

KNOWLEDGE ABOUT BLOOD-BORNE PATHOGENS AND THE PREVALENCE OF NEEDLE STICK INJURIES AMONG MEDICAL STUDENTS IN SERBIA

POZNAVANJE PATOGENOV, KI SE PRENAŠAJO S KRVJO, IN RAZŠIRJENOST POŠKODB Z INJEKCIJSKIMI IGLAMI MED ŠTUDENTI MEDICINE V SRBIJI

Vuk MARUSIC^{1*}, Ljiljana MARKOVIC-DENIC¹, Olivera DJURIC¹, Dragana PROTIC²,
Emilija DUBLJANIN-RASPOPOVIC³

¹University of Belgrade, Faculty of Medicine, Institute of Epidemiology, Visegradska 6, Belgrade 102, 11129, Serbia

²University of Belgrade, Faculty of Medicine, Institute of Pharmacology, Belgrade 102, 11129, Serbia

³University of Belgrade, Faculty of Medicine, Clinical Center Serbia, Clinic for Physical Medicine and Rehabilitation, Belgrade 102, 11129, Serbia

Received: Dec 1, 2016
Accepted: Apr 10, 2017

Original scientific article

ABSTRACT

Keywords:

Hepatitis B vaccine, knowledge, medical students, needlestick injuries, Serbia

Introduction. Medical students are mainly exposed to needle stick and sharp object injuries in the course of their clinical activities during studying. They are at high risk due to their undeveloped skills, restricted clinical experience, lack of knowledge and risk perception. The objectives of this study were to determine the prevalence of needle stick injuries of the fourth and final year medical students, and to estimate their knowledge about blood-borne pathogens disease transmission and standard precautions.

Methods. This cross-sectional study was conducted at the Faculty of Medicine, in February 2014. The students were invited to self-administer a questionnaire of 26 closed questions prepared for this study.

Results. The questionnaire was filled in and returned by 637 students. The prevalence of needle sticks and sharp object injuries was 29.5%. Needle stick injuries were the most common type of accidents, more frequent among the fourth compared to the sixth year students ($p=0.002$). The majority of accidents occurred in patient rooms (53%) and the emergency department (15%). 54% of participants reported an accident to the responsible person. Students without accidents had a significantly better perception of risk (3.79 vs. 3.35; $p<0.05$). Out of the total participating students, only 16.6% (106/637) received all three doses of Hepatitis B vaccination, while 16.2% were partially vaccinated.

Conclusions. There is a need for additional theoretical and practical education of our students on blood exposure via accidents, raising the awareness of the necessity of hepatitis B vaccination, and introducing the unique/comprehensive procedure for accident reporting for students and healthcare workers in the entire country.

IZVLEČEK

Ključne besede:

cepivo za hepatitis B, znanje, študenti medicine, poškodbe z injekcijskimi iglami, Srbija

Uvod. Študentje medicine so v okviru kliničnih dejavnosti med študijem izpostavljeni predvsem vbodnim poškodbam z iglami ter urezninam z ostrimi predmeti. Zaradi še nerazvitih kliničnih veščin, skromnih kliničnih izkušenj in omejenega znanja je tveganje za poškodbo pri njih višje. Cilj te raziskave je bil zato ugotoviti razširjenost poškodb z iglami in ostrimi predmeti v medicini med študenti četrtega in zadnjega letnika medicine ter oceniti njihovo znanje o boleznih, ki se prenašajo s krvjo, in poznavanje standardnih varnostnih ukrepov.

Metode. Februarja 2014 smo izpeljali presečno raziskavo na Medicinski fakulteti Univerze v Beogradu. Študentje so bili povabljeni, naj izpolnijo vprašalnik, sestavljen iz 26 vprašanj zaprtega tipa, pripravljenih za to študijo.

