

SUCCESSFUL TREATMENT WITH SPINAL NEUROSTIMULATION OF INTRACTABLE NEUROPATHIC CHRONIC PAIN IN PATIENTS WITH DEPRESSION: A SERIES OF 60 CASES

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Abstract

Background Patients with chronic neuropathic pain often report symptoms of depression.

The aim of this work is to determine the intensity of chronic neuropathic pain and to identify the efficacy of spinal neurostimulation in a group of patients with spinal surgery and depression.

Materials and Methods: The study includes 60 patients with chronic neuropathic pain after spinal surgery, who received spinal cord neurostimulation implant between October 2017 and January 2024, at the Professor Nicolae Oblu Emergency Clinical Hospital, Iasi. Prior to the spinal implant, the patient was evaluated neurologically, psychologically, imaging, electromyography and underwent appropriate treatment for chronic neuropathic pain for about 3 months. The patient self-assessed himself by completing the VAS pain scale, as well as the Roland Morris scale.

Results: Analysis of the data indicated that 37 women (61.7 %) and 23 men (38.3 %) were included, with an average age of 53.87 ± 12.033 years, the majority (35 patients, 58.3 %) being from urban areas. 39 cases (65 %), mainly women (29 patients, 78.4 %) presented depressive syndrome. In 26 cases (43.3%) chronic neuropathic pain started one year after surgery. Neurosurgical interventions prior to chronic neuropathic pain were mainly herniated disc (53 cases, 88.33%). The pain onset was generally quite violent, with 55 patients (91.7%) experiencing pain intensity between 7 and 10 on the VAS scale. The situation improved statistically significantly after implantation, with patients' VAS pain, this time, ranging from 1 to 8. Only in patients with depressive syndrome was there a statistically significant ($p = 0.041^*$) decrease (3.21 ± 2.002 versus 4.05 ± 2.012) in the average VAS pain score after implant compared to patients without depressive syndrome.

Conclusion: Neurostimulation is effective long-term as an adjuvant treatment for chronic neuropathic pain in patients with depressive syndrome.

Key words: chronic neuropathic pain, depression, spinal neurostimulation

The main reason for seeking a medical consultation is pain - an anatomopathologic-physiologic experience with an impact on the psychological and social spheres. The aim of the patient is the diagnosis of the cause and appropriate treatment to end this suffering. Pain is an

essential experience for survival, alerting us to external or internal dangers. For various reasons (avoidance of medical assessment, ineffective treatment), pain becomes chronic (more than 3 months after onset).

A particular situation is represented by chronic neuropathic pain, pain caused by a lesion or damage to the somatosensory nervous system (Scholz et al, 2019). The incidence of chronic pain in the French population is about 20 % - 22%, and chronic neuropathic pain presents about 7% of the general population (Bouhassira D. et al , 2008). In non-European countries the incidence of chronic neuropathic pain varies between 6 and 10% (Attal N. et al, 2018) .4.9% of the US adult population has been diagnosed with chronic pain and concomitant symptoms of anxiety or depression, leading to functional limitations in daily life (De La Rosa et al, 2024).

The pathophysiology of chronic neuropathic pain is vast, involving neurological and biochemical changes, involving peripheral and central sensitization, generation of ectopic impulses, loss of inhibitory control, central reorganization.

Due to the complexity of the mechanisms involved in the production of chronic neuropathic pain and the different levels at which they may act, the treatment of this pathology is a challenge for clinicians. Frequently drug treatment according to current guidelines for chronic neuropathic pain is ineffective or may become ineffective. To help these patients with treatment-refractory pain, spinal cord neurostimulation implants are practiced, which consists of applying electrical stimulation to the dorsal columns of the spinal cord to modulate the transmission of pain signals to the brain (Deer et al, 2019).

The principle of operation of the medullary neurostimulation implant is based on the gate control theory (Melzack and Wall,

1965) (Melzack R. et al.1965) according to which electrical stimulation of A β fibers inhibits the transmission of nociceptive stimulation through A α and C fibers.

