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Recovery of posterior communicating artery aneurysm-induced oculomotor nerve paresis after endovascular treatment

Da-Qun Gu, Bin Luo, Xin Zhang, Xiao-Ao Long, Chuan-Zhi Duan*

Department of Neurosurgery, Zhujiang Hospital, Southern Medical University, 253# Industry Road, 510282 Guangzhou, Guangdong, China

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ABSTRACT

Objective: Recovery of aneurysm-induced oculomotor nerve paresis (ONP) after endosaccular coiling has not yet been adequately assessed. The aim of this study was to investigate the factors that affect the outcome of ONP after endovascular treatment of posterior communicating artery (PcomA) aneurysms.
Materials and methods: We retrospectively evaluated the clinical characteristics and the outcome of oculomotor nerve function in a series of 36 patients with ONP due to PcomA aneurysms treated by endovascular coiling. Univariate analysis was applied to test the association between ONP recovery and clinical variables.
Results: Thirty-six consecutive patients (20 women, 16 men; mean age, 54.3 ± 9 years) presenting with ONP underwent endosaccular coiling were enrolled in this study. Subarachnoid hemorrhage was present in 21 patients. The mean size of the aneurysms was 9.3 ± 3.9 mm. ONP was complete in 14 patients (38.9%) and partial in 22 patients (61.1%) at admission. Seventeen patients (47.2%) had complete recovery of oculomotor nerve function, 15 had incomplete recovery (41.7%), and 4 (11.1%) remained unchanged after treatment. Factors showing significant association with recovery of oculomotor nerve function were the length and degree of ONP before treatment ($P = 0.035$ and $P = 0.019$, respectively).
Conclusions: Endosaccular coiling of PcomA aneurysms in patients with ONP resulted in cure or improvement of oculomotor nerve dysfunction in the majority of patients. The length and degree of preoperative ONP were the statistically significant predictors of complete ONP recovery.

1. Introduction

Oculomotor nerve paresis (ONP) is one of the clinical presentations associated with posterior communicating artery (PcomA) aneurysms. Direct mechanical compression or irritation by the aneurysms may result in partial or complete dysfunction of oculomotor nerve. Onset may be acute by sudden increase in aneurysm volume as a result of aneurysmal wall dissection with or without accompanying subarachnoid hemorrhage (SAH). Endovascular coiling is a less invasive alternative method to microsurgical clipping, and its efficacy concerning recovery of oculomotor nerve function has also been assessed in many studies. However, the number of patients included in each series reported in the literature was limited, and larger series is still needed for further evaluation. In this paper, we investigated the outcome of ONP following endovascular coiling and attempted to identify the factors affecting recovery of ONP in a larger number of patients. To the best of our knowledge, this is the largest series to date that assess the outcome of ONP after endovascular treatment of PcomA aneurysms.

2. Materials and methods

2.1. Patients

Endovascular treatment is the first therapeutic option for both ruptured and unruptured intracranial aneurysms at our institution. Between January 2004 and January 2010, thirty-six patients who presented with ONP due to PcomA aneurysms and underwent endovascular treatment by means of endosaccular coiling with or without additional use of stents in the parent artery were enrolled in our study. The study was approved by institutional review board.

2.2. Data collection

Patient data were obtained by consulting the computer database of our institution. Patient medical files, clinical presentation, ophthalmologic examination reports, the endovascular procedure reports, and the course of ophthalmologic and angiographic follow-up were studied retrospectively. Patients were also interviewed over the telephone about ocular symptoms and to evaluate the

* Corresponding author. Tel.: +86 013 539962233; fax: +86 020 61643269.
E-mail address: chuanzhiduan@126.com (C.-Z. Duan).

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clinical outcome. Neuro-ophthalmologic assessment, conducted by a neuro-ophthalmologist, was scheduled before embolization; at discharge; after 3, 6, and 12 months; and then annually or in case of recurrent symptoms.

2.3. Inclusion criteria

The inclusion criteria were (1) PcomA aneurysm; (2) the presence of oculomotor nerve dysfunction, which is explained by the location of the aneurysm; (3) the aneurysm was treated by endovascular coiling with or without additional use of stents in the parent artery; and (4) available routine postoperative follow-up.

2.4. Criteria for ONP and its recovery

The criteria for complete preoperative ONP were as follows: (1) reports of diplopia, (2) ptosis, (3) ophthalmoplegia, and (4) pupillary dysfunction. Partial preoperative ONP was identified as similar symptoms associated with partial extraocular movement in upward, medial, and downward gazes, or pupillary sparing. The postoperative evolution of ONP was classified as unchanged (no improvement), improved (incomplete recovery), or complete recovery. The criteria for complete recovery of ONP were no diplopia in all direction of gazes, complete resolution of ptosis, full range of movement in medial, downward, and upward gaze, and partial or complete recovery of pupillary reaction. In any case of only partial improvement, ONP recovery was considered to be incomplete.

