Continuing Study of Analgesia Resulting From Extracorporeal Shock Wave Therapy

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Extracorporeal shock wave therapy (ESWT) can be a valuable noninvasive mechanism to stimulate healing of some musculoskeletal injuries in horses. A major concern of ESWT in horses is the potential for analgesia after therapy. This paper includes two studies involving ESWT and analgesia: (1) the effect of ESWT on immunohistochemical staining of two neuropeptides, substance P and calcitonin gene-related peptide (CGRP) in skin and periosteum in a sheep model, and (2) a force plate analysis of analgesia in horses with unilateral forelimb lameness. We found that ESWT did not affect substance P and CGRP immunohistochemical staining of skin and periosteum. This indicates that they are not likely involved in the mechanism of analgesia. In the force plate analysis, we found that there is a 2-day period of analgesia in horses with naturally occurring forelimb lameness. At the very least, horses should not be allowed to compete for 2 days after ESWT. Authors’ addresses: Department of Veterinary Clinical Sciences (McClure, Dahlberg, Abed) and Department of Veterinary Diagnostic and Production Animal Medicine (Evans, Yaeger), College of Veterinary Medicine, Iowa State University, Ames, IA 50011; e-mail: mcclures@iastate.edu (McClure). © 2006 AAEP.

1. Introduction

The application of focused extracorporeal shock wave therapy (ESWT) for equine musculoskeletal diseases has been an area of research interest in recent years. One consideration that remains in addition to potential therapeutic value is the analgesic affect of ESWT.1 The horse is at risk of further injury if allowed to work without the perception of pain from an injury. The objectives of the two studies reported here were to evaluate the effect of ESWT and radial pressure wave therapy (RPWT) on staining of two neuropeptides (substance P [sP] and calcitonin gene-related peptide [CGRP]) in the skin and periosteum (mechanism of analgesia) and to determine the short-term effect of ESWT on lameness by force plate evaluation (duration of analgesia).

sP and CGRP are neuropeptides associated with nerve fibers responsible for perception of pain. In a previous study in rats, depletion of these neuropeptides was identified after ESWT of the paw.2 However, when concentrations of neuropeptides were measured in a sheep model, no treatment effect was found.1 The study reported here was performed because if the mechanism of analgesia can be identified, it may be possible to identify horses that have analgesia after ESWT.

In humans, there is a reported period of analgesia after ESWT.3 A number of anecdotal and published reports in the horse have had conflicting results as to the presence and duration of
analgesia. There has not been an objective measurement of lameness after ESWT to determine the amount and duration of analgesia after treatment.

The data from the study reported here are important in determining recommendations on when a horse could be returned to competition after treatment.

2. Study 1: Mechanism of Analgesia

Objective
The objective of this study was to evaluate the effect of focused ESWT and RPWT on the immunohistochemical staining for sP and CGRP of skin and periosteum in a sheep model.

Materials and Methods
All four limbs of 36 sheep were treated with ESWT, RPWT, or no treatment. Wool was clipped and shaved from a circular treatment area (3 cm in diameter) on the mid-dorsal portion of the third metacarpal and third metatarsal bones. Treatments were 1000 pulses at 0.15 mJ/mm² for ESWT, 1000 pulses at 0.16 mJ/mm² for RPWT, or an untreated control treatment. Two sheep were killed daily, and tissues were harvested for histologic evaluation of nerves staining for sP and CGRP in the skin and periosteum by immunohistochemistry. The persons evaluating the slides (JA, MY) were blinded as to the treatment and time of the sample until the completion of the evaluation. Three layers of the skin were evaluated separately. They consisted of (1) the superficial dermis—from the epidermis to the base of the hair follicles, (2) the deep dermis—from the base of the hair follicles to the subcutis, and (3) the subcutis—the transition from the dermal collagen to the subcutaneous adipose tissue. The large vessels at the dermal–subcutis junction were included in the subcutis category.

The number of sP and CGRP staining nerve fibers were counted in each layer of the skin across the center of the 6-mm biopsy sample at ×400 and totaled. Similarly in the periosteum, the number of sP and CGRP staining nerve fibers were counted across the 5-mm center of the biopsy sample at ×400.

Results
There was no effect of treatment for either RPWT or ESWT on the number of nerve fibers staining for sP or CGRP in the skin or periosteum.

Conclusion
Contrary to reports in laboratory animals that ESWT affected the small sP and CGRP staining nerve fibers, we were not able to identify these effects in a sheep model. The mechanism(s) of analgesia resulting from ESWT in the horse will require further study.

3. Study 2: Duration of Analgesia

Objective
The objective of this study was to evaluate the presence and duration of analgesia in unilateral forelimb lameness in horses after ESWT.

Materials and Methods
In this study, nine horses that had chronic unilateral lameness localized to the forelimb were used. To establish baseline, force plate data was obtained daily for each horse for 3 days (day –3 to –1) before ESWT. In addition, after the forceplate analysis on the first day (day –3), local anesthesia was used to alleviate the lameness and an additional forceplate analysis was completed to establish a “non-lame” measurement. On day 0, ESWT was done in the morning. The first post-treatment forceplate analysis was completed 7–8 h later. Forceplate analysis was repeated daily through day 7. Five valid trials for each forelimb were combined for the mean at each timepoint. The three baseline measurements were combined for a single average baseline value. p < 0.05 were considered significant.

Results
There was a significant difference between baseline peak vertical force (PVF) and PVF on days 0 (p = 0.003) and 2 (p = 0.0156). The PVF after local anesthesia was not significantly different (0.14) than the day 2 post-treatment PVF. Vertical impulse was significantly improved over baseline on day 0 (p = 0.0244) and day 2 (p = 0.232).

Conclusion
There was a significant analgesia after ESWT from 8 to 48 h after treatment. At 48 h after ESWT the PVF was not significantly different from the PVF measurements with local anesthesia in place. Horses should have limited exercise for a minimum of 2 days after shock wave therapy to avoid potential injury caused by a lack of pain perception.

References and Footnotes

*Equitron, Sanuwave Inc., Marietta, GA 30062.
**Swiss DolorClast Vet, Electro Medical Systems, Dallas, TX 75243.