Bleeding & Shock; IV Therapy
(Class 17)

- Blood Composition
  - Formed Elements
    - 45% of blood volume
  - Components
    - Erythrocytes
    - Leukocytes
    - Thrombocytes
  - Hematocrit
    - Ratio of Erythrocytes to plasma
    - Normally about 46% for men and 38% for women

- Blood Composition (Cont.)
  - Erythrocytes (RBCs)
    - Formed in red marrow
    - Normal is considered to be 4,200,000 to 6,100,000 cells per microliter (1/1000th cc) of blood
    - O2 transport
    - Hemoglobin
      - “Metalloprotein”
      - 97% of the RBC’s dry content, and 35% of the total content
      - Easily binds to oxygen and transports to systemic tissues
    - Biconcave disc
    - Anemia
      - Iron deficiency
      - Cell deficiency
    - Cyanosis
      - Bluish discoloration of the blood as seen through the skin tissues
      - Occurs when 85% or more of the blood is deoxygenated

- Blood Composition (Cont.)
  - Leukocytes (WBCs)
    - Formed in red marrow and lymph tissue
    - Variable percentage
      - Normal is considered to be 4,300 to 10,800 cells per microliter (1/1000th cc) of blood
    - Five types
      - Neutrophils
      - Basophils
- Eosinophils
- Monocytes
- Lymphocytes
  » Two sub-types
  » B and T Lymphocytes

• Blood Composition (Cont.)
  - Thrombocytes (Platelets)
    • Formed in red marrow
    • 150,000 to 400,000 cells per microliter (1/1000th cc) of blood
    • Clotting
      - Damage to blood vessel walls exposes collagen, which stimulate platelets
      - Platelets change shape from normal disc to sticky, spidery mass
      - Bind to collagen forming blood clot that plugs vessel wall

• Blood Composition (Cont.)
  - Thrombocytes (Platelets)
    • Hemophilia
      - Blood fails to clot normally
      - Little to none of a clotting factor (protein) needed for normal blood clotting
      - Types
        » Hemophilia A (little to no clotting factor VIII (8)); 9 out of 10 people with hemophilia has this type
        » Hemophilia B (little to no clotting factor IX (9))
        » Acquired (body forms antibodies to own clotting factors)
    - About 18,000 people in the United States have hemophilia
    - May bleed for longer time than others after an injury
    - May bleed internally, especially in knees, ankles, and elbows
    - Bruise easily

• Blood Composition (Cont.)
  - Plasma (liquid component)
    • 55% of blood volume
    • Straw-yellow in color
    • Components
      - Water (92% of plasma)
      - Proteins (8% of plasma)
» Albumin  
» Fibrinogen  
» Other clotting factors  
- Glucose (trace amounts)  
- Electrolytes (trace amounts)  
» Sodium  
» Potassium  
» Bicarbonate  

• Physiology of blood  
- Respiration  
- Nutrition  
- Excretion  
- Communication  
- Temperature regulation  
- Defense  
• WBCs  
• Clotting  

• Blood pressure  
- Ensures adequate perfusion (squeezing of blood) through the tissues  
- Components  
• Heart  
  - Adequate heart rate (HR)  
  - Adequate stroke volume (SV)  
    » Amount of blood ejected by left ventricle in one contraction  
  - Adequate force of contraction (FOC)  
    » Force with which left ventricle contracts  
• Blood Volume (BV)  
- Adequate volume of blood WITHIN the vascular space  
• Total Peripheral Resistance  
- Vascular tone  
- Adequate constriction of arterioles  
- Formula  
  • BP=(HR x SV x FOC) x BV x TPR  
    - Parenthetical is cardiac output  

