SCIENTIFIC PROCEEDINGS

ABSTRACTS OF COMMUNICATIONS.

Seventy-second meeting.

University and Bellevue Hospital Medical College, January 19, 1916.

President Lusk in the chair.

40 (1104)

On the relation of blood sugar to glycosuria in diabetes mellitus.

By **A. A. EPSTEIN** (by invitation).

[*From the Department of Pathology of Mt. Sinai Hospital, New York.*]

An extensive study on diabetic individuals and on animals in which diabetes was produced by the removal of the pancreas, reveals the fact that the current belief concerning the non-existence of a relationship between hyperglycemia and glycosuria is erroneous.

The error in the conclusions heretofore reached concerning this matter arises from several circumstances, chief of which are: First, the failure to recognize the fact that the blood volume in animals and man is capable of undergoing considerable variations, which affect the concentration and the total amount of the sugar present in the blood; second, the employment of the "percentage" of sugar found in the blood as a measure of hyperglycemia; third, comparing the "percentage" of sugar in the blood as found by single or isolated determinations, with the quantity of sugar eliminated in the urine in a given period of time.

Evidence is adduced to show that the volume of blood circulating in the body is capable of variation spontaneously, and as a result of the addition or abstraction of fluid. The degree of variation of the blood volume (*i. e.*, the relative blood volume)

may be determined by means of the hematocrit without resorting to the use of a method which measures the total blood volume. This is accomplished by establishing the changes that occur in the proportion of cells in the blood from time to time and computing therefrom, the alteration in the blood volume.

Variations in the blood volume appear to be capable of affecting the percentage relations of the different constituents of the blood, including sugar. This circumstance necessitates a consideration of the blood volume in the study of the sugar content of the blood; for a change in the blood volume may alter the percentage concentration of the sugar and thus mask or modify an actual increase or decrease in the amount of sugar present. Evidence is furnished showing that the percentage of sugar in the blood may rise or fall, as a result of change in the blood volume (bleeding, anesthesia, sweating, ingestion of fluid), but the total amount may remain unchanged. It is also shown that an increase in the total amount of sugar may occur synchronously with an increase in the blood volume (through dilution), causing little or no rise in the percentage of sugar.

In view of these facts it appears necessary to define hyperglycemia as an increase in the total amount of blood sugar over the normal, and not merely an increase in concentration or percentage. Thus it is possible to have a hyperglycemia even when the percentage of sugar is normal or below normal.

The blood sugar is subject to very rapid changes. A single examination of the blood sugar can not be used as a measure of the sugar content for any period of time, no matter how brief. Frequent estimations are therefore necessary, and the mean of two or three estimations must be used to represent the probable quantity of sugar in the blood for a given period of time. By following this plan in the examination of the blood of diabetic and non-diabetic individuals, it is found that the occurrence of glycosuria is intimately connected with a hyperglycemia, *i. e.*, an increase in the total amount of sugar in the blood.

In considering the quantitative relations between the glycosuria and the blood sugar in diabetes mellitus, the "hyperglycemia" is regarded as the sum of the greatest amount of sugar that can be present in the blood without giving rise to glycosuria,

plus an excess.[1] By comparing the urinary output of sugar in a given period of time with the "excess" of sugar present in the blood, a definite mathematical relation is found to exist between the percentage of sugar in the urine, and that in the blood. The proportion between the two tends to approach a constant, in one and the same individual, on a given day. This applies to individuals with normally functionating kidneys. In those with defective kidneys there is no parallelism. The hyperglycemia in such individuals is usually greater in proportion to the glycosuria than it is in those with normally functionating kidneys.

Diuresis in diabetes mellitus plays an important rôle in determining the total amount of sugar eliminated in the urine, but has no influence on its concentration or percentage.

41 (1105)

The relation of the sugar content and concentration of the blood to urine formation. (Preliminary report.)

By E. M. EWING.

[*From the Laboratory of Physiology, University and Bellevue Hospital Medical College.*]

The present experiments were performed in an effort to establish a standard of comparison for further experiments involving the study of the fate of sugar injected into the circulatory system under various conditions.

Various amounts of a dextrose solution (40 gm. in 40 c.c. water) were injected into the femoral veins of dogs under local anesthesia, and 20 c.c. of blood drawn from the femoral artery at 15-minute intervals. Twenty c.c. of citrated dog's blood previously prepared were injected into the artery immediately afterward, thus maintaining the normal concentration of the blood as indicated by the specific gravity and hemoglobin percentage. The specific gravity, hemoglobin and sugar content of the blood were determined, and also the urine obtained by catheter was

[1] The largest amount of sugar which may be present in the blood (with constant blood volume conditions) without giving rise to a glycosuria, is estimated at 0.1 per cent. In determining the excess of sugar in the blood, 0.1 per cent. is deducted from the values of blood sugar obtained after correction for blood volume.