Rezultati. Vprašalnik je izpolnilo 637 študentov. Razširjenost poškodb z iglami in ostrimi predmeti je bila 29,5-odstotna. Poškodbe z iglami so bile najpogostejša vrsta poškodb nasploh in pogostejša med študenti četrtega letnika v primerjavi s študenti šestega letnika ($p=0,002$). Večina poškodb se je pojavila v bolniških sobah (53%) in na urgentnih oddelkih (15%). Odgovorni osebi je nezgodo sporočilo 54% udeležencev. Študenti brez poškodb so bistveno bolj zaznavali tveganje (3,79 vs. 3,35; $p<0,05$). Le 16,6% sodelujočih študentov je bilo v celoti cepljenih proti hepatitisu B.

Zaključek. Obstaja potreba po dodatnem teoretičnem in praktičnem izobraževanju naših študentov o izpostavljenosti krvi zaradi poškodb z iglami in ostrimi predmeti, po dvigu zavesti o nujnosti cepljenja proti hepatitisu B in uvajanju celovitega postopka za poročanje o poškodbah z iglami in ostrimi predmeti za študente in zdravstvene delavce v celotni državi.

*Corresponding author: Tel: ++ 381 11 360 71 24; E-mail: marusicdrvuk@gmail.com

1 INTRODUCTION

The World Health Organization (WHO) estimated that approximately 3 million Health Care Workers (HCWs) experience percutaneous exposure to blood-borne pathogens each year due to needle stick and sharp instruments injuries (1). Occupational accident can be defined as any unintended contact with blood and/or body fluids during a medical intervention. Although most of these accidents are without adverse outcomes, a number of blood-borne pathogens (BBP), such as hepatitis B and C viruses (HBV and HCV) or human immunodeficiency virus (HIV), can be transmitted through needle stick and other sharp injuries (2, 3). Medical students, as the HCWs, are exposed mainly to needle stick and sharp object injuries in the course of their clinical activities during studying due to their undeveloped skills, restricted clinical experience, lack of knowledge and risk perception (4-12). This study is one of the limited number of studies especially in the eastern part of Europe, about medical students' knowledge, practice, and attitudes toward occupational accidents.

The aims of this study were: [1] to determine the prevalence of needle stick injuries of fourth and final year medical students and [2] to estimate their knowledge about blood-borne pathogens (BBP) disease transmission and standard precautions.

2 METHODS

2.1 Study Design and Participants

This cross-sectional study was conducted at the Faculty of Medicine, University of Belgrade in February 2014. The participants were students of the fourth and sixth year of the faculty (first and final year clinical study). At our faculty, students have an introductory module for clinical practice in first grade, but they start their real practical sessions in the first semester of the fourth year, during study subject of the internal medicine, when they had daily student clinical practice and contacts with doctors, nurses and other staff in the hospital. All students in fourth and sixth study year were invited to complete a questionnaire at the end of their lectures. They did not feel pressured to fill out the questionnaire, because the participation in the survey was voluntary and anonymous. A self-administered anonymous questionnaire was prepared for the purpose of this study according to literature data.

Draft version of the questionnaire was given to a group of 15 students to determine whether the questions were understandable, whether the choice of responses was compatible with the experience of the respondents, whether all respondents understood the questions in the same manner and whether the questions measured what they needed to measure. The questionnaire was revised

after the pretest and the final version was prepared. The students filled the questionnaire at the end of regular exercises

The questionnaire contained 26 closed questions that included: demographic characteristics (age, sex and type of finished secondary school), the number of accidents during previous year and during complete clinical schooling (fourth to sixth year of Medical faculty), place and circumstances of the accidents. Accidents were divided by nature of accidents on: a) needle stick injury (a sharp, penetrating stab wound from a needle that may result in exposure to blood or other body fluids); b) accident after handling with a contaminated sharp device; c) sharp injury after handling with the broken glass device (broken blood collection tubes, ampoules, thermometers etc.); d) accident after contact with a patient's blood through health care worker's damaged skin, and e) accident after contact with a patient's blood through HCW's conjunctiva/mucose membranes. Further, needle stick injuries are divided according the circumstances when an accident is occurring on: needle stick injury before using a needle (accident which occurred before needle contact with patient's blood or body fluids), needle stick injury after using a needle (accident made by any needle after exposure to the patient's blood of body fluids), accidents during needle recapping and during needle disposition in sharp containers. The level of knowledge was scored - the total score was 12 for knowledge of blood-borne diseases, 10 for knowledge of standard precautions and 8 for risk perception. The overall mean score for all three parties was taken for this survey.

