Emergency Management and Decision Making for Complex Trauma

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Features of Evolution

- Grey substance
- Upright gait
- Thumb Opposition
- Pro/Supination
Task of the Upper Extremity

Positioning of the Hand in the Space
Goal of treatment

- Functional restoration of
  - The hand
  - The «motor chain» that positions the hand in space
Long Term Loss of Function

- Loss of soft tissue
- Neurological impairment
- Stiffness of joints
- Bone: defects, infection
1895: Discovery of X-rays.

2015: X-ray single criteria to base treatment decisions on.

Wilhelm Conrad Röntgen
*27.3.1845 +10.1.1923
“a fracture is a soft-tissue injury in which the bone happens to be broken…”
"a fracture is a soft-tissue injury in which the bone happens to be broken..."
Faculty Manual

Section 1: Course Coordinator and Director Manual

Section 2: Student Course Faculty Manual

Section 3: Instructor Course Manual

PowerPoint® Presentations and Slide Guides

Radiographs to Accompany Initial Assessment Skills Stations

Skills Video: Initial Assessment and Management

Skills Video: Assessment and Management of Shock
Polytrauma Pathophysiology

Trauma

- Bleeding
- Hypoxemia
- Soft Tissue Damage
- Direct Injury to Organs
- Mass Transfusion

Shock - Systemic Reaction („host defense response“)
Polytrauma: Definition

„Systemic Surgical Disease“:

Multiple injuries of high severity (ISS>17) introducing a Systemic Inflammatory Response that can eventually lead to failure of remote organs initially not injured.
Life before Limb
**ATLS**

| A | Airway maintenance w/ c-spine protection |
| B | Breathing and ventilation               |
| C | Circulation w/ hemorrhage control       |
| D | Disability: Neurologic status           |
| E | Exposure / Environmental control: completely undress the patient, prevent hypothermia |
Local Crush Injury

2nd priority in acute phase

Can promote systemic response
Mechanism of Injury

- Fall, MVA, Assault etc.
- Amount of energy involved
- Blunt vs. penetrating injury
Assessment of extremity

• Neurovascular status
• Loss of skin/soft tissue
• Fractures
Classification systems

- Open Fractures
- Closed Soft Tissue Injury
- Injury to nerves and vessels
- Injury to muscles and tendons
- «mangled extremity» scores
Open Fractures

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| I    | Skin wound less than 1 cm  
      | Clean  
      | Simple fracture pattern |
| II   | Skin wound more than 1 cm  
      | Soft-tissue damage not extensive  
      | No flaps or avulsions  
      | Simple fracture pattern |
| III  | High-energy injury involving extensive soft-tissue damage  
      | Or multifragmentary fracture, segmental fractures, or bone loss irrespective of the size of skin wound  
      | Or severe crush injuries  
      | Or vascular injury requiring repair  
<pre><code>  | Or severe contamination including farmyard injuries |
</code></pre>
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIA</td>
<td>Adequate soft-tissue cover of bone despite extensive soft-tissue damage</td>
</tr>
<tr>
<td>IIIB</td>
<td>Extensive soft-tissue injury with periosteal stripping and bone exposure</td>
</tr>
<tr>
<td></td>
<td>Major wound contamination</td>
</tr>
<tr>
<td>IIIC</td>
<td>Open fracture with arterial injury requiring repair</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grad</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grad I</td>
<td>0-2%</td>
</tr>
<tr>
<td>Grad II</td>
<td>2-7%</td>
</tr>
<tr>
<td>Grad III</td>
<td>A 7%</td>
</tr>
<tr>
<td></td>
<td>B 10-20%</td>
</tr>
<tr>
<td></td>
<td>C 25-50%</td>
</tr>
</tbody>
</table>

Gustilo, J Trauma 1984
Treatment Principles in Open Fx

Soft Tissue Débridement
  • Senior surgeon, radical, repeated

Early Definite Soft Tissue Cover
  • Day 2 or 3

Stabilisation of Bony Injury
  • Ex Fix, early exchange Internal Fixation

Antibiotics
  • Prophylactic for I/II°, Therapy for III°

Débridement

• Wound:
  • Thorough mechanical cleansing
  • Excise of avital tissues, repeate within 24h

• Bone:
  • Remove all devitalised small fragments
  • Keep large fragments, if important for stability
  • Keep fragments with soft tissue bridge
High Energy Injury

- Primary Bone Loss
- Comminution
- Open Injuries, Contamination
- Cartilage Damage
Plating and Bone Graft after 6 W

3M after bone graft
Open Fx:

*Infection* = main reason for

- Amputation
- Non-Union
- Poor functional and cosmetic results
## Open Fractures

<table>
<thead>
<tr>
<th>Extremity</th>
<th>n</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Extremity</td>
<td>64</td>
<td>2 (3%)</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>174</td>
<td>30 (17%)</td>
</tr>
</tbody>
</table>

Roth, J Trauma 1986
## Open Fractures

### Time factor

<table>
<thead>
<tr>
<th>Hrs p/Injury</th>
<th>bacteria/g tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>&lt;10^2</td>
</tr>
<tr>
<td>3</td>
<td>10^2 - 10^5</td>
</tr>
<tr>
<td>5.1</td>
<td>&gt;10^5</td>
</tr>
</tbody>
</table>

Robson et al., J Surg Res 1973
Open Fx: secondary contamination

- Wound *covered* w/sterile dressing immediately: 4.3%
- Wound *left open* until OR: 18.2%

Tscherne 1983
- Vascular reconstruction
- Repeated debridements
- Compartment!
- Ex Fix
- Nerve Reconstruction?
Reconstruction of axillary artery and vein

Temp. Stabilisation of Bone w/ Ex Fix
External fixator

Temporary cover with artificial skin
Penetrating Injury
Closed Soft Tissue Injury

direct vs. indirect
w/ or w/o fracture
Closed Soft Tissue Injury

<table>
<thead>
<tr>
<th>IC1</th>
<th>no or minimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC2</td>
<td>Bruising, Contusion</td>
</tr>
<tr>
<td>IC3</td>
<td>local Degloving</td>
</tr>
<tr>
<td>IC4</td>
<td>extensive Degloving; Compartment-Sy.</td>
</tr>
<tr>
<td>IC5</td>
<td>Skin Necrosis</td>
</tr>
</tbody>
</table>
Classification: Muscle / Tendon

MT1: none
MT2: 1 comp.
MT3: 2 comp.
MT4: Defect, Tear, Contusion
MT5: Crush, Comp.-Syndrome
Classification: neurovascular

- NV1: none
- NV2: Nerv isolated
- NV3: Vessel local
- NV4: Vessel segmental
- NV5: Amputation
Degloving
Diagnostik
Diagnostics?

X-Ray?
Sonography?
MRI?
Blood Tests?

Clinical Assessment!
Compartmentsyndrome
Compartmentsyndrom
Forearm
Summary

• Complex Trauma = High Energy
• Goal: Restore Function
• Life before Limb: ATLS
• Soft Tissue >>>> Bone
• Multidisciplinary Approach