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Manual Therapy 10 (2005) 154–158
MANUAL THERAPY
www.elsevier.com/locate/math

Professional issue

Is it time to stop functional pre-manipulation testing of the cervical spine?

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Received 19 September 2003; received in revised form 2 April 2004; accepted 30 June 2004

Abstract

The combined extended and rotated cervical spine position has been postulated to affect vertebral artery blood flow by primarily causing a narrowing of the vessel lumen, usually within the artery contralateral to the side of head rotation. The production of brainstem symptoms during the manoeuvre has generally been considered to be a positive test result. As a consequence, functional pre-manipulation testing of the cervical spine has been part of clinical screening undertaken by chiropractors and other manual practitioners to rule out the risk of possible injury to the vertebral artery. To date, these testing procedures are taught to students and carried out in daily clinical practice, despite the considerable controversy that exists about their validity.

This paper considers and discusses the usefulness of functional pre-manipulation testing for clinical scenarios, involving dissection, spasm or stenosis of the vertebral artery, and makes the following recommendations: (1) Practitioners must assess the patient thoroughly, through careful history taking and physical examination, for the possibility of vertebral artery dissection. It is important to note that vertebral artery dissection (VAD) may present as pain only, and may not be associated with symptoms and signs of brainstem ischaemia. (2) If there is a strong likelihood of VAD, provocative pre-manipulation tests should not be performed, and the patient must be referred appropriately. (3) In the patient presenting with symptoms of brainstem ischaemia due to non-dissection stenotic vertebral artery pathologies, provocative testing is very unlikely to provide any useful additional diagnostic information. (4) In the patient with unapparent vertebral artery pathology, where spinal manipulative therapy (SMT) is considered as the treatment of choice, provocative testing is very unlikely to provide any useful information in assessing the probability of manipulation induced vertebral artery injury.

Functional pre-manipulation testing of the cervical spine has been part of clinical screening undertaken by practitioners of spinal manipulative therapy (SMT) for many years, and various protocols have been adapted to rule out the risk of possible injury to the vertebral artery (Carey, 1995; Rivett, 1995; Grant, 1996; Barker et al., 2000). Since first reported in the literature in 1927 by DeKleyn and Nieuwenhuyse (DeKleyn and Nieuwenhuyse, 1927), the combined extended and rotated cervical spine position has been postulated to affect vertebral artery blood flow by primarily causing a narrowing of the vessel lumen, usually within the artery contralateral to the side of head rotation. The production of brainstem symptoms during the manoeuvre has generally been considered to be a positive test result. To date, these testing procedures are continued to be taught to students and carried out in daily clinical practice, despite the considerable controversy that exists about their validity (Kunnasmaa and Thiel, 1994; Thiel et al., 1994; Cote et al., 1996; Rivett et al., 1998; Licht et al., 2000; Westaway et al., 2003). This may be partially based on the belief that performance of these screening tests, and a negative result, could offer the practitioner some form of medico-legal or clinical negligence protection, or that these tests may afford, both the practitioner and the patient, a lesser risk of post-manipulation stroke.

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1356-689X/$ - see front matter © 2004 Published by Elsevier Ltd.
doi:10.1016/j.math.2004.06.004

Clinical tests may have one or more of five functions (Table 1). Provocative or functional vertebral artery insufficiency tests are most commonly used for diagnostic or screening purposes. This commentary focuses on the role of functional vertebral artery insufficiency testing as a pre-manipulation screening tool. Clinical tests are used to perform a specific *function* for a specific *condition*, or risk factors for that condition, in a specific *population* (Lang and Secic, 1997). In this sense, the provocative or functional vertebral artery insufficiency tests are considered to be a screen for otherwise unapparent vertebral artery pathology that may represent a pre-manipulation risk, in a situation where SMT of the cervical spine is considered to be the treatment of choice. By 'unapparent' we mean the absence of historical or other clinical features suggestive of vessel pathology such as dissection, and/or brainstem ischaemia (Table 2). This scenario reflects the clinical situation that practitioners of SMT most commonly face with respect to pre-manipulation screening in their daily practice.

