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Case Study

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Aneurysm clipping following endovascular coil embolization: A report of two cases

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B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
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Summary

Background: Treatment of intracranial aneurysms by Guglielmi detachable coil (GDC) embolization is a useful therapeutic alternative to surgery. This procedure is attractive as a minimally invasive approach to treat cerebral aneurysms; however, is not devoid of complications or failure and retreatment, with either a surgical or endovascular technique, may often be required.

Case Reports: Two cases are presented in which surgery was required after coil embolization. In one case, surgical treatment was performed one month later because of regrowth and subsequent bleeding of the aneurysm. In the second case, surgical treatment was carried out six months later because of recanalization of the vascular malformation. Surgical treatment excluded both aneurysms from the cerebral circulation.

Conclusions: In this paper the authors illustrate their experience and underline the difficulty of aneurysm surgery with coils in place.

key words: **aneurysm rest • cerebral aneurysm • guglielmi detachable coils • retreatment**

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BACKGROUND

In 1990, Guglielmi et al. first described an interventional technique of endovascular occlusion with coils to treat cerebral aneurysms [1,2]. Since then, many authors have used this approach to successfully treat this pathology. Over the past several years this procedure has evolved from an experimental technique to a valid alternative treatment for cerebral aneurysms. At present the GDC technique is considered an efficacious alternative to surgery. The criteria of selection may include aneurysm location and geometry, the patient's general condition, and the surgeon's and patient's preference. Nevertheless, complications and failure related to this technique are now well known, but the long-term efficacy in preventing subsequent regrowth or rupture of the aneurysms is still not well determined. Although many authors have reported retreatment of partially occluded or recanalized lesions, only a few clearly report the details relating to surgical strategy performed to repair regrowth or bleeding of aneurysms after the GDC technique [3–12]. In this paper we report two cases in which surgery was required after coil treatment, underlining the difficulty in the surgical repair of an embolized aneurysm.

CASE REPORTS

Case 1

A 17-year-old woman was admitted to our institution because of a left facio-brachio-crural hemiparesis. A brain CT scan performed upon admission revealed a right cortical-subcortical temporo-parietal hematoma. Bleeding was also documented within the sylvian fissure. The patient underwent cerebral angiography, which disclosed a large saccular carotid-posterior communicating artery aneurysm (Figure lA). Transcranial surgery was declined because the patient was in the fifth month of pregnancy. Therefore, complete aneurysm obliteration was achieved by performing the GDC technique. One month later the patient complained of left facio-brachio-crural hemiparesis, which suddenly became severe. A brain CT scan revealed a right intracranial tempo-parietal hematoma. The patient was taken to the operating room and a right pterional craniotomy was performed. The aneurysm showed a residual canalized portion located on the lateral wall of the right internal carotid and on the M1 segment of the homolateral middle cerebral artery (MCA).

The aneurysm neck and the near wall vessel appeared thinned and fibrotic and the coils appeared to be densely adherent to the intima, implying that their removal might have caused the vessel's rupture. On the other hand, clip application on the remnant was impossible because it appeared thinned. To avoid aneurysm rupture, or vessel laceration, the lesion was covered using a temporal muscle fragment. Left hemiparesis gradually improved over several weeks and the patient was transferred to the obstetrics department. Follow-up angiography performed 18 months later did not show evidence of regrowth (Figure 1B).

Case 2

A 59-year-old woman was admitted to our neurosurgical department complaining of a long history of recurrent headache. Her neurological examination was normal. The presence of a cerebral aneurysm was first suggested by a brain CT scan and subsequently confirmed by cerebral angiography, which showed a large supraclinoid aneurysm of the left internal carotid artery (Figure 2A). The patient refused surgery and underwent GDC embolization with initial total obliteration of the lesion (Figure 2B). Two months later the patient presented with cerebral hemorrhage. At the six-month angiography follow-up, partial recanalization of the aneurysm was documented (Figure 2C). The patient underwent surgical treatment. Via a pterional approach, closure of the aneurysm was achieved using two fenestrate Yasargil clips, which were placed in an opposed manner. Follow-up angiography performed 18 months later demonstrated exclusion of the aneurysm from the cerebral circulation (Figure 2D).

DISCUSSION

Endovascular coil embolization to treat cerebral aneurysms is a valid alternative method to surgery. Such a technique is not traumatic and avoids brain retraction and long general anesthesia. However, complications may occur and technical failures of GDC treatment include aneurysm recanalization, regrowth, and hemorrhage. The natural history of residual and recurrent aneurysms after GDC embolization remains unclear and the indications for immediate further treatment for regrowth/refilling of an aneurysm have not been defined.

