

# Management of Medical Emergencies in the Dental Office: Conditions in Each Country, the Extent of Treatment by the Dentist

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**D**entists must be prepared to manage medical emergencies which may arise in practice. In Japan, a study was conducted between 1980 and 1984 by the Committee for the Prevention of Systematic Complications During Dental Treatment of the Japan Dental Society of Anesthesiology, under the auspices of the Japanese Dental Society.<sup>1</sup> The results from this study showed that anywhere from 19% to 44% of dentists had a patient with a medical emergency in any one year. Most of these complications, approximately 90%, were mild, but 8% were considered to be serious. It was found that 35% of the patients were known to have some underlying disease. Cardiovascular disease was found in 33% of those patients.

Medical emergencies were most likely to occur during and after local anesthesia, primarily during tooth extraction and endodontics. Over 60% of the emergencies were syncope, with hyperventilation the next most frequent at 7%.

In the United States and Canada, studies have also shown that syncope is the most common medical emergency seen by dentists.<sup>2,3</sup> Syncope represented approximately 50% of all emergencies reported in one particular study, with the next most common event, mild allergy, represented only 8% of all emergencies. In addition to syncope, other emergencies reported to have occurred include allergic reactions, angina pectoris/myocardial infarction, cardiac arrest, postural hypotension, seizures, bronchospasm and diabetic emergencies.

The extent of treatment by the dentist requires preparation, prevention and then management, as necessary. Prevention is accomplished by conducting a thorough medical history with appropriate alterations to dental treatment as required. The most important as-

pect of nearly all medical emergencies in the dental office is to prevent, or correct, insufficient oxygenation of the brain and heart. Therefore, the management of all medical emergencies should include ensuring that oxygenated blood is being delivered to these critical organs. This is consistent with basic cardiopulmonary resuscitation, with which the dentist must be competent. This provides the skills to manage most medical emergencies, which begin with the assessment, and if necessary the treatment of airway, breathing and circulation (the ABCs of CPR). Usually, only after these ABCs are addressed should the dentist consider the use of emergency drugs.

Drugs that should be promptly available to the dentist can be divided into two categories.<sup>4</sup> The first category represents those which may be considered essential. These drugs are summarized in Table 1. The second category contains drugs which are also very helpful and should be considered as part of the emergency kit. These supplementary drugs are summarized in Table 2. The precise composition of the drug kit can vary as the presence of the drugs in this latter group may depend on the nature of the dental practice.

Those with training in Advanced Cardiac Life Support would also have additional drugs. Dentists who are trained to administer general anesthesia or intravenous sedation would be expected to have additional drugs. These dentists should have a patent intravenous line in place and therefore drug administration could use this route, which may be considered ideal. It may be assumed that dentists without advanced training in anesthesia or sedation may not be proficient in venipuncture. In this case the intramuscular route of administration, which can include the intralingual injection, would be appropriate. The intralingual intramuscular injection should provide a more rapid onset of action compared with the more traditional sites, although not as rapid as intravenous. This manuscript will assume that the intramuscular route will be the one most likely to be used.

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**Table 1.** Essential Emergency Drugs

<i>Drug</i>	<i>Indication</i>	<i>Initial Adult Dose</i>
1. Oxygen	almost any medical emergency	100%: inhalation
2. Epinephrine	anaphylaxis	0.1 mg i.v., or 0.3–0.5 mg i.m.
	asthma unresponsive to albuterol/salbutamol	0.1 mg i.v., or 0.3–0.5 mg i.m.
	cardiac arrest	1 mg i.v.
3. Nitroglycerin	pain of angina	0.3–0.4 mg sublingual
4. Antihistamine (diphenhydramine or chlorpheniramine)	allergic reactions	25–50 mg i.v., i.m. 10–20 mg i.v., i.m.
5. Albuterol/salbutamol	asthmatic bronchospasm	2 sprays: inhalation
6. Aspirin	myocardial infarction	160–325 mg

## I. ESSENTIAL EMERGENCY DRUGS

The following will summarize the drugs which should be part of a dentist's emergency kit.<sup>4</sup> There are 6 drugs which should be considered essential for all dentists.

