Treating traumas: Plugs, coils, or liquids?

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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
40% deaths after trauma due to haemorrhage

Besides traumatic brain injury and mass haemorrhage, trauma to abdomen and pelvis is the most common cause of death within the first hour after the event.

TIME IS LIFE
What’s the most important factor influencing outcome?

Early access to treatment = Early ATLS Primary survey MD Evaluation OM or NOM
The goal of embolization is to obtain the occlusion or decrease of the blood flow through the endovascular application of different agents or materials.
The device used to embolize could be easy to use, versatile, and could achieve a high technical success rate as quickly as possible.

“Simple Short Safer”

E.S. Crawford, J Vasc Surg 1985
Classification: Physical State

Liquid
- Cyanoacrilate
- Copolymers
- Sclerosing agents
- Micro particles

Mechanical
- Coils
- Plug
<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>non target embolization, reflux</td>
</tr>
<tr>
<td>NBCA</td>
<td>alternative to coil / +++rebleeding</td>
<td>rapid; alternative in rebleeding</td>
<td></td>
</tr>
<tr>
<td>AVP</td>
<td>large vessel/AVF</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEMPORARY</td>
<td>gelatin sponge</td>
<td>rapid non selective control of haemorrhage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>autologous clot</td>
<td>cheap</td>
<td>↓ effectiveness (+++ in impaired hemostasis)</td>
</tr>
<tr>
<td></td>
<td>starch/swine skin gelatine particles</td>
<td>rapid effective uniform distribution</td>
<td>non target embolization</td>
</tr>
</tbody>
</table>

**Ideal embolic agent does not exist**
THE CHOICE OF THE EMBOLIC AGENT

- vessel size
- the duration of occlusion desired
- the need for tissue viability
- the patient’s clinical condition

- large
- small
- permanent
- temporary
- complete ischemia
- need to reperfusion
- vital parameters
- coagulation status
**EMBOLIC AGENTS**

**KEEP IN MIND**

- young pts (usually)
- smaller caliber aa
- “clamped down” (↓ intravascular V)
- higher V and rate of cm
- coaugulopathy

**the efficiency of some embolization agents may be altered**

*Kord A et al. Semin Intervent Radiol 2021;38:144–152*
They require a functioning coagulation pathway to obtain vessel thrombosis.

Table 1  Technical Pearls for Coil Embolization

<table>
<thead>
<tr>
<th>Issue</th>
<th>Pearl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaffolding</td>
<td>Adequate scaffolding can be obtained by initially deploying a larger coil, followed by smaller ones. An Amplatzer Vascular Obstruction Device may be used for vessels that do not taper; it has legs that penetrate the walls of the vessel, and it acts as a cone into which coils may be placed. Coils can be used as a scaffold in combination with Gelfoam when patient is coagulopathic (trauma/shock); such a “coil-Gelfoam sandwich” causes a complete, permanent mechanical occlusion. Stiffer coils are generally deployed first and are used as a “backstop.” Softer and pliable coils with unpredictable coil shapes that tend to conform to vessel anatomy, such as the Nestor coil (Cook, Inc., Bloomington, IN), may be deployed following a stiffer “backstop” coil deployment.</td>
</tr>
<tr>
<td>Microcoils</td>
<td>Microcatheters should be used when the coil is &lt;0.018 inches (microcoil) to prevent catheter occlusion; care should be taken to be certain that “high-flow” catheters are used with caution when deploying coils, as the larger inner lumen may allow the coils to partially form in the catheter, leading to catheter blockage.</td>
</tr>
<tr>
<td>Undersizing</td>
<td>Undersizing may lead to distal embolization and must be avoided especially in cases of PAVM; as a rule of thumb, the coil should be ~20% larger than the vessel diameter.</td>
</tr>
<tr>
<td>Oversizing</td>
<td>Too much oversizing will prevent the coil from achieving its shape; this leads to inadequate occlusions, as well as a markedly longer coil (which may in turn lead to proximal coil malposition).</td>
</tr>
<tr>
<td>Deployment</td>
<td>When deployment precision is required (i.e., intracranial procedures, PAVM), coils may be deployed using the floppy end of a “pusher wire”; when precision of deployment is not a concern (i.e., filling a pseudoaneurysm), the coil may be deployed using a saline bolus.</td>
</tr>
<tr>
<td>Retrievable coils</td>
<td>Retrievable coils allow the coil to be pulled back in the delivery catheter just before deployment; this technique is also helpful when precise placement is essential.</td>
</tr>
<tr>
<td>Composition</td>
<td>As a rule of thumb, steel coils tend to be stiffer while platinum coils tend to be softer.</td>
</tr>
</tbody>
</table>

