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General Dentistry

Sampler

Chapter 8: Sedation Emergencies and Monitoring From *Impacted Third Molars.*

by John Wayland

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Sedation Emergencies and Monitoring

The removal of third molars is one of the most feared surgical procedures in dentistry.[1] Third molars can be removed under local anesthesia alone, but most patients and dentists do not prefer this option. Conscious sedation options include nitrous oxide, oral sedation, and IV sedation. All of these options place the patient at some degree of risk for complications.

As stated previously in Chapter 7, the concept of sedation as a continuum is the foundation of patient safety. In 2004, the American Society of Anesthesiologists made the following statement: "Because sedation and general anesthesia are a continuum, it is not always possible to predict how an individual patient will respond. Hence, practitioners intending to produce a given level of sedation should be able to diagnose and manage the physiologic consequences (rescue) for patients whose level of sedation becomes deeper than initially intended."[2] Dentists providing sedation must have the training, skills, drugs, and equipment necessary to manage patients who are more deeply sedated than intended until EMS arrives or the patient returns to the intended level of sedation. These attributes are the keys to patient safety.

Patient Safety and Sedation Law

In 2002 the Dental Board of California called for a review of anesthesia laws and patient outcomes to see if any improvements could be made to the existing regulatory program. The board appointed the Blue Ribbon Panel on Anesthesia, an ad hoc committee composed of general dentists and dental specialists who were recognized experts in the field. The panel reviewed mortality data from the Dental Board of California, lawsuits from a major California malpractice insurance company, anesthesia regulations from other states, and the published scientific literature. The review found that in California, between 1991 and 2000, there were 12 deaths related to general anesthesia permits, 8 deaths related to nonpermit holders (four deaths with oral sedation in children and four deaths with local anesthesia alone), and 0 deaths related to conscious sedation permits.[3] The California Dental Board Blue Ribbon Panel review clearly demonstrates the efficacy of conscious sedation.

The American Dental Association has published recommended guidelines (adopted by the house of delegates in October 2016) for the use of sedation. California and the majority of states have adopted the American Dental Association's guidelines as state law.

Impacted Third Molars, First Edition. John Wayland.

Companion website: www.wiley.com/go/wayland/molars

California sedation laws and permit requirements (2016) are discussed in this chapter with emphasis on intravenous sedation emergencies and monitoring. A permit is not required in California for the administration of nitrous oxide and oxygen. The following excerpt is from the Dental Board of California.[4]

> To obtain a California permit for the administration of oral (moderate) conscious sedation, the applicant must have completed an approved postdoctoral or residency training program that includes sedation training, or a board-approved course that includes 25 hours of instruction and a clinical component utilizing at least one age-appropriate patient.
>
> To obtain a California permit for IV (moderate) conscious sedation, the applicant must complete at least 60 hours of instruction and 20 clinical cases of administration of parenteral conscious sedation for a variety of dental procedures. The course must comply with the requirements of the Guidelines for Teaching the Comprehensive Control of Anxiety and Pain in Dentistry of the American Dental Association.
>
> In California, a conscious sedation permit (IV sedation) is issued as a temporary permit for the first year. Within that time, the board conducts an onsite inspection and evaluation of the licentiate. Onsite inspections are required every six years. Fifteen units of continuing education related to conscious sedation and medical emergencies are required every two years.
>
> All offices in which conscious sedation is conducted in California must complete an office inspection and applicant evaluation. The office inspection consists of three parts:

Facilities and Equipment Requirements

The following office facilities and equipment must be available and maintained in good operating condition:

1) An operating theater large enough to adequately accommodate the patient on a table or in an operating chair and permit an operating team consisting of at least three individuals to freely move about the patient.
2) An operating table or chair that permits the patient to be positioned so the operating team can maintain the airway, quickly alter patient position in an emergency, and provide a firm platform for the management of cardiopulmonary resuscitation.
3) A lighting system that is adequate to permit evaluation of the patient's skin and mucosal color and a backup lighting system which is battery powered and of sufficient intensity to permit completion of any operation underway at the time of general power failure.
4) Suction equipment, which permits aspiration of the oral and pharyngeal cavities, and a backup suction device that can operate at the time of general power failure.
5) An oxygen delivery system with adequate full face masks and appropriate connectors that is capable of allowing the administering of greater than 90% oxygen at a 10 liter/minute flow for at least 60 minutes (650 liter "E" cylinder)

to the patient under positive pressure, together with an adequate backup system that can operate at the time of general power failure.

6) A recovery area that has available oxygen, adequate lighting, suction, and electrical outlets. The recovery area can be the operating theatre.
7) Ancillary equipment including all of the following:
   a) Emergency airway equipment (oral airways, laryngeal mask airways or combitubes, cricothyrotomy device).
   b) Tonsillar or pharyngeal type section tips adaptable to all office outlets.
   c) Sphygmomanometer and stethoscope.
   d) Adequate equipment for the establishment of an intravenous infusion.
   e) Precordial/pretracheal stethoscope.
   f) Pulse oximeter.

