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Efficacy of Spinal cord stimulation therapy for post thoracotomy pain syndrome: a case report

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Abstract

Background: Spinal cord stimulation (SCS) therapy is effective for the treatment of neuropathic pain, but there are few reports that demonstrated the efficacy of SCS for patients with post-thoracotomy pain syndrome (PTPS) who had received thoracic nerve root blocks with pulsed radiofrequency (PRF) but had not gotten sufficient pain relief.

Case presentation: The patient underwent resection of giant cell tumor in the right 6th rib in 2014. Due to right chest back pain after surgery, she received thoracic nerve root blocks with PRF several times at another institute. Although the pain was relieved for a couple of months after the block, she could not obtain permanent pain relief. She consulted our pain clinic in 2018. We prescribed 150 mg of pregabalin, 40 mg of duloxetine per day. We confirmed the efficacy of ultrasound-guided and fluoroscopy-assisted selective 6th thoracic nerve root block with PRF. Her pain relief continued for about 2 months. As she felt severe pain again, we administered PRF treatment and radiofrequency thermocoagulation (RFTC); however, she felt intractable pain again. Because her pain had neuropathic origin and was reactive to PRF, we decided to administer SCS therapy. She could feel the appropriate stimulated paresthesia for all regions of the pain, and her pain was also markedly reduced. As a result, we could reduce and finally discontinue her medications.

Conclusions: We described effective SCS therapy for the patient with PTPS for several years, which was resistant to various treatments and was mainly caused by neuropathic pain.

Key words: post-thoracotomy pain syndrome, spinal cord stimulation, neuropathic pain

Background

Post-thoracotomy pain syndrome (PTPS), a type of chronic postsurgical pain (CPSP), is defined as pain that occurs or persists in the area of the thoracotomy incision for at least 2 months following the initial procedure[1]. According to the previous reports[2, 3, 5], the incidence of PTPS is reported to have a wide range of occurrences from 5% to 90%, due to the factors such as lack of prospective tests, heterogeneity of perioperative management, and various types of surgeries. Maguire et al. demonstrated that the incidence of the PTPS was 40%, 5% of which were patients with medical treatment resistance[4].

Treatments for PTPS caused by neuropathic pain include administration of antidepressants, anticonvulsants, gabapentin, pregabalin, tramadol, and opioids, and the individual efficacy of medications, such as pregabalin, has been reported[6]. Spinal cord stimulation (SCS) is generally effective for neuropathic pain according to the chronic pain treatment guideline Clinical Question 31,"Is spinal cord stimulation effective for chronic pain treatment?" (Table 1). In this guide line, spinal surgery syndrome is strongly recommended but post-shingles neuralgia is weakly recommended, and PTPS is not listed.

We describe here our experience with a patient who suffered from severe PTPS for 4 years in spite of step-by-step treatment such as pregabalin administration and a thoracic nerve root block. Finally, we performed the SCS for the patient. SCS was so effective that we could reduce her medications.

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Table 1. The chronic pain treatment guideline CQ31: "Is spinal cord stimulation effective for chronic pain treatment?" [11]

disease	recommend	Summary of recommendation grades
Failed back surgery syndrome	1B	Execution is strongly recommended
Peripheral vascular disorders	1B	Execution is strongly recommended
Painful diabetic peripheral neuropathy	2B	Execution is weakly recommended
Central post-stroke pain	2C	Execution is weakly recommended
Pain in the extremities due to multiple sclerosis	2C	Execution is weakly recommended
Post-spinal cord injury pain	2C	Execution is weakly recommended
Complex regional pain syndrome : CRPS type Ⅰ CRPS type Ⅱ	2C 2D	Execution is weakly recommended Execution is weakly recommended
Phantom limb pain	2C	Execution is weakly recommended
Postcervical spine surgery cervico-omo-brachial pain	2D	Execution is weakly recommended
Brachial plexus avulsion injury	2D	Execution is weakly recommended
Postherpetic neuralgia	2D	Execution is weakly recommended
Angina pectoris	2D	Execution is weakly recommended

Case Presentation

A 33-year-old woman underwent resection of giant cell tumor, which had infiltrated into the sixth rib, under general anesthesia in 2014. She was administered medications, including pregabalin and tramadol, for about 3 years, because her right chest back pain on the sixth thoracic nerve lesion persisted. In addition to medication, she had received thoracic epidural block and thoracic nerve root block at the thoracic vertebrae 6 (Th 6) with local anesthetics several times, but pain relief did not last for a long time. In 2018 she underwent nerve root block with pulsed radiofrequency (PRF: Neuro Thermo JK3™, Neuro Therm Inc, MA, USA), which is the technique whereby radio frequency oscillations are gated at a rate of pulses per second, and the pain was relieved to 2-3/10 of the Numerical Rating Scale (NRS), which is graded from 0 to 10 according to the severity of pain, and 0 means no pain and 10 means intractable pain. As the pain was appeared again after 2 months, she consulted our hospital for the recurrence of pain in 2019.

