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Seroprevalence of Hepatitis C Virus among Chronic Hemodialysis Patients at the Renal Failure Treatment Center of Brazzaville, Republic of Congo

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Abstract

Background: Chronic hemodialysis patients represent a high-risk population for hepatitis C virus (HCV) infection due to repeated vascular access procedures, blood transfusions, and nosocomial transmission. No published data existed on HCV seroprevalence in this population in the Republic of Congo prior to this study. **Objective:** To determine the anti-HCV seroprevalence among chronic hemodialysis patients at the Renal Failure Treatment Center (RFTC) of Brazzaville and to identify factors associated with anti-HCV seropositivity. **Methods:** A cross-sectional, descriptive and analytical study with prospective data collection was conducted from March 1 to November 30, 2025 at the RFTC. Anti-HCV antibody detection was performed by rapid immunochromatographic test (SD Bioline HCV, specimen type: serum), systematically confirmed by sandwich ELISA (Sirio S analyzer, 3A Laboratory kit). The minimum sample size (n = 160) was calculated using the Schwartz formula based on an estimated prevalence of 23% and a significance level of 5%. Statistical analysis was performed using SPSS 25. **Results:** Of 151 recruited patients, 125 were included (male predominance: 77.6%; mean age: 50.7 ± 12.7 years). Anti-HCV seroprevalence was 14.4% (n = 18), with perfect concordance between the rapid test and ELISA. HCV-seropositive patients were predominantly male (66.7%), had a history of multiple blood transfusions (83.3%),

and were catheter-dependent (72.2%). Univariate analysis identified no statistically significant risk factor; these findings are preliminary given the small number of positive cases. **Conclusion:** Anti-HCV seroprevalence of 14.4% among hemodialysis patients at the RFTC of Brazzaville is intermediate on the African spectrum. These findings underscore the need for systematic screening, reinforcement of blood safety, and promotion of arteriovenous fistula in this vulnerable population.

Keywords

Hepatitis C Virus, Chronic Hemodialysis, Seroprevalence, Republic of Congo, Nosocomial Transmission, Chronic Kidney Disease

1. Introduction

Hepatitis C constitutes a major global public health problem due to its morbidity, mortality, and economic burden on healthcare systems. According to the WHO Global Hepatitis Report 2024, approximately 50 million people are currently living with chronic hepatitis C virus (HCV) infection worldwide, with nearly one million new infections annually [1]. In 2022, HCV caused approximately 242,000 deaths, predominantly from cirrhosis and hepatocellular carcinoma; viral hepatitis (B and C combined) claims approximately 3500 lives per day globally [1].

HCV transmission is essentially parenteral, through exposure to contaminated blood. The main routes include unsafe blood transfusions, injections and invasive procedures in healthcare settings, intravenous drug use, and, less frequently, sexual intercourse involving blood exposure [1] [2]. Diagnosis relies on anti-HCV antibody detection confirmed by viral RNA testing [3].

Chronic hemodialysis patients constitute a particularly high-risk population for HCV, owing to repeated vascular access procedures, prolonged use of central venous catheters, iterative blood transfusions related to chronic kidney disease (CKD) anemia, and the risk of nosocomial transmission within dialysis units [4]. In a recent meta-analysis of African hemodialysis patients, the pooled HCV prevalence was estimated at 23.04%, far exceeding the sub-Saharan general population prevalence (4.17% according to Adane and Getawa [4]; 2.30% to 4.17% according to Sonderup *et al.* [5]).

African data are nonetheless heterogeneous. In North Africa, HCV seroprevalence among hemodialysis patients ranges from 14% in Tunisia [6] to 60% in Morocco [7] and 31.1% in Libya [8]. In West Africa, estimates stand at 4.6% in Guinea [9] and 15% in Nigeria [10]. In Central Africa, Halle *et al.* reported 11.8% in Cameroon in 2016 [11], while Ngilibuma *et al.* described seroprevalence ranging from 0% to 52.9% across centers in the Democratic Republic of Congo [12]. HCV is a positive-sense single-stranded RNA virus classified into eight major genotypes [13]; genotype distribution varies widely across regions, with genotype 4 predominating in Central Africa [14] [15], while the clinical course of untreated chronic

infection typically leads to cirrhosis and hepatocellular carcinoma over decades [16]. A recent review by Fabrizio *et al.* (2024), covering 36 studies and 8420 African hemodialysis patients, confirms active nosocomial transmission within African dialysis units, linked to the high prevalence of central venous catheters, insufficient single-use sterile supplies, and inadequate hygiene protocols [17]. Furthermore, the KDIGO 2022 guidelines emphasize that hemodialysis duration is the principal independent risk factor for HCV acquisition in dialysis, with risk increasing beyond 24 months [18].

