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Original Article

The prevalence and association of neck (coat-hanger) pain and orthostatic (postural) hypotension in human spinal cord injury

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Objective: To investigate the prevalence of orthostatic (postural) hypotension (OH) and neck pain in a 'coat-hanger' occipito-cervical distribution in subjects with spinal cord injury (SCI), and their association.
Method: Blood pressure was measured during head-up tilt to 60° (to determine OH) and neck pain was assessed in 28 subjects with SCI (cervical, thoracic and lumbar level) with McGill Pain Questionnaire, visual analogue scale for pain intensity and Orthostatic Intolerance Symptoms Questionnaire for pain frequency.
Results: Neck pain was reported by 53.6% of subjects. Orthostatic hypotension was present in 57.1% of subjects. Neck pain was reported by 75% of subjects with OH and 25% of subjects without OH ($P<0.03$, Chi-square). Features of such pain included positive correlation to upright posture and exercise, and relief when lying flat.
Conclusion: There is a high prevalence of neck pain and OH in SCI, with a positive association similar to that reported in primary autonomic failure with OH.
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Introduction

Suboccipital and paracervical neck pain in a coat-hanger distribution is a common symptom in subjects with orthostatic (postural) hypotension (OH) due to pure autonomic failure (81–93%) and multiple system atrophy[1,2] (51–53%). It is provoked by an upright posture and is relieved by lying flat with a relationship to OH, probably through hypoperfusion of tonically active neck muscles.[2]

In spinal cord injury (SCI) OH frequently occurs, especially in subjects with cervical or high thoracic lesions or during mobilization following long-standing recumbency.[3–6] The prevalence of neck pain is also higher in SCI than in the general population, and it is commonly attributed to spine instability, surgical procedures, inflammatory processes, and neurovascular compression.[7–9] There have been no previous studies in SCI on the relationship between OH and neck pain. We therefore studied 28 subjects with SCI at various levels, to determine the prevalence of OH and neck pain, and their association.

Subjects and methods

A total of 28 subjects (23 males and five females, age range 17–70, average 34 years) participated in the study (which had the approval of Aylesbury Vale District Research Ethics Committee), after giving informed consent. All were examined and classified according to ASIA/IMSOP International Standards.[10] They had a varying range of SCI neurological level (C2 to L2), grade of completeness (A to D), and time from injury (4 to 211 weeks): details are summarized in Table 1. A complete medical history, neurological examination and imaging (X-ray and MRI of the spine) were obtained before enrolment into the study; subjects with cervical or occipital pain due to recognized regional causes (including arthritis, post-surgery pain, trauma, dystonia) were excluded.

All tests were performed between 15.00 and 17.00 h to avoid the effects of nocturnal recumbency, meal

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consumption or fasting, that are factors known to influence OH.[11] Medication with autonomic effects was suspended the day before the study. Subjects emptied their bladder (either by catheter or spontaneously) before the study. Blood pressure was measured with automated brachial artery recording (Dinamap, Critikon) before and after head-up tilting to 60°. Baseline values were obtained after at least 15 min of rest in the supine position. A fall of at least 20 mmHg in systolic blood pressure or 10 mmHg in diastolic blood pressure within the first 3 min of head-up tilt was considered to represent OH, as defined previously.[12] The McGill Pain Questionnaire[13] was used to describe localization and characteristics of pain and triggering/relieving factors. Pain intensity was quantified with a 10 cm visual analogue scale[14] (VAS). Where the disability prevented the subject from completing the scale manually, this was done following his/her verbal instructions. A further analysis was also performed adjusting the score for individual experience of physical pain, by calculating the proportion of the VAS for the neck pain over the VAS of the worst physical pain ever experienced by the same individual. The frequency of pain was also graded using the Orthostatic Intolerance Symptoms scale (0 = never; 1 = occurring less than once a week; 2 = at least once a week; 3 = more often than not; 4 = consistently present) of the Composite Autonomic Symptoms Score.[15,16]

Results

Prevalence of orthostatic hypotension and neck pain

In 16 of 28 subjects (57.1%) OH was recorded during head-up tilt. In seven subjects the test was stopped within 3 min because of imminent fainting. All SCI subjects with OH had a neurological level at T5 or higher. Only one subject with SCI below T5 (level L2) had OH, and she was studied after 3 months of recumbency.

All subjects completed the pain questionnaires. Neck pain (see Figure 1) was reported by 15 subjects (53.6%), of which the SCI level was cervical in 12 subjects, thoracic in two, and lumbar in one.

Association of orthostatic hypotension and neck pain

Neck pain was reported in 12 of 16 subjects (75%) with OH, and also in three of 12 subjects (25%) without OH (Figure 2); this difference was statistically significant ($P<0.03$, Chi-square).

