The use of the Nernst equation as a means of evaluating a theoretical potential difference (EPD) that could retard movement of the charged relative to the uncharged member of each solute pair is truly appropriate only under ideal equilibrium conditions that cannot prevail in studies such as these. It must be assumed that the two members of each pair move through identical channels so that the neutral member may serve as a marker for water flow. The luminal concentration of the anion may then be computed by dividing the rate of anion secretion by the clearance of the neutral moiety. Since the anion concentration at the counter-luminal surface is equal to the perfusate concentration, the inner-outer anion concentration ratio is equal to the anion-neutral clearance ratio and EPD = (RT/zF) ln C_i/C_n where C_i is the clearance of the charged and C_n the clearance of the neutral solute, R, T, z, F having their usual significance. The higher EPD (Table 1) for $^{C}C/C_H$ than for $^{C}F/C_S$ suggests that the larger monovalent molecule may encounter a greater bioelectrical resistance possibly because it more closely approximates fixed negative charges during transmembrane movement or because it moves by a different route. In both sets of experiments, observed (PD) and calculated (EPD) values changed in the same direction duirng Th-DBcAMP stimulation. Comparison of EPD and PD must obviously be made with considerable caution owing to the uncertain validity of both measurements as guides to bioelectric phenomena at the epithelial surfaces in these studies. Certainly the assumptions upon which the Nernst equation is used are not wholly acceptable for the experimental situation. The direct measurement of the potential difference between the duct and the perfusate at some distance from the secreting epithelium, may be markedly affected by short-circuits and inputs of various kinds that are not easily controlled or identified at present. Nevertheless, the observation that both approaches yielded comparable values and changed similarly during stimulation of rectal gland secretion suggests that the clearance probe may be a useful tool for the evaluation of bioelectric potentials in situations where direct measurements are impossible.

LACK OF EFFECT OF ANGIOTENSIN II IN DOGFISH

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INTRODUCTION. In mammals, the administration of angiotensin II can cause diuresis or antidiuresis or have no effect at all on urine flow. As a general rule, small doses of angiotensin cause antidiuresis and large doses, diuresis. The response depends on many factors. First, angiotensin increases arterial blood pressure and this may influence renal function. Second, angiotensin constricts both afferent and efferent arterioles. Depending upon the relative sensitivities of these vascular beds, glomerular filtration could decrease or increase, ultimately influencing urine flow rate in parallel. Moreover, angiotensin might be involved in redistribution phenomena and thereby alter urine flow. Finally, angiotensin II is thought to have direct tubular effects; both a stimulatory and an inhibitory effect on water and solute reabsorption have been reported. Thus, with respect to water and solute excretion the tubular effects of angiotensin might either accentuate or attenuate the vascular effects.

In the experiments described below, angiotensin II was infused intravenously into *Squalus acanthias*, an animal which lacks the renin-angiotensin system. A wide range of rate of administration was used, 15-36 ng/min/Kg body weight. Arterial blood pressure, plasma composition, and renal functions were measured before, during, and after the infusion.

METHODS. Female dogfish were kept in live cars until they were used, usually 2-3 days after capture. At least 24 hours before the acute experiments, inulin was injected i.m. at several sites (10 gm %, 1 ml/Kg body weight). On the experimental day, the fish was restrained in a tank filled with rapidly running sea water. A small ventral incision was made in an area previously infiltrated with Lidocaine and an hepatic vein and a celiac artery were catheterized with polyethylene tubing. The arterial catheter was connected

to a U-tube manometer filled with dogfish Ringers, and arterial blood pressure was recorded every 5-10 minutes throughout the experiment. Polyethylene tubing was inserted into the urogenital papilla and tied securely.

An intravenous infusion was begun, consisting of dogfish Ringers given at 0.108 ml/minute. Approximately 45 minutes later, the control clearance period, about 60 minutes long, was begun. Urine was collected in a graduated test tube and arterial blood (about 0.4 ml) was collected at the clearance midpoint. Following this, angiotensin II was added to the infusate (rate of administration ranged from 15-36 ng/min/Kg body weight and averaged 23 ± 2 ng/min/Kg body weight). Thirty minutes later, the experimental clearance period was begun. Finally, the infusate was switched back to dogfish Ringers without angiotensin, and 30 minutes later, the recovery clearance period was started. A second group of dogfish received dogfish Ringers only during the three clearance periods (Control group, to control for the effects of time on the measured parameters).

The paired t test was used to assess statistical significance of changes in both groups of fish.

RESULTS. Our observations are summarized in Tables 1 (Control) and 2 (Angiotensin II). Angiotensin II did not increase arterial blood pressure. In both groups, plasma Na, K, and osmolality tended to increase over

TABLE 1

CONTROL DOGFISH

	Control Period	Control Period	Control Period
Body Weight, Kg	4.76 ± 0.50 (7)		
Arterial Blood Pressure, cm H_2O	28.5 ± 2.1 (7)	29.1 ± 2.1 (7)	28.1 ± 2.3 (6)
Plasma Na, mEq/liter	257 ± 9 (7)	264 ± 8 (7)	268 ± 5 (7)
Plasma K, mEq/liter	3.1 ± 0.2 (7)	3.3 ± 0.2 (7)	3.3 ± 0.1 (7)
Plasma Osmolality, mOs/Kg H_2O	948 ± 29 (7)	978 ± 7 (7)	975 ± 9 (7)
Glomerular Filtration, ml/hr/Kg	2.0 ± 0.5 (6)	1.5 ± 0.3 (6)	1.5 ± 0.4 (6)
Urine Flow, ul/hr/Kg	288 ± 54 (7)	193 ± 33 (7)*	228 ± 42 (6)*
Urine/Plasma Na Ratio	1.4 ± 0.1 (7)	1.4 ± 0.1 (7)	1.3 ± 0.1 (6)*
Na Excretion, μEq/hr/Kg	101 ± 21 (7)	69 ± 12 (7)*	78 ± 14 (6)
Urine/Plasma K Ratio	17.1 ± 6.2 (6)	10.5 ± 3.6 (7)	8.2 ± 3.9 (6)
K Excretion, μEq/hr/Kg	10 ± 3 (7)	8 ± 3 (7)	9 ± 6 (6)

