

Preparing for medical emergencies

The essential drugs and equipment for the dental office

Morton Rosenberg, DMD

Every dentist can expect to be involved in the diagnosis and treatment of medical emergencies during the course of clinical practice. These emergencies may be related directly to dental therapy, or they may occur by chance in the dental office environment. Although just about any medical emergency can occur during the course of dental treatment, best practice dictates that dental personnel must be prepared to provide effective basic life support (BLS) and seek emergency medical services in a timely manner.¹

Dentists also must be able to diagnose and treat common emergent problems (for example, syncope or hyperventilation syndrome), as well as respond effectively to certain less common, or even rare, but potentially life-threatening emergencies, especially those that may arise as a result of dental treatment (for example, anaphylactic reaction to an administered drug). Although many medical emergencies can be treated properly without drugs, every dental office must have a basic emergency kit that contains drugs and equipment appropriate to the training of the dentist, state requirements, the type of patients being treated (for example, geriatric, special-needs, pediatric or medically compromised patients), the procedures performed (for example, whether sedation or general anesthesia is induced) and the geographical location (for

ABSTRACT

Background. Acute medical emergencies can and do occur in the dental office. Preparing for them begins with a team approach by the dentist and staff members who have up-to-date certification in basic life support for health care providers. The ability to react immediately to the emergency at hand, including telephoning for help and having the equipment and drugs needed to respond to an emergency, can mean the difference between successful management and failure.

Overview. The purpose of this article is to provide a vision of the training, basic and critical drugs, and equipment necessary for staff members in general dental offices to manage the most common and anticipated medical emergencies.

Conclusions and Clinical Implications. Completion of annual continuing education courses and office medical emergency drills ensure a rapid response to emergency situations. It is the combination of a knowledgeable and skilled dental team with the equipment for basic airway rescue and oxygenation, monitoring equipment, an automated external defibrillator and a basic drug emergency kit that make the dental office a safer environment for patients and enhance dental professionals' capability to render competent and timely aid.

Key Words. Blood pressure; cardiac arrest; dental team; coronary heart disease; automated external defibrillator; dental office staff members; drug therapy; medical emergencies; epinephrine.

JADA 2010;141(5 suppl):14S-19S.

Dr. Rosenberg is a professor, Oral and Maxillofacial Surgery, and head, Division of Anesthesia and Pain Control, Tufts University School of Dental Medicine, and an associate professor of anesthesia, Tufts University School of Medicine, 1 Kneeland St., Boston, Mass. 02111. e-mail "Morton.rosenberg@tufts.edu". Address reprint requests to Dr. Rosenberg.

example, an urban setting in which emergency help is close at hand versus a rural location in which there may be a significant delay until help arrives). Many factors determine the degree of preparedness needed for medical emergencies in a specific dental practice, but all dental offices must be ready at some minimum level. An overall emergency preparedness plan that includes equipment and a drug kit is essential for all dental practices (Box 1²).

Continuing education courses incorporating task training and high-fidelity human simulators (that is, computer-controlled simulated patients) that emphasize crisis management for life-like practice in managing medical emergencies are gaining popularity among dentists and clinical staff members. No drug can take the place of properly trained health care professionals in diagnosing conditions and treating patients in emergency situations. Nevertheless, having an appropriate emergency drug kit and equipment often plays an integral role in the course and outcome of emergency treatment.^{3,7}

EQUIPMENT

Oxygen is of primary importance in any medical emergency and must be available in a portable E cylinder that can be transported easily to any office location in which an emergency may arise.

A dental office should be equipped with a device for the administration of supplemental oxygen to a spontaneously breathing patient—such as nasal cannulae, nonbreathing masks with an oxygen reservoir or a nitrous oxide-oxygen nasal hood.

Every office must have the ability to deliver oxygen under positive pressure for use in situations in which the patient is unconscious and not ventilating adequately. Although mouth-to-mask devices such as pocket masks are useful, the best and most efficient method of ventilating with high concentrations of inspired oxygen in apneic patients is with a bag-valve-mask device with an oxygen reservoir connected to an oxygen source or a manually triggered oxygen-powered device (Table 1).

