Pain perception at slaughter

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Abstract

Recent developments related to quantitative analysis of the electroencephalogram (EEG) have allowed the experience of pain to be assessed more directly than has hitherto been possible. Variables derived from the EEG of animals anaesthetised using our minimal anaesthesia model respond to noxious stimulation in a manner similar to those from conscious animals. This methodology has been used in a variety of applications including the evaluation of analgesic options for painful husbandry procedures and investigation of developmental aspects of the perception of pain. We have now applied the minimal anaesthesia model to the question of the slaughter of calves by ventral-neck incision. A series of studies evaluated the magnitude of EEG response to the noxious stimulus of ventral-neck incision and the physiological mechanisms that underlie this response. We also investigated the EEG effects of stunning by non-penetrating captive bolt and the ability of such stunning to ameliorate the response to ventral-neck incision. The results demonstrate clearly, for the first time, that the act of slaughter by ventral-neck incision is associated with noxious stimulation that would be expected to be painful in the period between the incision and subsequent loss of consciousness. These data provide further support for the value of stunning in preventing pain and distress in animals subjected to this procedure. We discuss the development of the minimal anaesthesia model and its adaptation for use in the investigation of slaughter by ventral-neck incision as well as considering the contributions of these studies to the ongoing development of international policy concerning the slaughter of animals.

Keywords: animal welfare, cattle, EEG, pain, slaughter, stunning

Introduction

Commercial slaughter of farm livestock usually employs an extensive incision that severs the soft tissues of the neck including the major blood vessels supplying and draining the brain. It is intended to cause a catastrophic decrease in cerebral blood flow with rapid onset of unconsciousness or insensibility. The tissues of the neck are innervated with nociceptive nerve fibres and the transection of these fibres will cause a barrage of sensory impulses. Consciousness, and therefore the ability of the animal to feel pain and experience distress after the incision, may persist for 60 s or longer in cattle. These observations suggest that livestock may experience pain and distress during the period before they become insensible, but there have previously been no experimental techniques capable of assessing pain perception during this period.

In the early 1990s, there was an increased interest in the possibility of using the electroencephalogram (EEG) to monitor the adequacy of anaesthesia. Studies prior to this time had failed to identify quantifiable EEG changes that correlated with anaesthesia, but the rapid development of personal computers in the previous decade enabled formal signal analysis techniques such as Fast Fourier Transformation (FFT) to become widely available. In the field of veterinary anaesthesia there was particular interest in applying these techniques to horses, because this species had a much higher anaesthetic-related mortality than other common domestic animals (Johnston et al 2002).

Early studies investigating the usefulness of the EEG in the clinical arena suggested that FFT analysis may be a useful adjunct to monitoring and against that background the first author began to investigate the EEG effects of inhalational (Johnson et al 1994; Johnson & Taylor 1998) and injectable (Johnson 1996; Johnson & Taylor 1997, 1999; Johnson et al 2000a,b, 2003) anaesthetic agents in the horse. The EEG was divided into short segments and FFT analysis carried out on each segment to derive a power spectrum. This was then further analysed to derive the median frequency of the EEG (F50), the 95% spectral edge frequency of the EEG (F95) and later the total EEG power (ptot) (Figure 1). Changes in F50, F95 and ptot over time could then be compared in studies where the concentration of individual