# MEDICAL EMERGENCIES IN THE DENTAL OFFICE

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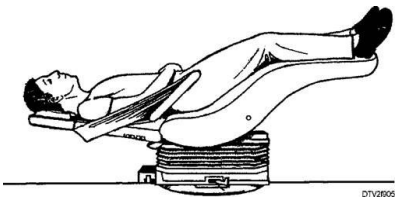
# C. Management

The clinician must approach each emergency with a plan! The emphasis in emergency management should be on a simplified approach, with an ultimate goal in mind. ***In every emergency, the ultimate goal is to provide adequate circulation of oxygenated blood to the brain and the heart!*** If the brain and heart are being adequately perfused (adequate blood pressure) with metabolic substrate (e.g., oxygen, glucose), the patient is more likely to have a positive outcome. The most useful and simple algorithm is the ABC's of basic life support. By addressing each letter in the acronym, confusion is avoided and the most important steps are addressed first. It must be appreciated that certain steps can be skipped depending on the emergency. For example, in the awake, verbalizing patient, there is no need to open the airway! In the patient that is experiencing acute hypoglycemia, time should not be wasted on the initial ABC algorithm steps, but rather skipping to D which involves delivery of drug (sugar). This accomplishes that ultimate goal of providing metabolic substrate (glucose) to the brain which is absolutely essential for CNS function (consciousness).

1. **P**-position
2. **A**-airway
3. **B**-breathing
4. **C**-circulation
5. **D**-drugs, Defibrillation

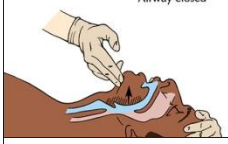
## Position



Goal- optimize blood flow to brain

- Conscious: semi-supine/comfortable
- Unconscious: supine or Trendelenberg (feet elevated)

## Airway

Goal: establish airway patency (allows gas exchange)

- Conscious: No intervention necessary
- Unconscious: Head tilt/Jaw thrust

## Breathing


Goal: adequate inflation and deflation of the lungs

- Conscious patient: if the patient is experiencing dyspnea, administer 100 % oxygen by nasal cannula or face mask
- Unconscious patient: Evaluate 10 seconds for chest rise
    1. Spontaneous respirations: Provide 100 % oxygen by face mask
    2. Apnea: Administer 100 % oxygen with positive pressure device

# Circulation

Goal: adequate blood flow to vital organs

- Check for pulse
    1. Conscious: palpate radial pulse (for baseline) and take blood pressure
    2. Unconscious: palpate carotid pulse
        - Pulse present-→ take blood pressure
        - No Pulse→ Begin CPR, Call for AED!!

# Drugs/Defibrillate

Goal: stabilization of vital signs/restoration of perfusing rhythm

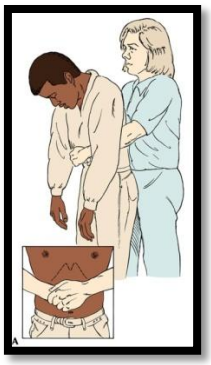
- Drugs
    - Administer drugs only if necessary
    - Most emergencies can be managed without administration of drugs
    - Use appropriate drug!
    - Use appropriate dose!
    - Use appropriate route of administration!
- Defibrillate
    - Only indicated in pulseless arrest
    - Attach AED pads and follow prompts
    - Device will indicate if shock is advised

We will know discuss and review the most common medical emergencies in the dental office. Each emergency will be defined, causes identified, signs and symptoms discussed and appropriate interventions reviewed. Each emergency should be approached with the emergency protocol (P-A-B-C-D) in mind, as discussed above.

**1) Airway obstruction**
**2) Acute coronary syndrome**
**3) Allergic reaction**
**4) Bronchospasm**
**5) Cardiac arrest**
**6) Convulsions**
**7) Hyperventilation**
**8) Hypoglycemia**
**9) Myocardial infarction**
**10) Syncope**

## Airway obstruction

**Definition: partial or complete blockage of respiration.**



**Causes:** Airway obstruction in the dental office is usually caused by foreign objects dropped into the Oropharynx. In the unconscious patient, obstruction is usually caused by the tongue falling back against the posterior wall of the pharynx.

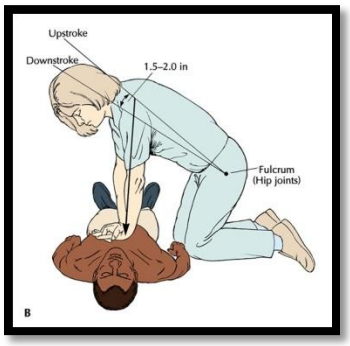
**Signs and Symptoms:**

1. Stridor, choking, coughing, inability to phonate
2. "see saw" pattern of chest/abdominal excursions
3. Cyanosis – mucous membranes, nail beds, ashen gray color of skin

**Treatment:**

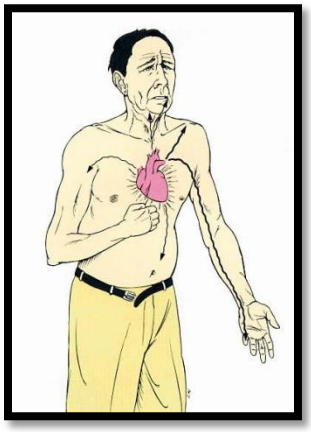
- Conscious patient
    1. **P**osition-comfortable
    2. **A**irway- Remove foreign body:
        a. Finger sweep or suction
        b. Abdominal thrusts (Heimlich maneuver)

- Unconscious patient (call for help!)
    1. **P**osition- supine
    2. **A**irway- head tilt/jaw thrust
        a. Suction/finger sweep to remove object
        b. **Perform CPR**
    3. **B**reathing- administer positive pressure oxygen
        a. If no chest rise- perform cricothyrotomy




## Acute Coronary Syndrome

**Definition:** Angina is defined as a myocardial oxygen supply/demand imbalance secondary to narrowing of the arteries as seen in CAD.



