REGION VIII
EMS SYSTEMS

BLAST INJURY
Feb 2015
Announcements

• Region

• System
History of Incidents in the US

- Few US bombings have caused mass casualties
  - First World Trade Center Attack, February 1993
  - Oklahoma City Bombing – April 19, 1995
    - Fuel and fertilizer used to create a bomb
    - 518 injuries and 168 deaths
  - Atlanta Olympic Park Bombing, July 27, 1996
  - World Trade Center and Pentagon
    - September 11th, 2001
    - Approximately 2,996 deaths total
  - Explosive device attacks at abortion clinics
History of Incidents in the US

- Boston Marathon bombings and subsequent related shootings
- Series of incidents on April 15, 2013
- Two pressure cooker bombs exploded during the Boston Marathon
- Killed 3 people & injured an estimated 264 others
- Bombs exploded about 12 seconds and 210 yards (190 m) apart, near the finish line on Boylston Street
History of Incidents in the US Boston Marathon

Lessons Learned- Scene Response

• Scene safety
  – Secondary device awareness
  – Personal protective equipment
  – Pre-hospital vs. In-hospital responders

• Equipment
  – Tourniquets
  – Triage Tags
  – Litters
History of Incidents in the US Boston Marathon

• Some directly transported from scene
• Some taken to Medical Tent A
• Blast scene cleared of patients within 18 minutes
History of Incidents in the US Boston Marathon

- Trauma paradigm
  - Bleeding out
  - Hypothermia
  - IVF vs. Blood
History of Incidents in the US

- Oklahoma City Bombing
- World Trade Center Attack
- Atlanta Olympic Park Bombing
Types of Incidents

USS Cole

Terrorism:

• Bombings are clearly the most common cause of casualties in terrorist incidents.

• Modern EMS must remain aware and cognitive of this threat.
Types of Incidents

Texas City, TX

Accident:

- *USS Grandcamp* was loading ammonium nitrate fertilizer. **2,300 tons** were already onboard.

- A fire was discovered in the hold of the ship.

- At 0912 hrs the ammonium nitrate exploded
Accidents

Grain Elevator Explosion

I-95 Vehicle Accident / Explosion
Physics of an Explosion

• Substance is detonated $\rightarrow$ converted into large volumes of gas under pressure
• Propellants- Explosives designed to release energy relatively slowly
Physics of an Explosion

- **Blast front** - Leading edge of a blast wave

- **Positive wave pulse** - Pressure front is higher than atmospheric pressure

- **Shock wave** - High-explosive blast waves

- **Negative wave pulse** - Pressure is less than atmospheric pressure
Physics of an Explosion

• The speed, duration, and pressure of the shock wave are affected by:
  – Size of the explosive charge
  – Nature of surrounding medium
  – Distance from explosion
  – Presence or absence of reflecting surfaces
Physics of an Explosion

• An explosion is more damaging in closed spaces

• Blast pressures cause destruction at:
  – Interface between tissues of different densities
  – Interface between tissues and trapped air
A little theory... What is an explosive

• There are four types...
  – High explosive
  – Low explosives
  – Fuel-Air explosives
  – Nuclear explosives

We won’t talk about nuclear explosions...

• High order
  – Detonation
  – Blast wave formation (supersonic)

• Low order
  – Deflagration
  – No blast wave formation (always subsonic)
High Order Explosives

- When a high explosive detonates, it is converted instantaneously into a gas at high pressure and temperature

- The expansion of these gases creates the blast wave
Low Order Explosives

- Gunpowder
- Nitrocellulose
  - Smokeless powder
  - (This is also is a high explosive under certain conditions)
- Match heads
- Multiple other compounds

- Don’t have a shock wave
- Can be a significant blast wind associated with large amounts
- Often called propellants
  - large amount of gas produced by the low order explosive
  - used to drive a bullet or shell through a barrel
Fuel-air explosives

• Neither a high explosive or a low order explosive
  – Has features of both
  – Most often has deflagration
  – May have supersonic detonation
    • May have much longer, broader blast wave than high explosive
Deflagration

Low-order explosive combustion

- Very rapid burning....
- The speed is increased by confinement
Types of Blast Injuries

- **Primary**
  - direct effect of pressure
- **Secondary**
  - effect of projectiles from explosion
- **Tertiary**
  - structural collapse and from persons being thrown from the blast wind
- **Quaternary**
  - Burns, inhalation injury, exacerbations of chronic disease
Primary Blast Injury

- Damage is caused by pressure wave generated by explosion

- Close proximity to the origin of the pressure wave carries a high risk of injury or death
Primary Blast Injury

