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Saja Khudhier Essa Al-Juboori
Dept. of Biology, College of Sciences for women - University of Baghdad, Baghdad, Iraq,
saja95.khudhier@gmail.com

Shaymaa Ismael Kadhum Al-Juboori
Dept. of Biology, College of Sciences for women - University of Baghdad, Baghdad, Iraq,
shamaa.i@csw.uobaghdad.edu.iq

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RESEARCH ARTICLE

Determination of the Hematological and Biochemical Parameters Associated with Liver Cancer, Hepatitis Types B, and C in Iraqi Patients

Saja Khudhier Essa Al-Juboori *, Shaymaa Ismael Kadhim Al-Juboori

Dept. of Biology, College of Sciences for women - University of Baghdad, Baghdad, Iraq

ABSTRACT

Hepatocellular carcinoma (HCC) is the second most common cancer in humans and the fifth most prevalent worldwide. Although the survival rate of HCC has increased over time, postoperative recurrences remain high after a decade. HCC can be caused by both viral and non-viral diseases. There are two major global risk factors for HCC these are: hepatitis B virus (HBV) and hepatitis C virus (HCV). As part of routine health exams, complete blood counts can detect a variety of disorders, including infections, anemia, immune system disorders, and blood cancers. A complete blood count (CBC) can be used to perform a biochemical profile, which evaluates several critical organs and systems. Additionally, the CBC can detect red blood cell disorders, inflammation, and other metabolic disorders. The aim of this study is to identify the most significant and co-related haematological and biochemical parameters among patients with HCC, HBV, and HCV. The results revealed that some haematological and biochemical parameters changed significantly in the three groups (HCC, HBV, and HCV). Each liver disease can be evaluated using a single parameter, including the MPV for HCC, the MID for HBV, and the P-LCC for HCV. Despite this, two parameters are common to all three liver diseases, namely GOT (AST) and indirect bilirubin.

Keywords: Hepatocellular carcinoma, HBV, HCV, Hematology, Biochemistry

1. Introduction

Various types of cancer can affect the liver. Hepatocellular carcinoma (HCC) is one of the most common types of liver cancer and a leading cause of cancer death in humans. HCC is highly aggressive and has a poor prognosis, making it a particularly dangerous form of

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* Corresponding author.
E-mail addresses: saja95.khudhier@gmail.com (S. Khudhier Essa Al-Juboori), shamaa.i@csw.uobaghdad.edu.iq (S. Ismael Kadhim Al-Juboori).

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cancer [1, 2]. Cancer can form new tumor colonies as it migrates from other tumors to the liver, making it difficult to detect the disease throughout its course [3]. HCC is caused by a variety of viral and non-viral diseases [4]. HCC kills approximately two million people worldwide. As a result, the aggressive nature of HCC makes it particularly dangerous and hard to identify in its early stages [5].

The Hepatitis B Virus (HBV) is one of the most common and deadly diseases in the world and infects over 2 billion people. HBV accounts for up to 80% of all HCC cases, which are prevalent in Chinese and African populations [6]. HBV infection persisting in liver tissue has been linked to cancer, inflammation of the liver, and chronic oxidative damage [7].

There is no doubt that the Hepatitis C Virus (HCV) is a major cause of HCC. HCV is associated with HCC, the fifth most common malignancy worldwide, accounting for 85 to 90% of all primary liver cancers. Despite the reduction in HCC risk with HCV treatment, patients with cirrhosis still face the risk of HCC. The prevention of HBV-associated HCC can also be achieved through immunization and antiviral therapy, but these methods are not widely available everywhere. To address HBV-related HCC effectively and affordably, further research is needed [8].

As part of a routine health examination, a complete blood count, or CBC, is often performed. Complete blood counts detect a variety of disorders, such as infections, anemia, immune system diseases, and blood cancers. Furthermore, a biochemical profile involves a series of blood tests that assess the function of several critical organs and systems. In addition to a complete blood count (CBC), tests can also be conducted on these organs and systems. Biochemical profiles can detect the presence of kidney disease, liver disease, diabetes, and other metabolic disorders. Additionally, they can be used to monitor the effectiveness of treatments and predict potential health risks [9].

Therefore, we analyzed the blood and biochemical test results of patients with HCC, HBV, and HCV liver disease to identify the most significant and co-related parameters.

2. Materials and methods

2.1. The collection of samples

64 blood samples were collected for this study, including 20 samples from individuals with HCC (under treatment), 4 samples from individuals before treatment, 10 samples from individuals with HBV, 10 samples from individuals with HCV, and 20 samples from healthy individuals. Patients were sampled after an oncologist diagnosed them with Hepatitis B and C infections and hepatocellular carcinoma.

Samples were collected from Baghdad hospitals provided samples, including the following:

1. Medical City Hospital (Oncology Teaching Hospital)
2. Medical City Hospital (Gastroenterology and Hepatology Teaching Hospital)
3. Al-Yarmook Teaching Hospital

Between November 2022 and April 2023.
Ethics committee approval was given by the Iraqi Ministry of Health.

