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ABSTRACT

BACKGROUND AND PURPOSE: Most distal MCA aneurysms are located within the insular segment, which lies between the limen insulae and circular sulcus. However, experience is limited in the microsurgical and endovascular management of insular segment MCA aneurysms. In this multicenter retrospective case series, we aimed to investigate the safety, efficacy, and durability of stent-assisted coiling for treatment of insular segment MCA aneurysms.

MATERIALS AND METHODS: A retrospective review was performed to identify patients with insular MCA aneurysms that were treated with stent-assisted coiling. The technical success of the procedures and the initial and follow-up clinical and angiographic outcomes were assessed. Periprocedural and delayed complications were reviewed.

RESULTS: Twenty-seven aneurysms in 27 patients with a mean age of 53.3 (SD,11.3) years were included. The mean size of the aneurysms was 6.3 (SD 2.6) mm. Endovascular procedures were successfully performed in all patients. Immediate postprocedural angiography revealed complete aneurysm occlusions in 81.5%. Periprocedural complications developed in 7.4% without causing permanent morbidity. A delayed thromboembolic complication resulted in a minor permanent morbidity in 1 patient (3.7%). There was no mortality. The mean duration of angiographic follow-up was 19.5 (SD, 9.8) months. The last follow-up examinations showed complete occlusion in 92.6%. During the follow-up period, none of the treated aneurysms showed recanalization.

CONCLUSIONS: The results of this study demonstrate that stent-assisted coiling with a low-profile self-expandable stent is a feasible and relatively safe technique for endovascular treatment of insular segment complex MCA aneurysms. Additionally, it provides an effective and durable treatment for insular MCA aneurysms.

MCA aneurysms constitute 18%–20% of all intracranial aneurysms.[1,2] Most MCA aneurysms are located at the bifurcation or trifurcation of the MCA in the proximal Sylvian fissure. Only 1.1%–6% of MCA aneurysms are located distal to the MCA bifurcation.[3-8] Most distal MCA aneurysms are located in the distal Sylvian fissure and along the insular branches that run between the limen insulae and circular sulcus. Because these are relatively rare vascular lesions, experience is limited regarding the microsurgical or endovascular management of insular segment MCA aneurysms.[3,4,8,9] The microsurgical treatment of distal MCA aneurysms is demanding compared with those located at the bifurcation. Because insular segment MCA aneurysms are embedded in the insular sulci, deep in the Sylvian cistern, it may be difficult to identify and access them during microsurgery.[3,8] Endovascular treatment of insular segment MCA aneurysms has not been specifically studied previously.[9]

Because the greatest branching of the MCA occurs in the insular segment, protection of the MCA branches supplying eloquent cortical regions is important during microsurgery or endovascular treatment. The stent-assisted coiling technique has been developed for the endovascular treatment of wide-neck intracranial aneurysms.[10,11] Self-expandable stents dedicated to intracranial use have enabled the coiling of wide-neck and complex bifurcation aneurysms. Deployment of a stent into a bifurcation creates a scaffold to protect the vessels during the coiling of a complex bifurcation aneurysm. The risk of vessel trauma during the catheterization and the navigation into small-sized insular branches are technical and safety concerns for endovascular treatment of insular segment MCA aneurysms. The introduction of low-profile self-expandable stents has been revolutionary in the endovascular surgery of intracranial aneurysms. Low-profile stents can be delivered through microcatheters with an internal

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diameter of 0.0165 inches, which facilitates the safe catheterization and easy navigation in small-sized vessels.[11-15] Moreover, low-profile stents can be implanted in arteries with diameters as small as 0.8 mm.[12,13] Thus, the introduction of low-profile self-expandable stents has expanded the scope of the endovascular surgery to include the treatment of aneurysms located distal to the circle of Willis.

In this multicenter retrospective study, we aimed to investigate the feasibility, safety, and efficacy of the stent-assisted coiling procedure using low-profile self-expandable stents for the treatment of insular segment MCA aneurysms. We also assessed the long-term clinical and angiographic outcomes.

MATERIALS AND METHODS

Study Design

After we obtained the local ethics committee approval of Istanbul Faculty of Medicine, a multicenter retrospective review was performed to identify patients with an insular segment MCA aneurysm treated with the stent-assisted coiling technique between January 2016 and January 2021. Stent-assisted coiling was performed in the treatment of aneurysms with a dome/neck ratio of <2 or a neck diameter of >4 mm, a sac morphology not suitable for primary coiling or recanalized aneurysms after primary coiling or balloon-assisted coiling. For the definition of the insular segment, the MCA was divided into 4 anatomic segments as described by Gibo et al.[16] The sphenoidal or horizontal (M1) segment begins from the internal carotid bifurcation and terminates at the site of a 90° turn called the genu. The insular (M2) segment begins at the genu and ends at the circular sulcus of the insula. On the basis of this anatomic classification, the MCA aneurysms located between the MCA genu and circular sulcus were defined as insular segment (M2) aneurysms and were included in this study.

