

# STUDENT MANUAL

## VENTILATORS

### PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain a ventilator in the interfacility transfer environment.

### OBJECTIVES

#### COGNITIVE

- Identify the indications for ventilatory support
- Identify the types of ventilators and be knowledgeable of the ventilator(s) most likely to be utilized
- Discuss the various ventilator controls and their corresponding settings
- Define the four major types of ventilator delivery modes
- Discuss ventilator complications with their associated remedies
- Name the major complication associated with barotrauma and describe its treatment

#### PSYCHOMOTOR

- Observe the steps required for attaching a patient to a ventilator
- Demonstrate the steps required to attach a patient to a ventilator

#### AFFECTIVE

- Explain the rationale for using a ventilator versus a bag-valve-mask device
- Defend the need to reassess the patient throughout transport with a ventilator

### INDICATIONS

There are many uses for a mechanical ventilator, whether it is a cardiac arrest situation to ease the workload on the code team, a tired asthmatic patient in need of assistance, or a victim of multiple trauma who has been pharmacologically paralyzed. However, all of these reasons may be broken down into one category, acute respiratory failure.

The objective criteria for respiratory failure are very simple and straight forward,  $\text{PaO}_2 < 60$  mm Hg on 50 % oxygen and/or  $\text{PaCO}_2 > 50$  mm Hg with a pH less than or equal to 7.25.

Many other factors must be taken into consideration before the decision is made to provide mechanical support, such as age, effort of breathing, etc.

There are five categories of pulmonary problems which may progress to the need for mechanical ventilatory support. These are:

- Central nervous system problems which depress the drive to breathe (e.g., cerebrovascular accident).
- Neuromuscular problems which lead to the failure of the peripheral nerves and muscles that aid respirations (e.g., multiple sclerosis).
- Musculoskeletal and pleural dysfunctions (e.g., flail chest)
- Problems with the airways themselves (e.g., asthma)
- Reduction in the ability to exchange gases (e.g., pneumonia)

## Ventilator Terminology

- **Tidal Volume (Vt):** the amount of volume delivered with each breath, and is calculated in mL. Normal Vt is 6-8ml/kg.
- **Respiratory Rate (f):** the amount of breaths the pt receives in one minute.
- **Minute Ventilation (V<sub>E</sub>):** volume of gas inhaled or exhaled per minute. Can be calculated by multiplying the Vt x f. The normal range is 4-8 L/min.
- **Exhaled Tidal Volume (Vte):** Gives you an actual breath to breath glimpse of the variations seen with how the pt's lung compliance is affecting overall minute ventilation.
- **I:E Ratio:** refers to the ratio of inspiratory time vs. expiratory time. In normal spontaneous breathing, the expiratory time is most often twice as long as the inspiratory time. Normal I:E ratio is 1:2. In COPD, ARDS, or asthmatics, the I:E may be 1:3 or 1:4.
- **I-Time:** the time over which the Vt is delivered or the pressure is maintained depending on the mode of ventilation.
- By adjusting your resp rate (f) and your I:E ratio, you are in turn affecting your I-time.
- **Fraction of Inspired Oxygen (FiO<sub>2</sub>):** the fraction or percentage of oxygen in the space being measured. Measured in 0.21 up to 1.00.
- **Positive End-Expiratory Pressure (PEEP):** tool used to maintain alveolar recruitment and optimize the ability to provide effective oxygenation.
- **Trigger (Sensitivity):** allows the patient to either take a breath or trigger the ventilator to deliver a breath.
- **Pressure Support (PS):** used in SIMV mode of ventilation, pressure support is used to help your patient take a triggered spontaneous breath. PS helps reduce dead space and the work of the pt taking spontaneous breaths.
- **Compliance:** refers to the lungs ability to stretch and expand.
- **Resistance:** resistance of the respiratory tract to allow airflow to enter and exit.
- **Peak Inspiratory Pressure (PIP):** the measurement of the volume of each breath, compliance of the lungs, airway resistance, and the force needed to deliver each breath. Most ventilators will give the clinician a second by seconds reading of the PIP. Goal is to have a PIP <40cmH<sub>2</sub>O.
- **Plateau Pressure (Pplat):** direct indication of alveolar function. A consistently high Pplat will lead to alveolar destruction and VLI which will ultimately progress to ARDS. Goal is to keep the Pplat <30cmH<sub>2</sub>O.

- **Mean Airway Pressure (MAP):** the average pressure exerted on the airways and lungs from the beginning of inspiration to the beginning of the next inspiration. Goal is to maintain a MAP <12 cmH<sub>2</sub>O.
- **Dead Space:** The amount of volume lost that doesn't reach the alveolar level during each mechanically delivered breath.

### Causes of High Pplat

- A Pplat >30 cmH<sub>2</sub>O is usually caused by:
- Increased V<sub>t</sub>
- Decreased pulmonary compliance
- Pulmonary Edema
- Pleural Effusion
- Peritoneal Gas Insufflation
- Tension Pneumothorax
- Trendelenburg
- Ascites
- Abdominal Packing

### Modes of Ventilation

- **Volume-Targeted (Initiated Ventilation)**
- volume targeted ventilation is our standard manner of delivery. This involves the simple concept of filling the lung with a set amount of volume.
- The volume that is determined by using the calculation formula 4-8 ml/kg based on lung protective strategies.
- Although this manner of delivery is simple and targeted, it can lead to barotrauma and high Pplat pressures if administered in high amounts.
- **Pressure-Targeted (Initiated) Ventilation**
- Pressure targeted ventilation is different from volume targeted ventilation in that the volume delivered is dependent on lung compliance.
- In this mode, you are basically blowing up a balloon to a set pressure. Based on that pressure and overall lung compliance, you'll get a volume.
- This is a great mode for sick lungs because it is compliance based.
- This mode protects lungs from barotrauma, and is the mode of delivery for neonates and pediatric patients.
- **Assist Control (AC)**
- This mode will deliver a set V<sub>t</sub> and (f) based on what the clinician enters into the vent settings. It guarantees this for every breath.
- AC can be used in both pressure and volume targeted ventilation.
- The pt can also trigger a breath, but will get the full control V<sub>t</sub> breath.
- In the transport setting, when using this mode ensure that the pt is adequately sedated, and not taking multiple spontaneous breaths which could lead to auto-peep issues, poor compliance, and poor eucapnia.
- **Synchronized Intermittent Mandatory Ventilation (SIMV)**

- SIMV allows you to set a guaranteed Vt and (f), and in addition you can set the trigger based on the pt's condition. Unlike AC which will deliver a full breath when the pt triggers the vent, in SIMV, when the pt triggers a breath, it will allow the pt to take their own Vt breath.
- This mode allows the clinician to augment the pt's attempt to initiate a breath, in turn starting the weaning process and making the pt more comfortable.
- Augmentation of the breath is assisted by Pressure Support, and it is best to set your Pressure Support to at least 5-10. A PS of 10 is a good starting point.
- The more PS added, the easier it will be for your patients to take spontaneous breaths based on the set flow trigger. PS essentially reduces the work load of your pt taking spontaneous breaths.
  
- **Pressure Regulated Volume Control (PRVC)**
- This mode will allow for improved oxygenation due to constant pressure and decreased inspiratory flow patterns.
- The ventilator adjusts pressure based on the pt's airway resistance and respiratory system compliance changes in order to set a Vt.
- The ventilator monitors each breath for Vt. If the Vt is too low, it increases the inspiratory pressure for the next breath. If it is too high, it decreases the pressure.
- It measures these pressures by examining the Vte and compares it to the desired Vt.
  
- **Continuous Positive Airway Pressure (CPAP)**
- CPAP overpowers the residual pressure that prevents the lungs from fully emptying on exhalation. This decreases the pt's workload and increases oxygenation.
- CPAP essentially equals PEEP in the sense that both maintain alveolar recruitment and prevent atelectasis.
- Intubation can be avoided in some pt's by the application of CPAP, which in turn reduces hospital stays and the risk for VAP.
  
- **Bi-Level Positive Airway Pressure (BiPAP)**
- BiPAP can be described as a continuous positive airway pressure system with a time-cycled or flow-cycled change of the applied CPAP level by using PEEP.
- It delivers a preset inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP) by applying PEEP.
- This mode is better overall and is used more consistently in treating pt's.
- A good starting point for a BiPAP setting is an IPAP of 10 and EPAP of 5, and adjust to maintain an appropriate oxygenation status.
- Monitor you PIP's as the PIP should correlate with your IPAP and EPAP's respectively, and be no higher than your IPAP.

## Making Vent Changes

- **To Improve Oxygenation (SpO2):**
  - i. Increase the FiO2
  - ii. Increase the PEEP
- **If the EtCO2 is high:**
  - i. Increase the respiratory rate
  - ii. Increase the Vt in volume mode
  - iii. Increase the pressure in pressure mode
- **If the EtCO2 is low:**
  - i. Decrease the respiratory rate

- ii. Decrease the  $V_t$  in volume mode
- iii. Decrease the pressure in pressure mode

# CHEST TUBES

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain a chest tube drainage system in the interfacility transfer environment.

## OBJECTIVES

### COGNITIVE

- Identify the indications for a chest tube
- Discuss the most serious potential problem of a chest tube and its treatment
- Explain the importance of drainage monitoring
- Discuss what should be observed for in the drainage
- State the procedure to reestablish chest tube patency
- Discuss the four primary functions of a chest tube
- Discuss the proper maintenance of chest tubes
- Explain the significance of constant bubbling in the seal chamber

### PSYCHOMOTOR

- Observe the proper setup of a disposable chest tube drainage system

### AFFECTIVE

- Defend the rationale for not routinely “milking” the chest tube
- Explain the importance of maintaining a “dependent loop”

## OVERVIEW

The integrity of the lung is maintained by the negative pressure that is generated between the visceral pleura and the parietal pleura. If air is allowed to enter the potential space that exists between these two layers they will separate and the lung will collapse.

Chest tubes have four primary functions:

- Act as a drain for air and fluid that are present in the chest cavity
- To replace the negative pressure required for chest wall integrity
- To provide a water seal for the pleura which will prevent air from entering the system
- Prevent the drainage from flowing back into the patient

The typical disposable chest tube drainage unit consists of three separate chambers. In order, from the patient, they are the collection chamber, the water seal chamber, and the suction control chamber.

The collection chamber will hold approximately 2.5 liters and is the area from which the chest drainage will be received. The water seal chamber will be 2 cm in depth. This provides the correct negative pressure for the chest tube unit. Bubbling should only be seen in the seal chamber during exhalation. Constant bubbling indicates that there is an air leak in the system. The final section is the suction control chamber which will be filled with water. This method is the safest way to regulate the amount of suction which is applied to the patient.

The insertion site of the chest tube may vary greatly depending on the patient's condition. The second intercostal space is a suitable site for a simple pneumothorax. In the event the patient has a hemothorax they may have a tube inserted into the sixth through the eighth intercostal spaces since the fluid will drain into the lower areas of the chest.

## INDICATIONS

Any event, whether injury or surgery, that disrupts the integrity of the chest wall may necessitate the placement of a chest tube.

## MAINTENANCE

- If it is permissible, the ideal position for the patient with a chest tube is the semi-Fowler's position.
- Air and fluid evacuation may be enhanced by turning the patient every 2 hours, if permissible.
- Frequently lift the latex tubing to drain into the collection chamber to prevent a possible obstruction
- NEVER raise the chest tube drainage system above the level of the patient's chest due to the fact that the contents will drain back into the patient.
- Fluctuations in the water seal chamber of two to four inches, when the patient breathes, are considered normal.
- Avoid creating loops in the drainage tube as clots may form.
- Encourage the patient to breathe deeply and to cough.
- Palpate the area around the insertion site for signs of subcutaneous emphysema.

## PROBLEMS

The most serious complication of a chest tube is the development of a tension pneumothorax due to an obstructed drainage tube. A common cause of obstruction is not periodically lifting the tube thereby allowing the collected blood to clot. Frequent monitoring and draining of the latex tubing will prevent this from occurring.

In the case of inadvertent chest tube removal the open wound should be treated as an open pneumothorax ("sucking chest wound"). Use an occlusive dressing, taped only on three sides if possible, and monitor the patient for signs of a developing tension pneumothorax.

## DRAINAGE MONITORING

Be certain that the chest tube drainage system is in full view so that you may observe the drainage for the following:

- Color

- Consistency
- Amount
- Any sudden changes in drainage are cause for alarm and the transferring, receiving or medical control facility should be contacted:
- An increase in the amount of drainage may mean hemorrhaging
- A decrease in the amount of drainage may mean an obstruction or a failure of the system

## PROCEDURE FOR REESTABLISHING TUBE PATENCY

In the event that the chest tube is no longer functioning, utilize the following procedure to reestablish patency:

- If permissible, reposition the patient
- If there is a clot visible in the tubing, straighten and raise the latex tubing to increase drainage
- Squeeze and release the tubing in an attempt to move the clot
- Only after the above steps have been attempted and failed should “milking” or stripping the tube towards the receptacle be attempted. “Milking” is a process where one pinches the latex tubing and, while maintaining pressure on the tubing, moves their fingers toward the receptacle.
- Routine stripping or “milking” of the chest drainage tube is to be avoided due to:
  - ✓ Generation of excessive negative pressures
  - ✓ Rupture of the alveoli
  - ✓ Persistent pleural leak

# FOLEY CATHETERS

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain a Foley catheter interfacility transfer environment.

## OBJECTIVE

### COGNITIVE

- Identify the two components in assessing a Foley catheter
- Identify the three primary indications for the placement of a Foley catheter
- Define the normal urinary output
- State the treatment for accidental removal of a Foley catheter
- State the treatment for a clotted catheter

### PSYCHOMOTOR

- View a Foley catheter
- Locate various components of a Foley catheter

### AFFECTIVE

- Defend the rationale for not raising the collection bag above the level of the patient
- Explain the reasoning for performing an hourly (or sooner) record of fluid input/output

## OVERVIEW

There are numerous types of Foley catheters available, but they all possess similar characteristics. A tube is introduced into the urinary meatus and passes through the urethra until the distal end resides in the bladder of the patient. A balloon is then inflated with sterile water which effectively anchors and seals off the bladder.

Foley catheters provide a means to drain the contents of the patient's bladder, as well as, giving an accurate reading on the patient's urinary flow. Foley catheters are the choice for patients with constricted areas along the urethra, such as benign prostatic hypertrophy.

The downside to the use of Foley catheters is the increased potential for infection. A 75 % chance of cystitis (bladder infection) exists if a catheter has been indwelling for three days. Near 100 % certainty of infection is present if the catheter is left in place for ten days.

## INDICATIONS

There are three primary indications for the placement of a Foley catheter:

- Urinary incontinence
- Monitoring an accurate fluid output (1 ml/kg/hr is the normal rate)
- Inability to void



## ASSESSMENT

- Assess drainage
  - ✓ Color
  - ✓ Amount
  - ✓ Consistency
- Assess entrance site
  - ✓ Redness
  - ✓ Swelling
  - ✓ Warmth
  - ✓ Discharge
  - ✓ Pain

## PROBLEMS

- Accidental Removal
  - ✓ Provide supportive treatment
  - ✓ If severe bleeding follows the accidental removal, apply a loose dressing
  - ✓ Document removal
- Clotting of the catheter
  - ✓ Maintain strict, aseptic technique
  - ✓ Flush catheter with 50 cc of sterile saline
  - ✓ Do not force solution, if resistance is encountered, stop
  - ✓ Observe the fluid collection in the bag following irrigation
  - ✓ Document procedure and time
- Do not raise the bag above the level of the patient's body thus allowing the contents to flow back into the patient.
- Be alert for sudden reduction in urine flow. Acute renal failure may develop from an occluded catheter. Document and notify the receiving facility.
- When moving the patient from the cot to the bed (or vice versa), always check to make sure the collection bag is detached from the bed and placed on the patient. Failure to do so may result in urethral or bladder damage.
- An hourly record (more if requested by the physician) may be needed on fluid input and output.

