Vascular Neurosurgery Update

The cerebrovascular program at the Oregon Neuroscience Institute

Erik Hauck, MD, PhD; Medical Director; Chairman
Objectives

• Vascular Neurosurgery - summary
• Breakthrough in aneurysm treatment
• Advances in the treatment of AVMs
• New technology for stroke interventions
Vascular Neurosurgery Summary

- Aneurysm
- Ischemic stroke
- AVM
- Carotid disease
Year #2 Summary: 532 procedures

- Craniotomies 62
  - Aneurysm 6 (tumor) 7
  - AVM 1
  - EC IC bypass 2
  - Gamma knife 13 (AVM) 2

- Catheter procedures 297
  - Aneurysm 46
  - AVM 5
  - Stroke 26
  - Dx angio 168

- Carotid procedures 52
  - CEA 10
  - CAS 42

- CSF shunting 52

- Spine 123
  - AVM 1 (tumor) 1
Aneurysms and subarachnoid hemorrhage
Size

Small & Giant
‘Saccular’
(based on a ‘normal’ parent vessel)
‘Fusiform’
(no ‘normal’ parent vessel)

Location

Brisman JL, Song JK, Newell DW. Cerebral aneurysms. NEJM 2006; 355:928-939
### Risk of Rupture (ISUIIA)

*5 year cumulative risk*

<table>
<thead>
<tr>
<th>Size</th>
<th>Anterior Circulation</th>
<th>Posterior Circulation</th>
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<tbody>
<tr>
<td>0 - 6</td>
<td>0 – 1.5%</td>
<td>2.5 – 3.4%</td>
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<tr>
<td>7 – 12</td>
<td>2.6%</td>
<td>14.5%</td>
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<tr>
<td>13 - 24</td>
<td>14.5%</td>
<td>18.4%</td>
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<tr>
<td>25+</td>
<td>40%</td>
<td>50%</td>
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</table>
Treatment Option

- Surgery (clip)
- Endovascular (coil)
## Evolution of aneurysm treatment

**Phase I (microsurgery)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Inventor</th>
<th>Method</th>
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<tbody>
<tr>
<td>1937</td>
<td>Dandy:</td>
<td>Clip</td>
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<tr>
<td>1966</td>
<td>Pool:</td>
<td>Microscope</td>
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<tr>
<td>1991</td>
<td>Guglielmi:</td>
<td>Coil</td>
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<tr>
<td>1997</td>
<td>Higashida:</td>
<td>Stent</td>
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<tr>
<td>2011</td>
<td>Hauck:</td>
<td>Tri-axial system</td>
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<tr>
<td>2011</td>
<td>Hauck:</td>
<td>Flow diversion, 1st in Oregon</td>
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</table>
Advantages of surgical clipping

- Immediate cure
- Recurrence is extremely unlikely
- No need for follow-up angiography
- Reduction of mass effect
- Primary reconstruction of wide-necked or bifurcation aneurysms with clips
- Trapping, distal or proximal occlusion with bypass is an option
The drawbacks of surgical clipping

- Open operation on the head and brain
- Risk of general anesthesia
- Surgical risk (wound complication, brain or cranial nerve injury)
- Increased risk with larger aneurysms
- Increased risk with older patients
- Increased risk in case of rupture
- Increased risk with posterior location
- Longer hospital stay and recovery period
- Slow evolution of surgical technique
Dandy's sketch of the first Aneurysm Clip 1937
R Pteryonal Approach

Small Aneurysm, Clip
Carotid ligation

26 yo M, L eye blind, 3.1 cm AN
Open surgical treatment

Clipping of unruptured intracranial aneurysms (2 - 6 cm): Anterior circulation

Change in my practice

• Year #1
  – 50 aneurysm total
  – 23 surgical clipping 46%
  – 27 endovascular (coil or stent/coil) 54%

• Year #2
  – 52 aneurysms total
  – 6 surgical clipping 12%
  – 46 endovascular (coil/ stent/flow diversion) 88%

p = 0.0001 Fisher’s exact test
Current percentage of aneurysms treated endovascularly here in Eugene now is 88%.
Why is my practice changing?

- World wide break through in endovascular technology
- Local improvement of endovascular technology and cathlab team
- Ability to treat MCA aneurysms with coiling
- Patient choices
Flow diversion – world wide break through in aneurysm treatment


53 Patients, nearly 100% cure over 12 months.

Reviewer comment (Hauck et al.):

… the pipeline embolization device promises to become the endovascular equivalent of a surgical clip…
Pipeline Embolization Device

- Braided mash cylinder
- 48 microfilaments
- platinum and cobalt chromium strands
- mounted on a flexible microwire
Deployment of the Pipeline Embolization Device
First patient treated in Oregon (7.28.2011)

52 yo F with CCF from ruptured cavernous aneurysm
First patient treated in Oregon (7.28.2011)

52 yo F with CCF from ruptured cavernous aneurysm
Pipeline/coil

87 yo F, acute left III nerve palsy
Right cavernous aneurysm

76 yo F with right hemispheric TIA
Right cavernous aneurysm

pipeline x 2

pre-op  post-op  6 months
Why is my practice changing?

