Hepatitis B, Hepatitis C, and Human Immune deficiency Virus Seroconversion Positivity Rates and Their Potential Risk Factors Among Patients on Maintenance Hemodialysis in Cameroon

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Introduction. Maintenance hemodialysis is a high-risk environment for transmission of blood-borne viruses. We aimed to assess the seroconversion rates of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immune deficiency virus (HIV) infections in patients on maintenance hemodialysis in a tertiary care hospital in Cameroon.

Materials and Methods. Patients with serology records at initiation of hemodialysis, and a minimum duration on hemodialysis of 4 months were included. Baseline demographic and clinical data were recorded. Patients were tested with a third and fourth generation immune-enzymatic assay for hepatitis B surface antigen and anti-HCV antibodies, respectively. For HIV, a rapid Ag/Ab combo test and an ImmunoComb II HIV (for confirmation) were used.

Results. Ninety-seven patients, 66% men, mean age of 51 ± 14 years and mean duration on hemodialysis of 32.8 ± 27.5 months, were included. Seroprevalence at dialysis initiation was 6.2%, 20.6%, and 9.3%, respectively, for HBV, HCV, and HIV. Ninety patients (92.8%) received blood transfusions while on hemodialysis. Seroconversion rates were 1.1% for hepatitis B surface antigen, 11.8%, for anti-HCV antibodies, and 0.0% for HIV. Longer duration on dialysis was associated with HCV seroconversion (62.7 months versus 29.2 months, $P < .001$).

Conclusions. Seroconversion rate in hemodialysis was high for HCV, low for HBV, and nil for HIV. Longer duration on dialysis was associated with HCV seroconversion. Our study suggests an urgent need to lay emphasis on universal precaution measures in order to reduce the risk of hepatitis seroconversion in the unit.

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INTRODUCTION

Infections by hepatitis B virus (HBV), hepatitis C virus (HCV), and human immune deficiency virus (HIV) are global health problems in the general population as well as in patients with end-stage renal disease (ESRD). The use of hemodialysis as renal replacement option in ESRD has provided better life expectancy in those patients, but maintenance hemodialysis is a high-risk environment for blood-borne viruses,[1,2]

especially HCV and HBV infections.[3,4] The rate of serum HBV surface antigen (HBsAg) seropositivity in hemodialysis in high-income countries is lower (≤ 10%) than that found in developing countries, which is as high as 20%.[2,5,6] The prevalence of HCV antibodies in dialysis ranges from 1.9% to 80%, with low rates in Western Europe and high rates in Eastern Europe and sub-Saharan Africa.[7,8,9]

Infection control measures, protocols for handling body fluids, isolation policies, and the use of erythropoietin has been developed to reduce the risk of transmission of blood-borne viruses in the ESRD population.[4,10] Despite these prevention methods, HCV and HBV still persists in hemodialysis units,[11] and many patients acquire the infection while on dialysis.[12,13,14] Reported seroconversion positivity rates vary from zero to 42% for HCV and zero to1.8% for HBV.[7,8,15,17]

Studies have identified risk factors associated with HCV and HBV infections in hemodialysis which are highly prevalent in sub-Saharan Africa,[7,10,13-15,17-21 5,16 15,18,22] where blood transfusion remains the main therapy for renal anemia. Also, the scarcity of hemodialysis facilities, the high patient load and the shortage of healthcare personnel make it difficult to adhere to universal infection control measures.[22,23] Despite the above, data on seroconversion of blood-borne viral infections are scanty.

Infections by HBV, HCV, and HIV are endemic in Cameroon, with prevalence rates in the general population of 13.8% for HCV,[6,7] 8% to 12% for HBV,[24-26] and 5.3% for HIV,[27] with significant interregional variations. Access to maintenance dialysis has improved in recent years through government subsidies.[28]A single-centre study in Cameroon on 40 patients showed a seroconversion rate for HCV of 25 % with blood transfusion and longer duration on dialysis being the main risk factors.[18] No data exist for the incidence of HBV and HIV in our setting. This cross-sectional study aimed to assess the seroconversion rates for HBsAg and anti-HCV and HIV antibodies among patients on maintenance hemodialysis in one of the major dialysis centers in Cameroon, and also to identify potential associated factors.

