INTERNAL MEDICINE

□ CASE REPORT □

Bilateral Vertebral Artery Aneurysms at the Atlantoaxial Joint Level Causing Recurrent Stroke

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Abstract

Vertebral arteries (VAs) are vulnerable to mechanical stress between the atlas and axis, and subsequent VA dissection can cause posterior circulation infarction. We herein present a rare but informative case of bilateral VA aneurysms that caused recurrent stroke. The localization of the aneurysms and dynamic angiography with neck movement suggested a pathogenesis related to chronic mechanical injury of the VAs, though no skeletal abnormality was detected. The recurrences stopped and both aneurysms shrank after neck collar fixation and after the combination use of antithrombotics. For patients with posterior circulation infarction of unknown origin, a careful evaluation of VAs with physicians paying special attention to the atlantoaxial joint level is therefore recommended.

Key words: vertebral artery dissection, atlantoaxial joint, dissecting aneurysm, posterior circulation, cryptogenic stroke

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Introduction

The vertebral arteries (VAs) are vulnerable to mechanical stress, such as torsion and stretching between the atlas and axis, and subsequent VA dissection is one of the major causes of posterior circulation infarction worldwide, especially in Asian countries (1). Less frequently reported are infarctions due to dissecting aneurysms at the atlantoaxial joint (AAJ) level, and all the cases described to date are mainly associated with either a bony anomaly or atlantoaxial dislocation (AAD) (2-4). We herein present a rare but informative case of bilateral VA aneurysms that caused recurrent stroke in the absence of any history of cervical trauma, anomaly, or AAD.

Case Report

A 64-year-old Japanese man with hypertension and diabetes presented with sudden right hemianopsia, which had appeared while he was sitting in a chair reading a newspaper. No neck pain was reported. He had not experienced any recent trauma, sports activity or chiropractic manipulation. His mother had suffered from brain infarction, and the patient had been prescribed aspirin by his local doctor. No other personal or family history was reported. His pulse was regular and blood pressure was normal. No carotid bruits or cardiac murmurs were detected. Neurological examination confirmed right upper quadrantanopsia, along with abnormal tandem walking. Brain MRI revealed acute infarction involving the bilateral cerebellar hemispheres (Fig. 1A) and occipital lobes. We could not find any abnormalities on brain MR angiography, cervical MR angiography or cervical CT angiography. No embolic sources were identified on carotid Doppler ultrasonography, transthoracic or transesophageal echocardiography, Holter electrocardiography, or venous Doppler ultrasonography of the lower limbs. The patient was discharged on warfarin instead of aspirin (Fig. 2), and the dose was adjusted to achieve a prothrombin time international normalized ratio (PT-INR) of 2.38. Two months later, he presented with transient dizziness, and brain MRI revealed recurrent infarction in the left cerebellum. The PT-INR was 1.23, and the warfarin dose was therefore increased. Four months later, he presented for a third time de-

