COENZYME Q 10: A REVIEW

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ABSTRACT: Ubiquinone or Co Q10 is essentially a vitamin like substance and is a cofactor of an enzyme. It is an integral part of the membranes of mitochondria where it is involved in the energy production. It is a nutrient necessary for the function of every cell of the body especially vital organs of the body like heart, liver, brain etc. Studies have shown that coenzyme Q10 alters the natural history of cardiovascular illness and has the potential of prevention of cardiovascular diseases through the inhibition of LDL cholesterol oxidation by maintenance of optimal cellular and mitochondrial function throughout the ravages of time internal and external stress.

INTRODUCTION

Ubiquinone is found in most body tissues, the highest amount is found in the heart, liver Kidney pancreas and lungs. It is an integral part of the membrane of the mitochondria. Ubiquinone is vitamin like substance (similar to vitamin A and E) and is coenzyme for at least three mitochondrial enzyme (complex I,II,III) involved in oxidative phosphorylation for the other part of the cell. Its electron and proton transfer function is of importance in electron transport side chain.1-7

Ubiquinone is only lipid soluble coenzyme of mitochondria and can migrate freely in the lipid mass of the mitochondria and can easily accept electron and protons from various dehydrogenase system with the reversible formation of dehydroubiquinone thus is get reduced and can oxidized other biomolecules. The reduced and can dehydroubiquinone can undergo oxidation and reconverted to oxidized form i.e. ubiquinone by cytochrome b and like substances in the body and further propagates the electron transport chain.12

The energy released during various stages of this redox system is conserved in the presence of ADP and inorganic Phosphate resulting in the formation of ATP, whish can be utilized for several metabolic needs thus making it essential for ht survival of living beings.

CHEMISTRY:

Chemically ubiquinone has a quinoid structure, one at 2nd and one at 3rd position, a methyl group at 5th position and a isoprenoid side chain at 6th position of quinoid ring. The number of isoprenoid unit in the side chain varies from 6-10 for Co
Q_{10}, the number is 10. The physiologically active form has all Trans configuration.\textsuperscript{13,14}

**CLINICAL INDICATION:**

The usefulness of ConQ_{10} in heart diseases is slowly but steadily been established in the past 30 years, after the discovery of Co Q_{10} by frederick crane et al. in 1957,others investigators and its first use in heart failure\textsuperscript{15-17}

Co Q_{10} is know to be highly concentrated in heart muscle cells, as cardiac cells have high metabolic demands in term of energy and Co Q_{10} is associated with energy production. Co Q_{10} has received particular attention in the prevention and treatment of various cardiovascular diseases like congestive heart failure, hypertension, arthymia’s ischemia, reperfusion injury and to hasten post cardiac surgery recovery.

**HYPERTENSION:**

Hypertension has always been associated with cardiac complications or development of other cardiac problems, studies have provided evidences that Co Q_{10} supplementation reduces blood levels of epinephrine (Adr) and other catecholamines. This is stated to be responsible of reduction of blood pressure and it protects the vascular endothelium from free radical induced damages. The property of reducing number of platelets and its size is also helpful in the management of hypertension.\textsuperscript{18-20}

**CONGESTIVE HEART FAILURE:**

The efficacy and safety of Co Q_{10} in the treatment of CHF, whether related to primary cardiomyopathies or secondary forms of heart fail appears to be well established.\textsuperscript{21,22}

Co Q_{10} treatment in CHF revealed a significant important cardiac parameters such as ejection fraction, stroke volume, cardiac output cardiac index and end diastolic volume index\textsuperscript{23}.

**DIASTOLIC DYSFUNCTIONNING:**

Use of Co Q_{10} improves diastolic function in all categories of cardiac disease and this improvement occurs earlier and is more consistent than improvement is systolic function. Diastolic dysfunction often precedes more advanced stages of congestive heart failure and is commonly seen in a wide variety of clinical syndromes, including symptomatic hypertensive heart disease with left ventricular hypertrophy, symptomatic mitral prolapse, hypertropic cardiomyopathy, aging heart etc. and often seen in fatigue status such as chronic fatigue syndromes.\textsuperscript{24} Co Q_{10} has shown improvement in diastolic function, a decrease in myocardial thickness and also improvement in functional classification, Load induced diastolic dysfunction is also normalized by CoQ_{10} supplementation, is also causes lessening in hypertrophy and improvement. In functional status of patients with hypertropic cardiomyopathy with overall improvement in diastolic function.\textsuperscript{25} Co Q_{10} supplementation no only causes improvement in NYHA classification and left ventricular hypertrophy but a significant improvement in diastolic function of hypertensive heart patients and also of that associated with aging heart\textsuperscript{26,27}.

