Medical/Legal Issues

Morals - What society deems is acceptable conduct of individuals; right and wrong
Ethics - What a profession deems is acceptable conduct and behavior; right and wrong

Categories of Law
- Criminal- federal court dealing with criminal offenses
- Civil- two or more parties against another party
- Tort- one individual against another

Laws Affecting EMS and the Paramedic
- Scope of Practice- Range of duties and skills paramedics are allowed and expected to perform. You may function as a paramedic only under the direct supervision of a licensed physician through a delegation of authority.
- Mandatory Reporting Requirements
  - Spouse abuse, Child abuse and neglect, Elder abuse, Sexual assault, Gunshot and stab wounds, Animal bites, Communicable diseases
- Legal Protection for the Paramedic
  - Good Samaritan Laws—provide immunity certain people who assist at the scene of a medical emergency.
  - Ryan White CARE Act—requires notification and assistance to paramedics who have been exposed to certain diseases.
  - Local laws and regulations
- Legal Accountability of the Paramedic
  - Always exercise the degree of care, skill, and judgment expected under like circumstances by a similarly trained, reasonable paramedic in the same community.

Negligence- Deviation from accepted standards of care recognized by law for the protection of others against the unreasonable risk of harm

Components of a Negligence Claim
1. Duty to act- a formal contractual or informal legal obligation to provide care.
2. Breach of duty- action or inaction that violates the standard of care expected from a paramedic
   a. Malfeasance—performance of a wrongful or unlawful act by a paramedic.
   b. Misseasance—performance of a legal act in a harmful or injurious manner.
   c. Nonfeasance—failure to perform a required act or duty.
3. Actual damages- refers to compensable physical, psychological, or financial harm
4. Proximate cause- An action or inaction that immediately caused or worsened the damage is called proximate cause.

Special Liability Concerns
- Borrowed Servant Doctrine- While supervising an EMT-I or EMT-B, a paramedic may be liable for any negligent act that person commits.

Civil Rights
- If medical care is withheld due to any discriminatory reason, a paramedic may be sued.
  - Examples: Race, Creed, Color, Gender, National origin, Ability to pay (in some cases)

Off-Duty Paramedics-Performing procedures that require delegation from a physician while off-duty may constitute practicing medicine without a license

Paramedic-Patient Relationships

Legal Principles
- Confidentiality is the principle of law that prohibits the release of medical or other personal information about a patient without the patient’s consent.
- Defamation is an intentional false communication that injures another person’s reputation or good name.
- Libel is the act of injuring a person’s character, name, or reputation by false statements made in writing or through the mass media with malicious intent or reckless disregard for the falsity of those statements.
- Slander is the act of injuring a person’s character, name, or reputation by false or malicious statements spoken with malicious intent or reckless disregard for the falsity of those statements.

A paramedic may be accused of invasion of privacy for the release of confidential information, without legal justification, regarding a patient’s private life, which might reasonably expose the patient to ridicule, notoriety, or embarrassment.

Consent-The granting of permission to treat a patient. You must have consent before treating a patient. Patient must be competent to give or withhold consent.

Informed Consent- Consent based on full disclosure of the nature, risks, and benefits of a procedure. Must be obtained from every competent adult before treatment may be initiated. In most states a patient must be 18 years of age or older to give or withhold consent. In general, a parent or guardian must give consent for children.

Expressed Consent- Verbal, non-verbal, or written communication by a patient who wishes to receive treatment. The act of calling for EMS is generally considered an expression of the desire to receive treatment. You must obtain consent for each treatment provided.

Implied Consent- Consent for treatment that is presumed for a patient who is mentally, physically, or emotionally unable to give consent.

Involuntary Consent
- Consent for treatment granted by a court order. Most commonly encountered with patients who must be held for mental-health evaluation or as directed by law enforcement personnel who have the patient under arrest. May be used on patients whose disease threatens a community at large

Minors- Usually a person under 18 years of age
- Consent must be obtained from a parent or legal guardian.
- Mentally incompetent adult
- Consent must be obtained from the legal guardian. For Minors & Mentally incompetent adults. If a parent or legal guardian cannot be found, treatment may be rendered under the doctrine of implied consent.

Emancipated Minors- Person under 18 years of age who is: Married, Pregnant, A parent, A member of the armed forces, Financially independent living away from home. Emancipated minors may give informed consent.

Withdrawal of Consent
- A patient may withdraw consent for treatment at any time, but it must be an informed refusal of treatment.
Legal Complications Related to Consent
- Abandonment is the termination of the paramedic-patient relationship without assurance that an equal or greater level of care will continue.
- Assault is an act of unlawfully placing a person in apprehension of immediate bodily harm without his or her consent.
- Battery is the unlawful touching of another person without his or her consent.
- False imprisonment is the intentional and unjustifiable detention of a person without his or her consent or other legal authority.
- Reasonable force is the minimal amount of force necessary to ensure that an unruly or violent person does not cause injury to himself, herself, or others.

Resuscitation Issues
- Advance Directives - A document created to ensure that certain treatment choices are honored when a patient is unconscious or otherwise unable to express his or her choice of treatment.
- A Living Will - allows a person to specify what kinds of medical treatment he or she should receive.
- Do Not Resuscitate Order (DNR) - indicates which, if any, life-sustaining measures should be taken when the patient's heart and respiratory functions have ceased.

Crime and Accident Scences
- If you believe a crime has been committed, involve law enforcement. Protect yourself and other EMS personnel. Initiate patient care only when the scene is safe. Preserve the scene as much as possible: Observe and document anything moved; Leave gunshot or stabbing holes intact if possible; If something must be moved, notify investigating officers and document your actions.

Documentation

Airway Management and Ventilation
Airway management and ventilation are the first and most critical steps in the initial assessment of every patient you will encounter.

Lower Airway Anatomy
- Trachea (C-shaped rings)
- Bronchi (main stems)
- Bronchioles (bronchiole rings)
- Alveoli (perfusion takes place)
- Lung parenchyma
- Pleura (parietal & visceral)

Differences Pediatric Airway - Smaller jaw, Larger tongue, Narrowest part of the pediatric airway is the cricoid cartilage, Epiglottis is rounder and flippier

Respiration is the exchange of gases between a living organism and its environment.

Ventilation is the mechanical process that moves air into and out of the lungs.

Pulmonary Circulation - perfusion of oxygen and carbon dioxide

Diffusion - Movement of a gas from an area of higher concentration to an area of lower concentration. Diffusion transfers gases between the lungs and the blood and between the blood and peripheral tissues.

Measuring Oxygen and Carbon Dioxide Levels - Partial pressure is the pressure exerted by each component of a gas mixture

Normal Arterial Partial Pressures
- Oxygen (PaO2) = 100 torr (average = 80 – 100)
- Carbon Dioxide (PaCO2) = 35-45 torr (average 40)

Factors Affecting Oxygen Concentration in the Blood
- Decreased hemoglobin concentration, inadequate alveolar ventilation, Decreased diffusion across the pulmonary membrane when diffusion distance increases or the pulmonary membrane changes, Ventilation/perfusion mismatch occurs when a portion of the alveoli collapses

Factors Affecting Carbon Dioxide Concentrations in the Blood
- Hyperventilation lowers CO2 levels due to increased respiratory rates or deeper respiration. Causes of increased CO2 production include:
  - Fever, muscle exertion, shivering, metabolic processes resulting in the formation of metabolic acids.
  - So, a patient with a PaCO2 of 30 will be alkalotic thus decreasing respiratory rate.
- Decreased CO2 elimination results from decreased alveolar ventilation.
  - Respiratory depression, airway obstruction, respiratory muscle impairment, obstructive diseases

Regulation of Respiration
- Respiratory Rate - Involuntary; however, can be voluntarily controlled. Chemical and physical mechanisms provide involuntary impulses to correct any breathing irregularities.
- Chemoreceptors - Located in carotid bodies, arch of the aorta, and medulla. Baroreceptors in carotid artery regulate BP. Stimulated by decreased PaO2, increased PaCO2, and decreased pH. Cerebrospinal fluid (CSF) pH is primary control of respiratory center
- Nervous Impulses from the Respiratory Center
  - Main respiratory center is the medulla. Neurons within medulla initiate impulses that produce respiration. Apneustic center assumes respiratory control if the medulla fails to initiate impulses. Pneumotaxic center controls respiration. Hypoxia is a profound stimulus of respiration in a normal individual. Hypoxic drive increases respiratory stimulation in people with chronic respiratory disease.
- Stretch Receptors - The Hering-Breuer reflex prevents over-expansion of the lungs.

Normal Respiratory Rates
- Adult = 12-20
- Pediatric = 18-24
- Infant = 40-60

Dead Space Volume (VD) - Amount of gases in tidal volume that remains in the airway. Approximately 150 ml in adult male

Total Lung Capacity (TLC) - Maximum lung capacity - Average adult male TLC—6 liters

Tidal Volume (VT) - Average volume of gas inhaled or exhaled in one respiratory cycle. Average adult male: VT = 500 ml (5-7 cc/kg)

Inspiratory Reserve Volume (IRV) - The amount of air that can be maximally inhaled after normal inspiration

Respiratory Problems
- Airway Obstruction - The tongue is the most common cause of airway obstruction.
- Other Causes of Airway Obstruction: Foreign bodies, Trauma, Laryngeal spasm and edema, Aspiration

Respiratory System Assessment
- Initial Assessment - Is the airway patent? Is breathing adequate? Look, listen, and feel. If patient is not breathing, open the airway and assist ventilations as necessary
- Physical Examination: Inspection, Skin color, Patient’s position, Dyspnea, Modified forms of respiration, Rate, Pattern, Mentation, Auscultation
- Listen at the mouth and nose for adequate air movement. Listen with a stethoscope for normal or abnormal air movement.
- Position for auscultation of breath sounds. Both anterior and posterior
- Abnormal Respiratory Patterns
  - Kussmaul’s respirations - Deep, slow or rapid, gasping; common in diabetic Ketoacidosis
  - Cheyne-Stokes respirations - Progressively deeper, faster breathing alternating gradually with shallow, slower breathing, indication brain stem injury
Agonal respirations- Shallow, slow, or infrequent breathing, indicating brain anoxia.
Disruption in Ventilation
Nervous System, Trauma, Poisoning or Overdose, Disease
Airway Sounds- Stridor, Wheezing, Rales, Rhonchi, Snoring, crackles
Palpate chest wall for tenderness, symmetry, abnormal motion, crepitus, and subcutaneous emphysema.
Other types of monitoring devices: Non-Invasive Respiratory Monitoring, Colorimetric End-Tidal CO2 Detector, Electronic End-Tidal CO2 Detector, Pulse Oximeter, Esophageal Detector Device (if the bulb does not refill its improperly placed. If bulb refills easily upon release, it indicates correct placement.)
Manual Airway Maneuvers: Head Tilt/Chin Lift, Modified Jaw Thrust, in Trauma, Jaw-Thrust Maneuver, Sellick’s Maneuver (Cricoid Pressure), Jaw-Lift Maneuver
Basic Mechanical Airways: Nasopharyngeal Airway, Oropharyngeal Airway, Insert oropharyngeal airway with tip facing palate & Rotate airway 180° into position.
Advanced Airway Management- Endotracheal intubation- is performed if basic airway management is not effective. Laryngoscopy Blades: Macintosh blade into vallecula & Miller lifts up the epiglottis.
Endotracheal Intubation Indicators: Respiratory or cardiac arrest, Unconsciousness, Risk of aspiration, Obstruction due to foreign bodies, trauma, burns, or anaphylaxis, Respiratory extremis due to disease, Pneumothorax, hemothorax. hemopneumothorax with respiratory difficulty.
Complications of Endotracheal Intubation: Equipment malfunction, Teeth breakage and soft tissue lacerations. Hypoxia, Esophageal intubation, Endobronchial intubation, Tension pneumothorax
Disadvantages of Endotracheal Intubation: Requires considerable training and experience, requires specialized equipment, requires direct visualization of vocal cords, and Bypasses upper airway's functions of warming, filtering, and humidifying the inhaled air.
Continuously recheck and reconfirm the placement of the endotracheal tube & secure the ETT on the maxilla for decreased chance of dislocation.
Foreign body removal with direct visualization and Magill forceps
Rapid Sequence Intubation- A patient who needs intubation may be awake. RSI paralyzes the patient to facilitate endotracheal intubation.
Nasotracheal intubation may be useful in some situations: Possible spinal injury, clenched teeth, fractured jaw, oral injuries, or recent oral surgery, Facial or airway swelling. Obesity, Arthritis
Other Intubation Devices: Esophageal CombiTube, Laryngeal mask airway, Pharyngo-tracheal lumen airway, esophageal gastric tube, esophageal obturator airway (EOA)
The only indication for a surgical airway is the inability to establish an airway by any other method.
Jet ventilation with needle Cricothotomy - 14 guage needle with positive pressure air delivery
Anatomical Landmarks for Cricothyrotomy: between the cricoid cartilage and the thyroid cartilage
Procedure-Make a 1 cm horizontal incision through the cricothyroid membrane
Tracheostomy Cannulae: Patients with Stoma Sites: Patients who have had a laryngectomy or tracheostomy breathe through a stoma. There are often problems with excess secretions, and a stoma may become plugged.
Suctioning: Anticipating complications when managing an airway is the key to successful outcomes. Be prepared to suction airways to remove blood or other secretions and for the patient to vomit.
Suctioning Techniques
Wear protective eyewear, gloves, and face mask, Preoxygenate the patient, Determine depth of catheter insertion, With suction off insert catheter, Turn on suction and suction while removing catheter (no more than 10 seconds), Hyperventilate the patient.
Oxygenation: Oxygen Supply and Regulators – green, chrome, white, 2.5 pin index, oxidizer, and oxygen label
To calculate how long an oxygen tank will last: Formula:
Oxygen Delivery Devices- percentage of oxygen each delivers
- Nasal Cannula – up 40 40%
- Simple Face Mask 40-60%
- Non-Rebreather-
- BVM- 100% with reservoir
Ventilation Methods: Mouth-to-mouth, Mouth-to-nose, Bag-valve device, Demand valve device, Automatic transport ventilator
When ventilating a patient, be conscious of the proper tidal volume: 5-10 cc/kg
Adult Respiratory Distress Syndrome or Acute Lung Injury
Causes: Sepsis, Aspiration, Pneumonia, Pulmonary Injury, Burns/Inhalation Injury, Drugs, High Altitude, Hypothermia
Pathophysiology: High Mortality, Multiple Organ Failure, Affects Interstitial Fluid, Causes increase in fluid in the interstitial space, disrupts diffusion and perfusion.
Assessment: Symptoms Related to Underlying Cause: Abnormal Breaths Sounds & Crackles and Rales
Management: Manage the underlying condition, Provide supplemental oxygen, Support respiratory effort, Provide positive pressure ventilation if respiratory failure is imminent, Monitor cardiac rhythm and vital signs, Consider medications (Corticosteroids)
Obstructive Lung Disease
Types: Emphysema, Chronic Bronchitis, Asthma
Causes: Genetic Disposition, Smoking & Other Risk Factors
Emphysema
Pathophysiology: Exposure to Noxious Substances, Exposure results in the destruction of the walls of the alveoli (Atelectasis) causing poor perfusion, Weaks the walls of the small bronchioles and results in increase residual volume, Loss of elasticity causes increased pressure, Right Sided Heart, Failure- Cor Pulmonale, Polycythemia, Increased Risk of Infection and Dysrhythmia
Assessment: Physical Exam, Barrel chest, prolonged expiration and rapid rest phase, Thin, Pink skin due to extra red cell production, Hypertrophy of accessory muscles, “Pink Puffers.”
Chronic Bronchitis
Pathophysiology: Results from an increase in mucus-secreting cells in the respiratory tree. Alveoli relatively unaffected, decreased alveolar ventilation.
History: Frequent respiratory infections, Productive cough, Smoker, Has been going on for years.
Physical Exam: Often overactive, Rhonchi present on auscultation, Jugular vein distention, Ankle edema, Hepatic congestion, “Blue Bloater.”
Bronchitis & Emphysema Management: Maintain airway, Support breathing Oxygen titrated to >94%, Find position of comfort, Monitor oxygen saturation, Be prepared to ventilate or intubate, Monitor cardiac rhythm, Establish IV access, Administer medications (Bronchodilators & corticosteroids)
Asthma
Pathophysiology: Chronic Inflammatory Disorder that results in widespread but variable air flow obstruction. The airway becomes hyperresponsive. Induced by a trigger, which can vary by individual. Trigger causes release of histamine, causing bronchoconstriction and bronchial edema. 6–8 hours later, immune system cells invade the bronchial mucosa and cause additional edema.
Physical Exam: Presenting signs may include dyspnea, wheezing, and cough. Wheezing is not present in all asthmatics. Speech may be limited to 1–2 consecutive words. Look for hyperinflation of the chest and accessory muscle use. Carefully auscultate breath sounds and measure peak expiratory flow rate. May stop breathing because of decreased lung capacity.
Management: Treatment goals:
Correct hypoxia, Reverse bronchospasm, Reduce inflammation.
Maintain the airway. Support breathing. High-flow oxygen or assisted ventilations as indicated. Monitor cardiac rhythm. Establish IV Access.
Administer medications (Beta-agonists, Ipratropium bromide, Corticosteroids)

Status Asthmaticus: A severe, prolonged attack that cannot be broken by bronchodilators. Greatly diminished breath sounds. Recognize imminent respiratory arrest. Aggressively manage airway and breathing. Transport immediately.

