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Seroepidemiology of hepatitis C antibodies among dentists and their self-reported use of infection control measures

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Objectives. To determine the prevalence of hepatitis C virus (HCV) antibodies among dentists graduated from various countries and assess the use of infection control measures in their dental practice. ***Research design.*** The study included 301 Israeli dentists who attended an annual dental conference. Participants filled out a structured questionnaire regarding demographic (age, gender, number of siblings, number of children) and occupational characteristics. Venous blood was examined for presence of HCV antibodies by enzyme immunoassay and confirmed by a third generation line immunoassay, which assesses antibodies to HCV-core antigens (INN-LIA™ HCV Ab III update, 100% sensitivity, 100% specificity). ***Results.*** The prevalence of HCV antibodies among Israeli dentists was 1/301 (0.33%), similar to the prevalence range (0.1-0.5%) among the general Israeli population. The studied population included dentists (30.6%) who immigrated from Asia, Eastern Europe and the former USSR, where HCV prevalence ranges from 3.1% to 26.5%. Dentists routinely used gloves (99.6%), gown (93.3%), autoclaves (90.3%), dry heat (29.1%) and mask (81%). Dentists who graduated after 1985 used a mask or gown significantly more often than dentists who graduated before 1985 ($p<0.001$ and $p=0.004$, respectively). ***Conclusion.*** It seems that dentists who usually adhere to basic infection control measures are not at an increased risk for HCV.

Key words: Dentist, hepatitis C virus, infection control

Introduction

The Centers for Disease Control and Prevention (Wasley 2007) estimate that approximately 20,000 people are infected with hepatitis C virus (HCV) each year in the US and about 170 million people around the world (World Health Organization, 2000). HCV is a major cause of acute hepatitis and chronic liver disease, including cirrhosis and liver cancer (World Health Organization, 2000). Therefore, infection by HCV has an important impact worldwide. This RNA virus proliferates in the liver and circulates in the blood. Hepatitis C is a particularly insidious disease. The acute infection is often asymptomatic with fever, malaise, and jaundice, which occurs in only 25% of the patients (Mondelli and Colombo, 1991). Furthermore, the chronicity rate after HCV infection is up to 80%, which is higher relative to other forms of viral hepatitis (Mondelli and Colombo, 1991). Chronic hepatitis C can progress to liver failure, cirrhosis, and hepatocellular carcinoma and is also associated with a carrier state. Asymptomatic chronic hepatitis C patients serve as an increasing reservoir of individuals who infect others. Spontaneous healing is rare and treatment is targeted toward antiviral (INFα) and immune-modulation (Ribavirin) medications. However, treatment is very expensive and its effectiveness with only interferon is approximately 10% to 20%. Interferon combined with Ribavirin is effective in about 30% to 50% of patients. Ribavirin used alone appears to be ineffective (World Health Organization, 2000).

Today, prevention is the key to eliminate HCV infection, usually transmitted through contaminated blood, *e.g.*, transfusion, hemodialysis, infected solid organ transplantation, a sharp infected instrument, drug abuse by injection, multiple sex partners, application of tattoo, or acupuncture, or through a wound of the skin or mucosa during medical treatment (World Health Organization, 2000). Since the etiology is unknown in 40% of the infected patients, there may be an additional infection route, *e.g.*, saliva, although still controversial. HCV RNA has been detected in the saliva of 0-100% of the infected individuals (Pastore *et al*. 2006). In primates, HCV can be transmitted by saliva and in humans by human bite (Abe and Inchauspe, 1991).

Health care workers are frequently exposed to blood and saliva and are prone to needle pricks. Since HCV is primarily spread through occupational needle sticks and sharp instruments, they are at a higher risk for HCV infection and transmission than the general population (Centers for Disease Control and Prevention, 2000) .

The purpose of the present study was to evaluate the seroepidemiology of HCV antibodies among dentists who have graduated from various countries vs the possible effect of the self-reported use of infection control measures in their daily dental practice.

Methods

The study population consisted of 301 dentists who attended an annual dental conference in Israel. Participation

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was on a first come basis. Participants were asked to sign an informed consent, fill out a structured questionnaire (described below), and provide 8 ml of venous blood. The Ethics Committee of Tel Aviv University approved the study.

