Surgical strategies to stop bleeding

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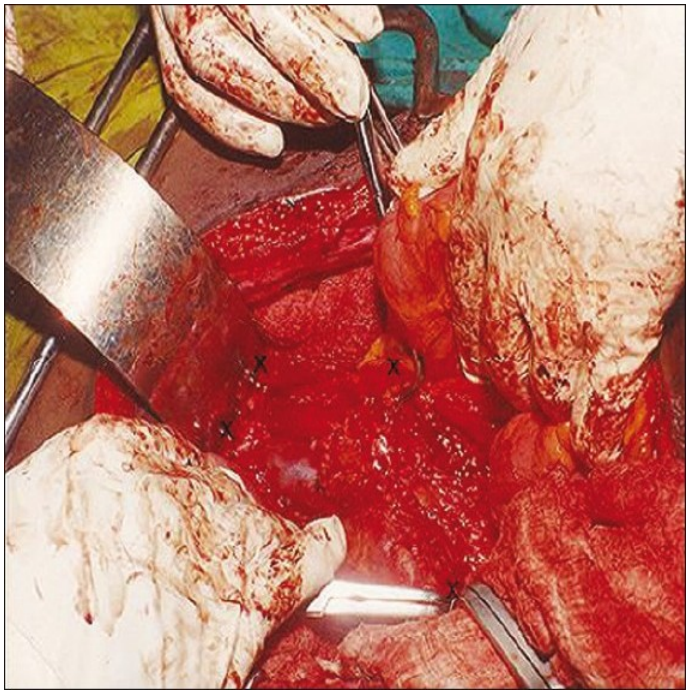


Aims
Talk Outline

What procedures and situations are associated with large blood loss ?

Packing – when to use it, does it work ?

Vascular Occlusion / Ligation

REBOA in trauma

Internal iliac arteries PPH

When do we get large blood loss ?

- Trauma
- Emergency vs Elective surgery
- Vascular Surgery (emergency)
- Tumour Surgery
- Post Partum

Open RAAA surgery on 161 patients,

median blood loss 4200 mls (IQR 2400 – 8000)

Dick F, et al BJS 2012; 99 : 940-47

Meta – analysis of EVAR for RAAA

Median blood loss 523 mls

Rayt HS et al EJVES 2008; 326(5): 536 - 44

Table 1: Type of surgery, blood loss, and blood transfusion.

Type of surgery	Range of blood loss (cc)	Range of PRBCs units
Spine tumors [38–43]	400–12,100	2–10
Sacral tumors [44–46]	3,000–37,000	0–43
Hemipelvectomy [47–50]	400–12,100	0–134
Total pelvic exenterations [47–50]	900–9,500	0–18
Nephrectomy with IVC embolectomy [37, 51–55]	200–16,000	0–91
Liver and multivisceral resection [12, 56–62]	200–>5,000	0–44
Extrapleural pneumonectomies [63–65]	900–65,00	0–18

Table 1 illustrates ranges of blood losses and PRBCs of transfused units reported in the literature.

Table 2: Perioperative interventions targeted to reduce blood loss during major oncological surgery.

Type of surgery	Anesthetic interventions	Surgical interventions
Spine tumors	Antifibrinolytics	Surgical hemostasis
	Controlled hypotension*	Preoperative tumor embolization
Sacral tumors	Antifibrinolytics	Surgical hemostasis
		Preoperative tumor embolization
		Aortic balloon occlusion-Iliac artery ligation
Hemipelvectomy	Antifibrinolytics	Surgical hemostasis
		Vascular control
Nephrectomy with IVC embolectomy	Antifibrinolytics	Surgical hemostasis
		Correction of hypothermia after CPB
Liver and multivisceral resection	CVP < 5 cm H_2O**	Surgical hemostasis
	Antifibrinolytics	Preoperative tumor embolization
		Vascular control
Extrapleural pneumonectomies	Antifibrinolytics	Surgical hemostasis

*Controlled hypotension has fallen in disfavor of many anesthesiologists due to its possible association with postoperative visual loss. **This practice has also been questioned due to the poor correlation between central venous pressure and central volume status.

