Investigation Of Viral Infectious Diseases In Oral-Maxillofacial Surgery Patients: Is Screening for these Infectious Diseases Necessary?

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Abstract

Objectives: We assessed the percentage of patients with hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV) infection diagnosed by preoperative screening, and estimated the cost of screening. Methods: We retrospectively analyzed elective surgical cases in our-maxillofacial surgery department between April 2012 and March 2015. We also compared the number of HBV+, HCV+, and HIV+ patients identified by preoperative screening to those identified through a preoperative interview and questionnaire. We also compared the prevalence of HBV and HCV infections by age, sex, and the eleven commonest dental diagnoses. Results: Of 4469 patients, 34 (0.76%) and 90 (2.01%) patients were seropositive for hepatitis B surface antigen (HBsAg) and HCV, respectively. Five (0.59%) of 845 patients exhibited HIV-1/2 antibody. The self-reported rates were as follows: HBV, 47.1% (16/34); HCV, 64.4% (58/90); and HIV, 60% (3/5). The odds ratio for HBsAg was not significant, irrespective of age. HCV antibody was more prevalent in patients with alveolar disorders and impacted teeth, after adjustment for age. The annual cost for screening was ¥12,750,000 (US $127,500 at an exchange rate of US $1 = ¥100). Conclusion: Given the high cost, low prevalence, and the real likelihood of seroconversion after testing, screening for HBV, HCV, and HIV infections in patients requiring dental and oral-maxillofacial surgery is impractical. Universal precautions, with post-exposure prophylaxis (PEP) as needed, remain the method of choice for minimizing risk to practitioners.

Key Words: Hepatitis B, Hepatitis C, HIV, Universal Precautions, Communicable Disease Control, Practice Pattern

Introduction

Needlestick injuries or cuts carry the risk of infection with hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV). In Japan, all dentists and dental hygienists typically receive hepatitis B vaccination, but dental assistants do not. Treatment of the oromaxillofacial area often involves contact with patients' blood and saliva, and dentists and maxillofacial surgeons can be exposed to pathogenic microorganisms such as those of HIV or viral hepatitis. Rates of injury vary between services and depend on the procedure, but most authors report rates of 2–10 injuries/100 procedures [1-3]. The risk of infection with HIV, HBV, or HCV after a single needlestick injury differs significantly, at approximately 0.3% for HIV, 3% for HCV, and 30–50% for HBV [4,5]. Although HIV, HBV, and HCV have different epidemiologic characteristics, all can be transmitted to dentists by professional exposure such as needlestick injuries or cuts. Therefore, dentists and oral-maxillofacial surgeons are at higher risk of viral infection relative to the general population [4-6].

Although it may seem desirable to identify all patients with viral infections preoperatively, a patient can seroconvert in the interval between testing and surgery. In addition, it has not been shown that prior knowledge of a patient's infectious disease status reduces health care worker infections [7]. There are established guidelines for dental professionals to prevent infections [8]. In Japan, there are approximately 1.5 million persistent HBV carriers and 2 million persistent HCV carriers [9], and the prevalence of HIV is increasing [10]. In many cases, patients are unaware of their disease. Many Japanese institutions screen their patients' blood prior to surgery. However, this has never been shown to be cost-effective, or to be superior to universal precautions. In Japan, the costs of screening are roughly ¥5000 (US $50 at an exchange rate of US $1 = ¥100) for the laboratory analysis and an additional logistics cost charge of ¥1440 (US $14.4). In addition, an inspection fee for each infection diagnosed by screening test has additional costs, such as ¥880 (US $8.8) for HBV and ¥1160 (US $11.6) for HCV. Insurance pays ¥1230 (US $12.3) for a preoperative examination, but this does not include screening tests. With the widespread advocacy for the use of universal precautions and the ease of post-exposure testing and prophylaxis, there is as yet no scientific evidence for this expensive measure [4,5,7].