Recurrence of an aneurysm after coil embolization is a complication reported with increasing frequency. Several theories have been proposed to explain aneurysm recurrences. Kwan and collaborators proposed the hypothesis of a "water-hammer effect"; a thrombus directly exposed to the internal arterial surface is pushed by the blood pressure towards the aneurysm dome, allowing aneurysm expansion [13]. It has also been suggested that the key step for complete obliteration of an embolized aneurysm is the formation of a membrane composed of fibrin gel across the aneurysm orifice, and only when such intimal overgrowth across the aneurysm neck develops will the aneurysm be completely excluded from the circulation [14]. This mechanism, which occurs during the early stages after coiling, is important because it represents a substrate for endothelialization and isolates the aneurysm sac from the cerebral circulation, avoiding recanalization.

The International Subarachnoid Aneurysm Trial (ISAT) compared surgical versus endovascular techniques in randomized patients with recent intracranial aneurysm rupture [15]. At one-year follow-up, death or disability was less frequent among those treated with coil embolization, there were more reruptures during the first year of follow-up among the patients treated with coil embolization. However, so far no other studies have directly compared the effectiveness of surgical clipping and endovascular coil embolization in terms of reducing subsequent rebleeding rates, the major goal of treating aneurysms. Although the ISAT findings have led to increased use of coil embolization, many have been concerned about the limited information on the long-term efficacy of coils in reducing risk of rebleeding [16]. As a consequence of this and other concerns, many institutions continue to prefer surgical clipping to coil embolization in

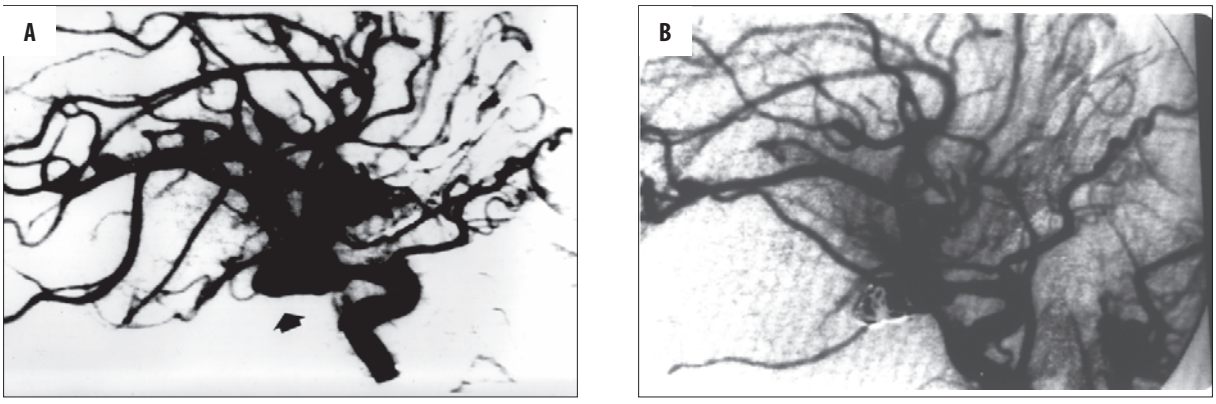

Figure 1. Right internal carotid angiograms of case 1. (**A**) A large saccular carotid-posterior communicating artery aneurysm. (**B**) Angiogram obtained 6 months after surgical repair showing the absence of signs of regrowth.

