Medical emergencies in dental offices

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Abstract

Recent surveys indicate that dentists individually encounter an average of 2–3 medical emergencies per year. The most common of these include vasovagal syncope, hypoglycaemia, hypertensive crisis and acute asthmatic exacerbation; while other reported emergency presentations, such as anaphylaxis, heart attack and stroke, are far less frequent. Since in general, dentists do not frequently encounter such medical conditions and may not achieve sufficient clinical exposure to foster a sustainable learning effect, regular education and training is imperative on an ongoing basis, in order to maintain the critical knowledge and skill threshold required to effectively deal with medical emergencies. Furthermore, as the British guidelines recommend, each dental office should be adequately equipped to handle all life-threatening medical emergencies, in addition to having an appropriate protocol in place, according to which all the members of the team would act during a medical emergency. Dental offices in Slovenia are not sufficiently equipped with instruments for responding to the spectrum of potential medical emergencies in dental practice. This reality is probably a consequence of insufficient knowledge and lack of clear standards and guidelines regarding the mandatory equipment needs for dental offices.

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1 Introduction

With an ageing population, the increasing burden of chronic comorbidities, the rise in medication prescriptions with mutual interactions and unwanted side effects, and longer periods of outpatient therapy, there is an increased probability that the staff at a dental clinic is faced with medical emergencies (1,2). This probability is higher during and after the administration of local anesthetics and especially during teeth pulling and endodontic therapy (3). Accordingly, it is imperative to understand the frequency of such events, to develop prevention strategies, to master the skills and have access to appropriate tools and medications in dental clinics (4). Dentists should be able to recognize medical emergencies and provide appropriate early treatment until the arrival of emergency medical technicians. Continuos learning and training can provide a higher quality and safety of treatment, which also significantly strengthens the feeling of trust in patients (5).

2 Frequency of medical emergencies at a dental clinic

The most frequent medical emergency conditions in dental clinics include syncope, diabetic emergencies (especially hypoglycaemia), hypertensive crisis, epileptic seizure, and acute asthmatic exacerbation. Less commonly encountered conditions include anaphylaxis, chocking on a foreign body, acute coronary syndrome, sudden heart attack and stroke (1,6-9). Greenwood et al. also include hyperventilation syndrome and adrenal insufficiency in the list of ten most frequent conditions (10).

The summary cross-sectional epidemiological study in Slovenia showed that in the past 12 months 67.5% of dentists encountered at least one medical emergency (and 26.3% of them had 3–10 medical emergencies), while during their whole career 93.4% encountered one. Most frequently dentists encounter syncope, on average twice per year, while they encounter other medical emergencies approximately once every two years. None of the 289 participating

Table 1: Relative frequency of individual medical conditions in dental clinics by country, in the number of cases per dentist during the year before the study was conducted (1,7,8,11,13,15).

Medical emergency condition	Girdler and Smith, United Kingdom, 1999	Müller et al., Germany, 2008	Arsati et al., Brazil, 2010	Laurent et al., France, 2014	Al-Turki et al., Saudi Arabia, 2017	Umek and Šoštarič, Slovenia, 2018	Median ± SD
Syncope	1.974	1.997	1.690	1.435	0.837	1.880	1.636 ± 0.444
Hypoglycaemia	0.179	0.053	0.100	0.342	0.342	0.200	0.203 ± 0.120
Hyperventilation syndrome	–	–	0.430	0.110	0.061	–	0.200 ± 0.200
Hypertension crisis	0.023	0.116	0.510	0.014	0.083	0.040	0.131 ± 0.189
Acute asthma attack	0.066	0.042	0.130	0.024	0.226	0.010	0.083 ± 0.082
Acute coronary syndrome	0.182	0.039	0.152	0.004	0.019	0.007	0.067 ± 0.079
Epileptic seizure	0.139	0.074	0.050	0.016	0.059	0.020	0.060 ± 0.045
Suffocation with a foreign body	0.089	0.008	0.070	0.047	0.017	0.010	0.040 ± 0.034
Anaphylaxis	0.013	0.015	0.004	0.009	0.022	0.030	0.016 ± 0.009
Cardiac arrest	0.003	0.006	0.002	0.004	0.010	0.000	0.005 ± 0.004
Stroke	–	0.006	0.010	0.003	0.002	0.003	0.005 ± 0.003
Other medical emergency conditions	0.026	0.042	0.390	0.112	0.138	0.080	0.131 ± 0.133
Total	2.694	2.398	3.536	2.120	1.816	2.585	2.525 ± 0.589

