CERVICAL SPINE ADJUSTING AND VERTEBRAL ARTERY ISSUES —AN UPDATE

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CASSIDY TO TODAY

• PRE-CASSIDY:
  • Rothwell, Stroke, 2001

• CASSIDY—SPINE, January 15, 2008

• POST-CASSIDY
  • Kosloff, Chiropractic and Manual Therapies, June 16, 2015
  • Church, Systematic Review and Meta-analysis of Chiropractic Care and Cervical Artery Dissection: No Evidence for Causation, 2016
  • Cassidy, Risk of Carotid Stroke after Chiropractic Care: A Population-Based Case-Crossover Study, 2016
ROTHWELL, STROKE, MAY 2001
CHIROPRACTIC MANIPULATION AND STROKE: A POPULATION-BASED CASE-CONTROL STUDY

Rothwell DM, Bondy SJ, Williams JJ.

BACKGROUND AND PURPOSE: Several reports have linked chiropractic manipulation of the neck to dissection or occlusion of the vertebral artery... We designed a population-based nested case-control study to test the association.
METHODS: Hospitalization records were used to identify vertebralbasilar accidents (VBAs) in Ontario, Canada, during 1993-1998. Each of 582 cases was age and sex matched to 4 controls from the Ontario population with no history of stroke at the event date. Public health insurance billing records were used to document use of chiropractic services before the event date.
RESULTS: Results for those aged <45 years showed VBA cases to be 5 times more likely than controls to have visited a chiropractor within 1 week of the VBA (95% CI from bootstrapping, 1.32 to 43.87). Additionally, in the younger age group, cases were 5 times as likely to have had ≥3 visits with a cervical diagnosis in the month before the case’s VBA date (95% CI from bootstrapping, 1.34 to 18.57). No significant associations were found for those aged ≥45 years.
CONCLUSIONS: While our analysis is consistent with a positive association in young adults, potential sources of bias are also discussed. The rarity of VBAs makes this association difficult to study despite high volumes of chiropractic treatment. Because of the popularity of spinal manipulation, high-quality research on both its risks and benefits is recommended.
Risk of Vertebrobasilar Stroke and Chiropractic Care

Results of a Population-Based Case-Control and Case-Crossover Study

J. David Cassidy, DC, PhD, DrMedSc,*†‡ Eleanor Boyle, PhD,* Pierre Cote´, DC, PhD,*†‡§ Yaohua He, MD, PhD,* Sheila Hogg-Johnson, PhD,†§ Frank L. Silver, MD, FRCP, † and Susan J. Bondy, PhD†
STUDY DESIGN. Population-based, case-control and case-crossover study

OBJECTIVE. To investigate associations between chiropractic visits and vertebrobasilar artery (VBA) stroke and to contrast this with primary care physician (PCP) visits and VBA stroke.
METHODS. Cases included eligible incident VBA strokes admitted to Ontario hospitals from April 1, 1993 to March 31, 2002. Four controls were age and gender matched to each case. Case and control exposures to chiropractors and PCPs were determined from health billing records in the year before the stroke date. In the case-crossover analysis, cases acted as their own controls.
RESULTS. There were 818 VBA strokes hospitalized in a population of more than 100 million person-years. In those aged <45 years, cases were about three times more likely to see a chiropractor or a PCP before their stroke than controls. Results were similar in the case control and case crossover analyses. There was no increased association between chiropractic visits and VBA stroke in those older than 45 years. Positive associations were found between PCP visits and VBA stroke in all age groups. Practitioner visits billed for headache and neck complaints were highly associated with subsequent VBA stroke.
CONCLUSION. VBA stroke is a very rare event in the population. The increased risks of VBA stroke associated with chiropractic and PCP visits is likely due to patients with headache and neck pain from VBA dissection seeking care before their stroke. We found no evidence of excess risk of VBA stroke associated chiropractic care compared to primary care.
ROTHWELL—CASSIDY LINKAGES

- Both from the University of Toronto
- Both used the same data set for their analysis, updated for the time period of each respective study
- Both included a shared researcher: Susan J. Bondy, Ph.D.
- Both published in Front Line Journals
- Both found increased risk associated with chiropractic visits
  - Rothwell did not have any other provider evaluation/comparison
  - Cassidy compared DCs and primary care physicians (PCPs)
- Both found a noteworthy change in outcomes and risk > 45 years of age
KOSLOFF, CHIROPRACTIC AND MANUAL THERAPIES, JUNE 16, 2015

