MODERN MEDICINE AND TRADITIONAL CHINESE MEDICINE

DIABETES MELLITUS

(PART ONE)

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1. Background

There is nothing new about diabetes; it has been a medical problem since antiquity. The name which was originated by Aretaeus (30-90 CE) came from the Greek words meaning 'siphon' and 'to run through', signifying the chronic excretion of an excessive volume of urine.

Diabetes mellitus, because of its frequency, is probably the single most important metabolic disease and is widely recognized as one of the leading causes of death and disability in the United States. It affects every cell in the body and the essential biochemical processes that go on there.

Diabetes has been linked to the western lifestyle, as it is uncommon in cultures consuming a more primitive diet. As cultures switch from their native diets to more commercial foods, their rate of diabetes increases, eventually reaching the same proportions seen in western societies.

A great deal of research has been conducted into the possible aetiology of diabetes. Most of the prevalent ideas can be classified under one of the following categories: heredity, endocrine imbalance, dietary indiscretion and obesity, sequelae of infection, and severe and continued psychic stress.

Although genetic factors appear important in determining susceptibility to diabetes, environmental and dietary factors are also important in its development and many have been identified. A diet high in refined fibre-depleted carbohydrate is believed to be the causative factor in many individuals, while a high intake of high-fibre complex carbohydrate foods is protective against diabetes.

Obesity appears to be a significant factor, particularly considering the fact that 90% of Type 2 (see below) sufferers are obese. Even in normal individuals, significant weight gain results in carbohydrate intolerance, higher insulin levels and insulin insensitivity in the fat and muscle tissue. The progressive development of insulin insensitivity is believed to be the main underlying factor in Type 2 diabetes. Weight loss can correct all of these abnormalities in many instances and significantly improves the metabolic disturbance of diabetes in most cases.

What has become apparent through years of research is that the diabetic condition is not simply a matter of one or two things having gone wrong. It is a complex condition with a multitude of metabolic imbalances. Consequently, the conventional medical approach of simply using insulin or oral drugs to treat diabetes is incomplete and the person relying on them to prevent long-term complications remains at risk.

About Blood Sugar

Carbohydrate is the active fuel of the body and is ordinarily the main source of energy of the tissue cell. In the normal digestive process, food sugars and starches (carbohydrates) are changed into sugar glucose. This is stored in the form of glycogen (animal starch) in the liver and muscles for later use as a body fuel, at which time it is reconverted into glucose. Blood sugar rises somewhat after eating, and in healthy individuals returns to normal levels in about an hour or two. The amount of glucose in the blood is controlled mainly by the hormones insulin and glucagon. Too much or too little of these hormones (or if they are somehow ineffective) can cause blood sugar levels to fall too low (hypoglycaemia) or rise too high (hyperglycaemia). Other hormones that influence blood sugar levels are cortisol, growth hormone and catecholamines (epinephrine and norepinephrine).

The pancreas, a gland in the upper abdomen is responsible for producing insulin and glucagon. The pancreas is dotted with hormone-producing tissue called the islets of Langerhans, which contain alpha and beta cells. When blood sugar rises after a meal, the beta cells release insulin. The insulin helps glucose enter body cells, lowering blood glucose levels to the normal range. When blood sugar drops too low however, the alpha cells secrete glucagon. This signals the liver to release stored glycogen and change it back to glucose, raising blood sugar levels to the normal range. The result of the disturbed metabolism of glucose causes an abnormal accumulation of sugar in the blood stream and the diabetic condition.

Blood Sugar Ranges

The quantity of glucose in the blood seldom exceeds 160 milligrams/decilitre (mg/dl) of blood shortly after food sugar has been absorbed, nor seldom falls below 60 mg/dl during fasting. This increases about 2 mg/dl per decade after age 30. Some mild diabetics will have normal fasting blood sugar values and values in the diabetic range only

after meals. Occasionally very mild cases will have values within normal at both times and the diabetic tendency will be evident only when these persons are required to handle more than an ordinary amount of carbohydrate.

In the fasting state, blood sugar can occasionally fall below 60 mg/dl and even to below 50 mg/dl and not indicate a serious abnormality or disease. This can be seen in healthy women, particularly after prolonged fasting. Blood sugar levels below 45 mg/dl in a woman or 55 mg/dl or less in a man indicate a strong possibility of hypoglycaemia.

Higher-than-normal blood sugar levels, for example 140 mg/dl or higher after an overnight fast, can indicate diabetes mellitus. In moderately severe diabetes, after-meal values of 250-350 mg/dl are not unusual. If a person with diabetes develops hyperglycaemia and it is left untreated, the result can lead to coma or death.

Diabetes is characterised by three well-known syndromes, polydipsia (excessive thirst), polyphagia (excessive hunger) and polyuria (excessive urination). Laboratory findings reveal high blood sugar and glucose in the urine and as the metabolic derangement worsens, excessive ketone bodies in the blood and urine. The accumulation of these produces acidosis which, if not counteracted, can result in coma and death.

There are three main types of diabetes:

- Type 1 or 'Insulin-Dependent Diabetes Mellitus' (IDDM) also known as 'Juvenile Onset Diabetes'.
- Type 2 or 'Noninsulin-Dependent Diabetes Mellitus' (NIDDM) also known as 'Adult Onset Diabetes'.
- Gestational diabetes.

