

Blood Sugar Response to Intraperitoneal Epinephrine Injections in Normal and Hypophysectomized Dogs.

PETER HEINBECKER AND T. E. WEICHSELBAUM.

From the Department of Surgery, Washington University School of Medicine, and the Laboratories of the Jewish Hospital, St. Louis.

Aschner¹ showed that epinephrine subcutaneously administered produces less glycosuria in the hypophysectomized dog than in the normal. Other investigators^{2, 3, 4} have since shown that epinephrine so administered produces less elevation of the blood sugar in hypophysectomized toads, rabbits and dogs than in the normal animals. Until the recent report of Russell and Cori⁵ the impression therefore prevailed that the glycogenolytic action of epinephrine is diminished in hypophysectomized animals. These investigators demonstrated, however, that in the rat intravenously administered epinephrine produces an effect on blood sugar similar to that obtained in normal controls. In the course of certain investigations on the carbohydrate metabolism of hypophysectomized dogs observations were made by us on the effect of intraperitoneal injections of epinephrine on blood sugar which are herein reported.

Nine normal and 9 completely hypophysectomized dogs were injected intraperitoneally. In 3 animals observations were made under identical conditions before and after hypophysectomy. The dosage used was 0.75 cc. (1-1000) in 10 cc. of normal saline per 6 kg. of body weight. Coincidental studies on insulin sensitivity revealed that the hypophysectomized animals were 2 to 4 times as sensitive as the normals. Autopsy later established the completeness of the hypophysectomy. Some of the dogs studied were on a balanced diet of carbohydrate, fat and protein, others were on a high fat, low carbohydrate diet and a third group was on a low fat, high carbohydrate diet. The alterations in diet made no appreciable difference in the effectiveness of epinephrine as a glycogenolytic factor. The effect on blood sugar was determined by analyses made at frequent intervals, up to 6 hours, using the Shaffer and Somogyi sugar method.⁶

¹ Aschner, B., *Pflüger's Arch.*, 1912, **146**, 1.

² Houssay, B. A., and Benedetto, E., *Compt. rend. Soc. Biol.*, 1932, **111**, 472.

³ Bachman, C., and Toby, G., *J. Physiol.*, 1936, **87**, 1.

⁴ Chaikoff, I. L., Reickert, F. L., Read, L. S., and Mathes, F. E., *Am. J. Physiol.*, 1935, **113**, 306.

⁵ Russell, J. A., and Cori, G. T., *Am. J. Physiol.*, 1937, **119**, 167.

⁶ Shaffer, P. A., and Somogyi, M., *J. Biol. Chem.*, 1933, **100**, 695.

TABLE I.
Blood Sugar Response to Intraperitoneal Epinephrine Injection in Normal Dogs.
Figures represent mg. of glucose per 100 cc. blood.

Dog No.	Date 1936	Time in min. after administration epinephrine								
		0	30	60	90	120	180	240	300	360
319	6/23	84	104	120	—	130	129	105	94	96
06	10/7	68	97	116	113	102	90	92	108	118
A.6	10/7	60	73	88	101	113	112	104	102	99
B.38	6/23	86	127	147	—	158	154	105	95	108
B.51	6/23	70	92	102	—	112	128	116	92	89
A.6	10/7	60	73	88	101	113	112	104	102	99
B.45	10/14	68	86	126	139	130	88	86	83	84
1	10/14	74	88	108	113	114	99	93	92	88
78	12/18	83	107	104	118	91	96	90	89	88

Dosage = 0.75 cc. 1:1000 epinephrine in 10 cc. n/saline per 6 kg. of body wt.

TABLE II.
Blood Sugar Response to Intraperitoneal Epinephrine Injection in Hypophysectomized Dogs. Figures represent mg. of glucose per 100 cc. blood.

