








Anaphylaxis Management for Dentists: Knowledge and Preparedness

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ABSTRACT

Background: Anaphylaxis is not common in dentistry, but poor anaphylaxis management may lead to mortality.

Objective: The aim of this study was to evaluate dentists' knowledge and preparedness to manage anaphylaxis.

Materials and Methods: The study was designed as an online survey. It included questions about anaphylaxis management practices and the availability of equipment and medications in dental facilities. An online survey link was sent to members of the Turkish Dental Association (TDA).

Results: A total of 952 TDA members responded to the survey. Fifty-seven point seven percent of dentists knew that adrenaline is the first choice drug to treat anaphylaxis. Fifty-two point four percent of dentists knew that intramuscular injection is the correct route of administration and 41.7% of dentists knew the correct dose to treat anaphylaxis. Only 15.3% of responding dentists answered all three questions correctly. Dentists who had previously been trained in the diagnosis and treatment of anaphylaxis performed better on questions about the first-choice drug, administration route, and dosage, when compared to untrained dentists ($p < 0.05$). Of the responders, only 4.9% of dental facilities possessed complete medications and equipment capabilities to treat anaphylaxis.

Conclusion: The majority of responding dentists did not seem to be aware of anaphylaxis management and did not have adequate equipment and medications for treatment of anaphylaxis in their dental facilities. There is an urgent need for undergraduate and post-graduate education programs to increase dentists' ability to manage anaphylaxis. The availability of emergency anaphylaxis medication and equipment in dental facilities should be ensured.

Keywords: Adrenaline, anaphylaxis, dentists, knowledge, preparedness

INTRODUCTION

Anaphylaxis is a serious, rapid onset allergic reaction that can be fatal (1, 2). The prevalence of anaphylaxis has been increasing worldwide but the disease remains underdiagnosed and undertreated (3, 4).

Anaphylaxis can be caused by a variety of therapeutic agents found in a dental practice (5). The incidence of anaphylaxis in dental practice has been reported to be 0.004-0.013 cases per dentist per year (6, 7). Common causative agents include antibiotics, latex, topical antiseptic agents (povidone-iodine/chlorhexidine), and anesthetic drugs (6, 8).

Drug allergies and anaphylaxis may occur without any previous symptoms (9). Allergic reactions in dental practice are rare, but a thorough knowledge of these reactions is important to give patients the best chance of recovery (5, 10). As health care providers, dentists must be prepared to recognize anaphylaxis and manage treatment properly (11).

Intramuscular (IM) adrenaline (epinephrine) is the main treatment for anaphylaxis. It should be administered as soon as possible and without hesitation (2, 5). If needed, standard life support procedures should also be performed: airway management, oxygen, aerosolized

β -agonist for bronchospasm, intravenous (IV) crystalloids for hypotension, and interventions for arrhythmias, including atropine for severe bradycardia, defibrillation for ventricular fibrillation, and external cardiac massage and bolus IV adrenaline for cardiac arrest. Steroids and antihistamines are considered to be second line therapies (2, 3, 12). To perform the correct and sufficient intervention, dental facilities should have the essential medications and equipment to treat anaphylaxis.

In our study we aimed to determine the dentists' knowledge of anaphylaxis management and whether they have adequate experience, equipment and medications to treat anaphylaxis in their dental facilities.

MATERIAL and METHODS

We conducted a national exploratory study among dentists in Turkey. We used a structured, self-reported, anonymous online survey.

We used the online survey tool "Onlineanketler" (<https://www.onlineanketler.com>, Enuvo GmbH, Zurich, Switzerland,) to create and conduct the survey. Participant browser session identification (ID) was locked and a cookie was set to prevent multiple submissions. The questionnaire surveyed dentists' general knowledge of anaphylaxis management and preparedness. The survey consisted of 17 questions. Four questions gathered demographic data and 13 asked about anaphylaxis (Table I-IV). The guidelines of the World Allergy Organization, the European Academy of Allergy and Clinical Immunology, and the Turkish National Society of Allergy and Clinical Immunology were used to prepare the survey questions (2, 12-14).

