Medical Emergencies in the Dental Setting

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Faculty Disclosure

Contributing faculty, Mark J. Szarejko, DDS, FAGD, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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Director Disclosure

The director has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for all members of the dental profession, including dentists, dental hygienists, and dental assistants.

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Course Objective

Patients, those who accompany them, or members of the dental staff can be stricken suddenly and without warning by any of a variety of medical emergency issues. The purpose of this course is to provide all members of the dental staff with the training necessary to provide immediate assistance to a patient that experiences any problem that constitutes a medical emergency.

Learning Objectives

Upon completion of this course, you should be able to:

1. Outline the importance of the medical history as a means to decrease the occurrence of medical emergencies.
2. Review the most common medical emergencies in the dental setting and how to identify patients who may be at risk.
3. Identify causes of allergic reactions during dental treatment and describe acute care interventions.
4. Discuss methods to prevent aspiration and the protocol to treat patients who have aspirated an object.
5. Outline the role and responsibilities of the dental staff during a medical emergency.

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

Dental treatment is usually not associated with the development of acute medical emergencies. However, exacerbations of medical conditions or the emergence of previously asymptomatic medical problems, inadequate pain control, and stress and anxiety associated with dental treatment can occur at any time [1]. Studies have found that acute medical emergencies occur in less than 0.5% of dental treatments but account for approximately 3% of all dental malpractice litigation [29; 47]. While medical emergencies cannot be prevented completely, a staff that can render appropriate assistance to a stricken patient can increase the chances for the patient's survival.

A comprehensive review of the patient's medical history that includes any current medications and any problems or issues that a patient has had with past dental treatment is an essential component of determining a patient's ability to withstand dental treatment. Incorporation of these findings before dental treatment may not eliminate the risk of a medical emergency developing during dental treatment, but it can minimize its occurrence.

This course will highlight the most frequently occurring medical emergencies that develop during the course of dental treatment and give an overview of management and prevention. Dental professionals should consult their individual state laws regarding the level of training required of dental staff, the type of emergency medications that must be available, and the necessity of certain resuscitation equipment. This is especially true when varying levels of sedation are used. When a practice is prepared to immediately respond to a patient that has been stricken with an acute medical problem, a life can be saved.

PATIENT ASSESSMENT AND MEDICAL HISTORY

Dental treatment cannot begin unless a current and accurate medical history is obtained from the patient. Dental professionals should involve the patient in an active discussion as to any active health issue(s) and medications being taken. All medications, whether prescribed or over-the-counter, must be disclosed. In addition, herbal and dietary supplements should be disclosed in order to reduce the risk of herb-drug interactions. Ample time should be allowed for this exchange of information between the dentist and patient. A medical history form may be used and should feature a comprehensive analysis of the myriad of medical conditions that can afflict a patient. The review of the medical history before dental treatment is not a task that the dentist should delegate to a staff member. Once completed, this form should be signed by the dentist and patient. For patients who have not attained the age of majority (usually 18 years of age) or who have a cognitive disability that precludes them from giving consent, a parent or legal guardian should sign the form. This document should be updated each time a patient returns for any dental treatment. Some patients may consider the disclosure of this information an invasion of privacy and/or refuse to complete certain sections. If a patient remains adamant and refuses to provide medical information even when its necessity for dental treatment is made known, the patient should not be treated.

According to the 2018 National Health Interview Survey (NHIS), 27.2% of adults 18 years of age and older have multiple chronic conditions [2]. The rate increases with age. Chronic illness affects an estimated 80% of people 65 years of age or older; 68% of individuals in this age group have two or more chronic illnesses [3]. A 2017 white paper published by the American Association of Dental Boards noted that "medical emergencies during dental treatment are increasing in frequency, intensity, and diversity" due to increases in the older population, medically

complex patients, invasive dental treatment, and in-office sedation [46]. Consultation with the patient's physician should be sought when one or more chronic illnesses may compromise the patient's ability to withstand dental treatment, especially dental surgery or invasive procedures. The dentist should also determine if the patient is compliant with any prescribed medication regimen(s). Non-compliance with prescription medications can increase the morbidity associated with systemic disease(s) and increase the potential for an exacerbation of the condition as a medical emergency during dental treatment.

The age of the patient is a consideration in dental treatment, especially when local anesthetics, sedatives, analgesics, and antibiotics are used in any combination. Children and adolescents usually require smaller doses of these medications as compared to adults, and the elderly may also require lower doses due to an increased sensitivity and lower body weight. Diseases that affect renal and/or hepatic metabolism can result in a toxic accumulation of any of these medications and require an adjustment of medication dosages and frequency. Caution should be taken to avoid using or prescribing medications in dental treatment that could adversely interact with those prescribed for chronic illnesses. If there is any doubt about a patient's ability to tolerate a medication used for dental treatment, the patient's physician should be consulted. Effects of medications used to treat varying medical conditions that can manifest as a medical emergency during dental treatment will be discussed in detail later in this course, as will potential interactions and adverse events. The dentist should consider these potential issues before any medication is used in any capacity for dental treatment.

COMMON MEDICAL EMERGENCIES IN THE DENTAL SETTING

SYNCOPE (FAINTING)

The most common emergency seen in the dental setting is vasovagal syncope [7]. This condition features a sudden and temporary loss of consciousness and can affect approximately 3% of men and 3.5% of women at some time in their lives [4]. There is a 6% incidence of syncope in patients who are older than 75 years of age [4]. Patients who have fainted maintain their pulse and their ability to breathe. However, because the nature of the loss of consciousness cannot be determined by visual means, the basics of airway patency, breathing, and circulation must be assessed to distinguish between syncope and a life-threatening condition such as a myocardial infarction.

The recovery from an episode of syncope is usually rapid, but the etiologies of this disorder can vary. Vasovagal syncope (or cardioneurogenic syncope) occurs when an acute decrease in blood pressure reduces the blood flow and subsequent oxygen perfusion to the brain. One source of this type of syncope is a condition called orthostatic hypotension. In patients with orthostatic hypotension, blood vessels in the legs do not constrict normally in the standing position, which results in pooling of blood in the legs and decreased blood flow to the brain. In a similar fashion, postural syncope (also referred to as postural hypotension) may occur when there is an abrupt change in a patient's position. This can occur after dental treatment when a patient has been in a supine position for an extended interval and abruptly changes to a standing position without allowing enough time for the cardiac output and blood pressure to properly equilibrate. Situational syncope is physiologically a variant of vasovagal syncope caused by the anxiety and stress that some patients experience during dental treatment.

Although patients recover quickly from an episode of syncope, all patients who faint in a dental office should be referred to their physician to determine the underlying cause and the appropriate treatment. Patients may emerge from syncope in a state of confusion and may experience emotional distress. Dental treatment should be terminated and not resumed until the cause of their syncope is determined and treated. Patients who have experienced previous episodes of syncope can usually determine the symptoms that occur just prior to their actual loss of consciousness. These may include sudden-onset dizziness, lightheadedness, weakness in the legs, and loss of peripheral vision ("tunnel vision"), among many others. If a patient can communicate these signs, the staff may be able to assist the patient to prevent a fall from a standing position and potential bodily injury.

After it is determined that the patient has maintained respiration and cardiac output and that cardiopulmonary resuscitation (CPR) is not necessary, the use of aromatic ammonia to facilitate the return to consciousness can be used. After regaining consciousness, the patient may be too distraught to drive, and arrangements should be made for transportation, preferably to a physician's office.

