Sudden Cardiac Arrest in a Dental Patient Awaiting Examination

Thunshuda Sumphaongern, MD*; Erika Yamahara, DDS†; and Ryo Wakita, DDS, PhD‡

*Instructor, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand, †Graduate Research Student, Department of Dental Anesthesiology and Orofacial Pain Management, Tokyo Medical and Dental University, Tokyo, Japan, ‡Associate Professor, Department of Dental Anesthesiology and Orofacial Pain Management, Tokyo Medical and Dental University, Tokyo, Japan

Sudden cardiac arrest (SCA) is an uncommon event in dental practice; however, the frequency of dentists encountering SCA and other major medical emergencies is increasing. We report the successful resuscitation of a patient who developed SCA while awaiting examination and treatment at a dental hospital. The emergency response team was called upon, and cardiopulmonary resuscitation/basic life support (CPR/BLS), including chest compression and mask ventilation, was promptly initiated. An automated external defibrillator was used, which indicated that the patient's cardiac rhythm was unsuitable for electrical defibrillation. The patient returned to spontaneous circulation after 3 cycles of CPR and intravenous epinephrine. The knowledge and skill levels of dentists regarding resuscitation under emergency circumstances should be addressed. Emergency response systems must be well established, and CPR/BLS knowledge and training should be updated regularly, including optimal management of both shockable and nonshockable rhythms.

Key Words: Sudden cardiac arrest; Cardiopulmonary resuscitation; Dentistry; Automated external defibrillators; AED; Epinephrine.

Major medical emergencies such as sudden cardiac arrest (SCA) are relatively rare in dental practice.[1] In the past 20 years, an average of 1 in 500 dentists per year have experienced a case of SCA in the United Kingdom, whereas a 2011 study from India showed that up to 10% of dentists had encountered SCA events.[2,3] The number of dental visits by patients with various systemic diseases is increasing as our society continues to age.[4,5] The sudden deterioration of a patient's condition in the dental clinic is a growing possibility that can occur even outside of a dental procedure is being performed. Furthermore, an increased incidence of dentists administering emergency medical treatment is also predicted. The association between high-quality cardiopulmonary resuscitation (CPR) and improved mortality outcomes is well known. Therefore, basic life support (BLS) and CPR knowledge and skills are necessary for all dental practitioners to effectively manage SCA.

We report the successful resuscitation of a patient who developed SCA while awaiting dental examination and treatment. This report also includes self-reflection on the response to this medical emergency that occurred at our dental hospital.