A further analysis of the relationship between OH, neck pain and level of lesion was performed. In cervical SCI the prevalence of neck pain was higher in subjects with OH (10 out of 13; 76.9%) than without OH (two out of four; 50%). In thoracic SCI, one of two subjects with OH (50%) and one of seven without OH (14%) reported neck pain. In two subjects with lumbar SCI, the one with OH was also the only one to report neck pain (see Table 1).

Intensity of pain

The mean ($\pm$standard deviation) intensity of neck pain, expressed in cm on a 0–10 VAS, was 3.87 ± 2.22; the mean pain intensity adjusted for individual experience of pain (expressed as proportion of scores of neck pain over the worst pain experienced by the same subject) was 0.49 ± 0.25.

There was a positive correlation between the degree of fall in blood pressure and the adjusted score for neck pain intensity. This correlation was statistically significant for both systolic ($P<0.001$, Pearson's correlation: see Figure 3) and diastolic blood pressure ($P<0.001$, Pearson's correlation).

Frequency of pain

The mean frequency of neck pain graded by the subjects was 2.47 ± 0.74 according to the Orthostatic Intolerance Symptoms scale (0–4). Out of 15 subjects, 14 were able to indicate the part of the day during which the occurrence of neck pain was most common. The most frequently reported terms were 'evening' or 'end of day' (eight subjects) and 'early morning', 'morning' or 'when getting up from bed' (five subjects). Two subjects indicated 'late afternoon', one 'afternoon' and one 'mid-day'. No subjects reported the occurrence of nocturnal neck pain. Regarding the way the pain fluctuated in time, reported in the McGill questionnaire, this was described as 'continuous' by eight subjects, 'steady' by 3, 'periodic' by two, 'constant' and 'momentary' by one subject each.

Characteristics of pain

The pain characteristics most frequently reported in the McGill questionnaire were 'aching' (nine of 15 subjects), 'tight' (7/15), 'tiring' (7/15) and 'intense' (3/15). No other characteristics were entered by more than two subjects.

Activating factors

Upright posture, expressed as 'sitting up' or 'standing in the wheelchair for long', was a factor triggering or worsening neck pain by 13 of 15 subjects. Two subjects reported 'bad position', and one 'tiredness'. One subject reported 'being off the ventilator' as an activating factor.

Relieving factors

Ten subjects reported the supine position ('lying down' or 'lying flat') as the most effective relieving factor. Five subjects used non-steroidal anti-inflammatory drugs (NSAIDs). Leaning forward on the wheelchair, a manoeuvre regularly performed to prevent pressure sores, was beneficial to neck pain in three subjects. No other relieving factors were entered by more than two subjects.