While syncope cannot be eliminated as a medical emergency, some practices can be instituted to minimize its occurrence. Patients who have experienced situational syncope during dental treatment may benefit from sedation for the duration of procedures. Repositioning a patient in gradual increments from a supine position to a sitting position after the completion of dental treatment can decrease the likelihood of postural syncope. It is important that patients be urged to remain seated until they feel stable and clear-headed.

CARDIOVASCULAR EMERGENCIES IN THE DENTAL SETTING

Approximately 126.9 million adults in the United States have some form of cardiovascular disease, and almost one of every three deaths is attributed to this problem [6]. The American Heart Association indicates that 805,000 adults experience a myocardial infarction each year. In addition, more than 7 million adults in the United States have ever experienced a stroke [6]. With so many patients afflicted with various forms of cardiovascular disease, dental practices will invariably treat patients with diagnosed and undiagnosed cardiovascular conditions. Thus, it is critical that each dental practice can respond appropriately to a medical emergency that is of cardiovascular origin.

Ischemic Heart Disease

An impediment to the flow of blood, as in the case of an artery that has become constricted, will decrease the perfusion of oxygenated blood to tissue or organs. When the reduction of perfusion to the myocardium of the heart is sufficient enough that the myocardial cells weaken but do not die, a condition known as angina occurs. When the supply of oxygenated blood to the myocardium is further reduced and the myocardial cells become necrotic, a myocardial infarction ("heart attack") occurs. Either of these conditions can occur spontaneously, without any previous symptoms or chest pain. The dental staff should have an established protocol in place to treat the emergency manifestations of these cardiovascular conditions.

Acute chest pain that occurs during dental treatment may be an infrequent event, but the underlying pathophysiology can be the source of dire consequences, especially if immediate action is not taken. Angina pectoris and acute myocardial infarction are the two most likely cardiovascular sources of chest pain that develop in a conscious patient while undergoing dental treatment [7]. Anxiety and panic are also potential causes of chest pain, although the seriousness of possible myocardial infarction requires that any report of pain be considered a medical emergency.

Angina pectoris may be classified as stable or unstable. Patients with stable angina experience chest pain when physical activity and/or emotional stress cause a metabolic demand on the myocardium that the existing supply of oxygenated blood cannot meet. For these patients, a sublingual tablet or a sublingual metered spray of nitroglycerin will relieve the pain within a few minutes. Patients with unstable angina experience cardiac-related chest pain even while at rest. Because these patients are at increased risk for adverse cardiac events, such as an acute myocardial infarction, ventricular tachycardia and fibrillation, and arrhythmias, they should not receive dental treatment until their unstable angina is treated. Emergency dental treatment of patients with unstable angina should only be done in an environment in which all vital signs can be monitored and in which emergency medical assistance is immediately available. A hospital setting, whether inpatient or outpatient, may be necessary.

Treatment of angina pectoris begins with a thorough review of the medical history. Patients who have been diagnosed with stable angina pectoris usually are aware of the events that will precipitate an angina attack. The stress and anxiety that some patients experience during dental treatment can be one such factor. These patients usually have a prescription for nitroglycerin, either as a sublingual metered 0.4-mg spray or a 0.3-mg sublingual tablet that dissolves quickly. Therefore, patients with a known history of angina pectoris should be asked to bring their own nitroglycerin tablets to the dental office. Dentists who have nitroglycerin included in their emergency kits should label the initial date the container was opened. After nitroglycerin tablets are exposed to air or light when their container is opened, the shelf-life is only three months [7; 45]. If three months have expired, a new supply must be purchased. Sublingual nitroglycerin spray may be used until the expiration date listed on its original container.

If a patient with a history of angina experiences chest pain, the dental procedure should be stopped immediately and the patient should be placed in a comfortable position. Administration of 0.3-mg tablet or 0.4-mg metered spray nitroglycerin sublingually is the initial treatment of choice. This dose should provide relief of the angina-related pain in just a few minutes. If needed, this same dose can be administered twice more at intervals of five minutes. If the pain is not relieved after the repeated doses of nitroglycerin, the dentist should consider that a myocardial infarction is developing and use the emergency protocol for this serious cardiac event.

Nitroglycerin is a vasodilator and causes the relaxation of smooth muscle of the vasculature; dilation occurs in venous and arterial beds and the coronary arteries. The ultimate effect is a reduction in systemic vascular resistance and left ventricular pressure, which reduces the myocardial demand for oxygen [8]. However, this vasodilation effect can interact synergistically with other medications and cause untoward effects. For example, male patients who are currently taking medications for erectile dysfunction, such as sildenafil, tadalafil, or vardenafil, can experience a significant decrease in blood pressure when these medications and nitroglycerin are combined. Unconsciousness and even death can occur from the resulting profound hypotension. The serious drop in blood pressure that can occur when these medications are combined may not readily be reversible with vasopressor medications. In these cases, supplemental oxygen may be helpful. While some patients may be reluctant to list these medications on their medical history, it is mandatory that the medical history of any male patient who is administered nitroglycerin is reviewed to determine if they are concurrently using medications for erectile dysfunction.

If a patient responds favorably to the nitroglycerin, it should be determined if the frequency and intensity of the attacks are progressing toward unstable angina. This diagnosis can only be made by the patient's physician or cardiologist, to which a referral should be made if angina-related chest pain has occurred during dental treatment.

If the repeated administration of nitroglycerin has not succeeded in the alleviation of the chest pain, the emergency protocol for the treatment of an acute myocardial infarction must be started. Emergency medical services (EMS) should be contacted immediately by one staff member while other staff members assist the patient.

The dentist should also suspect the occurrence of a myocardial infarction in all patients with acute chest pain, whether they have a history of myocardial infarction or have no history of cardiovascular pathology. Treatment should commence immediately while waiting for EMS to arrive.

A conscious patient should be placed in a comfortable position that is easily accessible by EMS personnel. The medications used to provide initial life-sustaining treatment for a conscious patient may be remembered by the acronym MONA: morphine, oxygen, nitroglycerin, and aspirin [9]. Morphine given by intramuscular or intravenous means provides relief from the acute, crushing pain that accompanies a myocardial infarction. Because many dental offices do not utilize this medication, the inhalation of a 50:50 ratio of nitrous oxide and oxygen can also be used for acute pain relief [10]. The inhaled concentration of oxygen in this mixture is more than ambient air concentrations. In offices that are not equipped with a nitrous oxide delivery system, oxygen from a portable tank through a nasal cannula or a nasal hood at a flow rate of 4–6 liters per minute is used. Nitroglycerin, as a sublingual tablet or a metered sublingual spray, will act as a vasodilator and ultimately reduce the oxygen requirements of the myocardium. In a conscious patient, a dose of 325 mg of aspirin, which provides antiplatelet activity, should be chewed and swallowed.

When a patient suspected of having an acute myocardial infarction becomes unconscious, then he or she should be positioned to assess the airway, breathing, and circulation. When neither a pulse nor breathing can be detected, CPR should be started.

Additionally, the use of an automated external defibrillator (AED) can be indispensable in saving the life of a patient experiencing a cardiac emergency. Every dental office should have an AED, even if it is not required by state law. When used with the basic life support techniques of CPR, defibrillation can significantly increase the chance of surviving a myocardial infarction. Each minute that elapses before the heart is successfully defibrillated results in a 7% to 10% decrease in the chance for survival [11]. Instructions on the use of this device should be incorporated into the office training for all staff members. Because the response time for EMS can vary, the dental staff should be prepared to provide medical support for the patient until EMS personnel can provide further assistance and transport the patient to the hospital.