In the Republic of Congo, the past decade has seen a multiplication of hemodialysis centers and a growing number of patients under care. However, no data had been published on HCV seroprevalence in this population. This knowledge gap constitutes a major obstacle to the development of adapted prevention and management strategies. The present study was therefore conducted with the primary objective of determining anti-HCV seroprevalence among chronic hemodialysis patients at the RFTC of Brazzaville and identifying factors associated with seropositivity.

2. Materials and Methods

2.1. Study Setting, Design, and Period

This was a cross-sectional, descriptive and analytical study with prospective data collection, conducted from March 1 to November 30, 2025 (nine months) at the RFTC of Brazzaville. The RFTC is the sole public hemodialysis center in Brazzaville, with 30 dialysis stations.

2.2. Ethical Considerations

The study was approved by the Ethics Committee of the Faculty of Health Sciences, Marien Ngouabi University (approval no. 25-082 UMNG/FSSA/CAB-DOY-VD) and authorized by the RFTC Director. It was conducted in accordance with the Declaration of Helsinki and good clinical practice guidelines. Written informed consent was obtained from each participant prior to any study procedure. All data were anonymized by numerical coding. No financial compensation was provided; biological investigations were offered free of charge. The authors declare no conflicts of interest.

2.3. Study Population and Sampling

All chronic hemodialysis patients receiving care at the RFTC during the study period were eligible. Inclusion criteria were: I) age ≥ 18 years; II) chronic hemodialysis for at least three months; III) written informed consent. Exclusion criteria were: hemodialysis for acute kidney injury and refusal to participate.

The minimum sample size was calculated using the Schwartz formula: $n = Z^2 \cdot p \cdot (1 - p)/d^2$, with $Z = 1.96$ (5% significance level), an estimated prevalence $p = 23\%$ (pooled African prevalence, Adane and Getawa [4]), and a precision $d = 7.5\%$. This formula yielded a minimum of 121 patients, increased to 160 after ap-

plying a finite population correction factor and a 30% allowance for potential incomplete data. The final included sample of 125 patients falls slightly below this target, which constitutes a study limitation (see Section 4.5).

2.4. Data Collection

For each enrolled patient, sociodemographic data (sex, age, nationality, educational level, marital status, religion, residence), clinical data (comorbidities, lifestyle, history of blood transfusion, tattooing, piercing), and therapeutic data (hemodialysis duration, type of vascular access, session modalities) were collected using a standardized questionnaire administered during an individual interview. Glomerular filtration rate (GFR) and CKD stage were recorded.

2.5. Biological Methods

2.5.1. Rapid Diagnostic Test (RDT)

A qualitative immunochromatographic RDT was performed at the bedside to detect anti-HCV antibodies (SD Bioline HCV kit, Standard Diagnostics Inc., Republic of Korea; reference: 06FK60; specimen: 10 µL serum or venous whole blood collected in a dry tube, placed in the sample well with 3 drops of buffer; visual reading at 15 minutes). A positive result required the appearance of a colored band in both the control (C) and test (T) zones. Internal positive and negative controls provided with the kit were systematically verified before each test series. Each reagent lot was subject to documented compliance verification by the responsible biologist.

2.5.2. ELISA Confirmation

All RDT-positive samples were systematically confirmed by sandwich ELISA (Sirio S analyzer, Radim S.p.A., Italy; anti-HCV antibody ELISA kit, 3A Laboratory, Brazzaville; specimen: 5 mL venous blood in a dry tube). Samples were transported in an isothermal bag (2˚C - 8˚C) and stored at −80˚C until analysis. After 30 minutes of coagulation at room temperature, tubes were centrifuged at 2500 rpm for 5 - 10 minutes. Optical density (OD) was measured at 450 nm; positivity threshold = mean negative control OD + 0.15. A sample was considered positive if OD ≥ positivity threshold. Calibrated positive and negative controls (kit-provided) were included in each ELISA plate to validate each run.