The aim of this work is to determine the intensity of chronic neuropathic pain and to identify the efficacy of spinal neurostimulation in a group of patients with spinal surgery and depression.

Materials and Methods

The study includes 60 patients with chronic neuropathic pain post-spinal surgery, who received spinal cord neurostimulation implant between October 2017 and January 2024, at the Professor Nicolae Oblu Emergency Clinical Hospital Iasi. This study was approved by the Ethics Committee of the Clinical Emergency Hospital Professor Dr. Nicolae Oblu 15/22.07.2024, and informed consent was obtained from the patients. Patients with previous spinal neurosurgical intervention for herniated disk, foraminal stenosis, spondylolisthesis and spinal fractures) were included in the study. Patients with other electrical pacemakers (cardiac peacemaker, cochlear implant -due to nerve impulse interference), patients with severe cardiac pathology, patients with coagulation disorders, patients with immune system deficits, drug-dependent patients, patients with local infections, inability of the patient to use the implant, presence of local infections were not included in the study.

As part of the protocol, before the spinal implant, the patient with chronic neuropathic pain refractory to conservative treatment was evaluated neurologically and psychologically and/or psychiatrically, was evaluated by imaging by dorsal and lumbar MRI to exclude a lesion with neurosurgical

indication, and by electromyography. He also received appropriate treatment according to pharmacologic guidelines for chronic neuropathic pain for approximately 3 months. In addition, the patient self-assessed his pain intensity by completing the standard pain assessment questionnaire-VAS scale (Allegri, M., et al) (in which no pain is scored as zero and the most intense pain is scored as 10).

Spinal neurostimulation implantation was performed in two stages. In the first stage, under local anesthesia and radiologic guidance, an 8-electrode linear lead was inserted percutaneously, extradurally, dorsally. Electrical stimulation was performed intraoperatively and the patient was communicated with to assess the coverage of the painful area by this procedure. If during the test period the patient declared the neurostimulation implant to be effective, the permanent spinal cord neurostimulation implant was performed after 3 to 5 days. Under general anesthesia, an internal electrical pulse generator was inserted into the pocket, subcutaneous gluteal or paraumbilical subcutaneous. The stimulation parameters were set by the clinician and the patient had a remote control with which he could select the stimulation intensity.

The statistical processing was performed using Microsoft Excel and SPSS 29.0 programs. For the qualitative data, (whose values represent codes) frequency distributions were realized on the whole lot and comparatively by stratification variables - using contingency tables. For numerical data, standard descriptive statistics parameters (average, standard error of the average, standard deviation, variance, minimum and maximum values)

were calculated. Tests of significance, with significance level $p = 0.05$, were also used for the comparative analysis of the values of the variables tracked in two or more batches. For the comparison of arithmetic means of a parameter analyzed in two samples, the t-Student test was used - under the assumption that the values of the analyzed parameter follow the normal distribution law (which was previously tested by means of a split test - e.g. Kolmogorov - Smirnov). If the law of normal distribution of values is not respected, when comparing a parameter between 2 samples we use the non-parametric Mann-Whitney test, and when comparing the same parameter between 3 or more samples we use the non-parametric Kruskal-Wallis test; both are based on the analysis of the ranks assigned to the values of the parameter to be compared. To compare the values of the parameters to be analyzed between paired samples (VAS score values pre-implant and post-implant) we use the t-test when the normal distribution law is verified and its nonparametric alternative, the Wilcoxon test, otherwise. The Chi-square test is used to test for differences between the values of a qualitative variable in different groups.

In order to characterize the association between the values of the VAS post-implant score and the time interval of onset of chronic neuropathic pain, i.e. the number of surgical interventions, Pearson r correlation coefficients were calculated, together with the associated significance level and 95% confidence interval.

The correlation coefficient values were interpreted according to the scale proposed by Colton, respectively: $r < 0.1$: no correlation; $0.1 \leq r < 0.3$: weak

correlation; $0.3 \leq r < 0.5$: moderate correlation; $0.5 \leq r$: strong correlation (because it is generally considered that if $r < 0.3$, the correlation is insignificant).

