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Original Research

Use of Infrared Thermography to Detect Intrasynovial Injections in Horses

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A B S T R A C T

Athletic horses often experience painful conditions of the musculoskeletal system, but their ability to compete can be prolonged using certain anesthetic agents. The present study investigated the ability of thermography to detect fetlock and middle carpal intrasynovial injections of bupivacaine hydrochloride in five mares. Saline injections were performed in the contralateral limbs. Thermographic evaluation was conducted at the dorsal and palmar aspects before (basal) and 15, 30, 60, 90, 120, and 1440 minutes after injection. The intrasynovial treatments resulted in increased limb temperature, with fetlock temperatures higher on the dorsal aspect at 15, 30, and 60 minutes and on the palmar aspect from 15 to 1440 minutes ($P < .05$) after the bupivacaine and saline injections. Increased carpal temperature was detected on the dorsal aspect at 60 and 90 minutes ($P < .05$). The present study demonstrates that thermography can be used to detect intrasynovial injections in horses.

1. Introduction

Sport horses are predisposed to a variety of orthopedic conditions that can cause lameness and poor performance, resulting in significant economic losses and immense frustration to the owners. Over the past few years, many drugs have been used to control musculoskeletal pain and allow unsound horses to perform without lameness [1], although the treatment of horses during a competition is ethically prohibited.

With advancements of antidoping screening techniques, the use of systemic analgesics has been restricted, and injectable local medications can be an option. Anesthetic blocks using bupivacaine hydrochloride and mepivacaine hydrochloride, usually used for local anesthesia during surgical procedures and lameness evaluations, have been performed [2]. However, injecting intra-articular blocks before exercise is prohibited by some associations because it represents a risky procedure for the athletic horse if performed before competitions, shows, or prepurchase examinations.

Recently, among other mechanisms, the *Fédération Equestre Internationale* (http://www.feicleansport.org/) has included thermography as a detection method for procedures used to either hypersensitize or desensitize horses' limbs. Additionally, thermography has previously been described as a reliable technique for detection of anesthetic procedures used on horses [3,4].

Infrared thermography (IT) is a noninvasive method currently used as a complementary tool to diagnose lameness in horses [5,6]. The basic principle of IT involves the transformation of surface heat from an object into a pictorial representation. The color gradients generated reflect differences in the emitted heat. Variations from pictures of a normal horse's surface heat can be used to detect lameness or regions of inflammation. Thermography has been used to evaluate several different clinical syndromes, not only for the diagnosis of inflammation [7] but also as a way to monitor the progression of healing [5].

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Interestingly, Hoogmoed and Snyder [3] found that IT can be used to detect the injection of analgesic and neurolytic agents and surgical palmar digital neurectomy in horses. Their study concluded that local injection of the lumbar region as well as suspensory and tibial nerve infiltration with a neurolytic agent produced detectable thermal patterns for 2 days. Similarly, Holmes et al. [4] concluded that the changes in the superficial temperature of a perineural anesthetic injection lasted 45 minutes.

Thermography may also be used to detect other types of injections used to eliminate pain before competitions, such as intra-articular blocks; however, there are no specific studies or data to confirm this possibility. The objective of this study was to evaluate the ability of IT to detect intra-articular injections of local anesthetic into the fetlock and middle carpal joints of horses. We hypothesized that intra-articular anesthesia would result in temporary changes in surface temperature over injection sites that are detectable by thermography.

2. Material and Methods

2.1. Chemicals

Bupivacaine hydrochloride (Marcaína; Astra Zeneca Laboratory, São Paulo, Brazil) and 0.9% sodium chloride (Sanobiol Laboratory, São Paulo, Brazil) were obtained from sources in Brazil.

2.2. Animals and Study Design

Five adult mixed-bred mares (body weight range, 390-470 kg) from the Pontifical Catholic University of Paraná herd were used in this study. Five hours before each procedure, the horses were cleaned and placed in stalls without bedding and with no access to natural sunlight.

