Endovascular treatment of pelvic trauma

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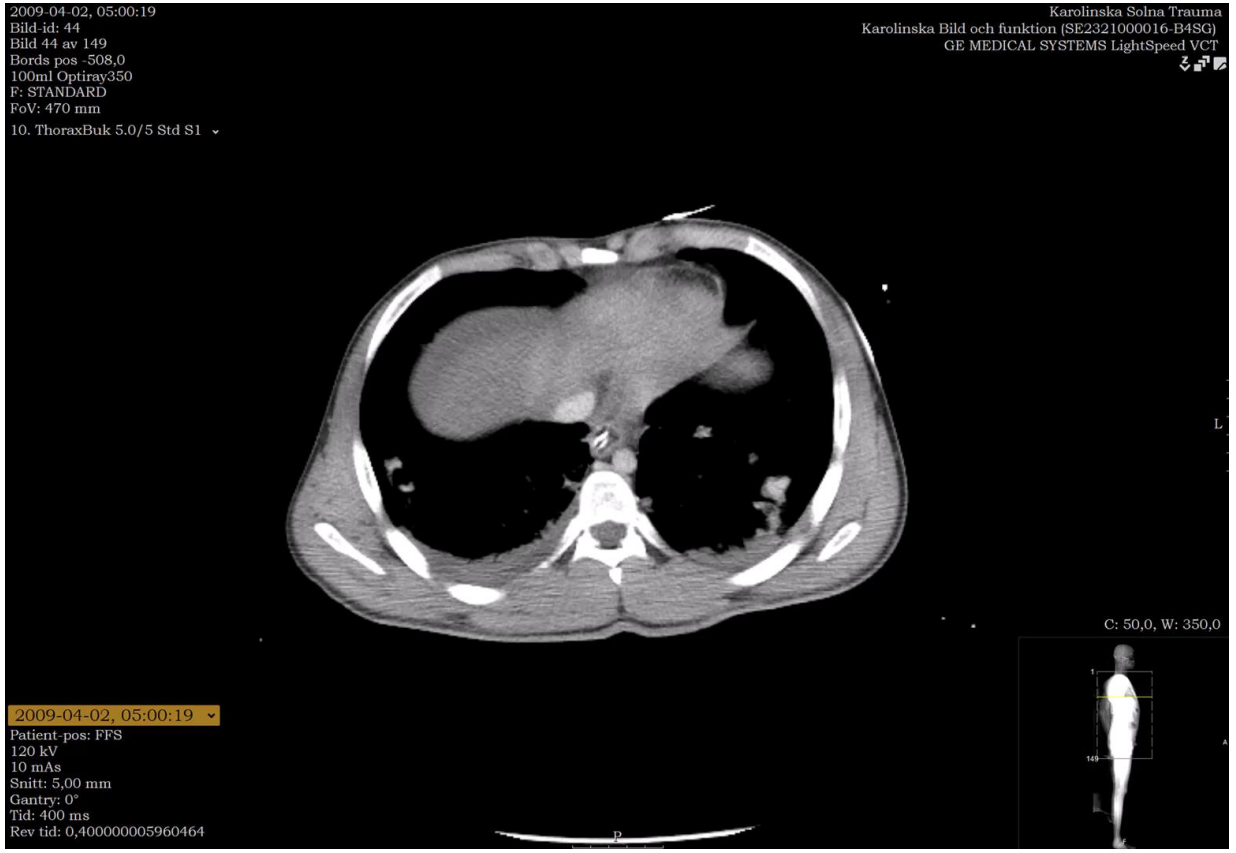
Case 1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10. ThoraxBuk 5.0/5 Std S1
Karolinska Solna Trauma
Karolinska Bild och funktion (SE2321000016-B4SG)
GE MEDICAL SYSTEMS LightSpeed VCT
L
C: 50,0, W: 350,0
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Case 1

Unknown M, motorbike accident.

CT on arrival: Multiple injuries including…

- TBI with cerebral oedema, SDH + SAH
- Large L-sided retroperitoneal haematoma w. ongoing L-sided pelvic bleeding
- Suspected renal lacerations
- Multiple fractures, including…
  - Pelvis (pelvic binder in situ on arrival)
  - Scapula
  - Femur, fibulae, ankle, foot

Pelvic trauma

- Haemorrhage most common cause of preventable death after trauma (Jansen 2023).
- Global Burden of Disease Study 2019: 6 million incident cases, 18.8 million prevalent cases of pelvic trauma (Hu 2023) .
- Pelvic fractures with haemodynamic instability carries up to 50% mortality (Franco 2020).
- 80% bleeding in pelvic fracture venous, 20% arterial (Coccolini 2017).
- Up to 20% of patients will need angiography and intervention (Geschwind 2014).

Jansen *et al*. Emergency Department Resuscitative Endovascular Balloon Occlusion of the Aorta in Trauma Patients With Exsanguinating HemorrhageThe UK-REBOA Randomized Clinical Trial *JAMA.* 2023;**330**:1862-1871

Hu *et al*. Epidemiology and burden och pelvic fractures: Results from the Gloval Burden of Disesase Study 2019 *Injury* 2023 **54**;2;589-597

Franco DF, Zangan SM. Interventional radiology in pelvic trauma Semin Intervent Radiol 2020 ;37: 44-54

