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Differences in the acute pain responses of two breeds of lamb following castration and tail docking with the rubber ring method

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Abstract

Charolais × and Suffolk × Mule lambs of less than one week of age were castrated and tail docked using a standard rubber ring technique. After these procedures, their behaviour was monitored for 1 h. Their respiration rates and scrotal sac measurements were also recorded. Both breeds of lamb exhibited abnormal behaviour patterns following these procedures. The recumbent behaviour pattern of both breeds was remarkably similar but their standing behaviour differed markedly. The Charolais × lambs were significantly more active and had significantly higher respiration rates compared with the Suffolk × lambs. They also took a greater amount of time to recover to a normal posture. Their abnormal behavioural responses suggested that both breeds of lamb experienced acute pain following castration and tail docking, but the type of behaviour exhibited was breed-dependent. The findings suggest that different breeds of lamb may experience different levels of distress in response to the same husbandry procedure. Alternatively, they may simply reflect a difference in the character and temperament of the breeds studied.

Keywords: *animal welfare, breed difference, castration, lambs, pain response, tail docking*

Introduction

The use of rubber rings to castrate and tail dock lambs within the first week of life is a common husbandry procedure in the UK. This method is quick, easy, economical and effective. Castration and tail docking are thought to be essential to avoid the aggressive behaviour, indiscriminate breeding and decreased carcass quality associated with raising lambs as entire rams (Eales & Small 1995; Wood & Molony 1998), and to reduce the incidence of fly strike (French *et al* 1994). The rubber ring is usually applied without anaesthesia or analgesia and this has raised many concerns regarding the welfare of the lambs involved (FAWC 1994; Barnett 1997; Molony *et al* 1997; Kent *et al* 1998; Mellor & Stafford 1999). Several investigations have therefore been conducted to assess the degree of pain and distress associated with these procedures (Schutt *et al* 1988; Mellor & Murray 1989; Robertson *et al* 1994; Kent *et al* 1995; Molony *et al* 1995; Graham *et al* 1997; Dinnis *et al* 1999; Thornton & Waterman-Pearson 1999).

Researchers have generally had to resort to a combination of physiological and behavioural measurements because no single parameter is sufficient to make an objective assessment of the level of pain being experienced by the animals. A rise in plasma cortisol levels is a commonly used physiological indicator of pain, but the collection of samples involves handling the animals. Handling alone has been found to induce stress and to lead to an artificial rise in the level of plasma cortisol (Haresign *et al* 1995; Khalid *et al* 1998; Jongman *et al* 2000). In comparison, the assessment of pain through the monitoring of behaviour avoids artefacts resulting from handling. The selection of appropriate parameters is also relatively straightforward as a result of the extensive studies and classifications of both normal and abnormal behaviour in several different species, including sheep (Mellor & Murray 1989; Fraser & Broom 1997). However, a subjective interpretation of the observations is required when relating each posture to the level of pain actually being experienced. Such interpretation would be made significantly more difficult if breed variability existed within the classifications.

Our preliminary observations (unpublished) revealed apparent gross differences in the behaviour of Charolais and Suffolk lambs following the same husbandry procedure; thus suggesting that the response to castration and/or tail docking is breed-dependent and that different breeds may experience different levels of distress in response to the same stimulus. Individual variability in cortisol level has also been documented (Molony & Kent 1997). If breeds do differ in their response to pain, individual categories of normal and abnormal behaviour would need to be assigned to each breed in order to improve the accuracy of any future welfare assessments. A method of relating individual behaviours to the level of distress that they represent would also need to be established so that an overall assessment of pain could be made. The current study was conducted to determine whether there was variation in the behavioural

Table 1 The standard classifications of normal and abnormal standing behaviours exhibited by lambs. Score values range from 1 (least painful) to 5 (most painful).

Standing	Score	Description of posture
Normal	1	Standing in a position that was normal for that lamb as observed pre-castration. This could include teat seeking or suckling.
Arched back	2	Standing immobile with feet positioned underneath the body but with the back clearly arched.
Splayed legs	3	Standing immobile with all four feet on the floor but with the hind limbs extended behind the body.
Kicking	4	Any evidence of raising a limb off the floor whilst standing. This included stamping or pawing of the foot and kicking at the body or other object.
Bucking	5	Raising two or more limbs off the floor simultaneously. Often involved jumping or running around the pen.