Oropharyngeal airways come in several sizes

BOX 1

Emergency preparedness checklist.*

- All staff members have specific assigned duties.
- Contingency plans are in place in case a staff member is absent.
- All staff members have received appropriate training in the management of medical emergencies.
- All clinical staff members are trained in basic life support for health care providers.
- The dental office is equipped with emergency equipment and supplies that are appropriate for that practice.
- Unannounced emergency drills are conducted at least quarterly.
- Appropriate emergency telephone numbers are placed prominently near each telephone.
- Oxygen tanks and oxygen delivery systems are checked regularly. Other emergency respiratory support equipment is present, in good working order and located according to the emergency plan.
- All emergency medications are checked monthly and replacements are ordered for specific drugs before their expiration dates have passed.
- All emergency supplies are restocked immediately after use.
- One staff member is assigned the task of ensuring that the above procedures have been completed and to document this checklist review.

* Adapted from Fast and colleagues.²

TABLE 1

Inspired oxygen concentration with different delivery systems.

DELIVERY SYSTEM	INSPIRED OXYGEN CONCENTRATION (%)
Spontaneous Breathing	
Nasal cannula	25-45
Simple face mask	40-60
Nonbreathing mask with oxygen reservoir	90-100
Positive Pressure Ventilation	
Mouth-to-mouth	17
Mouth-to-mask (oxygen flow to mask, 10 liters/minute)	80
Bag-valve-mask device with room air	21
Bag-valve-mask device with supplemental oxygen reservoir	75-95
Manually triggered oxygen-powered breathing device	75-95

(7, 8 and 9 centimeters for adults) and are a useful adjunct in overcoming airway soft-tissue obstruction in an unconscious patient. Magill forceps can be lifesaving in retrieving foreign objects lost in the hypopharynx during dental therapy.

The immediate availability of an automated external defibrillator (AED) adhering to the American Heart Association's (AHA) 2005 guidelines⁸ is an evolving standard of care in all health care settings. The AHA has made early defibrillation an integral part of the BLS chain of survival

ABBREVIATION KEY. ACLS: Advanced cardiac life support. AED: Automated external defibrillator. AHA: American Heart Association. BLS: Basic life support. PALS: Pediatric advanced life support.

BOX 2**Suggested basic emergency equipment for the dental office.**

- Portable oxygen cylinder (E size) with regulator
- Supplemental oxygen delivery devices
 - Nasal cannula
 - Nonbreathing mask with oxygen reservoir
 - Nasal hood
- Bag-valve-mask device with oxygen reservoir
- Oropharyngeal airways (adult sizes 7, 8, 9 centimeters)
- Magill forceps
- Automated external defibrillator
- Stethoscope
- Sphygmomanometer with adult small, medium and large cuff sizes
- Wall clock with second hand

for the treatment of patients in cardiac arrest.⁹ Since January 1998, the AHA's BLS health care provider cardiopulmonary resuscitation courses have included a mandated module regarding AED use. Some states (Florida, Washington, Illinois) have mandated the presence of an AED in dental offices. The immediate availability of an AED has been demonstrated to increase the success of resuscitation.¹⁰ Early defibrillation with these easy-to-operate devices will convert two of the most common lethal cardiac dysrhythmias—ventricular fibrillation and ventricular tachycardia—into a normal sinus rhythm and restore perfusion to vital organs.

Monitoring equipment that provides basic information for primary assessment should include a stethoscope and a sphygmomanometer with adult small, medium and large cuff sizes. An automated vital signs monitor can provide physiological data, including systolic, diastolic and mean blood pressure, along with the patient's oxygen saturation level, heart rate and temperature. A wall clock with a second hand is invaluable in assisting with the determination of heart rate and in documenting contemporaneous events and interventions (Box 2).

