DHEA: Anti-Aging Hormone

REDUCES INFLAMMATION, ENHANCES IMMUNITY, PROTECTS ARTERIES AND THE BRAIN - ***by Ivy Greenwell***

Dehydroepiandrosterone (DHEA) hormones are the most abundant steroids in the human body. Low levels of DHEA are associated with aging and disease states. Specifically, a deficiency of DHEA has been found to correlate with immune dysfunction, inflammation, greater risk of certain cancers, heart disease in men, and osteoporosis. The special interest in DHEA replacement, however, stems from its function as a prohormone, meaning a precursor to a great variety of beneficial steroids, both in the estrogenic and androgenic family, on an “as-needed” basis.

Perhaps the most exciting new finding relates to the antiatherogenic benefits of DHEA. The dramatic aging-related drop in DHEA levels is accompanied by an equally dramatic rise in cardiovascular disease. We have now come closer to elucidating the cardioprotective mechanism of DHEA. It appears that DHEA is incorporated into both high and low-density cholesterol, protecting it from oxidation. In the aged, however, cholesterol-bound DHEA becomes virtually undetectable, and the cholesterol molecules are much more susceptible to oxidation than in young individuals. But this is not the end of the story. It turns out that DHEA also increases the activity of platelet superoxide dismutase (SOD), one of our most important antioxidant enzymes. Thus, DHEA seems to play an essential role as part of the body’s antioxidant defenses.

Another recent finding involves the anti-inflammatory properties of DHEA. It has been known for a long time that DHEA can lower the levels of interleukin-6 (IL-6), a pro-inflammatory cytokine (meaning a chemical messenger used by the immune system) that seriously escalates the inflammatory process, recruiting immune cells that often end up destroying healthy tissue as well. Now it has been established that DHEA can lower the production of another inflammatory cytokine as well, one called tumor necrosis factor alpha (TNF-alpha). The levels of both IL-6 and TNF-alpha rise with aging, showing an increased inflammatory state and possible immune dysfunction. The role of DHEA in regulating the immune response has been shown to include also the enhanced secretion of interferon-gamma. The decline in DHEA levels is closely tied to immunosenescence.

This is excellent news for those who suffer from chronic inflammatory diseases. However, it could be argued that aging itself is, in a sense, a chronic inflammatory state. The levels of various chemical mediators of inflammation, such as IL-6 and TNF, increase as we age. At the same time, our production of DHEA plummets with aging. Maintaining youthful levels of DHEA means less chronic inflammation. It should be pointed out that chronic inflammation is known to play a critical role in the development of the killer diseases of aging: heart disease, Alzheimer’s disease and certain types of cancer.

More good news includes also the finding that DHEA protects brain tissue under conditions simulating stroke and trauma damage, and is likely to be involved in protecting the brain against the development of Alzheimer's disease. The neuroprotective mechanism of DHEA appears to go beyond its anti-glucocorticoid effect, that is, its ability to antagonize the harmful effects of cortisol; anti-inflammatory action is likely to be involved as well. DHEA has also been shown to lower hyperglycemia (elevated blood sugar) in diabetic rats, and protect their kidneys from the damage caused by high blood sugar. In addition, DHEA enhances the immune response and helps us fight infection; several studies have confirmed its usefulness in combating bacterial, parasitic and viral infections, including HIV. DHEA also helps protect the thymus against cortisol-induced atrophy.

One surprising finding showed that DHEA can help some infertile patients ovulate and become pregnant, making previously ineffective ovarian stimulation succeed at last.

Speaking of cortisol, we are beginning to understand that it is the ratio of DHEA to cortisol that is of critical importance in aging and certain diseases such as AIDS. A recent French study done at the Pasteur Institute in Paris found that the minority of patients who do not succumb to the severe side effects of highly aggressive antiretroviral therapy show a normalized DHEA/cortisol ratio. The majority of AIDS patients, however, have an abnormally low DHEA/cortisol ratio and thus suffer from symptoms usually associated with excess cortisol, even though their cortisol levels are within normal. Cardiac patients and the victims of Alzheimer's disease also show low DHEA/cortisol ratio. The manipulation of this crucial ratio, including DHEA therapy, could prove highly significant both in the treatment of AIDS and in anti-aging medicine in general. In fact, a small pilot study has already indicated that DHEA combined with an anti-inflammatory drug such as indomethacin can moderate or even normalize the various pathological changes of AIDS-related lipodystrophy.