Cerebrovascular Accidents (Strokes)

As noted, approximately 7 million adults in the United States have a history of stroke; of those, nearly 75% are older than 65 years of age [6; 12]. As the American population ages, the number of patients with a history of stroke who continue to seek dental care is considerable. Risk factors that were likely instrumental in the development of the initial stroke, such as hypertension, can remain as precipitating factors for another event.

There are two basic categories of stroke: hemorrhagic and ischemic. Hemorrhagic strokes occur when a blood vessel in the brain ruptures. Ischemic strokes occur when the partial or complete occlusion of a blood vessel by an emboli or atherosclerotic plaque diminishes or eliminates the perfusion of oxygenated blood to a section of the brain. Sudden confusion, weakness on one side of the body, visual disturbances, and a struggle to speak are common symptoms of a stroke. A patient who demonstrates any of these symptoms should be administered oxygen and EMS should be summoned immediately. If the patient lapses into unconsciousness, the basics of monitoring the airway, breathing, and circulation must be maintained.

Similar to a cardiac emergency, a stroke can occur without any prior symptoms and in patients with no medical history of cardiovascular disease. However, if the medical history is positive for stroke, the chance for a recurrent stroke and related morbidity and mortality is increased. Approximately 3% to 10% of strokes recur within one month, with an elevated risk of recurrence within the first six months [42]. With the passage of time, there is a decreased risk of another stroke. However, 33% of stroke survivors have a recurrence within two years [42]. When possible, dental treatment should be deferred during this interval. Patients who develop odontogenic pain or infection or who have experienced oral or maxillofacial trauma during this initial period may require treatment that cannot be postponed for six months. In these cases, the patient's physician should be consulted prior to any procedures, and treatment should be as conservative as the situation allows. Invasive treatment, such as oral surgery, may need to be completed in a hospital setting, so all vital signs can be monitored. Many post-stroke patients take anticoagulant medications, which can cause problems with hemostasis postsurgically.

Stroke survivors who seek dental care should be carefully assessed before any dental treatment, especially when the stroke has occurred within the last year. Vital signs should be taken as a baseline and monitored throughout the procedure. Stress should be minimized during any dental procedure, and pain control must be optimal. Sedation with a combination of nitrous oxide and oxygen can be beneficial in the reduction of anxiety and as a mild analgesic. Vasoconstrictors such as epinephrine should be avoided if at all possible. These steps are designed to decrease the chance of a recurrent stroke, but do not eliminate it. Quick response and knowledge of each patient's risk will allow for the best possible outcome.

SEIZURES

Seizures are a rare occurrence in the dental setting but can occur, and the characteristic convulsive movements of the limbs may endanger the patient. Epilepsy is a neurologic disease associated with recurrent, spontaneous seizure activity. However, seizures can occur in patients without a history of epilepsy for a variety of reasons, including brain tumors and withdrawal from alcohol, narcotics, or benzodiazepines.

The most serious manifestation of seizure activity is the tonic-clonic seizure (formerly grand mal seizure). These seizures, which are probably the best known, consist of two phases. The tonic phase features generalized muscle rigidity, dilation of the pupils, eyes that roll upward, and a loss of consciousness. The clonic phase includes uncoordinated movements of the limbs and head, often with the jaws tightly clenched. This clonic activity usually lasts less than two minutes, after which muscular relaxation and a return to consciousness occur.

The absence seizure was formerly referred to as a petit mal seizure. Absence seizures are rare in adulthood and almost always begin in children between 4 and 12 years of age [39]. This seizure is characterized by a brief period of altered consciousness, often described as a staring spell. The duration of the seizure is generally 5 to 30 seconds. The absence seizure may occur up to 100 times per day or only rarely [39]. The child is often described as having a blank stare that interrupts motor and mental activity, which begins and ends suddenly. The patient will have no loss of postural tone but may experience a mild increase or decrease in muscular tone. Occasionally, the child will exhibit minimal myoclonic movements around the eyelids or mouth. The patient may have automatisms associated with the seizure, including chewing or rapid blinking. During the seizure there is a loss of awareness [39]. There is usually no postictal period, and the individual may continue activities with full awareness after the seizure has subsided.

When patients do not enter the recovery phase and have repeated seizures, the condition is known as status epilepticus. This is a medical emergency, and EMS must be summoned as soon as possible, as patients can become hypoxic. If possible, supplemental oxygen should be administered.

Before any dental treatment is begun, the dentist should have a clear history of each patient's seizure activity and compliance with prescribed medications. Dental appointments should only proceed if a patient has been compliant with prescribed medications. Even when the precautions are followed, seizures can still occur. Many patients with a history of seizures have a prodromal phase or an aura prior to the tonic phase of seizure activity, allowing for some warning of the event. This provides an opportunity to remove any objects from the mouth that were placed for dental treatment to prevent aspiration or injury. This phase can also provide time to administer anticonvulsant medications. Attempting intramuscular injections or the placement of an intravenous line to administer anticonvulsant medications can be difficult and dangerous while the patient is seizing. Nothing, including a bite block or cotton rolls, should be placed in the mouth after the seizing activity has begun. The patient should remain in a supine position in the dental chair, and any dental instruments in the field of operation should be moved away to protect the patient from injury. Breathing is usually unaffected by seizure activity, but recording vital signs may not be possible. However, upon conclusion of the seizure, some patients will be unconscious and must have an evaluation of their airway, breathing, and circulation. Dental treatment should not be resumed but should be rescheduled to another time.

Because patients can emerge from seizures in a confused and exhausted state, they should not attempt to drive; transportation home may be provided by a responsible adult. If the seizure was a first-time occurrence for the patient, a referral to a physician is necessary in order to discover the underlying cause.

DIABETIC EMERGENCIES

In the United States, approximately 11.3% of the population, or 37.3 million children and adults, have diabetes [17]. Type 1 diabetes, in which the body does not produce adequate amounts of insulin, accounts for about 5% of these cases and usually has an onset in childhood, adolescence, or young adulthood. These patients require insulin injections to manage the disease. The remaining 95% of patients have type 2 diabetes, caused by the body's impaired glucose metabolism. These patients usually develop diabetes at 40 years of age or older, and oral hypoglycemic medications with occasional supplementation with insulin are utilized by these patients [18; 44]. Most dental practices will treat patients with diabetes and should be prepared for emergency situations that can develop before, during, or after dental treatment.

Dentists should discuss the type of diabetes, compliance with prescribed medications and dietary recommendations, problems with glycemic control, and acute and chronic complications of the disease with all patients with diabetes before dental treatment begins. Consulting a patient's physician before initiation of dental treatment can decrease the chance of a diabetic emergency. Diabetes-related emergencies in the dental setting usually involve hypoglycemia (low blood glucose) or, less frequently, hyperglycemia (elevated blood glucose).

Hypoglycemia

Hypoglycemia occurs most frequently in persons with type 1 diabetes but can also occur in individuals with type 2 diabetes. When a normal dose of insulin or oral hypoglycemic agent is taken prior to dental treatment and the patient eats minimally or not at all, blood glucose levels can plunge rapidly. Signs and symptoms of hypoglycemia can develop rapidly and include anxiety, skin that is cool and moist, sweating, confusion, difficulty speaking, labored breathing, and tremors. Tachycardia can exacerbate the anxiety that can accompany hypoglycemia. Some patients with diabetes will develop a condition known as hypoglycemia unawareness.

