

HBV and HCV infection in Japanese dental care workers

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Abstract. 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 dental care workers. To determine the best way to protect these workers, our study examined viral hepatitis infection in dental care workers in regions with a high prevalence of HCV infections in Japan. In total, 141 dental care workers (including dentists, dental hygienists and dental assistants) were enrolled. After a questionnaire to elicit demographic information was administered by an oral surgeon, hepatitis B surface antigen (HBsAg), antibody to HBs (anti-HBs), antibody to hepatitis B core antigen (anti-HBc) and antibody to HCV (anti-HCV) were measured. When necessary, HBeAg, anti-HBe, levels of HBV DNA, anti-HBc IgM and HCV RNA in serum were measured. Of the dental care workers included, 68 (48.2%) had been immunized with a HBV vaccine. Only 9 wore a new pair of gloves for each new patient being treated, 36 changed to a new pair only after the old gloves were torn and 24 did not wear any gloves at all. No one was positive for HBsAg or anti-HCV, though 73 (51.8%) and 17 (12.1%) workers were respectively positive for anti-HBs and anti-HBc. The positive rate of anti-HBc varied directly with worker age and experience. Of the 68 workers immunized with HBV vaccine, 51 (75%) were positive for anti-HBs. Of the 63 workers who were not so immunized, 17 (27%) were positive for anti-HBs and 15 of these were also positive for anti-HBc. Immunized workers were more protected against HBV infection than non-immunized workers, indicating that HBV vaccine was a useful measure for protection against the infection. The anti-HBc positive rate was significantly higher among dental care workers than general blood donors, suggesting that frequency of exposure to HBV was greater in

dental care workers. HBV vaccination should be made compulsory for all dental care workers who handle sharp instruments.

Introduction

It is important to protect dental care workers (who perform invasive procedures daily) from nosocomial, blood-transmissible infections of the hepatitis B virus (HBV) and hepatitis C virus (HCV). There are ~1.5 million persistent HBV carriers and 2 million persistent HCV carriers in Japan. These carriers may develop hepatocellular carcinoma (HCC) decades later. The incidence of HCC continues to increase in Japan and ~80 and 10% of HCC are due to HCV and HBV, respectively (1). Treatment methods for hepatitis C and hepatitis B are now well established, continue to improve annually and their effects are dramatic.

The worldwide HBV infection rate is higher in dentists than in the general population: 6 times higher in the USA, 4 times higher in Germany and 2.5 times higher in Japan. The incidence of HBV infection among dentists is 10.8% in Brazil (2), 9% in the USA (3) and 7% in Germany (4). Among medical care workers, dentists have the highest incidence of HBV infection and this incidence increases with the length of clinical experience of the dentist (5,6). An investigation conducted in 1978 in Japan found approximately half of dentists with 5 or more years of clinical experience were infected with HBV or had a history of HBV infection (7). A study of 998 dentists conducted in 17 regions throughout Japan from 1978 to 1982 reported that 37 (3.7%) were hepatitis B surface antigen (HBsAg)-positive and 420 (42.1%) were antibody to HBs (anti-HBs)-positive (8). The results indicated that infection occurred at work without the dentists' knowledge. Thus dental care workers should be advised to receive a hepatitis B vaccine and it should be confirmed if they have acquired immunity to HBV.

What is the HCV infection rate in dentists in Japan? The anti-HCV-positive rate was 2.6% (10/382) according to the seroepidemiological survey of Shinozaki *et al* who used frozen-preserved serum obtained from dentists between 1986 and 1994 (9). However, the status of HCV infection was unclear, as the mean age of subject dentists and other information were not recorded. In New York city, the positive rate of anti-HCV was clearly higher among oral surgeons (9.3%) and other dentists (1.75%) than blood donors (0.14%) (10). The finding shows that morbidity in dentists differs by specialties.