CASE PRESENTATION

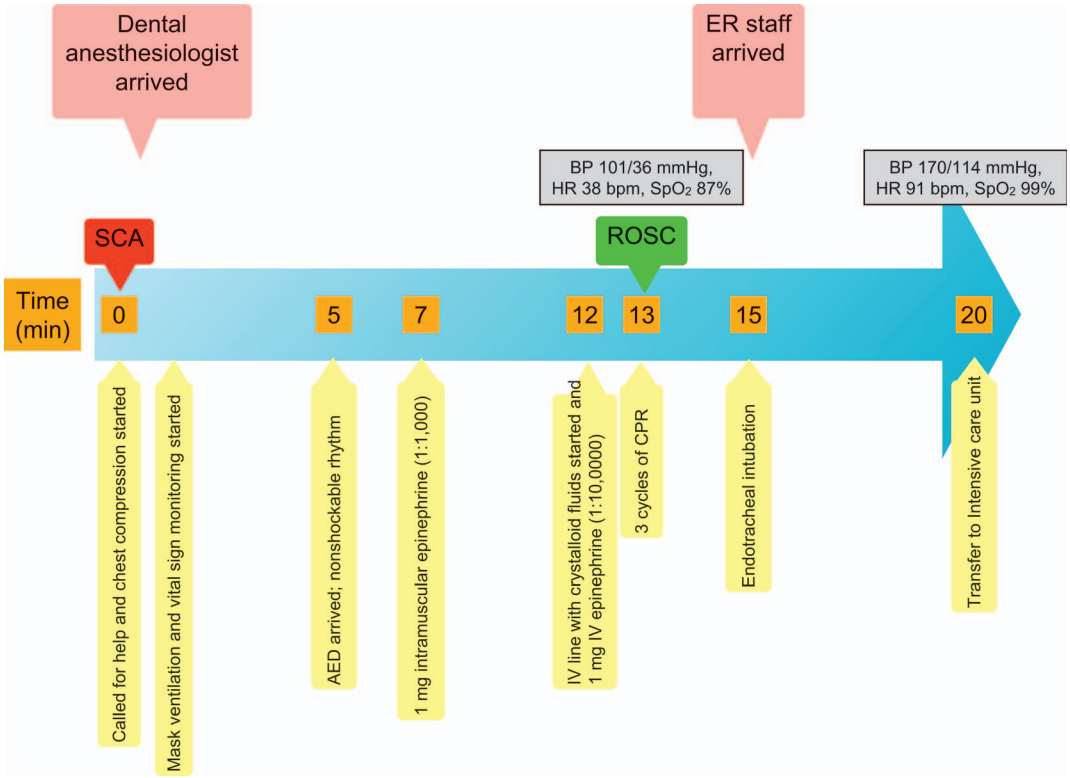
An 86-year-old man (height 156 cm; weight 52 kg; body mass index 21.4 kg/m^2) lost consciousness on his way to the restroom while waiting to be seen in the oral surgery department. He was highly independent in his activities of daily living, and this was his first visit to our dental hospital. Another person in the waiting room heard him collapse, found him, and immediately reported it to the medical staff. The oral surgeon, who first responded to the emergency, requested immediate support from the dental anesthesiology clinic and the school of medicine's emergency rescue center (ER). The time elapsed up to this point was at most a few minutes.

Received November 5, 2021; accepted for publication September 16, 2022.

Address correspondence to Dr Ryo Wakita, Department of Dental Anesthesiology and Orofacial Pain Management, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku, Tokyo 113-8549, Japan; ryoanph@tmd.ac.jp.

Anesth Prog 70:25–30 2023 | DOI 10.2344/anpr-69-04-05

Timeline of the SCA Event. Representation of the events along with the patient's responses shown below the timeline. SCA, sudden cardiac arrest; ROSC, return of spontaneous circulation; ER, emergency room; IV, intravenous.



Upon initial evaluation, the patient's carotid arterial pulse could not be palpated, and he was not breathing. An ambulance cart and automated external defibrillator (AED) were requested immediately. Chest compressions had already been initiated prior to the arrival of the dental anesthesiologists who quickly started mask ventilations. Tracheal intubation was not performed because the equipment required for intubation was not available and mask ventilation was easy and effective. Vital signs were obtained after the following monitors were applied: electrocardiography (ECG), noninvasive blood pressure (BP), and pulse oximetry. However, the patient's BP could not be measured as it was not registering. His oxygen saturation (SpO_2) on room air was 47%. Approximately 5 minutes after the patient was found, the AED arrived and was attached to the patient (event timeline is presented in Figure). AED analysis indicated that shock delivery was inappropriate at that time ("no shock advised"), suggestive of asystole or pulseless electric activity (PEA). The AED also directed the continuation of chest compressions. Therefore, chest compressions were immediately resumed after confirming the continued absence of a carotid pulse. A 1-mg intramuscular (IM) bolus of epinephrine (1:1000) was administered into the patient's anterolateral thigh ~7 minutes after SCA, followed by the placement of a 22-gauge intravenous (IV) line ~5 minutes later. A 1-mg IV bolus of epinephrine (1:10,000) was administered in Ringer solution. Throughout this period, the AED continued ECG analysis every 2 minutes, but no shock was advised, consistent with the continued absence of a pulse.

