Intracranial Aneurysms

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Ruptured Carotid terminus aneurysm
SAH; H+H stage III
Fishergrade III

Risk of re-rupture within 24 hours ≈ 4%

Ruptured aneurysms should be treated as early as logically and technically possible – at least within 72 h after onset of symptoms (we treat ruptured aneurysms within 24 hrs.)

ESO guidelines 2013
The goal of treatment of ruptured aneurysms is to prevent rebleeding

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mortality/Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coiling</td>
<td>23.5%</td>
</tr>
<tr>
<td>Clipping</td>
<td>30.9%</td>
</tr>
</tbody>
</table>

In cases where the aneurysm appears to be equally effectively treated either by coiling or clipping, coiling is the preferred treatment (class I, level A)
Incidental Aneurysms

- Patients have no symptoms
- When is treatment indicated?
- Should the patient be offered an intervention which has an inherent risk?

➢ Potential risk: stroke, SAH, death
### ISUIA Study - 2003

**Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment.**


1692 patients – 2686 no-rupt. aneurysms

### UCAS Study - 2012

**The natural course of unruptured cerebral aneurysms in a Japanese cohort.**

UCAS Japan Investigators, Morita A, Kirino T, Hashi K, Aoki N, Fukuhara S, Hashimoto N, Nakayama T, Sakai M, Teramoto A, Tominari S, Yoshimoto T.

5720 patients – 6697 non-rupt. aneurysms

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Rupture Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7 mm</td>
<td>0 - 1%</td>
</tr>
<tr>
<td>7-12 mm</td>
<td>2.6%</td>
</tr>
<tr>
<td>13-24 mm</td>
<td>14.5%</td>
</tr>
<tr>
<td>&gt; 25 mm</td>
<td>40%</td>
</tr>
</tbody>
</table>
Pooled data from 4 cohort studies
Nature reviews Neurology 2016
Which incidental aneurysm should be treated?

**PHASES aneurysm risk score**

**(P) Population**
- North American, European (other than Finnish): 0
- Japanese: 3
- Finnish: 5

**(H) Hypertension**
- No: 0
- Yes: 1

**(A) Age**
- <70 years: 0
- ≥70 years: 1

**(S) Size of aneurysm**
- <7.0 mm: 0
- 7.0–9.9 mm: 3
- 10.0–19.9 mm: 6
- ≥20 mm: 10

**(E) Earlier SAH from another aneurysm**
- No: 0
- Yes: 1

**Table 4: Predictors composing the PHASES aneurysm rupture risk score**

**Age** (single)
- <40 years
- 40-60 years
- 61-70 years
- 71-80 years
- >80 years

**Risk factor incidence (multiple)**
- Previous SAH from a different aneurysm
- Familial intracranial aneurysms or SAH
- Japanese, Finnish, Inuit ethnicity
- Current cigarette smoking
- Hypertension (systolic BP > 140 mm Hg)
- Autosomal polygenic kidney disease
- Current drug abuse (cocaine, amphetamines)
- Current alcohol abuse

**Clinical Symptoms related to UIA (multiple)**
- Cranial nerve deficit
- Clinical or radiological mass effect
- Thromboembolic events from the aneurysm
- Epilepsy

**Other (multiple)**
- Reduced quality of life due to fear of rupture
- Aneurysm multiplicity

**Life expectancy due to chronic and/or malignant Diseases (single)**
- <5 years
- 5-10 years
- >10 years

**Concomitant disease (multiple)**
- Neurocognitive disorder
- Obstructive, thrombotic diseases
- Psychiatric disorder

**Maximum diameter (single)**
- ≤3.9 mm
- 4.0–6.9 mm
- 7.0–12.0 mm
- 13.0–24.0 mm
- ≥25 mm

**Morphology (multiple)**
- Irregularity or lobulation
- Size ratio >3 or aspect ratio >1.0

**Location (single)**
- Basal bifurcation
- Vertebrobasilar artery
- AcornA or PcomA

**Other (multiple)**
- Aneurysm growth on serial imaging
- Aneurysm de novo formation on serial imaging
- Controversial monocoelic vessel disease

**Age-related risk (single)**
- <40 years
- 41-60 years
- 61-70 years
- 71-80 years
- >80 years

**Aneurysm size-related risk (single)**
- ≤6.0 mm
- 6.0-10.0 mm
- 10.1-20.0 mm
- >20 mm

**Aneurysm complexity-related risk**
- High
- Low
- Constant

**Treatment**

**Favors**
- Favorable outcomes with emergency or elective aneurysm repair

**Favors UIA**
- Favorable outcomes with conservative management

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*Phases score / Lancet Neurology 2014*  
*UIAT score / Neurology 2015*
Development of intracranial aneurysms

UIA

- Not congenital
- Likelihood increased with first degree relative SAB of UIA (PR 3.4)
- PCKD (PR 6.9)
- Connective tissue disease?
Finite Element Analysis-based Approach for prediction of Aneurysm-Prone arterial Segments
Viktor Yu. Dolgov et al.
Journal of Medical and Biological Engineering (2019)

