MR-DWI–Positive Lesions and Symptomatic Ischemic Complications After Coiling of Unruptured Intracranial Aneurysms

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MR-DWI–Positive Lesions and Symptomatic Ischemic Complications After Coiling of Unruptured Intracranial Aneurysms

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Background and Purpose—The aims of this study are to evaluate the risk factors for symptomatic ischemic complication (symptomatic ischemic complication [SIC], transient ischemic attack, or stroke) and microembolisms detected as MR diffusion-weighted imaging (MR-DWI)–positive (DWI(+)) lesions, and the relationship between DWI(+) and SIC after coiling of unruptured intracranial aneurysm.

Methods—Between March 2009 and November 2011, 382 unruptured intracranial aneurysms in 343 patients underwent both coiling and posttreatment MR-DWI. The incidence of and risk factors for SIC and DWI(+), and the relationship between DWI(+) and SIC were retrospectively analyzed.

Results—The incidence of SIC was 4.1%. The incidence of DWI(+) was 54.5%. The number of DWI(+) lesions was significantly larger in the SIC group, than in the asymptomatic one (12.1±10.4 versus 5.0±8.7, $P<0.00$). The cutoff value of DWI(+) for predicting SIC was ≥6 (sensitivity 85.7%, specificity 70.7%). The patients with DWI(+) ≥6 was 28.6%. Of the patients with SIC, the patients with DWI(+) ≥6 was 78.6%. Patients aged≥65 years had a trend for SIC, and it was the only independent risk factor for DWI(+) ≥cutoff (n=6; 95%CI, 1.167–3.083).

Conclusions—The number of DWI(+) lesions was significantly larger in the SIC group than in the asymptomatic one after coiling of unruptured intracranial aneurysm. Patients aged≥65 had a trend for SIC, and it was the only independent risk factor for the number of DWI(+) ≥cutoff value (n=6) for predicting SIC. **(*Stroke*. 2013;44:789-791.)**

Key Words: coils ■ intracranial aneurysm ■ outcomes

Clinical implications of microembolisms during or immediately after coiling of unruptured intracranial aneurysm (UIA) have not been well elucidated. Furthermore, the relationship between microembolisms detected as MR diffusion-weighted imaging (MR-DWI)–positive (DWI(+)) lesions and symptomatic ischemic complication (symptomatic ischemic complication [SIC], transient ischemic attack, or stroke) has not yet been studied. The aims of this study are to evaluate the risk factors for SIC and DWI(+), and the relationship between DWI(+) and SIC after coiling of UIA.

Methods

The respective institutional review board approved this retrospective study and waived the patient's informed consent. Between March 2009 and November 2011, 342 patients with 382 UIA underwent both coiling and MR-DWI in 2 hospitals. During the same period, 54 patients who underwent coiling were not examined with MR-DWI because of the patient's refusal (n=50) or procedural rupture (n=4). Microembolism detected as DWI(+) was defined as a high-signal-intensity lesion ≤15 mm in diameter, according to the imaging feature of small artery occlusion of TOAST (Trial of Org 10172 in Acute Stroke Treatment) classification.[1] Territorial infarction due to a branch occlusion was separately evaluated. SIC and MR-DWI were separately and independently assessed in each institution. The incidence of and risk factors for SIC, and the relationship between DWI(+) in the relevant brain region (the brain parenchyma supplied by the artery, where the guiding catheter was located during the procedure) were retrospectively analyzed.

Statistical Analysis

Statistical analysis was performed using SPSS for Windows (Version 17.0; SPSS, Chicago, IL). The χ^2 test or Fisher exact test was performed for categorical variables, as appropriate. The cutoff of the number of DWI(+) for predicting SIC was obtained using receiver-operating curve. The univariate analysis cutoff for inclusion in the logistic regression analysis was $P<0.20$. Statistical significance was determined as $P<0.05$, for a 95% confidence interval.

Results

Any patient who refused MR-DWI examination did not have SIC. There were no patients who showed a territorial

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infarction on MR-DWI. The incidence of SIC was 3.5% per patient (14/396). Among the patients who underwent MR-DWI, the incidence of SIC was 4.1% (14/342). All SIC developed within 12 hours posttreatment and were associated with the relevant brain. The ischemic symptoms were most severe at the beginning, but improved with time in all patients. The 1-month modified Rankin Scale scores of the 14 patients were 0 in 6, 1 in 5, 2 in 2, and 3 in 1 patient, respectively. The incidence of DWI(+) was 54.5%. The number of DWI(+) lesions was significantly larger than in the SIC group and in the asymptomatic one (12.1±10.4 versus 5.0±8.7, $P<0.01$). The cutoff value of DWI(+) for predicting SIC was ≥6 (sensitivity 85.7%, specificity 70.7%). The patients with DWI(+) ≥6 was 28.6% (98/343). Of the patients with SIC, the patients with DWI(+) ≥6 was 78.6% (11/14). Patients aged ≥65 had a trend for SIC, and it was the only independent risk factor for the number of DWI(+) ≥6 (Tables 1 and 2).

Discussion

Although a few small case series reported the incidence of DWI(+) after coiling,[2,3] there has been no report about the clinical implications of such lesions. In this study, the number of DWI(+) was significantly larger in the SIC group than in the asymptomatic one. Furthermore, we found the cutoff value (≥6) of DWI(+) for predicting SIC, and these data support the higher rate of microembolism detected, as DWI(+) may be a surrogate marker for SIC.

