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Musculoskeletal injury rates in Thoroughbred racehorses following local corticosteroid injection

R.C. Whitton [a,*], M.A. Jackson [a], A.J.D. Campbell [a], G.A. Anderson [a], T.D.H. Parkin [b], J.M. Morton [c], L.A. Boden [b]

[a] Faculty of Veterinary Science, University of Melbourne, 250 Princes Hwy, Werribee 3030, Australia
[b] School of Veterinary Medicine, College of Medical, Veterinary and Life Sciences, University of Glasgow, 464 Bearsden Rd, Glasgow G61 1QH, UK
[c] Jemora Pty Ltd., P.O. Box 2277, Geelong 3220, Australia

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ABSTRACT

A retrospective cohort study was performed to compare the rates of musculoskeletal injury (MSI) in horses receiving local corticosteroid injection (LCI) with those that were untreated and those prior to treatment. Of the 1911 study horses, 392 had been treated. A LCI was defined as any injection of corticosteroid into or adjacent to a synovial structure, muscle, or tendon/ligament. A MSI was defined as any limb injury identified by a veterinarian, following which the horse did not race for at least 6 months, or was retired. Hazard ratios (HR) comparing hazard of injury following injection to that in non-injected horses and prior to injection were calculated using Cox proportional hazards models.

At least one LCI was administered to 392 horses (20.5%; median 2, range 1–16). Most LCIs were performed bilaterally (70.9%) and intra-articularly into the carpal (49.7%) or fore fetlock (29.3%) joints. There were 219 MSIs of which carpal injuries (47%), fore fetlock (22%) and forelimb tendon injuries (16%) were the most common. The incidence rate of MSI in untreated horses and those prior to injection was 1.22 (95% CI 1.04–1.44) injuries/100 horse-months, and following LCI the hazard of MSI was greater (HR 4.83, 3.54–6.61, $P < 0.001$). The hazard ratio returned to levels indistinguishable from before treatment after 49 days. The hazard of MSI in horses following second and subsequent LCIs in the data collection period was greater than in horses following their first LCI (HR 2.10, 1.31–3.36, $P = 0.002$).

There was a positive association between LCI and subsequent musculoskeletal injury rates which was most likely due to progression of the musculoskeletal condition which prompted treatment. Assuming horses that received LCI were at increased risk of MSI subsequently, any beneficial effects of the LCI were insufficient to counter this increased risk for at least 49 days after the injection.

Introduction

Musculoskeletal injuries (MSI) are common in racehorses and may disrupt training, often necessitating prolonged periods of rest or, in severe cases, retirement or euthanasia (Perkins et al., 2005a). MSIs are often treated with local injections of corticosteroids (LCIs). These may alleviate lameness allowing the affected horse to continue to train and race. Many jurisdictions do not allow horses with detectable serum levels of exogenous corticosteroids to race, but these may not be measurable when bioactive concentrations are still present at the site of injection, and clinical effects are observed for prolonged periods post injection (Derendorf et al., 1986; Chen et al., 1992; Foland et al., 1994; Frisbie et al., 1997). Horses with pre-existing musculoskeletal pathology are at increased risk of subsequent MSIs developing (Cohen et al., 1999), and there is the potential for such horses to race and train while under the effect of LCIs.

In horses, intra-articular corticosteroids increase hyaluronate concentrations in synovial fluid, reduce lameness, synovial inflammation, and maintain cartilage morphology in joint injury models (Ronéus et al., 1993; Foland et al., 1994; Frisbie et al., 1997). There are also no detectable adverse effects of intra-articular corticosteroids on equine subchondral bone (Kawcak et al., 1998; Murray et al., 2002).

Many MSIs are unique to equine athletes that habitualy train at high speed. Horses moving at speed generate large loads in their joints, tendons and suspensory apparatus (Harrison et al., 2010). Stress fractures of long bones, articular fractures, subchondral bone injuries, tendon and suspensory ligament strains are all athletic injuries. There is rarely a history of direct impact, and pre-existing pathology is often identified (Birch et al., 1998; Norrdin and Stover,

* Corresponding author. Tel.: +61 3 97312268.
E-mail address: cwhitton@unimelb.edu.au (R.C. Whitton).

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2006; Parkin et al., 2006). Fatigue damage is not routinely recognised by veterinarians due to limitations of current diagnostic techniques (Trope et al., 2011). In horses with pain due to the accumulation of fatigue damage, it is possible that allowing continued training and racing by alleviating pain through medication potentially exposes horses to the risk of MSI, although evidence for this is lacking (McIlwraith, 2010). Alternatively pain alleviation may avoid overloading of unaffected limbs thereby reducing the risk of subsequent MSI (McIlwraith, 2010).

A placebo controlled trial examining the effect of LCI on MSI rates is impractical (and possibly unethical) in racing horses. However, it is possible to quantify the rate of MSI following the administration of LCIs in horses that continued to train and race. We compared MSI rates in horses receiving LCI with horses that were untreated and those prior to treatment in order to allow owners, trainers and veterinarians to make informed management decisions. Because horses generally receive LCIs to treat a musculoskeletal problem and pre-existing pathology increases the risk of subsequent MSI, we hypothesised that LCIs would not reduce this risk to that of horses not requiring LCI.

Materials and methods

Study design

A retrospective cohort study using veterinary and racing data was performed. Horses were convenience sampled, being selected if they were trained by trainers that used one of three Australian veterinary practices selected because they were judged to have good quality records. Records were available for the following periods: practice 1, December 1994 to March 2010; practice 2, September 2003 to January 2010; practice 3, May 2001 to October 2009.

