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RESEARCH ARTICLE

Assessment of the Level of Knowledge and Awareness of Dentists About Antibiotic Prophylaxis

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Abstract

Purpose

Antibiotic prophylaxis defines the practice of antibiotics prior to surgical or non-surgical procedures to prevent local or systemic bacterial infective complications. Infective endocarditis is a serious infection of the heart valves and endocardium mostly associated with congenital and acquired cardiac defects. It has also been shown that infective endocarditis is associated with bacteremia following dental treatment. The aim of the study is to determine the preferences of dentists for the application of antibiotic prophylaxis and to increase awareness by measuring their level of knowledge.

Material and Methods

This study was carried out in Turkey with dentists and dental students using online. In the survey, which was answered by 417 participants, participants were asked a total of 11 questions in 4 separate sections.

Results

The results of the study showed that the participants most frequently prescribed prophylactic antibiotics in the presence of heart valve prosthesis with 95.5% and a history of previous infective endocarditis with 92.9%, before surgical tooth extraction with 96.4% and implant surgery with 94.1 %. As a prophylactic antibiotic, 66.5% of the participants routinely preferred amoxicillin and 77.1% preferred clindamycin if the patient was allergic to penicillin. Answers regarding prophylactic antibiotic dose and duration were classified according to AHA's 2007 guidelines, and female participants (58%) and dentistry students (78.1 %) gave the highest correct answers accordingly.

Conclusion

With this study, it was once again demonstrated that it is extremely important for physicians to follow current guidelines and minimize the risk of bacteremia by taking detailed anamnesis from the patient, and the need to increase awareness of this issue.

Key Words: Antibiotic prophylaxis, infective endocarditis, bacteremia, dentists' knowledge

Introduction

Prophylaxis: It is a word derived from the verb "prophyláss" in ancient Greek, which means protection from disease, preventive measure while the term "antibiotic prophylaxis" defines the application of antibiotics before surgical or non-surgical procedures in order to prevent local or systemic bacterial infective complications[1]. Dentists prescribe antibiotics to treat oral and dental infections or as a prophylactic.

It has been shown that infective endocarditis is associated with bacteremia following dental treatment[2]. Bacterial endocarditis (BE) or infective endocarditis (IE) is a serious infection of the heart valves and endocardium mostly associated with congenital and acquired cardiac defects. BE usually occurs in patients with heart valve prosthesis. If left untreated, it can damage the heart valves and lead to life-threatening complications. It has been shown that approximately 10% of cases of IE occur with common bacteremia after invasive procedures in individuals prone to the disease[3]. Individuals with a prosthetic heart valve, a congenital heart defect or a recent history of IE are at risk of developing this disease. BE may occur after bacteremia in patients with predisposing heart lesions[4]. In about 60% of IE cases, it has been recognized that the causative organism is pathogen streptococci, and dental treatments such as tooth extraction, scaling and root surface corrections are a temporary source of bacteremia that leads to BE[5]. However, even in patients with a history of underlying

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heart disease, the incidence of BE following dental treatments is quite low[6].

It is remarkably recommended to use antibiotic prophylaxis before starting treatment in at-risk individuals with prosthetic heart valves, congenital heart defects, or a recent history of IE before surgical dental procedures[4,5]. As a general principle, the recommended standard regimen includes the application of a single dose of antibiotics prior to the necessary dental procedures. If the dose was omitted before the procedure, it is recommended to take it up to 2 hours after the procedure. The prophylaxis regime to be applied according to AHA's 2007 guidelines is shown in Table 1[7]. However, the efficacy of antibiotic prophylaxis applied to patients at risk of IE before dental procedures is still controversial[8]. A study conducted in the United States in 2019 reported that only 19.1% of antibiotics prescribed for prophylaxis prior to dental procedures were suitable for its purpose[9]. The main reason for the debate on the need to prevent unnecessary use and the necessity of prophylaxis is the possibility that unnecessary antibiotic use during dental procedures increases the antibiotic resistance of microorganisms and the risk of developing anaphylactic reactions in the patient[10].

Considering all this information, the aim of this article is to determine the antibiotic prophylaxis application preferences of dentists and to measure their knowledge level, as well as to increase awareness about unnecessary antibiotic use.

