Original Article

Occupational Hazards and HBV infection among health care workers in Public Teaching Hospitals in Khartoum State, Sudan: A multiple Discriminant Analysis

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Abstract

Background: Infection with HBV leads to a wide spectrum of liver injury. It ranges from acute self-limited infection and fulminant hepatitis to chronic hepatitis.

Objectives: To examine the prevalence of sero-epidemiologic markers of hepatitis B virus and to identify the risk factors of exposure to HBV among health care workers in Public Teaching Hospitals in Khartoum State, Sudan; in 2004.

Methods: The study was a cross sectional, facility-based study. It was conducted on stratified two-stage cluster sampling of 843 subjects. The study adopted multivariate statistical approach, using Multiple Discriminant Analysis (MDA) and some non-parametric tests.

Results: Infection rate measured by Anti-HB core, carrier rate measured by HBs Ag, and a profile of high infectivity rate measured by HBe Ag was found to be high; while immunity rate measured by Anti-HBs was found to be low. Needle stick injury, contaminated sharp instruments injury and exposure to blood are the most significant occupational variables related to infection rate of HBV. Contaminated sharp instruments injury and exposure to blood, are the most significant occupational variables related to carrier rate. Date of needle stick injury, incidence and date of contaminated sharp instruments injury, incidence and date of exposure to blood have significant relation to immunity rate against HBV infection.

Conclusion: The prevalence rate of HBV markers among HCWs in Public Teaching Hospitals in Khartoum State, Sudan, differs according to occupational hazard factors. With the exception of the HBeAg, seroprevalence of all HBV markers was found to be significantly correlated with occupational hazards ($P<0.05$).

Key words: HBV markers, HCWs.

Prevalence of previous infection with HBV was found to increase with increasing age and directly related to the number of years employed as an HCW. HCWs with frequent blood or needle stick exposures have a twofold higher prevalence of HBV infection than other HCWs. Physicians and dentists in specialties that involve frequent blood or needle stick exposure (e.g., obstetrician-gynecologists, pathologists, and oral surgeons) have a significantly elevated risk of HBV infection compared to specialists with less-frequent blood or needle stick exposure (e.g., pediatricians and psychiatrists)[1].

A combination of factors believed to be responsible for HBV transmission from HCWs to patients. One factor associated with increased risk of transmission is the HCW being HBe Ag positive, indicating a higher level of infectivity. Other factors believed to be responsible for HBV transmission from infected HCWs to patients include contamination of surgical wounds or traumatized tissue either from unintentional injury to the HCW during invasive procedures and/or a major break in standard infection control practices (e.g., not wearing gloves during an invasive procedure) [2].

Exposure to blood-borne pathogens possess a serious risk to HCWs. Transmission of at

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least 20 different pathogens by needle sticks and sharp instruments injuries have been reported. Despite improved methods of preventing exposures, occupational exposures will continue to occur[1].

HBV is present in the blood and body fluids of an infected individual. It is about 100 times more infectious than the virus that causes AIDS and is transmitted silently. Notably, most individuals infected with HBV (in contrast to HIV) will recover completely and develop immunity to the agent, but a small number may have some potential for transmission of infection and a few will have a higher risk of liver carcinoma[1, 3, 4]. HBV is present in high titers in blood and serous fluids, ranging from a few virions to 10^9 virions per ml[4, 5]. The virus is present in moderate titers in saliva, semen and vaginal secretions. Other body fluids such as urine and feaces contain very low levels of HBV unless contaminated with blood[5].

HBV is a major infectious occupational hazard of health care workers (HCWs). HCWs, who are considered as carriers, may present a threat to patients [6, 7].

Materials and Methods:

The study was a cross sectional, facility-based study. It was conducted at Public Teaching Hospitals in Khartoum State, Sudan; which composed of Federal and State Teaching Hospitals. The study population (HCWs) include those who have joined the work in hospitals for not less than 45 days in 17 Federal Teaching Hospitals (6753 HCWs) and 13 State Teaching Hospitals (1680 HCWs). Some of these hospitals had all specialties, others had more than one specialty, and some had only one specialty. Two stratification variables were used. These are: (a) type of hospital (Federal or State). (b) Degree of exposure (type of specialty).

