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Case Report

Delayed Self-expansion Phenomenon as a Complication of Neuroform Stent Assisted Coiling for Ruptured Intracranial Aneurysm

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Use of stent assisted coiling of intracranial aneurysms has shown a recent increase. Despite technical improvement and accumulated clinical experiences, due to insufficient study data, debate over short and long term durability and associated complication has continued.

To the best of our knowledge, this case report, for the first time, demonstrates delayed self-expansion phenomenon occurring as an acute and unpredictable complication of Neuroform stent assisted coiling for treatment of a ruptured intracranial aneurysm.

Keywords Delayed self-expansion, Neuroform stent, Intracranial aneurysm, Complication

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INTRODUCTION

The Neuroform stent (NFS; Boston Scientific/Target, Fremont, CA), a nickel-titanium alloy (Nitinol), provides a high grade of elasticity and deformability, and has been authorized for treatment of wide-necked aneurysms under a humanitarian device exemption by the Food and Drug Administration (FDA).

Stent-assisted embolization allows for adequate coil placement and prevents coil protrusion into the parent vessel. Several authors have already reported on use of the NFS for treatment of wide-necked aneurysms and have demonstrated its effectiveness.[1-3)8)11)] However, as a new device, study on short- and long-term effects of the NFS on cerebral vasculature is limited. In particular, there is limited data documenting the rate of complication in stent-assisted coiling in ruptured aneurysms.[5)13)]

CASE REPORT

A 43-year-old female patient who presented with subarachnoid hemorrhage (SAH) was admitted in Hunt and Hess Grade II. Findings on the initial computed tomography (CT) scan of the brain showed significant subarachnoid hemorrhage surrounding the basal cistern and interhemispheric fissure. Findings on cerebral angiography revealed a small aneurysm of the left anterior communicating artery (Acom) (Fig. 1A). Because the size of the aneurysm was small, and the dome and neck ratio was less than 2.0, we decided to deploy a stent prior to coil embolization. Preoperative antiplatelet treatment was not considered. A 2.5 mm × 20 mm NFS (Boston Scientific/Target Therapeutics, Fremont, CA) was deployed, followed by endovascular occlusion. We observed overlap of stent distal markers, which implied that the stent had

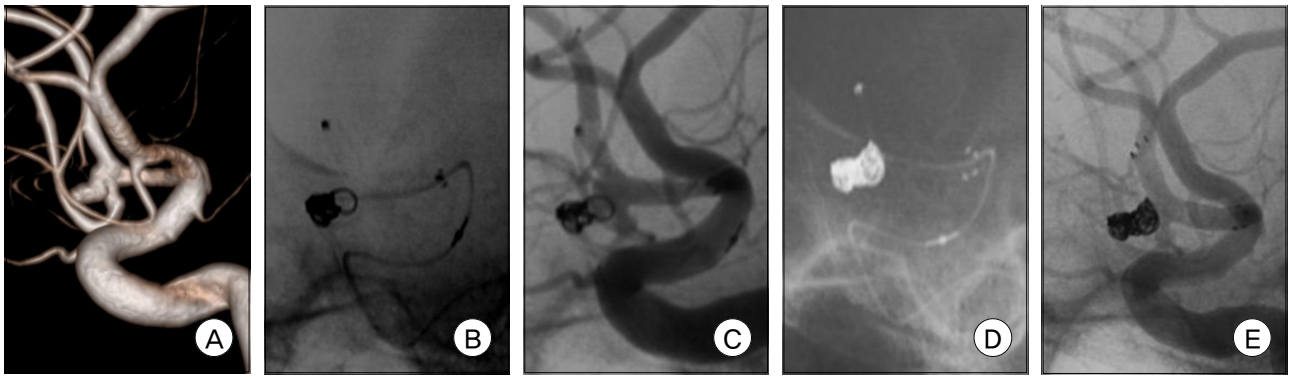

Fig. 1. Working view of the three dimensional (3D) left internal carotid artery (ICA) shows the aneurysm at the left dominant anterior communicating artery before stent-assisted coiling (A). Working view of the left ICA angiogram shows optimal stent deployment and coil delivery but overlap of distal stent markers (B). Working view of the left ICA angiogram shows intact distal flow despite overlap of distal stent markers (C). Working view of left ICA angiogram shows more coil packing on the aneurysm but not yet none expansion of the distal stent marker(D). Immediately posttreatment, working view of the unsubtracted left ICA shows no flow compromise of parent and expansion of the distal stent marker(E).

not expanded properly (Fig. 1B).

However, under this condition, distal flow remained stable without any remarkable change (Fig. 1C).