Records

The following records must be maintained:

1) Adequate medical history and physical evaluation records. Must be updated prior to each administration of sedation and shall include but are not limited to the recording of the age, sex, weight, physical status (American Society of Anesthesiologists Classification), medication use, any known or suspected medically compromising conditions, rationale for sedation of the patient, and visual examination of the airway, and for general anesthesia only, auscultation of the heart and lungs as medically required.
2) Conscious sedation records that show:
   a) A time-oriented record with preoperative, multiple intraoperative, and postoperative pulse oximetry (every 5 minutes intraoperative).
   b) Multiple blood pressure and pulse readings.
   c) Drugs administered, amounts administered, and time administered.
   d) Length of procedure.
   e) Any complications of anesthesia or sedation.
   f) Statement of the patient's condition at time of discharge.
3) Written informed consent of the patient or if the patient is a minor, the parent or guardian.

Drugs

Emergency drugs of the following types must be available:

1) Epinephrine
2) Vasopressor (other than epinephrine)
3) Bronchodilator
4) Appropriate drug antagonists
5) Antihistaminic
6) Anticholinergic
7) Coronary artery vasodilator
8) Anticonvulsant
9) Oxygen
10) 50% dextrose or other antihypoglycemic

The applicant evaluation consists of two parts:

(1) Demonstration of Conscious Sedation

A dental procedure utilizing conscious sedation administered by the applicant must be observed and evaluated. Any conscious sedation technique that is routinely employed can be demonstrated. The patient must be monitored while sedated and during recovery from sedation. The applicant for a permit must demonstrate knowledge of the uses of emergency equipment and the capability of using that equipment.

(2) Simulated Emergencies

Knowledge of and a method of treatment must be physically demonstrated by the dentist and his or her operating team for the emergencies shown in Box 8.1.

The 13 simulated emergencies evaluated in the state of California are representative of evaluations conducted in other states. The following section discusses recognition, treatment, and prevention of these emergencies.

Sedation Emergencies

When compared with local anesthesia alone, the two most significant negative variables introduced by any level of sedation are the added risks for either airway obstruction or respiratory depression (hypoventilation). Airway obstruction and respiratory depression are the most significant complications in deeply sedated or unconscious patients. Virtually all cardiovascular complications in healthy patients are preceded by airway complications.[5]

The management of any emergency begins with the ABC primary assessment taught in every basic life support course. Airway, breathing, and circulation are also the foundation of ACLS (advanced cardiovascular life support). Dr. Frank Grimaldi described this assessment in its simplest form: "air goes in and out and blood goes round and round."[6]

Airway Obstruction

Airway obstruction can be mechanical or pathological. Upper airway obstruction is caused by anatomical structures or foreign materials. The most common upper airway

Box 8.1 Simulated emergencies.

1) Airway obstruction
2) Respiratory depression
3) Allergic reaction
4) Bronchospasm
5) Emesis and aspiration
6) Angina pectoris
7) Myocardial infarction
8) Cardiac arrest
9) Hypotension
10) Hypertension
11) Seizure
12) Hypoglycemia
13) Syncope

obstruction is the tongue. Common foreign materials include crowns, bridges, and teeth. Lower airway obstruction is caused by bronchospasm, laryngospasm, or allergic reaction. Airway obstruction leads to hypoventilation and hypoxemia. It can be prevented by titration of drugs and the use of a throat pack barrier. The treatment for airway obstruction begins with the triple maneuver: head tilt, chin lift, and jaw thrust (if unconscious). Supplemental oxygen should be administered with airway adjuncts added as needed. Possible airway adjuncts include oropharyngeal airways (OPA), nonrebreathing masks (NRB), and bag valve masks (BVM). Drug reversal should be considered. EMS should be called if oxygen saturation does not improve (see Figure 8.1).

Respiratory Depression

Respiratory depression must be distinguished from airway obstruction. The risk of respiratory depression is low with moderate sedation when compared to anatomical airway obstruction (tongue, tonsils, adenoids). Patients with airway obstruction can't breathe. Patients with respiratory depression won't breathe. Respiratory depression is a side effect of CNS depressants. All opioids and sedatives have the potential to depress hypercapnic or hypoxemic drives. Opioids are the most powerful respiratory depressants. Treatment is the same as airway obstruction (see Figure 8.1).

