# Drugs for Pediatric Emergencies

Committee on Drugs

**ABSTRACT. This statement provides current recommendations about the use of emergency drugs for acute pediatric problems that require pharmacologic intervention. At each clinical setting, physicians and other providers should evaluate drug, equipment, and training needs. The information provided here is not all-inclusive and is not intended to be appropriate to every health care setting. When possible, dosage recommendations are consistent with those in standard references, such as the *Advanced Pediatric Life Support* (APLS) and *Pediatric Advanced Life Support* (PALS) textbooks.[1–3] Additional guidance is available in the manual *Emergency Medical Services for Children: The Role of the Primary Care Provider*, published by the American Academy of Pediatrics, as well as in the PALS and APLS textbooks.**

ABBREVIATIONS. APLS, *Advanced Pediatric Life Support* (textbook); PALS, *Pediatric Advanced Life Support* (textbook); IV, intravenous; IM, intramuscular; PO, oral.

The drug information in this statement assists health care providers and facilities in preparing for a crisis. **This document is not designed for use during an actual emergency.** It is useful to precalculate and distribute volumetric doses (eg, mL/kg) using the specific drug concentrations that are available in a particular institution. Precalculated drug cards or length-based resuscitation tapes are useful in the preparation process. **This document does not provide comprehensive drug information.** Descriptions of drug indications and side effects have been purposely limited.

Drug dosages are generally presented as milligram per kilogram (mg/kg). An exception is made for high-potency drugs (vasoactive amines and nitroprusside). For these drugs, dosage is given in microgram per kilogram ($\mu$g/kg) in Table 1.

In general, drug doses (including "bolus" doses) should be administered over several minutes to avoid transiently excessive blood levels of the drug. Exceptions to this rule include: adenosine, epinephrine, atropine, and muscle relaxants. Infusion devices (intravenous [IV] infusion pumps) should be used for all vasoactive drugs administered as a continuous infusion, such as dopamine or nitroprusside.

Unless otherwise indicated, the IV route is preferred. In an emergency, intraosseous administration is an acceptable alternative when IV access cannot be obtained within 90 seconds or after three attempts to establish IV access. For some drugs, such as epinephrine, atropine, naloxone, and lidocaine, endotracheal administration is appropriate. A recommended method of endotracheal delivery is to administer the *drug* with or dilute in 1 to 5 mL of isotonic saline through a catheter inserted to the tip of the endotracheal tube. This method may enhance absorption from the lung.

The dosages provided are recommendations based upon expert consensus. The Committee on Drugs recognizes that pediatric labeling and dosage information do not exist for many of these drugs. Dosage should be individualized, taking into account the patient's age, weight, underlying illness, concurrently administered drugs, and known hypersensitivity.

A physician who administers drugs that depress the respiratory or central nervous system must have the skills necessary to manage the potential complications. It is important to implement the guidelines for monitoring published by the American Academy of Pediatrics.[4] **A practitioner who uses a neuromuscular blocking agent ("muscle relaxant") must be qualified to maintain the patient's airway through bag and mask ventilation and endotracheal intubation. Once the patient has received the muscle relaxant, there is no longer any respiratory effort.**

## SOME CONSIDERATIONS FOR THE USE OF DRUGS FOR ENDOTRACHEAL INTUBATION

The choice of drugs for control of the airway should address two concerns: adequate sedation/analgesia for laryngoscopy and appropriate selection of a muscle relaxant, if indicated. A patient who is in full cardiac arrest does not require sedatives or muscle relaxants to safely gain control of the airway. When cardiac arrest has not occurred, endotracheal intubation of the patient who is ill or who has been injured—especially if there is associated head injury—may be facilitated by administration of a sedative (benzodiazepine), IV local anesthetic (lidocaine), opioid (fentanyl), and a neuromuscular blocking drug. The choice of drugs depends on the physiologic status of the patient. A patient who is hypovolemic would be placed at risk with the rapid IV administration of barbiturates (such as methohexital or thiopental) because of the cardiac depressant and vasodilator effects of barbiturates. Ketamine would be a better choice in this circumstance. Conversely, a patient with a closed head injury would benefit from the use of barbiturates and/or lidocaine and fentanyl because this would reduce cerebral blood flow and

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

PEDIATRICS (ISSN 0031 4005). 

cerebral oxygen consumption and therefore intracranial pressure. Following head injury, ketamine therapy increases cerebral blood flow and intracranial pressure.

Combining drugs with different modes of action may be advantageous. For example, adding a benzodiazepine or narcotic to the regimen may prolong the effect and/or enable a reduction in the dose of ketamine or barbiturate required to sedate.

