

ORIGINAL ARTICLE

Medical Emergencies in Dental Clinics: A Survey of 2013 Dentists in China

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Key words: dental clinics; dentists; medical emergency; frequency; survey

Objective To investigate the feature and frequency of medical emergencies in dental clinics in China and the associated factors for Chinese dentists experiencing medical emergencies.

Methods A survey study was conducted among 2408 dentists who attended continuing educational courses held by Society of Sedation and Analgesia of Chinese Stomatological Association in 18 cities from December 2015 to December 2018. Demographic information of the dentists and the characteristics of medical emergencies they encountered were collected and analyzed. The associated demographic features for dentist experiencing medical emergencies were analyzed by logistic regression model.

Results A total of 2013 dentists provided valid responses and reported 2923 events of medical emergencies in dental clinics. Among them, 85.0% reported that they had encountered medical emergencies, and 35.5% had encountered at least twice. Syncope (35.9%) and hypoglycemia (30.3%) were the most common reported medical emergencies. Medical emergencies were most likely to occur during local anesthesia (49.9%), out-patient oral surgery (25.9%), and root canal treatment (11.3%). There were 6 patients (0.2%) died in emergencies. 84.0% dentists reported that they had never received training courses about medical emergency management in dentistry other than Basic Life Support. Longer practicing time (10-15 years) ($OR=0.59$, 95% CI : 0.41-0.85, $P=0.004$), working in private dental facilities ($OR=1.69$, 95% CI : 1.20-2.38, $P=0.003$) were associated with an increased risk of experiencing medical emergencies.

Conclusion More efforts are needed in prevention, early identification, and timely management of medical emergencies in dental clinics in order to prevent fatal outcomes. The results of this survey are useful information for re-designing emergency training courses for Chinese dentists.

IN dental clinics, medical emergencies such as syncope, allergic reaction, local anesthetic intoxication, hypoglycemia, orthostatic hypotension and hypertensive crisis, are acute and potentially life-threatening situations that need immediate management.^[1] The reasons for medical emergencies in dental clinics could be subjective factors, like psychological stress of the patients, or objective factors, such as invasive or pain-causing procedures, e.g. tooth extraction and root canal treatment. Medical emergencies in dental clinics are becoming more prevalent^[2, 3] due to the following reasons: 1) it is increasingly common for dentists to conduct multiple procedures in a single visit of patient; 2) out-patient treatment is getting more and more complex; 3) the increasing use of various medications, e.g., local anesthetics, antibiotics, sedatives, analgesics, during peri-treatment period; 4) the increasing application of sedatives and related techniques in out-patient setting.^[4] Additionally, the number of elderly patients and medically compromised patients who seek dental care are increasing.^[5]

As an issue of patient safety, medical emergencies encountered by dentists are routinely reported in many countries. A survey among 419 Polish dentists found that vasovagal syncope is the most common medical emergencies which was experienced by 46% of participating dentists in the past 12 months.^[1] In Belgaum City, India, among 105 dental graduates, 41% of them encountered syncope or faint in the past 4 years.^[2] Another survey conducted in Germany among 2998 dentists found that 57% of the dentists encountered more than 3 medical emergencies in the past 12 months.^[5]

However, research on medical emergencies in dental clinics in China has been rare. Some dental and emergency medical associations in China suggest that dentists should receive regular training on medical emergency, and dental clinics should be equipped with first-aid device.^[5, 6] Studies showed that there was an alarming lack of preparation for dentists to respond to medical emergencies in the dental clinics.^[1, 7, 8] Although many medical institutions in China provide educational training programs that involve medical emergency, such as standardized residency training programs, continuing medical education courses and business trainings, etc., the training mainly focus on the basic life support (BLS). As medical emergencies are various and may require different management, it is important to know the features and frequencies of

medical emergencies in dental clinics in order to implement targeted, efficient and timely treatment in emergent situation. Designing a training course for dentists on emergency should also base on it.

