Operative approach to persistent trigeminal artery producing facial pain and diplopia

Case report

GLEN S. MERRY, F.R.C.S., AND KENNETH G. JAMIESON, M.S., M.D., D.S., F.R.A.C.S.

Department of Neurology and Neurosurgery, Royal Brisbane Hospital, Queensland, Australia

A case is reported of persistent trigeminal artery producing intermittent facial pain, the last episode being associated with diplopia. The trigeminal and abducent nerves were attached to the trigeminal artery by a congenital membrane. Blood supply to the vertebrobasilar system was via the persistent vessel. A new operative approach along the petrous-temporal ridge is described.

KEY WORDS • persistent trigeminal artery • facial pain • diplopia • trigeminal nerve • abducent nerve • operative approach

Because of the development of carotid-basilar anastomoses in relationship to cranial nerves, many authors have suggested the trigeminal artery may compress adjacent nerves. Trigeminal neuralgia, altered sensation, and diplopia have been reported. Supply of the vertebrobasilar system has been described by Padget. Surgical exposure of the trigeminal artery is rare. Morrison, et al., described a middle fossa approach to an aneurysm on a persistent trigeminal artery while Kempe and Smith exposed the vessel via the posterior fossa. An anterolateral combined with a supra-infratentorial approach along the petrous temporal bone provided exposure of the persistent trigeminal artery and trigeminal and abducent nerves in the case reported here.

Case Report

A 31-year-old woman was admitted to the Royal Brisbane Hospital on April 14, 1974, complaining of low back pain and left sciatica which resulted from a fall 4 days previously. She later suffered severe left facial pain in the area of the trigeminal nerve. There was also pain, paresthesia, and some decreased power in the left upper limb. The facial pain was throbbing in nature and was worse when she lay on her left side or was under emotional stress. On two previous occasions, 11 years and 4 years before, she had had episodes of left facial pain which improved after several weeks; these were also associated with stressful situations.

Examination. Clinical examination demonstrated limited straight-leg raising on the
left and a tender lower lumbar spine. There was hyperesthesia in the left side of her face, left arm, and leg. Vibration sense was mildly impaired in the left leg. Cranial nerve function from a motor aspect and hearing and corneal reflexes were normal. The optic discs appeared minimally pale. Visual acuity was unimpaired. Plain x-ray films of the skull and vertebral column were normal.

Myelographic studies in both the prone and supine positions were performed on April 18, 1974. An L4-5 prolapsed intervertebral disc was present but there were no other abnormalities present and no lesions at the craniocervical junction. Cerebrospinal fluid protein was 20 mg%, and the colloidal gold content was normal.

She was discharged relatively free of pain on April 20, 1974; however, the left trigeminal pain recurred. Left carotid angiogram on April 26, 1974, demonstrated a persistent trigeminal artery that supplied the vertebrobasilar system with retrograde flow in the vertebral artery to the level of the arch of the atlas (Fig. 1). There was a reasonable response to Tegretol (carbamazepine) combined with satisfactory control of her emotional state. However, during May, 1974, the left facial pain recurred, became intermittent, and was associated with episodes of numbness in the face.

With the persistence of severe left facial pain and the appearance of diplopia for the first time, she was readmitted on June 17, 1974. An angiogram of the aortic arch was performed on June 19, 1974, via femoral puncture. Selective catheterization of the left vertebral artery was unsuccessful. A mainstream pressure injection in the aortic arch revealed a grossly hypoplastic left vertebral artery arising directly from the arch while the right vertebral artery was patent, although also hypoplastic.

**Operative Procedure.** On June 26, 1974, exploration of the left trigeminal and abducant nerves in relation to the persistent trigeminal artery was performed. Through an anteriorly curved incision behind the ear, an osteoplastic flap crossing the transverse sinus was hinged downward on the suboccipital muscles (Fig. 2 left). Difficulty may be met in cutting its anterior limb just behind the root of the petrous crest. The scalp flap may be dissected forward to divide the cartilaginous external auditory canal if access is limited. The mastoid process was then removed to the

---

*Fig. 1. Left carotid angiograms. Left: Lateral view showing persistent trigeminal artery (vertical black arrow), basilar artery (horizontal black arrow), and vertebral artery (white arrow). Right: Anteroposterior view outlining the course of the trigeminal artery (black arrows).*
Trigeminal artery and facial pain

FIG. 2. Left anterolateral approach. Left: Line drawing showing incision and bone flap in the combined supra- and infratentorial craniotomy. Right: Exposure of the temporal dura (TD), posterior fossa dura (PD), transverse and sigmoid sinuses (TS, SS), and petrous temporal bone (PT).

level of the Fallopian canal. This can be done by bone nibblers or by Gigli saw cut. Early identification and division of the mastoid emissary vein was considered essential to tidiness lest it be avulsed from the junction of the transverse and sigmoid sinuses (Fig. 2 right). The dura mater was opened above the tentorium (Fig. 3 upper left) and the tentorium cerebelli divided from its free edge to the junction of the superior petrosal, transverse, and sigmoid sinuses. The sigmoid sinus was retracted posteriorly and the dura anteriorly incised. This incision can extend to the jugular foramen (Fig. 3 upper right). The superior petrosal sinus is divided close to the sigmoid. Retraction of the anterior cerebellum provides exposure of the fifth to eleventh cranial nerves inclusive (Fig. 3 lower left). Combined with further retraction of the temporal lobe the persistent trigeminal artery was seen medial to the trigeminal nerve (Fig. 4). The fifth and sixth cranial nerves were enveloped in a thick congenital membrane and were attached to the persistent trigeminal artery. This membrane was divided, thereby allowing the cranial nerves to lie free from the artery. A piece of Gelfoam was placed between the two structures.

