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Battery Life Matters in Deep Brain Stimulation

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Recently, we were surprised by a patient with Parkinson disease (PD) whose battery for bilateral subthalamic nucleus deep brain stimulation (DBS) ran out much earlier than we expected. This 56-year-old patient with 9 years of PD underwent bilateral micro-electrode-guided placement of a DBS electrode (model 3387; Medtronic Inc., Minneapolis, MN, USA) into the subthalamic nucleus with a bilateral Soletra™ implantable pulse generator (IPG; model 7460; Medtronic Inc.) in 2006 with excellent results. During the regular follow-up at 84.3 months after implantation, the voltage was noted to be 3.55 V in the left IPG and 3.58 V in the right IPG. The manufacturer recommends replacing Soletra™ at voltages lower than 3.64 V. Thus, both IPGs were replaced with Activa™ SC (model 37602; Medtronic Inc.) in 2013, and the stimulation setting was kept the same with his condition unchanged. However, during the periodic follow-up exam at 46.3 months after the battery replacement, the source battery voltage was noted to be 2.64 V in the left IPG and 2.57 V in the right IPG; thus, an emergency replacement was carried out.

After a couple more similar surprises, we conducted a survey of all patients who had undergone IPG changes. Our data suggest that the actual longevity of Activa™ SC is much shorter than that of Soletra™.

We were using Soletra™ until October 2012, and changed to Activa™ SC in November 2012. After excluding IPGs that were removed due to problems other than a low battery, such as infection, the number of IPGs used from June 2004 to June 2017 for patients with a movement disorder for which we could measure longevity was 318 for Soletra™ and 21 for Activa™ SC. The mean longevity of Soletra™ was 68.8 months, while that of Activa™ SC was only 37.7 months. This shorter duration was seen in PD (68.3 vs. 44.1 months), dystonia (58.4 vs 36.4 months), and essential tremor (79.9 vs. 32.7 months; Table 1). This decreased battery life was not explained by the differences in accuracy of the implanted electrodes or by the individual variations in the following data. There were 3 patients with PD who initially had Soletra™ implanted and then later had Activa™ SC: Soletra™ lasted 66.9 months and Activa™ SC lasted 42.5 months. There were 4 patients with dystonia who initially had Soletra™ implanted and then changed to Activa™ SC, and the battery was replaced after 48.4 and 33.5 months, respectively. There was 1 patient with essential tremor for which Soletra™ was changed to Activa™ SC, and the battery was replaced after 53.6 and 32.7 months, respectively. This decreased longevity of Activa™ SC compared with Soletra™ within a subject was also reported in an abstract by Hargreaves [1], and thus appears to be systemic.

This significantly shorter battery life is a big concern, which leads to more frequent surgeries for patients with DBS implantation, increasing the patient's medical costs and the risk of compli-

Table 1. Comparison of battery duration between Soletra™ and Activa™ SC

	Soletra™				Activa™ SC			
	PD (n = 255)	dystonia (n = 50)	ET (n = 13)	mean	PD (n = 8)	dystonia (n = 12)	ET (n = 1)	mean
Mean duration, days	2,077	1,776	2,429	2,094	1,340	1,107	994	1,147
Mean duration, years	5.7	4.9	6.7	5.7	3.7	3.0	2.7	3.1
Max. duration, days	3,543	2,695	3,676	3,305	1,485	1,473	994	1,317
Min. duration, days	1,099	779	1,096	991	1,094	558	994	882

n is the number of IPGs. PD, Parkinson disease; ET, essential tremor.

cations from surgery. The IPG duration may vary depending on the setting environment [2, 3]. However, we suspect that this shorter battery life is real, and we may need to inform patients before performing surgery and be prepared for earlier replacement of the battery than was previously expected. Close monitoring of the battery life in real environments rather than the stated battery life on the manufacturer's instructions will be important in future.

References

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