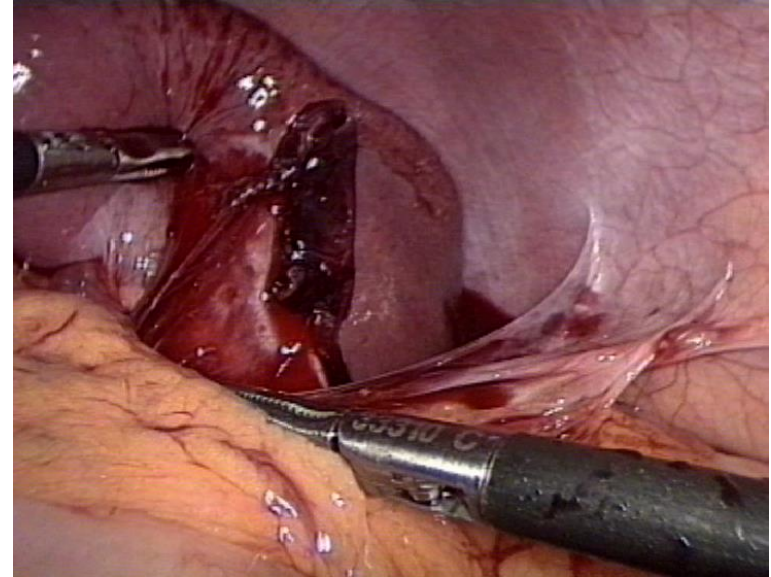
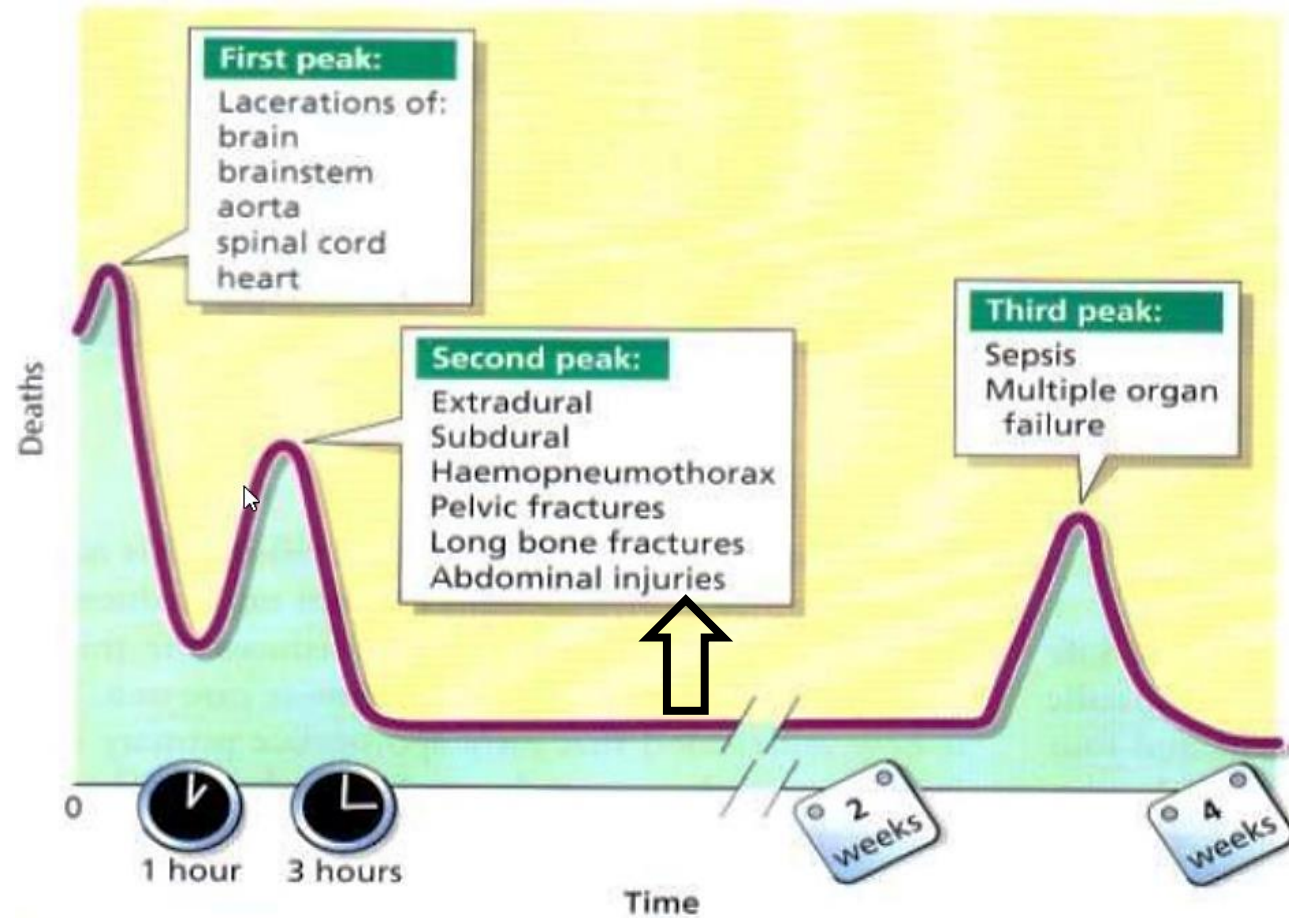


