



# Detection of Serum Markers of Hepatitis B Virus and Its Application in Clinical Diagnosis

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**Abstract:** Due to the rapid global population mobility and close interaction among populations, as well as the different medical and health conditions around the world, the prevention and control of hepatitis B face great challenges. In addition, the incubation period of hepatitis B is relatively long and easily overlooked, so the demand for early diagnosis is becoming increasingly prominent. This article focuses on the detection of serum markers of hepatitis B virus and their application in clinical diagnosis. By systematically exploring the detection methods of different biomarkers and their clinical applications, the aim is to deepen our understanding of the diagnosis and treatment of hepatitis B.

**Keywords:** hepatitis B, serum markers, detection method, clinical diagnosis, early diagnosis

## 1. Introduction

Hepatitis B is a global infectious disease caused by the hepatitis B virus (HBV), affecting millions of people. Despite the popularization and application of the hepatitis B vaccine, there is still a large number of people infected with the hepatitis B virus, especially in some regions and specific populations, where the spread of the virus is still relatively high, which makes hepatitis B an important issue in the global public health sector. This study aims to explore in depth the detection methods of serum markers of hepatitis B virus and their application in clinical diagnosis, in order to improve the diagnostic level and treatment effectiveness of hepatitis B.

## 2. Detection method for serum markers of hepatitis B virus

### 2.1 Detection of HBsAg

The detection of hepatitis B surface antigen (HBsAg) plays a crucial role in the diagnosis and monitoring of hepatitis B. HBsAg positivity usually indicates HBV infection, and its detection time window is 1-12 weeks after infection. For acute infected individuals, HBsAg can persist for 5 weeks to 5 months. If positive for more than 6 months, it indicates the possibility of developing into chronic infection, especially in chronic hepatitis B (CHB) and asymptomatic carriers, which can persist for many years or even lifetime.

In terms of HBsAg detection, commonly used methods include immunochromatography, enzyme-linked immunosorbent assay, and nucleic acid amplification technology. These methods differ in sensitivity and specificity, and researchers need to choose appropriate methods based on specific research objectives and actual needs[1]. For example, nucleic acid amplification technology is highly sensitive and can accurately detect patients with low viral loads, but its cost is relatively high. Immunochromatography and enzyme-linked immunosorbent assay are more convenient in practical applications and are suitable for large-scale screening and monitoring. In addition, the concentration of anti HBs antibodies in serum is also a key indicator for diagnosis and monitoring. Protective antibodies against HBs, with a concentration of  $\geq 10$  mIU/ml, indicate that individuals have immunity. For the anti HBs produced by vaccination, their protection for the population can be maintained for more than 30 years, and the general population does not need to receive booster shots. However, about 5% of infected individuals exhibit both HBsAg and anti HBs positivity, which may be due to immune stress caused by persistent viral infection or vaccination, leading to HBV mutations and the production of immune escape strains. In this case, anti HBs have no protective effect and may instead become a high-risk factor associated with liver fibrosis and cirrhosis.

### 2.2 Detection of anti HBc

The detection of anti HBc IgM and anti HBc IgG is of great significance in the diagnosis of hepatitis B virus infection and the evaluation of disease activity. Anti HBc IgM appears 2-4 weeks after HBsAg positivity and is considered a marker of acute and chronic HBV infection activity. Its early emergence indicates that the virus is active in the body and is a key indicator of acute infection. For chronic infected individuals, the sustained presence of anti HBc IgM may suggest the

activity of the disease, providing clues for timely intervention and treatment. In contrast, the emergence of anti HBc IgG is relatively slow, but once it occurs, it can persist for a long time, and even remain positive for life. It is a sign of current or past infection, as evidence of having already been infected with HBV. In HBsAg negative individuals, positive anti HBc IgG may indicate the presence of occult hepatitis B virus infection (OBI). For such patients, even if the surface antigen HBsAg is not detected, they may still carry potential viruses, which poses challenges for the development of prevention, control, and treatment. In terms of detection methods, commonly used methods include enzyme-linked immunosorbent assay, immunochromatographic techniques (such as colloidal gold technology), and chemiluminescence technology. Among them, chemiluminescence technology is gradually occupying a dominant position due to its advantages of high sensitivity and easy automation. The high sensitivity of this technology enables accurate detection in patients with low viral load, which is of great significance for screening early and potential infections[2].

### **2.3 Detection of HBeAg and anti HBe**

The detection of HBeAg and anti HBe plays a crucial role in the diagnosis and treatment of hepatitis B virus infection. HBeAg is an important indicator of viral replication, appearing slightly later than HBsAg, and has a good correlation with HBV DNA. Its positivity indicates active virus replication, and the patient has strong infectivity, which is a sign of acute and chronic infections. In the detection of HBeAg, commonly used methods include immunochromatography and radioimmunoassay. These two methods can meet clinical needs in terms of sensitivity and specificity, and are relatively simple, suitable for large-scale screening and monitoring[3]. With the continuous progress of technology, some emerging technologies such as chemiluminescence are gradually being applied in the detection of HBeAg, with higher sensitivity and faster operation speed, and are expected to become the mainstream in the future. The detection of anti HBe usually occurs after HBeAg turns negative, which is a sign of HBV replication and weakened infectivity. The detection methods for anti HBe also include immunochromatography, enzyme-linked immunosorbent assay, etc. Among them, immunochromatography is more widely used in clinical applications. The emergence of anti HBe indicates that patients have entered a non replicative stage, but it should be noted that some patients may still have virus replication after HBeAg turns negative, especially in the presence of pre C region or BCP mutations.