The medical records and radiologic images of the patients with insular aneurysms were collected. Three experienced endovascular surgeons (K.A., M. Berdikhojayev, and A.A.) assessed the surgery reports, medical charts, and radiologic images of the patients. Patient demographics and presenting symptoms, the size of the aneurysms, treatment history, technical and clinical complications, and the degree of aneurysm occlusion were recorded. Patient consent was not sought for this retrospective study.

Endovascular Procedures

Patients were pretreated with 75 mg of clopidogrel and 300 mg of aspirin daily for at least 5 days before the operation. Platelet function tests were performed before the operation (Multiplate Analyzer [Roche] or VerifyNow [Accumetrics]). Patients with a poor response to clopidogrel (area under curve of >52 or platelet inhibition ratio of <40%) were switched to prasugrel with a starting daily dosage of 10 mg or ticagrelor with a starting daily dosage of 2 × 90 mg. Endovascular procedures were performed with the patient under general anesthesia. Systemic anticoagulation was initiated at the beginning of the procedure with a bolus dose of 50- to 70-IU/kg heparin. The bolus dose was followed by an infusion to maintain an activated clotting time between 250 and 280 seconds during the operation. A 6F guiding sheath (Neuron MAX [Penumbra], AXS Infinity LS [Stryker]) or a 7F guiding catheter (Fubuki [Asahi Intecc Medical]) was positioned in the distal cervical segment of the ICA. A bolus dose of 2 mg of nimodipine diluted in 140 mL of 0.9% NaCl solution was infused through the guiding sheath for 10 minutes to prevent vasospasms during the procedure. The insular branch arising from the neck of the aneurysm (stem artery or cortical branch) was catheterized with a stent delivery 0.017-inch microcatheter (Headway-17 [MicroVention], Vasco 10 [Balt], or SL-10 [Stryker Neurovascular]). Another 0.017- inch microcatheter was jailed inside the aneurysm sac (Headway 17 or Echelon 10 [Medtronic]) for coiling if the plan was to implant a braided stent.

A low-profile self-expandable braided or laser-cut open-cell stent was deployed into the insular branch, extending proximally to the related MCA trunk or the sphenoidal (M1) segment of the MCA. Following the sealing of the aneurysm neck with the implanted stent, the aneurysm sac was coiled using bare platinum coils. In some cases in which we used a low-profile open-cell stent, the stent delivery catheter was used for coiling after the deployment of the stent. Dual antiplatelet treatment was continued for 3–6 months after the endovascular procedure, and the patients were switched to 100 mg of aspirin thereafter.

Complications

Any intraprocedural adverse event that caused the failure or modification of the stent-assisted coiling procedure was defined as a technical complication regardless of whether it resulted in clinical symptoms. Complications that developed during the procedure or within 7 days following the procedure were defined as periprocedural complications. Complications that developed >7 days after the procedure were considered delayed complications.

Angiographic Follow-up

Immediate postprocedural DSA images were obtained to assess the aneurysm occlusion status according to the Raymond-Roy classification.[17] The first follow-up DSA examinations were performed 6–15 months after the procedures. A second follow-up DSA was performed between 24 and 36 months postoperatively. The follow-up DSA images were evaluated by 3 experienced surgeons to assess the filling status of the aneurysms, patency of parent vessels, and the development of in-stent stenosis. On the follow-up imaging, progressive thrombosis was defined as an improvement in the Raymond-Roy classification. Recanalization was defined as a deterioration in the Raymond-Roy classification.

Clinical Follow-up

The patients' neurologic statuses were evaluated using the mRS before the endovascular procedure, at discharge, and during the clinical follow-up. The first clinical follow-up was performed 1–2 months after discharge. Additional clinical follow-ups were performed during every angiographic follow-up.

Statistical Analysis

The descriptive statistical analyses in this study were performed using SPSS Statistics 21.0 (IBM). Continuous variables were reported as mean (SD). Categoric variables were reported as proportions.

