

## Chiropractic Care and the Cardiovascular System

Charles S. Masarsky, DC • Edward E. Cremata, DC

Cardiovascular disease is one of the main causes of mortality and morbidity in the industrialized world. Cardiovascular health is one of the most important aspects of physical fitness. For these reasons, understanding the neurologic influence over cardiovascular tone is an important consideration for doctors of chiropractic (DC) who are interested in the role of subluxation correction in general and vertebral subluxation complex (VSC) correction in particular in the overall health and wellness of their patients.

### Basic Neurologic Considerations

#### Neurologic Control of the Heart

The heart is the most sophisticated muscular organ in the human body. Even if all sympathetic and parasympathetic fibers were disconnected from the heart, it would maintain an automatic rhythm because of a series of specialized muscle fibers capable of self-excitation that are connected to a network of fibers modified for rapid conduction.<sup>1</sup> This rhythm originates with a body of specialized fibers in the right atrium, called the *sinus* or *sinoatrial* node. Impulses are conducted from the sinus node by internodal pathways to the atrioventricular node. From here, impulses are conducted to all parts of the ventricles by the left and right bundles of Purkinje fibers (Figure 10-1).

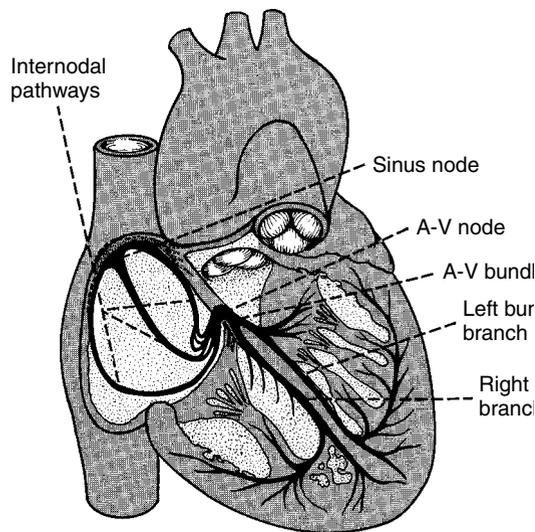
As impressive as this intrinsic neural structure may be, an isolated heart would not be able to

adapt its function to the needs of the rest of the body. Communication by parasympathetic, sympathetic, and sensory pathways is essential for coordinating cardiac tone with the physiology of the whole organism.

The parasympathetic innervation to the heart comes from cardiac branches of the vagus nerves. The terminal fibers of these vagus branches are most numerous at the sinus and atrioventricular nodes.<sup>2</sup> Vagal stimulation slows the rhythm of the sinus node while simultaneously decreasing the excitability of the internodal pathways. The net result is a slowing of heart rate and some decrease in the power of heart muscle contraction. Very strong stimulation of the vagi can cause cardiac arrest for up to 10 seconds.<sup>3</sup>

Sympathetic innervation to the heart originates from the first five thoracic spinal nerves. These preganglionic fibers synapse at the superior cervical, middle cervical, and stellate ganglia, from which postganglionic fibers reach the heart.<sup>4</sup> The effects of sympathetic stimulation are essentially the opposite of those caused by parasympathetic stimulation. Maximal stimulation can almost triple heart rate, while doubling the power of cardiac muscle contraction.<sup>5</sup>

Sensory innervation to the heart concerned with pain impulses generally follows the sympathetic efferent pathways outlined earlier, although some pain fibers reach the heart directly from the upper thoracic spine. General visceral afferent (nonpain) innervation to the heart is by the vagus nerves.<sup>6</sup>



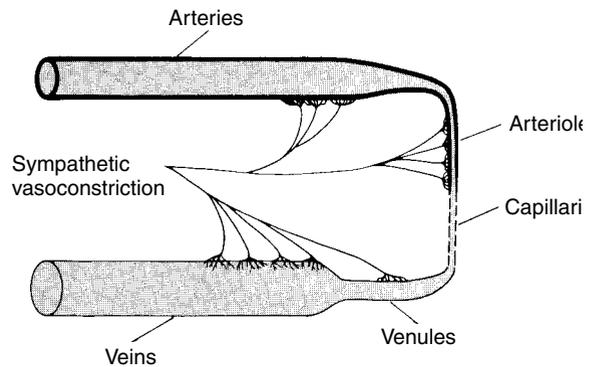
**Figure 10-1** The sinus node and the Purkinje system of the heart, showing also the A-V node, the atrial internodal pathways, and the ventricular bundle branches. (From Guyton AC: *Basic neuroscience: anatomy and physiology*, p 323, Philadelphia, 1991, WB Saunders.)