Damage Control Orthopedics – why, how and when

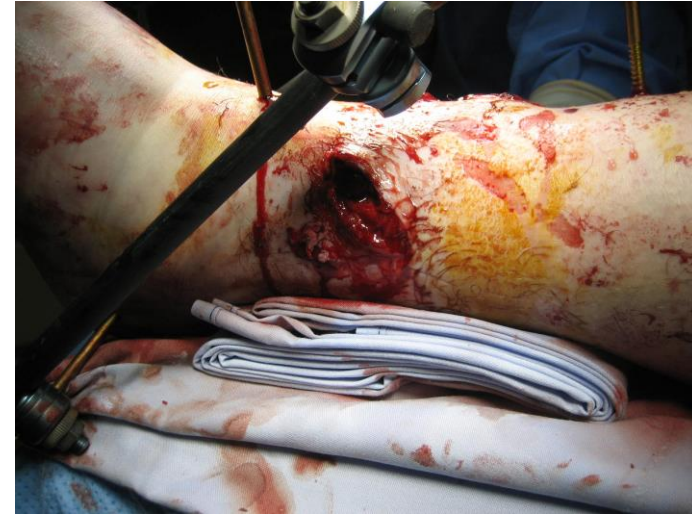
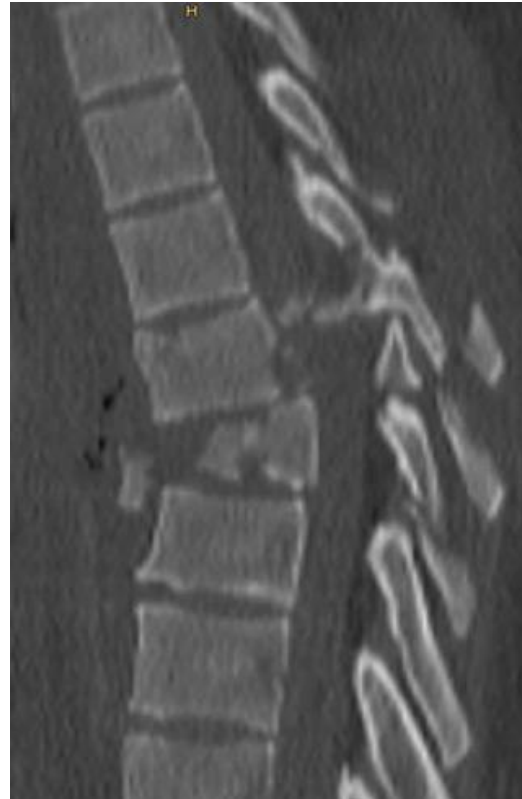
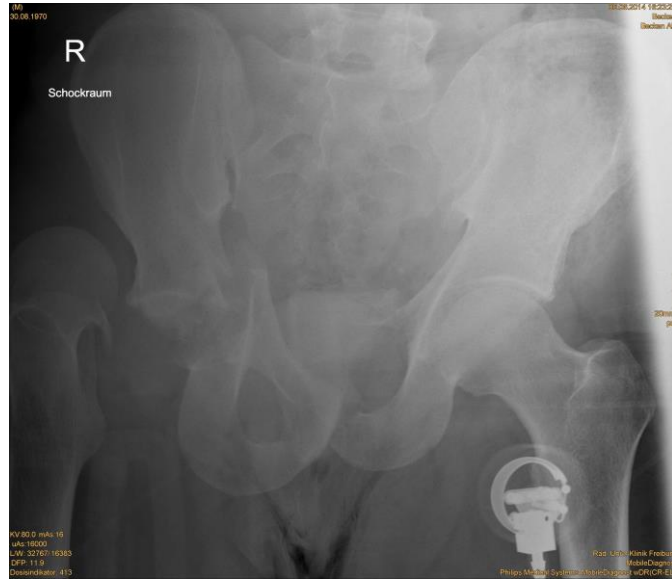
Hagen Schmal
University Hospital Freiburg

AOTrauma Course—Advanced Principles of Fracture Management
April 25–28, 2022 Fredericia, Denmark

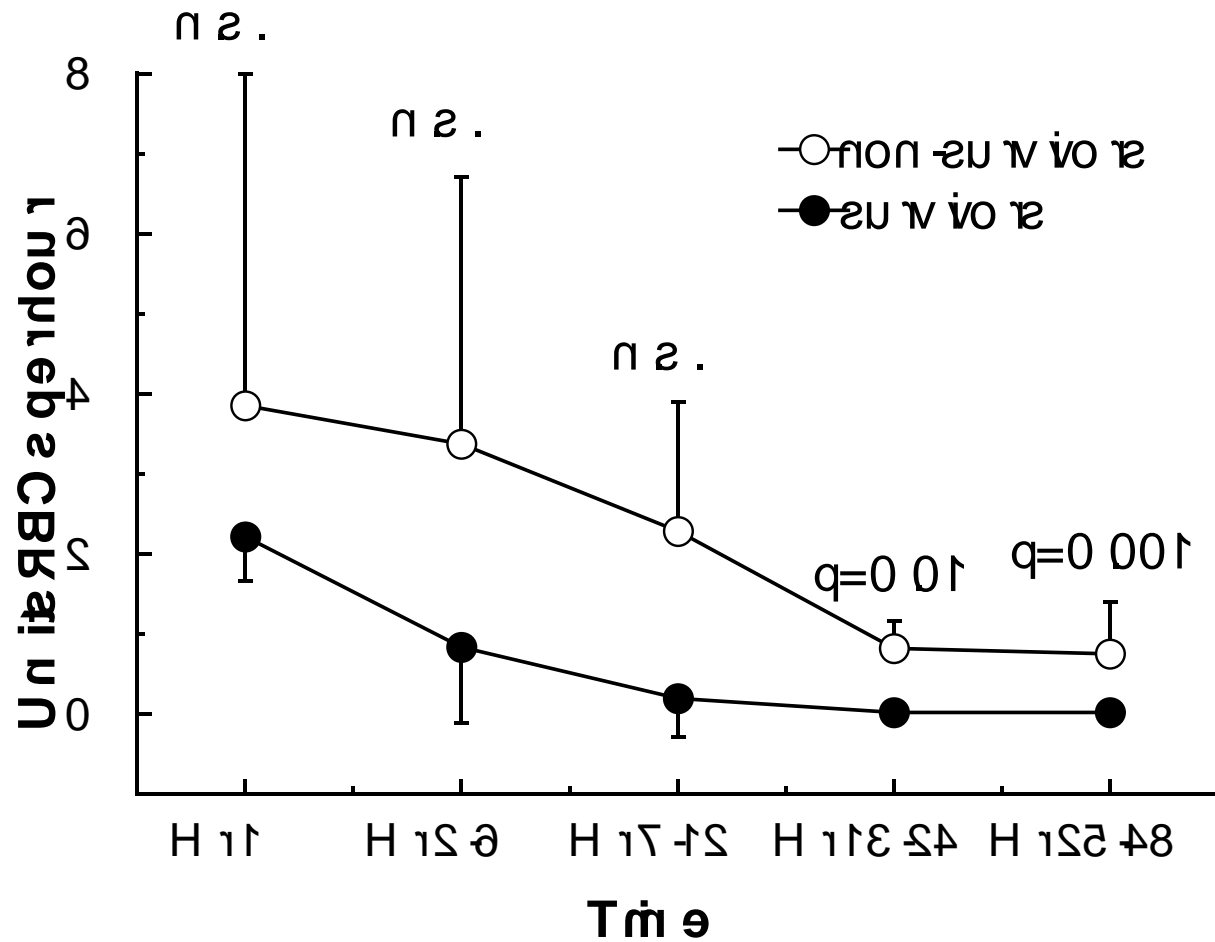
‘Treat first, what kills first’



