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Cortisol and pain-related behavior in disbudded goat kids with and without cornual nerve block

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HIGHLIGHTS

- Removing horns from domestic ruminants is a common and painful procedure.
- Anesthetic strategies have not been described sufficiently in disbudded goat kids.
- We used local lidocaine to reduce the painful response in disbudded goat kids.
- Nerve block (lacrimal and infratrochlear) did not attenuate the painful response.

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ABSTRACT

Plasma cortisol and behavior were measured in disbudded goat kids with and without the use of cornual nerve block. A total of 45 kids were used in 5 experimental groups (n = 9, males and females). Group LidoD was infiltrated with 1 mL of 2% lidocaine locally at the cornual branches of lacrimal and infratrochlear nerves, 15 min before thermal disbudding. Group Lido was similarly infiltrated and was not disbudded. In group Sim, the disbudding procedure was simulated. A control group (CD) was disbudded without lidocaine infiltration, and group SD was infiltrated with saline before disbudding. The cornual nerve block did not prevent the short-term increase in cortisol levels during and after disbudding. LidoD, CD and SD groups showed higher cortisol concentrations than Lido and Sim ($p < 0.05$) during the first 20 min after the procedure. Frequency of vocalizations during the procedure was significantly different between groups and was higher in SD (29.6 ± 3.1; mean ± SE) and CD (28.4 ± 3.1) than in Sim (16.6 ± 3.1; $p < 0.05$). Infiltrating lidocaine did not decrease this response to disbudding (21.1 ± 3.1; $p > 0.05$). Struggles tended to be higher in SD (16.5 ± 2.5), CD (17.8 ± 2.5) and LidoD (15.6 ± 2.5) than Sim (10.6 ± 2.5; $p = 0.1$). The total behavioral response was different between groups (CD, 59.6 ± 6.8; LidoD, 52 ± 6.8; SD, 62.6 ± 6.8; Sim, 36.8 ± 6.8; $p = 0.05$), and disbudded animals showed the strongest reactions (disbudded, 58.1 ± 3.9 vs non-disbudded, 36.8 ± 6.8; $p = 0.01$). It was concluded that cornual nerve block (lacrimal and infratrochlear) using 2% lidocaine did not prevent pain during thermal disbudding of goat kids.

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1. Introduction

Removing horns from domestic ruminants is a common practice in most dairy farms [1–3]. Dehorned animals are considered to be safer to handle [4], require less feeding and trough space [5,6], cause less damage to other animals and have less negative impact on their housing environment [3,4]. However, disbudding and dehorning are stressful and painful procedures, and a serious challenge to animal welfare [1,2,4].

Using cortisol levels as an indicator of stress and pain is a well accepted tool in cattle [7–9] and goats [10–12]. Some behaviors as vocalizations, attempts to scape and struggles have also been recorded as a clear sign of painful response in both species during disbudding or dehorning [8,11–13].

In calves, disbudding causes a physiological and behavioral response that indicates acute stress and pain [9]. Plasmatic cortisol levels and pain-related behavior increase sharply and remain up to 4–5 h after thermal disbudding [7,14,15]. With the aim of attenuating these responses several anesthetic strategies have been proposed [2,13,16–18].

Disbudding induces a similar response in goat kids [10], and some authors have suggested methods of controlling the pain during the procedure, such as the infiltration of lidocaine around each button [19–22]. However, those methods have proved not to be successful [11] in reducing signs of animal distress. Although no clear information is available on the issue, field observations suggest that disbudding is usually performed without providing any pain relief in Mexico. In countries

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like Canada and USA, a survey found that about 33% of producers used analgesic drugs, and about 70% of veterinarians use them, though no details are given on the kind of drugs used [23].

When dehorning adult goats, a nerve block has been suggested using lidocaine at two places per horn: the cornual branches of the lacrimal and infratrochlear nerves [21,24]. The cornual branch of the lacrimal nerve passes along the temporal line behind the supraorbital process, between the lateral canthus of the eye and the posterior angle of the horn. The cornual branch of the infratrochlear nerve passes over the dorsomedial rim of the orbit [21,24]. However, no information is available on the efficacy of this strategy for adults or young goats. The aim of the present study was to evaluate the cortisol levels and behavioral response of goat kids disbudded after the infiltration with 2% lidocaine at two sites per button (lacrimal and infratrochlear). Our hypothesis was that the use of lidocaine to block the cornual nerves decreases both the acute cortisol secretion and the behavioral response to thermal disbudding.

2. Materials and methods

2.1. Location and animals

The study was conducted at an experimental farm located 150 km north of Mexico City (20°30′46″ N; 99°53′17″ W). The Internal Animal Ethics Committee of the Faculty of Veterinary Medicine of the National Autonomous University of Mexico approved the experimental protocol.

