Chiropractic care of a patient with thoracic outlet syndrome and arrhythmia

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Received 7 July 2010; received in revised form 17 August 2010; accepted 7 September 2010

Key indexing terms:

Chiropractic;
Arrhythmia;
Thoracic outlet
syndrome;
Subclavian artery;
Cervical atlas

Abstract

Objective: The purpose of this article is to describe a case report and discuss a possible anatomical explanation of the occurrence of arrhythmias in patients with thoracic outlet syndrome (TOS).

Clinical Features: A 60-year-old man experienced arrhythmia when he turned his head to the left and had these symptoms for 7 years. The patient attributed his symptoms to TOS. The arrhythmia was triggered while performing an Adson test during the clinical evaluation.

Intervention and Outcome: The Grostic procedure as a measure of analysis of the biomechanical relationship of C1 to C0 and the lower cervical spine was performed. According to this analysis, the patient had a right laterality malposition of the atlas. High-velocity, low-amplitude manipulations (adjustments) were applied. The patient's symptoms improved after one visit and demonstrated resolution upon evaluation at the third visit. In the year following the initial presentation, he has had minor recurrent short-lived episodes of arrhythmia that abated with the atlas manipulation/adjustment.

Conclusion: There is a paucity of published reports describing the management of patients with arrhythmias through manipulative methods. This appears to be the first case that describes the successful amelioration of an arrhythmia associated with TOS using chiropractic adjustment of the atlas vertebra as the sole intervention.

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Introduction

Cardiac arrhythmias may be seen with a variety of disorders, including thoracic outlet syndrome (TOS).

There appears to be only one case of TOS and arrhythmia reported in the literature.¹ In another case report, tachycardia was linked with TOS and increased cardiac sympathetic activity. Kaymak et al² reported on a 22-year-old woman with the diagnosis of neurogenic TOS. The patient was evaluated with a Holter monitor during the performance of Roos test, both before and after surgical removal of her first rib. The tachycardia resolved after the surgery, and

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Kaymak et al postulated that the stellate ganglion or the postganglionic efferent sympathetic fibers forming the cardiac plexus were compressed while Roos test was being performed. There are a few reports of chiropractic care of patients with arrhythmias in the literature.³⁻⁵ Previous studies have demonstrated that spinal adjustment/manipulation appears to have had an effect on heart rate and blood pressure.⁶⁻⁸ In addition, stimulation of local cardiac nerves in animal experiments has induced arrhythmias.⁹ Arrhythmias are an uncommon presentation of TOS.¹⁰

This article discusses a patient who presented with cardiac arrhythmia and TOS, explores the relevance of this case to doctors of chiropractic and other health care practitioners, and suggests a hypothesis explaining the possible mechanism of structural and functional compromise.

Case report

Permission to have personal health information published without divulging person identifiers was obtained from the patient before the writing of this case report. A 60-year-old man had a chief complaint of an irregular heart rate when he turned his head to the left side. Secondary complaints included pain in the hip, thoracic spine, and neck. Medical history revealed similar prior episodes for approximately a 7-year period. Two months before our evaluation, he visited a local emergency department where an electrocardiogram was performed showing a pattern consistent with premature ventricular contractions.

Examination at the initial visit revealed a 6'1" white man weighing 214 lb, blood pressure of 112/78 mm Hg, and pulse of 68 per minute and regular. Chiropractic evaluation was performed using the protocols of supine leg check and radiograph examination based on the John F. Grostic Model and Procedure.¹¹ Eriksen and Rochester¹¹ report that inter- and intraexaminer reliability for the supine leg check was found to be very high and that reduction of a chiropractic upper cervical subluxation correlates with the balancing of the leg length inequality.

Supine leg check revealed a physiologic left leg length inequality of 3/8 in (.9525 cm). Cervical range of motion was within normal limits with the exception of left lateral flexion that was restricted to 30°/40° and left rotation that was restricted to 40°/60°. Adson test was performed by checking the patient's radial pulse and

then having the patient rotate his head to the left and extend the neck while taking a deep breath while holding it.¹² Performance of this test produced an irregular pulse. Upper cervical specific radiographic analysis included nasium, lateral, and vertex views and were analyzed using the Grostic procedure. Eriksen and Rochester¹¹ report that multiple studies on this method of upper cervical biomechanical assessment have shown good to excellent reliability with a 95% confidence interval.

The radiographic analysis demonstrated a biomechanical shift of right laterality and anterior rotation on the right at C1. The lower cervical spine had an acute angle on the right side relative to the atlas horizontal plane line. Practitioners familiar with orthogonal analysis procedures will recognize this as a right ipsilateral lower angle.

A high-velocity, low-amplitude thrust was delivered to the atlas using a vector determined by the Grostic analysis. After a rest period of approximately 5 minutes, the provocative Adson test was repeated and did not trigger any arrhythmias. Cervical range of motion after the first adjustment returned to normal. Leg length inequality balanced postmanipulation (postadjustment).

