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Evaluation of Knowledge About Anaphylaxis in Dentistry and Medical Faculty Students; Need for More Training

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ABSTRACT

Objective: Anaphylaxis is a serious reaction that needs rapid intervention. However, some healthcare professionals may have inadequate knowledge about anaphylaxis to manage this situation. The aim of this study was to evaluate the level of knowledge about anaphylaxis in dentistry students (DS) in comparison with medical school ones (MS).

Materials and Methods: Students were recruited from the Dentistry (n=81) and Medical (n=144) Faculties of the University Hospital. The level of knowledge about anaphylaxis was evaluated by using a questionnaire with 26 items that was used previously.

Results: The overall response rate was 89.9%. One tenth of the study group had ever encountered a case with anaphylaxis, but 2.8% of them stated that they had involved in the treatment by themselves. Almost all of the participants stated that allergy might be a life-threatening reaction. Additionally, 43.3% reported that they had epinephrine in their department. DS knew less than MS about the primary use of epinephrine after assessing the airway, breathing and circulation in the treatment of anaphylaxis, and even in suspicious cases (59.3% vs. 98.6%, and 42% vs. 94.4%, all p<0.001). DS had significantly less knowledge about anaphylaxis treatment and epinephrine application than medical ones (all p <0.001). Furthermore, the information of that "the minimum duration for re-administration of epinephrine as 10 minutes" was known by the half of MS, and one fourth of DS (p<0.001). The appropriate follow-up duration of patients with anaphylaxis was unknown in half of DS, and one fifth of MS (p<0.001). Even though MS had a higher rate of knowledge about the responsible and closest department dealing with anaphylaxis than dental students (p=0.02), DS were more aware of referring the patient with anaphylaxis to an allergy clinic (77.8% vs. 62.9%, p<0.001). Almost all MS had heard about the epinephrine auto-injector, in contrast to one third of the DS (p<0.001). Most of the participants, but mainly the MS knew that anaphylaxis could be diagnosed clinically. The case questions about diagnosis of anaphylaxis related to local anesthetic and beta-lactam antibiotic use were answered correctly in a higher rate in MS than DS (p=0.01 and p<0.001), whereas the rate of correct diagnosis of anaphylaxis following a bee sting was similar between the groups.

Conclusion: This study showed the gaps about the diagnosis and management of anaphylaxis not only in MS, but also in dentistry ones. It is possible to encounter a case of anaphylaxis for every student during clinical practice in the future. Thus, education about anaphylaxis should be included in the national dentistry core education programme and be improved in the medical school as well.

Keywords: Anaphylaxis, epinephrine, student, medical, dental

INTRODUCTION

Anaphylaxis is an acute, life-threatening clinical condition, and all healthcare professionals should be aware of a need for an immediate diagnosis and an appropriate management (1). The lifetime prevalence of anaphylaxis has been reported as 0.05-2% in the United States, and ~3% in Europe (2). In a retrospective study from Turkey, 224 cases of anaphylaxis were reported in 137 children from 1999 to 2009 (3).

Anaphylaxis guidelines recommend epinephrine as a first step of treatment. It should be injected intramuscularly to vastus lateralis at a concentration of 1:1.000, and a dose of 0.3 to 0.5 mL in adults and 0.15 mg or 0.01 mg/kg in children, because it has been proven to be the most effective route of treatment (4,5). Additionally, epinephrine at 1/10.000 concentration can be used intravenously in anaphylactic shock (5). In patients who do not respond to a single dose of epinephrine in anaphylaxis, it can be repeated in every 10 min (5).

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The diagnosis of anaphylaxis may be challenging, since it is based on clinical symptoms. Although elevated serum tryptase level is a diagnostic marker for anaphylaxis, it is rarely used in clinical practice since it has a 30min half-time which is difficult to obtain the serum of the patient in that time interval. Furthermore, there is no diagnostic threshold for tryptase in anaphylaxis, and it may be elevated in some other conditions such as mastocytosis and neoplasms.