## Neurologic Control of Vasomotor Function

Vasoconstrictor fibers are distributed from the sympathetic chain ganglia to virtually all blood vessels other than capillaries and precapillary sphincters (Figure 10-2). In the resting condition, a partial state of vasoconstrictor tone is maintained in the blood vessels throughout the body. Outside of the heart, parasympathetic efferents play little role in regulating circulation.

The major sensory innervation to the blood vessels consists of a series of stretch receptors in the walls of most of the large arteries in the neck and thorax. These stretch receptors are generally referred to as *baroreceptors* or *pressoreceptors*.

Baroreceptors are particularly abundant in the carotid bodies, located in the internal carotid arteries just above their origin from the common carotid arteries. Baroreceptor signals from the carotid bodies are conducted to the brainstem by the glossopharyngeal nerves. Baroreceptors are also quite abundant in the arch of the aorta. Signals from aortic baroreceptors are conducted to the brainstem by the vagus nerves. Normal baroreception is necessary for maintaining constant arterial pressure during postural changes; failure of



**Figure 10-2** Sympathetic innervation of the systemic circulation. (From Guyton AC: *Basic neuroscience: anatomy and physiology*, p 323, Philadelphia, 1991, WB Saunders.)

baroreception can cause postural hypotension, resulting in vertigo or syncope.

The same vagus and glossopharyngeal pathways from the aortic arch and carotid bodies also serve chemoreceptors. These receptors are sensitive to changes in oxygen, carbon dioxide, and hydrogen ion content in the blood. Although vasomotor tone is strongly influenced by these peripheral sensory inputs, central influences are also important and should not be forgotten. The initiation of exercise, cerebral ischemia, and fear will generate reflex responses in the vasomotor system.<sup>7</sup>

## Cardiovascular Neuroanatomy and the Vertebral Subluxation Complex

Subluxation may affect the rate, rhythm, and power of heart contraction through the sympathetic efferent pathways originating from T1-T5. Cervical subluxation at any level could also affect sympathetic efferent pathways to the heart by the superior cervical, middle cervical, and stellate ganglia. These cervical ganglia being part of a continuous body, called the *paravertebral chain*, should be remembered. A subluxation does not necessarily have to be located in the cervical spine to disturb the function of these ganglia. Homewood<sup>8</sup> has described cases in which postpartum subluxation of the coccyx was accompanied by tachycardia. This symptom was exacerbated during bowel movements. He hypothesized that anterior subluxation of the coccyx may irritate the junction of the left and right paravertebral chain at the gan-

gion impar. This could create a spreading electrical disturbance up the chain, leading to disruption of cardiac rhythm by the cervical levels. This irritation would be exacerbated when a pincer effect was created by the passage of a fecal bolus anterior to the coccyx.

Afferent and parasympathetic efferent innervation to the heart could be disturbed by upper cervical subluxation, primarily because of the passage of the vagus nerve through the jugular foramen. The relationship of this foramen to upper cervical structures is discussed in Chapter 4. Upper cervical subluxation could also disturb the afferent limb of vasomotor regulation in general because the jugular foramen conducts the glossopharyngeal nerve and the vagus.

The cranial nerves exerting profound reflex influences on each other should be noted. For this reason, disturbance in cranial nerves other than the vagus and glossopharyngeal affecting cardiac function is possible. Gottesman and others<sup>9</sup> reported the case of a 67-year-old man with a 12-year history of trigeminal neuralgia accompanied by fainting. During admission to the hospital for one such episode, the patient suffered a cardiac arrest. After resuscitation, ECG, cardiac enzymes, and echocardiogram were all within normal limits. However, massage of the carotid sinus on the side of the trigeminal neuralgia induced a 7.5 second cardiac pause, with a sensation of faintness. The authors concluded that trigeminal nerve activity triggered cardioinhibition by some vagus or glossopharyngeal connection. Although this case is unusual, the oculocardiac reflex (bradycardia after pressure over the orbits of the eyes) is a routine demonstration of a trigeminal connection to vagus and glossopharyngeal function.<sup>10</sup> Because the trigeminal nerve may be vulnerable to cervical subluxation by its cervical nucleus, the trigeminal-cardiac connection offers another pathway by which the VSC may affect the heart.

The same upper cervical relationships described previously are also relevant regarding general vasomotor tone, which is influenced by baroreceptive and chemoreceptive signals carried by the vagus and trigeminal nerves. Of course, sympathetic influence over vasomotor tone can be affected by the VSC at any level through the paravertebral chain ganglia.

Blood volume, and therefore blood pressure, is sensitive to changes in the overall amount of

water in the body and the osmolality of the body's fluids. The kidneys play a vital role in maintaining optimal water volume and osmolality through constant adjustments of urine output and concentration under the control of a complex network of neurohormonal feedback mechanisms.<sup>11</sup> When the VSC disturbs this delicate control of renal function, hypertension is one possible result.

