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Endovascular Treatment of Basilar Artery Thrombosis Secondary to Bilateral Vertebral Artery Dissection with Symptom Onset Following Cervical Spine Manipulation Therapy

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Female, 37
Final Diagnosis: Vertebral artery dissection
Symptoms: Neck pain and focal neurological deficits
Medication: No previous
Clinical Procedure: Endovascular thrombectomy
Specialty: Neurology

Objective: Rare disease

Background: Vertebral artery (VA) dissection (VAD) has been described following neck injury and can be associated with stroke, but the causal association with cervical spine manipulation therapy (cSMT) is controversial. The standard treatment for VAD is antithrombotic medical therapy. To highlight the considerations of an endovascular approach to VAD, we present a critical case of bilateral VAD causing embolic occlusion of the basilar artery (BA) in a patient with symptom debut following cSMT.

Case Report: A 37-year-old woman presented with acute onset of neurological symptoms immediately following cSMT in a chiropractic facility. Acute magnetic resonance imaging (MRI) showed ischemic lesions in the right cerebellar hemisphere and occlusion of the cranial part of the BA. Angiography depicted bilateral VAD. Symptoms remitted after endovascular therapy, which included dilatation of the left VA and extraction of thrombus from the BA. After 6 months, the patient had minor sensory and cognitive deficits.

Conclusions: In severe cases, VAD may be complicated by BA thrombosis, and this case highlights the importance of a fast diagnostic approach and advanced intravascular procedure to obtain good long-term neurological outcome. Furthermore, this case underlines the need to suspect VAD in patients presenting with neurological symptoms following cSMT.

MeSH Keywords: Manipulation, Chiropractic • Stroke • Vertebral Artery Dissection • Vertebrobasilar Insufficiency

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Background

Cervical artery dissection (CAD) comprises carotid and vertebral artery (VA) dissection. Vertebral artery dissection (VAD) has been described to occur spontaneously as well as following neck injury. Symptoms may be vague and non-specific, making the diagnosis challenging. The most common symptoms of VAD are dizziness/vertigo (58%), headache (51%) and neck pain (46%) [1], which are symptoms often encountered in the emergency department.

The incidence of VAD is approximately 1 per 100 000 per year and many risk factors have been described including hypertension and cervical trauma [2–4].

Vertebral artery dissection can be associated with subarachnoid hemorrhage (SAH) as well as ischemic stroke. Most often the course is mild with a favorable outcome, but a minority of patients suffer serious complications leading to poor outcomes [1]. Vertebral artery dissection can lead to a complete occlusion of the basilar artery (BA), which is a very serious condition, often resulting in death [5,6]. The treatment of BA occlusion is challenging and must be initiated rapidly to prevent irreversible cerebral damage.

Cervical spine manipulation therapy (cSMT) seeks to restore proper joint mechanics in order to reduce pain and stress on the surrounding tissue. Several mechanisms exist, including high-velocity low-amplitude manipulation where the patient's head is thrusted quickly within the spinal joint's range of motion [7].

We present a rare case of bilateral VAD and BA thrombosis following cSMT. We hope to provide an example of the diagnostic approach and treatment of this potentially fatal condition.

Case Report

A 37-year-old woman with a 1-month history of neck pain presented with acute onset of dizziness, diplopia, dysarthria, right hemiparesis, and right-sided central facial palsy in immediate continuation of cSMT in a chiropractic facility. The neck pain was initially ascribed to recent physical exercise on a step trainer with dumbbells. The patient had received cSMT once a week for her neck pain, and had just completed her third treatment when the symptoms developed while sitting in the chiropractor's waiting room after treatment. Four months previously, the patient had received chiropractic treatment for lumbar pain. The patient was otherwise healthy and physically fit with no