This study aimed to analyze the feature, frequency, and associated factors for dentists experiencing medical emergencies in China, and provide evidence for dental institutions to develop training programs for dentists on the targeted medical emergency response.

MATERIALS AND METHODS

Subjects and questionnaire

This survey study was conducted from December 2015 to December 2018. We sent self-designed questionnaire with on-site guidance to dentists who attended continuing education courses organized by the Society of Sedation and Analgesia of Chinese Stomatological Association after each training course. The questionnaire was semi-structured (supplementary **Table S1**) and generated through an commercial online questionnaire survey application (wenjuan.com, Shanghai Zhongyan Network Technology co., Ltd., Shanghai, China). Information collected included: dentists' general information, specialty, geographic region, type of dental facility they were serving, time length of dental practicing, type and frequency of medical emergencies encountered in the past 3 years in out-patient clinics, characteristics of these medical emergencies, including the time point of onset, the on-going procedures when medical emergencies occurred, disposal management, whether the medical emergency resulted in medical disputes, severe disabilities or deaths. We also asked whether the dentist had received training on medical emergency other than BLS. The medical emergency in our study referred to acute and potentially life-threatening situations that need immediate management in dental out-patient environment.^[1]

Data management and statistical analysis

Data was collected and analyzed by SPSS software (version 19.0). Responders with missing or repetitive values were excluded. The measurement data were compared by *t* test, and the numerical data were compared by chi-square test and probability test. Logistic regression analysis was used to examine the association between experiencing medical emergencies and the characteristics of dentists, which included the gender, age, length of service, number of specialties,

whether had received training on medical emergency other than BLS, the type of dental facility they served, and the geographic region of their service. The results were presented as odd ratios (OR) and 95% confidence interval (CI). $P < 0.05$ was considered as statistically significant.

RESULTS

Profile of the subjects

From December 2015 to December 2018, the survey was conducted on 18 national continuing education courses held in 18 different cities across China. Totally, 2408 dentists participated in these education courses. Among them, 2042 (84.8%) dentists filled in the questionnaire. After excluding uncompleted ($n=13$) and repeated ($n=16$) questionnaires, a total of 2013 (83.6%) valid questionnaires were included for analyses, with 2923 medical emergencies reported.

The demographic characteristics of 2013 dentists are shown in **Table 1**. Dentists who participated in this survey were from 30 provinces, municipalities or autonomous regions across China, with exception of Hong Kong and Macao special administrative regions, Tibet autonomous region, and Taiwan province. More than half of them (55.4%) were male, 30.7% of them were in 41-50 age group. The facilities they worked were mainly private dental clinics or hospitals (40.9%), department of stomatology in public general hospitals (33.6%), and outpatient of dental school hospitals (21.8%).

Most of these dentists majored in one specialty, while 19.52% of them majored in 2 or more specialties. General dentistry is the most common specialty (60.4%), followed by pediatric dentistry (21.8%), endodontology (14.1%), oral surgery & anesthesia (8.8%), periodontology (7.5%), prosthodontics & orthodontics (5.4%), radiology & others (1.1%). Dentists whose practicing time less than 10 years were found in 55.6% of participants. Regarding to medical training, 84.0% of the dentists reported that they had never received first-aid training on medical emergencies other than BLS.

Features of medical emergencies

Totally, 1710 (85.0%) dentists reported they had encountered 2923 medical emergencies in the past 3 years, with a frequency of 1.45 medical emergencies per Chinese dentist, and 735 (36.5%) dentists

encountered at least twice in the past 3 years. The number of dentists with variable frequency of medical emergencies was displayed in **Table 2**. Among 2923 medical emergencies reported, syncope (35.9%) and hypoglycemia (30.3%) were the most common types, details were listed in **Table 3**. BLS was performed in 152 (5.2%) cases. The medical emergent events led to medical dispute was reported by 96 dentists (4.8%), and verbal/physical attack to dentists or staff was reported by 14 dentists (0.7%). There were 6 deaths (0.2%) caused by medical emergencies (**Table 4**).

