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Hepatitis B virus prevalence among hemodialysis patients in Sana'a, Yemen

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Abstract

Background and Objective: The United Nations considers the situation in Yemen to be one of the world's worst humanitarian crises. The fastest-spreading viral infection has been recorded among dialysis patients. Therefore, this study was conducted at the Dialysis Unit of Al-Thawra Modern General Hospital to estimate the prevalence of Hepatitis B virus (HBV) infection among patients undergoing dialysis during the dialysis crisis in Yemen.
Methodology: The study included all patients who continuous dialysis from January 2023 to December 2024 who free of HBV infection at the start of dialysis. Patients who discontinued dialysis before the end of the year due to death or transfer were excluded. Patients were tested for hepatitis B surface antigens (HBsAg). Data for each patient were collected using a pre-designed questionnaire that included demographic data on dialysis frequency, probability of associated HBV infection, and laboratory results.
Results: The study of 226 patients undergoing dialysis at Al-Thawra Modern General Hospital in Sana'a showed a demographic distribution of 56.6% males and 43.4% females, with a mean age of 40.5 years. The 26-35 age group comprised 27.9% of the patients. The prevalence of hepatitis B surface antigen (HBsAg) was 11.7% in males and 0.0% in females, peaking at 26.3% in the 16-25 age group. Primary antibody positivity for HB-core was 49.2% in males and 58.2% in females, with a low prevalence of 21.4% among those aged $\leq$ 16 years. Living in rural areas was strongly associated with HBV infection (66.3%). Previous hepatitis B infections were also statistically significant, and non-vaccination was strongly associated with an infection rate of 73.7%.
Conclusion: In conclusion, the spread of hepatitis B virus infection in dialysis patients in our environment after dialysis was very common and could lead to a disaster for dialysis patients.

Article Info

Keywords:
haemodialysis (HD), Hepatitis B Virus (HBV), Sana'a, Yemen.

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INTRODUCTION

In patients with end-stage renal disease (ESRD), hemodialysis (HD) is a life-saving treatment that cleanses the blood. Hepatitis B virus (HBV) and other blood-borne illnesses are among the most significant adverse effects of hemodialysis. Chronic HBV infection (CHB) is caused by the hepatitis B virus (HBV), a hepatotropic deoxyribonucleic acid (DNA) virus. The World Health Organization (WHO) estimates that 296 million people worldwide suffer from CHB. The clinical consequences of CHB include a range of extrahepatic symptoms in addition to hepatic problems. Research shows that extrahepatic symptoms occur in approximately 20% of HBV-positive people, with chronic kidney disease (CKD) being one of the most common extrahepatic consequences [1]. Hepatitis B (HBV) viral infections are a significant contributor to morbidity and mortality among patients undergoing dialysis and present challenges for the care of these patients in renal dialysis units [2]. An estimated 170 million people worldwide have hepatitis B virus, and an

estimated 400 million people worldwide have HBV; of them, 75% live in Asia and the Western Pacific [3]. Infection with HBV/HCV is uncommon in extensively infected areas and among individuals at high risk of parenteral transmission because of the typical modes of transmission. Individuals with two HBV infections are more likely to develop cirrhosis [4] and hepatocellular carcinoma (HCC) [5].

Dialysis patients are more susceptible to these bloodborne illnesses due to repeated blood transfusions and prolonged contact with blood arteries. The spread of this infection may be significantly influenced by contaminated tools, supplies, equipment, surfaces in the environment, and personnel [6]. Irreversible renal settlement causes a major immune state malfunction that increases the risk of hepatitis virus infection in patients undergoing dialysis [6]. Due to the introduction of the HBV vaccination, isolation of HBV-positive patients, use of specialized dialysis machines, and routine monitoring of HBV infection, HBV infection is less common than HCV in dialysis units [7]. Although the prevalence rate of past HBV, as shown by HBV surface antigen, is thought to be between 1% and 9.9% in Yemen, population studies show that infections with this virus are more common among those who are old enough to have increased risks of HD [8–18].

