Trigeminal neuralgia: differences in magnetic resonance imaging characteristics of neurovascular compression between symptomatic and asymptomatic nerves

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Objectives. Neurovascular compression (NVC) of the trigeminal nerve is the primary cause of trigeminal neuralgia (TN) but is known to occur in both symptomatic and asymptomatic nerves. The purposes of this study were to evaluate the relationship between the magnetic resonance imaging (MRI) findings regarding the site of NVC and the manifestation of TN symptoms.
Methods. In 147 patients with unilateral TN, the presence or absence of NVC was evaluated on MRI in both symptomatic and asymptomatic nerves. In cases with NVC, the shortest distance from the trigeminal nerve root to the responsible vessel was measured.
Results. The mean distance from the trigeminal nerve root to the site of NVC in asymptomatic nerves (3.85 ± 2.69 mm) was significantly greater than that in symptomatic nerves (0.94 ± 1.27 mm). When the distance was 3 mm or less, the rate of the manifestation of TN symptoms was 83.1% (103/124). On the other hand, it was only 19.6% (9/46) in cases with a distance of greater than 3 mm.
Conclusions. Whether or not NVC of the trigeminal nerve was symptomatic was closely related to the distance from the trigeminal nerve root to the responsible blood vessel. (Oral Surg Oral Med Oral Pathol Oral Radiol 2015;119:113-118)

It is widely accepted that trigeminal neuralgia (TN) is primarily caused by neurovascular compression (NVC) at the root entry zone (REZ) of the trigeminal nerve in the cerebellopontine angle cistern.[1-3] Thus, microvascular decompression (MVD) is considered the most effective treatment for patients with TN.[4] The diagnosis of NVC is generally made by MR angiography and MR cisternography.[5] It has also been reported that NVC patterns on MRI are closely related to the region of neuralgic manifestation.[5] On the other hand, NVC is also known to occur in asymptomatic nerves, that is, those contralateral to TN symptoms or those in asymptomatic subjects.[6-10] Thus, the clinical significance of NVC detected on MRI has not been fully established. Clarifying the distinction between symptomatic and asymptomatic NVC would further increase the validity of MRI for the treatment planning for TN.

In asymptomatic NVC, vascular contact may be present at sites distal to the REZ of the trigeminal nerve. Thus, the likelihood of NVC causing clinical symptoms of TN is thought to be closely related to the distance from the trigeminal nerve root to the responsible blood vessel. However, to our knowledge, few studies have evaluated the relationship between this distance and the manifestation of TN.

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Against this background, the purposes of this study were to analyze MRI findings regarding the location of NVC in both symptomatic and asymptomatic nerves, and to evaluate the relationship between these findings and the presence or absence of clinical symptoms of TN.

MATERIALS AND METHODS

This retrospective study was approved by our institutional review board (No.895).

Patients

The subjects were 147 consecutive patients with idiopathic TN (61 men and 86 women; age range, 21-93 years; mean age, 64.7 years) who underwent MRI at our hospital from April 2010 to November 2012. Cases with brain tumor or multiple sclerosis were excluded from the study. Recurrent cases after MVD were also excluded. All 147 patients had unilateral TN. Of those, 88 had TN on their right side and 59 on their left side. The diagnosis of TN was made according to the criteria of the International Headache Society.[11]

Imaging examinations

A 1.5-T superconducting system (Magnetom Vision, Siemens AG, Erlangen, Germany) with a 2.5 mT/m

Statement of Clinical Relevance

Neurovascular compression (NVC) is known as the primary cause of trigeminal neuralgia. This study revealed that whether NVC is symptomatic or not is closely related to the distance from the trigeminal nerve root to the responsible blood vessel.

maximum gradient capability and a circularly polarized head coil was used to obtain all MR images.

In all patients, transverse T1-weighted spin-echo images (repetition time/echo time [TR/TE] = 560/14 msec) and T2-weighted turbo spin-echo images (TR/TE, 5000/96 msec; echo train length, seven) were obtained with a field of view of 230 × 230 mm, a matrix of 256 × 256, and a section thickness of 3 mm with a 1-mm intersection gap. These images were used to rule out the diagnoses of multiple sclerosis and brain tumor.