Table 1: Summary of the patient demographics and aneurysm characteristics

Demographics	
Mean age (yr)	53.3 (SD, 11.3)
Sex	
Female	19 (70.4%)
Male	8 (29.6%)
Aneurysm location	
Right superior MCA trunk	6 (22.2%)
Right inferior MCA trunk	8 (29.6%)
Left superior MCA trunk	9 (33.3%)
Left inferior MCA trunk	4 (14.8%)
Aneurysm size (maximal diameter)	
2–4 mm	7 (25.9%)
5–7 mm	14 (51.9%)
8–12 mm	5 (18.5%)
13–15 mm	1 (3.7%)
Aneurysm neck diameter (mm)[a]	3.8 (SD, 1.1) (2.1–6.7)
Diameter of the artery at the proximal end of stent (mm)[a]	2.1 (SD, 0.22) (1.7–2.8)
Diameter of the artery at the distal end of stent (mm)[a]	1.6 (SD, 0.17) (1.3–2.0)

[a] Data are given as the mean value (SD) (minimum-maximum values).

Table 2: Stents used in the endovascular procedures

Deployed Stent	No. of Patients
LEO Baby (Balt)	20 (74.1%)
Neuroform Atlas (Stryker)	5 (18.5%)
LVIS EVO (MicroVention)	1 (3.7%)
Accero (Accandis)	1 (3.7%)

RESULTS

Patients and Aneurysms

Twenty-seven patients (19 women, 70.4%) with an insular segment MCA aneurysm were included in this study. The mean age of the patients was 53.3 (SD, 11.3) years (range, 34–70 years). The mean size of the aneurysms was 6.3 (SD, 2.6) mm (range, 3–15 mm) (Table 1). All aneurysms had a saccular morphology. One of the 27 aneurysms had ruptured 16 weeks before the endovascular treatment, and the patient with the ruptured aneurysm was referred to JSC Central Hospital (Almaty City) center for endovascular treatment. Another patient had a recanalized aneurysm that had been treated previously with a primary coiling procedure. The preoperative mRS score of 26 patients was zero. The preoperative mRS score of 1 patient was 2 due to the recent subarachnoid hemorrhage.

Immediate Angiographic Results

In most of the patients (81.5%), a self-expandable nitinol braided stent was implanted (Table 2 and Fig 1). A laser-cut open-cell stent was implanted in 5 patients (18.5%). The immediate postprocedural DSA images revealed complete aneurysm occlusion in 22 patients (81.5%) and a neck remnant in 4 patients (14.8%). In 1 patient (3.7%), the aneurysm sac was intentionally partially coiled to maintain the patency of a stem artery that was filling from the superior-medial wall of the aneurysm sac (Fig 2).

Complications

Catheterization of side branches and the aneurysm sac, stent deployment, and coiling procedures were successfully completed in all patients. We did not have any technical complications. There was no mortality in this study. A delayed thromboembolic complication resulted in minor permanent morbidity in 1 patient (3.7%).

Periprocedural complications developed in 2 patients (7.4%) without causing permanent morbidity. The intraprocedural control DSA images of one of the patients revealed the development and formation of an in-stent thrombus, and in this patient, an intra-arterial bolus infusion of 25 µg/kg of tirofiban through the microcatheter achieved complete resolution of the thrombus. The periprocedural complication in this patient did not cause any symptoms, and the follow-up MR imaging performed 48 hours after the endovascular procedure did not reveal any ischemic lesion. The mRS score of this patient was zero at discharge. Another patient developed hemiparesis 6 hours after the completion of the endovascular procedure. An emergency DSA revealed an occlusion of the branch that was jailed by the deployed stent. An intra-arterial infusion of tirofiban through a 0.017-inch microcatheter achieved a resolution of the thrombus and complete patency of the side branch. The mRS score of this patient was zero at 1-month follow-up, and she remained asymptomatic on further follow-up. We also observed a delayed thromboembolic complication in another patient (3.7%). This patient developed dysphasia 2 weeks after the treatment of a left insular MCA aneurysm that was located in the territory of the superior trunk. Cranial MR imaging of this patient revealed an infarction with a diameter of 2 cm in the cortex of the left frontal operculum. The patient's dysphasia regressed considerably during the following 8 weeks, and the mRS score at the last follow-up was 1.

Follow-up

All patients underwent at least 1 follow-up DSA examination. The mean angiographic follow-up duration was 19.5 (SD, 9.8) months (range, 6–36 months). Fifteen patients (55.6%) underwent 2 follow-up DSAs, and the remaining 12 patients had only 1 follow-up angiography. The final follow-up angiography revealed complete occlusion of the aneurysms in 25 patients (92.6%) and neck filling in 2 patients (7.4%) (Fig 3). None of the treated aneurysms showed recanalization. One aneurysm with a residual sac filling found on the immediate postprocedural DSA eventually progressed to complete occlusion, which was seen on the 36-month second follow-up angiography (Fig 2). Another aneurysm with a neck filling on the immediate postprocedural DSA progressed to complete occlusion on the first follow-up DSA performed 7 months after the endovascular procedure. Two aneurysms that had a residual filling of the neck on the immediate postprocedural DSA remained stable on the first follow-up angiographies that were performed 6 and 9 months after the endovascular procedures. No patient required retreatment.

