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Review article

Blood-borne Viral Infections in Hemodialysis Units in Iraq: A Narrative Review of Prevalence and Contributing Factors

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Abstract
Hemodialysis (HD) patients are at heightened danger of acquiring blood-borne viral infections, particularly hepatitis B virus (HBV) and hepatitis C virus (HCV), due to repeated vascular access, immunosuppression, and frequent exposure to blood products and invasive procedures. This review studies the prevalence of HBV and HCV infection and its related risk factors among hemodialysis patients in Iraq. Several key factors influence its prevalence, including length of dialysis, blood transfusion records, inadequate infection control measures, and low vaccination coverage. Although the overall prevalence of HBV and HCV is low among the general Iraqi population, dialysis patients exhibit disproportionately high infection rates, underscoring the need for enhanced surveillance, targeted vaccination programs, and strict adherence to infection control protocols. This review aims to inform healthcare workers and policymakers about current epidemiological trends and recommend strategic interventions to reduce the transmission of HBV and HCV in dialysis centers in Iraq.
Keywords: *Viral Infections, HBV, HCV, CKD, Hemodialysis.*

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Introduction

Many viruses can be transmitted through blood, such as HBV and HCV, and pose serious health threats to people with chronic kidney disease (CKD) and those with end-stage renal disease (ESKD) receiving hemodialysis (HD) treatment worldwide [1,2]. Due to their weakened innate and acquired immune system, invasive medical interventions, frequent blood transfusions, frequent vascular access, and the potential for contamination of dialysis equipment and environments this all can lead to the development of blood-borne viral infection in Hemodialysis patients (HD) [3,4]. Incidence of bloodborne viral infections in dialysis patients increases in Iraq, for example, a previous study showed a high level (26%) of HCV infection among dialysis patients [5]. Another previous study showed that 10% of 100 kidney dialysis patients have HBV, and 36% have HCV [6].

Transfusions of blood, period of dialysis, and previous surgical procedures, all can lead to HBV and HCV infection in hemodialysis patients [5]. Other previous studies showed a moderate prevalence (9.2%)of HCV infection, highlighting the urgent need for strict adherence to infection control protocols to avoid transmission of these infections [7]. The general population in Iraq displays a moderately low level of HCV and HBV, confirming the increased susceptibility of dialysis patients to these infections. Understanding the incidence of this high-risk population and its related risk factors is essential to developing effective preventive strategies and improving patient outcomes [8]. Current studies have shown the critical role of vaccination programs, especially against HBV, as an effective preventive measure to protect hemodialysis patients from blood-borne viruses [9]. This study aims to assess the rate of bloodborne viruses and identify related risk factors among hemodialysis patients in Iraq, providing valuable insights into current epidemiological trends and supporting the development of effective infection control and prevention strategies.

Chronic kidney disease (CKD)

CKD is a long-term disease marked by incessant failure of kidney function, regardless of the unique cause or external influences like infection, toxic exposure, and inflammation. CKD characterizes a chief worldwide health concern, affecting millions and contributing to illness and death. Over time, CKD can develop to end-stage renal disease (ESRD), necessitating dialysis or a kidney transplant. The Global Burden of Disease study ranked CKD as the 18th leading cause of death worldwide in 1990, rising to the 9th position by 2019 [10,11]. The occurrence of CKD is on the rise, currently affecting an estimated 9.1% of the global population, equivalent to roughly 700 million individuals worldwide [12].

