

Formation of a large fusiform aneurysm next to a medullary infarction due to posterior inferior cerebellar artery dissection.

Running title: PICA dissection leading to a large An

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## Abstract

Posterior inferior cerebellar artery (PICA) infarction can lead to ischemic stroke at the lateral part of the medullary oblongata. PICA dissection can also elicit an ischemic event in this region but its detection on radiological images is difficult due to the small diameter of the vessel. We report a 48-year-old male with Wallenberg syndrome due to PICA dissection, which was difficult to diagnose on first admission. He reported sudden-onset sensory disturbance on the right side of his face, ataxic gait, and headache. Brain magnetic resonance imaging (MRI) revealed a fresh cerebral infarct in the right lateral medulla oblongata. Serial MRI and magnetic resonance angiography (MRA) performed at the time of his admission failed to demonstrate cerebral vessel abnormalities. MRI study performed 18 months after the attack revealed a fusiform aneurysm on the lateral medullary segment of the PICA; its site was extremely close to the cerebral infarct. We concluded that the infarct was due to PICA dissection because it was sudden onset of the symptom at the event and the lesion enlarged dissecting aneurysm located to be coincident with symptoms of Wallenberg syndrome. The aneurysm was trapped, and an occipital artery-PICA bypass was placed. At the latest follow-up, one year after the operation, he manifested no neurological symptoms.

Imaging findings at the time of his first admission indicated that the PICA was

intact in this patient with Wallenberg syndrome attributable to PICA dissection, which obscured on imaging studies performed at symptom onset and was diagnosed later.

However, 18 months later, MRI revealed enlargement of an aneurysm at the site of the dissection. A cerebral infarct in the PICA territory in patients with headache may be indicative of PICA dissection.

## Introduction

Ischemic stroke at the lateral part of the medullary oblongata results in Wallenberg syndrome. In most cases the infarct site is on the posterior inferior cerebellar artery (PICA) or the vertebral artery (VA).<sup>1</sup> Kim<sup>2</sup> reported that among 130 patients, most vascular events leading to infarcts were attributable to atherothrombotic and that among other vessels, PICA occlusion eliciting ischemic stroke was related to cardiogenic embolism. According to Kobayashi et al.,<sup>3</sup> PICA dissection can also result in ischemic events in this region. However, it may be difficult to identify ischemic PICA dissection on radiological images because the diameter of the vessel is small.<sup>4,5</sup>

We report a male with ischemic stroke at the lateral part of the medullary oblongata. It was initially thought to be due to an atherothrombotic because PICA dissection obscured on imaging scans obtained at symptom onset. However, it was caused by PICA dissection, retrospectively, and it was chronic progression in the formation of a large fusiform aneurysm during an 18-months clinical course.

## Case Report

A 48-year-old man with hypertension and diabetes mellitus reported sudden-onset sensory disturbance on the right side of his face, ataxic gait, and right occipital

headache. He provided prior written informed consent for inclusion in this report.

With symptoms of Wallenberg syndrome he was admitted to our hospital.

Diffusion-weighted brain MRI (Figure 1A) revealed a fresh cerebral infarct at the right lateral medulla oblongata. 3D-time-of-flight (TOF) MRA (Figure 1B), basi-parallel anatomical scanning (Figure 1C), and T2-weighted imaging (Figure 1D) failed to demonstrate vertebral artery (VA)- or PICA dissection. Our provisional diagnosis had been atherothrombotic cerebral infarction and for 2 weeks he was placed under in-hospital observation with antiplatelet therapy. At discharge he continued to manifest sensory disturbance on the right side of his right face (modified Rankin Scale, mRS = 1) and he was followed as an out-patient. MRI scans obtained 2 and 4 months after the attack revealed no new cerebral infarcts. However, routine follow-up brain MRI performed 18 months after the ictus showed a dissecting aneurysm on the lateral medullary segment of the PICA; its site was extremely close to the cerebral infarct (Figures 2A, 2B). Re-examination of magnetic resonance angiography (MRA)- and MRI findings made 2 months after his hospital admission detected a small dissecting aneurysm. The medulla oblongata harboring the first cerebral infarct was supplied by the PICA. Based on his post-hospitalization clinical course we finally diagnosed medullary infarction due to PICA dissection and recorded the development of a

gradually growing fusiform aneurysm on the lateral medullary segment of the PICA.

His earlier sudden-onset headache was consistent with this diagnosis.

Although he did not suffer new symptoms or recurrent cerebral infarction during the follow-up period, because the aneurysm grew gradually, we planned surgical treatment of the dissecting aneurysm to prevent its rupture. 3D-TOF MRA scans obtained 2-, 4-, and 18 months after his first admission demonstrated a 10 x 17-mm fusiform aneurysm located at the lateral medullary segment with extension to the caudal loop of the PICA (Figure 3). The pearl-and-string sign was observed (Figure 4). The aneurysm was trapped and an occipital artery (OA)-PICA bypass was placed (Figure 4B, C). Although postoperative MRI showed no new cerebral infarct, truncal ataxia and sensory disturbance in the left part of his body were observed. We repaired liquorrhea and he was transferred to a rehabilitation hospital 44 days later. Three months after the 2<sup>nd</sup> operation we placed a V-P shunt for hydrocephalus. His neurological deficits gradually improved and on the latest follow-up one year after his OA-PICA bypass he had no neurological symptoms.

