ASSESSMENT OF AWARENESS OF RECOMMENDATIONS FOR PREVENTION OF BACTERIAL ENDOCARDITIS AMONG A GROUP OF 136 IRANIAN DENTAL AND MEDICAL STUDENTS

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Abstract- Bacterial endocarditis is a serious disease that could occur after invasive dental procedures. Despite a large number of papers written about the knowledge of prevention of bacterial endocarditis among health care workers in western countries, little is known about awareness of this subject among practitioners and students in other countries. The purpose of the present study was to assess the knowledge of recommendations for prevention of bacterial endocarditis among a group of Iranian dental and medical students. A multiple choice test that included 15 questions about bacterial endocarditis and antibiotic prophylaxis was developed. The questionnaires were distributed to 136 dental and medical students who had passed a theoretical course about bacterial endocarditis successfully in the past. Success was defined as correct answers to at least 8 of the 15 questions. Of 136 students participating in this study, 34 (25%) passed the test successfully. The pass-rate of dental students (38%) was significantly higher than that of medical students (13.5%) ($P < 0.05$). The mean mark of dental and medical students was 6.74 ± 2.28 and 4.81 ± 2.1, respectively ($P < 0.05$). No significant difference in success rates or mean marks found according to sex or age in the present study. The results of the present study demonstrate an important lack of knowledge regarding prevention of bacterial endocarditis among a group of Iranian dental and medical students and the need for improved education in this field.

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INTRODUCTION

Bacterial endocarditis (BE) is a serious infection of the heart valves and endocardium that most often is related to congenital and acquired cardiac defects. Considerable progress in medical and surgical intervention has reduced the mortality rate for BE from 7-10% to about 3% in recent years (1).

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The causes of BE are often unknown. However, about 10% of cases occur after invasive procedures with associated bacteremia, almost invariably in susceptible patients (2). Viridans streptococci causes approximately 60% of cases of native valve endocarditis and dental manipulation have been repeatedly considered as a source of bacteremia that leads to BE (3). Investigators have reported a presumed oral portal of entry in 13.7-20% of patients with BE (4-8). However, the incidence of BE is low after dental treatments, even in patients with underlying cardiac conditions. Since invasive dental and medical procedures performed frequently, and

the frequency of predisposing underlying cardiac conditions appears to be increasing, the use of antibiotic prophylaxis in "at risk" patients before these procedures is a reasonably well-accepted practice (9). American Heart Association (AHA) and other committees of experts have proposed different guidelines and antibiotic prophylaxis regimens for prevention of BE in susceptible patients. These recommendations have been reviewed and modified periodically on the basis of experimental animal models, pharmacokinetic studies, bacterial susceptibility studies, BE series, studies of procedures-related bacteremia, and the efficacy of antimicrobial prophylaxis against bacteremia (9). The AHA has made 8 sets of recommendations regarding the prevention of BE, with the latest guideline published in 1997 (10). Bacterial endocarditis are taught to all dental and medical students during their education and they must be familiar with the latest AHA recommendations on prevention of BE. However, several studies have showed low compliance with AHA guidelines for prevention of BE, lack of knowledge at a reasonable level in this field among dental and medical students and practitioners, and the need for improved education regarding AHA guidelines (2,9,11-13).

The number of patients that undergo cardiac surgery (e.g. valve replacement surgery) and those with intravascular devices (e.g. coronary artery stent) has been increased dramatically in Iran during recent years, due to improved access to health care facilities all around the country. These patients are at risk for developing BE following invasive dental procedures (14). Considering this, it is critical that all dental and medical students have an up-to-date and reasonable knowledge about cardiac lesions and invasive procedures that predispose patients to the development of BE and prophylaxis regimens recommended by AHA for prevention of this disease. To our knowledge, despite a considerable volume of literature written about the level of knowledge of guidelines for prevention of BE among health care workers and dental and medical students in western countries, little is known about the awareness of this subject among dental and medical students of other countries, including Iran. The aim of the present study was to assess the knowledge of endocarditis prophylaxis recommendation on the basis of the latest AHA guidelines in a group of 136 Iranian dental and medical students at Kerman University of Medical Sciences (KUMS), Kerman, Iran.