# NG/OG TUBES

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain a nasogastric/orogastric tube during in the interfacility transfer environment.

## OBJECTIVES

### COGNITIVE

- Recall the five indications for the placement of an NG/OG tube
- Explain some of the problems associated with an NG/OG tube
- Discuss what the drainage from an NG/OG tube should be assessed for

### PSYCHOMOTOR

- View various types of NG/OG tubes
- method involved in clearing an obstructed tube

### AFFECTIVE

- Defend the need to avoid lying the patient supine when an NG/OG tube is in place

## OVERVIEW

Many different types of NG/OG tubes are in existence today. Examples include, Levin, Salem sump, Ewald, Sengsten-Blakemore and Dubhoff.

The three most common tubes in use today are the Levin, Salem sump, and Moss tube. The Levin tube is about 30 inches long with several holes along its side and at the end. It has one proximal opening.

The Salem sump tube is approximately 48 inches in length and it resembles the Levin tube except for the addition of the blue sump port. This port allows free air to enter the stomach thus preventing the tube from adhering to the mucosal lining.

The last tube, Moss, is usually inserted during surgery. It has three openings, the first serves as a balloon inflation port. The second is for esophageal aspiration. Finally, the third is for duodenal feeding.

## INDICATIONS

- Provides for short term **enteral** feeding
- Provides a means for medication administration
- Provides a means for gastric lavage and/or decompression
- Allows for removal of large particulate pills in cases of overdose
- Provides a quick means for hemostasis in upper GI bleeding

## PROBLEMS

- Vomiting may occur due to an improperly placed or clogged tube
- Dehydration and/or electrolyte imbalances may occur due to removal of gastric contents.
- Aspiration pneumonia is always a possibility due to capillary action occurring around the tube.

## DRAINAGE MONITORING

Check drainage for:

- Amount
- Color
- Consistency
- Odor

\*Normal gastric secretions have either no color or are yellow-green due to the presence of bile.

## TIPS FOR NG/OG TUBES

- Avoid laying the patient flat if possible; gastric juices may follow up the tube and be aspirated into the lungs.
- If using the NG tube to administer medications, irrigate the tube with 30 ml of sterile water before and after administration.
- Wait approximately 30 minutes after medication administration to replace suction, if ordered.
- Keep a precise record of fluid input and output
- If the NG/OG does not appear to function it is usually due to one of two things, either a clogged tube or the positioning is incorrect. Attempt to irrigate the tube, reposition the patient (if permitted), or rotate the tube.
- Correct tube placement may be confirmed by instilling ten ml of air from a syringe into the NG/OG tube while listening for bubbling sounds over the epigastrium.
- Usually the NG/OG tube will need to be irrigated every four hours. Consult with the hospital staff as to their procedure prior to transport if you anticipate the patient contact time to be over four hours.

# IV INFUSION PUMPS

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain IV infusion pumps and their respective agents in the interfacility transfer environment.

## OBJECTIVES

### COGNITIVE

- Differentiate between an IV controller and an IV pump
- Recall the tips for using an IV controller
- Differentiate between a peristaltic pump and a piston pump
- Name the two primary indications for the use of an infusion pump
- Describe the two basic infusion pump controls
- Describe the three basic pump alarms
- Explain why being alert for extravasation is important with IV infusion pumps

### PSYCHOMOTOR

- Observe the proper steps in setting up an IV pump/controller
- Demonstrate the proper steps in setting up an IV pump/controller
- Properly adjust an IV setting given a scenario in which the infusion rate is altered en route

### AFFECTIVE

- Explain the rationale for periodically moving the tubing in an IV controller
- Defend the reasoning for not using a peristaltic pump on “fragile” solutions
- Explain the rationale for evacuating air from the tubing and the drip chamber in infusion pumps
- Explain the rationale for setting the volume control about 50 cc less than the volume in the bag

## OVERVIEW

Some pharmacologic agents, such as heparin, require precise methods for administering very specific amounts of the medication over a very specific time frame. That is one of the purposes of IV infusion pumps.

Additionally, IV pumps help prevent fluid overload by limiting the amount of fluid administered. IV pumps will also alert the transport paramedic to potential problems, such as a reduced flow, occlusions or a low battery. Finally, the IV infusion pump, as the name implies, provides pressure to the solution. This helps in two ways. First, it assists in maintaining IV patency and second, it aids in overcoming any potential resistance. Resistance may be in the form of an indwelling problem in the patient (i.e., excessive vasoconstriction) or due to a small diameter of infusion tubing.

Numerous IV pumps exist on the market today thus preventing a detailed explanation of each individual type. However, there are certain generic similarities that exist between each

manufacturer's brand. The IV pumps that will be in use by the transport paramedic consist of three principle types, peristaltic, piston-driven, and smart pumps.

## TYPES OF IV PUMPS

### **PERISTALTIC IV PUMPS**

Peristaltic pumps derive their name by the “wave-like” action of the medication when it is delivered to the patient. The administration tubing is attached to the device and the pump applies pressure. This is accomplished by means of a rotating wheel which squeezes the medication through the infusion set. The medication action is very similar to the peristalsis that occurs in the intestines hence the name. These devices are very accurate, however, due to the squeezing nature of fluid delivery they are not the best choice for fragile solutions such as blood.

### **PISTON DRIVEN PUMPS**

Piston driven IV infusion pumps are similar to the action of a piston in an automobile. As the piston or plunger moves forward, a specific amount of medication is delivered. Piston driven pumps usually require IV tubing designed for the device. This tubing will generally have a cartridge containing the plunger. Like the peristaltic IV pumps, these intravenous infusion devices are highly accurate. Unlike the previously mentioned pump the piston driven pump is an excellent choice for fragile fluid products.

## INDICATIONS

### **IV Infusion Pumps**

- The purpose of this presentation is to discuss IV pumps used at the bedside in a hospital that a provider may see in a interfacility hospital transfer.
- There are a variety of IV infusion pumps on the market today that are used for many different routes of delivery.
- Many hospitals carry different brands and models of IV infusion pumps.
- It is important to be familiar with IV infusion pumps in the event a patient who you are transferring has an IV drip infusing through a IV pump.
- Many IV pumps will already be set and infusing at the time a patient is being transferred.
- It is important to know how to titrate medications on the IV pumps, as many medications require titration. Consult the sending facility RN, your clinical manager, or the manufacturer for instructions on how to titrate as IV pumps have different steps for medication titration.

### **Purpose of IV Infusion Pumps**

- The main purpose of an IV infusion pump is to deliver a set volume of fluid or a medication dose.
- When the set volume or dose of medication or fluid is infused through a smart IV pump, the risk for medication errors is reduced.
- IV pumps are beneficial because when programs correctly, the correct medication can be delivered safely.

## Smart Pumps

- In the past several years, IV pump manufacturers have developed the “smart” pump.
- The smart pumps are designed with medication doses preprogrammed, and all the trained operator has to do is input the applicable data such as the patient weight, volume of fluid to be infused, or what medication is being given. Once this is completed, the pump will allow the operator to initiate the medication infusion with the pump automatically providing the dosage calculation.

## IV Pumps

- There are a variety of IV pumps in the market.
- This presentation will briefly discuss some of the common IV pumps seen in today’s hospitals.

### Baxter SIGMA SPECTRUM Infusion Pump

- This is a smart pump that has many medication and their doses preprogrammed.
- Weighs 4 pounds.
- Has a single step titration option.
- Will help reduce medication errors.
- Will have audible and visual alarms for things such as, “air in the line”, “downstream occlusion”, or “upstream occlusion”.
- Consult with sending RN, clinical manager, or manufacturer if you have questions about this device prior to transport.

### Plum 360 Infusion System by Hospira MedNet

- Can deliver set medication doses or set volumes of IV fluid.
- Used for general administration of medications and fluid.
- Weighs about 10 lbs.
- Will give a variety of alarms.
- Consult with sending RN, clinical manager, or manufacturer if you have questions about this device prior to transport.

### Carefusion Alaris PC IV Pump

- Delivers a set volume and rate of medication and IV fluids.
- Reduces risk for medication errors by having preprogrammed medication doses.
- Can support 4 different medication infusions at the same time on 1 unit.
- Consult with sending RN, clinical manager, or manufacturer if you have questions about this device prior to transport.

## IV Pumps

- There are a variety of IV pumps in today’s hospitals.
- These IV pumps are just a few of the many IV pumps you may encounter.
- All smart IV pumps have the same function, but different steps to achieve the desired goal.
- Consult with the sending RN if you have any questions about the IV pump such as, what to do if the pump alarms, or how to titrate a medication.
- Always ask questions if in doubt!

# FLUID AND BLOOD THERAPY

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain fluid and blood therapy in the interfacility transfer environment

## OBJECTIVES

### COGNITIVE

- List the indications for crystalloid therapy
- List the indications for colloid therapy
- Recognize examples of hypertonic, isotonic, and hypotonic crystalloids solutions
- Recognize examples of colloid solutions
- List the indications for parenteral therapy
- Define TPN
- List the four indications for blood therapy
- Identify commonly used blood products
- Identify the four components that blood must be checked for prior to administration
- State the proper procedure to administer blood
  - List the three major types of reactions associated with blood product administration with their corresponding signs and symptoms
- Describe the proper patient management for the three major types of blood infusion reactions

### PSYCHOMOTOR

- View and compare the difference between a blood administration set and a standard IV set

### AFFECTIVE

- Defend the need to watch for signs of fluid overload with colloidal administration
- Explain the rationale for using sterile technique when changing solution bags of TPN
- Defend the reason why blood is initially infused slowly

## CRYSTALLOIDS

### OVERVIEW

Oftentimes it may be very confusing, given all of the choices of crystalloid solutions, why patients are placed on certain types of fluids. The choice may seem completely arbitrary, but there is a method to it.

The choice of a crystalloid solution is based on the **tonicity** (or the concentration) of the fluid with respect to the patient's tonicity. If a patient receives a solution that is higher in concentration than the patient's body fluid, the solution is said to be hypertonic. The net result is that the fluid would

be drawn out of the intracellular and interstitial compartments and placed into the intravascular compartment due to osmosis. If a patient receives a fluid that is hypotonic (a lower concentration than the patient), the fluid will follow the osmotic gradient from the intravascular compartment into the cell. It follows then that if a patient receives an isotonic solution no fluid shifting should occur.

What is this concentration then? The concentration is the number of particles (e.g., electrolytes) in a known quantity of liquid. The concentration may be expressed as the osmolality (the term osmolarity may be substituted; although not exactly the same, they are very close). The normal range of osmolality in a person is 275-295. The osmolality may be easily determined by multiplying the patient's  $\text{Na}^+$  concentration by two if the patient's blood glucose is within normal limits. If the patient's glucose level is outside of the normal range add two times the  $\text{Na}^+$  plus the BUN level divided by five plus the glucose level divided by 20. If the calculated number falls below 275, the patient has too much fluid (they are dilute). If the osmolality of the patient is greater than 295, the patient is dehydrated (they are concentrated).

To determine the concentration in the IV solution merely look at the IV bag as it will be listed on the label. As an illustration, D5/NS has a listed osmolarity of 559 mOsm/L. If a patient has an osmolarity of 260 (which indicates a fluid excess), a hypertonic solution would be called for. Solutions such as D5W/1/2 NS, D5W/NS, D10 W, and 3% Saline would assist in removing the excess fluid from the patient. Oftentimes, a post surgery patient will receive a hypertonic solution to treat the tissue edema that accompanies the operation.

## INDICATIONS

- Rehydration and fluid replacement
- Replenish  $\text{Na}^+$  and  $\text{Cl}^-$
- Provide energy replacement to protect protein stores (glucose containing solutions)

## EXAMPLES

### ISOTONIC

- Ringer's, Lactated Ringer's, 2.5 % Dextrose/Lactated Ringer's
- .9% Normal Saline

### HYPERTONIC

- 10% Dextrose, 20 % Dextrose, 50% Dextrose
- 3% Saline, 5% Saline
- 5% Dextrose/.45% Saline, 5% Dextrose/.9 % Normal Saline, 5% Dextrose/Lactated Ringer's

### HYPOTONIC

- 2.5% Dextrose, 5% Dextrose
- .45% Saline

## PRECAUTIONS

- Hypertonic solutions should be administered slowly as they could cause CHF
- Monitor flow rate carefully to prevent fluid overload



# COLLOIDS

## OVERVIEW

Colloids differ from crystalloids in two primary aspects. First, colloids are large particles made up of proteins and second, they are used for rapid expansion of the patient's intravascular volume. Crystalloids may be used to move fluid forwards and backwards across the cellular membrane.

Colloids tend to draw the fluid from the interstitial spaces of the body. A 50 cc container of 25% albumin solution is the equivalent of a 250 cc bolus of fluid.

## INDICATIONS

- Rapid replacement of intravascular fluid
- Hypotension
- Correct albumin and protein levels

## EXAMPLES

- 5 % Albumin
- 25 % Albumin
- Plasma protein fraction (5 % albumin and globulin in a solution of normal saline)

## PRECAUTIONS

- Due to the extreme osmotic gradient these products produce, be alert for signs of fluid overload (CHF and/or pulmonary edema).

# PARENTERAL THERAPY

## OVERVIEW

These supplements provide calories, fats, amino acids, and/or electrolytes to the patient that exhibits an impaired gastrointestinal tract or for short term nutritional management. The average daily protein (amino acids) requirements of an adult is approximately 1 gram/kg of body weight. The body requires within the area of 1,600 cal/day for daily maintenance. If the daily caloric intake drops below 400 cal/day, the body begins to use its own source of protein.

## INDICATIONS

- Provide calories
- Spare the body's protein
- Maintenance of nutritional status

## EXAMPLES

- Amino acids
- Fat emulsions
- Total parenteral nutrition (TPN)

## PRECAUTIONS

- Fat emulsions are incompatible with electrolyte solutions.
- Watch for adverse reactions to fat emulsion therapy, such as nausea, vomiting, headache, dyspnea and allergic reactions.
- Avoid using an in-line filter for the administration of fats
- Use an IV pump for TPN administration due to the possibility of inducing hyperosmolality
- Due to the high glucose content of TPN (and subsequently the chance for bacterial growth), sterile technique is called for when changing IV bag solutions.
- Glucose intolerance may occur with TPN administration due to the inability of the pancreas to handle the extra sugar load. Generally this occurs at the onset of treatment; however, close monitoring of the patient's glucose level is necessary. If the patient is found to be glucose intolerant insulin will be added to the mixture.

## BLOOD AND BLOOD PRODUCT THERAPY

### OVERVIEW

Blood volume in the adult is about 75 ml/kg and constitutes approximately 8 % of a person's total body weight. If a test tube were placed in a centrifuge and allowed to spin down, the two major portions of blood would be readily apparent.

Plasma (a straw colored liquid also known as the supernatant) would be on the surface and would be about 55% of the total volume. The plasma is composed of 91 % water, 7 % proteins (fibrinogens, albumins and globulins), and 2 % electrolytes, nutrients, and hormones. The majority of these plasma proteins are manufactured in the liver.

At the bottom of the test tube would lie the formed elements. These are made up of the red blood cells (which are the overwhelming majority of the formed elements), white blood cells, and platelets. A very thin band will separate the plasma from the red blood cells. This is the volume of white blood cells and platelets present. The amount of red blood cells is known as the hematocrit.

