Management of Pediatric Medical Emergencies in the Dental Office

Course Author(s): Steven Schwartz, DDS; Jayakumar Jayaraman, BDS, MDS, FDSRCS, MS, PhD
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- Dr. Schwartz was a member of the dentalcare.com Advisory Board. He has no relevant financial relationships to disclose.
- Dr. Jayakumar Jayaraman reports no conflicts of interest associated with this course. He has no relevant financial relationships to disclose.

Introduction – Pediatric Medical Emergencies

Successful management of medical emergencies by the Dentist requires preparation, prevention and knowledge of definitive management. The responsibility is held just not by the dentist but also by all dental staff members involved in the patient care. Although the primary focus of the Management of Pediatric Medical Emergencies in the Dental Office is the pediatric dental patient, adult medical emergencies should also be addressed, as necessary.

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Overview

Although uncommon, pediatric medical emergencies can occur in the dental office. When they do happen, they happen quickly without warning and with possible dire consequences. A child's under-developed physiology coupled with small oxygen reserves requires early recognition of the problem and swift definitive treatment.

Since adults accompany the pediatric patient to the dental office, there is a strong possibility that the accompanying adult may present with the emergency. Although the primary focus of this course is the pediatric dental patient, adult medical emergencies will also be addressed in this course.

The dentist's successful management of medical emergencies requires preparation, prevention, and knowledge of definitive management not just by the dentist but also by all dental staff members involved in the patient care.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Identify predisposing factors for medical emergencies.
- Structure an effective office medical emergency team.
- Choose the appropriate emergency drug kit and equipment.
- Recognize and provide definitive treatment for the following medical emergencies:
  - Syncope
  - Mild and anaphylactic allergic reactions
  - Acute asthmatic attack
  - Local anesthetic and vasoconstrictor toxicity
  - Hypoglycemia and hyperglycemia
  - Seizures
  - Respiratory distress
  - Drug overdose – benzodiazepines, narcotics
  - Cardiac arrest

Introduction

Although rare, medical emergencies do occur in the dental office. While the majority of medical emergencies occur in adult patients, pediatric medical emergencies can occur too. Pediatric medical emergencies occur quickly, without warning, and with possible severe consequences due to the child's under-developed physiology coupled with small oxygen reserves. Successful resolution of the emergency requires early recognition of the problem and swift definitive treatment.[1]

The primary focus of this course is the pediatric dental patient. However, adult medical emergencies will also be addressed as adults accompany pediatric patients to their appointments. Although the child is the one receiving dental treatment, there is a strong possibility it will be the accompanying adult that will experience the emergency. The most common medical emergency seen by dentists is syncope, and the vast majority of these events occur in adults.[2]

The dental office's successful management of medical emergencies requires preparation,

prevention, and response not just by the dentist but by all dental staff members involved in the patient care.

Preparation

Adequate preparation for emergencies reduces the possibility of an emergency occurring and further complications if it does occur. Preparation steps include:

- Taking and reviewing a comprehensive medical and dental history.
- Providing minimum basic life support (BLS) training for providers and staff.
- Advanced Cardiac Life Support (ACLS) or Pediatric Advanced Life Support (PALS) training, especially for those administering sedation and general anesthesia.
- Initiation and coordination of an office emergency team.
- Organizing an emergency drug kit and equipment.
- Retraining on a regular basis.

Medical and Dental History

Taking a comprehensive medical and dental history and noting not only contraindications to dental treatment but also previous medical and psychological experiences that can precipitate a medical emergency is important. This alerts the clinician and staff to any precautions or preparations that need to be taken to avert and manage an emergency. For example, a diabetic patient may not only have compromised healing but may undergo a hypoglycemic incident because of low blood glucose level due to not eating or excessive stress before and during treatment. Patients and parents of pediatric patients with previous negative dental experiences may develop syncope prior, during, and post-treatment due to anticipated or unanticipated discomfort, the sight of dental instruments, or upon seeing blood drenched gauze. The patient's medical problems and related potential emergency situations should be noted in a prominent location in the patient's chart so staff can prepare the necessary emergency drugs and equipment prior to seating the patient.

Staff Training and Duties

All staff involved in direct patient care should receive training in recognition of emergency situations and Basic Life Support (BLS). A receptionist at the front desk will be the one most likely to be alerted to an emergency in the waiting area. All staff should be familiar with the location of the emergency drug kit, monitoring and resuscitation equipment as well as Emergency Medical Services (EMS). For greater efficiency, each staff member should be assigned a predefined role during an emergency. Periodically these roles should be reassigned to other personnel, so staff is familiar with all aspects of emergency management. An efficient emergency team can be organized with as few as two or three staff. In offices where sedation and general anesthesia is administered, training in PALS or ACLS is recommended for the Dentist and in some states, this is required for the clinical staff. A suggested assignment of duties follows:

Team member #1 is the first person on the scene when the emergency occurs. Thus, every staff member should be familiar with the Team Member #1 duties since an emergency can occur in any location within the office. After the initial activation of the emergency team, a team with advanced training can assume the role of Team Member #1. Upon discovery of an emergency patient:

Team member #1 duties include:

- Alerting other office staff members.
- Activating BLS (Positioning, Circulation, Airway maintenance, Breathing, Definitive treatment) after assessing the victim's responsiveness.
- Staying with the victim.

Team member #2 duties include:

- Retrieval of the emergency drug kit, Oxygen cylinder, monitoring equipment and automated electronic defibrillator (AED) to the emergency site.
- Assist with BLS.
- Contact EMS, if deemed necessary and there is no other team member available.
- Check the level of Oxygen in the cylinder daily.
- Check the emergency kit weekly.
- Check the AED and monitoring equipment weekly.

Team member #3 duties include:

- Assist with BLS.

- Consult with family accompanying patient as to previous history and management of emergency.
- Contact EMS, if deemed necessary.
- Monitor vital signs.
- Prepare emergency drugs for administration.
- Meet the rescue team at the building entrance and escort them to the office.

Emergency Medical Service Contact

Once the determination is made that involvement of EMS is necessary, their prompt arrival is crucial. To facilitate this, the following information should be given to the EMS operator:

- The location of the emergency with the names of cross streets and the office and room number.
- The telephone number from where the call is being made.
- What happened - an accident, a medical condition, a reaction during treatment?
- How many people need help?
- What is the condition(s) of the victim(s)?
- What aid is being given to the victim(s) (CPR, drugs, AED)?
- Any other information requested.

To ensure the EMS personnel have no more questions, do not hang up until after the operator terminates the phone call.

Refresher Training

Since medical emergencies in the dental office are a rare occurrence, it is easy for staff members to not remember the process because of the lack of practice. Although recertification is required usually at two-year intervals, periodic in-office drills are recommended. Some suggestions are:

- **Mock Codes** – Medical emergency scenarios are presented to staff members. Mannequins or large life-like dolls can make the exercise more realistic. It can also be done through role playing as staff members can identify and practice the different member duties and responsibilities for various emergency situations.
- **Scavenger Hunt** – A staff member is given a list of items needed for a particular emergency and is required to obtain and prepare them for administration and use within a given amount of time.[1]

Emergency Equipment and Drugs

Trained office personal must have the appropriate emergency equipment and drugs available to render definitive treatment when indicated. All staff members should know where emergency equipment and drugs are located. A specific area or box can be prepared with the equipment and drugs readily available to be transported to the site of the emergency.

There are emergency kits produced commercially for sale to dental and medical professionals, including crash cart **(Figure 1)**.

Figure 1.

It is essential to have all the medications and equipment readily available in the emergency kit. For this purpose, the contents in the crash cart are marked and labelled. For example, the top two drawers consist of emergency medicines, including oral medications **(Figure 2)** and parenteral medications **(Figure 3)**, and the bottom drawers comprises of intubation **(Figure 4)** and airway equipment **(Figure 5)**. Some of the emergency kits may contain equipment and drugs of questionable value in a dental office setting because of limited medical training of the dentist and staff. For example, an emergency drug kit containing IV resuscitative drugs would be of negligible value to an emergency treatment provider with unfamiliarity in IV placement whether due to lack of training or not having the opportunity to practice the

Figure 2.

Figure 3.

Figure 4.

Figure 5.

technique due to rare exposure to dental office emergencies. A laryngoscope is not an essential piece of emergency equipment for those not trained in intubation technique.