dentists included in the study reported encountering a cardiac arrest. Dentists who work in public healthcare institutions reported a slightly higher proportion of medical emergencies than those in private practices (11). The frequency of reported conditions in dental clinics in Slovenia is comparable to international data. Girdler et al. found that 70.2% of participating dentists encountered at previous one medical emergency during the previous year, with a syncope every six months on average, and for any of the other medical emergencies approximately every year and a half (1). Müller et al. report that 57% of dentists encounter up to three, and 36% of them encounter up to 10 medical emergencies per year (7). Among the participating dentists, 75% of those in Brazil encountered at least one medical emergency (8), while in South Africa the percentage is 56% (12), in France it is 53.2% (13), in Iran 48.3% (14), and in Saudi Arabia 47.4% (15). The relative frequency of some medical emergencies by country are listed in Table 1.

Al-Turki et al. alerted to the possibility of results derogating due to population differences in age structure and the incidence and prevalence of chronic diseases (15). Arsati et al. have also pointed out the possibility of respondents listing the same medical emergency several times (8). Recent studies in France have shown that experienced dentists encounter a significantly smaller number of cases of syncope in their clinics compared to their younger and less experienced colleagues, which Laurent et al. attribute to a more exact risk assessment of syncope and a better mastering of syncope prevention strategies among more experienced dentists (13,16).

3 Preparedness of dentists to identify and act in medical emergencies

Successful identification and appropriate treatment of common medical emergencies in dental practice is possible through good knowledge of anatomy, pharmacology, physiology, pathology and internal medicine, and a good grasp on the skills of basic cardiopulmonary resuscitation (CPR) (17).

Dentists in Slovenia self-estimate that they are most qualified to identify and act when encountering syncope, and the least for a stroke, cardiac arrest, hypertensive crisis and acute asthma attack (11), which matches study results from Germany and Brazil (7,8). A self-assessment of the knowledge of appropriate therapy of cardiac arrest among dentists in Slovenia is consistent with findings in the United Kingdom and the United States of America (1,11,18). Dentists in Slovenia assess that they are more skilled in acting in than in identifying medical emergencies, which could point to insufficient emphasis in their education on diagnosis in the scope of their undergraduate or postgraduate dental studies (11). The higher self-assessment of their knowledge on how to act in emergencies could also be the result of derogations in the forgetting curves for the semantic and motor memory (19). The dentists' self-assessment of the competence in acting in the most frequent emergency conditions in Slovenia and other countries across the world is listed in Table 2.

Only a half (50.6%) of dentists in Slovenia believe that they can perform

effective CPR (11), which is close to the findings of other studies listed in Table 3 (7,8,18,20-23). Higher self-assessment scores were given by dentists in the United Kingdom and Saudi Arabia, however, their self-assessments for competence to act appropriately in cardiac arrest are significantly lower (1,24). Girdler et al. provide a possible explanation in that practising CPR is less complex than actually recognizing and appropriately acting when it occurs (1). The results of the studies are not easily comparable because of differences in educational programmes, clinical practice, access to and quality of refresher seminars, guidelines and legislation.

Nadel et al. pointed out the difference between self-assessment and actual knowledge, and the frequent overestimation of competence in identifying medical emergencies and responding to them (25). The dentists' actual theoretical and practical knowledge was verified in Saudi Arabia and the United States of America. Al-Irany et ali. tested 100 dentists' theoretical knowledge of pathophysiology, diagnosis and treatment of medical emergencies and received the average result of 54%, and consequently they recommended that the undergraduate courses have a higher emphasis on learning about emergency conditions and introduce obligatory postgraduate courses and refresher seminars (26). De Bedout et al. verified the knowledge on identifying and acting in the 10 most common medical emergencies, and reported of an average result of 80% in the theoretical part and 67% in the prac-

Table 2: The share of dentists who assessed themselves to be capable of taking action in the most frequent medical emergency conditions in Slovenia and some other countries (1,8,11,18,22,26).