• Hypoperfusion (Shock)  
- The bodily state resulting from inadequate tissue perfusion, usually due to hypotension (low blood pressure)  
- Causes  
• Low blood volume  
• Failure of the heart to pump  
• Failure of the peripheral arterioles to maintain adequate constriction
• Compensatory mechanisms
  - Catecholamine release
  • Sympathetic agents
    - Epinephrine
    - Norepinephrine
  • Effects
    - Tachycardia
      » Increases heart rate which increases blood pressure
    - Increased force of contraction
      » Increases strength of pulse wave which increases blood pressure
    - Increased peripheral resistance
      » Further increases arterial tone which causes pallor
    - Diaphoresis
      » "Cold sweat"
      » Actually tends to lower blood pressure by loss of plasma
      » Better thought of as a "side effect" of Catecholamine release

• Types of Hypoperfusion
  - Hypovolemic
    • Hemorrhage
    • Spacing
    • Metabolic
  - Cardiogenic
  - Distributive
    • Septic
    • Anaphylactic
    • Psychogenic
    • Neurogenic
    • Respiratory

• Hypovolemic
  - Hemorrhage (whole blood loss from vascular space)
    - External hemorrhage
    - Internal hemorrhage
      » Hollow organs
      » Into spaces
      » Dissecting hemorrhage
        * Aneurysm
        * Thigh muscles
  - Severe hemorrhage
    • 1000cc of blood in the adult patient
    • 500cc of blood in the child
    • 100 - 200cc of blood in an infant
    • The natural response to bleeding is blood vessel contractions and clotting;
however, a serious injury may prevent effective clotting from occurring.

- Hypovolemic (Cont.)
  - "Spacing"
    - Loss of plasma only
    - Formed elements remain in vascular space
    - Occurs in burn patients
  - Metabolic
    - Tremendous fluid loss
      - Vomiting
      - Diarrhea
    - Hypotension due to fluid loss

- Cardiogenic
  - Failure of the heart as a pump
    - Causes
      - Trauma
        » Pericardial tamponade
        » Massive coronary contusion
      - Medical
        » Heart attack (MI)
        » Congestive heart failure

- Distributive
  - Septic
    - Overwhelming systemic infection
    - Byproducts of bacterial metabolism are toxins that cause vasodilation
    - TPR cannot be maintained
  - Anaphylactic
    - Massive allergic reaction
    - Arteries and arterioles dilate
  - Psychogenic (Syncope)
    - Fainting
    - Momentary loss of nervous control of arteries and arterioles
    - TPR reduced
    - Hypotension

- Distributive (Cont.)
  - Neurogenic (Spinal)
    - Spinal cord is severed or otherwise injured
    - Arteries and arterioles no longer have nervous control
    - Arteries and arterioles relax (dilate)
    - Dilation decreases TPR
    - Hypotension
    - NO catecholamines are released
- No nervous innervation of adrenal glands
- Traditional signs of shock absent
  » No skin pallor
  » Skin is warm
  » No diaphoresis
- Spinal reflexes disappear for few days then reappear
- Loss of sweating
- Loss of bowel and bladder control

Distributive (Cont.)
- Respiratory
  » Hypoxia
  » Hypercarbia
  » Low blood pressure

Detrimental effects of Hypoperfusion
- Anaerobic metabolism
  » Oxygen deprivation
  » Body converts to non-oxygen metabolism
    - Excess acids produced
    - Acid-base balanced disturbed
  » Increased capillary permeability
    - Proteins leave vascular space
    - Water follows proteins
    - Interstitial edema forms
    - Diffusion of oxygen into cells further reduced
  » Red blood cell aglutination
    - Cells form tiny clots
    - Embolus formation

Signs and symptoms of hypoperfusion
- Mental states
  » Restlessness
  » Anxiety
  » Altered mental status
- Decreased peripheral perfusion
  » Delayed capillary refill greater than 2 seconds in normal ambient air temperature - infant and child patients only
  » Weak, thready or absent peripheral pulses
  » Pale, cool, clammy skin (except neurogenic shock)
- Vital sign changes
  » Decreased blood pressure (late sign)
  » Increased pulse rate (early sign) - weak and thready
  » Increased breathing rate
    - Shallow
    - Labored
- Irregular

- Signs and symptoms of hypoperfusion
  - Other signs and symptoms
    - Dilated pupils
    - Marked thirst
    - Nausea and vomiting
    - Pallor (except neurogenic shock) with cyanosis to the lips
  - Infant and child patients can maintain their blood pressure until their blood volume is more than half gone, so by the time their blood pressure drops they are close to death. The infant or child in shock has less reserve.

