Observational Study

Medicine®

OPEN

Anesthesiologists' acquisition of hepatitis B virus infection

Risk and prevention

Jingling Tian, MD[a], Fang Tan, MD[a], Lifei Lai, MD[a], Yingqing Deng, MD[a], Xinjin Chi, MD[a], Hongfang Geng, MD[b,*], Qianqian Zhu, MD, PhD[a,*]

Abstract

Occupational exposure remains a serious problem for medical staff, especially those working in operation rooms. Hepatitis B virus (HBV) is prevalent in patients undergoing surgery, and anesthesiologists are at risk of occupational acquisition of blood-borne HBV infection. To the best of our knowledge, there are no data about HBV prevalence and vaccinations, as well as attitudes toward sharp injuries and gloving among anesthesiologists in China, where the HBV prevalence is high. To clarify these, the present study was conducted.

An electronic questionnaire including HBV markers, gloving during practice, and reporting patterns of sharp injuries was created and sent to anesthesiologists.

After excluding 10 uncompleted questionnaires, 1739 questionnaires were included in the final analysis. Of all analyzed anesthesiologists, 1599 (91.9%) had experienced sharp injuries, and 1313 (75.5%) had experienced >1 sharp injury. Considering HBV vaccination histories, 1381 anesthesiologists (79.4%) received 3 vaccination doses, and only half of the immunized anesthesiologists received reminder HBV vaccination doses after work before exposure. There were 696 anesthesiologists (40.0% of all participants) who were ever exposed to HBV, and nearly two-thirds of them (440) were exposed to HBV more than once. There was a more positive attitude toward gloving and double-gloving to reduce HBV exposure.

The incidence of occupational HBV exposure among anesthesiologists is high, and its threat should be considered. HBV vaccinations and adherence to postexposure guidelines are recommended. The high prevalence of sharp injuries during anesthesia practice highlights the importance of safe anesthesia practices, such as gloving or double-gloving, especially when in contact with high-risk body fluids.

Abbreviations: HBIG = hepatitis B immunoglobulin, HBsAb = hepatitis B surface antibody, HBsAg = hepatitis B surface antigen, HBV = hepatitis B virus, HCV = hepatitis C virus, HIV = human immunodeficiency virus, ORs = operation rooms.

Keywords: anesthesiologists, hepatitis B virus, infection

1. Introduction

Occupational exposure remains a serious problem for medical staff, especially for those working in operation rooms (ORs). A high frequency of blood contact and sharp injuries occur in ORs. Factors contributing to the high occupational exposure are open surgical practice, sharp instruments, and frequent contact with blood and body fluids. Furthermore, in ORs, blood-borne pathogens like human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) have been shown to be common.[1,2] Therefore, accidental sharp injuries would place personnel at risk for blood-borne pathogens in ORs. Previous surveys have demonstrated that surgeons underestimate the risk of occupational exposure.[3–5] Studies have reported HIV and HCV infections after occupational exposure.[6,7] In comparison with HIV or HCV, HBV transmission risks from infections to nonimmune individuals through sharp injuries are higher.[8,9]

In addition to surgeons, anesthesiologists are also exposed to blood-borne pathogens in practice through central venous catheters, arterial catheterization, regional anesthesia, and exposure to blood and body fluids.[10,11] However, the report of occupational exposure is low among anesthesia personnel.[8] In contrast with other healthcare workers, sharp injuries among anesthesiologists confer a high risk.[8] Although wearing gloves could reduce the risk of percutaneous injuries and exposure to

Editor: Leyi Wang.

JT, FT, and LL contributed equally to this work.

This study was approved by the Ethics Committee of Henan Provincial People's Hospital. The requirement for informed consent was waived because completing the questionnaire was voluntary.

The National Natural Science Foundation of China 81600507 provided funding for editing support in the present research.

The authors have no conflicts of interest to disclose.

Supplemental Digital Content is available for this article.

[a] Department of Anesthesiology, The Seventh Affiliated Hospital of Sun Yat-Sen University, Shenzhen City, [b] Department of Anesthesiology, Henan Provincial People's Hospital of Zhengzhou University, Zhengzhou City, China.