Pedridis et al.; Clinics and Practice 2018
Treatment of intracranial aneurysms
- endoluminal vs. clipping -

- Ruptured Aneurysms: Endoluminal if possible (level I /class A evidence)
- Unruptured Aneurysms: less clear

<table>
<thead>
<tr>
<th>Table 13:</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-year outcome of the International Study of Unruptured Intracranial Aneurysms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Surgical, No Previous SAH</th>
<th>Endovascular, No Previous SAH</th>
<th>Surgical, Previous SAH</th>
<th>Endovascular, Previous SAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rankin 3-5, %</td>
<td>1.4</td>
<td>1.0</td>
<td>0.90</td>
<td>0</td>
</tr>
<tr>
<td>Impaired cognitive status only, %</td>
<td>5.5</td>
<td>3.2</td>
<td>7.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Rankin 3-5 &amp; impaired cognitive status, %</td>
<td>3.0</td>
<td>2.2</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>Total morbidity</td>
<td>9.9</td>
<td>6.4</td>
<td>9.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Overall morbidity and mortality for all patients, %</td>
<td>12.6</td>
<td>9.8</td>
<td>10.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

*SAH represents subarachnoid hemorrhage
*Overall morbidity & mortality includes death and one of both Rankin score 3-5 and impaired cognitive status

ISUIA / Evidence based Analysis /Ontario 2006
Achilles’s heal of Coiling
Achilles’s heal of Coiling

390 Aneurysms; 2 Rebleedings all in Class IIIb

Mascitelli et al.; J NeuroIntervent Surg 2015
Limitations of Coiling

- Broad neck aneurysms
- Fusiform aneurysms
- Dissecting aneurysms
Coiling – What else?

• Balloon supported coil embolisation
Stent assisted Coiling

Neurovascular stents need consequent antiplatelet therapy
Tirofiban in the acute setting
Clopidogrel and ASS in the non-acute setting
Flowdiverter

antiplatelett therapy is obligatory
Flow disrupter - WEB
Procedure time
60 min
WEB in Klagenfurt

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>WEB DL (Original platform Dual Layers)</td>
</tr>
<tr>
<td>2013</td>
<td>WEB SL and SLS (Single layer Lower profile)</td>
</tr>
<tr>
<td>2014</td>
<td>EV Technology (Enhanced Visualization Nitinol w/ platinum core)</td>
</tr>
<tr>
<td>2016</td>
<td>Current Platform Fourth Generation</td>
</tr>
<tr>
<td>2017</td>
<td>17 System Lower profile Addresses broader range aneurysms</td>
</tr>
</tbody>
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<thead>
<tr>
<th></th>
<th>Acom</th>
<th>MCA</th>
<th>Pcom</th>
<th>Basilaris</th>
<th>ACI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>24-77 Jahre (Mittel 59 a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rupture</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>4 – 11 mm (Mittel 7.1 mm)</td>
<td>9</td>
<td>16</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Procedure / Technique / FU

- WEB in broadbased aneurysms
- Dual PLAT + Heparin  n=6
- Single PLAT+ Heparin  n= 24  
  (2 ruptured aneurysms)

- Tria-axial system  
  (6-F Sheath / 70 cm; Navien 5-F; VIA microcatheter)

- MR und MRA before demission
- MRA (CTA)DSA controll after 6 mths.

- Clopidogrel für 3 mths.
Angiographic results - Exclusion rate

9/19 complete occlusion

Partial occlusion
Clinical experience in treatment of intracranial aneurysms with the WEB device

Does WEB modify its form?
Clinical experience in treatment of intracranial aneurysms with the WEB device

Does WEB modify its form?

Yes!

Ratio 1,1 -> 1,5
Diam. 5,1 -> 5,5 mm
WEB 6 x 3 mm

Ratio 1,1 -> 1,3
Diam. 5,8 -> 6,2 mm
WEB 7 x 5 mm

Ratio 1 -> 1,1
Diam. 2,6 -> 3,1 mm
WEB 5 x 2 mm

Ratio 1,2
Diam. 9,7 mm
WEB 10 x 7 mm
Clinical experience in treatment of intracranial aneurysms with the WEB device

Ratio 1,1 -> 1,3
Diam. 5,8 -> 6,2 mm
WEB 7 x 5 mm
Clinical experience in treatment of intracranial aneurysms with the WEB device

Ratio 1,2
Diam. 9,7 mm
WEB 10 x 7 mm
Are there other important issues?

- Currently we use WEBs in broad based aneurysms
- Seem to be attractive for ruptured aneurysms
- FU controls are necessary
Conclusion

• Management of intracranial aneurysms is complex

• Endoluminal techniques are advanced and full of variants

• It may be expected that the application of artificial intelligence will develop to helpful decision support tools – indication and technique wise.