Asthma in Children: Pathophysiology and management similar. Adjust medication dosages as needed.

Upper Respiratory Infection (URI)
Frequent patient complaint. Common pediatric complaint, rarely life threatening
Pathophysiology: Frequently caused by viral and bacterial infections. Affect multiple parts of the upper airway. Typically resolve after several days of symptoms.

Pneumonia: Infection of the Lungs. Problem in Immune-Suppressed Patients
Pathophysiology: Bacterial & Viral Infections, Hospital-acquired vs. community-acquired. Infection can spread throughout lungs. Alveoli may collapse, resulting in a ventilation disorder.
Management: Maintain the airway. Support breathing. High-flow oxygen or assisted ventilation as indicated. Monitor vital signs. Establish IV access. Avoid fluid overload. Medications (Antibiotics, antipyretics, beta-agonists.)

Lung Cancer
Pathophysiology: Majority are caused by carcinogens secondary to cigarette smoking or occupational exposure. May start elsewhere and spread to lungs. High mortality. Types: Adenocarcinoma. Epidermoid, small-cell, and large-cell carcinomas.

Toxic Inhalation
Pathophysiology: Includes inhalation of heated air, chemical irritants, and steam. Airway obstruction due to edema and laryngospasm due to thermal and chemical burns.
Assessment: Focused History & Physical Exam, SAMPLE & OPQRST History, Determine nature of substance, Length of exposure and LOC
Management: Ensure scene safety. Enter a scene only if properly trained and equipped. Remove the patient from the toxic environment. Maintain the airway. Early, aggressive management may be indicated. Support breathing. Establish IV access. Transport promptly.

Carbon Monoxide Inhalation
Carbon Monoxide is an Odorless, Colorless Gas. Results from the combustion of carbon-containing compounds. Often builds up to dangerous levels in confined spaces such as mines, autos, and poorly ventilated homes. Hazardous to Rescuers
Pathophysiology: Binds to Hemoglobin, 200-300 times affinity than that of oxygen. Prevents oxygen from binding (displacement of oxygen) and creates hypoxia at the cellular level.
Assessment: Focused History and Physical Exam, SAMPLE & OPQRST History, Determine source and length of exposure. Presence of headache, confusion, agitation, lack of coordination, loss of consciousness, and seizures,
Management: Ensure scene safety. Enter a scene only if properly trained and equipped. Remove the patient from the toxic environment. Maintain the airway. Support breathing. High-flow oxygen or assisted ventilations as indicated. Establish IV access. Transport promptly.

Pulmonary Embolism
Pathophysiology: Obstruction of a pulmonary artery. (so typically occurs from the right heart). Emboli may be air, thrombus, fat, or amniotic. Foreign bodies may also cause an embolus.
Risk Factors: Recent surgery, long-bone fractures, pregnancy (Pregnant or postpartum), Oral contraceptive use, tobacco use. IDDM, PE
Assessment: Focused History & Physical Exam, SAMPLE & OPQRST History, Presence of risk factors, unexplained tachycardia, sudden onset of severe dyspnea and pain. Cough, often blood-tined
Physical Exam: Anxiety, syncope, diaphoretic, JVD, and hypotension. Warm, swollen extremities
Management: Maintain the airway. Support breathing. High-flow oxygen or assist ventilations as indicated. Intubation may be indicated. Establish IV access. Monitor vital signs closely. Transport to appropriate facility.

Spontaneous Pneumothorax
Pneumothorax- Occurs in the absence of blunt or penetrating trauma.
Risk factors: Young, tall, skinny, lanky, men
Physical exam: Decreased or absent breath sounds on affected side, Tachypnea, diaphoresis, and pallor
Management: Maintain the airway. Support breathing. Monitor for tension pneumothorax. Pleural decompression may be indicated if patient becomes cyanotic, hypoxic, and difficult to ventilate. JVD and tracheal deviation away from the affected side

Hyperventilation Syndrome
Management: Maintain the airway. Support breathing. Provide high-flow oxygen or assist ventilations as indicated. Do NOT allow the patient to rebreathe exhaled air. Reassure the patient.

CNS Dysfunction
Pathophysiology: Causes can include traumatic/atraumatic brain injury, tumors, and drugs.
Assessment: Evaluate potentially treatable causes, such as narcotic drug overdose or CNS trauma. Carefully evaluate breathing pattern.
Management: Follow general management principles. Maintain the airway and support breathing. Use cervical spine precautions if indicated.

Dysfunction of the Spinal Cord, Nerves, or Respiratory Muscles
Pathophysiology: PNS problems affecting respiratory function may include trauma, polio, myasthenia gravis, viral infections, tumors.
Assessment: Rule out traumatic injury, and assess for numbness, pain, or signs of PNS dysfunction.
Management: Follow general management principles. Maintain the airway and support breathing. Use cervical spine precautions if indicated.
Patient Assessment in the Field

Components of Patient Assessment

Body substance isolation: Gloves, mask, gown, breathing support, etc. Always wear the appropriate personal protective equipment (PPE) to prevent exposure to contagious diseases. With a suspected tuberculosis patient, you may place a surgical-type mask on the patient while you wear a NIOSH-approved respirator. Monitor the patient’s airway and breathing carefully.

Scene Safety

Location of all patients

Mechanism of injury: The combined strength, direction, and nature of forces that injured your patient. With trauma, try to determine the mechanism of injury during scene size-up.

Nature of the illness: To determine the nature of illness: Use bystanders, family members, or the patient. Use the scene to give clues to the patient’s condition. Remember that the patient’s illness may be very different from the chief complaint.

Scene Safety: Scene safety simply means doing everything possible to ensure a safe environment for yourself, your crew, other responding personnel, your patient, and any bystanders—in that order. Look for potential hazards during scene size-up. Wait for the police before entering a potentially hazardous scene.

Location of All Patients: Scene size-up also includes a search of the area to locate all of the patients. Follow local protocols when you respond to a mass-casualty incident. The incident commander directs the response and coordinates resources at a multiple-casualty incident. But, the Medical Director is ultimately responsible for all medical treatment.

The Initial Assessment: The initial assessment is designed to identify and immediately correct life-threatening patient conditions of the Airway, Breathing, and Circulation (ABCs).


The General Impression: The general impression is the initial, intuitive evaluation of the patient to determine the general clinical status and priority for transport.

Mental Status: Alert, Verbal, Painful stimuli, Unresponsive

Airway Assessment: If the patient is responsive and can speak clearly, assume the airway is patent. If the patient is unconscious, the airway may be obstructed. So open the airway. Suction fluids from your patient’s airway. Immediately use a bag-valve mask to ventilate patients who are not moving air. Use an oropharyngeal airway for unconscious patients without a gag reflex. The nasopharyngeal airway rests between the tongue and the posterior pharyngeal wall. Endotracheal intubation or Needle Cricothyrotomy

Breathing Assessment: Rate, Quality, Pattern

Circulation Assessment: The circulation assessment consists of evaluating the pulse and skin and controlling hemorrhage. To assess an adult’s circulation, feel for a radial pulse. Palpate for a carotid pulse. Control major bleeding. Assess the skin. Elevate your patient’s feet if you suspect circulatory compromise. Apply a pneumatic antishock garment according to your local protocol.

Priority Determination: Once the initial assessment is completed, determine the patient’s priority. En route to the hospital, establish an IV.

The Focused History and Physical Exam

Types of Patients

Trauma patient with significant mechanism of injury.
Trauma patient with isolated injury.
Responsive medical patient.
Unresponsive medical patient.

The Major Trauma Patient

Sustained significant mechanism of injury. Exhibits altered mental status from the incident.

Predictors of Serious Internal Injury: Ejection from vehicle, Death in same passenger compartment, Fall from higher than 20 feet, Rollover of vehicle High-speed motor vehicle collision, Vehicle-passenger collision, Motorcycle crash, Penetration of the head, chest, or abdomen

Mechanism of Injury: Considerations for Infants and Children

Fall from higher than ten feet, Bicycle collision, and Medium-speed vehicle collision with resulting severe vehicle deformity

Evaluate the trauma scene to determine the mechanism of injury: A bent steering wheel indicates potentially serious injuries.

Rapid Trauma Assessment: Not a detailed physical exam Fast, systematic assessment for other life-threatening injuries

DCAP-BTLS, Vital Signs, Skin condition, SAMPLE

The Isolated-Injury Trauma Patient

No significant mechanism of injury. Shows no signs of systemic involvement, does not require an extensive history, does not require a comprehensive physical exam

The Responsive Medical Patient

Assessing the responsive patient with a medical emergency is entirely different from assessing the trauma patient for two reasons.

1. The history takes precedence over the physical exam.
2. The physical exam is aimed at identifying medical complications rather than signs of injury.

Begin treatment while you assess your responsive medical patient.

Chief Complaint: The pain, discomfort, or dysfunction causing patient to call for help; “What seems to be the problem?”

The History of the Present Illness (OPQRST-ASPN)

Past Medical History: General state of health, Childhood and adult diseases, Psychiatric illnesses, Accidents and injuries, Surgeries and hospitalizations

Current Health Status: Current medications, Allergies, Tobacco use, Alcohol and substance abuse, Diet, Screening exams, Immunizations, Sleep patterns, Exercise and leisure activities, Environmental hazards, Use of safety measures

Family history: AMI, CVA, IDDM, etc

Social history: Recreational drugs, quiet, disruptive

Baseline Vital Signs: Blood pressure, Pulse, Respiration, Temperature, Pupils, Orthostatic vitals (if possibly hypovolemic)

Additional Assessment Techniques: Pulse oximetry, cardiac monitoring, Blood glucose determination

Assessing the Unresponsive Medical Patient

Initial assessment (Rapid medical assessment), Brief history, Ongoing Assessment (Detects trends & Determines changes)

Ongoing Assessment: Mental status, Airway patency, Breathing rate and quality, Pulse rate and quality, Skin condition, Transport priorities, Vital signs, Focused assessment, Effects of interventions, Management plans, Re-evaluate the ABCs, Evaluate your interventions’ effects, perform your focused assessment again.
**Cardiology**

**Anatomy of the Heart**
- Location and Size of the Heart
- Tissue Layers: Endocardium, Myocardium, Pericardium
  - **Visceral Pericardium, Parietal Pericardium, Pericardial Fluid**

**Blood Flow** - trace a drop of blood through the body
- Coronary Circulation: Left Coronary Artery: separates into two: Circumflex & Left Anterior Descending
- Right Coronary Artery

**Systolic Pressure** - Strength and volume of cardiac output
**Diastolic Pressure** - More indicative of the state of constriction of the arterioles
**Mean Arterial Pressure** - 1/3 pulse pressure added to the diastolic pressure

**Tissue Perfusion Pressure**

**Nervous Control of the Heart**

**Sympathetic**
- Catecholamines: Epinephrine, Norepinephrine
  - Alpha 1 - vasoconstriction
  - Alpha 2 - inhibits the release of norepinephrine
  - Beta 1 - Increase heart rate, force, contractility
  - Beta 2 - bronchodilator
  - Beta 3 - adipose tissue

**Parasympathetic**
- Decreases: Heart rate, strength of contractions, blood pressure
  - Increases: Digestive system, Kidneys

**Autonomic Control of the Heart**

**Chronotropy** is rate, **Inotropy** is force, **Dromotropy** is electricity

**Role of Electrolytes:** Sodium, Potassium, Calcium, Magnesium

**Cardiac Conductive System**

**Properties:** Excitability, Conductivity, Automaticity, Contractility

**Cardiac Depolarization:** Resting Potential, Action Potential, Repolarization
  - Each myocardial cell has its sodium-potassium pump giving it the ability to beat on its own.

**Components:** Sinoatrial Node, Internodal Atrial Pathways, Atrioventricular Node, Atrioventricular Junction, Bundle of His, Left and Right Bundle Branches (Purkinje Fibers)

**ECG Leads**
- Bipolar (Limb): Einthoven's Triangle: Leads I, II, III
- Augmented (Unipolar): aVR, aVL, aVF
- Precordial: V1 – V6

**ECG Components:**
- P Wave, QRS Complex, T Wave, U Wave
- **Time Intervals**
  - P–R Interval (PRI) or P–Q Interval (PQI) 0.12–0.20 Seconds
  - QRS Interval 0.08–0.12 Seconds
  - S–T Segment
  - Q–T Interval 0.33–0.42 Seconds

**Refractory Periods**

**Absolute:** Heart may not beat during this time
**Relative:** Heart beats on the R wave (R on T phenomenon)
**S–T Segment Changes:** ST segment elevation

**Associated with Myocardial Infarctions**
- Ischemia: Represented by T wave inversion, Acid creates substernal, crushing chest pain
- Injury: Represented by ST segment elevation: THIS MEANS THEY ARE HAVING AN ACUTE HEART ATTACK
- Necrosis: Represented by Pathological Q Waves

**Interpretation of Rhythm Strips**

**Five-Step Procedure:**
- Analyzing Rate: Six-Second Method, Heart Rate Calculator Rulers, R–R Interval, Triplicate Method
- Analyzing Rhythm: Regular, Occasionally Irregular, Regularly Irregular, Irregularly Irregular
- Analyzing P Waves: Are P waves present? Are the P waves regular? Is there one P wave for each QRS complex? Are the P waves upright or inverted?
  - Do all the P waves look alike?
- Analyzing the P–R Interval: is it greater than 0.20 sec?
- Analyzing the QRS Complex: Do all the QRS complexes look alike? What is the QRS duration?

