

3. Although the data are too few for a final conclusion, there is no evidence that a decrease in the size of the cells accompanies an increased cell count. The contrary, however, is indicated, and this factor probably varies directly with the others.

OBSERVATIONS ON A CASE OF DIABETES TERMINATING IN COMA.¹

BY STUART HART, M.A., M.D.,

AND

WILLIAM J. GIES, M.S., PH.D.,
OF NEW YORK CITY.

THE excretion of organic acids in cases of severe diabetes has been extensively studied by Stadelman, Naunyn, Minkowski, and Magnus-Levy in Germany, and by Herter and Joslin in this country. These observers have emphasized the fact that diabetic coma is regularly attended by a considerable degree of acid intoxication. They have also shown that the degree of acidosis is of far greater prognostic value than the amount of sugar excreted. It has been found that in diabetes, β -oxybutyric acid and diacetic acid are prominent among the organic acids formed and eliminated, and also that the amount of ammonia in the urine is a rough index of the amount of organic acids thrown from the system. The source of these organic acids is still under debate. Some believe them to be due to an excessive proteid cleavage; others consider them intermediate products in the metabolism of fat. It has not been satisfactorily proved that they do not come from carbohydrate.

These facts and theories are of great practical importance in the therapeutics of diabetes, both in regard to the character of the diet and, also, to the possibility of neutralizing the condition of acidosis by the administration of alkalies. Since the accumulation of evidence is the only method by which the validity of the theories in this connection can be substantiated or refuted, we have thought it worth while to place on record the facts we were able to obtain from a case which has recently come under our observation.

The history of the case is as follows:

J. F., born in New York. When first seen he was twelve years of age, was attending school and advancing well in his studies. His father and mother, a brother, and two sisters younger than J. F., are all living, well and strong. None of his family has had any serious illness. J. F. was delivered at eight months and instruments were used, for what reason could not be ascertained. He was a very delicate child up to three years of age, but from this period seems to have been a

¹ Read before the New York Society of Internal Medicine, March 18, 1903.

strong boy. At six years of age he had whooping-cough and measles, which passed away leaving no known sequelæ. Up to the beginning of his present illness he was considered well and strong. Six months before he presented himself at the clinic he received a severe blow on the back of the head from a baseball. He fell down, but was not unconscious and no importance was attached to the injury. A severe bruise resulted. Up to the time he was first seen by us, J. F. attended school regularly and indulged freely in outdoor sports, in which he was proficient.

About the middle of November, 1901, his mother noticed that he had a tremendous appetite, had soon afterward that he was excessively thirsty, drinking a large amount of water and passing a great quantity of urine. The amount of urine continually increased, until he was obliged to get up several times each night to empty his bladder. About December 1st he began to have pains in the calves of his legs. His bowels were constipated.

On December 31, 1901, he came to the Vanderbilt Clinic for treatment. At that time he was on an unrestricted diet and passed about 6 litres of urine in twenty-four hours, of a specific gravity of 1040, and containing 480 grammes of sugar; also diacetic acid and a trace of albumin.

He was a well-nourished boy, weighing 81½ pounds, and the physical examination revealed nothing abnormal except a rough, harsh skin.

He was advised to give up carbohydrate food and to continue his visits to the clinic. On January 24, 1902, he passed 4000 c.c. of urine, of a specific gravity of 1033, containing 280 grammes of sugar and a trace of albumin. The amount of diacetic acid noted by Gerhardt's test did not seem to have changed.

On January 24th the patient was induced to enter the Roosevelt Hospital in the service of Professor Walter James, to whose courtesy we are indebted for the privilege of studying the case while in the hospital. He was under observation there for something over a month. The more important data which we were able to collect at that time are shown in the annexed table. During his stay in the hospital the patient was often drowsy, and continually complained of a slight pain in his lower extremities.

When his parents, much to our regret, insisted upon taking him home, his general condition did not appear to have materially altered, except that he had lost about five pounds in weight.

He continued to return to the clinic once a week and seemed as strong as ever. He was able to play ball and enjoy himself in outdoor sports. On March 23d he weighed 83 pounds, and the condition of his urine had not materially changed. We last saw him on May 2d, when he weighed 78½ pounds and seemed to be in as good condition as at any time during his illness. He passed on that day 2880 c.c. of urine, of a specific gravity of 1035, and containing 201 grammes of sugar, traces of albumin and diacetic acid.

