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Screening for Vertebrobasilar Insufficiency in Patients With Neck Pain: Manual Therapy Decision-Making in the Presence of Uncertainty

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Growing evidence supports the effectiveness of manual therapy interventions in patients with neck pain; however, considerable attention has also been afforded to the potential risks such as vertebrobasilar insufficiency (VBI). Despite the existence of guidelines advocating specific screening procedures, research does not support the ability to accurately identify patients at risk. The logical question becomes, "How does one proceed in the absence of certainty?" Given the lack of clear direction for decision making in the peer-reviewed literature, this commentary discusses the uncertainties that exist regarding the ability to identify patients at risk for VBI. The authors hope that this commentary adds additional perspective on manual therapy decision-making strategies in the presence of uncertainty. *J Orthop Sports Phys Ther 2005;35:300-306.*

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Approximately 54% of individuals have experienced neck pain within the last 6 months[14] and the incidence appears to be rising.[52] The economic burden due to neck disorders is high, second only to low back pain in annual workers' compensation costs in the United States.[76] Patients with neck pain are frequently encountered in outpatient physical therapy practice, consisting of approximately 25% of all patients.[35] Manual therapy interventions are one treatment strategy appropriate for patients with neck pain.[1] The Guide to Physical Therapist Practice[1] uses the term *mobilization/manipulation* to refer to a "manual therapy technique comprising a continuum of skilled passive movements to the joints and/or related soft tissues that are applied at varying speeds and amplitudes, including a small-amplitude/high-velocity therapeutic movement." Although this definition is useful to define physical therapy scope of

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practice, a distinction between manipulation and mobilization is helpful when discussing risk/benefit considerations of manual therapy interventions in patients with neck pain. For the purposes of this commentary, the term *manipulation* refers specifically to techniques involving a high-velocity low-amplitude thrust, whereas mobilization refers to techniques performed as lower-velocity passive movements of a joint.[40]

The effectiveness of manual therapy interventions in patients with neck pain and cervicogenic headaches is well established,[7,8,19,25,26,31,37] suggesting that both manipulation and mobilization are beneficial, particularly when combined with active exercise.[25,26] Although the effectiveness of manual therapy is supported in the literature, there is currently no evidence advocating the superiority of manipulation versus mobilization or vice versa.[25] Considerable attention has been given to the risk of vertebrobasilar insufficiency (VBI) in patients with neck pain.[16,28,30,34] Fortunately, most estimates of the risk of VBI attributable to cervical spine manipulation are extremely low (6 in 10 million, or 0.000 06%),[10,27,34,38] although some estimates are as high as 1 in 400 000.[17,46] Physical therapists who perform spinal manipulation in their clinical practice frequently use cervical manipulation and mobilization interventions in patients with neck pain and cervicogenic headaches.[33,46] Although the risk is very small, the extreme consequences associated with VBI require consideration in the treatment decision-making process for patients with neck pain.

Screening procedures to identify patients at risk for VBI prior to manual therapy interventions are widely advocated, accepted as standard of care, and routinely used in clinical practice.[5,33,47,56,72] For example, the Australian Physiotherapy Association published a clinical practice guideline in 1988,[3] which was updated in 2000.[45] The guidelines generally advocate that all patients with neck pain receive a subjective screening examination and perform active neck movements. Patients who demonstrate symptoms associated with VBI may then require referral for further investigation. At a minimum, these patients are not treated with cervical manipulation. Additional passive physical examination procedures are generally advocated for patients with a negative subjective history to further assess the potential for VBI.[46] Despite endorsement by guidelines and common clinical usage, current research does not support the contention that practitioners can accurately identify patients at risk for VBI. Rather, some experts contend that VBI is an inherently unpredictable, yet rare, complication of manual therapy procedures.[30,70] Therefore, an appropriate understanding of the limitations of screening procedures is essential.

