Available online at www.sciencedirect.com
ScienceDirect
Manual Therapy 13 (2008) 367–371
MANUAL THERAPY
www.elsevier.com/locate/math

Case report

Positive patient outcome after manual cervical spine management despite a positive vertebral artery test

Eric G. Johnson[a,*], Rob Landel[b], Randall S. Kusunose[c], Tetiana D. Appel[a]

[a]Department of Physical Therapy, Loma Linda University, School of Allied Health Professions, Loma Linda CA, 92350, USA
[b]Department of Biokinesiology and Physical Therapy at the School of Dentistry, University of Southern California, Los Angeles, CA, USA
[c]The Jones Institute, Carlsbad, CA, USA

Received 7 June 2007; received in revised form 21 November 2007; accepted 6 December 2007

1. Introduction

Dizziness is one of the most common symptoms reported to physicians and approximately 40% of adults experience clinically significant dizziness during their lifetime (Sloane, 1989; Koziol-McLain et al., 1991; Dallara et al., 1994; Furman and Cass, 1996; Schubert, 2007). The pathology responsible for the dizziness impairment is often difficult to determine (Furman and Cass, 1996). Vertebrobasilar insufficiency (VBI) has been described in the literature as a pathology that frequently produces dizziness (Williams and Wilson, 1962; Grad and Baloh, 1989; Clendaniel and Landel, 2007; Schubert, 2007). VBI is defined as an occlusion of blood flow during cervical rotation or extension in the "area of junction for the vertebral and basilar arteries" (O'Sullivan and Schmitz, 2007). Physical therapists use the vertebral artery test (VAT) to assess patient tolerance to cervical extension and rotation as well as for screening for VBI. The VAT involves placing the patient into cervical extension, rotation, or combined extension and rotation (cervical quadrant), sustaining the position for 10 s or more, and assessing for signs or symptoms (Magee, 2002; Clendaniel and Landel, 2007). Signs and symptoms associated with VBI include dizziness, vertigo, syncope, headaches, imbalance, nausea, vomiting, visual disturbances, dysarthria, sensory changes, disorientation, and extremity weakness (Grad and Baloh 1989; Baloh and Honrubia, 1990). The VAT has become standard clinical practice even though there is considerable controversy as to whether or not clinical tests purported to screen for the presence of VBI identify those at risk for vertebral artery dissection (Cote et al., 1996; Licht et al., 2000; Haldeman et al., 2002; Childs et al., 2005). Although cases of true VBI are exceedingly rare, ignoring the suspicion that a patient has VBI risks causing a catastrophic injury (Haldeman et al., 1999; Furman and Whitney, 2000). There are several diagnostic tests for vertebral artery occlusion including magnetic resonance angiography (MRA) and computed tomography scan. However, the duplex doppler ultrasound appears to be the most widely used due to its accessibility and cost-effectiveness for patients and health providers (Licht et al., 1998, 2000; Rivett and Milburn, 1999; Barker et al., 2000; Haynes, 2002; Mitchell, 2003).

Research suggests that coupled cervical spine rotation and extension decreases the blood flow of the contralateral vertebral artery (Licht et al., 1998, 1999; Rivett and Milburn, 1999; Yi-Kai et al., 1999; Mitchell, 2003; Arnold et al., 2004). Licht et al. (1999), in their study on vertebral artery volume flow, stated "During rotation, the ipsilateral atlantoaxial joint is fixed, but the contralateral joint slides forward and down. This causes the vertebral artery to stretch, kink, and narrow because it is fixed in the surrounding transverse foramina, paravertebral muscles, and fibrous ligaments." The authors further state that they have observed such narrowing in diagnostic tests of vertebral artery blood flow. This finding, however, is not universally accepted

*Corresponding author. Tel.: +1 909 558 4632x47471; fax: +1 909 558 4291.
E-mail address: ejohnson@llu.edu (E.G. Johnson).

