POLYTRAUMA –
PRINCIPLES OF MANAGEMENT

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POLYTRAUMA IS

- Injury of at least two systems, when one of the injuries is life threatening OR
- Injury of one cavity + fracture of two long bones OR
- Injury of two cavities + fracture of one long bone

MAIN CONDITIONS OF „IMMEDIATE KILLING TRAUMA”

- Exsanguinating hemorrhage
- Intracranial haemathoma
- Pathological pressure in the thoracic cavity
DEATH AFTER POLYTRAUMA OCCURS IN TRIMODAL DISTRIBUTION

♦ **Immediate peak** – seconds after very severe injuries

♦ **Second peak** – minutes to hour from shock

♦ **Third peak** – involving sepsis and multiple organ failure, after several weeks

The **SECOND PEAK** is the time when timely and organized resuscitation and life-saving surgery can save most lives. This period is called **GOLDEN HOURS**.

**ASSESSMENT**

General assessment of an polytraumatized patient starts at the site of injury with the first aid according to **ABC’s scheme**

♦ **AIRWAY**

♦ **BREATHING**

♦ **CIRCULATION**
ASSESSMENT

The further evaluation of the polytraumatized patients continues with DE scheme

♦ Disability - the observation of neurological deficit and state of consciousness
♦ Exposure - of the patient to skin, looking for visible injuries and other signs of any potential injury

A - AIRWAY

PROTOCOL FOR AIRWAY MANAGEMENT

♦ The assurance of a secure airway is the first priority in the treatment of trauma victim
♦ Absolute control of the cervical spine must be maintained throughout efforts to establish an airway

METHODS OF AIRWAY CONTROL

A. Basic maneuver
♦ Physical clearing of the oropharynx
♦ Chin lift
♦ Jaw thrust (pull jaw forward)
♦ Do not extend or flex the neck
♦ Nasopharyngeal airway
♦ Oropharyngeal airway
METHODS OF AIRWAY CONTROL

B. Endotracheal intubation
   - Orotracheal intubation
     - apneic trauma patients
     - severe maxillofacial trauma
     - coagulopathy
   - Nasotracheal intubation
     - patient is still breathing

SURGICAL AIRWAY

- Cryothyrodotomy
- Needle cryothyrodotomy
- Tracheostomy - NOT the preferred approach for emergency airway management

B - BREATHING

- If the airway has been cleared
- Aerate the lungs artificially if not breathing spontaneously
**C - CIRCULATION**

**D - DISABILITY**

- Brief neurological exam using the AVPU-system:
  - **A** - Alert and oriented
  - **V** - Response to verbal stimuli
  - **P** - Response to painful stimuli
  - **U** - Unresponsive

- The patient papillary reaction should be noted

- Ability to move the arms and legs equally symmetrically
**NEUROLOGIC EXAM**

- Glasgow Coma Scale
- Evaluation of deep tendon reflexes
- Notation of abnormal reflexes

**E - EXPOSURE**

The patient should be completely undressed and all areas exposed for further examination from head to toes.

**EMERGENCY MANAGEMENT**

Emergency management at accident site includes:

- Prophylactic splinting
- Compressive dressing for external hemorrhage
- Careful transport
### STAGING (4 periods)

1. **Acute period**
   - **Emergency OP**
   - (Reanimation)
   - (Life-saving surgery)

2. **First (primary) period**
   - **Primary OP**
   - (24h)

3. **Second period**
   - **Sec. OP**
   - (2nd-10th day)

4. **Third period**
   - **Late sec. or tert. OP**

### ACUTE PERIOD RESUSCITATION (1-3 hours)

- **Assessment & Resuscitation**
- **Life-saving surgery**
  - Massive haemorrhage (first priority)
  - Intracranial bleeding (second priority)

### MASSIVE HAEMORRHAGE

- **Haematotherax**
  - (Chest tube, thoracotomy)
- **Widening of mediastinum**
- **Massive bleeding in the peritoneal cavity** (Immediate laparotomy)
- **Massive bleeding from the pelvis**
- **External haemorrhage** (Compressive dressing)
<table>
<thead>
<tr>
<th>Physiological status</th>
<th>Surgical intervention</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response to resuscitation:</td>
<td>Live saving surgery</td>
<td>Day 1</td>
</tr>
<tr>
<td></td>
<td>„Damage control“</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delayed primary surgery</td>
<td></td>
</tr>
<tr>
<td>Hyper-inflammation</td>
<td>„Second look“, only!</td>
<td>Day 2-3</td>
</tr>
<tr>
<td>„Window of opportunity“</td>
<td>Scheduled definitive surgery</td>
<td>Day 5-10</td>
</tr>
<tr>
<td>Immunosuppression</td>
<td>No surgery!</td>
<td></td>
</tr>
<tr>
<td>Recovery</td>
<td>Secondary reconstructive surgery</td>
<td>Week 3</td>
</tr>
</tbody>
</table>
**PRIMARY PERIOD**  
*(Stabilization 1 – 72 hours)*