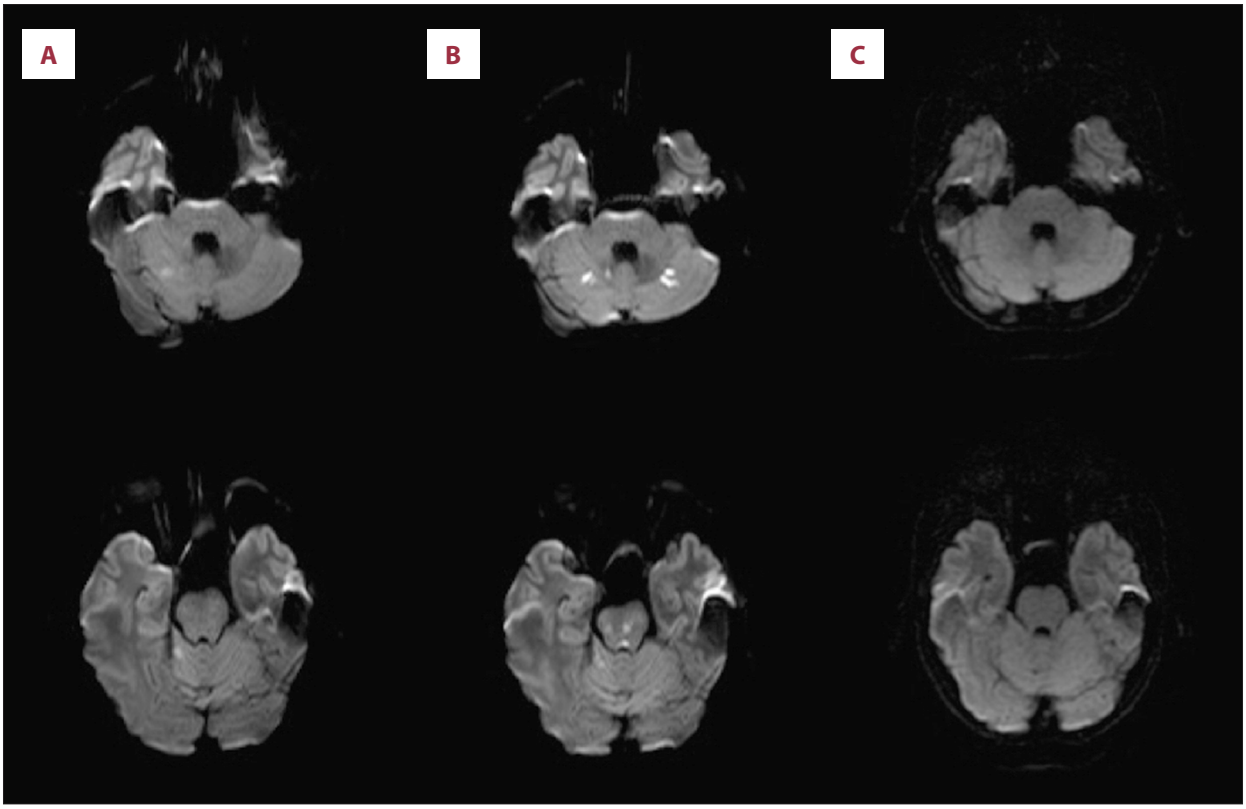

Figure 1. Pre- (**A**) and 24 hours post-operative (**B**) as well as 6-months follow-up (**C**) diffusion-weighted MRI. The pre-operative images depict minor diffuse ischemic lesions in the vertebrobasilar vascular network, which became more pronounced 24 hours post-operatively. At 6-months follow-up, no ischemic changes are seen.