The patient was evaluated again 1 week later. Evaluation revealed a balanced functional leg length, and the patient reported having only occasional episodes (less than 1 per day) of arrhythmia during the 1-week period as compared with frequent daily episodes before the initial chiropractic adjustment. There was no chiropractic adjustment rendered on the second visit. The patient was instructed to return in 1 week. When the patient returned for the third visit, supine leg length evaluation demonstrated balanced leg length. The patient reported an absence of arrhythmias during the prior week. There was no chiropractic adjustment rendered on the third visit.

Approximately 2 weeks later, the patient presented with a complaint of arrhythmia observed on left cervical rotation. The supine leg check revealed a physiologic left leg length inequality of 3/8 in (.9525 cm). A specific high-velocity, low-amplitude chiropractic adjustment of the atlas was performed on this fourth visit and again 4 days later when evaluation demonstrated a left leg length inequality of 3/8 in (.9525 cm). After each adjustment, the leg length inequality balanced; and the Adson test did not trigger arrhythmias. Over the following 12-month period, this patient has only had minor recurrences on 5 occasions of the arrhythmia that responded positively to Grostic-style chiropractic intervention.

Discussion

Doctors of chiropractic have reported positive results in the treatment of some forms of cardiac disease with spinal adjust/manipulation.¹³ Somatovisceral and viscerosomatic reflexes have been used to explain improved cardiac function. Chiropractors have also reported positive results in ameliorating some of the symptoms of TOS. Thoracic outlet syndrome is a clinically recognized entity.¹⁴ There are 2 types of TOS: vascular and neurogenic. Pure neurogenic TOS is a clinical rarity, with a reported incidence of 1/1,000,000.¹⁵ In the neurogenic type of TOS, the motor nerves, sensory nerves, and sympathetic nerves may be affected. There are many well-known neurological manifestations of TOS. Compression of the sympathetic fibers in the brachial plexus may cause hyperhidrosis, Raynaud disease, or complex regional pain syndrome. Irritation of the stellate ganglion has been used as the explanation of the connection between arrhythmias and TOS. Animal experiments have shown that stimulation of the stellate ganglia bilaterally and unilaterally will induce an arrhythmia; however, the type of arrhythmia was not specified in these studies.¹⁶ Sympathetic activity of the heart may also be seen in patients with TOS. There are only 2 previously reported cases of TOS with cardiac irregularities. The first case was reported in the *Lancet* in 1998 by Yoshikawa et al¹ who presented a patient with TOS, angina pectoris, and arrhythmias. Yoshikawa et al postulated that irritation of nearby sympathetic nerve fibers in the brachial plexus might be the cause of the cardiac manifestations. Kaymak et al² in 2003 reported a patient with TOS and tachycardia during the performance of the Roos test.¹⁷ Kaymak et al related the patient's tachyarrhythmia to possible irritation of the stellate ganglion.

A closer look at the detailed anatomy of the thoracic outlet or the superior thoracic aperture reveals that the stellate ganglion, which is the fusion of the first thoracic sympathetic ganglion with the inferior cervical sympathetic ganglion, crosses the neck of the first rib.¹⁸ The stellate ganglion occurs in 75% to 80% of people and lies on or just lateral to the lateral border of the longus colli muscle between the bases of the transverse process of the seventh cervical vertebra and the neck of the first rib. In some people, fibrous bands may stretch from the tip of the transverse process of the seventh cervical vertebra to the first rib; or there may be a cervical rib in the same region. Cervical ribs occur in 0.01% of the population; and in about 50% of these, the cervical ribs are bilateral. Any tight fascial tissue or a

cervical rib may compress the stellate ganglion or the postganglionic sympathetic fibers that arise from the ganglion. The postganglionic fibers from the cervical and upper thoracic sympathetic ganglia contribute to the formation of the cardiac plexuses. The cardiac plexus is subdivided into superficial and deep portions. The superficial cardiac plexus is found lying below the arch of the aorta and receives postganglionic sympathetic fibers from the left superior cervical ganglion. The deep cardiac plexus lies behind the arch of the aorta and receives its postganglionic sympathetic fibers from the other cervical ganglia and from the upper 4 or 5 thoracic sympathetic ganglia bilaterally. The cardiac plexus receives parasympathetic fibers from the superior and inferior cardiac branches and the recurrent laryngeal nerves that are branches of the vagus nerve. Occasionally, the postganglionic sympathetic fibers may pierce the anterior scalene muscle. Therefore, the authors believe that abnormalities in this muscle may cause sympathetic cardiac hyperactivity. Increased cardiac sympathetic activity appears to be linked with arrhythmias.

