

trol the Carrel-Daken technic. In the British hospitals, in 1918, where they could not control the Carrel-Dakin standard dressing, they used a solution of yellow soap on the wound. It did not dry, and harmful organisms cannot grow in a strongly alkaline solution. The mucus will be softened, and will come off easily; and such a dressing can be put on in the field. Other solutions can be used in the same way. Another point: In the latter part of these infections, the sepsis is chronic; we used to call it chronic pyemia; and in the lists of our battle casualties for the last six months, almost all the seriously sick had chronic pyemia, which means that the temperature ran up within a day or two, and an abscess formed in some part of the body. When this condition declares itself, the abscess is inert and practically sterile. All that you need to do, then, is to put the knife in and drain it. You do not need to use the surgical solution of chlorinated soda. Those who are old enough to know about surgery in pre-antiseptic days will remember that the things we have seen in France are exactly the things that we saw in those days.

DR. REGINALD H. SAYRE, New York: I have found that a combination pulley by which the patient can pull on a chain and raise himself, when immobilized and suspended in bed, is handier and more useful than the ordinary compound pulley with a rope which has to be belayed. He can pull himself up and down, and by means of the sprocket which articulates with the chain, fix himself in any position desired.

DR. WILLIS C. CAMPBELL, Memphis, Tenn.: I should like to ask Dr. Hawley whether he has had any experience with gonorrhoeal arthritis or other types of acute infectious arthritis treated by the mobilization method.

DR. H. WINNETT ORR, Lincoln, Neb.: No discussion of this subject should be considered complete until a word of caution has been given regarding the danger of rendering apparatus ineffective by attempting to provide motional treatment. It works out in a great many cases that attempts to provide knee or elbow motion render the apparatus ineffective between the times when the motion is given. Apparatus for fixation and traction must be kept in position during the entire time of treatment, if results are to be obtained from its use.

DR. JOSEPH BYRNE, New York: I have always admired the enthusiasm of the orthopedists in the problem of restoration of function, and for many years have collaborated in this neurosurgical orthopedic work with Drs. Alfred S. Taylor and Samuel W. Boorstein. Secondary suture and early restoration bear an intimate and essential relation to the mechanism of degeneration and regeneration not only of nerve trunks, but also of the finer nerve branches supplying the injured parts. Integrated function of all kinds has a close dependence on the integrity of the neural arcs, both afferent and efferent, as well as on their related correlating and coordinating mechanisms. Hence, what takes place within the neural mechanisms during the stages of degeneration and regeneration after nerve injuries is of vital importance. After injury of a nerve the related neuron bodies in the dorsal root ganglions may undergo complete degeneration or merely exhibit axonal reaction phenomena. In the latter case, function is suspended temporarily in the related axons for a period of from fourteen to twenty-one days, and for a much longer period where infection complicates the injury. It is obvious, therefore, that where infection is present, as in war injuries it usually is, no benefit is to be gained by primary suture, as nerve regeneration cannot take place until after the tissues have become sterilized. Connective tissue, however, forms much more readily in the presence of a waning infection and offers an impenetrable barrier to the axon branches when these begin to sprout from the central segment. Where, however, a period is allowed to elapse after sterilization of the wound, the neuron bodies take on hypermetabolic activity, which aids remarkably the outgrowth of the new axon branches after a secondary operation. Add to this the preparation already completed in the distal segments of the injured nerves by the formation of the tubulized protoplasmic bands for the reception of the outgrowing axon branches, and the conditions are ideal for rapid neural restoration after a secondary operation. Where very small nerve branches have been torn across, in

infected or sterile tissues, early movement of the parts aids greatly regeneration in the torn nerve by breaking up the connective tissue barriers, thereby throwing the connective tissue itself into an embryonal state which favors penetration by the axons.

DR. GEORGE W. HAWLEY, Bridgeport, Conn.: I should like to emphasize a point brought out by Dr. Orr, that of the extreme care that must be exercised when using motion, early motion, in injuries of the extremities. It is really a new field, and we have a great deal to learn yet. It is a matter, largely, of combining effective fixation with motion. In answer to Dr. Campbell's question, unfortunately we had very little experience in the treatment of infected joints. For some reason we had comparatively few joint wounds; so I really can say very little, almost nothing, regarding the mobilization treatment as applied to the arthritis of the type that we see in civil practice. The next few years will present to us the problem of trying to adapt the best that war surgery has developed during the last four years, especially to the treatment of injuries of the extremities.