One surprising finding showed that an 80 mg/day dose of DHEA can help some infertile patients ovulate and become pregnant, making previously ineffective ovarian stimulation succeed at last (in one case, the result was twins!). An animal study confirmed that DHEA is important as a steroidogenic substrate (precursor of other hormones) in ovarian production of various sex steroids. Interestingly, immunomodulatory 7-hydroxy metabolites of DHEA have also been discovered in human semen, with possible further implications for fertility. In postmenopausal women, research on DHEA replacement continues to indicate improved well-being and libido, among many other benefits. We are also closer to understanding the mechanism through which DHEA enhances the sense of well-being: it significantly increases the levels of beta-endorphins.

Those readers who are considering following a ketogenic (low-carbohydrate) diet may be interested in a small study done on rheumatoid arthritis patients: the low-calorie ketogenic diet using less than 40 g of carbohydrates per day resulted in a 34% rise in DHEA within a week; the ketogenic diet was as effective as sub-total fast in raising DHEA levels. This study needs to be replicated, however, using a larger number of healthy subjects. In primates, calorie restriction has indeed been found to preserve higher DHEA levels, indicating a slower rate of aging. In humans, fasting is known to raise DHEA levels in both sexes. Anorexic and bulimic women likewise show higher serum DHEA. Exercise can also raise DHEA in some individuals, possibly due to the inverse relationship between DHEA and insulin. Finally, while meditation has long been known to increase DHEA, participation in drum circles has also been shown to increase DHEA and DHEA/cortisol ratio, confirming the hypothesis that stress reduction in general boosts DHEA production, probably through a shift of adrenal steroidogenesis from cortisol to DHEA. High insulin, high cortisol and low DHEA constitute a large part of the pathological endocrine profile of aging. Restoring the correct hormonal ratios should be one of the primary goals of any anti-aging program.

DHEA protects the cardiovascular system

Epidemiological studies continue to confirm the correlation between the levels of DHEA in men with their risk of cardiovascular disease. Most recently, the Massachusetts Male Aging Study followed over 1700 men between the ages of 40 and 70 for nine years. The authors found that men in the lowest quartile of serum DHEA at baseline were 60% more likely to develop ischemic heart disease. Low serum DHEA was also a significant predictor. Likewise, studies continue to confirm lower DHEA values in cardiac patients combined with higher insulin levels, with a “close inverse correlation” between insulin and DHEA. This raises the question as to whether DHEA is the “missing link” in hyperinsulinemia and atherosclerosis.

A very important Canadian study has partly elucidated the way DHEA works to protect blood vessels against atherosclerosis. The authors found that in elderly patients vitamin E is unable to restore the resistance of LDL to oxidation back to the levels found in youth. DHEA, on the other hand, did increase the resistance of LDL to oxidation in a dose-dependent manner. This study found evidence indicating that DHEA is actually incorporated into the molecules of both LDL and HDL cholesterol, and acts as an antioxidant. During aging, however, cholesterol-bound DHEA practically disappears. In the elderly, the levels of cholesterol-bound DHEA are virtually nondetectable, and their LDL cholesterol becomes very susceptible to oxidative damage. (Estrogen esters apparently function in a similar way, protecting LDL against oxidation.)

DHEA has also been shown to reduce the amount of atherosclerotic plaque in rabbits fed a high-cholesterol diet. One clue about the cardioprotective mechanism of DHEA comes from a recent Japanese study, which compared animals given DHEA with animals given DHEA together with an aromatase inhibitor, a compound that prevents the conversion of DHEA to estrogens. The amount of the plaque was diminished by 60% in animals receiving DHEA alone, but only by 30% in animals receiving DHEA and an aromatase inhibitor. The authors conclude that approximately half of the antiatherosclerotic effect of DHEA is due to its conversion to estrogens and an increased release of nitric oxide.

