Specific Domains of Perioperative Medicine

"Damage Control Anesthesia" in Multiple Trauma Patients

Ioana Marina Grintescu
Epidemiology

- Every day 70-80 persons/million are victims of a traumatic injury;
- 50% address to a medical service, from which, 20-30% have potential lethal injuries and 5% are critical, unstable patients;
- Trauma causes more death among children and adolescents (ages 1 to 19) than all the other diseases combined.

Trauma and Critical Care; Traumatologie et soins critique
Acute resuscitation of the unstable adult trauma patient: bedside diagnosis and therapy
Andrew W Kirkpatrick, MD; Chad G Bati MD, Scott K Amours MD. CM David Avaun MD

Tintinalli, Emergency Medicine, 2000
Fildes. J. National Trauma Data Bank™ Report 2003
Multiple Trauma

Syndrome of multiple injuries exceeding a defined severity

with consecutive systemic reactions which may lead to
dysfunction or failure of remote of primarily not injured
organs or vital systems.

Otmar Trentz, Reto Stocker
Pathophysiology

“Genomic storm” : activation of inflammation and coagulation, microvascular dysfunction

1. Wijesuriya, J.D. and Keogh, S., 2017:

Systemic response
- SIRS; Shock
- Coagulopathy,

Aggravating factors
- acidosis, hypothermia

Organ and systems lesions

Surgical treatment

Resuscitation
Supportive therapy
### Trauma Mortality - temporal distribution-

<table>
<thead>
<tr>
<th>Mortality</th>
<th>Moment of Death</th>
<th>Cause of Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>within first 30 min.</td>
<td>complex and severe injuries, <strong>massive bleeding</strong>, survival impossible</td>
</tr>
<tr>
<td>50%</td>
<td>within 48 hours</td>
<td><strong>Severe TBI major blood losses</strong>, failure to provide and maintain airway and ventilation</td>
</tr>
<tr>
<td>20%</td>
<td>days and weeks after trauma</td>
<td>Sepsis, multiple organ failure, pulmonary embolism</td>
</tr>
</tbody>
</table>
Bleeding Is the Leading Cause of Death in Trauma*

*Hospital deaths in the first 48 hr

bleeding ...

- is the 1st cause of death in trauma
- is directly responsible for 40% of all trauma-related deaths
- major potentially treatable cause of death in the initial 48h

Chiara O et al. “Critical Bleeding in Blunt Trauma patients”; data from trauma registry of the Niguarda Hospital in Milan, 2005.
“Damage Control”
Modern Concept

The 1970’s – “the Golden Hour”
– Rapid diagnosis, surgery and resuscitation

The 1980’s – a “fix everything now” mentality
– Advantages: early fracture fixation improved patient mobilization and reduced the incidence of pulmonary complications; early diagnosis and treatment of aortic injuries doubtlessly saved lives.
– Disadvantages: prolonged procedures may have done more harm than good

The 1990’s – Damage control surgery
– A plan of care for the badly injured patient
– Limiting prolonged surgical procedures that increased blood loss, and with it the potential for hypothermia, coagulopathy and acidosis
The term “Damage control” is coined by the US Navy and refers to keeping afloat a badly damaged ship by procedures to limit flooding, stabilize the vessel, isolate fires and explosions and avoid their spreading.

These measures permit damage assessment and gain time to establish plans for definitive salvag

Rationale

Saving life by deferring repair of anatomical lesions and focussing on restoring physiology.
Rapid abbreviated laparotomy to stop hemorrhage and peritoneal soiling and staged sequential repair after ongoing resuscitation and recovery from hypothermia, coagulopathy, and acidosis.

Bailout-procedure: Aborted termination of surgery in a patient at imminent risk of death.