2.2. Specimen collection (Blood Samples Collection)

Each patient had five milliliters of blood taken by venipuncture using disposable syringes at Medical City Hospital (Oncology Teaching Hospital, Gastroenterology and Hepatology

Table 1. Distribution of HCC, HVC, HBV and apparently healthy control subjects by age group.

Group	HCC	HVC	HBC	Control
10–20	1	2	-	1
21–30	1	6	4	4
31–40	-	2	4	6
41–50	6	6	8	6
51–60	8	4	4	2
61–70	7	-	-	3
71–80	1	-	-	2

Teaching) Hospital and Al-Yarmook Teaching Hospital in Baghdad and apparently healthy control people obtained at various places.

A CBC test was performed by adding 2ml of blood to an EDTA tube K3 and mixing for 2 minutes to anticoagulant, then analyzing the samples using the CBC 3DIF device (Mindry).

The Spectrophotometer was used for the Biochemistry test to measure Blood sugar, Urea, Creatinine, Alkaline Phosphate, and Total Bilirubin. Biosystem devices, however, were used for GPT and GOT.

2.3. Statistical analysis

The statistical was performed software R package [10] and used Student's T-test evaluated the relation between normal and abnormal results for each analysis to get P value, and the Chi square test to get the percentage to normal, abnormal from the study sample to compare categorical data. Independent sample t-tests were used to compare two means, while one-way analysis of variance (ANOVA) was used to compare more than two means. The p-value was used ≤ 0.05.

In addition, Venny2.0, an interactive tool for comparing lists with Venn's diagrams, was used to analyze the data generated from previous tables [11].

3. Results

3.1. Distribution of the gender

A total of twenty-four patients with HCC were studied, including four samples of patients who had not been treated with HCC. Six of the patients were males and 18 were females. Twenty subjects with recurrent HBV were also included, ten males and ten females. A total of 20 subjects with recurrent HCV were included in the study, 10 of whom were males and 10 of whom were females. In addition, twenty-four healthy subjects were included as apparently control subjects, including ten males and fourteen females.

3.2. Distribution of age

According to this study, hepatocellular carcinoma risk increases with age. Based on the results illustrated in Table 1, the mean age at diagnosis was 43 years, ranging from 20 to 70 years. It was found that patients between 51 and 60 had the highest number of HCC cases. Hepatocellular carcinoma is more likely to occur in people over 44 years of age. HCV incidence rates were strongly related to age and gender, with the highest rates observed among younger men and women. Both males and females experienced a gradual increase in incidence rates between 21 and 30.

Table 2. Statistical correlation between hematological parameters of HCC.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
W.B.C	19(24)	79.17%	5(24)	20.833%	24	0.431
LYM%	18(24)	75.00%	6(24)	25.00%	24	0.362
GRAN%	18(24)	75.00%	6(24)	25.00%	24	0.362
LYM#	18(24)	75.00%	6(24)	25.00%	24	0.362
GRAN#	0(24)	00.00%	24(24)	100%	24	0.001***
RBC	11(24)	45.833%	13(24)	54.17%	24	0.0491 *
HGB	9(24)	37.5%	15(24)	62.5%	24	0.0463*
HCT	9(24)	37.5%	15(24)	62.5%	24	0.0423*
MCV	14(24)	58.33%	10(24)	41.66%	24	0.0831
MCH	16(24)	66.66%	8(24)	33.33%	24	0.6473
MCHC	8(24)	33.33%	16(24)	66.66%	24	0. 384
RDW-CV	5(24)	20.833%	19(24)	79.17%	24	0.0233*
RDW-SD	7(24)	29.83%	17(24)	70.17%	24	0.0322*
PLT	10(24)	41.33%	14(24)	58.66%	24	0.0373*
MPV	12(24)	50.00%	12(24)	50.00%	24	0.0482*
PDW	1(24)	4.17%	23(24)	95.83%	24	0.001***
PCT	0(24)	0.00%	24(24)	100%	24	0.001***
P-LCR	17(24)	70.83%	7(24)	29.17%	24	0.786
P-LCC	16(24)	66.66%	8(24)	33.33%	24	0.647
MID%	23(24)	95.83%	1(24)	4.16%	24	0.895
MID#	24(24)	100%	0(24)	80.00%	24	0.9998
Chi Square	$P = 7.006 \times 10^{-25}$					

3.3. Hematological parameters among patients with HCC

Results indicate that several parameters, including Granulocytes (GRAN), Platelet Distribution Width (PDW), and Platelet Concentration (PCT), were significantly abnormal compared to the respective control levels ($p \leq 0.001$). The levels of Red Blood Cells (RBC), Hemoglobin (HGB), and Hematocrit (HCT) as well as the red blood cell distribution width (RDW- CV), (RDW- SD), Platelet Count (PLT), and Mean Platelet Volume (MPV) were significantly altered compared with the control group ($p < 0.05$).