The NRS was 6-7/10 and Cornell Medical Index (CMI), which is purposed to meet the need for an instrument suitable for collecting a large body of pertinent medical and psychiatric data at a minimal expenditure of the physician's time. It serves as a standardized medical history and as a guide to subsequent interview, was II at initial diagnosis. She was taking 300 mg of pregabalin, 40 mg of duloxetine, and 150 mg of tramadol per day. Ultrasound-guided and sixth thoracic nerve root block with a contrast media was effective for the pain, and she was administered a nerve root block with the PRF of 40°C for 60 seconds. Although the pain was relieved for about 2 months, her pain appeared again. We performed the PRF of 40°C for 180 seconds and radiofrequency and thermocoagulation (RFTC: Neuro Thermo JK3™, Neuro Therm Inc, MA, USA), which is a procedure that uses radio waves and heat to destroy tissue, of 70°C for 180 seconds, but her pain did not ameliorate. She hoped to reduce or discontinue medication. We planned the SCS for 6 months at the start of treatment because her pain was neuropathic origin and reactive to the PRF.

We performed epidural tap at the intervertebral space between the thoracic vertebra (Th) 12 and the lumber (L) 1 with a 14G Toughy needle by the median approach using a resistance-elimination technique, and in addition confirmed the epidural space with a contrast medium. Through the Toughy needle, an 8-pole flexible electrode (Vectris SureScan™, MRI lead, Medtronic Inc, MN, USA) was inserted, the tip of which was placed at the height of the Th 4 and the tail of which was at the Th 6 (Figure 1). After checking appropriate stimuli using a temporary pulse generator for 1 week, we inserted a permanent pulse generator (Intellis™, Medtronic Inc., MN, USA (Low dose • Rate: 10 or 30 or 50 or 80Hz • Pulse wide: 210us~300us) in her buttock. She felt good stimulated paresthesia

for all the regions of pain during the stimulation, and thus her pain was ameliorated during and after the stimulation. We instructed her to use the SCS when she felt pain. As a result, we reduced and finally discontinued her medication. Although her pain of right shoulder blade downward remained at the NRS 0-3/10, her right chest back pain on the sixth thoracic nerve lesion improved to NRS 0/10. She received pregabalin 100 mg and duloxetine 20 mg per day in order to ameliorate her remaining pain. She could gradually stop the SCS during sleep and often stopped it for several hours during the daytime, and eventually pregabalin could be discontinued. Fortunately, she was able to return to work two weeks after the discharge from our hospital (Figure 2). The SCS setting after 3 months of discharge was adjusted to program 1: dermatome, program 2: from side thoracic to anterior thoracic, and programs 3 and 4: post-thoracotomy pain (Table 3). Her medicine was reduced to only duloxetine 40 mg per day. The analgesic effect was excellent and was maintained. Her satisfaction has been very high.