Airway equipment appropriate for the patient's size and age must be immediately available before a neuromuscular blocking agent is administered. This equipment includes an appropriate-sized face mask, a bag-mask-valve device for positive pressure ventilation, endotracheal tubes, oral airways, functioning laryngoscope blades, functioning handles, suction catheters, and suction apparatus to clear the airway if the patient vomits. The patient should be fully monitored with a cardiac monitor, blood pressure readings, and pulse oximetry. Nasogastric (orogastric) suction catheters are helpful in evacuating and decompressing the patient's stomach if gastric distention occurs. A stethoscope should be available to check breath sounds.

The choice of muscle relaxant depends on the circumstances. Succinylcholine remains the muscle relaxant of choice for the emergency control of the airway and is generally the muscle relaxant of choice for patients with a "full stomach." It has the most rapid onset and shortest duration of the relaxants that are currently available and has the longest "track record" for overall safety.

Administration of succinylcholine should be preceded by atropine to prevent significant bradycardia. In children over 5 years of age, a defasciculating dose of a nondepolarizing relaxant (10% of an intubating dose) 2 to 3 minutes before succinylcholine may prevent muscle fasciculations. Cricoid pressure is applied (firm pressure on the cricoid cartilage) to prevent passive regurgitation during laryngoscopy and intubation.

If succinylcholine therapy is contraindicated (history of malignant hyperthermia, muscular dystrophy, neuromuscular disease, neurologic denervation injury or crush injury), a nondepolarizing muscle relaxant is indicated. With nondepolarizing agents, the onset of neuromuscular blockade may be somewhat delayed compared with succinylcholine. Also, the duration of paralysis is markedly prolonged compared with succinylcholine. The peak effect of pancuronium, for example, generally occurs 2 to 3 minutes after administration. The effects of the most recently approved relaxant (rocuronium) occur within 45 seconds to 1 minute. This time is dose-dependent and in higher doses (0.8 to 1.2 mg/kg) is similar to that of succinylcholine. Rocuronium may be a reasonable alternative to succinylcholine when succinylcholine is contraindicated.

Recent concerns about the elective use of succinylcholine in pediatric patients have focused on the occasional reports of hyperkalemic cardiac arrest, particularly in children with undiagnosed Duchenne muscular dystrophy. The incidence of Duchenne muscular dystrophy is only 1 in 3000 to 8000 male children. The revised labeling continues to permit the use of succinylcholine for emergency control of the airway and treatment of laryngospasm. *Succinylcholine is the only neuromuscular blocking agent currently available that has been demonstrated to be effective after intramuscular (IM) administration when emergency control of the airway is required and there is no IV access.* In this circumstance, the dosage must be increased to 4 to 5 mg/kg IM. Atropine is administered simultaneously. Following IM succinylcholine, onset of neuromuscular blockade takes approximately 2 to 5 minutes; the response in patients who are hypotensive or hypovolemic is unpredictable. Standard textbooks of advanced life support, eg, *Pediatric Advanced Life Support* or *Advanced Pediatric Life Support* (PALS, APLS), should be consulted for more detail.[1–4]

**TABLE 1.** Frequently Used Emergency Drugs

| | | | | |
|---|---|---|---|---|
| Adenosine | Diazoxide | Glucose | Meperidine | Phenylephrine |
| Albuterol | Digibind | Haloperidol | Methylprednisolone | Phenytoin |
| Atropine | Diphenhydramine | Insulin | Midazolam | Procainamide |
| Bicarbonate | Dopamine | Ipecac | Morphine sulfate | Propranolol |
| Calcium chloride | Dobutamine | Kayexalate | Naloxone | Prostaglandin E |
| Calcium gluconate | Epinephrine | Ketamine | Nitroprusside | Rocuronium |
| Charcoal | Fentanyl | Lidocaine | Oxygen | Succinylcholine |
| Dexamethasone | Fosphenytoin | Lorazepam | Pancuronium | Thiopental |
| Diazepam | Glucagon | Mannitol | Phenobarbital | Vecuronium |

**Adenosine**

Indication: Supraventricular tachycardia

Dosage: Initial dose: 0.05 mg/kg as rapidly as possible followed by flush of the IV catheter.
Subsequent doses: If atrioventricular (AV) block occurs or if there is no response within 30 seconds, increase by 0.05 mg/kg (eg, 0.1 mg/kg followed by flush of the IV catheter; if no response, increase to 0.15 mg/kg and flush IV catheter).
Maximum single dose, 12 mg.

**WARNING: Contraindicated in heart transplant patients.**

Note: Higher doses of adenosine may be needed when a patient is taking methylxanthine preparations.

Note: The antidote for profound bradycardia is aminophylline, 5 to 6 mg/kg over 5 minutes. *Atropine is contraindicated.* A defibrillator must be immediately available.