Table 2 illustrates the Hematological parameters and correlation coefficients and normal values. Furthermore, the percentage of normal and abnormal hematology distributions of HCC patients according to normal levels is also provided. It was noted that participants with HCC showed a significant correlation between the ratio of GRAN normal (00.00%) and abnormal (100%), PDW normal (4.17%) and abnormal (95.83%), and PCT normal (0.00%) and abnormal (100%). In addition, a significant correlation ($p < 0.05$) has been found between RBC normal (45.333%) and abnormal (54.17%), HGB normal (37.5%) and abnormal (62.5%), HCT normal (37.5%) and abnormal (62.5%), RDW-CV normal (20.833%) abnormal (79.17%), RDW-SD normal (29.83%) and abnormal (70.17%), PLT normal (41.33%) and abnormal (58.66%) and MPV normal (50.00%) and abnormal (50.00%). Other parameters, however, did not show a significant correlation.

3.4. Hematological parameters among patients with HBV

It was found that several parameters, including lymphocytes (LYM), red blood cells (RBCs), hemoglobin (HGB), and Platelet-large cell ratio (P-LCR) were significantly abnormal compared with their respective control levels ($p \leq 0.001$). The percentages of normal and abnormal hematology distributions of HBV patients are also presented in Table 3. Participants with HBV had significantly abnormal lymphocyte ratios (100%) and normal

Table 3. Statistical correlation between hematological HBV parameters.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
W.B.C	7(10)	70.00%	3(10)	30.00%	10	0.065
LYM%	7(10)	70.00%	3(10)	30.00%	10	0.065
GRAN%	8(10)	80.00%	2(10)	20.00%	10	0.203
LYM#	0(10)	0.00%	10(10)	100%	10	0.001***
GRAN#	7(10)	70.00%	3(10)	30.00%	10	0.065
RBC	0(10)	0.00%	10(10)	100%	10	0.001***
HGB	0(10)	0.00%	10(10)	100%	10	0.001***
HCT	10(10)	100%	0(10)	0.00%	10	0.993
MCV	5(10)	50.00%	5(10)	50.00%	10	0.0322*
MCH	6(10)	60.00%	4(10)	40.00%	10	0.0473*
MCHC	5(10)	50.00%	5(10)	50.00%	10	0.0322*
RDW-CV	6(10)	60.00%	4(10)	40.00%	10	0.0473*
RDW-SD	5(10)	50.00%	5(10)	50.00%	10	0.0322*
PLT	6(10)	60.00%	4(10)	40.00%	10	0.0473*
MPV	8(10)	80.00%	2(10)	20.00%	10	0.203
PDW	10(10)	100%	0(10)	0.00%	10	0.993
PCT	4(10)	40.00%	6(10)	60.00%	10	0.0254*
P-LCR	1(10)	10.00%	9(10)	90.00%	10	0.002**
P-LCC	7(10)	70.00%	3(10)	30.00%	10	0.065
MID%	7(10)	70.00%	3(10)	30.00%	10	0.065
MID#	2(10)	20.00%	8(10)	80.00%	10	0.00714**
Chi Square	$P = 3.806 \times 10^{-9}$					

(00.00%), abnormal RBC ratios (100%) and normal (0.00%), and abnormal HGB ratios (100%) and normal (0.00%), as well as P-LCRs that were normal (10.00%) and abnormal (90.00%) in significant correlation (0.002).

A significant correlation was found (p 0.05) between mean corpuscular volume (MCV) normal (50.00%) and abnormal (50.00%), and mean corpuscular hemoglobin (MCH) normal (60.00%) and abnormal (40.00%) in participants with HBV. Furthermore, the mean corpuscular hemoglobin concentration (MCHC) is normal and abnormal (50.00%), the Red Blood Cell Distribution Width CV (RDW-CV) is normal and abnormal (40.00%), the Red Cell Distribution Width (RDW-SD) is normal and abnormal (50.00%), the PLT is normal (60%) and abnormal (40.00%), the minimum inhibitory dilution (MID) is normal (20.00%) and abnormal (80.00%), and the procalcitonin level in the blood (PCT) is normal (40.00%) and abnormal (60.00%). However, no significant correlation was found with any other parameters.

3.5. Hematological parameters in patients with HCV

Most of the hematology parameters that were examined in this study changed significantly, including LYM%, LYM, RBC, HGB, HCT, MCV, MCHC, PLT, PCT, P-LCR, and P-LCC. When compared with respective normal ranges, the percentage of normal patients was (0.00%) and the percentage of abnormal patients was (100%) at ($P = 0.001$). Additionally, a significant change was observed in MCH and RDW-CV, both of which were normal (10.00%) and abnormal (90.00%) in correlation ($P = 0.002$). Furthermore, significant modifications were observed in the percentages of GRAN with normal ratios of (40.00%) and abnormal ratios of (60.00%), in GRAN# normal (60.00%) and abnormal (40.00%), in RDW-SD normal (30.00%) and abnormal (70.00%), and in PDW normal (30.00%) abnormal (70.00%) with a correlation of p value ($p = 0.05$). However, there was no

