Complications of Spinal Manipulation

A Comprehensive Review of the Literature

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Background. Spinal manipulative therapy (SMT) is a frequently applied therapy for back and neck pain. Serious complications of SMT are presented primarily in case reports. Many patients seen by physicians also seek care from therapists applying manipulative techniques. Therefore, background information on the risks of SMT is essential for physicians.

Methods. Relevant case reports, surveys, and review articles were identified using a comprehensive search of online and bibliographical databases. For every case, a record was made of first author, publication year, country, age and sex of the patient, background of the manipulator, preexisting conditions, type of complication, and course of the complication. Based on case reports and surveys, an estimation was made of the risk for the most frequently reported complications: vertebrobasilar accidents (VBAs) and cauda equina syndrome (CES).

Results. We derived 295 complications of spinal manipulations from the literature: 165 VBAs; 61 cases with disc herniation or progression to CES; 13 cerebral complications other than VBAs; and 56 other types of complications. The average age of patients with VBA was 38 years. Vertebrobasilar accidents occur mainly after a cervical manipulation with a rotatory component. Estimates of VBA range from 1 per 20,000 patients to 1 per 1 million cervical manipulations. The incidence of CES is estimated to be less than 1 per 1 million treatments.

Conclusions. It is difficult to estimate the incidence of SMT complications, as they are probably underreported in the literature. Most non-VBA complications can be prevented by excluding patients with contraindications for SMT. Patients who develop complications such as CES should be treated as soon as possible. VBAs, however, are difficult to prevent and treat. Referral for SMT should not be made to practitioners applying rotatory cervical manipulation. Information about the risk of VBA should be included in an informed consent procedure for cervical manipulation with thrust techniques.

Key words. Manipulation, orthopedic; chiropractic; treatment outcome; cauda equina syndrome; vertebrobasilar accidents. (*J Fam Pract 1996; 42:475-480*)

Low back and neck pain is a frequently encountered complaint in medical practice. From 1980 to 1990, the incidence of low back pain as a primary or secondary reason for visiting a physician's office in the United States was 4.5%.[1] Spinal manipulation is a widely practiced treatment for low back and neck pain. For example, in the United States, 25% of patients with chronic low back pain attended a chiropractor,[2] who mainly provided spinal manipulation.[3] Regarding the effectiveness of spinal manipulation, a recent meta-analysis of 25 randomized controlled trials reported that spinal manipulation appears to hasten the recovery of some patients with acute complaints.[4]

The number of medical referrals among chiropractic patients is relatively low.[5-7] Curtis and Bove[8] assume that the perceived lack of basic scientific evidence of the efficacy of spinal manipulation is one of the most important arguments against chiropractic. For example, in a recent survey among various types of US physicians, it was found

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that there was a greater belief in the effectiveness of physiotherapy than in the effectiveness of spinal manipulation.[9] For acute cases, 81% of the physicians found physiotherapy to be a useful intervention, whereas only 36% considered spinal manipulation to be effective. For chronic back pain, 93% of physicians found physiotherapy useful, and just 35% thought spinal manipulation was effective. Apart from this lack of perceived effectiveness, the impression that manipulation is a potentially dangerous intervention is another important reason for the low level of cooperation between medical doctors and chiropractors.[8] Most physicians do not seem to know enough about chiropractors, however. In a 1988 survey of family physicians, Cherkin et al[10] found that 50% of the physicians were insufficiently informed about the clinical scope and skills of chiropractors. In connection with spinal manipulation, various mild and transitory complications as well as more serious complications, such as vertebrobasilar accidents (VBAs) and cauda equina syndrome (CES), have been described. Various reviews have been written on the complications of spinal manipulative therapy.[11–18] Most of these reviews either are difficult to obtain or address only one specific kind of complication. The aim of this paper is to provide an up-to-date review of the available literature on serious complications associated with spinal manipulative therapy. Detailed information on these complications is important for patients, the physicians who treat them, those involved in the development of practice guidelines, and health care decision-makers.

