BODY AND PERITESTICULAR TEMPERATURES OF MUSK SHREWS (*SUNCUS MURINUS*)

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Dryden (1969) reported that the testes in the musk shrew resided in the posterior position of the abdominal cavity in shallow coelomic evaginations called cremaster sacs. Dryden & McAllister (1970) found the testes in this species were resistant to cadmium damage and suggested this was due to the similarity between testicular temperature and body temperature and the apparent lack of a pampiniform plexus. They reported a mean rectal temperature of $33.7 \pm 0.3^\circ\text{C}$ and a mean cremaster sac temperature of $32.4 \pm 0.3^\circ\text{C}$ under ether anaesthesia. Since it is known that the process of spermatogenesis is very heat-sensitive, the control of deep body temperature may be as important to testis-bearing species as the control of testis temperature is to scrotal mammals. For this reason, we performed two experiments: (1) measurement of the deep body temperatures in non-anaesthetized intact and gonadectomized adult male and female musk shrews, and (2) measurement of deep body and peritesticular temperatures in non-anaesthetized intact male shrews. The shrews were from a laboratory breeding colony, maintained as described by Dryden & Ross (1971). Gonadectomies were performed using Metofane anaesthesia (Pitman-Moore) a minimum of 4 weeks before testing. A Honeywell multi-point recording potentiometer and 40 gauge (0.5 mm) copper-constantan thermocouples were used to record temperatures. All thermocouples were calibrated immediately before testing. To record deep body temperatures in Exp. 1, each thermocouple was inserted rectally to a depth of 2.6 to 4.0 cm, depending on the size of the animal, and secured in place by taping to the individual's tail. The shrew was then placed in an observation cage where it could move around freely, and its body temperature was recorded for 60 to 90 min. The depth of insertion of the probe was checked after each test. In Exp. 2, a rectal probe was inserted as described above. In addition, a thermocouple was inserted into a 23-gauge needle and 'injected' into the peritesticular space within 1 to 2 mm of the testis. The location of the testes was determined surgically before these experiments. The needle was then removed and the temperature recorded. The shrew was restrained during this manipulation and for the duration of the recording (10 to 20 min). No anaesthesia was used. All tests were performed between 13.00 and 16.00 hours. Ambient temperatures were 22 to 23°C . The results are shown in Table 1.

In Exp. 1, the body temperatures in the intact males were significantly lower than the values for the other three groups but there was no significant

difference between the values for intact males in Exps 1 and 2. The temperatures recorded in the males were 4.4°C higher than the body temperature reported by Dryden & McAllister (1970) in male shrews under ether anaesthesia, but were within the range reported by Waites (1970) for non-anaesthetized mammals with scrotal testes. The body temperatures were higher, however, than published values for other mammals with permanently intra-abdominal testes: African elephant (Short, Mann & Hay, 1967), Indian elephant (Wislocki, 1933; Waites, 1970), anteaters, sloths and armadillos (Wislocki & Enders, 1935), echidna, platypus, whale, dolphin, and killer whale (Wislocki, 1933) and hyrax (Bartholomew & Rainy, 1971).

The mean peritesticular temperature was slightly lower (1.6°C) than the mean rectal temperature in the males tested, but was 3.6°C higher than

Table 1. Mean body and peritesticular temperatures in adult musk shrews

<i>Experiment</i>	<i>N</i>	<i>Body temperature (°C)</i> (Mean ± S.E.)	<i>Peritesticular temperature (°C)</i> (Mean ± S.E.)
(1) Intact males	8	38.1 ± 0.2*	36.0 ± 0.4**
Intact females	4	38.9 ± 0.1	
Castrated males	4	39.1 ± 0.2	
Ovariectomized females	3	39.3 ± 0.2	
(2) Intact males	6	37.6 ± 0.3 N.S.	

* Significantly less than intact females ($P < 0.05$), castrated males ($P < 0.02$), and ovariectomized females ($P < 0.01$).