Table 2 The standard classifications of normal and abnormal recumbent behaviours exhibited by lambs. Score values range from 1 (least painful) to 5 (most painful).

Recumbent	Score	Description of posture
Normal	1	Lying in a position that was normal for that lamb as observed pre-castration.
Ventral	2	Lying on the sternum with all of the limbs flexed and in such a position that the scrotum was raised off the floor
Ventro-lateral	3	Lying on the sternum with the forelimbs flexed and the hind limbs extended.
Lateral	4	Lying completely on side with three or four limbs extended.
Rolling	5	Rolling from side to side or rolling and maintaining position on back for an interval of time.

responses of Charolais and Suffolk lambs to the pain induced by rubber ring castration and tail docking.

Methods

Animals

The investigation was carried out during two weeks of routine lambing at a local farm. The Mule (Bluefaced Leicester × Swaledale) ewes were managed according to the regular procedures conducted on the farm. The investigation involved all male Charolais × (n = 14) and Suffolk × Mule (n = 24) lambs that were produced during that period. Each ewe was housed in an individual pen with her lambs.

Treatment

Between 12 and 48 h after birth, all male lambs were castrated and tail docked using a standard-sized elastrator ring (Castrator Antiseptic Rubber Rings: Net-Tex Agricultural Limited, Priestwood, Harvel, Kent DA13 0DA, UK). A ring was applied to the neck of the scrotum so that both testicles were below the ring and two teats were above the ring. Another ring was applied around the tail at a position so that the remnant of the tail would cover the anus. Following this procedure, the breed of each lamb was recorded before it was placed back into its original pen. The lamb had unrestricted access to its dam and any siblings.

Measurement of behaviour

Behaviour was recorded according to specific postural subdivisions within two broad categories: standing and recumbent. A score value (range: 1–5) was assigned for both standing (Table 1) and recumbent (Table 2) postures depending on the degree to which they differed from the normal standing or recumbent postures. The highest value was assigned to the posture that differed the most from normal and was taken as representing the greatest degree of pain. It also took into account that avoidance posture(s) may be associated with a similar intensity of pain as escape mechanisms.

In order to assess normal behaviour, observations began 30 mins before the commencement of the castration and tail docking procedures. Lamb posture was recorded at 5 min intervals during this time. Post-procedure observations began within 1 min of the lamb being returned to its pen (classified as time 0). Recordings were then made at 5 min intervals for a total of 1 h. Lambs were looked at once every 5 mins and their posture recorded at that time only (ie instantaneous sampling [Martin & Bateson 1993, p 90]). Although this observation method gives proportional rather than exact duration data, it was not possible to watch all of the lambs for all of the time and since the same criteria were applied to lambs of both breeds this should minimise any bias. Thereafter, observations continued every 10–15 mins until a normal posture was resumed. The lambs and ewes were not disturbed during the observation period except at 30 mins post-procedures when the pen was entered and the lamb approached to see if it would show an evoked response. Each posture was assigned a score (Tables 1 & 2), and the incidence of any other behaviours, eg bleating, teat seeking and suckling, was also noted.

Other measurements

Respiration rate was recorded at the end of the pre-procedures observation period and again 30 mins post-procedures. The overall change in respiration rate was calculated by subtracting each pre-procedures value from its respective post-procedures value.

The maximum length and circumference of the scrotal sac, with both testicles contained, was measured immediately

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prior to castration. These measurements were then used to calculate the volume of the scrotal sac and its contents (assuming an approximately cylindrical shape) using the following formula:

Volume = $\pi r^2 h$

where r = circumference / (2π), and h = length of the testes.

Measures and statistical analysis

Restlessness scores

Two types of restlessness score were calculated from the behavioural data collected as described above. 'Major restlessness scores' were calculated using inter-posture category changes by assigning a score of 1 each time a lamb moved from a recumbent to a standing position or vice versa, and 'Minor restlessness scores' were determined by assigning a value of 1 each time a lamb changed between any of the individual postural (standing or recumbent) sub-divisions.

Clinical score

Within each behavioural category (recumbent & standing), a weighted score of 1 (least painful) to 5 (most painful) was associated with a representative behaviour (see Tables 1 & 2). An individual's score over the 1 h period was calculated by adding the number of observations in which the animal was observed in each of the five postures, multiplied by the respective pain score of each posture. Total clinical score for each breed was calculated by adding together all of the individual scores for each lamb drawing on both major categories (ie the sum of 10 individual scores for each lamb). The mean clinical score was the sum of the total clinical scores divided by the number of lambs of each breed.

