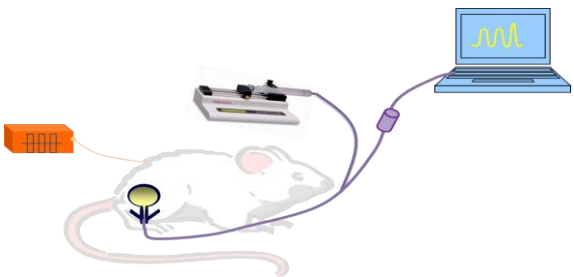
Evaluation Of Pulse Width Of Spinal Nerve Stimulation In A Rat Model Of Bladder Micturition Reflex

Xin Su, Heather Simenson, David Dinsmoor, Heather Orser
Restorative Therapies Group, Research & Core Technology
7000 Central Avenue NE, Minneapolis, MN USA

Hypothesis / aims of study: The optimal stimulation frequency and intensity of neuromodulation have been identified for spinal nerve stimulation (SNS) induced inhibition of the bladder rhythmic contraction (BRC) in the rat under isovolumetric conditions. In this study, the SNS evoked motor threshold (T_{mot}) response across different pulse widths (PWs) was first explored. A subset of selected stimulation PWs at T_{mot} intensity were then further tested on the BRC.

Study design, materials and methods: Wire electrodes were placed bilaterally under each of the L6 spinal nerves in anesthetized female rats (urethane, i.p. 1.2g/kg). A cannula was placed into the bladder via the urethra. Saline infusion was used to induce BRC. The T_{mot} was plotted against PW to elucidate the effect of PW on motor function. For effect of PW on BRC, 10 Hz, T_{mot} intensities of nerve stimulation was applied for 10 min at a given PW.



Results:

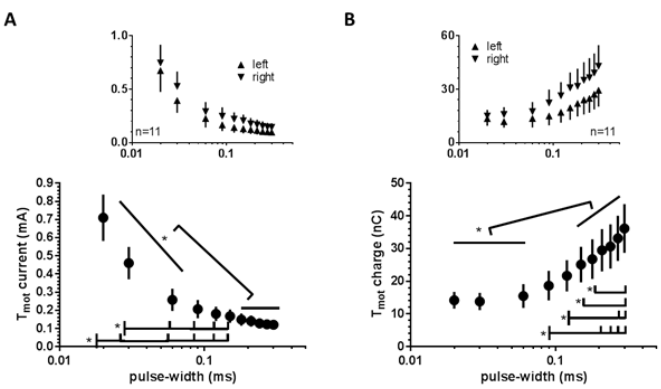


Figure 1. Summary data of visual motor threshold (T_{mot}) responses to graded pulse width of bilateral spinal nerve stimulation. A. Stimulation current intensity at T_{mot} (mA). B. Stimulation charges at the T_{mot} (current*pulse-width, nC). Inset illustrates the T_{mot} on the two sides of the spinal nerve which are independently expressed. * p<0.05, ANOVA Bonferroni post test.

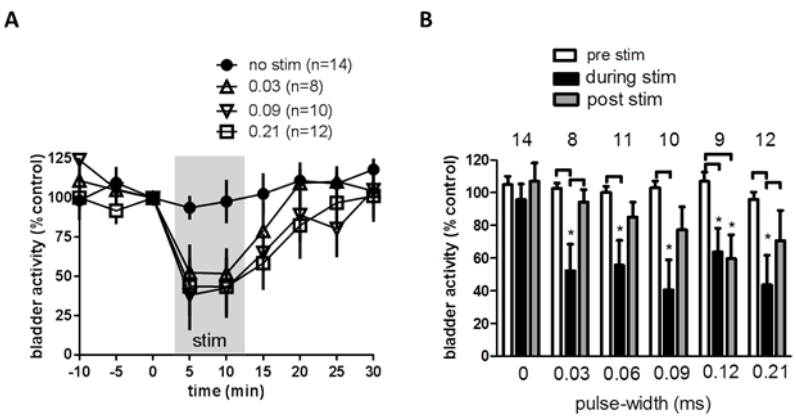


Figure 2: Effects of spinal nerve stimulation at different pulse widths (motor threshold, 10 Hz) on the frequency of the bladder reflex contraction. A. Time course response of frequency of the bladder reflex contraction to spinal nerve stimulation at pulse widths of 0.03 ms, 0.09 ms and 0.21 ms. The shaded areas is during 10 min stimulation (stim). B. Mean responses of 10 min contraction frequency under three conditions before (pre stim), during and post stimulation. The significance of differences was demonstrated by Student's t test. * p<0.05. The trial numbers are indicated over each bar set.

Concluding message: We have reported the chronaxie (0.042 ms) of SNS evoked motor response and demonstrated effective BRC inhibitory effects between short and long PWs of SNS in a preclinical model. Potential battery savings manifested by shorter pulse-width while maintaining equivalent efficacy would provide more efficient therapy delivery and increased longevity of the stimulator.

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