Main Surgical method to stop significant arterial and venous bleeding is ligation and suture

Packing

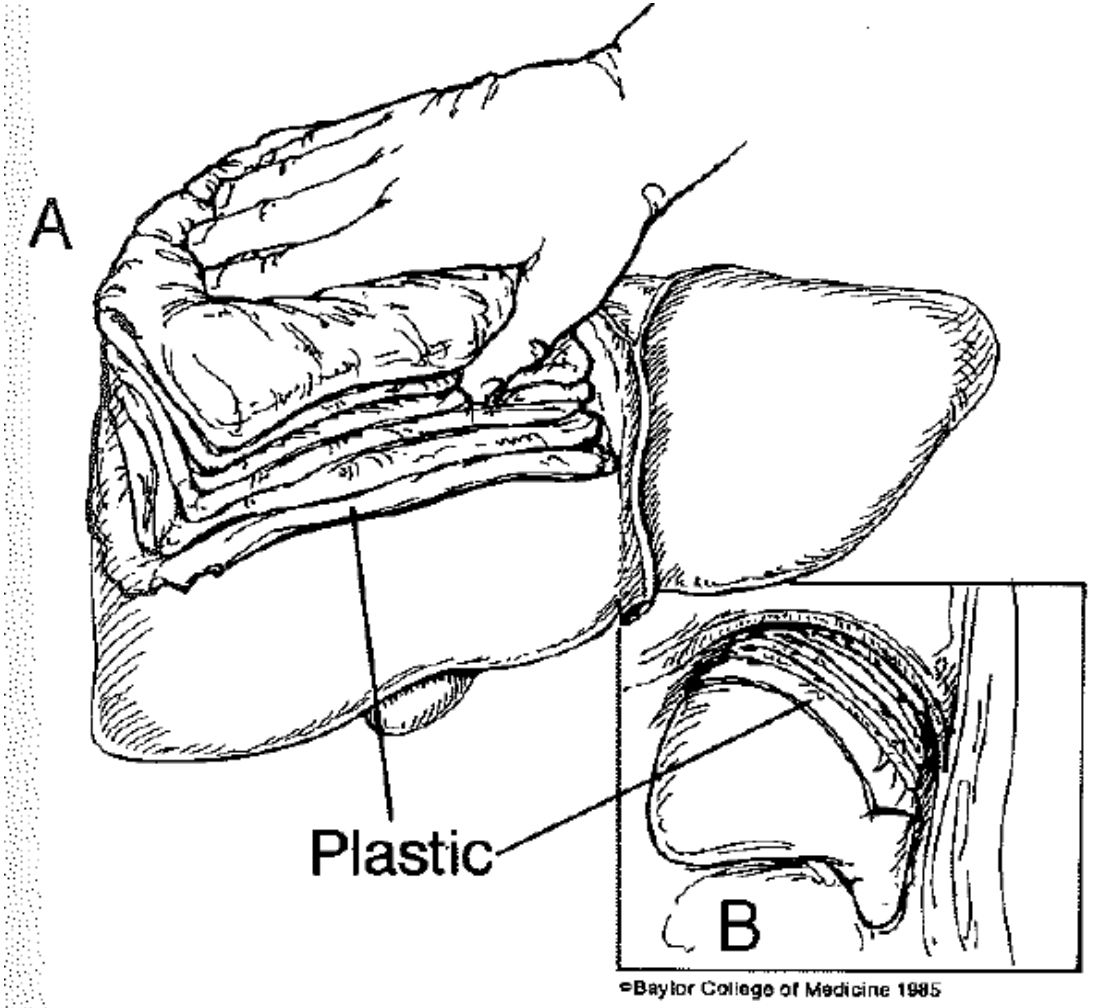


FIG. 1. A folded Steri-Drape (3M, St. Paul, MN) is placed between the surface of the liver and the dry laparotomy pads used as packing.

Packing

Feliciano D et al J.Trauma 1986; 26: 738-42 Houston

1978 – 85 1348 hepatic injuries

66 (5.6%) packing attempted

17 died in theatre.

49 successfully packed

SURVIVAL 28/49 = 57%

Deaths mainly due to shock and persistant coagulopathy

Packing

Feliciano D et al J.Trauma 1986; 26: 738-42 Houston

TABLE I
Mechanism of injury

Mechanism	Number	(%)
Penetrating		
GSW	36	
SW	10	(74.2%)
SGW	3	
Blunt	17	(25.8%)

TABLE II
Indication for packing in patients surviving first operation

Indication	Number	(%)
Coagulopathy	42	(85.8%)
Capsular problem	6	(12.2%)
Planned reoperation	1	(2.0%)

Liver Packing for Uncontrolled Hemorrhage: A Reappraisal

Ivatury R et al J.Trauma 1986; 26 : 744-52 New York

Found little improvement in overall mortality for liver injuries when comparing two consecutive periods, one where packing was in use, one where it was not.

