

# Temporary Semi-Jailing Technique Avoiding Inevitable Antiplatelet Medication for Coil Embolization of Wide-necked Cerebral Aneurysms

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**Purpose:** Stent-assisted neck remodeling for wide-necked aneurysms requires long-term medication with antiplatelet agents. We describe here a temporary semi-jailing technique (SJT) for wide-necked aneurysms that avoids the need for antiplatelet medications.

**Materials and Methods:** Among 101 patients who underwent stent- and/or balloon-assisted embolizations, 3 wide-necked aneurysms, including 1 ruptured aneurysm, underwent the temporary SJT using Enterprise stents. Temporary SJTs were used due to resistance to antiplatelet agents prior to cardiac surgery or to a ruptured aneurysm with a wide neck. The aneurysms were located in the middle cerebral artery, the paraclinoid internal carotid artery segment, and the posterior communicating artery.

**Results:** Enterprise stents were retrieved after coiling without any change in coil mass stability. The final angiogram showed good patency of each parent artery, good stability of the coil mass and total occlusion of the aneurysm. None of the patients experienced any periprocedural or delayed neurological complications. While retrieving the stent from tortuous vessels, we experienced the jumping phenomenon associated with this device.

**Conclusion:** Temporary SJTs have the advantage of stent retrieval, thus avoiding inevitable antiplatelet medication. However, care should be taken in tortuous vessels to avoid the jumping phenomenon associated with the device.

**Key Words :** Aneurysm; Stent; Stent-assisted coiling; Wide neck

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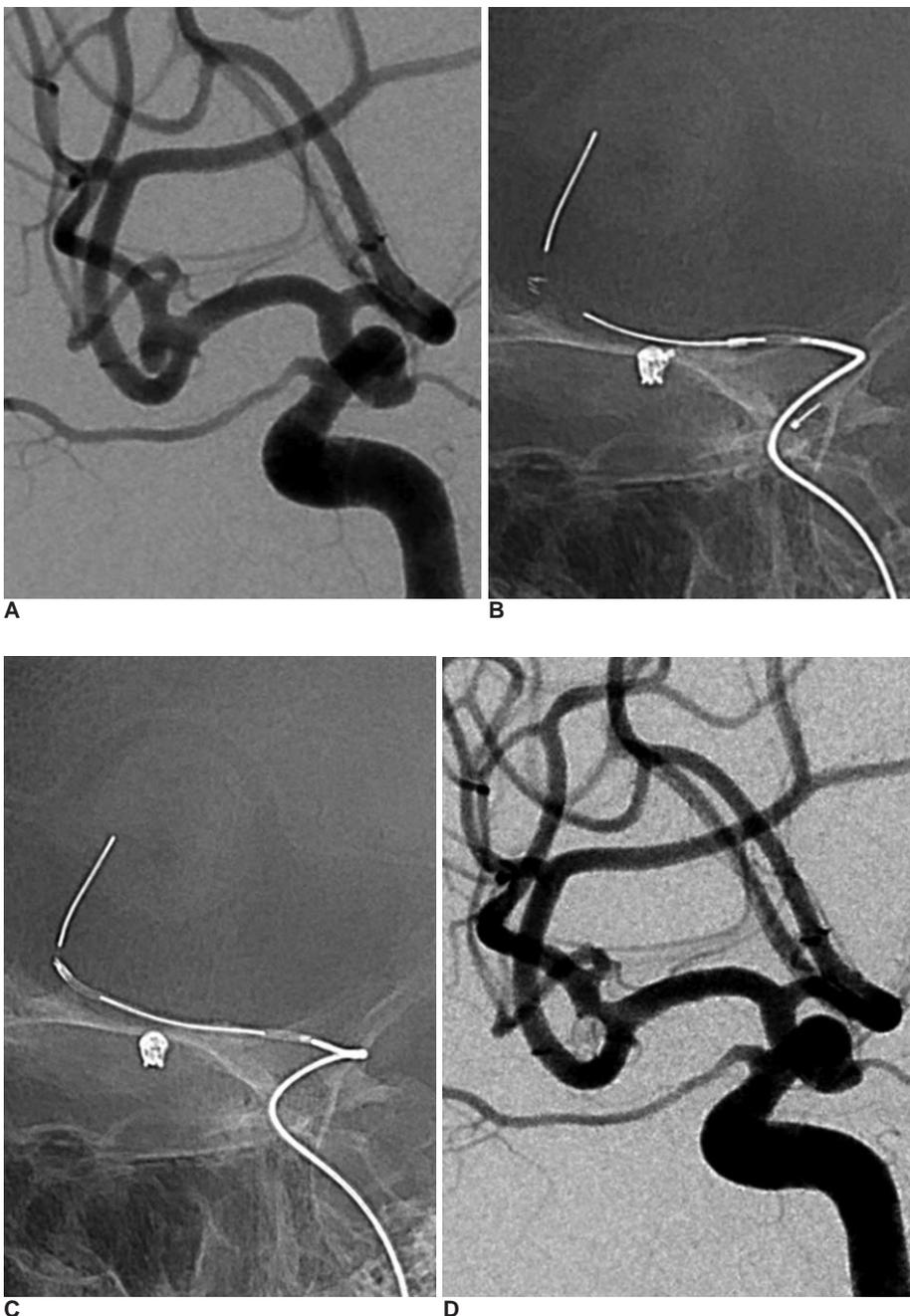
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The development of the stent-assisted coiling technique has allowed endovascular treatment strategies to treat wide-necked, smaller berry and complex aneurysms (1–5). More recently, the stent-jack (6) and semi-jailing (7, 8) techniques have been described for patients with relatively small, wide-necked aneurysms (7, 8). Stent-assisted coil embolization of wide-necked aneurysms is not advised in patients with resistance to antiplatelet agents and in patients with complex medical conditions, including patients with severe liver disease, those scheduled for subsequent surgery, and those with acute subarachnoid hemorrhage or gastroin-

