PHYSIOLOGICAL EFFECTS OF SURGICAL STRESS IN ACTH-IMMUNE EWE

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Both general anaesthesia and surgery elicits an acute stress response which activates the sympathomedullary and the hypothalamic-pituitary-adrenal (HPA) axis. The principal hormones secreted from these axes are the catecholamines, noradrenaline and adrenaline, and cortisol which readily mobilise free fatty acids (FFA's) and glucose. Previous studies have shown that cortisol levels increase during surgery, (man: Ichikawa *et al.* 1971 and sheep: Jones 1990). Similarly plasma glucose and FFAs were reported to increase in response to this stress while insulin levels were suppressed.

In this study, we evaluated the roles of adrenocorticotropic hormone (ACTH), cortisol and the catecholamines in the regulation of glucose, FFAs and insulin levels during anaesthesia and surgery. Mature merino ewes (n=3) were irnmunised against ACTH l-24 ovalbumin conjugate (0.5 mg) in Freund's complete (primary) and incomplete (3 booster injections) adjuvant. Another 3 ewes received the adjuvant alone. All 6 ewes underwent surgery (catheterisation of the carotid artery) while under general anaesthesia. Venous blood samples from all ewes were taken from an indwelling jugular catheter prior to, during and after surgery. Plasma samples were analysed for cortisol and insulin by RIA, for glucose and FFAs by enzymic analysis and for noradrenaline and adrenaline by HPLC.

There was no increase in noradrenaline or adrenaline levels in response to surgery in sheep either immunised (T) or not immunised (C) against ACTH. Plasma cortisol levels in the C group increased significantly (P c 0.01) in response to anaesthetic induction and surgery. In contrast, there was no increase in plasma cortisol for the T group. There was no significant difference in plasma FFAs and glucose. Plasma insulin levels increased, but not significantly in both groups following anaesthetic induction, declined during surgery in the C group but remained elevated in the T group.

Table 1: Mean circulating levels (±SEM) of cortisol (ng/mL) and insulin (ng/mL) in non-immune (C) and ACTH-immune (T) sheep

	Pre-induction	Induction	Surgery 20 minutes	Surgery 40 minutes	Recovery
Cortisol C	15.3 ± 3.4[a]	48.8 ± 9.9[b]	105 ± 17.9[b]	121 ± 26.8[b]	141 ± 30.6b
Cortisol T	13.8 ± 5.6	11.8 ± 4.2	5.8 ± 2.4	14.7 ± 7.0	33.0 ± 10.1
Insulin C	1.84 ± 0.7	3.98 ± 1.4	1.03 ± 0.3	0.60 ± 0.2	1.12 ± 0.5
Insulin T	0.81 ± 0.3	2.90 ± 0.5	1.92 ± 0.3	1.93 ± 0.5	1.15 ± 0.4

Within rows, means with different superscripts differ significantly (P<0.01).

Despite the sympathomedullary axis having an acute role in the modulation of the physiological response to stress, these results show that, for the ewe, surgical stress does not stimulate noradrenaline or adrenaline release. It appears that the sheep relies on the stimulation of the HPA axis and the subsequent release of cortisol to acutely modulate insulin secretion during surgery. Therefore, changes in plasma cortisol rather than catecholamines should be used to indicate the level of stress during surgery in the sheep.

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