Highlighted a high incidence of intra-abdominal abscesses after packing

Packing

Sharp KW et al Ann Surg 1992; 215 : 467-73

Planned intra-abdominal packing for surgically uncontrollable hemorrhage from liver and retroperitoneal injuries exacerbated by hypothermia, acidosis, and coagulopathy regained popularity over the past decade. The authors reviewed 39 patients injured between August 1985 and September 1990; 31 packed for liver injuries, eight for nonliver injuries. The overall mortality rate was 44% (17/39); 9 (23%) exsanguinated, 3 (8%) died of head injuries, 3 (8%) of multisystem organ failure, 2 (5%) of late complications. The mean age was 33.9 ± 16.2 (range, 16 to 79); there

"Packing may be done to prevent development of acidosis, hypothermia, and coagulopathy or may be done early in the treatment of cold acidotic patients rather than massive transfusion in the face of surgically uncorrectable bleeding"

Packing

Sharp KW et al Ann Surg 1992; 215 : 467-73

“The timing of the decision to pack is controversial: should packing be used before coagulopathy develops or only after the onset”

Packing

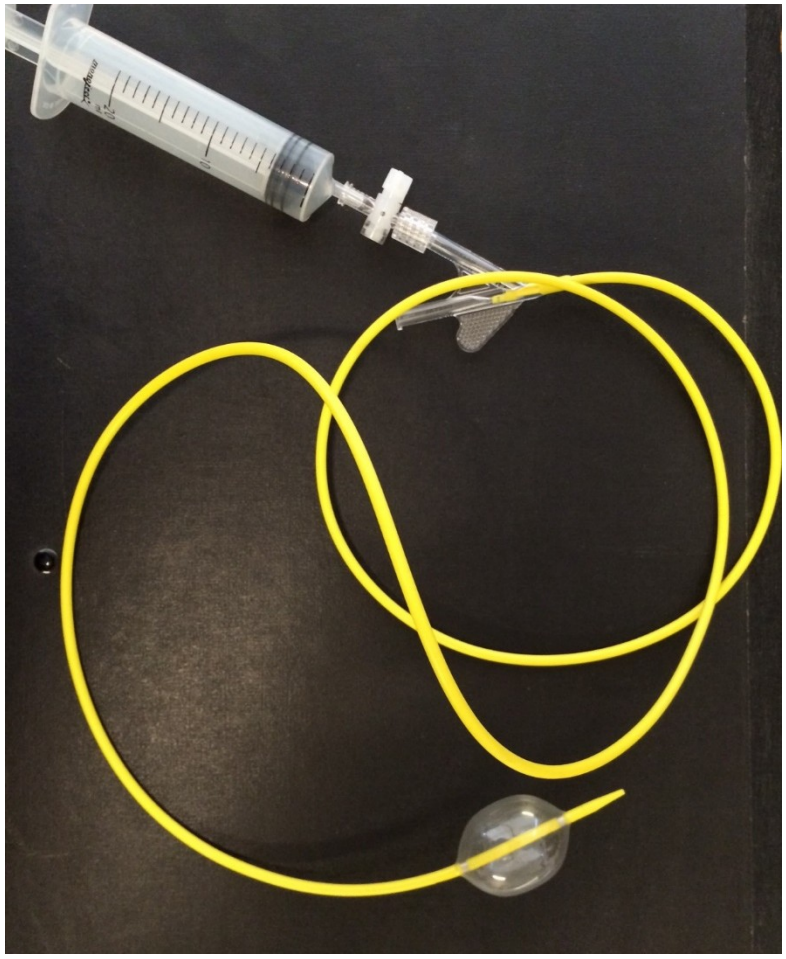
Summary

A useful manoeuvre used usually in difficult situations, often late on, when coagulopathy, hypothermia and acidosis are in place.