- Treatment (OTHER THAN ANAPHYLACTIC SHOCK)
  - Body substance isolation.
    - Body substance isolation must be routinely taken to avoid skin and mucous membrane exposure to body fluids.
      - Eye protection
      - Gloves
      - Gown
      - Mask
      - Hand washing following each run.

- Treatment (Cont.)
  - Maintain airway/artificial ventilation. Administer oxygen if indicated.
    - Airway
      - Positioning
        » Modified jaw thrust
        » Chin lift
      - Adjuncts as needed
        » Nasal airway
        » Oral airway
        » PTL
      - Spinal precautions while managing airway
        » Manual immobilization
        » Ask patient to remain motionless

- Treatment (Cont.)
  - Breathing
    - High flow oxygen
      » Non-rebreathing mask
      » 15 LPM
    - Bag-valve-mask assembled and ready
    - Assist and supplement breathing as necessary
    - Artificial ventilation as necessary
Treatment (Cont.)
- Control any external bleeding
  - Direct pressure (always first choice)
    - Apply finger tip pressure directly on the point of bleeding.
    - Large gaping wounds may require packing with sterile gauze and direct hand pressure if direct finger tip pressure fails to control bleeding.
    » Substitute BP cuff?
    - Elevation (may be used in combination with direct pressure)
      - Elevate above level of patient’s heart
    - Indirect pressure (may be used in combination with direct pressure)
      - Pressure proximal to injury
      - Actually localized tourniquet effect without halt of collateral blood flow

Treatment (Cont.)
- If direct pressure fails to control external bleeding, apply a tourniquet
  - Shuts off ALL circulation, including collateral circulation
  - Application of a tourniquet can cause permanent damage to nerves, muscles and blood vessels resulting in the loss of an extremity if not applied correctly and/or patient not promptly transported.

Treatment (Cont.)
- Tourniquet
  - Procedures for applying a tourniquet:
    - Use a bandage 4 inches wide and 6 to 8 layers deep.
    - Wrap it around the extremity twice at a point proximal to the bleeding but as distal on the extremity as possible.
    - Tie one knot in the bandage and place a stick or rod under the bandage and away from the knot.
    - Twist the stick until the bleeding stops.
    - Once the bleeding has stopped, secure the stick or rod in position using the remnants of the knot.
    - Notify other emergency personnel who may care for the patient that a tourniquet has been applied.
    - Document the use of a tourniquet and the time applied in the prehospital patient report.
    - A continuously hyperinflated blood pressure cuff may be used as a tourniquet until bleeding stops.

Treatment (Cont.)
- Tourniquet
  - Precautions with the use of a tourniquet:
    - Use a wide bandage and secure tightly.
    - Never use wire, rope, a belt, or any other material that may cut into the skin and underlying tissue.
- Do not remove or loosen the tourniquet once it is applied unless directed to do so by medical direction.
- Leave the tourniquet in open view (Do NOT cover).
- Do not apply a tourniquet directly over any joint, but as close to the injury as possible.
- Clearly identify patient as having had a tourniquet applied
- Immediate transport

• Treatment (Cont.)
  - Other options to minimize bleeding
    • Splints
      - Reduction of motion of bone ends will reduce the amount and aggravation of tissue damage and bleeding associated with a fracture.
      - Splinting may allow prompt control of bleeding associated with a fracture.
    • Pressure/air splints
      - The use of air pressure splints can help control severe bleeding associated with lacerations of soft tissue or when bleeding is associated with fractures.
      - Pneumatic counter pressure devices (pneumatic antishock garment) can be used as an effective pressure splint to help control severe bleeding due to massive soft tissue injury to the lower extremities (leg compartments only) or traumatic pelvic hemorrhage (all compartments).