This is a condition whereby a patient who has experienced many hypoglycemic events will not manifest the early signs and symptoms of hypoglycemia. These patients can progress rapidly to severe hypoglycemia and may have seizures and lose consciousness [19]. When the dental staff is treating a patient with diabetes, they should recognize that the occurrence of these symptoms indicates hypoglycemia and requires immediate treatment.

A glucometer provided by the patient or the dental staff may be used to measure blood glucose. A conscious hypoglycemic patient may take fruit juice, regular soda, or a glucose gel that can be absorbed through the oral mucosa in order to stabilize the blood glucose level. After 15 minutes, the blood glucose should be rechecked. If it has not returned to an acceptable level (i.e., a concentration higher than 60 mg/dL), another dose of glucose should be taken and the levels rechecked in 15 minutes. After the level has reached at least 60 mg/dL, a mixed snack can be provided [20]. Any remaining dental treatment should be rescheduled, and the patient should be referred to their physician for further evaluation.

If a patient with hypoglycemia lapses into unconsciousness, EMS should be summoned and the patient's physician notified immediately. The staff should begin immediate measures to raise the blood glucose level, although no food or beverage that must be chewed and swallowed should be placed into the mouth of an unconscious patient. Glucose gel may be applied onto the oral mucosa, through which systemic absorption occurs. An intramuscular injection of glucagon (1 mg) may be administered, which stimulates the formation of glucose from glycogen stored in the liver. If an intravenous line can be prepared by the dentist, a solution of 50% dextrose in water can be used [21; 45]. The patency of the airway, breathing, and circulation should be monitored as with any unconscious patient. The patient should have blood glucose levels monitored every 15 minutes and should be transported to the hospital, where further evaluation and stabilization of the blood glucose can be done.

Prior to any further dental treatment, patients should have their insulin and/or oral hypoglycemic agent regimen and diet re-evaluated by their physician. Patients who have had surgical procedures must be counseled to maintain the dietary and medication regimen as prescribed to avoid the precipitation of another hypoglycemic crisis at home. The physician may recommend a temporary dose adjustment in oral hypoglycemic agents or insulin.

Hyperglycemia

As noted, hyperglycemia is a less frequent emergency issue among patients with diabetes. However, elevation in blood glucose can lead to an altered mental status, the odor of acetone on the breath, blurred vision, excessive thirst and hunger, rapid and deep breathing, cardiac arrhythmias, and in severe cases, coma. The onset of these symptoms is more gradual compared to those associated with an acute hypoglycemic crisis. Most dentists do not have training in the administration and dosage of insulin specific to the patient's glycemic control goals. In cases of hyperglycemic emergencies, a physician should be contacted and EMS summoned for appropriate treatment. Monitoring the airway, breathing, and circulation along with providing supplemental oxygen as needed may be necessary until EMS arrives.

ASTHMA ATTACK

According to the Centers for Disease Control and Prevention, 8% of adults and 5.5% of children are currently diagnosed with asthma [22]. This disease is the most common cause of respiratory distress among dental patients [23]. Asthma features the constriction of the bronchial and bronchiolar muscles and extensive secretion of viscous mucus in the respiratory tract, making breathing difficult to impossible. It is a chronic inflammatory respiratory disease characterized by recurrent episodes of dyspnea, coughing, and wheezing [24]. Asthma attacks occur when the bronchiolar tissue is hyperresponsive to a variety of stimuli, including cold air, smoke, medications (e.g., salicylates and nonsteroidal anti-inflammatory drugs [NSAIDs]), various chemicals, stress, allergens, exercise, and anxiety, among many others.

When a patient's medical history reveals asthma, it is important for the dental professional to determine the severity of the illness, the types of medication(s) prescribed, frequency and the severity of attacks, and known triggers that have stimulated asthma attacks in the past. If a patient is a persistent asthmatic with a high frequency of asthma attacks, his or her physician should be consulted before any treatment is begun, as the stress and anxiety that some patients associate with dental treatment can precipitate an attack.

Dental offices that treat patients with asthma should have short-acting inhalers, such as albuterol, available to rapidly reverse asthma symptoms in the event the patient does not bring one. Albuterol is a bronchodilator that acts by inducing the relaxation of constricted bronchiolar smooth muscles and inhibiting the release of substances from mast cells that cause bronchiolar constriction. Most inhalers are aerosol, although dry powder and nebulizer types are also available. If an asthma attack occurs during dental treatment, the procedure should be stopped, the patient placed in an upright position, and the albuterol inhaler should be used.

Intramuscular injections of 0.3–0.5 mg epinephrine in a 1:1,000 (1 mg/mL) concentration may be used if albuterol is not available. Epinephrine may be used every 20 minutes for two additional doses [5; 45]. If necessary, supplemental oxygen and a second administration of the albuterol inhaler may be administered. A pulse oximeter can be used to determine oxygen saturation. Because members of the dental staff generally do not have the experience to discern the severity of an asthma attack, EMS should be summoned if the patient has not responded to the initial use of these medications.

If the anxiety and stress of dental procedures has been a stimulant for an asthma attack in the past, inhalation sedation with nitrous oxide may be helpful. However, nitrous oxide may cause irritation of the airway in sensitive patients. In these patients, nitrous oxide should only be used if it is approved by a physician. Moderate sedation can prove to be dangerous in patients with asthma because of the limited control of the airway. This method should only be used with physician approval and may need to be performed in a hospital environment. Narcotic analgesics should be avoided as they can stimulate histamine release, which can result in bronchospasm [25]. As a class, narcotics also cause respiratory depression.

ALLERGIC REACTIONS DURING DENTAL TREATMENT

According to some estimates, more than 53 million Americans have at least one allergy [26]. Furthermore, approximately 5% to 10% of adverse reactions to medications are allergic reactions. The clinical manifestations of these reactions can range from a rash and erythema (in nearly 50% of medication-related reactions) to a 1% incidence of anaphylaxis. In general, when a medication is consumed, there is a 1% to 3% chance of an allergic reaction [43].

Medical emergencies related to allergic reactions are uncommon but possible in the dental office. Prevention of this kind of emergency begins with a review of the medical history as it relates to prior allergic reactions to medications, food, or materials. It is important to note that patients who do not have any past allergic reactions are not guaranteed immunity from future allergic reactions [27].

Today, penicillin is the most common cause of drug-related allergic reactions, and latex is the most common material in the dental environment that causes an allergic reaction [28]. Approximately 1% to 5% of the general population has a latex allergy, but the prevalence is increased in certain populations, including atopic patients and persons who have chronic occupational exposure (e.g., healthcare professionals, rubber industry workers) [33]. There are several different types of latex allergies, but those who experience immediate hypersensitivity after exposure (a type I reaction) are the most likely to develop anaphylaxis. The use of non-latex gloves and rubber dams is the most practical remedy for this problem, but this requires that a latex allergy be communicated to all staff members involved with direct

clinical care and contact with the patient before a procedure. A life-threatening allergic reaction can occur if a dentist does not inform other clinical staff about a patient's latex allergy and latex gloves are subsequently used during the patient's treatment.

Allergic responses to medications and materials begin at the cellular level and involve various degrees of hypersensitivity reactions. The ingestion of a medication or exposure to a material such as latex can stimulate an inappropriate immune response in some patients. A type I reaction manifests as an allergic response when a complex is formed between the ingested material (allergen) and an immunoglobulin, such as immunoglobulin E (IgE). This unique biochemical complex then stimulates the release of histamines from mast cells, which increases vascular permeability with fluid from the vasculature extruding into the adjacent tissues. The degree to which this affects the patient can vary from local involvement to a systemic reaction to anaphylaxis and even death.

