

## Progressive Bilateral Vertebral Artery Dissection in a Case of Osteogenesis Imperfecta

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A 32-year-old woman with osteogenesis imperfecta (OI) was admitted to the hospital because of a right-sided occipital headache and facial paresthesia. She was diagnosed with lateral medullary syndrome due to right vertebral artery (VA) dissection. She was treated conservatively without antithrombotic therapy. She developed subarachnoid hemorrhage because of contralateral VA dissection 18 days later. This clinical course may reflect the underlying weakness of the vessel wall in OI. In patients with OI, occlusion of a unilateral VA could cause dissection and subsequent rupture of the contralateral VA. Early surgical treatment for lesions of the VA is required in such cases. **Key Words:** Osteogenesis imperfecta—bilateral vertebral artery dissection—lateral medullary syndrome—subarachnoid hemorrhage.

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### Introduction

Osteogenesis imperfecta (OI) is a heterogeneous and inherited connective tissue disorder that is characterized by excessive bone fragility.<sup>1</sup> OI is caused by abnormalities of type I collagen, which is a major structural component of vessel walls. Nevertheless, cerebrovascular complications have not been well analyzed in OI.<sup>2-7</sup>

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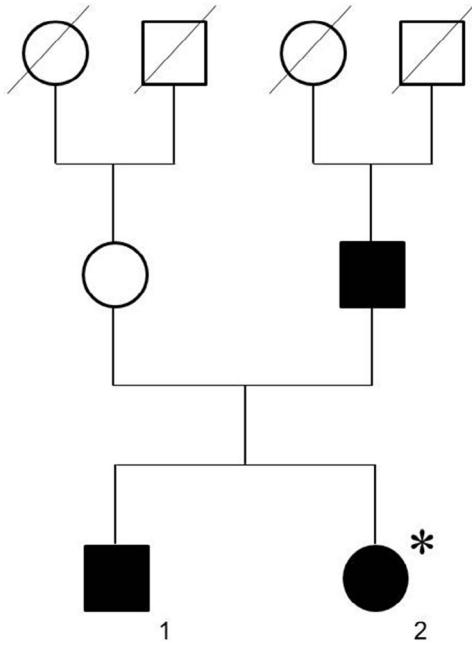
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We present a case of progressive bilateral vertebral artery (VA) dissection in a patient with OI.

### Case Report

A 32-year-old woman developed a right-sided occipital headache and facial paresthesia. The patient had clinically diagnosed OI (type 1) because of the presence of bone fragility, blue-tinged sclerae, a family history, and bone X-ray findings, including Wormian bone and low bone density.<sup>1,8</sup> She had a medical history of fractures of the limbs (4 times), which were associated with minor trauma since she was 4 years old. Her father and elder brother also had a history of multiple fractures and were clinically diagnosed with OI. The family history of the patient suggested autosomal dominant transmission (Fig 1). She had no risk factors, such as hypertension, dyslipidemia, arrhythmia, or other cardiovascular diseases, or diabetes mellitus.

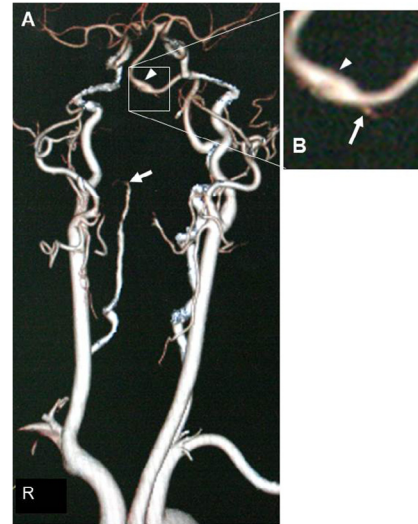
She was alert on admission and her height was 140 cm. Her blood pressure was 127/76 mmHg and her heart rate was 84 beats/minute. A neurological examination showed right-sided blepharophimosis, miosis, and facial anhidrosis.



**Figure 1.** Abbreviated family pedigree. The square indicates a man and the circle indicates a woman. Dark squares and circles indicate a history of multiple fractures. An asterisk indicates the present case.