RESULTS IN THE MODERN TREATMENT OF DIABETES *

HENRY RAWLE GEYELIN, M.D.

NEW YORK

It seems appropriate at this time, after four years or more of trial, to review the therapeutic results that have been obtained with the Allen treatment for diabetes, which has received such universal adoption by the medical profession. With this in view I am going to discuss certain aspects of the treatment of diabetes, and with the help of charts illustrate some of the results obtained during the past four years, during which time we have treated patients according to the general principles laid down by Dr. Allen.

It is not necessary to go into a detailed description of the modern treatment, as it has received a great deal of attention in medical literature during the past four years and the reader, doubtless, is familiar with it. I have been much impressed, however, by the fact that, while many practitioners who have employed the fasting treatment have quite generally appreciated the use of the preliminary fasting period to abolish glycosuria and acidosis, they have not fully appreciated the great importance of the subsequent method of regulating the diet and the importance of keeping the patient free from sugar and ketone bodies. Probably the most important feature of the after fasting treatment is the proper regulation of the relative proportions in the amount of protein, carbohydrate and fat in the diet and the appropriate distribution of half days and fast days. Under the older methods of treatment it was the common practice to keep the carbohydrate intake very low and make up for its absence by feeding large amounts of protein and fat, particularly fat. The object was to keep up the patient's nutrition and body weight. How injurious to the diabetic process the high fat feeding can be has been well shown by Allen on dogs, and can be readily demonstrated in our diabetic patients.

The high fat feeding of former years has probably led to more fatal outcomes in diabetes than any other one factor. This has been so forcibly impressed on me in the past four years that I am inclined to say that

* Read before the Section on Pharmacology and Therapeutics at the Seventieth Annual Session of the American Medical Association, Atlantic City, N. J., June, 1919.

coma may be averted in almost all our cases, even in the presence of infections, provided the fat of the food is kept at the proper level, or in extreme instances totally eliminated. One reason that it has taken so long to recognize the harmful effects of diets over-balanced in fat has been the fact that the effects are very insidious. For example, a patient may be put on a diet very high in fat and very low in carbohydrate and remain sugar and ketone free for a long period of

This table shows in the second column to the left the total number of diabetic patients treated in the Presbyterian Hospital during the years 1912 to 1918, inclusive. During 1912, 1913 and 1914 all the cases were treated by the old method of treatment. During 1915 most of the cases were treated by the old method, but some were treated by the modern treatment, as shown. From 1916 to 1919 all patients received the newer treatment.

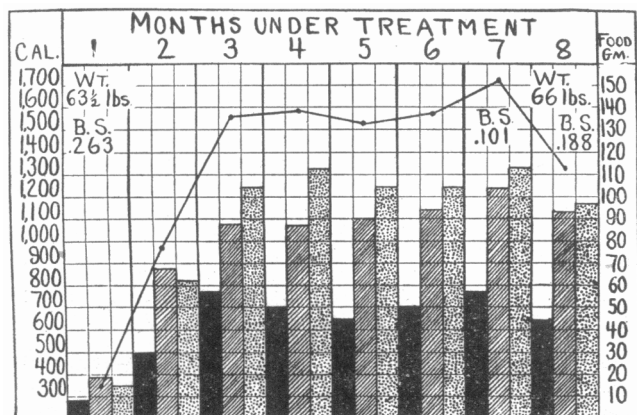


Chart 1.—Course of diabetes in Case 1. In this and the following charts, the numbers on the extreme left border indicate the number of calories. The numbers on the extreme right border represent the grams of food. The numbers at the top of the charts indicate the months during which the patient has been under treatment. The three columns in each numbered space represent the average daily intakes of food; in grams reading from left to right they are: carbohydrate, protein and fat. In Charts 3, 4 and 6 the figures 1=3, 3=4 at the top represent three-month periods. The continuous and irregularly horizontal lines running across the charts represent the total caloric intake. The body weights are indicated by "Wt." The blood sugar values are indicated by "B. S," and are given in percentage amounts.

It will be noticed, first, that the number of patients treated by the modern method in three and one-half years is more than double that treated by the older method over a similar period of time, owing largely to the fact that it became known that the hospital was studying diabetes. In spite of the greatly increased number of patients, who were equally divided between the medical and the surgical wards, the mortality percentage (Column 4) has been notably diminished. It will also be noted that there are proportionately fewer deaths from coma during the past three and one-half years. This, I think, is due to the early withdrawal of fat from the diet on admission to the hospital, and the institution of fasting treatment.