Table 5 shows that the number of medical emergencies dentists encountered were associated with their practicing time length. Dentists with the longest practicing years (>20 years) had encountered 2.02 cases of medical emergencies per person in the past 3 years, which was the highest among all groups of dentists; while those with the shortest practicing years (<5 years) had encountered 1.19 cases of medical emergency per person, the lowest among all groups.

Dental procedures of the emergencies

Analysis of the on-going procedures when medical emergencies occurred (**Figure 1**) showed that medical emergencies most commonly occurred during local anesthesia (49.9%), followed by tooth extraction and out-patient surgery (25.9%), and root canal treatment (11.3%). Totally, 96.4% of these emergencies occurred during therapeutic procedures.

Associated factors

The associated factors of Chinese dentists experiencing medical emergencies in dental clinics are shown in **Table 6**. Longer practicing time, working in private dental facilities, working in regions other than Beijing-Tianjin-Hebei were associated with an increased risk of experiencing medical emergencies. No association was found between the chance of experiencing medical emergencies with dentist's sex and the number of their majored specialties. Similar result was found for experiencing multiple medical emergencies (>1 event), except that the years of practicing were found as a protective factor.

DISCUSSION

To our best knowledge, the current study is the largest and most extensive survey on medical emergencies in dental clinics in China. The online survey covered

Table 1. Demographic characteristics of dentists participating in the survey ($n=2013$)

Characteristics	Encountering medical emergencies		Sub-total	χ^2	P value
	No ($n=303$)	Yes ($n=1710$)			
Gender [$n(\%)$]				0.27	0.60
Male	172 (15.43)	943 (84.57)	1115 (55.39)		
Female	131 (14.59)	767 (85.41)	898 (44.61)		
Age [years, $n(\%)$]				57.16	<0.01
<30	133 (23.54)	432 (76.46)	565 (28.07)		
30-40	80 (14.44)	474 (85.56)	554 (27.52)		
41-50	76 (12.30)	542 (87.70)	618 (30.70)		
>50	14 (5.07)	262 (94.93)	276 (13.71)		
Practicing Region [$n(\%)$]				41.03	0.01
Beijing-Tianjin-Hebei	90 (21.38)	331 (78.62)	421 (20.91)		
North China	69 (12.00)	506 (88.00)	575 (28.56)		
East China	91 (18.72)	395 (81.28)	486 (24.14)		
Northeast China	23 (15.75)	123 (84.25)	146 (7.25)		
Central and South China	20 (10.87)	164 (89.13)	184 (9.14)		
West China	10 (4.98)	191 (95.02)	201 (9.99)		
Type of facility [$n(\%)$]				11.49	0.01
Outpatient department of dental school hospital	83 (18.91)	356 (81.09)	439 (21.81)		
Private dental clinics or hospitals	110 (13.35)	714 (86.65)	824 (40.93)		
Stomatological department in a general hospital	93 (13.76)	583 (86.24)	676 (33.58)		
Other unspecified	17 (22.97)	57 (77.03)	74 (3.68)		
Length of practice (years)				19.43	<0.01
<5	133 (23.54)	432 (76.46)	565 (28.07)		
5-10	80 (14.44)	474 (85.56)	554 (27.52)		
11-15	51 (12.78)	348 (87.22)	399 (19.82)		
16-20	25 (11.42)	194 (88.58)	219 (10.88)		
>20	14 (5.07)	262 (94.93)	276 (13.71)		
Number of specialties per dentist [$n(\%)$]				5.68	0.02
1	259 (15.99)	1361 (84.01)	1620 (80.48)		
≥ 2	44 (11.20)	349 (88.80)	393 (19.52)		
Training on medical emergency other than BLS [$n(\%)$]				18.93	<0.01
No	280 (16.57)	1410 (83.43)	1690 (83.95)		
Yes	23 (7.12)	300 (92.88)	323 (16.05)		

BLS: basic life support.