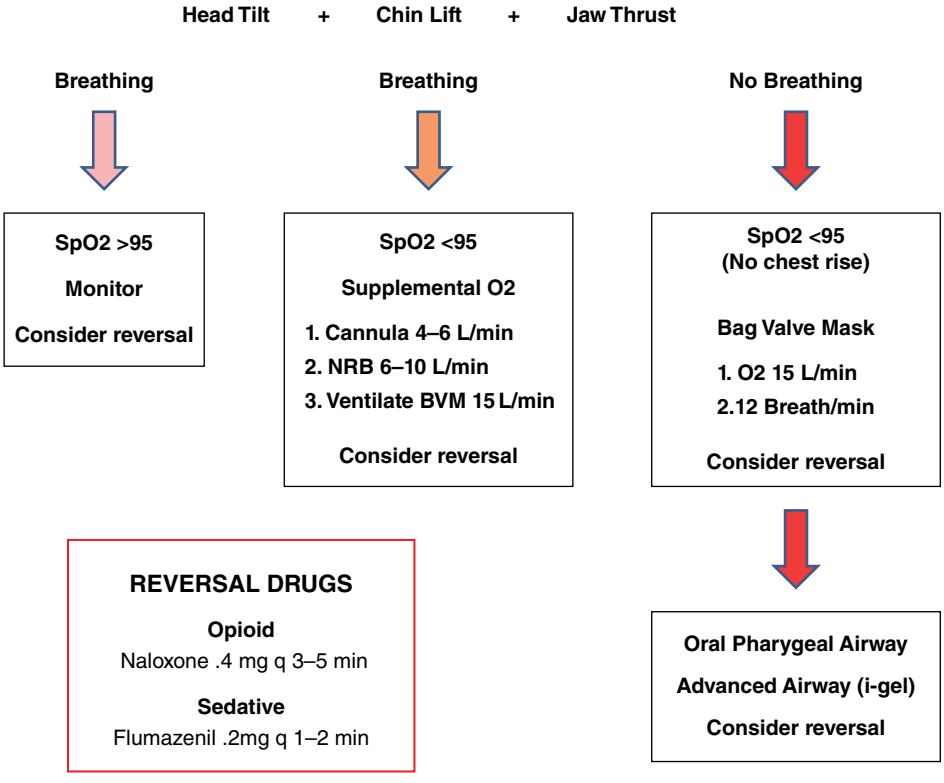

Figure 8.1 Airway obstruction/respiratory depression alogrithm.

Allergic Reaction

It is not uncommon for a patient's medical history to list adverse drug reactions. Generally, these are found to be drug sensitivities and not true allergic reactions. When the patient's history includes airway compromise or cutaneous reactions, allergy is more likely. In terms of cutaneous reactions, urticaria (hives) is most indicative of an IgE-mediated reaction.[7] Histories of compromised airway or difficulty breathing should be taken seriously. These reports indicate severe allergic reaction and anaphylaxis. A partial airway obstruction from anaphylaxis is characterized by a high-pitched crowing sound.

Allergic reactions can be reduced by completing a thorough medical history and interview. Intravenous administration of a drug test dose and titration may provide an early warning of adverse reactions. Mild allergic reactions are treated by oral, intramuscular, or intravenous administration of diphenhydramine. Severe allergic reactions are treated with epinephrine (see Figure 8.2).

Bronchospasm

Bronchospasm is a lower airway obstruction resulting from contraction or spasm of bronchial smooth muscle. Laryngeal edema is a common characteristic. Bronchospasm can result from an anaphylactic reaction or from a hyperactive airway as found with asthmatic patients. Dyspnea and wheezing are common characteristics of bronchospasm due to obstructions in the chest, not the throat or mouth.

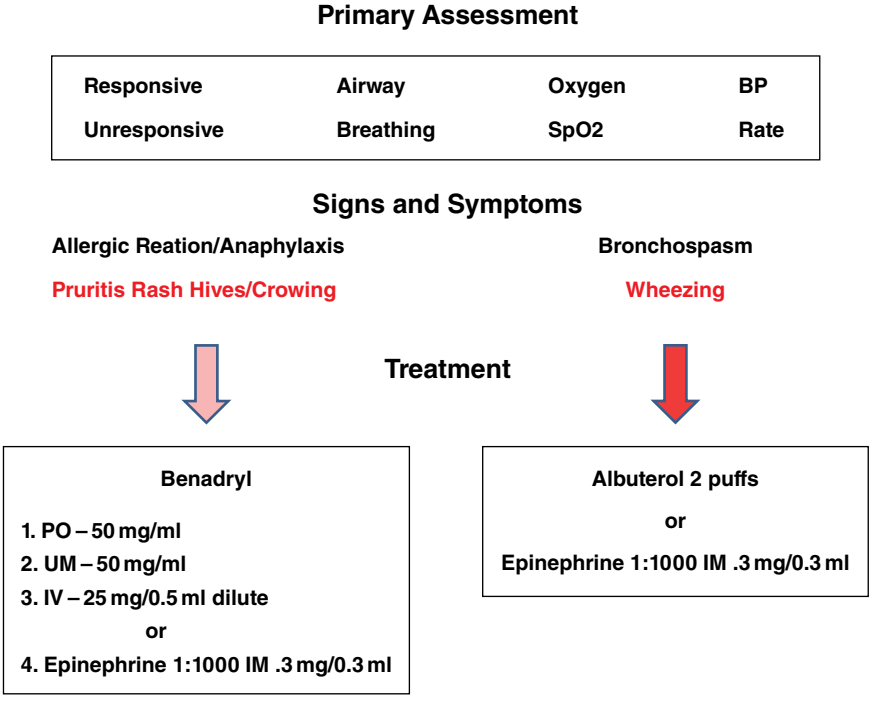

Figure 8.2 Allergic reaction and bronchospasm algorithm.

Stress may trigger an asthmatic attack and bronchospasm. Sedation may decrease stress and help prevent bronchospasm in patients with asthma. Treatment includes use of a bronchodilator, such as albuterol, or epinephrine (see Figure 8.2).

Emesis and Aspiration

Emesis is possible following the administration of sedative drugs including nitrous oxide. Although aspiration of vomitus is unlikely when airway protective reflexes are intact, dentists should be prepared for this emergency. Aspiration of liquids usually results in bronchospasm. Pulse oximeter values are usually under 90% and cannot be improved. EMS should be immediately activated. Patients should be placed in the Trendelenburg position with their head turned to the right to prevent vomitus from entering the left bronchus and lungs. The pharynx should be suctioned using pharyngeal suction. Oxygen should be administered and drugs reversed.

