

appear to be structurally simpler and the possibility of an anatomical non-respiratory shunt is more remote. The elasmobranch is left with two possible mechanisms for adjusting functional surface area, recruitment and lamellar narrowing. Although the results of the present study are preliminary, it is clear that hypoxia, hypercapnia and serotonin decrease functional surface area while resistance to blood flow increases. This gives evidence in support of the recruitment theory, because a decrease in functional surface area with increasing resistance could occur only if fewer lamellae were being perfused. Epinephrine probably acts by decreasing the intralamellar space. In this case the water space may be expanded. This concept is consistent with the findings of an increased gill resistance and increased functional surface area. The effect of atropine, opposite to the effect of hypoxia and hypercapnia, is to be expected. Since vagal pathways carry information which increases gill resistance while decreasing functional surface area, it is not surprising that atropine brings about the converse.

The thermal wash-out technique provides a sensitive, reproducible, simple method for quantifying changes in functional surface area in the fish gill. The method, in elasmobranchs, provides a way of differentiating between recruitment and lamellar narrowing as mechanisms controlling gill blood flow. This project supported by Veterans Administration Hospital, Bronx, New York, Project #4901-01 and 4901-02.

#### KIDNEY FUNCTION IN SPINY MICE (*Acomys cahirinus*) ACCLIMATED TO WATER RESTRICTION

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Spiny mice (*Acomys cahirinus*) readily acclimate to conditions of water shortage (Borut et al. Int'l. Congr. Physiol. Paris, 1977). This preliminary study was done to evaluate the role of the kidney in the acclimation process.

Eighteen *Acomys cahirinus* were studied. The animals were maintained several months previous to this study in the animal facilities of the MDIBL. Temperature was 30°C with a 12 hours light, 12 hours dark cycle. One week prior to testing the animals were placed individually in cylindrical wire cages. The cages were equipped with food and water receptacles and could be placed on petri dishes for collection of urine samples. Six control animals received water and food as desired (controls). Six acutely dehydrated animals (ADA) were deprived of water for 24 hours prior to testing. Six chronically dehydrated animals (CDA) were forced to acclimate over a 14-day period to minimal water supply. The acclimation procedure was described earlier (Haines et al. Am. J. Physiol. 227:958-963, 1974).

Glomerular filtration rate was measured with  $^{14}\text{C}$  polyethylene glycol (MW 4000) after the method of Truniger and Schmidt-Nielsen (Am. J. Physiol. 207:971-978, 1964). Urine samples (usually 20-50  $\mu\text{l}$ ) were diluted 5-10 times with distilled water. Aliquots of diluted urine were counted by liquid scintillation (Packard, Tricarb 3002) for  $^{14}\text{C}$ . Osmolality was measured by vapor pressure osmometer (Wescor), concentrations of  $\text{Na}^+$  and  $\text{K}^+$  by Instrumentation Laboratory Model 343, and urea by the Conway method (Conway, E.J. and E. O'Malley. Biochem. J. 36:655, 1942). Samples of plasma were counted and analyzed identically to urine samples except that there was no dilution.

The average body weight of controls was  $48.5 \pm 2.4$  g; in acutely dehydrated animals it was  $36.0 \pm 2.5$  g and in chronically dehydrated animals it was maintained at  $32.6 \pm 2.1$  g. Acutely and chronically dehydrated animals showed no differences from controls in plasma solute concentrations or osmolality. This observation supports previous findings (Horowitz and Borut, Comp. Biochem. Physiol. 51A:827-831, 1975) and our unpublished data on the capacity of this species to maintain normal plasma concentrations during dehydration.

Urine flow rate (V) in ADA was approximately one-quarter that of the controls. In CDA it was less than one-tenth that of controls (Table 1). Glomerular filtration rate (GFR) was greatly reduced in the CDA and unchanged in ADA animals (Table 1). Urea clearance ( $C_u$ ) in ADA was unchanged from controls but was reduced

Table 1. Glomerular filtration rate (GFR), rate of urine formation (V) and clearance of urea (C<sub>u</sub>). All rates are in  $\mu\text{l}/\text{min}$ .

GFR	V	C <sub>u</sub>
417 $\pm$ 17*	<u>CONTROLS</u> (N=5) 2.8 $\pm$ .9	184 $\pm$ 38
189 $\pm$ 83	<u>CDA</u> (N=6) 0.25 $\pm$ .09	39 $\pm$ 19
519 $\pm$ 130	<u>ADA</u> (N=6) 0.76 $\pm$ 0.10	143 $\pm$ 30

\*Mean  $\pm$  SEM

in CDA. Mean ratios of C<sub>u</sub>/GFR, 0.43, 0.21 and 0.30 for controls, CDA and ADA respectively, were not statistically different from the grand mean of 0.31.

The osmotic concentration of the urine from CDA and ADA was similar. Urine osmolality in the CDA and ADA was slightly more than twice that in controls, and this was true of the concentrations of urea, sodium and potassium as well (Table 2). The highest osmolality was 4760 mOsm/Kg in an acute animal and this value was followed by 3800 mOsm/Kg in a chronic animal. Solute excretion rates (U x V) were lower in CDA and ADA than in controls.

Table 2. Urine osmolality (U<sub>osm</sub>) and concentrations of urea (U<sub>urea</sub>), sodium (U<sub>Na</sub>) and potassium (U<sub>K</sub>). Units are mOsm/kg and mM/l.

U <sub>osm</sub>	U <sub>urea</sub>	U <sub>Na</sub>	U <sub>K</sub>
	<u>CONTROLS</u> (N=6)		
1410 $\pm$ 323*	862 $\pm$ 153	145 $\pm$ 38	155 $\pm$ 50
	<u>CDA</u> (N=6)		
3037 $\pm$ 323	2036 $\pm$ 289	256 $\pm$ 31	382 $\pm$ 34
	<u>ADA</u> (N=6)		
3123 $\pm$ 350	1968 $\pm$ 280	243 $\pm$ 63	360 $\pm$ 50

\*Mean  $\pm$  SEM

GFR was reduced an average of 55% in the chronically dehydrated animals whereas the acutely dehydrated animals showed no reduction. Clearly, the reduction in GFR was associated with long-term exposure to water restriction. The physiological mechanism underlying this reduction must await further analysis. A reduction in GFR of the magnitude observed in the chronically dehydrated spiny mice is unknown in rodents although camels, dehydrated for 10 days under hot desert conditions, showed reduced GFR (Yagil and Berlyne, J. Appl. Physiol. 41:457-461, 1976).

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