FHSI for the parameters of glucose transport is thus due to interaction between many factors and it can be characterized most completely only on the basis of data from all levels of organization of the small intestine.

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# THYROID FUNCTION AND MOTOR ACTIVITY IN DOGS DURING DEVELOPMENT


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The intensity of motor activity and the serum level of protein-bound iodine (PBI) were investigated in 62 puppies aged from 1 to 12 months. During the first 4 months of life a parallel increase in motor activity and PBI of the puppies was observed. The increase in motor activity of puppies between the ages of 7 and 9 months was not accompanied by any increase in PBI. In hypothyroidism caused by methimazole in puppies aged 1 and 3 months increased motor activity was observed, whereas in animals aged 7 months it was reduced. A higher intensity of motor activity than in the control animals also was observed 1 month after the operation in puppies thyroidectomized at the ages of 1 and 3.5 months. The activity of puppies thyroidectomized at the age of 1 month was sharply reduced 2-4 months after the operation. In dogs thyroidectomized at the ages of 7.5 and 11.5 months, reduced activity was observed as early as 1 month after the operation. The data showing opposite effects of thyroid hormones on the behavior of puppies at different ages point to a complex relationship between motor activity and thyroid function.



KEY WORDS: thyroid gland; motor activity; ontogeny.


In the postnatal development of man and animals periods of maturation of thyroid function can be distinguished [1,3,4, 7-9,11,12]. These periods may perhaps determine age differences in the formation of certain


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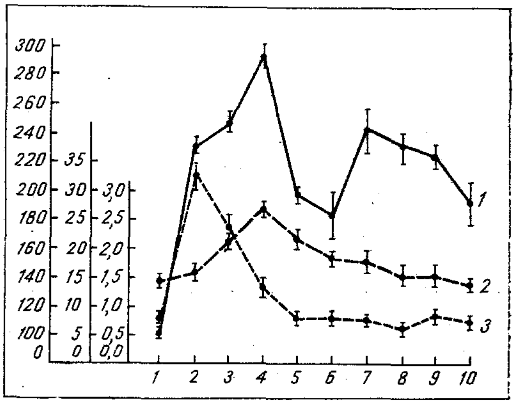


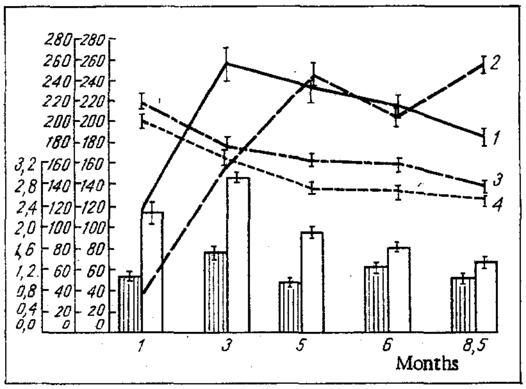


Fig. 1. Fig. 2.

Fig. 1. HA and VA and serum PBI concentration in puppies of different ages. Abscissa, age (in months); ordinate, first scale, number of sides of squares crossed in 20 min (1), second scale, number of standings up on hind limbs in 20 min (3), third scale, serum PBI concentration (in $\mu$g %) (2). M ± m.

Fig. 2. Effect of methimazole on serum PBI concentration, motor activity, and pulse rate in puppies of different ages. Abscissa, age (in months); ordinate, first scale, serum PBI concentration (in $\mu$g %) (shaded columns represent experiment, unshaded columns control), second scale, pulse rate (beats/min) (4 — experiment, 3 — control), third scale, numbers of sides of squares crossed in 20 min (1 — experiment, 2 — control).

behavioral and autonomic reactions. This applies in particular to the dependence of motor activity on the level of thyroid hormones in the body. However, because of the lack of any systematic research in this direction it is impossible to conclude whether there are any relationships of cause and effect between these parameters. The object of the present investigation was to study changes in motor activity in dogs, at different stages of postnatal development, under normal conditions and during depression of thyroid function.

## EXPERIMENTAL METHOD

Experiments were carried out on 62 mongrel puppies born and reared in the Nursery of the Institute. The concentration of protein-bound iodine (PBI) in the blood serum of all the animals between the ages of 1 and 12 months was determined by the method in [5] and the spontaneous motor activity of the animals was recorded as in [10].

The floor of the experimental chamber was divided into 20 squares (80 × 80 cm). Motor responses — the number of sides of the squares crossed by the animal (horizontal activity — HA) and the number of times the animal stood up on its hind legs (vertical activity — VA) were recorded by the experimenter in another room, through a glass window. Each animal was studied monthly in two 20-min tests with an interval of 1 h between them in the course of one experimental day. Unlike in the program recommended by the authors cited, only two tests were used instead of 10, and each animal was studied several times. According to some data [10], the first two tests were the most important for the determination of motor activity.

Thyroidectomy was performed on 13 animals and in another 18 hypothyroidism was produced by prolonged administration of methimazole until the appearance of a peripheral effect (slowing of the pulse). The control group consisted of 31 puppies. Methimazole was given daily with milk in increasing doses — from 5 to 20 mg — to puppies under 4 months of age, whereas the older puppies (5-8.5 months) received doses of 10 to 30 mg. Thyroidectomy was performed at the ages of 1, 3, 5, 7.5, and 11.5 months. Changes in body weight, cardiac frequency, and motor activity of the thyroidectomized and control puppies were studied 1, 2, 3, and 4 months after the operation.

