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BRIEF COMMUNICATION

Transmission of hepatitis C virus by occupational percutaneous injuries in South Korea

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Korea is an endemic area of hepatitis. Hepatitis C virus (HCV) infections caused by occupational percutaneous injuries are a serious problem for healthcare workers and there has been a gradual increase in the number of HCV infections. We therefore determined the transmission rate of HCV after occupational percutaneous injury. This was a retrospective cohort study reviewing all occupational blood exposure reports made between January 1, 2004, and December 31, 2008, at a university-affiliated acute care hospital. Over the 5-year study period, there were 1,516 accidents of occupational exposure to blood; of these, 327 (21.6%) were to the blood of HCV-infected patients and 3 (0.9%) healthcare workers became infected with HCV (95% CI 0.6–8.8). In Korea, although the bloodborne accidents leading to exposure to HCV occurred frequently (21.6%), the transmission rate was very low (0.92%).

Introduction

Hepatitis C virus (HCV) affects approximately 130 million individuals worldwide per year and is associated with significant morbidity and mortality.[1–4] South Korea is an endemic area of viral hepatitis. The seroprevalence of hepatitis B virus surface antigen (HBsAg) in the general Korean population (4.1%–8.9%) is much higher than other countries.[5–7] However, the implementation of universal precautions has markedly reduced the occupational threat of hepatitis B virus (HBV) infection,[1–3] as did the widespread vaccination and postexposure prophylaxis of healthcare workers for HBV. By contrast to HBV, there is no present HCV vaccination or post exposure prophylaxis therapy to prevent infection. In addition, there has been

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a rapid increase in the incidence of occupational percutaneous injuries (OPI) to HCV in South Korea.[8] Thus, HCV infections caused by OPI remain an important occupational threat to health care workers.[9]

In the absence of post exposure prophylaxis for HCV infection, it is important to know the transmission rate of HCV infection for counseling and follow-up of healthcare workers. The risk of developing acute HCV infection after exposure to an HCV-contaminated needle has varied greatly depending on the countries studied. For example, in Japan, the rate of anti-HCV seroconversion in healthcare workers after OPI was 5.4%[10] and 0.36% in Italy.[11] However, the transmission rate of HCV from OPI to healthcare workers in South Korea has not yet been reported.

