The Current State of Aneurysm Surgery

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Introduction

Absolute risk reduction, 6.9%
Relative risk reduction, 22.6%

Current Trends

- Disappearance of community aneurysm surgery
  - Endovascular results
  - Complexity of care
  - Liability
  - Medical economics
  - Patient appeal, preferences

- Decentralized coiling
- Centralized clipping

Aneurysm Surgery

- Outline
  - Basic techniques (MCA)
  - Complex techniques (BTA)
  - Giant aneurysms
  - Bypass
MCA Aneurysms

- “Clip First” Policy:
  - Favorable surgical anatomy
  - Endovascular limitations
  - Simple exposure
  - Multiple surgical options
  - Minimally invasive, retractorless
  - Low therapeutic risk
  - Good outcomes

UCSF Experience

- Consecutive series, single surgeon
- Review period (years) 14
- Total aneurysms 3000
- Total patients 2301
- MCA aneurysms 805
- MCA aneurysm patients 701
- Percentage 25%

→ Most common aneurysm

Sylvian Split

Sylvian Veins
Fissures

A. Atrophic Fissure

B. Apophasis Fissure

C. Frontal-Impalasting Fissure

D. Temporal-Impalasting Fissure

MCA Aneurysm Dissection

Artery may adhere to the same lobe as it supplies.

Artery may bridge Sylvian fissure adhering to different lobe than it supplies.

Distal-to-Proximal MCA Aneurysm Dissection
MCA Aneurysm Clipping

Clipping Techniques

Endovascular Therapy for MCA Aneurysms
Aneurysm Projection
Contralateral MCA Clipping

Aneurysm Surgery

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Current Practice

- Charing Cross Hospital, London
  “All posterior circulation aneurysms, if technically feasible, were coiled”

- Mayo Clinic, USA
  “Endovascular treatment is definitely superior to surgical clip ligation of basilar bifurcation aneurysms”

ISAT

- Eligible patients 9559
- Included patients 2143
- Excluded patients 7416

- Anterior circulation 2085
- Posterior circulation 58 (2.7%)
  - Basilar apex 26
  - PICA 31
- Aneurysm unsuitable for clipping or coiling
- Uncertainty about best tx (lack of equipoise)

→ No data about management of posterior circulation aneurysms

Posterior Circulation Aneurysms

- Technically difficult, high morbidity
- Endovascular option is appealing
- Absence of definitive data

- What should neurosurgeons be doing?
  - Stop clipping
  - Limit aneurysm surgeons
  - Selected aneurysms
**Indications**
- Low-riding aneurysm
- No proximal control
- Too tight

**Technique**
- Anterior clinoidectomy
- Posterior clinoidectomy
- Unroof cavernous sinus
Transcavernous Approach

UCSF Experience

- Consecutive series, single surgeon
- Review period (years) 14
- Total aneurysms 3000
- Total patients 2301
- Basilar apex aneurysms 317
- Percentage 10%

→ Most difficult aneurysm

Basilar Apex Aneurysms

- Aneurysm surgeons should not abandon basilar aneurysms
- Best therapy for basilar aneurysms is unclear
- Endovascular therapy is eroding case volume, neurosurgical manpower, and technical proficiency
- Surgery preferred for aneurysms with broad necks, large and giant size, abnormal branches, thrombus
Aneurysm Surgery

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Endovascular Therapy

- The problem with coiling giant aneurysms:
  - Incomplete aneurysm obliteration
  - Coil compaction/extrusion
  - Recurrence, rehemorrhage, retreatment

Endovascular Results

- Total patients: 38
- Giant aneurysms: 39
- Complete occlusion: 36%
- Need for stent: 66%
- Sessions/aneurysm: 1.9
- Cumulative Morbidity: 12 / 32%
- Cumulative Mortality: 6 / 16%
- Follow-up (months): 25
- Late Morbidity: 10 / 26%
- Late Mortality: 11 / 29%


Transforms giant aneurysms into a chronic disease requiring surveillance, retreatments, repeated risk exposure, and relapsing course
UCSF Experience

- Consecutive series, single surgeon
- Review period (years) 14
- Total aneurysms 3000
- Total patients 2301
- Giant aneurysms 168
- Giant aneurysm patients 167
- Percentage 5.6%

Giant aneurysms remain a surgical disease.

Anterior Circulation

- Cavernous 19
- Supraclinoid ICA 18
- Ophthalmic 15
- Superior Hypophyseal 5
- Posterior Communicating 5
- MCA 23
- Anterior Communicating 13
- Pericallosal 2
- Total 100

Posterior Circulation

- Basilar Bifurcation 14
- SCA 2
- PCA 7
- Basilar Trunk 9
- PICA 4
- Vertebral Artery 5
- Total 41

Direct Clipping

A. Simple Clipping
B. Multiple Clipping, Intersecting Clips
C. Multiple Clipping, Stacked Clips
D. Multiple Clipping, Overlapping Clips

Pre-Op

Post-Op
Clip Reconstruction

UCSF Experience

- Direct Aneurysm Occlusion
  - Neck clipping 64 45%
  - Neck clipping + bypass 2 1%
- Indirect Aneurysm Occlusion
  - Parent artery clipping 20 14%
  - Parent artery clipping + bypass 29 21%
  - Endovascular occlusion + bypass 23 16%
- Other 3 2%
Patient Outcomes

- Neurologically improved or unchanged: 106 (75%)
- Surgical Mortality: 18 (13%)
- Permanent neurological morbidity: 16 (11%)