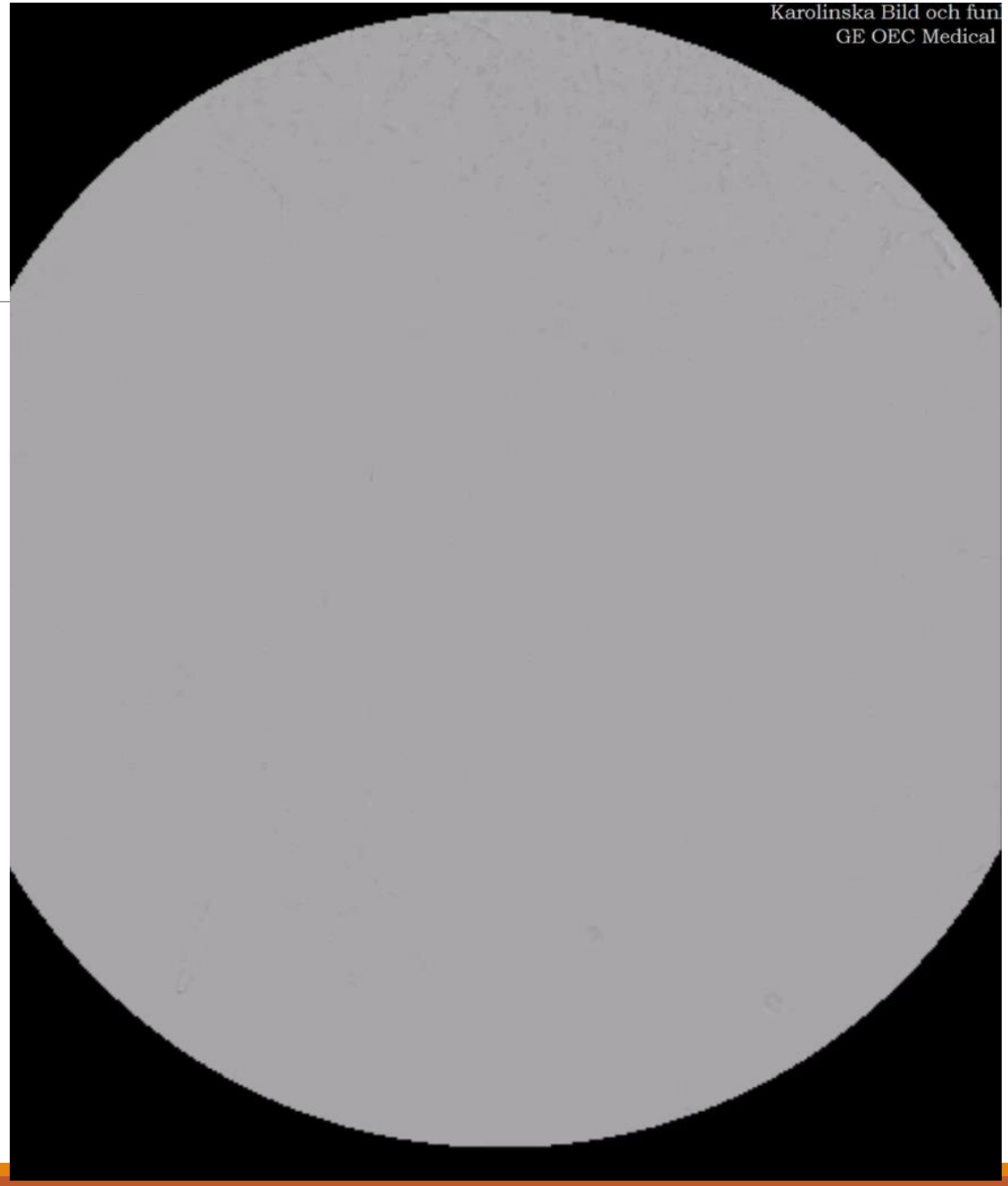
Coccolini, F et al. Pelvic trauma: WSES classification and guidelines. *World J Emerg Surg* **12**, 5 (2017). https://doi.org/10.1186/s13017-017-0117-6

Geschwind J-FH, Dake MD. Angiographic management of Hemorrhage in Pelvic Fractures. In: Abrams Angiografphy Interventional Radiology. Lippincott Williams & Wilkins 2014: 841-851

