serosal border of the chloride cell, proposed by Silva et al. (Amer. J. Physiol. 233:298-306, 1977), is not a step in the Cl^- transport pathway across this epithelium or, if it is, the high Na^+ permeability and the diffusion of Na^+ from the mucosal side is sufficient to maintain this coupled entry and to activate the ATPase. The fact that the Isc could be stimulated by isoproterenol under serosal Na^+ substituted conditions (Figure 4b), suggests that this transport mechanism was not impaired by this substitution. This work was supported by NIH grants GM 25002 and EY 01340.

RECTAL GLAND VASCULATURE

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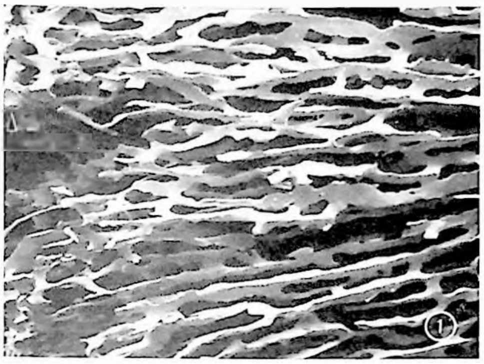
Continued interest in the mechanisms of salt secretion has fostered numerous physiological and morphological studies of the selachian rectal gland. We have employed methacrylate corrosion casting techniques and scanning electron microscopy to further identify the general organization of the rectal gland vasculature of *Squalus acanthias*

Two rectal glands were obtained from *S. acanthias* following methyl methacrylate infusion via the ventral aorta. The preparative methods were identical to those described for a study of *S. acanthias* gills (Olson and Kent, this bulletin).

The rectal gland receives arterial blood from the posterior mesenteric artery (also called rectal artery; Bulger, Anat. Rec. 147:95, 1963, or digitiform artery; Hoskins, J. Morphol. 28:329, 1917). As it approaches the anterior third of the gland it bifurcates sending rostral and caudal branches into the outer capsule. These arterial branches course the length of the gland and periodically give rise to singular or paired circumferential arteries which encircle the gland. The latter vessels ramify freely within the outer capsule to form a dense arterial web which supplies the sinus vessels of the secretory parenchyma. Paired veins are closely associated with the mesenteric artery and form an extensive venous net around the artery and over the exterior portion of the rostral and caudal branches. Smaller paired veins course lateral to each circumferential artery and through many small branches form a venous network which overlays the arterial vasculature.

The secretory parenchyma is invested with sinus-like vessels that occupy the spaces between the tubules thus giving them a triangular appearance in cross section. The sinus vessels in the peripheral half of the tubular tissue are radially oriented and frequently connected to each other by short cross branches (Figure 1). Midway into the gland the sinus vessels undergo a rather abrupt change and appear to orient around tubules in both radial and longitudinal axes (Figure 2). The sinus vessels drain into one or several central vessels that anastomose into a single vein which leaves the gland at the level of the post-valvular intestine. Rarely, a singular arterial vessel will course centrally through most of the tubular tissue and then abruptly return to the capsular tissue.

Three types of vessels communicate between the rectal gland and the post-valvular intestine. 1) As the posterior branch of the rectal artery approaches the recto-intestinal junction it divides into three vessels, two of which enter directly into the intestinal tissue. Thus there is an anatomical arterial bypass of the tubular sinuses. 2) The large singular central venous vessel which drains the tubular sinuses leaves the gland in this region and reflects cephlad into the intestine. 3) The capsular venous network, which is so intimately associated with the capsular arterial vessels, also follows the latter vessels as they enter the intestinal tissue. In addition, several capsular veins are closely associated with the sinus vein as it leaves the gland but no anastomoses between the two have been found. The capsular venous vessels appear to communicate with the mucosal sinus veins of the intestine.



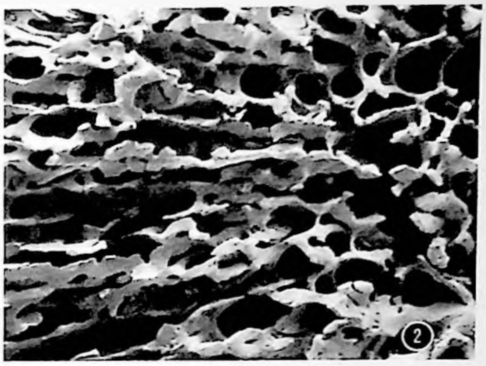


Figure 1. Scanning electron micrograph of outer tubular sinus vessels (75X). Flow is from left (capsular tissue) to right. Note small arteriole at left (arrow).

Figure 2. Scanning micrograph of inner tubular sinus vessels (75X). Plane of section is the same as Figure 1. Rectal gland lumen is out of view to the right and blood flows left to right.

The sinus vessels around the tubules appear to provide a pathway for unidirectional blood flow that is concurrent with tubular secretion as has been described previously (Bulger, Anat. Rec. 147:95, 1963; Doyle, Bull. MDIBL 17:34, 1977). However, the close association between the capsular arterial and venous vessels does suggest countercurrent exchange is possible between these vessels. The connections of the venous capsular vessels with veins leaving at the level of the mesenteric artery and the vessels entering the post-valvular intestine suggest that the direction of flow in the capsular area might be regulated by the relative resistances between the mesenteric and intestinal veins. Thus venous flow could be counter- or concurrent with arterial capsular flow. Although these studies could not conclusively demonstrate arterio-venous anastomoses between capsular vessels, this cannot be discounted and could perhaps contribute to A-V exchange. Clearly additional studies on flow patterns within rectal gland vasculature are warranted. This work was supported in part by Research Project #4901-01 and 02, Veterans Administration Medical Center, Bronx, New York and by NSF #PCM 76-16840.

INHIBITION OF CHLORIDE TRANSPORT BY ACETYLCHOLINE IN THE ISOLATED OPERCULAR EPITHELIA OF *Fundulus heteroclitus*. PRESENCE OF A MUSCARINIC RECEPTOR

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The isolated opercular epithelium of *Fundulus heteroclitus* contains great numbers of chloride cells and transports chloride ions from blood to seawater in in vitro conditions. In order to understand the mechanisms of control of this secretion, cholinergic agonists and antagonists have been tested on this preparation. An advantage of this model of study of fish osmoregulatory phenomena is that interference by vascular responses is excluded.

Opercular epithelia were dissected out and mounted in lucite chambers on sylgard covered disks as previously described (Degnan et al. J. Physiol. 277:155, 1977). After equilibration of the spontaneous potential difference the preparations were short circuited and drugs added to the serosal side in volumes of 25 μl or 250 μl in order to achieve the final concentrations referred to below. The volume of Ringers solution in the chambers was 2.5 ml. Radioisotopic fluxes were measured with $^{36}Cl^-$ which was added to the serosal or mucosal side in amounts ranging from 2 to 5 μC. Samples of 250 μl from the nonradioactive side and 25 μl from the radioactive side were taken at intervals of 30 minutes,