Cervical Spine Adjusting and the Vertebral Artery

Contemporary perspectives on patient safety and protection, clinical reality and patient management
Why understand this?

Currently the single most important issue related to the practice of chiropractic from a **public safety issue standpoint** is associated with vertebral artery related matters.

Similarly, a key issue from a **public relations perspective** is related to the practice of chiropractic as associated with vertebral artery related matters.
Why understand this?

The Lewis Inquest in Toronto, Ontario has provided a treasure trove of information related to vertebral artery issues of interest to practicing chiropractors.

The recent controversy surrounding Vioxx and Accutane signals a changing public expectation with respect to health care interventions.
Today’s Outcomes

To provide the practicing chiropractor with:

- A review of the relevant anatomy, physiology and pathology associated with vertebral artery injuries, particularly vertebral artery dissection, to assure an understanding of the basic mechanisms involved
- A review of the current demographic and incidence data, the sources of the data, and the strengths and weaknesses of the data associated with vertebral artery injury and cervical spine adjusting
Today’s Outcomes

• Current thoughts on the appropriate procedures to be used before the initiation of cervical spine adjusting and the recommended procedures in the event a patient demonstrates signs of VAD before, during, or after a care encounter.

• Current perspectives on VAD in progress and the clinical warning signs of the patient who presents in a potentially compromised state, as well as the most appropriate response thereto.
A 30,000 foot perspective!

- U.S. population: 300,000,000
- Strokes in a year in the U.S.: 700,000
- VAD occurs at a rate of: 1/100,000 pop.
- VADs annually in the U.S.: 3,000
- % of pop. To visit a DC in U.S.: 10%
- # of VAD patients likely to see a DC: 300
- 60,000 DCs in U.S., if evenly distributed then 1/200
Stroke Overview

- 700,000 strokes annually
- 80% are ischemic (clot related)
- 20% are hemorrhagic (bleed related)
- 3,000 VADs per year
- 1 of every 233 strokes is related to a VAD
- 75% of VAD related strokes make a good recovery
- 5% of VAD related strokes result in death
Stroke Overview

- Olmstead County, Wisconsin incidence
  0.97/100,000 population

- Ontario, Canada 109,020,875 person years with 818 CVA strokes or 1/133,000 or 0.75/100,000
Review: Anatomy, Physiology & Pathology of Vertebral Arteries

1. Gross anatomy
2. Histology
3. Mechanism of Basic Pathology:
   a. Injury and inflammation
   b. Clotting and thrombus formation
   c. Emboli
   d. Ischemia
1. Gross Anatomy Review

Arterial circulation of the vertebral arteries:

a. Origin
b. Course
c. Distribution
d. Common anomalies
Arterial Circulation

a. Origin of the Vertebral arteries:

- Arise from the Subclavian arteries bilaterally
- Arise proximal to the Thyrocervical trunk and distal to the Common Carotid artery
b. Course of the Vertebral arteries:

- Divided into four segments as they ascend the cervical spine:
  1. From the Subclavian artery to the transverse foramen of C6
Arterial Circulation

II. Within the transverse foramina from C6-C2
Arterial Circulation

III. From the superior of C2 foramen to the dura
IV. From the dura into the cranium
Arterial Circulation

c. Distribution from the Vertebral arteries:

- From the Subclavian arteries, the Vertebral arteries ascend to ultimately unite and form the Basilar artery.

- The Posterior Inferior Cerebellar artery (PICA) arises prior to the junction of the right and left Vertebral arteries forming the Basilar artery.
d. Common anomalies:

Approximately 10% of patients have some form of anomaly in their Vertebral artery(ies).

- Unilateral or bilateral absence of the Vertebral artery
- Origin of the Vertebral arteries varies in 3.5% of cases
- The PICAs have an extra dural origin in 5-20% of cases: arising approximately 1 cm proximal to dural penetration
Normal right vertebral artery

Absent left vertebral artery
Arterial Circulation

Anomalies, continued:

- Contralateral rotation can cause alteration in blood flow at the C1-C2 level on MRA
- Compression of the Vertebral artery(ies) is seen in 5% of the population in both a neutral position and in rotation
- Variations in arterial diameter (average 4.3 mm on the right, 4.7 mm on the left)
- Segment 1 is tortuous in 39% of specimens
- 7% of Vertebral arteries cannot be imaged with sonography due to the depth of the tissue
- A change in excess of 56% is needed to detect alterations using Doppler imaging
2. Histology of Blood Vessels

- The Vertebral arteries are comparable in size and design to the renal arteries or some of the smaller coronary arteries.