Case 1

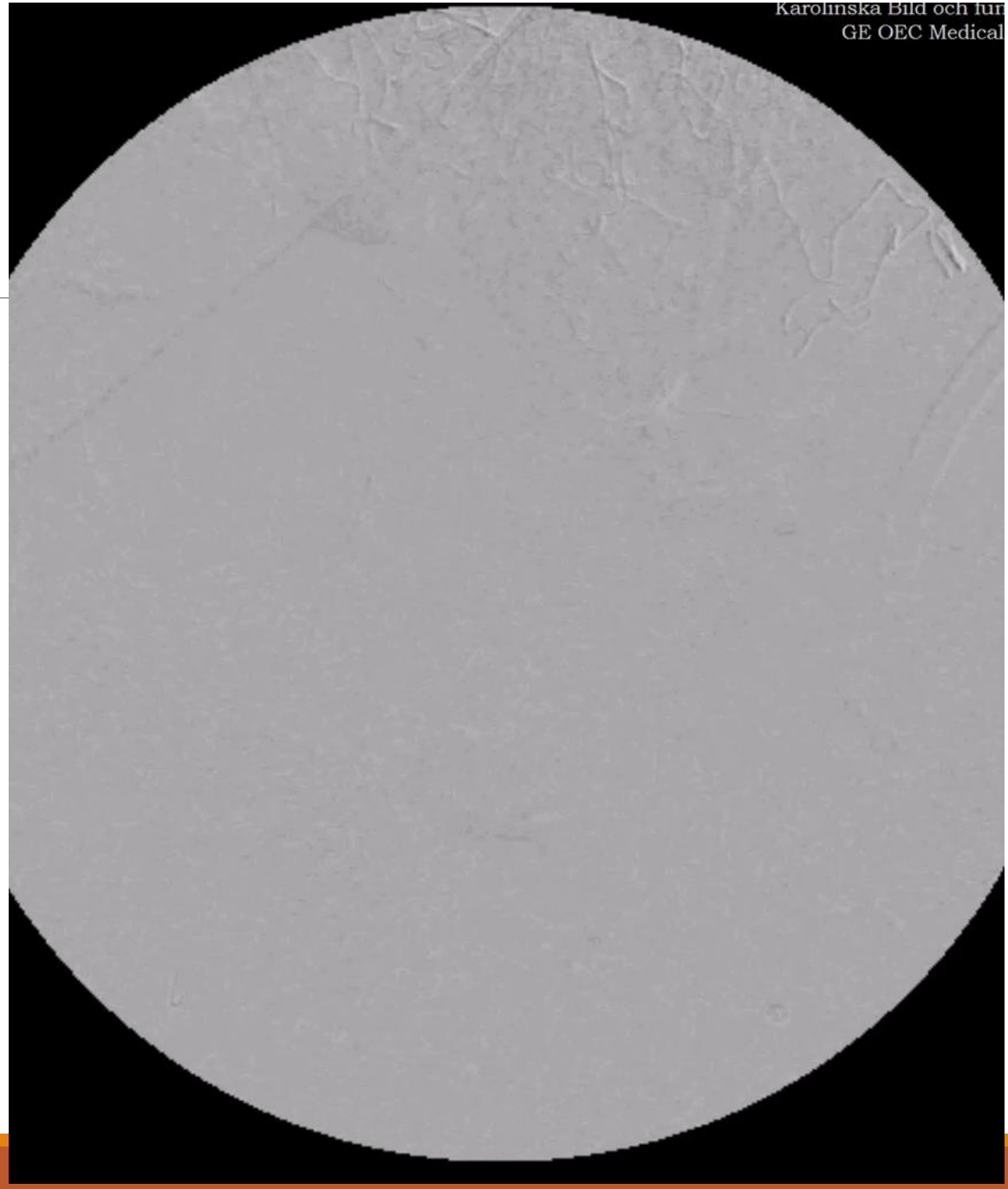
Immediately taken to trauma theatres, IR referral for intraoperative embolisation.

Brisk bleeding from several branches of the left IIA.



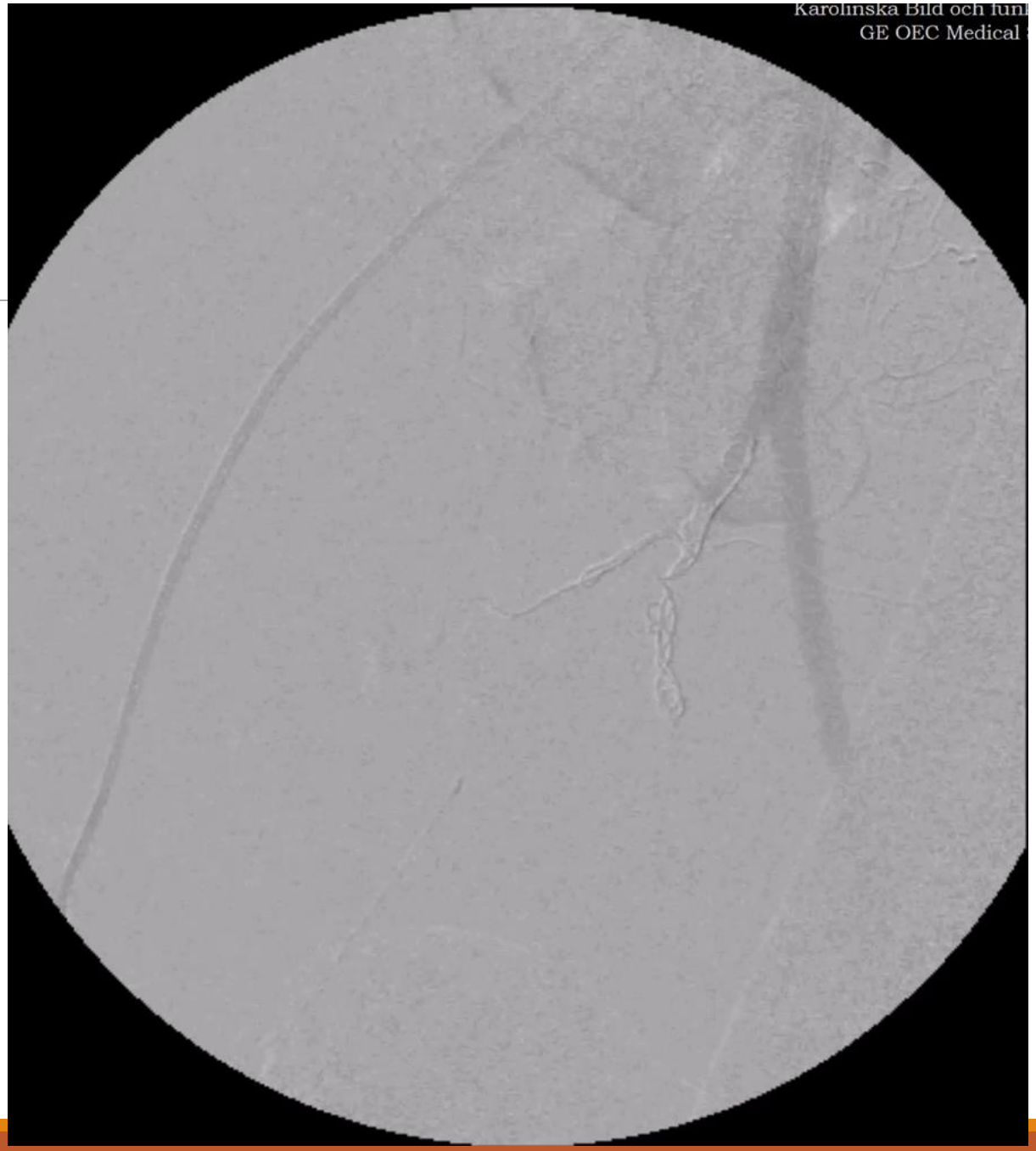
Case 1

Immediate injection of Gelfoam slurry into the IIA
→ temporary haemostatic control.