Roughly 13 minutes after SCA, which was after 3 cycles of CPR, the presence of a carotid pulse was confirmed, and the return of spontaneous circulation was announced. The patient's BP was 101/36 mm Hg, heart rate (HR) was 38 beats/min with regular sinus rhythm, and SpO_2 was 87%, although he remained unconscious. Fifteen minutes after SCA, the ER staff from the medical school hospital arrived and orally intubated the patient. He was transferred to the hospital's intensive care unit ~20 minutes after SCA at which time his vital signs were as follows: BP 170/114 mm Hg, HR 91 beats/min with normal sinus rhythm, and SpO_2 99% on 100% O_2. The patient regained consciousness following his arrival to the medical hospital. In total, 7 staff members were involved in this patient's emergent resuscitation: 3 from the oral surgery department, 2 from the dental anesthesiology department, and 2 from the ER.

The following information was later obtained from the patient's family members: he was visiting our dental hospital for tooth extraction following referral by a primary-care dentist. His medical history included hypertension, atrial fibrillation, ventricular septal defect with a history of surgical correction, and gastric cancer with a history of surgical resection. The patient had discontinued warfarin therapy on his own the day of his visit. He had started home oxygen therapy 10 days before the visit because of increasing shortness of breath and respiratory distress that had been ongoing for 1 month.

Acute coronary syndrome was suspected after transfer to the medical hospital where he underwent coronary angiography that revealed no significant stenosis. Two weeks later, the patient experienced another SCA episode followed by successful resuscitation. No abnormalities were found on cardiac electrophysiological examination. The cause of the SCA was assumed to be chronic congestive heart failure, and the patient was referred to a cardiologist.

Postcardiac arrest analysis of the AED revealed PEA. We analyzed the ECG data from the AED and measured the time points during the patient's emergency care. The time from discovery of the patient to application of the AED was 5 minutes. After each ECG analysis by the AED, it took 26 seconds to resume CPR the first time, 8 seconds the second time, and 7 seconds the third time, respectively.

DISCUSSION

This report describes the successful resuscitation of a patient experiencing SCA. The dentists who administered emergency medical care were members of the oral surgery and dental anesthesiology departments and as such were familiar and well trained in CPR, BLS, and advanced cardiovascular life support (ACLS). All dentists should be aware of how to respond promptly when confronted with a medical emergency, including SCA. An AED is a device that almost everyone can use, and staff who can act as rescuers should be appropriately trained in their use.[6]

Upon reviewing the details of this case, we identified several areas for improving our emergency responses to increase the efficacy of patient resuscitation. These included minimizing the AED arrival time and the time to resume CPR after a rhythm check, performing emergent tracheal intubation, securing IV access, and administering epinephrine appropriately.

The 5-minute delay in the arrival of the AED occurred because few staff members knew the exact location of the AEDs even though they had been placed at the same location on each floor and were easily accessible. Despite this, the team had only a rough idea of the AED's location, which delayed its application. After this incident, the hospital decided to conduct annual training for all employees using an environment consistent with the actual location of the equipment.

In dental hospitals and clinics, emergency response systems should be established and regularly audited, and emergency equipment, including an AED, must be easily accessible. The introduction of emergency training in simulated office environments enables efficient learning, such as identifying the location and contents of emergency equipment and drugs, in addition to the AED.[5] Simulation studies in critical situations have found that the use of cognitive aids, like posters and smartphone apps along with emergency manuals, improves the performance of healthcare providers.[7,8] These cognitive aids may also help practitioners avoid errors in management when a patient's condition suddenly becomes critical.

