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CORRESPONDENCE

Bilateral Vertebral Artery Dissection After Chiropractic Maneuver

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Introduction

There is an established epidemiologic association between chiropractic maneuvers and cervical artery dissection [1, 2]. In spite of clinical evidence, however, proof that spinal manipulative therapy can be the actual cause for dissection is still a matter of debate. It has been argued that chiropractic maneuvers are performed for neck pain that may have been caused by preexisting dissection of a cervical artery, and hence the manipulation may coincide with, rather than cause, the vessel lesion [3–5].

Here, we present the case of a young woman with posterior circulation strokes due to magnetic resonance imaging-(MRI-)proven bilateral vertebral artery dissection. Clinical evidence strongly supports the notion that the dissection occurred during the maneuver, since an MRI scan prior to the manipulation showed a protruded intervertebral disk, and intact cervical vessels.

Case Report

A 33-year-old mother in good previous health was treated with nonopioid analgesics and physiotherapy for lumbar and neck pain for several months by her primary-care provider and an orthopedic practitioner. Cervical MRI revealed a medial cervical disk protrusion at the C6/7 level with vertebral and basilar arteries intact (Fig. 1). Following MRI, an orthopedist and chiropractor performed a rotating abrupt chiropractic maneuver. During this maneuver, the patient felt a snapping sensation in her neck. Immediately after this manipulation, she experienced, for the first time, severe throbbing headache. She went home with no focal neurological deficits. The following day, she collapsed with generalized tonic-clonic seizures. The emergency service found her comatose, but she gradually regained consciousness during helicopter transport to our hospital. Neurological examination on admission revealed no focal signs. There was no tongue bite or enuresis. Electrocardiogram and laboratory examinations were normal. A cranial computed tomography (CT) revealed no abnormalities. The patient was admitted for evaluation of a presumed seizure.

During the following night, she again developed severe nuchal throbbing headaches. Now, nystagmus to the right and right-sided hemiataxia and Babinski's sign were found. Multimodal cranial MRI revealed acute infarctions in the cerebellum and pons on the right, and in the left thalamus and posterior limb of the internal capsule (Fig. 2). Cervical magnetic resonance angiography (MRA) showed bilateral vertebral artery dissections in the V3 segments and progression of the dissection into the V4 segment and the lower basilar artery (Fig. 3). The patient was treated with intravenous heparin. Extensive laboratory tests were performed to rule out other underlying disorders. Extensive screening for vasculitis parameters yielded negative results. On the

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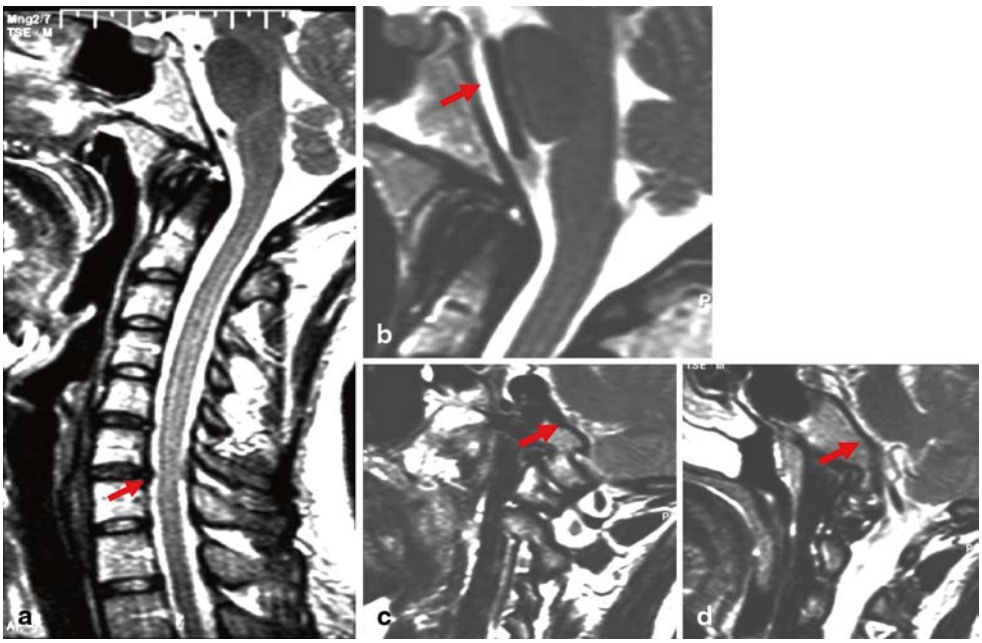

