Atlas Vertebra Realignment and Arterial Blood Pressure Regulation in 42 Subjects

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ABSTRACT

Objective: To investigate the effect of the Atlas Orthogonal (AO) upper cervical adjustment on arterial blood pressure (ABP).

Methods: Forty-two patients in a private chiropractic practice met and participated in the study. Upon radiological examination, coordinate values were recorded per AO Technique. Pre and post adjustment ABP measurements were recorded for the following groups: Hypotensive, Normotensive, Pre-Hypertensive, Stage One Hypertensive, and Stage Two Hypertensive. Atlas was adjusted utilizing the AO technique. No adverse events were recorded.

Results: Pre-Hypertensive, Stage One Hypertensive, and Stage Two Hypertensive groups had a statistically significant decrease in ABP. There was an increase in ABP in the Hypotensive group.

Conclusion: These findings suggest realignment of the atlas does not simply lower ABP but may also be part of a systemic homeostatic mechanism not yet completely understood. The same adjustment that decreased hypertensive ABP measurements also increased hypotensive ABP measurements to more normal levels. Exploration into the potential cause of these observed effects is also discussed.

Keywords: Atlas, upper cervical, hypertension, blood pressure, chiropractic, antihypertensive therapy

Introduction

This paper explores the proposed connection between misalignments of the atlas vertebrae as it relates to the regulation of ABP in the body. Misalignment of the atlas with its surrounding structures is sometimes pain free and has been linked in the literature with postural distortion, headaches, arterial hypertension, tinnitus, Tourette’s Syndrome, cerebral palsy, bowel dysfunction, asthma, multiple sclerosis, Arnold-Chiari malformation, autism, neck pain, cervicalbrachial pain, motor vehicle injuries, lower back pain, Parkinson’s Disease, Fibromyalgia, vertigo, and hearing loss. The articulations of the upper cervical spine have been described by White and Panjabi as “the most complex joints of the axial skeleton, both anatomically and kinematically.”

Both the atlantooccipital and the atlantoaxial joints have no intervertebral discs linking them with the occipital condyles or adjacent vertebrae as seen with other levels of the spine located inferiorly. They rely on a double condylar joint structure superiorly and inferiorly with an anterior pivot joint. The atlas has a posterior and anterior arch connecting two lateral masses in place of the normal vertebral body or spinous process. These latter structures contribute to osseous stability at lower vertebral levels, stacking one block on top of the other.

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Further guiding normal lower cervical spinal motion are the uncinate processes and the lamina, structures anatomically absent from the atlas. As a result, stability and proper alignment of these upper cervical joints are primarily due to a balance of the muscular contraction and soft tissue tension supporting the area.

The movements of the atlas in particular are primarily passive and are governed by the larger muscles acting upon the head. This unique relationship between the occipital condyles of the skull, the atlas and the axis vertebrae leaves the atlas “uniquely vulnerable to displacement.”

Review of Literature

A search of the literature from 2001 to the present specifically involving “upper cervical chiropractic” and “blood pressure” revealed one double-blind, placebo controlled study conducted at the University of Chicago Pritzker School Of Medicine in 2007. The lead author George Bakris, MD, is a renowned doctor and researcher in the field of hypertension. He worked in conjunction with Marshall Dickholtz, Sr., DC, a chiropractor specializing in NUCCA upper cervical chiropractic technique. The authors implemented the upper cervical chiropractic technique NUCCA from the National Upper Cervical Chiropractic Association and concluded the effects of correcting the position of the atlas bone were equivalent to giving two different antihypertensive agents simultaneously to primary hypertensive patients.

All participants were washed out of their respective blood pressure medications previous to the study. The findings demonstrated a decrease in arterial blood pressure (ABP) following the correction of atlas misalignments. The treatment effect for the systolic value, adjusted for baseline, was an average change of -13.2 ±2.9 mm Hg, and for the diastolic value, -7.6 ±2.3 mm Hg, adjusting for baseline. The 70% male cohort consisted of 50 patients with documented Stage 1 hypertension, average age was 52.7 ±9.6 years of age. The authors stated the observed reduction in blood pressure was “not associated with pain or pain relief” as none of the participants in the study reported pain and the change persisted at eight weeks after the study’s completion.