A thorough patient interview may reveal a history of nausea and vomiting. Sedated patients should be NPO for 6 hours prior to the removal of third molars. Unfortunately, patients are not always compliant with this rule. Slow titration of drugs to light or moderate sedation reduces the possibility of nausea and vomiting (see Figure 8.3).

Angina Pectoris

Ischemic heart disease is a condition whereby coronary perfusion is inadequate for myocardial oxygen requirements. Angina pectoris is defined as chest pain caused by narrowing of coronary arteries and reduced oxygen to the heart. Inadequate oxygen supply precipitates angina and myocardial infarctions. Patients with a history of angina whose chest pain is provoked by stress, anxiety, or inadequate local anesthesia are treated with nitroglycerin. Unprovoked chest pain may be a myocardial infarction.

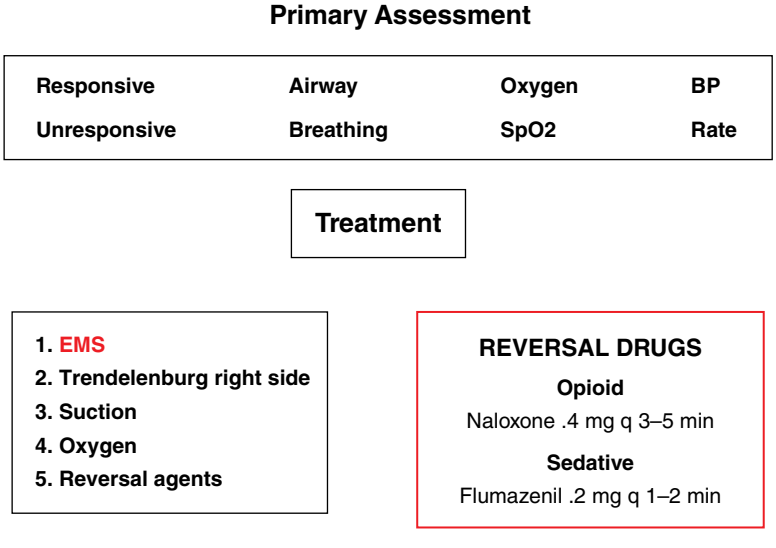

Figure 8.3 Emesis and aspiration algorithm.

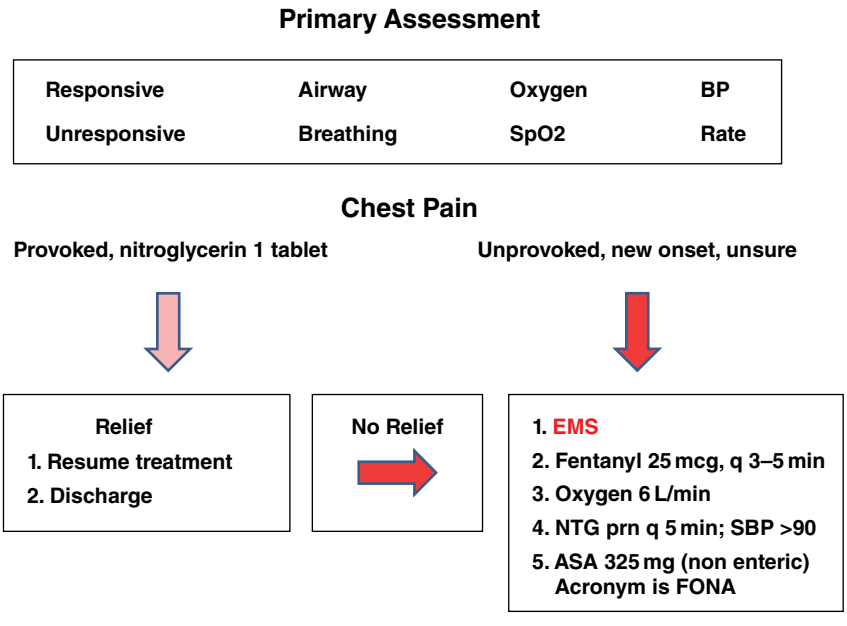

Figure 8.4 Angina pectoris/myocardial infarction algorithm.

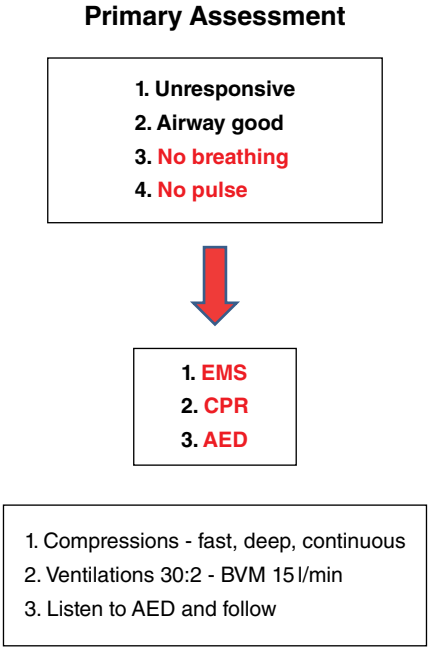

Figure 8.5 Cardiac arrest algorithm.