Type 1 Diabetes (Insulin-Dependent Diabetes Mellitus/IDDM)

Insulin-dependent diabetes is considered an autoimmune disease in which the immune system attacks the insulin-producing beta cells in the pancreas and destroys them. The pancreas produces little or no insulin and it is then almost certain that life-long insulin replacement will be necessary. The exact mechanism for the body's immune system attack to the beta cells is unknown but the most likely causes are viral infection, genetic factors and free radicals.

Interest has been generated lately in the strong evidence linking exposure to a protein in cow's milk (bovine albumin peptide) in infancy to the autoimmune response and subsequent Type 1 diabetes. In detailed studies[1] it was shown that patients with Type 1 diabetes were more likely to have been breast-fed for less than three months and to have been exposed to cow's milk or solid foods before the age of four months. Since the cow's milk protein can enter the mother's breast milk, in cases of family history of diabetes it is recommended that the mother avoid cow's milk while breast-feeding.

IDDM accounts for about 5 to 10 percent of diagnosed diabetes in the USA and develops most often in children and young adults, but the disorder can appear at any age. Symptoms usually develop over a short period, although beta cell destruction can begin months, even years, earlier.

Over time both Type 1 and Type 2 diabetes are accompanied by many severe complications, such as blindness, renal failure, lower- limb amputations, cardiovascular disease and stroke. For those with Type 1 diabetes the object is not to find a way to get off insulin but rather to prevent the long-term complications. It is encouraging to note that modern research has demonstrated the amount of insulin required could be reduced through appropriate life style modifications and the likelihood of consequent complications significantly lowered.

Type 2 Diabetes (Noninsulin-Dependent Diabetes Mellitus/NIDDM)

The most common form of diabetes is noninsulin-dependent diabetes. About 90 to 95 percent of people with diabetes have Type 2. In the USA more than 16 million people, over 7% of the adult population, have Type 2 with 600,000 new cases diagnosed each year. In many patients, the initial diagnosis of Type 2 diabetes is delayed perhaps by as much as 10 years because symptoms are often absent or very mild during its early stages.

Type 2 diabetes usually develops in adults over the age of 40 and is most common among adults over age 55. It is particularly common among the elderly and in many minority populations, including African Americans, Hispanic Americans, American Indians and Asian and Pacific Islander Americans, in whom it may occur in 10–50% of adults.

Type 2 diabetics typically have elevated levels of insulin, often producing two to three times the normal amount. Rather than an insulin deficiency condition it is an "insulin resistance" condition whereby the body loses its ability to properly respond to the signals given by insulin. We now know that excess insulin brought on by insulin resistance is not only associated with elevated blood sugar levels, but also with high blood pressure and increased rates of atherosclerosis.

In the treatment of Type 2 diabetes, dietary modification has been found to be of primary importance and should be diligently followed before using drug intervention since most cases can be controlled by diet alone. For all Type 2 diabetics an effective treatment approach should employ a broad-based therapeutic regimen. Such a regimen would incorporate appropriate diet, prescribed exercise, stress reduction techniques and a substantial amount of specific nutritional supplements. If adequate control of blood sugar levels remains problematic, conventional treatment with insulin and oral agents can be initiated.

Gestational Diabetes

Gestational diabetes develops or is discovered during pregnancy. This type usually disappears when the pregnancy is over, but women who have had gestational diabetes have a greater risk of developing NIDDM later in their lives.

2. Presenting Symptoms

The clinical manifestations of diabetes in the order in which they usually appear are:

- frequent, copious urination
- excessive thirst
- rapid weight loss
- excessive hunger
- drowsiness, fatigue
- itching of the genitals and skin
- visual disturbances
- skin infections
- slow healing
- paraesthesia in the hands or feet

Other signs of diabetes include lingering influenza-like symptoms, loss of hair on the legs, increased facial hair, small yellow bumps anywhere on the body (known as xanthomas-cholesterol) and inflammation of the penile skin.

In most juvenile cases the earliest symptoms noted are increased urination, thirst and hunger. Other symptoms include irritability, nausea or vomiting, weakness and fatigue. Physical findings in the adult are mostly attributable to complications, and the first sign of the disease may be some dermatological, circulatory, neurological or visual complications.

3. Laboratory diagnosis

The laboratory diagnosis of diabetes depends on finding glucose in the urine together with an elevated blood sugar. The newest routine diagnostic test for diabetes is a fasting plasma glucose test rather than the previously preferred oral glucose tolerance test. A confirmed fasting plasma glucose value of greater than or equal to 126 mg/dl indicates a diagnosis of diabetes.

In certain clinical circumstances physicians may still choose to perform the more difficult and costly oral glucose tolerance test. When a doctor chooses to perform this test a confirmed glucose value of greater than or equal to 200 mg/dl indicates a diagnosis of diabetes. According to World Health Organisation standards an oral glucose tolerance test is performed by administering 75 grams of anhydrous glucose dissolved in water and then measuring the plasma glucose concentration 2 hours later.

Monitoring the Diabetic Patient

There appears to be a strong relationship between blood sugar levels and the development of the complications of diabetes. Specifically, when blood sugar levels are chronically elevated, the risk of complications is very high. To reduce the risk of developing complications it is important to control elevations in blood sugar by careful monitoring. The availability of home glucose monitoring kits makes this easier now than in the past.