Probably the most striking feature of this comparison is the great increase in the number of patients discharged free from sugar and ketone bodies. Except for the patients that died, there were only six patients out of ninety-five in 1918 discharged with sugar (and this was only in traces). These patients who were discharged sugar free derived more benefit from their hospital stay than did those in preceding years, because in addition to being sugar and acetone free and being on a properly balanced diet, all whose intelligence permitted received instruction in calculation of their diets and the use of Benedict's solution in testing for the presence of sugar in the urine. They were thus able to control their condition in a much better manner.

time; but without further change in the food, the time invariably comes, if the fat in the diet is high enough, when the blood sugar begins to rise and the blood carbonate begins to fall, then sugar and ketone bodies in steadily increasing amounts make their appearance in the urine. With this as a rule go all the subjective symptoms of mild acidosis. The danger of acidosis is not the only one, for there is also the difficulty of reestablishing the food tolerance and rid-

RESULTS OF OLD AND NEW METHODS OF TREATMENT

	Year	Cases No.	Deaths		Deaths in Coma		Dish Sugar Free		Dish Ketone Free	
			No.	%	No.	%	No.	%	No.	%
Old Method	1912	24	6	25.0	4	66.6	3	12.5	12	50.0
	1913	37	5	13.5	4	80.0	18	48.6	23	62.1
	1914	39	7	17.9	5	71.4	16	41.0	13	33.3
	1915	24	9	37.5	5	55.5	13	53.0	11	45.8
	Total	124	27	21.7	18	66.6	50	36.8	59	47.6
New Method	1915	19	1	5.0	0	0.0	16	93.5	14	73.6
	1916	71	8	11.2	2	25.0	58	81.6	57	81.0
	1917	90	11	12.0	3	27.2	78	86.4	60	66.6
	1918	95	12	12.6	3	25.0	82	88.1	70	73.0
	Total	275	32	11.6	8	25.0	234	85.0	207	75.3

ding the patient of his subjective symptoms, which in severe cases takes several months at a much lower caloric level.

In order to demonstrate in a general way the favorable results of the modern treatment (they are not all favorable) I have prepared the accompanying table, which offers a rather striking comparison between the results obtained with the new and old methods of treatment.

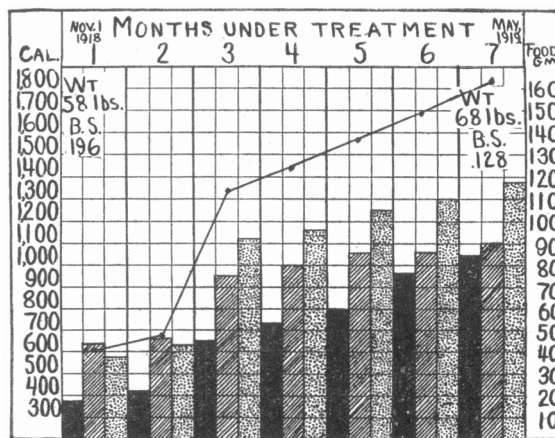


Chart 2.—Course of diabetes in Case 2.

The comparison between the old and new methods of treatment is just as striking in the subsequent care of these patients outside the hospital. It used to be the aim in the dispensary to keep the glycosuria as low as possible; but always from 80 to 90 per cent. of the patients who returned for their dispensary visits showed traces of sugar or more, whereas under present day care less than 40 per cent. return for their regular visits showing sugar in the urine. It is not possible in this paper to take up a more detailed and statistical comparison of the old and new methods of treatment

as they apply to the dispensary care, but later on I shall show charts of patients originally treated in the hospital whose subsequent course has been carefully followed and controlled outside the hospital.

The table does not demonstrate one other advantage that has been very noticeable in the new method of

(fasting value) should be maintained at the normal or nearly normal level.

Half days or fast days, depending on the severity of the case, are given when sugar appears, and additional half days or fast days are given at regular intervals with the purpose of increasing further tolerance. If with this system of treatment we also obtain faithful cooperation of the patient in following his diet and testing the urine daily, together with timely observations of the blood sugar, improvement unquestionably occurs for periods of from one to three years at least, and possibly longer. This in a very general way sums up the treatment that has been carried out with the patients whose charts are given. All of these charts are from cases chosen, not because the patient showed an unusual type of diabetes, but because the case was rather typical of certain common forms of the disease and because they illustrate what treatment can or cannot accomplish in these groups.

