Risk Management for Chiropractors and Osteopaths: Neck Manipulation & Vertebrobasilar Stroke

John Reggars D.C., M.Chiro.Sc.
Simon French B.App.Sc.(Chiro.)., M.P.H.
Bruce Walker D.C., M.P.H.
Melainie Cameron B.App.Sc.(Osteo.)., M.H.Sc.
Henry Pollard Ph.D., B.Sc., Grad.Dip.Chiro., Grad.Dip.App.Sc., M.Sport.Sc.
Andrew Vitiello B.Sc., M.Chiro.
Peter Werth B.App.Sc.(Chiro.).

This article is the first in a series of articles dealing with risk management in the practise of chiropractic and osteopathy, prepared by the COCA Risk Management Subcommittee.

Abstract:

Although rare, vertebrobasilar stroke is the best known of the possible side effects of cervical manipulation. Due to the serious sequelae that may result from cervical manipulation, chiropractors and osteopaths must take the appropriate steps to ensure the risk is minimised. This article outlines how the astute practitioner can minimise this risk. Practitioners must decide on the options for treatment of a patient with neck problems. Practitioners must also advise the patient of these options as part of an appropriate informed consent.

Correspondence

Simon French
Centre for Clinical Effectiveness
Monash Institute of Health Services Research
Monash Medical Centre
Locked Bag 29
CLAYTON VIC 3168, Australia
Phone: (+61 3) 9594 7526
Fax: (+61 3) 9594 7552
Email: simon.french@med.monash.edu.au

Introduction

Of all the complications associated with spinal manipulative therapy (SMT), vertebrobasilar stroke (VBS) is by far the best known and may result in devastating neurological sequelae, including death. It appears that in rare instances SMT applied to the cervical spine may damage the vertebral artery (VA) or carotid artery (CA), leading to arterial dissection or vasospasm. These events stimulate thrombus formation, which in turn may occlude blood vessels in this region of the arterial tree.

In spite of extensive investigations the exact mechanism by which SMT is thought to produce arterial damage is not fully understood. However, it is thought that with a thorough patient clinical history and physical examination, combined with judicially applied cervical spine techniques, the risk of this complication may be significantly reduced.

In the first instance, practitioners must decide on the options for treatment of a patient with neck problems. Practitioners must also advise the patient of these options as part of an appropriate informed consent. Manipulation/adjustment is but one option, with alternatives including mobilisation, traction, PNF/muscle energy, massage techniques and electrotherapy (including ultrasound, interferential and TENS). These 'other' techniques are not known to produce serious events such as stroke, and therefore should be considered as options in the treatment of neck pain. A recent randomised controlled trial of 336 neck pain patients concluded 'Cervical spine manipulation and mobilization yield comparable clinical outcomes.' The investigators added, 'Given the risk of serious – though rare – complications resulting from cervical spine manipulation, chiropractors should consider mobilization as an effective treatment option for their neck pain patients.'[1].

Incidence

The incidence of VBS associated with SMT has been the subject of numerous research papers and for serious complications, has been reported as being as low as one in 14 million manipulations[2], to as high as one in 4,500 cervical manipulations[3].

In a recent Canadian study, it was reported that for every 100,000 persons aged less than 45 years, 1.3 cases of VBS

attributable to chiropractic would be observed within 1 week of their manipulation[4].

Anecdotal Australian data is revealing. In a recent letter to the Chiropractors' Association of Australia (CAA) membership, the President of the CAA, in conjunction with its Professional Indemnity insurer Guild Insurance Limited (personal correspondence 23/10/01), reported an unprecedented 12 cases in 6 months of alleged chiropractic manipulation related VBS. The CAA has a membership of approximately 1500 chiropractors and if we assume that each chiropractor sees 100 patients per week, this would equate to a total of 150,000 patient visits per week and 7.8 million visits per year. Assuming 50% of those patients receive SMT to the cervical spine, for a six month period the total number of patients receiving cervical spine manipulation would be 1,950,000. Therefore, on this basis the risk of a chiropractic patient experiencing a VBS associated with SMT would be 1,950,000 divided by 12 or one in 162,500 patient visits. However, this calculation is based on anecdotal data only. The exact risk of SMT related VBS is extremely difficult to establish.

It is well known that many of these complications are never reported and therefore fail to be included in the scientific literature, but it is generally agreed that the risk is far greater than the published studies suggest[5].

