

INITIAL EXPERIENCE WITH BIOACTIVE CERECYTE DETACHABLE COILS: IMPACT ON REDUCING RECURRENCE RATES

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OBJECTIVE: Despite proven safety of endovascular coil embolization of intracranial aneurysms, the potential need for retreatment remains criticized. The goal of this prospective study was to assess the safety, durability, and effect on recanalization rates of the Cerecyte (Micrus Corp., Sunnyvale, CA) bioactive coil.

METHODS: Two hundred twelve ruptured and unruptured aneurysms in 176 patients were prospectively enrolled in a database registry during a 12-month period. Adverse clinical outcomes directly attributed to the use of the Cerecyte coil were documented. Angiographic outcomes were determined immediately after coil embolization and during follow-up studies. All patients who received stent assistance or a non-Cerecyte coil were excluded. Two independent endovascular surgeons reviewed follow-up films. Any discrepancy was deemed a recurrence.

RESULTS: After exclusion criteria, 81 patients with 89 aneurysms were available for a minimum of 6 months of follow-up. Of those 89 aneurysms, 65% were ruptured aneurysms and were treated in the acute setting. The mean size of the aneurysm was 7 mm. The mean angiographic follow-up period was 11.2 months. Recurrences requiring retreatment as a result of dome filling were identified in six aneurysms (6.7%). Four aneurysms (4%) developed compaction of more than 20%, which was defined as interstitial filling of the fundus. There was one thromboembolic event leading to permanent neurological deficit. No cases of chemical meningitis or delayed hydrocephalus occurred.

CONCLUSION: The Cerecyte bioactive coil seems to be safe and effective for use in both ruptured and unruptured aneurysms. The bioactive polymer within the coils allows similar handling characteristics of a bare platinum coil. Studies to assess long-term outcomes with direct comparison to platinum coils and alternative bioactive coils are warranted.

KEY WORDS: Aneurysm, Bioactive coils, Subarachnoid hemorrhage

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More than 10 years ago, the introduction of detachable coils for endovascular management of intracranial aneurysms revolutionized cerebrovascular neurosurgery. The refinement of techniques and tools such as intracranial stents and complex-shaped coils has further expanded the role of endovascular treatment strategies. The safety of coil embolization for ruptured aneurysms has been validated by the International Subarachnoid Hemorrhage Trial demonstrating superior clinical outcomes compared with surgical clip ligation (20, 19). Endovascular techniques have reduced length of hospital stay, hospital costs, and, most importantly, neurological complications and adverse outcomes compared with surgical clip ligation in unruptured aneurysms (4, 12).

Despite the advantages of current endovascular technology, the need for close surveillance with follow-up imaging studies, including cerebral angiography, to monitor for aneurysm recurrence is unique to this treatment modality because of the risk of aneurysm recanalization or regrowth. Historically, the largest single-center long-term follow-up studies involving bare platinum coils have reported a 14 to 34% incidence of aneurysm recurrence or “coil compaction” (9, 26). With stent-assisted coiling techniques and softer, more complex-shaped coils, recurrence rates for both small and large aneurysms have declined. Despite the unclear natural history of residual aneurysm filling after initial coil embolization, there are reports of delayed episodes of rehemorrhage after treatment (7). This has led to

retreatment in patients with significant aneurysm recurrence as revealed by posttreatment surveillance imaging studies.

The goal of improving long-term durability of endovascular aneurysm occlusion led to development of several "bioactive" coils aimed at stimulating intra-aneurysm thrombus formation. Animal studies with the first such coil, Matrix (Boston Scientific, Natick, MA), were promising; however, clinical studies have been disappointing, with higher reported recanalization rates than with bare platinum coils (11, 22, 24). The HydroCoil for Endovascular Aneurysm Occlusion Study showed no improvement in occlusion rates with the HydroCoil (Microvention, Inc., Aliso Viejo, CA) and a slightly higher incidence of thromboembolic events (8). These devices have a biologically active agent on the outer surface of the coil, which causes more tension during coil deployment into the aneurysm and leads to concern for intraprocedural perforation, particularly when used in patients with ruptured aneurysms. The poor outcomes in terms of aneurysm recurrence with these coils may be the result of eventual breakdown of the bioactive agent on the outer surface of the coil without induction of long-term scar formation by the agent, allowing for coil compaction. The Cerecyte (Micrus Corp., Sunnyvale, CA) bioactive coil offers a new design that places the polyglycolic acid (PGA) within the coil, thus taking advantage of PGA's ability to induce thrombus formation. This maintains the soft properties of the current systems, which minimizes the risk of use and allows increased coil-packing density. As the PGA breaks down, there is no loss to the density of coil mass as observed on the immediate postembolization images. The current study was designed to assess the safety of and define the recurrence rate associated with the use of the Cerecyte coil's unique design.

