# INTERFACILITY CRITICAL CARE TRANSPORT PROTOCOLS

FOR

CRITICAL CARE TEAM

CRITICAL CARE PARAMEDIC

(CCP)

Policy, Procedure & Protocols

Manual

Leon County EMS

Critical Care Paramedic Policies & Procedures reviewed, revised and approved by:

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Medical Director

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# CRITICAL CARE TRANSPORT PROTOCOLS
# CRITICAL CARE EMT - PARAMEDIC
# (CCP)

Policy, Procedure & Protocol Manual
Leon County EMS

## I. Statement of Purpose

The Critical Care Emergency Medical Technician - Paramedic (CCP) will render care to critically ill or injured patients who are being transported to a facility that provides an equal or higher level of care, for continued treatment. In addition to standard ALS equipment utilized routinely by paramedics, the CCP or ALS Paramedic with guidance and supervision of the transferring, receiving or EMS MD may be required to manage special equipment/medications being used on a patient provided by the transferring hospital. The CCP may need to perform advanced procedures, as well as monitor and administer medications not routinely used by ALS Paramedics. When called for, additional critical care personnel such as a respiratory therapist, ICU nurse, physician, or another paramedic may accompany patient to assist in providing care. The CCP will be the team member in charge but will recognize and respect the expertise of the other care givers on board.

The decision to transfer a patient rests with the transferring physician (or other care provider, such as a physician assistant). This physician bears responsibility for the transfer decisions. It is the transferring physician who must:

1) Determine whether the benefits of transfer outweigh the risks.
2) Ensure that the patient is properly stabilized prior to departure.
3) Be responsible for complying with currently accepted community standards of practice regarding interfacility transfer.

The CCT Paramedics/CC Teams and Medical Control Physician (MC) assume responsibility for management of the patient, given the circumstances of the patient's condition, while en route between facilities.

This protocol recognizes there will be situations where potentially unstable patients will require transfer to another facility to obtain a higher level of care.

**It should be noted that the Interfacility Transfer Protocol is a supplement to the Leon County Medical Protocols Vs 2.0 and requires additional training. In this light, patient care during transport can be defaulted to that delineated by the Leon County Medical Protocols Vs 2.0.**

## II. Requirements of CCP

1. Current State or National Paramedic Licensure
2. Successful completion & maintenance of an approved Critical Care EMT-P (or equivalent) course.
3. Current BCLS, ACLS. ITLS and PHTLS/PALS certifications
4. Maintain competency specific to critical care transfers
    a. Biannual review of equipment and/or medication with LCEMS training staff.
    b. 16 hours of continuing education relevant to critical care transfer every 2 years.
5. CCP will run a minimum of 3 transfers per year and/or receive approval from the medical director prior to annual recertification.
6. Respond to any and all quality assurance issues identified during routine quality review of run reports by the medical director and/or the clinical quality coordinator.

## III. Transferring Documents/Written Orders

It is the responsibility of the transferring hospital/physician to provide appropriate documentation which includes a transfer form or other documentation indicating compliance with current statutes or laws regarding patient transfers. Included should be patient identifying information (name, address, date of birth, etc.), treatments, test results, preliminary diagnosis, reason for transfer, names of transferring/accepting physicians/institutions, pertinent medical records and orders.

Each patient should have a unique set of written orders provided by the transferring physician, specific to the patient's medical condition. The patient will be treated according to those orders unless a physician's written orders differ from our protocols. If the written orders differ from our protocols, review the orders with medical director prior to the transport for approval to follow.

Any concerns regarding patients written orders should be voiced to the physician caring for the patient (transferring) physician/or the EMS MD prior to transport.

The CCP will receive (or make) two copies of written orders prior to departure. One copy will become part of the patient's transport record maintained by the ambulance service. The second copy will be left at the receiving facility.

Must have name and phone number of the transferring MD as well as the receiving MD readily available in the event you need to contact them for unexpected problems or for clarification to orders provided. The EMS MD should also be put on notice that a critical care transport is in progress and will be on standby to intervene if unable to contact the transferring or receiving MD.

## IV. Quality Assurance

All critical care transfers will be reviewed following the mission. Any deviation from these policies/protocols will be reviewed by the QA Officer and/or medical director and discussed with

the CCP involved. Any concerns in patient care (from physicians, nurses, paramedics, respiratory therapists, patients of family members of patients) will be addressed by the medical director.

## V. Documentation

All Critical care transports will have documentation that supports or identifies the trip as being a critical care transport (see list***). Documentation, be it electronic or hand written, will detail the patient's chief complaint, reason for the transfer, historical data related to the current problem, pertinent past medical history, medication list, allergy list, and a timed, chronologic description of patient care, medications, vital signs, and changes in patient status with corresponding response of medical crew to the changes. In addition to giving a verbal report to the receiving medical staff, a copy of run report will be left at the receiving facility or faxed shortly thereafter (be sure to obtain a fax number).

## VI. On Line Medical Control

**Medical Control (MC) may be defined as either the EMS Medical Director, the transferring or receiving MD and as a last resort the ED physician of the transferring or receiving hospital**

In any situation that the CCP needs to contact a physician for medical direction they will first attempt to contact the transferring MD or the receiving MD. If unable to reach either one, the EMS MD can be contacted. As a last resort, use on-line medical control at the sending or receiving facility. Any orders from on-line medical control will supersede written orders.

If the CCEMT-P is unable to contact the receiving or sending facility, the CCP will follow Leon County EMS Medical Protocols and LCEMS Critical Care Protocols until contact can be established. In a situation when medical control is unreachable and intervention is necessary, the transport team will divert to the nearest appropriate medical facility.

**The Medical Director of the transporting service may set additional standards regarding contacting MC.**

Medical Control **MUST** be contacted in the following circumstances:

1. Ongoing administration of blood products or resuscitative medications
2. Intubated patients
3. Patients with chest tubes
4. Patients with temporary pacemakers
5. Changes in symptoms/ signs/ conditions potentially indicating deterioration
6. Unstable vital signs
7. Medications not specifically listed in the protocol

Patients with the first four listed items should be contacted before arrival, and preferably before the

patient leaves the sending facility. Patients with the 5th and 6th listed items should have MC called en route as these occur.

Patients on medications not specifically listed in the protocol may be transported by **CCPs ONLY**. These medications will need to be reviewed by their EMS medical director and must fall into a similar category as other drugs **ALREADY LISTED** in the protocol. A patient receiving a completely new category of drug **may not be transported without further personnel** trained in the use of that drug.

## VII. **Transferring Patients with Drugs and Devices**

During inter-hospital transfer crew members shall follow all regionally approved BLS/ALS protocols. In addition, the patients on the stated drugs and devices may only be transported **if the respective drugs have been initiated at the transferring hospital by the transferring physician/care provider.** None of these may be initiated en route. At the discretion of MC, the drug rates/doses may be altered or discontinued depending on the patient's clinical condition. Where indicated, CCPs may titrate a drug up or down once depending on parameters delineated in the specific protocol.

The following precautions should be kept in mind by transferring providers:

1. All medications have potential to cause allergic reactions.
2. Some medications cause local irritation around the IV site. Several may even cause tissue necrosis if there is infiltration. If there is infiltration of any line, the IV should be immediately discontinued.
3. Many of the listed drugs are incompatible with other medications. Therefore, additional medication should be given through a separate IV line, or, if one is not established, the infusion should be stopped and the line flushed before administering a second medication. This should only be done under direct MC guidance.
4. Most require infusion pumps and/or cardiac monitoring.
5. MC should be contacted if there is any change in patient condition or if any medication needs to be emergently discontinued during transport.
6. If the need arises for emergency medications to be given, infusions may need to be discontinued; contact MC.
7. The MC physician may determine that the number or types of drugs/devices may require the presence of additional personnel (such as a second paramedic, nurse or physician).
8. Transfer of patients with ongoing infusion of medication outside the scope of practice and training of the transporting crew (either because of lack of credentialing or medication not listed in the protocol) cannot be accomplished without additional personnel who possess a higher level of training.

## VIII. **Requesting Additional Personnel**

When the EMS provider anticipates that they will require more assistance to appropriately care for the patient during transfer, they shall request the transferring physician/health care provider to provide appropriately trained hospital staff to accompany the patient and assist.

The EMS provider must contact MC for medical direction in all situations where they are not comfortable with the circumstances of the transfer. **The transfer will not occur unless the EMS provider and MC are confident the personnel and equipment are appropriate for transfer.**

## IX. Clinical Procedures/Protocols

All current adult, pediatric and procedural protocols used by our LCEMS ALS crews to treat patients in the field will also apply to critical care transports if applicable to patient's condition/situation. In addition, advanced protocols, specific for critical care patients, may apply and be used by the critical care transport team members who are qualified and familiar with the procedures listed.

If at any time a critical care team member feels a protocol is beyond their skill level or comfort level, DO NOT PROCEED WITH THE TRANSPORT, instead, contact medical control and/or your supervisor to discuss your concern.

NOTE: some of the procedures listed are to be performed by MD only. The steps in performing the procedures are listed as you may be called upon to assist the physician and will need to know the steps involved.

A protocol has been written for the following topics:

- Arterial Blood Gas Sampling (restricted to MD or RT)
- Blood Transfusion Protocol
- Blood Transfusion Reaction Protocol
- Chest tube
    - Insertion (restricted to MD)
    - Management
- Emergency Escharotomy
- Hemodynamic Monitoring Protocol
    - CVP Monitoring
    - Arterial Line Monitoring
    - Swan Ganz Monitoring
- ICP (Increased intra-cranial pressure) monitoring
- Intra-Aortic Balloon Pump (Requires additional training/certification)
- Ventricular Assist Device
- I-STAT use (Protocol Pending for this device)
- Pericardiocentesis (restricted to MD)
- Temporary cardiac pacing
- Tracheostomy care
- Venous Access Devices

- Ventilator protocol

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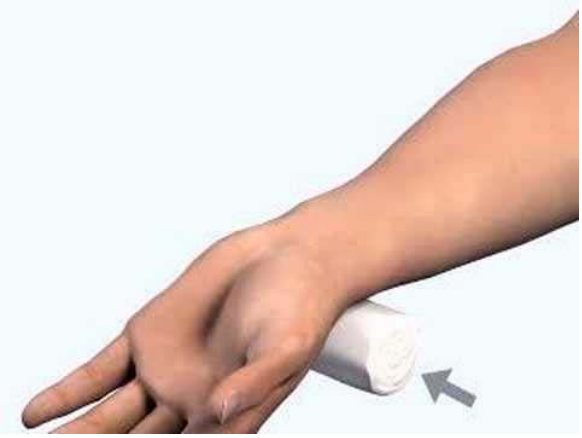
**Arterial Blood Gas Sampling**

**Purpose**: A sample of arterial blood is needed to analyze the oxygen content in the blood as well as assess the acid base status of a critical patient. This policy explains how to obtain an arterial blood sample. This procedure is restricted to an emergency physician, respiratory therapist, and those who have demonstrated proficiency in performing an arterial stick and have been authorized and approved by the medical director.

**Procedure**:

1. Appropriately identify the patient. Explain the procedure. Determine the appropriate arm from which to take the specimen.
2. Perform an Allen test. Have the patient raise the hand above the level of the heart. Then have the patient make a fist while you simultaneously compress the radial and ulnar arteries
3. When the patient's hand turns white or pale, release compression of the ulnar artery and assesses circulation. The color should return to normal in approximately 5 to 7 seconds
4. Repeat while releasing the radial artery. Sluggish return of color may indicate occlusion in one or both of the arteries. Arterial puncture should not be performed on this extremity
5. Ensure universal precautions
6. If possible, position the patient's arm with a small towel roll beneath the wrist to slightly extend the wrist (do not overextend).
7. Prepare the site with betadine or chlorhexidine
8. Palpate the radial artery with our index and middle fingers (do not use your thumb).
9. Locate the radial artery and puncture the skin with the bevel of the needle at a 45° angle. The syringe should rapidly fill with bright red blood. Do no dig or probe with the needle. If you have difficulty, slightly reposition the needle. If you continue to have difficulty, stop and restart the procedure.
10. Once the appropriate amount of blood has filled the syringe, rapidly remove the needle and hold pressure for approximately 2 to 5 minutes.
11. Safely remove the needle and expel any air contained within the syringe
12. Place a rubber stopper on the syringe
13. Label the syringe with appropriate patient identification
14. Immediately perform the test (via I-STAT if available) or place the specimen on ice.
15. Reassess neurovascular status.
16. NOTE: If a patient has an arterial line in place to monitor blood pressure, you can collect a sample of arterial blood via connecting the ABG syringe to the stop cock on the A-line. Be sure to flush the catheter afterwards using the pigtail or squeeze system connected to the pressure bag.



After a pulse is found, a blood sample is taken from the artery

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**Blood Products Transfusion Protocol**

**Purpose**: This protocol is restricted to Critical Care Trained Paramedics and/or RNs, or Paramedics under direct supervision of the EMS MD. It applies to patients receiving or in need of receiving blood transfusions or any blood products in transit between facilities as provided by the transferring facility.

Blood administration may be required to restore circulating blood volume, improve oxygen-carrying needs, or correct specific coagulation components. The blood product may be in the form of:

1. Whole Blood (450 – 500 ml/unit),
2. Packed Red Blood Cells (250 ml/unit)
3. Platelets
4. Fresh Frozen Plasma
5. Cryoprecipitate
6. Albumin
7. Plasma Protein Fractions (83% Albumin and 17% globulins)
8. Synthetic Blood Substitutes

**Procedure**: The procedure for administering blood or blood products are:

**1.** Indications:
   a. Significant hypovolemia as the result of acute blood loss
   b. Symptomatic anemia
   c. Decreasing hemoglobin level
   d. Decreasing hematocrit value
   e. To increase oxygen-carrying ability
   f. Decrease clotting factors
   g. Presurgical care in select cases

**2.** Equipment
   a. Physician orders
   b. Blood product, typed and crossmatched (in some cases may be cryoprecipitate, platelets, or plasma)
   c. Dedicated venous access line (18-guage or larger needle)
   d. Filtered administration set
   e. Normal saline solution
   f. Thermometer

**3.** Complications:
   a. Anaphylaxis
   b. Hemolytic reaction
   c. DIC
   d. Transfusion reaction
   e. Infection

**4.** Signs of complications include the following
   a. Body temperature of 2°F (1°C) or more above the baseline temperature

b. Hives, itching, or skin symptoms
c. Swelling, soreness, or hematoma at the venous site
d. Flank pain
e. Tachycardia
f. Respiratory distress (wheezing and dyspnea)
g. Hypotension
h. Bleeding from widely varied sites or previously clotted wounds
i. Blood in urine
j. Anaphylaxis
k. Nausea and vomiting

**5.** Steps: If you are to start a blood product provided by the transferring facility;

a. Prior to leaving the transferring facility, physically look at the product with the transferring nurse and confirm you have the right product for the right patient. Review the order with the transferring nurse.
b. ALL PRODUCTS MUST BE ADMINISTERED VIA AN IV PUMP
c. Re -confirm the order or protocol prior to administering
d. Check the patient for the following: right patient, right blood product, and right type. **Have a second provider confirm steps c and d with you**.
e. Assess baseline vital signs and temperature
f. Ensure suitable venous access (usually requires 18 – gauge or larger). At this point, patient preparation is complete and the transfusion procedure begins.
g. Check the blood for the following: right patient, right blood product, right type, and expiration date.
h. Asses the patient for the possibility of a transfusion reaction, and consider prophylactic administration of ibuprofen or acetaminophen and diphenhydramine
i. Maintain the temperature of the blood product
j. Flush the primary tubing with normal saline
k. Cover the administration filter with blood
l. Connect the blood to the tubing
m. Piggyback into the IV line of normal saline
n. Start the transfusion slowly
o. Monitor every 5 minutes for adverse reactions

NOTE:

- DO NOT MIX BLOOD WITH 5% DEXTROSE IN WATER (CAUSES HEMOLYSIS).
- DO NOT MIX WITH LACTATED RINGERS (CAUSES CLOTTING)
- DO NOT MIX WITH MEDICATIONS (MAY REACT)
- HAVE A SECOND VENOUS ACCESS AVAILABLE

**Transfusion Reactions (to blood products) Protocol**

**Purpose**: To identify the various types of transfusion reactions and how to manage them.

**Protocol**: Types of reactions with signs and symptoms and treatment protocols: If it is unclear what type of reaction the patient is having, stop the transfusion, keep vein open with normal saline, contact MD (transferring, receiving, or EMS MD) for guidance.

1. **Allergic reaction (mild); sensitivity to infused plasma proteins (Severe): antibody – antigen reaction**
    a. S/S (Mild): chills, facial and laryngeal edema, pruritus, urticaria, and wheezing
       S/S (Severe): Dyspnea, chest pain, circulatory collapse, cardiac arrest
    b. Tx:
        i. Stop the transfusion. Disconnect the blood administration set from the adapter or hub of venous access device.
        ii. Keep the vein open with normal saline
        iii. Monitor vital signs
        iv. Notify med control or EMS MD if able
        v. Follow **Allergic Reaction Protocol 2.8.1**
2. **Bacterial contamination: Contaminated blood administration**
    a. S/S: chills, fever, chills, vomiting, abdominal cramps, bloody diarrhea, hemoglobinuria, shock, renal failure, DIC.
    b. Tx:
        i. Stop the transfusion. Disconnect the blood administration set from the adapter or hub of venous access device.
        ii. Keep vein open with normal saline
        iii. Hold and send the remaining blood to a laboratory (at receiving hospital if in transit or at transferring hospital if haven't left yet)
        iv. Obtain blood specimen from pt for culture
        v. Administer IV fluids to maintain SBP > 90 mm Hg
        vi. Further orders per med control (transferring MD, receiving MD, or EMS MD)
3. **Febrile transfusion reactions: Sensitivity of the client's blood to white blood cells, platelets, or plasma proteins**
    a. S/S: Temp (as high as 104°F), chills, headache, facial flushing, palpitations, cough, chest tightness, increased pulse rate, flank pain
    b. Tx:
        i. Discontinue the transfusion immediately
        ii. Give antipyretics (Tylenol 650mg to 1 gm po or Ibuprofen 400 – 800 mg po)
        iii. Keep the vein open with Normal Saline
        iv. Notify MD
4. **Hemolytic transfusion reaction: Incompatibility between client's blood and donor's blood.**

a. S/S: Chills, fever, headache, backache, dyspnea, cyanosis, chest pain, tachycardia, hypotension
b. Tx:
    i. Discontinue the transfusion immediately. NOTE: When the transfusion is discontinued, the blood tubing must be removed as well. Use new tubing for the normal saline infusion.
    ii. Keep the vein open with normal saline.
    iii. Send the remaining blood, a sample of the client's blood and a urine sample to the laboratory
    iv. Notify transferring MD, receiving MD or EMS MD as soon as possible
    v. Monitor vital signs
    vi. Monitor fluid intake and output

5. **Circulatory overload: Blood administered faster than the circulation can accommodate**.
    a. S/S: Cough, dyspnea, crackles (rales), distended neck veins, tachycardia, hypertension
    b. Tx:
        i. Place patient upright with feet dependent
        ii. Administer Lasix 20 – 40 mg IV
        iii. Oxygen 2 – 4 L/Min via nasal cannula
        iv. Stop or slow the transfusion
6. **Other adverse reactions to consider and treatment options that may be ordered by transferring facility or Medical Control**
    a. **Bleeding tendencies**: (from low platelets)
        i. S/S: Bleeding and oozing from breaks in the skin or gums, abnormal bruising and petechiae.
        ii. Tx: May be ordered to give platelets, FFP (fresh frozen plasma) or cryoprecipitate, if provided by transferring facility
    b. **Hypocalcemia**: (from citrate toxicity that binds calcium)
        i. S/S: arrhythmias, hypotension, muscle cramping, nausea, vomiting, seizure activity, and/or tingling sensation in the fingers
        ii. Tx:
            1. Slow or stop transfusion
            2. If ordered by medical control (transferring MD, Receiving MD, EMS MD), Calcium gluconate 1 gm IV infused slowly.
    **c. Hypothermia**
        i. S/S: chills, shivering, hypotension, arrhythmias, bradycardia, and/or cardiac arrest if temp falls below 30° C (86°F)
        ii. Tx:
            1. Stop the transfusion,
            2. Warm the patient
            3. Obtain 12 lead EKG
            4. Warm the blood if the transfusion is resumed
    **d. Potassium intoxication (Hyperkalemia)**

i. S/S: Diarrhea, intestinal colic, flaccidity, muscle twitching, oliguria, signs of renal failure, bradycardia, EKG changes (tall peaked T waves, prolonged pr interval, prolonged QRS and/or cardiac arrest). See Hyperkalemia Protocol 2.8.9

ii. Tx:

1. If I-STAT available, obtain blood sample an measure serum K+
   a. Consider Severe Hyperkalemia if: >7.0 mmol/L or 6.0-7.0 mmol/L with EKG changes.
2. Perform 12 lead EKG
3. Administer Albuterol (only) nebulizer
4. Administer Sodium Bicarb 1 amp IV
5. Administer Regular Insulin 20 units IV
6. If Glucose < 200, administer 1 amp of D50W IV
7. Give Kayexcelate 30 gms po or per rectum

**7. Documentation Guidelines**

a. Time and date of reaction
b. Type and amount of infused blood product
c. Patient's vital signs, and all signs and symptoms noted.
d. All specimens collected and sent to laboratory for testing
e. Time MD notified and emergency medical treatment provided, including medication administered, times and dosages, and response to treatment
f. Patient's status at end of the incident.