• Unique to high explosives

• Due to impact of over-pressurization wave with body surfaces

• Most commonly involve air-filled organs and air-fluid interfaces
  – Middle ear
  – Lungs
  – Gastrointestinal tract

• Explosion SHOCK WAVES and Blast Injuries – YouTube

• Types of injuries
  – Blast lung
  – Tympanic Membrane (TM) rupture
  – Abdominal hemorrhage and perforation
  – Globe rupture
  – Traumatic brain injury (TBI) without physical signs of head injury
Primary Blast Injury

- Differential pressures in tissues
  - Organ distortion
  - Tensile strength of the tissue is exceeded
  - Tissue tearing
Tympanic Membrane Injury

- Most frequently injured by blast

- Symptoms:
  - Hearing loss
  - Tinnitus
  - Vertigo
  - Bleeding from external canal
  - Mucopurulent otorrhea (fluid from the ear canal)

- TM rupture is sensitive marker
  - Keep on looking for more injuries
Blast Lung

• Lung
  – 2nd most susceptible organ to blast injury
  – Most common fatal primary blast injury among initial survivors

• Pulmonary barotrauma includes
  – Pulmonary contusions
  – Systemic air embolism
  – Free radical associated injuries
    • Thrombosis
    • Disseminated Intravascular Coagulation (DIC)- What is this?
Blast Lung

• Clinical triad
  – apnea, bradycardia, hypotension

• Signs usually at initial presentation but may manifest as late as 48 hours after explosion

• Should be suspected if dyspnea, cough, hemoptysis, or chest pain

• Radiographic findings
  – Bihilar “butterfly” pattern
  – Pneumothorax or hemothorax
  – Pneumomediastinum and subcutaneous emphysema
Blast Lung

- Blood vessels stretched and torn causing pulmonary contusion
- Mild interstitial hemorrhage with minor oxygen diffusion problems
- Bruises on lungs produced when primary blast wave rapidly accelerates ribs into underlying lung tissue
# ADULT CHEST INJURIES

## BLS/ALS

1. Initial Trauma Care SOP, p. 53
2. **HIGH FiO₂** or **VENTILATION**
3. Begin expeditious transport to appropriate facility and contact Medical Control enroute

## SUCKING CHEST WOUND/OPEN PNEUMOTHORAX

3. Apply occlusive dressing taped on three sides
4. If patient deteriorates, remove dressing temporarily to allow air to escape
5. **ALS:** Consider intubation

## FLAIL CHEST

3. If respiratory distress, appropriately **VENTILATE WITH HIGH FiO₂ VIA BVM** to provide internal splinting.
4. **ALS:** Consider intubation

## TENSION PNEUMOTHORAX

3. Suspect when patient presents with severe respiratory distress or difficulty ventilating, hypotension, distended neck veins, absent breath sounds on the involved side, and/or tracheal deviation.
4. **ALS:** **PLEURAL DECOMPRESSION** of affected side
5. Assess for PEA. If present, refer to **Asystole/PEA SOP**, p. 19

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**Note:** The landmark for pleural decompression is the second intercostal space in the mid-clavicular line. The needle should be inserted above the third rib to avoid the intercostal nerve, artery, and vein.
Blast Abdominal Injury

- Colon
  - visceral organ most frequently affected
- Could have delayed rupture
- Intestinal barotrauma more common with underwater air blast
- Solid organ injury less likely

- Signs and symptoms
  - Abdominal pain, nausea, vomiting, hematemesis
  - Rectal pain and tenesmus
  - Testicular pain
  - Unexplained hypovolemia
Blast Abdominal Injury

Delayed onset > 8-36 hours
*** more common in submersion

- Intestinal intra-wall hemorrhages
- Shearing of local mesenteric vessels
- Sub-capsular and retroperitoneal hematomas
- Fracture of liver and spleen
- Testicular rupture
Other Primary Blast Injuries

- Eye
  - Globe rupture
  - serous retinitis
  - Hyphema
  - Lid laceration
  - Traumatic cataracts
  - Injury to optic nerve
- **Signs and symptoms:**
  - eye pain
  - foreign body sensation
  - blurred vision
  - decreased vision
  - drainage
### GENERAL APPROACH

**BLS/ALS**

1. **Initial Trauma Care SOP, p. 53**
   - Assess pain on a 0-10 scale
   - Quickly obtain gross visual acuity in each eye: light perception, motion, acuity
   - Discourage patient from sneezing, coughing, straining or bending at the waist
   - Elevate head of cot or backboard Semi-Fowler’s position unless contraindicated
   - Vomiting precautions

**ALS**

2. If systolic BP > 100 mmHg, administer **FENTANYL 1 mcg/kg SLOW IV/IM, max first dose 100 mcg.** Repeat dose 0.5 mcg/kg SLOW IV/IM in 5 min, max repeat dose 50 mcg.
   - Patients > 65 years old and if systolic BP > 100 mmHg, administer **FENTANYL 0.5 mcg/kg SLOW IV/IM, max dose 50 mcg.** Repeat dose 0.25 mcg/kg SLOW IV/IM in 5 min, max repeat dose 25 mcg.