The formed elements are produced from stem cells that are located in the red bone marrow. During fetal development, the liver and spleen produce the cells for the embryo. As the individual progresses into adolescence the femur and the tibia become additional sources. In adulthood, the primary source is in the marrow located in the bones of the head and trunk (sternum, ribs and vertebrae). Although the cross sectional area of bone marrow may appear small, it is actually one of the three largest organs in the body (the skin and the liver are the other two). Production of red blood cells may be stimulated by the release of erythropoietin. Thrombopoietin assists in the production of platelets. Several humoral factors aid in the release of white blood cells from the stem cells.

There are 13 known clotting factors and they are designated by roman numerals. The numbering of these agents occurred in the order in which they were discovered. Unfortunately, the Roman numeral classification does not follow the order in which the clotting factors are activated. A predictable and reliable sequence of events occurs in which one factor is activated and, in turn,

activates the next factor. The process continues along the chain until a stable clot is formed. The absence of just one factor disrupts the clotting mechanism and the clot will not form.

Certain diseases cause greatly prolonged coagulation times due to the absence of one of the 13 clotting factors. Von Willebrand's disease, also known as hemophilia Type A, presents in a patient who is deficient in factor VIII. A patient with Christmas disease, hemophilia Type B, lacks clotting factor IX. Both of these diseases are hereditary in nature. Other conditions which prolong or inhibit clotting are thrombocytopenia (a reduction in platelet production) which may be caused by a variety of events, radiation, drug therapy, etc. Finally, a vitamin K deficiency will increase clotting times. Although vitamin K does not act directly on either the intrinsic or extrinsic clotting pathways, it is required for prothrombin synthesis in the liver.

In blood therapy, it is critical that the patient receive the proper type of blood in order to avoid an adverse reaction. The present ABO system, along with the Rh (rhesus) system provides a safe way to determine which patient receives what type of blood. If a person receives blood of a different type other than their own, agglutination (clumping of red blood cells) may occur. This is due to the **glycoproteins** which exist on the surface of the red blood cells coming in contact with specific agglutinins.

## **INDICATIONS**

- Decreasing hemoglobin
- Decreasing hematocrit
- Large volume/blood loss
- Increase the oxygen carrying capacity

## **TYPE OF BLOOD PRODUCTS**

- Common
  - ✓ Packed red blood cells
- Erythrocytes and 100 ml of plasma
  - ✓ Platelets
- Plasma volume of 50 ml
  - ✓ Fresh Frozen Plasma
- Volume of 200 to 250 ml, contains all coagulation factors, but no platelets
  - ✓ Whole blood
- Volume of 500 ml, missing factors VII and V, no platelets
- Uncommon
  - ✓ Cryoprecipitate
- Plasma volume of 10 to 25 ml including factor VIII and fibrinogen
  - ✓ Clotting factors

## **BLOOD MUST BE CHECKED FOR:**

- The right patient
- The right blood product
- The right blood type
- Expiration date

## **POINTS TO CONSIDER**

- Use an 18 gauge needle or larger
- Flush tubing with normal saline
  - ✓ causes hemolysis
  - ✓ chloride
- Be sure to use a blood administration set
- Blood can never be “piggybacked” with anything else
  - ✓ No more than 1 drop every 5 seconds initially
  - ✓ 5-10 ml of blood required to initiate a reaction
  - ✓ If no reaction takes place within 15 minutes increase rate
  - ✓ Try to complete transfusion in one to one and one-half hours
  - ✓ Blood can only remain at room temperature for four hours
  - ✓ Never reuse the same administration set if the patient needs another unit of blood
  - ✓ If a reaction does occur, stop the infusion and save the blood
  - ✓ Avoid pressure infusing of blood

## **TYPES OF REACTIONS AND/OR COMPLICATIONS**

### **CIRCULATORY OVERLOAD**

Signs and Symptoms:

- Dyspnea, Coughing, Cyanosis
- Headache, Sudden anxiety
- Significant increase in systolic blood pressure
- Jugular vein distention
- Pulmonary edema followed later by peripheral edema

Treatment

- Stop the infusion
- IV Normal Saline at KVO
- Place patient sitting upright
- Oxygen
- Consider diuretics, analgesics and aminophylline (cardiac asthma)

### **FEBRILE REACTION (NON-HEMOLYTIC)**

- Most common reaction with blood transfusions
- Caused by mild immune type reaction to material (WBC, platelets, etc.) in the donors blood
- Usually occurs within 30 minutes

Signs and Symptoms

- Elevated temperature
- Chills
- Stable vital signs except for the elevated temperature

## Management

- Stop the transfusion
- Change the tubing
- Maintain venous access with normal saline
- Aspirin or Tylenol for fever
- Document
  - ✓ Episode
  - ✓ Time
  - ✓ Amount of blood given
  - ✓ Treatment performed

If only a mild febrile reaction occurred, the decision to restart the transfusion may be made by medical control.

## ALLERGIC REACTION

- More common in patients with history of receiving multiple transfusions
- More common in patients with a history of allergies
- Reactions may be grouped into two classifications, mild and severe

### Mild

#### Signs and Symptoms

- Aching joints
- Urticaria
- Mild fever

#### Management

- Stop the transfusion and change tubing
- Benadryl 50 mg IM or IV
- Maintain IV Normal Saline
- Aspirin or Tylenol for fever

### Severe

#### Signs and Symptoms

- Occurs after a few ml of blood or blood products have been infused
- Absence of fever
- Wheezing and coughing
- Tracheal edema
- Respiratory distress
- GI complaints
- Signs and symptoms of anaphylaxis

#### Management

- Stop the transfusion and change tubing
- IV fluids to support blood pressure as needed
- Epinephrine .3 to .5 ml 1 :1000 SQ (or 3 to 5 ml 1:10,000 IV)

- Benadryl 50 mg IV
- Consider steroids and aminophylline

**Never restart a transfusion after an apparent anaphylactic event**

# FIBRINOLYTICS

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain thrombolytic agents and their adjunctive treatments in the interfacility transfer environment.

## OBJECTIVES

### COGNITIVE

- Discuss the purpose of thrombolytic therapy
- List the five types of thrombolytic agents with their respective dosages
- List the potential side effects of thrombolytic therapy
- Explain the purpose of the five adjunctive pharmacologic agents during thrombolytic therapy
- Describe the proper methods for administering the five fibrinolytic agents
- Identify the proper dosage and potential side effects of the seven adjunctive pharmacologic agents during fibrinolytic therapy
- Describe the pathophysiology involved in an acute myocardial infarction
- Recall that fibrinolytic agents may be used for other thrombic emergencies
- State the sequential management to handle bleeding problems

### PSYCHOMOTOR

- View various 12 lead ECG recordings of acute infarctions

### AFFECTIVE

- Explain the importance of handling a fibrinolytic patient gently
- Explain the rationale for dividing the contraindications to fibrinolytics into potential and absolute
- Defend the reasons for adjunctive pharmacologic therapy

## OVERVIEW

With approximately 1.5 million Americans experiencing heart attacks each year, it is easy to see why coronary artery disease is the United States' number one cause of death. Over half-a-million people will die before they reach the hospital.

Fibrinolytics were first used in the late 1950's, but it was not until nearly 30 years later that they became the standard in treating myocardial infarctions (MI). There are presently five agents in use today.

Streptokinase (SK) was the original thrombolytic with Anisoylated Plasminogen SK Activator Complex (APSAC) developing later as a SK hybrid. Due to the manufacturing process these agents should not be used if the patient has previously been treated with them in the past six months. Additionally, a history of a recent “strep” infection may preclude their use.

Tissue plasminogen activator (tPA, Alteplase) has the distinction of being considered a clot specific agent at low doses. This implies that tPA will work on those clots in the coronary arteries that were recently formed and leave other clots in the systemic circulation alone. Unfortunately, at therapeutic levels, tPA does not appear to noticeably decrease the incidence of bleeding when compared either with SK or Urokinase (UK).

The newest agent, Retavase, was approved by the Food and Drug Administration in the latter part of 1996. This fibrinolytic is given as a double bolus of 10 Units each with the second bolus given 30 minutes after the first. Paramedics in Lansing, MI and Miami, FL are currently in prehospital field trials with this thrombolytic agent.

The last agent, Urokinase (UK), has been involved in the least amount of trials. UK has been available for use a longer period of time than either tPA or APSAC.

The purpose of fibrinolytics is the “lysing” or destruction of the thrombi which has precipitated the heart attack, stroke, or pulmonary embolism. The five brands of fibrinolytics all, either directly or indirectly, activate plasminogen which is the precursor to plasmin. The plasmin then destroys the fibrin surrounding the clot. Once the thrombus has been dissolved, reocclusion may occur unless other pharmacologic agents are present. These agents will be discussed in a later section.

## PATHOPHYSIOLOGY

The events which precede the occlusion of a coronary vessel occur in a very predictable and straightforward manner. The first step is that an event has occurred that has damaged the delicate endothelial lining, tunica intima, of the blood vessel. Once this has occurred the clotting mechanism begins.

Platelets adhere to the rough edges of the damaged vessel wall and rupture. This rupturing releases serotonin (which causes localized vasoconstriction), adenosine diphosphate (ADP) and thromboxanes. ADP promotes the attraction of additional platelets to the damaged site as well as thromboxanes (a type of prostaglandin), which causes further aggregation and clotting. This is the reason that aspirin, which inhibits prostaglandins, is such an important component in the treatment of an acute myocardial infarction (AMI). Prothrombin, a naturally occurring substance in the body, is converted into its active form thrombin. The enzyme thrombin then acts on fibrinogen, which is manufactured in the liver, to transform the fibrinogen into fibrin. Fibrin acts like a net to secure the clot in place.

From this point, unless the body’s own naturally occurring fibrinolytic (plasmin) can dissolve the clot, or definitive treatment (fibrinolytics) takes place, the cycle keeps building on itself, with the help of fatty acids (plasma cholesterol), until the blood vessel becomes occluded. Once

the vessel has become occluded, or if perfusion distal to the thrombus is reduced sufficiently, the patient experiences a heart attack and damage results to the myocardium.

## TRANSPORT CONSIDERATIONS

As the patient reperfuses they will oftentimes experience “reperfusion arrhythmias”. These arrhythmias are usually bradycardic, short lived and usually do not require any aggressive interventions. In 1991, a study published in the Heart & Lung journal found that dysrhythmias began in 80 % of the cases within 1.5 hours from onset of thrombolytic therapy.

## TYPES OF FIBRINOLYTICS

### **ALTEPLASE**

***Trade Name:***

Activase

***Onset:***

Immediate

***Peak:***

45 minutes

***Duration:***

4 hours

***Dosage:***

100 mg IV over 3 hours, given as: 60 mg in the first hour (6-10 mg of which is bolused first over 1-2 minutes) the remaining 40 mg is infused at 20 mg/hr.

### **ANISTREPLASE**

***Trade name:***

Eminase

***Onset:***

Immediate

***Peak:***

45 minutes

***Duration:***

6 hours to 2 days

***Dosage:***

30 units IV over 2 to 5 minutes

### **STREPTOKINASE**

***Trade name:***



Streptase, Kabikinase

***Onset:***

Immediate

***Peak:***

20 minutes to 2 hours

***Duration:***

4 hours

***Dosage:***

140,000 units followed by maintenance infusion. Loading dose is 20,000 units with maintenance infusion of 2,000 IU/min over 1 hour.

**Note: Due to manufacturing process a chance for an allergic reaction is possible**

## **UROKINASE**

***Trade name:***

Abbokinase

***Onset:***

Immediate

***Peak:***

20 minutes to 2 hours

***Duration:***

4 hours

***Dosage:***

6,000 IU/minute is initiated for up to 2 hours. Typical dose is 500,000 IU total.

## **RETEPLASE, RECOMBINANT**

***Trade Name:***

Retavase

***Onset:***

Unknown

***Peak:***

Unknown

***Duration:***

Half life is 13-16 minutes in length

***Dosage:***

Double bolus of 10 U + 10 U each given over 2 minutes. The second bolus is administered in 30 minutes if no untoward effects occur.

Fibrinolytics may be used for other types of medical emergencies that are caused by a thrombus. Recently, the use of fibrinolytics in the setting of an embolic stroke has been performed. Alteplase, streptokinase, and urokinase are approved for use in massive (hypotension) pulmonary emboli. Streptokinase and urokinase may also be used in the treatment of deep venous thrombosis (DVT) and to clear blocked IV catheters.

In the setting of excessive bleeding due to the use of fibrinolytics, there is an antidote available. Aminocaproic acid (Amicar) is given 5 g PO or slow IV followed by a dose of 1.25 g every hour up to a maximum dose of 30 g total in a 24 hour period.

## CONTRAINDICATIONS

### POTENTIAL ABSOLUTE

- Active internal bleeding
- History of CVA, intracranial neoplasm, AVM, or aneurysm
- Recent intracranial or intraspinal injury
- Past or present bleeding disorder
- Uncontrolled hypertension (systolic >180 mm/Hg, diastolic >110 mm/Hg)
- Pregnancy

### POTENTIAL RELATIVE

- Diabetic hemorrhagic retinopathy or other hemorrhagic ophthalmic conditions
- Prolonged CPR (longer than 10 minutes)
- Major surgery at non-compressible site (eg. CABG) within 10 days
- Documented cerebrovascular disease
- Gastrointestinal or genitourinary bleeding within last 7 days
- Significant liver dysfunction
- PHYSICALLY advanced age (>75 years with multiple disease states beyond AMI).
- Patients currently receiving oral anticoagulants
- Previous thrombolytic therapy
- Trauma to the head in the last two weeks
- Any trauma in the last two weeks
- Surgery in the last two weeks

## SIDE EFFECTS

There are numerous side effects which may occur following the administration of fibrinolytic agents. With the exceptions of urticaria (due to an allergic reaction) and the effects of reperfusion, all side effects may be lumped into one category, hemorrhage. Whether it is intracranial, conjunctival, internal, etc., it is bleeding that is the major side effect. Handle these patients very gently to avoid these problems. Specifics of bleeding management will be dealt with in the next section.

## BLEEDING MANAGEMENT

- Avoid IM injections
- Avoid unnecessary handling of patient
- Consider padding the side rails of the stretcher
- Keep venipunctures to an absolute minimum
- For active bleeding venipuncture sites apply direct pressure for at least 15 minutes
- Keep the involved extremity in straight alignment
- Be aware that the bleeding may be internal. Keep a close eye out for hypovolemia

- Aggressively assess the patient for signs and symptoms of internal hemorrhaging every 15 minutes for the first hour and every 30 minutes from hours two to eight of the therapy.
- Avoid placing nasotracheal tubes and nasogastric tubes.

## SEQUENTIAL MANAGEMENT TO BLEEDING PROBLEMS

- Apply manual pressure to bleeding site
- Administer crystalloid volume replacement
- Interrupt anticoagulant therapy
- Interrupt thrombolytic therapy

## ADJUNCTIVE AGENTS

### **NITROGLYCERIN**

#### ***Effects:***

Nitroglycerin acts as a smooth muscle relaxant which serves to decrease myocardial oxygen demand by reducing the preload on the left ventricle. At the same time it increases the myocardial oxygen supply by dilating the coronary vessels. Nitroglycerin acts primarily on the venous side of the systemic circulation, but at high doses does exhibit some arterial effect.

#### ***Dosage:***

IV form is typically initiated at 10-20 mcg/min and titrated to effect

#### ***Contraindications:***

Hypersensitivity to the agent  
Hypotension

#### ***Onset:***

Immediate with IV form

#### ***Side effects:***

Headache  
Orthostatic hypotension  
Tachycardia  
Flushing  
Palpitation  
Nausea/Vomiting

## **LIDOCAINE**

### ***Effects:***

A Class I B antiarrhythmic which affects the fast channel (sodium) during depolarization. This causes a decrease in excitability and conduction, as well as, an increase in the fibrillation threshold (the point at which the heart may begin to fibrillate). Lidocaine works only on the ischemic portions of the heart. In effect, it makes those cells of the heart which are “a little sick” and irritable, very sick to the point where they will not initiate an impulse.

