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Neurologic complications following chiropractic manipulation: A survey of California neurologists

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Chiropractic is the most popular alternative therapy in the United States, and there is a public perception that spinal manipulation is risk free. However, in 1947 Pratt-Thomas and Berger reported two patients who became unconscious during chiropractic adjustment and died in less than 24 hours. Since their report, a number of authors have described patients who experienced adverse neurologic outcomes following chiropractic manipulation. The most frequently reported complication is posterior circulation stroke, usually related to vertebral dissection, occurring during or shortly after cervical manipulation. Anterior circulation stroke appears to be much less common. Spinal disk herniation or displacement of bony structures can result in spinal cord compression, radiculopathy, or cauda equina syndrome. Also reported are other much less frequent complications such as meningeal hematoma, diaphragmatic paralysis, and compression neuropathy. Most of this literature is composed of case reports, and the frequency of complications following spinal manipulation is not known but is estimated to be small. The objective of this study was to determine how often neurologists in California encounter patients with complications following chiropractic manipulation and to learn more about the clinical features of these complications.

Methods. A one-page survey questionnaire was mailed to each member of the American Academy of Neurology (AAN) residing in California in January 1992. The total number surveyed was four hundred eighty-six. All Academy members were included regardless of their type of practice. The Academy members were asked to report all cases of neurologic complications following chiropractic manipulation and to learn more about the clinical features of these complications.
The questionnaire was formatted so that each respondent could simply place a check mark to indicate the patient’s age group (in two-decade intervals: 0 to 20, 21 to 40, 41 to 60, 61+), gender, site of the adjustment (cervical, thoracic, lumbosacral region), the nature of the complication (stroke, myelopathy, or radiculopathy), and the outcome 3 months after the onset of the complication. Outcome categories included no deficits, mild deficits, marked deficits, severe deficits, death, and unknown. All cases of stroke were further classified into anatomic (anterior versus posterior circulation) and etiologic (arterial dissection versus other) categories. The respondents were asked to mark dissection as the etiology only if it was proven by angiogram.

Results. One hundred seventy-seven AAN members in California (36% of those surveyed) responded to the questionnaire. Of those responding, 126 neurologists (71% of the respondents) reported seeing no neurologic complications during the designated 2 years. Fifty-one neurologists (29% of the respondents) reported a total of 102 neurologic complications (figure). Fifty-five male and 47 female patients were described. The complications included 56 strokes, 16 myelopathies, and 30 radiculopathies.

Thirty-seven neurologists (21% of those responding) reported 56 cases of stroke: 25 respondents described one case, seven described two cases, four described three cases, and one described five cases. All of the strokes occurred after cervical manipulation. All patients suffering a stroke were between the ages of 21 and 60 and were evenly divided between men and women. Fifty-three strokes (95% of all strokes reported) were in the vertebral artery distribution, compared with only three in the carotid distribution (p < 0.001, two-tailed binomial test). Angiographically proven dissection accounted for 25 strokes (45%). For the remainder of the strokes, either the mechanism was unknown or angiography was not performed. Forty-eight stroke patients (86%) were left with at least mild deficits 3 months after the onset of their strokes. Of those with persistent disability, 46% had marked or severe deficits (table).

Sixteen cases of myelopathy were reported by 13 neurologists: ten respondents described one case and three described two cases. Thirteen cases (81%) occurred in the cervical region, one in the thoracic region, and two in the lumbosacral region. Fourteen of the myelopathy patients (88%) were left with at least mild deficits. Of these, eight (57%) had marked or severe deficits (table).

Thirty cases of radiculopathy were reported by 11 neurologists: five respondents described one case, three described two, one described four, one described five, and one described ten. Twenty-two cases (73%) occurred in the cervical region. The remainder occurred in the lumbosacral region. Twenty-nine radiculopathy patients (97%) were left with at least mild deficits. Of these, 16 (55%) had marked or severe deficits (table).

