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Community Medicine Department

Epidemiology of Hepatitis B & C virus infections among hemodialysis patients in five centers in Yemen

انتشار فيروس الكبد سي و بي بين مرضى الغسيل الكلوي

Research of community medicine to obtain bachelor's degree

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Abstract

Background: Patients on hemodialysis (HD) are at high risk of viral hepatitis due to high number of blood transfusion sessions, prolonged vascular access, high exposure to infected patients and contaminated equipment, or cross contamination from the dialysis circuits and pose problems in the management of patients in the renal dialysis units.

Objectives: This study was conducted to determine the prevalence of Hepatitis B virus (HBV) & Hepatitis C virus (HCV), in patients on hemodialysis in Zabid, Al-qanawes, Al-jumhori (Al-mahweet), Amran and 22and of May HD centers in Yemen.

Methods: we use descriptive retrospective study. Data was collected from the medical reports of 521 patients from Ministry of Public Health And Population presented to Zabid, Alqanawes, Aljumhori-Mahweet, 22 May Sana'a governorate and Amran governorate hemodialysis centers in the period from 1st of Jan 2020 to 1st of September 2020.

Conclusion: The findingssuggest that blood transfusion and duration of hemodialysis were considered the main most important risk factors for HBV and HCV infection among hemodialysis patients. Moreover, the factors associated with HBV and HCV infection are highly suggestive of nosocomial transmission within HD units. Urgent action is required to improve infection control measures in HD centers and to reduce dependence on blood transfusions for the treatment of anemia associated with ESRD. We need to increase the capacity of each center and isolate HBV & HCV seropositive with specific HD units**.**

الخلاصة

الخلفية : المرضى الذين يخضعون لغسيل الكلى (HD) معرضون لخطر الإصابة بالتهاب الكبد الفيروسي بسبب العدد الكبير من جلسات نقل الدم ، والوصول إلى الأوعية الدموية لفترات طويلة ، والتعرض الشديد للمرضى المصابين والمعدات الملوثة ، أو التلوث المتبادل من دوائر غسيل الكلى ويطرح مشاكل في إدارة المرضى في وحدات غسيل الكلى.

الأهداف: أجريت هذه الدراسة لتحديد مدى انتشار فيروس التهاب الكبد الوبائي ب (HBV) وفيروس التهاب الكبد الوبائي سي (HCV) في مرضى غسيل الكلى في مراكز زبيد والقناوص والجمهوري (المحويت) ,عمران , 22 مايو.

الطرق: دراسة وصفية بأثر رجعي. البيانات المستخرجة والمجمعة من التقارير الطبية لـ ٥٢١ مريضاً لوزارة الصحة العامة والسكان اليمنية لمرضى الغسيل الكلوي في مراكز زبيد ، القناوص ،(الجمهوري) المحويت ، ٢٢ مايو محافظة صنعاء ، ومركز غسيل الكلى بمحافظة عمران في الفترة من ١ يناير ٢٠٢٠ إلى أول سبتمبر ٢٠٢١.

الخلاصة : تشير النتائج إلى أن نقل الدم ومدة غسيل الكلى يعتبران من أهم عوامل الخطر للإصابة بفيروس التهاب الكبد الوبائي ب HBV و إلتهاب الكبد الوبائي ج HCV بين مرضى غسيل الكلى. علاوة على ذلك ، فإن العوامل المرتبطة بالعدوى بفيروس التهاب الكبدالوبائي ب HBV و إلتهاب الكبد الوبائي سي HCV توحي بشدة بانتقال العدوى داخل وحدات الغسيل الكلوي . مطلوب اتخاذ إجراءات عاجلة لتحسين تدابير مكافحة العدوى في مراكز الغسيل الكلوي وتقليل الاعتماد على عمليات نقل الدم لعلاج فقر الدم المرتبط بالداء الكلوي بمراحله الأخيرة. نحن بحاجة إلى زيادة قدرة كل مركز وعزل المرضى المصابين بإلتهاب الكبد الوبائي ب HBV و إلتهاب الكبد الوبائي ج HCV في وحدات غسيل كلوي مخصصة لهم.

Acknowledgment

First, our prayers are to Allah the most gracious the most merciful for helping us in completing this humble work.

Second, many warm thanks covered with our love and gratitude for the full support, encouragement and inspiration of our families.

Third, special thanks dedicated to Dr. Ahmad AL-Shahithe for his professional notes and comments and for accepting to be the supervisor of this study. We can't forget his role in encouraging us to finish this study and for his efforts at every step of this monumental work.

Finally, We would thank all those who contributed directly and indirectly to the success of this humble effort, to the people who contributed in finishing this study and getting it in its final version.

The Researchers

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Abbreviation list

Abbreviation	*Meaning*
HD	**Hemodialysis**
HBV	**Hepatitis B virus**
HCV	**Hepatitis C virus**
ESRD	**End stage renal disease**
SD	**Standard deviation**
Min	**Minimum**
Max	**Maximum**
ELISA	**Enzyme linked immunoassay**
PCR	**Polymerase chain reaction**
Anti-HCV Ab	**Anti-Hepatitis C virus antibody**
HBs ag	**Hepatitis B surface antigen**
CRF	**Chronic renal failure**
ARF	**Acute renal failure**
ICRC	**International Committee of the Red Cross**
COVID-19	**Corona virus disease 2019**
WHO	**World health organization**
RNA	**Ribonucleic acid**
DNA	**Deoxyribonucleic acid**
Co-HBV, HCV	**Coinfection of hepatitis B & C viruses**
HBcAb	**Hepatitis B core antibody**

CHAPTER 1: INTRODUCTION

1.1 Study Background

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 units. 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 virus . 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).

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 infection Infections of hepatitis viruses in dialysis patients are enhanced by a significant dysfunction of the immune state that develops due to irreversible renal settlement.

Patients on hemodialysis (HD) are at high risk of viral hepatitis due to high number of blood transfusion sessions, prolonged vascular access, high exposure to infected patients

and contaminated equipment, or cross contamination from the dialysis circuits and pose problems in the management of patients in the renal dialysis units.

Renal failure remains a serious cause of mortality in Yemen (M Al-Rohani, 2004). However Chronic renal failure (CRF) remains a significant cause of mortality in Yemen. There are about 568 patients with end-stage renal failure (ESRD) who receive chronic hemodialysis in seven centers in Yemen **(Muhamed Al-Rohani, 2003).**

An astonishing 25 percent of dialysis patients in Yemen have died every year since conflict began in 2015. More dialysis supplies, functioning dialysis machines, and funding for staff salaries are urgently needed to ensure the mortality rate does not rise further for Yemen's 4,400 renal failure patients.

Testing for HCV relied on a third generation ELISA to detect anti-HCV antibodies and confirmation or genotyping with PCR is currently not available in all centers. Noticing that the variable courses of serological and PCR tests tells us the needing of both.

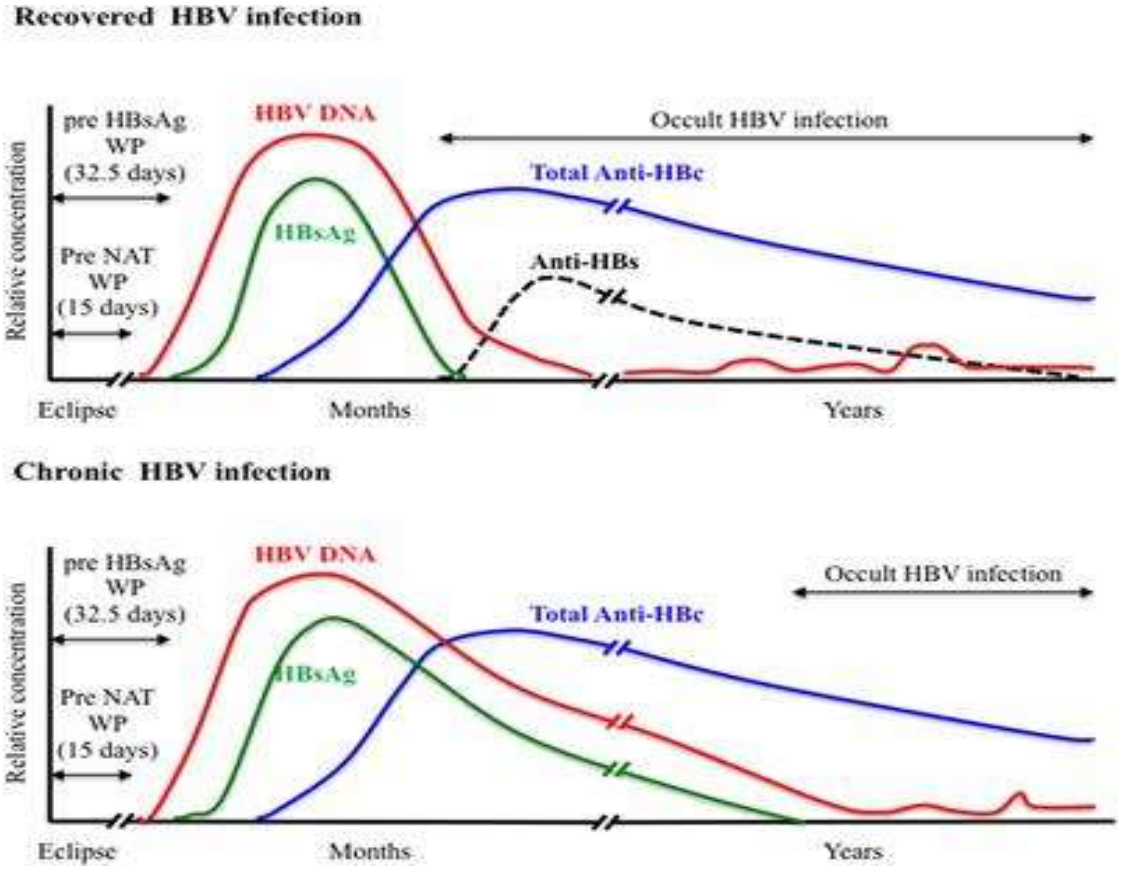


Figure 1: Recovered Hepatitis B and C infections

The urgent needs of dialysis patients underscore how conflict has devastated Yemen's health care system, negatively affecting many people with long-term health concerns," said Alexandre Faite, ICRC's head of delegation in Yemen.Travel to dialysis centers is frequently an odyssey of checkpoints and insecurity.

