SYSTEMATIC REVIEW

Manipulation of the cervical spine: a systematic review of case reports of serious adverse events, 1995–2001

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ABSTRACT

Objective: To summarise recent evidence from case reports (published January 1995 – September 2001) of adverse events after cervical spine manipulation.

Data sources: Five computerised literature searches (*MEDLINE – Pubmed*; *EMBASE*, the *Cochrane Library*, *AMED [Allied and Complementary Medicine Database]*, and *CISCOM [Centralised Information Service for Complementary Medicine]*) were performed. No language restrictions were applied.

Study selection: All case reports containing original data of adverse events after cervical spine manipulation were included.

Data extraction: All articles were evaluated and key data extracted according to pre-defined criteria: patient's age, sex and diagnosis; type of therapist; type of treatment; nature of adverse event; method of diagnosis; and clinical outcome.

Data synthesis: Thirty-one case reports (42 individual cases) were found. The patients were equally distributed between the sexes (21 male, 20 female, one unknown) and mostly middle-aged (range, 3 months to 87 years). Most were treated by chiropractors. Arterial dissection causing stroke was reported in at least 18 cases.

Conclusions: Serious adverse events after cervical spine manipulation continue to be reported. As the incidence of these events is unknown, large and rigorous prospective studies of cervical spine manipulation are needed to accurately define the risks.

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SPINAL MANIPULATION is a popular form of treatment used by chiropractors, osteopaths, doctors, physiotherapists and other healthcare professionals to treat a range of (mostly) musculoskeletal problems. The American Chiropractic Association[1] defines spinal manipulation as a passive manual manoeuvre "during which the three-joint complex is carried beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity". The essential characteristic is a low- or high-velocity thrust — brief, sudden, and carefully administered at the end of the normal passive range of movement — in an attempt to increase the joint's range of movement. This distinguishes manipulation from other forms of manual therapy.

The one-year prevalence figures of spinal manipulation in representative samples of general populations are high: 15% (1996, Australia), 10% (1988, Austria), 33% (1996, UK), 7% (1997, USA), and 16% (1998, USA).[2] Several articles[3,4] published before the mid-1990s described the potential risks of spinal manipulation, and showed that, in particular, manipulation of the cervical spine is associated with serious risks. This systematic review of case reports published between 1995 and 2001 evaluates the reported evidence of serious adverse events after cervical spine manipulation.

METHODS

Computerised literature searches were performed using *MEDLINE* (via *Pubmed*); *EMBASE*; the *Cochrane Library*; *AMED* (*Allied and Complementary Medicine Database*); and *CISCOM* (*Centralised Information Service for Complementary Medicine*) (January 1995 – September 2001). The search terms used were "adverse effects", "adverse events", "chiropractic", "complications", "manual therapy", "osteopathy", "risk", "safety", "spinal manipulation", "strokes", "vascular accidents". In addition, I searched my own files and consulted nine other experts. The bibliographies of all located articles were also searched.

All case reports containing original data relating to serious adverse events associated with cervical spine manipulation were included. No language restrictions were applied.

RESULTS

The 31 case reports (42 individual cases)[5-35] that met the inclusion criteria are summarised in the Box. Most reports were from the United States, but the spread across countries is wide. The reports were published fairly evenly over the time period, with a greater number in 1996 and 2001. The patients were equally distributed between the sexes (21 male, 20 female, one unknown) and middle-aged (range, 3 months to 87 years). Most were treated by chiropractors ($n = 30$). The exact nature of the cervical spine manipulation was frequently not described in detail; when it was, rotation and tilting of the head were often involved. Arterial dissection, usually of the vertebral arteries, causing stroke was the most common serious adverse event (at least 18

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cases). In most instances, the acute onset of symptoms after the manipulation made a causal relationship likely. Symptoms often developed quickly — after or during therapy — and varied widely according to the exact nature of the injury. The eventual outcome was often not reported, but included serious sequelae, such as permanent visual field loss, permanent neurological deficit and death (serious sequelae in at least 17 cases) (see Boxes on *pages 378, 379*).

