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NEW IDEAS REGARDING DIABETES MELLITUS

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When I was asked to preside over the medical session of this Conference and to speak on some medical subject, I felt I could do nothing better than to tell you something about a disease which is very common in my province and I am sure is common over the rest of India, and to compare notes regarding our views as to its causation and treatment.

In Bengal, diabetes used to be more prevalent in the generation preceding mine and more common among the intelligentsia than among the working classes, so much so that it was a common saying that the occurrence of this disease indicated the social status of the sufferer. However that be, the fact remained that one of the first results of the adoption of western type of civilization, culture and mode of living was the widespread occurrence of this disease amongst those who left their rural habitat and migrated to the town areas with their artificial surroundings and manner of life. Personally speaking, it is one of the diseases which interested me most, as many members of my family, both on my mother's and father's side, suffered from it and ultimately died as a consequence.

Take any ordinary book on diabetes mellitus and you will find it defined as follows:

Diabetes mellitus is a disease of metabolism due to inadequate supply of the pancreatic hormone. While this sentence gives you the relevant facts as we see them in diabetes, yet this definition does not give us the complete picture of the disease nor the comprehensive disturbance of metabolism that we find. We have to consider not merely the changes met with in the utilisation of carbohydrates, but also the way in which the diabetic deals with the products of digestion of fats and proteids; we have to consider not merely the variation in the quantity and quality of the pancreatic hormone but also the extent to which there are variations in the nature and character of hormones of other ductless glands; we cannot ignore the part played by the liver which stores sugar and the tissues which utilise them. In a diabetic we often find marked uric acid dyscrasia, alternating with glycosuria; we find the presence in the system products of irregular and incomplete fat and proteid metabolism. Any discussion regarding diabetes as being a disease of metabolism naturally raises the issues of proteid and fat metabolism as well and any attempt to ascribe the whole blame to disease of the pancreas must ignore the corresponding and concomitant changes met with in the suprarenals, pituitary and thyroid.

Let us consider for a moment the definition given above. Supposing we accept the proposition that diabetes is due to inadequate supply of the pancreatic

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hormone—a question will immediately arise—what causes this inadequate supply? Is diabetes due merely to static causes, like changes in the pancreatic tissues, or are those changes due to some other vital processes going on with the system? Why should inadequate pancreatic secretion produce a metabolic disease?

There was a time in the middle of the last century when we had a static conception of diseases. From time to time, diabetes mellitus came to be regarded as a disease of the kidneys, or of the stomach, of the nervous system, of the liver and finally of the pancreas. At present, it appears that the pancreatic theory holds the field; and yet cases are recorded where post-mortem has shown the pancreas to be absolutely healthy, although sugar appears in the urine. The famous experiment of Claude Bernard —the puncture of the IV ventricle—resulted in glycosuria, but not due to inadequate supply of the pancreatic hormone. Hypersecretion of the anterior pituitary body alone may cause symptoms resembling diabetes. The frequent association of acromegaly with diabetes is significant. Recent experiments have shown that this action of the anterior pituitary is partly due to the influence of suprarenal cortex on carbohydrate metabolism, an influence quite distinct from that of suprarenal medulla. Is there any justification for us to distinguish between pancreatic and non-pancreatic diabetes?

Before proceeding to consider the question, it would be interesting to trace the fate of carbohydrate in the system which has been carefully worked out, and it would be interesting to trace the salient features of carbohydrate metabolism in the system. All carbohydrates are converted by the gastro-intestinal juices into disaccharides like maltose, lactose and sucrose. These again, by the action of the invertases, are converted into monosaccharides like glucose, fructose and galactose, of which glucose and to a certain extent fructose are utilised by the system as available sources of energy. A portion of these sugars are converted into glycogen and stored up in the liver and muscles, a portion is excreted by the kidneys and the rest circulates in the system to be utilised as a source of energy. It may be that a portion is stored up as fat. To meet special needs or to provide more energy, glycogenolysis occurs and the blood sugar level rises. In a normal individual, however, nature attempts to keep a constant level of fasting blood sugar. The internal secretion of the pancreas which controls glycogenolysis on the one hand and possibly the utilisation of the sugar by the tissues on the other is the chief agency for keeping a constant fasting blood sugar level. The secretion of the pancreas is controlled by the nervous system. Besides pancreas, other ductless glands have influence on the carbohydrate metabolism; the most modern view is that the suprarenals promote glycogenolysis and helps the tissues to oxidise sugar, that thyroid and anterior pituitary bodies exercise their influence on carbohydrate metabolism through the suprarenals. Recently, Houssay demonstrated that after hypophysectomy, animals become very sensitive to the action of insulin and that in depancreatised dogs, this operation alleviates the symptoms of diabetes. Houssay believed that anterior pituitary glands stimulate the formation of sugar from proteids as also from fats. The alleviation of symptoms of diabetes is due to the fact that the removal of the anterior pituitary stops sugar formation from proteins and fats.