Knutson, published a study on blood pressure in 2001. His cohort ranged from normotensive, borderline hypertensive and hypertensive patients and was divided into two groups, a treatment and a control. Each group was similar in number, age, and age range of participants. If the subject had atlas misalignment upon examination they were placed in the treatment group or a sham adjustment in the control group. After correction of the confirmed atlas misalignment in the treatment group or a sham adjustment in the control group (lying in a lateral decubitus position) a post-ABP was recorded and compared with the pre-ABP value.

In the treatment group there was a decrease in the systolic value on average of -10.3 ±2.5 mm Hg, and there was no change in diastolic values for this group. The changes in systolic or diastolic values in the control group did not reach statistical significance. This non-blind study demonstrated that there was a statistically significant change in systolic values.

One inherent flaw in this study was assigning all of the misaligned patients to the treatment group and all of his “normal” patients to the control group. A more significant assessment may have been attained had both misaligned and aligned patients been included in both cohorts. While this design flaw does dilute comparison findings between treatment and control groups, it does not change the findings as they pertain to the statistically significant changes observed in the treatment group, pre versus post treatment.

Purpose

The primary purpose of the study was to investigate the effectiveness of the AO upper cervical chiropractic technique and its effect on ABP. The study conducted by Bakris and Dickholtz at the Pritzker School of Medicine in Chicago involved only stage one hypertensive patients. The author preferred the design aspect of the Knutson study utilizing a non-specific generic sampling of chiropractic patients to explore the relationship between upper cervical misalignment and ABP.

However, in contrast to the Knutson study design, this author felt it imperative to include a broad spectrum of ABP measurements in the cohort, inclusive of normotensive, hypotensive and hypertensive ABP’s. This author felt it might lead to a more sensitive assessment of the true regulation of ABP, not just in a decrease in ABP previously so effectively demonstrated. If the same adjustment both decreased higher ABP and increased lower ABP then it would indicate there is a yet unknown or unidentified homeostatic mechanism at work rather than a simple cause and effect.

Guyton defines “homeostasis” as the maintenance of a static or constant condition in the internal environment of the body. Homeostasis has also been described as the maintenance of the normal internal stability of an organism by coordinated responses of the organ systems that automatically compensate for environmental changes. Returning the body to natural homeostatic regulation of its systems through the nervous system has always been the primary focus of traditional chiropractic. Therefore, the author believed this study might provide evidence that the body could return to a more normal, homeostatic state regardless of whether hypertension or hypotension were present.

Methods

The procedures used in this study were performed in accordance with the Declaration of Helsinki (2000) and permission was obtained from the patients for participation and to publish these findings. It was reviewed by the Independent Review Board of the Foundation for Vertebral Subluxation.

The cohort study was conducted in a private chiropractic practice. Inclusion criteria for subjects was as follows: (1) a misalignment of the atlas bone confirmed by physical exam and x-ray analysis, and (2) the absence of (a) red flags or other significant findings (past cardiothoracic surgery or angina symptoms, past fracture, pacemaker) that would preclude inclusion in the study, (b) suspected or admitted drug addiction or (c) pregnancy, (3) a history of “white coat”
hypertension, and (4) excessive daily activity or abnormally high intensity exercise routines beyond what would be considered average. The cohort was selected from current active patients within the practice and consisted of 16 males and 26 females, between the ages of 15 and 80 years of age with an average age of 47.3 years of age.

Specific cervical radiographs were attained for each subject using a Bennett Model 325 X-ray generator and examined to investigate upper cervical architecture and misalignment of the atlas. Coordinate values were calculated using these radiographs to enable the proper alignment of the atlas vertebrae as per the methods of the upper cervical specific AO technique.

Using a Welch Allyn Tycos sphygmomanometer and a Harvey Elite stethoscope three ABP readings were obtained before the adjustment was administered to all subjects and an initial calculated average ABP for each patient was identified. All patients were seated comfortably for approximately five minutes before readings were obtained, subjects were instructed to not perform any exercise or similar physical activity and to not consume alcohol or nicotine to insure a normal resting ABP value.

Temperature in the office was maintained at approximately 74±1 degrees Fahrenheit. Hypotensive readings were those with systolic values equal to or less than 90 mmHg and diastolic values equal to or less than 60 mmHg.39 Normotensive readings were those with systolic values between 91 and 120 mmHg and diastolic values between 61 and 80 mmHg. Pre-hypertensive readings were those with systolic values between 121 and 139 mmHg and diastolic values between 81 and 99 mmHg.

