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A first description of the physiological and behavioural responses to disbudding in goat kids

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Abstract

In order to determine the stress response to disbudding, physiological and behavioural response was investigated in disbudded kids and compared with a control group. Disbudded kids (n = 14), were disbudded by thermal cauterisation, and control kids (n = 15) received the same management without being disbudded. Cortisol was measured at –20, –10 and 0 min (pre-treatment), 0, 10, 20 and 30 min as well as 1, 2, 3 and 4 h from disbudding. Frequency and intensity of the behavioural response (kicks, vocalisations) were also recorded during disbudding. Cortisol was higher in disbudded than in control kids during the first 2 h after disbudding. The cortisol area under the curve was 235% higher in disbudded compared to control animals (828 [± 67.4] and 350 [± 65] nmol L^{-1}, respectively). Disbudded kids showed high intensity behaviours in a greater number of animals (100%) and with a greater frequency than controls. These results indicate the presence of acute stress and a potentially painful experience. In conclusion, disbudding in goat kids induces an acute cortisol increase, which lasts for a duration of 2–3 h and a significant behavioural response. This clearly suggests the necessity of using anaesthesia/analgesia to avoid pain and stress.

Keywords: *animal welfare, dehorning, disbudding, goat kid, pain, stress*

Introduction

In the wild, animals use their horns as weapons for defence against predators, and offence in battles between males for breeding access to females; horns are also used during competitive situations in domestic ruminants (Al-Sobayil 2007).

In housed conditions, horned animals are more likely to be a threat to pen mates and are more likely to destroy facilities than animals without horns. They are also more dangerous to personnel when handled. In cattle, horns are the single major cause of carcase wastage due to bruising (AVMA 2006). In goats, horned animals require more feeding space at the trough (Loretz *et al* 2004). Dehorning/disbudding is a common practice to avoid the occurrence of these problems (Harjinder *et al* 1980).

In goat kids, the practice of disbudding is performed during the first 2–4 weeks of life, to remove the germinal tissue of the horn (Smith & Sherman 1994; Al-Sobayil 2007; Valdmanis *et al* 2007), which prevents horn development in adults.

During the process of disbudding/dehorning, animals are exposed to conditions that reduce their welfare and a number of behaviours indicative of acute pain and distress are clearly observed (Graf & Senn 1999; Stafford & Mellor 2005; AVMA 2006). However, there is no available information on this issue in goat kids.

In other species (calves), disbudding produces both physiological and behavioural changes indicative of acute stress and general malaise (Bristow & Holmes 2007). Fluctuations in plasma cortisol concentrations have been widely used as an index for distress caused by husbandry practices (Molony *et al* 1995; von Borell 1995; Molony & Kent 1997). In calves, cortisol levels and behaviours indicative of pain rise abruptly from the time of disbudding, and remain high for 4–5 h (Morisse *et al* 1995; McMeekan *et al* 1998; Sylvester *et al* 2004).

In goat kids, disbudding is clearly a stressful situation and, although it is a common practice, there is no information regarding the ensuing physiological and behavioural response. Disbudding is carried out by thermal cauterisation; however, no descriptions have been published on the cortisol response to this method of disbudding. Consequently, the objective of the present study was to determine the cortisol and behavioural response of goat kids to disbudding by thermal cauterisation.

Materials and methods

The study was conducted at an experimental farm located 30 km south of Mexico City, in accordance with the university guidelines for animal research and with the approval of the Internal Animal Ethics Committee of the Faculty of Veterinary Medicine and Zootechnie. A total of 29 kids (< 20 days of age, French Alpine and Saanen) were used. Each kid was randomly allocated to one of the two groups. In disbudded kids (n = 14), horn buds were cauterised using an electric dehorner (220 volts) heated to 600°C (Buttle *et al* 1986). Disbudding was only simulated in control kids (n = 15), which were only handled to obtain samples. The same person always performed disbudding and simulation. During disbudding, each kid was held by an expert assistant in a gentle and safe way, immobilising the head. The hair around each horn bud was shaved before the procedure; after disbudding, each button was sprayed with a local disinfectant (Furazolidone, Topazone, Pisa, Mexico). During the study, kids were fed according to the typical management procedures of the farm (*ad libitum* milk at 0900 and 1600h), and kept (4.5 h duration for every single kid) in groups of four in 0.5 m^2 pens fitted with a clean, dry bed.