## Discussion

We report a patient with Wallenberg syndrome attributable to a PICA dissection obscured on imaging studies performed at onset. During the follow-up period he manifested chronic progression in the formation of a large fusiform aneurysm close to the dissection site. Mizutani<sup>6</sup> reported that over time, approximately 4% of unruptured dissecting aneurysms, particularly those involving VA dissection, become enlarged. It is not known how often PICA dissecting aneurysms enlarge.

In 2014, Matsumoto et al.<sup>7</sup> reported that most patients with PICA dissection presented with subarachnoid hemorrhage. A later study by Kobayashi et al.<sup>3</sup> showed that 6% of infarcts in PICA territory were due to PICA dissection and that in a similar number of patients they were attributable to VA dissection. They also reported that patients with- tended to be younger than patients without PICA dissection and their initial NIH stroke score was lower. Ischemic PICA dissection is almost always accompanied by occipital headache.<sup>4</sup> Our 48-year-old patient suffered sudden-onset right occipital headache; his proximal PICA dissection that resulted in lateral medullary infarction and the development of a fusiform aneurysm was not detected on the initial TOF-MRA- or on (BPAS) images.

Because the PICA is tiny, it is difficult to diagnose ischemic PICA dissection.<sup>4,5</sup> Hosoya et al.<sup>8</sup> reported that a high-intensity signal on axial T1-weighted images helps to



diagnose VA dissection. Susceptibility-weighted- and high-resolution MRI imaging were useful for the identification of VA- and PICA dissection.<sup>4</sup> However, we did not perform these studies. Our experience indicates that such studies should have been performed at the time of his first admission.

Patients with VA dissection must undergo follow-up radiological studies because the intramural lumen becomes fragile within 3 weeks after symptom onset. Although most unruptured VA dissections remain stable in the course of a few months, some patients require long-term observation.<sup>9</sup> Sasaki et al.<sup>10</sup> encountered a patient with a growing PICA aneurysm secondary to a cerebellar infarct. The aneurysm grew in the 2 weeks following symptom onset; intraoperatively a diagnosis of PICA dissecting aneurysm was made. To our knowledge, ours is the first case with a secondary enlarged PICA dissecting aneurysm detected 18 months after a cerebral infarct. During the preoperative observation period our patient developed no new neurological deficits despite the presence of an enlarging aneurysm in close proximity to the medullary oblongata. Surgery avoided aneurysmal rupture and cranial nerve involvement.

Endovascular treatment has been applied to address aneurysms of the posterior circulation, including VA-PICA aneurysms. Aneurysms at the trunk of the PICA can also be treated endovascularly, however, the procedure can be difficult and complex.<sup>11</sup>

Our patient's aneurysm was large and fusiform and although endovascular treatment was an option, it may have required parent artery occlusion. Therefore we performed revascularization via an OA-PICA bypass and trapped the aneurysm.

Based on our experience we suggest that in patients with ischemic stroke in the PICA territory who report occipital headache, consider the PICA dissection that is not clear on radiological imaging, susceptibility-weighted- and high-resolution MRI scans help to diagnose PICA dissection.

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## Figure Legends

### Figures 1 A - E

Images acquired at the time of admission and 6 days later (T1-weighted images)

- A. Diffusion-weighted image obtained at the time of admission. Note the spotty high-intensity area the right lateral medulla oblongata. (arrowhead)
- B. 3D-TOF MRA. No abnormal finding. The arrowheads point to the proximal dissection site (B1, B2).
- C. Basi-parallel anatomical scan. No abnormal finding. The arrowhead points to the dilation site.
- D. T1-weighted image. No abnormal finding. The arrowhead points to the dilation site.
- E. T2-weighted image. No abnormal finding. The arrowhead points to the dilation site.

Figures 1 F-H. Images acquired 18 months after admission.

- F. Basi-parallel anatomical scan. The arrowhead points to the dilated dissecting aneurysm.
- G. T1-weighted image. The arrowhead also points to the dilated dissecting aneurysm.
- H. T2-weighted image. The arrowhead points to the dilated dissecting aneurysm.

Figure 2.

3D-TOF MRA (axial view) performed 2-, 4-, and 18 months after his first admission.

The images confirm gradual enlargement of the aneurysm (arrowheads).

Figure 3

Comparisons of the MRA-TOF axial images, obtained at the time of his first admission and 18 months after attack. Arrow heads point to the dilated dissecting aneurysm.

Figure 4.

A preoperative VA angiogram (lateral view) revealed a 10 x 17-mm aneurysm.

A Postoperative angiogram

- B. VA (lateral view). The aneurysm is trapped.
- C. External carotid artery (lateral view). The occipital artery (OA) is anastomosed to the PICA distal of the aneurysm.