MATERIALS AND METHODS

Study Design and Setting

This was a cross-sectional study carried out from 1st of June to 30th of September 2012 at the hemodialysis unit of the Douala General Hospital, a tertiary public hospital and one of the main reference hospitals in the country. This center is the largest in Cameroon and receives the majority of ESRD patients in the littoral region, which has a population of about 3 million inhabitants. In the hospital's blood bank, blood donors are routinely screened for HIV, HBV, HCV, and HIV since 1990, 1993, and 2000 respectively, but blood may come from other blood banks in the city.

At the time of the study, the center was equipped with 17 Fresenius 4008S hemodialysis generators (Fresenius Medical Care, Hamburg, Germany), synthetic polysulfone dialysis membrane, and bicarbonate dialysate. The center had 1 nephrologist, 2 general practitioners, and 12 nursing staff. The patient-to-nurse ratio was 4:1. Five nurses were on their first job and had worked in the center for less than 2 years. Only 4 of the nurses had received formal training in hemodialysis for at least 3 months.

The center opens from Monday to Saturday, runs 3 dialysis shifts a day and offers to registered patients two 4-hour dialysis sessions per week. It also serves for acute dialysis. Nurses work in teams and shifts following a monthly roster. Chemical disinfection of hemodialysis generators is carried out between sessions in accordance with the manufacturer's protocol. No dialysis membrane is reused and no isolation policy for infected patients are practiced in the unit. Heparin in multidose vials is the main anticoagulant, and recombinant erythropoietin in prefilled syringes is available for patients who can afford it.

Participants

During the study period, all consenting patients with a baseline anti-HVC, HBsAg, and anti-HIV serology at initiation of dialysis and with a minimum duration on hemodialysis of 4 months were included. Data were collected by a final-year medical student using a questionnaire. Baseline demographic characteristics such as age and sex were recorded. Clinical data included time spent on dialysis, etiology of ESRD, number of blood transfusions received, and history of surgery, scarification, or tattoos. Ethics approval was obtained from the Douala University Ethics Review Board, and administrative authorization from the Douala General Hospital.

Viral Serology Testing

Five milliliter of venous blood was drawn from each patient. Analyses were done in the hospital laboratory. Third and fourth generation immune-enzymatic assay were respectively used to assess HBsAg and anti-HCV antibodies (enzyme-linked immunosorbent assay kit, Biorex Diagnostics, Muckamore, Antrim, UK). For HIV, a rapid Ag/Ab Combo test was used to detect antibodies; for positive patients, an enzyme-linked immunosorbent assay kit was used for confirmation and differentiation (ImmunoComb II HIV 1 & 2 BiSpot, Ireland).

Statistical Analysis

Data were analysed using Stata (version 11.2, StataCorp LP, College Station, TX, USA). Continuous variables were expressed as mean ± standard deviation unless stated otherwise and categorical variables as proportions. The Fisher exact test was used to compare categorical variables, and the Student *t* test for quantitative variables. A *P* value less than .05 was considered significant.

RESULTS

Characteristics of Participants

Of the 97 patients included, 64 (66%) were men. Dialysis duration ranged from 5 to 127 months with a mean of 32.8 ± 27.5 months. The main presumed etiologies of ESRD were hypertension (25.8%), chronic glomerulonephritis (20.6%), and diabetes mellitus (17.5%) (Table 1). Ninety patients (92.8%) had received blood transfusions while on dialysis, and transfused blood originated mainly from Douala General Hospital blood bank, meanwhile 6.2% used erythropoietin (Table 1). There was a low but significant positive correlation between the duration on dialysis and the number of transfused blood units (r = 0.30; *P* = .003).

