Diabetes, scleroderma, oils and hormones

From the original article in 2006. Author: Ray Peat.

The basic argument: Stress and aging make cells less responsive in many ways by damaging their ability to produce energy and to adapt. The polyunsaturated fats are universally toxic to the energy producing system, and act as a "misleading signal" channeling cellular adaptation down certain self-defeating pathways. Diabetes is just one of the "terminal" diseases that can be caused by the polyunsaturated vegetable oils. Coconut oil, in diabetes as in other degenerative diseases, is highly protective.

When the oral contraceptive pill was new (Enovid), it was found to produce signs of diabetes, including decreased glucose tolerance. Spellacy and Carlson (1966) suggested that an elevation of circulating free fatty acids might be responsible, and remarked that "Free fatty acids can block the Krebs cycle, with relative insulin action resistance resulting." "The potential danger of the oral contraceptives is one of prolonged pancreatic stimulation." Recent papers are reporting that the estrogen used to "treat menopause" causes an increase in free fatty acids. Spellacy and Carlson suggested that estrogen's effect was mediated by growth hormone, and that is now the consensus. Women are much more likely than men to develop diabetes.

Ephraim Racker observed that free unsaturated fatty acids inhibit mitochondrial respiration, and recent studies are finding that free linoleic and linolenic acids act as intracellular regulators, stimulating the protein kinase C (PKC) system, which is also stimulated by estrogen and the (cancer promoting) phorbol esters. They stimulate the cell while blocking the energy it needs to respond.

Scleroderma, or systemic sclerosis, is a supposedly mysterious condition in which tissues harden, with an excessive deposition of fibrous material. Besides hardening the skin, it can involve fibrosis of the heart and other organs, and can cause changes in blood vessels of the kidneys like those seen in some types of hypertension, and often involves Raynaud's phenomenon and osteoporosis of the fingers. (Silicone functions as an adjuvant, making exposure to irritants, solvents or infections more harmful. This seems to be the reason for the association between breast implants and scleroderma.) Another type of disease that involves hardening of the skin is scleredema, in which the skin thickens with an accumulation of "mucin" between collagen bundles, and in which fibroblasts are overactive in producing collagen. (Varga, et al.) This condition is believed to often follow a "febrile illness" and is associated with diabetes. My interest in these conditions comes from my awareness that estrogen promotes collagen formation, and that changes in the connective tissue are deeply associated with the processes of stress and aging, following the ideas of Metchnikov and Selye.

Many people are still committed to the various old theories of diabetes, though a few are showing ways in which multiple causes can lead to diabetes. Increasingly, old age itself is seen to be "like diabetes (Meneilly, et al.; Smith, et al.), and the situation is ripe for a recentering of our understanding of diabetes around some of the general facts about aging and stress.

Diabetes mellitus, as named, refers to excessive urination and sugary urine, but it is now often diagnosed in people who neither urinate excessively nor pass glucose in the urine, on the basis of a high level of glucose in the blood. Many other signs (abnormal mucopolysaccharide metabolism with thickening of basement membranes, leakage of albumin through capillary walls and into the urine, a high level of free fatty acids in the blood, insensitivity of tissues to insulin, or reduced sensitivity of the beta cells to glucose) are considered diagnostic by some people, who believe that the worst aspects of the disease can be prevented if they can diagnose early and take preventive measures. This attitude derives largely from the genetic theory of causation, though it incorporates a belief that (environmental) intervention can ameliorate the course of the disease. When I wrote Nutrition for Women, I mentioned that the sudden appearance of diabetes in non-European Jews when they moved to Isreal made the genetic theory of diabetes untenable, and since then other studies have made the similar point that environmental factors seem crucial. (Shaltout, et al.) Many people are arguing for the racial/genetic theory of diabetes, but they are failing to consider some simple dietary factors, especially the high consumption of unsaturated seed oils and the combination of nutritional deficiencies and environmental stress.

I have known adults and children who were diagnosed as diabetic, and given insulin (and indoctrinated with the idea that they had a terminal degenerative disease) on the strength of a single test showing excessive glucose. When I taught at the naturopathic medical school in Portland, I tried to make it clear that "diabetes" (a term referring to excessive urination) is a function, and that a high level of glucose in the blood or urine is also a function, and that the use of insulin should require a greater diagnostic justification than the use of aspirin for a headache does, because insulin use itself constitutes a serious health problem. (And we seldom hear the idea that "diabetes" might have a positive side [Robinson and Johnston], for example that it reduces the symptoms of asthma [Vianna and Garcialeme], which get worse when insulin is given. Normal pregnancy can be considered "diabetic" by some definitions based on blood sugar. I got interested in this when I talked to a healthy "diabetic" woman who had a two year old child whose IQ must have been over 200, judging by his spontaneous precocious hobbies. Old gynecologists told me that it was common knowledge that "diabetic" women had intellectually precocious children.)