The recently developed methods of determining the physico-chemical changes of the blood underlying metabolic processes within the body have supplied us with more accurate knowledge of the mechanism by which the sugar content of the blood is normally maintained at a particular level; and we should look to a failure or disturbance of this mechanism for the hyperglycæmia and glycosuria seen in diabetes.

What is this mechanism which maintains a constant blood sugar level in the system?

Normally food increases the sugar content of the blood and raises its fasting level. It is known also while proteids and carbohydrates produce equal rises, with fats and oils there is actual reduction of blood sugar level; if hydrochloric acid be added to the meal, the maximum of blood sugar level is reached quicker and is higher than it would be if no hydrochloric acid were given, and conversely with the addition of alkali to the food, the maximum is less and reached later. Experiments with rabbits injected with Locke's solution to which acid or alkali are added show that with acid the glycogen of the liver is more easily hydrolysed than when Locke's solution is given alone and is much more so than if alkali is added to it. After food, here is at first a flow of gastric juice and an alkaline tide is met with in the blood; there is a corresponding fall of blood sugar.

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But soon after, within half an hour or so, the influence of secretion of alkaline juices by the pancreas and intestines soon asserts itself and as alkalipenia develops, the amount of sugar in the blood rises and continues to do so, so long as alkaline juice continues to be secreted. When this ceases, the normal fasting relation between fixed acids and bases is gradually restored, the percentage of sugar in blood falls until the fasting level is reached. We fed animals with hydrochloric acid and found, as Elias did in 1912, and Cammidge in 1920, that this resulted in glycosuria and hyperglycaemia. In 1921, Underhill showed that intravenous injection of soda bicarb in animals produced hypoglycæmia. The influence that hydrochloric acid secretion in the stomach has on blood sugar level is further proved by the following experiments :

In 1915, Blohm showed that while giving sugar by the mouth increases the blood sugar level, the introduction of sugar per rectum causes no such increase, obviously because, while in the former process, hydrochloric acid is secreted, in the latter, sugar is directly absorbed and passes into the liver ; he argued that there was no alteration in the gastric and pancreatic secretions nor any consequent disturbance of acid base equilibrium in the blood, no hyperglycæmia was noticed when glucose was given per rectum. There is thus a clear relation between the sugar value of the systemic blood and the fixed acid base balance at any particular moment. This is further proved by taking the dissociation constant of hæmoglobin of the blood at different intervals after food intake ; with increased alkalipenia, the dissociation constant falls and the blood sugar rises. It has also been proved that the level to which the blood sugar rises after the digestion of food varies in different individuals and one of the causes of such variation is whether the person experimented upon suffers from hyper- or hypochlorhydria. Besides such conditions of the stomach, similar disturbances of acid base equilibrium and resulting hypoglycæmia are noticed under other circumstances.

In 1911, Pavy and Godden showed that in chloroform anæsthesia, glycosuria is produced and if the patient is injected with soda bicarb the glycosuria is diminished and urine becomes sugar free afer a time.

In 1920, Chautraine found an increase of blood sugar after ether and CHCl, narcosis and that this hyperglycæmia disappears if alkali is injected intravenously in sufficient amounts to lower the hydrogen ion concentration of the blood.

In 1920, Fatum found that after hæmorrhage there is disturbance of acid base equilibrium along with hyperglycæmia. Reismann proved that after operation partly due to anæsthesia and partly due to hæmorrhage, acidosis developed and he found acetone and diacetic acid present in a large number of cases.

