CASE REPORTS

Vascular Compression of the Medulla Oblongata by the Vertebral Artery: Report of Two Cases

Kazuhiro Hongo, M.D., Hiroshi Nakagawa, M.D., Nobuhito Morota, M.D., Masanori Isobe, M.D.

Department of Neurological Surgery, Aichi Medical University, Nagakute, Aichi, Japan

CASE REPORTS

Patient 1

A 36-year-old man, who was a pediatrician, was admitted to our institute with a 9-month history of right hemiparesis, hemisensory disturbance, and slight difficulty swallowing. These symptoms gradually worsened before admission.

Examination

At admission, the neurological examination disclosed an onionskin-like hypalgesia, a diminished gag reflex on the right side, and slight atrophy of the right sternocleidomastoid and supraspinatus muscles. Mild right hemiparesis was also noted. Preoperatively, MRI revealed significant compression of the right anterolateral side of the medulla oblongata, indicating a tortuous right vertebral artery that was causing severe indentation at the medulla (*Fig. 1A*). The right vertebral angiogram (Fig. 2) revealed a tortuous, elongated right vertebral artery and deviation of the vertebral union to the right. His symptoms and the MRI findings suggested that the vertebral artery was the cause of his symptoms. Surgery was performed after obtaining informed consent from the patient.

OBJECTIVE AND IMPORTANCE: Compression of the medulla oblongata by a tortuous vertebral artery is rare. We report two patients with this lesion who were treated with vascular decompression of the vertebral artery. CLINICAL PRESENTATION: A 36-year-old man developed right hemiparesis with lower cranial nerve deficits, and a 47-year-old man developed left lower cranial nerve deficits and left cerebellar dysfunction. In both patients, magnetic resonance imaging revealed a tortuous vertebral artery compressing the medulla oblongata.

INTERVENTION: In both patients, the compressed medulla oblongata was treated by detaching the vertebral artery from the medulla oblongata, shifting it, and anchoring it to the nearby dura mater. Postoperatively, both patients are asymptomatic and have returned to their previous jobs.
CONCLUSION: Although compression of the medulla oblongata by a tortuous vertebral artery is rare, it can cause brainstem dysfunction. Magnetic resonance imaging clearly revealed the vascular compression in these patients. Surgical treatment was effective. The symptoms related to a tortuous vertebral artery and some techniques for surgical treatment are discussed. Awareness of this rare lesion is necessary to ensure appropriate treatment. (Neurosurgery 45:907–910, 1999)

Key words: Medulla oblongata, Vascular compression, Vertebral artery

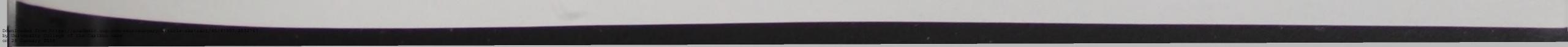
Operation

The patient was placed in the left lat-

The concept of neurovascular compression as cranial nerve dysfunction resulting from the vascular compression of cranial nerves is widely accepted. However, there are very few reports of brainstem dysfunction caused by vascular compression. Kim et al. (5) were the first to report such a patient, and there have been several subsequent reports (2, 4, 6, 8-10). The authors reported a similar case previously in which the elongated vertebral artery caused a progressive pyramidal tract sign, and the artery was eventually sectioned to relieve the neurological signs (4). In this report, we present two patients who were treated successfully with mi-

crovascular decompression achieved by shifting the tortuous vertebral artery. Because a tortuous, thick vertebral artery usually causes the compression, careful and adequate decompression is needed to treat this type of lesion operatively. The routine placement of a prosthesis to achieve microvascular decompression in the treatment of hemifacial spasm or trigeminal neuralgia may not be adequate to achieve a definitive surgical result and to avoid recurrence in these patients. We report two such patients, describe the symptoms related to the tortuous vertebral artery, and discuss some of the surgical techniques used for treatment.

eral decubitus position under general anesthesia. A right suboccipital craniotomy was performed. The dura mater was opened, and the inferolateral portion of the posterior fossa was exposed. There was marked compression of the anterolateral portion of the medulla oblongata by a medially bent and tortuous vertebral artery at the level of the hypoglossal nerve, anterior to the dentate ligament. The vertebral artery was carefully separated from the medulla oblongata and from the small vessels. A 7- \times 20-mm piece of Teflon felt was inserted beneath the vertebral artery and used to elevate the artery; 5-0 nylon sutures were used to anchor it to the dura mater near the foramen magnum.



