ENDOVASCULAR EMBOLIZATION IN THE SETTING OF TRAUMATIC OR INFECTIOUS ARTERIAL DISRUPTION

Can we just plug this?

PRESENTER DISCLOSURES

• None

DISEASE PROCESSES

• Trauma (mechanical arterial disruption)
• Infection (mycotic arterial disruption)
TRAUMA

- The leading cause of death and disability worldwide
- Hemorrhage is responsible for 30-40% of those deaths
- Transcatheter embolization is a modern way to address many of these

TRAUMA

- Benefits of Embolization:
  - Minimally invasive
  - Effective
  - May provide safer control when compared to open exploration.

TRAUMA

- Factors to consider:
  - Are access vessels adequate?
  - Size of vessel needing occlusion.
  - Need for treatment of several vessels (arcade with multiple injuries)
  - Other vascular supply to end organs
  - Collateral filling of the area
  - Is the vessel expendable?
  - Is there a traumatic AVF?
SAMPLE CASE

- 60 yoM Presented to the ED after Motorcycle crash
- Injuries:
  1. Grade 4 splenic laceration with active extravasation.
  2. Left 6th, 7th, and 9th rib fractures.
  3. Right 5th, 6th, 7th, 8th, 9th and 10th rib fracture.
  5. C6-C7 fracture.
  6. Large flank hematoma
- PMH: History of Tobacco and ETOH abuse with reported history of early cirrhotic changes.
- No use of anticoagulant or antiplatelet regularly

Visualized active extravasation on CTA.
EMBOLIZATION OPTIONS:

- What is embolization:
  - Placement of some form of occluding media into a vascular bed.

- Options:
  - Foam
  - Coils
  - Plugs
  - Autologous tissue
  - Particles
  - Polymers


FOAM

- Gelatin sponge is a temporary agent derived from a biologic substance made of purified skin gelatin that has been used for many years as the primary embolization agent.
- Commonly used to provide relatively distal target embolization followed by more proximal embolization with coils
- Also used after placement of coils to reinforce thrombosis, especially in patients with coagulopathy where coils alone may not provide vessel occlusion.
- Inexpensive, temporary, readily available.
- Particle size is not uniform, disruption with re-bleeding is possible if used as a solo agent.

COILS

- Coils provide a framework for clot formation and have the addition of some fibers (made of wool, nylon fibers, polyester, silk) to increase thrombogenicity.
- Coils are made of steel or platinum.
  - Platinum is more expensive but is very radiopaque and more malleable than steel.
- For trauma embolization, the main types of coils used are the macrocoils in 0.038- and 0.035-inch sizes and available in diameters from 3 to 15 mm.
- Must be sized appropriately to avoid migration.
PLUGS

- Occlusion devices derived from septal occluders used in cardiology.
- Non-covered nitinol mesh that should be oversized 30 to 50% of the vessel.
- The device can be re-sheathed if not in satisfactory position.
- Although the device is more expensive than the regular pushable coils, usually a single device is required, saving time and the cost of multiple coils.
- Multiple different plug configurations.

PARTICLES

- Same principles as gelfoam.
- Uniform hydrogel particle size.
- Permanent.
- Several different sizes depending on the desired vessel occlusion:
  - 100 to 300 µm
  - 300 to 500 µm
  - 500 to 700 µm
  - 700 to 900 µm
  - 900 to 1200 µm
- Mixed with contrast for administration.

POLYMERS

- Similar in embolization to gelfoam and particles.
- Fills the vascular space.
- Permanent.
- Good for non-critical structures with multiple areas of extravasation.
- Need to remove catheter quickly to prevent adherence of the catheter tip to the polymer.
SAMPLE CASE

- What did we use?

- No further concerns of intra-abdominal bleeding during his admission.
- Was able to discharge with no other procedures.
- Seen in clinic 4 weeks later with no abdominal complaints and near complete resolution of hematoma.
• But what if there is an infection?

**INFECTION:**

• Infection leading to hemorrhage is not a common problem, but does occur in deep set infections.
  • Mycotic Pseudoaneurysms (Infectious invasion of vessel wall)
  • Infective endocarditis emboli (occurs in up to 15% of cases)
  • Infected AVF
  • Erosion of abscess cavity into neighboring vessel

**CONCERNS**

• Placement of a foreign body in a known infected field.
  • Long term antibiotics?
  • Removal if needed?
MYCOTIC PSEUDOANEURYSMS

- Thin walls which could lead to rupture during the procedure
- Can develop anywhere in the arterial tree if source is an infected aortic valve.
- *Strep Viridans* has been identified as a cause in several extracranial cases.