We evaluated the prevalence of HBV, HCV, and HIV infection identified by preoperative screening, the incidence of newly recognized HBV, HCV, and HIV infection identified by pre-operative screening, and the resulting costs. We also investigated the percentage of patients' self-reporting positivity for these infections, and the prevalence of HBV and HCV infection in patients with the eleven most frequently represented diseases, according to age and sex.

Materials and Methods

At our hospital, HBV, HCV, and HIV testing is performed in all patients scheduled to undergo general anesthesia, and HBV

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and HCV testing is performed in all patients scheduled to undergo local anesthesia with intravenous sedation. We retrospectively analyzed the number of operations performed in our department between April 2012 and March 2015. In patients who underwent several operations during a 1-year period, we evaluated only the first. We counted the number of oromaxillofacial surgery patients with HBV, HCV, and HIV infection diagnosed by pre-operative screening. We identified a total of 4469 consecutive patients who underwent oromaxillofacial surgeries (male : female ratio, 1869 : 2600). The mean age of the patients was 41.2 ± 20.5 years. In addition, we pre-operatively investigated the patient-reported infection-positive rate by questionnaire. The respective serological markers were evaluated using the ARCHITECT i2000SR Immunoassay Analyzer (Abbott Japan Co., Ltd., Tokyo). At our hospital, as a routine preoperative examination, HBV, HCV, and HIV testing is performed in all patients scheduled to undergo general anesthesia, and HBV and HCV testing is performed in all patients scheduled to undergo local anesthesia with intravenous sedation. The all data were drawn from electronic registry of our hospital. Questionnaire was done at the time of the first visit, and the blood samples were taken on the day that decided the day of surgery. This retrospective study was approved by the Ethics Committee of Kagawa Prefectural Central Hospital (Approval No. 395). All data are presented as means andstandard deviations. We compared categorical variables using the chi-squared test, and evaluated differences between more than two groups by one-way analysis of variance. When one-way analysis of variance identified a significant F-value, we conducted post-hoc analysis between groups using the Bonferroni/Dunn method. The relationship between oral diseases and the prevalence of viral hepatitis infection was evaluated by logistic regression analysis with control for sex, age, and previous surgery using commercial software (JMP 11.0 for Mac; SAS Institute Inc., Cary NC, USA). A P value < 0.05 was considered to indicate statistical significance.

Results

Of 4469 oromaxillofacial surgery patients tested for HBV and HCV, Hepatitis B surface antigen (HBsAg) was present in the serum of 34 (0.76%), and 90 patients were seropositive for HCV (2.01%).

Table 1. *Prevalence of Hepatitis B surface antigen, Hepatitis C virus antibody, and Human Immunodeficiency Virus antibody among patients in this study.*

HBV			HCV			HIV		
HBV + n	HBV- n	total	HCV + n	HCV - n	total	HIV + n	HIV - n	total
(%)	(%)		(%)	(%)		(%)	(%)	
34	4435	4469	90	4379	4469	5	840	845
0.76	99.24		2.01	98		0.59	99.41	

Of 845 oromaxillofacial surgery patients tested for HIV (only patients undergoing general anesthesia are tested for HIV), HIV-1/2 antibody was present in the serum of five (0.59%) (*Table 1*). Of the patients screened, the self-reported infection rates of patients in a pre-operative interview and questionnaire were HBV, 45.7% (16/34); HCV, 64.4% (58/90); and HIV, 60% (3/5) (*Table 2*).

Table 2. *Prevalence of Hepatitis B surface antigen, Hepatitis C virus antibody, and Human Immunodeficiency Virus antibody based on patient self-reporting by questionnaire.*

	HBV	%	HCV	%	HIV	%
positive	16	47.1	58	64.4	3	60
negative	18	52.9	32	35.5	2	40
total	34	100	90	100	5	100

The HBV+ and HCV+ groups were much older than the negative groups (HBV: $p < 0.0001$, HCV: $p < 0.0001$). In contrast, no difference in age was seen between the HIV+ and HIV- subjects ($p = 0.68$). Further, there were no differences in gender between patients with and without HBV, HCV or HIV infections (*Table 3*). Among the patients screened, a previously unidentified infection was diagnosed in only two patients. These new diagnoses were infection with HBV (n = 1) and HCV (n = 1). On further investigation, we detected risk factors only in the HBV patient, who had received a blood transfusion previously. The other patient with HCV had no evaluable or obvious risk factors. There were no newly diagnosed cases of HIV.

