Trauma treatment

- Represent a chain of health services in which outcome depends on all contributors where the weakest point can have a crucial effect on outcome
Purpose of Pelvic Lecture

• To present algorithms applicable in all clinical settings for treatment of the most severe and challenging orthopedic injuries

Frame

• The C problem first – pelvic bleed
  – Ullevål protocol
• Open fractures
• Urogenital injuries
### Management Pelvic Bleed - Open Fractures – Urogenital Injuries

#### Controversies in Pelvic Haemorrhage Control
- Great support for embolization in the US
- Packing in some European centres (Hannover)
- Combination packing/embolization

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#### Embolization - Applicable in all Settings?
- Is not available in either small or all regional hospitals which constitutes the basis of the health care system in Nordic countries
Embolization - Applicable in all Settings?

- Angio suite is usually located far away from the ER
Strategies for Haemorrhage Control

- Venous - Packing/fracture reduction
  Post-mortem studies by Huittinen og Slatis 73
- Bony site - Fracture reduction
- Arterial - Embolization/(Packing)
  - Internal iliac branches

Management Pelvic Bleed - Open Fractures – Urogenital Injuries

Protocol for Pelvic Bleeding Ullevål University Hospital (Established 1994/1995)

Severe bleeding

Fracture stabilization
  Bed sheet (sling)

Tolerate transfer from ER to angio

Patient in Extremis

Ekstraperitoneal packing

Angio and embolisation
Angiography

- Angiography and embolization is the most effective treatment in pelvic bleed
- Angio suite in Admission ward
  - “The surgeon is the greatest threat to survival”

Ben-Menachem, 1994, Pelvic congress, Pittsburgh

Bleeding Control in Pelvic Injuries
Fracture Reduction and Stabilization

Embolization
Main method

Ekstraperitoneal packing
Alternative in severe cases

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Management Pelvic Bleed - Open Fractures – Urogenital Injuries

Initial Treatment – Options for Fracture Reduction/Stabilization

- Reduction of pelvic fracture by traction
- External fixator
  - Time consuming procedure in inexperienced hands
  - C-clamp - Potentially hazardous procedure in inexperienced hands

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Management Pelvic Bleed - Open Fractures – Urogenital Injuries

Initial Treatment – Options for Fracture Reduction/Stabilization

- Reduction by traction
- Bed sheet (Pelvic binder)
  - Effective and simple procedure

C Routt et al, J Orthop Trauma, 2002

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Management Pelvic Bleed - Open Fractures – Urogenital Injuries

Clinical case

Pelvic Bleed – Embolization or Packing?

- The decision has to take into account;
  - The clinical status
  - Is angiographic service available?

If the answer is no

Consider packing

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JC Krieg et al, J Trauma, 2005
Extraperitoneal or Intraperitoneal Packing?

Abdominal Compartment Syndrome (ACS)
Severe Complication to Laparotomy

- ACS
  - Compromised renal, pulmonary and GI function
  - Might be lethal
    - 5% of 311 patients with laparotomy developed ACS

Ertel et al., Crit Care Med, 2000, 28:1747-53
Complications - Intraperitoneal Pelvic Packing

- High incidence of abdominal compartment syndrome (ACS)
  - 5/14
  - 5/14 died
    - 4 early and one late due to MOF

Ertel et al. J Orthop Trauma, 2001

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The Rationale for Extraperitoneal Packing
The Rationale for Extraperitoneal Packing

- Surgical dogma states; Never go into retroperitoneal haematoma –
- Bleeding is localized in the true pelvis

The abdominal cavity is large and outside the true pelvis
Limitations of Intraperitoneal Packing

- The filling up with dressings to the abdominal cavity has at most an indirect effect on bleeding in the true pelvis.
- Necessitates high pressure in the abdominal cavity with risk of abdominal compartment syndrome (ACS).

Rationale for Extraperitoneal Pelvic Packing
Removal of Dressings

• Second look after 48 hours
  – Internal fixation if bleeding control and patient otherwise fit
• Repacking if rebleeding

Sheet Complications
Treatment of Venous Stases

• Reduce sheet pressure
• Convert sheet to external fixation
  – Very seldom necessary
Initial Treatment at Rural Hospital

- Bleeding
  - Stable for transfer
    - Fracture stabilization
      - Bed sheet, ex fix
    - Transfer trauma unit with angio service
  - Circulatory unstable
    - Not suitable for transfer
    - Ekstraperitoneal packing and fracture stabilization

Initial Treatment in Hospitals with Angio Service

- Bleeding
  - Stable for transfer to angio suite
    - Fracture stabilization
      - Bed sheet, ex fix
  - Circulatory unstable
    - Not suitable for transfer
    - Ekstraperitoneal packing and fracture stabilization

Angiography
Indication for Angiography

- >6 units of packed erythrocytes during the first 24 hours
- >4 units of packed erythrocytes per 24 hours after day one