4. Complications or Sequelae of Diabetes

Sometimes a complication of diabetes may give a clue to the presence of the disease. The principle complications or sequelae associated with diabetes are retinopathy, neuropathy, nephropathy and arteriosclerosis. Whether these are the unavoidable consequences of the diabetic state over time or whether they may be influenced by controlling the diabetes through aggressive monitoring, treatment and life-style management, including diet and supplements, remains a central topic.

One of the largest, most comprehensive diabetes studies conducted to date[2] showed that keeping blood sugar levels as close to normal as possible through aggressive management slows the onset and progression of eye, kidney and nerve diseases caused by diabetes. In fact it demonstrated that any sustained lowering of blood sugar helps, even if the person has a history of poor control.

Specifically it found that lowering and maintaining more constant blood sugar levels reduced the risk of eye disease by 76%, kidney disease by 50%, nerve disease by 60% and cardiovascular disease by 35%.

Since the discovery of insulin nearly 70 years ago, the patterns of morbidity from diabetes have changed. Where the major causes of death were ketoacidosis and infection, they are now the microvascular and cardiovascular complications of diabetes (renal failure and myocardial infarction). These complications are responsible for a reduction in the life expectancy of a newly diagnosed insulin dependent diabetic by about one-third. The basis of managing diabetes in the 90's is an improvement in the life-style of the diabetic and prevention of complications responsible for morbidity and mortality in diabetes.

Neuropathy (nerve disease)

Diabetic neuropathies are among the most frequent complication of long-term diabetes. It is estimated that 60% to 70% of diabetics have mild to severe forms of nervous system damage. The femoral nerve is commonly involved giving rise to symptoms in the legs and feet. Pain is the chief symptom and tends to worsen at night when the person is at rest. It is usually relieved by activity and aggravated by cold. Paraesthesias are a common accompaniment of the pain. Cramping, tenderness and muscle weakness also occur but atrophy is rare. Advanced femoral nerve disease is a major contributing cause of lower extremity amputations.

Nerves in the arms, abdomen and back may also be affected. Symptoms may include impaired heart function, slowed digestion, reduced or absent perspiration, severe oedema, carpal tunnel syndrome, alternating bouts of diarrhoea and constipation, bladder atony, urinary and faecal incontinence and impotence.

With respect to sexual impotence, diabetes is probably the single most common disease associated with erectile failure (termed neurogenic impotence in the diabetic). Since diabetes is a metabolic disease with vascular and nervous system complications and an erection involves all levels of the nervous system from the brain to the peripheral nerves, lesions anywhere along the path may be responsible for

erectile failure. It has been estimated that close to 50% of diabetic males have some degree of erectile dysfunction.

Neuropathies usually improve with the control of the diabetes. Severe or chronic changes may require several weeks or months to show maximum improvement.

Retinopathy (eye disease)

Changes occurring in the eye which are distinctive of diabetes involve the narrowing, hardening, bulging, haemorrhaging or severing of the veins and capillaries of the retina. This is a serious complication known as retinopathy and may lead to loss of vision. Visual changes in the earlier stages may include diminished vision, contraction of the visual field, changes in the size of objects or photophobia. In the more advanced stage, termed 'proliferative retinopathy', haemorrhages, retinal detachment and other serious forms of deterioration are observed. When the disease progresses to this late stage total blindness may occur.

It usually takes between 10-13 years for diabetic retinopathy to develop and it is present in some degree in most diabetics who have had the disease for 20 years. In only about half of the diabetics who develop it however, is vision markedly impaired and blindness occurs in only about 6%. Still, diabetes is the leading cause of blindness in adults 20 to 74 years old and is estimated to cause from 12,000 to 24,000 new cases each year. Two other complications of diabetes, cataracts and glaucoma, can also lead to loss of vision

The development of laser therapy will probably reduce the prevalence of diabetes-induced blindness, however this therapy is not without occasional side effects (haemorrhage, retinal detachment and loss of visual field) and is therefore indicated only for the more serious conditions.

Arteriosclerosis (vessel disease)

The diabetic state is associated with earlier and more severe vascular changes than normally occur at a given age. Cardiovascular-renal disease is the leading cause of death among diabetics. Atherosclerosis can be accurately described as the end stage of Type 1 and Type 2 diabetes, since the vast majority of diabetes patients will die from an atherosclerotic event. Most commonly these events are cardiovascular in nature (an estimated 60% to 65% of diabetics have high blood pressure) although 20-25% of atherosclerotic events may be cerebrovascular or microvascular. The incidence of coronary occlusion in persons with clinical diabetes has been estimated at from 8-17% with diabetic adults having heart disease death rates about 2 to 4 times as high as the general population. The risk of stroke is also found to be 2 to 4 times higher in people with diabetes.

Arteriosclerosis obliterans in the lower extremities, a form of peripheral vascular disease, may produce disturbances in sensation, decrease in muscular endurance, intermittent claudication on effort, absence of peripheral pulses in the lower legs and feet and gangrene, and ultimately lead to amputation of the extremity. Diabetic gangrene usually involves the toes, heels or other prominent parts of the feet and is precipitated by trauma, infection or extremes in temperature. Needless to say, careful attention to proper foot care, avoidance of injury and consistent use of methods to improve peripheral circulation, including withdrawal from tobacco use in any form, are critical for the diabetic.

The aetiology of large vessel disease is multi-factorial in the diabetic as well as the non-diabetic population with lipoprotein metabolism, hypertension, physical activity, obesity, cigarette smoking, stress, personality and genetic and racial factors all playing a part.