Diagnostic procedures:
- Further laboratory tests;
- Advanced cardiovascular measurements (*P.A.; P.CVP.; CI; …*)
- Exclusion of vascular injuries (Doppler sonography or angiography)
- Exclusion of injuries of urogenital system (retrograde cystography)
- Skeletal radiography for fractures

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**CEREBRAL INJURIES**
- *Epidural and subdural hematomas* (second priority after massive bleeding in the acute period)
- *All other cranial injuries* should be treated during a delayed primary period

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**Priorities for surgical treatment after resuscitation during stabilization period 1-72 hours**
- Brain injuries
- Eye & facial injuries
- Progression of the neurological deficit
- Visceral injuries
- Musculoskeletal injuries
**EYE & MAXILLOFACIAL INJURIES**

- Perforating injuries of the eyes
- Major lesions of facial soft tissues
  (beginning of the primary period)
- Maxillofacial fractures – two stages
  - maxillomandibular fixation (primary)
  - definitive reconstruction (delayed)

**VISCERAL INJURIES**

- Injuries of the small and large intestine;
- Rupture of diaphragm;
- Lesion of the pancreas and duodenum;
- Injuries of the urogenital system
PRIORITIES IN THE MANAGEMENT OF THE MUSCULOSKELETAL INJURIES IN POLYTRAUMATIZED PATIENT

- Divascular limb secondary to fractures or dislocations
- Fractures with compartment syndrome
- Open fractures
- Unstable spine fractures
- Unstable pelvic ring fractures
- Femoral-Tibial shaft fractures

DIVASCULAR LIMBS

- Fractures or dislocations which are most notable:
  - posterior dislocation of the knee
  - supracondylar femur – humerus fractures
OPEN FRACTURES
DEGLOVING INJURY

SPINAL FRACTURES

- Neurological deficit in progress

- Cord compromise of displaced fragments or fracture dislocations which requires urgent reduction
SPINAL FRACTURES

SPINAL FRACTURES

SPINAL FRACTURES

SPINAL FRACTURES
SEVERE PELVIC INJURY

- Usually open book type
- Bleeding into enlarged pelvis

TREATMENT:
- Evaluation of the patient by trauma surgeon;
- Place external fixateur to close down the diastase;
- Tamponade the pelvic cavity
SEVERE PELVIC INJURY

\[ \frac{4}{3} \pi r^3 \]

- \( r = 10 \text{cm} \) \( PV = 4000 \text{ml} \)
- \( r = 20 \text{cm} \) \( PV = 32000 \text{ml} \)
SEVERE PELVIC INJURY

EARLY FRACTURE FIXATION

- Adequate intensive care
- Especially for polytraumatized patient with brain and thoracic trauma
- Preventing:
  - acute respiratory distress
  - multiple organ failure
  - late death from sepsis
DISLOCATIONS OF THE HIP

Prompt management to reduce risk of avascular necrosis of the femoral head!!!

ACUTE COMPARTMENT SYNDROME

♦ Early recognition and fasciotomy

♦ Avoid muscle necrosis and nerve damage
The factors which determine clinical course and the outcome of the treatment of an polytraumatized patient are:

- the degree of initial trauma
- the individual biologic response
- clinical management
  - surgical and
  - intensive care treatment

After trauma, there is a balance between the systemic inflammatory response and the contraregulatory anti-inflammatory response.
TNF
IL-6
TGF β
CORTICOSTERONE

FIRST HIT
SECOND HIT
REACTION
RESOLUTION
MOF/ARDS

NATURE

INFECTION
LATE

MODERATE IMMUNOSUPPRESSION
SEVERE IMMUNOSUPPRESSION

FIRST HIT
SECOND HIT
MOF/ARDS

MODERATE SIRS
SEVERE SIRS
MODERATE SIRS
SEVERE SIRS
MODERATE IMMUNOSUPPRESSION
SEVERE IMMUNOSUPPRESSION

INFECTION
LATE

EARLY
MODS
EARLY
MOF

tissue injury
shock
host factors
second hits
Planning and optimal timing of fracture stabilization is essential in the treatment of polytraumatized patients. Any mistakes will lead to difficult consequences regarding the morbidity and may increase the mortality rate.

