

# EARLY SURGERY FOR RUPTURED CEREBRAL ANEURYSMS

## Technical note

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**ABSTRACT** - We describe a collection of techniques to be considered in the early clipping of ruptured cerebral aneurysms located in the anterior circulation when dealing with the swollen red and scaring brain many times found after craniotomy.

**KEY WORDS:** cerebral aneurysm, early surgery, techniques.

### **Cirurgia precoce para aneurismas cerebrais rotos: nota técnica**

**RESUMO** - Descrevemos uma coleção de técnicas a serem consideradas na clipagem precoce dos aneurismas cerebrais rotos localizados na circulação anterior quando lidando com o cérebro vermelho inchado e assustador encontrado muitas vezes após a craniotomia.

**PALAVRAS-CHAVE:** aneurisma cerebral, cirurgia precoce, técnicas.

The incidence of aneurysmal subarachnoid hemorrhage (SAH) remains constant over the years. It is estimated to be about 11 cases per 100000 population per year. However, the average annual mortality rate for SAH has shown a decreasing trend that is believed to be related to changes in management strategy, including surgeries on patients in the early phase, within 72 hours after the onset of SAH<sup>1</sup>. Extensive evidence<sup>2-4</sup> is available demonstrating that early surgery is associated with improved outcome among patients with ruptured cerebral aneurysms in the anterior circulation. The timing of surgery for cerebral aneurysms in the posterior circulation is still controversial. Following aneurysm occlusion, the treatment of vasospasm with triple-H therapy can be undertaken in a safe manner and without risk of rebleedings.

Whether clipping or coiling is the best treatment modality for ruptured cerebral aneurysms is still being debated<sup>5,6</sup>. However, we believe that surgical results with microneurosurgery will be proved to be better for some reasons that include more commitment to the patient by the neurosurgeon, better understanding of neuroanatomy, more involvement in the intensive care of the patients, larger availability of the neurosurgeon, among others<sup>7-9</sup>.

We describe a collection of operative techniques to be used in the early clipping of ruptured cerebral aneurysms that are located in the anterior circulation when dealing with the swollen red and scaring brain found many times after craniotomy.

### **OPERATIVE TECHNIQUES**

Approximately 20 to 30 cases of aneurysmal SAH are operated per year in our department. Aneurysm clipping is usually attempted on the other day of admission; even high-grade SAH patients (Hunt and Hess 4-5) are included in this policy if the ruptured aneurysm is located in the anterior circulation.

This study was approved by the local ethics committee.

*Positioning of the patient* – The operating table should provide a reliable mechanism to allow the nurse to make positional changes during operation when necessary such as head up or down and table rotation to the left or right side. Tapes should be used to secure the patient to the table and all pressure areas must be protected with cushions and pads. Of important note, we place a roll under the patient shoulder to guarantee that the head will be well above the cardiac level (Fig 1).

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**Head fixation and craniotomy** – The authors have been using the standard pterional craniotomy<sup>10</sup>, which is a time-honored operative technique, with some practical modifications in the early surgery for ruptured cerebral aneurysm in the anterior circulation.

Our usual technique involves skull fixation with a three-pin head frame, elevation of the head above the cardiac level and its rotation in 20-30 degrees to the opposite side with slight lateral tilting, and also extension. Overturning of the head can jeopardize the approach to internal carotid and middle cerebral artery aneurysms when adjustments in the patient position are not feasible during operation. The temporal lobe will fall over the frontal lobe blocking the working area of approach.

After minimal shaving, skin preparation is undertaken with iodine solution. An oblique frontotemporal skin incision is outlined with a surgical marker behind the hair line until 2-3 cm above the zygomatic arch (Fig 2). Infiltration of the incision site with lidocaine and epinephrine is used to optimize hemostasia. To avoid temporal muscle atrophy and weakness of the frontalis muscle, we elevate the temporalis muscle with the skin flap as a single one-layer flap. Retraction of the flap to front, with the aid of fish hooks, results in excellent exposure of the superior orbital rim and of the zygomatic arch frontal process.

