Statistical Epidemiological Study of the Frequency of Infection with Hepatitis B and C Viruses Among Hemodialysis Patients in Tarhouna Teaching Hospital

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الملخص

الخلفية: تشكل عدوى التهاب الكبد الفيروسي البائي والجيمي تهديداً استثنائيًا للمرضى الذين يخضعون لغسيل الكلى، حيث أن العرض السريري في هذه المجموعة من المرضى تختلف عن تلك في عامة السكان ، فالغسيل الكلوي عامل خطر شائع للإصابة بمثل هذه العدوى. يتعرض المرضى الذين يخضعون لغسيل الكلى لخطر متزايد للإصابة بعدوى التهاب الكبد البائي و الجيمي مقارنةً بعامة السكان. عرضت الدراسة الحالية التوزيع الوبائي لفيروس التهاب الكبد البائي و الجيمي بمستشفى ترهونة التعليمي - ليبيا.

المواد والطرق المستخدمة: أجريت الدراسة في الفترة من مايو 2022 إلى يونيو 2022 ، وتم جمعها من الإحصائيات الصادرة عن أرشيف وحدة غسيل الكلى ، وهدفت إلى تقدير الانتشار الوبائي لفيروس التهاب الكبد البائي و الجيمي بمدينة ترهونة وتقييم حدوثه لدى الأفراد الذكور والإناث وشملت الدراسة 120 حالة تم الإبلاغ عنها ، منها 72 حالة من الذكور و 48 حالة من الإناث.

النتائج: تمَّ الكشف عن اصابة أحد عشر مصاباً بفيروس التهاب الكبد البائي (HBsAg) و فيروس التهاب الكبد الجيمي من المرضى أي بنسبة (16.9٪) ومعظمهم من الذكور، حيث خضع جميع المرضى المصابين بالفيروس لغسيل الكلى ثلاث مرات في الأسبوع ، وأمضى معظم المرضى المصابين بالتهاب الكبد البائي (HBsAg) أربع ساعات في كل جلسة من جلسات التنقية الدموية.

الإستنتاج: نستنتج أن متلقي زرع الكلى المصابين بفيروس التهاب الكبد البائي والجيمي معرضون بشدة لخطر التدهور السريري، وكذلك يكون للمستضد السطحي HBsAg و فيروس التهاب الكبد الجيمي في مرضى غسيل الكلى لهما تأثير سلبي على الزرع وبقاء المريض على قيد الحياة.

التوصيات: يوصى بشدة بفحص عدوى التهاب الكبد البائي والجيمي بواسطة جهاز الـ ELISA قبل كل مرة من غسيل الكلى ، ويجب إجراء الفحص الفيروسي الكبدي البائي والجيمي قبل البدء عند كل جلسة غسيل الكلى وبشكل دوري بعد ذلك.

الكلمات الدلالية: التهاب الكبد البائي، التهاب الكبد الجيمي ، غسيل الكلى والعدوى.

Abstract:

Background: Viral hepatitis B and C infections are an exceptional threat to patients on hemodialysis, and their presentation and clinical course in this group of patients are different from those in the general population. Renal hemodialyses are a common risk factor for such an infection. The patients on hemodialysis are at increased risk of acquiring HBV and HCV infections as compared to the general population. The current retrospective study has presented the epidemiological distribution of HBV and HCV at the Teaching Hospital of Tarhona, Libya.

Materials and Methods: The study was conducted from May 2022 to June 2022. It was compiled from data released by the haemodialysis unit's archive in order to estimate the epidemiological prevalence of HBV and HCV in Tarhona and evaluate occurrence in both male and female individuals. The study involved 120 reported cases, of which 72 were males and 48 were females.

Results: Hepatitis B surface antigen (HBsAg) and HCV were detected in 11/120 (9.16%), most of them males. All of the HBsAg and HCV seropositive patients were having hemodialyses three times per week, and most of the infected patients with HBsAg spent four hours in each hemodialyses session.

Conclusion: We conclude that HBV and HCV-infected kidney transplant recipients are at a high risk of clinical deterioration. In hemodialyzed patients, HBsAg and HCV have a negative impact on transplantation and patient survival.

Recommendations: It is strongly recommended to screen for hepatitis B and C infection by ELISA before each dialysis session, and viral screening for hepatitis must be performed before beginning hemodialysis and on a regular basis thereafter.

Keywords: Hepatitis B, Hepatitis C , Haemodialysis and Infection.