MR angiography was performed using a 3D fast imaging with steady-state precession (3D-FISP) sequence with the following parameters: TR/TE 39/6.5 msec, 20-degree flip angle, 230 × 230-mm field of view, and 256 × 512 matrix. The other imaging parameters included a slab thickness of 60 mm with 60 sections, yielding transverse images with a section thickness of 1 mm. The acquisition slab was oriented in the transverse direction on the sagittal and coronal scout images so that both sides of the trigeminal nerve could be included in the image. After obtaining transverse images, coronal reformatted images were also obtained by using a multiplanar reconstruction (MPR) algorithm.

MR cisternography was performed using a 3D constructive interference in steady state (3D-CISS) sequence with the following parameters: TR/TE 12.25/5.9 msec, 70-degree flip angle, 230 × 230-mm field of view, and 512 × 512 matrix. The other imaging parameters included a 34-mm slab thickness with 34 sections, which yielded transverse images with section thicknesses of 1 mm. The acquisition slab was oriented in the same direction as in the 3D-FISP sequence. Coronal reformatted images were also obtained by using an MPR algorithm.

Image analysis

All 3D-FISP and 3D-CISS images were independently and separately evaluated for the presence or absence of NVC by two radiologists (M.S and N.Y.) who were blinded to the clinical findings. NVC was regarded as present when no cerebrospinal fluid (CSF) was visible between the vessel and the nerve in both of transverse and coronal 3D-CISS images. 3D-FISP images were used to determine whether the responsible blood vessel was an artery or a vein. When disagreement existed about the presence or absence of NVC, a consensus was reached through discussion. In cases with NVC, the same two radiologists used a DICOM viewer (Syngo Via version: VA20A, Siemens AG, Erlangen, Germany) to independently and separately measure the shortest distance between the trigeminal nerve root and the responsible blood vessel. The details of the measurement methods are shown in Figure 1. To evaluate both intra- and interobserver agreement, they measured the distance twice, with a 1-week interval. The mean value of the four measurements (two observers, two measurements each) was adopted as the distance from the trigeminal nerve root to the responsible blood vessel in each case, and this distance was compared between symptomatic and asymptomatic nerves.

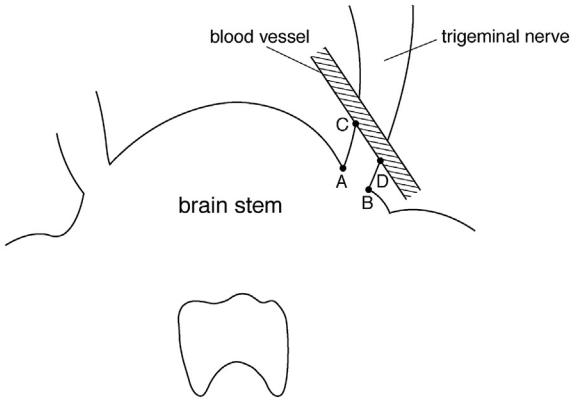

Fig. 1. The measurement methods of the shortest distance between the trigeminal nerve root and the blood vessel at the site of neurovascular compression (NVC). (**A**, **B**) The medial and lateral margin of the entrance of the trigeminal nerve into the brain stem, respectively. (**C**, **D**) The site of NVC on the medial and lateral side of the trigeminal nerve, respectively. When the contact was seen on both medial and lateral sides of TN, either shorter one of the two distances—distance between A and C or that between B and D—was measured. When the contact was seen only on either side, the distance on the corresponding side was measured.

Statistical analysis

Statistical analysis was performed using IBM SPSS 21.0 software (New York, NY). Interobserver agreement regarding the presence or absence of NVC was evaluated by the κ-coefficient. The κ values were interpreted as follows: less than 0.40, poor agreement; 0.40-0.59, fair agreement; 0.60-0.74, good agreement; and 0.75 or more, excellent agreement.[12] The intra- and interobserver agreements for the distance from the trigeminal nerve root to the responsible blood vessel were evaluated using the intraclass correlation coefficient (ICC). An ICC of 0.20 or less was considered to indicate slight agreement; 0.21-0.40, fair; 0.41-0.60, moderate; 0.61-0.80, substantial; and 0.81 or more, almost perfect. The Mann-Whitney U test and the chi-square test were used to compare symptomatic and asymptomatic nerves in terms of the mean value and distribution, respectively, of the distance from the trigeminal nerve root to the responsible blood vessel.

RESULTS

The interobserver agreement for the presence or absence of NVC was excellent (κ = 0.8534). For the measured distance from the trigeminal nerve root to the