

ORIGINAL ARTICLE

pISSN: 1907-3062 / eISSN: 2407-2230

Assessment of needlestick injuries and hepatitis B and C infection among surgeons

Shaban Mehrvarz*, Seyed Masoud Khatami, Shahram Manoochehry*[@],
Hossien Khedmat**[,] Mahdi Arefinia***[,] and Hamid Reza Rasouli*

ABSTRACT

BACKGROUND

Specialist surgeons are at high risk of exposure to hepatitis viruses through occupational exposure to blood or body fluids. Protective measures against occupational exposure to the hepatitis B virus (HBV) and hepatitis C virus (HCV) must be taken in order to prevent infection in surgeons. We aimed to determine the needlestick injuries, and markers HBV and HCV in Iranian surgeons.

METHODS

This study was cross-sectional research, performed in Baqiyatallah, Shohada, Rasoul Akram, Sina, Taleghani, and Emam Hossein hospitals (all university hospitals) of Tehran, Iran. Overall 318 eligible surgeons were included. Anonymous questionnaires were used containing data about demographic characteristics, self-reported blood and needlestick contacts, occasional exposures, risk behaviors and vaccination. Also, the blood samples were taken and tested for hepatitis B surface antigen (HBsAg), antibody against Hepatitis B surface antigen (antiHBs) and HCV antibody (HCVAb). Fisher exact test and Kruskal Wallis test were used to analyze the data.

RESULTS

The mean age of the surgeons was 47.76 ± 8.95 years and 177 of them (55.66%) were male. The average number of needle-sticks was 28.28 ± 16.58 during the surgeons' working life. Among them, 5 cases (1.59%) were positive for HBsAg and 2 cases (0.66%) were positive for HCVAb.

CONCLUSION

In spite of the high needlestick rate in Iranian surgeons, prevalence of hepatitis B and C is not very high among them. A high degree of vigilance and a careful surgical technique is the only means available to prevent the transmission of the viruses.

Keywords: Hepatitis B virus, hepatitis C virus, surgeon

*Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran.

**Baqiyatallah Research Center for Gastroenterology and Liver Diseases, Baqiyatallah University of Medical Sciences, Tehran, IR Iran.

***Department of General Surgery, Faculty of Medicine, Baqiyatallah University of Medical Sciences, Tehran, IR Iran.

Correspondence:

[@]Shahram Manoochehry, Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran.

Email:

shahram.manoochehry@yahoo.com

Tel/Fax: +982188053766

ORCID ID: 0000-0002-0424-1763

Date of first submission, January 19, 2020

Date of final revised submission, August 9, 2020

Date of acceptance, August 11, 2020

This open access article is distributed under a Creative Commons Attribution-Non Commercial-Share Alike 4.0 International License

Cite this article as: Mehrvarz S, Khatami SM, Manoochehry S, Khedmat H, Arefinia M, Rasouli HR. Assessment of needlestick injuries and hepatitis B and C infection among surgeons. *Univ Med* 2020;39:113-20. doi: 10.18051/UnivMed.2020.v39.113-120



INTRODUCTION

Viral hepatitis is a systemic infection that involves the liver. Severe viral hepatitis cases occur as types A, B, C, D, and E.⁽¹⁾ All the viral hepatitis agents are RNA viruses, except for hepatitis B which is a DNA virus.⁽¹⁾ These agents are characterized by different molecular and antigenic characteristics, but all create similar clinical signs in humans.^(1,2) The hepatitis B prevalence in various areas in Iran is estimated to be about 1.3%-2.4%.⁽³⁾ Hepatitis C prevalence is estimated to be around 0.13%-0.89% in Iran.⁽⁴⁻⁶⁾ Compared to similar studies in other countries, the prevalence of hepatitis B virus (HBV) and hepatitis C virus (HCV) infection in Iran is low.⁽⁷⁻⁹⁾ Hepatitis B is the 10th cause of death in the world.⁽⁴⁾ Annually, 0.5-1.2 million people die because of hepatitis B infection in the world, of whom 75% are in Asia.^(4, 5) Cirrhosis and hepatocellular carcinoma are the leading causes of death in HBV infected patients. Annually more than half a million people are infected with HBV, and if they receive no treatment about 15%-40% of them are at high risk of cirrhosis or hepatocellular carcinoma.⁽⁵⁾ This imposes high expenses to the patients and the health systems of countries. In the United States, admission fee of these patients is about one billion dollars.⁽⁶⁾