CHIROPRACTIC CARE AND THE RISK OF VERTEBROBASILAR STROKE: RESULTS OF A CASE–CONTROL STUDY IN U.S. COMMERCIAL AND MEDICARE ADVANTAGE POPULATIONS

Thomas M Kosloff1*,†, David Elton1†, Jiang Tao2† and Wade M Bannister2†
KOSLOFF, CHIROPRACTIC AND MANUAL THERAPIES, JUNE 16, 2015

BACKGROUND: There is controversy surrounding the risk of manipulation, which is often used by chiropractors, with respect to its association with vertebrobasilar artery system (VBA) stroke. The objective of this study was to compare the associations between chiropractic care and VBA stroke with recent primary care physician (PCP) care and VBA stroke.
KOSLOFF, CHIROPRACTIC AND MANUAL THERAPIES, JUNE 16, 2015

Methods: The study design was a case-control study of commercially insured and Medicare Advantage (MA) health plan members in the U.S. population between January 1, 2011 and December 31, 2013. Administrative data were used to identify exposures to chiropractic and PCP care. Separate analyses using conditional logistic regression were conducted for the commercially insured and the MA populations. The analysis of the commercial population was further stratified by age (<45 years >45 years). Odds ratios were calculated to measure associations for different hazard periods. A secondary descriptive analysis was conducted to determine the relevance of using chiropractic visits as a proxy for exposure to manipulative treatment.
RESULTS: There were a total of 1,829 VBA stroke cases (1,159 – commercial; 670 – MA). The findings showed no significant association between chiropractic visits and VBA stroke for either population or for samples stratified by age. In both commercial and MA populations, there was a significant association between PCP visits and VBA stroke incidence regardless of length of hazard period. The results were similar for age-stratified samples. The findings of the secondary analysis showed that chiropractic visits did not report the inclusion of manipulation in almost one third of stroke cases in the commercial population and in only 1 of 2 cases of the MA cohort.
Conclusions: We found no significant association between exposure to chiropractic care and the risk of VBA stroke. We conclude that manipulation is an unlikely cause of VBA stroke. The positive association between PCP visits and VBA stroke is most likely due to patient decisions to seek care for the symptoms (headache and neck pain) of arterial dissection. We further conclude that using chiropractic visits as a measure of exposure to manipulation may result in unreliable estimates of the strength of association with the occurrence of VBA stroke.
CASSIDY—KOSLOFF LINKAGES

• **The under and over 45 years of age marker still exists**

• **Cassidy, Re: Association** “Our population-based case-control and case-crossover study shows an association between chiropractic visits and VBA strokes. However, we found a similar association between primary care physician visits and VBA stroke.”

• **Kosloff, Re: Association** “We found no significant association between exposure to chiropractic care and the risk of VBA stroke.”

• **Cassidy, Re: Causation:** “We have not ruled out neck manipulation as a potential cause of some VBA strokes.”

• **Kosloff, Re: Causation:** “However, the current study does not exclude cervical manipulation as a possible cause or contributory factor in the occurrence of VBA stroke.”
SYSTEMATIC REVIEW AND META-ANALYSIS OF CHIROPRACTIC CARE AND CERVICAL ARTERY DISSECTION: NO EVIDENCE FOR CAUSATION

Church et al., Department of Neurosurgery, Penn State Hershey Medical Center

SYSTEMATIC REVIEW AND META-ANALYSIS OF CHIROPRACTIC CARE AND CERVICAL ARTERY DISSECTION: NO EVIDENCE FOR CAUSATION

The annual incidence of internal carotid artery dissection has been estimated at 2.5–3 per 100,000 patients and that of vertebral artery dissection at 1–1.5 per 100,000. Stroke occurs in a small proportion of those with CAD, and its true incidence is difficult to estimate. Overall, dissection accounts for two percent of all ischemic strokes.
SYSTEMATIC REVIEW AND META-ANALYSIS OF CHIROPRACTIC CARE AND CERVICAL ARTERY DISSECTION: NO EVIDENCE FOR CAUSATION