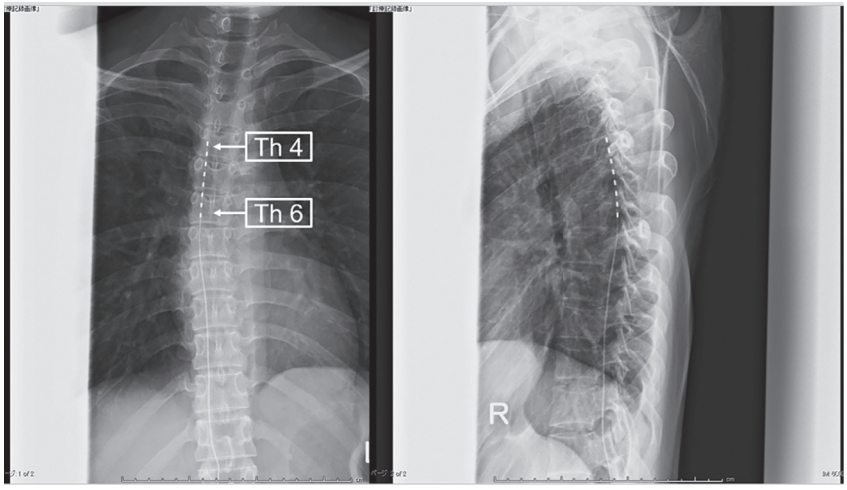

Figure 1. Chest X-ray after placement of an 8-pole electrode
An 8-pole flexible electrode is placed in the epidural space. The tip of the electrode is located at the 4th thoracic vertebral position and the tail is located at the 6th thoracic vertebral position.

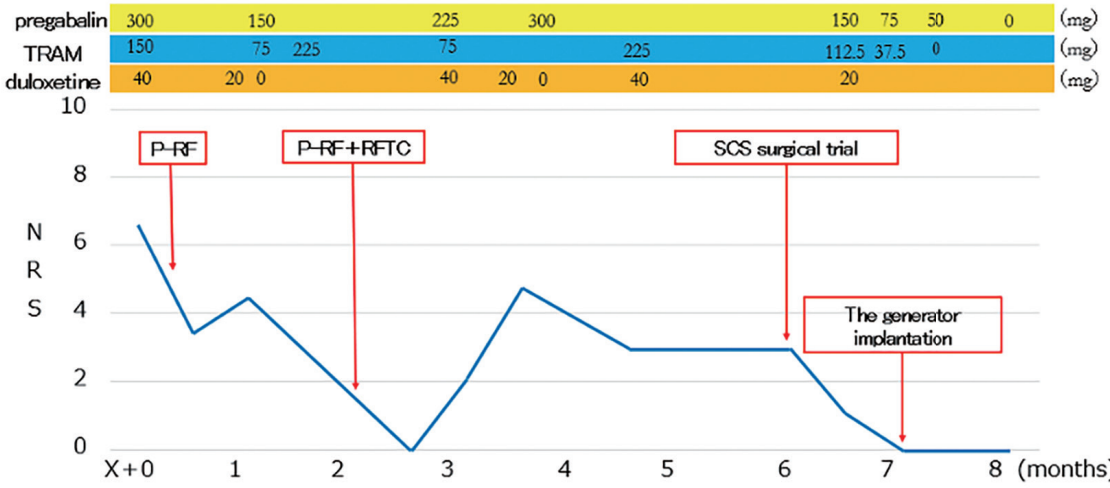

Figure 2. The time course of the patient's treatment
The patient was given 300 mg of pregabalin, 40 mg of duloxetine, and 150 mg of tramadol per day. After giving PRF, we could reduce the patient's medications. Although the pain was once relieved for about 2 months, we had to increase the patient's medications again because of recurrence of pain. Next, we tried PRF and RFTC, but her pain was not ameliorated. Therefore, we administered SCS to the patient. As a result, the patient felt good stimulated paresthesia for all the regions of pain during the stimulation, and thus the pain was ameliorated during and after the stimulation. Finally, we reduced the patient's medication for only duloxetine 40 mg per day.
TRAM: tramadol hydrochloride PRF: pulsed radiofrequency
RFTC: radiofrequency thermocoagulation SCS: Spinal Cord Stimulation

Table 3. The program of spinal cord stimulation (SCS)

program	1	2	3	4
amplitude (mA)	0.3−1.2	0.4−0.7	0.4−1.1	0.5−0.8
pulse width (μs)	400	460	440	430
frequency (Hz)	100	100	100	100
0	・ ・	・ ・	・ ・	+ ・
1	− ・	・ ・	・ ・	− ・
2	− ・	・ ・	・ ・	・ ・
3	− ・	− ・	− ・	・ ・
4	+ ・	− ・	− ・	・ ・
5	・ ・	+ ・	− ・	・ ・
6	・ ・	・ ・	+ ・	・ ・
7	・ ・	・ ・	− ・	・ ・

Vertical axis:electrocode
Transverse sxis:program(program 1: dermatome, program 2: from side thoracic to anterior thoracic, program 3,4: post-thoracotomy pain)
The patient feel good stimulated paresthesia for all the regions of pain by the program of SCS, which give electrical stimulation on program (program 1: dermatome, program 2: from side thoracic to anterior thoracic, program 3,4: post-thoracotomy pain) for right thoracic back-related pain associated with the sixth thoracic nerve lesion.

