Endovascular Treatment of Paraclinoid Aneurysms

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Summary

The anatomical complexity of the paraclinoid region has made surgical treatment of intracranial ophthalmic segment aneurysms (OSAs) difficult. This study evaluated the safety and efficacy of endovascular treatment of paraclinoid aneurysms. We conducted a retrospective study of 28 patients with 30 aneurysms of the paraclinoid in whom treatment with endovascular techniques was attempted. Patient age, sex, presence of subarachnoid hemorrhage, aneurysm type, size of aneurismal sac and treatment modality were reviewed. Clinical evaluation and control angiography were performed between one and 43 months. Overall, complete occlusion was obtained in 26 aneurysms (86.6%), nearly complete (>90%) occlusion in two aneurysms (6.7%) and incomplete occlusion was observed in two aneurysms (6.7%). All endovascular techniques were successful. Procedure-related complications were observed in two patients (7.1%). Patients underwent follow-up for a mean of 14.8 months (range 1-43 months). Repeated coil treatment was performed in one patient. One patient died of massive brain infarction six days postoperatively and thus no follow-up data were available for this case. In 27 patients with follow-up studies, aneurysm closure was complete in 22 (81.5%) and incomplete in five (18.5%). Endovascular treatment is a safe and efficient alternative approach for paraclinoid aneurysms.

Introduction

Aneurysms arising from the internal carotid artery (ICA) between its point of exit from the roof of the cavernous sinus and the origin of

the posterior communicating artery have been collectively termed paraclinoid/carotid-ophthalmic aneurysms. With advances in endovascular techniques, coiling of intracranial aneurysms is considered a valid alternative to surgical treatment¹.

Paraclinoid aneurysms present a true surgical challenge owing to their complex anatomy, proximity to the optic apparatus and to a partial intracavernous extension in some cases.

The difficult proximal control and the narrow space to work with lead to a higher frequency of failed clipping procedures as well as to a higher surgical morbidity and mortality²⁻⁶.

The goal of this study was to evaluate the safety and efficacy of endovascular treatment with coil embolization for ophthalmic segment aneurysms.

Materials and Methods

This retrospective study includes 30 aneurysms in 28 patients referred for endovascular treatment between March 2007 and November 2010.

The study included 22 women and six men ranging in age from 20 to 70 years (mean, 51.5 years). Four patients had multiple aneurysms and two had bilateral paraclinoid aneurysms. Aneurysms were considered small when less than 11 mm in greatest diameter (12 aneurysms), large when between 11 and 25 mm (17 aneurysms), and giant when more than 25 mm (one aneurysm).

Aneurysmal neck size was considered narrow when equal to 4 mm or less (five aneurysms) or wide when more than 4 mm (25 aneurysms).

Figure 1 A 47-year-old female had an unruptured paraclinoid aneurysm. A) of the left internal carotid artery injection revealed a 5mm×5.5mm aneurysm arising from the paraclinoid region with a wide neck. B) Angiogram after stent-assisted coil embolization showed complete obliteration.

Clinical presentation

There were six (20%) ruptured and 24 (80%) unruptured paraclinoid aneurysms (Table 1). Among the patients with ruptured aneurysms, the Hunt and Hess grades were I in five patients, III in one. Among the patients with unruptured aneurysms, seven patients presented with visual disorders, including blurred vision (n=6), cranial nerve VI palsy (n=1) and another 17 patients were incidental. Among the 30 aneurysms, one was of dissecting type and partial thromboses and 29 were saccular type.

Treatment

Patients typically were treated while under general anesthesia. Heparin was administered intravenously just after the guiding catheter was introduced, first as a 3000 U bolus followed by infusions at 1000 U/hour. A coaxial technique was used for microcatheter, balloon, and stent catheter access^{7,8}. In general, balloons were used when there was even a moderate suspicion that balloon assist would be needed. Stents were

typically used in cases of failed balloon-assist coiling (Figures 1 and 2). The types of coils used varied by operator and changed over the period of the study. Bare platinum coils and Hydrocoils from Microvention, Cordis, and M.T.I-ev3 were used in the treatment of 30 aneurysms. In seven recent patients, Chinese manufactured coils (Jasper, Shanghai, China) were used in conjunction with other coils. Patients treated with stent assistance were preloaded with the dual antiplatelet agents, 75 mg clopidogrel daily and 200 mg aspirin daily for three days before treatment. In ruptured aneurysms, patients were preloaded with 300 mg clopidogrel and 300 mg aspirin two hours before the procedure. Post-procedure, the patients were kept on a dual antiplatelet regimen between three and six months.

