Prevalence of Hepatitis C Virus Infection in Hemodialysis Patients in Egypt: A systematic Review

ABSTRACT

Background: Patients on hemodialysis (HD) are at high risk of acquiring hepatitis c virus (HCV) infection which is associated with significant morbidity and mortality in this subpopulation. The aim of this work was to establish a comprehensive characterization of HCV epidemiology among HD patients in Egypt.

Methods: In this systematic review we gathered all reports related to HCV prevalence among HD patients in Egypt published between 2010 through 2022. Studies that had proper sampling and measurement method as well as valid statistical analysis were selected.

Results: A high overall prevalence of HCV infection among HD patients in Egypt is (45.13%) which is considerably higher than the global levels. Strikingly, 7.14% of HD patients developed serconversion while on HD, thus highlighting the acquisition of HCV infection during HD. Furthermore, the overall prevalence of HCV infection in HD patients was much higher than that in the general population in all included studies, reinforcing the role of HD in the transmission of HCV infection among HD patients. The decline in HCV prevalence among HD patients in Egypt from 65% in the year 2016, to 41% in the year 2017, to 34.8% by the year 2020, reflects improved standards of infection control in HD centers.

Conclusions: Egypt is challenged with a very high HCV prevalence among HD patients, with evidence for some ongoing HCV transmission. It is important for health care policy makers and health care providers to deal with the mechanisms of HCV transmission in HD units and treat infected HD patients to reduce the transmission rates as well as the prevalence of HCV among HD patients.

Keywords: Hepatitis C Virus, Hemodialysis, Egypt, Epidemiology

1. INTRODUCTION:

Hepatitis C virus (HCV) infection is one of the most commonly reported viral infections in both developing and developed countries, causing significant mortality and morbidity and costing billions of dollars annually [1].

Renal replacement therapies, including hemodialysis (HD), peritoneal dialysis, and kidney transplantation, are the main treatment modality for end-stage renal disease (ESRD) [2].

In low- to middle-income countries, kidney transplantation is rare, and the majority of patients require life-long dialysis in which HD is more common than peritoneal dialysis [3].

The prevalence of HCV among HD patients varies worldwide, ranging from as low as 1 to up to 70%, and the dialysis-related risk of HCV infection is estimated at 2% per year [4].

Overall, HCV prevalence in patients in HD is below 5% in most countries of Northern Europe, around 10% in most countries of Southern Europe and the United States, and between 10 and 50% and up to 70% in many parts of the developing world, including many Asian, Latin American and North-African countries [5].

Egypt, was the country with the highest prevalence of HCV infection (14.7%), with genotype 4 representing 90% of HCV cases [6].

Routine laboratory diagnosis of HCV infection is based on the specific antibodies identified by an immunoenzyme assay [enzyme-linked immunosorbent assay (ELISA)]. All anti-HCV positive results have to be verified by detecting HCV RNA levels (viral load) in the blood, commonly using the PCR technique [7].

Despite infection control practices and routine screening of HD patients for HCV, the acquisition of HCV infection in HD centers remains a problem [8].

HD patients are at high risk for acquiring Hepatitis B Virus (HBV) and HCV infections due to the high number of blood transfusion sessions, the potential for exposure to infected patients and contaminated HD machines and equipments and interpersonal horizontal transmission in the dialysis units [9].

It was known that higher rates of mortality and morbidity in HD patients than in the general populations are caused with HCV nosocomial infections [10].

Conversely, an increase in highly trained HD staff correlated with a lower rate of new HCV infections [9].

The aim of this work was to provide a systematic review of the prevalence of HCV in hemodialysis patients in Egypt.

2. MATERIAL AND METHODS

2.1 Inclusion criteria

In this systematic review we gathered all reports related to HCV prevalence among HD patients in Egypt published between 2010 through 2022.

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All cross-sectional (descriptive and/or analytical) and cohort studies, conducted on humans in Egypt, used HCV Ab test for diagnosis of HCV infection, with sufficient participants, reporting HCV prevalence in HD units and published from 2010 to 2022 were included.