Table 4. An analysis of the correlation coefficient between hematological parameters and HCV infection.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
W.B.C	7(10)	70.00%	3(10)	30.00%	10	0.065
LYM%	0(10)	0.00%	10(10)	100%	10	0.001***
GRAN%	4(10)	40.00%	6(10)	60.00%	10	0.0254*
LYM#	0(10)	0.00%	10(10)	100%	10	0.001***
GRAN#	6(10)	60.00%	4(10)	40.00%	10	0.0473*
RBC	0(10)	0.00%	10(10)	100%	10	0.001***
HGB	0(10)	0.00%	10(10)	100%	10	0.001***
HCT	0(10)	0.00%	10(10)	100%	10	0.001***
MCV	0(10)	0.00%	10(10)	100%	10	0.001***
MCH	1(10)	10.00%	9(10)	90.00%	10	0.002**
MCHC	0(10)	0.00%	10(10)	100%	10	0.001***
RDW-CV	1(10)	10.00%	9(10)	90.00%	10	0.002**
RDW-SD	3(10)	30.00%	7(10)	70.00%	10	0.0214*
PLT	0(10)	0.00%	10(10)	100%	10	0.001***
MPV	8(10)	80.00%	2(10)	20.00%	10	0.203
PDW	3(10)	30.00%	7(10)	70.00%	10	0.0214*
PCT	0(10)	0.00%	10(10)	100%	10	0.001***
P-LCR	0(10)	0.00%	10(10)	100%	10	0.001***
P-LCC	0(10)	0.00%	10(10)	100%	10	0.001***
MID%	9(10)	90.00%	1(10)	10.00%	10	0.945
MID#	9(10)	90.00%	1(10)	10.00%	10	0.945
Chi Square	$P = 3.858 \times 10^{-15}$					

Table 5. Statistical correlation between biochemistry parameters of HCC.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
Blood Sugar	17(24)	70.83%	7(24)	29.17%	24	0.793
Urea	20(24)	83.33%	4(24)	16.66%	24	0.562
Creatinine	14(24)	58.33%	10(24)	41.67%	24	0.0422*
GPT (ALT)	22(24)	91.67%	2(24)	8.33%	24	0.792
GOT(AST)	14(24)	58.33%	10(24)	41.67%	24	0.0422*
Alkaline Phosphatase	19(24)	79.17%	5(24)	20.83%	24	0.913
Total Bilirubin	18(24)	90.00%	6(24)	24%	24	0.845
Indirect Bilirubin	2(24)	8.33%	22(24)	91.67%	24	0.001***
Chi Square	$P = 1.597 \times 10^{-9}$					

significant correlation between other parameters. The following Table 4 illustrates the above-mentioned results [6].

3.6. Biochemistry parameters in patients with HCC

Table 5 shows that the distributions of indirect bilirubin normal (8.33%) and abnormal (91.67%) in HCC patients were highly significant ($P = 0.001$). Additionally, there was a significant correlation between Creatinine levels that were normal (58.33%) and abnormal (41.67%), as well as GOT (AST) levels that were normal (58.33%) and abnormal (41.67%). Other parameters, however, did not show a significant correlation.

3.7. Biochemistry parameters in patients with HBV

As shown in Table 6, HBV patients have elevated levels of Indirect Bilirubin, GPT (ALT), GOT (AST), and Alkaline Phosphatase as compared to normal individuals with

Table 6. Correlation between biochemistry parameters and HBV infection.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
Blood Sugar	10(10)	100%	0(10)	0.00%	10	0.993
Urea	7(10)	70.00%	3(10)	30.00%	10	0.065
Creatinine	5(10)	50.00%	5(10)	50.00%	10	0.0322*
GPT (ALT)	0(10)	0.00%	10(10)	100%	10	0.001***
GOT(AST)	1(10)	10.00%	9(10)	90.00%	10	0.002**
Alkaline Phosphatase	0(10)	0.00%	10(10)	100%	10	0.001***
Total Bilirubin	9(10)	90.00%	1(10)	10%	10	0.945
Indirect Bilirubin	0(10)	0.00%	10(10)	100%	10	0.001***
Chi Square	$P = 3.806 \times 10^{-9}$					

Table 7. Indicates the correlation coefficient between biochemistry parameters related to HCV.

Analysis name	Normal	Percentage (%)	Abnormal	Percentage (%)	Total	P
Blood Sugar	10(10)	100%	0(10)	0.00%	10	0.993
Urea	9(10)	90.00%	1(10)	10.00%	10	0.945
Creatinine	5(10)	50.00%	5(10)	50.00%	10	0.0322*
GPT (ALT)	2(10)	20.00%	8(10)	80%	10	0.00714**
GOT(AST)	0(10)	0.00%	10(10)	100%	10	0.001***
Alkaline Phosphatase	1(10)	10.00%	9(10)	90.00%	10	0.002**
Total Bilirubin	0(10)	0.00%	10(10)	100%	10	0.001***
Indirect Bilirubin	0(10)	0.00%	10(10)	100%	10	0.001***
Chi Square	$P = 2.805 \times 10^{-9}$					

highly significant p values ($p \leq 0.001$). GPT (ALT), Alkaline Phosphatase, and Indirect Bilirubin are normal (0.00%) and abnormal (100%), while GOT (AST) is normal (10.00%) and abnormal (90.00%). In contrast, there was no significant correlation between other variables. These tests are all indicators of liver function. Liver function tests are a group of blood tests that aid in diagnosing liver disorders, detecting inflammation, and preventing liver damage. Chi Square $P = 3.806 \times 10^{-9}$

