Simultaneous Trial of Thalamic Deep Brain Stimulation and Motor Cortex Stimulation in Chronic, Intractable Neuropathic Pain

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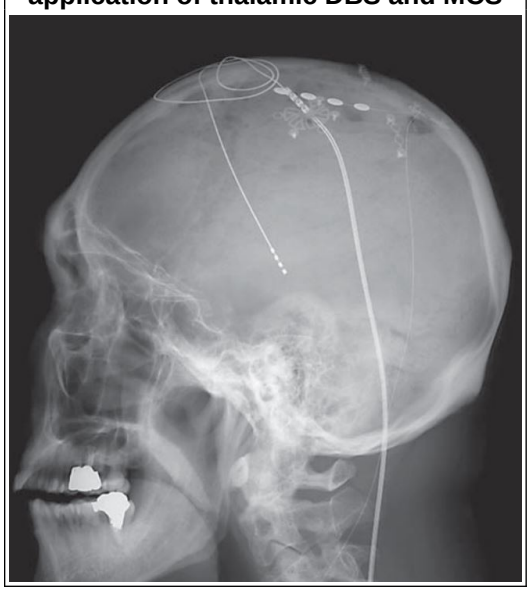
Introduction

Both motor cortex stimulation (MCS) and deep brain stimulation (DBS) of the ventralis caudalis (Vc) thalamus have been shown to be effective in chronic neuropathic pain and modulation of thalamic and thalamocortical activity is regarded as a possible mechanism. Although Vc DBS and MCS share a common analgesic mechanism, application of MCS and DBS is still considered empirical and there is no consensus on which one is better.

Methods

We performed a simultaneous trial of thalamic Vc DBS and MCS in 9 patients with chronic neuropathic pain and investigated the results of the stimulation trial and long-term pain relief.

Skull x-ray showing simulataneous application of thalamic DBS and MCS



Demographics

Patient	Sex/age, years	Diagnosis	Duration of pain, years	Location of pain	NRS score preoperatively	Surgical target (final target)	Trial success	Length of FU, months	Duration of analgesic effect, months	NRS score at last FU	Percent pain relief
1	M/63	spinal cord injury	40	both extremities (right more severe)	9	Vc/PVG MCS (MCS)	yes	68	6	7	22
2	M/66	CPSP (pontine ICH)	3	contralateral hemibody	8	Vc/MCS (MCS)	yes	42		4	50
3	M/47	amputation stump pain	5	left upper extremity	8	Vc/MCS (Vc)	yes	68		5	37.5
4	F/52	CPSP	2	contralateral hemibody	7	Vc/MCS (MCS)	yes	48		4	43
5	M/63	spinal cord injury	10	right upper extremity, right trunk	8	Vc/MCS (MCS)	yes	41		7	12.5
6	M/53	spinal cord injury (transitional zone pain)	3	left trunk	8	Vc/MCS	no	N/A		4	N/A
7	F/56	CPSP	4	contralateral trunk, lower extremities	8	Vc/MCS (MCS)	yes	16		4	50
8	F/32	cervical syrinx	5	right upper extremity	8	Vc/MCS (Vc)	yes	16		5	37.5
9	M/75	CPSP	2	contralateral hemibody	8	Vc/MCS (MCS)	yes	12		4	50

FU = Follow-up; ICH = intracerebral hematoma.

Results

Of the 9 patients initially implanted with both DBS and MCS electrodes, 8 of them (89%) had a successful trial. Six of these 8 patients (75%) responded to MCS and two out of the 8 patients responded to Vc DBS. With long-term follow-up, the mean NRS decreased significantly ($p<0.05$). Percentage pain relief in the chronic MCS group and chronic DBS group was 37.9±16.5% and 37.5%, respectively, and there was no difference ($p=0.157$).

Conclusions

Considering the initial success rate and the less invasive nature of epidural MCS than DBS, we think MCS would be a more reasonable, initial means of trial in chronic intractable neuropathic pain.

Summary of demographic and long-term results

Age, years	49.3
F:M, n	3:6
Duration of pain, years	8.1±12.2
NRS score (preoperative)	8±0.5
Successful trial stimulation, n	
MCS	6
DBS	2
Trial failure, n	1
Length of follow-up, months	38.9±22.6
NRS score at last follow-up	5±1.3
Percentage of pain relief	
MCS	37.9±16.5
DBS	37.5

Values denote means ± SD unless specified otherwise.

Parameters of chronic stimulation

	Patient							
	1	2	3	4	5	7	8	9
Diagnosis of pain	SCI	CPSP	Amp.	CPSP	SCI	CPSP	syrinx	CPSP
Chronic stimulation	MCS	MCS	Vc	MCS	MCS	MCS	Vc	MCS
Parameters of chronic stimulation								
Polarity	1−2+	2−3+	0−1−2+	C+2−	0−1+	1−2+	C+1−	1−2+
Amplitude, V/mA	2.5	2.8	2.5	3.0	2.3	2.8	1.6	3.0
Rate, Hz	30	160	30	45	60	30	50	60
Pulse width, μs	90	120	270	120	180	210	120	90

Amp. = Amputation stump pain.

Learning Objectives

to decide which method of pain treatment, MCS or DBS, would be a more reasonable approach for patients with chronic neuroapthic pain.

References

9.Son BC, Kim MC, Moon DE, Kang JK: Motor cortex stimulation in a patient with intractable complex regional pain syndrome type II with hemibody involvement. Case report. J Neurosurg 2003;98:175-179.

17.Son B, Choi ES, JT Hong, SW Lee. Motor cortex stimulation for central pain caused by traumatic brain injury. Pain 2006

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Changes in medication

Patient	Preoperative usage		Postoperative usage (last follow-up)	
	anticonvulsant/antidepressant weak opioid	moderate-to-strong opioid	anticonvulsant/antidepressant weak opioid	moderate-to-strong opioid
1	gabapentin 1,800 mg Ultracet 6T amitriptyline 30 mg	–	gabapentin 1,800 mg Ultracet 9T Mypol 3T	morphine 90 mg fentanyl 50 μg/h
2	gabapentin 900 mg tramadol 150 mg	oxycodone 20 mg fentanyl 25 μg/h	gabapentin 800 mg tramadol 150 mg	oxycodone 20 mg
3	gabapentin 1,800 mg amitriptyline 20 mg	oxycodone 40 mg fentanyl 25 μg/h	gabapentin 1,800 mg amitriptyline 10 mg Ultracet 3T	oxycodone 40 mg fentanyl 25 μg/h
4	pregabalin 300 mg tramadol 150 mg amitriptyline 10 mg		gabapentin 800 mg	
5	baclofen 60 mg tramadol 100 mg amitriptyline 20 mg	oxycodone 40 mg fentanyl 50 μg/h	baclofen 60 mg tramadol 100 mg	oxycodone 100 mg fentanyl 25 μg/h
7	pregabalin 150 mg alprazolam 50 mg amitriptyline 20 mg		gabapentin 1,200 mg baclofen 30 mg	
8	gabapentin 900 mg alprazolam 50 mg amitriptyline 20 mg	oxycodone 40 mg fentanyl 12.5 μg/h	gabapentin 1,700 mg alprazolam 50 mg	oxycodone 40 mg IRodon 15 mg
9	gabapentin 1,200 mg tramadol 100 mg clonazepam 2 mg amitriptyline 10 mg		gabapentin 800 mg clonazepam 1 mg	oxycodone 40 mg