Anesthesia for multiple trauma: from the field to the OR

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Course outline

- philosophy of trauma care
- ATLS principles
- pre-hospital phase
- emergency department phase
- operating room phase
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Philosophy of trauma care

- Trauma is a surgical disease
- Trauma requires a team approach at all phases
  - Pre-hospital
  - Emergency department
  - Operating room
  - Intensive care unit
Philosophy of trauma care

- trauma is a dynamic process
  - TEMPORAL EVOLUTION
    - primary lesion(s)
  - "GEOGRAPHIC" EVOLUTION
    - site → emergency department → OR → ICU
    - patient factors
    - response to therapeutic interventions

⇒ requires constant re-evaluation
Trimodal death distribution

Number of deaths

Immediate deaths

Early deaths

Late deaths

0 2 4 1 3 5
(hours) (weeks)

0 2 4 1 3 5
(hours) (weeks)
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ATLS principles

- Advanced Trauma Life Support®
- Trauma kills in reproducible time-frames
- "ABCDE" approach
  - Priorities established according to risk
  - Emphasize first hour after injury
  - SYSTEMATIC approach to trauma victim
ATLS sequence of care

- primary survey
- resuscitation
- secondary survey
- continuing monitoring and re-evaluation
- definitive care
The "ABCs" of ATLS

- **Airway** (with cervical-spine control)
- **Breathing**
- **Circulation** (with control of hemorrhage)
- **Disability**
- **Exposure** (with temperature control)
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Goals of pre-hospital care

- **AVOID SECONDARY VICTIMS**
- minimize secondary lesions
  - secure airway, provide $O_2$, ensure ventilation
- packaging
- provide necessary analgesia
- prepare receiving hospital

provide MEDICAL care
Limitations of pre-hospital care

- "scoop and run" vs. "stay and play"
- physiologic normality is NOT goal
- example: penetrating thoraco-abdominal trauma
  - increased mortality with fluid therapy
  - increased ICU complications
  - concept of "permissive hypotension"
Practical aspects

• spinal stabilization
  – rigid cervical collar, KED®, vacuum mattress, spine board

• analgesia / sedation
  – potent opioids, titrated to effect
  – low-dose ketamine
  – midazolam for amnesia, anxiolysis

• anesthesia
  – indications, choice of agents
  – preparation (!!!)
Prepare / choose receiving hospital

- closest *appropriate* facility (burns, cardio-thoracic trauma, neurosurgery, etc)
- transmit necessary information:
  - time of injury
  - related events
  - patient history
  - mechanism of injury
  - initial status and response to treatment
  - estimated time of arrival
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Primary survey

- **AIRWAY (with C-spine control)**
  - identify obstruction (inspect, palpate)
  - maneuvers: jaw thrust > chin lift, suction
  - devices: oral airway, nasopharyngeal airway
  - definitive airway control
- **cervical-spine protection**
  - neutral position, alignment of head-neck-trunk
  - immobilization
Resuscitation: airway control

• definitive control: endotracheal intubation

• indications for intubation
  – obstruction unresponsive to maneuvers
  – $S_pO_2 < 90\%$ on supplemental oxygen
  – shock (e.g. $Bp_{syst} < 90$ mm Hg)
  – head injury / unconsciousness (GCS $\leq 8$)
  – anticipated surgery with multiple injuries
  – agitation rendering care difficult
Intubation technique: trauma patients
C-spine protection

- **MANUAL** immobilization when collar off
- **ASSUME** c-spine injury with trauma
  - depressed level of consciousness
  - blunt injury (esp. above clavicle)
- spine not cleared until:
  - full, adequate neurologic exam
  - **AND** full, adequate radiology studies (5 views !!!)
Primary survey

- BREATHING
  - inspection, palpation, percussion, auscultation
    - tension pneumothorax
    - flail chest (pulmonary contusion)
    - open pneumothorax
    - massive hemothorax
Resuscitation: breathing

- 100% O₂ to ALL patients
- non-rebreathing mask with reservoir
- 12-15 l/m flow
Primary survey

• **CIRCULATION (with hemorrhage control)**
  – predominant cause of treatable deaths
  – *hypotension = hypovolemia until proven otherwise*
  – rapid assessment of hemodynamic status
    • **LEVEL OF CONSCIOUSNESS**
    • **PULSE** (central and peripheral, bilaterally)
    • skin color, capillary refill, temperature
  – identify and control external hemorrhage
# Grades of shock

