Rate of Recanalization and Safety of Endovascular Embolization of Intracranial Saccular Aneurysms Framed with GDC 360 Coils

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Summary

Coil compaction and recanalization of cerebral aneurysms treated with coil embolization continue to be of great concern, especially in patients that presented with subarachnoid hemorrhage. The incidence of recanalization reported by previous studies ranges from 12 to 40 percent in experienced centers. We reviewed the incidence of recanalization requiring retreatment in patients treated with GDC 360 framing coils.

A retrospective review of every patient who underwent coil embolization with GDC 360 coils for saccular aneurysms at our institution from December 2004 to March 2008 was performed. We studied the patients' demographics, clinical presentation, aneurysm size and configuration, type of coils used to embolize the aneurysm, the percentage of coils that were GDC 360 in any given aneurysm, the need for remodeling techniques like stent and/or balloon for embolization, immediate complications, cases in which we were unable to frame with the GDC 360 coil, and rate of recanalization on follow-up.

A total of 110 patients (33 men, 77 women) and 114 aneurysms were treated with GDC 360 coils. Ninety-eight aneurysms were framed with the GDC 360 coils. There were two patients in whom the initial GDC 360 coil intended for framing had to be pulled out and exchanged for another type of coil. There were five procedure

related complications (4.4%). Four patients required intra-arterial abciximab due to thrombus formation. One patient that presented with a grade III subarachnoid hemorrhage had aneurysm rupture while the coil was being advanced. A total of 50 patients (15 men and 35 women) underwent follow-up femoral cerebral angiograms at least six months after coiling (mean follow-up was 15 months). Forty-four of the patients with follow-up had the GDC 360 coil used as a framing coil. Three patients (6%) required retreatment due to recanalization. Every patient with recanalization requiring treatment had aneurysms of the anterior communicating complex that presented with subarachnoid hemorrhage.

The rate of recanalization of cerebral aneurysms embolized with GDC 360 framing coils was lower in our case series compared to the existing literature reports. Patients with aneurysms of the anterior communicating artery were at increased incidence of recanalization in our patient cohort.

Introduction

Coil compaction and recanalization of previously embolized cerebral aneurysms continues to be a significant concern, especially in patients with previously ruptured aneurysms. The incidence of recanalization has been documented to be anywhere from twelve to forty

Figure 1 A) The patient is a 64 y/o man with a grade III subarachnoid hemorrhage and an anterior choroidal artery aneurysm. B) The patient is a 66 y/o man with an anterior communicating artery aneurysm and a posterior communicating artery aneurysm found during work-up for headache.

percent in different experienced centers¹⁻⁴. The incidence of recanalization has been attributed to multiple factors, including packing density, aneurysm shape, aneurysm location, and history of smoking^{5,6}.

The GDC 360 coils (Boston Scientific, Fremont, CA, USA) have a double omega configuration intended to decrease the chance of coil herniation into the parent vessel while being advanced⁷. "The first one-and-a-half loops of the GDC 360 coil have a two-dimensional configuration and are 25% smaller than the stated coil diameter. Subsequent coil loops are designed in a pattern that changes direction in three-quarter loop increments"⁸. This complex shaped bare platinum coil mounted on a double strand of polypropylene suture should allow for better packing density. Using the GDC 360 as a framing coil should potentially eliminate two of the predisposing factors for recanalization: aneurysm shape and packing density.

We reviewed our experience in patients treated with GDC 360 coils (0.010-inch and 0.018-inch) to assess safety and compare the rate of recanalization with previously published rates.

Methods

An all-inclusive retrospective review of every patient who underwent coil embolization of saccular aneurysms with GDC 360 coils at our institution from December 2004 to March 2008 was performed. We studied the patients' demographics, clinical presentation, aneurysm size and configuration, type of coils used to embolize the aneurysm, the percentage of coils that were GDC 360 in any given aneurysm, the need for vessel remodeling techniques like stent and/or balloon for embolization, immediate complications, cases in which we were unable to frame with the GDC 360 coil, and rate

Table 1

Patients	Aneurysms	Framed with GDC 360	Thrombotic complications (%)	Hemorrhagic complications (%)	Mortality
110 (33M, 77W)	114	98	4 (3.5)	1 (0.9)	None

of recanalization on follow-up. Patients with fusiform, dissecting and extracranial aneurysms, and patients in whom GDC 360 coils were used for retreatment after recanalization of a previous embolization without GDC 360 were excluded from the study.

Results

The total number of patients with intracranial saccular aneurysms treated with GDC 360 coils during this time was 110 (33 men and 77 women) (Table 1). Ninety-eight aneurysms were framed with GDC 360 coils. There were two patients in whom the initial GDC 360 coil intended for framing had to be pulled out and exchanged for another type of coil (Figure 1). There were five cases (4.4%) of intraprocedural complications. Four patients required intra-arterial abciximab for thrombus formation in the parent artery at the end of the procedure. One patient who presented with a grade III subarachnoid hemorrhage had an intraprocedural rupture while advancing the framing coil. There were no mortalities in the group.

After framing with the GDC 360 coils, most of the aneurysms were packed with hydrogel coated Hydrocoils (MicroVention, Inc., Aliso Viejo, CA, USA) and Hypersoft (MicroVention, Inc., Aliso Viejo, CA, USA) finishing coils. In aneurysms that were not framed with GDC 360 coils, the framing coil was Cerecyte (Micrus Endovascular, San Jose, CA, USA).

