The Effect of Milk Suckling from the Dam or Glucose Administration on the Behavioural Responses to Tail Docking in Lambs

L. LANDA

Department of Pharmacology, Faculty of Medicine, Masaryk University Brno

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Abstract

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Rubber ring tail docking is a painful procedure and elicits changes in behaviour of lambs. The aim of this study was to find out if natural suckling of milk or administration of glucose prior to rubber ring tail docking could decrease painful responses to the procedure. The first result of this study was that rubber ring tail docking elicits pain in lambs of age less than 24 hours, which has not been published yet. In the naturally suckled group (Experiment 1), suckling did not produce any significant decrease in the behavioural responses to tail docking. No significant differences in responses were observed in the group given glucose (Experiment 2) when measured over the thirty minute period after the treatment. However, in this experiment when behavioural responses were analysed for the three ten-minute periods after treatment a significant reduction of abnormal lying was found during the first ten-minute interval in the group given glucose ($p = 0.03$). In this group, non-significant decreases in the incidence of head turning and overall limb activity score also occurred. This suggests that there was at least some small effect of glucose intake on the behavioural responses to the rubber ring tail docking.

Tail docking, rubber rings, lamb, suckling, pain, analgesia

Rubber rings are the most widespread method of tail docking in England and Wales (French et al. 1992). Non-tail docked lambs are more likely to suffer from fleece soiling and fly strike than tail docked animals (French et al. 1994ab) and this could cause even more pain and distress than tail amputation. Whereas tail docking in other farmed species is prohibited (calves) or under discussion (pig) in the UK tail docking in lambs is likely to be necessary until another practical means of reducing fly strike is found. However, consumer interests regarding animal welfare are increasing and so the methods used for painful procedures should be improved and refined to decrease the suffering of animals. In comparison to other methods (surgery, hot iron, Burdizzo) manipulation with rubber rings is very easy and quick and moreover cheap and effective. Barrowman et al. (1954), Lester et al. (1991) and Graham et al. (1997) suggest that rubber ring tail docking causes pain in young lambs. Lester et al. (1991) found using cortisol response for assessment of distress and pain that rubber rings (and heated iron) are less painful than surgical tail docking with a knife in lambs aged between 4 and 5 weeks. Nevertheless these procedures still produce pain even in lambs during the first week of life (Kent et al. 1998) although it has been thought that the young organism is less capable of perceiving pain because its nervous system was not fully developed (Katz 1977). Owens (1984) demonstrated that anatomical structures involved in pain perception are already developed during gestation and may be in function.

Noonan et al. (1994) who observed reactions of piglets during painful procedures (tail docking, ear notching and teeth clipping) suggested that teat-seeking activity could be redirected behaviour that helps the animals to cope with stressful situations. Some recent studies confirmed that components of breast milk activate endogenous opioid system (Korthank and Robinson 1998) and other findings showed that release of endogenous

Address for correspondence:
MVDr. Leoš Landa
Farmakologický ústav LF MU
Joštova 10, 662 43 Brno
Czech Republic

Phone: +420 542 126 371
Fax: +420 542 126 377
E-mail: landa@med.muni.cz
http://www.vfu.cz/acta-vet/actavet.htm

opioids can also be induced in young animals by intake of sweet tasting food (Blass and Hoffmeyer 1991; Nikfar et al. 1997). It was also believed that activation of endogenous opioid system is associated with decreased response of children and young animals to painful stimulation after intake of breast milk and sweet solutions (Shide and Blass 1989; Blass et al. 1987). Increased threshold of pain induced by intake of breast milk or sweet tasting solution was conversely completely blocked by opioid antagonist naltrexone (Kehoe and Blass 1986) which confirms that suckling or sweet taste-induced analgesia is mediated by endogenous opioids (Blass and Hoffmeyer 1991). Furthermore, Smotherman and Robinson (1992) specified the involvement of μ and κ opioid receptors in mediation of that effect. Besides the above-mentioned mechanisms a possible increase of pain threshold in regard to the presence of estrogens and progesterone in milk is also discussed (Dawson-Basoa and Gintzler 1998). Effect of these hormones on modulation of behaviour associated with pain was also confirmed by Vincler et al. (2001). In addition, Meisel et al. (1989) reported that milk proteins are also a rich source of biologically active peptides (casomorphins among others) that are released during intestinal ingestion of caseins.