In asphyxia, Underhill and McLeod proved that hyperglycæmia and glycosuria appear and is proportional to the extent to which respiration is interfered with ; he further proved that the presence of excess of CO_2 or acidæmia is the direct exciting cause of asphyxial hyperglycæmia.

In 1923, myself and Dr. Mukherjee found that in any typical case of bronchial asthma, the R.P.H. (residual hydrogen ion concentration) varied between 8·1 to 8·4 and that the blood sugar is below normal fasting level. We argued that the lowering of the fasting blood sugar level in these cases was due to the fact that all the available circulating sugar in the blood was utilised towards meeting this condition of acidosis in the asthmatic ; such utilisation was possible because in an asthmatic both adrenalin and insulin in sufficient quantities are available for the purpose.

Looking at the clinical and experimental evidences there seems no doubt, therefore, that hyperglycæmia occurs under varying conditions of health and disease whenever there is a lowering of alkalinity of the blood or a tendency towards acidosis. Let us discuss for a moment the other methods which are available to the system, besides hyperglycæmia, to meet any condition of acidosis.

The following processes are at work whenever a condition of acidosis tends to develop in the system :

(1) Bases like soda bicarb and the phosphate combined with the acid radicle ; in the former case, excess of CO_2 is formed in the blood and is eliminated by the lungs ; in the latter case, acid phosphates are eliminated by the kidneys. (2) These fixed bases also combine with the acids and when they reach the kidneys, ammonia is substituted for them and ammonia salts of the acids are eliminated by the kidneys ; the fixed bases are thereby retained in the

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system. (3) Oxyhæmoglobin is comparatively more acidic than hæmoglobin though both are very weak acids. During acidosis oxyhæmoglobin is converted into hæmoglobin and this means an increase in the amount of bases, which helps in maintaining acid base equilibrium. (4) In acidosis, there is a shift of hydrochloric acid from plasma to corpuscles and base is thus liberated which form bicarbonate so essential to preserve the necessary pH value.

If there be on account of faulty metabolism, and in spite of the operation of the processes described above, there is excessive production or deficient elimination of the acids acidosis develops.

In various pathological conditions this acid base balance has a tendency to be upset. For example :

(a) In nephritis, cholera, uræmia—due to failure of phosphate secretion acidosis results.

(b) In decompensated heart disease and in emphysema—defective elimination of CO_2 will cause acidosis.

(c) In certain diseases like diabetes, vomiting in children, fasting etc.,—increased production of diacetic acid and acetone causes acidosis.

In these conditions of health and disease, nature attempts to relieve acidosis by the ordinary methods mentioned above ; when these methods fail, then hyperglycæmia is produced and becomes established for a long or short period. This excess of sugar in the blood is in the first instance the result of break down of glycogen in the liver reservoir ; very soon proteids and fats begin to be broken down in large quantities in order to continue the hyperglycæmia. The object of this hyperglycæmia is evidently to reduce or control acidosis. How is this brought about ? One can suggest three possible theories which either singly or in combination can explain how this control is brought about.

(1) In any condition of acidosis, the sodium buffer substances are utilised in the first instance to neutralise the acid ; as a result the $H_2CO_3/NaHCO_3$ ratio is disturbed, the numerator CO_2 being in excess, increased respiratory movements follow ; very soon, however, the balance is disturbed the other way, partly because CO_2 is thus largely eliminated and partly because of the interaction of sodium salt of the fixed acid with H_2CO_3 reproducing the buffer substance. It may be that after the buffer substances have failed to maintain the ratio, excess sugar is produced to compensate acidosis. The sugar is burnt up and the liberated excess CO_2 acts in the manner mentioned above and restores $H_2CO_3/NaHCO_3$ balance.

(2) It may be that acidosis lowers insulin production the result of which is, as I shall show presently, hyperglycæmia. There is some experimental evidence in favour of this view. It was found by Young in 1937 that repeated injections of anterior pituitary substance increased the fat and proteid destruction which led to ketosis and acidosis ; simultaneously with it, destruction of islets of Langarhans were found ;

(3) It may be that if sugar is available for combustion, fat metabolism becomes more complete. The amount of intermediate substances like β-oxybutyric acid which are produced in incomplete combustion of fat becomes less and acidosis is relieved.