Charts 1, 2 and 3 represent the course of diabetes in a certain group of young people. All of these patients have done well.

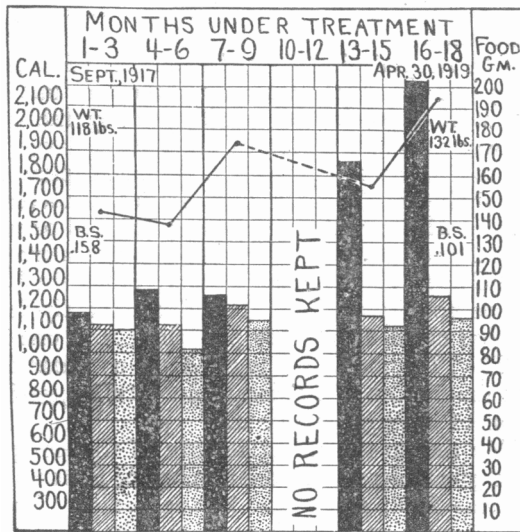


Chart 3.—Course of diabetes in Case 3.

treatment, namely, its effect on surgical conditions in association with diabetes. In cases of gangrene, carbuncles and other local infections, the results of combined medical and surgical treatment with its effect on the saving of life and preservation of limbs have been very much better than with the previous method of treatment; in fact, many operative procedures which were done hitherto have been rendered unnecessary.

As I indicated earlier in the paper, the most difficult part of the treatment for both the patient and the physician comes after the original fast, which we will assume has been effective in eliminating glycosuria and controlling acidosis.

The next step is gradually to increase the food until traces of sugar appear in the urine. A fast, or half day, is then given to eliminate glycosuria, and following this the patient is put on a slightly lower intake of carbohydrate, protein and fat, various ones of all these foods being gradually increased until a definite tolerance is determined. The manner of increasing the various foods, that is, carbohydrate, protein and fat, varies considerably with the type of case and also, to some extent, with the personal judgment of the physician. In a general way we aim to reach:

1. A much higher allowance of carbohydrate than was customary under the older methods of treatment. (It is astonishing at times to see how much more carbohydrate may be tolerated when we adopt the general policy of keeping the fats low.)
2. An allowance of fat ranging from 130 to 180 gm., depending on the patient's tolerance (it may be much lower).
3. A protein intake of about 1½ to 2 gm. per kilogram of body weight.

The urine must be kept free from sugar and ketone bodies, while the blood carbonates and blood sugar

CASE 1.—A boy, aged 12, had shown sugar for one month previous to going under treatment. The onset had been sudden and the symptoms were severe. The day he appeared for treatment he was distinctly drowsy, the skin was very dry, and he was breathing deeply. It required four fast days to make him sugar free, and his average daily food intake for the first month was very low, a little over 300 calories. His food tolerance could not be raised above this level. For the next seven months his food was steadily increased until 1,700 calories were reached. This was obviously too much for him at this time, and the more frequent fast days and slightly lower regular diet that was instituted lowered his average daily calories for the eighth month, which was May, 1919. So far in June his diet has averaged 1,400 calories daily and I think will be maintained

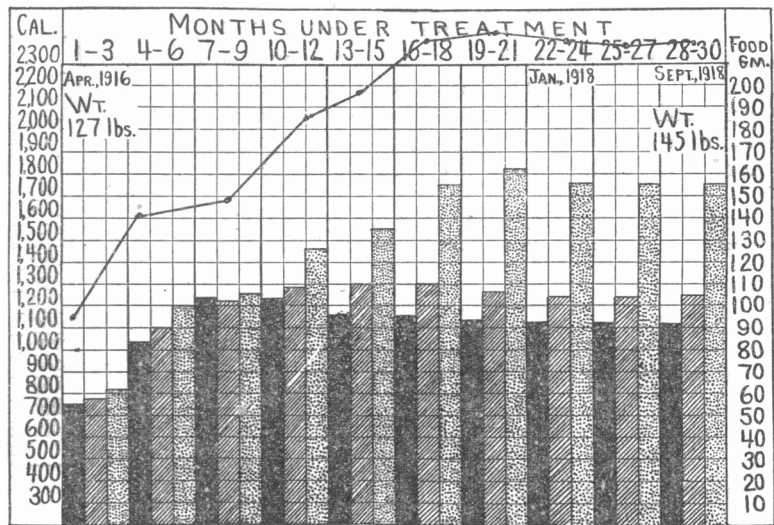


Chart 4.—Course of diabetes in Case 4.

at this point for from two to four weeks with the hope of gradual increase. He has not lost weight in this time but feels well, is quite active, perhaps too much so, and leads a normal life except as regards his diet.