Methods

Relevant case reports, surveys, and review articles were identified using a comprehensive search of online and relevant bibliographical databases. The details of the literature search are available on request from the first author (W.J.J.A.). For every reviewed case, a record was made of first author, publication year, country, age and sex of the patient, background of the manipulator, preexisting conditions, type of complication, and course of complication. Complications were grouped into four categories: VBAs, cerebral complications other than VBAs, disc herniation, and "other types of complications," eg, fractures, luxations, and spinal cord compression.

On the basis of case reports and several retrospective surveys, we attempted to estimate the risks associated with the most frequently reported complications: VBA and CES. Since VBAs are by far the most frequently reported and most serious complications, the anatomical and pathophysiological background of these complications is also briefly discussed.

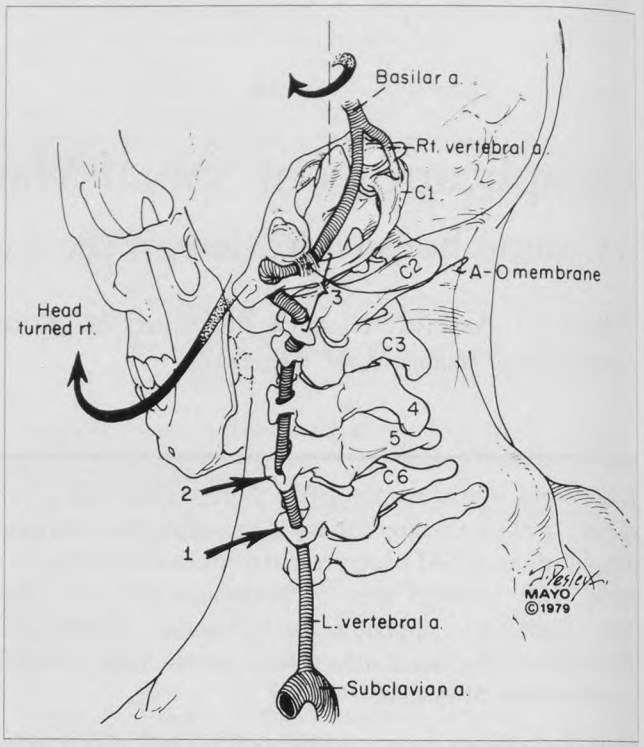

Figure. Relationship of vertebral artery to adjacent structures. Reproduced with permission from Krueger BR, Okazaki H. Vertebral basilar distribution infarction following chiropractic cervical manipulation. Mayo Clin Proc 1980; 55:322–32.

Vertebrobasilar Accidents

Pathogenesis and Provocation Tests

For a better understanding of the relation between cervical manipulation and vertebrobasilar accidents, insight into the anatomy of the cervical arteries is essential. This anatomy also provides the basis for the specific premanipulative provocation tests.

After the vertebral arteries emerge from the cervical foramina, they run along the grooves in the superior aspects of the posterior arch of the atlas and then through the posterior atlanto-occipital membrane before entering the dura (Figure). The most common site of injury to the vertebral artery following cervical manipulation appears to be at the site of the atlanto-occipital joint, where the artery changes its vertical course to a horizontal one.[19,20] Interruption of the flow in one of the vertebral arteries or the basilar artery can result in signs and symptoms related to the dependent parts of the central nervous system: brain stem (several vital functions, sensory and motor pathways, and nuclei), occipital cerebral lobes (vision), or cerebellum (balance).[19] Rotating and tilting the neck stretches the extracranial arteries and produces shearing force on the segment at the atlanto-axial joint.[19,20]

Table 1. Number of Complications of Spinal Manipulative Therapy per Category, by Profession of the Manipulator

Type of Complication	Profession of Manipulator						
	All	DC	MD	DO	PT	Other	Unknown
Vertebrobasilar	165	92	15	8	6	10	34
Other cerebral	13	9	—	—	1	1	2
Hernia and cauda equina	61	11	24	3	2	—	21
Other complications	56	23	3	7	3	2	18
All	295	135	42	18	12	13	75

DC denotes doctor of chiropractic; MD, medical doctor; DO, doctor of osteopathy; PT, physical therapist.