Table 1. Demographic and Clinical Characteristics of the Study Population

Characteristic	Value
Sex	
Male	64 (66.0)
Female	33 (34.0)
Age, y	
Mean	51 ± 14
Range	13 to 85
Cause of kidney failure	
Hypertension	25 (25.8)
Chronic glomerulonephritis	20 (20.6)
Diabetes mellitus	17 (17.5)
Unknown	15 (15.5)
Human immunodeficiency virus	8 (8.2)
Others*	12 (12.4)
History of blood replacement therapy	
None	1 (1.0)
Transfusion	53 (54.6)
Erythropoietin	6 (6.2)
Transfusion and erythropoietin	37 (38.2)
Number of transfusion units in dialysis	
≤ 5	31 (32.0)
6 to 10	21 (21.6)
11 to 15	18 (18.6)
16 to 20	8 (8.2)
> 20	19 (19.6)

*Others included polycystic kidney disease, obstructive uropathy, and chronic interstitial nephritis.

Seroprevalence and Seroconversion

Seroprevalence at initiation of dialysis was 20.6% (20 of 97 patients) for HCV, 6.2% (6 of 97 patients) for HBV, and 9.3% (9 of 97 patients) for HIV. Concurrent infection rate was 2.1% for HBV and HCV (2 patients) and 2.1% for HCV and HIV (2 patients). Of the 76 and 91 seronegative patients, respectively for anti-HCV antibodies and HBsAg at baseline, 9 (11.8%) and 1 (1.1%) became seropositive for HCV and HBV, whereas no seroconversion was found for HIV. Duration on dialysis was significantly longer in patients with HCV seroconversion (*P* < .001). Patients who seroconverted for HCV were also older, but the difference did not attain statistical significance (Table 2). The number of blood units received did not influence HCV and HBV seroconversion status (Table 2).

DISCUSSION

In this study carried out on 97 patients with a mean duration in dialysis of 32.8 months, and a blood transfusion rate in dialysis of 92.8%, we have shown that the seroprevalence before initiation of dialysis was 6.2% for HBV, 20.6% for HCV, and 9.3% for HIV. Seroconversion rates were 1.1% for HBV, 11.8% for HCV, and nil for HIV. We also found that longer duration on dialysis was the main risks factor for HCV seroconversion.

In patients on maintenance hemodialysis, the risk of hepatitis is still a serious problem despite the availability of infection prevention and control measures, and vaccine for hepatitis B virus infection.

Table 2. Factors Potentially Associated With Hepatitis B and Hepatitis C Viruses Seropositivity

Factor	Hepatitis B Virus			Hepatitis C Virus		
	Positive	Negative	*P*	Positive	Negative	*P*
Age, y	50	51.5 ± 13.7	.91	56.4 ± 13.8	48.5 ± 13.0	.09
Sex						
Male	1 (1.7)	58 (98.3)		6 (11.8)	45 (88.2)	
Female	0	32 (100)	.46	3 (12)	22 (88.0)	.98
Duration on dialysis, mo	25	34.01 ± 28.1	.75	62.7 ± 45.3	29.2 ± 21.7	< .001
Number of blood units						
< 20	1 (1.4)	69 (98.6)		7 (11.5)	54 (88.5)	
> 20	0	19 (100)	.61	2 (13.3)	13 (86.7)	.84
History of sex partners						
≤ 1	0	21 (100)		1 (5.6)	17 (94.4)	
≥ 2	1 (1.4)	68 (98.6)	.58	8 (14.0)	49 (86.0)	.34
History of sexually transmitted infection						
Yes	1 (4.2)	23 (95.8)		1 (4.5)	21 (95.5)	
No	0	65 (100)	.10	8 (15.4)	44 (84.6)	.2
History of surgery						
Yes	0	25 (100)		3 (15.0)	17 (85.01)	
No	1 (1.5)	64 (98.2)	.54	6 (1 .9)	49 (89.1)	.63
Scarifications						
Yes	0	50 (100)		5 (11.1)	40 (88.9)	
No	1 (2.6)	38 (97.4)	.26	4 (13.8)	25 (86.2)	.73

In general, the prevalence and incidence of HBV and HCV infections in hemodialysis patients reflects the prevalence of these infections in the general population, the quality of healthcare services and the standards of infection control practices in hemodialysis unit. The seroconversion rate of 1.1% for HBV is in the range reported in studies in developed countries zero to 1.8%.[16] Other studies in Africa reported 0.6% in Soudan and 0.6% in Libya.[29,30]