[*] Correspondence: Qianqian Zhu, Hongfang Geng, No. 628 Zhenyuan Road, Department of Anesthesiology, The Seventh Affiliated Hospital of Sun Yat-Sen University, Shenzhen, Guangdong Province 518107, China (e-mails: zhu.qian.qian123@stu.xjtu.edu.cn, hnsyghf@126.com).

Medicine (2019) 98:29(e16416)

Received: 11 March 2019 / Received in final form: 29 April 2019 / Accepted: 19 June 2019

http://dx.doi.org/10.1097/MD.0000000000016416

blood and body fluids, some anesthesiologists do not wear gloves during high-risk procedures.[8]

The HBV prevalence is high, especially in China.[12,13] In a Taiwanese study, 16.7% of inpatients were seropositive for the surface antigen of HBV (HBsAg).[9] HBV prevalence is common in patients undergoing surgery, and anesthesiologists are at risk for occupationally acquired blood-borne HBV infections. However, previous studies have focused on surgeons in developed countries and other healthcare workers. To the best of our knowledge, there are no data about the prevalence of HBV and vaccinations, as well as the attitudes toward sharp injuries and gloving among anesthesiologists in China, where the HBV prevalence is high. To clarify these, the present study was conducted.

2. Methods

2.1. Questionnaire

An electronic questionnaire including the seropositivities of HBV markers, gloving during practice, and reporting patterns of sharp injuries was created using www.wenjuan.com, a freely obtained website. The questionnaire was completed at May 18, 2018, and then sent to anesthesiologists of hospitals in Zhengzhou and Shenzhen through WeChat (Tencent, China). The data collected were closed at October 1, 2018. The questionnaire is included in the supplement file, http://links.lww.com/MD/D111.

2.2. Ethics statements

This study was approved by the Ethics Committee of Henan Provincial People's Hospital. The requirement for informed consent was waived because completing the questionnaire was voluntary. Participants were assured that their answers were confidential and no data compromising privacy could be obtained.

2.3. Statistical analysis

Qualitative data were presented as percentage/composition ratios, and the Pearson Chi-squared test or Fisher exact probabilities were used to compare the differences. Two-tailed *P*-value <.05 was considered significant. SPSS 19.0 software (SPSS Inc, Chicago, IL) was used to perform statistical analyses.

3. Results

After excluding 10 uncompleted questionnaires, a total of 1739 questionnaires were included in the final analysis. Men comprised 50.6% of the responders. Of all responders, 40.5% were anesthesiology residents. The characteristics of the studied participants are shown in Table 1.

Of the total analyzed anesthesiologists, 1599 (91.9%) had experienced sharp injuries, and 1313 (75.5%) had experienced sharp injuries more than once. Almost half (817, 47.0%) of the responders reported experiencing sharp injuries caused by anesthesia practice, like catheterization and spinal anesthesia. Furthermore, 1251 (71.9%) responders experienced bleeding caused by sharp injuries.

Considering the history of HBV vaccinations, 1381 anesthesiologists (79.4%) received 3 doses of vaccinations, and only half of the immunized anesthesiologists received reminder doses of HBV vaccinations after work before exposure. Among those who had knowledge of their seropositivity of HBV markers (77.1%), the HBsAb(+) prevalence was 44.0%. Nineteen anesthesiologists were HBsAg(+) positive before work.

Table 1

Characteristics of participants.

	N (1739)	%
Male/female	880/859	50.6/49.4
Sharp injuries	1599	91.9
Sharp injuries (1 time)	286	16.5
>1 sharp injury	1313	75.5
Sharp injuries from anesthesia practice	817	47.0
Sharp injuries cause bleeding	1251	71.9
History of HBV vaccination		
Three doses	1381	79.4
Reminder dose	720	41.4
Knowledge of HBV markers before work	1340	77.1
HBs-Ab(+) before work	765	44.0
HBs-Ag(+) before work	19	1.1
Knowledge of HBV markers current	1136	65.3
HBs-Ab(+) current	747	43.0
HBs-Ag(+) current	25	1.4

HBsAb = hepatitis B surface antibody, HBV = hepatitis B virus.