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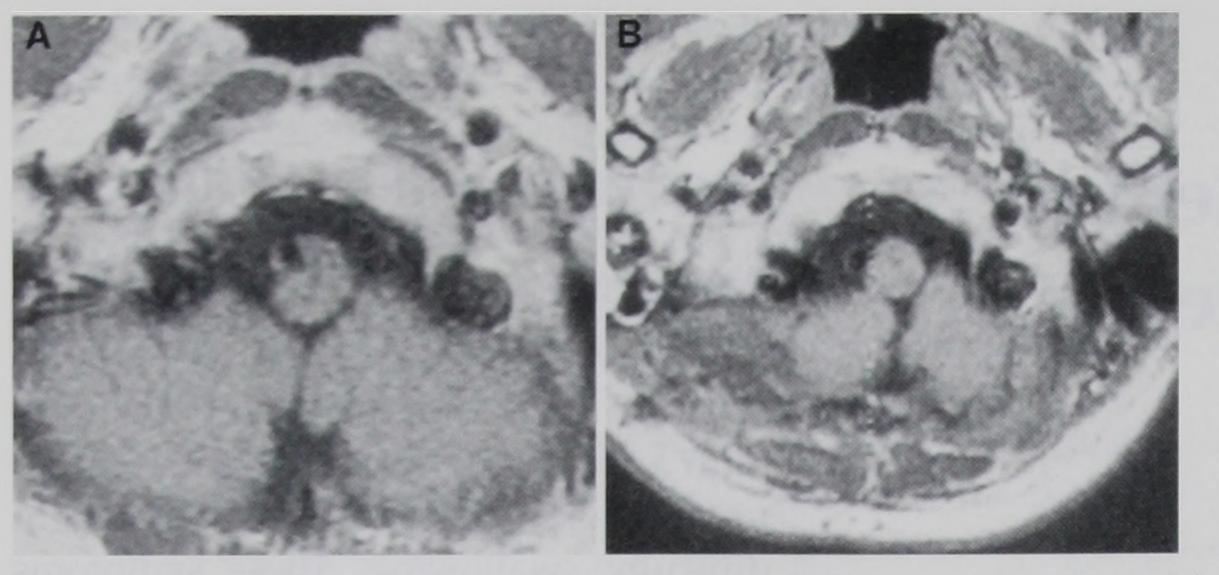


FIGURE 1. T2weighted MRI scans of Patient 1. *A*, preoperative MRI scan revealing a flow void in the right side of the medulla oblongata, which indicates severe vascular

compression. *B*, postoperative MRI scan demonstrating that this void is no longer visible and indicating good decompression of the medulla oblongata.

Indentation, apparently caused by the vertebral artery, was noted on the me-

healthy in the almost 9 years since the operation.

artery. Surgery was performed after obtaining informed consent from the patient.

Operation

The patient was placed in the right decubitus position under general anesthesia, and a left suboccipital craniotomy down to the foramen magnum was performed. The lateral edge of the foramen magnum was widely drilled out near the occipital condyle, and the dura mater was opened. The vertebral artery was exposed by retracting the cerebellum and evacuating the cerebrospinal fluid. The vertebral artery appeared to compress the anterolateral surface of the pontomedullary junction, where the posteroinferior cerebellar artery originates. When the vertebral artery was detached from the medulla oblongata, an indentation caused by the artery was visible. The root entry zone of the VIIIth De cranial nerve was exposed, but no abnormality was found. We suspected that vertebral artery compression of the medulla oblongata might be responsible for the patient's symptoms, so the artery was shifted. A thin, $4 - \times 22$ -mm piece of Gore-Tex (W.L. Gore & Associates, Inc., Flagstaff, AZ) was passed under the vertebral artery just proximal to the posteroinferior cerebellar artery origin. A 6-0 nylon suture was passed through two slits made in the dura mater over the jugular tuberculum and tied to the Gore-Tex sheet to detach the vertebral artery from the medulla oblongata, IUS which achieved vascular decompression

dulla where the right hypoglossal nerve originates, and the right vertebral artery was clearly indented by the hypoglossal nerve. The VIIIth, IXth, Xth, and XIth cranial nerves were all spared.

