CoQ10, THE BODY’S “SPARK PLUG”

By Barrie Carlsen

Coenzyme Q10, called Ubiquinone because of its ubiquitous nature, can be called Nature’s ‘spark plug’.

Ubiquinone, is concentrated in the mitochondria - the “power plants” of the cell - and plays a vital role in the production of adenosine triphosphate (ATP), the body’s so called “energy currency”. Through its synthesis of energy Ubiquinone is involved in all body processes requiring energy; energy synthesis; active transport; membrane and nucleotide stability; syntheses of enzymes, coenzymes, hormones; neurotransmitter synthesis and reuptake; ciliary activity in the upper respiratory systems; all muscle contractile functions; sperm production and motility; deactivation of muscle contractions; pumping action of sweat and other cutaneous glands; etc.

Ubiquinone is the hub around which life processes revolve in the human body.

Coenzyme CoQ10 exists in two forms and structure as Ubiquinone and Ubiquinol, having two separate but essential functions, and its ability to act as a redox pair to recycle each other as needed. Without Ubiquinone, life is not possible because the body cannot survive without energy. Ubiquinol, due to its antioxidant properties, recycles Ubiquinone to maintain the life sustaining supply of energy. Ubiquinol and other antioxidants act as part of the host defense system and prevent the toxic by-products (free radicals and super oxides) from the synthesis of energy, from damaging our cells and shortening and reducing the quality of life.

Ubiquinone and Ubiquinol, being redox pairs, are easily converted from one form to the other in the body. When exogenous Ubiquinone is absorbed from the intestines it is converted to Ubiquinol in the absorption cells, the lymph, or in the blood. Since CoQ10 is not used to produce energy in the lymph system or blood, it is understandable that this conversion takes place to fulfill the need for anti-oxidant protection in the circulation.

On the other hand, in the inner membrane of the mitochondria where energy is made, the oxidized Ubiquinone is necessary, and the reduced form Ubiquinol is rapidly converted to the oxidized Ubiquinone form. This conversion is known as the Q cycle, and it was once thought that the proportion of Ubiquinone and Ubiquinol required for energy synthesis would last indefinitely. It is now known that age and disease diminish the body’s ability to produce Ubiquinone and to convert it to Ubiquinol and that CoQ10 deficiency would be prevalent in an ageing society.

Pyridoxyl-5'-Phosphate (PLP), the active form of vitamin B6 should be included with CoQ10 supplementation because it further enhances plasma concentrations of CoQ10. PLP is essential to the endogenous (internal) synthesis of CoQ10. It is known that the endogenous bio-synthesis of CoQ10 from the precursor tyrosine is dependent on adequate PLP levels. Research has found that individuals with low plasma CoQ10 status are also low in plasma PLP. Taiwanese researchers found that high blood levels of CoQ10 and vitamin B6 (pyridoxyl-5-phosphate) were linked to lower artery disease risk.

Phosphatidylcholine (PC): A more effective delivery system (release in the small intestine) should include the use of fat soluble emulsifying agents such as phosphatidylcholine to increase the bio-activity of CoQ10. It was demonstrated that the bio-availability of sitostanol, a phytosterol compound, was increased when formulated with lecithin. Another study showed that absorption of the fat soluble carotenoid lycopene was enhanced with the enteral administration of phosphatidylcholine. In addition to PC’s ability to assist in the transport of CoQ10 throughout the bloodstream and bile, it functions structurally as a component of the cell membrane and as a neurotransmitter for normal brain function.

Supplemental intake of CoQ10 formulated with phosphatidylcholine and pyridoxyl-5'-phosphate will enhance plasma concentrations of CoQ10 thereby improving its bio-activity. In addition, this combination of nutrients may also help reduce the levels of plasma homocysteine (an independent marker for
cardiovascular disease risk), since pyridoxyl-5'-phosphate and phosphatidylcholine support the methylation pathways responsible for lowering homocysteine levels.

**Bio-Availability of Ubiquinone and Ubiquinol**

CoQ10 (Ubiquinone) is a large molecule that is absorbed through the absorption cells in the small intestine by a simple passive facilitated diffusion process. Passive means that the process does not require energy; Facilitated means that the process requires a lipid molecule such as phosphatidylcholine to act as a carrier for the CoQ10 molecules.