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Chronic kidney disease (CKD) imposes a substantial economic burden globally [13]. The rising incidence of CKD is largely attributed to the increasing rates of diabetes and hypertension, the two causes of CKD. Furthermore, the aging global population adds to this increasing burden, as the likelihood of developing CKD rises with advancing age [14]. The hypothesis of CKD development includes glomerular damage resulting from hyperfiltration. Multiple aspects can hasten the disease progression, and several biomarkers have been identified to help track its development. Many studies have investigated the risk factors linked to CKD progression, some of which are modifiable. Moreover, a range of pharmacological treatments is now available that can assist in slowing the progression of CKD [15].
Previous studies in Diyala province in Iraq established that hypertension, diabetes mellitus, polycystic kidney disease, interstitial nephritis, kidney stones, and renal genesis are risk factors for CKD [16–18]. Elderly people aged 75 and over are most susceptible to CKD [19]. CKD leads to numerous lifestyle changes that extremely impact their physical and psychological health. The elderly suffer from many comorbidities and serious complications, their quality of life rapidly declines, and their symptom burden increases rapidly [20]. Renal replacement therapy (RRT) is the current treatment for patients with ESRD, typically dialysis, while the latter has not always been considered suitable.

Hemodialysis (HD)

Hemodialysis (HD) is a critical treatment for individuals with kidney failure, serving as a life-saving intervention when the kidneys are unable to filter waste and excess fluids from the blood effectively. This process involves using a dialyzer, or artificial kidney, to cleanse the blood outside the body before returning it to the patient. Hemodialysis is typically performed three times a week, with each session lasting about three to four hours, although longer sessions may be required for larger patients. The treatment can be conducted in a dialysis center or at home, offering flexibility for patients [20,21]. Although HD is a life-sustaining treatment for patients with ESRD, it does not fully replicate all the functions of healthy kidneys and is not a cure for advanced kidney failure. It remains essential for survival unless a kidney transplant becomes an option. Hemodialysis can lead to various complications, including vascular access problems such as stenosis in arteriovenous accesses, as well as infections, such as HCV, HBV, and HIV, particularly associated with the use of central venous catheters [22,23]. Anticoagulation plays a vital role in HD by preventing blood clot formation during the procedure. Recent studies highlight the need for effective management of those complications to enhance the long-term success and safety of HD therapy [23].

Blood-Borne Viral Infections

Blood-borne viral infections represent a major global health concern due to their serious health consequences and the difficulties associated with their prevention and control. The infections are spread through exposure to infected blood and other potentially bodily fluids, such as semen, vaginal secretions, and breast milk. Among the most common blood-borne viruses (BBVs) are HBV, HCV, and HIV [1,2]. This review specifically examines HBV and HCV infections in the context of HD patients.

Hepatitis B virus (HBV)

HBV poses an important global community health challenge, with an estimated 2 billion people having been infected at some point, and around 296 million living with chronic HBV infection [24]. In 2016, the World Health Organization set a goal to eliminate viral hepatitis as a public health threat by 2030, defined as a 90% reduction in new infections and a 65% reduction in hepatitis-related deaths compared to 2015 levels [25]. The HBV genome is a partially double-stranded, circular DNA (cDNA). The basic structure of HBV is illustrated in **Figure 1** [26,27]. There are several methods used to diagnose HBV infection by detecting molecular genes and serologic parameters: viral nucleic acid, HBsAg, HBeAg, anti-HBs, anti-HBe and anti-HBc [28].