DISCUSSION

Cervical spine manipulation continues to be associated with vascular, neurological and other serious complications. In particular, high velocity thrusts of the cervical spine, especially with rotational movement, seem to result in complications.[3,4] The force and extent of these movements can cause arterial dissection, particularly of the vertebral arteries, in predisposed individuals. In isolated cases, forceful massage alone can lead to serious problems.[35] No particular risk factors for such events, or adequate, practical means of prevention, have yet been convincingly demonstrated. Some authors simply recommend not referring patients to practitioners practising rotary cervical manipulation.[3,4]

The obvious and important limitations of the data must be acknowledged. On the one hand, case reports and case series are by definition anecdotal (Level IV evidence, according to the National Health and Medical Research Council system for assessing level of evidence),[36] and thus are rarely conclusive. In many instances, not all details of the case were reported (eg, the exact nature of the interventions and a causal relationship between the intervention and the clinical event was not always established.

On the other hand, under-reporting is likely to significantly distort the evidence. A recent survey of neurologists found 35 cases of neurological complications occurring within 24 hours of cervical spine manipulation,[34] none of which had been published. Robertson took an audience poll at a meeting of the Stroke Council of the American Heart Association, which disclosed 360 unreported cases of stroke after spinal manipulations.[37] De Bray and colleagues estimated that 12% of all vertebrobasilar artery dissections follow cervical spine manipulations.[38]

In view of this, all existing estimates of risk must be seen as not sufficiently reliable for responsible decision-making, and information about these risks should be included when informed consent is obtained.[39] This is supported by several investigators.[23,40] Recent survey data[41] suggest that Australian chiropractors rarely obtain verbal consent, and never written consent, from their patients. They also seldom discuss the potential risks of chiropractic adjustments, and may therefore not meet all the legal requirements for informed consent.[41]

How can the risk of adverse events associated with cervical spine manipulation be minimised in future? Clinical competence in those performing spinal manipulation seems an essential and obvious precondition. Contraindications must be strictly observed. Vautravers argued that even minor unwanted effects should be considered as an absolute contraindication for future spinal manipulations.[40] About 50% of all chiropractic patients experience such minor adverse effects.[42]

In conclusion, serious complications of cervical spine manipulation appear to occur regularly. Their incidence is essentially unknown and should be established as a matter of urgency through adequately designed investigations.

COMPETING INTERESTS

I have received training in spinal manipulation and have applied it clinically, but have no financial competing interests related to spinal manipulation.

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Summary of case reports of adverse events after cervical spine manipulation

Ref no.	Patient and indication (if provided)	Type of therapist (if provided) and intervention	Adverse event	Diagnosed by§	Outcome
5	36-year-old man with low back pain	Chiropractor — all spinal regions manipulated, including the cervical spine, with forceful rotation of flexed head	Symptoms developed "within hours" of CSM. Long thoracic nerve palsy with motor axon degeneration causing paraesthesiae, pain and reduced mobility of right arm	Nerve conduction studies, EMG, MRI	No details provided