Results

The study group of 60 patients included 37 women (61.7%) and 23 men (38.3%). Of these 35 (58.3%) were from urban and 25 (41.7%) from rural areas (Table 1). The age

of the patients ranged from 31 to 82 years with a mean of 53.87 ± 12.033 years. The mean ages reported by sex were close in males and females (54.48 ± 13.777 years old versus 53.49 ± 10.997 years old). The age of urban patients is significantly higher than that of rural patients (57.46 ± 12.552 years old compared to 48.84 ± 9.362 years old) (Table 2).

Tabel 1. Demographic characteristics of the study group.

Variabil	n	%	
Gen	men	23	38.3
	women	37	61.7
Resideance	urban	35	58.3
	rural	25	41.7
Total		60	100.0

Table 2. Age of patients - overall and compared by gender and background.

age		N	mean	Standard deviation	Mean standard error	Min	Max	Mediana	T Student test
Total		60	53.87	12.033	1.553	31	82	52.00	
Gen	men	23	54.48	13.777	2.873	31	80	58.00	t = 0.292
	women	37	53.49	10.997	1.808	36	82	52.00	p = 0.772
residence	urban	35	57.46	12.552	2.122	35	82	60.00	t = 2.902
	rural	25	48.84	9.362	1.872	31	68	48.00	p = 0.005**

Several specific conditions that may have a particular impact on the VAS score were tracked in this study group. In first place

was depressive syndrome, observed in 39 cases (65%) (Table 3).

Table 3. Distribution of cases by associated systemic pathology

Patologie sistemică asociată	absent		prezent		total	
	n	%	n	%	n	%
Cardiovascular	35	58.3	25	41.7	60	100.0
Lung disease	55	91.7	5	8.3	60	100.0
Renal	56	93.3	4	6.7	60	100.0
Endocrinology	53	88.3	7	11.7	60	100.0
Gastrointestinal disease	54	90.0	6	10.0	60	100.0
Allergies	54	90.0	6	10.0	60	100.0
Other	31	51.7	29	48.3	60	100.0
Hypothyroidism	57	95.0	3	5.0	60	100.0
Depressive syndrome	21	35.0	39	65.0	60	100.0
Osteoporosis	59	98.3	1	1.7	60	100.0
Osteopenia	59	98.3	1	1.7	60	100.0

The comparative study by sex reveals statistically significant differences in the case of depressive syndrome, which was more frequent in women, with 29 patients

(78.4%) being identified compared to men, of whom only 10 patients (43.5%) presented this pathology (Table 4).

Table 4. Associated systemic pathology - comparative study by sex

		men		women		Total		Pearson Chi-squared test
		N	%	N	%	N	%	
PS: Sindrom depresiv	abs	13	56.5%	8	21.6%	21	35.0%	Chi2 = 7.594 p = 0.006**
	prez	10	43.5%	29	78.4%	39	65.0%	
Total		23	100.0%	37	100.0%	60	100.0%	

Before the spinal implant, patients had frequent being the cases with 2 (28.3%) and between 1 and 9 spinal surgeries, the most 3 (36.7%) surgeries respectively (Table 5

Table 5. Distribution of cases according to the number of spine operations

Spine operations	n	%
0	1	1.7
1	6	10.0
2	17	28.3
3	22	36.7
4	6	10.0
5	5	8.3
6	1	1.7
7	1	1.7
9	1	1.7
Total	60	100.0

In 26 cases (43.3%) the onset of chronic neuropathic pain was 1 year after surgery and in 16 cases (26.7%) it was 2 years after surgery (Table 6)

Table 6. Distribution of cases according to the onset interval of chronic neuropathic pain

years	n	%
1	26	43.3
2	16	26.7
3	8	13.3
5	2	3.3
6	1	1.7
7	1	1.7
8	1	1.7
9	2	3.3
10	1	1.7
13	1	1.7
14	1	1.7
Total	60	100.0

In almost half of the cases 26 (43.3%), the neuropathic chronic pain started within the first year from the surgical intervention and for a quarter of the cases 16 (26.7%) the pain installed after 2 years.