The urgent needs of dialysis patients underscore how conflict has devastated Yemen's health care system, negatively affecting many people with long-term health concerns. Yemen only 32 dialysis centers had before the war, four have closed; the other 28 are struggling to provide services, with broken machines, a lack of essential supplies and unpaid staff. Patients normally require three, four-hour sessions per week. In Yemen the fragile situation has forced patients to cut back to two sessions Although, reducing the weekly dialysis sessions causes increased side-effects and a lower quality of life. Without dialysis treatment, the outcome is fatal (Relifeweb, 2018).

War 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 centers in Yemen before the war, four were closed. The others are struggling to provide services, with broken machines, lack of basic supplies and unpaid staff. 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 study based in HD unit was conducted in

some HD centers, Yemen to estimate the prevalence of hepatitis B and C viruses among dialysis patients during the dialysis crisis in Yemen.

This study aimed to evaluation the prevalence of Hepatitis B and C, transmission in patient with dialysis in areas with poor consideration in previous studies

1.2 Study Significance

The finding of this study will rounded for that the HD play important role in increasing the prevalence of hepatitis b and c are increasing among painted o HD . that's all because increase number of hd patient and lacking of centers and hemodialysis machines and nosocomial infection and blood transfusion. also no spectating infected painted how are seropositive from patient seronegative . the benefits of this study to made spot light how great this problem focus government to make more centers to determine this huge problem and for all society and medical stuff specially in dialysis center that they have to prevent their self from nosocomial infection.

This study aimed to assess the prevalence of Hepatitis B and C virus infections, among patients with dialysis in areas with poor consideration in previous studies.

1.3 Study Objectives

1.3.1 General objective:

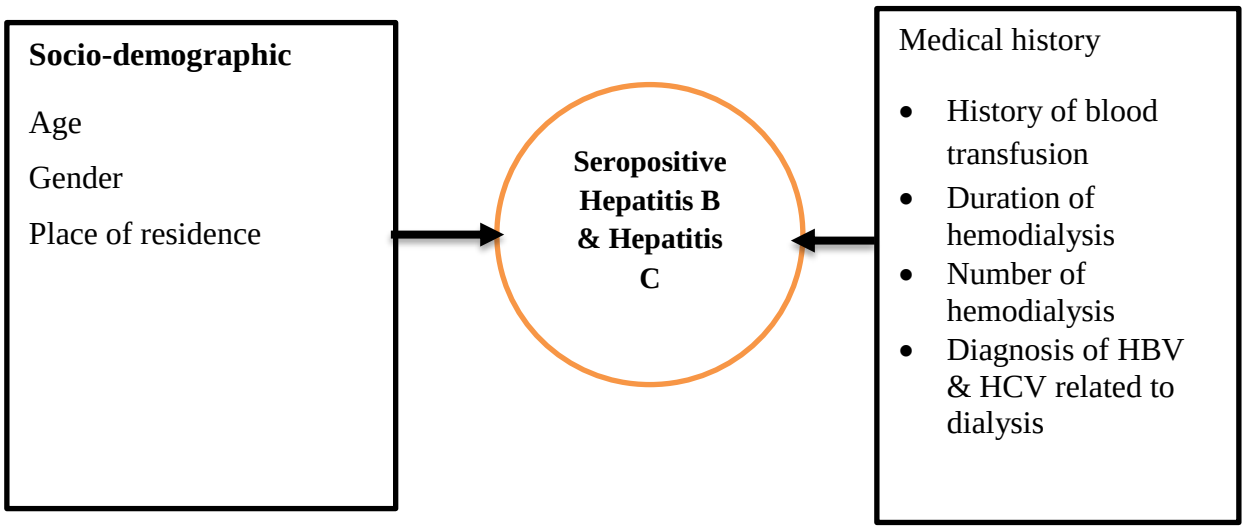
The general objective aimed to determine epidemiology of hepatitis C,B transmission during dialysis in Zabid, Al-qanawes, Al-jumhori (Al-mahweet), Amran and 22and of May HD centers.

1.3.2 Specific objectives:

1. To identify the prevalence of HBV, HCV.
2. To Describe of the respondents with infection of HBV, HBC during dialysis.

3. To determine of risk factors associated with infection of HBV & HCV among dialysis respondents.

1.4 Conceptual framework for the study



1.5 Study Limits

- **Place limits:** Far centers and there were not enough facilities to visit the centres to get more information about each canter due to war
  - There were variable numbers of patients between the selected hemodialysis centers
  - COVID-19 infection which prevent us to go centers and do survey
  - Numbers of hemodialysis patients were emerged between centers
  - Time limits

CHAPTER 2: LITERATURE REVIEW

2.1 Hepatitis Background

Viral hepatitis is one of the major public health concerns around the world but until recently it has drawn little attention or funding from global health policymakers. Every year 1.4 million people die from viral hepatitis-related cirrhosis and liver cancer. However, the majority of the infected population is unaware of their condition. This population has significant obstacles to overcome such as lack of awareness, vulnerability, increased migration, disease stigma, discrimination, as well as poor health resources, conflict in policy development and program implementation. However, viral hepatitis is a serious disease, which results in a high number of fatalities that increase each year, with the majority of infected people being unaware of their condition. Viral hepatitis results in around 1.4 million deaths each year, HBV and HCV are responsible for about 90% of these fatalities, whilst the remaining 10% of fatalities are caused by other hepatitis viruses (Jefferies, Rauff, Rashid, Lam, & Rafiq, 2018).

Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease.

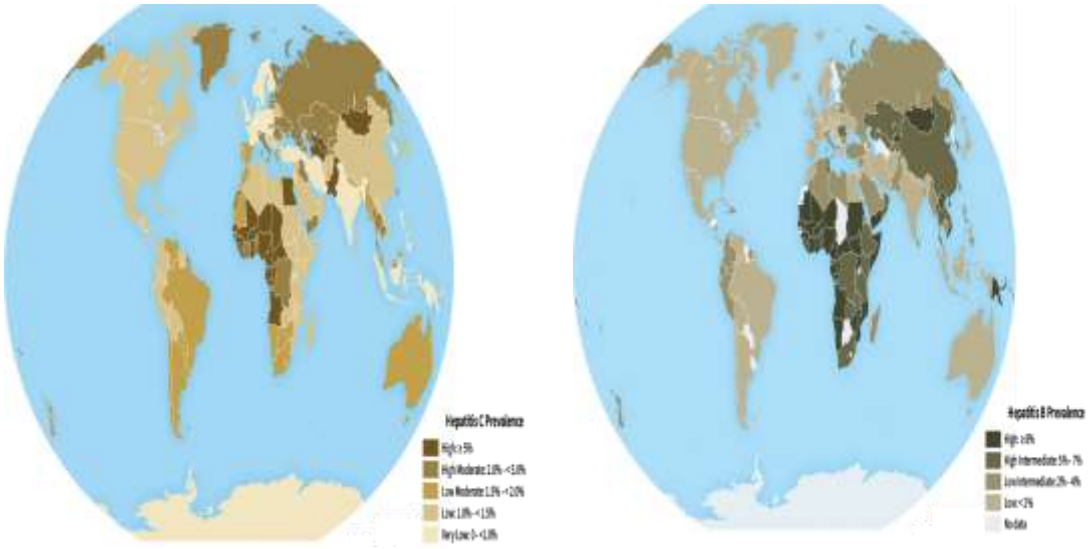


Figure (3): Global distribution of Hepatitis B & C prevalence

2.2 Geographical distribution of Hepatitis B

Hepatitis B prevalence is the highest in the WHO Western Pacific Region and the WHO African Region, where 6.2% and 6.1% of the adult population is infected respectively. In the WHO Eastern Mediterranean Region, the WHO South-East Asia Region and the WHO European Region, an estimated 3.3%, 2.0% and 1.6% of the general population is infected, respectively. And in the WHO Region of the Americas, 0.7% of the population is infected (WHO, 2021).

The virus is most commonly transmitted from mother to child during birth and delivery, as well as through contact with blood or other body fluids, including sex with an infected partner, injection-drug use that involves sharing needles, syringes,

or drug-preparation equipment and needle sticks or exposures to sharp instrument (WHO, 2021).

WHO estimates that in 2015, 257 million people were living with chronic hepatitis B infection (defined as hepatitis B surface antigen positive).

In 2015, hepatitis B resulted in an estimated 887 000 deaths, mostly from cirrhosis and hepatocellular carcinoma (i.e. primary liver cancer).

As of 2016, 27 million people (10.5% of all people estimated to be living with hepatitis B) were aware of their infection, while 4.5 million (16.7%) of the people diagnosed were on treatment. According to the latest WHO estimates, the proportion of children under five years of age chronically infected with HBV dropped to just less than 1% in 2019 down from around 5% in the pre-vaccine era ranging from the 1980s to the early 2000s (WHO, 2021) [2]

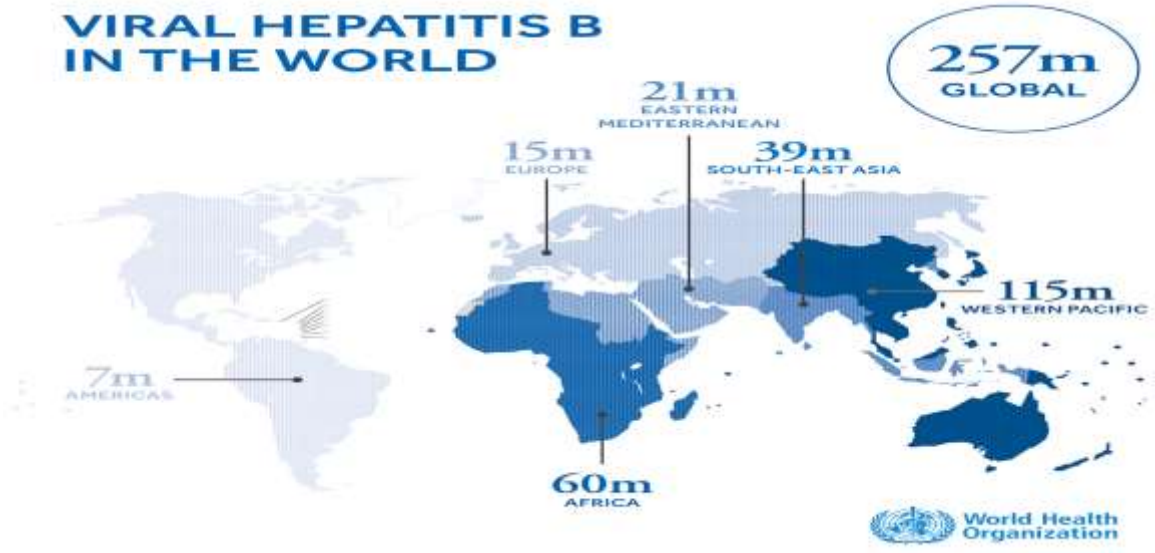


Figure (4): Viral Hepatitis B in the world

Hepatitis C is a liver disease caused by the hepatitis C virus (HCV). It can cause both acute and chronic hepatitis, ranging in severity from a mild illness lasting a few weeks to a serious, lifelong illness (Fabrizi, Poordad, & Martin, 2002).