**Chest Tube – Insertion (MD Only unless otherwise specified)**

**Purpose**: For the most part, unless you have been trained and signed off by the medical director or you are very experienced in this procedure, it will only be done by a physician. You may however be called upon to assist the physician in performing this procedure and therefore must know the steps involved. Unless you are a physician, it can only be performed on the direct verbal order of the medical control physician. It is NOT a routine procedure for any critical care transport team member. It is to be used in an emergency situation to treat a patient with a large pneumothorax prior to transport from a transferring facility or in transit if equipment was sent by the transferring facility and patient's condition is deteriorating. Alternatively, chest needling can be done to alleviate a tension pneumothorax. A chest X-ray must be done prior to leaving a transferring facility (if inserted prior to leaving) or as soon as possible on arrival at receiving facility if done in transit.

**Equipment**: (usually included in a chest tube tray)

1. Body substance isolation equipment, including sterile gloves
2. Scalpel
3. Chest tube 36F – 40F
4. Kelly clamps (curved or straight)
5. Sterile occlusive dressing
6. Suturing material
7. 2% Chlorhexidine
8. Local anesthetic if patient is awake
9. A fluid collection device with a one-way valve that allows air, fluid, or pus to flow out of the chest. If not available, an indwelling catheter bag with a one-way valve may be used
10. Tape
11. Mechanical suction device (not always used)

**Procedure:**

1. Select the appropriate site: midaxillary over the fifth rib
2. Connect the indwelling catheter bag or the collection device to the distal end of the one-way valve with a rubber band. Be certain that the arrow on the one way valve is facing away from the patient.
3. Cleanse the site with the appropriate aseptic technique
4. Anesthetize the area, including the pleura and periosteum, over the fifth rib, if the patient is conscious and time permits. If possible, place the patient in a 30° reverse Trendelenburg (head up) position so blood drains to the low end of the lung.

5. Mark the tube for the desired length of insertion
6. Clamp the distal end of the tube with a large clamp (such as a Kelly clamp) and the proximal end of the tube with a curved clamp
7. Make a 2 – 3 cm transverse incision over the fifth rib in the midaxillary line. If the patient has fractured ribs, use the midclavicular line (between the midaxillary line and the nipple line)
8. Tunnel over the fifth rib with a large curved clamp, push through the pleura, spread the clamp, put a gloved finger into the incision to avoid injury to the other organs and to clear any adhesions, clots, etc..
9. Grasp the clamp attached to the end of the chest tube and advance it through the space created by the first clamp, directing it posteriorly and downward toward the diaphragm.
10. Remove the clamps and advance the tube to the predetermined mark indicated on the tube, at least 5 cm beyond the last hole.
11. Connect the collection device
12. Remove the distal clamp
13. Suture the tube in place and close the wound
14. Note the depth of the tube at the skin (marked on the tube) and mark with a felt-tip pen
15. Cover the insertion site with an occlusive dressing and reinforce all connections with tape.
16. Upon arrival at the receiving facility, obtain a chest X-ray to confirm placement.
17. Document the procedure, including the size of the chest tube inserted, the amount of return of air/fluid after insertion of the tube, and any changes in patient condition (including oxygen saturation).

**Complications**:

1. Laceration or puncture of intrathoracic and or abdominal organs, which can be prevented by using the finger technique before inserting the chest tube
2. Introduction of pleural infection, eg thoracic empyema
3. Damage to the intercostals nerve, artery or vein

a. Converting a pneumothorax to a hemothorax
b. Resulting in intercostals neuritis/neuralgia

4. Incorrect tube placement, extrathoracic or intrathoracic
5. Chest tube kinking, clogging, or dislodging from the chest wall, or disconnection from the underwater-seal apparatus
6. Persistent pneumothorax

a. Large primary leak
b. Leak at the skin around the chest tube; suction on tube too strong
c. Leaky underwater-seal apparatus

7. Subcutaneous emphysema, usually at tube site
8. Recurrence of pneumothorax upon removal of chest tube; seal of thoracostomy wound not immediate
9. Lung fails to expand because of plugged bronchus; bronchoscopy required
10. Anaphylactic or allergic reaction to surgical preparation or anesthetic

**Chest Tube - Post Insertion Management**

**Purpose**: To guide the critical care transport team in managing a chest tube after it was placed in a patient as treatment of a pneumothorax, hemothorax or other pulmonary indication.

**Procedure:**

1. Upon arrival at transfer facility, review most recent chest X-ray to confirm proper placement and functioning of chest tube
2. Auscultate breath sounds for presence and symmetry
3. Make sure all connections are taped or banded with wire to prevent accidental separation
4. Ensure that the dressing over the insertion site is securely taped and occlusive. Use a felt tip marker to mark the depth of the tube; if there are markings, note the depth of the tube on the transfer chart. Make sure the tube is sutured, wired, or taped so it cannot be accidentally pulled out.
5. Maintain the drainage unit below the level of the chest at all times during transport. Many units have bed hangers so that the unit can be hung on the stretcher. If there is water in the unit, keep it upright at all times. If attached to a suction device, find out if the suction can be discontinued for transport; if not, attach to portable suction and/or suction in unit.
6. Tubing should be kept coiled to prevent kinks or dependent loops.
7. Asses and document bubbling in the water seal (does not have to be continuous), any output in the collection chamber, and its type (eg, frank blood).
8. Do not clamp tubes for transport. This is likely to cause a tension pneumothorax.
9. Continuous bubbling may be a sign of tracheal-bronchial laceration. Large amounts of frankly bloody drainage need to be balanced by transfusion.
10. Should chest tube be connected to a one way Heimlich valve, assure connection is tight. Monitor valve for continued proper function.
11. Assess breath sounds periodically and document findings.

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**Emergency Escharotomy**

**Purpose**: Patients with circumferential burns of a limb are at risk for vascular compromise. Circumferential burns to the torso can limit chest excursion and compromise respirations. It is imperative that an escharotomy is performed to increase chance of salvage of a limb and/or the patient. Escharotomy is a procedure in which an incision is made through the stiff edematous burned skin to restore mobility to the chest or circulation to an extremity. Note: Most burn specialists discourage the use of field escharotomy **unless** absolutely and immediately necessary to preserve life or limb.

**Equipment**:

1. Scalpel
2. Pain medication
3. Sedation
4. Sterile dressing
5. 4" X 4" gauze pads

**Procedure**:

1. Prepare your equipment
2. Administer sedation and pain medications. Burns that cause such injuries are deep and destroy nerve endings; therefore, this procedure can be performed without anesthesia.
    a. Versed 2 mg IV initially then titrate 1 mg increments till sedated
    b. Morphine 4mg IV initially then 2 mg increments up to 10 mg. Call med control if more is needed

       Or

       Fentanyl 50 mcg IV, can repeat x 1 then call med control if more is needed.
3. Maintain aseptic technique
4. Determine a well-defined incision pattern. The incision should be of sufficient depth for an obvious release in pressure on the skin and for fat to bulge through the incision.
    a. For the chest, an incision is made along both anterior axillary lines and may also be performed transversely.
    b. For an extremity, an incision is made parallel to the bone. A single incision may be sufficient for an extremity
    c. Hand escharotomies are performed with incisions in the medial and lateral surfaces of each finger and of the palm
5. Incise the derma of the burned tissue. Built-up pressure should cause the tissue to open even more.

6. Prepare to manage bleeding
7. Apply a sterile dressing over the incision.

**Hemodynamic Monitoring/Central Vascular Access Lines**

**Purpose**: There will be occasions when a critical care transport team is called upon to transport a patient who is in need of or has in place one or more invasive monitoring or central vascular access lines. The purpose of these invasive and/or central vascular access lines are to monitor a patient's hemodynamic status or for administering fluids and/or medications. The insertion of central vascular lines or invasive monitoring lines is restricted to qualified physicians or designated personnel (requires considerable skill and practice), and is beyond the scope of a critical care transport paramedic. Although the majority of transports will only require careful monitoring and maintenance of the central line to prevent accidental removal, it is imperative that members of the critical care transport team be familiar with the use and care of such lines. Critical Care Team Members must be familiar with the methods for using each type of catheter and have the knowledge to interpret the data provided. They must also be familiar with common complications involved with these invasive catheters, including what must be done if the catheter is prematurely removed.

Keep in mind, physical assessment techniques, such as capillary refill, skin color, skin turgor, skin temperature, lung sounds, heart sounds, and mental status, should coincide with high-tech invasive hemodynamic measurements.

The following type of invasive monitoring/vascular access lines will be discussed:

1. Central Venous Lines (for measuring CVP)
   a. Monitoring of the CVP is used to determine right ventricular preload and intravascular volume status and to assess right heart function.
2. Arterial Lines (for measuring Arterial Blood Pressure and sampling arterial blood for ABGs)
3. Pulmonary Artery Catheters (Swan-Ganz) (for measuring pulmonary artery pressure/right ventricular pressure and pulmonary capillary wedge pressure)

**Procedure**:

**1: General Management of Central IV Lines/Invasive monitoring catheters**:

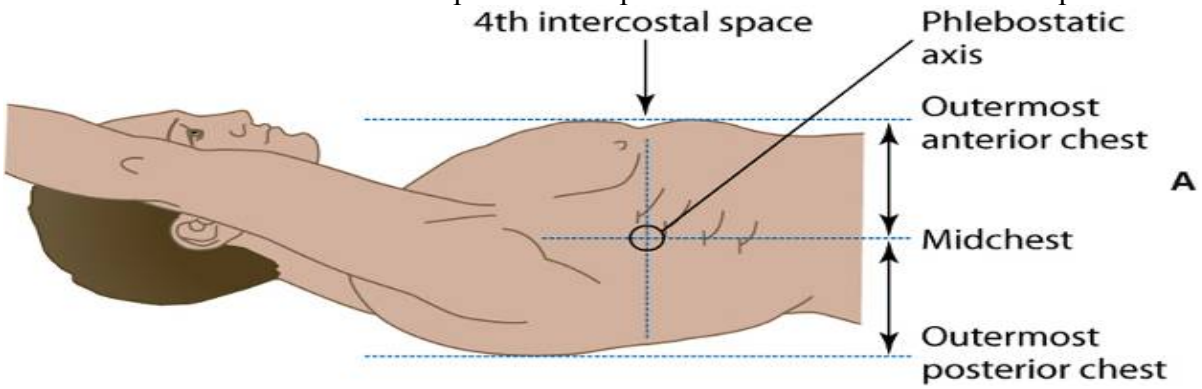
A. Mandatory cleansing of hands via washing with soap and water and/or with alcohol-based skin gel before and after contact with a central vascular access/invasive monitoring line/site.
B. Use aseptic technique throughout
C. Upon patient contact, note the values being displayed and trace the tubing from each transducer to the pressure monitoring catheter it is connected to.

D. Inspect the insertion site of the invasive catheter/central vascular access line. Check for redness, swelling, bleeding, and patency. If unable to directly visualize site, ascertain from nursing staff the patency and condition of the insertion site based on last dressing change.
E. Be sure you are familiar with the operation of the stopcocks and catheters in use, if not, ask the nurse to give you a bedside review of its proper use.
F. Re-dress or keep insertion site covered with a sterile dressing.
**G. Secure the external portion of the central vascular/invasive monitoring catheter to patient with tape, kling, or other method to prevent accidental removal during transport or movement of patient.**
H. Review most recent chest x-ray or x-ray report to confirm proper placement/position of the line (if in the chest). Confirm no pneumothorax.
I. Before loading patient onto CCT stretcher, take note of location/level of any transducer/monometer. Have nurse assist in getting a pressure reading prior to moving patient.
J. Move one pressure cable at a time to the transport monitor, ensuring that wave forms and values are similar to those that were displayed on the hospital monitor.
**K. Review written transfer orders and check for orders that pertain to:**
    **a. Management of the central catheter/monitoring line in transit.**
        **i. If none found, question the nurse or MD if any orders need to be given for the management of the line.**
    **b. Desired values/pressure readings during hemodynamic monitoring and what steps to take (or adjustment in medications to make) if the values fall outside the desired parameters. These must be clearly understood before leaving the transferring hospital.**
L. Re-assess the catheter/line/setup each time the patient is moved to assure no change in position.
M. Pressure transducers MUST be re-leveled with every position change of the patient
N. Mark the skin at the referencing level also called the phlebostatic axis.
O. If possible, secure the transducer to the phlebostatic axis
P. All medications and/or IV fluids used to treat critical patients MUST be on an IV pump and dosed as per physician orders.
Q. In general, to accurately obtain invasive pressure measurements, it is important to take the readings at the end of expiration.
R. Should an invasive line come completely out of a patient, apply direct pressure to the insertion site and hold until bleeding stops. Keep in mind holding pressure over an arterial site may take longer to control the bleeding.
S. DO NOT attempt to replace a catheter that dislodges but does not come completely out of the patient.
    a. Check for patency by attempting to aspirate blood from each of the lumens to determine if each remains in a blood vessel.
    b. Options for continued use should be discussed with MD.

**2: Leveling and Zeroing the pressure transducers:**

A. All invasive monitoring lines that utilize a pressure transducer must be leveled and zeroed to obtain a proper pressure reading. To accurately measure pressure, equipment must be referenced and "zero" balanced to environment and dynamic response characteristics optimized

B. Reference point for the placement of the transducer is the phlebostatic axis:




**C.** The transducer must be re-leveled with every position change of the patient; therefore, this point is often marked on the patient's skin

- **a.** For each inch that the transducer is leveled above the phlebostatic axis, readings will be 1.86 mm Hg less than the actual pressures in the patient
- **b.** For each inch that a transducer is leveled lower than the phlebostatic axis, the reading will be 1.86 mm Hg higher than actual.

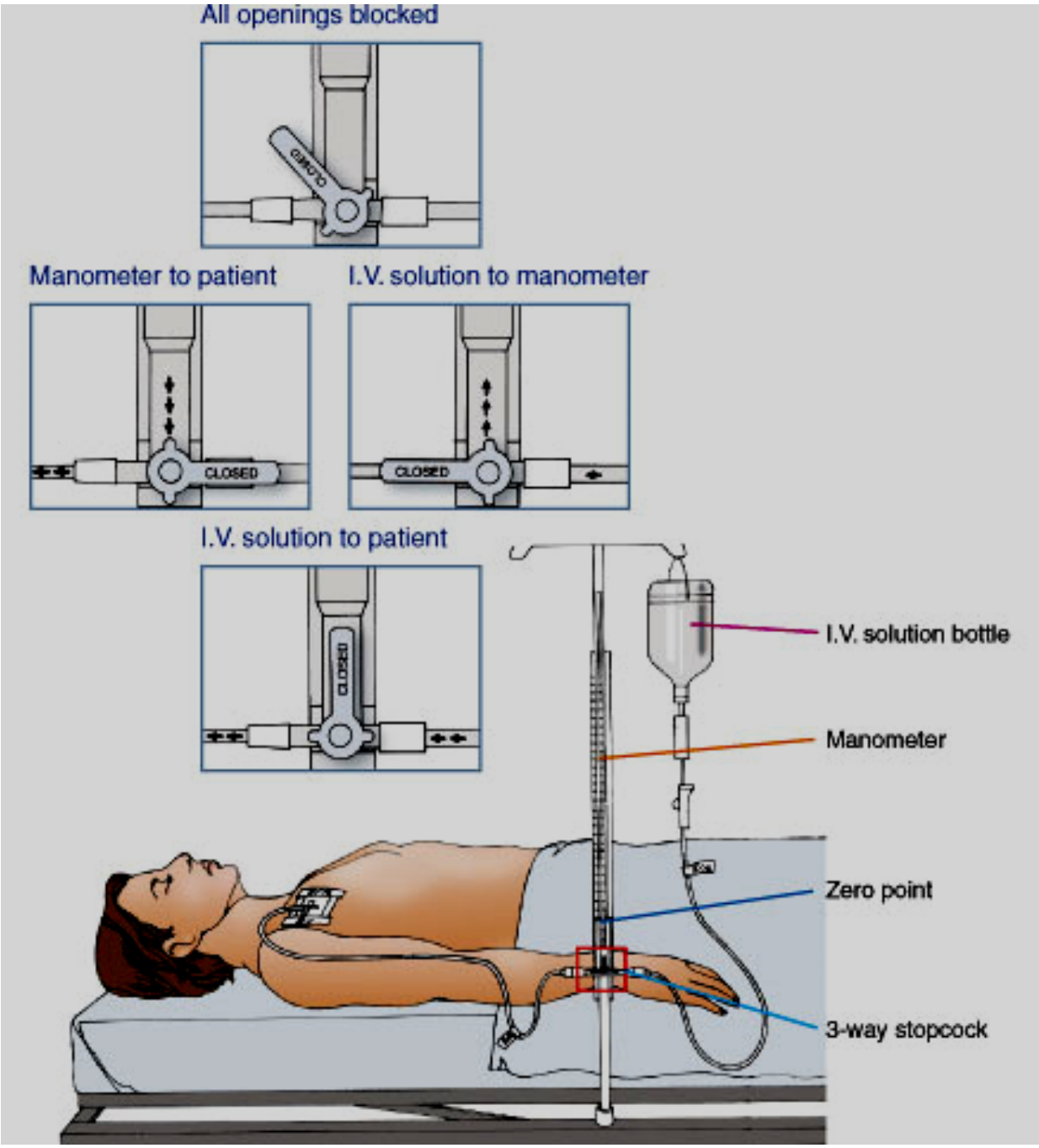
**D.** The simplest way to ensure proper placement during transport is to secure the transducer at the phlebostatic axis.

**E.** Zeroing:

- **a.** Process in which a transducer connected to the transport monitor is opened to the atmospheric air to obtain a baseline reading of pressure in the environment.
- **b.** Ensure the cable is connected to the monitor
- **c.** Close the stopcock to the patient, open the stopcock to the air
- **d.** Press the zero button on the monitor
- **e.** Confirm the monitor has accepted the zero value and actually indicates zero on the pressure and waveform display
- **f.** Zeroing should be performed:
  - **i.** Immediately after connecting the transducer to the transport monitor at transferring facility
  - **ii.** With any significant change in the altitude/elevation greater than 1 atm. Zero when at cruising altitude and again after descent.
  - **iii.** Whenever displayed values are in question
  - **iv.** When transducer has been disconnected from pressure cable or pressure cable has been disconnected from monitor

**3: Manual Measuring CVP via Central Venous Lines:**

A. CVP measurement should be obtained at the end of expiration for accuracy.
B. If measuring manually with a manometer, be sure the zero point on the manometer is level with the mid-axillary line on a supine patient. (see diagram)
C. Turn stop cock off to patient and allow the manometer to fill with IV fluid.
D. Turn stop cock off to IV fluid and allow the fluid in the manometer to flow into patient.
E. Take measurement at end of expiration when the level in the manometer reaches level where it stops flowing.
F. Record measurement
G. Turn stop cock off to manometer and resume IV fluid administration at desired rate.
H. Secure manometer to prevent accidental disconnect or injury to patient
I. In general:
    a. Elevated CVP (> 10) can be from
        i. Positive pressure ventilation
        ii. Increased peripheral vascular resistance
        iii. Hypervolemia
        iv. Right sided heart failure
        v. Cardiac tamponade
        vi. Tricuspid insufficiency
        vii. Significant vasoconstriction
        viii. Pulmonary embolus
        ix. Obstructive pulmonary disease
    b. Low CVP (<2) can be from
        i. Hypovolemia
        ii. Significant vasodilation
J. Follow written orders from transferring physician when measurements fall outside of normal parameters.


All openings blocked
CLOSED
Manometer to patient
CLOSED
I.V. solution to manometer
CLOSED
I.V. solution to patient
CLOSED
I.V. solution bottle
Manometer
Zero point
3-way stopcock

**4: Arterial Blood Pressure via an Arterial Line:**

a. Continuous arterial pressure monitoring ("Art line") use for patients experiencing acute hypertension and hypotension, respiratory failure, shock, neurologic injury, coronary interventional procedures, continuous infusion of vasoactive drugs, and frequent ABG sampling.
b. Arterial line set up (see figure next page) should include a bag of IV normal saline enclosed in a pressure bag (pressurized to 300 mm Hg) and connected to special arterial line tubing with a pressure transducer.
c. Level and Zero Transducer (as described in II above):

d. Take special care/precaution to protect the attached tubing/pressurized bag of IV fluid and catheter from damage or accidental removal from patient.
e. If arterial line is connected to a monitor for continuous monitoring of blood pressure, record measurements in patient care record q 10 – 30 minutes as indicated by the severity of patient condition.
f. High- and low-pressure alarms set based on patient's current status. Measurements obtained at ***end expiration*** to limit effect of respiratory cycle on arterial pressure.
g. To help maintain line patency and limit thrombus formation, patient should have in place a continuous flush irrigation system that delivers 3 to 6 ml of IV fluid per hour.
h. Assess neurovascular status distal to arterial insertion site hourly. Neurovascular impairment -result in loss of a limb-an emergency.
i. Inquire from transferring facility medical staff if arterial line needs to be flushed via the pigtail or squeezable flush system during the transport, and if so, how frequently.