MATERIALS AND METHODS

Patients treated with Cerecyte coils were entered prospectively into a database from December 2004 through January 2006. The Institutional Review Board at Thomas Jefferson University approved all protocols, subsequent data collection, and analysis methodologies. All patients presented to Jefferson Hospital for Neuroscience for endovascular treatment of either ruptured or unruptured aneurysms. Exclusion criteria for the study were treatment with a combination of non-Cerecyte coils and Cerecyte coils or stent-assisted embolization, and patients with vessel occlusion resulting from dissecting aneurysms. Important demographic features evaluated were aneurysm size; aneurysm morphology (small aneurysm [SA]/small neck [SN]) (SA/SN = fundus <10 mm/neck <4 mm, SA/wide neck [WN] = fundus <10 mm/neck >4 mm or fundus-to-neck ratio <2, large aneurysm [LA] = fundus 10–25 mm, giant aneurysm [GA] = fundus >25 mm); location; Hunt and Hess grade for ruptured aneurysms; history of smoking; and use of postprocedural antiplatelet agents or anticoagulation.

Clinical outcomes were determined by procedural morbidity and/or mortality resulting from the use of Cerecyte coils. Angiographic outcomes were assessed immediately postprocedure as one of three categories: complete (100%, no aneurysm filling), partial (90–99%, small neck remnant filling without interstitial filling of the coil mass), and incomplete (<90%, aneurysm fundus filling). Eligible patients were scheduled for digital subtraction cerebral angiography 6 months after initial treatment. Follow-up angiograms were reviewed and graded by

two separate nontreating neurointerventionalists as stable (no change from initial study), progressive thrombosis (smaller or absence of remnant filling), or recurrence (coil compaction, new aneurysm lobe developed, and/or enlarged residual neck). If discordance was observed, the patient was included in the recurrence group (one patient). Magnetic resonance arteriogram follow-up data were not included in the study; however, these data were used to perform repeat follow-up cerebral angiography when evidence of recurrence was demonstrated by magnetic resonance arteriography. Variables were analyzed in contingency tables with Pearson's test to identify significant predictors of angiographic outcome. Logistic regression analysis was performed to identify risk factors associated with recurrence.

RESULTS

Demographic Features

A total of 212 aneurysms in 176 patients were treated with Cerecyte coils at Jefferson Hospital for Neuroscience during a 12-month period. We present the analysis of 89 aneurysms in 81 patients who had a minimum of a 6-month follow-up digital subtraction angiography and did not meet the exclusion criteria. The majority of patients who were excluded received a combination of Cerecyte coils and bare platinum coils because the necessary size of Cerecyte coil was not available during the procedure. The average patient age was 50 years. Aneurysm morphology was SA/SN in 45 aneurysms (51%), SA/WN in 30 aneurysms (34%), LA in 13 aneurysms (14%), and GA in one aneurysm. The average aneurysm size was 7.5 mm (range, 3–25 mm). Aneurysm location was anterior circulation in 83% (posterior communicating artery most common) and posterior circulation 17% (basilar most common). Clinical presentation was acute subarachnoid hemorrhage in 65% of aneurysms. Post-discharge anticoagulation or antiplatelet medications (aspirin and/or clopidogrel) were used in 33% of treated aneurysms. Smoking during the perioperative period was identified in 58% of patients in this study. Only one GA was included in this series because it is difficult to achieve dense packing without a 0.18-mm Cerecyte coil.

Angiographic Outcomes

Immediate postoperative angiographic occlusion was deemed complete in 40 aneurysms (45%), partial with residual neck remnant in 43 aneurysms (52%), and incomplete with fundus interstitial filling in three aneurysms (3%). These results were achieved while patients were in a fully heparinized state to activated clotting times two to three times baseline. Follow-up cerebral angiography was performed an average of 11.4 months posttreatment (median, 8 mo). We were stringent and conservative in our independent reviewer's analysis of follow-up angiographic studies. We classified long-term outcomes as stable and/or progressive thrombosis in 64 aneurysms (72%), minor coil compaction with a small neck remnant less than 20% of original fundus maximal diameter in 15 aneurysms (17%), partial aneurysm recurrence with compaction greater than 20% of maximal aneurysm diameter and/or interstitial filling of neck in four aneurysms (5%), and major recurrence with fundus filling

