Endoscopic endonasal approach for intracranial aneurysm

The endoscope provides views that complement or improve the microscopic view at each aneurysm site except the middle cerebral artery. Endoscopy training and a thorough knowledge of endoscopic vascular anatomy are essential to safely introduce endoscopic assistance in vascular surgery [1].

The expansion of endovascular techniques highlights one of the drawbacks of clipping through the transcranial route, namely brain retraction or brain transgression. Sporadic case reports have emerged over the past years describing endonasal endoscopic clip ligation of cerebral aneurysms.

Limitations

There is a prerequisite for the surgeon to be familiar with this instrumentation and fully prepared for the risks and inconveniences of endoscopic procedures.

Endoscopic endonasal approach can provide direct access for microsurgical clipping of rare and carefully selected intracranial aneurysms.

The basic principles of vascular neurosurgery have to be followed throughout the procedure. These surgeries require a skull base team [2].

Described limitations of this technique include aneurysm orientation and location, the need for lower profile technology, and challenges with handling intraoperative rupture. The endonasal approach for clipping of intracranial aneurysms can be an effective approach in only very select cases as demonstrated clinically and through cadaveric exploration. Further investigation with lower profile clip technology and additional studies need to be performed. Options of alternative therapy, limitations of this approach, and team experience must first be considered [3].

Indications

The use of the endoscope to assist the microsurgical clipping of cerebral aneurysm was first reported by Fischer and Mustafa in 1994. The rigid endoscope has been increasingly used during aneurysm surgery in which structures around the aneurysm can be detected with high quality imaging.

The endoscope can carry out a supportive role in planning surgical manoeuvres and in verifying whether clipping has been performed correctly or not.

The endoscopic transnasal approach provides excellent visualization of the paraclinoid region vasculature and offers potential surgical alternative for paraclinoid aneurysms [4].

see Endoscopic endonasal approach for basilar artery aneurysm.

see Endoscope assisted surgery for anterior circulation aneurysm

Anatomical studies

Szentirmai et al. present a detailed anatomical study to evaluate the feasibility of an endoscopic

endonasal approach for application of aneurysm clips.

Nine human cadaveric head specimens were used to evaluate operative exposures for clip ligation of aneurysms in feasible anterior and posterior circulation locations. Measurements of trajectories were completed using a navigation system to calculate skull base craniectomy size, corridor space, and the surgeon's ability to gain proximal and distal control of parent vessels.

In each of the 9 cadaveric heads, excellent exposure of the target vessels was achieved. The transplanum approach, transtuberculum approach, and transcavernous approaches were used to explore the feasibility of anterior circulation access. Application of aneurysm clips was readily possible to the ophthalmic artery, A1 and A2 segments of the anterior cerebral artery, anterior communicating artery complex, and the paraclinoid and paraclival internal carotid artery. The transclival approach was explored, and clips were successfully deployed along the proximal branches of the vertebrobasilar system and basilar trunk and bifurcation. The median sizes of skull base craniectomy necessary for exposure of the anterior communicating artery complex and basilar tip were 3.24 cm2 and 4.62 cm2, respectively. The mean angles of surgical corridors to the anterior communicating artery complex and basilar tip were 11.4° and 14°, respectively. Although clip placement was feasible on the basilar artery and its branches, the associated perforating arteries were difficult to visualize, posing unexpected difficulty for safe clip application, with the exception of ventrolateral-pointing aneurysms.

The authors characterize the feasibility of endonasal endoscopic clip ligation of aneurysms involving the paraclinoid, anterior communicating, and basilar arteries and proximal control of the paraclival internal carotid artery. The endoscopic approach should be initially considered for nonruptured aneurysms involving the paraclinoid and anterior communicating arteries, as well as ventrolateral basilar trunk aneurysms. Clinical experience will be mandatory to determine the applicability of this approach in practice [5)].

Complications

For clinical applications of these approaches, some relevant complications, mainly related to the endonasal route, such as proximal and distal vascular control, major arterial bleeding, postoperative cerebrospinal fluid leak, and olfactory disturbances must be considered [6)].

Case series

Ten patients underwent EEA for clipping of 11 intracranial aneurysms arising from the paraclinoidal internal carotid artery (n = 9) and vertebrobasilar system (n = 2). The internal carotid artery aneurysms projected medially, whereas the vertebrobasilar artery aneurysms were directly ventral to the brainstem with low-lying basilar apices. One patient required craniotomy for distal control given the size and thrombosed nature of the aneurysm. Proximal and distal vascular control with direct visualization of the aneurysm was obtained in all patients. In all cases, aneurysms were completely occluded. Among complications, 3 patients had postoperative cerebrospinal fluid leakage and 2 other patients had meningitis. Two patients suffered lacunar strokes. One recovered completely and the other remains with mild disabling symptoms.

EEAs can provide direct access for microsurgical clipping of rare and carefully selected intracranial aneurysms. The basic principles of cerebrovascular surgery have to be followed throughout the

procedure. These surgeries require a skull base team with a neurosurgeon well versed in both endoscopic endonasal and cerebrovascular surgery, working in concert with an otolaryngologist experienced in skull base endoscopy and reconstruction [7].