Medical emergency condition	Girdler and Smith, United Kingdom, 1999	Arsati et al., Brazil, 2010	Geguzis et al., Lithuania, 2016	Umek and Šoštarič, Slovenia, 2018	Al-Irany, Saudi Arabia, 2018	de Bedout, USA, 2018	Median ± SD
Syncope	96.3	77.1	98.3	93.1	74.6	78.9	86.4 ± 10.6
Hypoglycaemia	71.1	49.2	44.2	80.2	78.2	80.0	67.5 ± 16.3
Epileptic seizure	90.3	52.0	71.8	72.7	54.3	38.9	63.35 ± 18.4
Suffocation with a foreign body	70.5	53.8	41.7	79.2	–	56.8	60.4 ± 14.7
Acute asthma attack	76.4	29.7	–	52.2	64.3	60.0	56.5 ± 17.4
Anaphylaxis	38.0	25.5	51.2	59.6	35.5	78.9	48.1 ± 19.3
Cardiac arrest	60.5	29.7	–	48.0	24.2	66.3	45.7 ± 18.5
Acute coronary syndrome	45.3	19.1	17.5	58.8	16.4	22.1	40.5 ± 25.9
Hypertension crisis	–	36.1	–	45.1	–	–	40.6 ± 6.4
Hyperventilation syndrome	–	45.4	25.0	–	–	23.2	31.2 ± 12.3
Stroke	–	12.2	19.4	46.5	–	–	26.0 ± 18.1

tical part of the test. The best results in the latter were obtained by dentists who graduated in the past five years (18). In Slovenia it would also be reasonable to focus new studies into verifying the actual knowledge of identifying and acting in other medical emergencies in dental clinics (besides cardiac arrest), both among dental graduates and interns, as well as among licensed dentists, and the undergraduate and postgraduate programmes of dental medicine should be appropriately adjusted.

4 Education of dentists on medical emergency conditions

Dentists who work in the Republic of Slovenia mostly graduated from the Faculty of Medicine, University of Ljubljana, where teaching CPR has been part of the curriculum since 1988, while education about emergency conditions has been part of it for at least a decade longer (27). In the old curriculum dental medicine students only learned about emergency conditions in their first year (28), while as part of the revamped, uniform Dental medicine masters course, which started in the 2009/2010 year, first year students have 90 hours of lectures and practice to learn CPR and first aid in all life-threatening conditions, then they refresh and upgrade their knowledge in the third year. They also learn about additional resuscitation procedures with emphasis on defibrillation, establishing a venous pathway, clearing the breathing pathway, and using an automated external defibrillator (AED), and reanimation medicine. In the sixth year they refresh and practice CPR and first aid, especially in a dental clinic (29). In July 2018, new rules on internship and certification exams of medical workers introduced the field of general dentistry into the internship programme. As part of their rounds the interns learn about medical emergencies and measures in dentistry. The certification exam after a year's internship is the final obligatory test on medical emergencies and the

Table 3: Share of dentists who assessed themselves capable of successfully performimg CPR and successfully establishing an intravenous pathway. Attendance of CPR courses in Slovenia and abroad (1,7,8,11,13,20,26).

	Self-assessment for successfully performing CPR	Self-assessment for successfully establishing an intravenous pathway.	Attendance of at least one CPR course in career	Attendance of a CPR course in the past year
Umek and Šoštarič, Slovenia, 2018	50.6	39.6	85.1	74.4
Chapman, Australia, 1997	55.0	–	64.0	20.0
Girdler and Smith, United Kingdom, 1999	96.3	50.3	96.0	59.0
Müller et al., Germany, 2008	49.0	32.0	92.0	36.8
Arsati et al., Brazil, 2010	43.0	35.9	12.7	–
Laurent et al., France, 2014	–	–	64.3	13.1
Al-Irany, Saudi Arabia, 2018	86.1	16.6	–	–

organization and provision of first aid to patients under ordinary and extraordinary conditions (30).