## **3. Application of hepatitis B virus serum markers in clinical diagnosis**

### **3.1 Used for early diagnosis**

Early diagnosis is a crucial part of hepatitis B management, as it helps to take early treatment measures, slow down disease progression, and reduce the risk of transmission. Firstly, early detection of HBsAg can quickly confirm infection, as it appears slightly earlier than the onset of symptoms. Especially in asymptomatic carriers and acute infected individuals, early detection of HBsAg helps to take appropriate isolation and treatment measures in the shortest possible time, effectively reducing the risk of transmission. The detection of anti HBc IgM also plays a crucial role in early diagnosis, as it can appear 2-4 weeks after infection. Its early positivity can indicate the activity of acute infection, which helps to take timely treatment measures. Especially in high-risk situations such as healthcare workers or family members, testing for anti HBc IgM can provide earlier intervention opportunities.

In addition, the detection of HBeAg also has important value in early diagnosis. Its appearance indicates active virus replication and strong infectivity, therefore early detection of HBeAg helps to quickly confirm the infectivity level of infected individuals. This plays an important guiding role in timely isolation and treatment, as well as in developing preventive measures. In practical applications, establishing a comprehensive and efficient screening system is the key to early diagnosis. The combined screening of HBsAg, anti HBc IgM, and HBeAg can be widely applied in high-risk populations. Through comprehensive analysis of these serum markers, infected individuals can be quickly identified and corresponding isolation and treatment measures can be taken. In addition, combining modern detection technologies such as chemiluminescence can improve the sensitivity and accuracy of detection, and shorten the diagnostic time window.

### **3.2 Monitoring and personalized treatment of disease progression**

The monitoring of disease progression and personalized treatment have important strategic significance in the management of hepatitis B. By regularly monitoring the serum markers of patients, it is possible to comprehensively understand the virus replication level, disease activity, and immune status of infected individuals, thereby achieving personalized treatment plans. Firstly, for chronic infected individuals, dynamic monitoring of HBeAg and anti HBe is an important means of understanding virus replication activity and infectivity. As the disease evolves, the conversion of HBeAg to negative is often accompanied by a decrease in viral replication, while the emergence of anti HBe suggests a decrease in infectivity. Therefore,

regular monitoring of these two biomarkers can provide a basis for timely adjustment of treatment plans and slow down disease progression. Secondly, for patients who have already turned negative, monitoring anti HBs becomes crucial. The concentration of anti HBs  $\geq 10$  mIU/ml indicates that individuals have immunity, but over time, antibody levels may decrease or even disappear. Therefore, by regularly monitoring the concentration of anti HBs, immune status can be evaluated in a timely manner, and if necessary, booster shots can be considered to maintain long-lasting immune protection[4].

In terms of personalized treatment, it is crucial to develop appropriate treatment strategies based on the different stages of the disease and individual differences of patients. For chronic infected individuals, the timing and plan of antiviral treatment should comprehensively consider multiple factors such as virus replication level, liver function, and clinical symptoms. Some patients may require long-term antiviral treatment, while others may choose to discontinue medication at specific stages and regularly monitor the virus's rebound. In practical applications, by establishing a comprehensive patient database and using mathematical models for risk assessment, personalized treatment plans can be formulated more accurately. Modern detection technologies, such as chemiluminescence, not only improve the sensitivity and accuracy of monitoring, but also provide researchers with more biological information, which helps to better understand the course and prognosis of patients.

### 3.3 Evaluating the therapeutic effect of chronic hepatitis B

Chronic hepatitis B is a serious disease with the potential to lead to cirrhosis and liver cancer, therefore accurate evaluation of treatment efficacy is crucial. In practical applications, monitoring serum biomarkers has become the main means of evaluating the therapeutic effect of chronic hepatitis B, including HBsAg, HBeAg, anti HBe, etc. The dynamic monitoring of HBsAg is one of the key indicators for evaluating treatment efficacy. In the treatment of chronic hepatitis B, the disappearance of HBsAg is often considered the ultimate goal of treatment. By regularly detecting changes in HBsAg, patients can understand their virus clearance status, guide doctors in determining whether to adjust treatment plans, and consider stopping the use of antiviral drugs. For patients who are HBeAg positive, the evaluation of treatment efficacy also needs to consider changes in HBeAg and anti HBe. Effective patients may experience a negative HBeAg conversion during the treatment process, which is the transition from the active stage of the virus to the inactive stage. This change is often accompanied by the emergence of anti HBe, indicating a decrease in viral replication activity and a weakening of infectivity. Therefore, by monitoring the dynamic changes of HBeAg and anti HBe, a more comprehensive understanding of treatment efficacy can be obtained, providing a basis for further clinical decision-making. When evaluating the therapeutic effect, it is also necessary to consider changes in virus replication levels, namely the monitoring of HBV DNA. During the treatment process, the rapid decline of HBV DNA is often closely related to the effectiveness of the treatment[5]. Therefore, regularly testing the trend of HBV DNA changes can more accurately assess the patient's treatment response and provide guidance to doctors to determine whether adjustments to the treatment plan are necessary.

## 4. Conclusion

In the study of serum biomarker detection of hepatitis B virus and its application in clinical diagnosis, this article deeply analyzes the important roles of HBsAg, anti HBc, HBeAg, anti HBe and other biomarkers in early diagnosis, treatment monitoring, and personalized treatment. Through modern detection technologies such as chemiluminescence, it is possible to more accurately and comprehensively evaluate the infection status and treatment effectiveness of patients. In the future, with the continuous development of technology, serum biomarker detection will become more accurate, providing more possibilities for personalized management of hepatitis B.

## References

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