

Hepatitis B immunization in healthcare workers

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Abstract

Background Healthcare workers (HCWs) are at high risk for hepatitis B virus (HBV) infection. The aim of the study was to evaluate HBV immunization status and anti-HBs titer among HCWs.

Methods AntiHBs titer was prospectively examined in all vaccinated of the 464 HCWs enrolled. A comparison was done between two groups who had received vaccination within or beyond 5 years (Group A >5 years, Group B <5 years) and also between those who received a booster dose, Group I (<1 year) and Group II (>1 year).

Results 49.6% HCWs were vaccinated, 46.1% were unvaccinated, and 4.3% were partially vaccinated. Among HCWs, doctors had the highest vaccination rate of 92.5%, followed by medical students (62.4%), nursing staff (41.6%), technical staff (24.2%), administrative staff (12.1%), nursing students (8.5%), and grade IV/laundry staff (0%). Of the vaccinated HCWs, 30% had anti-HBs titer <10 mIU/mL, 10.8% between 10-100 mIU/mL, and 59.2% >100 mIU/mL. Mean anti-HBs titer between groups A and B was 334.8 and 649.2 mIU/mL, respectively (P<0.05); mean anti-HBs titer between groups I and II was 1742.7 and 629.2 mIU, respectively (P<0.002).

Conclusion A significant proportion of HCWs is unvaccinated. A fair proportion of fully vaccinated HCWs can have low titers to protect them against HBV infection. Measuring anti-HBs titer, administering a booster dose, and offering general screening for HBs antigen should be made compulsory for HCWs.

Keywords Healthcare workers, hepatitis B virus, hepatitis C virus

Ann Gastroenterol 2015; 28 (2): 276-280

Introduction

Dr Sampurnanand Medical College is one of the popular medical colleges of Rajasthan. The college was established in the year 1965. The land area of the state covered by the medical college is about 60,980 km² with a population of approximately 1.3 million. There are about 2000 medical students, 500 doctors, 500 nursing students and 1000 other healthcare workers (HCWs) attached with the medical college.

Hepatitis B virus (HBV) is highly infectious and causes serious health problems worldwide. Approximately one third of the world population has been infected, and 400 million have become chronic carriers. HCWs are at high risk for HBV

infection because of particular exposure of mucus membranes and breached skin to blood [1-4]. HBV-infected HCWs also pose a potential risk for patients as there is documented risk of HBV transmission to patients from treating doctors or medical staff [5]. According to WHO, 5.9% of HCWs are each year exposed to blood-borne HBV infections corresponding to about 66,000 HBV infections in HCWs worldwide [6]. Approximately 70% of HCWs in hyper- or intermediate endemic countries have been reported to have needle-stick injuries, with an average of two needle pricks a year. However, only about 10-30% of needle-stick injuries are reported to the authorities [7-10]. Risk of HBV infection is also related to the HBe antigen (Ag) status of the source person. HCWs who sustained injuries from needles contaminated with blood containing HBV, the risk of developing clinical hepatitis is variable from 1-6% to 22-31% depending on HBeAg (positive or negative) of the source. HBV infections in HCWs without a history of exposure might have resulted from direct or indirect blood or body fluid exposures that have led to inoculation of HBV in the mucosal surfaces or cutaneous scratches [11,12]. Reports from India indicate that only 16-60% of HCWs have received complete HBV immunization. Paramedics have a higher risk of HBV/HCV transmission and receive HBV vaccination less often than doctors [13,14]. The practice of universal precautions, such as safe needle disposal, wearing

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Conflict of Interest: None

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Received 30 March 2014; accepted 15 September 2014

gloves during phlebotomy and using goggles is suboptimal among HCWs in developing countries [15,16]. In the present study we evaluated the HBV immunization status and anti-HBs titer among the HCWs of Dr Sampurnanand Medical College.