Nephropathy (kidney disease)

Nephropathy is a common and important accompaniment of diabetes and one that in young diabetics takes precedence over heart disease as a cause of illness and death. As with eye changes, there is a wide variation in the type and degree of renal damage. Nephropathy is less frequent than retinopathy and where it occurs is also a development of long standing diabetes. Nevertheless, diabetes is the leading cause of end-stage renal disease in the US, accounting for about 40% of new cases. In 1995, a total of 98,872 people with diabetes underwent dialysis or kidney transplantation and 27,851 developed end-stage renal disease.

One study[3] reported that among 200 juvenile diabetics who survived 20 years after onset, one half had evidence of renal disease. Another study found that the majority of these patients have hypertension and two thirds show significant albuminuria, but the fully developed nephrotic syndrome of hypertension, proteinuria and oedema occurs in less than 10% and renal function is impaired in only one half to three quarters of those patients.

Like other long-term complications, good blood glucose control goes a long way towards reducing the risk of diabetic nephropathy. In addition to monitoring the blood sugar levels, periodic monitoring of a diabetic patient's kidney function (blood urea nitrogen, uric acid, creatinine and creatinine clearance) is important.

Hypoglycaemia

If there is too much insulin in the body compared to the amount of blood sugar, and the blood sugar falls below normal levels, a condition known as hypoglycaemia occurs. This problem of hypoglycaemia due to insulin or oral hypoglycaemic drugs is much more common in Type 1 than Type 2 diabetes since the Type 1 diabetic is directly injecting insulin. If too much insulin is administered, or the person misses a meal or over-exercises, hypoglycaemia may result. In this condition, commonly referred to as insulin shock, the brain is deprived of an essential energy source. The first sign is mild hunger, quickly followed by dizziness, sweating, palpitations, mental confusion and eventual loss of consciousness. Before the condition reaches emergency proportions, most diabetics learn to counteract the symptoms by eating a sweet or drinking a glass of orange juice. In some cases, the only effective measure is an intravenous injection of glucose.

Digestive Disorders
Based on the 1989 US National Health Interview Survey, diabetics are more likely than the general population to report a number of digestive conditions, including ulcers, diverticulitis, symptoms of irritable bowel syndrome, abdominal pain, constipation, diarrhoea and gallstones.

Oral Complications
Periodontal disease, which can lead to tooth loss, occurs with greater frequency and severity among diabetics. Periodontal disease has been reported to occur among 30% of people aged 19 years or older with Type1 diabetes.

Infections
Studies in clinic, community and hospital populations indicate that diabetic subjects have a higher risk of some infections, including asymptomatic bacteriuria, lower extremity infections, re-activation tuberculosis, infections in surgical wounds and group B streptococcal infection. Population-based data suggest a probable higher mortality from influenza and pneumonia.

Complications of Pregnancy
The rate of major congenital malformations in babies born to women with pre-existing diabetes varies from 0% to 5% among women who receive preconception care, to 10% among women who do not receive preconception care. Between 3% to 5% of pregnancies among women with diabetes result in death of the new-born; the rate for women who do not have diabetes is 1.5%[4].

Ketoacidosis
Another acute complication more likely to occur in the IDDM is ketoacidosis, a condition caused by a lack of insulin leading to a build-up of ketoacids. Chemical compounds called ketones are one of the natural by-products of fat metabolism. Excessive ketone bodies are formed by the biochemical imbalance in uncontrolled or poorly managed diabetes. The condition known as diabetic ketoacidosis can directly cause an acute life-threatening event, a diabetic coma.

The possibility of ketoacidosis is suggested by:
- Confusion or coma, the patient almost always appearing extremely ill.
- Air hunger - an attempt to compensate for metabolic acidosis.
- Acetone odour (fruity) invariably on the breath.
- Nausea and vomiting almost always present.
- Abdominal tenderness which may mimic viral gastroenteritis.
- Extreme thirst and dry mucous membranes.
- Diabetic history (present in about 90% of cases).
- Weight loss.

Before the discovery of proper treatment by insulin and other intravenous injections, acidosis was the chief cause of death among diabetics. Today diabetics can use a simple urine dipstick at home to measure the level of ketones (excreted ketoacids) in the urine.

5. Conventional Medical Treatment

Insulin was the first, and remains the primary means of treatment for Type 1 diabetes and is administered by subcutaneous injection. This method is necessary since insulin is destroyed by gastric stomach secretions when it is taken by mouth. Insulin injections must be balanced with meals and daily activities, and glucose levels must be closely monitored through frequent blood sugar testing. Many diabetics need inject insulin only once a day; others require two or more injections. The usual time for a dose of insulin is before breakfast. The dosage is initially established according to the severity of the condition, but it often has to be reassessed as one or another of the variables in the person's condition changes.

During the past several years a large number of different classes of drug therapies for patients with both Type 1 and Type 2 diabetes have been developed. The concept of genetic re-engineering of insulins to produce insulin analogs (synthetic insulin) with improved properties has enhanced the ability to affect glycaemic control with fewer adverse reactions. For Type 2 patients, the number of orally active antidiabetic agents has increased from one class of agents (the sulfonylureas - sulfa drugs) to the current total of four classes of agents. The three new classes include agents of potentially even greater glycaemic efficacy, such as Biguanide 'Metformin'; agents directly improving the underlying insulin resistance of Type 2 diabetes, specifically thiazolidinediones such as 'Troglitazone'; and finally agents that alter the rate of hydrolysis and absorption of oligosaccharides, such as the alpha-glucosidase inhibitor 'Acarbose'.

