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# Endovascular Treatment with a Stent-Graft for Internal Carotid Artery Laceration during Trans Sphenoidal Surgery: A Case Report[1]

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An internal carotid artery (ICA) tear during or after trans-sphenoidal surgery (TSS) is rare but may cause potentially lethal complications. A 23-year-old female patient visited our hospital for treatment of a Rathke's cleft cyst. The patient had massive hemorrhage during surgery and angiography performed after surgery showed laceration of the cavernous ICA. We successfully controlled the hemorrhage with emergency placement of an endovascular stent-graft.

**Index words :** Stents
Carotid artery injuries

A rupture of the internal carotid artery (ICA) during trans-sphenoidal surgery (TSS) is rare and may lead to permanent disability or death. Emergency surgical packing and ligation have traditionally been the only therapeutic maneuvers available for carotid artery rupture despite the well-documented risk of cerebral ischemia, resulting in major neurologic morbidity and mortality (1).

Following its introduction in the 1970s, the use of detachable balloon occlusion soon became the best treatment to treat carotid injuries after TSS. Despite the risk of cerebral ischemia, detachable balloon occlusion has been used in order to prevent life-threatening bleeding episodes (1, 2).

To reduce of the risk of cerebral ischemia or death, the ICA should be preserved and, therefore, a new treatment option was required. Over past decade, just as stenting represented an evolutionary advance in the interventional technology of balloon angioplasty, the use of stent-grafts have allowed effective percutaneous repair of vascular pathologies (3-5).

To the best of our knowledge, there have been few studies in the published literature regarding treatment of an ICA tear following TSS using a stent-graft (6-8). We present a case of an iatrogenic ICA tear during TSS that was successfully treated by placement of a stent-graft.

## Case Report

A 23-year-old woman presented with symptoms of dizziness and hypomenorrhea of two months duration. MR imaging revealed the presence of an intrasellar Rathke's cleft cyst. The patient was admitted for TSS for this mass. During trans-sphenoidal resection, upon opening the dura, profuse arterial bleeding began. The profuse bleeding could not be controlled with the use of local packing and cauterization. A continuous nasal hemorrhage also developed. The patent was moved under emergency conditions to the angiography suite for local-

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ization of the bleeding focus and potential endovascular treatment for arterial injury.

On an initial left ICA angiogram, we noted contrast media leakage from the anterior genu of the left cavernous ICA into the sphenoid sinus (Fig. 1). In order to preserve the ICA, we decided to place a stent-graft for treatment of the left ICA injury. An Excel 14 microcatheter (Boston Scientific, Natick, MA U.S.A.) was passed through the injured segment by use of an angled Transend ES microwire (Boston Scientific). The microcatheter was then replaced with a 0.014-inch×260 cm exchange guidewire. A 6 F Shuttle Sheath (Cook, Bloomington, IL U.S.A.) was introduced into the distal portion of the ICA. Using the transaxial system, we advanced a Jostent GraftMaster (4×16 mm; Jomed, Rangendingen, Germany) to the just below the bifurcation of the ophthalmic artery in order to preserve the artery. Ballooning was then performed slowly, up to a pressure of 8 atm at the stenting site. A postprocedural left ICA angiogram still demonstrated extravasation of contrast material from the left cavernous ICA (Fig. 2). We attempted ballooning in the covered stent several times to seal the leakage of contrast media, but cessation of the contrast extravasation failed. We had no choice to stop the hemorrhage, so another bare FlexerMaster stent (4 × 19 mm; Jomed) was deployed inside the covered stent that overlapped each end. After the second stenting, the amount of contrast extravasation decreased, but we still noted contrast media leakage at the same site of the ICA injury (Fig. 3). Additional ballooning was performed using a pressure of 10 atm. A repeat angiogram of the left ICA demonstrated the cessation of the contrast extravasation from the anterior genu of the left ICA (Fig. 4). We decided to delay surgery to remove the remaining tumor. The patient was transferred the

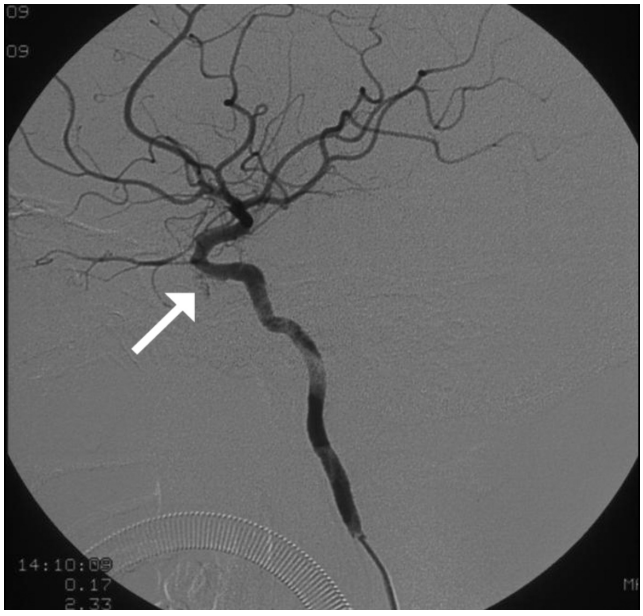

**Fig. 1.** Lateral view of a left ICA angiogram shows extravasation of contrast media (arrow) at the anterior portion of the cavernous ICA.