Previous studies have indicated some deficits in the management of anaphylaxis (6), such as inadequate prescription and use of epinephrine by physicians, as well as other medical workers (7). Supporting this, the rate of using a standard algorithm of anaphylaxis treatment was only 62.6% in general practitioners, specialists, nurses and paramedics (6). Among emergency department staff, 85.1% were shown to know the correct application route of epinephrine, and 73.3% chose the correct dose (8). Furthermore, only 16.8% of junior hospital doctors had correct information about epinephrine dosage and route of administration (9). These results suggest that there is a knowledge gap of anaphylaxis in different types of medical professionals.

Dental physicians may see anaphylaxis in their daily clinical life due to local anesthetic agents, pain relievers and antibiotics. In a study of 86 dentists working in private offices, only 48.8% of the participants knew that the first treatment of anaphylaxis was epinephrine, and 31.5% confirmed the most effective route of administration (10). However, it is not well known if dental facilities have essential equipment to treat anaphylaxis, and there is no anaphylaxis education in the national dentistry school core education program

The rationale of this study was to increase the awareness about anaphylaxis in dentistry education programme. The objective was to assess the level of knowledge of anaphylaxis among students in a dental faculty in comparison with those in a medical faculty.

MATERIAL and METHODS

The study was conducted with a prospective design over a period of six months. Eligibility criteria were: female/male subjects training in the 5th grade of the Faculty of Medicine or Dentistry at Kirikkale University. Those who refused to participate or filled out the form incompletely were excluded. The study was compliant with the Declaration of Helsinki Principles, and had local ethical approval (No: 2020.09.08). Written consent was obtained from the participants.

A previous validated anaphylaxis questionnaire was modified due to updated guidelines (Table I) (1). The questionnaire consisted of 26 questions, including demographic data (4 item), epinephrine administration (10 item), signs and symptoms (4 item), experience (4

Table I: Modified anaphylaxis questionnaire for health care workers (26-Item) (6).

Q: Questions, and Answers
Q1. Age:…….
Q2. Gender: ❑ Male ❑ Female
Q3. Department: ❑ Medical student ❑ Dentistry student
Q4. How long have you been studying in the Faculty?
Q5. Do you think that allergy can be life threatening? ❑ Yes ❑ No
Q6. Have you ever encountered a patient with anaphylaxis? ❑ Yes ❑ No
Q7. If yes, how many patients have you encountered?.....
Q8. Have you ever treated a patient with anaphylaxis? ❑ Yes ❑ No
Q9. Which medical branch do you think will investigate the cause of anaphylaxis? ❑ Internal Medicine ❑ Emergency ❑ Allergy Diseases ❑ Chest Diseases ❑ I don't know
Q10. A 30-year-old female patient had a history of allergy to local anesthetic agents. She developed angioedema and urticaria within 1 hour after local anesthesia that was administered during dental treatment. Blood pressure, pulse, breathing, and other system examinations were normal. Do you think that the diagnosis was anaphylaxis? ❑ Yes ❑ No

Table I continued

Q11. A 58-year-old woman was prescribed a penicillin group antibiotic due to a dental abscess. Twenty-five minutes after taking the first tablet, she was developed urticaria and shortness of breath.
Do you think that the diagnosis was anaphylaxis? ❑ Yes ❑ No

Q12. A beekeeper's son had no symptoms in his first stung by a wasp -a kind of bee-, but fainted with nausea and vomiting within minutes after stung in the second time.
Do you think that the diagnosis was anaphylaxis? ❑ Yes ❑ No

Q13. How do you diagnose anaphylaxis? (Only one choice)
❑ Clinical (at least 2 organ system involvement such as suddenly developing skin, respiration, cardiovascular system findings), and/or laboratory findings
❑ Laboratory findings (increase in serum tryptase and/or histamine)
❑ I don't know

Q14. Do you apply epinephrine to a patient in case of suspicion of anaphylaxis? ❑ Yes ❑ No

Q15. What is the first intervention in the treatment of anaphylaxis? (Only one choice)
❑ Assess airway, circulation and consciousness. Inject epinephrine intramuscularly in upper leg. Put patient in the Trendelenburg position.
❑ Call emergency center. Establish intravenous access. Inject H_1-antihistamine and corticosteroid intravenously.
❑ I don't now