1356-689X/$ - see front matter
doi:10.1016/j.math.2007.12.001

in the literature and there is evidence that suggests vertebral artery blood flow is not decreased as the result of cervical spine position (Cote et al., 1996).

Muscle imbalances leading to painful trigger points could potentially produce symptoms similar to those of VBI. Muscle balance is "a state of equilibrium that exists when there is a balance of strength of opposing muscles acting on a joint, providing ideal alignment for movement and optimal stabilization" (Kendall and McCreary, 1993). Simons et al. (1999) reported that trigger points located in the sternocleidomastoid muscle (SCM), and/or upper trapezius can elicit symptoms of dizziness, nausea, spatial disorientation and syncope, particularly if the trigger points are severe and placed on sudden stretch, such as head rotation.

2. Case description

2.1. Examination

The patient was a 24-year-old female with a one-year history of dizziness provoked by left cervical rotation. The dizziness was described as a feeling of anxiety and difficulty communicating. She reported no mechanism of injury and was otherwise healthy. Because the primary complaint was dizziness with cervical rotation, the examiner performed the VAT as described by Schubert (2007). This version of the VAT combines cervical spine rotation and extension with the patient in the seated position to minimize disruption of the semicircular canals (Fig. 1). This was an important consideration in the event her dizziness was being caused by benign paroxysmal positional vertigo (BPPV). The Hallpike–Dix test is used to assess for the presence of BPPV and because of it's similarities to the supine version of the VAT, the clinician would not be able to determine whether symptoms of dizziness were due to VBI or BPPV (Appendix 1). For a detailed description of BPPV and the Hallpike–Dix test the reader is referred to Herdman (2007). The VAT was negative when performed to the patient's right but when performed to patient's left, it provoked the patient's dizziness and slowed verbal responses to questions were observed. The VAT was therefore judged to be positive. The patient was referred to her physician for further evaluation, and subsequently underwent a duplex doppler ultrasound. The findings from this test indicated that there was no evidence of any significant stenosis in the bilateral common carotid, internal carotid, external carotid, or vertebral arteries. Given the negative radiology report, further investigation for a mechanical cause of the symptoms was deemed appropriate and of minimal risk. A palpatory examination of the muscles in the upper quarter region identified several tender points bilaterally including the upper trapezius, SCM, levator scapulae, and anterior scalene muscles.