The extremely rare occurrence of VBI associated with manual therapy interventions limits the possibilities for research on the condition. Accumulating a sufficient number of cases to permit a meaningful analysis would require many years, creating inherent difficulties for prospective research. Additionally, there are no standardized reporting procedures for the rare occasion when serious complications do occur. Therefore it is debatable whether research in our immediate future will be able to more clearly inform clinical practice. The logical question then becomes, "How does one proceed in the absence of certainty?" Given the lack of clear direction from the peer-reviewed literature, an understanding of the mechanics of manual therapy and the decision-making strategies used by expert practitioners may be helpful to inform clinical practice until more definitive evidence is provided. Therefore, the purposes of this commentary are (1) to discuss the uncertainties that exist regarding the ability of the screening examination to identify patients at risk for VBI and (2) to consider the plausibility that positioning considerations may offer a more compelling explanation for the occurrence of VBI following manual therapy interventions than the speed or amplitude of the procedure used. We will also discuss the potential role for thoracic spine manipulation as a possible alternative to manual therapy interventions directed to the cervical spine. Readers are referred elsewhere for practice guidelines that outline specific decision-making strategies for screening patients in whom manual therapy interventions are being considered[45,46] and information on screening for other conditions in patients with neck pain who warrant medical referral.[11]

The Uncertainties of Screening Procedures for Vertebrobasilar Insufficiency

Performing a screening examination in patients with neck pain is an important decision-making priority,[5,33,47,56,72] particularly given the frequency with which manual therapy interventions are utilized in these patients,[33,46] and a legitimate concern to minimize the risk of harm. Unfortunately, although VBI screening guidelines exist,[45,46] there is currently no clinical prediction rule that can accurately identify patients at risk for VBI and there is little evidence substantiating the accuracy of historical information, physical examination screening procedures, or diagnostic imaging to accurately identify patients at risk for VBI prior to manual therapy interventions.[6,15,16,28,30,70] For example, Haldeman et al[30] recently reviewed 64 medical and legal records of patients who had experienced a stroke presumably linked to cervical spine manipulation and was unable to identify any risk factors from the history and physical examination predictive of VBI. Hufnagel et al[32] reviewed the reports of 10 patients who sustained VBI following cervical spine manipulation, all of

whom had negative histories for symptoms purported to be associated with an increased risk for VBI. Krespi et al[41] reported on 3 patients with confirmed VBI after a manipulation intervention who initially reported only isolated acute neck pain, with no other findings suggestive of an increased likelihood for injury.

A variety of specific physical examination screening procedures have been described as useful to identify patients at risk for VBI[48]; however, the common purpose of these tests is to position the cervical spine in a manner believed to compromise the vertebrobasilar system and to monitor for provocation of signs and symptoms suggestive of such compromise (eg, dizziness, diplopia, dysarthria, diminished pupillary light reflex, nystagmus, impaired sensation of the face, deviation of the tongue with protrusion, etc). To the authors' knowledge, however, there are no studies in the peer-reviewed literature that suggest these tests can be accurately used for decision making. In particular, therapists must recognize the potential for obtaining false negative results, suggesting that a patient may still be at risk for VBI, despite a negative test. Cote et al[15] demonstrated that the extension-rotation test has a sensitivity that approximates zero, indicating a high likelihood of a false negative results. Studies by Dvorak et al[17] and Haldeman et al[30] illustrate the problem of false negative findings by reporting multiple cases (26 and 27 patients, respectively) in which VBI occurred, despite the practitioner having performed a screening examination and judged it to be negative. In a study by Dvorak and Orelli,[17] all screening procedures were negative in a group of 13 patients reported to have experienced signs and symptoms consistent with VBI following cervical spine manipulation. It has been suggested that there is no compelling evidence that either clinical examination findings, or results of diagnostic testing procedures such as ultrasonography, can identify patients at risk for VBI,[16,70] making it impossible to accurately counsel patients or practitioners as to the risks.[28,30]