The Turkish Dental Association (TDA) board is the national dentist society and the professional organization for all dentists in Turkey. The TDA approved this study and agreed to use its TDA member list for the survey, which included all ordinary TDA members (n=19,521).

An email containing an online survey link was sent to all TDA members in February 2019. It was sent again in March 2019. Responses were due by the end of April 2019. Study participants were enrolled after obtaining informed consent. The time required to complete the questionnaire was 5-10 minutes. Our study data were obtained from completed questionnaires.

Ethics committee approval was obtained from Trakya University Medical School for the study (Date: 04.02.2019, Decision Number: 02/31).

We performed statistical analysis using the IBM SPSS Statistics for Windows, V.25.0 (IBM, Armonk, New York, USA) software. We used descriptive statistics to summarize responses to the individual questions and to present the results of different subgroups. Statistical significance between the subgroups was assessed using the Chi-square test.

In order to treat anaphylaxis correctly, the dentist should know that adrenaline is the first drug of choice to treat anaphylaxis, should know the correct dose of adrenaline (0.01mg/kg, the maximum dose in adults is 0.5 mg), and should know correct route (intramuscular) to administer adrenaline. We regarded the participants who answered all three questions correctly as having "correct knowledge about adrenaline treatment". We evaluated the factors that may affect the "correct knowledge about adrenaline treatment" with the chi-square test. The possible factors identified with univariate analyses were further analyzed with multivariate logistic regression analysis to determine independent factors affecting the "correct-knowledge about anaphylaxis" among the dentists.

A p-value of less than 0.05 was considered statistically significant.

Table I. Demographic variables of dentists.

Questions	Answers n (%)
1. Age	
a. 25-35	461 (48.4)
b. 36-45	203 (21.3)
c. >45	288 (30.3)
2. Sex	
a. Female	453 (47.6)
b. Male	499 (52.4)
3. Duration of dental practice (years):	
a. Less than 5	283 (29.7)
b. 6-15	279 (29.3)
c. >15	390 (41)
4. Institution	
a. Private office	756 (79.4)
b. Hospital	196 (20.6)

Table II. Anaphylaxis awareness.

Questions	Answers n (%)
1. Do you ask your patients whether they have received local anesthetics in the past before starting your dental procedures ?	
a. Yes	843 (88.6)
b. No	109 (11.4)
2. Do you ask your patients whether they have experienced any allergic reactions against local anesthetics in the past before starting your dental procedures?	
a. Yes	858 (90.1)
b. No	94 (9.9)
3. Do you ask your patients whether they have had any allergy to medications other than local anesthetics, such as latex, chlorhexidine, formaldehyde, benzodiazepine previously before starting your dental procedures?	
a. Yes	445 (46.7)
b. No	507 (53.3)
4. Which patients do you refer to the allergy department before administering local anesthetics?	
a. Patients had previously experienced an allergic reaction with any local anesthetic.	922 (96.8)
b. Patients with other allergic diseases, such as eczema, asthma or hay fever.	143 (15)
5. Have you ever seen a patient with anaphylaxis during dental procedures?	
a. Yes	125 (13.1)
b. No	827 (86.9)
6. If you have seen a case with anaphylaxis during dental procedures, has this occurred during your treatment?	
a. Yes	45 (4.7)
b. No	907 (95.3)
7. Do you know how to perform cardiopulmonary resuscitation (CPR)?	
a. Yes, and I have performed CPR before.	36 (3.8)
b. Yes, but I haven't performed CPR before.	254 (26.7)
c. I had CPR training before, but I don't know well enough to perform it.	454 (47.7)
d. No, I didn't have CPR training.	208 (21.8)
8. Have you ever been trained in the diagnosis and treatment of anaphylaxis?	
a. Yes	723 (75.9)
b. No	128 (13.4)
c. I do not remember	101 (10.6)
9. If the patient underwent an allergy test with a local anesthetic and the result revealed no reaction, you can safely use that local anesthetic.	
a. True	57 (6)
b. False	895 (94)