Measurement methods as well as valid statistical analysis were selected without less regard to age or gender of the participants.

2.2 Exclusion criteria

Studies with less than 10 HD patients, case reports (those that did not report HCV prevalence in HD patients and those conducted outside Egypt were excluded during the analysis of point prevalence.

2.3 Electronic databases and gray literature:

The gray literature included conferences that were held during the study period, and we searched their abstract books for any relevant reports related to the subject. We also searched the websites of the university thesis related to the subject during the study period.

Selection of studies: the selection process was applied in two steps: Firstly, the titles and abstracts were evaluated thoroughly for eligibility criteria to be included in the analysis. Secondly, full texts of the selected studies were retrieved.

2.4 Data extraction:

Only, full text papers were retrieved and reviewed for extraction of relevant data. The extracted data included: A) Study characteristics (first author, year of publication, study location, study period, study design, sample size, HCV detection method and the number of HCV infected subjects. Participant characteristics (age, sex, number of participants, inclusion criteria and duration of HD or blood transfusion if reported). Point prevalence of HCV in the participants, occult HCV and seroconversion reported by some studies.

2.5 Statistical analysis

The extracted data were dealt with via Rev-Man software for meta-analysis. The pooled prevalence HCV along with 95% confidence intervals was visually displayed using a forest plot. The heterogeneity of included studies was assessed via the I2 index with values of 25%, 50%, 75% representing low, medium and high heterogeneity respectively. Publication bias was assessed statistically by using cochrane guidelines.

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3. RESULTS AND DISCUSSION

Table 1: Elzorkany and Zahran .2017, Khodir et al., 2012, Sarhan and Kamel. 2015

Domain	Comment
Source	Saudi J Kidney Dis Transpl. 2017 Sep-Oct; 28(5):1126-1132.
Study title	Hepatitis C Virus Status in Hemodialysis Patients in Menoufia Government, Egypt, Five Years Apart: Do We Have Any Improvement?
Author	Elzorkany, K. M. A., & Zahran, A.
Inclusion criteria	Patients on regular hemodialysis
Exclusion criteria	-
Study design	Observational Cross-sectional Study
Study duration (months)	October 2016 through December 2016
Sample	Sample sie:1891patientsRandomly selected
Setting	The study initially included patients on hemodialysis for 3 months from hemodialysis units at Menofia Governorate in the period from October 2016 through December 2016.
Outcome	Prevalence of overall HCV: 794 out of 1891 (41.99%) Prevalence of HCV seroconversion : 92 out of 1891 (4.86%)
Khodir et al., 2012	
Source	Arab Journal of Nephrology and Transplantation. 2012 Sep;5(3):145-7
Study title	Prevalence of HCV Infections Among Hemodialysis Patients in AlGharbiyah Governorate, Egypt
Author	Khodir, S. A., Alghateb, M., Okasha, K. M., & Shalaby, S. S.
Inclusion criteria	Patients on regular hemodialysis
Exclusion criteria	-
Study Design	Observational Cross-sectional Study
Study Duration(months)	April 2011 through November 2011
Sample	Sample sie :2351 participants Randomly selected
Setting	Patients included from All HD units in the eight towns of Al Gharbiyah Governorates including private and public units were During the period from April 2011 to November 2011, data was collected from 2351 patients, including their reported HCV antibody status at the start of HD.
Outcome	Prevalence of HCV: 992 / 2351 (42.19%) Prevalence of HCV seroconversion: 168 / 2351 (7.14%)
Sarhan and Kamel. 2015	
Source	Egyptian Liver Journal 2015, 5:34–39
Study title	Prevalence of hepatitis C virus seroconversion among hemodialysis patients in Egypt
Author	Sarhan, I. I., & Kamel, C. R.
Inclusion criteria	Patients on regular hemodialysis
Exclusion criteria	-
Study Design	Cross-sectional multicenter study
Study duration (months)	March 2011 through April 2011.
Sample	Sample size :987 participants Randomly selected
Setting	This study included 987 end-stage renal disease (ESRD) patients undergoing maintenance hemodialysis therapy in Cairo governorate sector B (north Cairo), including El Zawia El Hamra, El Sharabia,El Zaiton, Rod El

	Farag, El Sahel, and Hadaek El Koba.
Outcome	Prevalence of overall HCV: 504/987 (51.06%), Prevalence of seroconversion 58/987 (5.87%)

Table 2: Senosy and Elshabrawy. [6], Kerollos et al., [11] and Abdelrahim et al,[12].