Postoperative course

The postoperative neurological examination revealed that hypalgesia had subsided, and the patient had a feeling of fatigue in his right arm and leg. The atrophy of the right sternocleidomastoid and supraspinatus muscles remained. The postoperative MRI scan revealed good decompression of the medulla oblongata (*Fig. 1B*). The patient was discharged 2 weeks after surgery. His symptoms gradually decreased, and he returned to his previous work 6 months after surgery. He has remained

Patient 2

A 47-year-old man, the master of a sushi shop, first complained of vertigo 7 years before presentation. One year later, he noticed difficulty hearing on his left side. In March 1996, his gait was unsteady and he could not stand without holding onto a bar. At that time, he was referred to us by an otolaryngologist.

Examination

At admission, the patient was deaf in his left ear and had a decreased gag reflex on the left side. Standing on his left foot and maintaining a tandem gait were impossible because of left cerebellar dysfunction. Preoperative MRI revealed a tortuous left vertebral artery compressing the left anterolateral side of the medulla oblongata, resulting in deformity of the medulla oblongata (*Fig. 3A*). On the basis of the neurological and MRI findings, his symptoms were thought to be caused by the vertebral

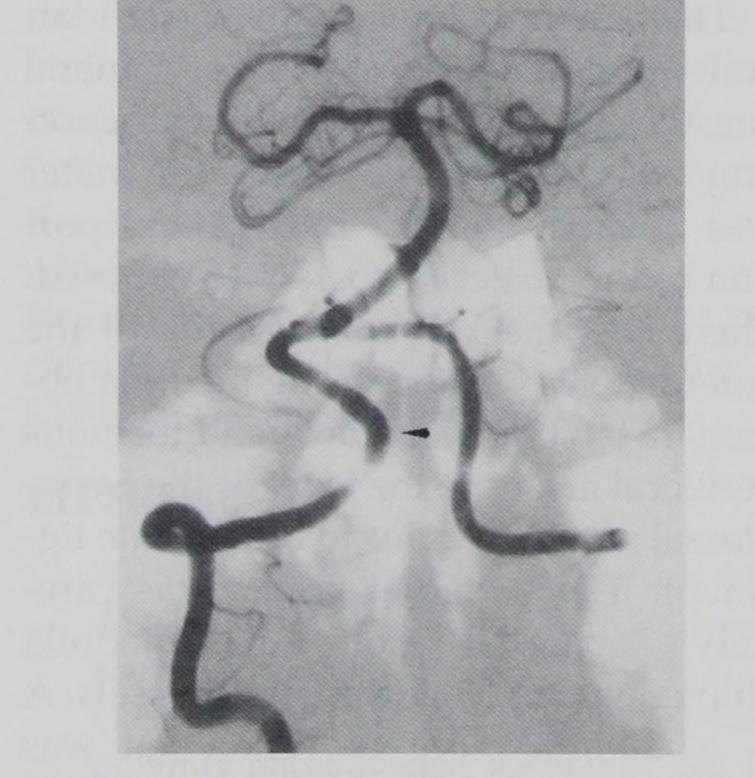


FIGURE 2. Vertebral angiogram of Patient 1, revealing tortuous vertebral arteries bilaterally and the point of medulla compression (*arrowhead*). (*Fig.* 4). Throughout the procedure, the somatosensory evoked potential remained unchanged.