Discussion

Strong postoperative pain is an important risk factor for CPSP development, and severe postoperative pain of long duration is involved in CPSP[7]. The onset of neuropathic pain from early postoperative course may be associated with the development of neuropathic pain of CPSP[8]. Thus, active and early treatment intervention for postoperative pain is important. The treatment for CPSP includes pharmacotherapy, such as neuropathic pain medicines and opioids, nerve block, and intervention pain treatment such as neurostimulation therapy. The use of SCS for CPSP may be selected when it is resistant to medicine therapy and nerve block. In 2009, the British Pain Society reported the efficacy of SCS for each disease[9] (Table 2). In the report, "Intercostal neuralgia, such as post-thoracotomy or post-herpetic neuralgia" is summarized as having intermediate indications for SCS. However, in Clinical Question 31, the section of "Is spinal cord stimulation effective for chronic pain treatment?" did not include a description of PTPS but a description of post-herpetic neuralgia[10] (Table 1).

As far as we know, however, there were only 3 case reports which demonstrated the efficacy of SCS for PTPS[11, 12, 13]. Jordan et al.[11] reported the successful use of SCS as well as complete resolution of symptoms at 4 months follow-up in a 71-year-old man with persistent PTPS that was resistant to other modalities. Kevin et al.[12] reported that the use of SCS suppressed intractable pain target at the T6 and T7 dermatomes of the chest wall in the manifestation of post-thoracotomy neuralgia: non-small cell lung cancer at 24 months. The study reported > 75% pain relief, an overall improvement in quality of life described as less pain with breathing, and improved functional ability pertaining to arm movements and improved sleep patterns. Nebojsa et al.[13] reported a 39-year-old woman who had already been implanted with SCS at T7 for Complex regional pain syndrome (CRPS) type I of the lower left limb, and she was adjusted SCS to PTPS for slipping rib T12 rib from an unrelated trauma. At 1 year follow-up, the use of SCS provided significant lasting pain relief for both CRPS and PTPS and had sufficient analgesic effects. The efficacy of SCS for PTPS was described in all three cases; however, there was no detailed description of reduction and discontinuation of medicines.

When neuropathic pain is a major factor in PTPS, a sufficient analgesic effect can be expected by SCS. It has been demonstrated that electric currents through the dorsal column induced by SCS, excitatory neurotransmitters, such as glutamate and aspartate, are reduced, but inhibitory neurotransmitters, such as γ-aminobutyric acid (GABA), are increased. Therefore, SCS provides suppression of excessive excitation of wide dynamic range neurons that relay pain, attenuation of upper pain transmission, activation of the lower pain suppression system, and suppression of sympathetic nerves. In the present case, SCS had a dramatic analgesic effect, even though SCS treatment was

Table 2. The British Pain Society:Spinal cord stimulation for the management of pain: Recommendations for best clinical practice[9]

Good indications for SCS (likely to respond)	Neuropathic pain in leg or arm following lumbar or cervical spine surgery (FBSS/FNSS)
	Complex regional pain syndrome (CRPS)
	Neuropathic pain secondary to peripheral nerve damage
	Pain associated with peripheral vascular disease
	Refractory angina pectoris (RAP)
	Brachial plexopathy: traumatic (partial, not avulsion), post-irradiation
Intermediate indications for SCS (may respond)	Amputation pain (stump pain responds better than phantom pain)
	Axial pain following spinal surgery
	Intercostal neuralgia, such as post-thoracotomy or post-herpetic neuralgia
	Pain associated with spinal cord damage
	(other peripheral neuropathic pain syndromes, such as those following trauma may respond)
Poor indications for SCS (rarely respond)	Central pain of non-spinal cord origin
	Spinal cord injury with clinically complete loss of posterior column function
	Perineal or anorectal pain
Unresponsive to SCS	Complete spinal cord transection
	Non-ischaemic nociceptive pain
	Nerve root avulsion

applied 4 years after the onset of PTSP, which is comparable to previously reported cases of the use of SCS for PTPS[11, 12, 13]. We were able to reduce and discontinue her medicines, and there was a marked improvement in activities of her daily life.

In conclusion, the use of the SCS for PTPS, which is resistant to various treatments and is mainly caused by the neuropathic mechanism, may be an effective treatment option of pain relief, and the pain relief can be expected to continue for several years.

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