Applied Animal Behaviour Science 135 (2011) 252–258

Contents lists available at SciVerse ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Pain issues in poultry

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ARTICLE INFO

Article history:
Available online 17 November 2011

Keywords:
Chicken
Pain
Nociceptors
Beak trimming
Skeletal disorders
Shackling
Feather removal
Environmental pollution
Lameness

ABSTRACT

This review highlights the possible pain experienced by layer and broiler poultry in modern husbandry conditions. Receptors which respond to noxious stimulation (nociceptors) have been identified and physiologically characterised in many different part of the body of the chicken including the beak, mouth, nose, joint capsule and scaly skin. Stimulation of these nociceptors produces cardiovascular and behavioural changes consistent with those seen in mammals and are indicative of pain perception. Physiological and behavioural experiments have identified the problem of acute pain following beak trimming in chicks, shackling, and feather pecking and environmental pollution. Chronic pain is a much greater welfare problem because it can last for long periods of time from weeks to months. Evidence for possible chronic pain is presented from a variety of different conditions including beak trimming in older birds, orthopaedic disease in broiler and bone breakage in laying hens. Experiments on pain in the chicken have not only identified acute and chronically painful conditions but also have provided information on qualitative differences in the pain experienced as well as identifying a cognitive component providing evidence of conscious pain perception.

1. Introduction

Pain in humans is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage (IASP, 1979). However, animals cannot be asked directly about the pain or suffering they may be enduring and even in humans, verbal assessment of pain is difficult, especially in children. Although the exact nature of the emotional component in animal pain is uncertain (Wall, 1992; Anil et al., 2002), and there is no universal indicator of pain (Rutherford, 2002), Zimmermann (1986) has proposed a working definition of pain in animals:

> "*Pain in animals is an aversive sensory experience caused by actual or potential injury that elicits protective motor and vegetative reactions, results in learned avoidance, and may modify species specific behaviour, including social behaviour*".

This may not help to determine whether or not an animal is in pain but it does provide a framework of physiological and behavioural indicators for experimental studies with which to detect pain. The presence of nociceptors which signal actual or potential tissue damage, the behavioural and physiological changes resulting from nociceptive stimulation together with the physiological and behavioural changes following trauma would amply satisfy Zimmermann's definition of pain applied to poultry (Gentle, 1992a).

Pain is usually divided into acute pain and chronic pain. The former lasts for second to days and follows nociceptive stimulation or minor trauma and goes following healing. Chronic pain however, lasts for weeks or even years and is seen in chronic disease states or after major trauma. As part of a framework for detecting acutely painful experiences it is important to determine firstly that the animal has the necessary sensory receptors to detect the actual or potential injury and secondly that activation of these nociceptors results in both behavioural and autonomic cardiovascular changes. Chronic pain on the other hand, is not simply a continuation of acute pain; with prolonged pain

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doi:10.1016/j.applanim.2011.10.023

new factors emerge following pathological changes in the peripheral nervous system and physiological changes in both the spinal cord and the brain. The behavioural changes seen in chronic pain in both humans and animals are often more global in nature with not only guarding of the injured structure but also reductions in a variety of behaviour patterns including overall activity, exploratory and grooming behaviour.

Poultry throughout their lives sometimes experience a variety of acute or chronic painful conditions which are either inflicted on the animal as a result of current husbandry practices (e.g. beak trimming, pre-slaughter shackling) or occur as a result of trauma (e.g. bone breakage resulting from osteoporosis in the laying hen) or disease (e.g. orthopaedic disease in broilers). This review aims to identify potentially painful conditions in poultry and use the current state of knowledge regarding each issue to allow a scientific evaluation of the resulting welfare compromises.

2. Beak trimming

Beak trimming is recognised as an effective method of minimising feather pecking and cannibalism in layer flocks, but the procedure gives rise to welfare concerns due to its potential to cause short and/or long term pain and loss of function. An extensive review of pain resulting from beak trimming has been published by Cheng (2005). Recently, the more traditional method of applying a hot blade to remove the beak tip has been replaced by Infra-red (IR) beak treatment, in which a high intensity infra-red energy source is applied to the beak causing the tip to be lost after approximately 2 weeks (Marchant-Forde et al., 2008).