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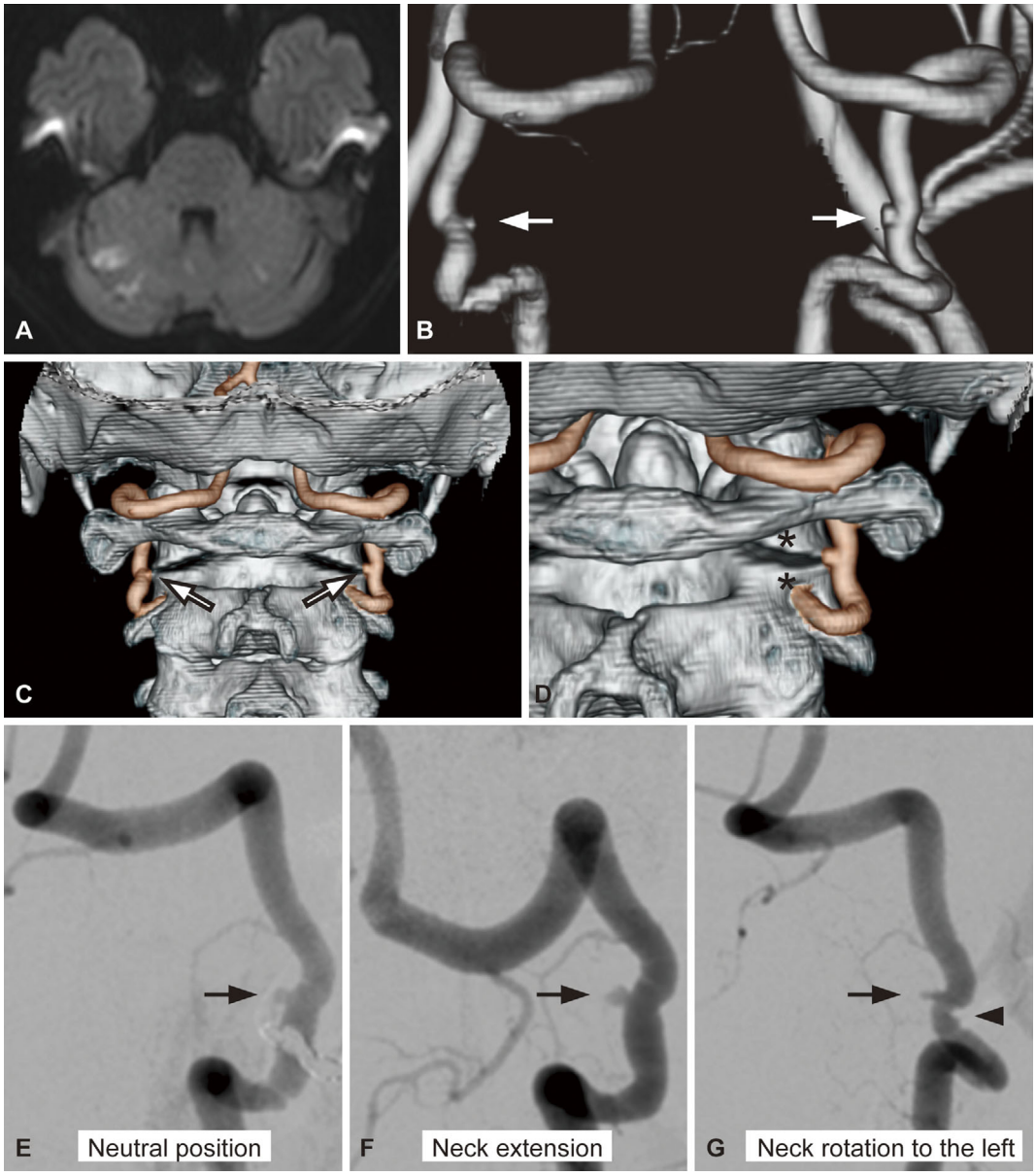

Figure 1. **MRI, CT angiography and dynamic angiography. (A) Acute cerebellar infarction on initial MRI. (B) Bilateral vertebral artery aneurysms (arrows) on CT angiography. (C) Both aneurysms (arrows) are located at the atlantoaxial joint level. (D) Higher magnification of panel C, viewed from the right posterior side. Asterisks show facets of the atlantoaxial joints. (E-G) Angiography reveals a mild enlargement of the left aneurysm on neck extension (F) and an irregular endothelial surface near the aneurysm on neck rotation to the left (G, arrowhead), compared with the neutral position (E). Arrows indicate left vertebral artery aneurysm. (B-D: posterior views; E-G: anterior views.)**

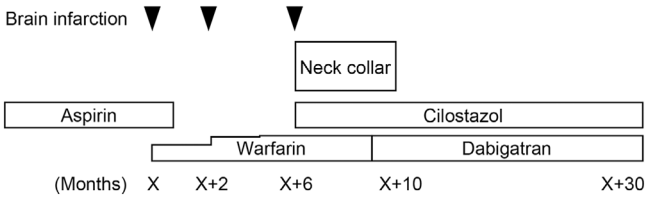

Figure 2. **Clinical course. Monotherapy with aspirin or warfarin did not stop stroke recurrence. Recurrences stopped after temporary immobilization of the atlantoaxial joint using a soft cervical collar, together with the administration of an anticoagulant and cilostazol.**

scribing a "sick feeling" and abnormal visual sensations. These symptoms had appeared after he had been putting up posters for an hour and then ate a meal. Brain MRI revealed recurrent infarction in the left cerebellum and right occipital lobe, although the PT-INR at this time had increased to 3.13.