In recent years, the infection rate in dentists in Japan remains unclear. The last estimates were made in the 1980s and

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Abbreviations: HBV, hepatitis B virus; HBsAg, hepatitis B surface antigen; anti-HBs, antibody to HBsAg; anti-HBc, antibody to hepatitis B core antigen; HCV, hepatitis C virus; anti-HCV, anti-bodies to HCV; HCC, hepatocellular carcinoma; CLEIA, chemiluminescent enzyme immunoassay

Key words: dentists, hepatitis B virus, hepatitis C virus, vaccine

1990s, before more sensitive tests became available. Viral levels have never been measured (7-9). The status of hepatitis viral infection in dental care workers in the northern part of Kyushu, where the infection rates are the highest in Japan should be determined in order to assess the extent to which further health measures are needed to protect and maintain the health of dental care workers.

The present study screened for the presence of HBV and HCV infections in dental care workers in the Fukuoka prefecture (northern Kyushu). Since viral hepatitis is treatable, this investigation could contribute to the health maintenance of dental care workers.

Patients and methods

Patients. Participants included 141 dentists belonging to the X Dental Association in the Fukuoka prefecture and dental care workers (dental hygienists, assistants, mechanics and clerks) employed at dental clinics. Each member was notified by mail about the study before the examination. The examination was performed on 2 days (September 22 and 27, 2007).

Methods. Each participant gave informed consent and had a blood sample taken. An oral surgery specialist interviewed the subjects. Items of inquiry included gender, age, occupation, years employed as a dental care worker, disposable glove use, history of jaundice, history of blood transfusion, clinical history of liver diseases, family history of liver disease and hepatitis B vaccination status.

Viral markers of hepatitis were measured by chemiluminescent enzyme immunoassay (CLEIA) including HBsAg, anti-HBs and anti-HBc and by solid phase RIA including anti-HCV. When the serum was HBsAg-positive, HBeAg (CLEIA), anti-HBe (CLEIA), HBV DNA level (PCR method) and HBV genotype (PCR method) were assayed; when the serum was anti-HBc-positive, the anti-HBc IgM and HBV DNA level were assayed; and when the serum was anti-HCV-positive, RT-PCR was carried out to determine quantitative HCV RNA and HCV genotype.

Results were mailed to each participant. Ethical guidelines for the research were observed closely in order to protect participant confidentiality.

Results

There were 141 (43 males and 98 females) participants. Table I shows 43 were in their 20s, 35 in their 30s, 36 in their 40s, 17 in their 50s, 7 in their 60s, 2 in their 70s and 1 in his 80s. There were 42 dentists, 35 dental hygienists, 41 dental assistants, 8 dental mechanics and 15 clerks. Six subjects had a clinical history of liver disease that was unrelated to HBV or HCV infection.

As for hepatitis B vaccination, 68 (48.2%) were and 63 (44.7%) were not vaccinated. Dentists were the largest vaccinated group (39.7%, 27/68) and dental assistants were the largest unvaccinated group (34.9%, 22/63).

Regarding disposable glove use, only 9 people reported use of new gloves with every new patient. The highest number of people (36/141) said that they changed gloves only when the

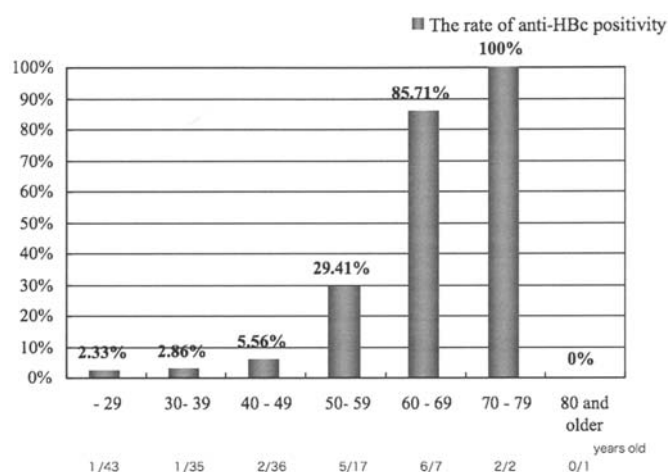


Figure 1. The rate of anti-HBc in 141 subjects classified according to age brackets. The rate of anti-HBc positivity increased with increased age.