Disbudding was performed using a modification of the technique described by Al-Sobayil (2007), by applying the electrically-heated dehorner three or four times per horn (3–4 s each time); the head was allowed to cool before reapplying the heater (10 s, approximately). The disbudding was considered sufficient when the corium of the horn was completely cauterised according to the same author.

Cortisol was measured in blood samples (1 ml) collected by venipuncture from either jugular vein at –20, –10 and 0 min (pre-treatment), 0, 10, 20 and 30 min as well as 1, 2, 3 and 4 h after treatment. Samples were collected while the kid was gently, but safely, restrained by an assistant. All samples were collected using 22 G 11/2 needles (PrecisionGlide®, Becton Dickinson Vacutainer Systems, Franklin Lakes, NJ, USA) and kept in heparinised tubes. Plasma was obtained by centrifugation immediately after sampling and frozen until assayed using a commercial RIA kit (Diagnostics Products Corporation, Los Angeles, CA, USA). Sensitivity of the assay was 5.5 nmol L^{-1}, while intra- and inter-assay variations were 2.3 and 5.4%, respectively. In order to make a comparison between groups, cortisol levels at every sampling point (–20 min to 4 h) were added to calculate the area under the curve for each group (AUC), so AUC indicates the total mean of cortisol secreted during the study by each treatment. Heart rate (HR) and respiratory rate (RR) were also monitored using a stethoscope before collection of each blood sample.

Behavioural reactions and vocalisations were video-recorded during disbudding or simulation. The behaviours that were registered included kicks (slight or vigorous movements of legs, and attempts to escape), and vocalisations (emission of bleats with open or closed snout), as described before in calves (Graf & Senn 1999; Grondahl-Nielsen *et al* 1999). The video camera was always at the same distance from the kid when filming. The intensity of the movements was classified as high (vigorous and sharp movements) or low (slight and hardly perceivable movements; Grondahl-Nielsen *et al* 1999). To classify vocalisations, a digital sound meter (Digital Sound Level Meter, model 33-2055, RadioShack, Fort Worth, TX, USA) was placed at a distance of 20 cm from the loudspeaker of the video recorder, and was always kept at the same volume level; vocalisations were considered high intensity when the readings were > 90 decibels. The individual analysing the video film was unaware which treatment the kids had received.

Data analysis

In order to ascertain the effect of treatment on cortisol secretion, repeated samples ANOVA was used, considering the group as the between-subjects factor and samples as the within-subjects factor. Behavioural data were analysed by comparisons of groups using the Mann-Whitney *U*-test. Comparisons of HR and RR between groups were performed using Duncan's multiple-range test after the repeated measures ANOVA. Association between the intensity of the behaviours and group was made using the Fisher's exact test. A value of $P < 0.05$ was considered as significant (SAS 1999).

Results

Cortisol, heart rate and respiratory rate

Figure 1 shows the individual values of cortisol for both groups. Cortisol values were not significantly different between the groups before the disbudding ($P > 0.05$). Plasma cortisol was significantly elevated immediately after disbudding ($P < 0.0001$), compared to the control group. During the first 2 h after disbudding, cortisol values of disbudded kids were higher than those of the control group ($P < 0.01$; Figure 1).

In the disbudded group, ten minutes after disbudding, cortisol increased to values that were 400% greater than those before the procedure. On average, the cortisol increase lasted for 2–3 h after disbudding, when (3 h after disbudding) corticoid levels in the disbudded group were similar to levels recorded prior to the procedure (Figure 1).

Cortisol AUC was higher in the disbudded than the control group (828 [± 67.4] and 350 [± 65] nmol L^{-1}, respectively; $P < 0.01$).

The HR and RR were not significantly different before the procedure ($P > 0.05$) and were not significantly affected by treatment ($P = 0.26$ and $P = 0.37$, respectively; Figure 2).

Behavioural response

The percentage of kids showing kicks and vocalisations of high intensity was higher in the disbudded (100 and 100%, respectively) than in the control group (13 and 20%, respectively; $P < 0.001$). Disbudded kids showed a higher number of kicks (13 [± 0.7]) and vocalisations of high intensity (18.4 [± 1.6]) than the control (6.8 [± 0.7]; 10.7 [± 1.5], respectively; $P < 0.001$). The percentage of vocalisations that were over 90 decibels was higher in the disbudded kids (91 [± 3]) than in the control (52 [± 6.3]; $P < 0.05$).