CASE 2.—A girl, aged 11, had had diabetes for two months before coming under observation. Her history was essentially the same as the boy's and it took three fast days to rid her of sugar. She has had half days every two weeks and has shown sugar only twice in seven months. This child has shown a steady gain in tolerance, her present diet being

85 gm. of carbohydrate, 90 gm. of protein and 120 gm. of fat. and is one of five very favorable cases of children seen in the past four years. It is, of course, impossible to say what her prognosis is, but it would be more favorable than that of the preceding case.

CASE 3.—A man, aged 23, has been under treatment since September, 1917. Sugar was first discovered in a life insur-

continued diets too high in fat. How difficult it was, how long it took to develop a food tolerance, and how permanent this tolerance has been since 1916 is well shown in Chart 4. Unfortunately, the tolerance acquired by many similar patients is not so high as in the case of this man.

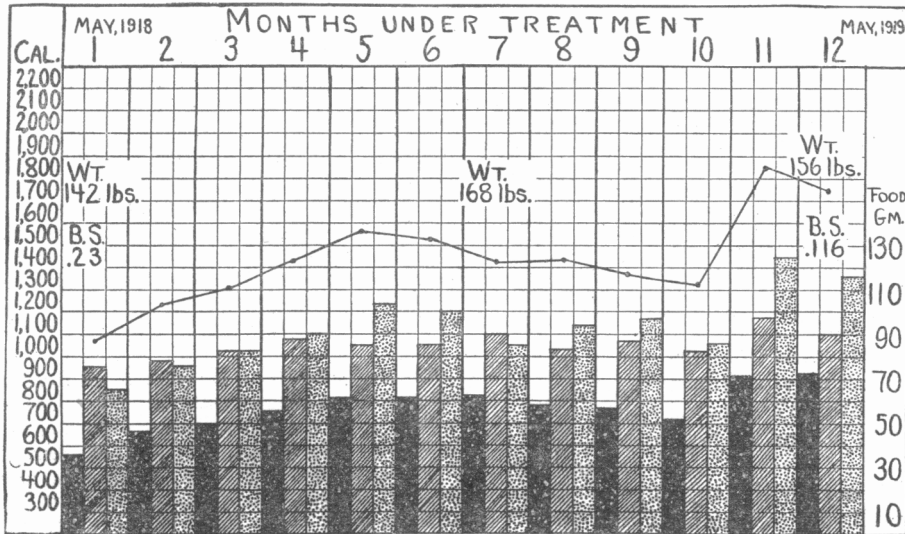


Chart 5.—Course of diabetes in Case 5.

ance examination. For two months previous to institution of treatment, he had followed a diet spasmodically. Glycosuria was eliminated in one fast day and the food was increased within six days to 60 gm. of carbohydrate, 90 gm. of protein and 70 gm. of fat, which produced glycosuria in considerable amounts. Chart 3 shows the subsequent course of events. This patient has been very faithful and has followed his diet religiously and very accurately, weighing all of his food for a long time; and when he became very proficient at this he began estimating the amounts of food, controlling this at intervals by periods of two to three weeks in which he weighed all the food. He has shown definite traces of sugar from time to time in daily tests, but has always been able to clear up the sugar by reducing his carbohydrate only. The patient has had almost no half days or fast days. He has been able to gain his normal weight and do a full day's work as electrical engineer. His blood sugar begins to rise as soon as he raises his carbohydrate intake above 250 gm. or if he stays on a daily intake of 250 gm. for more than one week.

Charts 4 and 5 are those of older patients who have done well. They have increased their food tolerance, and have gained in weight. Both were originally fairly severe cases, particularly Case 4.

CASE 4.—A man, aged 57, first came under treatment in April, 1915. He was showing much sugar and large amounts of diacetic acid in the urine. He was also suffering from very painful neuritis in both of his legs, which kept him awake at night. He had had diabetes for five years and had been on a very high fat diet with moderate restriction of carbohydrates but had never been sugar free. It took six fast days to render him sugar free, and for six weeks it was impossible to raise his tolerance above 900 calories, in spite of a very restricted intake of fat. He continued to have pains in the legs and show traces of diacetic acid in the urine. Fast days were liberally distributed throughout this entire period. It was not until his tolerance had been raised to about 1,600 or 1,800 calories that the pains and diacetic acid began to disappear.

