

Effects of High Frequency Spinal Cord Stimulation (HF-SCS) Applied to the Ventral Surface of the Spinal Cord

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Introduction: HF-SCS applied to the ventral surface of the upper thoracic spinal cord (T2 level) results in physiologic activation of both the diaphragm and inspiratory intercostal muscles.

Objective: To evaluate the effects of HF-SCS (500Hz, 1mA) applied to the ventral surface of the entire thoracic spinal cord.

Material and Methods: In 4 anesthetized dogs, three eight plate stimulation leads, were inserted epidurally and positioned on the ventral surface of the spinal cord via laminectomies at the T6 and T10 levels. Changes in airway pressure (P) were assessed over different regions of the thoracic spinal cord following electrical stimulation (HF-SCS: 500 Hz, 1 mA, 0.2ms) at each electrode lead in separate trials, under conditions of airway occlusion and hyperventilation induced apnea.

Results: HF-SCS (500Hz, 1mA) resulted in negative P generation over the ventral surface of the entire thoracic spinal cord. Negative P generation was most pronounced at the T2 level (60±2 cmH₂O) and T9 levels (46±8 cmH₂O). Further examination of HF-SCS at the T9 level demonstrated that maximum negative P was dependent upon low stimulus currents (1-3 mA) and high stimulus frequencies (>300 Hz). Both the diaphragm and inspiratory intercostal muscles contributed to negative P generation.

Conclusions: The unique findings of the present investigation include the demonstration that spinal circuits which have connections to the inspiratory motoneuron pools exist over the ventral surface of the entire thoracic spinal cord. We postulate that responses are mediated, in part, by stimulation of the previously described intercostal to phrenic excitatory reflex. The large negative P generated at the T9 level suggests that HF-SCS in

this region of the spinal cord may be a useful method to restore breathing in ventilator dependent tetraplegics.

Keywords: High frequency stimulation, spinal cord, spinal circuits, motoneurons,

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