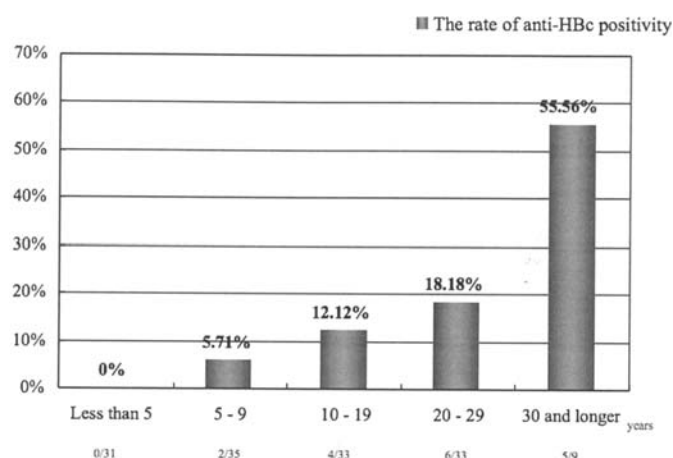


Figure 2. The rate of anti-HBc in 141 subjects classified according to years of experience in dental care. The rate of anti-HBc positivity increased with the number of years of dental care experience.

old pair of gloves were torn. Twenty-four workers did not wear gloves.

In hematological tests, no subjects were HBsAg-positive or anti-HCV-positive (Table II). However, 73 (51.8%) subjects were anti-HBs-positive and 17 (12.1%) were anti-HBc-positive. The rates of anti-HBc positivity increased with age: 85.7% of subjects in their 60s and 100% of subjects in their 70s (Fig. 1). The rate of anti-HBc positivity increased with the number of years of dental care experience (Fig. 2). As Table II shows, anti-HBs turned positive, indicating vaccine effectiveness, in 75% (51/68) of the vaccinated group and 27% (17/63) of the unvaccinated group. Fifteen of these 17 were anti-HBc-positive, indicating that these 15 were infected with HBV in the past.

Most (52.9%) of the 17 anti-HBc-positive subjects were dentists (Table III). The largest proportion of the anti-HBc-positive subjects were in their 60s (35.3%) and had 20 years of experience working in dentistry. Sixteen of the HBc-positive subjects (94.1%) were anti-HBs-positive. However, no HBV DNA was detected in the blood.

Table I. Background factors of 141 subjects classified by hepatitis B vaccination status.

	Total (n)	Vaccination yes (n)	(%)	Vaccination no (n)	(%)	During vaccination (or Drop-out) (n)	(%)	Unknown (n)	(%)
Sex									
Male	43	25	36.8	15	23.8	2	50.0	1	16.7
Female	98	43	63.2	48	76.2	2	50.0	5	83.3
Age									
29 years old	43	18	26.5	19	30.2	2	50.0	4	66.7
30-39	35	20	29.4	13	20.6	0	0.0	2	33.3
40-49	36	24	35.3	12	19.0	0	0.0	0	0.0
50-59	17	4	5.9	11	17.5	2	50.0	0	0.0
60-69	7	2	2.9	5	7.9	0	0.0	0	0.0
70-79	2	0	0.0	2	3.2	0	0.0	0	0.0
80 and older	1	0	0.0	1	1.6	0	0.0	0	0.0
Type of occupation									
Dentist	42	27	39.7	12	19.0	2	50.0	1	16.7
Dental hygienist	35	19	27.9	14	22.2	0	0.0	2	33.3
Dental assistant	41	15	22.1	22	34.9	2	50.0	2	33.3
Dental mechanic	8	4	5.9	4	6.3	0	0.0	0	0.0
Clerk	15	3	4.4	11	17.5	0	0.0	1	16.7
Years engaged in dental care									
<5 years	31	10	14.7	16	25.4	1	25.0	4	66.7
5-9	35	18	26.5	14	22.2	1	25.0	2	33.3
10-19	33	21	30.9	12	19.0	0	0.0	0	0.0
20-29	33	17	25.0	15	23.8	1	25.0	0	0.0
30 and longer	9	2	2.9	6	9.5	1	25.0	0	0.0
How to equip oneself with disposable gloves (Plural answers were given)									
Wear new pair with every new patient	9	6	8.8	3	4.8	0	0.0	0	0.0
Wear new pair with every 2 to 3 patients	31	19	27.9	9	14.3	1	25.0	2	33.3
Wear new pair when old one is torn	36	18	26.5	15	23.8	1	25.0	2	33.3
Wear new pair about twice a day	7	5	7.4	2	3.2	0	0.0	0	0.0

Table I. Continued.