### CHEMICAL SPLASH/BURN

**BLS/ALS:** Immediately irrigate affected eye(s) using copious amounts of normal saline. Continue irrigation while enroute to hospital.

**ALS:**

1. **Instill 0.5% TETRACAINE 1 drop in each affected eye.** May repeat until pain relief achieved.
2. **Irrigate per appropriate System-specific procedure.**

### SUSPECTED CORNEAL ABRASIONS

**ALS:**

1. **Instill 0.5% TETRACAINE 1 drop in each affected eye.** May repeat until pain relief achieved.
2. **Patch affected eye(s).**

### PENETRATING INJURY/RUPTURED GLOBE

**ALS:**

1. **Do not** remove impaled objects; **do not** irrigate or instill tetracaine.
2. Avoid any pressure on the injured eye(s). Cover with cup, or metal or plastic protective shield.
3. **Patch unaffected eye.**
Other Primary Blast Injuries

• Brain
  – TBI due to barotrauma of gas embolism or coup and countercoup injuries
Traumatic Brain Injury

**Physical**
- Headaches
- Dizziness
- Insomnia
- Fatigue
- Uneven gait
- Nausea
- Blurred Vision

**Cognitive**
- Attention difficulties
- Concentration problems
- Memory problems
- Orientation problems

**Behavioral**
- Irritability
- Depression
- Anxiety
- Sleep disturbances
- Problems with emotional control
- Loss of initiative
- Problems related to employment, marriage, relationships, and home or school management
# ADULT HEAD INJURIES

## BLS/ALS

1. **Initial Trauma Care SOP, p. 53**
   - Assure adequacy of ventilation
   - Apply C-spine immobilization
   - Keep patient flat
   - Take vomiting and seizure precautions
   - Glasgow Coma Scale (GCS) score
   - Identify deficits

2. Begin expeditious transport and contact Medical Control enroute

## Altered Mental Status

### ALS

3. If GCS score ≤ 8, **INTUBATE** using in-line procedure. If unable to INTUBATE, consider use of **ALTERNATE AIRWAY DEVICE**. Refer to **Drug Assisted Intubation – Etomidate SOP, p. 24**, if indicated.

4. Obtain and record blood glucose level, if available. If glucose < 60, treat per **Diabetic/Glucose Emergencies SOP, p. 29**

5. If seizure activity, treat per **Seizures/Status Epilepticus SOP, p. 31**

6. For the combative patient, consider **VERSED** (midazolam) 2 mg increments IV q 2 minutes up to 10 mg total as necessary.
   - May administer **VERSED** (midazolam) IM if unable to start IV
     - < 70 kg = 5 mg IM
     - ≥ 70 kg = 10 mg IM
Other Primary Blast Injuries

• Larynx is most sensitive non-auditory structure to repeated blast

• Repeated exposure to blast waves significantly increases severity of injury/likelihood of death
Secondary Blast Injury

- Result from being struck by flying debris
- A blast wind occurs
- Flying debris may cause blunt and penetrating injuries
Secondary Blast Injury

#1 source of injury/death from explosions

• Fragments…
  – munitions (design)
  – “spiked” terrorist bomb
  – Nails, Glass, Unique IEDs
  – Blast environment
  – Glass fragments are a common cause of injury/death related to blast in civilian settings
  – Rock, wood, metal, concrete, etc…anything within the blast radius has the potential to be converted into a projectile.

• From the bomber…
  – At least one recorded event reports infections from fragments
Secondary Blast Injury
Secondary Blast Injury
Fragments

• Travel at HIGH velocity
  – Conventional military explosives create fragments with initial velocity > 8000 fps.
  – M16 round travels at 2800 fps
  – Studies have shown that explosion travel well within the fps velocity range as listed above.