Another study using male castrated cholesterol-fed rabbits as an animal model of atherosclerosis compared the effects of oral DHEA against those of testosterone enanthate given by injection, oral synthetic testosterone and placebo. Sham-operated non-castrated rabbits also served as a control group. Aortic atherosclerosis was highest in the placebo group and lowest in the group receiving testosterone injections. The degree of atherosclerosis was intermediate in the DHEA group, which did better than the oral testosterone group, and slightly better than the noncastrated rabbits that had the benefit of their own testosterone. The study showed that both testosterone and DHEA help prevent atherosclerosis. The benefit could be only partly explained in terms of the impact on the serum lipids.

Finally, a study done at the University of Wroclaw, Poland, found that DHEA decreased the levels of serum lipid peroxides in rabbits fed a normal diet, but not in rabbits with induced severe hypercholesterolemia. However, both healthy rabbits and rabbits with extremely high cholesterol showed an increase in the activity of platelet superoxide dismutase (SOD), a crucial antioxidant enzyme. Again, it should be stressed that this increase in SOD activity was observed both in rabbits fed a normal diet and in rabbits fed an atherogenic diet, which usually show decreased SOD activity. Increase in SOD activity may partly explain DHEA’s antioxidant effects.

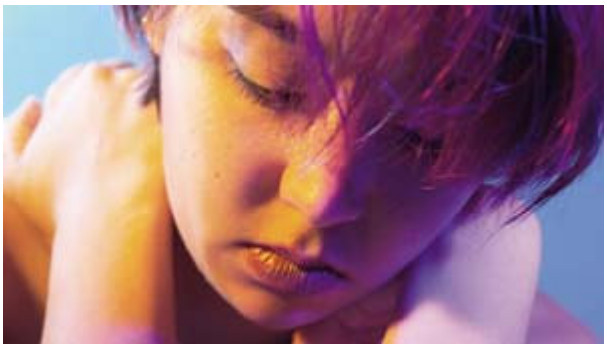
Overall, there seems to be a consensus that while DHEA may not be cardioprotective in women, men with low levels of DHEA are at a greater risk of a heart attack. For older men, cardiovascular health appears to be yet another excellent reason for taking DHEA supplements.

Brain protection

DHEA is especially abundant in the human brain. Many earlier studies reported a protective effect of DHEA against the deterioration of mental function with aging, and an inverse correlation between DHEA levels and neurodegerative disease such as Alzheimer's. A recent Canadian study found that rats implanted with a high dose of DHEA showed significantly less hippocampal damage after stroke was induced (60% injured neurons as compared to 88% for placebo).

In another study, DHEA proved to be the most potent of all the steroids tested in its ability to inhibit the formation of excess reactive astroglia in the event of a penetrating wound of the cerebral cortex, thus downregulating the immune response, which otherwise might injure healthy neurons in the vicinity of the wound. It has been demonstrated that DHEA markedly inhibits tumor necrosis factor alpha (TNF-alpha) and IL-6 in glial cells. The ability to lower the levels of these inflammatory mediators may be an important part of the neuroprotective mechanism of DHEA.

In addition, DHEA has been shown to protect against the toxicity of the amyloid-beta protein and excess glutamate. Treatment with glutamate produced a copious increase in the neuronal glucocorticoid receptor. Treatment with DHEA reversed this increase, demonstrating again the anti-glucocorticoid action of DHEA.