When non-diabetic apes were given insulin treatments, they developed some of the same "complications of diabetes" that are seen in humans, and antibodies to insulin were found in their retinas, suggesting that some "complications of diabetes" were complications of insulin treatment. Patients were seldom well informed of the arguments against the use of insulin, but the justification for the new genetically engineered human insulin is precisely that it avoids immunological damage.

Insulin was introduced into medicine in the 1920s. According to the Britannica Book of the Year for 1947, page 265, "Mortality from diabetes in 1920 in the United States was 16.0 per 100,000, 14,062 deaths, but in 1944, it was 26.4 per 100,000, 34,948 deaths."

One of the theories of the cause of diabetes is that a virus damages the beta cells in the pancreas, and the main argument for

that in the 1970s was that the onset of diabetes in children can often be dated to a time shortly after a severe viral infection. It is true that intense sickness and a high fever (and high doses of drugs given to treat the sickness) can cause very high levels of glucose in the blood, and even glucose in the urine, but this is a fairly well recognized consequence of stress. High doses of cortisone (prednisone, etc.) typically cause elevated glucose levels. Cushing's syndrome usually involves hyperglycemia. Normally, this is just a functional response to an excess of glucocorticoids, but studies in dogs suggested that intense and/or prolonged stress can damage the insulin-secreting cells in the pancreas. Dogs had half of their pancreas removed, to increase the burden put on the remaining tissue, and after a large dose of cortisone the dogs became (and remained) diabetic.

One of the problems associated with diabetes is the calcification of blood vessels, though now there is more emphasis on fatty degeneration. Other blood vessel problems include hypertension, and poor circulation in general, leading to gangrene of the feet, impotence, and degeneration of the retina. In muscles, and probably in other tissues of diabetics, capillaries are more widely spaced, as if the basal oxidative requirement were lower than normal. However, mitochondria contain more respiratory enzymes, as if to partly compensate for the poor delivery of oxygen to the cells. Osteoporosis or osteopenia is a common complication of diabetes, and seems to be associated with the calcification of soft tissues.

F. Z. Meerson's description of the stress-injured heart is very similar to the general changes that occur in chronic diabetes. He found that the stressed heart becomes rigid and unable to contract completely, or to relax completely. Excess calcium enters cells, and fatty acids are mobilized both locally and systemically, and both of these tend to damage the mitochondria. In diabetes, fatty acids are mobilized and oxidized instead of glucose, and calcium enters cells, increasing their rigidity and preventing relaxation of muscles in blood vessels. (I'm not sure whether it is relevant to cell physiology, but the presence of an excess of free unsaturated fatty acids, and of calcium, in cells makes me think of the insoluble soap that these substances form in other situations, including the intestine. It seems that this could form a harmful deposit in cells, blocking many metabolic processes.)

For many years, histologists have observed that calcium and iron tend to be deposited together in "devitalized" tissues. Now we know that cell death from a great variety of causes involves the cell's absorption of increased amounts of calcium. Simply the lack of energy increases the amount of calcium in a cell, and stimulation or excitation does the same, creating or exaggerating a deficiency of energy. In low thyroid people, many (if not all) tissues are very easily damaged. Since glucose is needed by liver cells to produce the active (T3) form of thyroid, diabetes almost by definition will produce hypothyroidism, since in diabetes glucose can't be absorbed efficiently by cells.

In the form of cell damage caused by the "excitotoxins," glutamic and aspartic acids, the damage seems to require both stimulation, and difficulty in maintaining adequate energy production. This combination leads to both calcium uptake and lipid peroxidation. When cells are de-energized, they tend to activate iron by chemical reduction, producing lipid peroxidation. This could explain the presence of chemically active iron, but an actual increase in the iron concentration suggests that there has been prolonged injury (oxidative stress) to the cell, with increased production of the heme group, which binds iron.

