

Hemorrhage Control



Pea Ridge Fire Department
EMS refresher



Introduction

- “A before B, except after C.”
 - Focus first on circulation, not airway, given severe hemorrhage.
 - Bleeding is extremely time sensitive.
 - Goal in trauma care is to maintain perfusion.
 - Given massive hemorrhage, C of circulation takes priority over airway and breathing (CAB).

Introduction

- Airway management requires adequate circulation.
- Even minor bleeding may be dangerous.
 - Vague symptoms, such as general weakness, may progress to shock.

Anatomy and Physiology

- Cardiovascular system keeps blood flowing between lungs and peripheral tissues
 - Right side: blood to lungs
 - Left side: receives blood from lungs and pumps it throughout body

Anatomy and Physiology

- In lungs, blood:
 - Unloads waste products
 - Picks up oxygen

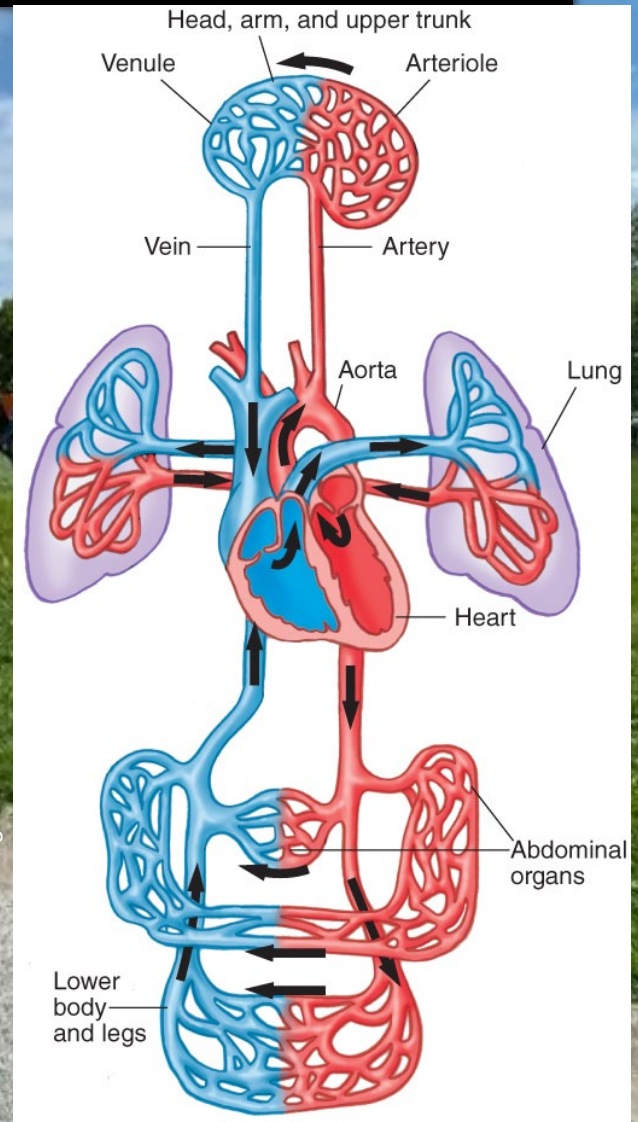
- In peripheral tissues, blood:
 - Unloads oxygen
 - Picks up waste

Anatomy and Physiology

- If blood stopped or slowed:
 - Cells engulfed by waste products.
 - Oxygen delivery to tissues disrupted.
 - Cells switch to anaerobic metabolism.
 - Would begin to die within a few minutes of circulatory failure

Anatomy and Physiology

- Circulatory system requires:
 - Pump
 - Pipe
 - Fluid



The Cardiac Cycle

- Repetitive pumping process
 - Preload: Amount of blood returned to heart to be pumped out
 - Afterload: The pressure in the aorta, against which the left ventricle must pump blood

The Cardiac Cycle

- Blood pressure = Cardiac output (CO) $\times$ Peripheral vascular resistance (PVR)
 - PVR is measured as mean arterial pressure (MAP)
 - MAP = Diastolic pressure + $\frac{1}{3}$ Pulse pressure
 - Pulse pressure = SBP – DBP

The Cardiac Cycle

- Cardiac output
 - $CO = \text{Stroke volume} \times \text{Pulse rate}$
 - Increased venous return results in increased cardiac contractility.

