Neuropathic Pain in People with Spinal Cord Injury: Quantitative Clinical Trials

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Abstract

One of the biggest problems of spinal cord injuries (SCI) is neuropathic pain. Moreover, it is pointed out by several studies as one of the major difficulties for SCI patients. Nowadays, the current challenge is to understand the etiology of the neuropathic pain in SCI patients. The objective of this study is use from quantitative clinical trials to observe the differences between spinal cord injuries who have neuropathic pain and those who do not. 30 individuals separated in 3 groups: 10 SCI with neuropathic pain (SCI-P); 10 SCI without neuropathic pain (SCI-NP); 10 controls (non-SCI subjects). They were submitted with quantitative tests: tactile and thermal sensitivity, evoked pain (allodynia, dysesthesia and hyperalgesia) and the McGill Pain Questionnaire. All SCI individuals do neuromuscular electrical stimulation. SCI-NP detected more cold, heat pain, and tolerance of heat pain than the SCI-P. The SCI-P detected more heat than the SCI-NP. There was no statistical significance between the groups SCI- P and SCI-NP when comparing pain and tactile sensitivity, but SCI-P reported more tactile sensitivity than the SCI-NP. Hyperalgesia below the level of injury was most often detected by SCI-NP. This study has replicated clinically some of the diverse mechanisms of neuropathic pain, gathering and quantifying various forms of sensitivity affected by the injury. We demonstrate that neuropathic pain after traumatic SCI is not due to only anatomic lesion, but also related to complex neural processes, biochemical, and physiological prior uncorrelated, thus contributing to better solidify the knowledge about this area.

Keywords*: Neuropathic pain, neuropathic pain in spinal cord injury, spinal cord injury, quantitative tests.*

Introduction

One of the major problems followed by the damage to the spinal cord is the neuropathic pain[1]. Neuropathic pain is one type of non-nociceptive pain, or in other words, not from the stimulation of nociceptors (sensory pain fibers which detect tissue damage by physical phenomena, chemical or thermal), but due to injury or dysfunction of the Peripheral and Central Nervous systems. Sources differ on the prevalence of neuropathic pain in SCI subjects. Bonica[1] found an average of 69%, and of these, about one-third reported severe pain. Nowadays the current challenge is to understand the etiology of the neuropathic pain and the current study aimed to deepen knowledge about neuropathic pain in SCI subjects, using quantitative clinical tests and a pain questionnaire, trying thus to fill this important gap on this area.

Material and Methods

Selected 30 individuals separated in 3 groups: 10 SCI with neuropathic pain (SCI-P); 10 SCI without neuropathic pain (SCI-NP); 10 controls (non-SCI subjects).

McGill Pain Questionnaire

The questionnaire, that was validated and translated into Portuguese[2], was applied before the completion of other quantitative tests in the subjects in the SCI-P. The variables used were: PRI (T) (pain rating index (total), NWC (number of words chosen) and PPI (present pain intensity) for data analysis.

Tactile sensitivity

Were used the Semmes-Weinstein monofilaments (esthesiometer). The tactile and pain threshold were measured as the force required for bending the monofilament for 3 seconds. The location of the stimulus was the dominant leg at a point 10 cm distal to the patella, in the anterolateral side of the leg, corresponding to the L5 dermatome.

Thermal sensitivity

The site of stimulation was the same of tactile sensitivity. Temperature thresholds were accessed with a Peltier temperature module[3], whose temperature is monitored by a thermistor. The stimuli were initiated at 30° C, touching the skin of

the patient by over 3s. The next stimulus was 35° C, and so on until the temperature of 60° C. Subsequently, the test was restarted, starting from 30° C and the temperature was subsequently reduced in increments of 5° C until 0° C.

Evoked pain

We tested allodynia, with a stimulation of the L5 dermatome with cotton and was observed when the subject reported pain. In addition to allodynia were also observed dysesthesia / paresthesia. Hyperalgesia by sharp objects were tested also with an esthesiometer. All this testes were measured with a quantitative scale.

Results

There was no statistical significance between the groups with or without neuropathic pain about thermal sensitivity (table 1). However, the SCI-NP group detected more cold, more heat pain, and more tolerance of heat pain than the group SCI-P group. The SCI-P detected more heat than the SCI-NP group (table 2).

	CTL	SCI-P	SCI-NP	P*
CDT	20,8 (13,3-25,0)	17,5 (1,6-25,0)	23,3 (13,3-25,0)	0.59
HDT	35,0 (33,3-41,6)	40,0 (23,3-50,0)	38,3 (NR)	0.77
HPT	50,0 (50,0-56,6)	47,5 (41,6-55,0)	50,0 (NR)	0.71
HPTT	53,3 (50,0-56,6)	47,5 (43,3-55,0)	50,0 (NR)	0.71

Table 1: Comparison of thermal sensibility in the groups SCI Pain Subjects and pain-free SCI Subjects; *Mann-Whitney U test. (CDT = Cold detection threshold; HDT = Heat detection threshold; HPT = Heat pain threshold; HPTT = Heat pain tolerance threshold; N = number of patients).