There are several organs which are regarded as having direct concern with glycogenolysis and oxidation of sugar in tissues. The pancreas acts through its internal secretion, insulin ; the most recent view is that insulin controls glycogenolysis and perhaps influences tissue oxidation. There is a strong difference of opinion as to whether the pancreas helps glycogenesis, but the majority of opinion is that the pancreas has no such influence. On the other hand, the suprarenals and all organs which influence the sympathetic system directly or indirectly (like the anterior pituitary and thyroid) excite glycogenolysis and also promote tissue oxidation. In Claude Bernard's classic experiment, puncture of the 4th ventricle, the hyperglycæmia was due to stimulation of the sympathetic.

As is well known, the pancreas has two types of secretion, external and internal. It is also well established that these two secretions cannot be fully produced simultaneously ; if the external secretion is increased there is a corresponding diminution in the internal secretion. The internal secretion of the pancreas influences carbohydrate metabolism through a ferment which is antagonistic in action to the glycogenolytic ferment of the liver and other gly-

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cogen containing tissues. Therefore, with an increased external secretion which necessarily implies lessened internal secretion, the restraining influence—antiferment action—of the pancreas is taken off, and glycogenolysis goes on unhampered resulting in hyperglycæmia. There is an intimate relation between the amount of hydrochloric acid secreted by the stomach and the amount of external secretion of the pancreas. Increased hydrochloric acid secretion in the stomach will produce increased external secretion and proportionately lessened internal secretion and this will lead to hyperglycæmia.

It is also believed by many observers that hyperglycæmia and glycosuria associated with diseases of the suprarenal, thyroid, and pituitary—whatever the mechanism of such glycosuria be—produce pathological changes in the pancreas. The pancreas, as stated above, will all along try through the restraining influence on glycogenolysis, to prevent any condition of hyperglycæmia in whatever manner it is produced, by increased internal secretion. Such hypersecretion of these ductless glands continued for a long period of time, produces fatigue of the pancreas and eventually to permanent defects causing histological changes in the pancreas and the islets as are found in a case of confirmed hyperglycæmia. In such cases, the islets are found sclerosed and destroyed.

Any condition of the stomach, like hyperchlorhydria, any fault in the diet like alcohol habit or the habit of taking excess of sugar, overwork, anxiety and worry, catarrhal condition of the gastro-intestinal tract, septic teeth and tonsils causing changes in the intestinal flora might, by excessive formation of secretion of hydrochloric acid and by increasing external secretion of the pancreas, diminish the internal secretion and will tend to produce hyperglycæmia. The same results will follow if the pancreas owing to congenital defect or defects or through overwork loses its internal secretion.

If we imagine a condition where the internal secretion of the pancreas is totally abolished, then the glycogenolytic ferments of the liver and other tissues will have full play, little or no glycogen will be stored in the liver and other tissues, all the carbohydrate will pass into the circulation as sugar; if, however, the control is only partially impaired, glycogenesis and glycogenolysis will go on side by side but both will be imperfectly carried out, soluble intermediate bodies like dextrin and other polysaccharides will be circulating in the blood. Such a type of carbohydrate will not be available to the tissues for metabolic purposes until dextrin is hydrolysed into sugar.

Let me now consider the various theories that have been put forward from time to time to explain the metabolic disease—diabetes mellitus. Claude Bernard originally suggested two possible causes of diabetes:

(1) Excessive production of sugar from the storage in liver (over-production theory),

(2) inability of the extrahepatic tissue to utilise sugar (under-utilisation theory).

More recently McLeod has suggested that the cause of diabetes is uncontrolled hepatic gluco-neogenesis *i.e.*, in all cases of diabetes there is excessive formation of sugar from non-carbohydrate sources (proteins and fats) along with non-utilisation of sugar by tissues. Although the level of blood sugar may be due to the adjustment of the processes of sugar formation and utilisation, it is just possible that in diabetes, with an aberrant sugar metabolism, the blood sugar level is shifted to a pitch much higher than normal.

