

METABOLIC AND PERFORMANCE EVENTS FOLLOWING EPIDURAL SPINAL CORD STIMULATION (ESCS) IN SUBJECTS WITH SPINAL CORD INJURY

Herman R^{1,2,3}, Willis W³, He J², Carharts M²

Banner Good Samaritan Medical Center, Phoenix, AZ, USA (1)

Harrington Dept. of Bioengineering and Arizona BioDesign Institute, Arizona State Univ.,
Tempe, USA (2)

Department of Kinesiology, Arizona State University, Tempe, USA (3)

We have observed that two incomplete, wheelchair-dependent, Spinal Cord Injury (SCI) subjects (“low ASIA C”) trained to elicit rhythmic locomotor patterns following 4 months of Partial Weight Bearing Therapy did not exhibit corresponding changes in preferred rates of walking, endurance and perceived sense of effort (PE) during overground walking.

Hence, a trial of ESCS was conducted. Overground walking was examined: (1) under 2 conditions in one tetraplegic subject (C5,C6), i.e., with (suprasensory, submotor) and without ESCS; and (2) under 4 conditions in one paraplegic subject (T8), i.e. with no stimulation, with FES of the common peroneal nerve to elicit a phase-dependent reflex activity, with ESCS at suprasensory and motor threshold levels with/without FES.

When the ESCS system was implanted to excite upper lumbar neural segments, there was a strikingly rapid switch in locomotion behavior in that endurance and preferred rates of walking increased by 3-fold and sense of effort for a given distance decreased by roughly the same magnitude. ESCS more than FES improved locomotion performance with respect to preferred rates of walking (increasing in order of conditions in the second subject), endurance, PE, and reliance on a walker but improvement in ESCS-related movement kinematics was much less significant. Indirect calorimetry revealed that the enhanced physical performance and attenuation of PE was associated with only a modest reduction in O₂ cost of transport; in contrast, ESCS promoted a profound switch in fuel selection by active muscle, increasing the apparent fat oxidation rate by ~ 8-fold.

We posit that the change in fuel selection accounts for the observations of “sense of lightness” of the limbs and reduced PE among MS patients treated with ESCS (Cook and Weinstein, 1973) and for the recovery of functional locomotion at home and community. Recruitment of an oxidative motor unit pool may be a mechanism.

Author’s Address

Richard M Herman, Research Director
Banner Good Samaritan Medical Center
1111 E. McDowell Rd
85006 Phoenix Arizona US

e-mail: richard.herman@bannerhealth.com