EMERGENCY DRUG KITS

Practitioners can organize emergency kits themselves or purchase them. Many dentists are not comfortable choosing and purchasing individual drugs for their emergency kits, and a high-quality, commercially available emergency drug kit modified for dentistry can provide consistent drug availability (an automatic drug updating service often is included) in an organized fashion.¹¹ Emergency drugs generally are powerful, rapidly acting

compounds. The correct approach to using drugs in any medical emergency essentially should be supportive and conservative.

BASIC EMERGENCY DRUGS

All dentists must keep a fresh supply of critical drugs in the office for immediate administration (Table 2). Dentists must know reflexively when, how and in what doses to administer these specific agents for life-threatening situations. The drugs described should be included in a basic medical emergency kit for the general dental practice. They consist of agents that are noninjectable or can be administered via subcutaneous, intramuscular or sublingual routes, and, for dentists with advanced training, via intravenous or intraosseous routes.

Oxygen. Oxygen is of primary importance in any medical emergency in which hypoxemia might be present. These emergencies include, but are not limited to, acute disturbances involving the cardiovascular system, respiratory system and central nervous system. In the hypoxemic patient, breathing enriched oxygen elevates the arterial oxygen tension, which, in turn, improves oxygenation of peripheral tissues. Because of the steepness of the oxyhemoglobin dissociation curve, a modest increase in oxygen tension can significantly alter hemoglobin saturation in the hypoxemic patient. Hypoxemia leads to anaerobic metabolism and metabolic acidosis, which often diminish the efficacy of pharmacological interventions in emergencies.

Epinephrine. Epinephrine is the single most important injectable drug in the emergency kit. Epinephrine is an endogenous catecholamine with both α - and β -adrenergic receptor-stimulating activity. It is the drug of choice for treating cardiovascular and respiratory manifestations of acute allergic reactions. The beneficial pharmacological actions of epinephrine, when administered in resuscitative dosages, include bronchodilation and increased systemic vascular resistance, arterial blood pressure, heart rate, myocardial contractility, and myocardial and cerebral blood flow.¹²

For effective treatment of life-threatening signs and symptoms of an acute allergic reaction, the clinician must administer epinephrine immediately after recognizing the condition. He or she can inject the drug subcutaneously (0.3 to 0.5 milligram of a 1:1,000 solution) or intramuscularly for a more serious emergency (0.4 to 0.6 mg of the

TABLE 2

Suggested basic emergency drugs for the general dental office.			
INDICATION	DRUG	ACTION	ADMINISTRATION
Bronchospasm (Severe Allergic Reaction)	Epinephrine	α - and β -adrenergic receptor agonist	Autoinjectors or preloaded syringes, ampules; 1:1,000 solution subcutaneously, intramuscularly or sublingually; adults, 0.3 milligram; children, 0.15 mg
Mild Allergic Reaction	Diphenhydramine	Histamine blocker	50 mg intramuscularly; 25 to 50 mg orally every three to four hours
Angina	Nitroglycerin	Vasodilator	Sublingual tablet: one every five minutes up to three doses; translingual spray: one spray every five minutes up to three times
Bronchospasm (Mild Asthma)	Bronchodilator such as albuterol	Selective β_2 -adrenergic receptor agonist	Two or three inhalations every one to two minutes, up to three times if needed
Bronchospasm (Severe Asthma)	Epinephrine	α - and β -adrenergic receptor agonist (bronchodilator)	Autoinjectors or preloaded syringes, ampules; 1:1,000 solution subcutaneously, intramuscularly or sublingually; adults, 0.3 mg; children, 0.15 mg
Hypoglycemia	Glucose, as in orange juice	Antihypoglycemic	If the patient is conscious, ingest
Myocardial infarction	Aspirin	Antiplatelet	One full-strength tablet (165-325 mg) chewed and swallowed
Syncope	Aromatic ammonia	Respiratory stimulant	Inhalant crushed and held four to six inches under nose

same solution). Epinephrine should be available in preloaded syringes or autoinjectors for immediate use, as well as in ampules.¹³ Because of its profound bronchodilating effects, epinephrine also is indicated for the treatment of acute asthmatic attacks that are unrelieved by sprays or aerosols of β_2 -adrenergic receptor agonists.¹⁴

Diphenhydramine. Histamine blockers reverse the actions of histamine by occupying H_1 receptor sites on the effector cell and are effective in patients with mild or delayed-onset allergic reactions.