		Regimen: Single Dose 30 to 60 min Before Procedure	
Situation	**Agent**	**Adults**	**Children**
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin **OR** Cefazolin or ceftriaxone	2 g IM or IV	50 mg/kg IM or IV
		1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin—oral	Cephalexin*† **OR** Clindamycin **OR** Azithromycin or clarithromycin	2 g	50 mg/kg
		600 mg	20 mg/kg
		500 mg	15 mg/kg
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone† **OR** Clindamycin	1 g IM or IV	50 mg/kg IM or IV
		600 mg IM or IV	20 mg/kg IM or IV

IM indicates intramuscular; IV, intravenous.

***Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosage.**

†Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria with penicillins or ampicillin.

Table 1: Prophylaxis Practice According to 2007 AHA Guidelines

Materials and Methods

This study was carried out in Turkey with dentists and dentistry students using the "Survey Monkey" online software between December 2020 and April 2021. The questionnaire was delivered to the participants via e-mail and the questions were answered online. This study was approved by Başkent University Institutional Review Board (Project no: D-KA20/30) and also supported by Başkent University Research Fund. The survey was answered by 417 participants and participants were asked a total of 11 questions in 4 separate sections.

In the first part of the survey, personal information (age, gender, professional experience) was given, and physicians were asked how to monitor a patient who needs antibiotic prophylaxis. In the second part, systemic conditions requiring antibiotic prophylaxis, and in the third part, dental procedures requiring antibiotic prophylaxis were investigated. In the last part of the survey, dentists were asked about their preferred antibiotics, the dose they prescribed, and the duration of treatment.

SPSS 25.00 (Statistical Package for Social Sciences, IBM Inc., USA) tool was used for statistical analysis while the normality control of continuous variables was performed by Kolmogorov-Smirnov test. Differences between groups were evaluated using the Student t-test in normal distribution data, while group comparisons for data not suitable for normal distribution were performed using the Mann Whitney U test. ANOVA test and Tukey Post Hoc test were used in normal distribution data and Kruskal-Wallis h test and Tamhane's post Hoc tests were used in non-normal distribution variables in comparison of more than two groups. Descriptive statistics were identified by giving the mean, standard deviation, minimum and maximum values of the continuous variables. The entire study was conducted within 95% reliability limits and in statistical decisions, the level of $p \leq 0.05$ was considered an indicator of a significant difference.

Results

The sociodemographic characteristics of our participants are given in Table 2. The average age of the 417 volunteers who participated in our survey was 34.88 ± 12,706 [21-80]. Gender distribution was determined as 187 men (44.8%) and 230 women (55.2%). 34 (8.2%) of the participants were trainee dentists, while 164 (39.4%) had 1 – to – 5 years, 47 (11.3%) had 6 – to-10 years, 35 (8%, 4) had 11-to-15 years, and 137 (33%) had more than 15 years of professional experience. 373 of the participants (89.5%) had previously encountered a patient requiring prophylactic antibiotics to prevent the risk of bacteremia, while 44 (10.5%) had not. Of the physicians who answered the questionnaire, 354 (85%) prescribed antibiotics to their patients to prevent the risk of bacteremia, but 63 (15%) did not previously prescribe them for prophylaxis purposes. 205 (49.1%) participants consulted their patient's doctor before starting the treatment, 206 (49.5%) participants prescribed prophylactic antibiotics, and only 6 (1.4%) participants refused treatment and referred the patient to another physician. No statistically significant difference was observed compared to the responses to this question (p=0,172).

	Number	Percent (%)
Gender		
Female	230	55,2
Male	187	44,8
Professional Experience		
Dentistry Students	34	8,2
1-5 years	164	39,4
6-10 years	47	11,3
11-15 years	35	8,4
>15 years	137	33
Encountering a Situation That Needed Prophylaxis Before		
Yes	373	89,5
No	44	10,5
Prescribing Antibiotic Prophylaxis Before		
Yes	354	85
No	63	15
When Prophylactic Antibiotics Are Needed		
Write a consultation	205	49,1
Prescribe antibiotics	206	49,5
Refuse treatment and guidance	6	1,4

