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Chronic pain and spinal cord stimulation

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Abstract

Chronic pain can have a devastating impact and lead to patient isolation. Many people with chronic pain are predisposed to anxiety-depressant symptoms, due to a lower quality life. The aim of the study is to demonstrate how neuromodulation methods, can encourage the reduction of chronic pain and an improvement in the quality of life, therefore advancing the restoration of psychological well-being.

We involved 50 patients with a diagnosis of pain that not respond to traditional pharmacological therapies. Interventions: All subject had depression and anxiety symptoms and a low-quality life. We used the spinal cord stimulation treatment and a psychological evaluation for assessment of depression-anxiety symptomatology and the level of quality life.

We observed a significant difference in physical functioning, role limitations due to physical health, general health perceptions, vitality, social functioning, role limitations due to emotional problems and mental health.

Our study affirms that the perception of chronic pain has a great impact on the perception of psychological well-being, quality of life, and the performance of normal daily social and professional activities.

Abbreviations: BDI = beck depression inventory, HAM-A = Hamilton anxiety rating scale, NRS = numerical rating scale, PD = panic disorder, SCS = spinal cord stimulation, SF-36 = Short Form Health Survey - 36.

Keywords: anxiety, chronic pain, depression, neurostimulator system, quality of life

1. Introduction

Chronic pain is any agony that has persisted for more than 6 months and is not related to a continuous peripheral disease process.[1] Unlike acute pain, lasting less than 3 months, it has no biological utility[2]; it is rarely diagnosed, and it does not react to medical treatment, as long as it is completely relieved. The patient tests chronic pain as unresolved persistence of acute pain that keeps more after due. In this way, the experience of chronic pain often involves a prolonged process in which the patient experiments a series of disastrous interventions. The chronic pain can lead to a series of negative perception that can have a significant impact on functionality levels and pain tolerance.[3,4] Many people with chronic pain are less able or unable to perform a variety of daily activities, they have difficulties sleeping or doing domestic activities, or having sex or to keep a stable relationship; additionally, they have not an independent lifestyle.[5] This condition can lead a significant risk of depression and anxiety symptomatology for various reasons.[6] First, the presence of chronic pain can influence the course of the disease and the insurgence of depression and anxiety.[7–16] Second, chronic diseases and pain can lead to the use of negative coping strategies, disability and a reduced quality of life[16,17]; quality of life means the possibility/ability of an individual to perform the multiplicity of roles assigned to him/her in society, drawing an acceptable level of psychological, professional and economic satisfaction.[18] Third, several studies suppose shared pathophysiological mechanisms for chronic somatic diseases and pain, and depression and anxiety,[19–21] survey neuromodulation methods. They are an efficient alternative when pharmacological and surgical treatments are not effective in controlling pain. In particular, spinal cord stimulation (SCS) is the most incisive. The first use of neuromodulation methods is the Neurostimulation of the spinal cord and peripheral nerves (SCS) by Shealy et al in 1967.[22] Several studies have reported that the 50% of patients treated with neurostimulation achieves an improvement in pain relief.[23–31] It also reduces the opioid use and quality of life improves in most patients treated with SCS.[32] For years, SCS was successfully used to treat selected patients with chronic pain, particularly failed back surgery syndrome patients.

In general, the SCS has several advantages compared to a possibility of a r-operation: first of all, it is a non-invasive

Editor: Massimo Tusconi.

Being a retrospective study, the approval of the Ethics Committee was not necessary.

Informed written consent was obtained from the patient for publication of this study.

The authors have no funding and conflicts of interest to disclose

Funding: None.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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How to cite this article: Corallo F, De Salvo S, Cannistraci C, Buono VL, Di Cara M, Floridia D, Cerra F, Romeo L, Pria D, Bramanti P, Marino S, Bonanno L. Chronic pain and spinal cord stimulation. Medicine 2020;99:22(e20490).

