ANATOMICAL VALUES OF NORMAL TESTIS AND EPIDIDYMIS OF INDONESIAN SWAMP BUFFALO (*BUBALUS BUBALIS*)

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ABSTRACT

Genitalia from 140 buffalo bulls (39 young, 71 mature and 30 old) were collected from an abattoir in Jakarta, Indonesia. The genitalia, which were apparently normal on gross and histological examination, were used to provide some anatomical values of the testis and epididymis of Indonesian swamp buffaloes. This study revealed that the testis and epididymis attained their mature weight after the age of 3.5 years. The left testis was significantly heavier ($p < 0.001$) than the right testis. The mean total weights (right ± left) of the testes in young (9 months to 3 years), mature (3.5 years to 7 years) and old (over 7 years) buffaloes were 111.8 g, 155.8 g and 171 g, respectively; the mean total epididymal weights for those age groups were 25.9 g, 32.8 g and 35.1 g, respectively. These weights of the testes and epididymides of the Indonesian buffaloes were lower than those reported for Egyptian buffaloes, but slightly higher than those for Indian buffaloes. The mean epididymal/testicular weight ratio (0.23) found in the present study was much higher than that reported for bulls.

ABSTRAK

Alat kelamin dari 140 ekor kerbau jantan (39 muda, 71 dewasa dan 30 tua) diambil dari rumah potong hewan di Jakarta. Alat kelamin tersebut, yang pada pemeriksaan makroskopis dan histologis tidak menunjukkan kelainan patologis digunakan sebagai bahan untuk penyediaan data anatomis kerbau lumpur di Indonesia. Penelitian ini menunjukkan bahwa testis dan epididimis mencapai ukuran dewasa pada umur sekitar 3,5 tahun. Testis kiri sedikit lebih berat dari testis kanan, tetapi perbedaan ini sangat nyata ($p < 0,001$). Rata-rata bobot total testis (testis kanan ± testis kiri) pada kerbau muda (9 bulan sampai 3 tahun), dewasa (3,5 tahun sampai 7 tahun) dan tua (di atas 7 tahun) berturut-turut adalah 111,8 g, 155,8 g dan 171 g; sedangkan bobot total epididimis untuk kelompok umur tersebut di atas masing-masing adalah 25,9 g, 32,8 g dan 35,1 g. Testis dan epididimis kerbau Indonesia lebih ringan dibandingkan dengan yang dilaporkan untuk kerbau Mesir, tetapi lebih berat sedikit jika dibandingkan dengan yang dilaporkan untuk kerbau India. Rasio bobot epididimis/bobot testis (0,23) dalam penelitian ini adalah lebih kurang dua kali dari yang dilaporkan untuk sapi.

INTRODUCTION

Literature on the anatomical values of normal testis and epididymis of swamp buffalo bulls is lacking and no study has been conducted to provide information on the anatomical values of genitalia of Indonesian swamp buffalo bulls. This information is a prerequisite for studies on genital pathology and other aspects of reproduction.

MATERIALS AND METHODS

Macroscopically and histologically normal testes and epididymides from 140 buffalo bulls were used. All the buffaloes were of the swamp type and had reached puberty. The animals were classified into young (nine months to three years of age), mature (3.5 to seven years) and old (more than seven years). This classification was adapted from that of bulls (Ladds *et al.*, 1973). Corresponding dentition for the above ages for buffalo was as follows:

young - a full mouth of temporary incisors to the stage of eruption of the first of permanent incisors,

mature - eruption of the second pair of permanent incisors to the stage where the first pair of incisors were fully developed and,

old - the stage when and after the second pair of incisors were fully developed (Cockrill, 1974).