Office personnel should be able to provide basic management of airway, breathing and circulation. This can be achieved with basic medical equipment and essential drugs that dentists without advanced life support training can feel comfortable using. For the Dentist and staff members involved in the provision of sedation or general anesthesia, it is imperative to have adequate training in providing pediatric advanced life support in case of emergency. In this case, the emergency kit should contain all the medications and equipment to effectively handle such emergencies.

Emergency Equipment

Emergency oxygen - The basic goal of nearly all emergencies in the dental office is to maintain sufficient oxygenation of the brain and heart. Thus, oxygen should be available for every emergency except hyperventilation. It should be provided with a clear face mask for patients with spontaneous breathing, and a bag-valve mask for the apneic patient in both adult and pediatric sizes. The oxygen should be available as a portable unit with an "E" size cylinder that can deliver greater than 90% oxygen at a flow of 5 L/min for a minimum of 60 minutes. For ease of transport and delivery, the oxygen cylinder is usually attached to the emergency crash kit trolley **(Figure 6)**. The Dentist must perform periodic check to ensure that the volume and pressure of oxygen in the tank is at appropriate levels.

Suctioning equipment - Although usually available in the treatment room, a portable suction unit is useful for suctioning fluids and vomit if the emergency occurs in another area of the office (waiting room).

Automated electronic defibrillator (AED) - The AED is used during cardiac arrest to shock a defibrillating heart. Resuscitation with BLS during cardiac arrest is most successful if defibrillation is performed within 3 to 5 minutes of collapse.[2] Manual, automatic or semiautomatic defibrillators are available. Manual defibrillators require interpretation of a monitor or cardiac rhythm strip by a trained

Figure 6. "E" Size Oxygen Cylinder.

Figure 7. Automated electronic defibrillator (AED)

Figure 8. Pulse oximeter connected to a monitoring device on a patient receiving oral conscious sedation

rescuer. Automated and semi-automated AEDs analyze the patient's rhythm and advise the rescuer to defibrillate if ventricular tachycardia or ventricular fibrillation is present or to continue CPR if no pulse is present. The AED should accept adult and pediatric paddles **(Figure 7)**. The AED should be placed in an accessible location in the dental office. The Dentist and the staff members should be familiarized with its location for ready access in the event of emergency.

Pulse oximeter and blood pressure monitor - While pulse oximeters are usually found in dental offices where sedation and general anesthesia is administered to patients, they are useful in monitoring the effectiveness of CPR efforts. The pulse oximeter monitors the patient's pulse rate and the percent oxygenation of the blood. It is important to continuously monitor oxygenation in patients receiving sedation **(Figure 8)**.[3] This will help to address any deficiencies in oxygenation as most of the sedation medications may cause some level of respiratory depression.[4]

Emergency Drugs

Emergency drugs may be divided into two categories. The first category is drugs that are essential and should be part of every emergency drug kit. The second category consists of drugs that are useful but are optional depending on the practitioner's training in emergency medical procedures and whether sedation and general anesthesia are used for behavior and anxiety management. Thus, emergency drug kits will vary from office to office. A dentist trained to administer general and intravenous sedation with greater proficiency in venipuncture would have a more comprehensive drug kit than a dentist without such training. For dentists not proficient in venipuncture, optional drugs that can be administered orally, intramuscularly/ sublingually and intranasally will be discussed. For a more comprehensive review, kindly refer to American Dental Association's recently published guide on preparation of a dental team for medical emergencies.[5]

At the very least, a basic dental office emergency drug kit should contain the eight drugs summarized in **Table 1**.

For the dentists with advanced training and skills in sedation and general anesthesia, the additional emergency drugs in **Table 2** may be added to the drug kit.

Emergency Treatment

The following steps are taken for all emergencies:

- Discontinue dental treatment
- Activate the office emergency system
- Call for assistance
- The oxygen and emergency drug kit are brought to the site of the emergency
- Attend to the patient
- Position the patient to ensure an open and unobstructed airway
- Monitor vital signs
- Support respiration and circulation
- Provide definitive treatment
- Notify 911 if it is determined to be needed[2]

The following sections will discuss the definitive treatment for the most popular emergencies encountered in the dental office.

Syncope

Vasodepressor syncope is the most common emergency seen in dental offices and comprises of approximately 53% of all emergencies.[8] Although it occurs predominately in adults, since an adult accompanies all pediatric dental patients, it can readily occur in a pediatric dental office. Syncope occurs because of a "fight or flight" response and the absence of patient muscular movement, leading to a transient loss of consciousness. It is most common in young adults, most commonly between the ages of 16 to 35 years, and in men more than women. Pediatric patients rarely develop syncope because they do not hide their fears and readily react emotionally and physically during a stressful situation. If a pediatric patient or an adult older than 60 years exhibits syncope without predisposing factors, they should be sent for medical consultation.[9]

Predisposing factors for syncope can be divided into two categories, psychogenic or non-psychogenic factors.

<u>Psychogenic factors include</u>:

- Fright
- Anxiety (due to the anticipation of

Table 1. Essential Emergency Drugs.[6,7]

Drug	Indication	Dose	Quantity
Oxygen	Almost any emergency	100% inhalation	1 "E" cylinder with adjustable regulator (0-15L)
Epinephrine	Anaphylaxis Asthma unresponsive to albuterol/salbutamol	1: 1000 (1mg/ml), auto injector 0.3 mg/ml (EpiPen), 0.15 mg/ml (EpiPen Jr)	1:1000 mg/ml ampule, 1 EpiPen, 1 EpiPen Jr auto injectors
Nitroglycerin	Angina pain	0.4 mg sublingual every 3-5 minutes	1 metered spray bottle (0.4 mg)
Diphenhydramine	Allergic reactions	1 mg/kg IM/IV; max 50 mg *(See table 2 for dosage by age)*	50 mg/ml vials and 1 box 25 mg tablets
Albuterol/salbutamol	Asthmatic bronchospasm	2 puffs; repeat as needed	Metered dose inhaler 2.5 mg/3ml nebulized solution
Aspirin	Myocardial infarction	81 mg chewable tablet	Chewable tablet, bottle baby aspirin (81 mg)
Glucose	Hypoglycemia (patient unconscious)	37.5 mg; repeat as needed	1 tube (37.5 mg)

Table 2. Additional Emergency Drugs.[6]

Drug	Indication	Dose	Quantity
Atropine	Clinically significant bradycardia	0.5 mg IV or IM	1 ampule (1 mg/10 ml)
Hydrocortisone	Adrenal insufficiency Recurrent anaphylaxis	100 mg IV or IM (mixed with 3-5ml sterile water)	1 vial (100 mg)
Morphine or nitrous oxide	Angina pain unresponsive to nitroglycerin	Titrate 2 mg IV, 5 mg IM ~ 35% N2O inhalation	Titrate 2 mg IV, 5 mg IM ~ 35% N2O inhalation
Naloxone	Reversal of opioid overdose	0.1 mg/kg up to 2mg IV or IM	4 mg/10 ml multi-dose vial
Lorazepam or Midazolam	Status epilepticus	4 mg IM or IV 5 mg IM or IV	50 mg/10 ml multi-dose vial
Flumazenil	Benzodiazepine overdose	0.01 mg/kg at 1-minute intervals up to 1 mg IV or IM	0.5 mg / 5 ml multi-dose vial

discomfort or the fee)
- Emotional Stress
- Receipt of unwelcome news (treatment or the treatment fee)
- Sudden and unanticipated pain (injection or during treatment)
- The sight of blood (gauze, dental instruments)

A parent, with a history of negative dental experiences, accompanying their child for an emergency dental extraction, who was informed of the treatment fee, and is standing in the treatment room doorway, observing the extracted tooth in blood soaked gauze, is a prime candidate to develop syncope.

Non-psychogenic factors include:
- Sitting in an upright position (especially during the injection) or immobility while standing resulting in blood pooling in the peripheral extremities, decreasing the flow of blood to the brain.
- Hunger from dieting or missed meals resulting in decreased glucose supply to the brain.
- Exhaustion
- Poor physical condition
- Hot, humid environments

The physiological mechanism for the onset of syncope is:
- Stress causes increased amounts of catecholines (epinephrine, norepinephrine) to be released into the circulatory system to prepare the individual for increased muscle activity (fight or flight reaction in a threatening situation).
- The responses to the catecholine release are decreased peripheral vascular resistance and increased blood flow to the peripheral skeletal muscles.