Twenty-five patients had mRS scores of zero at the final clinical follow-up. One patient had a preprocedural mRS score of 2 that did not change during the follow-up period. One patient who developed a delayed ischemic complication had an mRS score of 1 at the final clinical follow-up.

DISCUSSION

Among MCA aneurysms, insular segment aneurysms have been analyzed within the context of distal MCA aneurysms. Insular

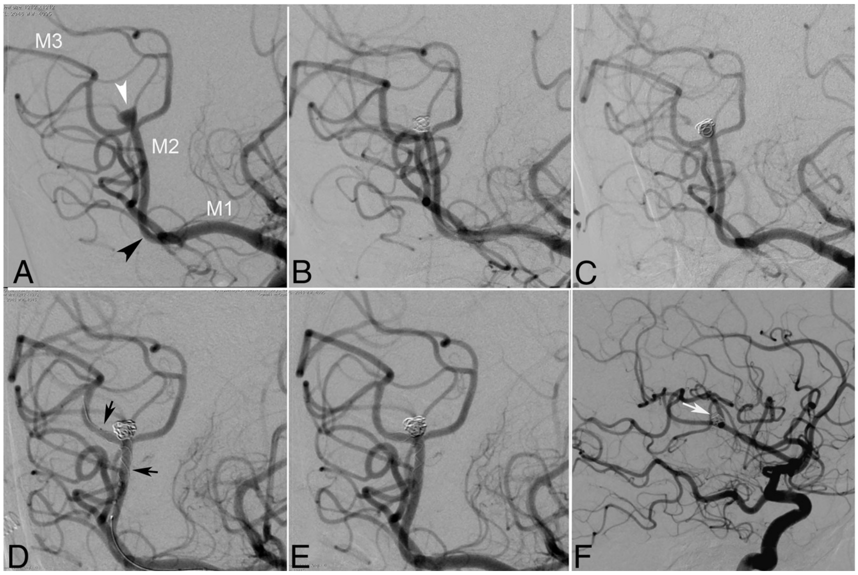

FIG 1. An adult patient with a recurrent right insular segment MCA aneurysm. *A*, DSA image shows a saccular aneurysm located distal to the MCA genu (*arrowhead*) in the insular segment of the right MCA. Two cortical branches arise from its neck. *B*, Postprocedural DSA image after the primary coiling procedure reveals complete occlusion of the aneurysm. *C*, Follow-up DSA after the primary coiling shows coil compaction and recanalization of the sac. *D*, The immediate postprocedural DSA image that was obtained following the stent-assisted coiling shows complete occlusion of the aneurysm. A self-expandable stent is deployed into one of the cortical branches (*arrows*). *E* and *F*, 36-month follow-up DSA images demonstrate the stable occlusion of the aneurysm (*white arrow*) and the patency of the cortical branches arising from its neck.

segment aneurysms constitute most distal MCA aneurysms.[18] Microsurgical management of insular segment MCA aneurysms remains demanding. The difficulty in localizing these aneurysms deep in the Sylvian cistern requires navigation using special techniques. Furthermore, because they frequently have a complex morphology, the microsurgical management of these insular aneurysms often necessitates trapping and bypass.[3,18] Although insular segment MCA aneurysms were included in the previous case series presenting the endovascular results of distal intracranial aneurysms, there has not been a prior report focusing on the endovascular treatment of insular aneurysms. This may also be related to the reluctance of performing endovascular treatment in distal, tortuous arteries with an eloquent supply.

Endovascular surgery has long been considered unfavorable for MCA aneurysms on the basis of their complex neck morphology incorporating the MCA branches, the complexity of the anatomy of the MCA branches that are difficult to decipher on 2D angiography images, and the requirement for catheterization of the distal and small-sized MCA branches.[5,7,19] However, in the past decade, the advances in 3D angiography and the improvements in the microcatheter, coil, and stent technologies, especially introduction of low-profile self-expandable stents, have expanded the scope of endovascular surgery to include the treatment of complex intracranial aneurysms located distal to the circle of Willis.[13,20,21] 3D angiographic imaging techniques have facilitated the deciphering of the complex anatomic relationships between the neck of MCA aneurysms and the incorporating MCA branches. Improvements in the hydrophilic coating and microcatheter design technologies have introduced the low-profile microcatheters with enhanced flexibility and have allowed less traumatic and easier navigation in small-sized, distal, tortuous vessels. Last, low-profile, self-expandable stents have enabled the coiling of wide-neck aneurysms located in small-sized distal vessels.

