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Angiographic follow-up of cerebral aneurysms treated with Guglielmi detachable coils (GDCs): An analysis of 162 cases of 173 aneurysms

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【**Abstract**】 **Objective** To evaluate the mid- and long-term radiological outcomes of cerebral aneurysms with GDCs embolization. **Methods** One hundred and sixty-two patients with 173 aneurysms embolized with GDCs underwent angiographic follow-up from 1 to 54 months post-operatively and were retrospectively reviewed. Three neuro-radiologists reviewed each angiogram and made a comparison between initial and follow-up angiograms. Morphological outcomes were evaluated as follows: unchanged; progressive thrombosis; and re-opening or re-growth. **Results** Of 173 aneurysms with GDC embolization, 142 aneutysms had total or nearly total occlusion, 23 subtotal occlusion and 8 partial occlusion shown on initial angiograms. The incidence of re-opening was 17.1% (13/76) in less than 3 months, and 6.2% (6/97) between 3 and 6 months postoperatively. Four aneurysms showed recurrency (2.3%) on second follow-up angiography in one year after procedure and one-year cumulative recurrent rate was 13.3% of 56 aneurysms with the third follow-up angiography in the post-operation period of 12 to 54 months, four showed a little enlargement and the cmnulative recurrent rate so far was 20.2% (35/173). **Conclusions** The direct and main causes for aneurysmal recurrence are incomplete and loosening packing. The first angiographic follow-up is recommended to be performed at 3 months or earlier after the procedure, especially in aneurysms with initial incomplete occlusion. Re-treatment with balloon- or stent-assisted coil embolization is recommended in re-opening aneurysms. (J Intervent Radiol, 2005, 14: 472-479)

【**Key words**】 Cerebral aneurysm; GDC; Embolization; Follow up

INTRODUCTION

Traditionally, surgical clipping of aneurysmal neck has been a valuable method for treating cerebral aneurysms. Since the introduction of GDCs in 1991[1], endovascular embolization of cerebral aneurysms has been increasingly growing ever since. Many investigators have justified the immediate safety and efficacy of this modality[2-8], but the mid- to long-term efficacy of patients treated with GDCs is still under close observation and further investigation, especially in terms of angiographic results[2,4,9,10]. The fact is that there is a certain recurrent rate in coil-embolized aneurysms even though the recurrent rate varies with different reports. Both regrowth of aneurysmal with incomplete occlusion and enlargement of aneurismatic neck remnant, with or without re-bleeding, are still under close investigation to determine the recurrent rate[2,4,11]. The time and mechanism of recurrence are of vital importance in terms of both appropriate follow-up time and proper measures of prevention and treatment. The purpose of this study is to evaluate the mid- to long-term efficacy through angiographic follow-up of 162 cases with 173 aneurysms treated with GDCs.

Materials and methods

From April 1998 to March 2004, 162 cases with 173 aneurysms were treated with GDCs and subsequently

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underwent angiographic follow-up at Shanghai Sixth People's Hospital. There were 63 males and 99 females with an age range from 17 to 83 years (mean: 49.5). Of these 162 cases, acute subarachnoid hemorrhage (SAH) presented in 140, unilateral oculomotor paralysis in 10 and other symptomatic or incidentally-found aneurysms in 12. Of 140 cases with SAH, Hunt and Hess Grade Ⅰ was found in 51 cases, Ⅱ in 60, Ⅲ in 19 and Ⅳ in 10 at operation. In 173 aneurysms with follow-up angiography, aneurysmal locations involved the siphon segment of internal carotid artery (ICA, $n = 20$), the posterior communication artery (PCoA $n = 58$), the anterior communication artery (ACoA, $n = 54$), the anterior cerebral artery (ACA, $n = 6$), the bifurcation of M1-2 segments ($n = 13$) and the M1 segment ($n = 3$) of the middle cerebral artery (MCA), the posterior cerebral artery (PCA, $n = 3$), the tip of the basilar artery (BA, $n = 7$), the superior cerebellar artery (SCA, $n = 2$), the posterior inferior cerebellar artery (PICA, $n = 2$), and the vertebrobasilar artery ($n = 5$). The largest diameter of aneurysm was equal to or less than 10 mm in 147 aneurysms and more than 10 mm in 26. Aneurysms had a narrow-neck (i.e. neck width $\leqslant 4$ mm, or aneurysm sac/neck ratio $\geqslant 2$) in 111, and a wide-neck (i.e. neck width > 4 mm, or aueurysm sac/neck ratio < 2) in 51 aneurysms. The necks of the remaining 11 aneurysms were not demonstrated clearly enough for evaluation (not available).