If muscle activity occurs (fight or flight), the blood volume diverted to the muscles is returned to the heart. If muscle activity does not occur (sitting or standing still), there is increased peripheral pooling of the blood in the extremities and a decreased return of blood to the heart. This leads to a decrease in the circulating blood volume, a drop in arterial blood pressure and diminished cerebral blood flow resulting in syncope. Not managing the body's mechanism to compensate for the decreased circulatory volume in a timely manner leads to:
- Reflex bradycardia
- Decreased cardiac output
- Decreased blood pressure
- Cerebral ischemia
- Convulsions

The signs and symptoms of syncope are divided into early and late stages.

In the early stage the patient:
- Expresses feeling warm
- Exhibits loss of color with an ashen-gray skin tone
- Perspires heavily
- Reports "feeling bad" or "feeling faint"
- Reports feeling nauseous
- Exhibits slightly lower blood pressure and tachycardia

In the late stage the patient exhibits:
- Pupillary dilation
- Yawning
- Hyperpnea
- Cold extremities
- Hypotension
- Bradycardia
- Visual disturbances
- Dizziness
- Loss of consciousness

Emergency Management

The first step in the management of syncope is prevention. This is accomplished by:
- Taking a thorough medical and dental history to identify any predisposing factors that might contribute to syncope, i.e., previous history of syncope, a fear of dental treatment due to previous traumatic dental experiences or pain, and hypoglycemia.
- Patients, especially those that are anxious, should eat a light meal prior to treatment to maintain a stable blood glucose level during stressful treatment.
- Patients should be treated in a supine or semi-supine position (30-45 degrees), especially during the injection.
- Consider the use of anxiety techniques such as premedication and nitrous oxide anxiolysis.

Should a patient experience syncope, the following steps should be taken that includes **P>C>A>B (Position > Circulation > Airway > Breathing):**

- **Discontinue treatment**
- **Assess the level of consciousness:** Evaluate the patient's lack of response to sensory stimulation.
- **Activate the office emergency system:** Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
- **Position the patient:** The patient should be in a supine position with the feet elevated slightly.
- **Assess airway and circulation:** Assess the patient's breathing and airway patency and adjust the head and jaw position accordingly; monitor the pulse and blood pressure.
- **Provide definitive care:**
  - Administer oxygen
  - Monitor vital signs
  - Administer aromatic ammonia ampoules **(Figure 9)**. Crush the ampule between the fingers and position it under the patient's nose. The irritating fumes stimulate movement of the extremities and aids in blood return from the peripheral areas to the heart and brain.

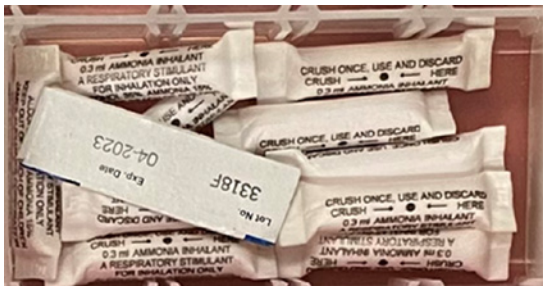

Figure 9. Ammonia ampoules

- **Postsyncopal management:** If recovery occurs in less than 15 minutes, postpone further dental treatment. If recovery is delayed by more than 15 minutes, contact EMS while continuing definitive care until arrival of trained emergency care providers.
- **Determine precipitating factors:** Determine the cause of the syncope (anxiety, the sight of blood, unexpected pain, hypoglycemia, etc.).[9]

Allergic Reactions

Allergic reactions are hypersensitive responses by the body's immune system to antigens that are recognized as foreign bodies, with subsequent antibody formation. There are four types:

- Anaphylaxis (immediate, antigenic-induced, antibody mediated)
- Cytotoxic (antimembrane)
- Immune complex (serum-sickness like)
- Cell mediated (delayed)

In this course the discussion will be limited to the anaphylactic and cell mediated types.

For an allergic reaction to occur, the patient must have been previously exposed to the antigen (sensitizing dose). The subsequent exposure to the antigen (challenge dose) causes the reaction. The latent period (the time between the sensitizing dose and the challenge dose) when the IgE antibody is produced varies in duration. The duration and severity of the reaction will vary by the individual.[10]

Anaphylactic Allergic Reactions

An anaphylactic reaction is due primarily to the release of histamine from IgE sensitized mast cells. Histamine produces inflammation and vascular effects such as:

- Cardiovascular
  - Capillary dilation and increased capillary permeability resulting in blushing and edema formation.
  - Decreased venous return, blood pressure and cardiac output.
- Stimulation of secretions
  - Increased secretions by the mucous, lacrimal, salivary, pancreatic, gastric and intestinal glands.
- Respiratory
  - The above described effects can lead to asphyxia from upper respiratory tract obstruction.

It is possible for the patient to develop an *anaphylactoid* reaction which mimics a true IgE mediated anaphylaxis reaction. An *anaphylactoid* reaction is an idiosyncratic reaction that occurs when the patient is first exposed to a drug or

other agent. Although it is not immunologically mediated, the emergency management is the same as a true anaphylactic reaction.

There are several primary allergic agents used in dentistry:

- **Antibiotics (penicillins, cephalosporins, tetracyclines, sulfonamides)**: Parenterally administered penicillin can cause an anaphylactic reaction. The incidence of allergy from Penicillins ranges from 0.7 to 10% and around 2.5 million persons have been estimated to have allergy to Penicillins in the United States.[11] Orally administered usually causes a delayed reaction. Patients may not realize they have been previously exposed to a sensitizing dose because the exposure could have been environmental, i.e., penicillin mold in the air, meat, and milk.
- **Analgesics (aspirin, opioid, NSAIDS)**: Symptoms can range from mild urticaria to anaphylaxis. Bronchospasm is the most common reaction. For patients with a known allergy to the above analgesics, acetaminophen should be prescribed.
- **Local anesthetics (esters, procaine, benzocaine, tetracaine)**: Injectable and topical ester local anesthetics have been primarily implicated in allergic reactions. Reported allergic reactions in amides are probably due to reactions to preservatives such as parabens and sodium metabisulfate.
- **Other agents**: Acrylic resins (denture repairs) and latex (gloves, rubber dams) primarily cause contact dermatitis.

An anaphylactic episode is exhibited by the following reactions:

- Skin
  - Urticaria - itching, hives (elevated patches of skin)
  - Erythema – rash
  - Angioedema - localized swelling
- Respiratory
  - Bronchospasm - respiratory distress, wheezing
  - Angioedema to the larynx leading to airway obstruction
  - Rhinitis
- Cardiovascular reactions
  - Circulatory collapse due to vasodilation presented by light headedness, weakness, syncope and ischemic chest pain
  - Dysrhythmias - as above plus palpitations
  - Cardiac arrest

The progression of symptoms is:

1. Skin
2. Eyes, nose, GI
3. Respiratory system
4. Cardiovascular system

Emergency Management

Should a patient experience an anaphylactic episode, the following steps should be taken:

- **Assess the problem:** Recognize and acknowledge itching, hives, edema, flushed skin.
- **Discontinue treatment**
- **Activate the office emergency system:** Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
- **Position the patient:** The patient should be positioned comfortably.
- **Assess circulation, airway and breathing:** Monitor the patient's pulse and blood pressure. Provide BLS as needed. Assess the patient's airway patency, breathing and adjust the head and jaw position accordingly. If the patient's condition continues to worsen, contact EMS.
- **Provide definitive care:** Administer epinephrine. Epinephrine counteracts most of the effects of histamine. It produces bronchodilation, raises blood and the heart rate via its α and ß effects and counters skin rash, urticaria and angioedema by an unknown mechanism.

While available in 1 ml ampules of 1:1000 (0.30 mg/dose) for adults and 1:2000 (0.15 mg/dose) for children that is drawn into and administered via a syringe **(Figure 10)**. A more efficient manner of administration during an emergency is with an EpiPen.

Figure 10.
Epinephrine injection

EpiPen (0.3 mg epinephrine) and EpiPen Jr (0.15 mg epinephrine) are preloaded epinephrine autoinjectors. They are extremely easy to use and are routinely available with prescription to the public for everyday allergic reactions (insect bites, food allergies).

Directions for use of EpiPen:
1. Pull off the blue safety release cap.
2. Swing and firmly push the orange tip against the outer thigh so it "clicks." HOLD the EpiPen on the thigh for approximately 10 seconds to deliver the drug. Do not inject intravenously as this can cause ventricular tachycardia or into the buttock as this may reduce drug efficacy.