Fig. 1 **a** MRI, T2-weighted midsagittal turbo-spin-echo sequence (*TSE*). Note medial intervertebral disk protrusion at C6/7 level (*arrow*) and—to a lesser extent—at the segment above (C5/6) as the likely cause of the patient's neck pain. **b–d** In the midsagittal and paramedian T2-weighted sequences, arrows indicate the basilar artery (**b**) and left (**c**) and right (**d**) vertebral arteries, respectively. The basilar artery appears to be of thick caliber running parallel to the anterior pontine circumference

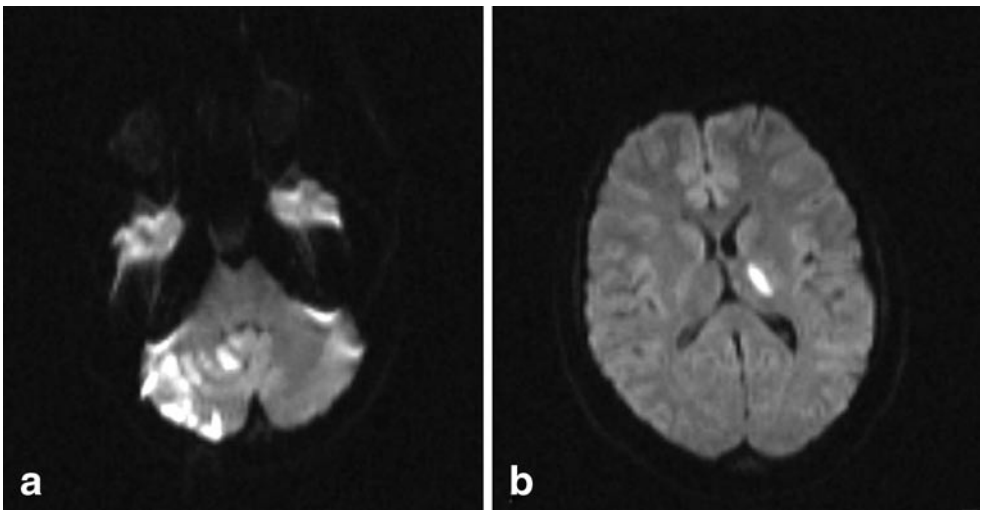

Fig. 2 MRI, diffusion-weighted imaging (DWI) obtained after onset of focal symptoms revealing multiple hyperintense ischemic lesions in the right cerebellar hemisphere (**a**) and the left thalamus and posterior limb of the internal capsule (**b**). These lesions were identified as acute ischemias in corresponding apparent diffusion coefficient (*ADC*) maps (not shown)

3rd night, she further deteriorated with occipital pain and transient loss of consciousness. Thereafter, she remained somnolent but fidgety with repeated right-sided myoclonic movements. Neurological examination now revealed bilateral Babinski's signs and hyperreflexia and follow-up MRI displayed a progression of the pontine lesion (not shown). It took several weeks before she regained full consciousness and alert memory. During rehabilitation, she gradually regained full motor control on her legs, and ataxia improved gradually. Heparin was switched to oral anticoagulation with phenprocoumon. After 3 months, she was able to walk without assistance and to perform most activities of daily living, yet she tired easily during both physical and cognitive tasks. MRA after 6 months showed a residual aneurysm of the left extracranial vertebral artery (Fig. 4). After 3 years she is now symptom-free, except for a slight depressive reaction; her lumbar and neck pain have remitted without specific therapy.