Subjects and methods

We constructed a multiple-choice test according to the latest AHA recommendations (1997) to assess the knowledge of dental and medical students related to the prevention of endocarditis. The test included three sets of questions:

- Basic questions about the causative bacteria and underlying cardiac conditions that predispose patients to BE. Included in this part were four multiple-choice questions.
- Questions addressed commonly performed dental procedures, oral cavity as a possible source of bacteremia, and the safety of electric powered toothbrushes in susceptible patients. This part of the questionnaire consisted of four tests.
- Questions addressed the type of antimicrobial prophylaxis to be prescribed for "at risk" patients before invasive dental procedures. Seven tests were included in this part.

We pretested the questionnaire to evaluate its quality. The questionnaire was evaluated and modified for interpretability and time needed for completion according to the results of this pretest and received comments.

The tests were distributed to 74 medical students at Afzali-Poor teaching hospital and 62 dental students at Kerman school of dentistry in April 2005. The test was given during a scientific weekly meeting to be completed in 15 minutes. The filled questionnaires were collected in a ballot box. The test was anonymous. However, each participant completed a separate sheet included questions about age, sex, and self-evaluation of his/her BE knowledge. An acceptable level of success for the test was defined as at least 8 correct answers out of 15 (53%). Difficulty and discrimination indexes were calculated for each question. Questions with a difficulty index of less than 30% were considered as "difficult", while questions with a difficulty index of over 50% were considered as "simple". We

considered those questions with a discrimination index of over 30% as "good" questions and those with a discrimination index of less than 20% as "bad" questions. The statistical analysis included *t* test, chi square, and ANOVA analysis. *P* values < 0.05 were considered significant.

RESULTS

136 (74 medical students and 62 dental students) out of 148 students who had passed a theoretical course about BE successfully, participated in the present study. The elapsed time between passing the course and participation in the present study was less than 2 years in 90.4% of cases. The age range of the participants was between 21 and 29 with a mean of 24.5 ± 1.7. Of 136 students, 64 (47.1%) were male and 72 (53.9%) were female. Of 136 students, 104 (76.5%) rated their level of knowledge of BE as moderate. As mentioned earlier, success had been defined as correct answers for at least 8 out of the 15 questions. Of 136 students participating in this study, 34 (25%) passed the test successfully. The pass-rate of dental students (24/62 or 38%) was significantly higher than that of medical students (10/74 or 13.5%) ($p < 0.05$). The mean mark was 6.74 ± 2.28 for the dental student group and 4.81 ± 2.1 for the medical student group ($p < 0.05$). Although the mean mark of male students (5.9 ± 2.38) was higher than that of female students (5.5 ± 2.38), the difference was not statistically significant. As mentioned in the previous section, the test included three sets of questions. Table 1 shows the mean mark of the dental and medical student groups for each set of questions. As it can be seen, the mean mark of dental students for each set of questions (even basic questions) was higher when compared with medical students ($p < 0.05$). Table 2 shows ranking of questions on the basis of difficulty and discrimination indexes.

Table 1. Mean mark of the participants according to three sets of questions.

Type of Questions	Mean Mark of Dental Students ± SD	Mean Mark of Medical Students ± SD	*P* Value
Basic	1.85 ± 1.03	1.29 ± 1.02	0.002
Dental Procedures	1.25 ± 0.72	1.04 ± 0.86	0.0001
Antimicrobial Prophylaxis	3.62 ± 1.69	2.47 ± 1.49	0.0001
Total	6.74 ± 2.28	4.81 ± 2.1	0.0001

Table 2. Difficulty and discrimination indexes of questions.

	Number of questions (%)	Explanation
Difficulty Index:		
Simple	2 (13.3%)	> 50%
Intermediate	8 (53.3%)	30-49%
Difficult	5 (33.3%)	< 30%
Discrimination Index:		
Good	10 (66.6%)	> 30%
Intermediate	3 (20%)	20-30%
Bad	2 (13.3%)	< 20%