- They exhibit the typical 3 layer pattern from inside out: tunica intima, tunica media and tunica adventitia.
3. Mechanism of Basic Pathology

a. Injury and Inflammation

Arteriopathy may arise from conditions such as:

- Marfan’s Disease
- Ehler Danlos Syndrome-types IV and VI
- Autosomal Dominant Polycystic Kidney Disease
- Osteogenesis Imperfecta Type I (yielding cystic medial degeneration)
- Fibromuscular Hyperplasia
3. Mechanism of Basic Pathology

b. Clotting and thrombus formation

• Arterial damage, particularly involving the tunica intima, will yield the start of increased localized clotting and thereby thrombus formation.

• Arterial flow changes can result from histological changes as well as from mechanical changes in the vessel.
3. Mechanism of Basic Pathology

Intimal dissection with blood flow beneath the intima and associated thrombus formation
3. Mechanism of Basic Pathology

c. Emboli

- Emboli present in three primary forms:
  - Liquid—amniotic fluid
  - Solid—excessive clotting
  - Gaseous—Caisson’s Disease

- The thrombus at the site of arterial damage is invariably the source of emboli yielding ischemic stroke from the Vertebral artery.
3. Mechanism of Basic Pathology

d. Ischemia

- The degree of ischemia resultant from an embolism is the consequence of the size and location of the embolism, as well as the presence/absence of collateral circulation to the affected area.
From the Basics to the Advanced

1. Mechanisms/origins of Vertebral artery dissection (VAD)
2. Types of VAD
3. Pathophysiology of VAD
4. Sequellae of VAD
1. Mechanisms/origins of VAD

The literature indicates that VAD arises spontaneously, from trivial movement, minor trauma or major trauma.

The following have been cited in the literature as preceding VAD: judo, yoga, ceiling painting, nose blowing, hypertension, oral contraceptive use, sexual activity, receiving anesthesia, use of resuscitation activities, receiving a shampoo, vomiting, sneezing, adjustment or manipulative procedures.
2. Types of VAD

Dissections arise from an intimal tear, yielding an intramural hematoma, which is then identified as subintimal or subadventitial.

- Subintimal dissections tend to result in stenosis of the artery
- Subadventitial dissections tend to result in aneurysm formation
3. Pathophysiology of VAD

The root of the problem is an expanding hematoma in the wall of the Vertebral Artery as a result of:

- hemorrhage of the vasa vasorum within/associated with the tunica media
- development of an intimal flap in the lumen of the vessel
Subintimal vs. Subadventitial

- Subintimal
- Subadventitial

Vessel lumen

Aneurysm
3. Pathophysiology of VAD

The evolution of the hematoma may include the following:

- It seals off, remains small and is largely asymptomatic.
- An expanding hematoma of a subintimal nature occludes the vessel, yielding ischemia and subsequent infarction.
- A lesion of a subadventitial nature yields an aneurysm that is prone to rupture through the adventitia, yielding a subdural hematoma.
3. Pathophysiology of VAD

The consequences of an intimal disruption may include:

- alteration of normal hemodynamics
- creation of a thrombogenic environment
- formation of a thrombus
- potential generation of emboli
4. Sequellae of VAD

The effects of altered arterial flow through the Vertebral artery as a result of a dissection can yield:

- Few or minimal symptoms
- Transient ischemic attacks
- Development of thrombi and emboli
- Potential for ischemia and/or infarction
VAD in Literature

1. Mechanisms of origin
2. Incidence
3. Morbidity and mortality
4. Predisposing factors
5. Theorized predisposing factors
6. Predictors of VAD
1. Mechanism of origin

According to Haldeman et al. Spine 1999 Apr 15;24(8):785-94 (Based on cases reported in scientific literature):

- 43% of are spontaneous in nature
- 31% are associated with cervical spine manipulation
- 16% from trivial trauma
- 10% from major trauma
Vertebral Artery Dissection