Hans Selye found that he could produce scleroderma (hardening and calcification of the skin) in rats by giving them a toxic dose of a heavy metal, and then irritating the skin a little by plucking hair. Iron is now tending to be recognized as a factor in inflammation. Vitamin E was able to prevent the development of scleroderma under Selye's experimental conditions, suggesting that the irritation allowed the heavy metal to cause oxidative damage to the skin. Selye found other ways to cause calcification of tissues, including the walls of arteries, but he directed most of his attention to the role of "pro-inflammatory" hormones. A decreased blood supply was often used to predispose an organ to calcification. In diabetes, a characteristic feature is that the blood supply is relatively remote from cells in muscle and skin, so the oxygen and nutrients have to diffuse farther than in normal individuals, and the ATP level of cells is characteristically lower than normal. In blood cells, both red (Garnier, et al.) and white cells are probably more rigid in diabetes, because of lower ATP production, and higher intracellular calcium and sodium.

Magnesium in the cell is largely associated with ATP, as the complex Mg-ATP. When ATP is "used" or converted to ADP, this lower-energy substance associates with calcium, as Ca-ADP. In a hypothyroid state, the energy charge can be depleted by stress, causing cells to lose magnesium. ATP is less stable when it isn't complexed with magnesium, so the stress-induced loss of magnesium makes the cell more susceptible to stress, by acting as a chronic background stimulation, forcing the cell to replace the ATP which is lost because of its instability. In this state, the cell takes up an excess of calcium.

The picture that I think explains many of the features of diabetes is that an energy deficit produces an alarm state, causing increased production of adrenalin and cortisol. Adrenalin mobilizes fat from storage, and the free fatty acids create a chronic problem involving 1) blocked ATP production, 2) activation of the protein kinase C system (increasing tension in blood vessels), 3) inhibition of thyroid function with its energetic, hormonal, and tissue-structure consequences, 4) availability of fats for prostaglandin synthesis, and 5) possibly a direct effect on clot dissolving, besides the PAI-1 (plasminogen activator inhibitor) effect seen in diabetes (Ceriello, et al., Udvardy, et al., Vague, et al.). (Estrogen has many pro-clotting effects, and one of them is a decreased activity of vascular plasminogen activator. K. E. Miller and S. V. Pizzo, "Venous and arterial thromboembolic disease in women using oral contraceptives," Am. J. Obst. Gyn. 144, 824, 1982. In 1968, D. G. Daniel et al., reported that estrogen promotes thromboembolism by increasing clotting factor IX in the blood.)

Increased entry of calcium into cells is complexly related to increased exposure to unsaturated fatty acids, decreased energy, and lipid peroxidation. Osteoporosis, calcification of soft tissues and high blood pressure are promoted by multiple stresses, hypothyroidism, and magnesium deficiency. The particular direction a disease takes--diabetes, scleroderma, lupus, Alzheimer's, stroke, etc.--probably results from the balance between resources and demands within a particular organ or system. Calcium overload of cells can't be avoided by avoiding dietary calcium, because the bones provide a reservoir from which calcium is easily drawn during stress. (In fact, the reason calcium can temporarily help prevent muscle cramps seems to be that it makes magnesium more available to the muscles.)

If we want to stop a disease that involves abnormal calcification or contraction of muscle (see Zenere, et al.), we can increase our consumption of magnesium, and to cause cells to absorb and retain the magnesium, we can increase our thyroid function. The use of coconut oil provides energy to stabilize blood sugar while protecting mitochondria and the thyroid system from the harmful effects of unsaturated fats.

In 1947, B. A. Houssay found that a diet based on sugar as a source of energy was more protective against diabetes than a diet based on lard, while the most protective diet was based on coconut oil. Lard reflects the pigs' diet, and is usually extremely unsaturated, especially since it became standard to fatten them on soybeans and corn. Essentially, his study seems to show that unsaturated (pork) fat permits diabetes to develop, sugar is slightly protective, and coconut oil is very protective against the form of diabetes caused by a poison.

At the same time, A. Lazarow was demonstrating that a low protein diet made animals more sensitive to diabetes, and that cysteine, glutathione, and thioglycolic acid (antioxidants) are protective against diabetes. The chelator of metals, BAL (British anti-lewisite), was also found to protect against diabetes.

Taken together, those studies suggest that the oxidizable unsaturated fats are involved in the process of producing diabetes. At the same time, other studies were showing that the unsaturated oils suppress the thyroid, and that coconut oil increases the metabolic rate, apparently by normalizing thyroid function. Hypothyroidism is known to include deposition of mucopolysaccharides in tissues, increased permeability of capillaries with leakage of albumin out of the blood, elevated adrenalin which can lead to increased production of cortisol, decreased testosterone production, high risk of heart and circulatory disease, including a tendency to ulceration of the extremities, and osteoporosis, all of which are recognized "complications of diabetes." Broda Barnes gave all of his diabetic patients a thyroid supplement, and found that none of them developed the expected complications of diabetes.