**Causes:** Coronary artery disease

**Symptoms:**

1. Chest pain (Not always): Radiating pain to the left shoulder, arm and lower jaw
2. Squeezing, burning, pressing, palpitation, "indigestion"

**Treatment:**

1. **P**osition: comfortably
2. **A**irway: Administer 100% oxygen
3. **C**irculation: Monitor vitals (HR, BP)
    a. Blood pressure/Heart rate usually goes up in a patient experiencing angina!
4. **D**rugs:
    a. Administer Nitroglycerin (spray: 1-2 actuations or sublingual:0.4mg) administer one tablet every 5 minutes, if needed, as long as systolic pressure is > 90 mmHg up to a maximum of three doses (relieve usually within 1-2 minutes)
    b. Administer chewable aspirin 160-325 mg
    c. Administer 30 % N20 if no pain relief from nitroglycerin

5. Transport to ER if new onset, angina recurs or if anginal pain does not diminish with nitrates

## Allergic Reaction (Anaphylaxis)

**Definition:** allergic reactions are sensitivity reactions to substances (allergens). These range from mild to life-threatening (anaphylactic shock). In the case of a mild reaction, the symptoms are delayed onset and may not require treatment. However, it may be appropriate to administer Benadryl orally. In the case of a rapid onset allergic reaction, intervention must be rapid to avoid an escalating and deteriorating situation.

**Causes:**

1. #1 Food
    a. Peanuts, Shellfish, Tree nuts, Seeds, Fish, Soy, Wheat, Milk Eggs
2. # 2 Drugs (All drugs)
    a. ABX
    b. NSAIDS
    c. Barbiturates
    d. Neuromuscular blockers etc
3. Latex
4. Idiopathic
5. Physical factors (exercise, heat, cold, sunlight)

**Symptoms:** Urticaria, Angioedema, dyspnea, wheezing, extremely low blood pressure

**Treatment:** (911)

1. **P**osition
    a. Conscious- comfortable
    b. Unconscious- supine, legs elevated
2. **A**irway/breathing: Administer 100 % oxygen
3. **C**irculation: Monitor vitals (HR, BP), low blood pressure and rapid heart rate are bad!
4. **D**rugs
    a. **Anaphylaxis**
        i. **Epinephrine**: adult-0.3 mg/ Peds (<20 kg) 0.15 mg IM
        ii. Bronchodilator: Albuterol 2-4 puffs (alleviates bronchoconstriction)
        iii. Anti-histamine: Benadryl adult-50 mg/Peds 1 mg/kg IM/IV (antagonizes further histamine receptor binding. Remember, epinephrine is short acting!)
        iv. Steroid : Hydrocortisone adult 100 mg/Peds 1-2 mg/kg or decadron adult 8-12 mg/Peds 0.1 mg/kg IV/IM (prevents recurrence-immune suppressant)
        v. Fluids 1-2 liters (if IV access)
        vi. Transport to ER
    b. Mild hypersensitivity
        i. Anti-histamine: Benadryl adult 50 mg/Peds 6.25-25 mg oral (onset 30 minutes) or IM (onset 5-10 min)
        ii. Bronchodilator: Albuterol 2-4 puffs (if difficulty breathing)

## Bronchospasm

**Definition:** Constriction of bronchial smooth muscle resulting in reduced or lack of airflow in the lungs.
**Causes:**

1. Emotional stress
2. Upper respiratory infections (Most common in children with asthma)
3. Environmental allergens
4. Allergic reaction to drugs (immune mediated)

**Signs and Symptoms:**

a. Coughing
b. Wheezing
    i. Mild/Moderate Bronchospasm: Audible wheezing with or without auscultation.
    ii. Severe Bronchospasm: May not hear wheezing due to minimal airflow movement through completely restricted airways.
c. Difficulty in breathing
d. Chest Pain or Pressure

**Treatment:**

1. **P**osition-Comfortable
2. **A**irway/breathing- provide 100 % oxygen
3. **C**irculation- Monitor vitals (HR, BP)
4. **D**rugs
    a. Administer bronchodilator
        i. ≤ 12 years: 4-8 puffs of albuterol Q 20 minutes for 3 doses
        ii. > 12 years: 4-8 puffs Q of albuterol 20 minutes for up to 4 hours
    b. Refractory to bronchodilator therapy
        i. Epinephrine: adult 0.3 mg/Peds 0.15 mg IM

## Cardiac Arrest

**Definition:** Defined as abrupt cessation of effective circulation of the blood due to heart failure (e.g., VF, asystole)
**Causes:**

1. Coronary artery disease/myocardial infarction
2. Cardiomyopathy
3. Myocarditis
4. Drug overdose (local anesthetic)
5. Trauma, drowning

**Treatment:** **Call for help/911 and defibrillator!**
**AHA 2010 cardiac arrest protocol:** evidence now points to the importance of providing good quality CPR initially to patients with cardiac arrest. It was found that too much time was being wasted assessing for breathing and retrieving ventilation equipment. Studies show that when CPR is delayed or stopped, the left ventricle is drained of blood= no coronary artery perfusion= unsuccessful shock.

1. **P**osition: supine
2. **C**irculation: administer CPR
3. **A**irway: head tilt/chin lift

4. **B**reathing: Positive pressure ventilation with 100 % oxygen
5. **D**efibrillation: administer shock therapy

## Cardiac arrest protocol

a) Begin CPR (5 cycles)
b) Shock therapy (Shock as soon as device is available)
    i. 120-200 J (biphasic)
    ii. AED (device specific)
    iii. 360 J (monophasic)
c) Resume CPR immediately-5 cycles (30:2)
d) Check pulse/analyze rhythm
    i. Continue CPR while charging device!
    ii. Shock
        1. 120-200 J (biphasic)
        2. AED (device specific)
        3. 360 J (monophasic)
    iii. Resume CPR immediately after shock (5 cycles)
e) Check pulse/analyze rhythm
f) Continue sequence until patient recovers or help arrives

## Convulsions

**Definition:** Uncontrolled electrical activity in the brain, which may produce a physical convulsion, minor physical signs, thought disturbances, or a combination of symptoms

**Causes:**

1. Unprovoked- Epilepsy (Seizure disorders)
2. Provoked
    a. Head injury
    b. Intoxication with drugs (alcohol)
    c. Drug toxicity (local anesthetic)
    d. Infection
    e. Fever
    f. Metabolic disturbances (hypoglycemia, hypoxia)
    g. Brain lesions

**Symptoms:**

1. Tonic-clonic
    a. patient may cry out
    b. lose consciousness
    c. fall to the ground
    d. Convulse
2. Complex partial seizure
    a. Confusion
    b. Dazed and unable to respond to questions
3. Absence
    a. Rapid blinking or staring into space

