Onyx & AVM’s  
Mollie Meek, MD  
Interventional Radiology  
University of Arkansas for Medical Sciences  
athertonmarye@uams.edu

Disclosures
• None

Overview
• Basic Science of Angiogenesis
• Onyx Histological Data
• Why does this matter

Embolization Induced Angiogenesis
• Hemodynamic
• Hypoxia
• Inflammatory

Hemodynamic
• Intraluminal shear stress
  – Increases VEGF
  – Increases MMP pathways

Hypoxia
• VEGF mRNA increases within hours of hypoxic stress
• partially embolized AVMs: localized hypoxia
• HIF-1 regulates VEGF and WT1
Inflammatory

- Interleukin-6 activates endothelial cells
- IL-6 upregulates VEGF
- IL-6 activates IL-8

Methods

- Evaluation of surgical pathology specimens:
  1. Presence of intraluminal onyx cast material.
  2. Presence of recanalized blood vessels in the onyx cast material.
  3. Degree of vascular & perivascular inflammation.

Results

- 7 patients
  - 4 Females (mean age, 28 years; median, 26 years; range, 16-44 years)
  - 3 Males (mean age, 35 years; median, 39 years; range, 13-53 years)
- 16 combination embolization/surgical specimens
- Average time period between endovascular embolization with onyx and surgery:
  - 23 Months

Results

- Blood-filled recanalized endothelia in Onyx cast material.
  - None: 25% (4/16)
  - Few: 25% (4/16)
  - Moderate: 6.25% (1/16)
  - Extensive: 43.75% (7/16)
Results

• Degree of Vascular & Perivascular Inflammation
  – None: 18.75% (3/16)
  – Mild: 62.5% (10/16)
  – Moderate: 18.75% (3/16)
  – Severe: 6.25% (1/16)

• Foreign Body Giant Cells in Cast Material
  – None: 0%
  – Rare: 12.5% (2/16)
  – Present: 87.5% (14/16)
Results

- Mural Angioneecrosis
  - None: 56.25% (9/16)
  - Focal: 25% (4/16)
  - Mural: 18.75% (3/16)

Murayama

- Analysis of histologic changes post-onyx embolization in swine animal model
  - Subacute (18 days)
    - Mild granulomatous inflammatory response with many elongated epithelioid cells & scattered foreign body giant cells.
    - Focal adventitial lymphoplasmocytic and histiocytic response.
  - Chronic (1, 3, & 6 months)
    - Robust intraluminal foreign body giant cell reaction with abundant surrounding lymphoplasmacytoid cells.

Conclusion

- Adventitial lymphoplasmocytic and histiocytic response concordant with literature (7-9)
  - Mild: 10/16 (63%)
  - Moderate: 3/16 (19%)
  - Severe: 1/16 (6%)

- Robust foreign body giant cell reaction concordant with literature (7-9)
  - Rare: 2/16 (12.5%)
  - Present: 14/16 (87.5%)

What does this mean?

- Onyx is not permanent
- Specimens with little or no inflammatory changes, had no recanalization
- Inflammatory mediated angiogenesis should not be ignored