Original article

Common knowledge regarding prevention of infective endocarditis among general dentists in Japan

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Endocarditis; Infectious disease; Patient care; Prevention; Risk factors

Summary
Background: Infective endocarditis (IE) is known as a life-threatening disease, with bacteremia-inducing dental procedures considered to be one of the major factors. Thus, prevention of IE onset with antibiotics is widely recommended. Guidelines composed in the USA for prevention and treatment are well known, while the Japanese Circulation Society recently presented their own guidelines. On the other hand, there are few studies of the general knowledge of dentists regarding IE prevention.

Methods and results: Questionnaires were distributed by postal mail to dentists who graduated from the Osaka University Faculty of Dentistry. Those with special backgrounds, such as oral surgeons, anesthesiologists, and orthodontists, were excluded. We analyzed a total of 159 questionnaires that were returned by the owners and staff of private dental clinics throughout Japan, whose careers as dentists ranged from 5 to 53 years. Approximately 90% reported encountering fewer than several patients at risk for IE per year and only 40% of the respondents were aware of the guidelines for its prevention. Furthermore, only 23 dentists reported the use of amoxicillin for prevention of IE, with diverse dosages and timing noted.

Conclusions: These findings suggest that promotion of guidelines for prevention of IE to general dentists is important, although the frequency of cases encountered by general dentists is extremely low.

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Introduction

Infective endocarditis (IE), a well-known disease in the field of dentistry, is initiated by bacterial adherence to pre-existing damaged valves during transient bacteremia, which is considered to be mainly caused by invasive dental proce-
dures, although it remains controversial [1—5]. The aortic valve is more frequently affected, followed by mitral valve, whereas tricuspid valve involvement is considered to be rare [6]. In a review of cases published between 1993 and 2003 presented by Moreillon and Que [4], the median incidence was 3.6 per 100,000 of the general population per year, while the median in-hospital mortality rate was 16%. In addition, a retrospective observational cohort study of Japanese patients with congenital heart disease from 1997 to 2001 showed that in-hospital mortality was 10% with the presence of heart failure one of the most important risk factors [7]. A more recent survey reported that staphylococci are more often identified in western countries, whereas oral streptococci are regarded as the major pathogens in Japan [4,8—12]. It is considered that bacteremia is induced by invasive dental procedures, such as tooth extraction and periodontal surgery, and antibiotic prophylaxis given prior to performing such dental procedures to patients at risk for IE has been recommended, with amoxicillin the major oral prophylactic regimen recommended in guidelines for IE prevention [9,13,14].

Guidelines for the prevention of IE have been modified based on updated knowledge obtained by clinical and basic science studies. Those proposed by the American Heart Association are the most well known and the most recent version was presented in 2007 (AHA2007), which was dramatically changed as compared to the previous version presented in 1997 (AHA1997), in order to more clearly define when IE prophylaxis should be used and provide more uniform and consistent global recommendations [14]. The most notable changes in AHA2007 are that prophylaxis prior to dental procedures is considered reasonable only for patients with underlying cardiac conditions associated with the highest risk of an adverse outcome from IE, as well as for dental procedures that involve manipulation of gingival tissue or the periapical region of the teeth or perforation of the oral mucosa in such patients [14].

The first guidelines for prevention of IE published in Japan (JCS2003) were presented by the Japanese Circulation Society [9] based on the results of a nationwide survey held in 2001 and 2002 [8], which was then updated in 2008 (JCS2008). Individuals at risk for IE designated in JCS2003 and JCS2008 are similar to those in AHA1997. As for dental procedures noted to be at risk for IE in JCS2003 and JCS2008, there are no significant differences between them, with invasive dental procedures with bleeding recommended for consideration. However, JCS2003 notes that the dose of amoxicillin might be reduced according to body weight, whereas the description in JCS2008 was changed to note that such a reduction “is possible.” In the present study, we conducted a survey of Japanese dentists to obtain understanding of their knowledge regarding the prevention of IE in cooperation with the Osaka University Faculty of Dentistry Alumni Society.

Methods

Subjects

We sent questionnaire forms by regular mail to dentists who were members of the Osaka University Faculty of Dentistry Alumni Society in June 2010. Staff members of Osaka University Faculty of Dentistry and Dental Hospital were excluded. Survey forms were sent to approximately 2200 dentists living throughout Japan, with 215 completed questionnaires returned. We carefully selected questionnaires that were completed by general practitioners who were either the owners or staff members of a private clinic. Orthodontic specialists (n=7), anesthesiologists (n=4), oral surgery specialists (n=31), and a radiologist (n=1) were excluded, as we hoped to reveal the common knowledge of clinical dentists in Japan. Thirteen dentists who returned a questionnaire did not include their background information. Finally, 159 completed questionnaires were selected for analysis, which had been returned by dentists with a career range of 5—53 years (median 24 years).

