Appendix 9
Protocols for Emergencies

For all emergencies
• Stop the procedure
• Continue to monitor vital signs
• Consider calling 911 early

All complications should be handled in an organized manner following the basic algorithm
• Position the patient (P)
• Airway (A)
• Breathing (B)
• Circulation (C)
• Definitive treatment, consisting of differential diagnosis, drugs and defibrillation (D)

Respiratory

LARYNGOSPASM
• Administer 100% oxygen via nasal mask
• Suction the oropharynx, hypopharynx, and nasopharynx with a tonsil suction tip
• Suction/remove all blood, saliva, and foreign material from the oral cavity
• Pack the surgical site to prevent bleeding into the hypopharynx
• Draw the tongue and/or mandible forward
• Depress the patient’s chest while listening with the ear close to the patient’s mouth for a rush of air. If a clear “huff” of air is heard, the airway is patent, and the spasm probably is resolved.
• If a clear “huff” is not heard
  ✓ try to break the spasm mechanically by attempting to ventilate the patient with a full face mask and 100% oxygen
  ✓ administer an IV dose of succinylcholine (partial spasm: 10-20 mg IV; complete spasm: 20-40 mg) immediately and oxygen under pressure (Alternative: rocuronium 0.6-1.2 mg/kg IV; may require prolonged ventilatory support)
  ✓ administer intubating IV dose of succinylcholine, intubate, and secure the airway (Alternative: rocuronium 0.6-1.2 mg/kg IV; be prepared to ventilate patient for prolonged period). Consider atropine with repeat dose of succinylcholine to prevent bradycardia

BRONCHOSPASM

Awake patient
• Administer 4-8 puffs of a beta-agonist inhalant either via inhaler or nebulizer in an awake patient (2-4 puffs for pediatric patient)
• Administer supplemental oxygen via face mask.

Obtunded nonintubated patient
• Consider albuterol nebulizer via facemask prior to administration of epinephrine
• Administer 0.3 to 0.5 mg epinephrine (1:1,000 solution) subcutaneously
• If hypotension is present and believed to be a sign of acute anaphylaxis
  ✓ administer intravenous bolus dose of 10 to 20 mcg of a 1:10,000 solution of epinephrine titrated to response
Intubated patient
- Administer 100% oxygen with positive pressure ventilation
- Administer 5 to 10 puffs of a beta-agonist inhalant from an inhaler into the open end of the endotracheal tube or through a medication elbow added to the circuit designed for inhalant medication delivery
- Consider deepening plane of anesthetic
- Check breathing circuit
- If persistent, consider epinephrine as above for nonintubated patient

Hypoxemia in spontaneously breathing patient
- Administer 100% oxygen by face mask
- Consider reversal of sedative medications
- Perform chest auscultation and treat findings
- Intubate and administer positive-pressure ventilation with 100% oxygen if the patient continues to deteriorate with hypoxemia, impending respiratory muscle exhaustion, or worsening obtundation

EMESIS AND ASPIRATION
- Place the patient in the Trendelenburg position with the head down at least 15 degrees and rolled onto the right side
- Clear any vomitus in the oropharynx with finger sweeps and large-bore suction
- If no improvement, place the patient in the supine position and intubate (may be necessary to use muscle relaxants prior to intubation)
- Remove any solid particles in the laryngeal region with Magill forceps at time of intubation
- Oxygenate the patient as soon as possible and manage any bronchospasm as previously described
- Tracheobronchial lavage is not performed except for small volumes (5 to 10 mL) of saline to facilitate suction
- Maintain a patent airway and continue ventilation with 100% oxygen in route to hospital

OMS DIFFICULT AIRWAY ALGORITHM
- Chin lift/jaw thrust
- Pull tongue forward, reposition airway
- Full face mask positive pressure ventilation
- Consider nasal/oral pharyngeal airways
- Consider Laryngeal Mask Airway (LMA) or other adjunct airway devices
- Consider endotracheal intubation
- Consider needle cricothyrotomy
- Consider surgical cricothyrotomy
- Consider tracheostomy

Cardiovascular
ANGINA/ACUTE MYOCARDIAL INFARCTION
- Terminate the surgery and all stimulation of the patient
- Place the patient in a comfortable position and loosen tight clothing
- Administer oxygen at 4 L/min via mask or nasal cannula
- Apply pulse oximeter and ECG monitor
- Obtain vital signs with automatic or standard blood pressure cuff
- Administer nitroglycerin sublingually or via spray every five minutes if the systolic blood pressure is greater than 90 mm/Hg.
- Establish IV access, if not already obtained
• If AMI is suspected, activate the EMS 911 system.
• Employ the pneumonic MONA, but not in that order; use ONAM because use of chewed aspirin may decrease absorption of subsequent nitroglycerin
• Administer nonenteric aspirin (160-325 mg) and direct the patient to chew one and swallow one, except in cases of allergy to this drug
• Administer morphine, 1 to 3 mg IV every 5 minutes to control pain if systolic blood pressure is greater than 90 mm/Hg. Watch carefully so the patient does not become overly sedated or lose respiratory drive.

