Urgent Intracranial Carotid Artery Decompression after Penetrating Head Injury

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We describe a case of intracranial carotid artery occlusion due to penetrating craniofacial injury by high velocity foreign body that was relieved by decompressive surgery. A 46-year-old man presented with a penetrating wound to his face. A piece of an electric angular grinder disc became lodged in the anterior skull base. Computed tomography revealed that the disc had penetrated the unilateral paracocinoid and suprasellar areas without flow of the intracranial carotid artery on the lesion side. The cavernous sinus was also compromised. Removal of the anterior clinoid process re-opened the carotid blood flow, and the injection of glue into the cavernous sinus restored complete hemostasis during extraction of the fragment from the face. Digital subtraction angiography revealed complete recanalization of the carotid artery without any evidence of dissection. Accurate diagnosis regarding the extent of the compromised structures and urgent decompressive surgery with adequate hemostasis minimized the severity of penetrating damage in our patient.

Key Words : Penetrating craniofacial injury · Carotid artery · Cavernous sinus.
Penetrating Head Injury | SJ Kim and IS Park

or perfusion CT, it is possible to assess vascular injuries at the same time4).

Since damage to the carotid artery by penetrating foreign bodies can cause fatal consequences, action for the immediate restoration of blood flow is always necessary. Arterial dissection by foreign bodies often develops, and bypass surgeries or endovas-

FIG. 1. Photograph and CTs obtained at the time of admission. Deep penetrating laceration is visible (A). A piece of grinder blade is visible on facial bone three dimensional CT (B). Preoperative facial bone CTs show the broken blade involving the right cavernous sinus, optic nerve and paraclinoid segment of the internal carotid artery (C and D). Preoperative brain CTs show the involvement of the right temporal lobe, cavernous sinus, paraclinoid segment of the carotid artery (E), and traumatic subarachnoid hemorrhage, pneumocephalus without apparent low attenuation area of the right intracranial carotid artery (F).

DISCUSSION

High resolution CT (HRCT) is useful for evaluating the severity of damage to intracranial structures. When HRCT is performed alongside CT angiography

FIG. 2. CT angiography and perfusion study showing the injury of the right internal carotid artery (ICA). Right ICA is not visible while the left ICA density remained visible on the raw data of CT angiography (A and B). Perfusion CTs show the delayed time to peak of the right hemisphere suggesting the right ICA occlusion (C and D). Preoperative CT angiography shows the right ICA impinged between broken blade and anterior clinoid process (E).
appropriate measures to control massive sinus bleeding before extraction. Among these measures, Sekhar et al.\textsuperscript{6} reported that the injection of glue is effective to prevent bleeding in cases of possible cavernous sinus or venous plexus bleeding during removal of a foreign body penetrating the cavernous sinus.

Using the same method to control sinus bleeding, we removed anterior clinoid process and performed sinus unroofing. After these manipulations, the compressed ICA was decompressed, blood flow was restored and the bypass surgeries became unnecessary.

We were concerned about severe brain edema and ischemic brain injury, and therefore acted to prevent secondary brain injury by performing decompressive craniectomy and administering barbiturate coma therapy.

The main complications after penetration of the foreign body were infection and CSF leakage\textsuperscript{1}. Devitalized tissues and clots should be removed followed by meticulous homeostasis and watertight dural closure, to avoid CSF fistulae, prevent cerebral infestation, and provide an important barrier to infection\textsuperscript{1}. If the defect is large, it can be closed with pericranium, fascia lata, or temporalis fascia and fibrin glue as a sealant followed by prophylactic CSF lumbar drainage. In the present case, the wound was irrigated and the bone defect was closed with artificial dura and the temporalis muscle. Lumbar puncture and draining were performed for the prevention of CSF leakage from the wound.

**CONCLUSION**

Prompt treatment is very important in acute carotid artery occlusion. Especially, the injection of glue is effective to prevent bleeding in cases of possible cavernous sinus or venous plexus bleeding during removal of a foreign body penetrating the cavernous sinus. We have presented photos and illustrations describing the appropriate management of ICA occlusion due to penetrating head wounds.

**Fig. 3.** Operative microscopic view. Extradural view shows the blade fragment penetrating temporal lobe after removal of the anterior clinoid process (A). Intradural views show the displacement of the internal carotid artery (ICA) due to blade fragment (B) and restoration of flow to the ICA after extraction of broken blade (C). The broken blade with the size of 9×10 cm was extracted from the face (D).

**Fig. 4.** Postoperative angiography obtained at 2 months after surgery. Complete recanalization of the right internal carotid artery is visible.

Cerebrovascular approaches can be applied to restore blood flow\textsuperscript{3}. In the present case, the foreign body was located in the paracclinoid ICA and distal ICA was not observed on the source image from CT angiography. We presumed that there was no blood flow in the right ICA due to a delay in the time to peak on the right side from perfusion CT. Prompt treatment was needed to restore blood flow, similar to stroke management from acute ICA occlusion, but it was impossible to apply endovascular therapies because the ICA was displaced and compressed by the foreign body. Therefore, we planned emergency high flow bypass surgery without DSA considering the patient’s critical condition.

Because a blade penetrated our patient’s cranium from the nose to the dorsum sellae area and right cavernous sinus, we anticipated that there would be massive sinus bleeding if we extracted the blade from the external wound. Therefore, we took appropriate measures to control massive sinus bleeding before extraction. Among these measures, Sekhar et al.\textsuperscript{6} reported that the injection of glue is effective to prevent bleeding in cases of possible cavernous sinus or venous plexus bleeding during removal of a foreign body penetrating the cavernous sinus.

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**References**