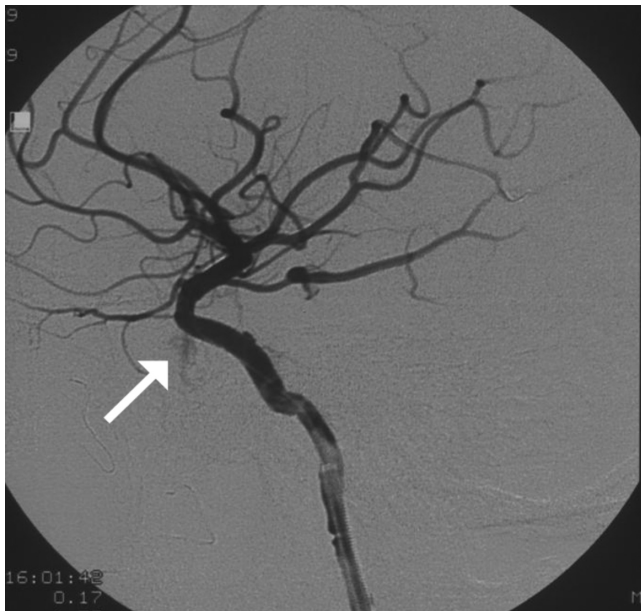

**Fig. 2.** After stent deployment (Jostent GraftMaster, 4.0 × 16 mm), a left ICA angiogram still shows extravasation of contrast media (arrow) at the previous perforation site of the ICA.

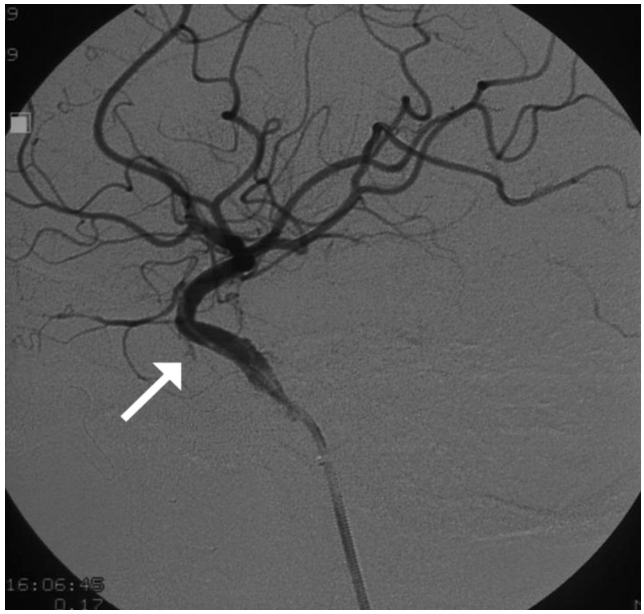

**Fig. 3.** A 4 × 19 mm Jostent Flexmaster was additionally placed in the left cavernous ICA within the stent-graft. A second postprocedural angiogram of the left ICA obtained after deployment of the bare stent shows a small amount of contrast extravasation (arrow).

**Fig. 4.** A lateral view of the final left ICA angiogram after double stenting demonstrates cessation of hemorrhage from the anterior genu of the left ICA.

intensive care unit and was extubated after post-stent-grafting for four hours during which time no neurological deficits were demonstrated. After the procedure, the patient received 100 mg aspirin and 74 mg clopidogrel daily. A dose of 2,850 IU Fraxiparine (Sanofi-Synthelabo, Seoul, Korea) was also subcutaneously administered two times a day for three days. After stent-grafting, the patient did not show any neurological symptoms or deficit during the three-year follow-up period.

## Discussion

Arterial injury is one of the severe complications associated with TSS for pituitary lesions. In particular, ICA injury may cause hemorrhage, a carotid-cavernous fistula, a false aneurysm and carotid occlusion. The incidence of these complications during TSS varies according to a previous report by Raymond and colleagues (2). A survey by Ciric et al. showed that 12% of responding neurosurgeons had caused injury to the ICA during TSS. Raymond et al. (2) reported that arterial injuries during and after TSS were relatively rare (1%) but were associated with notable morbidity (24%) and mortality (14%) in a series of 21 patients.

Immediate diagnosis and treatment of arterial lesions is essential to prevent permanent neurological disability or death. Emergency treatment of a carotid injury usually involves surgical packing and ligation of the artery. Surgical closure of the ICA is infrequently chosen because of the risk of well-documented cerebral ischemia resulting in major neurological morbidity and mortality (1).

