The Committee on Trauma Presents

TEAM

Trauma Evaluation and Management:
Early Care of the Injured Patient

Program for Medical Students and Multidisciplinary Team Members based on the ATLS® Course for Doctors
Goals/ Principles of Trauma Care

• Rapid, accurate, and physiologic assessment
• Resuscitate, stabilize, and monitor by priority
• Prepare for transfer to definitive care
• Teamwork for optimal, safe patient care
Objectives

• Describe fundamental principles of initial assessment and management

• Identify correct sequence of management priorities

• Describe appropriate techniques of resuscitation
Objectives

• Recognize value of patient’s history
• Understand importance of injury mechanism
• Identify concepts of teamwork in caring for injured patient
The Need for Early TEAM

• Leading cause of death in ages 1 through 44
• Disabilities exceed deaths by ratio of 3:1
• Trauma-related costs > $400 billion per year
• Lack of public awareness for injury prevention
Injury Prevention

- Analyze injury data
- Build local coalitions
- Communicate the problem
- Develop prevention activities
- Evaluate the interventions
Trimodal Death Distribution

The graph illustrates the trimodal death distribution over time after injury. It shows three distinct peaks:

- **Immediate deaths**: Highest number of deaths occurring within the first hour after injury.
- **Early deaths**: Highest number of deaths occurring between 1 to 2 hours after injury.
- **Late deaths**: Highest number of deaths occurring between 2 to 5 weeks after injury.

The distribution is represented by bars and a line graph, with the horizontal axis showing time after injury in hours and weeks, and the vertical axis showing the number of deaths.
TEAM Principles

• Treat greatest threat to life first
• Definitive diagnosis less important
• Physiologic approach
• Time is of the essence
• Do no further harm
• Teamwork required for TEAM to succeed
TEAM Approach

A. Airway with c-spine protection
B. Breathing/ventilation/oxygenation
C. Circulation: Stop the bleeding!
D. Disability (neuro status)
E. Expose/Environment/body temp
TEAM Sequence

Definitive Care

Rapid primary survey
ABCDE + Adjuncts

Safe transfer

Detailed secondary survey/ reevaluation
Head-to-toe + Adjuncts
TEAM Sequence and Teamwork

- Simultaneous primary survey and resuscitation of vital functions
- Simultaneous secondary survey and reevaluation of vital functions
Together Everyone Achieves More
Pre-hospital Preparation

- Closest appropriate facility
- Transport guidelines/ protocols
- On-line medical direction
- Mobilization of resources
- Periodic review of care
In-hospital Preparation

- Preplanning essential
- Team approach
- Trained personnel
- Proper equipment
- Lab / x-ray capabilities
- Standard precautions
- Transfer agreements
- QI Program
Standard Precautions

- Cap
- Gown
- Gloves
- Mask
- Shoe covers
- Goggles/ face shield
Triage

• Sorting of patients according to
  - ABCDE’s
  - Available resources
  - Other factors, e.g., salvageability
Primary Survey

Priorities are the same for all!
Primary Survey

A. Airway / C-spine protection
B. Breathing / Life-threatening chest injury
C. Circulation / Stop the bleeding
D. Disability / Intracranial mass lesion
E. Exposure / Environment/ Body temp
Special Considerations: Children

• Leading cause of death
• Immature, anatomic/ mechanical features
• Vigorous physiologic response
• Limited physiologic reserve
• Outcome depends on early aggressive care
Special Considerations: Children

- Size, dosage, equipment, surface area, and psychology
- Airway: Larynx anterior and cephalad, short tracheal length
- Breathing: Chest wall pliability, mediastinal mobility
Special Considerations: Children

• Circulation: Vascular access, fluid volume, vital signs, and urinary output

• Neurologic: Vomiting, seizures, and diffuse brain injury

• Musculoskeletal: Immature skeleton, fracture patterns
Special Considerations: Pregnancy

- Anatomic/physiologic changes modify response to injury
- Need for fetal assessment
- 1st Priority: Maternal resuscitation
- Outcome depends on early, aggressive care
Special Considerations: Pregnancy

- Gestation and position of uterus
- Physiologic anemia
- $\downarrow P_{co_2}$
- $\downarrow$ Gastric emptying
- Supine hypotension
- Isoimmunization
- Sensitivity of fetus
Special Considerations: Elders

- 5th leading cause of death
- Diminished physiologic reserve and response
- Co-morbidities:
  Diseases/ Medications
- Outcome depends on early, aggressive care
Primary Survey: Airway

- Assess for airway patency
- Snoring
- Gurgling
- Stridor
- Rocking chest wall motions
- Maxillofacial trauma/ laryngeal injury
Resuscitation: Patent Airway

- Chin lift/ Modified jaw thrust
- Look, listen, feel
- Remove particulate matter
- Definitive airway as necessary
- Reassess frequently

