Original Article

Assessment of Immune Response in Hepatitis B Virus Infection: A Cross-Sectional Study

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Abstract

Background: Hepatitis B virus (HBV) is a significant health problem worldwide. Antibody (IgG and IgM) are basic line to evaluate immune response and differentiate between acute, chronic or even post treatment HBV infection. **Objective:** to discover the rate of acute and chronic patterns of HBV infections and asses the immune response for individuals exposed to HBV infection. **Materials and Methods:** 80 participants involved in this cross sectional study by blood samples and IgG, IgM concentrations were definite by ELISA technique. **Results:** out of the 80 patients, 65(81.2%) give positive result for HBV, while 15 (18.8%) tested negative. Chronic/pre-existing disease (58.8%) is the most common rate followed by (21.3%) as acute infection state, only one individual (1.3%) has pre-existing infection, result of age ($p = 0.9183$), sex ($p = 0.5667$), or residency ($p = 0.8099$) was not statistically significant and didn't show any correlation. Infected individual had markedly IgG levels (3.12 ± 0.45) ($p <0.0001$) which is the dominant test result compared to the IgM indicating either a past or chronic illness infection, acute infection were less prevalent. **Conclusion:** acute, chronic, and past hepatitis B virus (HBV) infections can be differentiated using IgG and IgM antibody analysis. Chronic infection was the most common in our community, highlighting the importance of serological testing in monitoring HBV and assessing the immune response.

Keyword: Hepatitis B virus, Immune response, IgG, IgM, Serology, Cross-sectional study.

Introduction

One of the primary causes of liver illness is the hepatitis B virus (HBV). Most HBV infections are asymptomatic, but they can also produce acute or chronic infections that can lead to cirrhosis, hepatocellular cancer, liver failure, fulminant hepatitis, and even death [1,2]. First step of HBV diagnosis is achieved by using serological markers like hepatitis B surface antigen (HBsAg) and anti-HBs, anti-HBc IgM and IgG, and hepatitis B e antigen (HBeAg) and anti-HBe (3,4). While HBV IgM antibodies are linked to prior exposure or chronic infection, they are a crucial marker of recent or active infection and are frequently used to distinguish between acute hepatitis B and acute exacerbations of chronic infection (5,6). HBc IgM antibody titers are extremely sensitive in identifying acute infection and can be detected for up to two years, according to clinical and laboratory research, however levels decrease when the illness advances to a chronic state or is treated [7,8]. According to recently released guidelines, like the EASL and AASLD guidelines, HBV infection is not a static, phased condition but rather advances through discrete

stages, each of which is distinguished by different levels of viral replication, immune response patterns, and the degree and severity of liver damage [9-11]. Because of this, serological markers are crucial for clinical evaluation. According to epidemiology, the virus's incidence varies across people and is greatly impacted by sociodemographic characteristics including sex, age, and location of residence [12-14]. This study aims to discover the rate of acute and chronic patterns of HBV infections and asses the immune response for individuals exposed to HBV infection.

Materials and Methods

Study of design and participants

Patients with clinically or laboratory-confirmed probable hepatitis B virus (HBV) and outpatients (for admission of acute and chronic cases, as well as asymptomatic carriers) comprise the study population who determined by prior research and the anticipated community incidence of HBV [15-17], where selected and data like (age, sex, employment, location of residence, risk factors (blood transfusion, surgery, infection) history of HBV infection, and immunization was gathered using a standardized questionnaire, were collected in Imam Al-Sadiq Teaching Hospital, Department of Laboratories and Analysis, Hilla, Babylon, Iraq from January 2025 to June 2025.

Serological assay

Serological Tests: To identify the IgM and IgG subtypes, a crucial serological marker for the hepatitis B virus (HBV) (core antigen), and serum samples were subjected to conventional immunoassays (ELISA/photochemical test). IgG anti-HBc was thought to be a sign of persistent infection or prior exposure. A sign of recent or acute infection was IgM anti-HBc [16-18].

