16 Surgery of Posterior Cerebral Artery Aneurysm

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16.1 Sign and Symptoms

This case illustration was a 62-year-old male presenting with the acute onset of worst headache of life symptoms (Hunt and Hess grade 2). Head computed tomography (CT) revealed Fisher grade 3 subarachnoid hemorrhage (SAH).

16.2 Investigation

As in most centers, CT angiography is the preferred imaging modality for the identification and evaluation of intracranial aneurysms at our institution. In this case, the CT angiogram revealed a 3.5-mm saccular aneurysm arising from P1 segment of right posterior cerebral artery (PCA) (Figs. 16.1 and 16.2).

16.3 Preoperative Preparation

Procurement of proximal control must be considered first when preparing to approach any ruptured aneurysm. For PCA aneurysms, we obtain proximal control at the distal part of basilar artery

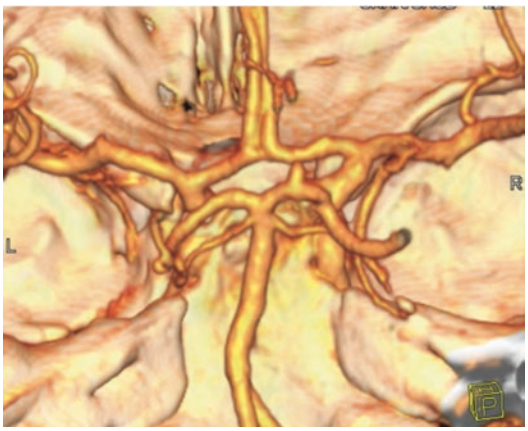

Fig. 16.1 A superiorly projecting right P1 segment PCA aneurysm is seen from this CT angiogram. Also of note, the basilar apex is well above the posterior clinoidal process allowing easy exposure of the basilar artery from an anterolateral approach for proximal control

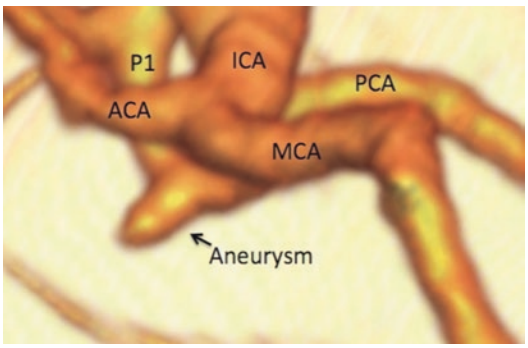

Fig. 16.2 Using CT angiography to create a surgical view of the aneurysm, neurosurgeons can study the vascular anatomy as it will be encountered intraoperatively. This view, through the supracarotid window, exposes the aneurysm well for clip application

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just proximal to the origins of the superior cerebellar arteries. This area of the basilar artery is usually devoid of brainstem perforating arteries. The anatomical obstruction when approaching the posterior circulation through a pterional craniotomy is the posterior clinoid process (PCP). The relationship of the PCP to the basilar apex is assessed through sagittal or coronal reconstruction of the CT angiogram, which best demonstrates vascular and bone anatomy. If the basilar apex is above the PCP, it is possible to obtain proximal control of the basilar artery prior to clipping the posterior cerebral artery aneurysm. If the basilar apex is at the level of the PCP, removal of the PCP with a drill or ultrasonic bone curette may be required to achieve proximal control. If the basilar apex is below the PCP, proximal control cannot be achieved with a pterional approach, and a subtemporal approach is usually preferred.

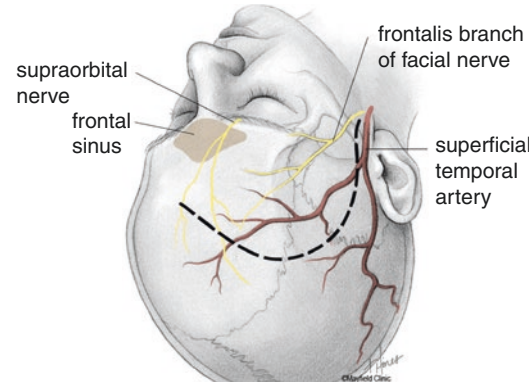

Fig. 16.3 The patient is positioned supine with the head extended and rotated 15° contralaterally. Relevant anatomy when using the pterional approach is seen with this schematic. Commonly the frontal branch of the superficial temporal artery is under the skin incision and must be ligated. The skin incision is kept posterior to the frontalis branch of the facial nerve to prevent its injury. There is wide variation in the pneumatization of the frontal sinus, and this must be studied preoperatively to prevent entering the sinus and causing a cerebrospinal fluid leak (Printed with permission from Mayfield Clinic)