Yemen's infrastructure has been devastated by the war, leading to catastrophes like the current HD crisis. However, Yemen's healthcare system has been severely damaged, and those with chronic illnesses are unable to receive life-saving care. Four of Yemen's thirty-two dialysis facilities were shut down prior to the conflict. Due to malfunctioning equipment, a shortage of basic supplies, and unpaid employees, others find it difficult to deliver services [19]. Typically, patients require three four-hour sessions per week. Patients in Yemen have been compelled to cut back on two cycles due to the precarious situation. Yemen's humanitarian conditions are regarded by the UN as the worst in the world. During this period, the fastest-growing viral infection among HD patients was noted. To evaluate the hepatitis B virus epidemic and related factors among dialysis patients during Yemen's dialysis crisis, this HD unit-based study was conducted at Al-Thawra Modern General Hospital in Sana'a City, Yemen.

SUBJECTS AND METHODS

This single-center, cross-sectional investigation was carried out in the HD unit at AL_Thawra Modern General Hospital in Sana'a, Yemen. From January 2023 to December 2024, every patient receiving dialysis was free of HBV/HCV at the start of HD. The study did not include patients who stopped dialysis before the end of the year because they were transferred or died.

Specimen Collection and Laboratory Investigation

226 HD patients had 5 ml of venous blood extracted under sterile settings after giving their informed consent. The fourth generation of the Enzyme-Linked Immunosorbent Assay (ELISA) (ARCHITECT PLUS, Abbott) system was used to detect Hepatitis B markers (HBsAg, anti-HBs, and anti-HBc IgG). The sample was deemed confirmed positive for both HBsAg and Hepatitis B Core antibodies if the findings were greater than or equal to the cutoff value and the percent neutralization was greater than 50%. Findings below the cutoff value were considered negative for both.

Data collection

A pre-made questionnaire was used to gather individual data, including laboratory findings, risk factors for hepatitis virus infection, HD frequency, demographic information, and HD duration.

Statistical analysis

The data were analysed in a comparative positive anticore with negative one format in order to relate potential risk factors for HBV infection. The association Odds Ratios (OR) and their 95% confidence intervals (CI) were displayed using the chi-square test. To determine the potential odds ratios for the occurrence of HBV and their significance, values (OR, CI, $\chi 2$) were computed using 2×2 tables. A result was deemed statistically significant if the p-value was ≤ 0.05.

Ethical consideration

The Faculty of Medicine and Health Sciences' Research Review Committee granted ethical approval for the study. Prior to sampling, patients gave informed consent.

RESULTS

Table 1 shows the gender and age distribution of 226 hemodialysis patients who underwent hepatitis B virus testing at the dialysis unit of Al-Thawra Modern General Hospital in Sana'a. Males comprised 128 (56.6%) and females 98 (43.4%). The mean age was 40.5 $\pm$ 15.6 years, with an age range of 7 to 75 years. Patients aged 26–35 years constituted 63 (27.9%), followed by the 36–45 age group 50 (22.1%). Children comprised 14 (6.2%) of the total. Table 2 shows the prevalence of hepatitis B surface antigen (HBsAg) among different age and sex groups of 226 hemodialysis patients at the dialysis unit of Al-Thawra Modern General Hospital in Sana'a. The HBsAg prevalence was 15 (11.7%) in males and 0 (0.0%) in females. When considering age, the mean age of patients with HBsAg-positive was 34.3 years lower

than the overall mean age of patients (40.5 years). The highest HBsAg prevalence was recorded in the 16-25 year age group 5 (26.3%), followed by the under-16 year age group 2 (14.3%). The association between age, sex, and HBV infection (HBV core IgG-positive) in patients undergoing hemodialysis is shown in Table 3. In the male group, the HBV core antibody was positive in 57 (49.2%) and female was 63 (58.2%). There were no discernible differences between the sexes in the correlation of HBV core IgG. When examining the relationship between HBV core IgG and age, the age group under 16 years old had a significantly low incidence of 21.4%, with an OR of 0.22, a 95% confidence interval of 0.06-0.8, an X^2 of 6, and a p of 0.01. However, there was no discernible correlation with other age groups.