### 1. Oxygen

Oxygen is indicated for every emergency except hyperventilation. This should be done with a clear full face mask for the spontaneously breathing patient and a bag-valve-mask device for the apneic patient. Therefore whenever possible, with the exception of the patient who is hyperventilating, oxygen should be administered. For the management of a medical emergency it should not be withheld for the patient with chronic obstructive lung disease, even though they may be dependent on low oxygen levels to breathe if they are chronic carbon dioxide retainers. Short term administration of oxygen to get them through the emergency should not depress their drive to breathe.

Oxygen should be available in a portable source, ideally in an "E"-size cylinder which holds over 600 liters. This should allow for more than enough oxygen to be available for the patient until resolution of the event or

transfer to a hospital. If the typical adult has a minute volume of 6 liters per minute, then this flow rate should be given as a minimum. If the patient is conscious, or unconscious yet spontaneously breathing, oxygen should be delivered by a full face mask, where a flow rate of 6 to 10 liters per minute is appropriate for most adults. If the patient is unconscious and apneic, it should be delivered by a bag-valve-mask device where a flow rate of 10 to 15 liters per minute is appropriate. A positive pressure device may be used in adults, provided that the flow rate does not exceed 35 liters per minute.

### 2. Epinephrine

Epinephrine is the drug of choice for the emergency treatment of anaphylaxis and asthma which does not respond to its drug of first choice, albuterol or salbutamol. Epinephrine is also indicated for the management of cardiac arrest, but in the dental office setting, it may not be as likely to be given, since intravenous access may not be available. Its administration intramuscularly is not as likely to be very effective in this latter emergency, where adequate oxygenation and early defibrillation is most important for the cardiac arrest dysrhyth-

**Table 2.** Additional Emergency Drugs

<i>Drug</i>	<i>Indication</i>	<i>Initial Adult Dose</i>
1. Glucagon	hypoglycemia in unconscious patient	1 mg i.m.
2. Atropine	clinically significant bradycardia	0.5 mg i.v. or i.m.
3. Ephedrine	clinically significant hypotension	5 mg i.v., or 10–25 mg i.m.
4. Hydrocortisone	adrenal insufficiency	100 mg i.v. or i.m.
	recurrent anaphylaxis	100 mg i.v. or i.m.
5. Morphine or nitrous oxide	angina-like pain unresponsive to nitroglycerin	titrate 2 mg i.v., 5 mg i.m.
	angina-like pain unresponsive to nitroglycerin	~35%, inhalation
6. Naloxone	reversal of opioid overdose	0.1 mg i.v.
7. Lorazepam or Midazolam	status epilepticus	4 mg i.m. or i.v.
	status epilepticus	5 mg i.m. or i.v.
8. Flumazenil	benzodiazepine overdose	0.1 mg i.v.

The final composition of the supplementary emergency drugs will depend on the individual dentist's needs and the nature of the practice. The drugs listed above should be considered. Dental offices that provide conscious sedation, deep sedation and/or general anesthesia require additional drugs.

mias with the relatively best prognoses, namely ventricular fibrillation or pulseless ventricular tachycardia.

As a drug, epinephrine has a very rapid onset and short duration of action, usually 5 to 10 minutes when given intravenously. For emergency purposes, epinephrine is available in two formulations. It is prepared as 1 : 1,000, which equals 1 mg per ml, for intramuscular, including intralingual, injections. More than one ampule or pre-filled syringe should be present as multiple administrations may be necessary. It is also available as 1 : 10,000, which equals 1 mg per 10 mL for intravenous injection. Autoinjector systems are also present for intramuscular use (such as the EpiPen) which provides one dose of 0.3 mg as 0.3 mL of 1 : 1,000, or the pediatric formulation which is 1 dose of 0.15 mg as 0.3 mL of 1 : 2,000.

Initial doses for the management of anaphylaxis are 0.3 to 0.5 mg intramuscularly or 0.1 mg intravenously. These doses should be repeated as necessary until resolution of the event. Similar doses should be considered in asthmatic bronchospasm which is unresponsive to a beta-2 agonist, such as albuterol or salbutamol. The dose in cardiac arrest is 1 mg intravenously. Intramuscular administration during cardiac arrest has not been studied, but would appear to be unlikely to render significant effect.

