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Original research article

Stent-assisted coiling of very small wide-necked intracranial aneurysms: Complications, anatomical results and clinical outcomes

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ABSTRACT

Background and objective: Treatment of very small (≤3 mm) wide-necked intracranial aneurysms remains controversial, we investigated the efficacy and safety of stent-assisted coiling of such aneurysms.

Methods: From September 2008 to December 2012, 112 very small wide-necked intracranial aneurysms in 108 patients were embolized with stent-assisted coiling. We assessed the initial neurological conditions, complications and anatomic results. The follow-up results were evaluated with DSA and mRS.

Results: Stent deployment was successful in 104 of 108 procedures (96.3%). 11 complications (10.2%) occurred during procedures, including 5 events of aneurysm rupture, 3 events of thromboembolism. The rate of complication, rupture and thromboembolism was not statistically different between the ruptured and unruptured patients ($P = 0.452$, $P = 0.369$, $P = 1.000$, respectively). The initial aneurysmal occlusion was Raymond scale (RS) 1 in 34 patients (31.5%), RS2 in 53 patients (49.1%), and RS3 in 21 patients (19.4%). 79 aneurysms were available for anatomic follow-up of 12–47 months, stable occlusion in 45 aneurysms (57.0%), progressive complete occlusion in 34 aneurysms (43.0%). 95 patients (88.0%) were available for a clinical follow-up of 12–52 months, 92 patients (96.8%) had favorable clinical outcomes (mRS ≤2), 3 patients (3.2%) had morbidity (mRS: 3–5). The morbidity was not statistically different between the ruptured and unruptured patients ($P = 1.000$).

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Conclusions: Stent-assisted coiling of very small wide-necked intracranial aneurysms may be effective and safe. Because of low risk of rupture in such aneurysms, the coiling of unruptured such aneurysms must be selective. The long-term efficacy and safety of coiling such aneurysms remains to be determined in larger prospective series.

1. Introduction

The International Subarachnoid Aneurysm Trial (ISAT) provided evidence of the efficacy of coiling [1]. Endovascular coiling of intracranial aneurysms has become an efficient technique comparable to surgical clipping. However, International Subarachnoid Aneurysm Trial hasn't specifically provided the outcomes of endovascular treatment of very small (≤3 mm) intracranial aneurysms. To the best of our knowledge, endovascular treatment for very small intracranial aneurysms has been sporadically reported and Guglielmi detachable coiling of very small intracranial aneurysms was demonstrated to be feasible. However, this technique remains controversial for its high failure rates, especially for wide-necked and very small aneurysms, which are considered to have technically challenging and high complication rates [2,3].

Brinjikji et al. reported the results of a meta-analysis suggesting that the treatment of very small aneurysms was feasible and effective in more than 90% of treated aneurysms [4]. However, that study did not clearly show the results of very small intracranial aneurysms with wide-necked. In the present study, to investigate the feasibility and efficacy of stent-assisted coiling of very small aneurysms with a maximum aneurysm size ≤3 mm and a dome-to-neck ratio <1.5, we reported our series of 108 patients with initial and mid-long term results of the management of very small wide-necked intracranial aneurysms using stent-assisted coiling.

2. Materials and methods

2.1. Patients

After institutional review board approval, we performed a retrospective analysis of all consecutive adult patients who underwent attempted stent-assisted coiling of intracranial aneurysms at our institution between September 2008 and December 2012 to identify embolization procedures performed in very small (maximum dimension, 3 mm) and wide-necked (dome-to-neck ratio <1.5) intracranial aneurysms. The indication for treatment and its modality were based on characteristics of individual patients and aneurysms through interdisciplinary decision making by a neurovascular team, offering endovascular embolization as a primary treatment. For ruptured very small aneurysms, the patients with older age, and the aneurysms located in the posterior circulation were included. For very small unruptured intracranial aneurysms, patients included for treatment were according to results of International Study of Unruptured Intracranial Aneurysms (ISUIA) and Unruptured Cerebral Aneurysm Study (UCAS) of Japan [5–7]. Aneurysms with irregular shape, located in anterior communicating artery and posterior communicating artery, aneurysm size increasing after dynamic imaging follow-up, and multiple aneurysms with previous subarachnoid hemorrhage were included. Furthermore, patient preferences were also considered.

All patients provided approval for the use of their medical records for retrospective analysis. Patients were identified through a search of angiographic records and then further identified on the basis of the size of their intracranial aneurysms. For each patient, demographic data, clinical presentation, clinical outcome, aneurysm size and dome-to-neck ratio measured by 3D digital subtraction angiography (DSA), aneurysm rupture status, and aneurysm location were collected. For patients who presented with subarachnoid hemorrhage, Hunt and Hess scores were provided by the neurology team who was responsible for the management of the patients.

2.2. Endovascular procedure and complications

Patients with unruptured aneurysms or ruptured aneurysms in the nonacute phase were premedicated for 3 days prior to the procedure with dual antiplatelet therapy consisting of aspirin (100 mg/d) and clopidogrel (75 mg/d). Patients with acutely ruptured aneurysms were loaded with clopidogrel (300 mg) and aspirin (300 mg) before the procedure.

Patients typically were treated while under general anesthesia. Typically, 6F or 8F guiding catheters (Envoy, Codman, Miami Lakes, FL, USA) were placed into the internal carotid or vertebral arteries. All of the DSA examinations were performed by using a biplane, digital angiography suite (Integris Philips Medical Systems, Best, Netherlands). A volume of 24(18) ml of nonionic contrast medium was injected through a 6–8 F catheter by use of an injector with a velocity of 4(3) ml/s. Biplane DSA images of the entire circulation were usually performed, followed by ''working-projection'' DSA.A coaxial technique was used for microcatheter and stent catheter access. We navigated the microcatheter (Prowler select plus, Codman, Fremont, CA, USA; Renegade microcatheter, Stryker Neurovascular Freemont, CA, USA; Headway-21, eV3, Irvine, CA, USA) over a standard microguidewire (Traxcess14, Microvention, Aliso Viejo, CA, USA; Synchro14, Boston Scientific, Fremont, CA, USA) as distally as possible beyond the aneurysm neck. Another steam-shaped microcatheter (Prowler-14, Cordis Neurovascular, Bridgewater, NJ, USA) or Echelon-10 (eV3, Irvine, CA, USA) was navigated into the aneurysm dome or near the neck. Positioning of the microcatheters, a coil was partially deployed into the aneurysm sac, and then the stent and delivery system were advanced beyond the neck within the microcatheter. The stent was semi-deployed or fully deployed, Aneurysms were coiled until there was no further evidence of angiographic contrast

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