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Technical Notes

Anterior transpetrosal approach for microvascular decompression associated with the dolichoectatic vertebrobasilar artery in two patients with refractory trigeminal neuralgia: Technical note

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ABSTRACT

Background: Trigeminal neuralgia (TN) due to compression from the dolichoectatic vertebrobasilar artery (DVBA) is extremely rare and difficult to treat due to its morphological characteristics. We report two cases of good transposition of DVBA and postoperative course obtained using the anterior petrosal approach and a new vasoculopexy method.

Methods: We describe two cases of microvascular decompression (MVD) for refractory TN associated with DVBA. In both cases, MVD was performed through the anterior petrosal approach. The DVBA was decompressed using a GORE-TEX sling and WECK clip in an inferomedial direction.

Results: Complete pain relief without new neurological deterioration was achieved immediately in both patients.

Conclusion: We experienced a rare condition of TN due to exclusion by the DVBA. The anterior transpetrosal approach was extremely effective in this case. This approach secured the surgical field, allowed transposition of the DVBA, and caused no perioperative complications.

Keywords: Anterior petrosal approach, Dolichoectatic vertebrobasilar artery, Microvascular decompression, Retrosigmoid approach, Trigeminal neuralgia

INTRODUCTION

Jannetta first reported trigeminal neuralgia (TN) due to vascular compression in 1967.[6] TN due to compression of the dolichoectatic vertebrobasilar artery (DVBA) is extremely rare, ranging from 1.4% to 2.4% of TN cases.[14] Microvascular decompression (MVD) is widely established for typical TN. However, MVD for DVBA is difficult to treat, and various approaches and vasculopexy methods have been reported.[4,5,9,10,14] We report two cases of successful transposition of the DVBA and a good postoperative course obtained using the anterior petrosal approach and a new vasculopexy method. An edited high-definition video with detailed subtitles is provided that illustrates this technique and its nuances [Video 1, Supplemental Digital Content].

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CASE REPORT

Case 1

History and examination

A 65-year-old man presented with refractory TN (BNI pain intensity scale IV) in the left V2–3 area.

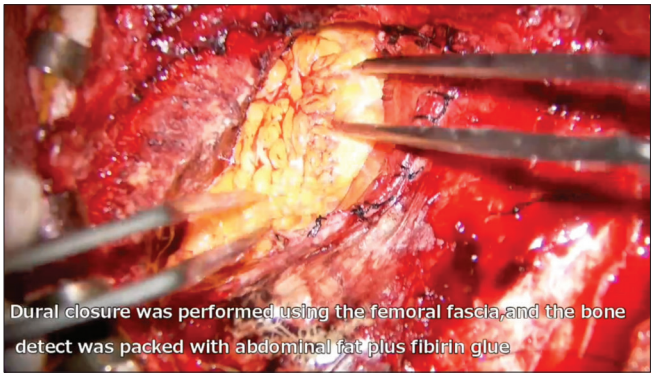
Imaging studies

Magnetic resonance imaging (MRI) showed the DVBA with compression of the left trigeminal nerve (CN5) [Figures 1a and b] and the left CN7,8 [Figure 1c]. Oral treatment and nerve blocks were ineffective and the patient chose surgical treatment.

Surgical report

The retrosigmoid approach is typical for MVD. However, considering the difficulty of securing the surgical field and the transport direction, we chose the anterior petrosal approach.

Auditory brainstem responses (ABR) and facial nerve monitoring were placed while the patient was under general anesthesia [Figure 2]. A left temporal craniotomy was performed and the middle base was flattened along the zygomatic arch and the supramastoid crest using a 5-mm course diamond drill. The dura mater was rapidly detached from the calvarium up to the foramen spinosum. The middle meningeal artery was cauterized and cut. The groove of the greater superficial petrosal nerve was exposed. The dura mater was elevated interdurally, leaving the greater superficial petrosal nerve (GSPN) on the middle base, up to the point where the GSPN submerges inside the foramen ovale [Figure 3a]. The tip of the petrosal bone and the latter half of the trigeminal impression were exposed. An extradural anteromedial petrosectomy was started from just medial to the GSPN and advanced toward the petrous edge**.** The drilling proceeded inferiorly up to the depth of the internal carotid artery on the deep anterior border [Figure 3b].



