

# EFFECT OF THYROID HORMONES ON TRANSPORT OF ORGANIC SUBSTANCES IN THE KIDNEYS

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Changes in renal transport of organic substances were studied in rabbits during the first 6-8 days of oral administration of thyroid extract and tri-iodothyronine. Renal tubular secretion was found to be activated by thyroid hormones much sooner than glucose reabsorption and glomerular filtration.

KEY WORDS: thyroid hormones; glomerular filtration; tubular secretion; glucose reabsorption.

According to data in the literature thyroid hormones increase the secretion of organic substances in the proximal tubules of the kidneys [2, 4, 6, 9]. In view of the hypothesis that the secretory transport of organic substances is an inducible process [1], it ought to be more sensitive to the action of thyroid hormones than glucose reabsorption, which continues throughout life and employs permanently functioning carriers.

The object of this investigation was to make a parallel study of the dynamics of changes in the maximal secretion of diodone and the maximal glucose reabsorption in the kidneys under the influence of thyroid hormones.

## EXPERIMENTAL METHOD

Chronic experiments were carried out on 16 rabbits by Smith's method [11]. During the experiments the rabbits were kept in special hammock cages and the urine was collected by catheterization of the urinary bladder. A solution containing 10% glucose and 2.5% diodone was injected into the marginal vein of the ear at the rate of 1-2 ml/min, thereby maintaining the glucose concentration in the plasma between 250 and 500 mg % and the diodone concentration between 25 and 50 mg %, i.e., at levels sufficient to saturate the corresponding transport systems. Collection of the urine began after 30 min and was repeated twice at intervals of 20 min (two clearance periods). At the middle of each period a blood sample was taken from

TABLE 1. Effect of Thyroid Extract on Filtration, Maximal Diodone Secretion, and Maximal Glucose Reabsorption in Rabbits ( $M \pm m$ )

Parameter studied	Initial level	Admin. of thyroid extract (0.2 g/kg)	
		2nd-3rd day	6th day
Filtration (in ml/min)	12,7±0,35	11,5±0,51	12,3±0,64
P		>0,05	>0,5
Maximal diodone secretion (mg/min)	18,1±0,67	20,8±1,34	34,2±1,04
P		>0,05	<0,001
Maximal glucose reabsorption (mg/min)	29,5±0,89	25,8±2,02	26,4±1,70
P		>0,05	>0,1

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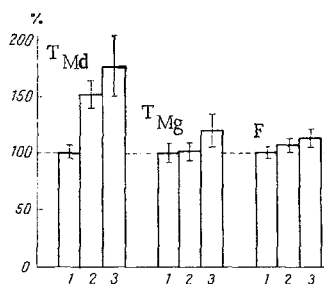


Fig. 1. Effect of triiodothyronine (10  $\mu$ g/kg) on maximal diodone secretion (T<sub>Md</sub>), maximal glucose reabsorption (T<sub>Mg</sub>), and filtration (F) in rabbits. Abscissa: 1) initial level; 2) 4th day; 3) 8th day of triiodothyronine administration; ordinate, changes in per cent of initial level taken as 100.

As Table 1 shows, during the first 6 days of thyroid administration no change in glomerular filtration was observed. Meanwhile, the maximal secretion of diodone gradually increased, and by the 6th day of administration it was significantly higher than initially. However, the maximal glucose reabsorption was unchanged.

Thyroid had a marked stimulant action on only one of the transport processes studied in the proximal portion of the nephron.

In the other series of experiments, the rabbits received triiodothyronine by mouth daily for 8 days (10  $\mu$ g/kg body weight). As in the experiments with thyroid extract no appreciable changes were observed in filtration (Fig. 1). The maximal diodone secretion rose more rapidly than in the experiments with thyroid extract and on the second day of administration of the hormone it was already significantly higher than in the control ( $P < 0.01$ ). On the following days of the experiment the cardiostat secretion continued to rise. Transport for glucose reabsorption, on the other hand, did not increase until the 8th day of the experiment ( $P < 0.05$ ). The increase in secretion then amounted to 77% and the increase in glucose reabsorption was 20%.

These results are in agreement with those obtained by other workers [4, 6, 9] who found that the secretory power of the tubules increases sooner and by a greater degree than the renal plasma flow or the glomerular filtration under the influence of thyroid hormones.

Figures showing increased glucose reabsorption under the influence of thyroid hormones are given in the literature [7, 8] but this effect was studied 7-14 days after the beginning of administration of the hormones, whereas stimulation of secretion in the kidneys, as the present experiments show, begins much sooner and glucose reabsorption is unchanged during the first 6 days.

The increase in renal secretion under the influence of thyroid hormones is possibly connected with an increase in the synthesis of protein carriers participating in the transport of the secreted substances, for the antibiotic aurantin, which inhibits DNA-dependent RNA synthesis, completely prevented the action of thyroid extract on renal tubular secretion [2].

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a vein of the other ear. Creatinine [3], diodone [5], and glucose (by the orthotoluidine method) were determined in the blood and urine. The glomerular filtration, the maximal diodone secretion, and the maximal glucose reabsorption were calculated.

Every day for 6-8 days, 9 rabbits were given thyroid extract by mouth in a dose of 9.2 g/kg and 7 rabbits were given L-3,3',5-tri-iodothyronine in doses of 10  $\mu$ g/kg body weight. At least two control experiments and 3-4 tests at different times after the beginning of thyroid hormone administration were carried out on each rabbit. The results of both clearance periods were considered in each experiment.

#### EXPERIMENTAL RESULTS

In the control tests the glomerular filtration, measured with respect to endogenous creatinine, averaged  $11.8 \pm 0.85$  ml/min, the maximal diodone secretion was  $17.9 \pm 0.46$  mg/min, and the maximal glucose reabsorption was  $26.4 \pm 0.80$  mg/min, in agreement with data in the literature [3, 10].

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