Table 2. The frequency and number of medical emergencies reported by Chinese dentists participating the survey ($n=2013$)

Category	Medical emergencies reported by a dentist							Total
	0	1	2	3	4	5	6	
Dentists [$n(\%)$]	303 (15.1)	975 (48.4)	418 (20.8)	206 (10.2)	73 (3.6)	26 (1.3)	12 (0.6)	2013
Emergent events (n)	0	975	836	618	292	130	72	2923

dentists from wide ranges of geographic regions, facility types and specialties, and had acquired a high response rate (83.6%) by using smart-phone application and face to face approach. We found that 85.0% dentists have encountered medical emergencies during

their practice in the past 3 years, among which syncope was the most common type. This finding is similar to the results from a recent study in Saudi Arabia, where dentists encountered medical emergencies in a slightly lower rate (67%), and vasovagal syncope was the

Table 3. Spectrum of the medical emergencies reported by Chinese dentists ($n=2923$)

Type of emergency	Frequency	%
Syncope	1050	35.9
Hypoglycemia	885	30.3
Adrenalin reaction	249	8.5
Allergy	170	5.8
Local anesthetic intoxication and adverse reactions	123	4.2
Aspiration and accidental swallowing	117	4.0
Severe hypertension	108	3.7
Epileptic seizure	90	3.1
Orthostatic hypotension	90	3.1
Heart diseases (myocardial infarction, angina pectoris, etc.)	20	0.7
Airway obstruction	12	0.4
Stroke	9	0.3

most common type.^[8]

Study from other country reported that dentists encountered medical emergencies twice annually.^[9] In our survey, dentist annually encountered 1.45 emergent events in average. Interestingly, we found dentists with the longest practicing time had the highest frequency of medical emergency, which probably indicated that patients with complicated conditions or those need longer time or more complicated dental procedures intend to visit senior dentists. In addition,

the risk of unexpected emergency in dental clinics exists through the whole career life of dentists. All dentists during their entire career life should actively be prepared.

Syncope was one of the most common medical emergencies in the current study, which was consistent to the studies from multiple countries.^[2, 7, 10] It is suggested that dentists should pay more attention to prevention, early diagnosis of these common but less fatal adverse events, and be prepared with pain and anxiety relief methods for effective management.^[5, 11-14] In the current study, hypoglycemia (30.3%) and adrenaline reactions (8.5%) were reported as the other two common emergencies; however, the incidence of hypoglycemia in studies from other country was less than 20%.^[11,14] The reason of this difference may lie in that many dentists participating in this survey were not able to effectively make differential diagnosis of syncope, hypoglycemia and other emergencies. Therefore, it is necessary to strengthen the knowledge in the medical emergencies in forthcoming training courses.

In this study, only 5.6% dentists reported the medical emergencies they encountered resulted in medical disputes, and of all reported emergencies, BLS is actually performed in only 5.2% cases; only 0.7% cases were diagnosed as myocardial infarction or angina pectoris. The rate of severe cardiac conditions in medical emergencies occurred in dental practicing ranged

Table 4. Details of 6 deaths associated with medical emergencies reported by Chinese dentists

No.	Specialty and patient status	Type of facility	Type of emergency	Related dental procedure
1	Pediatric dentistry (child)	Private dental clinic	Airway obstruction	Root canal treatment
2	Pediatric dentistry (child)	Private dental clinic	Cardiac arrest	Dental treatment under general anesthesia
3	Maxillofacial surgery (adult)	Public general hospital	Airway obstruction	Abscess incision and drainage
4	Maxillofacial surgery (adult)	Dental school hospital	Local anesthetic drug intoxication	Removal of impacted wisdom teeth
5	Prosthodontics (elderly with basic diseases)	Dental school hospital	Myocardial infarction	Tooth preparation
6	Endodontics (elderly with basic diseases)	Private dental clinic	Stroke	Root canal treatment

Table 5. Practicing time of Chinese dentists and the number of medical emergencies encountered

