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RESEARCH PAPER

The effects of two non-steroidal anti-inflammatory drugs on the mobility of laying hens with keel bone fractures

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Abstract

Objective Investigate the effects of administration of meloxicam and carprofen on the mobility of hens with and without keel fractures.

Study design Within each of two experiments a 'blinded' randomised cross over design whereby birds received either the test drug (carprofen or meloxicam) or saline.

Animals Two groups of Lohman Brown hens with and without keel bone fractures.

Methods The first group (n = 63) was treated with carprofen 25 mg kg^{-1} and saline subcutaneously, twice. The second group (n = 40) was treated with meloxicam (5 mg kg^{-1}) and saline subcutaneously. The latency of birds to fly down from perches 50, 100 and 150 cm above the ground was measured after each treatment. Data from experiment 1 and 2 were analysed separately; the effects of drug treatment compared with saline on landing time for birds with and without keel bone fractures were evaluated using MLwiN.

Results In both experiments latency to fly down from perches was longer in hens with keel fractures and there was a significant interaction between perch height and fracture status. For carprofen, at the 50 cm, 100 cm and 150 cm perch heights, birds with fractures took (mean ± SD) 2.5 ± 2.9, 6.8 ± 9.7 and 11.5 ± 13.2 seconds respectively to fly down compared with 1.3 ± 0.5, 2.3 ± 1.2 and 4.2 ± 3.1 seconds for birds without fractures. For meloxicam, at the 50 cm, 100 cm and 150 cm perch heights, birds with fractures took 2.9 ± 2.5, 49.8 ± 85.4 and 100.3 ± 123.6 seconds respectively compared with 0.7 ± 0.5, 2.5 ± 7.1 and 3.0 ± 4.6 seconds to fly down for birds without fractures. There was no significant effect of carprofen or meloxicam treatment.

Conclusion and clinical relevance These data provide further confirmation that keel fractures reduce the willingness of birds to move from perches.

Keywords fracture, hens, keel, mobility, non steroidal anti-inflammatory drug, pain.

Introduction

Keel bone fractures in laying hens housed in non-caged and furnished caged systems occur frequently, with prevalences of up to 80% reported in some studies (Wilkins et al. 2011). We have recently shown that healed keel bone fractures reduce bird mobility (Nasr et al. 2012a). Mobility can be partially improved (by approximately 20%) by the administration of butorphanol, a kappa opioid agonist (Nasr et al. 2012b), suggesting that keel bone fractures may be painful in hens. However, opioids also have complex effects on mood and reward systems (Bruchas et al. 2010). In mammals, kappa agonists produce dysphoria

and a feeling of unpleasantness (Wee & Koob 2010). Although, the effects of kappa agonists on mood, reward and behaviour in birds are unknown, it is possible that butorphanol improved the mobility of the hens with keel bone fractures indirectly through an effect on behaviour mediated by an interaction between butorphanol and dopaminergic pathways, rather than via a direct analgesic effect mediated by kappa opioid receptors located in areas of the central nervous system involved in nociceptive processing and pain. To provide further evidence about whether the impairment of mobility in hens with keel bone fractures can be attributed to pain it is logical to investigate the effects of other classes of analgesic drugs on hen mobility in the same model.

Non steroidal anti-inflammatory drugs (NSAIDs) are widely used in mammals for analgesia. The major mechanism of action of NSAIDs is a reduction in the synthesis of prostaglandins; mediators that play a key role in both peripheral and central nociceptive pathways, contributing to upregulated sensory processing and heightened sensitivity to pain following inflammation (Vane et al. 1998; Kelly et al. 2001). The antinociceptive effects of different NSAIDs have been studied in birds with experimentally induced arthritis (Hocking et al. 2005; Cole et al. 2009; Paul-Murphy et al. 2009). The NSAIDs carprofen, flunixin and ketoprofen altered behaviours in chickens with induced arthritis, though effects were discerned only at doses much higher than those recommended for administration to cats and dogs (Hocking et al. 2005; Leece et al. 2005). The behavioural effects of carprofen and meloxicam (also an NSAID) have been investigated in parrots with experimentally induced arthritis in one limb (Cole et al. 2009; Paul-Murphy et al. 2009). Carprofen (3 mg kg^{-1}), did not change motor activity or weight bearing on the affected limb compared to parrots treated with saline (control). In comparison, meloxicam (1 mg kg^{-1}), increased weight bearing on the affected limb compared to parrots treated with saline, indicative of an antinociceptive effect in this model. Very recently, in a fracture model in pigeons, Desmarchelier et al. (2012) reported that meloxicam did not show any effect at low dose (0.5 mg kg^{-1}), but a higher dose (2 mg kg^{-1}) improved the weight bearing and lowered the pain score.

The effects of both carprofen (25 mg kg^{-1}) and meloxicam (5 mg kg^{-1}) on the gait characteristics of lame broiler chickens were investigated using kinematic analysis (Caplen et al. 2013a). At the doses studied, both drugs increased walking velocity, indicating improved walking ability, accompanied by changes in gait characteristics at a slow walking speed that may have been indicative of improved walking stability. The effect of carprofen on the agility of lame broiler chickens has also been investigated (McGeown et al. 1999; Danbury et al. 2000). Carprofen (1 mg kg^{-1}) decreased the time taken by lame broiler chickens to complete an obstacle course compared to untreated lame birds, whereas no effect of carprofen on the agility of non-lame birds was found. Collectively these studies demonstrate that some NSAIDs modulate the behaviours of birds with both experimentally induced and naturally occurring lameness, although the efficacy and dose of NSAID necessary to produce a behavioural effect varied markedly between studies. Given the well described mechanism of action of NSAIDs in other spontaneous diseases associated with lameness (for example osteoarthritis in dogs), it is very likely that the improved mobility in birds with lameness following NSAID administration can be attributed to the anti-inflammatory effect of this class of drugs. However underlying mechanisms following NSAID administration have not yet been robustly investigated in birds.

The aim of this study was to test the prediction that carprofen and meloxicam would improve the mobility of hens with keel fractures. We used a mobility test that had previously discriminated between injured and uninjured birds. When hens were placed on perches of different heights, and provided with a food reward placed on the ground, individuals with healed keel bone fractures took longer to leave the perch than individuals with no fractures (Nasr et al. 2012a). The latency to leave the perch was (somewhat) reduced when hens with keel fractures were given an appropriate dose of an opioid drug (Nasr et al. 2012b). If hens with fractures are unwilling to leave a perch to fly down to the ground because they are in pain, then we suggest that NSAID drugs should similarly reduce the latency to fly down. We therefore compared the time taken for hens with keel bone fractures to leave perches of different heights following NSAID and saline administration. We also predicted that NSAID administration would have no effect on latency in hens without keel fractures.