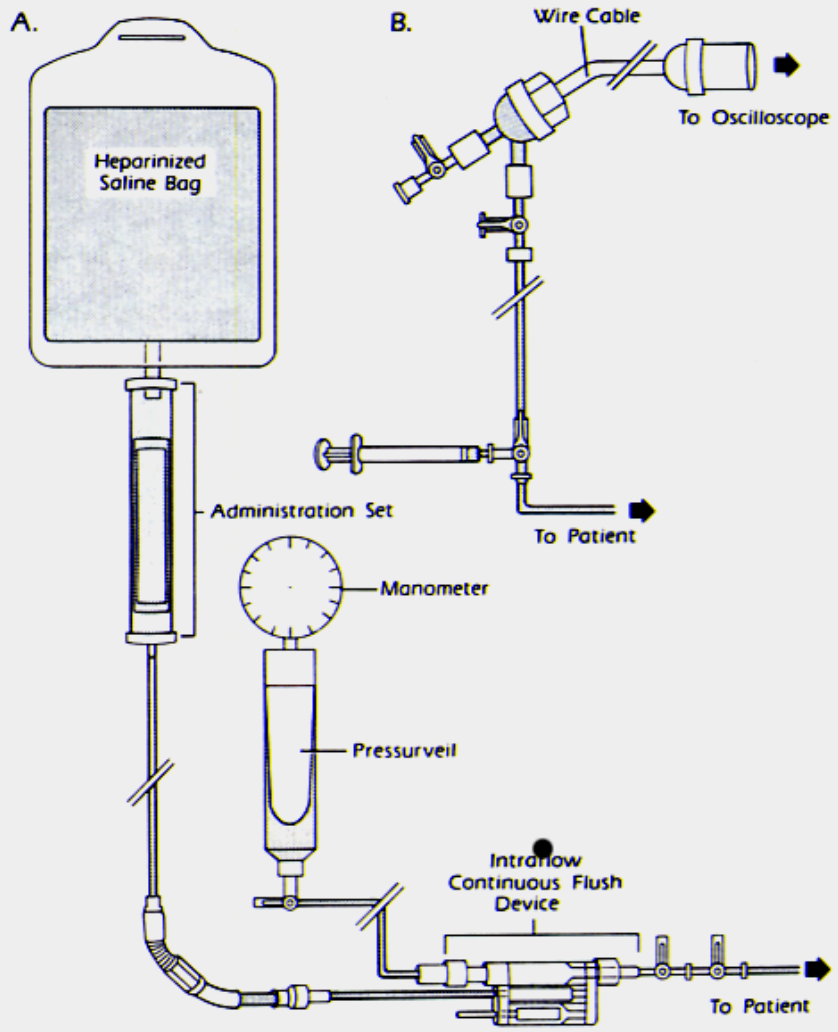
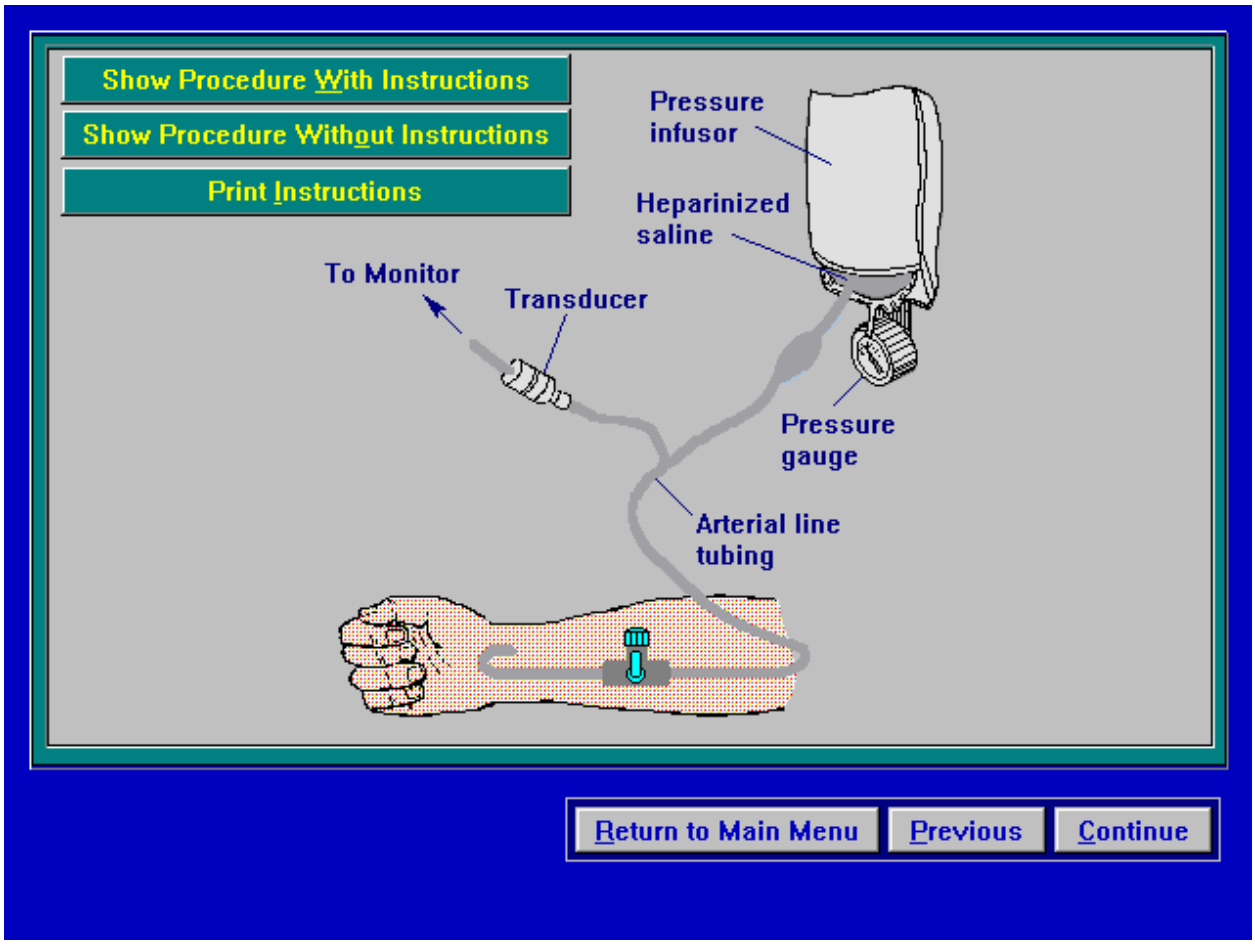


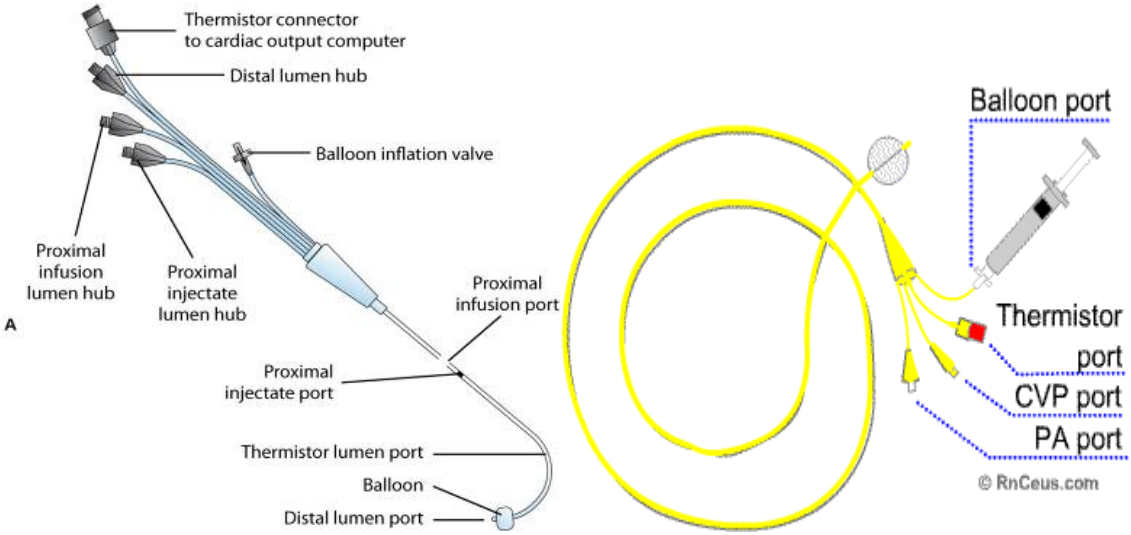

***Figure 19–3.*** Arterial pressure monitoring systems. *A*, System for continuous flush. Heparin (2 ml of 1:1000 unit solution) is added to a 1-liter bag of normal saline, and the bag is pressurized to 300 mm Hg using a metered blood pump (not shown). The continuous flush device is set to deliver 3 ml of the heparinized saline per hour. A mechanical pressure transducer (Pressurveil, Concept Co.) is depicted. The transducer device is a sterile, inexpensive, fully assembled monitor that can be used during patient transfer. Alternatively, the electronic transducer depicted in *B* may be used. *B*, System for manual flush. A heparinized saline flush solution can be injected manually through a syringe at the proximal or distal port. The transducer dome should be maintained at the level of the patient's heart. (From Beal JM (ed): Critical Care for Surgical Patients. New York, Macmillan Publishing Co, Inc., 1982. Reproduced by permission.)


Show Procedure With Instructions
Show Procedure Without Instructions
Print Instructions
Pressure infusor
Heparinized saline
To Monitor
Transducer
Pressure gauge
Arterial line tubing
Return to Main Menu
Previous
Continue

**5: Pulmonary Artery Catheter/Swan-Ganz Catheter**: **(Measurements will be per Critical Care Nurse familiar with procedure)**

A. General Considerations:
Pulmonary artery (PA) pressure monitoring, guide acute-phase management of patients with complicated cardiac, pulmonary, and in intravascular volume problems. Normal PA (pulmonary artery pressure- PAP) pressure: 20-30 mmHg systolic and 8-12 diastolic usual is 25/10; mean is 15 mm Hg; increased systolic in pulmonary HTN, increased diastolic from ventricular failure; decreased PAP with hypovolemia, shock.

1. PA diastolic (PAD) pressure and PAWP-sensitive indicators of cardiac function and fluid volume status-routinely monitored.
2. Monitoring PA pressures-allows precise therapeutic manipulation of Preload- allows CO to be maintained without placing patient at risk for pulmonary edema.
3. PA flow-directed catheter (e.g., Swan-Ganz)- measure PA pressures**,** including PAWP




a) Distal lumen port (catheter tip) placed within PA, used to monitor PA pressures and sample mixed venous blood specimens (e.g., to evaluate oxygen saturation).
b) Additional lumens-exit ports in right atrium or right atrium and right ventricle (if two).
c) Right atrium port- used for measurement of CVP, injection of fluid for CO determination, and withdrawal of blood specimens.
d) If a second proximal port available-used for infusion of fluids and drugs or blood sampling.
e) Thermistor (temperature sensor) lumen port located near distal tip-for monitoring blood or core temperature; used in

thermodilution method of measuring CO.

f) During initial assessment, note the centimeter measurement of the PAC at the introducer and document in your run report.

B. Two of the lumens are connected to pressure transducers that continuously display measurements.
   **1.** RA pressure:
   **2.** Pulmonary artery pressure (when balloon is deflated) and pulmonary capillary wedge pressure (when balloon is briefly inflated)
C. Connect the transducers to the monitor
D. Zero the transducers
E. Monitor pressure in pressure bag frequently (especially if flying), maintain at 300 mm Hg..
F. If transfer will involve air medical transport, expel all the air left inside of the fluid bag that will be in the pressure bag to prevent expansion during flight.
G. PA measurements-obtained at end of expiration.
   1. Chronic elevation due to;
      i. right heart failure
      ii. pulmonary hypertension
      iii. atrial/ventricular septal defect
      iv. Hypervolemia.
   2. Elevation of the pulmonary diastolic pressure due to
      i. Tachycardia
      ii. Pulmonary emboli
   3. Acute/sudden elevation due to hypoxemia and hypercarbia
   4. Decrease pulmonary artery diastolic pressure seen with hypovolemia
H. PAWP measurement-**obtained by slowly inflating balloon with air (balloon capacity usually 1 – 1.5ml) until PA waveform changes to a PAWP waveform; balloon-** *not inflated for more than four respiratory cycles* **or 8 to 15 seconds- *inflation of balloon blocks pressure from behind (wedging)- allows measurement of pressure generated by left ventricle=** Pulmonary Artery Wedge Pressure (PAWP**).** Measure at end of expiration
   1. Patient – Peak
   2. Ventilator – Valley

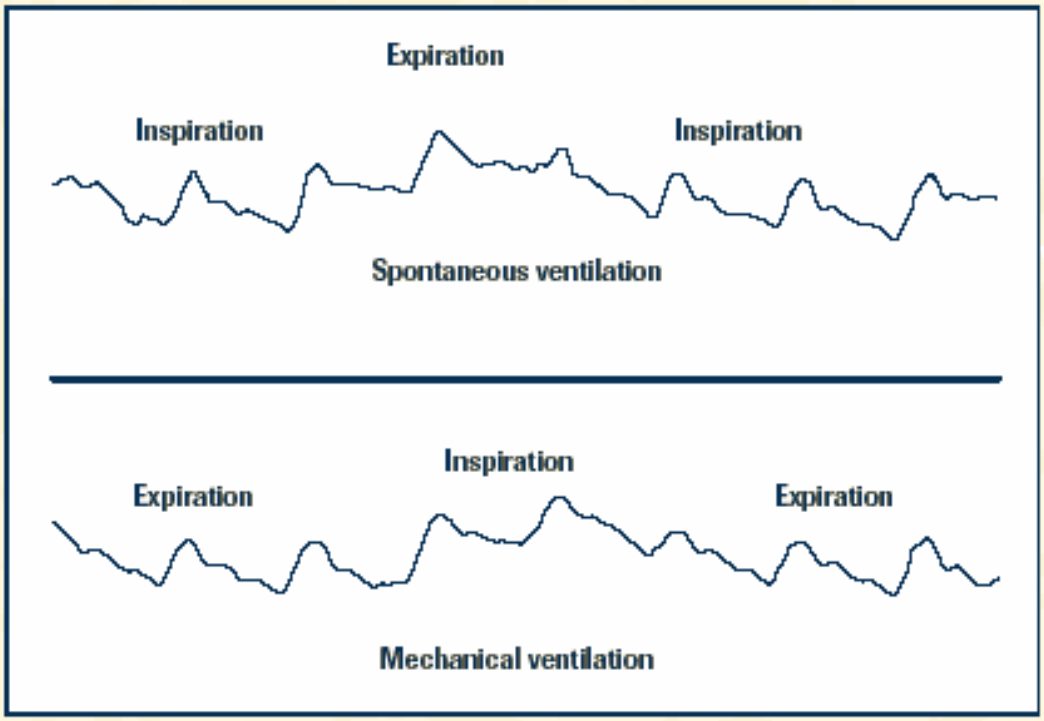
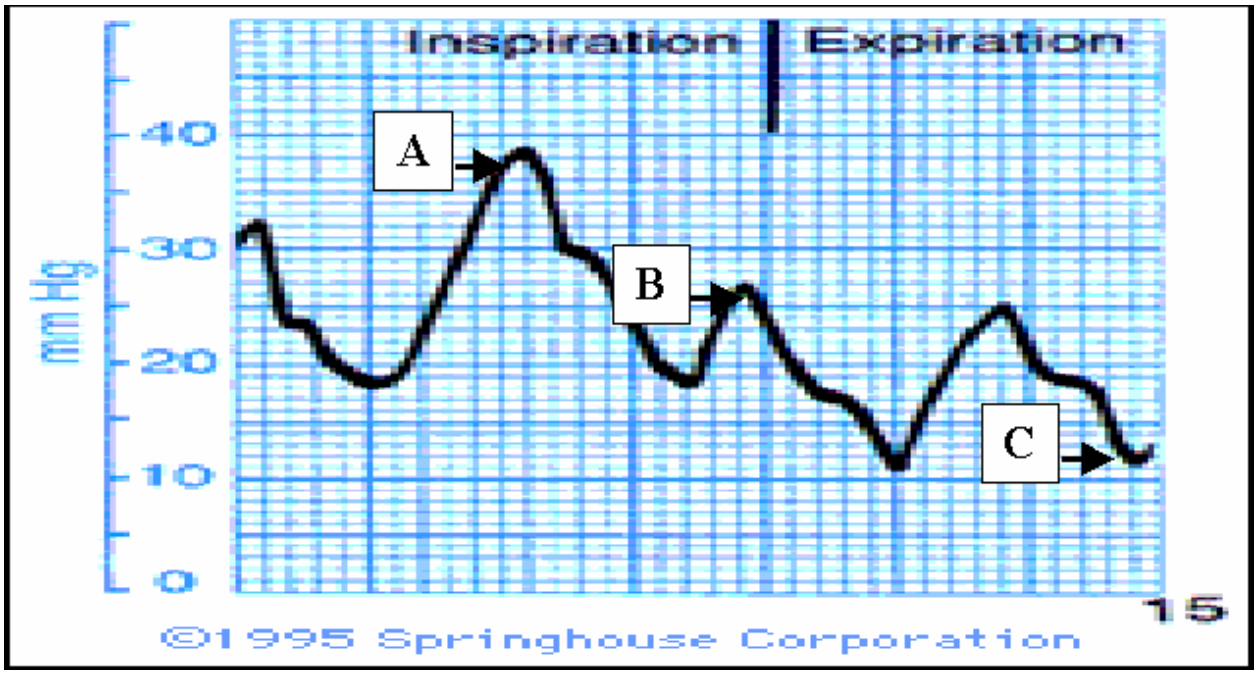


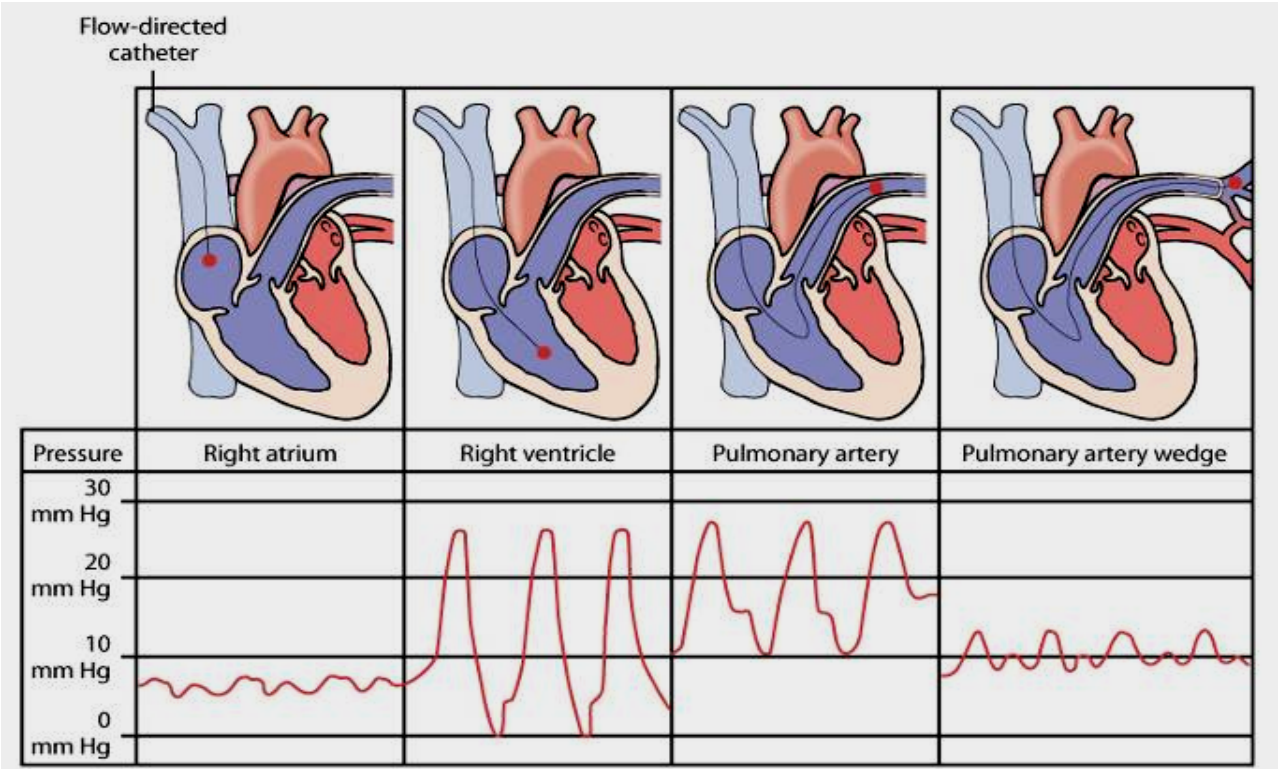

**Figure 2.** These figures show how spontaneous and mechanical ventilation affect PA catheter tracings.




If patient above were being ventilated, measure pressure at "C".

