

ANGIOGRAPHIC INTERVENTION IN PELVIC BLEEDING

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Introduction

Pelvic fractures ~ 10 % of all blunt abdominal traumas

- of these ~ 10 % are severe

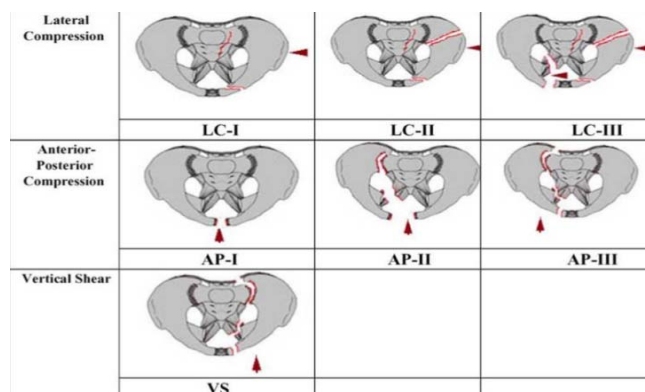
Uncontrolled pelvic bleeding has a high mortality rate

- 60 % of early deaths in crush injuries are due to bleeding

Mechanisms of injury

Study	n	MVC	PV	FFH	MC	Other
Poole, Ward 1994	348	228 (66%)	46 (13%)	16 (5%)	19 (5%)	39 (11%)
Demetri-Ades 2002	1545	605 (39%)	647 (42%)	180 (12%)	47 (3%)	28 (2%)
Henry et al 1997	234	150 (64%)	44 (19%)	22 (9%)		17 (7%)
Totals	2127	983 (46%)	948 (45%)	218 (10%)	66 (3%)	84 (4%)

Classification of pelvic fractures



Pelvic bleeding

Increases with pelvic instability and larger pelvic volume

Lateral compression III: 60%

Anterior compression III: 52%

Vertical Shear: 40%

Loss of pelvic integrity prevents tamponade by hematoma

- blood escapes to peritoneum, buttocks and retroperitoneum

Associated injuries

Tötterman A et al. Acta Orthopaedica 2006; 77:462

Order of frequency in 31 embolized:

- Lower extremity fracture
- Cardiopulmonary injury
- Cerebral injury
- Upper extremity fracture
- Abdominal injury

When to do angiography/embolization?

Impact of early embolization

Pelvic fracture related hemodynamic instability

(6 u RBC < 12 hrs, ISS > 15, acidosis)

Exclude major intra-abdominal injury in first 15 min.

Pelvic binding in first 15 min.

Angiography within 90 min.

Minimally invasive pelvic fixation within 24 hours

Survival improves from 65 % to 93 % !

Balogh J Trauma 2005; 58:778

Surgery - not always the answer!

Difficult to localize bleeding

Proximal arterial ligation is not always successful

External stabilization does not increase retroperitoneal pressure enough to stop bleeding

Even after stabilization, mortality is 10-20 %

But early pelvic stabilization reduces bleeding by reapproximating bone fragments and reducing the volume of the pelvic cavity

Who needs embolization...

After resuscitation and pelvic stabilization 5-20 % of patients will need embolization to control bleeding

Risk of death increases considerably for each 1 U/hour increment in blood transfusion requirement

Embolization serves best before transfusion related coagulopathy develops

- if delayed 10-20 % mortality even with technically successful embolization

Extravasation....

Be aware, in almost 30 % of patients with pelvic fractures, extravasation is not seen

When an artery is occluded, there is a chance for resolution of possible thrombus and potential re-bleeding

Arteries of the pelvis

Variations: Common trunk of both divisions 10%. Obturator artery arising from inferior epigastric artery 22%. Inferior gluteal artery arising from superior gluteal artery 25%. Accessory internal pudendal artery 6%. Lateral sacral arteries, may be multiple.