Dentists must regularly renew their license by collecting credit points in the scope of their Continuing Professional Development (CPD) programmes and courses, however, the required 75 points for every 7 years can be easily earned through numerous opportunities, even without attending a seminar on medical emergencies (31). The latter are also not obligatory in Croatia, Belgium, and United Kingdom (32-34). Bailey et al. recommend medical emergencies be included among the four obligatory CPD topics for dentists in the European Union (35) based on the findings of the study on CPD in 30 European countries, of which 14 have legally compulsory CPD for dentists (36). British guidelines from 2018 recommend at least 2 hours of education on medical emergencies per year as part of CPD for dentists (34).

In Slovenia dentists can voluntarily attend numerous CPR seminars organized by the Medical Chamber of Slovenia (MCS), community health centres, both Faculties of Medicine, the Union of Dentists of Slovenia, private doctors, regional associations of dentists, the Red Cross of Slovenia and both University Medical Centres (11). In Slovenia CPR courses should be standardised and include at least the following areas: CPR provision, using AED and recognition of and action at cardiac arrest. The Medical Chamber of Slovenia organises courses of medical emergency procedures for dental teams that also include teaching how to use relevant equipment and the recognition of and required action in cases of foreign bodies in upper breathing pathways, acute coronary syndrome, acute stroke, disorders of consciousness, and anaphylaxis through practice on models. Since 2012 the Chamber also holds an annual meeting on medical emergency conditions (37).

The study conducted by Umek and Šoštarič showed that dentists in Slovenia are well informed about emergency conditions, fairly regularly attend CPR courses and follow the developments in this area (Table 3). After completing their studies, 85.1% of the participating dentists attended at least one CPR course, most of them (74.4%) in the past five years. These dentists are on average 7.5 years older than the ones who did not attend any courses. A possible reason for this difference is that younger dentists overestimate their own knowledge because they recently concluded their studies and have fewer experience with medical emergencies in practice (11) The findings are comparable to the results of the studies conducted in Germany, United Kingdom and Lithuania (7,9,22), while those from France (2014), Belgium (2013) and Australia (1997) report on approximately 20% lower attendance in courses on medical emergencies (13,20,32). Saudi Arabia requires by law that all dentists take a CPR class every two years (24).

In India researchers discovered that only 42.1% of dentists had any practical training for managing emergency conditions during their undergraduate studies (38), while in Brazil only less than a third had such training exposures (8). In New Zealand studies have also alerted to exceptional dissatisfaction (more than a half) with the undergraduate training in medical emergency assistance (39). In Belgium 21.4% of participating dentists were not included in any CPR training at either undergraduate or postgraduate level (32). The studies on the competence of dental medicine students in Germany and France in recognizing a cardiac arrest and responding appropriately pointed mainly towards the lack of practical knowledge (40,41). This is further con-

firmed by the results of the study from the United Kingdom, which showed that only a good half of dental students have the required know-how on using the available tools for treating a patient with oxygen (42). In Slovenia more emphasis should be on practical training for managing emergency conditions as part of the undergraduate studies of dental medicine, especially through simulation learning. Studies from abroad confirm a positive contribution of this training method to the educational outcome (43).

Attending CPR classes is very important, as dentists in Slovenia fairly frequently (12.8%) perform CPR (external heart massage and artificial respiration) in practice, most of them outside on the field or at home as first responders providing first aid in the community (11). Immediate CPR can double or even triple the survival rate after a cardiac arrest outside a hospital because of fibrillation of the chambers, and in combination with defibrillation within 3–5 minutes after collapse it increases survival rates by 49–75% (44). In order to shorten the delay until defibrillation, AEDs are increasingly prevalent, and are included in the basic sequence of core reanimation procedures (5). However, approximately three quarters of dentists in Slovenia seem to be appropriately trained to use them (11).