He died on May 9th, after being in coma for eighteen hours. We were not aware of his death until four days later.

During the period after he left the hospital he was on a diet from which the carbohydrates were supposed to have been excluded. He was given a pint of cream a day and 10 grammes of bicarbonate of soda in each twenty-four hours.

The Period during Which the Patient was Under Observation in the Hospital. It was our intention to study our patient's condition and his metabolism under the influence of different diets and the administration of various drugs. On admission to the hospital he was allowed a full diet, consisting of carbohydrates, proteids, and fats. At the end of a week, at which time it may be supposed he was fully under the influence of the diet, his urine was analyzed, with the result shown in part in the table. On February 1st his diet was made to consist of meat, eggs, gluten bread, and cream and water in equal parts. This diet was continued through the remainder of the period. From February 1st to February 12th he suffered from a slight tonsillitis, but was practically free from fever. On February 14th he was given aspirin, 0.3 grammes three times a day, for the pain in the legs, which it relieved; this was stopped on February 18th. From February 19th to the end of the period, 10 grammes of bicarbonate of soda were given in each twenty-four hours.

TABLE OF ANALYTICAL RESULTS AND OTHER DATA.

Date.	Urine.											Patient.		
	Total volume (c.c.).	Specific gravity.	Acetone (gram.).	Diacetic acid.	Rotation.	Rotation after fermentation.	Sugar (grams.).	Total nitrogen (grams.).	Nitrogen of am- monia (grams.).	Ratio of N of NH ₄ to total N.	Per cent. of N of NH ₄ of total N.	Weight (pounds).	Character of diet.	Drugs given.
Jan. 30	3726	1.0365	+	+	+8.30	-0.10	290	16.47	1.16	1:14	7.76%	Unre- stricted.		0
" 31	2358	1.0383	+	+	+8.3	0.0	233	16.50	1.13	1:15	7.5%			
Feb. 5	1715	1.0330	+	+	+4.1	-1.2	123	18.65	3.24	1:5	20.73%	Re- stricted.		0
" 6	2455	1.0349	+	+	+6.7	-0.8	184	17.09	2.92	1:6	17.7%			
" 12	2601	1.0325	0.292	+	+6.0	-1.0	131	13.97	3.70	1:4	25.73%			0
" 13	2010	1.0314	0.225	+	+6.1	-0.7	143	15.80	3.43	1:5	20.4%			
" 17	5323	1.0345	0.917	+	+7.1	-0.9	422	21.10	4.01	1:5	20.75%	"		Aspirin 0.3 gm. t. i. d. Sod. bicarb. 10 grms. each 24 hrs.
" 22	5090	1.0335	0.902	+	+6.8	-0.4	351	22.58	3.27	1:7	14.76%			

The chemical work was done in the laboratory of physiological chemistry of Columbia University, at the College of Physicians and Surgeons.

Analyses of the urine were made daily from January 29th to February 28th. The above abbreviated summary shows clearly the fluctuations in the amounts of the various constituents. The methods of analysis were those now commonly employed.

These figures for acetone on February 17th and 22d are rather high. We attribute the rise in part to the fact that the urines of both days

had fermented slightly. The alcohol formed in the process unavoidably affected the results.

We are indebted to Dr. Wm. A. Taltavall for all of the gravimetric determinations of acetone.

From a review of the analytical data in the accompanying table the following points connected with the urine may be emphasized:

β -oxybutyric acid, as indicated by levorotation after complete fermentation of the sugar, was present throughout. The observed levorotation was not due to alumin.

Acetone and diacetic acid were also always detected.

The amount of sugar was at first diminished under the restricted diet, but later rose to its highest point, although the patient was continued on the same diet. This result may have been connected with the administration of aspirin (acetylsalicylic acid). A point seemingly in harmony with this conclusion is the fact that at this time there was also a considerable increase of the nitrogen output—an occurrence indicating a greater nitrogenous catabolism. This result as a specific influence of salicylic compounds has been established by the investigations of Kumagawa and others.