RESULTS

Our study surveyed 19,521 members of the TDA, and 952 (4.9%) responded to the survey. Half of the responding dentists' ages were between 25-35 years old and 47.6% of dentists were female. Of the participants, 79.4% worked in a private dental office and 20.6% in hospitals. Ninety point one percent of dentists reported that they asked patients about a prior allergic reaction to local anesthetics (LAs)

before any procedure. Only 46.7% reported that they asked about prior reactions to other agents before treatment, such as latex, chlorhexidine, formaldehyde, benzodiazepine. Seventy-five point nine percent of responding dentists have been trained in the diagnosis and treatment of anaphylaxis and 30.5% of the responders described themselves as competent at cardiopulmonary resuscitation (CPR). Fifty-seven point seven percent of responders identified adrenaline as the first drug of choice to treat anaphylaxis,

Table III. Treatment of anaphylaxis.

Questions	Answers n (%)
1. Which drug should be used as the first choice to treat anaphylaxis?	
a. Adrenaline	549 (57.7)
b. Antihistamine	260 (27.3)
c. Corticosteroids	99 (10.4)
d. Glucagon	0 (0)
e. Salbutamol	0 (0)
f. I do not know	44 (4.6)
2. Which route do you prefer as the initial route for adrenaline injection?	
a. Intramuscular	499 (52.4)
b. Intravenous	273 (28.7)
c. Subcutaneous	127 (13.3)
d. I do not know	53 (5.6)
3. What is the dose of intramuscular adrenaline (adrenaline) in an adult patient weighing 70 kg in the treatment of anaphylaxis?	
a. 0.5 mg	397 (41.7)
b. 0.9 mg	243 (25.5)
c. 1.4 mg	193 (20.3)
d. 2 mg	95 (10)
e. 14 mg	24 (2.5)

Table IV. Anaphylaxis preparedness.

Questions	Answers n (%)
Which of the following equipment(s) and medications for the treatment of anaphylaxis are available in your office?	
a. Adrenaline solution and/or adrenaline auto injector	864 (90.8)
b. Tourniquet	766 (80.5)
c. 1-mL and 5-mL disposable syringes	888 (93.3)
d. Oxygen tank and mask/nasal prongs	841 (88.3)
e. Diphenhydramine/antihistamine injectable	773 (81.2)
f. Ranitidine or cimetidine injectable	195 (20.5)
g. Injectable corticosteroids	728 (76.5)
h. Ambu-bag, oral airway, laryngoscope, endotracheal tube	660 (69.3)
i. Intravenous setup with large-bore catheter	705 (74.1)
j. Intravenous fluids: (Ringer's lactate solution, 0.9% normal saline)	714 (75)
k. Aerosol β 2-bronchodilator and compressor nebulizer	250 (26.3)
l. Glucagon	170 (17.9)
m. Electrocardiogram	86 (9)
n. Stethoscope	753 (79.1)
o. Blood pressure cuff	856 (89.9)
p. Pulse oximeter blood oxygen saturation monitor	228 (23.9)

52.4% of responders knew the administration route (intramuscular), and 41.7% knew the correct adrenaline dose (Table III). Only 15.3% of responders answered all three questions correctly, so they had “correct knowledge about adrenaline treatment”. Six point two percent of these responders do not have adrenaline in their dental facilities. In total, 14.4% of the participants answered all three questions correctly and there was adrenaline available in their dental facilities. So, our findings suggest that only 14.4% of dentists would be able to properly treat an anaphylactic event with adrenaline (Figure 1). Our survey showed that younger dentists are better trained to diagnose and treat anaphylaxis when compared to older dentists. Younger responders were better in knowing adrenaline as the first-choice drug and identify intramuscular delivery as the correct delivery route ($p<0.05$). Dentists who have been trained to diagnose and treat anaphylaxis identified the first-choice drug, initial route and dose better than untrained dentists ($p<0.05$).

Being trained about anaphylaxis, being younger than 35 years and having less than 5 years of work experience were statistically significantly associated with “correct knowledge about adrenaline treatment”. When statistically significant parameters were analyzed in a logistic regression model, being previously trained on anaphylaxis diagnosis and treatment was the only independent factor affecting the “correct knowledge about adrenaline treatment” (OR:2.48, 95% CI: 1.45-4.24, $p=0.001$) (Table V).