After re-evaluating the cervical CT angiography from the first admission, we noticed tiny VA aneurysms bilaterally at the level of the AAJ (Fig. 1B-D), and therefore performed dynamic angiography. The left VA aneurysm showed a mild enlargement on neck extension, and an irregularity of the endothelial surface of the VA near this aneurysm was observed on neck rotation to the left (Fig. 1E-G). Cervical X-

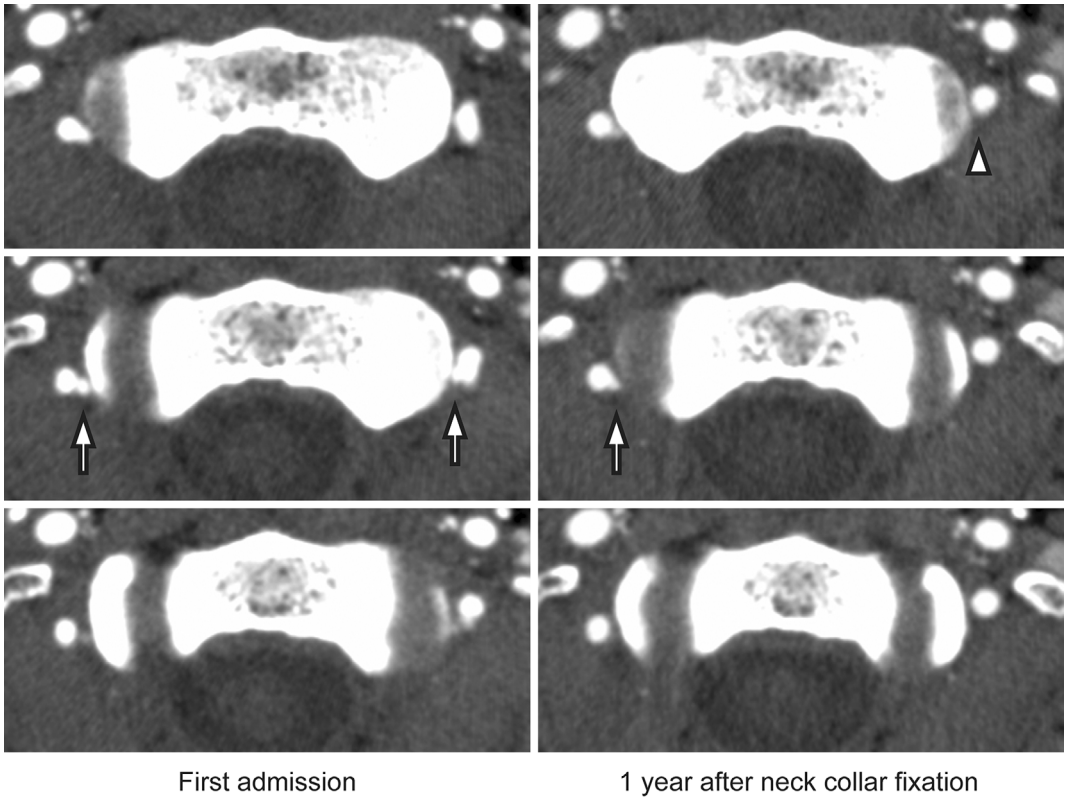

Figure 3. **CT angiography before and after treatment. The left panels show axial images of CT angiography performed on first admission. The right panels show axial images of CT angiography performed 1 year after treatment with neck collar fixation and antithrombotics. The slice thickness is 1 mm. Both aneurysms have decreased in size, with the left aneurysm becoming undetectable. Arrows indicate vertebral artery (VA) aneurysms. Arrowhead in the right upper panel indicates the position of the left VA aneurysm on the first CT angiography.**

ray, CT and MRI revealed no AAD, bony anomaly or disc herniation. A soft cervical collar was prescribed for immobilization of the AAJ and cilostazol, an endothelial protective agent (5), was added to warfarin. Warfarin was changed to dabigatran 3 months later in order to achieve a more stable effect. The cervical collar was removed 4 months after the infarction. No further recurrences have been detected on annual follow-up MRI during 2 years of observation. Moreover, follow-up CT angiography has demonstrated the shrinkage of both aneurysms, with the left lesion becoming undetectable by 1 year after starting combination therapy with the cervical collar and antithrombotics (Fig. 3).

Discussion

We herein presented a case with bilateral VA aneurysms that caused recurrent stroke. This case showed two unique features. First, the patient showed no abnormalities of the cervical spine. Second, the aneurysms were so small that detection was only achieved with a second, very careful examination of the imaging results.