The Cardiac Cycle

- A normal heart pumps same percentage of blood returned to the right atrium.
 - If more blood returns, the heart pumps harder.
 - Maintained through position changes, coughs, etc.
- Connecting the equations yields:
 - $BP = SV \times \text{Heart rate} \times PVR$

Blood and Its Components

- Blood consists of:
 - Plasma
 - Formed elements in plasma
 - Red blood cells
 - White blood cells
 - Platelets

Blood and Its Components

- Purpose of blood:
 - Carry oxygen and nutrients to tissues
 - Carry cellular waste products away from tissues
 - Other functions of formed elements:
 - Fighting infection
 - Controlling bleeding

Blood and Its Components

- Plasma: Watery, straw-colored fluid
 - More than half of total blood volume
- Platelets: Small cells essential for clot formation
 - Coagulation process involves:
 - Clotting proteins in plasma
 - Other proteins
 - Calcium

Blood Circulation and Perfusion

- Arteries carry blood away from the heart.
- Veins transport blood back to the heart.
- Perfusion
 - Circulation of blood in adequate amounts to meet cells' current needs

Blood Circulation and Perfusion

- Autonomic nervous system adjusts blood flow to meet body's needs.
 - Sympathetic system
 - Parasympathetic nervous system

Blood Circulation and Perfusion

- Vasomotor center in the medulla oblongata helps regulate blood pressure.
- Endocrine system also responds to changes.
 - Fall in blood pressure causes the release of:
 - Aldosterone
 - Antidiuretic hormone (ADH)

Blood Circulation and Perfusion

- Insufficient circulation leads to hypoperfusion or shock.
 - Delivery of oxygen depends on:
 - Adequate heart rate
 - Stroke volume
 - Hemoglobin levels
 - Arterial oxygen saturation

Pathophysiology of Hemorrhage

- Hemorrhage means bleeding.
 - External hemorrhage usually controlled by:
 - Direct pressure
 - Pressure bandage
 - Internal hemorrhage is usually only controlled by surgery.

External Hemorrhage

- Extent/severity is often a function of the type of wound and vessel.
 - Capillary
 - Vein
 - Artery
- If injury is large enough, person can exsanguinate in just a few minutes.

Internal Hemorrhage

- Hemorrhage may appear in any area.
- Nontraumatic internal hemorrhage usually occurs in cases of:
 - GI bleeding
 - Ruptured ectopic pregnancies
 - Ruptured aneurysms

Internal Hemorrhage

- Must be treated promptly
 - Pay close attention to:
 - Complaints of pain and tenderness
 - Development of tachycardia
 - Pallor
 - Be alert to development of shock.

The Significance of Hemorrhage

- The body cannot tolerate more than 20% blood loss.
 - Typically, more than 1 L of blood loss will change vital signs.
 - Compensation depends on how rapid a person bleeds.

The Significance of Hemorrhage

- Consider bleeding to be serious if:
 - Significant MOI
 - Poor general appearance
 - Signs and symptoms of shock
 - Significant amount of blood loss
 - Rapid blood loss
 - Uncontrollable bleeding

Physiologic Response to Hemorrhage

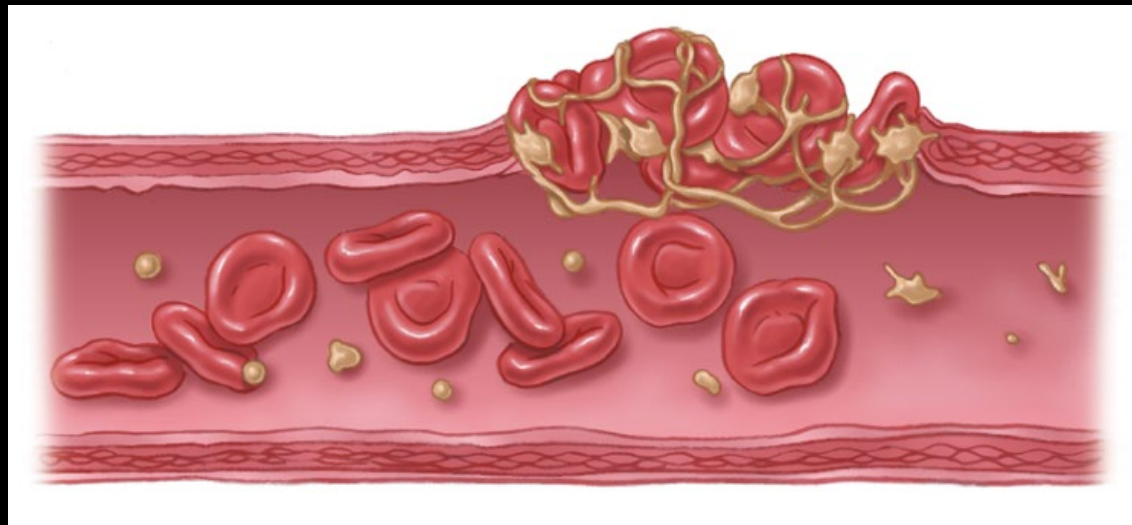
- Bleeding from an open artery is bright red.
 - spurts with pulse
- Blood from open veins is darker.
 - Flows steadily
- Bleeding from damaged capillary vessels is dark red.
 - Oozes steadily but slowly

Physiologic Response to Hemorrhage

- Venous/capillary bleeding is more likely to clot than arterial bleeding.
 - Bleeding tends to stop within 10 minutes.