Hepatitis C is a major cause of liver cancer. Hepatitis C virus is a bloodborne virus. The most common modes of infection are through exposure to small quantities of blood. This may happen through injection drug use, unsafe injection practices, unsafe health care, transfusion of unscreened blood and blood products, and sexual practices that lead to exposure to blood.

Globally, an estimated 71 million people have chronic hepatitis C virus infection (Fabrizi et al., 2002). A significant number of those who are chronically infected will develop cirrhosis or liver cancer.

WHO estimated that approximately 399 000 people died in 2016 from hepatitis C, mostly from cirrhosis and hepatocellular carcinoma (primary liver cancer).

Antiviral medicines can cure more than 95% of persons with hepatitis C infection, thereby reducing the risk of death from cirrhosis and liver cancer. However, access to diagnosis and treatment is low. There is currently no effective vaccine against hepatitis C but research in this area is ongoing (Fabrizi et al., 2002).

2.3 Geographical distribution of hepatitis C

Hepatitis C is found worldwide. The most affected regions are the WHO Eastern Mediterranean Region and the WHO European Region, with an estimated prevalence in 2015 of 2.3% and 1.5% respectively. Prevalence of HCV infection in other WHO regions varies from 0.5% to 1.0%. Depending on the country, hepatitis C virus

infection can be concentrated in certain populations. For example, 23% of new HCV infections and 33% of HCV mortality is attributable to injecting drug use. Yet, people who inject drugs and people in prisons are not often included in national responses (Fabrizi et al., 2002).

In countries where infection control practices are or were historically insufficient, HCV infection is often widely distributed in the general population. There are multiple strains (or genotypes) of the HCV virus and their distribution varies by region. However, in many countries, the genotype distribution remains unknown.

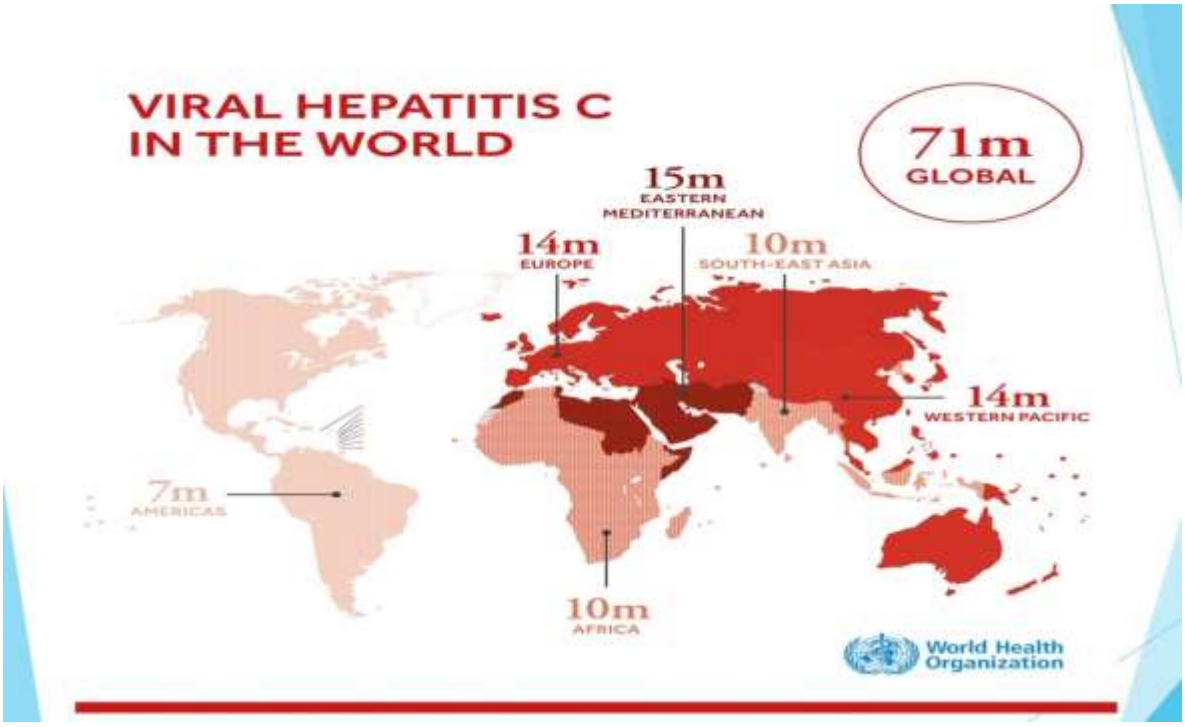


Figure (5): Viral Hepatitis C in the world

Hepatitis B epidemiology in Asia, the Middle East and Africa

Asia and Africa have previously been classified as areas of high endemicity for hepatitis B virus (HBV), but, in some countries, highly effective vaccination

programmers have shifted this pattern towards intermediate or low endemicity. Thus, China is now the only country in Asia where HBV endemicity is high. Countries with intermediate endemicity include India, Korea, the Philippines, Taiwan and Thailand, and those with low endemicity include Japan, Pakistan, Bangladesh, Singapore, Sri Lanka and Malaysia. Most countries in Africa have high HBV endemicity, with the exceptions of Tunisia and Morocco, which have intermediate endemicity. Zambia has borderline intermediate/high endemicity. In the Middle East, Bahrain, Iran, Israel and Kuwait are areas of low endemicity. Cyprus, Iraq and the United Arab Emirates have intermediate endemicity. Egypt, Jordan, Oman, Palestine, Yemen and Saudi Arabia have high endemicity. All of these Middle East countries reach a large proportion of their population with hepatitis B vaccination, which is reducing the infection rate, particularly in Saudi Arabia. The vaccination programme in Taiwan has also greatly reduced the HBV infection rate. Future vaccination programmes must take into account the mode of transmission of HBV, the healthcare infrastructure to deliver vaccination, and the socioeconomic and political factors in each individual country in order to determine the most cost-effective way of infection control (André, 2000).

2.4 Hepatitis C infection in the Middle East and North Africa

There are insufficient data about HCV pre-valence and prevention methods in some areas of the Middle East. Although there are significant differences in prevalence and epidemio-logy of HCV among the Middle East countries or even different communities within the same country, control strategies should take these specific differences into account (Chaabna et al., 2018).

HCV infection is unevenly distributed in different countries, with worldwide prevalence in the general population ranging from 0.5 to 6.5%. In Western countries and Australia this rate ranges from 0.5 to 1.5%, and reaches 2.3% in countries of south-east Asia and eastern Mediterranean regions, 3.2% in China, 0.9% in India, 2.2% in Indonesia and 6.5% in Pakistan; in sub-Saharan Africa the prevalence of HCV infection varies from 4 to 9%. Immigrants and refugees from intermediate/high HCV endemic countries to less- or non-endemic areas are more likely to have an increased risk of HCV infection due to HCV exposure in their countries of origin. Because of the high HCV endemicity in immigrant populations and of the high efficacy of directly acting antiviral agent therapy, a campaign could be undertaken to eradicate the infection in this setting (Chaabna et al., 2018).

To establish public health strategies, more well-programmed, population-based and certain HCV infection at-risk surveys are needed in the Middle East countries in addition to education of people about the risk of HCV infection from contaminated instruments and certain traditional habits. Furthermore, efforts should be continued for HCV screening in intrave-nous drug users (IVDU), those who received transfusions, dialysis patients, those with incidental exposures in addition to expatriate workers, gypsies, and occupations such as barbers, fire fighters, health care workers. Finally, better laboratory facilities and investigations should be provided for detection of HCV RNA in high-risk groups negative for HCV antibodies (Chaabna et al., 2018).

2.5 Hepatitis B & C epidemiology in Yemen

In Yemen, there were different researches that confirm the viral infection of hepatitis B and c has high prevalence and incidence(Gacche, 2012).

The prevalence of chronic HBV infection varies geographically, from high (> 8 %), intermediate (2-7 %) to low (< 2 %) prevalence. The endemicity of infection is considered high in Yemen, where prevalence of positive HBsAg ranges from 8 % to 20 %, and up to 50 % of the populations generally have serological evidence of previous HBV infection.

In other studies, the prevalence of HBsAg in Yemen is 12.7 % –18.5 % . However, the prevalence of antibodies to HCV is 1.7 % in healthy volunteers. Most of epidemiological studies were done in different cities in Yemen, the prevalence rates of HBsAg and HCV antibodies are 10.5 % and 2.3 % in Sana'a, 4.75 % and 0.6 % in Aden, 5.6 % and 0.8 % in Hajah, 26.3 % and 5.1 % in Socotra respectively. Although Ibb city is the densest populated governorate outside of Sana'a city and it has the largest Yemeni expatriates abroad, data for prevalence of HBsAg and HCV antibodies in Ibb city were rare and inadequate.(Gacche, 2012).

National HCV prevalence in Yemen appears to be higher than in Djibouti, Somalia, and Sudan as well as most other MENA countries(Chaabna, Kouyoumjian, & Abu-Raddad, 2016). The prevalence of antibodies to HCV was 1.7% in healthy volunteers, 2.7% in blood donors, 33.8% in patients on regular HD, and 33.75% in patients with chronic liver diseases.72 Similar patterns were found in other studies (Fallahian & Najafi, 2011). So, viral hepatitis is a major public health problem across the globe it has not been prioritized until now.

Yemen is considered as endemic area of hepatitis C and B. That's why, we want to focus our research on this huge problem specially for people who have chronic renal failure. However, renal failure remains a serious cause of mortality in Yemen. Our study based on a retrospective data of the documented files for five major dialysis centers from different regions, Zabid, Al-qanawes, Al-jumhori (Al-mahweet), Amran and 22and of May centers, which distributed in different rigion: Al-Hodaidah, Al-Mahweet, Amran city and Sana'a.