Case 1

Final run, permanent occlusion of the L IIA with coils.



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Embolisation in pelvic trauma

Immediate haemostatic control available through

- Preperitoneal pelvic packing
- REBOA deployment (also in a pre-hospital setting)
- Angiography + embolisation (AE).

- Of these, only AE has been shown to reduce mortality (OR 0,62, 95% CI 0,47-0,82) (Anand 2023)
- Longer time to AE, repeat AE, higher age, haemodynamic instability on arrival and need for blood transfusion correlate with increased mortality (Tanizaki 2014, Shapiro 2005, Hagiwara 2003).

Anand *et al*. Association Between Hemorrhage Control Interventions and Mortality in US Trauma Patients With Hemodynamically Unstable Pelvic Fractures *JAMA Surg*. 2023;**158**: 63-71

Tanizaki *et al.* Time to pelvic embolization for hemodynamically unstable pelvic fractures may affect the survival for delays up to 60 min. *Injury*. 2014;**45**:738–41.

Shapiro *et al*. The role of repeat angiography in the management of pelvic fractures. *J Trauma*. 2005;**58**:227–31

Hagiwara *et al*. Predictors of death in patients with life-threatening pelvic hemorrhage after successful transcatheter arterial embolization. *J Trauma*. 2003;**55**:696–703.

Embolisation in pelvic trauma: How?

Transfemoral access, if practicable → US guided.

Often need to remove (partially) any pelvic binders in situ for access to groin.

Aortogram using side-hole catheter(use injector, volume ≈ 20ml, flow rate ≈ 15-20ml).

Multiple projections.

Selective catheterisation of pelvic +/- lumbar vessels for selective or non-selective embolisation if extravasation seen.

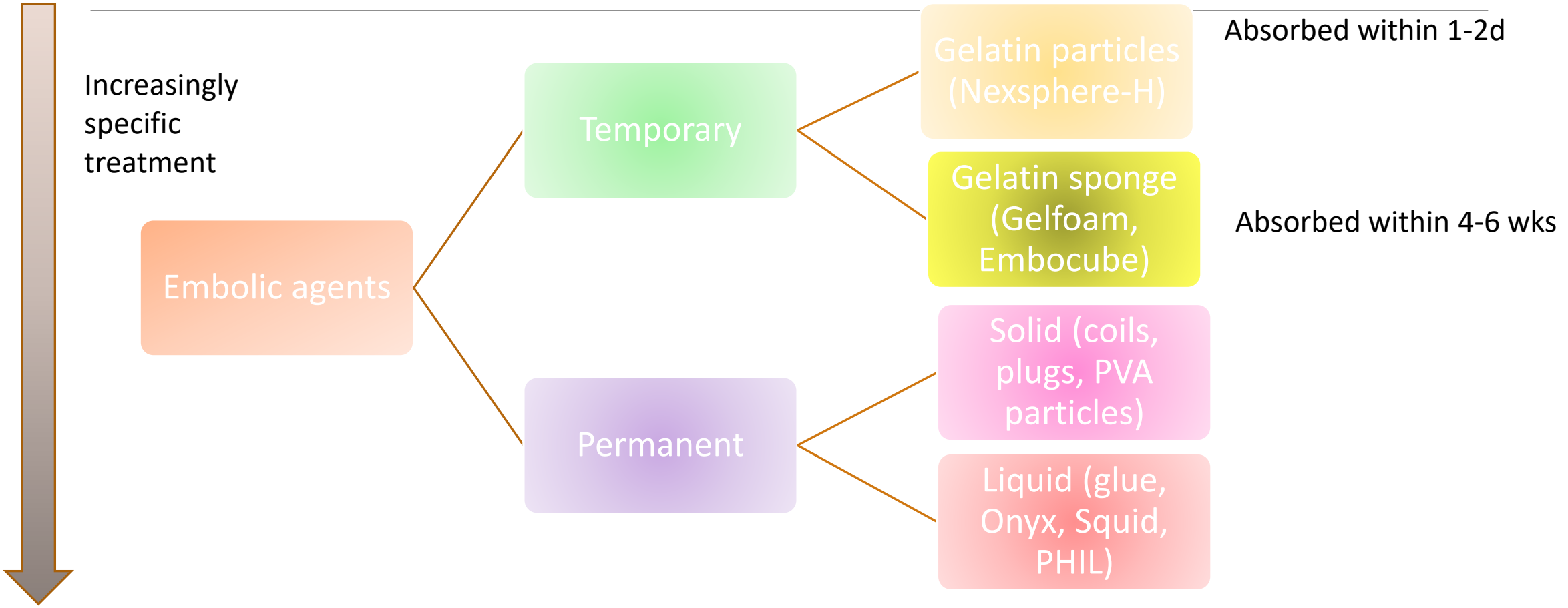
NB! Risk of false-negative angiogram compared with CT (possibly r/t vasospasm, reduced sensitivity).

