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Intracranial aneurysm coiling with PGLA-coated coils versus bare platinum coils: long-term anatomic follow-up

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Abstract
Introduction The purpose of this study is to compare the long-term (≥12 months) angiographic follow-up of aneurysms treated with polymer polyglycolic-lactic acid (PGLA)-coated coils versus bare platinum coils.
Methods Long-term angiographic follow-up results of 90 aneurysms treated exclusively with PGLA-coated coils were retrospectively analyzed and compared to those of 158 aneurysms treated exclusively with bare platinum coils.
Results There were 32 ruptured aneurysms (35.5%) in the PGLA-coated coil group and 62 (39.2%) in the bare platinum coil group. The mean angiographic follow-up was 29 months in the PGLA-coated coil group versus 27 months in the bare platinum coil group (P=0.2297). The mean time to angiographic recurrence was 14 months in the PGLA-coated coil group versus 18 months in the bare platinum coil group (P=0.1088). Recurrence rates were 35.6% (32/90) and 31.0% (49/158) in the PGLA-coated coil and bare platinum coil groups, respectively (P=0.4837). The major recurrence justifying retreatment was 5.6% (5/90) in the PGLA-coated coil group versus 6.7% (10/158) in the bare platinum coil group (P=1.000).
Conclusion PGLA-coated coils provided no better long-term recanalization rates than bare platinum coils.

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Introduction

Recanalization remains a limitation of aneurysm coiling (1, 2). Bioactive coils such as Matrix (Boston Scientific, Fremont, CA) were designed to reduce recanalization. However, controversy still exists about its efficacy (3–9). Our objective was to evaluate the long-term anatomical results in 90 intracranial aneurysms treated with polymer polyglycolic-lactic acid (PGLA)-coated coils.

Materials and methods

Patient selection

From 2002 to 2010, 587 aneurysms were selectively treated with either bare platinum coils (GDC, Boston Scientific, Fremont, CA) or PGLA-coated coils (Matrix, Boston Scientific, Fremont, CA) exclusively. All patients were referred to us from other institutions for endovascular treatment. Only aneurysms with long-term angiographic follow-up (≥12 months) were considered for the purpose of this study.

Definition endpoint

All aneurysms were saccular. Aneurysm occlusion was classified as described by Roy (10). Aneurysm dimensions were determined on 3D images derived from rotational angiography. The same reader reviewed follow-up angiograms, and aneurysm recurrence was dichotomized as absent or present.

Table 1 Summary of the 248 aneurysms with follow-up ≥12 months

	Matrix	GDC	Fisher exact test	Mann–Whitney *U* test	Unpaired *t* test
Age, mean±SD (*n*)	48.1±11.3 (90)	47.6±11.0 (158)	NA	*P*=0.9165	*P*=0.7403
Gender, F/M	62/28, 69%/31%	122/36, 77%/23%	*P*=0.1748	NA	NA
Mean aneurysm size ± SD (mm)	7.2±2.9	5.7±2.8	NA	*P*<0.0001*	*P*<0.0001*
Hemorrhagic presentation (*n*)	32/90, 35%/65%	62/158, 39%/61%	*P*=0.5887	NA	NA
Mean packing density ± SD (%)	28±7	23±7	NA	*P*<0.0001*	*P*<0.0001*
Balloon remodeling (*n*)	56/90, 62%/38%	101/158, 64%/36%	*P*=0.7861	NA	NA
Stented aneurysms, % (*n*)	10.0% (9)	11.4% (18)	*P*=0.8338	NA	NA
Initial total angiographic occlusion, % (*n*)	53.3% (48)	61.4% (97)	*P*=0.2300	NA	NA
Mean duration of follow-up ± SD (months)	29±14	27±13	NA	*P*=0.2303	*P*=0.3010
Recurrence, % (*n*)	35.6% (32)	31.0% (49)	*P*=0.4837	NA	NA
Mean time to recurrence ± SD (months)	14±11	19±12	NA	*P*=0.0595	*P*=0.1088
Major recurrence, % (*n*)	5.6% (5)	6.3% (10)	*P*=1.000	NA	NA

SD standard deviation, *NA* not applicable

* Significant values

Follow-up protocol

Angiographic images obtained immediately after endovascular treatment were compared with those obtained at each follow-up examination. All follow-up angiograms were obtained with catheter digital subtracted angiography. The standard angiographic follow-up protocol consisted of a first angiographic follow-up performed 1 to 6 months after endovascular treatment, a second angiographic follow-up performed 1 year after the first follow-up, and a third angiographic follow-up performed 2 years after the second follow-up. In case of angiographic recurrence and/or associated aneurysms left untreated, the follow-up was continued on a yearly basis.