16.3.1 Approach

Dealing with most aneurysm near basilar apex (including P1 segment aneurysms), we prefer an anterolateral approach based upon the pterional approach popularized by Dr. Yasargil [1]. As an extension of this approach, the pterional approach via the extended lateral (PAVEL) corridor is helpful [2]. The patient position is supine, with the head extended and rotated 15° contralaterally (Fig. 16.3). Relevant anatomy to consider when planning the craniotomy includes the superficial temporal artery, frontalis branch of facial nerve, and frontal sinus (Fig. 16.4) [3]. A branch of superficial temporal artery is often encountered during the skin incision and must be ligated. The skin incision must remain posterior to the frontalis branch of the facial nerve for prevention of postoperative frontalis palsy. The extent of pneumatization of the frontal sinus should be assessed preoperatively to prevent encountering the frontal sinus during craniotomy. In the event that the craniotomy is exposing the frontal sinus, cranialization of frontal sinus should ensue.

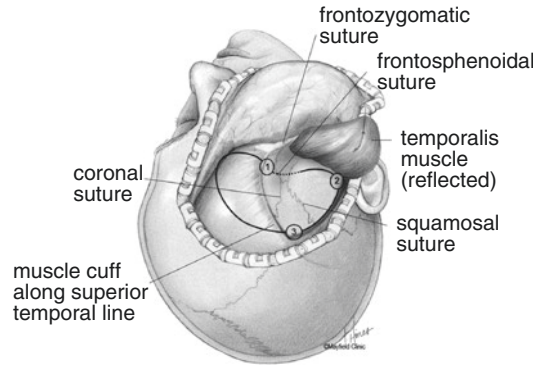

Fig. 16.4 The skin incision has been made with the myocutaneous flap retracted anteriorly. A frontal, temporal, and posterior burr hole is made to aid in dissection of the dura from the inner skull cortex and prevents a durotomy by the craniotome (Printed with permission from Mayfield Clinic)

After minimal shaving of the hair, a skin incision is made behind the hairline. The incision starts 1 cm anterior to tragus at zygoma root, and curve extends to midline. Then myocutaneous flap is detached in one single layer and retracted with spring hooks toward the anterior to expose the orbital rim. We prefer a one layer myocutaneous flap as opposed to an inter- or subfascial dissection that is associated with more jaw pain and temporal wasting [4]. Three burr holes are made to allow adequate dissection of the dura

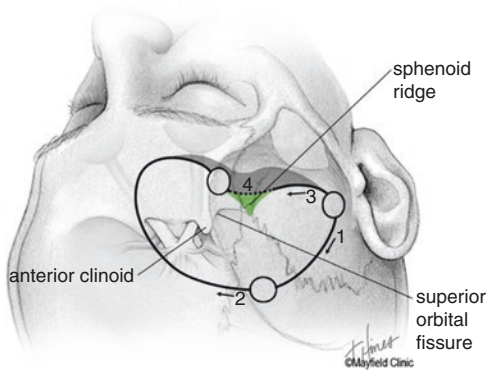

Fig. 16.5 Using a craniotome, cuts 1–3 are made until the sphenoid ridge is encountered. Cut #4 is made with a high-speed drill. Green-shaded area represents the thickened bone of the sphenoid ridge, which will subsequently be drilled off (Printed with permission from Mayfield Clinic)

away from the inner skull cortex (Fig. 16.5). A side-cutting craniotome with footplate is used to create a bone flap from the supraorbital notch, medially, to the mid-temporal lobe, exposing Sylvian fissure laterally. Sphenoid ridge is then drilled off in its entirety with the coarse diamond drill. Dura is cut with curvilinear shape and reflected anterolaterally.

