
# Stop the Bleeding


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I have nothing to disclose

# Introduction

- Injuries are the third leading cause of death across all ages
- Active bleeding is the most common cause of death among trauma patients

Papakostidis C, Kanakaris N, Dimitriou R, Giannoudis PV. The role of arterial embolization in controlling pelvic fracture haemorrhage: a systematic review of the literature. Eur J Radiol 2012; 81: 897–904.

# Introduction

- While surgery is often considered the definitive treatment for bleeding control, it may not always be the optimal solution for stabilization of a patient with polytrauma
- Specifically, arterial hemorrhage arising from pelvic fractures and solid organ injuries

Zealley IA, Chakraverty S. The role of interventional radiology in trauma. BMJ 2010; 340: 356–60.
Nicodemo A, et al. A treatment protocol for abdomino-pelvic injuries. J Orthopaed Traumatol 2008; 9: 89–95.
Hoff WS, et al. East practice management guidelines work group: practice management guidelines for the evaluation of blunt abdominal trauma. J Trauma 2002;

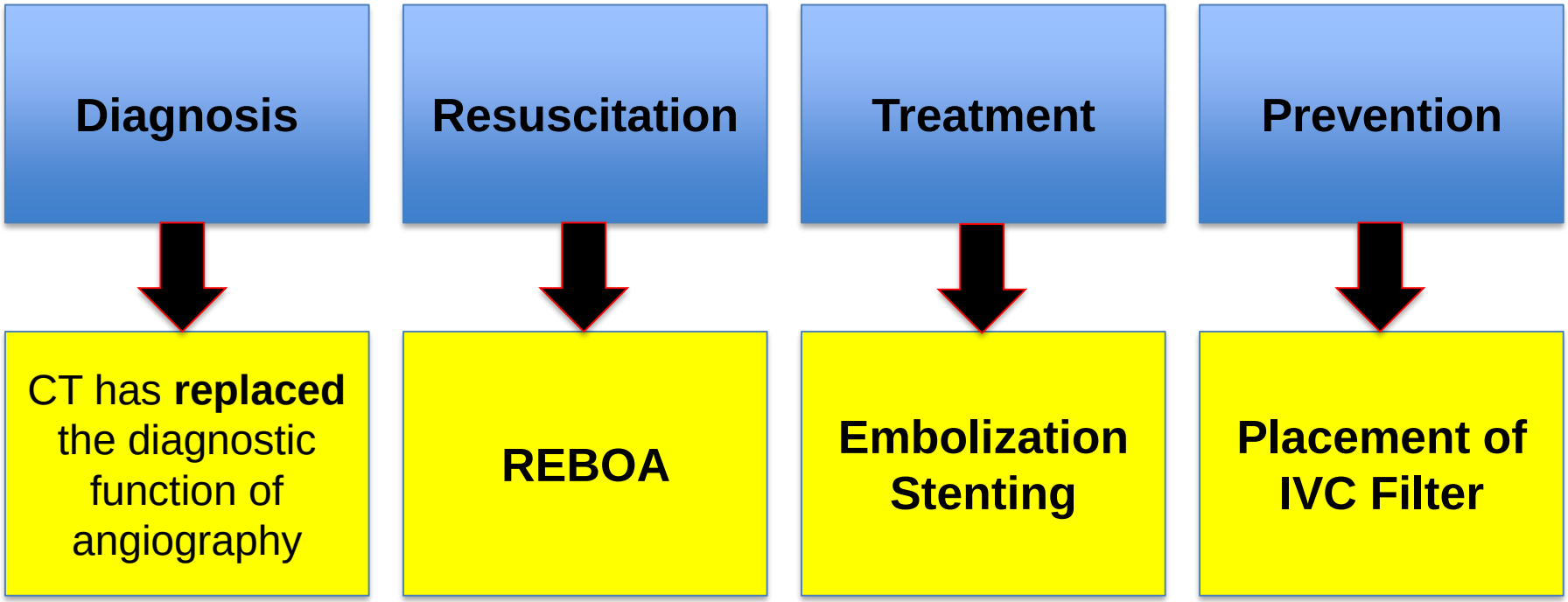
# Introduction

- The management of trauma patients has evolved in recent decades
- Specially with the introduction of advance endovascular intervention modalities

# Introduction

# Introduction

## Endovascular Intervention Modalities

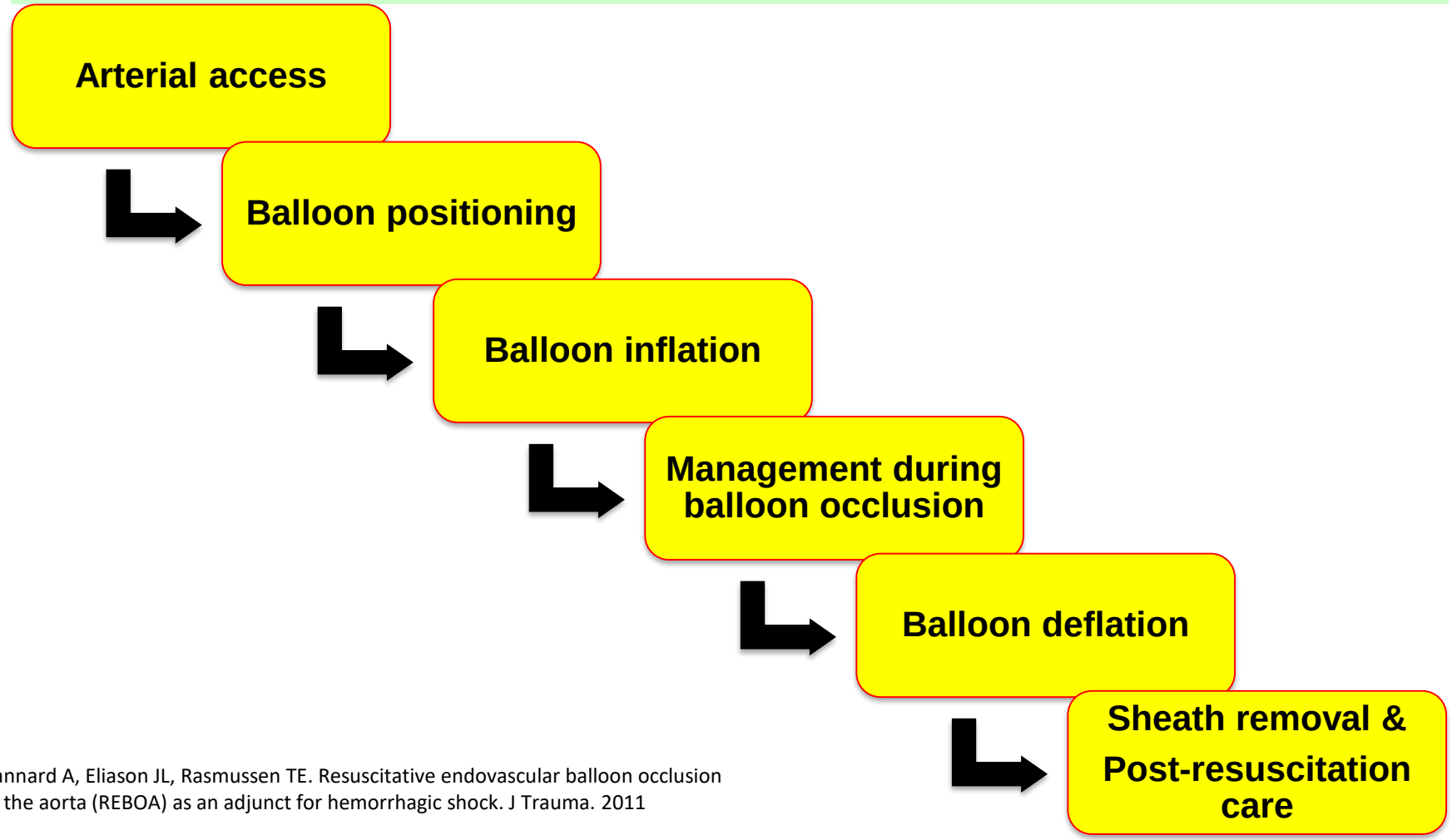


# Resuscitation

## Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

**Non-Compressible Hemorrhage**

# Principles of REBOA Technique




Stannard A, Eliason JL, Rasmussen TE. Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. J Trauma. 2011