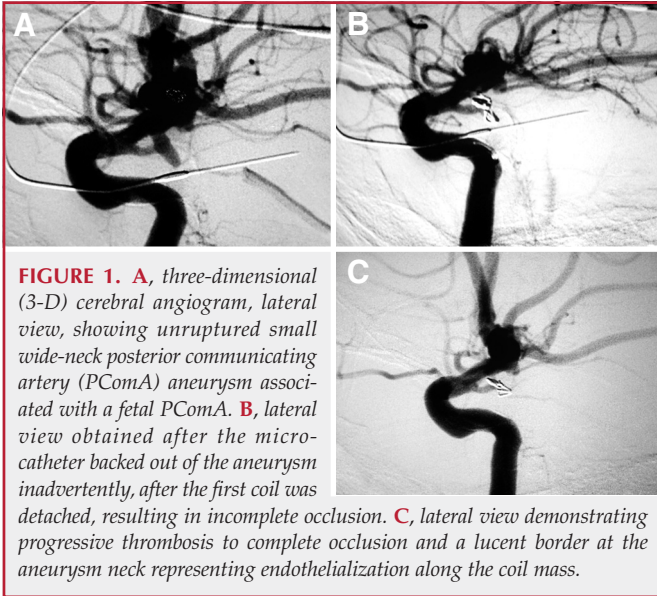


FIGURE 1. **A**, three-dimensional (3-D) cerebral angiogram, lateral view, showing unruptured small wide-neck posterior communicating artery (PCoM) aneurysm associated with a fetal PCoM. **B**, lateral view obtained after the microcatheter backed out of the aneurysm inadvertently, after the first coil was detached, resulting in incomplete occlusion. **C**, lateral view demonstrating progressive thrombosis to complete occlusion and a lucent border at the aneurysm neck representing endothelialization along the coil mass.

requiring retreatment in six aneurysms (6%). Aneurysms with minor coil compaction (<20%) have been followed-up with serial magnetic resonance arteriography without any cases of worsening compaction; thus, these aneurysms were not deemed a true recurrence because the aneurysm fundus remains completely occluded. *Figure 1* illustrates a case of a small unruptured wide-neck aneurysm associated with a fetal posterior communicating artery. The microcatheter inadvertently backed out of the aneurysm after detachment of the first coil, resulting in incomplete occlusion. After attempts to return the microcatheter into the aneurysm caused the coil to move, we decided to treat the patient with clopidogrel in preparation for a stent-assisted coil embolization. The patient did not return for 6 months, at which point the aneurysm thrombosed off completely with lucency consistent with an endothelial layer lining the coil mass at the aneurysm neck. *Figure 2* illustrates progressive thrombosis of a ruptured large wide-neck posteroinferior cerebellar aneurysm initially coiled with a neck remnant to maintain patency of the parent vessel. Aneurysm morphology of the major recurrences requiring retreatment included SA/SN in one aneurysm, SA/WN in four aneurysms, and LA in one aneurysm. Aneurysm morphology was not a significant predic-

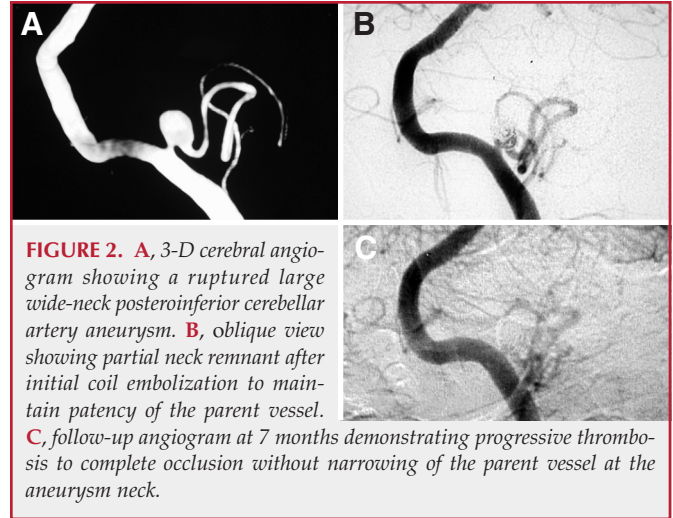


FIGURE 2. **A**, 3-D cerebral angiogram showing a ruptured large wide-neck posteroinferior cerebellar artery aneurysm. **B**, oblique view showing partial neck remnant after initial coil embolization to maintain patency of the parent vessel. **C**, follow-up angiogram at 7 months demonstrating progressive thrombosis to complete occlusion without narrowing of the parent vessel at the aneurysm neck.

tor of initial or long-term angiographic outcome (*Table 1*). The initial degree of occlusion in the aneurysms requiring retreatment as a result of recurrence was complete in one and partial in five. The initial degree of occlusion was a statistically significant predictor ($P < 0.001$) of long-term aneurysm occlusion (*Table 2*). Rupture status and aneurysm location did not predict long-term occlusion rates. *Figure 3* illustrates a case of a large WN posterior communicating artery aneurysm that recurred at 6 months despite complete occlusion with bare platinum coils. The recurrence was treated with Cerecyte coil embolization with a residual neck remnant to maintain patency of a fetal posterior communicating artery aneurysm that progressed to complete occlusion at the 12-month follow-up examination.