Monitor vital signs closely. Watch for hypotension, hypoxemia, bradycardia, ventricular dysrhythmias, and cardiac arrest and manage appropriately per ACLS protocols.

MANAGEMENT OF PERIOPERATIVE HYPOTENSION
• Treatment of hypotension is directed toward its cause
• Decrease anesthetic depth if patient is under anesthesia
• Terminate the surgery
• Place the patient in the supine position with legs elevated
• Administer 100% oxygen
• Re-evaluate blood pressure, heart rate, and rhythm and treat dysrhythmias
• Administer a bolus of isotonic fluid
• Titrate ephedrine or phenylephrine or other suitable vasopressor to preserve adequate systemic pressures (Ephedrine is generally used unless there is tachycardia and hypotension in which case phenylephrine may be a better choice.)

Dosing of Sympathomimetic Agents for Treatment of Hypotensive Emergencies

Ephedrine: Dilute a 50 mg/mL vial in 9 mL of saline to make a 5 mg/mL solution and administer at a dose of 2.5 to 5 mg IV, which can be repeated until the blood pressure is stabilized. The drug’s effects occur in approximately 1 minute, peak at 15 minutes, and last approximately 1 hour.

Phenylephrine: Dilute single dose vial (10 mg/mL) in 9 mL of saline; discard 9 mL and dilute with an additional 9 mL of saline to create a 0.1 mg/mL concentration; administer IV in 0.1 mg/mL increments until the desired effects are achieved. The effects are seen within 1 minute and last for approximately 20 minutes.

MANAGEMENT OF PERIOPERATIVE HYPERTENSION

Therapeutic approaches to treating perioperative hypertension are directed at producing vasodilatation or altering cardiac output by beta-adrenergic receptor blockers. Among the drugs that may be useful are beta blockers such as esmolol (Brevibloc) and metoprolol (Lopressor), the selective alpha blocker labetalol (Normodyne, Trandate), and the vasodilator hydralazine.

**Esmolol** dosing

*Immediate control dosing:*

80 mg (approximately 1 mg/kg) over 30 seconds followed with a 150 mcg/kg/min infusion (0.15 mg/kg/min) that is adjusted as required to a maximum of 300 mcg/kg/min (0.30 mg/kg/min) to maintain the desired heart rate and/or blood pressure.

*Gradual control dosing (when there is time to titrate):*

Loading dose infusion of 500 mcg/kg/min for 1 minute followed with a 50 mcg/kg/min over 4-minutes

If an adequate therapeutic effect is not seen in 5 minutes loading dose infusion of 500 mcg/kg/min for 1 minute followed with a 100 mcg/kg/min

**Labetalol** dosing (a selective alpha 1 blocker, and non selective beta blocker)

Initial adult dose 5 to 20 mg IV over 2 minutes followed by 2 mg/min (maximum dose, 300 mg) IV infusion

Onset 5 minutes, duration 3-6 hours

**Hydralazine** dosing (a direct vasodilator for patient who can tolerate an increase in heart rate and cardiac output but who has a history of asthma)

Initial adult dose of 5mg IV, can titrate up to 25mg

Onset 5 minutes, duration 2 hours
Venipuncture Complications

Hematoma
• Apply pressure to the venipuncture site.

Extravasation
• Apply moist heat and elevate extremity above level of heart (for many cases this simple treatment is all that is required)
If irritating drugs have extravasated, then consider
• Infiltrate 1% plain lidocaine (Xylocaine) at the site, if needed for pain
• Administration of ibuprofen, and possible use of steroids and antibiotics may be necessary to prevent or lessen the sloughing

Phlebitis
• Apply heat to the area
• Administer ibuprofen or other nonsteroidal anti-inflammatory drugs, steroids and antibiotics
• Limit motion to alleviate symptoms
• Seek appropriate consultation if severe symptoms persist beyond 3 or 4 days

Intra-arterial injection
• Prevention is the best treatment
• No single treatment regimen has been found to be completely effective
• Leave the needle in place
• Inject 10 mL of 1% plain lidocaine into the artery
• Consider transfer patient to a hospital for further therapy and consider vascular consult