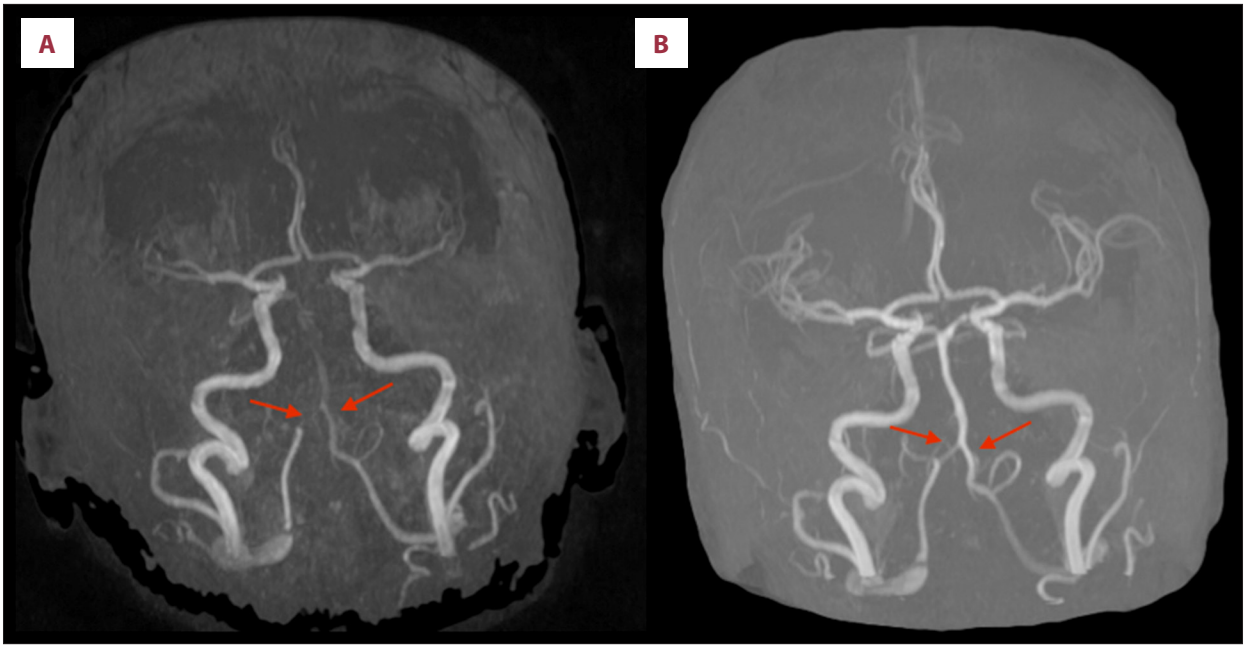

Figure 2. Pre- and post-procedure MRI angiography. Occlusion of the basilar artery was observed before thrombectomy (**A**). Complete recanalization of the BA and VA was obtained after endovascular treatment (**B**).

predispositions to stroke, no history of smoking or hypertension, and no reported co-morbidities. Current medication included contraceptive pills and an antihistamine for allergic rhinitis.

The patient arrived at the neurological department 1 hour and 10 minutes after symptom debut, presenting with bilateral internuclear ophthalmoplegia and right-sided ataxia, scoring 6 on the National Institutes of Health Stroke Scale (NIHSS). She was awake and her blood pressure was 160/90 mmHg with a pulse of 100. Respiratory rate was 14, with a saturation of 100% without supplementary oxygen. Acute magnetic resonance imaging (MRI) showed acute ischemic lesions in the right cerebellar hemisphere on diffusion-weighted imaging (Figure 1A). Magnetic resonance angiography (MRA) depicted occlusion of the distal part of the BA and occlusion of the right VA after the origin of the posterior inferior cerebellar artery (PICA) together with severe stenosis of the left VA due to bilateral VAD (Figure 2A).

Intravenous thrombolytic treatment was initiated 1 hour and 44 minutes after symptom onset. Because symptoms progressed during thrombolysis (increase in NIHSS score to 10), it was decided to proceed with endovascular therapy 2 hours and 40 minutes after symptom onset. A catheter was placed in the left VA, and balloon dilatation was performed. A retrievable stent was used to aspirate the thrombus. Dysarthria and hemiparesis remitted during the endovascular procedure, and NIHSS score decreased to 1 with remaining diplopia. The BA was recanalized 4 hours and 56 minutes after symptom onset. Post-procedure MRA showed complete recanalization of the BA and right VA, but remaining severe stenosis of the left VA with distal filling from muscular collaterals (Figure 2B).

