The androgenic control of the composition of the rat epididymis determined by efferent duct ligation or castration

D. E. Brooks

Department of Animal Physiology, Waite Agricultural Research Institute, University of Adelaide, Glen Osmond, South Australia 5064

The mechanisms controlling the maturation of spermatozoa in the epididymis remain poorly understood although it is clear that an adequate supply of androgens is required for the normal maintenance of the organ. The technique of efferent duct ligation prevents spermatozoa from entering the epididymis and therefore enables metabolic processes to be studied in the androgen-maintained epididymis without contribution from spermatozoa. Castration enables the epididymis to be studied when spermatozoa and androgenic support are absent. Determinations of enzyme activities have indicated that, provided about 6 weeks are allowed following efferent duct ligation for the epididymis to become largely emptied of spermatozoa, the results of efferent duct ligation are indistinguishable from those after castration and later androgen replacement (Brooks, 1976b, c). These two techniques therefore enable a study to be made of the epididymis with and without androgenic support.

Previous data have been presented of the gross biochemical composition of the epididymis during the pubertal period (Brooks, 1976a), when circulating androgen levels are rising (Lee, de Kretser Hudson & Wang, 1975) and spermatozoa first enter the epididymis. The present study extends these observations by providing measurements of the androgenic control of biochemical parameters in the epididymis of mature animals. Details of the operative procedures and of the chemical estimations have been given by Brooks, Hamilton & Mallek (1974) and Brooks (1976a, b). Adult male albino rats weighing 326 ± 13 g were used and the segments taken as caput and cauda epididymidis were identified as described by Brooks (1976b).

Table 1. The composition of the caput and cauda epididymidis of rats 6–8 weeks after bilateral efferent duct ligation or castration

	No. of replicates	Caput epididymidis		Cauda epididymidis	
		Efferent duct ligated	Castrated	Efferent duct ligated	Castrated
Wet wt (mg)	17	101 $\pm$ 6	*** 34.5 $\pm$ 2.5	157 $\pm$ 8	*** 51.6 $\pm$ 3.5
Dry wt (%)	4	18.1 $\pm$ 0.5	*** 23.6 $\pm$ 0.3	18.4 $\pm$ 0.7	** 22.9 $\pm$ 0.8
Total protein (mg/g wet wt)	3	122 $\pm$ 13	140 $\pm$ 7	95 $\pm$ 14	* 148 $\pm$ 9
Soluble protein (% total protein)	3	37.5 $\pm$ 1.4	** 25.4 $\pm$ 2.0	41.0 $\pm$ 3.0	* 22.1 $\pm$ 2.9
Total lipid (mg/g wet wt)	4	36.1 $\pm$ 2.4	31.3 $\pm$ 2.6	20.3 $\pm$ 1.7	20.9 $\pm$ 0.9
Phospholipid (mg/g wet wt)	4	10.6 $\pm$ 0.3	*** 7.54 $\pm$ 0.27	10.1 $\pm$ 0.4	* 7.47 $\pm$ 0.69
DNA (mg/g wet wt)	4	2.18 $\pm$ 0.05	** 4.85 $\pm$ 0.14	2.26 $\pm$ 0.06	*** 4.49 $\pm$ 0.10
RNA (mg/g wet wt)	4	3.44 $\pm$ 0.15	* 2.81 $\pm$ 0.10	3.08 $\pm$ 0.07	** 2.55 $\pm$ 0.11
Acid-soluble phosphorus (mg/g wet wt)	4	1.05 $\pm$ 0.05	*** 0.468 $\pm$ 0.008	0.951 $\pm$ 0.023	*** 0.549 $\pm$ 0.003
Glycogen (mg/g wet wt)	3	0.82 $\pm$ 0.04	0.74 $\pm$ 0.06	0.93 $\pm$ 0.15	0.68 $\pm$ 0.12
Total sialic acid (μ mol/g wet wt)	3	1.58 $\pm$ 0.08	* 2.01 $\pm$ 0.10	2.62 $\pm$ 0.13	2.30 $\pm$ 0.19
† Soluble sialic acid (μ mol/g wet wt)	3	0.627 $\pm$ 0.041	* 0.458 $\pm$ 0	0.901 $\pm$ 0.055	** 0.519 $\pm$ 0.041

Values are $\pm$ S.E.M. and the significance of difference between means was determined by a *t* test: **P* < 0.05; ***P* < 0.01; ****P* < 0.001.

† Sialic acid was determined in the 100,000 g supernatant fraction of tissue homogenized in 0.1 N-H₂SO₄.

Castration is followed by a substantial regression of the epididymis (Table 1) and results for the various biochemical parameters have been presented on a concentration basis rather than as amount per organ. This form of presentation facilitates identification of those changes in tissue characteristics brought about by castration which are of greater magnitude than those resulting from the general tissue regression.

For most parameters, similar changes occurred in the caput and cauda epididymidis after castration. Tissue from castrated rats had a greater dry weight, a lower proportion of soluble protein and lower amounts of phospholipid, RNA and acid-soluble phosphorus. These changes are those expected for a tissue, in which the cells contain few reticular membranes and have reduced synthetic activity. The difference in acid-soluble phosphorus would largely be accounted for by the fall in glycylphosphorylcholine resulting from castration (Dawson & Rowlands, 1959; Brooks *et al.*, 1974).

The concentration of epididymal DNA increased after castration. Multiplication of DNA levels by tissue weight indicates that the total DNA in the tissue fell by only about 25% and the involution of the epididymis must therefore occur more by cytoplasmic shrinkage than by reduction in cell numbers. Cell turnover in the normal epididymis of the adult rat is low as judged by labelling and mitotic indices (Clermont & Flannery, 1970). These parameters are also low in the caput and cauda epididymidis after administration of testosterone to castrated animals, although the corpus epididymidis appears to be more active in cell proliferation (Niemi & Tuohimaa, 1971).

The concentrations of total lipid and glycogen were not influenced by the androgen status. Unaltered glycogen concentrations have been reported previously (Scholl & Leathem, 1973). These results indicate that the reserves of energy-producing substrates are maintained in the epididymis of the untreated castrated animal.

Total sialic acid was little changed by castration although an increase was found in the caput epididymidis. In contrast, castration resulted in a decline in acid-soluble sialic acid. Rajalakshmi & Prasad (1968) reported a large decline in sialic acid concentration in the cauda epididymidis after castration. However, more recent results, when expressed on a tissue weight basis, indicate that changes in soluble sialic acid resulting from androgen manipulation are similar to those found in this study (Fournier-Delpech, Bayard & Boulard, 1973; Gupta, Rajalakshmi & Prasad, 1974; Laporte, Gillet & Peyre, 1975).

Histochemical studies have shown that castration causes extensive cellular changes in the rat epididymis (Cavazos, 1958). There has been no comprehensive report of the alterations in fine structure caused by androgen deprivation in the rat, although Brandes (1974) has indicated that the changes are similar to those seen in the prostate. In the epididymis of the mouse and rabbit, androgen deprivation results in a loss of smooth endoplasmic reticulum, a marked reduction in the size of the Golgi apparatus and an increase in the concentration of free ribosomes (Hamilton, Jones & Fawcett, 1969; Orgebin-Crist & Davies, 1974). Cell morphology was largely restored by androgen-replacement therapy. The alterations in biochemical composition reported herein therefore supplement anatomical studies in indicating that the androgen-deprived epididymis is an involuted organ which probably has a markedly reduced synthetic activity.

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