In the dental setting, many potential allergens are present. Medications (over-the-counter or prescribed), materials such as latex, or even local anesthetics used for dental procedures can all induce allergic reactions. Some allergic reactions develop slowly, while others can progress rapidly and cause systemic collapse. When an allergic reaction is suspected, dental treatment should cease and the emergency treatment protocol should be initiated. Mild allergic reactions in which there is localized rash, hives, or itching and during which the patient remains conscious can be treated with a histamine blocker, such as 25–50 mg diphenhydramine taken orally every six to eight hours [5]. Patients should be referred to a physician or an allergist to determine the source of the allergic response. If there is any doubt about the stability of the patient or the potential for a progressive allergic response that could lead to anaphylaxis, the patient should continue to receive supportive care and the EMS should be summoned.

ANAPHYLAXIS

An anaphylactic reaction represents the most serious degree of an allergic response. It is characterized by a set of symptoms that involves various organs and systems and occurs independently, simultaneously, or subsequently [30]. Initial symptoms often involve widespread hives and progress rapidly to bronchospasm, respiratory arrest, and ultimately, cardiac arrest. Whether the anaphylactic reaction is of immune or nonimmune origin, the stimulation of mast cells and circulating basophils release chemical mediators that begin the anaphylactic process.

The release of histamine and bradykinins causes vasodilation and edema, while the release of prostaglandin D2 and leukotrienes results in bronchoconstriction [31]. These biochemical events can cause a transfer of as much as 50% of intravascular fluids to extracellular spaces [32]. A steep decline in blood pressure and cardiovascular collapse can ensue. Immediate emergency treatment and contact of EMS is mandatory to save the patient's life.

While the patient is conscious, any dental materials in the patient's mouth should be removed to prevent their aspiration and further complication of the efforts to treat the patient. The patient should be placed in a supine position with the legs slightly elevated to facilitate blood flow to the brain. The basics of airway, breathing, and circulation should be constantly monitored.

Epinephrine remains the medication of choice to treat anaphylactic shock. Commercially prepared pre-loaded syringes of 0.3 mg of 1:1,000 epinephrine (usually referred to by their brand name, EpiPen) can be injected into the deltoid or vastus lateralis muscles or in the sublingual region. The highly vascular sublingual region can promote rapid absorption of the epinephrine. Subcutaneous administration of epinephrine does not provide as much bioavailability of epinephrine as the intramuscular or sublingual routes [5; 45].

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the Australasian Society of Clinical Immunology and Allergy, epinephrine is the first line treatment of anaphylaxis and acts to reduce airway mucosal edema, induce bronchodilation, induce vasoconstriction, and increase strength of cardiac contraction.

(https://www.allergy.org.au/images/ASCIA_HP_Guidelines_Acute_Management_Anaphylaxis_2023.pdf. Last accessed January 25, 2023.)

Level of Evidence: Expert Opinion/Consensus Statement

Once absorbed, epinephrine targets the alpha and beta receptors of the cardiovascular system, inducing vasoconstriction and increasing the systolic blood pressure. Epinephrine also acts as a bronchodilator and can relieve the respiratory distress associated with anaphylaxis. The dose of 0.3 mg epinephrine can be administered every 5 to 15 minutes until hypotension and respiratory distress are stabilized. An intramuscular injection of a histamine blocker such as diphenhydramine can also help by reducing the effects of the histamine release from the mast cells [5].

Positive pressure oxygen delivered through a mask can provide supplemental oxygen. Some patients will exhibit severe pharyngeal and laryngeal swelling and require intubation for the proper exchange of oxygen. All anaphylactic patients must be transferred to a hospital for further treatment and observation, as some patients have a biphasic response and begin to display symptoms of anaphylaxis even after seemingly effective treatment. Biphasic reactions have been reported to occur in 1% to 20% of anaphylaxis episodes, usually about eight hours after the first reaction, although they can occur up to 72 hours later [16]. After recovery from the anaphylaxis reaction, the patient should consult with his or her physician or allergist to identify which substance(s) caused the event and to prevent recurrence.

LOCAL ANESTHETIC REACTIONS

Local anesthetics provide a means by which restorative, surgical, and endodontic procedures can be completed in a comfortable fashion. Some estimates suggest that approximately 300 million cartridges of local anesthetics are used in the United States annually [34]. These injected medications have an outstanding record of safety, and allergies to local anesthetics are rare. Systemic complications that occur after the injection are also rare but do occur and can progress rapidly. However, the safety record of local anesthetics should not allow a sense of complacency to develop among clinicians regarding their use. Package inserts from the manufacturers contain warnings that those who administer local anesthetics should be prepared to diagnose and treat emergency situations such as dose-related toxicity and acute reactions that may occur after administration. The availability of oxygen and resuscitative equipment and the competence to use this equipment properly is also advised.

As discussed, the medical and dental history of each patient should be reviewed prior to the initiation of treatment and the administration of any medication. When the dental history reveals that a patient has had problems with local anesthetics before, a thorough investigation of the nature the problem, the local anesthetic used, and the required emergency treatment and outcome can provide important information. A consultation with dental clinicians involved in prior treatments and, if applicable, physicians involved in their emergency treatment may help to identify the etiology of the toxicity reaction so it can be avoided in subsequent appointments.

Allergic Reaction

Allergic reactions can occur upon the administration of local anesthetics. Some patients have allergies to the anesthetic itself, but some patients will be allergic to sulfite compounds. Antioxidants such as sodium metabisulfite or potassium metabisulfite are used as stabilizers in local anesthetic solutions that contain vasoconstrictors, such as epinephrine or levonordefrin. The presence of a documented sulfite allergy or a history of an allergic-type asthma attack should prompt the clinician to utilize a local anesthetic without a vasoconstrictor.

Toxicity

Although vasoconstrictors must be avoided in patients with sulfite compound allergy, they usually play an important role in minimizing the rapid systemic dissemination of the local anesthetic. Both epinephrine and levonordefrin constrict blood vessels in the injection area, resulting in a slower systemic absorption and decreasing the chance of systemic toxicity. Aspirating before injecting slowly also minimizes the chance that the local anesthetic will be injected directly into a blood vessel, decreasing the rate of systemic circulation. Direct intravascular injection of an entire cartridge of a local anesthetic can have adverse effects on both cerebral and cardiac tissues.

The prevention of toxicity from local anesthetics involves more than a careful injection technique. A patient's age, weight, medical conditions, and current medications can all influence the metabolism and clearance of local anesthetics. The most common cause of local anesthetic toxicity is an overdose of the medication relative to the age and weight of the patient. This occurs most often in pediatric patients, but excessive doses also occur in adults, particularly elderly individuals [35]. Each local anesthetic has a maximum allowable dosage schedule as a guideline when calculating doses, expressed as the maximum total dose (in mg) of a given anesthetic relative to the weight of the patient. Some local anesthetics, such as bupivacaine, are not recommended for use in patients younger than 12 years of age. Children do not have the capability to metabolize and excrete local anesthetics as well as healthy adults. In addition, the elderly, adults with low body weight, and those with chronic illness(es) may have a diminished capacity to metabolize and excrete local anesthetics. Clinicians should avoid using the same dose on each patient without regard to these factors.