We determined dentists’ preparedness to treat anaphylaxis based on the drugs and equipment available in their facilities. Four point nine percent of the overall respondents, 19.4% of the dentists working in hospitals and 1.2% of the ones having private practice reported that they have all necessary medications and equipment in their facility to treat anaphylaxis.

Table V. Factors affecting the “correct knowledge about adrenaline treatment”* among the dentists.

	Univariate analysis		Multivariate logistic regression analysis	
	p	OR (95%CI)	p	OR(95%CI)
Previously trained about anaphylaxis	<0.001	2.71 (1.6-4.6)	0.001	2.48 (1.45-4.24)
Age≤35 years	0.001	0.53 (0.37-0.76)	0.218	0.74 (0.45-1.2)
Working experience ≤5 years	0.001	0.53 (0.37-0.76)	0.134	0.69 (0.45-1.2)
Female gender	0.649	0.92 (0.65-1.31)	-	-
Institution is private office	0.077	1.44 (0.96-2.17)	-	-

CI: confidence interval; OR: odds.

* In order to treat anaphylaxis correctly: correctly identified adrenaline as first-choice drug, correct administration route and dosage.

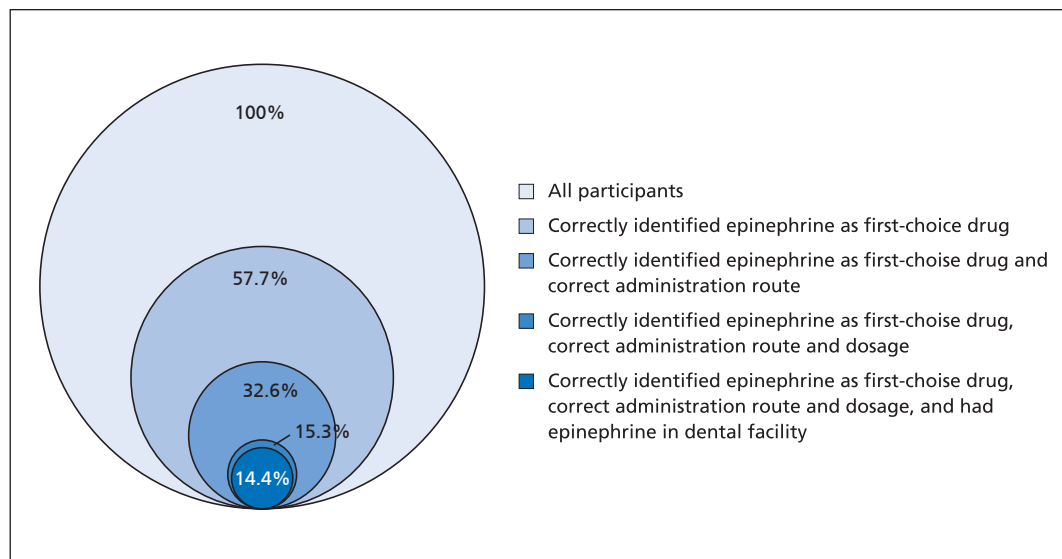


Figure 1. Dentists who would be able to properly treat anaphylaxis with adrenaline.

DISCUSSION

Our study revealed deficiencies in dentists' knowledge of anaphylaxis treatment. In previous studies, dentists' knowledge in anaphylaxis management was assessed with individual questions. However, rather than as correct answers given to individual questions, when we consider dentists' preparedness as a comprehensive ability to treat anaphylaxis, we showed that the lack of knowledge about anaphylaxis management is more severe than previously reported. To the best of our knowledge, our study is the first study which asked detailed questions about equipment and medications required for the complete treatment of anaphylaxis. Further, to the best of our knowledge, our study surveyed the greatest number of dentists to assess dentists' knowledge and preparedness to treat anaphylaxis. Our results demonstrate that dentists are inadequately trained and ill-equipped to manage anaphylaxis.