The major bifurcation of the MCA gives rise to 2 or 3 trunks. The insular segment of the MCA includes the trunks that lie on and supply the insula. The greatest branching of the MCA occurs at the anterior part of the insula, which is distal to the genu.[16] Six to 11 stem arteries arise from the trunks, and each stem artery gives rise to 1–5 cortical arteries. Therefore, there are many bifurcation points in the insular segment, and the insular segment MCA aneurysms usually arise from these bifurcations. Therefore, insular segment MCA aneurysms frequently have a complex neck morphology that incorporates the stem arteries or proximal parts of the cortical branches. The protection of the incorporating branches is a technical concern for the treatment of insular segment aneurysms. In our cases, we used low-profile, self-expandable stents to protect the incorporating branches during coiling of insular segment aneurysms. In the current study, the stent deployment and coiling procedures were successfully completed in all patients. We did not observe any technical complications. Thus, the results of the current study demonstrate that stent-assisted coiling with low-profile, self-expandable stents is a feasible technique for the endovascular treatment of insular segment MCA aneurysms.

In the current study, coiling with the assistance of a low-profile stent achieved immediate postprocedural complete aneurysm occlusion in 81.5% of patients. We observed a complete aneurysm occlusion rate of 92.6% during a mean follow-up period of 19.5 months. The angiographic results of the current study indicate that stent-assisted coiling provides an effective and durable treatment for MCA aneurysms located within the M2 segment. In a meta-analysis, Brinjikji et al[22] included 12 case series to investigate the angiographic outcomes of the MCA aneurysms treated with various endovascular methods. Approximately 50% of the aneurysms had been ruptured. They found that 82.4% of the MCA aneurysms were completely occluded during an immediate postprocedural angiographic follow-up. However, 9.6% of the aneurysms showed recanalization that required retreatment during the follow-up period. Most aneurysms included in this meta-analysis had been treated by primary coiling, and in only 20.4% of the cases had adjunctive endovascular devices such as stents been used. Several studies have demonstrated that the recurrence risk of aneurysms treated with stent-assisted coiling is lower than that of aneurysms treated with simple coiling or

