

CHANGES IN GLYCOGEN CONCENTRATION AND UPTAKE OF GLUCOSE-1,6-C¹⁴ INTO GLYCOGEN IN HEART MUSCLE IN RESPONSE TO HYDROCORTISONE

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The glycogen concentration in the heart muscle and incorporation of glucose-1,6-C¹⁴ into it are increased 3 h after administration of hydrocortisone to rats. The increase in the glycogen level is maintained 6, 12, and 18 h after administration of the hormone.

KEY WORDS: hydrocortisone; glycogen; myocardium.

The role of glucocorticoids in the regulation of the metabolism and function of the heart is under intensive investigation at the present time [6, 7, 10]. Repeated injections of hydrocortisone lead to an increase in the glycogen concentration in the heart muscle [9]. After adrenalectomy the glycogen concentration in the heart muscle falls sharply. Glycogenolysis and glycolysis in the myocardium are known to play an important role in the contractile function of the myofibrils and in the activity of the calcium pump [11].

The glycogen concentration in the heart muscle and incorporation of glucose-1,6-C¹⁴ into the glycogen were investigated at various times after administration of hydrocortisone.

EXPERIMENTAL METHOD

Experiments were carried out on 72 rats. Hydrocortisone was injected intraperitoneally in doses of 10 or 30 mg/kg. The animals were killed 1, 3, 6, 12, and 18 h after injection of the hormone. The heart was removed and frozen. The glycogen concentration was determined with anthrone reagent [12]. In special experiments, 20 mg/kg hydrocortisone was injected. The animals were killed 3 h later. Glucose-1,6-C¹⁴ was injected intraperitoneally (50 μ Ci/kg) 60 min before sacrifice. After isolation of the glycogen its radioactivity was determined with an end-window counter and expressed in counts/min/mg glycogen (specific activity). The method of glucosazone formation [5] was used to determine the specific activity of glucose in the heart muscle. On the basis of the concentration and specific activity of glycogen and glucose, their activity was calculated per gram heart tissue. The relative activity of glycogen was determined from the ratio between the glycogen activity and glucose activity per gram of tissue.

EXPERIMENTAL RESULTS AND DISCUSSION

Injection of hydrocortisone in doses of 10-30 mg/kg led after 3 h to an increase in the glycogen concentration in the heart muscle. The most effective dose of the hormone was 20 mg/kg. The increased glycogen level remained 6, 12, and 18 h after injection of hydrocortisone (Table 1). It is interesting to note that 1 h after injection of hydrocortisone a tendency for the glycogen concentration in the myocardium to diminish was observed, probably as a result of its increased breakdown. Glucocorticoids are known to potentiate the action of the sympathetic nervous system of the heart and to increase phosphorylase α activity in the heart [1].

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TABLE 1. Effect of Hydrocortisone on Glycogen Concentration in Rat Heart Muscle ($M \pm m$)

Dose of hydrocortisone (in mg/kg)	Glycogen concentration (in mg %)					
	control	after injection of hydrocortisone				
		1 h	3 h	6 h	12 h	18 h
10 P	435 \pm 24	386 \pm 48 <0,5	603 \pm 43 <0,01	626 \pm 50 <0,01	634 \pm 21 <0,001	591 \pm 48 <0,01
20 P		—	673 \pm 45 <0,01	—	—	—
30 P		369 \pm 48 >0,2	548 \pm 24 <0,01	617 \pm 30 <0,001	792 \pm 48 <0,001	648 \pm 47 <0,001

TABLE 2. Effect of Hydrocortisone on Incorporation of Radioactive Label into Myocardial Glycogen after Administration of Glucose-1,6- C^{14} ($M \pm m$)

Group of animals	Activity (in counts/min/g tissue)		Relative activity of glycogen (in %)
	glycogen	glucose	
Control	1078 \pm 57	1642 \pm 30	65 \pm 4
Hydrocortisone (20 mg/kg) P	1273 \pm 36 <0,05	1339 \pm 28 <0,001	94 \pm 5 <0,02

The glycogen activity in the myocardium increased after injection of hydrocortisone, but the glucose activity decreased. The relative activity of glycogen in the heart also increased (Table 2).

Considering the increase in the glycogen concentration at this time, it could be supposed that at certain stages of the action of hydrocortisone the intensity of glycogen synthesis in the heart muscle was increased, although a decrease in the intensity of its breakdown must also play a definite role. Repeated injections of hydrocortisone have been shown to inhibit phosphorylase α activity in skeletal muscle [4].

The increase in glucose-1,6- C^{14} incorporation into heart muscle glycogen under the influence of hydrocortisone could be explained by an increase in hexokinase activity. However, glucocorticoids inhibit the activity of this enzyme [3, 8]. The increase in glycogen synthesis in the heart muscle under the influence of hydrocortisone could be assumed to be connected with the liberation of insulin in response to the hyperglycemia that follows injection of glucocorticoids [2], more especially because insulin prevents inhibition of hexokinase activity by glucocorticoids in the myocardium [8].

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