Table 4 shows the Risk factors associated with the risk of hepatitis B virus infection among hemodialysis patients in the hemodialysis unit of Al-Thawra Modern General Hospital in Sana'a City. HBV infection was significantly correlated with living in rural areas, where the rate was 66.3% (OR = 2.3, CI = 1.3-4, X^2 = 8.6, p = 0.003). When the rate reached 100%, there was a significant correlation between HBV infection and organ transplantation (X^2=8.7, p = 0.003). There was a significant correlation with OR of 2.4, CI=1.2-4.4, X^2=7.6, p=0.005 when prior hepatitis virus infections were considered as a risk factor. There was a strong correlation between HBV infection and non-vaccination when prior hepatitis virus vaccination was considered. The rate was 73.7%, with OR equal to 36.4, CI = 13.7 -96, X^2 = 85.9, and $p < 0.0001$.

DISCUSSION

One of the groups most at risk for HBV infection is patients receiving maintenance HD. The majority of HBV infection outbreaks in HD unit patients are caused by cross-contamination through the following mechanisms: [1) environmental surfaces, supplies (such as hemostats and clamps), or equipment that is not routinely disinfected after each use; [2) multiple-dose medication vials and intravenous solutions that are not used exclusively for one patient; [3) injection medications prepared in areas close to blood sample handling areas; and [4) staff members who concurrently care for both susceptible and HBV-infected patients. Compared to other prevalent blood-borne viruses, there is a higher and more serious risk of HBV transmission from blood-contaminated products in this environment [20, 21]. Patients receiving dialysis may expose the microbial circulatory system, which could result in bacteremia or viral infections, including HBV, HCV, and HIV, since dialysis necessitates access to the circulatory system [22]. The type of access used determines the risk of infection. Additionally, bleeding is possible; once more, the risk varies according to the manner of access. Strict adherence to the recommended infection control procedures can reduce infection [22].

According to the current study's findings, 15 (6.6%) of HD patients had HBsAg. These findings suggest that the transmission of HBV may be more significant in HD units due to contaminated HD equipment. Reuse of analyzers or transfusions may be the source of infection in HD patients. Dialysis equipment can be reused or disposed of after each treatment, as is well known. A preliminary discussion has been held on whether the reuse of dialysis machines worsens patient outcomes [23]. Reuse necessitates thorough and high-level cleaning of the device. It is now widely accepted that, when performed properly and carefully, reusing dialysis machines can produce results comparable to those of single use. However, because of the circumstances surrounding the Yemeni conflict, dialysis machines are reused improperly, which can lead to negative outcomes, such as HBV infections.

Due to the conflict and the closure of Sana'a Airport, which is the only point of entry for medical supplies, most hospitals in Yemen have taken inadequate steps to screen blood donors for hepatitis B using inadequate supplies and equipment, which may be the second source of HBV infection in the HD patients involved [24]. The current study's HD patient prevalence of HBV infection is lower than that of earlier research conducted in poor nations, where the prevalence of HBV in dialysis patients ranged from 15 to 40% [14, 25–28].

The current study's prevalence of HBV infection (HBVsAg) in dialysis patients (6.6%) is lower than that of HD patients in Yemen before, where the prevalence was previously reported to be between 8.9% and 17.9% [2, 29]. Worldwide, there are few studies on the prevalence of HBV infection in HD; three out of 67 patients with paralysis in Turkey had a dual incidence, according to Kara et al. [30]. A common infection rate of 30.4% was reported by Hong et al. [31] in China, which was greater than the 3.8% reported by dialysis patients. In India, Reddy et al. [27] discovered that 3.7% of HD patients had two infections. In another investigation by Saravanan et al., 112 (44.6%) of the 251 patients with Saravanan et al. [28] tested positive for HBV. According to a study conducted in India by Bhaumik and Debnath [32], the prevalence of HBV was 7%. Additionally, another study by Jain et al. [33] revealed an 11% prevalence of HBV infection. Furthermore, a study conducted in Libya by Alashek et al. [34] revealed that the prevalence of HBV is 2.6%.

