Count

For each patient, blood was collected into an EDTA tube (Ethylenediaminetetraacetic acid) to obtain plasma or whole blood. This tube is commonly used for hematological and biochemical analyses (e.g., glycated hemoglobin, hemoglobin electrophoresis).

CBC analysis was performed using the Yumizen H-550 hematology analyzer, which combines electrical impedance and flow cytometry technologies.

When blood enters the analyzer, cells pass through a narrow capillary subjected to a low-frequency electric current. Variations in the current generate impedance signals that are detected and analyzed. Flow cytometry, based on lasers and detectors, further differentiates blood cell populations.

By integrating these technologies, the Yumizen H-550 provides a comprehensive analysis, including red and white blood cell counts, platelet count, hemoglobin concentration, mean corpuscular volume, hematocrit, and other key hematological parameters.

2.10. HBsAg Detection

For serological testing, samples were collected in silica-coated dry tubes to allow serum separation. These tubes are routinely used for immuno-serology and biochemistry.

Screening was first performed using the Determine™ HBsAg rapid diagnostic test (RDT), an immunochromatographic strip-based assay that enables rapid

identification of HBsAg-positive patients. The technique relies on capillary migration of viral antigens along a nitrocellulose membrane, where they bind to immobilized antibodies. Antigen-antibody complexes are visualized using colloidal gold or latex particles, producing a colored band. A control band validates the test result [15].

Confirmation was performed using the MINI VIDAS® (bioMérieux) system, which combines enzyme-linked immunoassay with fluorescence detection (ELFA).

Briefly, after washing steps, antigens from the sample simultaneously bind to monoclonal primary antibodies immobilized on the solid phase and to biotinylated secondary antibodies. After washing, streptavidin-conjugated alkaline phosphatase binds to the biotinylated antibody. In the final detection step, the substrate (4-methylumbelliferyl phosphate) is hydrolyzed into 4-methylumbelliferone, which emits fluorescence measured at 450 nm.

The fluorescence intensity is proportional to the antigen concentration in the sample, and results are expressed as an index relative to a standard [16] [17].

2.11. Data Processing and Statistical Analysis

Data were entered into Microsoft Excel 2010. The variables studied included age, sex, HBsAg status, hemoglobin level, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), white blood cell count, leukocyte differential, and platelet count.

Qualitative variables were expressed as counts and percentages, whereas quantitative variables were expressed as means with standard errors. Comparisons between HBsAg-positive and HBsAg-negative groups were performed using the Chi-square (χ^2) test to assess differences in the distribution of hematological parameters.

3. Results

3.1. General Description of the Study Population

A total of 150 patients were included in this study.

3.2. Sex Distribution

The study population consisted of 108 women (72%) and 42 men (28%), corresponding to a sex ratio of 0.39 (**Figure 1**).

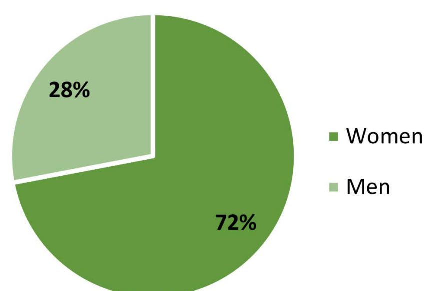


Figure 1. Distribution of the study population by sex.

3.3. Age Distribution

The mean age of the study population was 31 ± 1 years, with extremes ranging from 2 days to 73 years.

3.4. Distribution of the Study Population According to HBsAg Status

Among the 150 patients, 75 were HBsAg-positive and 75 were HBsAg-negative, forming the group of HBV-infected individuals and the control group, respectively (Figure 2).

