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Abstracts

pp 149

Mitochondrial density and distribution by histochemical approaches distinguish muscle fiber types and support clinical improvements due to FES as a treatment of equine epaxial muscle spasms

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Functional Electrical Stimulation (FES) has been used extensively over several decades to reverse muscle atrophy during rehabilitation for spinal cord injury patients.[1-3] The benefits of the technology are being expanded into other areas, and FES has been recently utilized for injury rehabilitation and performance enhancement in horses.[4] FES can obtain precise, controlled functional movement and therefore can be used to initiate conservative movement early in the rehabilitation plan, as well as obtain more aggressive movement during the later stages of healing. Six retired horses, that had been previously used mainly for dressage riding, were selected for this study. The horses ranged in age from 10 to 17 yr and had all been clinically evaluated by veterinarians for axial musculoskeletal skeletal pathologies and none had been noted. Clinical evaluation found epaxial muscle spasms in all horses with minimal to no pelvic extension when manually palpated. FES treatments were performed on the sacral/lumbar region 3 times per week for a period of 8 weeks. The Modified Ashworth Scale for grading muscle spasms found a one grade improvement after approximately 4 FES treatments, indicating improved functional movement of the sacral/lumbar region, supporting the evidence by clinical palpations that a reduction in epaxial muscle spasms occurred. Skeletal muscle biopsies Pre and Post FES treatments were obtained from the *longissimus lumborum* muscle at a depth of 3 cm on the same side of each horse. Cryosections were stained with a Hemotoxylin- Eosin (H-E), and nicotinamide adenine dinucleotide tetrazolium reductase reaction (NADH-TR). The eventual size change of the muscle fibers due to FES or co-morbidities were evaluated by morphometry in H-E and NADH-TR stained cryosections, while in the NADH-TR slides the density and distribution of mitochondria were also determined.[5] Main results of the morphometric analyses were: 1) As expected for the type of FES treatment used in this study, only a couple of horses showed significant increases in mean muscle fiber size when Pre- vs Post-FES biopsies were compared; 2) In the older horses, there were sparse (or several in one horse) severely atrophic and angulated muscle fibers in both Pre- and Post-FES samples, whose distribution suggests they were denervated due to a distal neuropathy; 3) The hypothesis of generalized FES- induced muscle fiber damage during epaxial muscle training is not supported by our data since: 3.1) Denervated muscle fibers were present in the Pre-FES biopsies and 3.2) Only one horse (age 15 yr) presented with high numbers of long- term denervated muscles fibers Post-FES; 4) Preliminary data indicate that the increased density and distribution of mitochondria in Post-FES biopsies suggests that the clinical improvements in the treated horses may be related to the increased muscle contractions, therefore improving muscle perfusion which is induced by FES training. In conclusion, FES in horses is a safe treatment that provides clinical improvements in equine epaxial muscle spasms.

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1. Kapadia N, Masani K, Catharine Craven B, et al. A randomized trial of functional electrical stimulation for walking in incomplete spinal cord injury: Effects on walking competency. J Spinal Cord Med 2014;37:511-24. doi: 10.1179/2045772314Y.0000000263.
2. Kern H, Carraro U, Adami N, et al. Home-based functional electrical stimulation rescues permanently denervated muscles in paraplegic patients with complete lower motor neuron lesion. Neurorehabil Neural Repair. 2010;24:709-21. doi: 10.1177/1545968310366129. Epub 2010 May 11.
3. Kern H, Carraro U. Home-based Functional Electrical Stimulation (h-b FES) for long-term denervated human muscle: History, basics, results and perspectives of the Vienna Rehabilitation Strategy. Eur J Transl Myol/Basic Appl Myol 2014:24:27-40. DOI: 10.4081/bam.2014.1.27.
4. Schils SJ, Turner TA. Functional Electrical Stimulation for equine epaxial muscle spasms:retrospective study of 241 clinical cases. Comparative Exercise Physiology, 2014;10: 89-97.
5. Ravara B, Gobbo V, Carraro U, et al. Functional electrical stimulation as a safe and effective treatment for equine epaxial muscle spasms: Clinical evaluations and histochemical morphometry of mitochondria in muscle biopsies. Eur J Transl Myol 2015;25:109-20.