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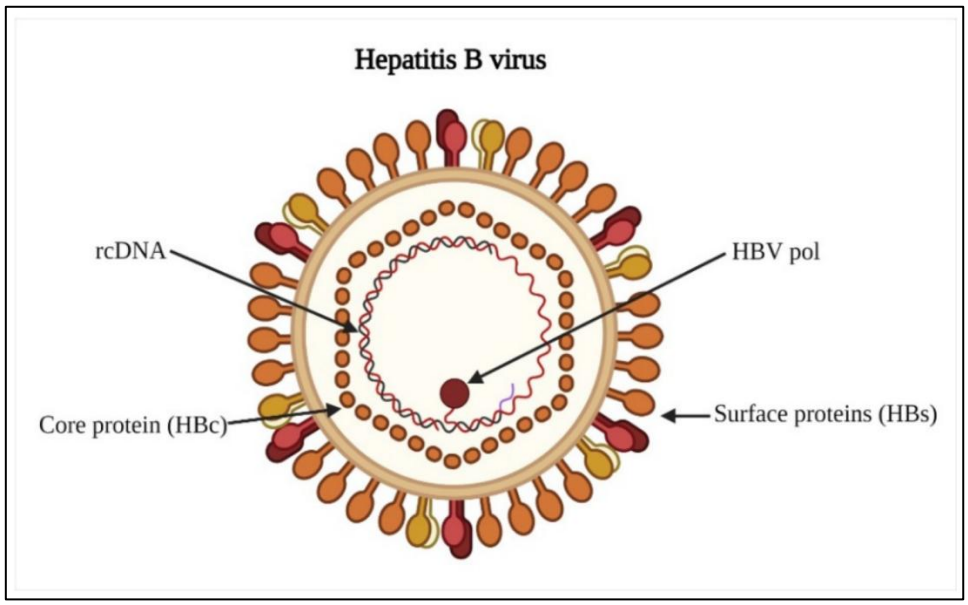

Figure 1: HBV virion structure [26].

Hepatitis C (HCV)

One of the most important bloodborne viruses is HCV which infects the liver and is transmitted by exposure to infected blood, such as contaminated needles use and unscreened blood transfusions. Acute HCV infection have mild or absent symptoms [29]. Infection with the virus may lead to serious liver complications such as liver failure, cirrhosis and hepatocellular carcinoma (HCC) [24]. There have been therapeutic developments in treatment of this virus, as direct-acting antivirals (DAAs) have altered the treatment of HCV [30]. Virion of HCV is small enveloped virus, single-stranded RNA (ssRNA) genome, ssRNA genetic material bind to the inner surface of the capsid, while the viral envelope binds to the outer surface, this envelope made up of of a lipid bilayer and two glycoproteins, E1 and E2 (**Figure 2**). The E1 and E2 proteins are responsible for viral attachment and entry into host cells [31].

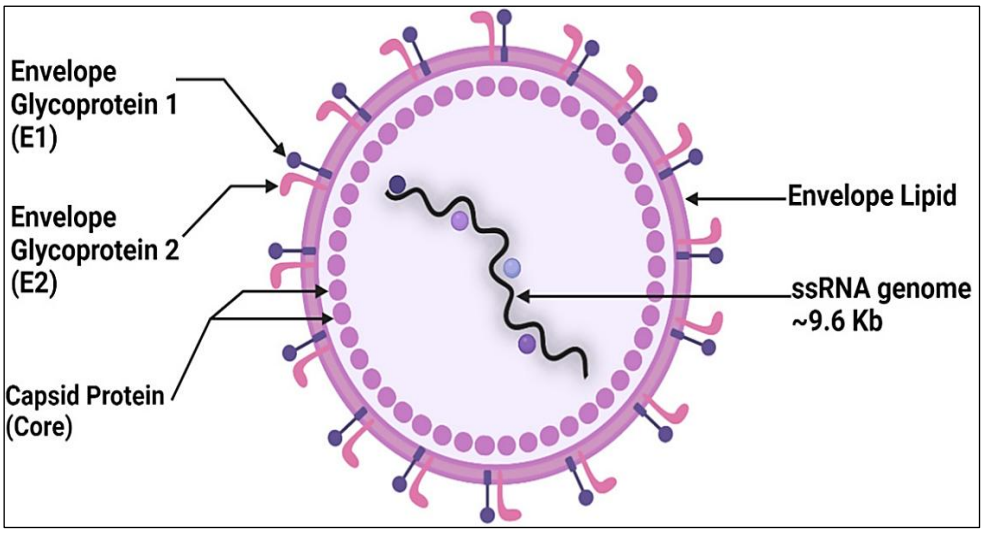

Figure 2: Structure of HCV [32].