Considering the causes of the neuropathic chronic pain, patients had either a single spinal pathology prior to implant or

associated spinal pathologies, some identified

simultaneously or metachronously. 4 main categories have been identified: herniated disk (53 cases, 88,33 %), lumbar stenosis (8 cases, 13.3%), spondilolistezis (9 cases, 15%), and spine fractures (4 cases, 6,7%) as well as other pathologies (7 cases, 17,7%) Fig 1.

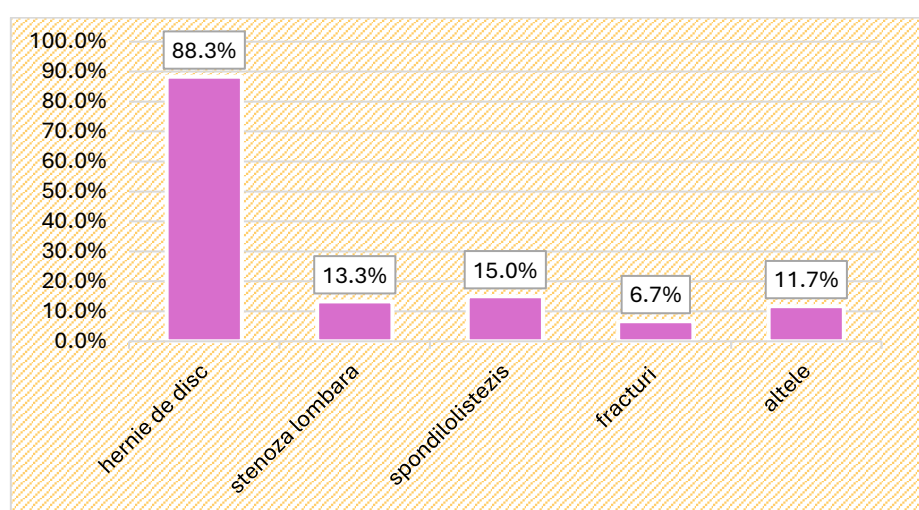


Figure 1. spinal pathology prior to implant

The pain onset was generally quite violent, with 55 patients (91.7%) experiencing pain intensities between 7 and 10. Just over a third of the cohort (9 patients, 35%) rated the pain at an intensity of 9 on the VAS scale, while 17 patients (28.3%) rated it at an intensity of 8 and a further 17 patients (28.3%) rated it at a maximum

intensity of 10. The situation improved statistically significantly after implantation, with patients' VAS pain rating this time ranging from 1 to 8. 40 patients (66.7%) rated their pain at 2 or 3, and 12 patients (20.1%) rated their pain at a VAS intensity ranging from 6 to 8.

Table 7. Patients' VAS pain ratings before and after implant

VAS scale before implant		VAS scale after implant	
n	%	n	%
		3	5.0
		20	33.3
		20	33.3
		5	8.3
		1	1.7
5	8.3	7	11.7
17	28.3	4	6.7
21	35.0		
17	28.3		
60	100.0	60	100.0

Only in patients with depressive syndrome there is a statistically significant ($p = 0.041^*$) decrease (3.21 ± 2.002 versus 4.05 ± 2.012) in the mean VAS pain score after implant placement compared to patients without depressive syndrome (Table 8).