Systemic disease can also affect an individual's ability to metabolize and excrete local anesthetics. The amide type of local anesthetics, which includes lidocaine, mepivacaine, bupivacaine, and prilocaine, undergoes metabolism primarily in the liver and excretion is via the kidneys. The majority of articaine is metabolized in the plasma. It has an amide component but is the only amide with a thiophene ring. Diseases such as hepatitis and cirrhosis can adversely affect hepatic function and decrease the liver's ability to metabolize these anesthetics; a dose that is usually appropriate for the age and weight of a healthy patient can gradually accumulate to toxic levels. Patients with impaired renal function, especially those with end-stage renal disease and those on dialysis, will have difficulty excreting metabolized local anesthetics. These patients' physicians and specialists should be consulted about an appropriate dosing schedule. When multiple quadrants of restorative treatment are performed, full-mouth extractions completed, or multiple doses are administered in the same area in patients who are having difficulty achieving a state of anesthesia, the maximum allowable local anesthetic dose for the patient can be achieved quickly.

The concurrent use of certain medications can also alter the metabolism of local anesthetics. Medications such as phenytoin, meperidine, and desipramine compete with local anesthetics for the same protein binding sites, which can decrease efficacy of both drugs [36]. Cimetidine, which is in common use for the treatment of gastroesophageal reflux disease and ulcers, can decrease the rate at which lidocaine is metabolized in the liver, as both medications compete for the same hepatic enzymes [37]. These instances of competitive drug metabolism can cause a local anesthetic to be retained longer and a toxic accumulation may be reached faster if the dose is not adjusted.

The manifestations of toxicity to local anesthetics and their vasoconstrictors can have different clinical appearances. When a local anesthetic with epinephrine is injected into a blood vessel and distributed systemically, patients may experience tachycardia, heart palpitations, and anxiety. This is usually a transient reaction that subsides in a few minutes. However, patients should be monitored to assure that it is not the beginning of a more progressive toxic reaction. Furthermore, patients should never be left alone after a local anesthetic has been injected.

Local anesthetics can cross the blood-brain barrier and can exert a depressant or excitatory action on both the central nervous system (CNS) and the cardiovascular system. Some toxic reactions to local anesthetics can occur rapidly after the injection, while others may be delayed for several minutes. A clinically evident excitatory phase, featuring excessive talking, apprehension, and excitability, may be present during these reactions. Among the local anesthetics used, the lack of this phase occurs more frequently with lidocaine [38]. Patients can progress to demonstrate signs of slurred speech, diaphoresis, nausea, vomiting, tachycardia, and an increased rate of breathing when the degree of toxicity is minimal to moderate. When higher doses of a local anesthetic cause more severe acute toxicity, the patient may develop seizures, CNS depression, hypotension, bradycardia, and a decreased respiratory rate.

When any sign of local anesthetic toxicity emerges, members of the dental care team should begin with an initial monitoring of the vital signs. Fortunately, most reactions to a local anesthetic toxicity are mild and self-limiting, with only the use of supplemental oxygen needed to assist the patient. More severe reactions occur within one minute of administration of the local anesthetic and can lead to seizures and unconsciousness. When this occurs, one staff member should contact EMS while the dentist and others are monitoring the airway, breathing, and circulation of the patient. If the patient has seizures that do not appear to be decreasing in intensity, a benzodiazepine may be used. The dental staff should stabilize the patient until EMS has arrived. In rare cases, this may involve the administration of CPR and/or the use of an AED. An analysis should be completed to determine the cause of the toxic reaction so recurrence can be prevented.

ASPIRATED AND INGESTED OBJECTS DURING DENTAL TREATMENT

The aspiration of an object into the bronchi or lung or the ingestion of an object into the esophagus and ultimately the gastrointestinal tract during a dental procedure is a potentially life-threatening event. Among the objects that have been aspirated or ingested are extracted teeth, crowns, bridges, implant instruments, endodontic instruments, rubber dam clamps, cotton rolls, and parts of teeth or old restorative materials that have fractured during extractions or during instrumentation with a high-speed handpiece. The saliva in the oral environment, limited access and vision, and occasional abrupt movements by the patient can cause the clinician to lose control of an object in his or her grasp. The inability to retrieve an object from the mouth can result in its displacement into the posterior pharynx and the potential to enter the esophagus or bronchi. There are several practices that can be used to decrease the incidence of this problem.

Patients who have any congenital or acquired diseases that affect neuromuscular control can have difficulty with their gag reflex and swallowing and may experience excessive movements of the tongue, lips, and cheeks. Patients with a history of conditions associated with neuromuscular deficits, such as cerebral palsy, Parkinson disease, and stroke, often require special care and attention. Patients who have a high level of anxiety about dental treatment may move abruptly during the dental procedure, causing the clinician to lose control of instruments or objects (such as crowns) that are being held within the mouth. Various levels of sedation can diminish the fear and anxiety that these patients associate with dental treatment, but it can also decrease protective reflexes such as gagging and coughing.

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the Hartford Foundation Center of Geriatric Nursing Excellence, older adults with neurologic conditions such as Parkinson disease can experience dysphagia. These patients may often appear to have excess saliva, but this is usually the result of their inability to retain contents in the oral cavity and swallow adequately. Oral care is most effective when these patients can be in a semi-upright position to avoid choking or aspiration.

(http://m4.wyanokecdn.com/6c3b9e6272d6a4834c6dc9b1c2ce3e04.pdf. Last accessed January 25, 2023.)

Level of Evidence: Expert Opinion/Consensus Statement

When patients are anesthetized, especially when multiple quadrants are involved, their ability to detect loose or foreign objects before they enter the posterior pharynx can be compromised. Barriers may be placed to prevent objects that have become dislodged in the mouth from being aspirated or ingested. During most restorative procedures and endodontic procedures, rubber dam isolation of the tooth being treated provides a dry operating field and can prevent pieces of the tooth or old restoration and endodontic instruments from entering the posterior pharynx.

However, the rubber dam clamp itself can become dislodged and mobile within the oral cavity. A small piece of dental floss may be tied around the clamp, with the free ends extending out from the mouth. This can aid in retrieving the clamp should it become dislodged. Isolation during extractions can be accomplished with a 4-inch x 4-inch piece of cotton gauze. These procedure-related practices can diminish the chance of aspirating or ingesting an object.

Despite the best efforts of isolation, objects may enter the posterior pharynx during dental treatment. When this occurs, patients should be placed in an upright position and allowed time to determine if a productive cough will force the object into the mouth, where its retrieval is possible. If the object cannot be found in the mouth, the patency of the patient's airway and his or her ability to breathe should be monitored. If the patient can breathe independently, the airway remains unobstructed. However, objects can be lodged in a bronchus without labored breathing or coughing.

When the object cannot be located, an immediate medical consultation is required. Aspirated objects may have sharp and irregular surfaces that can traumatize tissue. Further, these objects may be laden with bacteria of the oral flora, which can cause complications such as post-obstructive pneumonitis, pulmonary abscesses, and bronchiectasis [41]. Chest radiography including posteroanterior and lateral projections is required to detect the presence of a foreign object in the bronchi or lungs [40]. When located, the object can be removed by surgical procedures such as bronchoscopy.

Radiographs of the abdomen should also be taken, as it is more likely that an object will be swallowed and introduced into the gastrointestinal tract than it will be aspirated into the bronchi or lung [41]. Swallowed objects that are sharp and irregular have the capability of perforating the gastrointestinal mucosa, and medical and surgical consultation with a gastroenterologist is required in these cases. While some objects may require surgical removal from the gastrointestinal tract, others may safely progress through the entire system and be eliminated with solid waste.

