

EFFECTS OF HYPOPHYSECTOMY AND ADRENOCORTICOTROPIN ON BLOOD GLUCOSE REGULATION IN THE SKATE (Raja erinacea)

William C. Grant, Jr. and Peter M. Banks, Williams College, Williamstown, Mass.

Previous investigations (Am. Zool. 4:227) indicate that insulin may have only a minor effect on normal regulation of carbohydrate metabolism in the skate. Intravenous administration of catecholamines (50 μ g/kg) produces rapid hyperglycemia (MDIBL Bull. 5 (2):15-16). Norepinephrine elicited twice the response of epinephrine with a mean rise of 75.8% in two hours. In recent studies intramuscular injection of L-norepinephrine bitartrate (Sigma 16B-9000) produced a rise in glucose levels of $117 \pm 2.1\%$ in five hours. There was no significant difference between intravenous and intramuscular administration of L-epinephrine bitartrate (Sigma 125B-1340). The present study was initiated in order to determine the role of the pituitary in blood sugar regulation in elasmobranchs. In all cases determinations were made with the glucose oxidase method.

Skates (0.8-1.2 kg range) of both sexes were anesthetized with MS222 and a plug 1/4 inch in diameter removed from the median floor of the braincase just anterior to the juncture of the internal carotid arteries. In most cases the entire hypophyseal structure including the saccus vasculosis remained adherent to the plug and was thus easily removed without damage to the brain. Within twelve hours post-operative animals showed extensive bleaching with maximum melanophore contraction. In Squalus acanthius bleaching following hypophysectomy usually occurs within two hours.

Hypophysectomized skates showed a definite hypoglycemia of 37.6 ± 3.6 below base levels which continued until the animals were sacrificed at fourteen days. Sham operated controls showed a maximum rise of 18.6 ± 3.4 at four days. The continued high activity and viability of hypophysectomized animals, which generally exceeded that of controls is an observation requiring further investigation. Blood sugar levels of hypophysectomized dogfish were erratic. These extended both above and below that of controls in an oscillatory manner suggesting the introduction of lag effects into a feedback system which may not be operative in the skate.

Intramuscular injection of 10 I.U./kg of ACTH (Sigma 76B-161D) produced intense darkening of hypophysectomized skates in thirty minutes. No increase in pigmentation above normal levels was detectable in controls. On the first day following injections blood sugar levels rose to $26.7 \pm 5.2\%$ over base levels in operated animals with no significant increase noted in controls. Repeated injections at 96 and 120 hours produced marked hyperglycemia with a rise of 68.5 ± 5.8 over base in hypophysectomized animals and a 38.7 ± 3.5 rise in controls. One pancreatectomized-hypophysectomized specimen showed an increase in glucose values of 320% by the sixth day. Initial tests also indicated that operated skates are far more sensitive to administration of mammalian glucagon than controls. Prolactin (NIH), 2.2 mg/kg had no conspicuous effect on running blood sugar levels over a five day period.

These results suggest that the pituitary and adrenal complex (chromaffin tissue and interrenal organ) may play an important role in normal blood glucose regulation in the skate. The fact that pancreatectomy produces hypoglycemia and that the effect of glucagon is potentiated

when blood sugar levels are lowered also suggests that hyperglycemic factors may have greater functional significance than in most higher vertebrates.

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EFFECTS OF THYROXINE ON TISSUE RESPIRATION IN DOGFISH AND POLLOCK

Jack Harclerode, Robert Vidingshoff, and Diana Schain, Bucknell University, Lewisburg, Pa., and Hahnemann Medical College, Philadelphia, Pa.

The role of the thyroid gland of teleosts and elasmobranchs in regulating the consumption of oxygen by the tissues is unclear at this time. Many investigators have found that thyroid hormones are not effective in stimulating oxygen consumption, while others produced effects with the acetic acid derivatives of thyroid hormones (Biol. Bull. 119:109, 1960).

In the present experiment a group of dogfish (Squalus acanthias) and pollock (Pollachius viriens) were injected daily for six days with thyroxine (dogfish, 1.8×10^{-7} g; pollock, 6×10^{-7} g). The same number of pollock and dogfish were kept as saline injected controls. After treatment, the animals were killed and the kidneys, liver, and a portion of the longitudinal bundle of the hypaxial musculature were excised and homogenized in iced homogenization medium consisting of 75 mM sucrose, 225 mM mannitol and 1mM EDTA, pH 7.1. The oxygen consumption of a sample of each homogenate was determined in a reaction medium consisting of 15 mM sucrose, 45mM mannitol, 40mM KCl, 20mM MgCl, 2μ M EDTA, and 20mM phosphate buffer, pH 7.4. Respiration was determined polarographically using a YSI model 53 oxygen electrode.

The following measurements were made on all homogenates: (1) endogenous respiration rate; (2) respiration rate in the presence of excess substrate, succinate, beta-hydroxybutyrate, and alpha-ketoglutarate, separately; (3) respiration rate after adding an excess of ATP in the presence of excess substrate; and (4) respiration rate after adding an excess of ADP in the presence of excess substrate. Microkjeldahl determinations of each homogenate were made and respiration rates were expressed as μ M O₂ consumed/second/mg N₂.

Generally, the levels of thyroxin used produced the following results:

- 1) No differences were found in the rates of either the control or thyroxin treated liver homogenates in both pollock and dogfish.
- 2) No differences were found in the rates of either the control or thyroxin treated kidney homogenates in both pollock and dogfish.
- 3) Thyroxin depressed respiration in muscle tissue of both pollock and dogfish.

There seems to be a difference in sensitivity of the various tissues to thyroxin, since muscle was the only one which responded to treatment, and then it responded with a decreased oxygen utilization. The reason for this is unclear at this time; however, it could be that there are metabolic alterations in the muscle of the starved dogfish which are enhanced by thyroxine treatment, such as an increased dependence on glycolysis. Others have found increased lactate in the blood of captive dogfish which indicates that this may be the case (Bull. M.D.I.B.L. (5-2): 30-31.

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