Proceeding in the Absence of Certainty: Patient History

Practitioners wishing to judiciously use evidence to minimize the risk of harm are faced with a difficult dilemma. On the one hand, therapists are confronted with having to rely on a set of screening procedures that, while generally accepted as standard of care, have limitations in their diagnostic accuracy to the extent that their results may not be particularly useful, and even misleading. On the other hand, therapists who suggest that screening is futile and forgo screening potentially place themselves at legal risk should an adverse event occur. The lack of clear guidance for accurate decision-making does not obviate the practitioner's responsibility to perform a prudent examination and clearly document that screening was performed. However, practitioners who are not fully informed may have a false sense of security that adhering to recommendations in screening guidelines[45,46] will enable them to accurately detect the majority of patients at risk.[30] In a survey of Canadian physical therapists, 88% strongly agreed that all available screening tests should be performed prior to cervical manipulation,[33] suggesting that therapists may have a false sense of security regarding the accuracy of screening procedures.

Despite the uncertainties, there is some existing information that can help define prudence with regard to screening for the risk of VBI in patients with neck pain. First, the extreme consequences related to VBI lend support to screening guidelines advocating a generally conservative approach.[45,46] It is a rare occurrence, but 18% of patients developing VBI will experience complete recovery, although the prognosis is more favorable if detected early.[30] Therefore, it may be unwise to ignore the signs and symptoms thought to be associated with VBI or a positive screening test, regardless of the level of evidence to support the accuracy of these findings. For example, a therapist's suspicion of VBI may be increased in the patient with neck pain who also reports dizziness, lightheadedness, nystagmus, impaired sensation to the face, blurred vision, or other signs or symptoms consistent with compromise to the vertebrobasilar complex. It may also be unwise to perform screening procedures in test positions that are more likely to compromise the vertebrobasilar system than the examination and treatment procedures to be used (eg, having the patient in supine with the head unsupported in a position of terminal rotation and extension). Test positions such as this may pose greater risks to patients than manual therapy interventions performed with the spine in a more neutral position.[43,70,69,75] Prudence would dictate that if a suspicion of VBI exists, based on the patient's history, then end range provocative testing should be avoided; the physical therapist should refer these patients to the appropriate medical practitioner.

Second, the mechanism of injury can also be helpful to guide decision making. The most common reported cause of sudden-onset VBI is trauma, particularly from high-velocity flexion-distraction and rotational forces that may occur during a whiplash incident.[60] There have recently been multiple sources of evidence substantiating that suspicion of VBI should be heightened in the patient whose neck pain results from a traumatic episode.[12,53,58,59,73,74] In a prospective study of 47 patients who had experienced recent trauma to the cervical spine, an alarming 25% (12/47) of the patients demonstrated evidence of VBI on either magnetic resonance imaging or magnetic resonance angiography.[53] Similar rates of injury

to the vertebrobasilar system have been reported in other studies.[20,22] Giacobetti et al[22] reported complete disruption of blood flow in 20% (12/61) of patients sustaining cervical spine trauma, with 83% (10/12) reporting a flexion mechanism of injury. It is also important to distinguish between evidence of injury to the vertebrobasilar system suggested by imaging, and the actual occurrence of VBI. The presence of injury on imaging does not guarantee progression to VBI, or that a patient with such imaging findings, who receives manipulation during treatment, would experience symptoms associated with VBI. To put these findings in context, it is important that practitioners not be unwarrantedly alarmed by a patient presenting with dizziness, lightheadedness, and unsteadiness following whiplash injury. Vertebral artery injuries associated with whiplash are usually associated with significant trauma,[59] raising the practitioner's awareness that manual therapy would be contraindicated for these patients. Furthermore, symptoms such as dizziness, lightheadedness, and unsteadiness following whiplash injury are common[71] and more likely attributable to altered sensorimotor function[61-64] or vestibular involvement,[77] suggesting that these patients may benefit from rehabilitation focused on sensorimotor training.