The structured questionnaire was designed to assess variables associated with exposure to HCV. a) Demographic characteristics and risk factors: age, gender, ethnicity, marital status, place of birth, date of immigration, years of education, history of jaundice, history of jaundice in the family, history of operations, unprotected sexual relations, and intravenous drug use. b)Occupational characteristics: dental subspecialty, duration (years) of work in dentistry, duration (years) of work in hospital (if any), average hours of work during each week, typical patient population, exposure to blood and past treatment of HCV-infected patients. c) Use of infection control measures in dental office: gloves (changed between patients), protective glasses, gown, autoclave and dry heat sterilization as recommended by the Centers for Disease Control and Prevention (William et al. 2003)

Venous blood, 8 ml, was collected in dry tubes. After clotting and centrifugation, sera were separated and stored in -20ºC until tested. HCV antibodies were detected by enzyme immunoassay (Abbott AxSYM system, HCV version 3.0 ref: 3B44-20, specificity 99.84% and sensitivity 100%, Abbott Laboratories, Germany). Positive sera were confirmed by a third generation line immunoassay that assesses antibodies to HCV-core antigens (INNO-LIA HCV-antibody test III, 100% sensitivity, 100% specificity, Innogenetics N.V., Haven, Belgium). Only positive confirmation tests were defined as HCV-antibody positive.

Univariate analysis: χ^2 test was used to determine the significance of differences among proportions (rate of seropositivity for HCV) and Student-t test for continuous variables (*e.g.*, years of work). SPSS software Number 9.0 for Windows (SPSS Inc. Chicago, IL, USA) was used for statistical analyses.

Results

More than half (67.4%) of the 301 participating dentists were male. The group consisted of 233 general dentists and 68 (23%) specialists in various fields of dentistry. Table 1 shows the distribution of the studied population according to place of birth.

Participants were mostly Jewish (92.7%). Of the participants, 113 immigrated to Israel before 1985 and 133 graduated in dentistry before 1985.

Table 2 shows the potential risk factors associated with HCV infection among the studied population. Accordingly, 59.1% of the participants had surgery in the past, 83.1% performed surgery in their daily dental practice, and 52.6% treated HCV infected patients.

Serum could be analyzed in 299 samples; two were excluded due to technical failure. Only one blood sample was positive for HCV antibodies. The profile of the seropositive dentist was a drug- abuser, treated mostly (70%) immigrants, among them HCV positive patients and had several per-cutaneous injuries. The subject was not aware of their own seropositive status.

Table 3 describes the self-reported use of infection control measures according to the country of graduation. Accordingly, dentists who graduated in Asia and Eastern Europe used masks more frequently than dentists who graduated in Israel or in Western Europe and USA (90% vs 75.7% and 75.7%, p=0.012). However, no statistical differences were found between country of graduation and the use of protective glasses, gloves, autoclave, or dry heat sterilization.

Among the studied population work, duration ranged from 1 to 52 years (mean 17.5 + 10.8 y). A significant negative correlation was found between years of occupation in dentistry and use of a mask or gown during work ($p<0.001$ and $p=0.047$, respectively), but no correlation between years of occupation and use of gloves and glasses. Similarly, dentists who graduated before 1985 reported significantly less usage of a mask and gown than dentists who graduated after 1985 ($p<0.001$ and $p=0.004$, respectively). In contrast, no statistically significant correlations were found between years of work in dentistry or graduation after 1985 and use of protective glasses, gloves, autoclave, or dry heat sterilization though the same tendency was observed (Figure 1). Infection control guidelines were first published by Centers for Disease Control in 1986 .

No correlations were found between performance of dental surgery and use of a mask, protective glasses, gloves, gown, autoclave and dry heat sterilization. No correlation was found between work with children and use of a mask, protective glasses, gloves or dry heat sterilization. In contrast, dentists who worked with children used a gown (73.9% vs. 90.7%, respectively, p=0.085) or autoclave (78.3% vs. 97.7%, respectively, p= 0.017) less frequently than dentists who did not work with children. No significant correlation was found between working in public clinics and practicing universal precautions of infection control.

