CASE REPORT

Deep brain stimulation in a Chinese Tourette's syndrome patient

Michael WY Lee 李永恩
Mandy M Au-Yeung 歐陽敏
KN Hung 洪君毅
CK Wong 黃志強

A 31-year-old Chinese man with intractable severe, lifelong Tourette's syndrome characterised by forceful self-injurious motor tics and socially embarrassing vocal tics was treated with bilateral deep brain stimulation. Electrodes were implanted into the thalamic targets at the centromedian-parafascicular complex according to Hassler's nomenclature. A dramatic reduction of tics resulted. At 18 months postoperatively, there was an 81% improvement in his total tics count and a 58% improvement in his Yale Global Tic Severity Scale. His modified Rush video scale decreased from 13 to 8 and visual analogue scale from 10 to 3. These data show that bilateral deep brain stimulation of the thalamus can have a favourable immediate effect on severe tics in a selected group of adult patients suffering from intractable Tourette's syndrome and postoperatively the beneficial effects persisted for at least 18 months.

Case report

Herein we present the first reported case of deep brain stimulation (DBS) treatment for Tourette's syndrome (TS) in a Chinese patient. This 31-year-old, right-handed, otherwise healthy man had had severe, lifelong TS since he was 7 years old. He had an uneventful peri-natal history. He was born full-term, having had a normal spontaneous vaginal delivery. He had a gradual onset of facial, neck, and vocal tics beginning at the age of 7 years. The facial tics entailed excessive blinking, staring gazes, sniffing, and grimacing. His vocal tics included grunting, loud noises, and very occasionally cursing. His neck tics included head nodding and jerking towards the right side with a right shoulder shrug. Aged 12, he was told he had 'just a bad habit' by a general practitioner. He resolved to take cannabinoids, which he perceived as affording transient relaxation.

He first presented to the Neurology Clinic of the Pamela Youde Nethersole Eastern Hospital when he was 24 years old. At that time he was single and unemployed 'because of his tics'. Besides the tics, physical examination and routine blood tests yielded no abnormality. He was treated with clonidine and tetrabenazine, but with unsatisfactory effects. After shopping around between various neurologists, psychiatrists, and clinical psychologists and an exhausting array of pharmacological treatment, he returned to us with worsened tics at the age of 30 years. Being encouraged by the successful results of DBS in TS, he requested surgery.

Apart from the increased blinking, staring gaze and facial grimacing, he had frequent forceful, orchestrated tics entailing head jerks and right arm swings, so violent that he often hurt himself. Extreme head and neck musculoskeletal pain also affected his sleep. His frequent grunting and sniffing vocal tics severely disturbed his speech. He had endured a few layoffs from work, due to misunderstandings arising from echolalia and coprolalia. His Yale Global Tic Severity Scale (YGTSS[1]) score was 89 (range, 0-100). Psychiatrists opined that he did not have obsessive-compulsive symptoms and that he was mentally fit to consent for surgery. After extensive discussion regarding the potential benefits, risks, and complications of DBS, he was scheduled for surgery.

Customary stereotactic targeting and procedures were performed in February 2009 under general anaesthesia. The centromedian-parafascicular (Ce-Pf) complex thalamic target used was 4 mm posterior, 5 mm lateral, and 0 mm inferior to the mid-commissural point, as reported by Visser-Vandewalle et al.[2] Macrostimulation was performed with the patient awake after the stimulating quadripolar electrode (model 3387; Medtronic, Minneapolis [MN], US) was implanted at the target. Marked reduction of tics was observed immediately with monopolar stimulation at contact 1. No side-effects were noted with 7 V at contact 1 and 5 V at other contacts bilaterally. Then the neurostimulator (Kinetra; Medtronic, Minneapolis [MN], US) was implanted and active contact locations were confirmed by postoperative imaging to be within 1 mm of the targets.

In the first postoperative week, there were reduced tics even with the stimulator off.