Specific premanipulative vertebral provocation tests are generally recommended to identify a threatening ischemia preceding a manipulation of the neck, and are an obligatory component of cervical manipulation standards.[21–23] There are several methods of testing. In conducting any of these tests, the manipulator positions the head in the manipulation starting position for up to 40 seconds.[13] If signs of brain stem ischemia (vertigo, nystagmus, nausea, headache, or sensory disturbance) occur, manipulation should be abandoned.[13]

Results

Case Reports

Our review of the literature through 1993 disclosed 295 complications of spinal manipulations. Tables and references for all four categories of complications are available on request from the first author (W.J.J.A.).

Table 1 summarizes the professions of the spinal manipulators according to the case reports. In 135 of the 220 reported cases in which the type of practitioner was known (61%), a chiropractor was the spinal manipulator who treated the patient. The total number of fatal cases was 39. A chiropractor was involved in 23 of the fatal cases; a medical doctor in 8 cases, an osteopath in 1 case, and someone from another profession in 3 cases. The manipulator was unknown for 4 cases.

Through 1993, a total of 165 VBAs had been reported. The mean age of the affected patients was 38 years. Vertebrobasilar accidents were reported slightly more often for women than for men (84 and 67, respectively; sex was not reported in 14 cases). Most VBAs (n=85, 51%) were reported by authors in the United States. Twenty-nine patients were reported to have died, and the majority of the others suffered a residual handicap (Table 2).

Sixty-one cases were described in which spinal manipulation resulted in disc herniation or in progression of radicular symptoms to CES. All but 5 cases in this category (4 cervical and 1 thoracic) occurred in the lumbar region. Most of the complications in the lumbar region (82%) concerned progression to CES. Almost one half (49%) of the lumbar complications occurred during manipulation under anesthesia. All complications in this category led to surgical intervention. Despite this interven-

Table 2. Course of Vertebrobasilar Complications of Spinal Manipulative Therapy, by Profession of the Manipulator

Outcome	Profession of Manipulator						
	All	DC	MD	DO	PT	Other	Unknown
Death	29	15	7	1	—	3	3
Residual handicap	86	51	4	4	4	2	21
Complete recovery	44	24	4	3	1	4	8
Unknown	6	2	—	—	1	1	2
All	165	92	15	8	6	10	34

DC denotes doctor of chiropractic; MD, medical doctor; DO, doctor of osteopathy; PT, physical therapist.

tion, a residual handicap resulted in 21 (54%) of the 39 cases with known sequelae, and 2 fatal complications of surgery were reported.

A total of 13 cerebral complications other than VBAs were reported. In a majority of cases, the nondetection or negligent treatment of a preexisting serious condition contributed to the development of the complication.

We retrieved 56 reports of other types of complications, a substantial number of which involved dislocations and fractures often accompanied by spinal cord compression. This category also contains numerous cases related to negligence or nondetection of preexisting serious conditions.