Introduction: It is well known that patients who undergo HD are at risk of contracting viral infections. This is due to underlying impaired cellular immunity. Furthermore, the HD requires prolonged exposure to infectious materials via extracorporeal circulation. Moreover, HD patients may need transfusions of blood and frequent admissions to the hospital and surgery, which increase opportunities for nosocomial infection exposure. The most common viral infections encountered in HD units are hepatitis B virus (HBV) and hepatitis C virus (HCV) (Karkar A. *et al*., 2006).

The primary purpose of the renal system is to maintain the body's state of homeostasis by carefully regulating fluid and electrolytes, removing wastes, and providing other functions (Kanda H. *et al*., 2015). Dysfunction of the kidneys is common and may occur at any age with varying degrees of severity. (Janice L. *et al*., 2014). Liver disease due to the hepatitis C virus (HCV) is a major public health concern that affects millions of people globally (Popping S., *et al*., 2018).

Infection by viral hepatitis leads to significant morbidity and mortality in developing and undeveloped countries. The clinical manifestations of viral hepatitis ranged from mild to life-threatening (Nakayama E. *et al*., 2000).

Initial testing is suggested with either an enzyme immunoassay or a nucleic acid test, depending on the low or high prevalence of the virus in the country and the particular hemodialysis unit (Butt T. and Amin MS., 2008).

Patients with end-stage renal disease are at increased risk of acquiring HBV and HCV infections than the general population due to their deficient immune responses, exposure to blood transfusions, and HD equipment. These are the most common viral infections among individuals with renal disease (Edey M. *et al*., 2010; Sit D. *et al*., 2007).

These patients are often anemic, require prolonged vascular access, and have a high possibility of exposure to infected patients and contaminated equipment, as well as cross-contamination from the dialysis circuits (Boulaajaj K. *et al*., 2005).

Patients undergoing hemodialysis should be tested when they first start dialysis or when transferred from another dialysis facility (Bostan N. and Mahmood T., 2010).

Although HD is an important modality of therapy for CRF patients, it may also lead to the transmission of some bloodborne infections. Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections are the most common infections among patients with maintenance hemodialysis. (Saha D. and Agarwal SK., 2001).

Rationale: HBV and HCV are the most contagious viruses that are transmitted through blood or contaminated sharp materials. Hemodialysis patients are more susceptible to infection due to regular contact with the blood exchange machine.

Aim of the study: This study aimed to evaluate the prevalence of Hepatitis B and C virus infections that determined the complications of patients with chronic renal failure.

Objectives:

General Objective:

-To estimate the proportion of hemodialysis patients infected with hepatitis B and C viruses.

Specific Objectives:

-To detect the hepatitis B and C viruses.

-To determine the prevalence of Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections among hemodialysis patients at Tarhona teaching hospital.

-To determine the relationship between infection frequency and risk factors (age, gender, number of dialysis sessions per week, and dialysis duration).

Materials and Methods: A retrospective study depended on estimating the proportion and frequency of hepatitis B and C virus infections that occur among haemodialysis patients, to detect the presence of the viruses, and to find out the relationship between the infections and the study variables. This study was based on the prevalence of infection with the hepatitis B and C viruses in patients with chronic renal failure.

1.Type of study:

a retrospective study.

2. Area of study:

Tarhouna, Libya (hemodialysis unit in the Teaching Hospital of Tarhona).

3. Duration of study:

This study was started on 15 May 2022 and ended on 16 June 2022.

4. Study variables:

4.1. Dependent variable:

Hepatitis B and C viruses.

4.2. Independent variable:

Gender, age, the number of different dialysis sessions per week, and the duration of hemodialysis.

5. Study Criteria:

5.1. Inclusion Criteria:

All of the patients are receiving hemodialyses.

5.2. Exclusion Criteria: None

6. Target population and sample size:

120 patients have chronic renal failure.

7. Data collection:

The data for this study were collected from the archives of the hemodialysis unit of the Education Hospital of Tarhona in 2022. Age, gender, duration of renal haemodialysis, and number of haemodialysis sessions per week were all recorded.

8. Study population: The study population consisted of men (72) and women (48), aged between 15 and 73 years.

9. Statistical Analysis: The data entered into the computer after coding; to perform the statistical analysis using the statistical packages for social sciences (SPSS) used to answer the questions of the study at a significant level (P-value less than 0.05).