Key words
Deep brain stimulation; Electric stimulation therapy; Midline thalamic nuclei; Tic disorders; Tourette syndrome

Hong Kong Med J 2011;17:147-50

Department of Neurosurgery, Pamela Youde Nethersole Eastern Hospital, Chai Wan, Hong Kong
MWY Lee, FRCSEd(SN), FHKAM (Surgery)
CK Wong, FRCS, FHKAM (Surgery)
Department of Neurology, Pamela Youde Nethersole Eastern Hospital, Chai Wan, Hong Kong
MM Au-Yeung, FRCP, FHKAM (Medicine)
Division of Neurosurgery, Department of Surgery, Queen Mary Hospital, Pokfulam Road, Hong Kong
KN Hung, FRCS, FHKAM (Surgery)

Correspondence to: Dr MWY Lee
Email: michaelwylee@yahoo.com

一名華籍「妥瑞氏症」患者接受腦深部電刺激法治療

一名31歲華籍男性自小患有嚴重的頑性「妥瑞氏症」（Tourette's syndrome），經常有不受控的自殘性的重覆而且劇烈的抽搐動作，並有構音障礙，社會功能嚴重受損。我們為病人進行雙側腦深部電刺激治療（deep brain stimulation），把電極植入病人丘腦的靶標——根據Hassler所命名的中央核—束旁核複合體處（centromedian-parafascicular complex），發現他的抽搐動作大幅度下降。術後18個月，病人抽搐的次數有81%改善，採用美國耶魯大學綜合抽動嚴重程度評分量表（Yale Global Tic Severity Scale）評估的改善程度亦有58%。病人的改良版美國拉什大學錄像評分量表（modified Rush video scale）由13分降至8分，視覺模擬評分量表亦由10降至3。本報告顯示替特別揀選的「妥瑞氏症」成年患者進行雙側腦深部電刺激法可即時緩解嚴重抽搐的症狀，本病例亦顯示療效改善至少可維持18個月。

The patient estimated near-complete improvement of his arm tics, and ever since he has had no more coprolalia. The tics reappeared 1 week later and the stimulator was turned on. Despite the absence of right arm tics, there was no significant improvement of the neck and facial tics by 1 month postoperatively. Hence the stimulus voltage was gradually increased from 2.5 to 5 V, bilaterally. The control remained unsatisfactory, and monopolar double negative stimulation of the central two contacts was used bilaterally. The frequency was also increased from 130 to 200 Hz and the pulse-width from 60 to 180 ms. As there was no significant improvement, the voltage was reverted to 3 V, bilaterally. He came back with increased tics a week later. Thus the voltage was increased back to 5 V, bilaterally. At around 6 weeks postoperatively, he reported considerable improvement in the control of his tics.

Realising that there might be delayed cumulative effect of DBS in this TS patient, we attempted to reduce the stimulus voltage gradually from 5 to 3.5 V between the fifth and sixth postoperative month. He remained well, so the impulse frequency was gradually decreased to 135 Hz between the sixth and seventh postoperative month. As he complained of increased tics again, the impulse frequency was reverted to 180 Hz. His tics control remained satisfactory thereafter, with reduced dosage of medications that were previously proven to be ineffective. Six months after operation, his YGTSS score had decreased from 89 to 34 (62% improvement) and the beneficial effect was sustained 18 months postoperatively. His modified Rush video scale score decreased from 13 to 8 and visual analogue scale score from 10 to 3 (Table 1).

Concerning his preoperative neuropsychological assessment, intellectual functioning, neurocognitive abilities and emotional status were normal, except that his motor tics compromised his performance on task-demanding motor involvement to score in non-verbal fluency. Besides, his vocal and motor tics constrained his personal and social life. After surgery, his overall cognitive functioning was well preserved. In fact, there was an improvement in the performance of some cognitive tasks, due to better tics control (Table 2). There was also better adjustment to the psychosocial constraints imposed upon by his illness.

Our patient was unemployed because of tics before the surgery. With improvement in his tics, he managed to find a job about a year after the surgery.

TABLE 1. Patient's clinical and stimulation parameters

Parameter*	Preoperative	Postoperative						% Improvement
		1 Week	1 Month	3 Months	6 Months	9 Months	18 Months	
Clinical tic severity								
Total tic counts/5 min	68	18	36	32	21	19	13	81
Tics of arm	2	0	0	0	1	0	0	100
Tics of neck	16	8	11	5	7	2	3	81
Facial tics	20	8	20	23	7	9	6	70
Vocal tics	28	2	5	4	6	8	4	86
YGTSS (0-100)	89	49	57	35	34	34	37	58
MRVS	13	10	11	7	7	8	8	39
VAS (0-10)	10	7	8	6	5	5	3	70
Stimulation parameters								
Electrode contacts	-	Off	1-2-C+	1-2-C+	1-2-C+	1-2-C+	1-2-C+	-
			5-6-C+	5-6-C+	5-6-C+	5-6-C+	5-6-C+	
Frequency (Hz)	-	-	180	200	150	180	180	-
Pulse width (ms)	-	-	150	150	180	180	180	-
Amplitude (V)	-	-	5	5	3.5	3.5	3.6	-