• Treatment (Cont.)
  - Special areas (bleeding from the nose, ears or mouth)
    • Potential causes:
      - Injured skull
      - Facial trauma
      - Digital trauma (nose picking)
      - Sinusitis and other upper respiratory tract infections
      - Hypertension (high blood pressure)
      - Coagulation disorders

• Treatment (Cont.)
  - Special areas (bleeding from the nose, ears or mouth)
    • Bleeding from the ears or nose may occur because of a skull fracture. If the bleeding is the result of trauma, do not attempt to stop the blood flow. Collect the blood with a loose dressing, which may also limit exposure to sources of infection.

• Treatment (Cont.)
  - Special areas (bleeding from the nose, ears or mouth)
    • Emergency medical care for epistaxis (nosebleed):
      - Place the patient in a sitting position leaning forward.
      - Apply direct pressure by pinching the fleshy portion of the nostrils together.
      - Keep the patient calm and quiet.
Treatment (Cont.)
- Circulation
  - Check and maintain a central pulse
  - Two IV’s of normal saline or lactated ringers running to keep a hypotensive patients blood pressure 90 to 110 mmHg.
  - If patient is not hypotensive, one IV of normal saline or lactated ringers TKO.
- Elevate the lower extremities approximately 8 to 12 inches (Trendelenburg position).
  - If the patient has serious injuries to the pelvis, lower extremities, head, chest, abdomen, neck, or spine, keep the patient supine.
- Splint any suspected bone or joint injuries.
- Prevent loss of body heat by covering the patient with a blanket when appropriate.
- Nothing by mouth (NPO)
- Immediate transport with frequent vital signs.

Treatment (Cont.)
- If signs of shock (hypoperfusion) are present and the lower abdomen is tender and pelvic injury is suspected, with no evidence of chest injury, apply and inflate the pneumatic antishock garment if approved by medical direction.

**MAST Trousers**

- Names
  - Military Anti-shock Trousers
  - Medical Anti-shock Trousers
  - Pneumatic Anti-shock Garment

- Suit types
  - MAST I
    - One compartments
  - MAST II
    - Abdominal compartment
    - Legs compartment
  - MAST III
    - Abdominal compartment
    - Left leg compartment
    - Right leg compartment

- Purpose
  - Increase peripheral resistance via circumferential pressure
  - Mechanism
    - Increase preload
      - Increased venous return
    - Decrease afterload
      - Reduce arterial flow to the lower extremities
• Advantages
  - 2000 cc auto-transfusion
  - Increased cerebral perfusion pressure
  - Increased preload
  - Increased lower peripheral resistance
  - Splint
  - Direct pressure for open wounds

• Indications
  - Systolic B/P below 80 mm Hg
    • History of trauma
    • History of blood loss
  - Lower extremity fractures
    • Treatment of choice for pelvic fractures
    • May substitute for traction splint
      - Pull usual traction, then inflate
  - Neurogenic (spinal) shock
  - Massive abdominal bleeding
  - Any trauma patient
    • Even if B/P not low, may apply and not inflate to save time

• Contraindications
  - Pulmonary edema
  - Rales
  - Rhonchi
  - Uncontrolled hemorrhage
  - Chest injury (some medical directors only)
  - Head injury (some medical directors only)

• Modified application
  - Evisceration
    • Use leg compartments only
  - Pregnancy
    • Use leg compartments only
  - Impaled objects
    • Abdomen
      - Use leg compartments only
    • Either leg
      - Use other leg only

• Removal
  - Should never remove unless directed by medical control
  - Prior requirements
    • Stable B/P
• Surgeon present
• Someone to continually monitor B/P
• Infusing IVs
• Pump for reinflation