These centers are far away from the centers in the capital, where all past similar studies were taken from. So in these, study we want to focus on this different population who are away from the focusing spot. Sample was taking from these centers by retrospective sampling of the files for 521 patients presented to these centers from the 1st of January 2020 till the 1st of September 2020. Although 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 infection. 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 (Amran, Al-Shamahy, Al Hadad, & Jaadan, 2019).

2.6 Previous Studies

Hepatitis is inflammation of the liver tissue. Hepatitis is most commonly caused by the viruses hepatitis A, B, C, D, and E. Hepatitis B is mainly sexually transmitted, but may also be passed from mother to baby during pregnancy or childbirth and spread through infected blood. Hepatitis C is commonly spread through infected blood. For example, it may occur during needle sharing by intravenous drug users. Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease.

The virus is most commonly transmitted from mother to child during birth and delivery, as well as through contact with blood or other body's fluids, including sex with an infected partner, injection-drug use that involves sharing needles, syringes, or drug-preparation equipment and needle sticks or exposures to sharp instruments.

WHO estimates that in 2015, 257 million people were living with chronic hepatitis B infection (defined as hepatitis B surface antigen positive).

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Globally, an estimated 71 million people have chronic hepatitis C virus infection.

A significant number of those who are chronically infected will develop cirrhosis or liver cancer. WHO estimated that in 2016, approximately 399 000 people died from hepatitis C, mostly from cirrhosis and hepatocellular carcinoma (primary liver cancer).

Antiviral medicines can cure more than 95% of persons with hepatitis C infection, which can reduce the risk of death from cirrhosis and liver cancer, but access to diagnosis and treatment is low.

There is currently no effective vaccine against hepatitis C; however, research in this area is ongoing.

Study was conducted a research to identify the prevalence of hepatitis C and hepatitis B in patients with hemodialysis in Libya. Participant median age was 49 years and 58% were male. 831 patients (34.9%) were sero-positive for HBV and/or HCV (anti-HCV positive 31.1%; HBsAg positive 2.6%; both positive 1.2%). Out of the sero-positive patients, 4.7% were known to be infected before the initiation of HD. The prevalence of HBV±HCV infection varied widely between HD centers from 0% to 75.9%. Sero-positive patients were younger, had longer time on dialysis and more previous blood transfusions. Prospective follow-up revealed an incidence of sero-conversion of 7.7% during 1 year (7.1% HCV; 0.6% HBV). Wide variation in rates of

newly acquired infections was observed between dialysis centers. All new HBV cases were referred from centers already treating HBV infected patients. New HCV infections were reported in most centers but the rate of HCV sero-conversion varied widely from 1.5% to 31%. Duration of dialysis, history of previous renal transplant and history of receiving HD in another centre in Libya were significantly associated with sero-conversion (Elzouki et al., 2013).

Hande Berk conducted a research in (2017) to study the prevalence of hepatits B and C virus in patients who undergo hemodialysis in Antalya, Turkey. They included 1347 patients with end stage of renal failure under treatment HD at once of the 23 center in Antalya from January 1st to March31st, 2014, using retrospective cross-sectional study. They clinically assesse HB surface antigene &HC seropositivly, using third generation enzyme linked immunosorbent assay. HBV DNA &HCV RNA were determined in HBs AG positive & anti HCV positive hemodialysis patient respectively (Oztoprak, 2017).

Previous study in Yemen was carried out by Omar Ayedh Abdullah Amran in his research (1 RNA test is not available) in Yemen.

Of the 1,347 patients included, 805 (59.8%) were male, and 547 (40.2%) were female. The mean age (± standard deviation) of the patients was 53.9 ±17.0 (range 17-89) years. The sera of 2.4% patients who underwent HD in Antalya province was positive for HBsAg, and the sera of 5.5% of the patients was positive for anti-HCV. The sera of 56% of patients positive for HBsAg was also positive for HBV DNA, and the sera of 43% of patients positive for anti-HCV was also positive for HCV RNA. Coexistence of HBsAg and anti-HCV was 1.02.(Amran et al., 2019).

Hamzeh Al Zabadi, Hani Rahal at all(2016) conducted a study to estimate the prevalence of Hepatitis B and C among hemodialysis patients in the West Bankhospitals, Palestine, using cross sectional study. The overall prevalence of hepatitis B virus was found to be 3.8 % (33 cases) with a range from 0.0 % (in Jericho and Qalqelia districts) to 11.8 % (in Bethlehem district). Regarding hepatitis C virus, the overall prevalence was estimated around 7.4 % (64 cases) with a range from 2.9 % (in Nablus district) to 15.9 % (in Qalqelia district)(Al Zabadi, Rahal, & Fuqaha, 2015). Another study in Saudia Arabia by Saleh Mohammed Abdullah in 2018 aimed to determine the causes of high prevalence HBC in hemodialysis patients, using cross-sectional study. The study concluded that anti HCV:68% (14.5-94.7)% correlation between antiHBC male sex less than 0,006 (Abdullah, 2018).

Najla m.baghea in (2012) made also a study to determine the prevalence of Hepatitis C Virus Infections among hemodialysis Patients in some Yemeni public hospitals, using cross sectional study. Over all prevalence of HCV-antibodies among hemodialysis patients was 45 (22.5)% using ELISA methoed includes 18 females 40% &male 60%. The association between the HCV antibodies positively in Gender were not statistically significant. The duration of dialysis was staticky significant Najla M. Baghea's research was only about HCV(Al Waleedi & Khader, 2012).

Mohammed A. Al-Hegami, Abdullah Al-Mamar et al in assessed the prevalence and risk factors of Hepatitis B and Hepatitis C virus infections among patients with chronic renal failure in Zabeed city, Republic of Yemen. They used as well cross sectional study on 243 chronic hemodialysis patients in Zabeed City during a period of June

2013 to October, 2014. Patients were selected by cluster sampling from Zabeed public hospital, (hemodialysis center) in Zabeed City.

Their results showed that the prevalence of positive HBV Ag was 104 patients (48.83%) while positive anti-HCV was 98 patients (46.01%) and 11 patients (5.16%) had mixed infection with HBV and HCV among hemodialysis patients in studied population. Duration of dialysis was significantly associated with risk of HCV infection. The positive patients showing the highest prevalence between the age of 15 and 55 years with HBV 50 (52.08%) & HCV 40 (41.67%), while was low with the >55years 15 (55.56%), 12 (44.44%) respectively. The results of this study also showed that the prevalence of HBV and HCV infection among males 87 (55.41%) and 63 (40.13%) respectively while in females was 17 (30.36%) and 35 (62.50%) respectively in patients on hemodialysis.

The last result I think it was irrelevant and not helpful to say the gender difference is risk factor for transmission.

Their study concluded that viral hepatitis has a special relationship to renal disease. Hepatitis B virus (HBV) and hepatitis C virus (HCV) Infections are more prevalent in renal failure patients than in the general population. Viral hepatitis is an important cause of morbidity and mortality of renal failure patients on chronic dialysis and after renal transplantation. The association between viral hepatitis and renal failure is largely due to the high number of blood transfusion session in patients with end-stage kidney disease and to the multiple invasive medical procedures to which these patients are exposed(Al-Hegami, 2015).

Furthermore, Mohamad A. Bajubair et al in (2008) [16]ran a study to To determine the prevalence of hepatitis B surface antigen (HBsAg), and hepatitis C virus (HCV) antibodies in Sanaa, and other governorates of Yemen. Using systematic review with meta-analysis, they collected the research data in different governorates of Yemen during the period 2000-2005.

Their study included the published papers (peer reviewed), and the papers presented at Yemeni conferences. they identified 4 groups with separate prevalence. Found HBsAg to be 8% in healthy volunteers, 10.8% in blood donors, 12.3% in patients under dialysis, and 23% in patients with chronic liver diseases. Antibodies to HCV show different results, namely, 1.7% in healthy volunteers, 2.7% in blood donors, 33.8% in patients under dialysis, and 33.75% in patients with chronic liver diseases. The viral markers in different governorates showed significant differences in healthy and blood donor groups. The means of HBsAg and HCV antibodies in patients with liver diseases were recorded to be 26.2% for HBsAg, and 33.8% for HCV antibodies, with a total of 60%. The means in patients under dialysis, for HBsAg was 10.9%, and for HCV antibodies was 33.8%, with a total mean of 44.7%. Although Mohamad A. Bajubair's study made valued contribution, further replicated studies are needed in the future in the Yemeni eastern governorates to confirm the generality of his research's results (Bajubair, Elrub, & Bather, 2008).

In addition, another study was added by Omar Ayedh Abdullah Amran et al in (2019) [9]to estimate the outbreak of hepatitis B and C viruses among dialysis patients during the dialysis crisis in Yemen, in Dhamar Hospital. They used cohort, single study

centered in the HD unit at Dhamar Hospital, Dhamar City, Yemen. All patients consistently undergoing dialysis.

Their study concluded that there was a 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. There were significant 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. There were significant 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. The study also shows the effect of hemodialysis frequency on contraction HBV infection among HD patients. 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 1.1for 8 times; but differences between rates in the dialysis frequency groups were not statistically significant. Their

results also shows the effect of dialysis frequency on hepatitis C virus infection among HD patients. There was an increase in 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 statistically significant. In my opinion, their study concentrated on the prevalence of HCV and HBV according to age and sex which were statistically non-significant in the previous researches. However, their study contributes to show the major effects the political situation in Yemen has on how quickly the diseases can spread. They also contribute to suggest thoughtful recommendations and points to solve this problem(Amran et al., 2019).

CHAPTER 3: METHODOLOGY

3.1 Study Design

A descriptive retrospective study. Data extracted and collected from the medical reports of 521 patients of Ministry of public health and population of Yemen presented to Zabid, Alqanawes, Aljumhori-Mahweet, 22 May Sana'a governorate and Amran governorate hemodialysis centers in the period from 1st of Jan 2020 to 1st of September 2020.

3.2 Population and sample of the study

Population and sampling places of study located in spot map (see above) (Figure 1), these five HD centers received patients from 4 major regions, Sanaa, Amran, Al mahweet and Al hodaidah.