Injection, exposure to blood products and transfusion, organ transplantation, hemodialysis and unsafe sex are major transmission pathways of HCV.^(7,8) Sharp injuries and needlestick injuries are the most important occupational routes of HBV, HCV and human immunodeficiency virus (HIV) infections in health-care workers (HCWs).⁽⁹⁻¹¹⁾ The risk of transmission via percutaneous injury with HCV infected blood is estimated to be 3% to 10% and 7% to 30% for HBV.^(12,13) Hepatitis B infection has a higher prevalence in physicians, dentists, dialysis unit staff and laboratory workers compared with the general population.^(14,15) Among HCWs, surgeons have the highest risk of HBV infection from their patients.⁽¹⁶⁾ Surgeons are at risk of infection with

blood-borne pathogens, including HBV, HCV and HIV.^(17, 18) Specialist surgeons are at high risk of occupational exposure to these viruses through blood and body fluids.

A systematic review showed that the highest incidence of needlestick injuries was seen in nurses and contraction of hepatitis B or hepatitis C from work-related needlestick injuries is one of the most common occupational hazards among health care workers.⁽¹⁹⁾ A comprehensive national survey of surgical residents showed that needlesticks occurred frequently.⁽²⁰⁾

There is no previous study regarding evaluation of markers of HBV in surgeons with different specialties. We therefore aimed to determine the needlestick injuries, and markers of HBV and HCV in Iranian surgeons.

Methods

Research design

This cross-sectional study was conducted at six hospitals of Tehran from January to May 2013.

Research subjects

Surgeons of Baqiyatallah, Shohada, Rasoul Akram, Sina, Taleghani, and Emam Hossein hospitals of Tehran, Iran, who had a history of needlestick injury, were included in this study. The sample size was calculated based on an odds ratio of 0.7 and using the formula for determination of prevalence in one group, with α and β set to 0.05 and 0.2 respectively. Accordingly, the minimum sample size was calculated as $n=318$.

Among 318 eligible surgeons who participated in the study, surgeons of the all fields (general, orthopedic, urology, neurosurgery, gynecology, ENT and etc.) were included in this study. Surgeons with a previous history of exposure to blood or blood products, those who had undergone major surgeries or had a history of traumatic injuries, and those who had a history of contact with B or C hepatitis patients, were excluded from the study.

Data collection

We made use of anonymous questionnaires. Information regarding subjects' demographics, number of their surgeries per month, medical history, occupational history, number of needlestick contacts, occasional exposures, risk behaviors and vaccination history were recorded after detailed interviews with the subjects. We also investigated the surgeons' reaction to needlestick injuries or to positive viral markers of themselves or their patients. We assessed the average number of needle stick in the whole experience work of Iranian surgeons. A high risk exposure was defined if the number of needle stick > average number of needle stick and low exposure was defined if the number of needle stick < average number of needle stick.

Laboratory tests

Under aseptic conditions, about 5 mL of venous blood was obtained from the subjects using standard procedures and the serum was stored frozen at -20°C before tests. Blood samples were coded according to coding of the questionnaires. All samples were first screened for HBV and HCV through immune-chromatographic technique. We used enzyme-linked immunosorbent assay (ELISA) to carry out HBs antibody (HBsAb), HCV antibody (HCVAb), HBsAg and anti-HBs tests. Testing for HCV antibodies was performed using a third generation enzyme immunoassay.

Data analysis

Descriptive statistics was used to summarize the variables and distribution of variables in the samples. The relationship between these variables was assessed using Fisher's exact test and the Kruskal-Wallis test was used to analyze the data. Data were analyzed using SPSS 20 software (IBM Corp, Armonk, NY, USA). A p-values less than 0.05 were considered significant.