6	29-year-old woman with neck pain, vertigo	Chiropractor — CSM with tilting and rotation of head	Dissection of internal carotid artery causing stroke with somnolence. Acute dissection confirmed by autopsy	CT	Death
7	32-year-old man	CSM	Dissection of right vertebral artery causing basilar artery infarction and stroke	CT, MRI	Mild residual neurological deficit
8	65-year-old man with neck pain	CSM	Diaphragmatic palsy (patient remained symptom-free) — a chance finding on routine x-ray	Chest X-ray, fluoroscopy	Not applicable
	49-year-old woman with arthritic pain	Chiropractor — CSM	Diaphragmatic palsy causing chronic dyspnoea. Symptoms developed over several months of regular CSM — all other causes were excluded	Chest X-ray, fluoroscopy, lung function tests	No details provided
9	48-year-old woman with neck pain	CSM	Dissection of right intracranial artery causing Wallenberg's syndrome	MRI	Persistent neurological deficit
	47-year-old man	Chiropractor — CSM	Intimal tear of right vertebral artery causing transitory neurological deficits	Arteriogram	Bypass surgery, complete recovery
10	59-year-old patient	Chiropractor — CSM	Emboli released from arteriosclerotic internal carotid artery causing partial loss of vision. Symptoms started during CSM	Ophthalmoscopy	Permanent visual field defects
11	87-year-old man	Chiropractor — CSM	Retinal artery occlusion. CSM probably released emboli from arteriosclerotic carotid artery	MRI	No details provided
12	67-year-old man with neck pain	Chiropractor — CSM	Prolapse of discs C5/C6 and C6/C7 causing radiculopathy. Symptoms developed either during or shortly after CSM	MRI, EMG	Gradual improvement
	60-year-old man	CSM	Disc herniation at C4/C5. Symptoms developed either during or shortly after CSM	CT	Full recovery
	56-year-old man with neck pain	Chiropractor — CSM	Protrusion of discs C4/C5, C5/C6 and C6/C7 causing cervical myelopathy. Symptoms developed either during or shortly after CSM	MRI	Surgery, gait remained ataxic
	62-year-old man with neck pain	Chiropractor — CSM	Stenoses of spinal canal at C3, C5/C6, C7 causing cervical myelopathy. Symptoms developed either during or shortly after CSM	MRI	Surgery, permanent neurological deficit
13	33-year-old woman with neck pain	Chiropractor — CSM ("neck manipulation")	Spinal epidural haematoma. Symptoms started 15 minutes after CSM	CT, MRI	Haematoma was surgically removed, full recovery
14	39-year-old woman	Chiropractor — CSM	Ischaemic lesion in medulla oblongata causing stroke. Symptoms developed 5 hours after CSM	MRI, cerebral angiography	No details provided
15	39-year-old woman with neck and shoulder pain	Chiropractor — CSM	Acute infarction of the ventromedial aspect of the inferior right occipital lobe causing stroke with left peripheral visual field loss. Symptoms started immediately after CSM	MRI	No details provided
16	45-year-old woman with tension headache	Chiropractor — CSM with high velocity rotational thrust	Dissection of carotid artery causing complete ophthalmoplegia. Unusual case of previously asymptomatic posterior communicating artery aneurysm	CT, MRI	Surgical intervention, full recovery
17	36-year-old man with neck and shoulder pain	Chiropractor — CSM	Vertebral artery dissection causing stroke. Symptoms started 30 min after CSM	MRI, angiography	Good clinical improvement and resolution of dissection
18	38-year-old woman with neck pain	Chiropractor — CSM with sudden lateral flexion	Cervical injury causing profuse vomiting, vertigo and Horner's syndrome. Symptoms started 30 min after CSM	MRI, angiography	No details provided
19	58-year-old woman with neck pain	Chiropractor — CSM with high velocity thrust	Contusion of upper spinal cord causing Brown–Séquard syndrome. Symptoms started immediately after therapy	MRI	Residual neurological deficit