The study in Slovenia has shown that only one (2.8%) participating dentist has performed CPR in a dental clinic. Most (88.9%) have however, dealt with cardiac arrest in the field or at home (11). The French studies also report of highly rare encounters with cardiac arrest in a dental clinic (13,16). Considering the relatively low frequency of cardiac arrest in a dental clinic when compared with other emergency conditions (1,7,8,11,13,32) it would be sensible to expand the current training programmes which place focus mainly on CPR and other reanimation procedures (ORP) by including theoretical courses on how to recognize and act in other emergency conditions that dentists face during their work. The organizers of courses should have more focus on brushing up on practical skills and teaching how to use available tools. It would be reasonable to further refresh this knowledge also through internally organized practical (simulation) practices, which are also recommended in the United Kingdom and New Zealand (45,46). The Medical Chamber of Slovenia estimates that the duration of a refresher CPR course for dentists, when taking into account their previous knowledge of basic reanimation measures, should be 1–2 hours (5).

Cooper et al. warn that knowledge and skills of performing CPR and taking action during emergency conditions significantly decrease already six months after attending a course (47), while according to the Slovenian study, the self-assessment of the capability for recognition and response in such conditions decreases after 3–5 years at the latest (11), emphasizing the importance of refresher courses. A higher level of confidence for managing emergency conditions after participating in appropriate courses was also confirmed by studies abroad and in Slovenia (11,32,33). The latter especially emphasized exceptional improvement in the dentists' self-assessment of their competence to recognize emergency medical conditions.

5 Tools and medications for medical emergency conditions

In order to effectively act during medical emergencies, dentists require appropriate tools. The Health Services

Act sets that professional, technical and other terms and conditions for performing activities are written by the Health Minister (48). In Slovenia we still do not have such a document. The Act on the Changes and Amendments to the Health Services Act of 2017 did not provide any relevant changes (48), and consequently an initiative was submitted to the Slovenian Reanimation Council with the Slovenian Society for Emergency Medicine (5). The Rules on the conditions for performing private healthcare activities defines inter alia that the equipment must be suitable for the activities performed and comparable to that available in public healthcare institutions, including the sanitary material for providing first aid (49). Exemplary guidelines were prepared in the United Kingdom and New Zealand (45,46).

The Manual of the Medical Chamber of Slovenia proposes the following 10 obligatory tools for use in medical emergency situations in dental clinics: a 300-litre oxygen canister that can suffice for at least 20 minutes at maximum use (a bigger one if the clinic is more than 15 minutes away from emergency medical teams), a pocket mask for mouth-to-mouth resuscitation with a plug for the oxygen, basic size mouth-throat breathing tubes, a breathing bag (i.e. ambu) with a face mask, non-return valve and an additional self-inflating bag, face mask with an oxygen tank, face masks of different sizes, aspirator (can be a mobile one for use outside the clinic), single use syringes and needles, spacer for the inhaler, and a blood pressure monitor (5). The British guidelines also include among obligatory tools a blood glucose monitor and an AED (45). The latter is also required in dental clinics in New Zealand when administering sedation during dental therapy (46). Installing an AED at a dental clinic is also recommended by the US guidelines and Cram et al. for when there is a probability it will be used at least once every 5 years (50,51). Installing them into every dental clinic in Slovenia would not be cost efficient, as the probability of a cardiac arrest in a dental clinic is exceptionally low, and 76.5% of Slovenian dentists know the location of the nearest available AED to their clinic (11). Installing them would most likely be sensible, if there are no publicly available AEDs nearby, and the expected response time of a medical emergency team is longer than 5 minutes (52). Low cost-efficiency of AEDs is also reported from Germany, where 2% of dentists have AEDs in their clinics, while only 5% of the respondents also affirm they have sufficient know-how to use them (7). Considering the high levels of reported hypoglycaemia in dental clinics in Slovenia it would be sensible to also include a blood glucose meter among the obligatory tools (11).

All the obligatory tools for use during emergency conditions should be accessible quickly and simply, and stored at the same place that the whole staff knows, preferably in special case. A designated staff member should in weekly or monthly intervals conduct logged reviews of all the tools on the list, including the expiration date, and when required, replace or add items as appropriate (4,5,45). Intravenous use of medication at a dental clinic is mostly not recommended because of lack of experience (3,45,46). Only 39.6% dentists in Slovenia, 32% in Germany and 35.9% in Brazil estimate that they can appropriately establish a venous pathway (7,8,11). Some recommend using pre-prepared syringes, however, these are not yet available on the Slovenian market.

