Mechanism of Dorsal Root Ganglion Stimulation for Pain Relief is not dependent on GABA Release in the Dorsal Horn of the Spinal Cord: a Quantitative Immunohistochemical Study

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Objective

It is hypothesized that dorsal root ganglion stimulation (DRGS), sharing some of the mechanisms of traditional spinal cord stimulation (SCS) of the dorsal columns, induces γ-aminobutyric acid (GABA)-release from interneurons in the spinal dorsal horn.

Methods

We used quantitative immunohistochemical analysis in order to investigate the effect of DRGS on intensity of intracellular GABA-staining levels in the L4-L6 spinal dorsal horn of painful diabetic polyneuropathy (PDPN) animals. To establish the maximal pain relieving effect, we tested for mechanical hypersensitivity to von Frey filaments and animals received 30 minutes of DRGS at day 3 after implantation of the electrode. One day later, 4 Sham-DRGS animals and 4 responders-to-DRGS received again 30 minutes of DRGS and were perfused at the peak of DRGS-induced pain relief.

Results

No significant difference in GABA-IR was observed between DRGS and Sham-DRGS in lamina 1-3 of the spinal levels L4-6 neither ipsilaterally, nor contralaterally.

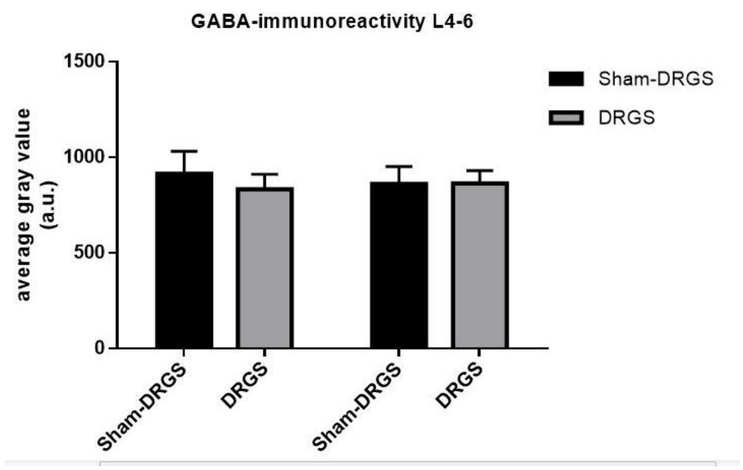

Figure 1. Average gray values of both the ipsilateral and contralateral dorsal horn in lamina 1-3 of spinal level L4-L6. Data are expressed as means ± SEM. GABA, γ-aminobutyric acid; DRGS, Dorsal Root Ganglion Stimulation; DH, Dorsal Horn.

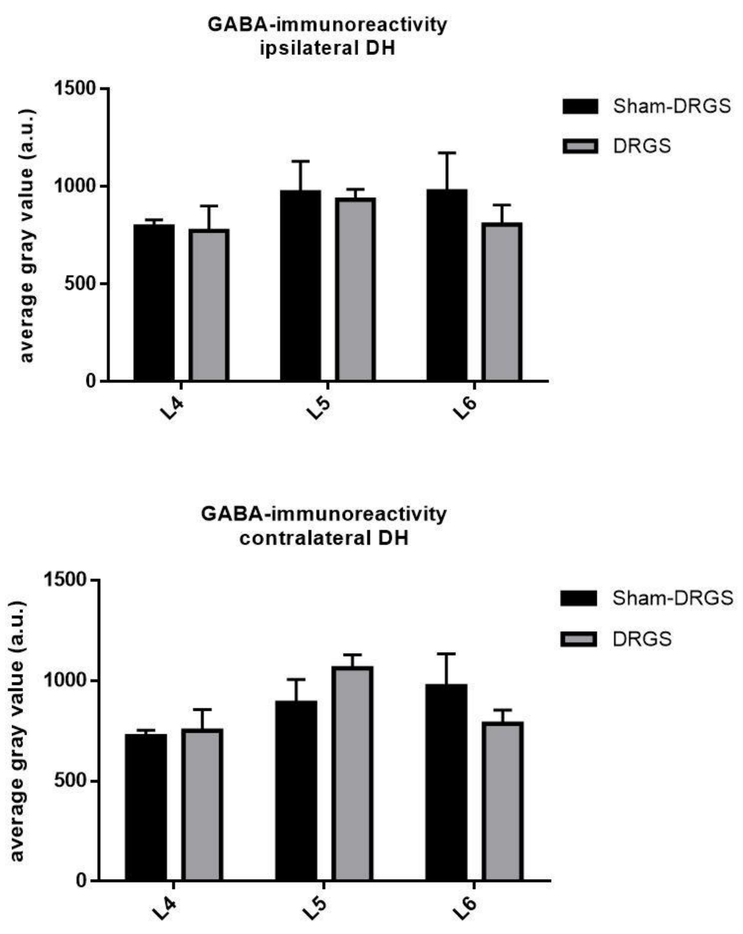

Figure 2. Average gray values of the ipsilateral dorsal horn in lamina 1-3 per spinal level (L4, L5 and L6). Data are expressed as means ± SEM. GABA, γ-aminobutyric acid; DH, Dorsal Horn; DRGS, Dorsal Root Ganglion Stimulation.

Figure 3. Average gray values of the contralateral dorsal horn in lamina 1-3 per spinal level (L4, L5 and L6). Data are expressed as means ± SEM. GABA, γ-aminobutyric acid; DH, Dorsal Horn; DRGS, Dorsal Root Ganglion Stimulation.

Conclusions

DRGS does not induce GABA release from the spinal dorsal horn cells, suggesting that the mechanisms underlying DRGS in pain relief are different from those of conventional SCS. The modulation of a GABA mediated “Gate Control” in the DRG itself, functioning as a prime Gate of nociception, is suggested and discussed.