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A Case of Hemifacial Spasm Caused by Penetration of the Anterior Inferior Cerebellar Artery between the Facial Nerve and the Nervus Intermedius

Yuji TAKANO,[1] Yoji TANAKA,[1] Azumi KANEOKA,[1] Mayuko IMAMURA,[1] Kaoru TAMURA,[1] and Taketoshi MAEHARA[1]

[1]*Department of Neurosurgery, Tokyo Medical and Dental University, Tokyo, Japan*

Abstract

Hemifacial spasm (HFS) is a disorder that causes involuntary movements of the ipsilateral facial muscles because of vascular compression of the facial nerve. Microvascular decompression (MVD), a surgical procedure to detach the culprit vessel from the nerve is believed to be the most effective treatment for HFS. Nevertheless, in the rare case in which the vessel penetrates the nerve, positioning the vessel sufficiently far from the nerve is challenging. In this report, a case of right HFS in a 54-year-old man with an anterior inferior cerebellar artery that had penetrated the nerve fiber cleft between the facial nerve and the nervus intermedius is presented. In the present case, the patient achieved relief from spasm, and postoperative facial hemiplegia was prevented by splitting the cleft slightly, gently moving the vessel, and affixing it to the petrous part of the temporal bone. The anatomic relationship between the facial nerve and the offending vessel must be properly understood, which must be carefully manipulated in such "penetration-type" HFS cases.

Keywords: hemifacial spasm, microvascular decompression, penetrating artery, anterior inferior cerebellar artery, facial nerve

Introduction

Hemifacial spasm (HFS) is a disease that causes involuntary movements of the ipsilateral face owing to vascular compression of the facial nerve, especially the part of the nerve known as the root exit zone (REZ).[1)] The prevalence of this disorder is 10 per 100,000 population, and its typical onset takes place at approximately the age of 54.[2)] The first treatment options are the use of antiseizure medication and botulinum toxin injection; if these measures cannot relieve the spasm, microvascular decompression (MVD) is an effective alternative. This procedure, which involves moving the culprit vessel away from the facial nerve, was originally proposed by Janetta[1,3)] and can achieve total relief from spasms in 85%-90% of patients.[4)] Nevertheless, performing decompression when the vessel is penetrating the nerve is difficult. In the present case, the patient underwent MVD due to HFS in which the responsible vessel, the anterior inferior cerebellar artery (AICA), penetrated between the facial nerve and the nervus intermedius, and was difficult to translocate.

Case Report

A 54-year-old man presented with a 10-year history of right HFS beginning with eyelid spasm. After 5 years, he received botulinum toxin injections on three separate occasions, but they were not effective. At 8 years after onset, the spasms progressed from the eyelid to the mouth, and he had difficulty opening his right eyelid. Dysgeusia had never appeared. The patient was referred to our neurosurgery department for treatment, which included surgery.

At the initial visit, narrowing of the right palpebral fissure and spasm of the right eyelid were observed. Blood tests, plain chest X-ray, and electrocardiogram were normal. The findings of heavy T2-weighted head MRI and MRA showed contact between the loop of the right AICA and the right facial nerve (Fig. 1A, B). In the 3D recon-

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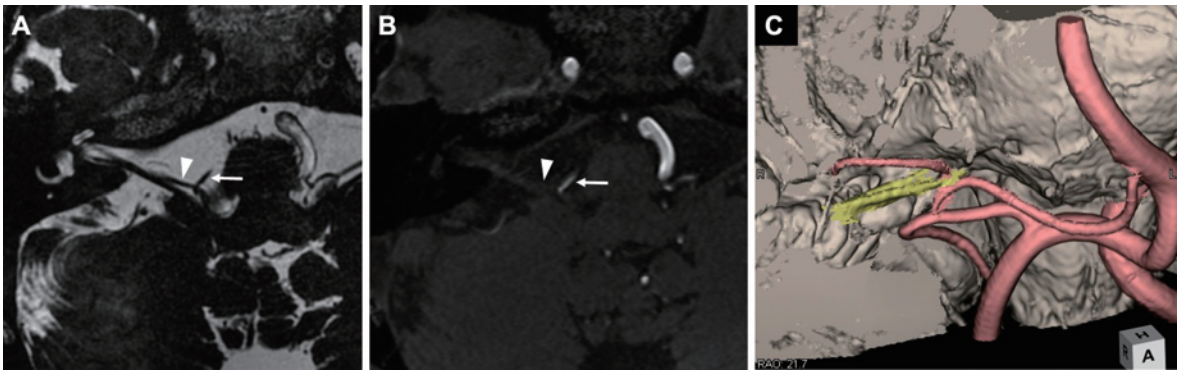