3. Elevated PCWP
    i. Hypervolemia
    ii. Left ventrical failure
    iii. Mitral valve disease
    iv. > 18 mm Hg potential for pulmonary edema
    v. High PEEP
        1. For every 5 cm H2O of peep, subtract 1.5 from measured PCWP. This is the corrected PCWP

4.




1) Assesses left ventricular function
2) **Normal PAWP: 6–12 mm Hg** (slightly different values various sources; average value)-**Reflects preload of the LV or LVEDP;** equal to PA diastolic if no pulmonary problems
3) Inc. PAWP due to left ventricular failure, mitral valve problems, hypervolemia and pericardial tamponade
4) Decreased PAWP due to low stroke volume, hypovolemia, shock

I. Common hemodynamic measurements and the method obtained

1. Central Venous Pressure (central line or PAC)
2. Systemic Blood pressure (arterial line)
3. Diastolic Blood pressure (arterial line)
4. MAP (arterial line, calculated or computed)
5. Pulse Pressure (arterial line, calculated)
6. Pulmonary artery pressure (systolic, diastolic, and mean) (PAC)
7. PCWP (PAC)
8. CO (PAC)
9. Pulmonary vascular resistance (PAC, Calculated)
10. SVR (PAC, calculated)
11. Stroke volume (PAC, calculated)
12. Mixed venous oxygen saturation (PAC)
13. Total body surface area
14. Cardiac index (PAC, calculated)

## Normal Ranges and values for Hemodynamic Measurements

| Assessment Parameter | Normal Range/value |
|---|---|
| CVP, mm Hg | 2 to 6 |
| SBP, mm Hg | 100 to 120 |
| DBP, mm Hg | 60 to 80 |
| MAP, mm Hg | 70 to 105 |
| Pulse pressure, mm Hg | 40 to 60 |
| Heart rate, mm Hg | 60 to 100 |
| Pulmonary artery pressure, systolic | 15 to 30 |
| Pulmonary artery pressure, diastolic | 8 to 15 |
| PCWP | 4 to 12 |
| CO, L/min | 4 to 8 |
| Pulmonary vascular resistance, dyne-sec/$cm^{-5}$ | 100 to 250 |
| SVR, dyne-sec/$cm^{-5}$ | 800 to 1,200 |
| SV, ml/beat | 60 to 100 |
| $Svo_2$, % | 60 to 80 |
| $Scvo_2$, % | ≥ 70 |
| Cardiac Index, L/min/$m^2$ | 2.5 to 4.2 |
| Stroke volume index, ml/beat/$m^2$ | 30 to 50 |

**Abbreviations**: CO, cardiac output; CVP, central venous pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; PCWP, pulmonary capillary wedge pressure; SBP, systolic blood

pressure; Scvo2, mixed central venous oxygen saturation; SV, stroke volume; Svo2, mixed venous oxygen saturation; SVR, systemic vascular resistance

## 6. Useful formulas for Critical Care Transport Teams

### A. Cardiac Output

**CO = SV X HR**

Or using the Fick Principle

**CO = Oxygen consumption ÷ Arteriovenous Oxygen Content Difference**

Using: 1. BSA
2. Hemoglobin level
3. Arterial Oxygen saturation (from bld gas) or O2 sat from pulse ox

To Calculate CO:

1. Calculate the oxygen consumption based on presumed 125 ml of oxygen consumed per square meter of BSA (1.25 x BSA)
2. Calculate the arteriovenous oxygen content difference. Each gram of hemoglobin can carry 1.36 ml of oxygen. Hence the difference is expressed as follows:

1.36 x hemoglobin x (Arterial Saturation – Venous Saturation) x 10

3. Divide the calculated oxygen consumption by the calculated arteriovenous oxygen content difference to produce the estimated CO in liter per minute. NOTE: Venous saturation is blood gas sample drawn from pulmonary artery port.

### B. Cardiac Index:

**Cardiac Index = CO ÷ BSA**

**Estimating body surface area**

| weight kg | SA m2 | weight kg | SA m2 | weight kg | SA m2 |
|---|---|---|---|---|---|
| 0.7 | 0.07 | 12 | 0.56 | 38 | 1.23 |
| 1.0 | 0.10 | 13 | 0.59 | 40 | 1.27 |
| 1.6 | 0.14 | 14 | 0.62 | 42 | 1.32 |
| 2.0 | 0.16 | 15 | 0.65 | 44 | 1.36 |
| 2.6 | 0.19 | 16 | 0.68 | 46 | 1.40 |
| 3.0 | 0.21 | 17 | 0.71 | 48 | 1.44 |
| 3.6 | 0.24 | 18 | 0.74 | 50 | 1.48 |
| 4.0 | 0.26 | 19 | 0.77 | 52 | 1.52 |
| 4.5 | 0.28 | 20 | 0.79 | 54 | 1.56 |
| 5.0 | 0.30 | 22 | 0.85 | 56 | 1.60 |
| 5.5 | 0.33 | 24 | 0.90 | 58 | 1.63 |
| 6.0 | 0.35 | 26 | 0.95 | 60 | 1.67 |
| 7.0 | 0.38 | 28 | 1.00 | 65 | 1.76 |
| 8.0 | 0.42 | 30 | 1.05 | 70 | 1.85 |
| 9.0 | 0.46 | 32 | 1.09 | 75 | 1.94 |
| 10.0 | 0.49 | 34 | 1.14 | 80 | 2.03 |
| 11.0 | 0.53 | 36 | 1.19 | 90 | 2.19 |

**C. Mean Arterial Pressure**

$$MAP = DBP + 1/3\ (SBP - DBP)$$

**D. Pulse Pressure**

$$\text{Pulse Pressure} = SBP - DBP$$

**E. Pulmonary Vascular Resistance**

$$PVR = \frac{(\text{Mean Pulmonary Artery Pressure} - PCWP)}{CO} \times 80$$

**F. Systemic Vascular Resistance**

$$SVR = \frac{(MAP - CVP)}{CO} \times 80$$

**G. Stroke volume**

$$SV = CO \div HR$$

## H. Stroke Volume Index

**Stroke Volume Index = SV ÷ BSA**

**Intracranial Pressure Monitoring (ICP)**

**Purpose**: The transferring MD may only require that you take care of the ICP device and not necessarily monitor the ICP in transit. Care must be taken not to accidently dislodge it.

The primary goals of ICP monitoring are identification of ICP trends and evaluation of therapeutic interventions to minimize ischemia in the brain-injured patient. ICP monitoring allows for early detection of intracranial hypertension (> 15 mm Hg) and subsequent aggressive management.

Recall MAP – ICP = CPP where MAP is mean arterial pressure, ICP is intracranial pressure and CPP is cerebral perfusion pressure. If the ICP rises too high, it will decrease the CPP. The goal is for the cerebral perfusion pressure to be maintained between 50 to 70 mm Hg. In order to achieve this, the critical care transport team may be given orders from the transferring facility on parameters to maintain the ICP and if necessary, drain off fluid to lower the ICP if it rises.

Signs and Symptoms:

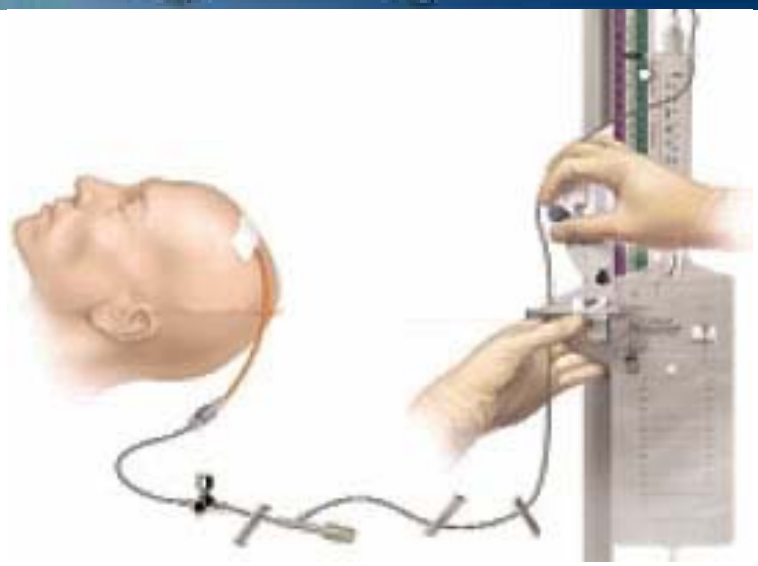
1. Cushing's triad (widening pulse pressure, bradycardia, and abnormal respiratory patterns)
2. Hypertension
3. Increased respiratory rate
4. Pulmonary edema

**Procedure:**

1. Equipment:
    a. External drainage system with mounting card
    b. Pressure tubing with 48" pressure tubing
    c. Sterile 0.9% sodium chloride (NaCl) with sterile 20 ml syringe
    d. Pressure monitoring cable
    e. IV tubing
    f. Bag-Valve Mask and 100% oxygen source
    g. Cardiopulmonary monitor
    h. BSI attire.
2. MUST use aseptic technique at all times.
3. If using the CORDIS EDS DEVICE (most commonly used)

   a. Assemble the Cordis EDS as instructed per the package insert and per the mounting card diagrammatic instructions, using 0.9% NaCl to flush the system. Place the 48" tubing, with connected pressure transducer, on the plastic mounting card.
   b. Avoid tension or kinking of the pressure monitoring cable
   c. Place the patient in a semi-fowler's position and position the zero reference point at the outer canthus of the eye
   d. Obtain the ICP waveform on the cardiopulmonary monitor. Turn the stopcock nearest the patient so that the ICP waveform is visualized.
   e. Zero the transducer at the distal stopcock
   f. Record the ICP on the printer and mark and post the strip. Calculate and record the CPP on the strip.
   g. For continuous drainage, turn the stopcock nearest the patient so that drainage resumes and pressure monitoring is discontinued. Note: It is recommended that pressure monitoring and CSF drainage not be done simultaneously.
   h. Maintain a clean and intact dressing. If the dressing is soiled or contaminated, change it using a sterile technique.
4. If other type of monitoring system and/or external drainage system is in use, the CCT team MUST review the equipment with the transferring staff and be absolutely confident in their capability of monitoring the ICP and or draining the CSF as ordered by the transferring MD.
5. The physician's order for drainage must include a pressure reading either in mm Hg or cm $H_2O$ and the height (as marked on mounting card) at which the drainage cylinder must be maintained.
6. The zero reference point for ICP monitoring always remains the outer canthus of the eye.
7. **Only small amount of CSF (not to exceed 3ml) should be drained at one time. Rapid cerebral decompression from CSF over-drainage may result in herniation.**
8. Simultaneous drainage and pressure monitoring are not recommended
   a. To ensure precise pressure measurements, perform only pressure monitoring while keeping the stopcock closed to the drainage system
9. Precautions:
   a. Tight connections must be maintained
   b. System must remain free of air
   c. Never use a flush device for ICP monitoring
   d. Use only sterile 0.9% NaCl to fill the pressure tubing.
   e. Never use a heparinized solution
   f. Must maintain proper leveling and zeroing of system
   g. Care must be taken when turning or positioning patient to avoid accidental decannulation or disconnection of the tubing.
   h. Maintain HOB at 30° to 45° head-up
   i. If monitor

10. You may be given other orders and provided medications to administer to manage the increased ICP during transport including:
    a. Intubate and mechanically ventilate the patient. Do no hyperventilate the patient unless he or she acutely deteriorates.
    b. Administer an osmotic diuretic such as Mannitol
    c. Administration of dexamethasone or methyprednisolone
    d. Maintain blood pressure to systolic of less than 150 mm Hg
    e. If surgical drain (bolt) has been installed, you may be ordered to drain CSF if the ICP is greater than 20cm $H_2O$
    f. If patient with intracranial hemorrhage was on Coumadin, you may be requested to give fresh frozen plasma or platelets (provided by the transferring facility)



# INTRA-AORTIC BALLOON PUMP TRANSPORTS (Must be certified to operate)

**Purpose:** To guide the critical care transport team in transporting a patient on an Intra-Aortic Balloon Pump. At least one member of the critical care team MUST be a certified perfusionist, critical care nurse trained to operate an Intra-Aortic Balloon Pump console, or other person certified to operate the IABP Console on all IABP transports.

**Equipment**:

The following equipment should be available for IAB transports:

1. IABP with transport module
2. Appropriately sized balloon catheters with insertion kit (Only if qualified personnel will be accompanying the transport team to use this)
3. Spare Helium tank (200 psi)
4. Operator's manual
5. Stopcocks
6. 60-ml syringe (Luer tip)
7. Skin electrodes
8. IABP extension tubing
9. Doppler ultrasound device (to assess distal pulses)
10. Extra EKG cables
11. 2" cloth tape to secure IABP EKG electrodes and catheter to patient
12. Arterial pressure monitoring transducer and setup
13. Pressure transducer cables
14. Arterial flush solution (500 ml NS with 1,000 U of heparin)
15. Adapters to fit other brands of balloon catheters to the IABP console
16. Knee immobilizer
17. Soft restraints

**Policy**:

**General Guidelines**:

1. When entering the facility to transport a patient receiving IABP therapy, visually assess the surroundings to ensure that hallways, elevators and routes of travel will accommodate necessary equipment and personnel.
2. Obtain patient report
3. Ascertain current IABP settings and note typical pressures (console systolic, diastolic, augmentation, and mean arterial pressures)
4. Determine IABP catheter model, size, and insertion depth (measurement at insertion site). **Know and document the insertion depth prior to moving**
5. Ascertain that the balloon tip location has been verified by chest x-ray.
6. Conduct an assessment. IABP focus includes inspection of the insertion site for active bleeding, peripheral pulses in both lower extremities (may require doppler confirmation), and a radial pulse in the left upper extremity (to ensure subclavian blood flow)

7. Attach new EKG leads and secure each lead over the electrode with 2" cloth tape. This step will prevent lead disconnection and potential loss of trigger during transport.
8. Ensure the IAB tubing and catheter are taped securely to the patient's leg, however**, DO NOT TAPE THE IAB CATHETER AND THE IAB TUBING TOGETHER AT THE CONNECTOR. IF THE IAB TUBING IS ACCIDENTLY PULLED, IT IS BETTER FOR THE BALLOON CATHETER TO SEPARATE FROM THE TUBING AT THE CONNECTOR THAN FOR THE BALLOON TO BE PULLED OUT WITH THE TUBING.**
9. Apply a knee immobilization splint to the leg in which the IAB was inserted to prevent leg flexion during transport
10. Ensure that the appropriate connectors to attach the IABP to the transport console are available. Determine the console that will be used at the receiving facility, and be certain to take any necessary adapters or connectors (usually included in the IAB insertion kit)
11. Move the patient to the transport stretcher. Connect and secure all pumps, monitors, ventilators, and other equipment. Do not elevate the head of the bed greater than 30 degrees.
12. Transfer the IABP to the transport console at the bedside or in the transport vehicle (if the IABP console is mounted in the vehicle)
13. Establish power to the transport IABP console
14. Open the helium tank, and verify pressure.
15. Follow the IABP console instructions for start-up (on console help screens or in the manufacturer-provided user manual)
    a. Establish EKG and pressure waveforms from the patient
    b. Confirm initial pump settings
    c. Set timing
    d. Initiate IAB pumping
    e. Set console alarms
    f. Confirm all pump settings
16. Optimize IABP timing in the 1:2 mode
    a. Set inflation by adjusting inflation to a later time until the dicrotic notch becomes visible, then move inflation to an earlier time until a crisp V pattern appears at the dicrotic notch
    b. Set deflation to achieve the lowest possible diastolic pressure while maintaining maximal augmentation.
17. Assess pressures every 5 minutes or with any changes in the patient's condition during transport. Check the insertion site and pulses every 15 minutes.
18. Restrain and sedate patient as needed
    a. Use soft restraints prn to protect patient from causing harm if he is confused and may pull at tubes, etc.
    b. Can sedate with Versed 1 – 2 mg IV prn up to 6 mg to keep sedated.
19. If patient being transported by air,

a. Verify if IABP Console has ability to compensate for altitude changes
b. switch to AUTO FILL mode (if available)
c. If no auto-fill capability, the IABP operator can manipulate the extent to which the balloon inflates to make it safer. The manual fill must be performed at the same intervals that an auto fill would occur.

20. Document parameters q 15 minutes or prn change in patient status
21. Monitor for complications frequently
    a. Bleeding at insertion site
    b. Frequently compare left radial pulse to right radial pulse to assess if catheter has moved cephalad (balloon may have occluded left subclavian artery)
    c. Monitor depth of catheter
    d. Watch for sudden decrease in urine output (balloon may have occluded renal arteries)
    e. Check pulses in distal extremity where catheter is inserted

NOTE: if any complication occurs, contact medical control (transferring MD, receiving MD, or EMS MD) immediately for assistance or see below

## IABP EMERGENCY INTERVENTIONS:

### Console Failure:

If the IABP console becomes disabled, manual inflation and deflation should be performed as soon as possible. The balloon must not remain idle (ie, immobile) in a patient for more than 30 minutes. To manually inflate and deflate the IAB Catheter:

1. Disconnect the IAB from the male Luer end of the extension tubing
2. Attach the three-way stopcock and 60 ml syringe to the IAB catheter's male Luer. **Warning: Never inject air into the central lumen (female Luer hub).**
3. Aspirate to ensure that blood is not returned through the extracorporeal tubing. **Warning: If blood is aspirated from the male Luer fitting of the extracorporeal tubing, immediately remove the IAB catheter owing to damage to IAB.**
4. Inflate the IAB with 40 ml of air or helium, and immediately aspirate. Repeat every 5 minutes while IAB is inactive.

### Cardiac Arrest:

1. Switch the IABP trigger to pressure mode.
2. Initiate CPR
3. Provide standard ACLS and BCLS resuscitation, including defibrillation, if indicated

4. Once return of spontaneous circulation occurs, MAP is adequate (> 60 mm Hg), and the EKG rhythm is stable, return the IABP trigger to EKG mode

**Balloon Rupture or Leak**:

1. Inspect IAB tubing frequently for blood in air channel
   a. If blood detected inside gas lumen of catheter, IABP therapy should be discontinued immediately
   b. Catheter should be disconnected
   c. If signs/symptoms of gas embolus are present, place patient in the left lateral recumbent position
   d. Administer high flow oxygen
   e. Transport to nearest appropriate facility
2. If gas alarm sounds on console
   a. Assess patient and tubing, check connections
   b. If source of leak cannot be determined then assume an IAB leak is possible.

NOTE: Fever and tachycardia can cause a gas loss alarm to sound.

**Depletion of Helium**:

1. If console indicates "empty tank", verify the tank valve is open
2. If tank requires changing, close the valve on depleted tank and replace with full one. Be sure the washer is in position between the tank and the regulator (similar to an oxygen tank)

**Excessive Bleeding;**

1. Apply direct pressure to insertion site.
2. Consult med control (Transferring or receiving MD or EMS MD) for consideration to discontinue infusion of anticoagulation medications
3. If bleeding cannot be controlled, divert to the closest appropriate facility.

