Topics in Diagnostic Imaging

Chiropractic Response to a Spontaneous Vertebral Artery Dissection

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Abstract

Objective: The purpose of this case report is to describe a case in which early detection and proper follow-up of spontaneous vertebral artery dissection led to satisfactory outcomes.

Clinical Features: A 34-year old white woman reported to a chiropractic clinic with a constant burning pain at the right side of her neck and shoulder with a limited ability to turn her head from side to side, periods of blurred vision, and muffled hearing. Dizziness, visual and auditory disturbances, and balance difficulty abated within 1 hour of onset and were not present at the time of evaluation. A pain drawing indicated burning pain in the suboccipital area, neck, and upper shoulder on the right and a pins and needles sensation on the dorsal surface of both forearms. Turning her head from side-to-side aggravated the pain, and the application of heat brought temporary relief. The Neck Disability Index score of 44 placed the patient's pain in the most severe category.

Intervention and Outcome: The patient was not treated on the initial visit but was advised of the possibility of a vertebral artery or carotid artery dissection and was recommended to the emergency department for immediate evaluation. The patient declined but later was convinced by her chiropractor to present to the emergency department. A magnetic resonance angiogram of the neck and carotid arteries was performed showing that the left vertebral artery was hypoplastic and appeared to terminate at the left posterior inferior cerebellar artery. There was an abrupt moderately long segment of narrowing involving the right vertebral artery beginning near the junction of the V1 and V2 segments. The radiologist noted a concern regarding right vertebral artery dissection. Symptoms resolved and the patient was cleared of any medications but advised that if symptoms reoccurred she was to go for emergency care immediately.

Conclusion: Recognition and rapid response by the chiropractic physician provided the optimum outcome for this particular patient.

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Introduction

Stroke was the fifth leading cause of death in the United States in 2013.¹ Most vascular diseases, including stroke, “share common risk factors (high blood pressure,

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diabetes, dyslipidemia, and obesity), which can be influenced by modifiable health behaviors such as unhealthy diet, smoking, lack of physical activity, and stress.”² The disruption of blood flow to the brain is also affected by anatomical variations and anomalies, disruption of the arterial intimal lining in the carotid and/or vertebral arteries, and disease resulting in coagulation issues and/or the obstruction of normal hemodynamics. (See Figs. 1– 7.)

Not all patients who experience stroke symptoms face immediate death or disability. The traditional definition of a transient ischemic attack (TIA) is a time-defined temporary blockage of blood flow in the brain that causes brief stroke symptoms. A new definition is a tissue-defined TIA that exhibits an absence of evidence of fresh brain infarction on magnetic resonance imaging (MRI). Such tissue-defined TIAs are considered to be warning signs of more serious strokes in the future. Transient ischemic attack symptoms do not last long. Such symptoms may include weakness on one side of the body, dizziness, blurred vision, confusion, and speech problems.³ As a vascular disease, TIAs share the same risk factors as stroke and can be influenced by modifiable health behaviors.²

Although there is no evidence to support causation, an association between manual cervical spine manipulation and the occurrence of stroke or stroke-like symptoms has been suggested in the medical literature^{4–6} and occasionally mistakenly attributed to chiropractic manual

Fig. 1. Pain drawing indicating burning pain in the area of the right sub-occipital and cervical area and pins and needles sensation on the dorsal surface of both forearms.

Fig. 2. MRA neck image. Three-dimensional dynamic time-resolved contrast-enhanced MRA of the neck reveals abrupt moderate long segment narrowing of the right vertebral artery involving the V2 and distal V1 segments. (Color version of figure appears online.)

manipulation.⁷ Practitioners of manual manipulation of the cervical spine, including chiropractic physicians, osteopathic physicians, qualified medical physicians,

Fig. 3. MRA neck image. Fat suppressed axial T1 weighted imaging of the neck utilizing IDEAL technique (Iterative Decomposition of water and fat with Echo Asymmetry and Least squares estimation) reveals high signal within the wall of the V2 segment of the right vertebral artery compatible with intramural hematoma. (Color version of figure appears online.)