Some observations (Barrowman et al. 1954; Graham 1997; Graham et al. 1997) suggest that a certain number of lambs show little response to tail docking in the first ten minutes after treatment. These lambs have been described as 'low responders', however, the mechanism underlying these limited responses is still unclear. The phenomenon of suckling and sweet taste induced analgesia described in human infants, rats and mice could nevertheless provide a possible explanation for the limited response shown by some lambs. It was therefore decided to determine if this phenomenon occurred in lambs and if it can affect the responses of lambs to tail docking with rubber rings. If this analgesic effect occurs, it might be used to improve animal welfare by reducing suffering from this procedure.

Materials and Methods

The observations were carried out during April and May at Moredun Research Institute's Firth Main Farm near Edinburgh in two experiments. Experiment 1 was designed to test the null hypothesis that suckling milk for at least 2 min from the dam immediately before treatment would not reduce the abnormal behavioural responses to rubber ring tail docking. In the Experiment 2, the null hypothesis was tested that administering 2 ml 30% glucose solution immediately before treatment would not reduce the abnormal behavioural responses seen after rubber ring tail docking.

Experimental design

The effect of natural suckling of the ewe (Experiment 1)

Forty-four Suffolk cross Greyface lambs with a mean body mass of 4.8 kg (range 3.5-7.0 kg) were treated 12-24 h after birth. There were 19 male and 25 female lambs. Lambs were placed in pens (1.30 m 1.64 m) on straw with their dams at birth. They were weighed and tail docked using a standard rubber ring (Paragon Co. Ltd., Skegness UK), either immediately after suckling the dam for at least 2 min (TS, n = 22) or after the lamb had not suckled for at least 10 min (TN, n = 22). All behavioural observations were made for 30 min by one person standing outside the pen and recording the behaviour on pre-defined paper forms of ethograms. The behaviour of the untreated siblings was observed for 30 min as a control suckled group (CS, n = 11) or control non-suckled group (CN, n = 11) lamb. Moreover, some of the tail docked lambs were later on observed for a 30 min period, which began 35 to 45 min after tail docking. These lambs were divided in two "recovering" groups, either suckled (RS, n = 11) or non-suckled (RN, n = 11) and considered also as control individuals.

According to studies in human infants (Blass and Watt 1999), suckling-induced analgesia (SIA) appears to occur immediately after suckling for two minutes and therefore, in this experiment the rubber ring was also applied to the tail immediately after suckling. Using an elastrator the rubber ring was placed about 10 cm from the base of the tail (at the point where the wool starts on the underside of the tail).

The effect of the glucose solution intake (Experiment 2)

Sixteen Suffolk cross Scottish Blackface lambs were weighed 12-24 h after birth [3.5 kg-8.5 kg (mean 5.0 kg)]. Lambs were accommodated in the same way as described above. There were 10 male and 6 female lambs. Non-tail docked lambs were firstly observed as handled controls. Note was taken of whether they had drunk glucose (HSu, n=8) or not (HNSu, n=8) prior to observations. Then some animals were fed 2 ml of 30% glucose solution from a plastic syringe and immediately thereafter a standard rubber ring was placed on the tail as described above (TSu, n = 8). Other animals were tail-docked without getting the glucose solution (TNSu, n = 8).

Classification of behavioural responses used to assess pain

Assessment of pain was based on the methodology used by Molony and Kent (1997) and Graham et al. (1997). During the 30-min period immediately after tail docking changes in posture were recorded every 2 min and changes in locomotor activity (restlessness - RTL, rolling and jumping - RL/JP, foot stamping and kicking - FSK, easing quarters - EQ, tail wagging - TW, head turning - HT) were recorded continuously. All activities associated with movements of the limbs (RTL, RL/JP, FSK, EQ) were combined in an overall limb activity score (REQ), (Molony and Kent 1997). For restlessness a count of 1 represented either the act of lying down or standing up. HT was considered as a movement of the head to the site of pain (i.e. tail). Slow movements of the hindquarters alternately without locomotion were indicated as EQ. In addition, each cry (vocalisation - VOC) and each period at the teat (suckling - SUCK) were recorded. TW was not counted during teat-seeking activity and during suckling because it represents a characteristic sign of lambs' behaviour. Postures were distinguished as standing or lying. Standing was further subdivided into normal standing or walking (S1), abnormal standing or walking with moderate ataxia, swaying or abnormal stance (S2) and severe abnormal standing or walking with stilted gait, walking on knees or walking backward (S3). Lying was subdivided into normal lying ventral (sternal) with head down (V1) or with head up (V2) and abnormal ventral lying with partial or full extension of one or more legs (V3). Lateral lying with a shoulder down and head up or down was indicated as LL and considered as abnormal. Abnormal lying (ABL) was the sum of V3 and LL. Abnormal standing (ABS) was the sum of S2 and S3.