# Principles of REBOA Technique

- **Planning**
  - Training
  - Based on protocol and pathways
  - Device / Occlusion Balloons
  - Team work (multidisciplinary)
  - Good communication

# REBOA Training Courses

**ASSET**
Advanced Surgical Skills for Exposure in Trauma

**BEST**
Basic Endovascular Skills for Trauma

**CAMLS**
Center for Advanced Medical Learning and Simulation

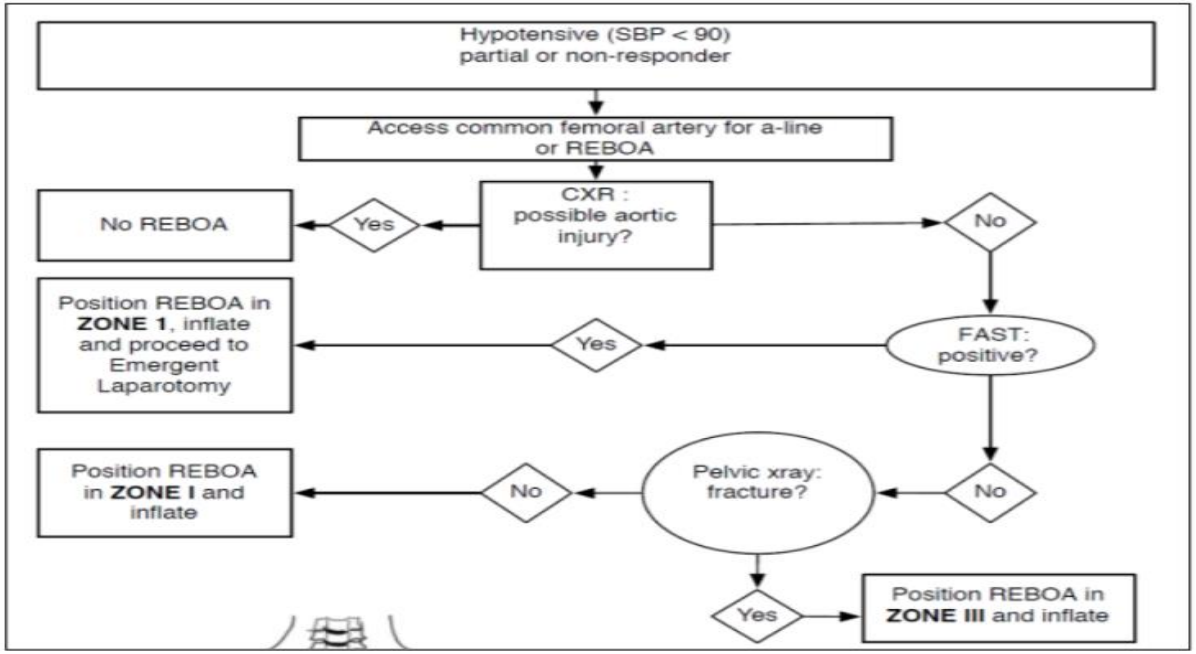
**GREAT**
Grady Rescue & Endovascular Approaches to Trauma

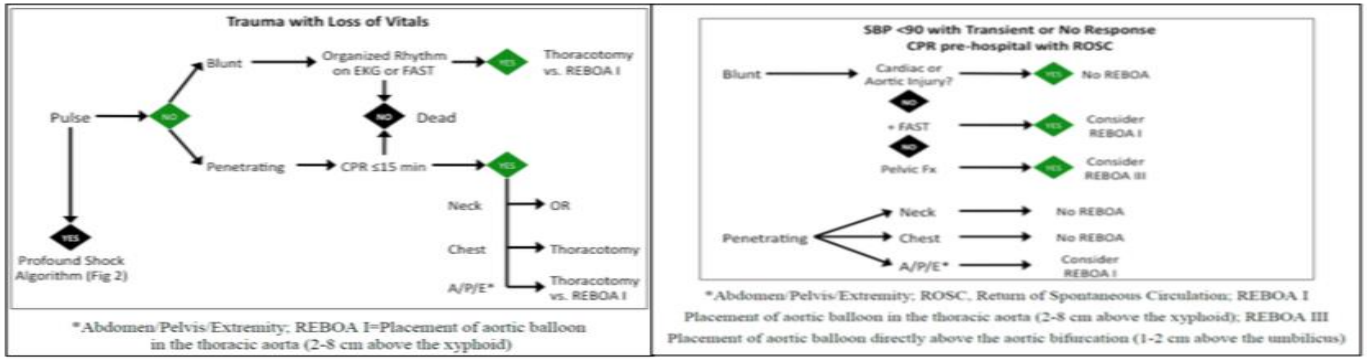
**Didactics**

**Simulators**

**+/_ Perfused cadavers**

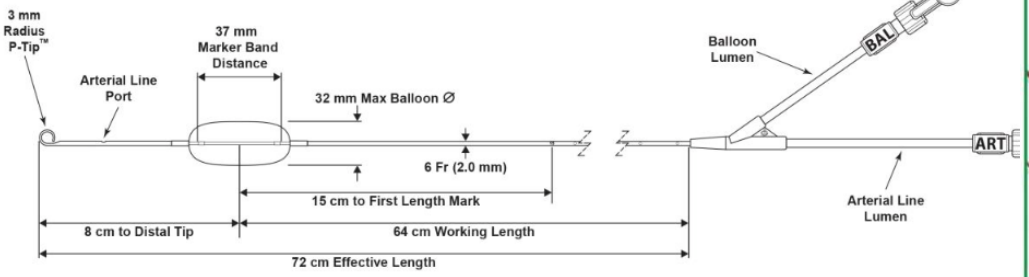
# Protocol & Pathways in REBOA

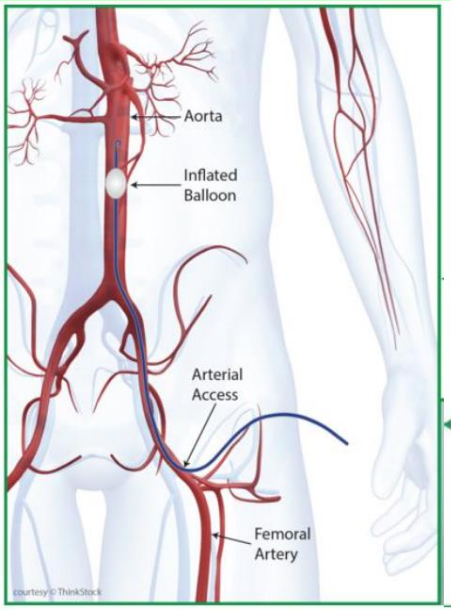


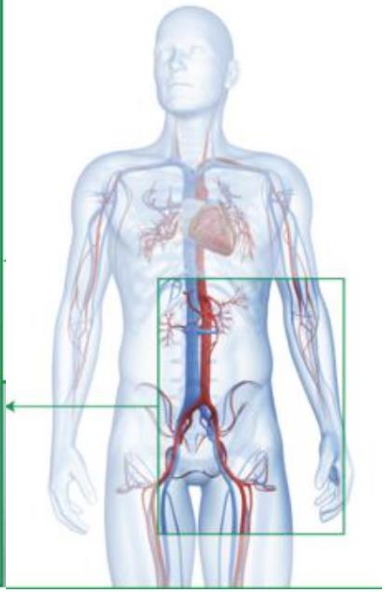




Joint Theater Trauma System Clinical Practice Guideline: REBOA for Hemorrhagic Shock.
http://www.usaisr.amedd.army.mil/assets/cpgs/REBOA_for_Hemorrhagic_Shock_16Jun2014.pdf