## EXPERIMENTAL RESULTS AND DISCUSSION

During the first year of life two periods of increased HA of the puppies were observed (Fig. 1). It began to rise in the second month of life to reach a maximum by the age of 4 months. HA was low in animals aged 5 and 6 months, but increased again at the ages of 7 and 9 months. Only one peak of VA was observed, at the age of 2 months. This peak of activity later fell sharply — at 3 months, it is one-half of that at 2 months.

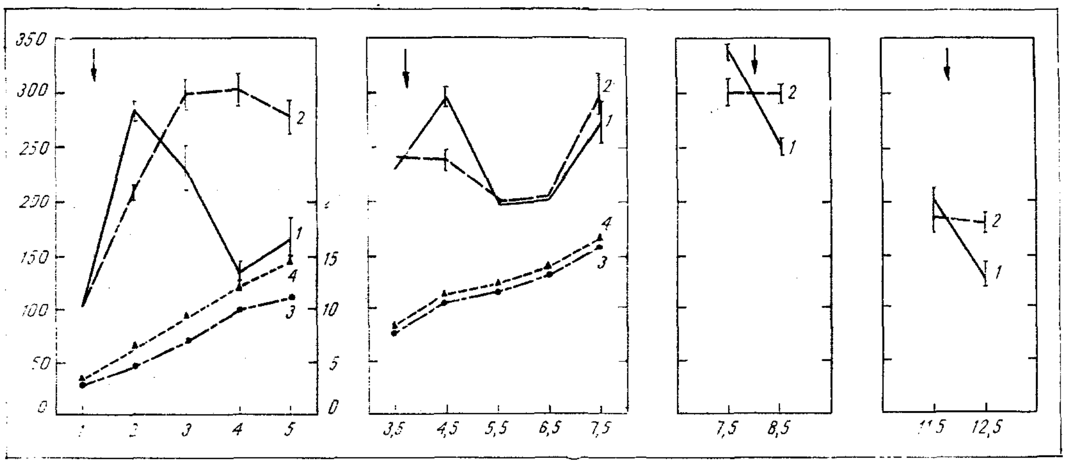


Fig. 3. Changes in motor activity and body weight of puppies of different ages 1-4 months after thyroidectomy. Abscissa, age (in months), first number gives age after operation, subsequent numbers each month thereafter; ordinate, left — number of sides of squares crossed in 20 min (1 — experiment, 2 — control), right — body weight (in kg) (3 — experiment, 4 — control).

The dynamics of PBI is also shown in Fig. 1. Clearly the PBI level rose from the age of 1 month and was highest at the ages of 2-4 months, after which it fell gradually. In puppies aged 6 to 12 months the PBI concentration was stabilized at the definitive level.

A parallel increase in HA and PBI was thus found only between the ages of 3 and 4 months. The increase in HA at the age of 7-9 months was not accompanied by any increase in PBI. Moreover, analysis of these data for separate litters showed that whereas in two litters the increase in HA and PBI concentration coincided (puppies aged 4 months), in a third litter no such parallel trend was found: The peak of HA was observed at 3 months and of PBI at 4 months. Consequently, the dynamics of motor activity in postnatal development does not correlate directly with thyroid activity. Meanwhile motor activity is known to be increased in hyperthyroidism and reduced in hypothryroidism, which suggests that thyroid hormones have a definite influence on motor activity. This influence is evidently most clearly manifested in thyroid gland pathology. Accordingly it was decided to carry out experiments in which thyroid activity was depressed in puppies of different ages by administration of methimazole.

In young puppies (1 and 3 months) depression of thyroid activity, reflected in slowing of the pulse ($P < 0.01$) and a fall in the PBI concentration in the experimental puppies compared with the control ($P < 0.01$), was accompanied not by a decrease in HA, as might be expected, but with an increase (Fig. 2).

No changes in behavior after administration of methimazole were observed in the puppies aged 5-6 months despite the definite peripheral effect and the fall in the PBI concentration ($P < 0.01$). In the mature dogs at the age of 8.5 months depression of thyroid function was accompanied by a decrease in HA. At that age the effect of methimazole was similar to that of other antithyroid substances on motor activity in adult animals [6]. According to evidence in the literature [2], after administration of antithyroid agents hypertrophy of the thyroid gland is observed and is most marked in young animals. To rule out any possible role of adaptive compensatory processes, experiments were carried out on 13 puppies thyroidectomized at the same stages of development as when methimazole was given. Changes in body weight, PBI concentration, and motor activity of the thyroidectomized and control puppies are shown in Fig. 3. Clearly 1 month after the operation the puppies aged 2 and 4.5 months, just as in the experiments with methimazole, were distinguished by more intensive motor activity than control animals of the same age ($P < 0.01$). When the observations were repeated 2-4 months after the operation, puppies thyroidectomized at the age of 1 month were less active than the controls ($P < 0.01$), whereas puppies thyroidectomized at the age of 3.5 months were indistinguishable from the controls as regards HA. By contrast with these animals and with puppies thyroidectomized at the ages of 7.5 and 11.5 months, a decrease in HA was found as early as 1 month after thyroidectomy ($P < 0.01$).

Thyroid hormones were thus found to give opposite effects on spontaneous motor activity of puppies at different ages.

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