The third decade of life (ages 16 to 25) showed a trend towards higher HB surface antigen levels, with a prevalence rate of 26.3%. The results of earlier research conducted in Yemen among at-risk and general populations are comparable to this [35–37]. Additionally, this study sought to assess the sociodemographic, behavioral, clinical, and cultural patterns associated with hepatitis B infection. Age and sex were not major risk variables

among the cases in our investigation. Interestingly, there was a strong correlation between HBV infection and residing in rural areas, where the rate was 66.3% (OR = 2.3, 1.3-4, X2 = 8.6, p = 0.003). This is in contrast to earlier research conducted in sub-Saharan African nations, which often reported higher infection rates among urban dwellers [38].

HBV infection and organ transplantation were not correlated in the current study with HBV infection. Because immunosuppressive medications may reactivate a latent virus, organ transplantation may increase the risk of hepatitis B virus (HBV) infection. Receiving an organ from an HBV-positive donor carries a higher risk, especially for liver transplants from anti-HBV (anti-HBc +) donors. Viral replication caused by immunosuppression may cause severe hepatitis, liver failure, or even death [39].

When previous Hepatitis virus infections were considered as a risk factor in the current investigation, there was a significant link with OR equal to 2.4, CI=1.2-4.4, X2=7.6, p=0.005. Prior hepatitis infections are a significant risk factor for hepatitis B virus (HBV) infection, especially when immunosuppression is present, as they may result in viral reactivation. Additionally, a history of primary HBV infection, indicated by the presence of primary antibodies, can complicate the treatment of subsequent viral infections, including hepatitis C, and may accelerate the development of liver disease. A history of HBV infection increases the likelihood of co-infection with other hepatitis viruses, such as hepatitis D, which may worsen the condition [40].

When prior Hepatitis virus vaccination was considered, the current study found a high association between HBV infection and non-vaccination. With an OR of 36.4, CI of 13.7-96, X2 of 85.9, and $p < 0.0001$, the rate was 73.7%. Non-vaccination is strongly and consistently linked to a markedly elevated risk of contracting hepatitis B virus (HBV). The best way to prevent HBV infection is through comprehensive vaccination programs, which have significantly decreased the number of cases. Numerous studies and public health data support this correlation, indicating a decrease in infection rates. Since routine newborn vaccination was implemented in the early 1990s, the number of new hepatitis B virus (HBV) infections in children and adolescents in the United States has dropped by 99%. Studies comparing vaccinated and unprotected groups consistently demonstrate a large decrease in HBV marker rates among vaccinated individuals, indicating that prevalence also decreases in vaccinated populations. Additionally, vaccination reduces the risk in a quantifiable manner. For instance, vaccinated healthcare personnel have been shown to have a much lower prevalence of HBV than their unvaccinated counterparts. According to one study, vaccinated individuals had a 100-fold lower infection rate. Lastly, the effect of national programs: nations with extensive national HBV vaccination programs have met the World Health Organization's target of lowering the prevalence of HBV surface antigens in children to less than 1%, demonstrating the influence of mass vaccination on public health [41].

CONCLUSION

In conclusion, dialysis patients had a disastrous condition due to the high prevalence of Hepatitis B virus (HBV) infection. Due to the shutdown of Sana'a Airport, the only point of entry for pharmaceuticals, there was a shortage or limited supply of dialysis supplies and laboratory reagents for testing the virus. Additionally, individuals with chronic renal disease (CRF) have a significant risk of infection because they are frequently exposed to blood from transfusions and extracorporeal circulation during dialysis. Transmission within dialysis units is strongly suggested by factors associated with HBV infection. The duration of dialysis or history of blood transfusions was not found to be a significant risk factor for HBV infection in individuals undergoing continuous dialysis. Improving infection control procedures in dialysis facilities and reducing HBV transmission require immediate attention.

ASSERTIVE

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DISPUTE OF INTEREST

This study is not connected to any conflicts of interest.

AUTHOR'S CONTRIBUTION

Ghada Hussein Ali Al-Falahi Khaled Abdulkareem Al-Moyed: writing original draft, methodology, investigation. Anwar G Al-Madhaji: formal analysis, data curation, conceptualization: writing, Al-Shamahy H: review and editing, methodology. Formal analysis, data curation, and conceptualization were performed.