Epinephrine is administered every 15 minutes until recovery or help arrives.

Mild or Delayed Allergic Reactions

Mild or delayed allergic reactions present as a less severe reaction to allergens than anaphylaxis. They can occur as a reaction to such things as oral antibiotics, latex and (cold cure) acrylics. The signs and symptoms are classified as skin allergies: urticaria (itching), angioedema and, respiratory allergies: rhinitis, laryngeal edema, and bronchospasm.[12]

Treatment consists of
- Discontinuing the source of the allergy.
- Administration of oral diphenhydramine at a dosage of 1 mg/kg every six hours for children or 25-50 mg for adults every 6 hours for 24 to 48 hours. Diphenhydramine is available in an oral form 12.5 mg/5 ml **(Figure 11)** and 1 ml ampules or Min-i-jet (50 mg/ml) **(Figure 12)**.

Acute Asthmatic Attack

Asthma is defined as a chronic inflammatory disorder that is characterized by reversible obstruction of the airways. Approximately 9.5% of children in the United States suffer from asthma. Asthma is the most chronic childhood disease that affects around 7.1 million children in the United States.[13] Half of all cases develop before patients reach 10 years of age. It appears more frequently in African American and Hispanic populations. Most of the acute asthmatic episodes are usually self-limiting.

Figure 11. Diphenhydramine for oral use

Figure 12. Diphenhydramine for parenteral use

In contrast, status asthmaticus is the most serious clinical condition that manifests with wheezing, dyspnea, and hypoxia. Patients with this condition do not respond to bronchodilators and it is considered as a true emergency.

Asthma is classified into 2 categories; extrinsic (allergic asthma) and intrinsic (non-allergic asthma).

Extrinsic asthma occurs more often in children. It is triggered by specific allergens such as pollens, dust, molds, and highly allergenic foods such as milk, eggs, fish, chocolate, shellfish,

and tomatoes. Drugs and chemicals such as penicillin, vaccines, aspirin, and sulfites can trigger an allergic asthmatic attack. Approximately 50% of asthmatic children outgrow extrinsic asthma by late teens or early twenties.[14]

Intrinsic asthma usually develops in adults older than age 35 years. Attacks are precipitated by non-allergic factors, respiratory infection, physical exertion, environmental and air pollution. Psychological and physiologic stress can induce an attack. The stress of disciplinary action by a parent or entering the treatment area in a dental office can trigger an asthmatic attack in children and adults.

With either type of asthma the mechanism for initiating an attack is the same. The allergen or non-allergen factors stimulates the vagus nerve to release acetylcholine which produces constriction of the airways and increased glandular secretions which plug the small airways in the lungs leading to bronchial edema and airway obstruction.

The signs and symptoms of an acute asthmatic attack are:
- Shortness of breath
- Wheezing and coughing
- Tightness in the chest
- Hypoventilation
- Cyanosis
- Tachycardia

The management of an asthmatic patient begins with the pretreatment history. Ask the patient:
- How attacks occur and their severity
- What triggers attacks
- What medications are taken

If the patient uses a self-administered bronchodilator aerosol during acute asthmatic attacks e.g., albuterol (Proventil, Ventolin) isoproterenol (Isuprel) or metaproterenol (Metaprel, Alupent), they should bring it to their appointment. The bronchodilators produce bronchial smooth muscle relaxation. Albuterol has the least side effects of all the bronchodilators and should be the drug of choice for inclusion in the emergency drug kit. **(Figure 13).**

Figure 13. Ventolin (Albuterol sulphate) for inhalation.

The steps in emergency management of an acute asthmatic episode are:
- Terminate treatment and remove all dental materials and instruments from the patient's mouth.
- Sit the patient upright or in a comfortable position with the arms thrown forward over a chair back.
- Administer a bronchodilator supplied by the patient or from the emergency drug kit. The directions for use of the aerosol inhaler are:
  - The patient holds the inhaler 1 or 2 inches in front of their mouth.
  - The inhaler is placed in the mouth.
  - As the patient breaths in slowly through their mouth, they press down on the inhaler one time.
  - The patient continues breathing as deep as they can and holds their breath for 10 seconds.
  - Improvement should occur within 15 seconds.
  - If there is no improvement, the process should be repeated.
- If after three doses of the bronchodilator there is no improvement, take additional measures:
  - Administer oxygen
  - Call for medical assistance
  - Administer epinephrine 1:1000 concentration for an adult, 1:2000 concentration for a child.
- If possible, determine the cause of the attack (anxiety, air contaminants).
- If the attack is resolved quickly, the patient may be discharged on their own. If medical assistance or the administration of

epinephrine is necessary, the patient should be discharged to EMS for transport to the hospital.[14]

Anesthetic Toxicity (Overdose)

While rare in adults, young children are more likely to experience toxic reactions because of their lower weight and inadequate growth and development. Most adverse drug reactions occur within 5-10 minutes of injection without vasoconstrictor and around 30 minutes for local anesthetics with vasoconstrictor.[15] Local anesthetic toxicity is caused by high blood levels of anesthetic because of:

- Exceeding recommended local anesthetic dosages
- Inadvertent intravascular injection
- Repeated injections
- Idiosyncratic responses
- Interactive effects with other agents (sedatives)

The signs and symptoms of local anesthetic toxicity are biphasic; initial excitation, followed by depression. During the initial excitation stage, there is CNS stimulation of the heart rate and blood pressure increases. As blood plasma levels of the anesthetic increase, vasodilatation occurs followed by depression of the myocardium with subsequent fall in blood pressure. Bradycardia and cardiac arrest may follow.

Early subjective symptoms of the central nervous system include dizziness, anxiety and confusion and may be followed by diplopia, tinnitus, drowsiness and circumoral numbness or tingling.

Objective signs include muscle twitching, tremors, excessive talking, slowed speech and shivering followed by overt seizure activity. Unconsciousness and respiratory arrest may occur.

Local anesthetic toxicity is preventable by following proper injection technique, i.e., aspiration during slow injection to detect intravascular injection. Amongst all intraoral injections, the most positive aspirations were recorded for inferior alveolar nerve block (11.7%), followed by mental nerve block (5.7%).16 Clinicians should be knowledgeable of maximum dosages based on weight **(Table 3)**.

If lidocaine topical anesthetic is used, it should be factored into the total administered dose of lidocaine as it can infiltrate into the vascular system. After injection, the patient should be observed for any possible toxic response as early recognition and intervention is the key to a successful outcome.

Table 3. Maximum Recommended Dosage of Local Anesthetic Agents.[17]

Anesthetic	Max Dosage mg/kg	Max Dosage mg/lb	Maximum total dosage	Mg anesthetic/1.7ml cartridge	Mg of vasoconstrictor /1.7ml cartridge
Lidocaine 2% 1:100,000 epi	4.4	2.0	300 mg	34 mg	0.034 mg
Mepivicaine 2% 1:20000 levonordefrin	4.4	2.0	300 mg	51 mg	0.085 mg
Articaine 4% 1:100,000 epi	7.0	3.2	500 mg	68 mg	0.017mg
Prilocaine 4% plain	6.0	2.7	400 mg	68 mg	-
Bupivicaine 0.5% 1:200,000 epi	1.3	0.6	90 mg	8.5 mg	0.0085 mg

Emergency Management
Should a patient experience local anesthetic toxicity, the following steps should be taken:
- Stop treatment.
- Assess and support the airway, breathing and circulation.
- Administer oxygen via mask.
- Monitor vital signs.
- If the patient exhibits tonic-clonic seizures, follow the protocol for seizures (see the section on Seizures). With proper airway management the seizure should subside within two minutes as the level of local anesthetic decreases and the patient regains consciousness.
- Contact EMS if consciousness is not regained within 2 minutes.

Allergic Reaction to Local Anesthetics

Although allergic reactions to injectable amide local anesthetics are rare, patients may exhibit a reaction to the bisulfite preservative added to anesthetics containing epinephrine. Patients with a sulfa allergy should not receive articaine. Patients may also exhibit allergic reactions to benzocaine topical anesthetics. Allergies can manifest in a variety of ways including urticaria, dermatitis, angioedema, fever, photosensitivity and anaphylaxis. If the patient exhibits an allergic reaction to a local anesthetic or any of its additives, follow the protocol for management of allergic reactions.[15]

Anesthetic Reaction to Vasoconstrictors

Vasoconstrictors (epinephrine and levonordefrin) are added to local anesthetics to counteract their vasodilatory action by constricting blood vessels, thus decreasing blood flow to the injection area. The absorption of the local anesthetic into the cardiovascular system is slowed resulting in lower anesthetic levels, minimizing the risk of local anesthesia toxicity and increasing the duration of anesthesia by allowing the local anesthesia to remain around the nerve for a longer period of time.