Third, in some cases, the presence of VBI following a traumatic event may be associated with cervical fracture.[59] Unlike screening for VBI, well-validated evidence exists to guide clinicians in screening patients for an increased risk of fracture. A clinical prediction rule has been developed[65] and prospectively validated[4] to assist practitioners in determining which patients experiencing trauma should undergo cervical radiographs to rule out injuries such as fractures, dislocations, or ligamentous instability. The rule has been 100% sensitive in detecting these injuries in over 15 000 patients with trauma to the head or neck,[4,65] indicating an absence of false negative results and giving practitioners a high degree of confidence that patients' cervical spine injuries, including fracture, are unlikely to be missed when the rule is used. Therefore, adequately screening patients for fracture using the cervical spine radiography prediction rule,[4,65] may help in the detection of patients with an elevated risk of VBI with manual therapy interventions based on the possibility of a concomitant fracture.[12,53,73]

Finally, it is important to remember that patients with vertebral artery injury can present with neck pain as the only symptom and thus be misdiagnosed as strictly a mechanical problem.[66] Therefore, despite a temporal relationship between an ischemic event and manual therapy intervention, the ischemic event may have already been in progress and thus not directly attributable to the manipulative intervention. It is unknown how frequently VBI is temporally linked to cervical spine manipulation, when it was actually previously existing and misdiagnosed as mechanical neck pain upon presentation to the manipulative practitioner. Therefore, to account for this uncertainty, we would generally avoid using thrust manipulation in the initial session for patients with acute onset of neck pain and for patients with recent changes to their chronic neck symptoms. It may be unclear if these patients are experiencing a rare VBI incident or more common mechanical neck pain.

Proceeding in the Absence of Certainty: Physical Assessment and Monitoring

When a patient's history does not indicate the potential for VBI to exist, we advocate a model of physical assessment that introduces the application of incrementally greater movements and loads. A guiding principle is to minimize challenging the cervical spine beyond what will be imposed by any treatment procedures such as manual therapy interventions. For example, prior to performing a manual therapy procedure, the therapist can maintain the patient's head in the position from which the procedure will be performed for a period of 10 to 15 seconds prior to imparting the force, assessing for signs and symptoms consistent with VBI (ie, premanipulative hold technique).[23] If any of the pertinent signs or symptoms is observed, performance of the manual therapy procedure would be contraindicated and further consultation may be warranted. Although this appears to be a prudent and intuitively sensible approach in the authors' opinion, there is no evidence to support the accuracy of this procedure in screening for VBI.

It is important for therapists to recognize that symptoms of VBI may be delayed by several days or even weeks following injury,[2] and it has been suggested that complications related to manipulation frequently do not occur during the initial treatment.[21] Regardless of the testing method used, it is important that therapists constantly monitor a patient's response to treatment both immediately after treatment and upon subsequent follow-up visits. Powell et al[55] reviewed 138 cases of complications following spinal manipulation and concluded that misdiagnosis and the failure to recognize the onset or progression of neurologic signs or symptoms was a primary risk factor for complications resulting from manual therapy. In many reported cases where death or serious neurologic complications ensued following manual therapy, the practitioner ignored a progressive worsening in the patient's status and continued to utilize the techniques.[68] Clearly, this is inappropriate. Clinicians should consistently monitor their patients and take immediate and appropriate actions when adverse effects become apparent.

Proceeding in the Absence of Certainty: Manual Therapy Techniques

Although estimates of vertebral artery dissections attributable to manipulation range from 1.5%[57] to 31%,[28] recent evidence suggests that the amount of strain on the vertebral arteries during manipulation is similar to, or lower than, the strain recorded during routine range-of-motion testing and other diagnostic testing procedures.[67] The force associated with manipulation also appears to generate only a fraction of the strain necessary to result in vertebral artery failure, indicating that most patients should easily tolerate the forces imparted during cervical manipulation.[67] Serious complications have also occurred following mobilization procedures,[28,29,49] suggesting that the speed and amplitude of the technique used (ie, manipulation versus mobilization) may not be the only consideration necessary for prudent decision making.

