EFFECTS OF MANAGEMENT PRACTICES ON CORTISOL, B-ENDORPHIN AND BEHAVIOUR IN YOUNG GOATS

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Significant increases (P<0.01) in plasma cortisol and B-endorphin occurred following hot iron disbudding or rubber ring castration of 1-3 week old goats. Behavioural observations indicated that castration resulted in severe distress in these kids, although disbudding caused little if any distress post-treatment. Plasma cortisol values in kids following rubber ring castration were higher than previously reported for calves and lambs subjected to the same treatment. The salivary cortisol technique was found to have limitations in young goats due to problems in collecting timed samples in some experiments without contamination with blood plasma.

INTRODUCTION

Management practices which may result in acute stress in goat kids include hot iron disbudding, castration and eartagging. Disbudding is performed because of potential danger to goats and handlers in the dairy, while castration is practised to avoid problems associated with maintaining entire male goats.

Minimization of stress is important for the welfare of farm animals, and in order to improve performance. Indicators of the response to acute stressors include saliva cortisol (Fell et al. 1985), plasma cortisol and B-endorphin (Shutt et al. 1987) and behaviour following a stressful event (Shutt et al. 1988; Fell and Shutt 1989). In this paper cortisol and B-endorphin concentrations and behaviour of 1-4 week old goats following acute management stressors are reported. The results are discussed, as are factors affecting the suitability of the salivary cortisol technique as an indicator of stress in young goats.

MATERIALS AND METHODS

In experiment 1, 1-4 week old Saanen goats weighing 3.3-8.7 kg were assigned to a control group, or treatment groups which underwent castration (C), disbudding (D), eartagging (E) or combinations of these operations (2 x 2 x 2 factorial design), depending on the number of suitable animals available at each of four visits to a co-operating property. Each C group contained at least 5 male kids and each D and E group at least 5 female kids. These kids were weighed following a 15 min post-treatment saliva collection. Kids were held in a one-metre diameter round crate prior to and after treatment and saliva sampling. Controls (male and female) were held for a similar period of time. The disbud operation involved placement of a hot iron over the horn bud for 15 to 30 seconds to destroy all proliferative tissue. Castration was performed by the release of a latex ring over the scrotum and testicles, and bayonette-type eartags were inserted using a proprietary applicator. Behaviour of kids was noted during each treatment and for approximately 3 hours following. Saliva sampling and cortisol assay were essentially as described by Fell et al. (1985).

In experiment 2, 15 Saanen goats aged 1-3 weeks and weighing 4.3-7.8 kg were divided into three groups of five depending upon sex and whether they were horned or polled, and held as described above. One group was a control group and the other two groups were castrated or disbudded. Jugular blood samples

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were collected into 10 ml heparinized vacutainers prior to treatment and at 5, 15, 30, 60 and 120 min post-treatment and at equivalent times for control animals. The blood was centrifuged on-farm and the plasma transported and stored frozen until assayed for cortisol and B-endorphin using the techniques described by Fell et al. (1985) and Shutt et al. (1987).

RESULTS

Comparative values for salivary cortisol (mean ± s.e.) following management practices are presented in Table 1. The results from experiment 1 show that treatments involving castration or disbudding resulted in significant increases (P<0.01) in salivary-cortisol above control values with the exception of two groups (D+E and D+C). No significant difference was apparent between the control and eartag groups, while the highest cortisol concentration (20.9 ± 2.2 nmol/l) occurred in the group which underwent all three treatments (D+C+E). The C group exhibited a more variable response at 15 minutes than the D group.

Table 1 Effect of management practices on concentration of salivary cortisol (nmol/l) in young goats, compared with live weight (kg), age (days) and sampling time post-treatment (min)

<table>
<thead>
<tr>
<th>Treatment*</th>
<th>No. of goats</th>
<th>Salivary cortisol</th>
<th>Live weight</th>
<th>Age</th>
<th>Sampling time post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>11</td>
<td>4.4 ± 0.7a</td>
<td>6.6 ± 0.4a</td>
<td>16.6 ± 2.1a</td>
<td>n.a.</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>17.1 ± 4.2b</td>
<td>6.7 ± 1.1a</td>
<td>17.0 ± 4.1a</td>
<td>15.1 ± 0.1a</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>17.9 ± 2.3b</td>
<td>6.4 ± 0.5a</td>
<td>18.4 ± 1.7a</td>
<td>15.0 ± 0.0a</td>
</tr>
<tr>
<td>E</td>
<td>7</td>
<td>6.1 ± 1.3a</td>
<td>7.1 ± 1.0a</td>
<td>18.2 ± 3.7a</td>
<td>15.0 ± 0.0a</td>
</tr>
<tr>
<td>C+E</td>
<td>8</td>
<td>16.0 ± 3.7a</td>
<td>5.8 ± 0.4a</td>
<td>13.3 ± 1.3a</td>
<td>22.3 ± 4.7a</td>
</tr>
<tr>
<td>D+E</td>
<td>7</td>
<td>11.9 ± 2.2ab</td>
<td>5.8 ± 0.4a</td>
<td>14.3 ± 2.5a</td>
<td>18.1 ± 1.8a</td>
</tr>
<tr>
<td>D+C</td>
<td>5</td>
<td>12.6 ± 2.4ab</td>
<td>6.0 ± 0.5a</td>
<td>12.0 ± 1.4a</td>
<td>15.4 ± 0.3a</td>
</tr>
<tr>
<td>D+C+E</td>
<td>5</td>
<td>20.9 ± 2.2a</td>
<td>5.2 ± 0.4a</td>
<td>12.0 ± 2.0a</td>
<td>15.0 ± 0.0a</td>
</tr>
</tbody>
</table>

*C, castration (rubber ring); D, disbudding (hot iron); E, eartagging (bayonet).