Rotatory nystagmus in the fast phase was directed toward the left side. She had dysphagia resulting from soft palatal paresis. The gag reflex had disappeared on the right side, as well as dysmetria on the right side by finger-to-nose testing, and ataxic gait.

Diffusion-weighted magnetic resonance (MR) imaging on admission showed acute infarction at the right posterolateral medulla (Fig 2, A). T1-weighted MR imaging, MR angiography, and partial maximum intensity projection

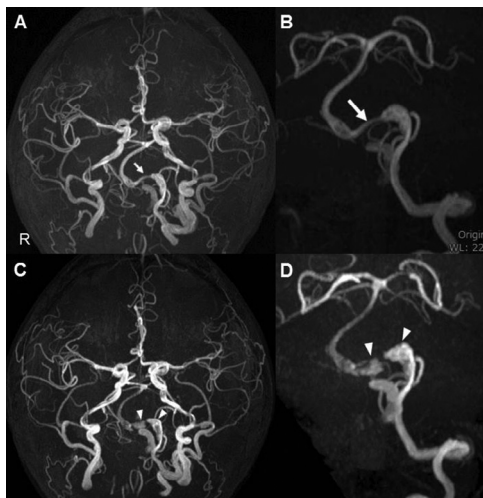


**Figure 3.** Three-dimensional computed tomography angiography on admission shows occlusion in the right vertebral artery (A, arrow) and dilation of the proximal basilar artery (A, B, arrowhead), although there appears to be retrograde residual flow (B, arrow).

(MIP) images of the vertebrobasilar system showed thrombotic occlusion in the right VA and dilation of the proximal basilar artery (BA) (Fig 2, B-D). An MR angiographic source image showed a double lumen in the occluded right VA (Fig 2, E). Basi-parallel anatomical scanning-MR imaging<sup>9</sup> showed dilatation of the outer contour at the right VA and proximal BA (Fig 2, F). Three-dimensional computed tomography angiography on admission showed almost complete occlusion in the right VA and dilation of the proximal BA (Fig 3, A), although there appeared to be retrograde residual flow (Fig 3, B). Based on these findings, we diagnosed lateral medullary syndrome due



**Figure 2.** Diffusion-weighted MR imaging (A) performed on admission shows hyperintensity in the right posterolateral medulla (arrow). T1-weighted MR imaging (B), MR angiography (C), and a partial maximum intensity projection image of the vertebrobasilar system (D) show occlusion of the right VA with thrombus in the pseudolumen (arrowheads) and dilation of the proximal basilar artery (BA) (arrow). MR angiographic source image (E) shows a double lumen in the right occluded VA (arrow). Basi-parallel anatomical scanning-MR imaging (F) shows dilatation of the outer contour at the right VA (arrowheads) and the proximal BA (arrow). Abbreviations: MR, magnetic resonance; VA, vertebral artery.



**Figure 4.** MR angiography (A) and a partial maximum intensity projection (MIP) image of the vertebrobasilar system (B) on day 11 showing left VA dissection with severe stenosis (string sign, **arrows**). MR angiography (C, **arrowheads**) and an MIP image of the vertebrobasilar system (D, **arrowheads**) on day 18 show enlargement of the pseudolumen in the left dissecting VA. Abbreviations: MR, magnetic resonance; VA, vertebral artery.

to right VA dissection associated with proximal BA dissection. The patient was treated conservatively without antithrombotic therapy because of an increased risk of a dissected VA and BA rupture. Her blood pressure remained well controlled (<140/90 mmHg) without antihypertensive agents during hospitalization. MR angiography and a partial MIP image of the vertebrobasilar system on day 11 showed stenosis of the left VA, which suggested newly developed dissection after admission (Fig 4, A, B). However, the patient showed no neurological deterioration. MR angiography and a partial MIP image of the vertebrobasilar system on day 18 showed enlargement of the left dissecting VA (Fig 4, C, D). On the 20th hospital day, she suddenly entered a coma and was immediately intubated. Brain computed tomography