With all the patients under general anesthesia and systemic heparinization, a microcatheter (Tracker or Excel, Boston Scientific; Prowler, Cordis) with properly reshaped tip was introduced by a platinum-tip micro-guidewire (Transend, Boston Scientific) into the aneurysm sac. GDCs with appropriate size and memmory shape (standard, soft, or matrix GDC18, GDC10, Boston Scientific) were selected according to the size of aneurysms and packed in the aneurysm sac with "cocooninig" occlusion technique (i.e. the embolization is from aneurysm wall toward its center) and "encroaching" occlusion technique (i.e. the shadow of aneurysm become defective with GDC packing under road-mapping), until the aneurysm sac was occluded as densely as possible or until another GDC could no longer get in. We employed re-modeling technique and stent-assisted GDC packing technique in wide-necked aneurysms since 2002. Among patients whose anemysm sac was totally and densely occluded on initial or immediate angiography after the procedure, systemic heparinization was continued for 24 hours with 4000 U every six hours. Use of heparin was forbidden in aneurysms with subtotal or partial occlusion.

Immediately after procedure, digital subtraction angiography (DSA) was performed to assess the degree of aneurysmal occlusion, which was classified as follows: 1) total or nearly total occlusion (95% – 100%) when the sac and neck were densely packed with no or little contrast material visible; 2) subtotal occlusion (80% – 95%) when persistent opacification of the sac or the neck remnant was seen; 3) partial occlusion (< 80%) when occlusion extent was less than 80%, also known as loose packing.

The first follow-up angiography was performed within 3 months after the procedure in 76 aneurysms, between 3 and 6 months in 97. The mean time for first angiographic follow-up was 3.9 months after the procedure. All patients had the second follow-up angiography within 12 months post-operatively. A third follow-up angiography was performed between 12 and 24 months in 34, between 24-36 months in 16, more than 36 months in 6, and is still in progress. Follow-up angiography was performed twice in all patients and three times in 56. And all patients who had not taken followed up angiography were all contacted by telephone with 9 deaths of un-related diseases and the rest alive with no recurrent aneurysmal hemorrhage. Three neuro-radiologists reviewed each angiogram and made a comparison between initial angiograms and follow-up ones. The morphological outcomes were evaluated as follows: unchanged (stable status of occlusion compared to the initial angiograms); progressive thrombosis (reduction or elimination of residual filling of contrast material compared to the initial angiograms); and re-opening or re-growth (enlargement of residual neck or compaction of coils compared with initial angiograms). In 12 aneurysms with re-opening or re-growth, endovascular re-treatment with GDCs was performed.

Statistical analysis

Statistical analysis was performed with SAS 6.12.

χ^2-test was used for comparing pre- and postprocedure data. A P value <0.05 was considered significant and a p value <0.01 highly significant statistically.

Results

The immediate angiography after procedure of aneurysms treated with GDCs was total or nearly total occlusion in 142 aneurysms, subtotal occlusion in 23, and partial occlusion in 8. The rate of total or nearly total occlusion was obviously higher in aneurysms with a narrow-neck (102/111, 91.9%) than in aneurysms with a wide-necked and unmeasurable neck (40/62, 64.5%), and there was a highly significant difference statistically between the two kinds of aneurysms (P = 0.001) (Table 1). The first follow-up angiography, in comparison with the initial angiography after the procedure, showed unchanged in 142 aneurysms (82.0%), progressive thrombosis in 12 (7.1%), and re-opening or re-growth in 19 (11.2%) (Table 2). In 12 aneurysms with progressive thrombosis, 8 aneurysms demonstrating initial nearly total occlusion exhibited spontaneous progression of thrombosis to total occlusion on follow-up angiograms, 4 aneurysms demonstrating initial subtotal or partial occlusion showed opacification reduction of the sac or the neck remnant or total occlusion on follow-up angiography. In 19 aneurysms with re-opening or re-growth, 14 aneurysms had initial subtotal or partial occlusion, and 5 had initial total or nearly total occlusion with severe spasm of parent artery at initial emholization (Fig. 1). In 142 unchanged aneurysms, 128 were aneurysms with initial total or nearly total occlusion, 14 with initial subtotal or partial occlusion.

Table **1**　The occlusion degree of aneurysms with GDCs

occlusion degree	narrow neck	wide neck/unavailable
total or nearly total	102	40
subtotal occlusion	8	15
partial occlusion	1	7
total	111	62

Note: $\chi^2 = 21.551$, $P = 0.001$

Table **2**　Occlusion comparison between initial and first follow-up angiograms

initial angiography	n	follow-up angiography		
		unchanged	re-opening	progressive thrombosis
total/nearly total	142	128	5	8
subtotal occlusion	23	11	10	3
partial occlusion	8	3	4	1
total	173	142(82.1%)	19(11.0%)	12(6.9%)