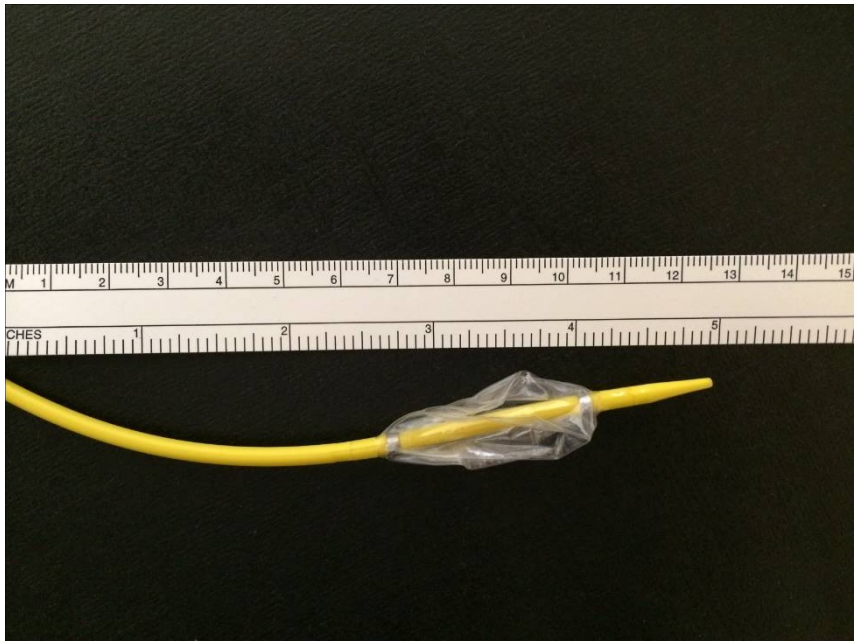
Success varies - 44-57% mortalities reflect how ill these trauma patients are.

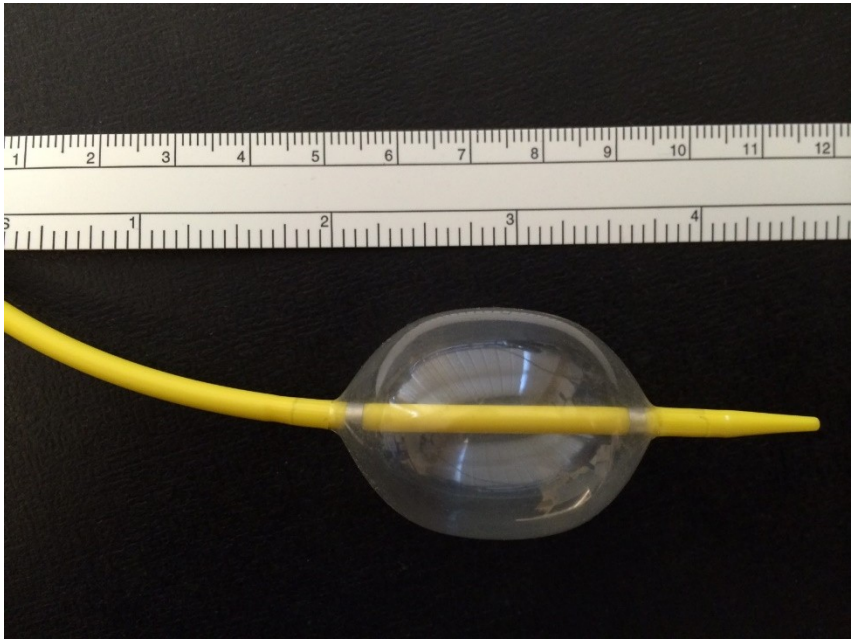
Improvements in warming, acidosis prevention and avoiding transfusion coagulopathy have improved outcomes and reduced the need for packing in my experience.

Vascular Occlusion/Ligation
REBOA



Vascular Occlusion/Ligation
REBOA





Balloon Occlusion (BO) vs. Thoracic Clamp vs. No clamp in animal model

Conclusion. *Resuscitative aortic BO increases central perfusion pressures with less physiologic disturbance than thoracotomy with aortic clamping in a model of hemorrhagic shock. Endovascular BO of the aorta should be explored further as an option in the management of noncompressible torso hemorrhage. (Surgery 2011;150:400-9.)*