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DHEA is often advertised as a remedy for depression. At this point we know that depression is more than just a shortage of neurotransmitters; it is a whole-body degenerative disease, the most frightening aspect of which is aging-like loss of neural tissue. There has been a steady interest in DHEA as an antidepressant. First, however, it should be established whether depression is indeed associated with low DHEA. A study done in Cambridge, England, compared DHEA and cortisol levels in clinically depressed patients (categorized as "major depressives") with a matched group of patients in remission from depression and healthy controls. Both morning and evening levels of DHEA were lowest in depressed patients, with inverse correlation between the morning DHEA levels and the severity of the depression. Evening cortisol levels were highest in the depressed group. The low DHEA/cortisol ratio (similar to the shift seen in aging) also characterized the depressed group. The authors point out that DHEA not only antagonizes harmful effects of excess cortisol, but also may have mood improving properties. This may have "significant implications" for the treatment of depression.

Another study on the role of DHEA deficiency in depression focused on recovering alcoholics, a group especially susceptible to depression, and hence to relapse into drinking. The authors found that abstinent alcoholics showed a deficiency of noradrenaline and a low DHEA to cortisol ratio, indicating lower ability to deal with stress. Hypothetically, DHEA might prove a useful adjunct therapy for recovering alcoholics.

There is still some controversy over whether or not DHEA produces cognitive enhancement in humans. Diamond (1999) has suggested that such enhancement may depend on the degree of psychological stress. In his study on rats, DHEA was found to increase hippocampal activity, but only under non-stressful conditions. Stress appears to block the DHEA-induced enhancement.

The ability of DHEA to protect the hippocampus and enhance its activity is important in regard to Alzheimer's disease. Studies have generally found increased cortisol and lower DHEA in

Alzheimer's disease patients, together with a low DHEA/cortisol ratio. We know that excess cortisol damages the hippocampus and potentiates beta-amyloid toxicity. DHEA is believed to be able to antagonize the destructive effects of excess cortisol. The authors of a recent study have concluded that dementia is correlated with low DHEA more so than with high cortisol. Another study also showed that while the aging process decreases the DHEA/cortisol ratio, victims of dementia have a significantly lower ratio rather the healthy elderly. Based on the opposite effects of cortisol and DHEA on the brain, especially on the hippocampal region, the authors suggest that it is possible that this pathological imbalance between stress hormones and DHEA accounts for much of the damage.

There has also been some research on the effects of androstenedione, the main metabolite of DHEA, on cognitive enhancement. Androstenedione sulfate has been shown to increase neural activity in certain sections of the rat brain, with implications for memory enhancement and antidepressant action similar to those already found for DHEA.

DHEA's role in chronic inflammatory diseases

An important overview of the role of DHEA in reducing the damage produced by chronic inflammation was recently published by a team of researchers at the University of Regensburg, Germany. The authors point out that patients with chronic inflammatory diseases such as rheumatoid arthritis show adrenal dysfunction that manifests itself both in insufficient levels of cortisol in response to adrenocorticotropic hormone (ACTH) and low levels of DHEA. With both cortisol and DHEA being too low, the inflammation progresses and leads to harmful consequences.

The current practice is to use synthetic corticosteroids such as prednisolone in an effort to fight chronic inflammation. DHEA remains neglected, in spite of repeated findings of low DHEA levels in patients suffering from chronic inflammatory diseases. But DHEA also plays an important role in preventing inflammation. It is a potent inhibitor of pro-inflammatory cytokines (hormone-like immune chemicals), which in turn signal the immune system and provoke further cellular destruction.

Of special interest is DHEA's ability to inhibit interleukin 6 (IL-6) and tumor necrosis factor (TNF). These pro-inflammatory cytokines rise with age, and are especially high in patients with inflammatory diseases. IL-6 is known to play a role in promoting bone loss and possibly also joint destruction. In addition, IL-6 promotes the production of certain immune cells which attack the body's own tissue in autoimmune conditions such as rheumatoid arthritis. High serum IL-6, as seen in rheumatoid arthritis, for instance, is regarded as a reliable biomarker of inflammation. The finding that DHEA supplementation can lower IL-6 makes it a very promising anti-inflammatory agent, especially for chronic disorders which are characterized by significantly elevated IL-6. Besides rheumatoid arthritis, the conditions associated with abnormally high IL-6 include atherosclerosis, osteoporosis, Alzheimer's disease and certain cancers.