The relationship between follow - up angiographic time

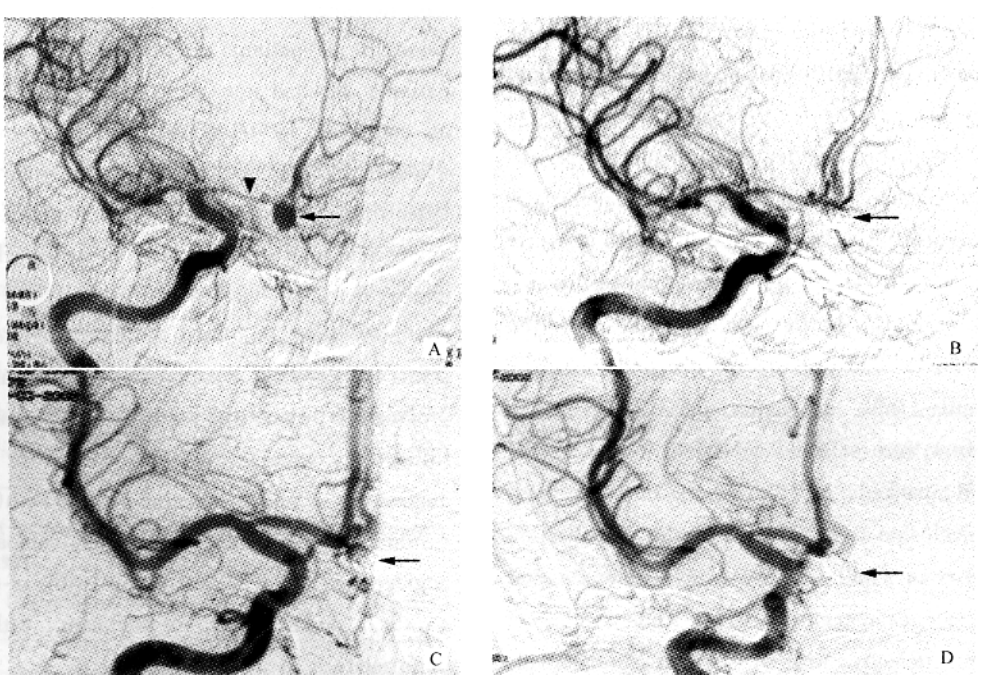

Fig.1　A 45-year-old woman presented with subarachnoid hemorrhage six days ago. A. DSA showed an aneurysm of ACoA(←) with the spasm of A1 segment (▲); B. Post-embolization with GDCs showed subtotal occlusion of the aneurysm(←); C. Follow-up DSA three months later showed the relief of the spasm of A1 segment and re-opening of the embolised aneurysm(←); D. After re-embolization with GDCs, the aneurysm was totally occluded(←).