This patient illustrates very aptly the fact previously referred to, namely, the bad effect produced by long

CASE 5.—A man, aged 47, had had diabetes for one year previous to his first visit. Sugar had always been present in large amounts and he had lost 80 pounds. He was so weak he could hardly walk and had been very drowsy and nauseated at times. He also had a very high fat intake; but his carbohydrate intake had been well over 100 gm., as the result of a generous allowance of gluten bread. It took three fast days to make him sugar free. The upward trend in this case has been somewhat interrupted twice, but he has gained in weight, is able to do a full day's work, and shows a normal amount of blood sugar.

I do not wish to give the impression that all cases of diabetes at this or at any other age show such favorable and encouraging progress; but of those who follow treatment day in and day out with the care that these patients have, it is very unusual for them to do badly and show a progressive down hill course.

Among older people, that is, those over 30 years of age, I have seen very few patients with uncomplicated diabetes who have followed strict treatment go steadily down hill. This does not mean that many diabetics of this age have not shown downward progress, for many have; but with the exception of the few cases just mentioned, they have all flagrantly violated their dietary regimen. It has been considered almost axiomatic that diabetes in the young is fatal. That such may not

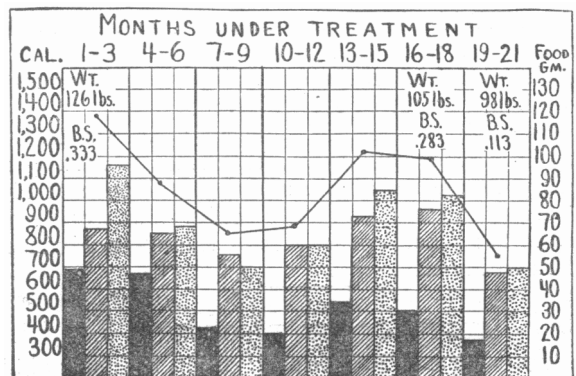


Chart 6.—Course of diabetes in Case 6.

always be the case is suggested by some of the results just cited. But for a certain group of diabetics more often encountered in the young than in the old, there is no doubt that an inherent tendency to a downward course does exist and persists until death, in spite of any treatment. Such a case is Case 6.

CASE 6.—A woman, aged 23, had had diabetes for one year. It has never been difficult to clear up glycosuria by fast or half days, but this patient has always shown a tendency to

develop high blood sugar on even a very low food intake. Now after almost two years of faithful adherence to diet, with many changes in the relations between carbohydrate, protein and fat, she has gradually lost tolerance. There has been a loss of 28 pounds in weight, and there can be no doubt that she is slowly and steadily losing ground. Her present tolerance may be noted on chart.

There have been several other similar cases at this age; but only two of the patients have faithfully kept the diet. It would seem most advisable in this type of case to feed the patient, allow glycosuria in moderate amounts to continue, and make an attempt to build up the strength.

CONCLUSIONS

As the result of the experience of the past four years in dealing with many diabetic patients treated by the above described methods, and as the result of reviewing complete records of these patients who have been cared for under the modern treatment, there are certain inevitable conclusions to be drawn:

1. Diabetes in its severe and acute form is not limited to the first three decades of life, but may be found at any age, although rare in persons over 30. In my experience it is more common between 50 and 70 than between 30 and 50.

2. Absolute adherence to the diet is essential to a maximum degree of successful results in treatment. Without there is no hope unless the diabetes is very mild; and even in that case there is great risk of it becoming severe.

3. Fast days and half days are of great help in treatment of the majority of patients, but are not necessary as routine measures in all cases at all times.

4. It is wise for a patient under treatment to realize that he is not a normal person on a normal diet and to regulate his mental and physical activities, and, therefore, his caloric output, by his caloric intake.

5. Exercise should be advised only in exceptional cases and in proportion to the amount of energy afforded by the caloric intake. Rest rather than exercise should be urged.

6. Long continued diets overbalanced in fat (180 gm. and over) are harmful, and their harmful effect is insidious. Aside from their immediate effects in the production of acidosis and glycosuria, they have a depressing effect on tolerance. This effect is overcome only by long periods of low caloric intake.

7. We have no cure for diabetes; but we have a greatly improved method of treatment, particularly as regards prolongation of life and the avoidance of surgical complications, as many observers who have employed the general principles of treatment advanced by Allen will testify.