A single burr hole is placed just under the superior temporal line and a free bone flap is then detached by cutting with a high speed craniotome. Most of the time the cut is so close to the orbital roof that no further drilling is necessary (Fig 3). When necessary it should be resected with the lateral sphenoid ridge using the drill to create an unobstructed view of the anterior clinoid process. The dura mater is then carefully opened in a curvilinear fashion and secured over the craniotomy dressing with multiple stitches to reduce epidural oozing. From this point on, we use the operating microscope until the last dura stitch.

**Brain relaxation** – Using the appropriate neuroanesthetic technique is essential in maximizing brain relaxation<sup>11</sup>. Mannitol 1 g/kg and furosemide 20 mg should be given early after patient positioning so that the brain relaxation will be optimal near the end of the craniotomy, which has never taken more than 20 minutes. Ventriculostomy has proved to be crucial when a swollen red brain is found after craniotomy. Instead of using the technique described by Paine<sup>12</sup>, we prefer to open the lamina terminalis through a subfrontal route and release cerebrospinal fluid (CSF). As a matter of fact, it is the shortest



Fig 1. Digital photography showing the patient positioning with a roll under the patient shoulder and the skull fixed with the three-pin frame.



Fig 2. Digital photography showing the oblique frontotemporal skin incision site that was outlined with a surgical marker and the operative field with drapes.



Fig 3. Digital photography showing the modified pterional craniotomy, after elevation of the bone flap. Of note: the single burr hole was made near the superior temporal line; the proximity of the bone cut to the orbital roof; the excellent exposure of the superior orbital rim and of the zygomatic arch with the aid of fish hooks; the dotted line is the proposed site for dura opening.

way to the ventricle and a ventriculostomy catheter can be left inside the third ventricle, if necessary, by the end of surgery for intracranial pressure monitoring and CSF drainage. It has proved to be especially helpful for poor-grade patients that have the swollen brain in association with packing of blood in almost all subarachnoid cisterns.

*Dissection and clipping* – Each aneurysm case should be planned before operation so that vivisection is not performed. For example, it is nonsensical to perform whole Sylvian fissure dissection for a carotid-posterior communicating aneurysm that is offering itself to the clip with a small neck and a well defined relationship to the arteries since the injured brain may not tolerate long manipulations. Microsurgical anatomy should be learned in the laboratories and workshops with cadaveric specimen. Microneurosurgical dissection should be tailored to each aneurysm location depending on brain condition, aneurysm size, aneurysm neck and relationship to the arteries. Dissection should be performed sharply with microscissors or delicate blades whenever feasible. Water dissection technique<sup>13</sup> is very helpful in the opening of the Sylvian fissure, expanding it and washing the blood clots away. We have been using suction tube 8 French in diameter with different lengths. It is better when sucking blood clots, more efficient during inadvertent aneurysm rupture and serves as a retractor without injuring the brain.

Application of the first clip should not be considered the end of the surgery but only the beginning of the working process. It is the pilot clipping. After that the aneurysm dome should be punctured or even cut to verify if it is completely occluded. After the aneurysm collapses, we seal the edges with gentle bipolar coagulation, as it should be done with any bulging part of the aneurysm that is obstructing the view of important surrounding structures such as parent artery, branches, perforators and cranial nerves. This is the most reliable method to assess clip exclusion of the aneurysm. The ideal clip should be 1.5 times the aneurysm's neck size and should be applied definitively, if possible, in a parallel orientation with the correlate parent artery or branch to avoid tearing at the

neck of the aneurysm or kinking of the artery itself<sup>14</sup>. If any important structure was inadvertently included in the clip it should be immediately repositioned. Whenever possible, temporary clipping should be used before application of the pilot or definitive clip, the aneurysm sac will become slack and it will be easier to include all neck between clip blades. Intraoperative rupture of the aneurysm will be far less common if temporary clipping is used. Computed tomography angiography is very helpful in identifying calcified arteries when temporary clips should not be applied.

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