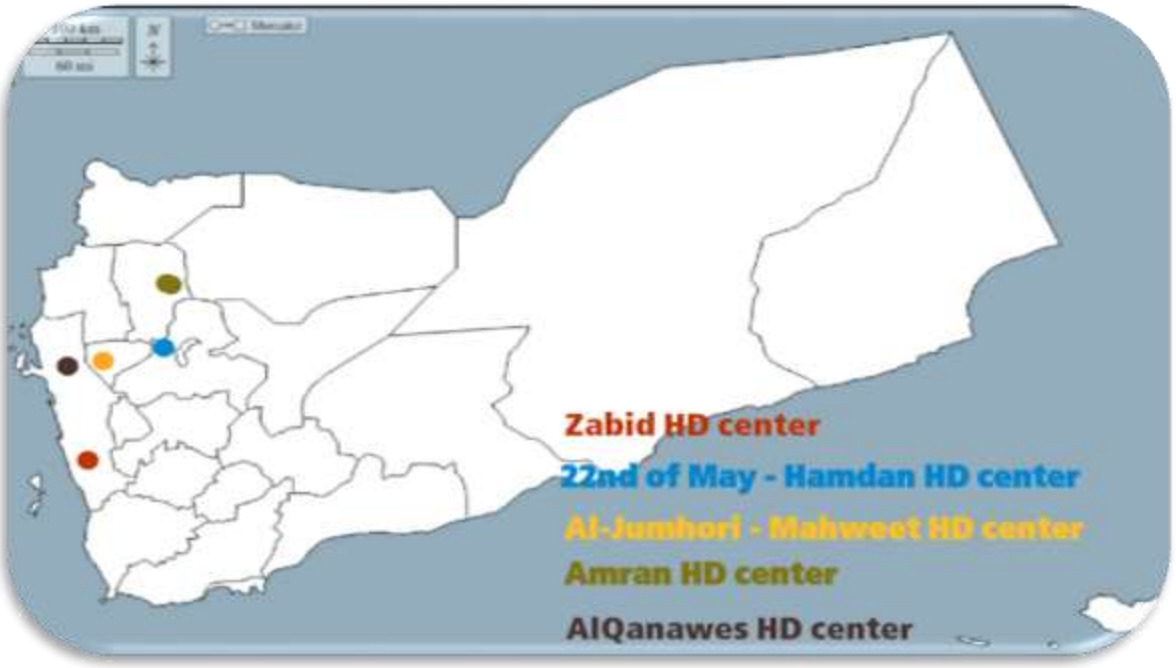

Figure (6): Population and sample of the study map

3.3 Inclusion and exclusion criteria:

3.3.1 Inclusion criteria:

Pretense of gender, time of dialysis, blood transfusions times, seropositivity or seronegativity of HBV. If one of these criteria absent, case not included.

3.3.2 Exclusion Criteria

Exclusion criteria not fulfilled in any case, i.e. time of dialysis not recorded.

3.4 Sample Size

521 hemodialysis respondents in one of 5 HD centers recognized in study, and total of 325 were eligible to analysis emplyed.

3.5 Sampling Methods

All respondents presented to one of 5 HD centers collected, samples taken from patients records. As 223 from Zabid HD center, 74 from 22nd of May HD center, 96 from Al-jumhori – AlMahweet HD center, 67 from Amran HD center, 61 from AlQanawes HD center.

Table (1): Distribution of Sample Size according HD centers

HD centers	N.
Zabid HD center	**223**
22nd of May HD center	**74**
Al-jumhori – AlMahweet HD center	**96**
Amran HD center	**67**
AlQanawes HD center.	**61**
Total	**521**

3.6 Data collection technique and tool

Patient records were used to obtain patients' age, gender, time on HD, number of blood transfusion, period of hemodialysis and sero-positivity to HBV and HCV. Sero-positivity to HBV was defined by detection of hepatitis B surface antigen (HBsAg) and sero-positivity to HCV by detection of anti-HCV antibodies by a third generation enzyme linked immunoassay (ELISA). ELISA tests were performed in local laboratories. These tests obtained annually or every six months, different from center to other and between the patients.

3.7 Data processing and analysis

Data was entered in excel sheet initial and described by using SPSS program and are presented as Frequency, percentages, Mean and standard deviation (Mean±SD).

3.8 Ethical Considerations

Permission to conduct the study was granted from the Ministry of Health and population.Data collected from the statistic department within the HD administration in the minister of health.

CHAPTER 4: RESULTS

4.1 Profile of the study

The sample in our study obtained retrospectively, containing 521 patients presented regularly for hemodialysis in the period between the 1st of Jan 2020 and the 1st of Sep 2020, in one of those dialysis centers (Zabid, 22nd of May-Hamdan, Amran, Al-Jumhori/Al-Mahweet, Al-Qanawes). The cases is distributed as 223/521, (42.80%) from Zabid dialysis center, 74/521 (14.20%) from 22nd of May dialysis center, 96/521 (18.42%) from Aljumhori/Almahweet dialysis center, 67/521 (21.85%) from Amran dialysis center, 61/521 (11,70%) from Al-Qanawes dialysis center. Sample contains 351/521 male (67.37%) (mean=67.87% SD=5.72% max=71.30% min=56.75%) and 170/521 female (32.63%) (mean=34.12% SD=5.72% max=43.23% min=28.70%).

Table (2): Distribution of respondents according to place of residence sorted by gender

Dialysis Centers	Male	Female	Total
Zabid dialysis center	159 (71.30%)	64 (28.70%)	**223**
22nd of May dialysis center	42 (56.75%)	32 (43.25%)	**74**
Aljumhori/Almahweet dialysis center	63 (65.62%)	33 (34.37%)	**96**
Amran dialysis center	47 (70.14%)	20 (29.86%)	**67**
Al-Qanawes dialysis center	40 (65.57%)	21 (34.43%)	**61**
Total	**351**	**170**	**521**

Table (3): Distribution of respondents according to Age group

Dialysis Centers	Age group				Total
	<18	18-40	40-65	>65	
Zabid dialysis center	4	67	103	49	223
22nd of May dialysis center	0	23	31	20	74
Aljumhori/Almahweet dialysis center	0	37	44	15	96
Amran dialysis center	0	16	33	18	67
Al-Qanawes dialysis center	3	22	26	10	61
Total	**7 (1.34%)**	**165 (31.66%)**	**237 (45.48%)**	**112 (21.49%)**	**521**

Age group varying from 9 to 76 years old, the median age was 56 years old (range=69years, mean=50.92, SD=17,00) varying for each age group. 7/521 (1.34%) patients for less than 18 years age group, 165/521 (31.66%) patients from 18-40years age group, 237/521 (45.48%) for 40-65years age group and 112/521 (21.49%) patients older than 65 years.

Table (4): Distribution of respondents according to Duration of hemodialysis

Dialysis Centers	Duration of hemodialysis			Total
	<1 year	1-5 years	>5 years	
Zabid dialysis center	45(20.17%)	133(59.64%)	45(20.18%)	223
22nd of May dialysis center	30(40.54%)	33(44.59%)	11(14.86%)	74
Aljumhori/Almahweet dialysis center	28(29.17%)	42(43.75%)	26(27.08%)	96
Amran dialysis center	24(35.82%)	37(55.22%)	6(8.95%)	67
Al-Qanawes dialysis center	19(31.14%)	24(39.34%)	18(29.51%)	61
Total	**146(28.02%)**	**269(51.63%)**	**106(20.34%)**	**521**

Duration of hemodialysis varying from 4 months to 11 years (mean=47months with SD=39months). Patients presented for less than 1 year were 146/521 (28.02%), ranging from 20.17% to 40.54% for each center (mean=31.37% SD=7.6%). 1 to 5 years dialysis duration group patients were 269/521 (47.21%) (mean=48.51% SD=8.53% min=39.34% max= 59.64%). More than 5 years dialysis duration patients were 106/521 (20.34%) (mean= 20.11% SD=9.20% max=29.50% min=8.95%).

Table (5): Distribution of respondents according to Blood Transfusion

Dialysis Centers		Blood Transfusion			Total
		1-5units	5-10units	10<units	
Zabid dialysis center	No	72	25	36	90
	%	32.29%	11.21%	16.14%	40.36%
22nd of May dialysis center	No	10	14	7	33
	%	13.51%	22.97%	18.92%	44.59%
Aljumhori/Almahweet dialysis center	No	16	22	24	34
	%	16.67%	22.92%	25%	35.42%
Amran dialysis center	No	8	19	13	27
	%	11.94%	28.36%	19.40%	40.30%
Al-Qanawes dialysis center	No	13	11	16	21
	%	21.31%	18.03%	26.23%	34.43%
Total	**No**	**119**	**94**	**103**	**205**
	%	**22.84%**	**18.04%**	**19.77%**	**39.35%**

As the patients of hemodialysis are almost ESRD (end stage renal disease), so there is a proportion of them in recurrent need of blood transfusion. In our study sample, the number of patients receiving blood transfusion were 316/521 (60.65%) of patients, while 205/521 (39.35%) of patients never received blood transfusion. Patients receiving blood transfusion then divided according to how many blood units they get.

Table (6): Distribution of respondents according to seroprevelance of HBV and HCV

Dialysis Centers	Negative	HBV	HCV	HBV&HCV
Zabid dialysis center	195	10	16	2
22nd of May dialysis center	66	4	4	0
Aljumhori/Almahweet dialysis center	83	4	9	0
Amran dialysis center	50	11	6	0
Al-Qanawes dialysis center	36	5	19	1
Total	**430** **82.53%**	**34** **6.53%**	**54** **10.36%**	**3** **0.58%**

Positive seroprevelance of HBV and HCV among 91/521 (17.46%) varying from 25/61 (40.98%) in Al-Qanawes dialysis center to 8/74 (10.81%) in 22nd of May dialysis center (mean=20.36% SD=12.74%) . HBV seropositive in 34/521 (6.52%) of patients (mean=7.72% SD=5.10% max=16.41% min=4.16%). HCV seropositive in 54/521 (10.59%) of patients (mean=12.40% SD=10.59% min=5.40% max=31.14%. HBV & HCV both at the same time seropositive in 3/521 (0.57%) of patients (mean=0.63% S.D=0.78% max=31.14% min=5.40%). Among dialysis community, the prevalence of HCV is more than HBV.

Table (7): Distribution of respondents according to Diagnosis of HBV & HCV related to dialysis

Dialysis Centers	Diagnosis of HBV & HCV related to dialysis	
	Before	after
Zabid dialysis center	20	8
22nd of May dialysis center	5	3
Aljumhori/Almahweet dialysis center	9	4
Amran dialysis center	10	7
Al-Qanawes dialysis center	14	11
Total	**58** **63.74%**	**33** **36.26%**

Among seropositive viral hepatitis (either B or C or B&C), 58/91 (63.74%) were diagnosed prior to the onset of the dialysis sets. While 33/91 (36.26%) were diagnosed in post dialysis routine viral hepatitis serology tests annually in some centers or every six months in others.

