PROPOSITION:
Polymerizing Agents Can and Do Cure AVMs
And Are Now the Agents of Choice:
Ethanol is Too Dangerous

A.S. Gomes, MD
VEITHsymposium 2018

DEBATE:
FOR
• “Dangerous”
  • In IR we do dangerous every day – especially in July
• “Cure”
  • Mostly “fix things”

Proper Use of Ethanol

Risks of Ethanol in Medicine

Issues with Ethanol
• Is a sclerosing agent - toxic to tissue
  • Denatures proteins of endothelium activates, coagulation system to produce blood clots
• Generates acetaldehyde and reactive oxygen species damage healthy tissue - endotoxin leakage, inflammatory cytokine release, modification signal transduction cell membrane
• Unless diluted with contrast, cannot see where it goes

Issues with Ethanol
• Impairs wound healing
  • Ulcers are difficult to heal
  • Skin grafts fail
• Use in an area of surgical scar - high risk of skin injury
Ethanol
- Painful procedure
- In proximity to a nerve – injury
  - Sciatic nerve injury
- Dosing – volume delivered
  - High doses – systemic effects
    - Elevated blood alcohol
    - Hemoglobinuria
  - Low volumes require multiple treatments

Ethanol
- Cardiopulmonary problems
  - Arrhythmias
  - Bronchospasm
  - Pulmonary embolism
    - Sludge
  - Cardiovascular collapse - rare

Polymer: Cyanoacrylate
- Liquid embolic
  - Viscosity can be altered
  - Downside: Difficult to control
  - Long term experience shows degradation

Ethylene Vinyl Alcohol Copolymer
- Behaves as a filler
  - Mild inflammatory reaction
  - Minimal pain
  - Skin injury infrequent
  - Permanent agent

Ethylene Vinyl Alcohol Copolymer
- Issues:
  - Difficulty getting it to travel deep into nidus.
    - Dilute
    - Harder to see when diluted
  - Glue roadmap
    - Reduce radiation dose
    - Obscuration of vessels by prior Onyx placement

Ethylene Vinyl Alcohol Copolymer
- Without operative resection - Off label use
  - Facilitates operative resection
    - Bipolar bovie
CURE

- Definition of "cure"
  - Polymer occlusion will result in relief of AVM symptoms
  - Can cure some lesions
  - Remove all shunting in large lesion – doubtful
  - EVOH copolymer use is associated with lower morbidity than alcohol

Ethanol vs. Polymers

- One Gen Only ethanol
- CH₂CH₂OH

- Second Gen EVOH
- (C₆H₅O-C₄H₄)ₙ

- First Gen Cyanacrylate
- (CH₂=C₂N)COOC₂H₅

Ethanol vs. Polymers

- Versus Polymers

Comparison

<table>
<thead>
<tr>
<th>ISSUES</th>
<th>Polymerizing Agents</th>
<th>Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization</td>
<td>Filler</td>
<td>Sclerosing</td>
</tr>
<tr>
<td>Visualization</td>
<td>Easy</td>
<td>Not-so-much</td>
</tr>
<tr>
<td>Patient Pain</td>
<td>Low Risk</td>
<td>Higher Risk</td>
</tr>
<tr>
<td>Experience</td>
<td>EXCELLENT</td>
<td>Not-So-Much</td>
</tr>
<tr>
<td>Pre Surgical</td>
<td>Low</td>
<td>HIGH</td>
</tr>
<tr>
<td>Treatment</td>
<td>Lower</td>
<td>HIGHER</td>
</tr>
<tr>
<td>Risk of Injury</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Complication Rates</td>
<td>LOW</td>
<td>High</td>
</tr>
<tr>
<td>Morbidity</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Skill Level to Use</td>
<td>Unlimited</td>
<td>Limited</td>
</tr>
<tr>
<td>Future Products</td>
<td>Unlimited</td>
<td>Limited</td>
</tr>
</tbody>
</table>

POLYMERS and The Future

I just want to say one word to you, just one word: Plastics.