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Bioenergetic and antioxidant properties of coenzyme Q10: recent developments.

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Abstract

For a number of years, coenzyme Q (CoQ10 in humans) was known for its key role in mitochondrial bioenergetics; later studies demonstrated its presence in other subcellular fractions and in plasma, and extensively investigated its antioxidant role. These two functions constitute the basis on which research supporting the clinical use of CoQ10 is founded. Also at the inner mitochondrial membrane level, coenzyme Q is recognized as an obligatory co-factor for the function of uncoupling proteins and a modulator of the transition pore. Furthermore, recent data reveal that CoQ10 affects expression of genes involved in human cell signalling, metabolism, and transport and some of the effects of exogenously administered CoQ10 may be due to this property. Coenzyme Q is the only lipid soluble antioxidant synthesized endogenously. In its reduced form, CoQH2, ubiquinol, inhibits protein and DNA oxidation but it is the effect on lipid peroxidation that has been most deeply studied. Ubiquinol inhibits the peroxidation of cell membrane lipids and also that of lipoprotein lipids present in the circulation. Dietary supplementation with CoQ10 results in increased levels of ubiquinol-10 within circulating lipoproteins and increased resistance of human low-density lipoproteins to the initiation of lipid peroxidation. Moreover, CoQ10 has a direct anti-atherogenic effect, which has been demonstrated in apolipoprotein E-deficient mice fed with a high-fat diet. In this model, supplementation with CoQ10 at pharmacological doses was capable of decreasing the absolute concentration of lipid hydroperoxides in atherosclerotic lesions and of minimizing the size of atherosclerotic lesions in the whole aorta. Whether these protective effects are only due to the antioxidant properties of coenzyme Q remains to be established; recent data point out that CoQ10 could have a direct effect on endothelial function. In patients with stable moderate CHF, oral CoQ10 supplementation was shown to ameliorate cardiac contractility and endothelial dysfunction. Recent data from our laboratory showed a strong correlation between endothelium bound extra cellular SOD (ecSOD) and flow-dependent endothelial-mediated dilation, a functional parameter commonly used as a biomarker of vascular function. The study also highlighted that supplementation with CoQ10 that significantly affects endothelium-bound ecSOD activity. Furthermore, we showed a significant correlation between increase in endothelial bound ecSOD activity and improvement in FMD after CoQ10 supplementation. The effect was more pronounced in patients with low basal values of ecSOD. Finally, we summarize the findings, also from our laboratory, on the implications of CoQ10 in seminal fluid integrity and sperm cell motility.

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