According to ATENA study, dome size ≥7 mm was significantly associated with the rate of thromboembolic complications and patients aged >60 showed significantly higher morbidity and mortality rate on univariate analysis.[4] In our study, dome size ≥7 mm and neck size ≥4 mm were significantly associated with both SIC and DWI(+) ≥6 on univariate analysis, but neither was associated with SIC or DWI(+) ≥6 in the logistic regression analysis. It may be because of low statistical power from low incidence of SIC (Tables 1 and 2). In contrast, patients aged ≥65 were significantly associated with both SIC and DWI(+) ≥6 on univariate analysis and also had a trend for SIC, and it remained the only independent risk factor for DWI(+) ≥6 in the logistic regression analysis. These data suggest that theoretically more baseline atherosclerosis and vascular tortuosity in the older patients may increase microembolisms, and in turn may increase the probability of SIC.[3] Additionally, it is notable that DWI(+) lesions ≥6 was significantly higher in stent group on univariate analysis, and its *P*-value was close from significance in logistic regression. Contrary to expectation, antiplatelet premedication significantly increased DWI(+) lesions ≥6 on univariate analysis. Until late 2010, antiplatelet premedication had been given only to patients who had undergone stent-assisted coiling. However, stent itself may increase DWI(+) lesions ≥6, which seemed to be a compounding factor.

In conclusion, the number of DWI(+) lesions was significantly larger in the SIC than in the asymptomatic group after coiling of UIA. Patients aged ≥65 had a trend for SIC, and it was the only independent risk factor for the number of DWI(+) ≥cutoff value for predicting SIC.

Table 1. Risk Factors for Symptomatic Ischemic Complication After Coiling

Variables	Category	Ischemic Complication	No Ischemic Complication	P_{uni}	$P_{logistic}$(Odds Ratio, 95% CI)
Age (years)	≥65 (n=101)	7 (6.9)	94 (93.1)	0.042	0.081 (2.787, 0.883–8.798)
	<65 (n=281)	7 (2.5)	274 (97.5)		
Sex	M (n=99)	2 (2.0)	97 (98.0)	0.312	
	F (n=283)	12 (42.4)	271 (57.6)		
Location	ICA (n=216)	9 (4.2)	207 (95.8)	0.041	Indicator
	MCA (n=38)	0 (0.0)	38 (100)		0.998
	ACA (n=69)	0 (0.0)	38 (100)		0.997
	Posterior (n=59)	5 (8.5)	54 (91.5)		0.447
Antiplatelet	Yes (n=236)	10 (4.2)	226 (95.6)	0.449	
	No (n=146)	4 (2.7)	142 (97.3)		
Intraoperative clot formation	Yes (n=28)	2 (7.1)	26(92.9)	0.309	
	No (n=354)	12 (3.4)	342 (96.6)		
Balloon use	Yes (n=69)	2 (2.9)	67 (97.1)	0.708	
	No (n=313)	12 (3.8)	301 (96.2)		
Stent use	Yes (n=77)	5(6.5)	72 (93.5)	0.139	0.945
	No (n=305)	9 (3.0)	296 (97.0)		
Dome size	<7 mm (n=304)	6 (2.0)	298 (98.0)	0.001	0.114
	≥7 mm (n=78)	8 (10.3)	70 (89.7)		
Neck size	<4 mm (n=293)	6 (2.1)	287 (97.9)	0.002	0.608
	≥4 mm (n=89)	8 (9.0)	81 (91.0)		

Number in parenthesis indicates percentage, otherwise not mentioned; P_{uni}, *P*-value on univariate analysis; and $P_{logistic}$, *P*-value in the logistic regression test.

Table 2. Risk Factors for the Number of DWI(+) ≥Cutoff Value for Predicting Symptomatic Ischemic Complication After Coiling

Variables	Category	No. of DWI Lesions ≥6	No. of DWI Lesions <6	P_{uni}	$P_{logistic}$(Odds Ratio, 95%CI)
Age (years)*	≥65 (n=101)	42 (41.6)	59 (58.4)	0.010	0.010 (1.897, 1.167–3.083)
	<65 (n=281)	78 (27.8)	203 (72.2)		
Sex	M (n=99)	26 (26.3)	73 (73.7)	0.597	
	F (n=283)	82 (29.0)	201 (71.0)		
Location	ICA (n=216)	71 (32.9)	145 (67.1)	0.448	
	MCA (n=38)	8 (21.1)	30 (78.9)		
	ACA (n=69)	24 (34.8)	45 (65.2)		
	Posterior (n=59)	17 (28.8)	42 (71.2)		
Antiplatelet	Yes (n=237)	83 (35.0)	153(65.0)	0.044	0.239
	No (n=145)	37 (25.5)	109 (74.5)		
Intraoperative clot formation	Yes (n=28)	8 (28.6)	20 (71.4)	0.736	
	No (354)	112 (31.6)	242 (68.4)		
Balloon use	Yes (n=69)	18 (26.1)	51 (73.9)	0.292	
	No (n=313)	102 (32.6)	211 (67.4)		
Stent use	Yes (n=77)	34 (44.2)	43 (55.8)	0.007	0.084
	No (n=305)	86 (28.2)	219 (71.8)		
Dome size	<7 mm (n=304)	88 (28.9)	216 (71.1)	0.040	0.594
	≥7 mm (n=78)	32 (41.0)	46 (59.0)		
Neck size	<4 mm (n=293)	82 (28.0)	211 (72.0)	0.009	0.344
	≥4 mm (n=89)	38 (42.7)	51 (57.3)		

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Disclosures

None.

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