In previous studies, 42-72.9% of dentists correctly identified adrenaline as the first-choice drug to treat anaphylaxis. Twenty two point nine-31.3% of dentists knew the correct administration route, and 7-9.3% of dentists knew the correct dosage (9, 10, 15). The rates in our study were 57.7%, 52.4% and 41.7%, respectively. In order to use the adrenaline correctly during anaphylaxis, it is necessary to know all three steps. In previous studies, the rate of dentists who knew all three questions correctly was not examined. In our study, we analyzed this and detected that only 15.3% of dentists answered all three questions correctly. Our findings show that the lack of knowledge about anaphylaxis management is greater than expected. Additionally, some responders who answered all questions correctly do not have adrenaline in their dental facilities. Only 14.4% of dentists would be able to properly treat an anaphylactic event with adrenaline (Figure 1).

Chlorhexidine mouthwash and latex are common causes of anaphylaxis in dental practice. Anaphylaxis to LAs is very rare (5, 8). In our study the majority of participants (90.1%) hypersensitivity asked about LA allergy history but almost half of dentists did not ask about allergic reaction to medications other than LA such as latex, chlorhexidine, formaldehyde, benzodiazepine that are more frequent causes of anaphylaxis. Research by Cetinkaya et al. (9) reported that 91% of dentists asked about LA allergy history before treatment but did not evaluate the history taking habits of dentists about non-LAs medications in their study. Currently, allergen avoidance remains the mainstay

of treatment (13). A complete, detailed medical history, which includes allergies, can help to avoid allergens and reduce the risk for anaphylaxis (13, 16). Dentists should take a detailed history including all prior allergic reactions before any dental procedure.

In our study 15% of participants declared that they refer patients with eczema, asthma and allergic rhinitis to allergy clinics. Atopic diseases, such as eczema, asthma and allergic rhinitis are not a risk factor for LA hypersensitivity (17). The presence of previous allergic reaction to LAs in the history is regarded as a risk factor of a similar or even more severe reaction after further exposure to the same agent (18). Nonetheless, when there is uncertainty regarding diagnosis, or if there is any real concern about a possible allergy, it is best to defer dental procedure and refer the patient to an allergist for further work-up (5, 19).

Proper management of anaphylaxis in dental facilities depends on effective and continuing education. Most people who receive CPR training lose their skills after eighteen months (20). The European Resuscitation Council (ERC) suggests that dental care professionals undergo annual practical training in the recognition and management of medical emergencies (16). In our study, 75.9% of dentists had participated in anaphylaxis training, but many dentists were unaware of proper treatment. They were unaware about the first drug of choice to manage anaphylaxis, the proper route for adrenaline injection, and the correct dose of adrenaline. In 2011 Cetinkaya et al. (9) reported that approximately half of Turkish dentists recognized adrenaline as the first drug to use in the treatment of anaphylaxis, 31.5% of dentists knew the proper route for adrenaline injection and 7-9.3% of dentists knew the correct dose of adrenaline. These results may indicate an increased awareness of the proper management of anaphylaxis in Turkey in the last 8 years. In addition, younger dentists in our study were better trained about anaphylaxis than the older ones. The proportion of the younger dentists who chose adrenaline as the first drug and IM route was higher than the older ones. The graduation of new dentists who are better trained to treat anaphylaxis in the last 8 years may have contributed to better awareness about anaphylaxis management. In our study, being previously trained on anaphylaxis diagnosis and treatment was independently associated with better knowledge about correct treatment of anaphylaxis. Our study results indicate that better postgraduate training should be offered to teach proper anaphylaxis treatment.

Turkish dentistry school curriculums are the same as those in the United States and Europe covering anaphylaxis prevention measures, recognition and emergency treatment of anaphylaxis (9). Despite the education programs in dentistry schools, the deficiency in knowledge in the treatment of anaphylaxis shows the importance of postgraduate education. Over time, knowledge of anaphylaxis management may decrease (21, 22). This can be prevented with repeated training on anaphylaxis at regular intervals (21, 22). Arga et al. (23) reported that physician's ability to diagnose anaphylaxis and proper use of adrenaline autoinjectors were low in their study. In this study, they demonstrated that training physicians on adrenaline auto injector by theoretical, plus practical education, improved its proper use more than three times when monitored after 6 months. In a study conducted on pharmacists, it was shown that e-learning programs also increase long-term anaphylaxis knowledge (21). It is possible to increase the knowledge level of dentists about anaphylaxis by regular postgraduate training on anaphylaxis. Trainings can be in the form of practical, theoretical, e-learning or their combination. The support of the dental associations (for example TDA for Turkey) may be sought to deliver training to dentists.