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• Removal (Cont.)
  - Auscultate B/P
  - Note duration of application
    • Bicarbonate
  - Assure all valves closed
  - Remove pump
  - Release pressure
    • Place thumb over abdominal hose
    • Open valve
    • Slowly release pressure
    • 15 minutes to completely deflate compartment
    • Continually recheck B/P
  - Repeat with lower extremities

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• Removal (Cont.)
  - Precipitous fall in B/P
    • Close valves
    • Trendelenburg position
    • Increase fluids
    • Re-inflate if B/P continues to fall after above

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• Special concerns
  - Do NOT allow suit to be cut
  - Apply MAST before attempting IV
  - Always check breath sounds
  - Always give high flow oxygen
  - Always remove
    • Shoes
    • Socks
    • Pants

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• Special concerns (Cont.)
  - Always check distal pulses
  - Ignore gauges on suit with trauma patients
    • B/P is best indication of adequate inflation
  - Pressure changes
    • Altitude
      - Increase will increase pressure
      - Decrease will decrease pressure
    • Temperature
- Increase will increase pressure
- Decrease will decrease pressure

**Skills**
- Bleeding Control/Shock Management
- Skills Manual pages 29 & 30
- Video

**Skills**
- PASG
- Skills Manual pages 51 & 52
- Video

**IV Therapy**

**Terms**
- Bevel - the sloped edge of a needle
- cc - cubic centimeter (same as ml)
- d/c - discontinue
- Drip chamber - the clear, expanded portion of administration set
- Drip rate - the number of drops per minute
- Extravasation - a leaking of IV fluid into the surrounding tissue
  - Also known as infiltration
- Gauge - the measurement of the external diameter or thickness
- gtt - drop

**Terms (Cont.)**
- ml - milliliter (same as cc)
- Infiltration - a leaking of IV fluid into the surrounding tissue
  - Also known as extravasation
- IV - intravenous infusion
- Lumen - inner open portion of needle
- Positional IV - one in which the drip rate may vary as the patient moves his/her arm
- TKO or KVO - to keep open or keep vein open
  - Rate of infusing the IV solution to avoid blood clot formation on the tip of the catheter while not administering much fluid
  - Equal to approximately 8 to 15 drops per minute

**Equipment**

**Catheters**
- Bends with tissues and does not infiltrate as easily as needles
- Types
• Catheter over needle
  - Used most frequently
• Needle over catheter
  - Must be placed by physician
- Sizes
  • Diameter
    - The smaller the diameter, the slower the flow
    - 14 gauge (large)
    - 23 gauge (small)
    - 16, 18, 20, and 22 gauges are available too
  • Length
    - The longer the catheter, the slower the flow
    - 2½ inch (long)
    - ¾ inch (short)

• Butterfly
  - Steel needle with sharp point which remains in the vein; infiltrates easily

• Administration set
  - Carries the fluid from the container to the needle and provides control of fluid rate by evenly breaking the fluid into droplets
  - Also known as
    • IV tubing
    • Infusion set
    • Drip set

• Administration set (Cont.)
  - Basic components
    • Rigid plastic drip chamber
    • Spike
      - The piercing spike is the end of the administration set that is inserted into the tubing insertion port of the IV bag. It comes packaged with a protective cap to prevent it from being contaminated prior to use.
    • Plastic tubing which ends with a lure tip
    • Drug administration port (Secondary Port)
    • Flow clamp
      - Used to control the amount of IV fluid the patient receives
      - Roller, slide or screw type clamp
• Administration set (Cont.)
  - Types of sets based on drip chamber
    - Macrodrip
      - 10 gtts/cc
      - 12 gtts/cc
      - 15 gtts/cc
      - 20 gtts/cc
    - Microdrip
      - 60 gtts/cc
  - Moderates the amount of fluid sent to patient by changing the size of drops traveling through the drip chamber

IV Fluids

• Types
  - Colloids
    - Dissolved proteins in water
      - High molecular weight
      - Stays in vascular system a long time
      - Tremendous osmotic drawing power
      - Fluid moves out of cells and into vascular system
    - Examples
      - Plasmanate
        » Will not use as an EMT
      - Dextran
        » Will not use as an EMT