Discussion

The highest known frequencies of HCV seropositivity, up to 44%, are in developing countries, particularly in Africa (el-Nanawy *et al*., 1995). Between 1952 and 1989, the annual number of immigrants to Israel ranged from 10,000 to 70,000. According to the Israel Central Bureau of Statistics, there was a dramatic increase (10-fold) in the 1990s, reaching 100,000 immigrants per year from the former USSR. In one study of 136,977 blood donors in Israel during 1992, the prevalence of seropositivity to HCV was positively correlated with age and country of birth, with the highest seropositivity noted among people born in the former USSR (3.1%) and Eastern Europe (2%), and the lowest among native-born Israelis (0.4%) (Bar-Shany *et al*., 1995). Nevertheless, there are specific Jewish populations in Israel with significantly higher seropositivity. For example, among the healthy Bukharian Jewish population, who immigrated from Uzbekistan and Tajikistan to Israel from 1972 to 1989, 26.5% were positive to HCV antibodies, with the highest prevalence rates among the older population (Glikberg *et al*., 1997). In another study the prevalence of anti-HCV among 5,444 employees of a large university hospital in Israel was 0.1% among native-born Israelis and 5.7% among

Table 1. Distribution of the study population according to the place of birth and place of graduation from dental school

Country	*Place of birth (%)*	*Country of graduation from dental school (%)*
Israel	141 (46.8)	141 (46.8)
Asia	6 (2)	3 (1)
Former USSR	31 (10.3)	21 (7)
Eastern Europe	55 (18.3)	60 (19.9)
North America	12 (4)	10 (3.3)
South America	21 (7)	19 (6.3)
Australia and South Africa	7 (2.3)	5 (1.7)
Western Europe	16 (5.3)	23 (7.6)
Missing Information	12 (3.9)	19 (6.3)
Total	301(100)	301(100)

Table 2. Potential risk factors for HCV infection among the studied population

Potential risk factors	*Number (%)**
Used intravenous drugs in the past	2/285 (0.7)
Had surgery in the past	165/279 (59.1)
Received blood infusion	39/277 (14.1)
Perform surgery in daily dental practice	236/284 (83.1)
Had HBV infection	8/274 (2.9)
Had HAV infection	30/269 (11.2)
Immunized against HBV	246/285 (86.3)
Immunized against HAV	126/270 (46.7)
Had HCV infected person in their family	8/286 (2.8)
Treated HCV infected patients in the past	144/274 (52.6)
Percutaneous injury during treatment of HCV infected patient	7/191 (3.7)
Never treated HCV infected patients	118/274 (43.1)
Unprotected sexual relations with 0 to 5 persons	210/270 (77.8)
Unprotected sexual relations with 5 to 10 persons	27/270 (10)
Unprotected sexual relations with 10 to 15 persons	11/270 (4.1)
Unprotected sexual relations with more than 15 persons	22/270 (8.1)

*Results expressed as positive answers divided by number of negative answers

Table 3. Distribution of self-reported use of infection control measures according to country of graduation.

Prevention measures	*Self-reported use of infection control strategists*					*Significance*
	Israel (%)	*Asia and Eastern Europe (%)*	*Western Europe and USA (%)*	*Others* (%)*	*Total population (%)*	
Mask	106/134 (79.1)	72/80 (90)	25/33 (75.7)	14/21 (66.7)	217/268 (81)	p=0.012
Glasses	74/134 (55.2)	52/80 (65)	21/33 (63.6)	14/21 (66.7)	161/268 (60.1)	p=0.88
Gloves	134/134 (100)	79/80 (98.7)	33/33 (100)	21/21 (100)	267/268 (99.6)	p=0.99
Gown	123/134 (91.8)	77/80 (96.2)	29/33 (87.8)	21/21 (100)	250/268 (93.3)	p=0.68
Autoclave	127/134 (94.7)	68/80 (85)	27/33 (81.8)	20/21 (95.2)	242/268 (90.3)	p=0.35
Dry heat	39/134 (29.1)	20/80 (25)	13/33 (39.3)	6/21 (28.6)	78/268 (29.1)	p=0.75

*South America, South Africa and Australia

those born in Central Asia. Prevalence positively correlated with 10 or more years of occupational exposure to blood (Sermoneta-Gertel *et al*., 2001).

