Vascular Loop Compressing Facial Nerve in Hemifacial Spasm : Demonstrated by 3D-phase Contrast Magnetic Resonance Angiography in 101 Patients

SUTHISUK SUTHIPONGCHAI, MD*,
ANCHALEE CHUROJANA, MD*,
ORASA CHAWALPARIT, MD*,
NIPHON POUNGVARIN, MD**

Abstract

Background : Vascular compression of the facial nerve is deemed to be the common cause of hemifacial spasm producing emphatic transmission. Although facial nucleus supersensitivity is more accepted as the main cause of hemifacial spasm.

Purpose : To determine the vascular loop compression of the facial nerve in patients with hemifacial spasm by 3D-phase contrast (PC) magnatic resonance imaging (MRI).

Material and Method : A retrospective study of 101 patients with hemifacial spasm who went MRI and magnetic resonance angiography (MRA) of the brain was done. The magnitude images of the 3D-PC MRA was evaluated in axial and oblique coronal reconstruction planes blindly from symptomatic information.

Results : Among 101 patients, 53 affected the left side, 48 patients were right sided and none had bilateral involvement. Vascular loop compressing on the symptomatic side was found in 61 (60.4%) patients. For the asymptomatic side, there were 14 (13.86%) with vascular loop contact. Five patients (4.9%) had bilateral vascular compression. The proportion of vascular contact of the symptomatic and asymptomatic side was significantly different (with $p < 0.001$). The offending vessels were vertebral artery (32, 52.46%), posterior inferior cerebellar artery (7, 6.93%), anterior inferior cerebellar artery (6, 5.94%) and artery of uncertain origin (16, 26.23%).

Conclusion : The study implied the usefulness of this simple technique to demonstrate the neurovascular contact of the facial nerve.

Key word : Hemifacial Spasm, MRI, Diagnosis, Vascular

SUTHIPONGCHAI S, CHAWALPARIT O, CHUROJANA A, POUNGVARIN N
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* Department of Radiology,
** Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

Hemifacial spasm is a symptomatic complex of hyperactive dysfunction of the unilateral facial nerve. The syndrome is characterized by the onset of mild and intermittent spasms in the orbicularis oculi muscle that gradually progress in severity and frequency and spread downward to include all the muscles of facial expression including the platysma (1). It is widely believed that the common cause is vascular compression of the seventh cranial nerve usually by the adjacent artery(1). Although many approaches to treatment have been proposed, microvascular decompression usually leads to complete relief of the symptoms in the majority of cases(2).

Although magnetic resonance (MR) imaging has been reported to be useful for pre-operative evaluation, conventional spin echo techniques are not adequate to delineate small vessels in relation to the facial nerve(3). The results of many studies document the clinical efficacy of 3-dimensional (3-D) time-of-flight (TOF) MR angiography (MRA) and recently constructive interference in steady state (CISS) images (4). To the authors' knowledge, no studies have evaluated the detectability of 3D-phase contrast (PC) MRA for hemifacial spasm. The purpose of this study was to assess the detectability of the source images and multiplanar reconstruction images from 3D-PC MRA in patients presenting with hemifacial spasm.

MATERIAL AND METHOD

The study was performed by retrospective evaluation of the 3D-PC MRA of patients with a history of hemifacial spasm coming to our department from June 2000 to June 2001. Because the MR machine in the department (ACS II, Philips) cannot perform CISS or related pulse sequence (such as DRIVE in the new MRI machine of Philips), patients with hemifacial spasm were requested to have a MRI and MRA to identify the possible cause of the symptoms. The routine protocol of MRI of the brain was performed in all patients, which composed of axial T_1- and dual-echo T_2-weighted images, coronal T_2-weighted images, and sagittal T_1-weighted images. Then 3D-PC MRA of the brain was done. All cases were retrospectively reviewed to exclude cases with abnormality in the brain stem or other causes not related to neurovascular contact such as a tumor seen on routine MRI of the brain. The raw data of 3D-PC was then analyzed. The magnitude images in the axial stack were selected including the pontomedullary junction and internal acoustic canal. The multiplanar reconstruction (MPR) in the oblique coronal plane of each side of the facial nerve was done by using the magnitude images stack. (Fig. 1) The selected axial images and MPR images were recorded on hard copy. The maximum intensity projection reconstruction of the vertebrobasillar arteries was done. The images were interpretated blindly from clinical symptoms and separately by two experienced neuroradiologists to identify any vascular compression of the facial nerve at the root exit zone (REZ), cisternal part or porus acousticus and the name of the compressive vessels. The pontomedullary junction was evaluated for any deformity. If there was any discrepancy of findings between both radiologists, a consensus was done for final diagnosis.