1. Mechanism of origin

According to Beaudry and Spence (The Canadian Journal of Neurological Sciences, V. 30, No. 4, November 2003, pp. 320-304)

- The most common cause of traumatic Vertebrobasilar ischemia is motor vehicle accidents.
- Of 80 cases that presented over 20 years to a single neurovascular practice, 70 were related to MVAs, 5 to industrial injuries, 5 associated with chiropractic. Consideration was offered that some of the cases that were related to chiropractors were also involved in MVAs, further confounding the matter.
Vertebral Artery Dissection

2. Incidence of VAD (Schievink, NEJM 3/22/01)

- Approximately 3,000 of the 700,000 reported strokes yearly are VADs.
- Dissections account for 10-25% of all ischemic strokes in young or middle aged persons.
- VAD and CAD account for 2.6 per 100,000 strokes.
- Female to male ratio: 3:1 (disputed)
- Average age: VAD—40, CAD—47 (disputed)
Vertebral Artery Dissection

2. Incidence of VAD—Reported Numbers

- 1 in 5,000 adjustments cause a stroke (Norris, SPONTADS, unpublished)
- 1 in 20,000 adjustments cause a stroke (Vickers, BMJ, 1999)
- 1.3 in 100,000 patients (Rothwell, Stroke, 2001)
- 1 in 1 million adjustments (Hosek et al, JAMA, 1981)
- 1 in 2 million adjustments (Klougart et al, JMPT, 1996)
- 1 in 5.85 million cervical spine adjustments (Carey et al, CMAJ, 2001)
Vertebral Artery Dissection

2. Incidence of VAD—Discussion

- The Rothwell data involves all patients who experienced a stroke within 7 days of a chiropractic office visit.
- The Carey data reflects claims filed for a stroke following chiropractic care.
- It is likely that among the Rothwell data there were unrelated strokes and among the Carey data there were unreported claims.
- Safe number: 1/1-2 million adjustments.
Vertebral Artery Dissection

4. Predisposing factors

• Aforementioned heritable conditions

• “approximately 5 percent of patients with spontaneous dissection of the carotid or vertebral artery have at least one family member who has had a spontaneous dissection of the aorta or its main branches.” (Schievink, NEJM 2001)
5. Theorized predisposing factors

- Migraine—One case-control study in 1989 suggested that migraine was a risk factor for cervical artery dissection (D’Anglejan, Headache, 1989)
- Hyperhomocysteinemia—reported by Pezzini, J Neurology, 2002
- Previous respiratory infection together with other neurological symptoms
Vertebral Artery Dissection

6. Predictors of VAD

“Thus, given the current state of the literature, it is impossible to advise patients or physicians about how to avoid vertebrobasilar artery dissection when considering cervical manipulation or about specific sports or exercises that result in neck movement or trauma.” (Haldeman et al, Spine 1999)
Clinical Pearl Number One

Current thinking holds that the majority of patients who develop frank symptoms of a vertebral artery dissection following chiropractic care were in the process of dissection when they presented for care.
Risk of Vertebrobasilar Stroke and Chiropractic Care, Cassidy, SPINE, Volume 13, number 45, pp. 5176-5183

- “Because the association between chiropractic care and VBA stroke is not greater than the association between PCP visits and VBA stroke there is no excess risk of VBA stroke from chiropractic care.”
“We have not ruled out neck manipulation as a potential cause of some VBA strokes. On the other hand it is unlikely to be a major cause of these rare events. Our results suggest that the association between chiropractic care and VBA stroke found in previous studies is likely explained by presenting symptoms attributable to vertebral artery dissection.”
Table 7. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Control and Case Crossover Estimates of the Association Between the Total Number of Chiropractic (DC) and Primary Care Physician (PCP) Visits in the Month Prior to the Index Date