Materials and methods

To analyze the status of HBV immunization among HCWs a prospective study was conducted over a period of 6 months. The study was approved by the ethics committee of the medical college. A total of 500 HCWs were included in the study of a total of 4000. Thirteen subjects did not complete the questionnaire and 16 were lost to follow up, thereby leaving 471 HCWs. Seven HCWs were found to have HBsAg positive (1.5%) and were excluded. Finally 464 patients who were seronegative for HBsAg were eligible for the study. After written consent, HCWs received counseling and explanation on the objectives of the study by a qualified medical doctor. Detailed personal history was taken using a standard questionnaire and 5 mL of blood sample was collected. Inclusion criteria: 1) doctors; 2) nurses; 3) medical students; 4) technical staff; 5) nursing students; 6) administrative staff; and 7) laundry and grade IV staff (sweepers or cleaners). Exclusion criteria: 1) chronic liver disease; and 2) prolonged steroid therapy or immunosuppression.

HCWs were grouped into 7 categories as according to the nature of work they performed at the medical college. The categories included doctors from all disciplines (n=93), medical students (n=173), nursing staff (n=48), laboratory technicians (n=33), technical staff (n=33), nursing students (n=47), grade 4 staff (sweepers or cleaners), and laundry workers (n=37) (Table 1). The personal health information included demographic details of the HCWs regarding their

age, sex, and occupation, duration of employment, alcohol history, past history of blood donation or transfusion. Moreover, the status of HBV vaccination, exposure to blood and/or blood products, and the way of HBV transmission were also recorded. Use of universal precautions in daily practice was also taken into account. Patients were classified on the basis of HBV vaccination status. Vaccinated group was considered in subjects receiving 3 doses of HBV vaccination at 0, 1, and 6 months; whereas partially vaccinated group received either single or 2 doses at 0 and 1 month and unvaccinated group for those who had received no dose of HBV vaccination.

Assessment of HBV infection

HBsAg testing was done by enzyme-linked immunosorbent assay (ELISA) using a commercial kit (HBsAg ultra kit manufactured by BIOMERIEUX) according to the manufacturer's protocol. The positive reports with the ELISA test were confirmed with HBsAg UNIFORM II (manufactured by BIOMERIEUX).

Assessment of anti-HBs titer

Antibody titers were tested by Abbott Architect anti-HBs assay on the Architect i2000 system (Abbott, Chicago, IL). We also divided all vaccinated HCWs (n=166) into two groups on the basis of completion of their full schedule of vaccination. Group A: those who had completed vaccination more than 5 years ago, and Group B: those who had completed vaccination less than 5 years ago. Another comparison was done between the subjects who had received the booster vaccination less or more than 1 year ago.

Table 1 Baseline characteristics

S. no	Category (N=464)	N=464 (%)	Vaccinated (n=230)	Unvaccinated (n=214)	Partially vaccinated (n=20)	P value
1	Age (mean±SD)	30.2 ± 8.1	28.6 ± 8.1	30.3 ± 7.9	31.6 ± 8.4	0.89
2	Sex (M:F)	1.7:1				
	Male	294	153 (52)	126 (42.9)	15 (5.1)	0.048 [†]
	Female	170	77 (45.3)	88 (51.8)	5 (2.9)	
3	Healthcare workers					
	Medical students	173 (37.3)	108 (62.4)	51 (29.5)	14 (8.1)	
	Doctors	93 (20.4)	86 (92.4)	5 (5.4)	2 (2.2)	
	Nursing staff	48 (10.3)	20 (41.7)	27 (56.2)	1 (2.1)	
	Technical staff	33 (7.1)	8 (24.2)	24 (72.7)	1 (3.1)	
	Nursing students	47 (10.1)	4 (8.5)	41 (87.2)	2 (4.3)	
	Administrative staff	33 (7.1)	4 (12.1)	29 (87.9)	0 (0)	
	Laundry/Grade IV staff	37 (7.7)	0 (0)	37 (100)	0 (0)	
4	Booster dose	34 (7.3)				
	<1 years ago		12			
	>1 years ago		22			

[†]P value between vaccinated and unvaccinated. Chi square was used for the comparison of dichotomous variables and ANOVA one-way was used to calculate P value in comparisons of more than two continuous variables. Vaccinated: 3 doses of HBV vaccination (0, 1, 6 months); Partially vaccinated: a single or 2 doses (0, 1 month) of HBV vaccination; Unvaccinated: no dose of HBV vaccination

Statistical analysis

Parametric data are expressed as mean values \pm standard deviation (SD) and categorical variables as percentages. The chi-square test was used for the comparison of dichotomous variables and the Student's *t* test for continuous variables. ANOVA one-way was used to calculate P values for comparisons of more than two continuous variables. A P value <0.05 was considered as statistically significant. All data were analyzed by SAS 8.0 statistical package.

