POLYTRAUMA
SHOCK
• TRAUMA RELATED COSTS IN THE U.S. 400 BILLION $

• 3.8 MILLION DEATHS PER YEAR

• THE LEADING CAUSE OF DEATH IN PERSONS AGED 1 TO 45 IN THE MOST DEVELOPED COUNTRIES

• TRIMODAL DEATH DISTRIBUTION
  1. SECONDS, MINS FOLLOWING INJURY
     DUE TO BRAIN, C. SPINE, LARGE VESSEL INJ.
  2. 1-2 HOURS FOLLOWING INJURY
     DUE TO EPIDURAL HAEMATOMAS, BLEEDINGS

  **GOLDEN HOUR**

  3. SEVERAL DAYS FOLLOWING INJURY
     DUE TO M.O.F., SEPSIS
TRIMODAL DEATH DISTRIBUTION

The second group is decreasing due to proper treatment.
GOLDEN HOUR

NOT ONLY SALVAGEABILITY

BUT

MANY LATE PROBLEMS (SIRS, MOF) ARE THE CONSEQUENCES OF THE PRIMARY HYPOXIA AND MEDIATOR RELEASE

SILVER DAY BRONZE WEEK PLATINA 10 MIN
DEFINITION OF POLYTRAUMA

A. INJURY TO ONE OR MORE BODY REGIONS OR ORGANS OF WHICH ONE, OR THEIR COMBINATIONS IS LIFE THREATENING

B. INJURY TO MORE BODY REGIONS FOLLOWING WHICH, DURING TREATMENT, WE HAVE TO MAKE COMPROMISES

C. INJURY TO HOLLOW ORGANS + INJURY TO EXTREMITIES

D. INJURY DEFINED BY A SCORING SYSTEM
## Trauma Score

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score Range</th>
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<tbody>
<tr>
<td>Number of Breaths per Min</td>
<td>0-4</td>
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<tr>
<td>Intensity of Breathing</td>
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<td>Systolic Blood Pressure</td>
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<td>Capillary Refill</td>
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<td>Glasgow Coma Scale</td>
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### Possibility for Survival

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<tr>
<td>16+</td>
<td>&lt;2</td>
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<td>99%</td>
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## GLASGOW COMA SCALE

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<td>To Speech</td>
<td>3</td>
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<tr>
<td>To Pain</td>
<td>2</td>
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<td>None</td>
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<tr>
<th>Best Motor Response</th>
<th>Obeys Commands 6</th>
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<tr>
<td>Localizes Pain</td>
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<td>Normal Flexion</td>
<td>4</td>
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<tr>
<td>Abnormal Flexion</td>
<td>3</td>
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<tr>
<td>Extension</td>
<td>2</td>
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<td>None</td>
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<th>Verbal Response</th>
<th>Oriented 5</th>
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<td>Confused Convers.</td>
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<tr>
<td>Words</td>
<td>3</td>
</tr>
<tr>
<td>Sounds</td>
<td>2</td>
</tr>
<tr>
<td>Nothing</td>
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</table>
ABBREVIATED INJURY SCALE (ISS)

1  MILD
2  MEDIUM
3  SEVERE
4  VERY SEVERE
5  CRITICAL
6  NOT SURVIVABLE
INJURY SEVERITY SCORE (ISS)

SIX REGIONS
THE THREE MOST SEVERE
THE SQUARE OF EACH VALUE
THE SUM OF THE RESULTS

• HEAD AND NECK
• FACE
• CHEST
• ABDOMEN
• EXTREMITIES (PELVIS)
• SKIN
<table>
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<tr>
<th>Body Part</th>
<th>Injury</th>
<th>Value 1</th>
<th>Value 2</th>
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<tr>
<td>HEAD, NECK</td>
<td>BRAIN CONTUSION</td>
<td>3</td>
<td>9</td>
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<tr>
<td>FACE</td>
<td>NONE</td>
<td>0</td>
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<tr>
<td>CHEST</td>
<td>UNSTABLE CHEST</td>
<td>4</td>
<td>16</td>
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<td>ABDOMEN</td>
<td>SPLEEN RUPTURE</td>
<td>2</td>
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<td>SEVERE LIVER RUPTURE</td>
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<td>25</td>
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<tr>
<td>EXTREMITIES</td>
<td>FRACTURE OF THE FEMUR</td>
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<tr>
<td>SKIN</td>
<td>Bruises</td>
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**SUM** 50

**SEVERE:** MORE THAN 20
PROBLEMS OF ISS

• IN ONE BODY REGION ONLY ONE INJURY
• SOMETIMES CAN BE DEFINED AFTER SURGERY
• ONLY 3 REGIONS
• THE 2ND MOST SEVERE IN ONE REGION CAN BE WORSE THAN THE MOST SEVERE IN ANOTHER REGION
• PHYSIOLOGY DATA NOT TAKEN INTO CONS.
• EVERY REGION WITH THE SAME IMPORTANCE?