## Clinical Research: Historic Perspectives

The influence of the spinal nerves on cardiovascular function has been a chiropractic concern since the profession's earliest days. D.D. Palmer<sup>12</sup> described a case of "heart trouble" shortly after the Harvey Lillard case. Palmer recommended adjusting T4 for functional and organic disease of the heart and pericarditis.<sup>13</sup>

Henry K. Winsor,<sup>14</sup> a medical anatomist at the University of Pennsylvania, reported autopsy results correlating regions of spinal curvature to 20 cases of heart and pericardium pathology. Spinal curvature was found in the T1-T5 region in 18 cases, and at C7-T1 in 2 cases.

Osteopathic researcher Louisa Burns and others<sup>15</sup> demonstrated cardiac pathology in rabbits with experimentally induced lesions at T2. In one case, the pathology was verified by microscopic examination of the heart muscle. In a later experiment by Burns, experimental lesions at T3 were found to produce clear clinical signs of cardiac pathology in two rabbits of the same litter.<sup>16</sup> One of the rabbits was sacrificed and an autopsy confirmed cardiac pathology. The other rabbit underwent osteopathic manipulation to correct the T3 lesion. Clinical signs abated, and when this rabbit was later sacrificed, an autopsy revealed much less severe cardiac pathology than the rabbit with the uncorrected T3 lesion.

A later study by Burns<sup>17</sup> included a record of pulse tracings of the cardiac apex beat of rabbits with experimentally induced lesions of T3, T4, C1, or the occiput. Irregularities in pulse rate and intensity were found in the rabbits that were so lesioned; in some cases, these abnormalities were reversed when manipulation was performed to correct the spinal lesions. Interestingly, autopsy generally revealed notable myocardial pathology in rabbits with T3 or T4 lesions but not in rabbits with C1 or occipital lesions.

Based on years of private and academic osteopathic clinical experience, Arthur D. Becker<sup>18</sup> recommended close attention to lesions from T1-T6 and the upper cervical spine. He also emphasized the importance of correcting lesions of the left third, fourth and fifth ribs and soft-tissue work for the intercostal tissues at these levels. Illustrative cases included a 3-week-old infant with cyanotic spells and an 80-year-old woman with angina pectoris.

Chiropractic clinician, educator, and researcher Carl S. Cleveland, Jr.<sup>19</sup> published a number of pilot studies similar in some respects to the earlier osteopathic work by Burns and others. While Burns and others produced lesions in rabbits by manually administered spinal trauma, Cleveland used a surgical technique done with fluoroscopic assistance to produce measured misalignments verified by radiographs. Physiologic measures on live rabbits were correlated with postmortem findings. Heart diseases, valvular leakages, arrhythmias, and vasomotor paralysis were noted, but the exact spinal levels were apparently not reported. Cleveland did note a direct correlation between T12 subluxation and renal pathology.

Osteopathic researcher Richard Koch<sup>20</sup> presented a clinical series including 50 cases of organic heart disease in which the diagnosis was verified by cardiologic examination, including ECG, fluoroscopy, and chest x-ray. He also reported 100 cases of functional heart disease in which patients demonstrated clinical signs consistent with heart disease but no clear objective evidence of pathology.

In 93% of the functional group and 100% of the organic group, palpatory and roentgenographic evidence of vertebral dysfunction was noted in the T2-T6 region, with findings clustering at T4-6. In summarizing the histories of these patients, Koch found that they all experienced upper thoracic symptoms. Furthermore, the majority of these patients reported that they developed upper thoracic spine symptoms months or years before the onset of their cardiac symptoms. Koch also observed a high frequency of noncardiac conditions referable to the upper thoracic spine in these patients, including arthritis and tendonitis in the upper extremities, frozen-shoulder syndrome, and bronchial disease.

Koch also noted that general body or lower extremity exertion was less likely to precede heart

attacks in these patients than upper extremity exertions (lawn-mowing, long periods of desk work or driving, ironing, carrying suitcases, etc.). Clinical improvement was noted in all cases with osteopathic manipulative therapy combined with home exercises for cervicothoracic spine flexibility. This favorable clinical response was true of patients taking heart medication and those not undergoing drug therapy.

After retrospectively reviewing 5,000 case records, Thomas Northup<sup>21</sup> selected those of 100 hypertensive patients who demonstrated highly favorable responses to osteopathic manipulation. Among these patients, the average reduction in pressure immediately after intervention was 33 mmHg systolic and 9 mmHg diastolic, with decreases as great as 70 mmHg systolic and 20 mmHg diastolic in a few instances.

In essential hypertension, Northup focused on spinal dysfunction at the T8-9 and upper cervical areas, along with cranial faults at the occipitomastoid junction. He found that patients with higher systolic pressure in the supine position than in the sitting position were more likely to be hypertensives complicated by nephritis; for these patients, he emphasized the importance of lower thoracic dysfunction.