If too much vasoconstrictor is injected or the anesthetic is injected intravascularly, the vasoconstrictor is absorbed into the vascular system just as the anesthetic (see Table 3). Overuse of gingival retraction cord, especially in patients with a history of cardiovascular disease can cause vasoconstrictor toxicity. Increased vasoconstrictor into the blood stream causes moderate increases in systolic and diastolic blood pressures, cardiac output and stroke volume. These actions lead to an overall decrease in cardiac efficiency.

After reviewing the pre-operative medical history, the vasoconstrictor use should be avoided or minimized in:
- Patients with a blood pressure in excess of 200 mm Hg systolic or 115 mm Hg diastolic.
- Patients with uncontrolled hyperthyroidism.
- Patients with severe cardiovascular disease.
  - Less than 6 months after myocardial infarction, post-coronary bypass surgery or cerebrovascular incident.
  - Daily episodes of angina pectoris.
  - Cardiac dysrhythmias
- Patients receiving halogenated general anesthetic agents.
- Patients receiving nonspecific ß-blockers, MAO inhibitors, or tricyclic antidepressants.

The signs and symptoms of vasoconstrictor toxicity are:
- Anxiety
- Tachycardia/palpitations
- Restlessness
- Headache
- Tachypnea (abnormal rapid breathing)
- Chest pain
- Cardiac arrest

Emergency Management
Should a patient experience vasoconstrictor toxicity, the following steps should be taken:
- Stop treatment
- Reassure the patient
- Assess and support circulation, airway, and breathing
- Administer oxygen
- Monitor vital signs
- Contact EMS

Sedatives and Anxiolytic Agents (Overdose)

The number of dental procedures for pediatric dental patients requiring the use of sedative and/or anxiolytic agents has increased in the past several decades. Associated with

the increase in pharmaceutical management of pediatric dental patients is an increased likelihood of untoward medical emergencies. In recognition of this situation the American Academy of Pediatrics and the American Academy of Pediatric Dentistry published guidelines for the monitoring and management of sedated pediatric patients during and after treatment.[3] However even with the practitioner following these guidelines there is a low but occurring rate of potential life threatening events, such as apnea, airway obstruction, laryngospasm, pulmonary aspiration, desaturation and others.

The sedation of children is different from the sedation of adults. Physiologic functions in children may vary considerably from those in adults. The metabolic rate is increased in pediatric patients. Conversely enzyme systems responsible for the biotransformation of specific drugs may not be as functional as in adults. This can lead to the increased possibility of higher blood levels of the sedative drugs even when the calculated dosage is reduced from the adult dose based on reduced weight. In addition, the effectiveness of particular dosage o administered sedative/anxiolytic agents may vary from patient to patient.[2]

Factors determining drug dosages in children include:

- Age and weight of the child: In general, the older the child, the larger the dosage to achieve the desired clinical result. However, in very young and pre-cooperative children, larger dosages may be needed to overcome their extreme level of fear.
- Mental attitude: The greater the degree of anxiety the larger the dose of drugs required.
- Level and length of time of sedation desired. The depth of sedation (minimal, moderate, deep) and the anticipated length of time for treatment will influence the required dosage. The depth of sedation will be dictated by the complexity of treatment. A minimally invasive restoration may be completed with less cooperation than an aesthetic full coverage restoration requiring pulp therapy.
- Physical activity of the child: Hyperactive tend to require increased drug dosages.
- Stomach contents: The presence of food in the stomach influences the rate of absorption of orally administered drugs. Patient receiving sedative/anxiolytic drugs whether enterally or parenterally should be NPO so as not to affect the absorption rate and of importance to reduce the likelihood of vomiting and possible airway obstruction and aspiration. This usually range between 2 hours for clear liquids to 6 hours for a light meal.[3]
- Ability to titrate: The ability to titrate aids in the determination of the proper drug dosage for a patient. Intravenous and inhalation administration allows titration, while oral, intramuscular, and submucosal administration does not permit titration.

It is beyond the scope of this course to detail the preoperative preparation (medical, social and dental history), required monitoring equipment and personnel, and training of operator and support staff. Studies have shown it is common for children to pass from the intended level of sedation to a deeper unintended level of sedation. Those practitioners engaged in administering sedative/anxiolytic drugs should have the skills to rescue a patient from a deeper level than intended for the procedure. For example, if the intended level is minimal, the practitioner should have the skills to rescue from moderate level. If the intended level is moderate, the practitioner should have the skill to rescue from deep level. If the intended level is deep level the practitioner should have the skill to rescue from general anesthesia. These skills are learned from comprehensive instruction that includes 12-24 hours of didactic and hands on training. In addition, practitioners engaged in sedation/ anxiolytic drug administration should be certified in Advanced Cardiac Life support (ACLS) and/or Pediatric Advanced Life Support (PALS).

Oral sedation is the most popular route of administration by pediatric dentists, although alternative routes such as the intranasal, sublingual and buccal routes are becoming increasingly popular. Among the oral sedative

drugs most commonly administered, benzodiazepines (midazolam, diazepam) and narcotics (meperidine) are the only drugs with reversal agents and are preferred over drugs nonreversibility i.e.: chloral hydrate, hydroxyzine and promethazine. Therefore our discussion will be limited to benzodiazepines and narcotics.

It is important to note the use of local anesthetics in concurrence with sedative/anxiolytic agents can increase respiratory depression in patients and therefore the amount of local anesthesia administered to the sedated patient should closely monitored and kept well below the maximum recommended dose.

Benzodiazepine Overdose
The two most common benzodiazepine used in dentistry are midazolam (Versed) and diazepam (Valium) **(Figure 14)**. The dosage ranges from 0.25 to 0.30 mg/kg with an onset of around 15 to 60 minutes. Midazolam is most commonly used in pediatric dentistry as a sedative/anxiolytic agent. It provides anxiolysis, sedation, hypnosis, skeletal muscle relaxation, anterograde amnesia, respiratory depression and an anticonvulsant effect but has no analgesic properties **(Figure 15)**. It has a wide margin of safety between the therapeutic and toxic doses and has a rapid onset of action. Its administration is usually combined with nitrous oxide/oxygen to enhance the above effects and provide analgesia. It is usually given orally, as syrup, at a dosage of 0.25 mg/kg-1.0 mg mg/kg, depending on age and anxiety level of the patient, with an onset of sedation in 20-30 minutes. The intranasal dosage is 0.25mg/kg with an onset of sedation in 10 to 15 minutes. The time available for treatment will vary from 20 minutes to 40 minutes. Benzodiazepines are metabolized by the hepatic microsomal enzyme system and presence of other agents, for example, grapefruit juice may result in adverse drug reactions.

The signs and symptoms of benzodiazepine overdose are:
- Somnolence
- Confusion
- Diminished reflexes

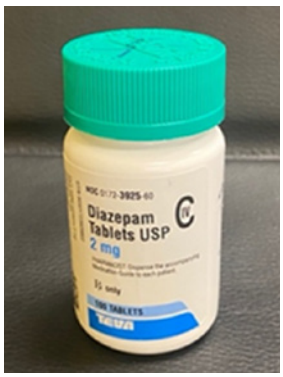

Figure 14. Diazepam (Valium) tablets

Figure 15. Midazolam (Versed) syrup

- Respiratory depression
- Apnea
- Respiratory arrest
- Cardiac arrest

The treatment for benzodiazepine overdose is:
1. Discontinue dental treatment
2. Call for assistance; someone to bring oxygen and emergency kit
3. Position the patient to ensure an open and unobstructed airway
4. Assess and support circulation, airway, and breathing
5. Administer oxygen
6. Monitor vital signs
7. If there is severe respiratory depression, establish intravenous (IV) access and reverse with flumazenil (Romazicon). If IV access is not available, the flumazenil may be administered intramuscularly (IM). The dosage of flumazenil is 0.01 mg/kg with maximum dose is 0.2 mg. It may be repeated at 1 minute intervals, not to exceed a cumulative dose of 0.05 mg/kg or 1 mg, whichever is lower.
8. Monitor recovery for at least 2 hours after the last dose of flumazenil and call for emergency medical services with transportation for advanced care if indicated.

