Analysis of intraoperative complication of ruptured cerebral aneurysm with detachable coils embolization

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Abstract: Objective: To report the incidence of intraoperative complications of coiling of ruptured cerebral aneurysms leading to permanent disability or death in a consecutive series of 341 patients and to identify risk factors for these events. Methods: Between January 2007 and May 2011, 341 consecutive patients with ruptured intracranial aneurysms were treated with detachable coils. Procedural complications of coils embolization leading to death or neurologic disability at the time of hospital discharge were recorded. For patients with procedural complications, odds ratios (OR) with corresponding 95% confidence intervals (CI) were calculated for the following patient and aneurysm characteristics: patient age and sex, use of a supporting balloon, aneurysm location, timing of treatment, clinical condition at the time of treatment, and aneurysm size. Results: Procedural complications occurred in 21 of 341 patients (6.16%; 95% CI, 4.2% to 8.1%), leading to death in 9 patients (procedural mortality, 2.6%; 95% CI, 1.6% to 4.2%) and to disability in 12 patients (procedural morbidity, 3.5%; 95% CI, 2.0% to 5.3%). There were 4 procedural ruptures and 17 thrombotic complications. The significant risk factors for the occurrence of procedural complications were use of supporting balloon (OR, 5.3; 95% CI, 2.3 to 16.1%) and stent (OR, 8.4; 95% CI, 4.1 to 20.5%). Conclusion: Procedural complication rate of coiling of ruptured aneurysms leading to disability or death is 6.16%. In this series, the use of a temporary supporting balloon and stent in the treatment of wide-necked aneurysms was the risk factors for the occurrence of complications. [**Analysis of intraoperative complication of ruptured cerebral aneurysm with detachable coils embolization.** Life Science Journal. 2011;8(3):543-546] (ISSN: 1097-8135). http://www.lifesciencesite.com.

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1. Introduction

Endovascular coiling of ruptured cerebral aneurysms has become an accepted treatment with good clinical results and valuable protection against rebleeding[1,2]. However, intraoperative complications during the endovascular treatment can result in poor patient outcome. Complications of endovascular coiling consist of procedural perforation by the microcatheter, microguidewire, or coil and thrombotic complications. In this study, we report the incidence of procedural complications of coiling of ruptured intracranial aneurysms leading to permanent disability or death in a consecutive series of 341 patients. In addition, we tried to find risk factors associated with the occurrence of procedural complications.

2. Methods

2.1 Subjects

Between January 2007 and May 2011, 341 consecutive patients with ruptured intracranial aneurysms were treated with detachable coils. There were 107 men and 234 women with a mean age of 53.2 years (median, 52 years; range, 19–83 years). Clinical grading according to the Hunt and Hess scale (HH) at the time of treatment was:HHI – II, 219 patients; HH III, 61 patients; and HH IV – V, 61 patients. Mean size of the 341 ruptured aneurysms was 8.0 mm (median, 7; range, 2 – 40 mm). Timing of treatment after SAH was < 3 days in 158 patients, between 4 and 10 days in 117 patients, and > 11 days in 66 patients. Size and locations of the aneurysms are listed in Table 1.

2.2 Coiling Procedure

All patients were treated with coil embolization under general anesthesia and systemic heparinization. Heparin was continued intravenously during the procedure, Coiling was performed with detachable coils. The aim of coiling was to obtain an attenuated packing of the aneurysm, until not a single coil could be placed. 30 (8.8%) and 45 (13.2%) wide-necked aneurysms were coiled with the aid of a supporting balloon and stent, respectively. In the occurrence of aneurysm perforation during coiling, heparin was reversed instantaneously and coiling was continued until the bleeding stopped. In the occurrence of thromboembolic complications, usually

a selective bolus injection of 200,000 –750,000 U of urokinase was administered in the involved vessel.

Table 1: Location of 341 ruptured aneurysms treated with detachable coils

location	N
Posterior circulation (N= 21)	
Basilar tip	3
Basilar trunk	3
Vertebral artery	4
Posterior inferior cerebellar artery	8
Superior cerebellar artery	3
Anterior circulation (N =320)	
Anterior communicating artery	88
Posterior communicating artery	101
Carotid tip	4
Carotid ophthalmic artery	25
Anterior choreoideal artery	9
Middle cerebral artery	93

2.3 Procedural Complications

Procedural complications (aneurysm rupture or thrombotic) of coiling leading to death or neurologic disability at the time of hospital discharge were prospectively recorded in our data base during a weekly joint meeting with neuroradiologists, neurosurgeons, and neurologists. For comatose patients, thrombotic complications were considered to have caused neurologic deficit if this was either clinically evident or if there were infarctions on subsequent CT scans in the territory of the involved vessel. Procedural rupture in comatose patients who subsequently died was considered procedural mortality. Outcome of surviving patients with procedural complications was assessed according to the Glasgow Outcome Scale (GOS) at the joint outpatient clinic at 6 weeks. All procedural aneurysm ruptures, independent of clinical consequences were recorded.

2.4 Statistical Analysis

For patients with procedural complications, odds ratios (OR) with corresponding 95% confidence intervals (CI) were calculated using univariate logistic regression analysis for the following patient and aneurysm characteristics. Separate univariate logistic regression analyses were performed for the same patient and aneurysm characteristics for thromboembolic complications and procedural ruptures.

3. Results

Procedural complications occurred in 21 of 341 patients (6.16%; 95% CI, 4.2% to 8.1%), leading to death in 9 patients (procedural mortality, 2.6%; 95% CI, 1.6% to 4.2%) and to disability in 12 patients (procedural morbidity, 3.5%; 95% CI, 2.0% to 5.3%). There were 4 procedural ruptures and 17 thrombotic complications. Two of 4 procedural ruptures and seven of 17 thrombotic complications led to mortality (Table 2). Of 12 patients with procedural morbidity, 5 had a nondisabling neurologic deficit and were independent (GOS 4) and 7 were dependent (GOS 3) at 6 weeks after coiling. There were no patients in vegetative state (GOS 2).