Statistical tests

Comparisons of mean values between the two breeds were made using Student's *t*-tests for the following parameters: 1) frequency of specific behaviours; 2) time to recovery following castration and tail docking; 3) respiration rate before and after castration; and 4) scrotal sac volume. A paired *t*-test was used to compare changes in respiration rate as a consequence of castration and tail docking between the two breeds.

Comparisons of median values between the two breeds were made for the overall clinical scores and the major and minor restlessness scores using Mann-Whitney *U*-tests. Correlations between restlessness scores and scrotal sac volumes were looked for using Spearman rank correlations.

Results

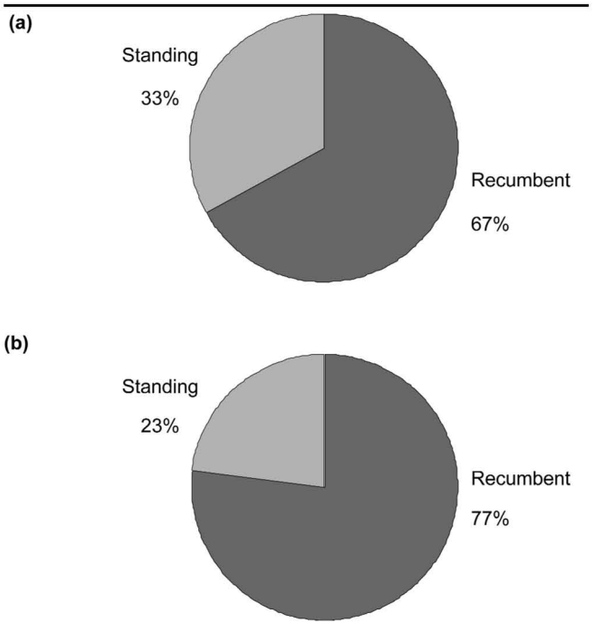
Pre-procedures behaviour

All of the lambs displayed normal behaviour patterns before castration and tail docking with the exception of two (one Charolais and one Suffolk) that lay in a ventro-lateral position throughout the pre-procedures observation period. These lambs were examined and appeared to be clinically normal. They both maintained normal postures throughout a second pre-procedures observation period.

Post-procedures behaviour

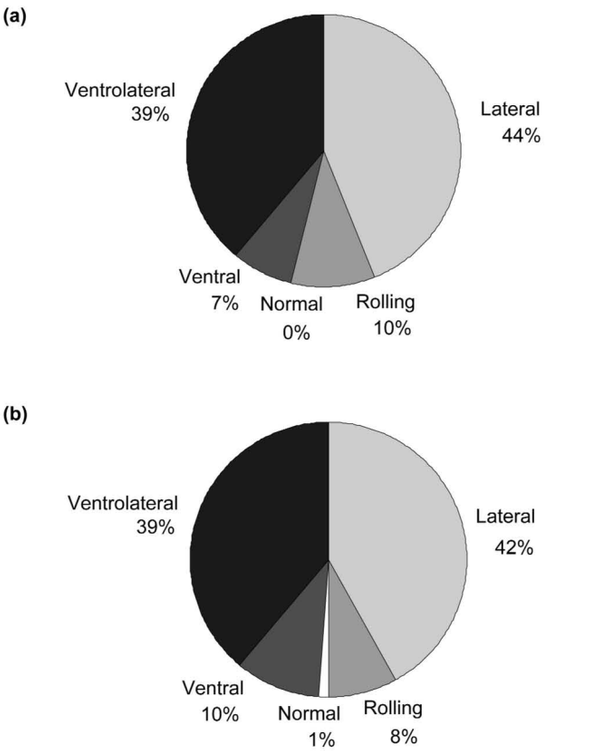
All of the lambs displayed abnormal behaviour patterns post-procedures. Both breeds of lamb spent the majority of

Figure 1



Percentage of time that Charolais (a) and Suffolk (b) lambs spent in either of two broad behaviour categories during the 1 h post-procedures observation period after castration and tail docking with the rubber ring method.

Figure 2



Percentage of time that Charolais (a) and Suffolk (b) lambs spent in each individual position within the recumbent behaviour category during the 1 h post-procedures observation period.

