The seasonal physiology of *Antechinus stuartii*: renal and gonadal correlates

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Declaration

I certify that this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Bronwyn M. McAllan

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Summary

Antechinus stuartii is a small marsupial that has an unusual life history pattern. It includes a highly synchronised brief mating period occurring at the same time every year within a particular population. Following the mating period all males die from an uncontrolled stress response, which is associated with high plasma concentrations of glucocorticoids and testosterone. Seasonal changes in renal structure and function, and their contributions to male mortality were investigated. Changes in the reproductive tract were also assessed. Following the seasonal study, changes in renal structure and function and reproductive tract were assessed in males given depot injections of either saline, testosterone only, cortisol only or testosterone plus cortisol at doses mimicking those found in the mating period.

Glomerular filtration rate (GFR) changed seasonally, with GFR of males lower in July and August, and that of females lower only in the premating period. Plasma sodium and chloride levels were higher, and potassium levels were lower in July and August in both sexes. GFR decreased following testosterone treatment, independent of cortisol. Urinary electrolytes, osmolality, and urea significantly decreased in all cortisol treated animals. Plasma potassium and chloride were affected by the administration of cortisol.

In the seasonal study, glomerular volumes increased in July and August in males, coinciding with a reduction in glomerular number per mm^2 of cortex. Tubular diameters and cellular volumes increased in males from July and August. In the hormone study, glomerular volumes were increased by the administration of cortisol, with numbers of glomeruli per mm^2 reduced by cortisol or testosterone administration. Testosterone administration increased the diameters of the proximal and distal tubules, and caused cellular hypertrophy. Cortisol administration increased the diameters of the collecting tubules without cellular hypertrophy.

In the seasonal study the reproductive tract was undifferentiated in February and May. Differentiation and hypertrophy of the accessory reproductive tract were observed in July, and continued into August. In the hormone study neither treatment affected spermatogenesis, although testosterone treatment caused hypertrophy of the epididymal cells. The mass, differentiation and secretory activity of the accessory

reproductive tract were increased by testosterone administration. Adding cortisol to the testosterone treatment reduced the mass and secretory activity of the glands which appeared similar to those of males captured in August.

The present study has demonstrated that there are seasonal changes in renal structure and function in male *A. stuartii*, and these changes were mimicked by the administration of testosterone, with less influence from cortisol administration. The accessory reproductive tract was also sensitive to these hormones. This study demonstrates that the synchronous seasonal changes that occur in *A. stuartii* are not confined to the reproductive tract, and the changes are governed less by cortisol, than by the sensitivity of *A. stuartii* males to testosterone.

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Abbreviations

ACTH	Adrenocorticotrophic hormone
ADH	Antidiuretic hormone
CBG	Corticosteroid binding globulin
CCD	cortical collecting duct
CD	collecting duct
Cl^-	chloride ions
CNT	connecting tubule
CRF or **CRH**	Corticotropin releasing hormone
^{51}Cr-EDTA	^{51}Chromium-Ethylene diamine tetra acetic acid
DHEA	dehydroepiandrosterone
DHT	dihydrotestosterone
DCT	distal convoluted tubule
DST	distal straight tubule
FSH	Follicle stimulating hormone
g	grams
GFR	Glomerular filtration rate
hCG	human chorionic gonadotrophin
11β-OHSD	11β - hydroxysteroid dehydrogenase
IMCD	inner medullary collecting duct
IU	International Units
JGA	juxtaglomerular apparatus
kg	kilogram
L	Litre
LH	Luteinising hormone
LVP	lysine vasopressin
mL	millilitre
mol	moles
MT	Medullary thickness
OMCD	outer medullary collecting duct
osm	osmolal
PCT	proximal convoluted tubule
PLSD	protected least significant difference
PST	proximal straight tubule
PMS	Pregnant mares serum

PMT	Percentage medullary thickness
POMC	Propiomelanocortin
RIA	Radioimmunoassay
RMT	Relative medullary thickness
TAL	thick ascending limb of the loop of Henle
TALH	thin ascending limb of the loop of Henle
TDLH	thin descending limb of the loop of Henle

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