

The Treatment of Large and Giant Paraclinoid Internal Carotid Artery Aneurysms

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Abstract

Paraclinoid internal carotid artery aneurysms originate from the internal carotid artery between the distal dural ring and the posterior communicating artery. Surgical treatment of these aneurysms is technically challenging because of the surrounding neurovascular structures. There are several ways to treat these lesions: direct clipping with retrograde suction decompression, endovascular coiling, coiling with stent, and flow diverter stent. Here, I briefly review the surgical and endovascular options.

Keywords: Paraclinoid internal carotid artery aneurysm; Retrograde suction decompression; endovascular; Visual function

Abbreviations: ICA: Internal Carotid Artery; RSD: Retrograde Suction Decompression

Introduction

Since the publication of the International Subarachnoid Aneurysm Trial [1], there has been a paradigm shift in the treatment of intracranial aneurysms, and more aneurysms are referred for endovascular coiling. In particular, treating giant and large paraclinoid internal carotid artery (ICA) aneurysms continues to be a challenge, even for experienced neurosurgeons. Paraclinoid ICA aneurysms are defined as those originating from the ICA between the distal dural ring and the posterior communicating artery.

These lesions can be treated using several different methods, each of which has its advantages and disadvantages. Direct clipping methods were developed for paraclinoid ICA aneurysms, which includes suction decompression of giant aneurysms to deflate the aneurysm and improve dissection. Furthermore, intraoperative monitoring of electrophysiology and blood flow is indispensable for minimizing complications. The electrophysiology can be monitored with somatosensory-evoked potentials, motor-evoked potentials, and visual-evoked potentials; blood flow can be monitored with a Doppler flow meter, intraoperative angiography, and intraoperative indocyanine green videoangiography. In order to treat paraclinoid aneurysms, it is necessary to use a combination of these intraoperative monitoring techniques, in addition to gaining information on the anatomy, size, collateral flow pattern, and patient age.

Retrograde Suction Decompression

The key to successful surgical treatment of paraclinoid ICA aneurysms is to establish control of the proximal artery, gain adequate exposure to the aneurysm neck, and successfully obliterate the aneurysm with minimal manipulation of the optic nerve. Gaining proximal control of these aneurysms is difficult as they are positioned near the skull base and anterior clinoid process. Paraclinoid ICA aneurysms have a tendency to compress adjacent brain regions and the optic nerves, thus increasing the risk of surgical injury.

In 1990, Batjer et al. [2] first described the retrograde suction decompression (RSD) technique via direct cannulation of the cervical ICA with an 18-gauge angiocatheter, which is followed by gentle aspiration using a 20-mL syringe. Using the RSD technique, they successfully collapsed and clipped more than 40 aneurysms. Mattingly

et al. [3] reports using the RSD technique over a 17-year period in 18 patients, which showed all positive outcomes. In that study, the mean aneurysm size was 26 mm. Eleven (79%) of the 14 patients experienced visual improvement, whereas the remaining 3 (21%) patients experienced worsened vision after surgery [3].

The RSD technique received an endovascular modification soon after it was first described. Temporary proximal occlusion of the ICA was accomplished via a transfemoral approach with a double-lumen occlusion balloon catheter. The advantages of this modification are that it eliminates the need to expose the carotid artery in the neck, and it allows simultaneous intraoperative angiography. Nevertheless, several complications with this technique have been described: thromboembolism and vessel dissection can occur, and one group calculated a 16% complication rate [4]. In Eliava's report, 83 paraclinoid aneurysms were surgically treated with the RSD technique performed with the neck route (62 patients), or with endovascular means (21 patients) [5]. In 90.4% (75) of these RSD surgeries, the aneurysm was successfully removed, and 83.1% (69) of the patients showed good or excellent results (Glasgow Outcome Scale score of 4 or 5) at discharge.

RSD therefore greatly facilitates surgical clipping for large and giant paraclinoid aneurysms. Visual preservation or improvement occurs in the majority of these cases, which is an important outcome measure.

Endovascular Treatment

Because of the complex anatomy and the inherent risks associated with microsurgery, endovascular techniques are increasingly used to treat these aneurysms [6-8]. The endovascular options include occlusion of the parent artery; coiling of the aneurysm, stent-assisted coiling, and the newest technical advance—flow diversion. These solutions are attractive and minimally invasive, but they have low rates of complete occlusion and high rates of recanalization [9]. Furthermore, numerous reports have emerged that describe increased visual impairments in

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patients with carotid ophthalmic aneurysms (large or giant) that were treated with coil occlusion.

In a recent retrospective study of unruptured ophthalmic aneurysms and visual compromise, initial coiling results were near complete occlusion in 50% of the subjects, and included significant residual aneurysms in 37.5%. Some degree of coil compaction was noted in 83% of the subjects on follow-up angiography [6]. Aneurysms with wide necks have a potentially higher risk of thromboembolic events.

Flow-diverting stents, also known as endoluminal reconstruction, offer a new option to manage large and giant carotid ophthalmic aneurysms. These devices can be used as an adjunct to coiling, or as standalone devices that rely on flow diversion that causes aneurysm thrombosis [10-13]. The majority of target aneurysms identified in a study evaluating the Pipeline embolization device (ev3, Inc.) were paraophthalmic, and some of these were large to giant [11-13]. The possibility for complete aneurysm thrombosis and involution is suggested by their results.

Preservation of Visual Functions

In general, there are many connections between the branches from the ophthalmic artery and numerous branches from the external carotid artery. Ezura successfully treated three giant aneurysms of the supraclinoid internal carotid artery by a combination of parent artery occlusion and occlusion of the origin of the OA [14]. Thus we can stenting or clipping the aneurysm that involves the original of ophthalmic artery without visual impairment. However, patients presenting with visual deficits often report a history of poor or worsening vision, and in most cases, vision loss. Despite recent technical advancements that have provided remarkable risk reductions in paraclinoid ICA aneurysm surgeries, postoperative deterioration of visual function remains a significant problem.

Nanda and Javalkar [15] reported positive surgical outcomes in patients who underwent surgical clipping over a period of 15-years. The overall mortality rate was 6.3%, and the clinical outcomes were excellent or good (GOS score of 5 or 4) in 88% of the patients. Moreover, they observed improved visual symptoms in 77% of the patients who presented with preoperative visual disturbances. Visual morbidity was only 2.5%, which is in agreement with other studies in which visual morbidity was up to 5% when an ophthalmic segment of the ICA aneurysm was present.

With respect to visual outcome, coiling large or giant aneurysms does not appear to provide an advantage over clipping [16]. A recent meta-analysis of 21 studies concluded that patients undergoing micro-neurosurgical decompression and clipping exhibited visual improvement more often than patients undergoing endovascular coiling did ($p = 0.002$; odds ratio [OR] = 2.9; 95% confidence interval [CI] = 1.5–6.0). In the multivariate analysis, surgical clipping was the only predictor for improvement of visual deficits ($p = 0.02$; OR = 3.8; 95% CI = 1.2–12.2) [16]. Flow-diverting stents can complete obliterate aneurysm equally to surgical clipping but the rate of optic nerve decompression is questionable [11].

Conclusion

Surgical treatment of large and giant paraclinoid ICA aneurysms are technically challenging for many neurosurgeons. RSD greatly facilitates surgical clipping for large and giant paraclinoid ICA aneurysms. Visual preservation and improvement occur in the majority of these cases, which are important outcome measures. New

and developing endovascular technology must be superior, or at least equivalent to surgery for this specific outcome. Paraclinoid aneurysms should be assessed jointly by the neurosurgeon and the endovascular team to choose the proper management strategy.

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