Statistical analysis

The data of neurovascular contact from each radiologist was calculated to analyze agreement by using unweighted kappa. The percentage of neurovascular contact for the symptomatic and asymptomatic side was calculated. Then both proportions were compared by using McNemar test. The proportion of compressive vessels was also calculated.

RESULTS

Among 101 patients with hemifacial spasm, 69 were female and 32 were male with a mean age of 56.98 years (range 33-80). Twenty-seven patients were hypertensive and 17 patients had tinnitus. Left sided hemifacial spasm was noted in 53 patients and 48 affected the right side. No patients had bilateral

Table 1. Neurovascular contact and location of compression on the facial nerve.

	REZ*	%	Cisternal part	%	Porus acousticus	%
Symptomatic side	56	55.45	5	4.95	0	
Asymptomatic side	8	7.92	6	5.94	2	1.98

* REZ = root exit zone

involvement. Two radiologists interpreted the neuroimages with good agreement (kappa = 0.53).

For left hemifacial spasm, 34 (64.2%) had a vascular loop contacting the left facial nerve, 4 (7.5%) had a vascular loop contacting the right side and 2 (3.8%) had bilateral vascular loop contact. (Fig. 2)

Concerning right hemifacial spasm, 22 (45.8%) had a vascular loop contacting the right facial nerve, 5 (10.5%) had a vascular loop contacting the left side and 3 (6.2%) had bilateral vascular loop contact. No other demonstrable causes corresponding with the side of the symptoms were found.

Total vascular loop compressing on the symptomatic side was found in 61 (60.4%) of 101 patients. For the asymptomatic side, there were 14 (13.86%) with vascular loop contact. The proportion of vascular loop contact of the symptomatic and asymptomatic side were significantly different ($p < 0.001$).

The location of compression on the symptomatic and asymptomatic sides is shown in Table 1. Briefly, compression at the REZ was clearly more common than other locations in the symptomatic side. Compression at REZ on the asymptomatic side was not significantly higher than the other locations. When considering pontomedullary junction, the deformity was found in 26 (25.74%) on the symptomatic side and 2 (1.98%) on the asymptomatic side. (Fig. 3) When both vascular loops contacted at REZ and deformity of the pontomedullary junction was analyzed together, the findings were found on 25 (24.75%) on the symptomatic side and 2 (1.98%) on the asymptomatic side. These two proportions were also significantly different ($p < 0.001$).

The vascular tortuous was observed in 69 MRA (68.32%). The identified compressive vessels on the symptomatic side mostly were vertebral arteries (Table 2). The other less common were the posterior inferior cerebellar artery and anterior inferior cerebellar artery. In 16 cases the origin of the compressive vessels could not be definitely identified.

Table 2. Compressive vessel on symptomatic and asymptomatic facial nerve.

	Symptomatic	%	Asymptomatic	%
No vascular contact	40	39.6	84	83.17
Vertebral artery	32	52.46	6	5.94
PICA*	7	6.93	0	
AICA*	6	5.94	7	6.93
Uncertain origin	16	26.23	4	3.96

PICA = posterior inferior cerebellar artery, AICA= anterior inferior cerebellar artery.