The seroconversion rate for HCV in this study was 11.8 % for a mean duration in dialysis of 32.8 months. The reported seroconversion rate of HCV varies considerably between countries and also depends on the time spent by patients on hemodialysis. Our results are similar to those reported by Khodir and colleagues in 2011 on hemodialysis patients in Egypt.[31] Higher rates were found by El Amin and colleagues in Soudan (17.1%) in a population with a mean dialysis duration of 33.7 months and by Ashuntantang and coworkers (25%) in another unit in Cameroon in a sample of 40 hemodialysis patients with a median duration on dialysis of 17 months.[15,18] Trends are globally lower in western countries and vary between zero to 4%.[7,8,14,30] We found no case of HIV seroconversion in this study. Data on this are scanty in the literature.

In our study, patients who seroconverted for HCV had been receiving dialysis for a longer period compared to those who did not. This finding is similar to many recent studies that have suggested the length of time on hemodialysis as a risk factor for HCV seropositivity.[7,9,10,17,20] This positive association is consistent with nosocomial transmission related to dialysis since longer duration of hemodialysis represents a longer period of exposure and therefore a higher risk of acquiring an infection.

Hepatitis C and B infections in hemodialysis patients have been reduced considerably since the reduction in the number of blood transfusions, isolation of infected patients, and use of dedicated machines for seropositive patients.[32,33] Improved staffing in the dialysis units and use of oxidative disinfectants has been advocated to decrease the occurrence of HCV infection in hemodialysis patients.[34-36] In our study setting, many factors could have led to the nonrespect of infection control measures. The unit faced a problem of increasing number of patients at the expense of staff work load (higher number of daily dialysis shifts), the high patient-to-nurse ratio and a high number of inexperienced nurses, factors that has been shown in others studies to favour nosocomial infection in hemodialysis.[7,12,20,36] On the other hand, dialysis membrane reuse was not practiced

and all bloodlines as well as other consumables were disposed after single use. However, most nondisposable instruments used in hemodialysis environment were shared between seropositive and seronegative patients. The use of multidose vials of heparin was common and is likely to have been an important cause of nosocomial infection as shown by other authors.[12]

Historically, the number of blood transfusions received has been consistently reported in the literature to be associated with an increased prevalence of HCV-positive dialysis patients. However, several recent reports have not found blood transfusion as an independent risk factor of HCV spread among hemodialysis patients.[17,37,38] Blood transfusion, however, continues to be a major risk factor for hemodialysis-acquired HCV infection in regions with high prevalence in the general populations of countries such as Egypt and Pakistan.[31,39] In the present study, despite the high number of blood transfusion as the main treatment for anaemia, we did not find any association with the risk of infection. The lack of association between blood transfusions and new infections suggests that fewer infections were acquired through this route than was the case previously. This may be a result of a good blood security policy in the hospital. Also, the correlation between the number of blood transfusion and the time spent on dialysis was low in our study. However, another study on 40 patients in another unit in Cameroon reported and association between HCV positivity and blood transfusion.[21] This difference can be explained by the small sample size of that study rather than difference in facilities practice in the country.

We acknowledge the following limitations: data regarding antihepatitis B core antibodies (anti-HBcAb) or hepatitis B DNA were not available. It is therefore possible that we failed to detect cases of occult hepatitis B infection. Testing for HCV relied on a third generation assay to detect anti-HCV antibodies and confirmation or genotyping with polymerase chain reaction was not done. Also, we excluded patients who did not perform a viral serology at initiation of dialysis. Despite these limitations, our study has provided reference data on the incidence of the 3 blood-borne viruses in the largest hemodialysis unit of the country and the subregion of Central Africa. This may therefore help to elaborates strategies to prevent the transmission of viral infections in hemodialysis units.