** Significantly less than body temperature ($P < 0.02$).

N.S. Not significantly different from intact males in Exp. 1.

the cremaster sac temperature reported by Dryden & McAllister (1970). Because the testes lie in the abdominal cavity, without any apparent cooling mechanism, the peritesticular and intratesticular temperatures are assumed to be approximately the same. This means that the testis-body temperature differential is less than that reported for mammals with scrotal testes (Waites, 1970), and that the testis temperature is in the range reported by Cowles (1965) to cause aspermia and increased mutation rates in scrotal mammals.

The peritesticular temperature of *Suncus* is higher than intratesticular temperatures reviewed by Waites (1970) for scrotal mammals, except for two reports in the rabbit (Hall, 1965; Waites, 1970). The only report of intratesticular temperatures in a mammal with abdominal testes is by Waites (1970) for the Indian elephant. The testis temperature was 36.1°C, as was the body temperature; however, these temperatures were taken after the death of the animal and so may not reflect the situation accurately.

It is well known that spermatogenesis in mammals is a heat-sensitive phenomenon and that increasing the temperature of the testis above an optimal level causes meiotic abnormalities and/or destruction of the cell stages involved (see review, VanDemark & Free, 1970). In all cases studied to date, either normal or experimental cryptorchidism in a scrotal mammal that resulted in sustained testicular temperatures equal to those of the body produced a

permanent sterility (Cowles, 1965; VanDemark & Free, 1970). Therefore, it is unclear how the shrew maintains normal spermatogenesis at abdominal temperatures. It is possible that for a short period during the 24-hr day, the shrew lowers its body temperature long enough for spermatogenesis to occur. This phenomenon was described by Riley (1937) for the English sparrow, although it has not been demonstrated to occur in any other avian species.

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REFERENCES

- BARTHOLOMEW, G. A. & RAINY, M. (1971) Regulation of body temperature in the rock hyrax, *Heterohyrax brucii*. *J. Mammal.* **52**, 81.
- COWLES, R. B. (1965) Hyperthermia, aspermia, mutation rates and evolution. *Q. Rev. Biol.* **40**, 341.
- DRYDEN, G. L. (1969) Reproduction in *Suncus murinus*. *J. Reprod. Fert.*, Suppl. **6**, 377.
- DRYDEN, G. L. & McALLISTER, H. Y. (1970) Sustained fertility after CdCl₂ injection by a non-scrotal mammal, *Suncus murinus* (Insectivora, Soricidae). *Biol. Reprod.* **2**, 23.
- DRYDEN, G. L. & ROSS, J. M. (1971) Enhanced growth and development of captive musk shrews, *Suncus murinus*, on an improved diet. *Growth*, **35**, 311.
- HALL, P. F. (1965) Influence of temperature upon the biosynthesis of testosterone by rabbit testis *in vitro*. *Endocrinology*, **76**, 396.
- RILEY, G. M. (1937) Experimental studies on spermatogenesis in the house sparrow, *Passer domesticus* (Linnaeus). *Anat. Rec.* **67**, 327.
- SHORT, R. V., MANN, T. & HAY, M. F. (1967) Male reproductive organs of the African elephant, *Loxodonta africana*. *J. Reprod. Fert.* **13**, 517.
- VANDEMARK, N. L. & FREE, M. J. (1970) *Temperature effects*. In: The Testis, Vol. III, p. 233. Eds. A. D. Johnson, W. R. Gomes and N. L. VanDemark. Academic Press, New York.
- WAITES, G. M. H. (1970) *Temperature regulation and the testis*. In: The Testis, Vol. I, p. 241. Eds. A. D. Johnson, W. R. Gomes and N. L. VanDemark. Academic Press, New York.
- WISLOCKI, G. B. (1933) Location of the testes and body temperature in mammals. *Q. Rev. Biol.* **8**, 385.
- WISLOCKI, G. B. & ENDERS, R. K. (1935) Body temperatures of sloths, anteaters and armadillos. *J. Mammal.* **16**, 328.