Table 3. Translation of the complete questionnaire

Questions and Answers *(Correct Answers in Italic)*	**Correct Answers**	**Discrimination Index**
Section A: Basic questions		
1. In which of the following cardiac conditions the risk of occurrence of bacterial endocarditis is lower than others?	36.7%	37.5%
a. Prosthetic heart valve		
b. Previous infective endocarditis		
c. Tetralogy of Falllot		
d. Mitral stenosis		
2. In which of the following cardiac conditions there is a low or negligible risk for developing bacterial endocarditis?	48.5%	45%
a. Mitral valve prolapse without regurgitation		
b. Surgically constructed systemic-pulmonary shunts		
c. Ventricular septal defect		
d. Coarctation of aorta		
3. Which of the following sentences is <u>true</u>?	24.2%	25%
a. All patients with a history of rheumatic fever are at risk for development of bacterial endocarditis.		
b. Patients with cardiac pacemakers or implanted defibrillators are at high risk for development of bacterial endocarditis for the rest of their lives.		
c. Antibiotic prophylaxis is not necessary for patients with atrial septal defect of secundum type before invasive dental procedures.		
d. Patients with coronary artery bypass graft surgery need to be premedicated before invasive dental procedures for the rest of their lives.		
4. The most common causative pathogen in "right-heart" bacterial endocarditis is:	50%	42.5%
a. Streptococcus Viridans		
b. Staphylococcus Aureous		
c. Candida Albicans		
d. Actinobacillus actinomycetemcomitans		
Section B: Dental procedure and home care questions		
5. The predominant source of oral bacteremia with resultant bacterial endocarditis is:	8%	7.5%
a. Dental extraction		
b. Periodontal surgery		
c. Scaling		
d. Chewing food and carrying out oral hygiene		
6. The bacteremia resulted from invasive dental procedures <u>usually</u> lasts for about:	36.7%	12.5%
a. 10 to 15 minutes		
b. 1 to 2 hours		
c. 3 to 4 hours		
d. 5 to 6 hours		
7. According to American Heart Association, in which of the following procedures antibiotic prophylaxis <u>is not indicated</u>.	44.8%	40%
a. Dental extraction		
b. Initial placement of orthodontic bands		
c. Scaling and root planning		
d. Restoration of occlusal class 1 cavity on the first upper molar		
8. AHA lists electric toothbrushes as recommended dental aids for patients who are susceptible to bacterial endocarditis.	24.2%	25%
a. True		
b. False		

Table 2. Translation of the complete questionnaire (continued)

Questions and Answers *(Correct Answers in Italic)*	**Correct Answers**	**Discrimination Index**
Section C: Antimicrobial prophylaxis questions		
9. According to AHA guideline, the first-line antibiotic for prevention of bacterial endocarditis in dental practice is:	80.1%	67.5%
a. Clindamycin		
b. Amoxicillin		
c. Azithromycin		
d. Cephalexin		
10. Which of the following antibiotics is no longer recommended by the AHA for prevention of bacterial endocarditis?	34.5%	47.5%
a. Erythromycin		
b. Parenteral ampicillin		
c. Parenteral cefazolin (Ancef)		
d. Cephalexin (Keflex)		
11. Which of the following regimens is recommended by AHA for antibiotic prophylaxis in susceptible patients?	45.5%	50%
a. Azithromycin, 1 g PO, 1 hour before treatment		
b. Clarithromycin, 500 mg PO, 2 hours before treatment		
c. Cephalexin, 2 g PO, 1 hour before treatment		
d. Penicillin V, 3 g PO, 1 hour before treatment		
12. What is the clindamycin dose in the most recent set of recommendation for prevention of bacterial endocarditis?	29.4%	42.5%
a. 150 mg		
b. 300 mg		
c. 600 mg		
d. 1200 mg		
13. The recommended regimen for antibiotic prophylaxis using amoxicillin is:	63.2%	60%
a. 1 g of amoxicillin PO 2 hours before the appointment		
b. 2 g of amoxicillin PO 1 hour before the appointment		
c. 3 g of amoxicillin PO 1 hour before the appointment		
d. 4 g of amoxicillin PO 2 hour before the appointment		
14. The second (follow-up) dose of amoxicillin according to the latest AHA guideline is:	30.1%	47.5%
a. 500 mg of amoxicillin PO 6 hours after the initial dose		
b. 1 g of amoxicillin PO 8 hours after the initial dose		
c. 1.5 g of amoxicillin PO 6 hours after the initial dose		
d. The second dose is no longer recommended.		
15. Your patient has forgotten to take his/her premedication. In such a case, effective prophylaxis is possible if the patient is medicated anytime up to …… from the time of induced bacteremia.	16.9%	30%
a. 1 hour		
b. 2 hours		
c. 4 hours		
d. There is no prophylactic benefit, if the patient is medicated after occurrence of bacteremia.		

