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Pain and discomfort caused by parturition in cows and sows

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ABSTRACT

This review focuses on parturition as a painful process in cows and sows. Firstly, the different stages of parturition associated to the origin and transmission of pain stimuli are described. Hypoalgesia during the late pregnancy and parturition has been shown, perhaps as an endogenous defence against the pain of parturition. The principal factors affecting parturition pain are parity and dystocia, which are more likely in cases of long parturition, feto-pelvic disproportion and/or foetal malpresentation. The main consequences of pain caused by parturition are reviewed; parturition is an intrinsically risky process for both mother and young and can cause a stress response, health problems and maternal mortality, in addition to decreased food intake and production. The assessment of parturition pain has tended to use one of three approaches: measures of general indices, physiological and behavioural indicators. Finally, the impact of analgesia after parturition in cows and sows is reviewed. It is concluded that pain caused by parturition in animals deserves more research in order to optimize the parturition process and reduce its negative consequences on health, welfare and productivity.

1. Parturition as a painful process

1.1. Introduction

It is generally accepted that animal welfare comprises physical and mental health (Dawkins, 2004) and includes several aspects such as absence of thirst, hunger, discomfort, disease, pain, injuries and stress, as well as the expression of normal behaviour (FAWC, 1992). In consequence, one of the essential components of good welfare is the recognition and control of pain. Pain is defined by the International Association for the Study of Pain (IASP) as an unpleasant sensory and emotional experience normally associated with tissue damage or described in terms of such damage (Merskey, 1979). Pain serves a useful function because it is closely linked to some of the neurohumoral responses that are necessary for inflammation, and it can modify physiological responses, which in turn help the subject cope with an injury (Gregory, 2004). Labour pain is recognized as acute pain with at least two dimensions, a sensory and an affective component (Chapman and Nakamura, 1999). As a result of this, in humans, labour pain has received a great deal of scientific interest. However, most studies in animals concern endocrine changes associated with gestation, parturition and lactation, but there are only few studies of pain associated with the parturition process.

According to a survey of 2,700 parturient women, 15% reported no or little pain, 35% reported moderate pain, 30% reported intense pain, and 20% reported very intense pain (Bonica, 1994). Melzack et al. (1981) found that mean labour pain scores were higher in both primiparous and multiparous women than in patients with other pain syndromes such as arthritic pain, back pain or toothache and concluded that labour pain ranks among the most intense pains recorded with the McGill Pain Questionnaire (Melzack, 1975).

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There are many similarities between animals and humans in anatomical and chemical pathways of pain perception (Morton and Griffiths, 1985). An animal can feel pain at a conscious level if the following criteria are met: (1) it possesses receptors sensitive to noxious stimuli, (2) its brain has structures analogous to the human cerebral cortex, (3) nervous pathways link the receptors to the higher brain and (4) painkillers modify the response to noxious stimuli. Additionally, some criteria related to behaviour in response to noxious stimuli would be as follows: (1) the animal responds to noxious stimuli by consistently avoiding them, (2) the animal can learn to associate neutral events with noxious stimuli and (3) it chooses a pain killer if given access to one, when pain is otherwise unavoidable (Gregory, 2004). In consequence, it is generally accepted that the perception of pain is similar in human beings and other mammals; therefore it can be assumed that what is painful in humans is also painful in animals (Morton and Griffiths, 1985). In consequence, from the maternal perspective, parturition in any species is generally accepted to be a painful process. Additionally, births associated with difficult parturitions or dystocia may cause unacceptably high levels of pain in the mother. For instance, in a questionnaire survey in the UK, dystocia was ranked by cattle practitioners as one of the most painful conditions of cattle obtaining a score of 7 in a scale from 1 to 10. Only claw amputation, caesarean section and left displaced abomasal surgery were considered more painful processes (Huxley and Whay, 2006).

1.2. Stages of parturition: origin and transmission of parturition pain stimuli

Traditionally, the process of parturition has been divided into three separate stages.