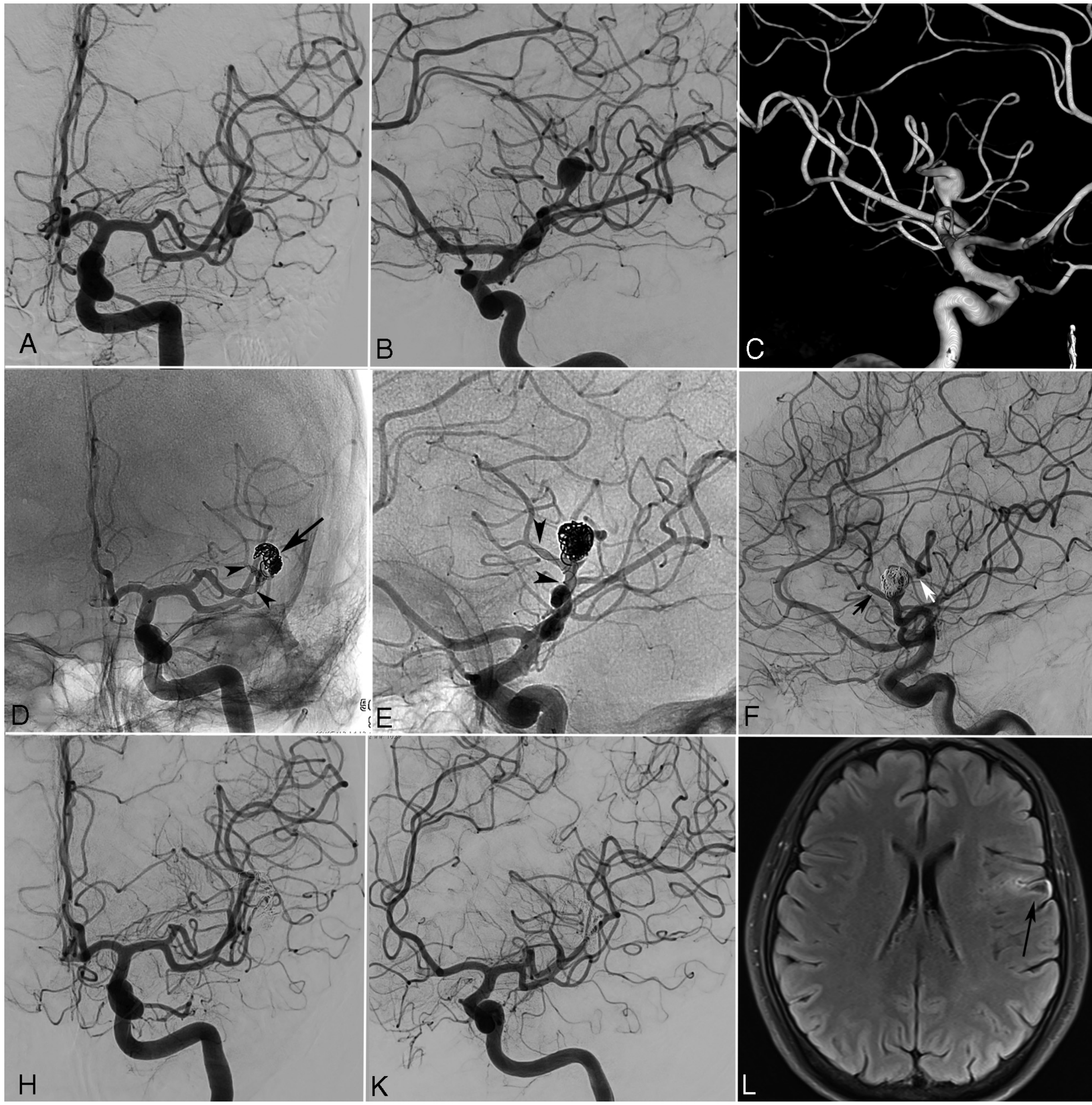

FIG 2. An adult patient with a left insular segment MCA aneurysm. *A–C*, Preprocedural DSA and 3D reconstructed angiography images show an insular segment MCA aneurysm with a very complex morphology. Two cortical stem arteries of the superior trunk originate from the neck and the superior-medial wall of the aneurysm sac. *D* and *E*, Immediate postprocedural nonsubstracted angiography images show the deployment of a self-expandable braided stent (*arrowheads*) into the stem artery that arises from the neck, extending proximally to the superior trunk. The sac of the aneurysm is partially coiled. Only the lateral compartment of the aneurysm sac is coiled to sustain the patency of the stem artery arising from the superior-medial wall of the sac. The *arrow* shows the coil mesh inside the aneurysm sac. *F*, Immediate postprocedural DSA image shows the patency of 2 stem arteries that arise from the neck (*black arrow*) and sac of the aneurysm (*white arrow*). *H* and *K*, Thirty-six-month follow-up DSA images demonstrate complete occlusion of the aneurysm. *L*, Follow-up MR image (FLAIR) shows a small cortical infarction (*arrow*) in the left frontal operculum. The mRS score of the patient was 1 during the clinical follow-up.

balloon-remodeling techniques.[23,24] In an animal study, Raymond et al[24] showed that stent-assisted coiling provided more stable treatment than simple coiling. Deployment of a self-expandable stent into the parent artery provides a mechanical scaffold that assists in achieving a dense coil mesh inside the aneurysm sac, which prevents recanalization. Furthermore, self-expandable stents have hemodynamic effects that remodel the arterial blood flow in the parent artery and reduce the hemodynamic stress on the aneurysm neck. Therefore, the flow-remodeling effect of the stents promotes the thrombosis of aneurysms and prevents recanalization.

Johnson et al[25] investigated the angiographic and clinical outcomes of 100 MCA aneurysms treated with a stent-assisted coiling technique using laser-cut self-expandable stents. In this study,