The inverse relationship between DHEA and IL-6 has been confirmed through the study of the menstrual cycle. Serum IL-6 showed a marked rise during the luteal (post-ovulation) phase. This pro-inflammatory cytokine was highest when DHEA levels were lowest, and vice versa.

The primary metabolite of DHEA, androstenedione, has also been found to inhibit the production of IL-6. Likewise, pregnenolone and progesterone also inhibit TNF production.

The deficiency of DHEA in inflammatory diseases also implies a deficiency in peripheral tissue of various sex steroids for which DHEA serves as a precursor. These steroids, both estrogenic and androgenic, are known to have beneficial effects on muscle, bone, blood vessels and so forth. The mainstream therapy with corticosteroids is itself known to lower androgen levels. Consequently, the authors argue that hormone replacement for patients with chronic inflammatory diseases should include not only corticosteroids, but also DHEA.

Other studies also found that adrenal hormones, including DHEA, are of special importance in the treatment of rheumatoid arthritis. There is some evidence pointing to adrenal hypofunction before the onset of rheumatoid arthritis, especially in female patients, who constitute the

overwhelming majority of rheumatoid arthritis victims, and whose serum DHEA levels are low (male rheumatoid arthritis patients show low plasma and synovial fluid testosterone). Androgens in general appear to be protective against the development of autoimmune diseases, and DHEA is an important precursor of various androgens. DHEA replacement appears to be especially important for female rheumatoid arthritis patients.

Lupus is another autoimmune inflammatory disease where DHEA (usually in high doses of up to 200 mg) has proven to be a useful adjunct therapy. One author has reviewed the results of all the studies done to date, and concluded that DHEA appears to decrease the requirement for glucocorticoid steroid therapy and somewhat improves symptoms. More important, perhaps, is its protection against bone loss (osteopenia and osteoporosis), as well as improved mental function. Side effects include acne and the lowering of HDL cholesterol (the ratio of HDL to total cholesterol tends to remain the same, however, since LDL cholesterol is also lowered due to DHEA replacement).

Ordinary aches and pains may also be related to low DHEA. When men and women complaining of either lower back pain or neck and shoulder pain were tested, the consistent finding for women was low DHEA and low beta endorphins.

Adrenal hypofunction replacement

Addison's disease is another chronic condition that results from the dysfunction of the adrenals. Addison's patients are given corticosteroids and mineralocorticoids to compensate for their low adrenal production of these vital hormones, but so far the need to raise their abnormally low DHEA levels has not been addressed by the mainstream medical establishment. A much-needed double-blind, placebo-controlled study has finally investigated the effects of 50 mg of oral DHEA on male and female patients suffering from Addison's disease. As a result of DHEA replacement, the levels of DHEA and androstenedione reached physiological levels in both sexes. In women, the effect of DHEA included a rise in total testosterone to low-normal levels and a decrease in serum sex hormone-binding globulin (this leads to greater bioavailability of all sex hormones). Both sexes showed an improvement in self-esteem and overall well-being, with less fatigue. The authors point out that the psychological improvement in male Addison's patients indicates that the action of DHEA on the brain may be independent of the levels of testosterone.

DHEA helps fight bacteria and viruses, including HIV

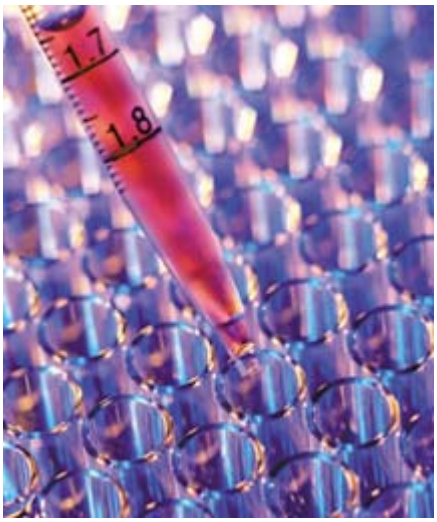
An infection with human immunodeficiency virus (HIV-1) typically does not result in full-blown AIDS except after a period of latency. Certain factors have to activate the virus. These factors include antigens, mitogens and cytokines such as tumor necrosis factor alpha (TNF-alpha). Some experts think that a state of inflammation is actually required for the activation of HIV and progression to full-blown AIDS. If DHEA has potent anti-inflammatory properties, then it should be of great interest to HIV-infected patients, since high levels of DHEA might help prevent the activation of the virus. Even if based on only partial evidence, the advice that HIV patients should maintain their DHEA as high as possible appears to be sound.