3.8. Analysis of the biochemistry of patients with HCV

According to Table 7, HCV patients have elevated levels of, GOT (AST), Total Bilirubin, and Indirect Bilirubin. A normal ratio of (0.00%) and abnormal (100%) with a correlated significant P value ($P = 0.001$). The normal percentage of GPT(ALT) is 20.00 percent and the abnormal percentage is 80.00 percent, and the normal levels of Alkaline Phosphatase are 10.00 percent and the abnormal percentage is 90.00 percent.

3.9. Comparison of common parameters from hematology and biochemistry tests among different samples of HCC, HBV, and HCV patients

Venny2.0, an interactive tool for comparing lists with Venn's diagram, was used to analyze the data generated from previous Tables. Based on the Venn diagram in Fig. 1, it can be seen that the major hematological parameters are quite similar between blood samples from patients suffering from HCC, HBV, and HCV.

Alternatively, Fig. 2 shows that blood samples from patients with HCC, HBV, and HCV share significant biochemical parameters.

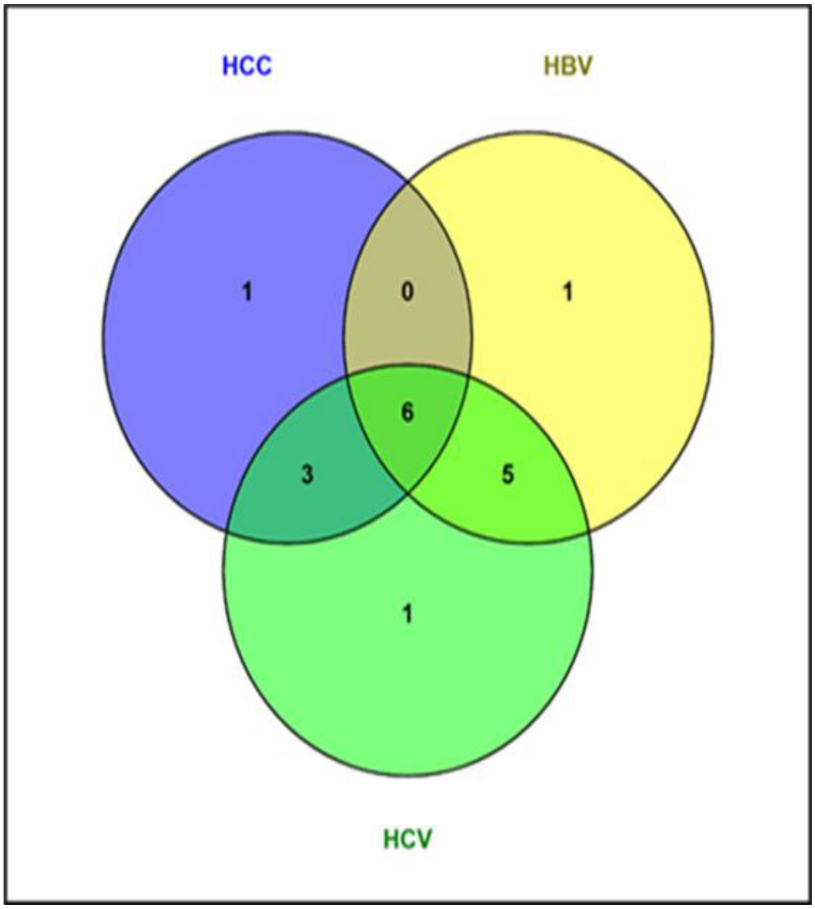

Fig. 1. Venn diagram showing commonalities between the different significant hematological parameters between HCC, HBV, and HCV patient blood samples.

4. Discussion

The complete blood count (CBC) with differential leukocyte count is one of the most requested blood tests in medical laboratories. A CBC test can be used to detect anemia and leukemia, as well as to assess general health. The test measures three types of blood cells: red blood cells (RBC, HCT, HB, erythrocyte indices), white blood cells (numbers and differential counts), and platelets. The results of the CBC test provide vital data for early diagnosis of a number of diseases, as well as for monitoring the progress of treatment and assessing overall health. Therefore, we analyzed the blood and biochemical test results of patients with HCC, HBV, and HCV liver disease to identify the most significant and co-related parameters. According to the results, some hematological and biochemical parameters significantly changed from their respective levels in the control group as compared to the (HCC, HBV, and HCV) groups.

