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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Protection of health workers employed in a tertiary health institution from hepatitis B virus infection

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SUMMARY

Introduction/Objective More than 300 million people around the world are infected with hepatitis B virus (HBV). It is transmitted through blood, blood derivatives, sexually, and vertically, and healthcare workers, due to the nature of their work, represent a vulnerable group.

The aim of this research is to determine the coverage of vaccination against HBV infection of health workers working in a tertiary health institution – the Clinical Centre of Vojvodina, the level of protection by determining anti-HBs antibodies, the exposure degree, the degree of examinee's compliance with implemented protection measures in the workplace, and the level of knowledge about post-exposure prophylaxis (PEP) measures.

Methods The research was conducted as a descriptive analytical cross-sectional study, in which a questionnaire on protection of health workers from blood-borne diseases (BBD) was used as an instrument for research, as well as blood sampling to determine HBs antibody titer. The sample covered 100 health care workers.

Results The research showed a large coverage of vaccination against HBV infection (97%). Aside from continuous seroprophylaxis, 7% of examinees did not have protective anti-HBs antibodies. Health workers' level of exposure to HBV infection incidence is 90%. Protection measures in the workplace are applied by 89% of examinees, whereas 86% are familiar with the PEP measures.

Conclusion The research showed a large coverage of health workers using specific HBV infection protection, insufficiently implemented protection, high exposure to HBV infection incidence, incomplete compliance with safety measures and insufficient knowledge of PEP measures.

Keywords: anti-HBs antibodies; health workers; hepatitis B; incident; safety at work

INTRODUCTION

Hepatitis B virus (HBV) infection represents a global public health problem, due to its high rate of prevalence and severe consequences upon the health of the affected [1, 2]. Data by the World Health Organization (WHO) indicate that a third of the world population is infected with the hepatitis B virus, and 10–30 million newly infected people are registered annually, whereas as much as one million people die as a consequence of the infection caused by the virus [3, 4].

Health care workers (HCWs) are under occupational risk from blood-borne diseases (BBD) [5, 6]. The main BBD prevention measure in health institutions is to avoid exposure (professional exposure), apply hepatitis B vaccines, and adequate post-exposure prophylaxis (PEP) [7, 8]. In the Republic of Serbia there is no precise data on the coverage and the degree of HCWs' specific protection from hepatitis B virus, the number, and the type of incidents in the workplace and PEP, even though there are certain legal provisions governing this issue (Rulebook on Immunization and Protection Measures Using Medicines, Law on Protection of Population Against Infectious Diseases, European Guide for Prevention of Blood-Borne Diseases Transmission, Statistical Yearbook of the Republic of Serbia) [1, 9–12].

Infections caused by HBV among HCWs can be prevented by vaccination [13]. However, vaccination efficacy is not absolute and it correlates with achieved immunological response, represented by the level of HBs antibodies. Post-vaccination immunity is established when the level of anti-HBs antibodies is > 10 mIU/ml [14]. There are several factors that influence the level of HBs antibodies: vaccine factors (dose, schedule, the location of vaccine administration, time after vaccination), and host factors (senior age (40+), male sex, obesity, smoking and chronic diseases) [12].

Beyond the level of HBs antibodies, other factors that impact the risk of infection in

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health workers are the type of needle used, i.e. the instrument that caused the injury, the characteristics and the severity of the injury, the type and amount of the potentially infected fluid, i.e. inoculum, the patient's viremia degree [12].

However, the only conclusive evidence that a post-vaccination immunity has been established is the anti-HBs antibodies' control, and yet, in our country, these levels are not monitored after health workers complete the HBV infection immunization procedure.

The aim of this research was to determine the coverage of vaccination against HBV infection, the level of protection against HBV infection by determining anti HBs antibodies, employee exposure, compliance with the work safety measures, and knowledge about the PEP measures.

METHODS

The research was conducted as a descriptive analytical cross-sectional study. The data were collected by surveying examinees with a questionnaire, which they filled out themselves, and by blood sampling in order to determine anti-HBs antibodies (in February and March of 2019).