NISS (NEW ISS)

THE 3 MOST SEVERE INJURY
TREATMENT

1. PREHOSPITAL STAGE
   AIRWAY/BREATHING
   CONTROL OF EXTERNAL BLEEDING AND SHOCK
   IMMOBILISATION/DRUG THERAPY
   TRANSFER TO THE CLOSEST TRAUMA CENTER

2. IN- HOSPITAL STAGE
   THE SAME AS 1, BUT
   PROPER EQUIPMENT/STAFF (TRAUMA SURGEON)

TRIAGE
SORTING OF THE PATIENTS
MULTIPLE CASUALTIES / MASS CASUALTIES
PLAY AND STAY

GERMANY: TRAINED DOCTORS INFUSIONS, TREATMENT

SCOOP AND RUN

U.S.: PARAMEDICS, BASIC SUPPORT, FAST TRANSFER
ATLS CONCEPTION

ADVANCED TRAUMA LIFE SUPPORT

ABCDE APPROACH

FIRST THE LIFE THREATENING INJURY

THE IMMEDIATE EXACT DIAGNOSIS IS NOT IMPORTANT

THE TIME FACTOR IS THE MOST IMPORTANT

DO NOT DO MORE HARM

EMS, BLS, ALS
TIME TO BEAT

AIRWAY
BREATHING/HYPOXIA
CIRCULATION/BLEEDING
DISABILITY/BRAIN STEM HERNIATION

1-5 MINS
5-10 MINS
10-30 MINS
30-60 MINS
ATLS CONCEPTION
PRIMARY SURVEY

A  AIRWAY + C SPINE
B  BREATHING/ VENTILATION/
    OXYGENISATION
C  CIRCULATION - STOP THE BLEEDING
    RESTORE VOLUME
D  DISABILITY / NEUROL STATUS
E  EXPOSE/ ENVIRONMENT/ BODY TEMP.
LOGROLL
BODY 3 PERS. / HEAD + 1
HANDS OVERLAP
FAST EXAMINATION

10 SECONDS

PRIMARY SURVEY
1 MINUTE (A, B, C, D, E)

SECONDARY SURVEY

RESUSCITATION

FOCUSED EXAMINATION
A, B  AIRWAY/BREATHING  
(OXYGENISATION)

ADEQUATE AIRWAY  
ADEQUATE OXYGENISATION  
„DEFINITIVE AIRWAY”  
(TUBE WITH INFLATED CUFFAL  
IN THE TRACHEA)  
TO MAINTAIN THE ADEQUATE  
OXYGENISATION

AGAIN AND AGAIN  
GCS < 9
A, B  AIRWAY/BREATHING
(OXYGENISATION)

C  SPINE PROTECTION
PHYSICAL EXAMINATION (TENSION PTX)
PULSE-OXYMETER
(CHEST RTG)

SURGICAL AIRWAY

AGAIN AND AGAIN
BREATHING, OXYGENISATION PROBLEMS

IS IT A PROBLEM OF THE AIRWAY OR VENTILATION?
PTX, TENSION PTX:
NEEDLE THORACOSTOMY
IATROGENIC PTX
MAIN INJURIES CAUSING A, B PROBLEMS

- PTX, TENSION PTX
- MASSIVE HTX
- FLAIL CHEST
- OPEN WOUNDS
- MEDIASTINAL WOUNDS
- TRACHEAL INJURIES
- DIAPHRAGMATILOCAL RUPTURE
- PULMONARY CONTUSION
TENSION PNEUMOTHORAX
TENSION PTX NEEDLE
THORACOCENTESIS
CIRCULATION-STOP THE BLEEDING

WHAT IS THE SHOCK?
(TISSUE HYPOPERFUSION)

TO RECOGNIZE THE SHOCK
TO RECOGNIZE THE REASON
TREATMENT (VENOUS LINE)
THE IMPORTANCE OF EARLY RECOGNITION
TO EVALUATE PATIENT RESPONSE
SHOCK