The best treatment for carotid injuries is carotid occlusion with the use of a balloon. The endovascular approach is simple and can immediately follow diagnostic angiography. Before undertaking detachable balloon occlusion of a carotid artery, a test balloon occlusion should be performed to ensure appropriate collateral flow through the circle of Willis. If the test is well tolerated by the patent, endovascular balloon occlusion can be performed. Despite a successful negative occlusion test, a small subset of patients will have ischemic complications (1). Skull-bypass surgery has significant risks in hemodynamically unstable hemorrhagic patients. Surgery also has technical difficulties and takes a longer time than any endovascular procedure (2, 4).

During the past decade, endoluminal placement of endovascular stent-grafts has become established as an effective alternative to most surgical repair techniques for the aorta, peripheral and visceral arteries (3). In particular, several reports have documented the use of stent-grafts in supra-aortic lesions such as fistulas, pseuedoaneurysms and intracranial aneurysms (4, 5). Macdonald et al. (4) reported that endovascular management by placement of a covered stent allowed immediate exclusion of a pseudoaneurysm, preservation of the carotid artery, cessation of hemorrhage and rapid patient stabilization. There have been a few case reports detailing successful stent-graft treatment of an iatrogenic ICA laceration after TSS that resulted in a carotid cavernous fistula and pseudoaneurysm (6-8).

Based on the reports described above, we attempted placement of a stent-graft for an ICA injury during TSS, as surgical packing could not control hemorrhage. The hemorrhage at the sphenoid sinus was not indicated by coil occlusion. The balloon occlusion of the ICA at the site of the rupture was technically possible, but the patient was hemodynamically unstable and had a risk of possible ischemic complications. We therefore decided to use a stent-graft to control the hemorrhage and to preserve the parent artery. The placement of a stent-graft in the carotid siphon could not control the hemorrhage by the ICA laceration in spite of sufficient and multiple inflation of the balloon. There may have been a small gap and incomplete proximal or distal coverage between the stent-graft and the vessel wall due to the curved course

of the carotid siphon. We tried to deploy another longer bare stent that overlapped the stent-graft site with high pressure ballooning. Fortunately, contrast media leakage was not detected on a delayed angiogram.

Stents covered with polyterafluoroethylene (PTFE) have been used in the treatment of pathological conditions of the coronary arteries because of a low rate of stent-related coronary artery stenosis that prevents debris protrusion and neointimal proliferation through the stent. The main problem of the use of this type stent is the stiffness of its profile with placement in the ICA because of the tortuous course, especially in the cavernous portion. This rigid stent configuration causes difficult navigation of the distal ICA and can be a cause of a periprocedural spasm or dissection. An arterial spasm is a common complication during an endovascular procedure, especially with the use of stiff materials such as a stiff guidewire and guiding catheter. In most cases, an arterial spasm is not clinically relevant and will resolve spontaneously within a few minutes and the spasm can be treated by intra-arterial injection of papaverine or nimodipine.

In addition to an arterial spasm and dissection, another important issue regarding the use of PTFE-covered stents is the short- and long-term patency of the artery. There are also reports detailing the angiographic follow-up results of traumatic carotid cavernous fistulas treated using endovascular stent-grafts (9, 10). In a report by Archondakis et al. (9), angiographic follow-up demonstrated good patency of the ICA in six of seven patients; in one patient, there was asymptomatic ICA occlusion that occurred because of discontinuation of antiplatelet therapy. Recently, Gomez et al. (10) also reported that the mean angiography follow-up for seven patients was 18.4 months, with a patency rate of 85.7%. The patency rate was adversely affected by a noncompliant patient who did not follow the prescribed antiplatelet regimen. The patient subsequently developed an early ICA occlusion noticed during the one-month follow-up period. From these reports, we conclude that an adequate antiplatelet therapy permits good long-term patency results. In our case, the long-term patency of angiographic follow-up was not assessed as the patient refused to undergo cerebral angiography by unwanted admission and anxiety for complications of undertaking an invasive study. However, a three-year clinical follow-up showed no definite complications.

In conclusion, the use of a stent-graft for treatment of hemorrhage and psuedoaneurysm of an ICA rupture after TSS seems to be a safe and effective treatment method. The method has an important role in preserving the ICA and may therefore be the treatment of choice.

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# 접형동을 통한 수술시 내경동맥 열상의 스텐트 그래프트를 이용한 혈관내 치료: 증례 보고[1]

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두경부의 접형동을 통한 수술 시 내경동맥의 열상은 드물지만, 열상이 있을 때 심각한 합병증을 일으킨다. 23세 여자가 라트케열 낭종으로 접형동 경유수술을 위해 내원하였다. 환자는 수술 중 다량의 출혈이 있었으며 응급으로 시행한 혈관조영술 상 내경동맥에서 의인성 열상이 관찰되었다. 이에 저자들은 스텐트 그래프트(stent - graft)를 위치시켜 성공적으로 출혈을 치료하였기에 이에 대한 증례를 보고하고자 한다.