After stent placement, coil embolization was performed through a microcatheter (Excelsior SL-10; Boston Scientific/Target Therapeutics) located in the aneurysm through the interstices of the stent, using detachable coils. An unsubtracted image showed the stent and coil in place (Fig. 1D). The distal markers did not expand properly during coil embolization; however, we observed unexpected expansion of the distal marker on angiography when the last coil was completed (Fig. 1E). Even before performing any necessary procedures, self-expansion phenomenon was observed, and, after performance of distal subtracted angiography, distal flow was in good preservation, and the shape of the coil was not distorted.

The patient was discharged from the hospital 14 days after admission without any neurologic deficit.

DISCUSSION

Endovascular treatment of intracranial aneurysms using detachable coils has developed into an effective and widely used technique. Despite increasing clinical experience and technological improvements, endovascular treatment is still associated with inherent risks of morbidity and mortality.[7] In particular, this treatment is not a useful option for treatment of certain types of complicated aneurysms; embolization of wide-necked aneurysms remains complicated due to the risk of coil migration or coil protrusion into the parent vessel.

The Neuroform was initially designed uniquely for use in cerebral vessels. It consisted of nickel titanium alloy, known as nitinol, a shape memory alloy, which possesses a high grade of elasticity and deformability due to its self-expandable properties. The austenite temperature of the Neuroform stent is body temperature, at which the stent will convert from martensite to austenite, the original cylindrical form of the stent.[4)6)]

Most of the stent is radiolucent, excluding the bilateral platinum end markers. The stent is placed in position; the stabilizer catheter then proceeds, guided by the wire, where it reaches the proximal tip of the stent. The micro-delivery catheter is then retracted over both the stabilizer catheter and the microwire, to the point where the stent is released. Once the stent expands, the widening can be seed through the platinum marker, and the stent itself becomes radiolucent. With successful deployment, the marker must exist at both ends to the neck of the aneurysm in expanded state.

A growing number of reports on use of the NFS in

endovascular treatment of wide-necked aneurysms have been published.[9] The most frequently published data on stent-assisted coil embolization consists of results from patients with unruptured aneurysms, and the safety of stent insertion under acute subarachnoid hemorrhage is still open to discussion.[12] In a large study reported by Tähtinen et al.,[10] 61 patients presented with ruptured wide-necked aneurysms. The overall complication rate was 21%, which was thought to be associated with the procedure. Benitez et al.[2] presented on the use of NFS in 56 patients with wide-necked aneurysms, nearly half of whom were harboring subarachnoid hemorrhage. The procedure-related morbidity and mortality were 8.6% and 2.1%, respectively. Akpek et al.[1] reported on a study of 32 patients with 35 aneurysms, with only four ruptured aneurysms. Adverse events occurred in 25% of patients, in which 9.3% showed persisting neurologic deficit. Forming of thrombus in the stent was found in 18.8% of patients. Use of the NFS can cause complications, as reported in the above-mentioned articles.[5][11][13]

However, we believe that no report on delayed or none expansion of intracranial stent strut has been published. In cases of none expansion of the stent distal or proximal maker band, an unexpanded stent strut might act as a thrombogenic focus, and, finally, we might encounter a fetal complication, such as a thrombogenic event, especially in aneurysms within a small parent artery. We propose that stent platinum markers are entangled tightly together inside the microcatheter sheath and are rarely untangled in unsheathe state.

Because this is a seldom occurrence, there have been few reports that explain this phenomenon. The original cylindrical configuration, as previously mentioned, may explain this phenomenon. In other words, the stent itself maintains a cylindrical shape inside the sheath before deployment, not folded simply, failure of mechanical expansion can occur at the moment of coming out from the stent sheath. This failure can be temporally or permanent. Stent application should be considered specifically for this undesirable situation, especially for patients who present with a small parent artery or any other risks of unstable stent deployment, even a wide neck aneurysm.

Solutions for unexpanded stent problems are limited. Expansion of a stent strut is impossible using a balloon system because the distal marker still blocks the space for passage of a balloon guiding catheter. Waiting until self expansion of the stent marker is another option under the condition that distal blood flow is maintained. Treatment with heparin can be considered when distal blood flow is compromised or when there is a high risk of thrombogenic events. In the case of total occlusion of the parent artery, catastrophic consequences may occur, therefore, stent removal is inevitable.

More reports suggesting solutions for these problems and modification of the stent technique will be needed in the future.

CONCLUSION

NFS-assisted coiling is an important addition to the devices used in endovascular treatment of wide-necked aneurysms. In most cases, this phenomenon represents a rare event and is not predictable. However, when handling stents, interventionists should always bear in mind this unpredictable phenomenon of none or delayed expansion and it is also needed in such situations in order to establish optimal treatment guidelines.

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