**Treatment:**

a. **P**osition
   - Do not restrain patient (remove dangerous objects)
   - Do not force in a mouth prop
   - After seizure- place patient in recovery position (if unconscious)

b. **A**irway/Breathing: After seizure-administer oxygen and keep airway patent
c. **C**irculation: Monitor vitals (HR, BP) when seizure stops
d. **D**rugs: Midazolam adult 5 mg/Peds 0.1-0.2 mg/kg IM
e. Transport to ER
   - If seizure is >2 min (medical emergency)
   - If followed immediately by another seizure
   - If patient is injured

## Hyperventilation

**Definition:** abnormally fast respiration greater than the metabolic need of the body

**Causes:**

1. Unknown
2. Abnormal respiratory response to
   a. ***Stress***, emotional triggers
   b. Caffeine
   c. Lactate
   d. $C0_2$
3. Abnormal respiratory mechanisms
   a. Thoracic breathing results in expanded chest (hyperinflated lungs) which sets off a "Suffocation alarm"

**Symptoms:**

1. Rapid respiration, feeling of suffocation
2. Tightness in chest
3. Giddy light-headedness
4. Paresthesia of hands, feet, perioral
5. Trembling
6. Carpopedal spasm
7. Color usually good

**Treatment:**

1. **P**osition: Comfortable
2. **A**irway/breathing: Oxygen not necessary!
   a. Reassure patient
   b. Instruct patient to breathe slowly and use diaphragmatic breathing!!
   c. No paper bag!! ($C0_2$ may be a trigger)
3. **C**irculation: Monitor vitals (HR, BP)
4. **D**rugs: Midazolam (extreme cases) 1 mg/min IV (titrate)

## Hypoglycemia

**Definition:** defined as a blood glucose reading of less than 70 mg/dl (panic range: 50 mg/dl in males and < 40 mg/dl in females)

**Signs and Symptoms:**

1. shakiness, nervousness, tremor
2. palpitations, tachycardia
3. sweating, pallor, coldness, clamminess
4. hunger, nausea, vomiting
5. headache, impaired judgment, abnormal mental status, seizures, unconsciousness

**Causes:**

1. prolonged fasting
2. improper use of diabetic medications

**Treatment:** Treatment should not be delayed as coma, dysrhythmia and death can ensue

1. **P**osition: comfortable
2. **A**irway/Breathing: administer 100 % oxygen
3. **C**irculation: Monitor vitals (HR, BP)
4. **D**rugs:

**Conscious patient**

a. Check blood glucose, of blood glucose is <60mg/dl
   i. Administer oral glucose (20 grams)
   ii. Wait 15 minutes
   iii. If symptoms continue, recheck blood glucose and administer oral glucose until blood glucose is >80 mg/dl

**Unconscious patient**

a. Check blood glucose, if blood glucose is <60 mg/dl

**No IV access:**

i. Glucagon: adult 1 mg/Peds(<20 kg) 0.5 mg IM
ii. Check blood glucose in 15 min
iii. If patient regains consciousness give oral carbohydrate and bread exchange
iv. Check blood glucose in 15 minutes
v. Repeat oral treatment until blood glucose >80 mg/dl
vi. If patient does not regain consciousness, start IV and administer dextrose

**IV access:**

i. $D_{50}$ adult 25 g/Peds 1g/kg IV
ii. Check blood glucose in 5 min
iii. If patient regains consciousness give oral carbohydrate and bread exchange
iv. Check blood glucose in 15 minutes
v. Repeat oral treatment until blood glucose >80 mg/dl
vi. If patient does not regain consciousness, administer 1-2 amps of $D_{50}$

## Myocardial infarction

**Definition:** Myocardial infarction is defined as necrosis and death of myocardial cells. Myocardial infarction occurs when myocardial ischemia exceeds a critical threshold and overwhelms the myocardial cellular repair mechanisms that are designed to maintain normal operating function.

**Causes:** Coronary artery disease, coronary artery spasm (cocaine intoxication). A large majority of MI's occur during minimal exertion or at rest

**Symptoms:**

1. Severe chest pain (Not always) that is unrelenting regardless of treatment
2. Radiating pain to the left shoulder, arm and lower jaw
3. Squeezing, burning, pressing, palpitation, "indigestion"
4. Shortness of breath, diaphoresis, fainting
5. Nausea, vomiting, seizures
6. Dysrhythmias (Bradycardia, ventricular tachycardia/fibrillation, asystole): watch out for these- ***most important/common is ventricular fibrillation! (patient will lose consciousness)***

**Treatment:**

1. **P**osition: comfortably
2. **A**irway: Administer 100% oxygen
3. **C**irculation: Monitor vitals (HR, BP)
   a. Blood pressure usually falls in patients experiencing an MI!
4. **D**rugs/Defib:
   a. Administer Nitroglycerin (spray: 1-2 actuations or sublingual:0.4mg) administer one tablet every 5 minutes, if needed, as long as systolic pressure is > 90 mmHg up to a maximum of three doses
   b. Administer chewable aspirin 160-325 mg
   c. Administer 30 % N20 if no pain relief from nitroglycerin (morphine 2-4 mg IV)
   d. Prepare for defibrillation while awaiting arrival of EMS!
5. **Symptoms are not relieved by oxygen, rest and nitrates!! (Most important!!)**
6. Call 911 and transport to ER

## Syncope

**Definition:** temporary loss of consciousness (fainting)

**Causes:** Cessation of blood flow to the brain

1. Non cardiac
   - Vasovagal
   - Pain and anxiety
2. Cardiac
   - Orthostatic
   - Dehydration and hypovolemia
   - Elderly (blunted baroreceptor response)
3. Medications
4. Arrhythmia
5. Hypoglycemia
6. Unknown

**Symptoms:**

1. Pale Ashen-Grey Appearance
2. Sweaty
3. Nausea
4. Eyes Dilate
5. Convulsive Movements / twitching

**Treatment:**

1. **P**osition: Supine/feet elevated (usually respond in < 60 seconds)
2. **A**irway: Head tilt/jaw thrust
3. **B**reathing: Administer 100% oxygen (positive pressure is rarely needed)
4. **C**irculation: Monitor vitals (HR, BP)
5. **D**rugs (rarely needed)
    a. Aromatic ammonia
    b. Ephedrine 10-20 mg IM/IV (refractory hypotension)
    c. Atropine adult 0.5 mg/Peds 0.02 mg/kg) IM/IV (bradycardia)

# Differential Diagnosis

It is very helpful to think of a differential for particular emergency symptoms involving respiratory distress, loss of consciousness and chest pain. The underlying etiology can be any number of causes and are treated quite differently.