Q16. Which one is the first step medication in the treatment of a subject with anaphylaxis? (Only one choice)
❑ Oxygen ❑ Epinephrine ❑ Glucocorticoid (methylprednisolone) ❑ H_1-antihistamine (e.g. diphenhydramine)
❑ 0.9% (isotonic) saline ❑ β_2 adrenergic agonist (e.g. salbutamol) ❑ I don't now

Q17. What is the recommended route of epinephrine administration as first line medication in anaphylaxis? (Only one choice)
❑ Intravenous ❑ Intramuscular ❑ Subcutaneous ❑ All routes ❑ I don't know

Q18. What dilution is used for <u>intramuscular</u> administration of epinephrine? (Only one choice)
❑ 1/1000 epinephrine solution ❑ 1/100 epinephrine solution
❑ 1/10000 epinephrine solution ❑ I don't know

Q19. What is the recommended <u>intravenous</u> bolus epinephrine dilution? (Only one choice)
❑ No dilution ❑ 1/1000 epinephrine (1 mg/mL) 1-3 cc ❑ 1/10.000 epinephrine (0.1 mg/mL) 1-3 cc
❑ 1/100.000 epinephrine (0.01 mg/mL) 1-3 cc ❑ I don't know

Q20. Which body localization is recommended for intramuscular epinephrine application? (Only one choice)
❑ Deltoid muscle (mid-anterolateral upper arm) ❑ Vastus lateralis (mid-anterolateral thigh)
❑ Gluteus maximus (buttocks) ❑ I don't know

Q21. How often can epinephrine be repeated? (Only one choice)
❑ Cannot be re-administered ❑ 10 minutes ❑ 30 minutes ❑ 1 hour ❑ I don't know

Q22. How long should the patient be followed up after anaphylaxis reaction? (Only one choice)
❑ 1-2 hours ❑ 6-8 hours ❑ No need for a follow up ❑ I don't know

Q23. Do you keep epinephrine drug in your department? ❑ Yes ❑ No

Q24. What do you recommend for patients who had an anaphylaxis reaction?
❑ Refer to the allergy department in order to investigate for anaphylaxis etiology
❑ Always carry epinephrine, corticosteroid, and H_1-antihistamine ampoules
❑ Live in a place close to hospital
❑ I don't know

Q25. Have you ever heard about the epinephrine auto-injector? ❑ Yes ❑ No

Q26. Do you know where is the closest Allergy Department to your clinic? ❑ Yes ❑ No ❑ I don't know
If yes, which center has an Allergy Department in your city?
❑ University hospital ❑ Tertiary care ❑ Secondary care
❑ Primary care ❑ In a nearby city ❑ I don't know

item), and anaphylaxis (4 item). Subjects were instructed to self-administer the questionnaire with no time limit. After completing the questionnaire, participants were given a guide of anaphylaxis management plan including the right answers of the questions.

Statistical Analysis

The target population size was the number of 5th grade students in the Medical and Dental Faculties. The sample size was calculated as "at least 200" by using the Raosoft programme with a target population size (n=300), an acceptable margin of error of 5%, confidence level of 95%, and response distribution of 50%.

Statistical analysis was performed with the SPSS program. Dentistry and medical student groups were compared with the chi-square test for categorical variables, and with Student's t-test according to data normality for quantitative ones. Categorical variables were given as "%", and parametric ones were expressed as "mean ± standard deviation. P<0.05 was regarded as statistically significant.

RESULTS

The general response rate was 89.9% with a female predominance, aged 21 to 30 years (23.25 ± 1.34 years) (Table II). Sixty four percent (n = 144) of the participants were from the medical faculty, and 36% (n=81) were from dentistry.

Overall 11.2% of the study group had encountered a case with anaphylaxis, but only 2.8% of them stated that they had been involved in the treatment by themselves, with no difference between the medical and dental groups (Table III). Almost half of them (43.3%) knew that they had the epinephrine drug in their department, and 94.2% of the participants thought that allergies could be life threatening.