Physiologic Response to Hemorrhage

- Three steps of hemostasis:
 - Vasoconstriction
 - Platelet aggregations
 - Fibrin formation



Physiologic Response to Hemorrhage

- System may fail in certain situations.
- Hemophilia
 - Condition where one or more of the blood's clotting factors are missing
 - All injuries are potentially serious.

Physiologic Response to Hemorrhage

- Trauma triad of death
 - Combination of hypothermia, coagulopathy, and acidosis
 - Coagulopathy, disruption of the body's ability to clot, can lead to further hemorrhage.
 - To prevent hypothermia, trauma patients must be kept warm.

Shock

- Shock can result from many conditions, including:
 - Bleeding
 - Respiratory failure
 - Acute allergic reactions
 - Overwhelming infection

Table 30-1

Causes of Shock

Respiratory Failure

- Obstruction—airway or embolism
- Chest wall movement problems—such as flail chest
- Diffusion failure—acute respiratory distress syndrome (ARDS)
- Toxic exposures—such as carbon monoxide and cyanide

Pump Failure

- Cardiogenic shock
 - Intrinsic
 - Extrinsic
 - Cardiac tamponade
 - Tension pneumothorax

Poor Vessel Function

- Distributive shock
- Septic shock
- Central nervous system disruption
 - Neurogenic shock
 - Psychogenic shock (vasovagal syncope)
- Anaphylactic shock

Low Fluid Volume

- Hypovolemic shock
 - Hemorrhagic shock, such as internal or external bleeding
 - Nonhemorrhagic shock, such as dehydration
 - Third space loss, such as with some fractures and burns

Shock

- Hypovolemic shock
 - Shock from inadequate blood volume
 - Volume can be lost as:
 - Blood
 - Plasma
 - Electrolyte solution

Hemorrhagic Shock

- Often due to:
 - Blunt or penetrating injuries
 - Long bone or pelvic fractures
 - Vascular injuries
 - Multisystem injury

- High incidence of exsanguinations:
 - Heart
 - Thoracic system
 - Abdominal system
 - Venous system
 - Liver

Hemorrhagic Shock

- Hypovolemic shock caused by hemorrhagic trauma is classified into four classes.
 - Compensated shock (Classes I and II)
 - Decompensated shock (Class III)
 - Irreversible shock (Class IV)

Hemorrhagic Shock

Table 30-2 **Estimated Fluid and Blood Loss for a 154-lb (70-kg) Patient**

	Class I	Class II	Class III	Class IV
Blood loss (mL)	<750	750–1,500	1,500–2,000	>2,000
% Blood loss	<15	15–30	30–40	>40
Heart rate (beats/min)	Minimally elevated or normal	100–120	≥120, thready	Marked tachycardia
Systolic blood pressure	Within normal limits	Minimal or no change	Significant drop	Significant depression
Pulse pressure	Within normal limits	Narrow	Narrow	Very narrow
Capillary refill	Within normal limits	May be delayed	Delayed	Delayed
Respiratory rate (breaths/min)	14–20	20–24	Markedly elevated	Markedly elevated
Central nervous system/mental status	Slightly anxious	Mildly anxious	Anxious and confused	Confused and lethargic
Skin condition	Cool, pink	Cool, moist	Cold, pale, moist	Cold, pale
Urine output (mL/h)	>30	20–30	Diminished	Minimal or none
Fluid replacement	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

Hemorrhagic Shock

- Initial stage is characterized by:
 - Low circulating blood volume
 - Minimal signs of hypoperfusion
- As the body begins to compensate, patients have:
 - Tachycardia
 - Hypotension
 - Signs of poor tissue perfusion

Hemorrhagic Shock

Table 30-3

Compensated Versus Decompensated Shock

Compensated Shock

- Agitation, anxiety, restlessness
- Sense of impending doom
- Weak, rapid (thready) pulse
- Clammy (cool, moist) skin
- Pallor with cyanotic lips
- Shortness of breath
- Nausea, vomiting
- Delayed capillary refill in infants and children
- Thirst
- Normal blood pressure

Decompensated Shock

- Altered mental status (verbal to unresponsive)*
- Hypotension
- Labored or irregular breathing
- Thready or absent peripheral pulses
- Ashen, mottled, or cyanotic skin
- Dilated pupils
- Diminished urine output (oliguria)
- Impending cardiac arrest

*Mental status changes are late indicators.