SMA

  - 60, 64, and 65 years old
  - Distal SMA aneurysm found nearly 30 days after initial admission
  - All had microcoils placed
  - No relapse of infection at 60, 30, and 15 months.

RIGHT GASTRIC

- Varasai and colleagues demonstrated the use of embolization in a large right gastric artery pseudoaneurysm in a patient with severe pancreatitis. *J Vasc Interv Radiol.* 2018 May; 12(5)
  - 35 year old female
  - Presented with increased abdominal pain
  - Coil embolization was performed with resolution of the pseudoaneurysm flow.
  - 6 month CT with pancreatic pseudocyst, but no infection
INTRACRANIAL

  - 25 year old man
  - Rupture detected 39 hours after initial embolism
  - Coil embolization
  - No reported infectious sequelae.
- Eddleman and colleagues reported a similar presentation in a child. Childs Nerv Syst. 2007 Jun;23(6)
  - 9 year old boy
  - Neurodeficits on presentation
  - Coil embolization with sparing of distal vessel.
  - Recovered all neurologic function.

GLUTEAL

- Bouarhroum presented a case of bilateral SGA pseudoaneurysms in a young patient with endocarditis also. Ann Vasc Surg. 2009 Sep-Oct;23(5)
  - 16 year old boy
  - Ruptured was treated surgically
  - Non-ruptured treated with coils
  - Can be an uncommon source for sciatic pain

PATIENT PRESENTATION

- 24 year old female who initially presented to an outlying facility with altered mental status and swelling in her left neck.
  - CT scan done there concerning for a carotid injury of some form.
  - Intubated and transferred for higher level of care.
PATIENT PRESENTATION

- She was unable to answer questions on initial presentation to our ED.
- She was found to have a history of polysubstance abuse, but no other significant histories.
- Exam revealed a large pulsatile mass on the left neck.
- Imaging was reviewed.
• Significant soft tissue hematoma/abscess/swelling seen on soft tissue reformats.
ALTERED MENTATION

• Because of the altered mentation associated, CT Head was performed that showed “multifocal hemorrhages associated with the acute left middle cerebral artery territory infarction.”
• Flaccid paralysis of the right half of the body without response to any stimuli.

• MRI to better evaluate extent of the brain lesions
PLANNING

- Ideally, patient would undergo an interposition repair of the pseudoaneurysm – given her young age and adequate anatomy.
- The extent of the abscess was prohibitive for access in the neck.
- With her CVAs, Neurology would not allow any anticoagulation or anti-platelets.
PLANNING

• Repeat imaging showed worsening of both the pseudoaneurysm and the CVAs without intervention beyond medical management.
• With the worsening clinical picture, plan was made to ligate the carotid artery.
• Size of pseudoaneurysm and abscess was still prohibitive for access from the neck – Concern that lack of proximal control would result in uncontrollable hemorrhage.

PLANNING

• Alternative proposed for proximal control...
SEVERAL OPTIONS AVAILABLE:
THIS WAS AN INFECTED FIELD.

• Goal was for proximal control prior to formal ligation.
• She was then taken to the OR the following day for formal ligation and plug retrieval.
POST-PROCEDURE

- Extubated and began to move right upper extremity on command on POD#2
- Ambulated with PT on POD#4
- Persistent dysphagia and aphasia post-procedure.
  - PEG placed on POD#10 after multiple failed swallow studies
  - Speech returned on POD#16
  - Swallowing normal by POD#18
- Discharged to a rehab facility on POD#18
FOLLOW-UP

• PEG tube has since been removed
• No further infection identified
• No neurologic deficits persist

CONCLUSIONS

• Endovascular interventions are increasingly popular for the use in active hemorrhage from almost any source.
• In the setting of traumatic injuries, embolization can help to stabilize an unstable patient and provide a bridge to any further therapy needs.
• In the setting of infection (mycotic) arterial disruption, endovascular exclusion has been successfully used with very few reported long term infectious complications.