MULTIMODAL TREATMENT TO PREVENT THE LATE WHIPLASH SYNDROME

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ABSTRACT. In order to assess the long-term efficacy of a multimodal rehabilitation approach on whiplash injury, 60 patients were recruited within two months after neck injury. They were randomly allocated either to an experimental multimodal treatment (A) consisting of postural training, manual techniques and psychological support or to a control treatment (B), using physical agents only, such as electrical and sonic modalities. Pain level, range of movement, self-rating scale of treatment efficacy and return-to-work delay were evaluated before and at the end of the treatment, and later, 30 and 180 days after randomisation. The benefit obtained with treatment A was greater and longer lasting than that experienced using B, despite the fact that the same benefit was obtained in joint mobility by the two groups. Patrons undergoing the experimental treatment returned to their usual occupations sooner than the controls. The results seem to confirm the hypothesis of a multifactorial involvement as a possible mechanism for the late whiplash syndrome.

Key words: whiplash injury, physical therapy, rehabilitation, neck sprain.

INTRODUCTION

For many years now there has been a lively debate about the symptoms following whiplash injury. Even the terms regarding causal mechanisms and clinical pattern are not widely accepted (17, 8, 10, 19, 21, 28, 32, 39). Whiplash may be defined, according to the original description of Crowe in 1922 (6), as the effects of sudden acceleration-deceleration forces on the neck and upper body due to external forces causing a "lashlike effect". The main consequences of dynamic injury on the cervical spine are often called "necksprain" pointing to a collection of painful symptoms following injury to the neck, usually of a hyperextension-flexion type, without symptoms or signs of traumatic nerve root or cord dysfunction (33). The occurrence of long-lasting extra-articular symptoms focused attention on the so-called "late whiplash syndrome" whose nature and pathogenesis is still far from being defined (5, 7, 12, 15, 16, 99), owing to its peculiar epidemiological and clinical features, i.e. an unexplained higher incidence in women (2, 19), the frequent involvement of patients in compensation claims (30), the occurrence of "neurotic" symptoms such as anxiety, fatigue, insomnia (25) and the poor efficacy of analgesic drugs.

The clinical picture was justified on the basis of spine, neuromuscular and neurological involvement. An antidisturbant cervical sympatholysis highlighted by radiological investigation and including disk space narrowing and posterior osteophyte formation was described by some authors while others emphasized the role of cervical sympathetic ganglion or disk lesions (10, 14, 29). The role of root, cervical cord and myofascial lesions is widely discussed, but the occurrence of persistent neurological signs excludes a real neck sprain (22), whereas an injury to the neck muscles (torticollis and partial avulsion of sternocleidomastoid or longissimus capitis), followed by vertebral artery spasm, might explain both the physical and behavioural symptoms (23).

Recent data provide evidence of the involvement of the central nervous system (CNS) after a whiplash injury (11). While Ettl et al (12) try to correlate the abnormal behavioural response to pain with subtle structural damage of the basal frontal and upper brain-stem structures, Pearce (31) reverts the hypothesis of any ataxonomical disruptive lesion on the basis of the normal RAEP and MRI results described by

different authors in patients having suffered neck injury (9, 12, 24, 38).
Radanov et al. (35) have advanced the theory of functional brainstem damage producing both cervical and encephalic symptoms (the so-called "cervico-
encephalic syndrome"), and discussed psychosocial, financial, demographic and clinical factors influencing the persistence of the syndrome (34).
Unfortunately, most of the works quoted address prognosis through a retrospective evaluation of patients, without considering an adequate control group obtained through randomised treatment protocols (28).
The usefulness of any treatment for the late whiplash syndrome is still subject to discussion (29). Since Mealy et al. (26), who obtained a greater benefit using early mobilisation than that produced by the standard treatment based upon rest and immobilisation with a soft cervical collar, there have been very few reports on this issue. Recent approaches include different techniques, ranging from the application of physical agents (13, 14) to subcutaneous sterile water injections (6), to intraarticular steroid or intraarticular anesthetic injection (3, 4). No report seems to be conclusive and the chronic whiplash syndrome continues to be a frequent cause of absence from work.
The present study aims to evaluate the efficacy of a multimodal treatment in reducing symptoms during the acute phase and preventing their continuation in the form of a delayed syndrome.