Recent reports, including case control studies, have suggested an association between chiropractic neck manipulation and cervical dissection. Notably, a recent study from the American Heart Association evaluated the available evidence and concluded such an association exists. This report did not include a meta-analysis, nor did it seek to classify studies and grade the body of evidence. We sought to examine the strength of evidence related to this question by performing a systematic review, meta-analysis, and evaluation of the body of evidence as a whole.
SYSTEMATIC REVIEW AND META-ANALYSIS OF CHIROPRACTIC CARE AND CERVICAL ARTERY DISSECTION: NO EVIDENCE FOR CAUSATION

The results of our systematic review and meta-analysis suggest a small association between chiropractic care and CAD. There are no Class I studies addressing this issue, and this conclusion is based on five Class II and III studies. Scrutiny of the quality of the body of data using the GRADE criteria revealed that it fell within the “Very Low” category. We found no evidence for a causal link between chiropractic care and CAD. This is a significant finding because belief in a causal link is not uncommon.
Systematic review and meta-analysis of chiropractic care and cervical artery dissection: no evidence for causation

We uncovered evidence for considerable risk of bias and confounding in the available studies. In particular, the known association of neck pain both with cervical artery dissection and with chiropractic manipulation may explain the relationship between manipulation and CAD. There is no convincing evidence to support a causal link, and unfounded belief in causation may have dire consequences.
RISK OF CAROTID STROKE AFTER CHIROPRACTIC CARE: A POPULATION-BASED CASE-CROSSOVER STUDY

Article in Press

J. David Cassidy, DC, PhD, DrMedSc,*†‡ Eleanor Boyle, PhD,*† Pierre Côté, DC, PhD,‡§ Sheila Hogg-Johnson, PhD, ||¶ Susan J. Bondy, PhD,‡ and Scott Haldeman, MD, PhD#

Journal of Stroke and Cerebrovascular Disease, 2016
RISK OF CAROTID STROKE AFTER CHIROPRACTIC CARE: A POPULATION-BASED CASE-CROSSOVER STUDY

BACKGROUND: CHIROPRACTIC MANIPULATION IS A POPULAR TREATMENT FOR NECK PAIN AND HEADACHE, BUT MAY INCREASE THE RISK OF CERVICAL ARTERY DISSECTION AND STROKE. PATIENTS WITH CAROTID ARTERY DISSECTION CAN PRESENT WITH NECK PAIN AND/OR HEADACHE BEFORE EXPERIENCING A STROKE. THESE ARE COMMON SYMPTOMS SEEN BY BOTH CHIROPRACTORS AND PRIMARY CARE PHYSICIANS (PCPs). WE AIMED TO ASSESS THE RISK OF CAROTID ARTERY STROKE AFTER CHIROPRACTIC CARE BY COMPARING ASSOCIATION BETWEEN CHIROPRACTIC AND PCP VISITS AND SUBSEQUENT STROKE.
RISK OF CAROTID STROKE AFTER CHIROPRACTIC CARE: A POPULATION-BASED CASE-CROSSOVER STUDY

METHODS: A POPULATION-BASED, CASE-CROSSOVER STUDY WAS UNDERTAKEN IN ONTARIO, CANADA. ALL INCIDENT CASES OF CAROTID ARTERY STROKE ADMITTED TO HOSPITALS OVER A 9-YEAR PERIOD WERE IDENTIFIED. CASES SERVED AS THEIR OWN CONTROLS. EXPOSURES TO CHIROPRACTIC AND PCP SERVICES WERE DETERMINED FROM HEALTH BILLING RECORDS.
RISK OF CAROTID STROKE AFTER CHIROPRACTIC CARE: A POPULATION-BASED CASE-CROSSOVER STUDY

RESULTS: We compared 15,523 cases to 62,092 control periods using exposure windows of 1, 3, 7, and 14 days prior to the stroke. Positive associations were found for both chiropractic and PCP visits and subsequent stroke in patients less than 45 years of age. These associations tended to increase when analyses were limited to visits for neck pain and headache-related diagnoses. There was no significant difference between chiropractic and PCP risk estimates. We found no association between chiropractic visits and stroke in those 45 years of age or older.
RISK OF CAROTID STROKE AFTER CHIROPRACTIC CARE: A POPULATION-BASED CASE-CROSSOVER STUDY

