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Case Report

Retreatment of Recanalized Aneurysms After Y-stent-assisted Coil Embolization with Double Enterprise Stents: Case Report and Systematic Review of the Literature

Çift Enterprise Stentli Y Stent Yardımlı Sarmal Embolizasyonu Sonrasında Rekanalize Anevrizmaların Tekrar Tedavisi: Olgu Sunumu ve Literatürün Sistematik Gözden Geçirilmesi

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ABSTRACT

It is necessary to consider possibility of recanalization and retreatment after coil embolization for cerebral aneurysms. There is concern that retreatment for recanalized aneurysms after Y-stent-assisted coil embolization may be difficult because of double stents, especially in Y-stents with double closed-cell stents owing to narrowed structures. However, no detailed reports of retreatment after Y-stent have been reported. Between July 2010 and June 2013, we treated four aneurysms with Y-stent-assisted coil embolization using Enterprise closed-cell stents. Recanalization occurred in one case (25%), and retreatment was performed. We easily navigated a microcatheter into the target portions of the aneurysm through the Y-stent and occluded the aneurysm with coils. Additionally, by systematically searching in PubMed, we found 105 cases of Y-stent-assisted coil embolization using Enterprise stents or Neuroform stents with more than 6 months of follow-up. Among them, retreatment was performed in 10 cases (9.5%). There were no significant differences in retreatment rates among different stent combinations (P=0.91; Fisher's exact test). In conclusion, navigation of a microcatheter into the aneurysm through the Y-stent with double Enterprise stents was feasible, and retreatment rates after Y-stent-assisted coiling may not depend on stent combinations.

KEYWORDS: Cerebral aneurysms, Enterprise stent, Recanalization, Retreatment, Y-stent-assisted coil embolization

ÖZ

Serebral anevrizmalar için sarmal embolizasyon sonrasında rekanalizasyon ve tekrar tedavi olasılığının ele alınması gerekir. Y stent yardımlı sarmal embolizasyon sonrasında rekanalize anevrizmaların tekrar tedavisinin özellikle çift kapalı hücre stentli Y stentlerde daralmış yapılar nedeniyle, çift stentler durumunda zor olabileceği konusunda endişe vardır. Ancak Y stent sonrasında tekrar tedavi açısından ayrıntılı bir rapor yoktur. Temmuz 2010 ile Haziran 2013 arasında Enterprise kapalı hücre stentlerini kullanarak Y stent yardımlı sarmal embolizasyon ile dört anevrizmayı tedavi ettik. Bir olguda (%25) rekanalizasyon oldu ve tekrar tedavi yapıldı. Mikrokateterden anevrizmanın hedef kısımlarına Y stent aracılığıyla kolayca navigasyon yaptık ve anevrizmayı sarmallarla tıkadık. Ayrıca PubMed üzerinde sistematik araştırmayla 6 aydan fazla takibi olan Enterprise stent veya Neuroform stent kullanılan Y stent yardımlı sarmal embolizasyonlu 105 olgu bulduk. Bunlar arasında tekrar tedavi 10 olguda (%9,5) yapılmıştır. Farklı stent kombinasyonları arasında tekrar tedavi oranları açısından önemli bir fark yoktu (P=0,91; Fisher'in kesin testi). Sonuç olarak çift Enterprise stentlerinde Y stent içinden anevrizmaya bir mikrokateter navigasyonu mümkündü ve Y stent yardımlı sarmal konması sonrasında tekrar tedavi oranları stent kombinasyonlarına bağlı olmayabilir.

ANAHTAR SÖZCÜKLER: Serebral anevrizmalar, Enterprise stenti, Rekanalizasyon, Tekrar tedavi, Y stent yardımlı sarmal embolizasyonu

INTRODUCTION

Y-stent-assisted coil embolization is performed for complex or wide-necked bifurcation aneurysms. In most Y-stent cases, a second stent is deployed through the interstices of the first stent (crossing Y-stent) (1, 2, 4, 10, 12, 14, 17). Use of double closed-cell stents causes narrowing of the second stent through the interstices of the first stent (12), while using an open-cell stent as the first stent can avoid this effect of narrowing (10). There is concern that retreatment may be difficult in recanalized aneurysms after Y-stent-assisted coil embolization because double stents may disturb insertion of a microcatheter into aneurysms through stent pores, especially in Y-stents with closed-cell stents. We present a case of retreatment of a recanalized aneurysm after Y-stent-assisted coil embolization with double closed-cell stents. This is the first detailed description of retreatment for a recanalized aneurysm after Y-stent-assisted coiling. In addition, we

performed systematic review of the literature to examine whether different stent combinations in Y-stent have different recanalization and retreatment rates.