The first stage includes dilation of the cervix, the onset of myometrial contractions and the placement of the foetus for expulsion (Noakes et al., 2001a). In cows and sows, the dilation of the cervix starts gradually during the last stage of gestation and occurs more rapidly just prior to parturition (Taverne, 1992). The initial preparation of the birth canal takes places without uterine contractions, but in presence of the typical prepartum endocrine changes (relaxin release, withdrawal of progesterone and enhanced oestrogen and prostaglandin production) (Challis and Lye, 1986). At least in sows, oestrogens and relaxin induce the dilation of the cervix through modifying the activity of collagen. In cows, the role of endogenous relaxin remains uncertain (Taverne, 1992). The myometrial contractions vary from species to species and individual to individual. In general, their duration, frequency and amplitude increase and become more regular approximately 12 h before the onset of the second stage. Finally, foetal movements occur in response to increased uterine pressure caused by the myometrial contractions of the first stage (Noakes et al., 2001a).

During the dilatation phase, visceral pain predominates, with pain stimuli arising from mechanical distention of the lower uterine segment and cervical dilation. In women, these nociceptive stimuli of the dilation phase are predominantly transmitted to the posterior nerve root ganglia at T10 (spinal nerve of the thoracic segment that originates from the spinal column from below the thoracic vertebra 10) through L1 (spinal nerve of the lumbar segment that originates from the spinal column from below lumbar vertebra 1). Similar to other types of visceral pain, parturition pain may be progressively referred to the abdominal wall, lumbosacral region, iliac crests, gluteal areas and thighs (Lowe, 2002).

The second stage is characterized by the appearance of abdominal contractions, allantochorionic sac rupture and expulsion of the foetus. This phase includes the final widening of the cervix which is accomplished by the propulsive forces of the regular uterine contractions during parturition (Taverne, 1992). As parturition advances, the distension of the maternal birth canal causes great increases in the release of oxytocin from the posterior pituitary and this, in turn, accentuates the myometrial contractions (Noakes et al., 2001a). In sows as well as in women, the number of oxytocin receptors in the uterus is elevated, which explains the greater sensitivity to exogenous oxytocin at this stage, relative to the response seen during gestation (Fuchs, 1987; Gorodeski et al., 1990; Soloff, 1975). In cows, increased oxytocin release, rather than a changed oxytocin binding capacity, is involved in the pattern of myometrial contractions (Taverne, 1992).

In this stage, somatic pain predominates due to distention and traction on pelvic structures surrounding the vagina and from distention of the pelvic floor and perineum. In women, sharp and generally well localized, stimuli are transmitted via the pudendal nerve through the anterior rami of S2 (spinal nerve of the sacral segment that originates from the spinal column from below the second body of the sacrum) through S4 (spinal nerve of the sacral segment that originates from the spinal column from below the fourth body of the sacrum) (Lowe, 2002).

The third stage includes the expulsion of the foetal membranes. In polytocous species (such as sow) the foetal membranes are sometimes voided together with the foetuses, but only the expulsion of the last afterbirth simulates the third stage in monotocous species (such as cow). During this stage, myometrial contractions persist, decreasing in amplitude but becoming more frequent and less regular. When a large portion of the afterbirth becomes detached and inverted it forms a mass within the maternal pelvis which stimulates reflex contractions of the abdominal muscles (Noakes et al., 2001a).

1.3. Hypoalgesia during parturition

An increase in nociceptive threshold has been shown during the late pregnancy and parturition not only in women (Cogan and Spinnato, 1986; Whipple et al., 1990) and rats (Gintzler, 1980; Wardlaw and Frantz, 1983), but also in cattle (Aurich et al., 1990) and sows (Jarvis et al., 1997), perhaps as an endogenous defence against the pain of parturition. This pregnancy-induced hypoalgesia is mediated via endogenous opioids (Gintzler, 1980; Sander and Gintzler, 1987). It is well known that endogenous opioids are released in response to nociception and have potent analgesic properties (Dalayeun et al., 1993). Both neuronal and hormonal factors may be involved in the