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Review

The endonasal approach for treatment of cerebral aneurysms: A critical review of the literature

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ABSTRACT

The last two decades of neurosurgery have seen flourishing use of the endonasal approach for the treatment of skull base tumors. Safe and effective resections of neoplasms requiring intracranial arterial dissection have been performed using this technique. Recently, there have been a growing number of case reports describing the use of the endonasal approach to surgically clip cerebral aneurysms. We review the use of these approaches in intracranial aneurysm clipping and analyze its advantages, limitations, and consider future directions. Three major electronic databases were queried using relevant search terms. Pertinent case studies of unruptured and ruptured aneurysms were considered. Data from included studies were analyzed. 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.

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Abbreviations: EA, endonasal approach; EEA, endoscopic endonasal approach; SHA, superior hypophyseal artery; OA, ophthalmic artery; ACoA, anterior communicating artery; PICA, posterior inferior cerebellar artery; AVM, arteriovenous malformation; AICA, anterior inferior cerebellar artery; VBJ, vertebrobasilar junction; ON, optic nerve; OC, optic chiasm; CA, carotid artery; PG, pituitary gland; PS, pituitary stalk; LT, lamina terminalis; OMN, oculomotor nerve; PCA, posterior cerebral artery; MB, mammillary body; ASA, anterior spinal artery; VA, vertebral artery; BA, basilar artery; A1, A1 segment of the anterior cerebral artery; A2, A2 segment of the anterior cerebral artery; Mm, millimeters; CSF, cerebrospinal fluid.

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1. Introduction

The field of endonasal surgery has been revolutionized in the past two decades through advances in endoscopic and microscopic optics, neuroimaging, neuronavigation, and surgical instrumentation. Endonasal approaches (EA) provide a direct corridor to intracranial and extracranial anterior cranial base pathology facilitating removal of tumors and repair of cranial base defects with minimal morbidity [1]. At times, they can be expanded to reach for pathology extending to the adjacent middle and posterior cranial fossa [2]. Furthermore, successful intracranial arterial dissection and neurovascular manipulation has been performed for complex tumor resection through this approach.

This growing success and the continuous evolution of aneurysm treatment has prompted some neurosurgeons to utilize the EA to surgically clip intracranial saccular aneurysms. This is an exciting, novel, and provocative advancement in the field of cerebrovascular and skull base neurosurgery. Increasing numbers of case reports and cadaveric studies have recently been published. The purpose of this manuscript is to critically assess the existing literature on endonasal techniques utilized to clip intracranial aneurysms and analyze the described advantages and limitations of this novel approach. This will help identify when the EA can complement or possibly supplant existing cranial and endovascular techniques for the treatment of intracranial aneurysms.

2. Methods

We conducted a systematic review of the literature pertaining to endonasal clipping of intracranial aneurysms. Three independent reviewers (D.M.H., A.S., and A.V.G.) performed detailed electronic searches of major electronic databases including MEDLINE (PubMed and Ovid), Cochrane Library, and Google scholar for studies published between January 1970 and December 2014 written on this topic without language restriction. Searched keywords and MeSH terms were: “endoscopic”, “microscopic”, “endoscopic-assisted”, “endonasal”, “sublabial”, “transnasal”, and “intracranial aneurysm”. Relevant case studies of unruptured and ruptured aneurysms were considered, including those performed in conjunction with craniotomy, through sublabial exposure, and on occluded aneurysms. References of these studies, all “related articles,” and all “cited by” articles were manually screened to include any additional applicable studies. Data from included studies were summarized qualitatively, addressing patient demographics, aneurysm size, morphology, location, and orientation, visualization tool, ability to gain vascular control, clip construct, postoperative course, complications, and long-term follow-up.

3. Results

Eight case studies describing nine aneurysms (four ruptured and five unruptured) treated by an EA met inclusion criteria (Tables 1–3). Four studies describe a purely endoscopic endonasal approach (EEA) for aneurysm clipping, two studies report an endoscopic or endoscopic-assisted sublabial EA, one study describes an EEA for aneurysmorrhaphy, and one study notes an EEA following craniotomy in the same operative setting. Anterior and posterior circulation aneurysms were treated, and titanium aneurysm clips were used in treating eight of nine aneurysms. One aneurysm was treated using a low-profile Weck clip (Weck Closure Systems, Research Triangle Park, NC) because of difficulty with dural closure from the higher profile hub of a titanium aneurysm clip [3]. All studies note the ability to gain proximal and distal control and successful aneurysm obliteration was obtained in eight of nine aneurysms. Postoperative angiography on a patient with a ruptured basilar trunk aneurysm that underwent an EA for clipping revealed continued dilation in the region of the aneurysm and the patient underwent endovascular stent placement with subsequent reduction in size of her aneurysm on delayed 3-month angiography [3]. A postoperative CT angiogram on another patient revealed partial filling of a basilar aneurysm and AVM vessel and underwent repeat EEA the next day with complete obliteration of the aneurysm and AVM [4]. One intraoperative rupture occurred and was controlled without any complications [5]. Delayed complications of CSF leak, vasospasm, and hydrocephalus each occurred in one, one, and two patients, respectively, all of whom had posterior circulation aneurysms [3,6]. CSF rhinorrhea presented 15 days postoperatively in a patient with a ruptured vertebral-PICA aneurysm treated with the EA and was treated with repeat endonasal exploration and repair of necrotic nasoseptal flap; this patient ultimately developed hydrocephalus treated with ventriculoperitoneal shunting [6]. The patient with a ruptured basilar trunk aneurysm developed vasospasm treated with hypertensive therapy and hydrocephalus treated with lumboperitoneal shunting [3]. There were no reports of infection.

Table 1
EA aneurysm clipping patient demographics and aneurysm characteristics.

Report	Patient age/sex	Aneurysm location	Size (mm)	Ruptured (Y/N)
Kassam 2006	51/F	R. VA	11	Unruptured
Kassam 2007	56/F	L. SHA	5	Unruptured
Kitano 2007	58/F	ACoA	“small”	Unruptured
Eloy 2008	28/F	BA trunk	2.5	HH3, FG3
Germanwala 2011	42/F	R. Paraclinoidal ICA	10	HH2, FG1
		R. OA	5	
Ensenat 2011	74/F	R. VA-PICA	1.2	HH3, FG2
Froelich 2011	55/M	ACoA	7	Unruptured
Drazin 2012	59/F	R. BA-SCA	4	HH2

3.1. Early EA aneurysm clippings (2006–2008)

Kassam et al. [7,8] pioneered the use of the EEA to successfully clip intracranial aneurysms. In 2006, they described a 51-year-old woman with an unruptured 11-mm vertebral artery (VA) aneurysm who initially presented with severe headaches, neck pain, hemisensory changes, left leg weakness, incoordination, and vertigo [7]. The initial treatment plan to treat the aneurysm was