2.6. Statistical Analysis

Data were entered and cleaned using Microsoft Excel 2021. Statistical analysis was performed with SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Normality of distributions was assessed using the Shapiro-Wilk test. Quantitative variables were expressed as mean ± standard deviation (SD). Qualitative variables were expressed as frequency and percentage. Between-group comparisons used Pearson's chi-squared test (or Fisher's exact test when expected cell frequency < 5). Crude odds ratios (ORs) with 95% confidence intervals (95% CI) were calculated in univariate analysis. The significance threshold was set at 5%. Given the small number of positive cases (n = 18), no multivariate analysis was performed.

3. Results

3.1. Participant Flow

Of 151 patients registered at the RFTC during the study period, 125 were included in the final analysis. Twenty-six patients were excluded: 6 refused participation at the time of interview, and 20 had incomplete data (questionnaire not completed or blood sample not obtained during the scheduled dialysis session, due to logistical constraints or temporary patient unavailability). These exclusions reflect inherent constraints of data collection in a clinical setting and may introduce moderate selection bias: the most severely ill patients or those with the least access to care may be underrepresented.

3.2. Sociodemographic Characteristics

The male-to-female sex ratio was 3.46 (77.6% male). Mean age was 50.7 ± 12.7 years (range: 23 - 78; median: 52 years). The predominant age group was 50 - 59 years (30.4%). Almost all patients (99.2%) were Congolese nationals and Christian (99.2%). Secondary education was the most frequent (76.8%). Most patients were single (52.0%) or in common-law unions (28.8%) (Table 1).

Table 1. Sociodemographic characteristics of the study population (n = 125).

Characteristic	n	%	Remarks
Sex			Sex ratio M/F = 3.46
Male	97	77.6	
Female	28	22.4	
Age group (years)			Mean ± SD: 50.7 ± 12.7 years
18 - 29	9	7.2	
30 - 39	17	13.6	
40 - 49	26	20.8	
50 - 59	38	30.4	
60 - 69	29	23.2	
>70	6	4.8	
Educational level			
Primary	4	3.2	
Secondary	96	76.8	
University	24	19.2	
Not schooled	1	0.8	
Marital status			
Single	65	52.0	
Common-law union	36	28.8	
Married	18	14.4	
Widowed	6	4.8	

3.3. Clinical and Therapeutic Characteristics

Hypertension was present in 98.4% of patients (n = 123), diabetes in 19.2% (n = 24), cardiac disease in 13.6% (n = 17), stroke in 10.4% (n = 13), and HIV co-infection in 2.4% (n = 3). Alcohol consumption was reported by 44.8% and tobacco use by 14.4%.

Blood transfusion was the most frequently reported dialysis-related risk factor (97/125 patients, 77.6%), followed by piercing (12.0%) and tattooing (8.8%). All patients had end-stage CKD (stage 5). The majority (68.8%) had been on hemodialysis for less than one year. Regarding vascular access, 56 patients (44.8%) used a permanent catheter (PC), 44 (35.2%) an arteriovenous fistula (AVF), and 25 (20.0%) a temporary catheter (TC). All 125 patients received three sessions per week of four hours each (Table 2).

Table 2. Clinical and therapeutic characteristics of the study population (n = 125).

Variable	n	%
Comorbidities		
Hypertension	123	98.4
Diabetes	24	19.2
Cardiac disease	17	13.6
Stroke	13	10.4
HIV	3	2.4
Dialysis-related risk factors		
Blood transfusion	97	77.6
Piercing	15	12.0
Tattooing	11	8.8
Hemodialysis duration		
<1 year	86	68.8
1 - 3 years	21	16.8
>3 years	18	14.4
Vascular access		
Arteriovenous fistula (AVF)	44	35.2
Permanent catheter (PC)	56	44.8
Temporary catheter (TC)	25	20.0

3.4. Anti-HCV Seroprevalence

Eighteen patients (14.4%) were anti-HCV seropositive, with perfect concordance between the RDT and confirmatory ELISA (concordance rate: 100%). One hundred and seven patients (85.6%) were seronegative. HCV RNA was not measured in this study; therefore, anti-HCV seropositivity reflects prior or ongoing exposure to HCV without allowing distinction between active infection and spontaneously resolved past infection.