### ***Dose:***

1-1.5 mg/kg IV bolus (maximum of 3 mg/kg), followed by a 4:1 maintenance infusion at 2-4 mg/min.

### ***Contraindications:***

Hypersensitivity to the agent  
Heart blocks  
Sick Sinus Syndrome

### ***Onset:***

Immediate

### ***Side effects:***

Confusion  
Tremor  
Hypotension  
Bradycardia  
Worsened Arrhythmias

## **ASPIRIN**

### ***Effects:***

Blocks prostaglandin formation which in turn leads to a decrease in the synthesis of thromboxane A<sub>2</sub>. Thromboxane A<sub>2</sub> causes platelets to adhere to each other.

### ***Dosage:***

324 mg orally.

### ***Contraindications:***

Known hypersensitivity to the drug  
Bleeding disorders  
Use with caution in patients with a known hypersensitivity to NSAIDS

### ***Onset:***

5-30 minutes after ingestion

***Side effects:***

Tinnitus  
Dizziness  
GI disorders

**MORPHINE SULFATE**

***Effects:***

Morphine has three primary actions which benefits the patient. First, morphine is a venodilator which serves to reduce the workload of the heart. Second, morphine is a central nervous system depressant which will aid in the reduction in the amount of circulating catecholamines (catecholamines will only serve to increase the demand on the already ischemic heart). Finally, it is a potent analgesic which will aid in relaxing and calming the patient.

***Dosage:***

4 mg slow IV push initial dose, titrate to pain relief in 2 mg doses, every 3-5 minutes, 10 mg MAX. If pain is not relieved after 10 mg, call online medical direction (OLMD) for further doses.

***Contraindications:***

Known  
hypersensitivity  
Hypotension

***Onset:***

Less than 5 minutes IV

***Side Effects:***

Respiratory  
Depression  
Hypotension  
Lightheadedness

**OXYGEN**

***Effects:***

Elevates the PaO<sub>2</sub> thereby increasing the amount of oxygen available for the ischemic tissue of the heart

***Dosage:***

American Heart Association recommends beginning with 4 L/min via nasal cannula and increasing the amount of oxygen until the oxygen saturation is greater than 97%.

***Contraindications:***

The problem with COPD patients and hypoxic drive is greatly overestimated. Less than 2% of the COPD patients utilize hypoxic drive. There are no contraindications to the administration of oxygen.

***Onset:***

Immediate

***Side Effects:***

None

# PHARMACOLOGY

## PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain pharmacologic agents in the interfacility transfer environment

## OBJECTIVES

### **COGNITIVE**

- Discuss those pharmacologic agents that are commonly used during interfacility transport
- Discuss the administration, side effects, and transport considerations of those pharmacologic agents commonly used by the individual paramedic's agency

### **PSYCHOMOTOR**

- No psychomotor skills have been identified

### **AFFECTIVE**

- Defend the reasoning behind having a general knowledge of the commonly pharmacologic agents a paramedic may encounter on an interfacility transfer
- Explain the importance of knowing transport considerations, if any, of a particular agent

## Terminology Review

- Class: how a medication is grouped based on its physiologic effect on the body.
- Mechanism Of Action: the physiologic or biochemical process inside the body where a drugs action produces a response.
- Indication: a condition that warrants a medication to be given.
- Contraindication: a condition that renders a medication or treatment improper.
- Side Effects: a typically undesirable effect of a medication.
- Titrate: adjustment of a medication dose based on the desired effects of the drug.
- Half-Life: the time where half the quantity of a drug is metabolized by the body.
- Onset: The time where a drugs effects are first seen.
- Peak: The time where a drugs effects are at their highest.

- Duration: The length of time where a drug's effects are present in the body.
- Elimination: How a medication is excreted from the body (i.e.: liver or kidney)
- Many vasopressors and vasodilators require titration due to the hemodynamic condition of the pt. For example, if a patient is receiving Dopamine at 5mcg/kg/min and the patient's blood pressure has not improved, you can increase, or titrate, the dose to bring up the patient's blood pressure. If the blood pressure is too high, you can decrease, or titrate, the medication dose to get the desired blood pressure. Many vasopressor or vasodilator medication doses will be "titrate to effect". Titration is very important because it requires thorough, continuous monitoring of the patient's vital signs and condition.

## 7 Rights to Medication Administration

- Following these steps prior to medication administration will prevent a medication error.
  - Right Patient
  - Right Drug
  - Right Route
  - Right Dose
  - Right Time
  - Right Frequency
  - Right Documentation

## Beta Blockers

### ***Esmolol***

- Dose: initial dose is 150 mcg/kg/min and titrated to the desired blood pressure and heart rate.
- Mechanism of Action: exerts selective inhibitory effects on beta 1 receptors found in the heart, reducing blood pressure.
- Indications: Aortic Dissection, Hypertension, SVT
- Contraindications: cardiogenic shock, decompensated heart failure, IV administration of calcium channel blockers (i.e. Verapamil), pulmonary hypertension, 2nd or 3rd degree heart block
- Side Effect: hypotension, diaphoresis, weakness, dizziness, vision changes
  - Esmolol is most commonly used for Abdominal and Thoracic Aortic Dissection.

## Calcium Channel Blockers

### ***Nicardipine (Cardene)***

- Dose: start at 2.5mg/hr and titrate up to 15 mg/hr max dose. Increase dose by 2.5 mg/hr every 15 minutes.
- Mechanism of Action: Calcium channel blocker that inhibits the influx of calcium ions into the myocardium and coronary vessels. This relaxes blood vessels, lowering blood pressure.
- Indications: Hypertension, SAH, CVA
- Contraindication: Hypotension, Aortic Stenosis
- Side Effects: chest discomfort, diaphoresis, nausea, edema, tremors

- Cardene works especially well in reducing the blood pressure in subarachnoid hemorrhage and hemorrhagic stroke.

### ***Diltiazem (Cardizem)***

- Dose: 5mg/hr titrated up to 15mg/hr max dose. Increase by 5 mg/hr.
- Mechanism of Action: blocks calcium influx into cardiac and smooth muscle, slowing cardiac conduction to the AV node reducing thereby reducing cardiac workload
- Indications: A-fib or A-flutter with RVR, hypertension, PSVT, stable angina
- Contraindication: administration of IV beta-blockers, cardiogenic shock, WPW, V-tach, hypotension
- Side Effects: dizziness, weakness, headache, hypotension

## Antidysrhythmic Medications

### ***Lidocaine***

- Dose: 1-4 mg/min
- Mechanism of Action: decreases automaticity, depolarization, and excitability by decreasing the influx of sodium ions during the diastolic phase.
- Onset: Immediate
- Indications: ventricular fibrillation or ventricular tachycardia without a pulse, ventricular tachycardia with a pulse (stable), Multifocal PVC's
- Contraindications: 2nd or 3rd degree heart block
- Side Effects: flushing of the skin, warm skin, itching, nausea, vomiting
  - Lidocaine is a class IB antiarrhythmic and sodium channel blocker. Do not administer Amiodarone and Lidocaine at the same time. Use one or the other. Amiodarone is a potassium channel blocker.

### ***Amiodarone***

- Dose: 0.5 mg/min
- Mechanism of Action: prolongs cardiac action potential and blocks myocardial potassium channels resulting in delayed conduction and a prolonged refractory time.
- Indications: V-fib or V-tach without a pulse, Stable v-tach
- Contraindications: hypotension, bradycardia, cardiogenic shock, 2nd or 3rd degree heart block
- Side Effect: dizziness, nausea, weakness or numbness to arms or legs, light sensitivity, cough
  - Amiodarone is a class III antiarrhythmic potassium channel blocker. Do not give with Lidocaine. This could cause cardiac arrest.

## Nitrates

### ***Sodium Nitroprusside (Nipride)***

- Dose: 0.3-10 mcg mcg/kg/min; 10 mcg/kg/min is MAX dose
- Mechanism of Action: relaxes smooth muscles of blood vessels and consequently dilates peripheral arteries and veins.
- Route: IV
- Indications: Hypertension, acute CHF, pulmonary hypertension



- Contraindications: hypotension
- Side Effects: hypotension, tachycardia, bradycardia, dizziness, tremors.
- Precautions: Prolonged administration can lead to cyanide toxicity or thiocyanate. Symptoms include: nausea, confusion, and tinnitus (ringing in the ears).

### ***Nitroglycerin***

- Dose: 5-300 mcg/min; start at 5mcg/min and titrate every 3-5 minutes to desired blood pressure or a reduction in chest pain associated with angina or an myocardial infarction.
- Mechanism of Action: causes arterial and venous vasodilation, and helps to decrease preload, reduce pulmonary congestion, and decrease cardiac workload and oxygen consumption.
- Route: IV
- Indications: Chest pain, hypertension
- Contraindications: hypotension, inferior wall MI, shock, cardiac tamponade, severe anemia
- Side Effects: flushing, headache, weakness, hypotension, nausea, vomiting

## Natriuretic Peptides

### ***Nesiritide (Natreacor)***

- Dose: 0.01 mcg/kg/min
- Mechanism of Action: increases available cGMP in turn relaxing vascular smooth muscle.
- Indications: acute CHF
- Contraindications: hypotension, cardiogenic shock, systolic BP less than 100 mmHg.
- Side Effects: hypotension, weakness, nausea, dizziness
- Precautions: stop or discontinue if pt has a systolic BP less than 100 mmHg.
  - Natreacor is a recombinant human B-type natriuretic peptide. cGMP is messenger to dilate veins and arteries. Human BNP increases intracellular cGMP.

## Sympathomimetic Agents / Vasopressors

### ***Dopamine (Inotropin)***

- Dose: 2-20 mcg/kg/min; titrate to effect.
- Mechanism of Action: Dopamine is a neurotransmitter that stimulates alpha and beta receptors thereby increasing heart rate and blood pressure.
- Indications: hemodynamically significant hypotension
- Contraindications: pheochromocytoma, hypertension, tachyarrhythmias
- Side Effects: ventricular ectopy, hypertension, nausea, vomiting, oliguria
  - A pheochromocytoma is a tumor on the adrenal glands. It can release a large amount of catecholamines into the bloodstream that can lead to life threatening hypertension. Oliguria is decreased urine output. This can occur with Dopamine administration due to vasoconstriction of renal blood vessels.

### ***Dobutamine (Dobutrex)***

- Dose: 2-20 mcg/kg/min
- Mechanism of Action: synthetic catecholamine that produces an inotropic effect on the heart.

- Indications: decreased cardiac output, heart failure
- Contraindications: hypersensitivity to corn or corn products, subaortic stenosis
- Side Effects: chest pain, hypertension, tachyarrhythmia, headache
  - Dobutamine is very helpful in pt's who have heart failure because it helps the contraction of the heart, not the rate.
  - Inotropic: refers to the squeeze of the heart
  - Chronotropic: refers to heart rate (think of a chronograph, and that is where chronotropic is derived).

### ***Epinephrine***

- Dose: 2-10 mcg/kg/min; 10 mcg/kg/min is MAX dose
- Mechanism of Action: catecholamine produced by the adrenal glands that exerts it's effect on the alpha and beta receptors of the hearts and blood vessels, increasing blood pressure and heart rate, and relaxing bronchial smooth muscle.
- Indications: hypotension, septic shock
- Contraindications: hypertension, ischemic heart disease, tachycardia
- Side Effects: palpitations, tremors, headache, dizziness

### ***Norepinephrine (Levophed)***

- Dose: 2-30 mcg/kg/min; titrate to effect
- Mechanism of Action: similar to epinephrine, norepinephrine is a catecholamine that stimulates alpha and beta receptors increasing heart rate and blood pressure, but not relaxing bronchial smooth muscle.
- Indications: septic shock, hypotension
- Contraindications: hypotension due to hypovolemia, hypovolemic shock, hypertension
- Side Effects: hypertension, nausea, vomiting, tremors, extravasation at IV site
  - If possible, give Levophed through a central line.

### ***Phenylephrine (Neo-Synephrine)***

- Dose: 10-100 mcg/min; titrate to MAX dose of 100 mcg/min
- Mechanism of Action: synthetic sympathomimetic agent that exerts its effect on the alpha receptors of the heart with minimal effect on the beta receptors. It exerts moderately extended vasoconstriction, and increases heart rate.
- Indications: hypotension, neurogenic shock
- Contraindications: v-tach, narrow angle glaucoma, hypertension
- Side Effects: reflex bradycardia, chest pain, decreased cardiac output, cardiac dysrhythmia's

### ***Vasopressin (Pitressin)***

- Dose: 0.01-0.04 units/min with a MAX dose of 0.2 units/min; titrate to effect
- Mechanism of Action: vasopressin directly stimulates V1 receptors in the vascular smooth muscle, resulting in vasoconstriction of capillaries and small arterioles.
- Indications: hypotension, shock

- Contraindications: hypertension
- Side Effects: brady or tachy arrhythmias, right heart failure, pulmonary edema, limb ischemia

## Anticoagulants

### **Heparin**

- Dose: 12units/kg/hr; MAX dose is 1000 units/hr
- Mechanism of Action: prevents conversion of prothrombin to thrombin, and fibrin to fibrinogen. This inhibits the mechanisms that lead to the formation of blood clots.
- Indications: DIC, PE, A-fib, ACS, DVT
- Contraindications: pregnant or nursing women, thrombocytopenia, uncontrolled active bleeding except when due to DIC, neonates and infants
- Side Effects: bleeding, heparin induced thrombocytopenia

## Glycoprotein IIb/IIIa Inhibitors

### **Eptifibatide (Integrillin)**

- Dose: 180mcg/kg bolus dose followed by a 2 mcg/kg/min
- Mechanism of Action: prevents the aggregation of platelets by reversibly binding to the platelet receptor GP IIb/IIIa. This prevents the binding of fibrinogen, von Williebrand factor, and other binding agents.
- Indications: ACS
- Contraindications: abnormal bleeding, hypertension, renal dialysis, hemorrhagic stroke, major surgery within the previous 6 weeks
- Side Effects: hypotension, hemorrhage, thrombocytopenia, cerebral hemorrhage
  - Dose is commonly seen in interfacility transports of pt's who are suffering from ACS. Bolus doses normally given by hospital staff prior to the pt being transferred to another facility.
  - ACS – Acute Coronary Syndrome

### **Tirofiban (Aggrastat)**

- Dose: Initial bolus of 25 mcg/kg, then a maintenance infusion of 0.15mcg/kg/min
- Mechanism of Action: inhibits aggregation of platelets by reversibly antagonizing fibrinogen binding to the GP IIb/IIIa receptor.
- Indications: ACS, NSTEMI, Ischemic CVA
- Contraindications: bleeding, thrombocytopenia
- Side Effects: coronary artery dissection, bleeding, bradyarrhythmia

## Sedatives

- Many sedatives belong to a different class of drug. The most common sedatives seen in the critical care interfacility transport are listed below. The class for each medication has been included with the medication information, as the medications are clumped into one section.

### Things To Consider

- Many sedatives can cause a substantial drop in blood pressure. Closely monitor the patient's vital signs as you titrate the sedation of the medication based on the clinical presentation.
- Many patients who are intubated require continuous sedation and even intermittent pain management.
- Patients who are intubated and under-sedated can self extubate themselves.
- Monitor vital signs very closely.
  
- Some signs and symptoms of under-sedation include:
  - Restlessness
  - Agitation
  - Biting the ETT
  - Tachycardia
  - Elevated blood pressure
  - Movement of the eyelids, tongue, fingers, hands, or arms.
    - Administer a fluid bolus if the patient becomes hypotensive and is receiving sedation.
  - A decreased blood pressure could be a result of an antihypertensive medication along with a sedative.
  - Sedative medications do not treat pain. Treat pain per protocol.
  - Consult the sending physician or OLMD for guidance.

