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Academic Advance

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"Radical" Medicine

Free radicals (FR) are generated during the use of oxygen for the synthesis of ATP. Several hundred thousand FR are produced every day in every cell due to aerobic inspiration or ozone-induced ionizing radiation. FR are reactive oxygen atoms or molecules which contain an orbital with an unpaired electron. They have the potential to cause enormous damage to proteins, DNA, membrane lipids and other molecules ("oxidant stress"). They can also start chain-reactions that can alter the structural integrity of cell membranes and ultimately cause cell death. Since the 1950ies, FR have been implicated as an important factor of aging with its associated diseases. They may also participate in the formation of some forms of cancers and, as recent research suggests, be a major causative agent for several neurological diseases, such as Parkinsonism and amyotrophic lateral sclerosis (Lou Gherig).

Organisms have developed anti-oxidant defense mechanisms that normally limit FR production and cell damage. Thus, superoxide dismutase transforms superoxide FR to water. FR scavengers, such as alpha-tocopherol (vitamin E) and ascorbate (vitamin C) can react directly with FR and eliminate their toxicity. Another powerful anti-oxidant is melatonin which is produced in substantial amounts in the pineal body at night time (see Guldner, 1994). Indeed, a reduction in the synthesis of melatonin in older age may be a reason for the higher incidence of malignancies during this period of life. Recent findings point to mutations in genes that are responsible for the formation of superoxide dismutase in cases of Lou Gherigûs disease. The mutated enzyme is likely to increase the production of FR speeding up exponentially the destruction of neurons. Motor neurons are selectively more vulnerable as they have a very high metabolic rate and are more active than most other neurons. They therefore take up relatively more oxygen, which produces more FR, which again makes them more dependent on a well functioning superoxide dismutase than other neurons (Olanow, 1993). Other neurons with a high metabolic rate are the dopamine producing cells in the substantia nigra of the midbrain (Olanow, 1993). Apart from the future possibilities of gene repair, it is presently tempting to assume that an intake of mega doses of vitamins C and E might be important for preventing such neurodegeneration, but much further research still has to be done.

The possibility that strenuous exercise not only improves our fitness but also speeds up aging causes vivid and understandable interest (see Edgington, 1994). Although researchers still refrain from official recommendations, most of them admit privately that they already take daily mega-doses of vitamin C (one gram and more; the 93 years old nobelist Linus Pauling was reported to take more than 10 grams per day) and vitamin E (400 mg daily and more).

Vitamin C and E and other anti-oxidant compounds may well become important tools for reducing oxidant stress under normal circumstances as well as during disease, after operations and exercise, to delay aging and to prevent its related diseases.

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