The present study is the first to evaluate the seroepidemiology of HCV antibodies among dentists who were born in Israel and those who have immigrated to Israel from various countries. The prevalence of HCV antibodies among this dentist population was only 0.3%, which is in agreement with the prevalence found among blood donors in Israel, although the study group included 30.6% dentists from Asia, the former USSR, and Eastern Europe, where the prevalence of HCV is higher (Sermoneta-Gertel *et al*., 2001; World Health Organization, 2000). These results indicate that dentists in Israel are not at an increased risk for HCV infection and are actually at a lower risk for HCV infection than other health workers in Israel (Sermoneta-Gertel *et al*., 2001). This could be attributed to a higher awareness of infection control measures, to the higher socioeconomic level, or to less behavioral risk factors among the dentists. It is noteworthy that the one

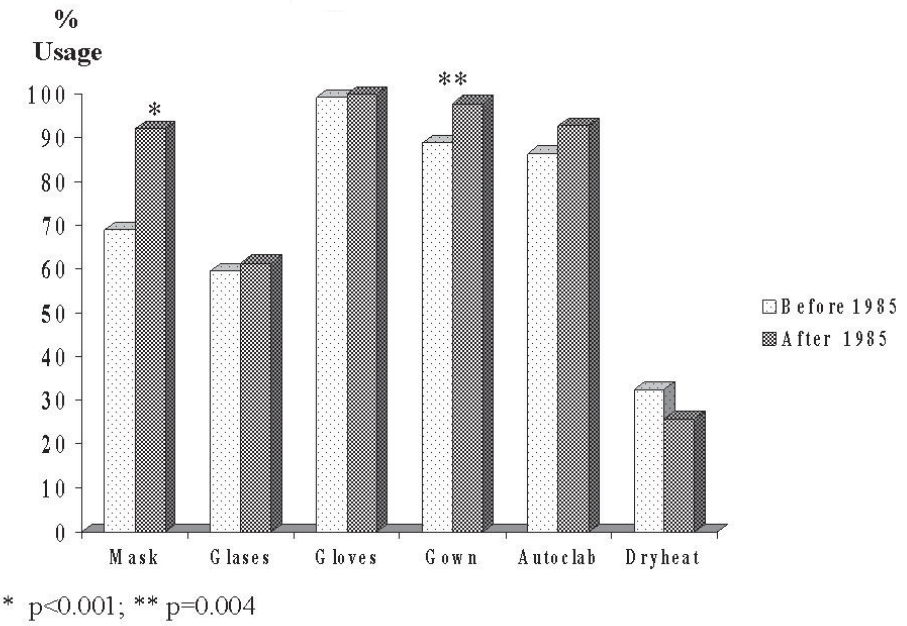

Figure 1. *Association between year of graduation from dental school (before and after 1985) and use of different infection control measures.*

positive HCV participant was an intravenous drug abuser. Since HCV infection is much more frequent among IV drug users, it is more likely that this subject was infected by drug use than by the subject's occupation. Therefore, it is suggested that no occupational transmission was detected in the study group.

Studies in which the risk of dentists' infection with HCV compared to the general population have shown controversial results. In Switzerland and in the USA the prevalence of Anti-HCV among general dentists was lower than in the general population (0.095% vs. 0.5-1% and 0.7% vs. 2%, respectively) (Othman and Monem, 2001; Chou *et al*., 2004,). It should be emphasized that a higher prevalence in USA was found in older dental personnel with more years of practice (Chou *et al*., 2004). In Taiwan and Scotland, the prevalence of HCV antibodies among dentists was similar to the general population (Kuo *et al*., 1993, *Roy et al.,* 2003.) In contrast, studies in the United States (New York) and in a United Kingdom dental hospital show that dentists are 2 to 15 times at higher risk for HCV infection relative to the general population, and oral surgeons a 10-fold higher risk (Lodi *et al*., 1997).

