A Newly Developed 3 cm Marker Balloon Microcatheter

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Summary

No balloon microcatheter with a 3 cm marker has been developed to date. We developed a new balloon microcatheter with a double marker. This balloon microcatheter, with an outer diameter of 2.8 F, has a balloon on the most distal portion with a maximum inflation diameter of 4 mm and two markers, one is on the tip and the other is 3 cm proximal to the tip. This balloon microcatheter would make interventional procedures, especially for parent artery occlusion, simple to perform and safer.

Introduction

The role of coil embolization for the treatment of cerebral aneurysms has recently received much attention. Coil embolization is sometimes performed in combination with a balloon microcatheter. However, no balloon microcatheter with a 3 cm marker has yet been developed. So, if we want to use a microcatheter and a balloon microcatheter in the same session, we must use two catheters. In the situation of parent artery occlusion, for example, we usually introduce a balloon microcatheter first, then exchange the balloon microcatheter for a microcatheter. This is relatively complicated process for such a simple technique. We have therefore developed a balloon microcatheter with a 3 cm marker.

Materials

This is a double lumen balloon microcatheter. The balloon is made of silicone with a length of 10 mm and a nominal inflation diameter of 4 mm (Figure 1). There are three types of distal tip (distal to the distal end of the balloon), 2 mm, 8 mm and 15 mm. There is a ventilator hole just proximal to the proximal end of the balloon. The air in the dead space is purged from the hole, but 50% contrast medium does not escape from the hole. The balloon diameter is 4 mm with a nominal inflation volume of 0.06 ml and 5.5 mm with a maximum inflation volume of 0.12 ml. There are two markers on this balloon microcatheter, on each end of the balloon, on the tip and 3 cm proximal to the tip. The outer diameter is 2.8 F and the inner diameter is 0.014 inches. It accepts 0.012 inch microguide wire and detachable coils for the 10-system.

Case Report

A 58-year-old woman was diagnosed to have an unruptured left middle cerebral artery (MCA) aneurysm and a right vertebral artery (VA) aneurysm. Treatment of the VA aneurysm was planned months after the coiling of the left MCA aneurysm. The VA aneurysm was thought to be a large fusiform aneurysm (Figure 2A), so parent artery occlusion seemed

Figure 1 Profile of 3 cm marker balloon microcatheter.

Figure 2 A) Right vertebral angiograms, right anterior oblique view showing fusiform aneurysm on the right vertebral artery (VA) distal to the origin of the right posterior inferior cerebellar artery (PICA). B) Right vertebral angiogram during balloon occlusion test. The balloon is inflated at the origin of the right PICA (arrow). C) Skull x-ray during insertion of the 12th coil. The balloon is inflated. Note that the balloon is partially herniated to the right PICA (arrow). D) Right vertebral angiogram immediately after embolization. The right VA is completely occluded while preserving the right PICA.

to be a beneficial treatment approach. It was essential to preserve the right posterior inferior cerebellar artery (PICA), but the distance between the proximal portion of the aneurysm and the origin of the right PICA was short. As a result, we planned to use a balloon catheter in the later stage of embolization to prevent the

coils disturbing the origin of the PICA. We wanted to perform such a procedure using only one microcatheter, and that is the reason we developed this balloon microcatheter.

A 6F introducing catheter was inserted to the right VA and the 3 cm marker balloon microcatheter (Fuji Systems, Tokyo, Japan) was

introduced into the aneurysm using the 0.012 inch guide wire under systemic heparinization. At first, the balloon was inflated at the origin of the PICA to check the tolerance of the right VA occlusion as well as temporary occlusion of the PICA (Figure 2B). The patient's clinical condition did not change after inflation of the balloon. As a result, we concluded that the patient could tolerate the right VA occlusion. A platinum detachable coil, measuring 7 mm in diameter and 13.9 cm in length (Micrusphere, San Jose, CA), was first used without any inflation of the balloon. The balloon was not inflated until the sixth coil. The aneurysm was then diffusely filled by six coils, while the right VA remained open. We then inserted the seventh coil, a Guglielmi detachable coil (GDC) Ultra-soft, (Boston Scientific, Natick, MA) under balloon inflation. Thanks to the balloon, the coil never protruded toward the proximal portion of the right VA. We next continued embolization using eight more coils with inflation of the balloon (Figure 2C). The right VA was occluded at the site of the aneurysm while preserving the right PICA (Figure 2D).

Discussion

Coil embolization has been one of major options for treating cerebral aneurysm since the introduction of GDC in 1991. There have been several improvements in coil embolization, such as the introduction of stretch resistant technology¹, a 3D system² and the double catheter technique³. Among them, the combined use of a balloon catheter is considered to be one of the most important techniques to have helped to widen the indications for coil embolization. The combined use of a balloon microcatheter in coil embolization was introduced in 1997⁴⁻⁶. This technology further expanded the indications for coil embolization⁷⁻⁹. However, no balloon microcatheter with 3 cm marker has been developed to date.

It is widely known that parent artery occlusion is often effective and a safe treatment for some aneurysms. A balloon microcatheter with a 3 cm marker makes parent artery occlusion simple to perform and safer. It also helps to re-

duce the time needed to carry out this procedure because we can perform coil embolization after a balloon occlusion test. It may also reduce catheter routes in some situations. For example, we successfully performed parent artery occlusion with the preservation of the right PICA using only one microcatheter in the case described. Otherwise, it would have been necessary to cannulate a balloon microcatheter to the PICA in order to preserve the artery.

Parent artery occlusion of an internal carotid artery is sometimes performed under proximal flow control. In such a situation, we must use a balloon catheter as an introducing catheter. Balloon catheters are substantially worse to use than introducing catheters. This newly developed balloon microcatheter makes proximal flow control possible using an ordinal introducing catheter.

Parent artery occlusion has already been performed using a similar concept reported by Handa et al¹⁰. However, they used a double lumen balloon microcatheter with a single marker. Using such a balloon microcatheter, determining whether a detached point is inside the catheter or outside is thus often difficult. This difficulty may carry the risk of vessel perforation.

The balloon microcatheter used this time was immature and as a result there were several points that need to be improved. This catheter could accept only a 10-system coil, but we already developed a new type with a larger inner diameter allowing an 18-system. The balloon is usually inflated from the center so there was some dead length beyond the equator of the balloon. We recently developed a new type balloon with uniform inflation, in which the most distal part inflates earlier than the other areas.

If we improve the trackability of the catheter, then this catheter could be utilized for intra-aneurysmal embolization. The catheter would then become a 3 cm marker microcatheter with a balloon instead of a balloon microcatheter with a 3 cm marker as at present. In such a situation, the microcatheter may therefore have the potential of becoming the standard microcatheter for neuro-intervention in the future.

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