Results

Of the 464 HCWs included, 230 (49.6%) were vaccinated, 214 (46.1%) were unvaccinated, and 20 (4.3%) were partially vaccinated, i.e. they had not completed the full schedule of HBV vaccination. Most of the partially vaccinated subjects had missed their 3rd dose. Males were more often vaccinated than the females ($P=0.04$). Of the 294 (63.4%) males in the study, 153 (52%) were vaccinated, 126 (42.9%) were unvaccinated, and 15 (5.1%) were partially vaccinated, while of the 170 (36.6%) females, 77 (45.3%) were vaccinated, 88 (51.8%) were unvaccinated, and 5 (2.9%) were partially vaccinated. Among various groups of HCWs, the vaccination rate was the highest among doctors (92.5%) (Fig. 1). Vaccination status according to HCWs groups was as follows: doctors (92.5%), medical students (62.4%), nursing staff (41.6%), technical staff (24.2%), administrative staff (12.1%), nursing students (8.5%), and grade IV/laundry staff (0%) (Table 1).

Seven of 471 (1.5%) HCWs were found to have HBsAg positive. Of the 230 vaccinated HCWs 166 were subjected to anti-HBs titer estimation. Fifty (30%) had anti-HBs titer <10 mIU/mL, 18 (10.8%) between 10-100 mIU/mL, and 98 (59.2%) >100 mIU/mL (Table 2).

Out of the 250 patients who had received full or partial vaccination for HBV; 166 patients were randomly selected for assessment of anti HBs titer. Two groups (A and B) were created on the basis of time period since vaccination

Table 2 Anti HBs titer in the vaccinated patients in HCWs (seronegative to HBsAg)

Category	Vaccinated (N=166)	Time since vaccination		P value
		Group A (>5 years) (n=76)	Group B (<5 years) (n=90)	
Anti-HBs titer (mIU/mL)				
Mean \pm SD		334.8 \pm 515.1	649.2 \pm 706.3	0.001
Range		(0-2426)	(0-2635)	
<10	50 (30)	28 (36.8)	22 (24.4)	0.04
10-100	18 (10.8)	12 (15.8)	6 (6.7)	0.03
>100	98 (59.2)	36 (47.4)	62 (68.9)	0.003

Group A: vaccination >5 years ago, Group B: vaccination <5 years ago; P value was calculated by Student's *t* test; Chi square was used for the comparison of dichotomous variables

($>$ or <5 years). Mean values of anti-HBs titer in groups A (vaccination >5 years ago) and B (vaccination <5 years ago) were 334.8 mIU/mL and 649.2 mIU/mL, respectively. Anti-HBs titer was significantly lower in group A than B ($P<0.05$). The mean titer of anti-HBs in 'group B' who had received a booster dose was 1359.2 mIU/mL as compared to 419.6 mIU/mL in those who had not received a booster dose ($P<0.001$). Among the vaccinated HCWs, only 34 (14.7%) had received a booster dose irrespective of the time period since vaccination. Of them, 10 (29.5%) subjects received the booster dose less than 1 year ago, and the rest 24 (70.5%) received it more than 1 year ago. The mean anti-HBs was 1742.7 mIU/mL and 629.2 mIU respectively, which was statistically significant ($P<0.002$) (Table 3).

