Carotid Blowout Treated by Direct Percutaneous Puncture of Internal Carotid Artery with Temporary Balloon Occlusion

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Summary

Direct percutaneous puncture of a cervical carotid pseudoaneurysm for coil placement or acrylic embolization is described for the endovascular management of acute carotid blowout. However, direct puncture of the internal carotid artery (ICA) for the endovascular management of carotid blowout has not been described.

We report a difficult case of acute carotid blowout syndrome in a patient who had radiation-induced occlusion of the right common carotid artery with vasculopathy and pseudoaneurysm in the right cervical ICA. Collaterals from the branches of the contralateral external carotid artery (ECA) anastomosed with branches of right ECA supplied the vasculopathy. We performed direct percutaneous puncture of the bulb of the right ICA using a spinal needle and placed fiber coils to occlude antegrade flow of the artery. During the injection of a mixture of N-butyl cyanoacrylate and lipiodol oil for embolization of the remaining carotid bulb, we transiently inflated an occlusion balloon in the contralateral common carotid artery to further arrest antegrade flow in the ICA. The vasculopathy and pseudoaneurysm of the right cervical ICA were successfully embolized, with preservation of the distal branches of the right ICA.

Introduction

Carotid blowout refers to rupture of the carotid artery and its branches¹⁻³. It is one of the most devastating complications associated with radical head and neck surgery. Surgical management of carotid blowout is usually technically difficult for exploring and repairing the previously radiated field. Endovascular therapy with either permanent balloon occlusion or with the deployment of stent grafts has been reported as an alternative for management¹⁻⁴. In cases in which an endovascular approach is difficult, direct percutaneous puncture of the focal vascular nidus of a carotid artery, such as an aneurysm or a pseudoaneurysm, has been applied for embolization^{5,6}. However, we know of no reports of direct percutaneous puncture of the internal carotid artery (ICA) for embolization of a ruptured lesion involving the ICA itself.

We report our experience with direct percutaneous puncture of the ICA with transient balloon occlusion of the contralateral common carotid artery to treat acute carotid blowout in a patient with an occluded proximal common carotid artery. The placement of fiber coils in the ICA and the transient inflation of an occlusion balloon in the contralateral carotid artery arrested antegrade flow of the ICA and safely enhanced the effect of acrylic embolization.

This technique of endovascular management may be feasible in patients with carotid blowout and inaccessible transarterial approach.

Case Report

This 58-year-old man received a diagnosis of nasopharyngeal carcinoma (stage T3N1M0) four years before his presentation. Pathologic examination revealed an undifferentiated carcinoma. The patient received definite conventional radiotherapy with a total dose of 7211 cGy to the skull base, nasopharynx, and neck region. The tumor was in complete remission after this radiation therapy. The patient had diplopia due to right abducens nerve palsy one year ago. Magnetic resonance imaging (MRI) of the nasopharynx showed recurrent tumor with invasion of the right cavernous sinuses and skull base. To treat this lesion, gamma-knife radiosurgery with 72 Gy to the lesion was performed. For the recurrent tumor, we performed chemotherapy with cisplatin and leucovorin and definite radiotherapy with 5460 cGy administered to the skull base and neck region. After concurrent chemoradiotherapy, the patient's condition was stable.

Three months later, the patient was admitted to our hospital because of fever and general weakness. Clinical examination revealed debris and mucopurulent discharge from the nasopharynx. Cultures of necrotic tissue from the nasopharynx confirmed infection with *Staphylococcus aureus* and *Streptococcus pneumoniae*. Chest images showed pneumonia in the right lower lung. Laboratory tests showed a white blood cell count of 15,200/mm³ (segment 94.9%), and a ESR of 94 mm/h. CT scans revealed obvious radiation necrosis of the skull base and craniocervical junction. The patient accepted aggressive antibiotic treatment and tracheostomy.

On the seventh day of his hospitalization, he had four-limb weakness and a sudden deterioration in consciousness. Neurologic examination revealed a consciousness of E3 Vt M3 and hemiplegia more obvious in the left limbs than in the right. Emergency brain MRI showed acute infarction in the territories of the right middle cerebral artery. MRI also depicted a retropharyngeal abscess, an epidural abscess of the cervical spine and radiation-induced myelopathy of the cervical spinal cord. The patient received conservative care, and his symptoms

partially improved. He also had many episodes of sepsis due to pneumonia and necrosis associated with infection of the skull base and neck.