ABSTRACT OF DISCUSSION

DR. ALFRED STENGEL, Philadelphia: In the beginning of his paper Dr. Geyelin stated that while the modern treatment of diabetes is now quite generally understood, there is a question in the minds of many practitioners regarding the latter part of the treatment, and with many the after-treatment is the most difficult. This has been precisely my experience. Beginning with the same form of treatment in 1915 my results have been substantially the same as his, and the after-treatment of the disease has been that which has given me the most difficulty. I am quite certain that if I had all of my figures here they would show about the same proportion of cases in which the patient was rendered sugar free and ketone free in a relatively short time; but a very considerable number of these cases subsequently relapsed owing to imperfect methods of

treatment, failure to carry out instructions and various other causes. I want to point out particularly the difficulty of determining when and whether a case of diabetes is actually cured. One of my most instructive experiences was made in the case of a young man who had been sugar free and ketone free for nearly four years, and for three years had had a normal blood sugar figure despite the fact that he was on quite a substantial general diet. As a result of a mild attack of influenza his diabetic condition immediately relapsed, and he died in coma in seventy-two hours. Several other less striking cases have illustrated the unwise of asserting that a case of severe diabetes has been cured. The underlying conditions of the disease are apparently not cured, though the patient may have been got to a place where with some care in his mode of life the disease remains inactive. In milder diabetes there can be no doubt that a complete cure is much more frequent and can with greater propriety be assumed to have been attained. I do not wish to give the impression that even in severe cases a complete cure is an impossibility, but wish to insist on the importance of a distinction between rendering a patient temporarily sugar free, ketone free and with a normal blood sugar figure and absolute cure.

DR. JACOB ROSENBLUM, Pittsburgh: I think these figures are misleading, that there are few hospitals in this country which would allow such a large percentage of the older cases to go out with glycosuria. My difficulty in the adoption of this method in many cases has been that the patients are not intelligent, they will not stick to it, and in many cases they consider themselves too intelligent and tell you "we will not stand for such restrictions in our diets," and I think that the older methods of treatment have still a place. In cases which have to come to operation, in pregnancy and in children, I feel that the Allen treatment is certainly the best to use.

DR. PHILIP ROY, Washington, D. C.: This subject is very interesting. I was called to see a gentleman who had lost one leg by gangrene; the other leg was badly swollen; his urine contained 3 per cent. of sugar and it was also filled with casts and albumen. Under the Allen treatment the swollen leg has become better, and he is enjoying good health and attending daily to his business. I have not seen him for a year, but I know that he is perfectly well.

DR. H. O. MOSENTHAL, New York: In regard to the after-treatment: The primary treatment is to render the patient sugar free, and whatever method we pursue makes little difference. The big difference of Dr. Allen's treatment from others is that we can render practically every person sugar free. The one problem we have to meet is when we cannot make the person sugar free, and have to restrict the diet in such a way that he cannot obtain enough nourishment to live. The form of diet that we have to give such a person is a mixture of art and routine. Formerly, we gave these people high fats and raised the calories in this way. But now the question of restriction of fats is the best course, and the best service which Allen has given us.

DR. E. P. JOSLIN, Boston: Dr. Geyelin's paper gives much encouragement. It is a striking fact that prior to 1915 one quarter of all diabetic patients entering the hospital died, and that since that date the mortality has been reduced to 10 per cent.; that prior to 1915 two thirds of the patients died in coma, and since that date a very small percentage die in coma, e. g., two out of forty. The statistics of the Massachusetts General Hospital showed that between 1898 and 1914 no improvement in diabetic treatment was obtained but since the Allen treatment was introduced marked improvement has taken place.

DR. L. F. KEBLER, Washington, D. C.: I am gratified at the conservatism of Dr. Stengler relative to the curing of diabetes. Cases are reported free of sugar for a time and then relapse. I would like to ask Dr. Geyelin whether the increase from 19 to 95 represents a percentage increase of diabetic conditions or just an increase of cases that came to the hospitals, and if the latter, why did they come to the hospital? Since the enforcement of the food and drugs act we have done a great deal by restricting the statements

appearing on packages, and one disastrous result is that these people have transferred their statements to newspapers. We have a number of cases under consideration now where people are using the mails to treat diabetic cases by means of drugs.

DR. L. G. HEYN, Cincinnati: I had a patient who had been rendered sugar free for some time, and had applied for a life insurance examination. This particular company has a habit of giving all candidates from 100 to 150 gm. of glucose on an empty stomach. He remained sugar free. I think this was a very severe test.