A ThermaCAM i40 (Flir Systems, São Paulo, Brazil) was used to obtain the images of the front fetlocks and middle carpal joints from a distance of 1 m from the dorsal and palmar aspects and was always operated by the same professional (B.D.). Every experiment began at the end of the day to avoid daily temperature variation, and the basal temperatures of the examined areas (fetlock and middle carpal joints) were obtained in each view aspect immediately before horse preparation. Sedation was not applied, and, if necessary, a twitch was used for restraint during joint injection.

Initially, the fetlock joints were aseptically prepared using a 5-minute povidone–iodine scrub followed by alcohol, and then randomly chosen for bupivacaine (Bupi group) or 0.9% sodium chloride (saline; Sal group) injection. The limb was suspended in a non-weight-bearing position with the fetlock flexed, and a 1.5-inch 21-G needle was used to inject 5.0 mL of bupivacaine hydrochloride into the lateral palmar aspect of the articular surface of the third metacarpal bone and the articular surface of the lateral sesamoid bone [8]. The contralateral joint received 5.0 mL of saline. The thermographic images were obtained 15, 30, 60, 90, 120, and 1440 minutes after the injections, on each aspect of evaluation. The same protocol was repeated after 7 days, inverting the limbs, resulting in n = 10 for each group.

A week after the evaluation of the fetlock joint, the same procedure was repeated for the investigation of the bupivacaine hydrochloride and saline injections in the middle carpal joint. Joint preparation was the same as described for fetlock evaluation.

This study was approved by the Committee on Animal Experimentation of the Pontifical Catholic University of Paraná, Curitiba, Brazil, registered as number 523, and is in accordance with the guidelines in the *Care and Use of Animals*.

2.3. Statistical Analysis

The thermographic images were blindly analyzed by one of the authors using QuickReport (Flir Systems, São Paulo, Brazil). The mean temperature for each time and aspect was compared with the mean basal temperature obtained for the group on that specific aspect, using a paired *t* test in GraphPad Prism version 5.0 for Windows (San Diego, CA). A value of $P < .05$ was considered significant, and all values are represented as mean ± standard deviation.

3. Results

The fetlock joint injection of bupivacaine hydrochloride resulted in higher temperatures at 15-1140 minutes at the palmar aspect, being highest from 15 to 90 minutes ($P < .01$, n = 10) (Fig. 1). The increased temperature was also detected at the dorsal aspect of evaluation from 15 to 120 minutes ($P < .05$, n = 10) (Fig. 2).

Additionally, fetlock temperatures were higher after saline injection and were observed at the dorsal aspect from 15 to 120 minutes and at the palmar aspect from 15 to 1440 minutes ($P < .05$, n = 10). There were no differences between the temperatures after bupivacaine hydrochloride or saline injections at each evaluation time.

The middle carpal joint injection of bupivacaine hydrochloride resulted in higher temperatures from 60 to 90 minutes at the dorsal aspect (Fig. 3) and at 60 minutes at the palmar aspect (Fig. 4) ($P < .05$, n = 10) compared with

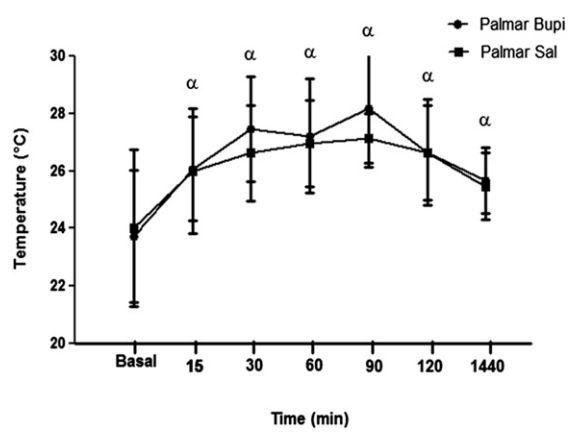

Fig. 1. Mean and standard error of skin temperature (°C) at the palmar aspect of the fetlock joint after intrasynovial injection of bupivacaine hydrochloride (Bupi) and 0.9% sodium chloride.(Sal). α, $P < .05$ versus basal temperature for both Bupi and Sal groups.