The sulfonylureas as a group have proven to be not very effective. After three months of continual treatment at an adequate dosage, only about sixty percent of Type 2 diabetics are able to control blood sugar levels using these drugs. Furthermore these agents generally lose their effectiveness over time. After an initial period of success they fail to produce a positive effect in about thirty- percent of the cases at best.

In addition to being of limited value, there is evidence that the sulfonylureas actually produce harmful long-term effects. Tolbutamide has been reported to be associated with increased cardiovascular mortality. Other major side effects of the sulfonylureas are hypoglycaemia, allergic skin reactions, headache, fatigue, nausea, vomiting and liver damage. Common examples of sulfonylureas include Chlorpropamide (Diabinese), Glipizide (Glucotrol), Tolazamide (Tolinase) and Tolbutamide (Orinase).

Metformin has been used in the management of Type 2 diabetes in more than 90 countries for over 30 years. It was approved for use in diabetes patients in the United States in 1995. Metformin reduces the excessive hepatic glucose production that characterizes Type 2 diabetes. With reduced

hyperglycaemia, glucose uptake by peripheral tissues is enhanced while insulin levels remain stable or decline. Metformin also lowers elevated cholesterol and lipids, particularly the serum levels of triglycerides. Frequency of adverse effects is low at the doses needed to obtain the desired metabolic effect.

Troglitazone is a member of a new class of drugs that are 'insulin sensitizers'. It was selected on the basis of its effect to lower glycaemia without increasing insulin levels, its ability to improve lipid levels and absence of significant side effects or adverse events in short-term human studies.

The new generation oral drugs do have a specific and beneficial place particularly for patients who are on an appropriate diet and exercise program, have attained an optimal weight and are still unable to adequately control blood sugar levels. However with the increased number of oral antidiabetic agents soon to increase even further, the medical emphasis upon management of hyperglycaemia in Type 2 diabetes with these agents will likely increase. Realistically this is the easiest and least time-consuming response that can be made by practitioners to the impact of managed care plans. However to prescribe these agents alone and in combination for even minimal degrees of hyperglycaemia without an adequate trial of diet and exercise will only serve to accentuate the problem. For the non-insulin dependent diabetic, dietary and life style changes can often provide adequate remediation.

Medical Cost Attributed To Diabetes

Medical cost for persons with diabetes are higher because they visit physician's offices, hospital outpatient departments and emergency rooms more frequently than their non-diabetic counterparts and are more likely to be admitted to hospitals and nursing homes. One estimate of the total health-care expenditures for diabetes in the USA is approximately $100 billion per year in both direct and indirect costs, or about 12% of all health-care expenditures.

6. Nutritional Therapy

Meal Planning

A non-diabetic produces the constantly varying amounts of insulin necessary for obtaining energy from glucose. A diabetic cannot achieve this balance. Beyond the basic requirements to provide adequate calories and necessary nutrients, there are marked differences in diet strategy for the two major groups of diabetic patients: Type 1 insulin-dependent non-obese patients and Type 2 obese patients who do not require insulin. Patients who are on insulin therapy must schedule their meals to provide regular caloric intake. In overweight patients, special attention must be given to total caloric consumption.

There is no need to disproportionately restrict the intake of carbohydrates in the diet of most diabetic patients. In fact, Dr. H.P. Himsworth demonstrated in 1930 that if carbohydrates were taken out of the diet and replaced by either protein or fats, a person would quickly develop insulin resistance and diabetes[5]. The key here is in the choice of high-fibre complex carbohydrates.

One of the first dietary rules for all diabetics is to avoid all sugar and foods containing sugar, such as pastry, candy and soft drinks. While these refined sugars and other simple carbohydrates like white flour must be carefully watched, most diabetics are actually encouraged to eat more complex carbohydrates - the same bulky, fibre-rich unprocessed foods that are now recommended for everyone. Vegetables are ideal. For example, a diabetic can eat a large plate of spinach that contains as much carbohydrate as a tablespoonful of sugar, without suffering any ill effects.

Spinach, asparagus, broccoli, cabbage, string beans and celery are among the so-called "Food Exchange Group A" vegetables that the American Diabetes Association (ADA) says can be generously included in the diabetic diet. What makes these complex carbohydrates special is their ability to slow down the body's absorption of carbohydrates by helping to delay the emptying of the stomach and thereby smoothing out the absorption of sugars into the blood. Whole grain cereals also have this ability.

Fully one third of diabetic patients in clinical surveys have hyper-lipidemia, clearly indicating the need for dietary management. The most sensible approach is to limit the amount of fat in their diet and to substitute polyunsaturated fats for the saturated type when possible. Fish and poultry are especially recommended instead of fatty cuts of meat. Greasy, fried foods are strongly discouraged.

Obesity is much more likely in people who eat a high-fat diet, which is often a high calorie diet, since each gram of fat contains nine calories instead of the four calories in each gram of protein or carbohydrate. With obesity comes an increased risk of a variety of problems, not the least of which is adult-onset diabetes.

Overweight diabetics, by carefully calculating the proper daily calorie intake for their body weight and activity level, and never exceeding it, can usually bring their weight down to an optimal level - a level which is actually 10% less than the standard height and weight charts recommend. "The overweight diabetic who successfully brings their weight back to normal usually experiences a dramatic improvement in their condition. Indeed the symptoms often virtually disappear," says Charles Weller M.D. in his book *The New Way to Live with Diabetes*[6]. He goes on to state "Weight reduction and control can bring this incurable disease closer to complete remission than any medication."