The recurrent aneurysms requiring retreatment were located in the anterior circulation in four patients and posterior circulation in two patients. *Figure 4* illustrates a case of recurrence of a ruptured anterior communicating artery aneurysm in a patient who smoked and who developed a new lobe requiring retreatment. Smoking during the perioperative period occurred in five of six patients with recurrence requiring retreatment, making the risk of major recurrence 10% in smokers and 3% in nonsmokers ($P < 0.01$). All recurrences associated with interstitial filling were retreated to 95% or greater occlusion without additional morbidity or mortality. Interestingly, five of the six

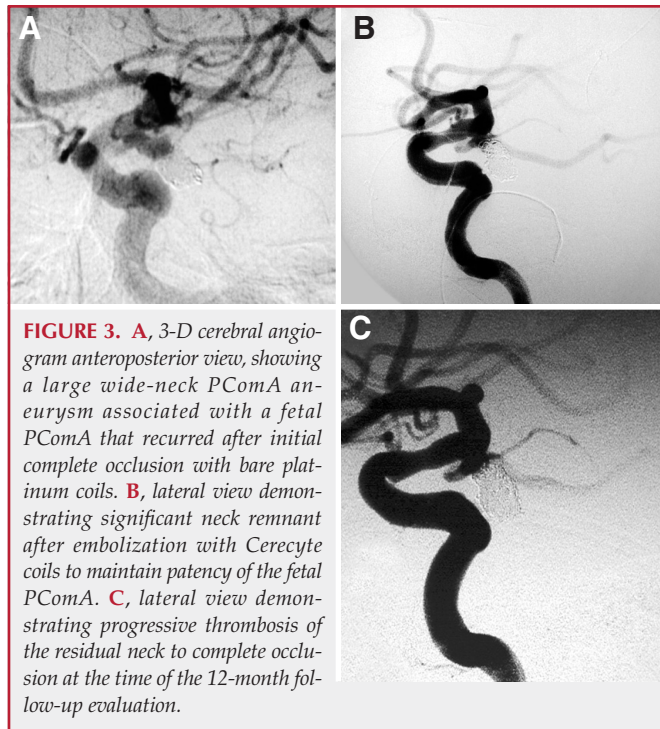
TABLE 1. Six-month follow-up occlusion^a

	No.	Initial occlusion				Six-month follow-up occlusion			
		Complete	Incomplete	Partial	Thrombosis	Stable	Recurrence ≤20%	Recurrence ≥20%	
SA/SN	45	22	1	22	12	20	10	3	
SA/WN	30	14	1	15	7	14	4	5	
LA	13	4	1	8	4	6	1	2	
GA	1	0	0	1	0	1	0	0	

^a SA/SN, small aneurysm/small neck; SA/WN, small aneurysm/wide neck; LA, large aneurysm; GA, giant aneurysm.

TABLE 2. Long-term aneurysm occlusion

	Stable	Thrombosis	Recurrence (>20%)	Coil compaction (<20%)
Complete	32	0	2	6
Incomplete	1	0	1	1
Partial	8	23	7	8



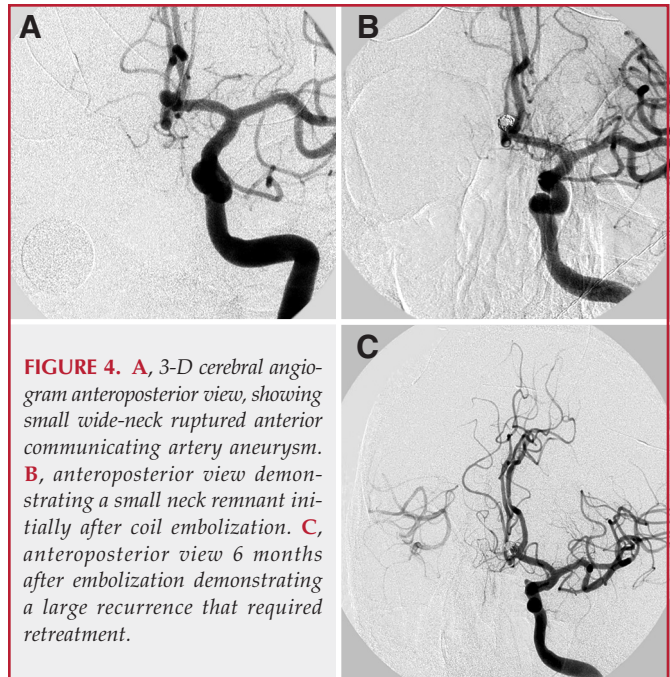
patients with significant recurrences requiring retreatment were initially treated within the first month in which the Cerecyte coil was used.