testinal bleeding.

Although the balloon remodeling technique can also be used, its application, involving flow arrest by the balloon, may be limited in small-caliber parent arteries and in vessels of the collateral circulation that cannot be tested for tolerance of occlusion.

We describe here a temporary semi-jailing technique (SJT) using the Enterprise stent system for the treatment of wide-necked aneurysms. This technique, which avoids inevitable antiplatelet medications, can therefore be used in patients with antiplatelet resistance or complex medical conditions, as well as prior to



**Fig. 1.** A 53-year-old woman with a left M1 bifurcation aneurysm.  
**A.** A digital subtraction angiogram showing a 2.5-mm wide-necked aneurysm of the left middle cerebral artery bifurcation.  
**B.** Partial deployment of a 4.5 × 22-mm stent and a stable coil mass inside the aneurysm.  
**C.** Non-subtracted image showing a stable coil mass after recapture of the stent.  
**D.** Angiogram showing aneurysm obliteration

## Semi-Jailing Technique for stent-assisted coiling

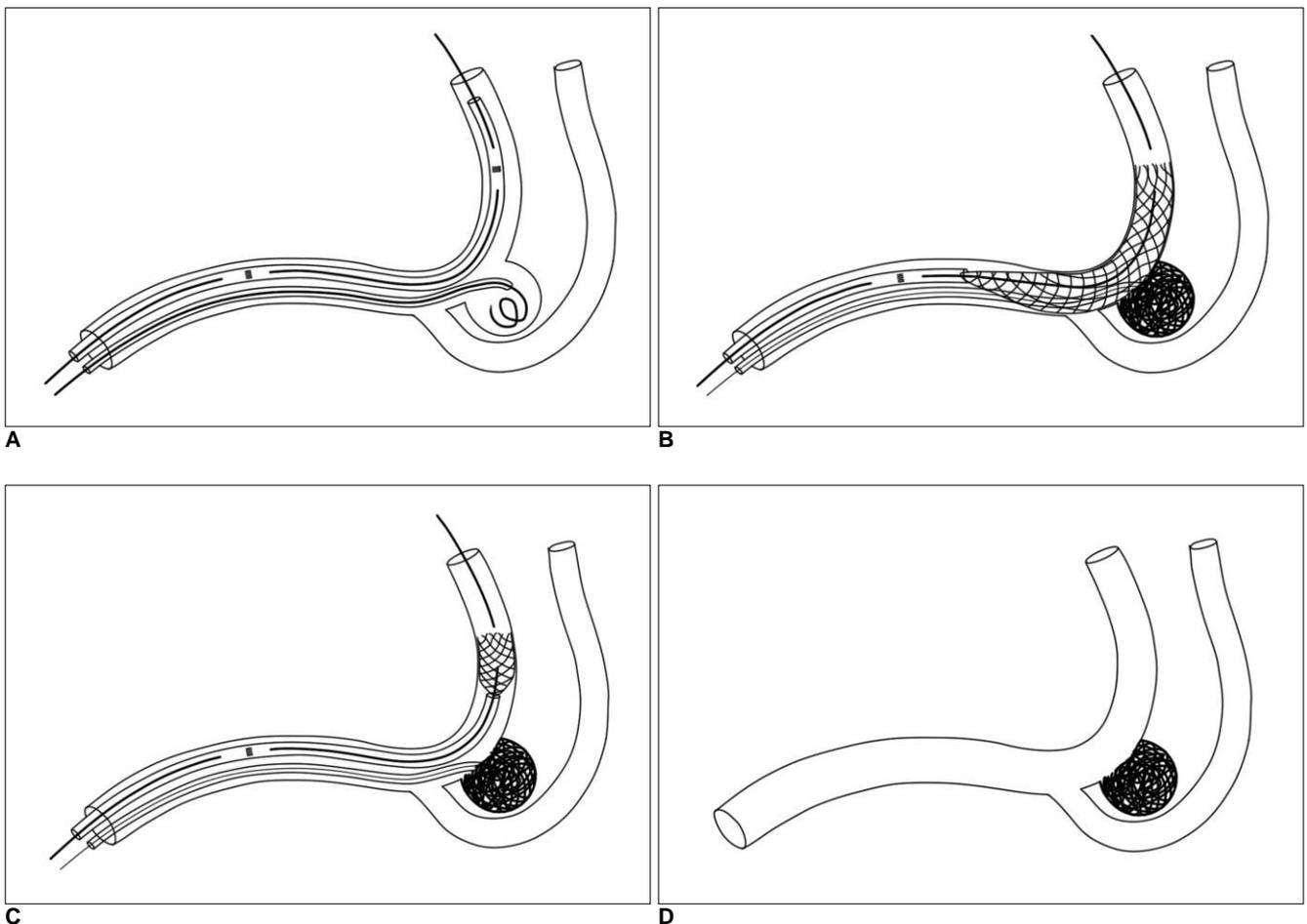
cardiac surgery or subarachnoid hemorrhage (SAH).

### MATERIALS AND METHODS

A review of our prospective database of 309 patients who underwent aneurysm coil embolizations between February 2002 and April 2010 identified 101 patients, of whom 85 underwent stent-assisted, 9 underwent balloon-assisted, and 7 underwent stent- and balloon-assisted coilings. We obtained written informed consent from each patient and/or the patient's family. Three