3.5. Profile of HCV-Seropositive Patients

HCV-seropositive patients (n = 18) had a mean age of 51.2 ± 13.9 years (range: 28 - 78). The majority were male (66.7%), had secondary education (61.1%), and were single (50.0%). All seropositive patients were hypertensive (100%) and 83.3% (n = 15) had a history of blood transfusion. Alcohol consumption was reported by 44.4%. Most (72.2%) had been on hemodialysis for less than one year and used either a permanent catheter (38.9%, n = 7) or a temporary catheter (33.3%, n = 6); only 27.8% (n = 5) had an AVF (Table 3).

Table 3. Profile of HCV-seropositive patients (n = 18).

Characteristic	n (%)	Comment
Male sex	12 (66.7)	Sex ratio M/F = 2:1
Age ≥ 40 years	15 (83.3)	Mean: 51.2 ± 13.9 years
Secondary education	11 (61.1)	
Single	9 (50.0)	
Hypertension	18 (100)	Universal in HCV+ group
History of blood transfusion	15 (83.3)	Main risk factor identified
Alcohol consumption	8 (44.4)	
Hemodialysis < 1 year	13 (72.2)	
Permanent catheter	7 (38.9)	
Temporary catheter	6 (33.3)	
Arteriovenous fistula	5 (27.8)	

3.6. Univariate Analysis: Factors Associated with Anti-HCV Seropositivity

Univariate analysis identified no statistically significant association between anti-HCV seropositivity and any of the studied variables. All odds ratios had wide confidence intervals, reflecting the very limited statistical power due to the small number of positive cases (n = 18). These results should be interpreted as strictly preliminary and do not allow conclusions about the presence or absence of individual risk factor associations. Key results are summarized in Table 4.

Table 4. Univariate analysis: factors associated with anti-HCV seropositivity (n = 125).

Variable	HCV+ n/total (%)	HCV− n/total (%)	Crude OR [95% CI]	p-value
Sex				
Female (Ref.)	6/28 (21.4)	22/28 (78.6)	Ref.	—
Male	12/97 (12.4)	85/97 (87.6)	0.52 [0.17 - 1.53]	0.234
Blood transfusion				
No (Ref.)	3/28 (10.7)	25/28 (89.3)	Ref.	—
Yes	15/97 (15.5)	82/97 (84.5)	1.52 [0.41 - 5.66]	0.761

Continued

Vascular access (Ref.: TC)				
TC (Ref.)	6/25 (24.0)	19/25 (76.0)	Ref.	—
Permanent catheter (PC)	7/56 (12.5)	49/56 (87.5)	0.45 [0.13 - 1.52]	0.206
Arteriovenous fistula (AVF)	5/44 (11.4)	39/44 (88.6)	0.41 [0.11 - 1.50]	0.188
Hemodialysis duration (Ref.: 1 - 3 years)				
1 - 3 years (Ref.)	4/21 (19.0)	17/21 (81.0)	Ref.	—
<1 year	13/86 (15.1)	73/86 (84.9)	0.76 [0.22 - 2.61]	0.740
>3 years	1/18 (5.6)	17/18 (94.4)	0.25 [0.03 - 2.47]	0.349

TC: temporary catheter; PC: permanent catheter; AVF: arteriovenous fistula; OR: crude odds ratio; 95% CI: 95% confidence interval. Calculated by Fisher's exact test.

4. Discussion

4.1. Anti-HCV Seroprevalence and African Context

The anti-HCV seroprevalence of 14.4% places the Republic of Congo at an intermediate level on the African hemodialysis spectrum. This value is substantially lower than the pooled African prevalence estimated by Adane and Getawa at 23.04% (95% CI: 18.51 - 27.57) [4], and far below rates reported in Morocco (60% - 76%) [7] [19] and Libya (31.1%) [8]. It exceeds figures from Guinea (4.6%) [9] and Cameroon (11.8%) [11], and is consistent with estimates from Nigeria (15%) [10].