## Recent Research Developments

In 1975, the U.S. Department of Health, Education, and Welfare held its first interdisciplinary conference on spinal manipulation, under the auspices of the National Institutes of Neurological and Communicative Disorders and Stroke (NINCDS).<sup>22</sup> This conference evidenced a new level of interest in chiropractic and osteopathic research by the scientific community at large. A gradual movement towards increased funding and rigor and decreased professional isolation has characterized chiropractic, osteopathic, and manual medicine research initiatives since the NINCDS conference. For this reason, 1975 appears to be a reasonable date for the dawn of the modern research era of these fields.

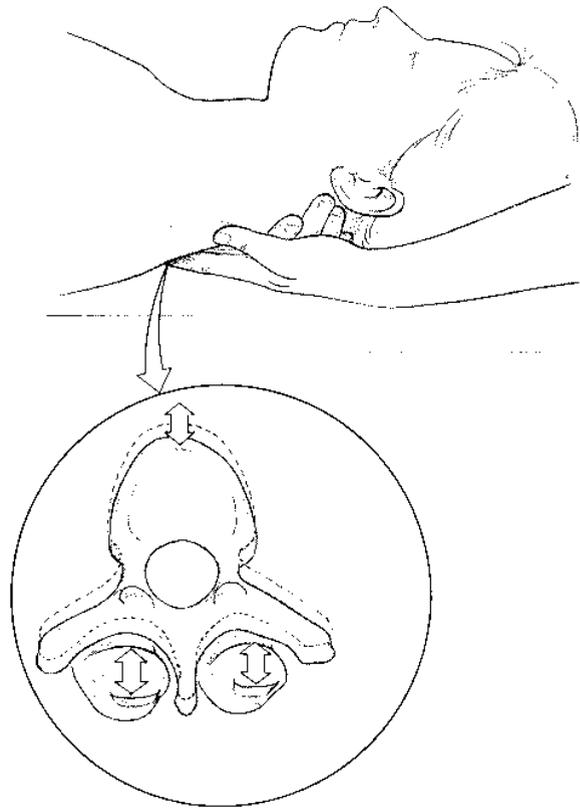
Larson<sup>23</sup> reported palpation findings for 196 patients with diagnoses of myocardial disease in the intensive care unit (ICU) of Chicago Osteopathic Hospital. The abnormal findings clustered around T2-T5 and C2. The thoracic involvements were somewhat more frequent on the left side,

with T2 involvement most commonly found with arrhythmias. When C2 involvement was found, it was almost universally on the left side.

Cox and others<sup>24</sup> found a significant correlation between spinal palpation findings and coronary artery disease. Musculoskeletal findings were reported for 97 patients before cardiac catheterization for angiography. In those patients with angiographically demonstrated coronary artery disease, musculoskeletal findings clustered around T4. This was especially significant when soft-tissue texture (compliance of the paravertebral and intercostal tissue at the T4 area) and range of motion (intersegmental restriction of T4 against T5 or T3) were considered. In the same year, Cox and Rogers<sup>25</sup> presented a study demonstrating osteophytosis of the thoracic spine in 43% of patients with coronary artery stenosis, compared with 15% in heart-healthy controls.

Myron Beal,<sup>26</sup> reporting on a series of approximately 100 patients with confirmed cardiovascular disease, stated that some 90% of patients had segmental dysfunction somewhere between T1 and T5 on the left side, with findings clustered at T2-T3. He also noted that the majority of such patients demonstrated left-sided dysfunction at C2. Beal maintained that hypertonicity of the deep paraspinal tissues was the most important finding and that a supine compression test was the most effective examination procedure (Figure 10-3).

An interesting biomedical observation relating *straight back syndrome* (SBS) to heart disease was investigated by Ansari.<sup>27</sup> SBS consists of loss of normal physiologic curvature in the upper dorsal spine, with narrowing of the anteroposterior diameter of the chest. Radiographically, SBS is determined by measuring the anteroposterior diameter of the chest by drawing a line from the anterior border of T8 to the posterior border of the sternum. This is compared with the transthoracic diameter, measured by a line connecting the inner margins of the left and right ribs at the level of the greatest width of the rib cage. The ratio of anteroposterior diameter to transthoracic diameter is expressed as a percentage. The mean of this ratio is 35% (+/- 2.3%) in patients with SBS versus 45% (+/- 3.5%) in controls. Among 55 patients with SBS, Ansari reported that 71% had valvular heart disease, with the most common form being mitral valve prolapse.



**Figure 10-3** Beal's springing assessment for paraspinal facilitation rigidity associated with segmental facilitation. (From Chaitow L: *Palpation skills*, p 66, New York, 1997, Churchill Livingstone.)