In assessing the usefulness of a screening procedure, a prerequisite must be to define the pre-symptomatic condition that it is aimed at detecting. Although the exact pathophysiological mechanisms underlying stroke and SMT are still unclear, the most commonly accepted one is that of vertebral artery dissection (Frisoni and Anzola, 1991). If this dissection or other sequelae related to vessel wall injury was to be due to a pre-symptomatic congenital or acquired weakness of the vessel wall, it is hard to see how positional tests, aimed at assessing the haemodynamics of that still patent vessel, will afford any useful clinical information regarding the possible risk of injury. Furthermore, in this scenario, performing these tests alone may possibly put the patient at a higher risk due to the potential stretching forces exerted on an already weakened vessel wall. While obviously not in vivo, studies on human cadavers have shown that strain values exerted onto the vertebral artery during a pre-manipulation test are higher than those observed during a typical cervical SMT procedure (Symons et al., 2002). Although there are no documented cases of dissection following pre-manipulation testing alone, the literature cites many examples of non-manipulation positional manoeuvres of the head and neck that have been associated with cerebrovascular injury (Thiel, 1991; Rosner, 2003).

Vessel spasm is another pathophysiological process that has been hypothesised by some to lead to vertebral artery occlusion following SMT (Easton and Sherman, 1977; Schmitt, 1991). This may occur with or without arterial wall damage. Again, and for the same reason as for dissection, it is hard to see how on biologically plausible grounds, a positional pre-manipulation test could assess for the possibility of an impending vasospasm. In summary, the construct validity of the tests with these pathologies in mind is poor.

A less commonly accepted link between SMT and stroke is embolisation from a pre-existing thrombus formation in the vertebral artery. In the absence of endothelial injury, this pathological process is most commonly associated with atherosclerosis. The atheroma alone may result in an asymptomatic partial stenosis of the arterial lumen. Hypothetically, the addition of a test, which may further occlude the vessel, could result in sufficient alteration in arterial flow characteristics to produce ischaemic brainstem symptoms. On the other hand, it is also conceivable that the test may dislodge the embolus resulting in stroke.

Hypoplasia of the vertebral arteries ($\leqslant 2$ mm) has been considered another stenotic factor related to post-manipulation stroke (Mann and Refshauge, 2001). There is no evidence to suggest that a hypoplastic vessel has a greater predisposition to dissection. However, some reports suggest that in the event of vessel injury, a contralateral hypoplastic artery may not be able to provide sufficient collateral circulation to prevent ischaemia and possible infarction (Henderson and Cassidy, 1998; Mann and Refshauge, 2001).

So what is the usefulness of the provocative or functional vertebral artery insufficiency tests in detecting lumenal stenosis due to thrombus or hypoplasia? In attempting to address this question only in vivo Doppler ultrasound studies of vertebral artery flow in human subjects have been reviewed. As mentioned previously, it is generally assumed that pre-manipulation positional manoeuvres measure the degree of lumenal patency, or absence thereof, via the production of transient brain-

Table 1
Functions of clinical tests

A *Screening* test	Performed on healthy asymptomatic people; used to identify those who are at risk of a specific disorder; outcome may justify a subsequent diagnostic test or direct preventative action; a good screening test has high *sensitivity*.
A *Routine* test	Performed on symptomatic subjects; used as part of a battery of tests and may result in a 'finding' that is unrelated to the presenting condition.
A *Diagnostic* test	Performed on symptomatic subjects; used specifically either to identify the presence or absence of a disorder: a good diagnostic test has high specificity.
A *Staging* test	Performed to quantify and characterise the nature or extent of a condition.
A *Monitoring* test	Performed to track the progress of a condition over time.

Adapted from Lang and Secic (1997)

Table 2
Clinical features of vertebral artery dissection and brainstem ischemia arising from vertebral artery insufficiency

Historical and clinical features suggestive of vertebral artery dissection
- Most common presenting symptoms are pain in the head and neck (in almost 90% of cases), often unilateral and sub-occipital
- Patient often never experienced a similar pain before
- Onset often acute, may be related to trauma or spontaneous. Distinction between traumatic and spontaneous quite arbitrary—spontaneous usually means no major trauma (RTA, fall). Detailed and careful history may reveal minor or trivial trauma (sports activities, painting the ceiling, sneezing).
  Searching for these things preceding the neck pain or headache may raise suspicion.
- Pain has distinct, but non-specific features, intensity often severe and quality sharp
- Patient may report a sensation of neck stiffness, but there is no limitation of ROM
- Time delay between onset of symptoms and clinical features of brainstem ischaemia can range from hours to up to 14 days