**Albuterol**

Indication: Status asthmaticus, bronchospasm

Dosage: 0.1 to 0.15 mg/kg by nebulization. Repeat as needed.

Note: 0.02 to 0.03 mL/kg of 5 mg/mL solution with normal saline to make 3 mL total in nebulizer; maximum single dose, 2.5 mg.

Note: Administration can be repeated and dose adjusted until desired clinical effect or symptomatic tachycardia.

Note: Oxygen is the preferred gas source for nebulization. Supplemental oxygen should be considered when compressed air driven nebulizers are used or when oxygen flow rate dictated by nebulizer is inadequate. Blended oxygen may be required for premature newborns who are still at risk for retinopathy of prematurity.

**Atropine Sulfate**

Indication: 1) Symptomatic bradycardia

Dosage: Intramuscular (IM): 0.02 to 0.04 mg/kg
Intratracheal: 0.02 to 0.04 mg/kg
IV: 0.02 mg/kg.
Minimum single dose, 0.1 mg
Maximum single dose, 0.5 mg for child, 1.0 mg for adolescent. This dose may be repeated once.

Note: Oxygenation and ventilation are essential first maneuvers in the treatment of symptomatic bradycardia. Epinephrine is the drug of choice if oxygen and adequate ventilation are not effective in the treatment of hypoxia-induced bradycardia.

Note: If administered through an endotracheal tube, follow the dose with or dilute in saline flush (1 to 5 mL) based on patient size.

Indication: 2) Anticholinesterase poisoning.

Dosage: IV: 0.05 mg/kg
Repeat as needed for clinical effect.

Note: Anticholinesterase poisonings may require large doses of atropine or the addition of pralidoxime.

Indication: 3) To prevent succinylcholine-induced bradycardia.

Dosage: 0.02 mg/kg IV or 0.02 to 0.04 mg/kg IM just before or simultaneously with succinylcholine

**Bicarbonate, Sodium**

Indication: 1) Metabolic acidosis
2) Tricyclic antidepressant overdose.

Dosage: IV: 1 to 2 mEq/kg

**WARNING: Only 0.5 mEq/mL concentration should be used for newborns; dilution of available stock solutions may be necessary.** Administer slowly because bicarbonate solution is hyperosmotic.

Note: Routine initial use of sodium bicarbonate in cardiac arrest is not recommended. However, sodium bicarbonate may be used in cases with documented metabolic acidosis *after* effective ventilation has been established.

**Calcium Chloride**

Indication: 1) Ionized hypocalcemia
2) Hyperkalemia
3) Hypermagnesemia
4) Calcium channel blocker toxicity

Dosage: IV: 20 mg/kg (if using 10% $CaCl_2$, dose is 0.2 mL/kg). Inject slowly. Repeat dose as necessary for desired clinical effect.

**WARNING: Stop injection if symptomatic bradycardia occurs. Extravascular administration can result in severe skin injuries.**

Note: Calcium is recommended for cardiac resuscitation only in cases of documented hyperkalemia, hypocalcemia, or calcium channel blocker toxicity.

**Calcium Gluconate**

Indication: 1) Ionized hypocalcemia
2) Hyperkalemia
3) Hypermagnesemia
4) Calcium channel blocker toxicity
Ionizes as rapidly as calcium chloride and may be substituted using three times the dose of calcium chloride (mg/kg).

Dosage: IV: 60 mg/kg (if using 10% gluconate, dose is 0.6 mL/kg). Inject slowly. Repeat dose as necessary for desired clinical effect.

**WARNING: Stop injection if symptomatic bradycardia occurs. Extravascular administration can result in severe skin injuries.**

Note: Calcium is recommended for cardiac resuscitation only in cases of documented hyperkalemia, hypocalcemia, or calcium channel blocker toxicity.

**Charcoal, Activated**

Indication: Acute ingestion of selected toxic substances

Dosage: 1 to 2 g/kg

Note: Administer as a slurry or down a nasogastric tube. Note that iron, lithium, alcohols, ethylene glycol, alkalies, fluoride, mineral acids, and potassium do not bond to activated charcoal.

**WARNING: Commercially available preparations of activated charcoal often contain a cathartic, such as sorbitol. Fatal hypernatremic dehydration has been reported after repeated doses of charcoal with sorbitol. Nonsorbitol-containing products should be used if repeated doses are necessary.**

**Dexamethasone**

Indication: 1) Emergency treatment of elevated intracranial pressure due to brain tumor

Dosage: IV: 1 to 2 mg/kg as a loading dose
Maintenance dose, 1 mg/kg/24 h

Indication: 2) Croup

Dosage: IV, IM, or PO: 0.6 mg/kg dexamethasone, 1 dose/d, or 2 mg/kg/24 h of prednisone. Further dosing and route of administration determined by clinical course.

