

prandial rise in blood sugar. This delay may allow the absorptive period to come within the range of insulin activity of the current injection.

The sustained absorption seen with the fat mixtures tends to prevent the disturbing post-hyperglycemic hypoglycemias previously described.

### 10161

#### Protein as a Source of Carbohydrate for Patients Using Protamine Zinc Insulin.

HERBERT POLLACK AND HENRY DOLGER.

*From the Diabetic Clinic and from the Laboratories of the Mount Sinai Hospital, New York City.*

The introduction of protamine zinc insulin for the management of diabetes gave rise to several difficulties. Some of these, with suggested solutions, have been discussed in previous papers.<sup>1, 2, 3</sup> In addition, the prolonged action of protamine zinc insulin during the whole 24-hour period led to severe nocturnal hypoglycemic episodes. The recommendation by Conn and Newburgh<sup>4</sup> of high protein diets for the treatment of spontaneous hypoglycemia can be applied in principle to this problem. It is well known that about 50% of protein is available to the body as carbohydrate. It is also known that the gastric-emptying time with a meat meal may be prolonged to 3 or more hours. The time of small intestinal digestion, absorption, transportation to the liver, deamination, and synthesis of glucose further delays this availability.

To test this hypothesis, 40 diabetic patients were given 400 g of lean chopped beef, lightly broiled. This test meal was given 24 hours after the last dose of insulin (protamine zinc insulin) on a fasting stomach. Blood sugars were taken at one-half hourly intervals for a period of 4 hours, as previously described. Control experiments consisted in blood sugar determinations on the same patients under similar conditions, but without any food.

The results were uniform in all patients. There is a slow but definite rise in blood sugar concentration throughout the whole experi-

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<sup>1</sup> Pollack, H., and Lande, H., *N. Y. State J. Med.*, 1938, **38**, 1.

<sup>2</sup> Pollack, H., *J. Mt. Sinai Hosp.*, **4**, 437.

<sup>3</sup> Pollack, H., and Dolger, H., *PROC. SOC. EXP. BIOL. AND MED.*, 1938, **38**, 577.

<sup>4</sup> Conn, J. W., and Newburgh, L. H., *J. Clin. Invest.*, 1936, **15**, 665.

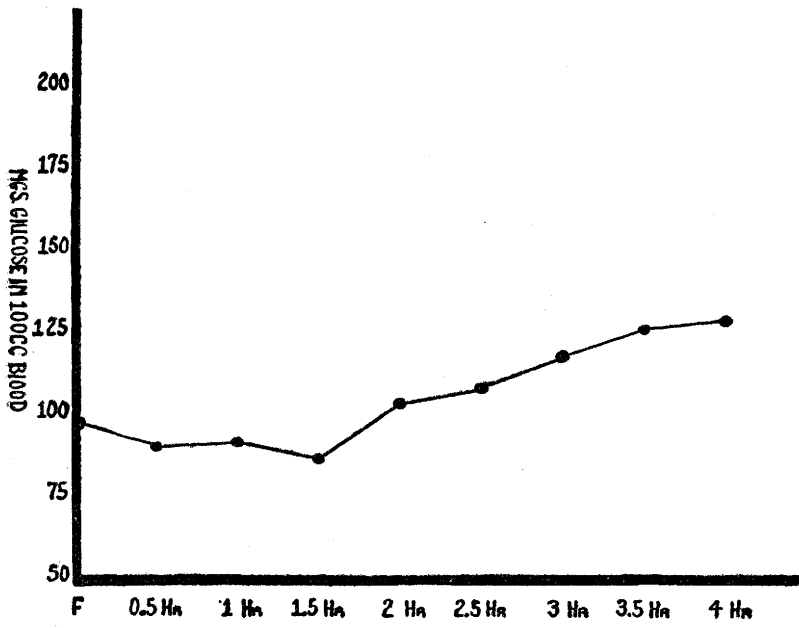


FIG. 1.

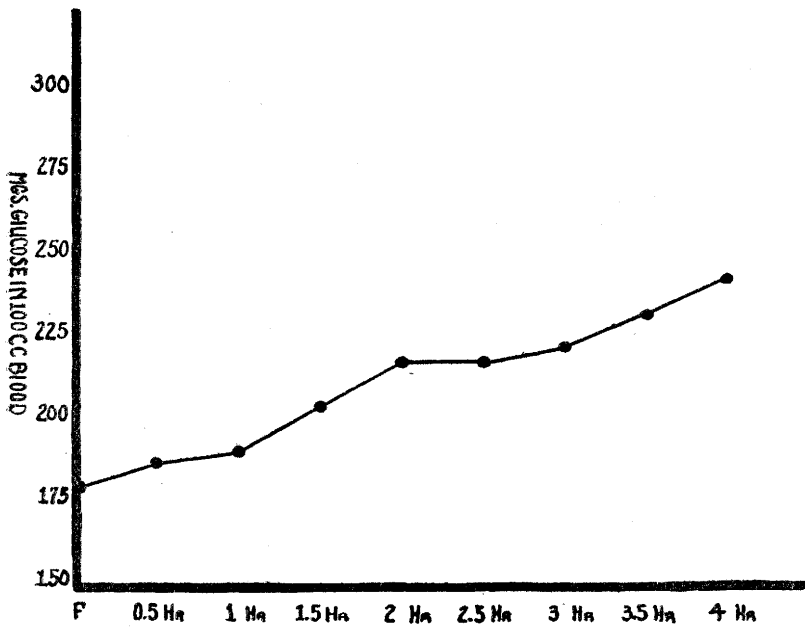


FIG. 2.

mental period. In contrast to the curves obtained after orange juice, banana, or banana and cream, previously published, and bread, oatmeal and potato, there is absolutely no compensatory drop in blood sugar level. Curves 1 and 2 are representative examples of this series of experiments with their controls.

The application of this principle to the problem of protamine zinc insulin therapy has eliminated nocturnal hypoglycemia. Patients are instructed to take 50% or more of the daily protein allowance at the evening meal, in order to buffer the tendency toward decreasing blood sugar concentration during the night.

### 10162 P

#### Syndromes Secondary to Prolonged Hypoglycemia.\*

H. E. HIMWICH, J. F. FAZEKAS, A. O. BERNSTEIN, E. H. CAMPBELL AND S. J. MARTIN.

*From the Departments of Physiology and Pharmacology and Surgery, Albany Medical College, Union University, Albany, N. Y.*

In an attempt to study the effects of prolonged hypoglycemia dogs and cats were injected with insulin and subjected to coma for varying periods. The duration of the coma was frequently extended as long as possible compatible with life. The symptomatology, which subsequently developed, occurred despite a blood sugar raised to normal levels or higher by the administration of sugar. The post hypoglycemic syndromes are characterized by their variability. For example, dog No. 4, which received insulin for 4 days and was intermittently in coma for approximately one-half of that time, became totally blind in his left eye and retained only light perception in his right one. He was continually moving about and in his aimless restlessness would bump into any object that might confront him. When food was placed in his mouth he showed no inclination to swallow it, but kept it there indefinitely. Another animal, cat No. 2, remained in a fixed position, an awkward one, standing on his hind legs and leaning upright against the side of the cage for at least 12 hours, though the blood sugar was raised to normal levels throughout this period.

Cat No. 6 displayed the crossed extensor reflex and spasticity of the posterior extremities. In cats the temperature regulation is frequently impaired after prolonged hypoglycemia. Cat No. 3 became

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