The VAs are vulnerable to mechanical stress between the atlas and axis, and subsequent VA dissection represents one of the major causes of posterior circulation infarction (1). Infarctions due to VA aneurysm at the AAJ level are reported less frequently (Table) (2-4). The present case is unique in that the patient had no cervical spine abnormality, while all previously reported cases have been associated with either Klippel-Feil anomaly (2, 3) or AAD (4), both of which can cause hypermobility between the atlas and axis. Even though hypermobility of the AAJ was not detected in this case, we consider the pathogenesis of the aneurysms to have involved chronic mechanical injury of the VAs based on the following reasons: 1) bilateral aneurysms were localized at exactly the same AAJ level; 2) at least one of the aneurysms showed morphological changes during neck movement; and 3) both aneurysms shrank and the recurrent strokes stopped after immobilization of the AAJ together with pharmacotherapy. Further supporting this consideration, we recently encountered another case of VA aneurysm causing recurrent stroke without any predisposing factors in which atlantoaxial fixation served to stabilize and shrink the aneurysm, thereby stopping any recurrence of the stroke (6). Unrecognized minor trauma or sudden neck motion that was forgotten or considered insignificant by the patient might have induced VA injury in these cases, as hypothesized for "spontaneous" VA dissections (7). In the present case, one of the episodes of stroke recurrence occurred after the patient had been putting up posters, where repeated neck extension and rotation might have injured the VAs. Chronic

Table. Previous Cases of VA Aneurysms at the Atlantoaxial Joint Level Causing Recurrent Stroke.

Age	Sex	Underlying diseases	Lesions	Treatment		References
				Medications	Physical/surgical	
64	M	None	Bilateral	Cilostazol Dabigatran	Cervical collar	Presented case
1	M	KFA	Unilateral	Aspirin	Cervical collar	2
39	F	KFA	Unilateral		Distal ligation Coil embolization Posterior fixation	3
20	M	AAD	Unilateral		Posterior fixation	4
27	F	None	Unilateral	Warfarin	Atlantoaxial fixation	6

KFA: Klippel-Feil anomaly, AAD: atlantoaxial dislocation

hypertension might also have increased the susceptibility of the VAs (1).

Regarding the relationship between aneurysms and infarction, intra-aneurysmal thrombus was detected and was considered to be an embolus in a case described by Shimizu et al. (3), while thrombosis due to dissection itself was considered as an embolus in a case reported by Ross et al. (2). In our case, the distribution and recurrence of the infarctions suggested arterial embolism originating from the posterior circulation. No thrombus was detected, but this is consistent with the pathomechanisms discussed above, because the emboli in our case would have been very small, as suggested by the small size of each infarction. Angiographic findings in the acute phase and shrinkage of both aneurysms in the chronic phase indicate that both the microdissection and aneurysm formation in the VAs were in the active phase during the recurrent infarction, and that the microdissection or aneurysms would have been the most likely embolic source.

We prescribed a cervical collar to immobilize the AAJ, but did not perform atlantoaxial fixation, as the possibility of such aneurysms representing the embolic source was at that time considered to be equivocal. The aneurysms appeared to be extremely small, and the possibility of simple atherosclerosis as the cause of infarction had not been entirely excluded. However, the subsequent clinical course demonstrated a relationship between the aneurysms and recurrent stroke, as previously discussed. The aneurysmal form in extracranial VA dissection is reported to show a better resolution rate (80%) than the aneurysmal form in internal carotid artery dissection (36%) (8), and atlantoaxial fixation might be unnecessary when such aneurysms resolve. The patient is now being carefully followed-up with guidance to avoid any excessive neck extension or rotation. Atlantoaxial fixation will be considered if the size of the aneurysm increases or recurrent stroke is detected on annual follow-up MRI. Cilostazol was added with the hope of promoting the healing of endothelial injury, but the clinical significance of this approach still requires further investigation.

The small aneurysms in our case were not apparent on MR angiography, but they were detectable on CT angiography and conventional angiography after special attention was given to the AAJ level. Such minor findings are easily missed, and thus may account for some such cases showing "cryptogenic" stroke.

In conclusion, careful evaluation of the VAs with special attention to the AAJ level is recommended for patients with posterior circulation infarction of unknown origin. CT angiography is necessary to detect minor lesions, and dynamic angiography is useful for understanding the pathogenesis.

The authors state that they have no Conflict of Interest (COI).

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