Discussion

Cervical artery dissections account for up to 20% of strokes in patients below the age of 50 years [6]. It may also be a more frequent cause of strokes in the elderly than previously recognized [7]. The annual incidence of vertebral artery dissection is estimated at 2 per 100,000 [1]. Meticulous history taking will often reveal a precipitating trauma such as motor vehicle accidents and sports injuries or sudden neck movements [8]. In nontraumatic dissections, connective tissue abnormalities or lesions can often be found ultrastructurally [9]. The typical course of vertebral artery dissec-

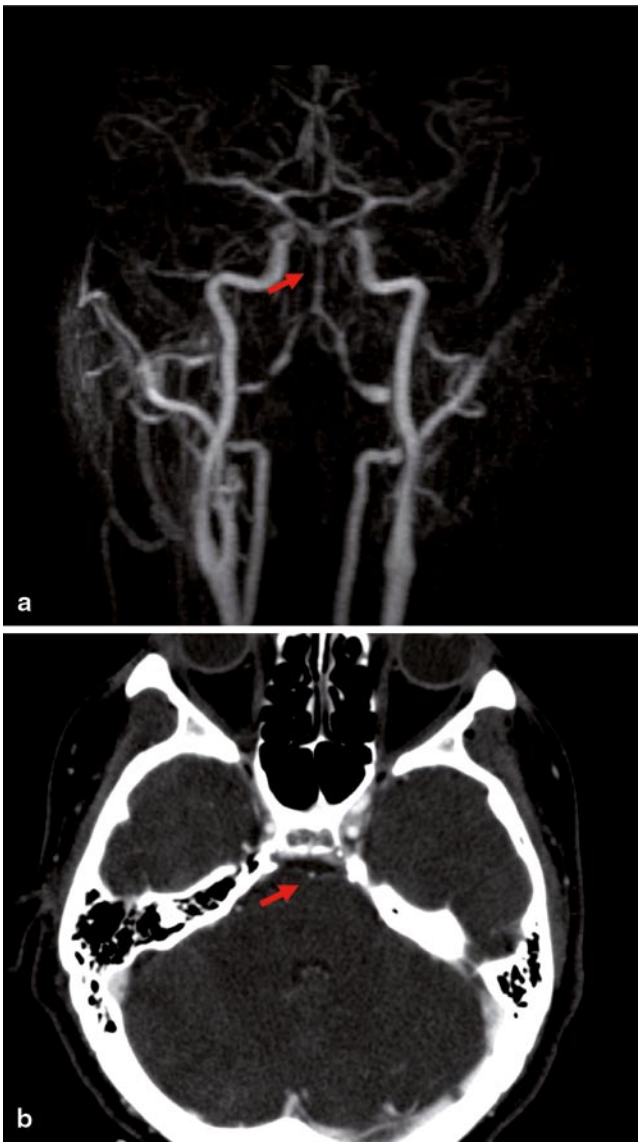

Fig. 3 **a** MRI, time-of-flight (*TOF*) angiogram showing thin-calibered vertebral arteries bilaterally and a slim and irregularly configurated basilar artery as compared with preincidental image (*see* Fig. 1) as an indirect equivalent to dissection. **b** CT angiogram prior to reconstruction at midpontine level depicting a very slim basilar artery. A clear difference in vessel caliber is obvious in comparison to Fig. 1, although different imaging modalities have been applied