Surveys and Clinical Trials

Several attempts have been made to assess the incidence of complications of spinal manipulative therapy in a retrospective survey. Dvorak and Orelli[24] conducted a mail survey among the members of the Swiss Society for Manual Medicine. In one out of 40,000 cases, slight neurological complications were observed, and an average of one important complication was observed in an estimated total of 400,000 manipulative procedures. Haynes[25] tried to assess the incidence of stroke in Perth, Australia, in relation to the available data on chiropractic utilization. He concluded that the incidence was less than 5 per 100,000 patients who had received neck manipulation. In a survey among South African physiotherapists covering the period 1971 to 1989, Michaeli [26] found one reported case of VBA out of an estimated 228,050 manipulations performed during that period. No complications were reported in the available clinical trials of manipulation, which in total comprised more than 1500 patients treated with manipulation.[4]

Discussion

There are many publications on the complications of spinal manipulative therapy, primarily published as case reports. Unfortunately, at present, it is impossible to derive exact figures regarding the risks for patients from these data. It is very likely that the number of complications is actually higher than the cumulative number of cases reported in the literature, and case reports mainly describe the more severe complications. Consequently, the medical literature offers a biased sample of complications and the incidence is probably underreported.

Many attempts have been made to estimate risk on the basis of the cumulative number of complications. Gutmann[27] estimated the number of VBAs to be 2 to 3 cases per 1 million cervical manipulations, and Henderson and Cassidy[28] reported an incidence of 1 per 1 million manipulations. These figures resemble the findings in the therapist surveys[24–26]; however, owing to recall bias in retrospective surveys, underreporting of VBAs can be expected.

Concerning the risk of lumbar spine manipulation, Haldeman[15] assumed the incidence of CES caused by manipulation to be approximately "one in many millions of treatments." Shekelle et al[4] estimated that the rate of occurrence of CES as a complication of spinal manipulation was about 1 per 100 million manipulations.

The fairly consistent findings on the incidence of VBAs is sometimes challenged by medical authors. In an editorial in 1981, Robertson,[29] reporting on an audience poll at a meeting of the Stroke Council of the American Heart Association, claimed finding "360 heretofore unreported cases." He concluded that VBA "is far more common than the literature would reflect."[30] Lee et al[31] reported on a survey among California neurologists, in which, for a 2-year period, they identified 56 cases of stroke associated with cervical manipulation. Forty-eight patients (86%) were left with a persistent neurological deficit and one patient died.

Apart from the doubt about the correctness of the assumed incidence numbers, other medical authors emphasized that not only absolute risk, but also the risk-benefit ratio should be considered.[18,32] Powell et al[18] concluded that for acute low back pain, this ratio is acceptably low. For indications such as neck pain and prolapsed disc, they considered the ratio to be unacceptably high. Since the incidence of adverse effects of spinal manipulation has not yet been investigated adequately, however, there is an urgent need for a prospective study, involving an extensive dynamic population, in which cases of main adverse events must be correctly identified and classified, as outlined by Miettinen.[33]

The majority of complications reported is ascribed to chiropractors. Some authors hold the high-velocity "thrust" technique of chiropractic manipulation responsible for this.[34] There are alternative explanations, however, for the high proportion of chiropractic complications: (1) chiropractors make a relatively large contribution to the total number of manipulations applied; (2) many reviews are based on searches of databases originating in English-speaking countries, where chiropractors are the main providers of spinal manipulative therapy[4,35]; and (3) spinal manipulative therapy injuries are often misclassified.[36,37] Because of these considerations, it is unclear whether the high proportion of complications linked to chiropractic can be attributed entirely to certain specific aspects of chiropractic treatment techniques.

Given the serious nature of most reported complications, especially VBAs, the main emphasis should be on

the prevention of complications. It is questionable, however, whether VBA can be prevented. Because these complications usually affect relatively young adults without previous complaints or known abnormalities,[13] and osteoarthritis does not appear to increase the risk of stroke after manipulation,[13] premanipulative radiographs are not considered useful for prevention of VBAs. Although vertebrobasilar provocation tests are the main components of professional guidelines aimed at the prevention of VBAs,[21–23] the thrust component of a manipulation cannot be simulated in a test; therefore, premanipulative tests will always give a certain proportion of false-negative results.[38]