Myocardial Infarction (MI)

MI is the death of myocardium caused by ischemia. MI should be suspected in patients with unprovoked chest pain and no prior history of angina. Angina patients who do not get relief from nitroglycerin may also be having an MI. An MI is a serious complication requiring EMS intervention. Treatment includes fentanyl for pain, oxygen to increase coronary perfusion, nitroglycerin for vasodilation, and chewed aspirin to prevent clot formation by decreasing platelet aggregation (FONA). Adverse cardiovascular events are reduced when stress, pain, and myocardial oxygen demand are decreased (see Figure 8.4).

Cardiac Arrest

Cardiac arrest is confirmed by absence of a pulse. Immediate actions include EMS activation, CPR, and AED (automated external defibrillator) deployment. Deep sedation, general anesthesia, and treatment of medically compromised patients will increase the likelihood of this emergency (see Figure 8.5).

Hypotension

Hypotension during sedation is defined as 30 mm Hg below systolic baseline. It is prevented by slow titration of fentanyl and sedatives. Treatment includes the Trendelenburg position and the rapid administration of 500 ml of IV solution. Atropine is the drug of choice for hypotension accompanied by bradycardia (pulse rate less than 60 bpm). Ephedrine is recommended when the heart rate is normal (see Figure 8.6).

Hypertension

A hypertensive crisis is often described as diastolic blood pressure greater than 120 mm Hg. The most common cause is pain and anxiety. A "time out" is often all that is needed to restore normal blood pressure. In some cases, additional local anesthetic will correct the problem. Hypertension is considered an emergency when it is accompanied by signs or symptoms. Headache, chest pain, and visual disturbances are all indications of a hypertensive emergency. Treatment includes the administration of nitroglycerin and activation of EMS (see Figure 8.7).

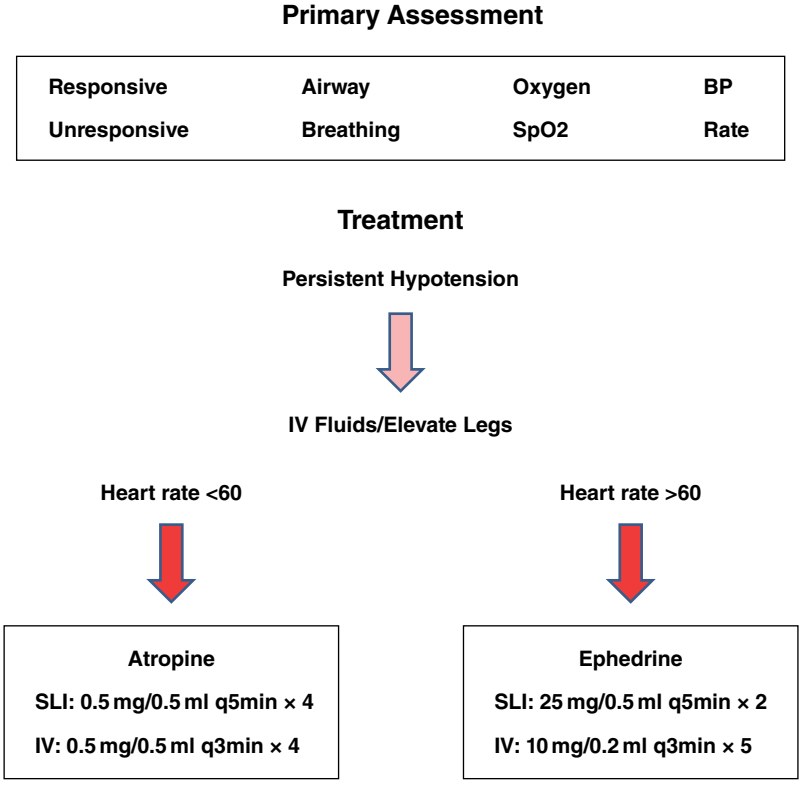

Figure 8.6 Hypotension algorithm.

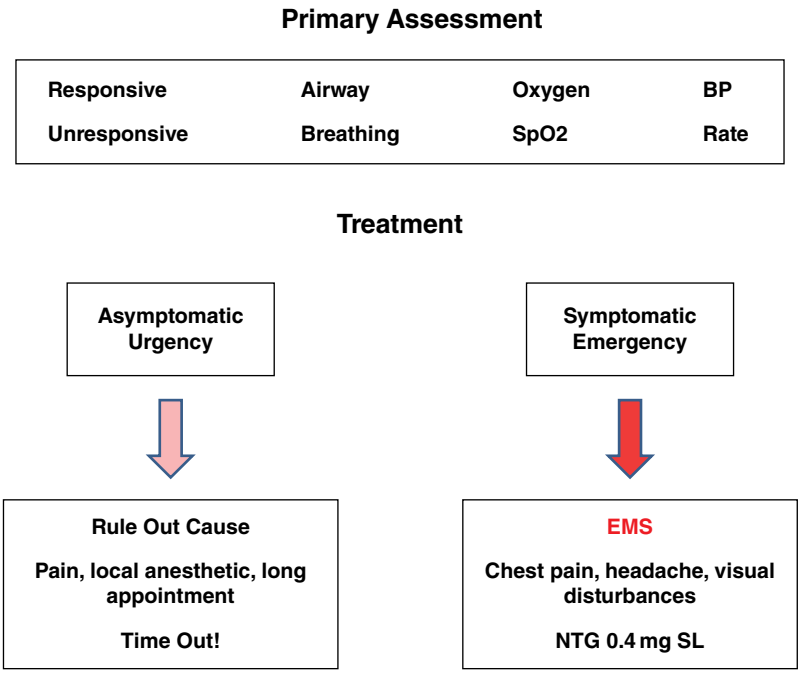

Figure 8.7 Hypertension algorithm.