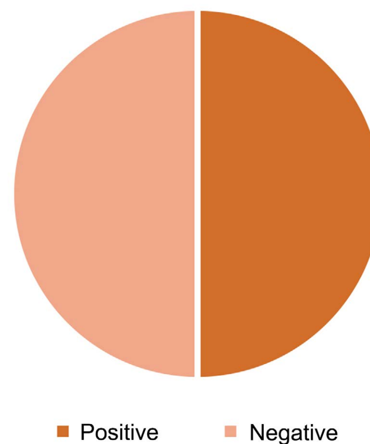
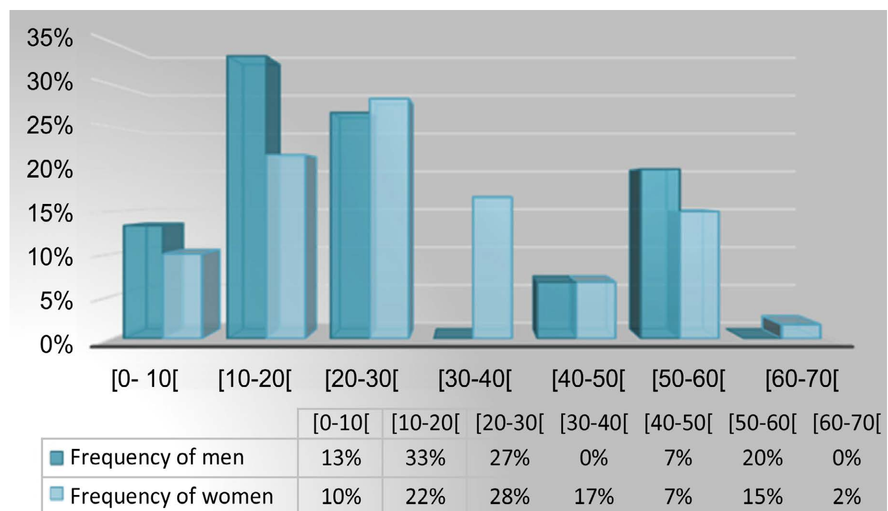


Figure 2. Distribution of the study population according to HBsAg status.

3.5. Distribution of HBsAg-Negative Patients by Age Group and Sex

The mean age of HBsAg-negative patients was 29 ± 2 years (range: 3 days to 66 years). Among men, the most represented age group was 10 - 20 years (33%), while among women, the most represented group was 20 - 30 years (28%). No men were observed in the 30 - 40 and 60 - 70 years age groups (Figure 3).



	[0-10[	[10-20[	[20-30[	[30-40[	[40-50[	[50-60[	[60-70[
Frequency of men	13%	33%	27%	0%	7%	20%	0%
Frequency of women	10%	22%	28%	17%	7%	15%	2%

Figure 3. Distribution of HBsAg (−) patients by age group and sex.

3.6. Distribution of HBsAg-Positive Patients by Age Group and Sex

For HBsAg-positive patients, the mean age was 34 ± 2 years (range: 2 days to 73 years). The most represented age group was 32 - 43 years, with 48% of men and 31% of women (Figure 4).

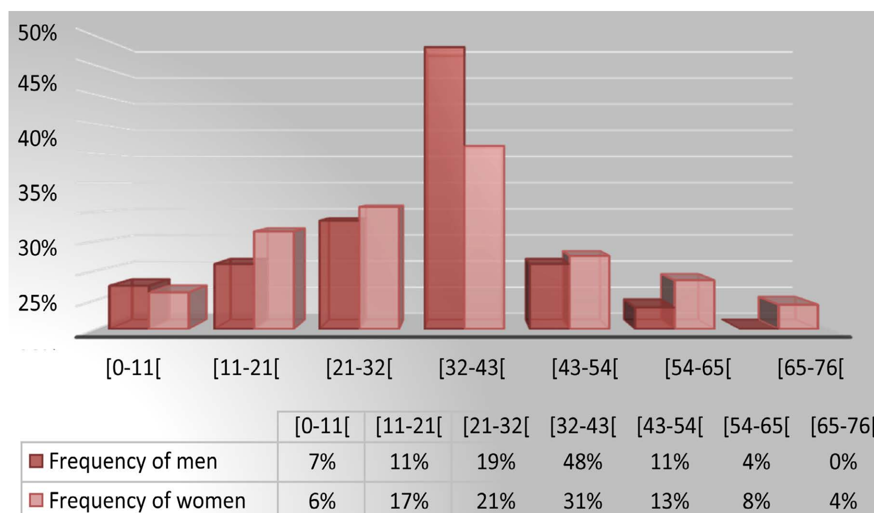


Figure 4. Distribution of HBsAg (+) patients by age group and gender.

3.7. Hemoglobin Levels in HBsAg-Negative and HBsAg-Positive Patients

Hemoglobin levels were assessed in both HBV-infected and HBsAg-negative individuals. A decrease in hemoglobin levels was observed in both groups, with 37% of HBV-infected patients presenting anemia. Notably, none of the HBsAg-positive patients showed hemoglobin overproduction (Table 1).

Table 1. Hb levels in HBsAg (−) and HBsAg (+) individuals.