Clinical Outcomes

There was one thromboembolic event that led to a permanent neurological deficit, but no delayed events such as chemical meningitis or hydrocephalus resulted from use of the Cerecyte coil. As revealed by follow-up angiography, there was no evidence of endothelial or thrombus ingrowth into the lumen of the parent vessels at the aneurysm neck.

Statistical Analysis

Based on Fisher’s exact test and logistic regression models, risk factors associated with recurrence were smoking ($P = 0.01$) and multiple aneurysms ($P = 0.04$) (Table 1). The following factors were found not to be statistically significant risk factors for recurrence: age, rupture status, poor Hunt and Hess grade, and use of prolonged postoperative antiplatelet agents or anticoagulation.



DISCUSSION

Historical Outcomes with Bare Platinum Coils

Despite clinical evidence of superior clinical outcomes associated with endovascular aneurysm treatment versus surgical clip ligation, the risk of aneurysm recurrence, need for retreatment, and delayed recurrent hemorrhage remain concerns specific to coil embolization. Human autopsy studies suggest bare platinum coils are associated with an incomplete membrane at the neck and minimal endothelialization and empty space between coils within the aneurysm (5). Murayama et al. (21) reported long-term follow-up of 916 aneurysms in patients treated during an 11-year period with recanalization rates of 26% in patients treated during the first 5 years and 17% in patients treated in the later period, for an overall rate of 21%. This group determined that recanalization was dependent on aneurysm morphology. They also reported risk of delayed rupture of 1.1 and 0.5% in the two treatment groups, respectively, with increased risk in large or giant aneurysms. Raymond et al. (26) reported long-term outcomes in 501 aneurysms treated during a 10-year period, with a recurrence rate of 34% with a delayed rebleeding rate of 0.8%. The authors counted any worsening in degree of filling as a recurrence, with a major recurrence requiring retreatment in 21%. They identified aneurysm size of at least 10 mm, treatment during the acute phase of rupture, incomplete initial occlusion, and duration of follow-up as predictors of recurrence. This was important in identifying the need to monitor coiled aneurysms closely for recurrence even years after treatment, because more than 90% of recurrences were detected 3 years or more after treatment. Byrne et al. (6) analyzed 315 patients

with subarachnoid hemorrhage during a 5-year period, demonstrating a recurrence rate of 15% with rebleeding rates of 0.8% in the first year, 0.6% in the second year, and 2.4% in the third year after aneurysm embolization with no rebleeding in subsequent years. The risk of rebleeding was associated with known aneurysm recurrence. These studies are important in identifying the long-term need to image coiled aneurysms for recurrence and aggressively retreat significant recurrences to prevent delayed rebleeding. Recent evidence suggests that the risk of retreating a recurrent aneurysm is extremely low (15). However, these studies serve as historical controls only because they do not evaluate the impact of endovascular advances for aneurysms during the past 3 years, which include stent-assisted embolization, complex-shaped coils, and “bioactive” coils coated with agents aimed at promoting thrombosis and endothelialization.

Current Evidence on “Bioactive” Coils

Concerns regarding aneurysm recurrence with bare platinum coils have led to a rapidly evolving interest in the use of growth factors such as vascular endothelial growth factor, gene therapies, or cellular substrates to modify the bare platinum coil—promoting growth of an endothelial layer across the aneurysm neck (1, 2, 3, 10, 14, 16, 17, 18, 25). One of the first models to be translated from the laboratory to human studies is the Matrix coil (Boston Scientific). The Matrix coil involves a platinum coil with an outer coating of a bioabsorbable polymeric material (polyglycolic acid/lactide) that has been shown in swine aneurysm models to accelerate aneurysm fibrosis and neointima formation with increased neck tissue thickness but no parent artery stenosis (22, 23). Results of human studies have been disappointing, with higher recurrence rates than those associated with bare platinum coils. Niimi et al. (24) reported 46 aneurysms treated by Berenstein’s group with greater than 50% Matrix coils, with a 54% recurrence rate and perioperative morbidity and mortality of 1.4%, respectively. Fiorella et al. (11) reported a 7-month mean follow-up of 82 aneurysms treated with more than 50% Matrix coils, with a recurrence rate of 37% with retreatment in 23%. They offer several possible biases that resulted in a high recurrence rate, such as inclusion of a large percentage of patients with underpacked subarachnoid hemorrhage to prevent intraprocedural rupture, few initial complete aneurysm occlusions despite excellent packing densities, and improved imaging equipment for follow-up studies. They suggest that specific patients do not respond to the polyglycolic acid/lactide polymer that accounts for 70% of the total coil volume, which allows completely occluded aneurysms to recur as the polymer is reabsorbed without formation of residual thrombus within the aneurysm. They also raise the concern that the mechanics of Matrix coil delivery differs from its bare platinum counterpart because it is “stiffer” with increased friction during aneurysm packing.