Focus of DCO



Hemorrhage control decides about survival (ATLS C) → But how?



Acta Orthop. Belg., 2005, 71, 41-47

ORIGINAL STUDY

Epidemiology and outcome of complex pelvic injury

Hagen SCHMAL, Max MARKMILLER, Alexander T. MEHLHORN, Norbert P. SUDKAMP

From the University of Freiburg Medical Center, Freiburg, Germany

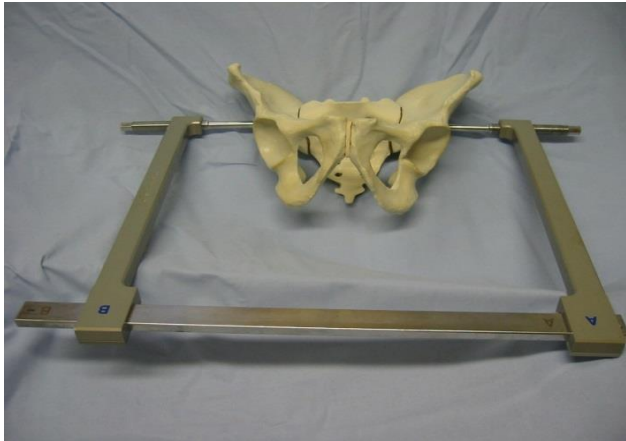
After 12 hours it is decided.

Options in case of pelvic hemorrhage?

circumferential sheets



c-clamp



pelvic binder



Circumferential sheets, pelvic binders, and c-clamps?

Injury, Int. J. Care Injured 44 (2013) 1760–1764



Contents lists available at [SciVerse ScienceDirect](#)

Injury

journal homepage: www.elsevier.com/locate/injury



Emergency stabilization of the pelvic ring: Clinical comparison between three different techniques



A. Pizanis^a, T. Pohlemann^a, M. Burkhardt^a, E. Aghayev^b, J.H. Holstein^{a,*}

^aDepartment of Trauma, Hand, and Reconstructive Surgery, University of Saarland, Kirrberger Strasse 1, 66421 Homburg, Germany

^bInstitute for Evaluative Research in Medicine, University of Bern, Stauffacherstrasse 78, 3014, Bern, Switzerland

Emergency stabilization of the pelvic ring by binders and c-clamps is associated with a lower incidence of lethal pelvic bleeding compared to sheet wrapping.

AO

Efficacy of emergency stabilization of the pelvis: registry data



Effectiveness and complications of primary C-clamp stabilization or external fixation for unstable pelvic fractures

Hagen Schmal^{a,*}, Morten Schultz Larsen^a, Fabian Stuby^c, Peter C. Strohm^d, Kilian Reising^e, Kelly Goodwin Burri^b

- **Decrease of mortality by 32%**
- **No increase in secondary complications or morbidity**
- **Except: 5-fold increased risk for infection when implantating an IS-screw following c-clamp**