Clinical features suggestive of brainstem ischaemia arising from vertebral artery insufficiency
Major (most common) symptoms of vertebro-basilar insufficiency are:[a]
- **D**izziness/vertigo/giddiness/light headedness
- **N**ausea (often with vomiting)
- **N**umbness—most often unilateral facial; less commonly may involve trunk and limbs (contraversive or ipsiversive)
- **A**taxia/unsteadiness of gait is the most common
- **D**iplopia,
- (Patient may report limb weakness—uncommon feature)

Major (most common) neurological signs are:
- Ipsilateral Horners syndrome
- Ipsilateral limb ataxia
- Gait ataxia
- Ipsilateral sensory abnormalities of face (CN V); most commonly a loss of pain and temperature (dissociated sensory loss); can get diminished/absent ipsilateral corneal reflex
- Contraversive sensory abnormalities of trunk and limbs; most commonly dissociated (alternating analgesia)
- Ipsilateral cranial nerve IX–XII abnormalities
- Nystagmus; cerebellar or vestibular in origin
- Possible ipsilateral cranial nerve VII deficit
- Possible pyramidal signs; uncommon and often seen in isolation

Most clinical features arise from the territory of the posterior-inferior cerebellar artery (Wallenberg Syndrome)

Adapted from Sturzenegger (1993) and Saeed et al. (2000)
[a]Listed in descending order of frequency; data obtained from patients with dissection as the cause of vertebro-basilar insufficiency; symptoms are listed using the 5 D's and 3 N's framework.

stem ischaemic symptoms. In other words, the test is believed to be an indirect measure of vertebral artery haemodynamics. However, a review of the literature on vertebral artery flow studies clearly shows conflicting results with regard to the effects of sustained pre-manipulation positional manoeuvres. Doppler studies attempting to measure the volume, velocity, or resistance to contralateral vertebral artery flow, have inconsistently indicated either a decrease or disappearance in some of these flow parameters (Stevens, 1984, 1991; Refshauge, 1994; Haynes 1995, 1996, 2000, 2002; Licht et al., 1998; Rivett et al., 1999; Yi-Kai et al., 1999; Mitchell, 2003), or an insignificant or no change at all (Weingart and Bischoff, 1992; Thiel et al., 1994; Cote et al., 1996; Lantz et al., 1996; Licht et al., 1999; Zaina et al., 2003) when applying a variety of functional pre-manipulation tests. Further, there have been reports of patients who had either known vertebral artery hypoplasia or complete lumenal occlusion on neck rotation but did not experience any symptoms during the pre-manipulation manoeuvres (Bolton et al., 1989; Rivett et al., 1998; Westaway et al., 2003). Of particular interest are the Doppler studies by Licht and his co-workers which seem to indicate that flow velocity in the vertebral artery is neither significantly affected shortly after SMT of the neck in asymptomatic subjects (Licht, 1998), nor in subjects who had tested positive on performing pre-manipulation tests (Licht et al., 2000).

Even if one accepts that to an extent, the significant disparity of the results of the various studies on vertebral artery flow during functional pre-manipulation testing, is dependent upon a variety of methodological factors, the weight of the evidence seems to strongly suggest that these screening tests lack the necessary sensitivity in order to be valid and dependable predictors of risk. As such, a negative test result cannot determine the safety of cervical SMT. The lack of sensitivity of the pre-manipulation tests as a valid screening procedure is further supported by some of the findings of Haldeman et al. in their review of 64 medicolegal cases of cerebrovascular accidents associated with SMT of the cervical spine (Haldeman et al., 2002). In 27 of the cases, the practitioner had described the use of a pre-manipulation provocative screening manoeuvre,

however, none of these patients had shown any adverse responses to this screening test before the manipulation.

In view of these arguments, we would like to make the following observations and recommendations:

1. Practitioners must assess the patient thoroughly, through careful history taking and physical examination, for the possibility of vertebral artery dissection. It is important to note that VAD may present as pain only, and may not be associated with symptoms and signs of brainstem ischaemia (Table 2).
2. If there is a strong likelihood of VAD, provocative pre-manipulation tests should not be performed, and the patient must be referred appropriately.
3. In the patient presenting with symptoms of brainstem ischaemia due to non-dissection stenotic vertebral artery pathologies, provocative testing is very unlikely to provide any useful additional diagnostic information.
4. In the patient with unapparent vertebral artery pathology, where SMT is considered as the treatment of choice, provocative testing is very unlikely to provide any useful information in assessing the probability of manipulation induced vertebral artery injury.
5. Practitioners might well now consider whether provocative testing provides any real benefit to any of these patient populations.

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