## Respiratory distress

1. *Hyperventilation*: usually associated with a panic/anxiety attack. Vitals signs are usually elevated and oxygen levels are normal despite patient's complaint of dyspnea. The patient takes very rapid, short breaths, resulting in inadequate exhalation which results in breath stacking.

2. *Airway obstruction*: in the unsedated dental patient, this is almost always a result of aspiration of a foreign object (crown). In the sedated patient, this is usually the result of soft tissue (tongue) obstruction.

3. *Bronchospasm:* this diagnosis is frequently associated in patients with a diagnosis of asthma or chronic obstructive pulmonary disease. The signs and symptoms of dyspnea result from the narrowing of the bronchioles. In the case of a severe allergic reaction, the cause of the dyspnea is the same; a restriction of air movement in the bronchioles due to bronchospasm.

## Loss of consciousness

1. *Syncope*: usually breathing spontaneously, pulse present (usually weak) and most often responds to positioning (feet elevated) within a minute
2. *Postural hypotension*: spontaneous respirations present, pulse present (usually weak) and most often occurs when assuming the upright position and responds to repositioning (supine)
3. *Hypoglycemia*: spontaneous respirations and pulse present, often insulin-dependent diabetic
4. *CVA/Stroke*: usually characterized by elevated blood pressure
5. *Cardiac arrest*: no respirations or pulse!!

## Chest pain

1. *Angina/myocardial infarction*: classic symptoms related to oxygen supply and demand imbalance
2. *Anxiety attack*: often results in atypical chest pain
3. *Acid reflux*: may be described as similar symptoms to angina/MI- burning, indigestion etc
4. *Tachycardia*: often described by patients as "palpitations or heart flutter"

# Preparedness Checklist

Assessment of your offices level of preparedness can be done by reviewing and marking the boxes on the following checklist. One point is given if the office is compliant for each particular element of preparedness. In the rapid response grade box, a letter grade is assigned, based on the speed with which the tasks are carried out. For example, an "A" grade is given in offices that can accomplish these tasks in less than 2 minutes.

| Office Preparedness Checklist Scoring | |
|---|---|
| **21 points/A on rapid response grade** | Highest level of preparedness |
| **16-20 points/B on rapid response grade** | Well prepared |
| **13-15 points/C on rapid response grade** | Prepared, practicing within standard of care |
| **12 points or less/D on rapid response grade** | Missing key elements of preparedness |

| | Preparation<br>*(Modified from: Rosenberg. Preparing for Medical Emergencies: the essential drugs and equipment for the dental office. JADA 2010;141;14s-19s* |
|---|---|
| 1 ☐ | ***1. BLS certification for all office personnel (ACLS/PALS if required by law or practice model)*** |
| 2 ☐ | ***2. Didactic and clinical courses in emergency medicine*** |
| 3 ☐ | ***3. Well-defined roles defined for at least 3 team members (4 is better)*** |
| 4 ☐ | ***4. Emergency "crash cart" immediately available*** |
| 5 ☐ | ***5. Emergency oxygen cylinder pressure and supplies checked daily*** |
| 6 ☐ | ***6. Emergency phone numbers for emergency medical services posted near every phone*** |
| 7 ☐ | 7. ***Periodic emergency drills are scheduled to simulate life-threatening emergencies*** |

## Team Member Role Description

**Team member #1**

8 ☐
- *Assume leadership role*
- *Implements ABC's of BLS*
- *Uses closed loop communication*

**Team member #2**

9 ☐
- *Retrieves oxygen*
- *Monitors vitals*
- *Assists with ABC's as directed*
- *Responsible for checking oxygen system daily*

**Team member #3**

10 ☐
- *Retrieves "crash cart"*
- *Turns on AED and follows prompts*
- *Assists with ABC's as directed*
- *Responsible for maintaining "crash cart"*
- *Responsible for checking AED (daily)*

**Team member #4**

11 ☐
- *Activates 911*
- *Assists with ABC's as directed*
- *Meets EMS personnel at entrance and directs them to emergency*

Adapted from: Haas D. Preparing dental office staff members for emergencies. JADA 2010; Vol 141

## Emergency Medications for the General Dental Office

| Medications | Formulation | indication | Dosage |
|---|---|---|---|
| 12 ☐ Sugar | Juice Box/glucose gel | Hypoglycemia | Oral 15-20 Grams Q 15 min |
| 13 ☐ Nitroglycerin | 0.4 mg SL Tabs or Translingual spray | Angina | 1 Tab SL Q 5 min x 3 doses or 1-2 sprays SL x 3 doses (if SBP >90 mmHg |
| 14 ☐ Albuterol | 90 mcg/puff | Acute/Severe Asthma Exacerbation | Adult 4-8 puffs Q 20 min (4 hours)<br>Peds 4-8 puffs Q 20 min (Max 3 doses) |
| 15 ☐ Aspirin | 81 mg tablets | Myocardial Infarction | 162-364 mgs (2-4 tabs) |
| 16 ☐ Benadryl | 50 mg/mL | Allergic rxn | Adult 50-100 mg IM<br>Pediatrics 25 mg IM |
| 17 ☐ Epinephrine | 1:1000 (1mg/mL)<br>or<br>EpiPen/EpiPen jr | Anaphylaxis,<br>Severe Bronchospasm | Adult 0.3 mg IM<br>Peds 0.15 mg IM |

IM- intramuscular
SL- sublingual
SBP- systolic blood pressure

| GENERAL DENTAL OFFICE<br>**"Crash Cart"** | |
|---|---|
| 18 ☐ | **i. Oxygen Delivery System** |
| 19 ☐ | **ii. Automated External Defibrillator (AED)*** |
| 20 ☐ | **iii. Blood Pressure Monitor** |
| 21 ☐ | **iv. Syringes**<br>a. 1 mL (Tuberculin)<br>b. 3 mL Syringe |

During periodic office medical emergency drills, it must be an objective to improve on response times. As stated in resuscitation literature, for every minute that passes without perfusion of the vital organs with oxygen and other metabolic substrate, the chances of return of spontaneous circulation diminishes dramatically. Therefore, focusing on reducing response times should be a major focus for emergency preparedness.