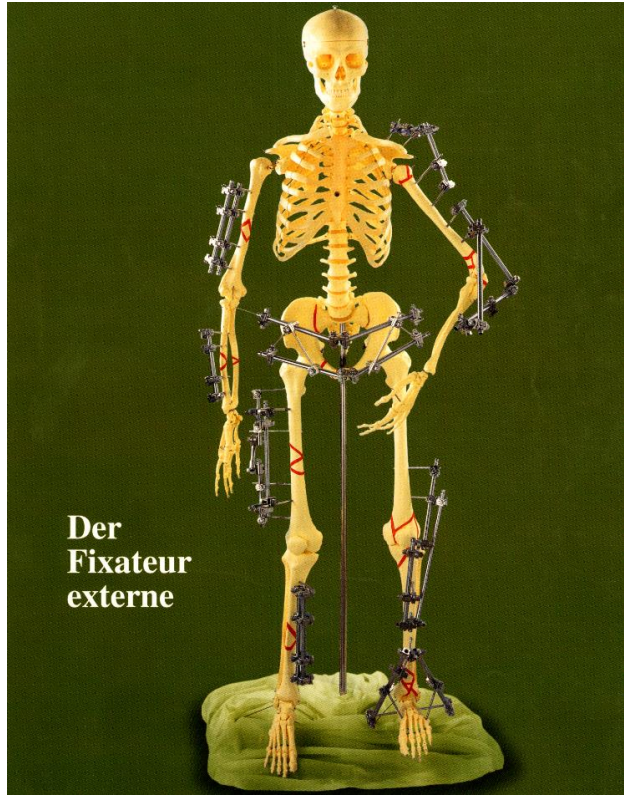
Evaluation: ATLS

American College of Surgeons
Student Course Manual, 8th Edition

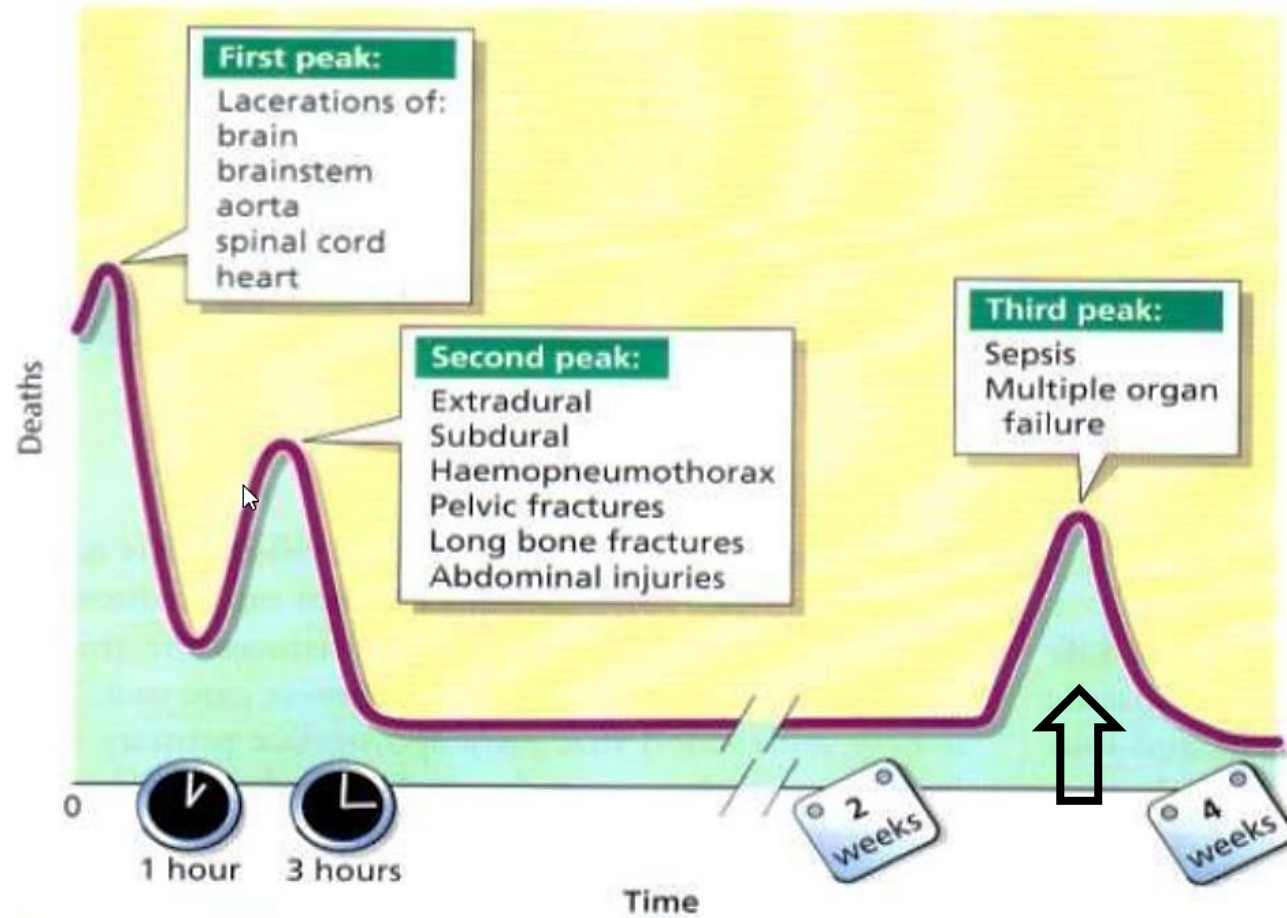
- A Airway maintenance with cervical spine protection
- B Breathing and ventilation
- C Circulation with hemorrhage control**
- D Disability: Neurologic status**
- E Exposure/Environmental control: Completely undress the patient, but prevent hypothermia