A pre-tested, coded questionnaire was used to collect occupational hazards (occupational exposure to needle stick injury, sharp instruments injury, blood and body fluids of patients and handling jaundiced patients) data. Five mills of venous blood were collected using 10 ml vacotainer. Sera were separated and stored at – 20ºcentigrade, until testing. ELISA was used to screen for anti HB core total. Reactive and part of non-reactive specimens for anti HB core were tested for HBs Ag. Reactive and part of non-reactive specimens for HBsAg were tested for HBeAg. Vaccinated HCWs and part of the reactive specimens for anti-HB core, but non-reactive for HBsAg were tested for Anti-HBsAg.

Data were processed using statistical package for social sciences (SPSS), version 15. Some non-parametric tests such as Z-test for single proportion, and Chi-Square test were used, in addition to Multivariate Discriminant Analysis (Using occupational hazards variables). The P-value of <0.05 was considered statistically significant for the results.

Results:

Data about occupational hazards and blood samples were collected from 843 HCWs; 628 (74.5%) from Federal Teaching Hospitals and 215 (25.5%) from Khartoum State Teaching Hospitals. The mostly represented age group was the age group 30-49 (58.4%) followed by less than 30 years (30.7%), and the least one was the age group of 50+ years (10.9%).The gender representation was 366 males (43.4%) and 477 females (56.6%). Regarding education, the result was found to be as follow: 269 (31.9%) for university education; 214 (25.4%) for high secondary education; 5 (0.6%) for Quranic (khalwa) school education. Concerning the original residency of HCWs in the study, it was found that: 288 (34.2%) from the Central Region; 235 (27.9%) from the Western Region, 212 (25.1%) from the Northern Region, 86 (10.20%) from the Southern Region and 22 (2.6%) from the Eastern Region. Regarding the marital status of HCWs in the study, 460 (54.6%) were married, 381 (45.2%) were not married and 2 (0.2%) refused to identify themselves.

Out of the 843 HCWs tested, 477 (57%) showed positive Anti-HBc marker. According to the Z-test for single proportion: the P-value was 0.000, which means that there was a significant difference between the prevalence

of 57% and the tested rate of 50% (i.e. 0.5). This concludes that HBV was highly prevalent among HCWs in Public Teaching Hospitals in Khartoum State. The above results were significant at 5% confidence level, since all the P-values were less than 5%.

To investigate the relation of occupational characteristics to rates of HBV, a discriminatory analysis was conducted for identifying discriminatory HBV prevailing characteristics. The result was shown in the following tables.

Infection Rate (measured by Anti-HBcore): In the ANOVA Table (1), the smaller the Wilks's lambda, the more important the variable to the discriminant function. It was significant for needle stick injury, injury with contaminated sharp instruments, and exposure to blood as occupational hazard.

Table(1): Tests of Equality of Group Means for Anti –HBc core.

Occupational hazard	Wilks' Lambda	F	DF1	DF2	SIG.
Needle stick injury	0.987	11.184	1	841	0.001
Date of needle stick injury	1	0.261	1	841	0.61
Contaminated sharps instruments injury	0.989	9.642	1	841	0.002
Date of contaminated sharp instruments injury	1	0.034	1	841	0.855
Exposure to blood	0.989	9.731	1	841	0.002
Date of exposure to blood	1	0.374	1	841	0.541
Exposure to amniotic fluid	0.999	0.931	1	841	0.335
Date of exposure to amniotic fluid	1	0.158	1	841	0.691
Handling patient with HBV	0.997	2.247	1	841	0.134
Date of handling patient with HBV	0.997	2.587	1	841	0.108

Carrier rate (as measured by HBsAg): The same procedures were used to investigate the carrier rate. However, as Table (2) shows, the Discriminant Function for carrier rate, over all, was not significant with Wilks' Lambda 0.854 and the P-value (sig. =0.217), so the analysis was terminated at this stage.

Profile of High Infectivity Rate (as measured by HBeAg): Discriminatory analysis for the profile of high infectivity rate (positive HBeAg). (Table3)

Table (2): Tests of Equality of Group Means for HBsAg.