Follow-up MRI after 24 hours showed minor pontine and bilateral cerebellar lesions (Figure 1B). The patient was discharged 5 days later to ambulant rehabilitation. She received dual antiplatelet treatment with 75 mg clopidogrel and acetylsalicylic acid (ASA) for 3 months daily, and afterwards only ASA.

After 6 months, sensory disturbances in the left face and both upper extremities remained, together with reduced working memory and reduced mental capacity. No ischemic lesions were found on MRI (Figure 1C). MRA on follow-up showed persisting stenosis of the left VA but normal caliber of the right VA and BA.

Discussion

The standard treatment of VAD is antithrombotic, with either antiplatelet or anticoagulant therapy to prevent thrombogenic or embolic occlusion of the vertebrobasilar vascular network and subsequent ischemic injury to the areas supplied [8,9]. Before initiation of antithrombotic therapy, contraindications such as concurrent SAH must be ruled out. In our case, VAD was complicated by complete occlusion of the BA, and intravenous thrombolytic therapy failed to resolve symptoms.

No randomized studies of endovascular treatment for CAD, including VAD, exist, and most of the literature consists of case series [8]. Treatment options are balloon angioplasty, stenting of

stenotic vessels, and coiling of dissecting aneurysms. Generally, treatment strategies can be divided into deconstructive (where the parent vessel is sacrificed by occlusion) or reconstructive (preserving flow through the parent vessel) [9].

A recent systematic review on the safety of stenting extracranial CAD found that the procedure is safe and effective. Complications were seen only in 2/153 procedures and did not have clinical significance and no procedure related deaths were seen [10].

Intracranial dissection can lead to SAH, resulting in a more heterogeneous patient population. Reports often include treatment of both CAD with ischemic symptoms as well as patients presenting with SAH. On the basis of a literature search, Mohan reports of 151 patients treated with endovascular therapy for VAD. Of these, stents alone were used in 81 lesions and stents plus coils were used in 89 lesions. There were 8 deaths, 5 strokes and 6 stent occlusions [8].

Nam et al. reported a case series of 26 patients with VAD. Of these, 12 presented with severe headache but no hemorrhage and were treated with different combinations of coiling and stents (including both reconstructive and destructive treatments). Upon follow-up (6–71 months), all 12 patients had recovered with a modified Rankin Scale of 0 [11]. Generally, endovascular treatment of intracranial VAD is considered to carry greater risk, and should therefore be reserved for patients who cannot be managed by medical therapy.

A severe complication of VAD is occlusion of the BA. Recanalization of the BA remains essential for a favorable outcome, with mortalities of 92% in patients failing to achieve this even in addition to intravenous or intra-arterial thrombolytic therapy [6]. The superiority of endovascular treatment for BA occlusion has been disputed by a prospective observational study by Schonewille et al. who found no difference between normal antithrombotic treatment, intravenous thrombolysis and endovascular treatment in patient with BA occlusion [12]. However, only 5% of the BA occlusions in this study were due to dissection. Occlusion of the BA remains a medical emergency requiring acute treatment. Intravascular management should be considered if symptoms progress or fail to resolve.

In our case, stroke symptoms started in immediate continuation of cSMT. Conclusive evidence is lacking for a strong association between cSMT and VAD [13], and the quality, completeness, and consistency of reporting adverse events is essential for future risk assessment [14–16]. Meanwhile, a recent statement from the American Heart Association/American Stroke Association (AHA/ASA) [17] recommend practitioners to both consider the possibility of CAD and inform patients of the statistical association between particularly VAD and cSMT, prior to performing manipulation of the cervical spine.

Conclusions

In the presented case of combined VAD and BA thrombosis, thrombectomy was complicated by difficult intravascular accessibility due to the bilateral VAD. Complete recanalization of the BA was achieved and the patient recovered almost completely. This case underlines the need for a fast diagnostic approach and skillful endovascular procedures to ensure a favorable long-term neurological outcome.

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