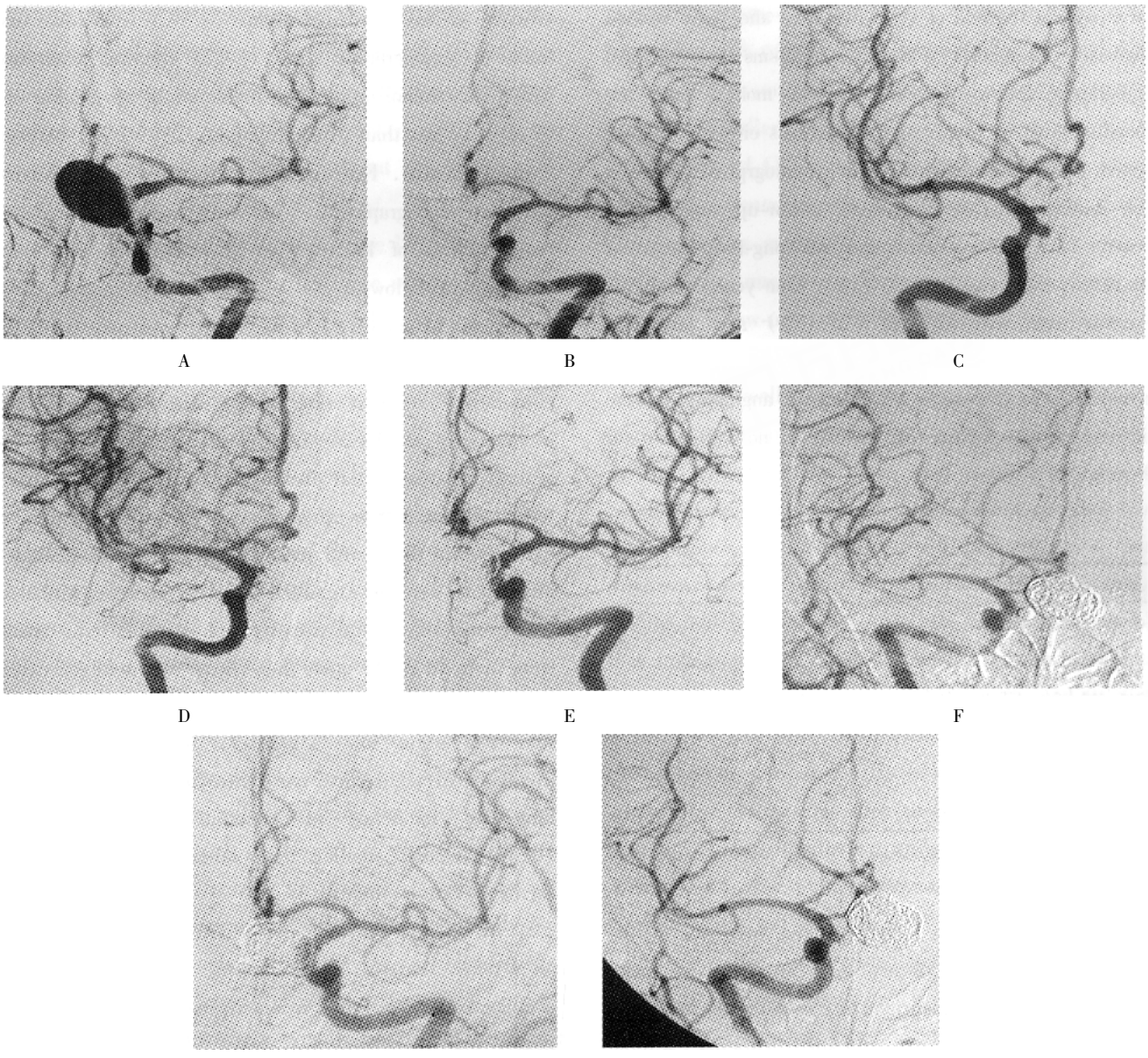

Fig.2 A 49-year-old woman presented with subarachnoid hemorrhage. A: Angiography of the left ICA showed a large aneurysm on the C2 segment of the left ICA. B: After GDC embolization with stent-assisted technique, the aneurysm was nearly total occluded. C: Angiography of right ICA demonstrated a small aneurysm on the right posterior communication artery. D: The small aneurysm was totally packed withy GDCs 3 months after the super aneurysm had been embolized. E + F: At 6-month follow-up of the large aneurysm and 3-month follow-up of the small aneurysm respectively, the large one was still totally occluded whereas the neck of the small one re-opened a little. G + H: At 14-month follow-up of the large aneurysm and 11-month follow-up of the small aneurysm respectively, the large one remained at the same occluded degree and the neck of the small one re-opened the same as in the last follow-up angiography. And the small aneurysm is still under close observation.

and outcome was shown in Table 3. In 19 aneurysms with re-opening or re-growth in the first follow-up angiography, 13 re-opened or re-grew at 3 months and 6 between 3 and 6 months after the procedure (Fig 2). Of the 19 aneurysms, 8 aneurysms were re-emholized with only GDCs and 4 underwent stent-assisted GDC embolization, with all ending in total occlusion after retreatment. The remaining 7 re-opening aneurysms underwent continuous angiographic follow-up up to 54 months after the procedure with four showing a slight enlargement and 3 unchanged comparing with the last follow-up angiograms. These patients are still under observation. All 12 aneurysms with progressive thrombosis were thrombosed within 6 months after the procedure.

The second angiographic follow-up within 12 months post-operatively showed re-opening of aneurysm in 4 (2.3%, Table 3) with much lower recurrent rate than the first follow-up one(17.1% at the end of third month,

and 6.2% at the end of sixth month), and there was no progressive thrombosis. Fifty-six aneurysms had the third angiographic follow-up more than 12 months after the procedure with no progressive thrombosis either. Four re-opened aneurysms on the second angiogrphy showed a little enlargement on the third follow-up angiography between 12 and 54 months and the long-term recurrent rate at this time was 7.1%(4/56). One year cumulative recurrent rate was 13.3% (23/173) and long-term 20.2%(35/173). The re-opened aneurysms during the second and third periods of follow-up angiography were still under close monitoring because of no indication for re-treatment.

Table 3　Relationship between follow-up duration and follow-up outcomes

duration	n	unchanged	re-opening	progressive thrombosis
< 3m	76	55	13(6)	8
3 to 6m	97	87	6(6)	4
> 6 < 12m *	173	169	4	0
12 – 24m**	34	32	2	0
> 24 < 36m**	16	14	2	0
36 – 54m**	6	6	0	0

Note: * second follow-up angiography; ** third follow-up angiography; () re-embolization with GDCs; m = month

One patient with a loosely-packed aneurysm on the anterior communicating artery died at 50th day post-operatively due to aneurismatic re-rupture and was excluded from follow-up program. Patients without angiographic follow-up one year post-operatively all lived well through telephone consultation with no recurrent aneurismatic rupture except 9 deaths of irrelated diseases.

Discussion

Since 1991, GDC embolization of intracranial aneurysms has evolved from an experimental procedure to a well-accepted, widely-performed method for protecting aneurysms from rupture or re-rupture. Many investigators believe that endovascular therapy with GDCs provides a reliable technique with a good anatomic and clinical result in the treatment of ruptured or un-ruptured cerebral aneurysms[5-8,12-14]. The follow-up course showed that re-opening or re-growth of the treated aneurysms with GDCs may occur at different times after the procedure[2,4,7,10,11] requiring periodic follow-up angiography to evaluate the efficacy of GDCs embolization[2,4,11,15,16]. In our first follow-up angiographic study of 173 cerebral aneurysms with GDCs embolization, the incidence of re-opening was 17.1% in less than 3 months and 6.2%(6/97) between 3 and 6 months. Four aneurysms recurred on the second follow-up angiography(2.3%) with one-year cumulative recurrent rate of 13.3%. In 56 aneurysms with third angiographic follow-up between 12 and 54 months, four re-opened aneurysms(7.1%) on the second follow-up showed a little bit enlargement with a long-term cumulative recurrent rate of 20.2% (35/173). The incidence of recurrence in less than 3 months was the highest because partial packing and parent arterial spasm led to having follow-up angiography at three months or earlier while those with totally or nearly totally occluded aneurysms were re-examined at sixth month. Moreover aneurysms with partial packing and parent arterial spasm were more likely to open than those with total or nearly total packing. Although the second follow-up recurrent rate was quite low (2.3%), one-year cumulative incidence of recurrence was quite high(13.3%). The long-term incidence of cumulative recurrence was 16.8%, much smaller than other reports[17] with a recurrent rate as high as 33.6%.