Table 8 Patients' pain rating on the VAS scale before and after implant -comparison according to systemic pathology (a)

systemic pathology				Standard					Mann-Whitney
		N	mean	Standard deviation	d error of mean	Min	Max	Median	test
SCALA VAS ANTERIOR IMPLANTULUI									
Cardiovascular	abs	35	8.66	0.998	0.169	7	10	9.00	U = 337.000
	prez	25	9.08	0.812	0.162	8	10	9.00	p = 0.114
Lung disease	abs	55	8.78	0.956	0.129	7	10	9.00	U = 87.000
	prez	5	9.40	0.548	0.245	9	10	9.00	p = 0.187
Renal	abs	56	8.80	0.961	0.128	7	10	9.00	U = 83.000
	prez	4	9.25	0.500	0.250	9	10	9.00	p = 0.413
Endocrinology	abs	53	8.81	0.962	0.132	7	10	9.00	U = 168.000
	prez	7	9.00	0.816	0.309	8	10	9.00	p = 0.702
Gastrointestinal disease	abs	54	8.81	0.973	0.132	7	10	9.00	U = 147.000
	prez	6	9.00	0.632	0.258	8	10	9.00	p = 0.727
Allergies	abs	54	8.81	0.953	0.130	7	10	9.00	U = 147.000
	prez	6	9.00	0.894	0.365	8	10	9.00	p = 0.727

Other	abs	31	8.65	0.985	0.177	7	10	9.00	U = 358.000
	prez	29	9.03	0.865	0.161	8	10	9.00	p = 0.156
Hypothyroidism	abs	57	8.86	0.953	0.126	7	10	9.00	U = 55.000
	prez	3	8.33	0.577	0.333	8	9	8.00	p = 0.325
Depressive syndrome	abs	21	8.62	0.921	0.201	7	10	9.00	U = 326.000
	prez	39	8.95	0.944	0.151	7	10	9.00	p = 0.175
Osteoporosis	abs	59	8.81	0.937	0.122	7	10	9.00	U = 8.000
	prez	1	10.00	.	.	10	10	10.00	p = 0.300
Osteopenia	abs	59	8.83	0.950	0.124	7	10	9.00	U = 27.000
	prez	1	9.00	.	.	9	9	9.00	p = 0.933
Hysterectomy	abs	56	8.84	0.949	0.127	7	10	9.00	U = 103.000
	prez	4	8.75	0.957	0.479	8	10	8.50	p = 0.808

SCALA VAS DUPĂ IMPLANT

Cardiovascular	abs	35	3.57	2.146	0.363	1	8	3.00	U = 434.500
	prez	25	3.40	1.893	0.379	1	8	3.00	p = 0.963
Lung disease	abs	55	3.49	2.008	0.271	1	8	3.00	U = 137.500
	prez	5	3.60	2.510	1.122	2	8	3.00	p = 1.000
Renal	abs	56	3.59	2.061	0.275	1	8	3.00	U = 72.500
	prez	4	2.25	0.957	0.479	1	3	2.50	p = 0.253
Endocrinology	abs	53	3.49	2.035	0.279	1	8	3.00	U = 174.500
	prez	7	3.57	2.149	0.812	2	8	3.00	p = 0.804
Gastrointestinal disease	abs	54	3.46	2.016	0.274	1	8	3.00	U = 125.500
	prez	6	3.83	2.317	0.946	1	8	3.50	p = 0.378
Allergies	abs	54	3.43	1.948	0.265	1	8	3.00	U = 138.500
	prez	6	4.17	2.787	1.138	1	8	3.50	p = 0.572
Other	abs	31	3.58	1.996	0.359	1	8	3.00	U = 409.000
	prez	29	3.41	2.096	0.389	1	8	3.00	p = 0.533
Hypothyroidism	abs	57	3.44	1.982	0.263	1	8	3.00	U = 59.000
	prez	3	4.67	3.055	1.764	2	8	4.00	p = 0.396
Depressive syndrome	abs	21	4.05	2.012	0.439	2	8	3.00	U = 283.000
	prez	39	3.21	2.002	0.321	1	8	3.00	p = 0.041*
Osteoporosis	abs	59	3.49	2.046	0.266	1	8	3.00	U = 14.000
	prez	1	4.00	.	.	4	4	4.00	p = 0.500
Osteopenia	abs	59	3.49	2.046	0.266	1	8	3.00	U = 14.000
	prez	1	4.00	.	.	4	4	4.00	p = 0.500
Hysterectomy	abs	56	3.59	2.069	0.277	1	8	3.00	U = 64.000
	prez	4	2.25	0.500	0.250	2	3	2.00	p = 0.165