Video 1: Video demonstrating technique for MVD for dolichoectatic vertebrobasilar artery

The anterior superior wall of the internal auditory canal was opened and the tip of the petrous bone was removed up to the height of the inferior petrosal sinus. The dura mater of the middle fossa and posterior fossa was incised perpendicular to the superior petrosal sinus (SPS). The SPS was cauterized and divided anterior to the petrous vein, and the cerebellar tentorium was cut toward the free edge of the tentorium. The stretched trigeminal nerve, pons, yellowish DVBA, and anterior inferior cerebellar artery (AICA) were confirmed [Figure 4a]. A GORE-TEX sheet was cut into a slip and wound around the DVBA. The slip was immobilized on the DVBA and the dura mater of the clivus in the midline portion was sutured using 8-0 nylon thread. The GORE-TEX slip was immobilized on the dura mater of the clivus with a WECK clip [Figures 4b and c]. The patency of the perforators, DVBA, and AICA were confirmed using Doppler ultrasonography and indocyanine green video angiography. Additional stitches were performed for further slip fixation with 8-0 nylon thread. Finally, the abducens nerve arising from the bulbopontine groove was confirmed. Dural closure was performed using the femoral fascia and the bone defect was packed with abdominal fat plus fibrin glue.

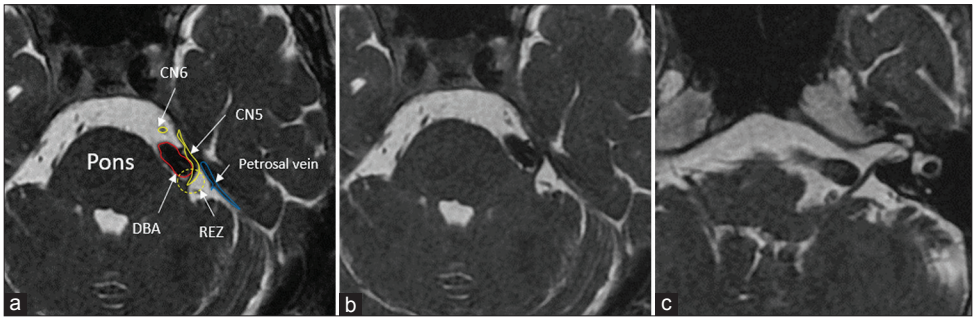


Figure 1: (a and b) DBA compressing the left CN5 on preoperative magnetic resonance imaging (MRI) FIESTA (fast imaging employing steady-state acquisition). (c) DBA also compress the left facial and cochlea nerves. CN5, trigeminal nerve; CN6, abducens nerve (yellow line); DBA, dolichoectatic basilar artery; petrosal vein (blue line); REZ, root exit zone (yellow dotted line).

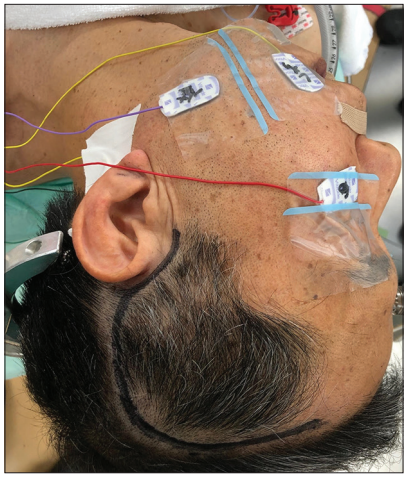


Figure 2: Left question mark skin incision (black line).

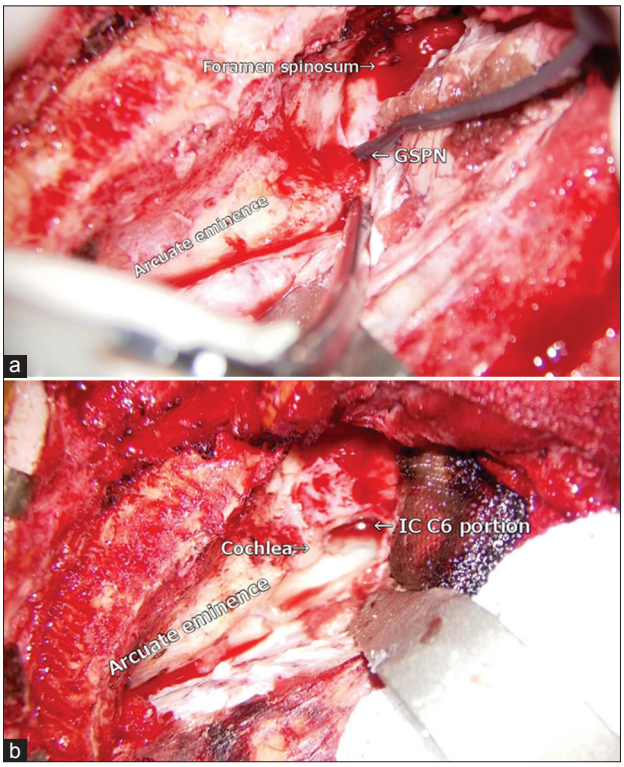


Figure 3: (a) The dura mater was elevated interdurally, leaving the GSPN on the middle base, up to the point where the GSPN submerges inside the foramen ovale. (b) The drilling proceeded inferiorly up to the depth of the internal carotid artery on the deep anterior border. GSPN: Greater superficial petrosal nerve.