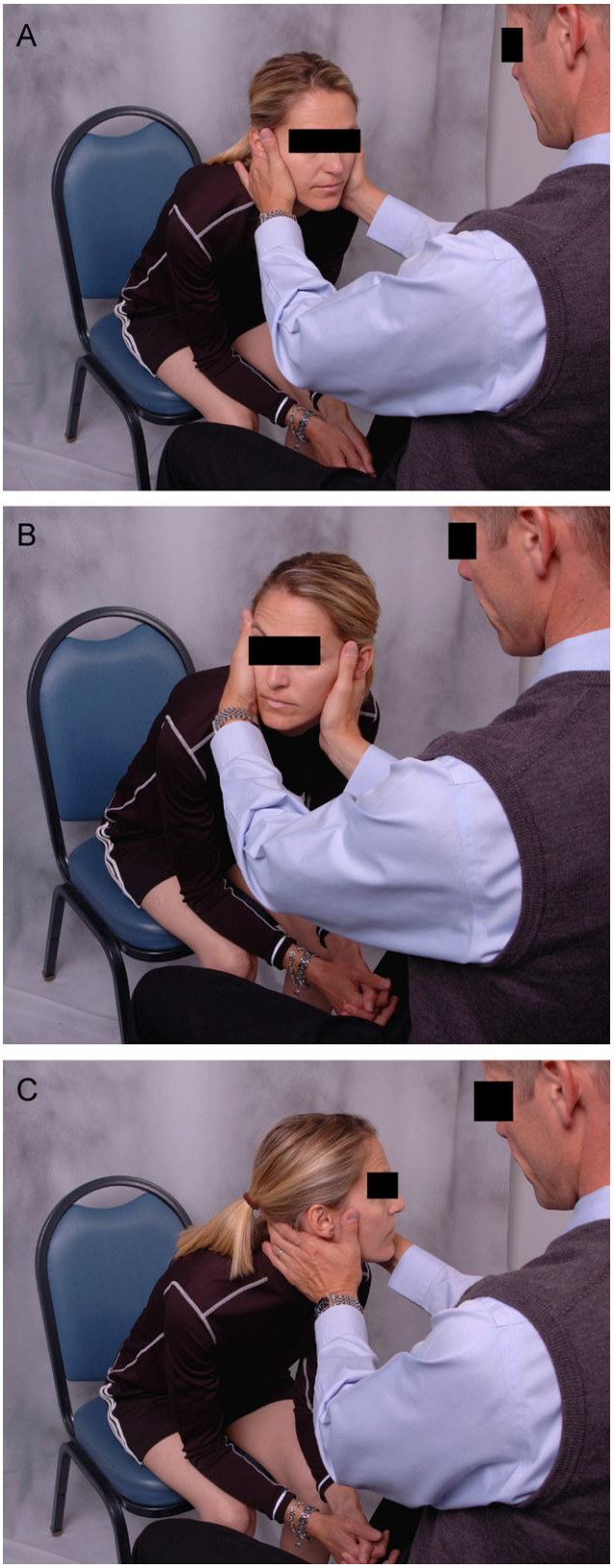

Fig. 1. Seated VAT position 1 (A), position 2 (B), position 3 (C). (A model was used for photographs).

Fig. 1. (*Continued*)

2.2. Interventions and outcomes

Strain-counterstrain (SCS) techniques were performed to the bilateral upper trapezius, levator scapulae, anterior scalenes, and SCM muscles based on the palpatory examination. Three principles common to all SCS techniques include the following: (1) passively moving the affected joint into its position of greatest comfort, (2) maintaining the position for ninety seconds, and (3) returning the patient slowly back to neutral avoiding any sudden return (Jones et al., 1995). SCS is defined as the "relief of rheumatic pain by placing a joint in its position of greatest comfort" (Jones et al., 1995; Lewis and Flynn, 2001). The dysfunction of proprioceptive reflexes is thought to result in false messages of strain causing a protective muscle spasm. Relief of these false messages of strain can potentially be achieved by applying strain in the opposite direction. This is accomplished by shortening the muscle that contains the false message of strain to the point that it stops reporting strain, for a period of ninety seconds (Kusunose, 1993; Jones et al., 1995). When a muscle is shortened, it places the muscle spindle on slack and decreases the afferent discharge of information to the central nervous system, thereby relieving the muscle spasm and improving joint range (Kusunose, 1993; Jones et al., 1995). For a detailed description of SCS, the reader is referred to Jones et al. (1995). There was no other intervention administered. The patient was tested with VAT again after several weeks and again one-year later and the VAT remained negative.

3. Discussion

Despite the fact that dizziness is a common complaint of patients, differential diagnosis of dizziness can be extremely challenging for both the physician and the physical therapist (Furman and Cass, 1996). The purpose of this case study was to describe the diagnosis and management of a patient who had a positive VAT but a negative doppler ultrasound examination. Complaints of dizziness can be the result of more than one pathology, requiring the clinician to generate a list of hypothetical causes. Because of a history of dizziness provoked by sustained cervical rotation, VBI, cervical muscular disorder and BPPV were included as potential contributory pathologies. The examination strategy included performing the VAT first because of the potential severity of complications due to compromised cerebral blood flow and dissecting aneurysms. Based on a positive VAT, physical therapy was deemed to be inappropriate at that time, and the patient was referred to a radiologist for a diagnostic vascular evaluation.