Data collection and statistical analysis

Aneurysm status (ruptured versus unruptured), patient's gender, use of balloon remodeling technique, use of stent-assisted coiling technique, initial total angiographic occlusion, and angiographic recurrence were noted and evaluated for statistical significance using a two-tailed Fisher exact test. Patient ages, size of aneurysms, packing densities (the ratio between the volume of the inserted coils and the volume of the aneurysm), duration of follow-up, and time to recurrence were compared by using the Mann–Whitney *U* and unpaired *t* tests. A stepwise multivariate logistic regression analysis was performed to control for potential confounders in aneurysm characteristics and in the occurrence of angiographic recurrence. A *P* value of <0.05 was considered statistically significant. Statistical tests were performed with SAS Release 8.2 (SAS Institute Inc., Cary, NC).

Results

Rebleeding

Among the 187 ruptured aneurysms treated with GDC, four rebled (three within a few days after coiling, the other

Table 2 Logistic regression for factors affecting angiographic recurrence

	Logistic regression (Wald $\chi 2$)		
Effect	*P*	Odds ratio	95% CI
Aneurysm size	0.5974	0.971	0.869–1.084
Hemorrhagic presentation	<0.0001*	0.247	0.132–0.463
Coil type (Matrix versus GDC)	0.5390	0.802	0.397–1.620
Duration of follow-up	0.1941	0.986	0.965–1.007
Packing	0.4488	1.017	0.973–1.064
Balloon remodeling	0.6810	1.140	0.611–2.128
Stent	0.1356	3.204	0.694–14.787
Initial total angiographic occlusion	0.5778	0.833	0.439–1.583

* Significant value

one 57 months after initial treatment) leading to the patients' death in three cases and a vegetative state in one patient. Among the 74 ruptured aneurysms treated with Matrix, one rebled 4 days after coiling leading to the patient's death.

Followed aneurysms

Overall, 397 (67.6%) aneurysms were followed, 248 (90 Matrix, 158 GDC) having been followed for at least 12 months (Table 1). Among these 248 aneurysms, 35 (14.1%) aneurysms (26 GDC, 9 Matrix) had only one follow-up digital subtraction angiography (DSA) (mean cumulative follow-up of 18 and 25 months for GDC and Matrix, respectively). One hundred thirty-four aneurysms (86 GDC, 48 Matrix) had only two follow-up DSAs (mean cumulative follow-up of 22 months for both GDC and Matrix). Seventy-nine aneurysms (46 GDC, 33 matrix) had three (75 aneurysms) or four (4 aneurysms) follow-up DSAs (mean cumulative follow-up of 42 months for both GDC and Matrix). Among these 79 aneurysms, 57 aneurysms (36 GDC, 21 Matrix) were followed by a third DSA after a 2-year interval without follow-up.

Recurrence rates

The overall recurrence rates are shown in Table 1. Recurrence rates were similar for both groups. A hemorrhagic presentation was the lone factor affecting angiographic recurrence in the multivariate analysis (Table 2). There were significantly more late (at the third or fourth follow-ups) recurrences detected in the GDC group (P=0.0007; odds ratio, 3.571) than in the Matrix group (P=0.4974; odds ratio, 0.6917). There were five major recurrences in the Matrix group of aneurysms, two were retreated, and the three remaining were managed conservatively. There were ten major recurrences in the GDC group of aneurysms, eight were retreated, and the two remaining were managed conservatively.

Discussion

Our series is the unique series assessing the long-term anatomical results of aneurysms treated exclusively with Matrix coils. Previous studies reported the mid-term anatomical result of aneurysms treated with Matrix in conjunction with bare platinum coils. The duration of angiographic follow-up is a known important factor; the longer the follow-up, the higher the rate of recurrence. This is why we specifically focused on aneurysms that had been followed at least for 1 year. Our recurrence rate of 35.6% with Matrix coils was within the range of the previously published series (9, 11). Similarly, the recurrence rate of 31.0% with GDC coils was in accordance with the historical series (2). The rates of major recurrence requiring retreatment were also similar in both groups, showing no superiority of Matrix coils.

The correlation between embolized volume and stability of aneurysm occlusion had been a source of controversy in the literature (12, 13). In this series, packing density did not interfere with the recurrence rates for both types of coils. Packing densities of aneurysms treated with Matrix were higher than those of aneurysms treated with GDC. This was due to the bigger section of the Matrix coils, giving more volume of coils for a given length. In our series, aneurysms that were treated with Matrix were larger than those treated with GDC coils. Nevertheless, aneurysm size was not found as a key factor in the multivariate analysis for recurrence since the difference in aneurysm sizes between the two groups was modest. In the multivariate analysis for recurrence, a hemorrhagic presentation was the most important factor affecting recanalization. This is in keeping with previous published series dealing with aneurysm coiling (2, 12).

Conclusions

The use of Matrix coils did not influence the long-term recanalization rate of aneurysms. Consequently, there is definitely no evidence to recommend the use of Matrix over GDC bare platinum coils.

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Conflict of interest We declare that we have no conflict of interest.

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