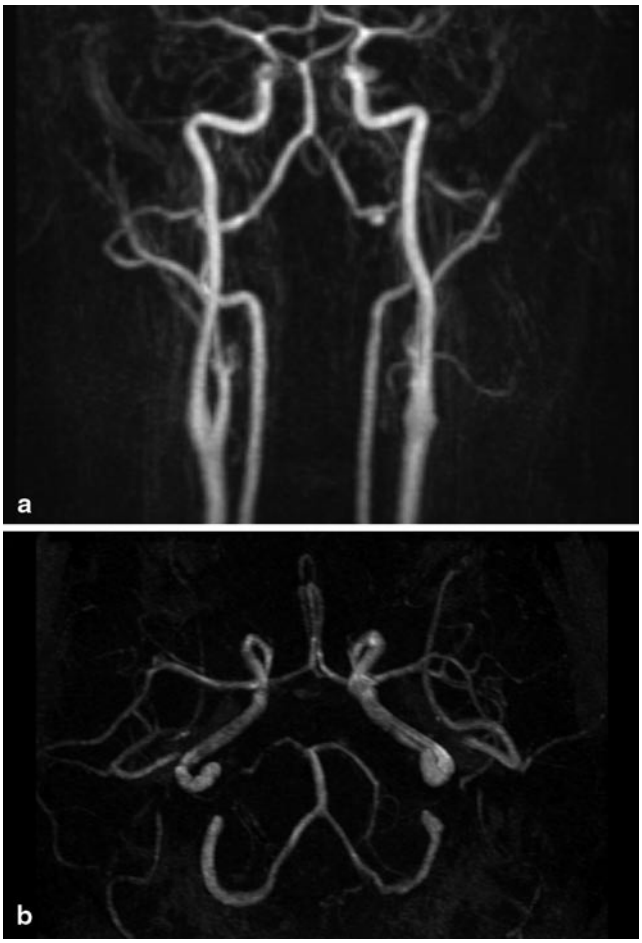

Fig. 4 MR-angiographic follow-up at 6 and 17 months. **a** Residual (pseudo)aneurysm of left extracranial vertebral artery. **b** After 17 months, only a TOF was performed showing normalized vessel status

tion involves vigorous neck pain followed by nonspecific symptoms such as vertigo, tinnitus, or nausea. Neurological deficits may occur hours to days (and up to several weeks) later. Secondary deterioration is frequent and may be ascribed to progression of the dissection or thrombus formation and thromboembolic disease [10, 11]. Ischemia involves the brainstem in 75%, and the cerebellum, diencephalon, and occipital lobe in the remaining patients [10–12]. MRI including fat-suppressed T1 sequences, black-blood MRI and MRA has now replaced digital subtraction angiography (DSA) as the gold standard for diagnosis of cervical artery dissection [11, 12]. However, in vertebral artery dissection sensitivity of MRA is lower than in carotid artery dissection (20% vs. 95%) emphasizing the usefulness of conventional angiography in some cases of vertebral artery dissection where MRA may fail to reveal the dissection. Data on the sensitivity of MRA for detection of cervicocephalic arterial dissection vary considerably between 50% and 100% in comparison to DSA [13]. For diagnosis and follow-up of extracranial internal carotid artery dissections, MRA serves as a noninvasive and reliable method, though.

The pathologic hallmark of dissection is an intramural hematoma showing evolution of signal intensity in repeat MRI with high signal on proton density and T2 and intermediate signal in T1 in the early stage, and high T1 signal thereafter. The detection of extracranial dissection is more challenging due to slow blood flow proximal and distal to the stenosis and the intermediate or high signal of the perivascular structures in this area [12].

An analysis by the Canadian Stroke Consortium found that 28% of strokes following cervical artery dissection were

preceded by chiropractic neck manipulation [8]. Dziewas et al. obtained a similar rate in patients with vertebral artery dissections [14]. Affected patients tend to be young and healthy without vascular risk factors [10]. Women are more often affected than men, especially in bilateral vertebral artery dissection following cervical manipulation [10, 14, 15]. Dissections after chiropractic neck manipulation occur more frequently in the posterior circulation than in the carotid arteries, and usually in the segment near the atlantoaxial joint [8, 10, 16]. Here, the artery leaves its fixed position in the vertebral canal into the free segment at the atlas loop and is prone to mechanical impacts.