Less than half of the dental students (DS) compared to medical students (MS) agreed that epinephrine could be used in suspicious cases (42% vs. 94.4%, p<0.001) (Table III), but almost two thirds of them had knew that epinephrine use was the first intervention after assessing the airway, breathing and circulation in the treatment of anaphylaxis (59.3% vs. 98.6%, p<0.001). Furthermore, DS had significantly lower knowledge than MS about the anaphylaxis treatment steps, appropriate route, and the localization and doses of epinephrine (all p<0.001). On the other hand, the information that "the minimum duration for re-administration of epinephrine is 10 minutes" was known by the half of the medical and one fourth of the dental group (p<0.001). The appropriate duration of follow-up of patients with anaphylaxis was unknown by one fifth of the MS and half of DS (p<0.001).

Even though MS had a higher rate of knowledge about the responsible and closest department for anaphylaxis than DS (p=0.02), DS were more aware of referring the patient with anaphylaxis to an allergy clinic (77.8% vs. 62.9%, p<0.001). Almost all MS had heard about the epinephrine auto-injector, in contrast to one third of the DS (p<0.001).

Most of the participants -mostly MS- knew that the diagnosis of anaphylaxis could be done clinically (92.9% overall, p<0.001) (Figure 1). Considering the case questions regarding the diagnosis, the rate of knowledge about urticaria developing after exposure to a known allergen was not anaphylaxis was 57.6% in medicine and 39.5% in dentistry (p=0.01). There was a higher ratio of students who could make an anaphylaxis diagnose about the case about with urticaria and shortness of breath after beta-lactam antibiotic use in the medical group (96.5%) than the dentistry group (79%)(p<0.001). The ratio of correct diagnosis about a patient who developed nausea, vomiting and syncope after a bee sting was similar between the groups (overall 76.5%, and p>0.05).

DISCUSSION

This study evaluated deficiencies in the management of anaphylaxis in medical and dental students who were likely to see patients with anaphylaxis throughout their careers. The lower knowledge levels of anaphylaxis in DS compared to MS indicated a need for training in this subject in dental departments. In addition, the medical education program on anaphylaxis should also be improved to prevent misdiagnoses and deaths from anaphylaxis.

Table II: Demographic characteristics of the study groups.

	All (n = 225)	Medical Students (n = 144)	Dental Students (n = 81)	P
Age (Year), mean ± standard deviation	23.25 ± 1.34	23.21 ± 1.24	23.32 ± 1.50	0.57
Gender, female, n (%)	144 (64)	91 (63.2)	53 (65.4)	0.73

We compared the level of knowledge about anaphylaxis in DS with that of MS studying at an university hospital as a tertiary reference center. Although the incidence of anaphylaxis was not uncommon in dental clinics (11), only a few participants from both groups had seen patients with anaphylaxis. This may be due to undiagnosed cases of anaphylaxis and inadequate referral. Additionally, less than half of the student groups reported having epinephrine in their departments, contrary to the statement that all types of healthcare institutions should have epinephrine. Supporting this result, the proportion of dentists who approved to keep epinephrine in their practice was 55.6-61.5% (10,12). As a similar result, in another study from Turkey, especially one third of secondary healthcare workers reported that there was no epinephrine in their clinics (6). In another study conducted in Turkey, one-third of secondary health care workers reported that epinephrine was not available in their clinics (6).

The diagnosis of anaphylaxis is usually done clinically and is based on early symptom pattern after exposure to an allergen in the absence of tryptase tests. It may be difficult to anticipate anaphylaxis and misdiagnosing it may lead to death due to airway obstruction or vascular collapse.

Table III: Rates of subjects that agree with the given information about anaphylaxis.

