Endoscopic endonasal clipping of an unsecured superior hypophyseal artery aneurysm

Technical note

AMIN B. KASSAM, M.D.,1 PAUL A. GARDNER, M.D.,1 ARLAN MINTZ, M.D.,1 CARL H. SNYDERMAN, M.D.,2 RICARDO L. CARRAU, M.D.,2 AND MICHAEL HOROWITZ, M.D.1,3

Departments of 1Neurosurgery, 2Otolaryngology, and 3Radiology, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

Paraclinoidal aneurysms, especially superior hypophyseal artery (SHA) aneurysms (with medial projection), can be challenging to access via a pterional craniotomy and damage to the optic nerve can occur during surgery. The authors have previously reported on endonasal clipping and aneurysmorrhaphy of a vertebral artery aneurysm following proximal and distal protection of the aneurysm using partial coil embolization. To the best of the authors’ knowledge no unprotected aneurysm has been clipped using an endonasal approach.

The 56-year-old woman in this report was found to have two unruptured aneurysms: an anterior communicating artery (ACoA) aneurysm and a SHA aneurysm. An endoscopic endonasal, transplanar–transsellar approach was used to successfully clip the SHA aneurysm. Proximal and distal control was obtained endonasally prior to successful clip occlusion of the aneurysm. The ACoA aneurysm was clipped via a pterional craniotomy during the same anesthetic session. This report shows that it is possible to successfully clip a medially projecting, paraclinoidal aneurysm using an endonasal approach. Such cases must be chosen with extreme caution and only performed by surgeons with significant experience with both endoscopic endonasal approaches and neurovascular surgery. (DOI: 10.3171/JNS-07/11/1047)

KEY WORDS • anterior communicating artery • endoscopic endonasal approach • paraclinoidal aneurysm • superior hypophyseal artery

Paraclinoidal aneurysms, especially superior hypophyseal artery (SHA) aneurysms (with medial projection), can be challenging to access via a pterional craniotomy and damage to the optic nerve can occur during surgery. The authors have previously reported on endonasal clipping and aneurysmorrhaphy of a vertebral artery aneurysm following proximal and distal protection of the aneurysm using partial coil embolization. To the best of the authors’ knowledge no unprotected aneurysm has been clipped using an endonasal approach.

The 56-year-old woman in this report was found to have two unruptured aneurysms: an anterior communicating artery (ACoA) aneurysm and a SHA aneurysm. An endoscopic endonasal, transplanar–transsellar approach was used to successfully clip the SHA aneurysm. Proximal and distal control was obtained endonasally prior to successful clip occlusion of the aneurysm. The ACoA aneurysm was clipped via a pterional craniotomy during the same anesthetic session. This report shows that it is possible to successfully clip a medially projecting, paraclinoidal aneurysm using an endonasal approach. Such cases must be chosen with extreme caution and only performed by surgeons with significant experience with both endoscopic endonasal approaches and neurovascular surgery. (DOI: 10.3171/JNS-07/11/1047)

KEY WORDS • anterior communicating artery • endoscopic endonasal approach • paraclinoidal aneurysm • superior hypophyseal artery

Illustrative Case

This 56 year-old woman presented with two anterior circulation aneurysms (left ACoA and left SHA) that were discovered during a routine magnetic resonance screening, performed after a family history of cerebral aneurysms was revealed. Four-vessel cerebral angiography was performed to better determine the anatomy of these aneurysms and to evaluate the potential use of coil embolization for treatment (Fig. 1). After several discussions with the patient about the risks of treatment compared with observation of these aneurysms (which were approximately 5 mm), she decided to have both of them treated. Given her relatively young age and the presence of multiple aneurysms, we agreed that this choice was reasonable. Neither aneurysm was believed to be favorable for coil embolization because they were small, tubular aneurysms with relatively broad necks, putting them at high risk for coil herniation.

The surgical treatment of paraclinoidal aneurysms is known to produce a relatively high risk of optic apparatus injury, related to the anterior clinoidectomy and optic nerve manipulation involved in treatment.1,2,7–11

The SHA aneurysm in this patient had a typical projection for these types of aneurysms (medial or inferomedial), which would require optic manipulation during surgery. This same projection, extending into the sella (Fig. 2), makes it accessible via an anterior endonasal approach while avoiding any manipulation of the optic apparatus. After careful consideration of the anatomy of the aneurysm and several long discussions with the patient about the risks involved, including visual loss and cerebrospinal fluid leakage, it was decided that the SHA aneurysm would be treated using a transplanum, fully endoscopic, completely endonasal approach.