Previous researchers had suggested that SBS affects the heart by mechanical pressure—a pancake or squashing effect. Ansari did not find this to be the case and instead proposed that SBS and valvular heart disease are aspects of a genetically determined fault in development.

Interestingly, SBS bears a striking similarity to the type of subluxation complex referred to in chiropractic as the *Pottenger's saucer*, or the *thoracic anteriority*.<sup>28,29</sup> These chiropractic sources generally define this subluxation complex as a series of extension malpositions superior to a flexion malposition. Chest pain, dyspnea, and dyspepsia are concomitant symptoms commonly reported in patients with thoracic anteriority; these same symptoms often accompany cardiac disease. This subluxation complex is commonly reported in the upper half of the thoracic spine, which has been connected with cardiovascular disorders in a number of the studies already reviewed.

Morgan and others<sup>30</sup> presented a study in which osteopathic mobilization techniques were compared with a sham procedure (soft-tissue massage) in treating a group of 29 hypertensive patients. Mobilization consisted of figure-8 motion of the head, with an attempt to isolate the upper cervical region, extension mobilization of T1-T5, and muscle energy technique for the mobilization of T11-L1. This study failed to demonstrate a significant decrease in systolic or diastolic blood pressure with either the mobilization or the sham procedure. If some or all of these patients had SBS, the extension mobilization used by Morgan and others may have actually exacerbated these patients.

The adrenal cortical hormone *aldosterone* is one of the components in the neurohormonal control of renal activity; it acts on the kidney to cause sodium retention. An elevated serum level of aldosterone is associated with an increased risk of hypertension. Osteopathic researcher Mannino<sup>31</sup> investigated the effect of Chapman's neurolymphatic reflexes on serum aldosterone levels. Chapman's reflexes are areas in the subcutaneous tissue that become tender and palpably nodular when active. Stimulation of these reflexes is thought to normalize lymphatic flow through associated organs.

Mannino selected a pair of Chapman's reflexes associated with the adrenal glands located between T11 and T12, midway between the spinous processes and tips of the transverse processes. In a group of hypertensive patients, a statistically significant drop occurred in serum aldosterone levels within 36 hours of Chapman's reflex stimulation. No significant changes in serum aldosterone levels were demonstrated in the controls. After a sham treatment, serum aldosterone levels returned to baseline in the hypertensive patients and then were reduced again with stimulation at the Chapman's reflex for the adrenals.

No significant reduction in blood pressure was noted, but the author cited previous research indicating that pharmaceutical aldosterone-blocking agents do not begin to affect blood pressure for 5 to 7 days. Mannino suggested that future studies with a longer period of follow-up may be required to determine whether a change in blood pressure eventually follows the modifications in serum aldosterone levels.

Wagnon and others<sup>32</sup> investigated the effect of chiropractic adjustments on serum aldosterone

levels in a group of hypertensive patients. Subluxation findings clustered at the upper cervical spine, T9 and L5, were reported in a group of hypertensive patients after chiropractic analysis, including x-ray assessment, static and motion palpation, and heat-reading instrumentation. The group received Gonstead or diversified adjustments at these levels, with blood pressure and serum aldosterone measurements performed before and after the adjustment. Reduction in blood pressure was noted postadjustment for most subjects, but a return to baseline levels usually appeared within 72 hours. A statistically significant decrease in serum aldosterone levels occurred postadjustment, and these levels remained substantially below baseline levels 10 days after the adjustment. Echoing Mannino, these authors suggested that long-term effects of the chiropractic adjustment on blood pressure and serum aldosterone levels could only be observed with a much longer follow-up period than the one available in their study.

Reviewing clinical literature presented over a period of 30 years by members of the International College of Applied Kinesiology, Walther<sup>33</sup> noted an association between disturbance of the heart meridian of acupuncture and subluxation of the T5-6 motion segment. An association has also been noted linking dysfunctions of the heart meridian and dystonia of the subscapularis muscle. This connection is interesting in view of Koch's finding that cardiac patients have a higher incidence of upper extremity problems, including frozen-shoulder syndrome.<sup>20</sup>

Walther<sup>34</sup> also cited literature by Goodheart, indicating that hypertensive patients with higher systolic blood pressure in the recumbent position than the seated position are often suffering from renal complications, implying involvement of the thoracolumbar area. This clinical finding is in agreement with the earlier publication by Northup.<sup>21</sup>

After an extensive literature review, Jarmel<sup>35</sup> concluded that increased sympathetic tone or decreased vagal tone predisposes the heart to ventricular fibrillation and sudden cardiac death. Intense vagal stimulation tends to cause vasospasm of the coronary arteries, possibly generating cardiac arrhythmias leading to sudden cardiac death. Because upper cervical subluxation can disturb vagal function and upper thoracic sublux-

ation can disturb sympathetic innervation to the heart, Jarmel proposed that such subluxation could generate or aggravate cardiac arrhythmias that are risk factors for cardiac sudden death.