The need to reduce fat is reflected in the standard diet and food exchange lists prepared by the ADA that restricts the intake of fat to 35% of calories. The reduction of saturated fats to one-third of the fat intake by substituting poultry, veal and fish for red meats, and the reduction of cholesterol to less than 300 mg/day are stressed. The carbohydrate content is 40-50 per cent of total calories, with unrefined carbohydrates recommended to the exclusion of refined and simple carbohydrates.

Currently another diet, known as the 'HCF (high-carbohydrate high plant-fibre) diet' popularised by James Anderson[7] has substantial support and validation in the scientific literature as the diet of choice in the treatment of diabetes. It is high in cereal grains, legumes and root vegetables and restricts simple sugar and fats. The calorie intake consists of 70-75 per cent complex carbohydrates, 15-20 per cent protein and only 5-10 per cent fat, and the total fibre content is almost 100 grams/day. The positive metabolic effects of the HCF diet are many: reduced after-mealtime hyperglycaemia and delayed hypoglycaemia; increased tissue sensitivity to insulin; reduced cholesterol and triglyceride levels with increased HDL-cholesterol levels; and progressive weight reduction.

In general the HCF diet is adequate for the treatment of diabetes. However improvements can be made, primarily by substituting more natural (primitive) foods wherever possible. The Modified HCF or MHCF diet recommends a higher intake of legumes, along with restrictions of several foods allowed on the HCF diet, namely processed grains, and excludes fruit juices, low fibre fruits, skimmed milk and margarine. It is noteworthy that if patients resume a conventional ADA diet, their insulin requirements return to prior levels.

Many diabetics have found it beneficial to eat smaller, more frequent meals, rather than the two or three big meals most people consume daily. Researchers have found that multiple frequent feedings tend to keep blood cholesterol levels lower, for the diabetic and non-diabetic alike.

Vitamins and Minerals

Generally a well-balanced diet rich in vitamins and minerals is one of the most important factors in the control of diabetes and prevention of diabetic complications. One reason for stressing the need for proper levels of nutrients is the excessive urination experienced by the diabetic.

Normally the body reabsorbs glucose and other water-soluble nutrients. When glucose rises to levels above 160-170mg/dl, as it does quite frequently in even well controlled diabetic patients, it acts as an osmotic diuretic. This process overwhelms the kidney's ability to reabsorb glucose and other water-soluble nutrients, thus the increased urination, and substantial losses of nutrients such as vitamins B-1, B-6 and B-12 and the minerals magnesium, zinc and chromium pass out along with the urine. Consequently diabetes and its complications are as much a result of nutritional wasting as of elevated blood sugar.

In an article in the *American Journal of Clinical Nutrition* where 247 studies were reviewed[8], it was found that Type 1 (IDDM) diabetics generally had deficiencies in zinc, calcium, magnesium and the more active form of vitamin D. Those with Type 2 diabetes (NIDDM) generally were found to be low in zinc and magnesium and often low in vitamins B6 and C.

The physical body needs all these water-soluble nutrients to maintain the integrity of its organ system. Perhaps one of the most important nutrients is magnesium. The medical literature is full of studies showing that diabetic patients invariably have lower blood levels of magnesium than normal, also with higher urinary losses. In a landmark study conducted in 1978 by Dr. P. McNair and titled *Hypomagnesemia, a Risk Factor in Diabetic Retinopathy*[9], it was demonstrated that diabetics with the lowest magnesium levels had the most severe retinopathy, and that low magnesium levels were linked significantly to retinopathy more than any other factor. The article argued that simply elevating the magnesium concentration with supplements would protect the eyes.

Other nutrients are also attracting serious attention. Researchers in London recently reported that vitamin D is essential for the islet cells in the pancreas to be able to secrete insulin properly[10]. Their studies have shown that individuals with the lowest vitamin D levels experienced the worst blood sugar-handling problems and had a greater risk of developing diabetes. They found that those with greatest risk of developing vitamin D deficiency included the elderly who were either institutionalised or stayed indoors, those living in climates where sunlight is scarce several months a year, and those with indoor sedentary jobs. In an effort to eliminate the widespread vitamin D deficiencies in the institutionalised elderly, over 80% of those individuals are now being given 800 IU/day vitamin D3 supplements.

Other researchers have found that the diabetic is unable to convert carotene into vitamin A. It is advisable therefore for the diabetic to ingest at least the recommended dietary allowance of vitamin A from a non-carotene source such as fish-liver oil. Diabetics and others on low-fat diets often need supplemental amounts of this fat-soluble nutrient. Also recommended is a vitamin E supplement, ranging from 400-1200 IU per day and a vitamin C supplement ranging from 1000-4000 mg per day to help prevent small-vessel disease of the extremities.

Brewer's yeast is another food supplement that is recommended for the diabetic patient. The yeast is a rich source of chromium-containing GTF (glucose tolerance factor) which is able to potentiate the insulin in our bodies. GTF also contains amino acids such as glutamic acid, glycine, and cysteine. Both brewer's yeast (9 gm/day) and trivalent chromium (150-1000 mcg/day) have been shown to significantly improve blood sugar metabolism when taken for several weeks to months. As a side benefit it has also been found that brewer's yeast and chromium supplementation lower elevated total cholesterol and total lipids, and significantly raise the levels of HDL-cholesterol, the beneficial or protective fraction of cholesterol.

