PRE-HOSPITAL HIGH RISK CRITERIA

- **Blunt injury**
  - Significant injury; physiologic compromise

- **Penetrating injuries**
  - Thorax, abdomen, head and neck

- **High risk burns**: > 10% second degree
  - > 5% third degree

Destination: specialized pediatric burn unit after stabilization on-site/initial facility
SCENE IMMOBILIZATION
TRAUMA
PRIMARY SURVEY

A - Airway patency
B - Breathing and ventilation
C - Circulation with hemorrhage control
D - Disability: Mental status
E - Exposure: Completely undress patient
A – AIRWAY
(PRIMARY SURVEY)

- Midline positioning
- Do jaw thrust to open airway and protect c-spine
- Head tilt and chin lift are contraindicated
- Cervical spine immobilization
CHILDREN AIRWAY: PRACTICAL CONSIDERATIONS

- Prominent occiput
- More secretions
- Relatively larger tongue
- Larger adenoids
- Softer cartilage
- Epiglottis omega-shaped in anterior position
- Subglottic region cone-shaped
Airway assessment in children

- Stable airway
- If it is possible to keep the airway open
  - Airway opening maneuvers
  - Devices: oral or nasal airway
- If it is NOT possible to keep the airway open
  - Bag-Valve-Mask (BVM)
  - Endotracheal tube (rapid sequence intubation)
  - Cricothyrotomy
B - BREATHING

- Assess minute ventilation
- Assess chest expansion
- Breath sounds
- Heart sounds
- Chest percussion
BAG-VALVE-MASK VENTILATION

- Midline position
- "Open" airway
- Proper sized mask
- Proper sized bag
C - CIRCULATION

- Assess pulse, end organ perfusion (capillary refill, temperature/appearance of extremities, CNS) and blood pressure
- Control external hemorrhage using direct pressure to wounds

REMEMBER: Hypotension in children will not be evident until 25% to 30% of blood volume is lost. Begin aggressive fluid resuscitation immediately
D - DISABILITY

- Determine mental status with rapid assessment
- Is the child responsive?
- Pupil and motor exam
- AVPN evaluation: (Alert, responsive to Voice, responsive to Pain, Nonresponsive)
E - EXPOSURE

- Completely undress the patient
- Perform a complete examination
- Don’t let the patient get cold
- Glucose, lab tests
Polytrauma: Secondary survey

- Vital signs assessment
- Head-to-toe examination
- Laboratory and radiologic studies
- Splinting fractures and applying wound dressings
# Shock Related to Trauma

<table>
<thead>
<tr>
<th>Classify</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemic</td>
<td>• Hemorrhage</td>
</tr>
<tr>
<td></td>
<td>• Burns</td>
</tr>
<tr>
<td>Cardiogenic</td>
<td>• Myocardial contusion</td>
</tr>
<tr>
<td>Obstructive</td>
<td>• Massive hemothorax</td>
</tr>
<tr>
<td></td>
<td>• Tension pneumothorax</td>
</tr>
<tr>
<td></td>
<td>• Tamponade</td>
</tr>
<tr>
<td>Distributive</td>
<td>• Spinal cord injury</td>
</tr>
</tbody>
</table>
SHOCK TREATMENT

• Control external bleeding

• Líquids:
  – Cristaloids 20 ml/kg
  – NaCl 3% 10 ml/kg
  – Coloids 5-10 ml/kg
  – Red Cells desplasmatizados 10 ml/kg
  – Blood 20 ml/kg

• If still unstable → surgery
# Pediatric Trauma Score

<table>
<thead>
<tr>
<th>Category</th>
<th>+2</th>
<th>+1</th>
<th>-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size/weight</td>
<td>&gt;20 kg</td>
<td>10-20 kg</td>
<td>&lt;10 kg</td>
</tr>
<tr>
<td>Airway</td>
<td>Normal</td>
<td>Stable</td>
<td>Unstable</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>&gt;90 mm Hg</td>
<td>50-90 mm Hg</td>
<td>&lt;50 mm Hg</td>
</tr>
<tr>
<td>CNS</td>
<td>Awake</td>
<td>Obtunded</td>
<td>Comatose</td>
</tr>
<tr>
<td>Open wound</td>
<td>None</td>
<td>Minor</td>
<td>Major</td>
</tr>
<tr>
<td>Fractures</td>
<td>None</td>
<td>Closed</td>
<td>Open or Multiple</td>
</tr>
</tbody>
</table>
ASSESSMENT OF THE CERVICAL SPINE

Severe or high-risk mechanism of injury

Altered level of consciousness, less than 5 years old

Neurologic abnormality at any time after injury

Complaints of neck pain

Cervical spine tenderness

Limited or painful neck motion

Consider clinical evaluation without radiographs

Immobilize
Radiographic evaluation
MANAGEMENT OF CERVICAL SPINE INJURIES

• The main goal is to avoid secondary injuries

Total immobilization!!!