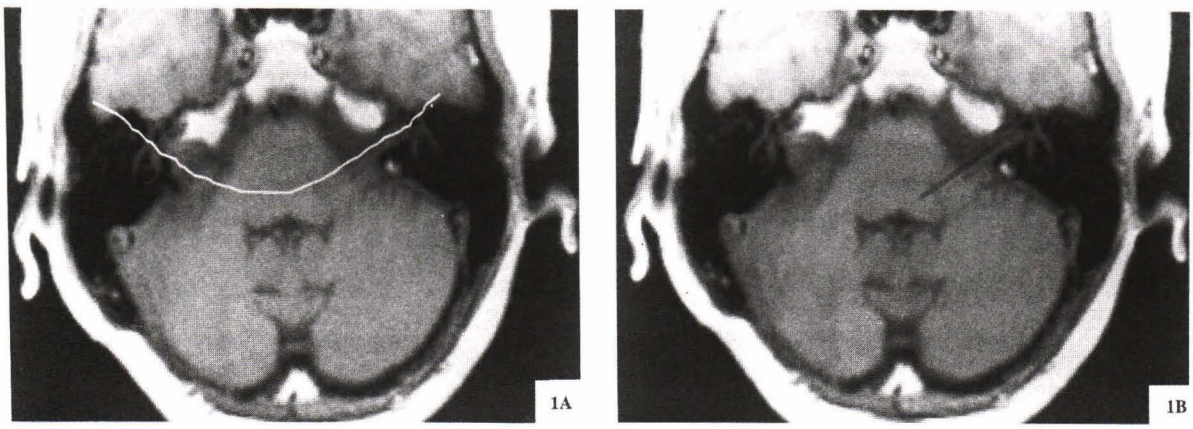

Fig. 1. Planes of multiplanar reconstruction of the magnitude image MRA. A) curve reconstruction, B) oblique coronal reconstruction.

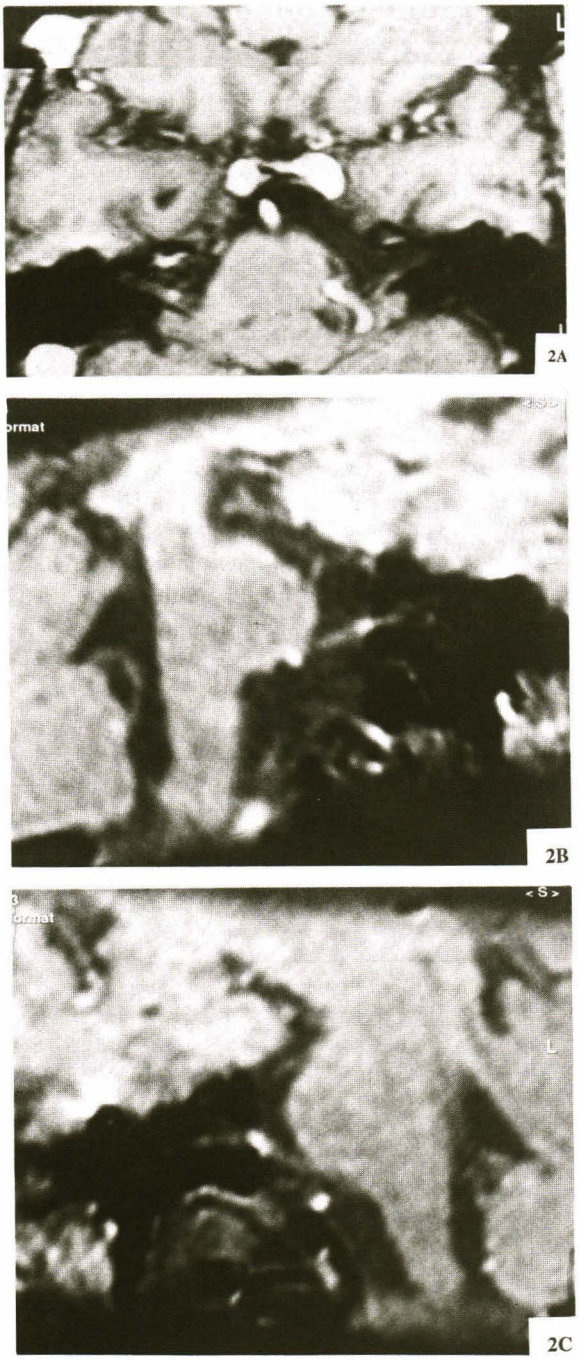

Fig. 2. Left hemifacial spasm with neurovascular contact of the left facial nerve. Magnitude images of 3D-PC MRA in A) axial, B) left oblique coronal, and C) right oblique coronal planes demonstrate high intensity vascular loop compressing root exit zone of the left facial nerve.