PAVM, pulmonary arteriovenous malformations.  
The AVP acts as an embolic agent by promoting clot formation.

Large vessel size, high flow situations, and abnormal coagulation factors can prolong the occlusion time.

**Table 2** Technical Pearls for Amplatzer Vascular Plug Embolization

<table>
<thead>
<tr>
<th>Issue</th>
<th>Pearl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oversizing</td>
<td>Oversize the device by 15–30% (30–50% for the single disc device) relative to the vessel to prevent distal migration.</td>
</tr>
<tr>
<td>Positioning</td>
<td>Two platinum bands serve as radiopaque markers.</td>
</tr>
<tr>
<td>Deployment</td>
<td>A simple unscrewing mechanism allows for precise deployment of the device.</td>
</tr>
</tbody>
</table>
Embolization with MVP (Micro Vascular Plug®): experience on 104 patients in emergent and elective scenarios

Francesco Giurazza¹, Anna Maria Ierardi², Andrea Contegiacomo³, Fabio Corvino¹, Giampaolo Carrafiello² and Raffaella Niola¹

- **Coagulation status** does not influence the device embolic property
- **Straight and longer landing zone** are statistically associated with higher technical success compared to curved and shorter ones
• can function independently of the patient’s clotting ability

• liquid embolics can induce embolization via biochemical reactions
Endovascular Use of Cyanoacrylate-Lipiodol Mixture for Peripheral Embolization: Properties, Techniques, Pitfalls, and Applications

Pierre-Olivier Comby 1,2, Kévin Guillen 2,3, Olivier Chevallier 2,3, Marc Lenfant 1,2, Julie Pellegrinelli 3, Nicolas Falvo 3, Marco Midulla 3 and Romaric Loffroy 2,3,*

Table 5. Advantages and drawbacks of cyanoacrylate glues.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast polymerization allows for less procedural</td>
<td>May stick to the catheter if not used properly</td>
</tr>
<tr>
<td>radiation dose</td>
<td></td>
</tr>
<tr>
<td>Permanent occlusion prevents recanalization</td>
<td>Very adhesive with inflammatory reaction</td>
</tr>
<tr>
<td>Efficacy does not depend on coagulation</td>
<td>Must be mixed with lipiodol to be radiopaque</td>
</tr>
<tr>
<td>parameters</td>
<td></td>
</tr>
<tr>
<td>Can reach distal targets that cannot be</td>
<td>Learning curve by the operator is needed to</td>
</tr>
<tr>
<td>navigated with microcatheters</td>
<td>use it</td>
</tr>
<tr>
<td>Cheap *</td>
<td>Use of a microcatheter is necessary</td>
</tr>
</tbody>
</table>

* In Europe, not in the USA.
M, 68 yo; bleeding of a renal angiomyolipoma (after blunt trauma)

Embolization with Squid 12
When can we use them in combination?

In some situations, mechanical agents make safer the use of liquids.

In other situations, liquids complete the embolization performed with mechanical agents.
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When can we use them in combination?
When can we use them in combination?

In other situations, liquids complete the embolization performed with mechanical agents.
Conclusions

• **Time is life!** Being fast is crucial

• Ideal embolic agent doesn’t exist

• The best embolic agent depends on operator’s experience, patient’s characteristics, setting

• If necessary, they can be used in combination

• New agents in the next future...
Conclusions

"shear thinning"

"We’ll see..."

OBSIDIO™ Conformable Embolic
Simply Different
Thank you for the attention!