	Total (n)	Vaccination yes (n)	(%)	Vaccination no (n)	(%)	During vaccination (or Drop-out) (n)	(%)	Unknown (n)	(%)
	68	48.2	63	44.7	4	2.8	6	4.3	
Wear when invasive treatment is performed	30	14	20.6	15	23.8	0	0.0	1	16.7
Wear when infected patients are treated	29	8	11.8	19	30.2	1	25.0	1	16.7
Wear when instrument is washed	2	0	0.0	2	3.2	0	0.0	0	0.0
Do not use	24	10	15	12	19	1	25.0	1	17
History of jaundice									
Yes	1	1	1.5	0	0.0	0	0.0	0	0.0
No	133	66	97.1	57	90.5	4	100.0	6	100.0
Unknown	7	1	1.5	6	9.5	0	0.0	0	0.0
History of blood transfusion									
Yes	5	1	1.5	4	6.3	0	0.0	0	0.0
No	133	66	97.1	57	90.5	4	100.0	6	100.0
Unknown	3	1	1.5	2	3.2	0	0.0	0	0.0
Clinical history of liver diseases									
Yes	6 ^a	5	7.4	1	1.6	0	0.0	0	0.0
No	135	63	92.6	62	98.4	4	100.0	6	100.0
Unknown	0	0	0.0	0	0.0	0	0.0	0	0.0
Family history of liver diseases									
Yes	9	4	5.9	4	6.3	1	25.0	0	0.0
No	124	63	92.6	54	85.7	3	75.0	4	66.7
Unknown	8	1	1.5	5	7.9	0	0.0	2	33.3

^aFatty liver (n=3), acute hepatitis A (n=1), primary biliary cirrhosis (n=1) and hepatitis (unknown cause).

Table II. Hepatitis virus markers classified by hepatitis B vaccination status.

Hepatitis B virus markers	Total	Vaccination yes		Vaccination no		During vaccination (or Drop-out)		Unknown	
		(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
HBsAg		68	48.2	63	44.7	4	2.8	6	4.3
Positive (+)	0	0	0.0	0	0.0	0	0.0	0	0.0
Negative (-)	141	68	0.0	63	0.0	4	0.0	6	0.0
Anti-HBs									
Positive (+)	73	51	75.0	17	27.0	2	50.0	3	50.0
Negative (-)	68	17	25.0	46	73.0	2	50.0	3	50.0
Anti-HBc									
Positive (+)	17	1	1.5	16	25.4	0	0.0	0	0.0
Negative (-)	124	67	98.5	47	74.6	4	100.0	6	100.0
Anti-HBs positive (+)									
Anti-HBc positive (+)	16	1	1.5	15	23.8	0	0.0	0	0.0
Anti-HBc negative (-)	57	50	73.5	2	3.2	2	50.0	3	50.0
Anti-HBs negative (-)									
Anti-HBc positive (+)	1	0	0.0	1	1.6	0	0.0	0	0.0
Anti-HBc negative (-)	67	17	25.0	45	71.4	2	50.0	3	50.0
Anti-HCV									
Positive (+)	0	0	0.0	0	0.0	0	0.0	0	0.0
Negative (-)	141	68	0.0	63	0.0	4	0.0	6	0.0

Table III. Breakdown of results classified by anti-HBc (+) and anti-HBc (-).