In a later study, Jarmel and others<sup>36</sup> demonstrated that cardiac arrhythmias in 11 asymptomatic patients noted on 24-hour Holter monitoring were improved after correction of cervical or upper thoracic subluxation. Spinal analysis largely consisted of unilateral palpatory tenderness over a spinal joint facet or the paravertebral muscles. Diversified chiropractic adjusting at a frequency of 3 visits per week for 4 weeks was the sole intervention.

Premature ventricular contractions and abnormal heart rate variability during sleep were the two arrhythmias most often noted. The authors offered the following speculation based on their findings<sup>36</sup>:

Cervical or upper thoracic spinal joint dysfunction may thus act as a chronic trigger of the electrophysiologic substrate favoring the development of arrhythmias. Aggravation of cervical or upper thoracic spinal joint dysfunction may also act as an acute trigger, initiating a sequence of events resulting in sudden death.

A previous study also found electrocardiographic evidence of improvement in arrhythmia under a treatment package that included chiropractic care, dietary advice, and exercise recommendations.<sup>37</sup> Tachycardia and atrial flutter were among the arrhythmias found to respond to this treatment. Unfortunately, the levels of chiropractic adjustment were not noted and the dietary and exercise programs were not described.

Reviewing seminar material by chiropractic technique developer, researcher, and educator Clarence S. Gonstead from 1964-1991, Plaughter and others<sup>38</sup> indicated that cardiac arrhythmias were generally associated with the region T1-T4 or the upper cervicals. Gonstead also maintained that diastolic hypertension was often associated with subluxations from occiput-C5, systolic hypertension was associated with subluxations from C7-T3 and T10-L2, mixed hypertension was most often correlated with subluxations from T10-T12, and hypotension related to adrenocortical insufficiency was associated with subluxations from T8-T12.

Yates and others<sup>39</sup> presented a controlled clinical

trial involving activator adjustments with hypertensive patients. A total of 21 hypertensive patients were randomly assigned to active treatment with adjustments in the region of T1-T5, based on Activator analysis, placebo treatment with sham adjustments with the Activator instrument set on 0 tension, and control groups with no intervention. Noting that previous studies may have been confounded by elevated initial readings because of anxiety, Yates and others used a standard psychologic questionnaire before and after the intervention. They found a statistically significant decrease in systolic and diastolic blood pressure in the active treatment group but not in the placebo-treated or control groups. Because the active and control groups did not differ in terms of anxiety reduction, this was ruled out as an explanation for the difference between groups. These findings supported the hypothesis that blood pressure reduction in hypertensives is a true physiologic effect of the chiropractic adjustment.

Plaughter and Bachman<sup>40</sup> published an instructive case study involving a 38-year-old man with a 14-year history of hypertension. He also reported side effects because of his two medications, including bloating sensations, depression, fatigue, and impotence. Low back pain was also reported as an incidental issue.

Examination according to Gonstead analysis protocols revealed evidence of the VSC at various levels, with signs clustering at the midcervical, upper thoracic, and middle thoracic regions. Adjustments were administered once per week. After three visits, the patient's medical doctor was able to stop one medication altogether and reduce the dosage of the other. All medication was discontinued after seven visits. After this, the frequency of visits was reduced to twice per month. Follow-up at 18 months showed that blood pressure was stabilized at normal levels without medication. Bloating, depression, fatigue, and low back pain had abated and normal sexual function had returned.

Peterson<sup>41</sup> reported reduction in serum cholesterol levels by more than 22% in two patients after a single chiropractic adjustment each. These adjustments were administered according to neuroemotional technique (NET) protocols, in which an attempt was made to link a patient's subluxation complex to memories of emotionally stressful events. An elevated level of serum cholesterol is

associated with an increased risk of hypertension. Because spontaneous fluctuations in serum cholesterol levels average only 4.8%, Peterson maintained that spontaneous fluctuation was an unlikely explanation for these clinical results.

The results of Peterson's study are particularly interesting when considered in the light of an earlier study by Gutstein and others.<sup>42</sup> In this study, laboratory rats were exposed to electric stimulation of the lateral hypothalamus. Behavior during stimulation was suggestive of anxiety (hurrying and scurrying about the cage, whisker-twitching, and rapid and shallow breathing). Serum cholesterol levels increased as much as 24% during these hypothalamic stimulations. Post-mortem histologic examination of the abdominal aorta and left descending coronary artery revealed pathologic changes, including plaque formation, consistent with the early stages of arteriosclerosis. Gutstein and others chose an arteriosclerosis-resistant species for this experiment, making the results all the more impressive. The authors concluded that important components of the development of arteriosclerosis were mediated through the nervous system.

