"Stop bleeding! Techniques, tips, and tricks to manage bleeding in various locations"

Anna Maria Ierardi
Diagnostic and Interventional Radiology dpt
Fondazione IRCCS Ca’ Granda,
Ospedale Maggiore Policlinico
Milan, IT
Disclosure

Anna Maria Ierardi

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)

I do not have any potential conflict of interest
IR in Emergency workup

CONVENTIONAL SCHEME

PROMPT and RAPID...

Prompt and Rapid Endovascular Strategies in Trauma Occasions

Matsumoto J et al; DIR 2015; 96: 687-91
J Tr Ac Care Surg 2016; 80(3):457-60
Injury 2017; 23:511-19
DCIR: Damage Control Interventional Radiology

not a perfect distal embolization
contain the ongoing hemorrhage in the fastest way possible

“Simple”
• clear strategy in your mind
• From catheterization to the final visual confirmation of embolization: 10-minute window for each targeted vessel

“Short”
• the operator is expected to re-assess each maneuver every 5 minutes

“Safe”
• alike surgery, DCIR is a concerted teamwork effort
• good organization (co-operators, nurses, technicians)

“Start soon and finish sooner”

Matsumoto J et al. DIR 2015; 96: 687-91
Simultaneous damage control surgery and endovascular procedures for patients with blunt trauma in the hybrid emergency room system: New multidisciplinary trauma team building

Kaori Ito, MD, Tsuyoshi Nagao, MD, Kahoko Nakazawa, MD, Akinori Kato, MD, Hiroto Chiba, MD, Hiroshi Kondo, MD, PhD, Yasufumi Miyake, MD, PhD, Tetsuya Sakamoto, MD, PhD, and Takashi Fujita, MD, PhD, Tokyo, Japan

The HERS is a novel tool for trauma patient care that enables the evaluation and treatment to be completed in a single room. Building a multidisciplinary team involving surgery, IR, anesthesiology, and EM is a crucial part of HERS-based trauma care.

24h/day-7d/week
perfect team work
HYBRID ROOM

EVERYTHING x ALL COLLABORATION SYNERGY
Technical Considerations

Techniques

- **Localized embolization**: super-selective (no embolization of adjacent arteries)
- **Proximal embolization**: only the artery proximal to the bleeding point is embolized (e.g., inaccessible bleeding point)
- **Segmental embolization**: not only bleeding point but also adjacent branches

Rebleeding owing to distal back flow

Ischemic complications

Yu A et al. KJR 2012; 13(S1):S31-S39
Technical Considerations

Techniques

PSA/BLUSH

sandwich

proximal
Technical Considerations

Techniques

- **Stenting**
- **Stenting + Coiling**
- **Assisted Coiling**

*Madhusudhan KS et al. KJR 2016; 17(3) 351-363*
«SANDWICH» TECHNIQUE

The sandwich technique implicates embolization of both the afferent and efferent vessels to completely remove all portions of a target lesion from the circulation.

- Sandwich technique is indicated in peripheral embolization, especially in districts in which back flow from collaterals should be fill the bleeding site.
- The “back door”, also named the efferent artery, is usually closed first, followed by the “front door”, namely the afferent artery.
Technical Considerations

Injection: sandwich/filler

Glue 1:3
KIDNEY INJURIES

- In the vast majority of cases, renal injuries are minor and self-limiting. Conservative (expectant) treatment is increasingly accepted as the preferred approach.

- Renal arteries are end-arteries: embolization will result in necrosis—> distal embolization is preferred rather than proximal embolization.
SPLEEN INJURIES

**Proximal vs Distal**

- Higher failure rate of the procedure after distal embolization compared to proximal embolization.
- Distal Embolization is usually associated with splenic infarcts larger than Proximal Embolization (risk of splenic abscess).

For these reasons, *proximal embolization* is preferred to distal embolization; the choice of devices is the prerogative of the interventional radiologist, according to his familiarity with the various materials available.