MATERIAL AND METHODS

Patients
A randomised controlled single-blind prospective study was carried out on 60 consecutive patients suffering from a cervical whiplash-deceleration injury following a car accident. The dynamics of the cervical involvement were always represented by primary rear impact with the strike car either in motion or stationary. Inclusion criteria were: (i) time interval between injury and randomisation of less than 60 days; (ii) regular performance of job or profession before the car accident; (iii) no infectious, neoplastic, metabolic or inflammatory bone disease; (iv) no X-ray evidence of traumatic or severe degenerative lesions of the cervical spine; (v) no symptoms exaggerating with the intention of enhancing financial awards; and (vi) informed consent to the investigations.
Patients included were 25 men and 35 women, suffering from "neck sprain" and showing both joint problems (range of neck movement decreased) and myofascial symptoms (muscle spasm, painful contractions). Furthermore, they complained of extraganglionic symptoms, such as headache, fatigue, dizziness, poor concentration, disturbed accommodation and improved adaptation to light intensity, thus meeting the criteria described by Radanov et al. (35) for the "cervico-encephalic syndrome".
Patients were enrolled within an average of 30 days from whiplash (SD: 17.4 days; range: -6 to 60 days) and showed satisfactory clinical and/or radiological treatment was applied.

They all received muscle relaxants and/or analgesics (i.e. Diclofenac) and were given a soft cervical collar during the first two weeks following injury.

Procedure
Cervical and extracervical symptoms were recorded using a check-list. The clinical examination assessed the occurrence of orofacial and myofascial disorders such as mobility restriction and pain. A cervical X-ray, using routine A/P, side and foramen projections was employed to rule out spine dislocation, magnetic resonance imaging was performed in few cases, when a spinal cord injury was suspected.
After the basal examination, patients were randomly assigned to two groups of 30 subjects each.
Group A underwent an experimental multimodal treat-
ment, providing:
- relaxation training based on diaphragmatic breathing in supine position (56).
- active reduction of cervical and lumbar lordosis, based on the suggestions provided by the Neck School (57).
- psychological support to reduce anxiety and limit emo-
tional influence, according to Radanov's suggestions (14).
- eye fixation exercises in order to prevent diziness, accord-
ing to the technique described by Shany et al. (58).
- manual treatment (massage, mobilisation of the cervical spine 28).

Group B received a treatment based on the application of physical agents (i.e. electrotherapy and modalities), including:
- transcutaneous-electrical nerve stimulation (TENS) (espe-
ically the A7 and Amold's sites) and pulsed electro-
therapy, as suggested by Foley-Nolan (14), and
- ultrasonic therapy and calciferol administered with calcium chloride, as frequently applied after neck injury (15).

Each underwent 10 therapeutic one-hour sessions over a two week period. One physician, blind to patient allocation, performed the clinical assessment four times before treatment (T0), on completion of rehabilitation inter-
ventions, i.e., 15 days later (T1), and one and six months (T2 and T1) respectively after T0.

The outcome was judged by considering the following measures: (a) range of neck movement (ROM); (b) pain level; (c) self-ratings scores of treatment efficacy, and (d) patient satisfaction.

a) Cervical ROM was quantified by measuring maximal flexion, extension and rotation, i.e., (i) the distance from the chin to the breast-bone after maximal flexion and neck extension, (ii) the distance between the tragus and the anterior superior right and left, and (iii) the distance between the chin and the acromion after left and right rotation. According to the procedure adopted by Foley-Nolan (14), the values obtained for each parameter were transformed into ordinal scores, after the comparison with normal data, as follows. 7 = values above normal; 6 = subnormal (P<0.05); 5 = normal; 4 = value lower than 0.05 a normal values. Such a method led to a maximum score of 6 (i.e. 2 points x 3 measures) and a minimum score of 0.
RESULTS

No differences were found between the two groups with respect to personal data (age, sex, injury-randomisation interval, early treatment) (Table I), basal clinical features (Table III) or negative prognostic factor distribution (Table III).