### ***Diprivan (Propofol)***

- Dose: 5-50 mcg/kg/min
- Class: Sedative - Hypnotic
- Mechanism of Action: Propofol crosses the blood-brain barrier, slowing cerebral metabolism, and leading to sedation. Exact mechanism is unknown.
- Onset: 1-2 minutes
- Duration: 5-10 minutes
- Indications: sedation for a mechanically ventilated patient
- Contraindications: allergy to eggs or egg products, hypersensitivity to Propofol.
- Side Effects: hypotension, respiratory depression, apnea
- Special Consideration: Give Propofol through a dedicated IV with no other medications infusing. Can cause profound hypotension. Use with caution.

### ***Midazolam (Versed)***

- Dose:
  - Adult: 2-5 mg bolus dose every 3-5 min; 0.02 to 0.1 mg/kg/hr continuous dose
  - Pediatric: 0.05-0.1 mg/kg
- Class: Benzodiazepine
- Mechanism of Action: CNS depressant that binds with GABA receptors in the CNS which exhibit sedative, amnesic, and hypnotic effects.
- Onset: 2-5 minutes after administration
- Duration: 30-45 minutes
- Indications: sedation for mechanically intubated patients
- Contraindications: hypotension
- Side Effects: hypotension, respiratory depression
- Consider lower doses in pediatric, elderly, and chronically ill patients.

### ***Ketamine (Ketalar)***

- Dose: 0.5-1 mg/kg IV every 10 minutes as necessary
- Class: Anesthetic Adjunct
- Mechanism of Action: blocks NMDA receptors leading to sedation and amnesia
- Onset: 30 seconds to 1 minute
- Duration: 5-10 minutes
- Indications: sedation for mechanically intubated patients, induce sedation for RSI procedure
- Contraindications: hypertension (SBP >180), closed head injury
- Side Effects: hypertension, tachycardia, respiratory depression
- Special Considerations: Give medication slowly over 1-2 minutes to prevent laryngospasm. Can lead to increased intracranial pressure in patients with a closed head injury to intracranial hemorrhage.

### ***Lorazepam (Ativan)***

- Dose:
  - Adult: 1-2 mg bolus dose; 0.05-0.1 mg/kg/hr continuous infusion.
  - Pediatric: 0.05-0.1 mg/kg
- Class: Benzodiazepine
- Mechanism of Action: binds with the GABA-benzodiazepine receptor complex exerting tranquilizing action on the CNS.
- Onset: 2-5 minutes after administration
- Duration: 15-20 minutes
- Indications: status epilepticus, anxiety, sedation of mechanically ventilated patients.
- Contraindications: narrow-angle glaucoma, respiratory depression (unless the patient is intubated)
- Side Effects: hypotension, respiratory depression
- Special Considerations: If giving an IV bolus dose, dilute the medication with 10ml of NS prior to administration.

### ***Etomidate (Amidate)***

- Dose: 0.3 mg/kg
- Class: Anesthetic
- Mechanism of Action: short acting hypnotic. Produces GABA like effects, and reduces subcortical inhibition.
- Onset: 30 seconds – 1 minute
- Duration: 3-5 minutes
- Indications: Induction of sedation for RSI
- Contraindications: sepsis, adrenal insufficiency
- Side Effects: nausea, vomiting, pain at injection site

## Opiates

### ***Fentanyl (Sublimaze)***

- Dose: 0.5-1mcg/kg slow IV
- Mechanism of Action: narcotic agonist-analgesic of opiate receptors. Inhibits ascending pain pathways, thus altering response to pain.
- Onset: 2-3 minutes
- Duration: 30-60 minutes
- Indications: pain management
- Contraindications: hypersensitivity to Fentanyl
- Side Effects: dyspnea, nausea, vomiting
- Special Considerations: Give slow IVP to prevent rigid chest syndrome. Can cause respiratory depression and apnea.

## Rapid Sequence Intubation Medication Overview

### Rapid Sequence Intubation

- RSI is the administration, after proper preoxygenation, of a potent induction agent followed immediately by a rapidly acting neuromuscular blocking agent (NMBA) to induce unconsciousness and motor paralysis for tracheal intubation.
- RSI is done with the assumption that the pt's stomach is full, and that aspiration is imminent.
- The preoxygenation phase is done prior to drug administration, and permits a period of apnea safely between the administration of drugs and intubation of the trachea.
- \*\*\* Do not attempt RSI using sedatives only (i.e. Valium, Morphine, or Versed) as studies have proven that sedatives only does not facilitate first pass intubation success. You MUST use a paralytic. By using a sedative only to facilitate intubation, the risk for vomiting and aspiration is dramatically increased. This poses a risk for a decline in the pt's already critical condition. You must use a paralytic for RSI intubation.

## RSI Medications

### Induction Agents (Sedatives):

- Etomidate
- See above medication overview
- Ketamine
- See above medication overview
- Paralytics:
- Succinylcholine
- Rocuronium

### **Succinylcholine (Anectine)**

- Dose: 1.5-2 mg/kg
- Class: Depolarizing Neuromuscular Blocking Agent (NMBA)
- Mechanism of Action: The onset, activity, and duration depend on rapid hydrolysis by pseudocholinesterase (PCHE), an enzyme of the liver and plasma that is not present at the neuromuscular junction. Succinylcholine depolarization manifests as fasciculations, but this is followed rapidly by complete motor paralysis.
- Onset: 45 seconds
- Duration: 5-10 minutes
- Indication: Induce paralysis for RSI
- Special Considerations:
- Only use for induction only.
- Multiple contraindications for this medication. See next slide.

### Succinylcholine Contraindications

- Known or suspected hyperkalemia (watch your P waves)
- Severe crush or traumatic injuries > 2 days old
- Spinal cord injuries > 2 days old
- Burn injuries > 24 hours old
- Renal Failure
- Pseudocholinesterase deficiencies
- Hx of malignant hyperthermia
- Neuromuscular disorders such as Muscular Dystrophy
- Penetrating Eye Injuries

### **Rocuronium (Zemuron)**

- Dose: 1mg/kg
- Class: Non-depolarizing Neuromuscular Blockers
- Mechanism of Action: Competes with, and blocks the action of ACH at the motor end plate postjunctional cholinergic nicotinic receptors.
- Onset: 60 seconds
- Duration: 40-60 min
- Indications: Induction of paralysis, and for continued paralysis
- Contraindication: known anaphylaxis
- Special Considerations: May be used as the primary drug of choice for RSI when Succinylcholine is contraindicated.

# GLOSSARY

**Adenosine Diphosphate:**

Produced by the splitting of adenosine triphosphate after a cell performs work. Example, after a muscle contraction.

**Adrenal Insufficiency:**

Adrenal glands of the body fail to produce sufficient hormones. If the disease is chronic it is known as Addison's disease. The symptoms are sluggishness, weakness, etc.

**Agonist:**

Any agent which causes or promotes an effect. Example, adrenaline is a beta agonist in that it causes the beta receptors to become stimulated.

**Albumins:**

Simple proteins found in the body.

**Alopecia:**

Hair loss

**Amino Acids:**

Building blocks of protein. May be broken down into essential amino acids (those not produced in the body) and nonessential amino acids (those which are produced in the human body).

**Angiotensin:**

A vasopressor which is found in the body. It may be divided into its inactive form (Angiotensin I) which when exposed to its conversion enzyme is quickly transformed into its two active forms (Angiotensin II & III). The active form is a potent arteriolar vasoconstrictor and has the additional effect of increasing the patient's thirst.

**Antagonist:**

Any pharmacologic agent which inhibits a bodily function or inhibits another drug. Example, Narcan is a narcotic antagonist.

**Aplastic Anemia:**

Reduction in red blood cell production due to bone marrow disorders.

**Benign Prostatic Hypertrophy:**

An enlargement of the prostate gland not due to cancer that occurs in males over the age of 50.



**Blebs:**

An elevation or blister on the surface of the lung.

**Catalyst:**

Any substance which speeds up or accelerates a chemical reaction without itself becoming permanently altered.

**Catecholamines:**

Classified as amines, they are a group of chemicals (epinephrine, norepinephrine and dopamine) that have a marked effect on the physiology of a person's heart, nervous system and smooth muscle.

**Central Nervous System:**

The brain and the spinal cord, which controls voluntary and involuntary actions.

**Chronotrope:**

Any agent which increases the heart rate.

**Coenzyme:**

A substance when combined with an inactive form of a protein forms an active enzyme.

**Colloid:**

A large protein or starch molecule.

**Cortex:**

May refer to the outer layer of an organ with reference to its inner medulla. May refer to the outer layer of the brain.

**Cross Linking:**

When bonds of the DNA strand have been formed into groups that will not replicate effectively shutting down DNA synthesis.

**Crystalloid:**

A substance which can be diffused through a cell membrane. Additionally, when removed from its solution, has the ability to become crystalline in shape.

**Cyclic AMP:**

Acts as a "second messenger" after the initial hormonal release. As an example, when epinephrine acts on the liver to increase the liberation of glucose, cAMP, acts on an enzyme which releases even more glucose. The net effect is to amplify what the first action was. This amplification effect can be found in several different reactions, such as the lungs, etc.

**Diabetic Hemorrhagic Retinopathy:**

A progressive degenerative bleeding condition of the eye.

**DNA Gyrase:**

Enzyme required for synthesization of DNA.

**Dromotrope:**

An agent that affects the SA and/or the AV node of the heart.

**Electrolyte:**

An ionized salt found in the blood, tissue, and cells that dissociates when an electrical current is applied.

**Endothelial:**

Inner lining of a cell that is adjacent to the lumen.

**Enteral:**

“By way of the intestines”.

**Enzyme:**

Proteins which act as catalysts for physiologic reactions.

**Extrapyramidal Reactions:**

Extrapyramidal reactions are involuntary movements or tremors caused by a degenerative disease process of the basal ganglia and the extrapyramidal tracts of the brain (e.g. Parkinson's disease)

**Fast Channel:**

The movement of  $\text{Na}^+$  into the cell to initiate depolarization.

**Fibrin:**

A protein which forms a web in which to trap and hold the ingredients for a clot. Fibrin is the product of the enzyme thrombin on fibrinogen in the clotting cascade.

**Fibrinogen:**

An inactive protein which when combined with thrombin and  $\text{Ca}^{++}$  yields fibrin.

**Folic Acid:**

A member of the vitamin B family.

**Fractional Inspired Oxygen:**

The amount of oxygen in inspired air.

**GABA:**

Gamma-amino butyric acid. A potent synaptic inhibitor.

**Glaucoma:**

Increased intraocular pressure which progresses towards blindness.

**Globulins:**

A simple protein found in the serum of the body.

**Glycoprotein:**

A structure made up of both protein and carbohydrates.

**Gram Positive Bacteria:**

Refers to a method of staining bacteria in order to better classify them. Invented by Hans Gram in the 1800's, a gram positive organism will "soak up" the violet colored stain.

**Gram Negative Bacteria:**

As above with the exception that this bacteria will turn the color of the counter stain, red.

**Hemolytic:**

A process that refers to the destruction of red blood cells.

**Histamines:**

Produced from the amino acid histidine; this substance is located in mast cells in the body. When released they cause vasodilatation and an increase in capillary permeability which leads to edema.

**Hyperuricemia:**

Increase in uric acid levels in the blood. May lead to gout.

**Inotrope:**

An agent which affects the force of contraction of the heart.

**Kinins:**

A group of polypeptides which exerts numerous effects on the body.

**Leukocyte Lysosomal Membrane:**

Outer lining of a structure which resides within the cell. Lysosomes acts as scavengers within the cell.

**Malignant Hyperthermia:**

Severe form of temperature elevation (in excess of 106 degrees F) that is associated with a 70% mortality rate if left untreated. It is caused by an inherited genetic trait and is usually precipitated by inhalation anesthesia or muscle relaxants.

**Mast Cells:**

Cells which contain both heparin and histamine

**MCL<sub>1</sub>:**

Modified Chest Lead. Closely approximates lead V<sub>1</sub> (twelve lead ECG) with a standard three lead monitor. It is obtained by leaving the white and black electrodes in their respective places (white, right shoulder and black, the left shoulder) and moving the red electrode (left leg) to the fourth intercostal space just to the right of the sternum. The lead select switch is then placed in lead III. The presence of a bundle branch block (and which type) may be noted among various other conditions.

**Meatus:**

Opening

**Medulla:**

Either refers to the inner portion of an organ or the medulla oblongata of the brain.

**Multiple Sclerosis:**

An autoimmune disease in which white blood cells attack and destroy the outer covering (myelin) of the nerves. Characterized by weakness and/or numbness in the extremities.

**Myasthenia Gravis:**

A disease characterized by extreme muscular weakness which is relieved with rest. The disease is caused by either a deficiency of acetylcholine or an excess of cholinesterase production.

**Mycoplasma:**

Classification of bacteria in which the majority have no cell walls.

**Narcolepsy:**

Patient cannot control bouts of drowsiness or sleepiness.

**Osmolality:**

Osmotic concentration.

**Osmolarity:**

Concentration of osmotically active particle in a given amount of solution.

**Osmotic Gradient:**

Can best be described as a hill. The steeper the hill, the faster the movement down the hill. The more solutes with which to create osmosis behind a membrane, the faster the movement of the solvent towards the solutes.

**Parenteral:**

Any route other than the normal digestive tract.

**Parietal Pleura:**

Pertains to the outer covering of the lung; closest to the chest wall.

**Parkinson's Disease:**

See extrapyramidal reactions.

**Penduloft Effect:**

Pertaining to ventilation. If one slows down the force of the air movement, more time is allowed for partially blocked airways to become perfused. If air is forced into the lungs, the areas distal to the partial blockage will not receive the air.

**Plasmin:**

Enzyme which destroys fibrin. It is produced in response to the activation of plasminogen.

**Plasminogen:**

Inactive form of plasmin that helps to destroy clots.

**Positive End Expiratory Pressure:**

Method used to help “splint” the alveoli open.

**Preload:**

Also known as the end diastolic pressure. It is the amount of blood returning back to the heart into the right atrium.

**Prinzmetal’s Angina:**

Also known as variant angina. It is caused by coronary artery spasms. Unlike other ischemic episodes of the heart which show T wave depression, Prinzmetal’s will exhibit T wave elevation.

**Prostaglandins:**

Fatty acids which have an extremely varied range of effects.

**Prothrombin:**

The inactive form of thrombin. When combined with  $Ca^{++}$  yields thrombin.

**PT:**

Prothrombin time is a test to measure the effectiveness of oral (coumadin) therapy in increasing clotting times. It is achieved by adding thromboplastin and  $Ca^{++}$  to decalcified blood. An increase in time indicates adequate therapy.

**PTT:**

Partial Thromboplastin Time is a test to help indicate adequate heparin levels.

**Rheumatic Fever:**

Systemic disease which may follow a “strep” A infection. May lead to either cardiac or renal problems.

**Rickettsia:**

A classification of organisms that lie somewhere between bacteria and viruses.

**Right Ventricular Infarction Syndrome:**

Hypotension due to the administration of an agent which will reduce the preload on the heart such as nitroglycerin and/or morphine. Clues for the presence of a right ventricular infarction are JVD, hepatomegaly, and an inferior pattern of MI on the 12 lead ECG.

**Serotonins:**

A potent vasoconstrictor which plays a large part in the nervous system.

**Slow Channel:**

Pertains to the influx of  $Ca^{++}$  which occurs at a much slower rate than that of  $Na^{+}$  in the depolarization of cells.

**Somogyi Phenomenon:**

The diabetic patient experiences a bout of hyperglycemia following an occurrence of hypoglycemia due to the stimulation of regulatory hormones.