Risk Factors of HBV and HCV among Hemodialysis patients

Blood-borne viral infections, especially HBV and HCV, present serious health threats to people with CKD and end-stage kidney disease (ESKD) undergoing hemodialysis globally. These infections not only worsen pre-existing renal conditions but also significantly elevate morbidity and mortality rates among dialysis patients. Various studies have identified multiple risk factors associated with occurrence of HCV and HBV in the general population. These includes frequent visits to barbers, having multiple sexual partners, ear and nose piercings, dental procedure, tattooing,

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circumcision, intravenous (IV) drug use, receiving blood transfusions, and undergoing invasive medical procedures such as endoscopy [33,34].

While the most common risk factors among dialysis patients were immunosuppression (dialysis affects innate and acquired immunity), multiple blood transfusion events, invasive medical procedures, continuous vascular exposure, sharing of dialysis machines and surroundings of infected patients. [3,4,33]. Patients with hemophilia, IV drug addicts, and on long-term HD were found to have the highest HCV incidence [35]. Therefore, HD patients are at risk of viral infections compared to other vulnerable groups [36,37].

Epidemiology of Blood-borne Viruses (HBV and HCV) Among Hemodialysis (HD) in Iraq

The epidemiology of blood-borne viruses (HBV and HCV) among hemodialysis patients in Iraq reveals significant disparities in prevalence rates and risk factors. Research from various regions consistently indicates that HCV is significantly more prevalent than HBV among HD patients. For instance, a 2019 cross-sectional study conducted in Al-Diwanyah, Iraq, involving 160 HD patients, found that the prevalence of HCV was 21.2%, while HBV was observed in only 1.2% of cases. Additionally, the co-infection with both viruses was reported in 1.2% of the patients [38]. Likewise, a 2023 study conducted in Al-Muthanna city reported HCV prevalence of 36% and HBV prevalence of 10% among HD patients. The study highlighted higher infection rates in rural areas and identified significant association with longer dialysis duration (7-9 years) and history of blood transfusion [6]. Additionally, another study conducted in Baghdad reported an HCV prevalence of 26% among HD patients, which further underscores the significant burden this infection places on dialysis patients [5].

Risk factors contributing to HCV transmission among HD patients include extended duration of dialysis treatment, frequent blood transfusions, and lapses in infection control measures. For example, in a study performed between 2014 and 2020 in Kerbala, Iraq identified that both prolonged and a history of blood transfusions as significant risk factor for HCV infection [39]. Although the prevalence of HBV is lower compared to HCV, it remains a significant concern. Reported rates in Iraq are comparable to those in neighboring countries, such as Saudi Arabia at 4.6% and Jordan at 5.9% highlighting the regional burden of HBV among HD patients [38,40]. Iraq's relatively low HBV prevalence is partly credited to widespread vaccination programs and decreased dependence on blood transfusions, largely due to the use of erythropoietin [40]. However, ongoing challenges remain, including limited dialysis infrastructure and inconsistent access to vaccinations, especially in underserved areas such as Al-Diwaniyah [38].

Another group of studies have examined the prevalence of blood-borne viral infections, particularly Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV), in hemodialysis units across Iraq. A study conducted in Baghdad in 2015 involving 651 patients revealed a high prevalence of HBV (7.8%) and HCV (30.87%), emphasizing the role of nosocomial transmission and the importance of strict infection control practices [41]. Another study in Duhok in 2017 involving 94 patients found a lower prevalence of HBV (3.2%) and HCV (4.3%), which may be attributed to improved infection control protocols in the dialysis units [42]. In Karbala, a study conducted between 2019 and 2021 with 236 patients explored the association of dialysis duration with increased HCV infection risk, highlighting the chronic nature of exposure in long-term dialysis patients [43]. Additionally, Kamal and colleagues studied HBV, HCV, and HIV prevalence and seroconversion in Baghdad among hemophilia patients who often receive blood transfusions, showing potential overlaps with risks in HD settings, although they did not report specific prevalence rates [44]. Across these studies, HIV was consistently reported as either absent or not detected, reflecting a low prevalence in the HD patient population in Iraq.