Answers of "yes" - n (%)	All (n = 225)	Medical Students (n = 144)	Dental Students (n = 81)	P
Experiences				
Have you ever encountered a patient with anaphylaxis? (average number: 1-4 / life)	25 (11.2)	13 (9.1)	12 (14.8)	0.19
Have you ever treated a patient with anaphylaxis?	6 (2.8)	3 (2.2)	3 (3.9)	0.66
Do you keep epinephrine in your department?	93 (43.3)	61 (45.5)	32 (39.5)	0.53
Do you think that allergy can be life threatening?	211 (94.2)	140 (97.2)	71 (88.8)	0.01
Treatment				
Do you administer epinephrine to a patient in case of a suspicion of anaphylaxis?	170 (75.6)	136 (94.4)	34 (42.0)	<0.001
Is using epinephrine the first intervention after assessing the airway, breathing and circulation in the treatment of anaphylaxis?	190 (84.4)	142 (98.6)	48 (59.3)	<0.001
Is epinephrine the first line medication in the treatment of a subject with anaphylaxis?	191 (84.9)	134 (93.1)	57 (70.4)	<0.001
Is the intramuscular way the recommended route for epinephrine administration as first line in anaphylaxis?	174 (77.3)	129 (89.6)	45 (55.6)	<0.001
Is 1/1000 the appropriate concentration of intramuscular epinephrine in anaphylaxis?	126 (57.0)	103 (72.5)	23 (29.1)	<0.001
Is 1/10000 the recommended concentration of intravenous epinephrine in anaphylaxis?	93 (41.5)	78 (54.5)	15 (18.5)	<0.001
Is the vastus lateralis (mid-anterolateral thigh) the recommended intramuscular administration site of epinephrine?	167 (74.6)	134 (93.7)	33 (40.7)	<0.001
Is 10 minutes the right interval for re-administration of epinephrine in case of no response?	99 (44.0)	80 (55.6)	19 (23.5)	<0.001
Is a duration of 6-8 hours the appropriate follow up for an anaphylaxis reaction?	152 (68.8)	115 (82.1)	37 (45.7)	<0.001
Management				
Do you think the Allergy Division investigates the cause of anaphylaxis?	188 (85.1)	126 (88.7)	62 (78.5)	0.02
Do you refer patients with anaphylaxis to the Allergy Department?	153 (68.3)	90 (62.9)	63 (77.8)	<0.001
Where is the closest Allergy Department to your clinic?	208 (92.9)	137 (95.1)	71 (88.8)	0.02
Have you ever heard about the epinephrine auto-injector?	160 (72.4)	137 (95.8)	23 (29.5)	<0.001

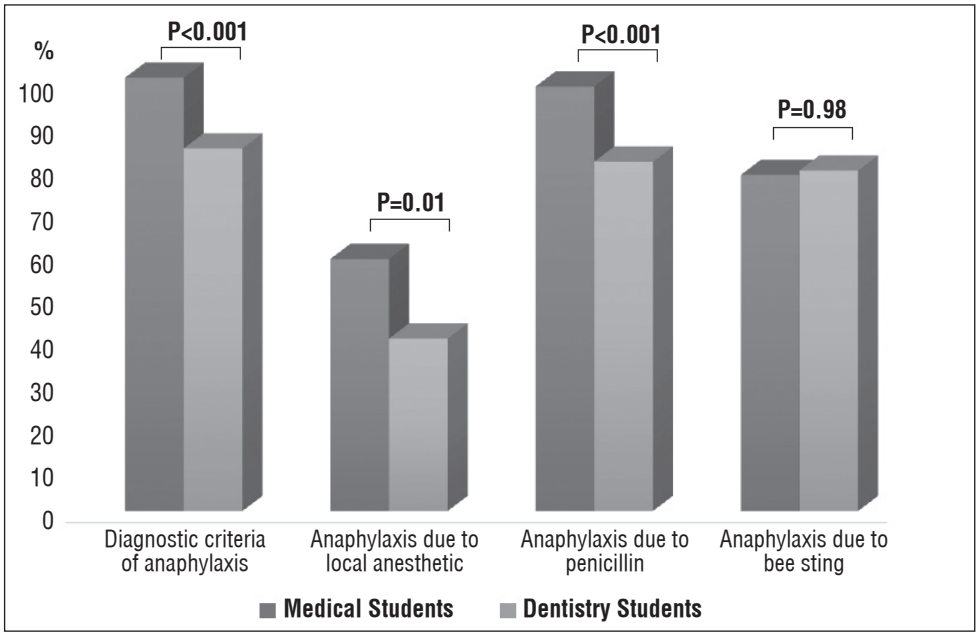

Figure 1. Knowledge of anaphylaxis diagnosis, regarding case questions (Table I). Question (Q)10 showed the rate of knowledge of that urticaria developing after exposure to a known allergen was not anaphylaxis (medical students: 57.6%, dental students: 39.5%, p=0.01). Q11 showed the proportion of students who were able to correctly diagnose anaphylaxis in a patient who developed urticaria and dyspnea after beta-lactam antibiotic use (medicine; 96.5%, dentistry; 79%, p<0.001). Q12 showed the rate of correctly diagnosing anaphylaxis in a patient who was developed nausea, vomiting and syncope after bee sting (overall 76.5%).