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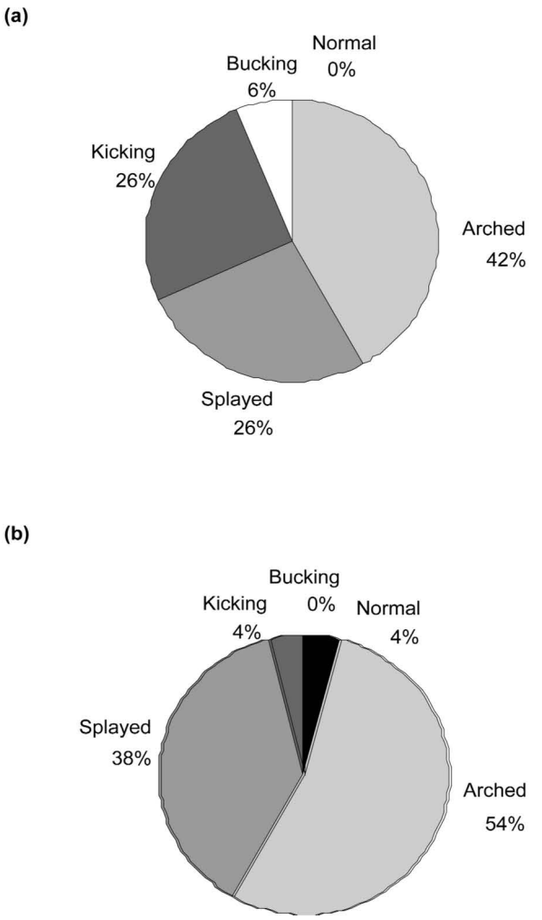
Figure 3



Percentage of time that Charolais (a) and Suffolk (b) lambs spent in each individual position within the standing behaviour category during the 1 h post-procedures observation period.

the observation period in a recumbent position (Figure 1). Suffolk lambs spent an extra 10% of their time lying down compared to Charolais lambs, but this difference was not statistically significant.

No significant difference was found between the percentage of time that lambs of the two breeds spent in each of the five recumbent postures. In fact, the time spent in these different postures was remarkably similar between breeds (Figure 2).

Analysis of the individual standing postures observed in the post-procedures period revealed a marked breed variation (Figure 3). A significant difference was found between the percentage of time that Charolais lambs spent kicking, compared with Suffolk lambs ($P < 0.01$). Ten of the 14 Charolais lambs (71.4%) were observed kicking at one or more observation times during the post-procedures observation period, compared with only two of 24 Suffolk lambs (8.3%).

No significant difference was found between the mean clinical scores of the two breeds (Charolais: [mean ± standard error] 43.6 ± 1.3; Suffolk: 41.6 ± 1.4), despite the observed difference in standing behaviour described above. With respect to evoked responses, all of the lambs showed a response to entry into the pen with the exception of one Suffolk lamb. Responses varied from movement of the head alone to a complete change in position. The time taken to return to a normal posture (ie recovery) was significantly greater for Charolais lambs (159.0 mins) than for Suffolk lambs (97.8 mins) ($P < 0.01$). Three of the 14 Charolais lambs took more than 3 h to recover, whereas none of the twenty Suffolk lambs exceeded this time point.

Respiration rate

The respiration rate of all lambs prior to castration and tail docking was found to be within the normal range expected for neonates of these species (30–70 breaths per min [Terra 1996]), and there was no difference between the two breeds (Charolais: 40.3 ± 3.0 breaths per min; Suffolk: 42.7 ± 1.8 breaths per min). All lambs showed an increase in respiration rate following castration and tail docking, resulting in post-procedures values of 85.29 ± 4.23 and 72.33 ± 4.38 breaths per min for Charolais and Suffolk lambs respectively. However, one Suffolk lamb showed no change between the pre and post-procedures measurement and another showed an overall decrease. The increase observed in respiration rate as a result of castration and/or tail docking was significantly greater in Charolais (45.0 ± 3.7 breaths per min) than in Suffolk lambs (29.7 ± 4.4 breaths per min) ($P < 0.05$).

Scrotal sac measurements

The mean scrotal sac volume of Suffolk lambs (67.0 ± 3.8 cm^3) was significantly greater than that of Charolais lambs (40.8 ± 2.1 cm^3) ($P < 0.01$).