Preemptive intervention: Calculated early decision to accomplish definitive correction of injuries in staged sequential procedures.
Major shift in trauma care

“Damage Control Surgery”
The primacy of hemorrhage control to prevent the “lethal triad”

Modern paradigm: appropriate damage control resuscitation and together with appropriate damage control surgery

“Damage Control Resuscitation”

Damage control resuscitation proposes a series of early and aggressive strategies to treat or prevent early trauma-associated coagulopathy
Major shift in trauma care

Major Trauma

Definitive Care
- Damage control surgery
- Control of bleeding

Surgical Intervention

Radiological intervention

Resuscitation Protocol
- ATLS
- Damage control resuscitation

Major Trauma Resuscitation and Massive Blood Transfusion Protocol

- Blood, FFP, Cryo, Platelets, FBN
- Fluids Correct hypothermia, acidosis
- MSOF support

Break the lethal triad

Control of bleeding

Supportive therapy and monitoring

Haemorrhagic shock

Major Trauma

Damage control surgery

Control of bleeding

Surgical Intervention

Radiological intervention

Resuscitation Protocol
- ATLS
- Damage control resuscitation

Major Trauma Resuscitation and Massive Blood Transfusion Protocol

- Blood, FFP, Cryo, Platelets, FBN
- Fluids Correct hypothermia, acidosis
- MSOF support

Break the lethal triad
The new millenium – the concept of damage control has extended

– Even in the absence of hypoperfusion and coagulopathy.
– Prevents the effects caused by the “second hit”, leading to fatal exacerbation of TBI, to SIRS, to ARDS or to early sepsis

Nowadays, damage control applies on:

• Resuscitation
• Anaesthesia
• Surgery
• Orthopaedic procedures
• Intrathoracic surgery
• Neurosurgery
Primary survey
ATLS®

Response?

Evaluation
Vital functions?
Response?

Resuscitation
Oxygenation, perfusion

„in extremis“
Life saving surgery

Non-responding

„borderline“

Damage control:
- Preemptive intervention
- „Bail-out“ procedure

Day 1 surgery

ICU

„secondary survey“

Scoring Evaluation Stabilization

Delayed primary surgery

Keel, Stoker; Labler, Trentz. Eur J Trauma. 2009
Patient selection for "damage control"

Coagulopathy

Hypothermia: < 34° C

Acidosis: pH < 7.2,

Serum Lactate > 5 mmol / L

Blood Pressure < 70 mm Hg

Transfusion approaching 15 Units

Injury Severity Score > 36
Damage Control Resuscitation (DCR)

- “ABC” resuscitation
- Permissive hypotension
- Limitation of crystalloid with early use of blood products
- Early use of tranexamic acid (TXA)
- Early and appropriate use of damage control surgery

control the external haemorrhage as the first intervention prior to the airway management.

Approaches to control external haemorrhage:

- Direct pressure, elevation of bleeding limb, application field dressing
- Limb tourniquets
- Haemostatic agents
- Pelvic binder – pelvic trauma
- Resuscitative endovascular balloon occlusion of the aorta
Step II: Permissive Hypotension

Attempts to normalize blood pressure in cases of uncontrolled bleeding may result in increased blood loss and worse outcomes.

In contrast, the concept of “permissive hypotension” does not exclude therapy by means of IV fluids, inotropes and vassopressors, but avoids completely normalizing blood pressure in a context where blood loss can be enhanced.

Hypotensive resuscitation limits blood losses ⇒ less acidemia, improves survival.

Determining the optimum target blood pressure - the depth and duration of hypotension that can be tolerated.

Still an issue with traumatic brain injury.

(Bickell WH, PepePe, New England Journal of Medicine, 1994)
## Ressuscitation Goals

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure</td>
<td>90 mmHg* (MAP 50-60)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>&lt; 120 b/min</td>
</tr>
<tr>
<td>Puls oximeter functioning</td>
<td>SaO$_2$ &gt; 95%</td>
</tr>
<tr>
<td>Urine output</td>
<td>present</td>
</tr>
<tr>
<td>PaCO$_2$</td>
<td>&lt; 50 mmHg</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>&gt; 25%</td>
</tr>
<tr>
<td>Lactate</td>
<td>stable or decreasing</td>
</tr>
<tr>
<td>Ionized calcium</td>
<td>&gt; 1.0</td>
</tr>
<tr>
<td>International normalized ratio</td>
<td>&lt; 1.6</td>
</tr>
<tr>
<td>Platelets</td>
<td>&gt; 50,000</td>
</tr>
<tr>
<td>Normothermia</td>
<td></td>
</tr>
<tr>
<td>Deep anesthesia</td>
<td></td>
</tr>
</tbody>
</table>

*lower blood pressure may be tolerated as long as acidosis is not worsening*
Fluids should be replaced “like for like”

The “Assessment of Blood Consumption Score” (ABC Score)

The parameters include

- Penetrating mechanism (0 = no, 1 = yes)
- ED SBP of 90 mm Hg or less (0 = no, 1 = yes)
- ED HR of 120 bpm or greater (0 = no, 1 = yes)
- Positive FAST (0 = no, 1 = yes)

ED emerrgency Departament

ABC score of 2 or greaterf predicting MT ,

Early Prediction of Massive Transfusion in Trauma: Simple as ABC (Assessment of Blood Consumption)?
Limitation of Crystalloid with Early Use of Blood Products

Component blood therapy
The use of thrombelastometry (ROTEM) to guide blood product usage
Early infusion of fresh frozen plasma and platelets decreased mortality within 6 h of admission.