Epinephrine is clearly a highly beneficial drug in these emergencies. Concurrently, however, it can be a drug with a high risk if given to a patient with ischemic heart disease. Nevertheless, it is the primary drug needed to reverse the life-threatening signs and symptoms of anaphylaxis or persistent asthmatic bronchospasm.

### 3. Nitroglycerin

This drug is indicated for acute angina or myocardial infarction. It is characterized by a rapid onset of action. For emergency purposes it is available as sublingual tablets or a sublingual spray. One important point to be aware of is that the tablets have a short shelf-life of approximately 3 months once the bottle has been opened and the tablets exposed to air or light. The spray has the advantage of having a shelf-life which corresponds to that listed on the bottle. Therefore, if a patient uses his/her own nitroglycerin, there is a possibility of the drug being inactive. This supports the need for the dentist to always having a fresh supply available. With signs of angina pectoris, one tablet or spray (0.3 or 0.4 mg) should be administered sublingually. Relief of pain should occur within minutes. If necessary, this dose can be repeated twice more in 5-minute intervals. Systolic blood pressures below 90 mmHg contraindicate the use of this drug.

### 4. Injectable Antihistamine

An antihistamine is indicated for the management of allergic reactions. Whereas mild non-life threatening allergic reactions may be managed by oral administration, life-threatening reactions necessitate parenteral administration.

Two injectable agents may be considered, either diphenhydramine or chlorpheniramine. They may be administered as part of the management of anaphylaxis or as the sole management of less severe allergic reactions, particularly those with primarily dermatologic signs and symptoms such as urticaria. Recommended doses for adults are 25 to 50 mg of diphenhydramine or 10 to 20 mg of chlorpheniramine.

### 5. Albuterol (Salbutamol)

A selective beta-2 agonist such as albuterol (salbutamol) is the first choice for management of bronchospasm. When administered by means of an inhaler, it provides selective bronchodilation with minimal systemic cardiovascular effects. It has a peak effect in 30 to 60 minutes, with a duration of effect of 4 to 6 hours. Adult dose is 2 sprays, to be repeated as necessary. Pediatric dose is 1 spray, repeated as necessary.

### 6. Aspirin

Aspirin (acetylsalicylic acid) is one of the more newly recognized life-saving drugs, as it has been shown to reduce overall mortality from acute myocardial infarction.

The purpose of its administration during an acute myocardial infarction is to prevent the progression from cardiac ischemia to injury to infarction. There is a brief period of time early on during a myocardial infarction where aspirin can show this benefit. For emergency use there are relatively few contraindications. These would include known hypersensitivity to aspirin, severe asthma or history of significant gastric bleeding. The lowest effective dose is not known with certainty, but a minimum of 162 mg should be given immediately to any patient with pain suggestive of acute myocardial infarction.

### 7. Oral Carbohydrate

An oral carbohydrate source, such as fruit juice or non-diet soft-drink, should be readily available. Whereas this is not a drug, and perhaps should not be included in this list, it should be considered essential. If this sugar source is kept in a refrigerator it may not be appreciated that it is a key part of the emergency equipment. Therefore, consideration should be given to making this part of the

emergency kit. Its use is indicated in the management of hypoglycemia in conscious patients.

## II. ADDITIONAL DRUGS

In addition to the 6 drugs discussed above, a number of other drugs should be considered as part of an emergency kit, as shown in Table 2.<sup>4</sup>

### 1. Glucagon

The presence of this drug allows intramuscular management of hypoglycemia in an unconscious patient. The ideal management of severe hypoglycemia in a diabetic emergency is the intravenous administration of 50% dextrose. Glucagon is indicated if an intravenous line is not in place and venipuncture is not expected to be accomplished, as may often be the case in a dental office. The dose for an adult is 1 mg. If the patient is less than 20 kg, the recommended dose is 0.5 mg. Glucagon is available as 1 mg formulation, which requires reconstitution with its diluent immediately prior to use.

### 2. Atropine

This anti-muscarinic, anti-cholinergic drug is indicated for the management of hypotension, which is accompanied by bradycardia. The dose recommended is 0.5 mg initially, followed by increments as necessary until one reaches a maximum of 3 mg. Paradoxically, doses of less than 0.4 mg have been associated with induction of a bradycardia, likely due to atropine's central nervous system's actions.