CONCLUSIONS

Our results show that seroconversion rate is relatively high for HCV in this hemodialysis unit, low for HBV, and nil for HIV. Longer duration in dialysis is associated with HCV seroconversion. Taken together, these suggest that the nonadherence to universal precaution measures could be one of the main factors for hepatitis seroconversion positivity in this unit. Elaboration of, as well as emphasis on, strict adherence to infection control measures as well as avoiding the use of multiple doses of heparin vials alongside with improving the staff knowledge and the nurse-patient ratio will probably reduce the burden of blood-borne viral infections among hemodialysis patients.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Wreghitt TG. Blood-borne virus infections in dialysis units--a review. Rev Med Virol. 1999;9:101-9.
2. Fabrizi F, Lunghi G, Martin P. Hepatitis B virus infection in hemodialysis: recent discoveries. J Nephrol. 2002;15:463-8.
3. Santos MA, Souto FJ. Infection by the hepatitis C virus in chronic renal failure patients undergoing hemodialysis in Mato Grosso state, central Brazil: a cohort study. BMC Public Health. 2007;7:32.
4. Fabrizi F, Poordad FF, Martin P. Hepatitis C infection and the patient with end stage renal disease. Hepatology. 2002;36:3-10.
5. [No authors listed]. Centers for Disease Control and Prevention. Hepatitis C virus transmission at an outpatient hemodialysis unit--New York, 2001-2008. MMWR Morb Mortal Wkly Rep. 2009;58:189-94.
6. Fabrizi F, Martin P, Messa P. Hepatitis B and hepatitis C virus and chronic kidney disease. Acta Gastroenterol Belg. 2010;73:465-71.
7. Fissell RB, Bragg-Gresham JL, Woods JD, et al. Patterns of hepatitis C prevalence and seroconversion in hemodialysis units from three continents: the DOPPS. Kidney Int. 2004;65:2335-42.
8. Jadoul M, Poignet JL, Geddes C, et al. The changing epidemiology of hepatitis C virus (HCV) infection in haemodialysis: European multicentre study. Nephrol Dial Transplant. 2004;19:904-9.
9. Alavian SM. A shield against a monster: Hepatitis C in hemodialysis patients. World J Gastroenterol. 2009;15:641-6.
10. Hinrichsen H, Leimenstoll G, Stegen G, Schrader

H, Fölsch U, Schmidt W; the PHV Study Group. Prevalence and risk factors of hepatitis C virus infection in haemodialysis patients: a multicentre study in 2796 patients. Gut. 2002;51:429-33.