The research included 100 health workers employed in a tertiary health institution in the Republic of Serbia – the Clinical Centre of Vojvodina in Novi Sad, in the organizational units in which employees very often come into contact with patients' biological material, i.e. where employees are more exposed due to the nature of services provided to patients (Infectious Diseases Clinic, Emergency Center, Centre for Laboratory Medicine, and Dialysis Unit).

Along with survey questionnaires, the examinees received a designated data sheet with the basic information about the research. The examinees were required to sign an informed consent.

The questionnaire on BBD protection of health workers was used as the research tool designed specifically for this purpose, based on the literature data and examiners' experience.

The questionnaire on BBD protection of health workers consisted of 40 questions divided into four parts. The first part related to general questions, regarding socio-demographic data and the workplace itself, and contained 10 questions. The second part of the questionnaire contained questions relating to safety measures in the workplace and contained 11 questions. The third part examined incident situations at the examinees' workplace and it contained 11 questions, while the final (fourth) part dealt with examinees' vaccination status and encompassed eight questions.

The examinees were tested after the survey, i.e. their blood was taken to determine anti-HBs antibodies at the Laboratory for Virus Examinations of the Centre for Laboratory Medicine, Clinical Centre of Vojvodina, on a MINI VIDAS (bioMerieux, Marcy-l'Étoile, France) apparatus using the enzyme-linked fluorescence assay method.

The study involved workers engaged in immediate care and treatment of patients in tertiary health protection, with at least one year of service and voluntary consent for participation in the research. The research was approved by the Ethics Council of the Clinical Centre of Vojvodina on January 29, 2019 in the Consent Decision No.00-52.

The IBM SPSS Statistics, Version 20.0 (IBM Corp., Armonk, NY, USA) program package was used for statistical data processing. Methods of descriptive and interferential statistics were used for data analysis. Numerical marks with normal placement were described using the arithmetic mean and standard deviation (SD).

The existence of correlation between variables was examined with the Spearman's rank correlation, and the strength of bonds was determined with guidelines provided by Cohen (small correlation r = 0.1–0.29; medium correlation r = 0.3–0.49; large correlation r = 0.5–1) [15].

RESULTS

The average age of the examinees was $\bar{x}$ = 43.13 years (SD = 10.22 years), the average height $\bar{x}$ = 168.17 cm (SD = 7.83 cm), the average body weight $\bar{x}$ = 70.59 kg (SD = 14.44 kg). The examinees had an average of $\bar{x}$ = 18.83 years of service (SD = 10.15 years).

Ninety examinees (90%) were female, and 10 (10%) were male.

The examinees were mostly medical nurses/technicians employed in internal medicine fields, who perform their tasks in wards, working in shifts (Table 1).

Table 1. Structure of the examinees in relation to their workplace

Branch of medicine	n	%
Surgery	13	13
Internal medicine	66	66
General medicine	21	21
Occupation		
Specialist doctor	15	15
Doctor	5	5
Registered nurse	12	12
Nurse with bachelor's (appl.) Degree	7	7
Nurse	61	61
Workplace		
Ambulance	18	18
Ward	75	75
Intensive / semi-intensive care unit	7	7
Shift work		
Yes	54	54
No	46	46
Total	100	100

Vaccination coverage in the observed sample was 97%. Completed HBV vaccination was listed by 87% of the examinees, majority of whom indicated that the time passed from the vaccination was 5–10 years. Testing for BBD during employment was reported by 41% of the examinees (Table 2).

Out of the total number of the examinees, 7% did not have anti-HBs antibodies for HBV infection, i.e. their values were lower than 10 mIU/ml (Table 3).

Table 2. Examinee structure according to the vaccine status (coverage) against HBV infection

Have you been vaccinated against HBV?	n	%
Yes	97	97
No	3	3
Are you completely vaccinated against HBV?		
Yes	87	87
No	13	13
When were you vaccinated against HBV?		
A year ago	9	9
Between five and 10 years ago	51	51
More than 10 years ago	37	37
I am not vaccinated	3	3
Were you tested for BBD during employment?		
Yes	41	41
No	45	45
I do not remember	14	14
Do you have HBV infection?		
Yes	0	0
No	100	100
Total	100	100

Table 3. Examinee structure by anti-HBs antibodies values

Anti-HBsAt	Min.		Max.	$\bar{x}$	SD
	3–10 (7)	11–500 (63)	≥ 500 (30)	247.94	199.704

Carrying out medical tasks in which they come into contact with blood and other patients' bodily fluids was stated by 90% of the examinees, out of whom 77% believed that they have been exposed to a constant HBV infection risk (Table 4).