Ethical clearance

This study was approved by the medical research ethics committee of Baqyatallah

University under no. IR.Bmsu.rec.1395.2. The selected hospitals had been notified and visited to offer administrative assistance before the questionnaires were given to the participants. Participation in the study was strictly voluntary. Informed consent sheets were obtained from all participants, each assured of maximum confidentiality.

RESULTS

Among the 318 eligible surgeons who participated in the study, 177 surgeons (55.66%) were male. 93 general surgeons, 93 gynecologists, 37 orthopedists, 40 urologists, 34 ENT surgeons and 21 were neurosurgeons. Table 1 depicts demographics and distribution of selected variables in the surgeons of different specialties participating in the study.

There was a significant lower number of monthly operations in orthopedists compared with other groups of surgeons ($p < 0.01$). Among the 318 surgeons, 291 surgeons (91.51%) had the complete vaccination for HB. And the highest duration of HB vaccination was among the urology ($p < 0.001$) The mean number of needlesticks was 28.28 ± 16.58 during the surgeons' working life. Although orthopedists had the lowest number of surgeries per month, they had the highest number of needlesticks compared with general surgeons, ENT surgeons, gynecologists and neurosurgeons. Then the highest rate of needlesticks also occurs in the orthopedist group ($p < 0.001$). (Table 1).

Mean HBsAb concentration was 149.05 ± 288.03 IU/mL in surgeons and 15.7% of surgeons had antibody concentrations of less than 10 IU/mL such that they were not immune against hepatitis B virus. The HBsAb level in ENT surgeons was lowest. ($p < 0.001$) (Table 2).

Among the 318 surgeons, 5 cases (1.59%) were positive for HBsAg and 2 cases (0.66%) had a positive HCVAb. The positive HBsAg cases consisted of two orthopedists, two gynecologists and one general surgeon, while the HCVAb positive cases consisted of one

Table 1. Distribution of demographic characteristics and selected variables in participants of the study

	General surgery	Gynecology	Urology	Orthopedics	ENT	Neurosurgery	Total	p-value
Number	93 (29.2)	93 (29.2)	40 (12.6)	37 (11.6)	34 (10.7)	21 (6.6)	318	
Sex	69	0	33	37	18	20	177	<0.001
Male	24	93	7	0	16	1	141	
Female	47.66 ±	48.96	48.47	50.10	38.94	51.61	47.76	<0.001
Age (years)	9.30	± 8.35	± 8.45	± 8.89	± 4.03	± 8.83	± 8.92	
Working experience (years)	11.10	12.88	12.77	11.24	5.02	13.38	11.35	<0.001
	± 7.19	± 6.92	± 7.05	± 5.98	± 2.95	± 7.85	± 7.03	
Number of surgeries per month (mean)	51.50	41.02	52.12	32.18	43.38	48.80	45.22	<0.001
	± 24.77	± 17.50	± 26.21	± 14.90	± 14.85	± 21.03	± 21.72	
Needlestick injury (mean)	27.41	31.66	30.12	41.21	13.23	15.19	28.28	<0.001
	± 16.75	± 12.73	± 20.95	± 14.87	± 5.75	± 8.78	± 16.58	
Vaccination for hepatitis B	88.17%	95.70%	90.00%	100.00%	76.40%	100.00%	91.52%	<0.001
Yes	11.83%	4.30%	10.00%	0.00%	23.60%	0.00%	8.48%	
No								
Duration of HB vaccination (years)	10.01	11.75	12.91	10.76	7.34	10.04	10.76	<0.001
	± 5.06	± 6.77	± 6.44	± 5.44	± 3.58	± 6.94	± 6.03	

Data presented as n (%) and Mean ± SD

Table 2: Distribution of selected variables of different specialty groups in the study population