The theories mentioned above were based on the assumption that ordinarily the constant blood sugar level is maintained by an adjustment between the amount of sugar that reaches the blood either from the liver by glycogenolysis or from fats and proteids by the process known as gluco-neo-genesis and the amount of sugar utilised by the tissues. If the controlling influence of insulin is lost then glycogenolysis goes on unchecked. If the pituitary body and suprarenals are stimulated glycogenolysis and tissue oxidation are increased. In diabetes, it is suggested that this adjustment between sugar production and sugar utilisation is lost and then either the increased blood sugar is produced or the tissue oxidation becomes less.

But the question still remains—what is it which diminishes the internal secretion of the pancreas or stimulates the sympathetic system?

In 1923, Dr. Mukherjee and myself reported that in practically every demonstrable case of diabetes, while the urine shows no abnormal constituents indicating acidosis, the R.P.H. value is below 8·45 (the normal value); the value some time going down

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to 7·65 (in a case of diabetic coma). In all such cases, there is usually hyperglycæmia, the value varying between 16 per cent to 5 per cent. Let me give you a picture of the metabolic processes in the diabetic as I conceive them. Owing to faulty over-eating, nervous excitement, worry, dyspepsia (with hyperchlorhydria), infection of gastro-intestinal or biliary tracts, we may have hyperchlorhydria and resulting acidosis and hyperglycæmia. Under such circumstances, the acidosis as I have explained above, alters the balance between glycogenesis and glycogenolysis and abnormal products of glycogen destruction, dextrin and other polysaccharides, appear in the blood which, therefore, cannot be utilised by the tissues. If the cause which brought about acidosis persists, the acidosis continues ; this leads ultimately to fatigue of the islets of Langerhans. As the pancreas owing to lessened insulin production loses its controlling influence over glycogenolysis, sugar of abnormal types continues to be produced in the blood ; the tissues, though bathed in blood containing higher percentage of sugar, cannot utilise it ; the adrenals are stimulated and promote further destruction of glycogen into sugar and thus a vicious circle is established. When the glycogen reservoirs are emptied, perhaps even before that, abnormal sugars are produced from the destruction of fats and proteids. The metabolism of fats under such conditions of non-combustion of sugar is incomplete ; abnormal bodies like the oxybutyric acid appear in the urine.

I have said above that the tissues in diabetes do not utilise the sugars produced under such circumstances. It was at one time suggested that they have lost their faculty of oxidising sugar altogether. In our communication to the press in 1935 and 1939 we gave it as our experience that a diabetic is able to utilise sugar given intravenously in the form of glucose in large quantities, say 200 c.c. of 25 per cent i.e., about 50 gramme of glucose a day without permanently increasing the blood sugar ; in fact, our experience has been, as the charts will show, that the sugar level is lowered and even reaches the normal values and concomitant glycosuria disappears. I have here several charts to prove this point (*vide* charts). Therefore, the tissues have not lost their power of oxidation. And further, in the majority of cases, with suitable dietetic regimen, the pancreas regains its normal function. Of course, the initial causes of acidosis, the hyperchlorhydria, the worry, the nervous excitement, the overfeeding, should all be corrected or else the vicious circle will start again.

Let me now put the facts I have presented above in seriatim and place before you my answer to the question—"What is diabetes due to?" Various organs of the body exercise their influences on the carbohydrate metabolism. It is safe to assume that the rate of removal of sugar from the blood is dictated and directed in some way through nervous system perhaps—by the needs of the organism ; fluctuation in sugar concentration in the blood being compensated for by the variation in the rate of output. The fluctuation in sugar level and the compensatory mechanism are governed by the following factors:

(1) *Acidosis*—This is the essential element in the production of diabetes. In our experiments we proved that the acidity of blood

