Early Endovascular Management of Oculomotor Nerve Palsy Associated with Posterior Communicating Artery Aneurysms

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Summary

Palsy of the third cranial nerve (oculomotor nerve, CNIII) is a well-known clinical presentation of posterior communicating artery (P-com) aneurysm. We report a series of 11 patients with partial or complete third nerve palsy secondary to P-com aneurysm. All were treated with endovascular embolization within seven days of symptom onset. Third nerve palsy symptoms resolved in 7/11 (64%), improved in 2/11 (18%) and did not change in 2/11 (18%) patients

Introduction

The incidence of third nerve palsy (TNP) associated with ipsilateral P-com aneurysm has been reported as high as 56%¹⁻⁵. However, these data likely are inflated by selection bias at tertiary care centers. Our experience is more consistent with reports that describe the true incidence of TNP among patients with ruptured or unruptured P-com aneurysm at or below 30%⁶. The presence of unilateral TNP in association with ipsilateral P-com aneurysm has been used as a rationale for surgical clipping rather than endovascular coiling based on the theory that surgical clipping provides better decompression of the aneurysm and decreased mass effect on the third cranial (oculomotor) nerve.

However in small series, increasingly more authors have reported resolution of TNP after

coil embolization of P-com aneurysms^{1,7-12}. This paper reports the long-term clinical follow-up after early aneurysm embolization in 11 patients with P-com aneurysms and TNP.

Patients and Methods

Retrospective medical record analysis was performed from our institutional database of 516 aneurysms treated by coil embolization from November 2001 to August 2009. There were 101 P-com aneurysms in 101 patients, 17 of whom demonstrated TNP. Four patients were lost to follow-up due to poor compliance. Two patients were treated outside of the early window (one month and 14 years following onset of TNP, respectively), neither of whom demonstrated improvement in TNP after embolization. The remaining 11 patients were treated within seven days of TNP onset and represent the population of this small study.

In September of 2009, we interviewed by telephone 11 patients treated within seven days of TNP onset using a standardized questionnaire to describe ocular symptoms prior to treatment and after coiling. Each patient was asked to use a mirror to grade the degree of eyelid droop. Ptosis was graded as complete if the affected eyelid could not be opened, partial if it could be opened only partially or absent if the eyelids were symmetric. The patient also was asked to compare the size of his/her pupils. If the affected pupil was enlarged or if the pa-

tient reported the subjective finding of photosensitivity, he/she was graded as having pupillary dysfunction. Finally, patients reporting double vision during reading or walking down stairs were said to have ophthalmoplegia. Historical information regarding symptoms at presentation was corroborated with documented neurological examination in hospital and/or clinic records when possible.

Patients were stratified into two groups based on severity of TNP at admission. "Complete TNP" at presentation was defined to have three components: complete ptosis, pupillary dysfunction and ophthalmoplegia. "Partial TNP" at presentation was defined as incomplete or absent ptosis, pupillary sparing and mild or absent ophthalmoplegia (i.e. without limitation in the activities of daily living).

Following coil embolization, patients were stratified into three outcome groups. The "improved" group includes patients initially presenting with complete TNP, who improved to partial TNP after treatment. The term "re-

solved" describes patients presenting with complete or incomplete TNP, who demonstrated complete abrogation of cranial nerve III (CN III) symptoms following treatment. "Unchanged" describes to patients who gained no symptomatic benefit from coil embolization. Clinical improvement was correlated with patient age and sex, time interval from symptoms onset to treatment, cardiovascular risk factors at the time of hospital admission (i.e. hypertension, diabetes mellitus and smoking), association with subarachnoid hemorrhage (SAH) (+/-), coil type (bare platinum vs. coated), aneurysm size, dome/neck ratio and length of follow-up interval.

Angiographic follow-up was conducted using digital subtraction angiography (DSA) in five patients and magnetic resonance angiography (MRA) in four. Two patients are scheduled but have not yet undergone follow-up angiography. Aneurysm embolization was evaluated immediately following treatment and at follow-up using the Raymond scale¹³.

Table 1 Clinical characteristics, angiographic features and outcomes of P-com aneurysms associated with third nerve palsy (TNP).