Narcotic Overdose
The most common oral narcotic used as a sedative in pediatric dentistry is meperidine (Demerol) **(Figure 16)**. It has analgesic, sedative and euphoric properties and potentiates the action of other sedatives. After oral

administration its analgesic effects are detected after 15 minutes, reaching a peak effect in 2 hours. Therefore, it tends not to be administered as a standalone sedative agent, but to increase treatment time, depth of sedation and provide analgesic effects. The recommended dosage of oral meperidine is 1.0 mg/kg – 2.0 mg/kg.

The signs and symptoms of narcotic overdose are:

- Decreased responsiveness
- Respiratory depression
- Respiratory arrest
- Cardiac arrest

The treatment for narcotic overdose is:

1. Discontinue dental treatment
2. Call for assistance; someone to bring oxygen and emergency kit
3. Position the patient to ensure an open and unobstructed airway
4. Assess and support circulation, airway, and breathing
5. Administer oxygen
6. Monitor vital signs
7. If there is severe respiratory depression, establish IV access and reverse with naloxone (Narcan) **(Figure 17)**. If IV access is unavailable the naloxone may be administered intramuscularly (IM) or subcutaneously (Sub). The dosage for naloxone is 0.1 mg/kg up to 2 mg and may be repeated every 2-3 minutes until the patient becomes responsive.
8. Monitor recovery for at least 2 hours after the last dose of naloxone and call for emergency medical services and transportation for advanced care if indicated.[2,3,4,5]

Figure 16. Meperidine (Demerol) oral solution

Figure 17. Naloxone nasal spray

Diabetes Mellitus – Hyperglycemia/ Hypoglycemia

Diabetes mellitus is a disorder characterized by inadequate insulin production by the pancreas leading to compromised carbohydrate, fat, and protein metabolism. If untreated, it leads to hyperglycemia (increased blood glucose levels). The most common type of diabetes in children is Type I diabetes (juvenile diabetes). It is diagnosed in about 1 in 400 to 600 children and adolescents in the United States.[18] There is little, or no pancreatic ß cell function and thus daily injections of insulin are required. Blood glucose levels are difficult to control leading to emergencies involving hyperglycemia or hypoglycemia (decreased blood glucose levels).

In hyperglycemia, blood glucose levels are extremely elevated due to low or absent plasma insulin levels for a long period of time. Because of the absence of insulin, glucose cannot enter cells, forcing the cells to metabolize fat and proteins to produce glucose. In the process ketones and other metabolic acids are produced leading to a condition known as diabetic ketoacidosis which, if not treated over a period of days, can lead to coma and death. Because it takes several days for ketoacidosis to occur, hyperglycemic patients do not exhibit acute emergency symptoms.

The emergency most likely encountered in the dental office is a patient with hypoglycemia or insulin shock. This condition is caused by an excessively high level of insulin due to the patient taking their daily dose of insulin with inadequate intake of carbohydrates. It can also occur when excessive amounts of carbohydrates are utilized during increased exercise and stress leading to low blood glucose levels. As glucose and oxygen are the primary metabolites for brain cells, the decreased serum glucose level leads to neurologic symptoms. If a diabetic patient, who is doing well, suddenly develops symptoms, it is most likely due to hypoglycemia rather than hyperglycemia.[19]

The signs and symptoms of hypoglycemia are:
- Lethargy
- Change in mood
- Nausea
- Strange behavior
- Tachycardia
- Hypertension
- Anxiety
- Sweating

Emergency Management
Should a patient experience hypoglycemia, the following steps should be taken:
- Recognize and acknowledge the signs and symptoms.
- Discontinue treatment
- Activate the office emergency system. Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
- Position the patient so the patient is comfortable.
- Monitor patient's circulation by assessing pulse and blood pressure. Provide BLS as needed. Assess the patient's airway and breathing patency and adjust the head and jaw position accordingly. If the patient's condition continues to worsen, contact EMS.
- Provide definitive care:
  - Administer glucose
  - If the patient is conscious, the source of glucose (sugared soft drink, juice, Instaglucose) may be administered orally **(Figure 18)**.
  - If the patient is unconscious, having uncontrolled seizures or can't swallow, administer 50% dextrose intravenously or Glucagon intramuscularly until consciousness is regained.

Figure 18. Insta-Glucose

If you're not sure if the patient's blood glucose level is too low or too high, give the glucose. There is no danger of giving too much.

Glucagon
Glucagon, a hormone secreted by the pancreas, raises blood glucose levels. It has an effect opposite that of insulin, which lowers blood glucose levels. The pancreas releases glucagon when blood sugar levels fall too low. Glucagon causes the liver to convert stored glycogen into glucose, which is released into the bloodstream. It is available in injectable form (Glucagon) for intramuscular administration.

A glucagon emergency kit contains a bottle of glucagon (dry powder) and a syringe of clear liquid.

The directions for use are:
- Remove the flip-off seal from the bottle of glucagon.
- Remove the needle protector from the syringe and inject the entire contents of the syringe into the bottle of glucagon.
- Remove the syringe and shake the bottle gently until the liquid is clear.
- Hold the bottle upside down, reinsert the needle and withdraw all the solution from the bottle.
- For children under 44 lbs, give 0.5cc (1/2 the syringe) to start and then the remaining 0.5cc 20 minutes later.
- Older children and are given 1cc (the entire syringe).
- Give the injection in a large muscle such as the buttocks, thigh or arm.
- As glucagon can cause vomiting, place the patient on their side prior to the injection to prevent choking.
- When the patient regains consciousness and can swallow, give small sips of a carbohydrate fluid (fruit juice).
- If tolerated, follow with 15 grams of a carbohydrate and a fat containing food (crackers and cheese).[19]

Seizures
Seizures are temporary alterations in brain function resulting in an abrupt onset of motor, sensory or psychic symptoms. Except when

seizures follow one another closely for an extended period, they are not considered life threatening. Emergency management of a patient experiencing a seizure is essentially preventing injury during the seizure and supportive therapy post seizure. While all patients with epilepsy have seizures, many more patients have a single seizure during life and do not have epilepsy.

Around 10% percent of the U.S. population have been estimated to have least one seizure in their lifetime, while the overall incidence of epilepsy is less than 1%.20 There are multiple causes of seizures:

- Congenital abnormalities
- Perinatal injuries
- Metabolic and toxic disorders
- Head trauma
- Tumors
- Vascular diseases
- Degenerative disorders
- Infectious diseases
- Elevated body temperature (febrile seizures)
  - Most commonly occurs between 6 months and 3 years
  - Fever of 38.8° C (102°F)
  - Infection not associated with the CNS
  - Seizures are short (<5 minutes)
  - Are insignificant in the dental setting

There are three major forms of seizures:

- Grand mal (tonic-clonic seizure)
- Petit Mal (absence seizure)
- Status epilepticus

Grand Mal Seizures

Grand mal seizures (tonic-clonic seizures) are the most common form found in epilepsy. They can also be brought on by cerebrovascular accidents, meningitis, encephalitis, drug withdrawal, photic stimulation, fatigue and intoxicants. The entire seizure may be broken down into prodromal, preictal, itcal and post-itcal phases which last no more than 5 to 15 minutes. However, it may take up to 2 hours for normal, preictal cerebral function to return. A grand mal seizure that lasts for hours or days is termed status epilepticus and can lead to death if not managed.

In the prodromal phase the patient may exhibit changes that may be evident only to a relative, such as increased anxiety or depression. A patient with a history of seizures may recognize the development of an "aura" consisting of olfactory, visual, gustatory, or auditory changes. If the aura is noted by the patient or the dental staff, treatment should be terminated immediately before it progresses to the preictal phase.

The preictal phase is clinically manifested by:

- A loss of consciousness.
- If standing, falling to the floor (most prevalent time for injuries).
- Myoclonic jerks.
- Increase in heart rate and blood pressure.
- Diaphragmatic muscles go into spasm.

The ictal phase (tonic component) is clinically manifested by:

- Alternating muscular relaxation and violent contractions.
- Frothing at the mouth due to mixing of saliva and air.
- Bleeding from the mouth due to biting the lateral borders of the tongue.
- Lasting 2 to 5 minutes.