Angiographic and clinical results and follow-up

Treatment complications, clinical outcome, and follow-up data were recorded. The Glasgow Outcome Scale (GOS) was used to classify clinical outcome⁹. Anatomic results include

Table 1 Consecutive Intracranial paraclinoid Aneurysms

Patient No.	Sex/age	Clinical presentation	Type	Size (mm)	Neck	Treatment	Complications	Results	Follow-up (months)	Clinical outcome (GOS)	Angiography outcome
1	F/54	Incidental	Saccular	4×4	Narrow	Coiling	No	70%	21	5	Stable
2	F/60	Incidental	Saccular	16×20	Wide	Stent assistance	No	70%	21	5	Stable
3	M/60	Incidental	Saccular	4.4×4.7 3.1×3.5	Wide	Stent assistance	No	100%	10	5	Complete
4	F/48	Incidental	Saccular	6×8	Wide	Stent assistance	No	100%	4	5	Complete
5	F/46	Incidental	Saccular	10.8×12.2	Wide	Stent assistance	No	100%	5	5	Complete
6	F/52	Incidental	Saccular	3.5×4	Wide	Stent assistance	No	100%	7	5	Complete
7	F/44	Incidental	Saccular	15×16	Wide	Stent assistance	No	100%	6	5	Recanalization
8	F/66	Incidental	Saccular	12×13	Wide	Stent assistance	No	100%	10	5	Complete
9	F/69	Incidental	Saccular	10×10	Wide	Stent assistance	No	100%	10	5	Complete
10	F/70	Incidental	Saccular	11×12	Wide	Stent assistance	No	100%	1	5	Complete
11	M/40	Incidental	Saccular	18×20	Wide	Balloon assistance	No	100%	2	5	Complete
12	M/41	Incidental	Saccular	5×7	Narrow	Coiling	No	100%	39	5	Complete
13	F/45	Incidental	Saccular	3×4 21×23	Wide	Coilin Stent assistance	No	100% >90%	23	5	Complete
14	F/43	Incidental	Saccular	3×3	Wide	Balloon assistance	Yes	100%	43	5	Complete
15	M/61	SAH	Saccular	12×12	Wide	Stent assistance	No	100%	8	5	Complete
16	M/20	SAH	Dissecting	28×30	Narrow	Coiling	No	>90%	6 days	1	Complete
17	F/55	SAH	Saccular	4.5×4.6	Wide	Stent assistance	No	100%	3	5	Complete
18	F/47	SAH	Saccular	5×5.5	Wide	Stent assistance	No	100%	3	5	Complete
19	F/38	SAH	Saccular	3.2×5	Narrow	Coiling	No	100%	25	5	Complete
20	F/65	SAH	Saccular	12×14	Wide	Stent assistance	Yes	100%	42	4	Complete
21	F/50	Diplopia	Saccular	13×17	Narrow	Coiling	No	100%	43	5	Complete
22	F/47	Blurred vision	Saccular	2.5×3.2	Wide	Stent assistance	No	100%	23	5	Complete
23	F/48	Blurred vision	Saccular	17×18	Wide	Stent assistance	No	100%	3	5	Complete
24	F/56	Blurred vision	Saccular	13×14	Wide	Stent assistance	No	100%	23	5	Complete
25	F/46	Blurred vision	Saccular	15×18	Wide	PVO	No	100%	4	5	Complete
26	F/48	Intracranial bruits	Saccular	9.2×12	Wide	Stent assistance	No	100%	5	5	Complete
27	F/59	Blurred vision	Saccular	32×34	Wide	PVO	No	100%	18	5	Recanalization
28	F/64	Blurred vision	Saccular	12×12	Wide	Stent assistance	No	100%	6	5	Complete

Figure 2 A 48-year-old female had an unruptured paraclinoid aneurysm. A) of the left internal carotid artery injection revealed a 16 mm×17 mm aneurysm arising from the paraclinoid region with a wide neck. B) Post-embolization angiogram demonstrated the completely occluded aneurysm after stent-assisted coiling.

those seen immediately after treatment and at follow-up. These results were divided into complete occlusion (100%), nearly complete (>90%) and incomplete occlusion (<90%)¹⁰.

Results

Patients' age, sex, clinical presentation, aneurysm type, size of the aneurysm and the neck, anatomic results, clinical outcome and interval to follow-up are summarized in Table 1. Clinical examples are illustrated in Figures 1 and 2.