Table 4. Examinee structure according to the degree of exposure to HBV infection and the number of workplace incidents

Exposure to infection risk	n	%
Yes	77	77
No	4	4
Periodically	19	19
Contact with biological material		
Yes	90	90
No	10	10
Needle prick		
Yes	36	36
No	64	64
Injury by a sharp object		
Yes	34	34
No	66	66
Contact with blood through the skin		
Yes	53	53
No	47	47
Contact with blood through the mucous membranes		
Yes	23	23
No	77	77
Total	100	100

The incident situation at workplace mentioned most frequently by the examinees was exposure to patients' biological material through skin (53%) and by needle prick (36%) (Table 5).

Table 5. Review of mean values for the number of workplace incidents

Workplace incident	n	$\bar{x}$	M	Min.	Max.	SD
Needle prick	36	3.78	2.5	1	20	3.78
Injury by a sharp object	34	5.21	5	1	20	4.48
Exposure through the skin	53	7.34	4	1	110	14.94
Exposure through the mucous membrane	23	4.91	3	1	20	4.69

Safety measures while working with patients are applied by 89% of the examinees. In regard to the safety measures the examinees use in their workplace during care and treatment procedures, the highest percentage of examinees specified the use of protective gloves (88%), while the use of safety glasses was reported by the lowest percentage of the examinees (24%).

Eighty-seven examinees (87%) confirmed that the employee safety was carried out continuously in their institution (Table 6).

Table 6. Examinee structure according to the use of protection measures in the workplace

Using protection measures while working with patients	n	%
Yes	89	89
No	11	11
Use of gloves		
Almost never	4	4
Seldom	5	5
Always	88	88
Only when I know that a patient has an infectious disease	3	3
Use of a mask		
Almost never	8	8
Seldom	21	21
Always	60	60
Only when I know that a patient has an infectious disease	11	11
Use of safety glasses		
Almost never	52	52
Seldom	15	15
Always	24	24
Only when I know that a patient has an infectious disease	9	9
Protection of workers from HBV in your institution is enforced		
Continuously	87	87
Sporadically	11	11
I am not informed	2	2
Total	100	100

An equal percentage of the examinees (92%) was aware of the meaning of the PEP term and of the department they need to contact for help after being exposed. Incidents in the workplace as adverse events were mentioned by 22% of the examinees, while 97% disposed of infective waste according to the rules of profession (Table 7).

Correlation of certain variables was examined with the aim to determine the relation between age, sex, body mass index (BMI), field of medicine in which the examinees work, workplace and years of service with certain factors affecting the health workers' protection from HBV infection (vaccination completeness, titer HBs antibodies, exposure to the risk of infection, number of interventions, the use of protective equipment, number of incidents, and more) (Table 8).

Table 7. Examinee structure according to the degree of familiarity with the procedures that affect the protection in the workplace and PEP measures

Existence of instructions for the protection of employees in the workplace	n	%
Yes	91	91
No	2	2
I am not sure	7	7
Reporting incidents as adverse events		
Yes	22	22
No	29	29
I am not sure	19	19
Knowledge of the term PEP		
Yes	92	92
No	3	3
I am not sure	5	5
Knowledge of post exposure procedures		
Yes	86	86
No	8	8
I am not sure	6	6
Knowledge of post-exposure help services		
Yes	92	92
No	4	4
I am not sure	4	4
Disposal of infectious waste in accordance with the rules of the profession		
Yes, always	97	97
No, never	2	2
From time to time	1	1
Total	100	100

Years of age have a weak positive statistically significant correlation with testing during employment (older employees were seldom tested during employment), and the time passed from vaccination (with older examinees more time passed since vaccination).