* YGTSS denotes Yale Global Tic Severity Scale, MRVS modified Rush video scale, and VAS visual analogue scale

Discussion

Being named after the French neuropsychiatrist Georges Albert Édouard Brutus Gilles de la Tourette (1857-1904),[3,4] TS is a chronic neuropsychiatric disorder with early childhood onset. It is characterised by tics and often accompanied by disturbances in behaviour, such as obsessive-compulsive disorder, attention-deficit hyperactivity disorder anxiety, and affective disorders.[5] Tics are sudden, brief, intermittent, involuntary or semi-voluntary movements (motor tics) or sounds (phonic or vocal tics). The frequency and intensity usually wax and wane. The estimated worldwide prevalence was 4 to 5 cases per 10 000 individuals.[6] A study of mainstream secondary schools in the United Kingdom reported a prevalence of 31 to 157 cases per 1000 individuals in 13- to 14-year-old children.[7] Among 9742 children aged 7 to 16 years in Wenzhou China, the prevalence of TS was 43 per 10 000.[8]

The standard treatment is pharmacological, viz neuroleptics, α_2-adrenergic agonists, and dopamine agonists, as well as local injections of botulinum toxin.[9] Behavioural treatment using techniques like habit reversal has also been effective.[10] Nevertheless, the symptoms are sometimes refractory to these treatments. Since 1955, there have been various attempts to treat these patients by neurosurgical procedures, the most promising being bilateral ablation of midline thalamic nuclei.[11] In 1999, DBS was introduced as a new approach for intractable TS. To date, there have been at least 56 reported cases[12-16] of DBS for treatment-refractory TS, with promising results for the control of tics and associated behavioural disorders. Most of these involved bilateral thalamic stimulation (Ce-Pf). Other targets have also been used: posteroventral globus pallidus internus,[17,18] nucleus accumbens, as well as the anterior limb of the internal capsule.[19]

In the present case involving a Chinese patient with severe refractory TS, there was a good effect from bilateral thalamic DBS on motor and vocal tics. The dramatic cessation of tics immediately after the operation could be due to the effect of transient microthalamotomy; such improvements having been observed previously after thalamic stimulation for tremor and seizures.[20,21] The delayed tic control response at around 6 weeks resembles the delayed effects on dystonia from pallidal stimulation, and may suggest an element of neuronal plasticity following DBS.[22,23]

The DBS programming is not a trivial aspect of this form of treatment, as experience is sparse and guidelines are lacking.[24] In our patient, the optimal voltage (3.5 V) was similar to values reported earlier (2.2-6.4 V), whereas a higher than previously reported impulse frequency (65-130 Hz)[2] appeared necessary. This case report adds to the body of evidence that bilateral thalamic DBS is a safe and effective treatment option for a selected group of adult refractory TS patients with motor and vocal tics.

TABLE 2. Results of the neuropsychological assessments

Tests	Score		Two-tailed P value (preop vs postop)
	1-Month preop	7-Month postop	
Balloons test			
Laterality B	0.5	0.5	1.000
Chinese version of Auditory Verbal Learning Test			
Trial 1-5 total	59	60	0.976
Immediate recall	15	14	0.675
Delay recall	14	14	1.000
Recognition	15	14	0.478
Continuous Visual Memory Test			
Acquisition			
Hits	42	39	0.223
False alarms	12	2	0.040
Delayed recognition	6	5	0.384
Digital Vigilance Test			
Total reaction time	324.84	344	0.131
Figural fluency			
Total production	64	89	<0.001
Hooper Visual Organization Test (total score)	24.5	24	0.780
Judgment of Line Orientation Test (total score)	29	28	0.653
Stroop Color and Word test, Chinese version			
Interference	8.44	2.94	0.246
Symbol Digit Modalities Test			
Written	70	56	0.234
Oral	68	92	0.055
Verbal fluency			
Fruits / vegetables production	25	21	0.317
Animal production	25	23	0.624

Acknowledgements

We thank the patient and his family for their perseverance in searching out treatments for TS and the courage to trying them. Acknowledgement is also due to Prof Tatia Lee and her clinical team of the Laboratory of Neuropsychology, The University of Hong Kong, for the neuropsychological consultation and assessments.

