given intravenously in 6-8 ml sea water; urine collection periods were resumed one hour later. Pertinent data are displayed in Table 1.

Note that glucose reabsorption is markedly inhibited at phlorizin dosages of 2 mg/kg BW. At 50 mg/kg reabsorption is completely blocked and glucose clearance is equal to the clearance of inulin ($C_G/C_{In}$ = 7.75/7.62 = 1.02). This total blocking effect was first demonstrated quantitatively by Shannon (J. Cell. and Comp. Physiol. 5:301, 1934) in the dogfish at phlorizin dosages of 300-400 mg/kg. Note also that GFR is generally but not consistently reduced following administration of the drug.

We had previously used the augmenting effect of epinephrine on GFR in the dogfish to study the relationship of reabsorbed glucose to GFR in this animal at high plasma glucose levels (Bull. MDIBL 6:36, 1966). At that time it appeared that epinephrine itself might have increased renal glucose reabsorption. This effect was re-examined at normal plasma glucose levels in eight female dogfish. In six of these epinephrine produced a substantial increase in GFR and the parameters of glucose reabsorption under these and control conditions are set forth in Table 2.

Note that administration of epinephrine is followed by an increase in GFR, generally more than twofold and that this, in turn, is associated with a parallel increase in glucose reabsorption ($T_G$). The ratio $T_G$/GFR is not significantly different in the two groups; its control values have a mean of 0.72, following epinephrine the mean of these ratios is 0.78. From this it appears most unlikely that any of the increase in the rate of glucose reabsorption is due to a specific action of epinephrine.

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## EFFECT OF PHLORIZIN ON PHOSPHATE EXCRETION IN THE SPINY DOGFISH, Squalus acanthias

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Phosphate excretion is diminished in dogs and chickens by administration of phlorizin. Pitts and Alexander (Am. J. Physiol. 142:648, 1942) proposed that glucose competes with phosphate for reabsorption and that when phlorizin interferes with the reabsorption of glucose the competition is eliminated so that phosphate reabsorption increases. Ferguson and Wolbach (Am. J. Physiol. 212:1123, 1967) proposed that tubular secretion of phosphate, readily demonstrated in chickens, might be directly blocked by phlorizin. The effect of phlorizin on phosphate excretion in the spiny dogfish was studied to help us discriminate between these two postulates.

Eight female dogfish were prepared as described by Boylan and Antkowiak (Bull. of Mt. Desert Island Biological Laboratory 6:2, 1966). Inulin clearance was used as a measure glomerular filtration rate. Phosphate concentrations in blood plasma and urine were estimated using a modification of the procedure of Fiske and SubbaRow. The rates of phosphate filtration and excretion were calculated during a one-hour collection period preceding phlorizin injection and during two similar collection periods following intravascular phlorizin injection. The dogfish were at least 20 hours post-absorptive and no glucose was given them.

Table 1

EFFECTS OF PHLORIZIN IN THE SPINY DOGFISH (S. acanthias)

| Experiment | Body weight kg | Dose of phlorizin mg | Glucose | | | Phosphate | | |
|---|---|---|---|---|---|---|---|---|
| | | | Plasma mg/ml | Excreted mg/hr | Excr./filt. | Plasma M/ml | Excreted M/hr | Excr./filt. |
| B | 4.7 | 0 | 0.72 | 0.09 | 0.015 | 1.36 | 36 | 2.9 |
| | | 10 | 0.93 | 7.78 | 0.59 | 1.28 | 143 | 7.8 |
| C | 4.1 | 0 | 0.36 | 0.07 | 0.031 | 1.01 | 104 | 15.1 |
| | | 50 | 0.35 | 0.16 | 0.69 | 1.20 | 21 | 26.3 |
| D | 3.5 | 0 | 0.40 | 0.03 | 0.015 | 1.00 | 55 | 12.1 |
| | | 50 | 0.41 | 0.70 | 0.61 | 1.47 | 56 | 13.7 |
| E | 4.0 | 0 | 0.48 | 0.36 | 0.19 | 1.17 | 26 | 5.7 |
| | | 50 | 0.54 | 1.17 | 0.56 | 1.44 | 34 | 6.1 |
| G | 3.9 | 0 | 0.86 | 0.04 | 0.009 | 1.51 | 107 | 15.7 |
| | | 100 | 0.78 | 2.92 | 0.80 | 1.55 | 75 | 10.4 |
| H | 5.7 | 0 | 1.38 | 1.19 | 0.08 | 1.33 | 35 | 2.4 |
| | | 100 | 1.33 | 15.88 | 0.82 | 1.42 | 38 | 1.9 |
| I | 3.7 | 0 | 0.97 | 0.03 | 0.010 | 1.36 | 24 | 5.0 |
| | | 100 | 0.82 | 3.36 | 0.97 | 1.35 | 77 | 13.6 |
| K | 3.6 | 0 | 0.88 | 0.07 | 0.022 | 1.13 | 65 | 15.5 |
| | | 200 | 0.66 | 4.60 | 1.01 | 1.24 | 129 | 15.0 |

The results of these experiments are summarized in Table 1. The effects of phlorizin on glucose reabsorption were always more marked in the second collection after phlorizin injection than in the first. For this reason, the results obtained in the first or control period of each experiment are followed by the results obtained during the second period after phlorizin injection and the observations made in the intervening hour have been omitted.

As shown in this table, low doses of phlorizin (10 or 50 mg) block glucose reabsorption partially, while larger doses (100 or 200 mg) may completely block glucose reabsorption. However, no consistent change in either phorphate excretion or the ratio of phosphate excretion to phosphate filtration occurred as a result of these phlorizin injections. During the control periods, the ratios of phosphate excretion to phosphate filtered in excess of 1.0, indicate that a significant fraction of excreted phosphate could not be accounted for by filtration and must have been the result of tubular secretion of phosphate. After either low or high doses of phlorizin, tubular secretion of phosphate continued to provide a large fraction of excreted phosphate. These experiments indicate that, at least in the dogfish, phlorizin does not block tubular secretion of phosphate. The relatively large magnitude of tubular secretion makes it impossible to judge whether the blockade of endogenous glucose reabsorption increased phosphate reabsorption.

Because phosphate secretion was so large relative to phosphate filtration in the foregoing experiments, two additional experiments were performed to estimate the fraction of renal plasma flow which was cleared of phosphate. In each of these two experiments, phosphate and paraamino hippurate (PAH) clearances were measured simultaneously during two successive periods. Average results of these paired collections are shown in Table 2.

Table 2

CLEARANCES OF PAH AND PHOSPHATE IN THE SPINY DOGFISH, S. acanthias

| Experiment | $\frac{P_{PAH}}{mg\ \%}$ | $\frac{C_{PAH}}{ml/hr}$ | $\frac{P_{Phosphate}}{\mu M/ml}$ | $\frac{C_{Phosphate}}{ml/hr}$ | $C_{Phos.}/C_{PAH}$ |
|---|---|---|---|---|---|
| 3 | 4.9 | 114 | 1.42 | 94 | 0.82 |
| 4 | 1.6 | 48 | 1.81 | 13.6 | 0.28 |

Although phosphate is cleared from a volume several times larger than the volume filtered at the glomeruli, it is apparent from the clearance ratios at the right hand side of Table 2, that PAH is cleared from blood perfusing the kidneys more effectively than phosphate is.

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