Table 2: Morbidity and mortality for 4 procedural ruptures and 21 thromboembolic events in 341 patients

	Procedural Rupture	Thrombotic event
Morbidity	5	5
Mortality	2	7
Total	9	12

Overall rupture during coiling occurred in 15 patients (4.4%) and was without clinical sequelae in 11 (73.3%). These 11 patients with procedural rupture without clinical consequences were not included in statistical analysis of procedural complications.were not included in statistical analysis of procedural complications.

In the 30 patients with wide-necked aneurysms treated with a supportive balloon, 5 complications leading to disability or death occurred (16.7%): thrombotic complications in 5 patients and no procedural rupture. In the 45 patients with wide-necked aneurysms treated with a assisted stent, 9 complications leading to disability or death occurred (20%): procedural ruptures in 1 and thromboembolic complications in 8 patients. The significant risk factors for the occurrence of procedural complications were use of supporting balloon (OR, 5.3; 95% CI, 2.3 to 16.1%) and stent (OR, 8.4; 95% CI, 4.1 to 20.5%). Results of univariate logistic regression for the different variables for occurrence of all complications are listed in Table 3.

4. Discussion

We found that procedural complications of coiling of ruptured intracranial aneurysms leading to permanent disability or death occurred in 6.16% of patients. Thromboembolic complications accounted for 80% and procedural rupture for 20% of

complications. The overall complication rate is in concordance with previous studies: Sluzewski et al[3]reported, in a meta-analysis of 1256 patients, a 3.7% procedural complication rate leading to permanent deficits. In a meta-analysis limited to posterior circulation aneurysms, Lozier et al[4] found 1.4% procedural mortality and 5.1% procedural morbidity. Henkes et al[5] reported a procedural mortality of 1.5% and morbidity of 5.0% in 1034 coiled ruptured aneurysms.

Table 3: Odds ratios for different patient and aneurysm characteristics for the occurrence of all procedural complications leading to disability or death in 341 patients

Variable	OR	95% CI
Men	0.71	0.34–1.48
Timing after SAH		
≤3 d	0.75	0.39–1.44
4〜10 d	0.81	0.40–1.62
≥10d	1.90	0.94–3.84
Aneurysm location		
Posterior circulation	0.67	0.30–1.48
Anterior cerebral artery	1.00	0.52–1.92
Middle cerebral artery	1.47	0.50–4.32
Carotid artery	1.23	0.61–2.47
balloon	5.3	2.31–16.32
stent	8.4	4.12-20.54
HH		
HH I–II	0.67	0.35–1.28
HH III	1.49	0.78–2.84
HH IV–V	0.79	0.32–1.93
Aneurysm size (mm)		
≤5	0.76	0.39–1.51
5-10	0.59	0.31–1.13
＞10	1.58	0.79–3.13

The risk factors for the occurrence of complications was the use of balloon and stent to assist in coiling of wide-necked aneurysms. This may be explained by the following 3 reasons: first, the technique requires the introduction of an additional balloon microcatheter, with inherent higher risk of thromboembolic events as was shown by Soeda et al[6] in a study using diffusion-weighted MR imaging. Second, the (thrombotic) coil mesh in a wide necked aneurysm has a large surface area in contact with blood. Third, there is a higher tendency for procedural rupture when the microcatheter is fixed by the balloon or stent and coils are deployed[7].

Incidence of procedural rupture was similar to that reported by others: in a meta-analysis of 1248 ruptured aneurysms by Ross et al8, the procedural rupture rate was 4.1%, leading to mortality in 1.8% and morbidity in 0.2%. Henkes et al[5] reported a procedural rupture rate of 5.0% in 1034 ruptured aneurysms. Most aneurysm perforations remain without clinical sequelae. Countermeasures such as reversal of anticoagulation and securing the perforation site with additional coils seem to be effective in preventing disability or death in most cases.

The thrombotic complication rate is comparable with that reported in other studies: Henkes et al[5] found a thromboembolic complication rate of 4.7% in 1034 ruptured aneurysms. The rate of thromboembolic stroke was 6% in a series of 118 patients by Ross[8]. In the occurrence of clot formation, local intra-arterial fibrinolysis with urokinase, abciximab, or recombinant tissue plasminogen activator may help to recanalize the occluded artery, but even complete recanalization may not prevent a major neurologic deficit[9]. Aneurysmal rebleeding due to intraarterial fibrinolysis has been observed in this setting and has a poor prognosis. Thrombotic complications occurred significantly less often in posterior circulation aneurysms. We do not have a solid explanation for this finding. It is possible that the access to posterior circulation aneurysms is less difficult and time-consuming then for anterior circulation aneurysms.

In the present study, patient age, clinical condition, timing of treatment, and aneurysm size and location had no influence on the occurrence of procedural complications. The interval between endovascular treatment and SAH did not affect periprocedural morbidity rates in a study of 327 patients by Baltsavias et al[10]. Lubicz et al reported that thrombotic events during embolization of a ruptured aneurysm were more frequent in elderly people than in younger patients (9.6% versus 1.4%), but this could not be confirmed by Lubicz et al, who found a permanent morbidity as a result of thromboembolic complications of 2.9% in 68 patients older than 65 years.

In conclusion, the procedural complication rate of coiling of ruptured aneurysms leading to disability or death is 6.16%. The use of a temporary supporting balloon in the treatment of wide-necked aneurysms is the only risk factor for the occurrence of complications

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