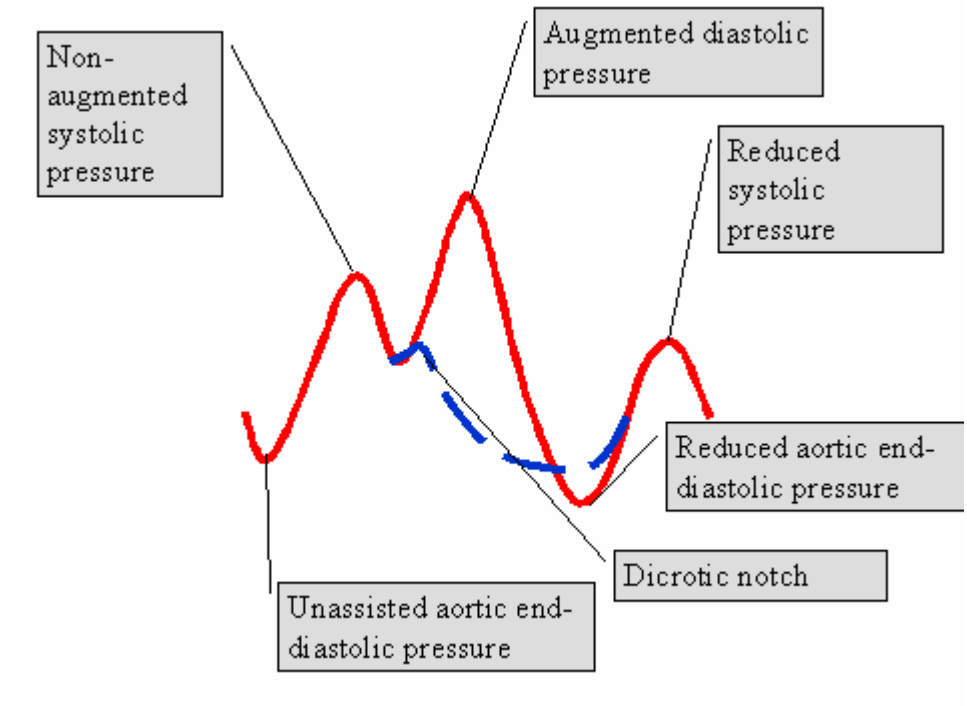
**Catheter Migration or Accidental Removal:**

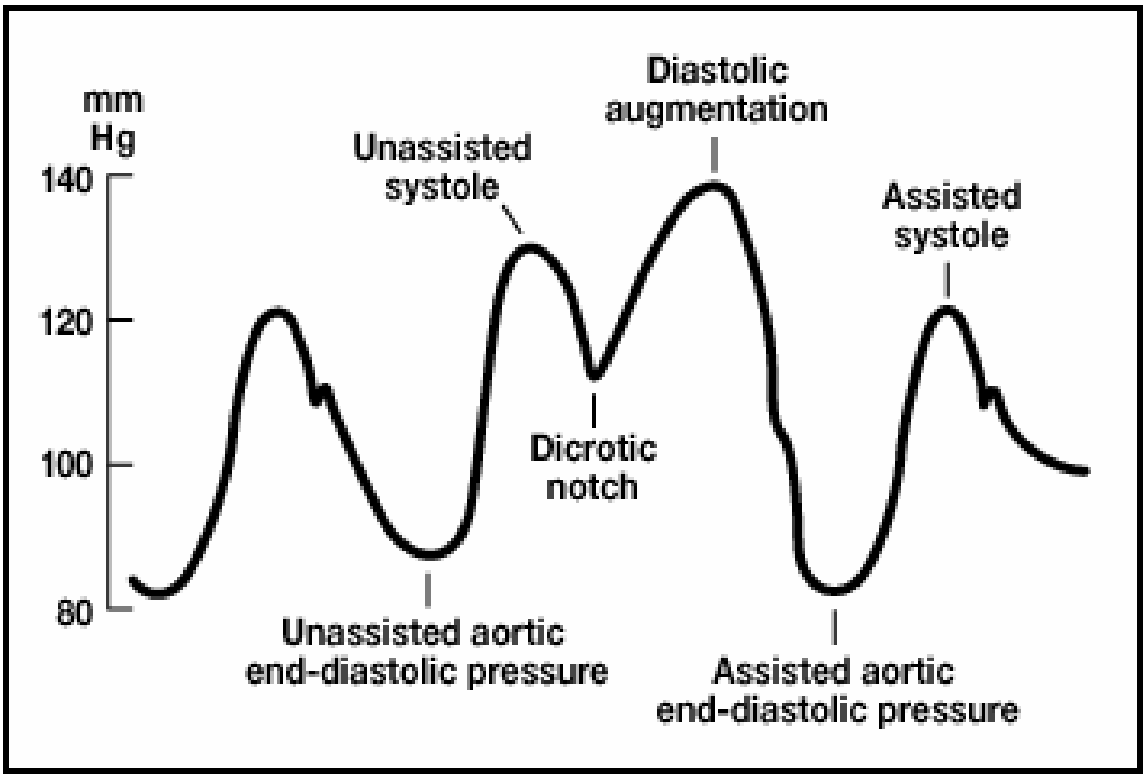
1. IAB catheters have sterile sheaths that allow for the adjustments of the insertion depth without contaminating the catheter
2. If catheter has moved significantly but has not become dislodged or disconnected from the sterile sheath, The IABP should be placed on standby mode (pumping stopped) and the catheter reinserted to the appropriate depth (same level as when patient was picked up)
   a. Significant accidentally movement of more than a few cm should not be adjusted without consulting med control (transferring MD, receiving MD, or EMS MD).
3. If movement of catheter occurred at the referring facility;
   a. Request a chest X-ray prior to transport to verify the location of the cath

b. Consult the MD who inserted cath to re-evaluate position

4. If significant movement/migration or accidental removal occurred during transport, consider discontinuing IABP therapy after consulting with medical control

## IAB timing of inflation/deflation in relation to wave forms;




mm
Hg
140
120
100
80
Unassisted
systole
Diastolic
augmentation
Assisted
systole
Dicrotic
notch
Unassisted aortic
end-diastolic pressure
Assisted aortic
end-diastolic pressure

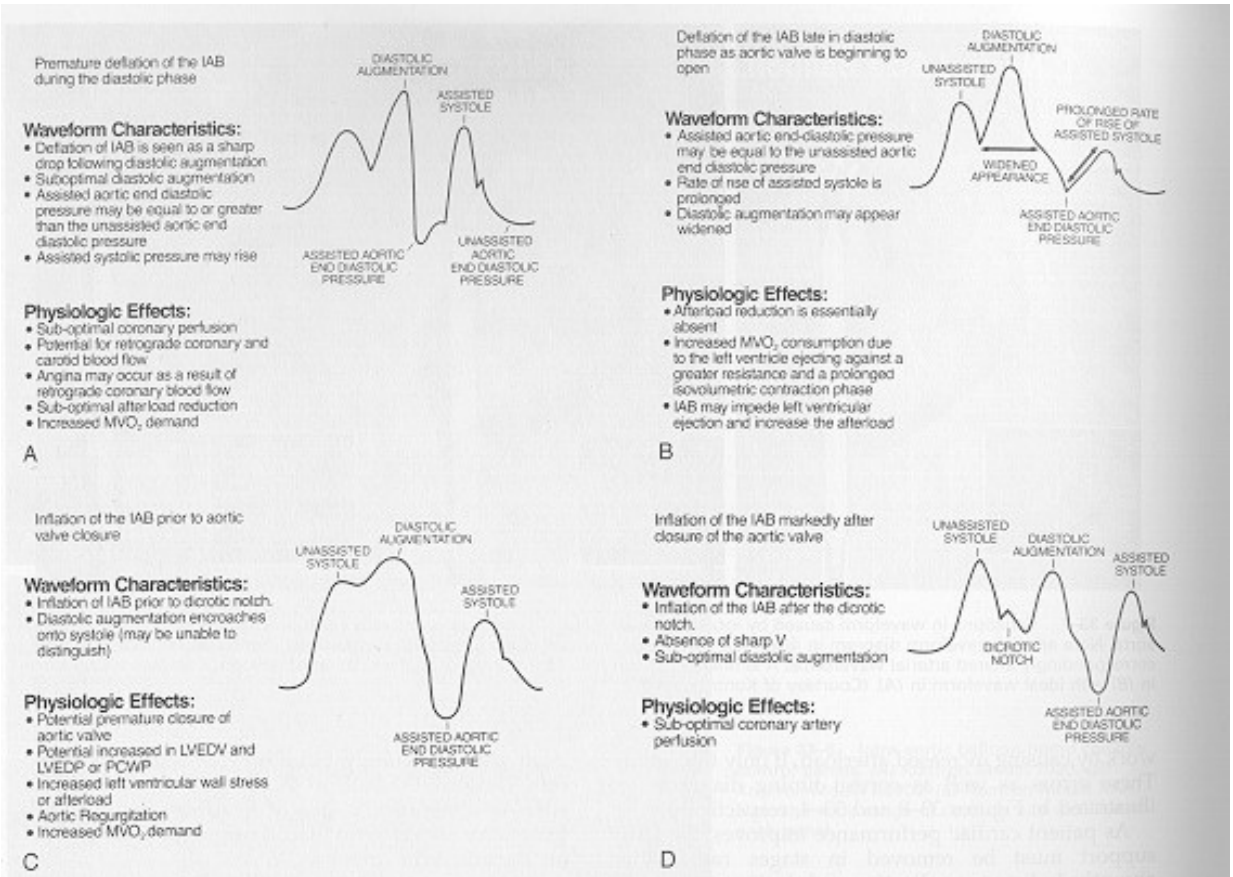
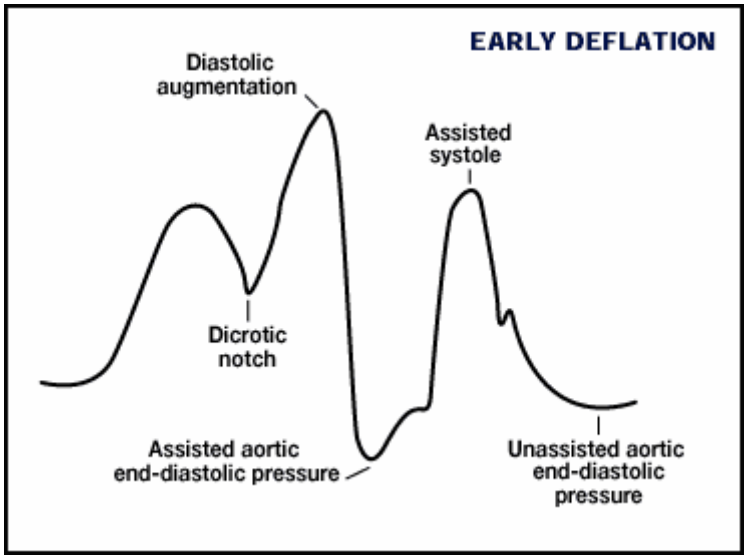



**Figure 33–8.** Alterations in arterial waveform tracings caused by errors in timing of IABP. *(A)* Balloon deflated too early. *(B)* Balloon deflated too late. *(C)* Balloon inflated too early. *(D)* Balloon inflated too late. (Courtesy of Datascope Corporation.)



*Devices*

## Ventricular Assist Devices (VADs)

**Uses**: Implantable external heart pump used to treat patients with debilitating heart failure
May be used in patients who are not candidates for heart transplant as well as those awaiting transplant

**FAQs**: There are many types of VAD units; some have pulses (usually pulse will not be in sync with the patient's rhythm) and some are continuous flow units resulting in no pulse

**Complications:**

**VAD Pump Failure:** Need to initiate hand pumping at a rate of 60-90 strokes/min; may be a Bi-VAD with two pumps

**VAD Working-Blood Flow Low-ECG Abnormal:**
Usually with a single VAD device; patient's function is influenced by arrhythmia-may need to treat the rhythm if patient is symptomatic LVAD (Left-sided VAD) patient may require large amounts of IV fluids RVAD (Right-sided VAD)patient should not get IV fluids

**VAD Working-Blood Flow Low-ECG Normal:**
Hypovolemia; could be internal bleeding. If symptomatic initiate appropriate therapy to treat cause of hypovolemia

**Procedures:**

***If need to transport a STABLE patient…* Heart monitor:**
***ECG may not match pulse***
**Large bore IV should be started**
**Bring companion with patient if available who is able to hand pump the VAD if needed**
**Bring backup equipment: Hand pumps, extra batteries, primary and backup drivers, if available**

**Special Considerations:**

***Need to ask patient:***

1. Can I perform CPR on you?
2. IF not-is there a hand pump?
3. If the device slows down-will alarms go off for low flow state?
4. How can I speed up the device?
5. Does patient need heparin if the device slows down?
6. Can patient be defibrillated while connected to the device?
7. If can be defibrillated, do I need to disconnect anything first?
8. Does the patient usually have a pulse with the device?
9. What are acceptable vital sign parameters?

10. Can patient be externally paced?

**Contact Patient's Cardiac Care Team ASAP for problems and prior to transfer**
**Unstable VAD patients should be transferred with a higher level of care**

NOTE:

1. A critical care RN with specialized VAD training or a perfusionist should always accompany a patient with a cardiac assist device during transport
2. Be sure all the necessary adapters, connectors, and charging units accompany the patient during transport.
3. Most VAD (Ventricular Assist Device) have some ability to be manual operated using a hand or foot pumping accessory in case of mechanical or power failure. Be certain that such emergency equipment also accompanies patient.
4. Request from the transferring facility, specific guidelines in the event of cardiac arrest. With some VAD it is inadvisable to perform CPR. Treatment of arrhythmias either pharmacologically or with defibrillation is typically attempted before consideration of CPR.

## I-STAT

Protocol pending

## Pericardiocentesis (MD procedure only, Medic may assist)

**Purpose**: For the most part, unless you have been trained and signed off by the medical director or you are very experienced in this procedure, it will only be done by a physician. You may however be called upon to assist the physician in performing this procedure and therefore must know the steps involved. Unless you are a physician, it can only be performed on the direct verbal order of the medical control physician. It is an invasive technique that may allow restoration of adequate cardiac output by relieving pericardial tamponade.

**Indication**:

Emergency relief of pericardial tamponade with:

- Severe hemodynamic compromise
- Shock state refractory to; fluid loading, chest decompression, and pharmacological intervention.
- Cardiac Arrest

**Contraindications**

None

**Complications**:

1. Cardiac Dysrhythmias
   a. Ventricular Fibrillation
   b. Asystole
2. Pneumothorax
3. Hemothorax

**Procedure**:

1. Place patient in the supine position or torso elevated 20 – 30 degrees
2. Prepare the skin with Betadine or Chlorhexidine
3. Select a 4-inch 16-gauge needle with 35 cc syringe attached.
4. Insert the needle between the xiphoid process and the left costal margin at a 30 – 45 degree angle to the skin.
5. Advance the needle toward the left shoulder, aspirating constantly. A distinct “give or “pop” may be felt as the needle enters the taut pericardium. Contact with the epicardium may produce a “scratchy” sensation, or dysrhythmias.
6. Grossly bloody fluid from the pericardial space should not clot.
7. Reassess the patient.

NOTE: If a pericardiocentesis was performed at the transferring facility, they may have placed a catheter into the pericardial sack with a stopcock attached to the external end of

the tubing. The transferring MD should give you specific orders as to when to open and drain a given amount of fluid/blood from pericardial sack if condition deteriorates.

*Devices*

# Temporary Cardiac Pacing

**Uses:** To ensure adequate heart rate;
Most common use is for symptomatic bradycardia or heart block

**Adverse Effects:**

Problems related to transvenous/transthoracic insertion: pericardial tamponade, pneumothorax, myocardial perforation, air embolus sepsis and thrombophlebitis

Failure to pace due to: displacement of pacing electrode (most common complication), loose connection, faulty generator, myocardial ischemia

Failure to sense due to: patient's native beats not sensed by the pacemaker and the output pulse may occur after a spontaneous beat which may induce dysrhythmias

Catheter induced dysrhythmias

**Pacer Box Settings:**

**Rate control**: usually between 60-100 beats/minute

**Output:** (electric current used to stimulate myocardium): usually between 5-20 mAmps

**Sensitivity control**: used to sense heart's native electrical activity (QRS deflection)

**Special Considerations:**

- Monitor heart rhythm.
- A functioning pacemaker usually reveals a pacer spike followed by a bundle branch pattern on the monitor strip
- Contact MC if develops a bradycardia with no pacer spikes or non capturing of the QRS; consider initiating transthoracic pacing if patient is unstable

*Devices*

## Tracheostomy Care

**Uses:** Inadequate airway
Respiratory Insufficiency
Excessive secretions
Need for prolonged mechanical ventilation

**Adverse Effects:**
Dislodgement of tracheostomy tube
Obstruction of tube or stoma
Malfunction of mechanical ventilator or loss of O2 supply

**Procedures: Suctioning:**
Sterile gloves
Suction with 120-150mmHg (adults); 80-100mm Hg (pediatric)
Hyperventilate with 100% O2
Suction up to 10 seconds (adult); up to 3-4 seconds (pediatric)
If mucus plugs/thick secretions-may instill 3-5cc sterile saline

**Bronchodilator Administration:**
Assemble nebulizer assembly as usual
Attach trach collar to reservoir tubing
Connect to oxygen source at a flow rate sufficient to produce misting
Fit trach collar over stoma and have patient breathe slowly and deeply

**Stoma Intubation:**
Select largest tube able to fit in stoma without force; cuffed for adult, uncuffed for pediatric
Sterile gloves
Hyperventilate with 100% O2
Suction, if necessary.
Pass the ET tube and inflate the cuff.
The tube will protrude several inches.
Hold the tube and watch for chest rise with ventilation; secure the tube.
Auscultate the lung fields.
Check for subcutaneous emphysema.
Allow no longer than 30 seconds for the procedure.

**Special Considerations:**
Avoid oral intubation if possible
**DO NOT USE DEMAND VALVE WITH BVM!**

*Devices*

## Vascular Access

**Uses:** Specialty vascular access in patient with problematic access or requiring frequent infusion of medication or parenteral nutrition

**Adverse Effects:**

Line infection can cause bactermia/sepsis Complications can be related to insertion of line such as pneumothorax, hematomas, vascular rupture

**Different Types:**

**Triple Lumen Central Venous Catheter:**

Can be in Femoral, Internal Jugular or Subclavian location Usually red hub is for blood draws-it is typically the most certain line of the three ports in emergency situations

**Indwelling Catheter External Access (Broviac, Hickamn, Groshung) catheters:**

Usually placed in Subclavian region
Usually contains heparin; draw 10 mL waste before infusions

**Implanted ports (Part-a-cath, Bard Port):**

Require Huber needle to access

**Shiley:**

Usually used for dialysis Usually contains heparin; draw 10 mL waste before infusions, then flush with saline if needed in emergency situations

**Peripherally Inserted Central Catheter (PICC) line:**

Location usually in the antcubital regions Usually contains heparin; draw 10 mL waste before infusions

**Special Considerations:**

STERILE TECHNIQUE is imperative!
**Only to be accessed in emergency situations**

## VENTILATOR ASSIST PROCEDURE

**Purpose:** From time to time EMS will be called upon to transport patients whose ventilations are being assisted by a mechanical ventilator. Ventilators are used to provide respiratory support for patients who are unable to effectively breathe on their own. This protocol will guide the caregiver in maintaining proper settings involved in providing adequate ventilatory assistance to the patient.

**Indication**:

1. Continuation of ventilator controlled respirations on chronic ventilator dependant patients
2. Assist/Control ventilations on any intubated patient in respiratory failure/arrest that is being transported to a care facility.

**Adverse Effects/Complications**:

1. Increased intra-thoracic pressure
2. Decrease venous return to the heart and decrease cardiac output (hypotension, tachycardia)
3. Increased V/Q ratio (ventilation/perfusion ratio)
4. Decrease blood flow to the kidney with resultant fluid retention (edema)
5. Air trapping and intrinsic PEEP (auto PEEP)
6. Barotrauma
7. Nosocomial infections of the lungs and sinuses
8. Respiratory alkalosis
9. Agitation and increased respiratory distress
10. Increased work of breathing

**General Comment**: There are many commercial ventilators on the market. Most of the ventilators used in the pre-hospital settings are fairly simple to use. Most if not all have built-in safety features, which prevent over inflating the lungs and causing barotrauma. Everyone must be familiar and in-serviced on the particular ventilator being used.

**General Ventilator settings for transport ventilators**:

For the most part, there are a few settings that are common/standard to all ventilators:

1. **$FIO_2$** (Percent of inspired oxygen (room air is 21%): **21% - 100%.** Titrate to maintain pulse ox between 92% - 94%
2. **Tidal Volume**: **7 – 10 ml/kg** (ideal body weight)
3. **Select Mode**: CPAP, Intermittent mandatory ventilation (IMV, Synchronized Intermittent mandatory ventilation (SIMV)

   a. To manage work of breathing, use assist/control mode. If patient is paralyzed and sedated, there is no difference between assist control (AC) and SIMV
4. **Respiratory rate**: **Set between 10 – 12 breaths/minute**. Selection varies on ventilators to accommodate a range of patient ages and conditions.
   a. NOTE: On some ventilators, inspiratory flow rate (usually 40 – 60 L/second) is determined by tidal volume, respiratory rate, and in the inspiratory: expiratory (I: E) ratio. (The I: E ratio is generally 1:2 to allow for complete exhalation and prevent air trapping). On other ventilators, flow rate is independently set, which allows adjustment of air-flow to the flow wave pattern that is most comfortable for the patient. If the patient is having difficulty with spontaneous breathing, increasing the flow rate may be indicated. However, a higher flow rate means a shorter inspiratory time and usually a higher respiratory pressure secondary to increased resistance, with a lower flow rate requiring a longer inspiratory time with a decreased inspiratory pressure. The paramedic should always consult with medical control before changing the flow rate on any ventilator device.
5. **Adjust the peak flow rate or inspiratory time** to accommodate the patients inspiratory flow demand and to allow for sufficient expiratory time and avoidance of auto-PEP
6. **Adjust the sensitivity to -1cm H2O**
7. **Pressure suppor**t: Usually set at **10 cm $H_2O$**
8. **PEEP (Positive End Expiratory Pressure): Usual setting is 5 cm $H_2O$**

**Procedure**:

**Patients already on Ventilator**

1. As part of your initial patient assessment inquire if patient has any spontaneous respiratory effort or is 100% dependant on the ventilator
2. Make note of patient's vital signs before any change over occurs. This includes the pulse ox.
3. Assess the ET tube or Trachea tube placement to assure they are properly secured
4. Acquire the patient's current ventilator settings from the nurse or RT caring for the patient. Try to match these settings on the transport ventilator to be used (do this before patient is switched to transport ventilator).
   a. IF unable to match the settings and there is a significant discrepancy, contact medical control for assistance.