• Russian Gas Truck Crash Leads To Explosion And Projectile Fireballs - YouTube
Secondary Blast Injury
Fragments

• Glass causes up to 50% of secondary blast injuries
  – 88% of Khobar Towers patients were injured by flying glass
  – Occur most often in exposed areas such as head, neck and extremities
Tertiary Blast Injuries

• Occur when a person is hurled against stationary, rigid objects

• Ground shock
  – Physical displacement when the body impacts the ground
Tertiary Blast Injuries

- Due to persons being thrown into fixed objects by wind of explosions
- Also due to structural collapse and fragmentation of building and vehicles
- Structural collapse may cause extensive blunt trauma
  - Crush syndrome
    - Damage to muscles and subsequent release of myoglobin, urates, potassium, and phosphates
  - Compartment syndrome
    - Edematous muscle in an inelastic sheath promotes local ischemia, further swelling, increased compartment pressures, decreased tissue perfusion, and further ischemia
Crush Syndrome

- These systemic effects are caused by a traumatic rhabdomyolysis -
  - break down of muscle tissue
  - As muscle cells die, they absorb sodium, water & calcium
  - Rhabdomyolysis releases:
    - Potassium
    - Myoglobin
    - Phosphate
    - Thromboplastin
    - Creatinine
    - Creatinine kinase
Compartment Syndrome

- Tissue pressure within a closed muscle compartment exceeds the perfusion pressure and results in muscle and nerve ischemia

- Typically occurs subsequent to a traumatic event
  - Fracture with/without cast
Crush Injury vs. Compartment Syndrome

* Treatment is different for both
  • Ultimately, need to relieve the pressure
  • Compartment Syndrome- may need fasciotomy
  • Crush Injury Treatment:
    • Fluid Bolus & Sodium Bicarbonate 8.4% 1 mEq / kg
### ADULT MUSCULOSKELETAL INJURIES

#### BLS/ALS
1. **Initial Trauma Care SOP**, p. 53
2. **ALS**: Consider analgesia, if patient is hemodynamically stable
   - NITROUS OXIDE per System-specific policy for MILD pain
   - For SEVERE pain:
     - If systolic BP > 100 mmHg, administer FENTANYL 1 mcg/kg SLOW IV/IM, max first dose 100 mcg. Repeat dose 0.5 mcg/kg SLOW IV/IM in 5 min, max repeat dose 50 mcg.
     - Patients > 65 years old and if systolic BP > 100 mmHg, administer FENTANYL 0.5 mg/kg SLOW IV/IM, max first does 50 mcg. Repeat dose 0.25 mcg/kg SLOW IV/IM in 5 min, max repeat dose 25 mcg.
3. Immobilize and/or splint. If pulses are lost after applying a traction splint, leave splint in place. Do not release traction. Notify Medical Control of change in status.
4. Elevate extremity and or apply cold pack after splinting when appropriate.
5. **ALS**: If long bone fracture with displacement/muscle spasm, and hemodynamically stable, consider VERSED (midazolam) 2 mg increments IV q 2 minutes up to 10 mg total as necessary.

### AMPUTATION / DEGLOVING INJURIES
1. If amputation is incomplete, stabilize with bulky dressing.
2. If uncontrolled bleeding continues, apply tourniquet above amputation as close as possible to the injury. Note time tourniquet applied. DO NOT release tourniquet once it has been applied.
3. Care of amputated parts:
   - Wrap in normal saline moistened gauze or towel. Place in plastic bag and seal. DO NOT immerse tissue directly in water or normal saline.
   - Place plastic bag in second container filled with ice or cold water or place on cold packs and bring with patient to the hospital.
Crush Syndrome vs. Compartment Syndrome

**Crush Syndrome**
- Vascular compromise
- Force compresses large vessels resulting in loss of blood to supply muscle tissue
- Normally, muscles can withstand approx 4 hours without blood flow before cell death occurs
- After this time, cells begin to die

**Compartment Syndrome**
- Defined as an “increased pressure within a confined space that leads to micro-vascular compromise and ultimately to cell death as a result of oxygen starvation”
Quaternary (Misc) Blast Injuries

- Occur from the miscellaneous events that occur during an explosion
- May include:
  - Burns
  - Respiratory injury
  - Crush injury
  - Entrapment
## ADULT BURN INJURIES

### BLS/ALS
4. Initial Trauma Care SOP, p. 53
5. Unresponsive patients found at the scene of a fire, consider cyanide poisoning. Refer to Toxicologic Emergencies SOP, p. 34
6. Evaluate depth of burn and estimate extent using rule of nines or palm method (patient’s palm equals 1% BSA). Assess need for transport to Burn Center.

### ALS
4. If systolic BP > 100 mmHg, administer FENTANYL 1 mcg/kg SLOW IV/IO/IM/IN, max first dose 100 mcg. Repeat dose 0.5 mcg/kg SLOW IV/IO/IM/IN in 5 min, max repeat dose 50 mcg.
   - Patients > 65 years old and if systolic BP > 100 mmHg, administer FENTANYL 0.5 mcg/kg SLOW IV/IO/IM/IN, max dose 50 mcg. Repeat dose 0.25 mcg/kg SLOW IV/IO/IM/IN in 5 min, max repeat dose 25 mcg.
5. Consider aggressive fluid resuscitation per Parkland Formula (4 ml x kg x % BSA burned = amount IV fluid delivered in first 24 hour period. Half of the amount to be infused over first 8 hours, other half to be infused over last 16 hours).