Results: A retrospective study involved 120 participants (patients with CRF who undergo hemodialyses), of whom 72 were males (60%) and 48 were females (40%). Their ages ranged from 15 to 73. The average age for all injured patients with HBsAg was 46 years, whereas the group age of all positive patients with the hepatitis B virus was 41–50 years, and the patients infected with the hepatitis C virus had their age periods ranging from 41 to 70 years. Data recorded in Table (1.1) showed the HBV infection was distributed by age. In general, during the investigation of epidemiological statistics of haemodialysis patients, a high increase in proportion of infection with the hepatitis B virus was observed in all positive patients aged 41–50 years (4.1%), but the hepatitis C virus was completely different from the hepatitis B virus in the age groups, which stretched from (41–50), (51–60), and (61–70) by 0.8%, 1.7%, and 0.8%, respectively. Our study revealed that there was a difference among patients with HBV infection by sex, as illustrated in Table (1.2). It should be mentioned that the presence of HBsAg and HCV indicates that hemodialysis participants are in the chronic phase. Meanwhile, the study displayed that all positive cases (11) were subjected to hemodialyses by proportion (9.1%); most of them were men, i.e., 63.6%, while the incidence in the female sex was 36.4%. It was discovered that the spread of HBV infection among hemodialysis patients in a unit was rapidly increasing. Most of the infected patients were from the male category; this is for hepatitis B virus infection, but for hepatitis C virus infection, the infection rate

was equal for both sexes. According to the data in Table (1.3), there is a statistically significant relationship between payment on receipt and injury, which means that there are significant differences between the injury and the number of dialysis sessions, where the P-value is less than 0.05. On the other hand, there was a high increase of the hepatitis B virus among participants (three times a week) of 9.1. Instead, with sessions of hemodialyses twice a week, it can be seen that the infection rate of hepatitis B and C viruses is nearly the same among males and females. Through the tabulated data, it became clear that there is a significant relationship based on statistical differences between the duration of dialysis and infection with the hepatitis B and C viruses. Our study found a relationship between the duration of hemodialysis and HBV infection. The majority of hepatitis B and C viruses infected people (5.8%) perform dialysis for 4 hours (see table 1.4).

1. The relationship between age and infection by hepatitis B and C viruses:

Table (1.1) shows the results of the Chi^2 distribution test for the relationship between age and infection by the hepatitis B and C viruses:

Age	Infected HBV cases		Infected HCV cases		Non infected cases	
	Frequency	Proportion %	Frequency	Proportion %	Frequency	Proportion %
15 - 20	00	(00%)	00	(00%)	07	(5.8%)
21 - 30	00	(00%)	00	(00%)	10	(8.3%)
31 - 40	00	(00%)	02	(1.7%)	27	(22.5%)
41 - 50	05	(4.1%)	01	(0.8%)	24	(20%)
51 - 60	00	(00%)	02	(1.7%)	17	(14.2%)
61 - 70	00	(00%)	01	(0.8%)	23	(19.3%)
More than 71	00	(00%)	00	(00%)	01	(0.8%)
Total	05	(4.1%)	06	(05%)	109	(90.9 %)
P-Value= 0.199 Calculated Chi^2 Value=3.228 df= 2 Tabulated Chi^2 Value = 5.99						

The results in Table **(1.1)** showed that the P-value equaled 0.199, which was more than 0.05 and indicated that there weren't any differences in infection by hepatitis B and C viruses according to age. This was confirmed by the calculated Chi^2 value of 3.228, which was less than its tabulated value of 5.99, so the infection by hepatitis B and C viruses wasn't related to age.

2. The relationship between gender and infection by hepatitis B and hepatitis C viruses:

Table (4.2) illustrates the results of the Chi^2 distribution test for the relationship between gender and infection by the hepatitis B and C viruses:

Gender	Infected HBV cases		Infected HCV cases		Non infected cases	
	Frequency	Proportion (%)	Frequency	Proportion (%)	Frequency	Proportion (%)
Male	04	(3.3%)	03	(2.5%)	65	(54.2%)
Female	01	(0.8%)	03	(2.5%)	44	(36.7%)
Total	05	4.1%	06	05%	109	90.9%
P-Value= 0.166 Calculated Chi^2Value= 9.13 df= 6 Tabulated Chi^2 Value = 12.59						

The results in Table (4.2) revealed that the P-value equals 0.166, which is more than 0.05 and indicates that there are no differences in infection by hepatitis B and hepatitis C viruses according to gender. This was confirmed by the calculated Chi^2 value of 9.13, which was less than its tabulated value of 12.59, so the infection by hepatitis B and hepatitis C viruses wasn't related to gender.