Brenner M et al J Trauma 2013; 75 : 506-11

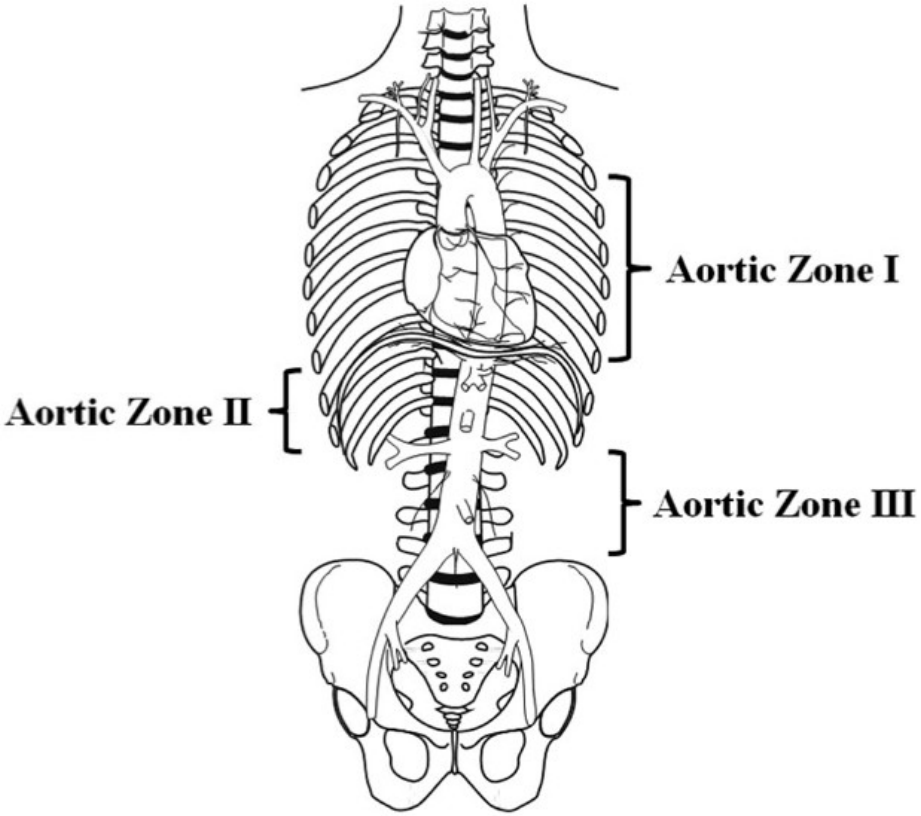


TABLE 1. Demographics and Summary of REBOA Use in Six Patients

Patient	1	2	3	4	5	6
Age, y	62	24	59	25	40	27
Sex	Male	Male	Male	Male	Male	Female
Mechanism of injury	MVC	GSW	GSW	MVC	MCC	ATV collision
Injury Severity Score (ISS)	28	50	9	25	48	43
SBP before REBOA, mm Hg	70	70	0	60	70	85
Cardiac arrest before REBOA	No	No	Yes	No	No	No
SBP after REBOA, mm Hg	135	122	100	110	130	125
Admission base deficit	12	4	NA	16	14	19
Time to occlusion, min	5	4	4	6	6	6
Time of occlusion, min	12	16	70	60	65	36
Surgery after REBOA	No	Yes	Yes	Yes	Yes	Yes
Pelvic embolization after REBOA	Yes	Yes	No	No	Yes	Yes
Complication of REBOA	No	No	No	No	No	No
Outcome	Alive	Alive	Alive	Alive	Brain death	Death (care withdrawn)

REBOA issues

- Further experience needed
- Use defined
- Training
- Need plan for definitive haemorrhage control
- What level of imaging is needed ?
- Avoidance of Vascular injury

Vascular Ligation IIA for PPH

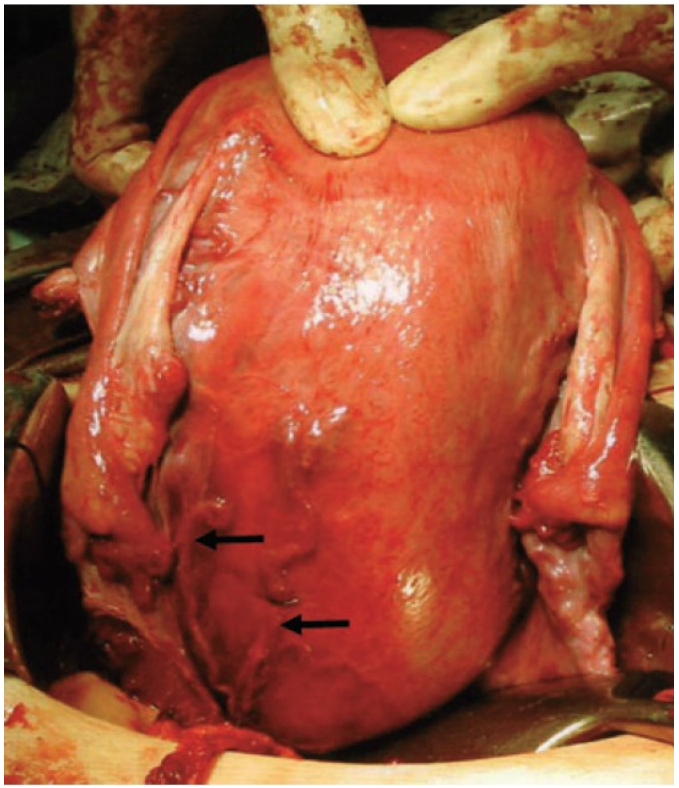
- Major PPH (>1 L)
- Incidence 0.5%
- Uterine atony.
- Medical therapies
- Suture techniques (compress uterus, target uterine arteries / ovarian)
- Hysterectomy