Despite a positive VAT, having a negative duplex doppler ultrasound is not a surprising finding. The findings in our patient case are similar to those reported by Licht et al. (2000) who found that none of the 15 patients they studied, referred for evaluation of vertebral artery flow velocity because of symptoms produced during premanipulative testing, had significant decrease in blood flow in any of the head positions tested. There is evidence that the VAT has a sensitivity of 0% and a positive predictive value of 0% for detecting decreased vertebral artery blood flow (Cote et al., 1996). Others

have reported similar concerns about the usefulness of the VAT as a screening tool (Haldeman et al., 2002; Childs et al., 2005). On the contrary, Asavaopon et al versus Asavasopon and Jankoski (2005) identified a positive VBI using the VAT and their test result was confirmed via duplex doppler ultrasonography and MRA. Arnold et al. (2004) also reported that the doppler ultrasound was able to detect blood flow reductions during the VAT in a prospective study of 22 men and women.

Since the patient denied any spinning sensation in her history, BPPV was deemed unlikely. With VBI ruled out based on duplex doppler ultrasound, the physical therapist next investigated the possibility of a muscular disorder in the cervical region as the primary pathology. The palpatory examination of the upper quarter musculature revealed several tender points in the bilateral cervical spine region, which supported the hypothesis.

The goal was for the patient to be symptom-free while turning her head to the left. The next step was to formulate a plan for determining testing criteria and for assessing the status of the problems and goals. The testing criterion used to examine the validity of the hypothesis was re-evaluating the results of the VAT. The therapist was then able to plan an intervention strategy based on the hypothesis and indicate how the intervention would be implemented. The treatment tactics implemented were SCS techniques to the bilateral upper trapezius, levator scapulae, anterior scalenes, and SCM muscles. Because her initial complaint was dizziness with active range of motion (AROM) of left cervical spine rotation, post-intervention re-assessment included AROM of left cervical spine rotation. The result of this AROM test was negative. Subsequently, the VAT was performed and it was negative as well.

Licht et al. (2000) reported on patients who have had a positive VAT but normal vertebral artery sonography, and who were subsequently treated with spinal manipulation with resolution of their symptoms. To our knowledge there are no reports of improvement of dizziness in the extension-rotation position after treatment of the cervical soft tissues. The scientific theory underlying the SCS technique is that dysfunction of proprioceptive reflexes results in a false message of strain causing a protective muscle spasm (Jones et al., 1995). Restoration of normal muscle balance by resolving the reflexive dysfunction could theoretically reduce the mechanical compression on the arterial structures during the clinical VBI test. A case study by Lewis and Flynn (2001) reported that two to three sessions of SCS resolved "aberrant neuromuscular activity" in four patients with lower back pain. No evidence exists to support using these techniques in the cervical spine other than clinical anecdotes. The decision to use these techniques in this case was based on the therapist's level of expertise and clinical experience.

Another possible etiology leading to symptoms similar to those of VBI is mechanical deformation of baroreceptors in the carotid artery. Baroreceptors detect mechanical deformations that occur in vascular walls and regulate them by opening or closing ion channels. These channels send signals to the control mechanisms that determine the appropriate changes needed for the change in pressure (Guyton, 1971). Wijetunga and Schatz (2005) reported that in patients with carotid sinus hypersensitivity (CSH), "mechanical deformation of the carotid sinus (located at the bifurcation of the common carotid artery) leads to an exaggerated response with bradycardia or vasodilatation, resulting in dizziness or syncope." In the human body, the carotid artery runs parallel to the jugular vein. These vessels are fairly superficial with the omohyoid and SCM, respectively, crossing just above the bifurcation of the common internal/external carotid arteries (Netter and Hansen, 2003). If the VBI test is performed on a patient with a muscle imbalance in the cervical region and CSH, it is plausible that the testing position could exaggerate the physical compression on the arterial structures, stimulating the baroreflex, thereby provoking symptoms including dizziness.