Lambs were classified by Graham (1997) as 'low responders' when the total time spent in abnormal postures for the first 10 min after tail docking was below 2 min and total abnormal frequency score below 20 (a sum of REQ, tail wagging, head turning and vocalisation).

Statistical analysis

For the statistical analysis package CSS STATISTICA (Statsoft, Tulsa, USA) was used. As data were not normally distributed the non-parametric Kruskal-Wallis test was applied to find out if there is a significant difference among the groups, and the non-parametric Mann-Whitney U test was applied to find out between which group pairs a significant difference exists. Values were considered significant if $p < 0.05$ and non-significant if $p > 0.05$.

Results

Effect of natural suckling on the ewe on responses to tail docking

There were no significant differences in behaviour of control lambs either before (CS, CN) or when recovering after tail docking (RS, RN) – see Table 1c. Tail docking significantly increased the overall limb activity score (REQ) ($p < 0.05$), head turning ($p < 0.05$) and tail wagging ($p < 0.05$) - see Table 1b, and Fig. 1. No significant differences were found in suckling ($p > 0.05$) - see Table 1b and Fig. 1. Very little abnormal standing was seen.

Milk suckling did not produce any significant decreases in the abnormal behavioural responses to tail docking – see Table 1b. In fact the incidence of overall limb activity score, tail wagging, head turning and vocalisation were higher in the naturally suckled lambs – see Table 1a and Fig. 1. Thus, the null hypothesis was not disproved and no evidence for effect of suckling on the responses to tail docking was found. There were 3 'low responders' among the naturally suckled lambs and 2 'low responders' among the lambs that did not suck milk - i. e. 11.4%.

Table 1a
Effect of suckling milk prior to tail docking on the median
(interquartile range Q1 to Q3) of REQ, HT, SUCK, TW, VOC and ABL

Treatment	REQ	HT	SUCK	TW	VOC	ABL
TN	31.5 (14.5 to 78.5)	8.0 (2.0 to 15.0)	1.0 (0.0 to 2.0)	41.0 (17.0 to 60.0)	1.5 (0.0 to 10.0)	3.0 (0.0 to 10.0)
TS	52.8 (39.5 to 91)	12.0 (7.0 to 17.0)	2.0 (0.0 to 3.0)	43.0 (30.5 to 65.0)	2.0 (1.0 to 8.0)	2.0 (0.0 to 12.0)
CN	6 (3.5 to 12.0)	1.0 (1.0 to 4.0)	1.0 (0.0 to 3.0)	4.0 (3.0 to 14.0)	1.0 (0.0 to 2.0)	0.0 (0.0 to 6.0)
CS	7.5 (1.5 to 12.5)	1.0 (0.0 to 2.0)	2.0 (1.0 to 4.0)	7.0 (4.0 to 12.0)	0.0 (0.0 to 1.0)	0.0 (0.0 to 2.0)
RN	7.5 (2.0 to 13.5)	1.0 (1.0 to 5.0)	1.0 (0.0 to 2.0)	6.0 (1.0 to 13.0)	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)
RS	3.5 (2.5 to 10.5)	1.0 (0.0 to 2.0)	1.0 (0.0 to 2.0)	5.0 (3.0 to 13.0)	0.0 (0.0 to 1.0)	0.0 (0.0 to 2.0)

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), TN = tail docked non-suckled milk, TS = tail docked suckled milk, CN = control non-suckled milk, CS = control suckled milk, RN = recovering non-suckled milk, RS = recovering suckled milk

Table 1b

P values for TW, HT, VOC, SUCK, REQ and ABL showing whether or not there is a significant difference between various treatments (TN – TS, TN – CN, TN – CS, TN – RN, TN – RS, TS – CN, TS – CS, TS –RN, TS -RS)

Treat.	TN - TS	TN – CN	TN - CS	TN – RN	TN – RS	TS - CN	TS - CS	TS -RN	TS - RS
TW	0.78	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
HT	0.29	**0.01**	**0.00**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
VOC	0.56	0.31	**0.03**	**0.03**	0.17	0.10	**0.00**	**0.00**	**0.03**
SUCK	0.35	0.72	0.05	0.75	0.82	0.75	0.26	0.29	0.33
REQ	0.15	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ABL	0.70	0.10	**0.03**	**0.02**	0.10	0.22	0.11	0.06	0.23

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), TN = tail docked non-suckled milk, TS = tail docked suckled milk, CN = control non-suckled milk, CS = control suckled milk, RN = recovering non-suckled milk, RS = recovering suckled milk, values were considered significant if $p < 0.05$ (these cases are in bold).