**Diazepam**

Indication: Status epilepticus

Dosage: IV: 0.1 mg/kg every 2 minutes. Maximum dose, 0.3 mg/kg (maximum 10 mg/dose).

Dosage: Rectal: 0.5 mg/kg up to 20 mg

Note: Do not give as IM injection.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents or when given rapidly. One must be prepared to provide respiratory support. Monitor oxygen saturation.**

**Diazoxide**

Indication: Hypertensive crisis

Dosage: IV: 1 to 3 mg/kg rapid IV push.

Note: Alternative regimen: 3 to 5 mg/kg IV over 30 minutes. This is reported to result in fewer problems with hypotension or hyperglycemia.

**Digoxin Immune FAB (Digibind)**

Indication: Digoxin or digitoxin toxicity

Dosage: 1) Administer digoxin immune FAB intravenously in an amount equimolar to the total body load of digoxin or digitoxin.
2) 38 mg digoxin immune FAB binds 0.5 mg digoxin or digitoxin

Dosing methods:

A: Based on amount ingested:

1) For digoxin tablets, oral solution, IM injection

$$\text{Dose in mg} = \frac{\text{dose ingested (mg)} \times 0.8}{0.5} \times 38;$$

2) For digitoxin tablets, digoxin capsules, IV digoxin or IV digitoxin

$$\text{Dose in mg} = \frac{\text{dose ingested (mg)}}{0.5} \times 38;$$

B: Based on serum digoxin or digitoxin concentration (SDC)

1) Digoxin

$$\text{Dose in mg} = \frac{\text{SDC (ng/mL)} \times \text{weight (kg)}}{100} \times 38$$

2) Digitoxin

$$\text{Dose in mg} = \frac{\text{SDC (ng/mL)} \times \text{weight (kg)}}{1000} \times 38$$

C: If neither amount ingested nor serum concentration is known, 760 mg of digoxin immune FAB should be administered.

**Diphenhydramine**

Indication: 1) Acute hypersensitivity reactions
2) Dystonic reactions

Dosage: V or IM: 1 to 2 mg/kg.
Maximum dosage, 50 mg.

Note: May cause sedation, especially if other sedative agents are being used.
May cause hypotension.

**Dopamine**

Indication: Continued shock after volume resuscitation

Dosage: IV infusion: 2 to 20 μg/kg/min.
A widely recommended starting dosage is 10 μg/kg/min. Titrate to desired clinical effect.

Note: Preparation of infusion solution: 6 mg × body weight (kg) diluted to 100 mL. Infuse at 10 mL/h = 10 μg/kg/min using a constant infusion pump.

**WARNING: Extravascular administration can result in severe skin injuries.**

**Dobutamine**

Indication: Impaired cardiac contractility

Dosage: IV infusion: 5 to 25 μg/kg/min.
A widely recommended starting dosage is 10 μg/kg/min. Titrate for desired clinical effect.

Note: Preparation of infusion solution: 6 mg × body weight (kg) diluted to 100 mL. Infuse at 10 mL/h = 10 μg/kg/min using a constant infusion pump.

**Epinephrine**

Indication: 1) Cardiac arrest or profound bradycardia, asystole, ventricular fibrillation, or pulseless electrical activity

Initial Dose: IV: 10 μg/kg (0.01 mg/kg)
Intraosseous: 10 μg/kg (0.01 mg/kg)
Endotracheal: 100 μg/kg (0.10 mg/kg)

Note: 10 μg/kg = 0.1 mL/kg of 1:10 000 dilution
100 μg/kg = 0.1 mL/kg of 1:1000 dilution

Note: If administered through an endotracheal tube, follow the dose with saline flush or dilute in isotonic saline flush (1 to 5 mL) based on patient size.

Subsequent doses: given every 3 to 5 minutes
IV: 100 μg/kg (0.1 mg/kg)
Intraosseous: 100 μg/kg (0.1 mg/kg)
Endotracheal: 100 μg/kg (0.1 mg/kg)

Note: For subsequent doses of epinephrine, a dosage up to 200 μg/kg (0.2 mg/kg) may be given.

Indication: 2) Anaphylaxis

Dosage: Subcutaneous (SC): 10 μg/kg per dose (maximum 3 doses)
IV: 10 μg/kg per dose:
10 μg/kg = 0.01 mL/kg of 1:1000 dilution or 0.1 mL/kg of a 1:10 000 dilution

Note: Repeat the SC dose every 20 minutes while attempting IV access. Some anaphylactic reactions, eg, latex allergy, require large doses of epinephrine. A continuous infusion of epinephrine may be necessary.