Category	Length of practicing time (years)					Total
	< 5	5-10	11-15	16-20	>20	
Dentists [$n(\%)$]	565 (28.1)	554 (27.5)	399 (19.8)	219 (10.9)	276 (13.7)	2013 (100)
Medical emergencies (n)	672	753	579	362	557	2923
Average per dentist	1.19	1.36	1.45	1.65	2.02	1.45

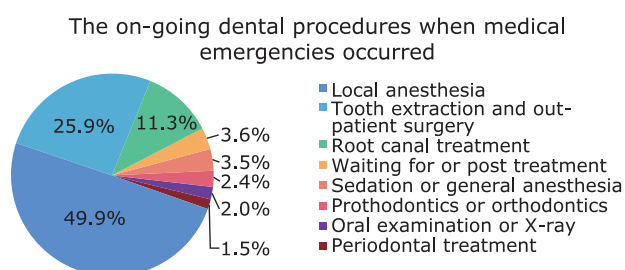


Figure 1. The types of dental procedures conducting when the medical emergencies occurred ($n=2923$).

from 0.3% to 22% as reported in literature,^[11, 14-15] which indicates that most emergencies in dental clinics won't cause serious consequences. Other medical emergencies are mostly less life-threatening if detected at a very early stage, and can be resolved by corresponding measurements such as verbal comfort, head low feet high position, oxygen supplement, epinephrine injection, vital signs monitoring, Heimlich Maneuver, jaw thrust,

etc. BLS or advanced cardiac life support (ACLS) might not always be necessary. Therefore, in order to improve the management of medical emergent events and prevent fatal consequences effectively, it is necessary to adjust the training content accordingly, focusing on the common medical emergencies in dental practice.^[5, 11] Meanwhile, the workflows for emergencies, drug and equipment allocation in dental clinics should also be more targeted accordingly.^[9, 11]

During the whole processes of diagnosis and treatment in a dental clinic, medical emergencies often occur in procedures that cause pain and stress, such as local anesthesia, tooth extraction, root canal treatment. Additionally, some medical emergencies can be caused by the toxicity and allergic reactions related to local anesthetics. To prevent emergencies, dentists should have strong pharmacological knowledge in common medications in the dental settings and the

Table 6. Associated factors of Chinese dentists experiencing medical emergencies in the dental clinic

Characteristics of dentists	Experiencing medical emergency ($n=2013$)			Experiencing multiple medical emergencies ($n=1710$)		
	OR	95% CI	P	OR	95% CI	P
Gender*	1.02	0.78, 1.32	0.91	0.98	0.80, 1.20	0.850
Age* (years)						
30-40	1.81	1.31, 2.51	<0.001	1.11	0.83, 1.47	0.493
41-50	2.17	1.50, 3.14	<0.001	1.87	1.31, 2.67	0.001
>50	6.10	3.39, 10.96	<0.001	2.16	1.56, 3.00	<0.001
Length of practicing time* (years)						
5-10	NA			NA		
11-15	NA			0.59	0.41, 0.85	0.004
16-20	1.19	0.71, 2.00	0.52	NA		
>20	NA			NA		
Number of specialty*	1.25	0.87, 1.78	0.23	1.33	1.04, 1.71	0.023
Training on medical emergency other than BLS*	3.13	1.99, 4.94	<0.001	1.09	0.84, 1.42	0.508
Type of working facility*						
Private dental clinics or hospitals	1.69	1.20, 2.38	0.003	0.78	0.59, 1.03	0.084
Department of stomatology in general hospital	1.33	0.93, 1.90	0.12	0.92	0.69, 1.23	0.568
Other unspecified	0.93	0.49, 1.74	0.81	0.83	0.46, 1.49	0.533
Region of service*						
West China	6.52	3.27, 13.04	<0.001	0.93	0.69, 1.26	0.637
Central/South China	2.78	1.62, 4.77	<0.001	1.88	1.38, 2.56	<0.001
Northeast China	1.93	1.13, 3.30	0.02	0.88	0.56, 1.38	0.574
East China	1.28	0.90, 1.81	0.17	1.89	1.28, 2.80	0.001
North China	1.89	1.30, 2.73	<0.001	2.21	1.52, 3.21	<0.001

*references of each variables were: sex, male; age, <30 years; length of practicing time, <5 years; number of specialty, 1; training on medical emergency other than BLS, no; type of working facility, outpatients department of dental school hospital; region of service: Beijing-Tianjing-Hebei.

ability to apply them properly in accordance with dental procedures,^[12, 16] e.g., skills in pain control and anxiety relieving.