Studying a group of 21 baseball players randomly assigned to either a control group or an upper cervical adjusting group, Schwartzbauer and others<sup>43</sup> observed changes in athletic ability and physiologic measurements. One measure of extremity microcirculation, or capillary count was made by viewing the nailbed of the right and left middle fingers through a microscope at 60× magnification. The number of capillaries visible in one microscopic field was recorded. As microcirculation to the fingers improved, more capillaries became visible. Athletes receiving upper cervical adjustments demonstrated statistically significant improvements in capillary count. The control group did not.

Connelly and Rasmussen<sup>44</sup> reported favorable results with three hypertensive patients, using the cranial procedures of sacro-occipital technique (SOT) developed by DeJarnette. When the patient sought treatment for hypertension, SOT protocols required special attention to the occipitomastoid suture. According to DeJarnette's writings, opening this suture was intended to decompress the jugular foramen, which therefore would reduce interference to the vagus nerve. In the osteopathic field,

Northup made the same observation regarding the occipitomastoid suture.<sup>21</sup>

## Clinical Implications

From the perspective of chiropractic analysis, a history of cardiovascular disease does not isolate an area of subluxation with certainty. The findings recorded in the medical, osteopathic, and chiropractic literature made it clear that subluxations from the cranium to the coccyx must be considered. However, increased suspicion is certainly warranted regarding subluxation at the upper thoracic and upper cervical regions and the occipitomastoid suture. Beal's supine compression test can contribute to accurate analysis of the upper thoracic region in general,<sup>26</sup> and assessment of subscapularis function may be useful in monitoring the severity of the T5-T6 VSC in particular.<sup>33</sup>

In patients with signs consistent with renal involvement, including elevated systolic pressure in the recumbent position compared with the seated position, special attention is indicated at the thoracolumbar junction.<sup>21</sup> Chapman's neurolymphatic reflexes may prove a useful manual adjunct to the chiropractic adjustment in such cases.<sup>31</sup>

The patient with a cardiovascular history raises a number of risk-management issues for the chiropractic clinician. At a meeting of medical neurologists sponsored by the American Heart Association, Dr. William Powers of Washington University stated, "Every neurologist in this room has seen two or three people who have suffered this (cerebrovascular accident) after chiropractic manipulation."<sup>45</sup> This statement, quoted or paraphrased, was widely reported by the news media in the United States in February 1994. This statement is exemplary of a perennial effort by various nonchiropractic organizations to create a perception in the general public that chiropractic procedures for the cervical spine are an important risk factor for stroke.

A clear-headed review of the literature reveals that this perception is not evidence-based. Estimates of the probability of stroke after chiropractic manipulation of the cervical spine range from 1 case in 400,000 manipulations to less than 1 in 5 million manipulations.<sup>46-51</sup>

Terrett,<sup>52</sup> reviewing original sources for some

cases reported in the biomedical literature as stroke resulting from chiropractic manipulation, found that many of these cases did *not* involve a doctor of chiropractic. Terrett found that a significant number of these cases of stroke followed cervical manipulation by medical doctors, osteopaths, massage therapists, physical therapists, kung fu instructors, barbers, the patient's spouse, and even the patient.

Viewing this stunning biomedical exaggeration of danger from chiropractic cervical procedures is useful because of the established danger from certain medical procedures widely believed to be "safe." For instance, nonsteroidal antiinflammatory drugs (NSAIDs) are common first-line medical treatment for many musculoskeletal pain syndromes.<sup>53</sup> Yet, gastrointestinal bleeding is a widely reported complication of NSAID use, accounting for an estimated 3,200 deaths per year in the United States alone.<sup>54</sup> Less adverse reactions include renal dysfunction, liver damage, and central nervous system (CNS) disorders.<sup>55,56</sup>

Media warnings concerning the danger of chiropractic cervical manipulation appear absurd when looked at from the point of view of the published evidence. However, this should not lull the clinician into complacency. Reasonable prudence can make safe chiropractic care of the cervical spine even safer. Lauretti<sup>57</sup> advocated the use of nonmanipulative adjusting techniques for high-risk patients.

Manipulation generally involves a high-velocity motion of a joint past its physiologic range of motion, usually resulting in an audible cavitation noise. Many nonmanipulative techniques exist that are generally known as *nonforce adjustments*. Lauretti suggested that nonmanipulative adjusting be strongly considered when the patient has a history of dizziness, drop-attacks, diplopia, difficulties in speaking or swallowing, or ataxia. These indicators are particularly significant when provoked by cervical motion, especially rotation and extension (particularly with a latency of 15 to 30 seconds). Avoiding extremes of rotation and extension in such patients is wise, whether manipulative or nonmanipulative adjustments are used.