patients with wide-necked aneurysms, including one with a ruptured aneurysm, were treated using the temporary SJT technique with Enterprise stents (Cordis Corporation, Bridgewater, NJ, U.S.A.). The patient with the ruptured aneurysm (patients' 3) was treated at Jiangsu Subei People's Hospital. Patients' demographics, clinical outcomes, and angiographic details were collected.

### Technique

All procedures were performed using a transfemoral approach under general anesthesia. During the procedure, each patient received 2,000 to 4,000 U intravenous heparin. A 6-French guiding catheter was advanced into the internal carotid artery, followed by the careful navigation of a microcatheter with a microguidewire into the aneurysm. Following partial introduction of a coil into the aneurysmal sac to protect against unexpected injury to the microcatheter tip in the aneurysm, a Prowler Select Plus catheter (Cordis Corporation, Bridgewater, NJ, U.S.A.) was navigated across the aneurysm neck. Subsequently, an Enterprise stent was partially deployed, up to 70% of its length, across the wide neck of the aneurysm (Fig. 1 and 2). Because the coil delivery catheter was temporarily jailed to the vessel wall, it remained maneuverable during the procedure. After coiling, the microcatheter was removed and the stent was partially recaptured into



**Fig. 2.** Schematic representation of the temporary semi-jailing technique.

**A.** Introduction of the stent and microcatheter with a partially introduced coil to protect against injury to the aneurysm.