• Types (Cont.)
  - Crystalloids
    - Dissolved salts or sugars in water
    - Cross into cells quickly
      - Particularly sugar solutions
    - Must give increased amount of solution to compensate for blood loss
      - 3 liters of solution for each liter of blood lost

• Types (Cont.)
  - Crystalloid examples
    - Dextrose 5% in Water (D5W)
      - Isotonic in container
      » Acts more like hypotonic when in circulation
- Contents
  » Sugar (Dextrose)
  » Sterile water
- Contraindications
  » Patients at risk for increased intracranial pressure
  » Patients who have an acute neurological dysfunction
  » Hypovolemic states
  » Patients at risk for third-space fluid shifts
  » Elevated blood glucose concentrations.

Types (Cont.)
- Crystalloid examples (Cont.)
- Normal saline (NS)
  • Isotonic
  • Contents
    » Sodium (.09%)
    » Chloride
    » Sterile water

Types (Cont.)
- Crystalloid Examples (Cont.)
  • Lactated Ringers Solution (LR or Ringer's)
    • Isotonic
    • Closely resembles blood plasma but without proteins
    • Contents
      » Sodium (.09%)
      » Calcium
      » Chloride
      » Lactate
      » Sterile water

Containers
- Types
  • Non-rigid Bags
    » 1000 cc (1 liter)
    » 500 cc
    » 250 cc
    » 100 cc
    » 50 cc
  • Glass
  • Semi-rigid plastic
    » Some may be used as IV fluid or as irrigant
• Containers (Cont.)
  - Inspection
  • Clarity
  • Date
  • Floating material
  • Leaks
  • Proper solution
  •

• Miscellaneous equipment
  - Alcohol swabs or Betadine swabs
    • Check with patient to make certain not allergic to the iodine in the Betadine swabs
  - Antiseptic ointment to reduce chance of infection
    • Neosporin
    • Bacitracin
  - Armboards
  - Tape
    • Check for allergy
  - Tourniquet
    • Actually more accurately referred to as a venous constricting band

Site Selection

1. Digital Dorsal veins
2. Dorsal Metacarpal veins
3. Dorsal venous network
4. Cephalic vein
5. Basilic vein

1. Cephalic vein
2. Median Cubital vein
3. Accessory Cephalic vein
4. Basilic vein
5. Cephalic vein
6. Median antebrachial vein

Site Preparation

• Alcohol
  - Select site and cleanse from insertion point outward in a swirling motion
  - If patient particularly dirty, cleanse twice
• Betadine
  - Select site and cleanse from insertion point outward in a swirling motion
  - Wipe Betadine away with alcohol
IV Insertion

• Skill
  - IV Cannulation
  - Skills Manual pages 86 & 87
  - Video

Regulating the Flow

• Calculating drop rates
  - To be able to calculate the rate of infusion you need three items of information
    • The volume of fluid to be infused
    • The length of time in which this volume of fluid is to be given
    • The “drop factor” (number of drops per cc) for the administration set.
      - This information is found on the package (refer to macrodrip, microdrip)
  • Use the following formula:

Problem 1
  - Your order is 250 cc/hr.
  - You have a 10 gtt/cc drip set.

Problem 1
  - Your order is 250 cc/hr.
  - You have a 10 gtt/cc drip set.

Problem 2
  - Your order is 250 cc/hr.
  - You have a 15 gtt/cc drip set.

Problem 2
  - Your order is 250 cc/hr.
  - You have a 15 gtt/cc drip set.

Problem 3
  - Your order is 250 cc/hr.
  - You have a 60 gtt/cc drip set.

Problem 3
  - Your order is 250 cc/hr.
- You have a 60 gtt/cc drip set.

- **Problem 4**
  - Your order is 380 cc/hr.
  - You have a 15 gtt/cc drip set.

