Management of petrosal veins during microvascular decompression for trigeminal neuralgia

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Objective: Venous compression might be the main cause of incomplete decompression and symptom recurrence after microvascular decompression (MVD) in patients with trigeminal neuralgia. Although it can be killed in most cases, cutting the vein sometimes has the potential risk arising from venous congestion. To maneuver the vein safely, we introduced a temporary occlusion test of the vein.

Methods: Among 407 consecutive MVD cases, 48 (11.8%) offending and 157 block veins were encountered. The vein was cut directly in 147 (71.7%). Owing to the potential risk following killing of the vein, 58 (28.3%) patients underwent venous occlusion test with neurophysiologic monitoring during the operation. The temporal occlusion should be ceased immediately as soon as any changes in brainstem auditory evoked potential (BAEP) or trigeminal evoked potential (TEP) wave figure turn up; otherwise, it would last for 15 minutes.

Results: The occlusion test was negative in 53 (91.4%), while positive in five patients (8.6%). According to the results, we cut the vein in test-negative patients, which made the operation easy and offered a satisfactory decompression. Among the five positive cases, the vein was finally saved in two and cut in three cases. Yet, all the three patients developed a severe ipsilateral cerebellar edema and brainstem shift after the vein was sacrificed. Despite those patients were reoperated on immediately for posterior fossa decompression, they remained equilibrium disorder with numbness in ipsilateral face and limb hemiparesis in contralateral extremities post-operatively. The residual two patients had an incomplete pain relief.

Conclusion: This venous occlusion test could help the surgeon in making a right decision before manipulation of the petrosal veins during MVD. [Neurol Res 2008; 30: 697–700]

Keywords: Petrosal vein; microvascular decompression; trigeminal neuralgia; venous occlusion test; neurophysiology

INTRODUCTION

The procedure of microvascular decompression (MVD) has now become widely accepted as a remedy for trigeminal neuralgia. The surgical outcome depends on different facts, e.g. the fashion of the offending vessel and its compression degree. Although arterial compression has been reported to be the main cause in most cases of trigeminal neuralgia, venous compression alone or in combination with arterial compression has also been observed frequently during surgery. Venous compression might be the main causation of incomplete decompression and symptom recurrence. Sometimes, it would be very difficult or even hazardous to dissect the offending vein away from the nerve in case of the following situations: (1) there are severe adhesions between the vein and nerve; (2) the vein drains deeply from brainstem; (3) the vein goes through the nerve fibers. Until now, the management of those veins has been still controversial. Killing the vein may influence the brainstem function or raise the intracranial pressure, while saving the vein may provide a dissatisfactory decompression or recurrence.

In the present paper, we retrospectively studied on the superior petrosal veins (SPV) involved in the procedure of MVD. The occlusion test was employed for those potential risky veins. With the test, the surgeon can predict the safety before killing the vein and therefore, simplify the operation and obtain a satisfactory decompression with lower complications.

MATERIALS AND METHODS

From August 2000 through December 2006, 407 consecutive patients with trigeminal neuralgia underwent MVD. The patients included 199 men and 208 women with an averaged age of 64.6 years old (41–81 years old). During the surgery, it was found that the SPV compressed the trigeminal nerve or interfered with the surgical approach in 205 cases. A temporal venous occlusion before manipulation of the vein was
employed in 58 cases for those big and deep draining veins.

The operation
A suboccipital superior-lateral cerebellar approach via a retromastoid craniectomy was used for MVD in all the cases. After the dura was opened and sutured back, a direct corridor along the petro-tentorial bone was created. With microscopic visualization, all arachnoids around the nerve and vessels were sharply dissected. The trigeminal nerve was circumferentially inspected along its entire intracranial course from its root entry zone at the brainstem laterally to its entrance into the Meckel’s cave. Small veins (<2 mm in diameter) or those located dorsal-laterally to the trigeminal nerve and mainly drain from lateral cerebellum were coagulated and cut in the operation, when they blocked the access or adhered to or even go through the nerve. Large veins (>2 mm in diameter) or those drained from ventral brainstem underwent an occlusion test with a mini scatheless clip. The occlusion test should be ceased immediately as soon as any changes in brainstem auditory evoked potential (BAEP) or trigeminal evoked potential (TEP) wave figuration turn up; otherwise, it would last for 15 minutes (Figure 1). According to the temporal occlusion test result, the vein was cut or transposed or interposed for the decompression.