Discussion. Strokes following chiropractic manipulation have most often been associated with vertebral artery dissections. After the vertebral arteries emerge from the cervical foramina, they run along grooves in the superior aspect of the posterior arch of the atlas and then through the posterior atlanto-occipital membrane before penetrating the dura. The most common site of injury to the vertebral artery following cervical manipulation appears to be at the site of the atlantoaxial joint where the artery changes from its vertical course to a horizontal one. Rotating and tilting the neck stretches the extracranial vertebral arteries and produces a shearing force on the segment at the atlantoaxial joint, which may produce intimal tearing, dissection, and thrombus formation. Brown and Tatlow, using angiography on cadavers, demonstrated occlusion of vertebral artery flow in five of 41 cadavers subjected to simultaneous full extension and 90° rotation. The total number of subjects with vertebral artery occlusion increased to 18 of 41 when a traction equal to half the body weight was applied to the head.

Table. Summary of the severity of clinical deficit at 3 months following onset of neurologic complications

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>No deficit</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>56</td>
<td>8 (14%)</td>
<td>26 (46%)</td>
<td>12 (21%)</td>
<td>9 (16%)</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Myelopathy</td>
<td>16</td>
<td>2 (13%)</td>
<td>6 (38%)</td>
<td>5 (31%)</td>
<td>3 (19%)</td>
<td>—</td>
</tr>
<tr>
<td>Radiculopathy</td>
<td>30</td>
<td>1 (3%)</td>
<td>13 (43%)</td>
<td>15 (50%)</td>
<td>1 (3%)</td>
<td>—</td>
</tr>
</tbody>
</table>
In the studies of cervical carotid artery injury induced by neck rotation, the arterial lesion is usually an intimal tear thought to occur because of compression of the internal carotid artery against the transverse processes of the upper cervical vertebra.\textsuperscript{6,9} The intimal tear may cause vessel occlusion or artery-to-artery embolism, or may become the origin of a dissection.\textsuperscript{9}

The two most common techniques of chiropractic spinal adjustment are a "low velocity-high amplitude" method (where a series of gentle and repeated motions are delivered to a joint) and a "high velocity-low amplitude" method (where a sudden thrust is delivered to the involved vertebrae). There are no studies as to which method is more likely to cause arterial dissection.\textsuperscript{5,10}

During the 2-year period covered by the survey, 29\% of those responding reported evaluating at least one patient with a neurologic complication following chiropractic procedures. However, our data do not allow determination of the frequency of chiropractic complications, and the study has many limitations. First, our sample size is small. We surveyed only the AAN members in California and only one-third responded. Therefore, our survey included a small subset of physicians who may encounter patients with chiropractic complications. Second, even among those who responded, their practice patterns varied. Some indicated that they did not have an active practice or were subspecialists (such as pediatric neurologists or movement disorder specialists) and were not likely to see patients with chiropractic complications. Third, six of those responding reported five or more patients with complications, and thus 12\% of the positive respondents (6 of 51 neurologists) accounted for 38\% of the cases (39 of 102 patients). Fourth, our survey did not ask the physicians to indicate whether the patients who suffered an adverse neurologic outcome had any contraindications to spinal manipulation. Conditions such as vertebral bony abnormality, myelopathy, cauda equina syndrome, hypermobility syndrome, infection, malignancy, severe diabetes, and anticoagulation therapy may be absolute contraindications, and pregnancy, radicular pain, and migraine relative contraindications.\textsuperscript{3,10} Finally, we had no means of independently verifying the results of the responses.

Despite these limitations, this survey revealed several important findings. Cervical manipulations accounted for the majority of the reported cases (100\% in stroke, 81\% in myelopathy, 73\% in radiculopathy), and virtually all the strokes reported were in the posterior circulation. Most of the patients described were relatively young, which probably reflects the age of people who seek chiropractic care. These young patients suffered substantial long-term morbidity as the majority continued to have persistent deficits 3 months after the onset (86\% in stroke, 88\% in myelopathy, 97\% in radiculopathy), and of the patients with persistent disability, about one-half (46\% in stroke, 57\% in myelopathy, 55\% in radiculopathy) had marked or severe deficits. Therefore, our study indicates that patients, chiropractors, and physicians should be aware of the potential adverse neurologic outcomes following chiropractic adjustment. In addition, physicians should question patients with posterior circulation strokes, unexplained myelopathies, or radiculopathies about recent chiropractic manipulation.

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