Spahn DR. “Coagulopathy and blood component transfusion in trauma”, Br J Anesth 95: 130-139, 2005
Limitation of Crystalloid with Early Use of Blood Products

Fresh Whole Blood vs Component Therapy
Transfusion with plasma, platelets and packed red blood cells in a 1:1:1 ratio

Whole blood donated 500 ml
(Hct. 38%-50%; Plts 150K – 400K; Fi 1500 mg;
Plasma coagulation activity 100%)

150 ml, anticoagulant added; centrifuged

1 Unit PRBC
(335ml, Hct-55%)

1 Unit Plasma
(275ml, coagulation activity 80%)

1 Unit PLT
(50 ml, 5,5x1010 plts)

1 Unit CRYO
(Fi 250 mg)

Patient recieves 650 ml. fluid
(Htc 29%, plts 88K, 65% coagulation activity )

Limitation of Crystalloid with Early Use of Blood Products

**Step III:**

World War II

Blood

Mid 70’ – 2003

Fresh hole blood

Whole blood donated 500 ml
(Hct: 38%-50%, Plts 150K – 400K; Fii 1500 mg; Plasma coagulation activity 100%)

150 ml, anticoagulant added; centrifuged

1 Unit PRBC
(335 ml, Hct-55%)

1 Unit Plasma
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1 Unit PLT
(50 ml, 5,5x1010 plts)

1 Unit CRYO
(Fi 250 mg)

Patient receives 650 ml fluid
(Hct 29%, plts 88K, 65% coagulation activity)

Blood volume:
Crystalloids, Colloids, Packed cells

2008

Blood + FFP + Plt + Cryo

“Back To Square One”

2003 - 2007

Acute posttraumatic coagulopathy
Attention!

!! Each 500 mL of cold blood transfused reduces patient core temperature by 0.5–1.0°C

For all trauma patients, transfused blood products should be administered via an appropriate warming device so as not to worsen hypothermia.
Step IV:
Early Use of Tranexanic Acid (TXA)

Good quality randomized trail evidence of reduction in mortality - CRASH 2

Maximal benefits appears when TXA is administered within 1 hour of injury and there may be a potential harm when administered > 3 hours post injury

Inhibition of fibrinolysis
It may modulate the plasmin-mediated inflammation and neurotoxicity

Tranexamic Acid

CRASH-2 trial
- 274 hospitals in 40 countries
- 20,211 adult trauma patients with, or at risk of, significant bleeding
- tranexamic acid (loading dose 1 g over 10 min then infusion of 1 g over 8 h) or placebo
- 10,096 patients were allocated to tranexamic acid and 10,115 to placebo

Tranexamic acid safely reduced the risk of death in bleeding trauma patients in this study. On the basis of these results, tranexamic acid should be considered for use in bleeding trauma patients.
### CRASH II

<table>
<thead>
<tr>
<th>Time from injury (h)</th>
<th>Tranexamic acid allocated</th>
<th>Placebo allocated</th>
<th>Risk ratio (99% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1</td>
<td>509/3747 (13.6%)</td>
<td>581/3704 (15.7%)</td>
<td>0.87 (0.75-1.00)</td>
</tr>
<tr>
<td>&gt;1-3</td>
<td>463/3037 (15.2%)</td>
<td>528/2996 (17.6%)</td>
<td>0.87 (0.75-1.00)</td>
</tr>
<tr>
<td>&gt;3</td>
<td>491/3272 (15.0%)</td>
<td>502/3352 (14.9%)</td>
<td>1.00 (0.86-1.17)</td>
</tr>
</tbody>
</table>

