Programming parameters and outcome in GPi Deep Brain Stimulaiton (DBS) for Tourette Syndrome (TS)

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ABSTRACT

Objective: To describe the programming requirements for patients with medication refractory TS who are treated with bilateral GPi DBS.

Background: DBS for TS is an emerging therapy. Long term therapy and outcomes data is limited.

Methods: DBS programming records of patients treated with bilateral GPi DBS were reviewed and analyzed. Individual stimulation parameters, side effects of stimulation, and need for battery exchange were identified.

Results: 3 patients wtih TS have been treated for 5, 4, and 2 years. Monopolar stimulation was used throughout the treatment period. Adjustments were performed in response to changes in tic symptoms. Mean amplitude of stimulation across all sessions was 4.9V, mean pulse width was 198 microseconds, and mean frequency was 168 Hz. The most common side effects of programming included hand bradykinesia, throat tightening, and dysarthria and all resolved with parameter adjustment. The need for battery exchange was identified on average every 11 mos (Range 6-17 mos), and 10 total battery exchanges were performed. All patients transitioned to rechargeable generators without difficulty. Subjective symptom exacerbations were observed during periods of battery depletion but control was recaptured after exchange. Transient reduction and gradual retitration of stimulation parameters was sometimes required after an exchange. Overall, clinical improvement was maintained over the treatment period.

Conclusions: Treatment of medically refractory TS with bilateral GPi DBS is a dyanmic process. TS patients require high settings and frequent battery exchanges, similar to those with dystonia. Any side effects of stimulation resolved with further programming and did not compromise tic control. Symptom benefit can be maintained for up to 5 years.

BACKGROUND

TS is characterized by tics and co-moribidities such as attention-deficit/hyperactivity disorder (ADHD) and obsessive-compulsive behaviors (OCBs) that can wax and wane over time based on a variety of factors (1).

DBS for TS should be reserved for severe cases refractory to usual medical and behavioral therapies (2).

The ideal target for TS and/or associated co-morbidities remains under debate. The most commonly reported and studied targets include the centromedian parafascicular complex (CM-Pf) of the thalamus (3, 4), globus pallidus interna (GPi) (5,6,7), anterior limb of the internal capsule and/or nucleus accumbens (8,9).

We have previously described the improvement of tics and psychiatric co-morbidities in a 16-year-old patient treated with posteroventral GPi DBS (5) and reported similar improvement in two additional patients early after DBS (6).

Limited data exist on stimulation parameters and side effects, longitudinal programming requirements, and fluctuations in symptom control following DBS.

The objective of this poster is to describe the programming requirements and fluctuations in patients with medication refractory TS who are treated with bilateral GPi DBS.

METHODS

DBS programming records of TS patients treated with bilateral GPi DBS were reviewed and analyzed. Individual stimulation parameters, side effects of stimulation, and need for battery exchange were identified.

3 subjects are now 5.75, 4.5, and 2.8 years post bilateral GPi DBS.

RESULTS

	Age at implant	Patient Histories	Years post implant
Patient 1	16yrs Male	This patient's history and response to stimulation after 1 year has been previously described (5). Severe tics, self-injurious behaviors (SIBs), co-morbid ADHD and OCBs were refractory to usual treatments. He is now a full-time college student. His major limitation from TS is fear of driving due to tics.	5
Patient 2	35yrs Male	This patient's history and response to stimulation after 6 months has been previously described (6). Severe, constant motor and vocal tics, SIBs, OCBs and ADHD were refractory to numerous medications but improved after bilateral GPi DBS. He is married with children and drives without interference. His major limitations from TS are poor self-esteem and a failed attempt at employment.	4
Patient 3	35yrs Male	Severe tics and SIBs, ADHD, and OCBs were limiting this patient professionally and socially. Bilateral GPi DBS was performed after his symptoms became refractory to usual agents. Persistent OCBs after 1 year required cognitive-behavioral therapy. His major limitation from TS is pain related to tics.	2