C-Spine Injury
Resuscitation: Assess Breathing

- Chest rise and symmetry
- Air entry
- Rate/ Effort
- Color/ Sensorium

Tension / open pneumothorax
Resuscitation: Breathing

- Administer supplemental oxygen
- Ventilate as needed
- Tension pneumothorax: Needle decompression
- Open pneumothorax: Occlusive dressing
- Reassess frequently
Primary Survey: Circulation

- Children
- Elderly
- Athletes
- Pregnancy
- Medications
Primary Survey: Circulation

- Non hemorrhagic shock
  - Cardiac tamponade
  - Tension pneumothorax
  - Neurogenic
  - Septic (late)
Primary Survey: Circulation

- Assess organ perfusion
  - Level of consciousness
  - Skin color
  - Pulse rate and character
Primary Survey: Circulation

Assess Organ Perfusion

1. Tachycardia
2. Vasoconstriction
2. ↓ Cardiac output
2. Narrow pulse pressure
3. ↓ MAP
3. ↓ Blood flow
Primary Survey: Circulation

- Children
- Elderly
- Athletes
- Pregnancy
- Medications
Resuscitation: Circulation

Bleeding?

Find it!

- Direct pressure
- Operation
- Avoid blind clamping
Resuscitation: Circulation

- Obtain venous access
- Restore circulating volume
  - Ringer’s lactate, 1-2 L
  - PRBCs if transient response or no response
- Reassess frequently
# Resuscitation: Circulation

## Table 1

Estimated Fluid and Blood Losses\(^1\)
Based on Patient’s Initial Presentation

<table>
<thead>
<tr>
<th></th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>Up to 750</td>
<td>750–1500</td>
<td>1500–2000</td>
<td>&gt;2000</td>
</tr>
<tr>
<td>Blood loss (% blood volume)</td>
<td>Up to 15%</td>
<td>15%–30%</td>
<td>30%–40%</td>
<td>&gt;40%</td>
</tr>
<tr>
<td>Heart rate</td>
<td>&lt;100</td>
<td>&gt;100</td>
<td>&gt;120</td>
<td>&gt;140</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Pulse pressure (mm Hg)</td>
<td>Normal</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>14–20</td>
<td>20–30</td>
<td>30–40</td>
<td>&gt;35</td>
</tr>
<tr>
<td>Urine output (mL/hr)</td>
<td>&gt;30</td>
<td>20–30</td>
<td>5–15</td>
<td>Negligible</td>
</tr>
<tr>
<td>CNS mental status</td>
<td>Slightly anxious</td>
<td>Mildly anxious</td>
<td>Anxious, confused</td>
<td>Confused, lethargic</td>
</tr>
<tr>
<td>Fluid replacement (3:1 rule)</td>
<td>Crystalloid</td>
<td>Crystalloid</td>
<td>Crystalloid and blood</td>
<td>Crystalloid and blood</td>
</tr>
</tbody>
</table>

\(^1\)For a 70-kg man.
Resuscitation: Circulation

Consider

- Tension pneumothorax: Needle decompression and tube thoracostomy
- Massive hemothorax: Volume resuscitation and tube thoracostomy
- Cardiac tamponade: Pericardiocentesis and direct operative repair
Primary Survey: Disability

- Baseline neurologic evaluation
  - Pupillary response
  - Neurosurgical consult as indicated

Observe for neurologic deterioration
Primary Survey: GCS Score

- Eye opening: Range 1-4
- BEST Motor response: Range 1-6
- Verbal response: Range 1-5
- Score = (E + M + V)
- Best score = 15
- Worst score = 3
Primary Survey: Disability

![Diagram showing intracranial pressure (ICP) vs. volume of mass, with key milestones: Compensation, Point of Decompensation, and Herniation.](image-url)
Primary Survey: Exposure

- Completely undress the patient
- Remove helmet if present
- Look for visible / palpable injuries
- Log roll, protect spine

Prevent hypothermia
Resuscitation: Overview

- If in doubt, establish definitive airway
- Oxygen for all trauma patients
- Chest tube may be definitive for chest injury
- Stop the bleeding!
- 2 large-caliber IVs
- Prevent hypothermia
Adjuncts: Urinary Catheter

- Blood?
- Decompress bladder
- Monitor urinary output

- Blood at meatus
- Perineal ecchymosis/hematoma
- High-riding prostate
Adjuncts: Gastric Catheter

- Blood or bile?
- Decompress stomach

- CSF rhinorrhea / otorrhea
- Periorbital ecchymosis
- Mid-face instability
- Hemotympanum
Primary Survey: Adjuncts

Monitoring
• Vital signs
• ABGs
• ECG
• Pulse oximetry
• End-tidal CO$_2$

Diagnostic Tools
• Chest / pelvis x-ray
• C-spine x-rays when appropriate
• FAST
• DPL

Consider need for transfer
Secondary Survey: Start After

- Primary survey completed
- Resuscitation in process
- ABCDEs reassessed
- Vital functions returning to normal
Secondary Survey: Key Parts

