Neuropathic pain in Spinal Cord Injury Subjects: Somatosensory differences

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Abstract

Nowadays little is known about the neurophysiology and somatosensory differences in spinal cord injured with and without neuropathic pain. The objective of study is to use somatosensory evoked potential to observe the differences between spinal cord injuries who have neuropathic pain and those who do not. ***Methods****: 30 individuals separated in 3 groups: 9 SCI with neuropathic pain (SCI-P); 10 SCI without neuropathic pain (SCI-NP); 8 controls (non-SCI subjects). Each group was submitted to ASIA Impairment Scale and somatosensorial evoked potential by stimulating the peroneal nerve. The latencies of the stimuli (N8, N22. N45) or loss of the standard curve were compared between groups by One Way Anova.* ***Results****: The SCI-P group presented the following average latency (mean ± standard deviation): N8 (9.01 ± 1.17), N22 (20.14 ± 1.18), N45 latency was not possible to calculate response; for SCI-NP group: N8 (8.63 ± 1.7), N22 (21.48 ± 5.2), N45 latency, response was not possible to calculate, for the control group: N8 (8.79 ± 0.83), N22 (19.87 ± 0.41), N45 (43.57 ± 1.56). There was no statistical differences for N8 and N22 latencies (p>0,05).* ***Conclusion****: It was not possible to differentiate spinal cord injured subjects with neuropathic pain from those who do not by somatosensorial evoked potential, although this test is closely correlated with the clinical trial ASIA Impairment Scale, which assesses functionally the spinal cord injured subjects about sensitivity and motor function without taking into account the presence or absence of neuropathic pain in these subjects.*

Keywords: *Neuropathic pain, neuropathic pain in spinal cord injury, spinal cord injury, somatosensorial evoked potential*

Introduction

The central neuropathic pain is a non-nociceptive pain, ie, not due to stimulation of nociceptors, but from lesion or dysfunction of the central nervous system (CNS). According to Bonica [1] it affects approximately 69% of spinal cord injured (SCI) individuals. The pathophysiology of neuropathic pain involves mechanisms of modified impulse transmission in somatosensory pathways. The axonal injury leads to an excitatory input in the transmission due to molecular rearrangement of ion channels in the axonal membrane, leading to abnormal sensations [2]. However, there are no published data that explains if neuropathic pain after spinal cord injury will occur. In this study, through the somatosensory evoked potential (SEP) we tried to check whether there are electrophysiological differences between sensory pathways in spinal cord injured subjects with and without neuropathic pain, and to compare these to a control group without spinal cord injury, also correlating these tests with the ASIA Impairment Scale.

Material and Methods

Subjects

27 subjects were selected divided into the following categories: 9 subjects with traumatic spinal cord injury above T12 with central neuropathic pain below the neurological level (SCI-P); 10 subjects with traumatic spinal cord injury above T12 without central neuropathic pain and show no spontaneous dysesthesia (SCI-NP); subjects without spinal cord injury or central neuropathic pain (control group). Gender was not used as a criterion for the selection of the subjects.

Clinical Examination

The subjects were all examined by the same qualified professional and classified according to the American Spinal Injury Association's (ASIA) standards for classification of SCI [3].

Somatosensorial Evoked Potential (SEP)

The SEP was performed with the device Neuropack Σ Nihon Kohden, model MEB-5504K Tokyo (Japan) - in all subjects in a supine position on the horizontal bed. The posterior tibial nerve was selected for electrical stimulation. Electrical stimulation had the following parameters: 2000 square-wave stimuli of 0.2 ms duration at a frequency of 5 Hz and impedance of 10 kΩ in accordance with the standards of the International

Federation of Clinical Neurophysiology [4]. Evaluations were performed three times for each subject, on three different days in both hemi-bodies, and then obtained the arithmetic mean of the values for better reliability of results. In each evaluation were carried out three tests, each with 2000 responses and a response was over the other. The stimulus intensity (in *miliampèr* - mA) was gradually increased until muscle contraction was visible or reached the motor threshold. The highest intensity reached 40mA. The action potential was obtained in the region of the popliteal fossa. The 0,7cm silver electrodes were placed on cleaned skin with alcohol at 70%. The stimulation electrode was positioned on the topographic path of the posterior tibial nerve at the medial malleolus. The recording electrodes were positioned according to the International 10-20 System [5] in the popliteal fossa with reference to the lateral condyle of the tibia (*channel 4*), T12 with the reference in the sacrum bone (*channel 3*), in reference to Cz inion (*channel 2*), and Cz 'with reference to the inion (*channel 1*). The value of the latencies corresponding to the recording electrodes fixed on the topography of the somatosensory pathways were used as paremeters[6]. Latencies are *N8* (popliteal fossa), *N22* (lumbar cord) and *N45* (cortical latency).