The treatment evaluation indicated greater improvement in Group A, when compared with Group B, for all outcome measures except for neck mobility. Median ROM values recorded at T0 were 3.8 for Group A and 3.9 for Group B. At T3, they increased respectively to 5.3 and 4.6 (two-way Friedman test: intra-group comparison: p > 0.0001). Although patients from Group A showed a progressively increasing benefit, even after the intervention of treatment, in contrast to Group B subjects, whose recovery reached a plateau, the data analysis failed to demonstrate any significant difference in ROM trend between the two groups (Fig. 1).

Pain intensity decreased in both groups at a similar rate. At the six-month check-up, 21 patients from Group A and 20 from Group B did not complain of pain. Pain intensity decreased from median VAS scores of 6.5 and 7.4 (respectively in Groups A and B) at T0 to 9.0 and 6.8 at T3, the advantage for Group A becoming more evident in the longer period (two-way Friedman test: time x treatment interaction: γ = 0.001) (Fig. 2).

Self-assessment of outcome showed a greater satisfaction for the recovery in patients undergoing the experimental treatment, than in controls. At the end of therapy sessions (T1), median outcome scores were 1 and 0, respectively for Group A and B. At T3, these scores had increased to 2, in Group A, but decreased to 1 in Group B (Fig. 3). The analysis of contingency tables confirmed the statistical significance of the different distribution of judgements, both at T1 (p < 0.01) and at T3 (p < 0.001).

Table I. Personal data of randomized subjects

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>N of subjects</td>
<td>30</td>
</tr>
<tr>
<td>Age (years), mean (SD)</td>
<td>49.0 (22.1)</td>
</tr>
<tr>
<td>Male/female ratio</td>
<td>13/17</td>
</tr>
<tr>
<td>Post-trauma interval (days), mean (SD)</td>
<td>11.1 (10.8)</td>
</tr>
<tr>
<td>Acute phase treatment</td>
<td>12.0 (7.3)</td>
</tr>
<tr>
<td>Application of a soft collar (days), mean (SD)</td>
<td>10.5 (6.0)</td>
</tr>
</tbody>
</table>

Table II. Occurrence of symptoms at randomization, in the two groups of patients

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Group A (n)</th>
<th>Group B (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck pain</td>
<td>27 (90)</td>
<td>28 (93)</td>
</tr>
<tr>
<td>Headache</td>
<td>19 (63)</td>
<td>25 (83)</td>
</tr>
<tr>
<td>Shoulder pain</td>
<td>1 (19)</td>
<td>12 (50)</td>
</tr>
<tr>
<td>Back pain</td>
<td>9 (29)</td>
<td>10 (17)</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>6 (19)</td>
<td>5 (17)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>24 (80)</td>
<td>20 (67)</td>
</tr>
<tr>
<td>Transient finger paresthesia</td>
<td>9 (29)</td>
<td>7 (23)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>18 (60)</td>
<td>18 (60)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>14 (47)</td>
<td>15 (50)</td>
</tr>
<tr>
<td>Sleep disturbances</td>
<td>16 (53)</td>
<td>17 (57)</td>
</tr>
<tr>
<td>Irritability</td>
<td>7 (23)</td>
<td>5 (17)</td>
</tr>
<tr>
<td>Poor concentration</td>
<td>6 (19)</td>
<td>21 (70)</td>
</tr>
<tr>
<td>Forgetfulness</td>
<td>3 (10)</td>
<td>3 (10)</td>
</tr>
</tbody>
</table>

Fig. 3. Acute phase treatments

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Fig. 4. Change in pain intensity over time (VAS scores)

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Table III. Occurrence of risk factors influencing the outcome, in the two groups

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Early onset of pain (within 12 hours of injury)</td>
<td>12 (40)</td>
<td></td>
<td>14 (47)</td>
<td></td>
</tr>
<tr>
<td>Past history of back pain</td>
<td>5 (17)</td>
<td></td>
<td>4 (13)</td>
<td></td>
</tr>
<tr>
<td>Degenerative (not severe) changes on Rx</td>
<td>11 (37)</td>
<td></td>
<td>9 (30)</td>
<td></td>
</tr>
<tr>
<td>Loss of consciousness (less than 7)</td>
<td>1 (3)</td>
<td></td>
<td>2 (7)</td>
<td></td>
</tr>
<tr>
<td>Past history of trauma</td>
<td>3 (10)</td>
<td></td>
<td>4 (13)</td>
<td></td>
</tr>
</tbody>
</table>

Finally, a difference between the two groups was observed by comparing the delay in returning to work at the 6-month follow-up stage all patients but one from Group A were engaged in their usual occupation, as compared to 24 subjects out of 36 from Group B. The mean values of the delay in Groups A and B were 38.4 ± 10.5 days and 54.3 ± 14 days, respectively (ANOVA; \( p < 0.001 \)).