The HydroCoil (MicroVention, Inc., Aliso Viejo, CA) is another “bioactive” coil consisting of a platinum coil coated with a polymer that “swells” on contact with blood, increasing coil volume up to 11-fold. Cloft (8) reported initial periproce-

dural results in the HydroCoil for Endovascular Aneurysm Occlusion Study, which demonstrated a 92% complete or near-complete occlusion rate and a perioperative complication rate of 11%. He concludes that initial results suggest no advantage to use of the more costly HydroCoil versus platinum; however, long-term studies are needed to document the possibility of reducing recurrence rates.

Impact of Cerecyte Coil on Recurrence Rates and Safety

Given the success of PGA-coated coils in animal models, the Cerecyte coil was developed differently than the Matrix coil, because the PGA polymer was placed within the platinum coil to prevent loss of packing density when the polymer resorbs, as well as to allow similar handling characteristics as bare platinum coils. To date, there are no clinical studies describing the safety or efficacy of the Cerecyte coil. We followed 89 aneurysms treated only with 100% Cerecyte coils. We were stringent in requiring our independent reviewers to identify any evidence of coil compaction. Follow-up angiography at a mean of 11 months posttreatment demonstrated a lower recurrence rate of aneurysms (11%) than that reported with use of other bioactive coils or bare platinum coils. There are several explanations for this finding. The first is the unique design of the Cerecyte coil, in which the PGA polymer may generate an inflammatory response to promote thrombus and collagen formation within the aneurysm before it resorbs. Once it resorbs, there is no change to the packing density of the aneurysm because the polymer is implanted within the coil, thus reducing risk of recurrence. The design also allows the Cerecyte coil to behave in a similar manner to bare platinum coils. This means that there is no increased risk of aneurysm rupture resulting from greater tension during coil deposition within the aneurysm dome. Our study confirms the safety of the Cerecyte coil, because there were no episodes of swelling within the aneurysm leading to local mass effect or hydrocephalus, and no growth of thrombus beyond the aneurysm neck causing stenosis within the parent vessel.

Predictors of Aneurysm Recurrence

Smoking has been established as a risk factor for subarachnoid hemorrhage with as high as a three- to fourfold increase (13). The impact of smoking on aneurysm recurrence after coil embolization has only recently been evaluated. In this study, five of six patients with recurrences smoked during the perioperative period, making smoking a statistically significant risk factor for recurrence. This is the first study to document smoking as a risk factor for recurrence associated with the use of a “bioactive” coil and may explain why some patients fail to respond to PGA polymer in a similar manner to animal models. The initial degree of occlusion was also a predictor of recurrence. This may explain why five of the six recurrences requiring retreatment were initially coiled early in our experience, because we have more recently attempted a greater degree of occlusion when possible. Another risk factor in this study predictive of recurrence was the presence of multiple aneurysms.

One reason these patients may be at risk for recurrence could be the development of a new aneurysm lobe at the site of a residual neck postembolization, given their predisposition to develop additional aneurysms. Interestingly, both smoking and multiple aneurysms at the time of subarachnoid hemorrhage were identified previously as risk factors for recurrent subarachnoid hemorrhage after clip ligation of a ruptured aneurysm (27). The use of prolonged postoperative antiplatelet agents and/or anticoagulation may, in theory, prevent progressive thrombosis; however, this was not a statistically significant variable predictive of recurrence. Inclusion of a larger proportion of ruptured aneurysms, specifically patients with higher Hunt and Hess grades, may also predict recurrence because they are often less densely packed with a goal of dome occlusion in the acute setting to minimize risk and duration of treatment. However, neither of these variables was related to recurrence in our study.

Limitations of the Present Study

The most important limitation of this study is duration of follow-up. We would certainly expect the number of aneurysm recurrences to increase as the duration of follow-up is extended. However, the use of the Cerecyte coil has produced a similar or lower recurrence rate at 11 months of follow-up than that reported with bare platinum coils. We acknowledge such a comparison does not involve a uniform protocol among institutions regarding standardized analysis and classification of long-term angiographic outcomes; thus, it is merely a historical control comparison. The small sample size in this study also limits our results; however, it is the first and thus largest group of patients treated with Cerecyte coils to be reported to date. One reason for the small sample size is the exclusion of patients who received even a single non-Cerecyte coil. We think one reason for the lower recurrence rate in our study is the inclusion of only "pure" Cerecyte-coiled patients, which suggests the use of combined bare platinum and bioactive coils, as with Matrix and the HydroCoil, may dilute the effect of the bioactive agent. We are closely monitoring all patients enrolled in our prospective database, and we will be sure to report longer-term follow-up on a much larger series as it becomes available.