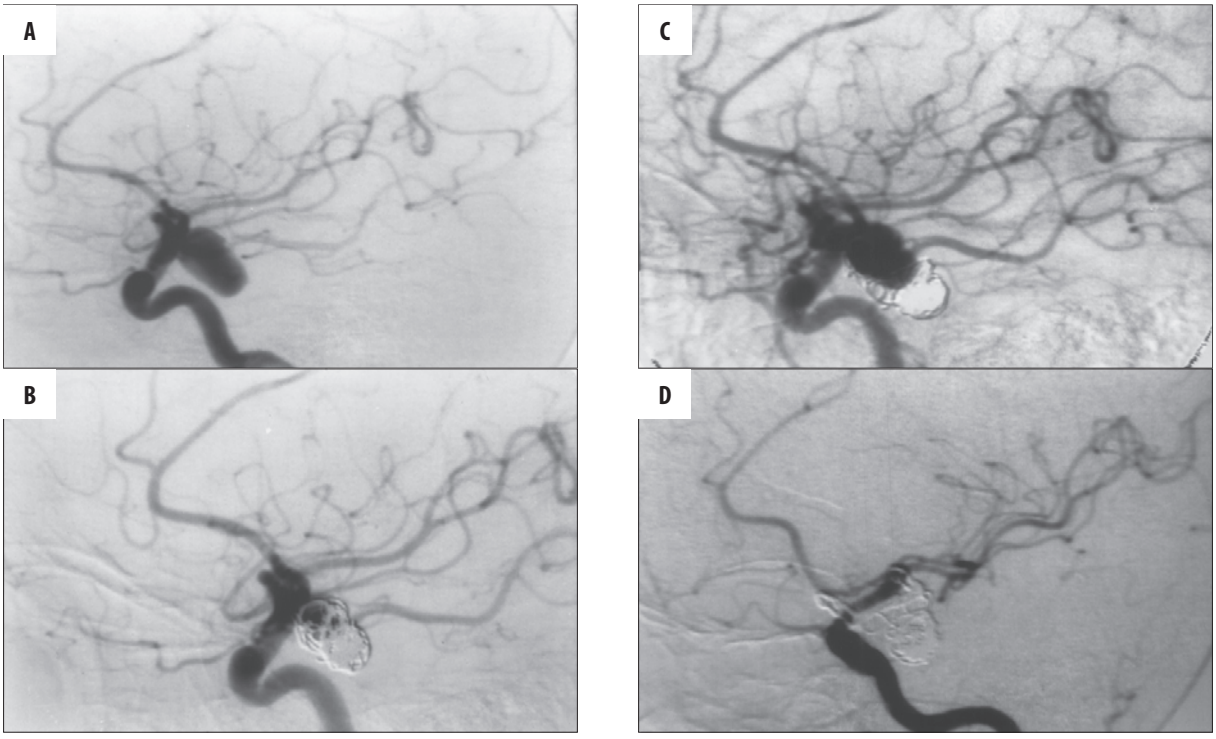

Figure 2. Left internal carotid angiograms of case 2. (**A**) Angiogram showing a right large supraclinoid internal carotid aneurysm. (**B**) Angiogram obtained after complete endovascular treatment. (**C**) Angiogram obtained 8 months later demonstrating re-expansion of the aneurysm. (**D**) Post-operative angiogram showing exclusion of the aneurysm by placing of two Yasargil clips, with restoration of the flow in the ICA.

patients with aneurysms that can be treated by either method. In our cases the reasons which led to the endovascular procedure rather than surgical clipping were pregnancy in the first case and patient choice in the second. However, in both cases surgery was required after coil embolization. In the first case surgical treatment was performed one month later because of regrowth and subsequent bleeding of the aneurysm. In the second case surgical treatment was carried out six months later due to recanalization of the vascular malformation.

There is a great deal of controversy regarding the treatment of recurrent aneurysm after coil embolization. Some authors used coils for subsequent treatment of recurrent aneurysms, with many difficulties in completely occluding wide-necked recurrent aneurysms [17,18]. On the other hand, aneurysm surgery after coil embolization is very hazardous because of the altered form and configuration of the aneurysm sac. If considerable time has passed since embolization, the thrombus surrounding the coils forms a fibrotic mass, causing pitfalls in surgical repair. We experienced these difficulties in case one, in which clip application was impossible because of the presence of embolic material and coils in the neck region. Moreover, the neck and the near wall vessel appeared fibrotic and thinned. To avoid aneurysm rupture or vessel laceration, the lesion was covered using a temporal muscle fragment.

It was pointed out that coil removal could be very hazardous [11]. Coil extraction can be easy if the operation is

performed shortly after the embolization. In the long run, coils will be fixed in place by tenacious thrombus and by a fibrotic process and extraction might cause vessel damage. In these cases it becomes very difficult to preserve the smooth luminal surface. Accordingly, in our first case above, the aneurysm was not opened and decompression by a combination of endoarterectomy and coil removal was not performed because the aneurysm's neck and the portion of the internal carotid artery near the aneurysm were thinned and fibrotic.

CONCLUSIONS

Aneurysm recurrence may be reduced by further technological innovations, such as new coil designs that incorporate bioactive materials [19]. From our experience and similar cases reported in the literature, we suggest that the choice of the appropriate management for retreatment of previously embolized aneurysms using the GDC technique depends on an analysis of the different cases.

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