Vascular territories and injury patterns

Artery	Territory supplied	Common associated injuries
Superior gluteal	Piriformis/ gluteal muscles	Iliac, posterior pelvic ring
Internal pudendal	Perineum, anal/ urogenital triangles	Anterior pelvic ring
Obturator	Obturator internus/ thigh adductors	Acetabular, pubic rami
Inferior gluteal	Piriformis/gluteals/ hamstrings	Iliac, posterior pelvic ring
Lateral sacral	Piriformis/sacrum/ erector spinae	Sacrum
Iliolumbar arteries	Psoas major/iliacus	Iliac crest, sacroiliac joint disruption

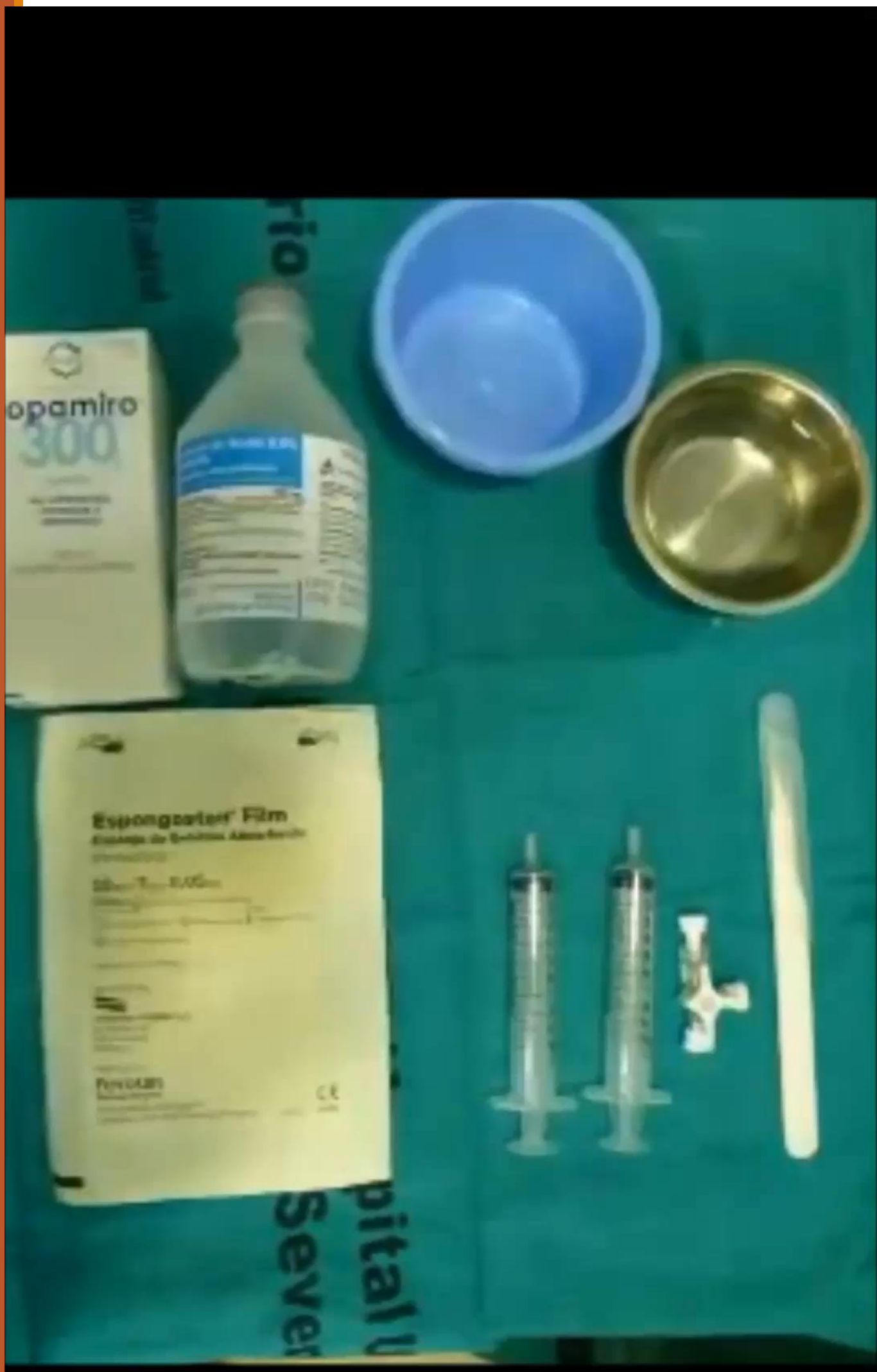
Adapted from Franco 2020

Embolisation in pelvic trauma: Embolic agents



Approaches to embolisation

Injury type	Embolisation technique and approach	Potential issues
Multifocal bleeding sites/brisk bleeding/haemodynamic instability	Proximal/non-selective injection of temporary embolisation agent (e g Gelfoam)	Non-target embolisation (reduced risk of permanent injury due to recanalisation & collateral blood supply.
Large vessel injury	Coil embolisation, stent graft, plug	If occlusion necessary, risks of ischaemia
Pseudoaneurysm	Coil embolisation, stent grafting	Possible later recanalisation/endoleak
Traumatic A-V fistula	Coil embolisation, plug	Migration of coils through shunt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300
Espongaster Film

Am J Surg. 2020 Aug;220(2):454-458. doi: 10.1016/j.amjsurg.2019.12.013. Epub 2019 Dec 31.

Bilateral internal iliac artery embolization for pelvic trauma: Effectiveness and safety

Alexander Bonde [a, b], Andriana Velmahos [a], Sanjeeva P. Kalva [c], April E. Mendoza [a], Haytham M.A. Kaafarani [a], Charlie J. Nederpelt [a, 1, *]

[a] Division of Trauma, Emergency Surgery and Surgical Critical Care, Massachusetts, General Hospital, Harvard Medical School, Boston, United States
[b] Department of Anesthesia, Center of Head and Orthopedics, Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark
[c] Division of Interventional Radiology, Massachusetts General Hospital, Harvard Medical, School, Boston, United States

- Retrospective, 2008 – 2018. n=61/9656
- Bilateral embolisation of internal iliac arteries together with external fixation.
- Gelfoam was used for 100% of procedures.
- Bleeding control clinically and angiographically > 90%.
- No complications reported after AE!