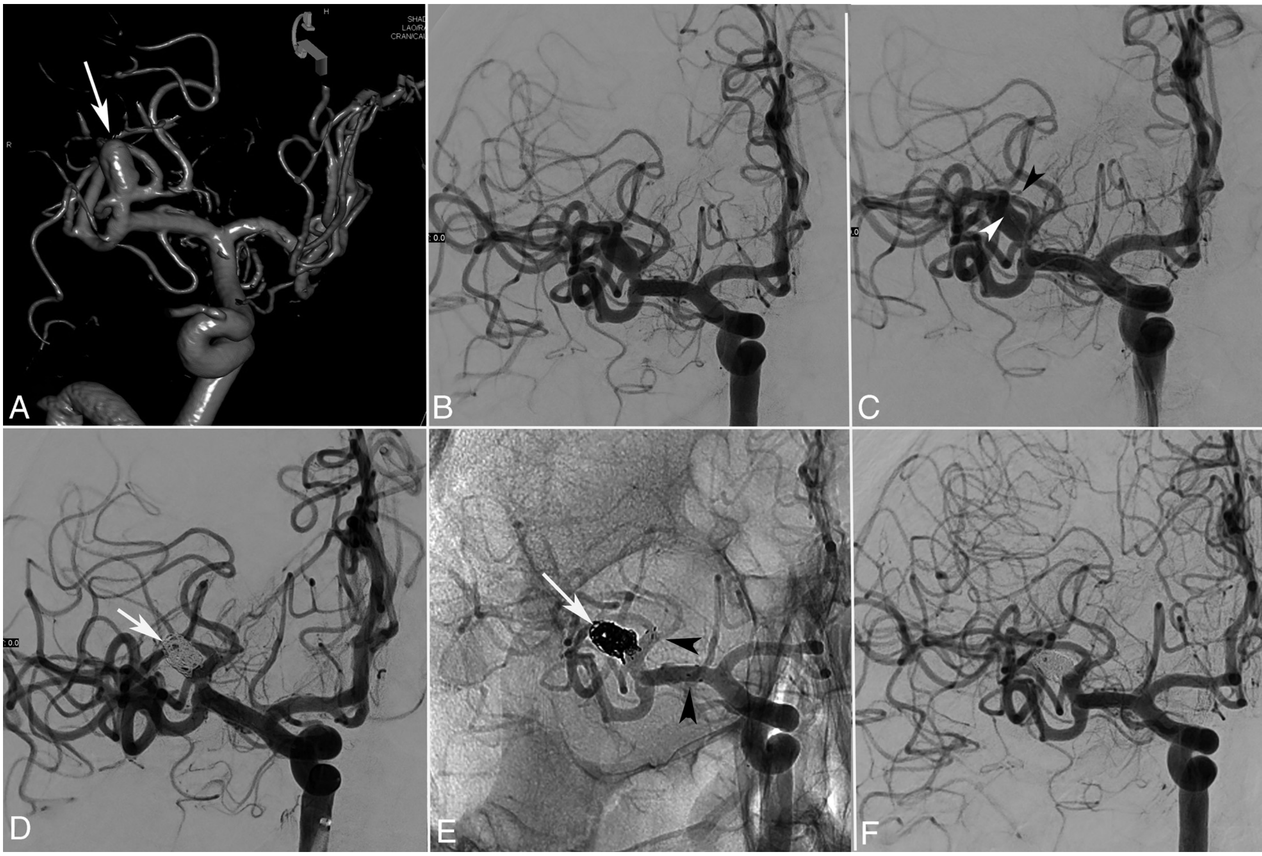

FIG 3. A 35-year-old male patient with a right insular segment MCA aneurysm. *A* and *B*, Preprocedural 3D-reconstructed angiography and DSA images show a wide-neck saccular aneurysm (*arrow*) located at the superior trunk of the right MCA. Three stem arteries arise from the aneurysm neck. *C*, Intraprocedural DSA shows that one of the branches arising from the aneurysm neck is catheterized for stent placement (*black arrowhead*) and another microcatheter is jailed inside the aneurysm for coiling (*white arrowhead*). *D* and *E*, Immediate postprocedural DSA and nonsubstracted angiography images show that the aneurysm is coiled (*white arrow*) after the deployment of an open-cell self-expandable Neuroform Atlas stent into one of the stem arteries arising from the neck, which extends proximally to the superior trunk (*arrowheads*). *F*, A 24-month follow-up DSA image demonstrates the complete occlusion of the aneurysm and patency of all the MCA branches.

only 5% of the aneurysms were ruptured. They found a complete aneurysm occlusion rate of 90.4% at the 6-month angiographic follow-up. The retreatment rate was 4.7%. In a recent study, Hanel et al[26] investigated the angiographic and clinical outcomes of patients with MCA aneurysms that were treated with stent-assisted coiling using laser-cut open-cell stents. In their study, most aneurysms were located at the MCA bifurcation, and only 8.6% were located within the insular segment. They reported a complete aneurysm occlusion rate of 80.8% at the end of a 12-month follow-up period, whereas 5.7% of their patients were retreated.

The long-term angiographic outcomes of the current study are slightly better than those of previous endovascular studies that have reported the results of MCA aneurysms. In our study, 2 aneurysms with partial neck and sac filling at the immediate post-procedural angiography progressed to complete occlusion during the follow-up period. None of the aneurysms recanalized or required retreatment. In most of our cases, we used self-expandable braided stents. Compared with self-expanding laser-cut stents, braided stents have a lower porosity and higher metal coverage ratios. The relatively high mesh density of braided stents provides a relatively high flow-diversion capacity.[27] The high flow-diversion capacity of the braided stents lowers the risk of recanalization and enables the progressive thrombosis of partially coiled aneurysms. The use of self-expandable braided stents in most of our cases might have contributed to the favorable angiographic outcomes in our series. All aneurysms except 1 were unruptured in our study. The rupture status of the aneurysms might have also contributed to the good angiographic and clinical outcomes in our patients.

