Alteration of pain processing by transcutaneous vagus nerve stimulation

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Introduction

Stimulation of vagus nerve afferents has been shown to modulate nociception and pain processing in animal and human experimental studies (1, 2). Due to the invasive procedure of vagus nerve stimulation, studies have been limited to patients mainly suffering from both drug-resistant epilepsy and pain (2). Recently, a medical device has been developed that allows for transcutaneous electrical stimulation of the auricular branch of the vagus nerve (t-VNS). The present study addressed the hypothesis that t-VNS alters pain processing.

Materials and Methods

In this randomized, controlled study somatosensory processing was assessed by the quantitative sensory testing (QST) protocol with mechanical and thermal stimulation in 48 healthy volunteers (24 female, 24 male, 23.3±2.1 years). Each volunteer participated in two experimental sessions with or without (control) active t-VNS on different days in randomized order. In one session QST was performed before and during t-VNS on both hands. After baseline QST (approx. 45 min), t-VNS at the left ear was started with a non-painful stimulus intensity using rectangular pulses (250 µs, 25 Hz; 70 min).

Results

A repeated measures ANOVA showed significant interactions between stimulation and side for the parameters mechanical pain sensitivity (MPS) and pressure pain threshold (PPT). MPS of the left hand was lower under t-VNS as compared to control and the right side ($p<0.05$). PPT was higher under t-VNS as compared to control and the right side ($p<0.05$). Sustained application of painful heat for 5 min induced increased perception ratings under baseline conditions. Under t-VNS pain rating increase was significantly reduced as compared to control ($p<0.001$). All other QST parameters remained statistically unchanged.

Conclusion

The results indicate reduced sensitivity to mechanically evoked pain on the ipsilateral hand. Besides flattening of the stimulus-response function for superficial mechanical pain (MPS), increased PPT reveals suppression of deep muscle pain under t-VNS. Furthermore, temporal summation of noxious heat seems to be inhibited with t-VNS. This study shows alteration of mechanical and thermal pain processing in healthy volunteers. Future studies in chronic pain patients will address the potential analgesic effects of t-VNS.

References

(1) Randich and Gebhart, Brain Research Reviews 17: 77-99, 1992
(2) Kirchner et al., Neurology 55: 1167-71, 2000

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