The circumference, length, width, thickness, weight and volume of each testis and weight of each epididymis were measured. The circumference was measured at the middle part of the testis using a flexible plastic measuring tape. The length (dorso ventral distance), width (mediolateral diameter) and thickness (cranio caudal diameter) were measured with a sliding gauge. The volume (in ml) was calculated from the length, width, and the thickness (in cm) according to the formula for an ellipsoid volume (4/3 x 22/7 x 1/2 length x 1/2 width x 1/2 thickness or 0.82 x length x width x thickness) (Osman and Zaki, 1971). In addition, the

volumes of 22 paired testes were measured by a water displacement technique to assess the accuracy of the testicular volume as determined by the ellipsoid volume formula.

The differences of the mean values between right and left-sided organs were analyzed using paired t-tests, whereas those between age groups were analyzed using analysis of variance. The statistical analyses were perform using a statistical package programme, Panacea programme (Pan Livestock Service Ltd., University of Reading, Reading, Berkshire, England).

RESULTS

The anatomical values of normal testis and epididymis of buffalo bulls are presented in Table 1. Except for the testicular density and epididymal/testicular weight ratio, there were significant differences ($p < 0.001$) for all of the values between young and mature ages. Between mature and old age, however, the only significant ($p < 0.05$) differences were in the length of left testis, weight of testis, volume of left testis and total weight of epididymis. The epididymal/testicular ratio was significantly greater ($p < 0.05$) in young buffalo bulls than in mature ones.

The differences in the values between the right and left testes were significant ($p < 0.05$) in regard to length, weight and volume; the left testis being heavier by 3.11 ± 0.39 g (mean ± S.E.) and longer by 0.2 ± 0.02 cm than the right testis. The values of the testicular volume determined by the water displacement technique and by applying the ellipsoid volume formula were not significantly different ($p > 0.05$). The width

Table 1. Anatomical values of the testis and epididymis of Indonesian swamp buffalo