Order of frequency:

- A. Glutealis sup
- A. Pudendalis int.
- A. Obturatoria
- A. Glutealis inf.
- A. Sacralis lat.
- A. Epigastrica inf.
- A. Circumflexa iliaca

Arterial injury

- Intimal tear
- Complete transaction
- Intramural hematoma
- Acute AVF
- Spasm

Pitfalls

- Uterine blush
- Stain at base of penis
- Anatomic variants

Embolization

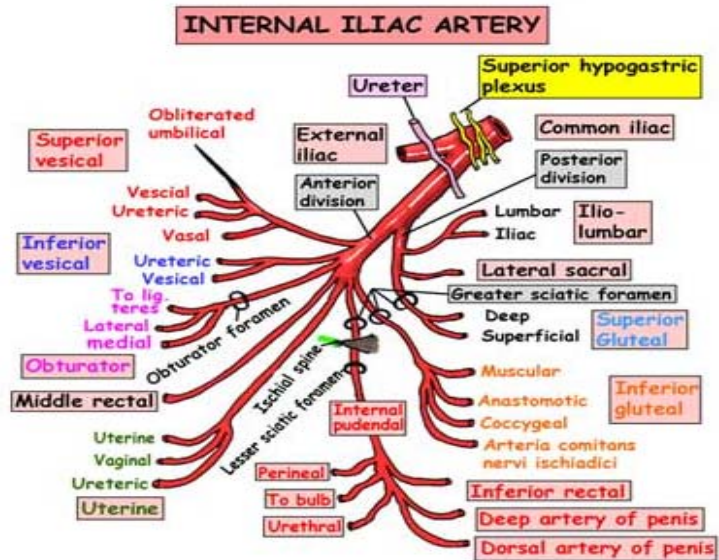
- Primary goal: achieve hemostasis expeditiously (preferably superselective)
- Use gelfoam or coils, size to vessels, or Amplatzer plug
- Do not use glue, autologous clots, PVA, gelfoam powder, alcohol

Gelfoam AII technique

- Scatter technique for multiple bleeding sites: 2 mm pieces introduced in a pulsatile fashion
- Empirical bilateral AII embolization is tolerated in unstable patients (even if extravasation is not seen)
- Embolize until extravasation stops on angiography

Complications

- Most complications are acceptable in light of alternative
- Non-target complications seldom occur due to rich visceral supply



Male impotence is very rare, more likely related to injury

Gluteal necrosis is seen, often due to initial deep traumatic contusion

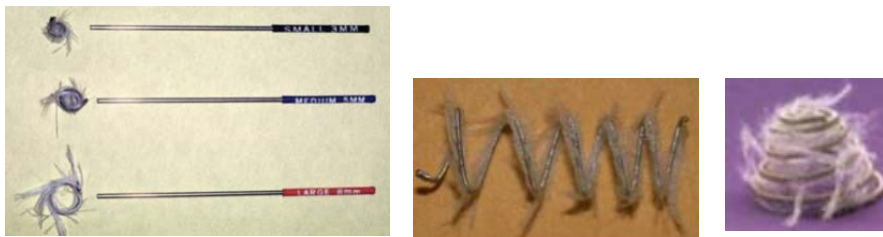
Coils

more frequently used as a superselective embolic agent

depending on intact clotting cascade

the fibers induce a thrombogenic response

can fail if patient becomes coagulopathic



Nester coils

0.035 and 0.038 G platinum coils

14 cm long, 4-12 mm diameter

Micronesters 0.018, 3-10 mm diameter

Tornado 0.035, small 3-5 mm, large 4-10 mm, lengths 2.6-12.5 cm

Protocol for angiographic embolization in exsanguinating pelvic trauma

Tötterman A et al. Acta Orthopaedica 2006; 77:462

After pelvic reduction and stabilization with a sheet, and excluded thoracic and intra-abdominal hemorrhage, patient was transferred to the angio-suite if:

1. Initially stable patient, but protracted hemorrhage (>4 RBC/24H within following days)
2. Hemodynamically unstable patient (clinical signs + and >6 RBC within first 24 hrs from admission)

- 1260 pelvic traumas over 8.5 years
- 4 % (46) had angiography
- 2.5 % (31) required embolization
- Only 34 % (of 31) had unstable fractures
- Internal iliac branches were injured in 28/31
- Multiple arterial injuries in 6
- Arterial injury was noted even with isolated acetabular (4/31) and sacral (3/31) fracture
- Survival rate after embolization was 84 %
- Mortality and injury scores higher in embolized patients
- 3 cases of gluteal muscle necrosis
- No embolization related complications
- Mortality 16 % despite successful embolization, but no mortality due to bleeding!

Thank you!