Table 2: Mean Stimulation Parameters

	# visits per year (total)	Amp (V)	Pulse Width (usec)	Freq (Hz)
Patient 1	9 (45)	4.78	172.44	148.56
Patient 2	8.5 (34)	4.83	207.35	173.97
Patient 3	8.5 (17)	4.99	231.18	184.12

Patient 1 required double monopolar settings four months after 2nd exchange
Patient 2's settings markedly reduced after 3rd IPG exchange to preserve battery

Table 3: Time (months) to IPG exchange (bilateral Soletra IPGs)

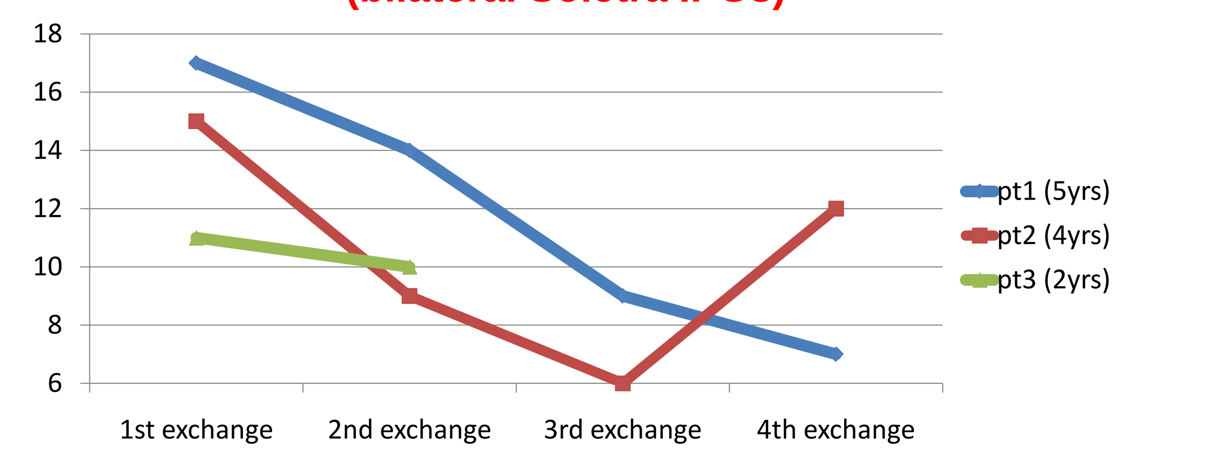


Table 4: Stimulation side effects

Side effect	Adjustment required
Speech: dysarthria, word-blocking	Reduce pulse width or frequency
Dystonia: face, throat, limb	Reduce pulse width or amplitude
Contralalateral bradykinesia	Reduce frequency

