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ORIGINAL ARTICLE

The recovery time of traumatic carotid-cavernous fistula-induced oculomotor nerve paresis after endovascular treatment with detachable balloons

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Traumatic carotid-cavernous fistula;
Oculomotor nerve paresis;
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Detachable balloon

Summary
Purpose: The recovery time of traumatic carotid-cavernous fistula-induced oculomotor nerve paresis (ONP) after endovascular embolization with detachable balloons has not yet been adequately evaluated. This study was performed to make a deep analysis of the factors, which affect the prognosis of ONP after endovascular treatment of traumatic carotid-cavernous fistula (TCCF).
Materials and methods: We retrospectively evaluated the clinical characteristics and the outcome of oculomotor nerve function in a series of 98 consecutive patients with ONP due to traumatic carotid-cavernous fistula which were endovascular treated with detachable balloons. Univariate analysis was applied to test the association between the time of ONP recovery and clinical variables.
Results: Ninety-eight consecutive patients (62 males, 36 females, mean age 34.2 ± 12.7 years) having presented with ONP underwent endovascular treatment with detachable balloons were enrolled in this study. ONP was complete in 22 (22.4%) patients and partial in 76 (77.6%) patients. Ninety (91.8%) patients were successfully occluded by single-session endovascular embolization. Retreatments by transarterial routes had to be performed in 8 (8.2%) patients because of recurrent fistula having occurred within 4 weeks after embolization. ONP was recovered completely

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in all the patients, among who 4 (4.1%) were treated with occlusion of internal carotid artery. Factors showing significant association with the recovery time of ONP were the location of the fistula ($P = 0.007$), the degree of preoperative ONP ($P = 0.003$), the number of detachable balloon used ($P = 0.000$) and the length of ONP before endovascular treatment ($P = 0.000$).
Conclusion: Endovascular treatment of traumatic carotid-cavernous fistula-induced ONP with detachable balloons is a safe and effective method. The length of ONP before endovascular treatment, the location of the fistula, the degree of preoperative ONP, the number of detachable balloons used were the statistically significant predictors of the length of ONP complete recovery.

Introduction

Traumatic carotid-cavernous fistulas (TCCFs) are anomalous connections between the carotid circulation and the cavernous sinus caused by trauma, and may cause significant morbidity [1]. ONP is one of the serious clinical manifestations associated with traumatic carotid-cavernous fistula (TCCF). Once forming carotid cavernous sinus fistula after trauma, direct or indirect damage mechanism [2,3] may result in partial or even complete dysfunction of oculomotor nerve after a period. With the pressure of draining veins increasing gradually, the presentations of conjunctival congestion, chemosis, ophthalmoptosis and cephalic bruit become more and more outstanding. Additionally, the majority of patients complained of visual disturbance, including diplopia, blurry vision and orbital pain. Endovascular embolization with detachable balloons is a less invasive alternative method to surgical intervention. However, the efficacy of ONP was rarely assessed. In this study, we investigated the outcomes of ONP following endovascular embolization with detachable balloons and attempted to identify the factors affecting the recovery time 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 TCCF.

Materials and methods

Patients and balloons

Endovascular treatment of TCCF with detachable balloon is a kind of priority method in our institution. Between January 2005 and December 2012, a total of 98 patients who presented with ONP due to TCCF were underwent endovascular treatment with detachable balloons (GOLDBAL1,2,3, BALT, CA, France). We use Visipaque (GE Healthcare, Princeton, New Jersey) as the contrast agent during the operation and inflate balloons. This study was approved by institutional review board.

Data collection

Medical records were obtained by consulting the computer database in 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 contacted by telephone about ocular symptoms to evaluate the clinical outcomes. Neuro-ophthalmologic assessment conducted by a neuro-ophthalmologist was scheduled before embolization, at discharge, after 1, 3, 6, and 12 months, and then annually or in case of recurrent symptoms.

Include criteria

The inclusion criteria were:

- traumatic carotid-cavernous fistula;
- the presence of oculomotor nerve dysfunction, which was explained by traumatic carotid-cavernous fistula;
- the traumatic carotid-cavernous fistula was treated only with detachable balloons;
- on admission, patients hadn't accepted any endovascular treatment in other hospitals;
- and available routine postoperative follow-up.

Exclude criteria

The exclusion criteria were:

- patients who have been diagnosed as ONP before trauma;
- patients who have been accepted surgical or endovascular treatment on admission;
- fistula is too small to use detachable balloon;
- general condition cannot tolerate anesthesia;
- incomplete function of serious heart, liver, kidney diseases;
- patients and families who refuse to surgery.

Criteria for oculomotor nerve paresis and its recovery

The criteria for complete ONP were as follows [4]:

- reports of diplopia;
- ptosis;
- ophthalmoplegia;
- and pupillary dysfunction.

Partial preoperative ONP was identified as similar symptoms associate with partial extraocular movement in