Clinical evidence of Onyx for the treatment of endoleakages and AVM’s

LINC 2019
Leipzig, Germany, 24. January 2019

Walter A. Wohlgemuth
University Clinic and Policlinic of Radiology
Martin-Luther University Halle-Wittenberg, Germany
Conflicts of interest

Scientific grants:
Siemens, Phillips, ab medica, ev3/covidien/medtronic, itm Flowmedical, Toshiba, Cook, W. L. Gore

Lectures:
ev3/covidien/medtronic, Biotronic, St Jude Medical, Abbott, Siemens, ab medica, Boston Scientific, itm Flowmedical, Terumo, W. L. Gore

Consulting:
1st WITiG, itm Flowmedical, Siemens, ev3/covidien/medtronic, ab medica

Proctoring:
W. L. Gore, ev3/covidien/medtronic, ab medica
Clinical significance of endoleaks

<table>
<thead>
<tr>
<th>Secondary procedures</th>
<th>Patients</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>339</td>
<td></td>
</tr>
<tr>
<td>Endoleak Type I</td>
<td>51</td>
<td>15,0%</td>
</tr>
<tr>
<td>Endoleak Type II</td>
<td>136</td>
<td>40,1%</td>
</tr>
<tr>
<td>Endoleak Type III</td>
<td>5</td>
<td>1,5%</td>
</tr>
<tr>
<td>Endotension</td>
<td>8</td>
<td>2,4%</td>
</tr>
<tr>
<td>Stentgraftmigration</td>
<td>46</td>
<td>13,6%</td>
</tr>
<tr>
<td>Stenosis/Thrombosis</td>
<td>25</td>
<td>7,4%</td>
</tr>
<tr>
<td>Iliac aneurysm</td>
<td>39</td>
<td>11,5%</td>
</tr>
<tr>
<td>Aneurysm rupture</td>
<td>29</td>
<td>8,6%</td>
</tr>
</tbody>
</table>

- 1768 pats. with mean 34 months after EVAR
- 339 (19%) reinterventions
- 200 (58,9%) Endoleaks, most of them type II


<table>
<thead>
<tr>
<th>Variable</th>
<th>No enlargement (n=33)</th>
<th>Enlargement (n=23)</th>
<th>OR</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding/draining arteries of the nidus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean number</td>
<td>2.2 (SD 1.1)</td>
<td>3.5 (SD 1.3)</td>
<td>2.43 (1.39, 4.24)</td>
<td>.002</td>
</tr>
<tr>
<td>Mean diameter [mm]</td>
<td>2.1 (SD 0.6)</td>
<td>2.5 (SD 0.7)</td>
<td>2.93 (1.16, 7.39)</td>
<td>.023</td>
</tr>
<tr>
<td>Combinations (subtypes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple-LA</td>
<td>5 (15%)</td>
<td>0 (0%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Simple-IMA</td>
<td>4 (12%)</td>
<td>1 (4%)</td>
<td>0.33 (0.03, 3.16)</td>
<td>.34</td>
</tr>
<tr>
<td>Complex-LA</td>
<td>16 (49%)</td>
<td>2 (9%)</td>
<td>0.10 (0.02, 0.50)</td>
<td>.005</td>
</tr>
<tr>
<td>Complex-IMA-LA</td>
<td>8 (24%)</td>
<td>20 (87%)</td>
<td>20.8 (4.9, 88.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nidus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial phase [cm³]</td>
<td>4.1 (IQR 2.1, 8.6)</td>
<td>10.2 (IQR 4.1, 19.2)</td>
<td>1.07 (1.01, 1.15)</td>
<td>.040</td>
</tr>
<tr>
<td>Delayed phase [cm³]</td>
<td>5.6 (IQR 2.3, 9.9)</td>
<td>8.7 (IQR 3.4, 18.7)</td>
<td>1.06 (0.99, 1.13)</td>
<td>.077</td>
</tr>
</tbody>
</table>

Ethylene Vinyl Alcohol Copolymer (EVOH)

