OXYGEN CONSUMPTION BY SEMINIFEROUS TUBULES AND INTERSTITIAL TISSUES OF NORMAL AND CRYPTORCHID RAT TESTES

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In his recent review of carbohydrate metabolism in the testis, Free (1970) summarized evidence that glucose stimulates respiration of testis tissue *in vitro* from adult rats, mice, rabbits, rams and chickens. However, when most germinal elements are absent from the testis (e.g. following cryptorchidism, hypophysectomy, irradiation or treatment with antispermatogenic chemicals), the stimulation of oxygen consumption by exogenous glucose is lost (Free, 1970). These results suggest that glucose is oxidized primarily in the more mature germinal elements rather than in Sertoli cells or interstitial tissues (Tepperman, Tepperman & Dick, 1949; Free, Massie & VanDemark, 1969; Free, 1970), but one cannot overlook the possibility that biochemical alterations may result from changes in the endocrine (Johnsen, 1970) or nutrient (Massie, Gomes & VanDemark, 1969) environment during such treatments, or that enzymatic capabilities of surviving tissues are altered (Blackshaw, 1970).

The present study was undertaken to determine whether stimulation of oxygen consumption *in vitro* by glucose is limited to seminiferous tubules in normal rat testes and to investigate the effects of cryptorchidism on respiration of tubules and interstitial tissues of the rat testis.

Mature male Wistar rats were randomly assigned to control or 28-day cryptorchid groups; artificial cryptorchidism was produced bilaterally as described earlier (Free *et al.*, 1969). For respiration studies, rats were anaesthetized with ether and the testes were dissected, weighed, stripped of the tunica and large blood vessels, and immersed in cold Krebs–Ringer phosphate buffer (pH 7.2). Portions of tissue were removed for dry weight determination and whole tissue respiration analysis. The remainder was used for physical separation of seminiferous tubules and interstitial tissues as described by Christensen & Mason (1965).

Thirty minutes after testes were removed from the rats, weighed samples of testis tissue, seminiferous tubules and interstitial tissues were placed in an electronic oxygen monitoring system (Yellow Springs Model 53 Biological Oxygen Monitor) utilizing a Clark-type membrane-covered electrode (Lessler & Brierly, 1969). Oxygen uptake of duplicate samples (in Krebs–Ringer phosphate buffer at 37.5° C) with and without added glucose (1 mg/ml) was recorded for 5-min periods.

As shown in Table 1, oxygen consumption by testis tissue and seminiferous tubules from normal rats was markedly stimulated ($P < 0.01$) by the addition of

glucose to the medium, but the exogenous substrate was without effect on respiration rates of interstitial tissues. Testis tissue and seminiferous tubules from 28-day cryptorchid rats, however, exhibited no response to added glucose; indeed, the tubules consumed far less oxygen than normal tubules ($P < 0.01$) whether glucose was added to the medium or not. Respiration of interstitial tissue appeared unaffected by the period of residence in the abdomen and remained unresponsive to exogenous glucose (Table 1).

The data in this study suggest that physical separation of testicular components may increase respiration *in vitro*, compared to intact tissues (i.e. endogenous respiration of normal tissue should more nearly reflect its major constituent—seminiferous tubules—than is seen in Table 1), making direct comparisons between separated and intact tissues hazardous. Whether this is due to alterations in medium: tissue relationships, or caused by a removal of endocrine inter-

TABLE 1
OXYGEN CONSUMPTION IN VITRO BY TESTIS TISSUE, SEMINIFEROUS
TUBULES AND INTERSTITIAL TISSUE OF NORMAL AND CRYPTORCHID
RATS

<i>Treatment</i>	<i>Testis tissue</i>	<i>Seminiferous tubules</i>	<i>Interstitial elements</i>
Control			
Endogenous	1.08 ± 0.12	1.70 ± 0.28	1.02 ± 0.16
Glucose*	1.69 ± 0.25	5.06 ± 1.84	1.06 ± 0.14
Cryptorchid (28 days)			
Endogenous	1.09 ± 0.12	0.61 ± 0.08	1.04 ± 0.20
Glucose	1.00 ± 0.19	0.72 ± 0.07	1.10 ± 0.20

Values for oxygen consumption expressed as $\mu\text{l/hr/mg}$ dry weight. Each value represents the mean $\pm$ S.E. of duplicate samples of ten testes from five rats.

* 1 mg glucose added per ml of Krebs-Ringer phosphate buffer.

relationships which may depress oxygen consumption by whole tissues (Vera Cruz, Gomes & VanDemark, 1970), is not known. Nonetheless, comparison of the data for tubular and interstitial tissues supports the concept that enhancement of testicular oxygen consumption by glucose is attributable almost exclusively to effects on normal tubules. This property is absent in interstitial tissues of normal and cryptorchid rats, in agreement with the hypothesis that Leydig cells and other interstitial materials cannot efficiently utilize exogenous glucose *in vitro*, whether the cells have been subjected to abdominal temperatures or not. The respiratory quotient of testis tissue is about 0.5 in cryptorchid testes compared to 0.9 to 1.0 in the scrotal testes of rats (Tepperman *et al.*, 1949), suggesting that normal interstitial tissues, and those tubular elements which survive residence in the abdomen, oxidize primarily lipids *in vitro* (Free, 1970). Thus, the utilization of glucose by normal testes seems to reside in the more mature elements of the germinal epithelium.

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