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CARDIORESPIRATORY EFFECTS OF COMBINING TRANSCUTANEOUS SPINAL STIMULATION AND ROBOT ASSISTED WALKING: A CASE STUDY.

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Introduction

Previous research has demonstrated that spinal control of locomotor patterns can be up-regulated by assisted walking or spinal stimulation. However it remains to be elucidated if a combined approach may enhance function in spinal cord injured individuals. The current case study examined the effect of combining transcutaneous spinal stimulation with robot assisted walking on cardiorespiratory measures of exercise performance in a spinal cord injured individual.

Methods

The participant (39 year old male; height 1.81m, mass 84kg) with spinal cord lesions at T9 and L1 vertebral levels, had been assessed clinically as motor and sensory complete (ASI A). Test sessions of 60 min robot assisted walking were performed on three consecutive days using an exoskeleton (EKSO bionics). Each session included 4 by 15 min of walking with 5 min of seated recovery between exercise bouts. Electrical current was delivered transcutaneously to the spinal cord at the level of T10 (30Hz) and C01 (5Hz) during 2 of the 15 min exercise bouts in each session. This resulted in the completion of 12 by 15 min exercise bouts (6 with and 6 without stimulation). Cardiorespiratory data were collected via a portable metabolic analyser (Cosmed K4b²); hip and knee motor torque data were collected from the exoskeleton throughout all sessions. Data averaged over 3 min increments within each 15 min exercise bout were statistically compared using a 2-factor repeated measures ANOVA (time by stimulation).

Results

Robot assisted walking resulted in a mean $\dot{V}O_2$ of $12.3 \pm 1.5 \text{ mL.kg}^{-1}.\text{min}^{-1}$. The addition of spinal stimulation to robot assisted walking resulted in a significant increase in $\dot{V}O_2$ ($14.7 \pm 1.5 \text{ mL.kg}^{-1}.\text{min}^{-1}$, $F=35.6$, $P<0.01$). Heart rate was also significantly greater with combined spinal stimulation and robot assisted walking (128 ± 10 vs. 107 ± 8 beats. min^{-1} , $F=32.2$, $P<0.01$). Both $\dot{V}O_2$ and heart rate significantly increased during the course of the 15 min exercise bout ($F=5.8$, $P<0.01$; $F=11.6$, $P<0.001$, for $\dot{V}O_2$ and heart rate, respectively). Knee torque data were consistently lower throughout the 15 min exercise bouts with stimulation, however this result was not statistically significant. Both left and right knee torque data significantly increased throughout the 15 min exercise bouts ($F=3.2$; $P<0.01$ for left; $F=3.1$ $P<0.05$ for right).

Discussion

The addition of transcutaneous spinal stimulation significantly increased metabolic and cardiovascular cost associated with robot assisted walking in a paraplegic individual. No significant differences in hip or knee joint torque data were observed. Further research is therefore required in order to establish what is causing the increased energy cost and whether this effect is consistent across a group of spinal cord injured individuals.

Topic: Adapted Physical Activity

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