The recommended medications for use in medical emergency conditions in dental clinics includes oxygen, adrena-

line, nitroglycerine, acetic acid, salbutamol in spray form, antihistamine, intravenous liquid with added glucagon, and carbohydrates for oral administration. The New Zealand guidelines require access to the first five of the above medications in all dental clinics, and the remaining ones only when patients are sedated (46).

The Slovenian study reported that Slovenian dental clinics are not suitably equipped with the tools to respond to emergency conditions, as most dentists only have access to about a half of the tools listed in the MCS manual (5,11). The fewest have access to the spacer for inhaling medications (8.7%) and to a face mask with an oxygen tank (26%). Only 4% of dentists have access to all the recommended tools, while only 3.6% have access to an AED and a blood glucose meter. Moreover, in spite of access to the tools, most of the dentists have never used them. The most frequently used are the blood pressure monitor, needles and syringes (11). The same would most likely apply to pre-prepared toolkits offered by numerous companies that most often have a short expiration date (7). Access to oxygen, which is either recommended or obligatory for the care of most emergency conditions in a dental clinic (10), is only available to 49.5% of dentists in Slovenia, 72% in Germany, and 66% in France (7,11,13). The study from Croatia also reports of insufficient availability of tools in dental clinics (33). In France the researchers emphasized the issue of elapsed expiration date of tools, especially oxygen and medications, as most dentists (nearly 90%) have never used them in their clinics (13).

6 Prevention of medical emergencies at dental clinics

Preventing medical emergencies in dental clinics is based on a detailed anamnesis, with a focus on accompanying diseases, current treatment and the data on known allergies, as this provides a good individual assessment of the risk level for sudden decrease in health, and an appropriate adjustment of the dental therapy. Consequently dentists should at every visit take and write down the medical history and assess the current threat level to the patient's health (17,53). In Slovenia about 60% of the dentists take medical history of the patient's general health condition and allergies at every visit or most of them. A similar share of dentists writes down the anamnesis at every visit or most of them, and about a third do so only during the patient's first visit. Older dentists take and write down the anamnesis on the general medical condition somewhat more often than their younger colleagues (11), which is similar to what Čuković-Bagić et al. discovered in Croatia (33). Insufficient focus and time spent on a detailed anamnesis and risk assessment is also reported in studies from Belgium and Germany (7,32). In Saudi Arabia a detailed anamnesis for every patient is conducted by 96% of dentists, and in India 98% (15,54). The authors of both these studies believe that dentists should at every dental treatment also assess and note all the vital signs: blood pressure, heart rate, breathing frequency and body temperature.

Abraham-Inpijn et al. developed a questionnaire that helps better prevent medical emergencies at dental clinics, and based on this, dentists in 10 European countries effectively assessed individual risk in dental procedures. The European Medical Risk Related History (EMRRH)

includes questions on specific disease symptoms, most frequent diseases, current medication, past procedures, allergies and pregnancy, and all are assessed using the scale of the American Society of Anaesthesiologists (ASA) (55). A correlation between the frequency of taking and writing down the anamnesis on the general medical condition and allergies, and the frequency of reports on medical emergency conditions, was not confirmed by the studies from Belgium and Slovenia (11,32). It would be sensible also in Slovenia to use verified questionnaires and to develop other tools that can assist in more effectively recognizing patients with a higher risk for a sudden medical emergency.

7 Conclusion

Studies show that medical emergency conditions in dental clinics are relatively frequent, as every dentist can expect to face at least one emergency condition per year. Regular courses to refresh knowledge and skills for appropriate treatment are of essential importance. In order to more easily prepare guidelines that would define the most appropriate types of training and the content of the courses on medical emergencies, further studies would be needed.

Dental clinics in Slovenia are insufficiently equipped with the tools required for medical emergencies, which is likely partially a consequence of a low awareness of their frequency, as well as the lack of clear guidelines on obligatory tools and medications for using them with these medical emergencies in dental clinics. According to recommendations from the United Kingdom every dental clinic should have an appropriate protocol for emergencies that all team members would follow, and every dental clinic should have access to appropriate equipment for handling life-threatening conditions.

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