Statistical Analysis

For comparison of average latencies between groups was performed *One Way ANOVA* (*Analysis of Variance*) with *post hoc Tukey test*. Values are presented as mean ± standard deviation. Differences were considered significant at $p < 0.05$ All statistical analyzes were performed using the software SPSS version 18.

Results

On Table 1, the *N8* latency values are presented as mean, standard deviation (SD), confidence interval (CI) and p-value (p) for the three groups. SCI-P groups (SCI with neuropathic pain) and SCI-NP (SCI without neuropathic pain) are compared to the control group. There was no statistical differences between the values of the *N8* latency.

On Table 2, the *N22* latency values are presented as mean, standard deviation (SD), confidence interval (CI) and p-value (p) for the three groups. SCI-P groups are compared to the control group. There was no statistical differences between the values of the *N22* latency.

Side	**Compared Groups**	**Mean**	**SD**	**IC 95%**	***p***
Right	SCI-P	9.01	1.17	(-1.4;1.8)	0.94
	Control	8.79	0.83		
Left	SCI-P	9.41	1.59	(-1.1;2.4)	0.66
	Control	8.79	0.83		
Right	SCI-NP	8.63	1.7	(-1.7;1.4)	0.96
	Control	8.79	0.83		
Left	SCI-NP	8.93	1.65	(-1.5;1.8)	0.97
	Control	8.79	0.83		

Table 1: Statistical comparison between the three groups for the *N8* latency.

Side	Compared Groups	Mean	SD	CI 95%	*p*
Right	SCI-P	20.14	1.18	(-3.9; 4.4)	0.98
	Control	19.87	0.41		
Left	SCI-P	21.08	1.27	(-1.4;3.8)	0.51
	Control	19.87	0.41		
Right	SCI-NP	21.48	5.20	(-2.3;5.5)	0.57
	Control	19.87	0.41		
Left	SCI-NP	21.88	3.21	(-0.5;4.5)	0.14
	Control	19.87	0.40		

Table 2: Statistical comparison between the three groups for the *N22* latency.

For the N45 latency it was not possible to carry out statistical analysis, since for each group of subjects with spinal cord injuries, only two latency values were captured , and for the other subjects of these same groups, electrical latencies were not detected. The data was analyzed categorically, checking the presence and absence proportion of cortical response in each group. Table 3 with shows de proportion of presence and absence of *N45* latencies for each group.

Latency N45	**SCI-P**	**SCI-NP**	**Control**
Presence	2 (22%)	2 (20%)	8 (100%)
Absence	7 (88%)	8 (80%)	-
Total	9 (100%)	10 (100%)	8 (100%)

Table 3: Categorical distribution based on the presence or absence of *N45* latency (cortical response).

Discussion

According to our hypothesis, normal latencies *N8* and *N22* were expected, since the recording electrodes - in the popliteal fossa and lumbar cord - capture the resulting electrophysiological response of the infinite sum of nerve fibers present in this specific somatosensory pathway, which are generated below the level spinal cord injury, without interruption between the nerve stimulation site and the recording site, generating normal latency values. These data corroborate those obtained by Gaspar *et al* [7], they have obtained similar values of latencies below the neurological level of SCI for the median nerve and posterior tibial nerve when compared to the control group. According to Van De Meent *et al* [8] after spinal cord injury, the peripheral motor axons below the level of injury have severe transsynaptic degeneration. According to the author, there was severe decrease in the amplitude of muscle action potential thus reducing the motor function of the SCI subjects. However, in the present study to peripheral axonal degeneration below the level of injury did not seem to affect the values of N8 and N22 latencies.

The N45 latency was present only in ASIA C subjects, ie subjects with incomplete spinal cord injury who have some degree of motor skills below the level of injury. In complete injury subjects (ASIA A) and even in the ASIA B subject (group SCI-NP), there was no 45 latency measured. With these data we can infer that it is necessary that the spinal cord must present a minimum morphofunctional preservation to observe a cortical response which is observed clinically and functionally to a minimum degree of mobility, which is corresponding to the ASIA C classification. Kovindha and Mahachai[9] also found no cortical response in complete spinal cord injured subjects (ASIA A).

Conclusions

It was not possible to differentiate spinal cord injured subjects with neuropathic pain from those who do not by somatosensory evoked potential, although this test is closely correlated with the clinical trial ASIA Impairment Scale.

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