In contrast, growing evidence implicates cervical rotation near the terminal range of motion as the primary component of movement in over 80% of patients who experienced VBI after manual therapy intervention.[16,17,29,34] In a survey of 367 members of the Swiss Society for Manual Medicine in the early 1980s, Dvorak and Orelli[17] found that among 13 patients reported to have experienced changes in consciousness following manipulation, treatment was directed to the upper cervical spine in each case using a manipulation intervention with the patient's neck in a position of maximal extension and rotation. These clinical reports are corroborated by a number of recent ultrasonography and angiography studies demonstrating that cervical spine rotation,[42,44,51,75] extension,[43,75] and a combination of extension with rotation[43] result in diminished vertebral artery blood flow. In a review of the literature, Mann and Refshauge[47] reported that 16 out of 20 studies showed a decrease in vertebral artery blood flow during neck rotation, with or without neck extension. It seems reasonable that neck positioning may have a stronger relationship to the onset of VBI following manual therapy than the speed and amplitude of the technique. Many routinely used manual therapy procedures do not place the patient's neck in terminal ranges of motion. Perhaps rather than focusing exclusively on the speed and amplitude of the procedure, practitioners should consider performing all manual therapy interventions in positions that do not place the patient's neck in the terminal ranges of motion. Several experts concur with this sentiment,[16,17,50] recommending that manual therapy interventions involving a rotational component in the terminal range of rotation range of motion be abandoned. Although it is unclear whether adhering to this recommendation would reduce the already low incidence of VBI, therapists should at least consider whether terminal-range manual therapy interventions are worth the apparent risks. Screening guidelines might consider discouraging the use of manipulation interventions that incorporate an end range rotational component, regardless of the speed and amplitude of the procedure used.

Directing manual therapy interventions towards the thoracic region instead of the cervical spine is another approach to minimizing the risks associated with manual therapy in patients with neck pain. It is theorized that biomechanical relationships between the cervical and thoracic spine make it possible that disturbances in joint mobility in the thoracic spine may contribute to movement restrictions and pain in the cervical region.[24,36,39] The substitution of thoracic techniques for interventions directed to the cervical spine could avoid even the small risks associated with cervical techniques yet achieve similar therapeutic benefits[18]; however, only limited evidence exists to support the notion that thoracic spine manipulation is beneficial for patients with neck pain.[9,13,54] Cleland et al[13] recently demonstrated that thoracic spine manipulation results in immediate reduction in pain in patients with neck pain compared to patients receiving sham manipulation. Further research is necessary to determine the long-term effectiveness of thoracic spine manipulation in patients with neck pain and whether a subgroup exists for whom this treatment approach is optimal.

CONCLUSION

Although growing evidence supports the effectiveness of manual therapy interventions for patients with neck pain, current evidence is unable to sufficiently guide decision making to the extent that therapists can confidently conclude that a negative screening examination rules out the possibility for VBI. Fortunately, the risk appears to be extremely low. Research also suggests that the use of cervical techniques that do not place the neck into end range positions, or the use of thoracic techniques instead of cervical procedures, may further minimize the risk. In the absence of convincing evidence, a conservative approach based on prudence, experience, and limited research findings is presented.

We do not intend this commentary to be viewed as prescriptive practice guideline. Instead, we hope that it will provide additional perspective on manual therapy decision-making strategies in the presence of uncertainty. As with any intervention, patients should be informed of the risks and benefits to make an informed decision. The demeanor and goals of the patient, nature of referral, skill of the therapist, and bias of the referring provider must all be weighed in the context of the overall decision-making process.

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