Indication for Packing

- Unstable circulation
  - Hypotension (< 90 mmHg)
  - Without response to fluid resuscitation
  - Clinical judgement depending on facilities
    - Local hospital without angio services
    - Trauma centre without radiological interventional services during night/weekends
    - Angio suite in the ER
Results
Ullevål University Hospital

Extraperitoneal Pelvic Packing: A Salvage Procedure to Control Massive Traumatic Pelvic Hemorrhage

Anna Tottersen, MD, Jan Erik Madsen, MD, PhD, Nils Oddvar Skaga, MD, and Ole Reise, MD, PhD

Objective: To describe the method of extraperitoneal pelvic packing (EPP), and to assess the impact of EPP on outcome in severely hemodynamically unstable patients after blunt pelvic trauma.

Methods: Of 645 patients treated for pelvic trauma, 16 underwent EPP as part of our protocol with the intent to control massive pelvic bleeding and constituted the study population. Data retrospectively collected from the medical records and from the Ullevål Trauma Registry included demographics, fracture classification, additional injuries, blood transfusions, surgical interventions, angiographic procedure, physiologic parameters, and survival.

Results: Survival rate within 30 days was 72% (15/18), and correlated inversely to the age of the patient (p = 0.038). Only one of the nonsurvivors died of exsanguination. A significant increase in systolic blood pressure (SBP) (p = 0.002) was observed immediately after EPP. Angiography performed after EPP was positive for arterial injury in 80% of patients. All types of pelvic ring fractures were represented.

Conclusions: EPP as part of a multilocational resuscitation protocol might be life saving in patients with life-threatening pelvic injury who are exsanguinating. However, the high rate of arterial injuries seen after EPP indicates that the procedure should be supplemented with angiography once the patient is sufficiently stabilized to tolerate transportation to the angiography suite.

Key Words: Pelvis, Hemorrhage, Outcomes, Damage control, Trauma.

72% survival, one patient died of bleeding
Management Pelvic Bleed - Open Fractures – Urogenital Injuries

- 18 of 661 were packed extraperitoneally
  - by resident on call
- ISS was 47 (9 – 66)
- 7 of 18 (39 %) had no measurable BP on arrival
- Emergency thoracotomy with clamping of aorta in 4 patients
- Survival rate within 30 days was 72 % (13/18)
- 5 patients died
  - 2 patients within 24 hours
    - 1 of exanguination due to pelvic bleeding
    - 1 of severe head injury
  - 3 of the 4 patients treated with aorta clamping and EPP died later of MOF (day 2, 9 and 28)

Toetteman et al. 2007, J Trauma;62:842-53

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How Effective is Extraperitoneal Packing on Arterial Bleed?
Effect on Arterial Bleeding?

- A subgroup of 5 patients who went to angiography after EPP with a negative angiogram were studied
- Retrospective analysis of angiograms showed
  - Reduced caliber of either the external or internal iliac or the left obturator artery in three
  - Delayed flow in the right internal iliac artery in one
  - Occlusion of the right internal iliac artery in one

Nordaas et al 2002
Occluded internal iliac artery by the packing

Decision making
Open fractures
Diagnostics

- AP film (primary survey)
- Clinical examination with packing of bleeding wound
  - The back
  - Perineum

Circulatory Unstable

Treat the greatest threat to life first

Follow the protocol for bleeding
Circulatory Stable

- Secondary survey
  - CT of the pelvis for planning emergent stabilization of the fracture
    - Internal preferred
    - External if necessary resources are not available

Assessment Occult Open Fracture

- Colon contrast examination is not sensitive
  False negative in this case
Assessment Occult
Open Fracture

Haemorrhage in introitus
Blood on examining finger after rectal or vaginal examination

Vaginal speculum examination
Proctoscopic and sigmoidoscopy examination of rectum

Management Pelvic Bleed
- Open Fractures
- Urogenital Injuries

Decision Making
Urogenital Injuries
When should urogenital injuries be suspected?

- Severe open book injury (B1)
- Vertical unstable shear fractures (C)
- Lateral compression injuries with anterior major displacement (B2)
- Scrotal haematoma
- Blood in meatus

If injury to the urogenital system is suspected, passing the catheter should not be carried out before injury to the urethra is ruled out by urethra/cystography as adjunct to secondary survey.
Treatment

• Team approach (urologist and orthopaedic pelvic surgeon)
• Early (primarily) reestablishment of the urinary tract or suprapubic catheter

Conclusion

• The sling/sheet for stabilizing fracture when bleeding
• Embolization is the definitive treatment for arterial bleeding
• Extraperitoneal packing is a simple and life saving procedure
  • Should be trained in all hospitals treating emergencies
Conclusion

- Open fractures are treated according to the bleeding protocol when bleed
  - Early internal fixation is the “undocumented” golden standard
- Urogenital injuries should be suspected in all severe pelvic injuries (Open book, Vertical shear, dislocated fractures close to the symphysis)