Sample size

The number of MSIs required to detect a signficant difference at the 0.05 level if the hazard ratio is 1.5 with a power of 80% was estimated to be 200 using the method of Schoenfeld (1983), as implemented in PASS (NCSS) software,[1] and this required the inclusion of 2000 horses assuming an incidence of MSI of 10% (Bailey et al., 1999; Perkins et al., 2005b).

Study population

Horses were entered into the study when they had their first official trial or race start with a trainer that solely utilised one of the three selected veterinary practices. Horses exited the study at the first of the following events: changed to a trainer not using the selected veterinary practices, raced inter-state, exported internationally, trialled or raced in a jumps race, ceased racing (not raced for >12 months, or reported as retired), suffered a MSI, or the data collection period ended.

Data collection and definitions

Horse and racing data

All horse and racing data were obtained from the Racing Victoria Sirius database.[2] These data (or dates derived from these data) included: horse gender, foaling date, trainer, date of first official trial or race start, date of exit from the study, date of last start prior to a rest period, and date of first start back from a rest period. A rest period was considered to have occurred if a horse had longer than 28 days between race starts. The date of entry into the study was 28 days prior to the horse's first official trial or race start. Duration of rest period was calculated by subtracting the date of last start prior to a rest period from the date 28 days prior to first start back from a rest period. Rest periods were treated as 'gaps' in statistical analyses and so did not contribute to time at risk of MSI. The time at risk of MSI was calculated as the time in the study (exit/censor date minus entry date) less duration of rest period(s). Horses' ages at time of each event were calculated by subtracting the foaling date (1st August) from the event date and using the integer component of the age in years.

Veterinary data

Data pertaining to LCI and MSI were collated from each horse's veterinary history. A horse was excluded from the study if there were unexplained gaps in its veterinary record.

A LCI was defined as any injection containing corticosteroid into or adjacent to a synovial structure, muscle, tendon or ligament. Data collated for LCIs included: date of injection, corticosteroid type and dose injected, site or sites injected, the reason for injection, any recorded side effects or complications of injection, and addition of hyaluronate (HA).

Towards the end of the data collection period, autologous conditioned serum (ACS) became available and in some instances replaced the use of corticosteroids. Data were recorded for these treatments as for corticosteroids.

A MSI was considered to be any limb injury identified by a veterinarian where the attending veterinarian recommended that the horse should not continue training and required a rest period, retirement or euthanasia, and the horse did not trial or race for at least 6 months. Following the first occurrence of a MSI during the study period, the horse was excluded from contributing further time at risk. MSI was further classified as non-catastrophic or potentially catastrophic where the treatment options were internal fixation or euthanasia.

Statistical analyses

Stata v 10.1 software (StataCorp) was used for all analyses. Incidence rates were compared between groups by calculating incidence rate ratios and corresponding exact confidence intervals (Rothman, 1986).

Associations between LCI variables and each of MSI and potentially catastrophic MSI were examined using Cox proportional hazards models with the horse as the unit of analysis and LCI, ACS, HA and age (continuous variable in 1 year units) fitted as time-varying covariates (Cox, 1972). Gender, age and veterinary practice were forced into all models as fixed effects. Trainer was included as a random effect via the shared option of the *-stcox-* command. The efron method for ties was used. Schoenfeld residuals were used to test the proportional hazards assumption via the *-stphtest-* command. A two-tailed *P*-value of <0.05 was considered significant.

As risk of subsequent MSI after LCI was likely to be temporary, separate models examining the relationship between LCI and MSI were used to analyse data within serial time periods of 7 days, commencing on the date of the LCI, to investigate how the hazard changed with time since injection.

Results

Horses

There were 1911 horses trained by 36 trainers enrolled in the study; 922 (48.2%) fillies/mares, 915 (47.9%) geldings and 74 (3.9%) entire males. Horses known not to have experienced a MSI before exiting the study were right-censored (i.e. their records were ended before they experienced a MSI) for the following reasons: 689 (36.1%) for a trainer change, 485 (25.4%) finished racing, 294 (15.4%) raced inter-state, 202 (10.6%) study ended, 15 (0.8%) exported, and 7 (0.4%) jumps trialled or raced. The mean days at risk were 206.2 (median 159, range 28–1242). The mean age at entry into the study was 2.3 years (2; 2–6) and at exit was 3.6 years (3; 2–9).

Veterinary data

A total of 392 horses (20.5%) received at least one LCI and local corticosteroids were injected on 858 occasions (2.2 occasions/horse, median 2, 1–16). The majority of treatments were performed bilaterally simultaneously (608/858; 70.9%; Table 1). Of these, triamcinalone acetonide (563 occasions; 65.6%) and betamethasone acetate (265 occasions; 30.9%) were the most commonly used whereas methylprednisolone acetate (17 occasions; 2.0%) and dexamethasone (13; 1.5%) were used rarely. On 524 (61.1%) occasions, sodium hyaluronate was combined with the corticosteroid. The total amounts administered at each individual injection of triamcinolone acetonide ranged from 5 to 40 mg (mean 12.4, median 10.0), for betamethasone acetate 3 to 17 mg (mean 6.1, median 5.7), for methylprednisolone acetate 20 to 200 mg (mean 112.9, median 100) and dexamethasone 13 to 150 mg (mean 46.9, median 25). ACS was injected in 16 horses on 63 occasions.

Of horses receiving LCI, 197 (50.3%) were injected on multiple occasions (mean 3.4 median 3; 2–16) (Table 1). The specific joint for carpal and tarsal intra-articular injections was not recorded in

[1] See: http://www.ncss.com/software/pass/.
[2] See: http://Sirius.racingvictoria.net.au/roarrs/frmDefault.asp.