Evaluation of euthanasia of sheep with intravenous saturated salt solutions to enable the collection of whole, intact brains

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Abstract

Captive bolts or firearms are unsuitable for euthanasia of livestock when an intact brain is required for diagnostics. Injectable barbiturates can be used, but this method carries risk of poisoning animals eating the carcase. Intravenous saturated salt solutions have been used to euthanise heavily sedated ruminants and are cheap, readily available and not a risk to scavenging animals. However, there is concern that they may be painful or cause distress to animals that are not unconscious. This study aimed to determine the suitability of saturated salt solutions, in combination with xylazine, as a method of euthanasia of ruminants using a sheep model. Thirty-two sheep were sedated with xylazine (0.4 mg kg⁻¹ IM) and euthanased with an intravenous overdose of pentobarbitone (PENT; n = 10), saturated potassium chloride (KCL; n = 11) or saturated magnesium sulphate (MGS; n = 10). Time until end of rhythmic breathing and cardiac arrest, and movement events were recorded. Conscious perception of pain was evaluated by measuring cortical brain activity by electroencephalography (EEG). There was no evidence of perceived pain or unpleasant sensory experience for any treatment as indicated by P50, P95 and Ptot, and so all methods were deemed humane. Time until transient EEG was comparable for all treatments. Time until onset of isoelectric EEG was prolonged for KCL. Animals euthanased with KCL consistently exhibited severe reflex movements during infusion (eg kicking, convolution). No severe movement events were observed in animals euthanased with MGS, hence, physiological and movement data support the preferential use of MGS over KCL.

Keywords: animal welfare, electroencephalogram, intravenous euthanasia, magnesium sulphate, potassium chloride, ruminant

Introduction

In Australia, the recommended method of euthanasia of ruminant livestock is captive bolt or firearm (Animal Health Australia [AHA] 2016a,b). These devices provide a rapid and humane means of euthanasia but may not always be available. Further, the use of firearms and captive-bolt devices may not be appropriate when whole brains are required for diagnostic investigation. In Australia, brains submitted for exclusion of transmissible spongiform encephalopathies (TSEs) as part of the National TSE Freedom Assurance Program must be whole and intact (Anon 2017). There are currently no tests to diagnose TSE in live animals, and so diagnosis requires necropsy and microscopic examination of the brains from ruminants that have shown signs of neurological disease.

Firearms or captive bolts are unsuitable methods of euthanasia for TSE surveillance because they cause extensive damage to the brain and brainstem. Consequently, veterinarians typically use an injectable barbiturate anaesthetic (eg pentobarbitone; PENT) in this situation, but this creates the risk of poisoning scavenging animals (including farm dogs and wildlife) due to the chemical residues in the carcase. Poisoning through the ingestion of barbiturate-laden carcasses has caused the death of animals fed or scavenging carcass parts up to two years later (Kaiser et al 2010; Payne et al 2015). Consequently, barbiturates should only be used when a carcase can be disposed of immediately by deep burial or incineration (Leary et al 2013). These disposal requirements present difficulties for farmers due to cost and may discourage them from requesting disease investigations.

Euthanasia of ruminant livestock using saturated salt solutions, such as magnesium sulphate (MGS) or potassium chloride (KCL) provides a potential alternative to barbiturate use. These saturated salt solutions are not controlled substances, they are cheap, readily available, easily stored and transported, can be prepared in the field and pose minimal risk...