Table 2: Sociodemographic characteristics of the participants

Prophylactic antibiotic prescription rates according to medical status and dental procedures are shown in Table 3. Volunteers most frequently prescribed prophylactic antibiotics in the presence of heart valve prosthesis with a rate of 95.5% and a history of previous infective endocarditis with a rate of 92.9%. The lowest rate with 6.6% was observed in arrhythmia response. The dental procedures most frequently prescribed for prophylactic antibiotics were surgical tooth extraction with 96.4% and implant surgery with 94.1%. According to the responses, with a ratio of 1.9%, prosthesis cementation was the preferred dental procedure, with minimal prophylaxis.
Participants ' choice of prophylactic antibiotics in case of routine and allergies is shown in Table 4. According to the survey, amoxicillin was the most preferred antibiotic for prophylactic purposes by 281 participants (66.5%), followed by penicillin with 125 participants (29.5%). No statistically significant difference was observed between them compared to the professional experience of the volunteers surveyed and the antibiotics they would choose for prophylaxis (p=0.147). It has been observed that dentists with professional experience highly prefer amoxicillin. In the case of penicillin allergy, clindamycin with 324 participants (77.1%) and macrolide group antibiotics with 80 participants (19%) were most frequently preferred (Table 4). A statistically significant difference was observed between the professional experience of the survey volunteers and the antibiotics they would choose for prophylaxis in patients with penicillin allergies (p=0.000). When the data were examined, all dentists with professional experience preferred clindamycin for patients with high penicillin allergies, while at low rates they preferred cefazolin and tetracycline (Figure 1). No statistically significant difference was observed compared to the gender of the volunteers surveyed and the antibiotics they would choose for prophylaxis (p=0,124).

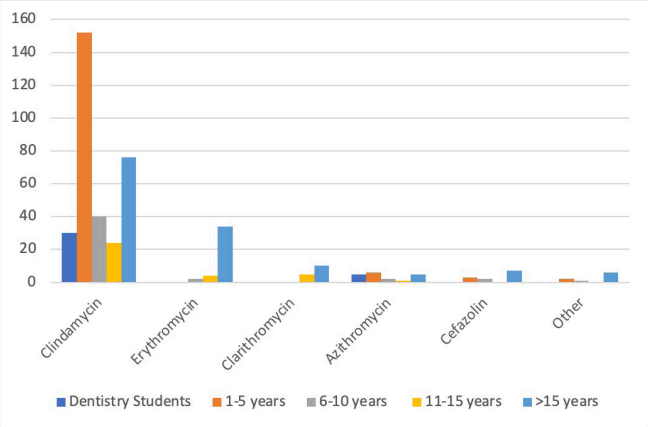


Figure 1: Comparison of the antibiotic to be preferred in patients with penicillin allergy and professional experience

Medical Status	Number	Percent (%)
Presence of a heart valve prosthesis	405	95,5
Presence of stent	136	32,8
Patients who have undergone open heart surgery	217	51,2
Ischemic heart disease	137	32,3
Ventricular septal defect	223	52,6
Atrial septal defect	219	51,7
Rheumatic heart disease	322	75,9
Cyanotic congenital heart disease	196	46,2
Arrhythmia	28	6,6
Previous infective endocarditis	394	92,9
Previous cardiac by-pass operation	136	32,1
Presence of a pacemaker	117	27,6
Mitral valves prolapse or regurgitation	239	56,4
Physiological murmur	40	9,4
Prior heart transplantation	336	79,2
Presence of joint prosthesis	228	53,8
Rheumatoid arthritis	226	53,3
Type I diabetes	89	21
Type II diabetes	71	16,7
Previous kidney transplantation	284	67
Previous liver transplantation	267	63
Dental Procedures		
Simple tooth extraction	299	70,5
Surgical tooth extraction	409	96,4
Periodontal surgery	385	9,8
Implant surgery	399	94,1
Biopsy	292	68,9
Apical resection	382	90,1
Scaling and polishing	181	42,7
Endodontic treatment	198	46,7
Abscess drainage	338	79,7
Dentoalveolar trauma	279	65,8
Fixed orthodontic band placement	109	25,7
Placement of orthodontic brackets	12	2,8
Simple and complex restorations	58	13,7
Tooth preparation and impression taking	139	32,8
Inserting rubber-dam	59	13,9
Matrix band and wedge placement	112	26,4
Intraligamentary anesthesia	178	42
Regional anesthesia	110	25,9
Prosthetic cementation	8	1,9
Suturing	36	8,5