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Scene Size-up

- Once scene is deemed safe, take standard precautions.
- High-energy MOI should increase suspicion.
- Internal bleeding may also be caused by illnesses.
- Attempt to determine amount of blood.
- If significant MOIs, scene time should not exceed 10 minutes.

Primary Survey

- Determine patient's mental status using the AVPU scale.
- Locate and manage immediate life threats.
- Manage any major external hemorrhage.

Primary Survey

- A patient with internal hemorrhage needs rapid transport.
 - Tachycardia is an early sign of hypoperfusion.
 - Late signs of internal hemorrhage include:
 - Weakness, fainting, or dizziness at rest
 - Dull eyes
 - Altered level of consciousness

Primary Survey

- If minor external hemorrhage:
 - Make note and complete assessment.
 - Manage after patient has been properly prioritized.
- Consider internal bleeding if patient has signs and symptoms of shock, but only minor visible bleeding.

History Taking

- Ask about:
 - Dizziness or syncope
 - Current medication that may thin blood
 - History of clotting insufficiency
 - Use of beta blockers, calcium channel blockers, antidysrhythmics, or nitroglycerin
 - Any pain, tenderness, bruising, guarding, or swelling

Secondary Assessment

- Perform a systematic full-body scan.
 - Symptoms of internal hemorrhage often include:
 - Pain and swelling
 - Hemorrhage from any body opening
 - Note bleeding characteristics and try to determine source.

Secondary Assessment

- Other signs of internal hemorrhage include:
 - Hematoma
 - Melena
 - Hematuria
 - Pain, tenderness, guarding

Secondary Assessment

- Assess the following:
 - Respiratory system
 - Cardiovascular system
 - Neurologic system
 - Musculoskeletal system
 - All anatomic regions

Reassessment

- Reassess, especially where abnormal findings were found.
- Reassess interventions.
- In cases of severe hemorrhage, obtain vital signs every 5 minutes en route.

Emergency Medical Care of Bleeding and Hemorrhagic Shock

- Follow standard precautions.
- If signs of hypoperfusion:
 - Transport rapidly.
 - Provide aggressive management en route.
 - Provide psychological support.

Managing External Hemorrhage

- Hemorrhaging from nose, ears, and mouth
 - Ear or nose hemorrhage may indicate skull fracture.
 - Do not attempt to stop blood flow.
 - Cover bleeding site loosely with sterile gauze pad.

Managing External Hemorrhage

- Hemorrhaging from nose, ears, and mouth (cont'd)
 - Nosebleed from other conditions
 - Apply cold compresses to end of nose.
 - Or place rolled gauze under the upper lip.
 - Check blood pressure.

Managing External Hemorrhage

- Hemorrhaging from other areas
 - Control through use of direct pressure.
 - Pack large, gaping wounds with sterile dressing.
 - Keep patient warm and in appropriate position.
 - Patient's condition should indicate mode of transport.

Tourniquets

- Useful for severe hemorrhaging from extremity injury below axilla or groin
- Many commercially available options

