Spontaneous Healing of Iatrogenic Direct Carotid Cavernous Fistula

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Summary

Direct carotid-cavernous fistula (CCF) by selective navigation using a microcatheter or microwire is a rare complication, and its timing of treatment has not been elucidated. We report two cases of direct CCFs resulting from injury to the cavernous posterior segment of the internal carotid artery during selective navigation. We did not plan to perform emergent endovascular treatment for these direct CCFs because no symptoms related to direct CCFs developed. Follow-up angiography revealed spontaneous healing of both direct CCFs. Close observation rather than emergent treatment may represent another option for direct CCF by selective navigation during the endovascular procedure.

Introduction

Internal carotid artery (ICA) injury is a rare but potentially fatal complication of transsphenoidal surgery or intracranial angioplasty¹⁻⁴. Immediate treatment is usually recommended due to fatal morbidity or mortality in internal carotid artery injury during transsphenoidal surgery or intracranial angioplasty. However, relatively little attention has been paid to the timing or indications of treatment in iatrogenic direct carotid cavernous fistula (CCF) by super-selective navigation of a microcatheter or microwire during the endovascular procedure. Most neurointerventionists may consider emergent or early treatment of these direct CCFs due to the risk of progression or aggravation of these CCFs. We describe two cases of direct CCFs by arterial injury dur-

ing super-selective navigation of the microcatheter or microwire and the subsequent, spontaneous healing.

Case 1

A 70-year-old woman presented to the emergency room with sudden severe headache. The patient had no medical history and no neurologic deficit. Brain computed tomographic angiography (CTA) revealed subarachnoid hemorrhage in the basal cistern but no definite aneurysm sac. Transfemoral angiography (TFCA) showed an acute angled left proximal carotid artery (Figure 1A) and abrupt occlusion of the left internal carotid artery (ICA) by dissection of the proximal ICA during manipulation of the angiocatheter in the acute angled proximal ICA (Figure 1B). The patient experienced a sudden onset of right hemiparesis. Therefore, carotid artery stenting was planned for the dissected lesion to prevent recurrent ischemic stroke and restore the compromised blood flow. An Excelsior SL 10 microcatheter (Boston Scientific, Natick, MA, USA) was navigated coaxially with Choice PT 300-cm exchange microwire (Boston Scientific, Natick, MA, USA) through the lesion to the cavernous ICA. Then, the microcatheter was removed and a Precise stent (7×40 mm; Cordis, Miami Lakes, FL, USA) was advanced to the dissected segment of the left ICA, and the stent was gradually deployed. The control angiogram showed restoration of nearly occluded flow. However, direct CCF was newly found in left posterior cavernous ICA with drainage into the cavernous sinus and contralateral inferior petrous si-

Figure 1 A) Roadmap of the left ICA angiogram revealed acute angle proximal ICA. B) Dissecting occlusion of the left ICA occurred during manipulation of the angiocatheter. C) A direct CCF developed during carotid artery stenting. The fistula drains into the cavernous sinus and contralateral inferior petrosal sinus. E,F) Follow-up angiography 1 week after the procedure revealed complete occlusion of the direct CCF.

nus (Figure 1C,D). The patient recovered from right hemiparesis with a new moderate degree of headache. Because the patient's neurologic status was stable, we decided to observe the fistula closely. Subsequent TFCA revealed complete obliteration of the fistula one week after the procedure (Figure 1E,F).

Case 2

A 64-year-old woman was admitted to our institution with complaints of severe headache. Brain CTA and diagnostic TFCA revealed a 7.4 × 7.0-mm aneurysm with a wide neck (6.0 mm) located at the left pericallosal artery (Figure 2A). We planned to perform detachable coil embolization using the Jeiling stent-assisted technique.

A Prowler Plus Select microcatheter (Codman Neurovascular, Raynham, MA, USA) was placed coaxially with synchro 14 microwire

(Boston Scientific, Natick, MA, USA) into the left pericallosal artery distal to the aneurysm sac for deployment of the stent. Control angiogram during the procedure revealed a new direct CCF that had originated from the left posterior cavernous ICA, draining mainly to the cavernous sinus and contralateral inferior petrosal sinus (Figure 2B,C).

We decided to perform coil embolization first and to evaluate iatrogenic direct CCF afterward. The pericallosal artery aneurysm was near completely packed using the Jeiling technique (Figure 2D). The final angiogram revealed the same features to characterize direct CCF. We planned to deploy the wingspan stent first and then to embolize the fistulous tract secondarily after short-term follow-up evaluation of the fistula (Figure 2E). The patient had no neurologic deficits with a mild degree of headache. Follow-up TFCA revealed a spontaneous obliteration of the fistula one month after the procedure (Figure 2F).

Figure 2 A) Angiography showed a left 7.4×7.0 -mm pericallosal aneurysm with a neck of 6 mm in size. B,C) Anteroposterior and lateral angiography revealed a direct CCF. The fistula drains into the cavernous sinus and contralateral inferior petrosal sinus. D) Control angiography revealed near complete occlusion of the aneurysm sac with no interval change of the fistula. E) Angiography showed no interval change of the fistula after deployment of Wingspan stent. F) Follow-up angiography 1 month after the procedure revealed complete occlusion of the direct CCF.

Discussion

The most frequent cause of direct CCF is trauma such as frontal blunt trauma, optic globe injury, gunshot wounds, and iatrogenic causes (following transsphenoidal surgery or glycerol rhizotomy), which account for 70 to 90% of cases. These fistulae are less likely to resolve spontaneously and may require intervention if symptomatic⁵. These insults influence the vascular wall exteriorly and extensively disrupt all layers of the vessel wall. Extensive injury to the vascular wall may prevent spontaneous healing of the vessel wall. Therefore, the fistulae caused by these insults are generally progressed and aggravated. Emergent or early intervention of these fistulae should be required.

The development of direct CCF by vessel injury during endovascular angioplasty and its treatment with transarterial coil embolization were reported². This insult affected the vascu-

lar wall interiorly from the intima to the adventitia and disrupted the vessel wall extensively. Therefore, it is impossible to anticipate spontaneous physiologic healing of the vessel wall in this injury.

To our knowledge, direct CCF insulted by navigation of a microcatheter or microwire occurred rarely and has not been reported. The timing and indications for treatment for these fistulae have not been elucidated. The mechanism of spontaneous healing is uncertain. Several theories have been suggested in the literature⁶⁻⁸. An explanation is based on the effect of iodinated contrast media which aggregates leukocytes, promotes clot formation, and has a direct effect on the vascular endothelium leading to thrombosis⁶. Other theories are that spontaneous healing may be provoked by venostasis following alteration in the pressure gradient during angiography^{6,8} or increased intracranial pressure may cause venostasis⁷. In our cases, the mechanism of the spontaneous healing is

that iodinate contrast media may promote clot formation in the focal injured vessel wall. Spontaneous healing of the injured vessel wall may be highly probable. Therefore, direct CCF by vessel injury during navigation involving microcatheter or microwires may need to be observed closely rather than treated emergently unless they are associated with cortical venous reflux or hemodynamic compromise.

In our cases, direct CCF was located at the posterior genu of the cavernous ICA. This may be related with the acute angled vasculature in this region. Careful navigation of the micro-

catheter or microwire under full inspection of the roadmap and positioning of the exchange microwire distal to this cavernous ICA may prevent or reduce the incidence of direct CCFs.

Conclusions

Close follow-up evaluation rather than emergent treatment may need to be considered in the context of direct CCF by navigation of a microcatheter or microwire due to the high probability of spontaneous healing.

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