

CHANGES IN THYROID FUNCTION PRODUCED BY GLUTAMIC ACID UNDER NORMAL AND ANOXIC CONDITIONS

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Administration of glutamic acid lowers the basal metabolism under normal conditions and prevents its decrease and the increase in I^{131} incorporation into the thyroid gland in anoxia. Glutamic acid has no action on thyroidectomized rats whether under normal conditions or in anoxia.

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Administration of glutamic acid to animals under anoxic conditions helps to maintain the glycogen and ATP level in the liver and muscles, increases the intensity of oxidative processes, and stimulates the activity of some respiratory enzymes [1-3, 5].

Since carbohydrate and energy metabolism are dependent on thyroid function, it was decided to investigate the effect of glutamic acid on absorption of radioactive iodine by the thyroid in rats and the basal metabolism under normal and anoxic conditions and after thyroidectomy.

EXPERIMENTAL METHOD

Experiments were carried out on male rats weighing 120-180 g. The animals were deprived of food for 18-20 h before the experiment. Glutamic acid was injected subcutaneously in a dose of 1 mg/g body weight as a neutral aqueous solution. Control animals were injected with an equal volume of physiological saline. Anoxia was produced 1 h after the injection by placing the rats in a pressure chamber at an "altitude" of 8000 m for 1 h in the experiments with radioactive iodine and for 2 h when the basal metabolism was to be determined. Total thyroidectomy was carried out under ether anesthesia. The rats were used in the experiments 6-7 days after operation.

The basal metabolic rate (BMR) was determined twice in the same animals: before injection of glutamic acid or physiological saline and 3 h after injection. In the case of anoxia, the second determination of the BMR was made 30 min after removal of the rats from the pressure chamber. The BMR was determined in an open-type apparatus, in which atmospheric air was passed through the chamber containing the animal at constant velocity. The expired air was analyzed in a Haldane apparatus. The BMR was calculated from the oxygen absorption in kcal/100 g body weight/day.

Absorption of radioactive iodine by the rat thyroid was measured at intervals of 1, 2, 4, and 24 h after injection of $0.2 \mu I^{131}$. The results were expressed as percentages of the administered dose.

EXPERIMENTAL RESULTS

Under normal conditions (Table 1) the BMR was unchanged after injection of physiological saline, but fell significantly, by 12.4% below the initial level, after injection of glutamic acid. Thyroidectomy caused a marked decrease in the BMR (by 23.4%). However, the BMR of the thyroidectomized rats was virtually unchanged after injection of either physiological saline or glutamic acid. It can be postulated that under normal conditions the effect of glutamic acid on the BMR is mediated primarily through the thyroid.

After anoxia the BMR fell considerably (by 22.7%). Preliminary injection of glutamic acid into the rats to some extent prevented this decrease. In this case the BMR fell only 17.2%. This may be due to the fact that glutamic acid is readily incorporated into oxidative metabolic processes, reducing the severity of the anoxia [1, 2, 5], so that the thyroid function is depressed to a lesser degree.

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TABLE 1. Effect of Glutamic Acid on BMR of Rats (in kcal/100 g body weight/day) under Normal Conditions, in Anoxia, and after Thyroidectomy

	Index	Physiological saline		Glutamic acid		Thyroidectomy		Injection of physiological saline into thyroidectomized rats		Injection of glutamic acid into thyroidectomized rats	
		before injection	after injection	before injection	after injection	before injection	after injection	before injection	after injection	before injection	after injection
Normal	$M \pm m$	44.11	44.03	45.53	39.87	43.63	33.44	36.95	37.53	32.56	30.64
		1.48		1.43		1.74		3.10		1.97	
	Difference relative to initial level (in %) P	-0.2 >0.5		-12.4 <0.01		-23.4 <0.001		+1.6 >0.5		-5.9 <0.5	
Anoxia	Index			Glutamic acid		Thyroidectomy		Injection of physiological saline into thyroidectomized rats		Injection of glutamic acid into thyroidectomized rats	
				before injection and anoxia	after injection and anoxia	before injection and anoxia	after injection and anoxia	before injection and anoxia	after injection and anoxia	before injection and anoxia	after injection and anoxia
	$M \pm m$			40.07	30.96	39.81	32.98	31.47	28.02	31.63	28.79
				1.56		0.89		1.31		1.67	
	Difference relative to initial level (in %) P			-22.7 <0.01		-17.2 <0.02		-11.0 <0.05		-9.0 <0.2	

TABLE 2. Effect of Glutamic Acid on Absorption of Radioactive Iodine by the Thyroid of Rats under Normal and Anoxic Conditions

	Index	1 h		2 h		4 h		24 h	
		control	experiment	control	experiment	control	experiment	control	experiment
Normal	$M \pm m$	24,2 1,89	21,6 1,44	28,3 1,97	24,5 1,79	33,5 3,39	30,6 5,32	36,5 4,27	31,9 3,11
	Difference relative to control (in %)	-10,7		-13,4		-5,7		-12,6	
	P	<0,5		<0,2		>0,5		<0,5	
Anoxia	$M \pm m$	14,2 1,09	17,5 1,12	20,9 1,29	21,9 1,05	26,1 2,09	26,7 2,06	33,9 3,10	30,9 2,42
	Difference relative to control (in %)	+23,2		+4,8		+0,2		-8,8	
	P	<0,05		>0,5		>0,5		<0,5	

A slight decrease in BMR (by 11%) occurred in the thyroidectomized rats in a postanoxic state, and preliminary injection of glutamic acid has only a slight effect on this result (the BMR fell by 9%). Hence, the change in BMR after anoxia was evidently due mainly to a change in thyroid function, and removal of the thyroid led to only a very slight change in the BMR during anoxia and after injection of glutamic acid.

Absorption of radioactive iodine by the thyroid (Table 2) under normal conditions was not significantly changed by glutamic acid at all times of investigation. Anoxia caused a marked decrease in the absorption of radioactive iodine by the thyroid, particularly in the first 4 h, in agreement with data in the literature [4, 6-7]. Preliminary injection of glutamic acid into the rats increased the I^{131} absorption by the thyroid by 23.2% ($P < 0.05$) after 1 h. Consequently, glutamic acid prevents the inhibitory action of anoxia on thyroid function, an effect which was particularly well marked in the earlier period after removal of the rats from the pressure chamber.

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