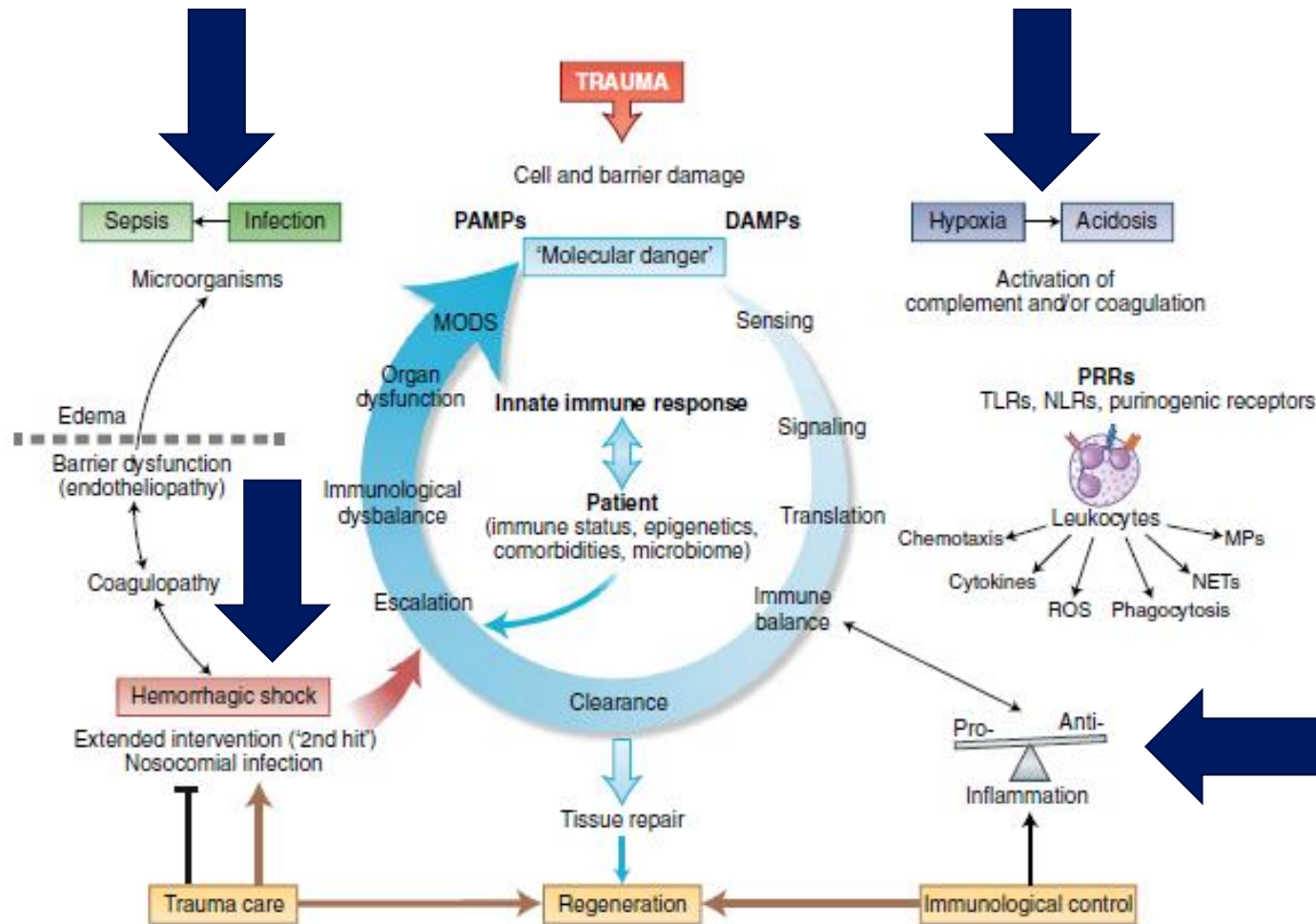
Working horse: external fixation



Death because of immunological consequences



Picture of immune response in multiply injured patients: complex

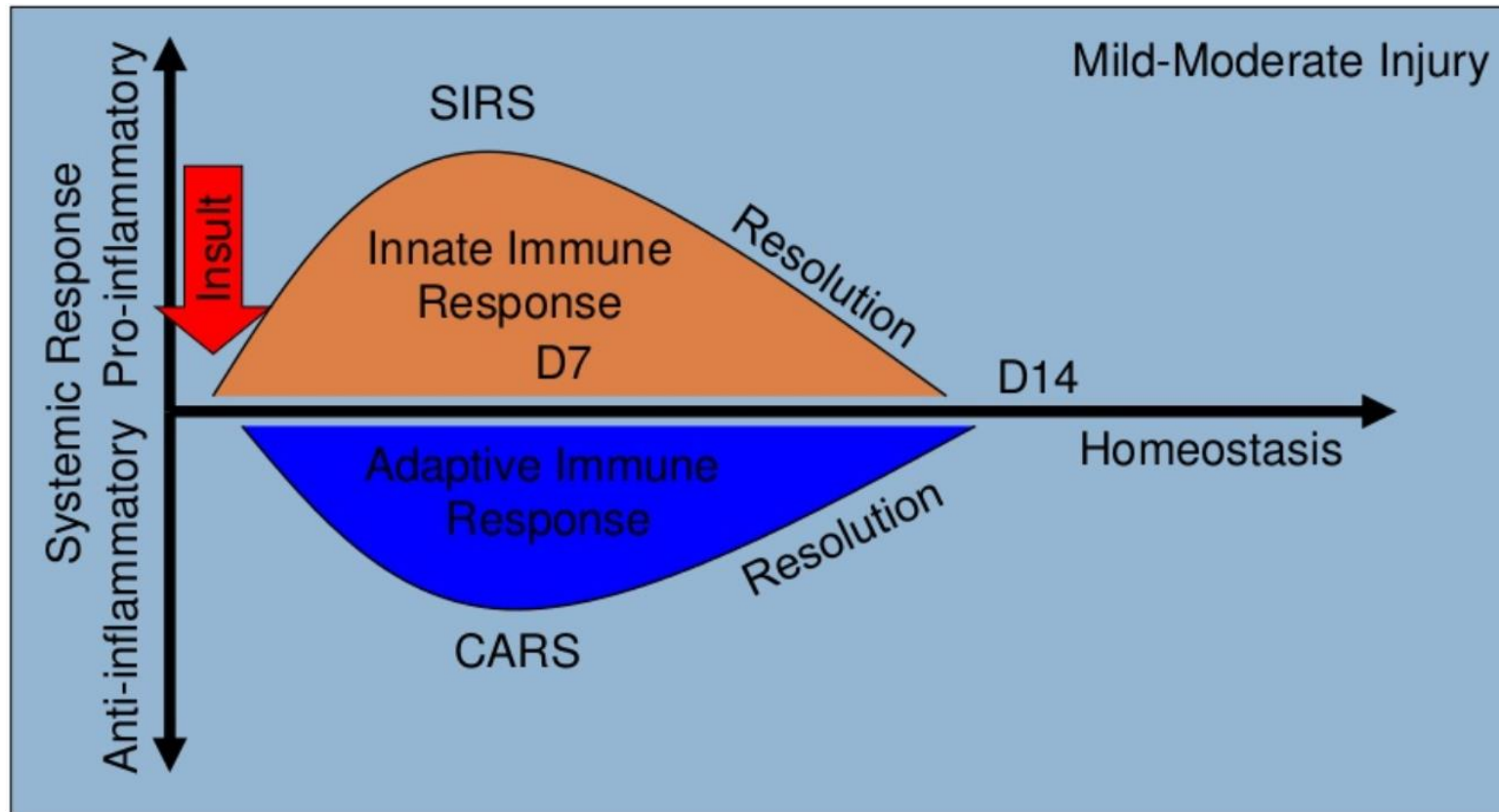


Innate immune responses to trauma

Markus Huber-Lang^{1*}, John D. Lambris² and Peter A. Ward³

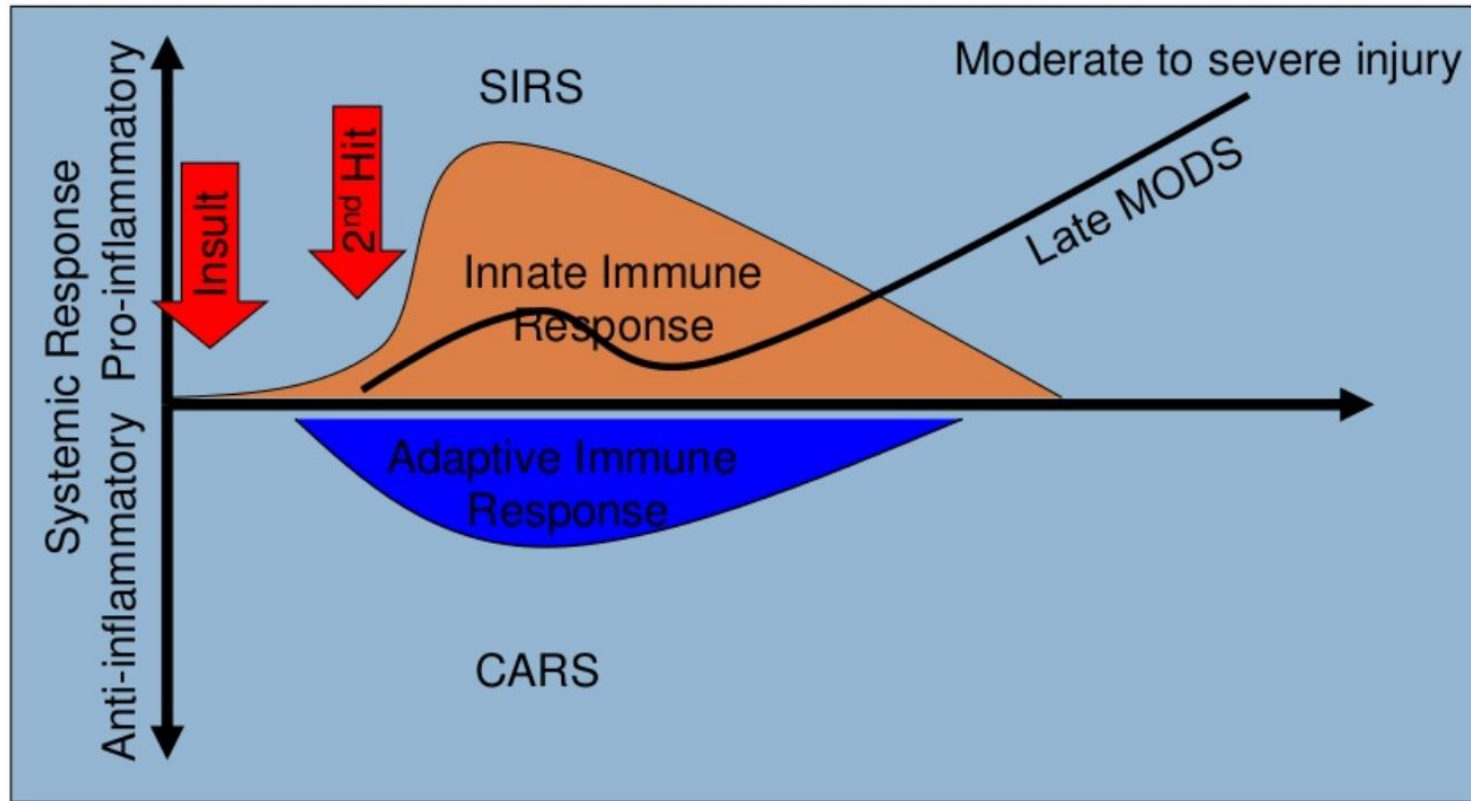
Trauma can affect any individual at any location and at any time over a lifespan. The disruption of macrobarriers and microbarriers induces instant activation of innate immunity. The subsequent complex response, designed to limit further damage and induce healing, also represents a major driver of complications and fatal outcome after injury. This Review aims to provide basic concepts about the posttraumatic response and is focused on the interactive events of innate immunity at frequent sites of injury: the endothelium at large, and sites within the lungs, inside and outside the brain and at the gut barrier.

Balanced immunological response



Balanced SIRS-CARS maintains homeostasis

Imbalanced immunological response



Imbalanced $SIRS > CARS$ leads to hyper-inflammation or delayed MODS