Table 3. *Prevalence of Hepatitis B surface antigen, Hepatitis C virus antibody, and Human Immunodeficiency Virus antibody, distributed according to gender and in addition to the average values. *Results were considered statistically significant when the P value was < 0.05.*

	Sex		Age			
	male	female	P value	Average	Standard deviation	P value
HBV						
positive	14	20	0.5954	55.8	13.9	<.0001
negative	1855	2580		40.9	20.5	
HCV						
positive	40	50	0.661	65.2	15.9	<.0001
negative	1829	2550		40.5	20.3	
HIV						
positive	5	0	0.062	50.8	7.7	0.6788
negative	430	410		54.9	21.9	

We compared the prevalence of positivity for HBsAg between patients with different dental disorders, such as impacted teeth (0.40%), oral cancer (0.02%), oral inflammation (0.07%), oral cysts and benign oral tumors (0.04%), maxillofacial trauma (0.04%), alveolar disorders such as mandibular tori and palatine torus (0.02%), and dental implants (0.16%). Positivity for HCV antibody was also seen with varying frequencies in patients with different dental disorders (impacted teeth, 1.39%; oral cancers, 0.04%; oral inflammation, 0.07%; oral cysts and benign oral tumors, 0.13%; maxillofacial trauma, 0.11%; alveolar disorders,

0.04%; salivary disorders, 0.04%; temporomandibular joint disorders, 0.02%; and dental implants, 0.13%).

We found significant differences in the prevalence of HBsAg positivity. HIV antibody was only detected in patients with impacted teeth (0.61%) (*Table 4*). The combined prevalence of HBsAg and HCV antibody was not significantly different between patients with different oral diseases. The odds ratio for HBsAg was not significant.

Table 4. *Prevalence of Hepatitis B surface antigen, Hepatitis C virus antibody, and Human Immunodeficiency Virus antibody, distributed according to various oral diseases.*

	HBV			HCV			HIV		
	Negative	**Positive**	**Total**	**Negative**	**Positive**	**Total**	**Negative**	**Positive**	**Total**
Impacted teeth	3222	18	3240	3178	62	3240	464	5	469
Oral cysts, benign oral tumors	343	2	345	339	6	345	81	-	81
Dental implant	349	7	356	349	6	355	44	-	44
Alveolar disorder	158	1	159	157	2	159	37	-	37
Maxillofacial trauma	118	2	120	115	5	120	75	-	75
Oral inflammation	117	3	120	117	3	120	43	-	43
Oral cancers	47	1	48	46	2	48	46	-	46
Salivary disorder	39	-	39	35	2	37	17	-	17
Jaw deformity	19	-	19	19	-	19	18	-	18
Maxillary sinus disorder	12	-	12	12	-	12	9	-	9
TMJ disorder	11	-	11	10	1	11	6	-	6
Total	4435	34	4469	4379	90	4469	840	5	845

The odds ratio for HCV antibody was not significant, irrespective of adjustment for age (*Table 5*). Given the abovementioned screening costs per patient, the annual cost isabout ¥12,750,000 (US $127,500) [¥8500 (US $85) × 1500 patients/year).

Discussion

HBV and HIV are primarily transmitted in blood and body fluids as a result of needle sharing among intravenous drug users, unprotected sexual activity, and mother–infant transmission. The principal vector of HCV infection is blood. HBV generally exhibits strong infectivity. The rate of acquisition of HBV infection from HBV-contaminated needles is high, ranging from 12% [11] to 60% [12] in unvaccinated individuals. Needle stick injuries or cuts contaminated with HBsAg- or HBeAg+ blood are associated with a 37–62% probability of establishing HBV infection and a 22–31% risk of developing hepatitis B in unvaccinated individuals [13]. The probability of HCV infection as a result of contaminated needle stick injuries is lower than that of HBV. Accidental injury with a needle contaminated with HCV+ blood reportedly caused HCV infection in 1.4% [14]–10% [15]. The risk of occupational transmission of HIV varies with the type and severity of exposure.