Means ± SEMs. Numbers of observations in parentheses. *indicates $p<0.05$, paired t test, comparing with immediately preceding clearance period.

time, and in some cases, the increases were statistically significant. None of these increases can be attributed to angiotensin II administration, however, since both groups behaved similarly. Glomerular filtration rate was fairly constant in both groups, but urine flow and Na and K excretion rates tended to decrease over time, again effects that cannot be attributed to the administration of angiotensin II.

DISCUSSION. In contrast with its effects in mammals, angiotensin II (in doses ranging from 15-36 ng/min/Kg body weight) does not have a pressor effect in dogfish. Although arterial blood pressure does increase when 20 μg doses are given (Bull. Mt. Desert Island Biol. Lab. 15:61, 1975), the effect is attributed to release of catecholamines from chromaffin tissue, which is stimulated by both angiotensins I and II.

We observed no unequivocal direct effect of angiotensin II on renal function of dogfish. This research was supported by grants from the Skillman Foundation and NIH grant AM05077.

TABLE 2

ANGIOTENSIN II IN DOGFISH

	Control	Experimental	Recovery
Body Weight, Kg	5.26 ± 0.27 (14)		
Arterial Blood Pressure, cm H_2O	30 ± 1 (14)	29 ± 1 (14)	27 ± 1 (14)*
Plasma Na, mEq/liter	272 ± 3 (14)	283 ± 2 (14)*	288 ± 2 (14)*
Plasma K, mEq/liter	4.2 ± 0.1 (14)	4.6 ± 0.2 (14)*	4.9 ± 0.2 (14)*
Plasma Osmolality, mOs/Kg H_2O	997 ± 7 (14)	1013 ± 6 (14)*	1016 ± 6 (14)
Glomerular Filtration, ml/hr/Kg	1.6 ± 0.3 (8)	1.5 ± 0.3 (9)	1.5 ± 0.2 (9)
Urine Flow, µl/hr/Kg	302 ± 69 (10)	260 ± 68 (12)	253 ± 63 (12)
Urine/Plasma Na Ratio	1.1 ± 0.1 (14)	1.0 ± 0.1 (14)	0.8 ± 0.1 (14)*
Na Excretion, µEq/hr/Kg	83 ± 19 (10)	72 ± 20 (12)	57 ± 17 (12)*
Urine/Plasma K Ratio	14.8 ± 2.0 (14)	16.6 ± 4.0 (14)	23.5 ± 4.5 (14)*
K Excretion, µEq/hr/Kg	20 ± 8 (10)	16 ± 7 (12)	27 ± 10 (12)*

Means ± SEMs. Numbers of observations in parentheses. *indicates $p < 0.05$, paired t test, comparing with immediately preceding clearance period. Angiotensin II was infused during the experimental period (average dose, 23 ± 2 ng/min/Kg body weight; range, 15 - 36 ng/min/Kg body weight).

EFFECTS OF SARALASIN IN *Lophius americanus*

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INTRODUCTION. We have reported on the effects of exogenous angiotensin II in goosefish (Bull. Mt. Desert Island Biol. Lab. 16:5-8, 1976). Following a control clearance period, angiotensin was infused intravenously at rates ranging from 10-100 ng/min/Kg body weight. We observed diuresis, natriuresis, and pressor effects directly related to administered dose in all fish studied. Urine flow, Na excretion, and arterial blood pressure returned to control levels shortly after discontinuing the infusions.

The experiments described below were designed to elucidate the roles, if any, of endogenous angiotensin II in goosefish. Following a control period during which mean arterial blood pressure and various renal functions were measured, a competitive inhibitor of angiotensin II (P-113, Saralasin, 1-Sar-8-Ala-angiotensin II) was infused intravenously and the measurements were repeated. A recovery clearance period was not done since the half-life of Saralasin is relatively long. Instead, a second group--infused with 150 mM NaCl only--was studied to control for possible effects of time on the various parameters.

METHODS. Goosefish were kept in live cars until used, usually the day after capture. The fish were restrained in tanks filled with rapidly running sea water. A small ventral incision was made in an area previously infiltrated with Lidocaine. Both ureters, a hepatic vein, and a celiac artery were catheterized with polyethylene tubing. The arterial catheter was attached to a U-tube manometer which was filled with 150 mM NaCl, and blood pressure was recorded at 5-10 minute intervals throughout the experiments. An intravenous infusion was begun (150 mM NaCl at 0.1083 ml/min) and approximately 60 minutes later, the control clearance period was begun. The usual duration of this period was 60 minutes. Following this, Saralasin was added to the infusate (average rate of administration was 231 ± 15 ng/min/Kg body weight) and approximately 30 minutes later, the first of 2 consecutive experimental clearance periods was begun.