HBsAg.	Wilks' Lambda	F	df1	df2	Sig.
Occupational hazard Characteristics					
Needle stick injury	0.996	1.937	1	486	0.165
Date of needle stick injury	1	0.21	1	486	0.647
Contaminated sharp instruments injury	1	0.088	1	486	0.767
Date of contaminated sharp instruments injury	0.995	2.591	1	486	0.108
Exposure to blood	1	0.071	1	486	0.79
Date of exposure to blood	0.992	3.798	1	486	0.052
Exposure to amniotic fluid	0.999	0.653	1	486	0.42
Date of exposure to amniotic fluid	0.993	3.475	1	486	0.063
Handling jaundiced patient	1	0.039	1	486	0.843
discriminant function overall significance	0.854				0.217

Table (3): Tests of Equality of Group Means for HBeAg.

HBeAg	Wilks' Lambda	F	df1	df2	Sig.
Occupational hazard Characteristics					
Needle stick injury	0.991	0.274	1	30	0.605
Date of needle stick injury	0.92	2.625	1	30	0.116
Contaminated sharps instruments injury	0.999	0.034	1	30	0.856
Date of contaminated instruments injury	0.952	1.507	1	30	0.229
Exposure to blood	0.982	0.553	1	30	0.463
Date of exposure to blood	0.871	4.44	1	30	0.044
Exposure to amniotic fluid	0.995	0.147	1	30	0.704
Date of exposure to amniotic fluid	0.993	0.208	1	30	0.651
Handling jaundiced patient	0.953	1.48	1	30	0.233

It was obvious that the only variable identified as significant for HBeAg was date of exposure to blood.

To study the effect of occupational hazards on the level of HBV markers; cross tabulation of the various occupational hazards, and episode-specific characteristics, with HBV markers was made and a Chi-Square test was used to investigate if there is any significant relationship between them as shown in Table (4).

Prevalence of infection of HBV (measured by Anti-HB core): Three variables had shown a significant result: namely needle stick injury, contaminated sharp instruments injury and exposure to blood. Among those who had needle stick injury 60.8% showed positive result compared to 34.2% for those who had never had a needle stick injury. For those who were subjected to contaminated sharp instruments injury, 45.1% showed positive result, while it was 49.5% for those who were never subjected to contaminated sharp instrument injury. Regarding exposure to blood, the positive result among those exposed to blood was found to be 62.1% and 32.9% among non-exposed ones.

Carrier rate of HBV (measured by HBs Ag): Being subjected to contaminated sharp instruments injury and exposure to blood had proven statistical significance with HBs Ag positivity. Those who were subjected to contaminated sharp instruments injury showed a positive rate of 29.6%. Concerning exposure to blood, those who were exposed showed greater positive rate of 44.4% compared to 40.7% for non-exposed.

Immunity rate (measured by Anti-HBs Ag): Five factors had shown significant result: date of needle stick injury, incidence and date of contaminated sharp instruments injury, incidence and date of exposure to blood. Among those subjected to needle stick injury for a period more than 45 days, the positive rate was 84.8% compared to 0.0% in less than 45 days, and 15.2% in non-exposed. Those who were subjected to contaminated sharp instruments injury got a positive rate of 73.9% relative to 23.9 for non-exposed and 2.2% for NAP. Those who were subjected to contaminated sharp instruments injury before 45 days showed a positive rate of 73.9% compared to NAP who got 26.1%. HCWs exposed to blood have a positive rate of 89.1%, compared to 8.7% for non-exposed and 2.2% for NAP.

Profile of High Infectivity rate (measured by HBe Ag): None of the occupational hazards and episode factors had shown significant results with HBe Ag.

Discussion: The result of the Z-test for single proportion showed that there is a significant difference between the actual prevalence and the expected rate. This concludes that HBV is very prevalent among HCWs in Public Teaching Hospitals in Khartoum State, Sudan. The obtained results were consistent with international study as recorded by WHO; B. Hamidi et al in Iran; Teo E.K., Lok A. S. in U.S.A. and College of Physicians and Surgeons of Alberta[1, 6, 8, 9].