11. Oesterreicher C, Hammer J, Koch U, et al. HBV and HCV genome in peripheral blood mononuclear cells in patients undergoing chronic hemodialysis. Kidney Int. 1995;48: 1967-71.
12. Jadoul M. Epidemiology and mechanisms of transmission of the hepatitis C virus in haemodialysis. Nephrol Dial Transplant. 2000;15:39-41.
13. Ayed K, Gorgi Y, Ben Abdallah T, et al. Hepatitis C virus infection in hemodialysis patients from Tunisia: national survey by serologic and molecular methods. Transplant Proc. 2003;35:2573-5.
14. Izopet J, Sandres-Sauné K, Kamar N, et al. Incidence of HCV infection in French hemodialysis units: a prospective study. J Med Virol. 2005;77:70-6.
15. El-Amin H, Osman E, Mekki M, et al. Hepatitis C virus infection in hemodialysis patients in Sudan: two centers' report. Saudi J Kidney Dis Transpl. 2007;18:101-6.
16. Burdick RA, Bragg-Gresham JL, Woods JD, et al. Patterns of hepatitis B prevalence and seroconversion in hemodialysis units from three continents: the DOPPS. Kidney Int. 2003;63:2222-9.
17. Salama G, Rostaing L, Sandres K, Izopet J. Hepatitis C virus infection in French hemodialysis units: a multicenter study. J Med Virol. 2000;61:44-51.
18. Ashuntantang GE, Njouom R, Kengne AP, et al. Incidence and potential risk factors for seroconversion to Hepatitis C positivity in patients on Maintenance Hemodialysis in Sub-Saharan Africa: A single center study. Health Sci Dis. 2013;14:11-5.
19. Abdelaali B, Omar M, Taoufik D, Samir A, Saad M, Benyahia D. Hepatitis C Viral Prevalence and Seroconversion in Moroccan Hemodialysis Units: Eight Year Follow Up. J Med Diagn Meth. 2013;2:1000141.
20. Arenas MD, Sánchez-Payá J, Barril G, et al. A multicentric survey of the practice of hand hygiene in haemodialysis units: factors affecting compliance. Nephrol Dial Transplant. 2005;20:1164-71.
21. Fabrizi F, Messa P, Martin P. Hepatitis B virus infection and the dialysis patient. Semin Dial. 2008;21:440-6.
22. Patrice HM, Namme LH, Elvis T, l. Prevalence of Hepatitis B surface antigen and anti-HIV antibodies among patients on maintenance haemodialysis in Douala, Cameroon. Health Sci Dis. 2013;14.
23. Naicker S. Burden of end-stage renal disease in sub-Saharan Africa. Clin Nephrol. 2010;74:S13.
24. Mbanya D, Takam D, Ndumbe P. Serological findings amongst first-time blood donors in Yaoundé, Cameroon: is safe donation a reality or a myth? Transfus Med. 2003;13:267-73.
25. Ndumbe PM, Skalsky J. Hepatitis C virus infection in different populations in Cameroon. Scand J Infect Dis. 1993;25:689-92.
26. Madhava V, Burgess C, Drucker E. Epidemiology of chronic hepatitis C virus infection in sub-Saharan Africa. Lancet Infect Dis. 2002;2:293-302.
27. Joint United Nations Programme on HIV/AIDS (UNAIDS). Global report: UNAIDS report on the global AIDS epidemic 2010. Available from: http://www.unaids.org/ globalreport/ documents/20101123_GlobalReport_full_en.pdf. Accessed 21 March 2016.
28. Kaze FF, Kengne AP, Choukem SP, et al. Dialysis in Cameroon. Am J Kidney Dis. 2008;51:1072-4.
29. Elamin S, Salih LO, Mohammed SI, et al. Staff knowledge, adherence to infection control recommendations and seroconversion rates in hemodialysis centers in Khartoum. Arab J Nephrol Transplant. 2011;4:13-9.
30. Alashek WA, McIntyre CW, Taal MW. Hepatitis B and C infection in haemodialysis patients in Libya: prevalence, incidence and risk factors. BMC Infect Dis. 2012;12:265.
31. Khodir S, Alghateb M, Okasha K, Shalaby S-S. Prevalence of HCV Infections Among Hemodialysis Patients in Al Gharbiyah Governorate, Egypt. Arab J Nephrol Transplant. 2012;5:145-7.
32. Taal M, van Zyl-Smit R. Hepatitis C virus infection in chronic haemodialysis patients–relationship to blood transfusions and dialyser re-use. S Afr Med J. 2000;90:621-5.
33. Harmankaya Ö, Çetin B, Öbek A, Seber E. Low prevalence of hepatitis C virus infection in hemodialysis units: Effect of isolation? Ren Fail. 2002;24:639-44.
34. Espinosa M, Martín-Malo A, Ojeda R, et al. Marked reduction in the prevalence of hepatitis C virus infection in hemodialysis patients: causes and consequences. Am J Kidney Dis. 2004;43:685-9.
35. Huraib S, Al-Rashed R, Aldrees A, Aljefry M, Arif M, Al-Faleh F. High prevalence of and risk factors for hepatitis C in haemodialysis patients in Saudi Arabia: a need for new dialysis strategies. Nephrol Dial Transplant. 1995;10:470-4.
36. Saxena AK, Panhotra B. The impact of nurse understaffing on the transmission of hepatitis C virus in a hospital-based hemodialysis unit. Med Princ Pract. 2004;13:129-35.
37. Amiri ZM, Shakib AJ, Toorchi M. Seroprevalence of hepatitis C and risk factors in haemodialysis patients in Guilan, Islamic Republic of Iran. East Mediterr Health J. 2005;11:372-6.
38. Schneeberger PM, Keur I, van Loon AM, et al. The prevalence and incidence of hepatitis C virus infections among dialysis patients in the Netherlands: a nationwide prospective study. J Infect Dis. 2000;182:1291-9.
39. El-Ottol AEKY, Elmanama AA, Ayesh BM. Prevalence and risk factors of hepatitis B and C viruses among haemodialysis patients in Gaza strip, Palestine. Virol J. 2010;7:210.

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