Parameter	Young (9 months - 3 years)			Mature (3.5 - 7 years)			Old (>7 years)			Total or mean	
	No. sample	Range	(Mean ± S.E.)	No. sample	Range	(Mean ± S.E.)	No. sample	Range	(Mean ± S.E.)	No. sample	(Mean ± S.E.)
Circumferance (cm)											
right	30	8.7 – 13.0	(10.9 ± 0.15)a	51	10 – 15.3	(12.2 ± 0.15)b	19	10.4 – 14.5	(12.4 ± 0.25)b	100	(11.9 ± 0.12)x
left	30	9.0 – 13.0	(11.0 ± 0.15)a	51	10.2 – 14.4	(12.3 ± 0.14)b	19	10.5 – 14.5	(12.4 ± 0.25)b	100	(11.9 ± 0.12)x
Length (cm)											
right	39	5.8 – 7.9	(6.8 ± 0.06)a	67	6.2 – 9.6	(7.8 ± 0.08)b	28	6.9 – 9.6	(8.0 ± 0.11)b	134	(7.5 ± 0.07)x
left	39	5.9 – 8.2	(6.9 ± 0.05)a	67	6.3 – 9.5	(7.9 ± 0.08)b	28	7.0 – 9.9	(8.2 ± 0.11)b	134	(7.7 ± 0.07)y
Width (cm)											
right	39	3 – 4.6	(3.9 ± 0.05)a	67	3.6 – 5.2	(4.3 ± 0.04)b	28	3.5 – 5.5	(4.5 ± 0.08)b	134	(4.2 ± 0.03)x
left	39	3.2 – 4.8	(3.9 ± 0.05)a	67	3.6 – 5	(4.3 ± 0.04)b	28	3.9 – 5.2	(4.5 ± 0.08)c	134	(4.2 ± 0.03)x
Thickness (cm)											
right	39	2.7 – 4.4	(3.6 ± 0.05)a	67	3 – 5	(4.1 ± 0.05)b	28	3.3 – 4.9	(4.2 ± 0.08)b	134	(4.0 ± 0.03)x
left	39	2.8 – 4.7	(3.7 ± 0.05)a	67	3.3 – 4.8	(4.1 ± 0.05)b	28	3.5 – 5.0	(4.2 ± 0.08)b	134	(4.0 ± 0.03)x
Weight (g)											
right	39	33.6 – 84	(54.9 ± 1.63)a	71	42.6 – 114.6	(76.3 ± 1.93)b	30	48.2 – 113.3	(83.6 ± 2.87)c	140	(71.9 ± 1.55)x
left	39	33.4 – 91	(56.9 ± 1.73)a	71	44.9 – 117.91	(79.5 ± 2.05)b	30	53.2 – 121.3	(87.8 ± 2.78)c	140	(75.0 ± 1.62)y
total	39	67 – 175	(111.8 ± 3.30)a	71	87.5 – 231.6	(155.8 ± 3.93)b	30	108 – 235	(171.4 ± 5.55)c	140	(146.9 ± 3.14)
Volume (ml)											
right	39	25.3 – 80	(50.8 ± 1.70)a	67	36.8 – 117.4	(72.1 ± 1.93)b	28	41.4 – 113.2	(78.3 ± 3.29)b	134	(67.2 ± 1.58)x
left	39	28.4 – 92.4	(53.6 ± 1.81)a	67	40 – 112.6	(74.8 ± 1.95)b	28	51.1 – 122.0	(82.5 ± 3.33)c	134	(70.2 ± 1.62)y
Density (g/ml)											
right	39	0.9 – 1.4	(1.1 ± 0.02)a	67	0.8 – 1.2	(1.1 ± 0.01)a	28	0.9 – 1.2	(1.1 ± 0.02)a	134	(1.1 ± 0.01)x
left	39	0.8 – 1.2	(1.1 ± 0.02)a	67	0.9 – 1.3	(1.1 ± 0.01)a	28	0.9 – 1.3	(1.1 ± 0.02)a	134	(1.1 ± 0.01)x
Epididymis											
Weight (g)											
right	39	8.8 – 17.5	(13.0 ± 0.40)a	71	9.6 – 24.5	(16.2 ± 0.33)b	30	10.4 – 26.0	(17.4 ± 0.64)b	140	(15.3 ± 0.31)x
left	39	8.8 – 18	(12.9 ± 0.38)a	71	10.7 – 26.4	(16.6 ± 0.36)b	30	11.9 – 26.3	(17.7 ± 0.62)b	140	(15.9 ± 0.30)x
right	39	0.17 – 0.32	(0.24 ± 0.01)a	71	0.16 – 0.37	(0.22 ± 0.01)b	30	0.15 – 0.38	(0.21 ± 0.01)b	140	(0.22 ± 0.002)x
left	39	0.18 – 0.36	(0.24 ± 0.01)a	71	0.13 – 0.43	(0.22 ± 0.01)b	30	0.16 – 0.39	(0.22 ± 0.01)b	140	(0.23 ± 0.003)x

Note: Mean values with different superscript a to c indicate significant differences ($p<0.05$) between age groups of the mean values, whereas mean values with different superscript x and y indicate significant differences ($p<0.05$) between the right and left mean values

of the testis was significantly greater than the thickness ($p < 0.001$) by (0.3 ± 0.005) cm in all age groups. Testicular length was approximately 1.8 times the width, and 1.9 times the thickness in all age groups.

DISCUSSION

The anatomical values for the normal testis and epididymis of the Indonesian swamp buffalo bulls found in this study were much lower than those reported in the Egyptian buffalo (Osman and Zaki, 1971; Abdel-Rahman *et al.*, 1982), but were slightly higher than those reported in Indian buffaloes (Joshi *et al.*, 1967; Maurya *et al.*, 1968a; Pal and Bharadwaj, 1983) of comparable age. Testicular weight and epididymal weight were, however, only about 29% and 62%, respectively of the values reported in post-pubertal *Bos taurus x Bos indicus* cross bulls (Ladds *et al.*, 1973).