Indication: 3) Continued shock after volume resuscitation

Dosage: IV infusion: 0.1 to 3.0 μg/kg/min.
Start at lowest dose and titrate for desired clinical effect.

Note: Preparation of infusion solution: 0.6 mg × body weight (kg) diluted to 100 mL. Infuse at 1 mL/h = 0.1 μg/kg/min using a constant infusion pump.

Note: Extravasation can result in tissue necrosis injuries.

Indication: 4) Status asthmaticus, bronchospasm

Dosage: SC: 10 μg/kg per dose
10 μg/kg = 0.01 mL/kg of 1:1000 dilution
Maximum single dose, 300 μg (0.3 mL of 1:1000 dilution).

Note: Albuterol administered by inhalation is now considered the agent of choice for treatment of acute exacerbations of asthma.

Note: Repeat SC dose every 20 minutes if needed for clinical effect. Total of 3 doses.

Indication: 5) Laryngotracheobronchitis:

Dosage: Racemic epinephrine, 2.25% inhalation solution
0–20 kg: 0.25 mL in 2 mL with normal saline administered by nebulizer
20–40 kg: 0.50 mL in 2 mL with normal saline administered by nebulizer
>40 kg: 0.75 mL in 2 mL with normal saline administered by nebulizer

Note: L-Epinephrine: An equal volume of 1% L-epinephrine (1:100) is approximately equivalent in biologic activity to 2.25% racemic epinephrine; one can be substituted for the other in equal volumes for inhalation.
Alternatively, 5 mL of 1:1,000 L-epinephrine is equivalent to 0.5 mL of 1:100.

**Fentanyl**

Indication: Pain

Dosage: IV: 0.5 μg to 2.0 μg/kg. Repeat dose as necessary for clinical effect.

Note: Higher doses may be necessary if the patient is tolerant.

Note: Rapid administration of fentanyl has been associated with both glottic and chest wall rigidity even with dosages as low as 1 μg/kg. Therefore, fentanyl should be titrated in slowly over several minutes.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.**

**Flumazenil**

Indication: Benzodiazepine intoxication

Dosage: IV: 5 to 10 μg/kg (up to 100 μg/kg has been used)
Maximum dose, 1 mg

Note: Useful only for benzodiazepine intoxication.

**WARNING: Duration of action is shorter than most clinically important benzodiazepines. Resedation may occur. May precipitate acute withdrawal in dependent patients; use drug with caution as its use may be associated with seizures. Patients who receive flumazenil should be continuously observed for resedation for at least 2 hours after the last dose of flumazenil.**

**Fosphenytoin**

Indication: Status epilepticus (same as phenytoin)

Dosage: ALWAYS IN PHENYTOIN EQUIVALENTS (PE)
10 to 20 mg PE/kg (same as phenytoin)

Route of administration: IM or IV: 1 to 3 mg PE/kg/min; maximum rate 150 mg PE/min

Note: Data are currently being collected on children less than 6 years of age.
Itching is a common and controllable by reducing flow rate.

**WARNING: Rate of infusion should not exceed 3 mg PE/kg/min. Heart rate should be monitored and the rate of infusion reduced if the heart rate decreases by 10 beats/minute (same as phenytoin).**

**Furosemide**

Indication: 1) Fluid overload
2) Congestive heart failure

Dosage: IV, IM: 1 mg/kg

**Glucagon**

Indication: 1) Hypoglycemia due to insulin excess

Dosage: Adult and adolescent: 0.5 to 1.0 mg SC, IM, IV; repeat every 20 minutes
Pediatric: 0.025 mg/kg up to 1.0 mg SC, IM, IV; repeat the dose every 20 minutes if needed for clinical effect. Total of 3 doses.

Note: An attempt should be made to provide a simultaneous IV glucose infusion.

Indication: 2) Beta-blocker or calcium channel blocker overdose

Dosage: Adolescent
IV: 2 to 3 mg followed by a 5 mg/h infusion.

Pediatric
IV: 0.025 to 0.05 mg/kg followed by 0.07 mg/kg/h infusion.

**Glucose**

Indication: Hypoglycemia

Initial Dose: IV: 250 to 500 mg/kg

Maintenance

Dose: Constant infusion of 10% dextrose in water at a rate of 100 mL/kg/24 h (7 mg/kg/min). Older children may require a substantially lower dose. The rate should be titrated to appropriate glucose values.

Note: 250 to 500 mg/kg = 2.5 to 5.0 mL/kg of D10%
250 to 500 mg/kg = 1.0 to 2.0 mL/kg of D25%
250 to 500 mg/kg = 0.5 to 1.0 mL/kg of D50%

Note: Neonates should receive 10% to 12.5% glucose administered slowly.

Note: Glucose levels should be determined before and during administration. If large volumes of dextrose are administered, include electrolytes to prevent hyponatremia and hypokalemia.