**Thalamus:**

A division of the diencephalon of the brain, it receives all sensory inputs.

**Thrombin:**

An enzyme that occurs from prothrombin that reacts with fibrinogen to release fibrin in the clotting cascade.

**Thrombolytic:**

Any agent which breaks down a thrombus.

**Thrombopoietin:**

Relates to the production of platelets.

**Tonicity:**

The amount of solutes in a solution when compared with another solution.

**Tracheal Stenosis:**

Narrowing of the trachea due to decreased perfusion caused by an over-inflated ET tube cuff.

**Tracheal Malacia:**

The destruction of blood vessels and nerves due to unnecessarily high pressures in the ET tube cuff.

**Tunica Intima:**

Inner most lining of a blood vessel.

**Visceral Pleura:**

The outer surface of the lung itself.

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# Appendix A

## RESPIRATORY AGENTS

*Respiratory problems usually present with one (or more) of three different modalities, an increase in bronchiole constriction, increase in mucus production and edema of the airways. This classification of drugs may be broken down into these three primary pathologies. First, drugs which affect the smooth musculature of the bronchioles, bronchodilators. Second, those drugs which act in some way on the patient's secretions (antitussive, expectorant, or mucolytic). Third, agents which reduce the inflammation of the airways. Finally, agents which control the response of allergic reactions.*

### **BRONCHODILATORS AND STEROIDS**

#### **ADRENERGIC AGONISTS**

- Mechanism:** Causes bronchodilation due to stimulating production of cAMP
- Indication:** Bronchospasms
- Examples:** Albuterol, Salmeterol, Epinephrine, Isoetharine, Ephedrine Sulfate, Terbutaline
- Side effects:** Anxiety, tremor, nervousness, palpitations, tachycardia

#### **METHYLXANTHINES**

- Mechanism:** Inhibits breakdown of cAMP
- Indications:** Bronchospasm
- Examples:** Slo-bid, Theophylline, Aminophylline
- Side Effects:** as above

#### **ANTI-INFLAMMATORY**

- Mechanism:** Inhibits the release of kinins, serotonin, and histamines that precipitate inflammation that leads to bronchoconstriction due to edema.
- Indications:** Bronchoconstriction due to edema
- Examples:** Beclomethasone, Cromolyn sodium, Dexamethasone, Flunisolide
- Side effects:** If used as an inhaler, irritation to the mouth and throat

### **MUCOLYTICS AND COUGH SUPPRESSANTS**

#### **ANTITUSSIVES**

- Mechanism:** Depress cough reflex located in the medulla

**Indications:** Nonproductive cough  
**Examples:** Codeine phosphate, Benzonatate, Dexamethorphan  
**Side effects:** Drowsiness, dizziness

### **EXPECTORANT**

**Mechanism:** Decreases the thickness of secretions by increasing the amount of fluid in the respiratory tract.

**Indications:** Upper Respiratory Infections

**Examples:** Guaifenesin

**Side Effects:** Vomiting, Diarrhea, Drowsiness

### **MUCOLYTIC**

**Mechanism:** Decreases the thickness of secretions by dissolving the glycoprotein bonds in the mucus.

**Indications:** Abnormally thick secretions, Acetaminophen overdose

**Examples:** Acetylcysteine

**Side Effects:** Nausea and Vomiting, Severe rhinorrhea

### **ANTIHISTAMINES**

**Mechanism:** Blocks the release of histamine from the mast cells

**Indications:** Edema due to an allergic reaction

**Examples:** Diphenhydramine

**Side effects:** Drowsiness, Tachycardia

### **COMMONLY TRANSPORTED RESPIRATORY PHARMACOLOGIC AGENTS**

*This section is left blank for the services medical director or training officer to review those agents which are commonly used for transport. Topics which should be covered include dosages, indications, side effects, and any transport considerations.*

# CARDIOVASCULAR AGENTS

## INOTROPES

Inotropic agents affect, in some manner, the force of the contraction that the heart produces. The inotropic agents listed below do not act on the adrenergic system; they rely instead on alternate pathways.

- Mechanism:** Increases cellular levels of cAMP
- Indications:** CHF
- Examples:** Amrinone lactate, milrinone lactate
- Side Effects:** Arrhythmias, Nausea and vomiting, abdominal pain, and Thrombocytopenia

## CARDIAC GLYCOSIDES

This group of pharmacologic agents, more commonly known as digitalis, is derived from the plant purple foxglove. It is one of the oldest known medications that is currently in use today. This drug is a positive inotrope, as above, however, it also exerts a negative dromotropic (slows conduction through the nodes) effect on the AV node. This makes this drug an excellent choice for tachyarrhythmias such as atrial fibrillation with a rapid ventricular response.

- Mechanism:** Inhibits the  $\text{Na}^+ - \text{K}^+$  pump which affects the  $\text{Na}^+ - \text{Ca}^{++}$  exchanger. Net result is that more  $\text{Ca}^{++}$  is left in the cell. The more  $\text{Ca}^{++}$  in the myocardial cell results in a greater force of contraction. It also has the additional effect of enhancing vagal tone which decreases the activity of the SA and AV node.
- Indications:** PSVT, Atrial fibrillation, Atrial flutter, CHF
- Examples:** Digoxin, Digitoxin
- Side effects:** Fatigue, Weakness, Nausea and vomiting, yellowed blurred vision around points of light, arrhythmias

## COMMONLY TRANSPORTED CARDIOVASCULAR PHARMACOLOGIC AGENTS

This section is left blank for the services medical director or training officer to review those agents which are commonly used for transport. Topics which should be covered include dosages, indications, side effects, and any transport considerations.

## ANTIARRHYTHMICS

In 1969, the Vaughn-Williams classification system of antiarrhythmics was introduced. This gave clinicians the proper groupings of pharmacologic agents with respect to their specific actions in combating arrhythmias. With the exception of adenosine, all antiarrhythmics may be grouped into one of these four categories.

## CLASS I

**Mechanism:** Affects the Na<sup>+</sup> channel (fast channel) thereby altering depolarization and/or repolarization. Class I agents may be further divided into Class IA, IB, IC.

**Indications:** Life threatening ventricular arrhythmias

**Examples:** IA: Procainamide IB: Lidocaine IC: Flecainide

**Side effects:** Hypotension, CHF, Seizures, Arrhythmias

## CLASS II

**Mechanism:** Prolongs the refractory period while simultaneously reducing the actions of the SA and AV node. These drugs are also referred to as Beta blockers due to their beta antagonistic actions.

**Indications:** Sinus and atrial tachycardia, atrial fibrillation and atrial flutter

**Examples:** Propranolol, Esmolol, Acebutolol

**Side effects:** CHF, dizziness, heart blocks, bronchospasms

## CLASS III

**Mechanism:** Increases both the action potential and the refractory period

**Indications:** Life threatening ventricular arrhythmias

**Examples:** Bretylium, Amiodarone, Sotalol

**Side effects:** Hypotension, Nausea and Vomiting, Bradycardia

## CLASS IV

**Mechanism:** Blocks the calcium channel which decreases conduction through the AV node. Also dilates coronary arteries.

**Indications:** SVT, Atrial fibrillation and atrial flutter with rapid ventricular response

**Examples:** Verapamil, Diltiazem

**Side effects:** Hypotension, Use with caution in the setting of left ventricular failure, Bradycardia, dizziness

## ADENOSINE

**Mechanism:** Naturally occurring nucleoside which depresses AV node activity.

**Indications:** SVT

**Example:** Adenosine

**Side effects:** Palpitations, chest pain, facial flushing, bronchospasms

## **COMMONLY TRANSPORTED ANTI-ARRHYTHMIC PHARMACOLOGIC AGENTS**

*This section is left blank for the services medical director or training officer to review those agents which are commonly used for transport. Topics which should be covered include dosages, indications, side effects, and any transport considerations.*

## **ANTI-ANGINALS**

*Amyl nitrate was the mainstay treatment of anginal pain prior to the discovery of nitroglycerin. Today's treatment centers around dilation of the coronary vessels by causing relaxation of the smooth muscle that surround the arteries. Beta blockers, particularly those that are beta<sub>1</sub> specific, also aid in reducing anginal pain by reducing the amount of work on the heart.*

### **CALCIUM CHANNEL BLOCKERS**

**Mechanism:** Dilates coronary arteries as well as inhibiting calcium influx into smooth muscle cells.

**Indications:** Stable and unstable angina, Prinzmetal's angina

**Examples:** Nifedipine, Verapamil, Diltiazem, Bepridil

**Side effects:** Headache, hypotension, nausea and vomiting

### **NITRATES**

**Mechanism:** Causes smooth muscle relaxation which reduces the preload and/or afterload on the heart. Net effect is to increase the oxygen supply while at the same time, reducing the demand.

**Indications:** Angina

**Examples:** Isosorbide dinitrate, Nitroglycerin, Nitrostat

**Side effects:** Headache, dizziness, orthostatic hypotension, nausea and vomiting

### **BETA BLOCKERS**

**Mechanism:** Reduces the oxygen demand on the system by blocking the effects of catecholamines on the beta receptor sites. Some agents are more beta<sub>1</sub> specific (metoprolol) than others (propranolol).

**Indications:** Angina

**Examples:** Atenolol, Metoprolol, Nadolol, Propranolol

**Side effects:** Bradycardia, Hypotension, CHF, Bronchospasms

# COMMONLY TRANSPORTED ANTI-ANGINAL PHARMACOLOGIC AGENTS

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## ANTI-HYPERTENSIVES

*At present, there are four primary methods for decreasing the blood pressure in an individual. First, a reduction in the tone of the arterioles produces vasodilatation. This is accomplished in several different ways from directly acting on the alpha<sub>2</sub> receptor sites to preventing angiotensin from being converted into its active form angiotensin II. Second, the patient may be placed on a calcium channel blocker which acts in two ways, reducing the contractile force of the heart and promoting vasodilatation. Third, a beta blocker may be prescribed which will decrease the force of contractions, but depending on whether it is heart beta specific (beta<sub>1</sub> versus beta<sub>2</sub>) the medication may not promote vasodilatation. Finally, if the patient has an excess fluid volume the use of a diuretic will aid in its reduction.*

### **CENTRAL ACTING ADRENERGIC INHIBITORS**

***Mechanism:*** Activates alpha<sub>2</sub> receptors to reduce vasoconstriction

***Indications:*** Hypertension

***Examples:*** Clonidine, Methyldopa, Guanabenz

***Side effects:*** Depression, drowsiness, edema

### **PERIPHERALLY ACTING ADRENERGIC INHIBITORS**

***Mechanism:*** Decreases vasoconstriction caused by norepinephrine at the nerve endings

***Indications:*** Hypertension

***Examples:*** Doxazosin, Prazolin, Reserpine, Terazosin

***Side effects:*** As above

### **BETA BLOCKERS**

***Mechanism:*** Prevents beta stimulation by displacing the catecholamines from the receptor sites.

***Indications:*** Hypertension

***Examples:*** Acebutolol, Atenolol, Betaxolol, Labetolol, Propranolol

***Side effects:*** Bradycardia, Hypotension, heart blocks, CHF

### **ANGIOTENSIN CONVERTING ENZYME (ACE) INHIBITORS**

***Mechanism:*** Prevents the inactive form of angiotensin from being converted into its active form angiotensin II. Angiotensin II causes vasoconstriction.

- Indications:** Hypertension
- Examples:** Benazepril, Enalapril, Lisinopril
- Side effects:** Dizziness, Fainting, Tachycardia

### **CALCIUM CHANNEL BLOCKERS**

- Mechanism:** Reduces the available amount of calcium ions which promotes vasodilatation and a reduction in contractility.
- Indications:** Hypertension
- Examples:** Amlodipine, Diltiazem, Nicardipine, Nifedipine, Verapamil
- Side effects:** Heart blocks, Dizziness, Headache, Edema, Nausea

### **DIURETICS**

- Mechanism:** Prevents sodium re-absorption in the tubules of the kidneys, thereby increasing urinary output (“water follows sodium”). This in turn reduces the circulating volume leading to a reduction in the cardiac output. Diuretics are sometimes combined with centrally and peripherally acting adrenergic inhibitors.
- Indications:** Hypertension and CHF
- Examples:** Furosemide, Chlorothiazide, Hydrochlorothiazide, Indepamide
- Side effects:** Hypotension, Hypokalemia, Fatigue

## **COMMONLY TRANSPORTED ANTI-HYPERTENSIVE PHARMACOLOGIC AGENTS**

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## **GASTROINTESTINAL AGENTS**

*The gastrointestinal agents are reduced to three major categories. First, anti-ulcer agents act by reducing the stomach acid content either by directly neutralizing  $H^+$  or reducing the amount of acid produced. Some anti-ulcer agents may act to coat existing ulcers to prevent further damage. Second, anti-emetics act on centers in the brain to reduce the incidence of vomiting. The final category serves to either speed up or slow down the intestinal system. This is accomplished by either increasing or decreasing the water content of the stool or by increasing/decreasing gastrointestinal motility.*

### **ANTI-ULCER**

## ANTACIDS

- Mechanism:*** Neutralizes excess stomach acids
- Indications:*** GE reflux, ulcers
- Examples:*** Aluminum hydroxide, Magaldrate
- Side effects:*** Constipation and hypophosphatemia (aluminum hydroxide); diarrhea and hypermagnesemia (magnesium hydroxide)

## HISTAMINE<sub>2</sub> ANTAGONISTS

- Mechanism:*** Decreases the effect histamine has on the H<sub>2</sub> receptor sites. When these sites are stimulated, the parietal cells excrete gastric acid.
- Indications:*** Prophylactic treatment for stress ulcers and active gastric/duodenal ulcers
- Examples:*** Cimetidine, Famotidine, Nizatidine, Ranitidine
- Side effects:*** Headaches, dizziness, confusion

## LOCAL ACTING DRUGS

- Mechanism:*** Acts to coat the mucosal lining as well as any preexisting ulcers
- Indications:*** Short term treatment and prophylactic treatment of ulcers
- Examples:*** Sucralfate
- Side effects:*** Constipation

## CHOLINERGIC BLOCKING AGENTS

- Mechanism:*** By blocking the cholinergic receptor sites these drugs decrease intestinal motility and gastric secretions.
- Indications:*** Peptic ulcer disease
- Examples:*** Glycopyrrolate, Propantheline
- Side effects:*** Tachycardia, dry mouth, constipation, urine retention

## ANTI-EMETICS

- Mechanism:*** Anti-emetics tend to act on one of two sites within the brain. First, they may act directly on the vomiting center by depressing its function. Secondly, they may act to reduce the labyrinth function to transmit impulses to the brain.
- Indications:*** Prevention and/or treatment of nausea and vomiting



**Examples:** Phenergan, Metoclopramide, Phenothiazine

**Side effects:** Hypotension, Dizziness, Dry mouth

### **ANTI-DIARRHEALS**

**Mechanism:** One of two primary mechanisms predominate. Either, slows GI motility or two, decreases the fluid content in the stool.

**Indications:** Diarrhea

**Examples:** Loperamide, Octreotide

**Side effects:** Constipation, Abdominal pain, Nausea

### **LAXATIVES**

**Mechanism:** Many different variations on the same underlying mechanism are present, however, two predominate. Increase the water content of the stool and/or increase GI motility.