Stage one and stage two hypertensive values were those with systolic measurements of 140 mmHg or above and diastolic measurements at or above 90 mmHg.40,41 After all of the initial ABP’s were recorded, there were 12 hypotensive readings, 12 normotensive readings, 10 pre-hypertensive readings, and 8 stage 1 or stage 2 hypertensive readings.

Using the AO Adjusting Instrument the atlas was adjusted according to the coordinate values determined from the radiographs. Proper post-adjustment measures as per AO technique were obtained to insure accurate correction of the atlas displacement. After the adjustment was performed the patient sat upright approximately one to two minutes and a post-adjustment ABP measurement was attained and recorded. The average pre-treatment and post-treatment values are categorized and listed in Table 1.

**Results**

The data were analyzed using paired t tests to measure the statistical difference between the pre and post variables for significance in each of three groups: Group 1- hypotensives, Group 2- normotensives and Group 3- hypertensives, inclusive of pre-hypertensive, stage one and stage two hypertensive measures.

For the hypotensive group that demonstrated an increase in ABP: the systolic results after the adjustment demonstrated a two-tailed P value of less than 0.0001. The average pre-treatment systolic pressure was 84.33 mmHg with a standard deviation of 2.93. The average post-treatment systolic pressure was 98.17 mmHg with a standard deviation of 3.01. The mean change in systolic values calculated was 13.83 mmHg with a standard deviation of 4.13. The results for the change in diastolic values in that same group demonstrated a two-tailed P value of 0.0003.

The average pre-treatment diastolic pressure was 64.83 mmHg with a standard deviation of 2.76. The average post-treatment diastolic pressure was 73.67 mmHg with a standard deviation of 4.58. The mean difference between pre and post diastolic measurements was found to be 8.83 mm Hg with a standard deviation of 5.81.

For the group that was normotensive: the average pre-treatment systolic pressure was 108.92 mmHg with a standard deviation of 8.82. The average post-treatment systolic pressure was 105.00 mmHg with a standard deviation of 2.89. The mean change in systolic values calculated was -3.92 mmHg with a standard deviation of 7.82.

The results for the change in diastolic values in that same group demonstrated a two-tailed P value of 0.1107. The average pre-treatment diastolic pressure was 75.08 mmHg with a standard deviation of 5.84. The average post-treatment diastolic pressure was 73.50 mmHg with a standard deviation of 1.93. The mean difference between pre and post diastolic measurements was found to be -1.58 mmHg with a standard deviation of 4.50 and a two-tailed P value of 0.2486.

The systolic values for the pre-hypertensive and hypertensive stage one and stage two groups that resulted in a decrease in ABP values were analyzed together. The average pre-treatment systolic pressure was 152.61 mmHg with a standard deviation of 29.46. The average post-treatment systolic pressure was 132.39 mmHg with a standard deviation of 21.83. The mean change in systolic values calculated was -20.22 mmHg with a standard deviation of 10.49 and a two-tailed P value of less than 0.0001.

The results for the change in diastolic values in that same group also demonstrated a two-tailed P value of less than 0.0001. The average pre-treatment diastolic pressure was 83.83 mmHg with a standard deviation of 4.83. The average post-treatment diastolic pressure was 77.00 mmHg with a standard deviation of 4.81. The mean difference between pre and post diastolic measurements was found to be -6.83 mmHg with a standard deviation of 3.79.

**Discussion**

The atlanto-occipital (Co-C1) and the lateral atlantoaxial (C1- C2) zygapophyseal joints receive their innervation from the ventral rami of the C1 and C2 nerve roots.42 This afferent information is processed by nerves traversing the dorsal root ganglion (DRG). Colloca et al first demonstrated the link between mechanical spinal motion and resultant neurophysiologic responses or compound action potentials in a human population.43 This response is mediated via the somatic afferents of the
in the medial NTS that send their axons through the Deuchars who identified a subpopulation of baroreceptive neurons that are sensitive to changes in blood pressure. These neurons are part of the baroreceptor reflex, which helps to regulate blood pressure. 

Edwards stated “the projections from the cervical DRG to the InM (intermediate nucleus of the medulla, or nucleus intermedius) have been proposed to be proprioceptive, which suggests that activity within the InM is heavily influenced by the position of the head relative to the trunk.” He also recognized that chemical or electrical stimulation of the InM resulted in “monosynaptic excitatory and inhibitory projections from the InM to the NTS (Nucleus of Solitary Tract).” This neurologic connection was explored earlier by Deuchars who identified a subpopulation of baroreceptive neurons in the medial NTS that send their axons through the InM.