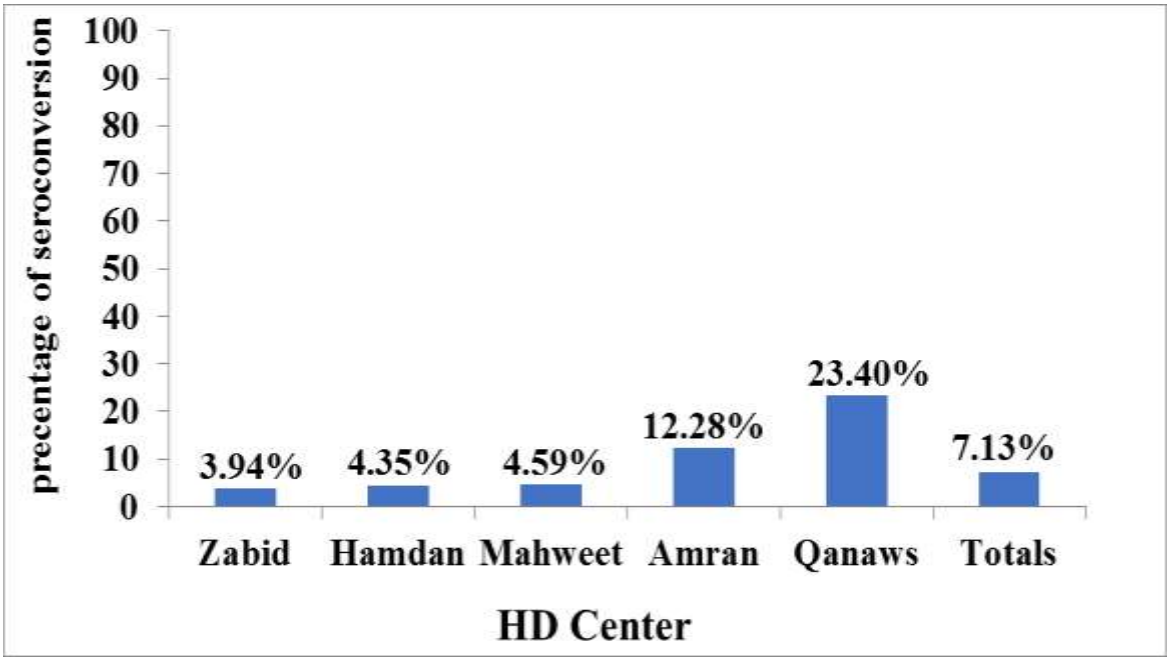

Figure (7): Presence of seroconverted patients among who started HD seronegative totally and in each center

Among patients started hemodialysis while they were seronegative HBV & HCV serology (463 patients in all 5 centers - varying from 203 in zabid center to 47 in AlQanawes center), 33 (7.13%) patients (mean=9.71% SD=8.40%) seroconverted to HBV & HCV positive serology in their course of hemodialysis. They are variant for each center, 8/203 (3.94%) in Zabid center, 3/69 (4.35%) in 22nd of May center, 4/87 in AlMahweet center, 7/57 (12.28%) in Amran center, 11/47 (23.40%) in AlQanawes center.

Table (8): Distribution of respondents according to Duration of dialysis in post dialysis diagnosed HBV & HCV

Dialysis Centers	Duration of dialysis in post dialysis diagnosed HBV & HCV		
	<1year	1-5 years	>5years
Zabid dialysis center	2	3	4
22nd of May dialysis center	0	2	1
Aljumhori/Almahweet dialysis center	1	1	2
Amran dialysis center	1	3	5
Al-Qanawes dialysis center	3	7	1
Total	**6** **18.18%**	**16** **45.45%**	**13** **36.37%**

In these group (post dialysis hepatitis B or C or both diagnosed patients), we found that HCV infection is the most common in the 21/33 patients (63.64%), comparing to HBV 9/33 patients (27.27%). The coinfection of HBV & HCV occurs in 3/33 patients (9.09%), which means that 100% of HBV & HCV co-infected patients in our study diagnosed after they started the dialysis. In these group patients, the prevalence increased in relation to the period of the dialysis, 16/33 (48.46%) and 13/33 (39.39%) were in 1-5years dialysis duration group and <5 years dialysis duration group respectively.

Table (9): Distribution of respondents according to Blood transfusion among post dialysis HB & HCV diagnosed

Dialysis Centers	Blood transfusion among post dialysis HB & HC V diagnosed			
	1 to 5	5 to 10	>10	NO
Zabid dialysis center	1	2	2	3
22nd of May dialysis center	0	1	1	1
Aljumhori/Almahweet dialysis center	0	3	0	1
Amran dialysis center	2	1	0	4
Al-Qanawes dialysis center	0	3	2	6
Total	**3(9.10%)**	**10(30.30%)**	**5(15.15%)**	**15(45.45%)**

45.45% (15/33) of seroconverted patients have never received blood transfusion more than 40.66% of total seropositive patients also haven't received blood transfusion. Indicating other strong risk factors. 55.55% (18/33) of seroconverted received blood transfusion.

As blood transfusion considered the most accepted and well known risk factor of HBV & HCV infection or coinfection, among seropositive patients 59.34% (54/91) have received blood transfusions categorized as 1-5 , 5-10 , >10 units 40.66% (37/91) have not, near to 39.35% of all HD respondents not recieved blood transfusion (table 5). So other risk factors than blood transfusion must be considered beside.

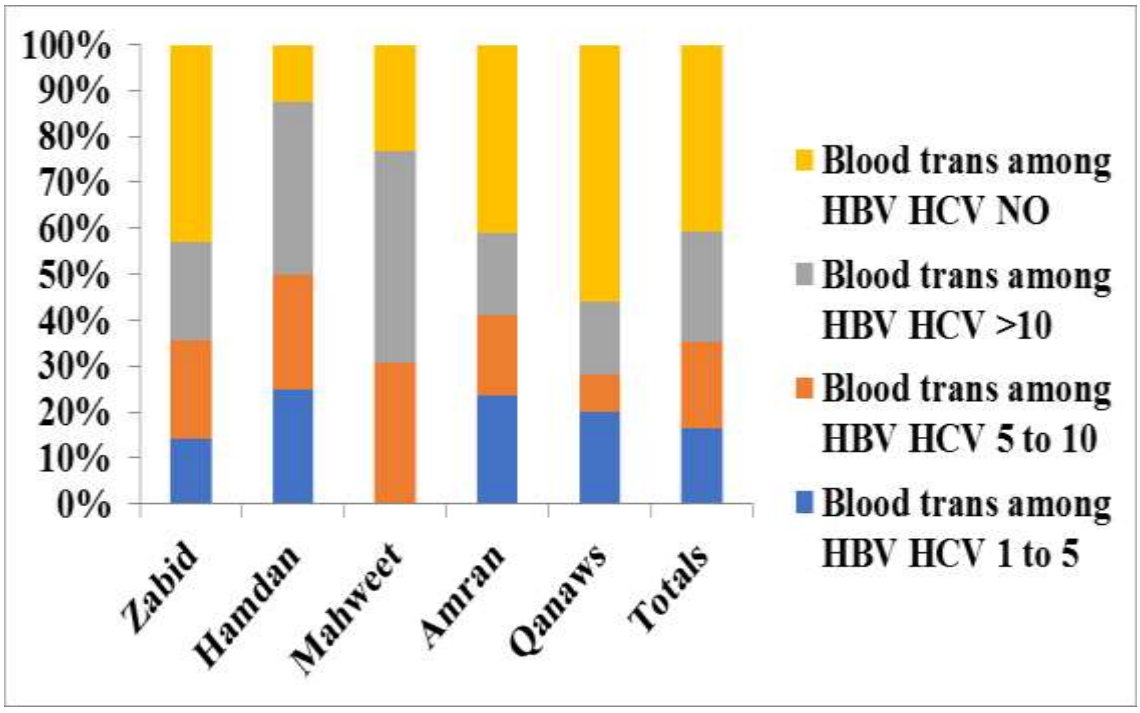

Figure (8): Presence of blood transfusion among all HBV & HCV patients

24.17% (22/91) of all seropositive patients recieved blood more than 10 unites indicating relation between the frequency of blood transfusion with HBV & HCV seropositivity.

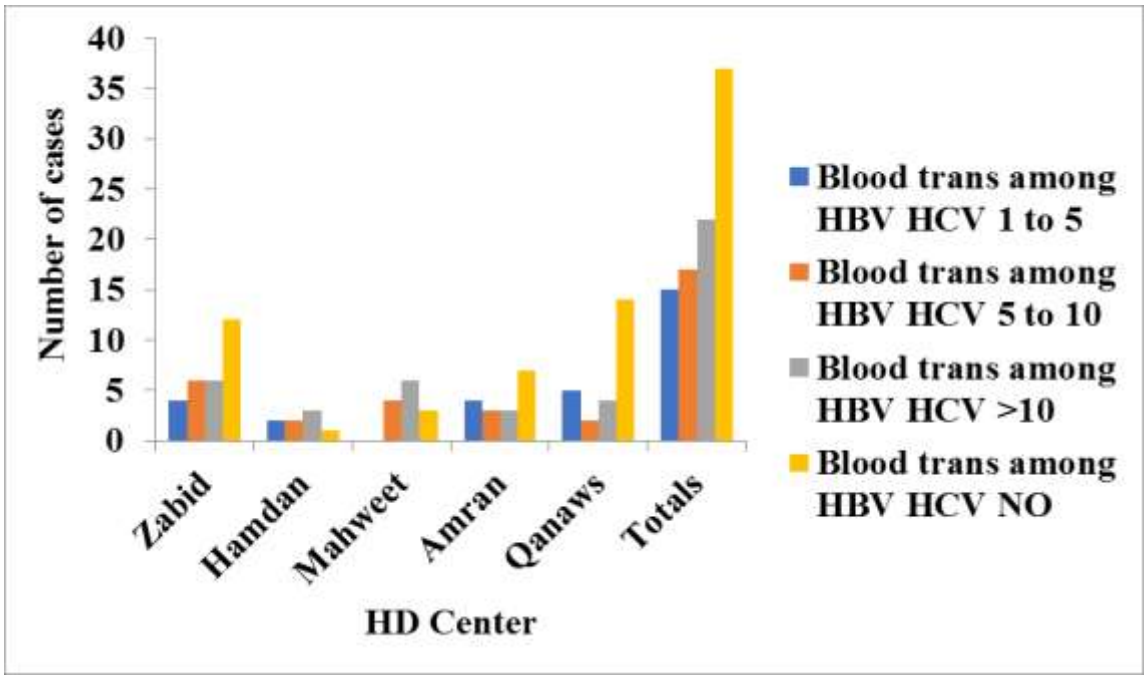

Figure (9): Distribution of HBV & HCV seropositive according to blood transfusion times

Prevalence of HBV & HCV infection had been related to the duration of dialysis in many previous studies. Our findings tell there're 73.62% (67/91) of seropositive dialysed more than 1 year .