Fig. 4. MRI brain image. Axial MRI of the brain (including diffusion weighted imaging) through the posterior fossa and posterior cerebral artery distribution territory reveals no evidence of acute or subacute infarction.

physical therapists, and any other qualified practitioners must be vigilant for signs of stroke. The early detection, immediate appropriate care, patient education, and short- and long-term follow-ups are key factors in the prevention of undue consequences and potentially tragic outcomes.

The purpose of this case report was to provide an example of how early detection and proper follow-up led to satisfactory outcomes.

Fig. 5. MRI brain image. Axial MRI of the brain (including diffusion weighted imaging) through the posterior fossa and posterior cerebral artery distribution territory reveals no evidence of acute or subacute infarction. (Color version of figure appears online.)

Fig. 6. CT angiography neck image. Curved planar reformatted imaging of the right vertebral artery from CT angiography of the neck performed 3 months after initial imaging reveal near complete resolution of the right vertebral artery narrowing related to arterial dissection.

Case Report

On July 22, 2013, a 34-year-old white woman reported to the office of a chiropractic physician in the

Fig. 7. CT angiography neck image. Curved planar reformatted imaging of the right vertebral artery from CT angiography of the neck performed three months after initial imaging reveal near complete resolution of the right vertebral artery narrowing related to arterial dissection. (Color version of figure appears online.)

Chiropractic Medicine division of the Lehigh Valley Hospital Network (LVHN). The patient worked as an operating room nurse in the same hospital system. The cardiothoracic surgeon whom the patient was working with directly referred her to the chiropractor.

Chief Complaint

The chiropractic physician initially saw the patient at 5 pm. The patient's chief complaint was a constant burning pain in the right side of her neck and shoulder with a limited ability to turn her head from side to side. She also experienced periods of blurred vision and muffled hearing since the onset of symptoms, which began at 9:30 AM on the same day. The immediate onset of symptoms started after she lifted a patient's legs onto the operating table. At the time onset, there was dizziness, spots in her field of vision, and a partial loss of balance that resulted in a walk that listed to the right. There were no nausea nor vomiting. She reported that her dizziness, visual and auditory disturbances, and balance difficulty abated within 1 hour of onset and were not present at the time of evaluation. The patient reported that she had "[taken] some ibuprofen and a little later some valium and left work early." The patient denied any prior symptoms of this nature.

History

There was no family history of any significant disease or condition. She had no known allergies and was taking ethinyl estradiol and levonorgestrel,⁸ for birth control and diazepam⁸ for pain. The patient had never been to a chiropractor prior to this event. The patient reported smoking 2 cigarettes per day, drinking 1 cup of coffee and tea per day and using alcohol "socially." The date of her last menstrual period was July 17 to July 21, 2013, and she stated that she was not pregnant. She had no history of cancer and no significant weight change over the last year. She presented with mild scoliosis in the lumbar and thoracic regions.

Initial Examination

The patient was 5' 10" in height, weighed 145 lb, and had a body mass index of 21, a blood pressure of 118/78, and a pulse rate of 70 beats per minute. Her

walking was normal with no drifting or abnormal gait. Her cervical range of motion exhibited limitations in flexion (40/45), extension (10/30), right lateral flexion (20/40), left lateral flexion (30/40), right rotation (40/80), and left rotation (60/80). Her eyes, ears, nose, throat, and heart were normal.

A cervical compression test was negative for aggravation of the symptoms, cervical distraction decreased the pain, and Spurling test⁹ reproduced the localized neck pain, particularly in the upper right cervical area, but no dizziness occurred. There was no nystagmus. The deep tendon reflexes, sensations, and muscle strengths of the upper extremities were normal. Cranial nerves 2 to 12 were normal. There were no long tract signs. Palpable tenderness, tension, and edema were noted in the upper right cervical region, and mild scoliosis was noted in the lumbar/thoracic region.