Regional disparities in HCV prevalence among HD patients are evident across Iraq. Al-Muthanna reported highest rate at 36% [6], followed by Baghdad at 26% [5], and Diwaniyah at 21.2% [38], highlighting a significant geographic variation in infection rates. Moreover, the influx of refugees and the demands of intensive dialysis schedule have also been linked to increased HCV prevalence in certain regions [40]. Despite these challenges, almost studies have consistently reported no case of HIV among Iraqi hemodialysis patients, emphasizing that HCV and HBV remain the primary vital threats in this populations. To reduce the transmission risks, it essential to strengthen infection control practices, expand HBV vaccination coverage, and enhance the resources and infrastructure of dialysis units.

Prevention and Control Strategies

Poor adherence to infection control protocols remains the leading cause of nosocomial transmission of HCV and HBV within HD units. This inadequate compliance significantly increases the danger of spreading blood-borne pathogens

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among vulnerable patients. There are several standard precautions to prevent infection, such as washing hands after contact with body fluids, wearing of face shields, wearing gloves when touching blood, and, gowns [45,46]. In addition to the general precautions mentioned above, additional unique precautions are recommended. It is recommended to clean and disinfect unused instruments, surrounding surfaces, and dialysis machines between uses. it is also recommended to avoid sharing supplies, tools, or medications between patients, including trays, clamps, scissors, blood pressure cuffs, and other non-disposable equipment components, in addition to vaccinating dialysis patients against HBV (**Figure 3**) [45,46].

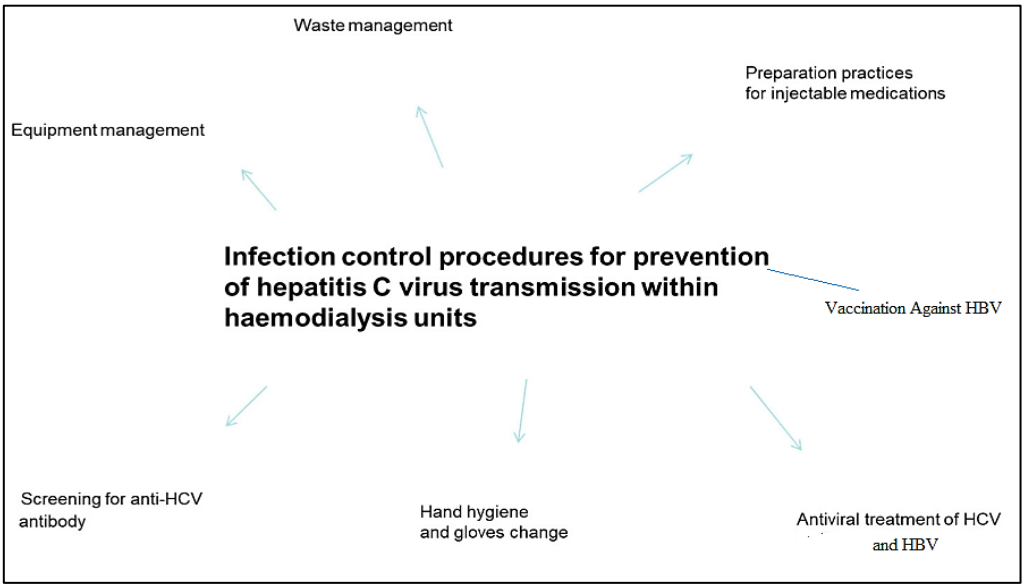

Figure 3: Overview of infection control practices for preventing HCV infection within hemodialysis units [46].

Conclusion

Blood-borne viral infections, particularly HBV and HCV, pose a significant threat to hemodialysis patients in Iraq due to their increased susceptibility from suppressed immunity, frequent blood transfusions, and invasive procedures. The prevalence of these infections varies across regions, with HCV being more common than HBV. Key risk factors include prolonged dialysis duration, history of blood transfusions, and inadequate infection control practices.

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