	General surgery	Gynecology	Urology	Orthopedics	ENT	Neurosurgery	Total	p-value
HBsAg								
Positive	1 (20.0)	2 (40.0)	0 (0.0)	2 (40.0)	0 (0.0)	0 (0.0)	5 (100.0)	0.733
Negative	91 (29.07)	90 (28.7)	39 (12.4)	34 (10.8)	34 (10.8)	21 (6.7)	313 (100.0)	
HCVAb								
Positive	0 (0.0)	1 (50.0)	0 (0.0)	1 (50.)	0 (0.0)	0 (0.0)	2 (100.0)	0.742
Negative	87 (29.1)	86 (28.8)	37 (12.4)	34 (11.4)	34 (11.4)	20 (6.7)	298 (100.0)	
HBSAb	130.18 ± 273.96	174.34 ± 301.47	152.79 ± 319.01	189.84 ± 313.89	31.85 ± 30.13	196.00 ± 355.54	149.05 ± 88.03	<0.00
Exposure								
High-risk exposure	9 (18.0)	20 (40.0)	8 (16.0)	9 (18.0)	2 (4.0)	2 (4.0)	50 (100.0)	0.055
Low risk exposure	84 (31.3)	73 (27.2)	32 (11.9)	28 (10.4)	32 (11.9)	19 (7.0)	268 (100.0)	

*Data presented as n (%) and mean ± SD

orthopedist and one gynecologist. None of these surgeons had positive HBsAg and HCVAb results simultaneously. Generally, high-risk exposure was 18.0% in the orthopedic group, 40.0% in gynecologists, 26.0% in urologists, 18.0% in general surgeons, 4.0% in neurosurgeons and 4.0% in ENT surgeons ($p=0.055$) (Table 2).

DISCUSSION

In the current study, HBsAg positive prevalence was 1.59% and HCVAB positive prevalence was 0.60%. This study shows that surgeons in Iran do not have a higher HBV and HCV infection prevalence than the general population. In a study in Lagos, Nigeria, there was a higher prevalence of HBV infection in surgeons than in the general population. The study reported that the prevalence of surface antigen in the surgeons was found to be 25.7%.⁽²¹⁾ Another study in Poland on medical students reported that anti-hepatitis core antigen (HBC) was positive in 5.3%, and HBsAg was positive in 0.7%.⁽²²⁾

The prevalence of hepatitis B in various areas of Iran is about 1.3-2.4% which is considered a low prevalence in comparison to other countries.⁽³⁾ Anti-HCV positive prevalence is 0.20-0.89% in Iran.⁽²³⁻²⁵⁾

According to another study on 3411 orthopedists, the percentages of hepatitis B infection and positive HCVAb were 13% and less than 1%, respectively.⁽²⁴⁾ In the orthopedic group of our study, the percentages of positive HBsAg and positive HCVAb were 5.55% and 2.7%, respectively. In the gynecology group, the percentages of positive HBsAg and positive HCVAb were 2.171 and 1.14%, respectively. Needle-stick injury is one of most prevalent modes of transmission for hepatitis B and C.⁽¹²⁾

In our study, numbers of needle-stick in orthopedists group was more than other groups; it's because of type of instruments and tissues which orthopedists work with. In our study, all surgeons had needle-stick history and high risk

exposures were seen in 15.72%. One of the groups at high risk is orthopedic surgeons. Apart from needles, they frequently use other sharp materials, such as wires, drills and saws.⁽²⁶⁾

In our study, in spite of the lower number of surgeries in the orthopedic and gynecology groups, these groups were at higher risk of needlesticks and had more positive HBsAg and HCVAb results in comparison to the other surgeons.

In this study, the most complete vaccination coverage was seen in the neurosurgery and orthopedic groups, followed by the gynecology group. The least complete vaccination coverage was seen in the ENT group. The neurosurgeons, orthopedists and gynecologists also had highest level of serum HBSAb. Nevertheless, in this study there was no significant relationship of positive HBSAb, needlesticks, high-risk exposure and the number of surgeries with any of the surgeons' groups. Despite the availability of hepatitis B vaccine, orthopedic surgeons remain at risk for acquiring blood-borne viral infection. Also, there is a relationship between positive HCVAb results and high-risk exposure.