5. Patient should already be on cardiac monitor and pulse ox prior to switching ventilators.
6. Depending on reason for transport and patients condition, IV access should be considered.
7. Have an Ambu-Bag and suction available for unexpected emergencies

8. Switch patient over to the transport ventilator and observe for any distress. It may take a minute or so for the patient to become accustomed to the new ventilator. If necessary, ventilate with an ambu bag for several minutes.
9. Closely monitor pulse ox, signs of labored respirations, chest rise for any signs of hypoxia/distress. Remove patient from ventilator and assist respirations with an Ambu-bag if there are ANY concerns or problems with ventilation after patient was switched to transport ventilator.
10. Once patient has been switched to the transport ventilator and is tolerating this well, then move patient over to the EMS stretcher for transport.
11. If alarm on ventilator sounds, immediately check patient. Reasons for alarm:
    a. Low Battery/power source: sounds when electrical supply to the ventilator is inadequate or the gas inlet pressure is low. It is corrected by restoring the proper power supply.
    b. Low-pressure alarm:
        i. Leak or disconnection (reconnect or tighten connections)
        ii. Cuffed tube may be leaking
        iii. Check $O_2$ supply (self explanatory
    c. High-pressure alarm:
        i. Ventilator uses too much pressure to deliver the tidal volume
            1. Bronchospams
            2. Secretions in airway that increased the resistance/pressure in airway (suction airway)
            3. Kinks in ET tube (unkink tube)
            4. Biting on ET tube
            5. Coughing
            6. Gagging
            7. Breathing asynchronously or bucking the vent
            8. Alveolar over distention
            9. Improper ventilator settings (High or low tidal volumes, excessive rate causing stacking and auto PEEP) (Consult medical control for change)
            10. Water in the ventilator tubing (disconnect the tubing, empty water, reconnect tubing)
            11. Pneumothorax (notify hospital to set up for this if you are en route. If tension pneumothorax, go to that protocol)
            12. Patient anxiety (contact medical control for sedation order)
    d. IF unable to identify the cause of the ventilator alarm and/or patient's condition deteriorates, disconnect from ventilator and assist respirations via the Ambu-bag.
12. Upon arrival at the care facility, follow above steps when transferring from EMS stretcher to care facility stretcher. Report any problems to the accepting staff.
13. Document vent settings used, vital signs, pulse ox, any changes in the patient's condition during transport

14. Contact medical control during any of the above steps for assistance as needed.

***Intubated patients not on ventilator***

1. Ventilate patient with ambu-bag till ventilator can be set up
2. Patient should: be on Monitor, pulse ox, IV access, have suction available
3. Initial vent settings: (Call medical control as soon as possible to verify or assist with settings)
    i. $FIO_2$: 100% then titrate to pulse ox of 92 – 94%
    ii. Tidal Volume: 7 – 10 ml/kg
    iii. Be aware: If patient is a tight asthmatic, has severe COPD or has had prior lung surgery (partial lung removed), use smaller tidal volume (7 ml/ kg) and faster rate to maintain pulse ox.
    iv. Rate: Adult 10 – 12 bpm, Children 12 – 24, pre-school 20 - 30
    v. Pressure support: 10 cm $H_2O$ (if available on ventilator)
    vi. Peep: 5 cm $H_20$ (if available on ventilator)
4. Monitor patient/vital signs/pulse ox for signs of adequate ventilations
5. If any distress or concerns, remove from ventilator and assist respirations with ambu-bag.
6. If ventilator alarm sounds, see step 11 above
7. En-route to hospital; notify the staff so they can have a ventilator set up on your arrival.

Document vents settings, vitals, pulse ox, patient response.

## X. Critical Care Drugs

The following category and list of drugs are commonly used on critical care patients during transport. This list does not in any way represent all of the drugs that may be involved in treating a critical patient, but are some of the more common drugs used.

a. Cardiovascular Drugs

i. Antiarrythmic Drugs

ii. Beta Blockers

iii. Blood Pressure Lowering Drugs

iv. Calcium Channel Blockers

v. Glycoprotein Iib/IIIa Inhibitors

vi. Heparin Drip

vii. Inotropes

viii. Nitroglycerine Drip

ix. Thrombolytic Therapy Cardiovascular Drugs

*Cardiovascular Drugs*

# Anti-arrhythmics

**Use:** Treatment and cardioversion of Atrial Fibrillation or Atrial Flutter
Treatment and prophylaxis of refractory Ventricular Tachycardia

**Adverse Effects:**
Hypotension, QT prolongation, Torsades, Ventricular Tachycardia AV Block

**Dosing:**

**Flecainide (Tambocor)**
Infuse: 2 mg/kg over 20 minutes

**Ibutilide (Corvert)**
Infuse: 1 mg IV over 10 minutes

**Magnesium Sulfate**
Bolus: 1-2 grams over 5 minutes
Infusion: 6-12 grams over 24 hours

**Propafenone (Rhythmol)**
Bolus: 2 mg/kg in 15-20 minutes; followed by
Infusion: 0.0067 -0.0078 mg/kg/minute

**Special Considerations:**

- Use infusion pump for drips.
- May not be compatible with heparin, lidocaine, amiodarone or bicarb Frequent BP checks for hypotension
- Increased risk for ventricular dysrhythmias if on certain antihistamines or anti-nausea medications

**Transport by CCPs, RNs only**

*Cardiovascular Drugs*

# Beta-Blockers

**Uses:** Slow ventricular response in SVT, Atrial Fibrillation and Atrial Flutter
Slow sinus node rate

**Adverse Effects:**
Hypotension, bradycardia
Hypoglycemia (diabetics on medications); usual signs and symptoms are masked
Bronchospasm
Sinus node arrest

**Dosing:**

**Atenolol (Tenormin)**
Infuse: 5 mg over 5 minutes
May be repeated in 10 minutes

**Esmolol (Brevibloc)**
Bolus: 500 mcg/kg (0.5 mg/kg) over one minute
Infusion: 50 mcg/kg/minute for 4 minutes

If inadequate response, repeat bolus and increase drip rate by 50 mcg/kg/minute up to 3 times **(total dose of 2000 mcg bolus and in fusion @ 200 mcg/kg/minute)**

Drug comes in a 100 mg (10 mg/ml) vial or 2500 mg ampule into 250 ml (10 mg/ml) or 500 ml (5 mg/ml) NS or D5W

**Labetalol (Normodyne)**
Infusion: 2 mg/minute (concentration 1mg/ml; 2ml/min) duration from 25 minutes to 2.5 hours

**Metoprolol (Lopressor)**
Inject: 2.5 mg IV slow push over 2 minutes May repeat dose up to 5 times every 5 minutes for a **total dose of 15 mg**

**Sotolol (Betapace)**
Bolus: 1-1.5 mg/kg; followed by
Infusion: 0.008 mg/kg/minute = 8 mcg/kg/min

**Special Considerations:**

- Use infusion pump
- Check BP frequently; monitor heart rate
- Carefully monitor for hypotension, excessive bradycardia or new AV blocks
- Patient with DIABETES may have symptoms of hypoglycemia masked; watch carefully for mental status changes
- Contact MC if develop adverse reaction

*Cardiovascular Drugs*

# Blood Pressure Lowering Agents

**Uses:** Short term parenteral treatment when oral treatment is not feasible Nitroprusside may be used in CHF to reduce both preload and afterload (reduces work of the heart)

**Adverse Effects:**

Hypotension, bradycardia, dysrhythmias
Palpitations, flushing, angina
Headache, restlessness, drowsiness, confusion or slurred speech

**Dosing:**

**Hydralazine**

Inject: 5- 40 mg IV push over 1-2 minutes
Usually given as repeat bolus doses every 20-30 min
Rarely given as drip: 1-10 mg/hour

**Nicardipene (Cardene)**

Dilute to: 0.1 mg/ml
Infusion: Start @ 50 ml/hr (5 mg/hr)
May increase rate by 2.5 mg/hr every 15 minutes until desired BP is reached for a **maximum dose of 15 mg/hr**

**Nitroprusside**

Infusion: Continuous to maintain BP **See dosage chart below; amount listed is in *ml/hr***

**Nesiritide (Natrecor)**

Inject: 2 mcg/kg IV push over 60 seconds
Infusion: 0.01 mcg/kg/min maintenance infusion

**Special Considerations:**

Use infusion pump
Dedicated IV line-should not administer in same IV line as other meds

**Nicardipene**:

- If hypotensive (BP<60) or tachycardic (HR>140), discontinue drip.
- May resume when stable @ 3-5 mg/hr
- Infusion site must be changed after 12 hours
- Use with caution in patients with liver failure, since it is metabolized in the liver.
- May be contraindicated in severe Aortic Stenosis as may decrease preload.

**Nitroprusside**:

- Small boluses or slight increases in infusion rate may produce profound hypotension
- Solution must be wrapped in foil to protect it from light
- Do not mix other medications in the same line
- Check BP and heart rate every 5 minutes
- Hypotension can be alleviated by decreasing the infusion rate

**Nesiritide**:

- Caution in pregnant or lactating patients
- Contact MC for worsening signs/symptoms, significant BP change or if BP<90

**Blood Pressure Lowering Drugs should be transported by CCPs or RNs only.**

*Cardiovascular Drugs*

NITROPRUSSIDE DOSING CHART

CONCENTRATION 200MCG/ML

100MG/500ML
50MG/250ML

| Pat Wt | MCG/KG/MINUTE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| in Kg | 0.5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 35 | 5 | 11 | 21 | 32 | 42 | 53 | 63 | 74 | 84 | 95 | 105 | 116 | 126 | 137 | 147 | 158 |
| 40 | 6 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 |
| 45 | 7 | 14 | 27 | 41 | 54 | 68 | 81 | 95 | 108 | 122 | 135 | 149 | 162 | 176 | 189 | 203 |
| 50 | 8 | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 |
| 55 | 8 | 17 | 33 | 50 | 66 | 83 | 99 | 116 | 132 | 149 | 165 | 182 | 198 | 215 | 231 | 248 |
| 60 | 9 | 18 | 36 | 54 | 72 | 90 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 |
| 65 | 10 | 20 | 39 | 59 | 78 | 98 | 117 | 137 | 156 | 176 | 195 | 215 | 234 | 254 | 273 | 293 |
| 70 | 11 | 21 | 42 | 53 | 84 | 105 | 126 | 147 | 168 | 189 | 210 | 231 | 252 | 273 | 294 | 315 |
| 75 | 11 | 23 | 45 | 68 | 90 | 113 | 135 | 158 | 180 | 203 | 225 | 248 | 270 | 293 | 315 | 338 |
| 80 | 12 | 24 | 48 | 72 | 96 | 120 | 144 | 168 | 192 | 216 | 240 | 264 | 288 | 315 | 336 | 360 |
| 85 | 13 | 26 | 51 | 77 | 102 | 128 | 153 | 179 | 204 | 230 | 255 | 281 | 306 | 332 | 357 | 383 |
| 90 | 14 | 27 | 54 | 81 | 108 | 135 | 162 | 189 | 216 | 243 | 270 | 297 | 324 | 351 | 378 | 405 |
| 95 | 14 | 29 | 57 | 86 | 114 | 143 | 171 | 200 | 228 | 257 | 285 | 314 | 342 | 371 | 399 | 428 |
| 100 | 15 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 450 |
| 105 | 16 | 32 | 63 | 95 | 156 | 158 | 189 | 221 | 252 | 284 | 315 | 347 | 378 | 410 | 441 | 473 |
| 110 | 17 | 33 | 66 | 99 | 132 | 168 | 198 | 231 | 264 | 297 | 330 | 363 | 396 | 429 | 462 | 495 |
| 115 | 17 | 35 | 69 | 104 | 138 | 173 | 207 | 242 | 276 | 311 | 345 | 380 | 414 | 449 | 483 | 518 |
| 120 | 18 | 36 | 72 | 108 | 144 | 180 | 216 | 252 | 288 | 324 | 360 | 396 | 432 | 468 | 504 | 540 |

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# Calcium Channel Blockers

**Uses:** Ventricular Rate Control in A Fib, Atrial Flutter, MAT or SVT

**Adverse Effects:**

May cause Atrial Flutter, AV Block, Bradycardia, Chest Pain, CHF, Ventricular Arrhythmias, nausea/vomiting, dyspnea or hypotension

**Dosing:**

**Diltiazem (Cardizem)**

Bolus: 0.25 mg/kg over 2 minutes (20 mg for average patient) If needed may repeat bolus in 15 minutes @ 0.35 mg/kg (25 mg in the average patient) over 2 – 5 minutes

Infusion: Dilute 125 mg (25ml) in 100 ml NS/D5W Drip @ 5 – 15 mg/hour titrated to heart rate

**Nicardipene (Cardene)**

Dilute to: 0.1 mg/ml

Infusion: Start @ 50 ml/hr (5 mg/hr) May increase rate by 2.5 mg/hr every 15 minutes until desired BP is reached for a **maximum dose of 15 mg/hr**

**Special Considerations:**

- Carefully monitor for hypotension/excessive bradycardia/ new A/V block
- PVC's can occur with conversion to NSR
- Don't use in the presence of a WIDE COMPLEX TACHYCARDIA
- **Nicardipene:**
  - If hypotensive or tachycardic, discontinue drip.
  - May resume when stable @ 3-5 mg/hr
  - Infusion site must be changed after 12 hours
  - Use with caution in patients with liver failure, since it is metabolized in the liver.
  - May be contraindicated in severe Aortic Stenosis as may decrease preload.

*Cardiovascular Drugs*

# Glycoprotein IIb/IIIa Inhibitors

**Use:** Unstable Angina Non Q-wave MI Percutaneous Coronary Intervention

**Adverse Effects:**

Bleeding (usually at cath sites) possible allergic reactions to ReoPro

**Dosing:**

**Abciximab (ReoPro)**

Loading bolus: 0.25 mg/kg over 10-60 minutes

Maintenance infusion: 0.125 mcg/kg/min for 12 hours following PCI or 18-24 hours for unstable angina

Should be administered through a 0.2 or 0.22 micron filter
Drip rates will vary depending on concentration that was mixed.
Verify drip rates/dosage calculations with the transferring facility staff prior to transport.

**Tirofiban (Aggrastat)**

Loading infusion: 0.4 mcg/kg/min for 30 minutes
Maintenance infusion: 0.1 mcg/kg/min

Rate will be halved for patients with renal insufficiency
Dosing table for Tirofiban (Aggrastat)

| **Patient Weight** | | **30 minute Loading** | | **Maintenance Infusion** |
|---|---|---|---|---|
| *(lb)* | *(kg)* | *Rate (ml/hr)* | *Volume (30 min)* | *Rate (ml/hr)* |
| 66-82 | 30-37 | 16 ml/hr | 8 ml | 4 ml/hr |
| 83-100 | 38-45 | 20 ml/hr | 10 ml | 5 ml/hr |
| 101-119 | 46-54 | 24 ml/hr | 12 ml | 6 ml/hr |
| 120-137 | 55-62 | 28 ml/hr | 14 ml | 7 ml/hr |
| 138-155 | 63-70 | 32 ml/hr | 16 ml | 8 ml/hr |
| 156-174 | 71-79 | 36 ml/hr | 18 ml | 9 ml/hr |
| 175-192 | 80-87 | 40 ml/hr | 20 ml | 10 ml/hr |
| 193-210 | 88-95 | 44 ml/hr | 22 ml | 11 ml/hr |
| 211-229 | 96-104 | 48 ml/hr | 24 ml | 12 ml/hr |
| 230-247 | 105-112 | 52 ml/hr | 26 ml | 13 ml/hr |
| 248-265 | 113-120 | 56 ml/hr | 28 ml | 14 ml/hr |
| 266-283 | 121-128 | 60 ml/hr | 30 ml | 15 ml/hr |
| 284-302 | 129-137 | 64 ml/hr | 32 ml | 16 ml/hr |
| 303-319 | 138-145 | 68 ml/hr | 34 ml | 17 ml/hr |
| 320-337 | 146-153 | 72 ml/hr | 36 ml | 18 ml/hr |

**Eptifibatide (Integrilin)**

Loading bolus: 180 mcg/kg over 1-2 minutes
Maintenance infusion: 2 mcg/kg/min up to 72 hours

Dosing table for Epitifibatide
Bolus drawn directly from "**bolus-vial**" (2 mg/ml)
Maintenance given directly from "**infusion vial**" (0.75 mcg/ml)

| **Patient Weight (kg)** | **Bolus Volume (mL)** | **Infusion Rate (mL/hr)** |
|---|---|---|
| 37-41 | 3.4 ml | 6 ml/hr |
| 42-46 | 4.0 ml | 7 ml/hr |
| 47-53 | 4.5 ml | 8 ml/hr |
| 54-59 | 5.0 ml | 9 ml/hr |
| 60-65 | 5.6 ml | 10 ml/hr |
| 66-71 | 6.2 ml | 11 ml/hr |
| 72-78 | 6.8 ml | 12 ml/hr |
| 79-84 | 7.3 ml | 13 ml/hr |
| 85-90 | 7.9 ml | 14 ml/hr |
| 91-96 | 8.5 ml | 15 ml/hr |
| 97-103 | 9.0 ml | 16 ml/hr |
| 104-109 | 9.5 ml | 17 ml/hr |
| 110-115 | 10.2 ml | 18 ml/hr |
| 116-121 | 10.7 ml | 19 ml/hr |
| >121 | 11.3 ml | 20 ml/hr |

| | | |
|---|---|---|
| | | |

**Special Considerations:**

- Use infusion pump
- Should always be given WITH heparin; if bleeding occurs, need to turn off heparin as well as the GPIIb/IIIa drug
- Eptifibatide dose will be decreased in patients with impaired renal function; settings to be determined by the patient's ordering physician

*Cardiovascular Drugs*

# Heparin Drip

**Uses:** Prevents blood clotting, especially in the following situations: Acute MI, Pulmonary Embolus, Deep Vein Thrombosis

**Adverse Effects:**

Hemorrhage from various sites including needle sticks, GI tract, CNS bleeds

**Dosing:**

Bolus: 15-18mg/kg
Infusion: 800-1600 mg/hour

Infusion rates may be outside this range and should not require adjustment during transport

**Special Considerations:**

- Use infusion pump
- D/C immediately for onset of major blleeding or acute mental status change
- Contact MC for any bleeding such as IV sites or gums

*Cardiovascular Drugs*

# Inotropes

**Uses:** Short term intravenous treatment of patients with acute decompensated heart failure Severe CHF/Cardiogenic Shock To increase cardiac output by increasing myocardial contractility and stroke volume Hemodynamically significant hypotension not resulting from hypovolemia

**Adverse Effects:**

May develop hypokalemia resulting from increased cardiac output and/or diuresis May have tachycardia, ventricular dysrhythmias or ectopy, hypertension, angina or ischemic chest pain

Dobutamine may also cause hypotension

Dopamine may cause nervousness, headache, palpitations, dyspnea, nausea or vomiting

**Dosing:**

**Inamrinone (Inocor):**

Loading dose over 2-3 minutes: 0.75 mcg/kg
Maintenance infusion: 5-10 mcg/kg/min

**Milrinone (Primacor):**

Loading dose over 10 minutes: 50 mcg/kg

| Pt. weight (kg) | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 (max) |
|---|---|---|---|---|---|---|---|---|---|---|
| Loading dose (mg) | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| Maintenance dose (mL/hr) 200 mcg/mL concentration | | | | | | | | | | |
| mcg/kg/min **0.375** | 3.4 | 4.5 | 5.6 | 6.8 | 7.9 | 9.0 | 10.1 | 11.3 | 12.4 | 13.5 |
| mcg/kg/min **0.50** | 4.5 | 6.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 |
| mcg/kg/min **0.75** | 6.8 | 9.0 | 11.3 | 13.5 | 15.8 | 18.0 | 20.3 | 22.5 | 24.8 | 27.0 |

**Dobutamine:**

Infusion: 2.5 – 20 mcg/kg/min continuous infusion; onset may be 10 minutes
**See dosing chart below for different concentration solutions**

