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BRIEF COMMUNICATION: Effect of disbudding on pain sensitivity and weight-gain of dairy goat kids

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Introduction

Cautery disbudding is a painful husbandry procedure commonly carried out on dairy cow and goat farms worldwide. Disbudding can cause third-degree burns, subcutaneous tissue damage, inflammation, bacterial infection and in some cases death (Sanford 1989, Thompson *et al.* 2005, Wright *et al.* 1983). Physiological (e.g., cortisol, β-endorphins) and behavioural (e.g., head shaking) changes indicative of pain have been described in response to cautery disbudding in kids (Alvarez *et al.* 2015, Greenwood & Shutt 1990, Ingvast-Larsson *et al.* 2011), but still little is known regarding the acute and long-term effects of cautery disbudding on goat kid welfare. Therefore, the aim of this study was to evaluate the effects of cautery disbudding on the acute pain response and weight-gain in goat kids. This study was part of a larger project investigating alternative methods of disbudding in goat kids.

Materials and methods

Animals and housing

This study was conducted between July 28, and August 31, 2016, on 140 Saanen male (n=113) and female (n=27) goat kids (5.0±0.04 kg) aged 2 to 7 days (mean±SEM, 4.0±0.15 days) on a private commercial dairy goat farm in New Zealand. The study was approved by the Ruakura Animal Ethics Committee (Protocol No 13907).

Kids were housed with others not enrolled in the study and kept within large pens (9.2x3.0 m; approx. 50 kids per pen); the ground was covered with pine shavings (15 cm deep). The number of experimental kids per pen differed over the study period. Kids had access to milk *ad libitum* via a milk feeder, and fresh water in a trough. The daily temperature within the goat barn ranged between 22.5 and 4.5 °C (mean±SEM, 14.3±0.10°C).

Experimental design

At least one kid per treatment group was treated per experimental day. Kids were allocated to treatment groups (n=70/treatment) balanced for sex and age. Kids were either (i) cautery-disbudded using a gas-powered cautery iron (CAUT) or (ii) sham-disbudded by massaging each horn bud (SHAM). Prior to administration of the treatments, the hair covering the horn buds was removed using clippers to easily locate the horn buds. Pain relief was not administered. Following handling or disbudding, kids were placed into a holding pen (within their home pen; 2.5x1.5 m) until post-treatment measurements concluded.

Pressure algometry

Pain sensitivity was measured based on the protocol described by Heinrich et al. (2010). Pain sensitivity was measured 15 min before, and approximately 1 h following, disbudding or sham-disbudding using a digital pressure algometer (Force one FDIX 50, Wagner Instruments, Greenwich, CT, USA). The algometer was equipped with a circular rubber head (1 cm diameter), which was placed at one site directly behind the horn bud (away from the muzzle). The amount of pressure a kid tolerated before it moved its head was measured in kilograms of force (kgf) over the area of the rubber tip and was referred to as the mechanical nociceptive threshold (MNT). Downwards pressure was applied at a steady rate of approximately 1 kgf/s until the kid moved its head. The algometer automatically read the highest level of pressure applied, and was then reset before the next measurement was taken.

Weight-gain

Kids were weighed using a hanging digital scale (Kamer, Shoof, Cambridge, NZ) attached to a calf weigh cradle modified for kids. Weight was measured on the day of treatment, two days after treatment and then weekly for two weeks.

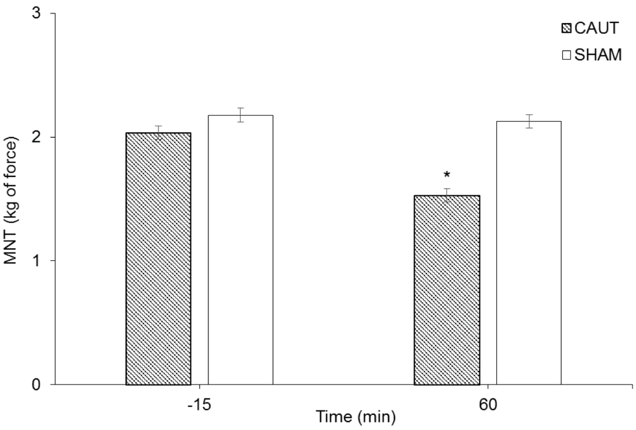
Statistical analysis

MNT and weight-gain data were analysed independently using an ANOVA in GenStat (Version 17, VSN International, Hemel Hempstead, UK). The models for both MNT and weight-gain included the fixed effects of treatment, time and their interaction and the random effects of treatment date and kid. The model had a repeated structure on time allowing incorporation of heterogeneity of variances across time. Differences in mean MNT and weight-gain were compared by Fisher's least significant differences test. Mean values were provided with approximate standard error of the difference. The level of significance was set at $P \leq 0.05$.

Results

A treatment-by-time interaction for pain sensitivity ($F_{1,129}$=74.9; P<0.001) was identified (Figure 1). CAUT and SHAM kids had similar MNT values 15 min before treatment (P=0.11). At 1 h after treatment, less force was tolerated by CAUT kids compared with pre-treatment values (P<0.01). SHAM kids tolerated the same amount of pressure before as after treatment (P=0.55). There was no effect of treatment (P=0.69) or a treatment-by-time

Figure 1 Mean (± SED) mechanical nociceptive threshold (MNT; kg of force), as measured by pressure algometry for goat kids that were either cautery disbudded (CAUT; n = 70) or sham-handled (SHAM; n = 70) at 15 min before treatment and 1 h after treatment. * indicates differences from measurements 15 min before treatment at P < 0.01.



interaction on weight-gain (P=0.52), however there was an effect of time ($F_{2,94}$=195.0; P<0.001). All kids had an average daily gain over two weeks of 0.15 kg (P≤0.05).

Discussion

This is the first study to evaluate the effects of cautery disbudding on pain sensitivity and weight-gain in goat kids. Cautery-disbudded kids tolerated less force around the horn bud area 1 h after cautery disbudding compared with before treatment values, indicating that these animals were more sensitive to pressure following treatment. SHAM kids had similar MNT values before and after treatment, which indicates that they were not more sensitive after handling and that kids did not have a learned response to pressure. Behavioural and physiological changes reported in response to cautery disbudding in kids (Alvarez *et al.* 2015, Hempstead *et al.*, 2017) and increased cortisol, heart rate and respiratory rates in disbudded calves (Allen *et al.* 2013, Heinrich *et al.* 2009) support the interpretation that this increase in tissue sensitivity after disbudding is due to pain. Similarly, Heinrich et al. (2010) found that pain sensitivity was greater in cautery-disbudded calves compared to calves that were disbudded with pain relief. It would be interesting to establish when sensitivity is reduced in disbudded goat kids.

In the present study, there was no difference in weight-gain between groups, which indicates there was no long-term effect of disbudding on weight-gain. Reduced weight-gain has been observed in calves disbudded without pain relief (Bates *et al.* 2015). Conversely, calves given pain relief prior to dehorning had higher average daily gains 10 days after treatment (Coetzee *et al.* 2012).

Based on our results, cautery disbudding appears to cause heightened pain sensitivity of the horn bud area, which may reflect reduced kid welfare.

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