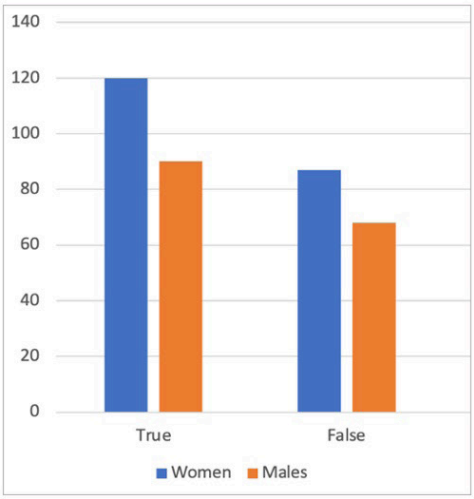
Table 3: Prophylactic antibiotic prescribing rates by medical status and dental procedures

Antibiotic Selection	Number	Percent (%)
Amoxicillin	281	66,3
Penicillin	125	29,5
Clindamycin	9	2,1
Erythromycin	0	0
Clarithromycin	1	0,2
Azithromycin	4	0,9
Cefazolin	2	0,5
Other	2	0,5
In Case of Penicillin Allergy		
Clindamycin	327	77,1
Erythromycin	42	9,9
Clarithromycin	15	3,5
Azithromycin	19	4,5
Cefazolin	11	2,6
Other	10	2,4

Table 4: Rates of antibiotics preferred for prophylaxis in routine and penicillin allergy

As the final question, the preferred dose of prophylactic antibiotics and the duration before the operation were manually filled out by the participants. Responses were determined according to AHA's 2007 guidelines (Table 1) and divided into two groups: "true" and "false". Every answer outside of the manual was deemed false. Those who were left blank were not included in the study for this question. Accordingly, 120 (58%) of women answered correctly, while 87 (42%) answered incorrectly. For men, 91 participants (57.2%) answered correctly, and 68 participants (42.8%) answered incorrectly (Figure 2). Looking at the results, it is quite clear that there is a statistically significant difference between the genders (p=0.02).

25 of 32 (78.1%) trainee dentists were correct; 83 of 147 (56.5%) dentists with 1-5 years experienced were correct; 27 of 43 (62.8%) dentists with 6-10 years experienced were correct, and 12 of 25 (48%) 11-15 years experienced dentists were correct; 64 of 119 (53.8%) dentists with more than 15 year experience were correct. No statistically significant difference was observed compared to professional experience (p=0.102).



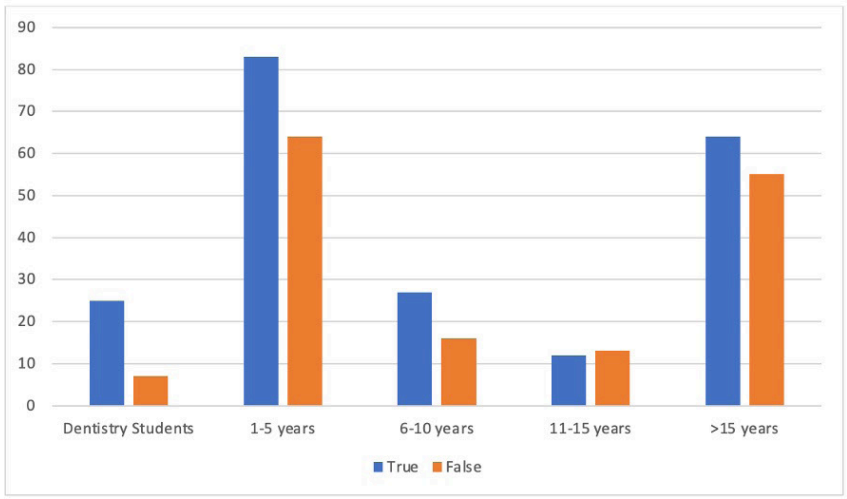


Figure 2a: Comparison of genders and preferred antibiotic dose and duration

Figure 2b: Comparison of preferred antibiotic dose and duration with professional experience

Discussion

Although IE is a rare disease, it is widely known that the prognosis is poor after being affected by this disease[11]. Studies have shown that even when prophylactic antibiotic regimens are used in all susceptible patients, the rate of IE is reduced by only 3.5%12. However, in a high-risk population, the risk of developing IE following dental procedures is minimal (1 in 95,000)[13]. In order to minimize this risk, dentists can prescribe consultations to patients' doctors, prescribe antibiotic prophylaxis, or refuse treatment and refer them to another dentist. Karadağ et al. demonstrated that medical consultation for cardiovascular system patients prior to dental treatments increases the success of prophylaxis against IE. They also attributed the reason for this to the fact that cardiologists and infectious disease specialists followed the guidelines on IE more closely [14]. In this study, the knowledge, the experience and the awareness of physicians about the antibiotic prophylaxis option were evaluated. 49.1% of our participants consulted the patient, 49.5% prescribed antibiotic prophylaxis, and 1.4% refused the treatment and referred them to another physician. In this research, our aim is to increase the sensitivity and awareness of dentists on this issue.

