GALACTOSE TOLERANCE IN HYPERTHYROIDISM [1, 2]

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Impaired tolerance to dextrose is found in about one-half of patients with hyperthyroidism. Since the cause of reduced sugar tolerance in the hyperthyroid state remains unsettled, we endeavored to obtain more information on this subject by studying the response of patients with this disease to galactose.

METHOD

Forty grams of galactose, dissolved in 400 cc. of water flavored with lemon juice, were administered by mouth to subjects who had fasted for 14 hours. Specimens of blood were obtained from the cubital vein before, and 5, 15, and 30 minutes after, administration of galactose. The dextrose and galactose fractions of these blood samples were determined separately by Raymond and Blanco's modification (1) of the method of Somogyi.

This experiment was performed on twenty-one normal individuals, twenty-six patients with hyperthyroidism, fourteen patients with diabetes, and five patients with miscellaneous diseases of the liver. The experiment was repeated on eight patients after thyroidectomy, and in one case after a period of medical treatment during which marked amelioration of symptoms took place.

RESULTS

From Table I, it is seen that there was only occasionally galactose in the blood of normal persons at the 5-minute period. Thereafter, the average galactose curve rose to 15 mgm. per cent at the 30-minute period (see Figure 1). The maximum normal galactose reading was 26 mgm. per cent. Most patients with hyperthyroidism had galactose in the blood at the 5-minute period. Galactose curves considerably higher than normal

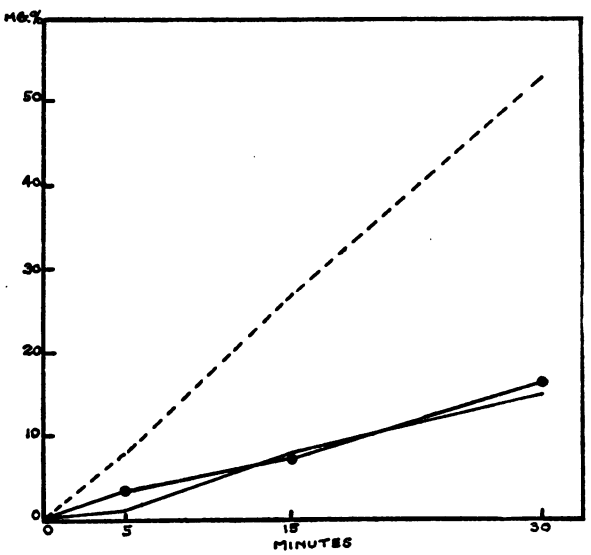

FIG. 1. GALACTOSE FRACTION OF THE BLOOD OF 21 NORMAL SUBJECTS (SOLID LINE), 26 PATIENTS WITH HYPERTHYROIDISM (BROKEN LINE), AND 14 PATIENTS WITH DIABETES MELLITUS (SOLID LINE WITH DISCS), AFTER ORAL ADMINISTRATION OF GALACTOSE.

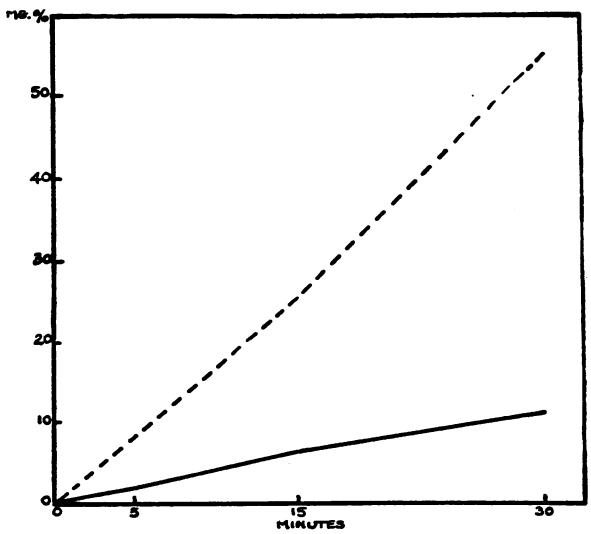

FIG. 2. GALACTOSE FRACTION OF THE BLOOD FOLLOWING INGESTION OF GALACTOSE IN 8 PATIENTS WITH HYPERTHYROIDISM BEFORE (BROKEN LINE), AND AFTER THYROIDECTOMY (SOLID LINE).

[1] Aided by a grant from the Christine Breon Fund for Medical Research.

[2] Read by title at the meeting of the American Society for Clinical Investigation, Atlantic City, May 6, 1935.

TABLE I

Normal individuals

Subject number	Galactose tolerance		
	5 minutes	15 minutes	30 minutes
	mgm. per cent	*mgm. per cent*	*mgm. per cent*
1	0	0	18
2	0	0	1
3	3	4	3
4	0	8	14
5	0	8	20
6	1	9	23
7		9	4
8	0		19
9		14	18
10	0	26	25
11	4	13	8
12	0	14	26
13	1	5	20
14	0	4	4
15	0	13	23
16	3	11	
17	0	9	23
18	4	9	23
19		0	11
20	0	4	18
21		0	4
Average	0.9	8.0	15.2

were the rule (Table II). Only two of these patients had maximum galactose readings below 30 mgm. per cent. Following thyroidectomy a marked increase in tolerance to galactose was observed in patients with hyperthyroidism (Figure 2).