Table 1c

P values for TW, HT, VOC, SUCK, REQ and ABL showing whether or not there is a significant difference between various treatments (CN – CS, CN – RN, CN – RS, CS – RN, CS – RS, RN – RS)

Treat.	CN - CS	CN - RN	CN – RS	CS - RN	CS - RS	RN - RS
TW	0.76	0.57	0.89	0.62	0.81	0.76
HT	0.24	0.89	0.24	0.20	1.00	0.22
VOC	0.12	0.13	0.54	0.75	0.33	0.28
SUCK	0.21	0.56	0.60	0.05	0.07	0.94
REQ	0.69	1.00	0.27	0.76	0.32	0.53
ABL	0.67	0.40	0.87	0.52	0.84	0.42

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), CN = control non-suckled milk, CS = control suckled milk, RN = recovering non-suckled milk, RS = recovering suckled milk, values were considered significant if $p < 0.05$

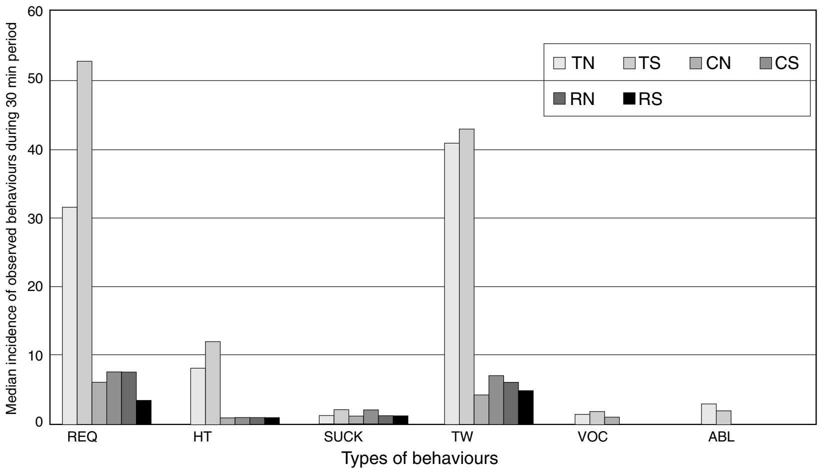

Fig. 1. The effect of natural suckling prior to tail docking on observed behaviours. TN = tail docked non-suckled milk, TS = tail docked suckled milk, CN = control non-suckled milk, CS = control suckled milk, RN = recovering non-suckled milk, RS = recovering suckled milk, REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL)

Effect of glucose solution

Similarly to the milk suckling experiment, intake of glucose had no significant effect on control (handled) groups – see Table 2b. Tail docking significantly increased the overall limb activity score ($p < 0.05$), head turning ($p < 0.05$), tail wagging ($p < 0.05$) – see Table 2b and Fig. 2. No abnormal standing was seen. Glucose intake did not produce any significant decreases in the abnormal behavioural responses to tail docking in the thirty minute period after treatment – see Tables 2a and 2b. Thus the null hypothesis was again not disproved and no substantial evidence for an effect of glucose was found. However, in this experiment behavioural responses were measured for the three ten-minute intervals post-treatment to find if a response occurred within the 30-min period. A significant difference was found in ABL during the first interval ($p < 0.05$) see Table 2c. No significant differences in other types of behaviour were found – see Table 2c.

'Low responders' were also found in this experiment. Six in the glucose intake group and four in the glucose no intake group i.e. ten out of a total number of sixteen.