**B.** A partially deployed stent during coil embolization.

**C.** Recapture of the stent after coiling and assessment of coil mass stability.

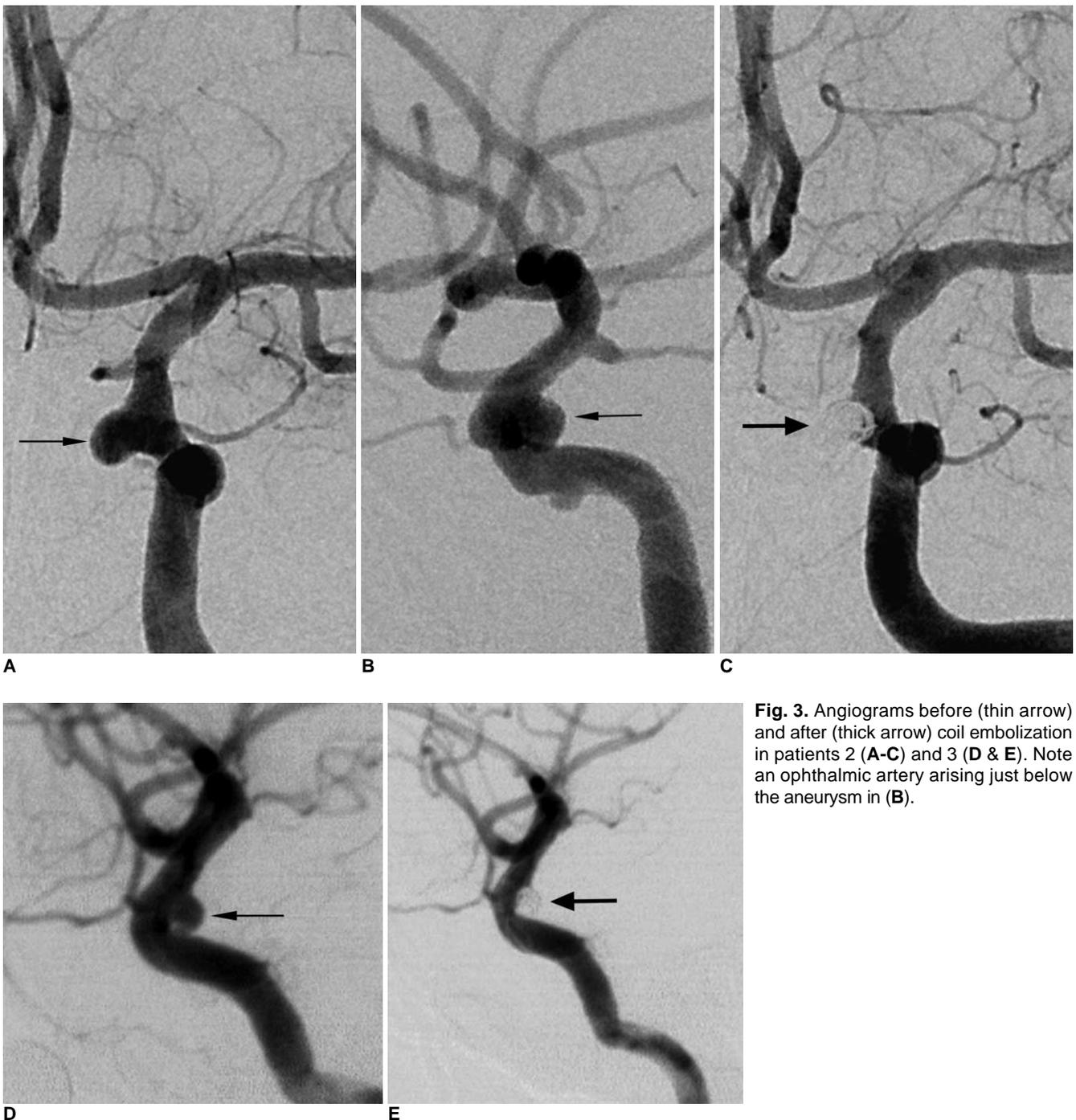
**D.** Stable coil mass after removal of the stent and microcatheter.