J Orthop Trauma. 2018 Sep;32(9):445-451.

Bilateral Internal Iliac Artery Embolization Results in an Unacceptably High Rate of Complications in Patients Requiring Pelvic/Acetabular Surgery

Eric Lindvall [1], Jason Davis, Armen Martirosian, Gustavo Garcia, Lisa Husak

- Comparison of surgical wound infections, necrosis, and/or fracture non unions between the embolisation group (n=50) and a control group (n=61)
- Gelfoam
- Significantly higher complications were noted in the AE group than in the control group (20% compared with 4.9%; P = 0.020).

Renzulli et al. Eur J Med Res (2021) 26:123

European Journal of Medical Research

REVIEW Open Access

Proposal of standardization of every step of angiographic procedure in bleeding patients from pelvic trauma

Matteo Renzulli[1,2*], Anna Maria Ierardi[3], Nicolò Brandi[1,2], Sofia Battisti[4], Emanuela Giampalma[4], Giovanni Marasco[5], Daniele Spinelli[1,2], Tiziana Principi[6], Fausto Catena[7], Mansoor Khan[8,9], Salomone Di Saverio[10], Giampaolo Carrafiello[3] and Rita Golfieri[1,2]

53 studies

- Unselective embo – use **absorbable embolisation material** (Gelfoam).
- When the bleeding site affects the vital organs, such as penis, vagina, intestine, marrow, testes, uterus and ovaries – **Absorbable embolization material** (Gelatine Sponge).
- Non-vital organs, such as muscles **use non-absorbable** embolisation material (Coils, plugs, NBCs, EVOH).

Case 2

79yo F, PMHx including AF (Rx dabigatran) and prev CVL.

Admitted after a fall. Initial conservative Mx but deterioration on ward.

CT on admission: Fractured superior and inferior pubic ramii on L side. Ipsilateral haematoma w ongoing arterial bleeding, source likely IIA branch or from epicastric a.

Case 2

Selective angiography from IIA → No bleeding

DSA from EIA → extravasation from small branch from inferior epicastric artery → ’corona mortis’.

Treated with gelfoam slurry and coils → complete haemostasis

Corona mortis

Corona mortis – anatomical variant with anastomosis between EIA/inferior epigastric and obturator artery. Can also be venous.

Prevalence between 20-30% in general population.

At risk in fractures of the pubic rami → often delayed haemorrhage.

Could be missed if not interrogating the EIA during angiography.

Case 3

39 yo M, multiple gunshot wounds to chest and abdomen.

Haemodynamically unstable – immediately taken for open surgery w/o preceding CT – L thoracotomy, splenectomy, pancreatic tail resection, small bowel resection, fractured R + L ilium

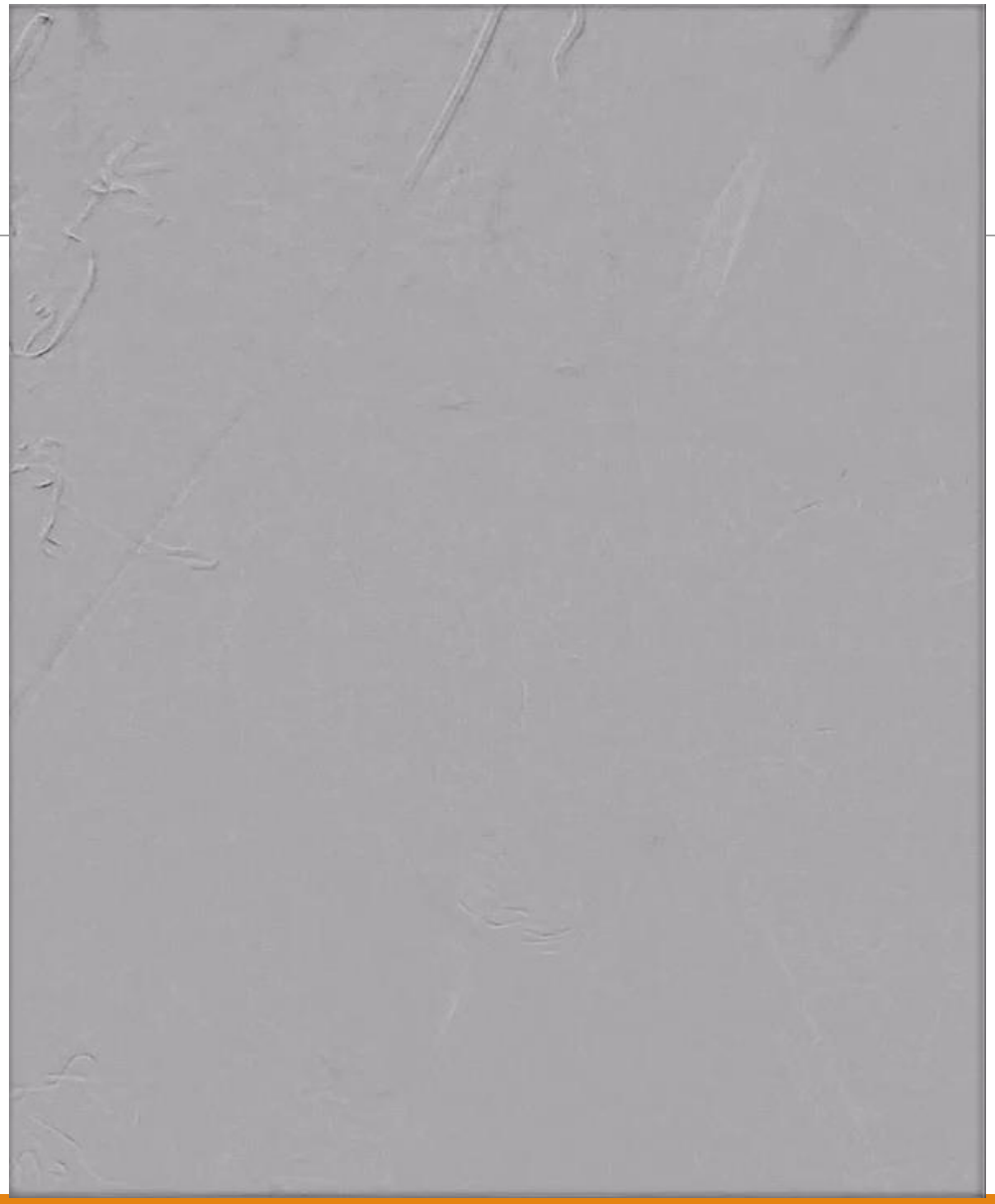
Pelvic haematoma seen during surgery → postop CT