Follow-up

Postoperative computed tomography angiography confirmed the appropriate range of bone removal and the positional relationship with the DVBA [Figure 4d]. Postoperative MRI showed good transposition of the DVBA and release of the

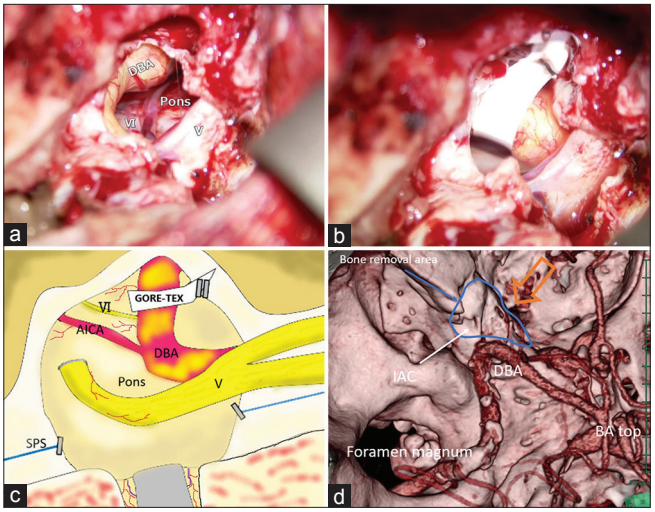


Figure 4: (a) The stretched trigeminal nerve, pons, yellowish DVBA, AICA were confirmed. (b) The GORE-TEX slip was immobilized on the dura mater of the clivus with a WECK clip. (c) Intraoperative anatomical schema. SPS (d) Postoperative computed tomography angiography 3D construction. Bone removal area (blue area) and DVBA. BA top: Top of the basilar artery, IAC: Internal auditory canal; Operative projection (orange arrow), SPS: Superior petrosal sinus, DVBA: Dolichoectatic basilar artery, AICA: Anterior inferior cerebellar artery.

excluded CN7,8 [Figures 5a-c]. No brainstem infarctions occurred and the patient's pain was immediately resolved without facial numbness (BNI scale I). He was discharged with a modified Rankin scale score of 0. At the 8-month postoperative follow-up, the patient remained symptom-free.

Case 2

History and examination

A 52-year-old man presented with refractory TN (BNI pain intensity scale: IV) in the left V2–3 area. Oral treatment was ineffective and the patient visited our hospital with an interest of undergoing surgery. The MRI scan revealed the DVBA and left AICA, with compression of the left CN5 in the posterolateral direction [Figure 6a]. MVD was performed with the left anterior petrosal approach, and the transposition of DVBA was confirmed using GORE-TEX sling [Figure 6b]. The left AICA was transpositioned with Teflon sling and the Meckel's cave was opened to redirect the CN5 [Figure 6c]. The postoperative MRI scan revealed good transposition of the offending artery [Figure 6d] and the TN was resolved immediately. The left Bell's palsy transiently appeared a few days after the operation, but the symptoms were completely resolved after 6 months of surgery.

DISCUSSION

TN due to vascular neuropathy is a painful disorder with an annual incidence of five in 100,000 people.[7] MVD

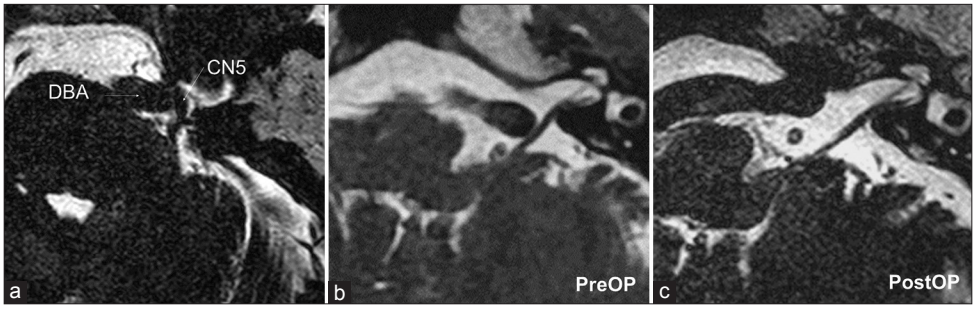


Figure 5: (a) Exclusion of the DVBA to CN5 was released on the postoperative magnetic resonance imaging FIESTA. Changes between (b) preoperative (PreOp) and (c) postoperative (PostOp) in DVBA running at the level of the internal auditory meatus. DVBA: Dolichoectatic basilar artery, CN5: Trigeminal nerve, FIESTA: Fast imaging employing steady-state acquisition.