3.The relationship between the number of different dialysis sessions per week and infection by the hepatitis B and C viruses:

Table **(4.3)** represents the results of the Chi^2 distribution test for the relationship between the number of different dialysis sessions per week and infection by the hepatitis B and hepatitis C viruses:

Number of different dialysis sessions per week	Infected HBV cases		Infected HCV cases		Non infected cases	
	Frequency	Proportion (%)	Frequency	Proportion (%)	Frequency	Proportion (%)

Twice a weak	00	(00%)	00	(00%)	00	(00%)
Three times a week	05	(4.1%)	06	(5%)	109	(90.9%)
Total	05	4.1%	06	05%	109	90.9 %
P-value = 0.008 Calculated Chi^2 Value=31.317 df= 15 Tabulated Chi^2 = 25						

The results in Table (4. 3) displayed that the P-value was equal to 0.008, which was less than 0.05, and indicated that there were differences in the number of different dialysis sessions per week according to infection by the hepatitis B and C viruses. This was confirmed by the calculated Chi^2 value of 31.317, which was more than its tabulated value of 25, so the number of different dialysis sessions per week were related to infection by the hepatitis B and C virus.

4- The relationship between the duration of hemodialysis and infection by the hepatitis B and C viruses:

Table (4.4) shows the results of the Chi^2 distribution test for the relationship between duration of hemodialysis and infection by the hepatitis B and C viruses:

Duration by hour	Infected HBV cases		Infected HCV cases		Non infected cases	
	Frequency	Proportion (%)	Frequency	Proportion (%)	Frequency	Proportion (%)
Three hour	01	(0.8%)	03	(2.5%)	44	(36.7%)
Four hour	04	(3.3%)	03	(2.5%)	65	(54.2%)
Total	05	4.1 %	06	05 %	109	90.9
P-value = 0.009 Calculated Chi^2 Value=15.375 df= 5 Tabulated Chi^2 Value = 11.07						

The results in Table **(4.4)** presented that the P-value was equal to 0.509, which was less than 0.05, and indicated that there were differences in the duration of haemodialysis according to infection by the hepatitis B and C viruses. This was confirmed by the calculated Chi^2 value of 15.375, which was more than its tabulated value of 11.07, so the duration of haemodialysis was related to infection by the hepatitis B and C viruses.

Discussion: This study investigated the following points: estimating the proportion and frequency of hepatitis B and C virus infections that occur among haemodialysis patients; detecting hepatitis B and C viruses; and finding out the relation between infection frequency and risk factors for the study. Hepatitis B and C viruses are major causes of chronic liver inflammation and thus increase the morbidity and mortality of patients (Kumar V. *et al*., 2010).

Reduced immunity from chronic renal disease makes patients susceptible to succumbing to HBV and HCV infections (Pol S. *et al*, 2012). Exposure to multiple blood transfusions and a deficient immune response put patients with end-stage renal disease at an increased risk of acquiring HBV and HCV infections than the general population. (Adane T. and Getawa S., 2021).

It should also be taken into consideration that hemodialyzed patients were free of HBV and HCV infection before beginning dialysis; after that, infection was transmitted among them. It has been suggested that the elevated infection is caused by HBV.

This finding was in agreement with the finding from (Seeff L.B. *et al*., 1987) who stated that the number of hemodialyses contributed to hepatitis B infection. This difference might be due to the fact that there was no sterilization of dialysis machines.

The aim of this study was to estimate the prevalence of HBV and HCV infection among hemodialysis patients in Tarhona Hospital and compare it with the study changes (age, gender, type of infection, and period of infection). Hepatitis B and C (HBV and HCV) is a common disease in dialysis patients, and this infection among dialysis patients leads to complications and low immunity.

In this study, 11 participants had hepatitis B and C viruses, and the rate was 9.16% of them; 7 were males, with a percentage of 5.83%, and 4 were females, with a percentage of 3.33%. The study offered the finding that the number of infected males was higher compared to females. These results are in agreement with previous studies in Iraq by (Khalaf A.A. and Hussein K. R., 2022) and in Egypt by (Ahmed H. *et al*., 2015).

While the results of the study did not agree with Mohamed O.O. *et al*. (2021) statement, the research was conducted in Somalia. This study also showed that patients infected with hepatitis C had a higher mortality rate than those with hepatitis B.

These findings are in disagreement with previous research conducted in Iraq in Di Qar (30%) and Basra (42.7%) by (Shihab S.S. *et al*., 2014), Baghdad (40.3%) by (Al-Rubaie, H. M. and Malik, A. S., 2011) and Egypt (39.7%) by (Ahmed H. *et al*., 2015). In Host City, Yemen, they concluded that the prevalence of HBV is 3% and HCV is 21% (Almezgagi, M.M. *et al*., 2020).