The patient had a prior history of mid and low back pain and arm/hand numbness. She reported that transient dizziness, loss of balance, ringing in ears, and blurred vision occurred earlier that day. At the time of the examination, she was still experiencing right-side neck and shoulder area pain, a headache, and neck tension.

On a pain drawing,¹⁰ the patient indicated the presence of burning pain in the sub-occipital area, neck, and upper shoulder on the right and a pins and needles sensation on the dorsal surface of both forearms, although this sensation had subsided on the right. The intensity of the pain ranged from 8 (worse) to 4 (best) and averaged 7 at the time of the clinic visit. Turning the head from side-to-side aggravated the pain, and the application of heat brought temporary relief. The Neck Disability Index¹¹ score of 44 placed the patient's pain in the most severe category. A working diagnosis of *ICD-9* code 723.1 (cervicalgia) and 737.3 (scoliosis) were entered into the patient's record. Based on the patient's age, sudden nontraumatic onset of severe upper neck pain and headache and transient neurological symptoms that included visual and auditory disturbances, dizziness, and mild ataxia, the index of suspicion was raised for the possibility of spontaneous vertebral or carotid artery dissection. These symptoms may also be observed in some patients with migraine headaches and viral infections.

Initial Management

The patient was not treated on the initial visit on the 22nd of July. The chiropractic physician advised her of the possibility that a vertebral artery or carotid artery

dissection caused reduced blood flow to the brain. The patient was provided a recommendation that she attend the Emergency Department (ED) for immediate evaluation. The patient declined, and said she decided to go home and rest. She was urged to go to the ED immediately if any of her neurological symptoms returned, and she was taken home by her husband. She was given a follow-up appointment on the following day for reassessment.

On the July 23, 2013, the patient returned feeling better with only minor right-side upper neck pain without recurrence of the neurologic symptoms. On examination, she exhibited mild tenderness of the right upper cervical area, and Spurling's test reproduced the mild right upper cervical pain. With both subjective and objective improvements, the initial symptoms were thought to have been due to vasovagal effect, and the continuing neck pain was likely mechanical/myofascial in nature. Treatment consisted of myofascial release and mild distraction and mobilization techniques, which provided some relief. Again, she was advised to go directly to the ED if any of her previous symptoms reoccurred. She was scheduled for another follow-up 2 days later.

On July 24, 2013, the chiropractic physician sent a report to the referring cardiothoracic surgeon and a copy to her primary care physician (PCP) that outlined his findings, diagnostic suspicions, and patient management plan.

The patient returned to the chiropractic physician on July 25, 2013. She continued to complain of pain of varying intensity in the right upper cervical area. She denied the return of dizziness, sensory problems, visual/auditory disturbances, or coordination difficulties but stated that she simply did not feel right. On renewed suspicion of vertebral or carotid artery dissection, the chiropractic physician ordered an MRI and magnetic resonance angiography (MRA) of the brain and MRA of the vertebral and carotid arteries at the hospital's Imaging Center, due to the acute onset of the right neck and head pain with transient dizziness and visual, auditory, and balance disturbances to rule out arterial dissection.

On July 25, 2013, at 8 PM, the patient reported to the LVHN Imaging Center. An MRA of the neck and carotid arteries was obtained using 3D time-of-flight and gadolinium-enhanced imaging. The common carotid and cervical internal carotid arteries were normal. The left vertebral artery was hypoplastic and appeared to terminate at the left posterior inferior cerebellar artery. There was an abrupt moderately long segment of narrowing involving the right vertebral

artery beginning near the junction of the V1 and V2 segments. The radiologist noted a concern regarding right vertebral artery dissection.

Images of the brain using MR sagittal T1, axial T2, axial FLAIR, axial fiesta, axial T1, axial SWI, and axial diffusion and post-contrast axial SPRG resulted in the impression of a normal brain scan with no masses, intracranial hemorrhages, or acute infarcts. An MRA of the head also failed to exhibit any abnormal findings.