Discussions

In antiquity, in the 4th or 3rd century BC, the famous physician Hippocrates implicated the human brain only in the realization of thought, emotional states being attributed to the cardiovascular system. The well-known philosopher Plato also advocated the encephalocentric model, in which the brain takes precedence over the rest of the body. He believed that the brain commanded and controlled the rest of the body, and that emotions, passions and desires were located in the areas below the head, namely the heart and abdomen, more precisely somewhere around the liver. Later, in the first centuries of the Christian era, the famous Roman physician Galen took up the encephalocentric theory, but modified it by introducing the ventricular-pneumatic doctrine, according to which the pneuma in inhaled air is transformed into vital spirit by the heart, and then, reaching the cerebral ventricles, is transformed into psychic pneuma, after which it enters the nerves and reaches the effector organs. The intracerebral ventricles were, therefore, the place where intellect and sensations were formed (Dumitrescu, 2016).

Nowadays, the interconnection between chronic neuropathic pain, cognitive, affective and emotional experiences is well known. The higher systems of modulation of this pathology, with a broad context of organization and response modulation, are related to the afferents, projections and descending pathways of the periaqueductal gray matter (periaqueductal gray matter) and the rostral ventromedial medulla (rostral ventromedial medulla).

The mechanisms involved in chronic neuropathic chronic pain are not

sufficiently elucidated despite sustained research in this area. The nociceptive afferents consist of the transmission of impulses through thin, long, fast myelinated A α fibres and short, thick, slow unmyelinated C fibres to the dorsal horn of the spinal cord. Here excitatory and inhibitory interneurons, with associated downward modulation from above, transmit pain sensation. The brain has no pain matrix. The ascending pathways - the spinothalamic, spinoreticular, spinomesencephalic, spinoparabrachial tracts - transmit pain impulses to the five specific cortical areas - the primary somatosensory cortex, secondary somatosensory cortex, insula, anterior cingulate cortex and prefrontal cortex.

The variability of pain sensation is recognized, pain is subjective. It has been quantified experimentally (Beecher, 1959), assessing this experience in relation to the consumption of narcotics required by wounded soldiers during war. The perception of pain was found to be reduced in this context, relative to the extent of the injury, due to the cognitive impact: soldiers were removed from the war, at least for a period of time.

The "stimulation produces analgesia" phenomenon is based on the anatomical substrate of descending control. Significant projections from the periaqueductal gray matter are sent to the rostral ventromedial medulla, which sends projections to the dorsal horn and influences the sensory process. Periaqueductal gray matter receives inputs from the anterior limbic system, anterior cingulate cortex, prefrontal cortex, amygdala and hypothalamus. (limbic forebrain structures, including the anterior cingulate cortex, prefrontal cortex,

insula, amygdala, and hypothalamus) (Winn, 2022). All of these processes are mediated by neurotransmitters: acetylcholine, monoamines (epinephrine, norepinephrine, dopamine, serotonin), amino acids (glycine, gluconic ac, aspartic ac, gamma-aminobutyric ac GABA).

Clinically and anatomically, the sensation of pain, with all the manifestations that it implies, causes disturbances in relational behavior, so that negative psychological states appear. The way in which chronic neuropathic pain limits daily activities, influences occupational performance, affects personal relationships, transforms chronic neuropathic pain into a trigger for depression, and the coexistence of the two pathologies can aggravate the course of both diseases. At the same time, sleep disorders anxiety and depression are factors that delay recovery in chronic pain or reduce the effectiveness of medication (Legrain et al., 2011, Baliki and Apkarian, 2015). Imaging studies in patients with chronic pain show altered activity in the nucleus accumbens and medial prefrontal cortex (Hashmi et al., 2013; Baliki et al., 2010; Moayedi et al., 2011), brain regions also documented in the pathology of depression (Russo et al., 2013). As a result one can hypothesize that there is an important correlation between the occurrence of chronic pain and depression.