*Hedmund H et al. J Vasc Interv Radiol 2012; 23:976–979*
*Bathia A et al. Ann Vasc Surg 2023;89:166-73*
HEPATIC INJURIES

Selective Embolization
✓ To minimize loss of liver function
✓ To avoid hepatic ischemia/infarction

Non-selective Embolization
✓ Widespread bleeding in unstable patient

Hepatic Transarterial embolization (TAE) can also be used to treat patients who have failed observational management or patients that have ongoing bleeding or rebleeding after surgical management.
HEPATIC INJURIES
Technical Considerations

G.I. B.

M, 50 yo; bleeding of a colic angiodysplasia

Embolization with Onyx 18
PERCUTANEOUS APPROACH

• It is usually used for cases of **failed endovascular approach** or pseudoaneurysms or bleeding not accessible endovascularly, PSA with narrow neck or localized in solid organs

Technical Considerations

Matherials

CATHETERS & MICROCATHERETERS

EMBOLIC AGENTS

STENT GRAFTS

BALLOONS
### Technical Considerations

#### Materials

<table>
<thead>
<tr>
<th>EMBOLIC AGENT</th>
<th>INDICATIONS</th>
<th>ADVANTAGES</th>
<th>DEMERITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMANENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coil</td>
<td>blush, PSA, AVF</td>
<td>superselective, rapid effective</td>
<td>effectiveness in coagulopathy</td>
</tr>
<tr>
<td>particles</td>
<td>injury terminal vessel</td>
<td>permanent</td>
<td></td>
</tr>
<tr>
<td>NBCA</td>
<td>alternative to coil/+++rebleeding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVOH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>starch/swine skin gelatine particles</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


---

**A good knowledge of each agent is mandatory**
How to choose

Effective and Safe

The choice of embolic agent is crucial

Gelatin sponge particles and N-butyl-Cyanoacrylate (NBCA) appears to be the most adequate in DCIR critical trauma

Permanently occludes vessels (not likely to recanalize)  
Temporary but fast (without coagulopathy and/or in the first phases)

the risk of forfeiting viable organs is secondary when every second is matter

Luo CB et al. AJNR Am J Neuroradiol 2006;27(7):1535—40
Matsumoto J et al. DIR 2015; 96: 687-91
ENDOVASCULAR TECHNIQUES MAY HAVE LIMITS

WHEN SHOULD WE STOP?

Never give up!
Let’s continue...
In most cases, modern tools and devices permit to overcome limits.

- No target visualization
- Non target embolization
- Incomplete embolization
- Contraindications to embolization
Contraindications

- Pregnancy
- Renal failure
- Contrast allergy

THERE ARE NO CONTRAINDICATIONS
to overcome visualization difficulties...
to overcome visualization difficulties...

CBCT and navigational softwares

4.1 seconds
intra-operative CBCT:
- 3D roadmap creation
- identification target
use of aortic occlusion balloon
to avoid non-target embolization...
to avoid non-target embolization...

- occlusion of vital branch vessels (with stent graft or embolic agent should be avoided)
- do not use liquid embolic agents in presence of patent collaterals or possible shunts

pancreatic arteries
To avoid incomplete embolization...

- Embolization of backdoor not feasible (PSA, arteries with reach collateral patterns)
- Impossibility to reach the bleeder vessel

Trying to overcome limits...
In the early future, new tools, devices and technologies, widespread of hybrid rooms are going to overcome some limits of embolization.

In several circumstances, no specific rules neither guidelines about embolic agents or techniques.

Knowledge, Experience, Skills, Teamwork to convert a difficult bleeding scenario into a more controlled one, or just to gain some time.
Thank you for the attention!
"Stop bleeding! Techniques, tips, and tricks to manage bleeding in various locations"

Anna Maria Ierardi
Diagnostic and Interventional Radiology dpt
Fondazione IRCCS Ca’ Granda,
Ospedale Maggiore Policlinico
Milan, IT