A total of 45 goat kids (10–20 days of age, French Alpine and Saanen, males and females) were assigned to one of five experimental groups ($n = 9$) balanced by bred and sex. All kids were separated from their mother at birth and fed by an artificial feeding system (milk ad libitum at 09:00 and 16:00 h). Animals did not undergo to a previous habituation plan of handling and sampling. During the study, the kids were kept in 2 m^2 pens (always in group, maximum 5 kids/pen) with water and clean, dry bedding. Those pens were temporarily adapted at a distance of about 10 m outside the kids housing, and at about 5 m from the place where the disbudding was done, with a physical barrier in between. The experiment was finished in a period of two weeks, and every working day one kid from each treatment group was selected at random by draw.

2.2. Experimental process

Group LidoD was administered 1 mL of lidocaine/epinephrine (20 mg/0.005 mg/1 mL, Pisa®, México) at the cornual branches of the lacrimal and infratrochlear nerves (zygomaticotemporal -lacrimal- and infratrochlear) 15 min before the disbudding procedure by thermal cauterization. One injection was applied midway between the lateral canthus of the eye and the lateral base of the horn bud. The second injection was applied at the frontal base of the horn bud, at approximately the medial canthus [21,24]. Group Lido was similarly infiltrated but was not disbudded. In group Sim, no lidocaine was infiltrated and the disbudding procedure was only simulated using a cold dehorner. Group CD was disbudded with no previous treatment, and group SD was infiltrated with saline (1 mL per branch, NaCl 0.9 g/100 mL) 15 min before disbudding, as described for group LidoD. Trained staff restrained and injected the kids using new insulin syringes and needles (30 G × 13 mm, BD Ultra-Fine™). During infiltration, disbudding and simulation, the kid was gently held on the legs and lap of an experienced assistant.

Disbudding was done without a pin prick test and using a previously used technique [10,11,22]. The electrically heated dehorner (Goat Dehorner, Lenk® 200GD) was applied three to four times (2–4 s each time) per button, and the area was allowed to cool for at least 5 s before re-application. The disbudding was considered sufficient when the corium of the button was completely cauterized and removed [22]. After disbudding, each button was sprayed with a local disinfectant (Furazolidone, Topazone®, PiSA®, México).

2.3. Blood sampling

Blood (1 mL) was sampled at −30, −15 and 0 min (immediately before disbudding), 0 (immediately after disbudding), 10, 20 and 30 min, 1, 1.5, 2, 3 and 4 h after disbudding. Samples were taken from both jugular veins (alternating sides) using new needles (PrecisionGlide™, 22 G × 1 1/2) and heparinized tubes (BD Vacutainer® Systems, Franklin Lakes, USA), while the kid was gently but safely restrained by an assistant. The jugular area was previously shaved, and once the kid was appropriately held, the time required to get the vein was about 5 s. Samples were centrifuged at 2500 rpm for 15 min and plasma was frozen (−20 °C) until assayed for cortisol, two months later, using a commercial RIA kit (Diagnostics Products Corporation, Los Angeles, CA., USA). Sensitivity of the assay was 5.4 nmol/L, and intra- and inter-assay variations were 2.1% and 5.2%, respectively.

2.4. Behavioral recording

All kids were filmed (DVD Camcorder, Samsung® SC-DC171) during disbudding or simulation, in order to record pain-related behavioral events, as has been done previously [4,8,10]. The camera was always at the same distance from the kid when filming. The videos were analyzed by a person who was unaware of the treatment received by each kid. The quantified behavior types included struggles (slight or vigorous movements of legs, and attempts to escape), high vocalizations (emission of bleats with open or closed mouth), and tail movements [10–12,25]. To classify vocalizations as high, 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 video-player loudspeaker. All recordings were replayed at the same volume. Only vocalizations of >90 dB were considered [11]. All behavioral events were added to calculate the total behavioral response to each treatment and the groups were compared.

2.5. Statistics

Cortisol concentrations were compared using repeated measures analysis of variance; the group was considered as the between-subjects factor, and samples as the within-subjects factor. Multiple comparisons were used to compare treatments across time. Behavioral data were compared between groups by the Kruskal–Wallis and Wilcoxon–Mann–Whitney tests. SAS program V9 was used, and a p-value of ≤ 0.05 was set as a significant level [26].

3. Results

3.1. Duration of disbudding

Duration of the complete procedure was not different between groups (CD: 81 ± 3.8; Sim: 75.6 ± 3.8; LidoD: 84.3 ± 3.8; SD: 76.6 ± 3.8; seconds, mean ± SE; $p > 0.05$).

3.2. Cortisol levels

High variability was detected in individual cortisol levels, independently of experimental group. Cortisol levels were similar between groups in samples −30 and −15, previous to infiltration and disbudding ($p > 0.05$). The effect of treatment on cortisol levels was not significant ($p > 0.05$), but time of sampling was significant ($p < 0.001$).

Lidocaine infiltration did not efficiently attenuate the acute cortisol elevation in response to disbudding. Hormone levels in groups CD and LidoD were significantly increased during the first 20–30 min after the procedure and then returned to concentrations previous to disbudding; both groups tended ($p = 0.1$) to be higher than Sim immediately after and at 10 min from the disbudding. When considered together,

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