Angiographic results

Of the 30 aneurysms, 20 (66.6%) were treated with stent assistance, six (20%) were treated without the assistance of adjunctive techniques, two (6.7%) were treated with parent vessel occlusion, and two (6.7%) were treated with balloon assistance. There were 26 (86.6%) complete occlusions, two (6.7%) nearly complete occlusions and two (6.7%) incomplete. No treatment attempts failed.

Complications

In two (6.7%) patients, ischemic complications occurred after embolization.

There was no evidence of thromboembolism on post-embolization angiogram and CT scanning, both patients were treated conservatively, which resulted in complete recovery in one and permanent detectable deficit in the other.

The complications were associated with a nonocclusive clot and distal emboli.

The patient made a good recovery but still has a residual paresis of the right hand.

Clinical Outcome

Among the 28 patients, 27 (96.4%) patients had good outcomes (GOS 5 and 4) with resolution of visual disturbance in three patients.

One (3.6%) patient died as a result of middle cerebral artery infarction on postembolization day 6 in a case of paraclinoid dissecting aneurysm.

There was no rebleeding among the surviving patients.

Angiographic follow-up

Angiographic control studies three to 18 months after treatment were available in 27 patients (mean angiographic follow-up, 7.8 months). Twenty-four (80%) complete occlusions persisted. Two minor recanalizations were observed and retreatment was successful in one of these two patients. In the seven other patients, control angiography showed a stable appearance.

Discussion

This article presented a single-center series focused on the safety, procedural techniques, and short- and long-term occlusion rates for coil embolization of paraclinoid aneurysms. Our results have demonstrated high rates of complete or nearly complete occlusion immediately and at follow-up.

Outcomes of surgical treatment

Many papers have been published on surgery for paraclinoid (ophthalmic segment) aneurysms^{2,3,6,11-17}. They report mortality rates varying from 0 to 13.8% and morbidity up to 26.8%. The complication rates associated with surgical treatment are 0%-25% and the complete obliteration rates of aneurysms are 66.7%-100%. The mean age of patients in these studies is 42-50 years old with a SAH rate of 0-80.8%, mostly large and giant but some small aneurysms, which are comparable to those in our study. Despite the advantages and improvement in surgical techniques there remains a significant morbidity and mortality associated with surgical treatment of these aneurysms. Our group of paraclinoid aneurysms, which includes small, large and giant aneurysms, has a procedure-related morbidity of 4.5%, permanent major morbidity of 2.4% and mortality of 2.4%. This compares favorably with the previously reported surgical series.

Endovascular results

The advent of adjunctive techniques, such as stent- or balloon-assisted coiling, has made possible the endovascular occlusion of an increasing number of ruptured and unruptured intrac-

ranial aneurysms. There have been only few reported series of paraclinoid (ophthalmic segment) aneurysms treated with endovascular coiling. Hauk et al. reported a 26.7% complete obliteration rate of OSA without any complications or deaths¹⁸. Heran et al. achieved complete occlusion in their 47% cases with a mortality of 11.8%¹⁹. Roy et al. reported 28 cases with three deaths (10.7%), one permanent morbidity (3.6%) and 50% complete obliteration rate²⁰. In another two papers^{21,22} the reported higher complete obliteration rates of paraclinoid aneurysms were 87.3% and 88.9% with complication rates of 18.3% and 0%. In our series, a favorable clinical outcome (GOS Scores 4-5) was achieved in 97.6% of patients at follow-up, with an 88.6% rate of complete to near-complete occlusion of the aneurysms. The indication for treatment of unruptured intracranial aneurysms is controversial. Paraclinoid aneurysms include a subset with a relatively low rupture rate. For unruptured carotid cave and small paraclinoid aneurysms, decision-making regarding whether or not to treat the aneurysm may be the most difficult step²³. Therefore, when treating unruptured paraclinoid aneurysms, the risk of treatment has to be balanced against the benign natural history. Our experience has shown that the risk of treating unruptured intracranial OSA has a low morbidity of 2.4%. The densely woven mesh of current flow diversion stents may constitute a treatment alternative since this mesh may help in preventing further progression of the aneurysm. But this new device is still not generally used in our center.

Limitations

This study has two limitations. Most of the series were single-center retrospective analyses. Moreover, there is a possible publication bias, as series with more positive results may have been more likely to be reported and published. Nevertheless, this study has shown that endovascular treatment of intracranial paraclinoid aneurysms can be done with an acceptable risk.

Conclusion

Endovascular embolization is a safe and effective treatment modality in cases of paraclinoid aneurysms.

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