Re-opening of aneurysms occurred more often in aneurysms initially demonstrating subtotal or partial occlusion (45.2%) than in aneurysms with initial total or nearly total occlusion (3.5%). There were several factors related to aneurysmal re-growth. Enlargement of the residual neck/sac was very likely to be responsible for re-opening in most aneurysms treated with GDCs. In partially-occluded aneurysms with residual neck/sac, the coils were compressed against the distal wall of the aneurysm by bloodstream, resulting in re-opening of aneurysms. Spasm of parent artery was another factor. Under circumstances of parent artery spasm, precise evaluation of aneurysmal occlusion was sometimes difficult and the degree of occlusion was often over-estimated. With the relief of parent artery spasm[18], the coil-occluded aneurysm may re-open. In our study, 5 aneurysms with parent artery spasm were evaluated initially as nearly total occluded, but showed re-opening after the relief of parent artery spasm within 3 months after procedure (Fig.1).

As regard to surgical clipping of aneurysm neck, the goal of cerebral aneurysmal embolization with GDCs is to exclude the aneurysms from normal circulation. Therefore aneurysms should be occluded and packed with GDCs as densely as possible in order to prevent the entrance of blood[15,19,20]. It was generally agreed[21,22] that a good anatomical and clinical outcome is more likely to have in aneurysms with narrow necks than those with wide necks. In our study, the total or nearly total occlusion rate in narrow-necked aneurysms (91.9%) was much higher than in wide-necked/unavailable aneurysms (64.5%) and the difference is statistically significant ($P = 0.001$). The use of advanced techniques[11,22-27], such as the balloon-or stent-assisted techniques and the aneurysmal neck-bridge device, might have the promise to achieve complete obliteration in large, wide-necked lesions previously associated with suboptimal occlusion. But in early period of this study these techniques were not available at our institute, resulting in neck remnant of wide-necked aneurysms after embolization, responsible for re-opening. Even if the sac of wide-necked aneurysms can be densely packed by colis, bridging the neck with coil mesh is difficult because of the risk of coil deposits into the parent artery, increasing the danger of parent vessel thrombosis[22]. Because the residual neck was usually big enough to act as a small aneurysm, strong bloodstream would scatter along the wall of residual neck, resulting in an increasingly thinner and bulgier neck with final re-opening of aneurysm. In this case. re-embolization with GDCs or surgical clipping should be considered, based on the size and shape of the re-opening aneurysms. In 19 re-opening aneurysms in the first follow-up, 12 were re-embolized with GDCs immediately after first follow-up angiography and totally occluded. The other 7 re-opening aneurysms and those re-opened during the second and third angiographic follow-up remained under further observation because of no indication for surgery or re-embolization.

Owing to GDS coiling in the aneurysm sac unevenly, sometimes space with existing between coils in some large aneurysms, which looks like "a smiling face" on angiograms[28]. These aneurysms were categorized as nearly total occluded in this study. And most of them became completely occluded on follow-up angiograms, suggesting progressive thrombosis. In addition, of all 12 aneurysms with progressive thrombosis, the residual neck/sac of 4 aneurysms with initial subtotal or partial occlusion appeared smaller to some extent. Because of the coagulability of GDC itself and the hemodynamic change within the aneurysms after GDCs packing, this kind of aneurysms may gradually progress to total occlusion and the patients may recover thoroughly[10,26]. Even so, periodic follow-up angiography should continue for monitoring the progress of thrombosis.

It is really important to perform follow-up angiography of an aneurysm with GDCs embolization[10]. In this study, 19 aneurysms were observed to re-open within 6 months and, among them, 13 re-opened at third month after the procedure. In 12 aneurysms with progressive thrombosis, the occurrance in 8 was within 3 months and in 4 within 6 months. It seemed reasonable that angiographic follow-up for aneurysms with initial total or nearly total occlusion should be performed at sixth month after procedure. If this kind of aneurysms remained unchanged or showed no sign of re-opening on follow-up angiograms six months after procedure, aneurysmal re-opening is very unlikely, and angiographic follow-up interval may be prolonged properly, or non-invasive methods such as MRI or MRA should be applied for follow-up. For aneurysms with subtotal or partial occlusion on initial angiograms, angiographic follow-up should be taken at third month or earlier after the procedure. One patient with a loosely-packed cerebral aneurysm had a recurrent rupture of the aneurysm with more abundant bleeding and died in the emergency room on the 50th day after the procedure. It is obvious that earlier angiographic follow-up is necessary in aneurysms with initial subtotal or partial occlusion, and angiographic follow-up should be performed periodically even if there is no sign of enlargement of residual neck/sac[23].