### THERMAL BURNS
4. If burned area ≤ 10% TBSA:
   - Cool burned area for no longer than five minutes with water or saline, if burn occurred within 15 minutes. **Wet dressing may be applied for local pain relief.**
5. Wear gloves and mask until burn wounds are covered.
6. **DO NOT** break blisters. **If > 10% TBSA affected**, cover burn with DRY, sterile dressings.
7. Open dry sheet on stretcher before placing patient for transport. Cover patient with dry sheets and blanket to maintain body temperature.

### INHALATION BURNS
4. Note presence of wheezing, hoarseness, stridor, carbonaceous (black) sputum/cough, singed nasal hair/eyebrows/eyelashes.
5. **HIGH FiO₂ or VENTILATION**

### ALS
- Consider INTUBATION if severe respiratory distress. If intubation unsuccessful, consider CRICOTHYROIDOTOMY.
- If wheezing, consider ALBUTEROL 2.5 mg (3 mL) or XOPENEX 1.25 mg (3 mL) via nebulizer. May repeat x 1.
Quaternary (Misc) Blast Injuries

• Caused by biologic, chemical, or radioactive contaminants added to an explosive

• Associated with “dirty bombs”
### ELECTRICAL BURNS
4. Immobilize as indicated

**ALS**
5. Assess ECG for dysrhythmias and treat according to appropriate SOP
6. Assess wounds, including neurovascular status
7. Cover wounds with dry sterile dressing (cooling not necessary)

### CHEMICAL BURNS
4. HazMat precautions
5. If powdered chemical, brush away excess. Remove clothing, if possible.
6. Irrigate with copious amounts of sterile water or NS ASAP and while enroute.
Medical Management

- Confined Space Incident Kills Company Employee and Rescuing Fireman 1984 Phoenix Arizona – YouTube

How would you handle this situation:
- Triage?
- Resources?
- Patient Care?
General Considerations

• Information about distance from and type of explosion predict injury severity and type

• Half of all initial casualties seek medical care over first hour

• Expect upside down triage
  – Most severely injured arrive after less injured who bypass EMS and self-transport to closest hospitals
  – Hospitals may be overwhelmed before you even transport during large scale incidents
### ADULT INITIAL TRAUMA CARE

#### BLS/ALS

**SCENE SIZE UP**
- Assess and secure scene safety.
- Use standard precautions on all patients.
- If indicated, follow department HazMat protocols.
- If a potential crime scene, make efforts to preserve integrity of possible evidence.
- Anticipate potential injuries based on the mechanism of energy transfer.