The radiologist called the chiropractic physician at approximately 11 PM to inform him of these findings. The patient was put on the phone, and the chiropractic physician instructed her to go immediately to the ED. The chiropractic physician phoned the ED in advance to advise the attending physician of her arrival.

At 11:26 PM on July 25, the patient went directly from the hospital imaging center to the emergency department and was admitted. The ED record noted the following: "Patient presented to the chiropractor with upper neck pain and some neurological symptoms... 3 days ago. The chiropractor advised her to go to the ED that day, but the patient declined (because she felt her symptoms were improving)." The record also noted that "on Monday afternoon, saw chiropractor, but did no manipulations." At 12:12 AM on July 26, she spoke with the neurologist on call who recommended a computed tomographic (CT) angiogram to confirm the vertebral artery dissection (VAD) and gave low-dose aspirin for blood thinning. At 3:10 AM on July 26, a CT angiogram was completed. A right VAD was confirmed. The patient was discharged from the hospital on July 26 to follow up with her PCP.

Post Imaging Follow-Up

The patient reported to her PCP on the August 1, 2013, for a follow-up visit after her release from the Emergency Department on July 26. The patient reported that the initial symptoms had subsided with the exceptions of the headache and neck pain. The remaining examinations and historical findings were not different from those entered into the record by the chiropractic physician on July 22, 2013, and are thus not repeated. A neurological consultation was scheduled for September 4, and daily aspirin was prescribed.

On August 15, 2013, the patient returned to the LVHN Family Practice Department for a routine follow-up visit. She reported significant improvement in all symptoms and no headaches. With her improved symptom picture, Percocet, and ibuprofen were

removed from her medication list. Future appointments were to be scheduled on an “as needed” basis.

The patient was seen on September 5, 2013, in the Neurology Department. The patient was reported to be stable with no brain infarct due to the VAD that seemed to occur with no clear cause. The daily use of 81 mg of aspirin was continued. A follow-up CT angiogram was scheduled for the October 28 at which time the right vertebral artery appeared normal with minimal residual circumferential narrowing at C5-C6 and in the distal V2 segment that was indicative of the previous dissection.

A final visit to the Neurology Department on November 11, 2013, revealed that all of the problems had resolved. The patient was taken off all medication with the exception of the continued daily use of aspirin and discharged with instructions to return if the symptoms reappeared. The patient provided consent for the publication of this case.

Discussion

The overall incidence of VAD is approximately 1 to 1.5 per 100 000.¹² Although some claim that there is an association of manipulation of the neck with VAD, a direct causal connection has not been established.^{13,14} The estimates and literature relating vascular accidents and chiropractic manipulation have been questioned.¹⁵ Evidence suggests that the majority of strokes related to vertebral or carotid artery dissection may be spontaneous in susceptible individuals.⁷ The common initial symptoms of neck pain and headache entice patients to seek professional attention from health care providers, including medical doctors and chiropractic physicians.^{16,17} Cassidy et al performed a study and found that patients who seek clinical care for neck pain and headache (chiropractic or medical) and subsequently experience stroke are likely experiencing an arterial dissection before any treatment is rendered.^{18,19} Additional analysis of this study revealed that the patients who consulted a chiropractor in the year before their strokes tended to be older, had one cardiac risk factor or comorbidity, and that women were more commonly affected than men.²⁰

Blood passing from the lumen of the artery into the layers of the arterial wall is considered a dissection. The accumulation of blood in the arterial wall can narrow the lumen and potentially occlude arterial blood flow to distal points.²¹ While arterial dissections may spontaneously occur, the risk factors contributing to the dissection include hypertension, diabetes mellitus,

smoking, hyperlipidemia, oral contraception, and connective tissue disorders.²² An arterial occlusion may be transient (TIA) or progress to a stroke with attendant cardiac or cerebral manifestations. A person with a transient occlusion may present with neck pain or suboccipital headache²³ and upper limb radiculopathy.²⁴

Prior to the case published by Maddox et al,¹⁶ only 1 case of an undiagnosed arterial dissection presenting to a chiropractor had been published.²⁵ The present case is the third published VAD case involving a patient who presented to a chiropractic physician with symptoms of neck pain and headache. This particular case is unique in that the chiropractic physician, the patient, the referring physician, and the radiological and neurological consults were all employed in the same hospital system. Consequently, expedient access, the flow of patient information between the providers, and the successes of the consultations and follow-up care were well managed and contributed to the positive outcome experienced by the patient. Such collaborative care appears to serve the needs of patients in an effective and efficient manner.