**Rhythms**

**Normal Sinus Rhythm**
- Rate 60–100
- Rhythm Regular
  - P waves Normal, upright, only before each QRS complex
  - PR Interval 0.12–0.20 seconds
  - QRS Complex Normal, duration of <0.12 seconds
  - Sinus Bradycardia - less than 60
  - Sinus Tachycardia - 100-150
  - Sinus Dysrhythmia irregular from breathing
  - Sinus Arrest - sinus and drops one complex

**Sinus Bradycardia**
- Treatment: Atropine, TCP, Dopamine Drip, Epi Drip

**Premature Atrial Contractions**

**Paroxysmal Supraventricular Tachycardia** - 220 – age is as fast as your Sinus node can beat. If it is less than that, it could be Sinus Tach.
- Treatment: Vagal Maneuvers, Pharmacological Therapy, Adenosine, Verapamil, Electrical Therapy (Consider if patient symptomatic with HR > 150. Synchronized cardioversion starting at 100 or 50/2.)

**Atrial Flutter**
- Treatment: Electrical Therapy, Consider if ventricular rate > 150 and symptomatic (Synchronized cardioversion starting at 100J.), Diltiazem, Verapamil, digoxin, beta-blockers, procainamide, and quinidine.
Management of Cardiac Emergencies

Atrial Fibrillation
Treatment: Electrical Therapy (Consider if ventricular rate > 150 and symptomatic. Synchronized cardioversion), Diltiazem, Verapamil, digoxin, beta blockers, procainamide, and quinidine. Anticoagulant (heparin or warfarin).

AV Blocks
First-Degree AV Block
Type I Second-Degree AV Block: PR interval is variable and drops a QRS complex.
Type II Second-Degree AV Block: PR interval is fixed and drops a QRS complex.
Third-Degree AV Block: no communication between the atria and ventricles.
Treatment: Transcutaneous pacing for acutely symptomatic patients. Treat symptomatic bradycardia. Avoid drugs that may further slow AV conduction.

Premature Junctional Contractions
Junctional Escape Complexes and Rhythm
Accelerated Junctional Rhythm
Characteristics: Inverted P Waves in Lead II, PRI of < 0.12 Seconds, Normal QRS Complexity
Paroxysmal Junctional Tachycardia
Treatment: Vagal Maneuvers, Adenosine, Verapamil, Electrical Therapy (Use if rate is > 150 and patient is hemodynamically unstable. Synchronized cardioversion starting at 100J.

Premature Ventricular Contractions
Malignant PVCs: More 6/minute, R on T phenomenon, couplets or runs of ventricular tachycardia, multifocal PVCs, PVCs associated with chest pain.

Treatment: Non-malignant PVCs do not usually require treatment in patients without a cardiac history. Just administer oxygen.
Malignant PVCs:
- Amiodarone 150mg IV infused in 10 minutes. May be repeated once.
- Lidocaine 1.0–1.5 mg/kg IV bolus. If PVCs are not suppressed, repeat doses of 0.5-0.75 mg/kg to max dose of 3.0 mg/kg.
- If PVCs are suppressed, administer lidocaine drip 2–4 mg/min.
- Reduce the dose in patients with decreased output or decreased hepatic function and patients > 70 years old.

Ventricular Tachycardia
Treatment: Perfusioning patient, Administer oxygen and establish IV access. Consider immediate synchronized cardioversion for hemodynamically unstable patients. Amiodarone 150mg IV infused in 10 minutes. May be repeated once.
Lidocaine 1.0–1.5 mg/kg IV bolus. If PVCs are not suppressed, repeat doses of 0.5-0.75 mg/kg to max dose of 3.0 mg/kg.
If PVCs are suppressed, administer lidocaine drip 2–4 mg/min.
Reduce the dose in patients with decreased output or decreased hepatic function and patients > 70 years old.

Nonperfusing patient: Follow ventricular fibrillation protocol.

Torsade de Pointes: Polymorphic VT. Caused by the use of certain antidysrhythmic drugs.
Treatment: Do not treat as standard VT. Administer magnesium sulfate 1–2 g diluted in 100 ml D5W over 1–2 minutes. Amiodarone 150–300 mg Ventricular Fibrillation
Treatment: Initiate CPR. Witnessed: Defibrillate once at the highest energy. Non-witnessed: CPR for 2 minutes, defibrillate once highest energy, control the airway and establish IV/O access. Administer epinephrine 1:10,000 every 3–5 minutes. Consider second-line drugs such as lidocaine, amiodarone, procainamide, or magnesium sulfate. Consider 40 IU Vasopressin IV (one time only) either 1st or 2nd line with Epi.

Asystole
Treatment: Administer CPR and manage the airway. Treat for ventricular fibrillation if there is any doubt about the underlying rhythm. Administer medications (Epinephrine and possibly consider and treat the causes.)
Pulseless Electrical Activity (PEA).
Electrical impulses are present, but with no accompanying mechanical contractions of the heart. Treat the patient, not the monitor.
Causes: Hypovolemia, cardiac tamponade, tension pneumothorax, hypoxemia, acidosis, massive pulmonary embolism, ventricular wall rupture.
Treatment: Prompt recognition and early treatment. Epinephrine 1 mg every 3–5 minutes.

Disturbances of Ventricular Conduction
Aberrant Conduction Bundle Branch Block: QRS complex greater than 0.12 sec
Causes: Ischemia or necrosis of a bundle branch
Pre-excitation Syndromes: Excitation by an impulse that bypasses the AV node
- Wolff-Parkinson-White Syndrome (WPW): Short PRI and long QRS duration, Delta waves, Treat underlying rhythm.
ECG Changes Due to Electrolyte Abnormalities and Hypothermia
- Hyperkalemia: Tall Ts, Suspect in patients with a history of renal failure.
- Hypokalemia: Prominent U waves
- Hypothermia: Osborn wave ("J" wave)

Managing Specific Cardiovascular Emergencies
Angina Pectoris: Chest Pain from lack of oxygen and a buildup of lactic acid
Pathophysiology: Angina occurs when the heart’s demand for oxygen exceeds the blood’s oxygen supply. Commonly caused by atherosclerosis. Stable (predictable) vs. Unstable Angina (unpredictable)
Relieved with: Rest, Oxygen, Nitro, Doesn’t last longer than 30 minutes
Management: Relieve anxiety. Place the patient in a position of physical and emotional comfort. Administer oxygen titrating to >94%. Establish IV access. Monitor ECG. Perform 12 Lead.
Consider medication administration: Nitroglycerin tablets or spray, Nifedipine or other calcium channel blockers, Morphine sulfate
Myocardial Infraction: Death and necrosis of heart muscle due to inadequate oxygen supply. Location and size dependent on the vessel involved.
Not Relieved with NTG, Oxygen, Rest. Lasts longer than 30 minutes in duration.
Goals of Treatment: Pain Relief, Reperfusion
Management:
- Prehospital: Administer oxygen titrating to >94%. Establish IV access. Consider medication administration: Aspirin, analgesia, antiemetics, Nitroglycerin, Nitrous oxide, Nubain, Antiarrhythmia medication as indicated, Monitor ECG, Rapid transport as indicated. Avoid patient refusals Identify candidates for thrombolytic therapy and Cath Lab.
- In-Hospital: Diagnostic ECGs, Enzyme levels. Risk assessment. Treatment: Thrombolitics (Retavase, Streptokinase, etc.), Cardiac catheterization, PTCA, and CABG.

Cocaine Induced Chest Pain
Sympathomimetic responses causes a low cardiac output and ischemia.
The treatment is benzodiazepines: Ativan, Valium, and Versed

Heart Failure
Left Ventricular Failure: Results in increased back pressure into the pulmonary circulation.
Right Ventricular Failure: Typically caused by left sided HF. Results in increased back pressure into the systemic venous circulation, causing PE
Field Assessment
Left Sided Heart Failure: Pulmonary Edema: Cough with copious amounts of clear or pink-tinged sputum. Labored breathing, especially with exertion. Abnormal breath sounds, including rales, rhonchi, and wheezes. Pulsus paradoxus and pulsus alternans. Remember-lower lobes are heard by auscultation of the posterior thorax, Paroxysmal Nocturnal Dyspnea (PND), Orthopnea, S/S: sympathetic nervous system
Right Sided Heart Failure: Peripheral Pitting Edema: Wherever gravity pulls it (extremities or sacral). Venous System Congestion, Liver & spleen engorgement, JVD, Ascites (fluid in abdominal space), pericardial effusion
Medications: Diuretics. Vasodilators (ACE Inhibitors, beta blockers, Calcium channel blockers, Meds to increase cardiac contractile force
Management: Avoid supine positioning. Avoid exertion such as standing or walking. Maintain the airway. Administer oxygen. Establish IV access. Limit fluid administration. Monitor ECG. Consider medication administration (Morphine, Nitroglycerine, Lasix, Enalapril (Vasotec), Dopamine/dobutamine, Promethazine, Nitrous oxide, Thyroid Gland

Cardiac Tamponade: Result of fluid accumulation between visceral pericardium and parietal pericardium. Increased intrapericardial pressure impairs diastolic filling. Typically worsens progressively until corrected.
Epidemiology: Acute onset typically the result of trauma or MI. Benign presentations may be caused by cancer, pericarditis, renal disease, and hypothyroidism.

Field Assessment
Patient History: Determine precipitating causes. Patient relates a history of dyspnea and orthopnea.
Exam: Rapid, weak pulse, Decreasing systolic pressure, Narrowing pulse pressures, Pulsus paradoxus, Faint, muffled heart sounds. Electrical alternans
Management: Maintain airway. Administer oxygen. Establish IV access. Consider medication administration (Morphine sulfate, Nitrous oxide, Furosemide, Dopamine/dobutamine), Rapid Transport, Pericardiocentesis (Pericardiocentesis is the definitive treatment. Insertion of a cardiac needle and aspiration of fluid from the pericardium. Procedure should be performed only if allowed by local protocol. Procedure should be performed only by personnel adequately trained in the procedure.)

Hypertensive Emergency
Causes: Typically occurs only in patients with a history of HTN. Primary cause is noncompliance with prescribed antihypertensive medications. Also occurs with toxemia of pregnancy.
Risk Factors: Age-related factors, Race-related factors,
Initial Assessment: Alterations in mental state, Signs & Symptoms: Headache accompanied by nausea and/or vomiting, blurred vision, Shortness of breath, Vertigo, Tinnitus
History: Known history of hypertension, noncompliance with medications
Exam: BP > 220/140, Signs of left ventricular failure, Strong, bounding pulse, abnormal skin color, temperature, and condition, Presence of edema
Management: Maintain airway. Administer oxygen. Establish IV access. Consider medication administration (Morphine sulfate, Furosemide, Nitroglycerin, Sodium nitroprusside, Labetalol)
Cardiogenic Shock: General Inability of the heart to meet the body’s metabolic needs. Often remains after correction of other problems. Severe form of pump failure. High mortality rate.
Causes: Tension pneumothorax and cardiac tamponade. Impaired ventricular emptying. Impaired myocardial contractility. Trauma. Management: Maintain airway. Administer oxygen. Identify and treat underlying problem. Establish IV access. Consider medication administration (Lasix, Dobutamine, Levophed)
Peripheral Vascular and Other Cardiovascular Emergencies
Atherosclerosis: Progressive degenerative disease of the medium-sized and large arteries. Results from the buildup of fats on the interior of the artery.
Aneurysm: Ballooning of an arterial wall, usually the aorta, that results from a weakness or defect in the wall
Types: Atherosclerotic, Dissecting, Infectious, Congenital, and Traumatic
Abdominal Aortic Aneurysm: Often the result of atherosclerosis
Signs and symptoms: Tearing abdominal pain, Back/flank pain, Numbness in legs, Hypotension, Urge to defecate

Endocrinology
Endocrine Glands-Have systemic effects. Act on specific target tissues in specific ways. May have single or multiple targets.
Disorders result from over- or underproduction of hormone(s).
Hypothalamus: Located deep within the cerebrum. Some cells relay messages from the autonomic nervous system to the central nervous system. Other cells respond as gland cells to release hormones. Body’s thermostat.
Posterior Pituitary: ADH, Oxytocin
Anterior Pituitary
Thyroid Gland
Hyperthyroidism & Hypothyroidism
Parathyroid Gland
Thymus Gland
Pancreas: Combination Organ, Exocrine tissues secrete digestive enzymes into the small intestine. Endocrine tissues secrete hormones. - Insulin, Glucagon, Somatostatin
Adrenal Gland
Adrenal Medulla: Inner segment of adrenal gland. Closely tied to autonomic nervous system.
Adrenal Cortex: Outer layers of endocrine tissue, which secrete steroidal hormones.
Gonads: Female (Ovaries) & Male (Testes)
Placenta: Located in the roof of the thalamus. Related to the body’s “biological clock”, Melatonin. Implicated in Seasonal Affective Disorder.
Placenta: Releases hCG throughout gestation
Digestive Tract: Gastrin and secretin
Heart: ANH
Kidneys: Renin
Endocrine Disorders and Emergencies
Disorders of the Pancreas
Diabetes Mellitus: Glucose Metabolism, Metabolism, Anabolism & catabolism, Insulin is required for glucose metabolism, Presence of enough insulin to meet cellular needs. Ability to bind in a manner to stimulate the cells adequately. When unable to obtain energy from glucose, the body begins to use fatty stores. This produces Ketones and ketoacidosis.
Regulation of Blood Glucose
Hypoglycemia and hyperglycemia
Role of pancreas, liver, and kidneys: Osmotic diuresis and glycosuria
Patients at risk for all kinds of problems: PE, AMI, CVA, etc
Anaphylaxis

Anaphylaxis is "allergic reaction." Hypersensitivity

Sensitization

Natural and Acquired Immunity

Humoral Immunity

Cellular Immunity

The Immune System

Anaphylaxis

Allergic Reaction

Type I Diabetes Mellitus: Also called juvenile or insulin-dependent diabetes mellitus (IDDM). Characterized by low production of insulin. Closely related to heredity. Results in pronounced hyperglycemia.

Symptoms of untreated Type I DM include polydipsia, polyuria, polyphagia, weight loss, and weakness. Untreated or noncompliant patients may progress to ketosis and diabetic ketoacidosis.

Type II Diabetes Mellitus: Also called adult-onset or non-insulin-dependent diabetes mellitus (NIDDM). Results from decreased binding of insulin to cells.

Related to heredity and obesity. Accounts for 90% of all diagnosed diabetes patients. Less risk of fat-based metabolism. Results in less-pronounced hyperglycemia. Hyperglycemic hyperosmolar nonketotic acidosis: Managed with dietary changes and oral drugs to stimulate insulin production and increase receptor effectiveness.

Diabetic Emergencies

Diabetic Ketoacidosis: Results from the body’s change to fat metabolism. Continuous buildup of ketones (osmolar diuretic) produces significant acidosis.


Hyperglycemic Hyperosmolar Nonketotic (HHNK) Coma

Pathophysiology: Found in Type II diabetics. Results in blood glucose levels up to 1000mg/dL. Insulin activity prevents buildup of ketones. Sustained hyperglycemia results in marked dehydration. Often related to dialysis, infection, and medications. Very high mortality rate.

Hypoglycemia: True medical emergency resulting from low blood glucose levels; rarely seen outside diabetics. By the time signs and symptoms develop, most of the body’s stores have been used. Diabetics with kidney failure are predisposed to hypoglycemia.

S/S: Symptomatic nervous system response, Adrenergic activation,

Disorders of the Thyroid Gland

Grave’s Disease: Probably hereditary in nature. Autoantibodies are generated that stimulate thyroid tissue to produce excessive hormone.