# Device / Occlusion Balloons

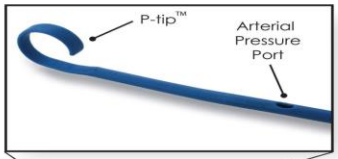


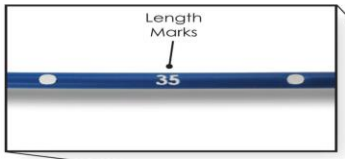



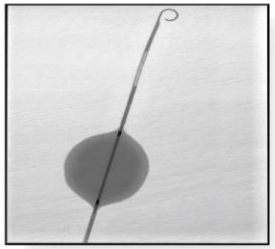



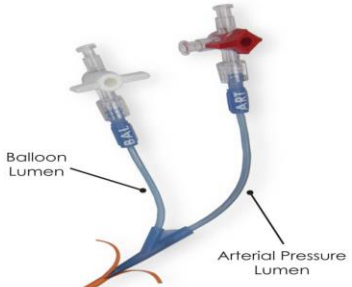
## ER-REBOA™ CATHETER

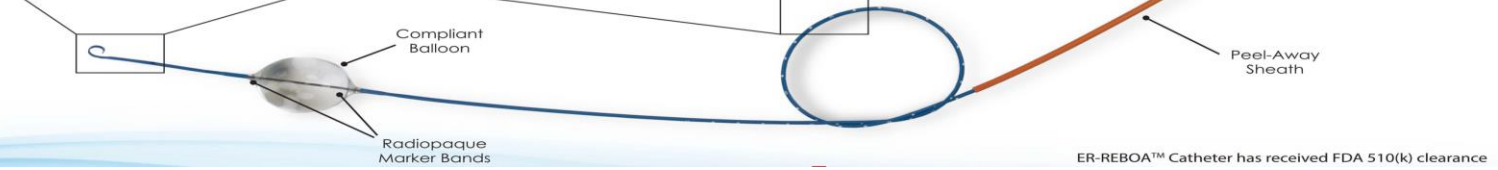
- 7 Fr compatible
- Large vessel occlusion (up to 32 mm)
- Guidewire free
- Integrated arterial pressure lumen





Fluoroscopic Image of ER-REBOA™ Catheter




ER-REBOA™ Catheter has received FDA 510(k) clearance

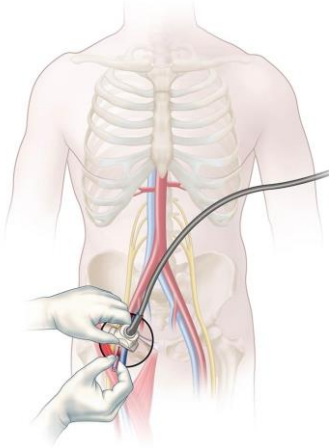
ire/injection port

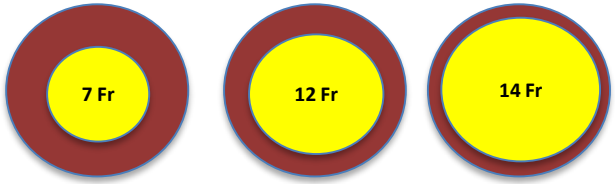
lude the ureter
t
se of placement
contrast media

# Team work & Good Communication
## Identifying & Treating Complications

**Arterial access**

Inability to obtain access
Bleeding
Improper location of arterial puncture
Venous access



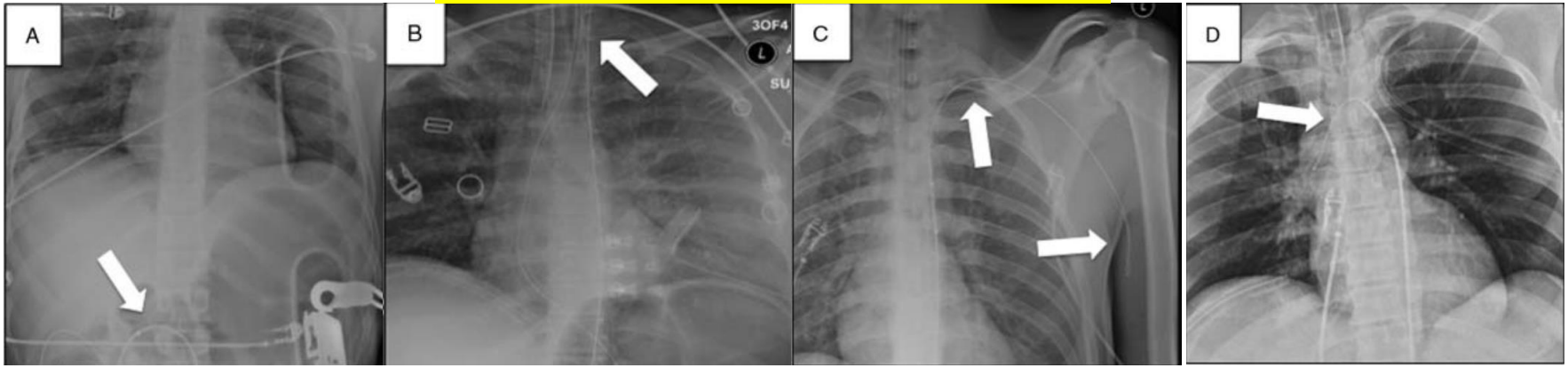


# Team work & Good Communication
## Identifying & Treating Complications

**Balloon positioning**

Wrong anatomical location
Inability to pass wire/catheter

X-ray depictions of wire malposition




Exit of the wire through an injury in the aorta

Inadvertent advancement of the wire into the left carotid artery

Inadvertent advancement of the wire into the left subclavian, axillary, and brachial artery

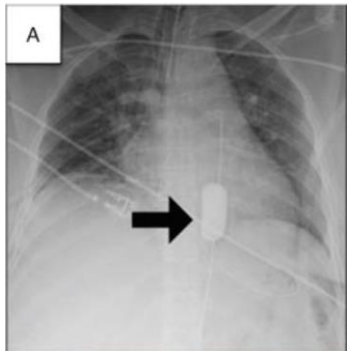
Inadvertent advancement of the wire into the aortic arch. White arrows denote wire

Davidson et al. J Trauma Acute Care Surg 2017.

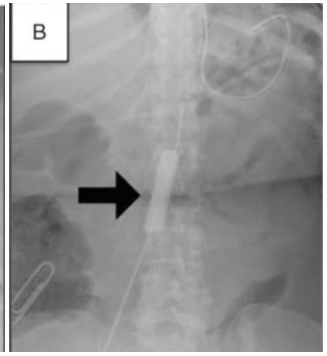
# Team work & Good Communication
## Identifying & Treating Complications

**Balloon inflation**

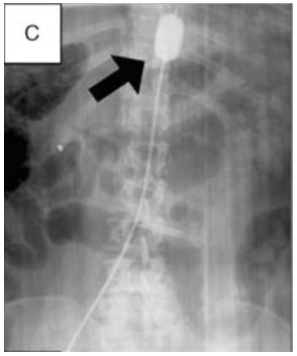
Arterial injury/rupture
Balloon rupture
Unintended ischemia
Exacerbation of proximal injuries



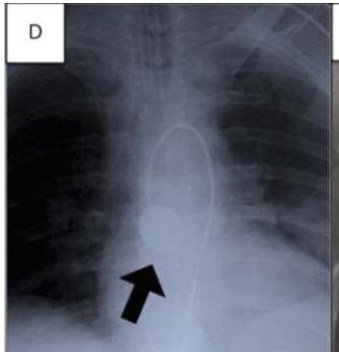

Appropriate position within Zone1 of the aorta




Appropriate position within Zone3 of the aorta

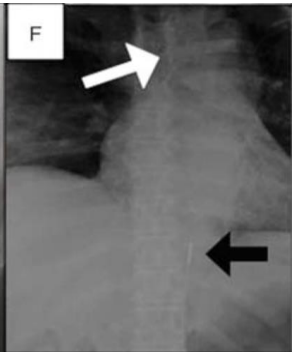



Inadvertent position within Zone 2 of the aorta




Inadvertent position within Zone 0 of the aorta


Inadvertent position within the Ipsilateral internal iliac artery




Exacerbation of proximal aortic hemorrhage (white arrow, note widened mediastinum) following inflation of a distally located balloon (now deflated). Black arrows

Davidson et al. J Trauma Acute Care Surg 2017.