To the previous indicators, one might add the auscultation of bruits over the cervical or carotid arteries and a previous history of stroke and

adverse reactions to cervical manipulation and current use of anticoagulant drugs.

Because the risk of stroke resulting from chiropractic care is more a phenomenon of perception than fact, the patient's perceptions should be addressed. If the patient expresses a fear of cervical manipulation, the use of a nonmanipulative adjusting technique is wise risk management.

An important aspect of patient perception was discussed by Plaugher and Bachman.<sup>40</sup> They noted that a patient on antihypertensive medication may experience additional lowering of blood pressure as a result of chiropractic care. Although this is beneficial in the long run, the combined effects of the drugs and the adjustments may render the patient temporarily hypotensive. A patient experiencing vertigo secondary to hypotension after a cervical adjustment may unfairly accuse the doctor of chiropractic (DC) of causing a stroke or some other form of damage. Explaining the possibility of transient hypotension to such a patient at the beginning of care can save the patient much anxiety and preserve the doctor's reputation.

As an additional risk management precaution, the DC should avoid describing a chiropractic technique as a "blood pressure control technique" or other such phrase. Describing a chiropractic technique in a way that implies cure or treatment of any disease is a slippery slope. This is especially true when the disease is a cardiovascular disorder. An offer to cure or treat disease can be seen as an implied contract that is broken when any patient fails to recover under care.

The chiropractic adjustment should never be presented as a cardiovascular treatment. What chiropractors treat, or more appropriately reduce or correct is the VSC and other subluxations, including cranial faults. These subluxations create disturbances of neurologic tone. Although subluxation and subsequent disturbed neurologic tone can provoke or aggravate a particular cardiovascular disease symptom in a particular person, it is the patient not the disease that is adjusted. The DC is justified in following blood pressure, arrhythmia, or any other cardiovascular manifestation as a general barometer of the patient's neurologic fitness but not as the actual rationale for the delivery of the adjustment.

For instance, if the T4-T5 motion segment is

found to be subluxated, it should be adjusted whether the patient's blood pressure is elevated. If the patient's blood pressure is elevated, the DC may choose to monitor it whether signs of the T4-T5 VSC exist.

Alerting patients to the potential benefit of subluxation correction for their overall health and wellness, including cardiovascular fitness, is essential. The normalization of arrhythmia in asymptomatic

subjects<sup>36</sup> and improvement in microcirculation in healthy athletes<sup>43</sup> are early indicators of what future investigations may find in terms of the preventive role of the chiropractic adjustment. Hopefully, future chiropractic literature will be as rich in this arena of preventive cardiovascular health and fitness as past literature has been in the area of active cardiovascular disease.

## STUDY GUIDE

1. The heart has specialized muscle fibers capable of maintaining an automatic rhythm, even in the absence of direct autonomic innervation. What are these fibers called and where are they located?
2. If the previous statement is true, why are sympathetic and parasympathetic innervation important to the heart's normal function?
3. What does vagal stimulation do to the heart? Is this sympathetic or parasympathetic?
4. Where does the major sympathetic innervation to the heart originate? Relate this to T4 syndrome.
5. Where do the preganglionic fibers of the above nerves synapse?
6. What is a baroreceptor and where would you find one?
7. Explain the baroreceptor in terms of tone. Explain this in terms of postural changes.
8. Could a postpartum coccygeal or SI subluxation generate tachycardia? How?
9. Describe the possible effects of the upper cervical VSC on the heart. How would this happen?
10. Describe the oculocardiac reflex.
11. Describe Henry Winsor's findings in relation to this chapter.
12. Describe Louisa Burns' study of genetically related rabbits with T3 subluxation. What is the importance of this study and how would you use it to educate a patient?
13. Describe Carl Cleveland Jr.'s findings regarding T12 subluxation. Why is this important in terms of patients with cardiac problems?
14. Relate Ansari's findings on SBS to the hypotheses of previous researchers.
15. Discuss Mannino's study of Chapman's reflexes on serum aldosterone levels. Which neurolymphatic reflexes did he use and at what spinal levels are they located? Why are his findings important to chiropractic?
16. Relate Walther's findings regarding the heart meridian and T5-6 subluxation to the work of Koch.
17. In Plaugher's review of Gonstead's work, what were the differences between the findings on diastolic and systolic hypertension? Although we must avoid a road map approach to subluxation and its results, what might be the significance of these findings?
18. What is the incidence of stroke following cervical manipulation as opposed to the number of deaths per year from NSAID use? Name some of the kinds of individuals who actually delivered the "chiropractic" in Terrett's study.
19. What are some indicators that could cause you to look to minimal force techniques for a patient?
20. Explain one possible effect of chiropractic adjustments on patients taking antihypertensive medication. How would you explain this to a patient?

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