Fortunately, according to the results of the present study, most of the MS but a lower percentage of DS had known that anaphylaxis could be diagnosed clinically, and they were aware of the life-threatening nature of the reaction. These results about the diagnosis of anaphylaxis were determined to be similar to previous studies. In a study, 97.8% of physicians in emergency department, and 83.7% of nurses approved the correct definition of anaphylaxis (9).

Beta lactam and bee mediated anaphylaxis was well known by both groups of students. However, the rate of distinguishing anaphylaxis from other allergic reactions such as urticaria was very low in DS and moderate in medical ones. In previous studies, correct answer rates to scenarios such as urticaria plus wheezing, urticaria plus hypotension, exposure to a known allergen plus hypotension were all found to be low in nurses but good in physicians (nurses: 72%, 68.2%, 64.5% vs. physicians: 93.6%, 89.4%, 89.1%, respectively)(9). A study with dentists has shown that their level of knowledge about anaphylaxis was also very low, as in this study (12).

Treatment of anaphylaxis without epinephrine may lead to biphasic reactions, and a delay in epinephrine administration is a common cause of fatal anaphylaxis (13). In this study, there were significant gaps in the knowledges of the diagnosis and management of anaphylaxis including epinephrine application in DS. Even though more than 80% of MS answered the questions about anaphylaxis treatment correctly, almost half of them were found to have a lack of knowledge about the intravenous doses and minimum duration for re-administration of epinephrine. Likewise, Baççıoğlu et al. found low rates of correct anaphylaxis management in medical staff including physicians (54.7%), medical students (50%), nurses (44.6%), and paramedics (27%), retrospectively among 1172 participants (6). In another study, the rate of the participants who knew that epinephrine was a first option in the treatment of anaphylaxis was found to be 94% among 4th to 6th grade medical students (14). This rate was 84.9% in this study, which included both dentistry and medical students. Likewise, the ratios of dentists who suggested epinephrine as a first line treatment of anaphylaxis and who preferred the intramuscular route were found to be very low as 48.8-68% in Turkey, and 28-31.5% in India (10,12). In another study in which pediatricians participated, those who knew the dose of epinephrine correctly were similar to our study (55% vs. 57%) (15). Another study has shown that almost half of professional dentists have adequate information about the management of anaphylaxis (16). They also found better performance in dentists who had previously been trained in the diagnosis and treatment of anaphylaxis. Likewise, a training programme on drug allergy and anaphylaxis resulted in an increase in the recognition rates of anaphylaxis symptoms in dentists, as well as MS (17-19). All these national results support the need for education on this subject in postgraduates, as well as undergraduates of dentistry schools.

Although both medical and dental students approved the allergy clinic as the department responsible for anaphylaxis, dental students were more conscious of referring the anaphylaxis patient to the allergy clinic. In a study conducted in Singapore, all pediatricians were found to be familiar with the epinephrine autoinjector's trademark, while in our study only one-third of DS knew epinephrine might also be an autoinjector for self-use. (9). However, only less than a quarter of healthcare workers from Turkey had heard of the epinephrine autoinjector as in this study (6). The variability among countries may be due to the lack of information about anaphylaxis in addition to the availability of the epinephrine autoinjector.

This study showed the gaps in knowledge about the diagnosis and management of anaphylaxis not only in medical students, but also in dental students. It was important to point out the knowledge deficiencies about anaphylaxis in the dentist as well as physician candidates, since they had the potential to see patients with anaphylaxis in their daily clinical practice. In conclusion, education about anaphylaxis should be provided in the national dentistry school core education programme and be improved in medical schools as well.

CONFLICTS of INTEREST

The authors have indicated that they have no conflicts of interest regarding the content of this article.

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