**Rapid Response Grade**

- *Retrieves oxygen, open valve, attach mask and ventilate*
- *Retrieves "crash cart"*
- *Turns on AED and attach pads*
- *Medication ready*

**A:** < 2 minutes
**B:** 2-3 minutes
**C:** 3-4 minutes
**D:** >4 minutes

- An **A** grade would mean that the office is a "well oiled machine", everyone is well trained, knows their role and there is an adequate number of individuals to carry out the various roles.
- Offices that attain a **B** grade are well prepared and with a little effort and practice can attain an A grade in the near future
- Offices that attain a **C** grade are practicing within the standard of care. The reason that response is slower may be related to lack of personnel (small office) or employees may be unfamiliar with office emergency protocols
- Offices that attain a D grade are unprepared for a life-threatening emergency

# Sedation and General Anesthesia

In this next section, we will discuss common emergencies that occur during the administration of oral and parenteral sedation and general anesthesia.

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

**A. Airway obstruction**

**Definition: partial or complete blockage of respiration.** The most common cause of airway obstruction in anesthesia/sedation is caused by the tongue falling back against the pharynx occluding the airway. Less commonly, obstruction is caused by foreign objects dropped into the Oropharynx or by protective reflex mechanisms (laryngospasm)

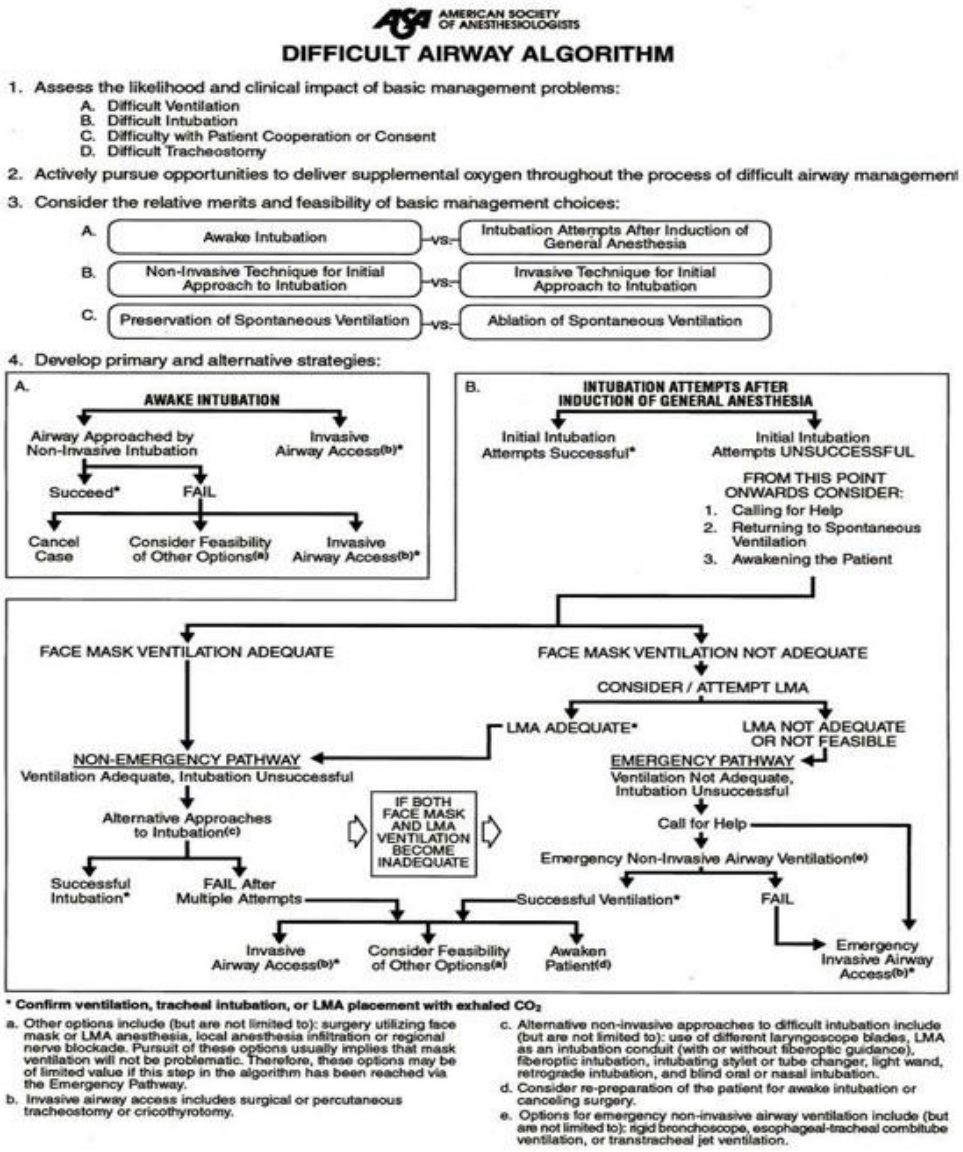
Signs and Symptoms:

1. "see saw" pattern of chest/abdominal rise
    a. Increased respiratory difficulty
2. $SPO_2$ monitoring decreases
3. Cyanosis – mucous membranes, nail beds, ashen gray color of skin
4. Lack of equal, bilateral breath sounds
5. Stridor/high pitched crowing sound on inhalation
6. Wheezing, choking, coughing

Treatment:

1. Obstruction
    - Reposition airway-head tilt
    - Jaw thrust- accomplished by finger pressure behind the angle of the mandible
    - Airway adjuncts: nasal or oral airways with positive pressure ventilation
    - Suction/magill forceps for retrieval of foreign objects
    - Laryngeal mask airway
    - Endotracheal intubation
    - Surgical airway-Cricothyrotomy

    } **See ASA difficult airway algorithm below**
2. Laryngospasm
    - Positive pressure oxygen delivery
    - Application of digital pressure of the "laryngospasm notch"
    - Succinylcholine 0.2 mg/kg (5-20 mg) IV/IM




**B. Bronchospasm**

**Definition:** Constriction of bronchial smooth muscle resulting in reduced or lack of airflow in the lungs.

Signs and Symptoms:

1. Preoperative and Postoperative:
    a. Coughing
    b. Wheezing
        i. Mild/Moderate Bronchospasm: Audible wheezing with or without auscultation.
        ii. Severe Bronchospasm: May not hear wheezing due to minimal airflow movement through completely restricted airways.
    c. Difficulty in breathing
    d. Chest Pain or Pressure