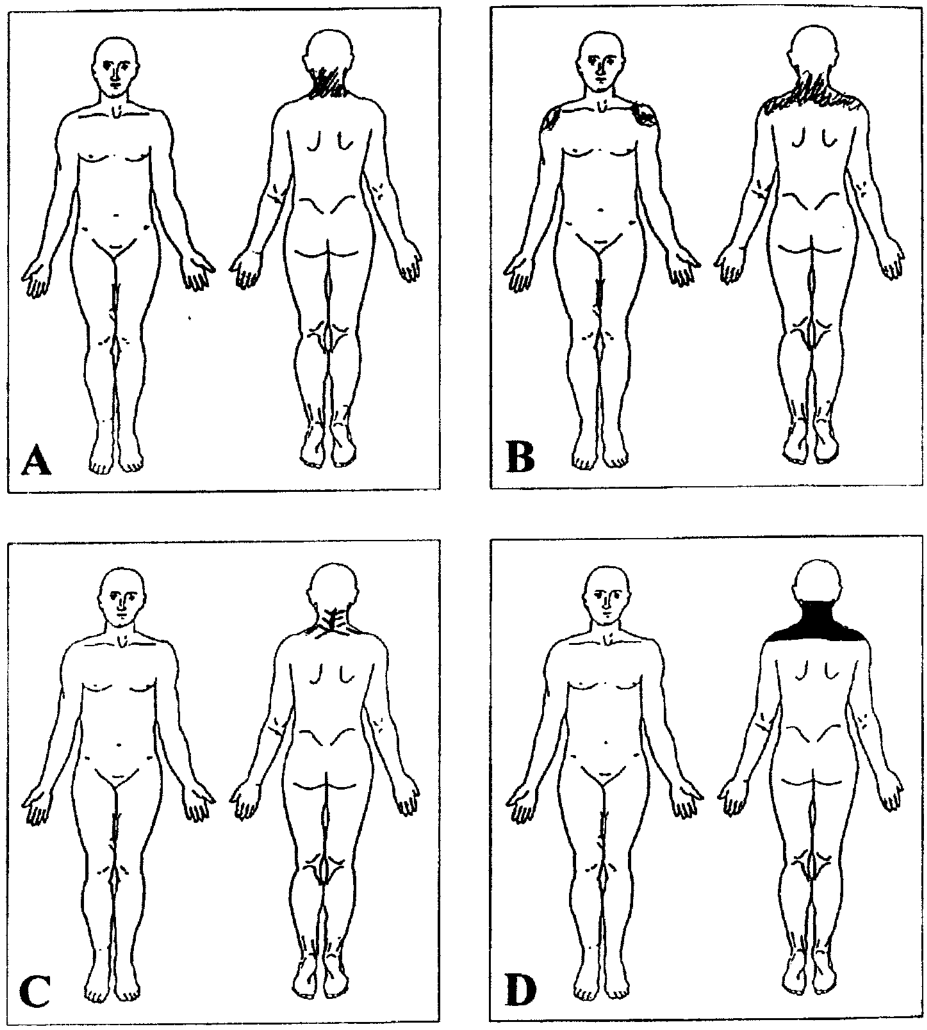

Figure 1 Localization of neck pain mapped by four SCI subjects. Figures A, B and C drawn by the subjects. Figure D drawn by the examiner under subject's instruction (complete tetraplegia)

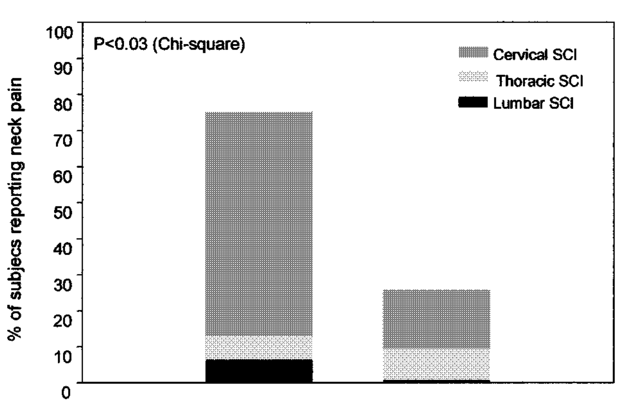

Figure 2 Presence of neck pain in SCI subjects with and without orthostatic hypotension (OH)

Relation to exercise and meal consumption

Upper limb exertion or exercise triggered or worsened neck pain in eight out of 15 subjects. None indicated a relationship to meal consumption.

Discussion

Our study demonstrates a high prevalence of OH (57.1%) and neck pain (56.3%) in SCI subjects, with a statistically significant positive correlation; 73% of subjects with OH reported neck pain, compared to 25% of subjects without OH ($P<0.03$). Such pain, with a coat-hanger distribution, was described by the subjects as tight, aching, tiring, related to upright posture, and of moderate intensity (about 50% of the most intense physical pain previously experienced by the individuals). It was also reported to occur more frequently when assuming the upright posture immediately after nocturnal recumbency, or during the late part of the day, and was made worse by exercise and relieved by lying flat.

Table 1 Individual details of subjects

Subject number	*Gender (M=male, F=female)*	*Age (years)*	*Time from injury (weeks)*	*Level of injury*	*ASIA grade*	*OH on head-up tilt*	*Neck pain*
1	M	32	71	C2	A	–	+
2	M	36	106	C3	A	+	+
3	M	40	27	C4	A	+	+
4	M	31	47	C4	A	+	+
5	F	27	13	C4	A	+	+
6	M	23	13	C4	B	+	+
7	M	23	42	C4	B	+	+
8	F	30	66	C4	B	+	+
9	M	29	12	C4	D	+	–
10	M	37	8	C4	D	–	–
11	M	25	18	C5	A	–	+
12	M	27	25	C5	A	+	+
13	M	50	10	C5	A	+	–
14	M	53	38	C5	B	+	+
15	M	17	18	C6	A	–	–
16	M	20	41	C6	A	+	+
17	F	50	10	C6	A	–	–
18	M	18	6	C8	C	+	–
19	M	21	32	T2	A	–	+
20	M	22	8	T4	A	–	–
21	M	35	13	T4	A	+	+
22	F	62	47	T4	A	–	–
23	M	30	4	T5	A	+	–
24	M	23	30	T6	A	–	–
25	M	37	44	T7	C	–	–
26	M	70	7	T8	B	–	–
27	M	61	211	L1	A	–	–
28	F	33	9	L2	D	+	+

