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Conventional microsurgical technique and endovascular method for the treatment of cerebral aneurysms: a comparative view

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Summary

Endovascular embolization using Guglielmi Detachable Coils (GDCs) for complicated intracranial aneurysms has become widely accepted as an alternative to direct surgery. There is now a choice of therapeutic options for the management of cerebral aneurysms. The decision for treatment of an individual patient should be based on objective selection of the safest and most effective treatment. In addition, less invasive and cost effective treatment should be chosen. It is self-evident that the primary consideration in the selection process must be the immediate and long-term welfare of the individual patient, rather than the physician's preference for any specific treatment modality.

GDC embolization is a less invasive and safe treatment with low incidence of periprocedural morbidity, and has been successful in preventing acute subsequent bleeding, whereas follow-up results are less satisfactory in cases involving incompletely obliterated lesions. High incidence of recanalization was promoted in cases with neck remnant and/or body filling.

In contrast, the most important advantage of direct surgery is long-term durability, while conditions of patients and aneurysmal geometry limit the indication of direct surgery. In addition, direct surgery could be applied to complicated aneurysms with wide-neck or branching from the neck in combination with vascular reconstruction technique, such as EC-IC bypass.

With these limitations in mind, patients need to be very carefully chosen for GDC embolization or direct surgery.

Keywords: Cerebral aneurysm; direct surgery; endovascular treatment; GDC.

Introduction

Recent advancement in neurosurgery and interventional neuroradiology has brought us a new aspect to the treatment of cerebral aneurysms. There is now a choice of several therapeutic options for the management of cerebral aneurysms [1, 2, 9]. The selection of interventional neuroradiologic techniques with GDC, therefore, requires consideration of neurosurgical techniques, just as the selection of neurosurgical treatment requires an analysis of endovascular alternatives. Decision for the treatment of an individual patient should be based on objective selection of the safest and most effective treatment. It is self-evident that the primary consideration in the selection process must be the immediate and long-term welfare of the individual patient, rather than the physician's preference for any specific treatment modality.

Safety, efficacy and limitations of treatment

As for the safety of treatment, there is no significant difference between coil embolization and direct surgery regarding the periprocedural mortality and morbidity. Concerning the degree of invasion, GDC embolization is apparently less invasive and has been successful in preventing acute subsequent bleeding, whereas follow-up results are less satisfactory in cases involving incompletely obliterated lesions. High incidence of recanalization was promoted in such cases. From my personal experience, 64.9% of incompletely obliterated aneurysms displayed recanalization or regrowth on follow-up angiography, 13.5% of incompletely obliterated aneurysms exhibited progressive thrombosis, 21.6% remained unchanged. The most important advantage of direct surgery is long-term durability, while conditions of patients and aneurysmal geometry limit the indication of direct surgery. In contrast, the advantage of coil embolization is that patients' medical condition and aneurysmal geometry do not affect the indication of coil embolization. Figure 1 demonstrates a ruptured large fenestrated basilar artery aneurysm. Direct surgery for this aneurysm was considered to be extremely difficult, while complete occlusion of aneurysm could be achieved by coil embolization.

Fig. 1. *Left:* Right vertebral angiogram demonstrates a ruptured large fenestrated basilar artery aneurysm. *Right:* Angiogram obtained after coil embolization demonstrates complete occlusion of aneurysm