Indeed, it has been shown that DHEA and its synthetic analogs are able to produce partial inhibition of HIV replication. One study discovered that one particular analog of DHEA, IM28, had a somewhat higher activity against HIV replication than DHEA, but at a price: it was more toxic than DHEA. The mechanism of DHEA's anti-viral action is not fully understood, but its antioxidant properties (perhaps deriving from the estrogenic metabolites) and its impact on metabolic enzymes are probably part of the explanation.

Another important aspect involves the close relationship between DHEA, cortisol and the types of cytokines produced. As AIDS progresses, we see a deficiency of type I cytokines (including interferon gamma and interleukin-2) and an excess of type II cytokines, including interleukin-6 (IL-6). This is accompanied by a rise in cortisol and a drop in DHEA levels. Effective therapy with protease inhibitors has been shown to increase DHEA levels.

HIV is not the only virus that can be inhibited by DHEA. An interesting study conducted at the University of Tucson in Arizona investigated the effect of DHEA and melatonin on the immune function and tissue vitamin E levels in healthy mice and mice infected with leukemia retrovirus, which leads to murine (mouse) acquired immune-deficiency syndrome (AIDS). The retrovirus causes a loss of tissue vitamin E, a decrease in T helper 1 (Th1) cytokines and an increase in T helper 2 (Th2) cytokines, as well as a reduction in B and T cell count. Both DHEA and melatonin prevented the drop in B and T cell proliferation, and the increase in Th2 cytokines. When melatonin and DHEA were used together, however, they were more effective. When administered simultaneously, DHEA and melatonin were also able to prevent vitamin E loss and reduce lipid peroxidation in the liver. Supplementing these two hormones also increased tissue vitamin E levels in healthy mouse. The results suggest that the combined treatment with DHEA and melatonin may be of use as adjunct therapy against retroviral infection.

Another interesting study to explore the combined use of DHEA and melatonin has been done in Korea. It studied the effects of DHEA, melatonin, and the combination of DHEA and melatonin on the release of tumor necrosis factor alpha (TNF-alpha) by mouse macrophages in the presence of the anthrax toxin, which is produced by the anthrax bacteria. The release of inflammatory cytokines, such TNF-alpha, is known to play a central role in the development of anthrax. The authors found that DHEA markedly inhibited the anthrax toxin-induced production of TNF-alpha; melatonin was also effective. Combining DHEA with melatonin, however, worked no better than single therapies.



In addition, DHEA's ability to help the body fight infection and infection-caused inflammation may be a part of its cardioprotective mechanism.

Another study investigating the protective effects of DHEA against the damage of bacterial sepsis (a condition that sets in as a wound becomes infected) was done at the University of Essen, Germany. Untreated mice with sepsis had a survival rate of 53% after 48 hours; a group of mice that received DHEA had an 87% survival rate. The authors found that the immunoenhancing effect of DHEA is associated with lower release of TNF-alpha and greater activity of T cells. Previous animal studies have also indicated that DHEA significantly improves bacterial killing due to sepsis associated with thermal injury. Trauma with ensuing sepsis is a leading cause of death in young people; the possibility that DHEA might be a helpful adjunct therapy for male trauma patients is being studied.