Seizure

The patient will usually present with a history of seizures. A seizure is usually preceded by an aura. The aura is unique to each individual. Examples of auras include unusual odors, headaches, and changes in vision. The aura can serve as a warning of an impending seizure, allowing time to prepare the patient. The patient should be on 100% oxygen in a supine position, and objects should be removed from the mouth.

Seizure patients lose consciousness and are unaware of their surroundings during the seizure. They should be gently protected from injuring themselves. A seizure can be tonic or tonic-clonic. During a tonic seizure the patient's body assumes a ridged, arched position. Tonic-clonic seizures involve flexion and extension of the arms and legs.

Seizures are very unusual in the patient sedated with midazolam since this drug is used to treat seizures. Fifty percent dextrose should be administered if an IV line is available. Airway adjuncts may be useful to help breathing during recovery after the seizure. The patient should be turned on their right side to prevent aspiration of vomitus postseizure. Recurring seizures or seizures lasting longer than 5 minutes require EMS (see Figure 8.8).

Hypoglycemia

Hypoglycemia is defined as blood glucose levels below 60 mg/dl. Signs and symptoms include diaphoresis, confusion, convulsions, and loss of consciousness. Prevention includes a thorough medical history, short appointments, and early morning appointments. Blood glucose should be checked before appointments. Dextrose 5% IV fluid is recommended for diabetic patients in lieu of normal saline when IV sedation is planned.

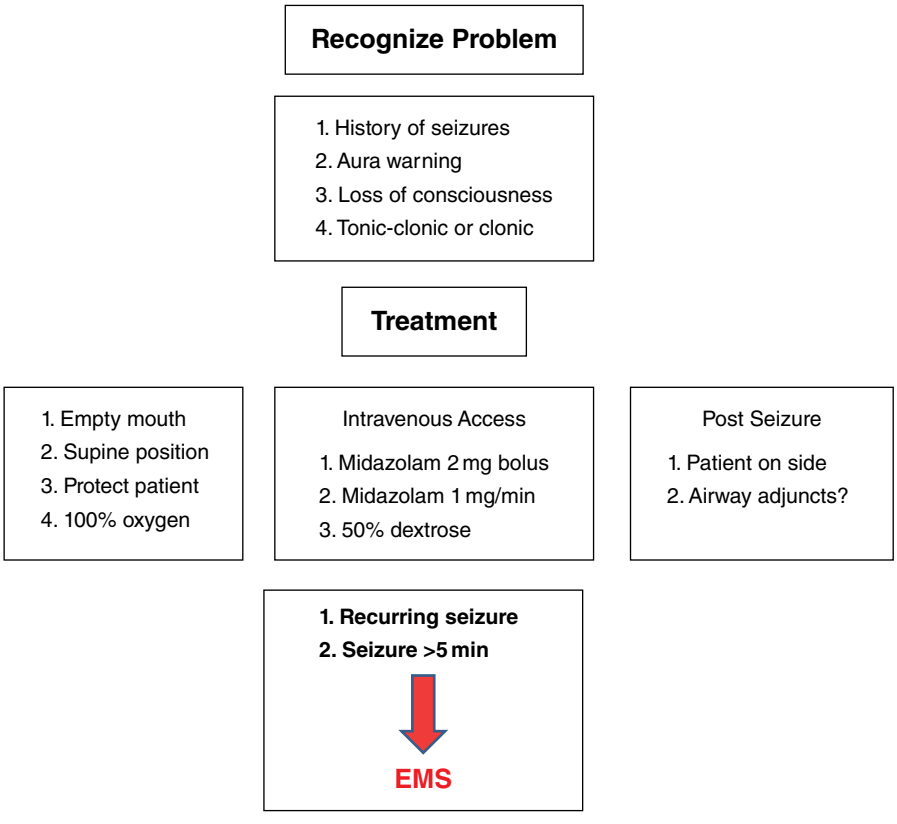

Figure 8.8 Seizure algorithm.

All patients with symptoms should receive 100% oxygen. Conscious patients should be given sugary food such as cake frosting. Unconscious patients should be given glucagon IM or 50% glucose IV. EMS should be activated if blood glucose level does not improve (see Figure 8.9).

Syncope

Syncope is the most common medical complication in dentistry. It is triggered by fear or pain. Vasovagal reactions decrease oxygen/glucose to the brain, causing loss of consciousness. A brief convulsive period is possible. Patients may appear pale and exhibit diaphoresis. They may feel cold or dizzy. Treatment includes emptying the patient's mouth, triple airway maneuver, and assessment. More serious complications should be suspected if this emergency does not resolve quickly (see Figure 8.10).