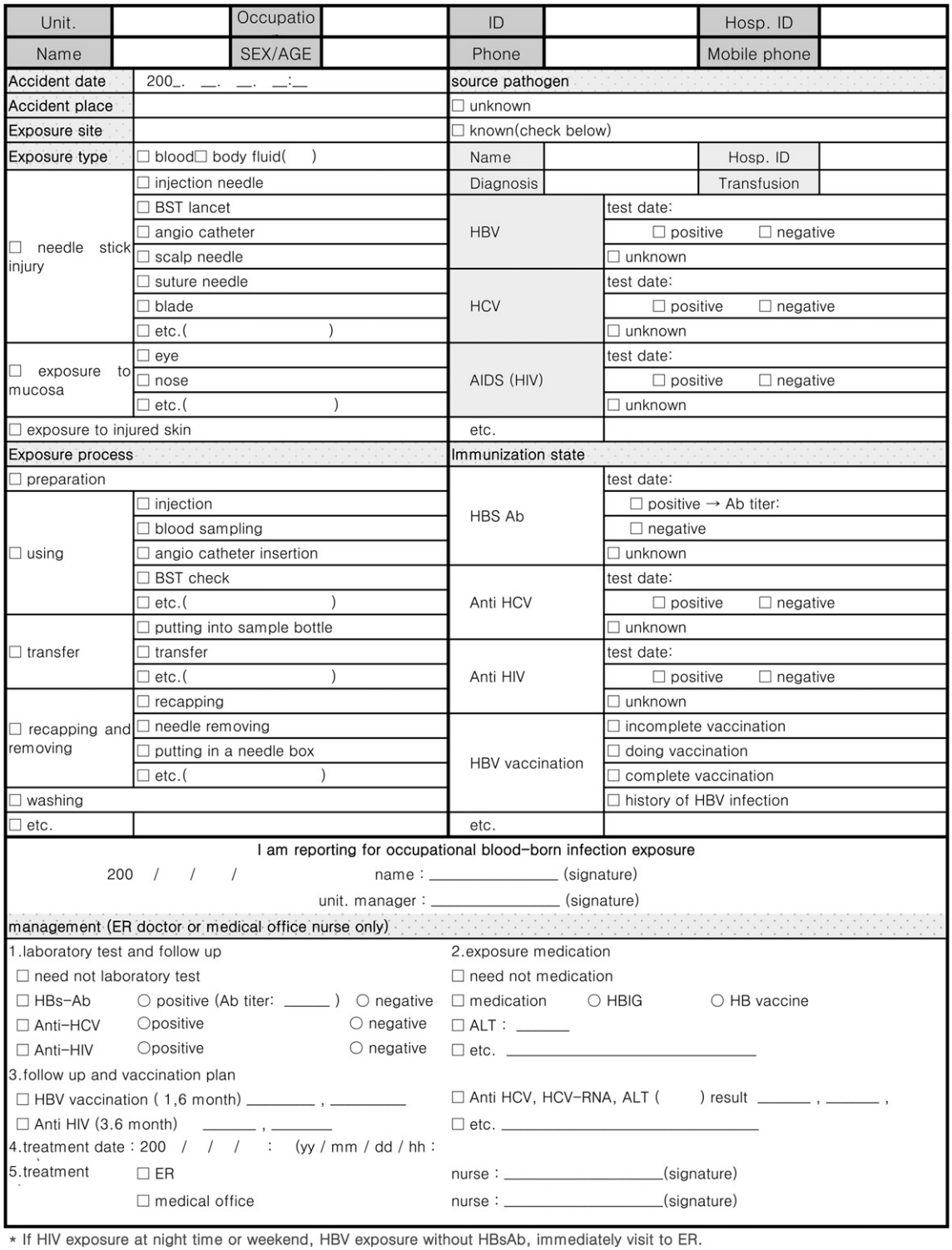

Figure 1 Occupational bloodborne infection exposure report used in Asan Medical Center.

The goal of the current study was to investigate the transmission rate after HCV-associated OPI in Seoul, Korea.

Materials and methods

Study design

A retrospective cohort design and medical record review was performed to determine the rate of HCV transmission and epidemiologic characteristics of HCV-associated OPI.

Setting

Asan Medical Center is an acute tertiary university hospital in Seoul, South Korea. This institution has approximately 6000 employees, 2800 beds, and a mean bed occupancy rate of about 92%. There are about 1400 doctors (approximately 500 attending physicians, 250 fellows, 500 residents and150 interns), 2500 nurses and 1500 technicians employed. Annually, 5500 HCV-infected patients are treated at this institution in the outpatient department, the emergency department, and the admission office.

Occupational bloodborne infection exposure reporting program

Healthcare workers who experience OPI are required to visit the employee health office and report the accident. This office has registered all accident reports in a special database since 2004. The employee health office is responsible for laboratory tests, postexposure prophylaxis, follow-up of all healthcare workers sustaining needle sticks, and record it on a report form (Fig. 1).

During the visit to the employee health office, blood was drawn from all healthcare workers who were exposed to HCV-infected blood. The sample was then tested for alanine aminotransferase (ALT), and anti-HCV antibody ([ELISA] Architect ISR, Abbott, IL USA). If the tests had been performed on a healthcare worker within the past 6 months, the initial baseline tests were not performed. ALT and anti-HCV antibody were measured a month after the accident as well as HCV-RNA, using a polymerase chain reaction ([PCR] M2000 SP, Abbott, IL USA) also tested at the same time. Long-term follow-up tests were performed 2 years after the accident with routine employee medical check-ups that are performed annually. If hepatitis developed it was then reported to the employ health office automatically.