The Adson test revealed a diminished radial pulse indicative of TOS.¹² In this test, the patient's radial pulse on the left side was palpated while the patient was asked to rotate his head to the left, extend the neck, and take a deep breath. His radial pulse was diminished during the test, triggering the arrhythmia. It is believed that, during this test, the subclavian artery was compromised by the narrowing of the scalene triangle through which the artery passes. The authors of this case report do not believe that the stellate ganglion is implicated in the maneuver and would like to suggest an alternate hypothesis that directly involves the subclavian artery. Their hypothesis is that the ansa subclavia was stretched and irritated during the Adson test when the patient rotated his head toward the left.

The first description of the ansa subclavia was in 1864 by Vieussens.¹⁹ He described this as a nerve loop surrounding the prescalene portion of the subclavian artery. Current anatomical texts describe the ansa subclavia as a nerve cord that forms a loop that passes below the first part of the subclavian artery and connects the middle and inferior cervical ganglia.^{18,20} The middle cervical ganglion is located at the level of the sixth cervical vertebra just superior or anterior to the inferior thyroid artery. Paturet²¹ in 1964 described several forms of the ansa subclavia including a flat band or several filaments. In addition, several anastomoses have been described between the ansa subclavia, the recurrent laryngeal nerves, and the

phrenic nerves in 1984 by Caliot et al.²² They reported that the sympathetic and recurrent laryngeal nerve anastomoses in 63% of the cadavers in their study on the right side. The description of the physiological functions of the ansa subclavia by Loukas et al²³ is largely based on animal models. The ansa subclavia distributes sympathetic fibers to the heart and the aortic bodies. Electrical stimulation of the ansa subclavia produces an overflow of norepinephrine and cyclic adenosine monophosphate levels into the coronary sinus blood. It activates the chronotropic and inotropic responses in the heart. Loukas et al found a difference in the cardiac responses between the stimulation of the right and left ansa subclavia. For example, there is a greater increase in the heart rate when the right is stimulated. Left-sided stimulation slightly increases the force of contraction of the right ventricle as compared with when the right side is stimulated. It is postulated that an imbalance of the rhythms of both ventricles may be due to the difference between the effects of stimulation of both right and left ansa subclavia. This hypothesis remains to be tested experimentally. The close relationship of the upper end of the extracranial part of the vagus to the atlas may explain how an atlas-specific chiropractic adjustment might ameliorate the effects of irritation of the ansa subclavia through its anastomoses with the vagus. The upper region of the extracranial course of the vagus lies within the carotid sheath along with the internal jugular vein and the internal carotid artery.²⁰ It lies on the anterior aspect of the transverse process of the atlas, with the superior cervical sympathetic ganglion lying in between the two.

The relationship of an atlas chiropractic subluxation and amelioration of cardiac symptoms may be similar to the amelioration of hypertension by an atlas-specific adjustment as described by Bakris et al²⁴ or in the treatment of infantile colic as reported by Wiberg et al.²⁵ The authors of this article theorize that the amelioration of the arrhythmia and hypertension may be linked to the moderating parasympathetic tone conveyed by the vagus directly on the heart through the cardiac plexus or on the ansa subclavia through the vagal anastomoses previously described in the article. The tachyarrhythmia in the 22-year-old female patient described by Kaymak et al² disappeared after she underwent surgery. During surgery, the first rib was resected; and this was followed by a scalenectomy. The patient in the current case report was offered a conservative nonsurgical option in the care and management of his arrhythmia.

Limitations

This case report presents an obvious limitation in that it involves a single subject. The results found in this patient may not be applicable to other patients, and there may be other reasons why the symptoms improved that are not associated with the treatment. Although the authors of this report offer the hypothesis of ansa subclavia nerve loop as the anatomical/neurophysiological explanation for this patient's symptomatic improvement, it is also plausible that firing of the mechanoreceptors in the muscles of the suboccipital triangle may be affecting the nucleus intermedius and thereby causing aberrant neurophysiology through the thalamic systems and subsystems. It would be interesting to investigate a case where cardiac arrhythmia is present along with a chiropractic upper cervical subluxation complex and confirmed through electrocardiogram where the Adson test result is negative and then to perform the appropriate upper cervical protocol, including the specific upper cervical chiropractic adjustment, and evaluate the arrhythmia postadjustment with an electrocardiogram. Additional case reports of this type may support the hypothesis offered by the authors of this article and identify any other contributing factors. Clinical situations with individual patients will require critical thinking when applying this hypothesis in their care and management.

Conclusion

This case report discusses the chiropractic care of a patient with an atlas malposition/subluxation and complaints suggestive of TOS and an arrhythmia. The authors have explored the literature regarding the association of arrhythmias and TOS and have postulated a possible link involving the ansa subclavia. In this case, chiropractic management of a patient presenting with arrhythmia and TOS was successful and may be considered in the evaluation of patients presenting with TOS. The authors suggest that more research is needed into the use of chiropractic in the treatment of arrhythmias. There is also a need to identify the exact mechanisms of arrhythmias related to TOS, as a better understanding of the underlying pathophysiology of this association may lead to the development of novel conservative approaches to its management.

Funding sources and potential conflicts of interest

There are no conflicts of interest or funding sources associated with this case report.

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