Assessment & Management: Usually arise from cardiovascular signs/symptoms. Manage signs and symptoms.

Thyrotoxic Crisis (Thyroid Storm): Life-threatening emergency, usually associated with severe physiologic stress or overdose of thyroid hormone.

Results when thyroid hormone moves from bound state to free state within the blood.

Signs & Symptoms: High fever (106º F or higher), Reflected in increased activity of sympathetic nervous system. Irritability, delirium or coma, Tachycardia and hypertension, Vomiting and diarrhea.

Assessment and Management: Support airway, breathing, and circulation. Monitor closely and expedite transport.

Hypothyroidism and Myxedema: Can be inherited or acquired. Chronic untreated hypothyroidism creates myxedema. Thickening of connective tissue in skin and other tissues. Infection, trauma, CNS depressants, or a cold environment can trigger progression to a myxedema coma.

Signs & Symptoms: Fatigue, slowed mental function, Cold intolerance, constipation, lethargy, Absence of emotion, thinning hair, enlarged tongue, Cool, pale doughlike skin, Coma, hypothermia, and bradycardia. Weight gain, "Moon-faced" appearance, Fat accumulation on the upper back, Skin changes and delayed healing of wounds, Mood swings, Impaired memory or concentration

Assessment and Management: Focus on maintaining ABCs. Closely monitor cardiac and pulmonary status. Establish IV access, but limit fluids, Transep.

Disorders of the Adrenal Gland

Hyperadrenalinism (Cushing’s Syndrome): Often due to abnormalities in the anterior pituitary or adrenal cortex. May also be due to steroid therapy for nonendocrine conditions such as COPD or asthma. Long-term cortisol elevation causes many changes. Atherosclerosis, diabetes, hypertension, Increased response to catecholamines, Hypokalemia and susceptibility to infection

Assessment & Management: Support ABCs. Use caution when establishing IV access. Report any observations indicative of Cushing’s Adrenal Insufficiency (Addison’s Disease): Due to destruction of the adrenal cortex. Often related to heredity. Stress may trigger Addisonian crisis. May be related to steroid therapy. Sudden withdrawal can trigger Addisonian crisis.

Signs & Symptoms: Progressive weakness, fatigue, decreased appetite, and weight loss. Hyperpigmentation of skin and mucous membranes, Vomiting or diarrhea, Hypokalemia and other electrolyte disturbances. Unexplained cardiovascular collapse

Assessment and Management: Maintain ABCs. Closely monitor cardiac and pulmonary status. Obtain blood glucose level and treat for hypoglycemia if present. Establish IV and provide aggressive fluid resuscitation. Expedite transport.

Allergies and Anaphylaxis

Allergic Reactions: An exaggerated response by the immune system to a foreign substance

Anaphylaxis: An unusual or exaggerated allergic reaction, A life-threatening emergency

The Immune System reacts to Pathogens & Toxins

Cellular Immunity

Humoral Immunity

Antibodies (Immunglobulins): IgA, IgD, IgE, IgG, IgM


Natural and Acquired Immunity and Induced Active Immunity

Sensitization

Hypersensitivity

Delayed: Results from cellular immunity and does not involve antibodies. Commonly results in skin rash. Results from exposure to certain drugs or chemicals.

Immediate: Exposure quickly results in secondary response. More severe than delayed hypersensitivity.

The Allergic Reaction: Exposure generates secondary response. Large quantities of IgE are released. Allergen binds to IgE, causing chemical release.

Release is "allergic reaction." Includes histamines, heparin, and other substances that are designed to minimize the body’s exposure to an antigen.

Histamine causes bronchoconstriction, vasodilation, increased gastric motility, and increased vascular permeability. Angioneurotic edema.


Administer medications (Antihistamines. Epinephrine 1:1000 0.3-0.5 mg SQ)

Anaphylaxis: Causes are Injections (Most anaphylaxis results from the injected route), Allergen rapidly distributed throughout the body, resulting in...
Hematology

The Study of Blood and Blood-Forming Organs and Includes study of blood disorders (Red blood cell disorders, White blood cell disorders, Platelet disorders, Coagulation problems)

Components: Blood, bone marrow, liver, spleen, kidneys

Hematopoiesis: Making of cells

Blood Volume: 6-8 liters of blood

Components of Blood
- Plasma: Water 90–92% by volume, Proteins 6–7% by volume, Other 2–3% by volume (Fats, carbs, electrolytes, gases, and messengers

Red blood cells: Laboratory analysis of red blood cells: that number is called the Hematocrit. Red Blood Cells contain Hemoglobin which allow for oxygen transport (Bohr effect)

White Blood Cells: perform Phagocytosis

White blood cell count: Increases with infection

Granulocytes: Neutrophil, Basophil (store histamine), Eosinophil (initiate the immune response), Lymphocytes, Monocytes

Immunity: Subpopulation of lymphocytes known as T cells and B cells. T cells develop cellular immunity. B cells produce humoral immunity.

Autoimmune disease is where the body destroys good and bad.

Inflammatory process: Platelets – clotting mechanism (Thrombocytopenia, Thrombocytosis)

Hemostasis: Controlling Blood loss by: Vascular spasms, Platelet plugs, Stable fibrin blood clots

Blood Types: Based on Antigens A, B, AB, O (Universal donors is O) Universal recipient is AB. We also have the Rh factor

Managing Specific Patient Problems

Diseases of the Red Blood Cells

Anemias: Anemia is a sign, not a separate disease process.

Signs and symptoms may not be present until the body is stressed. Differentiate chronic anemia from acute episode. Treat signs and symptoms.

Maximize oxygenation and limit blood loss. Establish IV therapy if indicated.

Sickle Cell Disease: Sickle cell crises is Vas-clo-sive

Management: 2 large bore IVs with IV bolus and Morphine for vasodilatation and pain. Follow general treatment guidelines.

Polycthemia: Overproduction of erythrocytes. Occurs in patients > 50 years old or with secondary dehydration. Results in bleeding abnormalities:
- Epistaxis, spontaneous bruising, GI bleeding.

Management: Follow general treatment guidelines.

Diseases of the White Blood Cells

Leukopenia/Neutropenia: Too few white blood cells or neutrophils. Follow general treatment guidelines and provide supportive care.

Leukocytosis: An increase in the number of circulating white blood cells, often due to infection.

Leukemia: Cancer of hematopoietic cells. Initial presentation: Acutely ill, fatsigued, febrile and weak, anemic, and Often have a secondary infection.

Management: Follow general treatment guidelines. Utilize isolation techniques to limit risk of infection.

Lymphomas: Cancers of the lymphatic system. S/S: Swelling of the lymph nodes, Fever, night sweats, anorexia, weight loss, fatigue, and pruritis

Management: Follow general treatment guidelines. Utilize isolation techniques to limit risk of infection.

Diseases of the Platelets

Thrombocytosis: An abnormal increase in the number of platelets

Thrombocytopenia: An abnormal decrease in the number of platelets

Management: Provide supportive care and follow general treatment guidelines.

Blood Clotting Abnormalities

Hemophilia: Deficiency or absence of a blood clotting factor (Deficiency of factor VIII causes hemophilia A. Deficiency of factor IX causes hemophilia B. Deficiency is a sex-linked, inherited disorder. Defective gene is carried on the X chromosome)

Signs & Symptoms: Numerous bruises, deep muscle bleeding, and joint bleeding.

Management: Treat the patient similarly to others. Administer supplemental oxygen. Establish IV access. Be alert for recurrent or prolonged bleeding, and prevent additional trauma.

Other Hematopoietic Disorders

Disseminated Intravascular Coagulation: System activation of coagulation cascade. Results from sepsis, hypotension, OB complications, severe tissue or brain injury, cancer, and major hemolytic reactions.

Multiple Myeloma: Cancerous disorder of plasma cells. Pathologic fractures are common.

Environmental Emergencies

Mechanisms of Heat Gain and Loss: Thermal Gradient by the Wind and Relative Humidity

Thermogenesis (heat production): Work-Induced, Thermoregulatory, Diet-Induced

Thermolysis (Heat loss): Conduction, Convection, Radiation, Evaporation, Respiration

Thermoregulation: Body Temperature is 98.6 axillary, Core temperature is 99.6 rectally

The Hypothalamus: Heat Dissipation is by Sweating and vasodilation, where Heat Conservation is by Shivering and vasoconstriction

Heat Disorders

Hyperthermia: Signs of Thermolysis, Diaphoresis, increased skin temperature, Signs of Thermolytic Inadequacy. Altered mentation or altered LOC

Manifestations: Heat cramps (Isolated muscle – loss of electrolytes), Heat exhaustion (compensated), Heat stroke (Non-compensated)

Role of Dehydration in Heat Disorders; that dehydration prevents thermolysis.

Signs & Symptoms: Nausea, vomiting, and abdominal distress, Vision disturbances, decreased urine output. Poor skin turgor and signs of shock

Treatment: Oral fluids if the patient is alert and oriented, IV fluids if the patient has an altered mental status or is nauseated

Cold Disorders

Hypothermia: Mechanisms of Heat Conservation and Loss depends upon some Predisposing Factors: Age of the Patient, Health of the Patient, Medications, Prolonged or Intense Exposure, Coexisting Weather Conditions

Preventative Measures: Dress warmly and ensure plenty of rest. Eat appropriately or at regular intervals. Limit exposure to cold environments.

Degrees of Hypothermia: Mild and Severe

Mild is Compensated Hypothermia

Signs & Symptoms: Mild: Compensated and Severe- Decompensated. ECG will have Pathognomonic J waves (Osborn waves). Eventual onset of bradycardia, Ventricular fibrillation probable below 86º F.

Treatment: Active Rewarming, Active external rewarming, Active internal rewarming, Rewarming Shock, Cold Diuresis

Resuscitation:
- BCLS: Perform pulse and respiration checks for longer periods. Administer one high energy defibrillation with the AED. Follow with CPR, rewarming, and rapid transport.

ACLS: Intubate and administer one high energy defibrillation and possibly initial medications (controversial). Establish IV access, begin rewarming, and transport rapidly. Avoid further resuscitation until the core temperature is above 86º F.
Frostbite
Superficial Frostbite: Freezing of epidermal tissue, Redness followed by blanching and diminished sensation
Deep Frostbite: Freezing of epidermal and subcutaneous layers, White, frozen appearance

Treatment: Do not thaw the affected area if there is the possibility of refreezing. Do not massage the affected area. Administer analgesia prior to thawing. Transport; re warm by immersion only if transport is lengthy or delayed. Cover the thawed part with a loose, sterile dressing. Elevate and immobilize the thawed part. Do not puncture or drain blisters. Do not re warm feet if walking will be required.

Drowning
Drowning is that they die within 24 hrs and Near-Drowning is when they die after 24 hrs
Dry is where the lungs don’t fill with water because of laryngospasm and Wet Drowning is where they fill with water.
Fresh water causes the alveoli to collapse from a lack of surfactant. Salt water causes pulmonary edema and hypoxemia due to its hypertonic nature.

Factors Affecting Survival: Cleanliness of Water, Length of Time Submerged, Victim’s Age and General Health, Water Temperature (Cold-water) Mammalian diving reflex. The cold-water drowning patient is not dead until he is warm and dead.

Diving Emergencies
Classification of Diving Emergencies: Injuries on the Surface or Injuries During Descent which causes Barotrauma
Injuries on the Bottom: Nitrogen narcosis
Injuries During Ascent: Decompression illness (Pulmonary overpressure and subsequent arterial gas embolism, pneumomediastinum, or pneumothorax)
Nitrogen Narcosis: Occurs during a dive. Can contribute to accidents during the dive.

Signs & Symptoms: Altered levels of consciousness and impaired judgment.

Treatment: Return to shallow depth. Some prevent this by the Use of oxygen/helium mix during dive.

Medical Emergencies
Overdose: Typically drug overdose –
TCA: Cardiotoxin causing acidosis. Treatment is sodium bicarb
Stimulants: Cocaine. Treatment is ativan or valium
Depressants: Barbitaluates: Treat S/S
Ethylene Glycol (Anti-Freeze): antidote methyl alcohol
CVA: Blockage of cerebral vessel causing permanent brain damage. Important treatment is decreasing time of incident to correction at ED

Migraines: Extreme headaches.
S/S: Worst headache ever, Photosensitive, Nauseated/vomiting, Vertigo, Malaise, Can’t handle loud noises

Treatment: General treatment

Psychiatric: S/S: Hallucinations, Violence, Hearing voices

Treatment: Do not agree with them, State you understand what they see or feel, Take vitals, Treat with medicines if needed.

GI Bleeding: Upper will have Hematoeensis (Coffee ground consistency) and Dark blood in stool
Lower will have Bright red blood in stool

Treatment: Treat for shock

Dialysis: Renal Failure- Artificial cleaning of blood
Complications: Electrolyte imbalances, Hypotension, Cardiac arrhythmias, death

Blunt Trauma
Energy exchange between an object and the human body, without intrusion through the skin

Kinetics of Blunt Trauma: Inertia’A body in motion will remain in motion unless acted upon by an outside force.” “A body at rest will remain at rest unless acted upon by an outside force.” Conservation of Energy: “Energy can neither be created nor destroyed. It is only changed from one form to another.”

Kinetic Energy is Energy in Motion: Double Weight = Double Energy and if you Double Speed = Quadruple Energy

SPEED IS THE GREATEST DETERMINANT

Force: Emphasizes the importance of rate at which an object changes speed (acceleration or deceleration)

Types of Trauma: Blunt

Closed injury: Indirect injury to underlying structures, Transmission of energy into the body, Tearing of muscle, vessels and bone, Rupture of solid organs (Ligamentum teres)

Penetrating: Open injury, Direct injury to underlying structures

Automobile Crashes
Events of Impact in Automobile Crash: Vehicle Collision, Body Collision, Organ Collision, Secondary Collisions (Objects inside vehicle strike occupant)

Additional Injuries when Vehicle receives a second impact

Restrains: Seatbelts- Occupant slows with the vehicle, Shoulder and Lap belts MUST be worn together, Injuries if worn separately
Airbags (SRS)-Reduce blunt chest trauma, Cause: Hand, Forearm, & Facial Injury, Check for steering wheel deformity, Side Airbags
Child Safety Seats: Infants and Small Children: Rear facing, Older Child: Forward facing

Types of Impact: Frontal: 32%, Lateral: 15%, Rotational: 38%, Left & Right – Front & Rear, Rear-end: 9%, Rollover: 6%

Frontal Impact: Down-and-Under (Knee, femur, and hip fracture, Chest trauma-Steering Wheel, Paper Bag Syndrome) and Up-and-Over (Tenses legs = Bilateral femur fracture, Hollow organ rupture and liver laceration, Similar chest trauma, Axial Loading

Ejection: Due to up-and-over pathway, Contact with the vehicle & external object

Lateral Impact: 15% of MVC’s but 22% of deaths: Upper extremity injury, Rib, clavicle, humerus, pelvis, femur fracture, Lateral compression, Ruptured diaphragm, Splenic fracture, and Aortic injury.

Evaluate the unrestrained occupant

Rotational: Vehicle struck at oblique angle. Less serious injuries unless strike a secondary object

Rear-end: Seat propels the occupant forward, Head is forced backwards, Stretching of neck muscles and ligaments, Hyperextension & hyperflexion

Rollover: Multiple points of impact, Ejection or partial ejection, Less injury with restraints

Vehicle Crash Analysis: Hazards, Crumple Zones, Intrusion, Deformity of Vehicle, Use of Restraints, Intoxication (Fatall Accidents: >50% involved ETOH Vehicle Mortality: Head: 48%, Internal (Torso): 37%, Spinal & Chest fracture: 8%, Extremity fracture: 2%, All Other: 5%


Motorcycle Crashes: Serious injuries can occur with high and low speed collision.