Apart from the above-mentioned one patient who had rebleeding of a partially-occluded aneurysm on the 50th day after procedure, there was no other cases of recurrent hemorrhage after coil packing. It is certain that endovascular treatment is effective in preventing recurrent aneurysmal bleeding and represents an alternative to surgery in the treatment of ruptured intracranial aneurysms[22,29]. The mechanism of preventing recurrent

hemorrhage by coil occlusion is the effect of direct coil packing plus thrombosis induced by coils and blood stagnation to cause mechanical exclusion of the intra-aneurysmal flow. But the direct packing of coils plays a major role than thrombosis. Coil embolization may induce flow stagnation and promote thrombus formation in tightly-packed aneurysms rather than in partially-occluded ones, because blood flow renders partially-occluded aneurysms "unstable" for thrombosis[22]. For non-tightly-packed aneurysms, GDCs are exposed to the "water-hammer effect", which is responsible for aneurysmal re-growth. Among 12 aneurysms with progressive thrombosis, 8 were initially nearly total occlusion, and only 4 belong to initially subtotal or partial occlusion. The percentage of progressive thrombosis among initially subtotal- or partial-occluded aneurysms was only 12.9% (4/31) which was quite unsatisfactory. During the second and the third angiographic follow-up, there was no progressive thrombosis, which indicated that if there was no progressive thrombosis within 6 months, there would be no such progressive thrombosis later either. Therefore, in embolizing aneurysms with coils, trying to achieve total or nearly total occlusion for the prupose of preventing recurrent hemorrhage and re-growth of aneurysms would be the key step.

Based on the analysis of 162 cases with 173 cerebral aneurysms treated with GDCs and subsequent angiographic follow-up of 3 months or more, a few points may be summarized as follows: 1) An aneurysm embolized with subtotal or partial occlusion will be more likely to experience re-opening or re-growth of residual neck/sac than those with total or nearly total occlusion. Nevertheless, progressive thrombosis may lead to total occlusion in some of these aneurysms with partial occlusion. 2) Loose packing with GDCs in ruptured aneurysms seems to be at more risk of recurrent subarachnoid hemorrhage. 3) It is recommended that follow-up angiography should be performed at 6 months for initial total or nearly total occlusion aneurysms and at 3 months or earlier for initial subtotal or partial occlusion aneurysms after the procedure. 4) Total occlusion should be achieved at re-embolization with GDCs for re-opening aneurysms, which usually necessitates stent- or balloon-assisted technique. Periodic angiographic follow-up is stressed especially for re-opening aneurysms with or without re-embolization.

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Angiographic follow-up of cerebral aneurysms treated with Guglielmi detachable coils(GDCs): An analysis of 162 cases of 173 aneurysms

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相似文献(10条)

1. 外文期刊 Y. KOGUCHI. S. KOBAYASHI. K. TSURU. M. WADA. A. MIYATA. T. YAGISHITA Medico-financial Environment on Treatment for Acutely Ruptured Cerebral Aneurysms GDC Embolization vs Neck Clipping

We have been using the Guglielmi detachable coils (GDC) since 1997 as one choice of cerebral aneurysm treatment. We have, at the present time, two effective radical treatment methods for acutely ruptured cerebral aneurysms, GDC em-bolization and conventional surgical aneurys-mal neck clipping. There ensued questions about the cost and efficacy of the two strategies. Retrospective analysis was done on a GDC group and a clipping group, with each twenty consecutive patients. The features of the GDC group patients were higher age, and poorer Hunt and Kosnik grades than the other group. All MCA aneurysms were treated with surgical neck clipping, while all the posterior circulation aneurysms were embolized with GDC. Based on the Japanese Medical Insurance and Payment System, 477,890 points (1 point = ￥10) as a mean was required with the GDC group, and 456,084 points with the neck clipping group, showing no

significant difference between the two groups. In the GDC group, the cost of the implanted medical device seemed to raise the total medical expense.At present, the GDC embolization is the preferred choice of strategies in acutely ruptured cerebral aneurysms, and its preference increases in the surgically difficult cases, very old, or poor grade patients, and in various complicated cases. And, the GDC embolization seems to be satisfactory from the medico-financial viewpoint

2.外文期刊 R. ORTIZ.J. SONG.Y. NIIMI.A. BERENSTEIN Rate of Recanalization and Safety of Endovascular Embolization of Intracranial Saccular Aneurysms Framed with GDC 360 Coils

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 procedurerelated 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 angio-grams 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 subarachn

3.外文期刊 H. MANABE.A. TAKEMURA.S. HASEGAWA.M. NAGAHATA.S. ISLAM The Choice of Treatment Method for Unruptured Cerebral Aneurysm Investigation from Clinical Outcome, Angiographical Result, Duration of Hospital Stay, and Cost for Treatment