Hemoglobin (g/dL)	HBsAg-negative (n, %)	HBsAg-positive (n, %)
<11.5	29 (39%)	28 (37%)
11.5 - 15.0	42 (56%)	47 (63%)
>15.0	4 (5%)	0 (0%)
Total	75 (100%)	75 (100%)

Mean corpuscular volume (MCV) in HBsAg-negative and HBsAg-positive patients

Most patients in both groups presented normal MCV values (80 - 100 fL), with 91% of HBsAg-negative and 88% of HBsAg-positive patients. No macrocytosis was observed. However, 12% of HBsAg-positive patients presented microcytosis (Table 2).

Table 2. MCV levels in HBsAg-negative and HBsAg-positive patients.

MCV (fL)	HBsAg-negative (n, %)	HBsAg-positive (n, %)
<80.0	7 (9%)	9 (12%)
80.0 - 100.0	68 (91%)	66 (88%)
>100.0	0 (0%)	0 (0%)
Total	75 (100%)	75 (100%)

Mean corpuscular hemoglobin concentration (MCHC) in HBsAg-negative and HBsAg-positive patients

MCHC analysis revealed a predominance of normochromia in both groups (84% in HBsAg-negative and 92% in HBsAg-positive patients). Additionally, 8% of HBsAg-positive patients presented hypochromia (Table 3).

Table 3. MCHC levels in HBsAg-negative and HBsAg-positive patients.

MCHC (g/dL)	HBsAg-negative (n, %)	HBsAg-positive (n, %)
<32.0	12 (16%)	6 (8%)
32.0 - 37.0	63 (84%)	69 (92%)
>37.0	0 (0%)	0 (0%)
Total	75 (100%)	75 (100%)

White blood cell (WBC) counts in HBsAg-negative and HBsAg-positive patients.

Most patients had normal WBC counts (4000 - 10,000/μL): 79% among HBsAg-negative and 81% among HBsAg-positive patients. However, leukopenia was more frequent in the HBV-infected group (11%) compared with controls (3%) (Table 4).

Table 4. WBC counts in HBsAg-negative and HBsAg-positive patients.

WBC (μL)	HBsAg-negative (n, %)	HBsAg-positive (n, %)
<4000	2 (3%)	8 (11%)
4000 - 10,000	59 (79%)	61 (81%)
>10,000	14 (19%)	6 (8%)
Total	75 (100%)	75 (100%)

3.8. Differential Leukocyte Counts

Differential leukocyte analysis showed that neutropenia and lymphopenia were more frequent in HBsAg-positive patients compared with controls (11 vs. 6 for neutrophils; 15 vs. 6 for lymphocytes) (Figure 5 and Figure 6).

3.9. Differential Leukocyte Counts in HBsAg-Negative Patients

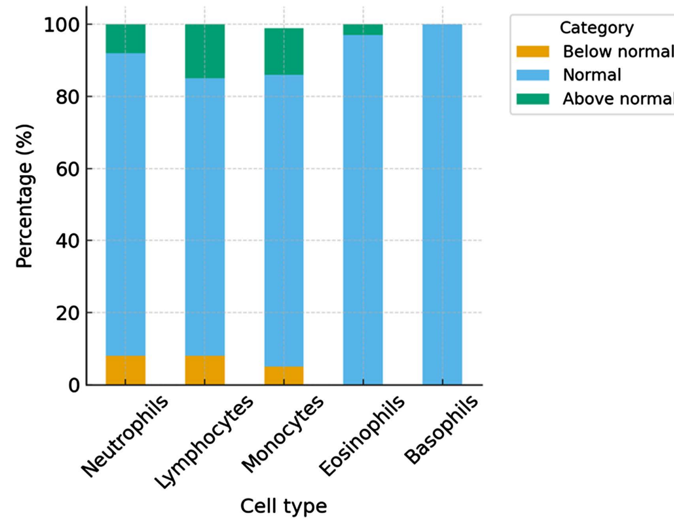


Figure 5. Differential leukocyte counts in HBsAg-negative patients.