Conclusions: We found no excess risk of carotid artery stroke after chiropractic care. Associations between chiropractic and PCP visits and stroke were similar and likely due to patients with early dissection-related symptoms seeking care prior to developing their strokes.
POLICY STATEMENTS RELATED TO CERVICAL SPINE ADJUSTING AND VERTEBRAL ARTERY ISSUES

Cervical Arterial Dissection and Association With Cervical Manipulative Therapy

- Joint American Heart Association and American Stroke Association Statement
- Jose Biller, MD, Chair
- 2014
- http://stroke.ahajournals.org/content/45/10/3155
INTERNAL FORCES SUSTAINED BY THE VERTEBRAL ARTERY DURING SPINAL MANIPULATIVE THERAPY

Bruce P. Symons, DC, Tim Leonard, Walter Herzog, PhD
DOI: http://dx.doi.org/10.1067/mmt.2002.12707

OBJECTIVES: Our objectives were to quantify the strains and forces sustained by the vertebral artery (VA) in situ during SMT.

STUDY DESIGN: This was a cadaveric study.
METHODS: Six VAs were obtained from 5 unembalmed post rigour cadavers. The cephalad/distal (C0-C1) and caudal/proximal (C6-subclavian artery) loops of the VA were carefully exposed and instrumented with a pair of piezoelectric ultrasonographic crystals. The strains between each crystal pair were recorded during range of motion testing and diagnostic tests and during a variety of SMT procedures. The VA was then dissected free and strained on a materials testing machine until mechanical failure occurred.
RESULTS: SMT performed on the contralateral side of the cervical spine resulted in an average strain of 6.2% ± 1.3% to the distal (C0-C1) loop of the VA and a 2.1% ± 0.4% strain to the proximal (C6) loop. These values were similar to or lower than the strains recorded during diagnostic and range of motion testing. Failure testing demonstrated that the VAs could be stretched to 139% to 162% of their resting length before mechanical failure occurred. Therefore the strains sustained by the VA during SMT represent approximately one ninth of the strain at mechanical failure.
Conclusions: SMT resulted in strains to the VA that were almost an order of magnitude lower than the strains required to mechanically disrupt it. We conclude that under normal circumstances, a single typical (high-velocity/low-amplitude) SMT thrust is very unlikely to mechanically disrupt the VA. (J Manipulative Physiol Ther 2002;25:504-10)
STRAIN RELATED ISSUES AND DISCUSSION

PRELIMINARY REPORT: BIOMECHANICS OF VERTEBRAL ARTERY SEGMENTS C1-C6 DURING CERVICAL SPINAL MANIPULATION

SARAH WUEST, DC, BRUCE SYMONS, DC, TIMOTHY LEONARD, MSc, WALTER HERZOG, PhD;

DOI: HTTP://DX.DOI.ORG/10.1016/J.JMPT.2010.03.007

OBJECTIVE

THE PURPOSE OF THIS STUDY WAS TO MEASURE STRAINS IN THE HUMAN VERTEBRAL ARTERY (VA) WITHIN THE CERVICAL TRANSVERSE FORAMINA AND REPORT THE FIRST RESULTS ON THE MECHANICAL LOADING OF SEGMENTS OF THE VA DURING SPINAL MANIPULATION OF THE CERVICAL SPINE.
METHODS: Eight piezoelectric ultrasound crystals of 0.5-mm diameter were sutured into the lumen of the left and right VA of one cadaver. Four hundred–nanosecond ultrasound pulses were sent between the crystals to measure the instantaneous lengths of the VA segments (total segments n = 14) at a frequency of 200 Hz. Vertebral artery engineering strains were then calculated from the instantaneous lengths during cervical spinal range of motion testing, chiropractic cervical spinal manipulation adjustments, and vertebrobasilar insufficiency testing.
STRAIN RELATED ISSUES AND DISCUSSION

RESULTS: The results of this study suggest complex and nonintuitive strain patterns of the VA within the cervical transverse foramina. Consistent (for 2 chiropractors) and repeatable (for 3 repeat measurements for each chiropractor) elongation and shortening of adjacent VA segments were observed simultaneously and could not be explained with a simple model of neck movement. We hypothesized that they were caused by variations in the location and stiffness of the VA fascial attachments to the vertebral foramina and by coupled movements of the cervical vertebrae. However, in agreement with previous work on VA strains proximal and distal to the cervical transverse foramina, strains for cervical spinal manipulations were consistently lower than those obtained for cervical rotation.
STRAIN RELATED ISSUES AND DISCUSSION