HCV was found to be more common than HBV in 8.5%–4.5% of people in Khartoum, Sudan, according to (Gasim I. *et al*., 2011). These findings are similar to the results of our study as well as those in Lebanon, where it was concluded that the prevalence of HBV and HCV was 1.6% and 4.7%, respectively (Abou Rached A. *et al*., 2016).

This study disagrees with that done in Somalia by Hassan-Kadle M.A. *et al*. (2018). In this study, the number of infected patients with hepatitis C was six cases (05%), including three males and three females, at a rate of(2.5) for each; the number of injured patients with hepatitis B was five (4.16%), including four males (3.33%) and one female (0.8%). Numerous measures have been taken to decrease the prevalence of viral hepatitis in HD units. However, the isolation of machines and patients in separate rooms to prevent or decrease transmission of viral hepatitis in HD units remains a controversial issue. (Karkar A. *et al*., 2006).

Da Villa, G., and Sepe, A. (1999) found that possible forms of transmission include blood transfusions and transfusions with other human blood products, and the re-use of contaminated needles and syringes. HBsAg and HCV were detected in (4.2 % and 05%, respectively) of hemodialysis patients; this finding is higher than the incidence of hepatitis B and C infection in Libya (Alashek W. *et al*., 2012) and Brazil (Fontenele A. M. M. *et al*., 2013), which were estimated (2.6% and 1.1%, respectively).

While these results were consistent with what was stated (Abu El Makarem M. A. *et al*., 2012) in the study conducted in Egypt, which estimated (4.1); this might be due to differences in geographic publication, a small sample size in our study, or the good separation of hepatitis B and C infected patients who were subjected to hemodialysis.

There was no correlation between the frequency of HBsAg and HCV and age groups, which was also found by (Ashek W. et al. 2012).

Most of the haemodialysis patients (60%) were male, with a slight recurrence of hepatitis B and C infection (5.5 % and 4.2 %respectively), which disagreed with the study of (Alashek W. *et al*., 2012) and (Altorshani I. M. *et al*., 2018), who determined nearly similar frequencies between male and female, although it is consistent with HCV infection; The association of hepatitis virus infection with travel suggests that the risk of nosocomial infection varies between dialysis centers within Libya and abroad. The former is confirmed by our data, which show a marked variation in both the prevalence and incidence of HBV and HCV infection among Libyan HD units. These observations emphasize the importance of isolating patients following their return and monitoring them for seroconversion.

The results of our study revealed that they are equal for both males and females. All hepatitis B and C seropositive patients (4.1% and 5%, respectively) have hemodialyses three times a week. This result disagreed with the findings from (Alashek W. *et al*., 2012) and (Altorshani I. M. *et al*., 2018), who stated that the number of haemodialysis sessions didn't contribute to hepatitis B and C infection. This difference might be due to the fact that most of our participants—99.9 percent—have hemodialysis three times a week.

The findings in Table (4.3) revealed that the differences in infected cases were related to the number of sessions of renal haemodialysis per week (twice and thrice), and the findings were consistent (Altorshani I. M. et al., 2018).

High-frequency HBsAg and HCV seropositives undergo four-hour hemodialyses.The duration of dialysis and hepatitis B virus infection were found to be related; this could be due to the fact that the majority of the participants' dialysis sessions lasted four hours.These results were agreed upon (Altorshani I. M. *et al*., 2018).

Our data show that sero-positive patients were significantly younger on average than sero-negative patients. This observation is in agreement with a previous report from Libya showing that the highest prevalence of HCV antibodies was observed in HD patients aged 31–70 years (Daw, M.A. *et al*., 2002).

Other studies (Burdick, R.A. *et al*., 2003; Saxena, A.K.; Panhotra, B.R., 2004; Mostaghni, AA. *et al*., 2011) have reported a higher prevalence of HBV or HCV seropositivity in older patients, but the reason for this difference is not clear.

On the other hand, the prevalence and incidence of HBV or HCV seropositivity were significantly related to the length of time on HD. This is consistent with nosocomial transmission related to dialysis since a longer duration of dialysis represents a longer period at risk of acquiring an infection; similar observations have been reported by other authors (Hardy, N.M., 1992; Fissell, R.B. *et al*., 2004).

