

Ca-free saline increases the population of tubules which have both faces exposed to the medium and so causes a greater tissue accumulation of any sugar which is reabsorbed by an active process at the luminal brush border. Further work will show whether Ca-free incubation exerts similar effects on other sugars, specifically D-glucose, 2-deoxy-D-glucose, and mannose. If so, this technique, in concert with clearance studies and in vitro incubation of teased tubules in normal Ca-containing saline, will provide a means for determining the loci of the various sugar transport systems of the flounder kidney.

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ORGANIZATION OF THE HAMSTER RENAL PELVIS

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The mammalian renal pelvis is an epithelial-lined hollow invagination of the kidney which opens at the point where the ureter meets the renal parenchyma. Both the shape and size of the pelvis vary among mammals. As the urine is discharged from the papilla tip in rodents it is forced retrograde into the pelvis by the muscular contractions of the upper ureter. The urine is then in contact with the papillary epithelium which has previously been shown to be highly permeable to urea and water (K. H. Gertz, B. Schmidt-Nielsen and D. Pagel, *Fed. Proc.*, 25:327, 1966). The possible role that the renal pelvis may have in the concentration of the final urine has been studied by Schutz and Schnermann (*Pflügers Arch.*, 334:154-166, 1972).

Mammals placed on reduced dietary protein excrete a decreased fraction of filtered urea compared to those on a normal protein diet (B. Schmidt-Nielsen, *Physiol. Rev.*, 38:139-168, 1958). Sheep and camel exhibit this urea conservation mechanism most profoundly while rat and man appear to be moderate urea conservers. It appears that mammalian species with a more extensive pelvis conserve urea most efficiently. To test the possibility that the upper extensions of the pelvis may be the site of the urea conservation mechanism we have begun by defining the anatomy and ultrastructure of the "high protein" hamster pelvis which will later be compared to the morphology of the hamster pelvis during urea conservation.

The cortex facing the urinary space in the lower half of the pelvis is covered by the expanded portion of the ureter, the pelvis wall (Figure 1). The transitional epithelium lining the lower pelvic wall is morphologically similar to the epithelium lining the ureter and bladder and has been shown to be impermeable to urea (R.M. Hicks, *J. Cell Biol.*, 28:21-31, 1966). Eight scallop-shaped segments of the kidney parenchyma, the peripelvic columns (PPC) which are exclusively inner strips of the outer medulla, project into the pelvic space (Figure 2).

Adjacent PPC are separated by an interlobar artery and vein. At their upper extent (away from the hilus) each PPC fuses with the neighboring PPC to form a blind tunnel (the fornix) over the interlobars. The PPC are covered by a single layer of low cuboidal epithelium. The fornix region exposes the outer strips of the outer medulla and also the cortex to the pelvic urinary space. Both of these tissue zones are covered by a flattened cuboidal to squamous epithelium which is significantly thinner than the epithelium covering the PPC (inner stripe of outer medulla). All PPC fuse in the center of the pelvis from which extends the papilla (inner medulla). Cuboidal

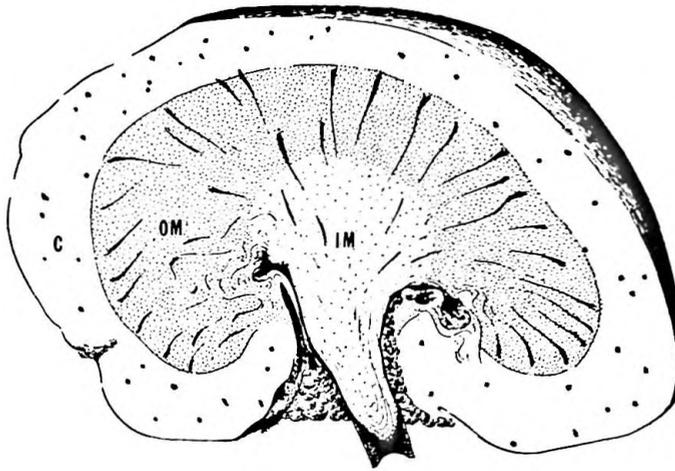


Figure 1. Hemisection of the hamster kidney made along the longitudinal axis. The upper ureter passes along the papilla and attaches to the renal parenchyma at the cortex and outer medullary zones. Cortex (C), outer medulla (OM) and inner medulla (IM).

