

5990

Effect of a Liver Extract on Blood Sugar and Respiratory Quotient in Diabetes.*

BYRON D. BOWEN AND GRACE E. SLY.

From the Buffalo General Hospital.

The effect of whole liver and various liver extracts on the blood and urine sugar of diabetic patients has been studied by Blotner and Murphy^{1,2}. It appeared to them that 180 gm. of raw liver was equal to the action of about 10 units of insulin. The use of liver extracts (480 gm. of liver) suggested very definite blood sugar lowering properties. The average drop of the blood sugar in the control group of patients in 8 hours was 32 mg., of those receiving liver extract, 80 mg., and those receiving insulin, 10 units, 68 mg. DePencier, Soskin and Best³ made a rather extensive study of the blood sugar and sugar excretion of depancreatized dogs after the ingestion of raw liver. They did not observe that liver had any favorable effect. Gutmann and Horwitz⁴ using whole liver on diabetic patients believed that liver did exert a slightly beneficial action on the diabetes. Habs⁵ observed no essential difference in the blood sugar curves of diabetic patients after cooked liver or raw chopped beef but he did find a higher alimentary rise of the blood sugar after the ingestion of raw liver. He attributed this to the high carbohydrate content of raw liver. Bertram, Horwitz and Wahncau⁶ concluded that liver and liver extracts had no influence on the blood sugar or glucose excretion. These same workers⁷, however, later reported that when insulin was added to the aqueous liver extract and given by mouth 1½ hours before glucose, a definite decline in the blood sugar occurred, but that this action was not obtained if given with a meal. They thought that the liver extract protected the insulin from destruction by the stomach contents and that the insulin was absorbed from the stomach.

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¹ Blotner, H., and Murphy, W. P., *J. Am. Med. Assn.*, 1929, **92**, 1332.

² Blotner, H., and Murphy, W. P., *J. Am. Med. Assn.*, 1930, **94**, 1811.

³ DePencier, M. T., Soskin, S., and Best, C. H., *Am. J. Phys.*, 1930, **94**, 548.

⁴ Gutmann, K., and Horwitz, S., *Klin. Wchnschr.*, 1931, **10**, 591.

⁵ Habs, H., *Klin. Wchnschr.*, 1931, **10**, 935.

⁶ Bertram, F., Horwitz, S., and Wahncau, E., *Klin. Wchnschr.*, 1931, **10**, 1162.

⁷ Bertram, F., Horwitz, S., and Wahncau, E., *Klin. Wchnschr.*, 1931, **10**, 1214.

A MILD DIABETIC PATIENT, AGE 68.

TABLE I.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:27	5.085	0.83		33.91
9:55	4.971	0.77	111	33.32
10:12	50 gm. glucose and 100 cc. lemon juice			
10:56	5.787	0.88	242	35.73
11:48	5.525	0.87	244	34.49
12:47	5.412	0.85	194	34.02

TABLE II.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:26	4.869	0.81		34.09
9:43	4.962	0.77	125	33.35
9:55	20 units insulin			
10:25	50 gm. glucose and 100 cc. lemon juice			
11:18	5.905	0.97	194	36.08
12:33	6.018	0.94	118	34.31
1:32	5.552	0.96	100	30.42

TABLE III.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:34	5.445	0.83		36.22
9:48	4.986	0.77	118	33.09
10:05	Extract—1600 gm. liver			
10:30	50 gm. glucose and 100 cc. lemon juice			
11:13	6.112	0.84	251	38.11
11:56	5.959	0.84		37.36
1:02	5.827	0.88	221	36.30
2:07	5.501	0.86	161	33.43

Discussion. Case 1. The maximum respiratory quotient after glucose alone was 0.88 (Table I). The response to insulin was typical (Table II). The liver extract (1600 gm.) given one-half hour before glucose brought about no change in the blood sugar curve and the respiratory quotient was not raised (Table III).