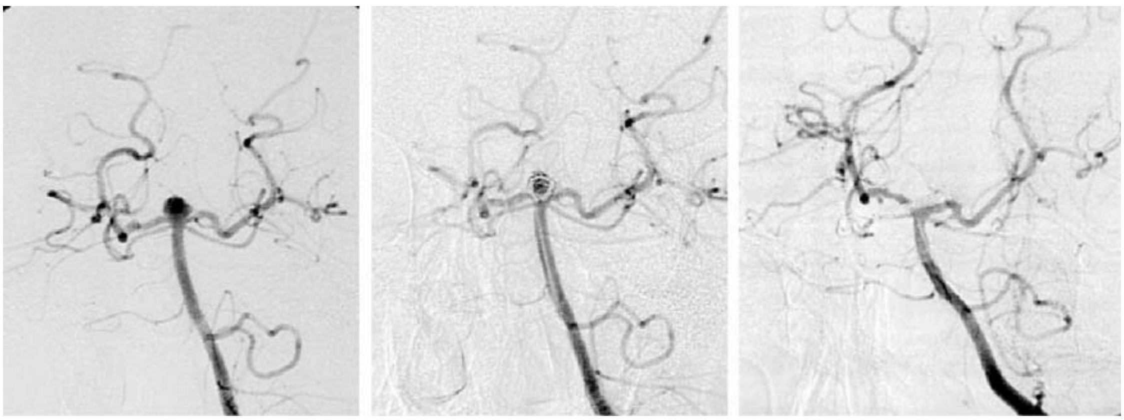

Fig. 2. *Left:* Left vertebral angiogram shows a small basilar tip aneurysm with relatively wide neck. *Center:* The first coil protruded to the basilar artery, so that the coil was retrieved to avoid thrombo-embolic complication. *Right:* Angiogram obtained after surgical neck clipping demonstrates complete obliteration of aneurysm

Aneurysms with ill-defined neck or branching from the neck or dome of aneurysm are not suitable for coil embolization. Figure 2 shows a small basilar tip aneurysm with relatively wide neck. Coil embolization was attempted once, but the first coil protruded to the basilar artery, so that the coil was retrieved to avoid thrombo-embolic complication. Surgical neck clipping was performed without any insults.

Aneurysms with mass effect may be a contra-indication for coil embolization. Direct surgery is to be preferred for this lesion.

Limitation of access route, such as marked atherosclerosis, makes endovascular coiling difficult. Figure 3 shows a low positional basilar tip aneurysm with limitated access via endovascular route, left VA was occluded and right VA origin exhibited coiling. Direct surgical clipping was done with modern skull base surgical technique, thus low positional basilar tip aneurysms could be managed safely. Through the standard pterional approach, the operative view is quite restricted. Anterior clinoidectomy enhanced mobilization of IC and widened the operative field, so that the posterior clinoid process could be removed. Definitive clipping could be achieved with preservation of all perforating branches.

Coil embolization could not be applied to compli-

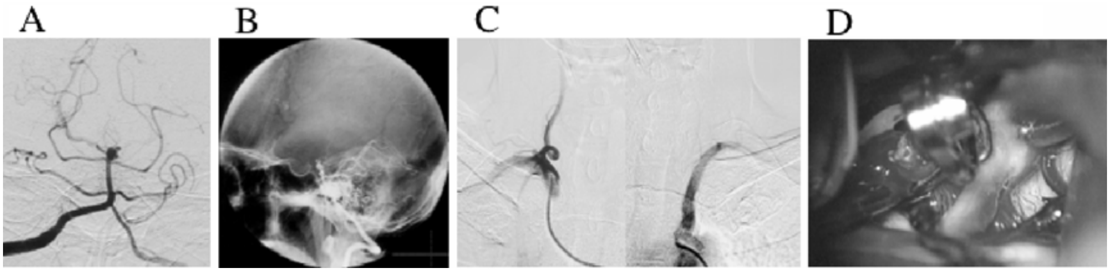

Fig. 3. (A) Left vertebral angiogram shows a small basilar tip aneurysm. (B) Lateral view of angiogram demonstrates that the neck of aneurysm was below the posterior clinoid process. (C) Angiograms demonstrate that a left VA was occluded and origin of right VA exhibited coiling. (D) Definitive clipping could be achieved with preservation of all the perforating branches