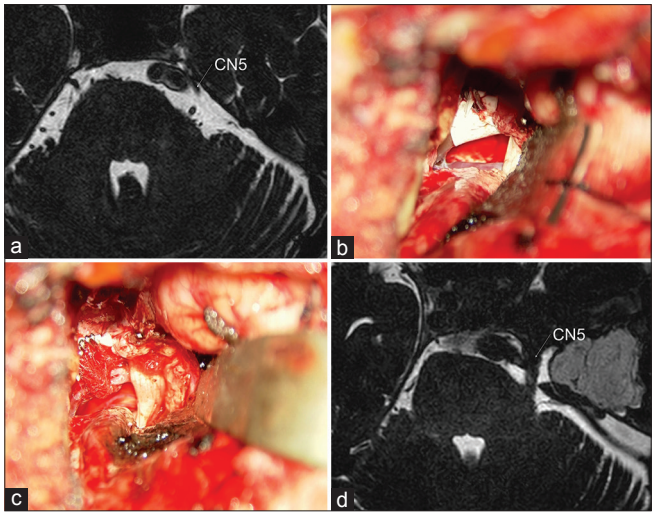


Figure 6: (a) Preoperative MRI FIESTA shows DVBA compressing the left CN5. (b) The DVBA was immobilized with GORE-TEX sling. (c) Left AICA was transpositioned with Teflon sling, and the Meckel's cave was opened to redirect the CN5. (d) The postoperative MRI scan confirmed the release of the nerve's compression and the straightening of the CN5. DVBA: Dolichoectatic basilar artery, FIESTA: Fast imaging employing steady-state acquisition, AICA: Anterior inferior cerebellar artery, CN5: Trigeminal nerve.

relieves pain in 90% of cases and the relief is effective after 15 years in 75% of cases.[1] Patients with DVBA may require extensive repositioning to decompress the cranial nerves, which increases the risk of cranial nerve injury and perforator occlusion.[13] Petty and Southby reduced pressure due to an ectatic BA and superior cerebellar artery with Gelfoam; this was the first description of MVD for BA pressure.[10] The efficacy of MVD for TN associated with the DVBA has not been evaluated in detail; however, recurrence rates (14–20%) are relatively high.[7,4,15] High postoperative complication rates (40–51%) have also been reported for TN by DVBA. Although the rates have been declining recently, complications, such as hearing impairment (3.8–14%), still occur.[2,5,11]

The retrosigmoid or far-lateral approach has been adopted in most MVD cases associated with the DVBA. This manipulation must be performed in a narrow corridor while paying attention to the facial and cochlea nerves (CN8). Yoon *et al*. used the Kawase approach for TN associated with DVBA and obtained a good clinical result, except postoperative facial numbness and sixth nerve palsy.[14] In our case, the DVBA excluded CN5 in the superolateral direction. Thus, DVBA transposition in the inferomedial direction was necessary to release the CN5 compression. If we had adopted the retrosigmoid approach, maneuvering over the compressed CN8 would have risked hearing loss. The anterior transpetrosal approach was safer because the DVBA was pulled away from the stretched CN8. Thus, intraoperative ABR did not change and hearing preservation was confirmed at the 2-month postoperative pure tone auditory test.

In the anterior petrosal approach, air cells in the petrosal apex and temporal bone are opened, which may cause postoperative cerebrospinal fluid (CSF) leaks and hearing impairment.[12] Femoral fascia was sewn to the dura mater of the posterior skull with 6-0 proline under the microscope and the opened mastoid air cells were packed with abdominal fat to prevent CSF leakage and preserve hearing. The anterior petrosal approach was more effective than other approaches at securing working space, accommodating the vasculopexy direction, and reducing hearing impairment.

The ectatic and atherosclerotic basilar artery has muscle memory and recoil and resists displacement. Teflon slings or pledgets are not sufficient to cushion the trigeminal nerve from DVBA compression from a severely ectatic basilar artery.[1] Aneurysm clip,[8] GORE-TEX slings,[9] or both,[3,14] and direct suturing of the artery[11] have been used for DVBA vasculopexy. In our case, a WECK clip was used to immobilize the GORE-TEX sling to the dura mater of the clivus in an inferomedial direction. The WECK clip is smaller than an aneurysm clip, providing ample workspace to suture the GORE-TEX sling. Transposition of the DVBA generally causes perforator infarction due to twitching.[3] The

transposition was performed by reversing the DVBA around the brainstem without changing the distance from the brainstem, which prevented over-stretching of the perforator. When performing vascular fixation with a GORE-TEX sling, the surgeon should be careful not to kink the blood vessels. The postoperative MRI angiography showed no stenosis of the DVBA by vasculopexy with a GORE-TEX sling.