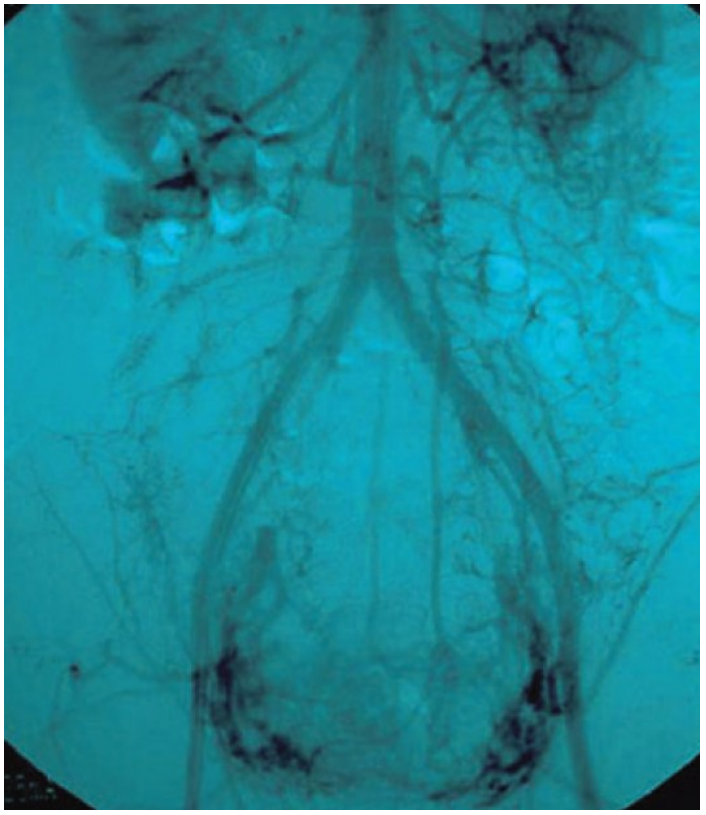
PPH when severe, what is the role of IIA ligation or embolization ?

- Success rates 70 – 80% in the literature
- What if it does not succeed ?
- Why does it not succeed ?

- Are there any ischaemic complications ?