Although fatality due to anaphylaxis is rare, it is difficult to predict severity (24). Mild symptoms can rapidly progress to cardiovascular and respiratory arrest (13). Cardiopulmonary resuscitation should be performed immediately if cardiorespiratory arrest occurs during anaphylaxis (12). Dentists should be certified in basic life support (BLS) and perform CPR (25). In our study, only 30.5% of participants assessed themselves as competent in CPR, and 21.8% of participants reported that they did not have CPR training. The rate of dentists who reported that they were competent to provide CPR in studies from Poland, Slovenia and Brazil was 58.7%, 50.6% and 43%, respectively (6, 16, 26). Arsati et al. (6) found that 40% of responding dentists in their study had never undergone training in CPR. Our study revealed that most responding dentists did not feel capable of performing CPR. To be prepared to treat anaphylaxis and other medical emergencies, better CPR training is required at both the under and postgraduate levels.

Dentist facilities should have an established protocol to manage anaphylaxis and have appropriate equipment and medications to treat anaphylactic reaction. In this study we asked whether recommended equipment and medications

were available for treatment of anaphylaxis and other common emergencies. Position statements on office equipment for treatment of anaphylaxis and other common emergencies include those from the American Academy of Allergy, Asthma, and Immunology; (Joint Task Force on Practice Parameters, Board of Directors); American College of Allergy, Asthma, and Immunology; World Allergy Organization; and World Health Organization (3, 13, 14, 27). To the best of our knowledge our study is the first to investigate the presence of all necessary medications and equipment required to treat anaphylaxis in a dental facility. While adrenaline was available in 90.8% of dental facilities, only 19.4% of dentists who worked in the hospital and 1.2% dentist who worked in the private office reported having access to all equipment and medications in their dental facilities. Cetinkaya et al. (9) reported that 56% of private-practice dentists have adrenaline in their offices, however, their research did not investigate other medications and equipment. Krishnamurthy et al. (10) reported that 62% of the dentists had emergency medicine kits in their facility but they did not examine the contents of the emergency medicine kit. Our research uncovered a lack of essential equipment and medication to treat anaphylaxis in dental facilities. Availability of emergency medical equipment in dental facilities is critical to adequate management of anaphylaxis.

An adrenaline auto injector is a medical device for injecting adrenaline quickly, at the correct dose, at the correct concentration, and through the correct route. Adrenaline auto injectors are used in the community to treat anaphylaxis (28). There has been a licensed adrenaline auto injector (Penepin®) in Turkey since 2016. The presence of adrenaline auto injectors in dental facilities can help ensure the correct and prompt delivery of adrenaline. Owning the adrenaline auto injector may be vital for use in case of need.

Our study is limited by the nature of our survey instrument. Dentists performed self-assessments of their own skills, which is not an objective evaluation. However, in this type of questionnaire surveys, it must be assumed that the responses are correct. In addition, our study is national, which compromises the generalizability of the results. However, the results of the study conducted by Çetinkaya et al. (9) in our country were similar to the results of another country, and the results of our study may also show the current situation in other countries.

The strength of our study is that, to the best of our knowledge, this is the largest study to survey the knowledge of the dentists about anaphylaxis management. Adrenaline is the first-choice drug in the anaphylaxis treatment; however, sometimes adrenaline injection alone is insufficient and additional treatment may be required. In our study, we asked detailed questions about equipment and medications required for the complete treatment of anaphylaxis.

In conclusion, the majority of the dentists did not seem to be aware of anaphylaxis management and did not have adequate equipment and medications for treatment of anaphylaxis in their dental facilities. Inexperience and lack of training to manage anaphylaxis may lead to undesirable outcomes. Adverse consequences may arise from legal actions brought by patients, since a dentist is ultimately responsible for managing all emergency situations in a dental facility. There is a need for undergraduate and post-graduate education programs to educate dentists in the management of anaphylaxis. Furthermore, required emergency medications and equipment to manage anaphylaxis should be available in dental facilities

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