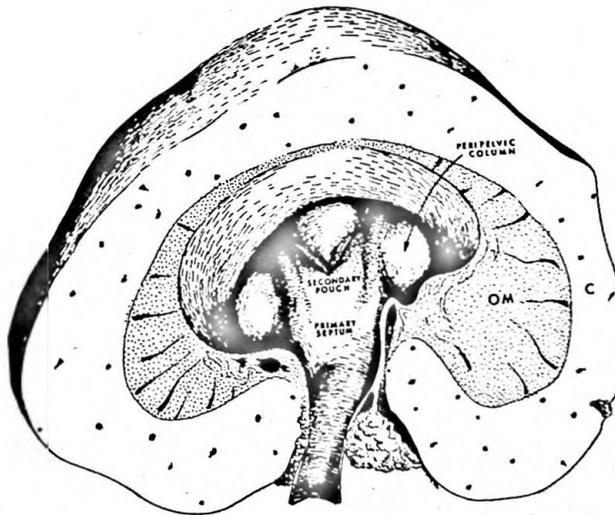


Figure 2. Hamster kidney cut in the same plane as Figure 1. The inner medulla and a portion of the outer medulla (OM) have been removed to reveal the pelvis on this half of the kidney. The primary septum has been cut at the lower extent of the peripelvic column to reveal the secondary pouch. The interlobar (I) artery and vein run inside the primary septum.

epithelium morphologically similar to that of the collecting ducts covers the inner medulla (F. J. Silverblatt, *Kidney Internat.*, 5:214-220, 1974).

Our studies have shown that: (1) each major tissue zone of the hamster kidney (cortex, outer stripe, inner stripe and inner medulla) is exposed to the urinary space of the pelvis; (2) four morphologically distinct types of epithelia line the pelvis; (3) each type of epithelium covers a particular kidney zone. These morphologically different epithelia and their relationship to specific kidney zones may suggest differences in permeability to urea.

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BRAIN EDEMA IN *Squalus acanthias*

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Brain edema is a pathological condition characterized by a marked increase in brain water. Current therapeutic regimens for treatment of brain edema, caused by such events as head trauma, brain tumor, and stroke, are rather disappointing. Although not totally ineffective, the treatment of brain edema by steroids, osmotherapy, craniectomy, and debridement is cumbersome or has significant risk. It might be argued that the greatest challenge to neurosurgical research lies in the search for precise pathogenesis and specific therapy of brain edema.

Most vertebrates will develop brain edema if the brain is frozen, lacerated, squeezed, pinched, seared or otherwise traumatized. It seemed a curious, perhaps heuristic, discovery when Klatzo reported (*Acta Neuropath.*, 5:161, 1965) that several lemon and nurse sharks subjected to freezing, searing, and detergent brain lesions did not develop histological evidence of inflammation nor did Evans blue-albumin complex suffuse the necrotic tissue, as it would in a mammal similarly injured. Hoping that the explanation of this unique resistance to brain edema might direct a new clinical therapeutic approach, a study in *Squalus acanthias* was undertaken to confirm Klatzo's earlier observation; water content and brain capillary permeability to sodium and albumin were the measured parameters.

Method. Dogfish sharks of varying size and sex were used in this study. A trephine hole, 1.5 cm in diameter, was made in the cartilagenous skull in an area over the olfactory lobes which was devoid of large blood vessels. For cold lesions, a small piece of dry ice was placed in contact with both telencephalic (cerebral) hemispheres and allowed to sublime. The hole was plugged with a rubber stopper, and the fish were returned to a live car. The stopper gave physical protection from trauma but did not prevent the leakage of some sea water into the extradural space which surrounds the brain and cranial meninges. For heat lesions, the right telencephalic hemisphere was seared through the trephine hole with a red hot rod. Following this the hole was plugged, and the animal returned to the water. Animals which resumed swimming within an hour of the operation were found to survive for many days without any apparent after effects. Those animals which did not promptly resume normal swimming behavior died within one day of the injury.

After one or more days the animals were killed by decapitation; the brains were removed, and the telencephalon and medulla were assayed for water content by drying the sample for 18 hours at 105°C. The water content was calculated as: $[1 - (\text{dry weight}/\text{wet weight})] \times 100$.