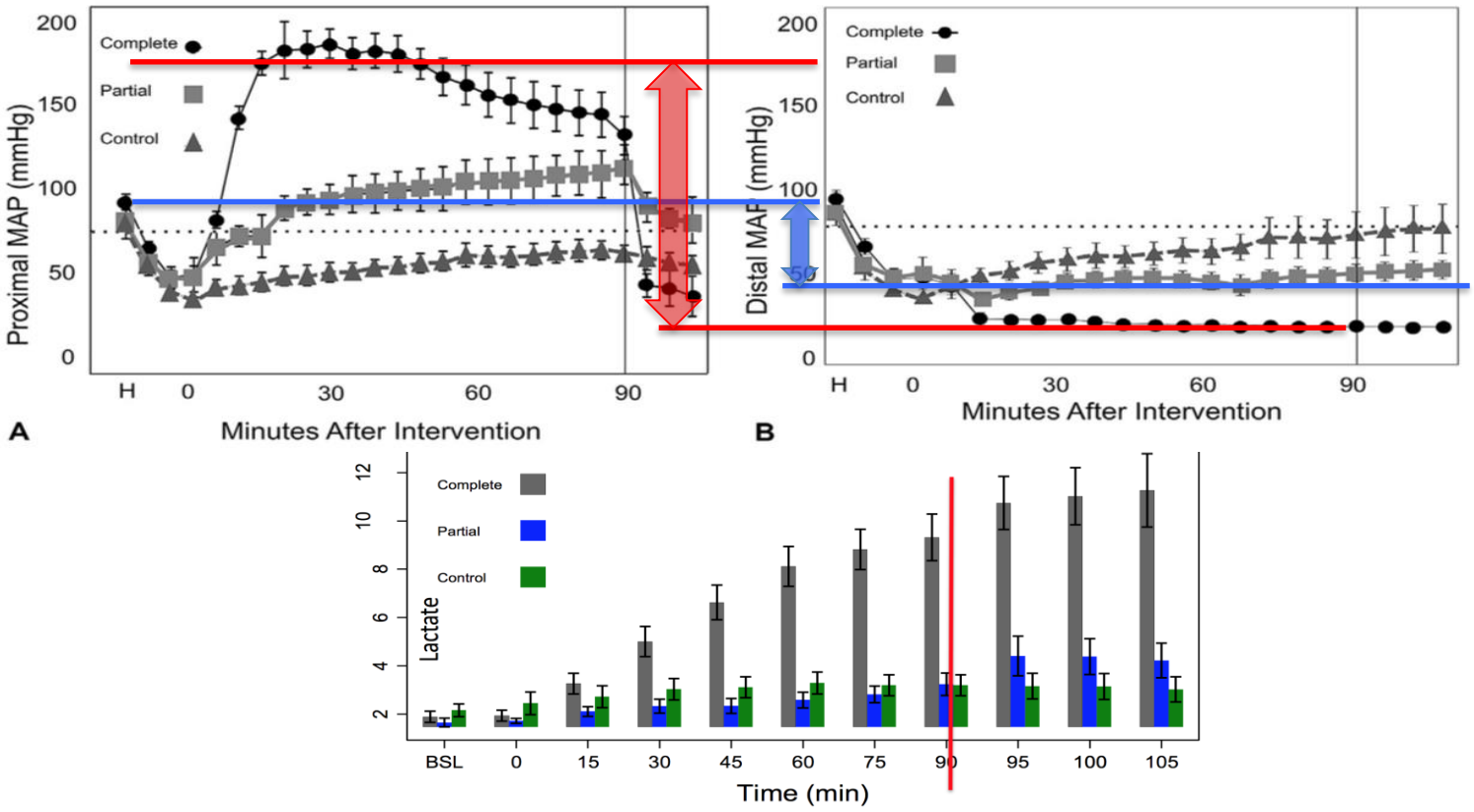
# Team work & Good Communication
## Identifying & Treating Complications

**Management during balloon occlusion**

Balloon migration/prolapse
Increasing ischemic burden
Supraphysiologic proximal pressures
Thrombosis of access site

# Team work & Good Communication
## Identifying & Treating Complications

**Balloon deflation**



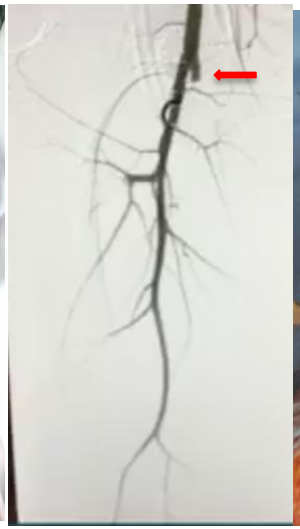
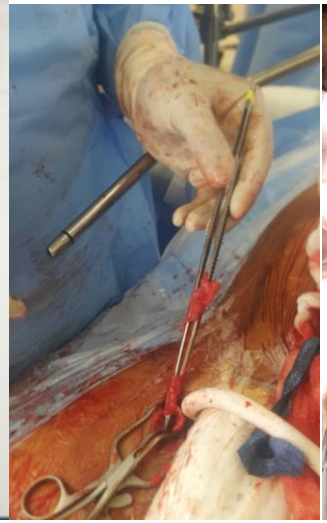

Russo et al Partial Aortic Occlusion in Shocked Swine. J Am Coll Surg. Vol. 223, No. 2, August 2016

# Team work & Good Communication
## Identifying & Treating Complications

**Sheath removal &**

**Post-resuscitation care**

Hematoma or pseudoaneurysm
Thromboembolism
Arterial dissection
Limb loss/amputation

# Treatment

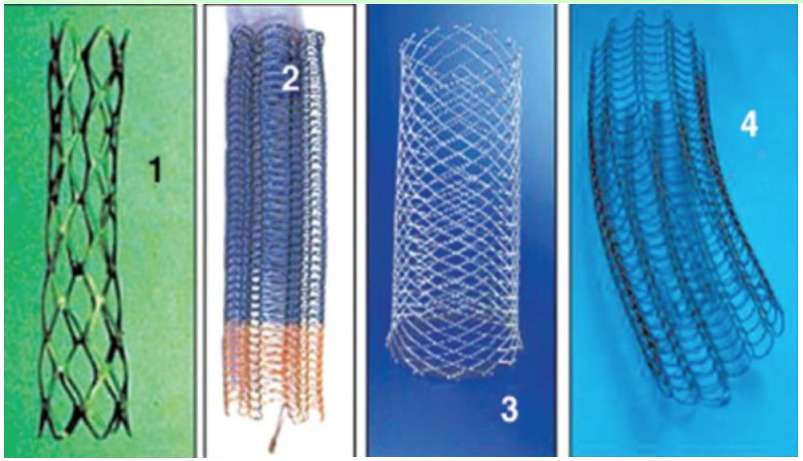
## Embolization

Defined as the intentional endovascular occlusion of an artery or vein

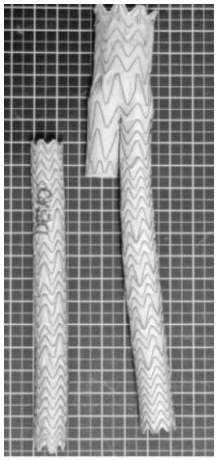
## Stenting

Rigid devices used to provide support for hollow structures.
Vary from tubular stent grafts composed of metal and fabric
Or tubes made of woven PolyTetraFluoroEthylene (ePTFE)