In 1985 Seibel and later Bone and Bucholz showed the importance of initial fracture treatment in these patients. On the other hand, there are many evidences that immediate fracture fixation (< 24 h) is not always appropriate or necessary.

The timing and the type (extent) of surgery has been considered to be especially important. Therefore, in patients at special risk for an adverse outcome, a stepwise approach can improve the clinical course.

The principles of reducing the second hit by adapting the surgical management to the individual biologic state of the polytraumatized patients were introduced as

- **Damage**
- **Control**
- **Orthopaedics**
DCO principles are used to:

- minimize degree of surgical impact as second hit
- reduce loss of temperature
- reduce additional blood loss

When the patient is adequately resuscitated (normal body temperature, normal coagulation profile), he can be taken to the OR for definitive treatment.

What are the orthopaedic injury complexes which lend themselves to DCO?

- femur fractures in polytrauma patients;
- bilateral femoral shaft fractures;
- exsanguinating pelvic ring injuries;
- patients > 65 years with polytrauma.

MATERIAL AND METHODS

From 1995 to 2005 there were 84 polytraumatized patients with femoral shaft fracture treated in our hospital. The outcomes of their treatment were retrospectively analyzed in this study.
MATERIAL AND METHODS

Patients were grouped according to the treatment strategies for stabilization of the femoral shaft fracture:

- **GROUP A** – 66 patients treated with early total care (ETC) - intramedullary nailing (IMN) within 24 h of injury
- **GROUP B** – 18 patients treated with temporary external fixation as a bridge to IMN - DCO surgery
The effect of the timing of IMN was analyzed regarding the site and severity of the trauma (ISS) and the incidence of:

- respiratory failure
- ARDS
- days of mechanical ventilation
- pneumonia, severe atelectasis, sepsis
- multiple organ failure (MOF)
- length of ICU stay and total days of hospitalization
- mortality

**DEFINITIONS**

- **PULMONARY FAILURE** was defined as ventilatory failure requiring mechanical ventilation (MV) for 3 or more days/tracheostomy

- **ARDS** was defined as:
  - the need for MV for more than 3 days
  - pO2 below 250 mm Hg (inspired oxygen of 100%)
  - diffuse pulmonary infiltrates on chest X-rays

- **MOF** was defined as failure (global disfunction) in three or more systems
RESULTS

SEVERITY OF INJURY vs TIMING OF FIXATION

<table>
<thead>
<tr>
<th>AIS</th>
<th>ETC</th>
<th>DCO</th>
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<tbody>
<tr>
<td>head</td>
<td>2.15 ± 0.30</td>
<td>2.60 ± 0.40</td>
</tr>
<tr>
<td>face</td>
<td>1.65 ± 0.22</td>
<td>1.32 ± 0.11</td>
</tr>
<tr>
<td>thorax</td>
<td>2.25 ± 0.34</td>
<td>2.82 ± 0.15</td>
</tr>
<tr>
<td>abdomen</td>
<td>1.60 ± 0.21</td>
<td>1.76 ± 0.14</td>
</tr>
<tr>
<td>extremities</td>
<td>3.10 ± 0.80</td>
<td>3.40 ± 0.60</td>
</tr>
<tr>
<td>superficial</td>
<td>0.55 ± 0.30</td>
<td>0.70 ± 0.11</td>
</tr>
<tr>
<td>ISS</td>
<td>22.6 ± 0.60</td>
<td>32.2 ± 0.90</td>
</tr>
</tbody>
</table>

The patients in group B (DCO) required significantly more fluids (14.2) than those in group A (ETC) 8.2

The patients in group B needed more blood 2.2 vs 1.31 in group A

There were more thoracic, abdominal and head injuries in group B compared to group A

There was significantly higher incidence of ARDS in group A 18.2% vs 8.6% in group B

The incidence of MOF was significantly lower in DCO group - 7.4% than in ETC group - 12.1%

There were 3 unexpected deaths and 2 cases with worsening in patients with head injury in group A

There were no significant differences in the incidence of local complications:
- infections
- delayed unions
- nonunions
CONCLUSIONS

- A significant reduction in the incidence of general systemic complications (ARDS, MOF) was found in group B (DCO) in comparison with group A (ETC).

- Changing of the treatment protocol from ETC to DCO is not associated with increased rate of local complications.

- Lower complication rate in DCO despite higher ISS appears to be an viable alternative for polytrauma patients with femoral shaft fracture at risk.