As mentioned before, the dentists who administered emergency medical care in this case were members of the oral surgery and dental anesthesiology departments; thus, they were more familiar with and better trained in CPR and BLS as compared with general dentists in our country. According to the American Heart Association (AHA) BLS guidelines, an AED should have been requested after confirming that the patient was unconscious and activating emergency medical services. In this case, an emergency call and a request for an AED were simultaneously made after verifying the patient's lack of consciousness, pulse, and breathing. Ideally, the emergency call and AED request should have been made as soon as the unconscious patient was found. Although this was not a complete error, the time taken to perform a pulse and breathing check may have contributed to the delay in the AED's arrival.

Although our first responders were well trained, there was a modest delay in resuming CPR after a rhythm check when they were confronted with an actual medical emergency. It took 26 seconds to resume chest compressions after the first ECG analysis using the AED, which confirmed the presence of a nonshockable rhythm. One potential reason may be that SCA is rarely encountered in dental practice, and apart from 1 dentist, this was the first time our dental providers had managed SCA.

Another possibility is that the oral and maxillofacial surgeons and dental anesthesiologists may not have retained sufficient knowledge and skills in BLS and CPR. Unlike many states in the United States, general dentists in Japan are required to be trained in CPR/BLS but are not required to be certified by an organization (eg, the AHA) or to receive regular refresher training

after graduation. Japanese oral surgeons and dental anesthesiologists who perform IV sedation or general anesthesia must be BLS certified as a minimum requirement but are not required to have ACLS certification, and regular certification renewal is not required, although it is expected. Only 1 dentist involved in this case regularly renewed their BLS/ACLS certifications. We suspect that many dentists would be unable to respond properly for the first time if they do not regularly receive refresher training in BLS and/or ACLS.

According to Baduni et al[9] and Mohan et al,[10] Indian dentists or undergraduate dental students who do not have certified BLS training lack awareness of BLS and have low BLS knowledge scores. A study by Alkandari et al[11] indicated that 64% of the general dentists in Kuwait had low CPR knowledge. Ekici[12] suggested that general dentists in Turkey lacked CPR knowledge; however, dentists who had worked in dental hospitals had more CPR knowledge than local practicing dentists due to a greater exposure to managing life-threatening situations.[3] In addition, Schizogiannis et al[13] found significant improvement in the CPR knowledge and skills of dentists who attended a CPR training course. Moreover, Nogami et al[14] showed that the skills and quality of BLS among dentists rapidly decreased over time after the completion of a BLS course. Alkandari et al[11] reported that dentists who underwent CPR training within the previous 2 years had significantly more knowledge than those who did not. These findings indicate that competency in BLS and CPR may be maintained and improved through regular practice and frequent CPR training courses.

Based on our case report, we suggest that BLS certification and routine refresher training are essential for all dentists. Along with regular BLS/CPR training, consideration should be given to the requirements for ACLS training for oral and maxillofacial surgeons and dental anesthesiologists. Although knowledge levels should be maintained through refresher training at appropriate intervals, there is no consensus regarding the training required for dentists to maintain their practical skill level. The AHA suggests that booster training in resuscitation is useful and considers that intervals <1 year may be better, but the specific intervals are still under consideration.[15] Both theory and practice of CPR training are recommended for both dental students and licensed dentists, who should regularly update their CPR knowledge every year or earlier to maintain competency during an actual SCA event.

In lieu of requiring BLS/ACLS refresher training in our country, it may be useful to develop emergency response training that includes BLS concepts as well as more advanced scenarios for shockable and nonshockable rhythms, particularly for dental clinics frequently visited by elderly and medically compromised patients. The administration of IV epinephrine along with other relevant medications and their correct dosing could be included. The need to ensure our dental clinics are sufficiently prepared and our staff appropriately trained for emergency resuscitation is essential.

Prompt use of AEDs in addition to high-quality CPR is critical to save the lives of patients who require early defibrillation. In Japan, $\sim$60% of ECGs indicated ventricular fibrillation or pulseless ventricular tachycardia at the time of SCA, and 40% of SCAs reflect ventricular fibrillation according to a study in the United States.[16–18] However, it is important to remember that the other half of SCAs represents nonshockable rhythms. The number of patients with various systemic diseases who visit dental clinics and the possibility of encountering various medical emergencies are increasing.[4,5] Hence, the possibility of dentists encountering nonshockable rhythms (ie, asystole and PEA) is also increasing.