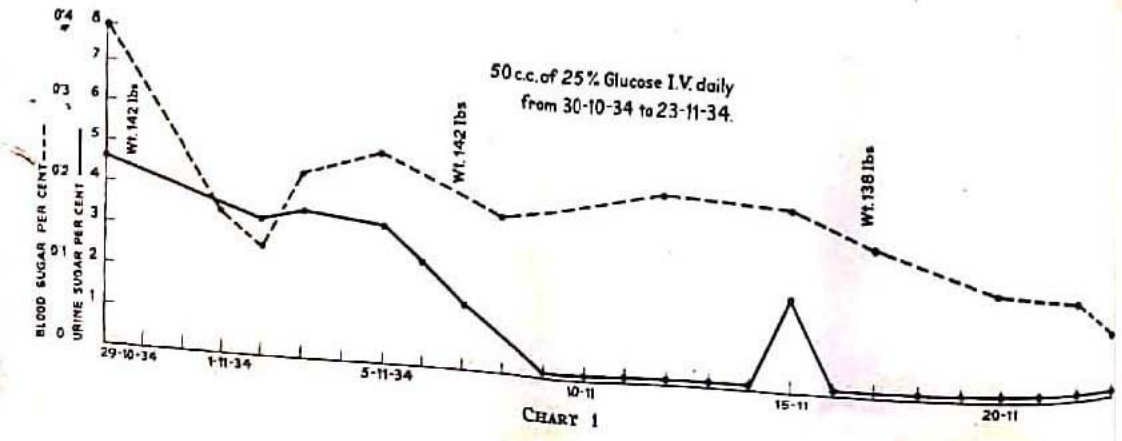

CHART 1

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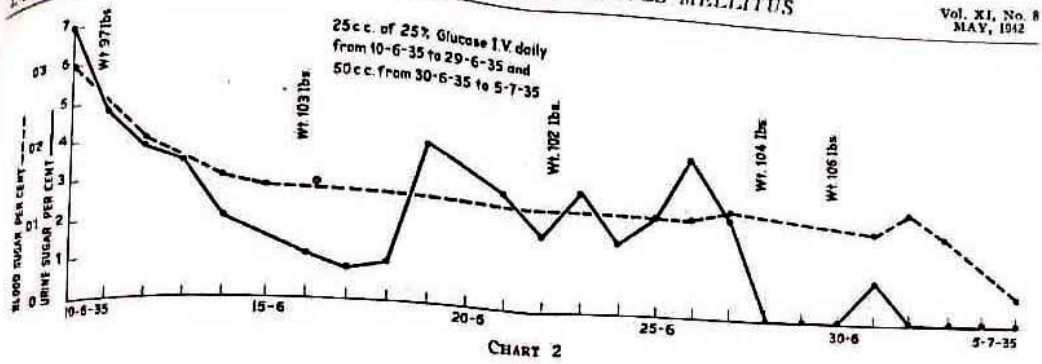

CHART 2

in the diabetic becomes high, at a much earlier stage than the appearance of abnormal substances in the urine indicating ketosis. As this acidosis sets in, insulin secretion is diminished, glycogenolysis follows.

(2) *Hyperglycæmia*—In diabetes, the excess of blood sugar is a physiological attempt on

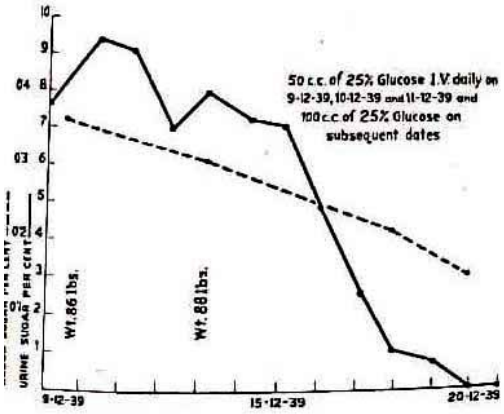

CHART 3

the part of nature to neutralise acidosis. It is an active phenomenon. The difficulty lies in the fact that the sugar is presented to the tissues in a form which they cannot utilise—their call for more is partially satisfied by glyco-neo-genesis, by abnormal breaking down of fats and proteids to produce sugar. Such abnormal fat and proteid metabolism results in the accumulation in the system of β-oxybutyric acids etc. (products of their incomplete combustion) and there is increase of acidosis. This acidosis increases hyperglycæmia. A vicious circle is, therefore, established.

(3) *Tissue metabolism*—It has been suggested that in diabetes tissue oxidation is deficient. But our experiments proved conclusively that the tissues of a diabetic could oxidise sugars if present in a suitable form. If large quantities of glucose are injected into the veins and utilised by tissues the call for sugar will be lessened, the abnormal production of sugars from proteids and fats—the gluco-neo-genesis—is also lessened in a marked degree.