Table 2a
Effect of glucose intake prior to tail docking on the median
(interquartile range Q1 to Q3) of REQ, HT, SUCK, TW, TW, VOC and ABL

Treatment	REQ	HT	SUCK	TW	VOC	ABL
TNSu	19.5 (9.5 to 40.25)	7.0 (3.0 to 10.0)	0.0 (0.0 to 1.0)	9.0 (0.0 to 0.0)	0.5 (0.0 to 1.5)	9.0 (1.0 to 22.0)
TSu	17.3 (10.5 to 45.5)	5.5 (2.5 to 9.0)	0.0 (0.0 to 1.0)	9.5 (5.5 to 28.5)	0.5 (0.0 to 3.5)	0.0 (0.0 to 5.0)
HNSu	4.0 (3.0 to 5.0)	1.5 (1.0 to 2.0)	2.0 (1.5 to 3.0)	3.0 (2.5 to 5.0)	0.0 (0.0 to 0.5)	0.0 (0.0 to 3.0)
HSu	4.3 (3.0 to 6.5)	1.0 (0.0 to 1.0)	2.0 (0.0 to 2.5)	3.0 (3.0 to 4.0)	0.0 (0.0 to 0.5)	0.0 (0.0 to 0.0)

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), TNSu = tail docked no glucose intake, TSu = tail docked glucose intake, HNSu = handled no glucose intake, HSu = handled glucose intake

Table 2b
P values for TW, HT, VOC, SUCK, REQ
and ABL showing whether or not there is a significant difference between various treatments

Treatment	TNSu - TSu	TNSu - HNSu	TNSu - HSu	TSu - HNSu	TSu - HSu	HNSu - HSu
TW	0.79	**0.00**	**0.00**	**0.02**	**0.02**	1.00
HT	0.71	**0.00**	**0.00**	**0.01**	**0.00**	0.10
VOC	0.86	0.22	0.22	0.22	0.22	1.00
SUCK	0.79	**0.01**	0.09	**0.01**	0.11	0.38
REQ	1.00	**0.00**	**0.00**	**0.00**	**0.00**	0.63
ABL	0.09	0.06	**0.02**	0.81	0.30	0.33

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), TNSu = tail docked no sucrose intake, TSu = tail docked glucose intake, HNSu = handled no glucose intake, HSu = handled glucose intake, values were considered significant if $p < 0.05$ (these cases are in bold).

Table 2c
p values for TW, HT, VOC, SUCK, REQ and ABL showing whether or not there is a significant difference
between HSu and HNSu groups during three ten minutes intervals

Behaviour	10 min	20 min	30 min
TW	0.11	0.66	0.65
HT	0.95	0.67	0.55
VOC	0.95	0.92	0.14
SUCK	0.53	0.31	0.31
REQ	0.75	0.91	0.67
ABL	**0.03**	0.21	0.15

REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL), TNSu = tail docked no glucose intake, TSu = tail docked glucose intake, HNSu = handled no glucose intake, HSu = handled glucose intake, values were considered significant if $p < 0.05$ (this case is in bold).

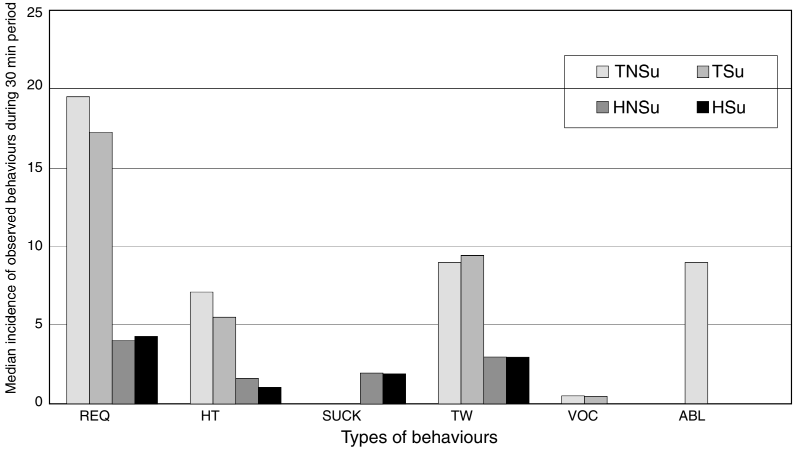

Fig. 2. The effect of glucose intake prior to tail docking on observed behaviours. TNSu = tail docked no glucose intake, TSu = tail docked sucrose intake, HNSu = handled no glucose intake, HSu = handled glucose intake, REQ = restlessness + rolling/jumping + foot stamping and kicking + easing quarters, HT = head turning, SUCK = suckling the ewe, TW = tail wagging, VOC = vocalisation, ABL = abnormal lying (V3+LL)

Discussion

The results of this study show that rubber ring tail docking elicits pain in lambs of age less than 24 hours. This was confirmed by significant increases in the overall limb activity score, tail wagging (those occurring during suckling not considered) and head turn. These changes in behaviour were similar to those described previously - for tail docking carried out in lambs of 5-6 days of age (Molony and Kent 1997) and for tail docking carried out on lambs of one week of age (Kent et al. 1998). Two types of behaviour, overall limb activity and tail wagging were mainly affected by tail docking - see Figs 1 and 2.