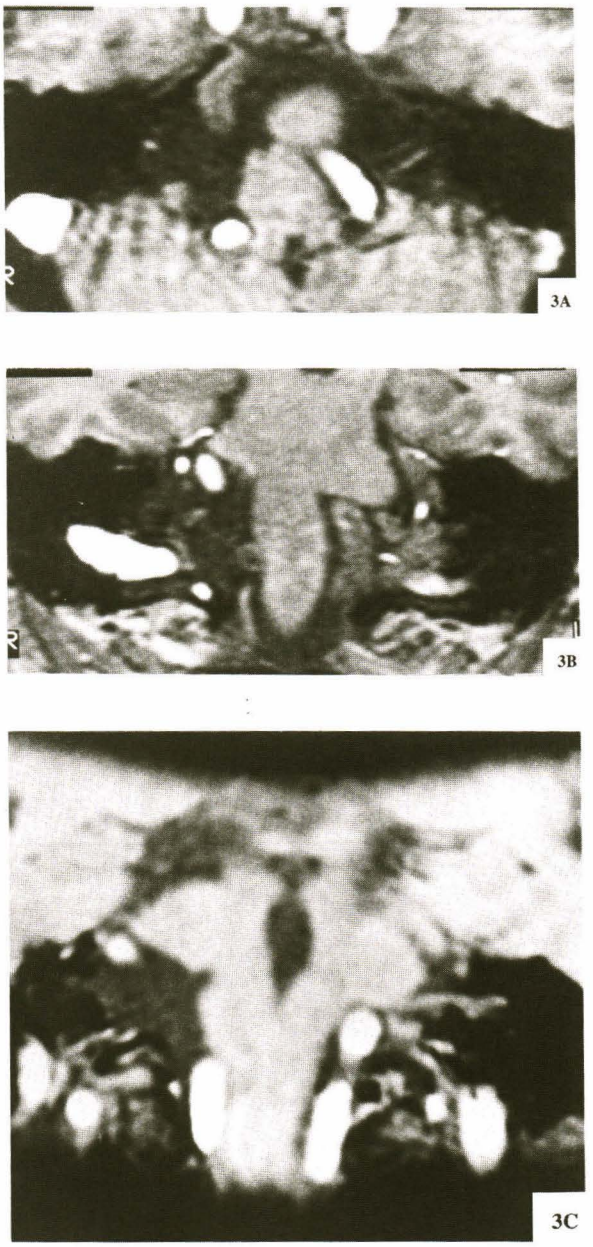

Fig. 3. Bilateral neurovascular compression of the facial nerve in Magnitude images of 3D-PC MRA in A) axial, B) coronal, and C) curve reconstruction of facial nerve demonstrate bilateral high intensity loop of vessels compressing the facial nerves. The coronal plane also shows deformity of the right pontomedullary junction.

DISCUSSION

Neurovascular contact of the facial nerve is accepted to be the most likely cause of hemifacial spasm[5]. The pathophysiology is still unclear. The possible hypothesis is pulsatile compression leading to demyelination of root exit zone and ectopic excitation, or to antidromic firing of neurons in the facial nucleus causing hyperactivity of those neurons. Whatever the pathophysiology, the definite treatment was proved to be decompression of the contact[6,7]. The pre-operative evaluations of with validity and accuracy MRI have been studied.. The CISS sequence was demonstrated to afford higher resolution and contrast between CSF, nerves and vessels than 3D-T_1-weighted image with high accuracy[4]. Previous studies using 3D-TOF source images were also proved for accuracy[8]. Though having a slightly lower specificity, the 3D-TOF is more available on older generation MR machines than CISS or related pulse sequence. In our institute, the authors found that the magnitude images from 3D-PC MRA gave a better resolution of vascular signal and nerve root than 3D-TOF. It was also found that MPR in oblique coronal view adds more information to confirm the neurovascular contact on axial source image as shown by Nagaseki et al [9]. The present study confirms the alternative choice for demonstrating neurovascular contact by the same basic principle of a previous 3D-TOF study.