Onyx™, SQUID
- EVOH
- DMSO
- Tantal
<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>Year</th>
<th>Patients</th>
<th>Endoleak Type</th>
<th>Transarterial approach %</th>
<th>Technical success %</th>
<th>Clinical success %</th>
<th>Follow-up, months</th>
<th>Follow-up range, months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eberhardt</td>
<td>JEVT</td>
<td>2014</td>
<td>6</td>
<td>Ia 4, Ib 2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>Mean 13.2</td>
<td>8–24</td>
</tr>
<tr>
<td>Bosiers</td>
<td>JCVS</td>
<td>2013</td>
<td>10</td>
<td>II</td>
<td>100</td>
<td>90</td>
<td>90</td>
<td>Mean 19.8</td>
<td>3–31</td>
</tr>
<tr>
<td>Müller-Wille</td>
<td>CIR</td>
<td>2013</td>
<td>11</td>
<td>II</td>
<td>100</td>
<td>55</td>
<td>73</td>
<td>Mean 26, median 18</td>
<td>6–50</td>
</tr>
<tr>
<td>Chunx</td>
<td>EJVES</td>
<td>2012</td>
<td>6</td>
<td>Ia 4, Ib 2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>Mean 3.75</td>
<td>1–10</td>
</tr>
<tr>
<td>Funaki</td>
<td>JVIR</td>
<td>2012</td>
<td>6</td>
<td>II 4, IIIb 2</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>Mean 8.8</td>
<td>6–13</td>
</tr>
<tr>
<td>Abularrage</td>
<td>JVS</td>
<td>2012</td>
<td>17</td>
<td>II</td>
<td>100</td>
<td>100</td>
<td>76</td>
<td>Median 45</td>
<td>20–75</td>
</tr>
<tr>
<td>Massisx</td>
<td>VES</td>
<td>2012</td>
<td>101</td>
<td>II</td>
<td>65</td>
<td>100</td>
<td>74</td>
<td>Median 4</td>
<td>n/s</td>
</tr>
<tr>
<td>Henrikson</td>
<td>Vasc</td>
<td>2011</td>
<td>6</td>
<td>Ia 5, Ib 1</td>
<td>100</td>
<td>100</td>
<td>67</td>
<td>n/s</td>
<td>3–18</td>
</tr>
<tr>
<td>Grisafi</td>
<td>JVS</td>
<td>2010</td>
<td>1</td>
<td>Ia</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Nevala</td>
<td>CIR</td>
<td>2010</td>
<td>3</td>
<td>II</td>
<td>33</td>
<td>100</td>
<td>33</td>
<td>n/s</td>
<td>n/s</td>
</tr>
<tr>
<td>Lingx</td>
<td>JVIR</td>
<td>2007</td>
<td>1</td>
<td>II</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>n/s</td>
</tr>
<tr>
<td>Martin</td>
<td>JVIR</td>
<td>2001</td>
<td>6</td>
<td>II</td>
<td>33</td>
<td>83</td>
<td>100</td>
<td>Mean 5</td>
<td>1.5–7</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td></td>
<td></td>
<td>174</td>
<td>21 not II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transarterial
Direct puncture of endoleak

- 30 type II endoleak pats., retrospective
- Cyanoacrylate glue only (45.5%), glue/coils (36.4%), and Onyx with or without glue/coils (18.1%)
- Technical success 29/30 pats.
- Freedom of aneurysm growth in 85.2%
- Complication rate 9.1% (3/33)
  - 1 case of nontarget embolization with transient neuropraxia and 2 self-limiting rectus sheath hematomas

Onyx in type IA endoleaks

• 4 pats. with previous cuff, 1 pat. directly
• 4 x transfemoral, 1 case transfemoral failed → direct puncture
  – Onyx, glue, coils in 3 pats.
  – Onyx + glue 1 pat.
  – Onyx + coil 1 pat
• Technical success 5/5
• No non-target embolization
• 4 pats. Stable, 1 decrease of aneurysm size

Onyx in type IA endoleaks after chimney

• 9 pats. with chimney EVAR
• Onyx only, transarterial
• Technical success 9/9, no complications
• Follow-up 16 months
• Primary clinical efficacy 8/9 patients (89%)
• Primary technical efficacy for 6/9 patients (67%)