Table (4): Occupational hazard and episode-specific Characteristics of HCWs and the HBV markers (all values in percentages)

	Anti-HBc			HBsAg			Anti-HBs			HBeAg		
	+	-	%	+	-	%	+	-	%	+	-	%
needle stick injury												
(NAP)	5.0	12.6	8.3*	14.8	4.6	5.1	2.2	1.3	1.6	0.0	13.8	12.5
No	34.2	28.1	31.6	29.6	34.7	34.4	13.0	31.2	24.4	0.0	34.5	31.3
Yes	60.8	59.3	60.1	55.6	60.7	60.5	84.8	67.5	74.0	100.0	51.7	56.3
date of needle stick injury								*				
(NAP)	39.2	40.7	39.9	44.4	39.3	39.5	15.2	32.5	26.0	0.0	48.3	43.8
Less than 45 days	1.5	1.9	1.7	0.0	1.5	1.4	0.0	2.6	1.6	0.0	0.0	0.0
More than 45 days	59.3	57.4	58.5	55.6	59.2	59.0	84.8	64.9	72.4	100.0	51.7	56.3
Contaminated sharp instruments injury								*				
(NAP)	5.5	12.6	8.5*	14.8	5.0	5.5*	2.2	2.6	2.4	0.0	13.8	12.5
No	49.5	42.9	46.6	55.6	49.2	49.6	23.9	53.2	42.3	33.3	55.2	53.1
Yes	45.1	44.5	44.8	29.6	45.8	44.9	73.9	44.2	55.3	66.7	31.0	34.4
Date of contaminated sharp instrument injury								*				
(NAP)	55.1	55.7	55.4	70.4	54.4	55.3	26.1	55.8	44.7	33.3	69.0	65.6
Less than 45 days	0.2	0.3	0.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
More than 45 days	44.7	44.0	44.4	29.6	45.3	44.5	73.9	44.2	55.3	66.7	31.0	34.4
Exposure to blood									*			
(NAP)	5.0	12.6	8.3*	14.8	4.6	5.1*	2.2	1.3	1.6	0.0	13.8	12.5
No	32.9	27.9	30.7	40.7	33.4	33.8	8.7	27.3	20.3	0.0	44.8	40.6
Yes	62.1	59.6	61.0	44.4	62.0	61.1	89.1	71.4	78.0	100.0	41.4	46.9
Date of exposure to blood									*			
(NAP)	37.9	40.2	38.9	55.6	38.0	38.9	10.9	28.6	22.0	0.0	58.6	53.1
Less than 45 days	1.7	1.4	1.5	3.7	1.5	1.6	2.2	5.2	4.1	0.0	3.4	3.1
More than 45 days	60.4	58.5	59.5	40.7	60.5	59.4	87.0	66.2	74.0	100.0	37.9	43.8
Exposure to amniotic fluid												
(NAP)	38.4	40.7	39.4	51.9	37.1	37.9	30.4	31.2	30.9	66.7	51.7	53.1
No	39.6	36.1	38.1	40.7	40.1	40.2	28.3	37.7	34.1	33.3	41.4	40.6
Yes	22.0	23.2	22.5	7.4	22.8	21.9	41.3	31.2	35.0	0.0	6.9	6.3
Date of exposure to amniotic fluid												
(NAP)	78.0	76.8	77.5	92.6	77.2	78.1	58.7	68.8	65.0	100.0	93.1	93.8
Less than 45 days	0.4	0.5	0.5	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0
More than 45 days	21.6	22.7	22.1	7.4	22.3	21.5	41.3	31.2	35.0	0.0	6.9	6.3
Handling jaundiced patient												
No	31.2	26.5	29.2	29.6	31.5	31.4	10.9	22.1	17.9	0.0	34.5	31.3
Yes	68.8	73.5	70.8	70.4	68.5	68.6	89.1	77.9	82.1	100.0	65.5	68.8
Date of Handling jaundiced patient												
(NAP)	31.2	26.5	29.2	29.6	31.5	31.4	10.0	22.1	17.9	0.0	34.5	31.3
Less than 45 days	4.2	3.6	3.9	3.7	4.1	4.1	4.3	6.5	5.7	0.0	3.4	3.1
More than 45 days	64.6	69.9	66.9	66.7	64.4	64.5	84.7	71.4	76.4	100	62.1	65.6

Infection rate: Regarding occupational hazards, three variables had shown significant results with Anti-HBc: namely needle stick injury, contaminated sharp instruments injury and exposure to blood. This coincides with other studies[5,6 ,9]. It was obvious that needle stick injury was the most important factor (in this study) for Anti-HBc prevalence among HCWs in Public Teaching Hospitals in Khartoum State, Sudan. There was a high positive result of Anti-HBc among those who had needle stick injury, who were subjected to accidental contaminated sharp instruments injury and those who were exposed to blood; compared to those who were not exposed to these conditions. This indicates that the main medical occupational hazards mentioned above serve as modes of transmission of HBV.