In some cases, aspirated objects may become lodged in the trachea and cause partial or complete obstruction of the airway. In the latter case, the Heimlich maneuver, or abdominal or chest thrusts in patients who are pregnant or obese, should be used. The activation of EMS is required if these procedures cannot remove the aspirated object and oxygen via CPR or positive pressure cannot be supplied to the lungs. Even if the object is retrieved and a normal flow of oxygen is resumed, the patient should be referred to a physician or specialist to determine if the lodged object caused any trauma to the area. When an object has been aspirated or swallowed by a patient, it is essential that the dental staff reviews the incident to determine methods by which this incident can be avoided in the future.

STAFF PREPARATION AND TRAINING FOR MEDICAL EMERGENCIES

An emergency can be defined as a sudden and unexpected occurrence that requires immediate action. This definition is applicable to the medical emergency situations described in this course as well as many others that can develop during dental treatment, even when measures have been taken to decrease the chance of their occurrence. A meticulous review of each patient's medical and dental history and an awareness of their current medication(s) can help to assess the degree to which patients are at risk for developing a medical emergency during dental treatment. However, because patients with benign medical histories can develop an emergent medical problem, all members of the dental staff should be trained to take immediate action to assist the patient.

STAFF TRAINING

There is no substitute for appropriate staff training for medical emergencies. The occurrence of a medical emergency is not the time to assign specific roles for each staff member, check the emergency medicine kit for drugs that have expired, or make sure that the AED is working properly. The chaos and panic that can ensue among an unprepared dental staff can mean the difference between life and death.

Each staff member should be assigned a specific duty to assume during a medical emergency. Contingency plans should be made for the times when a staff member is absent. New staff members should be assigned their specific role when they join the practice. One person should be the designated leader responsible for directing other staff members and performing the initial assessment of airway, breathing, and circulation. It is important that this person has the demeanor to remain calm amid stressful circumstances. A second team member is responsible for bringing the emergency kit, the portable oxygen tank, and the AED to the patient. This staff member should be trained to assist with CPR. A third staff member is responsible for contacting EMS and providing information about the nature of the emergency situation and the patient's current vital signs. An estimated response time should be obtained [13; 45]. Larger practices may have more than one such team, while practices that are just starting may have to divide the duties among just two or three staff members.

These roles should be practiced in medical emergency drills on a quarterly basis and should feature the various emergency situations to which the staff must respond. All staff members should be current with basic CPR training. Some states require a higher level of training, such as advanced cardiac life support, for practices that provide various levels of sedation for their patients.

Medications that are frequently used in medical emergencies have been highlighted in various sections of this course and can be purchased separately or as part of a medical emergency kit. Staff training for medical emergencies should highlight which medications are used for specific emergency situations, their route of administration, and the location of the emergency kit. A staff that is well-trained for medical emergencies during dental treatment can make the difference between the life and death of an afflicted patient.

AVAILABLE MEDICATIONS

Practices that routinely sedate patients with opioids or benzodiazepines should have antidotal drugs readily available to reverse the respiratory depression that can accompany the administration of these medications. Naloxone is an opioid antagonist that can reverse respiratory depression caused by this class of drugs, and flumazenil is capable of reversing the effects of benzodiazepine [14; 15]. Flumazenil is given via an intravenous route, so clinicians who utilize it must be capable of establishing an intravenous line. Naloxone can be provided by intramuscular or intravenous means. Because many practices utilize sedation, especially for patients with a high level of anxiety about dental treatment, there should be a means to reverse respiratory depression due to excessive sedation.

The dental staff should have immediate access to medications and equipment used during dental emergencies. These supplies should be kept in a centrally located area, and their location should be known to all staff members. Several manufacturers supply the most commonly used emergency medications as a kit, and some will automatically ship new medications when those previously provided have expired. It remains prudent to have one staff member who periodically reviews the expiration dates of all emergency medications and orders replacements for those that have been used for an emergency situation. The indications and appropriate use for these medications should be communicated to all staff members.

OXYGEN

The use of oxygen is common in many medical emergencies. A portable oxygen cylinder (E-size) with a nasal cannula or nasal hood should be present in each office. The oxygen cylinder(s) should be checked periodically for the appropriate volume of oxygen, as even a small leak can cause loss of the entire volume of oxygen. All staff members should know how to operate these oxygen cylinders. Some offices may have nitrous oxide and oxygen delivery systems for each operatory. However, the tubing for these systems is not long enough to reach a stricken person beyond the operatory itself. Therefore, even offices with these systems should have portable oxygen cylinders available. Replacement tanks should be ordered after a cylinder has been used for an emergency situation.

CIRCULATION AND AEDs

Monitoring vital signs is critical to any emergency situation, so each office should have a stethoscope and a sphygmomanometer to record blood pressure. Several automated devices that record vital signs are available and may be useful when patient movement, such as during a seizure, makes a manual blood pressure assessment difficult.

Some states require that each dental practice have an AED and that staff be trained in its proper use. These devices should be a part of every dental practice even if there is no requirement by law to do so. Most manufacturers can provide training for the entire staff via in-office presentations or training videos. AED training should be incorporated into practice emergency drills so each staff member can use this device in an emergency situation. Voice prompts guide the operator for proper assessment and use of the AED during a cardiac emergency. Because long intervals can pass between uses of this device, its batteries should be checked at regular intervals.

CONCLUSION

This course has reviewed some of the most common medical emergencies that can occur during dental treatment, but it is beyond the scope of this course to discuss the exhaustive list of all medical emergencies that can occur. All members of the dental staff should be prepared to act decisively when a patient is stricken with an acute medical problem. This can only happen if the staff has been adequately trained and has actively participated in preparatory medical emergency drills.

As noted, medical emergencies occur in less than 0.5% of dental treatments; however, the American Dental Association has reported that 3% of all litigation against dentists originated from the failure to properly respond to a patient who developed a medical emergency during dental treatment [29; 47]. Knowledge of the different kinds of medical emergencies and the corresponding emergency treatment protocols and medications empower the dental staff to act appropriately when a medical emergency arises. These problems may be infrequent in the dental setting, but because the possibility always exists, the dental staff should never be complacent about this issue. There is more than just a moral and ethical obligation to respond appropriately and to stabilize the patient before EMS arrives. A dental staff with proper training and equipment can save a life.