Abbreviations used in this paper: ACoA = anterior communicating artery; CT = computed tomography; ICA = internal carotid artery; SHA = superior hypophyseal artery.
The ACoA aneurysm would also be clipped while the patient was still receiving the same anesthetic agent. The ACoA aneurysm would be evaluated for clipping via the endonasal approach after the SHA aneurysm clipping was completed, but preparations were undertaken for a standard pterional clipping of the ACoA if the anatomy of this aneurysm were not favorable for using this procedure.

**Operative Technique**

The patient was placed supine on the operating table. Her head was placed in radiolucent three-pin fixation and attached to a radiolucent Mayfield head holder and was turned approximately 15° to the right. Image-guided CT angiography (Fig. 2) was registered, and the patient’s head was shaved and prepared for a left pterional craniotomy. Her midface area was also prepared with Betadine, and her abdomen was prepared for fat grafting. A sheath was placed in the right femoral artery, and the site was prepared for intraoperative angiography.

After administration of a third-generation cephalosporin, the operation was initiated by performing a left pterional
craniotomy without dural opening. This procedure was performed first in preparation for the ACoA aneurysm clipping, as well as a precaution before the endonasal aneurysm clipping. We opted to undertake removal of the bone flap prior to proceeding with the endonasal approach to minimize the risk of a catastrophic event. While we have previously repaired a partially protected, vertebrobasilar junction aneurysm via an endonasal approach, this was our first attempt at undertaking repair of a completely unsecured (unprotected) aneurysm. We believed that we could obtain proximal and distal control adequately using an endonasal route prior to aneurysm clipping, but to minimize risk to the patient we did want to have a pterional craniotomy incision in the event of an uncontrollable endonasal rupture. As it turned out, we did not require any transcranial augmentation or assistance for this particular aneurysm. The dura mater was covered with moistened sponges and the skin flap replaced over the dura and covered with sterile drapes.

A separate instrument set was then opened for the endonasal portion of the surgery, to separate the “clean” craniotomy from the “clean-contaminated” endonasal approach. A standard, expanded endonasal opening was performed by the senior otolaryngologist (C.H.S.), including a right middle turbinectomy. A vascularized nasal septal flap, which would be utilized for the closure, was prepared and tucked into the nasopharynx. The sphenoid sinus was opened widely, exposing the paraclival segment of the ICA, sella, and planum sphenoidale (Fig. 3). Proximal control was obtained by exposing the paraclival (vertical/proximal cavernous) ICA (Fig. 4). Temporary clip access to the proximal ICA was confirmed (Fig. 5). A transplanum exposure of the paraclinoidal carotid artery in the opticocarotid cistern provided distal control (Fig. 6).

At this point, final localization and exposure of the SHA aneurysm was completed by opening the suprasellar dura above (distal to) its neck and the sellar/cavernous dura below (proximal to) its neck (Fig. 7). The proximal/inferior aspect of the aneurysm neck was intimately associated with the cavernous sinus. To gain access to the neck at this most proximal portion, a small opening in the dura was made overlying the cavernous sinus. Venous bleeding from the cavernous sinus was controlled with bipolar electrocautery and microfibrillar collagen packing applied on a cottonoid “sandwich.” The proximal aspect of the aneurysm neck was dissected after this portion of the sinus thrombosed and a passage for the proximal clip blade was created. The dura overlying the dome of the aneurysm was not removed (Fig. 7).

A curved titanium aneurysm clip was applied using a pistol-grip applicator across the neck of the aneurysm and the overlying dura (Fig. 8). Intraoperative angiography confirmed obliteration of the aneurysm (Fig. 9). A second aneurysm clip was placed adjacent (distal) to the first clip to ensure adequate closing pressure (Fig. 10).