INADEQUATE TISSUE PERFUSION AND OXYGENISATION DOES NOT RESULT FROM ISOLATED BRAIN INJURY

HAEMORRHAGE IS THE MOST COMMON CAUSE

VASOPRESSORS ARE CONTRAINDICATED

ANY INJURED PATIENT WHO IS COLD AND TACHYCARDIC IS CONSIDERED TO BE IN SHOCK
THE CAUSE OF SHOCK

**BLEEDING**

- BLEEDING (FAST)
- FOCUSED ASSESSMENT
- SONOGRAPHY in TRAUMA
- CHEST, PELVIS X-RAY

**NON BLEEDING**

- TENSION PTX
- CARDIAC TAMP.
- CARDIOGENIC NEUROGENIC
- SEPTIC
MAIN CAUSES FOR BLOOD LOSS

- LARGE VESSEL INJURIES
- MASSIVE HAMOTHORAX
- INTRAABDOMINAL INJURIES
- PELVIC FRACTURES
- MULTIPLE FRACTURES
TREATMENT
FLUID THERAPY, BLOOD THERAPY
COMPRESSION BANDAGE
CLOSE THE PELVIS

SURGERY –
THORACOTOMY, LAPAROTOMY
PATIENT RESPONSE
AGAIN AND AGAIN
FLUID REPLACEMENT

2 LITER WARM LACTETED RINGER
20 ML/KG IN CHILDREN

3:1 RULE

MIN 16 GAUGE PERIPHERIAL NEEDLE
CENTRAL VEIN(S)
SUBCLAVIAN, JUGULAR, FEMORAL.
INTRAOSSEOUS

HYPEROSMOL. RINGER?
PATIENT RESPONSE

„RAPID RESPONDER”
CRISTALLOIDS

„TRANSIENT RESPONDER”
CRISTALLOIDS, TRANSFUSION
PATIENT RESPONSE?

„NON-RESPONDER”
CRISTALLOID, IMMEDIATE TRANSFUSION.
SURGERY
I. GR. BLOOD LOSS - 15% - 750 ml
RESPONDER CRISTALLOID

II. GR. BLOOD LOSS 15-30% -1500 ml
RESPONDER CRISTALLOID, BLOOD

III. GR. BLOOD LOSS 30-40% -2000 ml
TRANSIENT/NON RESPONDER CRISTALLOID, BLOOD, SURGERY

IV. GR. BLOOD LOSS 40%- 2000+ ml
NON RESPONDER CRISTALLOID, BLOOD, SURGERY
SMV RESUSCITATION

SMALL VOLUME RESUSCITATION

PROBLEM:

DURING MASSIVE VOLUME RESUSCITATION THE RISK OF BLEEDING MAY INCREASE

KEEP THE BLOOD PRESSURE ON AN ACCEPTABLE LEVEL (90 Hgmm)
BUT : PERFECT OXYGENISATION
STOP THE BLEEDING
FLUID THERAPY

PROBLEMS

AGED
CHILD
SPORTSMEN
DRUGS, MEDICAMENTS
I.V. LINE PROBLEMS
DISABILITY

GCS
MONROE - KELLY DOCTRINE
NEUROGENIC SHOCK
SYMPHATIC TRACT INJURY
VASOMOTORIC INSUFF.
SPINAL SHOCK
FOLLOWING SPINAL CHORD. INJ.
MAIN INJURIES CAUSING „D” PROBLEMS

- BRAIN CONTUSION
- EPIDURAL – SUBDURAL HEMATOMAS
- BRAIN EDEMA
- HYPOXIA

- INJURIES TO THE SPINE - FRACTURES
D, E DISABILITY, ENVIRONMENT PROBLEMS

GCS AGAIN AND AGAIN
PATIENT STATUS IS WORSENING
THERE IS NO FULL BODY EXAM.
HYPOTHERMIA
WRITTEN RECORDS
PROBLEMS:

BLOOD PRESSURE
HGB, HTK VALUES
AGE
HYPOTHERMIA
PREGNANCY
SPORTSMEN
DUGS
PACEMAKER
STABILIZATION FOR TRANSPORT

- FREE AIRWAY
- SATURATION MIN. 90%
- GCS - 9
- RR 90 Hgmm. I CASE OF POLYTRAUMA 90 (80) Hgmm IS ENOUGH, IN CASE OF CHILDREN (70 + (2x AGE)) INTUBATION OF CHILDREN IS DIFFICULT HYPOXIA!, HYPOTENSION
- TREATMENT OF CONVULSIONS, PAIN RELIEF
- PHYSICAL STABILIZATION
- MANNISOL IN CASE OF IMMINENT BRAIN STEM DMG
- STEROIDS??
- STAY AND PLAY/ SCOOP AND RUN
- IN HUNGARY TIME TO HOSPITAL 90 MINS AVG.
VACUUM MATTRESS - SPINE BOARD
THERE IS NO ABSOLUTELY GOOD METHOD
<table>
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<tr>
<th>MINS</th>
<th>TIMING/TEAMS</th>
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<tbody>
<tr>
<td>1</td>
<td>AN.</td>
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<tr>
<td>1-5</td>
<td>VITAL PARAM. INTUBATION</td>
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<td>ART. CANULE</td>
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<td>I.V. FLUIDS</td>
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<td>IMMobilisation</td>
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<td>CATHERETER</td>
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<td>STOP THE BLEEDING</td>
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<td>U.SONGRAPHY</td>
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<td>SKULL, C.SPIN/CT</td>
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<td>CHEST, ABD. CT</td>
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DIAGNOSIS