To compare complications, anigographical results, duration of postoperative hospital stay and cost for treatment of surgical clipping and coil embolization in the treatment of unruptured cerebral aneurysm.One hundred and nine non-giant saccular aneurysms in 90 patients were treated by either endovascular treatment (E group) or direct surgery (S group) in our Neurosurgical Department between April 1996 and April 2002. The complications and angiographical results were reviewed. The duration of postoperative hospital stay and cost for the treatment were calculated from bills for health insurance for 38 operations and 12 embolizations in 47 patients whose aim of hospitalization was only treatment for their unruptured aneurysm.Neck clipping was performed for 89 aneurysms (S group), wrapping for four (S group), embolization using Guglielmi's detachable coils (GDCs) for 15 (E group), and failed embolization followed by clipping for one (E group). The postoperative temporary deficit (disappeared within one month) and permanent deficit was seen in five cases (6.7%) and in three cases (morbidity: 4.0%) of S group, and in one case (6.7%) and none (morbidity; 0%) of E group, respectively. No death was seen in both group (mortality; 0% in both group). The rate of angiographical complete occlusion of the aneurysm was significantly higher in S group (P= 0.015, 88% in S group vs 50% in E group). The postoperative hospital stay was significantly shorter in E group (P= 0.000013, mean days: 17.1 in S group vs 6.3 in E group), but cost for treatment was rather cheep in S group (N.S., mean cost: 1684329 yen in S group vs. 2259011 in E group). This retrospective study suggested that surgical treatment may be less expensive treatment with higher rate of postoperative angio graphical complete occlusion than coil embolization, and treatment-related complication rate was similar in both treatment.

4.外文期刊 J.-K. KIM.Y.-J.KIM GDC Embolization of Intracranial Aneurysms with SAH and Mass Effect by Subdural Haematoma A Case Report and Review

A 43-year-old woman was brought to the emergency room due to the sudden onset of severe headache and stuporous consciousness. She had no history of head injury. Computerized tomography scan revealed subarachnoid haemorrhage and left SDH with midline shift of about 10 mm. Cerebral angiography demonstrated anterior communicating artery and right middle cerebral artery bifurcation aneurysms. Her family refused operation due to her religion never to permit blood transfusion. So just aneurysm coiling and medical ICP control was planned. Guglielmi detachable coil (GDCs) embolization of the two aneurysms was successfully performed. She made a neurological recovery after embolization without evacuation of the SDH. She was discharged from hospital with no neurological deficit on day 21. We report our experience of successful GDC embolization on multiple aneurysms without craniotomy even in the selected case of mass effect.incidence of SDH due to ruptured aneurysm is reported to be 0.5 ~ 7.9% . Reynolds (1981), in an autopsy study, found an incidence of 10.7% in a series of 205 cases. Urgent surgery for patients with ruptured aneurysm and SDH with mass effect has been strongly recommended for the purpose of aneurysm clipping and simultaneous clot removal. Guglielmi Detachable Coils (GDCs) embolization of aneurysms is also an option, especially in case of multiple aneurysms or high risk aneurysms. We experienced a case of SDH by ruptured aneurysm which was successfully treated using GDC embolization without open surgery for SDH removal.

5.外文期刊 Takao Sagiuchi.Katsumi Tadokoro.Akira Kurata.Sachio Suzuki.Ikuo Kobayashi.Kiyotaka Fujii.Katsumi Ishii Tc-99m ECD Early Dynamic Single Photon Emission Computed Tomography for Determination of Intra-Aneurysmal Dynamics Before and After Endovascular Treatment

The authors here describe a 44-year-old woman with a ruptured internal carotid-posterior communicating artery (IC-PC) aneurysm evaluated by Tc-99m ethyl cysteinate dimer (ECD) early dynamic single photon emission computed tomography (SPECT) before and after Guglielmi detachable coil (GDC) embolization. Our SPECT studies could be used to confirm the absence of aneurysmal blood flow after coiling.

6.外文期刊 定藤章代.滝和郎 脳外科領域におけるendovascularsurgery

脳神経外科領域の血管内手術のトピックスとして最近の脳動脈瘤の血管内手術について述べた．Guglielmi Detachable Coil（GDC：Boston，Scien一tic社）は離脱式コイルで，脳動脈瘤の瘤内塞栓による根治性を大いに高めている．動脈瘤の穿孔が数パーセントに起こることや，巨大なもの，血栓を伴うもの，broad neckの動脈瘤では未だ完全に閉塞させるのが難しい場合もあるが，ネッククリッピング術が困難な症例には第一選択の治療となりつつある．

7.外文期刊 佐藤清貴.加藤正人 破裂脳動脈瘤塞栓術中の再破裂

脳動脈瘤に対するGuglielmi detachable coil（GDC）による塞栓術は，直視下の手術ではないため破裂時の対処が問題となる。 そこで，当院における塞栓術症例を検討した。 症例は脳動脈瘤破裂によるくも膜下出血94症例で，女性59症例，男性35症例，年齢は21-88歳，平均67(+-)14歳であ