the Prowler Select Plus catheter just beyond the aneurysmal sac to confirm that the coiled mass was stably positioned in the aneurysmal sac. The stent was finally retrieved if there was no movement of the coiled mass in the aneurysmal sac. We took a final angiogram after removal of the stent and catheter to identify any spasm, vessel injury or exclusion of coils from the aneurysm. Because the stent was not implanted, there was no need for oral antiplatelet agents.

## RESULTS

### Patient 1

A 53-year-old woman was referred to our institute for coil embolization of bilateral M1 bifurcation aneurysms, which had been detected incidentally during evaluation of intermittent headaches prior to treatment of chronic active hepatitis. Two months previously, she underwent coiling of a broad necked



**Fig. 3.** Angiograms before (thin arrow) and after (thick arrow) coil embolization in patients 2 (A-C) and 3 (D & E). Note an ophthalmic artery arising just below the aneurysm in (B).

aneurysm (4 mm in size) in the right M1 bifurcation, after which she developed a transient mild left arm weakness, regarded as a thromboembolic event due to clopidogrel resistance. Measurement of her P2Y12 revealed 0% clopidogrel reactivity. Because the balloon remodeling technique may have been dangerous in her small-caliber middle cerebral artery lumen, we used the SJT to treat her left M1 bifurcation aneurysm, which had a relatively broad neck (Fig. 1A). Once a satisfactory coil mass was obtained (Fig. 1B), the stent was smoothly recaptured into the stent delivery microcatheter (Fig. 1C). During the recapture, we waited for 10 minutes to confirm that the coil mass was stable. Final angiogram after removal of the stent and catheter showed stable circulatory exclusion of the aneurysm (Fig. 1D, E). A skull X-ray of 4 months later showed no change in the coil mass and a 7 month follow-up revealed no neurologic deficit.

### Patient 2

A 62-year-old woman with a 15-year history of diabetes mellitus presented with visual disturbance and arterial hypertension. Magnetic resonance imaging of her brain revealed a broad-necked aneurysm, about 4 mm in size, in the left carotid cave. Because this patient had two-vessel coronary artery disease, which might later require coronary bypass surgery, we used the temporary SJT to reconstruct the parent artery. After coiling of the aneurysm, we observed severe resistance while retrieving the stent. While pushing and pulling the introducer and microcatheter, the stent delivery system jumped out of the carotid curve and into the horizontal cavernous segment. After positioning the unsheathed stent segment in a somewhat straight segment of the internal carotid artery, the stent was retrieved and removed. A final angiogram showed good patency of the parent artery and good stability of the coil mass in the aneurysm (Fig. 3C). A skull X-ray of 7 months later showed no change in the coil mass without any neurologic deficit.

### Patient 3

A 50-year-old woman was admitted with a Hunt and Hess grade IV SAH and a 10-year history of arterial hypertension. Cerebral angiography showed a ruptured wide-necked posterior communicating artery cerebral aneurysm, measuring 4.6 mm at its largest dimension and 4 mm at the neck (Fig. 3D). Coil framing was not indicated, even using the two-catheter technique. We therefore performed SJT using an Enterprise stent 28 mm in length, resulting in stable coil mass formation in

the aneurysm. The microcatheter was subsequently removed and the stent was recaptured into the Prowler Select Plus catheter. Resistance during the initial recapturing attempt was resolved by slight further deployment of the stent followed by resheathing. Final angiogram revealed good stability of the coil mass in the aneurysm (Fig. 3E). The patient made a good recovery and was discharged in good condition 21 days after initial presentation without antiplatelet medication.