# Treatment



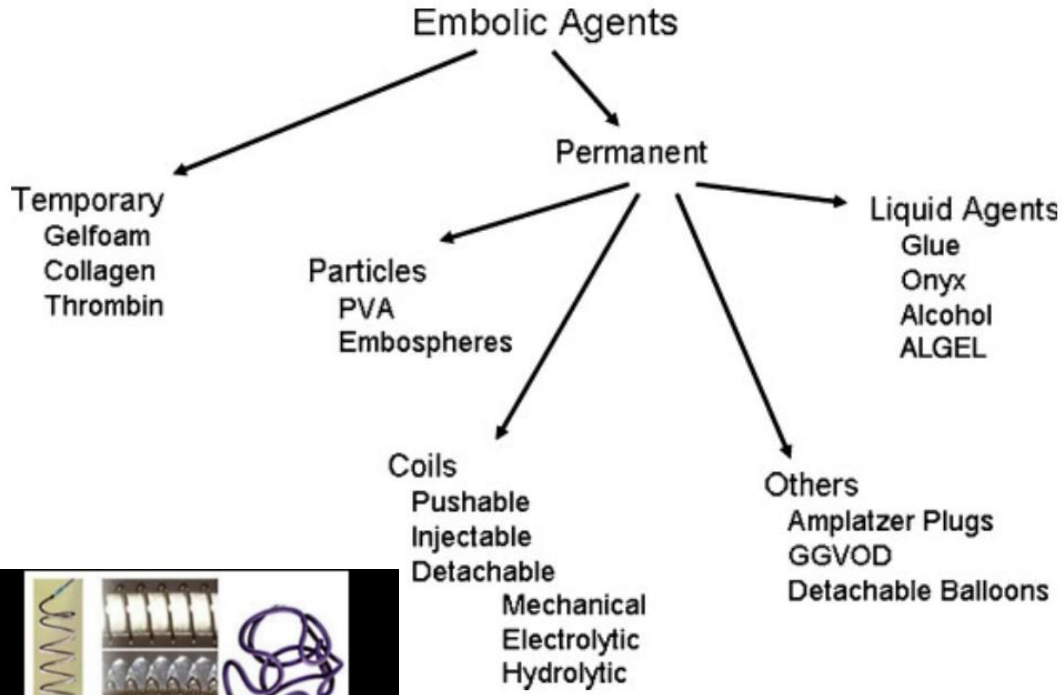

**Stenting**

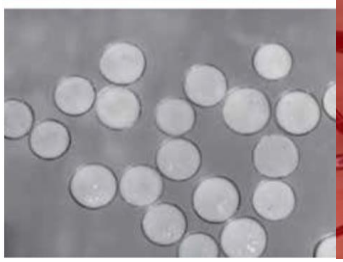


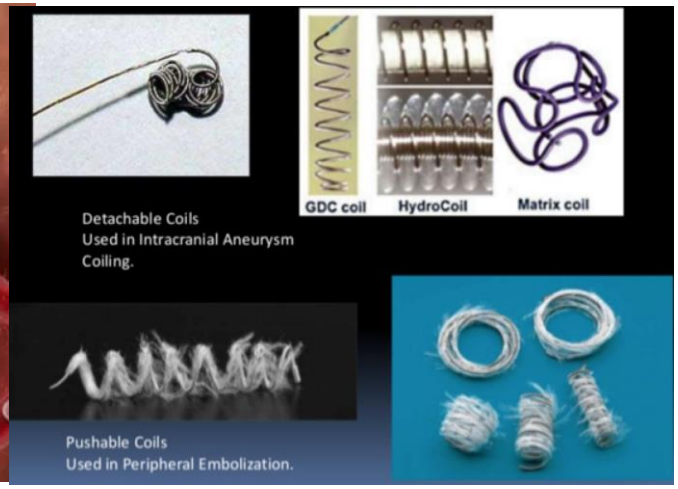
| Stent | Expansion | Dimensions: Caliber (F) | Dimensions: Length (mm) | Material | Duration of use (months) |
|---|---|---|---|---|---|
| Urolume/Wallstent | Self-expandable | 42 | 20–40 | Steel "Superalloy" | Permanent |
| Titan | Balloon-expandable | 33 | 19–58 | Titanium | Permanent |
| Memotherm | Thermo-expandable | 42 | 20–80 | Nitinol | Permanent |
| Ultraflex | Self-expandable | 42 | 20–50 | Nitinol | Permanent |