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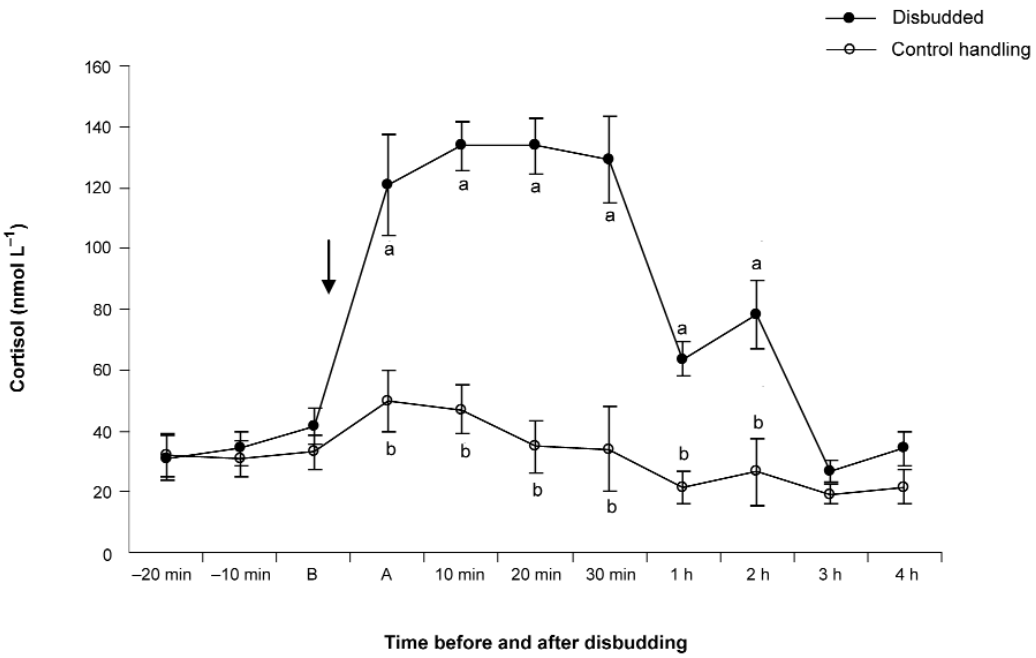
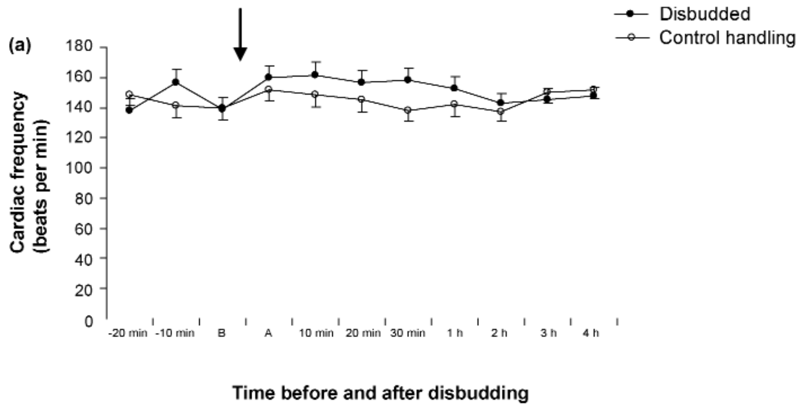
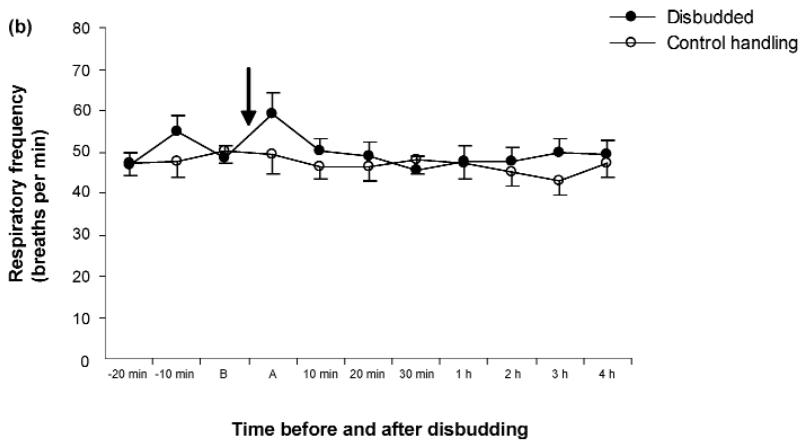
Figure 1



Mean (± SE) cortisol values in disbudded and control handling kids. Arrow indicates the disbudding. [a,b] means are significantly different ($P < 0.01$) between groups. B indicates immediately (2 min) before and A indicates immediately (1 min) after disbudding.