Previous studies showed that less than half of the dentists can independently identify the causes of emergencies, and most of them cannot perform BLS or intravenous injection.^[2, 17] Data in the current study revealed similar situation in China, which is not optimistic. There were 84.0% dentists reporting they had never received relevant first-aid training for medical emergency other than BLS. Dentists lack comparable knowledge and experience of clinical medication compared to physicians. Therefore, we would suggest to strengthen the training on emergency management as competencies in the national resident training programs for dentists.

The mortality in this survey was 0.2%, which was comparable to that reported by other studies (0.1%-0.2%).^[16] Deaths mainly occurred in elderly or pediatric patients with basic diseases, or as the serious consequences of airway obstruction, heart and brain conditions during diagnosis and treatment processes. However, in foreign studies, adverse reactions related to general anesthesia and sedation were reported as the main causes of deaths in dental patients.^[18] Due to the gradually increased application of such treatments in dentistry in China, it is essential to offer related trainings to professionals who provide these services, and we would suggest the Society of Sedation and Analgesia of Chinese Stomatological Association to take this responsibility.

Our study covered the largest sample to investigate the associated factors for Chinese dentists experiencing medical emergencies in dental practice. We found dentists with longer practicing years were more likely to experience medical emergencies, and dentists from private dental facilities was more likely to experience medical emergencies than those from dental school hospitals. Additionally, working in west China, Central/South China, Northeast and North China were more likely to encounter medical emergencies than those in Beijing-Tianjin-Hebei region. These situations probably mean that patients with complicated conditions tend to see senior dentists; dentists working in private facilities may be lacking knowledge and skills in medical emergencies prevention; the continuous educational courses for dentists on medical emergency are underdeveloped in some regions of China. We also found those dentists who

reported training history in medical emergencies other than BLS had a higher chance of encountering medical emergencies in dental clinic ($P < 0.001$). This group of dentists probably had a better sense and ability to identify potential medical emergencies, thus actively responded to the questionnaire and provided more information.

This study has some limitations. Firstly, among the dentists participating in this survey, there were relatively fewer dentists specializing in prosthodontics, orthodontics, oral medicine, dental radiology, etc. Secondly, as a retrospective study, bias caused by recall discrepancy and ambiguous diagnosis at the emergent situation by the dentists may overestimate or underestimate the frequency of the emergencies. Thirdly, we did not assess the quality of the questionnaire used in this study. However, the completion rate of the questionnaire was high (84.8%), which indicated that the questionnaire was easy and manageable for responders. Finally, the selection bias may exist, and we were not able to compare the characteristics of the dentists participating the survey with those who did not, so the extrapolation of the results in this study should be careful. A national reporting system on adverse events related to medical emergency in dentistry is probably needed in the future.

In conclusion, this study investigated the occurrence of medical emergencies and the associated factors for dentists experiencing these emergencies in China. The results provided some basic data and evidences to design or optimize the relevant training courses in the future. As most emergencies do not cause serious consequence, BLS is not necessarily to be the major measurement for emergencies in dental settings. Prevention, early identification, and timely management of the medical emergencies need be addressed in the educational materials in order to prevent fatal outcomes. We suggest the stakeholders, such as national academic committees, dental practitioners, and institutions actively engage in developing guideline and nationwide submitting system for dental medical emergencies, designing and executing targeted training programs, and preparing relevant equipment for the purpose to enhance the reaction ability in emergency and improve patient safety.

Conflict of interests

None.

Supplementary materials

Table S1: Items and options in the questionnaire exploring medical emergencies.

Available online at <http://cmsj.cams.cn/EN/10.24920/003708>.

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