	Subjects with anti-HBc (+) 17		Subjects with anti-HBc (-) 124	
	(n)	(%)	(n)	(%)
Hepatitis B vaccine				
Vaccination yes	1	5.9	67	54.0
Vaccination no	16	94.1	47	37.9
During vaccination (or Drop-out)	0	0.0	4	3.2
Unknown	0	0.0	6	4.8
Sex				
Male	9	52.9	34	27.4
Female	8	47.1	90	72.6
Age				
29 years old	1	5.9	42	33.9
30-39	1	5.9	34	27.4
40-49	2	11.8	34	27.4
50-59	5	29.4	12	9.7
60-69	6	35.3	1	0.8
70-79	2	11.8	0	0.0
80 and older	0	0.0	1	0.8
Type of occupation				
Dentist	9	52.9	33	26.6
Dental hygienist	2	11.8	33	26.6
Dental assistant	2	11.8	39	31.5
Dental mechanic	0	0.0	8	6.5
Clerk	4	23.5	11	8.9
Years engaged in dental care				
<5 years	0	0.0	31	25.0
5-9	2	11.8	33	26.6
10-19	4	23.5	29	23.4
20-29	6	35.3	27	21.8
30 and longer	5	29.4	4	3.2
How to equip oneself with disposable gloves (Plural answers were given)				
Wear new pair with every new patient	1	5.9	8	6.5
Wear new pair with each 2 to 3 patients	1	5.9	30	24.2
Wear new pair when old one is torn	0	0.0	36	29.0
Wear new pair about twice a day	0	0.0	7	5.6
Wear when invasive treatment is performed	7	41.2	23	18.5
Wear when infected patients are treated	9	52.9	20	16.1
Wear when instrument is washed	0	0.0	2	1.6
Do not use	4	23.5	20	16.1
History of jaundice				
Yes	0	0.0	1	0.8
No	17	100.0	116	93.5
Unknown	0	0.0	7	5.6
History of blood transfusion				
Yes	1	5.9	4	3.2
No	15	88.2	118	95.2
Unknown	1	5.9	92	1.6

	Subjects with anti-HBc (+) 17		Subjects with anti-HBc (-) 124	
	(n)	(%)	(n)	(%)
Clinical history of liver diseases				
Yes	1	5.9	5	4.0
No	16	94.1	119	96.0
Unknown	0	0.0	0	0.0
Family history of liver diseases				
Yes	2	11.8	7	5.6
No	15	88.2	109	87.9
Unknown	0	0.0	8	6.5
HBsAg				
Positive (+)	0	0.0	0	0.0
Negative (-)	17	100.0	124	100.0
Anti-HBs				
Positive (+)	16	94.1	57	46.0
Negative (-)	1	5.9	67	54.0
Anti-IgM-HBc				
Positive (+)	0	0.0	-	-
Negative (-)	17	100.0	-	-
HBV DNA quantitative measurement				
≥2.6 log/ml	0	0.0	-	-
<2.6 log/ml	17	100.0	-	-

Discussion

HBV infection is transmitted mostly through blood and body fluid as a result of bites, administration of blood preparations, sexual activities and mother-infant transmission. The principal route of HCV infection is through blood. Medical care workers are always at risk of infection as they are exposed to contaminated fluids from needle sticks and infected blood droplets. Hepatitis B immune globulin (HBIG) has been used since 1981 and hepatitis B vaccination since 1985 (whole virus) and 1988 (recombinant) to prevent infection.

Dental care workers are often exposed to blood because of stomatorrhagia and the use of sharp instruments (11). Meticulous measures should be taken to protect against the spraying of saliva, which contains blood inside the examination room (12,13). Our previous study reported that saliva from HCV carriers contained HCV RNA before and after scaling of dental calculus (14). HCV RNA was detected in exudates from gingival crevicular fluid and on materials used for making dental impressions, a work bench, an air turbine dental hand-piece, holders, suction units, forceps, dental mirrors and cutting bar (15-17). HCV RNA was still detectable on the surface of dental instruments several days after the HCV carriers received treatment (18). Although their risk of infection is high, dental care workers are obligated to prevent cross infection (i.e., from dental care workers to patients and patients to patients). Although there are no documented cases

of HCV transmission from dentists to patients, there is one case of the transmission of HBV by an oral surgeon (19).