Types of Impact: Frontal, Angular, Sliding, Ejection

Initial Bike/Object Collision, Rider/Object, Rider/Ground

Pedestrian Accidents: Adults turn away from car so the Bumper strikes lower legs first then the Victim rolls up and over and thrown

Children turn toward and face the car plus they are smaller so Femurs, Pelvis often injured, Thrown away or run over,

Recreational Vehicle Accidents: Lack structure and restraint system

Types of Vehicles: Snowmobiles, Personal watercraft, ATV’s

Blast Injuries: Dust, Fumes, Explosive Compounds Explosion

Fuel + Oxidant combine instantaneously making the explosion and it creates a Heat & Pressure Wave

Events of the Explosion: Pressure Wave, Structural Collapse, Blast Wind, Burns, Projectiles, Personnel Displacement

Blast Injury Phases: Primary: Heat of the explosion, Secondary: Trauma caused by projectiles, Tertiary: Personnel displacement and structural collapse

Blast Injury Assessment: Be alert for secondary device, Initial scene size-up important, Establish Incident Command System (ICS), Injury Patterns
Injuries to body parts: Rupture of Air or Fluid Filled Organs, Lung: Late manifestation (heat & pressure), Hearing loss,
Blast Injuries:
Lungs: Forceful compression and distortion of chest cavity, Compression and decompression, Pulmonary Embolism, Dyspnea, Hemothorax, pneumothorax
Abdomen: Compression & Decompression, Release of bowel contents Diaphragm rupture from pushing of organs up into thorax area
Ears: Initial Hearing Loss, Injury improves over time
Penetrating Wounds: Care as any serious open wound or impaled object
Burns: Treatment consistent with traditional management.

Other Types of Blunt Trauma
Falls: Falls from where? Stairs, Force, Surface, Landing Area, Surface Type, Body Part, Height of Fall, Elderly
Sports Injuries: Various Injury Patterns, Produced by extreme exertion, fatigue or direct trauma, Acceleration, deceleration, compression, rotation, hyperextension, or hyperflexion, Unconsciousness, neurological defect or decreased mental status require physician follow-up
Helmet Removal: If loose remove, If tight, remove face mask and immobilize in place, Take helmet to hospital
Crush Injuries: Caused by Structural collapse, explosion, industrial; or agricultural
Damage is produced by the Great force to soft tissue and bones, Tissue stretching and compression, Extended pressure results in anaerobic metabolism distal to compression, Return of blood flow, toxins to entire body, Severe hemorrhage due to severe damaged blood vessels
Care: Prolonged crush Medications (Sodium Bicarbonate: Reduce Acidosis, Dopamine: Improve Kidney Function, Morphine: Pain management)

Penetrating Trauma
Mechanisms of penetrating trauma: Knives, Arrows, Nails, etc
Understanding principles of energy exchange increase the Index of Suspicion associated with the MOI

Ballistics: Study of the characteristics of projectiles in motion and effects upon objects impacted,

Factors affecting energy exchange between a projectile and body tissue: Velocity, Profile, Stability, Expansion & Fragmentation, Secondary Impacts, and Shape, Small & Fast bullet can cause greater damage than large and slow.

Different bullets of different weights cause different injuries:

- Low Energy/Low Velocity Weapons: Handguns, shotguns, low-powered rifles, 250-400 mps
- High Energy/High Velocity: Assault Rifles, 600-1,000 mps

Bullet spays as it travels down barrel (Rifling in barrel Allows bullet to travel straight with slight yaw), Bullet departs barrel, spinning with a slight wobble or yaw, Weapon forced backward and absorbs energy, Recoil, Remainder of energy propels bullet forward at a high rate of speed.

Trajectory is curved due to gravity and then As bullet strikes object, it slows and energy is transferred to object (Law of Conservation of Energy)

Energy Dissipation
Drag- wind resistance
Cavitation: formation of a partial vacuum and cavity within a semi-fluid medium

Profile: Size and shape of a projectile as it contacts a target, Larger the profile–greater energy exchange

Expansion and fragmentation results in damage
Stability Allows for straighter trajectory, Decreases after striking object results in tumbling

Aspects of Ballistics
Velocity Causes Trajectory, Faster = straighter trajectory, Slower = more curved due to gravity
Profile-Portion of bullet you see as it travels towards you, Larger energy exchange (Caliber=Diameter of a bullet (ID of gun))

Bullet becomes unstable as they pass from one medium to another so you have to have Stability
Bullet length increases bullet tumbling, Can reduce the accuracy of the shot, Reduced by Rifling in barrel (spinning), Yaw (Gyroscopic effect on the center axis of the bullet that reduces tumbling), Tumbling of bullet once it strikes object, Reduces kinetic energy and causes Greater tissue damage

Expansion & Fragmentation- Results in increased profile, Mushrooming, Initial impact forces may result in fragmenting, Greater tissue damage

Secondary Impacts- Bullet striking other objects can cause yaw and tumble

Body Armor (Kevlar): Transmits energy throughout entire vest resulting in blunt trauma but can cause Myocardial Contusion, Pulmonary Contusion, and

Rib Fractures

Shape: Handgun Ammunition = Blunt = Tumble
Rifle Ammunition = Pointed = Piercing

Specific Weapon Characteristics

Handguns: Small caliber, short barrel, medium-velocity, Effective at close range, Severity of injury based upon organs damaged

Rifle: High-velocity, longer barrel, large increased accuracy at far distances

Assault Rifles: Large magazine, semi- or full-automatic, Similar injury to hunting rifles, Multiple wounds

Shotgun: Slug or pellets at medium velocity), Larger the load, the smaller the number of projectiles, Deadly at close range

Knives & Arrows: Low-energy & low-velocity, Damage related to depth and angle of attack, Movement of the victim can increase damage

Damage Pathway- women attackers vs men attackers

Proietle Injury Process: Tip impacts tissue, Tissue pushed forward and to the side, Tissue collagen with adjacent tissue, Shock wave of pressure, forward and lateral, Moves perpendicular to bullet path, Rapid compression, crushes and tears tissue, Cavity forms behind bullet pulling in debris with suction.

Damage Pathway

Direct Injury-Damage done as the projectile strikes tissue, Pressure Shock Wave (Human tissue is semi-fluid so Solid and dense organs are damaged greatly), Temporary Cavity (Due to cavitation), Permanent Cavity (Due to seriously damaged tissue)

Zone of Injury-Area that extends beyond the area of permanent injury

Low-Velocity Wounds from Knives, Ice-picks, Arrows, Flying objects or debris, Injury limited to tissue impacted

Specific Tissue & Organ Injuries-Density of tissue affects the efficiency of energy transmission, Resiliency-Strength and elasticity of an object

Connective Tissue: Absorbs energy and limits tissue damage

Organs: Solid Organs are Dense and low resilience

- Hollow Organs are Fluid filled: transmit energy = increased damage
- Air filled: absorbs energy = less damage Air in lung absorbs energy, Parenchyma is compressed and rebounds, Pneumothorax or hemotherax can result

Bone: Resists displacement until it shatters, Alters projectile path

Extremities: Injury limited to resiliency of tissue: 60-80% of injuries with <10% mortality

Abdomen (Includes Pelvis): Highly susceptible to injury and hemorrhage, Bowel perforation: 12-24 hrs peritoneal irritation

Thorax: Rib impact results in explosive energy, Heart & great vessels have extensive damage due to lack of fluid compression, Any large chest wound compromises breathing

Neck: Damages Trachea and Blood Vessels which would cause Neurological problems, Sucking neck wound

Head: Cavitation energy trapped inside skull, Serious bleeding and lethal

Wound Characteristics

Entrance Wounds: Size of bullet profile for non-deforming bullets, Deforming projectiles may cause large wounds
Close Range have Powder Burns (Tattooing of powder), 1-2 mm circle of discoloration, Localized subcutaneous emphysema
**Exit Wounds:** Appears to be "Blown" outward, Pressure wave

**Special Concerns with Penetrating Trauma**

Scene Size-Up is important, also involve Law-Enforcement  DO NOT ENTER UNTIL SCENE IS SAFE!

Weapons: Victim or Assailant

IF A CRIME SCENE DOCUMENT DO NOT DISTURB EVIDENCE RETAIN CLOTHING, ETC LIMIT PERSONNEL INVOLVEMENT

Facial Wounds-Difficult intubations, Pass ET through bubbling tissue, Consider LMA and Combitube, Consider Cricothyrotomy & Cricothyrotomy

Chest Wounds: Pneumothorax (2/3 "the diameter of the trachea or larger to entrain air), 3-sided occlusive dressing, Needle Decompress, Tamponade

Impaled Objects-Low-energy, Dangerous to remove, DO NOT REMOVE UNLESS In Cheek or it interferes with CPR: ASSESS!!!

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**Hemorrhage & Shock**

- **Hemorrhage:** Abnormal internal or external loss of blood
- **Homeostasis:** Tendency of the body to maintain a steady and normal internal environment
- **Shock:** INADEQUATE TISSUE PERFUSION, Transition between homeostasis and death
- **Hemorrhage Classification:** Capillary- Slow, ooze, Venous- steady flow, Arterial- spurring
- **Clotting:** Three Step Process
  1. Vascular Phase: Vasconstriction, Reduction lumen size = reduction blood loss
  2. Platelet Phase: Tunica intima damaged, Turbulent blood flow, Frictional damage to platelets, Agglutination and aggregation
  3. Coagulation Phase: Release of enzymes (Extrinsic= nearby tissue, Intrinsic= damaged platelets), FIBRIN release

**Normal coagulation = 7-10 minutes**

**Other Factors**

- **Nature of Wound:** Transverse, Vessels constrict and draw inward, Reduction of lumen, Reduction of blood loss (Example: Clean Tear)
- **Movement of wound site should be minimized and try to avoid Aggressive Fluid Therapy (Increases BP and pushes clots, Fluid dilutes clotting)**
- **Low Body Temperature:** Ineffective clot formation
- **Medications:** ASA, heparin, warfarin (Coumadin)

**Hemorrhage Control**

**External Hemorrhage:** General Management, Direct Pressure, Elevation, Tourniquet (over 12 hours-Release may send toxins to heart Lactic acid, and electrolytes)

**Internal Hemorrhage:** Hematoma: Pocket between muscle and fascia

**Humerus or Tibia/Fibula fracture:** 500-750 mL, Femur fracture: 1,500 mL, UNEXPLAINED SHOCK is BEST attributed to abdominal trauma

**General Management:** Immobilization, Stabilization, Elevation

**Epistaxis:** Nose Bleed, Causes: Trauma, Hypertension, Treatment: Lean forward, pinch nostrils

**Hemoptysis:** coughing up blood, possibly from Esophageal Varices

Melena: blood in the stool

**Chronic Hemorrhage can cause Anemia**

**Patient Types**

**Pregnant:** >50% blood volume than normal, Fetal circulation is impaired when mother is compensating

**Athletes:** Greater fluid and cardiac capacity

**Obese:** CBV is based on IDEAL weight (less CBV)

**Hemorrhage Assessment**

Fractures and Blood Loss: Pelvic fracture: 2,000 mL, Femur fracture: 1,500 mL, Tibia/Fibula fracture: 500-750 mL, Hematomas & Contusions: 500 mL

**Ongoing Assessment:** Reassess Vitals & Mental Status (Q 5 min: UNSTABLE patients & Q 15 min: STABLE patients), Reassess Interventions

**Specific Wound Considerations**

**Head Wounds:** Presentation with Severe bleeding, Skull Fracture

**Management:** Gentle Direct Pressure, Fluid drainage from Ears and Nose (DO NOT Pack), Cover and bandage loosely

**Gaping Wounds:** Presentation with Multiple sites, Gaping prevents uniform pressure

**Management:** Bulky Dressing, Trauma Dressing, Sterile, non-adherent surface to wound, Compression dressing

**Stages of Shock**

**Compensated Shock:** Minimal Change

**Decompensated Shock:** System beginning to fail

**Irreversible Shock:** Ischemia and death imminent

**Etiology of Shock**

**Hypovolemic Shock:** Loss of blood volume

**Distributive Shock:** Prevent appropriate distribution of nutrients and removal of wastes

**Anaphylactic:** Septic & Hypoglycemia:

**Obstructive Shock:** Interference with the blood flowing through the cardiovascular system (Tension Pneumothorax, Cardiac Tamponade, PE)

**Shock Management:** Airway & Breathing (NRP, PPV (overdrive respiration), ET, Difficult Airway Devices, LMA, PTI, Combitube, Decompression)

Hemorrhage Control: Fluid Resuscitation Catheter Size & length/Large Bore 20mL/kg of NS or LR just to STABILIZE VITALS

Temperature Control: Conserve core temperature (Warm IV Fluids)


Cardiogenic Shock: Fluid Challenge, Vasopressors: Dopamine, Cardiac Drugs: Epi, Atropine

Spinal & Obstructive Shock: IV resuscitation: NS & LR

**Distributive Shock:** IV Resuscitation, Dopamine, PASG

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**Head & Facial Trauma**

Cerebrum – Function Center of conscious thought, personality, speech, and motor control, Visual, auditory, and tactile perception

Cerebellum - Located under temponis, Function “Fine tunes” motor control, Allows smooth movement, Balance, Maintenance of muscle tone

Brainstem- Central processing center, Communication junction among the Cerebrum, Spinal cord, Cranial nerves, and Cerebellum

**Medulla Oblongata:** Bulge in the top of the spinal cord and it has Centers

- Respiratory Center: Controls depth, rate and rhythm
- Cardiac Center:Regulates rate and strength of cardiac contractions
- Vasomotor Center:Distribution of blood, Maintains blood pressure

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**Cranial Injury:** Trauma must be extreme to fracture: either Linear, Depressed, Open, Impacted Object

**Basal Skull:** Unprotected, Spaces weaken structure, Relatively easier to fracture
Basal Skull Fracture Signs: Battle's Signs, Retroauricular Ecchymosis, Associated with fracture of auditory canal and lower areas of skull, Raccoon Eyes, Bilateral Periorbital Ecchymosis, Associated with orbital fractures

Basilar Skull Fracture: May tear dura, Permit CSF to drain through an external passageway, May mediate rise of ICP, Evaluate for “Target” or “Halo”

Direct Brain Injury Types
Coup: Injury at site of impact and Contrecoup which is Injury on opposite side from impact
Focal Brain Injury could be a Cerebral Contusion: Blunt trauma to local brain tissue, Common with blunt head trauma
S/S: Confusion, Neurologic deficit, Personality changes, Vision changes, Speech changes, Results from, Coup-contrecoup injury
Epidual Hematoma: Bleeding between dura mater and skull, Involves arteries (Middle meningeal artery most common), Rapid bleeding & reduction of oxygen to tissues, Herniates brain toward foramen magnum
Subdural Hematoma: Bleeding within meninges, Beneath dura mater & within subarachnoid space, Above pia mater, Slow bleeding, Superior sagittal sinus, Signs progress several over days, Slow deterioration of mentation,

Compensating for Pressure – dangerous cycle
Compress venous blood vessels, Reduction in free CSF, Pushed into spinal cord, Decompensating for Pressure, Increase in ICP, Rise in systemic BP to perfuse brain, Further increase of ICP