CASE REPORT

Between July 2010 and June 2013, we treated four aneurysms with Y-stent-assisted coil embolization using Enterprise closed-cell stents (Cordis Neurovascular, Miami, FL, USA) as we described previously (8). The mean (± standard deviation) age was 66 ± 10 years. The cases were all unruptured basilar tip aneurysms. The aneurysm and neck size were 11.4 ± 4.9 mm and 9.8 ± 2.5 mm, respectively. All the patients were neurologically intact at the mean follow-up period of 32 ± 5 months. The latest follow-up imaging by angiography or magnetic resonance imaging was performed at 28 ± 3 months from treatment. Recanalization occurred in one case (25%), and retreatment was performed as follows.

A 77-year-old woman had an 18-mm unruptured basilar tip aneurysm (Figure 1A, E). The diameters of the basilar artery (BA), the right posterior cerebral artery (PCA), and the left PCA were 3.7 mm, 1.6 mm, and 1.5 mm, respectively. We treated the aneurysm with Y-stent-assisted coil embolization using double Enterprise stents. A Prowler Select Plus microcatheter (Cordis Neurovascular) for stent delivery was navigated into the right PCA. An SL-10 microcatheter (Stryker Neurovascular, Freemont, CA, USA) was placed into the aneurysm. After several coils were inserted in the aneurysm, a 4.5 mm × 28 mm Enterprise stent was deployed from the right PCA to the BA. The Prowler Select Plus microcatheter was navigated into the left PCA through the interstices of the first stent. Another 4.5 mm × 22 mm Enterprise stent was deployed from the left PCA to the BA. Additional coils were inserted and the procedure was completed. A slight neck remnant remained (Figure 1B, F). The total length of the coils was 439 cm and the coil packing density was 19.2%. No peri-procedural complications occurred. A schematic illustration of the procedure is shown in Figure 2A. There was a narrowed structure in the second stent.

Major recanalization occurred (Figure 1C, G), and we performed retreatment of the aneurysm 33 months after the first treatment. There were two portions of open space in the aneurysm: the mid-portion and the left lateral potion (Figure 1C, 2B). An SL-10 microcatheter was easily navigated into the mid-portion of the aneurysm over a 0.014″ Chikai guidewire (Asahi Intecc, Nagoya, Aichi, Japan) through a Y-stent. Coils were inserted, and open space remained at the left lateral portion. We pulled back the microcatheter, and easily navigated it into the open space (Figure 2B). There were no difficulties in navigation of a microcatheter into the target portions in spite of the existence of the Y-stent with double Enterprise stents. Coils were inserted, and the open space was almost occluded (Figure 1D, H). No complications occurred.