Questionnaire

Fig. 1 shows the questionnaire, which was composed of 7 major questions areas. Question 1 focused on the background of the dentist, in order to specify which of the respondents met the exclusion criteria. Questions 2 and 3 queried regarding the frequency of encountering subjects at risk for IE and how they were treated. In question 4, we enquired regarding what kind of guidelines for prevention of IE (AHA1997, AHA2007, JCS2003, and JCS2008) the dentist was aware of and which applied to their own daily practice. Question 5 asked how patients were designated at risk for IE and the dental procedures used in those cases. In question 6, we sought the opinion of each dentist regarding the validity of antibiotic administration for prevention of IE. Finally, in question 7 we asked them to freely describe what they considered to be important in the field of dentistry with regard to IE.

Results

Frequency of dental treatments for patients at risk for IE

When asked how often the dentists encountered patients at risk for IE, the most frequent answer (approximately 60%) was “several cases per year,” while approximately 30% of the dentists had no experience with patients at risk (Fig. 2). The rate of dentists who treated such patients several times per month was 8.9%, while a very limited number answered that they treated such patients several times per week or almost daily. Among dentists who encountered patients at risk for IE, approximately 40% performed dental treatments at their own clinic, while half of the dentists noted that they treated them at their own clinic or referred them to another clinic (Fig. 3). In addition, 7.3% of the dentists answered that they did not treat such patients, but rather referred them to another clinic.

General knowledge of guidelines for prevention of IE

Approximately 40% of the dentists answered that they were familiar with at least one of the queried guide-
Prevention of infective endocarditis by dentists

Questionnaire regarding prevention of infective endocarditis

Q1. General information.
   Year of DDS degree (                    )
   General practitioner / Private clinic staff / Staff of hospital / Other (                    )
   Specialty (                    )

Q2. How often do you encounter patients who are at risk for infective endocarditis?
   A) Never  B) Several cases per year  C) Several cases per month
   D) Several cases per week  E) Almost daily

Q3. Do you treat patients who are at risk for infective endocarditis?
   A) Yes.  B) No, I refer them to other clinics.  C) Both A and B

Q4-1. Are you aware of the following guidelines for prevention of infective endocarditis?
   Please select all of the guidelines you are familiar with (multiple answers are possible).
   AHA: American Heart Association, JCS: Japan Circulation Society

Q4-2 Which do you apply for treatment of your patients? (                    )

Q5-1. In your daily practice, how do you designate patients at risk for infective endocarditis?
   A) Based on the guidelines  B) Based on comments from their primary physician
   C) Based on comments from the patient  D) Other (                    )

Q5-2. In your daily practice, how do you designate dental procedures at risk for infective endocarditis?
   A) Based on the guidelines  B) Based on comments from their primary physician
   C) Based on comments from the patient  D) Other (                    )

Q5-3. Please explain the antibiotics that you use for prevention of infective endocarditis.
   Name (                    )  Amount (                    )
   Timing (                    )  Child cases (                    )

Q6. Do you think that an antibiotics prescription is necessary for prevention of infective endocarditis?
   A) It is definitely needed.
   B) It is partially needed due to the estimated presence of cases without need.
   C) It is not needed at all.
   D) Other (                    )

Q7. Please write your opinions regarding infective endocarditis and related dental treatments.

Figure 1  Questionnaire used in the present study.

Figure 2  Frequency of patients encountered who were at risk for infective endocarditis.

Figure 3  Place for dental treatment of patients at risk for infective endocarditis.

lines (AHA1997, AHA2007, JCS2003, JCS2008) (Fig. 4). The most familiar was reported to be AHA1997 (approximately 50%), while JCS2008, AHA2007, and JCS2008 were known by approximately 30% of the dentists. One dentist noted awareness of guidelines provided by the Japanese Society of Chemotherapy. Among the 4 guidelines noted in the questionnaire, the most frequently applied in daily practice was reported to be AHA1997, followed by JCS2008, both of which
were approximately 30%, while AHA2007 and JCS2003 were applied by less than 20% of the dentists.

**General approaches for patients at risk for IE**

Approximately 60% of the dentists replied that they referred to the advice of a medical doctor for designation of patients at risk for IE regarding dental procedures associated with IE (Fig. 5). On the other hand, only 20% of the dentists answered that they were the one who designated their patients at risk for IE and dental procedures associated with IE by use of the guidelines. In addition, the rates of dentists who asked patients whether they had been designated at risk for IE and were aware of procedures associated with IE were approximately 40% and 20%, respectively.