The NTS has been identified as a site of cardiorespiratory regulation since 2003. Afferent proprioceptive input from mechanoreceptors of the upper cervical spine may be responsible for the physiologic response of the cells within the InM and thereafter in the NTS. A question arises: Is this anatomical connection what enables the mechanical stimulation of the upper cervical spinal motor units to alter or regulate vasomotor tone?

The regulation of arterial blood pressure is a vital daily function. The question of why the body would want to down-regulate hypertension is more easily understood than the converse as the dangers of hypertension are well known. The American Heart Association identifies disease processes such as coronary heart disease, stroke, heart failure and end-stage renal disease as some complications due to hypertension.

Less understood would be why the body would want to up-regulate lower ABP. The dangers of hypotension are less well known and less severe but can be identified as syncope, cognitive dysfunction, shock, falls due to fainting, weakness, or minor to moderate oxygen deprivation that can lead to damage to the heart or brain.

The unique result of this small study was that the AO upper cervical adjustment demonstrated the ability to lower higher ABP values and the ability to raise lower ABP values. Were it not for the inclusion of hypotensive, normotensive, and hypertensive measures, these effects would not have been appreciated.

Edwards proposed that the same group of cells in the InM demonstrated both excitatory and inhibitory responses from the InM to the NTS. A better understanding of the differential activation of these specific cells in the future may better illuminate the neurologic or mechanistic action behind the results of this study. While previous studies have demonstrated this to be the case, this is the first study that demonstrated regulation of both hypertension and hypotension.

Further, the ability of an Atlas Orthogonal upper cervical adjustment in helping to regulate arterial blood pressure would be of tremendous benefit to the general population. This non-invasive, virtually painless therapeutic procedure may be of vital importance to populations such as renal transplant patients, those with a history of heart attack or stroke, and diabetics.

The study published by Bakris, et al demonstrated an effect similar to taking two hypertensive medications daily. This could lead one to the conclusion that this upper cervical specific adjustment may have positive economic ramifications for the American public also adding the benefit of a cost savings to insurance companies and therefore their policy holders as well as better general health for said population.

Limitations

This cohort study is not without limitations. Participants knew that their ABP was being measured. This may have influenced some subjects to focus on their heart beat and ABP possibly affecting their measured ABP values. Further, these results are based upon the abilities of one practitioner. This may be an issue as it pertains to reproducibility by other practitioners.

Results may vary with technique, efficacy of the upper cervical treatment employed and individual practitioner skill. Further, there was no specific control group measured to compare the presented research data from the participants, although the normotensive group may be considered a “normal” control. The study performed by Dr. Bakris assessed their cohort at an 8 week follow up period. Follow-up measurements were not sought from this cohort after the conclusion of the study to measure how long the effects lasted. ABP was measured only on the left arm of each participant, not bilaterally.

Repeating this study with a different study design utilizing average values attained from bilateral ABP measurements from each subject may have presented a slightly different outcome. Utilizing a control group that included subjects from each of the three categories investigated and attaining subsequent measurements a few months post experiment may have also had bearing on the outcome and may have led to a better understanding and investigation of the physiological outcome of the investigated upper cervical adjustment on ABP.

Funding sources and conflicts of interest

There were no funding sources necessary for the study implemented. There are no conflicts of interest and the author alone is responsible for the content of this paper.

References


Table 1. Displays Blood Pressure by Group in mmHg

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<thead>
<tr>
<th></th>
<th>Pre-systolic</th>
<th>Pre-diastolic</th>
<th>Post-systolic</th>
<th>Post-diastolic</th>
<th>Systolic change</th>
<th>Diastolic change</th>
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<tr>
<td>Hypotensive group</td>
<td>84.33</td>
<td>64.83</td>
<td>98.17</td>
<td>73.67</td>
<td>+13.84</td>
<td>+8.84</td>
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<tr>
<td>Normotensive group</td>
<td>108.92</td>
<td>75.08</td>
<td>105</td>
<td>73.5</td>
<td>-3.92</td>
<td>-1.58</td>
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<tr>
<td>Pre-hyper, Stage 1&amp;2 Hypertensive groups</td>
<td>152.61</td>
<td>83.83</td>
<td>132.39</td>
<td>77</td>
<td>-20.22</td>
<td>-6.83</td>
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