Of note, there were 4 anesthesiologists whose HBsAg turned from negative before work to positive after work. Two of them did not remember being exposed to HBV during work.

3.1. Exposure to HBV

There were 696 anesthesiologists (40.0% of total participants) who were ever exposed to HBV, and nearly two-thirds of them (440) were exposed to HBV more than once (Table 2). Most of the exposures (84.9%) were self-inflicted. More than two-thirds of participants (73.7%) experienced exposures resulting from anesthesia practice, including catheterization and spinal anesthesia. Although 1251 (71.9%) of exposed anesthesiologists experienced bleeding when exposed to HBV, only 20.1% of responders reported the exposure every time, and 38.4% never reported. Considering the reason, 34.5% responders thought that there was no utility in reporting, 26.9% thought that reporting was complicated, and 11.2% did not know the process of reporting.

Table 2

Characteristics of participants who exposure to hepatitis B virus.

	N (696)	%
Exposure once	256	36.8
More than once	440	63.2
Agent of injuries (self)	591	84.9
Task being performed at the time of injury		
Anesthesia puncture or suture	513	73.7
Loading syringe	287	41.2
Injection	329	42.3
Cleaning up	287	41.2
Report		
Every time	140	20.1
Occasionally	289	41.5
Never	267	38.4
Reason for not reporting		
No utility in reporting	240	34.5
Reporting is complicated	187	26.9
Do not know how to report	78	11.2
Others	191	27.4

Table 3

Comparison between exposure and nonexposure to HBV.

	Exposure to HBV (696)	Nonexposure to HBV (1043)	*P*-value
Gender (female)	326 (46.8%)	533 (51.1%)	.081
Knowledge of HBV markers before work	544 (78.2%)	796 (76.3%)	
Vaccination, 3 doses	547 (78.6%)	834 (80.0%)	.489
Reminder dose	324 (46.6%)	396 (38.0%)	<.001
Knowledge of HBV markers current	503 (72.3%)	633 (60.7%)	<.001
HBV infection resolvers	133 (19.1%)	67 (6.4%)	<.001
Working years			<.001
<5	123 (17.7%)	341 (32.7%)	
5–10	130 (18.7%)	247 (23.7%)	
11–15	126 (18.1%)	157 (15.1%)	
>16	317 (45.5%)	298 (28.6%)	
Sharp injuries	680 (97.7%)	919 (88.1%)	<.001
Gloving when contact body fluids			<.001
Always	264 (37.9%)	481 (46.1%)	
Occasionally forgot	400 (57.5%)	544 (52.2%)	
Never	27 (3.9%)	15 (1.4%)	
Other	5 (0.7%)	3 (0.3%)	
Double gloving			.026
Patients with confirmed infection	329 (47.3%)	566 (54.3%)	
Emergency	34 (4.9%)	46 (4.4%)	
Always	10 (1.4%)	19 (1.8%)	
Never	323 (46.4%)	412 (39.5%)	

HBV = hepatitis B virus.

Among the 429 exposed anesthesiologists who reported at least once, only 156 received hepatitis B immunoglobulin (HBIG). Eighteen exposed anesthesiologists received HBIG without report according to the questionnaire.

3.2. Comparison between exposure and nonexposure to HBV

There were no gender differences between anesthesiologists exposed and nonexposed to HBV. The percentage of those receiving 3 doses of vaccination showed no differences between participants who were exposed and nonexposed to HBV. However, the percentage of those receiving reminder doses before exposure was greater in participants exposed than those nonexposed to HBV (46.6% vs 38.0%, $P < .001$; Table 3).

The HBV infection resolvers were those who spontaneously recovered from HBV infection with normal liver function, seropositivity of anti-HBs and anti-HBc immunoglobulin G, and seronegativity of HBsAg, HBeAg, and anti-HBe. There were 200 HBV infection resolvers among all the participants. More HBV infection resolvers were found in participants exposed to HBV than in those nonexposed to HBV (19.1% vs 6.4%, $P < .001$). Noteworthy, the 67 HBV resolvers did not remember the experience of exposure to HBV.

