Effects of Transcutaneous Spinal Stimulation on Heart Rate Measures and Variance

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Abstract

Individuals with SCI, MS, and stroke face autonomic dysfunction regularly. Research on heart rate measures as a means for measuring autonomic function for these individuals while undergoing Transcutaneous Spinal Stimulation (TSS) has been limited. Therefore, establishing a baseline of data in healthy individuals is essential in determining consequences. To determine change in heart rate measures and heart rate variance (HRV), healthy individuals were recorded with a Pulse Transducer during rest and during TSS at T12-L1 for 3 minutes each. Beats, RR Intervals, Missed Beats, and Rhythms were measured. Overall, exposure to TSS results in increased missed rhythms compared to at rest. Beats decreased and RR intervals increased; an inverse relationship suggesting activation of the parasympathetic system via vagus. We suggest the use of the T34 Polar Strip in further studies focusing on HRV Functional Domain to elucidate autonomic processes with spinal stimulation.

Introduction

Individuals with SCI, MS, and Stroke face autonomic dysfunction regularly. Heart Rate Variance is the fluctuation of instantaneous heart period over time, a correlate of cardiac autonomic regulation (Task Force 1996). Research on Heart Rate Variance (HRV) for persons with Spinal Cord Injuries (SCI), MS, and stroke undergoing Transcutaneous Spinal Cord Stimulation (TSS) at T12-L1 has been limited. The cardiac preganglionic sympathetic and parasympathetic systems control the heart rate and rhythm, exiting from T1-T4/C5 and CN X. After SCI, cardiac sympathetic preganglionic extend further than T4/T5 (Krassanikou 2002, Phillips 2018). Transcutaneous electrical stimulation at T7 resulted in increased contractility (Phillips 2018). Per participants, the feeling of SCI is felt and no doubt affecting the autonomic nervous system based on the individual (Okuyucu 2018). In an effort to build a baseline of data translated to SCI, Stroke, and MS population, HRV will be conducted on subjects without illness undergoing Epidural SCS at T12-L1. We hypothesized individuals will undergo heart rate change with stimulation.

Methods

7 Subjects - 3 one minute segments of rest - 3 one minute segments of 30 Hz stimulation with increasing intensity - 6 minutes of HR Data per Subject

Pulse Transducer (7TV0125T)

- Missed Beats
- Missed Rhythms
- Multiple 1 Minute Segments

Significantly Increased Missed Rhythm Occurs with Epidermal SCS

- Missed Beats:

- Missed Rhythms:

Beats and RR Interval are Increased with SCS

A Better Method of Heart Rate Variance is Essential

- Multiple 1 Minute Segments

- Clarity of Signal

- New Technique

Wireless Heart Rate Kit

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Summary

In all, comparisons of Heart Rate Data during Rest and during TSS indicated involvement of the autonomic system. The number of missed beats was increased during TSS, although not significantly, whereas the missed rhythms was significantly increased from 0.5 to 3.7. The number of beats in a minute were decreased from 76.1 to 72.2 with increased RR Interval from 784 to 828 ms, indicating involvement and activation of parasympathetic system. These findings suggest a deeper involvement of TSS with spinal networks at the T12-L1 level.

An approach with Polar Wireless HR Monitor is indicated for consistent Functional Domain values to understand Autonomic function with TSS. Eventually, baseline data will be compiled and translated to SCI, Stroke, and MS population.

Conclusions

- With stim, missed rhythm/missed beats significantly increases compared to rest.
- With stim, average beat and RR interval undergo parasympathetic action
- Future
  - Pulse Transducer was unable to provide with consistent Functional Domain Data ➔ Polar T31
  - Varying term stimulation to determine Sympathetic action
  - Spinal device for autonomic spinal therapies for hypertension, arrhythmias (invoking paeakers), people with MS, SCI, Stroke with autonomic dysfunction.

References

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