The Journal of Trauma: Injury, Infection, and Critical Care.

55(1):7-13, JUL 2003

DOI: 10.1097/01.TA.0000075787.69695.4E, , PMID: 12855874

Issn Print: 0022-5282

Publication Date: 2003/07/01

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DCO matters...

Impact of Intramedullary Instrumentation versus Damage Control for Femoral Fractures on Immunoinflammatory Parameters: Prospective Randomized Analysis by the EPOFF Study Group

Hans-Cristoph Pape; K. Grimme; Martin van Griensven; A. H. Sott; P. Giannoudis; J. Morley; Olav Roise; Elisabeth Ellingsen; Frank Hildebrand; B. Wiese; Christian Krettek

ORIGINAL ARTICLES

Impact of the Method of Initial Stabilization for Femoral Shaft Fractures in Patients With Multiple Injuries at Risk for Complications (Borderline Patients)

Hans-Christoph Pape, MD, FACS, Dieter Rixen, MD,† John Morley, MD,‡
Elisabeth Ellingsen Husebye, MD,§ Michael Mueller, MD,¶ Clemens Dumont, MD,|||
Andreas Gruner, MD,|| Hans Joerg Oestern, MD,** Michael Bayeff-Filoff, MD,††
Christina Garving,*** Dustin Pardini, PhD,‡‡ Martijn van Griensven, PhD,§§
Christian Krettek, MD, FRACS,¶¶ Peter Giannoudis, MD,‡ and the EPOFF study group*