About two months after the major stroke, the patient had more than five episodes of active bleeding from the nose and mouth for three days. On physical examination, the right side of his upper neck and ear were indurated, swollen, and inflamed, with multiple bullae. The active extravasation had become progressively prominent and was refractory to surgical packing. He suffered from hypovolemic shock due to the active bleeding. The neurological deficit aggravated with loss of consciousness due to failure of intracranial collaterals in this hypotensive status. Emergency angiography was done and revealed total occlusion of right proximal common carotid artery (figure 1A). Collaterals from the branches of left external carotid artery (ECA) anastomosed with the branches of the right ECA to supply the right ICA (figure 1B,C). The right cervical ICA had long segmental stenosis with irregular bulging lesions, which were radiation-induced vasculopathy and pseudoaneurysms (figure 1C). The patient's clinical and angiographic findings indicated radiation necrosis involving the region of the right carotid bifurcation and the cervical ICA, which resulted in acute carotid blowout syndrome. Given the technical difficulty and critical clinical condition of the patient, we explained the risk of management to the family and suggested conservative treatment for him. But the family insisted on aggressive management to stop the active bleeding.

To target the source of bleeding, we performed direct percutaneous puncture of the right carotid bulb using a 19-gauge spinal needle. We confirmed its position on angiography (figure 2A). Fifteen fiber coils were densely packed to fill the right distal carotid bulb to arrest the antegrade flow of the right ICA (figure 2A,B). Because the right carotid bifurcation and the proximal ECA were also in the territory of radiation necrosis, we decided to embolize these vessels using N-butyl cyanoacrylate (NBCA; Histoacryl, Braun, Germany). Before the injection, we inflated a 9x20 mm balloon catheter (Powerflex; Cordis, Miami Lakes, FL) in the left common carotid artery to further arrest antegrade flow of the right ICA from the branches of the left carotid artery (figure 2B). Then, we slowly injected a mixture of 50%

Figure 1 Selective angiograms. (A) Image of the innominate artery shows total occlusion of right common carotid artery (arrow). (B) Anteroposterior view of the left carotid artery in the early arterial phase shows numerous collaterals from branches of the left ECA crossing the midline to branches of the right ECA. (C) Anteroposterior view of the left carotid artery in the late arterial phase shows radiation-induced vasculopathy and pseudoaneurysms, which cause irregular stenosis and focal dilatation of the right cervical ICA (arrowheads); this is supplied by the reversed flow of the right proximal ECA.

NBCA and 50% lipiodol oil through the spinal needle into the right carotid bulb. This mixture filled the bulb and refluxed to the proximal right ECA (figure 2B). Only a minimal amount of injected NBCA mixture flowed to the right proximal cervical ICA and stayed in place (figure 2B). The control angiogram showed complete obliteration of the right cervical ICA and preservation of the distal branches of the right ICA (figure 2C). Active extravasation stopped immediately after embolization.

However, after embolization the patient's cerebral ischemic symptoms were not improved because of impaired intracranial collaterals. The patient also had septic shock due to

his preexisting pneumonia and secondary infection in the necrotic tissue of the skull base. He died of septic shock four days after this treatment.

Discussion

Carotid blowout, or rupture of the carotid artery, is a dreaded complication of head and neck surgery for malignant disease. Patients with carotid blowout syndrome can have a variety of clinical presentations due to the carotid rupture, such as acute haemorrhage or exposure of part of the carotid artery⁴. The reported incidence of carotid rupture after radical neck dissection is 4.3%. Its estimated cumulative mortality rate is 40%, and its major neurologic morbidity rate is approximately 60%^{1,3}. Etiologic factors for carotid blowout include radiation therapy, radical resection, flap necrosis with carotid exposure, wound infection, and recurrent tumor^{1,2}. In patients with head and neck cancers, previous irradiation increases their risk of carotid blowout syndrome 7.6-fold^{2,4}. The carotid artery ruptures if its wall is damaged as a result of ischemia, as it receives 80% of its blood supply from the adventitia⁷.