Received: 11 February 2020 / Received in final form: 28 April 2020 / Accepted: 30 April 2020

http://dx.doi.org/10.1097/MD.0000000000020490

procedure, it has a very low rate of mortality[33]; is a completely reversible procedure and, before implanting a permanent system, patients are screened for physiological responses, with temporary percutaneous electrodes emulating the pain-relieving effects of the implanted system. Candidates for SCS are also subjected to psychological evaluation to address possible depression or other comorbidities.[34–36]

The aim of the study is to demonstrate how neuromodulation methods, in particular SCS (spinal cord stimulation), can encourage the reduction of chronic pain and an improvement in the quality of life, therefore advancing the restoration of psychological well-being.

2. Materials and methods

This observational study was conducted on a sample of 50 patients with a diagnosis of chronic pain from 6 months recruited at the IRCCS Centro Neurolesi "Bonino Pulejo," in antalgic therapy ambulatory. The patients recruited did not respond to traditional pharmacological therapies for chronic pain (paracetamol, non-steroidal anti-inflammatory drugs, opioids, anticonvulsants and cortisone). All subjects gave written consent to the study. Patients showed severe algic syndrome: chronic cervical and lumbar radiculopathy, post-traumatic brachial neuropathy and back pain and a moderate chronic pain. The exclusion parameters were the presence of psychiatric disorders, severe cognitive alteration, neurodegenerative disorders. All subjects had chronic pain associated with anxiety and depression symptomatology and a very low quality of life. We introduced a cable located in the epidural space using a Tuohy needle and connected to an implantable subcutaneous pulse generator, which contains the power source and electronics to provide programmable stimulations. The SCS treatment[37] started with percutaneous placement of a temporary electrode for a therapeutic test lasting at least 3 days for testing the system. Then, patients may receive permanent implantation if they have reported an estimate of at least 50% pain relief[38] based on standard pain assessment methods. The test employed to psychological disease were Beck depression inventory (BDI-II), Hamilton anxiety rating scale (HAM-A), short form health survey 36 (SF-36) and numerical rating scale (NRS) in 2 stages, at the initial assessment (T0) and after eight months from T0 (T1). BDI-II is a self-assessment questionnaire composed by 21 multiple-choice items. The score tolerates from 0 to 63: a score of 0 to 13 absence of depressive, from 14 to 19 mild depressions, between 27 and 29 moderate depression and finally 30 to 63 severe depression.[39] HAM-A measures the subjective severity of anxiety symptoms in the previous 7 days. It has long been used as an indicator of anxiolytics in panic disorder (PD) and general anxiety disorder. Each item is marked on a scale from 0 (not present) to 4 (severe), with a total score of 0 to 56, where a point <14 indicates no symptoms presence, ≥ 14 to 17 indicates meekness, 18 to 24 from mild to moderate, >25 severe symptoms presence.[40] The SF-36 is a short questionnaire (36 items) that assesses 8 dimensions: physical functioning, social functioning, limitations due to physical problems, limitations due to emotional problems, mental health, energy/life, pain and general health perception. The levels of anxiety, depression and quality of life were compared with the levels of pain, extrapolated from the results of the NRS.[41–43] NRS is a quantitative, one-dimensional, 11-point, quantitative clinical scale of pain assessment; in this scale the patient selects the number describing the intensity of the pain, from 0 to 10. The method of SCS was used to compare it with the diminution of chronic pain, anxiety-depressant symptoms and an improvement in quality of life.

3. Results

3.1. Statistical analysis

The analysis was conducted with descriptive statistic of respondent's sociodemographic characteristic, followed by the mean, standard deviation of sample. Normal distribution of the data was evaluated using the Shapiro-Wilk normality test. The Wilcoxon signed-rank test was used in order to compare the clinical variables (BDI-II, HAM-A, and NRS) and SF-36 sub-scores at T0 and T1. Finally, we performed an interaction effect analysis (improved time) by calculating the T1–T0 differences in variables scores to correlate by the Spearman's coefficient, clinical variables with SF-36 sub-scores. Analyses were performed using an open source R3.0 software package (R Foundation for Statistical Computer, Vienna, Austria). A 95% of confidence level was set with a 5% alpha error. Statistical significance was set at $P<.05$.