While associations of vertebral artery dissections have been described in a number of case reports, direct proof is difficult to obtain due to low absolute numbers that hamper a prospective study [17, 18]. Epidemiologic evidence supporting the notion of the Canadian Stroke Consortium comes from a population-based case-control study [8] that suggests an association of chiropractic manipulation of the neck with vertebral artery dissection in young (< 45 years) patients. The latter are five times more likely than controls to have visited a chiropractor within 1 week and five times more likely to have had three or more visits with a cervical diagnosis in the month before the vertebrobasilar accident.

Gouveia et al. report the predictors of adverse effects of chiropractic in a systematic review: women and those aged 27–46 years, patients undergoing the first treatment session, and patients who have more than one region treated, were more likely to experience adverse side effects. The risk for vertebral artery dissection also depends on the technique of chiropractic, where rotational cervical manipulation bears the highest risk [17].

In a case-control substudy, patients with vertebral artery dissection were found to be more likely to have had spinal manipulative therapy within 30 days (14% vs. 3%). Spinal manipulation and neck or head pain were independently associated with vertebral artery dissection [15]. Moreover, these authors argue that the association is likely causal, since two of the patients analyzed had strokes within seconds after manipulation and most of the dissections (85%) related to manipulation occurred in the vertebral arteries. Yet, it is conceivable that in some of the cases the neck manipulation is just one precipitating factor in a long series of minor traumatic injuries to cervical vessels. Indeed, many forms of everyday trauma have been linked to the risk of cervical artery dissection [19, 20]. By contrast, there are also studies that deny a higher risk of strokes in the posterior circulation associated with chiropractic therapy [21].

Our patient shows all clinical characteristics described for vertebral artery dissection. Dissection likely occurred during the rotating maneuver when she realized sudden neck pain. Delayed onset of posterior circulation compromise with alarming loss of consciousness as a symptom of basilar artery embolism is typical. Vasculitis as a possible differential diagnosis was ruled out by extensive laboratory tests. Further, the clinical course with abrupt symptom onset and gradual improvement in the absence of immunosuppressive treatment does not support the diagnosis of vasculitis. From the past medical history the patient did not have an increased risk for vascular pathologies. Völker et al. found evidence for tissue weakening in specimen taken from the temporal artery in patients with spontaneous dissection of the vertebral arteries [22]. Our case is unique in that premanipulation MRI showing normal vessel anatomy is available. Although the cervical arteries have not been depicted in their entire course, relevant parts are represented that are later affected by the dissection. MRI therefore provides evidence that in this patient, the dissection was not just temporally coincident with the cervical chiropractic maneuver, but was indeed a direct sequel of the procedure.

Estimates on the frequency of dissection following spinal manipulations range from 1 in 20,000 to 1 in 5,846,381 [23, 24]. The study by Rothwell et al. appears to give the best approximation to date and calculated that for every 100,000 persons aged < 45 years receiving chiropractic, 1.3 cases of vertebral artery dissection attributable to the manipulation would occur within 1 week of the manipulation [6]. Even if one considers that neck manipulation may be just one precipitating factor in a long series of minor traumatic injuries to cervical vessels [24], manipulation may still exacerbate a preexisting dissection that is asymptomatic or manifests just with neck pain or dizziness. Numbers may even be much higher, since it is conceivable that manipulation-associated dissections produce only transient symptoms or unrecognized neurological deficits [10].

Most authors agree that no parameters exist that would allow to identify patients at particular risk for developing vertebral artery dissection [15], although associations have been described with young age (< 45 years), female sex, migraine, cigarette smoking, hypercholesterolemia, hyperhomocysteinemia, alcohol consumption, and structural disorders of the arterial wall [9–11, 14, 24, 25].

Conclusion

Present evidence justifies the recommendation that patients be made aware of the risks of cervical spinal manipulation, and give informed consent. In patients with neck pain, MRI should be used more frequently before manipulation. Patients for rotational cervical chiropractic manipulation should be carefully evaluated for their risk of adverse events and for any evidence of vascular vulnerability.

Conflict of Interest Statement The authors declare that there is no actual or potential conflict of interest in relation to this article.

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