Chromium is found in foods as both inorganic and organic salts. Brewer's yeast contains a form of chromium with high bioavailability, chromium–dinicotinic acid–glutathione complex. The bioavailability of chromium in liver, American cheese and wheat germ is also relatively high. Chromium is also available from a variety of sources including whole grains, potatoes and apples with skins, spinach, oysters,

List of daily nutrients that may be beneficial in the treatment of diabetes

Nutrient	Dose	Action
B1 (Thiamin)	10 mg	Decreases sensory neuropathy
B2 (Riboflavin)	10 mg	For skin ulcers and eye and digestive problems
B3 (Niacin)	Up to 100 mg	Positive effect on glucose tolerance
B5 (Pantothenic acid)	250-500 mg	Adrenal support (anti-stress)
B6 (Pyridoxine)	500-1000 mg	Normalises blood sugar, protects nerves
B12 (Cobalamin)	25 mcg min	Maintains normal nerve impulses
B15 (Pangamic acid)	50-100 mg	Antioxidant, helps atherosclerosis
Biotin	200-400 mcg	Enhances insulin sensitivity
Inositol	500 mg	Improves nerve function
Vitamin C	1000-4000 mg	Benefits eyes and nerves
Flavonoids (mixed)	1-2 gr	Promote insulin secretion, uptake of Vit. C
Vitamin D	400-800 IU	Essential for proper functioning of islets cells
Vitamin E	400-1200 IU	Improves glucose tolerance and insulin sensitivity
EFA-Omega 3	1 Tbs	Protection against hardening of arteries
EFA-Omega 6	400-600 mg	General anti-inflammatory properties
Calcium	1000 mg	Important in nerve transmission and pH bal
Chromium	150-200 mg	Improves glucose tolerance and insulin sensitivity
Magnesium	500 mg	Helps protect eyes
Manganese	30-50 mg	Cofactor involved in glycaemic control
Potassium	300 mg	Maintains insulin sensitivity, responsiveness, secretion
Zinc	100-150 mg	Improves synthesis, secretion, utilisation of insulin
Lecithin	3 Tbs	Benefits cell membranes, brain and nerves
Spirulina	3-6 gr	Stabilises blood sugar levels
Vanadyl Sulfate	100-150 mg	Mimics insulin and improves the cells' sensitivity to insulin

Note: Quantities shown are not prescriptive; some are very high and represent therapeutic test dosages. Individual needs and tolerances will vary according to body size, metabolism, age, diet and ailment.

carrots, and chicken breast. Recent research has identified certain varieties of barley grown in Mesopotamia to be some of the richest sources of chromium.

A 1996 study of 180 Type 2 diabetics, carried out in China under the guidance of Dr. Richard A. Anderson[11], found that 500 mcg of chromium picolinate taken twice daily for four months lowered the fasting glucose level to an average of 129, compared to 160 in those taking a placebo. In addition, glycosylated haemoglobin (a test of longer-term glucose tolerance) averaged an almost normal level of 7.5% in those taking chromium - significantly lower than those on placebo. All of the effects of chromium appear to be due to increased insulin sensitivity.

Another exceptionally useful trace mineral to combat diabetes is vanadium, which lowers blood sugar by mimicking insulin and improving the cells' sensitivity to insulin. A growing body of human research shows that vanadium compounds, most notably vanadyl sulfate, consistently improve fasting glucose and other measures of diabetes. These benefits were often extended for weeks after the mineral supplementation was discontinued.

In addition to taking supplements, diabetics are encouraged to eat the widest possible variety of permitted foods to ensure getting the full range of trace elements and other nutrients. It is interesting to note that certain nutrients like vitamins B1, B2, B12, pantothenic acid, vitamin C, protein and potassium - along with small frequent meals containing some carbohydrate - can actually stimulate production of insulin within the body.

Cautions

1. Fish oil capsules or supplements containing large amounts of para-aminobenzoic acid (PABA) can elevate blood sugar.
2. Supplements containing cysteine interfere with absorption of insulin by cells.
3. Extremely large dosages of vitamins B1 or C may inactivate insulin. Dosages listed above are within normal ranges.

7. Botanical medicines

Since antiquity, diabetes has been treated with plant medicines. The following herbs appear to be the most effective, are relatively non-toxic and have substantial scientific documentation to attest to their efficacy.

***European Blueberry* (Vaccinium myrtillus)**

Traditional herbalism places great value on European Blueberry leaves, a.k.a. Bilberry, as a natural method of controlling or lowering blood sugar levels when they are slightly elevated. Results have shown the leaves have an active ingredient with a remarkable ability to reduce excess sugar in the blood. To use, steep two to three handfuls of leaves in 4 cups hot water for half an hour. Drink three cups a day. Modern research has demonstrated the berries or extract of the berries offer even greater benefit. The standard dose of the extract is 80-160 mg three times per day.

Gymnema sylvestre

Native to the tropical forests of India. Used to lower blood sugar and help repair damage to pancreatic cells. Therapeutic dosage is 400 mg/day. A good source is a preparation by Natrol as a single herb 5:1 extract containing 300 mg.

Bitter melon (Momordica Charantia)

Composed of several compounds with confirmed antidiabetic properties. 50-60 ml (about 2 oz) of fresh juice per day has shown good results in clinical trials. Charantin, the key ingredient extracted by alcohol, is a hypoglycaemic agent composed of mixed steroids more potent than the drug Tolbutamide that is often used to treat diabetes.