4. Results

Socio-demographic and characteristics of patients and caregivers showed in Table 1 and Figure 1. The Wilcoxon signed-rank test showed a highly significant difference in BDI ($P<.001$), HAM-A ($P<.01$) and in NRS ($P=.004$) (Table 2). In SF-36 scores, we observed a significant difference between T0 and T1 in physical functioning ($P=.001$), role limitations due to physical health ($P<.001$), general health perceptions ($P<.001$), vitality ($P<.001$), social functioning ($P<.001$), role limitations due to emotional problems ($P=.001$) and mental health ($P<.002$) but no significance difference in bodily pain ($P=.17$). Spearman's coefficient showed a significant positive correlation between NRS and BDI-II ($r=0.48$; $P=.05$), and between NRS and HAM-A ($r=0.53$; $P=0.03$). Moreover, in SF-36 sub-scores we highlighted significant negative correlation with NRS and physical functioning ($r=-0.51$; $P=0.03$), bodily pain general health perceptions

Table 1

Differences in clinical variables at T0-T1 of patients.

	T0 Median (I-III)	T1 Median (I-III)	*P*
BDI-II	11 (8–16)	6 (4–10)	.0003*
HAM	12 (9–14)	6 (5–8)	.0003*
NRS	3 (1–7)	0 (0–2)	.004*
SF-36 sub-scores			
PF	80 (80–80)	90 (90–100)	.001*
RP	80 (80–80)	90 (90–100)	.0007*
BP	100 (100–100)	100 (100–100)	.17
GH	60 (60–70)	80 (70–80)	.0002*
V	40 (35–40)	90 (80–90)	.0003*
SF	30 (30–30)	100 (90–100)	.0002*
RE	60 (60–60)	100 (90–100)	.001*
MH	50 (50–50)	90 (90–90)	.0002*

I = first quartile, III = third quartile, BDI = beck depression inventory, BP = bodily pain, GH = general health perceptions, HAM = Hamilton Anxiety Rating Scale, MH = mental health, NRS = Numerical Rating Scale, PF = physical functioning, RE = role limitations due to emotional problems, RP = role limitations due to physical health, SF = social functioning, V = vitality.