2.2 Statistical Analysis

A descriptive analysis was performed. Continuous variables were presented as mean values with standard deviation (SD). Categorical values were summarized in terms of absolute frequencies and percentages. All variables were normally distributed. Fisher's chi-square test or Student's t-test was used as appropriate. Differences with a $p < 0.05$ (two-tailed) were considered to be statistically significant. Two prevalence rates were calculated: the prevalence rate of students with accidents in previous year and prevalence rate of all accidents. The first one was calculated as the percentage of students who had reported at least one accident during the 12 months preceding the study. The second rate was calculated as the ratio between the number of all accidents during schooling and the number of students interviewed. We compared students' demographic characteristics and knowledge students' score about accidents between two groups of students (without accidents and with at least one accident). For the knowledge scores, one point was awarded for each correct answer and incorrect answer with a score of zero for a maximum aggregate knowledge

score of thirty points. Analysis of the database was done by SPSS 17.0 software package for Microsoft Windows.

3 RESULTS

Out of 769, a total of 637 students filled in and returned questionnaire. The response rate was 83% (89.4% in the fourth year and 73.8% in the final year of study). Demographic characteristics of students are given in Table 1. The majority of the students were female (68%), and two-thirds of all (68%) have graduated from a medical secondary school. Out of total participated students, only 16.6% (106/637) received all three doses of Hepatitis B vaccination, while 16.2% were partially vaccinated.

The reasons for not completing the course were that they forgot about the vaccination (77%), they were not at risk (11%), they believed that vaccine was not safe (4%), they already had antibodies towards Hepatitis B (1%). 8% of all students did not respond.

Table 1. Demographic characteristics of 4th and 6th year students, Medical school, University of Belgrade, Serbia, 2014 (N=637)¹.

	Frequency	(%)
Academic year		
Fourth	397	(62.3)
Sixth	240	(37.7)
Gender		
Male	201	(31.6)
Female	436	(68.4)
Finished secondary school		
Medical	434	(68.1)
Other	203	(31.9)
Taken Course on Occupational Exposure		
No	157	(24.6)
Yes	468	(73.4)
Hepatitis B vaccination		
No	428	(67.2)
Partially vaccinated	103	(16.2)
Vaccinated with 3 doses	106	(16.6)

¹Missing data were not included in some analyses

In total, 60 students had at least one accident during the previous twelve months, which corresponds to a prevalence of 9.4%, (95% CI=7.3-12.0), (10.1% in fourth year students and 8.3% in sixth year students; $p=0.466$). Eleven of 16 students who had multiple accidents were

fourth year students. There were a total of 188 episodes of accidents (ranging from 1 to 8). The prevalence rate of all accidents was 29.5% (95% CI=26.0-33.2). Needle stick injuries were the most common type of accidents, and they were more frequent among fourth compared to sixth year students ($p=0.002$). Those accidents happened before and after using hollow bore needles, during recapping or disposing of needles into sharp containers. The majority of episodes of accidents happened during performing procedures in patient's room (46%). Further, it was found that students in sixth year have statistically significant more often mucocutaneous exposure to blood and body fluids through non-intact skin and conjunctiva ($p=0.033$ and $p=0.003$, respectively) (Table 2). The majority of accidents occurred in the patient's rooms (53%) and emergency department (15%). Only 31 (54%) participants who had an accident reported it to the responsible person, regardless of the academic year. The two major reasons were the beliefs that it was not the type of exposition during which a student could be infected (32%), and the belief that the patient had not been infected (17%). Further, students failed to report because they did not know to whom to report (12%), or because they believed that it was not necessary to report (7%).