**Indications:** Constipation

**Examples:** Magnesium hydroxide, Mineral oil, Bisacodyl, Docusate calcium

**Side effects:** Nausea and vomiting, cramping, dehydration, electrolyte imbalances

## **COMMONLY TRANSPORTED GASTROINTESTINAL PHARMACOLOGIC AGENTS**

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## **HORMONAL AGENTS**

*Hormonal agents may be broken down into two primary forms, slow acting (steroid and thyroid) and fast acting (peptides and catecholamines). The slow acting hormones must first penetrate the cell membrane and enter the nucleus of the cell. Once there it either causes a change in the nucleus of the cell or a production of specific proteins. These effects may take anywhere from hours to days before they may be apparent. The fast acting hormones, such as catecholamines, only have to adhere to the cell membrane to initiate their events. Their actions may only take seconds to become evident.*

### **CORTICOSTEROIDS**

#### **GLUCOCORTICOIDS**

**Mechanism:** Suppresses the immune response; decreases inflammation by stabilizing the leukocyte lysosomal membrane.

**Indications:** Counter severe inflammatory response, adrenal insufficiency

**Examples:** Dexamethasone, Hydrocortisone, Methylprednisolone,

Prednisone **Side effects:** Peptic ulcer, mood swings, Hyperglycemia, Hypertension

### **MINERALCORTICOIDS**

**Mechanism:** Helps to regulate fluid and electrolyte balance by elevating  $K^+$  and  $H^+$  secretions. This is accomplished by an increase in the rate of  $Na^+$  re-absorption in the tubules of the kidneys.

**Indications:** Adjunctive therapy for adrenal insufficiency

**Examples:** Fludrocortisone acetate

**Side effects:** Hypernatremia, water retention, hypokalemia

### **ANTI-DIABETIC AGENTS**

#### **INSULIN**

**Mechanism:** Increases transport of glucose across the cellular membrane for use as energy by the cell. Additionally, causes glucose to be transformed into glycogen, thereby reducing the blood plasma levels further.

**Indications:** Hyperglycemia, Type I diabetes

**Examples:** Rapid acting: Humulin R\*, Novolin R\*  
Intermediate: Humulin N, Humulin L  
Long acting: Humulin U, PZI  
\*Only regular insulin may be administered IV

**Side Effects:** Hypoglycemia, Rebound hyperglycemia (Somogyi Phenomenon)

### **ORAL AGENTS**

**Mechanism:** Increases the beta cells of the pancreas to produce insulin

**Indications:** Type II Diabetes

**Examples:** Chlorpropamide, Glipizide, Tolbutamide

**Side effects:** Hypoglycemia, Nausea and Vomiting, Heartburn, Headache

## **GLUCAGON**

*Mechanism:* Catalyst required to change hepatic glycogen stores into glucose

*Indications:* Hypoglycemia, Beta Blocker Overdose

*Example:* Glucagon

*Side effects:* Hypotension, Nausea and Vomiting, Bronchospasm

## **THYROID AGENTS**

### **PROTHYROID AGENTS**

*Mechanism:* Used to either replace or increase production of thyroid hormones

*Indications:* Hypothyroidism, Goiter

*Examples:* Levothyroxine sodium, Liothyronine sodium

*Side effects:* Tachycardia, Arrhythmias, Nervousness, Weight loss, Insomnia

### **ANTITHYROID AGENTS**

*Mechanism:* Inhibits the production of thyroid hormones by blocking iodine's ability to be involved in certain physiologic reactions in the thyroid gland.

*Indications:* Hyperthyroid

*Examples:* Methimazole, Potassium iodide

*Side effects:* Bradycardia, Lethargy

## **ANDROGENS**

*Mechanism:* Replaces deficient hormones

*Indications:* Androgen deficiency, endometriosis, benign prostatic hypertrophy

*Examples:* Danazol, Finasteride, Testosterone

*Side effects:* Nausea and vomiting, diarrhea, Mood swings, Weight gain

## **ESTROGENS**

*Mechanism:* Replace deficient hormones

*Indications:* Hormonal deficiency, Contraception, Menopause

*Examples:* Diethylstilbestrol, Estradiol, Conjugated Estrogen Substances

*Side effects:* Nausea and vomiting, Diarrhea, Weight Gain, Headache, Insomnia

## COMMONLY TRANSPORTED HORMONAL PHARMACOLOGIC AGENTS

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## CENTRAL NERVOUS SYSTEM AGENTS

*The central nervous system agents have the largest amount of sub-classifications in this pharmacology section. Narcotic analgesics principally act on the sigma and mu receptors in the body to decrease the patient's perception of pain. Non-narcotic agents reduce the level of prostaglandin synthesis to decrease the inflammatory response. The cholinergic agents act by either increasing or decreasing the amounts of available acetylcholine or acetylcholinesterase. Adrenergic agents affect the sympathetic nervous system by promoting or depressing the alpha and/or beta responses. Most of these adrenergic agents are site specific (e.g., Metoprolol is beta<sub>1</sub> specific). The CNS stimulants act by increasing the available amount of the neurotransmitter norepinephrine which will increase cellular impulse transmission. Anti-convulsants act in several ways such as either increasing Na<sup>+</sup> evacuation or preventing its entry into the cell, elevating GABA levels, or decreasing acetylcholine levels. Sedatives and hypnotics reduce the activity in the thalamus and the cortex (the thalamus receives sensory input from the brain). Two major actions predominate for the anti-depressants, they either increase the norepinephrine and serotonin levels in the brain or they inhibit the production of monoamine oxidase (MAO) which breaks down the neurotransmitters. Antipsychotics block the dopamine receptor sites in the brain or decrease the responsiveness of the medulla. Finally, anxiolytics alter the responses in the limbic center or they increase GABA levels.*

### ANALGESICS

#### OPIOID AGONISTS

- Mechanism:** Binds to opioid receptor sites and depresses and/or alters the patient's pain response. Most also provide a euphoric effect.
- Indication:** Pain
- Examples:** Codeine, Fentanyl, Hydromorphone, Oxycodone, Propoxyphene, Morphine
- Side effects:** Orthostatic hypotension, Dizziness, Lightheadedness, Constipation

#### OPIOID AGONIST-ANTAGONIST

- Mechanism:** Binds to the opioid receptor sites while also exhibiting a mild narcotic antagonist action. Prevents further binding of the receptor site.
- Indications:** Pain
- Examples:** Buprenorphine, Butorphanol, Nalbuphine, Pentazacine

*Side effects:* as above

## **NON-OPIOID ANALGESICS**

*Mechanism:* Three major classes, salicylates (aspirin), para-aminophenol (Tylenol), and Non-steroidal anti-inflammatory drugs (NSAIDs, e.g., Ibuprofen). All inhibit prostaglandin synthesis which may increase the body's response to pain. They exhibit an anti-pyretic effect by either peripheral vasodilation or by acting on the thermoregulatory center.

*Indications:* Pain, Fever

*Examples:* Aspirin, Acetaminophen, Ibuprofen, Ketoprofen, Naproxen sodium

*Side effects:* GI problems, Tinnitus, Headache, Dizziness

## **CHOLINERGIC AGENTS**

### **CHOLINERGIC AGONISTS (PARASYMPATHOMIMETIC)**

*Mechanism:* Activate the cholinergic system by either inducing parasympathetic activity or by inhibiting the release of acetylcholinesterase (the enzyme required to break down acetylcholine).

*Indications:* Glaucoma, Myasthenia gravis, to increase bladder and intestinal function

*Examples:* Cholinergic activators: Bethanechol, Pilocarpine  
Acetylcholinesterase Inhibitors: Edrophonium, Neostigmine,  
Physostigmine

*Side effects:* Hypotension, Headache, Flushing, Nausea and Vomiting, Diarrhea, Bradycardia

### **CHOLINERGIC ANTAGONISTS**

*Mechanism:* Inhibits the effect of acetylcholine on the muscarinic sites

*Indications:* Bradyarrhythmias, Extraparamidal reactions, Parkinsonism

*Examples:* Atropine, Benztropine, Glycopyrrolate

*Side effects:* Tachycardia, Constipation, Dry mouth

## **ADRENERGIC AGENTS**

### **ADRENERGIC AGONISTS**

*Mechanism:* Stimulates the alpha and/or beta responses of the sympathetic nervous system. Alpha<sub>1</sub> causes vasoconstriction; Beta<sub>1</sub> increases the rate, force

and automaticity of the heart; Beta<sub>2</sub> produces bronchodilation and vasodilatation.

**Indications:** Bronchospasm, Hypotension due to CHF or heart rate deficiency, Vasoconstriction

**Examples:** Albuterol, Dobutamine, Dopamine, Epinephrine, Isoproterenol, Norepinephrine

**Side effects:** Arrhythmias, Tachycardia, Angina, Nervousness, Tremors

### **ALPHA ADRENERGIC BLOCKING DRUGS**

**Mechanism:** Stimulates the release of alpha<sub>2</sub> which prevents vasoconstriction

**Indications:** Reynaud's disease, vascular headache, IV extravasations

**Examples:** Ergotamine tartrate, Phenoxybenzamine, Phentolamine

**Side effects:** Orthostatic hypotension, Tachycardia, Dizziness, Numbness

### **BETA ADRENERGIC BLOCKING DRUGS**

**Mechanism:** Blocks or displaces the agent from the receptor sites

**Indications:** Hypertension, Angina, Glaucoma

**Examples:** Acebutolol, Atenolol, Esmolol, Labetalol, Metoprolol, Pindalol

**Side effects:** Arrhythmias, Bradycardia, Bronchospasm, Nausea and Vomiting

## **CENTRAL NERVOUS SYSTEM STIMULANTS**

**Mechanism:** Exact mechanism is unknown. It is believed that these agents stimulate the release of norepinephrine which will lead to an increase in nerve impulse transmission from cell to cell.

**Indications:** Narcolepsy, Attention Deficit Disorder, Respiratory stimulation

**Examples:** Dextroamphetamines, Doxapram, Methylphenidate hydrochloride, Pemoline

**Side effects:** Nervousness, Tremors, Irritability, Hypotension, Arrhythmias

## **ANTI-CONVULSANTS**

**Mechanism:** Depresses the discharge of abnormally fired neurons by a number of different mechanisms. These mechanisms range from promoting Na<sup>+</sup> exit from the cell, inhibiting Na<sup>+</sup> from entering the cell, increasing the inhibitory effect of gamma-amino butyric acid (GABA), prevention of

release of glutamate and aspartate, and decreasing acetylcholine released by the nerve impulses.

- Indications:** Seizures
- Examples:** Hydantoins (ethoin, felbamate, phenytoin)  
Barbiturates (phenobarbital, mephobarbital, primidone)  
Benzodiazepines (clonazepam, clorazepate, diazepam)
- Side effects:** Nystagmus, Drowsiness, Hypotension, Respiratory depression

## **SEDATIVES AND HYPNOTICS**

- Mechanism:** Decreases the amount of neurotransmissions form the **thalamus** and the **cortex** of the brain.
- Indications:** Wide ranging; from sedation and insomnia to treatment of alcohol withdrawal symptoms.
- Examples:** Thiopental sodium, Pentobarbital, Phenobarbital, Alprazolam, Cloracepate, Diazepam, Quazepam, Chloral Hydrate
- Side effects:** Drowsiness and respiratory depression

## **ANTI-DEPRESSANTS**

- Mechanism:** Two primary mechanisms prevail. The first, ticyclic antidepressants (TCA), is to cause an increase in the amount of norepinephrine and serotonin in the **central nervous system**. This is accomplished by inhibiting the re-absorption of these two substances in the presynaptic membrane. The second is a monoamine oxidase inhibitor (MAO) that prevents the central nervous system's neurotransmitters from being metabolized. After one of these two events has occurred the rest of the mechanism is unknown.
- Indications:** Depression
- Examples:** TCA & others: Amitriptyline, Clomopramine, Doxepin, Bupraprion  
MAO Inhibitors: Phenelzine, Tranylcypromine
- Side effects:** Hypotension, Tachycardia, Blurred vision, Dry mouth, Restlessness, Insomnia, Nausea and Vomiting

## **ANTIPSYCHOTICS**

- Mechanism:** The majority of agents block the post synaptic dopamine receptor which, in turn, inhibits the transmission of nerve impulses. Some others also have the effect of decreasing the cells responsiveness at the medullary chemoreceptor zone.

- Indications:** Psychosis, Schizophrenia, Alcoholism
- Examples:** Chlorpromazine, Mesoridazine, Perphenazine, Thioridazine, Droperidol, Haloperidol
- Side effects:** Extrapyramidal reactions, Tardive dyskinesia, Sedation, Blurred vision, Dry mouth, Heat intolerance

## **ANXIOLYTICS**

**Mechanism:** A number of actions among the various agents exist, but the vast majority appear to affect some level of the limbic or subcortical areas of the brain. One other major mechanism appears to be in the potentiation of GABA, which is an inhibitory neurotransmitter.

**Indications:** Anxiety, Alcohol withdrawal, Partial seizure disorder

**Examples:** Alprazolam, Chlordiazepoxide, Hydroxyzine, Midazolam

**Side effects:** Drowsiness, Respiratory depression

## **COMMONLY TRANSPORTED CENTRAL NERVOUS SYSTEM PHARMACOLOGIC AGENTS**

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## **NEUROMUSCULAR AGENTS**

*Indians in South America would place curari in the water to paralyze the fish they were attempting to catch (the idea to develop pancuronium came from this). Both of these neuromuscular blocking agents affect the transmitter acetylcholine and prevent depolarization of the muscle. Paralysis begins in the eyelids and then progresses rapidly throughout the body. Succinylcholine is used in some EMS systems for rapid sequence intubation (RSI).*

### **NONDEPOLARIZING (LONG ACTING)**

**Mechanism:** Prevents the firing of muscle fibers by blocking nicotinic receptors at the nerve endings which prevents acetylcholine from binding to the nerve receptor located on the muscle.

**Indications:** To induce paralysis for surgery, ET intubation, Ventilators, etc.

**Examples:** Atracurium, Doxacurium, Gallamine, Pancuronium

**Side effects:** Apnea, Hypotension, Tachycardia, Arrhythmias, Excessive bronchial secretions



## **DEPOLARIZING AGENTS (SHORT ACTING)**

- Mechanism:*** Mimics the effect of acetylcholine by depolarizing the muscle and then preventing any further depolarization.
- Indications:*** As above
- Examples:*** Succinylcholine chloride
- Side effects:*** Hyperkalemia (particularly in burns and trauma), Prolonged respiratory depression, Arrhythmias, Apnea, Malignant hyperthermia

## **COMMONLY TRANSPORTED NEUROMUSCULAR PHARMACOLOGIC AGENTS**

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## **OPHTHALMIC AGENTS**

*A word of caution is due when addressing “eyedrops”. In susceptible individuals it is possible that these medications will have detrimental effects on the cardiovascular system, specifically the heart. In the predisposed patient some of these agents may induce bradydysrhythmias and heart blocks.*

### **MIOTICS**

- Mechanism:*** Reduces intraocular pressure by stimulating the cholinergic system whether by acting as a cholinergic agent or a cholinesterase inhibitor.
- Indications:*** Glaucoma
- Examples:*** Carbachol, Pilocarpine hydrochloride
- Side effects:*** Myopia, Decreased vision, Headache

### **MYDRIATICS**

- Mechanism:*** Acts either by an anticholinergic effect or as a sympathetic agonist.
- Indications:*** Inflammation of the eye
- Examples:*** Atropine sulfate, Tropicamide, Epinephrine hydrochloride
- Side effects:*** Increased intraocular pressure, photophobia, Headache

## COMMONLY TRANSPORTED OPHTHALMIC PHARMACOLOGIC AGENTS

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## TEMPLATES FOR COMMONLY TRANSPORTED PHARMACOLOGIC AGENTS

### Acyclovir Sodium

Trade Name(s): Zovirax

Indications: Herpes simplex virus and herpes zoster virus

How Administered:

IV, PO

Dosage:

IV: 5 mg/kg over 1 hour; given every 8 hours for five days PO: 20 mg/kg over five days

Side Effects:

Headache, seizures, nausea and vomiting, phlebitis at injection site

Transport Considerations:  
None

### Aminophylline

Trade Name(s):

Aminophyllin, Somophyllin

Indications:

Respiratory difficulties due to asthma, COPD, or pulmonary edema

How Administered:

IV

Dosage:

5-6 mg/kg over 20 minutes

Side Effects:

Nervousness, headache, arrhythmias, nausea and vomiting

Transport Considerations:

Caution advised when using other catecholamine agents.  
Do not mix with beta blockers.