<table>
<thead>
<tr>
<th>Class</th>
<th>Blood loss</th>
<th>Pulse &gt; 100</th>
<th>↓ Syst-diast</th>
<th>↓ BP</th>
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<tbody>
<tr>
<td>I</td>
<td>( \leq 750 \ (\leq 15%) )</td>
<td>( + )</td>
<td>( + )</td>
<td>( + )</td>
</tr>
<tr>
<td>II</td>
<td>( 750 \leq 1500 ) (15 ( \leq 30% ))</td>
<td>( ++ )</td>
<td>( + )</td>
<td>( ++ )</td>
</tr>
<tr>
<td>III</td>
<td>( 1500 \leq 2000 ) (30 ( \leq 40% ))</td>
<td>( +++ )</td>
<td>( +++ )</td>
<td>( +++ )</td>
</tr>
<tr>
<td>IV</td>
<td>( &gt; 2000 ) (&gt; 40%)</td>
<td>( ++++ )</td>
<td>( ++++ )</td>
<td>( ++++ )</td>
</tr>
</tbody>
</table>
Resuscitation: circulation

• ≥ 2 large bore peripheral venous catheters
  – at least 16 gauge
• consider bi-caval placement
• remember external jugular, femoral veins
• adult: cutdowns
• children: interosseous
• draw labs: heme, coag, T&X, tox, β-HCG
Resuscitation: fluid therapy

• hypotensive: **BLUNT** trauma
  – adult: up to 2 liters *warmed* lactated Ringer's
  – child: up to 2 x 20 ml/kg *warmed* lactated Ringer's
  – inadequate response: transfuse; consider O.R., other diagnoses

• hypotensive: **PENETRATING THORACO-ABDOMINAL**
  – airway, 100% O₂
  – venous access
  – tolerate $Bp_{syst} \geq 70$ mm Hg
Primary survey

- **DISABILITY (neurological evaluation)**
  - pupils: symmetry, reactions
  - GCS (Glasgow Coma Score)
    - eye opening
    - verbal response
    - motor response
Primary survey

- **EXPOSURE (with environmental control)**
  - fully undress victim
  - MAINTAIN CORE TEMPERATURE
    - warm blankets
    - warmed fluids
    - warm environment
Intra-hospital transfers / transport

• pre-arrival preparation
• sufficient help
  – anesthesia personnel
  – nursing personnel
• sufficient supplies
  – (warmed) fluids
  – drugs
  – oxygen
• sufficient communication
• proper monitoring
• **MAINTAIN NORMOTHERMIA**
Radiology: unstable patient

• 3 standard X-rays
  – lateral cervical spine (include C7-T1 interspace)
  – AP chest
  – AP pelvis
• abdominal / cardiac / thoracic ultrasound
• immediate surgery?
Radiology: stabilized patient

- stabilized by SMUR or in ER
- intubated / sedated
- 3 standard X-rays
- "body - scan" (+ spiral scan cervical spine)
- full radiological imaging (spine *in toto* + sites of suspected bony injury)
Radiology: stable patient

- full standard imaging (include spine *in toto*)
- body scan (even without obvious lesions)
  - pedestrian vs. car
  - fall > 6 meters
  - frontal collision
  - ejected from car OR car vs. motorcycle
  - death OR serious injury in same vehicle
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Rapid "pre-anesthetic assessment"

- Allergies
- Medications
- Past illnesses
- Last meal
- Events related to the injury
Operating room: practical aspects

• re-verify ABCs, organize lines, take report
• ALWAYS full stomach
• often difficult intubations
  – maxillo-facial trauma
  – secretions / blood / vomitus
• conflicting priorities common
  – intracranial hypertension + systemic hypotension
  – agitated patient with difficult airway
Anesthetic technique: suggestions

• severe shock
  – 100% O₂
  – muscle relaxant
  – analgesic as tolerated (titrated doses opioid)
  – THEN amnesic as tolerated (e.g., BZD, low dose volatile agent)
  – THEN anesthesia as tolerated
Anesthetic technique: suggestions

- mild - moderate hypotension
  - 100% O₂
  - etomidate OR ketamine
  - muscle relaxant
  - titrated opioid
  - low dose inhalation anesthetic (increase as tolerated)
  - OR low dose propofol infusion (increase as tolerated)
Anesthetic technique: suggestions

- isolated intracranial hypertension
  - 100% O₂
  - propofol (2-3 mg/kg) OR thiopental (3-5 mg/kg)
  - 0.1-0.25 µg/kg sufentanil or equivalent
  - 1.5 mg/kg lidocaine IV (90 sec before intubation)
  - avoid N₂O
  - continuous propofol infusion
  - (low dose inhalational agent)
Operating room: practical aspects

- major trauma cases
  - one anesthesia team leader
  - one anesthetist per infusion line
  - one "secretary"
  - keep infused fluid containers for post-op totals
- anticipate needs
  - transfusion requirements (esp. massive transfusion)
  - ICU bed
- AVOID HYPOTHERMIA
Operating room: surgical priorities

- torso injuries with hypotension (± simultaneous)
- intracranial mass lesions
- peripheral vascular injuries
- orthopedic injuries
- maxillo-facial trauma
QUESTIONS ?