#### INITIAL ASSESSMENT:

1. **AIRWAY/C-SPINE**: Manual C-spine immobilization as indicated. Position airway and suction as needed. Advanced airway procedures as indicated. If unable to secure by other means, consider CRICOTHYROIDOTOMY.
2. **BREATHING/VENTILATION**: Assess ventilatory status; expose chest as needed.
   - Auscultate breath sounds.
   - Oxygen: Administer supplemental OXYGEN AT LOW FiO₂ (4-6 LPM nasal cannula).
   - If acute altered mental status, hemodynamically unstable, signs of hypoxemia, or meets Trauma Region Field Triage Criteria, increase OXYGEN TO HIGH FiO₂ (12-15 LPM non-rebreather mask).
   - If hypoventilating or apneic, VENTILATE WITH HIGH FiO₂ (BVM with ≥ 15 LPM oxygen supply).
   - ALS: If tension pneumothorax, perform PLEURAL DECOMPRESSION of affected side.
3. **CIRCULATION**: assess cardiovascular status.
   - If no carotid pulse, follow Traumatic Arrest SOP, p. 59.
   - Control all external hemorrhage.
   - ALS: Obtain VASCULAR ACCESS. Infusion rate as follows:
     - **Inadequate perfusion** (altered mental status or signs of hypoperfusion): Attempt large bore access (IV or IO if the patient meets all other criteria) enroute. Minimum fluid volume of 2 L unless contraindicated. Infusion rate based on clinical presentation.
     - **Adequate perfusion**: Attempt large bore IV enroute. Titrate fluid volume to patient condition.
   - Monitor ECG as appropriate.
   - Place a pelvic stabilizing device for suspected pelvic instability.
<table>
<thead>
<tr>
<th>ADULT INITIAL TRAUMA CARE</th>
<th>(Continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. DISABILITY/MINI-NEUROLOGICAL EXAM:</strong> Assess AVPU along with Glasgow Coma Scale and evaluate neurological function</td>
<td></td>
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<tr>
<td><strong>ALS</strong></td>
<td></td>
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<tr>
<td>• If GCS score ≤ 8, see HEAD INJURIES SOP, p. 56</td>
<td></td>
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<tr>
<td>• No neurological impairment: Reassess periodically and document changes</td>
<td></td>
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<tr>
<td>• Altered Mental Status: Seizure and vomiting precautions. Check glucose level. If glucose &lt; 60:</td>
<td></td>
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<tr>
<td>• Administer DEXTROSE 50% 25 gm (50 mL) IVP</td>
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<tr>
<td><strong>BLS/ALS</strong></td>
<td></td>
</tr>
<tr>
<td>1. Expose and examine as indicated. Consider potential injuries based on mechanism of injury.</td>
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<tr>
<td>2. Identify priority transport.</td>
<td></td>
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<tr>
<td>3. Complete spinal immobilization as indicated.</td>
<td></td>
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<tr>
<td>4. Assess pain score on a scale from 0-10. Treat pain per appropriate SOP.</td>
<td></td>
</tr>
<tr>
<td><strong>TRANSPORT DECISION:</strong> Once the initial assessment and resuscitative interventions are initiated, a decision must be made whether to continue with the rapid trauma survey and the need for additional interventions on scene, or to transport rapidly with interventions enroute. Document the patient condition(s) or behavior(s) that necessitated this decision.</td>
<td></td>
</tr>
<tr>
<td>Transport to closest appropriate facility per Trauma Region Field Triage Guidelines, p. 44.</td>
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<tr>
<td><strong>RAPID TRAUMA SURVEY</strong> (as allowed by time and patient condition)</td>
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</tr>
<tr>
<td>1. Systematic head-to-toe assessment</td>
<td></td>
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<tr>
<td>2. SAMPLE history</td>
<td></td>
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<tr>
<td>3. Recheck and record vital signs and patient condition at least q 15 minutes as able, and after each ALS intervention. For unstable patients, more frequent reassessment may be needed. Note the time obtained.</td>
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<tr>
<td>4. Revised Trauma Score</td>
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</table>
Multisystem Trauma

• Injuries that involve several body systems
  – ARDS (Acute respiratory distress syndrome)
  – DIC (Disseminated intravascular coagulation)

• If you suspect multisystem trauma:
  – Assess the entire body
  – Prioritize the treatment of the injuries
  – Transport without delay
Trauma Score

- Used to determine the likelihood of survival
- Takes into account:
  - Glasgow Coma Scale (GCS) score
  - Respiratory rate
  - Respiratory expansion
  - Systolic blood pressure
  - Capillary refill
## ADULT REVISED TRAUMA SCORE

<table>
<thead>
<tr>
<th>Glasgow Coma Score</th>
<th>Conversion Points</th>
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<tbody>
<tr>
<td>GCS 13-15</td>
<td>4</td>
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<tr>
<td>GCS 9-12</td>
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<td>GCS 6-8</td>
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<td>GCS 4-5</td>
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<td>&gt; 89</td>
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</table>

**TOTAL REVISED TRAUMA SCORE:** 0-12

## ADULT GLASGOW COMA SCALE

### EYE OPENING
- Spontaneous: 4
- To voice: 3
- To pain: 2
- None: 1

### VERBAL RESPONSE
- Oriented: 5
- Confused speech: 4
- Inappropriate words: 3
- Incomprehensible sounds: 2
- None: 1

### MOTOR RESPONSE
- Obeys commands: 6
- Localizes pain: 5
- Withdraws to pain: 4
- Abnormal flexion to pain: 3
- Abnormal extension: 2
- None: 1

**TOTAL GLASGOW COMA SCALE SCORE:** 3-15
## Pediatric Glasgow Coma Scale (PGCS)

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>&gt; 1 Year</th>
<th>&lt; 1 Year</th>
<th>Score</th>
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<tbody>
<tr>
<td>Spontaneously</td>
<td>Spontaneously</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>To verbal command</td>
<td>To shout</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>To pain</td>
<td>To pain</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor Response</th>
<th>&gt; 1 Year</th>
<th>&lt; 1 Year</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>Spontaneous</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Localizes pain</td>
<td>Localizes pain</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Flexion-withdrawal</td>
<td>Flexion-withdrawal</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Flexion-abnormal (decorticate rigidity)</td>
<td>Flexion-abnormal (decorticate rigidity)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Extension (de cerebrate rigidity)</td>
<td>Extension (de cerebrate rigidity)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verbal Response</th>
<th>&gt; 5 Years</th>
<th>2-5 Years</th>
<th>0-23 months</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oriented</td>
<td>Appropriate words/phrases</td>
<td>Smiles/cues appropriately</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Disoriented/confused</td>
<td>Inappropriate words</td>
<td>Cries and is consoleable</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>Persistent cries and screams</td>
<td>Persistent inappropriate crying and/or screaming</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Incomprehensible</td>
<td>Grunts</td>
<td>Grunts, agitated, and restless</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td>No response</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Total Pediatric Glasgow Coma Score:**