AO

Primary Fixation and Delayed Nailing of Long Bone Fractures in Severe Trauma

H. P. Friedl, M.D., R. Stocker, M.D., B. Czermak, M.D., H. Schmal, M.D.,
and O. Trentz, M.D.

DCO



ETC

Early Definitive Fracture Fixation is Safely Performed in the Presence of an Open Abdomen in Multiply Injured Patients

Glass, Nina E. MD^{*,†}; Burlew, Clay Cothren MD^{*}; Hahnhaussen, Jens MD^{‡,§}; Weckbach, Sebastian MD^{‡,||}; Pieracci, Fredric M. MD^{*}; Moore, Ernest E. MD^{*}; Stahel, Philip F. MD^{‡,¶}

Journal of Orthopaedic Trauma: December 2017 - Volume 31 - Issue 12 - p 624–630
doi: 10.1097/BOT.0000000000000959
Original Article

TABLE 1. Group I and Group II results

Nailing on	Patients	Mean ISS	ARDS	Mortality
Days 1–4	32	21.4	8/32	4/32
Days 5–14	23	41.8	0	0

ISS, injury severity score; ARDS, adult respiratory distress syndrome.

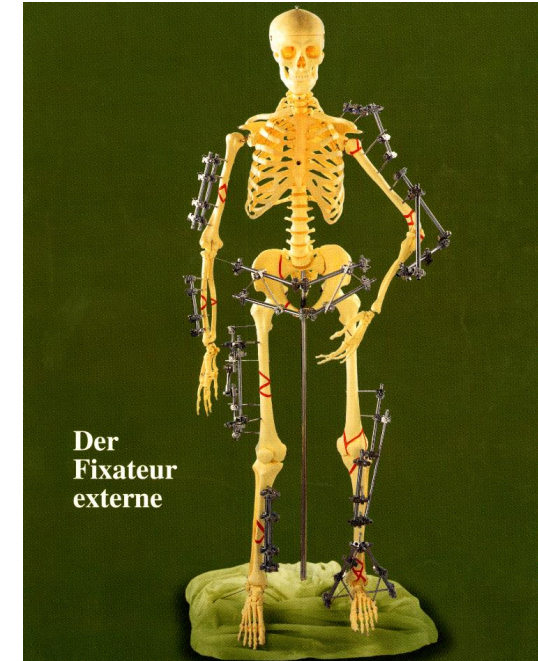
TABLE 2. Closed femoral and tibial fractures in the polytraumatized patient

ISS	Recommended stabilization method
Below 25	Primarily intramedullary nailing
Exceeding 40	Primarily external fixation, delayed nailing between days 5 and 14 after trauma

ISS, injury severity score.

The period between 24 and 72 hours is the most at-risk time.

- Conceptions
 - ‚Damage control‘ (unstable)
 - decreases the chances for a second hit
 - ‚Early total care‘ (stable)
 - Fractures are stabilized prior to the dangerous period.
- Borderline patients:
 - high ISS
 - hypothermia
 - coagulopathy



**In doubt be smart:
stabilize – not fix.**

Definition of „borderline patients“ is still a matter of debate

Journal of Orthopaedic Trauma: July 2021 - Volume 35 - Issue 7 - p e234-e240

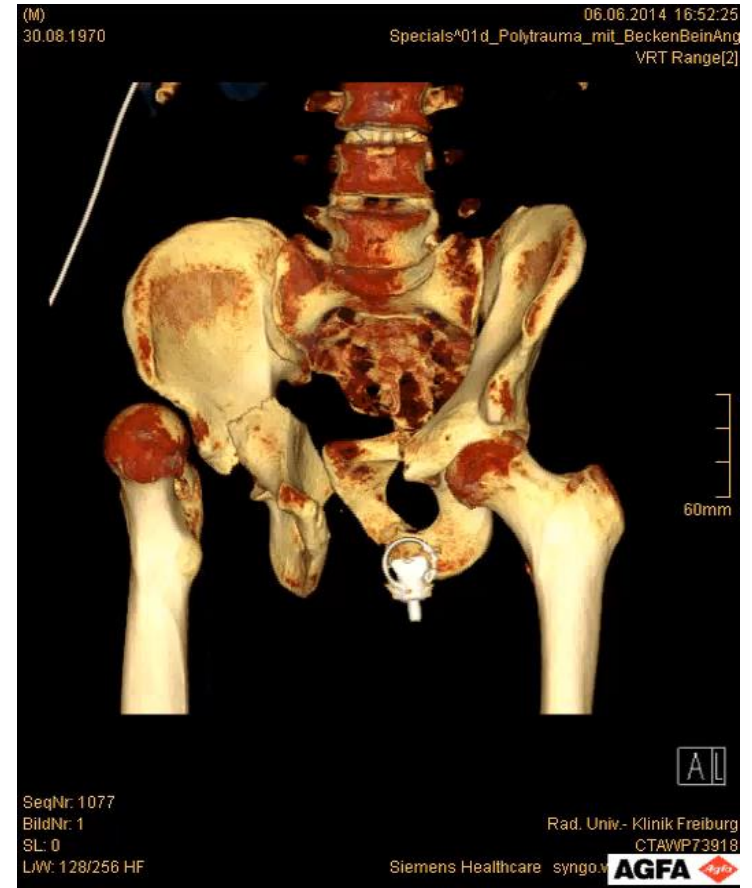
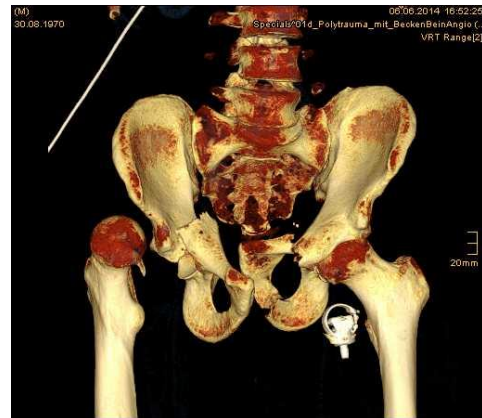
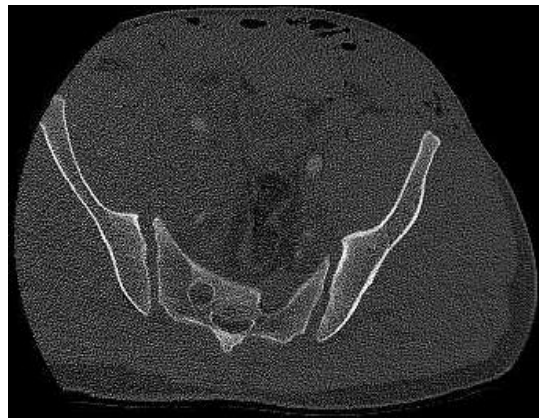