- **Problem 5**
  - Your order is 250 cc/30 min.
  - You have a 15 gtt/cc drip set.

- **Problem 6**
  - Your order is 1 Liter/hr.
  - You have a 10 gtt/cc drip set.

- **Problem 7**
  - Your order is 8 liters over 2 days.
  - You have a 15 gtt/cc drip set.

- **Problem 8**
  - Your order is ½ liter per ½ hr.
  - You have a 10 gtt/cc drip set.

- **Problem 9**
  - Your order is ½ liter per hour for three hours followed by 1 liter per 12 hours for 1 day.
  - You have a 10 gtt/cc drip set.

- **Problem 10**
  - Your order is 0.1 ml/Kg/min.
  - Your patient weights 120 lbs.
  - You have a 10 gtt/cc drip set.

- Improper drip rates
  - If the volume of fluid infused gets behind, take the new volume and refigure the
drop rate to allow the IV to finish at the appropriate time.
- Do not attempt to speed up the IV to catch up and then slow to the original rate.

**Problems with Fluid Flow**

- Maintaining the flow
  - An important responsibility of the EMT is to monitor the infusion for trouble and maintain its flow.
  - Some of the main problems the EMT might encounter in transfers are described on the following slides.

- Infiltration (Extravasation)
  - This is caused by the leaking of IV fluid into the surrounding tissue.
  - Pallor, swelling, coolness, pain at the site, and usually a diminished IV flow rate are all indications of infiltration.
  - An infiltrated IV must be discontinued.

- Failure to elicit a blood return into the catheter when the infusion bottle is lowered below the level of the needle and patient's heart while the clamp is open may also be a helpful sign; however, the IV may be infiltrated and blood return still be present.

- Obstruction
  - A decrease in flow rate or the complete cessation of flow might be indicators of obstruction.
  - It can be caused by a clot forming over the needle lumen, by the lumen being positioned against the wall of the vein, by kinking or pressure on the tubing, or the position of the arm may occlude the vessel proximal to the IV site.

- Obstruction (Cont.)
  - Locate the source of the obstruction and correct it.
    - If the tubing is kinked - straighten it.
    - If the position of the arm is causing the obstruction, correct the position. If possible, elicit the patient's cooperation to keep his arm in a good position.
    - If the lumen is against the wall of the vein, gently raise the hub of the needle and support it with an alcohol prep. Slight pressure may force wall of vein away from the needle. It may also release a small clot, however, a clot small enough to be dislodged in this manner generally will not cause an embolus.

- Circulatory overload
  - This may occur when excessive intravenous fluids are administered through miscalculation of the rate, miscalculation of the patient's fluid needs or a “run-away I.V.”
  - The symptoms of circulatory overload are those of congestive heart failure - dyspnea, rales, jugular vein distention.
  - The IV must be lowered or stopped
• Air embolism
  - This may occur with any intravenous infusion
  - Air embolism can be prevented by taking these appropriate precautions
    • Inspect tubing for defects
    • Make sure all connections fit tightly
    • Discontinue the infusion before the bottle is completely empty
    • Avoid circumstances which will increase negative pressure in the tubing
    • Do not elevate the extremity receiving the infusion above the level of the heart

Air embolism (Cont.)
  - Estimates vary from 35 ml to 350 ml of intravenous air as being necessary to cause the death of a person. The average infusion tubing holds about 5 ml of air. Patients, however, are often frightened and every effort should be made to avoid air in the tubing.
  - The drop rate may change due to changes in the height of the fluid container or IV needles in sites that allow for motion to affect their placement. For this reason, the EMT should frequently monitor the drip rate and adjust accordingly

• Line problems
  - If the drip chamber fills with fluid during transport, turn off the IV flow, invert bag and squeeze fluid into bag until chamber is filled to the fill-line.
  - If air is in the IV line above the slide clamp, pull line tight while being careful not to remove the line from the bag. Tap on the line to allow air to rise into the drip chamber. Large amounts of air may be removed using a needle and syringe.