We then further examined the suprasellar space and the optic chiasm. We decided that these anatomical features, together with the anatomy of the ACoA aneurysm (pointing posterosuperiorly), were not favorable conditions for using an endonasal approach to the anterior cerebral arteries without unnecessary manipulation of the optic apparatus. As a result, before any dissection of the interhemispheric fissure, we opted to terminate this portion of the procedure because we believed that it would be more prudent to proceed with a transcranial approach for repair of the ACoA aneurysm. The suprasellar dural defect was closed with an inlay Duragen graft (Integra Life Sciences). The space in the sphenoid sinus around the aneurysm clip was filled in with a fat autograft. Finally, the vascularized nasal septal flap was laid over this fat graft without pressure on the clip and secured with tissue glue and a Foley balloon buttress (Fig. 11).

After the endonasal portion of the procedure was completed, the “clean” craniotomy instrument trays were re-opened and a fresh drape was placed over the patient’s head, face, and body. The left pterional skin flap was turned down and a standard transsylvian approach was used to clip the ACoA aneurysm.

The patient tolerated the procedure well. She has had no postoperative infection and no cerebrospinal fluid leak. The
patient did experience postoperative confusion that had improved by discharge. Postoperative CT confirmed aneurysm clip placement and the presence of a small callosal infarct, presumably related to occlusion of a small perforating vessel as a result of clipping of the ACoA aneurysm (Fig. 12).

Discussion

We have previously described the endonasal repair of a vertebrobasilar aneurysm that was partially protected with endovascular therapy but required clipping and aneurysmorrhaphy for mass effect. To our knowledge, this is the first report of an endoscopic endonasal clipping of an unsecured aneurysm. This case represents a very unusual circumstance of an aneurysm with favorable anatomy for using an endonasal approach. We are not suggesting that endonasal aneurysm surgery should or will replace the gold standard of microsurgical repair of aneurysms. In well-selected cases, however, this technique may provide an adjunctive method for the microsurgeon. Both of the aneurysms that we have reported to date have been midline lesions, and the intent of an endonasal approach was to provide direct access to the lesion while minimizing neurovascular manipulation and resultant morbidity.

It must be emphasized, however, that principles of microsurgical repair were strictly followed in this particular case. Specifically, early proximal control was obtained with the proximal paraclival segment of the ICA just distal to the foramen lacerum. Alternatively, we could have sought proximal control by exposing the cervical ICA through a neck incision. Distal control was obtained by isolating the supraclinoidal segment of the ICA through a small transplanum window. Only when control was definitively established both proximally and distally and access with temporary clips was clearly feasible did dissection of the SHA aneurysm neck proceed. This basic principle of aneurysm surgery must be carefully preserved, regardless of the approach used. We believe that the inability to maintain basic microsurgical principles is a contraindication to endonasal surgery.

Although it is our hope that well-selected, midline lesions that may be amenable to endonasal surgery will be
treated in this way with a decrease in morbidity, it must be emphasized that this procedure should only be considered once the surgical team has acquired the appropriate experience. In our particular situation, the same surgical team that would typically perform an exovascular procedure—with years of exovascular surgical experience—performed the endonasal approach. In addition, it was the same team that has collaborated on endonasal work for the past 9 years at our institution. Familiarity with this type of work, as well as the incremental acquisition of endonasal skills, is an absolute requirement before proceeding with such complex surgical repairs. Long-term follow-up data will be required to address the feasibility of repair of such lesions along midline corridors.

![Fig. 7. Endoscopic view showing exposure of the SHA aneurysm neck (Ann). The dome (d) of the aneurysm is still covered by dura. SO = suprasellar opening.](image)

![Fig. 8. Endoscopic view showing placement of a curved titanium aneurysm clip across the neck of the SHA aneurysm.](image)

![Fig. 9. Intraoperative anteroposterior angiogram confirming the successful obliteration of the SHA aneurysm.](image)

![Fig. 10. Endoscopic view after a second aneurysm clip is placed distal to the first to ensure adequate closing pressure on the SHA aneurysm neck. The aneurysm dome is outlined by a dashed line.](image)
References


Manuscript submitted November 8, 2006. Accepted March 20, 2007. Address correspondence to: Amin B. Kassam, M.D., Department of Neurosurgery, University of Pittsburgh Medical Center, 200 Lothrop Street, Suite B400, Pittsburgh, Pennsylvania 15213. email: kassamab@upmc.edu.