The postictal phase is clinically manifested by:

- Tonic-clonic movements cease.
- Breathing returns to normal.
- Consciousness gradually returns with disorientation.
- Relaxation occurs.
- Muscular flaccidity resulting in urinary or fecal incontinence.
- Total amnesia of the seizure.

Emergency Management

Should a patient exhibit a grand mal seizure, the following steps should be taken:

PRODROMAL AND PREICTAL PHASE

- Recognize aura.
- Discontinue treatment and move bracket table and instruments out of the way.

ICTAL PHASE

- Activate the office emergency team.
- Position the patient in a supine position with the feet elevated or roll patient on their side to prevent aspiration.

- Protect the patient from bodily injury, however do not place objects in the mouth to prevent soft tissue injury.
- Assess and perform BLS as needed.

POSTICTAL PHASE
- Administer oxygen.
- Monitor vital signs.
- Reassure patient and permit recovery.
- Depending on the patient's history and if accompanied by an adult discharge patient to home or to the hospital or physician.

If the seizure lasts more than 15 minutes:
- Activate EMS.
- Assess and perform BLS as needed.
- Protect the patient from injury until EMS arrives.
- If available and the staff is trained in venipuncture, administer an IV anticonvulsant.
  - If intravenous (IV) access is available administer diazepam (Valium) IV:
  - Child up 5 years 0.2-0.5 mg slowly every 2-5 minutes with a maximum of 5mg.
  - Child up to 5 years and up 1 mg every 2-5 minutes with a maximum of 10 mg.

Petit Mal and Absence Seizures
Petit mal seizures occur in 25% of all epilepsy patients and 5% of pediatric epilepsy patients (are most common between ages 3-15 years). They occur frequently (multiple daily episodes) usually shortly after awakening or during periods of inactivity.

The clinical manifestations are:
- Unresponsiveness
- Eyelid clonus (rapid or cyclic blinking)
- Tonic or atonic features
- If standing, the patient will remain standing
- There is no aura or postictal state
- The duration does not exceed 10 seconds

Emergency Management
Management of petit mal seizure and absence seizures is to protect the victim from injury. Even with no assistance from staff there is little or no danger of death to the victim. Most seizures last from five seconds to two minutes. Should a seizure last longer than this, the following steps should be taken:
1. Recognize the problem based on the patient's medical history.
2. Recognize the problem (lack of response to stimulation).
3. Discontinue dental treatment.
4. Activate the office emergency team.
5. If the patient is standing allow them to continue to do so. If positioned supine in the dental chair do not change the position except to elevate the feet.
6. Once the seizure ceases (<5 minutes) reassure the patient.
7. Discharge patient once fully recovered with a responsible adult.

If the seizure lasts more than 5 minutes:
1. Activate EMS.
2. Perform BLS as needed.
3. If intravenous (IV) access is available administer diazepam (Valium) IV:
   - Child up 5 years 0.2-0.5 mg slowly every 2-5 minutes with a maximum of 5mg.
   - Child up to 5 years and up 1 mg every 2-5 minutes with a maximum of 10 mg.

Status Epilepticus
Status epilepticus is defined as a continuous seizure or a repetitive recurrence of any type of seizure without recovery between attacks. It is life threatening. Patients in status epilepticus exhibit the same clinical signs and symptoms as those in the convulsive phase of tonic-clonic seizure. The major difference is while a tonic clonic seizure may last 2 to 5 minutes, status epilepticus may last for hours or days and may lead to death.
The clinical manifestations are:
- Any clonic-tonic seizure lasting more than 5 minutes
- Nonresponsiveness or unconsciousness
- Cyanotic, diaphoretic
- Generalized clonic contractions with brief or absent tonic phase
- Elevated body temperature (41°C, 106°F)
- Tachycardia and dysrhythmias
- Elevated blood pressure

Unterminated status epilepticus may lead to the following:
- Death as a result of cardiac arrest
- Irreversible neuronal damage from cerebral hypoxia
- A decrease in cerebral blood flow in response to increased intracranial pressure
- A significant decrease in blood glucose

levels as the brain uses large amounts for metabolism

Management

Management of status epilepticus follows the same protocol as grand mal seizures (see above). However, if the seizure continues beyond 5 minutes activate emergency services and if the office staff is properly trained administer intravenous anticonvulsive drugs. Assess and perform basic life support until emergency medical support with advanced training arrives.[20]

Cardiac Arrest

Every year, around 350,000 people in the United States suffer from cardiac arrest and receive attempted resuscitation. Cardiac arrest, although common in adults, is a rare occurrence in the pediatric population. When it does occur, the outcome can be devastating. Death may result or if the patient is not resuscitated on time, permanent brain damage may occur.

The etiology of cardiac arrest in a child differs from an adult. Cardiac arrest in the pediatric patient is the result of prolonged respiratory depression and apnea. These situations are often associated with local anesthesia toxicity because of overdose or intravascular injection and with the administration of CNS depressant drugs for behavior management.

Comprehensive BLS training is not within the scope of the course, and it is recommended the reader seek out formal BLS instruction. The etiologies for cardiac arrest differ for adults (cardiac disease) and children (depleted oxygen in the myocardium). For unwitnessed and witnessed cardiac arrests with two or more rescuers present, assess the patient, initiate CPR, activate the emergency response system and obtain an automated external defibrillator (AED) simultaneously.

For unwitnessed and witnessed cardiac arrests with two or more rescuers present, assess the patient, initiate CPR, activate the emergency response system and obtain an automated external defibrillator (AED) simultaneously.

For the lone rescuer, the sequence varies:

- If the cardiac arrest is witnessed, the lone rescuer first activates the emergency response system, obtains an AED, and starts CPR. This approach is the same as for adult with cardiac arrest.
- If the cardiac arrest is unwitnessed, the lone rescuer should first perform two minutes of CPR, activate the emergency response system, and obtain an AED.
- This approach differs from that recommended for adult cardiac arrest, which is call for help, activate the emergency response system and initiate CPR and obtain an AED.
- For the summary of high-quality CPR for infants, children, and adolescents, kindly refer to American Heart Association guideline **(Figure 19)**.

Comprehensive CPR training is not within the scope of this course, and it is recommended the reader seek out formal BLS instruction.

It is important for BLS providers to realize because of different etiologies for cardiac arrest in adults (cardiac disease) and children (depleted oxygen in the myocardium) there is a significant difference in BLS protocols for adults and children. In adults, after initial assessment of the unresponsive patient, EMS is activated immediately (before starting BLS) so access to trained personnel and defibrillation equipment is available as soon as possible. In children, since the likely cause of cardiac arrest is lack of oxygen in cardiac muscle, BLS is started immediately, and EMS is contacted after delivery of BLS for 2 minutes.

Conclusion

In summary, although pediatric medical emergencies are a rare occurrence in the dental office, when it does occur, it is important that the Dentist and the staff members are well-trained in emergency management so efficient and timely treatment is administered to the physically and physiologically immature pediatric patient. Preparation includes the use of comprehensive medical and dental histories, at minimum BLS training for staff and providers, initiation of an office emergency team, organization of an emergency drug kit and equipment, and periodic reviews and simulation.

Component	Adults and adolescents	Children (age 1 year to puberty)	Infants (age less than 1 year, excluding newborns)
Verifying scene safety	Make sure the environment is safe for rescuers and victim		
Recognizing cardiac arrest	Check for responsiveness No breathing or only gasping (ie, no normal breathing) No definite pulse felt within 10 seconds (Breathing and pulse check can be performed simultaneously in less than 10 seconds)		
Activating emergency response system	***If a mobile device is available, phone emergency services (9-1-1)***		
	If you are alone with no mobile phone, leave the victim to activate the emergency response system and get the AED before beginning CPR Otherwise, send someone and begin CPR immediately; use the AED as soon as it is available	***Witnessed collapse*** Follow steps for adults and adolescents on the left ***Unwitnessed collapse*** Give 2 minutes of CPR Leave the victim to activate the emergency response system and get the AED Return to the child or infant and resume CPR; use the AED as soon as it is available	
Compression-ventilation ratio *without advanced airway*	***1 or 2 rescuers*** 30:2	***1 rescuer*** 30:2 ***2 or more rescuers*** 15:2	
Compression-ventilation ratio *with advanced airway*	Continuous compressions at a rate of 100-120/min Give 1 breath every 6 seconds (10 breaths/min)	Continuous compressions at a rate of 100-120/min Give 1 breath every 2-3 seconds (20-30 breaths/min)	
Compression rate	100-120/min		
Compression depth	At least 2 inches (5 cm)*	At least one third AP diameter of chest Approximately 2 inches (5 cm)	At least one third AP diameter of chest Approximately 1½ inches (4 cm)
Hand placement	2 hands on the lower half of the breastbone (sternum)	2 hands or 1 hand (optional for very small child) on the lower half of the breastbone (sternum)	***1 rescuer*** 2 fingers or 2 thumbs in the center of the chest, just below the nipple line ***2 or more rescuers*** 2 thumb–encircling hands in the center of the chest, just below the nipple line If the rescuer is unable to achieve the recommended depth, it may be reasonable to use the heel of one hand
Chest recoil	Allow complete recoil of chest after each compression; do not lean on the chest after each compression		
Minimizing interruptions	Limit interruptions in chest compressions to less than 10 seconds with a CCF goal of 80%		

*Compression depth should be no more than 2.4 inches (6 cm).
Abbreviations: AED, automated external defibrillator; AP, anteroposterior; CCF, chest compression fraction; CPR, cardiopulmonary resuscitation.