Fig. 5: Trend in ROM scores (median values) evaluated in the two groups, in different phases after randomization. No significant inter-group differences were found. Intra-group changes were highest immediately after treatment (\( p < 0.001 \)).

Fig. 6: Trend in VAS scores (median values) in the two groups. Intra-group differences are marked (*** \( p < 0.001 \)), *** \( p < 0.001 \)) inter-group changes were found to be significant at the 0.001 level for both groups.

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**Fig. 5.** Self-assessment of outcome on completion of treatment (T1) and six months later (T3). Both types of distribution of subjects in the two groups was significantly different (T1: p < 0.01 level; T2: p < 0.001). Score scale reads as follows: 3 = total recovery; 2 = marked improvement; 1 = slight improvement; 0 = no change; 1 = slight impairment; 2 = marked impairment; 3 = complete disability.

**DISCUSSION**

The purpose of this study was to assess whether spinalplast surgery resulted in treatment benefit in terms of disability and delay in return to work.

In this study, subjects were chosen who had homogeneous clinical features, all satisfying the criteria for cervico-epileptic syndrome. The population studied did not differ from other series with respect to age distribution (30) and male-female ratio (2:3:4). Symptom occurrence was similar to that described by others (2, 30, 34), with the exception of arm pain, ruled out by the inclusion criteria for the cervico-epileptic syndrome. The predictive factors of spinalplast outcome were similarly distributed in the two groups of patients.

Outcome measures were chosen by considering both parameters directly influenced by the treatment, such as pain and ROM, and independent measures of handicap, such as return to work delay. The use of an ordinal scale for the measurement of neck flexibility has been recommended by Fuchs-Nolfi et al. (4). This approach may be considered less sensitive than that based on goniometric values whose intrarater and interrater reproducibility is not high (1).

The application of a multimodal treatment aimed to reduce chronic pain has been discussed in a recent analysis by Linsch & Spinhoven (22). A few studies have been carried out on the efficacy of this approach to back pain (27). To our knowledge, no reports describe the benefits related to a multimodal approach, including a cognitive/behavioral treatment, in patients with cervical pain.

When analyzing the results, we found that neck movements improved both in patients given a multimodal treatment, including active mobilization (Group A), and in those treated with physical agents (Group B). However, a difference between the two groups was observed when considering the outcome expressed by subjective symptoms such as pain, emotional changes.

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and percutaneous dissection. The number of people free from pain was similar in the two groups, whereas pain intensity was greater in Group B patients. The overall percentage of people complaining of cervical symptoms falls within the range of other investigations (2, 14, 15).

All these features proved to be better controlled by the modulatory treatment both in the acute phase and in the long term. The duration of hospital stay for a long period after treatment interruption allows the ruling out of a placebo effect on the experimental treatment. On the other hand, the psychological support may reduce the emotional influence on muscle tone and increase tolerance for pain (13, 15).

Subjects undergoing the experimental treatment complained of persistent discomfort or pain at a rate similar to that described in other prospective studies (10, 19, 30), but they reported both a lower intensity of symptoms and a reduction in their disabling effect. Furthermore, almost all patients in Group A were able to carry on their usual occupations after six months, compared with other series which report return-to-work values of 74% to 80% (2, 30).

In conclusion, the comparison of a passive treatment with a multimodal approach may lead to the conclusion that many different interventions are better than one single type lasting the same time. However, an interesting point to note is that the persistence of disability is related to the rehabilitation approach independent of the amelioration of pain and neck mobility. This fact may support the hypothesis that many factors, other than pain and neck flexibility, are involved in the late whiplash syndrome. In line with Radanov’s opinion (155), postural and cognitive symptoms may be considered components of post-traumatic disability and secondary to functional CNS involvement.

REFERENCES