Table 2. Nature of accidents by the circumstances when the accidents occurred of 4th and 6th year students, Medical school, University of Belgrade, Serbia, 2014.

	n=60 Academic year No. (%)		P
	Fourth	Sixth	
Needle stick injury	32 (53.3)	8 (13.3)	0.002
Before using needle	1 (1.7)	2 (3.3)	0.209
After using needle	5 (8.3)	7 (11.7)	0.040
Needle recapping	12 (20.0)	4 (6.7)	0.409
During needle disposition in sharp container	9 (15.0)	0 (0)	0.018
Handling with contaminated sharp devices	12 (20.0)	2 (3.3)	0.084
Handling with broken glass devices (broken blood collection tubes, ampoules, thermometers etc.)	9 (15.0)	1 (1.7)	0.086
Contact with blood through damaged skin	0 (0)	5 (8.3)	0.003
Contact with boold through conjunctiva/mucose membranes	0 (0)	3 (5.0)	0.033

* P - according to Chi-square test or Fisher test

Factors possibly associated with an accident are presented in Table 3.

Table 3. Factors possibly associated with the accidents among Medical school students, University of Belgrade, Serbia, 2014.

	Students		P
	Without accidents	With at least one accident	
Academic year			
Fourth	357 (89.9)	40 (10.1)	0.466
Sixth	220 (91.7)	20 (8.3)	
Gender			
Male	177 (88.1)	24 (11.9)	0.139
Female	400 (91.7)	36 (8.3)	
Finished secondary school			
Medical	399 (91.9)	35 (8.1)	0.087
Other	178 (87.7)	25 (12.3)	
Mean Scores of:			
knowledge on BBD transmission	8.59±2.08	8.44±2.51	0.606
knowledge on standard precautions	6.05±2.08	6.35±2.19	0.281
risk perception	3.79±1.66	3.35±1.56	0.049
Total score	18.44±3.92	18.15±4.44	0.597

* P - according to Chi-square test, Fisher test or Student`s t-test

There were no statistically significant differences between students who had and who did not have any accident, regarding the year of study, sex and type of finished secondary school. The overall mean score on blood borne diseases (BBD), separated in three categories (knowledge on BBD transmission, knowledge on standard precautions and risk perception) was 18.41±3.97, with a score range from 0 to 30. The mean score on BBD transmission was 8.58±2.13 (with a range of 0-12); on standard precaution 6.08±2.09 (with range of 0-10), and 3.75±1.66 (with range of 0-8) on risk perception. Students without accidents during the past year had a slightly better perception of risk (3.79 vs. 3.35; $p < 0.05$). The statistical analysis did not reveal significant differences regarding other scores between the two groups of students.

Students who have taken the course on occupational exposure had a higher prevalence of accidents (needle stick injuries and sharp objects injuries) (10.9% vs. 5.1%; $p = 0.013$) and a better protection against hepatitis B virus; they were the ones who received all three doses of the vaccine (18.4% vs. 12.9%) ($p = 0.114$). But there was no statistical significance between students who have taken

the course on occupational exposure and those who have not, in relation to knowledge scores about BBD transmission (8.55±2.1 vs. 8.64±1.9; $p = 0.307$).

The majority of all students (74%) expressed their needs about additional education on needle stick and sharp devices accidents.