Postoperative Course. The patient's postoperative course was uneventful. Upon discharge on June 6, 1974, she had no facial pain, although diplopia persisted. The diplopia improved over the next 4 months. Sensation to her face was normal, although she noticed areas of numbness inside her left cheek, on the left side of her tongue and inner aspect of her lower lip for several months.

In February, 1976, she had pain above the left eyebrow, and was tender over the supraorbital notch. She responded to local injections of hydrocortisone acetate. There had been no further diplopia.

Discussion

The incidence of persistent trigeminal artery varies from 0.1% to 0.6%, the mean being 0.23%, 2,3,8,9,19 Developmentally and anatomically, the trigeminal artery could involve the third, fourth, and sixth cranial nerves in the cavernous sinus, or compress its adjacent fifth nerve. In the present case, both the trigeminal and abducent nerves were compressed in the posterior fossa. All three structures were enveloped in a discrete membrane, most likely congenital in nature.

There is always the problem of relating cranial nerve lesions with a demonstrable trigeminal artery as the causative factor. Sunderland17,18 and Parkinson and Shields19 demonstrated compression or a close anatomical relationship in dissected specimens.
The trigeminal artery was medial to the fifth nerve and in its posterior fossa segment was inferior and lateral to the sixth cranial nerve. This arrangement was confirmed in the current operative findings (Fig. 4).

Clinically, this patient had facial pain in the area of distribution of all three divisions of the trigeminal nerve and diplopia from involvement of the left abducent nerve. The pain was episodic over 11 years and was made worse by factors that increased transmission of arterial pressure, such as head position and emotional stress. Reference in the literature has been made to patients presenting with facial pain and altered sensation in the area of the fifth cranial nerve. Eadie, et al., reported three cases with diplopia.

Surgical treatment involves consideration of the blood supply to the brain stem and cerebellum. The persistent trigeminal anastomosis may be the vessel responsible for ensuring blood supply to posterior fossa structures (Fig. 1). Under this circumstance, the usual vertebral artery supply is most likely inadequate and the vessels are either absent or hypoplastic, as demonstrated in this patient on an angiogram of the aortic arch. Padget studied the embryological development of the cerebral vascular system and noted that in the early stages the precursors of the basilar artery are largely supplied by the trigeminal artery, which has arisen from the internal carotid artery.

The anterolateral approach was first suggested to Jamieson in his experience in excising a large osteoclastoma of the petrous temporal bone in 1961. This was based on previous endeavors with advanced carcinoma of the ear. A similar approach was developed independently and described by Henderson.
Trigeminal artery and facial pain

This procedure, combining a supra- and infratentorial approach with division of the superior petrosal sinus at its junction with the sigmoid sinus and with an anteriorly placed dural incision (Fig. 3 upper right), provides wide access to the anterior cerebellum. Examples of lesions well approached by this route include low clivus meningiomas, chordomas, anterior cerebellar arteriovenous anomalies, low basilar aneurysms, and large acoustic tumors.

Morrison, et al.,11 reported the first successful direct operative treatment of a persistent trigeminal artery aneurysm via a middle fossa approach. Kempe and Smith7 performed a retrogasserian sensory root section via the posterior fossa in a patient with typical trigeminal neuralgia in the left second and third divisions, and preserved the persistent trigeminal artery.

In our case, the trigeminal and abducent nerves and trigeminal artery were left intact. The decompression was obtained by dividing the membrane. The facial pain and diplopia remain absent and facial sensation is preserved.

Fig. 4. Operative photographs. Upper: The persistent trigeminal artery (PTA) is demonstrated medial to the fifth cranial nerve. Lower: The fifth cranial nerve is retracted to show its close relationship to the persistent trigeminal artery (PTA).
Acknowledgments

I record my debt to Kenneth G. Jamieson, who died on January 28, 1976, in Brisbane, Australia. He was the senior neurosurgeon, Royal Brisbane Hospital, and made many contributions to the Journal of Neurosurgery. This paper is written to emphasize the surgical technique he applied to this patient. I express my gratitude to Mr. Keith Henderson, Senior Neurosurgeon, St. Vincent's Hospital, Melbourne, for his help in discussing the operative approach and acknowledge his independent contribution.

References

4. Henderson JK: Personal communication, 1976
13. Padget DH: cited in Reference 1

Address reprint requests to: Glen S. Merry, F.R.C.S., 131 Wickham Terrace, Brisbane, 4000, Australia.