In the first part of the questionnaire, personal information such as age, gender and professional experience were included. In the second part of the questionnaire, situations requiring antibiotic prophylaxis were investigated. According to the 2007 AHA guidelines, IE antibiotic prophylaxis is recommended; prosthetic heart valve or the presence of prosthetic material used in valve correction, a history of previous IE, heart transplant patients who develop congenital heart disease and cardiac valvulopathy[7]. Our survey also yielded the results that support this. Participants mostly preferred IE prophylaxis in the presence of heart valve prosthesis with 95.5%, in the presence of previous IE with 92.9% and in patients with heart transplantation with 79.2%. In addition, although there is no evidence to support antibiotic prophylaxis in patients with diabetes mellitus, antibiotic prophylaxis is usually recommended[1]. The reason for this is to minimize the risk of potential late wound healing and postoperative infection[15]. However, in our study, this rate showed a low result with 21% for type I diabetes and 16.7% for type II diabetes. Diabetes mellitus is a very common disease so increasing the awareness of physicians about prophylaxis in patients with diabetes mellitus is extremely essential for the completion of wound healing without complications.

In the third part of the questionnaire, dental procedures requiring antibiotic prophylaxis were questioned. In general principle, a single dose of antibiotics is recommended before all dental procedures involving manipulation of the gingival tissue or the periapical region of the tooth and perforation of the oral mucosa[7]. These procedures include simple/surgical tooth extraction, endodontic treatment, apical resection, implant applications and preprosthetic surgery, periodontal surgery, biopsy and abscess drainage. Our survey results supported the AHA guidelines and gave the highest results in surgical tooth extraction, implant surgery and periodontal surgery with 96.4%, 94.1% and 90.8%, respectively. Palmer et al. in his study, most of the participants also recommended antibiotic prophylaxis for surgical tooth extraction [16]. However, although antibiotic prophylaxis was recommended for endodontic treatment, the result in our study was relatively low, with 46.7%.

In the fourth part of the survey, the level of awareness regarding the selection of antimicrobial agents, application time and dosage were evaluated. For 50 years, the AHA has been recommending penicillin as the preferred first choice for IE antibiotic prophylaxis. It is now believed that a single dose of amoxicillin or ampicillin is the appropriate and safe prophylactic choice for patients[17]. Recent studies have shown that amoxicillin therapy has a significant effect on reducing the incidence, nature, and duration of bacteremia caused by the dental procedure[20]. Amoxicillin was the most preferred antibiotic for prophylaxis with 68.3% in the study by Hashemipour et al. and 63.5% in the study conducted by Bahammam et al.[18,19]. According to our study, amoxicillin with 66.5% and penicillin with 29.5% showed the highest rates. In

addition, the most frequently prescribed prophylactic antibiotic in the case of penicillin allergy was observed as clindamycin with 77.1%, followed by macrolide group antibiotics with 19%, which is quite consistent with other studies.

Although Ghaderi et al.[21] reported that male dentists were more knowledgeable than female dentists in their study, female physicians were found to be more knowledgeable in terms of prophylactic antibiotic dose and duration in our study. Considering the professional experience, it was seen that the dentistry students gave the highest percentage of correct answers, and this can be associated with the situation in which interns learn the current regime in their training. On the other hand, it should be noted that the number of participants is less than the other groups. The group with the highest percentage of incorrect answers is physicians with 11-15 years of experience.

Conclusion

In conclusion, as a result of the studies, it was clearly seen that physicians applied prophylaxis in past infective endocarditis and heart valve diseases and generally preferred amoxicillin for prophylaxis, and clindamycin instead of penicillin derivatives in patients allergic to penicillin. Furthermore, it is extremely crucial for physicians to follow current guidelines and minimize the risk of bacteremia by taking a detailed anamnesis from patients. Further studies are also needed to increase awareness on this issue.

Declaration of conflicting interests

None.

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Authorship of Contributions

All authors read and approved the final manuscript.

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