Endovascular Coil Embolization for Cerebral Aneurysms Solely Using Ultrasoft Coils

T. TSUMOTO, T. TERADA, H. YAMAGA, T. ITAKURA

Department of Neurological Surgery, Wakayama Medical University, Japan

Key words: coil embolization, cerebral aneurysm, ultrasoft coil

Summary

We report a series of coil embolizations for small aneurysms solely using GDC ultrasoft coils and discuss the advantages of this method. Seven small aneurysms (<4.0 mm) were embolized solely with ultrasoft coils. Ultrasoft coils were sequentially inserted into aneurysms. Immediately after embolization, five aneurysms were completely occluded, and two exhibited body filling. All cases were treated successfully without any complications. In conclusion, ultrasoft coils were found efficacious for the treatment of small, irregular-shaped, and ruptured aneurysms; their softness and malleability facilitated their compaction into an aneurysm.

Introduction

The endovascular treatment of intracranial aneurysms with Guglielmi detachable coils (GDC; Boston Scientific, Fremont, CA) has become widely accepted as a safe and less invasive alternative to standard surgical clipping¹. However, using this method for small aneurysms still has a greater risk of rupture during coil embolization than it does for large ones. GDC-10 ultrasoft coils are the softest coils currently available for embolization of cerebral aneurysms. We report our experience of coil embolization for small aneurysms less than 4.0 mm solely using ultrasoft coils.

Material and Methods

Cases

Five consecutive patients with a total of seven aneurysms were treated solely with ultracoils in our institution (table 1). Two were ruptured aneurysms; three were unruptured aneurysms associated with ruptured aneurysms; and two were incidentally found. These aneurysms ranged from 2.5 mm to 4 mm in diameter; their locations were: two at the basilar-superior cerebellar artery (BA-SCA); one at the anterior communicating artery (Acom); one at the basilar artery (BA tip); one at the internal carotid artery (IC); one at the posterior inferior cerebellar artery (PICA distal); and one at the middle cerebral artery (MCA).

Method of Coil Embolization

In this series, we solely used GDC-10 ultrasoft coils, and remodeling was achieved with a balloon, if necessary². We sequentially inserted ultrasoft coils into the aneurysm until dense packing was achieved. Angiographic results were categorized as follows: complete occlusion; neck remnant; and body filling.

Results

All cases were successfully treated without any complications. Immediately following embolization, five aneurysms were completely oc-

Figure 1 Angiogram of the vertebral artery (Case 2). A) Pre-treatment, showing the PICA distal aneurysm. B) Immediately after treatment, showing complete occlusion. C) Five months after the initial treatment, showing recanalization of the aneurysm. D) Post-retreatment, showing disappearance of the aneurysm including the vermian branch of the PICA.

Table 1 Summary of Cases.

Case	Location	Symptoms	Procedure	Result	Retreatment
1	Acom	SAH (non ruptured)	simple technique	dome filling	+
	IC	SAH (non ruptured)	simple technique	complete occlusion	–
2	PICA distal	SAH (ruptured)	simple technique	complete occlusion	+
3	BA-SCA	SAH (ruptured)	simple technique	dome filling	–
4	BA-SCA	SAH (non ruptured)	simple technique	complete occlusion	–
5	BA tip	incidental	remodelling technique	complete occlusion	–
	MCA	incidental	simple technique	complete occlusion	–

cluded, and two exhibited body filling. The remodeling technique was necessary in one case of an asymptomatic BA aneurysm. Two patients received a repeat procedure. One was an Acom aneurysm, which resulted in body filling after the initial treatment. The other was a PICA distal aneurysm, which resulted in complete occlusion at the initial treatment.

Representative Cases

Case 2

A 52-year-old man with subarachnoid haemorrhage (SAH) due to a ruptured PICA distal aneurysm was treated with coil embolization. Complete occlusion was achieved with a 2 mm x 6 cm and a 2 mm x 4 cm ultrasoft coil, preserving the vermian branch of the PICA (figure 1A,B). However, five months after treatment, the aneurysm was found to be recanalized. The recurrent portion of the aneurysm, including the vermian branch of the PICA, was packed with a 2 mm x 3 cm coil, because it was perfused in retrograde fashion after temporary occlusion at its origin (figure 1C,D).

Case 5

A 39-year-old woman received treatment for incidental multiple aneurysms. Initially, the BA tip aneurysm was embolized with a 3 mm x 8 cm and a 3 mm x 6 cm ultrasoft coil, using a remodeling technique (figure 2A,B). Subsequently, the MCA aneurysm was packed with a 2.5 mm x 6 cm and a 2.5 mm x 4 cm ultrasoft coil. In similar fashion, the aneurysm was thoroughly embolized.

Discussion

Piecemeal Technique Compared to Standard Technique

In the standard technique, the tip of a microcatheter is placed in the center of an aneurysm. Then, a frame is made within the aneurysm using a coil as large as the aneurysm. Subsequently, coils of incrementally decreased size are introduced within the frame to fill the aneurysmal lumen.

In the "piecemeal technique" used in this series, a tip of a microcatheter is placed deeply in the dome, and an initial coil is compacted into the bottom of the aneurysm. The next coil is compacted proximal to the former coil. This method is repeated until dense packing is achieved.

Figure 2 Angiogram of the basilar artery Case 5. A) Pre-treatment, showing the BA tip aneurysm. B) Post-treatment, showing complete occlusion.

Advantages of the Piecemeal Technique Using Ultrasoft Coils

For small, irregular-shaped, and ruptured aneurysms less than 4.0 mm, GDC-10 soft coils are too rigid to fit into an aneurysm and have a risk of rupture because of stress to the aneurysmal wall. Conversely, GDC-10 ultrasoft coils are about 1.5 times softer than GDC-10 soft

coils; thus, facilitating compaction into an aneurysm with minimum stress.

Moreover, in a silicone sidewall aneurysm model, a 40% packing ratio (volume of coils/aneurysm volume) was achieved, solely using ultrasoft coils, compared to a 33% packing ratio with a combination of GDC-10 standard, GDC-10 soft, and GDC-10 ultrasoft coil^{3,4}. Therefore, the safe and thorough embolization

of small aneurysms can be accomplished with the sole use of ultrasoft coils.

Conclusions

In this series, we embolized small aneurysms safely and thoroughly with the sole use of ultrasoft coils. Ultrasoft coils were found to be useful for the “piecemeal technique”.

References

- 1 Raymond J, Roy D et Al: Safety and efficacy of endovascular treatment of acutely ruptured aneurysms. *Neurosurgery* 41: 1235-1245, 1997.
- 2 Moret J, Cognard C et Al: La technique de reconstruction dans le traitement des aneurysms intracraniens a collet large. Resultant angiographiques et cliniques a long terme. A propos de 56 cas. *J Neuroradiol* 24: 30-44, 1997.
- 3 Piotin M, Liebig T et Al: Increasing the packing of small aneurysms with soft coils: an in vitro study. *Neuroradiology* 46: 935-939, 2004.
- 4 Piotin M, Mandai S et Al: Dense packing of cerebral aneurysms: an in vitro study with detachable platinum coils. *Am J Neuroradiol* 21: 757-760, 2000.

Tomoyuki Tsumoto, M.D.
Department of Neurological Surgery
Wakayama Medical University
Japan