Curative Endovascular Management of Extensive Venous and Lymphatic Malformations in Complex Anatomies

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NOTHING TO DISCLOSE

Ethanol Endosurgical Ablation of Low-Flow Venous and Lymphatic Vascular Malformations

Vein Malformations
Slow-flow Lesions
Can Occur Anywhere
Connected to Veins
May Be Discontinuous
Can Have Mixed Lesions

Lymphatic Malformations
Slow-flow Lesions
Can Occur Anywhere
Arise From Vein Buds
Connected to Veins
May Be Discontinuous
Can Have Mixed Lesions

MR Low-flow Lesions
T1 Fat > VM > Muscle
T2 VM > Fat > Muscle
SE Sequences with Fat Suppression
High Signal on Long TR/TE SE
MR Imaging
True For VM or LM
Bright Signal on T-2
Fat-Suppression Useful
STIR sequences excellent
Decreased Signal in Treated Areas

As Reid has stated, “in view of the common development on each side of the vascular tree, and in view of the enormous constructive and destructive changes necessary before the final pattern of the vascular tree is reached, it is a marvel not that abnormal congenital communications occasionally, or rarely, occur, but that they do not occur more often.
Arch Surg 1925;10:601-638

Endothelial Cell Theory
• Lines every vascular lumen
• In direct contact with blood/lymph
• With thrombosis of the vessel, senses decreased oxygen tension and a relatively ischemic state
• Seeks to rectify this ischemic state

Endothelial Cell Theory
• It secretes “Chemotactic Cellular Factor” that stimulates cellular infiltration to remove embolization debris from the vascular lumen.
• The endothelial cell then re-endothelializes the new vascular lumen (termed “Recanalization Phenomenon”).
• It also secretes “Angiogenesis Factor” which then causes new blood vessel formation to collateralize to the thrombosed/occluded vasculature (termed “Neovascular Stimulation Phenomenon”).

Action of Ethanol
• Ethanol upon contact with blood proteins initiates the clotting cascade.
• Ethanol denudes the endothelial cell from the vascular wall and precipitates its protoplasm.
• Fractures of the vascular wall occur to the level of Internal Elastic Lamina.
• The denuded vascular wall causes platelet aggregation and luminal thrombosis from the vascular wall to the central lumen.
• Because the endothelial cell is destroyed, “Recanalization” and “Neovascular Stimulation” are now noticeably absent because the endothelial cell is gone and cannot secrete “Chemotactic Cellular Factor” and “Angiogenesis Factor”.
• Permanent thrombosis and cures are now possible.

THE YAKES VASCULAR MALFORMATION CENTER
January 2002 – December 2017
Embolization Statistics

- Procedures: 17,440
- Patients: 8,139
- Ethanol: 281,347 ml

Malformation Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Count</th>
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<tbody>
<tr>
<td>VM:LM : AVM</td>
<td>10:3</td>
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<tr>
<td>Head &amp; Neck</td>
<td>1,722</td>
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<tr>
<td>Upper Extremity</td>
<td>1,146</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>2,167</td>
</tr>
<tr>
<td>Chest/Abdomen</td>
<td>1,362</td>
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<tr>
<td>Pelvic/Buttock</td>
<td>962</td>
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Minor Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Count</th>
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<tbody>
<tr>
<td>Tissue Injury</td>
<td>368</td>
</tr>
<tr>
<td>Temporary Nerve Injury</td>
<td>129</td>
</tr>
<tr>
<td>Superficial Blood Clot</td>
<td>24</td>
</tr>
<tr>
<td>Infection</td>
<td>165</td>
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<tr>
<td>Bleeding</td>
<td>31</td>
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Major Complications

<table>
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<tr>
<th>Complication</th>
<th>Count</th>
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<tbody>
<tr>
<td>DVT</td>
<td>27</td>
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<tr>
<td>PE</td>
<td>10</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>6</td>
</tr>
<tr>
<td>Permanent Nerve Injury</td>
<td>4</td>
</tr>
<tr>
<td>Cardio-Pulmonary Arrest</td>
<td>5</td>
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<tr>
<td>Amputation</td>
<td>2</td>
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<tr>
<td>Hypoxia/Airway Compromise</td>
<td>13</td>
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<tr>
<td>Complications from Focal Swelling</td>
<td>14</td>
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<tr>
<td>Cerebrovascular Accident</td>
<td>6</td>
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<tr>
<td>Peripheral Ischemia</td>
<td>11</td>
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<tr>
<td>Anaphylaxis</td>
<td>1</td>
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<td>Bowel Perforation</td>
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</tbody>
</table>

Head & Neck Malformations

- AVMs, venous, lymphatic, mixed lesions all occur
- Involve soft tissues, bone, organs, in difficult surgical anatomies
- Can be multiple!!
- Endovascular approaches preferred rather than massive resections with serial difficult reconstructions and inevitable recurrences of the lesion

19 year old male with testicular involvement of venous malformation with verrucous excoriative hemorrhagic multiple lesions of the testicles.
After 7 serial ethanol treatments, the testicular lesions were ablated and the skin returned to normalcy. No further bleeding occurred.

20 year old female with vulval, labial, and vaginal venous malformations. Her OB/GYN physician told her never to become pregnant for during delivery, she could tear and have life-threatening hemorrhage. After Rx she has had 3 children uneventfully.

After 8 percutaneous ethanol treatments the Pt was able to have children and now is the mother of two.
Ethanol Ablation of Lymphatic Malformations: Both Cystic and Microcystic Forms
Lest We Forget…
Complications can occur in low-flow vascular malformations…

4 month old female presents with congenital LM in Lt face, neck, submandibular area, tongue, cervical prevertebral tissues, Lt suboccipital area, Lt supraclavicular area, Lt chest intra-thoracic areas requiring tracheostomy and G-tube.
Venous malformations are histologically identical no matter the structure that they occupy. Therefore, ethanol sclerotherapy is effective in treating them in ANY anatomy that they dwell. In the soft tissues and organs they shrink and scar down. In osseous structures the cystic spaces are replaced by bone marrow and the cortex thickens as the bone normalizes. Venous malformations may be cystic spaces of varying sizes or may have small luminal venular spaces. Venous malformations can typically have both macro and venular spaces in the same lesion. Ethanol sclerotherapy is curative in venous malformations involved in any structure and regardless if cystic or venular.