Restlessness scores

Further analysis of the behavioural observations revealed that the Charolais lambs were significantly more restless than the Suffolk lambs. Charolais lambs had significantly higher major restlessness scores ($P < 0.01$; Figure 4), with none of the Suffolk lambs achieving a score equal to the average value obtained by the Charolais lambs.

The minor restlessness scores of the Charolais lambs were also significantly greater than those of the Suffolk lambs ($P < 0.01$; Figure 5), although, in this case, the score of one Suffolk lamb did equal the average Charolais score.

Pooling data from the two breeds, an overall significant negative correlation was observed between scrotal sac volume and major restlessness score (Spearman rank correlation coefficient r = –0.4639; $P < 0.01$; Figure 6). The relationship between scrotal sac volume and minor restlessness score was also almost significant (Spearman rank correlation coefficient r = –0.3055; $P = 0.06$).

Discussion

The pre-procedures behaviour of all lambs of both breeds was normal. However, all lambs displayed abnormal postures following the application of rubber rings for castration and tail docking. The behavioural changes observed were probably a direct result of the application of rubber rings since no anaesthesia was used. The post-procedures

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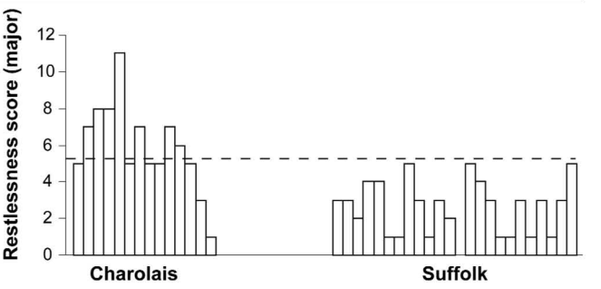
abnormal positions of lambs observed in this study seem to be a direct result of tail docking and castration as reported previously (Graham *et al* 1997; Molony *et al* 1997). However, from the results of this study it is difficult to determine the proportion of pain inflicted by castration and by tail docking separately. Nevertheless, significant differences were observed between the two breeds of lamb in their response to the same husbandry procedure.

The post-procedures recumbent postures of both breeds were remarkably similar (with ventro-lateral and lateral positions being most commonly observed), but there was marked breed variability within the standing category. Charolais lambs spent a significantly greater proportion of time exhibiting escape behaviours such as kicking and bucking, whereas Suffolk lambs demonstrated avoidance postures such as standing statuesque with the hind limbs splayed. Escape and avoidance mechanisms have been previously defined as categories of behaviour that are exhibited in response to distress (Chapman *et al* 1985). Escape mechanisms are characterised by an increased movement and alteration in posture and are thought to be largely involuntary in origin, whereas avoidance mechanisms are thought to be voluntary (Molony & Kent 1997). However, it remains to be determined whether the postural differences in standing behaviour observed between the two breeds in the present study are just different ways of expressing a similar level of distress or whether they relate to an underlying difference in pain thresholds. Some workers (Kent *et al* 1995) have suggested that lambs displaying avoidance behaviour are in less pain, whereas others (Morton & Griffiths 1985) have proposed that statuesque postures are adopted only in the case of extreme pain levels. There was no difference in the overall behaviour scores of the two breeds, which might suggest that the escape and avoidance mechanisms represent similar levels of distress. However, compared to Suffolk lambs, Charolais lambs showed a greater increase in respiration rate and prolonged recovery times as well as a higher restlessness score. If the increase in respiration rate, recovery time and/or degree of restlessness are taken as indicators of distress, it would be logical to suggest that the escape behaviour observed in Charolais lambs was associated with a greater degree of distress and pain. Or alternatively, the greater increase observed in the respiration rate of the Charolais lambs could be explained on the basis of a higher metabolic rate.

