Use of the Arachnoid Membrane of the Cerebellopontine Angle to Transpose the Superior Cerebellar Artery in Microvascular Decompression for Trigeminal Neuralgia: Technical Note

**BACKGROUND:** Microvascular decompression is an accepted, safe, and useful surgical technique for the treatment of trigeminal neuralgia. Autologous muscle or implant materials such as shredded Teflon are used to separate the vessel from the nerve but may occasionally be inadequate, become displaced or create adhesions and recurrent pain.

**OBJECTIVE:** The authors evaluated the use of arachnoid membrane of the cerebellopontine angle to maintain the transposition of vessels from the trigeminal nerve.

**METHODS:** The authors conducted a retrospective review of microvascular decompression operations in which the offending vessel was transposed and then retained by the arachnoid membrane of the cerebellopontine cistern, specifically by the lateral pontomesencephalic membrane.

**RESULTS:** This technique was used in 30 patients of the most recently operated series. Postoperatively, complete pain relief was achieved in 90% of the patients without any observed surgical complications.

**CONCLUSION:** To the authors’ knowledge this is the first report in which the arachnoid membrane is used in the microvascular decompression of the trigeminal nerve. While this technique can be used only for selected cases, the majority of the vascular compressions on the trigeminal nerve are due to the SCA, so this sling transposition technique can be useful and effective.

**KEY WORDS:** Arachnoidal membrane, Microvascular decompression, Trigeminal neuralgia
nerve in its passage through this cistern. The anterior pontine mem-
brane, and above the trigeminal oculomotor nerve, courses below the trochlear nerve and the lat-
tern by the lateral pontomesencephalic membrane. This mem-
brane is attached to the brainstem at the junction of the midbrain and pons and to the outer arachnoidal membrane near the free edge of the tentorium and spans the interval between the poste-
rior cerebral artery (PCA) and SCA. The most common vessel found compressing the trigeminal nerve in different surgical series of MVD is a rostroventral superior cerebellar artery loop, which compresses the trigeminal nerve either at the root entry zone or dis-
tally. The SCA enters the cerebellopontine cistern by passing through the junction of the anterior pontine membrane and the oculomotor nerve, courses below the trochlear nerve and the lateral pontomesencephalic membrane, and above the trigeminal nerve in its passage through this cistern. The anterior pontine mem-
brane separates the cerebellopontine and prepontine cisterns. This membrane crosses the interval between the pons and the outer arachnoid membrane that rests on the clivus, intersects the oculomotor nerve superiorly, and extends downward along the medial side of the abducens nerve.

The anterior inferior cerebellar artery (AICA) enters the lower part of the cerebellopontine cisterns by passing through or below the anterior pontine membrane. This anatomic configuration only allows the SCA to be sequestered with the help of the arachnoid.

PATIENTS AND METHODS

Patient Population

Between 1990 and 2006, 156 patients affected by TN underwent microvascular decompression performed by the senior author (M.S.); 90% of the patients were affected by typical TN. Seven patients, all with typical neuralgia, underwent reoperated for pain recurrence.

Surgical Technique

A classical surgical retrosigmoid approach, as described in the literature, with some insignificant modifications, has been used. When approaching the trigeminal nerve, care is taken to spare the lateral pontomes-
encephalic membrane and to preserve and better dissect the petrosal venous complex. The only vessel fit for this technique is the superior cerebellar artery or its distal branches. The arachnoidal membrane or the petrosal veins are positioned superiorly and medially to the nerve. Consequently, we may only lift up the vessel.

A long fissure is made in the arachnoidal membrane to allow the artery to pass through and move away from the nerve. Following transposition of the vessel with the arachnoidal membrane, a small piece of muscle or shredded Teflon may be positioned between the artery and arachnoidal membrane or vein to better guarantee the new position, avoiding any direct contact between the prosthesis and nerve root. Following transposition of the vessel, we observed a slight spasm because of the manipulation. A few drops of papaverin were sufficient to solve the spasm, keeping the ves-
sel in the new position. Alternatively, the superior cerebellar artery loop, which compresses the trigeminal nerve, may be sectioned or surgically decompressed. The immediate postoperative pain relief of this series was 100%; at 2 years, 1 patient required drugs to remain pain free.

RESULTS

The anatomic transposition technique was used in 30 cases, all with typical TN. In the cases in which this technique was used, it is obvious that a very significant compression of the nerve due to the SCA was present. None of the patients exhibited a new neurological deficit after surgery. The immediate postoperative pain relief of this series was 100%; at 2 years, 1 patient required drugs to remain pain free.