This technique and approach should only be considered in cases where compression is caused by severely vertebrobasilar ectasia, to reduce the risk of neurovascular injury and brainstem infarction. Surgeons dedicated and specifically trained in skull base microsurgery are critical for success and avoiding complications.

CONCLUSION

We experienced TN associated with DVBA exclusion. The anterior transpetrosal approach was extremely effective in securing the surgical field, accommodating the transposition, and avoiding perioperative complications.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Apra C, Lefaucheur JP, Le Guérinel C. Microvascular decompression is an effective therapy for trigeminal neuralgia due to dolichoectatic basilar artery compression: Case reports and literature review. Neurosurg Rev 2017;40:577-82.
2. Chai S, Xu H, Wang Q, Li J, Wang J, Wang Y, *et al*. Microvascular decompression for trigeminal neuralgia caused by vertebrobasilar dolichoectasia: Interposition technique versus transposition technique. Acta Neurochir (Wien) 2020;162:2811-21.
3. Choudhri O, Connolly ID, Lawton MT. Macrovascular decompression of the brainstem and cranial nerves: Evolution of an anteromedial vertebrobasilar artery transposition technique. Neurosurgery 2017;81:367-76.
4. El-Ghandour NM. Microvascular decompression in the treatment of trigeminal neuralgia caused by vertebrobasilar ectasia. Neurosurgery 2010;67:330-7.
5. Inoue T, Shitara S, Goto Y, Prasetya M, Fukushima T. Microvascular decompression for trigeminal neuralgia attributable to the vertebrobasilar artery: Decompression technique and significance of separation from the nerve root. Acta Neurochir (Wien) 2021;163:1037-43.
6. Jannetta PJ. Arterial compression of the trigeminal nerve at the pons in patients with trigeminal neuralgia. J Neurosurg 1967;26:159-62.
7. Linskey ME, Jho HD, Jannetta PJ. Microvascular decompression for trigeminal neuralgia caused by vertebrobasilar compression. J Neurosurg 1994;81:1-9.
8. Niizuma H, Ikeda S, Ohyama H. Trigeminal neuralgia and hemifacial spasm caused by the compression of tortuous vertebro-basilar system-a case report (author's transl). No Shinkei Geka 1981;9:1167-70.
9. Ogawa A, Suzuki M, Shirane R, Yoshimoto T. Repositioning of the tortuous vertebrobasilar artery for trigeminal neuralgia: A technical note. Surg Neurol 1992;38:232-5.
10. Petty PG, Southby R. Vascular compression of lower cranial nerves: Observations using microsurgery, with particular reference to trigeminal neuralgia. Aust N Z J Surg 1977;47:314-20.
11. Singh H, da Silva HB, Zeinalizadeh M, Elarjani T, Straus D, Sekhar LN. Basilar artery ectasia causing trigeminal neuralgia: An evolved technique of transpositional suture-Pexy, Oper Neurosurg (Hagerstown) 2018;14:194-9.
12. Tamura R, Tomio R, Mohammad F, Toda M, Yoshida K. Analysis of various tracts of mastoid air cells related to CSF leak after the anterior transpetrosal approach. J Neurosurg 2019;130:360-7.
13. Vanaclocha V, Herrera JM, Martínez-Gómez D, Rivera-Paz M, Calabuig-Bayo C, Vanaclocha L. Is there a safe and effective way to treat trigeminal neuralgia associated with vertebrobasilar Dolichoectasia? Presentation of 8 cases and literature review. World Neurosurg 2016;96:516-29.
14. Yoon S, Mascitelli JR, Mooney MA, Gandhi S, Chen T, Cole TS, *et al*. Kawase approach for Dolichoectactic basilar artery macrovascular decompression in a patient with trigeminal neuralgia: Case report. Oper Neurosurg (Hagerstown) 2019;16:E178-83.
15. Zaidi HA, Awad AW, Chowdhry SA, Fusco D, Nakaji P, Spetzler RF. Microvascular decompression for hemifacial spasm secondary to vertebrobasilar dolichoectasia: Surgical strategies, technical nuances and clinical outcomes. J Clin Neurosci 2015;22:62-8.

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