Fig. 1 Preoperative MRI. (A) Heavy T2-weighted image and (B) MRA showed that the right AICA (white arrow) was penetrating the right facial nerve (white arrowhead). (C) The 3D reconstruction of MRI images. It seemed that the AICA was running between the facial nerve and the vestibulocochlear nerve.
MRI, magnetic resonance imaging. AICA, anterior inferior cerebellar artery

struction image, the AICA appeared to be located between two separate nerves; thus, we considered the possibility that the AICA was running between the facial nerve and the vestibulocochlear nerve (Fig. 1C). We decided to conduct MVD considering that the HFS had been refractory to medical treatment.

Intraoperatively, the right AICA formed a loop with multiple perforating branches and its distal portion penetrated the facial nerve fibers (Fig. 2A, B). There was a nerve fiber cleft at the penetration point, which implied that the AICA passed between the facial nerve and the nervus intermedius. The facial nerve was mildly flexed where it was in contact with the AICA. Given that complete translocation of the AICA would be challenging, we split the nerve fiber cleft with a blunt instrument at the penetration point in the direction of the nerve fibers and moved the AICA toward the internal acoustic foramen (Fig. 2C, D). Then, we fixed the proximal part of the AICA loop to the surface of the petrous bone with Teflon cotton and fibrin glue (Fig. 2 E). Wave V in the auditory brainstem response presented a slightly prolonged latency (<0.5 ms); however, the amplitude was sufficient. Abnormal muscle response (AMR) was measured during surgery, but there was no change in the waveform observed after the AICA moved.

Postoperative CT scan revealed no intracranial hemorrhage. The right facial spasm disappeared after the surgery, and neither facial nerve palsy nor dysgeusia appeared postoperatively. The patient was discharged 10 days after the operation and had been completely free from facial spasm at the 1-year checkup.

Discussion

HFS is usually caused by contact between the facial nerve and a blood vessel. Cases in which the vessel penetrates the facial nerve are relatively rare. To our knowledge, vascular penetration of the facial nerve has been explored in five reports only (Table 1).[5-9] In a report of 4755 cases of MVD for HFS, eight (0.2%) were caused by penetration of the facial nerve by the culprit vessel.[5]

There are two possible patterns of penetration: (1) penetration of the main trunk of the facial nerve and (2) the passage between the main trunk of the facial nerve and the nervus intermedius. In a dissection of 25 cadavers (50 sides), the AICA penetrated the facial nerve trunk and the nervus intermedius on two sides (4%).[6] This means that there exists a small proportion of individuals with vascular penetration between the facial nerve and the nervus intermedius, including asymptomatic cases.

In cases of such vascular penetration undergoing MVD for HFS, translocation of the vessel is challenging and involves the risk of facial nerve palsy. In a previous study, Lee et al. reported that HFS disappeared immediately after surgery in 7 out of 8 cases of the penetration type, but postoperative facial nerve palsy occurred in one case.[5] In a report by Oh et al., the left AICA penetrating the REZ of the facial nerve was moved via a 2-mm incision in the direction of the facial nerve fibers and interposition of Teflon cotton.[9] After the surgery, ipsilateral facial nerve palsy remained, despite the disappearance of HFS. In our case, we made a similar incision in the direction of the facial nerve fibers; however, no postoperative facial nerve palsy took place. One possible reason for this difference seems that the penetration site was probably between the facial nerve and the nervus intermedius. A gap in the nerve fibers at the penetration site was already existing, and this site was able to be dissected easily. If the penetration site had been the main trunk of the facial nerve, blunt dissection would have been relatively challenging, and facial paralysis would likely have taken place. As for future work, if the relationships among the facial nerve, the nervus intermedius and the vessel could be identified via intraoperative nerve integrity monitoring, which would help to determine whether or not to split the nerve fibers and to predict the likelihood of postoperative facial nerve palsy.