2. Intraoperative:
    a. Expiratory Wheeze
        i. Mild/Moderate Bronchospasm: Wheezing may be evident with or without ascultation.
        ii. Severe Bronchospasm: Wheezing may not be audible due to complete restriction of bronchi.
    b. Prolonged Exhalation
    c. Decreasing Tidal Volumes
    d. Decreasing Oxygen Saturations
    e. Increasing Peak/Inflation Pressures
    f. End-Tidal CO2
        i. Mild/Moderate Bronchospasm : Rising end – tidal CO2
        ii. Severe Bronchospasm: Rise accompanied by a fall in end- tidal CO2

Treatment:

1. Rule out mechanical/equipment (kinked tube, plugged tube, misplacement of endotracheal tube, etc)
2. 100% oxygen
3. Deepen anesthetic- 8% sevoflurane and/or IV propofol
4. B-2 agonist (albuterol) 4-8 puffs
5. Epinephrine (adult IV 10-50 mcgs; IM 0.3 mg) (pediatrics IV 10-25 mcg; IM 0.15 mg)
6. Ketamine
7. Steroids
8. Modify ventilation method by using a self-inflating resuscitation bag.
9. Remove secretions and/or regurgitation especially if using a LMA.

**C. Emesis and aspiration**

**Definition:** Aspiration is the passage of particulate matter such as food or fluid, such as blood, saliva or GI contents into the trachea. Basically there are three types of aspirate:

- **Acidic fluid**- pH less than 2.5, results in immediate alveolar-capillary breakdown which leads to edema, intra-alveolar hemorrhage and atelectasis. Hypoxia is common and frequently leads to respiratory failure.
- **Non-acidic fluid**- destroys surfactant causing alveolar collapse and atelectasis. Hypoxia is common, however the destruction of lung architecture is not as great compared to aspiration of acidic fluid.
- **Particulate matter**- Causes both a physical obstruction of the airway as well as an inflammatory response. Hypoxia and hypercapnia results due to obstruction. If acid is mixed with the particulate matter, damage is often greater and the clinical picture worse.

Treatment:

1. Place patient in Trendelenberg position and head turned to side.
2. Suction oropharynx aggressively
3. Evaluate patient
    a. Monitor following parameters for 2 hours and discharge if none of the below
        i. Oxygen saturation (↓ saturation)
        ii. Respiratory rate (↑ RR)
        iii. Temperature (↑ temp)
        iv. Auscultation of lungs (rales-[noisy lungs])
        v. Skin color (cyanotic)
    b. If any of the above develop:
        i. Supplemental oxygen
            1. Mask
            2. Positive pressure ventilation

4. If VSS (no increased need for oxygen) for 2 hours, then the patient should recover uneventfully.
5. If oxygen saturation is < 93 and/or lungs are not clear, the patient should be transported to hospital
6. Antibiotics, lavage and corticosteroids are controversial and generally are not found to be helpful in controlled trials.

**D. Angina pectoris**

**Definition:** Angina is defined as a myocardial oxygen supply/demand imbalance secondary to narrowing of the arteries as seen in CAD.

Treatment:

6. Position comfortably
7. Administer 100% oxygen
8. Monitor vitals (HR, BP)
9. Administer Nitroglycerin (spray- 0.4mg , SL- 0.4mg, IV 5-200mcg/min) x 3 every 5 minutes (SBP > 90 mmHg)
10. Administer aspirin 325 mg SL
11. Transport to ER if new onset, angina recurs or if anginal pain does not diminish with nitrates

**E. Myocardial infarction**

**Definition:** Myocardial infarction is defined as necrosis and death of myocardial cells. Myocardial infarction occurs when myocardial ischemia exceeds a critical threshold and overwhelms the myocardial cellular repair mechanisms that are designed to maintain normal operating function.

**Risk Factors:**

- History of cardiovascular disease: angina, heart attack, stroke
- Older age (50 and above)
- Tobacco smoking
- Hypertension
- Hypercholesterolemia
- Diabetes
- Obesity
- Chronic Kidney Failure
- Heart Failure
- Alcohol/drug abuse
- Genetic predisposition
- Smoking and O.C. use

**Signs and symptoms:**

- Angina (Chest pain)
- Syncope
- Jaw pain, toothache, headache
- Shortness of breath
- Nausea, vomiting,
- Epigastric discomfort (upper middle abdomen),Heartburn/Indigestion
- Arm pain (more commonly left arm, but it could be both), Upper back pain
- General Malaise, Impairment of cognitive function
- ST segment changes, Arrhythmias
- No symptoms (approximately one quarter of all M.I's are silent without chest pain or new symptoms. These are common among patients with diabetes mellitus)

**Treatment/Management:** (remember MONA: Morphine, Oxygen, Nitro, Aspirin)
*The goal is reperfusion

1. Call for help
2. Monitor Vitals
3. **O**: Oxygen (or Nitrous and Oxygen mixture) 4-6 L/min
4. **N**: Administer Nitroglycerin (spray- 0.4mg , SL- 0.4mg, IV 5-200mcg/min) x 3 every 5 minutes- **S & S of MI don't completely improve with Nitrates!**
5. **A**: Aspirin 160-325 mg. sublingual (aspirin alone has one of the greatest impacts on reduction of MI mortality
6. **M**: Morphine 2-4 mg IV every 5 min. until pain relieved
7. Transport to E.R.

**F. Hypotension**

**Definition:** Defined as a blood pressure **below 20% of baseline or below a MAP of 50-60.**

Cause: Vasodilation (relaxation), commonly seen with anesthetic/sedative agents

- Dehydration (NPO)
- Hypertensive patients
    - Volume depleted (low intravascular volume due to vasoconstriction)
    - Medications result in relaxation of blood vessels (nitrates, Ca channel blockers, ACE inhibitors)
- Elderly patient

Signs and Symptoms

1. lightheadness
2. dizziness
3. fainting
4. seizures

Treatment:

1. Administer 100% oxygen
2. Decrease depth of anesthesia
3. Fluid challenge (Adults- 250 cc; pediatrics 100cc)
4. Pressors
    - Ephedrine 5-25 mg for low BP/HR
    - Phenylephrine 25-50 mcg for low BP/adequate HR
    - Epinephrine 2-20 mcg/min
5. Position patient supine and elevate legs to increase venous return

**G. Hypertension**

**Definition:** defined as blood pressure >20% of baseline or 140/90

Causes of Intra-operative hypertension: **Pain,** Inadequate anesthesia depth, full bladder, fluid overload, hypoxemia, hypercapnia