Upon encountering nonshockable rhythms, IV epinephrine administration should be considered. Three possible reasons for the delay in securing IV access after cardiac arrest were identified in our case. First, the BLS guidelines do not mention securing an IV line. Second, oral and maxillofacial surgeons or dental anesthesiologists can routinely secure IV access in Japan, but not all dentists in the oral surgery or dental anesthesiology departments are familiar with the same level of clinical practice. Hence, the IV line was secured only after a capable staff member had been recruited. Third, securing IV access was made more difficult due to the patient's ongoing cardiac arrest.

The deviation (IM epinephrine) from the standard epinephrine administration protocol (IV epinephrine) that occurred in this case was due to a communication error: a request for preparation was misunderstood as a request for administration. We concluded that a lack of team discussion and closed-loop communication resulted in a failure to share knowledge while performing CPR. A resuscitation member may have been impatient because of the delay in securing an IV line. If cardiac arrest occurs and the IV or intraosseous route is not feasible, IM epinephrine administration might be considered. However, there is little evidence regarding this route of administration, and there are no relevant recommendations in the AHA ACLS guidelines.[19,20] Although no adverse events have been reported, guidelines should be followed instead of attempting IM epinephrine administration.

Tracheal intubation is not necessarily always more advantageous than a bag valve mask, particularly when

adequate ventilation is being provided.[21] Because this SCA event occurred in a dental hospital, there were few staff members experienced with tracheal intubation. Furthermore, the hospital was not equipped with a carbon dioxide detector to be used after intubation; thus, tracheal intubation was not considered a priority. Capnography is useful not only for confirming tracheal intubation but also for improving the quality of CPR.[22] Therefore, improvements like equipping the dental hospital with a carbon dioxide detector and routine training for the insertion of supraglottic airways were considered. Following this case, we decided to include end-tidal carbon dioxide monitoring in addition to advanced airway devices and the necessary equipment for intubation in the emergency cart.

CONCLUSION

We reported a case of successful resuscitation of a patient who experienced SCA at our dental hospital. Although we were satisfied with the response to this emergency, there was considerable room for improvement based on our self-assessment regarding our utilization of resources, decision-making, and efficient emergency response systems. Our BLS response was generally successful, except for a modest delay in AED arrival and restarting chest compressions after the AED analyses. Routine refresher training in CPR, BLS, and ACLS is essential for effectively responding to emergencies. Although it is important to have emergency equipment and establish an effective emergency response system, it is also essential to provide regularly scheduled on-the-job training for staff and resource management to ensure that these systems are fully operational.

REFERENCES

1. Arsati F, Montalli VA, Flório FM, et al. Brazilian dentists' attitudes about medical emergencies during dental treatment. *J Dent Educ*. 2010;74:661–666.

2. Girdler NM, Smith DG. Prevalence of emergency events in British dental practice and emergency management skills of British dentists. *Resuscitation*. 1999;41:159–167. doi:110.1016/s0300-9572(1099)00054-00054

3. Singh K, Bhat N, Ramesh N, et al. Cardiopulmonary resuscitation: knowledge and personal experience among dentists in Udaipur, India. *J Dent Sci*. 2011;6:72–75.

4. Anders PL, Comeau RL, Hatton M, Neiders ME. The nature and frequency of medical emergencies among patients in a dental school setting. *J Dent Educ*. 2010;74:392–396.

5. Vaughan M, Park A, Sholapurkar A, Esterman A. Medical emergencies in dental practice - management requirements and international practitioner proficiency. A scoping review. *Aust Dent J*. 2018;63:455–466.