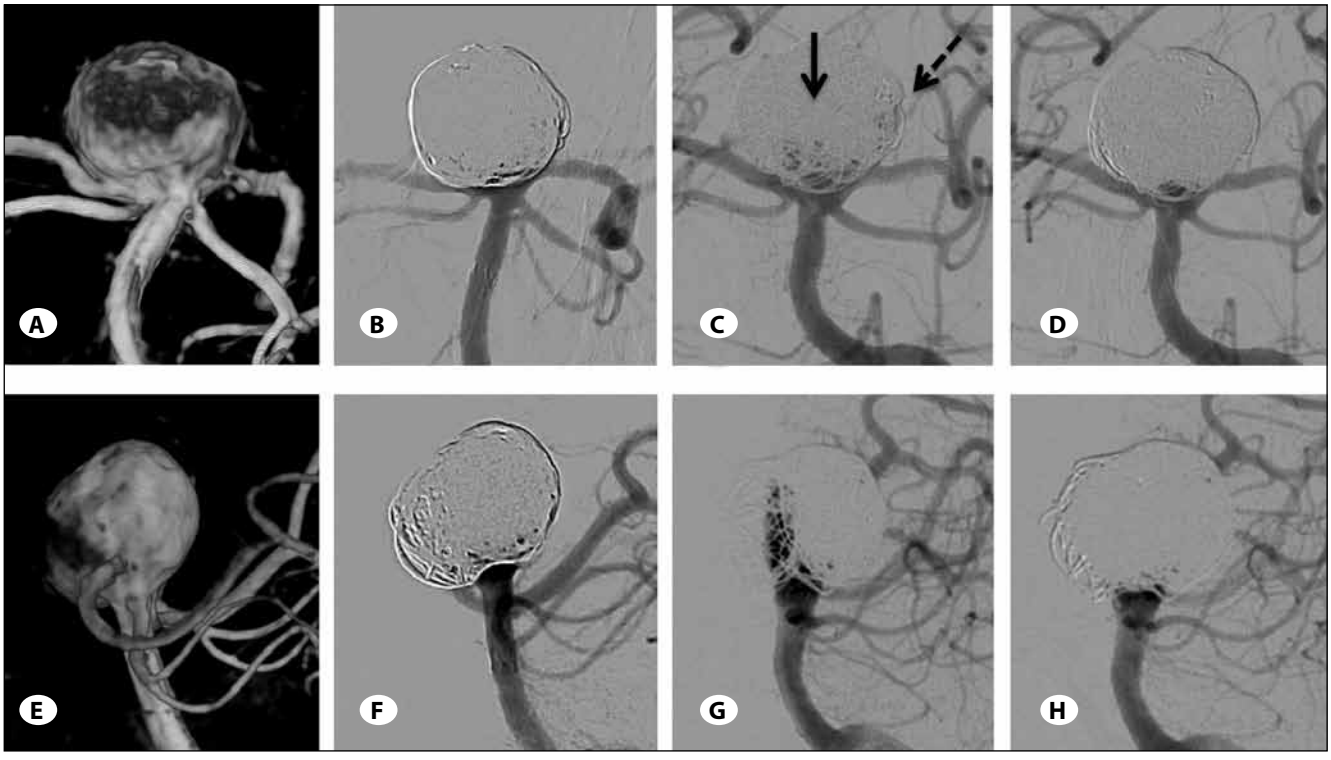

Figure 1: Anterior-posterior **(A-D)** and lateral **(E-H)** views of angiography. **(A, E)** Preoperative three-dimensional rotational angiography shows an 18-mm unruptured basilar tip aneurysm. **(B, F)** A slight neck remnant remained in the first treatment. **(C, G)** Major recanalization of the aneurysm occurred. There were two portions of open space in the aneurysm: the mid-portion (arrow) and the left lateral potion (dashed arrow). **(D, H)** Nearly complete occlusion of the aneurysm was achieved after retreatment.

The patient remained neurologically intact 4 months after the retreatment.

Review of the Literature and Statistical Analysis

We systematically searched the literature by PubMed using several keywords, including "Y-stent", "Y configuration", "dual/double stents", "cerebral/intracranial aneurysm", and "coil embolization". Checking titles, abstracts and manuscripts, we found 13 articles on Y-stent-assisted coil embolization with more than 6 months of follow-up (Table I) (1, 3, 5-7, 10-17). Among 13 case series and our series in Table I, we selected the series in which stent combinations and retreatment were confirmed (Table II). There were 105 Y-stent cases with three different stent combinations. Among them, retreatment was performed in 10 cases (9.5%). We performed statistical analysis using SPSS version 20 (IBM Corp., Armonk, NY, USA). P<0.05 was considered as significant. There were no significant differences in retreatment rates among different stent combinations (P=0.91; Fisher's exact test).

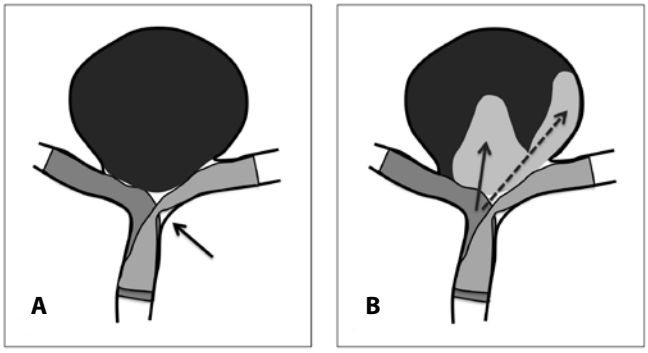

Figure 2: A schematic diagram of the case. **A)** In the first treatment of the aneurysm with Y-stent-assisted coil embolization, the second stent had a narrowed structure (arrow). **B)** Retreatment for the recanalized aneurysm was performed. A microcatheter was first inserted into the mid-portion of the aneurysm (arrow). After coils were inserted, the microcatheter was re-navigated into the left lateral portion of the aneurysm (dashed arrow). Coils were inserted in this portion.