Signs and symptoms:

1. BP elevation
2. headache
3. tinnitus
4. dizziness
5. confusion

Treatment:

1. Stop treatment and reestablish local anesthesia
2. Deepen anesthetic (volatile/IV anesthetics, narcotics)
3. Beta blockade
    - Patient must have good ventricular function
    - Useful with associated increased heart rate
    - Don't use Beta-blockers with bronchospastic disease (possible bronchoconstriction and interference with beta 2 agonists)
4. Calcium channel blockers
    - Useful for patients with bronchospastic disease
5. Hydralazine (5mg aliquots up to 25 mg)
    - Provides long term BP control but has a delayed onset, but might be associated with reflex tachycardia

**H. Cardiac arrest**

**Definition:** Defined as abrupt cessation of effective circulation of the blood due to heart failure (e.g., VF, asystole)

Treatment:

1. A-Airway
2. B-Breathing
3. C-Circulation- CPR (30:2)
4. D-Defibrillate if VF/Pulseless VT (biphasic-120-200J; monophasic-360J)
5. D-Drugs
    - Epinephrine 1 mg (Peds 0.01mg/kg) Q 5 min
    - Atropine 1 mg (Peds 0.01-0.02 mg/kg) max 0.04 mg/kg (both Peds/Adults)

**I. Allergic reactions**

Localized skin/mucous membrane reaction

- No treatment
- Steroid cream
- Oral anti-histamine (Benadryl 50 mg)
- Observation

Generalized skin reaction (stable VS)

- Antihistamine IM/IV (Benadryl 50 mg)
- Consultation with physician

Anaphylaxis

- Epinephrine

Adult

- Bronchospasm
    - 0.3 mg (0.3 mL of 1:1000) deep IM
    - EpiPen (0.3 mg) deep IM
    - 0.01mg- 0.05mg IV
- Anaphylaxis
    - 0.3 mg (0.3 mL of 1:1000)
    - EpiPen (0.3 mg) deep IM
    - 0.1 mg IV over 5 minutes

Pediatrics

- Bronchospasm
  - 0.15 mg (0.15 mL of 1:1000) deep IM
  - EpiPen jr (0.15 mg) deep IM
  - 0.01mg- 0.025mg IV
- Anaphylaxis
  - 0.15 mg (0.15 mL of 1:1000) deep IM
  - EpiPen jr (0.15 mg) deep IM
  - 0.05 mg IV over 5 minutes
- Oxygen
- Benadryl (50 mg)
- IV fluids (1-2 L)
- Hydrocortisone (100 mg)
- B-2 agonist (Albuterol)

**J. Convulsions**

**Definition:** Excessive/abnormal electrical discharge in the brain resulting in sensory or motor disturbance with or without loss of consciousness

Treatment

1. Recognize seizure activity and institute seizure precautions
   a. Turn the patient onto his side
   b. Remove or pad hard or sharp objects from area
   c. Loosen tight clothing
   d. Place padding under head
   e. Do not force anything into the person's mouth
   f. Apply monitors and assess ABC's
   g. Assess if injury occurred, especially the tongue
2. Do not restrain patient (remove dangerous objects) Do not force in a mouth prop
3. Monitor ABC's- After seizure administer oxygen and keep airway patent
   a. Ativan 2 mg every 5 minutes or 0.1 mg/kg (since 2 mg is usually inadequate and valuable time is wasted)
   b. Phenobarbital 15 mg/kg
   c. Valium 0.15 mg/kg IV (duration of valium is only about 20 minutes, therefore, ativan is preferred because it has a longer duration than valium)
   d. If no IV access available: Versed 5 mg IM
   e. Propofol (1-2 mg/kg)
4. Transport to ER
   a. If seizure is >5 min (medical emergency)
   b. If followed immediately by another seizure
   c. If patient is injured

**K. Hypoglycemia**

**Definition:** defined as a blood glucose reading of less than 70 mg/dl (panic range: 50 mg/dl in males and < 40 mg/dl in females)

Signs and Symptoms:

1. shakiness, nervousness, tremor
2. palpitations, tachycardia
3. sweating, pallor, coldness, clamminess
4. hunger, nausea, vomiting
5. headache, impaired judgment, abnormal mental status, seizures, unconsciousness

Causes:

1. prolonged fasting
2. improper use of diabetic medications

Treatment

a. Check blood glucose, if blood glucose is <60 mg/dl
    i. **Conscious patient**
        1. Check blood glucose, of blood glucose is <60mg/dl
            a. Administer oral glucose (20 grams)
            b. Wait 15 minutes
            c. If symptoms continue, recheck blood glucose and administer oral glucose until blood glucose is >80 mg/dl
    **ii. Unconscious patient**
        1. Check blood glucose, if blood glucose is <60 mg/dl
            **a. No IV access:**
                i. 1 mg glucagon (IM/SQ)
                ii. Check blood glucose in 15 min
                iii. If patient regains consciousness give oral carbohydrate and bread exchange
                iv. Check blood glucose in 15 minutes
                v. Repeat oral treatment until blood glucose >80 mg/dl
                vi. If patient does not regain consciousness, start IV and administer 1-2 amps of $D_{50}$
            **b. IV access:**
                i. 25 grams of $D_{50}$ IV
                ii. Check blood glucose in 5 min
                iii. If patient regains consciousness give oral carbohydrate and bread exchange
                iv. Check blood glucose in 15 minutes
                v. Repeat oral treatment until blood glucose >80 mg/dl
                vi. If patient does not regain consciousness, administer 1-2 amps of $D_{50}$

**Caution: infiltration of 50% glucose solutions can result in tissue necrosis**

**L. Syncope**

**Definition:** loss of consciousness resulting from insufficient blood flow to the brain

Treatment:

1. Position
    a. Supine / feet elevated
2. Airway
    a. Head tilt/jaw thrust (unconscious)
3. Breathing
    a. Monitor/Administer 100% oxygen
4. Circulation
    a. Monitor
5. Drugs
    a. Aromatic ammonia

**M. Respiratory depression**

**Definition**: respiratory depression occurs when ventilation is inadequate to perform needed gas exchange (Usually as a result of an overdose of anesthetic/sedative agents)

Treatment:

1. Airway- open airway with using head tilt/jaw thrust; place airway adjuncts if necessary
2. Breathing- provide 100% oxygen (positive pressure if apnea)
3. Circulation- monitor
4. Drugs
    - Opioid overdose
        1. Naloxone (0.04 mg-0.4 mg/1-2 min)
    - Benzodiazepine overdose
        1. Flumazenil (0.2mg/min up to 1 mg)
    - NMB- unable to sustain head lift for 5 seconds
        1. Reverse with Cholinesterase inhibitors

**O. Malignant Hyperthermia**

**Definition:** MH is a life threatening event that is triggered by halogenated volatile anesthetics and depolarizing neuromuscular blockers. MH is a hyper-metabolic condition of skeletal muscle that results in increased oxygen consumption, hypercarbia, increasing temperature and rhabdomyolysis, resulting in increased blood levels of myoglobin, CK enzymes and potassium.