Collateral pathways



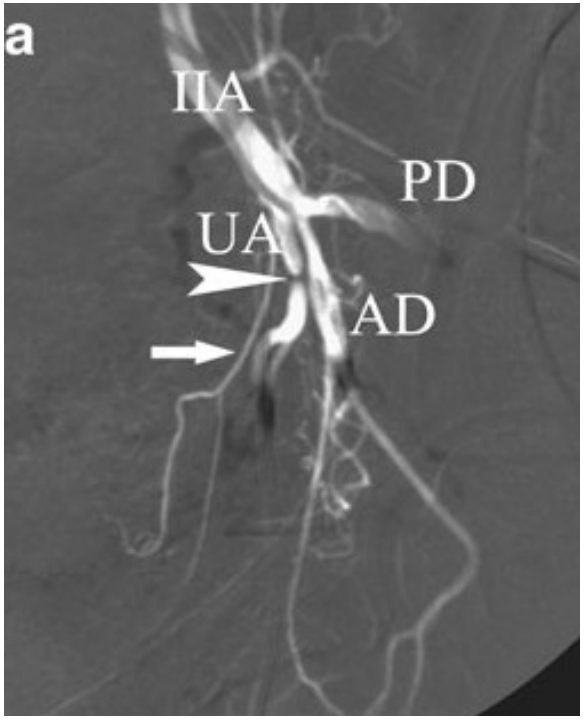


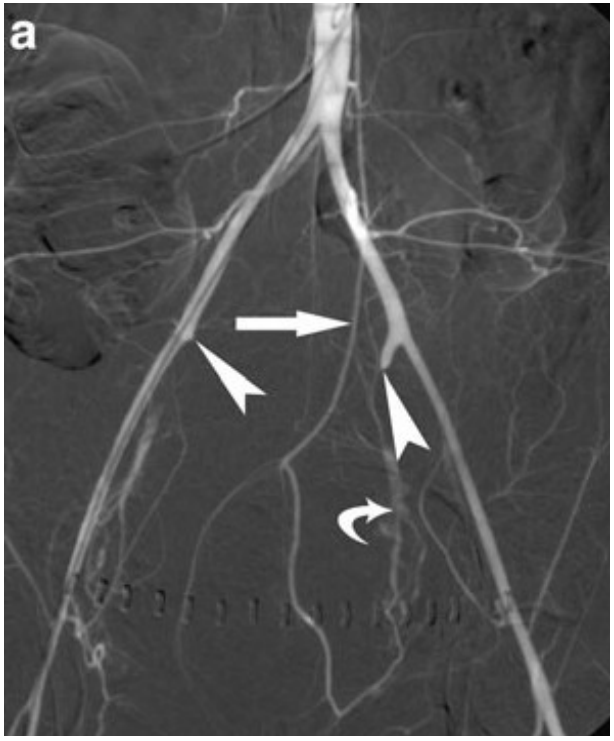
PPH after failed IIA ligation
value of pelvic embolization

Fargeaudou Y et al Eur Radiol (2010) 20: 1777–1785

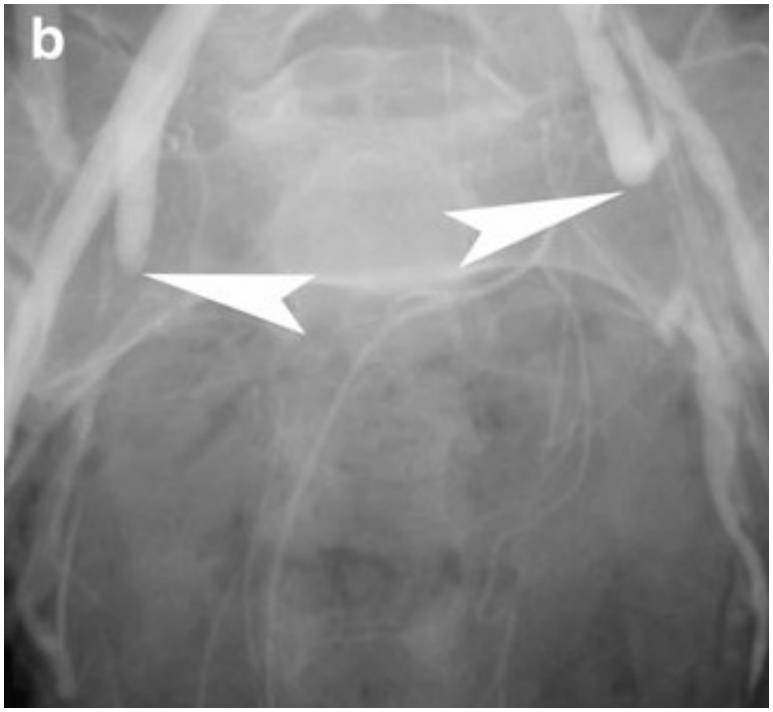
- 12 cases reviewed
- 8 collaterals
- 4 failed ligations
- Embolization
- 11stopped bleeding
- 2 ischaemic complications

Examples





Embolisation can complete occlusion and take out collateral pathways



- More precise control of bleeding but needs to be rapidly / readily available.

Vascular Occlusion / Ligation Themes

- Reduces but does not stop bleeding
- Needed when bleeding is severe.
- When other techniques are unsuccessful.
- Often used as an emergency procedure.
- Balloons, Ligations, Embolisations.

- Balance risk of ischaemic complications.