# Treatment

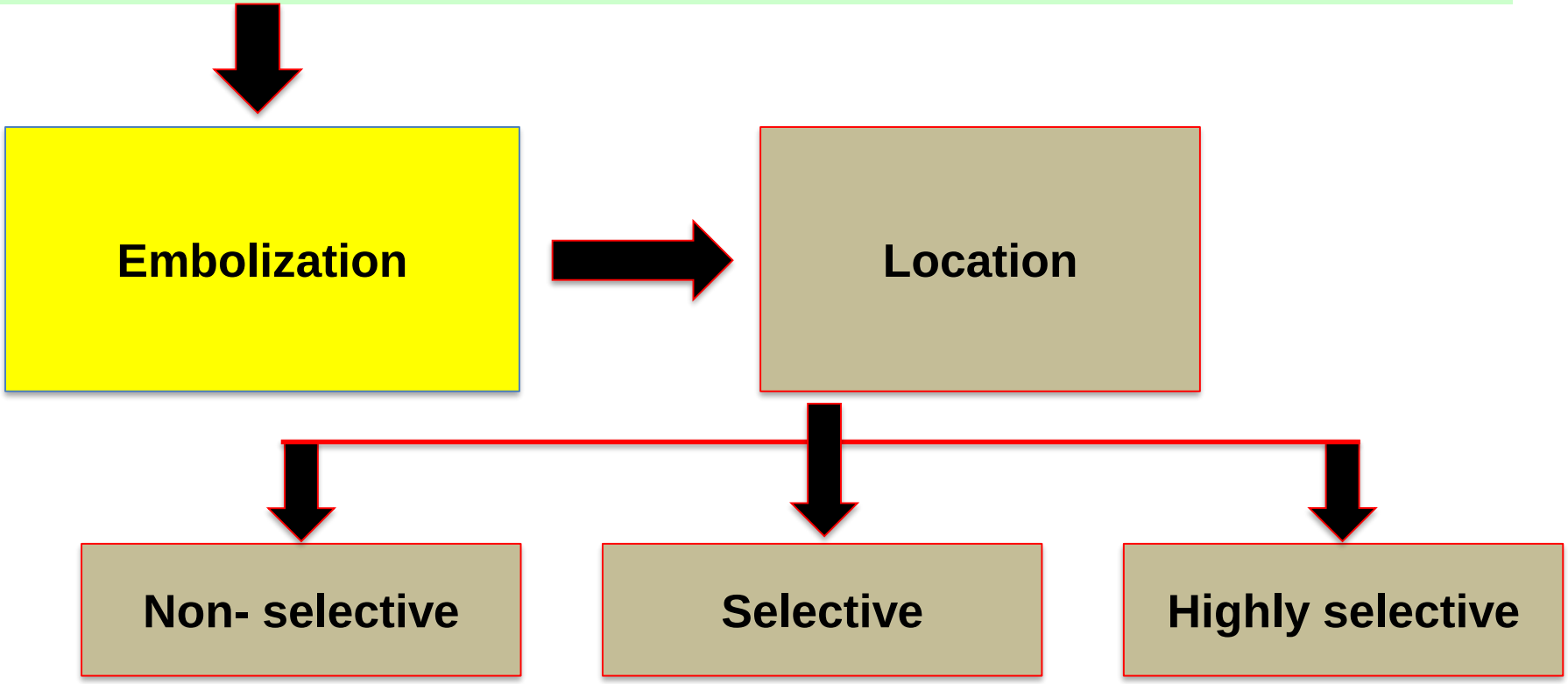
**Embolization**



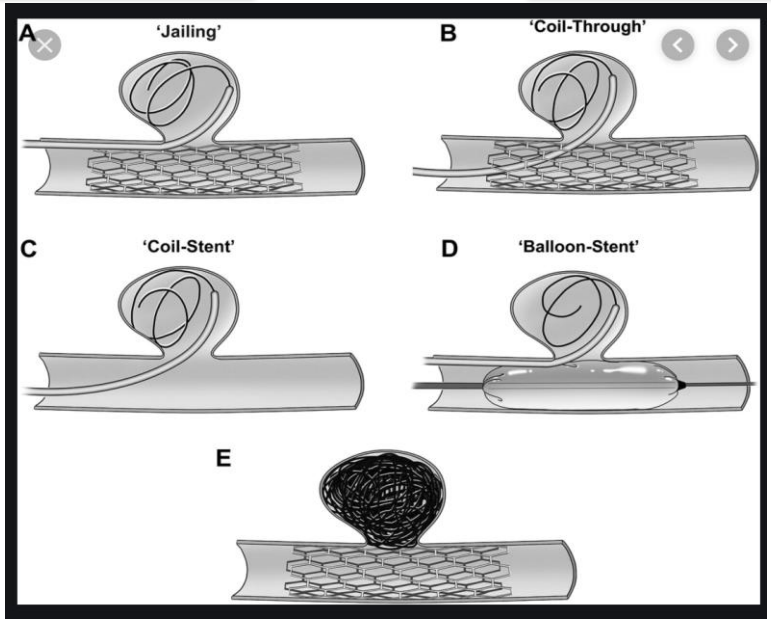


# Treatment


Embolization
Location
Non- selective
Selective
Highly selective

# Treatment

**Embolization** + **Stenting**



# Review of literature

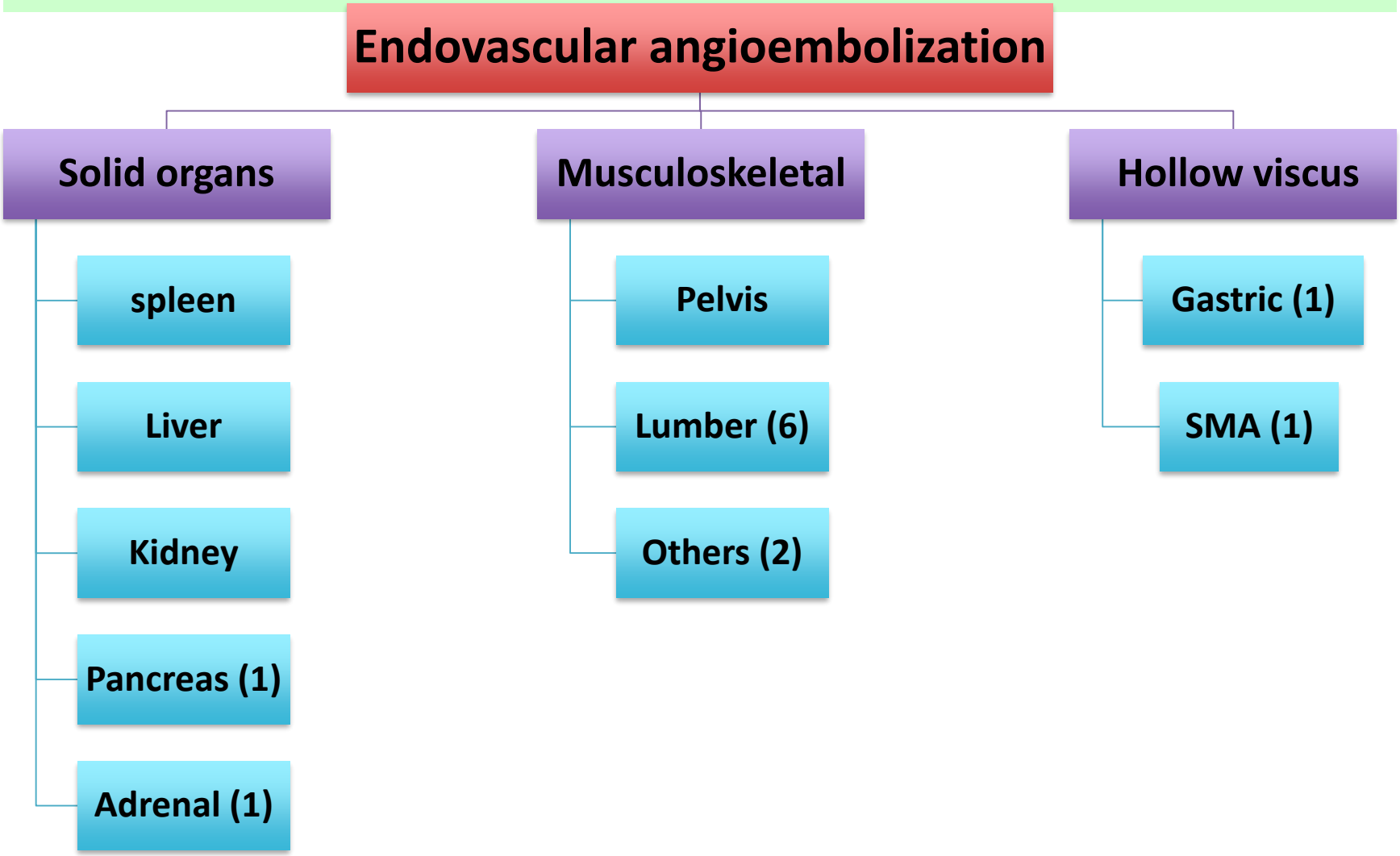
| Liver | Spleen | Renal | Pelvic |
|---|---|---|---|
| 10 studies<br>360 patients | 20 studies<br>939 patients | 20 studies<br>306 patients | 13 studies<br>627 patients |
| **Technical success**<br>**mean = 94.9%** | **Technical success**<br>**mean = 93.3%** | **Technical success**<br>**mean = 96.2%** | **Technical success**<br>**mean 98.9%** |
| **Clinical success**<br>**Mean = 79.8%** | **Clinical success**<br>**mean = 84.6%** | **Clinical success**<br>**mean = 90.92%** | **Clinical success**<br>**mean = 91.75%** |
| **Re-bleeding rate**<br>**Complications**<br>**Overall mortality rate**<br>**? %** | **Re-bleeding rate**<br>**Complications**<br>**Overall mortality rate**<br>**? %** | **Re-bleeding rate**<br>**Complications**<br>**Overall mortality rate**<br>**8.5%** | **Re-bleeding rate**<br>**Complications**<br>**Overall mortality rate**<br>**15.3%** |

Ierardi AM, et al. The role of interventional radiology in abdominopelvic trauma. Br J Radiol 2016; 89: 20150866.

