



RESEARCH ARTICLE

EXPLOSION OF HEPATITIS B AND C VIRUSES AMONG HEMODIALYSIS PATIENTS AS A RESULT OF HEMODIALYSIS CRISIS IN YEMEN

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Abstract



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Objective: The United Nations considers the situation in Yemen to be the worst humanitarian crisis in the world. In the midst of this, the fastest-spreading viral infection among HD patients was recorded. Therefore, this cohort study based in HD unit was conducted in Dhamar Hospital to estimate the outbreak of hepatitis B and C viruses among dialysis patients during the dialysis crisis in Yemen.

Methods: All the patients who continuous go through hemodialysis from January 2018 to December 2018 and they were free from HBV/HCV infections at the start of the study (January 2018) were included. Patients who were discontinued from dialysis before the end of the year due to death or relocation were excluded from the study. Patients were tested for anti-HCV antibodies and hepatitis B surface antigen (HBsAg) at study start (January 2018) then at the end of the follow up (December 2018). The individual's data were collected in a pre-designed questionnaire including; demographic data of HD frequency, and laboratory results.

Results: The study included 202 patients, 20 (9.9%), 18 (8.9%) and 6 (2.97%) were found to be infected with HCV, HBV and Co-HBV/HCV infection respectively. There was significant association between rise of HCV rate and younger patient age, and high frequency of dialysis.

Conclusion: In conclusion, the prevalence of HBV and HCV infection and HBV/HCV infection in haemodialysis patients in our surroundings one year after HD was extremely common and lead to disaster for HD patients. This catastrophe is due to the lack or limited availability of materials and tools for dialysis and laboratory materials for virus tests due to the unfair siege on Yemen from Saudi Arabia and the United Arab Emirates and the closure of Sana'a airport, which is the only entrance to medicines.

Keywords: Dhamar, haemodialysis (HD), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Yemen.

INTRODUCTION

Viral infections of hepatitis B (HBV) and hepatitis C (HCV) are major causes of morbidity and mortality in dialysis patients and pose problems in the management of these patients in renal dialysis units¹. An estimated 400 million people are living with HBV around the world; 75% of them reside in Asia and the Western Pacific, and an estimated 170 million people worldwide are living with hepatitis B virus². The prevalence and incidence of hepatitis C infection in dialysis patients varies from country to country and ranges from 1 to 84.6%³. Due to the common

transmission methods, infection with HBV/HCV is not common in severely infested areas and among people at high risk of parenteral transmission. Patients with dual HBV/HCV infection have a higher risk of progressing to cirrhosis⁴, as well as an increased risk of hepatocellular carcinoma (HCC)⁵. Long-term exposure to blood vessels and multiple blood transfusions increase the risk of these blood-borne diseases in dialysis patients. Contaminated devices, equipment and supplies, environmental surfaces and staff involved may play an important role in the transmission of this infection⁶. Infections of hepatitis viruses in dialysis patients are enhanced by a

significant dysfunction of the immune state that develops due to irreversible renal settlement⁶. HBV infection is less prevalent than HCV in dialysis units due to the introduction of HBV vaccine, isolation of HBV-positive patients, use of dedicated dialysis machines and regular monitoring of HBV infection have significantly reduced HBV prevalence in this situation⁷. Saudi-Emirati aggression in Yemen has destroyed the country's infrastructure, resulting in disasters such as the modern HD crisis. But the damage to Yemen's healthcare sector is so great that individuals with chronic illnesses do not have access to life-saving treatment. Of the 32 dialysis centres in Yemen before the war, four were closed. The others are struggling to provide services, with broken machines, lack of basic supplies and unpaid staff⁸. Patients usually need three sessions of four hours per week. In Yemen, the fragile situation has forced patients to reduce two cycles. The United Nations considers the situation in Yemen to be the worst humanitarian crisis in the world. In the midst of this, the fastest-spreading viral infection among HD patients was recorded. Therefore, this cohort study based in HD unit was conducted in Dhamar Hospital, Dhamar City, Yemen to estimate the outbreak of hepatitis B and C viruses among dialysis patients during the dialysis crisis in Yemen.

SUBJECTS AND METHODS

This cohort, single study centred was conducted in the HD unit at Dhamar Hospital, Dhamar City, Yemen. All patients consistently undergoing dialysis from January 2018 to December 2018 and were free of HBV/HCV infection at the beginning of the study (January 2018). Patients who stopped dialysis before the end of the year due to death or transfer were excluded from the study. Patients were tested for anti-HCV antibodies hepatitis B surface antigen (HBsAg) at study start (January 2018) then at the end of the follow up (December 2018).