Monitors

The most reliable monitor of patients who are moderately sedated is verbal communication. Patients who are aware of their surroundings and can respond to verbal commands are able to maintain their airway. Other monitors include the pulse oximeter, precordial stethoscope, capnometer, and electrocardiogram.

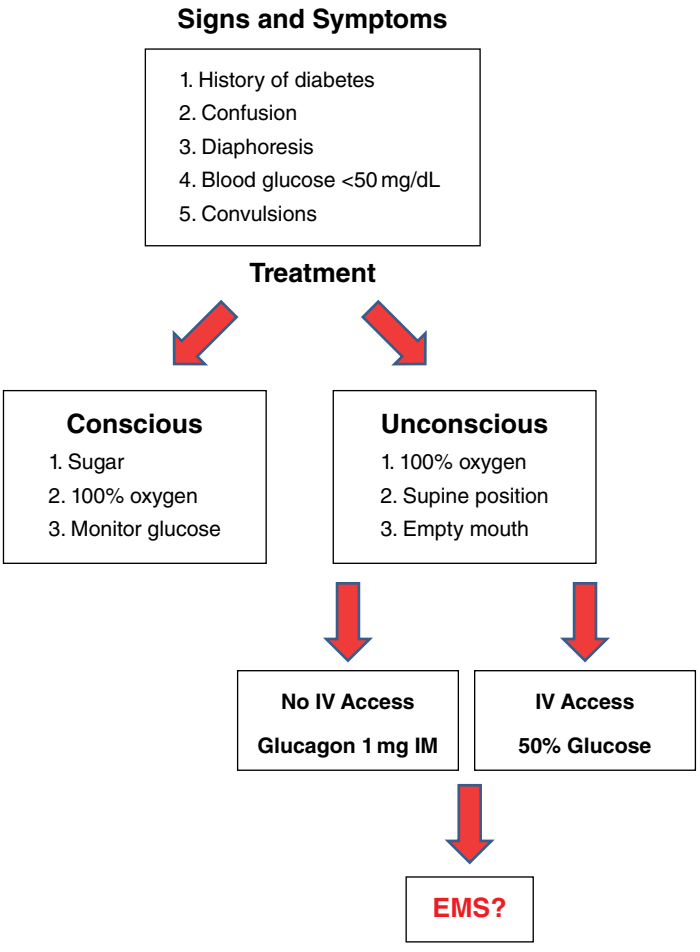

Figure 8.9 Hypoglycemia algorithm.

Pulse Oximeter

Pulse oximetry measures the saturation of oxygen in blood. It monitors a patient's peripheral oxygen saturation (SpO_2). A fingertip sensor compares red and infrared wavelengths of light passing through the fingertip (see Figure 8.11). The ratio of red to infrared is expressed as a percentage of oxygen in the hemoglobin molecule. Most pulse oximeters consist of a monitor, blood pressure cuff, sensor, and printer (see Figure 8.12). The Edan M3 pulse oximeter has an adjustable audible alarm and measures blood pressure, pulse rate, and mean arterial pressure in addition to oxygen saturation.

Pulse oximetery monitors oxygenation, the process of getting oxygen to blood and tissue. Capnography monitors the mechanical process of breathing, spontaneously or with help. This is important because pulse oximetry may indicate 99% oxygenation even when a patient is not breathing.

The oxyhemoglobin dissociation curve illustrates this concept (see Figure 8.13). The vertical axis is SaO_2, the amount of hemoglobin saturated with oxygen. The horizontal axis is PaO_2, the partial pressure of oxygen in the alveolus. The oxyhemoglobin dissociation curve

is important because it shows that oxygen saturation at the sensor is not equal to available oxygen in the lungs.

An SpO_2 of 90 reflects a PaO_2 of ~60 mm Hg. An oxygen saturation of 90% indicates that available oxygen is at the "edge of a cliff" and is a warning to aggressively reestablish adequate ventilation. By definition, this is hypoxemia. Saturation that repeatedly drops below 95% requires action such as telling the patient, "Take a slow deep breath," head tilt/chin lift, or nasal cannula.

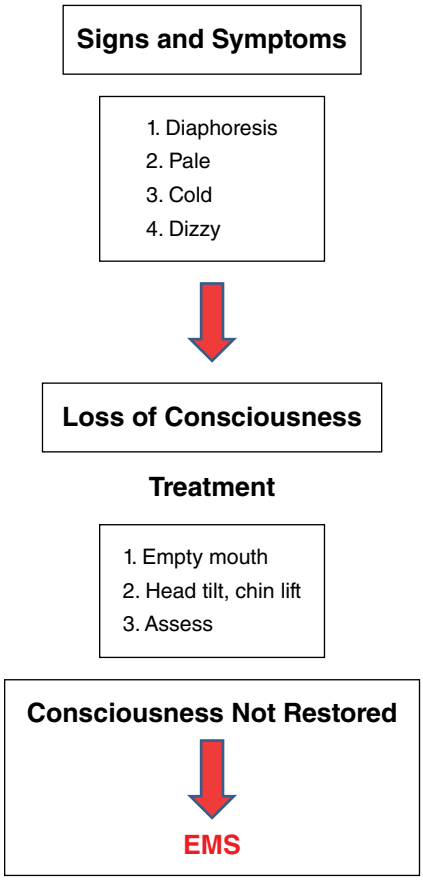

Figure 8.10 Syncope algorithm.