These different results can be explained by the wide range of differences in the regular use of universal precautions required for infection control and year of graduation from dental school. Since the mid-1980s, with an increase in awareness of blood-borne infections in general, and of human immunodeficiency virus (HIV) in particular, the recommended infection control measures, such as wearing gloves, masks, and the autoclaving of hand instruments, have increased. The concept that all patients must be regarded as potentially infectious and, as such, require the use of standard precautions, has become accepted in many countries. However, there are limited data describing the acceptance of these guidelines among dentists and the increasing use of infection control measures over the years. In the present study, gloves were the most commonly used among the studied population (99.3%) with the highest reported rate. There was no significant increase in glove use between dentists who graduated before or after 1985 (99.2% vs. 100%, respectively), which indicates a continuous extensive use. This confirms other studies (Mitchell and Russell, 1989) that showed a definite increase in glove use between 1983 and 1988. A high rate of routine glove use was found in 1995 (97%) (McCarthy *et al*., 1999), but a low rate can still be found in some countries (Ammon *et al*., 2000). Glove use is correlated with age and gender, with younger female dentists more likely to wear them (Hudson-Davies *et al*., 1995).

Use of wearing protective glasses and a mask ranges from 29% to 82% (Ammon *et al*., 2000; McCarthy *et al*., 1999) and from 38% to 82% (Ammon *et al*., 2000; McCarthy *et al*., 1999), respectively. In the present study the prevalence of wearing protective glasses and a mask was in accordance with the higher reported rates: 60.1% and 81%, respectively. A statistically significant improvement ($p<0.001$) was shown in the prevalence of mask use among dentists who graduated after 1985, while there were no differences in wearing protective glasses among these dentists. This indicates that there is a need to further emphasize to the dentists the importance of wearing protective glasses.

Wearing of gloves, gowns and facemasks are absolutely basic requirements of dental healthcare providers. In the present study, the fact that a number of responders still claimed not to use gloves, gowns and facemasks is alarming.

Another important measure to decrease cross infections is sterilization by an autoclave (Bagg *et al*., 2001;McCarthy et al, 1999). In the present study, 90.3% of the studied population reported used autoclaves and 29% used dry heat, which indicate that all the dentists use autoclave or dry heat, and few dentists use both sterilization techniques. Moreover, 93% of the dentists

graduated after 1985 used autoclave, which is the highest prevalence reported for this preventive measure. Dry heat is not considered an appropriate or acceptable method for sterilizing dental instruments nowadays. The fact that 29% of the dentists in this study were still using dry heat (even if combined with autoclave) might warrant health care intervention. Adherence to infection control guidelines have improved in the last decade mainly in some of the developed countries (Bagg *et al*., 2001; McCarthy et al, 1999). A Canadian study showed an increase in compliance from 83% in 1994 to 94% in 1995 in heat sterilization of hand instruments (McCarthy et al , 1999). Notwithstanding, when the dentists were asked whether they autoclave their handpieces after each patient, the compliance was reduced to 77% (McCarthy et al , 1999). In 2001, only 10 (3%) of the 327 dentists in private practice in the UK possessed a vacuum autoclave (Bagg *et al*., 2001).

In the present study, 86.3% of the dentists reported to be immunized against HBV and 46.7% against HAV (Table 2), which are in the higher range of the reports related to vaccination of dentists against HBV: 68% and 74% (Ammon *et al*., 2000; Leggat *et al*., 2001). This is the first study to report the prevalence of HAV vaccination among dentists in Israel. To date, there is no vaccination against HCV, and only infection control measures can prevent dental professionals from infection.

Although the present study showed a relatively high compliance with infection control measures among our dentists, yet, a substantial percent of the dentists did not follow the recommendation of WHO. Nevertheless, the infection rate of dentists was comparable to the general population. These results are in accordance with Roy et al (2003) who did not find evidence of patient to patient transmission of HCV among patients attending the practice of dentists who admitted using periodically un-sterilized equipment.

The present study did not reveal that HCV was a hazard to dental professionals. Although the risk for HCV infection among dental practitioners was relatively low, compliance with the guidelines for infection control should be strictly followed.

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