Case reports

2015

8 case studies describing 9 aneurysms (4 ruptured and 5 unruptured) treated by the endonasal approach met inclusion criteria. All studies note the ability to gain proximal and distal control and successful aneurysm obliteration was obtained for 8 of 9 aneurysms. 1 intraoperative rupture occurred and was controlled, and delayed complications of cerebrospinal fluid leak, vasospasm, and hydrocephalus occurred in 1, 1, and 2 patients, respectively. Described limitations of this technique include aneurysm orientation and location, the need for lower profile technology, and challenges with handling intraoperative rupture. The endonasal approach for clipping of intracranial aneurysms can be an effective approach in only very select cases as demonstrated clinically and through cadaveric exploration. Further investigation with lower profile clip technology and additional studies need to be performed. Options of alternative therapy, limitations of this approach, and team experience must first be considered [8].

A 72-year-old female patient who underwent endoscopic endonasal transplanum-transtubercular surgery for tuberculum sellae meningioma followed by clipping of the incidental AcoA aneurysm. After complete removal of a tuberculum sellae meningioma via an endoscopic endonasal approach, an anterior and superior projected saccular AcoA aneurysm in the gyrus rectus area was totally clipped successfully via pure endoscopic endonasal transplanum-transtubercular approach, without any damage to parent arteries. The patient was discharged from the hospital within a short period of time without any postoperative complication. Endoscopic endonasal approach is a new paradigm in the treatment of aneurysm. Although this technique cannot be routinely used due to lack of experience, it is an effective and safe method in selected and anatomically appropriate cases. We believe that increased knowledge and experience will create successful results in this approach, and it can offer an alternative method for selected aneurysm cases [9].

2011

First case of successful endoscopic endonasal clipping of an unruptured ACoA aneurysm.

An ACoA aneurysm was discovered in a 55-year-old man before he was to undergo an endoscopic biopsy of an orbital lesion. Because of the operative corridor formed during this first operation and ideal conformation of the aneurysm for this line of sight, they formulated an endoscopic route for this ACoA aneurysm.

An endoscopic endonasal transplanum-transtuberculum approach was performed. Proximal and distal control was obtained, and the AcoA aneurysm was successfully clipped. The postoperative course was uneventful with a rapid recovery.

The endoscopic approach provided another option the value of which value must be weighed in terms

not only of feasibility but the patient's best interest. We caution extreme prudence if considering this procedure as an alternative to well-established techniques. Yet its upward route offers limited retraction for deep-seated lesions. Rapid progress of endoscopic techniques may prove promising for well-selected cases of ACoA aneurysms [10)].

A 42-year-old woman, a Hunt and Hess grade 2 patient, presented with aneurysmal subarachnoid hemorrhage. An arteriogram revealed an irregular 10-mm right paraclinoidal aneurysm projecting posteromedially and a 5-mm wide-necked right ophthalmic artery aneurysm projecting superomedially. The patient was taken to the operating room where clipping of both aneurysms was performed through the use of an endonasal endoscopic approach with a pedicled nasoseptal flap reconstruction. Such an approach allowed excellent visualization without drilling of the clinoid process or mobilization of the optic nerve and potential control of the proximal and distal internal carotid artery. An intraoperative arteriogram showed obliteration of both aneurysms with patency of the surrounding vasculature. The patient did well postoperatively and was subsequently discharged home without any neurological deficits.

An endoscopic endonasal approach was immediately safe and effective for the clipping of both paraclinoidal aneurysms. Although there were benefits achieved from this particular unconventional approach, surgical clipping via traditional craniotomy and endovascular coiling are the established methods of aneurysm treatment and should always be primarily considered. More cases will determine the efficacy and safety of this approach, which should be attempted only by very experienced teams trained in both cerebrovascular and endonasal neurosurgery [11)].

A 74-year-old woman with the sudden onset of severe headache, nausea, and vomiting was admitted to our hospital. A computed tomography (CT) of the brain revealed diffuse subarachnoid hemorrhage associated with intraventricular hemorrhage and incipient hydrocephalus. Cerebral angiography revealed a 1.2-mm aneurysm arising at the origin of the right PICA. The aneurysm was considered unsuitable for selective coil embolization, so neck clipping was performed. With the use of an extended endoscopic endonasal transclival approach, the aneurysm was accurately reached endoscopically and successfully clipped from the parent artery. The patient was discharged neurologically intact.

To the best of the authors' knowledge, this is the first report of a successfully treated VA-PICA ruptured aneurysm using a pure endoscopic endonasal transclival approach. Endoscopic surgery may be added to the armamentarium of procedures for the treatment of posterior circulation aneurysms [12)].

2007

A 56-year-old woman was found to have two unruptured aneurysms: an anterior communicating artery (ACoA) aneurysm and an superior hypophyseal artery (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 [13].

2006

A case of a large vertebral artery aneurysm causing mass effect on the medulla. Initial treatment consisted of endovascular trapping of the aneurysm; however, because of concerns that the remaining aneurysm and intraluminal thrombus was causing mass effect and continued brainstem compression, a decompressive procedure was required.

After the endovascular trapping, the patient underwent a completely endoscopic transnasal surgical clipping and aneurysmorrhaphy. After exposure of the aneurysm, distal and proximal clips were applied transnasal, and the aneurysmorrhaphy completed using suction and ultrasonic aspiration.

In consideration of their surrounding regional anatomy, aneurysms of the vertebral artery present a formidable surgical challenge to the neurosurgeon. Although endovascular techniques have proven to be extremely valuable for the treatment of these lesions, they are limited when patients have significant mass effect with brainstem compression or cranial neuropathy. Advances in endoscopic transnasal surgery have provided an additional approach for the treatment of these difficult lesions. This case report represents, to our knowledge, the first literature report of a transnasal endoscopic aneurysm clipping and thrombectomy [14].

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