Neurovascular contact on the asymptomatic side was also found as described in previous reports[3]. The present study also demonstrated a significantly different proportion of the findings compared with the symptomatic side. The significance of deformity of the pontomedullary junction was also demonstrated nearly exclusively on the symptomatic side. Combining vascular contact at REZ and deformity of the pontomedullary junction gives more specificity for the symptomatic side (98%). For patient management, history of symptomatic side was given for interpretation and planning for more confident surgery.

Because most of the presented patients were treated palliatively with botulinum toxin injection, the authors could not study the diagnostic performance of the test.

SUMMARY

To identify the neurovascular contact in hemifacial spasm, the 3D-PC magnitude images is a promising technique especially in the older generation of MRI machines.

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การแสดงภาพหลอดเลือดกดทับเส้นประสาทสมองคู่ที่ 7 โดยใช้เอ็มอาร์ไอในผู้ป่วยโรคใบหน้ากระตุกข้างเดียว 101 ราย

สุทธิศักดิ์ สุทธิพงษ์ชัย, พบ, อรสา ชวาลภาฤทธิ์, พบ*,*
อัญชลี ชูโรจน์, พบ, นิพนธ์ พวงวรินทร์, พบ***

ได้ทำการศึกษาผู้ป่วยด้วยโรคใบหน้ากระตุกข้างเดียวจำนวน 101 รายเพื่อหาสาเหตุของอาการ ซึ่งเชื่อว่าเกิดจากหลอดเลือดกดทับเส้นประสาทสมองคู่ที่ 7 ผู้ป่วยได้รับการตรวจโดยการสร้างภาพเอ็มอาร์ไอของก้านสมองและเอ็มอาร์เอโดยวิธี 3-dimensional phase-contrast MR angiography (MRA) ภาพข้อมูลดิบจากเอ็มอาร์เอถูกนำไปสร้างใหม่โดยคอมพิวเตอร์ในแนวขนานกับเส้นประสาทสมองคู่ที่ 7 ภาพทั้งหมดได้รับการแปลผลโดยรังสีแพทย์ที่มีความชำนาญทางระบบประสาท 3 ท่าน ผลการศึกษาพบว่า ในจำนวน 101 รายมีอาการข้างซ้าย 53 ราย, ขวา 48 ราย ไม่มีรายใดที่มีอาการทั้งสองข้าง มีหลอดเลือดกดทับเส้นประสาทด้านเดียวกับอาการ 61 ราย (ร้อยละ 60.4) กดทับด้านที่ไม่มีอาการ 14 ราย (ร้อยละ 13.86) มี 5 ราย ที่มีหลอดเลือดกดทับทั้งสองข้าง (ร้อยละ 4.9) สัดส่วนของการกดทับจากหลอดเลือดในข้างที่มีอาการแตกต่างจากด้านที่ไม่มีอาการอย่างมีนัยสำคัญทางสถิติ ($p < 0.001$) หลอดเลือดที่กดทับเป็นส่วนของหลอดเลือดแดง vertebral 32 ราย (ร้อยละ 52.46) posterior-inferior cerebellar 7 ราย (ร้อยละ 6.93) anterior-inferior cerebellar 6 ราย (ร้อยละ 5.94) และไม่สามารถบอกจุดเกิดของหลอดเลือดได้ 16 ราย (ร้อยละ 26.23) สรุปได้ว่าการใช้วิธีการตรวจที่ง่ายนี้ มีประโยชน์ในการแสดงว่ามีการกดทับเส้นประสาทสมองจากหลอดเลือดหรือไม่

คำสำคัญ : โรคใบหน้ากระตุกข้างเดียว, เอ็มอาร์ไอ, วินิจฉัย

สุทธิศักดิ์ สุทธิพงษ์ชัย, อรสา ชวาลภาฤทธิ์,
อัญชลี ชูโรจน์, นิพนธ์ พวงวรินทร์
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* ภาควิชารังสีวิทยา,
** ภาควิชาอายุรศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10700