Several dialysis-specific factors may explain this intermediate level. The short mean hemodialysis duration (68.8% of patients dialyzed for less than one year) mechanically limits cumulative nosocomial transmission risk, which is known to increase with dialysis vintage [4] [18]. Recent improvements in hemovigilance at the National Blood Transfusion Center and the implementation of structured procedures at the RFTC may also have contributed to limiting iatrogenic exposure. Conversely, the high proportion of central venous catheters (64.8% combined PC + TC) constitutes a potential nosocomial risk factor requiring close monitoring, as catheters are recognized as the primary vector of HCV nosocomial transmission in resource-limited dialysis settings [17] [18].

4.2. Profile of Seropositive Patients and Dialysis-Related Risk Factors

The profile of HCV seropositive patients 72.2% catheter-dependent, 83.3% with a blood transfusion history is consistent with the African literature underscoring the predominant role of catheter-based vascular access and polytransfusion in nosocomial HCV transmission in dialysis [4] [11] [17]. The finding that 72.2% of seropositive patients had been on hemodialysis for less than one year suggests that nosocomial contamination can occur early after dialysis initiation, within the first weeks, in line with the observation by Adane and Getawa of an acquisition odds ratio of 1.44 per additional year on dialysis [4].

The higher proportion of AVF among seronegative patients (37.4% vs 27.8% among seropositive patients), although not reaching statistical significance due to small numbers, is a trend consistent with recommendations for early AVF creation as a protective factor against nosocomial HCV transmission [18]. Promotion of AVF creation remains a priority prevention measure in this context.

4.3. Univariate Analysis and Preliminary Interpretation

Univariate analysis identified no statistically significant risk factor for anti-HCV seropositivity. These results must be explicitly interpreted as preliminary and must not be taken as evidence of the absence of associations. The small number of positive cases (n = 18) provides very insufficient statistical power to detect associations of moderate magnitude, as evidenced by the wide confidence intervals obtained. Nosocomial transmission is largely determined by collective factors (aseptic practices, shared equipment, disinfection protocols) that are difficult to capture through individual questionnaires. Uncollected variables including prior surgical procedures, invasive dental care, and ritual scarification may also play a role. Multicenter studies with larger samples and longitudinal follow-up are needed to identify individual risk factors for HCV seropositivity in this context.

4.4. RDT-ELISA Concordance and Diagnostic Implications

The perfect concordance (100%) between the RDT and confirmatory ELISA demonstrates the reliability of the immunochromatographic RDT used for HCV screening in this population. This result is consistent with manufacturer data and published evaluations of third-generation anti-HCV RDTs [3] [19], and supports the use of RDT as a first-line screening tool in African dialysis units where ELISA is not always available in real time. It should be noted, however, that neither the RDT nor the ELISA can distinguish active from resolved past infection: HCV RNA testing by PCR would have been required to assess the prevalence of active infection, which constitutes an important limitation of this study.

4.5. Strengths and Limitations

Strengths of this study include prospective data collection; perfect RDT-ELISA concordance confirming diagnostic reliability; and the generation of the first published HCV data in the Congolese hemodialysis setting.

Limitations include: I) single-center design restricting generalizability; II) final sample size (n = 125) below the calculated minimum (n = 160), reducing statistical power and the interpretability of risk factor analysis, whose results must be regarded as purely preliminary; III) absence of HCV RNA testing and genotyping due to financial constraints, preventing distinction between active and resolved infection; IV) cross-sectional design precluding causal inference; V) potential selection bias related to 20 exclusions for incomplete data.

5. Conclusion

This study documents an anti-HCV seroprevalence of 14.4% among chronic he-

modialysis patients at the RFTC of Brazzaville, Republic of Congo, providing the first published estimate for this population in the country. The clinical and epidemiological profile of seropositive patients highlights the central role of blood transfusion history and catheter dependence as markers of nosocomial risk. The risk factor analysis, preliminary and limited by an insufficient number of positive cases, does not identify any statistically significant individual risk factor.

Author Contributions

Conceptualization, MIMIESSE MONAMOU Jile Florient and LOKO NTARI Gerdy Marie-Strecy; Bovane Molami Jospeh, Motoula Mac Dorché Peres, Ibobi Mauria;

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Conflicts of Interest

The authors declare no conflicts of interest.

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