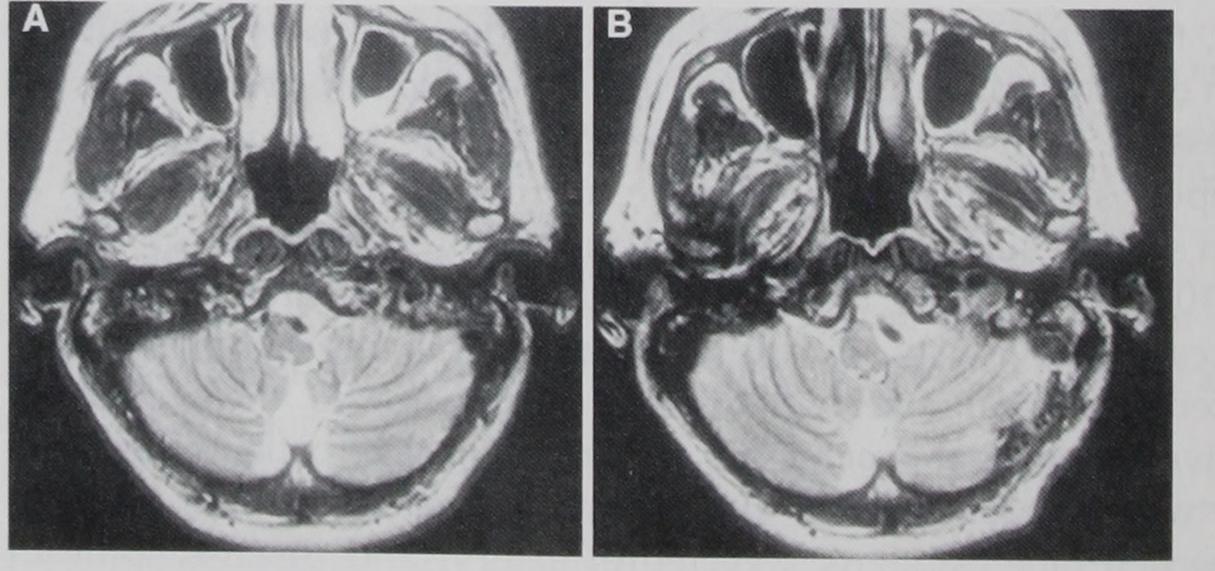
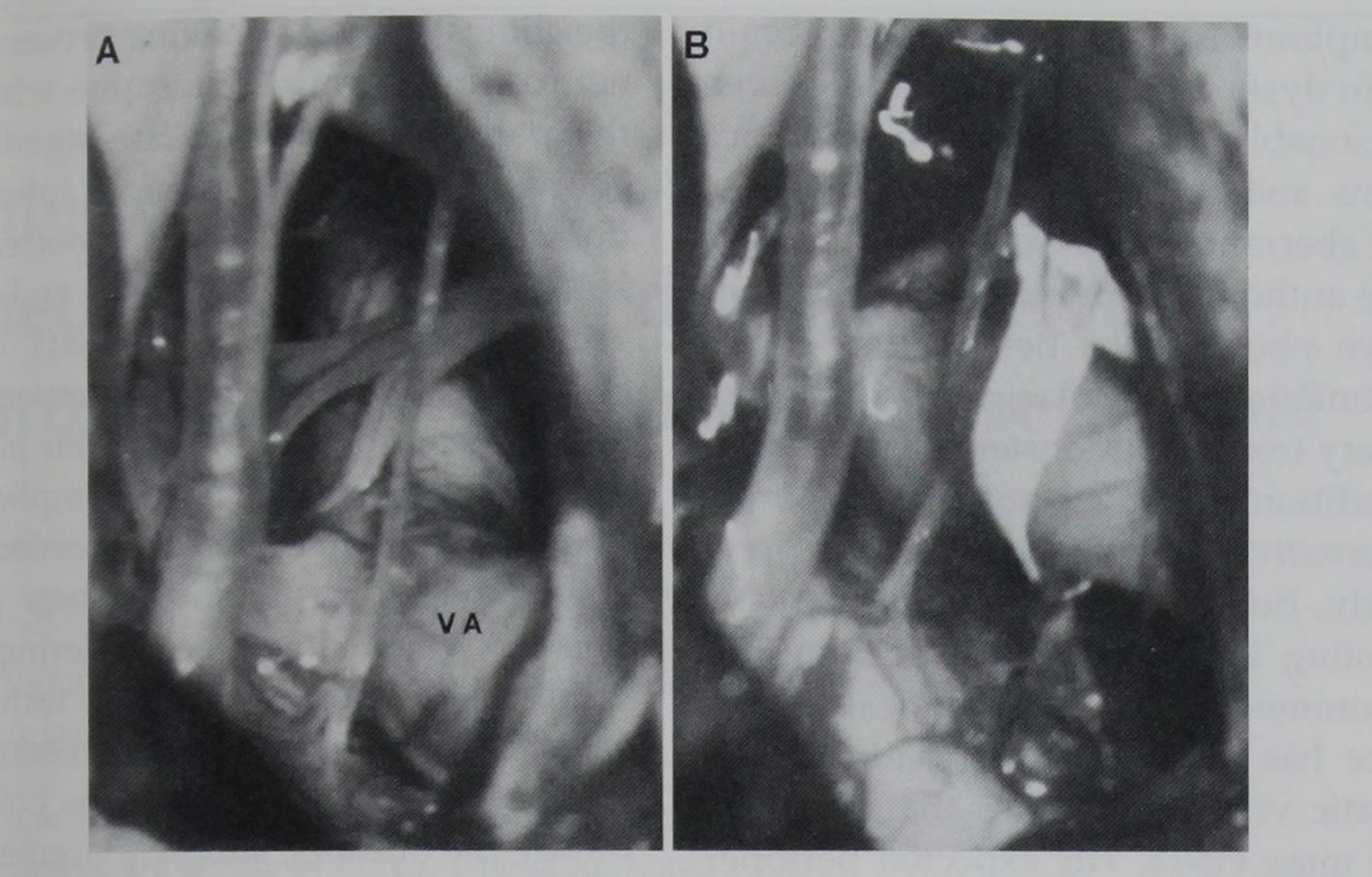