6. Gadipelly S, Neshangi S. Changing guidelines of cardiopulmonary resuscitation and basic life support for general dental practitioners and oral and maxillofacial surgeons. *J Maxillofac Oral Surg*. 2015;14:182–187. doi: 110.1007/s12663-12014-10649-12661

7. Siemens MJ, Rice AN, Jensen TF, Muckler VCS. Implementation of contextualized, emergency management cognitive aids in a periodontics clinic. *J Dent Anesth Pain Med*. 2021;21:227–236.

8. Saxena S, Krombach JW, Nahrwold DA, Pirracchio R. Anaesthesia-specific checklists: a systematic review of impact. *Anaesth Crit Care Pain Med*. 2020;39:65–73.

9. Baduni N, Prakash P, Srivastava D, Sanwal MK, Singh BP. Awareness of basic life support among dental practitioners. *Natl J Maxillofac Surg*. 2014;5:19–22. doi:10.4103/0975-5950.140159

10. Mohan M, Sharma S, Shetty T, Gupta P. Awareness of basic life support (BLS) among dental interns and dental practitioners. *J Health Allied Sci NU*. 2015;5:14–18.

11. Alkandari SA, Alyahya L, Abdulwahab M. Cardiopulmonary resuscitation knowledge and attitude among general dentists in Kuwait. *World J Emerg Med*. 2017;8:19–24.

12. Ekici Ö. Cardiopulmonary resuscitation knowledge and experience among dentists in Turkey. *Eurasian J Emerg Med*. 2020;19:226–231.

13. Schizogiannis V, Chalkias A, Kouskouni E, Iacovidou N, Xanthos T. Evaluation of resuscitation knowledge and skills in dentists before and after a European Resuscitation Council CPR/AED course. *J Resuscitatio Balkanica*. 2017;3:4–9.

14. Nogami K, Taniguchi S, Ichiyama T. Rapid deterioration of basic life support skills in dentists with basic life support healthcare providers. *Anesth Prog*. 2016;63:62–66. doi: 10.2344/0003-3006-2363.2342.2362

15. Cheng A, Magid DJ, Auerbach M, et al. Part 6: Resuscitation education science: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2020;142:S551–S579.

16. Japanese Circulation Society. Guidelines for cardiopulmonary resuscitation and cardiovascular emergency (JCS 2009). 2009. Accessed Apr. 26, 2022. https://www.j-circ.or.jp/cms/wp-content/uploads/2020/02/JCS2010kasanuki_h.pdf

17. Rea TD, Eisenberg MS, Sinibaldi G, White RD. Incidence of EMS-treated out-of-hospital cardiac arrest in the United States. *Resuscitation*. 2004;63:17–24.

18. SOS-KANTO Committee. Incidence of ventricular fibrillation in patients with out-of-hospital cardiac arrest in Japan: survey of survivors after out-of-hospital cardiac arrest in Kanto area (SOS-KANTO). *Circ J*. 2005;69:1157–1162.

19. Truhlář A, Deakin CD, Soar J, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances. *Resuscitation*. 2015;95:148–201.

20. Lim D, Lee SH, Kim DH, Kang C, Jeong JH, Lee SB. The effect of high-dose intramuscular epinephrine on the recovery of spontaneous circulation in an asphyxia-induced

cardiac arrest rat model. *BMC Cardiovasc Disord*. 2021;21: 113.

21. Soar J, Maconochie I, Wyckoff MH, et al. 2019 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations: summary from the basic life support; advanced life support; pediatric life support; neonatal life support; education, implementation, and teams; and first aid task forces. *Circulation*. 2019;140:e826–e880.

22. American Heart Association. Highlights of the 2020 American Heart Association guidelines for CPR and ECC. Accessed October 29, 2020. https://cpr.heart.org/-/media/cpr-files/cpr-guidelines-files/highlights/hghlghts_2020_ecc_guidelines_english.pdf