CONCLUSIONS: Although general conclusions should not be drawn from these preliminary results, the findings of this study suggest that textbook mechanics of the VA may not hold, that VA strains may not be predictable from neck movements alone, and that fascial connections within the transverse foramina and coupled vertebra movements may play a crucial role in VA mechanics during neck manipulation. Furthermore, the engineering strains during cervical spinal manipulations were lower than those obtained during range of motion testing, suggesting that neck manipulations impart stretches on the VA that are well within the normal physiologic range of neck motion.
STRAIN RELATED ISSUES AND DISCUSSIONS

VERTEBRAL ARTERY STRAINS DURING HIGH-SPEED, LOW AMPLITUDE CERVICAL SPINAL MANIPULATION

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HTTP://DX.DOI.ORG/10.1016/J.JELEKIN.2012.03.005
STRAIN RELATED ISSUES AND DISCUSSIONS

Spinal manipulative therapy (SMT) has been recognized as an effective treatment modality for many back, neck and musculoskeletal problems. One of the major issues of the use of SMT is its safety, especially with regards to neck manipulation and the risk of stroke. The vast majority of these accidents involve the vertebro-basilar system, specifically the vertebral artery (VA) between C2/C1. However, the mechanics of this region of the VA during SMT are unexplored.
STRAIN RELATED ISSUES AND DISCUSSIONS

Here, we present first ever data on the mechanics of this region during cervical SMT performed by clinicians. VA strains obtained during SMT are significantly smaller than those obtained during diagnostic and range of motion testing, and are much smaller than failure strains. We conclude from this work that cervical SMT performed by trained clinicians does not appear to place undue strain on VA, and thus does not seem to be a factor in vertebro-basilar injuries.
CONCLUSION: The results from this study demonstrate that average and maximal VA strains during high-speed low-amplitude cervical spinal manipulation are substantially less than the strains that can be achieved during ROM testing for all vertebral artery segments.

Furthermore, VA strains obtained during SMT and ROM testing are substantially smaller than average failure strains. Therefore, we conclude that cervical spinal manipulations, as tested here, are safe from a mechanical point of view for normal, healthy VA.
VERTEBRAL ARTERY GEOMETRY AND CERVICAL SPINE ADJUSTING

Changes in vertebral artery blood flow following various head positions and cervical spine manipulation.

Quesnele, JJ, Triano, JJ, Noseworthy MD, Wells, GD


Objective:

The objective of the study was to investigate the cerebrovascular hemodynamic response of cervical spine positions including rotation and cervical spine manipulation in vivo using magnetic resonance imaging technology on the vertebral artery (VA).
VERTEBRAL ARTERY GEOMETRY AND CERVICAL SPINE ADJUSTING

METHODS: This pilot study was conducted as a blinded examiner cohort with 4 randomized clinical tasks. Ten healthy male participants aged 24 to 30 years (mean, 26.8 years) volunteered to participate in the study. None of the participants had a history of disabling neck, arm, or headache pain within the last 6 months. They did not have any current or history of neurologic symptoms. In a neutral head position, physiologic measures of VA blood flow and velocity at the C1-2 spinal level were obtained using phase-contrast magnetic resonance imaging after 3 different head positions and a chiropractic upper cervical spinal manipulation. A total of 30 flow-encoded phase-contrast images were collected over the cardiac cycle, in each of the 4 conditions, and were used to provide a blood flow profile for one complete cardiac cycle. Differences between flow (in milliliters per second) and velocity (in centimeters per second) variables were evaluated using repeated-measures analysis of variance.
VERTEBRAL ARTERY GEOMETRY AND CERVICAL SPINE ADJUSTING

RESULTS: The side-to-side difference between ipsilateral and contralateral VA velocities was not significant for either velocities (P = .14) or flows (P = .19) throughout the conditions. There were no other interactions or trends toward a difference for any of the other blood flow or velocity variables.

CONCLUSIONS: There were no significant changes in blood flow or velocity in the vertebral arteries of healthy young male adults after various head positions and cervical spine manipulations.

Courtesy: John Triano, DC, PhD
MY THANKS TO YOU FOR YOUR KIND ATTENTION

ALL THE BEST FOR A WONDERFUL HOLIDAY SEASON!

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