This case demonstrates that signs and symptoms found upon positioning the patient in cervical extension and rotation, which would classically be attributed to VBI, were likely due to non-vascular causes. The specific etiology of the signs and symptoms elicited by the VAT remains unclear and warrants further investigation in controlled studies. Based on the response to manual intervention directed at the cervical soft tissues, it seems clear that non-vascular causes must be considered. The cause and effect relationship between the cervical soft tissues and the symptoms needs further study.

Financial disclosure and conflict of interest

All the authors confirm that here are no conflicts of interest or financial benefits associated with the writing and publication of this paper.

Acknowledgement

Work attributed to: Loma Linda University, Department of Physical Therapy.

Appendix 1. A brief description of the Hallpike–Dix test

The Hallpike–Dix test is used to identify BPPV. BPPV is a condition where patients experience episodes of dizziness, or vertigo, particularly after position changes affecting the head and neck. The Hallpike–Dix test is performed by having the patient long-sit on a plinth with their head rotated approximately 30-45 degrees (A). The examiner stands behind the patient

with one hand supporting their head/neck and other supporting their trunk (B). The patient is then assisted into a supine position with the patient's head slightly below the horizontal plane and the position is maintained for 30–60 s (C). The Hallpike–Dix test is performed on both sides and provocation of dizziness and nystagmus (involuntary eye movement) is considered a positive test. (A model was used for photographs).

References

Arnold C, Bourassa R, Langer T, Stoneham G. Doppler studies evaluating the effect of a physical therapy screening protocol on vertebral artery blood flow. Manual Therapy 2004;9(1):13–21.

Asavasopon S, Jankoski J. Godges JJ. Clinical diagnosis of vertebrobasilar insufficiency: residents case problem. Journal of Sports Physical Therapy 2005;35(10):645–50.

Baloh RW, Honrubia V. Clinical Neurophysiology of the Vestibular System. 2nd ed. F.A. Davis Company; 1990.

Barker S, Kesson M, Ashmore J, Turner G, Conway J, Stevens D. Guidance for pre-manipulative testing of the cervical spine. Manual Therapy 2000;5(1):37–40.

Childs JD, Flynn TW, Fritz JM, Piva SR, Whitman JM, Wainner RS, et al. Screening for Vertebrobasilar Insufficiency in Patients with Neck Pain: Manual Therapy Decision-Making in the Presence of Uncertainty. Journal of Orthopedic Sports Physical Therapy 2005;35(5):300–6.

Clendaniel RA, Landel R. Non-vestibular Diagnosis and Imbalance: Cervicogenic Dizziness. In: Herdman SJ, editor. Vestibular Rehabilitation. 3rd ed. Philadelphia, PA: F.A. Davis Company; 2007. p. 475–6 [chapter 29].

Cote PB, Kreitz G, Cassidy JD, Thiel H. The validity of the extension-rotation test as a clinical screening procedure before neck manipulation: a secondary analysis. Journal of Manipulative and Physiological Therapeutics 1996;19(3):159–64.

Dallara J, Lee C, McIntosh L, Sloane PD, Morris D. Emergency department length-of-stay and illness severity in dizzy and chest-pain patients. American Journal of Emergency Medicine 1994;12(4):421–4.

Furman JM, Cass SP. Balance Disorders: A Case-Study Approach. Philadelphia, PA: F.A. Davis Company; 1996 preface, p. iii.

Furman JM, Whitney SL. Central causes of dizziness. Physical Therapy 2000;80(2):179–87.

Grad A, Baloh RW. Vertigo of vascular origin: Clinical and ENG features in 84 cases. Archives of Neurology 1989;46(3):281–4.

Guyton AC. Textbook of Medical Physiology, 4th ed. W.B. Saunders Company; 1971.

Haldeman S, Kohlbeck FJ, McGregor M. Stroke, cerebral artery dissection, and cervical spine manipulation therapy. Journal of Neurology 2002;249(8):1098–104.

Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebrobasilar artery dissection after cervical trauma and spinal manipulation. Spine 1999;24(8):785–94.

Haynes MJ. Vertebral arteries and cervical movement: Doppler ultrasound velocimetry for screening before manipulation. Journal of Manipulative and Physiological Therapeutics 2002;25(9):556–67.

Herdman SJ. Vestibular Rehabilitation. 3rd ed. Philadelphia PA: F.A. Davis; 2007.

Jones LH, Kusunose R, Goering E. Jones Strain-Counterstrain. Boise, ID: Jones Strain-Counterstrain; 1995.

Kendall FP, McCreary EK. Provance PG: Muscles Testing and Function, 4th ed. Baltimore: Williams & Wilkins; 1993 [chapter 1, p. 3].

Koziol-McLain J, Lowenstein SR, Fuller B. Orthostatic vital signs in emergency department patients. Annals of Emergency Medicine 1991;20(6):606–10.

Kusunose R. Strain and Counterstrain. In: Basmajian JV, Nyberg R, editors. Rational Manual Therapies. Baltimore: Williams and Wilkins; 1993. p. 323–33.

Lewis C, Flynn TW. The use of strain-counterstrain in the treatment of patients with low back pain. The Journal of Manual and Manipulative Therapy 2001;9(2):92–8.

Licht PB, Christensen HW, Hoilund-Carlsen PF. Vertebral artery volume flow in human beings. Journal of Manipulative and Physiological Therapeutics 1999;22(6):363–7.

Licht PB, Christensen HW, Hoilund-Carlsen PF. Is there a role for premanipulative testing before cervical manipulation? Journal of Manipulative and Physiological Therapeutics 2000;23(3):175–9.

Licht PB, Christensen HW, Hojgaard P, Hoilund-Carlsen PF. Triplex ultrasound of vertebral artery flow during cervical rotation. Journal of Manipulative and Physiological Therapeutics 1998;21(1):27–31.

Magee DJ. Orthopedic Physical Assessment, 4th ed. USA: Elsevier Sciences; 2002 [chapter 3, p. 152–156].

Mitchell JA. Changes in vertebral artery blood flow following normal rotation of the cervical spine. Journal of Manipulative and Physiological Therapeutics 2003;26(6):347–51.

Netter FH, Hansen JT. Atlas of Human Anatomy. 3rd ed. R.R. Donnelly; 2003.

O'Sullivan SB, Schmitz TJ. Physical Rehabilitation: Assessment and Treatment, 5th ed. Philadelphia: F.A. Davis Company; 2007 glossary, p. 1348.

Rivett DA, Milburn PD. Effect of premanipulative tests on vertebral artery and internal carotid artery blood flow: a pilot study. Journal of Manipulative and Physiological Therapeutics 1999;22(6):368–76.

Schubert MC. Vestibular disorders. In: O'Sullivan SB, Schmitz TJ, editors. Physical rehabilitation: assessment and Treatment. 5th ed. Philadelphia: F.A. Davis Company; 2007 chapter 24, p. 1025.

Sloane PD. Dizziness in primary care: results from the National Ambulatory Medical Care Survey. Journal of Family Practice 1989;29(1):33–8.

Simons DG, Travell JG, Simons LS. 2nd ed. Myofascial pain and dysfunction: the trigger point manual volume 1. Upper half of body. Williams and Wilkins; 1999.

Wijetunga MN, Schatz IJ. 〈http://www.emedicine.com/med/topic299.htm〉; 2005. [accessed on 11/6/06].

Williams D, Wilson TG. The diagnosis of the major and minor syndromes of basilar insufficiency. Brain 1962;85:741–4.

Yi-Kai L, Yun-Kun Z, Shi-Zhen Z. Changes and implications of blood flow velocity of the vertebral artery during the rotation and extension of the head. Journal of Manipulative and Physiological Therapeutics 1999;22:91–5.