A point of particular interest to be observed from the tabulated data is the marked increase of N of NH_3 when the patient's diet was restricted. Normally a man should eliminate not over 2 grammes of N of NH_3 in twenty-four hours. In our patient, however, at one time the amount reached was over 4 grammes a day. The advocates of the acid-intoxication theory would claim that the increase was necessitated for the neutralization of the large amount of organic acid which failed of normal oxidation. According to Herter, 4 grammes of NH_3 would correspond to an output of approximately 16 grammes of β -oxybutyric acid. Later, as will be seen in the table, the administration of bicarbonate of soda, by neutralizing a certain amount of the unoxidized organic acid, made the demand for NH_3 less, and the amount excreted was decreased somewhat.

In a corresponding manner the changing ratio of N of NH_3 to the total nitrogen (to be seen in the table) would argue for an increasing condition of acidosis. Normally the N of NH_3 does not exceed 7 per cent. of the total nitrogen; when it reaches 20 or 25 per cent., as it did in our case, a grave condition of acid intoxication may be inferred.

It would seem in this case, judging from the nitrogen ratio, that the restricted diet had something to do with the increased excretion of acids. Such a result has been explained by previous observers on the ground that a certain amount of carbohydrate is necessary in the diet to insure the complete oxidation of these acids, and that the acids are produced from the fats (Magnus-Levy). On the other hand, Herter believes that the organic acids are the result of excessive proteid metab-

olism, and claims that most of his severe cases show a diminution in the excretion of organic acids when the patients are put on a diet containing the minimum amount of carbohydrate food.

That there was no correspondence in the amounts of sugar and organic acid in this case is indicated very clearly in the table.

We are hardly justified in drawing general conclusions from the data of a single case under observation for so short a period. We are certainly impressed, however, by the fact that the determination of the "nitrogen ratio" in severe cases of diabetes furnishes data of great prognostic value. Further, it would seem that diet, in certain cases at least, may not be restricted with impunity in carbohydrates, while it is quite possible that a restriction of the fats and a continuation of carbohydrates may be of advantage. On the acid-intoxication theory, the administration of alkalies affords a rational, if not an absolutely proved, means of combating the results of diabetic metabolism.

REFERENCES.

- Stadelman. Ueber den Einfluss der Alkalien. Stuttgart, 1890. Arch. f. Exp. Path. u. Pharm., 1893, Bd. xvii. Archiv f. klin. Med., 1896, Bd. xxxviii. p. 302.
 Nannyn. Volkmann's Sammlung klin. Vorträge, 1899, Nos. 249-350. Der Diabetes. Die Deutsche Klinik., Berlin, 1901, Bd. iii. p. 15.
 Minkowski. Arch. f. exp. Path. u. Pharm., 1884, Bd. xviii. S. 35.
 Magnus-Levy. Arch. f. exp. Path. u. Pharm., 1899, Bd. xiii. S. 142. Ibid., 1901, Bd. xiv. S. 389.
 Kumagawa. Virchow's Archiv, 1888, Bd. cxlii.
 Herter. Trans. Assoc. Amer. Phys., 1900, vol. xv., and 1901, vol. xvi. Lectures on Chemical Pathology, New York, 1902.
 Joslin. Trans. Assoc. Amer. Phys., 1901, vol. xvi. p. 612.

A CASE OF DIAPHRAGMATIC HERNIA; DEATH FROM ACUTE DISTENTION.

BY T. L. CHADBOURNE, M.D.,
OF GALLIPOLIS, OHIO.

(From the Pathological Laboratory of the Ohio Hospital for Epileptics.)

ON July 23, 1902, E. L., an inmate of the Ohio Hospital for Epileptics, died rather suddenly with a syndrome of symptoms, consisting of pain in the stomach region, dyspnoea, and abdominal distention. The patient's illness dated only from the previous day. Soon after a dinner consisting for the most part of vegetables and unripe fruit he became qualmish and vomited; after this he was noticeably short of breath and complained of pain in the abdomen. For this deodorized tincture of opium was given in water, which he had no difficulty in retaining, as there was no further vomiting. He remained sitting or lying on a cot until eight o'clock in the evening, when he was able to walk a short dis-