2.5. Recovery factors

The following factors were assessed: patient age, gender, size of the aneurysm, aneurysm neck size, aneurysm rupture status before treatment, length of ONP before treatment, degree of preoperative ONP, use of stents in the parent artery, and degree of aneurysm occlusion assessed by use of the modified 3-point Raymond scale (Raymond 1 = complete obliteration of aneurysm including the neck, Raymond 2 = contrast filling the neck of the aneurysm without opacification of the aneurysm sac, and Raymond 3 = contrast filling of the sac of the aneurysm) [1].

2.6. Statistical analysis

Due to the limited number of individuals, only univariate analysis was used. Frequencies and percentages were calculated for categoric variables that were analysed using Fisher's exact test. Continuous data with normal distribution were reported as mean ± SD and analysed with the Student's *t* test while those with non-normal distribution were reported as mean and analysed with the Wilcoxon two sample test. The level of statistical significance used was $P < 0.05$ for the whole study. Statistical analysis was performed with the SPSS statistical package (SPSS 13.0).

3. Results

3.1. Clinical findings

A total of 36 consecutive patients with 36 PcomA aneurysms were included in this study. Of the 36 patients, 20 were women and 16 were men. The mean age of the patients was 54.3 ± 9 years (range 39–71 years). SAH was present in 21 (58.3%) patients, whereas 15 (41.7%) patients had unruptured aneurysms. The mean size of the aneurysms was 9.3 ± 3.9 mm (range 3–22 mm). ONP was complete in 14 patients (38.9%) and partial in 22 patients (61.1%) at the time of admission. The mean interval between the onset of ONP and aneurysm embolization was 38 days (range 1–147 days). Demographic and clinical characteristics are summarized in Table 1.

Table 1
Demographic and clinical characteristics.

No of patients	36
No of aneurysms	36
Age (mean ± SD) (years)	54.3 ± 9 (range 39–71)
Gender	
Female (*n* (%))	20 (55.6)
Male (*n* (%))	16 (44.4)
Diameter of the aneurysm (mean ± SD) (mm)	9.3 ± 3.9 (range 3–22)
Aneurysm neck size	
Diameter <4 mm (n (%))	27 (75)
Diameter ≥4 mm (*n* (%))	9 (25)
Aneurysm rupture status	
Ruptured (*n* (%))	21 (58.3)
Unruptured (*n* (%))	15 (41.7)
Degree of preoperative ONP	
Partial (*n* (%))	22 (61.1)
Complete (*n* (%))	14 (38.9)
Length of ONP before treatment (mean) (days)	38 (range 1–147)

ONP, oculomotor nerve paresis.

3.2. Neuro-ophthalmologic follow-up

The mean postoperative follow-up was 15 months (range 3–36 months). Overall, 17 patients (47.2%) experienced complete recovery of oculomotor nerve function, 15 had incomplete recovery (41.7%), and 4 (11.1%) remained unchanged after treatment. The levator palpebrae and medial rectus muscles demonstrated rapid recovery and the parasympathetic fibers of the pupil and the superior and inferior rectus muscles lagged behind at follow-up term.

3.3. Analysis of ONP recovery in correlation with clinical factors

No statistically significant correlation could be found between age and final degree of ONP recovery ($P = 0.682$), and no relationship could be found between ONP recovery and gender ($P = 0.749$). Also aneurysm neck size ($P = 0.451$) and use of stents ($P = 0.684$) did not significantly contribute to different outcomes of ONP recovery.

According to aneurysm size, ONP recovered completely in 12 (54.5%), improved in 8 (36.4%), and unchanged in 2 (9.1%) among the 22 patients with small aneurysms (diameter ≤10 mm). While in the 14 patients with larger aneurysms (>10 mm), follow-up results showed complete recovery in 5 (35.7%), incomplete recovery in 7 (50%), and unchanged in 2 (14.3%). Small aneurysms showed a higher tendency for better ONP recovery (complete recovery) compared with larger aneurysms. Nevertheless, the difference did not reach statistical significance ($P = 0.322$).

Among the 21 patients with ruptured aneurysms, complete recovery of ONP was achieved in 12 (57.1%) patients, incomplete recovery 8 (38.1%), and unchanged 1 (4.8%). But in the 15 patients with unruptured aneurysms, complete recovery of ONP was achieved in 5 (33.3%) patients, incomplete recovery 7 (46.7%), and unchanged 3 (20%). Ruptured aneurysms have a higher rate of complete recovery of ONP than unruptured ones. But the difference was not statistically significant ($P = 0.192$).

According to degree of aneurysm occlusion, patients were divided into 3 different groups: complete occlusion, neck remnant, and residual aneurysm. No statistically significant correlation could be found between the degree of aneurysm occlusion and resolution of ONP.

The length of ONP before treatment had significant effect on its complete recovery ($P = 0.035$). Furthermore, the preoperative degree of ONP (complete vs. partial) was significantly associated with the outcome of oculomotor nerve function ($P = 0.019$). ONP recovered completely in 14 (63.6%), improved in 6 (27.3%), and