Prevention of nosocomial transmission is of vital importance in Libya, 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 received, were strongly linked to HBV or HCV infection at baseline, but not to new infections. With 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 (Hinrichsen, H. *et al*., 2002; Vladutiu, D.S. *et al*., 2000).

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.

In accordance with other studies Fissell RB. *et al*. (2004); Pereira BJ. (1995); Dusheiko G. *et al*. (1983): HBV or HCV infection was more prevalent in patients with a history of previous renal transplant. In these patients, the infection may have been spread by an infected donor kidney or blood transfused during surgery. This observation emphasizes the need for adequate screening of potential kidney donors, which is deficient in some countries.

The shortage of donated kidneys in Libya induces many patients to seek a transplant abroad. Another concern raised by the current study is that HBV or HCV infection was associated with a history of HD in another center, either in Libya or abroad. Many patients travel for social reasons, but some also transfer to a maintenance HD center after initiating dialysis as an emergency in a specialized center providing acute services or may travel to another center for surgery to create an arteriovenous fistula (Alashek W.A., 2011).

Conclusion: Based on the results of this research, we concluded that:

- The study revealed that there are no significant differences, i.e., (P-value > 0.05%) between the incidence of hepatitis B and C for the study participants and the study variables (age and gender).

- The study discovered significant differences in the incidence of hepatitis B and C among study participants and study variables (number of different dialysis sessions per week and duration of hemodialysing) with a P-value of 0.05%.
- There is a high prevalence of hepatitis B virus infection among hemodialysis patients, and it is more common in males than females, with a much higher prevalence in the age group between 41 and 50 years.
- Hepatitis C virus infection was discovered to be common among haemodialysis patients, with males and females affected equally across age groups (31-40) and (51-60).
- Hepatitis B and C infections were common, despite the fact that the vast majority of hemodialysis patients had a viral blood screen.
- A high prevalence of hepatitis B and C infection was found in hemodialyzed patients who received treatment three times a week for four hours.

Recommendations: Upon the results of this study, it's highly recommended to:

1. Conduct new research with larger sample sizes from different regions in Libya to determine the prevalence of hepatitis B and C virus infection among hemodialysis participants.
2. Before beginning hemodialysis, a viral hepatitis screen must be performed on a regular basis.
3. Separate hemodialysis patients according to infection.
4. Sterilize the dialysis machines daily.
5. Daily sterilization of dialysis machines after each hemodialyse process for each patient to avoid infection before disease discovery
6. The washing of the patient does not begin until an analysis of the hepatitis C and B epidemics is completed. It is also recommended that the patient be examined on a regular basis to avoid infection transmission.
7. Despite the ICT card, use the ELISA method for screening HBsAg and HCV.

List of Abbreviations

ABBREVIATIONS	MEANING
CRF	Chronic Renal Failure
ELISA	Enzyme Linked Immuno Sorbent Assay

HBsAg	Hepatitis B Surface Antigen
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus

References:

Abu El Makarem, M. A.; Abdel Hamid, M.; Abdel Aleem, A.; Ali, A.; Shatat, M.; Sayed, D.; Deaf, A.; Hamdy, L. and Tony, E.A.(2012): prevalence of occult hepatitis B virus infection in haemodialysis patients from Egypt with or without hepatitis C virus infection. Journal of Hepatitis Monthly, 12(4), 253-258.

Abou Rached, A., El Khoury, L., El Imad, T., Geara, A. S., Jreijiry, J., & Ammar, W. (2016). Incidence and prevalence of hepatitis B and hepatitis C viruses in hemodialysis patients in Lebanon. *World journal of nephrology*, *5*(1), 101.

Adane T, Getawa S (2021) :The prevalence and associated factors of hepatitis B and C virus in hemodialysis patients in Africa: A systematic review and meta-analysis. PLoS ONE 16(6): e0251570. https://doi.org/10.1371/journal.pone.025157

Alashek WA, McIntyre CW, Taal MW.(2012): Hepatitis B and C infection in haemodialysis patients in Libya: prevalence, incidence and risk factors. BMC Infect Dis.12:265. doi: 10.1186/1471-2334-12-265. [PubMed:23082935]. [PubMed Central: PMC3507892.]

Alashek, W.A.; McIntyre, C.W. and Taal, M.W. (2011): Provision and quality of dialysis services in Libya. Journal of heamodialysis International, 15(4), 444-452.

Almezgagi, M. M., Edrees, W. H., Al-Shehari, W. A., Al-Moyed, K., Al-Khwlany, R. S., & Abbas, A. B. (2020): Prevalence of hepatitis B virus and hepatitis C virus and associated risk factors among hemodialysis patients in Ibb city-Yemen. *PSM Microbiol*, *5*(2), 32-40.

