Journal of Clinical Neuroscience 17 (2010) 328–333

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

A retrospective clinical and angiographic study of the coiling outcome of ruptured intracranial aneurysms

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ARTICLE INFO

Article history:
Received 11 March 2009
Accepted 17 June 2009

Keywords:
Endovascular coiling
Outcome
Ruptured intracranial aneurysms
Subarachnoid hemorrhage

ABSTRACT

Many factors that determine the outcome of endovascular treatment of ruptured intracranial aneurysms are still controversial. We conducted a retrospective study of 203 patients with ruptured aneurysms treated by coiling to assess these factors. The Glasgow Outcome Scale score was used for clinical follow-up and magnetic resonance angiography for angiographic follow-up. Overall outcome and pretreatment variables predicting outcome were thoroughly analyzed. Good clinical grade on presentation was correlated with a better clinical outcome ($p < 0.001$); however, symptomatic vasospasm (15.8% of patients) was correlated with a worse clinical outcome ($p < 0.001$). Six patients (3%) suffered ischemic complications at the time of treatment, hemorrhagic events occurred in five patients (2.5%), permanent morbidity in five patients (2.5%) and overall mortality in 5.4%. In this series, we studied some factors currently debated in the literature and concluded that elderly patients ($\geqslant$65 years) with aneurysmal subarachnoid hemorrhage can safely be treated with endovascular therapy with a favorable outcome and that middle cerebral artery aneurysms can be safely embolized with results comparable to other locations.

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1. Introduction

Subarachnoid hemorrhage (SAH) represents only 5% of all strokes, but it is responsible for 25% of all fatalities related to stroke.[1] Rupture of an intracranial aneurysm may be associated with severe disturbances in intracranial and systemic physiology that represent a unique challenge to the clinician.[2]

The International Subarachnoid Aneurysm Trial (ISAT) demonstrated the clinical superiority of endovascular treatment to standard surgical management of ruptured intracranial aneurysms.[3] As clinical experience with this technique has increased and technological advances in coil design and adjunctive methods have improved, endovascular treatment has been used with increasing frequency.[4] Broader understanding and expertise are yielding benefits in the form of improved outcome after aneurysmal SAH.[2]

However, evidence for a direct relationship between aneurysmal SAH outcomes and a specific management strategy or intervention is still limited.[3,5–7] In several key areas of management, supporting data are lacking or equivocal, generating uncertainty and controversy among clinicians.[2] Regarding the best timing for coiling, there are no high quality studies and there is also a paucity of data in relation to specific subgroups of patients such as those in poor condition and the elderly.[8] Additionally, the full spectrum of clinical morbidity and management outcome may not be reflected in discussions limited to procedural outcomes.[4]

2. Patients and methods

2.1. Patients

We retrospectively analyzed 203 patients with aneurysmal SAH managed in Juntendo University Hospital and its affiliated hospitals between January 2006 and December 2007. All patients were treated by endovascular coiling. These included 117 males (57.6%) and 86 females (42.4%). The median age of patients was 62 years (range, 27–91 years; mean ± standard deviation [SD] 61.5 ± 13.5 years).

2.2. Assessment on admission

All patients were assessed on hospital admission in the form of detailed history, clinical examination, and standard assessment scales. Neuroradiologic investigations included brain CT scans, MRI and magnetic resonance angiography (MRA).

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doi:10.1016/j.jocn.2009.06.025

The standard assessment scales were used. On the Hunt and Hess (HH) scale, 48 patients (23.6%) had grade I SAH, 84 patients (41.4%) had grade II, 34 patients (16.7%) had grade III, 24 patients (11.8%) had grade IV, and 13 patients (6.4%) had grade V. SAH was also classified according to the Fisher scale: 13 patients (6.4%) had grade I, 58 patients (28.6%) had grade II, 107 patients (52.7%) had grade III, and 25 patients (12.3%) had grade IV. On the World Federation of Neurological Surgeons (WFNS) scale, 71 patients (35%) were assessed as grade I SAH, 71 patients (35%) with grade II, 12 patients (5.9%) with grade III, 31 patients (15.3%) with grade IV, and 18 patients (8.9%) with grade V. Symptomatic cerebral vasospasm occurred in 32 patients (15.8%).

2.3. Endovascular treatment

All endovascular procedures were performed in a neuroangiography suite equipped with digital subtraction angiography (DSA), road-mapping and three-dimensional rotational angiography (3DRA) capabilities under general anaesthesia. A baseline activated clotting time (ACT) was obtained and then repeated throughout the procedure to maintain a value 2–2.5 times of the normal by adjusting the systemic heparin dose. The aneurysms were coiled using Guglielmi detachable coils (GDC, Boston Scientific; Fremont, CA, USA), Orbit Truefill and MiniComplex fill coils (Cordis; Miami Lakes, FL, USA) and Electro Detach (ED) coils (Kaneka Medix Corporation; Kita-ku, Osaka, Japan). Hyperglide and Hyperform balloon microcatheters (MicroTherapeutics; Irvine, CA, USA) were used when necessary during the procedure. After the procedure, patients were moved to the neurointensive care unit until stable and then to the neurosurgical ward.