Early reports on Onyx in type II endoleak

• 10 pats. with 13 type II endoleaks, retrospective
• Transarterial, Onyx only
• Technical success 12/13
  – 2 pats staged procedure due to multiple leaks
  – 1 pat. rupture during cannulation → covered stent
  – 1 pat. Rupture of sac into IVC → removal via snare
• Follow-up 19,8 months
• All patients stable or decrease after procedure in CT

Early reports on Onyx in type II endoleak

• 11 pats. with persistent type II endoleaks, retrospective
• Transarterial, Onyx only
• Technical success 9/11
  – 6 pats directly from transarterial
  – 3 pats from distal artery (“plug & push”)
• Follow-up 26 months
• 8/11 patients stable or decrease after procedure in CT

Angiographic classification of AVM

Type I: Arterio-venous fistula
Up to 3 direct fistulas without circumscribed nidus

Type II: Arteriolo-venous Malformation
Many feeding arteries and one dominant draining vein (DOV = dominant outflow vein)

Type IIIa: Arteriolo-venulous Malformation
Non-dilated, microfistulous Nidus

Type IIIb: Arteriolo-venulous Malformation
Dilated Nidus

Onyx in peripheral AVM

- 17 pats., 38 sessions, retrospective
- 12 pats. Onyx only, transarterial
- 5 pats. additional agents
- No major complications
- Follow-up 30 days
  - Improvement of symptoms in 15/17 pats.
- Follow-up 1 year
  - Recurrence in 7 pats.

Onyx in peripheral AVM

• 19 pats., 28 sessions, retrospective
• 13 pats. Onyx only, 12 transarterial, 1 direct
• Complete devascularization in 12 pats.
  – Surgical excision in 9 pats.
• Complications: 1 stroke, 1 microcatheter rupture, 1 pain + bradycardia (selflimiting)
• Follow-up 10 – 34 months
  – 2 patients with persisting symptoms
  – 1 pat. Lost to follow-up
  – Symptom free 16/19 pats.

Onyx in peripheral AVM

• 22 pats., 25 sessions, retrospective
• Onxy only or Onyx + other adjuncts (41%), transarterial
• Complete devascularization in 8 pats. (36%)
  – Rest: “near-complete devascularization”
• Major complications in 2 pats.
• Symptom improvement in 18 pats. (82%)
• During follow-up recurrence in 7 pats.

Onyx in peripheral AVM – transvenous retrograde

• 11 pats., 20 sessions, retrospective
• Retrograde Onyx filling of Nidus via transvenous approach
  – Type II AVM with dominant outflow vein
  – Preparation: transarterial flow-reduction in 73% and transvenous Plugs in 27%
• Complete devascularization in 10 pats. (91%)
• 95% devascularization in remaining patient
  – Rest: “near-complete devascularization”
• 1 minor complication (pain + swelling)
• No symptoms 8 pats. (73%)
• Improved symptoms 3 pats. (27%)
• During follow-up 8 months 1 angiographic recurrence (without symptoms)

Endovascular treatment of peripheral AVM

- According to angio anatomy
  - **Type I (AVF)**, e.g. pulmonary AVM/AVF in HHT
    → Quite simple (Coils, AVP)
  - **Type II** with dominant venous outflow
    → transvenous + retrograde treatment options
    → Good long-term results when venous outflow occluded
    → EVOH, as adjunct: coils/AVP for flow-modulation
  - **Type III**, diffuse, net-like „Nidus“, multiple venous drainages
    → Direct puncture, i.a., i.v.
    → Difficult to treat
    → EVOH frontline, „finishing“ with ethanol
    → MEK1-Inhibitors, MAP2K1 pathway modulators (?)
    → Sometimes palliative results
  - Wrong technique worsens situation (PVA, coils etc.)!


www.compgefa.de

1) University Clinic and Policlinic of Radiology, Martin-Luther University Halle-Wittenberg, Germany
2) German Interdisciplinary Society of Vascular Anomalies
Clinical evidence of Onyx for the treatment of endoleakages and AVM’s

LINC 2019
Leipzig, Germany, 24. January 2019

Walter A. Wohlgemuth
University Clinic and Policlinic of Radiology
Martin-Luther University Halle-Wittenberg, Germany