Dog No.	Date 1936	Time in min. after administration epinephrine									Diet
		0	30	60	90	120	180	240	300	360	
319	7/8	79	100	117	—	108	88	89	81	93	Normal
06	11/16	57	82	96	114	114	83	71	84	86	"
A.6	11/16	59	63	110	128	121	82	64	69	69	"
112	6/26	60	80	113	—	160	128	93	69	62	"
A.4	6/3	75	89	127	151	116	81	83	88	—	"
A.7	12/4	76	97	128	143	133	94	58	69	77	"
113	5/9	77	102	110	128	133	126	—	—	—	High Fat
A.2	6/3	79	93	117	119	110	88	88	85	—	" CHO
A.2	6/26	62	83	101	—	119	93	60	60	69	Normal
A.2	10/4	58	68	98	107	97	81	53	50	59	"
A.1	6/26	62	89	91	—	96	89	77	74	78	"
A.5	6/26	64	80	98	—	97	83	75	78	82	"

Dosage = 0.75 cc. 1:1000 epinephrine in 10 cc. n/saline per 6 kg. of body wt.

Analysis of the results outlined in Tables I and II shows that epinephrine intraperitoneally administered is in general as effective in raising the blood sugar in hypophysectomized dogs as in the normal. Glycogen determinations on animals A.1 and A.2, Table II, carried out in the post-absorptive state, showed 5.4% and 6.1% glycogen content for the liver and 0.75% and 1.06% for the muscle of the 2 animals. The method of analysis used was that of Good, Kramer and Somogyi.⁷ It is apparent that hypophysectomized dogs, in a state of good nutrition, have an adequate liver and muscle glycogen supply to serve as substrate in the glycogenolytic process.

The reason for the lessened effect on blood sugar from subcutaneously administered epinephrine has not been definitely established. Russell and Cori suggested that it probably was due to a difference in the rate of absorption. Evidence in keeping with this explanation

⁷ Good, C. H., Kramer, H., and Somogyi, M., *J. Biol. Chem.*, 1933, **100**, 485.

has been provided by one of us⁸ in studies on the sensitivity of smooth musculature to exogenous epinephrine in cats as altered by hypophysectomy. It was found that the smooth musculature of such animals shows a definitely hyperdynamic contractility (30-40%) on contact with epinephrine. This would result in an accentuated contraction of the blood vessels at the site of subcutaneous injection with a corresponding slowing of the rate of absorption. Such a factor would not be active on intravenous or on intraperitoneal injection where absorption would occur largely through the lymphatics.

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Photoelectric Plethysmography of the Fingers and Toes in Man.

ALRICK B. HERTZMAN. (With the assistance of Clair R. Spealman.)
*From the Department of Physiology, St. Louis University School of Medicine,
 St. Louis, Mo.*

The detection of changes in the blood content of tissues with the aid of the photoelectric cell has been reported by several observers.¹ This paper reports the development of photoelectric plethysmographs which lend themselves to clinical use in dynamic analysis of the peripheral circulation and which may be "plugged in" in place of the patient's lead on the electrocardiograph. A summary of some observations thus recorded on the finger is reported elsewhere.²

A beam of light is directed from an ordinary automobile headlight bulb (direct current) on the finger or toe placed above a shielded photoelectric cell of the photo-emissive type, purchased in the radio trade, (cell current generated is approximately equal to 5×10^{-10} ampere—this may be increased by impressing 45-90 volts across the cell). The photoelectric oscillations with variations in the blood content of the digit are recorded by a string galvanometer or suitable oscillograph after amplification.

Adaptation of the principle of the method to the finger is shown in Fig. 1. A comfortable saddle or sling for the arm is necessary to

⁸ Heinbecker, P., *Am. J. Physiol.*, 1937, **120**, 401.

¹ Bonsmann, M. R., *Arch. f. exp. Path. u. Pharmacol.*, 1934, **176**, 460; Matthes, K., *Ibid.*, 1935, **179**, 698; Hanzlik, P. J., DeEds, F., and Terada, B., *J. Pharm. and Exp. Therap.*, 1936, **56**, 194; Molitor, H., and Kniazuk, M., *Ibid.*, 1936, **56**, 1.

² Hertzman, A. B., and Spealman, C. R., *Am. J. Physiol.*, 1937, **119**, 334.