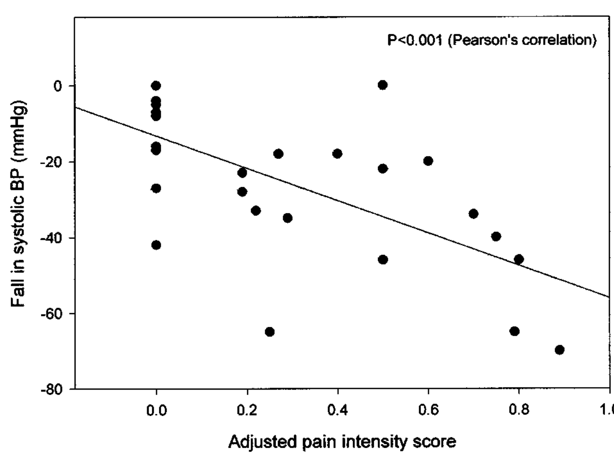

Figure 3 Correlation between neck pain intensity and degree of fall in systolic blood pressure (BP) after 3 min of head-up tilt

The prevalence of occipito-cervical pain in our SCI subjects with OH is within the range of values reported for other disorders where OH is a major feature, such as pure autonomic failure and multiple system atrophy.[1,2] The characteristics of neck pain described by our SCI subjects (such as the relationship to exercise and posture) were similar to those reported in pure autonomic failure and multiple system atrophy. Information on pain intensity was not obtained in previous studies. There was a statistically significant correlation between pain intensity (VAS score) and the degree of fall in blood pressure (both systolic and diastolic), further suggesting a causal relationship between the two factors.

It might be argued that the neck pain reported by our subjects and its association with OH was coincidental as both OH and cervical pain occur more frequently in cervical SCI. However, several factors suggest that the relationship between neck pain and OH was not fortuitous. Efforts were made in our study to exclude recognized causes of neck pain from the clinical history, physical examination, and imaging studies. Analysis of results at different SCI levels indicated that occipito-cervical pain was more frequent in cervical SCI and OH, than in cervical SCI without OH. Neck pain was associated with OH also in subjects with SCI at thoracic or lumbar level, where there was no reason to suspect a cause of pain related to the cervical spine. Furthermore, the characteristics of pain and relationship to head-up posture, arm exercise, and relief by lying flat favoured a causal link to OH, and were similar to those observed in subjects with pure autonomic failure and multiple system atrophy.

The reasons for the distribution of the pain and its characteristics warrant speculation. With a fall in perfusion pressure during orthostasis, organs and muscles that derive their blood supply from above the level of the heart are vulnerable. Thus cerebral hypoperfusion results in a variety of symptoms[2] often seen in the early stages of rehabilitation in high SCI. The cerebral vasculature however has considerable capacity for autoregulation, and this probably accounts for a reduction in symptoms with time. The muscles in the neck, particularly the deep cervical muscles that mainly obtain their blood supply from above the heart level, are presumably susceptible to ischaemia as they are tonically active. This would explain the relationship of neck pain to OH and also arm exertion, that may cause a 'steal' effect. The rapid response to lying flat, expected to reverse OH, is consistent with this conclusion. Some subjects were on NSAIDs, that may have been unnecessary; however these drugs have been used to reduce OH.[17] Finally, other factors such as lowering of cerebro-spinal fluid pressure cannot be excluded as causing or contributing to neck pain.

Food consumption is known to lower blood pressure[18] and to aggravate coat-hanger pain in autonomic failure and multiple system atrophy,[2] but no such relationship emerged in SCI subjects from the questionnaires of our study. A similar study with food challenge demonstrated an abnormal hormonal response in SCI, resulting in no effect on the OH induced by head-up tilt.[19]

Three subjects in our study reported that their pain improved when performing pressure sore prevention manoeuvres (leaning forward on the wheelchair with the head towards the knees) that are also expected to improve OH. Furthermore, a tetraplegic subject indicated that neck pain was triggered regularly when his ventilator was turned off to encourage active breathing; whether this suggested an influence of blood oxygenation on his neck pain, as may be expected with diminished blood flow in the other subjects, can but be speculated upon. Overall, the observations are consistent with the hypothesis of an effect of OH on neck pain, probably due to hypoperfusion of tonically active cervical muscles.

The results of our study may influence rehabilitation approaches to SCI. Both OH and neck pain are factors that limit the efficacy and viability of intense physical rehabilitation programmes in SCI.[4,6,8,20–22] Pharmacological and physical approaches to treat OH have been proven beneficial in SCI.[3,23,24] If OH is a potential cause for neck pain, as indicated by our study in SCI and also previous studies in pure autonomic failure and multiple system atrophy, a prompt diagnosis of OH and its treatment in SCI undergoing physical rehabilitation may improve neck pain. Such awareness would therefore also increase the tolerance for rehabilitation in SCI in which an association of OH and neck pain is suspected.

Conclusion

Our study indicates a high prevalence of OH and neck pain in SCI, with a positive correlation similar to previous reports in other conditions featuring OH. In subjects with SCI and neck pain of unknown aetiology, OH should be considered, especially if it is linked to the upright posture and relieved by lying flat. It is likely that the association between neck pain and OH in SCI has previously been underestimated.

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