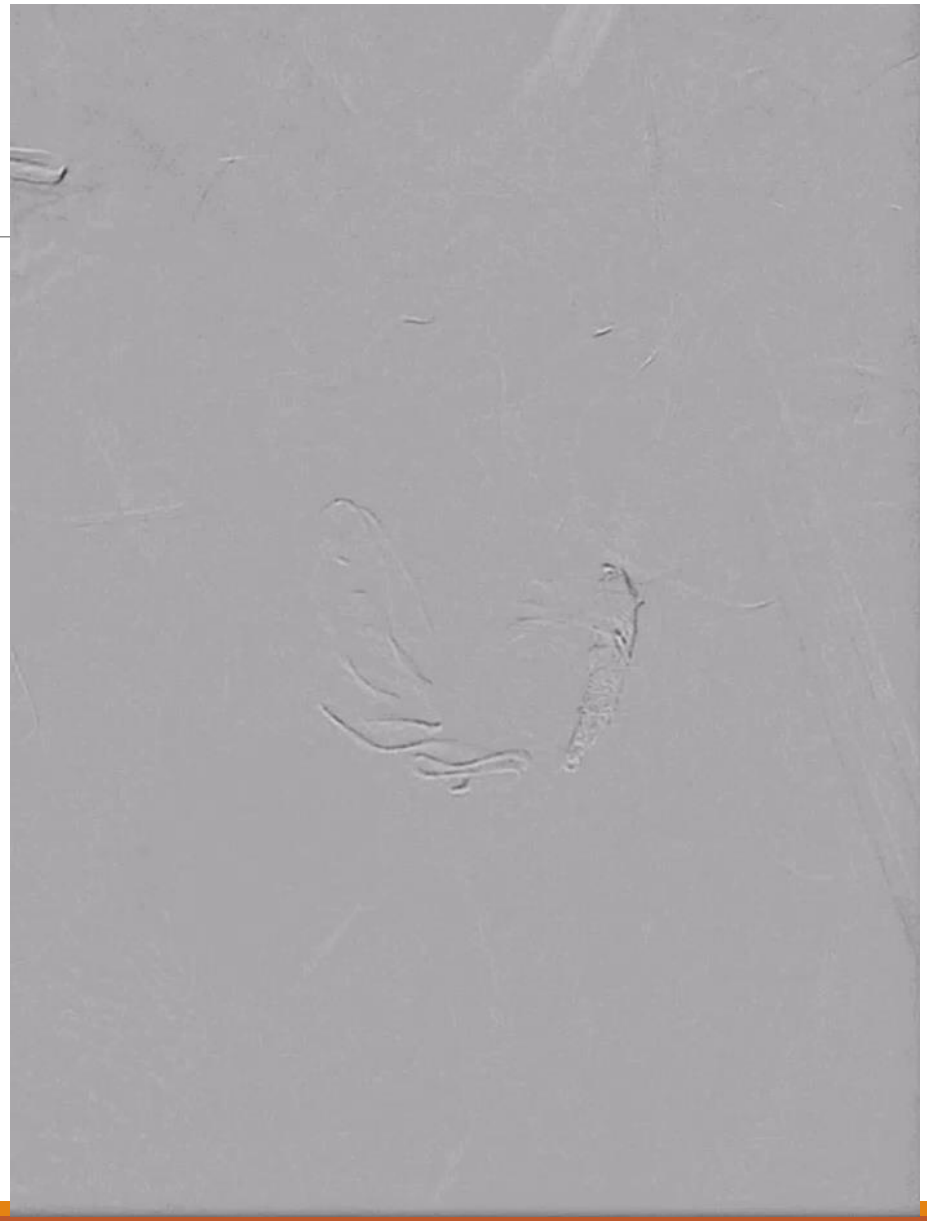
Case 3

Taken to hybrid OR for angiography

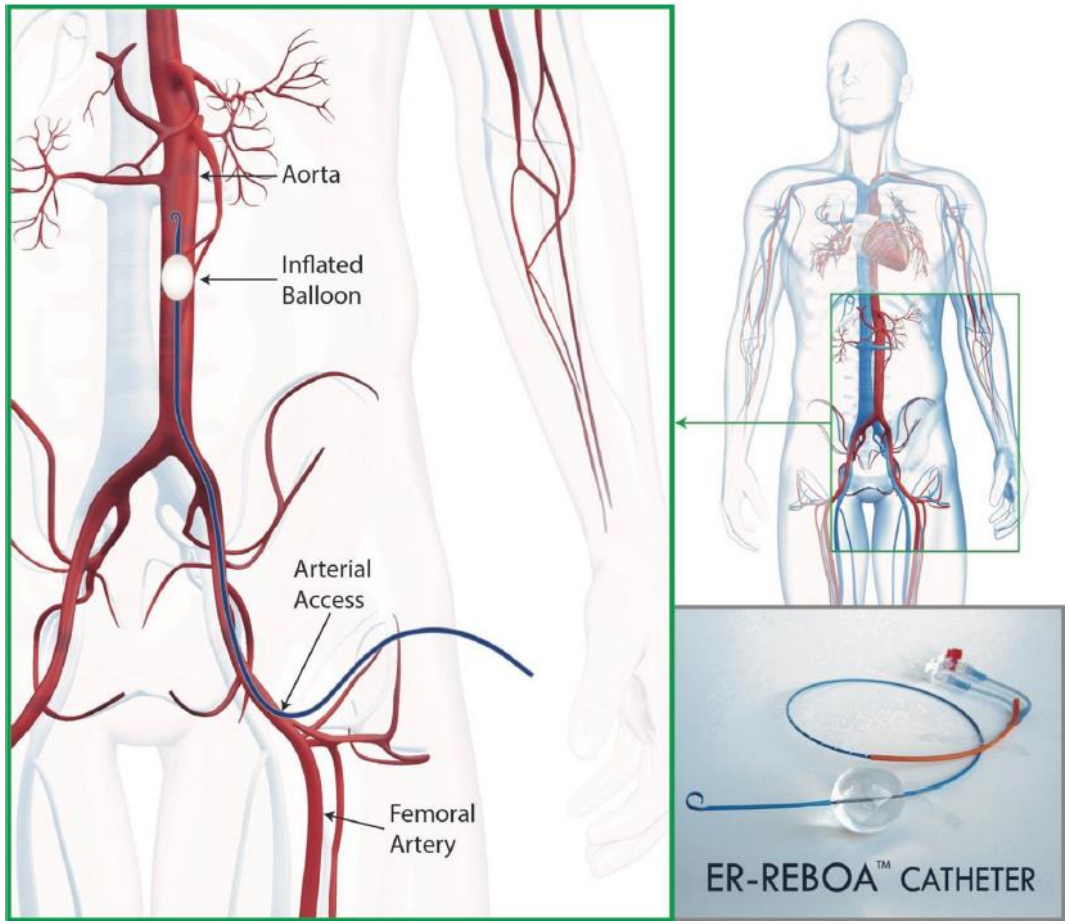
Case 3

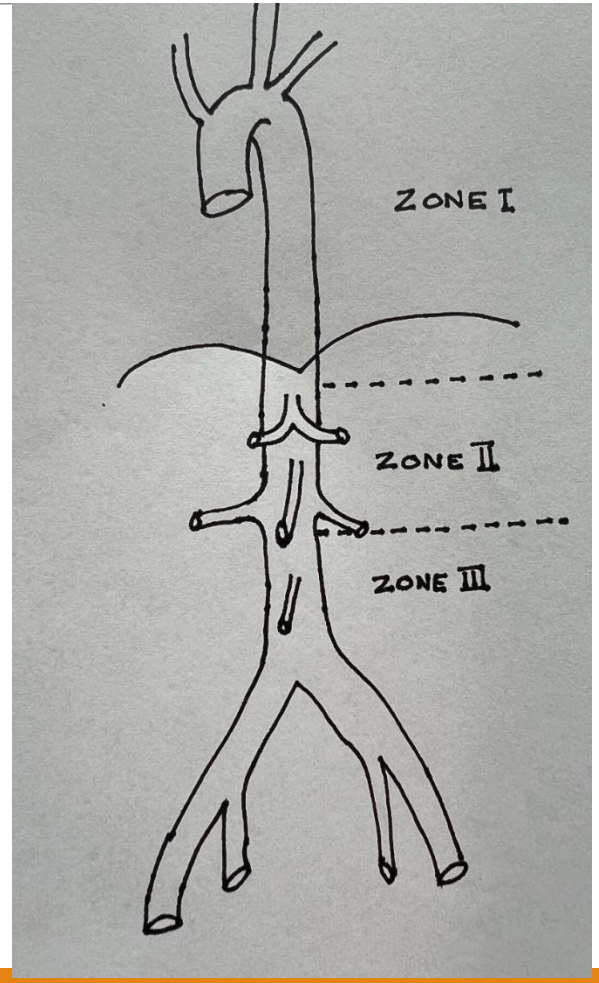
- Large AV-fistula between L IIA and IIV → coil embolisation.
- Remaining extravasation from peripheral branches of the IIA





REBOA





Adapted from Tran, Wilks & Dawson 2020

REBOA

Transfemoral insertion w or w/o US guidance and w/wo fluoroscopy.

Pre-hospital or inpatient setting

Zone 2 contraindicated due to risk of abdominal organ ischaemia.

Unclear survival benefit: Increased risk of death within 90d in severely injured pts receving REBOA in the ED compared with standard care alone.

Original Investigation | Caring for the Critically Ill Patient

October 12, 2023

Emergency Department Resuscitative Endovascular Balloon Occlusion of the Aorta in Trauma Patients With Exsanguinating Hemorrhage

The UK-REBOA Randomized Clinical Trial

Jan O. Jansen, PhD[1,2]; Jemma Hudson, PhD[1]; Claire Cochran, MSc[1]; et al

» Author Affiliations | Article Information

JAMA. 2023;330(19):1862-1871. doi:10.1001/jama.2023.20850

Conclusions

Endovascular treatment of traumatic pelvic bleeding is effective for haemorrhage control with a high technical success rate.

No clear evidence favouring non-selective or selective embolisation → probably beneficial to be as selective as possible.

Complications may be multi-factorial and also related to the initial trauma.

Variable access to IR-services problematic.

Thank you!

Case 4

L IIA embolised with Gelfoam → remaining extravasation.

R IIA also treated with non-sele injection of gelfoam (not shown haemorrhage control.