Domain	**Comment**
Source	Journal of the Egyptian Public Health Association 2016, 91:86–89
Study title	Hepatitis C virus in patients on regular hemodialysis in Beni-Suef Governorate, Egypt
Author	Senosy, S. A., & El Shabrawy, E. M.
Inclusion criteria	Patients on regular hemodialysis
Exclusion criteria	-
Study Design	Cross-sectional multicenter study
Study Duration(months)	May through June 2015
sample	Sample size :971 participants Randomly selected
Setting	All HD patients (971 patients) from all HD centers in Beni-Suef Governorate (13 centers) were included in the study during the period from May through June 2015.
Outcome	Prevalence of overall HCV628/971 (64.68%) Prevalence of overall HCV: 37/971 (3.81%)
Kerollos et al., 2020	
Source	The Egyptian Journal of Internal Medicine (2020) 32-2
Study title	Prevalence and seroconversion of hepatitis C virus among hemodialysis patients in assiut governorate, Egypt
Author	Kerollos, K. M. N., El-Ameen, H. A., El Wahed, L. A., & Azoz, N. M. A.
Inclusion criteria	All the patients who were on regular hemodialysis, the age group was 18–80 years.
Exclusion criteria	patients who died before the end of the study or received any HD sessions outside the government hemodialysis units,HD patients who initiated HD after the study had been started or those with hepatitis B coinfection and patients with diabetes mellitus were excluded from the study
Study Design	observational Cross-sectional multicenter study
Study Duratio(months	January 2017 to January 2018
Sample	Sample size :1435 participants randomly selected
Setting	This study was done in Assiut governorate including 14 dialysis units from January 2017 to January 2018.
Outcome	Prevalence of overall HCV: 500/1435 (34.8%) Prevalence of seroconversion 190/1435 (13.24%)
Abdelrahim et al.,2016	
Source	Journal of Medical Virology 88:1388–1393 (2016)
Study title	Occult Hepatitis C Virus Infection Among Egyptian Hemodialysis Patients
Author	Abdelrahim, S. S., Khairy, R., Esmail, M. A. M., Ragab, M., AbdelHamid, M., & Abdelwahab, S. F.
Inclusion criteria	Patients on regular hemodialysis
Exclusion criteria	-
Study Design	Observational Cross-sectional Study
Study Duratio(months)	June 2013 through July 2014

Sample	Sample size 224 patients,Randomly selected
Setting	The study initially included patients on maintenance hemodialysis (more than 6 months) from two hemodialysis units at Minia Governorate in the period from June 2013 through July 2014. The study was carried out at the Microbiology and Immunology Department, Faculty of Medicine, Minia University.
Outcome	Prevalence of overall HCV: 146 out of 224 (65.1%) Prevalence of occult HCV: 3 out of 224 (1.33%) Prevalence of overt HCV: 143 out of 224 (63.83%)

According to the age of participants the biggest mean age was (53.16+13.34) in Elzorkany and Zahran 2017 study and the smallest mean age was (44.5 ±13.8) in Abdelrahim et al.,2016 study.

Table 3: Age and sex of the six included studies

	Age	**Sex**
Abdelrahim et al.,2016	**44.5 ± 13.8**	**Male: (54%) Female: (46%)**
Elzorkany and Zahran .2017	**53.16+13.34**	**Male: (62.1%) Female: (37.9%)**
Khodir et al., 2012	**52±11**	**Male: (60%) Female: (40%)**
kerllolos et al., 2020	**51.47±13.45**	**Male (53.2%) Female: (46.8%)**
Sarhan and Kamel. 2015	**50 – 60 years**	**Male (55.9%), Female (44.1%)**
Senosy and Elshabrawy. 2016:	**46.14 ±9.9**	**Male (57.4%), female (42.6%)**

Data are presented as mean ± SD or frequency (%).