<table>
<thead>
<tr>
<th>Exposures</th>
<th>All Cases</th>
<th>Age &lt;45 yr</th>
<th>Age ≥45 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio (95% CI)</td>
<td>Bootstrap 95% CI</td>
<td>Odds Ratio (95% CI)</td>
</tr>
<tr>
<td>Case control estimates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any DC visit</td>
<td>1.14 (1.02–1.27)</td>
<td>1.00–1.27</td>
<td>1.58 (1.19–2.10)</td>
</tr>
<tr>
<td>Any PCP visit</td>
<td>1.77 (1.61–1.93)</td>
<td>1.61–1.94</td>
<td>2.12 (1.58–2.84)</td>
</tr>
<tr>
<td>Headache or cervical DC visit</td>
<td>1.13 (0.98–1.30)</td>
<td>0.96–1.31</td>
<td>1.57 (1.17–2.11)</td>
</tr>
<tr>
<td>Headache or cervical PCP visit</td>
<td>6.33 (4.27–9.37)</td>
<td>4.38–8.18</td>
<td>10.00 (3.26–30.63)</td>
</tr>
<tr>
<td>Case crossover estimates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any DC visit</td>
<td>1.10 (0.99–1.22)</td>
<td>0.97–1.24</td>
<td>1.37 (1.10–1.70)</td>
</tr>
<tr>
<td>Any PCP visit</td>
<td>1.49 (1.36–1.63)</td>
<td>1.34–1.66</td>
<td>1.34 (1.05–1.70)</td>
</tr>
<tr>
<td>Headache or cervical DC visit</td>
<td>1.18 (1.02–1.37)</td>
<td>0.99–1.45</td>
<td>2.80 (1.43–5.48)</td>
</tr>
<tr>
<td>Headache or cervical PCP visit</td>
<td>3.99 (2.88–5.53)</td>
<td>2.74–5.80</td>
<td>10.64 (3.45–32.78)</td>
</tr>
</tbody>
</table>

*Unable to compute due to small numbers.
In Support of this Idea


In support of the idea

- Risk of Vertebrobasilar Stroke and Chiropractic Care, Cassidy, SPINE, Volume 13, number 45, pp. 5176-5183

- Spinal manipulative therapy is an independent risk factor for vertebral artery dissection. Smith, Neurology, Vol. 60, pp. 1424-1428
Against this Idea

For the Practicing DC

• Pre-adjusting screening tests
• Pre and post adjustment indicators of VAD
  • Abnormal behavior/speech
  • Pathognomonic complaint
  • Pain patterns
• Important Steps to follow
Pre-adjustment screening tests?

We were all taught “George’s Test”, “DeKlynes Test” and other tests for Vertebral artery competency.

Regardless of what your teachers, colleagues, professional liability carriers, risk management consultants have told you about these provocative tests—DO NOT DO THEM.
Pre-adjustment screening tests

• Yield an unacceptable percentage of false positives and false negatives
• Offer no reliable information
• May be enough to make a bad situation worse for the patient who has a VAD in progress
• Were included in provocative testing that was abandoned by all of the clinic directors of U.S. chiropractic programs (which was supported by all of the presidents/deans of the schools) in March 2004
• **Bottom Line:** There are no reliable or safe tests that will rule out a VAD in progress and there are no tests that will identify a patient at risk for VAD.
What is a Person to Do?

- There are no clear-cut predisposing factors suggesting VAD...
- There are no testing procedures helpful in ruling out potential VAD patients...
- The great majority of VAD-in-progress patients present with musculoskeletal complaints...

What is a person to do?
What is a Person to Do?

Look, listen, ask and think
Look and Listen for:

- **Five “Ds”**
  - Dizziness
  - Drop attacks
  - Diplopia
  - Dysarthria
  - Dysphagia

- **And**
  - Ataxia

- **Three “Ns”**
  - Nausea
  - Numbness
  - Nystagmus
Perspective on the 5 D’s, 3 N’s and the A!

- Many patients present to chiropractors exhibiting one or more of these symptoms
- Many patients seek care for these symptoms
- The presence of these symptoms, in and of themselves, may or MAY NOT be an indication of a possible VAD-in-progress
- The constellation of symptoms (dizziness, nausea and diplopia for example), the uniqueness of the symptom (drop attacks for example) and/or the degree/severity of the symptoms should draw the clinician’s attention
Look and Listen for:

- Slurred speech
- Giddiness
- A change in voice pattern
- Lack of context in speech
- Inappropriate reactions to situations

One characteristic, almost pathognomonic phrase from your patient—whether they be an old or a new patient, getting their first adjustment or their 100th...
Clinical Pearl Number Two

The phrase:

“I have a pain in my neck and (or) head unlike anything I have ever had before.”
Clinical Pearl Number Three

For those patients who experienced a VAD, on follow-up 50% had a recent appearance of a new chief complaint of upper quadrant neck pain (occipital area) and/or the hemicranium. The pain was described as throbbing, steady or sharp: the “thunderclap” headache.
Pain referral common to Vertebral

Pain referral common to Internal Carotid
Ask Questions

DC: Tell me some more about this pain.

