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The Effect of Early Post-Natal Castration on Subsequent Electroencephalogram Response to Tail Docking in Lambs

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Steven Impey
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Abstract

The objective of this study was to investigate the effect of early age painful stimulation on the cortical response to subsequent painful stimulation in lambs. Using the electroencephalogram (EEG), the current study measured the effect of early age castration at one day of age on the cortical pain response to tail docking at 23 days of age in lambs.

Lambs were randomly assigned to rubber ring castration (n=12) or handling (n=12) at one day of age. At 23 days of age lambs were tail docked under a minimal plane of anaesthesia maintained using halothane in oxygen (PeHal = 1%). EEG data was recorded for two minutes pre-docking, and for eight minutes following tail docking. EEG median frequency, spectral edge frequency and total power were derived using fast Fourier transform. Data were analysed for group (castrated versus handled), time and group by time effects using mixed model analysis, as well as for the effect of group on pre-docking EEG.

Castrated lambs showed an increased cortical response to pain, demonstrated by a greater increase in EEG median frequency (Mixed model analysis; F = 5.45, P = 0.03) and greater reduction in total power (F = 5.15, P = 0.03) in response to subsequent tail docking.

These findings indicate that early age noxious stimulation results in an increased cortical response to subsequent noxious stimulation at approximately three weeks of age in lambs. The greater cortical response in the castrated lambs would likely correspond to an increased perception of pain, and therefore the potential for a greater degree of suffering and welfare compromise in response to subsequent painful injuries, for example lambing, injury and footrot.

There was also a tendency toward a higher pre-docking total power of the EEG in the castrated lambs when compared with handled lambs (Satterthwaite’s t-test; T = 1.86, P =
0.08). The higher pre-docking total power may indicate a greater background activity in the nociceptive centres of the castrated lambs. However, the significance of this finding is not clear at this stage, and further work is necessary to better define the basis and clinical importance of this observation.

Key Words: Pain, electroencephalogram, sheep, lamb, castration, hyperalgesia
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This study was approved by the Massey University Animal Ethics Committee (MUAEC Protocol 11/46).

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List of Abbreviations

CNS  Central nervous system
CT   Computed tomography
EEG  Electroencephalogram
F50  Median (50th percentile) frequency of the electroencephalogram
F95  Spectral edge (95th percentile) frequency of the electroencephalogram
FFT  Fast Fourier transform
fMRI Functional magnetic resonance imaging
Hz   Hertz
IASP International Association for the Study of Pain
KHz  Kilohertz
LTP  Long term potentiation
PHP  Painful husbandry procedure
Ptot Total power of the electroencephalogram
SE   Standard error