16.4 Steps of the Surgery

When clipping posterior circulation aneurysms through the pterional approach, the neurosurgeon works through the opticocarotid, oculocarotid, and supracarotid windows (Figs. 16.6 and 16.7). To safely access these corridors, mobilization of the temporal lobe is required [2]. This is accomplished with several key steps. It is important to split the sylvian fissure widely, and expose the supraclinoidal ICA (internal carotid artery) and MCA (middle cerebral artery). This is a crucial step, as retracting the temporal lobe without detethering the ICA and MCA can result in a vascular injury and stroke [5]. The middle Sylvian vein at its entrance into the sphenoparietal sinus must be coagulated and cut to allow for retraction of the anterior temporal lobe. Subsequent dissection is done to mobilize the anterior choroidal artery from the uncus, making it possible to retract the temporal lobe laterally. Lastly, third cranial nerve is followed posteriorly, and Liliequist membrane is opened to get to PCA (posterior cerebral artery). These steps comprise the PAVEL extension of the pterional approach and are described in detail elsewhere [2].

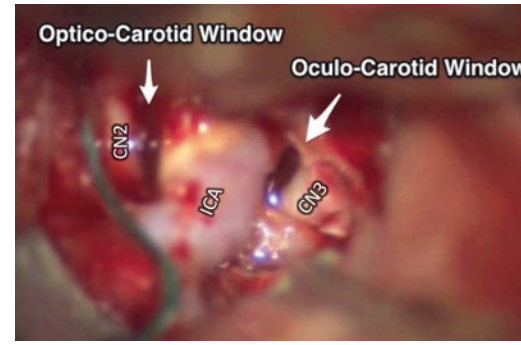

Fig. 16.6 After opening of the proximal Sylvian fissure, wide exposure of the optic nerve (CN2), supraclinoidal internal carotid artery (ICA), and oculomotor nerve (CN3) are demonstrated. The opticocarotid and oculocarotid windows are visualized

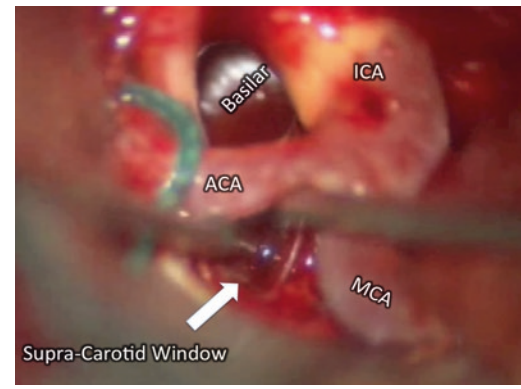

Fig. 16.7 Further dissection allows utilization of the supracarotid window above the carotid terminus, which will eventually be used for clipping of the PCA aneurysm. Exposure of the basilar artery within the opticocarotid window is well seen from this image. The opticocarotid window will be used for temporary clipping of the basilar artery for proximal control

After extensive subarachnoid dissection in this case, the opticocarotid corridor was used to obtain proximal control at basilar artery (Fig. 16.8). With the proximal control achieved, attention was directed toward the P1 segment aneurysm through the supracarotid window (Fig. 16.9). Given that this was a simple, small aneurysm, a straight clip was used to occlude the

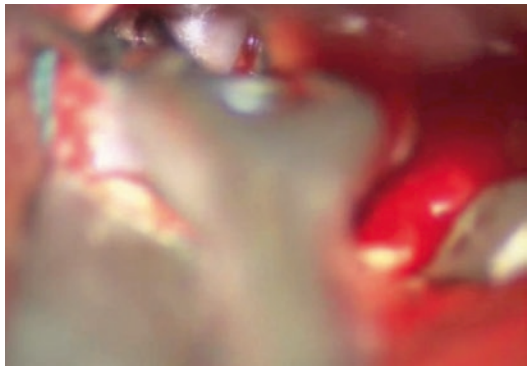

Fig. 16.8 A temporary clip is being placed on the basilar artery through the opticocarotid window

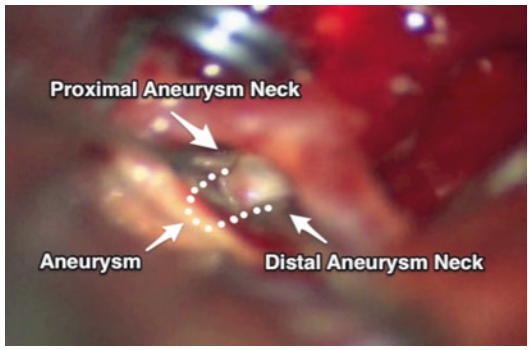

Fig. 16.9 The temporary clip has been placed on the basilar artery through the opticocarotid window. Looking above the carotid terminus (through the supracarotid window), the aneurysm is well exposed for clipping