DC: Were you doing anything before you experienced the pain, or did it come out of the blue?

Think About What?

Stopping cold in your tracks when you have heard *The* phrase.

Taking a step back, slowing down and paying close attention to everything about this patient.

Moving cautiously, discretion is the better part of valor.
Think About What?

In the presence of a patient who:

• expresses non-traumatic or post-whiplash neck pain as a new chief complaint...

• refers to the pain as unlike anything they have ever had before...

• is exhibiting other neurological symptoms...

...Referral for evaluation of possible VAD before adjusting is strongly recommended.
VAD Symptoms Following an Adjustment

• Your management and documentation of the situation are the most important issues in reducing morbidity and mortality, as well as in limiting or reducing liability.

• Your recognition of the post-adjustment symptomatic picture is critical. You cannot assume that because VAD is extremely rare that it won’t, didn’t or can’t happen in your office.
What should I do?

- Any of 5 D’s, an A or any of the 3 N’s should cause you to pay attention immediately.
- If the symptoms are mild, monitor them for their decrease or their resolution.
- If severe, consider emergency services immediately.
- Each situation will require a different response.
  - Always monitor the patient’s vitals, as well as specific neurological responses that drew attention.
  - Availability of baseline vitals will allow this data to be more meaningful.
What should I do?

- If the symptoms are very transient, limited and resolve quickly, take a position of “watchful waiting”
- Consider the area adjusted, the type of adjustment given, and if an alternate approach would be in order
- Do not readjust the patient at this time
What should I do?

- If the symptoms do NOT resolve quickly, monitor the patient and stay with the patient, no matter how the waiting room is stacked.
- Watch for the development of additional symptoms, note the mental status, degree of confusion if any, etc.
- If symptoms persist, or if they worsen, seek emergency services support. Monitor the patient while waiting for support services.
- Do not readjust the patient at this time.
Why Not Readjust?

IF the patient is experiencing a VAD, there is no form of adjustment that will minimize the consequences of the dissection, and the introduction of another force may serve to mobilize thrombi and create emboli, increasing the likelihood of an ischemic event.
Importance of Immediate Action

• VAD—>thrombus—>emboli—>cerebellar or brainstem ischemia

• Emergency pharmaceutical intervention, i.e. tPA, is most effective in the first 90 minutes, moderately effective for three hours and possibly effective for up to six hours

• Time is of the essence!
Professional Liability Complications

- Failure to recognize what is going on, to write it off as a “normal” or “typical reaction to an adjustment”
- Failure to monitor and document the progress of the patient following the onset of the problem, as well as to document your thought processes regarding the situation
- Failure to manage the situation properly and in a timely manner
- Readjusting the patient
- Sending the patient home if in an unstable/fragile state
- Taking a casual approach to seeing another provider
- Being less than honest and explicit in the record
Tomorrow Morning

- Do not be fearful of delivering a competent cervical spine adjustment
- Pay close attention to the responses of patients following cervical spine adjustments
- Do not assume, “it couldn’t happen in my office”
- Evaluate your procedures: are you asking the right questions? Does your staff understand the mechanisms involved and know what kinds of subtle changes to look for?
Tomorrow Morning

- Include your staff in a plan for what you would do if... (emergency numbers, possible scenarios with action plans so that you react to plans, not problems)
- Document, document, document
- Understand the mechanisms involved and respond accordingly
- Act in the best interest of your patient, always and in all ways—this is ultimately in your best interest as well.
Disclaimer

This lecture has been developed as an instructional guide. The information contained herein is based on sources believed to be generally correct, however, because of variances in state statutes, educational philosophy, professional assiduity, and court opinions the Association of Chiropractic Colleges assumes no responsibility as to the accuracy or scope of the suggestions offered in a particular circumstance. Legal counsel should be consulted for optimal guidance. The opinions expressed in this lecture are exclusively those of the author.
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Let us know the abstract(s) you wish, your postal address and telephone number!