Figure 19. Summary of high-quality CPR components for BLS providers.[21]

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: *www.dentalcare.com/en-us/professional-education/ce-courses/ce391/start-test*

1. The most common medical emergency in a dental office is _____.
A. Mild allergy
B. Seizures
C. Syncope
D. Local anesthesia overdose

2. A duty of the first person on the scene of an emergency is _____.
A. Alerting other staff members
B. Contacting EMS
C. Retrieving the emergency drug kit
D. Direct EMS to the site of the emergency

3. Essential emergency equipment includes:
A. Laryngoscope
B. Various sized intubation tubes
C. An "E" sized tank of oxygen
D. Atropine

4. Epinephrine is primarily recommended for managing _____.
A. Anaphylaxis
B. Myocardial infarction
C. Seizures
D. Hypoglycemia

5. Glucagon is used in the management of _____.
A. Seizures
B. Anaphylaxis
C. Hypoglycemia
D. Psychogenic syncope

6. Flumazenil is used in the management of _____.
A. Status epilepticus
B. Benzodiazepine overdose
C. Local anesthesia overdose
D. Narcotic overdose

7. The drug of choice for treating status epilepticus is _____.
A. Lorazepam
B. Atropine
C. Hydrocortisone
D. Naloxone

8. A non-psychogenic predisposing factor for syncope is _____.
A. The sight of bloody gauze
B. Sitting upright during local anesthesia administration
C. Sudden and unanticipated pain
D. Receipt of the treatment fee

9. A symptom during the early stage of syncope is _____.

A. Warm feeling
B. Cold extremities
C. Bradycardia
D. Pupillary constriction

10. A patient experiencing syncope should be positioned _____.

A. In a semi-supine position at a 30-to-45-degree angle
B. With the head and upper body pushed forward
C. In a supine position with the feet elevated
D. In a vertical standing position

11. The order of treating a patient with syncope is _____.

A. Airway>Breathing>Circulation
B. Circulation>Airway>Breathing
C. Circulation>Breathing>Airway
D. Airway>Circulation>Breathing

12. Anaphylactic reactions are caused by _____.

A. Release of catecholamines into the circulatory system
B. Intravascular injections
C. Release of histamine from IgE sensitized mast cells
D. Increased insulin production

13. The appropriate dose of epinephrine to a 5 year old child experiencing asthmatic attack is _____.

A. 1 ml of 1:1000 epinephrine
B. 1 ml of 1:10,000 epinephrine
C. 1 ml of 1:2000 epinephrine
D. 1 ml of 1:20,000 epinephrine

14. Mild allergic reaction in a 5 year old child is treated by administering _____.

A. Oral diphenhydramine 1 mg/kg every six hours
B. A one-time dose of oral diphenhydramine 25 mg
C. 1 ml of 1:1000 epinephrine intramuscularly
D. 1 ml of 1:2000 epinephrine intramuscularly

15. The position for managing a patient experiencing an acute asthmatic episode is _____.

A. A supine position with legs elevated
B. Upright with arms thrown forward over a chair
C. A semi-supine position at a 30 to 45 degree angle
D. Supine with the head tilted to the side

16. The signs and symptoms of acute asthma attack include_____.

A. Bradycardia
B. Hyperventilation
C. Lightness in the chest
D. Shortness of breath

17. The amount of vasoconstrictor in 1.7ml cartridge of Lidocaine 2% with 1:100,000 Epinephrine is _____.

A. 0.017 mg
B. 0.17 mg
C. 0.034 mg
D. 0.34 mg

18. Emergency management of local anesthesia toxicity in a five-year-old includes:

A. Administer 1 ml epinephrine 1:1000
B. Administer oxygen via a mask
C. Administer 1 ml of flumazenil 0.1 mg IV
D. Administer oral diphenhydramine 1 mg/kg

19. Vasoconstrictor should be avoided or minimized in patients with the following condition:

A. Blood pressure of 120 mm Hg systolic or 80 mg Hg diastolic
B. Blood pressure of 80 mm Hg systolic or 50 mg Hg diastolic
C. Uncontrolled hyperthyroidism
D. Uncontrolled hypothyroidism

20. An initial dose 0.5cc of glucagon IM is the drug of choice for treating _____.

A. A conscious 23 lb patient exhibiting hypoglycemia
B. An unconscious 23 lb patient exhibiting hypoglycemia
C. A conscious 23 lb patient exhibiting signs of hyperglycemia
D. An unconscious 23 lb patient exhibiting signs of hyperglycemia

21. The ictal phase of Grand Mal seizures usually lasts for _____.

A. Less than 1 minute
B. 1 to 2 minutes
C. 2 to 5 minutes
D. More than 5 minutes

22. Febrile Seizure occurs when the temperature exceeds _____.

A. 99°F
B. 100°F
C. 101°F
D. 102°F

23. The proper sequence of BLS for a child in cardiac arrest, witnessed by 2 rescuers, is:

A. Assess the patient, obtain an AED, initiate CPR, activate the emergency response system.
B. Assess the patient, initiate CPR, activate the emergency response system, and obtain an AED simultaneously.
C. Initiate CPR, assess the patient, activate the emergency response system, obtain an AED.
D. Activate the emergency response system, assess the patient, initiate CPR, obtain an AED

24. The drug of choice for treating narcotic overdose is _____

A. Atropine
B. Flumazenil
C. Phenobarbital
D. Naloxone

25. The compression-ventilation ratio for a 2-year-old child using 2 rescuers is _____.

A. 15:2
B. 30:2
C. 60:2
D. 90:2

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About the Authors

Steven Schwartz, DDS

The P&G team wishes to express its sadness over the loss of our colleague and friend, Dr. Steven Schwartz, who passed away on October 25, 2018. He was a tremendous help on impacting thousands of dental professionals through CE, making dentalcare.com one of the best CE providers in the world. He was a wonderful person! We will miss him.

Dr. Steven Schwartz was the former director of the Pediatric Dental Residency Program at Staten Island University Hospital and was a Diplomate of the American Board of Pediatric Dentistry.

Jayakumar Jayaraman, BDS, MDS, FDSRCS, MS, PhD

Dr. Jayaraman is a Pediatric Dentist with clinical and research training from India, Hong Kong, England and the United States. He obtained master's degrees in Pediatric Dentistry from the University of Hong Kong and the University of Texas Health San Antonio. Dr. Jayaraman also received his Diploma in Pediatric Dentistry and Fellowship at the Royal College of Surgeons of Edinburgh, United Kingdom where he also serves as an Examiner. For the past 10 years he has taught Pediatric Dentistry and supervised research projects for pre-doctoral, post-doctoral and PhD students in different countries. His research involves topics in Evidence-Based Dentistry, Forensic Dentistry, Human Biology & Anthropology. Dr. Jayaraman has published over 50 peer-reviewed scientific articles and reviewed articles for several leading pediatric, forensic, and multi-disciplinary journals. He serves as an Associate Editor for the Frontiers in Dental Medicine Journal and an Editorial Board Member of the International Journal of Pediatric Dentistry. Dr. Jayaraman is currently Associate Professor of Pediatric Dentistry at Virginia Commonwealth University, Richmond.

Email: jayakumar83@hotmail.com