Signs & Symptoms of Brain Injury: Altered Mental Status, Altered orientation, Alteration in personality, Amnesia (Retrograde or Antegrade), Cushing’s Reflex (Increased BP, Bradycardia, Erratic respiration)

Signs & Symptoms of Brain Injury Pediatric Head Trauma: Different pathology than older patients, Skull can distort due to anterior and posterior fontanelles Bulging, Slows progression of increasing ICP, Intracranial hemorrhage contributes to Hypovolemia, Decreased blood volume in ped’s General Management: Avoid hyperextension of head, Tongue pushes soft pallet closed, Ventilate through mouth and nose, Be Sure to Know Your Glasgow Coma Scale

Medications:
Oxygen: Primary 1st line drug, Administer high flow, Hyperventilation is contraindicated, Reduces circulating CO2 levels, NRB: 15 LPM, BVM:
Dosis 2-3 times per minute, Keep SaO2 > 95%. If cerebral herniation syndrome; hyperventilate at highest of the normal range and keep ETCO2 low normal.
Mannitol (esmolot), MOA, Large glucose molecule, Does not leave blood stream, Osmotic Diuretic, Effective in drawing fluid from brain, Contraindication: Hypovolemia & Hypotension, CHF, Dose is 1gm/kg

CAUTION Forms crystals at low temperatures and Reconstitute with rewarmin & gentle agitation so USE IN-LINE filter & PREFLUSH line
Succinylcholine (Anectine), MOA-Depolarizing Medication, Causes Fasciculations, Onset: 30-60 seconds, Duration: 2-3 minutes
Precaution is Paralyzes ALL muscles including those of respiration, Increases intracocular eye pressure

Contraindication is Penetrating eye injury & Digitalis

Dose: 1-1.5 mg/kg IV, Consider administration of 0.5 mg of Atropine to reduce fasciculations
Pancuronium (Pavulon): MOA-Non-depolarizing agent, Does not affect LOC, Onset: 3-5 min, Duration: 30-60 min, Dose Must premixed with sedative 0.04-0.1 mg/kg
Diazepam (Valium): MOA Benzodiazepine Anti-anxiety, Muscle relaxant, Onset: 1-15 min, Duration: 15-60 min, Dose 5-10 mg

Morphine: MOA Opium alkaloid, Analogic, Sedation Anti-anxiety, Reduces vascular volume & cardiac preload, Increases venous capacitance

Side Effects: Respiratory depression, Hypovolemia, Dose: 5-10 mg IV, Consider using promethazine with to reduce nausea
Atropine: MOA: Anticholinergic, Parasympathetic, Reduces parasympatholytic stimulation, Reduces volume of respiration, Reduce secretions, Reduces fasciculations, Papillary dilation, Dose: 0.5-1 mg rapid IVP, NOTE: 2.3 mg (high doses) will be needed in Organophosphate poisonings rapid

Spinal Trauma

Transection Cord Injury-Injury that partially or completely severs the spinal cord

Complete
Cervical Spine creates Quadriplegia, Incontinence, Respiratory paralysis
Below T-1 produces Incontinence, Paraplegia
Incomplete: Brown Sequard’s Syndrome-Partial cut to the spinal cord causing loss of sensation and movement to that side of the body.

General Signs & Symptoms: Extremity paralysis, Pain with & without movement, Tenderness along spine, Impaired breathing, Spinal deformity,
Medications & Spinal Cord injury: Steroids,-Reduce the body’s response to injury, Reduce swelling & pressure on cord, Administered within 1st 8 hours of injury

Types of Medications: Methylprednisolone (Solu-Medrol): Reduce capillary dilation and permeability, Loading dose: 30 mg/kg over 15 minutes, Maintenance: 5.4 mg/kg/hr over 23 hrs
Dexamethasone (Decadron, Hexadrol): Reduce capillary dilation and permeability, 5x more potent than Solu-Medrol, 4-24 mg (occasionally to 100 mg)

Fluid Challenge: Isotonic Solution: 20 ml/kg, 250 ml initially, Monitor response and repeat as needed
PASG: Controversial, Research shows no positive outcome

Dopamine: 2-20 mcg/kg/min titrated to blood pressure
Atracurium: 0.5-1 mg q 4-3 min (maximum of 2.0 mg)

Medications & the Comatose Patient: Consider sedatives to reduce anxiety and calm patient, Prevents spinal cord injury aggravation
Meperidine (Demerol): Diazepam (Valium), Consider paralytics

Thoracic Trauma

Contusion: Most Common result of blunt injury
Signs & Symptoms: Erythema, Ecchymosis, DYSPNEA, PAIN on breathing, Limited breath sounds, HYPOVENTILATION BIGGEST CONCER = “HURTS TO BREATHE”, Crepitus, Paradoxic chest wall motion

Rib Fractures: >50% of significant chest trauma cases due to blunt trauma, Compressional forces flex and fracture ribs at weakest points, Ribs 1-3 requires great force to fracture, Possible underlying lung injury, Ribs 4-9 are most commonly fractured, Ribs 9-12 less likely to be fractured, Transmits energy to organs of internal organs, If fractured, suspect liver and spleen injury, Hypoventilation is COMMON due to PAIN

Treatment: Consider analgesics for pain and to improve chest excursions, Valium, Morphine Sulfate, Meperidine, Nalbuphine, CONTRAINDICATION is Nitrous Oxide - May migrate into pleural or mediastinal space and worsen condition

Flail Chest: Segment of the chest that becomes free to move with the pressure changes of respiration, Three or more adjacent rib fracture in two or more places, Serious chest wall injury with underlying pulmonary injury, Reduces volume of respiration, Adds to increased mortality, Paradoxic flail segment movement, Positive pressure ventilation can restore tidal volume
Treatment: Place patient on side of injury ONLY if spinal injury is NOT suspected, Expose injury site, Dress with bulky bandage against flail segment, Stabilize fracture site, High flow O2, Consider PPV or ET if decreasing respiratory status, DO NOT USE SANDBAGS TO STABILIZE FX

Simple Pneumothorax-AKA: Closed Pneumothorax: Progresses into Tension Pneumothorax, Occurs when lung tissue is disrupted and air leaks into the pleural space, Progressive Pathology-Air accumulates in pleural space, Lung collapses, Alveoli collapse (atelectasis), Reduced oxygen and carbon dioxide exchange, Ventilation/Perfusion Mismatch, Increased ventilation but no alveolar perfusion, Reduced respiratory efficiency results in HYPOXIA, Typical MOI: "Paper Bag Syndrome"

Open Pneumothorax: Free passage of air between atmosphere and pleural space, Air replaces lung tissue, Mediastinum shifts to uninjured side, Air will be drawn through wound if wound is 2/3 diameter of the trachea or larger

Signs & Symptoms: Penetrating chest trauma, Sucking chest wound, Frothy blood at wound site, Severe Dyspnea, Hypovolemia

Management: High flow O2, Cover site with sterile occlusive dressing taped on three sides, Progressive airway management if indicated

Hemothorax: Accumulation of blood in the pleural space, Serious hemorrhage may accumulate 1,500 mL of blood, Mortality rate of 75%, Each side of thorax may hold up to 3,000 mL, Blood loss in thorax causes a decrease in tidal volume, Ventilation/Perfusion Mismatch & Shock, Typically accompanies pneumothorax

Treatment: High flow O2. 2 large bore IV’s, Maintain SBP of 90-100, EVALUATE BREATH SOUNDS for fluid overload

Hemopneumothorax: typically there is both during major trauma to the chest

Tension Pneumothorax: Buildup of air under pressure in the thorax... Excessive pressure reduces effectiveness of respiration, Air is unable to escape from inside the pleural space, Progression of Simple or Open Pneumothorax: Confirmation, Auscultation & Percussion, Hypercyanotic is air, Hyponessonant is blood or fluid

Treatment: Pleural Decompression: 2nd intercostal space in mid-clavicular line, TOP OF RIB, Consider multiple decompression sites if patient remains symptomatic, Large over the needle catheter: 14ga, Create a one-way-valve: Glove tip or Heimlich valve

Myocardial Contusion Bruise of the myocardial tissue

Signs & Symptoms: Bruising of chest wall, Tachycardia and/or irregular rhythm, Retrosternal pain similar to MI, Associated injuries, Rib/Sternal fractures

Chest pain unrelieved by oxygen, May be relieved with rest, THIS IS TRAUMA-RELATED PAIN, Similar signs and symptoms of medical chest pain

Treatment: Monitor ECG, Alert for dysrhythmias, IV if antidyssrhythmics are needed, Pericardial Tamponade, High flow O2, IV therapy, Consider pericardiocentesis if within scope and skill

Pericardial Tamponade: Restriction to cardiac filling caused by blood or other fluid within the pericardium, Occurs in ≤2% of all serious chest trauma, However, very high mortality, Results from tear in the coronary artery or penetration of myocardium, Blood seeps into pericardium and is unable to escape, 200-300 ml of blood can restrict effectiveness of cardiac contractions, Removing as little as 20 ml can provide relief

Signs and Symptoms: Dyspnea, Possible cyanosis, Beck’s Triad (JVD, Distant heart tones, Hypotension or narrowing pulse pressure), Weak, tready pulse, Shock,

Myocardial Aneurysm or Rupture: Occurs almost exclusively with extreme blunt thoracic trauma, Secondary due to necrosis resulting from MI,

Signs & Symptoms: Severe rib or sternal fracture, Possible signs and symptoms of cardiac tamponade, If affects valves only, Signs & symptoms of right or left heart failure, Absence of vital signs

Traumatic Aneurysm or Aortic Rupture: Aorta most commonly injured in severe blunt or penetrating trauma- 85-95% mortality, Typically patients will survive the initial injury insult but: 30% mortality in 6 hrs, 50% mortality in 24 hrs, 70% mortality in 1 week, Injury may be confined to areas of aorta attachment

Signs & Symptoms: Rapid and deterioration of vitals, Pulse deficit between right and left upper or lower extremities,

Traumatic Rupture or Perforation of the Diaphragm: High pressure blunt chest trauma, Perforation trauma, Most common in patients with lower chest injury. Most often occurs on left side

Signs & Symptoms: Herniation of abdominal organs into thorax, Restriction of ipsilateral lung, Displacement of mediastinum, Abdomen may appear hollow, Bowel sounds may be noted in thorax. Similar to tension pneumothorax, Dyspnea, Hypotension & JVD, Evaluate for other injuries

Treatment: AVOID jarring or rough handling, Initiate IV therapy enroute, Mild hypotension may be protective, Rapid fluid bolus if aneurysm ruptures, Keep patient calm

Traumatic Asphyxia: Results from severe compressive forces applied to the thorax, Causes backwards flow of blood from right side of heart into superior vena cava and the upper extremities

Signs & Symptoms: Head & Neck become engorged with blood, Skin becomes deep red, purple, or blue, NOT RESPIRATORY RELATED, JVD, Hypotension, Hypoxemia, Shock, Face and tongue swollen, Bulging eyes with conjunctival hemorrhage.

Treatment: Support airway, Provide O2, PPV with BVM to assure adequate ventilation, 2 large bore IV’s, Evaluate and treat for concomitant injuries, If entrapment > 20 min with chest compression, Consider 1mEq/kg of Sodium Bicarbonate

Abdominal Trauma

Three Specific Spaces: Peritoneal Space- Organs covered by abdominal (peritoneal) lining, Retroperitoneal Space- Organs posterior to the peritoneal lining, Pelvic Space- Organs contained within pelvis

Organs by Abdominal Quadrant: List the organs and their quads
Solid: Liver, Spleen, Pancreas, Kidneys, Ovaries
Hollow: intestines (large and small), stomach, gallbladder, bladder, appendix

Vascular: Key Vessels-
Abdominal aorta, Blood supply to abdomen, Left of spinal column
Iliac arteries: Bifurcation of aorta at the upper sacral level
Inferior Vena Cava: Adjacent to spinal column
Portal System: Venous subsystem, Collects venous blood, fluid and nutrients absorbed by the bowel, Transports to liver, Detoxification, Storage of excess nutrients. Adds deficient nutrients

Peritoneum: Serous membrane that surrounds the interior of most of the abdominal cavity, Covers most of small bowel and some of the abdominal organs, Small amount of fluid between peritoneal layers

Mesentery: Double fold of peritoneum, Supports and suspends small bowel from posterior abdominal wall

Omentum: Additional fold, Insulates & protects anterior surface of abdomen

Retroperitoneal Structures: Kidneys, Duodenum, Pancreas, Urinary Bladder, Posterior portions of ascending & descending colon, Rectum, Major vascular structures

Pathophysiology of Abdominal Injury: Skin and muscles transmit blunt trauma to internal structures, Typically only show erythema, Visible swelling and ecchymosis occur over several hours, Penetrating trauma may appear minimal externally in comparison to internal trauma, Muscle may mask the size of the external wound, Evisceration may be present, Trauma to thorax, buttocks, flanks & back may penetrate abdomen, Lower chest may injure spleen, liver, stomach or gallbladder

Diaphragmatic tears: Herniation of abdominal contents into thorax, Injury to the Hollow Organs, May rupture with compression from blunt forces, May tear due to penetrating trauma, Spillage of contents into Retroperitoneal space, Peritoneal space, Pelvic space

Intestines have a large amount of bacteria: Leakage can result in sepsis,

Injury to the Solid Organs: Dense and less strongly held together, Prone to contusion, Bleeding, Fracture (rupture), Unrestricted hemorrhage if organ capsule is ruptured

Specific Organs: Spleen: pain referred to left shoulder, Pancreas: pain radiate to back, Kidneys: pain radiate from flank to groin & hematuria, Liver: pain referred to the right shoulder

Injury to the Vascular Structures
Abdominal Aorta & Vena Cava: Prone to direct blunt or penetrating trauma, May be injured in deceleration injuries, Blood accumulates beneath diaphragm, Irritation of muscular structures. Produces referred pain in the shoulder region. Gastrointestinal tract, blood in abdomen, stimulates vagus nerve resulting in slowing of heart rate, Blood can isolate in any of the abdominal spaces

Injury to the Mesentery and Bowel: Provides bowel with circulation, innervation, and attachment, Disrupt blood vessels supplying the bowel, Lead to ischemia, necrosis, or rupture, Blood loss minimal, Peritoneal layers contain hemorrhage, Tear of mesentery may rupture bowel, Penetrating trauma to the lateral abdomen likely to injure large bowel

Injury to the Peritoneum: Delicate & sensitive lining of anterior abdomen, Peritonitis, Inflammation of the peritoneum due to Bacterial infection Due to torn bowel or open wound, Chemical irritation, Caustic nature of digestive enzymes. Urine initiates inflammatory response, Blood does not induce peritonitis (Progression: Slight tenderness at location of injury, Rebound tenderness, Guarding, Rigid, board-like feel)

Injury to the Pelvis: Serious skeletal injury, Life threatening hemorrhage, Potential injury to pelvic organs (Ureters, Bladder, Urethra, Female Genitalia, Prostate, Rectum, Anus

General Management: Position Patient- Position of comfort unless spinal injury, Flex knees or left lateral recumbent, General shock care, Fluid Resuscitation, Large bore IV with isotonic solution, Consider 2 bolus if pulse does not slow, Fluid challenge 250 ml or 20 ml/kg, Limit to 3 L, Titrate to SBP of 90 mmHg, PAGS application

Specific Injury care:
- Impaled Objects or Eviscerations- treat accordingly
- Penetrating abdominal trauma accounts for 36% of maternal mortality
- GSW account for 40-70% of penetrating trauma
- Blunt trauma due to improperly worn seatbelts
- Auto collisions are leading cause of mortality

Injury During Pregnancy: Trauma is the number one killer of pregnant females, Changing dimensions of uterus, Protects abdominal organs, Endangers uterus & fetus, Maternal Changes (Increasing size & weight of uterus, Compression of inferior vena cava, Reduce venous return to heart, Increasing maternal blood volume, Protect mother from Hypovolemia, 30-35% of blood less necessary before signs of shock, Uterus is thick and muscular, Distributes forces of trauma uniformly to fetus, Reduces chances for injury, Risk of uterine & fetal injury increases with the length of gestation, Greatest risk during 3rd Trimester, Penetrating trauma may cause fetal and maternal blood mixing
- Blunt trauma complications- Uterine rupture, Abruptio placenta, Premature rupture of amniotic sac

Management of the Pregnant Patient: Positioning, Left Lateral Recumbent, If on backboard tilt backboard, Facilitates venous return, Oxygenation, High flow O2, Consider PPV by BVM if hypoxia ensues, Maintain high index of suspicion for intra-abdominal bleeding, Consider IV and PASG

Burns
Layers: Epidermis, Dermis, Subcutaneous
Underlying Structures: Fascia, Nerves, Tendons, Ligaments, Muscles, Organs
Functions of the Skin: Protection from infection, Sensory organ, Temperature, Touch, Pain, Controls loss and movement of fluids, Temperature regulation, Insulation from trauma, Flexible to accommodate free body movement
Types of Burns: Thermal, Electrical, Chemical, Radiation
Thermal Burns: Jackson’s Theory of Thermal Wounds (Zone of Coagulation-Area in a burn nearest the heat source that suffers the most damage as evidenced by clotted blood and thrombosed blood vessels, Zone of Stasis-Area surrounding zone of coagulation characterized by decreased blood flow. Zone of Hyperemia-Peripheral area around burn that has an increased blood flow.