Data collection and analysis

We retrospectively reviewed all occupational infection exposure reports from the database of the employee health office, dated January 1, 2004, to December 31, 2008. Employees, who were exposed to blood of HCV-confirmed source patients were included in this study. Employees exposed to source patients who were not infected with HCV, including those whom no specific pathogen was identified, were excluded.

All data were descriptive and analyzed using SPSS version 12.0 for Windows (SPSS Inc., Chicago, IL USA). The cumulative incidence of HCV after a needle stick exposure together with the 95% confidence interval was then calculated.

Results

Over the 5-year study period, there were 1516 accidents of occupational exposure to blood; of these, 327 (21.6%) were to the blood of HCV-infected patients and 3 (0.9%) healthcare workers became infected with HCV (95% CI 0.6-8.8). All three employees were infected by known HCV carriers. The characteristics of the needle stick injuries are shown in Table 1. The cumulative incidence of OPI causing HCV infection for all employees was 0.92 cases per 100 patients. For physicians and nurses it was 0.67 and 1.27 cases per 100 patients, respectively.

Most reported occupational exposures to blood involved nurses (48.3%) followed by interns (26.9%), residents (11.0%), attending physicians (4.3%), technicians (3.7%), fellows (3.4%), and support personnel (2.4%); most were women (70.9%). These results are shown in Table 1. Of the three infected healthcare workers, two were female nurses and one was a male intern (Table 2).

Table 1 Epidemiological characteristics of healthcare workers with OPI over 5 years (*N = 327*).

Variables	Total (*N = 327*)	Percentage
Sex		
Men	95	29.1
Women	232	70.9
Occupation		
Nurse	158	48.3
Intern	88	26.9
Resident	36	11.0
Fellow	11	3.4
Professor	14	4.3
Technician	12	3.7
Support staff	8	2.4
Type of exposure		
Needles	169	51.4
BST lancet	19	5.8
Intravenous catheter	24	7.3
Suture needles	38	11.6
Blade	12	3.7
Operation device	21	6.4
Others	45	13.7
Accident process		
Preparation	2	0.6
Use	154	47.1
Transport	48	14.7
Recapping or removing	100	30.6
Washing	5	1.5
Miscellaneous	18	5.5

BST = blood sugar test; OPI = occupational percutaneous infection.

Table 2 Hepatitis C virus infected healthcare workers by occupational percutaneous injury.

	Patient 1	Patient 2	Patient 3
General characteristic			
Sex	Woman	Man	Woman
Age (yr)	29	27	26
Accident setting	ED	SICU	Ward
Occupation	Nurse	Intern	Nurse
Type of exposure	Needle	Needle	Needle
Accident process	Injection of drug	Blood sampling	Removing needles
Accident site	Left first finger	Right first finger	Right third finger
Accident time	Sep 13 06:40	Dec 26 04:00	July 20 23:30
Source patient	Anti-HCV Ab (+)	Anti-HCV Ab (+)	Anti-HCV Ab (+)
Laboratory test data			
Initial anti-HCV Ab	Negative	Negative	Negative[a]
Initial AST/ALT	16/14	14/13	17/9[a]
HCV confirmed day[b]	Nov 22	Jan 25	Sep 22
f/u AST/ALT	172/524	174/345	129/225
f/u anti HCV Ab	Positive	Negative	Positive
HCV-RNA PCR	Positive	Positive	Positive
HCV genotype	Ib	Ib	Ib
Treatment	Interferon, ribavirin	Interferon, ribavirin	Interferon, ribavirin
Treatment start day	Dec 08	Mar 31	Oct 11
Treatment period	6 months	6 months	12 months
Long term f/u			
AST/ALT	16/25	18/27	19/18
HCV-RNA PCR	Negative	Negative	Negative
HCV reactivation	No	No	No

ALT = alanine aminotransferase; Anti-HCV Ab = Anti-hepatitis C virus antibody; AST = aspartate aminotransferase; ER = Emergency department; HCV-RNA PCR = hepatitis C virus ribonucleic acid polymerase chain reaction; initial f/u = follow-up 1 month after the accident; long-term f/u = follow-up 2 years after the accident; SICU = surgical intensive care unit.