References

1. Leckman JF, Riddle MA, Hardin MT, et al. The Yale Global Tic Severity Scale: initial testing of a clinician-rated scale of tic severity. J Am Acad Child Adolesc Psychiatry 1989;28:566-73.
2. Visser-Vandewalle V, Temel Y, Boon P, et al. Chronic bilateral thalamic stimulation: a new therapeutic approach in intractable Tourette syndrome. Report of three cases. J Neurosurg 2003;99:1094-100.
3. Jankovic J. Tourette syndrome. Phenomenology and classification of tics. Neurol Clin 1997;15:267-75.
4. Lees AJ. Georges Gilles de la Tourette. The man and his times. Rev Neurol (Paris) 1986;142:808-16.
5. Leckman JF. Tourette's syndrome. Lancet 2002;360:1577-86.
6. Riederer F, Stamenkovic M, Schindler SD, Kasper S. Tourette's syndrome—a review [in German]. Nervenarzt 2002;73:805-19.
7. Hornsey H, Banerjee S, Zeitlin H, Robertson M. The prevalence of Tourette syndrome in 13-14-year-olds in mainstream schools. J Child Psychol Psychiatry 2001;42:1035-9.
8. Jin R, Zheng RY, Huang WW, et al. Study on the prevalence of Tourette syndrome in children and juveniles aged 7-16 years in Wenzhou area [in Chinese]. Zhonghua Liu Xing Bing Xue Za Zhi 2004;25:131-3.
9. Scahill L, Erenberg G, Berlin CM Jr, et al. Contemporary assessment and pharmacotherapy of Tourette syndrome. NeuroRx 2006;3:192-206.
10. Wilhelm S, Deckersbach T, Coffey BJ, Bohne A, Peterson AL, Baer L. Habit reversal versus supportive psychotherapy for Tourette's disorder: a randomized controlled trial. Am J Psychiatry 2003;160:1175-7.
11. Hassler R. Stereotaxic surgery for psychiatric disturbances. In: Schaltenbrand G, Walker AE, editors. Stereotaxy of the human brain: anatomical, physiological and clinical applications. Stuttgart, Germany: Georg Thieme Verlag; 1982: 570-90.
12. Porta M, Servello D, Sassi M, et al. Issues related to deep brain stimulation for treatment-refractory Tourette's syndrome. Eur Neurol 2009;62:264-73.
13. Zabek M, Sobstyl M, Koziara H, Dzierzecki S. Deep brain stimulation of the right nucleus accumbens in a patient with Tourette syndrome. Case report. Neurol Neurochir Pol 2008;42:554-9.
14. Burdick A, Foote KD, Goodman W, et al. Lack of benefit of accumbens/capsular deep brain stimulation in a patient with both tics and obsessive-compulsive disorder. Neurocase 2010;16:321-30.
15. Dueck A, Wolters A, Wunsch K, et al. Deep brain stimulation of globus pallidus internus in a 16-year-old boy with severe tourette syndrome and mental retardation. Neuropediatrics 2009;40:239-42.
16. Idris Z, Ghani AR, Mar W, et al. Intracerebral haematomas after deep brain stimulation surgery in a patient with Tourette syndrome and low factor XIIIA activity. J Clin Neurosci 2010;17:1343-4.
17. Houeto JL, Karachi C, Mallet L, et al. Tourette's syndrome and deep brain stimulation. J Neurol Neurosurg Psychiatry 2005;76:992-5.
18. Ackermans L, Temel Y, Cath D, et al. Deep brain stimulation in Tourette's syndrome: two targets? Mov Disord 2006;21:709-13.
19. Flaherty AW, Williams ZM, Amirnovin R, et al. Deep brain stimulation of the anterior internal capsule for the treatment of Tourette syndrome: technical case report. Neurosurgery 2005;57(4 Suppl):E403.
20. Benabid AL, Pollak P, Gervason C, et al. Long-term suppression of tremor by chronic stimulation of the ventral intermediate thalamic nucleus. Lancet 1991;337:403-6.
21. Andrade DM, Zumsteg D, Hamani C, et al. Long-term follow-up of patients with thalamic deep brain stimulation for epilepsy. Neurology 2006;66:1571-3.
22. Krauss JK, Loher TJ, Weigel R, Capelle HH, Weber S, Burgunder JM. Chronic stimulation of the globus pallidus internus for treatment of non-dYT1 generalized dystonia and choreoathetosis: 2-year follow up. J Neurosurg 2003;98:785-92.
23. Yianni J, Bain PG, Gregory RP, et al. Post-operative progress of dystonia patients following globus pallidus internus deep brain stimulation. Eur J Neurol 2003;10:239-47.
24. Mink JW, Walkup J, Frey KA, et al. Patient selection and assessment recommendations for deep brain stimulation in Tourette syndrome. Mov Disord 2006;21:1831-8.