Pt#	SAH	Third nerve palsy	Dome/Neck (mm)	Coil type	Post embo Raymond	Follow-up Raymond	Post treatment ocular symptoms
1	No	Partial	10/3	Bare	R1	R1 (6 years)	Resolved
2	No	Complete	8/4	Coated	R3	R2 (7 months)	Resolved
3	No	Partial	9.8/3.5	Coated	R3	R2 (2 years)	Unchanged
4	No	Complete	7.4/3.1	Bare	R1	*	Resolved
5	Yes	Complete	5.9/4	Bare	R2	R1 (10 months)	Resolved
6	No	Complete	6.2/1.8	Bare	R2	*	Improved
7	No	Complete	4.4/2.1	Bare	R2	R2 (6 months)	Resolved
8	No	Partial	9/3	Bare	R2	R2 (7 months)	Improved
9	Yes	Complete	7/2.2	Bare	R1	R1 (7 years)	Resolved
10	Yes	Partial	6.1/1.5	Coated	R1	R1 (2 years)	Resolved
11	No	Partial	11/4	Bare	R1	R3 (7 months)	Unchanged

* Denotes patients who have not yet received follow-up angiography.

Presence or absence of subarachnoid hemorrhage (SAH), degree of TNP, dome/neck ratio, coil type (bare or coated platinum coils) and clinical outcome of TNP following treatment are shown. The extent of P-com aneurysm embolization/filling is described using the Raymond scale, where Raymond 1= complete aneurysm obliteration, including the neck, Raymond 2= contrast filling the neck of the aneurysm without opacification of aneurysm sac and Raymond 3= contrast filling the sac of the aneurysm. Post embolization Raymond scores describe the degree of residual filling identified immediately following treatment using DSA. Follow-up Raymond scores describe the degree of embolization/filling identified using MRA or DSA 6 months to 7 years following treatment.

Results

The study population consisted of ten females and one male aged 32 to 82 years (mean and median age = 52.6 and 53 years, respectively). The duration of symptoms before treatment ranged from one to seven days. Six (54.5%) patients were hypertensive at hospital admission. Five (45.5%) patients were smokers. One patient (9.1%) was diabetic. Three (27.3%) demonstrated no cardiovascular risk factors. In eight (72.7%) patients, TNP was the

only presenting symptom. Three (27.2%) patients presented with SAH. P-com aneurysms were right-sided in six and left-sided in five patients. Eleven endovascular procedures were performed using standard technique and detachable coils. Bare platinum coils were used in eight patients and coated coils in three. All aneurysms were saccular. Size ranged from 4.4 to 11 mm (mean, median = 7.7, 7.4 mm) and only one aneurysm exceeded 10 mm. The aneurysm necks ranged from 2.1 to 4 mm (mean = median = 3.0 mm). Six patients pre-

Table 2 Summary of existing literature comparing third nerve palsy (TNP) recovery following endovascular coiling and surgical clipping.

Reported outcomes for third nerve palsy following endovascular coiling							
Author	Date	n	Time range from TNP onset to txt	Complete Recovery	Partial Recovery	Unchanged	Worse
Birchall, et Al	1999	3	5-21 days	3 (100%)	0	0	0
Mavilio, et Al	2000	6	2 days-6 months	6 (100%)	0	0	0
Inamasu, et Al	2002	1	1 day	1 (100%)	0	0	0
Stiebel, et Al	2003	11	3-23 days	0	11 (100%)	0	0
*Chen, et Al	2006	6	1-28 days	2 (33,3%)	4 (66,6%)	0	0
*Ahn, et Al	2006	10	Unknown	6 (60%)	3 (30%)	1 (10%)	0
Hanse, et Al	2008	21	1- (>14) days	8 (38%)	11 (52,3%)	2 (9,7%)	0
Kassis, et Al	2009	20	1 day-2.5 years	7 (35%)	12 (60%)	1 (5%)	0
#Santillan, et Al	2009	11	1-7 days	7 (63.6%)	2 (18.2%)	2 (18.2%)	0
Reported outcomes for third nerve palsy following surgical clipping							
Author	Date	n	Time range from TNP onset to txt	Complete Recovery	Partial Recovery	Unchanged	Worse
Perneckzy, et Al	1984	20	Unknown	6 (30%)	10 (50%)	4 (20%)	0
Kyriakides, et Al	1989	22	4-30 days	13 (59%)	9 (41%)	0	
Giombini, et Al	1991	49	1-14 days	17 (35%)	25 (51%)	7 (14%)	0
Lanzino, et Al	1993	13	Unknown	7 (54%)	6 (46%)	0	0
Leivo, et Al	1996	28	1- (> 28 days)	17 (61%)	Unknown	Unknown	Unknown
Yanaka, et Al	2003	16	2-50 days	7 (44%)	6 (37%)	2 (13%)	1 (6%)
*Chen, et Al	2006	7	1 day- 3 months	6 (85,7%)	1 (14,7%)	0	0
*Ahn, et Al	2006	7	Unknown	3 (42,9%)	4 (57,1%)	0	0
* Denotes a comparative series including endovascular and surgical data. # denotes our experience.							