Microsurgical treatment of unruptured insular segment MCA aneurysms has not been specifically studied previously. A standard or modified pterional approach reportedly suffices for the surgical treatment of insular aneurysms.[3] The surgical results of insular MCA aneurysms are similar to those of bifurcation aneurysms.[18] Therefore, for practical purposes, the results of microsurgery for insular segment aneurysms can be analyzed within the context of MCA bifurcation aneurysms. In a large case series including 716 patients with 750 unruptured MCA aneurysms, Nussbaum et al[28] demonstrated that microsurgery achieved complete aneurysm occlusion in 92% of their cases. In another large case series, Rodriguez-Hernandez et al[7] investigated the results of microsurgery for ruptured and unruptured MCA aneurysms. They reported a postoperative complete aneurysm occlusion rate of 98.3%. None of their patients required retreatment during a mean follow-up period of 3.9 years. Although the follow-up period of the current study is considerably shorter, the long-term angiographic outcomes of our patients are comparable with the results of patients with MCA aneurysms treated with microsurgery in previous studies.

The safety of stent-assisted coiling treatment for MCA bifurcation aneurysms has been demonstrated in previous studies. Vendrell et al[29] assessed the angiographic and clinical outcomes of 49 patients with 52 MCA aneurysms treated with a stent-assisted coiling procedure. They reported a procedure-related morbidity rate of 3.8%. Johnson et al[25] reported a morbidity rate of 1% and a mortality rate of 1% for the stent-assisted coiling procedure used to treat MCA aneurysms. In a recent study, Hanel et al[26] reported a permanent morbidity rate of 8.5% after Neuroform Atlas stent-assisted coiling of MCA aneurysms.

No mortality was observed in the current study. We observed asymptomatic intraprocedural and delayed thromboembolic complications in 2 patients (11.1%). These complications resulted in a minor morbidity in 1 patient (3.7%). Nussbaum et al[28] reported a 2.8% treatment-related complication rate after the microsurgical treatment of unruptured MCA aneurysms. The morbidity rate of the current study is comparable with the morbidity rates that had been previously reported for MCA aneurysms treated with stent-assisted coiling or microsurgical clipping. The favorable clinical outcomes in the current study demonstrate that stent-assisted coiling is a relatively safe treatment method for MCA aneurysms located within the insular segment.

The main safety concern of stent-assisted coiling treatment for insular segment complex MCA aneurysms might be the necessity of catheterizing small-sized distal arteries. The maneuvers for catheterization and navigation in small-sized insular branches with rigid microcatheters may produce a potential risk of vessel injury. To decrease this risk, we used low-profile microcatheters with soft distal tips for both stent delivery and coiling, and we did not experience any vessel injury induced by the catheterization maneuvers.

The risk of thromboembolic complications produced by the implantation of stents into small-sized vessels might be another concern. Introduction of low-profile self-expandable stents has been a major step in the evolution of endovascular aneurysm surgery. Several previous studies demonstrated the feasibility and safety of implantation of these low-profile stents into small-sized distal arteries.[12,13] In a recent study, Kim et al[30] investigated the safety of stent-assisted coiling of unruptured aneurysms using low-profile stents in small-sized vessels. They found a procedure-related morbidity in 4.5% without mortality. To reduce the risk of thromboembolic complications, we performed preoperative thrombocyte function tests to ensure sufficient antiaggregant activity levels in our patients. Furthermore, precise control of blood pressure and activated clotting time during the entire endovascular procedure might reduce the risk of intraprocedural thromboembolic events. Prevention of catheter-induced vasospasm is another important issue for the avoidance of intraprocedural thromboembolic complications. Intra-arterial nimodipine infusion during the endovascular operation impedes microcatheter-induced vasospasm.

There are some limitations of the current study. The main limitation of this study is the retrospective nature of the study design. Unblinded authors were the individuals who evaluated the postprocedural and follow-up angiographic images of this study. The decision for endovascular therapy in each case was made by the institutional neurovascular teams. Therefore, the effects of a selection bias cannot be excluded from the results of this study. Other limitations are the small number of patients and the relatively short angiographic follow-up duration. Because of the small number of patients, we could not investigate the potential effects of the stent types on the angiographic outcomes. Furthermore, the current study investigated the outcomes of insular segment MCA aneurysms. The results of this study cannot be generalized for distal MCA aneurysms located at the opercular (M3) or cortical (M4) segments.

CONCLUSIONS

The results of this retrospective case series demonstrate that stent-assisted coiling with a low-profile self-expandable stent is a feasible and relatively safe technique for endovascular treatment of insular segment MCA aneurysms. Additionally, it provides an effective and durable treatment for insular segment MCA aneurysms.

Disclosure forms provided by the authors are available with the full text and PDF of this article at www.ajnr.org.

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