## DISCUSSION

Different stenting strategies, including stenting alone, stent-assisted coiling, and stent-jack technique, require continuous antiplatelet medications because stent deployment before or after coiling may cause thromboembolic complications (9–12). Some patients have clinical conditions precluding the use of antiplatelet therapy. These conditions include resistance to antiplatelet medications (patient 1), complex medical diseases including severe liver disease (patient 1) or leading to a requirement for surgery (patient 2), acute subarachnoid hemorrhage (patient 3) and gastrointestinal bleeding.

One advantage of temporary SJT using the Enterprise stent system is the ability to retrieve the stent after coil embolization of the aneurysm, thereby avoiding the use of antiplatelet agents (13). In addition, this technique can reduce the risks of unnecessary thromboembolic complications and eliminate the risk of stent-induced stenosis associated with stent retention.

The balloon remodeling technique can achieve the same goals, while also avoiding permanent intravascular implants and the need for long-term antiplatelet medications (13–15). However, balloon inflation, which results in complete blood flow arrest in the parent artery, can increase the risk of thromboembolic and ischemic events. Furthermore, inflation and deflation of the balloon may be difficult in small-caliber vessels and may also lead to herniation of the coil mass (16).

Although retrieving the stent with the SJT was technically safe and feasible in our patients with wide-necked aneurysms, care must be taken in curved vessels such as the carotid siphon because resistance during stent resheathing, as seen in patient 2, may cause the stent to jump, or even lead to its unexpected deployment. Following recapture of the stent into the delivery catheter, it is necessary to wait for several minutes without retrieving the catheter to ensure coil

mass stability.

The temporary SJT can be used in selected patients with wide-necked aneurysms, in whom antiplatelet therapy is precluded, by retrieval of partially deployed retrievable stents, bridging part of the aneurysm neck and stent, and leaving space to maneuver the microcatheter (8). Care must be taken, however, in curved vessels such as the carotid siphon because resistance during retrieval of the stent delivery device and microcatheter can cause the stent to jump, leading to its unexpected deployment.

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## 넓은 목동맥에서 스텐트사용시 항혈소판제제의 투약을 피할 수 있도록 사용한 스텐트를 제거하는 임시 Semi-jailing Technique

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**목적:** 넓은 목을 가지는 동맥류에 대한 스텐트 보조 목 재형성술은 장기간의 항혈소판제제의 사용을 필요로 한다. 저자들은 넓은 목을 가지는 동맥류에 대한 항혈소판제제의 필요성을 방지하는 임시 semi-jailing technique을 기술하고자 한다.

**대상 및 방법:** 스텐트 및 풍선 보조 색전술을 경험한 101명의 환자 중 1개의 파열 동맥류, 3개의 넓은 목을 가지는 동맥류를 포함하여 Enterprise 스텐트를 사용하여 임시 semi-jailing 기술을 경험한 환자들을 대상으로 하였다. 임시 semi-jailing technique은 심장 수술 전 항혈소판제제에 대한 내성 또는 넓은 목을 가지는 파열 동맥류에 사용되었다. 이들 동맥류는 중간 대뇌 동맥, 속목 동맥의 침상돌기주위부 및 후교통동맥에 위치하였다

**결과:** Enterprise 스텐트는 코일 덩어리의 안정성이 유지된 채로 코일 시술 후 제거되었다. 마지막 혈관조영영상은 각 모동맥의 좋은 흐름, 코일 덩어리의 좋은 안정성과 동맥류의 완전 폐색을 보였다. 시술 중 또는 지연성 신경학적 합병증을 보인 환자는 없었다. 구불구불한 혈관에서 스텐트를 제거하는 동안, 저자들은 이 장치와 연관된 점프 현상을 경험했다.

**결론:** 임시 semi-jailing technique은 스텐트 제거시에 장점을 가지는데, 이로 인해 불가피한 항혈소판 제제 사용을 피할 수 있다. 그러나, 구불구불한 혈관에서는 장치와 관련된 점프 현상이 발생하지 않도록 주의해야 한다.

**Key Words :** Aneurysm; Stent; Stent-assisted coiling; Wide neck