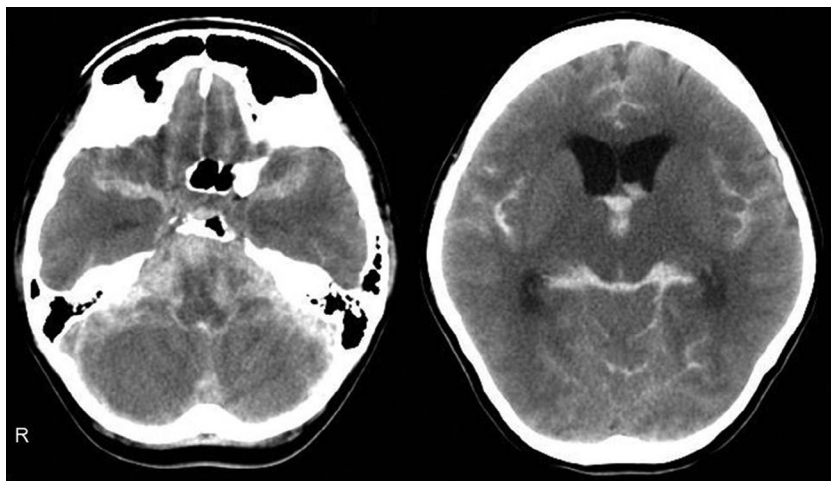
revealed diffuse subarachnoid hemorrhage (Fig 5). Despite intensive treatment, she died on day 28.

An autopsy was performed 3 hours after death. According to the autopsy record, the brain showed severe softening with massive subarachnoid hemorrhage, consistent with respiratory brain. Unfortunately, the major cerebral arteries and brain stem were not appropriately obtained. We analyzed multiple histological sections of the brain from archival slides, but identifying the major cerebral arteries, including the VAs, was difficult. Most neurons in the cerebral cortex were atrophic and eosinophilic. Red blood cells were observed in the subarachnoid space.

## Discussion

In the present case, OI (type 1) was directly diagnosed based on clinical signs, symptoms, and a positive family history, although we did not perform genetic analysis.<sup>1,8</sup> OI (type 1) results in an underproduction of type I collagen, which is deposited on the surface of smooth muscle cells or along elastin filaments in the cerebrovascular wall.<sup>10</sup> In patients with OI and aortic dissection, pathological examination of the resected aortic wall tissue shows cystic medial degeneration.<sup>11</sup> Therefore, type I collagen might play a role in the rigidity and elasticity of the vascular wall.<sup>12,13</sup>

Although sporadic case reports have described cerebrovascular complications in adult patients with OI, it is rare compared with other connective diseases. Particularly noteworthy are reports of cervicocephalic arterial dissection, such as dissection of the VA or basilar artery,<sup>4,14</sup> dissection of the carotid artery,<sup>3,5</sup> bilateral dissection of both internal carotid arteries and VAs,<sup>2</sup> and subarachnoid hemorrhage due to a ruptured aneurysm.<sup>6</sup> Vascular dissection may be an important pathological condition of OI, and may reflect the underlying weakness of the vessel wall of OI.



**Figure 5.** Brain computed tomography on day 20 shows diffuse subarachnoid hemorrhage.

Contralateral VA dissection occurs after spontaneous occlusion or occlusion therapy of ipsilateral VA dissection.<sup>15-19</sup> The clinical presentation of contralateral VA dissection is variable and occlusive ischemia and aneurysm development are possible.<sup>15-19</sup> In our case, the mechanism of left VA dissection after occlusion of a dissecting right VA is unclear. Changes in hemodynamic stress may contribute to this mechanism.<sup>15</sup> In previous reports of bilateral VA dissection, substantial elevation of arterial hemodynamic stress was indicated because the contralateral VA became dilated after the unilateral VA was occluded.<sup>16,17</sup> Alternatively, unilateral VA dissection may extend to the contralateral VA via the confluence of bilateral VAs.<sup>18</sup> In both mechanisms, vascular fragility in OI may have been a major factor in our case.

Conservative treatment was not effective for our patient. In patients with OI, occlusion of a unilateral VA could cause dissection and subsequent rupture of the contralateral VA. Early surgical treatment, such as parent vessel sacrifice of unilateral residual flow to prevent subsequent contralateral rupture and trapping of the dissected contralateral VA with anastomosis, is required in such cases.

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