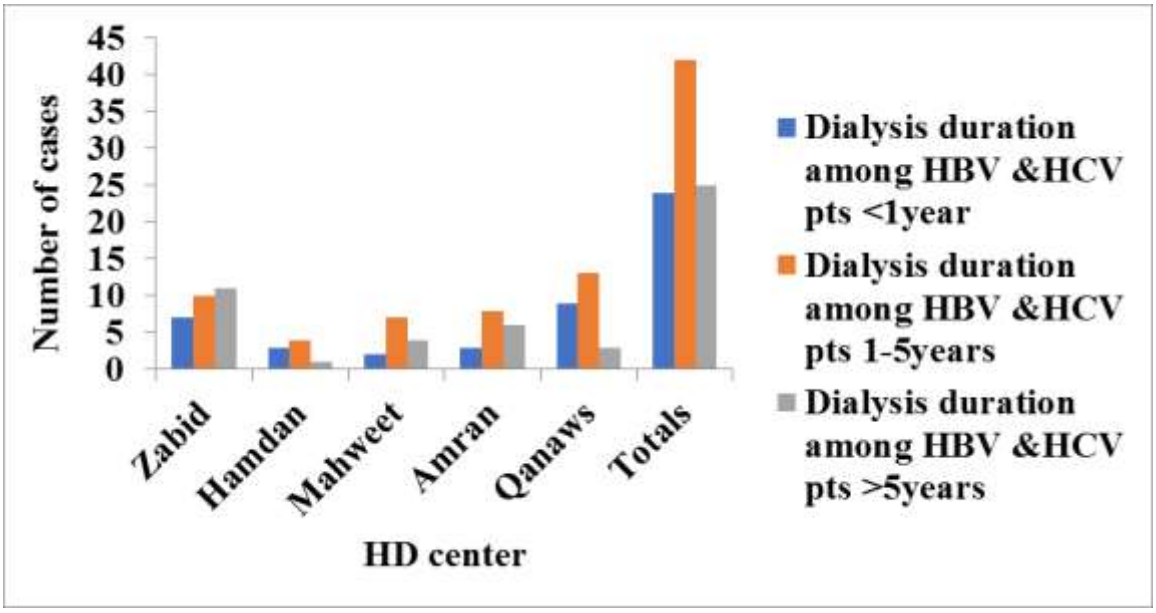

Figure (10): Distribution of HBV & HCV seropositive according to the dialysis duration

Noticing that 27.48% (25/91) dialysed more than 5 years while the majority subgrouped between 1 to 5 years, reflecting the decreased numbers of more than 5 years dialyzed patients which containing only 20.34% of all HD centers respondents (table 3)

Infection with HCV is most dominant among seroconverted patients 63.64% (21/33), these may relate to the difficulties in HCV diagnosis method. HBV affected 27.27% (9/33) of seroconverted. While 9.09% (3/33) converted to HBV & HCV coinfection in their HD course after they were seronegative before dialysis .

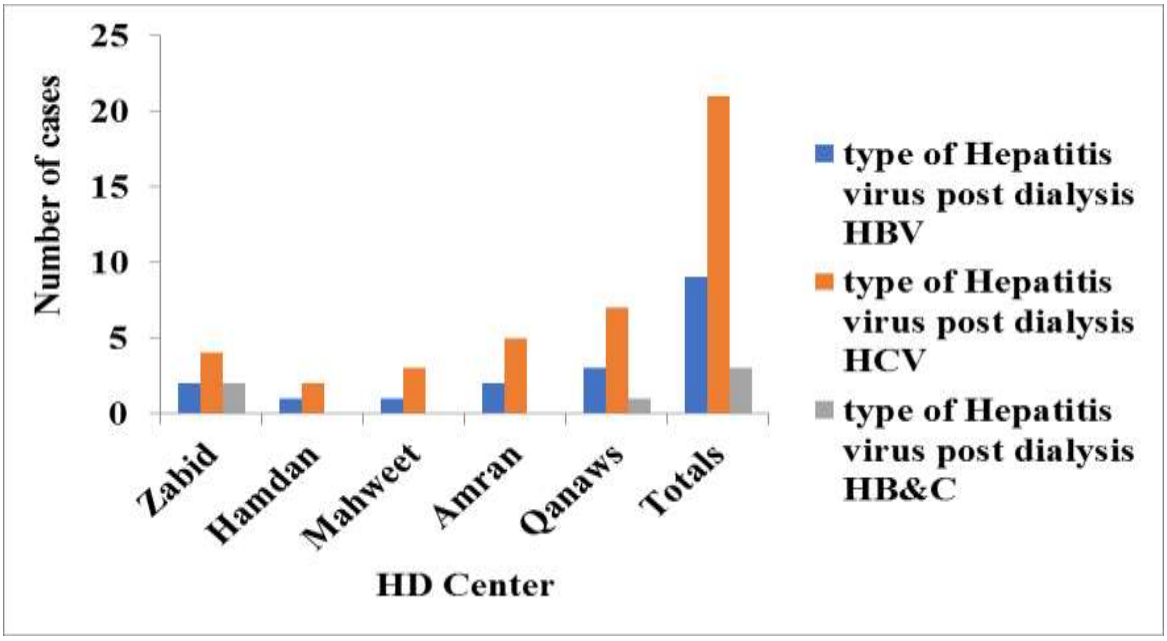

Figure (11): Distribution of seroconverted according to type of virus infection

Finding indicated strong relation between duration of dialysis with seroconvertion. Only 12.13% (4/33) of seroconverted HD patients dialysed less than one year . comparing to 73.62% in all seropositive and to 71.97% in all HD respondents (seronegative and seropositive)

(figure 8 , table 4 respectively).

Of seroconverted patients, 87.87% (29/33) dialyzed more than one year

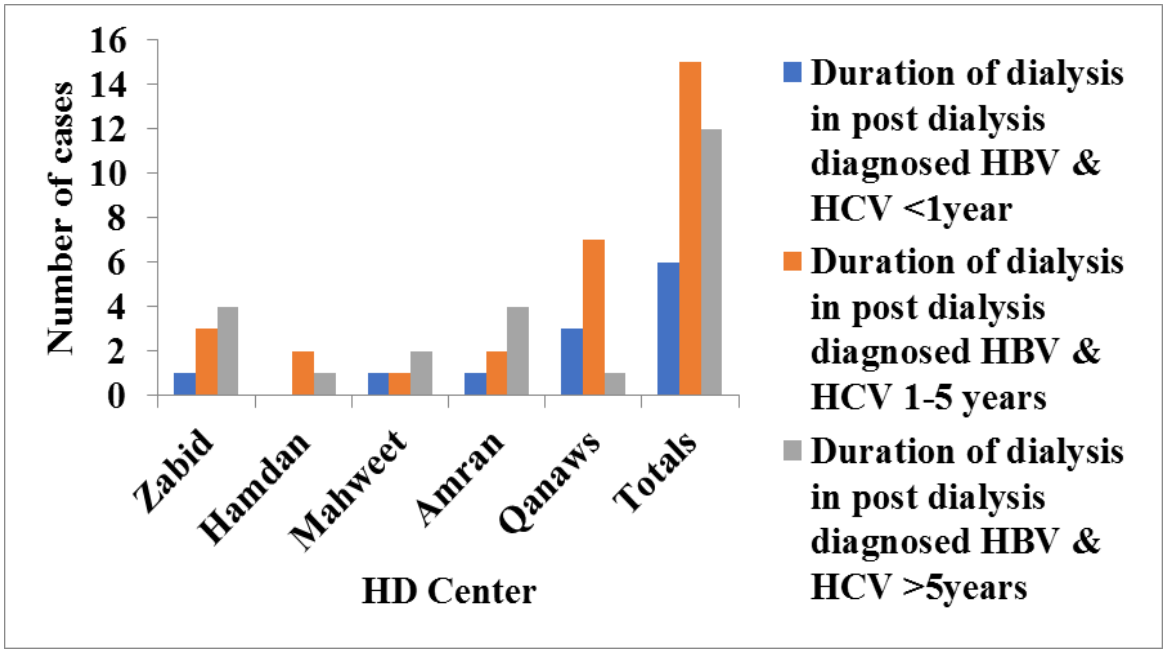

Figure (12): Distribution of post HBV & HCV seropositive according to the dialysis duration

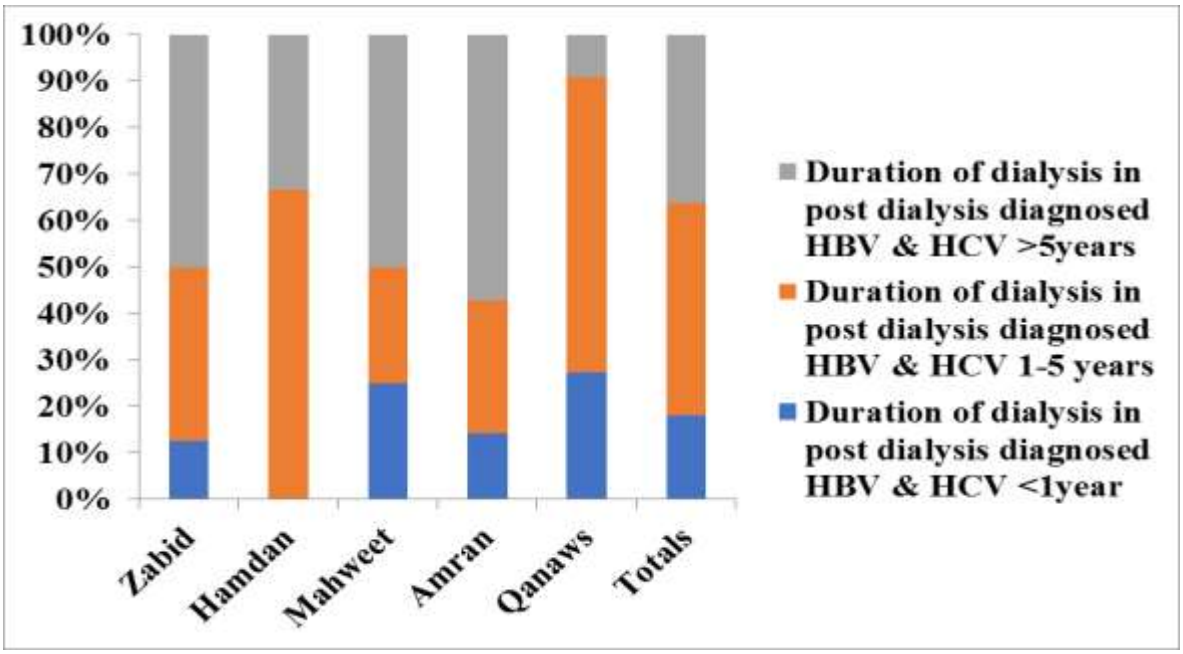

Figure (13): Presence of seroconverted and duration of dialysis

CHAPTER 5: DISCUSSION

The overall prevalence of anti-HCV antibodies in all patients included in our study receiving HD (10.59%) was remarkably high and is approximately 5 to 10 times higher than in the general population (Gacche, 2012).