Nitroglycerin. Although nitroglycerin is available in many preparations—long-acting oral and transmucosal preparations, transcutaneous patches and intravenous solutions—the appropriate forms for the dental office are the sublingual tablet or translingual spray. Nitroglycerin is the treatment of choice for an episode of acute chest pain in a patient with a history of angina pectoris. It acts primarily by relaxing vascular smooth muscle, dilating systemic venous and arterial vascular beds, and leading to a reduction in venous return and systemic vascular resistance. These actions combine to reduce myocardial oxygen consumption.

If the patient does not bring his or her own nitroglycerin to the dental office, the clinician should administer one tablet or metered spray (0.4 mg). This dosage may be repeated twice at five-minute intervals for a total of three doses. Relief should occur within one to two minutes; if

the discomfort is not relieved, the dentist must consider a diagnosis of evolving myocardial infarction. If the patient has never received a diagnosis of angina pectoris and develops symptoms of a possible acute myocardial infarction, such as chest pain or chest pressure, the clinician should consider administering 0.4 mg of sublingual nitroglycerin if the patient's systolic blood pressure is acceptable (> 90 to 100 millimeters of mercury) after first calling 9-1-1 and administering aspirin.

Contraindications to the administration of nitroglycerin are chest pain and hypotension or treatment with drugs prescribed for erectile dysfunction, such as sildenafil (Viagra, Pfizer, New York City), tadalafil (Cialis, Lilly USA, Indianapolis) or vardenafil (Levitra, Bayer HealthCare, Leverkusen, Germany). The combination of nitroglycerin and these compounds may lead to profound hypotension and unconsciousness.

Bronchodilator. Inhalation of a β_2 -adrenergic receptor agonist such as metaproterenol or albuterol is used to treat acute bronchospasm that may be experienced during an asthmatic attack or anaphylaxis. This results in bronchial smooth muscle relaxation and the inhibition of chemical mediators released during hypersensitivity reactions. Albuterol is an excellent choice because it is associated with fewer cardiovascular adverse effects than are other bronchodilators.

Glucose. Clinicians use glucose preparations

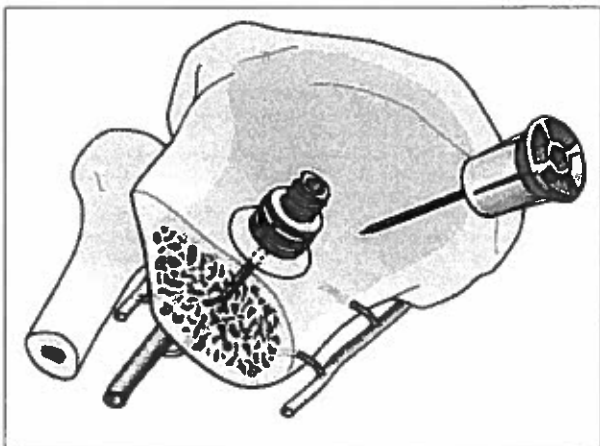


Figure. Intraosseous injection. Reproduced with permission of Vidacare, San Antonio.

to treat hypoglycemia resulting from fasting or an imbalance between insulin and carbohydrate in a patient with diabetes mellitus or in nondiabetic patients with hypoglycemia. If the patient is conscious, oral carbohydrates such as orange juice, a chocolate bar, cake icing or a cola drink act rapidly to restore circulating blood sugar. On the other hand, if the patient is unconscious and the dentist suspects acute hypoglycemia, he or she never should administer oral drugs because of the potential for airway obstruction and/or aspiration. There is no place for insulin in the vast majority of dental offices.