Prevalence of HCV among hemodialysis patients as reported by the included studies. It displays that the prevalence rates among hemodialysis patients ranged between 34.84% and 65.17%. with a total pooling rate of 45.35 %. The highest prevalence was reported by Abdelrahim et.al,.during the year 2016 while the lowest prevalence was reported by Kerollos et.al,in 2020.

Table 4: Prevalence of HCV among HD patients as reported by the included studies.

Study ID	**Year**	**Prevalence**	
		No.	**Rate**
Khodir et.al,	2012	992/2351	42.19%
Sarhan and Kamel	2015	504/987	51.06%
Senosy and Elshabrawy	2016	628/971	64.68%
Abdelrahim et.al,	2016	146/224	65.17%
Alzorkany and Zahran	2017	794/1891	41.99%
Kerollos et al,	2020	500/1435	34.84%
Total		3564/7859	45.35%

HD: hemodialysis.

Displays Prevalence rates of HCV among HD patients as reported by the included studies compared to prevalence among the general population in the same years. It shows that prevalence rates of HCV

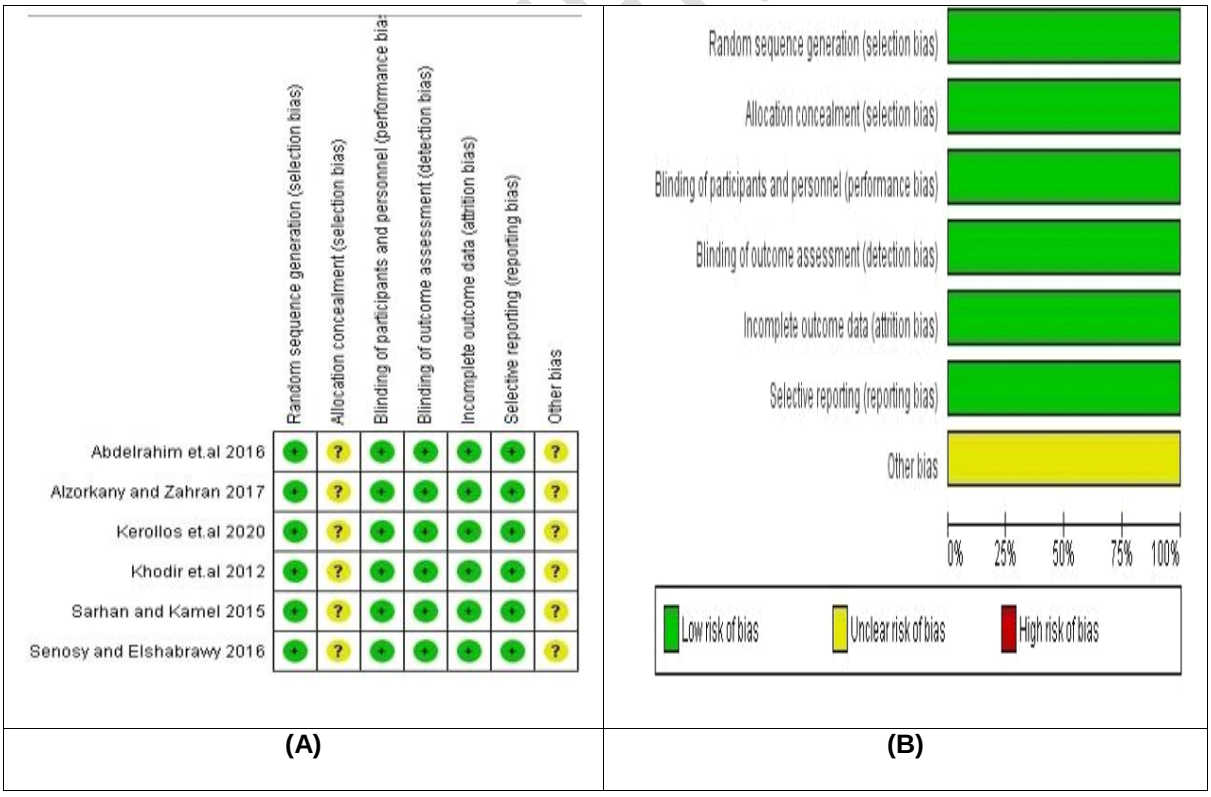
among HD patients were higher than that among the general population in the studies carried out during the years of 2012 through 2020. The prevalence rates of HCV among HD patients were increasing till the year 2016 then started to decline.