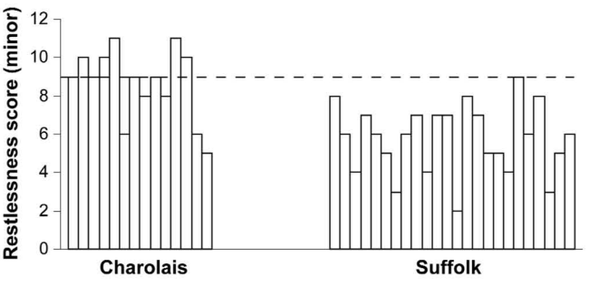
The level of restlessness in lambs of both breeds decreased with time. This is consistent with the findings of Molony and Kent (1997), and could be due to a gradual decline in pain or simply to fatigue. Most of the lambs had returned to a normal posture by 3 h post-procedures. However, the fact that some of the lambs resumed suckling for brief periods but returned to an abnormal posture at a later time, suggests that suckling should not be used as a marker for returning to normal behaviour. It is possible that suckling may have commenced whilst pain was still being experienced. Suckling may have been an attempt to seek comfort, and its occurrence is also likely to have depended on how recently the lamb had fed prior to castration and tail docking. Alternatively, the resumption of abnormal behaviour following a period of normal behaviour may have been indicative of a more chronic pain, although the fact that some lambs demonstrated this change within a few minutes of castration makes it highly unlikely.

Figure 4



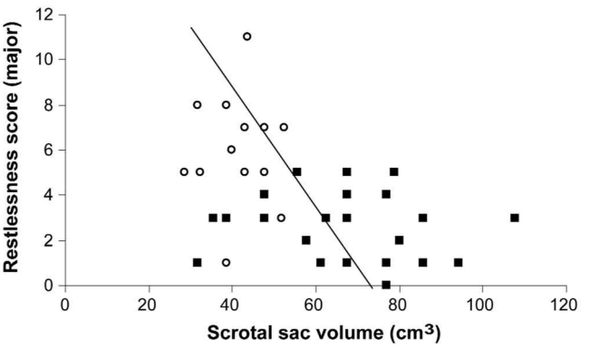
The major restlessness scores of individual Charolais and Suffolk lambs recorded during the 1 h post-procedures observation period. The horizontal dotted line indicates the median value for Charolais lambs.

Figure 5



The minor restlessness scores of individual Charolais and Suffolk lambs recorded during the 1 h post-procedures observation period. The horizontal dotted line indicates the median value for Charolais lambs.

Figure 6



The correlation between major restlessness score over the 1 h post-procedures observation period and scrotal sac volume for Charolais (circles) and Suffolk lambs (squares) (r = –0.4639).

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The possibility of a breed-related physical difference causing the observed changes in behaviour was investigated through measurement of the scrotal sac volume. Suffolk lambs had a significantly larger scrotal sac volume than Charolais lambs. The more restrictive nature of a smaller scrotal sac could explain the more intense reaction of the Charolais lambs to castration. However, although across all lambs a correlation was found between a small scrotal sac volume and increased restlessness, this relationship was not found when lambs of the two breeds were considered separately. Measurements of how large the testes were relative to the scrotal sac volume, how easily they could be moved and held in the scrotal sac, and how elastic the tissues were in general, may have been more appropriate.

Animal welfare implications

In the light of the findings of this and previous studies it is important to consider what degree of abnormal behavioural response should be considered unacceptable following castration and tail docking, and the extent to which pain can be reduced by modifying current procedures. Only those methods of castration and/or tail docking causing the least distress should be utilised. Surgical castration has been shown to cause the greatest rise in physiological indicators of pain (Mellor & Stafford 2000) and is therefore not an option. The use of local anaesthetic in conjunction with methods such as rubber ring castration and bloodless castration has been shown to abolish acute behavioural and cortisol responses (Wood *et al* 1991; Graham *et al* 1997; Molony *et al* 1997; Dinnis *et al* 1999; Sutherland *et al* 1999; Thornton & Waterman-Pearson 1999) and should be included whenever possible. It has been suggested that the use of a rubber ring and a distally placed bloodless castrator (which crushes sensory afferents) is one of the most effective methods of reducing acute pain following castration (Molony *et al* 1997) and tail docking (Graham *et al* 1997). More rapid healing of the scrotal wounds is a further advantage of this method (Kent *et al* 2000; Sutherland *et al* 2000). The procedure is relatively inexpensive and rapid, and would probably be acceptable to farm personnel, although re-training may be required. However, it does not avoid pain generation whilst the procedure is actually being performed (Sutherland *et al* 2000).

In conclusion, the results of this study suggest that there is breed variability in the acute pain responses of lambs to castration and tail docking with the rubber ring method. Including lambs of other breeds and additional methods of pain assessment (eg physiological markers) may further strengthen this finding. Moreover, further studies are required to determine whether the escape and avoidance behaviours exhibited by lambs reflect different intensities of pain or simply a difference in the temperament and character of different breeds.

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