A recent review demonstrated that neurostimulation for chronic pain can be used with very good long-term results for postherpetic neuralgia, trigeminal neuralgia, neuropathic pain and post-stroke pain, headache, migraine, nonsurgical back pain, and painful diabetic neuropathy. (Zheng et al., 2023; Deer et al., 2019).

Neurostimulation of the spinal cord is an opiate-free, minimally invasive therapy of chronic pain of relatively recent date that has already been shown to be effective in both patients without prior surgery (Deer et al., 2013; Eckermann et al., 2022) and in those who have had numerous surgeries for a specific pathology (van Bussel et al., 2015; Breel et al., 2016).

Neurostimulation of the spinal cord offers a non-pharmacologic treatment for patients with chronic refractory pain (Caylor et al., 2019). There are studies in the literature (Stubbs et al., 2016; Stubbs et al., 2018; Stubbs et al., 2017), which state that pain has a significant impact on mental health, being associated with depression spectrum, psychosis spectrum, anxiety, sleep disturbances and stress, especially among low- and middle-income countries

Due to the complexity of the clinical symptomatology, as well as its mechanisms and impact on the patient's psychological status, numerous studies have been conducted in an attempt to determine the direct link between chronic neuropathic pain and depression, how the two pathologies positively or negatively influence each other, and the medical management of both conditions. Typically, patients with chronic neuropathic pain correlated with failed back surgery syndrome often present with symptoms of anxiety and depression, which can amplify the pain and lead to failure of drug treatment.

A group of researchers in Ireland (Robb et al., 2017), who analyzed anxiety and depression scales in 26 patients, pre and post spinal cord implantation, identified a statistically significant reduction in both

reported depressive and anxiety symptoms as well as pain intensity in all participants, which resulted in a corresponding reduction in opioid use. These data confirm the results of the present study, which showed that chronic neuropathic pain was reduced after spinal implantation, with statistical significance obtained in patients with depressive syndrome.

In a recent study (Cherif et al., 2020), focusing on 60 spinal neurostimulator implant patients, including 40 females and 21 males with a mean age of 52.71 ± 14.29 years, depression was found to be present in 65.6% of the subjects and positively correlated with pain intensity. To quantify the depressive syndrome, the authors used the Hospital Anxiety and Depression Scale (HADS), Arabic version (Terkawi A. et al.). And the present study demonstrated that two thirds of patients with chronic neuropathic pain had depressive syndrome as associated pathology. We must also take into account that in our study chronic neuropathic pain associated with depression was assessed only in patients with previous spinal surgery, and the patients included in the study were evaluated by a psychologist, the application of the rating scales being independent.

However, there are studies in the literature (Sparkes E et al., 2010), which state that the presence of depression in patients with chronic neuropathic pain would be a negative predictor of the efficacy of spinal

neurostimulation implants, but in our study we found that in patients with depressive syndrome, the mean VAS pain score after implant application was statistically significantly lower than in patients without depressive syndrome.

The recommended periodic follow-up of patients is hampered, in some cases, by lack of patient compliance. Most of the time, the patient presents for follow-up only if the internal pulse generator needs to be changed, when it becomes exhausted, or the stimulation area is damaged (slipped or fractured electrode, lateralization of pain). Thus, not all patients who are trial-tested for the spinal cord neurostimulation implant report the effectiveness of this system.

Conclusions

Neurostimulation is effective long-term as an adjunctive treatment for chronic neuropathic pain in patients with depressive syndrome. In addition to its physiological effect of modulating pain transmission to the higher centers, the effectiveness of stimulation restores the ability to return to previous daily activities, to achieve previous occupational performance, to improve mood and to improve relationships with others. Future studies should assess whether multidisciplinary management of physical perception of pain, impairment and social stressors is superior to their management alone.

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