Aspirin. The antiplatelet properties of aspirin decrease myocardial mortality dramatically by preventing further clot formation when administered to patients during an evolving myocardial infarction.¹⁵ There is no substitute for aspirin for this indication, and contraindications to its use include allergy to aspirin and severe bleeding disorders. Patients who exhibit chest pain suggestive of ischemia and an evolving myocardial infarction should chew the aspirin and then swallow it.

Aromatic ammonia. Aromatic ammonia is a commonly used respiratory stimulant in dentistry. It is a general arousal agent that clinicians administer to patients experiencing vasodepressor syncope after ascertaining the patency of the patient's airway, repositioning him or her and administering oxygen.

SUPPLEMENTAL INJECTABLE DRUGS AND EQUIPMENT

Dentists with advanced training may consider including drugs and equipment in addition to

those described earlier. These might include the following injectable drugs:

- analgesics;
- anticholinergics;
- anticonvulsants;
- antihypertensives;
- antihypoglycemics;
- corticosteroids;
- vasopressors.

ADJUNCTIVE GENERAL ANESTHESIA DRUGS AND EQUIPMENT

Educationally qualified dentists¹⁶ who use deep sedation and general anesthesia must have additional emergency drugs immediately available (for example, if they use depolarizing neuromuscular blocking agents, they must have dantrolene sodium, as well as other drugs specific to these practices, such as those for advanced cardiac life support [ACLS]), and additional equipment, such as advanced monitoring systems and airway rescue equipment.

REVERSAL DRUGS

If dentists administer opioids or benzodiazepines to induce moderate or deep sedation, general anesthesia or both, they must include antidotal drugs in the emergency kit. Naloxone is a specific opioid antagonist that reverses opioid-induced respiratory depression.¹⁷ Flumazenil is a specific benzodiazepine antagonist that reverses sedation and respiratory depression resulting from benzodiazepine administration.¹⁸

INJECTABLE DRUG ACCESS

The injection of many emergency drugs into the vascular system is crucial to speed drug action. The intravenous route is rapid but requires skill in venipuncture. The intramuscular route, either into the vastus lateralis or mid-deltoid regions, results in slower uptake but perhaps easier access for many dentists, as does the sublingual approach. Establishing intravenous access may be difficult or impossible during medical emergencies. As advocated in the AHA's ACLS/PALS guidelines, intraosseous access often can save a significant amount of time, which can benefit patients in medical emergencies by decreasing the time needed to achieve access and administer medications and other fluids, especially in pediatric patients.^{19, 21} Establishing intraosseous access requires specialized equipment and training (Figure). All of these routes of adminis-

tration require adequate circulation for the drugs to be effective.

ADVANCED CARDIAC LIFE SUPPORT

ACLS for adults and pediatric advanced life support (PALS) for children are the standards of care for comprehensive resuscitation by health care providers with advanced skills and training. Pharmacotherapy plays an important role in the treatment of these patients, with guidelines for specific drug therapies centering on the use of many antidysrhythmic and vasoactive drugs.^{8,19}

ADVANCED AIRWAY DEVICES

Dentists with advanced training may wish to include advanced airway devices in their emergency kits. The indications for, the technique in using, and ensuring correct placement of these devices require training and clinical experience. Endotracheal intubation is accomplished with the use of a laryngoscope and an endotracheal tube. Gaining in popularity in airway rescue are supraglottic devices such as the laryngeal mask airway.²²

CONCLUSION

Urgent and emergent medical emergencies can and do occur in the dental office. Early diagnosis, telephone calls for help and proper management will increase the likelihood of a successful response. Accomplishing this depends on the combination of training and preparation by the dentist and staff members and the immediate availability of basic and critical emergency drugs and equipment. ■

Disclosure. Dr. Rosenberg did not report any disclosures.