DISCUSSION

MVD has been widely used and demonstrated as a safe and effective method in treating typical TN, with the operative outcomes varying in different reports. The institution at which the surgery is performed and the expertise of the surgeon are crucial for this surgery to achieve a high degree of safety. Barker et al reported that most cases of TN recurrence occurred in the first 2 years after surgery, and incidence of significant recurrence is reported to vary from 3% to 30% due to several causes, including how precisely the cisternal portion of the trigeminal nerve could be observed, how completely all offending vessels including veins could be decompressed, what kind of implant was used, and/or what kind of technique was utilized for the transposition of the culprit arter-
ies at the first operation. Incomplete vascular decompression is thought by some to be an important and frequent cause of fail-
ure. However, recurrent vascular compression has also occurred after decomposition of an absorbable implant, such as muscle or Gelfoam, slippage of a synthetic implant, or adhesions of the Teflon felt to the nerve. Different sling techniques have been used in MVD, in which several materials have been used, including Teflon...
felt, Dacron sponge, Ivalon sponge, cotton, periosteum muscle, fascia, Gore-Tex pad, and fenestrated aneurysm clips.\textsuperscript{5,6,16-19} These materials may cause side effects that evolve into recurrent TN.\textsuperscript{20-23} It is now well known that a muscle piece alone can be inadequate due to atrophy 3 years or more after MVD.\textsuperscript{18,24} Teflon felt is currently the material of choice for most neurosurgeons. This is due to its characteristics: (1) it is well tolerated by the body; (2) it is not reabsorbed; and (3) it has a lower complication rate compared with other materials. In these cases, the major complications are inflammatory foreign-body reactions. Teflon felt may cause thick, severe adhesion and granulomatous formations. The time necessary for Teflon felt to cause a fibrotic change ranges from 10 months to 5 years.\textsuperscript{24,25} These facts suggest that using any kind of implant in the interposing technique may cause adhesion of the inserted materials to the trigeminal nerve. Therefore, avoiding the contact of the prosthetic material with the trigeminal nerve or a sling retraction technique are recommended for the initial MVD for TN.

Even if the MVD is a well established procedure, there are still debates on the techniques to obtain decompression and on the materials used to allow it. Recently, Sindou et al\textsuperscript{15,26} provided evidence regarding how MVD should be performed by using a non-compressive technique, signaling how the presence of prosthetic material in contact with the trigeminal root should be a negative prognostic factor.

Some authors claim the MVD procedure could work through a lesioning mechanism and that it’s possible that an inflammatory response to the foreign body could be part of the reason for the pain relief acting as a lesioning mechanism.\textsuperscript{27,28} In our experience of reoperations limited to 7 cases, we found strong adhesions of the shredded Teflon felt with the trigeminal nerve. In all cases, we removed the Teflon and freed the nerve. Six of the 7 patients improved after the procedure. This finding has been the major cause of these recurrences.

The goal of this surgery is to hold the offending vessel away from the trigeminal nerve root and maintain this transposition without side effects. The key points of this surgical procedure are some anatomic conditions: the presence of a useful arachnoid membrane, a proper combination between the length of the SCA and the trigeminal nerve, and a favorable conformation of the petrous vein (Fig. 1). We need some space to lift the artery and leave it in a new position, avoiding kinking. In our cases, we never found small branches that prevented this mobilization. At this point, we are able to put some muscle or a piece of Teflon between the artery and the arachnoid membrane to ensure the new position of the vessel far from the nerve.

We see several advantages in using this technique. There is no need for any type of prosthesis to be placed in contact with the nerve, no need for sutures to secure the prosthesis to the dura mater, and no risk of inflammatory foreign-body reactions. We are aware that this technique cannot be used for any type of neurovascular compressions and that it is a useful tool only for the transposition of the SCA and its branches. In our experience, this technique has shown good clinical outcome with no evidence of surgical complications.

This technique implies the presence of a clear conflict with SCA or its branches, and we know that an evident conflict is clearly a good predictive factor for an optimal outcome.

**CONCLUSIONS**

Different sling techniques have been described for TN, in which several materials have been used. Our proposal is a natural sling technique without the aid of any prosthesis. We are aware that this technique can be used only for selected cases. However, considering that the majority of the vascular compressions on the trigeminal nerve are due to the SCA, this sling transposition technique can be useful and effective. Our experience suggests that approaching the cerebellopontine angle for TN is important to search for the anatomic conditions that can allow the surgeon to use this natural transposition technique.

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REFERENCES


Disclosure

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