FIGURE 3. T2weighted MRI scans of Patient 2. *A*, preoperative MRI scan revealing the left-sided deformity of the medulla oblongata with the vertebral artery attached to the medulla. *B*,

postoperative MRI scan demonstrating space between the vertebral artery and the medulla oblongata, which indicates that vascular decompression was achieved.



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long basilar artery, the vessel responsible is usually a tortuous vertebral artery, but never one with a "megadolicho" shape.

It is not easy to determine when surgery is indicated. For hemifacial spasm or trigeminal neuralgia, surgical microvascular decompression is indicated by the clinical status, even when no apparent offending vessels are observed on MRI scans or magnetic resonance angiograms. On the other hand, in symptomatic patients in whom compression of the medulla oblongata by the vertebral artery is suspected, a definite diagnosis should be made with the aid of MRI as well as with a precise neurological examination. In our two patients, the deformity of an apparently compressed medulla oblongata was visible on the MRI scans. There are several possible methods of surgical vascular decompression. Simply inserting a prosthesis between the brainstem and the offending vessel can usually decompress the typical hemifacial spasm or trigeminal neuralgia. However, with compression of the medulla oblongata by the vertebral artery, the offending artery may be thick and quite difficult to decompress by this method. Fukushima (3) and Kondo (7) proposed lifting and anchoring the offending vessel to the nearby dura mater with a variety of materials. In our cases, the tortuous vertebral artery was shifted and anchored to the dura mater with a Teflon sheet in Patient 1 and Gore-Tex in Patient 2, without inserting a prosthesis. Good vascular decompression was achieved, which improved the neurological deficits. The vertebral artery should be shifted carefully, to avoid damaging small branches or perforating arteries from the vertebral artery entering the medulla oblongata. We previously reported a patient treated by sectioning the tortuous vertebral artery to produce vascular decompression of the medulla oblongata (4). This is the ultimate way to achieve vascular decompression, but indications for this approach may be quite limited. Shifting the vessel and anchoring it to the dura mater is a more appropriate choice. In conclusion, careful examination using MRI may help diagnose this rare lesion more frequently. A precise diag-

FIGURE 4. Intraoperative photographs of Patient 2. A, the tortuous vertebral artery (VA) compressing the medulla oblongata. B, the vertebral artery is shifted away from the medulla oblongata with a Gore-Tex sheet and 6-0 nylon suture, which is anchored to the dura mater near the jugular tuberculum.

Postoperative course

The patient's postoperative course was uneventful. The gag reflex seemed normal, and his cerebellar dysfunction decreased; he could stand and walk without holding a bar. The postoperative MRI scan revealed that the vertebral artery was detached from the medulla oblongata, although some deformity of the medulla remained (Fig. 3B). He was discharged 2 weeks after surgery and returned to his previous job 3 months later.

DISCUSSION

Patient 1 presented with progressive pyramidal tract signs and lower cranial nerve deficits. The MRI scans and vertebral angiograms revealed compression of the medulla oblongata by a tortuous vertebral artery. The right vertebral artery was thought to be compressing both the corticospinal tract just below the pyramidal decussation and the nucleus solitarius in the anterolateral portion of the medulla, causing the right hemiparesis and difficulty swallowing. A surgical decompression was performed with good results. Patient 2 presented with left hearing loss, decreased gag reflex, and left cerebellar dysfunction. There were no pyramidal tract signs. The medulla oblongata was apparently compressed by a tortuous

vertebral artery, especially at its anteromedial side. The inferior olive and the olivocerebellar tract, as well as the nucleus ambiguus, were thought to be disturbed. Surgery was performed after obtaining informed consent from the patient regarding the benefits and possible risks of surgery. The reason for his hearing disturbance was not fully determined. Because the cerebellar signs disappeared after surgery, the tortuous vertebral artery may have been compressing the inferior olive and the olivocerebellar tract at the level of the medulla oblongata. In both patients, the symptoms disappeared almost completely after surgery, and both patients

returned to their previous jobs.