Review

Topical haemostatic agents

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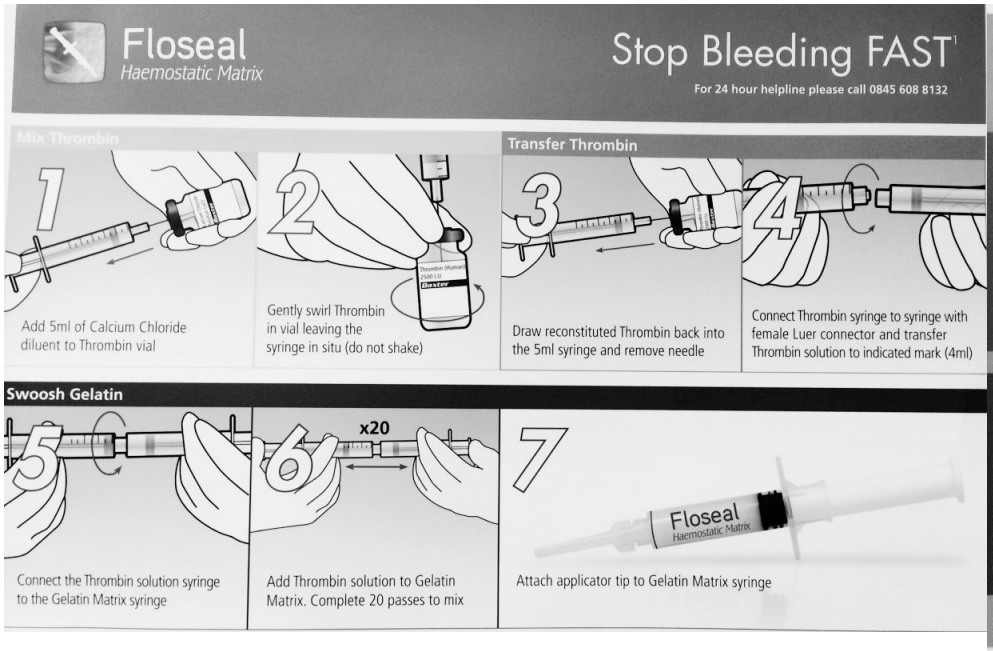
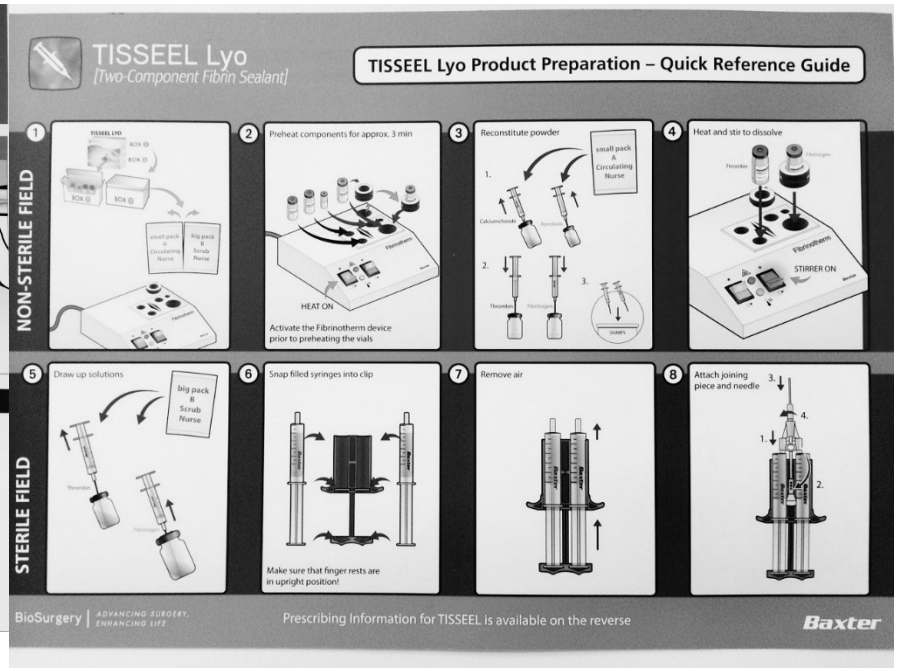
British Journal of Surgery 2008; **95**: 1197–1225





Summary
surgical control of bleeding

1. When you can plan for it. (tumours)
2. **<u>Suture,</u>** glue, coagulate the tissue bleeding
3. With major bleeding other strategies may be needed
4. Packing – get out of jail
5. Vascular occlusion – buy time, aid definitive control, success not guaranteed.