Complications
- Surgical: 8 (6%)
- Medical: 11 (8%)
- Complete Aneurysm occlusion: 108 (77%)
- Recurrence/retreatment: 2 (1.4%)
- Late rehemorrhage: 0 (0%)

Giant Aneurysms

- Coiling is ineffectual, due to high rates of incomplete obliteration, recurrence, and retreatment
- Flow diversion is unproven, but may offer a better endovascular option than coiling, particular in posterior circulation
- Conventional clipping is preferred, often inadequate
- Hypothermic circulatory arrest is rarely indicated
- Bypass used frequent, enabling reconstruction or indirect aneurysm occlusion

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Bypass Surgery

- Same old techniques
- More advanced applications
- Technical evolution *(not technological evolution)*
- Pushing the envelope
Evolution of Bypass Surgery

- 1st Generation: STA-MCA Bypass
- 2nd Generation: EC-IC Bypass
- 3rd Generation: IC-IC Bypass

Hypothesis:
- IC-IC bypass = EC-IC bypasses
- Move to intracranial reconstruction

Arterial Reconstruction (IC-IC)

<table>
<thead>
<tr>
<th>Technique</th>
<th>Total</th>
<th>MCA</th>
<th>ACA</th>
<th>PICA</th>
<th>Basilar</th>
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<tbody>
<tr>
<td>In Situ Bypass</td>
<td>16</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Reimplantation</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Reanastomosis</td>
<td>20</td>
<td>9</td>
<td>1</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Graft Reconstruction</td>
<td>17</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>65</strong></td>
<td><strong>17</strong></td>
<td><strong>8</strong></td>
<td><strong>29</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
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Bypasses for Aneurysms, 138

IC-IC Bypass

**Technique**  | **Anastomosis**
---|---
In Situ Bypass | Side-to-Side
Reanastomosis | End-to-End
Reimplantation | End-to-Side
Intracranial Bypass | Graft, 2x

**Sites**
- Sylvian fissure
- Interhemispheric fissure
- Carotid, crural cisterns
- Cisterna magna

a) In Situ Bypass (PICA-PICA)

b) Reanastomosis (PICA)
c) Reimplantation (PICA-VA)
d) Intracranial Bypass Graft (VA-PICA Bypass)
PICA-PICA Bypass

PICA Reanastomosis
MCA Aneurysm

MCA Reanastomosis
Excision - Reanastomosis

Pericallosal Reimplantation
Pericallosal Reimplantation

Basilar Apex

PCA Dissecting Aneurysm

Presentation
Endoscopic resection
New aneurysm
SCA-PCA In Situ Bypass

UCSF Experience
- Consecutive series, single surgeon
- Review period (years) 14
- Total aneurysms 3000
- Total patients 2301
- Bypasses 291
- Bypasses for aneurysms 121
- Percentage of aneurysms 4%

Bypass
- Old-fashioned *microsurgery* can create elegant bypasses
- Data support *intracranial bypass*
- Suture, meticulous technique will advance us from EC-IC to IC-IC bypasses
- ELANA, staplers, will not facilitate IC-IC bypasses
- Evolution depends on mastering *arterial anastomosis* in all its variations and expending extra effort
**Current Trends**

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<tr>
<th>Endovascular</th>
<th>Surgical</th>
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<tr>
<td>Patient demand</td>
<td>↑ ↓</td>
</tr>
<tr>
<td>Case volume</td>
<td>↑ ↓</td>
</tr>
<tr>
<td>Neurosurgeons</td>
<td>↑ ↓</td>
</tr>
<tr>
<td>Centralization</td>
<td>↓ ↑</td>
</tr>
<tr>
<td>Selectivity</td>
<td>↓ ↑</td>
</tr>
<tr>
<td>Expertise</td>
<td>↑ ↓</td>
</tr>
<tr>
<td>Complexity</td>
<td>- ↑</td>
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*Aneurysm surgeons are needed*

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**Vascular Volume**

<table>
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<tr>
<th>Year</th>
<th>Aneurysm</th>
<th>AVM</th>
<th>Cav Mal</th>
<th>Bypass</th>
<th>Total</th>
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<tr>
<td>1997</td>
<td>3195</td>
<td>600</td>
<td>527</td>
<td>316</td>
<td>3195</td>
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**UCSF Center for Stroke & Cerebrovascular Diseases**

877/BRAIN – 1 – 1

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**Seven Aneurysms**

Tenets and Techniques for Clipping

Michael T. Lawton
Aneurysm Surgery

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  - Complex techniques (BTA)
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Conclusions

- Vascular Neurosurgery
  - An endangered specialty
  - Residents are migrating to endovascular
  - Patients are demanding minimal invasion
  - ↓ Case volume
  - ↑ Case complexity
  - Aneurysm surgeons are desperately needed

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<thead>
<tr>
<th></th>
<th>Coiling</th>
<th>Clipping</th>
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<tr>
<td>Patients</td>
<td>295</td>
<td>706</td>
</tr>
<tr>
<td>Complete</td>
<td>39%</td>
<td>92%</td>
</tr>
<tr>
<td>Re-rupture risk</td>
<td>3.4%</td>
<td>1.3%</td>
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% Occlusion vs. annual re-rupture rate

<p>| | |</p>
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<tbody>
<tr>
<td>Complete</td>
<td>1.1%</td>
</tr>
<tr>
<td>91-99%</td>
<td>2.9%</td>
</tr>
<tr>
<td>70-90%</td>
<td>5.9%</td>
</tr>
<tr>
<td>&lt;70%</td>
<td>17.6%</td>
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Superior Hypophyseal Aneurysm
MCA-PCA Bypass

A3-A3 Bypass