**ISCHEMIC HEART DISEASES:**

Study have shown that Co Q_{10} supplementation in chronic stable anginal patients improves myocardial function measurements, improves exercise capacity, significant reduction in the number of anginal episodes and nitrate consumption. Since the Co Q_{10} treatment causes no
significant alteration in heart rate or blood pressure thus indication that the mechanism of action is directly related to myocardial metabolism. Study has proved that Co Q10 reduces frequency of angina attack up to 46% while improving the capacity of physical activity for those patients.

**OXIDATION (LDL CHOLESTEROL)**

It is generally believed that the oxidation of LDL cholesterol is of primary importance in the development of atherosclerosis. Supplementation of Co Q10 prevents the oxidant effect of alpha tocopherols. Supplementation with vitamin E alone results in LDL, which was more prone to oxidation. Supplementation of Co Q10 and vitamin E which increases the resistance to oxidation. Supplementation of Co Q10 increases the amount of Co Q10 and lowered the peroxidiazibility of the LDL.

**PRE AND POST OPERATIVE RECOVERY:**

Preoperative Co Q10 administration in patients undergoing heart valve replacement has significantly reduced the incidence of low cardiac output state during post operative recovery period. Administration of Co Q 10 prior to coronary artery bypass graft, cardiopulmonary by pass surgery, has shown a significant improvement of left ventricular stroke work index postoperatively. In patients undergoing coronary artery by pass surgery with valve replacement, a pre-operative Co Q10 administration has shown significant improvement in post operative cardiac index and left ventricular ejection fraction with a significant reduction in post –operative recovery time and also significant decrease in postoperative markers of oxidative damage. A low in cadence of ventricular arrhythmia is also seen during recover period.

The same improvement was observed with CoQ10 supplementation in left atrial pressure and low cardiac output state during postoperative period and a right and left ventricular myocardial ultrastructure was better prevented.

A significant decrease in markers of peroxidative damage was observed in Co Q10 treated patients.

CoQ10 protects the myocardium form ischemic reperfusion injury by its ability to increase aerobic energy production, protects creatine kinase form oxidative inactivation as well as its activity as an antioxidant.

Improved cardiovascular morbidity and mortality have been observed in several clinical studies of dietary supplementation with Co Q10. One attraction theory links Co Q10 with the inhibition of Platelets, Significant inhibition of vitronectin receptor is a direct evidence of link between dietary Co Q10 intake, platelets and homeostasis.

**CANCER AND OTHER DISEASES:**

Apart from the benefits in various cardiovascular diseases Co Q10 also shown light of hope in the treatment of cancer, neurogenerative diseases and problems associated with weight gain. Preliminary evidences suggests that Co Q10 may suppress the proliferation of cancer cells and boost factor that kill cancer cells. Even a spontaneous regression of breast cancer has been observed in some patients.
CoQ10 deficiency was noted in both carcinomas and non-malignant lesions $^{45,46}$. Studies have shown that the administration of CoQ10 resulted in significant increase in cerebral cortex mitochondrial concentration of CoQ10. Oral administration of CoQ10 markedly attributed striatal lesions produced by systemic administration of 3 nitropropionic acid and significantly increased life span. These results show that oral administration of CoQ10 increases both brain and brain mitochondrial concentrations. CoQ10 can exert neuroprotective action. CoQ10 can attenuate the MPTP induced loss of striatal dopamine and dopaminergic axon in aged mice and suggests that CoQ10 may be useful in the treatment of Parkinson’s disease. Studies indicate that oral administration of CoQ10 significantly reduces increased concentration of lactate in the occipital cortex of Huntington’s disease patients. These findings suggest that CoQ10 may be useful in treating neurodegenerative disease $^{47}$. Various studies have shown that obese peoples are always deficient in CoQ10 levels (50%) and like people can lose weight simple with the addition of CoQ10. This enzyme increases metabolic fuel efficiency within the cell thereby stimulate the natural weight loss $^{48}$.

**CONCLUSION:**

Thus it can be concluded that coenzyme Q10 through a simple molecule but it’s a essential requirement for the survival of human beings, Being involved in almost all energy related metabolic processes, CoQ10 supplementation has proved a beneficial effect in several metabolic disorders, most common among them are related with cardiovascular system. Apart from the beneficial effect in congestive heart failure, it has proved to be equally effective in ischemic heart diseases, hypertension and diastolic dysfunctioning, it has been also found to improve the postoperative recovery in several cardiac surgeries.

Besides these, studies are showing evidences for its effect in carcinomas, Parkinsonism and problems associated with weight gain. Hence further attention should be provided on this essential coenzyme Q10, as the best preventive measure from several severe diseases.

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