[a] The data were recorded 1 year before the accident by employee's routine medical check-up.

[b] HCV infection was confirmed by HVC RNA PCR.

The most common type of exposure device was an injection needle (51.7%). The highest risk of exposure (47.4%) was associated with use of the device and recapping or removing (30.6%) of needles (Table 1).

Two of the three HCV infected healthcare workers were initially anti-HCV negative. The other one tested negative one year ago from the accident, and had no risk of obtaining hepatitis infection (e.g., transfusion, infected blood exposure, intercourse with a hepatitis partner) from the routine medical check to the accident.

One month after exposure, two healthcare workers showed seroconversion, whereas the other one did not. The third patient developed anti-HCV antibodies 3 years later. Clinical details of the three healthcare workers in whom acute hepatitis C developed are provided in Table 2.

Discussion

In this study, the risk of transmission rate after HCV-associated OPI in Korea was only 0.92%. Studies in Germany, the United States, and Taiwan have reported transmission rates of 2.2%, 1.8%, and 2.5% respectively.[9,12] These transmission rates are lower than Japan (5.4%)[10] but higher than Italy (0.39%).[11] This difference suggests that the transmission rate may depend on factors specific to each individual country.

It may be influenced by differences in surveillance systems and rates of compliance (e.g., a reporting program) with standard universal precautions (e.g., education, use of protection device). Ippolito[11] reported 0.39% of transmission rate in Italy; there were 14 infected case of 3604 exposure. By contrast, Arai[10] showed 5.4% of seroconversion; 3 transmitted employees of 54 exposures in Japan. It means the sample size may influence a statistical conflict. Because of the high prevalence of hepatitis in Korea, healthcare workers are very sensitive about blood born infection so even minor exposures (e.g., scratch, eye exposure) are reported. This sensitive response might affect the results of a low transmission rate.

The rate of HCV infection after OPI seems to be associated with the type of device (e.g., blood filled angiocatheter), severity of accident (e.g., deep injuring), human immunodeficiency virus (HIV) co-infection and distribution of HCV infected source patients too.[13–18] However, there were no HIV infected source patients and only a few blood-filled angiocatheter (7.3%) induced injury in this study.

Generally, incubation periods for hepatitis C is known from 15–160 days (mean, 7 weeks),[19] but HCV seroconversion has been reported to occur as long as 8–13 months

after OPI. This is when blood is drawn from HIV-HCV co-infected patients, patients undergoing hemodialysis, or receiving multiple blood transfusions.[20]

One of our three HCV-positive health-care workers developed delayed seroconversion 3 years after the injury. After a month from the injury, although anti-HCV antibody was within normal ranges, the patient experienced fatigue and jaundice. His ALT level was 345 IU/L (normal $<$ 40 IU/L) and his serum HCV-RNA PCR was positive. Therefore, even if anti-HCV antibody negative, sometimes OPI patients need to check HCV-RNA PCR.

All three individuals were treated with interferon and ribavirin for 6 to 11 months, and all have remained HCV-RNA PCR negative for 3 years after treatment.

Our study is limited to a single hospital in South Korea and may not be reflective of other hospitals or settings, and our data were based on medical office report forms. For these reason, additional medical or social information about the injured healthcare workers could not be obtained due to privacy issues. Thus, we have missing data and it was difficult to follow-up, especially when the injured employee resigned. This resulted in not being able to calculate accurate incidence density and relative risk. However, because of an annual resignation rate of 5%, the follow-up loss in this study was roughly 16 cases. In addition, there were no extra reports about HCV infection from the routine employee medical check program during the long-term follow-up period. In one of our infected cases, the employee did not report at initial exposure; therefore, we could not confirm if she was infected or not at that time.

Conclusion

In this study, we found that the prevalence of exposures to HCV-positive blood was high (21.6%); however, the transmission rate after an accidental OPI was very low (0.92%) in Korea.

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