Difference in size between spermatozoa from the cauda epididymidis and the caput epididymidis of the rat

Janet Brotherton

Department of Gynaecological Endocrinology, Sterility and Family Planning, Klinikum Steglitz of the Free University of Berlin, Hindenburgdamm, 30, 1000 Berlin 45, Germany

The Coulter Counter has been used to determine the number and equivalent spherical volume of ejaculated or epididymal spermatozoa from several species, including man (Brotherton & Barnard, 1974; Brotherton, 1975a,b). In the present study, spermatozoa were obtained from the cauda and caput epididymidis of individual Sprague–Dawley rats, weighing 300–350 g, and their size determined and compared.

The spermatozoa were extruded from the lacerated coils of the cauda and caput epididymidis (see Glover & Nicander, 1971) of each rat into a suitable volume of Isoton reagent (Coulter Electronics Ltd) to give a dilution of about $6\text{--}14 \times 10^4$ spermatozoa/ml. Counting and sizing was carried out as described previously using a Coulter Counter, Model Z_B Industrial, with an aperture of nominal diameter 70.7 μm . The nominal machine constant for this aperture, $K_N = 22.625$, was used throughout and hence, taken in conjunction with the machine settings of $I = \frac{1}{4}$, $A = \frac{1}{2}$, $M = 2$ and $G = O$, the machine value, F , was $1.414 \mu\text{m}^3$ per unit of threshold.

Table 1. Differences in size between spermatozoa from the cauda and caput epididymidis of the rat

	Animal number					Mean	± S.D.
	1	2	3	4	5		
Caput epididymidis							
Threshold (T)							
Minimum	28.5	26.5	29.0	25.0	28.0		
Approx. mode	49.0	55.5	45.0	45.0	42.0		
Mean ($T\frac{1}{2}$)	53.0	58.0	55.5	52.5	56.5		
Volume (μm^3)							
Minimum	40.30	37.47	41.01	35.35	39.59	38.74	2.07
Mode	69.29	78.48	63.63	63.63	59.39	66.88	6.60
Mean	74.94	82.01	78.48	74.24	79.89	77.91	2.95
Total spermatozoa ($\times 10^6/\text{animal}$)	161.7	139.0	165.5	239.6	179.1	177.0	
Cauda epididymidis							
Threshold (T)							
Minimum	33.0	33.0	35.5	32.0	28.0		
Approx. mode	53.5	52.2	54.5	53.0	52.0		
Mean ($T\frac{1}{2}$)	59.5	63.0	64.0	59.0	60.5		
Volume (μm^3)							
Minimum	46.66	46.66	50.20	45.25	39.59	45.76	3.45*
Mode	75.65	74.24	77.06	74.94	73.53	75.08	1.22**
Mean	84.13	89.08	90.50	83.43	85.55	86.54	2.78***
Total spermatozoa ($\times 10^6/\text{animal}$)	63.8	24.2	60.0	92.7	75.0	63.1	
Loss in mean volume							
μm^3	9.19	7.07	12.02	9.19	5.66	8.63	2.16
%	10.9	7.9	13.3	11.0	6.6	10.0	2.4

Significantly different * $P < 0.01$; ** $P < 0.05$; *** $P < 0.005$.

The agreement between the size distribution curves for the spermatozoa from the caput or cauda epididymidis from the epididymides of individual rats was very close. The sperm volumes at the minimum, approximate mode (of a broad peak) and mean of the size distribution curves were significantly less (about 10%) for the spermatozoa from the cauda epididymidis than those from the caput (Table 1).

It is known that during their passage through the epididymis spermatozoa undergo changes in structure and function which collectively are said to reflect a process of maturation (Glover, 1974). These changes result in the spermatozoa acquiring the ability to fertilize and a capacity for vigorous motility if removed from the epididymis and exposed to oxygen or a glycolisable sugar such as fructose. The structural changes reported (Glover, 1974) for spermatozoa of rabbits, guinea-pigs and bulls during transit through the epididymis suggest that the spermatozoa undergo dehydration. The present findings of a change in total sperm volume are consistent with the occurrence of such dehydration.

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