Table 5: Prevalence rates of HCV among hemodialysis patients as reported by the included studies compared to prevalence among the general population in the same years.

Year	Meta-analysis included studies		Prevalence Rate among general population
	ID	Prevalence Rate	
2012	Khodir et.al,	42.19%	14.7%
2015	Sarhan and Kamel	51.06%	10.0%
2016	Senosy and Elshabrawy	64.68%	14.8%
2016	Abdelrahim et.al,	65.17%	14.8%
2017	Alzorkany and Zahran	41.99%	14.8%
2020	Kerollos et al,	34.84%	4.6%

Display risk of bias of the included 6 articles on the basis of Cochrane 8 domains. They reveal that there had been low risk of bias regarding, selection, allocation concealment, assessment detection, attrition and selective reporting. There has been insufficient information to permit judgment about the risk of bias due to blinding participants and personnel. Also there was insufficient rational that identified problem will introduce bias.

Figure 1



(A) **(B)**

Figure 1: (A) Summary of judgment of authors about each risk of bias item as percentage across all included articles and (B) judgment of authors about each risk of bias item as percentage across all included articles

Discussion

Previously, Egypt had the highest HCV prevalence in the world (14.7%) according to the Egyptian health survey conducted in 2008 [11].

HCV is primarily transmitted by blood, and among these pathways of transmission, transfusion, intravenous drug use and dialysis are the most widely documented [13].). Therefore, dialysis is a route of HCV transmission that needs to be more emphasized

The prevalence of HCV infection among HD patients is generally much more higher than that among the general population and is associated with increased morbidity and mortality of both HD patients and kidney transplant recipients [11].

In the context of growing HD population and the availability of the highly effective anti HCV therapy, it is critical to characterize HCV infection levels among HD patients and control its transmission via this mode of exposure thus preventing unnecessary health complications such as liver disease and HCC, consequently reducing associated health care costs

Therefore, in Tanta University Hospitals (TUH) this systematic review and meta-analysis was conducted to characterize HCV epidemiology among HD patients in Egypt. HD patients nationwide in Egypt.

This is the first systematic review and meta-analysis to characterize the HCV epidemiology among hemodialysis patients in Egypt.

A total of 6 studies were included in this synthesis, published between 2012 and 2020, and conducted on 15718 HD patients in HD centers in 6 Egyptian governorates, 3 of them in Upper Egypt and the other 3 in Delta region. They are predominantly males (53.2% to 62.1%) of a relatively older age (44.5± 13.8 to 53.2 ± 13.34 years).

All included studies used ELISA method for detection of HCV antibody at inclusion and for seoconversion except one study used RT-PCR for detection of occult HCV cases as well.

The prevalence of HCV infection among HD patients in Egypt ranged from 34.84% to 65.14% with an overall prevalence of 45.35%, which is much higher than the overall prevalence reported by 3 other international systematic syntheses and meta-analyses.

The first one conducted by kenfack-Momo et al. [13] and reported an overall HCV prevalence of 24.3% in HD patients globally.The 2nd one was conducted by Ashkani- Asfahani et al. [14]and reprted an overall HCV prevalence of 25.3% in HD patients in the Middle-East. The 3rd one reported an overall HCV prevalence of 29.2% among HD patients in the Middle-East and North Africa (MENA), conducted by Harfouche, M et al. [15].