った。 開頭根治術を第一選択とし，動脈瘤の部位，合併症などから急性期開頭術が適応とならない場合に塞栓術を行った。 3症例（3．2%）で術中再破裂がみられ，造影剤の血管外漏出が確認された。 いずれも嚢状動脈瘤で，解離性動脈瘤の再破裂はなかった。 2症例でコイルの動脈瘤外逸脱がみられた。 急激な血圧上昇がみられたが，ニカルジピン，プロタミン投与と維持麻酔の増量で5分以内に循環は安定し，出血はコントロールされ，手術を続行することができた。 麻酔は，1症例がプロポフォール，2症例がセボフルランで維持していた。 脳動脈瘤の塞栓術では，破裂を来した場合，術者は直接止血操作をすることができない。 したがって，麻酔科医が積極的に循環管理を行うことによって対処しなければならない。

8. 期刊论文 龙霄翱. 陈兵. 陈立一. 许成杰. 赵革灵. LONG Xiao-ao. CHEN Bing. CHEN Li-yi. XU Cheng-jie. ZHAO Ge-ling "篮筐"技术在颅内动脉瘤介入治疗中的应用 -中国综合临床2009,25(7)

目的 探讨"篮筐"技术在颅内动脉瘤介入治疗中的方法、机制、适应证及疗效.方法 1:1≥颈/体≥1:2的颅内宽颈动脉瘤156例,应用"3D弹簧圈"成篮技术;颈/体<1:2的窄颈动脉瘤,应用"2D弹簧圈"成篮技术;后继弹簧圈选用普通二维弹簧圈、水凝胶弹簧圈或毛弹簧圈以达致密填塞.结果 156例共158个颅内动脉瘤中100%闭塞143个(90.5%),出院格拉斯哥预后评分5分131例(84.0%),死亡2例(1.3%).结论 "篮筐"技术的应用能有效地增加颅内动脉瘤的填塞率,减少瘤颈残余,达到致密填塞,改善预后的目的 .

9. 期刊论文 段传志. 何旭英. 李铁林. 汪求精. 徐如祥. DUAN Chuan-zhi. HE Xu-ying. LI Tie-lin. WANG Qiu-jing. XU Ru-xiang 颅内动脉瘤血管内栓塞治疗的临床效果 -中华神经医学杂志2005,4(4)

目的探讨可脱性弹簧圈及可脱性球囊血管内栓塞治疗颅内动脉瘤的效果及技术要点.方法对1328例来自华南地区部分省市的颅内动脉瘤应用微导管技术,在数字减影血管造影监视下行血管内栓塞治疗,其中85例90个动脉瘤用机械式可脱性弹簧圈(MDS)栓塞,825例847个动脉瘤用电解式可脱性弹簧圈(GDC)栓塞.67例巨大动脉瘤中37例用可脱性球囊闭塞载瘤动脉,18例用GDC,11例用EDC,1例用MDS闭塞载瘤动脉. 结果成功栓塞1 328例1 370个动脉瘤,1322例痊愈,6例死亡.栓塞程度:100%栓塞1281个(包括载瘤动脉闭塞者),95%栓塞65个,90%栓塞20个,80%栓塞4个.术中动脉瘤破裂9例,并发脑梗死5例,1例微弹簧末端逸出并顽固性脑血管痉挛.2例复发者再给予GDC栓塞而治愈.结论血管内栓塞治疗颅内动脉瘤是一种比较安全、可靠、有效的治疗手段,动脉瘤较大者,术后复发率高;术前反复蛛网膜下腔出血者,术中动脉瘤破裂的可能性较大.

10. 外文期刊 Katsaridis V. Papagiannaki C. Violaris C Guglielmi detachable coils versus matrix coils: a comparison of the immediate posttreatment results of the embolization of 364 cerebral aneurysms in 307 patients: a single-center, single-surgeon experience.

BACKGROUND: Matrix coils are based on Gugliemi detachable coils (GDC) but are covered with polyglycolic/polylactic acid. We present our experience regarding the immediate posttreatment results of aneurysm embolization using the 2 coil systems. PATIENTS: We embolized 219 aneurysms in 187 patients with the use of GDCs and 145 aneurysms in 120 patients with the use of Matrix coils. Age, sex distribution, unruptured aneurysm cases, and multiple aneurysm cases were similar in the 2 groups. The percentage of patients in severe clinical condition was significantly higher in the Matrix group. The mean aneurysm size was slightly larger in the GDC group but the mean neck size was larger in the Matrix group. RESULTS: Satisfactory occlusion (at least 90%) was achieved in 95.9% of GDC-treated aneurysms and in 98.6% of Matrix-treated aneurysms. Procedure-related complications occurred in 19.6% of GDC procedures and in 15.6% of the Matrix ones resulting in procedure-related mortality and morbidity of 3.7% and 2.7% for the GDC group and 2.5% and 1.7% for the Matrix group. In the GDC group, outcome was good (modified Rankin Scale 0-2) in 92.6% of patients with unruptured aneurysms, in 82.6% of patients with Hunt and Hess grade I-III, and in 20.5% of those with Hunt and Hess grade of IV-V. The respective figures were 95%, 85.7%, and 22.7% in the Matrix group. CONCLUSION: In our series, Matrix coils have yielded slightly better results regarding satisfactory occlusion rate and clinical outcome but these differences are not statistically significant and probably reflect our increased experience in aneurysm embolization during the period we used Matrix coils.

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