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Prospective factors of temporary arterial occlusion during anterior communicating artery aneurysm repair

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Introduction

- Anterior communicating artery (**AComm**) aneurysms are the **most common** intracranial aneurysms, accounting for approximately 30-37% of intracranial aneurysms
- AComm aneurysms are also the **most complex** aneurysms of the anterior circulation due to the **angioarchitecture and flow dynamics** of the AComm region, **frequent anatomical variations**, **deep interhemispheric location**, and **danger of severing the perforators** with ensuing neurologic deficits
- AComm aneurysms present frequently with SAH at small size

Hernesniemi J, Dashti R, Lehecka M, Niemelä M, Rinne J, Lehto H, Ronkainen A, Koivisto T, Jääskeläinen JE. Microneurosurgical management of anterior communicating artery aneurysms. Surg Neurol. 2008 Jul;70(1):8-28; discussion 29.

Introduction

- AComm aneurysms are most commonly found at the **A1-A2 junction** on the dominant side
- The angle of the arteries at the bifurcation and the direction of blood flow are factors of hemodynamic stress in the apical region where these aneurysms often develop
- Worldwide the **endovascular** therapy is gaining an increasing role in the treatment of AComm aneurysms , but has not yet overwhelmed the **microneurosurgical** management

Bakker NA, Metzemaekers JD, Groen RJ, Mooij JJ, Van Dijk JM. International subarachnoid aneurysm trial 2009: endovascular coiling of ruptured intracranial aneurysms has no significant advantage over neurosurgical clipping. *Neurosurgery*. 2010 May;66(5):961-2.

Microneurosurgery

- A variety of operative approaches to the anterior communicating complex for intracranial aneurysms have been described, but the most commonly used is the **pterional approach** best described by Yasargil
 - neurosurgeons are familiar and comfortable with it;
 - it provides a rapid access to the basal cisterns;
 - it allows exposure to the proximal A1 segment to proximal control, and other common aneurysm locations when multiple ipsilateral aneurysms are present;
 - it provides an anterolateral trajectory to the Acomm region that allows for easier visualization of perforating vessels supplying the septal region and chiasm

Hernesniemi J, Dashti R, Lehecka M, Niemelä M, Rinne J, Lehto H, Ronkainen A, Koivisto T, Jääskeläinen JE. Microneurosurgical management of anterior communicating artery aneurysms. Surg Neurol. 2008 Jul;70(1):8-28; discussion 29.

Microneurosurgery

- **Pterional** approach may present some **disadvantages**
 - This is a unilateral approach to a midline structure
 - Sometimes **retraction** of the frontal lobe cannot be achieved adequately without widely opening the sylvian fissure, increasing the temporal lobe, insula, draining veins and middle cerebral artery dissection trauma
 - **Bone removal** is required to minimize brain retraction and can be cosmetically disfiguring
- To prevent some of these disadvantages, the **anterior subfrontal** and the **lateral supraorbital** approaches were proposed

Timing to surgery and technique

- According to **ISAT**
 - The risk for poor outcome was highest when treatment was performed after day 10
 - postponing treatment in patients who were eligible for treatment between days 5 to 10 after SAH was not recommended
- Precise dissection in the anatomy of the AComm complex and perforators requires not only experience and skill but patience to **work the dome and base** under repeated protection of **temporary clips**

Dorhout Mees SM, Molyneux AJ, Kerr RS, Algra A, Rinkel GJ. Timing of aneurysm treatment after subarachnoid hemorrhage: relationship with delayed cerebral ischemia and poor outcome. Stroke. 2012 Aug;43(8):2126-9.

Methods

- In a universe of **92 patients** submitted to AComm aneurysm clipping between 2000 and 2013
- **32** were operated in the **last seven years**
- Among these patients, **21 needed temporary arterial occlusion** during surgical aneurysm repair, and had their data examined retrospectively

Clinical characteristics of patients with AComm aneurysms

Characteristics	
Total number of patients	21
Sex	
Male	6 (29)
Female	15 (71)
Male/Female rate	0.4
Mean Age (years)	52.8 ± 16.5
Range (years)	19-78
Presentation	
Unruptured	9 (43)
Ruptured	12 (57)
Fisher Grade	
1	
2	6 (50)
3	5 (42)
4	1 (8)
Glasgow Coma Scale	
13-15	20 (95)
8-12	1 (5)
<8	0 (0)
Comorbidities	
Hypertension	16 (76)
Smoker	14 (66)
Alcohol	7 (33)
Obesity	8 (38)
Dyslipidemia	8 (38)

Summary of aneurysm morphological characteristics

Characteristic	
Aneurysm Size	
Small (<10mm)	21 (100)
Large (10-25mm)	0 (0)

Summary of surgical case characteristics and post-operative course

Characteristic	
Intraoperative aneurysm rupture	3 (14)
Temporary clipping performed	21 (100)
Average clip duration	13.8 ± 6.4
Lamina terminalis opening	15 (71)
Complications	
Vasospasm	14 (66)
Mild	10 (71)
Severe	4 (29)
Delayed ischemic deficit	6 (28)
Hydrocephalus	11 (52)
GOS 1-year follow-up	
GOS 5	8 (38)
GOS 4	6 (28)
GOS 3	2 (9)
GOS 2	3 (14)
GOS 1	2 (9)

Results

- Aneurysms **larger than 7mm** were more likely to be treated with **longer temporary clipping time** than small aneurysms, <7mm (22 ± 5.7 vs 11.3 ± 4.1 , t-Test, $p < 0.0001$)
- There was **no statistical correlation** between time of occlusion and outcome ($r=0.92$, Pearson, $p > 0.08$)
- There was also no statistical difference in outcome between patients submitted to intraoperative temporary clipping during **more or less than 20 min**

Results

- Age, Glasgow Coma Scale (GCS) at initial evaluation, and Fisher scale at 1st CT scanning were independent factors of **unfavorable outcome** (Glasgow Outcome Scale ≤ 3) (cox-regression, $p < 0.001$)
 - Among variable factors, being **older than 50 years**, an initial **GCS under 13**, and a **Fisher grade III or IV** resulted in worse outcome
- Gender, tobacco or alcohol addiction, obesity, arterial hypertension, dyslipidemia, location of temporary occlusion (A1 or A2), intraoperative rupture and the aneurysm size **were not identified** as independent prognostic factors

Results

- During follow-up period, **two thirds** of the patients had a favorable outcome (GOS \geq 4), accomplishing normal daily life activities without major complications
- Among nine patients with **unruptured** aneurysms **100% had a favorable outcome** at 1-year follow-up (GOS \geq 4), meanwhile, among 12 patients with **ruptured** aneurysms only **41.6%** had a favorable outcome

Results

- **Fifty-two** percent of patients evolved with **hydrocephalus**, despite of routinely fenestration of the lamina terminalis, performed in 71.4% of procedures
- Most patients also developed **clinical vasospasm (66.6%)**, with 29% of the patients harboring a severe disease
- **Delayed ischemic neurological** deficit was observed in **28.5%**, secondary to severe vasospasm, and without any statistical correlation to time of temporary occlusion or intraoperative aneurysm rupture

Conclusion

- **Temporary clipping** during ACom aneurysm repair **does not seem to add more morbidities** to the procedure, and is not an independent prognostic factor
- However, age, initial GCS and Fisher grade are associated to unfavorable outcome.