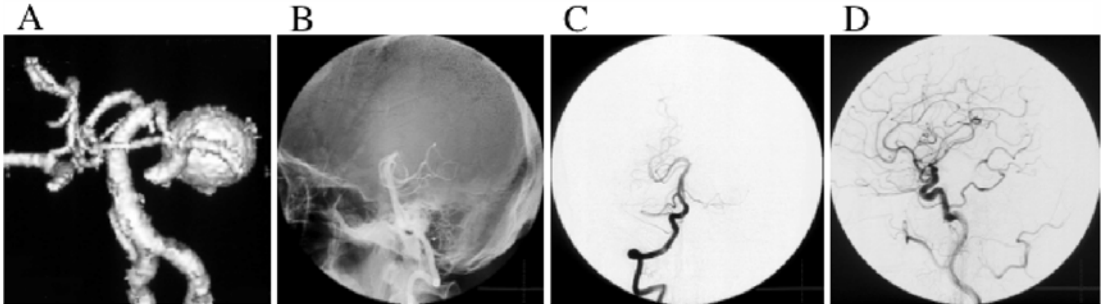

Fig. 4. (A) 3D CT angiogram shows a high positioned large left PCA (P2) aneurysm. (B) Lateral view of angiogram demonstrates that the aneurysm was 2 cm above the posterior clinoid process. (C) Angiogram obtained after surgical trapping demonstrates complete obliteration of aneurysm. (D) The post-operative left carotid angiogram demonstrates that the distal left PCA was perfused via STA-PCA anastomosis

cated aneurysms with occlusion intolerance, whereas such aneurysms could be managed by direct surgery in combination with vascular reconstruction technique, such as EC-IC bypass. Figure 4 shows a high positioned large left P2 aneurysm. Balloon occlusion test of left P1 indicated that the patient was intolerable for permanent PCA occlusion. Direct surgery is preferable for such complicated aneurysms with occlusion intolerance. STA-PCA anastomosis and trapping of aneurysm was performed. Proximal PCA was approached via supra IC bifurcation space, as aneurysm was high positional. Distal PCA was approached through partial corticotomy of entorhinal cortex. The post-operative angiogram demonstrated that the aneurysm was completely trapped and distal left PCA could be seen via STA-PCA anastomosis.

Collaboration between direct surgery and endovascular coiling

Collaboration between direct surgery and endovascular coiling has become an important factor. Not only when the procedure failed or to attempt another treatment modality, but also real collaboration, such as tentative coiling followed by definitive clipping or surgical vascular reconstruction followed by coil embolization, is useful in the treatment of complicated aneurysms. Figure 5 shows a case with ruptured right MCA aneurysm with ill-defined neck and mild vasospasm adjacent to the aneurysm. The patient consulted our clinic on day 7. In order to prevent rebleeding as well as deterioration of vasospasm, tentative coil embolization was performed with aneurysmal neck patent. It is one of the great advantages of coil embolization to occlude the aneurysm without manipulation of the brain parenchyma and the cerebral vasculatures. Two weeks later, definitive neck clipping was performed without any difficulty. Figure 6 shows large VA union aneurysm located midline, and left PICA was delivered from the dome of the aneurysm. OA-PICA anastomosis was made, and left PICA was clipped at its orifice. Coil embolization was followed by OA-PICA anastomosis.

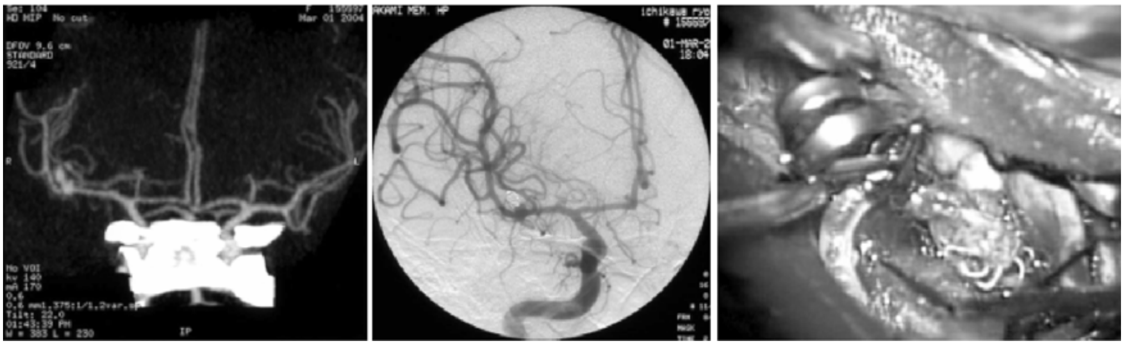

Fig. 5. *Left:* 3D CT angiogram shows a ruptured right MCA aneurysm with ill-defined neck and mild vasospasm adjacent to the aneurysm. *Center:* Right carotid angiogram obtained after tentative coil embolization demonstrates that the rupture site of aneurysm was occluded with aneurysmal neck patent. *Right:* Definitive neck clipping was performed without difficulty