**Importance of guidelines for prevention of IE**

More than 90% of the dentists considered that antibiotic prophylaxis is important for prevention of IE, while approximately 40% answered that they felt no necessity in some cases (Fig. 6). Only 1 dentist answered that antibiotic prophylaxis is not required, while the remaining described nothing or stated that they could not answer the question.

**Prevention of IE in daily practice**

There were only 23 dentists who answered that they use amoxicillin for prevention of IE, while the dosages and timing were diverse (Fig. 7). The most frequent answer was to administer amoxicillin once ranging from 30 to 120 min before performing treatment. The amount of amoxicillin...
Definitely needed (71.4%)
Partially needed (29.4%)
No need (2.1%)
Others (7.0%)

Figure 6  Consideration of necessity for current approaches for prevention of infective endocarditis.

prescribed was reported to range from 500 to 2000 mg. One of the dentists noted that they refer all cases to a medical doctor for the antibiotics prescription. In addition, there were 5 dentists who answered that they prescribe antibiotics to be taken multiple times before treatment. Of those, 3 noted that they ask the patients to take amoxicillin before treatment as well as 2 or 3 days after treatment, while 1 asked the patients to take amoxicillin 1 day before treatment only and another 1 day after treatment only. Table 1 lists the antibiotics prescribed by the dentists who replied to the present survey. The most frequently used antibiotics were cephems, followed by penicillin, although several dentists prescribed macrolides, azithromycin, and newly introduced quinolones for prevention of IE.

Other comments related to dentistry and IE

There were various comments given in reply to the final question, which revealed that most of the general dentists were not aware of the presence of guidelines for prevention of IE. Others noted that guidelines to be used in the field of dentistry should be produced by dentists in cooperation with medical doctors, so that the detailed categories related to risky dental procedures could receive focus based

Figure 7  Protocol of amoxicillin administration by 23 dentists. Closed circles indicate the timing allowed for taking amoxicillin. There was 1 dentist who did not answer the protocol.
on patient tooth conditions. On the other hand, some of the dentists considered that IE might be caused by invasive dental procedures and recommended that scientific evidence be accumulated to update the guidelines. In addition, some dentists anticipated that most patients categorized at risk for IE were not aware of the risk, which led them to recommend that dissemination of appropriate information to at-risk patients be done in case they later undergo dental treatment related to IE. Finally, some dentists proposed that routine dental hygiene procedures should be provided for patients at risk for IE, whereas others speculated whether those dental procedures were possible risk factors for IE.

### Table 1

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephems</td>
<td>51</td>
</tr>
<tr>
<td>Penicillin</td>
<td>40</td>
</tr>
<tr>
<td>Macrolides</td>
<td>9</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>3</td>
</tr>
<tr>
<td>Newly introduced quinolone</td>
<td>2</td>
</tr>
<tr>
<td>Faropenem sodium</td>
<td>1</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>1</td>
</tr>
<tr>
<td>Consultation with medical doctors</td>
<td>3</td>
</tr>
<tr>
<td>No description</td>
<td>22</td>
</tr>
</tbody>
</table>

*Multiple kinds of antibiotics were noted by 10 dentists.*

**Discussion**

Dental caries and periodontitis are regarded as two major diseases in the field of general dentistry, both of which are known to be caused by pathogenic oral bacterial species [15–17]. Furthermore, it is also well known that oral streptococci including pathogens related to dental caries and several different periodontopathic bacterial species are causative agents of IE [4,18]. However, there is only limited information regarding IE that has been disseminated to dentists, especially general dentists serving in community clinics, which may prevent them from understanding effective preventive procedures to avoid onset of the disease.

In the present study, we analyzed the current state of common knowledge regarding IE among general dentists in Japan. In order to obtain information from dentists with a wide age distribution, we sent questionnaires to individuals who graduated from Osaka University Faculty of Dentistry over the past 6 decades, which included dentists with various backgrounds, such as owners and staff of private dental clinics, hospital staff, and those conducting basic research, including some who specialized in oral surgery and general anesthesia as well as orthodontics, but did not serve as dentists for general treatment of dental caries or periodontitis. Since most of the dentists queried were owners or staff of private clinics and served as general dentists, we focused on their answers to analyze the general knowledge of the dental community regarding prevention of IE in daily practice.

