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Hypothalamic responses to peripheral glucose infusion in food-restricted sheep are influenced by photoperiod

Z A Archer, S M Rhind¹, P A Findlay, C E Kyle¹, M C Barber²
and C L Adam

Energy Balance and Obesity Division, Rowett Research Institute, Bucksburn,
Aberdeen AB21 9SB, UK

¹ Macaulay Institute, Craigiebuckler, Aberdeen AB15 8QH, UK

² Hannah Research Institute, Hannah Research Park, Ayr KA6 5HL, UK

(Requests for offprints should be addressed to C L Adam; Email: cla@rri.sari.ac.uk)

Nutritional feedback provided by systemic hormones, such as insulin and leptin, influences reproductive neuroendocrine output within the hypothalamus, yet the mechanisms and their interaction with photoperiodic cues remain unresolved in seasonal species. Here, peripheral glucose (G) infusion was used to increase endogenous concentrations of insulin and leptin in food-restricted sheep kept in either long-day (LD) or short-day (SD) photoperiod, and responses were examined in terms of pulsatile luteinising hormone (LH) (gonadotrophin-releasing hormone by inference) output and hypothalamic gene expression for nutritionally sensitive neuropeptides and receptors. We addressed the hypothesis that these hypothalamic responses were correlated and influenced by photoperiod. Oestradiol-implanted, castrated male sheep were kept 16 weeks in SD (8 h light/day) or LD (16 h light/day) and then transferred to the opposite photoperiods for 8 weeks, during which food was restricted to 90% requirement to maintain body weight (maintenance). For the final 6 days, food was reduced to 75% maintenance, and sheep in both photoperiods were infused intravenously with G (60 mM/h) or saline (S) ($n=8$ /group). G-infused sheep had higher mean plasma concentrations of G, insulin and leptin than S-infused sheep, with no effect of photoperiod. In LD, but not in SD, G infusion increased LH pulse frequency and pulse amplitude. In LD, but not in SD, gene expression in the hypothalamic arcuate nucleus was lower in G- than S-infused sheep for neuropeptide Y (NPY) and agouti-related peptide (AGRP) and was higher in G- than S-infused sheep for pro-opiomelanocortin (POMC). Gene expression for leptin and insulin receptors was not affected by photoperiod or infusion. These results are consistent with the involvement of NPY, AGRP and POMC in mediating the reproductive neuroendocrine response to increased systemic nutritional feedback, and they support the hypothesis that hypothalamic responses to nutritional feedback are influenced by photoperiod in sheep.

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