DHEA has long been known to boost the immune function. It is vital for the development of certain mature immune cells and for enhanced antibody production. A new study has found that the number of cells secreting interferon-gamma correlated with serum DHEA levels in men, and that the activity of these cells was associated with DHEA levels in premenopausal women. Thus, DHEA seems to be involved in modulating cytokine production. The same is true of one of its metabolites, androstenediol, which has been shown to protect bone marrow function and resistance to infection after exposure to radiation in rodents even more effectively than DHEA. Androstenediol has also been shown to protect against lethal infection with influenza A virus. Because infection produces a rise in cortisol, which in turn suppresses the immune system, it would be logical to try to counterregulate this immunosuppression with antiglucocorticoids such as DHEA.

In HIV patients, interferon gamma levels have been found to be significantly positively correlated with DHEA levels. Low DHEA, on the other hand, correlates with viral load and is a predictor of poor prognosis. One interesting finding has been that protease inhibitor therapy may help restore higher DHEA levels.

Since cortisol and DHEA partly control both metabolism and the immune response, one recent

study compared cortisol/DHEA ratio in healthy controls with that found in HIV-infected patients receiving different types of therapy. The findings were dramatic. First, it needs to be stated that an alarming 63% of AIDS patients receiving highly aggressive antiretroviral therapy develop lipodystrophy. Lipodystrophy is a lipid disorder characterized by accumulation of fat on the abdomen and neck and back (dorsocervical fat), high cholesterol, apolipoprotein and triglycerides, increased risk of diabetes or actual diabetes, cardiovascular disease, fragile bones and muscle loss. These patients showed low levels of DHEA and a low DHEA/cortisol ratio.

The pathological changes of lipodystrophy are typical of those induced by excess cortisol. A recent study showed that cortisol levels in HIV patients are actually within the normal range; it is the deficiency of DHEA that results in relative hypercortisolism. Those lucky patients who do not succumb to lipodystrophy, on the other hand, have been found to have considerably higher DHEA levels and a normalized DHEA/cortisol ratio. The patients with normal DHEA/cortisol ratio also have much better T cell counts. Obviously, DHEA/cortisol ratio is critical in this disease; restoration and maintenance of a normal DHEA/cortisol ratio should be one of the important goals of any AIDS treatment. (Considering how many elderly also show lipodystrophy, even though milder than that induced by retroviral drugs, it could well be argued that the maintenance of a normal DHEA/cortisol ratio should be a crucial part of any anti-aging regimen).

Fortunately, we now have the findings of a small study that used DHEA supplements in an attempt to combat lipodystrophy in HIV patients. Seven patients with lipodystrophy, three of whom had developed diabetes, were given 100 to 200 mg/day of DHEA and an anti-inflammatory drug (indomethacin or naprosyn). DHEA alone led to better blood sugar and lower serum lipids. The addition of an anti-inflammatory led to a further improvement in blood sugar and visible decrease in dorsocervical fat.

One of the markers of increasing immune dysfunction related to aging is the progressive atrophy of the thymus gland. DHEA and its metabolite 7alpha-hydroxy-DHEA have been shown to protect the thymus against atrophy induced by the stress hormones (glucocorticoids). A French study found that if either DHEA or its 7alpha-hydroxy metabolite were added to the in-vitro culture of thymocytes before its treatment with dexamethasone (a synthetic cortisol-like hormone), there was much less apoptosis (programmed cell death) of thymic epithelial cells. Thymus atrophy plays a part in the general immunosenescence that some scientists consider one of the most destructive mechanisms driving aging. The antiapoptotic action of DHEA in the thymus is thus of major importance for the preservation of immune competence.

In addition, DHEA's ability to help the body fight infection and infection-caused inflammation may be a part of its cardioprotective mechanism. Many holistic experts believe that infection is a significant causal factor in atherosclerosis, since infection increases inflammation. Part of the cardioprotective role of DHEA may stem from its ability to thwart viruses by inhibiting free radical generation and NF kappa B activation, thus reducing inflammation and viral replication. Thus, DHEA helps the body lower the pathogen load and use its resources to maintain healthy tissue, including a healthy cardiovascular system.

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