Table 5. *Logistic regression analysis for the prevalence of Hepatitis B surface antigen and Hepatitis C virus antibody in oral diseases relative to their prevalence in patients with impacted teeth.*

HBV	**odds ratio**	**95% CI**	**p value**	**HBV (age-adjusted)**	**odds ratio**	**95% CI**	**p value**
Alveolar disorder	0.883	0.181–15.922	0.905	Alveolar disorder	1.281	0.258–23.205	0.804
Oral cysts, benign oral tumors	0.958	0.275–6.042	0.955	Oral cysts, benign oral tumors	1.229	0.349–7.780	0.778
Oral cancers	0.263	0.052–4.770	0.282	Oral cancers	0.575	0.108–10.662	0.627
Maxillofacial trauma	0.33	0.094–2.088	0.199	Maxillofacial trauma	0.45	0.124–2.887	0.341
Dental implant	0.279	0.120–0.721	0.011	Dental implant	0.447	0.188–1.178	0.099
Oral inflammation	0.218	0.072–0.939	0.042	Oral inflammation	0.399	0.126–1.772	0.199
HCV	odds ratio	95% CI	p value	HCV (age-adjusted)	odds ratio	95% CI	p value
Alveolar disorder	1.531	0.473–9.385	0.529	Alveolar disorder	2.731	0.834–16.824	0.107

Oral inflammation	0.761	0.277–3.146	0.661	Oral inflammation	2.256	0.797–9.481	0.137
Dental implant	0.973	0.473–2.350	0.945	Dental implant	1.953	0.944–4.739	0.073
Oral cancers	0.449	0.134–2.785	0.328	Oral cancers	1.727	0.503–10.868	0.429
Oral cysts, benign oral tumors	1.102	0.513–2.870	0.819	Oral cysts, benign oral tumors	1.651	0.759–4.334	0.222
TMJ disorder	0.195	0.037–3.607	0.208	TMJ disorder	1.25	0.221–23.568	0.831
Salivary disorder	0.361	0.107–2.249	0.228	Salivary disorder	0.872	0.240–5.641	0.861
Maxillofacial trauma	0.449	0.195–1.301	0.128	Maxillofacial trauma	0.859	0.354–2.583	0.765

In prospective studies of HIV, the average risk of HIV transmission after percutaneous exposure to HIV-infected blood was estimated to be approximately 0.3% [16]. For post-exposure prophylaxis (PEP), although HCV exposure is managed with observation, HIV exposure is managed with the administration of anti-retroviral drugs [17], and HBV exposure with the administration of hepatitis B immune globulin or vaccination of unvaccinated individuals. Post exposure prophylaxis can be initiated before the source is tested, and discontinued if the source tests negative, using a test more accurate than that used for screening [18].

In this study, the rates of HBV, HCV, and HIV infection in oromaxillofacial surgery patients were found to be 0.76%, 2.01%, and 0.59%, respectively. Takata, et al. [19] reported that the prevalence of viral hepatitis infection in maxillofacial surgery patients is 2.1% for HBV, and 5.8% for HCV. These prevalence's were high compared with our results. Patients with impacted teeth or jaw deformities were much younger than patients with other oral diseases, such as oral cancer or oral cysts and benign tumors. Indeed, patients with impacted teeth and jaw deformities in the study by Takata, et al. [19] comprised 13.3% (587/4402); however, in our study, they accounted for 80.8% (3585/4435). Hepatitis is common among elderly patients; in this study, a correlation between age and hepatitis infection is evident.

