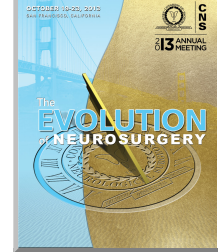


Evaluation of the Efficacy of Constant Current or Constant Voltage Deep Brain Stimulation: A Lab Based Study

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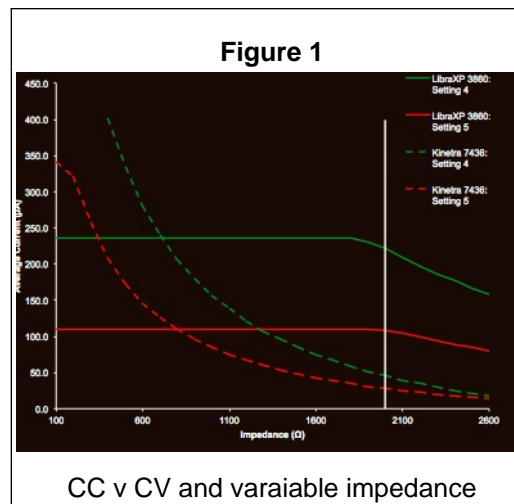


Introduction

Deep brain stimulation (DBS) has been used to treat movement disorders, drug resistant epilepsy, chronic pain and treatment resistant psychiatric disorders for over three decades. However, its exact mechanism of action is largely unknown or poorly understood with much debate recently about whether constant current or constant voltage imparts therapeutic effects. This study was carried out in the laboratory to compare head-to-head performances of voltage based and current based DBS-devices.

Methods

We studied two different primary cell dual channel implantable pulse generators (IPGs): the first was voltage based and the second was current based IPG. Each IPG was connected in a series circuit of standard lead-extender, standard DBS-lead, variable resistance box (representing impedance) and multimeter to measure the electric output in μAm . The IPG case was set as an anode and the DBS contact as a cathode. The output of each IPG was measured against a range of impedance from 100 to 26000. The following IPG settings were tested: 1- amplitude (A) 2.5, pulse width (PW) 90 μS , and rate (R) 130 Hz, 2- A=3.5, PW=210 & R=130, A=5.5, PW=210 & R=130, 3- A=5.5, PW=210 & R=130, 4- A=5.5, PW=450 & R=130 and 5- A=5.5, PW=450 & R=60.



Results

Voltage based IPG output in μAm was inversely related to impedance as per Ohm's law e.g. at setting number 2, the output was 298.4 μAm at 1000 and at 20000 the output fell to 3.1 μAm . While the current based IPG output remained at constant level till 18000 where the output fell sharply to zero (Figures 1).

Conclusions

Constant current IPGs provided constant output at impedance of up to 18000 while constant voltage IPGs provided inverse output in relation to impedance. If the mechanism of action of DBS is dependent upon the current output then constant current IPGs should provide more reliable steady therapeutic effect with reduced requirement for reprogramming and adjustments of settings over time as the impedance varies over time.

Learning Objectives

The delegate will learn about the role of DBS in movement disorders and the difference between current, voltage and impedance. How these parameters affect the therapeutic effects