Neurocardiogenic (Vasovagal) Syncope
• Place patient in a reclining position with the legs elevated
• Maintain airway
• Deliver 100% oxygen
• Support respiration if needed
• Take vital signs
• Apply cool compress to forehead
• Administer spirits of ammonia, if necessary
• Administer IV atropine 0.5 mg every 3-5 minutes up to 3 mg in the presence of bradycardia

Hyperventilation Syndrome
• Maintain adequate oxygen levels while reducing carbon dioxide elimination
If using oxygen delivery system with full face mask, closed circuit, and no carbon dioxide absorber:
• Deliver oxygen at 600 mL/min
• Have patient breathe into the circuit until the rebreathing bag is distended
• Continue until episode subsides
If using anesthesia reservoir or paper bag:
• Have patient exhale and inhale into the paper bag 6-10 times/min
If a nonsedated patient fails to respond:
• Administer suitable sedative to abort the hyperventilation episode
Seizures

- Prevent injury to the uncontrolled unconscious patient
- Loosen clothing about the neck
- Place pillow under the head
- Place padded tongue blade between the teeth if evidence that the patient's tongue is being traumatized
- Consider checking blood sugar

Local Anesthetic Toxicity

- Immediately discontinue any further administration of the local drug
- Call 911
- Place patient in supine position
- Administer oxygen
- Maintain airway and initiate CPR
- Confirm or establish IV access
- Administer IV diazepam 5 mg over one minute titrated to effect OR IV midazolam 2.5 mg over one minute titrated to effect
- Continue to closely monitor vital signs

Allergic Reaction

Mild reactions usually manifest as skin reaction without other systemic signs or symptoms

- Identify causative agent, if time permits
- Remove, dilute, negate, or antagonize, if possible
- Administer diphenhydramine adult dose 25-50 mg PO, 10-50 mg IV at a rate generally not exceeding 25 mg/min, deep intramuscular injection of 100 mg if required (maximum daily dosage is 400 mg)

OR

Chlorpheniramine maleate adult dose 5-20 mg, IV, IM, or SQ injection as a single dose; tablets or syrup, 4 mg every 4-6 hours

Severe Reactions (Anaphylaxis) manifest with all signs and symptoms of allergic reaction with skin rash, watery eyes and nose, abdominal cramps, wheezing, tachycardia, and hypotension.

It is important to have a plan or algorithm to guide treatment of a severe allergic reaction and impending cardiovascular collapse.

1. Stop administration of the antigen
2. Follow the ABCs:
   - Maintain an airway with supplemental oxygen
   - Support respiration and breathing
   - Support circulation by providing an IV route for volume loading with crystalloid solution. In the adult patient, rapidly infuse 1 L lactated Ringer’s solution. For children, administer fluid boluses of 20 mL/kg of lactated Ringer’s solution or normal saline.
3. Administer epinephrine
   - Intravenous
     Use a premixed solution of 1:10,000 (1 mg of epinephrine in 10 mL)
     Adults: Titrate 0.2 mg (2 mL) to 0.5 mg (5 mL) to effect and repeat every 2 to 5 minutes as needed
     Children: 0.01 mg/kg
   - Intramuscular or Subcutaneous
     If an IV route is unavailable, the drug can be administered IM or subcutaneously using a 1:1,000 solution (1 mg/mL).
     Adults: 0.3 to 0.5 mg of a 1:1,000 concentration. This dose may be repeated at 10- to 20-minute intervals based on patient response.
     Children: 0.01 mg/kg. This dose may be repeated at 10- to 20-minute intervals based on patient response.
4. As epinephrine administration continues, an H1-antihistamine may be administered IM or IV. Diphenhydramine (Benadryl) can be given IV in a dose of 50 mg for adults and older children. The child 6 to 12 years of age receives 25 mg. An H2 blocker, such as famotidine (Pepcid), can be administered to adults IV starting at 20 mg. The dose for children older than 1 year is 0.5 mg/kg IV up to 40 mg per day.

5. Albuterol inhaler can be administered at 4 to 5 puffs as needed (2 to 4 puffs for pediatric patient).

6. Administer corticosteroids
   The use of corticosteroids has been advocated in the past to treat asthma, edema, or intense pruritus. Although these drugs act too slowly to be life-saving in an acute anaphylactic episode, they are important in combating immunologic reactions and regaining homeostasis. Because of their slow action, they are the last drugs administered in the therapeutic regimen.
   Options include the following:
   • Hydrocortisone sodium succinate (Solu-Cortef) at a dose of 100 mg IV given slowly over one minute
   • Dexamethasone (Decadron) at a dose of 4 to 12 mg given slowly over one minute IV or IM
   Doses can be repeated at intervals as determined by the severity of symptoms. Because anaphylaxis is an acute process, corticosteroid use normally can be stopped after 36 hours without adverse sequelae.

