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Electroencephalographic responses of anaesthetised rats to carbon dioxide inhalation

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Abstract

*Exposure to high concentrations of CO_2 is a common means of stunning and killing laboratory rodents. However, there is concern regarding the potential for animals to have aversive experiences, such as pain or breathlessness, prior to loss of awareness. This preliminary study evaluated the electroencephalographic (EEG) responses of rats (*Rattus norvegicus*) to CO_2 inhalation, using a method based on a minimal anaesthesia model previously used to assess nociception in mammals. Fifteen adult female Sprague-Dawley rats were anaesthetised with halothane in oxygen and maintained at a minimal plane of anaesthesia. EEG was continuously recorded throughout a 10-min baseline period followed by sequential exposure to 5, 15, 30 and 50% CO_2. The EEG summary variables median frequency (F50), 95% spectral edge frequency (F95) and total power (P_{TOT}) were derived from the raw EEG. The F50 of the EEG, a sensitive indicator of nociception, increased significantly above baseline during exposure to 15% CO_2, suggesting this concentration was noxious to rats. This is consistent with behavioural aversion in rats at around the same CO_2 concentration. Stimulation of the rat mucosal nociceptors only occurs at CO_2 concentrations of 37% or greater; therefore, it is hypothesised that the observed response was a result of what would have been CO_2-induced aversive respiratory sensation in conscious animals, rather than pain. This study provides some evidence that an anaesthesia model may be utilised to study the nocuous effects of low-moderate CO_2 exposure in rodents.*

Keywords: *animal welfare, carbon dioxide, electroencephalogram (EEG), euthanasia, negative affective experience, rat*