Discussion

HCWs are at a greater risk of various blood-borne infections, including HBV. Vaccination is effective in protecting 90-95% adults [17]. Unfortunately the practice of vaccination is not well-accepted. According to WHO estimates, HBV vaccination coverage among HCWs varies from 18% (Africa) to 77% (Australia and New Zealand) [6]. In the present study, of 464 HCWs 230 (49.6%) were fully and 20 (4.3%) partially vaccinated. A similar study done at New Delhi showed that 55.4% of HCWs were fully vaccinated against HBV [13]. A slightly lower incidence of fully vaccinated HCWs, 42.2%, was observed by Kumar *et al* [18]. In the present study, vaccination coverage among the doctors was 92.4%, 62.4% in medical students, 41.7% in nursing staff, 24.2% in laboratory technicians, and 12.1% in nursing students, while none of grade 4/laundry staff were vaccinated. The difference in pattern of such vaccination in various groups of HCWs probably lies in their level of education and knowledge regarding vaccination. Socioeconomic status may also be an additive factor.

In our study, surprisingly 30% ($n=50$) of the vaccinated HCWs mainly comprising doctors and medical students had anti-HBs titer <10 mIU/mL while rest 70% had anti-HBs titer >10 mIU/mL (*protective titer*). This showed that 30% of the vaccinated HCWs were still at risk of acquiring HBV infection. The anti-HBs titer was significantly higher in the patients who had received vaccination within the previous 5 years; also the titer was significantly higher among those who had received an additional booster dose. Thirty-four vaccinated HCWs had received a booster dose, and those who received the booster dose within the previous 1 year had a mean anti-HBs of 1742.7 mIU/mL as compared to 629.2 mIU/mL in those who had received booster dose more than a year ago ($P<0.002$). As expected a decline in the anti-HBs titer (post booster dose) over a period of one year was evident; importantly the anti HBs titer was significantly lower in patients who had received vaccination 5 years ago. But it is difficult to comment about the speed of decay of anti-HBs titer. Long-term studies in hyper-endemic areas indicate that immunological memory remains intact beyond 10 years after vaccination; thus initial vaccination offers protection against HBV infection even after

Table 3 Anti-HBs titers in different groups who received booster at different intervals

N=166	Group A (vaccination>5 years ago)		P value	Group B (vaccination<5 years ago)		P value	Booster dose vaccination (n=34)		P value
	No booster (n=64)	Booster (n=12)		No Booster (n=68)	Booster (n=22)		Group I (<1 year ago) (n=10)	Group II (>1 year ago) (n=24)	
Anti-HBs titer (mIU/mL) mean±SD	347.8±550.3	277.3±287.8	0.66	419.6±518.1	1359.2±709.8	0.0001	1742.7±802.5	629.1±552.7	<0.0001

Group A: vaccination >5 years ago, Group B: vaccination <5 years ago, Group I: booster dose <1 year ago and Group II: booster dose >1 year ago; P value was calculated by Student's t test