4 DISCUSSION

The results of this study indicate that the prevalence of students with at least one accident was the prevalence obtained among students in developed countries, (6, 14, 15) but lower than the prevalence in some less developed countries (15, 16). The overall accidents were less frequent in the sixth year students than in younger students. Needle stick injuries and injuries with sharp and broken glass devices were less common in these students too. This can be explained by a higher theoretical education and better practical skills of older students. Other authors also revealed that final year students had a smaller number of accidents (13, 17). On the contrary, Zhang et al. found the highest rate of accidents in the fifth academic year (18). In a recently published study, which included students in the final year of education from 11 medical universities in Austria, Germany, and the United Kingdom, it is revealed that 34% of these students suffered at least one accident during medical school training with significant differences among countries (19). The authors postulated that the medical curricula in Austria and Germany included training and practice of blood collection. A higher workload regarding blood collection resulted in a higher rate of accidents in Austria and Germany. Higher lifetime prevalence in the final academic year was also noted in other studies (13). Although there were no significant differences regarding the level of knowledge on BBD transmission and standard precautions, our results revealed that the lower score of risk perception was present in students who experienced at least one accident. In a study conducted in the UK, Austria and Germany (5), the authors concluded that improved knowledge due to the training and implementation of the guidelines resulted in a significant reduction of needle stick injuries over the time (5). Both our student groups showed a relatively low knowledge level, although the lectures on occupational exposure to blood and body fluids are compulsory in some subjects during studying at the faculty. Even though there is a lack of safety devices (such as safety yellow biohazard containers, protective disposable goggles, masks, gloves and aprons, which should exist not only for health care work, but also for students during their practical training) in our country, it is important to improve students' theoretical knowledge and practical skills regarding needle stick and sharp device injuries, as it has been done in other countries (20).

Approximately three-quarters of our students expressed their needs and determination for additional education on occupational injuries.

Underreporting of accidents observed both in healthcare workers and students still remains a widespread public health problem. Kessler et al. noted underreporting from 14.8% to 97% in their review of literature (21). About half of our student did not report the accident in our study. The major reasons for not reporting were the lack of knowledge about proper reporting procedures and perceived low risk. Our country does not possess a comprehensive guide for blood exposure reporting. Therefore, underreporting in healthcare workers, in Serbia, was observed in the research conducted by Jovic-Vranes et al. (22).

Although vaccination against HBV for HCW's and medical students in secondary medical schools is mandatory, according to the Rulebook about immunisation and hemiprofilactic protective treatment of the Republic of Serbia, made by doctors and specialists selected by the Serbian Government, not enough HCW's and medical students have been vaccinated before they started their school or professional practice.

In our study, about 33% of medical students were immunised, with half of them receiving complete vaccination with three doses. It is particularly concerning that only 10% of the fourth year students, who begin their clinical practice and are exposed to blood borne viruses, have been vaccinated. The importance of immunisation is covered early in the medical training at our faculty, as early as in the second year and, in more detail, in the fourth year. Even though such education contributes to a higher percentage of those who get vaccinated in the senior years of their studies (47% of the sixth year students), that percentage is still much smaller compared to the percentage of medical students who get vaccinated in other countries (13, 15).

5 CONCLUSION

We can conclude that there is a need for additional theoretical and practical education of our students on blood exposure via accidents, raising the awareness of the necessity of hepatitis B vaccination, and introducing the unique/comprehensive procedure for accident reporting for students and healthcare workers in the entire country.

ACKNOWLEDGEMENTS

This work was supported by the Ministry of Education, Science and technological development of Serbia, contract No. 175046, 2011-2017.

CONFLICTS OF INTEREST

All authors confirm that no conflict of interests exists in this research article.

I confirm that this manuscript is not under simultaneous consideration by any other journal, and that it has not been previously published.

FUNDING

All authors confirm that this study was supported by the Ministry of Education, Science and technological development of Serbia, contract No. 175046, 2011-2017.

ETHICAL APPROVAL

This type of research did not require an ethical approval, but it complies with all ethical and moral standards. Participants were not being forced to participate in this research or to fill in questionnaires. They completed questionnaires at the end of their lecture in epidemiology.