*Not applicable.

Using one-way ANOVA, means (± s.e.) in each column with different superscripts are significantly different (P<0.01).

Observations of kids revealed marked differences in behaviour between groups. Kids vocalized throughout disbudding (up to 15 vocalizations per horn bud) and eartagging (1-3 vocalizations). In comparison, the response during castration was minimal apart from some bleating during handling of kids. When multiple treatments were performed kids bleated between operations, which in the case of the D+C+E group took up to 3 minutes per goat. Following eartagging or disbudding and return to the holding pen, kids tended to stand alone, shake their head and arch their back prior to commencement of normal behaviour within 5 min. No other behavioural effects were apparent following these treatments and kids were active for the remainder of the observation period. Less than 15 min after castration, goats stretched their hind legs and exhibited a kicking motion and within 30 min kids were reclined with hind legs outstretched, head turned posteriorly and eyes closed. They remained in this position for most of the observation period. Intermittently, shaking and twitching of the hind legs occurred and soft whimper-like sounds were heard. Following release, each kid quickly reassociated with its dam, although the castrated animals moved with a stiff gait.

Results from experiment 2 (Fig. 1) showed that in response to disbudding, the peak concentration (mean ± s.e.) of immunoreactive plasma B-endorphin (179±34 pg/ml) occurred at the 5 min sampling and peak plasma cortisol (186±25 nmol/l)
at 15 min. In comparison, castration resulted in a less rapid rise to a maximum B-endorphin value of 196±34 pg/ml at 15 min while cortisol followed a similar pattern to disbudding to 15 min but continued to increase to 259±20 nmol/l at 30 min and remained at a high level (254±21 nmol/l) at the 60 min sampling. In the control group cortisol ranged from 58±21 nmol/l (15 min) to 31±14 nmol/l (30 min) and B-endorphin from 79±11 pg/ml (5 min) to 116±13 pg/ml (30 min). Significant differences between the castrate and disbudd groups occurred for the concentrations of B-endorphin at 30 min (P<0.01) and cortisol at 60 minutes (P<0.001). Comparison with salivary cortisol was not reported due to difficulties encountered in collecting timed saliva samples free from blood plasma in this experiment.

DISCUSSION

The results demonstrated a clear difference in hormonal and behavioural responses when disbudding and castration were compared in young goats. It was not possible to categorize these responses using the criteria of Mellor and Murray (1989) for 'mild disturbance without distress', 'mild distress' and 'marked distress' in young lambs. The magnitude of the plasma cortisol response to disbudding in goat kids appeared greater than observed by the above authors in lambs exposed to tail docking or castration, and the behaviour during disbudding suggested a high level of pain, but the rapid return to normal behaviour suggested that these animals suffered little distress. On the other hand, the cortisol and behavioural responses to castration using rubber rings in the goats were more marked and lengthier than described for lambs. However, during our experiments animals were confined and denied access to
their dams, which may have had an effect on behaviour and hormonal status.

Salivary cortisol at 15 min for kids castrated with rubber rings (17.1±4.2 nmol/l) was greater than the peak value obtained by Fell et al. (1986) for calves (3.2±0.6 nmol/l), while plasma cortisol concentrations at 15 min (179±30 nmol/l) and 30 min (259±20 nmol/l) exceeded the levels obtained by Shutt et al. (1988) and Mellor and Murray (1989), of 128±9 nmol/l (15 min) and approximately 120 nmol/l (30 min) respectively in lambs which were castrated and tail docked using rubber rings. In addition, the peak B-endorphin value 15 min following castration of kids (179±34 pg/ml) was substantially higher than obtained by Shutt et al., (1988) following rubber ring castration and tail docking of lambs (88±18 pg/ml). While the above factors may support the general perception that goats are more stress susceptible than sheep (or cattle) (Devendra and Coop 1982) other factors need to be considered in interpreting these findings. Firstly, differences existed in the age of animals in the various studies described, and secondly, the cross-reactivity of caprine and ovine B-endorphin has not been established and hence precludes between-species comparisons at this stage.

Our findings also have important welfare and economic implications for producers. In the United Kingdom hot iron disbudding must be performed using local anaesthesia by a veterinarian (Buttle et al. 1986). This appears to be unnecessary provided that a very hot iron is used to minimize the time taken to carry out the operation (Baxendell 1984). On the other hand, a study to compare the effects of rubber rings and surgical castration could be interesting as a more marked physiological response to rings was found in kids than was found in lambs (Shutt et al. 1988).

Finally, the usefulness of the salivary cortisol technique of Fell et al. (1985) appears to be limited for young goats due to difficulties in collecting timed saliva samples in some experiments free from contamination with blood plasma.

ACKNOWLEDGEMENTS

We wish to acknowledge the generous support of John and Trish Hicks, "Rahi", Murrumbateman for the use of their animals and skilful conduct of the management practices investigated, and Tim Brock, Chris Fell, Sally Berridge, Arnold Turner and Fiona Bertus for their expert assistance in the field and laboratory.

REFERENCES