The cervical arteries are most vulnerable when the head is rotated.[19,20] Martienssen and Nilsson[39] as well as Terrett and Kleynhans[13] have found that VBAs mainly occur after cervical manipulation with a rotatory component. It is therefore recommended that referral should be made only to practitioners who do not apply these techniques for cervical manipulations.[13,39]

Manipulation under anesthesia is an important determinant of disc hernia or eventual progression to CES; today, however, manipulation under anesthesia has been almost completely abandoned.[4] Manipulation does not appear to be contraindicated for patients with bulging discs or herniation and is still widely prescribed and recommended for such patients.[15] According to Haldeman,[15] the rare occurrence of CES should not be a reason to avoid such treatment. Nevertheless, it is essential that those practicing or prescribing manipulation be aware of this potential complication so as to reduce the incidence further and to ensure that patients who develop CES are treated as soon as possible.[15,16]

The complications classified under "cerebral complications other than vertebrobasilar accidents" and "other types of complications" were mainly due to negligence with regard to specific preexisting medical conditions considered as relative or absolute contraindications for spinal manipulation. If reasonable doubt exists, it is the responsibility of the referring physician as well the manipulating practitioner to exclude the presence of contraindicating conditions before manipulation. Extensive descriptions of diagnostic procedures to detect conditions representing a contraindication are presented in detail elsewhere.[12] Absolute contraindications for manipulative therapy include acute arthropathies, acute fractures and dislocations, signs of ligamentous rupture or instability, bone malignancies and metastases, infections of bone and joint, acute myelopathy, and CES.[40] Obviously, patients with one or more of these conditions should not be referred for spinal manipulation. Relative contraindications are spondylolisthesis with progressive slippage, articular hypermobility, postsurgical joints, acute soft tissue injuries, demineralization of bone (eg, osteoporosis), benign bone tumors, clinical manifestations of vertebrobasilar insufficiency, aneurysm, anticoagulant therapy, and blood dyscrasias.[40] These conditions generally lead to a modification or abandonment of spinal manipulative therapy. In the case of a relative contraindication, the referring physician should seriously consider the risk in relation to the expected benefit. These conditions require personal communication with the treating spinal manipulator. Scoliosis, degenerative changes, subacute or chronic ankylosing spondylitis, and other chronic arthropathies in which there are no signs of ligamentous laxity, anatomic subluxation or ankylosing, are generally not regarded as contraindications.[40] For several contraindications, eg, malignancy, bleeding disorders, vertebrobasilar insufficiency, and myelopathy, the probability of such a condition predisposing to complications increases with age. This most likely explains the relatively high age of patients in the reviewed cases involving "cerebral complications other than vertebrobasilar accidents" and "other complications." (Supporting data are available on request from the primary author [W.J.J.A.].)

Almost all underlying systemic diseases can be screened for by means of radiography and erythrocyte sedimentation rate testing.[8] For the clinician intending to refer a patient for spinal manipulation, the following factors are indicative of probable contraindications: age greater than 50, history of significant trauma, fever greater than 100°F, history of prolonged corticosteroid use, unexplained weight loss, history of cancer, adenopathy, history of serious systemic inflammatory arthritides or vasculitides, endocrinopathies that affect calcium metabolism, and presence of a neurological deficit.[8,41]

While complications of spinal manipulation have not yet been studied in prospective surveys, the incidence of serious complications is generally considered to be low. Well-designed studies are necessary to provide valid estimates of the risk of spinal manipulation for various indications. Although many professional organizations prescribe premanipulative protocols, it will be impossible to prevent a certain number of VBAs. Information regarding the risk of VBA should be included in an informed consent procedure for cervical manipulation involving thrust techniques. Referral for spinal manipulation therapy should not be made to practitioners applying rotatory cervical manipulation. Cauda equina syndrome as a result of spinal manipulation can be assumed to be rare, and rapid surgical intervention is advisable when adverse sequelae occur. Finally, the referring physician should be aware of any underlying disorder representing a relative or absolute contraindication for spinal manipulation.

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