The number of years of experience in anesthesia were greater in participants exposed to HBV compared to those nonexposed to HBV. More participants exposed to HBV experienced sharp injuries than those nonexposed to HBV (97.7% vs 88.1%, $P < .001$).

Considering the attitude toward gloving (Table 4), there were significant differences between anesthesiologists exposed and nonexposed to HBV. A more positive attitude toward gloving and double gloving was associated with less exposure to HBV.

Table 4

Attitude toward gloving and double gloving when contact body fluids.

	N (1739)	%
Gloving when contact body fluids		
Always	745	42.8
Occasionally forgot	944	54.3
Never	42	2.4
Other	8	0.5
Double gloving		
Patients with infection	895	51.5
Emergency	80	4.6
Always	29	1.7
Never	735	42.3

4. Discussion

Some anesthesia practices including intravascular catheter insertion and spinal anesthesia might lead to accidental sharp injuries and contact with blood. In agreement with a previous study, the sharp injury incidence was high; 91.9% of anesthesiologists had experienced sharp injuries, and more than 3 quarters experienced more than one sharp injury.[5] In contrast to other medical staff, anesthesiologists spend most of their working time in ORs, where the prevalence of blood-borne pathogens is high.[1,2] Therefore, anesthesiologists' sharp injuries were riskier than those in other medical staff.[11,14] Sharp injuries place the anesthesiologists at risk for numerous blood-borne infections including HIV, HBV, and HCV. Forty percent of anesthesiologists were exposed to HBV, and nearly two-thirds of them were exposed to HBV more than once.

In mainland China, although the HBV infection incidence has decreased, the prevalence is still above 6%.[15] In comparison with the general population, HBV infection rates are higher in inpatients.[9] HBV transmission from infections to nonimmune exposures through sharp injuries has been estimated to be between 6% and 31%.[16,17] Sharp injuries are almost inevitable over time. The present study demonstrated that with an increase in the number of working years, the incidence of sharp injuries and exposure to HBV increased. On a more serious note, 70% of the anesthesiologists experienced bleeding when they were exposed to HBV and 73.7% of participants experienced injuries during anesthesia practices including intravascular catheter insertion and spinal anesthesia, which involved hollow-bore needles. Bleeding and hollow-bore needles are related to an increased risk of HBV transmission.[6] However, anesthesiologists might underestimate the risk of HBV transmission. There were 4 anesthesiologists whose HBsAg turned from negative before work to positive after work. We could not confirm whether they acquired HBV infections from patients because 2 of them did not remember being exposed to HBV. There were 200 HBV infection resolvers among the participants, and 33.5% of them did not remember the experience of exposure to HBV.

Anesthesiologists who are exposed to HBV are likely to know their own HBV status. However, some anesthesiologists did not receive HBV vaccinations or reminder doses, especially those who were not exposed to HBV. HBV vaccinations were available in 1985 and critical in preventing HBV infection. HBV vaccinations are recommended to all healthcare workers whose activities involve regular physical contact with patients' blood or

body fluids.[18] In the present study, 79.4% received vaccinations, which was higher than that in previous studies in other developing countries.[19,20] This might be attributed to the Chinese government initiating a universal HBV immunization program in 1992. It was only mandatory for newborns from 2005.[21] Some of the population failed to be vaccinated, and only 41.4% received reminder doses after work. Previous studies demonstrated that barriers to complete vaccination included low levels of awareness.[8,22] In addition to failure to receive vaccinations, another reason for nonprotection is nonresponse to HBV vaccinations.[18] Although nonresponders might benefit from revaccination, some healthcare workers did not even know their HBV status.[22–24] In the present study, only 77.1% were aware of their HBV status and 44% were HBsAb positive.

