Altered eating behavior by subdiaphragmatic truncal vagus nerve stimulation in rats

Helene Johannessen[1], David Revesz[2], Yosuke Kodama[1], Chun-Mei Zhao[1], Gjermund Johnsen[3], Ronald Mårvik[3], Bård Kulseng[1,3], Georg Kuhn[2], Thorleif Thorlin[2], Elinor Ben-Menachem[2], Duan Chen[1]

[1]Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology; Trondheim, Norway; [2]Institute of Neuroscience and Physiology, Department of Clinical Neuroscience and Rehabilitation, University of Gothenburg, Gothenburg, Sweden; [3]Department of Surgery, St. Olav's Hospital, Trondheim University Hospital, Trondheim, Norway.

Background/aim: The brain-gut axis has been considered as an autonomic neurohumoral pathway regulating eating behavior, intestinal motility and energy homeostasis. Eating disorders, irritable bowel syndrome (IBS) and obesity could be resulted from dysautonomia. The aim of the present study was to establish an animal model of subdiaphragmatic truncal vagus nerve stimulation (stVNS) in order to control eating behavior.

Methods: Male Sprague-Dawley adult rats and the standard maintenance rat diet were used. Electrodes were surgically attached to both anterior and posterior subdiaphragmatic vagal trunks through an abdominal midline incision. The electrodes were connected by a lead wire to a pulse generator that was implanted subcutaneously on the back. The pulse generator was operated by an external wireless controller that can be programmed individually and manually. Measurements of eating behavior, food intake and metabolic parameters were carried out for 48 hours by the comprehensive laboratory animal monitoring system (CLAMS). The high resolution CLAMS data were generated by monitoring all parameters every five minutes, and the data from the last 24 hours were used for the statistical analysis.

Results: In response to short-term stVNS at 0.5 mA, 30 Hz, 500 µ seconds pulse width, cycle of ON 30 seconds/OFF 5 minutes for 24 hours, number of meals and meal size (expressed as grams/meal) were reduced, while meal duration (minutes/meal) and intermeal interval (minutes) were increased during both daytime and nighttime. Food intake (grams/100 grams body weight) was reduced during both daytime and nighttime. In response to long-term stVNS over a time period of 5-10 weeks, starting at 0.5 mA and increasing to 1.0 and 2.0 mA with 30 Hz, 500 µ seconds pulse width, cycle of ON 30 seconds/OFF 5 minutes for 24 hours, satiety ratio (intermeal interval minutes/gram meal size) was increased, while food intake was reduced during nighttime but not daytime in comparison with sham-operated and age-matched controls. Sleep percentage, water intake, urine production, and energy expenditure (kcal/hour/100 grams body weight) were unchanged in response to either short- or long-term stVNS. Respiratory exchange ratio (VCO_2/VO_2) was unchanged in response to short-term stVNS, but reduced to long-term stVNS during both daytime and nighttime; the values remaining above 1.0.

Conclusions: The eating behavior could be altered in either short- or long-term by stVNS. This rat model of stVNS might be useful to explore how to control the eating behavior, and hopefully lead to the development of a new, reversible minimal invasive therapy for eating disorders, IBS and obesity.

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