(3-15)

## Pediatric Trauma Score (PTS)

<table>
<thead>
<tr>
<th>Component</th>
<th>+ 2</th>
<th>+ 1</th>
<th>- 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Child/adolescent &gt; 20 kg</td>
<td>Toddler 11 – 20 kg</td>
<td>Infant ≤ 10 kg</td>
</tr>
<tr>
<td>Airway</td>
<td>Normal</td>
<td>Maintainable</td>
<td>Unmaintained or intubated</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>&gt; 90 mmHg</td>
<td>50 – 80 mmHg</td>
<td>&lt; 50 mmHg</td>
</tr>
<tr>
<td>CNS</td>
<td>Awake</td>
<td>Obtunded/Lost consciousness</td>
<td>Coma/Unresponsive</td>
</tr>
<tr>
<td>Skeletal Injury</td>
<td>None</td>
<td>Closed Fracture</td>
<td>Open/Multiple Fractures</td>
</tr>
<tr>
<td>Open Wounds</td>
<td>None</td>
<td>Minor</td>
<td>Major/Penetrating</td>
</tr>
</tbody>
</table>
Scene Size-Up

- Attention to PPE is required.
- Anticipate possible scene hazards.
- Assess your environment carefully.
- Consider whether you will need additional medical resources.
Primary Assessment

- **Simple triage and rapid treatment (START)** is a triage method used by first responders to quickly classify victims during a mass casualty incident (MCI) based on the severity of their injury. The method was developed in 1983 by the staff members of Hoag Hospital and Newport Beach Fire Department located in California, and is currently widely used in the United States.
Primary Assessment

• First responders using START / Jump START evaluate victims and assign them to one of the following four categories:
  – Immediate (red)
  – Delayed (yellow)
  – Walking wounded/minor (green)
  – Deceased/expectant (black)
Respirations

Perfusion

Mental Status
Secondary Assessment

• Physical examinations
  – Most patients should have a thorough physical exam prior to or during transport.
  – The head-to-toe exam should be done in a systematic manner.
Reassessment

• Repeat the primary assessment
• Reevaluate vital signs
• Review the status of the interventions
• Notify the hospital staff
Management of Trauma

• During transport, begin interventions
• Most trauma patients will need to be treated for shock
  – Give oxygen
  – Keep supine with extremities slightly elevated if able
  – Transport rapidly to a trauma center
    • Time of day
    • Weather
    • Transport Time
    • Traffic
    • Availability of Resources
Management of Trauma

• Consider fluid resuscitation
  – Consult with medical control
  – Begin fluid resuscitation at volumes that maintain a minimum blood pressure

• Several techniques can be used
  – Use a team approach
  – Critical thinking is important
ALS / BLS

SCENARIO 1
Dispatch

- Dispatched to a commercial structure fire. Dispatch inform responding units of potential explosive hazards stored within the structure.
- Units arrive on scene to encounter what appears to be multiple victims lying on the ground outside the a partially collapsed structure with a large debris field.
- Bystanders inform you the structure “just appeared to blow-up”.
Patient

• Your EMS unit is assigned to a single patient:
  – 32 y/o male
  – Obvious facial lacerations w/ significant bleeding from his forehead
  – Pt is A/O x 4, speaks in full sentence, airway presents patent
  – Pt is complaining of left sided abdominal pain and SOB
  – Pt states he was outside the building when he thinks the fuel tanks exploded
Assessment

- A- Tachypnea w/ slightly labored breathing
- B- 28/min
- C- Strong and regular pulse present / 98 bpm
- D- Normal gait / pt is ambulatory upon arrival
- Pupils: PEARL bilaterally
- Lungs: Diminished left LS
- BP 80/P
Treatment Plan

• What is your treatment plan for this patient?
  – Stabilize the airway
  – Stabilize pt’s pressure???
  – Rapid transport to Trauma center

• What should we suspect with information provided?
  – Tension pneumothorax
  – Abdominal wall injury / internal bleeding
ALS arrives after IMC