# Hamad General Hospital

- 5 years (2014-2019)
- Total of 169 patients
- Had Angioembolization for abdominal trauma

# Hamad General Hospital



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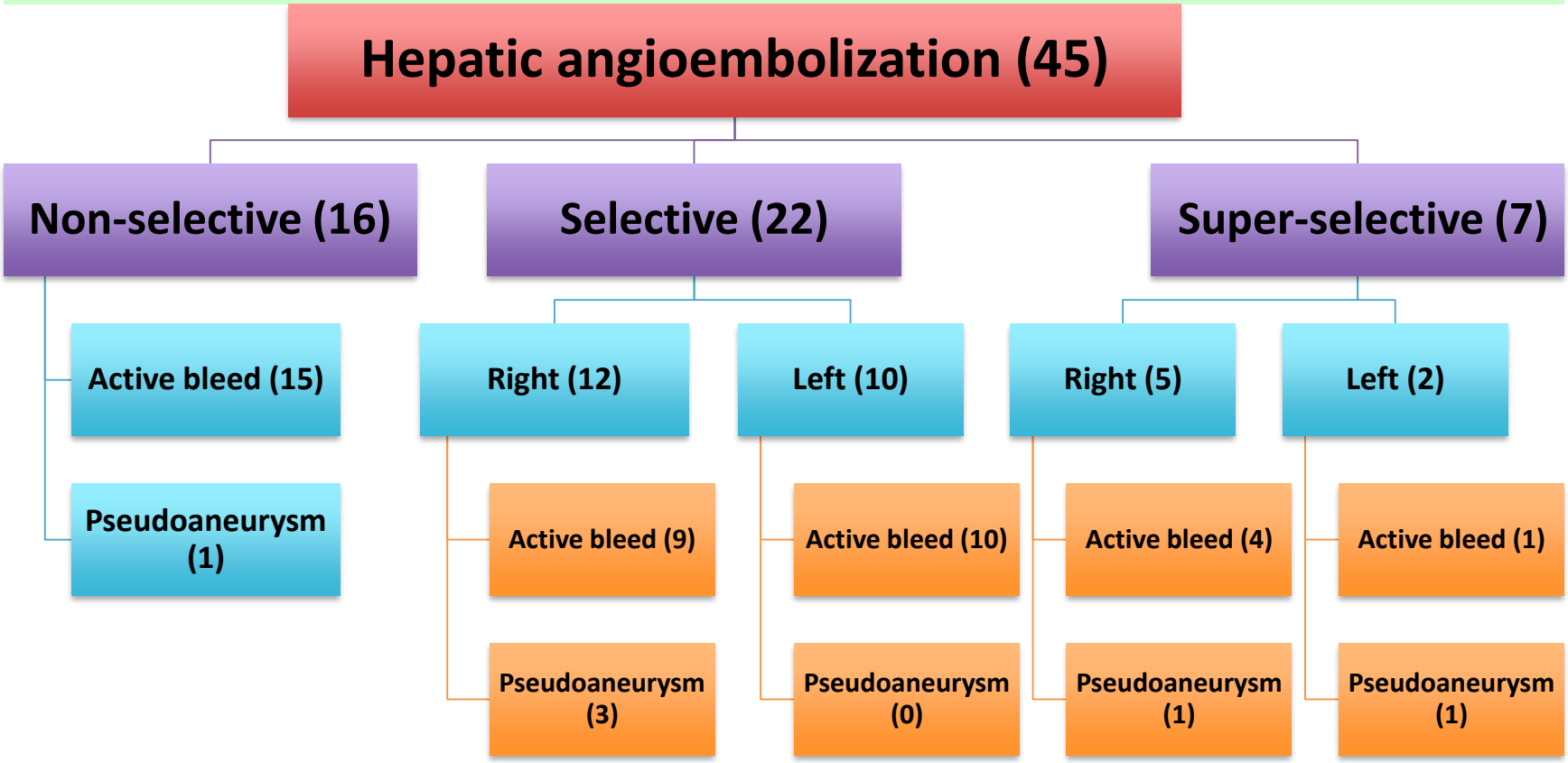

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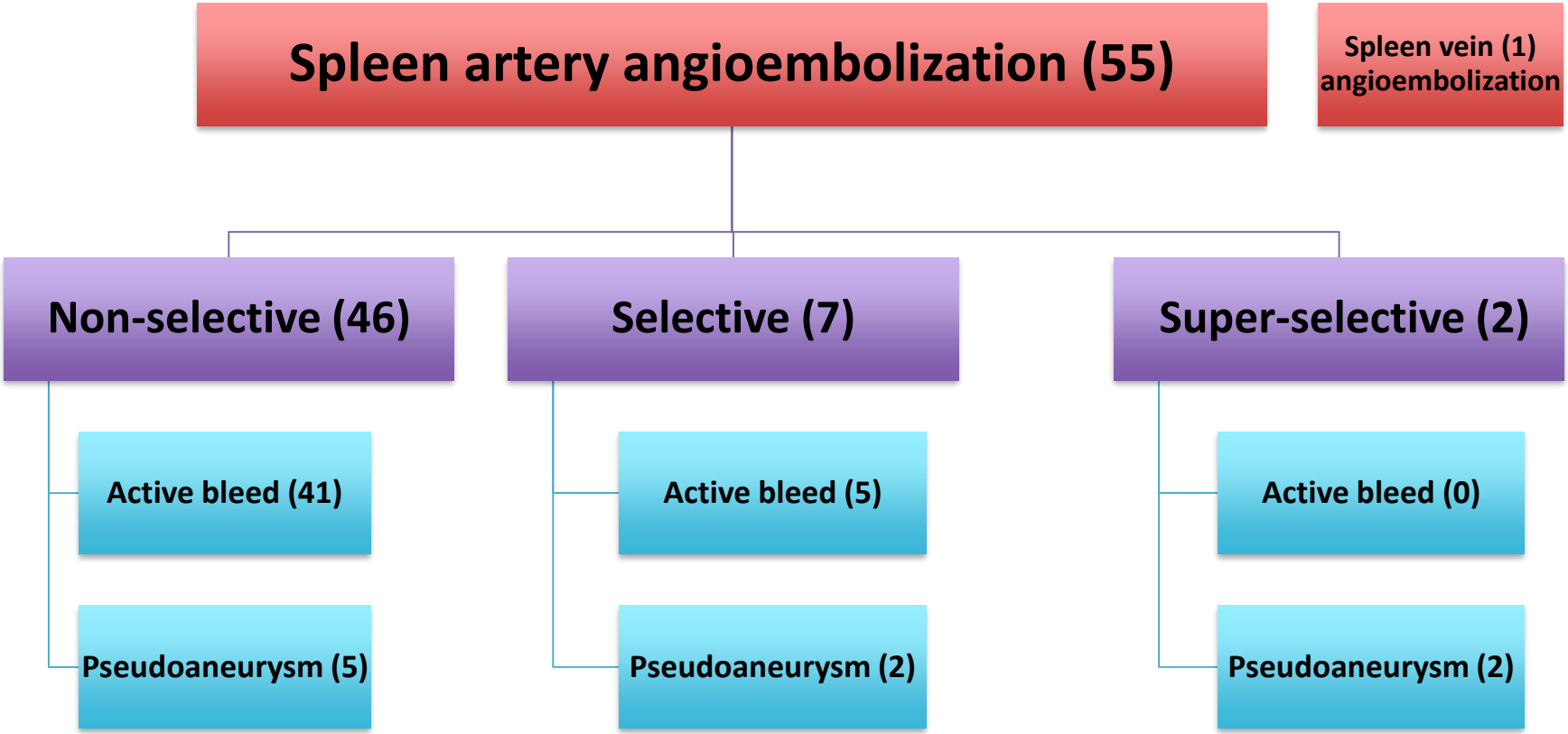