### **Ampicillin Trihydrate**

Trade Name(s):

Omnipen, Polycillin, Totacillin

Indications:

Bacterial infections

How Administered:

IV or IM

Dosage:

2 to 12 grams IV or IM daily

Side Effects:

Seizures, nausea and vomiting, thrombocytopenia, nephropathy

Transport Considerations:

Drug may be given with probenecid to increase antibiotic levels

### **Amrinone Lactate**

Trade Name(s):

Inocor

Indications:

Third line agent in the treatment of severe CHF

How Administered:

IV bolus

Dosage:

.75 mg/kg bolus over 2-3 minutes.

Followed by an IV infusion of 5-15 mcg/kg/min. Titrate to the desired effect.

Side Effects:

Hypotension, nausea and vomiting, arrhythmias

Transport Considerations:

Caution advised when administering digitalis.

A precipitate will form when amrinone and lasix are administered together.

Amrinone and dextrose are not compatible.

## **Bumetanide**

Trade Name(s):

Bumex

Indications:

Pulmonary edema and hypertension

How Administered:

IV or IM

Dosage:

.5 - 2.0 mg over 2 minutes.

Total daily dosage not to exceed 10 mg.

Side Effects:

Headache, hypotension, nausea and vomiting, hypovolemia

Transport Considerations:

Watch for signs of dehydration

## **Butorphanol**

Trade Name(s):

Stadol

Indications:

Severe pain

How Administered:

IV or IM

Dosage:

.5-2.0 mg every 3 hours.

Titrate to the desired level of effect

Side Effects:

Drowsiness, euphoria, hypotension, respiratory depression

Transport Considerations:

2 mg of stadol is the equivalent of 10 mg of morphine.

May cause withdrawal symptoms in patients addicted to opioid narcotics.

## Calcium Salts

Trade Name(s):

Calcium chloride Calcium gluconate

Indications:

Hyperkalemia Hypocalcemia

How Administered:

IV

Dosage:

Calcium chloride: 2-4 mg/kg

Calcium gluconate: 5-8 ml slow IV bolus

Side Effects:

Syncope, cardiac arrest, arrhythmias, nausea and vomiting, extravasation may cause tissue sloughing.

Transport Considerations:

Calcium and sodium bicarbonate will precipitate if mixed together.  
Digitalis and calcium should be used together with caution.

## Ceftriaxone Sodium

Trade Name(s):

Rocephin

Indications:

Bacterial infections

How Administered:

IV or IM

Dosage:

1 to 2 grams IV or IM daily

Side Effects:

Headache, dizziness, anaphylaxis, nausea and vomiting, phlebitis

Transport Considerations:

None

## Cefazolin Sodium

Trade Name(s):

Ancef, Kefzol, Zolicef

Indications:

Bacterial infections

How Administered:

IM or IV

Dosage:

250 mg to 1.5 grams every 6 to 8 hours

Side Effects:

Diarrhea, thrombocytopenia, nausea and vomiting, urticaria, pruritis

Transport Considerations:

None

### **Chlorpromazine**

Trade Name(s):

Promapar, Thorazine

Indications:

Acute psychosis and alcohol withdrawal

How Administered:

IM

Dosage:

25 mg

Side Effects:

Drowsiness, headache, hypotension, tachycardia

Transport Considerations:

Be cautious when using with other anticholinergic agents.

Hypotension may ensue when mixed with other antihypertensive agents.

### **Dexamethasone**

Trade Name(s):

Decadron, Hexadrol

Indications:

Shock, cerebral edema, allergic reactions

How Administered:

IV

Dosage:

100 mg for shock

10 mg for cerebral edema 4 mg for allergic reactions

Side Effects:

Headache, depression, restlessness, hypokalemia, hypertension

Transport Considerations:

Not to be mixed with other agents

### **Digitalis**

Trade Name(s):

Lanoxin

Indications:

CHF, atrial arrhythmias with a rapid ventricular response

How Administered:

IV

Dosage:

10-15 mcg/kg bolus

Side Effects:

Nausea and vomiting, yellowed blurred vision around light sources, arrhythmias, anorexia.

Transport Considerations:

Avoid simultaneous use of beta blockers and digitalis

### **Diltiazem Hydrochloride**

Trade Name(s):

Cardizem

Indications:

Angina, hypertension, and SVT

How Administered:

PO or IV

Dosage:

.25 mg/kg IV bolus over 2 minutes.

If unsuccessful bolus with .35 mg/kg IV bolus. Continuous infusion of 10 mg/hr.

Side Effects:

Headache, edema, flushing, arrhythmias, CHF, AV block

Transport Considerations:

Lasix and diltiazem form a precipitate when mixed.  
Beta blockers and diltiazem may prolong conduction times.  
If patient is on cimetidine, toxicity may result.

### **Dobutamine**

Trade Name(s):

Dobutrex

Indications:

Pulmonary edema and hypotension

How Administered:

IV

Dosage:

2-20 mcg/kg/min

Side Effects:

Headache, hypertension, arrhythmias, shortness of breath

Transport Considerations:

Beta blockers may negate the effect of dobutamine.  
Tricyclic antidepressants may increase the potential for hypertension.

### **Doxycycline**

Trade Name(s):

Doxylin, Vibramycin

Indications:

Gram negative and gram positive bacteria

How Administered:

IV or PO

Dosage:

IV dose: 200 mg per day

Side Effects:

Diarrhea, nausea and vomiting, photosensitivity, urticaria

Transport Considerations:

None



## **Epinephrine Infusion**

Trade Name(s):

Adrenalin chloride

Indications:

Cardiopulmonary arrest, refractory bradycardia

How Administered:

IV

Dosage:

1 mg mixed in 250 cc. Infuse at 2-10 mcg/min

Side Effects:

VF, excitability, arrhythmias

Transport Considerations:

None

## **Erythromycin**

Trade Name(s):

Erythromycin base

Indications:

Bacterial infections

How Administered:

IV or PO

Dosage:

500 mg every 6 hours

Side Effects:

Abdominal pain and cramping, anaphylaxis, urticaria, venous irritation

Transport Considerations:

Digitalis toxicity may ensue when mixed with this agent

## **Haloperidol**

Trade Name(s):

Haldol

Indications:

Psychosis

How Administered:

IM

Dosage:

2-5 mg IM

Side Effects:

Sedation, confusion, respiratory depression, hypotension

Transport Considerations:

May increase hypotension when used with antihypertensives.  
Phenobarbital may increase the effect of haldol.

### **Heparin**

Trade Name(s):

Heparin

Indications:

DIC, adjunct to treatment for AMI, and pulmonary embolus

How Administered:

IV

Dosage:

5,000 to 10,000 units IV push.

Followed by infusion of 1,000 units per hour

Side Effects:

Allergic reactions, bruising, epistaxis, hematuria

Transport Considerations:

Protect patient from rough handling.  
Verify drug dosage.

### **Hydromorphone**

Trade Name(s):

Dilaudid

Indications:

Severe pain

How Administered:

IV or IM

Dosage:

IV: 1 mg IV bolus titrate to effect IM: 2-4 mg every 4-6 hours

Side Effects:

Drowsiness, confusion, hypotension, bradycardia

Transport Considerations:

Watch for signs of respiratory depression

## **Insulin**

Trade Name(s):

Humulin, Novolin

Indications:

Hyperglycemia, hyperkalemia (with D50)

How Administered:

IV and SQ

Dosage:

.33 units/kg IV bolus.

Followed by an infusion of .1 units/kg/hr

IV insulin is usually continued until glucose levels drop below 250 mg/dl, then SQ therapy begins

Side Effects:

Hypoglycemia, rebound hyperglycemia

Transport Considerations:

Use insulin syringes calibrated for that concentration of insulin.

Do not rub injection site after administration of insulin SQ.

## **Magnesium Sulfate**

Trade Name(s):

Magnesium sulfate

Indications:

Pre-eclampsia, eclampsia, torsades de pointes

How Administered:

IV

Dosage:

2-4 grams of 10% solution over 3 minutes. IV infusion after the bolus of 1-2 grams/hour.

Side Effects:

Drowsiness, respiratory depression, arrhythmias, hypotension

Transport Considerations:

Do not administer via rapid IV bolus.

May cause respiratory depression and/or heart block.

Maintain close watch over blood pressure.

### **Mannitol**

Trade Name(s):

Osmitol

Indications:

Increasing intracranial pressure

How Administered:

IV

Dosage:

1.5-2 grams/kg

Side Effects:

Headache, confusion, CHF, pulmonary edema, dehydration

Transport Considerations:

Must use an in-line filter.

Be alert for CNS depression when mannitol is given simultaneously with other CNS depressant drugs.

Watch for signs of decreased skin turgor.

### **Meperidine**

Trade Name(s):

Demerol

Indications:

Severe pain

How Administered:

IV or IM

Dosage:

Infusion: 15-35 mg/hr

IM: 50-100 mg every 3-4 hours

Side Effects:

Headache, confusion, hypotension, bradycardia, respiratory depression

Transport Considerations:

Often given with phenergan.

Watch for signs of respiratory depression.

### **Methylprednisolone**

Trade Name(s):

A-methaPred, Medrol, Solu-medrol

Indications:

Severe inflammation or immuno-suppression

How Administered:

IV or IM

Dosage:

100-200 mg bolus either IV or IM

Side Effects:

Depression, euphoria, restlessness, hypertension, hyperglycemia

Transport Considerations:

When used with diuretics there stands an increased risk for hypokalemia

### **Norepinephrine**

Trade Name(s):

Levophed

Indications:

Hypotension

How Administered:

IV

Dosage:

Initiate infusion at .5 - 1.0 mcg/min. Average therapeutic range is 2-12 mcg/min.

Side Effects:

Headache, anxiety, arrhythmias, extravasation may lead to tissue sloughing

Transport Considerations:

Monitor EKG and blood pressure closely.  
Titrated to desired blood pressure range.  
The use of beta blockers and norepinephrine may lead to hypertension.

### **Ofloxacin**

Trade Name(s):

Floxin

Indications:

Bacterial infection

How Administered:

IV or PO

Dosage:

400 mg IV or PO every 12 hours

Side Effects:

Seizures, nausea, phlebitis

Transport Considerations:  
None

### **Oxytocin**

Trade Name(s):

Pitocin, Syntocinon

Indications:

Induction of labor and to control postpartum hemorrhage

How Administered:

IV or IM

Dosage:

IV: 10-20 Units added to 1 liter of fluid; titrate to appropriate response

IM: 3-10 Units

Side Effects:

Seizures, coma, hypotension, arrhythmias

Transport Considerations:  
May cause uterine rupture.  
Use with vasoconstrictors may cause hypertension.

## **Phenobarbital**

Trade Name(s):

Luminal

Indications:

Treatment of seizures

How Administered:

IV

Dosage:

100-300 mg slow IV bolus

Side Effects:

Headache, drowsiness, hypotension, nausea and vomiting

Transport Considerations:

Monitor airway at all times.

Phenobarbital may increase the effects of CNS depressants.

## **Phenytoin**

Trade Name(s):

Dilantin

Indications:

Seizures, also exhibits an antiarrhythmic effect

How Administered:

IV

Dosage:

150-250 mg slow IV bolus

Side Effects:

Dizziness, nervousness, hypotension

Transport Considerations:

Dilantin may increase the effects of other CNS depressants

## **Potassium Infusion**

Trade Name(s):

Potassium chloride

Indications:

Hypokalemia

How Administered:

IV

Dosage:

20-60 mEq over 24 hours

Side Effects:

Bradycardia, cardiac arrest, confusion, diarrhea, respiratory distress

Transport Considerations:

Not compatible with dobutamine, mannitol, or penicillin

### **Procainamide**

Trade Name(s):

Pronestyl, Promine, Procan

Indications:

Ventricular or supraventricular arrhythmias

How Administered:

IV

Dosage:

20 mg/min IV infusion.

Once infusion has been completed a maintenance drip is needed at 1-4 mg/min.

Side Effects:

Confusion, hypotension, prolongation of the Q-T interval which may lead to torsades de pointes.

Transport Considerations:

Keep close watch on the EKG and the patient's blood pressure

### **Promethazine Hydrochloride**

Trade Name(s):

Phenergan

Indications:

Nausea and to potentiate the effects of narcotics

How Administered:

IV or IM

Dosage:

25 to 50 mg IV or IM



Side Effects:

Drowsiness, sedation, dry mouth

Transport Considerations:

If giving IV do not exceed 25 mg/min.  
Shield from direct sunlight if given as an IV infusion.

## **Propranolol**

Trade Name(s):

Inderal

Indications:

Control ventricular and supraventricular arrhythmias, hypertension, adjunctive therapy for MIs (normally metoprolol is used)

How Administered:

IV

Dosage:

1-3 mg IV bolus every 5 minutes. Total dose is .1 mg/kg

Side Effects:

Weakness, bradycardia, wheezing, CHF, nausea and vomiting

Transport Considerations:

Monitor patient while administering the agent.  
Digitalis combined with this agent may greatly increase the bradycardic effect.  
Use with caution in patients with asthma.

## **Racemic Epinephrine**

Trade Name(s):

MicroNEFRIN

Indications:

Croup

How Administered:

Inhalation therapy

Dosage:

Usually only used in pediatric patients.  
.25-.5 ml/kg by inhalation

Side Effects:

Palpitations, fear, anxiety, nausea and vomiting

Transport Considerations:

Assess patient throughout the treatment.

### **Terbutaline**

Trade Name(s):

Brethaire, Brethine, Bricanyl

Indications:

Dyspnea and to halt premature contractions

How Administered:

SQ and inhalation

Dosage:

SC: .25 mg repeated every 15-30 minutes Inhalation: Two inhalations every 4-6 hours

Side Effects:

Nervousness, hypertension, arrhythmias

Transport Considerations:

Frequent assessment of vital signs during therapy is necessary

### **Vancomycin Hydrochloride**

Trade Name(s):

Vancocin, Vancoled

Indications:

Bacterial infections refractory to traditional antibiotics

How Administered:

IV

Dosage:

500 mg IV every 6 hours

Side Effects:

Tinnitus, nausea, fever, anaphylaxis

Transport Considerations:

Watch for signs of extravasation

## Vitamin Infusion

Trade Name(s):

MVC Plus, MVI-12, MVI

Indications:

Replenish vitamins

How Administered:

IV

Dosage:

5 - 10 ml every 24 hours. Dilute solution in 1,000 ml IV.

Side Effects:

Rare

Transport Considerations:

None

# APPENDIX B

## NOTIFICATION OF INTENT TO TRAIN

Name of Training Program:

Mailing Address:

City: State: Zip Code:

Contact Person: Phone Number:

Course Start Date:

Location of Class Meetings:

City: State: Zip Code:

Projected Enrollment:

Medical Director:

Course Coordinator: SSN:

Lead Instructor:

SSN:

Assistant Instructor: SSN:

Assistant Instructor: SSN:

\_\_\_\_\_The above application has been reviewed and is approved.

\_\_\_\_\_The above application has been reviewed and is disapproved. Please see enclosed for details.

Regional Education Coordinator/Date

Regional Executive Director/Date



## Student Completion Form

Students Name:

Address: City: State: Zip

Telephone Number: SSN:

EMT License Number: Expiration Date:

Pretest completed:

Yes

No

Satisfactory Participation in Skills:

Yes

No

Satisfactory Participation in Discussion of Commonly Transported Pharmacologic Agents:

Yes

No

Note any remediation required below:

Course Coordinator:

Date: