

Readers' Forum

Management of the Healthcare Worker Infected With Human Immunodeficiency Virus: Lessons From Nosocomial Transmission of Hepatitis B Virus

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INTRODUCTION

Since acquired immunodeficiency syndrome (AIDS) was first recognized and reported in 1981, more than 175,000 persons with AIDS have been reported to public health departments in the United States.¹ Despite advances in therapy, the median survival following the diagnosis of AIDS is approximately two years.² The dramatic increase in AIDS cases and their continued poor prognosis has resulted in great public concern regarding the risks of transmission of human immunodeficiency virus (HIV) from infected healthcare workers to patients.

The report of probable transmission of HIV infection from a dentist to five patients³⁻⁵ has led in part to the recent publication of recommendations by the Centers for Disease Control (CDC) for the prevention of nosocomial transmission of HIV during exposure-prone invasive procedures from infected healthcare workers to patients.⁶ In brief, these recommendations entail the following: all healthcare workers should adhere to Universal Precautions (UP); healthcare workers who perform exposure-prone invasive procedures should know their HIV status but testing should be on a voluntary basis; and healthcare workers testing positive for HIV or hepatitis B surface antigen (HBsAg) and hepatitis B "e" antigen (HBeAg) should not perform exposure-prone procedures unless cleared by an expert panel, and then only with informed consent of their patients.

Voluntary or mandatory exclusion from performing invasive procedures by HIV-infected healthcare

workers also has been recommended in position papers published by the American Medical Association,⁷ the Society for Hospital Epidemiology of America,⁸ and the Association for Practitioners in Infection Control.⁸ However, a position paper from the Infectious Disease Society of America indicates that HIV-infected healthcare workers who comply with standard infection control practices should not be routinely excluded or restricted from performing patient care activities, including invasive procedures.⁹ The scientific underpinning of the CDC recommendations is based on an evaluation of hepatitis B virus (HBV) outbreaks involving healthcare worker-to-patient transmission and the belief that HIV is transmitted in ways similar to HBV, but less readily. We will review the published reports of HBV transmission during invasive procedures as a guide to determine which procedures are likely to be associated with a risk of HIV transmission.

TRANSMISSION OF HBV

HBV transmission mechanisms have served as a model for both predicting and preventing HIV transmission. Like HIV, transmission of HBV is widely recognized to follow sexual,¹⁰ parenteral,^{11,12} or perinatal exposure.¹³ Although HBV may be demonstrated in saliva,¹⁴ transmission via oral secretions has not been demonstrated in animal experiments¹⁵ or reported in human exposures.^{16,17} HBV is more readily transmitted than HIV and therefore serves as a worse-case scenario for HIV transmission.

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Weber DJ, Hoffmann KK, Rutala WA. Management of the healthcare worker infected with human immunodeficiency virus: lessons from nosocomial transmission of hepatitis B virus. Infect Control Hosp Epidemiol. 1991;12:625-630.

TABLE
SUMMARY OF OUTBREAKS ASSOCIATED WITH HBV-INFECTED HEALTHCARE WORKERS

Information	Gynecologist	Cardiac Surgeon	Oral Surgeon	General Dentistry
No. reports	5	3	5	4
References	24,25,34,38,42	26,28,35	27,29,31,36,41	32,33,39,43
Incubating illness	0	2	0	1*
Transmission by chronic carrier	5	1	5	4
HBsAg-positive	5	1	5	4
HBeAg-positive	5	1	3, 2 not done	3, 1 not done
Symptomatic/total HBV cases†	32/49	10/25	39/199	32/49
Procedures (cases)	Hysterectomy (27) Cesarean section (15) Oophorectomy (2) Repair of prolapse uterus (1) Forceps delivery (2) Unknown (2)	Open-heart surgery (8) Cardiothoracic surgery (17)	Most commonly reported procedure: extractions (68)	Most commonly reported procedures: extractions, crowns, surgery
Proposed mode of transmission	Direct injury by sharps guided by gloved fingers during surgery ^{24,25,34,38,42} needle holder not used for suturing ²⁵	Procedures involved "high-risk" for sharps injury ^{26,28,35}	Injury (e.g., cuts) from instruments/teeth ^{27,29,31,36,41} ; no gloves during surgery ^{27,29,31,36,41} ; severe dermatitis ³⁶	Hand trauma (e.g., cuts) with subsequent bleeding into mouth of patient ^{39,43} ; no gloves ^{32,33,39,43}
Infection control techniques/precautions instituted	Unstated ²⁴ ; double glove ^{25,38} ‡; exclusion from surgical procedures ^{34,38,42}	Removed during illness ^{26,35} ; treated with interferon ²⁸	Gloves ^{27,29,41} ‡; exclusion from surgical procedures ^{29,31,36}	Exclusion from surgical procedures ^{32,33} ; gloves ^{39,43}

* One incubating dentist became a chronic carrier.

† Asymptomatic cases were not sought in all studies, and some cases may represent nonoutbreak-associated infection.

‡ Cases transmitted after precautions initiated.

The risks of acquiring infection following percutaneous exposure in the healthcare setting are approximately 30% for HBV if the source is HBeAg-positive¹¹ and 0.29% for HIV.¹⁸ HBV likely is more stable than HIV in the environment because HBV is a nonenveloped virus. Both agents are susceptible to disinfectants commonly used in the hospital.¹⁹ Indirect transmission of HBV has been reported in the hospital setting due to blood-contaminated instruments or other objects. Infection has been associated with a blood-contaminated jet gun injector,²⁰ an endoscope,²¹ a multi-dose heparin vial,²² and a spring-loaded fingerstick device.²³ Indirect transmission of HIV in the hospital setting has not been reported.

TRANSMISSION OF HBV FROM INFECTED HEALTHCARE WORKERS TO PATIENTS

Twenty reports have appeared in the English-language literature documenting transmission of HBV from infected healthcare personnel to patients in

healthcare settings (Table).²⁴⁻⁴³ Unpublished investigations also have been reported in the literature as "personal communications."^{38,40} Countries reporting outbreaks included the United States (13), England (4), Holland (1), Switzerland (1), and Norway (1). The outbreaks occurred between 1968 and 1986.

In these reports, 21 HBV-infected healthcare workers transmitted infection to approximately 400 persons. Seventeen of the infected healthcare workers routinely performed operative procedures or engaged in dentistry. The remaining four performed more minor invasive procedures, such as performing intramuscular injections, obtaining blood gases, performing venipunctures or operating a cardiac pump.

Transmission most commonly occurred (77%) from a healthcare worker who was chronically infected with HBV. In all cases in which HBeAg was sought, the healthcare worker was positive.^{24-26,28,30-32,34,36,38,39,41-43} In five cases, transmission occurred during the incubation phase of acute HBV infection.^{26,35,37,39,43} Of interest, the source of infection

TABLE (continued)

SUMMARY OF OUTBREAKS ASSOCIATED WITH HBV-INFECTED HEALTHCARE WORKERS

Information	General Medical		Registered Nurse	Perfusion Technologist
	Physician	Inhalation Therapist	(Surgical Ward)	
No. reports	1	1	1	1
References	30	40	37	26
Incubating illness	0	1	1	0
Transmission by chronic carrier	1	0	0	1
HBsAg-positive	1	1	Not done	1
HBeAg-positive	1	1	Not done	1
Symptomatic/total HBV cases†	41/41	2/2	11/11	11/11
Procedures	Venipuncture or prick (33 of 36 cases)	Drew blood gases	Gave IM injections	Fitted sterile parts of heartlung machine; operated pump during open-heart surgery
Proposed mode of transmission	Injuries from opening drug ampules; MD worked while severely ill, including esophageal bleeding; no gloves	Severe exudative dermatitis on hands may have caused contamination of arterial catheter; no gloves	Contamination of IM injections	Contaminated heart-lung machine from hand warts that bled; no gloves
Infection control techniques/precautions instituted	Gloves ³⁰ ‡; died	Removed during illness	Removed during illness	Gloves ²⁶ ‡; excluded from work

* One incubating dentist became a chronic carrier.

† Asymptomatic cases were not sought in all studies, and some cases may represent nonoutbreak-associated infection.

‡ Cases transmitted after precautions initiated.

for the healthcare provider was an infected patient in at least three instances.^{36,37,40}

In eight outbreak investigations, serologic testing was offered to exposed patients.^{24,27,28,32,35,36,38,39} Overall, 160 of 2,704 (5.9%) showed evidence of possible nosocomial acquisition. Interpretation of these data requires recognition of several important caveats. First, because not all exposed patients were tested, the sample population may not truly reflect the rate of HBV transmission. Second, this rate of transmission represents the upper bounds of infectivity because it was often impossible to separate out cases of nosocomial transmission from either previous or nonoutbreak-related infection. Third, these data represent the rate of HBV transmission only in outbreaks whose investigation was precipitated by known transmission.

Following recognition of an HBV outbreak traced to a healthcare provider, hospital or public health authorities suggested the following measures: institution of glove and/or mask use^{26,29,30,38,39,41,43}; obtaining informed consent^{25,27,38}; removal from work during acute illness^{26,35,37}; restriction from performing invasive procedures^{31-34,36,42,43}; and/or restriction from performing invasive procedures after glove use failed to prevent additional infections.^{26,29,38}

LESSONS FROM NOSOCOMIAL TRANSMISSION OF HBV

The overall seroprevalence of all HBV markers in the US population is 14% (0.9% HBsAg-positive) among African-Americans and 3% (0.2% HBsAg-positive) among caucasians.⁴⁴ Among healthcare workers with no or infrequent blood contact, the seroprevalence is 3% to 10% (0.3% HBsAg-positive), while among healthcare workers with frequent blood contact, it is 15% to 30% (1%-2% HBsAg-positive).⁴⁴ The high prevalence of HBV markers among healthcare workers has been related to duration and frequency of exposure to blood or blood products. Despite the large number of HBsAg-positive healthcare providers, only 20 reports have been published of HBV transmission from healthcare providers to patients. Several prospective studies⁴⁵⁻⁴⁸ have failed to discern a risk greater than background level of HBV transmission from infected healthcare workers to patients, even during invasive procedures. Because there are approximately 90,000 practitioners of general surgery, obstetrics/gynecology, orthopedic surgery, thoracic surgery, and colorectal surgery, and 140,000 active dentists, one could estimate that there are at least 2,300 to 4,600 HBsAg-positive healthcare workers

who perform exposure-prone invasive procedures. Given this large number of HBV-infected healthcare workers, physician-to-patient transmission is a very infrequent event.

The risks of patients acquiring HIV from their healthcare provider should be several orders of magnitude lower than the risk of acquiring HBV from their healthcare provider for the following reasons. First, the seroprevalence of HIV among healthcare providers averages 0.12%.⁴⁹ Unlike the situation with HBV, the prevalence of HIV infection among healthcare workers is similar to the general population.^{49,50} Second, all published reports of HBV transmission occurred in an era prior to the institution of UP. The most common risk factor for transmission was the failure to wear gloves during dental or oral surgery procedures. Third, based on data delineating the risk of infection following percutaneous exposure, the risk of HIV transmission would appear to be approximately 100-fold less than for HBV. Retrospective testing of patients operated on by HIV-positive physicians has failed to demonstrate transmission.⁵¹⁻⁵⁴ Thus, despite one probable case of transmission from an HIV-infected dentist to five patients, the risk of HIV acquisition per invasive procedure is low.

Procedures most commonly associated with transmission appeared to involve manipulation of needles or sharp instruments, especially in highly confined or poorly visualized spaces. Dental procedures, oral surgery, and major chest and abdominal/pelvic surgery were associated with almost all cases of HBV transmission. Thus, hysterectomies and caesarian sections have been associated with transmission but not nonforceps vaginal deliveries.^{24,25,34,38,42} Case/control studies in outbreaks involving dentists have reported that invasive procedures (e.g., surgery, crowns, extraction) were more frequently associated with HBV transmission than relatively noninvasive procedures (e.g., prophylaxis).^{32,39} Recommendations to restrict HIV-infected healthcare workers from invasive procedures should be interpreted such that exclusion would apply only to procedures involving the use of sharp instruments in highly confined or poorly visualized spaces or where digital palpation of needles or other sharp instruments is used.

The major risk factor associated with transmission of HBV was the failure to wear gloves while performing dental procedures or oral surgery.^{27,29,31,32,33,36,39,41,43} UP should be mandatory in all healthcare settings. Dermatitis, especially when associated with weeping or bleeding lesions, also was associated with HBV transmission.^{26,36,40} Healthcare personnel with exudative lesions or weeping dermatitis should be prohibited from direct patient contact and handling patient-care equipment. If prohibition is

not instituted, healthcare personnel with exudative lesions or weeping dermatitis should be required to wear gloves during direct patient contact and when handling patient-care equipment. In HBV outbreaks, the institution of a requirement to wear gloves or double-gloves eliminated HBV transmission in some outbreaks^{39,41} but led only to a decreased rate of transmission in others.^{26,29,30,38}

Many of the recommendations in the recent CDC publication have been used to control HBV outbreaks, including requiring informed consent of patients prior to an exposure-prone invasive procedure, restriction from performing invasive procedures, and evaluation of the risks of transmission on an individual basis by public health and hospital personnel.^{38,42}

Evaluation of potential transmission of HBV from healthcare workers to patients frequently led to general knowledge about the provider's HBV status. Tracing patients exposed to an HIV-infected healthcare worker also was likely to lead to a dissemination of the provider's HIV status.

Institution of the CDC recommendations for the management of the HIV-infected worker is likely to result in significant costs.⁵⁵ It remains to be seen whether the CDC recommendations or those from the Infectious Disease Society of America reflect a better balance between protection of the public and the rights of healthcare providers.

CONCLUSIONS

Despite the significant prevalence of HBsAg positivity among healthcare workers, transmission from infected healthcare workers to patients appears to be a rare event based on the relative scarcity of reported cases. Because the seroprevalence of HIV among healthcare workers is at least ten-fold less than HBsAg, and HIV is approximately 100-fold less transmissible than HBV following percutaneous exposure, transmission of HIV during an invasive procedure is likely to be a rare event.

High-risk invasive procedures for transmission of HBV include dental and oral surgical procedures and major chest and abdominal/pelvic surgery. Procedures such as nonforceps vaginal deliveries, cutaneous surgery, and placement of intravenous devices should not transmit bloodborne pathogens provided UP are followed.

The use of gloves during invasive procedures significantly decreases the frequency of HBV transmission. By extrapolation, the use of gloves should also decrease the transmission of other bloodborne pathogens. Gloves should be worn whenever contact with nonintact skin, mucous membranes, and blood is anticipated as well as during all invasive procedures. However, the use of gloves will not entirely eliminate

transmission of HBV from HBeAg-positive healthcare workers during exposure-prone invasive procedures.

Healthcare personnel with exudative lesions or weeping dermatitis should be prohibited from direct patient contact and from handling patient care equipment.

In all reported cases of HBV transmission from a chronically infected healthcare worker, the source was HBeAg positive. Therefore, chronically HBV-infected healthcare workers should be restricted from performing exposure-prone invasive procedures only if they are HBeAg-positive.

Periodic screening of healthcare workers for HBV will not prevent all cases of healthcare worker-to-patient transmission, as healthcare workers during the incubation phase of HBV infection also may transmit disease. If HIV transmission is determined to occur at a measurable frequency, transmission during the "window" period of disease also may occur.

Restrictions against performing invasive procedures have been employed to control HBV outbreaks in several cases, but only when an HBV-infected healthcare worker was the known transmitter.

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