One limitation of this study was the difficulty in convincing the faculty surgeons to undergo laboratory tests needed for the research. More studies are recommended to be done for better understanding about prevention and treatments in those high risks groups.

CONCLUSION

The results showed that in spite of the high needlestick rate in Iranian surgeons, the prevalence of hepatitis B and C is not very high among them. Most needlestick and positive cases were in the groups of gynecologists.

ACKNOWLEDGEMENT

We would like to thank the deputy research director of Baqiyatallah Hospital for their kind cooperation in this research.

CONFLICT OF INTEREST

All authors declare that there is no conflict of interest in this research.

CONTRIBUTORS

SM and SM contributed to conceptualization, data handling, and experimental design. SMK, HK, MA contributed to data analysis, provision of study materials and equipment. SM, MA and HRR contributed to study validation, supervision, data presentation, draft preparation, study consultation, writing and reviewing, and project administration. All authors have read and approved the final manuscript. ✚

REFERENCES

- Center for Disease Control and Prevention. What is viral hepatitis? Atlanta : Center for Disease Control and Prevention;2020.
- Westermann C, Peters C, Lisiak B, Lamberti M, Nienhaus A, Harling M. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. *Occup Environ Med* 2015 ;72:880-8. doi: 10.1136/oemed-2015-102879.
- Mohammadi Z, Keshtkar A, Eghtesad S, et al. Epidemiological profile of hepatitis B virus infection in Iran in the past 25 years; a systematic review and meta-analysis of general population studies. *Middle East J Dig Dis* 2016;8:5-18. doi: 10.15171/mejdd.2016.01.
- Shakeri MT, Foghanian B, Nomani H, et al. The prevalence of hepatitis B virus infection in Mashhad, Iran: a population-based study. *Iranian Red Crescent Med J* 2013;15:245-8. doi: 10.5812/ircmj.8200.
- Merat S, Rezvan H, Nouraie M, et al. Seroprevalence of hepatitis C virus: the first population-based study from Iran. *Int J Infect Dis* 2010;14:e113-e6. DOI: <https://doi.org/10.1016/j.ijid.2009.11.032>.
- Park H, Jeong D, Nguyen P, et al. Economic and clinical burden of viral hepatitis in California: a populationbased study with longitudinal analysis. *PLoS ONE* 2018;13: e0196452. <https://doi.org/10.1371/journal.pone.0196452>
- Kermani FR, Hosseini KM, Kafi-Abad SA, Mansournia MA, Sharifi Z, Maghsudlu M. Hepatitis C (HCV) viremic rate and its correlation to demographic factors among HCV confirmed Iranian blood donors. *Arch Iran Med* 2019;22:76-7.
- Alavian SM. Hepatitis B virus infection in Iran: changing the epidemiology. *Iranian J Clin Infect Dis* 2010;5:51-61.
- Razavi-Shearer D, Gamkrelidze I, Nguyen MH, et al. for Polaris Observatory Collaborators. Global prevalence, treatment, and prevention of hepatitis B virus infection in 2016: a modelling study. *Lancet Gastroenterol Hepatol* 2018;3:383-403. doi: 10.1016/S2468-1253(18)30056-6.
- Nelson NP, Easterbrook PJ, McMahon BJ. Epidemiology of hepatitis B virus infection and impact of vaccination on disease. *Clin Liver Dis* 2016;20: 607–28. doi: 10.1016/j.cld.2016.06.006.
- Al-Abhar N, Moghram GS, Al-Gunaid EA, Al Serouri A, Khader Y. Occupational exposure to needle stick injuries and hepatitis B vaccination coverage among clinical laboratory staff in Sana'a, Yemen: cross-sectional study. *JMIR Public Health Surveill* 2020;6:e15812. DOI: 10.2196/15812.
- Raimondo G, Locarnini S, Pollicino T, et al. Update of the statements on biology and clinical impact of occult hepatitis B virus infection. *J Hepatol* 2019 ;71:397-408. DOI: <https://doi.org/10.1016/j.jhep.2019.03.034>.
- Li M, Wang Z, Zhang L, Zheng H, Liu DW, Zhou MG. Burden of cirrhosis and other chronic liver diseases caused by specific etiologies in China, 1990–2016: findings from the Global Burden of Disease Study 2016. *Biomed Environ Sci* 2020; 33:1-10. doi: 10.3967/bes2020.001.
- Naglik J, Fay GG. Prevention and management of occupational exposures. In: DePaola L, Grant L. eds. *Infection control in the dental office*. Cham (Switzerland): Springer;2020. https://doi.org/10.1007/978-3-030-30085-2_9.
- Le MH, Yeo YH, Cheung R, Henry L, Lok AS, Nguyen MH. Chronic hepatitis B prevalence among foreign born and US born adults in the United States, 1999-2016. *Hepatology* 2020;71: 431-43. doi: 10.1002/hep.30831.
- Mbaawuaga EM, Hembah-Hilekaan SK, Iroegbu CU, Ike AC. Hepatitis B virus and human immunodeficiency virus infections among health care workers in some health care centers in Benue State, Nigeria. *Open J Med Microbiol* 2019;9:48-62. DOI: 10.4236/ojmm.2019.92007.
- Coppola N, De Pascalis S, Onorato L, Calò F, Sagnelli C, Sagnelli E. Hepatitis B virus and hepatitis C virus infection in healthcare workers. *World J Hepatol* 2016;8:273-81. doi: 10.4254/wjh.v8.i5.273.
- Sadlier C, O'Rourke A, Carr A, Bergin C. Seroepidemiology of hepatitis A, hepatitis B and