Definitive Surgery Is Safe in Borderline Patients Who Respond to Resuscitation

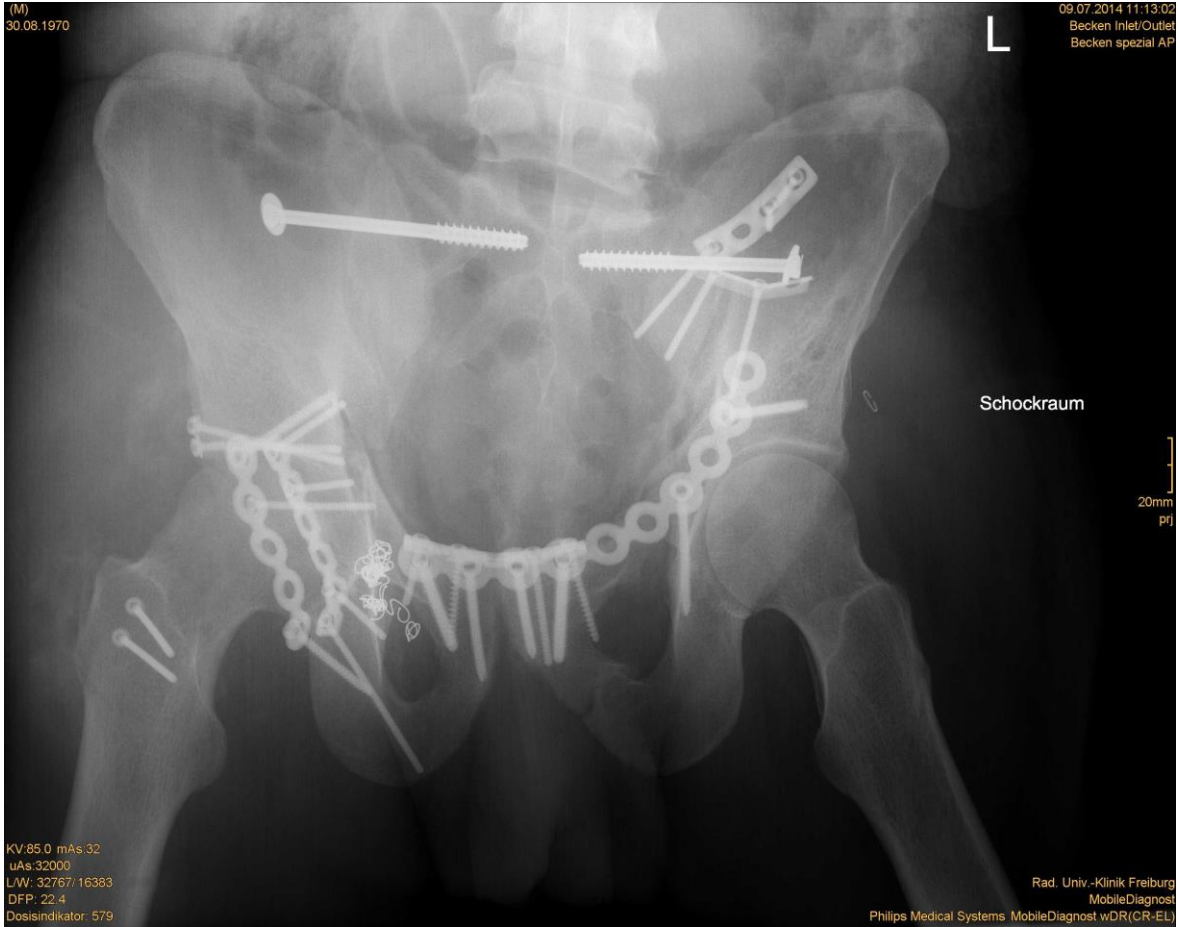
Jiong Hao Tan¹, Tian Yi Wu¹, Joel Yong Hao Tan¹, Si Heng Sharon Tan¹, Choon Chiet Hong¹,
Liang Shen², Lynette Mee-Ann Loo³, Philip Iau³, Diarmuid P Murphy¹, Gavin Kane O'Neill¹

Borderline polytrauma patients with no severe soft tissue injuries, such as chest or head injuries, may be treated with EDS if adequately resuscitated with no increase in need for postoperative ventilation and complications.

ER-CT



After about 15 hrs. operation time...



Educational challenges

- (1) thinking physiologically
- (2) applying damage control resuscitation and surgery
- (3) differing priorities and time management
- (4) impact of environment in pre-clinical or military situations
- (5) managing limited resources
- (6) facing lack of general surgical skills
- (7) encountering different cultural behavior and
- (8) ethical issues


World J Surg
<https://doi.org/10.1007/s00268-018-4460-x>

World Journal
of Surgery



ORIGINAL SCIENTIFIC REPORT

Decision-Making in Management of the Complex Trauma Patient: Changing the Mindset of the non-trauma Surgeon

Linda Sonesson^{1,6}  · Kenneth Boffard^{2,3,4} · Lars Lundberg^{1,2} · Martin Rydmark⁵ ·
Klas Karlgren⁶