Some lambs did not respond to painful stimuli caused by rubber ring tail docking in both experiments, however, these ‘low responders’ were not related to the different treatments and this suggests that milk suckling prior to treatment is not responsible for the lambs’ failure to respond. ‘Low responders’ were found in the group that suckled milk prior to tail docking and also in the group that did not. The occurrence of ‘low responders’ is consistent with the findings of Graham (1997), nevertheless the incidence in this study was about 3.5 percent less than in the study of Graham (1997).

‘Low responders’ were also found in Experiment 2: six in the group given glucose and four in the group without it. However, because the number of lambs in this experiment was rather small (n = 8 per group) and some of these groups had less than 5 lambs which responded, no conclusion could be drawn.

There was a significant difference in abnormal lying, during the first ten-minute interval, between tail docked glucose intake and tail docked no glucose intake lambs in our experiment. This suggests that there was a small analgesic effect of glucose intake consistent with the report of Skogsdal et al. (1997). They found that drinking of 30% glucose alleviated pain during heel-prick test in human infants whereas 10% glucose and breast milk did not. The reason for that remains unclear. In addition to significant changes in abnormal lying there were non-significant reductions in the incidence of head turn and overall limb activity in the group that drank glucose. Although these changes were non-significant a tendency to suppress painful responses caused by tail docking was to some extent apparent.

A possible explanation why natural suckling and glucose intake did not clearly reduce pain responses in the present experiments might be that the type of pain involved is different from that involved in the experiments on human infants and rats. The pain that was reduced in research made earlier in human infants (Blass and Hoffmeyer 1991) and rats (Ren et al. 1997) was caused by blood collection or circumcision and by application of hot iron, respectively. This means that the character of pain was surgical or caused by heat whereas the pain during tail docking was mechanical and ischaemic. This latter pain is likely to be caused by prolonged nociceptive stimulation due to direct pressure and subsequent ischaemia that develops distal to the ring (Graham et al. 1997). It is also possible that pain caused by tail docking using rubber rings is so intense and severe that any analgesic effect of suckling or glucose is too low to significantly affect the behavioural responses.

In conclusion, the present study has shown that rubber ring tail docking produces behavioural changes in lambs less than 24 hours old, which has not been published yet. No effects of milk suckling on behavioural responses to rubber ring tail docking in lambs of this age were found and the effects of glucose intake were very limited just to the first 10-min period after the application of the rubber ring. Thus, the present results did not fully confirm the assumption that suckling in lambs induces analgesia during rubber ring tail-docking. Further research would be required to solve this question.

Vliv sání mléka nebo příjmu glukózy na behaviorální odpovědi při zkracování ocasu u jehňat

Zkracování ocasu u jehňat nasazením gumového kroužku je bolestivý zákrok, který vyvolává změny chování. Cílem předkládané studie bylo zjistit, zda přirozené sání mateřského mléka nebo perorální aplikace glukózy před zkrácením ocasu pomocí gumového kroužku, může snížit bolestivé reakce jehňat na tento zákrok. Prvním, dosud nepopsaným zjištěním bylo, že zkracování ocasu gumovým kroužkem vyvolává bolest i u jehňat mladších než 24 hodin. Ve skupině, která sála mléko od matky (Experiment 1) nevyvolalo sání mléka signifikantní snížení behaviorálních odpovědí na bolestivou stimulaci. Žádné signifikantní změny chování se během měření třicetiminutového intervalu jako celku neobjevily ani po podání glukózy (Experiment 2). Avšak v tomto druhém experimentu s použitím glukózy byly behaviorální reakce na bolest analyzovány po aplikaci gumového kroužku pro každý desetiminutový interval zvlášť. Během prvního desetiminutového intervalu se objevilo signifikantní snížení abnormálního ležení (p = 0.03). V této skupině se také objevily nesignifikantní trendy poklesu frekvence otáčení hlavy k místu bolesti a celkové aktivity končetin. To naznačuje, že alespoň příjem glukózy měl určitý analgetický vliv na behaviorální odpovědi jehňat při bolestivé stimulaci gumovým kroužkem.

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