Vascular deficiencies can and do occur spontaneously and are occasionally associated with neck movement and the application of external mechanical forces to the neck. Such deficiencies are not limited to any particular age group, gender, or race, although they are believed to be more common in females. Common risk factors include high blood pressure, smoking, diabetes, dyslipidemia, birth control, and obesity.

People who experience neck pain and headaches may seek relief via either pharmacological or conservative manual procedure(s). The intent of this case report is not to extend the debate regarding the role of and/or potential risks associated with cervical spinal manipulation regardless of the type of provider performing the procedure. Rather, it is hoped this case report will accentuate the importance of the early recognition of classic symptoms associated with vascular deficiency in the brain when possible regardless of the causal factor.

Practitioners should be aware of the classic symptom picture of pain, dizziness, headache, visual and hearing disturbances, sensory disturbances, loss of balance, and nausea. When a vascular deficiency is suspected, immediate appropriate action is required. The action items include the following: (1) the withholding of manipulative procedures of the neck, (2) advanced imaging (MR and CT), (3) neurological consultation, and (4) pharmaceutical support. The goal is to prevent exacerbation and avoid progression of a developing

and potentially serious condition. We suggest that this case be considered as an example of an appropriate course of care.

Limitations

While this particular patient had a spontaneous vertebral artery dissection, not all cases with a similar signs or symptoms will result in similar diagnoses, and some positive cases may exhibit asymptomatic presentations. Nevertheless, when patients present with symptoms that are suggestive of a possible cerebral vascular event, caution in providing manipulative care seems advisable until the vascular disruption has been ruled out through proper examination procedures. This procedure may be construed as an error on the side of excessive caution or defensive medicine that requires unnecessary costly additional procedures and patient anxiety, but in the opinions of the authors, the potential for significant adverse results justifies these actions.

Conclusion

This case exemplifies a symptom picture of a potential vascular deficiency problem to the brain. Presentation of the classic symptom picture of pain, dizziness, headache, visual and hearing disturbances, sensory disturbances, loss of balance, and nausea requires immediate appropriate actions such as withholding manipulative procedures of the neck, advanced imaging (MR and CT), neurological consultation, and pharmaceutical support. Recognition and rapid response by the chiropractic physician provided the optimum outcome for this particular patient.

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No funding sources or conflicts of interest were reported for this study.