There was no statistical significance (P = 0,102 Mann-Whitney U test) between the groups SCI-SCI-P and NP when comparing pain and tactile sensitivity, but the SCI-P reported more tactile sensitivity than the SCI-NP (Mean Rank - Mann-Whitney U test).

	CDT Mean Rank (N)	HDT Mean Rank (N)	HPT Mean Rank (N)	HPTT Mean Rank (N)
SCI-P	7,25 (4)	11,71 (7)	6,12 (4)	4,88 (4)
SCI-NP	10,17 (3)	11,50 (2)	7,50 (1)	4,00 (1)
CTL	9,35 (10)	8,50 (10)	8,80 (10)	9,65 (10)

Table 2: Numerical comparison between groups (Mean Rank – Mann Whitney U test).

The hyperalgesia below the level of injury was most often detected by SCI-NP group and was statistically significant (P=0,021 Mann-Whitney U test).

In the Portuguese translated version of the McGill Pain Questionnaire (table 3 and figure 1), the most reported words in the sense group were burning (6 subjects), tingling (6 subjects), tugging (5 subjects) and throbbing (5 subjects). In the affective group of words the words mostly reported words were tiring and exhausting (4 subjects). In the evaluative group, four subjects chose annoying. Within the miscellaneous group, 6 subjects chose nagging. The PRI (T), NWC and PPI are shown on table 3.

PRI (T), mean (SD)	28,5 (13,7)
NWC, mean (SD)	12,7 (3,0)
PPI, mean (SD)	3,2 (1,4)

Table 3: Data from SCI-P group about McGill Pain Questionnaire (SD = Standard deviation).

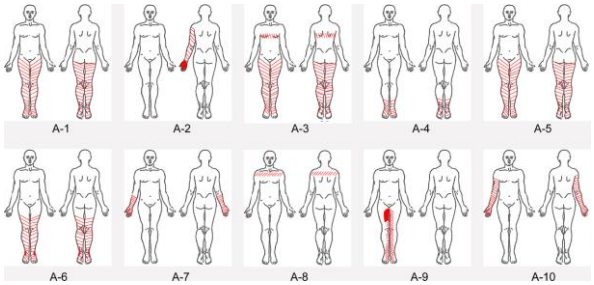

Figure 1: Figure showing the onset of neuropathic pain in SCI patients in group-P. Red hatches show the site of the pain felt by the subject. The areas painted in red are the areas the subject felt most pain.

Discussion

Some subjects experienced dysesthesia at a different location from that of the neuropathic pain, which suggests a neuronal hyperexcitability in subjects with neuropathic pain. This can be explained by neurochemical inflammatory reactions, with the release of excitatory aminoacids, particularly glutamate, which may result in neural hyperexcitability[4,5], in response to ischemia and membrane depolarization[6]. Furthermore, studies shows that there may be an activity decrease in pain inhibitory neurons (GABAergic neurons) because they are highly susceptible to hypoxia in spinal cord injury[7-9].

Subjects in the SCI-P group were the most affected by thermal sensitivity, compared to SCI-NP group (70% of subjects in P-SCI group felt some kind of thermal sensitivity, compared with 30% of SCI-NP group). Thus, the difference between a greater number of people with spinal cord injury with neuropathic pain who felt thermal sensitivity compared with the group without neuropathic pain corroborate with the findings of Wasner[9] who

reports that there is some preservation of the spino-thalamic tract in pain subjects, greater than in subjects without pain, which may be involved in the development of neuropathic pain.

In SCI-NP group, the two subjects who experienced tactile sensitivity had incomplete injury but, from the three subjects who detected thermal sensitivity, only 1 had a complete injury. In the SCI-P group, subjects who experienced tactile sensitivity possessed complete injury; in the thermal sensitivity, two were ASIA B, and 5 were ASIA A. Moreover, it can be observed that also occurred dysesthesia in subjects with complete lesion. These findings can be elucidated by theories that explain the cause of complete subjects (ASIA A) have no kind of feeling, of having traces of sensibility. These subjects have "discomplete" injuries (an injury that is not complete, but it fits the criteria of complete, according to ASIA), as first described by Dimitrijevic and Sherwood[10,11] that founded motor remnants in complete spinal cord injured subjects due to a neural control.

In this study, 8 out of 10 subjects in the SCI-P were spinal cord injured with complete injury (ASIA A). Wasner[9] reported that partially preserved pathways spinothalamic tract may be the local generator in this kind of subject (ASIA A), through provocative testing with capsaicin and heat. Other theories are about the thalamus activity, such as Pattany[12] who studied metabolic changes in the thalamus and inferred that there are anatomical, functional and biochemical changes in the thalamus.

Conclusions

This study revealed that spinal cord injured subjects with complete and incomplete injury still have some persistence of the spino-thalamic tract, supporting the Wasner's theory which says that a partial permanencestay, or " vestige" of the spino-thalamic tract may be the "generator" of pain injuries of pain in subjects with spinal cord injuries. We conclude that this study has replicated clinically some of the diverse mechanisms of neuropathic pain following traumatic spinal cord injury, gathering and quantifying in a single project various forms of sensitivity affected by the injury. We demonstrate that neuropathic pain after traumatic spinal cord injury is not due to only anatomic lesion, but also related to complex neural, biochemical, and physiological processes

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