DR. C. M. GRIGSBY, Dallas, Texas: I have never derived as much benefit from any therapeutic measure as I have from Dr. Allen's treatment for diabetes. In the statistics here, however, I wonder whether they are of full value, because in the last four years, we have had cases in the hospitals which were much more amenable to treatment than were those of the older days.

DR. H. RAWLE GEYELIN, New York: The time limit on all papers prevented my emphasizing and illustrating, by means of the charts, certain points concerning the treatment of diabetes. Whether the diabetes be mild or severe the patient should be made to realize that he must regulate his activities according to the amount of food he is able to take and remain sugar free. Mild cases of diabetes, cases that in all probability would always remain mild, may be rendered severe if diets, much overbalanced in fat, be administered over too long a period of time. As regards the glucose tolerance test, it should not be given often in the case of mild diabetes and certainly should not be used in cases of severe diabetes. I consider that the improvement in the treatment of diabetes made in the past five years has been quite remarkable and may yield the most favorable results in some cases. Whether or not diabetes is on the increase, or whether we are discovering it earlier, is a question which requires a thorough study of life insurance and other statistics of similar character before we can arrive at direct conclusions.

THE INFLUENCE OF DESICCATION ON HUMAN NORMAL ISOHEM- AGGLUTININS*

HOWARD T. KARSNER, M.D.

AND

HERBERT L. KOECKERT, M.D.

CLEVELAND

The practical importance of human normal isohemagglutinins in determining the suitability of prospective donors for the transfusion of blood has been emphasized many times. The quest for an accurate, rapid and convenient method of determining the compatibility of donor and recipient has led to the development of a large number of methods to supersede the older time-consuming methods described in the various textbooks.¹ The methods of Epstein and Ottenberg² and Fishbein,³ designed to accomplish a large number of tests with a small amount of blood, were simplified first by Weil.⁴ Rous and Turner⁵ then added the advantage of further blood economy. The time-

saving method of Brem⁶ was improved on by Moss,⁷ but involved the use of washed corpuscles; this was obviated by Minot's modification,⁸ which is quite similar to the method of Lee.⁹ These were followed by the methods of Coca,¹⁰ Vincent¹¹ and Abelmann,¹² but the methods as employed by Karsner¹³ and Lee⁹ in military hospitals testify to their efficiency.

As a further means of saving time and affording greater convenience, Sanford¹⁴ has recommended the use of dried serums. He allowed the serums to dry in air on cover-slips, after which they were wrapped in paper and kept in the icebox. For grouping an unknown blood, the dried drops of serums of Groups II and III were dissolved in one drop of the cell suspension and the grouping made according to the classification of Moss. He observed that the serums still possessed marked agglutinating properties after more than two months. Karsner¹⁵ noticed that in France there seemed to be a deterioration and loss of specificity of the agglutinins a short time after they were dried. It was with this in mind that the following experiments were carried out:

EXPERIMENTS

Serums of Groups II and III were used, and dilutions of 1:2, 1:4, 1:8, 1:16, 1:32 and 1:64 were made with physiologic sodium chlorid solution. Small drops of undiluted serum and of each dilution were allowed to dry on glass slides in the air. The initial agglutinating titer was noted and tests were made at the end of each week for twelve weeks. One third of the slides (A)¹⁰ were kept in the dark at room temperature, another third were kept in the refrigerator (B), and the remainder were kept in a vacuum desiccator over sulphuric acid (C). The corpuscles used were from individuals of Groups II and III, and the same individuals were used throughout the experiment. Further, in order to avoid variations in agglutination due to the quantity of cells used in the tests, a standard cell suspension was used throughout, namely, a suspension made by mixing in 1 c.c. of physiologic sodium chlorid solution the amount of blood which would fill the capillary tube of a white cell counting pipet, and which we have found to be the optimal concentration for isoagglutination tests. Since the erythrocyte count of the individuals used remained practically constant, the resulting cell suspensions were also constant. The dried serum drops were dissolved in a loopful of cell suspension of each group. Since agglutination occurred more slowly in the higher dilutions, as has been observed by Ottenberg, and since, if agglutination occurred in any dilution, it did so within thirty minutes, that time was taken as a standard during which the mixtures were frequently observed microscopically. The slides were kept inverted in a moist chamber during this period, and for observation were placed in the same position on a slide the ends of which were raised by means of two small pieces of glass glued on with balsam, thus affording a very serviceable hanging drop preparation.

At the same time a series of small capillary tubes were drawn out and filled with the various dilutions of both

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