Tourniquets



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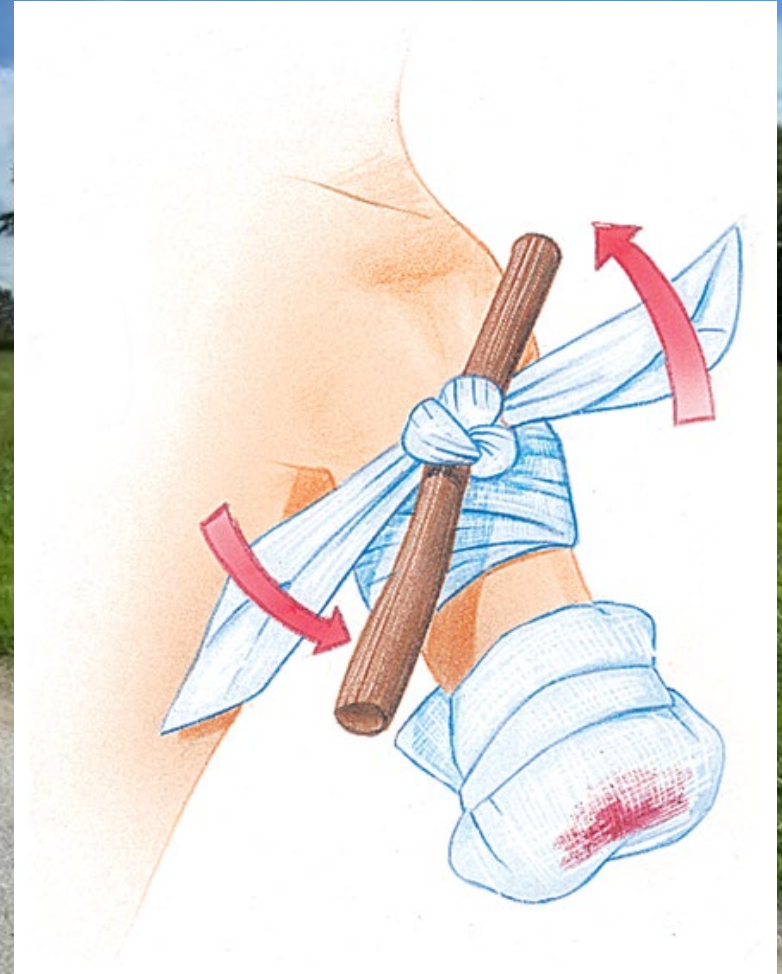
Photo by Diane Zahorodny. Courtesy of Chinook Medical Gear.



Photo by Diane Zahorodny. Courtesy of Chinook Medical Gear.

Tourniquets

- If commercial tourniquet is not available, apply a triangular bandage and a stick or rod.
 - Blood pressure cuff can be used as well.



Tourniquets

- Junctional tourniquet
 - Used when the hemorrhage is inguinal or axillary
 - Belt system holds the device in place.
 - Pump inflates a compression device to put pressure on the deep vessels.



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Tourniquets

- Precautions:
 - Do not apply directly over a joint.
 - Use widest bandage possible.
 - Never use narrow material.
 - Use wide padding underneath.
 - Never cover with a bandage.
 - Inform hospital of the tourniquet.
 - Do not loosen after application unless directed to by hospital personnel or medical control.

Splints

- Broken bones can lacerate tissue, causing bleeding.
- Immobilizing a fracture is a priority in bleeding control.



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Splints

- Air splints
 - Control hemorrhage associated with venous bleeding and stabilize fracture.
 - Monitor distal extremity circulation.
 - Use only approved valve stems.



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Splints

- Rigid splints
 - Stabilize fracture and reduce pain
 - Monitor distal extremity circulation.
- Traction splints
 - Stabilize femur fractures
 - Pad areas to prevent excessive pressure.
 - Monitor distal extremity circulation.

Hemostatic Agents

- Used to control severe hemorrhage when tourniquet cannot be placed
- Adhere to damaged tissue and dehydrate the blood or undergo a chemical reaction to cause clotting



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Hemostatic Agents

- Common attributes
 - Lightweight and easy to store/carry
 - Conform to wound itself
 - Can withstand high pressure of bleeding wound
 - Cause little or no damage to tissue
 - Easy to remove
 - Do not spread into rest of system

Hemostatic Agents

- Complications of hemostatic agents in powder form include introduction of:
 - Emboli through open vasculature
 - A foreign substance into the wound (the powder)

Hemostatic Agents

- Wound packing
 - Particularly helpful in junctional areas
 - Absorbs liquid from the blood and helps to concentrate clotting factors
 - When used with hemostatic dressings, can chemically accelerate clotting process

Managing Internal Hemorrhage

- Focuses on:
 - Treatment of shock
 - Minimizing movement of injured or bleeding part of region
 - Rapid transport
- Eventual surgery will be needed to stop bleeding.

Managing Internal Hemorrhage

– Process

- Give nothing by mouth.
- Establish two IV lines.
 - Use warm fluids to avoid hypothermia.
- Consider pain medication.
- Provide immediate transport.
- Monitor serial vitals en route.

Management of Hemorrhagic Shock

- Priorities are CAB.
- Treatment
 - Stop major bleeding.
 - Ensure open airway.
 - Calm patient and keep in supine position.
 - Allow nothing by mouth.
 - Splint and immobilize injuries as needed.
 - Prevent/manage shock.
 - Establish IV line(s).

Management of Hemorrhagic Shock

- Monitor:
 - ECG rhythm for dysrhythmias
 - State of consciousness
 - Pulse
 - Blood pressure

Thank You



Please continue to the next section