Recently, a high safflower oil diet was found to cause diabetes (Ikemoto, et al.), and obesity itself is thought to be a factor in developing diabetes. The hormone patterns associated with obesity can be seen as either cause or effect of the obesity (or both cause and effect), since, for example, low thyroid can increase both estrogen and cortisol, which support the formation of fat, and the fat cells can become a chronic source of estrogen synthesis.

On a diet lacking the "essential" unsaturated fatty acids, Benhamou (1995) found that nonobese diabetic mice didn't develop diabetes, that is, the unsaturated fats themselves, without obesity, are sufficient to cause diabetes. (Also see Girard; Golay, et al., and Kusunoki, et al.)

Estrogen and the polyunsaturated fatty acids (PUFA), linoleic and linolenic acid, alike activate the protein kinase C (PKC) system of cellular activation. Many of the functions of PUFA are similar to the functions of estrogen (e.g., antagonism to thyroid function, promotion of age pigment/lipofuscin), so this information showing that they both act similarly on the same basic regulatory pathway is important. Estrogen increases secretion of growth hormone (GH; it's closely associated with prolactin, also increased by estrogen), and GH causes an increase in free fatty acids in the blood. Estrogen promotes iron retention, so it sets the stage for oxidative stress. At least in some systems, both estrogen and PUFA promote the entry of calcium into the cell.

In diabetes, there is a generalized excess activation of the PKC system. The starch-based diet, emphasizing grains, beans, nuts, and vegetables, has been promoted with a variety of justifications. When people are urged to reduce their fat and sugar consumption, they are told to eat more starch. Starch stimulates the appetite, promotes fat synthesis by stimulating insulin secretion, and sometimes increases the growth of bacteria that produce toxins. It is often associated with allergens, and according to Gerhard Volkheimer, whole starch grains can be "persorbed" from the intestine directly into the blood stream where they may block arterioles, causing widely distributed nests of cell-death. I have heard dietitians urge the use of "complex carbohydrates" (starch) instead of sugar. In the first physiology lab I took, we fed rats a large blob of moist cornstarch with a stomach tube, and then after waiting a few minutes, were told to dissect the rat to find out "how far the starch had gone." In such a short time, we were surprised to find that not a trace of the starch could be found. The professor's purpose was to impress us with the rapidity with which starch is digested and absorbed. Various studies have demonstrated that starch (composed of pure glucose) raises blood glucose more quickly than sucrose (half fructose, half glucose) does. The sudden increase of blood glucose is sometimes thought to contribute to the development of diabetes, but if it does, it is probably mediated by fat metabolism and the hormones other than just insulin.

Brewer's yeast has been used successfully to treat diabetes. In the l930s, my father had severe diabetes, but after a few weeks of living on brewer's yeast, he recovered and never had any further evidence of diabetes. Besides its high B-vitamin and protein content, yeast is an unusual food that should be sparingly used, because of its high phosphorous/calcium ratio, high potassium to sodium ratio, and high estrogen content. The insulin-producing beta cells of the pancreas have estrogen receptors, but I don't know of any new research investigating this aspect of yeast therapy. In rabbit studies, diabetes produced by alloxan poisoning, which kills the beta cells, was cured by DHEA treatment, and beta cells were found to have regenerated in the pancreatic islets.

I think the basic anti-aging diet is also the best diet for prevention and treatment of diabetes, scleroderma, and the various "connective tissue diseases." This would emphasize high protein, low unsaturated fats, low iron, and high antioxidant consumption, with a moderate or low starch consumption. In practice, this means that a major part of the diet should be milk, cheese, eggs, shellfish, fruits and coconut oil, with vitamin E and salt as the safest supplements. It should be remembered that amino acids, especially in eggs, stimulate insulin secretion, and that this can cause hypoglycemia, which in turn causes cortisol secretion. Eating fruit (or other carbohydrate), coconut oil, and salt at the same meal will decrease this effect of the protein. Magnesium carbonate and epsom salts can also be useful and safe supplements, except when the synthetic material causes an allergic bowel reaction..

Although I started this newsletter with the thought of discussing the Mead acids--the unsaturated (n-9) fats that are formed

under certain conditions, especially when the dietary polyunsaturated fatty acids are "deficient"--and their prostaglandin derivatives as a distinct anti-stress, anti-aging system, the loss of which makes us highly susceptible to injury, I will save that argument for a future time, leaving this newsletter as an addition to the view that an excess of the polyunsaturated fats is central to the development of degenerative diseases: Cancer, heart disease, arthritis, immunodeficiency, diabetes, hypertension, osteoporosis, connective tissue disease, and calcification.

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