Capnometer

Capnography monitors ventilation and the partial pressure (concentration) of carbon dioxide (CO_2) in exhaled air. A capnometer provides a waveform tracing of every breath and measures respiratory rate and end-tidal CO_2 (see Figure 8.14). Infrared technology is used to analyze carbon dioxide in exhaled gas. Exhaled air enters a nasal cannula and passes between a light and a detector plate (see Figure 8.15). More light is absorbed by concentrated CO_2 and less light is transmitted to the detector plate. The amount of light absorbed reflects the partial pressure of CO_2 at the end of exhalation. This is called end-tidal CO_2, which is normally 35–45 mm HG.

Capnography provides three important parameters (see Figure 8.16):

1) Waveform tracing for every breath
2) Respiratory rate (AwRR)
3) End tidal CO_2 value—normal is 35–45 mm Hg

Figure 8.11 Finger sensor. *Source:* Reproduced by permission of Mediaid, Inc.

Figure 8.12 Edan M3 pulse oximeter. *Source:* Reproduced by permission of Edan Diagnostics, Inc.

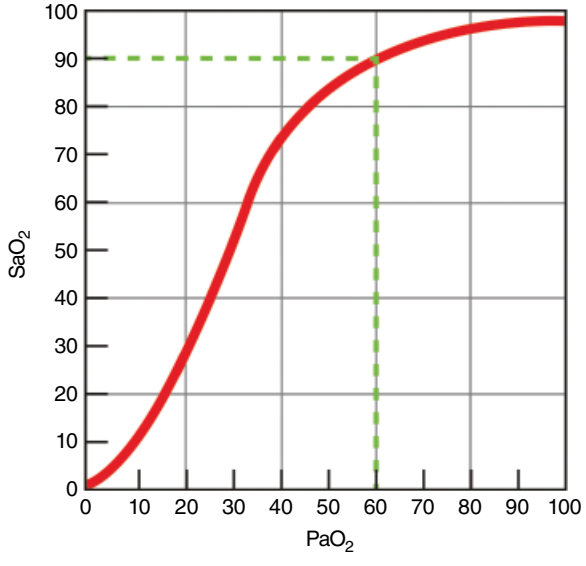

Figure 8.13 The oxygen dissociation curve.

Figure 8.14 Capnometer. *Source:* Reproduced by permission of Edan Diagnostics, Inc.

Capnography provides an earlier warning of airway obstruction or apnea when compared to pulse oximetry with supplemental oxygen. At the time of this writing, capnography is not required by most states. However, it is recommended by the American Dental Association and is likely to become the standard of care for moderate sedation.

Precordial Stethoscope

A precordial stethoscope is an affordable and effective way to monitor ventilation. It consists of a weighted stethoscope bell, rubber tubing, and an earpiece. The weighted pretracheal stethoscope bell, placed over the suprasternal notch, monitors airway patency and ventilation. Double-sided adhesive disks stabilize its position (see Figure 8.17a and 8.17b).

A normal open airway produces a whooshing sound. Gurgling indicates liquid in the airway. Wheezing is the hallmark of bronchospasm. A high-pitched crowing sound can be heard when partial laryngospasm is present. All of these conditions can be detected when using a simple pretracheal stethoscope.

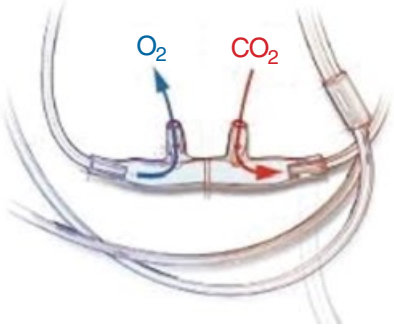

Figure 8.15 CO_2 sampling nasal cannula.

Electrocardiogram (EKG)

The electrocardiogram is a graphic representation of the cardiac cycle. Each event has a distinctive waveform (see Figure 8.18). The cardiac cycle refers to a complete heartbeat

Figure 8.16 Capnography parameters. *Source:* Reproduced by permission of Edan Diagnostics, Inc.

Figure 8.17a Pretracheal stethoscope bell.

Figure 8.17b Custom earpiece.

from its generation to the beginning of the next beat. The cardiac cycle is coordinated by a series of electrical impulses that are produced by specialized pacemaker cells found within the (SA) sinoatrial node and the (AV) atrioventricular node of the heart. Conduction of the electrical impulses produces a waveform. EKG is not required by most states for patient monitoring during moderate sedation.

The removal of impacted third molars can be done in relative comfort with moderate sedation. Patient safety is paramount when sedation is used. Monitoring patients during sedation alerts the dentist of impending sedation complications. Dentists employing sedation must have the training and knowledge to manage sedation emergencies.

The American Dental Society of Anesthesia provides a forum for education, research, and recognition of achievement in order to provide safe and effective patient care for all dentists who have an interest in anesthesiology, sedation, and the control of anxiety and pain. Membership in this organization is recommended for dentists providing sedation when removing impacted third molars.

Figure 8.18 Normal sinus rhythm.

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