We enquired regarding the experience of each dentist with encountering patients at risk for IE. It should be noted that the phrase "at risk" can be ambiguous since no specific definition was provided in the questionnaire, which may have affected the results to some extent. Our findings revealed that approximately two-thirds of general dentists encounter several patients at risk for IE each year, whereas 30% do not encounter any such cases in their daily practice. This low frequency could be one of the reasons why many dentists do not have special knowledge regarding the prevention of IE. In addition, 7% of those queried noted that they refer such patients to other clinics and another 50% treat only limited-risk patients. In addition, our results showed that only 40% of the dentists who answered the questionnaire knew at least one of the guidelines presented by the American Heart Association or Japanese Circulation Society. We speculated that younger dentists would have greater awareness of the guidelines. However, the percentage of dentists who knew at least one of the guidelines was similar (40–45%) in 4 groups divided by career length (5–15, 16–25, 26–35, and more than 36 years) (data not shown), indicating that understanding of the guidelines is poor in all generations of general dentists. Since IE is a life-threatening disease and dental procedures have been shown to be major causes, it is important to teach the appropriate methods to general dentists for IE prevention, and the guidelines along with other related materials must be distributed in a wide-ranging manner.

It is very important to be aware of the presence of heart disease in patients prior to dental treatment. When the patient is referred by a cardiologist, the condition is generally known. However, the number of such cases is speculated to be small, as patients often visit dentists directly without any referral. Therefore, education regarding the risk for IE caused by dental treatments is important for at-risk patients. The present survey showed that approximately 60% of the queried dentists referred to medical doctors for designation of patients at risk for IE as well as dental procedures related to IE, whereas only 10–20% of those noted that they designated patients after referring to the guidelines for IE. This low rate of utilizing the guidelines could be derived from not only a lack of their promotion to the dental community, but also from difficulties in understanding systemic conditions related to IE. Thus, some of the dentists noted that they wished to see guidelines for prevention of IE produced that specifically relate to the field of dentistry. We think that it is important to establish guidelines in cooperation with a large number of dentists who understand dental procedures that can lead to bacteremia. It is surprising that only about 40% of the dentists answered that they understand the current protocols for antibiotic prescription for IE, which indicates that there is limited information available showing the validity of antibiotic administration for prevention of this disease. Clinical research using human subjects could be performed with the cooperation of medical doctors and dentists in Japan until the next version of the guidelines is produced.

Although the guidelines for prevention of IE state that amoxicillin should be the first choice as an oral regimen, most general practitioners noted that they use a variety of other antibiotics, such as cephems, macrolides, azithromycin, with amoxicillin selected only by 23 of 121, which might be derived from a limitation of available antibiotics at their clinics. In addition, only one-third of the...
dentists use penicillin for prevention of IE. On the other hand, a nationwide survey of cardiologists in Japan revealed that 73.2% of them selected penicillin as oral antibiotic medication for prevention, followed by the cepham group of antibiotics (18.0%) [11]. It is possible that many dentists are not aware of the guidelines recommending amoxicillin. In addition, even when amoxicillin was selected in the survey, the dosage and administration period were shown to vary among the dentists, which may also have been related to the low awareness of the contents of the guidelines. Thus, it is important to consider approaches for education of general dentists regarding the guidelines, although cooperation between dentists and medical doctors will be important.

The concept of prevention of IE is controversial, as some insist on the necessity of antibiotics, while others propose no need for such administration [1—5]. The present survey shows that general dentists tend to have similar opinions. It should be noted that one of the responding dentists experienced a case of IE after extraction of the primary lateral incisor from a child, in whom the existence of heart disorders was clarified after the onset of IE. That dentist wrote that the parents of the child severely criticized the dental procedures used, even though they were not aware of any systemic condition in the child prior to visiting the clinic. Most of the dentists noted that they prescribed antibiotics because they wished to protect themselves in case of the onset of IE, although others insisted that the system of unnecessary antibiotic prescription be abolished. It is very difficult to provide correct information for the prevention of IE at the present time. Thus, cooperation between dentists and medical doctors to construct better guidelines for IE that reflect the current situation should lead to better promotion of such guidelines and allow more general dentists to apply them in their daily practice.

Conclusion

Some of the queried dentists were aware of the guidelines for prevention of IE, while others were not. We conclude that these guidelines have not been adequately promoted to general dentists who provide dental treatments to patients at risk for IE, even though the frequency of encountering such cases was estimated to be extremely low. Nevertheless, most of the dentists who answered the present questionnaire expressed a desire to learn appropriate methods for prevention of IE supported by evidence. Therefore, it is very important to encourage collaboration among dental and medical specialists in regard to the treatment of IE.

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