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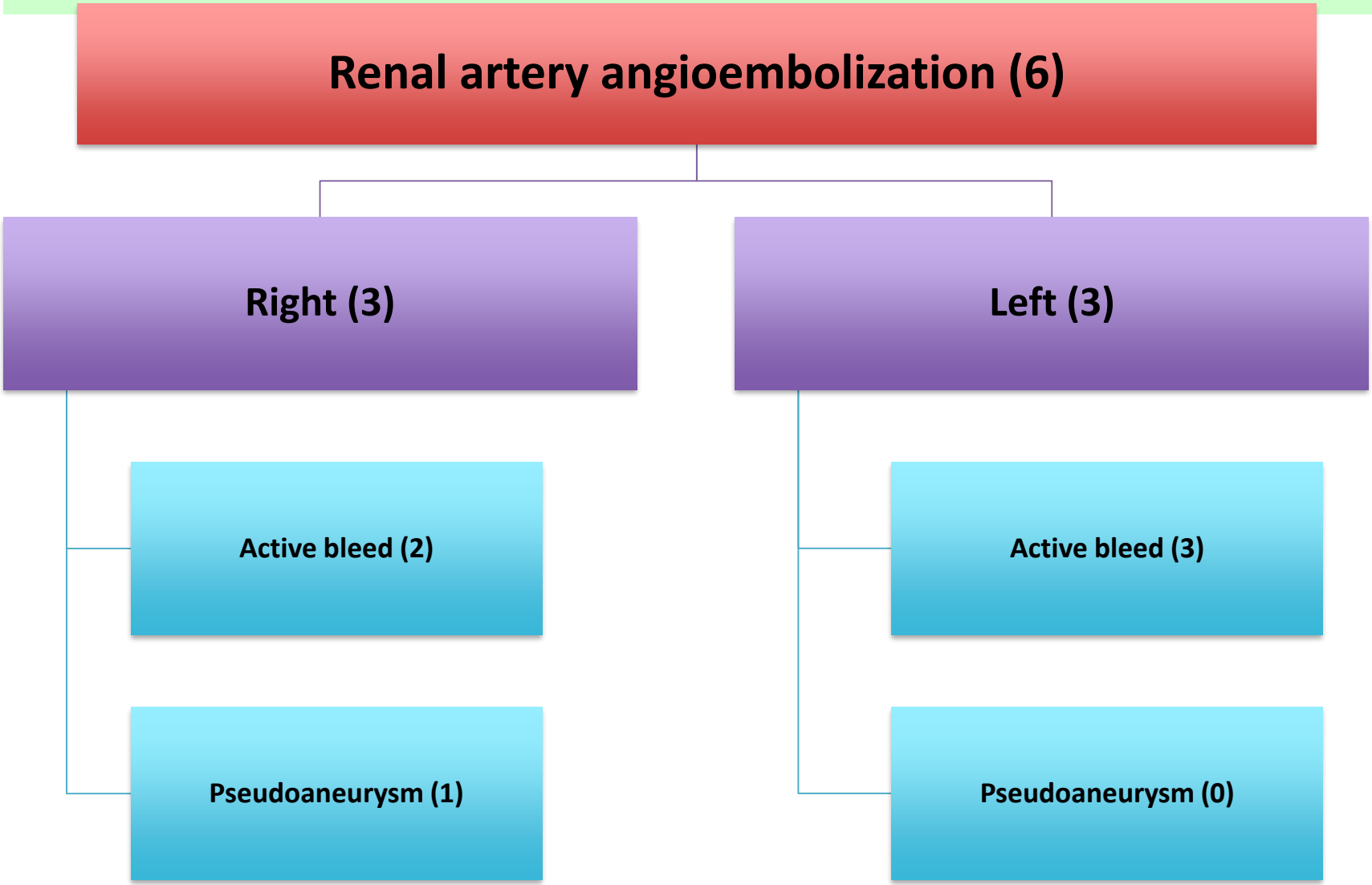

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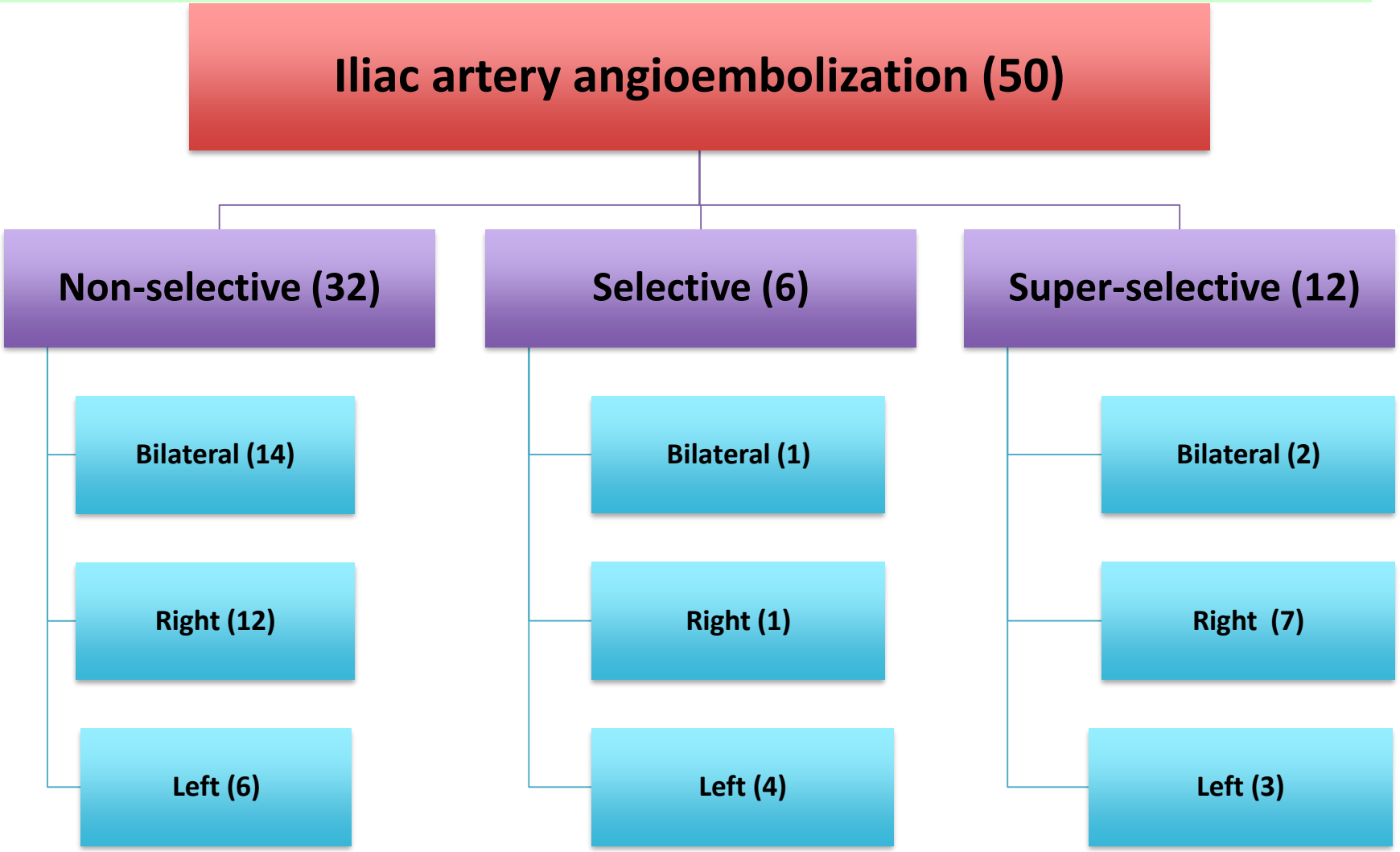

# Conclusions

- Embolization has an accepted role as an adjunct to NOM of abdominal trauma in hemodynamically stable patients with a contrast blush seen on arterial phase CT
- In hemodynamically unstable patients embolization can be combined with other adjunct like REBOA or following laparotomy

# Conclusions

- Embolization has significantly improved the success rate of NOM in high grades solid organ injury
- But was not associated with any improvements in mortality, hospital length of stay, or transfusion requirements compared to patients treated with NOM alone

مؤسسة حمد الطبية
Hamad Medical Corporation
HEALTH • EDUCATION • RESEARCH صحة • تعليم • بحوث
حمد Hamad