4.1. Distribution of ages

Age is associated with an increased risk of hepatocellular carcinoma. HCC cases were most prevalent among patients aged 51 to 60. In people over 44 years of age, hepatocellular

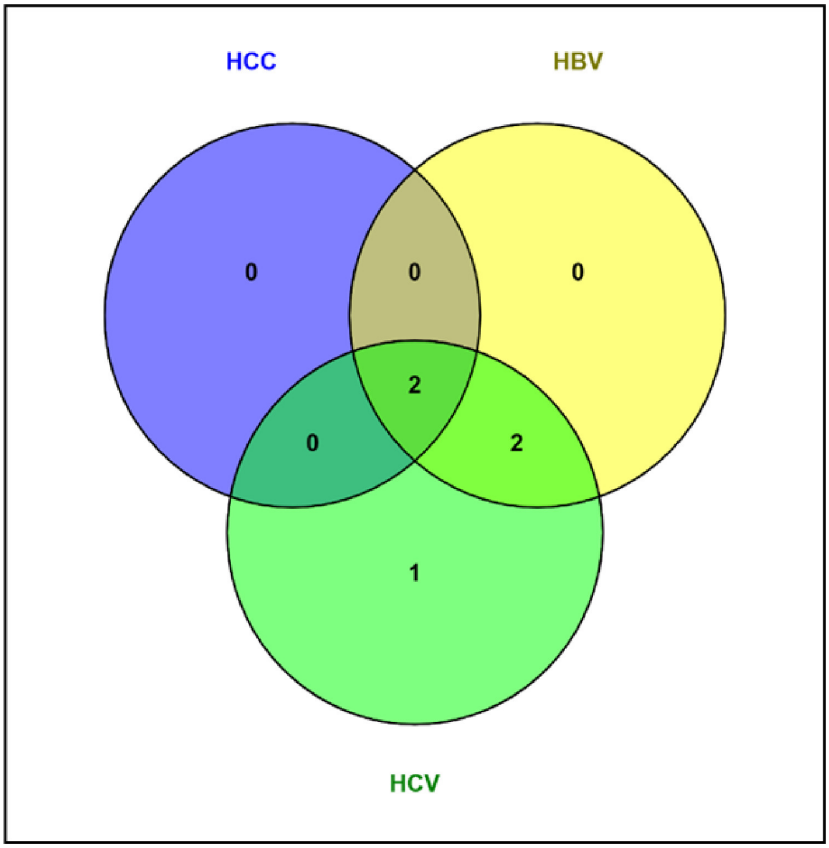

Fig. 2. Venn diagram showing the significant biochemical parameters shared by blood samples from patients with HCC, HBV, and HCV.

carcinoma is more likely to occur. In addition, HCV incidence rates are strongly correlated with age and gender, particularly among younger males and females. Between 21 and 30 years of age, incidence rates increased for both males and females. People over 44 are more likely to develop hepatocellular carcinoma, according in the previous studies [12]. Furthermore, in 2020, acute hepatitis C cases were high among those aged 20 to 39. In the United States, overdoses and injection drug use are most prevalent at this age [13]. HBV patients aged 30–40 had a mean age of 30–40 years within the group of 30–40 year olds. This result is in line with previous findings in the previous studies [14]. Most acute cases of hepatitis B occur among those 15–44 years old, while the majority of chronic cases occur among those 30–44 years old. From 2012 to 2018, chronic hepatitis B incidence rates increased in those over 45 but decreased differently in others. Men had a higher incidence rate than women.

4.2. The hematological parameters of HCC, HBV, and HCV patients

There were significant abnormalities in several parameters in patients with HCC, including Granulocytes (GRAN), Platelet Distribution Width (PDW), and Platelet Concentration (PCT). As compared with the control group, red blood cell counts (RBC), hemoglobin levels (HGB), hemoglobin saturation (HS), platelet counts (PLT), and mean platelet volume

(MPV) were significantly altered. The results of this study are in agreement in the previous studies [15]. Among hepatitis C patients, they found that hepatitis C patients had statistically significant differences in hemoglobin, platelets, white blood cells, HCT, neutrophils, and neutrophil/lymphocyte ratios (NLR). A similar pattern was observed for RBCs, MCVs, MCHs, MCHCs, lymphocytes, monocytes, and eosinophils. The peripheral hematological parameters of patients with HCV may serve as a valuable biomarker for HCV diagnosis.

Patients with HBV also had abnormal levels of lymphocytes (LYM), red blood cells (RBCs), hemoglobin (HGB), and platelet-large cell ratio (P-LCR) (p0.001). According to our study, some of the results are in agreement the previous studies [16]. Based on their study, patients with CHB have significantly higher monocyte counts and lower lymphocyte counts than healthy controls. A significant decrease in CD4+ T cell counts was also observed among CHB subjects compared to healthy controls. Furthermore, there were no significant changes in the total WBC, granulocytes, RBCs, PCV, hemoglobin concentration, and platelet count. In the previous studies [17]. found that WBC, RBC, PLT, and MIX% in hepatitis B patients were significantly higher than in controls ($p < 0.05$). A number of hematological parameters (HPs) were significant, such as HCT and WBC, HB and RBC with PLT, as well as RBC, HCT, and PLT with WBC.