Risk Factors

According to Terrett[2], the majority of those who suffered an SMT related VBS are in the 30 to 45 year age group. This data would tempt the conclusion that degenerative vascular or osseous changes are not a risk factor for SMT related arterial damage. However, this predilection for a younger age group could simply be a reflection of the age distribution of the population seeking manipulative therapy. Similarly a greater risk for females to have post SMT related VBS has also been postulated, but this may also reflect a gender difference in health care utilisation.

Table 1 outlines other known potential risk factors for SMT related VBS. However, as Terrett[2] suggests, patients who suffer VBS or stroke like symptoms following cervical manipulation are generally young healthy adults, have an uneventful medical history and have none, or only a few, of the stroke risk factors.

A recent review of 64 medicolegal records describing cerebrovascular ischaemia after cervical SMT concluded 'Cerebrovascular accidents after manipulation appear to be unpredictable and should be considered an inherent, idiosyncratic and rare complication of this treatment approach[6].

Table 1. Potential risk factors for SMT related VBS[14, 30].

Previous history of ischaemic symptoms
Dizziness from head movements
Anomalous cerebral circulation
Vascular disease
Connective tissue disease
Hypertension
Oral contraceptives
Family history of stroke
Migraine headaches
Smoking

Genetic testing has been mooted as an investigation for determining those patients at a higher risk of cardiovascular disease[7]. It is postulated that those patients carrying a mutation in the MTHFR gene (which increases homocysteine) are at higher risk of heart disease, deep vein thrombosis and stroke. The usefulness of this test in chiropractic and osteopathic practices for screening those patients who may be at a higher risk of VBS is speculative at this stage.

Mechanisms of Vertebral Artery Injury

It is not within the scope of this article to provide a detailed anatomical description of the cervico-cerebral circulation. However, a brief description is warranted to explain the mechanism of injury to the VA's. Also, recent research has implicated SMT in the damage of the carotid arteries[8].

Table 2 outlines the four anatomical sections of the VA. The two VA's are anatomically divided into 4 sections from their origin on the subclavian arteries. Although VA injury has been reported in all anatomical sections, by far the most VBS and stroke like symptoms occur from events within Section 3 of the artery. This is thought to be due in part to a lack of free movement of the artery at that level. Fibrous tethering of the VA during cervical rotation causes the VA to be stretched, compressed and torqued[2].

Cadaveric studies have shown that the VA will elongate on average 4.7 mm on cervical rotation and 5.8 mm on lateral flexion[9]. Cervical rotation elongates both the contralateral and the ipsilateral VA and at 30º of rotation, the contralateral VA kinks as it exits the C2 transverse foramen[10], while the ipsilateral VA kinks and elongates at 45º of rotation[11]. Stretching of the artery in this way reduces its lumen

Table 2. Anatomical sections of the vertebral artery.

Section 1	That part of the artery from its origin to its entry into the transverse foramen at C6
Section 2	The part of the artery as it ascends the transverse foramina from C6 to C2
Section 3	That part of the artery where it leaves C2 and travels upward and laterally to reach the foramina of the atlas transverse process
Section 4	Begins at the level of the foramen magnum and ends at the lower border of the pons, where it joins with the opposite VA to form the basilar artery

diameter[12] causing altered haemodynamics, such as turbulence or haemostasis, both of which can result in thrombosis[13].

It has therefore been suggested that SMT to the cervical spine utilising less than 30º rotation reduces mechanical stress on the artery and therefore the risk of VA injury[2,14].

In another study on artery deformation in relation to neck position, the research suggests that cervical rotation combined with extension and traction may obstruct flow in either VA[13]. However, it must also be remembered that no studies to date have investigated the biomechanical and/or pathological effects of the SMT thrust techniques on the VA. Therefore, even when SMT is delivered to the lower cervical spine, there is still a potential risk of VBS.

Spontaneous VA dissection has also been implicated as a possible cause of SMT related VBS. The annual incidence of spontaneous VA dissection has been estimated at one to 1.5 per 100,000, while spontaneous dissections of both the carotid artery and the VA accounts for 2 percent of all ischaemic strokes[15]. More importantly, this type of dissection accounts for between 10 to 25 percent of all ischaemic strokes in young and middle-aged patients[16].