CONCLUSION

The Cerecyte coil is associated with recurrence rates similar to or lower than those reported from other single-center trials of bioactive coils, on the basis of follow-up results of ruptured and unruptured aneurysms treated with 100% Cerecyte coils. The unique design enclosing the bioactive polymer within the coils may be responsible for preventing recanalization. The Cerecyte coil is safe and has similar mechanical properties to its bare platinum counterpart. Additional studies with a larger sample size that compare bioactive coils with bare platinum coils in a randomized fashion is warranted to determine whether this protective effect is maintained long term.

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COMMENTS

This experienced endovascular group reports their results in a series of patients treated with Cerecyte coiling of cerebral aneurysms. This is a novel coil device composed of an outer platinum coil and an inner bioactive polyglycolic acid polymer. The authors report a favorably low recurrence rate of 9.6% in a group of patients followed an average of 7 months after treatment. These results compare favorably to those obtained through the use of bare platinum coils as well as to recent reports of biologically active coils coated with the polymer described above.

Undoubtedly, the future management of cerebral aneurysms will involve the use of such biologically active agents and will require the development of novel endovascular devices. As these devices come to fruition, so too must our understanding of their mechanical and histological properties. Why a coil device such as the one used by the authors would have a more favorable recurrence rate than a coil coated with the same polymer remains a mystery. Further pathological and clinical explorations are needed to clarify this dilemma.

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This is an interesting study designed to assess the safety and recanalization rates associated with use of Cerecyte detachable coils in the management of intracranial aneurysms. This study is valuable for several reasons:

1. This new device has the touted advantage of having polyglycolic acid/lactide without sacrificing the ease of use associated with bare platinum coils nor the volume of platinum per coil. The author's experience supports this notion.
2. The safety data are exceptionally good, which probably relates to the high volume at this center, the technical skills of the operators, and the wisdom acquired over years of practice by the group.
3. The recurrence rate appears lower than the rate that has been reported for other coil types. The data are compelling with obvious limitations as outlined by the authors.
4. The authors examined aneurysms in which only Cerecyte coils were used. Studies regarding other bioactive coils have been criticized for "mixing."

What is most frustrating about the literature on aneurysm recurrence after coiling is the heterogeneity of approaches to classification of aneurysm occlusion and recurrence. It is hoped that the ongoing ran-

domized trials in this area will overcome this issue via core laboratory tests, and that data from these trials will provide practitioners with information that will make coil selection more scientifically based. Newer devices appear to be improving outcomes from endovascular treatments, but it is clear that we have more work to do.

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Veznedaroglu et al. present one of the first series describing the clinical performance of the bioactive Cerecyte coil (Micrus Corp., Sunnyvale, CA) in 81 patients with 89 aneurysms. The primary advantage of this particular bioactive coil is the lack of a mechanical shortcoming during deployment. In prior generations of surface-modified coils there was always a tradeoff in terms of ease of use. First, they demonstrate that there is no increase in complication rates associated with this device as there was only one thromboembolic complication in this series. Second, they demonstrate a retreatment rate of only 6.7%. These results, however, should be viewed in perspective with the significant selection bias associated with this study. The series contains a high proportion of small aneurysms with small necks (51%) as larger aneurysms were preferentially excluded owing to the unavailability of an appropriate system at the time of treatment. In the series published by Murayama et al. (2) the percentage of small artery/small neck aneurysms was only 36.5%. They also excluded aneurysms treated with stent assistance, again a more difficult group of aneurysms to treat endovascularly. Furthermore, their definition of recanalization only includes aneurysms demonstrating greater than 20% coil compaction of the aneurysm diameter. In their series, Murayama et al. defined recanalization as a greater than 10% increase in contrast filling of the aneurysm. Despite the more stringent criteria in the study of Murayama et al., the recanalization rate for the small artery/small neck group was 5.1%. From Table 1 of their article, there were 3 recanalizations out of 45 aneurysms for a recanalization rate of 6.7%, which presumably was higher, given the differing definitions of recanalization.

Overall, this series demonstrates that there is no acute performance tradeoff or increased complication rate associated with the use of the Cerecyte coil compared with bare platinum coils. A more definitive statement regarding potential improvements in the recanalization rate, however, cannot be made. Use of the Cerecyte coil does, however, appear to be favorable compared with other bioactive coils (1, 3). Currently the Cerecyte Trial is nearing completion of enrollment, and it is hoped that this trial will provide the answer to the question of whether this bioactive platform improves the recanalization rates associated with the use of the Cerecyte coil.