- Neutrophils: 8% below normal, 84% normal, 8% above normal
- Lymphocytes: 8% below normal, 77% normal, 15% above normal
- Monocytes: 5% below normal, 81% normal, 13% above normal
- Eosinophils: 0% below normal, 97% normal, 3% above normal
- Basophils: 0% below normal, 100% normal, 0% above normal

3.10. Differential Leukocyte Counts in HBsAg-Positive Patients

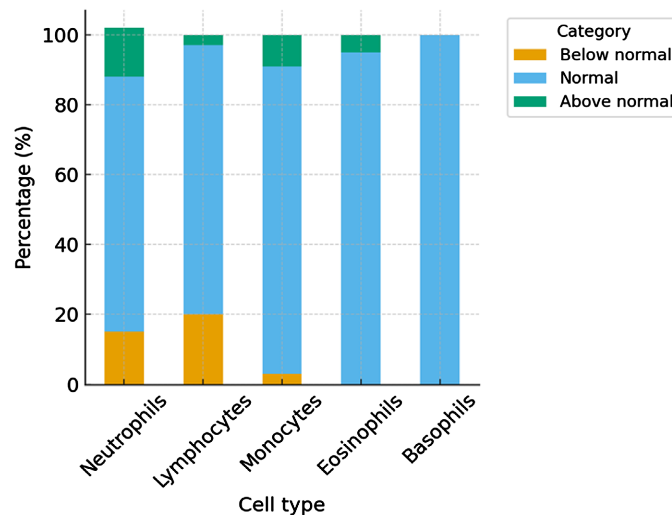


Figure 6. Differential leukocyte counts in HBsAg-positive patients.

- Neutrophils: 15% below normal, 73% normal, 14% above normal
- Lymphocytes: 20% below normal, 77% normal, 3% above normal
- Monocytes: 3% below normal, 88% normal, 9% above normal
- Eosinophils: 0% below normal, 95% normal, 5% above normal

- Basophils: 0% below normal, 100% normal, 0% above normal

3.11. Platelet Counts in HBsAg-Negative and HBsAg-Positive Patients

Platelet count analysis indicated that thrombocytopenia was more frequent in HBV-infected patients (29%) compared with controls (19%) (Table 5).

Table 5. Platelet counts in HBsAg-negative and HBsAg-positive patients.

Platelets (μL)	HBsAg-negative (n, %)	HBsAg-positive (n, %)
<150,000	14 (19%)	22 (29%)
150,000 - 400,000	55 (73%)	51 (68%)
>400,000	6 (8%)	2 (3%)
Total	75 (100%)	75 (100%)

Taken together, when comparing hematological parameters between HBsAg-positive patients and HBsAg-negative controls, no significant differences were observed in hemoglobin levels (p = 0.17), MCV (p = 0.88), MCHC (p = 0.34), or platelet counts (p = 0.16). However, a statistically significant difference was found for total white blood cell count (WBC), with HBsAg-positive individuals showing a distinct distribution compared with controls (p = 0.042).

4. Discussion

The present study aimed to evaluate hematological parameters in patients with hepatitis B virus (HBV) infection compared with HBsAg-negative controls. A total of 150 patients were included, with a predominance of women (72%). This female predominance was expected, since the study was conducted in a mother-and-child university hospital, whose main mission is maternal and child health care. Interestingly, among HBsAg-positive individuals, women were more frequently represented, which contrasts with previous findings by Ahmad *et al.* [14], Boungou [18], and Ag Mohamed [2], who reported that men are usually more affected by HBV infection. This difference is most likely due to the demographic profile of our study population, where women were overrepresented.

The mean age of HBV-infected patients was 34 ± 2 years, which is consistent with findings from Diallo *et al.* [5] in Senegal (mean age 33 years, range 14 - 83 years) and Ag Mohamed [2] (mean age 32.9 years, range 12 - 72 years). In our cohort, the most affected age group was 32 - 43 years, especially among men, which aligns with previous reports indicating that HBV infection primarily affects young adults [1]-[3] [5]. This observation is not surprising, as HBV is mainly transmitted through sexual contact, and this age group corresponds to the sexually active population. Similar data were also reported by Kolawole *et al.* [19], who identified the 30 - 34 years group as the most affected.

Regarding hematological parameters, HBV infection did not appear to signifi-

cantly alter hemoglobin concentration, mean corpuscular volume (MCV), or mean corpuscular hemoglobin concentration (MCHC). Normochromia was observed in the majority of patients in both groups (92% in HBsAg-positive vs. 84% in HBsAg-negative). These findings are consistent with Francisca *et al.* [13], who reported no significant changes in red blood cell counts or indices in HBV-infected patients. However, 37% of HBV-infected patients in our study presented with anemia, while 12% had microcytosis and 8% hypochromia. Although we do not have all the parameters to define the viral infection status of our patients (acute or chronic hepatitis), according to the literature, it is known that chronic HBV infection can lead to hepatic complications, such as cirrhosis and hepatocellular carcinoma, which may impair the liver's role in erythropoiesis and contribute to anemia [20] [21]. Indeed, anemia is a well-documented complication of advanced liver disease.