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RESULTS

Table 1. Sex and age distribution of 226 hemodialysis patients screened for hepatitis B virus and risk factors for infection in the dialysis unit at Al-Thawra University Hospital in Sana'a City

Characters	Number	Percentage
Sex		
Male	128	56.6
Female	98	43.4
Age in Years		
Less than 16 years	14	6.2
16-25 years	19	8.4
26 – 35 years	63	27.9
36-45 years	50	22.1
46-55 years	43	19
>55 years	37	16.4
Total	226	100
Mean	40.5 years	
SD	15.6 years	
Median	40 years	
Mode	30 years	
Min to Max	7 - 75 years	

Table 2. Prevalence of HBsAg among different age and gender groups of 226 hemodialysis patients in the hemodialysis unit of Al-Thawra University Hospital in Sana'a city

Characters	Number	Percentage
Sex		
Male n=128	15	11.7
Female n=98	0	0.0
Total n= 226	15	6.6
Age groups		
Less than 16 years n=14	2	14.3
16-25 years n=19	5	26.3
26 – 35 years n=63	2	3.2
36-45 years n=50	3	6
46-55 years n= 43	0	0.0
>55 years n=37	3	8.1
Mean	34.3 years	
SD	21.4 years	
Median	27 years	
Mode	25 years	
Min to Max	14- 75 years	

Table 3. Relationship between sex, age and HBV infection (HBV core IgG positive) in hemodialysis patients

Host Factors	Positive HBV n=120 N (%)	***OR***	***95% CI***	X^2	***p***
Sex					
Male n=128	63 (49.2)	0.69	0.4-1.2	1.7	0.18
Female n=98	57 (58.2)	1.4	0.8-2.4	1.7	0.18
Total n= 226	120 (53.1)				
Age in Years					
Less than 16 years n=14	3 (21.4)	0.22	0.06-0.8	6	0.01
16-25 years n=19	9 (47.4)	0.7	0.3-1.9	0.2	0.6
26 – 35 years n=63	37 (57.7)	1.4	0.7-2.4	1.1	0.29
36-45 years n= 50	29 (57.1)	1.2	0.6-2.4	0.6	0.43
46-55 years n=43	19 (44.4)	0.6	0.3-1.2	1.6	0.19
>55 years n=37	23 (62.5)	1.5	0.7-3.2	1.4	0.22

Table 4. Risk factors associated with the risk of hepatitis B virus infection among hemodialysis patients in the hemodialysis unit of Al-Thawra University Hospital in Sana'a City

Characters	Positive HBV n=120 N (%)	*OR*	*(CI95%)*	X^2	*p*
Urban n=146	67 (45.8)	0.4	0.24-0.7	8.6	0.003
Rural n=80	53 (66.3)	2.3	1.3-4	8.6	0.003
Blood transfusion					
Yes n=182	96 (52.7)	0.6	0.3-1.2	1.7	0.18
No n=44	24 (54.5)	-	-	-	-
Organ transplants					
Yes n=0	0 (0.0)	0.0	Undefined	8.7	0.003
No n=226	226 (100)	-	-	-	-
History of cupping					
Yes n=56	34 (60.7)	1.5	0.8-3.7	1.7	0.18
No n=170	86 (50.0)	-	-	-	-
Tattoos or body piercing					
Yes n=53	31 (58.5)	1.3	0.7-2.4	0.8	0.3
No n=173	89 (51.4)	-	-	-	-
Sharing toothbrush					
Yes n=0	0 (0.0)	0.0	Undefined	8.7	0.003
No n=226	226 (100)	-	-	-	-
Sharing razor					
Yes n=0	0 (0.0)	0.0	Undefined	8.7	0.003
No n=226	226 (100)	-	-	-	-
Previous Hepatitis virus infection					
Yes n=60	41 (68.3)	2.4	1.2-4.4	7.6	0.005
No n=166	79 (47.6)	-	-	-	-
HBV vaccination					
Yes n=70	5 (7.1)	0.02	0.01 -0.07	85.9	<0.0001
No n=156	115 (73.7)	36.4	13.7-96	85.9	<0.0001