Works Cited

1. Malamed SF. Knowing your patients. *J Am Dent Assoc*. 2010;141(Suppl 1):3S-7S.
2. Centers for Disease Control and Prevention. Prevalence of Multiple Chronic Conditions Among U.S. Adults, 2018. Available at https://www.cdc.gov/pcd/issues/2020/20_0130.htm. Last accessed January 19, 2023.
3. National Council on Aging. The Top 10 Most Common Chronic Conditions in Adults. Available at https://www.ncoa.org/article/the-top-10-most-common-chronic-conditions-in-older-adults. Last accessed January 19, 2023.
4. Cleveland Clinic. Syncope. Available at https://my.clevelandclinic.org/health/diseases/17536-syncope. Last accessed January 19, 2023.
5. LexiComp Online. Available at https://online.lexi.com. Last accessed January 19, 2023.
6. American Heart Association. Heart disease and stroke statistics—2022 update: a report from the American Heart Association. *Circulation*. 2022;145(8):e153-e639.
7. Malamed S. *Medical Emergencies in the Dental Office*. 8th ed. St. Louis, MO: Elsevier; 2022.
8. Rosenberg M. Preparing for medical emergencies: the essential drugs and equipment for the dental office. *J Am Dent Assoc*. 2010;141(Suppl 1):14S-19S.
9. Reed KL. Basic management of medical emergencies: recognizing a patient's distress. *J Am Dent Assoc*. 2010;141(Suppl 1):20S-24S.
10. Homayounfar SH, Broomandi SH. Evaluation of entonox as an analgesic for relief of pain in patients with acute myocardial infarction. *Iran Heart J*. 2006;7(3):16-19.
11. Malamed SF. Emergency medicine. *Dental Economics*. 2010;100(2):38-43.
12. National Institute of Neurological Disorders and Stroke. What You Need to Know About Stroke. Available at https://stroke.nih.gov/materials/needtoknow.htm. Last accessed January 19, 2023.
13. Haas DA. Preparing dental office staff members for emergencies: developing a basic action plan. *J Am Dent Assoc*. 2010;141 (Suppl 1):8S-13S.
14. Longnecker DE, Grazis PA, Eggers GW Jr. Naloxone for antagonism of morphine-induced respiratory depression. *Anesth Analg*. 1973;52(3):447-453.
15. Klotz U, Kanto J. Pharmacokinetics and clinical use of flumazenil (Ro 15-1788). *Clin Phamacokinet*. 1988;14(1):1-12.
16. National Institute of Allergy and Infectious Diseases. Guidelines for the diagnosis and management of food allergy in the United States: report of the NIAID-sponsored expert panel. *J Allerg Clin Immunol*. 2010;126(6):S1-S58.
17. American Diabetes Association. Statistics About Diabetes. Available at https://diabetes.org/about-us/statistics/about-diabetes. Last accessed January 19, 2023.
18. Little JW, Rhodus NL. Pharmacologic management of type 1 diabetes: a review for dentistry. *Gen Dent*. 2007;55(5):403-409.
19. Ryan ME. Diagnostic and therapeutic strategies for the management of the diabetic patient. *Compend Contin Educ Dent*. 2008;29(1):32-44.
20. Kidambi S, Patel SB. Diabetes mellitus: considerations for dentistry. *J Am Dent Assoc*. 2008;139(Suppl):8S-18S.
21. Dym H. Preparing the dental office for medical emergencies. *Dent Clin N Am*. 2008;52(3):605-608.
22. Centers for Disease Control and Prevention. FastStats: Asthma. Available at https://www.cdc.gov/nchs/fastats/asthma.htm. Last accessed January 19, 2023.
23. Malamed SF. Emergency medicine: beyond the basics. *J Am Dent Assoc*. 1997;128(7):843-854.
24. Masoli M, Fabian D, Holt S, Beasley R, Global Initiative for Asthma (GINA) Program. The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy*. 2004;59(5):469-478.
25. Steinbacher DM, Glick MD. The dental patient with asthma: an update and oral health considerations. *J Am Dent Assoc*. 2001;132(9):1229-1239.
26. Centers for Disease Control and Prevention. Allergies and Hay Fever. Available at https://www.cdc.gov/nchs/fastats/allergies.htm. Last accessed January 19, 2023.
27. Idsoe O, Guthe T, Willcox RR, De Week AL. Nature and extent of penicillin side reaction, with particular reference to fatalities from anaphylactic shock. *Bull WHO*. 1968;38:159-188.
28. Cleveland Clinic. Medication Allergies. Available at https://my.clevelandclinic.org/health/diseases/8621-medication-allergies. Last accessed January 19, 2023.
29. Castle MJ. Is your office ready for an automatic external defibrillator? *Implant News and Views*. 2008;10(4):3-5.
30. Detoraki C. Anaphylaxis: How to Recognize and Treat This Medical Emergency. Available at https://www.zerodonto.com/en/2010/05/anaphylaxis. Last accessed January 19, 2023.
31. Sharma R, Sinha R, Menon PS, Sirohi D. Management protocol for anaphylaxis. *J Oral Maxillofacial Surg*. 2010;68(4):855-862.
32. Volcheck GW. *Clinical Allergy: Diagnosis and Management*. New York, NY: Humana Press; 2009.
33. Behrman AJ. Latex Allergy. Available at https://emedicine.medscape.com/article/756632-overview. Last accessed January 19, 2023.

34. Pediatric Dental Health. Local Anesthetic Use in Children. Available at http://dentalresource.org/topic38anesthesia.htm. Last accessed January 19, 2023.
35. Malamed SF. Allergy and toxic reactions to local anesthetics. *Dentistry Today*. 2003.
36. Malamed SF. *Handbook of Local Anesthesia*. 7th ed. St. Louis, Missouri: Elsevier-Mosby; 2019.
37. Wood M. Pharmacokinetic drug interactions in anesthetic practice. *Clin Pharmacokinet*. 1991;21(4):285-307.
38. Munson ES, Tucker WK, Ausinsch B, Malagodi MH. Etidocaine, bupivacaine, and lidocaine seizure thresholds in monkeys. *Anesthesiology*. 1975;42(4):471-478.
39. Epilepsy Foundation. Types of Seizures. Available at https://www.epilepsy.com/what-is-epilepsy/seizure-types. Last accessed January 19, 2023.
40. Pingarrón Martín L, Morán Soto MJ, Sánchez Burgos R, Burgueño García M. Bronchial impaction of an implant screwdriver after accidental aspiration: report of a case and revision of the literature. *Oral Maxillofac Surg*. 2010;14(1):43-47.
41. Umesan UK, Chua KL, Balakrishnan P. Prevention and management of accidental foreign body ingestion and aspiration in orthodontic practice. *Clin Risk Manag*. 2012;8:245-252.
42. National Institute of Neurological Disorders and Stroke. Stroke: Hope Through Research. Available at https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Hope-Through-Research/Stroke-Hope-Through-Research. Last accessed January 19, 2023.
43. American Academy of Allergy, Asthma and Immunology. Drug Allergy. Available at https://www.aaaai.org/Conditions-Treatments/allergies/drug-allergy. Last accessed January 19, 2023.
44. Xu G, Liu B, Sun Y, et al. Prevalence of diagnosed type 1 and type 2 diabetes among U.S. adults in 2016 and 2017: population-based study. *BMJ*. 2018;362:k1497.
45. Donaldson M, Goodchild JH. Making dentistry even safer: understanding the proper choice and use of emergency medications. *CDA Journal*. 2019;47(7):455-463.
46. Sangrik LS. Medical Emergency Preparedness in Dentistry: A Comparison between the Public's Expectations and State Dental Board's Requirements [White Paper]. Available at http://www.interactivedentalseminars.com/files/Amer.%20Assoc%20of%20Dental%20Boards%202018.pdf. Last accessed January 19, 2023.
47. Obata K, Naito H, Yakushiji H, et al. Incidence and characteristics of medical emergencies related to dental treatment: a retrospective single-center study. *Acute Med Surg*. 2021;8(1):e651.

Evidence-Based Practice Recommendations Citations

Australasian Society of Clinical Immunology and Allergy. ASCIA Guidelines: Acute Management of Anaphylaxis. Available at https://www.allergy.org.au/images/ASCIA_HP_Guidelines_Acute_Management_Anaphylaxis_2023.pdf. Last accessed January 25, 2023.

Johnson VB, Chalmers J. *Oral Hygiene Care for Functionally Dependent and Cognitively Impaired Older Adults*. Iowa City, IA: University of Iowa College of Nursing, John A. Hartford Foundation Center of Geriatric Nursing Excellence; 2012. Available at http://m4.wyanokecdn.com/6c3b9e6272d6a4834c6dc9b1c2ce3e04.pdf. Last accessed January 25, 2023.