Case 2. The respiratory quotient after glucose alone rose to 0.84 (Table IV). When liver extract (2400 gm.) was given one-half hour before the glucose, the highest quotient was 0.86. The blood sugar after the liver extract failed to have the usual alimentary rise with its compensatory fall (Table V). The presence of a large amount of liver extract in the stomach and small bowel might have hindered the absorption of glucose. There was no essential change in the glucose excretion when liver extract was given before the glucose.

A SEVERE DIABETIC PATIENT, AGE 24.

TABLE IV.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:24	4.113	0.78		36.28
9:39	4.071	0.73	352	37.46
9:55	50 gm. glucose and 100 cc. lemon juice			
11:01	4.776	0.84	460	38.33
12:25	4.315	0.80	450	34.63
1:58	3.856	0.74	284	34.28
Glucose excretion after glucose 28.8 gm.				

TABLE V.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:14	4.069	0.76		35.19
9:29	4.012	0.75	316	35.31
9:45	Extract—2400 gm. liver			
10:15	50 gm. glucose and 100 cc. lemon juice			
11:25	4.381	0.86	345	34.83
1:03	4.086	0.78	286	32.50
2:57	4.245	0.76	316	35.56
Glucose excretion after glucose 25.7 gm.				

TABLE VI.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:18	4.431	0.87		33.66
9:33	4.222	0.82	330	33.44
10:00	200 gm. liver			
11:07	4.413	0.80	292	37.00
1:04	4.571	0.81	276	38.11
2:54	4.507	0.85	224	34.94

TABLE VII. Normal Subject.

Time	Ventilation	R.Q.	Blood Sugar Mg. per 100 cc.	Calories/ Sq. meter/ Hour
9:12	4.294	0.81		31.91
9:39	4.272	0.79	106	32.94
10:10	200 gm. liver			
10:47	4.594	0.83	102	31.39
11:10	50 gm. glucose and 100 cc. lemon juice			
11:59	5.972	1.00		36.61
1:11	5.701	1.00	93	35.36

The effect of 200 gm. of broiled liver given to a severe diabetic patient at a time when glycosuria without acidosis was present and to a normal individual three-quarters of an hour before the ingestion of 50 gm. of glucose and 100 cc. of lemon juice: This experi-

ment was done in order to be certain that the liver itself, because of its protein and fat content, did not depress the quotient. Since the quotient in the diabetic, while having glycosuria, did not rise higher than 0.85 but did reach unity in a normal individual, it seems probable that the feeding of liver had no action on the metabolism of glucose in the diabetic.

Conclusion. The effect of liver extract on the respiratory quotient and the blood and urine sugar was studied in 2 diabetic patients. The effect of whole liver was studied in one patient. There was no evidence that either had a favorable influence on the diabetes.

5991

Electromotive Effect of Concentration of Tissue Membranes as the Result of HCl Formation.

R. BEUTNER AND M. CAPLAN.

From the University of Louisville School of Medicine.

The large variability of certain biological potential differences with concentration¹ indicates that tissue membranes resemble metallic electrodes to some extent. This resemblance may lead to a better understanding of the nature of the electrical polarization in tissues as the cause of their irritability. Every attempt should be made, therefore, to understand the details of the physical nature of this important electrical property of tissues.

Beutner found that such a large electromotive effect of concentration can be imitated by a few water immiscible fluids, such as salicylic aldehyde.² The evidence points to *water immiscibility* and a certain *base binding power* as the essential properties for the production of a large electromotive variability with concentration. Michaelis found that collodion films also show such an effect.³ This confirms the theory, since collodion, a nitro-cellulose, has a marked base binding power, as will be demonstrated in a subsequent publication.

Electromotive measurements on a variety of substances and mixtures have been performed, as well as determinations of salt distribution, with the conclusion that a chemical reaction occurring at the phase boundary is the cause of the large electromotive effect of

¹ *Biochem. Z.*, 1912, **41**, 1.

² *Am. J. Physiol.*, 1913, **31**, 443.

³ Michaelis, L., *Biochem. Z.*, 1925, **161**, 47.