DISCUSSION

Several reports on Y-stent-assisted coil embolization with long-term follow-up showed 0–29% recanalization rates and 0–21% retreatment rates, although most of them consisted of a small number of case series (Table I) (1, 3, 5-7, 10-17). In these previous reports, although there were nine cases of retreatment in total, no details of the retreatments were described. In addition, Neuroform stents were used in all of the nine cases. Therefore, to the best of our knowledge, this is the first report of a detailed description of retreatment for Y-stents with double closed-cell stents. There is controversy whether the narrowed structure of Y-stents with closed-cell

Table I: Summary of the Literature on Y-Stent-Assisted Coil Embolization with More than 6 Months of Follow-Up

Series	n	Stent combination (n)	Recanalization	Retreatment Stent combination (n)
Sani et al, 2005 (13)	1	N×N (1)	0 (0%)	0 (0%)
Thorell et al, 2005 (15)	7	N×N (7)	2 (29%)	1 (14%) N×N (1)
Lozen et al, 2009 (10)	6	N×N (6)	1 (17%)	0 (0%)
Rohde et al, 2010 (12)	1	E×E (1)	0 (0%)	0 (0%)
Akgul et al, 2011 (1)	9	N×E (6), E×E (3)	0 (0%)	0 (0%)
Spiotta et al, 2011 (14)	19	N×N (19)	5 (26%)	4 (21%) N×N (4)
Martínez-Galdámez et al, 2012 (11)	6	S×S (6)	0 (0%)	0 (0%)
Darkhabani et al, 2012 (5)	4	N×N (4)	0 (0%)	0 (0%)
Chalouhi et al, 2012 (3)	12	N×N, N×E, E×E[a]	1 (8.3%)	0 (0%)
Zhao et al, 2012 (17)	11	N×N (8), N×E (1), E×E (2)	2 (18%)	1 (9%) N×E (1)
Johnson et al, 2013 (7)	10	Not reported	0 (0%)	0 (0%)
Yavuz et al, 2013 (16)	183	N×N, E×E, S×S, E×S[a]	4 (2.2%)	Not reported
Fargen et al, 2013 (6)	45	N×N (13), N×E (23), E×E (7)	4 (8.9%)	3 (10%) N×N (1), N×E (2)
Present series	4	E×E (4)	1 (25%)	1 (25%) E×E (1)

Only Y-stent cases with more than 6 months of follow-up were selected in each series.
a, *Numbers could not be determined from the literature;* ***N,*** *Neuroform stent;* ***E,*** *Enterprise stent;* ***S,*** *Solitaire stent (ev3, Irvine, CA, USA).*

Table II: Retreatment Rates among Different Combinations of Stents in the Literature

	N×N	N×E	E×E
Total	58	30	17
Retreatment	6 (10.3%)	3 (10.0%)	1 (5.9%)

N, *Neuroform stent;* ***E,*** *Enterprise stent.*

stents is beneficial or harmful. While this narrowed structure may increase thromboembolic complications (8), it may reduce recanalization rates by redirecting impingement flow into distal vessels (9). In the systematic review of the literature, we found no significant differences among different stent combinations. Because of limitations of literature review, we could not take other factors such as follow-up periods, aneurysm size, and packing density into consideration. In addition, the number of retreatment (n=10) may be small. Therefore, although the statistical analysis showed no significant differences of retreatments rates among different combinations of stents, different stent combinations may have different retreatment rates if the number of Y-stent cases is increased.

The possibility of retreatment after Y-stent-assisted coil embolization should be taken into consideration. Because a Y-stent is already placed, there are no other options of retreatment than coil embolization without any adjunctive techniques such as balloon or stent assistance. There is concern that a narrowed structure may disturb navigation of a microcatheter into an aneurysm through a Y-stent, especially with closed-cell stents. Our report demonstrates that it was feasible to navigate an SL-10 microcatheter into an aneurysm through a Y-stent with closed-cell stents. Because pores of Neuroform stents are larger than those of Enterprise stents and Y-stents with Neuroform stents have no narrowed structure, we could presume that it may be feasible to navigate a microcatheter into an aneurysm through a Y-stent with Neuroform stents. Since this is a single case report, we cannot generalize this feasibility of navigation of a microcatheter. Parent vessels with different sizes and shapes will produce different shape of stents, which may make navigation of a microcatheter difficult. Many more cases are necessary to elucidate technical procedures of retreatment for recanalized aneurysms after Y-stent-assisted coil embolization.

CONCLUSION

We report a case of retreatment of a recanalized aneurysm treated with a Y-stent using double closed-cell stents. We easily navigated an SL-10 microcatheter into the target potions of the aneurysm through stent pores and completed the coil embolization. Systematic review of the literature showed no significant differences in retreatment rates after Y-stent-assisted coil embolization among different combinations of stents.

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