And hospital referral
TRAUMATIC BRAIN / HEAD INJURY

• **Primary injury**
  - Blunt or penetrating
  - Concussion, cerebral contusion, diffuse axonal injury, intracranial hemorrhage

ASSESSMENT: AVPN

• **Secondary injury**
  - Result of metabolic events
    - Cerebral ischemia, brain edema
CLINICAL ASSESSMENT OF SEVERITY
TRAUMATIC BRAIN INJURY (TBI)

- Vital signs
- Level of consciousness (AVPN)
- Muscular strength/ tone
- Cranial nerve exam
**TBI: MANAGEMENT**

- **Airway control**: Keep O$_2$ saturation > 95%
  - Intubate if GCS \( \leq 8 \) or if impossible to keep a stable airway

- **Breathing**: Keep PCO$_2$ 35-40 mm Hg, unless there are clinical signs of cerebral hernia or neurological deterioration warranting a transitorily lower PCO$_2$

- **Circulation**: Start IV access
  - Avoid hypotension: Use vasopressors to keep blood pressure once intravascular volume is recovered.
MANAGEMENT
HEAD INJURY

• Maintain head in neutral position, use rigid cervical collar

• Administer short-term sedation and analgesia
  – Midazolam (0.1 mg/kg) and Fentanyl (1-2 mcg/kg)

• If there are clinical signs of ICP
  – Sedation, Mannitol (0.5-1 gm/kg), and hyperventilation (to PCO₂ of 25-30) until clinical signs improve
  – Consider elevating the head of the bed 30 degrees

• Consider a foley and nasogastric tube
THORACIC INJURIES

- Pulmonary contusion/laceration (53%)
- Pneumothorax/hemothorax (38%)
- Rib/sternal fractures (36%)
- Other injuries
  - Cardiac (5%)
  - Diaphragm (2%)
  - Major blood vessels (1%)
PULMONARY CONTUSION

• Most frequent injury

• ¡Usually undetected!

• Pulmonary hematoma:
  – Blood and fluid in the alveoli

• Hypoxemia (↓PaO₂), hypercarbia (↑Pa CO₂)

• Give oxygen 100%
PNEUMOTHORAX

- Simple vs Tension
  - Tracheal shift

- Air into pleural space
  - Loss of negative pressure
  - Collapse of lung

- Open pneumothorax
  - Occlusive dressing
HEMOTHORAX

• Blood accumulates in the pleural space
  – Lung compression

• Type of injury
  – Large pulmonary injury
  – Large vessels injury

• Hypovolemia
PERICARDIAL TAMPONADE

- Beck’s triad: narrow pulse pressure, neck vein distention, muffled heart tones
- Fluid in the pericardial sac
- Compresses heart and ↓ cardiac output
- Impairs venous return
- Arrhythmias
- Pericardiocentesis
ABDOMINAL INJURIES

• Third leading cause of death in children, after head and thoracic injuries

• Silent hypovolemia

• Solid organ vs hollow viscous
  – Spleen most common

• Unique features of children’s abdomen
BONE AND EXTREMITY INJURIES
INITIAL MANAGEMENT

• Splint, splint, splint…
  – Clean and cover wound
  – Different types of splints
  – Splint distally and proximally to joint

• Pain management
FRACTURES THAT NEED ORTHOPEDIC REFERRAL

- Fractures that affect joints or growth plates
- Fractures around the elbow or knee
- Significant soft tissue swelling (compartment concern)
- Fractures associated with an open wound
- Fractures with signs of vascular or nerve disruption
OPEN FRACTURES

• Implies significant force
  - Look for other injuries

• Increased complications
  - Infections, nerve impingement

• Management
  - Clean, cover, do not suture
  - IV antibiotics, keep NPO, and immobilize

• Will need OR surgical debridement
PELVIC FRACTURES

• Associated with high energy accidents
  – Blood loss can be significant

• Pelvic ring fracture: single fracture usually stable

• Multiple fractures: unstable
  – Genitourinary injuries
  – Abdominal injuries
  – Vascular abnormalities (pelvic vein section)
BURN CLASSIFICATION