X-RAY
SKULL  C.SPINE  CHEST  PELVIS
    (SPINE)

FAST (ULTRASONOGRAPHY)

CT SCAN (BRAIN, ABDOMEN ETC)

FAST SPIRAL CT   SPECIFIC X RAYS
SECONDARY SURVEY

ONLY IF THE PATIENT IS STABLE

PHYSICAL EXAM. „HEAD TO TOE” „TUBE AND FINGER IN EVERY ORIFICE” FULL NEUROL. STATUS BLOOD SAMPLES, URIN. CATHETER, X-RAYS

AGAIN AND AGAIN
SECONDARY SURVEY

AMPLE

A  ALLERGIES
M  MEDICATIONS
P  PAST ILLNESSES
L  LAST MEAL
E  EVENTS/ENVIRONMENT

WRITTEN RECORDS
THERAPEUTIC WINDOWS

1. FIRST 24 (48) HOURS
2. 5-7 DAYS FOLLOWING INJURY
3. 2-3 WEEKS

ABDIMINAL, THORACIC, BRAIN INJURIES

EXTREMITIES

VESSEL, NERVE INJURIES
INTRAMEDULLARY STABILISATION
EXTERNAL FIXATEUR
THERAPEUTIC WINDOWS

I. 24-48 HOURS
II. 5-10 DAYS
III. 2-3 WEEKS

REACTION

INFLAMMATION

REGENERATION

SKIN
TENDON
NERVE
BONE
WHAT, WHEN?

A – AIRWAY  
AIRWAY INJURY

B – BREATHING  
AIRWAY INJURY, THORACIC INJ.

C – CIRCULATION – STOP THE BLEEDING  
THORACIC, ABDOMINAL INJ. PELVIC INJ, LARGE VESSEL INJ

D – DISABILITY  
CNS. INJ
MAXILLOFACIAL, EYE INJ
UNSTABLE. SPINE INJ
NEURVE INJ. (?)

E – EXTREMITY(?)  
OPEN FR.
LONG TUBULAR BONE
INTRAART. INJ.
TENDON INJ. (?)
EPIPHYSEAL FR.
SOFT TISSUE INJ. /COMPARTEMENTE SY.
DAMAGE CONTROL SURGERY

EARLY YEARS: DELAYED FRATURE TREATMENT
BAD RESULTS
NO SKILLED PERSONEL, ANAESTHESIA, FEW HOSPITALS

AROUND 1980: EARLY TOTAL CARE
SOMETIMES GOOD RESULTS BUT MANY FAILURES
SIRS, MOF

FROM 2000: DAMAGE CONTROL SURGERY
UNDERSTANDING THE BIOLOGICAL MECHANISMS
MEDIATORS
DAMAGE CONTROL SURGERY

DEGREE ON INJURY DEPENDS:

„FIRST HIT”, BIOLOGIC ANSWER, „SECOND HIT”

- UNSTABLE STATUS, REANIMATION
- COAGULOPATHY THROMBOCYTOPHILIA < 90.000
- SHOCK, MORE THAN 25 U BLOOD
- BLIATERAL LUNG INJ.
- INJURY TO MORE EXTREMITIES, + INJ. OF THE THORAX
- OP. TIME MORE THAN 6 HOURS
- ARTERIAL INJ. HAEMODINAMIC INSTABILITY
DAMAGE CONTROL SURGERY

„SECOND HIT” – „THE SURGEON”
- LONG TUBULAR BONE – STABILIZATION
- CONTINUOUS MONITORING
- „MINIMAL” FAST SURGERY
- PATIENT RESPONSE

- INTRAARTICULAR, METAPHYSEAL FR. CAN WAIT
- FIXATEUR EXTERNE IS ADVISED
- EXPERIENCED TEAM
- „LIFE BEFORE LIMB”
DAMAGE CONTROL SURGERY

PRIMER „AGGRESSIVE „ STABILIZATION ? IF:

- POLYTRAUMA ISS > 20 AND CHEST TRAUMA AIS > 2
- POLYTRAUMA WITH ABDOMINAL THORACIC INJ. AND SHOCK (RR < 90 HGMM)
- ISS ≥ 40
- BILATERAL PULM. CONT.
- ART. PULM. PERSSSURE ON ADMISSION > 24 mm MERCURY
- ART. PULM. PRESSURE IN CASE OF INTRAMEDULLARY STABILIZATION RAISES MORE THAN 6 mm MERCURY
INJURIES TO THE EXTREMITIES -24 HOURS

- Traumatic Amputations
- Open Fractures (II-III Gr.)
- Fractures with Vasc. Damage
- Injuries to the Joints
- Multiple Pelvic Fr.
- Luxations (Hip, Knee)
- Compartmental Syndrome
- Proximal Tubular Bones
ABDOMINAL COMPARTEMENTE SYNDROME

THE RISE OF THE INTRAABDOMINAL PRESSURE

CAUSE: USUALLY RETRO – INFRAPERITONEAL BLEEDING

CONSEQUENCE: DETERIORATION OF THE ABDOMINAL BLOOD FLOW

CONSEQUENCE: INTESTINAL BARRIER FUNCTION DETERIORATED

CONSEQUENCE: TOXINEMIA, SIRS, MOF.
MOF AND SIRS
MULTIPLE ORGAN FAILURE
SYSTEMIC INFLAMMATORY RESPONSE SYNDROME

MOF

<table>
<thead>
<tr>
<th>HYPOXIA, HYPOPERFUSION,</th>
<th>SHOCK</th>
<th>„FIRST HIT”</th>
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BACTEREMIA TOXINS – INTESTINAL HYPOPERFUSION
FRACTURE OF THE LONG TUBULAR BONES, STABILIZATION
MEDIATORS
„SECOND HIT”

SIRS
TWO OR MORE OF THESE FACTORS
• TEMPERATURE > 38 OR < 36
• TACHYPNEA > 24/MIN
• TACHYCARDIA > 90/ MIN
• LEUCOCYTOSIS >12 000/ MM3
• LEUCUPENIA > 4000 OR YOUNG CELLS MOTE THAN 10%
Infecting organism

Endotoxin release

Tissue factor

Activation of coagulation

Factor VIIIa

Factor Va

inactivation

APC

Monocyte

IL-2

TNFα

Thrombin activation

Fibrin clot formation

IL 6 release

Nitric oxide release

Epithelial cell

Tissue factor

IL-1

TNFα

Neutrophil chemotaxis

inhibits

APC

inhibits

IL-1

TNFα

Major mediators of cytokine cascade in shock
HOST RESPONSE FOLLOWING TRAUMA

**Proteins**
- TNF
- IL-1
- IL-6
- IL-8

**Free radicals**
- O2
- H2O2
- NO

**Lipids**
- PGE2
- TXA2
- PAF

**Down-regulated**
- Harmful effects
  - No fever
  - No immune system stimulus
  - No bacterial kill

**Normo-regulated**
- „Good“ effects
  - Slight fever
  - General immune system stim.
  - Bacterial kill

**Up-regulated**
- Harmful effects
  - High fever
  - Hypotension
  - DIC
  - Shock

**Infection**

**Healing**

**SIRS**

**MONOCYTE**
TRIAGE

A. DEGREE OF LIFE THREAT POSED BY THE INJURY
B. INJURY SEVERITY
C. SALVAGEABILITY
D. RESOURCES AVAILABLE
E. TIME, DISTANCE, ENVIRONMENT

1 AMBULANCE UNIT FOR EVERY INJURED
A. DEGREE OF LIFE THREAT....

A.B.C.D.E.

THE PATIENT HAVING AN ‘A’ PROBLEM TAKES PRIORITY OVER A PATIENT WITH A ‘C’ PROBLEM

B. INJURY SEVERITY
C. SALVAGEABILITY

4 GROUPS

LIKEKIHOOD OF SURVIVAL
4 GROUPS

1. NOT SALVAGEABLE (UNDER GIVEN CIRCUMSTANCES)
2. SEVERE LIFE THREATENING INJURY BUT SALVAGEABLE
3. SEVERE BUT NOT LIFE THREAT. INJURY
4. LIGHT INJURY

1 HEAD GONE           CHERNOBYL
2 AIRWAY INJURY, SEVERE BLEEDING
3 OPEN FEMUR FRACTURE
4 DISLOCATION OF A FINGER

2-3-4-1
HAVE A NICE DAY