Besides these anatomical differences, careful intraopera-

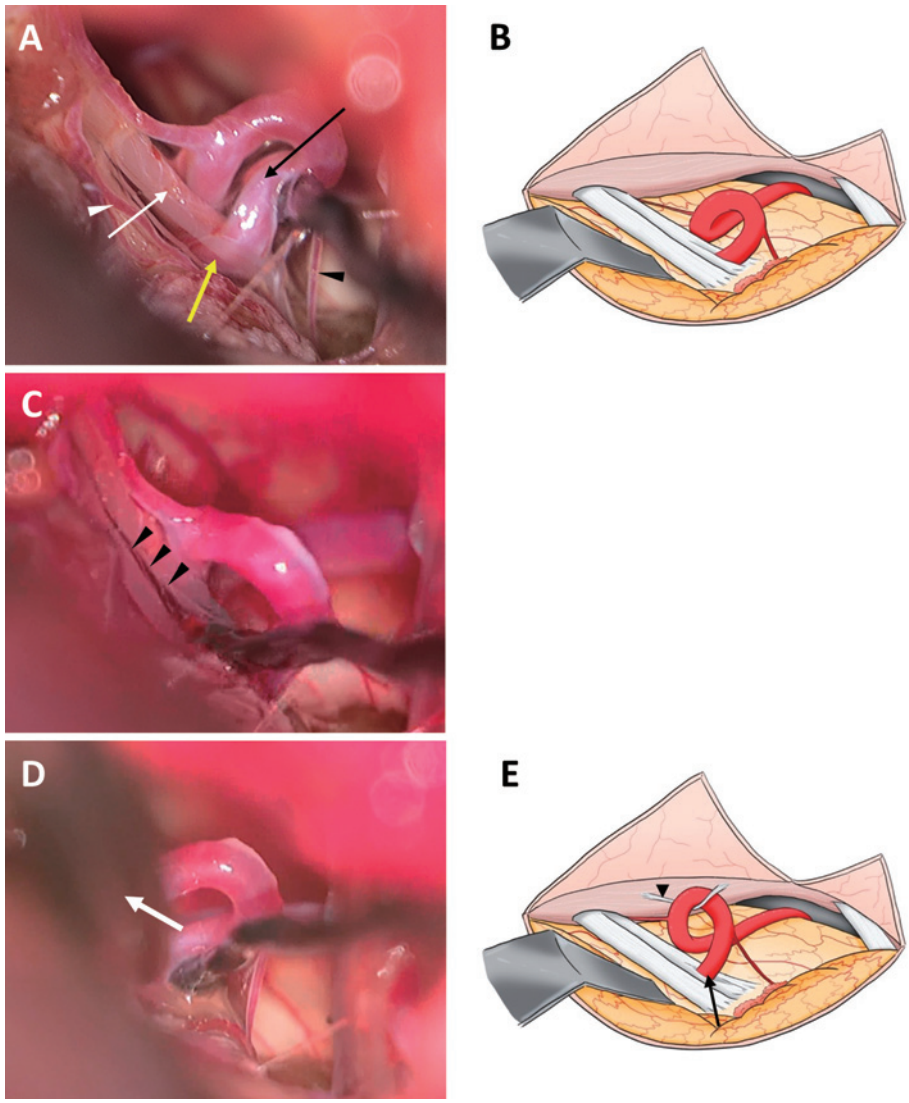

Fig. 2 Intraoperative findings. (A, B) The distal part of the loop of AICA (black arrow) was found to be penetrating the facial nerve fibers (white arrow). The yellow arrow shows the penetration point. The vessel was distant from the vestibulocochlear nerve (white arrowhead). The perforating artery of the AICA (black arrowhead) restricted its movement. (C) We split the nerve fiber cleft, probably between the facial nerve and the nervus intermedius, approximately 4 mm in the direction of the nerve fibers (black arrowheads). (D) Then, we moved the AICA approximately 2 mm toward the internal acoustic meatus. The white arrow shows the direction of the transposition of the AICA. (E) After moving the AICA (black arrow), the loop of the AICA was fixed on the petrous bone with Teflon (black arrowhead) and fibrin glue.
AICA, anterior inferior cerebellar artery