Prevalence of HBs Ag: In the investigation of occupational hazards, only two variables had shown significant results with HBV carrier rate namely: (a) contaminated sharp instruments injury and (b) exposure to blood. This agreed with other studies[6, 9]. Those who were subjected to contaminated sharp instruments injury showed a low positive rate of HBs Ag, compared to none exposed. This may be because the patient was not infected with HBV. Concerning exposure to blood, those who were exposed showed greater positive rate of HBs Ag. Here most probably, the source of blood was positive for HBs Ag and the precaution measures were inadequate.

Immunity rate: Regarding occupational hazards, five factors had shown significant results with (Anti-HBs): date of needle stick injury, incidence and date of contaminated sharp instruments injury, incidence and date of exposure to blood. This was consistent with the literature[6, 9]. A high positive rate of Anti-HBs was found among those who were subjected to needle stick injury for a period of more than 45 days, contaminated sharp instruments injury before 45 days and those who were exposed to blood; compared to other HCWs who were not exposed to these conditions. These indicated that most of these HCWs had post-infection immunity.

Profile of High Infectivity Rate: it was found that only one variable had a significant result with a profile of high infectivity rate. It was the date of exposure to blood. Blood is the main source of infection and the incubation period is very important. This agreed with other studies as reported elsewhere[6, 9].

Conclusion:

Needle stick injury, contaminated sharp instruments injury and exposure to blood were the most significant occupational variables related to infection rate of HBV among HCWs in Public Teaching Hospitals in Khartoum State, Sudan. For carrier rate (measured by HBsAg), age group 30-49, South and West States obtained the highest carrier rate. Contaminated sharp instruments injury and exposure to blood, were the most significant occupational variables related to carrier rate (measured by HBsAg).

Date of needle stick injury, incidence and date of contaminated sharp instruments injury, incidence and date of exposure to blood had significant relation to immunity rate against HBV infection as measured by Anti-HBs.

For persons in health-care fields, completion of vaccination was recommended during training in schools of medicine, dentistry, nursing, laboratory technology, and other allied health professions, before trainees have their first contact with patient's blood and body fluids. Establishment of an occupational health unit in each hospital and implementation of vaccination program against HBV all over the Sudan are highly recommended. Further studies are warranted for investigating the role of socioeconomic status as, a possible, confounding factor, in risk assessment of HBV among health care workers.

References

1. College of Physicians and Surgeons of Alberta (CPSA). Hepatitis B Virus Infection in Health Care Workers, CPSA Guideline, 1994.

2. Liaw YF, Tsai SL, Sheen IS, et al. Clinical and virological course of chronic hepatitis B virus infection with hepatitis C and D virus markers. Am J Gastroenterol 1998;93(3):354

4. Lavanchy D. Hepatitis B Virus Epidemiology, Disease Burden, Treatment, and Current and Emerging Prevention and Control Measures. Journal of Viral Hepat. 2004; 11(2):97-1073. The Massachusetts Department of public health, Facts about Hepatitis B Disease and Hepatitis B Vaccine. 2002.
5. Beltrami E.M, et al., Risk and Management of Blood-Borne Infections in Health Care Workers, Clinical Microbiology Review. 2000; 13(3): 385–407.
6. WHO, Hepatitis B Fact sheet, N°204, Revised August 2008
7. Gully P. Hepatitis B.CMAJ 1997;156: 1033-4.
8. Seyed Moayed Alavian, Vahid T, Alavian SM, Kabir A, Kafaee J, Yektaparast B. Hepatitis B prevalence and risk factors in blood donors in Ghazvin, IR.Iran. Journal of Hepatitis Monthly. 2005; 4(5):P. 117-122.
9. Rentería B.I, et al. Detection of Hepatitis B Virus in Seropositive and Seronegative patients with chronic liver disease using DNA amplification by PCR. Archives of Medical Research. Unidad de Higado, Hospital Universitario, Universidad Autónoma de Nuevo León (UANL), Monterrey, Nuevo León, Mexico , 2002, 33: 566-571.