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Disclosure

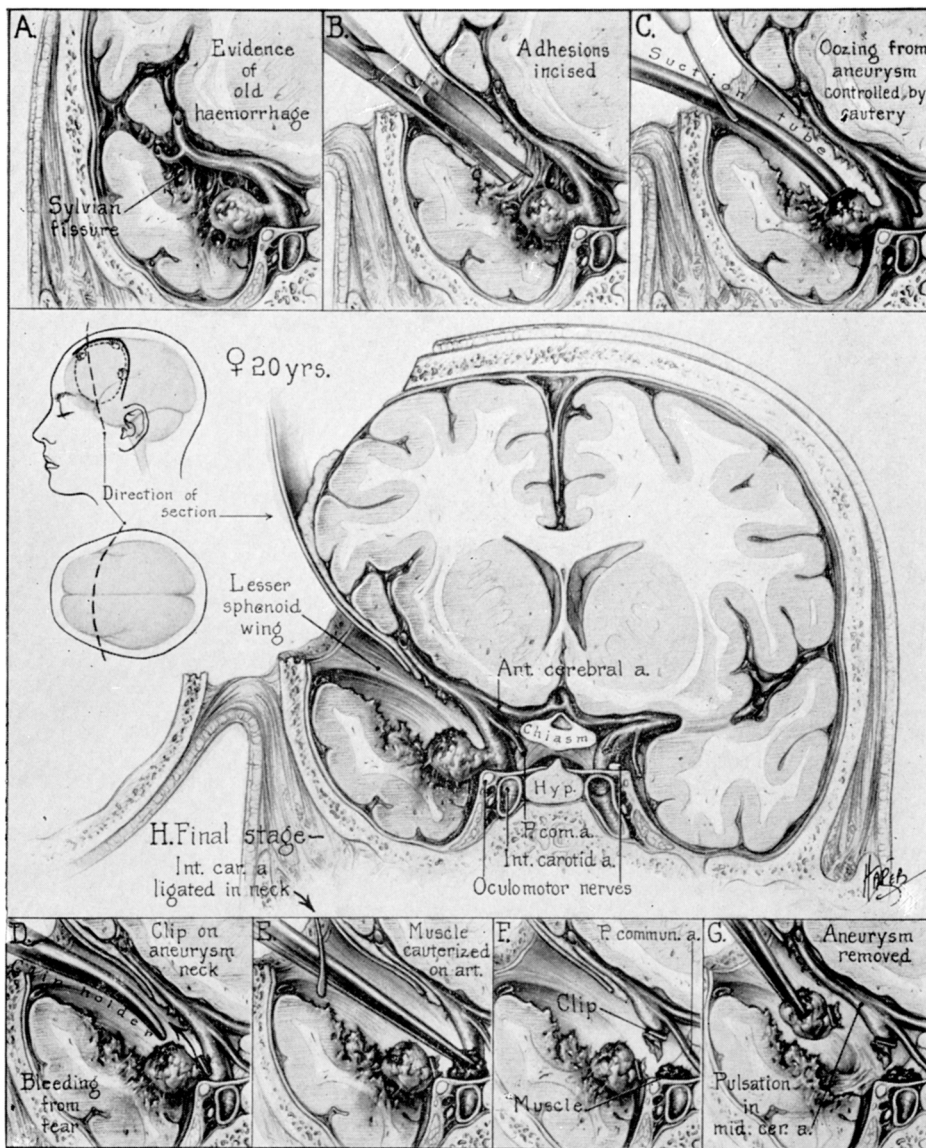
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The authors describe the use of the Cerecyte coil in 212 intracranial aneurysms. However, they analyzed only 89 of these that met their inclusion criteria and had 6-month angiographic follow-up. The authors do not discuss how many patients met the inclusion criteria without the appropriate follow-up. They simply mention that the majority of the excluded patients received a combination of various coils. This could mean that of the 123 aneurysms excluded, up to 61 lesions met the inclusion criteria of being treated exclusively with Cerecyte coils without the 6-month follow-up. Consequently, there is a large selection bias in the patients analyzed in this article. The authors met only the first goal of their study—showing that the use of Cerecyte

coils is relatively safe. We have also found that this coil is relatively soft and agree that its deployment is straightforward. The incompleteness of the data and the short duration of follow-up prevent any further conclusions. The authors have yet to meet the main objective of this article—showing that the long-term aneurysm recurrence rate is less with the use of Cerecyte coils.

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Drawings of the operative procedure related to upon an aneurysm of the intracranial portion of the internal carotid artery. From Dandy WE: *The Brain*. New York, Harper & Row, Publishers, 1969. Reprinted from Lewis' *Practice of Surgery*, Prior, 1933.