Post-natal development of EEG responses to noxious stimulation in pigs (*Sus scrofa*) aged 1–15 days

NJ Kells*, NJ Beausoleil†, MA Sutherland‡ and CB Johnson†

†Animal Welfare Science and Bioethics Centre, Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand

‡AgResearch Ltd, Ruakura Research Centre, Hamilton 3216, New Zealand

*Contact for correspondence: N.J.Kells@massey.ac.nz

Abstract

This study examined electroencephalographic (EEG) indices of acute nociception in pigs (*Sus scrofa*) aged 1, 5, 7, 10, 12 and 15 days, post-natal. Ten pigs per age were anaesthetised with halothane in oxygen and maintained at a light plane of anaesthesia. EEG was recorded bilaterally using a five-electrode montage. Following a 10-min baseline period, tails were docked using side-cutter pliers and recording continued for a further 5 min. Changes in the median frequency (F50), 95% spectral edge frequency (F95) and total power (P_{TOT}) of the EEG were used to assess nociception. Tail-docking at one day of age induced no significant changes in the EEG spectrum. A typical nociceptive response, characterised by an increase in F50 and decrease in P_{TOT}, was evident at ten days of age, with five and seven day old pigs exhibiting responses in either F50 or P_{TOT} only. Pooling of data into ≤ 7 days of age and > 7 days of age revealed F50 was higher overall in the older group. Whilst P_{TOT} decreased after docking in both groups, this response was larger and more prolonged in the older group. F95 increased after docking in the older pigs only. Overall, these data provide evidence of an increase in cortical responsiveness to noxious stimulation with increasing post-natal age, suggesting there may be qualitative differences in pain perception between age groups. Further, the data provide some support for current recommendations that tail-docking and other painful husbandry procedures be performed within seven days of birth in order to minimise their impact on animal welfare.

Keywords: animal welfare, EEG, nociception, pain, pig, tail-docking

Introduction

Tail-docking is commonly performed on commercial pig (*Sus scrofa*) farms to reduce the incidence of tail-biting behaviour, which can have severe welfare consequences for affected animals. The procedure is typically performed within seven days of birth, without the provision of analgesia. However, there is diverse evidence that the procedure is acutely painful to pigs, even when performed at a very young age (Noonan et al 1994; Sutherland et al 2008; Marchant-Forde et al 2009).

Current animal welfare guidelines recommend that tail-docking, along with other potentially painful husbandry procedures, be performed at a young age, reflecting a desire to minimise any associated pain. For example, in New Zealand, it is recommended that tail-docking of pigs be performed within 72 h of birth and minimum standards require the provision of analgesia for pigs aged seven days or over (Anonymous 2018). Similarly, both Australia and the UK recommend that tail-docking of pigs be performed within seven days of birth, with the latter stipulating that analgesia be provided for pigs > 7 days of age (Commonwealth Scientific and Industrial Research Organisation [CSIRO] 2008; Council of the European Union 2008). Despite such recommendations, there is little scientific evidence to support these age thresholds and little research has been undertaken comparing the effects of piglet age on pain responses.

The subjective nature of pain makes its assessment in animals complicated. Animals’ inability to report their experiences necessitates the use of indirect indices of pain, including metabolic, endocrine and behavioural measures (Livingston & Chambers 2000). However, the interpretation of these is confounded by the fact that they are non-specific and may alter in response to non-painful stressors, such as handling and restraint. In addition, these indices represent responses to noxious stimulation, rather than pain perception (Johnson et al 2005a) and have been shown to correlate poorly with reports of pain in people (Chapman et al 1985). More recently, electroencephalographic (EEG) indices of nociception have been used to infer pain and test analgesic efficacy in a range of mammals. The EEG provides a summation of electrical activity arising from the cerebral cortex. In man, changes in the frequency spectrum of the EEG mirrored changes in cortical activity relating to the cognitive perception of pain (Bromm 1984). Changes in the EEG frequency spectra under