Author, date of publication and time interval from onset of TNP to definitive treatment are described. As in our series, outcomes generally have been described as complete, partial, unchanged. One group also described a patient with worsened TNP following treatment.

sented with complete and five with partial TNP. There was no technical or clinical complication among these 11 embolizations. Post-embolization and follow-up angiograms were assessed using the modified Raymond scale 17 and aneurysms were classified as stable, improved or recanalized based on Raymond grade (Table 1).

Clinical follow-up ranged from six to 88 months (mean and median = 39.8 and 21 months). There was a complete resolution of third nerve palsy in 7/11 (64%), partial improvement in 2/11 (18%) and no change in 2/11 (18%) patients. Statistical analysis performed using the Fisher Exact Test did not demonstrate a significant ($P=.18$) relationship between the degree of nerve dysfunction at presentation (i.e. complete versus partial TNP) and clinical outcome (i.e. resolved or improved versus unchanged). Cardiovascular risk factors did not affect recovery ($P=.51$), nor did the use of coated versus bare coils ($P=.49$). Among the three SAH patients treated, all demonstrated resolved TNP at follow-up.

Discussion

Our experience suggests that coil embolization of small P-com aneurysms provided within one week of the onset of TNP results in symptomatic improvement (18%) or resolution (64%) of ocular symptoms. We found that when early management is provided, symptom severity at presentation does not predict symptom severity following treatment. Because the outcomes presented here and elsewhere^{1,8-10} describe improved TNP following endovascular management that is similar to outcomes reported in multiple previous surgical series^{5,6,14-16} (Table 2), we feel that the presence of aneurysmal TNP is not itself a sufficient criterion for the recommendation of surgical clipping over endovascular coiling of a P-com aneurysm. Ahn et al reached the same conclusion in a comparative analysis showing no statistical difference in the rate of complete TNP recovery between clipping and coiling⁷. However, this opinion is not widely agreed upon as Chen et al concluded that clipping was associated with a higher probability of complete recovery¹⁷. Independent of treatment modality, we believe that time interval between TNP onset and definitive management represents the strongest positive predictor of clinical outcome and that prompt

treatment with coiling or clipping offers the best probability for symptomatic improvement or resolution^{1,6,9,11,14,17,18}.

It has been suggested that impaired microvascular flow secondary to chronic vascular disease may compromise regeneration and healing in the injured CN III^{6,8,14}. We found no correlation between cardiovascular risk factors (i.e. diabetes, smoking, HTN) and symptomatic outcome. Six of eight patients with one or more such risk factor demonstrated improved or resolved third nerve palsy following early management.

Patients with aneurysmal TNP should be warned that symptoms likely may not improve immediately. Among our eleven patients with aneurysmal TNP, five described symptomatic improvement within one month following coiling. Two others described no improvement within one month but significant improvement at one year. These findings are consistent with previous reports suggesting symptomatic recovery generally begins within the first month after treatment^{9,19}, symptomatic improvement starting within the first month is likely to progress to complete recovery and recovery generally takes between one and three months^{6,14,18,20}. Among our eleven patients treated with early endovascular management, seven recalled symptomatic TNP improvement within three months and two more recalled TNP improvement within one year.

The pathophysiologic mechanisms underlying aneurysmal TNP also are not well understood. It was long believed that simple mass effect on CNIII is sufficient to cause TNP^{14,16}. However, more recent reports advance the idea that pulsatility rather than simple mass effect represents the salient feature underlying aneurysmal TNP^{1,5,11,12}. Indeed the latter explanation is consistent with our findings and previously reported series that endovascular coiling provides adequate relief of TNP symptoms without surgical decompression of the aneurysm sac.

Conclusions

Endovascular coiling is as effective as surgical clipping for treating third nerve palsy secondary to small posterior communicating aneurysms. Early management (within one week following CN III symptom onset) may represent the strongest positive predictor of clinical outcome.

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