- **Minor**
  - < 10% body surface area (BSA) second-degree, < 1% third-degree

- **Moderate**
  - 10-30% BSA second-degree, 1-10% third-degree
  - No hands, feet or genitalia

- **Critical**
  - Inhalational injury
  - > 30% BSA second-degree, > 10-20% third-degree
  - Complicating fracture
  - Extensive electric or chemical burns
BURNS MANAGEMENT

- Dilute and wash away offending chemicals
- Remove clothing
- Cover burns with clean dressing or sheet
  - Prevents contamination, decreases pain
- Keep warm
- Give pain medications
- **Replace fluids** – Rule of Nines…
  - >10% BSA in children
  - IV vs. oral (may attempt up to 25%BSA)
RULE OF NINES

**Figura 6-19** Los diagramas anatómicos modificados de niños de diferentes edades suministran una aproximación de la superficie corporal afectada para calcular la extensión de la quemadura en (A) lactantes, (B) niños y (C) adolescentes.
Surface of the palm

Figura 6-20 La palma representa aproximadamente el 1% de la superficie corporal.
INHALATION INJURY

The patient faints...

- Fire or smoke present in a closed area
- Evidence of respiratory distress or upper airway obstruction
- Soot around the mouth or nose
- Singed eyebrows, eyelashes
- Burns around the face or neck

Upper airway edema is commonly seen during the first 6 to 24 hours after injury

Management:
- Remove the patient from the gas and allow him to breathe air or oxygen
- Keep airway open: Early obstruction of the upper airway is managed with intubation
- Oxygen 100%
CIRCUMFERENTIAL BURNS
¿ESCHARECTOMY?

- Pain and color: unreliable
- Heat in extremity: good perfusion
- Remove tight clothing
- Elevate burned extremity
- Doppler pulse

- Indication of escharectomy: full thickness, circumferential burns in limbs and thorax
EXPLOSIONS AND BLAST INJURIES

- Bombs and explosives cause unique injuries
- Among survivors:
  - Injuries include penetrating and blunt trauma
  - Blast lung is the most common lethal injury
- Half of all initial casualties will seek medical care over a one-hour period

Initial patients: Less injured
Later patients: More injured

- Upside down triage triangle
BLAST INJURIES

- **Primary mechanism:** (Over-pressurization blast wave)

- **Secondary mechanism:** (Flying debris)

- **Tertiary mechanism:** (Blast wind throwing the individual)

**Miscellaneous:** Burns, crush injuries, respiratory (dust/toxins)
“BLAST LUNG”

- Over-pressurization wave
- Most common fatal injury
- Can be found 48 hours later
- Triad: apnea, bradycardia, hypotension
- Suspect if: dyspnea, cough, hemoptysis, CP, hypoxia
- CXR: butterfly pattern
BLAST BRAIN INJURIES

• Severe head injury is a leading cause of death
  – Subarachnoid, subdural hemorrhage most common (fatalities)

• Mild TBI’s are common, but may be occult

• Signs and symptoms may be subtle
  – Memory problems, headaches, dizziness, uneven gait, blurred vision, irritability, confusion…
EXPLOSIONS
EAR INJURIES

- They can be easily omitted
- Most common: perforation of tympanic membrane
- Rupture of the ossicular chain (33%)
- Sensorineural disorder in the internal ear
BLAST ABDOMINAL INJURY

• GI gas-containing structures
• Petechiae, hemorrhages, large intramural hematomas
  – Severe overpressure leads to intestinal laceration, bowel perforation
• Colon: most common site of injury
• Ruptures may occur acutely several days after stretching, ischemia, and subsequent weakening of the bowel wall
• Tension pneumoperitoneum

Ann Emerg Med 2001
CRUSH SYNDROME
CAUSES OF DEATH

• Highly severe hypovolemic shock
• Metabolic and electrolitic disorders: Hyperkalemia, Hypocalcemia, Metabolic acidosis
• Acute myoglobinuric renal failure
• Compartment syndrome

Treatment: massive volume replacement and alkaline solute (mannitol) diuresis

Detection of metabolic abnormalities
COMPARTMENT SYNDROME

• ↑ Intracompartment pressure $\rightarrow$ ischemia $\rightarrow$ muscle necrosis and nerve palsies

• Anterior compartment of lower leg is the most frequent

• Trauma does not have to be severe
  - Severe trauma interrupts the compartment

• ↑ Pain, especially with passive extension

• Absent Pulse, Paresthesia, Pallor, Paralysis/Paresis

• Direct measurement of compartment pressure
Thank you!