It is near to results from research conducted by Omar Ayedh Abdullah Amran in 2018 which reported the prevalence of 9.9% in sample of 202 HD respondents in Dhamar HD center (Amran et al., 2019). But It is also less than the prevalence of 21% reported in a sample of 100 HD patients between 2013 and 2016 in Ibb city (Almezgagi et al., 2020). Actually the prevalence varying from center to other, it is 31.15% in AlQanawes HD center to 5.40% in 22nd of May center. Globally the prevalence of HCV among patients receiving HD varies from as low as 6.1% in Germany (Hinrichsen et al., 2002), to as high as 76% in Casablanca (Boulaajaj et al., 2005). In general, North Africa and the Middle East are high prevalence areas both in the general population and in HD patients (Haga et al., 2015). Previous studies from the region have reported a prevalence of anti-HCV antibodies in HD patients of 50% in Saudi Arabia (Souqiyyeh, Al-Attar, Zakaria, & Shaheen, 2001). 42% in Tunisia (Jemni et al., 1994), 20.2% in Turkey (Yakaryilmaz et al., 2006), and 21% in Jordan(Batieha et al., 2007). In contrast, the observed prevalence of HBV infection (6.53%) is near to the general population (5.1% in study conducted in Aden)(Al Waleedi & Khader, 2012). It is near to prevalence reported in Omar Ayedh Abdullah Amran 8.9%(Amran et al., 2019). and when compared to that reported in HD patients in other regions including Europe (4.1%), Japan (2.2%) and the USA (2.4%) (Goodkin, Young, Kurokawa, Prütz,

& Levin, 2004). A study sample from the Dialysis Outcome and Practice Patterns Study that included 8615 adult HD patients from 308 dialysis facilities in Western Europe and the United States, reported prevalence rates for HBV infection ranging from 0% to 6.6% .(Goodkin et al., 2004). Studies from less developed countries estimated that the proportion of HBsAg carriers in the HD population varies from 2% to 20% (Alavian, BAGHERI-LANKARANI, MAHDAVI-MAZDEH, & Nourozi, 2008; El Makarem et al., 2012; Karkar, Abdelrahman, Ghacha, & Malik, 2006). According to the 2008 Saudi Centre for Organ Transplantation (SCOT) report, HBV sero-positivity was 4.6% in the Saudi HD population(Alashek, McIntyre, & Taal, 2011). while among Jordanian HD patients it was 5.9%(Al Hijazat & Ajlouni, 2008). In general, the prevalence and incidence of HBV and HCV infections in HD patients reflects the prevalence of these infections in the general population, the quality of healthcare services in a community and the standards of infection control practices in HD units.

The prevalence and incidence of HBV or HCV sero-positivity was significantly related to the length of time on HD. This is consistent with nosocomial transmission related to dialysis since longer duration of dialysis represents a longer period at risk of acquiring an infection. Prevention of nosocomial transmission is of vital importance in Yemen as HCV antiviral treatment is expensive and its availability is limited to only a few centers. A positive history of blood transfusions as well as the number of blood transfusions was strongly associated with HBV or HCV infection at baseline, but not with new infections. Prior to the introduction of effective screening of blood donors, blood transfusions were recognized as the leading source of HCV infection and some

of these infections may have been acquired before adequate screening was introduced. In addition it is possible that some blood donors with HCV infection are being missed by current screening procedures and these may need to be reassessed. On the other hand the lack of association between blood transfusions and new infections suggests that fewer infections are acquired by this route than previously. A large proportion of seropositive patients (40.66%) had not previously received blood transfusions. The risk of infection could therefore be further reduced by more effective management of anemia with iron supplementation and erythropoietin.

Following up of 463 sero-negative HD patients enabled to verify 33 sero-conversions for HBV or HCV and both giving an overall incidence of 7.13% for new infections. The incidence rate of 1.94% for HBsAg sero-conversion. In Europe, Japan and the USA (0.4-1.8 per 100 patient-years)(Burdick et al., 2003). Two new HBsAg positive patients were detected in a single center that was treating 8 HBsAg positive patients (Zabid HD center) and 2 new cases were detected in another center that was treating 3 HBsAg positive patients, suggesting that nosocomial transmission probably occurred. We observed a high incidence of new HCV infections (4.35%) varying from 14.89% in AlQanawes HD center to 1.97% in Zabid HD center. The reported incidence of new HCV infections varies considerably between countries. A rate as low as 0.4% was observed in France from 1997 to 2000. (Karkar et al., 2006), but higher rates have been reported from the Mediterranean region. According to the 2008 SCOT report, the annual rate of HCV sero-conversion in Saudi HD patients was 7-9%(Souqiyyeh et al., 2001), while in Jordan it was 2.6% (Batieha et al., 2007). In our study all new cases were observed in centers treating other patients with HCV infection, suggesting

nosocomial transmission. Interestingly most of new infections were in more than one year dialysis (73.63%). More interestingly all cases diagnosed with both HBV & HCV infection diagnosed after they started HD. This increases the possibility of transmission from a carrier that was not detected by current screening procedures.

A striking observation from this study is the wide variation in incidence and prevalence of HBV and HCV infections among different HD units. On the other hand, we observed variations in other practices that may be relevant. All the facilities faced a problem of increasing number of patients and most of them responded by adding more HD stations at expense of space and staff. Infection control precautions also varied widely between centers. They were strictly enforced in some places but frequently breached in others. This seemed to depend on staff initiative and the capacity and the utilities rather than national guidelines. On the other hand, dialyzer reuse was not permitted and all bloodlines as well as other consumables were disposed after a single use. Some brands of HD machines were equipped with a sphygmomanometer. Otherwise, most non- disposable instruments used in HD environment were shared between sero-positive and sero-negative patients.

There's time needed for total deserialization not always fulfilled which is one hour minimally, and some times the needed for urgent dialysis make them use washing (which ended within 10 minutes instead of deserialization). Using of multi-dose vials of heparin was common and is likely to have been an important cause of nosocomial infections. Most of patients started HD without being vaccinated against HBV. The wide variation in HBV and HCV prevalence and incidence between dialysis centers implies that there is potential to reduce blood-borne virus infection by transferring best

practice from HD centers with low infection rates i.e: separation of stuff between seropositive and seronegative, isolation of seropositive patients. We also need to increase the capacity of each center to make it easy for patient need urgent HD. In particular infection control procedures should be investigated in centers with high infection rates and the use of multidose heparin vials must be stopped urgently. Previous studies from the region show that with appropriate intervention HCV infection rates in HD centers may be substantially improved. For example in Iran, HCV prevalence reduced from 14.4% in 1999 to 4.5% in 2006.(Alavian et al., 2008), and in Saudi Arabia from 2.4% in 2001 to 0.2% in 2005(Karkar et al., 2006).

Several limitations of this study should be conceded. Medical records were often incomplete and additional clinical information was not included, the variable numbers of patients between selected HD centers, we needed to follow patients prospectively to recording new seroconverted cases and documenting them and there was no visiting to centers by the researchers to get more valuable information about each center instead of making calls with some of stuff. Numbers of HD patients have emerged between cities, i.e. from Zabid to AlHodaidah, so we missing out the opportunity to including them in our study. Accumulatively, we noticed that serological testing was done in local laboratories and it is likely that there was some variation in the quality of testing. Data regarding hepatitis B core antibodies (HBcAb) or hepatitis B DNA were not available. In one recent study of hemodialysis patients in Egypt who were negative for HBsAg, hepatitis B DNA was detected in 4.1% and HBcAb in 20% (El Makarem et al., 2012). It is therefore possible that we failed to detect cases of occult hepatitis B infection.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

In conclusion, patients that are on hemodialysis in the five hemodialysis centers, which included in our study, have a high incidence and prevalence of having HCV infection than having HBV infection, which is still high. The factors associated with HBV and HCV infection are highly suggestive of nosocomial transmission within HD units. Urgent action is required to improve infection control measures in HD centers, to reduce the dependence of blood transfusions in the treatment of anemia associated with ESRD. We need to increase the capacity of each center and isolate HBV and HCV seropositive patients in specific HD units. Training sessions is needed to educate the staff about infection control methods and increases the staff to maintain different staff dealing with seropositive patients and others dealing with seronegative, to avoid mixing these two groups of patients. It need to mention here that each center n should provide its own serological and PCR tests, in order to make it more affordable and reachable for each HD patient. This will make it easier for the patient to repeat the tests at least every 6 months. The data presented were obtained before the recent conflict in Yemen. It is possible that disruption of services due to the current conflict may have exacerbated the problem of hepatitis virus infection transmission in HD patients. We recommend to increase the demand for total deserialization measures after each session of hemodialysis for at least one hour, also there is a highly recommend to conduct new prospective studies about the incidence of viral hepatitis in HD centers, studies that are depending on blood testing, also more studies should be done on the prevalence of transmission of HBV and HCV among blood transfusion centers in Yemen which we

consider from the previous study that is a huge risk factor of HBV and HCV transmission.

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