The sex variable has a low statistically significant correlation with testing during employment (female examinees are tested more often) (Table 8).

Table 8. Significant correlations of the examined variables

Variable	Variable	ρ	p
Age	employment testing	0.206	0.039
	number of interventions	-0.224	0.025
	knowledge of the term PEP	-0.303	0.002
	time elapsed since vaccination	0.243	0.015
Sex	employment testing	0.211	0.035
	vaccination completeness	-0.246	0.014
BMI	knowledge of the term PEP	-0.271	0.006
	anti-HBs antibodies	-0.206	0.040
Branch of medicine	exposure to the risk of infection	0.208	0.037
	performing interventions	0.245	0.014
	spraying blood into the eye or other mucosa	0.243	0.015
	reporting incidents as adverse events	0.349	0.003
	disposal of infectious waste according to the rules of the profession	0.287	0.004
	testing for BBD	-0.385	0.000
Occupation	shift work	0.288	0.004
	performing interventions	-0.253	0.011
	number of interventions in 24 h	0.433	0.000
	use of protective equipment	-0.364	0.000
Workplace	testing for BBD	-0.239	0.016
	exposure risk from BBD	-0.230	0.022
	disposal of infectious waste according to the rules of the profession	-0.203	0.43
	anti-HBs antibodies	0.242	0.015
Years of service	knowledge of BBD	0.232	0.020
	employment testing	0.216	0.031
	number of incidents	-0.237	0.018
	knowledge of the term PEP	0.235	0.019
	time elapsed since vaccination	0.321	0.001

BMI – body mass index; PEP – post-exposure prophylaxis; BBD – blood-borne diseases

DISCUSSION

Due to disease risks of health professionals, vaccination for HBV infection is mandatory in most countries. However, health workers' vaccination ranges from 15% in Africa to 75% in Australia, the USA, and New Zealand [16].

Studies conducted in Nigeria, China, Tanzania, and the USA show that health workers' vaccination scope for HBV infection ranges from 18% (Nigeria) to 84% (USA) [17–20].

In our country, health care professionals are subject to mandatory hepatitis B immunization according to epidemiological indications since 1989.

An epidemiological study was carried out in the Republic of Serbia on the territory of Nišava and Toplica districts (2000–2009), which determined that the health workers' vaccination coverage for hepatitis B was 31% [21].

In December 2015, research was carried out for the predictors of vaccination status connected with immunization for hepatitis B with persons working at the Clinical Centre of Serbia (Belgrade) in a cross-sectional study. The prevalence of vaccination in the examined sample was 66% [22].

Our research with HCWs employed in a facility of tertiary health care showed a high vaccination coverage of 97%. The obtained results show an increase in the coverage degree, and the fact that important steps are taken in educating HCWs on the protection from BBD.

When it comes to personal protection, 89% of examinees used protective measures when performing professional duties and these most often included gloves (88%), while protective glasses were used least frequently 24%.

In the Republic of Serbia, a research was carried out on the territory of the Autonomous Province of Vojvodina related to the importance of blood-borne infection prevention and control for the decrease of professional risks amongst HCWs. The research results showed that health professionals in Vojvodina have a high rate (more than 80%) of professional exposure to these infections [23]. The same was confirmed by our research, *viz.* 90% of examinees carry out medical tasks during which they come into contact with patients' biological waste.

Some countries (Sudan) recognized the need to study the exposure of HCWs to HBV infection in the workplace when performing care and treatment activities. The obtained results showed a high level (above 65%) of infection exposure [24].

WHO estimates that every year around 66,000 health care professionals are infected with HBV, and 600,000–800,000 health professionals experience an incident in the workplace in the form of a cut or a needle prick [14, 25].

Our research shows that the highest exposure is suffered by HCWs who perform numerous medical tasks i.e. interventions during the day, and it is the nurses/technicians who are more exposed than other examinees. It is exactly the nurses/technicians who reported the highest number of incidents while working. The research carried out showed that younger nurses-technicians, especially those with higher BMI, have more frequent contacts with blood and other patients' bodily fluids (Table 8).