With regard to white blood cell (WBC) counts, most patients in both groups exhibited normal values (81% in HBsAg-positive vs. 79% in HBsAg-negative). Nevertheless, leukopenia was more frequent in HBV-infected patients (8 cases) compared with controls (2 cases). Given that WBCs play a central role in the immune response by targeting and destroying HBV-infected hepatocytes, their reduction during viral infection is not unexpected. Our results partially diverge from those of Ahmad *et al.* [14], who found no significant differences in total WBC counts. Moreover, neutropenia and lymphopenia were more frequent among HBV-infected individuals (11 vs. 6 for neutrophils; 15 vs. 6 for lymphocytes). HBV infection may impair leukopoiesis, leading to reduced neutrophil and lymphocyte counts. Neutrophils are the first line of defense against pathogens, mainly through phagocytosis, while lymphocytes recognize and attack HBV-infected hepatocytes. Thus, the observed cytopenias may reflect immune system exhaustion or viral-induced suppression. These findings are in agreement with Ahmad *et al.* [14], who reported lymphocyte depletion in HBV patients, and Kayhan *et al.* [9], who observed neutropenia in chronic HBV infection.

Thrombocytopenia was also more common in HBV-infected patients (22 cases) compared with controls (14 cases). Thrombocytopenia is a well-recognized hematological abnormality associated with chronic liver disease and HBV infection [22] [23]. The main mechanisms proposed include increased platelet destruction, peripheral sequestration, and hypersplenism secondary to portal hypertension [22].

Taken together, our findings suggest that HBV infection does not substantially impact red blood cell indices (hemoglobin, MCV, and MCHC) but is associated with a higher prevalence of anemia, leukopenia (particularly neutropenia and lymphopenia), and thrombocytopenia. These abnormalities may result from both direct viral effects and secondary complications of chronic liver disease.

In this study, most hematological parameters did not differ significantly between HBsAg-positive patients and HBsAg-negative controls. Hemoglobin levels, MCV, MCHC, and platelet counts showed comparable distributions between the two groups, suggesting that HBV infection alone may not substantially alter these parameters in asymptomatic or early-stage individuals. These findings are con-

sistent with reports indicating that hematological abnormalities in HBV infection often emerge only in advanced disease stages, during hepatic decompensation, or in the presence of associated conditions such as hypersplenism or bone marrow suppression.

However, a significant difference was observed in total white blood cell count (WBC) ($p = 0.042$). This finding may reflect an inflammatory or immunological imbalance associated with active viral infection. HBV is known to interact with the host immune system, particularly through antiviral T-cell responses, cytokine activation, and liver-mediated immunomodulation, which may influence circulating leukocyte profiles. An altered WBC distribution in HBsAg-positive individuals could indicate early immune activation even in the absence of clinical symptoms.

This observation highlights the potential value of incorporating inflammatory markers—such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR)—into routine evaluation of HBV-infected patients. These ratios have emerged as inexpensive, accessible indicators of systemic inflammation and may complement standard hematological parameters. Further studies integrating NLR, PLR, and biochemical markers (ALT, AST, bilirubin) could provide a more complete picture of disease activity and help identify early alterations associated with hepatic or bone marrow involvement.

A limitation of this study was the lack of detailed clinical information on the patients, such as liver disease stage, treatment history, and comorbidities, which could have influenced hematological outcomes. Further studies including larger cohorts and additional clinical parameters are warranted to clarify the mechanisms underlying hematological alterations in HBV infection. In addition, the absence of key virological and biochemical data, such as HBV DNA levels, HBeAg status, and liver enzyme measurements (ALT/AST), also constitutes a limitation in our study due to the retrospective nature of our study.

5. Conclusion

HBV infection appears to influence hematological parameters, particularly reducing leukocyte and platelet counts. These findings highlight the importance of monitoring hematological indices in HBV-infected patients, both for clinical management and for understanding virus-host interactions. Expanded studies are needed to investigate hematological ratios (NLR, PLR) and their prognostic relevance in HBV-related disease.

Acknowledgements

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Informed Consent Statement

Prior to enrollment, informed consent was obtained from each participant and written informed consent has been obtained from the patients to publish this pa-

per. Women identified with HBV infection were referred to a hepatologist for appropriate medical management.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no competing interests.

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