Al-Rubaie, H. M. and Malik, A. S. (2011): Seroconversion rate of hepatitis C virus infection among haemodialysis patients in Al-Kadhimiya Teaching Hospital (dialysis unit). *Iraqi Journal of Medical Sciences*, 343.

Ahmed Hassan A, Yassine Yassine S, Tawafe Ahmed R, Ebazaway Mohammed M (2015): "Epidemiological study of patients on regular haemodialysis at the Kafer El-Shakh Governorate, Egypt," Menoufia Med. J., vol. 28, no. 2, p. 267.

Altorshani, I. M., Elqut O. ,Alhadad A., Abohamra S. and Shkorfo O.(2018): Proportion of Infection by Hepatitis B Virus among Renal Haemodialysis Patients in National Center of Heart – Tajora. Altaqnia journal. Higher institute of science and technology. Vol. 4, no: 1&2. pp57-74.

Boulaajaj K, Elomari Y, Elmaliki B, Madkouri B, Zaid D, Benchemsi N. (2005): Prevalence of hepatitis C, hepatitis B and HIV infection among haemodialysis patients in Ibn-Rochd university hospital, Casablanca. Nephrologie & therapeutique. 1(5):274–84.

https://doi.org/10.1016/j.nephro.2005.06.012 PMID: 16895696.

Bostan N, Mahmood T. (2010): An overview about hepatitis C: A devastating virus. Critical reviews in microbiology 36, 91-133.

Burdick RA, Bragg-Gresham JL, Woods JD, Hedderwick SA, Kurokawa K,Combe C, Saito A, LaBrecque J, Port FK, Young EW(2003): Patterns of hepatitis B prevalence and sero conversion in hemodialysis units from three continents: the DOPPS. Kidney Int. 63(6):2222–2229.

Butt T, Amin MS. (2008): Seroprevalence of hepatitis B and C infections among young adult males in Pakistan.

Da Villa, G. and Sepe, A. (1999): Immunization programme against hepatitis B virus infection in Italy. Journal of cost-effectiveness Vaccine, 17, 34-38.

Dusheiko G, Song E, Bowyer S, Whitcutt M, Maier G, Meyers A, Kew MC (1983): Natural history of hepatitis B virus infection in renal transplan recipients–a fifteen-year follow-up. Hepatology 3(3):330–336.

Daw MA, Elkaber MA, Drah AM, Werfalli MM, Mihat AA, Siala IM (2002): Prevalence of hepatitis C virus antibodies among different populations of relative and attributable risk. Saudi Med. J. 23(11):1356–1360.

Edey M, Barraclough K, Johnson DW. (2010): Hepatitis B and dialysis. Nephrology. 15(2):137–45. https://doi.org/10.1111/j.1440-1797.2009.01268.x PMID: 20470270.

Fissell RB, Bragg-Gresham JL, Woods JD, Jadoul M, Gillespie B, Hedderwick SA, et al. (2004): Patterns of hepatitis C prevalence and seroconversion in hemodialysis units from three continents: the DOPPS. Kidney Int.65(6):2335–42. Doi: 10.1111/j.15231755.2004.00649.x.[PubMed: 15149347].

Fontenele, A.M.M.; Filho, N.S. and Ferriera, A.S.P. (2013): Occult hepatitis B in patients on heamodialysis: a review. Journal of Annals of hepatology. 12(4), 359-363.

Gasim I. Gasim, Hamdan Z. Hamdan, Sumaia Z. Hamdan, and Ishag Adam (2011):Epidemiology of hepatitis B and hepatitis C virus infections among hemodialysis patients in Khartoum, Sudan, Jou. Of Med. Viro. 84 (1), 52-55. Doi:10. 1002/jmv.22256

Hardy NM, Sandroni S, Danielson S, Wilson WJ(1992): Antibody to hepatitis C virus increases with time on hemodialysis. Clin. Nephrol. 38(1):44–48.

Hassan-Kadle, M. A., Osman, M. S., & Ogurtsov, P. P. (2018). Epidemiology of viral hepatitis in Somalia: systematic review and meta-analysis study. *World Journal of Gastroenterology*. *24*(34), 3927.

Hinrichsen H, Leimenstoll G, Stegen G, Schrader H, Folsch UR, Schmidt WE: (2002): Prevalence and risk factors of hepatitis C virus infection in haemodialysis patients: a multicenter study in 2796 patients. 51(3):429–433.