DISCUSSION

Bacterial endocarditis is a serious life-threatening cardiac disease accounted for approximately one case/1000 admission with a range of 0.16-5.4 cases/1000 in a review of 10 large studies (2). The worldwide incidence for BE has been estimated at 10 to 60 per 1 million population per year (14). It seems that the frequency of BE has increased in the last two decades, probably due to increasing age of the population, rising number of patients with prosthetic heart valves, and frequent usage of intravascular devices (15,16).

Some cases of BE occur after invasive procedures such as dental extraction that are associated with bacteremia. On the other hand, underlying cardiac conditions such as valvular abnormalities that render the patient susceptibility to BE are common. Considering these facts, AHA has started publishing recommendations for antibiotic prophylaxis and prevention of BE since 1955. This guideline is recently revised and updated (10) and has been accepted as the standard of care in many countries around the world, including Iran.

In the present study, we assessed the knowledge of 136 Iranian dental and medical students at Kerman University of Medical Sciences, the major university of biomedical sciences in the south east of Iran, regarding the latest recommendations for prevention of BE published by AHA in 1997. This study showed that only 25% (34 out of 136) of our students passed the test successfully and had an acceptable level of knowledge concerning this guideline. The mean marks of dental students in all three sets of questions were higher than that of medical students and the differences were statistically significant (Table 1).

No significant difference in success rates or mean marks found according to sex or age in the present study.

Although 109 (80%) of the participants in the present study recognized amoxicillin as the first-line antibiotic for BE prophylaxis in a dental practice, only 41 (30%) knew that the second (follow-up) dose was no longer recommended by the AHA. This study also showed that only 47 (34.5%) of the medical and dental students knew that erythromycin had been eliminated from the latest guideline for antibiotic prophylaxis (Table 3).

These findings are in agreement with the results that have been reported by different investigators during past two decades. Nelson and Van Blaricum (17) in a study on 1131 dentists and physicians in the United States found out that only 39.2% of them adhered to the latest AHA guideline when prescribing antibiotic for BE prophylaxis. This study also demonstrated that physicians might not be as familiar with the latest AHA recommendations as dentists (17). In a study amongst clinicians in a teaching hospital, Solomon and colleagues (2) showed that 62% of the participants had an acceptable level of knowledge about antibiotic prophylaxis and prevention of BE. In another survey on the method of antibiotic prophylaxis against BE by dentists, Bennis and colleagues (18) found out that only 21% of the dentists used the recommended dose of amoxicillin. This study also showed that approximately half of the participants started treatment 1 to 3 days too soon and less than 5% used the recommended single dose antibiotic therapy (18). Similar results have been reported by Tomas-Carmona and colleagues from Spain who showed that 45.5% of the 400 participating dentists would not administer any antibiotic prophylaxis before a tooth extraction in an “at risk” patient. Although erythromycin is no longer recommended by AHA for prevention of BE, 68.2% of the participants in this survey prescribed it as the antibiotic of first choice in penicillin allergic patients (9).

There is no doubt that lack of knowledge concerning AHA guidelines would lead to non-compliance. Considering the implication of invasive dental procedures in the development of BE, the severity of this disease, and the ease and efficiency of AHA recommendations, all dental and medical students should be qualified in prevention of BE. The results of this study shows while passing a theoretical course about BE is necessary, it will not guarantee such a qualification. Further studies are needed to explain why the level of BE knowledge among our students was low and why the mean mark of dental students was higher than that of medical students. However, it seems that important topics such as BE should be presented to the students using

various methods of teaching (e.g. lectures, handouts, computer assisted learning packages, etc) in order to improve learning. It is important to notice that each student has a main learning style (visual, auditory, reading and writing, and kinesthetic) (19). To improve learning quality, instruction should be adapted to accommodate these styles. Considering this, faculties are supposed to use different modes of instructional delivery to acknowledge the diversity of the students that they teach. Problem-based teaching that is not a common practice in KUMS and other biomedical universities of Iran will help to achieve this goal because it uses a rich array of modes.

In summary, this study shows lack of reasonable knowledge concerning prevention of BE among a group of Iranian dental and medical students. After graduation from dental or medical schools, these students will be entitled to provide care including invasive procedures that could lead potentially to the development of BE in susceptible patients. The results of present study demonstrate the need for improved education of dental and medical students regarding prevention of BE.

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