**Triggers:** Potent volatile agents & Depolarizing NMBDs

**Signs:** (remember sympathetic system overactivity)

- Tachycardia (early sign)
- Hypercarbia (early sign)
- Arrhythmias
- Hypertension
- Increased muscle rigidity (Masseter muscle, extremities etc)
- Tachypnea
- Hyperthermia (late sign; about 1 degrees C every 5 min)

**Treatment/Management:**

**Acute phase**

1. **<u>Get help, get dantrolene and notify surgeon (call 1-800- MH HYPER)</u>**
    a. Discontinue volatile agents/succinylcholine
    b. Hyperventilate with 100% oxygen at flows of 10L/min or more
    c. Halt the procedure as soon as possible, if emergent, continue with non-triggering anesthetics
    d. Don't waste time changing the circuit or $CO_2$ absorber
2. **<u>Administer dantrolene (2.5 mg/kg or 1 mg/pound</u>**) through large bore IV as soon as possible
    a. Dissolve the 20 mg vial with at least 60 ml's of sterile, preservative free water
    b. Repeat until signs of MH are reversed, sometimes up to 10 mg/kg (rarely up to 30 mg/kg)
    c. Cool down core temperature with ice, cooling blanket, and cold IV fluid
3. **<u>Administer bicarbonate for metabolic acidosis</u>**
    **a.** 1-2 mEq/kg if blood gas values are not yet available

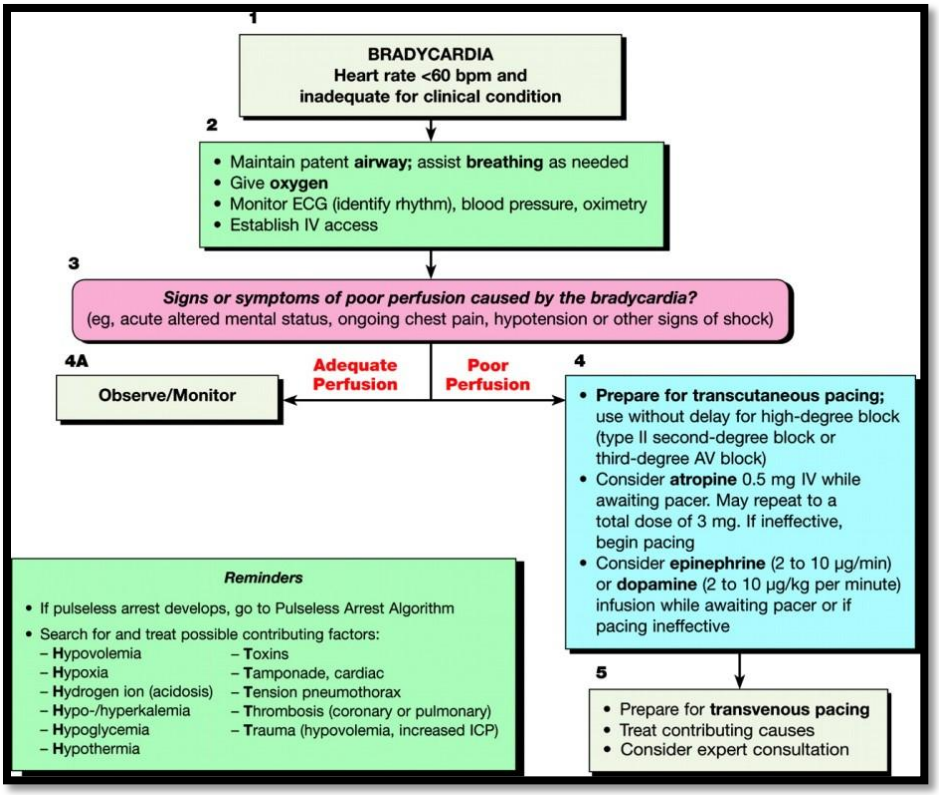
4. **<u>Cool the patient with core temperature >39ºC</u>**
    a. Lavage open body cavities, stomach, bladder, or rectum
    b. Apply ice to surface
    c. Infuse cold saline intravenously
    d. Stop cooling if temp. <38ºC and falling to prevent drift < 36ºC.
5. **<u>Dysrhythmias usually respond to treatment of acidosis and hyperkalemia</u>**
    a. Use standard drug therapy **except calcium channel blockers, which may cause hyperkalemia or cardiac arrest in the presence of dantrolene.**
6. **<u>Hyperkalemia – Treat with hyperventilation, bicarbonate, glucose/insulin, calcium.</u>**
    a. Bicarbonate 1-2 mEq/kg IV
    b. Insulin/dextrose (check glucose levels hourly)
        i. Pediatrics- 0.1 units/kg insulin and 1 ml/kg 50% dextrose
        ii. Adults- 10 units regular insulin IV and 50 ml of 50% glucose
    c. Calcium chloride 10 mg/kg or calcium gluconate 10-50 mg/kg for life-threatening hyperkalemia.
7. **<u>Follow ETCO2, electrolytes, blood gases, CK, core, temperature, urine output and color, coagulation studies</u>**
    a. If CK and/or K+ rise more than transiently or urine output falls to less than 0.5 ml/kg/hr, induce diuresis to >1 ml/kg/hr and give bicarbonate to alkalanize urine to prevent myoglobinuria-induced renal failure.
    b. Place Foley catheter and monitor urine output

**Post acute phase**

1. Observe the patient in the ICU for at least 24 hours due to the risk of recrudescence
2. Administer dantrolene 1 mg/kg 4-6 hours or 0.25 mg/kg/hr for 24 hours (more may be needed)
3. Follow vitals and labs as above

## P. Arrhythmia's

### I. Bradycardia



## II. Tachyarrhythmia's