References

1. Kochanek KD, Murphy SL, Xu J, Arias E. Mortality in the United States, 2013. *NCHS Data Brief* 2014;178:1–8.
2. O'Neill BJ, Rana SN, Bowman V. An integrated approach for vascular health: a call to action. *Can J Cardiol* 2015;31(1):99–102, <http://dx.doi.org/10.1016/j.cjca.2014.10.034> [Epub 2014 Nov 6].
3. Hayashi T, Kato Y, Nagoya H, et al. Prediction of ischemic stroke in patients with tissue-defined transient ischemic attack. *J Stroke Cerebrovasc Dis* 2014;23(6):1368–73.
4. Jones J, Jones C, Nugent K. Vertebral artery dissection after a chiropractor neck manipulation. *Proc (Bayl Univ Med Cent)* 2015;28(1):88–90.
5. Haynes MJ, Vincent K, Fischhoff C, Bremner AP, Lanlo O, Hankey GJ. Assessing the risk of stroke from neck manipulation: a systematic review. *Int J Clin Pract* 2012;66(10):940–7, <http://dx.doi.org/10.1111/j.1742-1241.2012.03004.x>.
6. Albuquerque FC, Hu YC, Dashti SR, et al. Craniocervical arterial dissections as sequelae of chiropractic manipulation: patterns of injury and management. *J Neurosurg* 2011;115(6):1197–205, <http://dx.doi.org/10.3171/2011.8.JNS111212> [Epub 2011 Sep 16].
7. Cassidy JD, Boyle E, Côté P, et al. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. *Spine (Phila Pa 1976)* 2008;33(4 Suppl):S176–83, <http://dx.doi.org/10.1097/BRS.0b013e3181644600>.
8. PDR Staff. *Physician desk reference* 68 ed. ; 2014 [Montvale, NJ].
9. Evans RC. *Illustrated essentials in orthopedic physical assessment*. St. Louis: Mosby/Elsevier; 1994:62–3.
10. Jamison RN, Fanciullo GJ, Baird JC. Usefulness of pain drawings in identifying real or imagined pain: accuracy of pain professionals, nonprofessionals, and a decision model. *J Pain* 2004;5(9):476–82.
11. Langenfeld A, Humphreys BK, de Bie RA, Swanenburg J. Effect of manual versus mechanically assisted manipulations of the thoracic spine in neck pain patients: study protocol of a randomized controlled trial. *Trials* 2015;16:233.
12. Bogousslavsky J, Regli F. Ischemic stroke in adults younger than 30 years of age. Cause and prognosis. *Arch Neurol* 1987;44:479–82.
13. Hufnagel A, Hammers A, Schonle PW, Bohm KD, Leonhardt G. Stroke following chiropractic manipulation of the cervical spine. *J Neurol* 1999;246:683–8.
14. American Heart Association/American Stroke Association Scientific Statement. Neck manipulation may be associated with stroke. August 07, 2014 categories: stroke news statement highlights; 2014.
15. Wynd S, Westaway M, Vohra S, Kawchuk G. The quality of reports on cervical arterial dissection following cervical spinal manipulation. *PLoS One* 2013;8(3):e59170.
16. Mattox R, Smith LW, Kettner NW. Recognition of spontaneous vertebral artery dissection preempting spinal manipulative therapy: A patient presenting with neck pain and headache for chiropractic care. *J Chiro Med* 2014;13(2):90–5.
17. Kosloff TM, Elton D, Tao J, Bannister WM. Chiropractic care and the risk of vertebrobasilar stroke: results of a case-control study in U.S. commercial and Medicare Advantage populations. *Chiropr Man Ther* 2015;23:19.
18. Cassidy JD, Boyle E, Cote P, et al. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. *Spine* 2008;33(4 Suppl):S176–83.

19. Cassidy JD, Boyle E, Cote P, et al. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. *J Manipulative Physiol Ther* 2009;32(2 Suppl):S201–8.
20. Choi S, Boyle E, Cote P, Cassidy JD. A population based case-series of Ontario patients who develop a vertebrobasilar artery stroke after seeing a chiropractor. *J Manipulative Physiol Ther* 2011;34(1):15–22.
21. Flis CM, Jager HR, Sidhu PS. Carotid and vertebral artery dissections: clinical aspects, imaging features and endovascular treatment. *Eur Radiol* 2007;17(3):820–34.
22. Rubenstein SM, Peerdeman SM, van Tulder MW, Riphagen I, Haldeman S. A Systematic review of the risk factors for cervical artery dissection. *Stroke* 2005;36(7):1575–80.
23. Redekop GJ. Extracranial carotid and vertebral artery dissection: a review. *Can J Neurol Sci* 2008;35(2):146–52.
24. Silbert BI, Khangure M, Silbert PL. Vertebral artery dissection as a cause of cervical radiculopathy. *Asian Spine J* 2013;7(4):335–8.
25. Mosby JS, Duray SM. Vertebral artery dissection in a patient practicing self-manipulation: the effect of referral bias. *J Chiropr Med* 2011;10(4):283–7.