In treating diabetes, therefore, the rule I follow is this—

(1) I put the patient on water only for four days and note the amounts of blood and urine

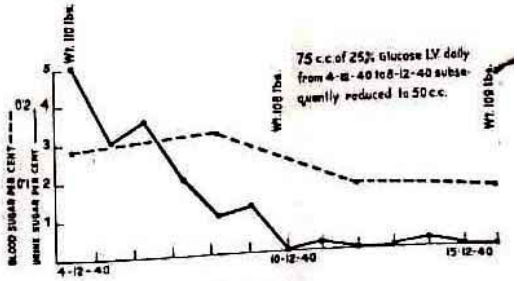

CHART 4

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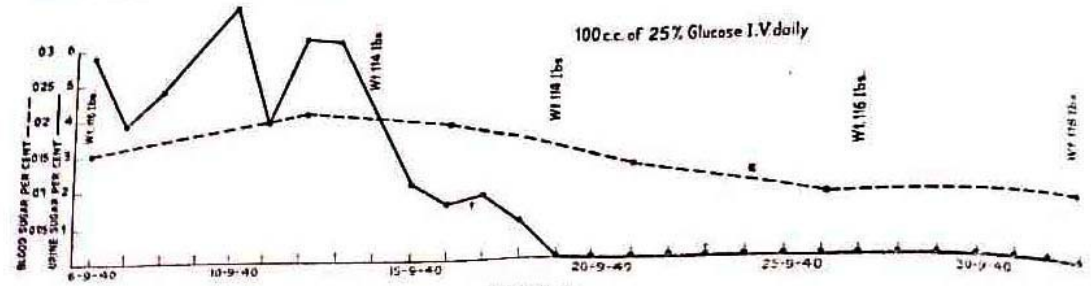

CHART 5

sugar before and after this period. If necessary, I give him a little soda bicarb in order to minimise the chances of aceto-nuria after fasting.

(2) In many early cases, this period of fasting sets the machinery in good working order. The blood sugar level falls to normal, the urine sugar disappears. Then the patient is allowed for 6 days 400-500 calories of food, with 35 per cent of proteids, 25 per cent of fats and 40 per cent of carbohydrates. If everything goes on normally, the food is gradually increased in caloric value keeping as far as possible to the above proportion of proximate principles until he is given 1500 to 1800 calories and he is allowed to remain on this for 4 to 6 months.

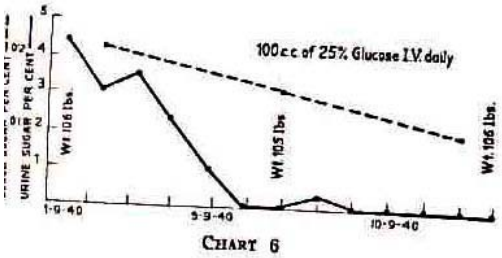

CHART 6

(3) If, however, with the preliminary four days treatment it does not reduce blood sugar to normal and if the urinary sugar persists, then I give him daily for a fortnight, while at rest in bed, 100-200 c.c. of glucose 25 per cent to 50 per cent intravenously. Usually I allow him some food, more of a starchy type which fills the stomach but does not interfere with metabolism. If the diet be so restricted, the external secretion of the pancreas is lessened, and, as I have indicated above, the internal secretion is correspondingly increased in amount, which thereby controls glycogenolysis. In my experience, the injection of glucose for 2 to 6 weeks will restore the system to normal. If the original troubles causing acidosis, the hyperchlorhydria, the worry and excitement etc., be removed, one need not fear relapses. Glucose by the mouth does not serve the purpose, because so long as the pancreas is at all functioning, this means imperfect glycogenesis and glycogenolysis; the abnormal sugars then released to the tissues cannot be utilised.

(4) I use insulin only if I am forced to. When there is an infection or the pancreas refuses to take up its normal role, then a help in the shape of insulin—a stick for an old man—is necessary.

This then is my view of the disease and the line of treatment that in my opinion is rational and satisfactory.*

* Presidential Address delivered at the Section of Medicine, Scientific Session, XVIII All-India Medical Conference, Hyderabad-Deccan, December, 1941.