Janice L, Kerry H. Brunner and Suddarath's (2014): textbook of medical surgical nursing. 13th ed. p: 1507.

Kanda H, Hirasaki Y, Iida T, Kanao-Kanda M, Toyama Y, Kunisawa T. (2015): Effect of fluid loading on left ventricular volume and stroke volume variability in patients with end-stage renal disease: a pilot study. Ther Clin Risk Manag. 11:1619–25.

Karkar A, Abdelrahman M, Ghacha R, Malik TQ. (2006): Prevention of Viral Transmission in HD Units: The value of isolation. Saudi J Kidney Dis Transpl. 17:183–8.

Khalaf A. A. and Hussein K. R. (2022): Assessment of Hepatitis C virus (HCV) associated with hemodialysis patients in Thi-Qar province, Iraq

.Kumar V., Das, S., & Jameel S. (2010). The biology and pathogenesis of hepatitis viruses. *Current Science*, *98*(3), 312–325. http://www.jstor.org/stable/24111580.

Mohamed Osman Omar Jeele, Rukia Omar Barei Addow, Faduma Nur Adan, Liban Hassan Jimale. (2021): "Prevalence and Risk Factors Associated with Hepatitis B and Hepatitis C Infections among Patients Undergoing Hemodialysis: A Single-Centre Study in Somalia", International Journal of

Nephrology, vol. 2021, ArticlID 1555775, 6 pages. https://doi.org/10.1155/2021/155577.

Mostaghni AA., Soltanian A, Mokhtari E, Japoni S, Mehrabani D (2011): Sero prevalence of hepatitis B virus among hemodialysis patients in Bushehr province, southern Iran: HBV seroprevalence in hemodialysis patients. Hepat Mon. 11(3):200–202.

Nakayama E, Akiba T, Marumo F, Sato C. (2000): Prognosis of anti-hepatitis C virus antibody- positive patients on regular hemodialysis therapy. J Am Soc Nephrol. 11(10):1896- 902.https://accounts.google.com/b/0/Add Mail Service.

Pereira BJ (1995): Hepatitis C infection and post-transplantation liver disease. Nephrol Dial Transplant. 10(Suppl 1):58–67.

Pol S., Vallet-Pichard. A, Corouge .M , Mallet V.O. Morales J.M. (2012): Hepatitis C in Renal Disease, Hemodialysis and Transplantation. Contrib Nephrol. Basel, Karger, vol 176, pp 1–9 https://doi.org/10.1159/0003323.

Popping S., Manal, E., Jordan, F., Angelos, H., Margaret, H., Olufunmilayo, L., Michael, N., John, W., and Charles, B. (2018): Report from the international viral hepatitis elimination meeting (IVHEM), 17-18 November 2017, Amsterdam, the Netherlands: gaps and challenges in the WHO 2030 hepatitis C elimination framework. J Virus Erad. 4(3):193- 195.https://doi.org/10.1016/S2055-6640(20)30281-8.

Saha D, Agarwal SK. (2001) :Hepatitis and HIV infection during haemodialysis. J Indian Med Assoc. 99(4):194-9. 203, 213.

Saxena AK, Panhotra BR. (2004): The vulnerability of middle-aged and elderly patients to hepatitis C virus infection in a high-prevalence hospital based hemodialysis setting. J Am Geriatr Soc. 52(2):242–246.

Seeff L.B. ; Beebe, G.W. and Hoofnagle, J.H. (1987): A serologic follow-up of the 1942 epidemic of post-vaccination hepatitis in the United States Army. Journal of Nantural English Medicine, 316, 65-70.

Shihab, S. S., Al-Hmudi, H. A., Al-Edani, H. S., & Mahdi, K. H. (2014): Viral hepatitis infections in Basrah haemodialysis unit: serological diagnosis and viral loading. *European Journal of Experimental Biology*, *4*(2), 106-12.

Sit D, Kadiroglu AK, Kayabasi H, Yilmaz ME, Goral V. (2007): Seroprevalence of hepatitis B and C viruses in patients with chronic kidney disease in the predialysis stage at a university hospital in Turkey. Intervirology. 50(2):133–7. https://doi.org/10.1.

Vladutiu D.S, Cosa A,Neamtu A, State D, Braila M, Gherman M, Patiu IM, Dulau-Florea I (2000): Infections with hepatitis B and C viruses in patients on maintenance dialysis in Romania and in former communist countries: yellow spots on a blank map? J Viral Hepat. 7(4):313–319.