Although the prevalence of HBV positivity was higher in patients with oral inflammation and dental implants, no significant difference in the combined prevalence of infection was evident between patients with different categories of oral disease after adjustment for the confounding variable of age. The prevalence of HCV antibody was not significantly associated with any particular dental diagnosis. Therefore, it is difficult to predict viral hepatitis infection based on the presence of oral diseases. This indicates that, at least in terms of patient populations, the risk of hepatitis transmission may be similar among different oral surgical procedures. Preoperative screening for hepatitis is therefore not recommended.

Screening by interview and patient self-reporting is non-invasive and would appear cost-effective. However, in our study, the viral hepatitis infection-positive rates self-reported by patients in a preoperative interview and questionnaire were: HBV, 45.7% (16/34); and HCV, 64.4% (58/90). These high false-negative rates indicate that interview and patient self-reporting are inadequate screening methods. In a Japanese study by Nagao, et al. [20] 209 patients receiving treatment for liver disease completed a questionnaire to determine whether those with HCV or HBV disclosed their disease status to personnel in dental clinics. They found that 59.8% always did, 12% sometimes did, and 28.2% never did. The main reason for nondisclosure was the failure of dental health-care workers to ask whether patients had systemic disease. Other reasons included fear of negative reactions from health care personnel and the belief by infected individuals that hepatitis is irrelevant to dental treatment. In the field of dental and maxillofacial treatment, except when patients are unaware that they are infected, it is necessary to consider that they may not convey information accurately regarding infection. Better oral health education is required for hepatitis-infected patients and for dentists, oral, and maxillofacial surgeons, [20-22] at present, preoperative screening tests are not recommended.

The prevalence of HIV in this study was 0.59%. In 180 patients at a maxillofacial hospital, Dreyer, et al. [23] reported a similar prevalence (1.1%) of HIV antibody. We found no significant difference in the combined prevalence of infection with HIV between patients with different oral diseases or of different ages. Therefore, PEP and post-exposure patient testing is essential. In our study, the infection-positive rate for HIV self-reported by patients in a pre-operative interview and questionnaire was 60% (3/5). Although this is relatively high, it must be considered that the number of patients enrolled in our study was small. In a study in Québec, Canada, Charbonneau, et al. [24] reported the behavior of 463 people with HIV/acquired immune deficiency syndrome (AIDS) regarding the disclosure of their HIV-positivity when seeking dental care: 54% reported that they always disclosed their HIV-positivity to dentists, whereas 25% reported that they never disclosed this information to dentists. Robinson, et al. [25] reported that, in a cohort of HIV-infected patients without AIDS who had visited a general dental practitioner at least once since diagnosis, half had withheld their HIV status to obtain treatment. These findings again indicate that screening by interview and patient self-reporting are inadequate.

We were unable to find evidence for a rationale to support routine preoperative screening. Our cost model shows that screening leads to additional costs of about ¥10,000,000 (US $100,000) for an average department of oral and maxillofacial surgery. Only two patients were found to have newly recognized infections, one each with HBV and HCV. The possibility that preoperative screening will detect new unrecognized, untreated infections is quite low, and the necessity of blood testing for infections is therefore entirely unsupported. The oral maxillofacial surgery departments of teaching hospitals, which accept less-experienced dentists,

such as trainees and residents, should play an active role in educating about infection transmission and the use of universal precautions and PEP.

Conclusion

In this study, we demonstrated the prevalence of HBV, HCV, and HIV infection and their association with oral diseases. Screening dental surgery patients for these infections by interview and self-reporting is inadequate. Presurgery screening of the entire population of patients is expensive and runs the risk of both a high false-positive rate and patient seroconversion between screening and surgery.

As has been shown in many public health studies, use of universal precautions including PEP is the most effective infection control measure.

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Conflicts of Interest

The authors declare no conflicts of interest.

Authors' contributions

SS participated in the design of the study and acquisition of data and carried out the manuscript drafting. TK and NK performed the coordination and contributed to draft the manuscript. AS and YS collected the data and compiled all medical records. YF conceived of the study and participated in its design. All authors approved the manuscript prior to submission.

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