1. American Heart Association. BLS for Healthcare Providers: Student Manual. Dallas: American Heart Association; 2006.
2. Fast TB, Martin MD, Ellis TM. Emergency preparedness: a survey of dental practitioners. *JADA* 1986;112(4):499-501.
3. Boyd BC, Hall RE. Drugs for medical emergencies in the dental office. In: Ciancio SG, ed. *The ADA/PDR Guide to Dental Therapeutics*. 5th ed. Montvale, N.J.: PDR Network; 2009:363-385.

4. Malamed SF. *Medical Emergencies in the Dental Office*. 6th ed. St. Louis: Mosby; 2007:51-92.
5. Haas DA. Emergency drugs. *Dent Clin North Am* 2002;46(4):815-830.
6. Rosenberg MB. Drugs for medical emergencies. In: Yagiela JA, Dowd FJ, Neidle EA, eds. *Pharmacology and Therapeutics for Dentistry*. 5th ed. St. Louis: Mosby; 2004:857-864.
7. Saef SN, Bennett JD. Basic principles and resuscitation. In: Bennett JD, Rosenberg MB, eds. *Medical Emergencies in Dentistry*. Philadelphia: Saunders; 2002:3-60.
8. ECC Committee, Subcommittees and Task Forces of the American Heart Association. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2005;112(24 suppl):IV1-203.
9. Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the "chain of survival" concept—a statement for health professionals from the Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee, American Heart Association. *Circulation* 1991;83(5):1832-1847.
10. White RD, Russell JK. Refibrillation, resuscitation and survival in out-of-hospital sudden cardiac arrest victims treated with biphasic automated external defibrillators. *Resuscitation* 2002;55(1):17-23.
11. ADA Council on Scientific Affairs. Office emergencies and emergency kits. *JADA* 2002;133(3):364-365.
12. Joint Task Force on Practice Parameters; American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; Joint Council of Allergy, Asthma and Immunology. The diagnosis and management of anaphylaxis: an updated practice parameter (published correction appears in *J Allergy Clin Immunol* 2008;122[1]:68). *J Allergy Clin Immunol* 2005;115(3 suppl 2):S483-S523.
13. Brown AF. Anaphylaxis gets the adrenaline going. *Emerg Med J* 2004;21(2):128-129.
14. McFadden ER Jr. Acute severe asthma. *Am J Respir Crit Care Med* 2003;168(7):740-759.
15. Henneke CH. Update on aspirin in the treatment and prevention of cardiovascular disease. *Am Heart J* 1999;137(4, part 2):S9-S13.
16. American Dental Association. ADA positions and statements. The use of sedation and general anesthesia by dentists. 2007. "www.ada.org/prof/resources/positions/statements/uaeof.asp". Accessed March 17, 2010.
17. Longnecker DE, Grazis PA, Eggers GW Jr. Naloxone for antagonism of morphine-induced respiratory depression. *Anesth Analg* 1973;52(3):447-453.
18. Klotz U, Kunto J. Pharmacokinetics and clinical use of flumazenil (Ro 15-1788). *Clin Pharmacokinet* 1988;14(1):1-12.
19. International Liaison Committee on Resuscitation. The International Liaison Committee on Resuscitation (ILCOR) consensus on science with treatment recommendations for pediatric and neonatal patients: pediatric basic and advanced life support. *Pediatrics* 2006;117(5):e955-e977.
20. Fowler R, Gallagher JV, Isaacs SM, Ossman E, Pepe P, Wayne M. The role of intraosseous vascular access in the out-of-hospital environment (resource document to NAEMSP position statement). *Prehosp Emerg Care* 2007;11(1):63-66.
21. Part 7.2. Management of cardiac arrest. *Circulation* 2005;112:IV-58-IV-66. "http://circ.ahajournals.org/cgi/reprint/112/24_suppl/IV-58.pdf". Accessed March 9, 2010.
22. Samarkandi AH, Seraj MA, el Dawlatly A, Mastan M, Bakhamees HB. The role of laryngeal mask airway in cardiopulmonary resuscitation. *Resuscitation* 1994;28(2):103-106.