**Haloperidol**

Indication: Psychosis with agitation

Dosage: IM, IV: 0.1 mg/kg, may repeat hourly as necessary. Maximum single dose, 5 mg.

Note: Hypotension and dystonic reactions may occur.

**Insulin, Regular**

Indication: 1) Diabetic ketoacidosis

Dosage: SC: 0.25 to 0.5 unit/kg per dose
IV infusion dose: 0.05 to 0.1 unit/kg/h
Neonatal dose: 0.05 unit/kg/h

Note: Blood glucose levels should be closely monitored. Appropriate fluid and electrolyte therapy are also required in treating diabetic ketoacidosis.

Indication: 2) Hyperkalemia

Dosage: IV: 0.1 unit/kg with 400 mg/kg glucose. Ratio of 1 unit of insulin for every 4 g of glucose.

Note: Potassium levels in blood or serum should be monitored.

**Ipecac Syrup**

Indication: Acute ingestion of selected toxic substances

Dosage: Oral (PO): 6-month-old to 1-year-old = 10 mL
>1 year old = 15 mL
Adolescent/young adult = 30 mL

**WARNING: Do not use when patient is suffering from central nervous system depression or if having seizures. Contraindicated in caustic and hydrocarbon ingestion. Patients who ingest pesticides or other chemicals that may have a hydrocarbon base may need to have emesis induced. Consult your regional poison control center.**

Note: Administer with 120 to 180 mL of fluid; 90% effective in inducing vomiting within 25 minutes of first dose. May repeat once.

Note: Activated charcoal is now considered the first line therapy for most oral ingestions treated in the hospital setting.

**Kayexalate (Sodium Polystyrene Sulfonate)**

Indication: Treatment of hyperkalemia

Dosage: Adults and adolescents
PO: 15 g (60 mL) 1 to 4 times/day
Rectal: 30 to 50 g every 6 hours
Children
PO: 1.0 g/kg every 6 hours
Rectal: 1.0 g/kg/dose every 2 to 6 hours (for small children and infants use lower doses by using the practical exchange ratio of 1 mEq K+/g of resin).

**WARNING: Avoid using the commercially available liquid preparation in neonates due to the hyperosmolar preservative (Sorbitol) content. Extremely premature newborns may develop intestinal hemorrhage (hematochezia) from rectal Kayexalate.**

**Ketamine**

Indication: 1) Sedation/analgesia

Dosage: IM: 1 to 2 mg/kg
IV: 0.5 to 1 mg/kg

Indication: 2) Adjunct to intubation

Dosage: IV: 1 to 2 mg/kg

Note: Laryngospasm associated with ketamine is usually reversed with oxygen administration and positive pressure ventilation.

Note: Atropine or other antisialogogue should be used to prevent increased salivation.

**WARNING: Be prepared to provide respiratory support. Monitor oxygen saturation. Avoid use in patients with increased intracranial pressure or increased intraocular pressure.**

**Lidocaine**

Indication: 1) Ventricular arrhythmia

Dosage: IV: 1 mg/kg as a single dose slowly, repeat every 5 to 10 minutes to desired effect or until maximum dose of 3 mg/kg is given
IV infusion: 20 to 50 $\mu$g/kg/min
Endotracheal: 1 mg/kg

Note: If administered through an endotracheal tube, follow the dose with saline flush or dilute in isotonic saline flush (1 to 5 mL) based on patient size.

Note: Preparation of infusion solution: add 120 mg (6 mL of a 2.0% concentration) to 100 mL of 5% glucose in water. Infusion of 1.0 to 2.5 mL/kg/h will deliver 20 to 50 $\mu$g/kg/min.

Note: A reduced infusion rate should be used in patients with a low cardiac output.

**WARNING: Contraindicated in complete heart block and wide complex tachycardia due to accessory conduction pathways.**

Note: Excessive dosage may result in myocardial depression, hypotension, central excitation, and seizures.

Indication: 2) To attenuate airway reflexes before endotracheal intubation or airway manipulation in patients with elevated intracranial pressure

Dosage: 1 mg/kg IV as a single dose 30 seconds before airway instrumentation.

**Lorazepam**

Indication: 1) Status epilepticus
2) Adjunct for intubation

Dosage: IM or IV: 0.05 to 0.1 mg/kg
Repeat doses every 10 to 15 minutes for clinical effect.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen saturation.**

**Mannitol**

Indication: Increased intracranial pressure

Dosage: IV: 0.25 g/kg given over a 15-minute infusion.

Note: A larger dose (0.5 g/kg given over 15 minutes) may be appropriate in an acute intracranial hypertensive crisis. In conjunction with mannitol, other measures to control intracranial pressure such as hyperventilation, barbiturates, and muscle relaxation (using a neuromuscular blocking agent) should be considered.