Specimen Collection and Laboratory Investigation

After obtaining informed consent, 5 ml of venous blood was withdrawn under sterile conditions from 202 HD patients. Serums were then screened for hepatitis B surface antigen (HBsAg) and hepatitis C virus (anti-HCV) antibody using the fourth generation of the enzyme-linked immunosorbent assay (ELISA) (Boehringer, Germany). Results greater than or equal to the cut off value and the percent neutralization is >50%, the sample is considered confirmed positive for both HBsAg and HCV and results less than the cut off value are considered negative for both.

Data collection

Individual data were collected in a pre-designed questionnaire including; HD frequency, demographic data, HD duration, risk factors for hepatitis B and hepatitis C virus infection, and laboratory results.

Statistical analysis

To relate possible risk factors for HBV and HCV infection, the data were examined in a case-control study format. For HBV or HCV, persons with evidence of previous or current infection with HBV or HCV

positive were matched up with those who were HBV or HCV negative. The chi square was used to see the association Odds ratios (OR) and their 95% confidence intervals (CI). Values (OR, CI, χ^2) were estimated using 2x2 tables to identify possible odds ratio on occurrence of HBV and HCV and their significance. The result at p-value 0.05 or less was considered as statistically significant.

Ethical consideration

Ethical authorization for the study was obtained from the Research Review Committee of the Faculty of Medicine and Health Sciences. Informed consent was taken from HD patients before sampling.

RESULTS

Table 1 shows the prevalence of different types of viral infections hepatitis among HD patients one year after dialysis. The prevalence rate of single hepatitis B virus was 8.9%, the rate of single hepatitis C virus infection was 9.9%, and 2.97% of HD patients found to have Co-HBV/HCV infection.

Table 1: The prevalence rate of different types of Hepatitis viral Infections among HD patients after 1 year of dialysis.

| Types of Hepatitis viral Infections | Frequency | |
|-------------------------------------|-----------|------|
| | Number | % |
| HBV single infection | 18 | 8.9 |
| HCV single infection | 20 | 9.9 |
| HBV+HCV co-infections | 6 | 2.97 |
| Total infections | 44 | 21.8 |

Table 2 shows the effects of sex and age groups on HBV infection among HD patients. The HBV rate among female patients was 15% higher than 9.8% of male patients. There was an increase in the HBV rate in the age group 30-39 years where the rate was 18.8% with OR equal to 1.8 and there was a lower rate of HBV in the age group less than 30 years (5.6%) but the differences between the rates in all age groups were not statistically significant. Table 3 shows the effects of sex and age on hepatitis C virus infection among HD patients. The hepatitis C virus rate among female patients was 15% higher than 11.5% of male patients. There was an increase in the HCV rate in the age group below 30 years where the rate was 27.8% with OR equal to 3.0, CI=1.0-9.2, and $P=0.04$; followed by 20.3% with OR equal to 2.5, CI =1.1-5.6, and $p=0.03$ in the age group 50-59 years; while there was a decrease in the rate of hepatitis C infection in the age group ≥ 60 years (4.5%) but differences between rates in the sexual groups and most age groups were not statistically significant. There was an increase in HBV rate in dialysis frequency 7 times where the rate was 16.7% with OR equal to 1.5, followed by 12.3% with OR equal to 1.1 for 8 times; but differences between rates in the dialysis frequency groups were not statistically significant (Table 4). Table 5 shows the effect of dialysis frequency on hepatitis C virus infection among HD patients.

DISCUSSION

Since dialysis requires access to the circulatory system, patients undergoing dialysis may expose the microbial circulatory system, which may lead to bacteremia, or viral infections as HBV, HCV, and HIV. The risk of infection varies depending on the type of access used. Bleeding may also occur; again the risk varies depending on the type of access used. Infection can be minimized by strict adherence to best infection control practices⁹. The results of the current study showed that the prevalence of HBV and HCV infection in HD patients is 8.9% and 9.9%, respectively, with the combined infection rate of HBV-HCV equal to 2.97% and the overall infection rate was 21.8%.