Emergency surgical ligation of the ICA or common carotid artery is typically used to treat carotid blowout syndrome. This approach is associated with an average neurologic morbidity rate of 60% and is difficult to perform in the field of previous irradiation³. Endovascular techniques, including permanent balloon occlusion of an affected ICA, substantially improve the outcomes of patients^{1,3}. However, as many as 15% to 20% of patients with carotid blowout syndrome who are treated with permanent balloon occlusion develop immediate or delayed cerebral ischemia^{1,8}. A balloon occlusion test may be performed before patients with threatened carotid blowout syndrome are treated definitively, but this is usually not possible in acute cases.

Direct percutaneous puncture and embolization have been applied in the treatment of pseudoaneurysm of the carotid artery and of hypervascular tumors in the head and neck region^{5,6,9}. This technique is also increasingly used in the management of peripheral and visceral aneurysm¹⁰. In these applications, percutaneous puncture of a vascular lesion using a needle is followed by embolization. To our knowledge, direct percutaneous puncture of the ICA to permit embolization of radiation-induced pseudoaneurysms of the vessel has not been described. In the two reported cases of direct percutaneous puncture of a pseudoaneurysm of the ICA, both patients had received previous

carotid stent deployment in the neck^{5,6}. One had a dissecting aneurysm of the ICA that was initially treated with the deployment of two overlapping stents in the neck of the aneurysm and with the placement of Guglielmi detachable coils (Target Therapeutic, Fremont, CA). When extravasation recurred at four-week follow-up, the residual lumen of the aneurysm was accessed by means of direct percutaneous puncture, and it was packed with more Guglielmi detachable coils (Target Therapeutic). The other patient had a pseudoaneurysm of the ICA had not been obliterated by using two overlapping self-expanding stents. The patient's recurrent carotid blowout syndrome was managed with direct percutaneous puncture of the pseudoaneurysm and the injection of NBCA mixed with ethiodized oil. In these two patients, the puncture sites were the vascular lesions rather than the ICAs themselves.

Our case illustrates the therapeutic challenge of embolizing an active, extravasating lesion of the ICA with an inaccessible transarterial approach. Occlusion of the common carotid artery after irradiation precluded the performance of transarterial interventional procedures. The right cervical ICA, affected with pseudoaneurysms due to irradiation, was reconstituted from the transfacial and transcervical branches of contralateral ECA via the ipsilateral ECA. The target vessel, the right cervical ICA, was the one in need of treatment. Completely embolizing the numerous branches of the contralateral ECA is hard and may pose a risk of stroke if embolic materials pass through the anastomotic collaterals to the right ICA. Moreover, the effect of haemostasis may be inadequate by this "distant embolization". In this case, percutaneous puncture of the radiation-injured bulb of the right ICA was a direct way to approach the target vessel. This approach can be achieved with biplane angiography.

The other challenge in this case was how to arrest antegrade flow of the ICA during its embolization. Fiber coils were placed in the right distal carotid bulb to stop this flow. In our patient, we used 15 large, long fiber coils to prevent coil migration. Fiber coils are easy to deploy through the short puncture needle; this feature can save time in this emergency procedure. The coils also have a good thrombogenic effect in arresting the flow of the treated vessels. Antegrade flow of the ICA can be further precluded by inflating an occlusion balloon in

the contralateral common carotid artery, the feeder of the right ICA, during the injection of the mixture of NBCA and lipiodol oil. This transiently inflated occlusion balloon can also provide flow arrest in the right ECA, which assisted us in reversing the flow of the injected NBCA mixture from the carotid bulb to the carotid bifurcation and proximal ECA. The radiation-injured arteries were then successfully embolized. In selected cases, this balloon-assisted technique may have an effect similar to that of a stent-assisted technique for localizing the injected embolic material during embolization.

The limitation of this management was that the patient was not a good candidate for aggressive interventional therapy. He was in a severely ill, terminal status with many episodes of sepsis. Poor neurological condition due to im-

paired intracranial collaterals and previous hypovolemic insult was also found. Although the vascular lesion of ICA was successfully embolized by this direct puncture procedure, the fate of the patient could not be changed definitively. However, this management is still an effective way for treating acute extravasation of this tough case.

Conclusions

Direct percutaneous puncture for embolization of the ICA is feasible for the endovascular management of carotid blowout syndrome, especially when the transarterial route does not provide access. Transient balloon occlusion upstream of the ICA is a reasonable technique for finishing this local embolization.

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