In addition to receiving vaccinations, following postexposure guidelines is another critical procedure to reduce HBV infection. Although the exposed healthcare workers' HBV status is critical for HBV exposure transmission, postexposure procedures are also effective for preventing HBV transmission.[17] For those who did not receive vaccinations, HBIG in combination with hepatitis B vaccine is the primary choice for protection. HBIG alone is the choice for those who did not respond to HBV vaccination. Multiple doses of HBIG should be initiated as soon as possible and no later than 72 hours after exposure to HBsAg-positive blood.[25] It provides an estimated 75% protection against HBV infection.[26] HBV vaccines are another choice and should be administered no later than 7 days after exposure.[25] HBIG could also be used with HBV vaccines at different injection sites simultaneously.[17,26]

Wearing gloves could reduce the risk of cutaneous exposure to blood and body fluids. Wearing gloves are recommended when contacting blood and body fluids. In agreement with a previous study, few participants did not wear gloves during contact with high-risk body fluids or blood.[8] In comparison with single gloving, double gloving could decrease the occupational exposure by reducing perforations and blood or fluid contact.[27] The present study demonstrated that a more positive attitude toward gloving and double gloving was associated with less exposure to HBV.

Limitations of the present study should be disclosed. First, the accuracy of the questionnaires might be biased by the responders. Although we consulted an infectious disease expert before creating the questionnaire, it still could reflect the attitudes of responders perfectly. Second, the questionnaire was a retrospective survey, and recall bias could not be avoided. Third, although the data of the present study were collected from 2 major regions in China, the results might not be representative of anesthesiologists in mainland China. Last but not least, postexposure preventive care for the participants could not be assessed very clearly. Usually, if an exposure is reported, the postexposure procedure would be followed. However, the postexposure procedure is not mandatory. In the present study, the number of exposed received HBIG was less than those reported. The data about the postexposure vaccination were not collected. The lack of postexposure prevention is one of the limitations of the present study and needed to be explored in the future.

In summary, the incidence of anesthesiologists' occupational exposure to HBV was high. The threat of HBV among anesthesiologists should be considered. Anesthesiologists' knowledge of HBV infections must be improved, and immunity against HBV and following postexposure guidelines is recommended. The high prevalence of sharp instrument injuries during anesthesia practice highlight the importance of safe anesthesia practice like wearing gloves, or even double gloves, especially during contact with high-risk body fluids or blood.

Acknowledgment

The authors thank the contributions made by Zhengwen Liu from First Affiliated Hospital of Xi'an Jiaotong University, for help of creating questionnaire and careful proofreading of this manuscript.

Author contributions

Conceptualization: Qianqian Zhu.
Data curation: Jingling Tian, Fang Tan, Lifei Lai, Xinjin Chi, Hongfang Geng, Qianqian Zhu.
Formal analysis: Jingling Tian, Fang Tan, Lifei Lai, Yingqing Deng, Hongfang Geng, Qianqian Zhu.
Funding acquisition: Qianqian Zhu.
Methodology: Hongfang Geng, Qianqian Zhu.
Supervision: Hongfang Geng, Qianqian Zhu.
Writing – original draft: Qianqian Zhu.
Writing – review & editing: Jingling Tian, Fang Tan, Lifei Lai, Yingqing Deng, Xinjin Chi, Hongfang Geng, Qianqian Zhu.