Table 5: Yale Global Tic Severity Scale

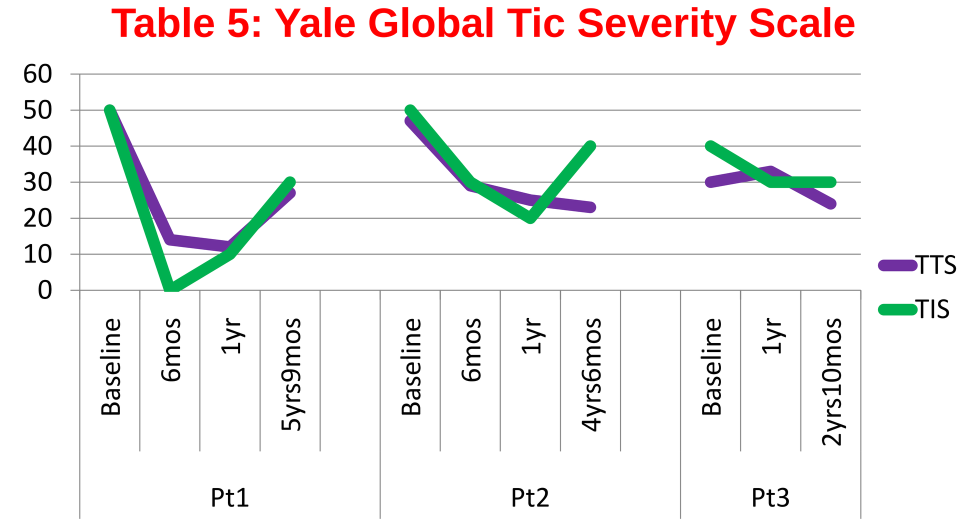
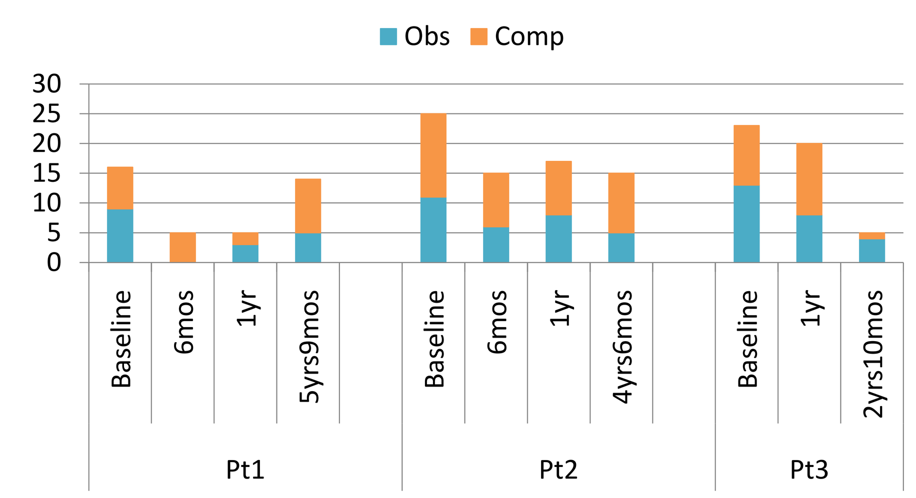


Table 4: Reasons for tic exacerbations

	Pt1	Pt2	Pt3
Stress (eg school or work events/responsibilities)	X	X	
Reduction in parameters due to side effects	X	X	X
Exacerbation of pain (non-TS)			X
Inadvertent stimulator inactivation	X	X	X
IPG end of life (prior to exchange)	X	X	X

Table 6: Yale-Brown Obsessive Compulsive Scale*



*Pt 3 required CBT for OCD after year 1

DISCUSSION

When GPi DBS is used to treat medically refractory TS, high stimulation parameters are required, similar to patients with dystonia

- Side effects of stimulation may occur, including speech problems, dystonia, and bradykinesia, but resolve with adjustment.
- Battery depletion commonly resulted in symptom exacerbation. Following IPG exchange, transient reduction with gradual re-titration of settings was frequently required
- The frequent need for IPG exchange led to placement of rechargeable batteries in all 3 subjects

Stimulator settings were influenced by:

- Need for symptom control
- Side effects of stimulation
- Need for IPG exchange

TS symptoms remain improved over time, though waxing and waning still occurs

- In all subjects, fluctuations were now also related to device-related issues in addition to external factors.
- In 2 subjects, fluctuations in tic impairment scores were related to current social situation and responsibilities (e.g., desire to work, desire to drive).
- Non-DBS therapy (e.g., cognitive behavior therapy) should still be considered in case of insufficiently controlled symptoms.
- Despite periods of worsening symptoms, all subjects maintain that quality of life was substantially improved.

CONCLUSIONS

Treatment of medically refractory TS with bilateral GPi DBS is a dynamic process. Both tics and OCBs can improve but continue to fluctuate.

TS patients treated with GPi DBS require high settings and frequent battery exchanges, similar to those with dystonia. Rechargeable IPGs from the outset may be preferable.

Any side effects of stimulation resolved with further programming and did not compromise overall tic control.

Despite programming challenges and symptom fluctuations, overall benefit can be maintained for over 5 years.

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