This finding confirmed that 21.8% of our patients were converted to positive viral hepatitis within a year, and this suggests that within the next four years of HD all HD patients who participated in this study will acquire viral hepatitis. The results indicated that spread of HBV and HCV may be of greater importance in HD units through contamination HD equipments. Infection for our HD patients may be from a reuse analyzer or transfusion. As is known, dialysis apparatus can be disused after each treatment or reused. Reuse requires extensive and high-level disinfection and there has been a preliminary debate on whether the reuse of dialysis machines has exacerbated patient outcomes¹⁰. Today's consensus is that the reuse of dialysis machines, if done carefully and correctly, leads to results similar to the single use of dialysis machine, but

due to situations arising from the war in Yemen, dialysis machines are reused, not carefully and properly done, and the bad results as HBV, HCV infections to reuse of dialyzers is the consequence. The second source of HBV and HCV infection in the participated HD patients may be through blood transfusion and this important relationship of HD with HBV and HCV, reflects poor measures in screening blood donors for hepatitis C and B using insufficient materials, and instruments in most hospitals in Yemen due to the Saudi/UAE aggression and the closure of Sana'a Airport, which is the only entrance to medical materials¹¹. The prevalence of HBV and HCV infection in HD patients in the current study is lower than the rates reported from old previous various studies in developing countries where the prevalence of HBV and HCV in dialysis patients ranged from 15-40%⁷⁻¹²⁻¹⁵.

The prevalence of HBV and HCV infection in dialysis patients in current study is lower than previously reported in Yemen among HD patients where the prevalence of HBV and HCV infection in dialysis patients was 17.9% and 22.5%, respectively¹⁶. Because these two viruses share a common method of transmission, we searched for co-infection with HBV and HCV among patients, and were seen in 6 patients, male (2/122=1.6%) and four females (4/80=5%). Studies on the prevalence of HCV and HBV infection in HD are rare; Kara *et al.*,¹⁷ in Turkey reported a dual incidence of three out of 67 paralysis patients.

Table 2: The effects of sex and age groups in HBV infections among HD patients.

| Characters | HBV positive cases (n = 24) | | OR | CI | χ^2 | p |
|----------------------|-----------------------------|-------------|------|----------|----------|------|
| | No. | % | | | | |
| Sex | | | | | | |
| Male, (n= 122) | 12 | 9.8 | 0.51 | 0.2-1.2 | 2.5 | 0.11 |
| Female, (n= 80) | 12 | 15 | 1.36 | 0.59-3.1 | 2.5 | 0.11 |
| Age groups | | | | | | |
| < 30 years, (n=18) | 1 | 5.6 | 0.37 | 0.04-2.5 | 0.9 | 0.33 |
| 30-39 years, (n=48) | 9 | 18.8 | 1.8 | 0.76-4.9 | 1.9 | 0.16 |
| 40- 49 years, (n=50) | 5 | 10 | 0.69 | 0.24-1.9 | 0.48 | 0.48 |
| 50- 59 years, (n=64) | 6 | 9.4 | 0.61 | 0.23-1.6 | 1.01 | 0.31 |
| ≥ 60 years, (n=22) | 3 | 13.6 | 1.1 | 0.29-3.9 | 0.01 | 0.9 |
| Total n=202 | 24 | 11.9 | | | | |

OR-Odds ratio = Relative risk, CI=Confidence intervals, χ^2 -Chi-square=3.9 or more significant, p-Probability value = 0.05 or less significant

Table 3: The effects of sex and age groups in HCV infections among HD patients.

| Characters | HCV positive cases (n = 26) | | OR | CI | χ^2 | p |
|----------------------|-----------------------------|-------------|------|-----------|----------|------|
| | No. | % | | | | |
| Sex | | | | | | |
| Male, (n= 122) | 14 | 11.5 | 0.7 | 0.32-1.6 | 0.53 | 0.46 |
| Female, (n= 80) | 12 | 15 | 1.4 | 0.5-3.1 | 0.53 | 0.46 |
| Age groups | | | | | | |
| < 30 years, (n=18) | 5 | 27.8 | 3.0 | 1.0-9.2 | 3.9 | 0.04 |
| 30-39 years, (n=48) | 3 | 6.3 | 0.37 | 0.1-1.3 | 2.5 | 0.1 |
| 40- 49 years, (n=50) | 4 | 8 | 0.51 | 0.16-1.57 | 1.4 | 0.23 |
| 50- 59 years, (n=64) | 13 | 20.3 | 2.5 | 1.1-5.6 | 4.6 | 0.03 |
| ≥ 60 years, (n=22) | 1 | 4.5 | 0.29 | 0.03-2.29 | 1.5 | 0.21 |
| Total n=202 | 26 | 12.9 | | | | |

OR-Odds ratio = Relative risk, CI=Confidence intervals, χ^2 -Chi-square=3.9 or more significant, p-Probability value = 0.05 or less significant

Hong *et al.*,¹⁸ in China reported a common infection of 30.4% and was higher than dialysis patients who had only 3.8%. Reddy *et al.*,¹⁴ in India found a prevalence of 3.7% of dual infections in HD patients. In another study by Saravanan *et al.*,¹⁵ out of 251 patients, 67 (26.7%) were positive for HCV, 112 (44.6%) were positive for HBV, 15 (5.9%) had a double infection, and 57 (22.7%) were non HBV/Non-HCV. Another study by Bhaumik and Debnath⁶ in India reported the

prevalence of HBV, HCV and HBV/HCV co-infection by 7%, 46% and 37%; respectively. What's more in another study by Jain *et al.*,¹⁹ reported the prevalence of HBV, HCV and HBV/HCV infection by 11%, 30% and 3%; respectively. Moreover, in another study by Alashek *et al.*,²⁰ in Libya reported that the prevalence of common infection HBV, HCV, and HBV/HCV is 2.6%, 31.1%, and 1.2%, respectively.