tive manipulation is important to avoid postoperative facial nerve palsy. In the present case, we took care to minimize the incision of nerve fibers and to avoid compression of the facial nerve by surgical instruments. Furthermore, several reports have suggested that the insertion of Teflon cotton between the nerve and the culprit vessel is insufficient for decompression[10] and that Teflon cotton forms granuloma.[11,12] Based on these facts, the disappearance of facial spasm after surgery in our case was believed to be because the offending artery was relocated without placing a prosthesis between the nerve and the artery.

The change of waveform on AMR or confirmation of nerve indentation after transposition of the offending artery would help determine whether successful nerve decompression was achieved. In the present case, the change of the waveform was not obvious when the AICA was moved, and the indentation could not be sufficiently observed because the perforating artery restricted the transposition of the AICA. In such cases, the AICA should be moved as far from the contact point of the facial nerve as safely possible.

Finally, the penetration of blood vessels into the facial

Table 1 Case reports of penetration of the artery into the facial nerve

Author (year)	Penetrating artery	Penetration site	Preoperative HFS	Postoperative HFS	Complications
Liu R (2001)[8]	AICA	Separated facial nerve trunk	–		
Oh CH (2015)[9]	AICA	Separated facial nerve trunk	+	Disappeared	Facial hemiplegia
Alonso F (2017)[6]	AICA	A cleft between the facial nerve and nervus intermedius	N/A		
Li L (2021)[7]	Perforating artery of AICA	A cleft between the facial nerve and nervus intermedius	+	Disappeared	None
Lee HS (2023)[5]	Six AICAs, one perforating artery of AICA, and one PICA	N/A	All (8/8)	Seven of the eight patients had no spasm on the fifth day after surgery	One of the eight patients suffered from transient facial hemiplegia
Present case	AICA	A cleft between facial nerve and nervus intermedius	+	Disappeared	None

AICA, anterior inferior cerebellar artery

nerve is of some interest from a developmental perspective. Sataloff et al. showed that a facio-acoustic primordium develops at the third week of gestation, which was followed by the peripheral extension of the facial nerve. In the fourth week, the facial nerve divides into two parts, one of which becomes the chorda tympani. The nervus intermedius arises in the fifth to sixth weeks of gestation.[13] By contrast, the AICA, which is the culprit vessel in many HFS cases, is said to arise at the fourth to fifth *month* of gestation.[14] At this time, the formation of the facial nerve fiber is complete. Hence, for the AICA to pass between the facial nerve trunk and the nervus intermedius, it must start developing much earlier than normal. Such developmental abnormalities are speculated to result in vascular penetration.

Conclusion

We carried out MVD for a case of HFS with the AICA penetrating the facial nerve fibers. In such cases, the vessel cannot be completely displaced, and separation or splitting of the nerve fibers must be performed to move the vessel; this action has the risk of postoperative facial paralysis. We think that careful intraoperative manipulation and understanding of the positional relationship between the facial nerve, the nervus intermedius, and the culprit vessel are important.

Abbreviations

HFS: hemifacial spasm
MVD: microvascular decompression
REZ: root exit zone
AICA: anterior inferior cerebellar artery

Informed Consent

The patient provided informed consent.

Conflicts of Interest Disclosure

All authors declare no conflicts of interest and have registered online self-reported COI Disclosure Statement Forms via the website for Japan Neurosurgical Society (JNS) members.

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Corresponding author: Yoji Tanaka, MD, PhD
Department of Neurosurgery, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku, Tokyo 113-8519, Japan.
e-mail: tanaka.nsrg@tmd.ac.jp