Types of Vertebral Artery Injury

The signs and symptoms produced by VBS are primarily caused by brainstem ischaemia. The mechanism involved is due to either mechanical and/or reflex constriction of the VA at the site of injury, or from emboli travelling from the injury site which then occlude the smaller arterial branches. Mechanical restriction can occur when damage to the intima of the vessel precipitates subintimal haematoma formation, which may then result in occlusion of the vessel. A subintimal haematoma may also result in a dissecting aneurysm and lead to inadequate hind-brain perfusion[17].

Arterial wall trauma can also produce arterial vasospasm, which, combined with the presence of a haematoma, can significantly affect VA blood flow. However, vasospasm by itself can produce ischaemic brainstem symptoms or may result in haematoma formation and in turn a dissecting aneurysm[18]. Once a haematoma or thrombus has formed it is then possible for emboli to break off and travel to the brainstem or cerebellum, leading to infarction.

It has been hypothesised that minor trauma to the VA from SMT may initially cause some minor vasospasm, which then results in clot formation without apparent neurological signs or symptoms[2,19]. On subsequent SMT procedures, emboli may be dislodged by neck position or the thrusting manipulation, thus resulting in brainstem or cerebellar signs and symptoms.

The time interval between the onset of VBS symptoms and the SMT procedure may reflect the type of injury. Sudden and severe neck pain immediately after SMT may indicate VA trauma, while the onset of ischaemic symptoms soon after SMT could indicate either VA vasospasm or the dislodgment of emboli from a pre-existing thrombus and subsequent infarct.

In a review of 198 cases, 69% of symptoms occurred either immediately or within minutes of the SMT, 18% within one to six hours, 5% between seven and 24 hours and 8% 24 hours or longer after SMT[2].

Patient History

It may not be possible with even the most careful patient history and physical examination to identify those patients at risk of VBS. However, a careful history may alert the astute practitioner to at least some people who may at higher risk of VBS, or to those individuals who may already be experiencing VA or carotid pathology and are therefore more likely to suffer an SMT related stroke.

The history should include questions related to known risk factors such as smoking, oral contraceptives, migraine headaches, connective tissue diseases and a family history of stroke and cardiovascular diseases, including past vascular surgery. The patient should also be questioned of any recent

history of episodes of dizziness, unsteadiness, vertigo or light-headedness, visual disturbance, nausea, vomiting, headache, paraesthesia or numbness, dysarthria, loss of taste, dysphagia and hiccups[19].

Dizziness is usually the most prominent symptom of vertebrobasilar insufficiency and may not be accompanied by any other signs or symptoms. Sudden and severe pain to the side of the head and or neck and or occipital pain, may also herald arterial trauma and possibly arterial dissection[2,20].

With VA dissection, pain in the back of the neck develops in half of patients, while in two thirds, headache occurs almost always in the occipital region[21]. The median interval between the onset of neck pain and the appearance of other symptoms is two weeks, whereas other symptoms occur only 15 hours after the onset of headache[22]. Carotid artery dissection should also be considered in patients presenting with anterolateral neck pain, unilateral facial or orbital pain and/or a unilateral fronto-temporal headache[18]. Further, practitioners should be aware of any patient presenting with neck pain that is either not improved, or is aggravated, by movement of the neck. This may indicate a vertebral or carotid artery dissection or some other 'red flag' condition.

The dilemma faced by chiropractors and osteopaths is that some of the symptoms of a dissecting VA, such as dizziness, neck pain and occipital headache, can mimic common musculoskeletal syndromes. The practitioner may assume that these symptoms are attributed to the minor mechanical strain, but the trauma may have actually precipitated a small VBS[2,20]. Cervical SMT of such a patient may result in a catastrophic sequela.

Physical Examination

To some degree the physical examination is dependent on the presenting complaint, signs and symptoms. In addition to a standard physical examination protocol, it has been suggested by various authors that blood pressure measurement, neck auscultation and functional vascular tests be performed to detect those patients at risk of VBS[2]. In one study, hypertension had been noted in 53% of patients presenting with spontaneous VA dissections[23].

Neck auscultation appears of limited value for detecting VA bruits, but may be of some benefit in detecting stenotic lesions of the carotid arteries[24].