Follow-up Measures
Pharyngeal edema and upper airway obstruction can occur and persist after the administration of epinephrine. Endotracheal intubation or tracheotomy may be necessary to secure an airway. If shock continues, the patient should be placed in a slight Trendelenburg position to provide circulatory support. If the patient develops dyspnea and wheezing, a semireclining position may be more helpful. If a significant decrease in blood pressure persists despite appropriate volume expansion and the use of epinephrine, an adjunctive vasopressor should be considered. (See the section on treatment of hypotension for management of this problem.)

Seizures may occur during allergic reactions and usually are due to circulatory and/or respiratory inadequacy. If convulsions persist after corrective measures have been taken to ensure cardiorespiratory sufficiency, diazepam, 1 mL (5 mg), can be administered IV for 1 minute, with midazolam (2.5 mg over one minute) used as an alternative. It is important to wait 2 minutes for the effect before giving another dose.

After successful treatment of a severe allergic reaction, the patient should be hospitalized and observed for 24 hours, receiving prophylactic antihistamines. Anaphylactic reactions have been known to recur after the initial effects of the counteracting drugs have worn off.

Malignant Hyperthermia
Following are the primary signs of impending MH:
   • Increase in end-tidal carbon dioxide (doubling or tripling, may occur rapidly or during 10 to 20 minutes)
   • Unexplained tachycardia, tachypnea, hypercarbia
   • Generalized muscle rigidity
   • Masseter muscle rigidity
   • Hyperthermia (often a late sign)
   • Respiratory and/or metabolic acidosis
   • Sudden/unexpected cardiac arrest (consider as secondary to hyperkalemia and treat as such)

Contact telephone number: 1-800-MHHYPER (1-800-644-9737)

EMERGENCY TREATMENT
Caution: These protocols may not apply to every patient and may require alteration according to specific patient needs.

Acute Phase
   • Immediately activate the EMS for patient transport and notify the receiving hospital to prepare for continuing treatment of an MH patient.
   • Immediately discontinue use of all volatile inhalation anesthetics and succinylcholine. Hyperventilate with 100% oxygen at high gas flows, at least 10 L/min. The circle system and carbon dioxide absorbent need not to be changed.
• Solubilize the dantrolene according to manufacturer’s instructions. If using the older formulation, (Dantrolene), it takes time to mix the solution, so it is recommended that 1 person be designated for this task.

• Administer dantrolene, 2 to 3 mg/kg initial bolus rapidly, with increments up to a total of 10 mg/kg. Continue to administer dantrolene until signs of MH (eg, tachycardia, rigidity, increased end-tidal carbon dioxide, and temperature elevation) are controlled. Occasionally, a total dose greater than 10 mg/kg may be needed.

• Administer bicarbonate to correct metabolic acidosis, as guided by blood gas analysis. In the absence of blood gas analysis, administer 1 to 2 mEq/kg.

• Simultaneously with the previous steps, actively cool the hyperthermic patient with IV cold saline (not Ringer’s lactate) 15 mL/kg every 15 minutes 3 times.

  ✓ Surface cool with ice and hypothermia blanket. A supply of ice or an ice machine is helpful for this purpose.

  ✓ Monitor closely because excessively vigorous treatment may lead to hypothermia.

• Arrhythmias usually respond to treatment of acidosis and hyperkalemia. If they persist or are life threatening, use standard antiarrhythmic agents, except calcium channel blockers, which may cause hyperkalemia and cardiovascular collapse.

• Determine and monitor end-tidal carbon dioxide concentrations; arterial, central, or femoral venous blood gases; serum potassium and calcium levels; clotting studies; and urine output.

• Treat hyperkalemia with hyperventilation, bicarbonate, and IV glucose and insulin (10 U of regular insulin in 50 mL of 50% glucose titrated to potassium level or 0.15 U/kg of regular insulin in 1 mL/kg of 50% glucose). Life-threatening hyperkalemia also may be treated with calcium (eg, 2.5 mg/kg of calcium chloride).

• Ensure urine output of greater than 2 mL/kg/h by hydration and/or administration of furosemide and additional mannitol, if necessary. Consider central venous or direct arterial monitoring because of potential fluid shifts and hemodynamic instability.

• Sudden unexpected cardiac arrest in children: Children younger than 10 years who experience sudden cardiac arrest after succinylcholine administration in the absence of hypoxemia and anesthetic overdose should be treated initially for acute hyperkalemia. In this situation, calcium chloride should be administered with other means to reduce serum potassium levels. Affected children should be presumed to have subclinical muscular dystrophy, and a neurologist should be consulted.