There are few reports describing a tortuous vertebral artery compressing the medulla oblongata and causing neurological deficits, such as pyramidal tract signs or lower cranial nerve deficits. In 1985, Kim et al. (5) reported the first such case. Their patient responded well to vascular decompression. Kobayashi et al. (6) reported a patient with compression of the medulla oblongata by the vertebral arteries bilaterally associated with a Chiari malformation, in which the symptoms improved after vascular decompression of the medulla oblongata. Except for the patient reported by Tanaka et al. (10), in whom the involved artery was an excessively



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nosis on the basis of both MRI and a careful neurological examination is essential to determine appropriate surgical interventions.

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Reprint requests: Kazuhiro Hongo, M.D., Department of Neurosurgery, Shinshu University School of Medicine, Asahi 3-1-1, Matsumoto 390-8621, Japan.

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symptoms suggestive of lower brainstem dysfunction. Imaging studies were reasonably correlated with neurological signs and suggested encroachment by the aberrant course of a vertebral artery. The authors' illustrations and intraoperative photographs demonstrate a nice technique for displacing the vertebral artery from the brainstem. This unusual condition, as well as potential treatment alternatives, has been described previously, but the authors supplement the existing literature with useful surgical recommendations. My typical experience has involved older patients with ectatic vertebral arteries that produced the mass effect. The expected perioperative course in elderly patients can be expected to be more difficult than that reported in this article. In addition, in patients with more advanced and disabling neurological symptoms, the dissection and displacement of the artery from the brainstem is not as well tolerated and has a higher morbidity. Nevertheless, anecdotal evidence suggests that this condition can be progressive, and therefore treatment is warranted. I plan to use the Gore-Tex sling, as reported by the authors, in my own practice.

the clinical decision-making process, the neurosurgeon must determine whether the patient's symptoms are significant enough to warrant surgical intervention. Each of the patients reported by Hongo et al. had significant and progressive neurological deficits that clearly justified surgical intervention. The surgical management of this particular disorder is much more complicated than microvascular decompression for cranial nerve dysfunction. These risks must be weighed when considering surgical intervention. Finally, the technical aspects of vascular decompression of the medulla are formidable. As pointed out by the authors, simple placement of a prosthetic device between the artery and brainstem is inadequate treatment. More often, the artery must be displaced from the brainstem by creation of a sling to the adjacent dura. Care must be taken to avoid injury to small perforating branches off the vertebrobasilar system. These authors have presented an important report and have achieved excellent surgical results in these two patients.

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H. Hunt Batjer *Chicago, Illinois*

I read with interest these two unusual case reports by Hongo et al. from Aichi Medical University. Symptomatic vascular compression of the medulla by a tortuous vertebral artery has been reported previously. This rare condition presents several challenges to neurosurgeons. As outlined by the authors, a careful neurological examination is imperative to ensure that the patient's symptoms are attributable to vascular compression of the brainstem. In the era of magnetic resonance imaging, it is not uncommon to identify asymptomatic distortion of the brainstem caused by a tortuous vertebral or basilar artery. In

Daniel L. Barrow Atlanta, Georgia

Tortuosity of the vertebral and basilar arteries is the rule rather than the exception. It is unusual, however, for such tortuosity to cause clinical symptoms. Patient 1 in this article is a compelling example of such a vascular compression syndrome. Patient 2 is less compelling, although the MRI scans are quite dramatic. The authors are correct in emphasizing the need for careful patient selection before any operative decompression. Moving large, tortuous posterior circulation vessels is more hazardous than the typical superior cerebellar artery manipulation in trigeminal neuralgia. The Gore-Tex sling is an innovative way of managing this problem.

COMMENTS

The authors report the successful treatment of two patients who were relatively young and who presented with

Steven L. Giannotta Los Angeles, California