Without doubt, the greatest emphasis in risk management of VBS has been on the use of various functional vascular screening tests in order to detect symptoms of cerebral ischaemia. However, in his recent review, Terrett[2] concludes that none of these procedures have good predictive value of an increased risk of VBS and should be abandoned for clinical and medico-legal purposes.

Notwithstanding their poor predictive value, the COCA Risk Management Subcommittee recommended that, prior to cervical SMT, all patients should undergo blood pressure testing, and in keeping with other similar guidelines for cervical SMT[25,26], at least one functional vascular test prior to manipulation. Where the patient presents with anterior neck pain or other symptoms possibly related to carotid artery disease, neck auscultation should also be performed. Although these tests may not reliably detect those patients at risk of impending arterial injury and subsequent VBS, they may detect pre-existing VA or carotid artery pathology, or anomalous cerebral circulation[14].

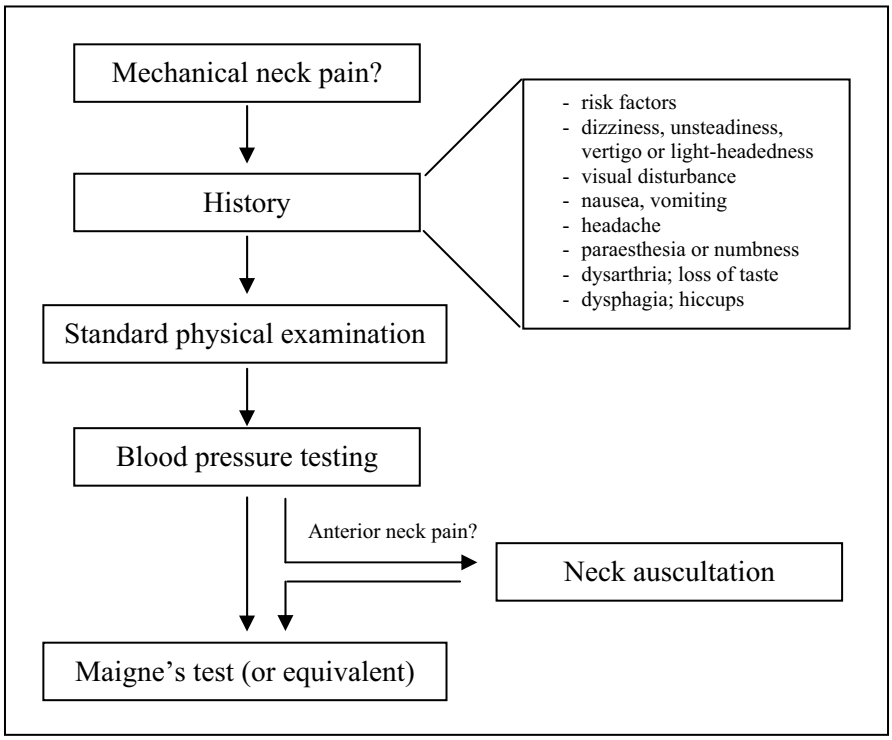
The Figure outlines the recommended history and examination procedure to conduct on a patient presenting with neck pain. These examinations should be performed on any new patient, or an existing patient with new symptoms whom, in the opinion of the practitioner, requires cervical spine SMT. For all subsequent visits, where cervical SMT is indicated, at the very least, a functional vascular test should be performed prior to SMT being administered.

The recommended pre-SMT functional vascular test is usually known as Maigne's test[27]. This involves holding the patient's head for between 10 and 20 seconds in a position of rotation and extension. The patient is then asked to report any development of ischaemic symptoms such as dizziness, nausea, numbness, paraesthesia etc, while the practitioner observes for nystagmus. If ischaemic signs become apparent, the patient's head should be immediately brought back to the neutral position.

It must be remembered that functional vascular testing is not without its own dangers and in patients who present with dizziness, vertigo or disequilibrium of unknown aetiology, or those who have a history of previous ischaemic episodes; this test should not be performed.

In both instances, where Maigne's test produces VBS symptoms or there are pre-existing VBS symptoms of unknown aetiology, SMT should be avoided until the cause is known. Further, the absence of ischaemic signs and symptoms on testing does not in anyway guarantee the practitioner that it is safe to proceed with manipulation[14].

Figure. Recommended approach to the patient with neck pain.