Ethical Approval

The patient gave both verbal and analytical permission prior to sample collection. The study methodology, subject information, and consent form were all assessed and approved by an ethics committee at the University of Babylon, Hammurabi College of Medicine, Babylon, Iraq.

Results:

Database characteristic

65 (81.2%) of the 80 individuals tested positive for HBV, whereas 15 (18.8%) tested negative. The most prevalent pattern was chronic infection (58.8%), which was followed by acute infection (21.3%) and a single early case (1.3%). HBV positive did not significantly correlate with age group, sex, or place of residence ($P > 0.05$) as shown in table (1). Participants with infection had substantially greater levels of IgG (3.12 ± 0.45) and IgM (1.05 ± 0.59) than those without infection (2.19 ± 0.53 and 0.63 ± 0.41, respectively) as detailed in table (2). IgG and IgM levels did not significantly differ between males and females or across age groups. Age and IgG or IgM levels did not significantly correlate, according to Spearman correlation. Age, sex, and place of residence were not significant predictors, according to binary logistic regression. Figure (1) below illustrate the correlation between IgG and IgM mean across HBV serologic classes depending and age versus IgM on previous results.

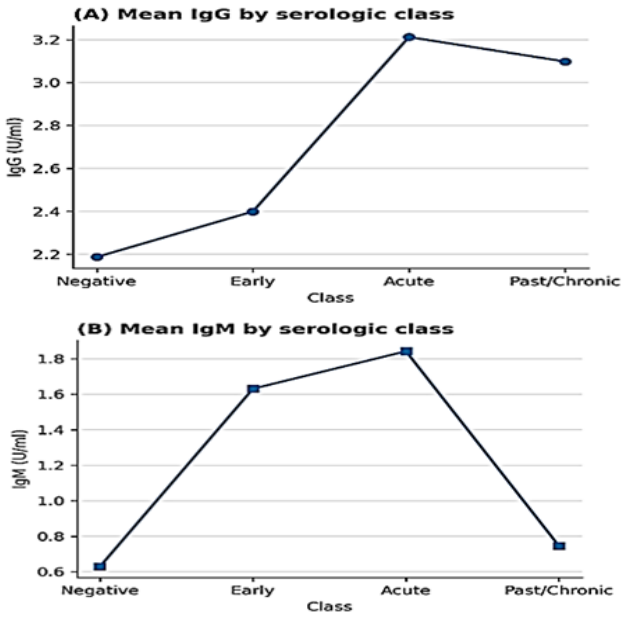
Table 1: demographic characteristic and HBV serologic result classification

Variable	Category	n (%)	p value
HBV status	Positive	65 (81.2)	—
	Negative	15 (18.8)	
HBV pattern	Chronic (Past/Chronic)	47 (58.8)	—

	Acute	17 (21.3)	
	Early infection	1 (1.3)	
Sex	Male	48 (60.0)	0.5667
	Female	32 (40.0)	
Residence	Urban	37 (46.3)	0.8099
	Rural	43 (53.7)	

Table2: the correlation and regression analysis between immunological parameters

Variable	Value	p value
IgG (U/mL)	Positive: 3.12 ± 0.45 Negative: 2.19 ± 0.53	<0.0001
IgM (U/mL)	Positive: 1.05 ± 0.59 Negative: 0.63 ± 0.41	0.004
Sex (IgG/IgM)	No significant difference	>0.05
Age group (IgG/IgM)	No significant difference	>0.05
Correlation (Age vs IgG)	r = weak positive	>0.05
Correlation (Age vs IgM)	r = weak negative	>0.05
Logistic regression	Age, sex, residence not predictors	>0.05