**WARNING: Rapid administration may cause hypotension, hyperosmolality, and elevated intracranial pressure.**

**Meperidine**

Indication: Pain

Dosage: IV or IM: 1 to 2 mg/kg
Repeat dose is necessary for clinical effect.

Note: Higher doses may be necessary if patient is tolerant.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.**

**Methylprednisolone**

Indication: 1) Asthma/allergic reaction

Dosage: IV: 1 to 2 mg/kg every 6 hours

Indication: 2) Spinal cord injury

Dosage: IV: 30 mg/kg over 15 minutes. In 45 minutes begin a continuous infusion of 5 to 6 mg/kg/h for 23 hours.

Indication: 3) Croup

Dosage: IV: 1 to 2 mg/kg of methylprednisolone, then 0.5 mg/kg every 6 to 8 hours.

**Midazolam**

Indication: Adjunct for endotracheal intubation or for sedation/anxiolysis

Dosage: IV: 0.05 to 0.2 mg/kg given over several minutes.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen saturation.**

**Morphine Sulfate**

Indication: Pain, infundibular spasm ("Tet Spell")

Dosage: IV (slowly) or IM: 0.05 to 0.1 mg/kg.
Repeat dose as necessary for clinical effect.

Note: Higher doses may be necessary if patient is tolerant.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.**

**Naloxone**

Indication: Respiratory depression induced by opioid

Dosage: IV, IM: 0.1 mg/kg from birth (including premature infants) until age 5 years or 20 kg of weight. Thereafter, the minimum dose is 2.0 mg. Doses may be repeated as needed to maintain opiate reversal. IM absorption may be erratic.

Note: This dosage is indicated for acute opiate intoxication. Titration to effect with lower initial doses (0.01 mg/kg or 10 $\mu$g/kg) should be considered for other clinical situations, eg, respiratory depression during pain management.

**WARNING: May induce acute withdrawal in opioid dependency. Patients who receive naloxone should be continuously observed for renarcotization for at least 2 hours after the last dose of naloxone.**

**Nitroprusside**

Indication: Hypertensive crisis

Dosage: IV: 0.5 to 10 $\mu$g/kg/min.
Start at the lowest dosage and titrate for the desired clinical effect. Administer through low dead space system or as close to IV catheter as possible to prevent accidental bolus injection.

Note: Preparation of infusion solution: 6 mg $\times$ body weight (kg) diluted to 100 mL D5W. Infuse at 1 mL/h = 1 $\mu$g/kg/min using a constant infusion pump.

Note: Bottle, burette, or syringe pump but not the IV tubing should be covered with protective foil to avoid breakdown by light.

**WARNING: Administration may result in profound hypotension. Patients should be closely monitored. Blood pressure should be continuously monitored with an arterial line.**

**WARNING: Cyanide toxicity can result from large doses and/or prolonged infusions. Patients should be closely monitored for the development of metabolic acidosis. Patients with decreased renal function may be at increased risk.**

**Oxygen**
Indication: 1) Hypoxemia and/or respiratory distress
2) Carbon monoxide poisoning
3) Shock
Dosage: 100% by nonrebreather mask initially or endotracheal tube; wean as tolerated.
Note: The administration of supplemental oxygen should be considered during **EVERY** pediatric emergency.

**Pancuronium**
Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation
2) Emergency intubation
Dosage: IV: 0.1 mg/kg
Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.
Note: This agent can be used when succinylcholine is contraindicated. Pancuronium is a long-acting neuromuscular blocker that requires ventilatory assistance for at least 1 hour. Satisfactory conditions for endotracheal intubation will generally occur 2 to 3 minutes after administration.
**WARNING: Ventilatory support will be necessary. Personnel with skills in advanced airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

**Phenobarbital**
Indication: Status epilepticus
Dosage: IV: 20 mg/kg. Maximum dose, 1000 mg.
Repeat dose once if necessary for clinical effect after 15 minutes.
**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen satura**

**Phenylephrine**
Indication: Infundibular spasm ("Tet Spell")
Dosage: 5 to 20 $\mu$g/kg push then followed by infusion at 0.1 to 5.0 $\mu$g/kg/min.
**WARNING: Blood pressure must be carefully followed and dose titrated to effect.**

**Phenytoin**
Indication: Status epilepticus
Dosage: IV: 10 to 20 mg/kg initial dose.
Maximum initial dose, 1000 mg.
Maximum rate of administration, 50 mg/min or 1 mg/kg/min, whichever is less.
Note: The lower dose is indicated in neonates because of increased risk of toxicity due to decreased protein binding. Should be diluted in normal saline to avoid precipitation.
**WARNING: Rate of infusion should not exceed 0.1 mL of undiluted preparation per kg/min. Heart rate should be monitored and the rate of infusion reduced if the heart rate decreases by 10 beats/minute.**