- What information do you need to obtain from the first arriving crew?
- What are your treatment priorities?
- What do you need to communicate to the ECRN?
IV FLUIDS

MEDICATION OF THE MONTH
Fluids

• 0.9% Normal Saline:

• Lactated Ringers:

• Dextrose 5% (D5W):
0.9% Normal Saline

Other Names
0.9% Sodium Chloride Solution

Classification
Isotonic volume expander
Electrolyte replacement

Indications
• Source of water and electrolytes
• In general, intravenous lines should not be started unless the patient currently, or may soon need either fluid replenishment or medication administration
• If used to replenish fluids, a large bore IV (18G or more) should be started, hung with a 1000 mL bag of saline
• If saline is being started for medication administration maintain at TKVO, or consider using a saline lock instead of intravenous line
Lactated Ringers

- Lactated Ringer's is a sterile solution for fluid and electrolyte replenishment
- It restores fluid and electrolyte balances, produces diuresis, and acts as alkalizing agent (reduces acidity)
- Isotonic solution with blood and intended for intravenous administration
- Often used for fluid resuscitation after a blood loss due to trauma, surgery, or a burn injury
Dextrose 5% (D5W)

- Dextrose is a form of glucose (sugar).

- Dextrose 5% in water is injected into a vein through an IV to replace lost fluids and provide carbohydrates to the body.

- Dextrose 5% in water is sometimes used as a diluent (liquid) for preparing injectable medication in an IV bag.
What is it?

CARDIAC RHYTHM OF THE MONTH
ST Elevation
Cardiac Tamponade

- Pressure on the heart muscle which occurs when the pericardial space fills up with fluid faster than the pericardial sac can stretch
  - Slow onset – the pericardial sac can expand to contain a liter or more of fluid prior to tamponade occurring
  - Rapid onset – may occur after trauma or myocardial rupture – as little as 100 ml can cause tamponade
TOURNIQUET

“The use of ‘elevation’ and pressure on ‘pressure points’ is no longer recommended because of insufficient data supporting their effectiveness” (PHTLS, 7th Ed, 2011. p.115)
TOURNIQUET

Apply a tourniquet 2-3 inches above the site of uncontrolled bleeding

- Tight enough to stop bleeding
- Tight enough to eliminate the distal pulse associated with the injured extremity
- Document application time

- Stabbings
- Gunshot wounds
- Mass trauma involving partial or complete amputation
- Entrapment with associated mass bleeding / volume loss
- Mass casualty incidents
- Amputation or traumatic extremity injury with extensive bleeding
- Unable to control bleeding with pressure dressing
- Significant bleeding with the need for other interventions (CPR, etc…)
- Bleeding from multiple locations
- Impaled / foreign body with bleeding
- Total darkness
TOURNIQUET

• CAT Tourniquet | ParamedicTV
SMART TAG
ALS SKILL REVIEW
Impending death

Bar Code for Identification
<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
<th>Priority:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>DEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Transport Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Complaint:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Transportation**
### Patient Details

**Past Medical History**
- No Past History
- COPD or lung disorder
- CVA/Stroke
- Hypertension
- Unknown
- Heart Condition
- Cancer
- Diabetes
- Seizures
- Other

**Main Complaint:**

**Mechanism of Injury:**

**Name:**

**Address:**

**City/Zip:**

**Insurance:**

**Medications / Allergies:**

---

### Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>Verbal Response</th>
<th>Motor Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>Oriented</td>
<td>Obey Commands</td>
</tr>
<tr>
<td>To voice</td>
<td>Confused</td>
<td>Localizes</td>
</tr>
<tr>
<td>To pain</td>
<td>Inappropriate</td>
<td>Pain withdraws</td>
</tr>
<tr>
<td>None</td>
<td>Incomprehensible</td>
<td>Pain flexion</td>
</tr>
<tr>
<td></td>
<td>No response</td>
<td>Pain extension</td>
</tr>
</tbody>
</table>

**Glasgow Coma Scale Total:**

<table>
<thead>
<tr>
<th>Total Glasgow Coma Scale</th>
<th>Respiratory Rate</th>
<th>Systolic BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 - 15</td>
<td>10 - 29</td>
<td>90 or more</td>
</tr>
<tr>
<td>9 - 12</td>
<td>more than 29</td>
<td>76 - 89</td>
</tr>
<tr>
<td>6 - 8</td>
<td>6 - 9</td>
<td>50 - 75</td>
</tr>
<tr>
<td>4 - 5</td>
<td>1 - 5</td>
<td>1 - 49</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total:** 12 = Minimal 3

11 = Delayed 2

10 or less = Immediate 1