In HCV patients, the majority of the hematology parameters examined changed significantly, including LYM%, LYM, RBC, HGB, HCT, MCV, MCHC, PLT, PCT, P-LCR, and P-LCC. The results of this study are in agreement with those of Rasheed and colleagues in 2022 [15]. Among hepatitis C patients, they found that hepatitis C patients had statistically significant differences in hemoglobin, platelets, white blood cells, HCT, neutrophils, and neutrophil/lymphocyte ratios (NLR). A similar pattern was observed for RBCs, MCVs, MCHs, MCHCs, lymphocytes, monocytes, and eosinophils. The peripheral hematological parameters of patients with HCV may serve as a valuable biomarker for HCV diagnosis.

4.3. HCC, HBV, and HCV biochemistry parameters

HCC patients had abnormal levels of indirect blood bilirubin, creatinine, and GOT (AST). This study confirms the findings in the previous studies [18], which found that serum bilirubin levels (total, direct, and indirect) and the presence of amyloid particles are higher in men than in women with HCC.

A high level of Indirect Bilirubin, GPT (ALT), GOT (AST), and Alkaline Phosphatase is present in HBV patients. Liver function tests are blood tests that diagnose liver disorders, detect inflammation, and prevent liver damage, and indicate liver function. In this study, the results are consistent with those in the previous studies [19]. In their study, they noted that these tests may aid in determining where damage is occurring in the liver and, depending on the pattern, may aid in establishing a differential diagnosis. Hepatocellular disease is indicated by elevations in ALT and AST that are disproportional to increases in alkaline phosphatase and bilirubin. A cholestatic pattern is characterized by elevated levels of alkaline phosphatase and bilirubin in comparison with ALT and AST. Liver function is determined by its ability to produce albumin and vitamin K-dependent clotting factors.

There was an increase in GOT (AST), total bilirubin, and indirect bilirubin levels in HCV patients. This study confirms the findings in the previous studies [20]. In comparing the control group with the HCV +ve group, serum AST and ALT were statistically significantly higher in the HCV +ve group ($P < 0.001$). In contrast, the prothrombin concentration was significantly lower in the HC +ve group ($P = 0.001$).

4.4. Comparing hematological and biochemical parameters between HCC, HBV, and HCV patients

From HCC, HBV, and HCV patients' blood samples, it is evident that the major hematological parameters are quite similar. In "HCC" one element is specifically included, in "HBV" one element is exclusively included, and in "HCV" one element is exclusively included. In contrast, blood samples from HCC, HBV, and HCV share significant biochemical parameters. "HCC," "HBV," and "HCV" share two common elements: GOT (AST), and indirect bilirubin. In addition, "HBV" and "HCV" share two elements: GPT (ALT), and Alkaline Phosphatase. Total bilirubin, however, is exclusive to "HCV".

5. Conclusion

According to the results of this study, some hematological and biochemical parameters were significantly different between the (HCC, HBV, and HCV) groups and the control group. One parameter can be used as a reference for each liver disease, including. MPV is the only element that is exclusive to "HCC" while MID is the only element that is exclusive to "HBV," and P-LCC is the only element that is unique to "HCV". Consequently, these parameters can be used as biomarkers for the diagnosis of these three liver diseases, allowing the differentiation of HCC, HBV, and HCV from the control group. In addition, the parameters GOT (AST) and indirect bilirubin have been found to be essential in diagnosing all three liver diseases, making them valuable indicators for the presence of a liver condition.

References

1. M. Omata, A. L. Cheng, N. Kokudo, M. Kudo, J. M. Lee, J. Jia, ... and S. K. Sarin, "Asia–Pacific clinical practice guidelines on the management of hepatocellular carcinoma: a 2017 update," *Hepatology International*, vol. 11, pp. 317–370, 2017.
2. Forner A, Llovet JM, and J. Bruix, "Hepatocellular carcinoma," *Lancet*, vol. 379, pp. 1245–55, 2012.
3. N. M. Abdel-Hamid, M. M. Abouzied, M. H. Nazmy, M. A. Fawzy, and A. S. Gerges, "A suggested guiding panel of seromarkers for efficient discrimination between primary and secondary human hepatocarcinoma," *Tumour Biology: The Journal of the International Society for Oncodevelopmental Biology and Medicine*, vol. 37, pp. 2539–46, 2016.
4. A. Morishita, K. Fujita, H. Iwama, T. Chiyo, S. Fujihara, K. Oura, ... and T. Masaki, "Role of microRNA-210-3p in hepatitis B virus-related hepatocellular carcinoma," *American Journal of Physiology-Gastrointestinal and Liver Physiology*, vol. 318, no. 3, pp. G401–G409, 2020.
5. C. Zhang, Y. Cheng, S. Zhang, and J. Fan, International QGL, undefined. Changing epidemiology of hepatocellular carcinoma in Asia. Wiley Online Library [Internet]. 2022 Aug 1 [cited 2023 May 11];42(9):2029–41. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/liv.15251
6. C. I. Song, J. Lv, Y. Liu, J. G. Chen, Z. Ge, J. Zhu, ... and China Kadoorie Biobank Collaborative Group, "Associations between hepatitis B virus infection and risk of all cancer types," *JAMA Network Open*, vol. 2, no. 6, pp. e195718–e195718, 2019.
7. M. Levrero and J. Zucman-Rossi, "Mechanisms of HBV-induced hepatocellular carcinoma," *Journal of Hepatology*, vol. 64, no. 1, pp. S84–S101, 2016.
8. X. Y. Huang, Z. L. Huang, J. Huang, B. Xu, X. Y. Huang, Y. H. Xu, ... and Z. Y. Tang, "Exosomal circRNA-100338 promotes hepatocellular carcinoma metastasis via enhancing invasiveness and angiogenesis," *Journal of Experimental & Clinical Cancer Research*, vol. 39, no. 1, pp. 1–16, 2020.
9. D. Raslan and T. Kaddar, "Optimization of criteria for manual smear review following automated blood cell analysis," *Tishreen University Journal-Medical Sciences Series*, vol. 44, no. 5, pp. 389–398, 2022.
10. R. Love, J. Adams, and E. M. van Sluijs, "Are school-based physical activity interventions effective and equitable? A meta-analysis of cluster randomized controlled trials with accelerometer-assessed activity," *Obesity Reviews*, vol. 20, no. 6, pp. 859–870, 2019.