Informed Consent

As there is no reliable and valid method of detecting those patients who are vulnerable to VBS, it is recommended that all patients be made fully aware of the rare but serious complications associated with cervical spine SMT. The use of a clearly written Informed Consent should clearly outline the risks and state what consequences may occur after cervical SMT[2,5,20,28].

Signs and Symptoms of Vertebrobasilar Insufficiency and Vertebral Artery Trauma

Any practitioner who employs therapeutic manipulation for the cervical spine should be fully aware of the signs and symptoms of post-manipulative VBS, vertebrobasilar ischaemia (VBI) or VA damage. Terrett[29] succinctly summarises these symptoms with the 5**D**'s **A**nd the 3**N**'s:

1. **D**izziness/vertigo/giddiness/light-headedness
2. **D**rop attacks/loss of consciousness
3. **D**iplopia (or other visual disturbances)
4. **D**ysarthria (speech difficulties)
5. **D**ysphagia
6. **A**taxia of gait, walking difficulties or incoordination of the extremities, falling to one side
7. **N**ausea and/or vomiting
8. **N**umbness to one side of the face and/or body
9. **N**ystagmus

In addition, severe and sudden head and/or neck pain after SMT, with or without neurological symptoms, may indicate vertebral or carotid artery damage.

Patient Management after SMT related VBI Symptoms

If any symptoms relating to VBI or VA damage occur, immediately return the patient's head to the neutral position and cease any further treatment. Under no circumstances should the neck be re-manipulated as this may cause further VA damage. Observe the patient and if symptoms do not resolve immediately, or they progress, arrangements should be made to transport the patient to the nearest hospital emergency department by ambulance. Both the paramedics and the emergency department should be advised as to the sequence of events and development of symptoms and what may be the possible cause. The patient should be comforted and without admitting guilt, the practitioner should be sympathetic to their needs. If the patient has to be transferred to hospital, the patient's nearest of kin should be advised.

The most common symptom of VBI is dizziness, which may not be accompanied by any other signs or symptoms. The problem for the practitioner is that there are many causes of dizziness and one such cause, cervicogenic vertigo, may be induced by the neck position during Maigne's test and may also respond to SMT. However, unless the practitioner is absolutely sure that these symptoms are not due to VBI, the suggested protocol should be followed.

If the symptoms resolve after resting the patient, the patient should still not be re-manipulated, but be reassessed and examined for possible referral to their general practitioner for further diagnostic testing or specialist neurological assessment. On future visits and after assessment by their GP or specialist, it is recommended that only low force (non-manipulative) techniques be employed until the practitioner is sure that the symptoms were not related to VBS. It is also important to remember that in many cases VBS and stroke like symptoms occur only after several previous uneventful manipulations to the cervical spine[4]. Therefore, any sign or symptom of VBI or VA trauma should be regarded as such until proved otherwise.

Given the appropriate emergency medical care, the prognosis for victims of VBS is very good with up to 75% of patients making a full or good functional recovery.

Conclusion

The use of this protocol in no way guarantees the prevention of SMT associated VBS but it is hoped that adherence to these guidelines will diminish the risk. Regardless of how careful a practitioner is, without adequate record keeping and clinical notes, and appropriate informed consent, most claims are indefensible in a court of law.

Summary of Important Points

- Risk factors for SMT associated VBS may include:
  - Previous history of ischaemic symptoms, such as dizziness from head movements
  - Anomalous cerebral circulation
  - Diseases of the vessels
  - Connective tissue diseases
  - Hypertension
  - Oral contraceptives
  - Migraine headaches
  - Smoking.

- Manipulation of the cervical spine should not be performed with techniques that employ greater than 45° of rotation, with or without neck extension.

- A thorough patient history is essential and should include questions relating to:
  - Known risk factors
  - Dizziness, unsteadiness, light-headedness etc.
  - Visual disturbances
  - Nausea/vomiting/hiccups
  - Paraesthesia/numbness
  - Headache
  - Dysarthria
  - Dysphagia
  - Sudden and severe neck/head pain.

- A thorough physical examination should be performed on all new patients, or existing patients with new symptoms whom, in the opinion of the practitioner, requires cervical SMT. This physical examination should include:
  - Blood pressure testing;
  - Neck auscultation (in the presence of anterior neck pain);
  - Maigne's test on all patients prior to every cervical manipulation.

- Every new patient who may require cervical spine manipulation should be fully informed of the attendant risks by the use of a clearly written Informed Consent form.

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