χ² = 4.411; p = 0.11

<table>
<thead>
<tr>
<th>Systolic blood pressure (mm Hg)</th>
<th>Tranexamic acid allocated</th>
<th>Placebo allocated</th>
<th>Risk ratio (99% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥90</td>
<td>702/6878 (10.2%)</td>
<td>736/6761 (10.9%)</td>
<td>0.94 (0.82-1.07)</td>
</tr>
<tr>
<td>76-89</td>
<td>280/1609 (17.5%)</td>
<td>313/1689 (18.5%)</td>
<td>0.94 (0.78-1.14)</td>
</tr>
<tr>
<td>≤75</td>
<td>478/1562 (30.6%)</td>
<td>562/1599 (35.1%)</td>
<td>0.87 (0.76-0.99)</td>
</tr>
</tbody>
</table>

χ² = 1.345; p = 0.51

<table>
<thead>
<tr>
<th>GCS (Severe 3-8, Moderate 9-12, Mild 13-15)</th>
<th>Tranexamic acid allocated</th>
<th>Placebo allocated</th>
<th>Risk ratio (99% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe (3-8)</td>
<td>796/1780 (44.5%)</td>
<td>860/1830 (47.0%)</td>
<td>0.95 (0.86-1.04)</td>
</tr>
<tr>
<td>Moderate (9-12)</td>
<td>219/1349 (16.2%)</td>
<td>249/1344 (18.5%)</td>
<td>0.88 (0.70-1.09)</td>
</tr>
<tr>
<td>Mild (13-15)</td>
<td>447/6915 (6.5%)</td>
<td>502/6877 (7.3%)</td>
<td>0.88 (0.75-1.04)</td>
</tr>
</tbody>
</table>

χ² = 1.387; p = 0.50

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Tranexamic acid allocated</th>
<th>Placebo allocated</th>
<th>Risk ratio (99% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blunt</td>
<td>1134/6788 (16.7%)</td>
<td>1233/6817 (18.1%)</td>
<td>0.92 (0.83-1.02)</td>
</tr>
<tr>
<td>Penetrating</td>
<td>329/3272 (30.1%)</td>
<td>380/3250 (11.7%)</td>
<td>0.86 (0.72-1.03)</td>
</tr>
</tbody>
</table>

χ² = 0.791; p = 0.37

<table>
<thead>
<tr>
<th>All patients</th>
<th>Tranexamic acid allocated</th>
<th>Placebo allocated</th>
<th>Risk ratio (99% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1463/10060 (14.5%)</td>
<td>1513/10057 (16.0%)</td>
<td>0.91 (0.85-0.97)*</td>
<td></td>
</tr>
</tbody>
</table>

Two-sided p = 0.0035

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Figure 3: All-cause mortality by subgroups

GCS = Glasgow Coma Score. *95% CI
RECOMBINANT factor VIIa
(NovoSeven)

Activated recombinant factor VII
Treatment of patients with haemophilia A and B with antibodies against factor VIII and factor IX
No longer recommended for trauma patients due to the arterial thrombotic events
Case series suggest that it should be considered for life-threatening, non-surgical hemorrhage

Protocol for the Use of rFVIIa in Trauma

Non-mechanical bleeding in:
- Pelvic ring disruption
- Intraperitoneal injury
- Injury of extremities
- Multiple transfusions (>8U RBC within 4 h)
- Coagulopathy (PT > 1.5xN, aPTT > 1.5xN, INR > 1.5)

Traumatic bleeding in patient on pre-injury anticoagulant therapy

Infuse FFP 10 ml/kg
- Give PLT (> 50000/mm3)
- Correct fibrinogen (>50mg/dl)

rFVIIa 90µg/kg

still bleeding

Still bleeding after 120 min

Check again for surgical bleeding !!!

Exclude (futile administration) if:
- pH < 7.1
- Lactate > 13 mmol/l
- Previous or impending CPR

Chiara O et al. “Critical Bleeding in Blunt Trauma patients”, 2014
Early and Appropriate Use of Damage Control Surgery (DCS)

Step V: Damage Control Surgery (DCS)

- abdominal trauma, thoracic trauma, penetrating neck trauma, peripheral vascular injuries

Early and appropriate application of damage control surgery
- a cornerstone of the modern DCR paradigm
- surgical strategy to restore physiology are required to save life for a subset of the most severely injured patients

Rapid control of haemorrhage
- Repair or ligation for accessible blood vessels
- Inflow-occlusion by cross-clamping or balloon-tamponade
- Packing: 4 quadrants, perihepatic packing
- Intravascular shunting or stenting