Figure 2





Mean (± SE) heart (a) and respiratory rate (b) in disbudded and control handling kids. Arrow indicates the disbudding in the respective group. B indicates immediately (2 min) before and A indicates immediately (1 min) after disbudding.

Discussion

The world goat population is approximately 800 million (Dubeuf & Boyazoglu 2009); 8–10% of this population is maintained in housed conditions and systematically disbudded/dehorned without any proven anaesthetic/analgesic strategy or a scientific description of the stress induction due to this procedure (Valdmanis *et al* 2007). This would appear to be the first published study to evaluate the adrenal activity and the behavioural response in goat kids as an indicator of stress and malaise in response to disbudding. The results indicate that cortisol levels increase immediately after disbudding, and that behaviour is significantly affected, suggesting an important reduction in the animal's welfare as a result of pain perception (Molony *et al* 1995, 2002), as has been widely observed in cattle (AVMA 2006).

Provision of effective anaesthesia to the horn area before disbudding may reduce or prevent the pain and cortisol elevation, as previously shown in calves (McMeekan *et al* 1998; Grondahl-Nielsen *et al* 1999; Stafford & Mellor 2005). However, preliminary results indicate that lidocaine 2% around horn buds, as has been indicated (Al-Sobayil 2007) and according to the innervation in adults (Lee *et al* 2006), is not efficient for that purpose in goat kids (Alvarez *et al* 2009).

In the control group, plasma cortisol levels increased slightly as a consequence of handling, but never surpassed typically normal values (Eriksson & Teräväinen 1989; Engelbrecht *et al* 2000; Alvarez & Galindo 2008), which corroborates previous results in yearling calves with similar treatments (Graf & Senn 1999). In sham disbudded calves, Graf and Senn (1999) found a minor and transitory increase in glucocorticoid levels, as well as in behaviours not considered to be signs of pain, but as momentary responses to handling and blood sampling of the animals.

HR and RR have been used as indices of acute and chronic stress in animals (Grondahl-Nielsen *et al* 1999; Mohr *et al* 2002; von Borell *et al* 2007). In the present study, these physiological variables did not reveal any significant effects of the disbudding procedure. Clearly, disbudding induces a strong agitation and, therefore, HR and RR would be anticipated to increase. Most likely these variables must be recorded during the procedure in order to detect any alterations. In 4–6 week old calves, Grondahl-Nielsen (1999) found that HR is significantly increased during the 3 h after disbudding.

Behavioural alterations in response to disbudding/dehorning have been widely studied in yearling calves, and it was concluded that such procedures induce increases in both the frequency and intensity of certain behaviours (kicks, vocalisations, head jerks, ear flicking, head rubs, etc; Graf & Senn 1999; Grondahl-Nielsen *et al* 1999; McMeekan *et al* 1999). All these previous studies support the proposal that these behaviours are useful indices of the acute stress and pain experienced by animals during and after dehorning/disbudding (Sylvester *et al* 2004; Weary *et al* 2006). In our study, kicks and vocalisations were of higher intensity and were present in more disbudded animals than in control kids, suggesting a painful experience. In other species of domestic ruminants, a similar experience might be represented by tail docking or castration (Graham *et al* 1997; Molony *et al* 2002), but no comparisons have been reported.

Thus, if high cortisol levels, and an increase in frequency/intensity of the registered behaviours in response to disbudding, indicate a decrease in the welfare of the animal (Molony *et al* 1995; von Borell 1995; Molony & Kent 1997; Grondahl-Nielsen *et al* 1999; AVMA 2006) and perception of painful experiences as well (Sylvester *et al* 2004; Weary *et al* 2006), this study indicates that thermal disbudding is a stressful and painful procedure in goat kids as well as in calves. Further research on possible anaesthetic techniques to avoid pain and stress is necessary to protect the welfare of kids during the disbudding procedure.

It is concluded that disbudding in kids induces a significant behavioural alteration, and an acute cortisol elevation which lasts for 2–3 h. This is strong evidence of a stressful and painful experience that should be prevented as far as possible with effective local anaesthesia/analgesia. Further research is needed to establish practical methods to achieve effective anaesthesia/analgesia.

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