- AMPLE History
- Complete physical exam: Head-to-toe
- Complete neurologic exam
- Special diagnostic tests
- Reevaluation
Secondary Survey: History

A  Allergies
M  Medications
P  Past illnesses / Pregnancy
L  Last meal
E  Events / Environment
Secondary Survey

Mechanism of Injury

Anatomy

Pattern of Injury

Physiology

Mechanism of Injury
Burn Injury

- Inhalation injury: Intubate and administer 100% oxygen
- Administer 2 – 4 mL / kg / % BSA burn in 24 hours (+ maintenance in children)
- Monitor urinary output
- Expose and prevent hypothermia
- Chemical burns: Brush and irrigate
Burn Injury

Rule of Nines

Infant

Adult
Cold Injury

- **Frostbite**: Rewarm with moist heat (40°C); wait for demarcation

- **Hypothermia**: Passive or active rewarming

- **Monitor**: Not dead until warm and dead
Secondary Survey: Head

- Complete neurologic exam
- GCS Score determination
- Comprehensive eye / ear exam

- Unconscious patient
- Periorbital edema
- Occluded auditory canal
Secondary Survey: Maxillofacial

- Bony crepitus / instability
- Palpable deformity
- Comprehensive oral / dental exams

- Potential airway obstruction
- Cribriform plate fracture
- Frequently missed injury
Secondary Survey: C-spine

• Palpate for tenderness
• Complete motor / sensory exams
• Reflexes
• C-spine imaging

- Injury above clavicles
- Altered LOC
- Other severe, painful injury
Secondary Survey: Neck

- Blunt vs penetrating
- Airway obstruction, hoarseness
- Crepitus, hematoma, stridor, bruit

- Delayed symptoms / signs
- Progressive airway obstruction
- Occult injuries
Secondary Survey: Chest

- Inspect, auscultate, palpate, percuss
- Reevaluate frequently
- Chest x-rays

- Missed injury
- ↑ Chest tube drainage
Secondary Survey: Abdomen

- Inspect, auscultate, palpate, and percuss
- Reevaluate frequently
- Special studies: FAST, DPL, CT

- Hollow viscus and retroperitoneal injuries
- Excessive pelvic manipulation
<table>
<thead>
<tr>
<th>Location</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perineum</td>
<td>Contusions, hematomas, lacerations, urethral blood</td>
</tr>
<tr>
<td>Rectum</td>
<td>Sphincter tone, high-riding prostate, pelvic fracture, rectal wall integrity, blood</td>
</tr>
<tr>
<td>Vagina</td>
<td>Blood, lacerations</td>
</tr>
<tr>
<td></td>
<td><strong>CAUTION!</strong> Pregnancy</td>
</tr>
</tbody>
</table>
Secondary Survey: Musculoskeletal

- Potential blood loss
- Limb or life threat (primary survey)
- Missed fractures
- Soft-tissue or ligamentous injury
Secondary Survey: Musculoskeletal

- Occult compartment syndrome
  (especially with altered LOC / hypotension)

- Examine patient’s back
Secondary Survey: Pelvis

- Pain on palpation
- Symphysis width ↑
- Leg length unequal
- Instability
- Pelvic x-rays
Pelvic Fracture

- Major source of hemorrhage
- Volume resuscitation
- Reduce pelvic volume
- External fixator
- Angiography / embolization
Secondary Survey: CNS

• Frequent reevaluation

• Prevent secondary brain injury

• Imaging as indicated

• Early neurosurgical consultation
Secondary Survey: Spine

- Complete motor and sensory exams
- Imaging as indicated
- Maintain inline immobilization
- Early neurosurgical consultation
Secondary Survey: Neurologic

- Incomplete immobilization
- Subtle ↑ in ICP with manipulation
- Rapid deterioration
Secondary Survey: Adjuncts

- Blood tests
- Urinalysis
- X-rays
- CT
- Urography
- Angiography

- Ultrasonography
- Echocardiography
- Bronchoscopy
- Esophagoscopy

Do not delay transfer!
Reevaluation: Missed Injuries

- High index of suspicion
- Frequent reevaluation
- Continuous monitoring
- Rapidly recognize patient deterioration
Pain Management

• Relieve pain and anxiety as appropriate

• Administer intravenously

• Careful patient monitoring is essential
Safe Transfer

When patient’s needs exceed institutional resources…

- Use time before transfer for resuscitation
- Do not delay transfer for diagnostic tests
- Physician- to – physician communication
Transfer to Definitive Care

- Local facility
- Transfer agreements
- Local resources
- Trauma center
- Specialty center
Emergency Preparedness

- Simple Plan
- Command structure
- Disaster triage scheme
- Traffic control system
Summary

Definitive care

Safe transfer

Continuous Reevaluation

Primary Survey Adjuncts

Resuscitation

Secondary Survey Adjuncts
Summary

- One, safe way
- Do no further harm
- Treat greatest threat to life first
- Teamwork