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Deep brain stimulation in routine clinical practice: monocentric study of the battery lifetime of different generations of neurostimulators

Authors:

Emmanuel De Schlichting (1,S), Ana-Raquel Marques (2), Aurélien Mulliez (3), François Gampourou (2), Philippe Derost (2), Bérangère Debilly (2), Jérôme Coste (4), Guillaume Coll (4), Franck Durif (2), Jean-Jacques Lemaire (4)

1. Service de neurochirurgie, University Hospital, Clermont-Ferrand, FRANCE
 2. Service de neurologie, University Hospital, Clermont-Ferrand, FRANCE
 3. Délégation à la recherche clinique et à l'innovation, University Hospital, Clermont-Ferrand, FRANCE
 4. Service de neurochirurgie, University Hospital, Université Clermont Auvergne, CNRS, Sigma, Institut Pascal, UMR 6602, Clermont-Ferrand, FRANCE
- S. Speaker

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Abstract:

Routine clinical practice of Deep Brain Stimulation (DBS) enters a new era where battery-related events are challenging. The important number of primary implantations and replacements pushed industrials to develop new generations of devices. We aimed to analyze the battery lifetime of different kinds of non-rechargeable devices, manufactured by a single company (Medtronic, USA): the first generation of 4-contact neurostimulator for one DBS-lead (1 channel; Soletra®) and 8-contact neurostimulator for two DBS-leads (two channels of 4 contacts; Kinetra®); the second generation of advanced programming neurostimulator (Activa® PC, two channels of 8 contacts, and SC, 1 channel of 8 contacts).

We retrospectively reviewed 281 consecutive patients operated on in a single institution (from 1995 to 2016): 584 surgeries for primary implantation or replacement of neurostimulator (infection and traumatic etiologies of battery replacement were excluded). The battery lifetime was defined as the period between the surgical implantation and the removal at battery depletion. Two hundred and eighty eight battery-lifetimes were analyzed in 157 patients suffering of Parkinson disease (n=129), essential tremor (n=19), dystonia (n=9). Exclusion criteria were: battery related, still operational (n=217); patient related, died before battery depletion (n=50); missing follow-up (n=3); and other diseases treated by DBS (n=2). Battery lifetime was analyzed using survival methods (univariate, Log-Rank test; multivariate, marginal cox model; two-sided tests) accounting for the following parameters: gender, neurological disease, age at the primary implantation, the UPDRS-score before DBS surgery, the deep brain target, battery model, mean voltage (low < 2V; usual from 2V to 4V; high > 4V), location of battery (abdominal or sub clavicular) and presence of an adapter for replacement of first generation (Kinetra or Soletra) by second generation model (Activa). Results: The battery lifetime was shorter in male (p=0.03) and young (p<0.001) patients suffering of essential tremor (p<0.001) and dystonia (p<0.001). High voltage reduced battery lifetime (p<0.001). The second generation device, Activa models, had shorter lifetime than first generation, Soletra and Kinetra (p<0.001). Replacement of battery decreased lifetime independently of models (p<0.001).

Patient and disease characteristics, high voltage, second generation devices and replacement seem to shorten lifetime of battery.