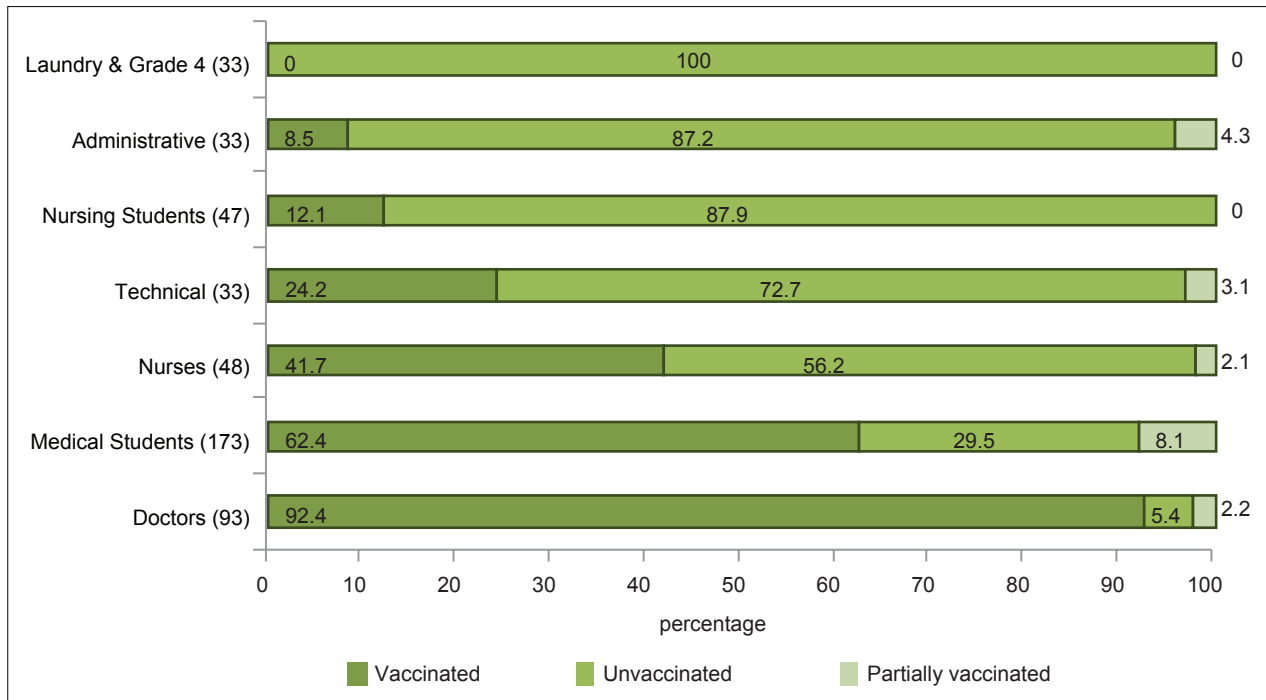


Figure 1 Hepatitis B vaccination status among healthcare workers

anti-HBs declines below detectable levels [19,20]. In fact, there is no evidence to show that healthy vaccinated individuals lose their immunity against HBV infection after anti-HBs titers decline to below 10 IU/mL.

The frequency of HBsAg positivity among HCWs in this study was 1.5%, lower than the 4.7% seen in population studies in India. Sixty percent of the study population comprised medical students and resident doctors, which might have contributed to low incidence of HBsAg positivity. Possibilities of non-response to vaccination might be multifactorial. The most probable factors leading to low or poor anti-HBs titer response are incorrect administration, improper storage (cold storage) or administration of vaccine out of the protocol. Sukriti *et al* stated that 20-50% of the vaccinees did not have protective anti-HBs levels (>10 IU/mL) after 5 and 10 years of vaccination, respectively [13]. The authors therefore recommended passive-active immunization for post-exposure prophylaxis after 5 years, with a booster dose after 10 years of initial HBV vaccination. Neither the European Consensus Group on Hepatitis B Immunity [21] nor the Steering Committee for

the Prevention and Control of Infectious Disease in Asia [22] recommend a booster vaccination for HCWs.

Our study shows almost 30% of the vaccinated HCWs, mainly treating doctors, were unaware that their anti-HBs titer has dropped down to less than 10 IU/mL. This fall in anti-HBs titer was mostly seen over a span of 5 years. The anti-HBs titer <10 mIU/ml was more commonly seen in Group A (vaccination > 5 years) as compared to Group B (vaccination <5 years) (P = 0.04, Table 2). Therefore there is a significant role of checking anti-HBs titer regularly at a span of 5 years post HBV vaccination in the HCWs. As HCWs are likely to contact with virally infected body fluids or blood, particularly those residing in countries of high and intermediate endemicity for HBV, they should receive vaccination at their initial entry to their respective training or professional practice. A booster dose should be recommended if anti-HBs titers are low.

In conclusion, a major population of HCWs is unvaccinated. There is a gradual decline in the anti-HBs titer over the period of time in the vaccinated persons, so partially vaccinated individuals as well as a significant percentage of the fully

Summary Box

What is already known:

- Healthcare workers (HCWs) are at risk for hepatitis B virus (HBV) infection
- Vaccination is less common among paramedics
- Anti-HBs titer declines over time

What the new findings are:

- Most of the paramedics, nursing and grade IV staff are unvaccinated
- 30% of the vaccinated HCWs have anti HBs-titers less than 10 mIU/mL
- Rate of anti-HBs decline is unpredictable, but should be checked every 5 years
- HCWs should also receive a booster dose when anti-HBs titer falls below 10 mIU/mL

vaccinated HCWs might have titers insufficient to protect them against HBV infection. The knowledge about vaccination, checking antibody titer regularly and screening for HBs antigen should be made compulsory for HCWs.

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