Limitation of contamination / Ligation, suture or stapling of bowels / Resection of damaged segments (clips, clamps or staples) / Anastomoses and stomas have to be deferred
The Modern Damage Control Sequence Can be Considered in Five Phases
Polytrauma.
Specific Principles of Approach

- Team approach
- Hierarchy in management and resuscitation
- The presumption of the worst injuries
- Treatment of rapidly fatal injuries while diagnosis
- Detailed evaluation
- Continuous monitoring
- Frequent reevaluations
Phase 0

Pre-operative phase
injury-pattern recognition
ATLS

direct transport to a trauma center
Phase 0

Pre-operative phase

injury-pattern recognition

ATLS

eyeal selection of candidates likely to
benefits from damage control surgery

Combined vascular, solid and hollow organ injury

Inaccessible major venous injury

Anticipated need for a time consuming procedure

Demand for operative control of other injuries

Inability to close the abdominal incision

Desire to reassess the intraabdominal contents

direct transport to a trauma center

Lethal six (immediately lethal)

• airway obstruction
• tension pneumothorax
• cardiac tamponads
• open pneumotharax
• massive hemothorax
• fail chest
Phase 0

DCR
localize the site of bleeding by using imaging
expedient transport to the operating theatre
Phase 1

Rapid control of “mechanical haemorrhage” and visceral contamination

Rapid haemorrhage control: ligation, packing, vascular shunts, stapling devices, balloon catheter tamponade

Contamination control: ligation, suture or stapling of bowels, resection of damaged segments, vascular shunts, stapling devices, balloon catheter tamponade

Use of cell salvage machines

Haemostatic agents

Temporary wound closure / Adjunctive angioembolism for high-grade liver injury
- towel clips
- Bogota Bag (temporary, silo)
- Opsite – sandwich or (VAC)
- Mesh closure / Ethizip
Phase 2

the ICU resuscitative phase:
“Inter-rellation Acidosis, Hypothermia, Coagulopathy in Trauma”

- re-warming and restoration of physiology
- the lactate level
- transfusion of blood products according to thromelastography or conventional laboratory indices
The Lethal Triade Correction

1. HYPOTERMIA

**first step** - providing a temporary closure of the abdominal wall

Patient should be warmed to 37°C within 4 hours of arrival to the ICU!

- preheat the ICU suite
- aluminum foil cap
- the ventilator circuit should be warmed

all transfusion lines should have a dedicated fluid-warming device attached to them – **LEVEL 1**

pleural lavage with warm saline via multiple chest tube warming device
The Lethal Triade Correction

2. ACIDOSIS

Usually corrects itself once patient is adequately rewarmed and resuscitated

Sodium bicarbonate only if pH is < 7.2
3. COAGULOPATHY

transfusion of blood products according to:

conventional laboratory indices

Routine tests:
PT, aPTT
Fbn, D-dimer
Plt

thromelastography

• CT (R = CT)
• CFT (k = CFT)
• Unghiul α
• MCF – MA = FMC
• LI 60 – (MA60 = CLI 60–

the 10-unit rule – transfusion guide

• prothrombin time < 15 seconds
• platelet counts > 100.000/mm3
• cryoprecipitate when fibrinogen level < 100 mg/dl

Huge Blood Transfusion in the First 24h
Is an Independent Predictor for ...

increase by ...

• Mortality 10 x
• ICU admission 3 x
• ICU LOS 6 x
• SIRS 3 – 5 x
The Lethal Triade Correction

3. COAGULOPATHY

Severe trauma → Coagulopathy → Acidosis → Bleeding → Hypothermia

- Coagulopathy is determined by both the volume and type of fluid infused
  - Dilutional Coagulopathy
  - Crystalloids / Colloides effects

initiation of fluid resuscitation

There is no evidence to support the superiority of any crystalloid or colloid over another in trauma patients!!
Phase 2

the ICU resuscitative phase....
return to operating theatre / angioembolisation
detailed examination and review of available imaging

Persisting bleeding

Increasing intraabdominal pressure (ACS)

Scheduled reoperation after repacking and extensive gut distension due to reperfusion

Physiological restoration

Removal of packs and definitive repair
Definitive repair of all injuries

- The timing depends on the individual patient’s physiology
- definitive procedures where possible
- intra-operative evaluation – the incidence of missed injuries is high
- may require several separate visits to theatre to complete the defects
# Phase 3