The patients in the diabetic group with two exceptions exhibited normal galactose curves (Table III). As was expected, the galactose fraction of most patients with hepatic disorders indicated diminished tolerance to this sugar.

Changes in the dextrose fraction of the blood, contrary to our original impression (2), were proven by further work not to be sufficiently decisive to warrant reporting.

COMMENT

Two explanations of the abnormally high galactose curve in the blood of patients suffering from hyperthyroidism occur to us. Accelerated intestinal absorption of galactose may account for the presence of larger amounts of this sugar in the blood. This possibility is suggested by the earlier appearance of galactose in the blood of patients with hyperthyroidism. We are at present testing

TABLE II

Patients with hyperthyroidism

Subject number	Basal metabolic rate	Galactose tolerance		
		5 minutes	15 minutes	30 minutes
	per cent	*mgm. per cent*	*mgm. per cent*	*mgm. per cent*
1	+ 60	12	65	91
2	+ 60		30	65
3	+ 64	4	21	42
3*a*		5	7	
4	+ 46	0	28	59
4*a*	− 27	0	0	0
5	+ 40	0	18	51
6	+ 22	12	12	30
6*a*	− 32	5	9	7
7	+ 32	18	35	40
8	+ 30	5		78
9	+ 46	5	10	31
10	+ 47	9	27	81
10*a*	− 7	0	5	12
11	+ 56	0	3	23
12	+ 66	17	26	35
12*a*		3	3	0
13	+ 36	13	18	31
13*a*	− 17	1	23	39
14	+ 13	3	26	49
15	+ 61	7	35	68
15*m*	+ 30	4	21	27
15*a*	− 3	0	5	0
16	+ 45	9	23	65
17	+ 39	5	38	94
17*a*		1	1	33
18	+ 62	7	7	21
19	+ 58	5		73
20	+ 65	20	29	61
21	+ 59	10	27	41
22	+ 50	14	27	64
23	+ 65	9	45	51
24	+ 70	5	45	40
25	+ 22	7	29	36
26	+ 48	3	27	54
Average *		8.0	27.1	52.8

a = after thyroidectomy.
m = after medical treatment.
* Curves obtained after thyroidectomy were excluded from this average.

this hypothesis by studies of the rate of intestinal absorption in animals rendered hyperthyroid.

The second explanation is reduced capacity to utilize galactose, probably due to hepatic injury. Hepatic insufficiency in hyperthyroidism, as indicated by liver function tests, has been observed by ourselves (3) and was also reported by Youmans and Warfield (4) and by Lichtman (5). In addition, Kerr and Rusk (6), and more recently, Weller (7) and Beaver and Pemberton (8) described hepatic lesions in hyperthyroidism which could account for functional impairment of the liver. The reduced ability to handle galactose in hyperthyroidism is evidently not dependent

TABLE III

Patients with diabetes mellitus

Subject number	Galactose tolerance		
	5 minutes	15 minutes	30 minutes
	mgm. per cent	*mgm. per cent*	*mgm. per cent*
1	0	5	21
2	3	30	77
3	5	20	29
4		7	7
5	0	0	4
6	0	4	9
7	0	8	20
8	0	7	0
9	3	0	0
10	3	7	0
11	23	33	23
12	0	5	14
13	5	0	17
14	4	0	16
Average	3.5	7.6	16.7

upon the low glycogen content of the liver characteristic of this condition, because almost all patients with diabetes who, as a rule, also have a low hepatic glycogen, exhibited normal galactose curves.

The changes in galactose tolerance were often not proportionate to the severity of hyperthyroidism, as judged by any one criterion. This is not remarkable when one considers that the basal metabolic rate and other manifestations of hyperthyroidism are also not necessarily of corresponding severity. In our small group of patients with hyperthyroidism, reduction of galactose tolerance was observed with sufficient constancy to permit it to be compared with the basal metabolic rate as a diagnostic aid. Of twenty-six patients with clinical hyperthyroidism, all but two had a galactose concentration in the blood of 30 mgm. per cent or over. In the same group one patient had a basal metabolic rate of only plus 13 per cent. Another patient was referred to us for hyperthyroidism with a basal metabolic rate of plus 26 per cent and plus 28 per cent respectively on two occasions. He had normal galactose tolerance and was found to suffer not from hyperthyroidism but from rheumatic heart disease.

At present we are studying a larger series of patients to determine the usefulness of this procedure in the differential diagnosis of hyperthyroidism.

SUMMARY

1. The curve of galactose in the blood, after oral administration of this sugar, is considerably higher in patients with hyperthyroidism than in normal or diabetic subjects.

2. Thyroidectomy in most instances restores normal tolerance to galactose.

3. Accelerated intestinal absorption or impaired utilization of galactose by the liver in hyperthyroidism probably accounts for this phenomenon.

4. Reduced tolerance to galactose is such a consistent finding in hyperthyroidism that it may prove to be of value in differential diagnosis.

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