

Demonstration that inulin concentration of brain ECF increases progressively with distance from CSF supports the sink hypothesis of CSF function. We are presently investigating the possibility that polar end products of brain metabolism may be removed from brain via net diffusion into CSF.

Supported in part by NSF grant GB-7529.

1968 #10

LINEAR VELOCITY AND FLOW RATE OF TUBULAR FLUID IN SURFACE NEPHRONS OF
Squalus acanthias IN SITU.

Peter Deetjen and John W. Boylan, Departments of Medicine and Physiology, State University of New York at Buffalo, N. Y.

Dogfish weighing 1-3 kg were injected with nembutal (15 mg/kg BW) and placed ventral side up on a V board. Their gills were perfused with running sea water. Through an 18G needle placed in the dorsal aorta a polyethylene catheter (PE10) was passed retrograde to a point approximating the cephalic end of the kidneys. The right kidney was exposed through a midline abdominal incision and gentle retraction of the viscera; its surface was visualized by incident light microscopy. In fish of about 1 kg BW the renal capsule is transparent and surface tubules can be seen through it. In larger fish the capsule is often dense and a portion must be removed to allow for a satisfactory study. Since in these larger fish the capsule is also closely adherent to the kidney surface, we encountered considerable bleeding during this surgical preparation.

A bolus of Lissamine green dye (0.5 ml of 5% aqueous solution) was rapidly injected into the catheter and its passage observed.

Deep vessels, fanning out radially and segmentally from the aortic region become colored 5-10 seconds after the injection. Filtered dye appears in loops of surface nephrons 8-15 seconds later. In measured lengths of surface loops the linear velocity ($\mu \text{ sec}^{-1}$) of the dye front was recorded. The inner diameter of these loops was taken as the width of the column of dye. Tubular fluid flow rates ($\text{ml min}^{-1} \times 10^{-6}$) were then calculated from linear velocity and cross-sectional area. Representative data from 12 measurements on 5 fish are set out in Table 1.

Linear velocity of tubular fluid ranged from 90 to 280 $\mu \text{ sec}^{-1}$, tubular diameter from 33 to 50 μ and flow rate from 9 to 33 with a mean of $20 \times 10^{-6} \text{ ml min}^{-1}$.

In a second population of surface loops, more numerous than the first and lateral to it, dye appears 100 to 300 seconds after the injection.

Ghouse and Brennan (this Bulletin, abstract #15) estimate about 8,800 glomeruli in a dogfish of average size. In these authors' micro-dissection study, 26 completely dissected nephrons were found to have a mean length of 31.3 mm. It is interesting to relate our functional data with these anatomical descriptions, now available for the first time. The appearance of dye in surface loops about 8-15 seconds after it reaches the kidney locates these loops in the first 1-3 mm of the nephron and means that a flow rate measured here would approximate single nephron filtration rate. In free-swimming dogfish, 2.6 - 4.4 kg BW, the clearance of inulin was found to average 12 ml hr^{-1} (Bull. MDIBL 6:2, 1966). At 8,800 glomeruli per fish this yields a mean GFR per nephron of $22.6 \times 10^{-6} \text{ ml min}^{-1}$ compared to our mean value of $20.6 \times 10^{-6} \text{ ml min}^{-1}$ cal-

Table 1

SOME PARAMETERS OF SURFACE NEPHRONS IN *Squalus acanthias*

No.	BW kg	KW g	Diameter μ	Linear flow velocity μ /sec	Flow rate 10^{-6} ml/min
1	3.0	8.6	50	187	22
2			50	281	33
3			50	281	33
4			50	225	27
5	2.1	6.0	50	173	20
6			50	207	24
7	4.5	12.8	50	190	23
8	0.9	3.6	40	112	9
9			33	252	13
10			40	207	16
11	1.7	5.9	50	90	11
12		5.9	50	108	13
$\mu = 12$			47 ± 6	193 ± 63	$20 + 9$

culated from linear velocity and radius. It should be noted that the former represents a mini-
mum value for single nephron GFR since in the normal state all glomeruli are probably not ac-
tive. The reappearance of dye in a second population of surface loops 100-300 seconds after in-
jection identifies these more numerous structures as distal convolutions (Ghouse and Brennan,
Section 5).

In a few experiments epinephrine (1 mg kg^{-1} BW) was given after the initial observations
had been recorded. After epinephrine it was noted that portions of kidney surface which previ-
ously had appeared avascular now became filled with blood. Linear velocity of proximal tubu-
lar fluid, however, did not appear to be increased. From these preliminary studies it would ap-
pear likely that the well-known effect of adrenalin increasing GFR in this animal probably op-
erates by augmentation of renal blood flow and recruitment of resting glomeruli.

Supported by NSF grant BG-2580.

1968 #11

EFFECT OF EPINEPHRINE AND ACETYLCHOLINE ON INTESTINAL VASCULAR RESIS-
TANCE OF *Squalus acanthias*

John N. Diana and A. Louise Diana, Department of Physiology and Biophysics, University of
Iowa School of Medicine, Iowa City, Ia.

Studies of intestinal vascular resistance in mammals have indicated that intravenous or in-
tra-arterial injection of epinephrine results in either an increase or no change in resistance to
blood flow (Texter, E. C. et al., J. Lab. Clin. Med. 64:624-30, 1964) while acetylcholine de-
creases intestinal vascular resistance (Boatman, D. L. and Brody, M. J., J. Pharm. and Exptl.