- varicella virus in people living with HIV in Ireland. *J Infect Public Health* 2017;10:888-90. doi: 10.1016/j.jiph.2017.01.019.
19. Motaarefi H, Mahmoudi H, Mohammadi E, Hasanpour-Dehkordi A. Factors associated with needlestick injuries in health care occupations: a systematic review. *J Clin Diagn Res* 2016;10:IE01-4. doi: 10.7860/JCDR/2016/17973.8221.
 20. Yang AD, Quinn CM, Hewitt DB, et al. National evaluation of needlestick events and reporting among surgical residents. *J Am Coll Surg* 2019; 229:609-20. doi: 10.1016/j.jamcollsurg.2019.09.001.
 21. Ishak AS, Haque MS, Sadhra SS. Needlestick injuries among Malaysian healthcare workers. *Occup Med (Lond)* 2019;69:99-105. doi: 10.1093/occmed/kqy129.
 22. Prester E, Diab-El Schahawi M, Lusignani LS, Paula H, Reilly JS. Blood-borne viruses: HIV, hepatitis B, and hepatitis C. Prester E, Diab-El Schahawi M, Reilly JS, eds. In: *Basic microbiology and infection control for midwives*. Cham (Switzerland): Springer Nature Switzerland AG; 2019. p.143-49.
 23. Shakeri MT, Nomani H, Ghayour Mobarhan M, et al. The prevalence of hepatitis C virus in Mmashhad, Iran: a population-based study. *Hepat Mon* 2013;13:e7723. doi: 10.5812/hepatmon.7723.
 24. Merat S, Rezvan H, Nouraie M, Jafari E, Abolghasemi H, Radmard AR, et al. Seroprevalence of hepatitis C virus: the first population-based study from Iran. *Int J Infect Dis*. 2010;14 Suppl 3:e113-6. doi: 10.1016/j.ijid.2009.11.032.
 25. Zamani F, Sohrabi M, Poustchi H, et al. Prevalence and risk factors of hepatitis C virus infection in Amol city, North of Iran: a population-based study 2008-2011. *Hepat Mon* 2013; 13: e13313. doi: 10.5812/hepatmon.13313.
 26. Fisher WD. Hepatitis C and the surgeon. *J Can Chir* 2013;56:80-1. DOI: 10.1503/cjs.000912.