RESULTS
With this petro-tentorial approach, the SPV was observed to be formed by the terminal segment of a single vein (6%) or the common stem formed by the union of two (26%), three (42%), four (19%) or five (7%) veins (Figure 2). Among the 407 MVD cases, 48 (11.8%) offending and 157 block veins were encountered. In terms of its relationship with trigeminal nerve, those offending veins were observed to penetrate the nerve in nine (19.1%) (Figure 3), to compress the nerve in 26
(53.8%) (Figure 4), to parallel and adhere tightly to the
never in 13 (26.9%) patients (Figure 5).
Among the 205 (50.1%) vein-involved cases, the vein
was cut directly in 147 (71.7%) cases. Owing to the
potential risk following killing of the vein, 58 (28.3%)
patients underwent vein occlusion test. During the test
period, no apparent changes in BAEP/TEP wave figuration
were noticed in 53 (91.4%), while more than 50% altera-
tion of BAEP/TEP amplitude or latency was found
in five (8.6%) cases. According to the results, we cut
the vein in the test-negative patients, which made
the surgery easy and offered a satisfactory decompression.
Among the five positive cases, the vein was at last
dissected away from the nerve and saved in two cases. The
vein was ruptured during the procedure and yielded to cut
in three cases. After the surgery, all of the three patients
developed a severe ipsilateral cerebellar edema as well as
brainstem shift, which was followed by an emergency
cranietomy for posterior fossa decompression. Although
the patients recovered post-operatively, they remained
equilibrium disturbance with numbness in ipsilateral face
and mild hemiparesis in contralateral extremities.

**DISCUSSION**

Exposure of the trigeminal nerve through a suboccipital
crianietomy commonly requires killing of one or more
bridging veins of SPV. The vein can be cut when it is
one of several SPVs. However, the vein may not be cut
in cases in which it is a large main drainer, because of
the potential complications arising from venous con-
gestion. To date, there is no acknowledged principle to
guide manipulation of the vein during the MVD procedure.
Some authors claimed to cut all the veins on the way of the surgical approach
when they obscured access or presented as the
offending vessel. Others deemed to save those veins
as soon as possible to protect the fetal complications
caused by the drainage obstruction.

An anatomical understanding of the common tribu-
taries of SPV and its relationship to the trigeminal nerve
is useful for achieving a satisfactory access and
complete decompression of the trigeminal nerve. The
transverse pontine veins are the most frequent veins to
compress the trigeminal nerve, which pass near the
nerve to reach the bridging veins entering the superior
dorsal sinus. The vein of the middle cerebellar
peduncle may compress the lateral or medial surface
of the nerve before joining the SPV as it ascends in the
pons. The vein of the cerebellopontine fissure may
indent the lateral margin of the nerve as it ascends
toward the superior petrosal sinus, and the pontotri-
geminal vein may indent the upper margin of the nerve.
Generally, those tributaries that receive the superior and
inferior hemispheric and vermian veins, and the vein of
the cerebellomesencephalic fissure may be killed with-
out adverse effect.

![Diagram depicting the decision-making process for manipulation of the offending vein during the microvascular decompression surgery](http://example.com/diagram.png)
Our technique of temporal vein occlusion test with electrophysiologic monitoring may provide a good alternative to management of those veins. However, not all the veins need to be temporally clipped before being cut. It has been believed that small veins (<2 mm in diameter) could be coagulated and cut in the operation without risk. Large veins (>2 mm in diameter) should be saved as long as an adequate exposure can be obtained. Those locate dorsal-laterally to the trigeminal nerve and mainly drain from lateral cerebellum could be killed, when they block the access or go through the nerve. For those drain from ventral brainstem or those big veins which merge into the nerve and could not be separated, a temporal occlusion test is suggested (Figure 6).

Nevertheless, the venous occlusion test should be the last choice, and a miniscatheless clip should be selected to avoid delayed fatal bleeding after the operation, since veins are more damageable compared with arteries.

Even if the patient has passed the occlusion test, we still concern cerebellar edema caused by killing of the vein. Occlusion of the vein may obstruct the cerebellar drainage and then induce an edema with an increased intracranial pressure (ICP) in the posterior fossa, which accordingly cause fatal complication and may need a reoperation to decompress the posterior fossa pressure. Until now, unfortunately, there is no device with which a real time ICP can be registered during the open brain surgery. Therefore, we should put more emphases on monitoring the conscious status and fatal sign of the patient who sustained the vein killing after the operation. Computer tomography or magnetic resource imaging might be helpful to detect the cerebellar edema and evaluate the posterior fossa pressure indirectly, which should be performed routinely for those patients post-operatively.

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REFERENCES