Body’s Response to Burns:
- Emergent Phase (Stage 1)-Pain response, Catecholamine release, Tachycardia, Tachypnea, Mild Hypertension, Mild Anxiety
- Fluid Shift Phase (Stage 2)-Length 18-24 hours, Begins after Emergent Phase, Reaches peak in 6-8 hours, Damaged cells initiate inflammatory response, Increased blood flow to cells, Shift of fluid from intravascular to extravascular space, MASSIVE EDEMA, “Leaky Capillaries
- Hypermetabolic Phase (Stage 3)-Last for days to weeks, Large increase in the body’s need for nutrients as it repairs itself
- Resolution Phase (Stage 4)-Scar formation, General rehabilitation and progression to normal function

Electrical Burns
Voltage: Difference of electrical potential between two points, Different concentrations of electrons
Ampere: Strength of electrical current, Resistance (Ohms), Opposition to electrical flow
Skin is resistant to electrical flow so Greater the current the greater the flow thru the skin and greater the release of heat. Greatest heat occurs at the points of resistance which are the Entrance and Exit wounds. Dry skin = Greater resistance and Wet Skin = Less resistance, Longer the contact, the greater the potential of injury, Increased damage inside body, Smaller the point of contact, the more concentrated the energy, the greater the injury
- Electrical Current Flows through the path of least resistance: Tissue of Less Resistance-(Blood vessels, Nerve), Tissue of Greater Resistance (Muscle, Bone), Results in Serious vascular and nervous injury, Immobilization of muscles, Flash burns

Chemical Burns
Chemical destroys tissue: two types: Acids-Form a thick, insoluble mass where they contact tissue. Coagulation necrosis, Limits burn damage
Alkalis: Destroy cell membrane through liquefaction necrosis, Deepen tissue penetration and deeper burns

Radiation Injury
Radiation is Transmission of energy. Different types: Nuclear Energy, Ultraviolet light, Visible Light, Heat, Sound, X-Rays
Radioactive Substance: Emits ionizing radiation, Radionuclide or Radioisotope,
Radiation Injury Basic Physics:
- Protons-Positive charged particles, Neutrons-Equal in mass to protons, No electrical charge
- Electrons-Minute electrically charged particles, When emitted from radioactive substances are termed Beta Particles
- Radioactive Substances: Alpha Particles: Slow moving, Low-energy. Stopped by clothing and paper, Penetrate a few cell layers on skin, Minor external hazard, HARMFUL if ingested
- Beta Particles: medium moving, medium entropy, stopped by clothes,
- Gamma Rays: Highly energized, Penetrate deeper than Alpha or Beta, EXTREMELY DANGEROUS, Penetrate thick shielding, Pass entirely thru clothing, and body, Extensive cell damage, Indirect Damage, Cause internal tissue to emit Alpha and Beta particles, LEAD SHIELDING Neutrons-Highly dangerous, come from nuclear core.

Management: Park upward, Notify Radiation Response or Haz-Mat Response Team, Look for radioactive placards, Measure radioactivity, Decontaminate patients before care, Routine medical care (ABC’s, etc)
Inhalation Injury

**Toxic Inhalation:** Synthetic resin combustion, Cyanide & Hydrogen Sulfide, Systemic poisoning. More frequent than thermal inhalation burn

**Carbon Monoxide Poisoning:** Colorless, odorless, tasteless gas. Byproduct of incomplete combustion of carbon products. Suspect with faulty heating unit, 200x greater affinity for hemoglobin than oxygen, cause Hypoxemia & Hypercarbia

**Airway Thermal Burn:** Supraglottic structures absorb heat and prevent lower airway burns. Moist mucosa lining the upper airway, Injury is common from superheated steam

**Risk Factors:** Standing in the burn environment, Screaming or yelling in the burn environment, Trapped in a closed burn environment

**Symptoms:** Stridor or “Crowing” inspiratory sounds, Singed facial and nasal hair, Black sputum or facial burns, Progressive respiratory obstruction and arrest due to swelling

**Thermal Burns**

**Depth of Burn**

Superficial Burn: 1st Degree Burn: Reddened skin, Pain at burn site, Involves only epidermis

Partial-Thickness: 2nd Degree Burn: Intense pain, White to red skin, Blisters, Involves epidermis & dermis

Full-Thickness: 3rd Degree Burn: Dry, leathery skin (white, brown, or charred), Loss of sensation, All dermal layers/tissue may be involved

**Body Surface Area**

Rule of Nines: Best used for large surface areas. Expedient tool to measure extent of burn: know your adult and pedi rule of nine charts

Rule of Palms: Best used for burns < 10% BSA. A burn equivalent to the size of the patient’s hand is equal to 1% body surface area (BSA)

**Systemic Complications:** Hypothermia, Disruption of skin and its ability to thermoregulate, Hypovolemia, Shift in proteins, fluids, and electrolytes to the burned tissue, General electrolyte imbalance, Eschar (Hard, leathery product of a deep full thickness burn, dead and denatured skin), Infection

Greatest risk of burn is infection, and Organ Failure because of Release of myoglobin

**Special Factors:** Age & Health, Physical Abuse, Elderly, Infirm or Young

**Management of Thermal Burns**

Local & Minor Burns-Local cooling (Partial thickness: <15% of BSA, Full thickness: <2% BSA): Remove clothing, Cool or Cold water immersion, Consider analgesics

Moderate to Severe Burns-Dry sterile dressings (Partial thickness: >15% BSA, Full thickness: >5% BSA): Maintain warmth, Prevent hypothermia, Consider aggressive fluid therapy, Burns over IV sites then you may Place IV in partial thickness burn site

Parkland Burn Formula = 4 mL x Pt wt in kg x % BSA = Amt of fluid: Pt should receive ½ of this amount in first 8 hrs. Remainder in 16 hrs, Caution for fluid overload, Frequent auscultation of breath sounds, Consider analgesic for pain (Morphine, Nubain), Prevent infection

Management of Inhalation Injury: Provide high-flow O2 by NRB, Consider intubation if swelling, Consider hyperbaric oxygen therapy

**Management of Cyanide Exposure**

Sodium Nitrite, Amyl Nitrite, Sodium Thiosulfate, Forms methemoglobin binds to cyanide, Non-toxic substance secreted in urine, Inhal 1 ampule of Amyl Nitrite, 300 mg Sodium Nitrite over 2-4 minutes, 12.5 g of Sodium Thiosulfate

**Management of Electrical Burns:** Safety, Turn off power, Energized lines act as whips. Establish a safety zone, Lightning Strikes (High voltage, high current, high energy and Lasts fraction of a second, No danger of electrical shock to EMS), Assess patient, Entrance & Exit wounds, Remove clothing, jewelry, and leather items. Treat any visible injuries, Thermal burns, ECG monitoring, Bradycardia, Tachycardia, VF or Asystole, ACLS Protocols, Treat cardiac & respiratory arrest, Aggressive airway, ventilation, and circulatory management, Consider Fluid bolus for serious burns-20 ml/kg, Consider Sodium Bicarbonate: 1 mEq/kg, Consider Mannitol: 10 g

**Management of Chemical Burns:** Scene size-up, Hazardous materials team, Establish hot, warm and cold zones, Prevent personnel exposure

Specific Chemicals: Phenol-Industrial cleaner, Alcohol dissolves Phenol, Irrigate with copious amounts of water

Dry Lime-Strong corrosive that reacts with water, Brush off dry substance, Irrigate with copious amounts of cool water, Prevents reaction with patient tissues

Sodium: Unstable metal, Reacts vigorously with water, Releases Hydrogen gas, Ignition, Decontaminate: Brush off dry chemical, Cover the wound with oil substance

Riot Control Agents: CS, CN (Mace), Oleoresin, Capsicum (OC, pepper spray): they cause irritation of the eyes, mucous membranes, and respiratory tract. No permanent damage, General Signs & Symptoms include: Coughing, gagging, and vomiting, Eye pain, tearing, temporary blindness

Management: Irrigate eyes with normal saline

Radiation Burns: Notify Hazardous Materials Team, Establish Safety Zones, Hot, Warm, & Cold, Personnel positioned Upwind and Uphill, Use older rescuers for recovery, Decontaminate ALL rescuers, equipment and patients, Ongoing assessment, Re-evaluate initial assessment and interventions

**Gynecology**

**Assessment of the Gynecological Patient**


Physical Exam: Respect patient’s privacy. Be professional. Explain procedures. Observe patient. Check vital signs. Assess bleeding or discharge:

- Do not perform an internal vaginal exam in the field. Abdominal examination.

**Management of Gynecological Emergencies**

General management of gynecological emergencies is focused on supportive care. Do not pack dressings in the vagina.

**Medical Gynecological Emergencies**

Gynecological Abdominal Pain: Pelvic Inflammatory Disease (from bad hygiene, Chlamydia, Gonorrhea), Ruptured Ovarian Cyst, Cystitis, Mittelschmerz, Endometriosis, Ectopic Pregnancy

Management of Gynecological Abdominal Pain: Make the patient comfortable and transport. Vaginal Bleeding? (Nontraumatic, Menorrhagia, Spontaneous abortion), Treatment for Vaginal Bleeding, Do not pack vagina., Transport, Initiate oxygen and IV access based on patient condition

**Traumatic Gynecological Emergencies**


Management of Gynecological Trauma: Apply direct pressure over laceration. Apply cold pack to hematoma. Establish IV if patient is severe. Transport. If Sexual Assault. Do not ask specific details of a sexual assault. Do not examine the external genitalia of a sexual assault victim unless there is a life-threatening hemorrhage. Protect the scrotum. Handle clothing as little as possible. If removing clothing, bag each item separately. Do not cut through any tears or holes in clothing. Place bloody articles in brown paper bags. Do not examine the perineal area. Do not allow patient to change clothes, bathe, or douche. Do not allow patient to comb hair, brush teeth, or clean fingernails. Do not clean wounds, if possible.

Documentation: State patient remarks accurately. Objectively state your observations of patient’s physical condition, environment, or torn clothing. Document evidence turned over to hospital staff. Do NOT include your opinions as to whether rape occurred.
Obstetrics

The Prenatal Period - The prenatal period is the time from conception until delivery of the fetus.

Physiologic Changes of Pregnancy:
- Respiratory System: Progesterone causes a decrease in airway resistance. Increase in oxygen consumption. Increase in tidal volume. Slight increase in respiratory rate.
- Cardiovascular System: Cardiac output increases. Blood volume increases.
- Gastrointestinal System: Hormone levels. Peristalsis is slowed.
- Urinary System: Urinary frequency is common.
- Musculoskeletal System: Loosened pelvic joints.

Fetal Circulation: Pulmonary system does not receive blood while in the uterus. Baby receives blood and nutrients by mom through the umbilical cord. When the baby is born, the pulmonary arteries are opened up to allow blood and perfusion to take place.

General Assessment of the Obstetric Patient

- Initial Assessment: History—SAMPLE, EDC. Preexisting Medical Conditions, Diabetes, heart disease, hypertension, seizure, Pain, Vaginal bleeding, are they in Labor, Physical Examination
- General Management of the Obstetric Patient: Do not perform an internal vaginal examination in the field. Always remember that you are caring for two patients, the mother and the fetus. ABC, monitor for shock.

Complications of Pregnancy Trauma - Transport all patients at 20 weeks or more gestation. Anticipate the development of shock.
- Trauma Management: Apply c-collar for cervical stabilization and immobilize on a long backboard. Administer high-flow oxygen concentration.
- Initiate two large-bore IVs per protocol. Place patient tilted to the left to minimize supine hypotension. Reassess patient. Monitor the fetal heart tones.

Medical Conditions - Any pregnant patient with abdominal pain should be evaluated by a physician.

- Causes of Bleeding During Pregnancy:
  - Abortion: Termination of pregnancy before the 20th week of gestation.
  - Different classifications: Less than 12 weeks is defined as a spontaneous abortion.
  - Signs and symptoms include cramping, abdominal pain, backache, and vaginal bleeding.
  - Treat for shock. Provide emotional support.
  - Ectopic Pregnancy: Assume that any female of childbearing age with lower abdominal pain is experiencing an ectopic pregnancy. Ectopic pregnancy is life-threatening. Transport the patient immediately.
  - Abruptio Placentae: Signs and symptoms vary. Classified as partial, severe, or complete. Life-threatening. Treat for shock, fluid resuscitation.
- Transport left lateral recumbent position.

- Hypertensive Disorders: Preeclampsia and Eclampsia – definition = Symptomatic with a BP or >140/90, difference between the 2 is seizures demonstrated.
- Chronic Hypertension, Chronic Hypertension Superimposed with Preeclampsia, Transient Hypertension, Supine Hypotensive Syndrome?
  - Treat by placing patient in the left lateral recumbent position, or elevate right hip, Monitor fetal heart tones and maternal vital signs, If volume is depleted, initiate an IV of normal saline.
  - Gestational Diabetes: Consider hypoglycemia when encountering a pregnant patient with altered mental status. Signs include diaphoresis and tachycardia.
  - If blood glucose is below 60 mg/dl, draw a red top tube of blood, give NS, give 25 g oral glucose, give IV, NS, give 25 grams of D50. If blood glucose is above 200 mg/dl, draw a red top tube of blood, administer 1–2 liters NS by IV per protocol.
  - Braxton-Hicks Contractions: False labor that increases in intensity and frequency but does not cause cervical changes.

Preterm Labor

- Maternal Factors: Cardiovascular disease, renal disease, diabetes, uterine and cervical abnormalities, maternal infection, trauma, contributory factors.
- Placental Factors: Placenta previa, Abruptio placenta.