**Dopamine:** 1-20 mcg/kg/min continuous infusion

Onset may be 10 minutes

**See dosing chart below for different concentration solutions**

Dopamine Dosing Chart
Single Concentration 1.6 mg / ml
800 mg / 500 ml
400 mg / 250 ml
mcg /kg /minute

| | | 1 | 2 | 3 | 4 | 5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| | 35 | 1 | 3 | 4 | 5 | 7 | 13 | 20 | 26 |
| | 40 | 2 | 3 | 5 | 6 | 8 | 15 | 23 | 30 |
| | 45 | 2 | 3 | 5 | 7 | 8 | 17 | 25 | 34 |
| | 50 | 2 | 4 | 6 | 8 | 9 | 19 | 28 | 38 |
| | 55 | 2 | 4 | 6 | 8 | 10 | 21 | 31 | 41 |
| Pt | 60 | 2 | 5 | 7 | 9 | 11 | 23 | 34 | 45 |
| wt | 65 | 2 | 5 | 7 | 10 | 12 | 24 | 37 | 49 |
| in | 70 | 3 | 5 | 8 | 11 | 13 | 26 | 39 | 53 |
| Kg | 75 | 3 | 6 | 8 | 11 | 14 | 28 | 42 | 56 |
| | 80 | 3 | 6 | 9 | 12 | 15 | 30 | 45 | 60 |
| | 85 | 3 | 6 | 10 | 13 | 16 | 32 | 48 | 64 |
| | 90 | 3 | 7 | 10 | 14 | 17 | 34 | 51 | 68 |
| | 95 | 4 | 7 | 11 | 14 | 18 | 36 | 53 | 71 |
| | 100 | 4 | 8 | 11 | 15 | 19 | 38 | 56 | 75 |
| | 105 | 4 | 8 | 12 | 16 | 20 | 39 | 59 | 79 |
| | 110 | 4 | 8 | 12 | 17 | 21 | 41 | 62 | 83 |
| | 115 | 4 | 9 | 13 | 17 | 22 | 43 | 65 | 86 |
| | 120 | 5 | 9 | 14 | 18 | 23 | 45 | 68 | 90 |

ml/hr or drops/min. using minidrip tubing = 60 drops/ml
**Dopamine (Single) Dosing Chart**

Dopamine Dosing Chart
Double Concentration 3.2 mg/ml
800 mg/250 ml
mcg/kg/minute

| | | 1 | 2 | 3 | 4 | 5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| | 35 | 1 | 1 | 2 | 3 | 3 | 7 | 10 | 13 |
| | 40 | 1 | 2 | 2 | 3 | 3 | 7 | 11 | 15 |
| | 45 | 1 | 2 | 3 | 3 | 4 | 8 | 13 | 17 |
| | 50 | 1 | 2 | 3 | 4 | 5 | 9 | 14 | 19 |
| | 55 | 1 | 2 | 3 | 4 | 5 | 10 | 15 | 21 |
| | 60 | 1 | 2 | 3 | 5 | 6 | 11 | 17 | 23 |
| | 65 | 1 | 2 | 4 | 5 | 6 | 12 | 18 | 24 |
| | 70 | 1 | 3 | 4 | 6 | 7 | 13 | 20 | 26 |
| Pt wt in Kg | 75 | 1 | 3 | 4 | 6 | 7 | 14 | 21 | 28 |
| | 80 | 2 | 3 | 5 | 6 | 8 | 15 | 23 | 30 |
| | 85 | 2 | 3 | 5 | 7 | 8 | 16 | 24 | 32 |
| | 90 | 2 | 3 | 5 | 7 | 8 | 17 | 25 | 34 |
| | 95 | 2 | 4 | 5 | 8 | 9 | 18 | 27 | 36 |
| | 100 | 2 | 4 | 6 | 8 | 9 | 19 | 28 | 38 |
| | 105 | 2 | 4 | 6 | 8 | 10 | 20 | 30 | 39 |
| | 110 | 2 | 4 | 6 | 9 | 10 | 21 | 31 | 41 |
| | 115 | 2 | 4 | 6 | 9 | 11 | 22 | 32 | 43 |
| | 120 | 2 | 5 | 7 | 9 | 11 | 23 | 34 | 45 |

ml/hr or drops/min. using minidrip tubing = 60 drops/ml
**Dopamine (Double) Dosing Chart**

**Epinephrine**:

Infusion: 1-10 mcg/min titrated to desired effect

**Norepinephrine (Levophed):**

Infusion: 0.5-1.0 mcg/min
Titrated up to 30 mcg/min to desired hemodynamic effect

**Special Considerations:**

- Use infusion pump
- For Inamrinone/Milrinone: do not mix with Lasix or dextrose-containing solutions
- **Should be transported by CCEMT-Ps or RNs only**
- Monitor for cardiac dysrhythmias; these may be caused by hypokalemia, pre-existing arrhythmias, abnormal drug levels, catheter placement, etc.
- Check blood pressure and heart rate frequently. Discontinue briefly if develop hypotension secondary to vasodilatation EMT-Ps may titrate up/down one increment without calling MC.
- Contact MC for any adverse affects

*Cardiovascular Drugs*

## Nitroglycerine Drip

**Uses:** Acute Coronary Syndrome, CHF,, Hypertension Decreases preload, and to a lesser extent, afterload

**Adverse Effects:**

Excessive hypotension which can provoke angina, headache, restlessness, palpitations, tachycardia or dizziness

**Dosing:** Continuous infusion titrated to maintain therapeutic effect while avoiding hypotension. Usual range 10-2000 mcg/min. May be higher in treatment of pulmonary edema.

NITROGLYCERIN DOSING CHART
CONCENTRATION 200MCG/ML
100 MG/500 ML
50 MG/250 ML

| MCG/MIN | PUMP SETTING | MCG/MIN | PUMP SETTING |
|---|---|---|---|
| 10 | 3 | 160 | 48 |
| 20 | 6 | 170 | 51 |
| 30 | 9 | 180 | 54 |
| 40 | 12 | 190 | 57 |
| 50 | 15 | 200 | 60 |
| 60 | 18 | 210 | 63 |
| 70 | 21 | 220 | 66 |
| 80 | 24 | 230 | 69 |
| 90 | 27 | 240 | 72 |
| 100 | 30 | 250 | 75 |
| 120 | 36 | 260 | 78 |
| 130 | 39 | 270 | 81 |
| 140 | 42 | 280 | 84 |
| 150 | 45 | | |

**DOUBLE CONCENTRATION**
NITROGLYCERIN DOSING CHART
CONCENTRATION 400MCG/ML
100 MG/250 ML

| MCG/MIN | PUMP SETTING | MCG/MIN | PUMP SETTING |
|---|---|---|---|
| 10 | 2 | 160 | 24 |
| 20 | 3 | 170 | 26 |
| 30 | 5 | 180 | 27 |
| 40 | 6 | 190 | 29 |
| 50 | 8 | 200 | 30 |
| 60 | 9 | 210 | 32 |
| 70 | 11 | 220 | 33 |
| 80 | 12 | 230 | 35 |
| 90 | 14 | 240 | 36 |
| 100 | 15 | 250 | 38 |
| 120 | 18 | 260 | 39 |
| 130 | 20 | 270 | 41 |
| 140 | 21 | 280 | 42 |
| 150 | 23 | | |

**Special Considerations:**

Use Infusion pump
Monitor heart rhythm
Check BP and HR frequently (every 5 minutes); may decrease to every 10 minutes if at the same rate for >1 hour
Do not mix other medications in the same line
Hypotension can be alleviated by decreasing the rate of infusion
D/C infusion if BBP systolic is <<60mm Hg and contact MC
Contact MC for worsening or persisting adverse signs//symptoms or for persisting BP < 90 mmHg

***CCPs* may perform <u>one</u> titration of 10 mcg for escalating chest pain without contacting MC**

*Cardiovascular Drugs*

## Thrombolytic Therapy

**Uses:** Dissolves clots in blood vessels Generally used in the setting of Acute MI or CVA; occasionally used Pulmonary Embolus

**Adverse Effects:**

Minor hemorrhages from IV sites and gums Major hemorrhage from GI and intracranial or spinal sites Reperfusion dysrhythmias often occur about 30-60 minutes after staring infusion Allergic reactions including anaphylaxis may occur with Streptokinase or APSAC

**Dosing:**

**Streptokinase, APSAC or TPA:**

Dose to be determined by transferring physician (determined by patient weight and indication for therapy)
Rate should not require adjusting en route

**Tenecteplase (TNK):**

Weight-based one time dose, administered over 5 seconds

| Pt weight: | <60 kg | Dose: 30 mg |
|---|---|---|
| | ≥60 - <70 kg | 35mg |
| | ≥70 - <80 kg | 40 mg |
| | ≥80 - <90 kg | 45 mg |
| | ≥90 kg | 50mg |

Occasionally used as continuous infusion for peripheral arterial thrombus 0.25-0.5 mg/hour up to 48 hours

**Retevase:** Given in 2 doses of 10 mg each, 30 minutes apart Given as a 2 minute IV push

**Special Considerations:**

- Use infusion pump
- Monitor heart rhythm
- Check BP and HR frequently
- Do not mix with other medications in the same line
- D/C infusion immediately if there is cardiac arrest, major hemorrhage, anaphylaxis or change in mental status **AND call MC**.

b. Sedation and Paralytic Agents

i. Benzodiazepine Drips

ii. Moderate Sedation Agents

iii. Opioid Drips

iv. Paralytic Agents Sedation and Paralytic Agents

# Benzodiazepine Drips

**Uses:** Sedation for patients who are intubated (and often concurrently on a paralytic drip)
May be used to treat Status Epilepticus

**Adverse Effects:**
May be more prone to hypotension if used with an opioid drug Can cause paradoxical agitation, hypertension or tachycardia

**Dosing:**

**Lorazepam (Ativan):**
Loading dose: 0.5-4.0 mg IV bolus; may be repeated in 10 min
Infusion: 0.02-0.1 mg/kg/hour

**Midazolam (Versed):** Loading dose: 0.01-0.1 mg/kg IV bolus Infusion 0.02-0.1 mg/kg/hour

**Special Considerations:**
Only to be used in intubated patients

*Sedation and Paralytic Agents*

## Moderate Sedation Agents

**Uses:** Sedation for patients who are intubated (and often concurrently on a paralytic drip)
May also be used for refractory seizures or therapeutic coma

**Adverse Effects:**
May be more prone to hypotension if used with an opioid drug
Can cause paradoxical agitation, hypertension or tachycardia

**Dosing:**

**Propofol:**
Loading dose: 0.5-5 mg/kg
Maintenance infusion: 2-10 mg/kg/hour

**Barbiturates:** *Pentobarbital* is most commonly used
Loading dose: 10 mg/kg; infuse up to 25 mg/min
Maintenance: 1-2 mg/kg/hour

**Ketamine:**
Loading dose: 1-5 mg/kg
Maintenance infusion: 0.01-0.05 mg/kg/hour

**Special Considerations:**
Only to be used in intubated patients

*Sedation and Paralytic Agents*

## Opioid Drugs/Drips

**Uses:** *Typically* ***part of*** *a sedation combination* for patients who are intubated. Occasionally for pain control

**Adverse Effects:**

May cause hypotension, especially in volume depleted patients or those with right-sided heart failure

**Special Considerations:**

Not advisable to give patients on narcotic drips Naloxone, as this may precipitate acute withdrawal

Antihistamines (both H1 and H2) may counteract hypotension; this is an MCO

*Sedation and Paralytic Agents*

# Paralytic Agents

**Uses:** Total muscular paralysis when patient movement may:

1. Compromise airway control (e.g. causing unwanted extubation)
2. Exacerbate a real or potential illness or injury (e.g. spinal cord injury from a spine fracture)
3. Endanger the patient, EMS care provider or others

**Adverse Effects:**

Bronchospasm, flushing, hypotension and tachycardia have been rarely reported

**Dosing:**

**Pancuronium:**

Loading dose: 10 mg/kg
May repeat dose every 1-2 hours as needed

**Vecuronium:**

Initial dose: 10 mg IV push
Repeat dose of 10 mg IV push every 20-40 minutes as needed
Maintenance infusion may be an alternative: 0.01mg/kg/min

**Rocuronium:** Loading dose 0.6 mg/kg
May rebolus 0.2 mg/kg every 30-45 minutes
Maintenance infusion may be an alternative: 0.01–0.15 g/kg/min

**Special Considerations:**

- Produces COMPLETE APNEA; therefore an intact airway (e.g. endotracheal intubation), and adequate ventilation/oxygenation **MUST BE ESTABLISHED PRIOR TO ADMINISTRATION.** Likewise, personnel and equipment with the ability to restore an airway, ventilation and oxygenation must be available during transport.

- Causes paralysis only; **therefore concomitant use of a sedative/hypnotic is indicated**

- Note: Paralysis may alter the clinical exam. For example, motor seizure activity will not be seen, but the brain will continue to undergo seizure activity, and this must be treated! Also, conditions such as shock, hypoxia, pain, intracranial injury, hypoglycemia, etc. maybe the cause of this unwanted, spontaneous patient movement in the first place. **These conditions must be addressed but may be masked by the paralytic agent!**

C. CNS Drugs

i. Anticonvulsants

ii. Mannitol

iii. Steroids

*CNS Drugs*

# Anticonvulsants

**Uses:** Prevention and treatment of seizures

**Adverse Effects:**

If intravenous phenytoin is given too rapidly, may result in:

1) Cardiac dysrhythmias including ventricular fibrillation or asystole
2) Hypotension

Subcutaneous extravasations of intravenous phenytoin may cause tissue necrosis or pain at the IV site

**Dosing:**

**Phenytoin:**

100-1200mg IV piggyback in normal saline;
Rate not to exceed 50 mg/min

**Fosphenytoin:** *dose expressed in* ***phenytoin equivalents (PE)***

15-20 PE/kg; rate up to 100-150 PE/min

**Valproic Acid:**

40-60 mg/kg Rate up to 3 mg/kg/min

**Special Considerations:**

- Use infusion pump
- Monitor heart rhythm
- Check BP frequently; vital sign monitor recommended
- D/C infusion and contact MC for any adverse effects

*CNS Drugs*

# Mannitol

**Uses:** Treatment of increased intracranial pressure or selected fluid overload states

**Adverse Effects:**

Hypernatremia
Volume Depletion

**Dosing:**

25-50 grams IV push or bolus infusion (in 50cc D5W over 20 minutes)

**Special Considerations:**

Patients receiving mannitol should have a Foley to monitor fluid status

*CNS Drugs*

# Steroids

**Uses:** Spinal cord injury to decrease edema
Cerebral edema due to injury or CNS mass or lesion

**Adverse Effects:**
GI Bleed
Electrolyte disturbance and hyperglycemia
Hypertension
Acute CHF
Agitation
Corticosteroid hormonal suppression (hypoglycemia, hypotension, hypothermia)
Higher risk for infection or masking symptoms of infection

**Dosing:**

**Methylprednisolone (Solumedrol):**
Initial bolus: 30 mg/kg over 15 minutes
Start infusion 45 minutes later: 5.4 mg/kg/hour for 23 hours

**Dexamethasone (Decadron):**
Cerebral Edema: start with 10 mg IV x 1, then 4 mg IM/IV q 6 hrs

**Special Considerations:**
Contact MC for question of adverse effects

d. Hyperalimentation/TPN, Insulin and Electrolytes

i. Hyperalimentation/TPN

ii. Insulin Drip

iii. Potassium Chloride Hyperalimentation/TPN, Insulin, Electrolyte solutions

*Hyperalimentation/TPN, Insulin, Electrolyte solutions*

# Hyperalimentation/TPN

**Uses:** Intravenous nutrition

**Adverse Effects:**

Catheter related sepsis
Air embolism if central venous IV tubing becomes disconnected
Subcutaneous extravasations of solution can cause tissue necrosis Discontinuation of infusion may cause hypoglycemia

**Dosage:** Continuous infusion usually through central venous catheter but occasionally through a peripheral IV line.
Rate should not require adjustment enroute.

**Special Considerations:**

- Use infusion pump.
- Do not administer any other medication through the same IV line.
- Contact MC for any adverse effects listed above
- Consider use of a cardiac monitor

*Hyperalimentation/TPN, Insulin, Electrolyte solutions*

# Insulin

**Uses:** Lowers blood glucose
Used in diabetics especially with ketoacidosis or hyperosmolar nonketonic coma.

**Adverse Effects:**
Hypoglycemia related (tachycardia, diaphoresis, mental status changes, and seizures)

**Dosage:**
5-15 units per hour but dosages outside this range may be used.

**Special Considerations:**

- Use infusion pump
- Do not administer medications in the same IV line except D50.
- If symptoms of hypoglycemia develop:
  - -turn off infusion,
  - -perform a D-Stick
  - -administer 25 grams, (one AMP) D50) if glucose <80,
  - -contact MC.
- Monitor blood sugar every 30 minutes during transport
- Cardiac monitoring required

**CCPs may manage isolated insulin drip or with one additional drip**

*Hyperalimentation/TPN, Insulin, Electrolyte solutions*

# Potassium Chloride

**Uses:** Replacement therapy for hypokalemia

**Adverse Effects:**

Cardiac dysrhythmias (prolonged PR interval; wide QRS complex; depressed ST segment; tall, peaked T-waves; heart block; cardiac arrest)

Subcutaneous extravasations of solution can cause tissue necrosis

**Dosage:**

Usual range is up to 20 mEq / hr., continuous infusion.

May be mixed with various IV solutions in various sized bags including "piggy back" solutions.

Rate should not require adjustment enroute.

**Special Considerations:**

- Monitor heart rhythm
- Often causes burning during infusion; contact MC if this is problematic
- Contact MC for changes in EKG configuration and/or dysrhythmias.

e. Obstetric Drugs

i. Magnesium Sulfate

ii. Oxytocin

*Obstetric Drugs*

# Magnesium Sulfate

**Uses:** Treatment of pre-eclampsia and eclamptic seizures
Premature rupture of membranes

**Adverse Effects:**
Lethargy, nausea, vomiting, hypotonia, respiratory depression, dysrhythmia

**Dosing:** Loading dose: 2 – 6 grams IV over 15 minutes (may give 2 gms over 5 minutes)
Followed by maintenance infusion: 1 – 2 gms/hr

**Special Considerations:**

- Monitor reflexes
- For symptomatic toxicity: 10 mLs of 10% Calcium Chloride and contact MC
- MC may also request furosemide and/or NS bolus as MCO
- In renal failure, patient may require emergency dialysis

*Obstetric Drugs*

# Oxytocin (Pitocin)

**Uses:** Stimulates post-partum contraction of the uterus to control bleeding

**Adverse Effects:**

Hypertension, tachycardia, dysrhythmias

**Dosing:**

10-40 units added to 1000 mL IV Fluid to control hemorrhage
Usual rate is 10-20 milliunits/min

**Special Considerations:**

- Use infusion pump
- Monitor heart rhythm
- Check BP frequently; vital sign monitor recommended
- Contact MC for any adverse effects

f. Anti-Infective Therapy

i. Antibiotics and Antiviral

ii. Antifungal

*Anti-Infective Therapy*

# Antibiotics and Antiviral

**Uses:** Bacterial or Viral infections (treatment and prophylaxis)

**Adverse Effects:**
Allergic signs and symptoms, including anaphylaxis

**Dosage:** Vary depending on the antibiotic
Generally given as a "piggyback" solution
Rate should not require adjustment en route

**Special Consideration:**
D/C infusions if there are any allergic signs or symptoms, then contact MC.

***Most Commonly used:***
***Acylcovir,***
***Azithromycin (Zithromax),***
***Cefazolin (Ancef)***
***Ceftriaxone (Rocephin)***
***Gentamicin***
***Levofloxacin (Levaquin)***
***Metronidazole (Flagyl)***
***Piperacillin/Tazobactam (Zosyn)***
***Vancomycin***

*Anti-Infective Therapy*

# Antifungal

**Uses:** Fungal infections

Often in immune-compromised patients, those on chemotherapy or chronic antibiotics

**Adverse Effects:**

Nausea or diarrhea

Amphotericin-fever, rigors, chills

**Dosing:**

**Amphotericin B, Azoles or "Fungins":**

Usually given as bolus dosing once daily to TID

May be given as continuous bladder irrigation: 50 mg/liter Over 24 hours @ 42 ml/hour

**Special Considerations:**

Drug interactions may occur with statins, coumadin, antivirals, benzodiazepines, oral hypoglycemic drugs and transplant anti-rejections drugs

Side effects can be pre-treated with Acetaminophen or Diphenhydramine

g. Pain Control

i. Opioid Drips

ii. PCA Pumps and Subcutaneous Pumps

iii. Anesthetic Sprays or Topical Gels

*Pain Control*

# Opioid Drips

**Uses:** Control of pain

**Adverse Effects:**

May cause hypotension, especially in volume depleted patients or those with right-sided heart failure Respiratory Depression

**Dosing:**

**Morphine:**

Loading dose: 2 mg increments given every 5-10 minutes until adequate pain control; typically max dose is 10 mg-may be higher in patients on chronic pain therapy

Infusion: 1-10 mg/hour

**Fentanyl:**

Loading dose: 1-5 mcg/kg given IV push

Infusion: 1-5 mcg/kg/hour

**Hydromorphone (Dilaudid):**

Loading dose: 0.5-4 mg IV slow push

Continuous infusion: 1-10 mg/hour

**Special Considerations:**

- Avoid Naloxone as this could precipitate acute withdrawal
- Pump malfunction could precipitate withdrawal
- Antihistamines (both H1 and H2) may counteract hypotension; this is an MC option

*Pain Control*

# PCA (Patient Controlled Anesthesia) Pumps and Subcutaneous Pumps

**Uses:** Treatment for patients with palliative care or chronic pain conditions
Often PO analgesia is not feasible

**Adverse Effects:**
Hypotension
Respiratory depression
Catheter site infection or irritation

**Dosing:**

**PCA (Patient Controlled Analgesia) Pumps**
**Morphine, Fentanyl and Hydromorphone are most commonly used.**
Pre-programmed settings for patient
Patient may require assistance to "self-administer" medication

**Subcutaneous Catheter Pumps**
**Morphine most commonly used.**
Up to 2 mLs volume at a time regardless of concentration
May also give IV fluids at a usual rate of 1-10 mLs/hour; MAX of 25 mLs/hr

**Special Considerations:**

- Encourage patient to use medication as needed
- Avoid Naloxone as this could precipitate acute withdrawal
- Pump malfunction could precipitate withdrawal
- Subcutaneous catheter sites need to be changed every 7 days

*Pain Control*

# Sprays and Gels

**Uses:** Topical pain control-usually prior to a procedure

**Adverse Effects:**

Allergy to medication
Depressed gag reflex if used orally

**Dosing:**

**Sprays:**

Usually 2-3 sprays to desired area

**Topical gels:**

Enough to thinly cover area

Duration can be minutes to hours

**Special Considerations:**

Some can induce ***Methemoglobinemia.***
Watch for hypoxia

h. Antidotes

i. NAC

ii. Sodium Thiosulfate

iii. Cyanokit

iv. Thiamine

v. Bicarbonate Drip

vi. Pyridoxine

vii. Atropine/2-PAM

*Antidotes*

# N-Acetyl Cysteine or NAC (Acetadote)

**Uses:** Acetaminophen overdose-toxic quantities

**Adverse Effects:**
Anaphylactoid type reactions (urticaria, flushing, hypotension and bronchospasm)

**Dosing:**

| | |
|---|---|
| Loading dose: | 150 mg/kg over 15-20 minutes |
| Maintenance infusion: | 50 mg/kg over 4 hours |
| Then: | 100 mg/kg over 16 hours |

**Special Considerations:**

- Ideal time of onset of treatment is within 8-10 hours of ingestion
- Anaphylactoid reactions may be treated with IV diphenhydramine
- Maintenance infusion must be doubled at the 4 hour period

*Antidotes*

## Cyanide Antidote Kit (Amyl Nitrate, Sodium Nitrate, Sodium Thiosulfate)

**Uses:** Cyanide poisoning

**Adverse Effects:**
May cause methemoglobinemia

**Dosing:**
Dosing as described in kit; weight based for children

**Special Considerations:**
Not to be used with ***Carbon Monoxide*** poisoning

*Antidotes*

# Cyanokit

**Uses:** Cyanokit is indicated for the treatment of known or suspected cyanide poisoning.

**Adverse Effects:**

Allergic reaction
HTN
Hematochezia

**Dosing:**

The starting dose: for adults: 5 g (i.e., both 2.5g vials)
Administered as an intravenous infusion over 15 minutes (approximately 15 mL/min), i.e., 7.5 minutes/vial.
Depending upon the severity of the poisoning and the clinical response, a second dose of 5 g may be administered by intravenous infusion for a total dose of 10 g.
The rate of infusion for the second dose may range from 15 minutes (for patients in extremis) to two hours, as clinically indicated.