• World wide break through in endovascular technology
  - flow diversion with pipeline
  - Eugene first site in Oregon
  - Eugene third site at the West Coast (after LA and Seattle)
Our cathlab

- 2 Million $ GE biplane
- 2 Million $ equipment
- World class cathlab team
  - priceless

👍👍👍
Direct coiling

Still a good option – simple and straightforward

DAC Catheters are designed to provide distal neurovascular access, providing **additional microcatheter stability** closer to the treatment site.
The ‘distal platform’ concept
Why is my practice changing?

- local improvement of endovascular technology and cathlab team
  - average aneurysm < 1 hr room time
  - patients typically no longer go to the ICU after coiling of unruptured aneurysms
  - any size aneurysm can be treated safely, even 1 mm aneurysms

- ability to treat MCA aneurysms with coiling

- Patient choices
Evolution of aneurysm treatment
Phase II (endovascular)

1937    Dandy:     Clip
1966    Pool:      Microscope
1991    Guglielmi: Coil
1997    Higashida: Stent
2011    Hauck:     Tri-axial system
2011    Hauck:     Flow diversion, 1st in Oregon
Advantages of endovascular tx

- Similar cure rate as with clipping
- Reduction of mass effect with flow diversion
- No surgery is involved
- No surgical risks (pain, wound, nerve/brain injury)
- No general anesthesia
- No need to recover from surgery
- Nearly outpatient procedure
- Reduced morbidity/mortality after rupture
- Rapid evolution of technology
Drawbacks of coiling

- Follow-up angio is required
- Possibly retreatment is required
- Occasionally, there is residual aneurysm
- No long term data for flow diversion
- Flow diversion works over time, not instantly
- Need for anti-platelet therapy with stents
Clip vs coil ≈ Manual skill vs technology
Treatment of cerebral AVMs
What is an AVM?
Natural history

• Congenital, life time risk of bleeding
• Prevalence 0.1%
• Risk of bleeding 2 – 4 % per year
• Initial risk of rebleeding 6% over first 6 months
• 25% significant morbidity/mortality with event
• Symptoms include hemorrhage & seizures
• Dx by CT, MRI, angio
<table>
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<th>Eloquence</th>
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<tbody>
<tr>
<td></td>
<td>0 – 3 cm</td>
<td>superficial</td>
<td>no</td>
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<tr>
<td></td>
<td>3 – 6 cm</td>
<td>deep</td>
<td>yes</td>
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<tr>
<td></td>
<td>&gt; 6 cm</td>
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AVM - background

• Endovascular treatment for intracranial aneurysms is frequently preferred because of similar success with lower morbidity

• Is this true for AVMs?
Clinical Case

• 45 yo M, sudden onset of H/A
• N/V
• Left upper quadrant anopsia
CT head
Right occipital III AVM
• Surgical resection is standard of care

• Endovascular curative embolization is possible

• Gamma Knife Surgery cures over time
Onyx – 2 catheter technique
Outcome

- Patient recovered his full vision the day of the procedure
- No ventric
- D/c home post bleed day 6
- Patient is back to work without restrictions post bleed day 14
Thought

• Will curative embolization replace AVM surgery?

• The novel 2 catheter technique increases the success of curative embolization
Stroke and carotid disease
Detailed Complication CASE Presentation

- 35 yo F, hx of right sided neck pain for a 4 days
- Mom had observed drooping of the right eyelid
- At 10:50 am, acute left hemiplegia
- Pt is confused, NIHSS 20, protects her airway
CT head 11:30 (40 min after onset)

Should we give IV TPA?
IV TPA was given,
but the patient is not improving
(large clot burden, ICA occlusion)
Acute ICA dissection with complete carotid occlusion... to the cathlab
Successful carotid recanalization with stents at 12:50
MCA perforation
F/u angiography shows no bleed
After thorough discussion with the team and the family, we decided to proceed with salvage stenting of the MCA.
Immediate result

The patient is significantly improved because of successful carotid and perforator revascularization, but her arm remains paralyzed and her MCA occluded.
Post op day #1

The patient is further improved with beginning MCA revascularization, she is able to wiggle her fingers in her left hand.
Post op day #92

The patient is substantially recovered with good arm strength, her MCA is recanalized. I am confident she is going to make a full recovery within the next few months.
Pearl

- Stroke happens in young people
- IV TPA is standard of care
- Intracranial stents can be amazing for stroke
THANKS!!!