Commentary

Legendary Prof BC Roy in December 1941 delivered his Presidential Address at the 58 th All India Medical Conferance in Hyderabad -Deccan on Newer Ideas on Diabetes Mellitus which was published in JIMA May 1942 issue . Today as we near a centenary of discovery of Insulin (we are in the 99th year) many of Prof BC Roy's ideas are relevant today .He first noticed in his state Bengal Diabetes was a diseases linked to social status and today we know it's link with affluence and we often link it with affluenza and modernisation .In 1941 he predicted that westernisation of habits and culture will lead to wild spread occurrence of the disease which is prophetic because we went on to become the diabetes capital of the world . It was only in 2011 we lost the first rank to China and now we aim to be the Diabetes care capital of the world .Dr BC Roy clearly describes the rural urban divide as well as the familial penetrance of the disease .He clearly predicted how type 2 Diabetes runs in families as well as its polygenic nature which form the major bulk of the burden today.He postulated then the endocrine and metabolic cross talk and it's link even to Uric acid then. He described the classic experiments of Claude Bernard of the puncture of the fourth ventricle leading to glycosuria. He described diabetes seen with endocrine disorders like acromegaly and went on to distinguish pancreatic and non pancreatic variants of diabetes. He elegantly described the pathophysiology of the intermediate steps of metabolism linked to food and blood glucose regulation and gave a detail analysis of the carbohydrates breakdown which occurs in energy homeostasis. The treatise contains experimental work done form 1900s in those four decades in animals and humans how glucose was controlled. With ensuing hyperglycaemia and as glucose rises it switched the acid base imbalance which he does in his own descriptive style where he lays the foundation of acidosis which occurs in diabetes .He then describes the toe theory concept of Claude Bernard for diabetes namely the excess hepatic glucose output (the sugar over production theory from liver) and inability of the extra hepatic tissue to utilise glucose (under utilisation theory).

Prof BC Roy then describes his own work with Dr Mukherjee each of the diabetes glycosuric cases has some degree of acidosis and described various biological mechanisms involved.There is a description of a triad of acidosis , hyperglycaemia and tissue metabolism.In 1940s Prof BC Roy describes the treatment of diabetes starting from pure hydrotherapy with water with some times little sodabicarb to reduce the ketosis for four days. Simple fasting in early cases normalised glucose and the cases are allowed 6 days of 400 to 500 calories with 35 percent proteins,25 percent fats and 40 percent carbohydrates with a gradual resumption of normal food group components and calories over next 6 months .Today we know from the various work done last decade by Roy Taylor's group from various studies till the randomised DIRECT trial on diabetes reversal ,actually Dr BC Roy and his group had described it in early 1940s of very low caloric diets. Even then Insulin was only reserved for infection or lack of pancreatic insulin secretion. His personalised views has rationality then and possibly deep relevance even today.

In the fast paced evidence based world there is hardly any role of descriptive narratives yet look at the vision eight decades back BC Roy has insights into protocols like reversal of diabetes to Insulin .He has deep knowledge of physiology and pathology of the disease process and the cross organ talks of pancreas, liver ,muscle and fat. He underlines role of glucose in urine which we now therapeutically exploit with SGLT2 inhibitors.He illustrated they role of hepatic glucose production and we know know most modern age diabetes medication including metformin turn of the liver glucose tap overnight to control fasting blood glucose. Prof Roy has clear idea of role of water and sodabicarb apart from insulin in managing acidosis and emergency of diabetes. Clinical medicine is built it's foundations from bench side experiments in animals to astute clinical observations systematically recorded.

Dr BC Roy's masterpiece treatise gives us glimpses how he predicted the diabetes epidemic due to westernised habits as well as its natural history including treatment protocols prevalent then with principles which are even applicable today.

India today has the second largest population as well as people living with diabetes .Currently we have approximately eighty million Indians with diabetes and possibly an equal of larger number with prediabetes. Its rapid adaptation of westernised habits,culture and lifestyle which prof BC Roy predicted in 1941 which has lead to this epidemic.We all aim to become the Diabetes care capital of the world .my prevention mantra draws inspiration from the legendary prof BC Roy "Eat Less,Eat on time,Eatright,WalkMore,Sleep well &on time and Smile."

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