**Special Considerations:**

- Caution should be exercised when administering other cyanide antidotes simultaneously with Cyanokit,
- If a decision is made to administer another cyanide antidote with
- Cyanokit, these drugs should not be administered concurrently in the same intravenous line.
- Comprehensive treatment of acute cyanide intoxication requires support of vital functions.
- Cyanokit should be administered in conjunction with appropriate airway, ventilatory and circulatory support.
- Once reconstituted, hydroxocobalamin is stable for up to 6 hours at temperatures not exceeding 40°C (104°F). Do not freeze.
- Any reconstituted product not used by 6 hours should be discarded.

*Antidotes*

# Thiamine

**Uses:** Wernicke's encephalopathy

**Adverse Effects:**
Possible anaphylactic reactions

**Dosing:** 100 mg IV over 15-30 minutes

**Special Considerations:**
Glucose administration in nutritionally depleted patients should be accompanied by thiamine

*Antidotes*

# Bicarbonate Drip

**Uses:** Tricyclic, aspirin or other acidotic overdoses
Renal protection after IV contrast or with sever e muscle breakdown (rhabdomyolysis)

**Adverse Effects:**
Sodium load

**Dosing:** Titrated to urine pH >7 by hospital staff

**Special Considerations:**
Usually will have a Foley to check urine pH and output
May be associated with hypokalemia

*Antidotes*

# Pyridoxine (Vitamin B6)

**Uses:** Isoniazide (INH) Overdose

**Adverse Effects:**
GI upset Headache or sleepiness Tingling or burning of hands/feet

**Dosing:** 5 grams IV over 3 – 5 minutes; repeat every 5-20 minutes until seizures resolve

**Special Considerations:**
Often patient is in status epilepticus; seizures may respond to benzodiazepines

*Antidotes*

# Atropine/2-PAM

**Uses:** For **SEVERE** Cholinesterase Inhibitor poisoning (e.g. pesticides, nerve agent)

**Adverse Effects:**

**Dosing:**

**Atropine:**

2-4 mg given every 5 minutes until signs of atropinization (this may take 25-50 mg)

**2-PAM (2-pyridinealdoxime)**

1 gram *slow* IV injection; if muscle weakness persists, give additional 500 mg after 30 minutes

**Special Considerations:**

2-PAM should be given WITH Atropine

*i.* GI Drugs

1. Antiemetic Agents
2. Acid Reduction
3. GI Bleed Related Medications

*GI Drugs*

# Antiemetic Agents

**Uses:** For control of severe nausea and vomiting

**Adverse Reactions:**

Drowsiness, dizziness, blurred vision, skin reactions, hypotension

Extrapyramidal symptoms (EPS) – motor restlessness, dystonic reactions, pseudo-parkinsonism, tardive dyskinesia with metaclopramide, prochlorperazine, or promethazine

Headache or dizziness may occur with ondansetron

**Dose:**

**Metaclopramide (Reglan)**

10 mg IV over 2 minutes

If needed, dose may be repeated once in 10 minutes

**Prochlorperazine (Compazine)**

5 mg IV over 2 minutes If needed, dose may be repeated oncein 10 minutes

**Promethazine (Phenergan)**

25 mg IV over 2 minutes If needed, dose may be repeated oncein 10 minutes

**Ondansetron (Zofran)**

4 mg slow IV over 2 minutes *or* IM If needed, dose may be repeated once in 10 minutes

**Special Considerations:**

- Extra-pyramidal symptoms may be treated by administering Diphenhydramine (Benadryl) 50 mg IV over 2 minutes
- Confirm with MD regarding IV administration of Promethazine due to “black box warning”

*GI Drugs*

# Acid Reduction

**Uses:** Decrease secretion of gastric acid or chronic reflux
Patients with UGI Bleed

**Adverse Effects:** (all rare)
Occasional CNS symptoms-more so in the elderly
Jaundice
GI upset

**Dosing:**

| | | |
|---|---|---|
| **Pantoprazole (Protonix)** | Bolus: | 80 mg over 5 minutes |
| | Infusion: | 8 mg/hr |
| **Lansoprazole (Prevacid)** | Bolus: | 30 – 60 mg over 30 minutes |
| | Infusion: | 6 mg/hr |
| **Ranitidine (Zantac)** | Bolus: | 50 mg over 20 -30 minutes |
| | Infusion: | 150 mg over 24 hours |

**Special Considerations:**
May be used for antihistamine effects

*GI Drugs*

# GI Bleed Related Medications

**Uses:** Variceal Upper GI Bleed

**Adverse Effects:**

Gall Bladder sludging or stones
Diarrhea and GI Upset
Hypoglycemia

**Dosing:**

**Octreotide:** 50 mcg IV bolus, then 50 mcg/hour

**Special Considerations:**

- Alters the balance between insulin/glucagon; could result in either hypoglycemia or hyperglycemia
- **Vasopressin** is presently rarely used due to its potent vasoconstrictive and catecholamine inducing properties

## XI. Critical Care Diagnosis.

A guideline has been written to guide the CCEMT-P in managing a patient with a specific critical care diagnosis. This list in no way covers all of the possible diagnosis but will address some of the major problems and common conditions that we are called upon to transport. Please note these are general guidelines. Specific orders to care for any patient should be obtained from the transferring facility/MD prior to departing.

- Anaphylactic Shock
- Aortic Rupture/Dissection
- Cardiogenic Shock
- Hypovolemic Shock
- Neurogenic Shock
- Sepsis and Septic Shock

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## Anaphylactic Shock

**Purpose:** To offer critical care transport team general management guidelines for patients with anaphylactic shock. Treatment is focused on removing the allergen that caused the severe reaction, including discontinuing the medication causing the reaction or simply removing the stinger after a bee sting. Drug therapy for anaphylaxis requires supporting the cardiovascular system and preventing further mediator release.

**Signs and Symptoms**:

1. Increased heart rate
2. Decreased blood pressure
3. Narrow pulse pressure
4. Decreased CVP/RAP
5. Decreased PCWP
6. Decreased CO/cardiac index
7. Decreased SVR/SVRI
8. Decreased $Svo_2$
9. Decreased urinary output
10. Flushed skin that is warm to hot, with pruritus and hives
11. Bronchoconstriction
12. Laryngeal edema
13. Angioedema
14. Airway compromise

**Differential Diagnosis**

1. Allergic reaction (from a triggering substance such as a diagnostic agent, specific food, bite, sting, chemical agent, or medication [antibiotics, immunologic agents, anesthetics, anti-inflammatory agents, narcotics and hormones])
2. Massive anaphylactic reaction that occurs in minutes or lesser reaction that occurs over hours or days.

**Transport Management Guidelines**

1. Administer oxygen
2. Maintain an adequate airway, intervene as necessary
3. Remove the allergen that caused the reaction
4. Administer epinephrine 1:1000 0.3 – 0.5 ml subcutaneous
5. If the patient is taking beta-blockers, administer glucagon 1 – 2 mg IV over several minutes
6. Initiate fluid therapy early with normal saline to maintain MAP of greater than 70 mm Hg or a systolic BP of greater than 90 mm Hg.
7. Administer vasopressor agents if crystalloid therapy is inadequate for maintaining CO.
8. Other pharmacologic agents to use
    a. H1 blocker: Benadryl 25 – 50 mg IV
    b. H2 blocker; Zantac 150 mg po
    c. Bronchodilators: Albuterol nebs
    d. Corticosteroids: Solu-Medrol 125 mg IV
9. Perform cardiac monitoring
10. Observe for a possible second-phase reaction

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## Aortic Rupture (traumatic)/Dissection

**Purpose**: To offer critical care transport team general management guidelines for patients with aortic dissection or traumatic rupture. Resuscitation efforts will have been initiated at the transferring hospital and will need to be continued in transit. Goal is directed at controlling the shearing forces, therefore controlling heart rate and blood pressure are important.

**Signs and Symptoms**:

1. Pulse deficit or blood pressure difference from one arm to the other
2. Hypotension
3. Decreased level of consciousness
4. Hypertension of the upper extremities
5. Decreased of pulse amplitude in the lower extremities
6. Decreased blood pressure

7. Chest pain
8. Chest wall burning
9. Widened mediastinum on chest X-ray with blurring of the aortic knob
10. Fractures of the first and second ribs

**Transport Management Guidelines:**

1. Maintain open airway; apply high flow oxygen, intervene as necessary
2. Assist ventilations; be prepared to intubate
3. Initiate or continue IV fluids
4. Orders may include administering beta-blockers (eg, Esmolol or Metoprolol) and withhold fluids to keep the MAP at 65 to 70 mm Hg.
5. Do not linger at transferring facility, load and go
6. Monitor oxygen saturation, vital signs, and the cardiac monitor

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## Cardiogenic Shock

**Purpose**: To offer critical care transport team general management guidelines for patients in cardiogenic shock. Primary management of cardiogenic shock is focused on enhancing CO while decreasing left ventricular workload.

**Signs and Symptoms**:

1. Poor cardiac output
    a. Severe reduction in cardiac index
        i. <1.8 L/min/$m^2$ without support
        ii. < 2.0 to 2.2 L/min/$m^2$ with support
    b. Elevated ventricular filling pressure (ie, left ventricular filling pressure of > 18 mm Hg or right ventricular filling pressure of > 10 to 15 mm Hg)
2. Low blood pressure (systolic blood pressure < 90 mm Hg or mean arterial pressure 30 mm Hg below baseline or MAP less than 65 mm Hg over time)
3. Altered mental status
4. Cool, pale, diaphoretic skin
5. Decreased urine output
6. Weak and thread pulse
7. Distant or abnormal $S_3$ or $S_4$ heart sounds
8. Fluid accumulation in the lungs or limbs (jugular vein distention or pedal edema)
9. Tachycardia

**Differential Diagnosis**

1. Aortic dissection
2. Coronary artery disease

3. MI
4. Pulmonary embolus
5. Acute myocarditis

**Transport Management Guidelines:**

1. May cover the cause of cardiogenic shock.
    a. If cause was thought to be from cardiac tamponade and patient has a catheter in the pericardial sack with a stopcock connected to the external portion, obtain orders from transferring physician for managing catheter, including specific directions on when to drain off pericardial fluid. If no catheter is in place, and patient is deteriorating, a pericardialcentesis may be performed by MD or personnel authorized by medical director. This will NOT be a routine procedure for any critical care transport team member.
    b. If cause was thought to be from a tension pneumothorax,
        i. Patient should have had a chest tube placed by the MD at the transferring facility.
            1. Obtain orders on continued specific management of chest tube.
            2. See Chest Tube – Post Insertion Management protocol.
        ii. If no chest tube was placed at the transferring facility and a tension pneumothorax is suspected or develops, two options:
            1. Chest tube insertion by MD or personnel authorized by medical director. See Chest tube insertion protocol.
            2. Chest needling per protocol: 4.26 Needle Decompression
2. Provide high-flow oxygen
3. Orders to eliminate chest pain
4. Orders to reduce anxiety
5. Perform hemodynamic and cardiac monitoring
6. Provide antiarrhythmics if arrhythmias are present
7. Provide judicious fluid therapy
    a. 200 – 250 ml boluses of NS at a time
    b. Frequently assess breath sounds, vital signs an heart sounds
8. May include administering vasopressors to physician ordered parameters
    a. Dopamine
9. May include administering inotropic agents to physician ordered parameters
    a. Milrinone and Dobutamine may be used.
    b. Use with caution. Research shows that high doses of inotropic support lead to a higher incidence of mortality
10. May include administering diuretics
    a. To reduce CVP and PCWP

11. May include using agents to decrease afterload
    a. Nitroprusside or milrinone
12. Have transferring facility insert an indwelling catheter prior to departure to monitor urinary output.

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## Hypovolemic Shock

**Purpose:** To offer critical care transport team general management guidelines for patients with hypovolemic shock. Treatment of hypovolemic shock revolves around treating the underlying condition, administering oxygen, and initiating volume replacement

**Signs and Symptoms**:

1. Tachycardia
2. Hypotension
3. Signs of poor tissue perfusion (pallor and delayed capillary refill)
4. Confusion
5. Anxiety
6. Cold, mottled, and pulseless extremities
7. Decreased mentation

**Differential Diagnosis**

1. Fever
2. Dehydration
3. Hemorrhage
4. Burns
5. Excessive third spacing

**Transport Management Guidelines:**

1. Treatment of underlying condition
2. Administer oxygen
3. Maintain open airway and ensure optimal ventilations
4. Initiate volume replacement (normal saline or lactated ringers preferred, in 250 – 500 ml increments)
5. Administer vasopressors if hypotension is refractory to fluid resuscitation
6. Administer blood products early if hemorrhage is suspected

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## Neurogenic Shock

**Purpose**: To offer critical care transport team general management guidelines for patients with neurogenic shock. Treatment for neurogenic shock is focused on maintaining an MAP greater than 90 mm Hg. Transportation considerations for neurogenic shock center on ensuring a patent airway, adequate ventilation, and oxygenation because, depending on the level of involvement, the patient may be unable to breathe without assistance or may have impaired ventilatory capabilities. Care includes cardiac monitoring, administration of IV fluids and vasopressor medications as ordered, and maintenance of spinal immobilization.

**Signs and symptoms:**

1. Relative hypovolemia as the result of vasodilation
2. Bradycardia
3. Significant drop in blood pressure
4. Normal pulse pressure
5. Decreased CVP/RAP
6. Decreased PCWP
7. Decreased CO/cardiac index
8. Significant drop in the SVR/SVRI
9. Decreased $Svo_2$
10. Decreased urinary output
11. Pink, warm, dry skin

**Differential Diagnosis**

1. Loss of sympathetic tone
2. Trauma to the brain or spinal cord
3. Pharmacologic agents such as general and spinal anesthetics, opiates, and barbiturates; insulin shock; various toxins; and extreme parasympathetic stimulation

**Transport Management Guidelines**:

1. Appropriate airway management to ensure adequate ventilation, and oxygenation.
2. Maintain MAP at greater than 70 mm Hg and/or systolic blood pressure at greater than 90 mm Hg
3. Consider administering vasopressors (dopamine, Norepinephrine, phenylephrine). Administer inotropic agents and vasopressors if traditional fluid resuscitation is insufficient to maintain MAP.
4. Initiate fluid therapy with isotonic crystalloids

5. Consider colloids if large volumes of crystalloid solutions are required to maintain blood pressure
6. Maintain heart rate (increase heart rate via pacemaker therapy or atropine administration)
7. Patient needs an indwelling catheter

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## Sepsis/Septic Shock

**Purpose**: To offer critical care transport team general management guidelines for patients with Sepsis or in Septic Shock. The primary goal of sepsis treatment is to maintain organ perfusion while enhancing tissue oxygenation. Achieving this requires balancing preload, afterload, and contractility to achieve an optimal level of homeostasis. Target criteria for maintenance levels have been established as follows:

1. MAP greater than 70 mm Hg or systolic BP greater than 90 mm Hg.
2. $Svo_2$ greater than 70%
3. CVP of 8 to 12 mm Hg
4. Urine output greater than 0.5 ml/kg/h
5. $Sao_2$ greater than 93%
6. Cardiac index of 2.5 to 4.0 L/min/$m^2$

**Signs and Symptoms**:

1. Distributive shock (beginning with hyperdynamic [warm] shock, progressing to hypodynamic [cold] shock
2. Infection confirmed or highly suspicious
3. Fever may or may not be present
4. Hypothermia may be present in later stages
5. Cardiovascular changes
6. Significantly lowered SVR
7. Tachycardia
8. Normal to low-normal blood pressure initially; hypotension once in septic shock
9. Normal skin color, normal mucous membrane color, but warm skin initially
10. Cold clammy skin with pallor or cyanosis when sepsis is more progressed
11. Petechiae
12. Blood oozing from mucous membranes and procedure sites
13. Decreased pulse pressure
14. Increased respiratory rate

15. Increased respiratory depth
16. Respiratory alkaloisis
17. ARDS

**Transport Management Guidelines**

1. Orders received will be focused on maintaining the following
    a. MAP greater than 70 mm Hg or systolic BP greater than 90 mm Hg
    b. $Svo_2$ greater than 70%
    c. CVP of 8 to 12 mm Hg
    d. Urine output greater than 0.5 ml/hg/h
    e. $SaO_2$ greater than 93%
    f. Cardiac index of 2.5 to 4.0 L/min/$m^2$
2. Administer Oxygen, monitor and maintain patent airway, intervene as needed.
3. Provide fluid resuscitation (isotonic crystalloids in 20 ml/kg [500-1000 ml of fluid] increments to stabilize filling pressures).
4. Consider colloid therapy
5. Administer vasoactive agents if two 20 ml/kg fluid challenges are inadequate to maintain blood pressure. Norepinephrine and dopamine are the vasopressor of choice in hypotensive patients with sepsis. Dobutamine may also be given if ordered.
    a. Norepinephrine typically starts at 2 mcg/kg/min and titrated to desired MAP
    b. Dopamine dose may range between 5 – 30 mcg/kg/min
    c. Dobutamine typically starts at 2.5 mcg/kg/min and may titrate as high as 40 mcg/kg/min
6. Monitoring D-dimer level is a tool used to determine severity of sepsis and response to treatment
7. Provide mechanical ventilatory support if patient has ARDS
    a. Maintain low tidal volumes at 6 ml/kg
    b. Provide high PEEP at ranges of 5 to 14 cm H2O. The PEEP is increased as the need arises for higher oxygen saturation.
    c. Make $FIO_2$ adjustments for oxygen saturation as needed.
    d. Maintain $PaO_2$ between 55 and 80 mm Hg or $Sa0_2$ between 88% to 95%
    e. Keep end-inspiratory plateau pressures lower than 30 cm $H_2O$
    f. Monitor $PaCO_2$ closely
    g. The oxygen saturation goal is greater than 92%
    h. Sedation, if needed, must be monitored closely
8. Give antibiotic therapy as ordered
9. Remove potential sources of infection: wound debridement, abscess drainage, and device removal
10. Transferring MD may consider administration of a corticosteroid or recombinant human APC