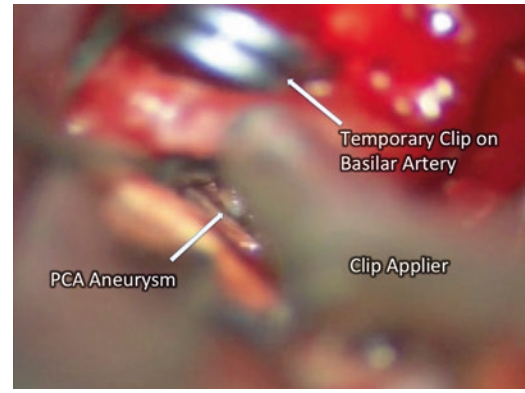

Fig. 16.10 A temporary clip has been placed on the basilar artery through the opticocarotid window. The PCA aneurysm is being clipped through the supracarotid window with a straight aneurysm clip

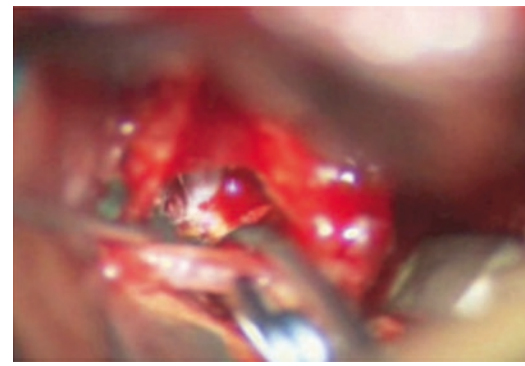

Fig. 16.11 After permanent clip placement through the supracarotid window and removal of the temporary clip, the tips of the permanent clip are inspected through the opticocarotid window to ensure complete occlusion of the aneurysm without incorporation of thalamoperforator arteries within the clip blades

aneurysm (Fig. 16.10). Lastly, the tips of the clip were inspected through the opticocarotid window to ensure the aneurysm was completely occluded and that no thalamoperforator arteries were incorporated within the clip (Fig. 16.11).

16.5 Surgeon Plans to Handle the Complication

A dreaded complication when using the pterional approach for posterior circulation aneurysms is vascular dissection of the middle cerebral artery [5]. Management of this complication depends on the presence of collaterals and the time from ictus. If the complication is identified intraoperatively by loss of somatosensory-evoked potentials or motor-evoked potentials, surgical revascularization by middle cerebral artery thrombectomy or bypass between the external carotid artery and the middle cerebral artery should be considered. However, the dissection commonly occurs during surgery, but occlusion of MCA occurs in a delayed fashion, with the acute onset of hemiparesis occurring postoperatively. At this time, cerebral angiography should be performed.

With good collaterals, postoperative augmentation of blood pressure is the preferred treatment. If poor collaterals are seen and the ictus of the patient's stroke is within 6 h, endovascular or surgical revascularization can be considered. Endovascular therapy is approached with

caution, as the patient will require some form of anticoagulation or antiplatelet therapy after thrombectomy to prevent recurrent occlusion. If there is any uncertainty regarding the timing of ictus, revascularization should be avoided, as this will likely result in the conversion of a morbid ischemic complication into a fatal hemorrhagic complication. The size of the stroke should be assessed radiographically for consideration of a prophylactic decompressive hemicraniectomy in order to prevent cerebral herniation due to malignant middle cerebral artery infarction.

16.6 Expert Opinion/Suggestion to Avoid Complication

Like most complications, they are better to prevent than manage. This complication is prevented by extensive mobilization of the temporal lobe and detethering of the middle cerebral artery as described above. In fact, the PAVEL extension of the pterional approach was developed specifically to prevent the complication of the middle cerebral artery injury while approaching basilar aneurysms [2, 5].

16.7 Things to Be Observed and Postoperative Care/ Follow-Up

This is a ruptured cerebral aneurysm case that will have the clinical sequelae of SAH, including posthemorrhagic cerebral vasospasm. Prophylactic treatment of vasospasm should include maintenance of a euvolemic state and administration oral nimodipine. Monitoring of posthemorrhagic cerebral vasospasm with frequent neurological exams and transcranial Doppler ultrasound should be performed. Consideration of cerebral angiography with endovascular treatment of vasospasm should occur with alterations of the neurological exam or elevation in transcranial Doppler ultrasound velocities. In accordance with recently published guidelines, delayed cerebrovascular imaging is recommended after clipping of ruptured aneurysms to evaluate for aneurysm recurrence (which occurs in approximately 4%) [6].

References

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