References

[1] Weiss ES, Makary MA, Wang T, et al. Prevalence of blood-borne pathogens in an urban, university-based general surgical practice. Ann Surg 2005;241:803–7.
[2] Weiss ES, Cornwell EE3rd, Wang T, et al. Human immunodeficiency virus and hepatitis testing and prevalence among surgical patients in an urban university hospital. Am J Surg 2007;193:55–60.
[3] Moghimi M, Marashi SA, Kabir A, et al. Knowledge, attitude, and practice of Iranian surgeons about blood-borne diseases. J Surg Res 2009;151:80–4.
[4] Lipson ME, Deardon R, Switzer NJ, et al. Practice and attitudes regarding double gloving among staff surgeons and surgical trainees. Can J Surg 2018;61:244–50.
[5] Hasak JM, Novak CB, Patterson JMM, et al. Prevalence of needlestick injuries, attitude changes, and prevention practices over 12 years in an urban academic hospital surgery department. Ann Surg 2018;267: 291–6.
[6] Cardo DM, Culver DH, Ciesielski CA, et al. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. Centers for Disease Control and Prevention Needlestick Surveillance Group. N Engl J Med 1997;337:1485–90.
[7] Yazdanpanah Y, De Carli G, Migueres B, et al. Risk factors for hepatitis C virus transmission to health care workers after occupational exposure: a European case-control study. Clin Infect Dis 2005;41:1423–30.
[8] Motavaf M, Mohaghegh Dolatabadi MR, Ghodraty MR, et al. Anesthesia personnel's knowledge of, attitudes toward, and practice to prevent needlestick injuries. Workplace Health Saf 2014;62:250–5.
[9] Shiao J, Guo L, McLaws ML. Estimation of the risk of bloodborne pathogens to health care workers after a needlestick injury in Taiwan. Am J Infect Control 2002;30:15–20.
[10] Bajwa SJ, Kaur J. Risk and safety concerns in anesthesiology practice: the present perspective. Anesth Essays Res 2012;6:14–20.
[11] Greene ES, Berry AJ, Jagger J, et al. Multicenter study of contaminated percutaneous injuries in anesthesia personnel. Anesthesiology 1998;89:1362–72.
[12] Franco E, Bagnato B, Marino MG, et al. Hepatitis B: epidemiology and prevention in developing countries. World J Hepatol 2012;4:74–80.
[13] Yu R, Fan R, Hou J. Chronic hepatitis B virus infection: epidemiology, prevention, and treatment in China. Front Med 2014;8:135–44.
[14] Greene ES, Berry AJ, Arnold WP3rd, et al. Percutaneous injuries in anesthesia personnel. Anesth Analg 1996;83:273–8.
[15] Liu J, Zhang S, Wang Q, et al. Seroepidemiology of hepatitis B virus infection in 2 million men aged 21–49 years in rural China: a population-based, cross-sectional study. Lancet Infect Dis 2016;16:80–6.

[16] Sharma R, Rasania S, Verma A, et al. Study of prevalence and response to needle stick injuries among health care workers in a tertiary care hospital in Delhi, India. Indian J Community Med 2010;35:74–7.
[17] U.S. Public Health ServiceUpdated U.S. Public Health Service Guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for postexposure prophylaxis. MMWR Recomm Rep 2001;50:1–52.
[18] Bonanni P, Bonaccorsi G. Vaccination against hepatitis B in health care workers. Vaccine 2001;19:2389–94.
[19] Kabir A, Tabatabaei SV, Khaleghi S, et al. Knowledge, attitudes and practice of Iranian medical specialists regarding hepatitis B and C. Hepat Mon. Summer 2010;10:176–82.
[20] Burnett RJ, Francois G, Mphahlele MJ, et al. Hepatitis B vaccination coverage in healthcare workers in Gauteng Province, South Africa. Vaccine 2011;29:4293–7.
[21] Wang FS, Fan JG, Zhang Z, et al. The global burden of liver disease: the major impact of China. Hepatology 2014;60:2099–108.
[22] Sukriti , Pati NT, Sethi A, et al. Low levels of awareness, vaccine coverage, and the need for boosters among health care workers in tertiary care hospitals in India. J Gastroenterol Hepatol 2008;23:1710–5.
[23] Salama II, Sami SM, Salama SI, et al. Immune response to second vaccination series of hepatitis B virus among booster dose non-responders. Vaccine 2016;34:1904–8.
[24] Walayat S, Ahmed Z, Martin D, et al. Recent advances in vaccination of non-responders to standard dose hepatitis B virus vaccine. World J Hepatol 2015;7:2503–9.
[25] Flisiak R, Halota W, Jaroszewicz J, et al. Recommendations for the treatment of hepatitis B in 2017. Clin Exp Hepatol 2017;3:35–46.
[26] Schillie S, Murphy TV, Sawyer M, et al. CDC guidance for evaluating health-care personnel for hepatitis B virus protection and for administering postexposure management. MMWR Recomm Rep 2013;62:1–9.
[27] Mischke C, Verbeek JH, Saarto A, et al. Gloves, extra gloves or special types of gloves for preventing percutaneous exposure injuries in healthcare personnel. Cochrane Database Syst Rev 2014;CD009573.