Table 4: The effect of dialysis frequency on HBV infections among HD patients.

| Frequency/months | HBV positive cases (n =24) | | OR | CI | χ^2 | p |
|-----------------------|----------------------------|------|------|----------|----------|------|
| | No. | % | | | | |
| 5 or less times, n=10 | 1 | 10 | 0.81 | 0.09-6.7 | 0.035 | 0.85 |
| 6 times, n=58 | 6 | 10.3 | 0.80 | 0.3-2.1 | 0.18 | 0.66 |
| 7 times, n=12 | 2 | 16.7 | 1.5 | 0.3-7.4 | 0.27 | 0.59 |
| 8 times, n=122 | 15 | 12.3 | 1.1 | 0.45-2.7 | 0.05 | 0.82 |

OR-Odds ratio = Relative risk, CI=Confidence intervals, χ^2 -Chi-square=3.9 or more significant, p-Probability value = 0.05 or less significant

Table 5: The effect of dialysis on HCV infections among HD patients.

| Frequency/months | HBV positive cases (n =24) | | OR | CI | χ^2 | p |
|-----------------------|----------------------------|---|------|----------|----------|------|
| | No. | % | | | | |
| 5 or less times, n=10 | 1 | | 0.83 | 0.1-6.8 | 0.029 | 0.86 |
| 6 times, n=58 | 5 | | 0.61 | 0.2-1.7 | 0.88 | 0.34 |
| 7 times, n=12 | 1 | | 0.62 | 0.08-5.2 | 0.16 | 0.68 |
| 8 times, n=122 | 19 | | 1.9 | 0.76-4.8 | 2 | 0.15 |

OR-Odds ratio = Relative risk, CI=Confidence intervals, χ^2 -Chi-square=3.9 or more significant, p-Probability value = 0.05 or less significant

There was a trend towards increased HB surface antigen levels with the third decade of age (age group 30-39 years) where the prevalence rate was 18.8%. This is similar to the findings of previous studies in Yemen among the general population and at-risk groups²¹⁻²³. There was a trend towards increasing HCV levels with the second and fifth decades of age (less than 30 years and 50-59 year groups) where the prevalence rate was 27.8% and 20.3%, respectively. This differs from the results of previous studies in developing and developed countries among dialysis patients^{24,25} which reported that the high prevalence of hepatitis C virus was in the sixth decade compared to the younger age groups of dialysis patients. In the current study, there was an increase in the HCV rate in dialysis frequency 8 times where the rate was 15.7% with OR equal to 1.9, while lower rates occurred in other frequency groups; however, differences between rates in dialysis frequency groups were not statistical significance. These results differ from those of Saha and Agarwal¹ and Bhaumik and Debnath⁶, where this former factor was a significant risk factor for hepatitis C virus infection in HD patients.

CONCLUSIONS

In conclusion, the prevalence of HBV and HCV infection and HBV/HCV infection in hemodialysis patients in our surroundings one year after HD was extremely common and lead to disaster for HD patients. This catastrophe is due to the lack or limited availability of materials and tools for dialysis and laboratory materials for virus tests due to the unfair siege on Yemen from Saudi Arabia and the United

Arab Emirates and the closure of Sana'a airport, which is the only entrance to medicines.

In addition, there is a high risk of developing the disease among chronic renal failure (CRF) patients due to frequent exposure to blood from transfusions and circulatory processes outside the body during dialysis. It was also found that the risk of co-infection is higher among patients with CRF due to the high frequency of blood transfusion/blood products and circulation outside the body during dialysis.

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AUTHOR'S CONTRIBUTION

This research work is part of a M.Sc. thesis. **Amran OAA:** conducted the laboratory and field works; and wrote up the thesis. **Al-Shamahy HA:** supervised the laboratory and field works. **Al Hadad AM:** writing, review and editing. **Jaadan BM:** methodology, formal analysis. Final manuscript was read and approved by all authors.

DATA AVAILABILITY

The data supporting the findings of this study are not currently available in a public repository but can be made available upon request to the corresponding author.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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