Puerperium—the time period surrounding the birth of the fetus

- Stages of Labor: Stage One (Dilation), Stage Two (Expulsion), Stage Three (Placental Stage).
- Management of a Patient in Labor: Transport the patient in labor unless delivery is imminent. Maternal urge to push or the presence of crowning indicates imminent delivery. Delivery at the scene or in the ambulance will be necessary.
- Abnormal Delivery Situations:
  - Breach Presentation: The buttocks or both feet present first. If the infant starts to breath with its face pressed against the vaginal wall, form a “V” and push the vaginal wall away from the infant’s face. Continue during transport.
  - Prolapsed Cord: The umbilical cord precedes the fetal presenting part. Elevate the hips, administer oxygen, and keep warm. If the umbilical cord is seen in the vagina, insert two gloved fingers to raise the fetus off the cord. Do not push cord back. Wrap cord in sterile moist towel. Transport immediately; do not attempt delivery.
  - Limb Presentation: With limb presentation, place the mother in knee–chest position, administer oxygen, and transport immediately. Do not attempt delivery.
  - Other Abnormal Presentations: Whenever an abnormal presentation or position of the fetus makes normal delivery impossible, reassure the mother. Administer oxygen. Transport immediately. Do not attempt field delivery in these circumstances.

- Other Delivery Complications:
  - Multiple Births: Follow normal guidelines, but have additional personnel and equipment. In twin births, labor starts earlier and babies are smaller. Prevent hypothermia.
  - Cephalopelvic Disproportion: Infant’s head is too big to pass through pelvis easily. Causes include oversized fetus, hydrocephalus, conjoined twins, or fetal tumors. If not recognized, can cause uterine rupture. Usually requires cesarean section. Give oxygen to mother and start IV. Rapid transport.
  - Precipitous Delivery: Occurs in less than 3 hours of labor. Usually in patients in grand multipara, fetal trauma, tearing of cord, or maternal accelerations. Be ready for rapid delivery, and attempt to control the head. Keep the baby warm.
  - Shoulder Dystocia: Infant’s shoulders are larger than its head. Turtle sign. Do not pull on the infant’s head. If baby does not deliver, transport the patient immediately.

Postpartum Hemorrhage: Defined as a loss of more than 500 cc of blood following delivery. Establish two large-bore IVs of normal saline. Treat for shock as necessary. Follow protocols if applying antishock trousers.

Uterine Rupture: Tearing, or rupture, of the uterus. Patient complains of severe abdominal pain and will often be in shock. Abdomen is often tender and rigid. Fetal heart tones are absent. Treat for shock. Give high-flow oxygen and start two large-bore IVs of normal saline. Transport patient rapidly.
Growth and Development

Neonatology

Newborn: A baby in the first few hours of its life, also known as a newborn infant.

Epidemiology: Approx. 6% of field deliveries require life support. The incidence of complications increases as the birth weight decreases. Approx. 80% of newborns weighing 1500 g (3 pounds, 5 ounces) at birth require resuscitation.

Determine at-risk newborns by considering antepartum and intrapartum factors that may indicate delivery complications.

Antepartum – before the onset of labor

Intrapartum – occurring during childbirth

Pathophysiology: Dramatic changes occur within the newborn to prepare it for extrauterine life. Fluid in the fetal lung will be forced out of the lungs during delivery by compression of the chest and entry of air into the lungs. Factors that stimulate the baby’s first breath… Mild acidosis, initiation of stretch reflexes in the lungs, Hypoxia, Hypothermia

Assessment: Assess the newborn immediately after birth. Ideally, one paramedic attends the mother while the other attends the newborn.

Remember—newborns will be slippery and require both hands.

Normal heart rate 150–180 per minute. Slowing to 130–140 thereafter. A pulse less than 100 indicates distress. Normal respiratory rate 40–60 per minute. Evaluate skin color as well. Use the APGAR score. You need to know your APGAR scores!

Treatment: Establishing an Airway, Airway management is one of the most critical steps in caring for the newborn. Suction the baby’s mouth first, then the nose, to avoid risk of aspiration. Prevention of Heat Loss (Heat loss can be life-threatening to newborns.) Most heat loss results from evaporation. Core temp. can quickly drop 1° Celsius from its original temp.

Cutting the Umbilical Cord: AFTER you have stabilized the patient’s airway and minimized heat loss, clamp and cut the umbilical cord. Do not “milk” or strip the cord. One 5 cm away and the other 10 cm away. Apply the clamps within 30–45 seconds after birth.

THE DISTRESSED NEWBORN: The distressed newborn can either be full term or premature. Aspiration of meconium can cause significant problems and should be prevented. newborns during the first minutes of life involve the airway. Of the vital signs, heart rate is the most important indicator of neonatal distress. A HR < 60 should be treated with chest compressions.

Inverted Pyramid for Resuscitation: Drying, Warming, Positioning, Suctioning, & Stimulating

Oxygen: If central cyanosis is present, administer supplemental oxygen. If possible, oxygen should be warmed and humidified. Never deprive a newborn of oxygen in the prehospital setting, for fear of toxicity.

Ventilation: Begin positive-pressure ventilation if any of the following present: Heart rate less than 100 beats per minute, Apnea, Persistent central cyanosis

Endotracheal intubation of a newborn should be carried out in the following situations: The BVM does not work. Tracheal suctioning is required. Prolonged ventilation will be required. A diaphragmatic hernia is suspected.

Chest Compressions: Initiate chest compressions if either of the following conditions exists: The heart rate is less than 60 beats per minute that does not increase with 30 seconds of positive-pressure ventilation and oxygenation.

Medications & Fluids: Most cardiopulmonary arrests in newborns result from hypoxia, so initial therapy consists of oxygen and ventilation. When oxygen & ventilation fail, fluids and medications should be administered. Vascular access can be managed by using the umbilical vein.

Maternal Narcotic Use: May complicate delivery. Shown to produce low birth weight infants. Such infants may demonstrate withdrawal symptoms, such as tremors, startles, decreased alertness, and respiratory distress. Naloxone is the drug of choice for respiratory depression, secondary to maternal narcotic use.

Neonatal Transport: Paramedics are called upon to transport a high-risk newborn from one facility to a neonatal intensive care unit (NICU). During transport, help to maintain body temperature, control oxygen, and maintain ventilatory support.

Specific Neonatal Situations

Meconium-Stained Amniotic Fluid: Occurs in approx. 10–15% of deliveries. An infant born in the presence of thin meconium may not require treatment, but those born through thick meconium should be intubated immediately if baby is not vigorous.

Apnea: Usually due to hypoxia or hypothermia; other causes include: Narcotic or CNS depressants, Weakness of respiratory muscles, Septicemia, Metabolic disorders, CNS disorders

Diaphragmatic Hernia: Most common posterolaterally. A rare condition (1 in every 2200 births). Survival rate is 50%. Do not use BVM; if necessary, provide positive-pressure ventilation via ET tube.

Bradydysrhythmia: Most commonly caused by hypoxia. Resist the temptation to treat bradydysrhythmia in a newborn with pharmacological measures alone.

Premature Infants: Are at a greater risk of respiratory depression, head injury, changes in blood pressure, intraventricular hemorrhage, and fluctuations in fluid osmolarity.

Other Problems

Seizures…may indicate serious illness.

Fever…uncommon and may also indicate serious underlying illness.

Hypothermia…may indicate sepsis.

Hypoglycemia…check blood glucose on all sick or unhealthy infants.

Vomiting/diarrhea…may cause dehydration and electrolyte imbalance.

Scabies in the poor hygiene families

Cardiac Resuscitation, Post Resuscitation, & Stabilization: The incidence of neonatal cardiac arrest is related primarily to hypoxia.

Risk factors include: Bradycardia, intrapartenerme asphyxia, Prematurity, maternal drug use, Congenital diseases, Intrapartum hypoxemia

Pediatrics

Role of Paramedics in Pediatric Care: Pediatric injuries have become major concerns. Children are at higher risk of injury than adults. Children are more likely to be adversely affected by the injuries they receive.

General Approach to Pediatric Emergencies: Communication and Psychological Support, Treatment begins with communication and psychological support. Responding to Patient Needs

The child’s most common reaction to an emergency is fear of: Separation, Removal from a family place, Being hurt, Being mutilated or disfigured, The unknown

Responding to Parents or Caregivers: Communication! One paramedic speaks with the adults. Introduce yourself and appear calm. Be honest and reassuring. Keep parents informed.

Growth and Development

Newborns- First hours after birth, Assessed with APGAR scoring system

Neonates- Birth to one month. Tend to lose 10% of birth weight, but regain in 10 days. Development centers on reflexes. Personality begins to form. Mother, occasionally father, can comfort child. Common illnesses include jaundice, vomiting, and respiratory distress. Do not develop fever with minor illness. Allow patient to remain in caregiver’s lap.
Infants- Ages 1 to 12 months. May stand or walk without assistance. Follow movements. Muscle development develops in cephalo-caudal progression. Allow patient to remain in caregiver’s lap.

Toddlers- Ages 1 to 3 years. Great strides in motor development. May stray from parents more frequently. Parents are the only ones who can comfort them. Language development begins. Approach child slowly. Examine from toe-to-head. Avoid asking “yes” or “no” questions. Allow child to hold a favorite blanket or item. Tell child if something will hurt.

Preschoolers- Ages 3 to 5 years. Increase in fine and gross motor skills. Children know how to talk. Fear mutilation. Seek comfort and support from within home. Distorted sense of time.

**Common Preschooler Illnesses:** Croup, Asthma, Poisoning, Auto accidents, Burns, Child abuse, Ingestion of foreign bodies, Drowning, Epiglottitis, Febrile seizures, Meningitis

**School-Age Children-** Ages 6–12 years. Active and carefree age group. Growth spurts are common. Give this age group responsibility of providing history. Respect modesty.

**Common Illness and Injuries in School-Age Children:** Drowning, Auto accidents, Bicycle accidents, Falls, Fractures, Sports injuries, Child abuse, Burns

**Adolescents-** Ages 13 to 18. Begins with puberty, which is very child- specific; are very “body conscious.” May consider themselves “grown up.” Desire to be liked and included by peers. Are generally good historians. Relationships with parents may be strained.

**Common Adolescent Illness and Injuries:** Mononucleosis, Asthma, Auto accidents, Sports injuries, Drug and alcohol problems, Suicidal gestures, Sexual abuse

**Anatomy and Physiology**

Anatomical and physiological considerations in the infant and child.

  a. In the supine position, an infant’s or child’s larger head tips forward, causing airway obstruction. Avoid stimulation of the vagus nerve. Check the pulse frequently.

**Basic Considerations:** Much of the initial patient assessment can be done during visual examination of the scene. Involve the caregiver or parent as much as possible. Allow to stay with child during treatment and transport. Scene Size-Up: Conduct a quick scene size-up. Take BSI precautions. Look for clues to mechanism of injury or nature of illness. Allow child time to adjust to you before approaching. Speak softly, simply, at eye level. Notice the components and signs in the Pediatric Assessment Triangle (PAT). Notice the conditions that can be determined by quick observation.

**General Approach to Pediatric Assessment:**

- **Basic Considerations:** Much of the initial patient assessment can be done during visual examination of the scene. Involve the caregiver or parent as much as possible. Allow to stay with child during treatment and transport.
- **Scene Size-Up:** Conduct a quick scene size-up. Take BSI precautions. Look for clues to mechanism of injury or nature of illness. Allow child time to adjust to you before approaching. Speak softly, simply, at eye level. Notice the components and signs in the Pediatric Assessment Triangle (PAT). Notice the conditions that can be determined by quick observation.
- **Initial Assessment:** Breathing, Appearance, Circulation. Anticipating Cardiopulmonary Arrest: Respiratory rate greater than 60, Heart rate greater than 180 or less than 80 (under 5 years), Heart rate greater than 180 or less than 60 (over 5 years), Respiratory distress, Trauma, Burns, Cyanosis, Altered level of consciousness, Seizures, Fever with petechiae.

**Glasgow Coma Scale:** Scoring Determines Severity- GCS 13–15 = Mild, GCS 9–12 = Moderate, GCS < 8 = Severe (Modifications for Infants)

Vital Signs in pediatric: Pulse, Respirations, Blood pressure (necessary in children over 3 years of age)

**General Management of Pediatric Patients**

- **Suctioning:** Decrease suction pressure to less than 100 mm/Hg in infants. Avoid excessive suctioning time—less than 15 seconds per attempt.
- **Oxygenation:** Adequate oxygenation is the hallmark of pediatric patient management. Insertion of Oral Airways:
  - In an adult, the airway is inserted with the tip pointing to the roof of the mouth, then rotated into position.
  - In an infant or small child inserted with the tip pointing toward the tongue and pharynx, in the same position it will be in after insertion.
- **Advanced Airway:** A straight blade is preferred for greater displacement of the tongue. The pediatric airway narrows at the cricoid cartilage.
- Uncuffed tubes should be used in children under 8 years of age. Intubation is likely to cause a vagal response in children.

**Pediatric Endotracheal Tube Size:** Use a resuscitation tape that estimates ET tube size based on height. Estimate the correct diameter, based on the child’s little finger.

- **Indications for Intubation:** Need for prolonged artificial ventilation, Inadequate ventilatory support with a BVM, Cardiac or respiratory arrest, Control of an airway in a patient without a cough or gag reflex, Providing a route for drug administration, Access to the airway for suctioning.

**Circulation:** Two problems lead to cardiopulmonary arrest in children: Shock and Respiratory failure.

- **Vascular Access:** Neck veins, Scalp veins, Arms, Hands, Feet. Intraosseous infusion
  - Indicators: Children less than 6 years of age. Existence of shock or cardiac arrest. Unresponsive patient, Unsuccessful peripheral IV
  - **Contraindications:** Fracture in the bone chosen for IO, Fracture of the pelvis or extremity fracture of bone, proximal to the chosen site.
  - **Drugs Administered through IO:** Epinephrine, Atropine, Dopamine, Lidocaine, Sodium bicarbonate, Dobutamine
  - **Fluid Administration:** 20 cc/kg in pediatrics, 10 cc/kg in infants

**Electrical Therapy:** Initial dose is 2 joules per kilogram of body weight. If unsuccessful, increase to 4 joules per kilogram. If still unsuccessful, focus on correcting hypoxia and acidosis. Transport to a pediatric critical care unit, if possible.

- **Respiratory Emergencies:**
  - **Infections:** Upper airway distress, Croup - viral (Laryngotracheal bronchiolitis) - Epiglottitis - bacterial. Lower airway distress: Asthma, Bronchiolitis
  - **Poisoning and Toxic Exposure:** Accidental poisoning is a common childhood emergency. Leading cause of preventable death in children.
  - **Trauma Emergencies:** Falls are the most common cause of injury in young children. Motor vehicle crashes, Car vs. pedestrian injuries, Drowning and near drowning, Penetrating injuries, Burns, Physical abuse.
  - In the trauma victim, use the combination of jaw-thrust/spine-stabilization maneuver to open the airway.
  - **Sudden Infant Death Syndrome (SIDS):** Unexplained death of an infant/child less than 1 year of age.
  - **Child Abuse and Neglect:** Beating with an electric wire. The burns on the buttocks and “sock burns” from submersion in hot water as a punishment. Cigarette burns, Malnutrition, Poor hygiene.
  - The effects of child abuse, both physical and mental, can last a lifetime.

**Infants and Children with Special Needs:** MS, SMA, MD, etc

**Common home-care devices:** Tracheostomy tubes, Apnea monitors, Home artificial ventilators, Central intravenous lines, Gastric feeding and gastrostomy tubes, Shunts