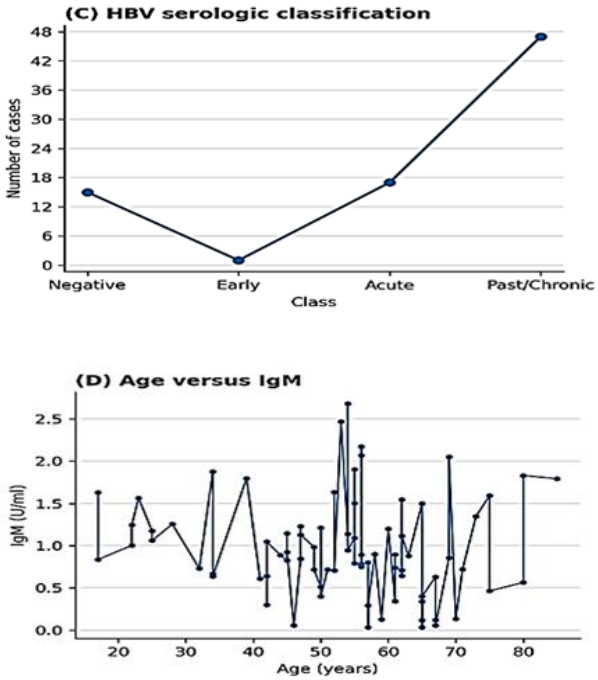


Figure 1: (A) Mean IgG; (B) Mean IgM; (C) HBV class distribution; (D) Age versus IgM.

Discussion

The results of this study show a relatively high prevalence of hepatitis B virus (HBV) infection, with 81.2% of cases testing positive (65/80) compared to 18.8% testing negative, indicating a clear prevalence of exposure within the studied sample. The most common serotype was past/chronic (58.8%), followed by acute (21.3%), while early infections were very limited (1.3%). This distribution is consistent with previous epidemiological studies indicating that most HBV cases in adults represent past or chronic infections rather than recent infections [19]. From an immunological perspective, the results showed a statistically significant increase in IgG and IgM levels in infected individuals compared to uninfected individuals. The mean IgG level was 3.12 ± 0.45 compared to 2.19 ± 0.53 in uninfected individuals ($P < 0.0001$), and the mean IgM level was 1.05 ± 0.59 compared to 0.63 ± 0.41 ($P = 0.004$). This support research and recommendation of CDC which concluded that anti-HBc IgM indicates a recent infection

and IgG high level prrof chronic or past exposure [20,21], after the statistical analysis of sex (P = 0.5667), place of residence (P = 0.8099), or age group (P = 0.9183) results, they revealed no significance differences which lines with past research that proof immunological variables affect and more critical than demographic ones in serological test. As we mentioned before there is no obvious variations in immune response of this sample based on age, sex and residence variables, this may be attributed to the nature of the data distribution, as most participants were in a similar age group, in addition to the small size of the negative cohort, which reduces the ability to detect significant differences. On other hand, when looking at the association between IgG and IgM levels we notice a mild positive correlation and weak negative relationship reliable with previous studies that suggest non-linear or other factor influenced the connection between age and immune response, these association didn't attain statistical significance (p >0.05), [22]. The prevalence of chronic infection in this study is also expected in communities with a long history of exposure to the virus, which is consistent with World Health Organization reports indicating that chronic infection accounts for the largest share of the global disease burden [21]. Furthermore, other Iraqi studies have shown that the distribution of infection is not directly related to place of residence (urban or rural), which is consistent with our results (P = 0.8099), indicating that residence did not have a clear effect on serostatus. Some studies have shown that older age groups represent the highest proportion of positive cases, but the statistical relationship was not always significant, which is consistent with our results (P = 0.9183).

Conclusion

The study revealed that the predominant serotype in the samples was IgG positive and IgM negative, which indicates either chronic inactive infection or a previous, symmetrical infection. Conversely, the lower percentage of acute infections suggests the presence of recent, rather than prevalent, infections among the sample. IgG and IgM markers were important diagnostic indicators since their levels were higher in positive instances. Variables of age, sex, and residence did not demonstrate statistical significance maybe because of sample size and distribution.

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