§ Tests that established diagnosis. CT = computed tomography. EMG = electromyography. MRI = magnetic resonance imaging. CSM = cervical spine manipulation.

Summary of case reports of adverse events after cervical spine manipulation *continued*

Ref no.	Patient and indication (if provided)	Type of therapist (if provided) and intervention	Adverse event	Diagnosed by§	Outcome
20	Young woman	Chiropractor — CSM	Infarct in left inferior cortex causing right superior homonymous quadrantanopia	MRI	Persistent abnormalities
21	34-year-old woman with neck pain	Chiropractor — CSM	Dissection of both vertebral arteries causing cerebellar infarction and stroke. Symptoms developed hours after therapy	MRI, duplex sonography	Residual neurological deficit
22	50-year-old woman with neck pain	Chiropractor — CSM including rotation and tilting of head	Left intracranial vertebral artery and carotid artery dissection causing stroke. Symptoms started " a few minutes" after CSM	MRI, doppler sonography	"Gradual improvement"
23	27-year old woman with shoulder stiffness	Chiropractor — CSM	Vertebral artery dissection causing stroke. Symptoms started after a 48-hour delay	MRI, CT	Minimal persistent neurological deficit
	37-year old man with headache	Chiropractor — CSM	Vertebral artery dissection causing multiple infarcts. Symptoms started immediately after CSM	MRI, CT, angiography	Persistent diplopia and ataxia
24	34-year old woman with neck pain	Chiropractor — CSM	Vertebral artery dissection causing occipital lobe infarction and hemianopsia. Symptoms started within minutes of CSM	MRI	Persistent visual field disturbances
25	31-year old woman	Chiropractor — CSM ("rapid rotary manipulation")	Left vertebral artery dissection causing cerebellar infarction	MRI	No details provided
	64-year-old man	Chiropractor — CSM	Dissection of left internal carotid artery causing parietal stroke	MRI	No details provided
	51-year-old man	CSM	Right internal carotid artery dissection causing subcortical stroke	MRI	No details provided
26	57-year-old man	Chiropractor — CSM	Vertebral arteriovenous fistula at C1 level causing radiculopathy of right arm. Vertebral artery dissection due to CSM the most likely cause	Angiography	Surgical obliteration of fistula, rapid improvement
27	3-month-old baby girl	Physiotherapist — forced active rotation and retraction of head	Bleeding into adventitia of both vertebral arteries causing ischaemia of caudal brainstem with subarachnoid haemorrhage	MRI	Death
28	34-year-old man with whiplash injury, non-radiating neck pain	Chiropractor — CSM	Dural tear causing persistent positional dizziness	No details provided	Full recovery
29	43-year-old man with tinnitus	Orthopaedic surgeon — CSM	Intracapsular/intraosseous oedema of the facet joints C2/C3, with lesions of the nerve root at C3 causing severe neck pain	CT	No details provided
30	30-year-old man (no indication)	"Untrained person" (barber) — CSM ("jerked his neck to the extreme right")	Extramedullary, intradural mass compressing spinal cord at C1/C2. Onset of symptoms immediately after CSM	Plain x-ray, MRI	Permanent neurological deficit
31	44-year-old man with a strained shoulder muscle	Chiropractor — CSM	Dissection of right internal carotid artery causing Horner's syndrome. There was also a subtle dissection of the right vertebral artery	MRI	No details provided
32	47-year-old man with stiffness of neck and shoulder	Chiropractor — CSM including neck rotation	Phrenic nerve injury causing diaphragmatic paralysis. Symptoms (severe dyspnoea) started after several hours delay	X-rays, fluoroscopy, lung function tests	Residual deficit, breathing difficulties
33	33-year-old woman with chronic headache	Chiropractor — CSM	Left vertebral artery dissection causing left pontine infarct and stroke. Symptoms developed during CSM	CT, MRI	Permanent severe neurological deficit
34	Woman	CSM	Vertebral artery dissection causing occlusion and stroke with cerebral oedema. Symptoms developed within 4 hours of CSM. Eight further cases of stroke described	CT, angiogram	Surgical decompression, removal of part of cerebellum, permanent neurological deficit
	46-year-old man	Chiropractor — CSM	Subdural haematoma. Symptoms developed immediately after CSM	No details provided	Surgical intervention, full recovery
	42-year-old woman	CSM	Prolapse of disc at level C5/C6. Report describes one further case of myelopathy	MRI	Major residual deficits
	32-year-old woman	Osteopath — CSM	Radiculopathy at level C6/C7/C8. Symptoms began within 12 hours of CSM	No details provided	Minor residual deficit
35	80-year-old man with neck and shoulder stiffness	Shiatsu practitioner — shiatsu massage of upper neck	Retinal artery embolism causing partial loss of vision. Treatment mainly forceful neck massage (it is arguable whether this constitutes CSM)	MRI, angiography	Permanent ocular effects

§ Tests that established diagnosis. CT = computed tomography. EMG = electromyography. MRI = magnetic resonance imaging. CSM = cervical spine manipulation.

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snapshot

Digit loss following misuse of temazepam

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A 29-YEAR-OLD unemployed man presented with pain and swelling of the right hand. He reported two occasions of intravenous drug use during the previous three days: a single heroin dose, followed by temazepam (4 x 10 mg gel capsules, dissolved in hot water). He was right-handed. On both occasions he injected into a superficial blood vessel on the back of the right hand. On presentation, the clinical diagnosis was inadvertent intra-arterial injection of temazepam, with vascular endothelial damage secondary to macrogols (used to increase viscosity in gel capsule manufacture). The patient's condition was managed with elevation of the forearm, aspirin, heparin anticoagulation, empirical parenteral antibiotics and analgesia. Over three days the patient showed substantial improvement, allowing discharge with follow-up in one week. Four days later, he returned with increasing pain. He denied further intravenous drug use. He had normal arterial pulses, but the distal fingers were cool. Fingertip sensation and capillary refilling were diminished. To improve perfusion and limit further thrombus development, an alprostadil infusion and oral nifedipine were introduced. Over 10 days, necrotic areas, involving index, middle and little fingers, developed and required amputation. The picture shows the patient's hand after surgical debridement and amputation of necrotic areas, three weeks after injection of temazepam.*

*In December 2001, the Pharmaceutical Benefits Advisory Committee recommended that prescribing of temazepam capsules be restricted to people who have failed to respond to the tablets because of concerns about misuse by intravenous drug users (see <http://www.health.gov.au/pbs/listing/pbacrec/pbacrecdec.htm>, accessed 20 March 2002).