ual variations did not permit statistical analysis. In neutral NaCl solution an important increase of net $Na^+$ flux is observed while the net $Cl^-$ flux increases less although still significantly.

To summarize, Rana clamitans placed in dilute NaCl solutions may pump $Na^+$ and $Cl^-$ at very different rates. The difference in pumping rates depends on the electrolyte composition of external solutions in which the animals were preadapted. This observation is considered as evidence that the mechanisms for sodium and chloride absorption are different. It can be observed however that both Na and Cl uptakes are lower if the animals were preadapted in 10 mEq/L rather than 3 mEq/L sodium sulfate solutions. Furthermore a shift from acid to neutral pH by buffering the experimental NaCl test solution may produce a simultaneous increase in Na and Cl net uptake. It appears, therefore, that the transepithelial transports of Na and Cl are not completely independent.

1970 #30

## RESPONSE OF THE KIDNEY OF Squalus acanthias TO DIURETICS

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The kidney of the dogfish, Squalus acanthias, has in several aspects been characterized as an organ with a relatively fixed pattern of function. Urine pH remains unchanged in the face of acid loading (Sharks, Skates and Rays, 1967, p. 249), and there is no demonstrable change in titrable acid excretion save for the increase that occurs with phosphate loading (W. W. Smith, J. Cell. & Comp. Physiol. 14:95, 1939). Although mercurials in the past have not been demonstrated to induce a renal response in the dogfish, Forster and coworkers reported that a diuresis and chloruresis was induced in the dogfish by epinephrine (Bull. MDIBL 9:14, 1969).

As part of a study of trace metal excretion in the dogfish, response to a series of diuretics was investigated. Inulin clearances were conducted 10 or more hours after the intramuscular administration of 3-4 ml 3.3% inulin in dogfish Ringers in divided doses. Following 2 control clearance collections, epinephrine (0.5-1.1 mgm/Kg), furosimide (8-17 mgm/Kg), ethacrynic acid (11-12 mgm/Kg), or chlorthiazide (80-125 mgm/Kg) were administered by intravascular route, and clearance collections were continued. Some fish received no drug and served as controls. Each drug studied, with the exception of chlorthiazide, produced diuresis and natriuresis. There was no measurable difference in the response with the higher doses of drugs used, indicating that the smallest doses used were effective. The higher dose of ethacrynic acid was associated with sluggish behavior of the fish. The large doses of chlorthiazide used were a result of previous failure to demonstrate response with lesser amounts of the drug. Following administration of chlorthiazide there appeared a white precipitate in the urine, presumably the chlorthiazide.

Change in sodium excretion was from a mean of 124 ± 15 (SE) to 310 ± 32 $\mu$Eq/Kg/Hr following epinephrine, 174 ± 26 to 438 ± 35 $\mu$Eq/Kg/Hr after ethacrynic acid and 136 ± 40 to 485 ± 118 $\mu$Eq/Kg/Hr in response to furosimide. There was no measurable change in sodium excretion in the fish that received chlorthiazide or no drug.

Inulin clearance increased in most fish studied, but the increase in sodium excretion was greater in magnitude and occurred in studies when no increase in inulin clearance was found.

Potassium excretion was variable. Although each fish that received chlorthiazide demonstrated an increase in potassium excretion, indicating some physiologic response to the drug, the same was not the case with those diuretics that induced natriuresis. With the latter group of drugs potassium excretion usually decreased if potassium excretion was high during the control periods but increased if potassium excretion was less than 10 $\mu$Eq/Kg/Hr during the control periods.

Supported by USPHS Grant AM-10417.

1970 #31

## EFFECT OF SPINAL CORD STIMULATION AND SYMPATHOMIMETIC DRUGS ON DORSAL AORTIC PRESSURE IN Squalus acanthias

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Descriptions of a neuronal system in elasmobranchs corresponding to the sympathetic division of the mammalian autonomic system are nebulous. Squalus acanthias exhibits vascular responses to sympathomimetic drugs and possesses abundant chromaffin tissue. This suggests that some degree of sympathetic control or regulation of peripheral circulation may occur. Experiments were conducted in an attempt to establish whether peripheral vascular responses could be elicited by stimuli which produce sympathetically mediated reflex vascular responses in mammals.

The spinal cord was stimulated in thirteen spino-medullary transected dogfish using faradic stimuli of 5-15 volts at 2-50 Hz. The gills of the fish were perfused with 2-4 L/min cold sea water via the spiracles. The stimulating electrode was introduced into the spinal canal and advanced from the tail region rostrally in 2 cm steps to the point of spinal transection (or beyond in some cases). No significant changes in dorsal aortic pressure or gill movement rate could be elicited by cord stimulation. Inhibition of the heart rate and gill movements could be elicited by stimulation just above the site of transection (in the fourth ventricle). Failure to elicit vascular or respiratory responses by direct stimulation of the spinal cord is presumptive evidence against the existence of a sympathetic autonomic control of the peripheral vascular system.

Shark Ringer's saline was rapidly infused into the dorsal aorta of six fish in an attempt to actuate vascular baroreceptor reflexes by volume loading since the efferent limb of such reflexes involve autonomic nervous system activity. The rapid injection of 30 ml saline in 5 ml increments resulted in an increase in dorsal aortic blood pressure in 3 fish but no decrease in heart rate or gill movement rate. No increase in blood pressure was observed in the other fish, nor did heart rate change. The decrease in hematocrit was consistent with the volume of saline infused. These experiments gave no evidence of sympathetic autonomic control.

If the dogfish possesses a sympathetic neuronal control of its peripheral circulation then it should respond to neurotransmitters, their blocking agents, ganglionic stimulators and blockers in a fashion similar to that observed in mammals. Table 1 presents the effects of several sympathetically acting drugs on dorsal aortic blood pressure, heart and gill movement rates in