Whether the disease is contracted depends on the levels of the virus in the blood, source of contamination, route of contact and blood volume transfused (20). The rate of acquiring HBV infection through HBV-contaminated needles is high [12% (21) to 60% (22) in unvaccinated persons]. Wounds caused by needles that are contaminated with HBsAg- and HBeAg-positive blood are associated with a 22-31% risk of developing hepatitis B and a 37-62% probability of establishing HBV infection (23). Wounds caused by needles contaminated with HBsAg-positive and HBeAg-negative blood are associated with a 1-6% risk of developing hepatitis B and a 23-37% probability of establishing HBV infection (21). However, infection can be prevented by HB vaccination and the administration of HBIG after these accidents occur.

Accidental prick with a needle contaminated with HCV-positive blood caused HCV infection in ~1.4 (24) to 10% (25) of cases. The probability of infection due to contaminated needle sticks is lower for HCV than HBV. However, the high risk of developing HCC through horizontal infection of HCV is a concern to often-exposed dentists. Feldman and Schiff found that hepatitis morbidity was 6.7% in dentists and 21% in oral surgeons in the State of Florida, USA (26). Although the risk of hepatitis among dentists is high, a long-term cohort study by Tanaka *et al* reported that liver cancer risk was no higher in Japanese dentists than in the general population (27).

In the present investigation, 51 of the 68 recipients of the HBV vaccine were anti-HBs-positive, indicating that 75% of vaccinated subjects developed an antibody to HBV infection. Of the 63 unvaccinated subjects, 16 (25.4%) were anti-HBc-positive and had no clinical history of HBV-related liver diseases, suggesting that they had been transiently and inapparently infected with HBV in the past. Only 1 (1.5%) of the 68 vaccinated subjects was anti-HBc-positive, indicating the protection rate against HBV infection was higher in vaccinated than unvaccinated subjects and that vaccination was a useful protective measure.

The Japanese Red Cross introduced the Hemagglutination Inhibition Test (HI) in 1989 for the screening of anti-HBc (28) and the Nucleic Acid Amplification Test (NAT) in 1999 for the screening of HBV, HCV and HIV in blood that was HBsAg-, anti-HBc-, anti-HCV- and anti-HIV-negative with ALT values <61 IU/l, dramatically increasing the safety of blood transfusion (29).

In Fukuoka and Kitakyushu Red Cross, 3,647 (1.1%) of 323,799 blood donors screened between April 2003 and October 2004 were anti-HBc-positive. Of these 3,647, a total of 445 were HBsAg-positive (30). In the remaining 3,202 anti-HBc-positive, HBsAg-negative donors, the rates of seroconversion to anti-HBc increased with age (0.10, 0.23, 0.57, 1.38, 2.10 and 2.29%, respectively, in age groups 16-19, 20-29, 30-39, 40-49, 50-59 and 60-69).

Seroconversion to anti-HBc occurred at a significantly higher rate in dental care workers (12.1%) than blood donors ($p < 0.05$).

Anti-HBc is a marker of latent hepatitis B (31,32). In previous years, it has been reported that HBV infection was transmitted through a liver transplanted from an anti-HBc-positive donor (32). HBV DNA has been detected in the serum of patients recovered from acute hepatitis B (33). Infection of latent HBV has been associated with the onset of HCV-related HCC (34,35). Therefore, from the standpoint of health safety, the prevalence of latent HBV infection among dental care workers must be acknowledged.

Of the 63 unvaccinated subjects, only 4.8% changed gloves to a new pair for each new patient and 19% never wore gloves. Since dental care workers have a high risk of exposure to the hepatitis virus, a compulsory vaccination for the hepatitis B virus is desirable for all dental care workers. In Japan, hepatitis B vaccination is voluntary. However, from the standpoint of effectiveness and safety and to reduce infection risk, it is important to vaccinate these workers.

Regrettably, no hepatitis C vaccine or immunoglobulin has been developed to prevent HCV infection. Although no persistent carriers of HBV and HCV were detected in the present investigation, the rate of infection is higher in the western portion of Japan, especially in the Saga and Fukuoka prefectures, than eastern Japan. Therefore, further precautions must be taken.

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