11. J. C. Oliveros, VENNY. An interactive tool for comparing lists with Venn Diagrams. http.bioinfogp.cnb.csic.es/tools/venny/index.html, vol. 5, pp. 119–134, 2007.
12. K. Kennedy, S. M. Graham, N. Arora, M. C. Shuhart, and H. N. Kim, "Hepatocellular carcinoma among US and non-US-born patients with chronic hepatitis B: Risk factors and age at diagnosis," *PloS One*, vol. 13, no. 9, p. e0204031, 2018.
13. A. E. Ahmad, A. G. Bakari, B. O. P. Musa, S. K. Mustapha, A. I. Nasir, M. I. Tahir, B. Y. Jamoh, A. O. Olatunji, S. H. Maishanu, A. B. Suleiman, C. A. Hawkins, A. S. Sagay, and A. T. Olayinka, "Haematological and immunological parameters in patients with chronic Hepatitis B infection in Zaria, Nigeria," *Sokoto Journal of Medical Laboratory Science*, vol. 3, no. 4, pp. 84–88, 2018.
14. M. Yonezawa, Y. Yoshida, and Y. Takikawa, "Circular microRNA profiles as biomarkers for early-stage hepatocellular carcinoma in patients infected with hepatitis B virus: a pair-matched case-control study," *Journal of Iwate Medical Assiociation*, vol. 72, no. 2, pp. 59–67, 2020.
15. H. Rasheed, M. Khawar, A. Sohail, S. Aman, A. Afzal, S. Hamid, S. Shahzaman, M. Abbasi, N. Sheikh, S. Shah, B. Nawaz, S. Tanveer, and M. Riasat, "Altered hematological parameters in HCV infection: a diagnostic approach," *Asian Journal of Health Sciences*, vol. 8, no. 2, p. ID46, 2022, https://doi.org/https://doi.org/10.15419/ajhs.v8i2.517.
16. G. H. Mahmoud, S. A. Saber, S. A. Loutfy, W. H. Salama, and A. Nabeeh, "Effect of Cerastes cerastes LAAO on Some Hematological Parameters in Hepatocellular Carcinoma-Induced in Rats," *Egyptian Academic Journal of Biological Sciences. C, Physiology and Molecular Biology*, vol. 15, no. 1, pp. 287–294, 2023.
17. A. F. Odusanya, G. I. Makinde, M. O. Idowu, and A. M. Adebayo, "Case control study of CD4 cell count and some haematological parameters among hepatitis and non-hepatitis B patients in Oyo State, South-west, Nigeria," *African Health Sciences*, vol. 23, no. 1, pp. 190–7, 2023.
18. L. Mehinović, Z. Vukobrat-Bijedić, A. Husić-Selimović, A. Kurtović-Kozarić, E. Islamagić, and D. Suljević, "Association between alpha-fetoprotein and other serological markers in patients with hepatocellular carcinoma: one center's experience," *Journal of IMAB–Annual Proceeding Scientific Papers*, vol. 24, no. 3, pp. 2160–2165, 2018.
19. V. Lala, M. Zubair, and D. A. Minter, Liver function tests. In StatPearls [internet]. StatPearls Publishing, 2022.
20. D. Hamed, B. El Kholy, H. G. El Deen, S. M. M. Momen, and N. M. Selim, "The XRay Repair Cross Complementing 1 (XRCC1) Rs25487 variation and susceptibility to Cirrhosis in patients with chronic Hepatitis C virus," *The Egyptian Journal of Hospital Medicine*, vol. 90, no. 1, pp. 453–458, 2023.