2.1. Young birds

The painful consequences of this procedure depend on the age at which it is performed. Beak trimming with a heated blade is likely to be acutely painful and increased heart rate associated with trimming may be related to short term pain (Glatz, 1987). Electrophysiological recordings from peripheral trigeminal afferent nerve fibres both during and after heated blade trimming showed a very large injury discharge which variable in duration but in some fibres lasted up to 48 s (Gentle, 1991). This injury discharge is likely to be felt as pain but of a relatively short duration because there was no abnormal neural activity recorded in the trigeminal nerve of the chicken for 4.5 h after the initial injury discharge, indicating a pain free period. Behavioural observations would support the absence of prolonged pain after trimming. In a study where birds where trimmed at one day of age, there were no significant effects on the behaviour of the chicks in the first hour after trimming or in the subsequent six weeks (Gentle and McKeegan, 2007). Behavioural effects which might reflect acute pain such as reduced feed intake, reduced activity and beak guarding have been reported in the first week after trimming day old birds in some studies (Gentle et al., 1997; Marchant-Forde et al., 2008) but not in others (Sandilands and Savory, 2002; Gentle and McKeegan, 2007) so there is currently no clear evidence of prolonged acute pain in birds beak trimmed at one day of age. The reason for the absence of any prolonged acute pain following beak trimming at a young age could be explained by the rapid regeneration of the beak in young birds. In the young birds there is an absence of scar tissue or neuroma formation following trimming and the beak rapidly regrows (Dubbeldam et al., 1995; Lunan et al., 1996; Gentle et al., 1997). The regrowing beak tissue allows the regenerating trigeminal sensory nerves to innervate normal beak tissue with free nerve endings and both Herbst and Grandry corpuscles have been observed in the regrown beaks at 10 and 70 weeks after trimming (Lunan et al., 1996; Lunam, 2005).

Recent work (McKeegan, unpublished) investigated the long term consequences of IR (infrared) beak treatment by examining changes in beak nerve function (neurophysiology) and anatomy over a range of ages. There was evidence for complete sensory regeneration in healed beaks and the results suggested that IR beak treatment of day old chicks does not result neither in chronic adverse consequences for sensory function, nor does it demonstrate evidence of chronic pain associated with the procedure.

2.2. Older birds

In older birds the trimmed beak rapidly heals but the beaks do not regenerate and the tip of the beak underlying the epidermis is composed of scar tissue (Breward and Gentle, 1985). At 10 days after trauma the damaged nerves show evidence of regrowth with some enlargement of the end of the nerve. This regeneration and regrowth of the nerve fibres continued so that by 15 days clear neuroma was present at the end of the nerve stump together with numerous bundles of regenerating fibres. These regenerating fibres continued to grow but, because of the adjacent scar tissue, were unable to innervate dermal structures and consequently the fibres grew back on themselves to form a complex mass of intertwining regenerating nerve fibres together with the surrounding tissue. In some nerves there was a simple terminal neuroma while in others a neuroma was formed at the original stump of the nerve in association with a large and complex neuroma formed adjacent to the scar tissue which forms the end of the beak. Some nerves did not appear to have a neuroma at the original stump but, instead, had a complex neuroma adjacent to the scar tissue. Subsequent electrophysiological recordings from the nerve fibres innervating these neuromas showed abnormal features not seen in normal trigeminal afferent fibres (Breward and Gentle, 1985). The most characteristic abnormality encountered in the stump was the presence of large numbers of spontaneously active nerve fibres with regular, irregular or bursting discharge patterns. This spontaneous activity seen in the amputated stump was similar to that observed in the experimental neuroma preparations developed initially by Devor, Wall and co-workers (Devor and Bernstein, 1982; Govrin-Lippmann and Devor, 1978; Wall and Gutnick, 1974) in the rat and later extended to the mouse (Scadding, 1981) and cat (Blumberg and Janig, 1984). This abnormal neural activity has been implicated in post-amputation stump pain in animals (Seltzer et al., 1991) and human amputees (Devor and Seltzer, 1999; Narsinghani and Anand, 2000).