Fifty patients (15 men and 35 women) had follow-up angiograms of at least six months after the initial coiling procedure (Table 2). The mean follow-up was fifteen months (six to 36 months). Forty-four of the patients with follow-up, were framed with GDC 360 coils. Seventeen patients presented with unruptured aneurysms, 12 patients with grade I subarachnoid hemorrhage (SAH), six patients with grade II SAH, 14 patients with grade III SAH, and one patient with grade IV SAH. A total of 114 aneurysms were treated with GDC coils. The average size of the aneurysms treated was 8 mm (3.5 to 22 mm). Three of the patients (6%) with follow-up required retreatment with clip ligation for recanalization of the aneurysm (Figure 2). All the patients with recanalization had anterior communicating artery aneurysms that presented with subarachnoid hemorrhage. Seventeen percent of the patients with anterior communicating artery aneurysms had recanalization. There

were no episodes or rehemorrhage during the follow-up period.

There were nine aneurysms with follow-up treated with stent assisted coiling. None of those aneurysms have required retreatment for recanalization. Of the thirteen aneurysms with follow-up treated with balloon assisted coiling, only one required retreatment for recanalization.

Discussion

Our case series demonstrated that framing of cerebral aneurysms with the GDC 360 coils represents a safe and durable option. Several studies have analyzed the rates of recanalization of previously coiled aneurysms. Multiple hypotheses about recanalization of the aneurysms included shape of the aneurysm, location of the aneurysm, size of the aneurysm neck, coil packing density, and history of cigarette smoking¹⁻⁶.

With the development of new technology in coils, the intent was to decrease the risk of recanalization by eliminating some of the factors that might predispose an aneurysm to recanalize. The double omega configuration of the GDC 360 framing coil was intended to improve the packing density in those aneurysms with unfavorable anatomy and location, by preventing herniation of the coil into the parent vessel^{7,8}.

The likelihood of deploying a framing GDC 360 coil was very high in our series (98 per-

Table 2

Patients with follow-up	50
Patients with GDC 360 framing	44
ACom aneurysms	17
PCom aneurysms	10
ICA terminus aneurysms	3
Basilar apex aneurysms	4
Vertebral Artery aneurysms	2
PCA aneurysms	2
Superior Hypophyseal Artery aneurysms	5
Ophthalmic Artery aneurysms	5
Ant Chor artery aneurysms	2
Recanalization requiring retreatment (%)	3 (6)

Figure 2 A) The patient is a 61 y/o woman with a grade I subarachnoid hemorrhage and an anterior communicating artery aneurysm. B) The patient is a 42 y/o man with a grade III subarachnoid hemorrhage and an anterior communicating artery aneurysm. C) The patient is a 43 y/o woman with a grade III subarachnoid hemorrhage and an anterior communicating artery aneurysm.

cent), and along with a technical complication rate of 4.4% makes the procedure a safe one. None of the thrombotic complications requiring intra-arterial antiplatelet therapy had clinical consequences. It was difficult to evaluate if the patient with the intraprocedural rupture had clinical consequences because she had al-

ready bled twice prior to the procedure, requiring intubation and placement of ventriculostomy, and she ended up recovering and being transferred to a rehabilitation unit. She was eventually discharged home and lives alone and able to perform activities of daily living without help.

The rate of recanalization requiring retreatment was low in our series (6%) when compared to the previously mentioned series (12-40%)¹⁻⁵. We believe that this finding was related to a higher packing density in cerebral aneurysms framed with the GDC 360 coil. Framing of the aneurysm with this coil allowed us to create a "scaffold" that prevented herniation of the coils into the parent vessel. It is very difficult to attribute results to only one factor in a small retrospective study in which different types of coils were used to embolize aneurysms. Packing of cerebral aneurysms with Hydrocoils has been demonstrated to be safe and effective^{1,9}. Framing of cerebral aneurysms with Cerecyte coils has also shown good results in previously reported series^{10,11}.

The fact that three aneurysms that had presented with subarachnoid hemorrhage had coil compaction and recanalization requiring retreatment is of concern.

All three aneurysms were "down pointing" aneurysms of the anterior communicating complex. This type of aneurysm needs to be evaluated on a case by case basis, but in several instances, especially in young patients, craniotomy and clip ligation should be considered the treatment of choice.

Mild coil compaction with minimal recanalization (less than 5% at the base of the aneurysm) not requiring retreatment was observed in several patients in our study, especially in those patients in whom part of the aneurysm base was left unprotected to prevent occlusion of the parent vessel (posterior and anterior communicating artery aneurysms). Aneurysms treated with vessel remodeling techniques (13 with balloons and nine with stents) had a low rate of recanalization (one patient) requiring treatment (4.5%).

An important pitfall of the study was the fact that we had follow-up angiograms in only 50 patients of the 98 treated with GDC 360 framing coils. Reasons for not having follow-up in all the patients included patients that were lost to follow-up, patients that were treated less than six months ago, and two patients with grade III subarachnoid hemorrhage that died during their hospital stay from complications of subarachnoid hemorrhage. Since this was a retrospective study, the medical history was incomplete in several patients and the link of cigarette smoking and recanalization was not assessed in our cohort.

Conclusions

Treatment of cerebral aneurysms with endosaccular embolization with GDC 360 framing coils is a safe and durable option. The risk of recanalization in our patient cohort is small compared to series that have been published elsewhere. Larger series of patients treated with this method are needed to support our evidence. Animal studies in which intrinsic factors and aneurysm characteristics can be controlled will be important to compare the different coils.

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