### 3. Ephedrine

This drug is a vasoconstrictor which may be used to manage significant hypotension. It has similar cardiovascular actions compared with epinephrine, except that ephedrine is less potent and has a prolonged duration of action, lasting from 60 to 90 minutes. Similar precautions as noted with epinephrine administration should be considered when given to a patient with ischemic heart disease. For the treatment of severe hypotension, it is ideally administered in 5 mg increments intravenously. Intramuscularly it should be given in a dose of 10 to 25 mg.

### 4. Corticosteroid

Administration of a corticosteroid such as hydrocortisone may be indicated for the prevention of recurrent anaphylaxis. Hydrocortisone may also play a role in the

management of an adrenal crisis. The notable drawback in their use in emergencies is their relatively slow onset of action, which approaches one hour even when administered intravenously. This is the reason why these drugs are not considered essential, as they are of minimal benefit in the acute phase of the emergency. There is low likelihood of an adverse response with one dose. The prototype for this group is hydrocortisone, which may be administered in a dose of 100 mg as part of the management of these emergencies.

### 5. Morphine

Morphine is indicated for the management of severe pain which occurs with a myocardial infarction. Advanced Cardiac Life support recommendations list morphine as the analgesic of choice for this purpose.<sup>5</sup> The dose involves titration in one to three mg increments intravenously until pain relief is accomplished. This should be guided by a decrease in blood pressure and respiratory depression. Extreme caution should be used in the elderly. If an intravenous is not in place, consideration can be given to administering morphine in a dose of approximately 5 mg intramuscularly. Again, lower doses need to be considered for the older patient.

### 6. Naloxone

If either morphine is included in the emergency kit, or opioids are used as part of a sedation regimen, then naloxone should also be present for the emergency management of inadvertent overdose. Doses should ideally be titrated slowly in 0.1 mg increments to effect.

### 7. Nitrous Oxide

Nitrous oxide is a reasonable second choice if morphine is not available to manage pain from a myocardial infarction. For management of pain associated with a myocardial infarction, it should be administered with oxygen, in a concentration approximating 35%, or titrated to effect.

### 8. Injectable Benzodiazepine

The management of seizures which are prolonged or recurrent, also known as status epilepticus, may require administration of a benzodiazepine. In most dental practices, it would not be realistic to assume that the dentist could achieve venipuncture in a patient having an active seizure. This leads to the need for a water-soluble agent such as midazolam or lorazepam. Lorazepam has been reported as the drug of choice for status epilepticus and can be administered intramuscularly. Midazolam, how-

ever, is another alternative which is water soluble and could be considered. Sedation would be an expected side effect and patients should be appropriately monitored. Adult doses to consider for lorazepam are 4 mg intramuscularly, or midazolam 5 mg intramuscularly. If an intravenous is in place, these drugs should be slowly titrated to effect.

### 9. Flumazenil

The benzodiazepine antagonist flumazenil should be part of the emergency kit when oral or parenteral sedation is used, as these techniques are usually based on effective use of benzodiazepines. Dosage is 0.1 to 0.2 mg intravenously, incrementally.

In addition to having drugs available, a small amount of basic equipment should be readily available. This includes a stethoscope, blood pressure cuff, an oxygen delivery system, syringes and needles. Dentists should also consider having an automated external defibrillator (AED), as a means to treat cardiac arrest. Usage of this latter piece of equipment is easily learned and only requires strong knowledge of basic CPR with a small amount of additional training.

In summary, medical emergencies do occur in dental offices with similar frequencies in both Japan and North America. Dentists must be prepared to manage these patients until they recover or help arrives.

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### REFERENCES

1. Matsuura H. Analysis of systemic complications and deaths during dental treatment in Japan. *Anesth Prog*. 1989; 36:223–225.
2. Fast TB, Martin MD, Ellis TM. Emergency preparedness: a survey of dental practitioners. *J Am Dent Assoc*. 1986;112: 499–501.
3. Malamed SF. *Medical Emergencies in the Dental Office*. 5th ed. St Louis: Mosby; 2000:58–91.
4. Haas DA: Emergency drugs. *Dent Clin North America*. 2002;46:815–830.
5. American Heart Association, Cummins RO, ed. *Advanced Cardiac Life Support Provider Manual*. 2001.