REFERENCES

1. World Health Organization, Secretariat of the Safe Injection Global Network, Department of Essential Health Technologies. Health care workers safety. Geneva: World Health Organization, 2003.
2. Rapiti, E, Prüss-Ustün, A, Hutin, Y. Sharps injuries: assessing the burden of disease from sharps injuries to health-care workers at national and local levels. Geneva: World Health Organization, 2005.
3. Serdar T, Derek L, Unić A, Marijancević D, Marković D, Primorac A et al. Occupational exposures in healthcare workers in University Hospital Dubrava - 10 year follow-up study. *Cent Eur J Public Health* 2013; 21: 150-4.
4. Lee LK, Hassim IN. Implication of the prevalence of needlestick injuries in a general hospital in Malaysia and its risk in clinical practice. *Environ Health Prev Med* 2005; 10: 33-41.
5. Elliott SK, Keeton A, Holt A. Medical students' knowledge of sharps injuries. *J Hosp Infect* 2005; 60: 374-7.
6. Sharma GK, Gilson MM, Nathan H, Makary MA. Needlestick injuries among medical students: incidence and implications. *Acad Med* 2009; 84: 1815-21.
7. Denić LM, Ostrić I, Pavlović A, Dimitra KO. Knowledge and occupational exposure to blood and body fluids among health care workers and medical students. *Acta Chir Jugosl* 2012; 59: 71-5.
8. Saleem T, Khalid U, Ishaque S, Zafar A. Knowledge, attitudes and practices of medical students regarding needle stick injuries. *J Pak Med Assoc* 2010; 60: 151-6.
9. Swe KM, Somrongthongs R, Bhardwaj A, Abas AB. Needle sticks injury among medical students during clinical training, Malaysia. *Int J Collab Res Intern Med Public Health* 2014; 6: 121-31.
10. Souza-Borges FR, Ribeiro LA, Oliveira LC. Occupational exposures to body fluids and behaviors regarding their prevention and post-exposure among medical and nursing students at a Brazilian public university. *Rev Inst Med Trop Sao Paulo* 2014; 56: 157-63.

11. Mittal G, Tanjea R, Garwal RK, Gupta P, Gupta P. Knowledge, awareness and prevalence of needle stick injury among students of medical college of Uttarakhand, India. *Int J Recent Sci Res* 2015; 6: 3055-8.
12. Camacho -Ortiz A, Diaz-Rodriguez X, Hernandez-Garcia R, Martiney-Palomares M, Chavez-Moreno S, Garza-Gonzalez E et al. Exposure and knowledge of sharps injuries among medical students in seven states of Mexico. *Int J Med Students* 2015; 3: 24-8.
13. Deisenhammer S, Radon K, Nowak D, Reichert J. Needlestick injuries during medical training. *J Hosp Infect* 2006; 63: 263-7.
14. Lauer AC, Reddemann A, Meier-Wronski CP, Bias H, Gödecke K, Arendt M et al. Needlestick and sharps injuries among medical undergraduate students. *Am J Infect Control* 2014; 42: 235-9.
15. Liyanage IK, Caldera T, Rwna R, Liyange CK, De Silva P, Karunathilake IM. Sharps injuries among medical students in the Faculty of Medicine, Colombo, Sri Lanka. *Int J Occup Med Environ Health* 2012; 25: 275-80.
16. Norsayani MY, Noor Hassim I. Study on incidence of needle stick injury and factors associated with this problem among medical students. *J Occup Health* 2003; 45: 172-8.
17. Varsou O, Lemon JS, Dick FD. Sharps injuries among medical students. *Occup Med (Lond)* 2009; 59: 509-11.
18. Zhang Z, Moji K, Cai G, Ikemoto J, Kuroiwa C. Risk of sharps exposure among health science students in northeast China. *Biosci Trends* 2008; 2: 105-11.
19. Salzer HJ, Hoenigl M, Kessler HH, Stigler FL, Raggam RB, Rippel KE et al. Lack of risk-awareness and reporting behavior towards HIV infection through needlestick injury among European medical students. *Int J Hyg Environ Health* 2011; 214: 407-10.
20. Seng M, Lim JW, Sng J, Kong WY, Koh D. Incidence of needlestick injuries among medical students after implementation of preventive training. *Singapore Med J* 2013; 54: 496-500.
21. Kessler CS, McGuinn M, Spec A, Christensen J, Baragi R, Hershov RC. Underreporting of blood and body fluid exposures among health care students and trainees in the acute care setting: a 2007 survey. *Am J Infect Control* 2011; 39: 129-34.
22. Jovic-Vranes A, Jankovic S, Vranes B. Safety practice and professional exposure to blood and blood-containing materials in Serbian health care workers. *J Occup Health* 2006; 48: 377-82.