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Impact of long-term epidural electrical stimulation enabled task-specific training on secondary conditions of chronic paraplegia in two humans

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Abstract

© 2020, © The Academy of Spinal Cord Injury Professionals, Inc. 2020. Introduction: Spinal cord injury (SCI) often results in chronic secondary health conditions related to autonomic and metabolic dysfunction. Epidural electrical stimulation (EES) combined with task-specific training has been shown to enable motor function in individuals with chronic paralysis. The reported effects of EES on secondary health conditions, such as bladder function and body composition, are limited. We report the impact of EES on SCI-related secondary health changes in bladder function and body composition. Methods: Two participants with motor and sensory complete SCI performed 6 months of rehabilitation without EES followed by 12 months of task-specific training with EES after implantation of a 16-electrode array on the surface of the lumbosacral spinal cord. Participants performed three days of training per week in the laboratory, and additionally performed task-specific activities with EES at home during this time frame. Changes in bladder and body composition were recorded via clinically-available testing of neurogenic bladder functionality and dual-energy X-ray absorptiometry, respectively. Results: In one participant, we observed an increase in episodes of urinary incontinence with worsening bladder compliance and pressures at the end of the study. Bone mineral density changes were insignificant in both participants; however, one participant showed a substantial increase in lean mass (+9.1 kg; 6 months of training) via redistribution of body fat through an android/gynoid ratio reduction (−0.15; 6 months of training). Conclusion: EES optimized for standing and stepping may negatively impact neurogenic bladder functionality. Close monitoring of bladder health is imperative to prevent undesirable bladder compliance, which can lead to upper urinary tract deteriorations. Conversely, EES may serve as an adjunct tool with regular exercise modalities to improve body composition through activation of musculature innervated by spinal segments that are below the SCI.

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Keywords

Chronic paraplegia, Epidural stimulation, Neuromodulation, Neurorehabilitation, Spinal cord injury

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