The aim of research conducted in China, India, Japan and Catalonia was to determine the level of health care professionals' protection against HBV infections after vaccination procedure has been completed. The acquired data indicate that the protection efficiency ranges between 64% (Catalonia) and 83% (Japan), i.e. these are the percentages of examinees with protective anti HBs antibodies [26–29].

Even though there is permanent seroprophylaxis at the Clinical Centre of Vojvodina, 7% of the examinees involved in this research did not have anti-HBs antibodies (< 10 mIU/ml), which implies that the protection efficiency for HBV infection in the monitored sample is 93%. All seven examinees who did not have a protective antibody titer were vaccinated with three doses of the vaccine. In four examinees, the time elapsed since the last of vaccine was one year, in two examinees between five and 10 years, and in one more than 10 years.

Among factors that influence the level of anti-HBs antibodies, our study confirms the influence of BMI, because it has a low negative correlation to anti-HBs antibodies (the higher the BMI, the lower the anti-HBs antibodies – Table 8).

Higher exposure to infection and lower level of response to the vaccine with examinees who have a higher BMI is explained through certain metabolic disorders that change the immune system's response and thus contribute to the increased sensitivity to bacterial, viral, or fungal infections [30].

Younger examinees were more familiar with the meaning of the PEP term, and the procedure after being exposed to a workplace incident, even though 86% gave a positive reply to a question about their knowledge of the post-exposure procedure. Knowledge on prevention and control of BBD and PEP should be implemented into school curriculums of vocational schools and faculties. It is the basis for acquiring knowledge and skills, which should be improved from the moment of employment for every health worker and then continued during the entire working life.

CONCLUSION

The conducted research showed high average HBV infection vaccination amongst HCWs (97%), as well as high level of protection 93%. Health workers' exposure in the observed tertiary health care institution was 90%. Safety measures against HBV infection were carried out by HCWs in 89% of the cases, whereas 86% of employees responded positively about being familiar with the PEP term.

Considering the fact that, in our country, there is no valid nor complete data on HCWs' vaccination coverage for HBV infections, on the protection level of employees who underwent immunization, on the number and the type of incidents in the workplace and the PEP applied, activities of all relevant institutions in the country should be guided towards solving this increasing problem.

Conflict of interest: None declared.

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Заштита здравствених радника запослених у терцијарној здравственој установи од инфекције вирусом хепатитиса Б

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САЖЕТАК

Увод/Циљ Вирусом хепатитис Б (ВХБ) инфицирано је више од 300 милиона људи широм света. Преноси се путем крви, крвних деривата, сексуалним путем и вертикално, а здравствени радници због природе свог посла представљају вулнерабилну групу.

Циљ овог истраживања био је да се утврди обухват вакцинацијом против инфекције ВХБ здравствених радника радно ангажованих у терцијарној здравственој установи –Клиничком центру Војводине, ниво те заштите одређивањем титра анти ХБс антитела, степен изложености, степен поштовања мера заштите на радном месту испитаника и степен познавања мера постекспозиционе профилаксе (ПЕП).

Методе Истраживање је спроведено као дескриптивна аналитичка студија пресека, у којој је као инструмент истраживања коришћен Упитник о заштити здравствених радника против крвнотрансмисивних болести, а узоркована је крв за одређивање титра анти-ХБс антитела. Узорак је чинила једна стотина здравствених радника.

Резултати Истраживање је показало висок ниво обухвата вакцинацијом против инфекције ВХБ (97%). Поред континуиране серопрофилаксе одређен број испитаника нема заштитни титар антитела (7%). Ниво експозиције здравствених радника настанку инфекције ВХБ износи 90%. Заштитне мере на радном месту користи 89% испитаника, док 86% познаје мере ПЕП.

Закључак Истраживање је показало висок ниво обухвата здравствених радника специфичном заштитом против инфекције ВХБ, недовољан степен спроведене заштите, висок ниво изложености настанку инфекције ВХБ, непотпуно поштовање мера заштите и недовољно познавање мера ПЕП.

Кључне речи: титар антитела; здравствени радници; хепатитис Б; акциденти; заштита на раду