* $P<.001$

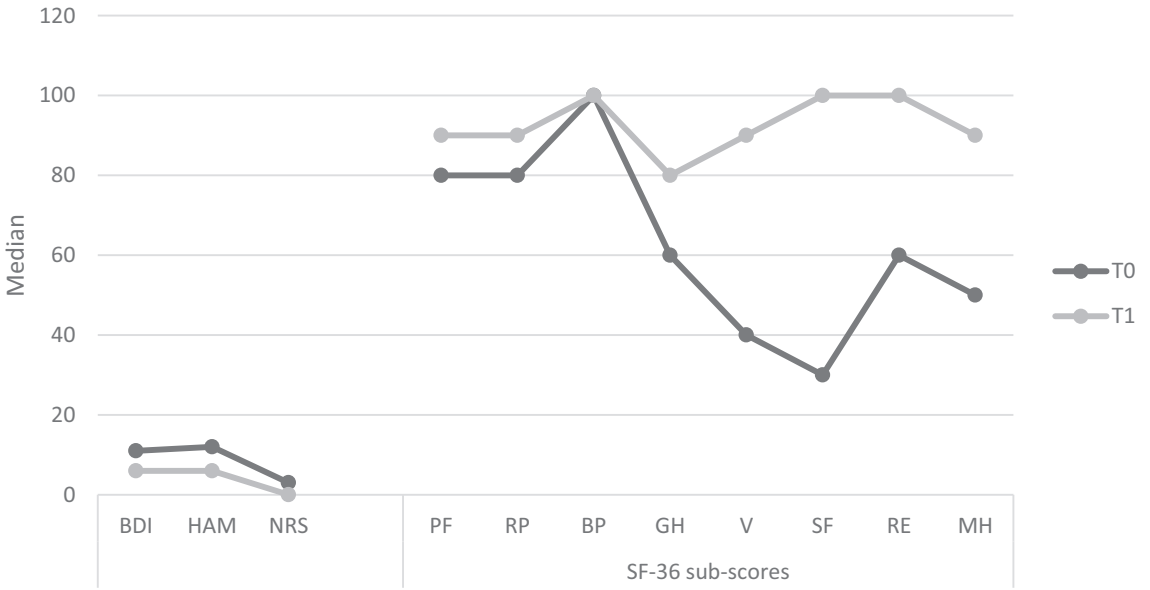

Figure 1. Trend of BDI-II, HAM-A, NRS and sub-items of SF-36 over time.

(r = −0.48; $P = 0.02$), general health perceptions (r = −0.49; $P = 0.04$), vitality (r = −0.55; $P = .02$), social functioning (r = −0.53; $P = .03$), and mental health (r = −0.48; $P = .02$) (Table 2). A trend significant between NRS and role limitations due to physical health (r = −0.39; $P = .06$) but no significant correlation with role limitations due to emotional problems (r = −0.41; $P = .08$) were found.

5. Discussion

Chronic pain often precedes physical and psychosocial changes. Everyday life becomes particularly heavy, due to pain that accompanies all daily activities: also, the simplest actions can be problematic, and this causes the person to isolate himself, withdrawing from his anxieties and sufferings. Pain implies a limitation of physical abilities and movement abilities, invalidating the autonomy of the person. The results of our study show that there has been a decrease in algic symptoms and an improvement in the quality of life, as a result of the use of the latest technologies. They have facilitated a better adaptation of the patient to daily life, reducing the pain perception and also the anxious-depressive symptoms. Therefore, alternative methods to traditional drug treatments bring relief to patients and ensure an improvement in psycho-physical well-being. These results have shown that painful perception, anxiety-depressant symptoms and quality of life, respectively, decrease and increase, highlighting a significant correlation between pain and psychological disorders. Other studies[44] demonstrate and define chronic pain as social and moral pain, emphasizing how chronic pain can put the subject in a state of psychological distress associated to anxiety for socially incorrect or destructive behavior. The social life of these subjects is characterized by retirement and self-criticism, probably due to shame for themselves, embarrassment, vulnerability to criticism and fear of punishment. The direct consequence is a lower quality of life, which is perceived by the patient in measure to health.[45–49] The quality of life is a not well known, but the pain is a critical factor that conditioned patient's life. Chronic pain causes a focus on the problem, producing distress, fear, a sense of loneliness and a progressive withdrawal from social relationships; isolation, in turn, makes suffering and the feeling of helplessness even more burdensome. To measure patients' perception of daily functioning, physical, social and psychological well-being, various instruments like HRQoL, SF-36 and heart rate measurement were used.[46–48,50] These measurements showed that the depressive symptoms are the most present and also the most disabling and they sometimes resulted life-threatening or fatal results.[51,52] In this study we have also used the BDI II to evaluate depressive symptoms. Depression symptomatology amplifies the experience and perception of pain[53]; the SF-36 can be a useful clinical instrument to measure the depression severity and also the quality of life in patients with chronic pain. In this study we have also used the BDI II to evaluate depressive symptoms. The reduction of chronic pain, achieved by SCS, has decreased the levels of anxiety and depression symptomatology

Table 2

Correlation between NRS scores and SF-36 Health Status Questionnaire sub-item scores.

	NRS	
	r	*P*
PF	−0.51	.03*
RP	−0.39	.06
BP	−0.48	.02*
GH	−0.49	.04*
V	−0.55	.02*
SF	−0.53	.03*
RE	−0.41	.08
MH	−0.48	.02*

BP = bodily pain, GH = general health perceptions, MH = mental health, NRS = numerical rating scale, PF = physical functioning, RE = role limitations due to emotional problems, RP = role limitations due to physical health, SF = social functioning, V = vitality.
* $P < .05$

changing in the subject's daily life. Therefore, non-invasive neuromodulation methods are an efficient alternative when pharmacological and surgical treatments are not effective in pain management.

Author contributions

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