**Procainamide**
Indication: Wide complex tachycardia
Dosage: IV: Start at 3 to 6 mg/kg/dose over 5 minutes not to exceed 100 mg to a titrated maximum of 15 mg/kg/loading dose.
Maintenance dose, 20 to 80 $\mu$g/kg/min (0.02 to 0.08 mg/kg/min); maximum, 2 g/24 h.
**WARNING: If 50% QRS widening or hypotension occurs during loading dose, the remainder of the loading dose is held, and the maintenance dose is delayed until these signs have resolved.**

**Propranolol**
Indication: Infundibular spasm ("Tet Spell")
Dosage: IV: 0.01 to 0.02 mg/kg per dose infused over 10 min in 5% dextrose in water.
Maximum initial dose, 1.0 mg
Note: Oxygen should be administered first. Morphine is also an effective treatment for infundibular spasms. Phenylephrine is another adjunct for reversal of infundibular spasm. Use is contraindicated in congestive heart failure. Avoid in patients with a history of bronchospasm.

**Prostaglandin $E_1$**
Indication: Possible ductal-dependent cardiac malformation in the neonatal period
Dosage: 0.05 to 0.10 $\mu$g/kg/min as an infusion in 5% dextrose in water.
Note: Preparation of infusion solution: 250 $\mu$g in 80 mL of D5W infuse at 1 mL/kg/h = 0.05 $\mu$g/kg/min.
**WARNING: Apnea, hyperthermia, and seizures may occur. Be prepared to provide respiratory support. Monitor oxygen saturation.**

**Rocuronium**

Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation
2) Emergency intubation

Dosage: IV: 0.8 to 1.2 mg/kg

Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.

Note: Alternative to succinylcholine for rapid intubation when succinylcholine is contraindicated. Duration of block is generally 30 to 45 minutes and is dose-dependent. Satisfactory conditions for endotracheal intubation will generally occur 45 to 60 seconds after administration.

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

**Succinylcholine**

Indication: Neuromuscular blockade for emergency intubation or treatment of laryngospasm

Dosage: 1 to 2 mg/kg IV
4 to 5 mg/kg IM

**WARNING: Contraindicated with previous history of malignant hyperthermia, severe burns, spinal cord injury, neuromuscular disease, or myopathies. When these contraindications exist use a non-depolarizing muscle relaxant such as rocuronium. Despite reports of acute rhabdomyolysis, hyperkalemia, and cardiac arrest with succinylcholine, this agent remains the drug of choice when immediate securing of an airway is indicated.**

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

Note: Atropine, 0.02 mg/kg (minimum dose, 0.1 mg), should be combined with or precede succinylcholine to prevent bradycardia or asystole. Satisfactory conditions for endotracheal intubation generally occur 30 to 45 seconds after IV administration and 3 to 5 minutes after IM administration.

Note: If cardiac arrest occurs immediately after administration of succinylcholine, hyperkalemia must be suspected and treatment for this condition initiated. Hyperkalemia is especially likely to be responsible for cardiac arrest occurring in male children 8 years of age or younger.

**Thiopental**

Indication: 1) Adjunct to intubation

Dosage: IV: 4 to 6 mg/kg

Note: A lower dose may be used if other sedatives/narcotics have been administered.

**WARNING: IM administration leads to tissue necrosis.**

**WARNING: Be prepared to provide respiratory support. Monitor oxygen saturation. High doses are associated with hypotension and apnea. Use with caution in patients with cardiac compromise or hypovolemia.**

Indication: 2) Control of intracranial hypertension

Dosage: 1 to 2 mg/kg, repeated as necessary

**Vecuronium**

Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation
2) Emergency intubation

Dosage: IV: 0.1 mg/kg

Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.

Note: This agent may be used for emergency intubation when succinylcholine is contraindicated. Satisfactory conditions for endotracheal intubation generally occur 1.5 to 2.0 minutes after administration.

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

## REFERENCES

1. American Academy of Pediatrics and American College of Emergency Physicians, Joint Task Force on Pediatric Life Support. *APLS: The Pediatric Emergency Medicine Course*. Elk Grove Village, IL: American Academy of Pediatrics; 1993
2. KidSTAT Plus (CD-ROM). Elk Grove Village, IL: American Academy of Pediatrics; 1996
3. American Heart Association, Subcommittee on Pediatric Resuscitation. *Pediatric Advanced Life Support*. Dallas, TX: American Heart Association; 1994
4. American Academy of Pediatrics. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. *Pediatrics.* 1992;89:1110–1115