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The higher prevalence of HCV infection among HD patients in Egypt may not only reflect the higher background of HCV prevalence in the whole population in our country, but also may suggest inferior standards of infection control in HD centers.

Moreover, the higher prevalence of HCV infection among HD dialysis in Egypt (45.35%) can potentially lead to transmission of infection to other patients through HD.

Interestingly, 5 of the 6 included studies in this systematic review reported HCV seroconversion from –ve HCV Ab at the start of these studies to +ve HCV Ab at the end, with an overall rate of seroconversion among HD patients in these studies of 7.14%, indicating that the acquisition of HCV infection during HD in Egypt remains a problem that needs more and more attention

Importantly, the highest prevalence of HCV of infection among HD patients was reported in Menya Governorate in the year 2016 (abdelrahim et al. [12]), and the lowest prevalence was reported in Assiut Governorate, in the year 2020 (kerollos et al. [16]), indicating that HCV prevalence in HD patients is on a declining trend. This finding suggests that the improvement in blood screening and infection control measures have made an impact on reducing HCV transmission in HD centers in Egypt.

In the meantime the prevalence of HCV infection among HD patients was much more higher than that in the general population in all included studies from 2012 through 2020.

Also, similar results were reported by the 3 international systematic reviews and meta-analysis dealing with HCV prevalence among HD patients in the Middle-East (Ashkani-Espahani,)[14], MENA region (Harfouche, M et al. [15]) and globally (Kenpack-momo et al, 2024)[13].

This considerable increase in HCV infection level among HD patients compared to the general population is related to the higher risk of exposure to HCV infection among HD patients from sharing of dialysis machines and the suboptimal standard of infection control in dialysis centers. This must be a great concern for health care providers in HD centers. Dealing with mechanisms of HCV transmission in HD units, improving the standards of infection control in these centers, and early detection and treatment of infected HD patients can effectively reduce the transmission rates as well as HCV prevalence among HD patients.

Lastly the results of our systematic review and meta-analysis presented a comprehensive characterization of HCV epidemiology among HD patients in Egypt.

The study revealed a very high prevalence of HCV infection among this special subpopulation (45.35%), which is much higher than what was reported globally and in other countries in the Middle East and MENA region. This can potentially transmit HCV infection to other patients through HD and to the general population as well, since 7.14% of our HD patients developed serconversion during HD.

Moreover, the prevalence of HCV infection among HD patients was much higher than that in the general population from the year 2012 through 2020, thus highlighting the problem of HCV transmission in dialysis centers that needs more attention.

Against this background, our study revealed HCV prevalence in HD patients in Egypt is declining over the last 4 years (65% in 2016, to 41% in 2017, to 34.2% by the year 2020).

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Despite these valuable data in our study that allowed us to produce a comprehensive mapping of HCV epidemiology among HD patients in Egypt Limitations needed to be considered.

First, there was a considerable variability in the methodology and quality of the included studies that may impact the reported prevalence.

Second, all included studies used anti HCV antibodies in HCV diagnosis at inclusion and for seoconversion which cannot differentiate between resolved and current infection, as well as it may be delayed after the development of viraemia.

4. CONCLUSION:

This is the first systematic review and meta-analysis to characterize the HCV epidemiology among hemodialysis patients in Egypt, It revealed a high prevalence of HCV infection among this critically ill subpopulation which is considerably higher than the global levels, with nearly one half of them is infected with HCV (45.35%). Strikingly, 7.138% of HD patients developed seroconversion from negative to positive HCV during HD, a finding that highlighted the acquisition of HCV infection during HD. Since, HCV infection in this group of critically ill HD patients is associated with significant morbidity and mortality, it is important for health care policy makers and health care providers to deal with the mechanisms of HCV transmission in HD units, improve the standard of infection control in HD centers, and the use of currently available very effective and safe anti HCV therapy to treat infected HD patients, to reduce the transmission rates as well as the level of prevalence of HCV among HD patients.

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Conflict of Interest: Nil

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