**Definitive repair of all injuries**

<table>
<thead>
<tr>
<th>Physiological status</th>
<th>Surgical intervention</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Life saving surgery</td>
<td>Day 1</td>
</tr>
<tr>
<td>?</td>
<td>&quot;Damage control&quot;</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>Early total care</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to resuscitation:</th>
<th>&quot;Second look&quot;, only!</th>
<th>Day 2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyper-inflammation</td>
<td>&quot;Window of opportunity&quot;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Immunosuppression</th>
<th>Scheduled definitive surgery</th>
<th>Day 5-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery</td>
<td>Secondary reconstructive surgery</td>
<td>Week 3</td>
</tr>
</tbody>
</table>
Reconstruction of abdominal wall

Final abdominal closure without tension

aggressive diuresis is implemented to reduce bowel and body wall oedema for facilitating early definitive closure

Direct closure – only without gut distension

After fascial retraction subsequent gradual V.A.C. (Vacuum-Assisted Closure)

Mesh repair

In an hostile abdomen: gauze packing, secondary granulation and skin grafting

Secondary plastic reconstruction
Damage Control Anesthesia

Anesthetic considerations in multiple trauma – general anaesthesia
The Essentials of Anaesthesia in multiple trauma patients

1. Airway and ventilator management
   – Rapid sequence intubation
   – Titration of ventilation

2. Control of bleeding
   – Deliberate hypotensive resuscitation
   – Maintenance of blood composition

3. Preservation of homeostasis
   – Normothermia
   – Restored and sustained end-organ perfusion

4. Anaesthesia
Anaesthetic Problems Specific to the Trauma Patient

hemodynamic instability traumatic, hemorrhagic, cardiogenic or septic shock
Shock in multiple trauma

Hypovolemic shock: ↓ circulation volume

Cardiogenic shock: ineffective pump function (myocardial contusion)

Vasogenic shock: ↓ SVR
  – Neurogenic shock
  – Septic shock
  – Obstructive shock: mechanical obstruction (cardiac tamponade, tension pneumothorax)

Traumatic shock: combination of above causes (hypovolemia, tissue injury-SIRS)

Anaesthetic Problems Specific to the Trauma Patient

MULTIPLE TRAUMA

Full stomach

Existing patient history?

Actual/potential injury of the cervical spine
Rapid Sequence of Intubation

- Manually inline stabilization of the cervical spine by an assistant
- Removal of the devices stabilizing the spine
- Preoxigenation for 2-3 minutes
- Administration of an iv anaesthetic (*etomidate/ketamine*)
- Application of cricoid pressure by a separate assistant (Sellick manoeuvre)
- Administration of a rapidly acting neuromuscular blocking drug (*suxamethonium/rocuronium*)
- Intubation of the trachea
- Check of position of the tracheal tube
- Release of cricoid pressure
- Securing the tracheal tube
- Reapplication of the stabilizing devices to the neck

Maryland Institute for Emergency Medical Services Systems Shock Trauma Center (Criswell et al., 1994)
## Induction doses and characteristics

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose [mg/kg]</th>
<th>Onset [s]</th>
<th>Duration [min]</th>
<th>Excitation</th>
<th>Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etomidate</td>
<td>0.2 - 0.4</td>
<td>15 - 45</td>
<td>3 - 12</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Propofol</td>
<td>1.5 - 3.0</td>
<td>15 - 45</td>
<td>5 - 10</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.2 - 0.4</td>
<td>30 - 60</td>
<td>15 - 30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ketamine</td>
<td>1 - 3</td>
<td>45</td>
<td>10 - 20</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>
Anaesthesia’s Goals

The anaesthesia quadrilateral

- Analgesia
- Hypnosis + Amnesia
- Relaxation
- Homeostasis preservation
Maintenance

- **Opioids**
  - ↓ serum catecholamine
  - Pain relief

- Unconsciousness patient
  - Propofol, midazolam, volatile agents
  - (-) inotropism and vasodilatation (hTA)
Over-utilisation of the Damage Control Concept

Selecting “Damage control” too careless may mean an unnecessarily premature termination of surgery in patients who would otherwise have recovered from a single definitive procedure.

It would subject the patients to risks and expenses of multiple surgical interventions.
Happy Holidays!
Sărbători Fericite!