2.4. Follow-up strategy

Clinical and angiographic follow-up (F/U) were planned for the immediate and long-term. The length of clinical F/U ranged from 0.3 months to 27.9 months (mean ± SD, 9.3 ± 7.7 months). Patients were divided into five categories according to the Glasgow Outcome Scale (GOS) score: (i) good recovery (GR), resumption of normal activities despite minor neurological or psychological deficits; (ii) moderately disabled (MD), independent in daily life but with significant deficits; (iii) severely disabled (SD), dependent upon others for daily life activities due to mental or physical disability or both; (iv) persistent vegetative state (VS); (v) death (D). The range of angiographic F/U was 0.6–26 months (mean ± SD, 11.8 ± 6.7 months) using DSA and MRA. Aneurysm occlusion was assessed as: complete occlusion (CO), the aneurysm is completely isolated from the circulation; neck residual (NR), the aneurysm neck is not completely embolized; and body filling (BF), the aneurysm sac is not completely embolized. Angiographic F/U was performed in 171 patients, who represented 89% of surviving patients, as some patients did not return for an angiographic F/U examination.

2.5. Statistical analysis

Data were tabulated and analyzed using the Statistical Package for the Social Sciences version 16 (SPSS; Chicago, IL, USA). Quantitative data were expressed as the mean and standard deviation (SD). The Student's *t*-test was used to compare two groups of normally distributed variables and the Mann–Whitney *U*-test for non-normally distributed variables. Qualitative data were expressed as the number and percentage and were then analyzed using a chi-squared (χ^2) test with or without Yate's Continuity Correction where appropriate. Cramer's V test was used to assess the degree of association between variables.

3. Results

The median duration between onset of aneurysm rupture and the coiling procedure was 1 day (range, 0–112 days; mean, 4 days) with 50% of procedures performed in the first 2 days and 75% in the first 4 days. The coiling technique was varied according to each aneurysm site and configuration: the "standard technique" was the most used (130 patients, 64%), particularly with relatively smaller aneurysm neck size (84.3% of aneurysms with neck size $\leqslant$1.7 mm); the "neck remodeling technique" was chosen in 71 patients (35%), with relatively larger neck size (56.8% of aneurysms with neck size >1.7 mm), and the double catheter technique was used in two patients (1%).

Anterior communicating artery aneurysms (ACom) were the most frequent in this study (66 aneurysms, 32.5%). Most aneurysms were located in the anterior circulation (179 aneurysms, 88.2%). In the posterior circulation, the basilar artery tip (BA tip) aneurysms were predominant (11 aneurysms, 5.4%) (Fig. 1).

The median size of aneurysms was 5 mm (range, 2–15.5 mm; mean ± SD, 5.5 ± 2.6 mm) on maximum dimension. The median neck size was 2.5 mm (range, 1–7.5 mm; mean ± SD, 2.8 ± 1.1 mm). The aspect ratio (dome:neck ratio) median was 1.8 (range, 1–5.2; mean ± SD, 2 ± 0.6). The most common clinical presentation was headache (65%), followed by disturbed consciousness (24%) (Table 1).

3.1. Clinical follow-up

The GOS score at discharge from hospital was 144 patients (70.9%) with GR, 17 (8.4%) with MD, 19 (9.4%) with SD, 13 (6.4%) with VS and 10 (4.9%) were dead. Table 2 shows the clinical and angiographic features of dead patients. Disturbed consciousness was the most common presentation in this group (60%), females were predominant (70%), and internal carotid–posterior communicating artery (ICA–PCoA) was the most common aneurysm location. Complete aneurysm occlusion was identified on immediate post-procedure angiography in 80% of patients who died in hospital. The clinical outcome at final F/U was 145 patients (71.4%) with GR, 18 (8.9%) with MD, 18 (8.9%) with SD, 11 (5.4%) with VS, and 11 (5.4%) were dead.

Among the factors that influenced clinical outcome, we found a strong association between outcome and assessment scales (WFNS scale, Fisher scale and HH scale). A better outcome was strongly correlated with better assessment scale scores ($p < 0.001$). Patients younger than 65 years ($n = 119/203$) showed better outcomes

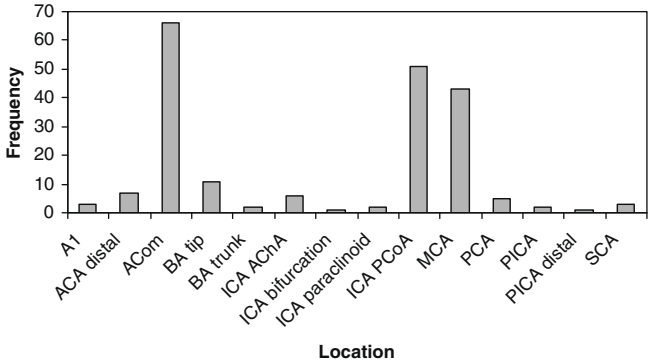

Fig. 1. Location of the studied aneurysms. *A1*; 1st segment of anterior cerebral artery, *ACA*; Anterior cerebral artery, *ACom*; Anterior communicating artery, *BA*; Basilar artery, *ICA AChA*; Internal carotid artery-anterior choroidal artery, *ICA PCoA*; Internal carotid artery-posterior communicating artery, *MCA*; Middle cerebral artery, *PCA*; Posterior cerebral artery, *PICA*; Posterior inferior cerebellar artery, *SCA*; Superior cerebellar artery.

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