The size and weight of the testis and epididymis increased with age from young (9 months to 3 years) to mature (3.5 to 7 years). From mature to old age (> 7 years), however, the testis and epididymis still increased in weight and size, but at a much lower rate. This increase was only detected from the weight and partly by the length and the volume, indicating that these three parameters were the most sensitive. The same pattern of growth had been reported in bulls (Ladds *et al.*, 1973), in Indian buffalo bulls (Pal and Bharadwaj, 1983) and in swamp buffalo bulls (McCool, 1987). In Egyptian buffalo bulls, however, the maximum size and weight of testis end epididymis were reached at 3.5 years of age after which no increase was repported (Osman and Zaki, 1971).

In the testis of the Egyptian buffalo, Osman and Zaki (1971), and Abdel-Rahman *et al.* (1982) reported that the width is less than the thickness, whereas in the testis of bulls, Abdel-Raouf (1960) observed the reverse; ie. the width was greater than the thickness. The length of testis in Egyptian buffaloes was 2 times the width and 3 times the thickness whereas in the testis of bulls the length was 3 times the width and 2 times the thickness. The testes observed in the present study were almost round in cross section so that diameter would be an appropriate measure. The width was only few millimetres greater than the thickness. The length was 1.8 times the width and 1.9 times the thickness.

The epididymal/testicular weight ratio found in the present study was significantly higher in the young than in the mature and old groups. This suggested that the pattern of growth rate of the epididymis may not be coincident with the testis between young and mature ages. The mean epididymal/testicular weight ratio was 0.23. In bulls, the normal ratio was reported between 0.09 to 0.11 (Ladds *et al.*, 1973) and in advanced testicular degeneration, it was usually about 0.16 (Ladds, cited by Krishnalingam *et al.*, 1982). In Indian and Egyptian buffalo bulls the ratio was reported to be 0.24 and 0.16, respectively (Maurya *et al.*, 1968b; Osman and Zaki, 1971). This indicates that buffalo bulls have a relatively heavier epididymis than bulls.

REFERENCES

ABDEL-RAHMAN, H., A. MOHAMMED and M.A. EL ASHRY. 1982. The development of male sex organs of Egyptian buffaloes. *Minufia J. Agric. Res.* 5: 183-201.

ABDEL-RAOUF, M. 1960. The postnatal development of the reproductive organs in bulls with special references to puberty. *Acta Endocr. (Kbh)* 34 suppl. 49: 1-109.

COCKRILL, W.R. 1974. Management, conservation and use. *In:* The Husbandry and Health of the Domestic Buffalo. pp. 276-312 W.R. Cockrill (ed.). FAO of the United Nations, Rome.

JOSHI, N.H., S.N. LUKTUKE and S.N. CHATTERJEE. 1967. Studies on the biometry of the reproductive tract and some endocrine glands of the buffalo male. *Indian Vet. J.* 44: 137-145.

KRISHNALINGAM, V., P.W. LADDS and K.W. ENTWISTLE. 1982. Quantitative microscopic and histological study in *Bos indicus* strain bulls. *Res. Vet. Sci.* 32: 131-139.

LADDS, P.W., D.P. DENNETT and J.S. GLAZEBROOK. 1973. A survey of the genitalia of bulls in Northern Australia. *Aust. Vet. J.* 49: 335-340.

MAURYA, S.N., R.C. BHALLA and B.K. SONI. 1968a. Studies on biometry of genital organs of buffalo bulls (*Bos bubalus*). Testis, epididymis and ampullae. *Indian Vet. J.* 45: 742-752.

MAURYA, S.N., R.C. BHALLA and B.K. SONI. 1968b. Studies on testicular calcification in buffalo bulls (*Bos bubalus*). *Indian J. Vet. Sci.* 38: 238-242.

MCCOOL, C.J. 1987. Aspect of reproduction in the Australian swamp buffalo. PhD Thesis, James Cook University of North Queensland, Townsville, Australia.

OSMAN, A.M. and K. ZAKI. 1971. Clinical and anatomical studies on the scrotum and its contents in buffaloes. *Fortpfl. Haust. Bd.* 7: 57-81.

PAL, C. and M.B.L. BHARADWAJ. 1983. Morphology and biometry of the testis in Indian buffalo (*Bubalus bubalis*). *Philippine J. Vet. Med.* 22: 7-12.