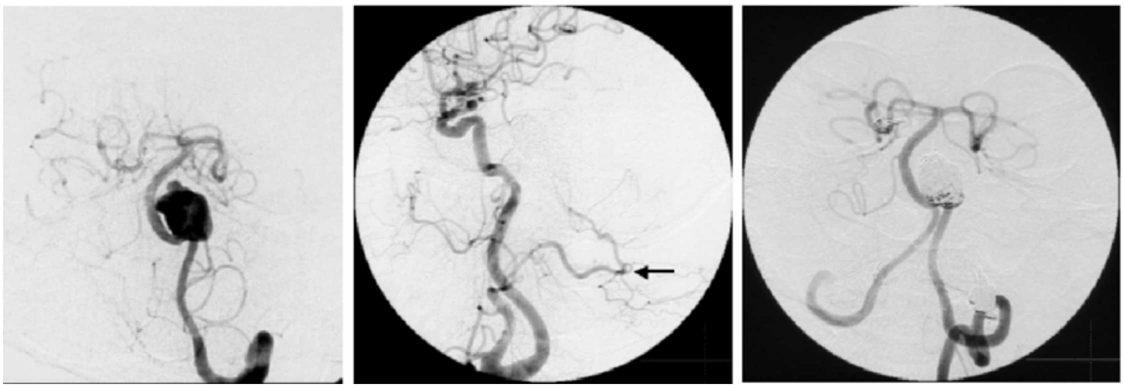

Fig. 6. *Left:* Left vertebral angiogram shows a large VA union aneurysm located midline, and the left PICA was delivered from the dome of the aneurysm. *Center:* Left carotid angiogram obtained after left OA-PICA anastomosis demonstrates that the left PICA was perfused via OA-PICA anastomosis (arrow). *Right:* Angiogram obtained after coil embolization demonstrates occlusion of aneurysm

Discussion

Endovascular embolization using GDCs for complicated intracranial aneurysms has become widely accepted as an alternative to direct surgery. Published reports of early clinical and angiographical results have been promising [1, 2, 9], but long-term efficacy of the GDC methods remains to be determined. International Subarachnoid Aneurysm Trial of neurosurgical clipping versus endovascular coiling (ISAT) suggested that in patients with a ruptured aneurysm, for which endovascular coiling and surgical clipping are therapeutic options, outcome is significantly more favorable with endovascular coiling [5]. The ISAT also suggests that the risk of rebleeding is higher and retreatment has to be performed somewhat more frequently with endovascular coiling. Longer term follow-up is vital to answer the question of durability of endovascular coiling. Endovascular coil embolization is a safe treatment with low incidence of periprocedural morbidity, and has been successful in preventing acute subsequent bleeding, whereas follow-up results are less satisfactory in cases involving incompletely obliterated lesions. High incidence of recanalization was promoted in such cases. 64.9% of incompletely obliterated aneurysms showed aneurysmal recanalization or regrowth in my series [7]. Incomplete endovascular occlusion of aneurysm leaves the patient at risk for future expansion and future subarachnoid hemorrhage [3, 4, 6, 8, 10]. Coil embolizations should not be chosen unless complete obliteration of aneurysms can be achieved. Surgical clipping can be applied to complicated aneurysms which have unsuitable configuration for coil embolization, such as ill-defined neck or branching from the neck, in combination with the vascular reconstruction technique. With this limitation in mind, patients need to be very carefully chosen for GDC.

Conclusions

The selection of interventional neuroradiologic techniques requires consideration of neurosurgical techniques, just as the selection of neurosurgical treatment requires an analysis of endovascular alternatives. The decision for treatment should be based on objective selection of the safest and most effective treatment. Further refinements of GDC technology are necessary to improve morphological and clinical outcomes.

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