Onion and Garlic

The common bulbs, onion and garlic, have significant blood

sugar-lowering action as well as lowering lipids, inhibiting platelet aggregation, and reducing blood pressure.

Fenugreek

Fenugreek seeds have demonstrated anti-diabetic effects in experimental and clinical studies. Administration of the defatted seed (in daily doses of 1.5-2g/kg) reduces fasting and after-meal glucose, glucagon, somatostatin, insulin, total cholesterol and triglycerides, while increasing HDL-cholesterol levels.

Salt Bush (Atriplex halimu)

Rich in fibre, protein, and numerous trace minerals, including chromium. Human studies in Israel have demonstrated improved blood glucose regulation and glucose tolerance in Type 2 diabetes. Dosage used in this study was 3g per day.

Ginkgo biloba

Gingko biloba extract improves blood flow in the peripheral tissues of the arms, legs, fingers and toes and is therefore an important medicine in the treatment of peripheral vascular disease. It has also been shown to prevent diabetic retinopathy. Dosage of the extract standardised to contain 24% ginkgo flavoglycosides is 40-80 mg three times per day.

Ginseng (Panax ginseng)

Ginseng, besides reducing fasting blood sugar levels and body weight, can elevate mood and improve psycho-physiological performance. Therapeutic dosage is 100-200 mg daily.

8. Status of diabetes research

In recent years, advances in diabetes research have led to better ways to manage diabetes and treat its complications. Major advances include:

- New forms of purified insulin, such as human insulin produced through genetic engineering.
- Better ways for doctors to monitor blood glucose levels and for people with diabetes to test their own blood glucose levels at home.
- Development of external and implantable insulin pumps that deliver appropriate amounts of insulin, replacing daily injections.
- Laser treatment for diabetic eye disease, reducing the risk of blindness.
- Successful transplantation of kidneys in people whose own kidneys fail because of diabetes.
- Better ways of managing diabetic pregnancies, improving chances of successful outcomes.
- New drugs to treat NIDDM and better ways to manage this form of diabetes through weight control.
- Evidence that intensive management of blood glucose reduces and may prevent development of microvascular complications of diabetes.
- Demonstration that anti-hypertensive drugs called ACE-inhibitors prevent or delay kidney failure in people with diabetes.

9. Diabetes in the year 2010 - what will the future bring?

Although there are no definitive preventative measures that can be taken against diabetes at this time, except for identifying persons at high risk and encouraging appropriate dietary and exercise guidelines, research into the causes and control of this disease continues to provide the possibility of new cures. With the discovery of insulin in the 1920's and the development of oral hypoglycaemic drugs in the 1950's, a person who has diabetes can live an active and productive life. The importance of early detection and proper management of this chronic disease cannot, however, be emphasised too strongly.

The therapy of insulin-dependent diabetes will surely be altered dramatically over the next few decades. One can project that there will be improved strategies for glucose control in established IDDM. This will include the widespread use of mechanical devices, which will involve both implantable glucose sensors and implantable insulin infusion systems; and successful pancreas, islet or beta cell transplantation, in the absence of the need of immunosuppressive therapy to prevent rejection.

An inhaled form of insulin, under development for several years, appears to be ready for wide scale application by the year 2000. Recent studies conducted at the Universities of Miami and Vermont involving Type I and Type II patients demonstrated that inhaled insulin is at least as effective as injected insulin in controlling the symptoms of diabetes and has no side effects. The delivery system, whereby a finely powdered form of insulin is inhaled directly into the lungs, promises to greatly simplify management of both forms of diabetes. Powdered insulin requires no refrigeration and since it is absorbed into the bloodstream though the lungs, there will generally be no need for hypodermic needles. Type I patients will still require an injection of slow-acting insulin at bedtime[12].In the future it may also be possible to administer insulin in the form of a pill or patch. All of these advances will change the face of diabetes, as we know it.

Moreover, we will see the application of immune intervention strategies at the time of onset of IDDM, with the reversal of the disease process. Ultimately, these strategies will be applied earlier in the sequence during a stage that we do not yet recognise as clinical diabetes. In these individuals otherwise destined to develop IDDM, the disease will be prevented.

Part Two of this article to be published in the next issue will cover the traditional Chinese medicine treatment of diabetes, including differentiation, needling prescriptions, dietary medicine, individual herbs and herbal prescriptions.

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12 Researchers will begin their final six-month trial on 1000 patients in the fall of 1998 and if successful, expect the product to be on the market within two years. US volunteers interested in participating in the study can call 1-800-438-1985.

The following websites offer further information on diabetes:

- American Association of Diabetes Educators
  http://www.diabetesnet.com/aade.html
- American Diabetes Association
  http://www.diabetes.org
- National Center for Nutrition and Dietetics, Consumer Nutrition Hotline (a part of The American Dietetic Association)
  Home page: *http://www.eatright.org*
- The International Diabetes Federation (IDF)
  Home page: *http://www.idf.org*
- National Institute of Diabetes and Digestive and Kidney Disease of the National Institutes of Health
  http://www.niddk.nih.gov
- Centers for Disease Control and Prevention
  http://www.cdc.gov/diabetes
- Department of Veterans Affairs
  http://www.va.gov/health/diabetes/
- Health Resources and Services Administration
  http://www.hrsa.dhhs.gov

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