After absorption, CoQ10 accumulates in the blood and becomes bio-available to all body cells. Bioavailability reflects absorption but it is not the actual absorption and should not be used as an accurate measure of such; it does, however, give a good estimate of the amount of CoQ10 available as an antioxidant in the blood and that's available to the body cells. CoQ10 is accumulated and is stored in the cell membranes and in the membranes of the organelles in the cell.

It has been known for over two decades that the bio-availability of the pure crystalline CoQ10 is less than that of liposome, micelle, and dissolved CoQ10 forms. The current commercial and scientific issue is the bio-availability of Ubiquinol compared to that of Ubiquinone.

Both forms are poorly absorbed when supplemented in traditional hard and soft gelatin capsules or tablets, with only 1% of the oxidized Ubiquinone absorbed in its pure crystalline state. Up to a 3 times increase in absorption is possible with Ubiquinol or with micelle forms of Ubiquinone; however, 3 x 1% is still only 3%, a very low absorption. The 97% of ingested CoQ10 is “digested” by stomach acids and enzymes and very little actually enters the small intestine for absorption.

**Coq10 and Congestive Heart Failure:**

Ubiquinone has been scientifically evaluated for over 40 years with hundreds of published clinical studies and is accepted as the choice of practicing cardiologists worldwide. It is now presented in basic and graduate level textbooks of the biomedical sciences. A May, 2013 presentation at the Congress of the European Society of Cardiology shows that CoQ10 (ubiquinone) can reduce heart failure by half.

A study from Taiwan published in the October, 2011 edition of Nutrition titled “Coenzyme Q10 supplementation reduces oxidative stress and increase antioxidant enzyme activity in patients with coronary artery disease”. The authors reported: “A daily CoQ10 (Ubiquinone) dose of 150 mg was associated with 29% lower levels of malon-dialdehyde (MDA - a reactive carbonyl compound and a well-established marker of oxidative stress) after eight weeks, compared with the placebo group”.

An analysis of 13 clinical studies found that taking CoQ10 (usually 100 mg daily) significantly improves how well the heart pumps blood (i.e. ejection fraction) by about 3.7% compared to a placebo in people with mild to moderate heart failure.

The largest and longest clinical study to date found that taking 100 mg three times daily of CoQ10 for 2 years significantly reduced the chance of an adverse cardiovascular event (e.g. hospitalization, worsening heart failure, or death) by almost 50% compared to a placebo in people with moderate to severe heart failure and significantly improved measures of quality of life such as activity levels, fatigue and shortness of breath.

**Vitex’s Coenzyme Q10 formula** received a Health Canada NPN number on September 9, 2009 and is approved for the claim: “Helps to maintain and/or support cardiovascular health”
**DRcaps**

A revolutionary new capsule technology has recently entered the market. These delayed release vegetarian capsules called **DRcaps** resist the low Ph of stomach acids and enzymes and will release the capsule contents directly to the higher Ph of the small intestine. For nutrients such as CoQ10, NAG, pancreatic enzymes and other antioxidants, this is a substantial advantage as absorption is increased substantially.

**References:**

12. European Journal of Heart Failure (2013) 15 (S1), S20. The effect of coenzyme Q10 on morbidity and mortality in chronic heart failure. Results from the Q-SYMBIO study
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Coenzyme Q10 for Migraine Prevention

Health Canada has approved Coenzyme Q10 for the following claim: “Helps to reduce the frequency of migraine headaches and associated nausea and vomiting when taken as a prophylactic.

Open label trial of coenzyme Q10 as a migraine preventive

Abstract

The objective was to assess the efficacy of coenzyme Q10 as a preventive treatment for migraine headaches. 32 patients (26 women, 6 men) with a history of episodic migraine with or without aura were treated with coenzyme Q10 at a dose of 150 mg per day. 31 of 32 patients completed the study; 61.3% of patients had a greater than 50% reduction in number of days with migraine headache. The average number of days with migraine during the baseline period was 7.34 and this decreased to 2.95 after 3 months of therapy, which was a statistically significant response (P < 0.0001). Mean reduction in migraine frequency after 1 month of treatment was 13.1% and this increased to 55.3% by the end of 3 months. Mean migraine attack frequency was 4.85 during the baseline period and this decreased to 2.81 attacks by the end of the study period, which was a statistically significant response (P < 0.001). There were no side-effects noted with coenzyme Q10. From this open label investigation coenzyme Q10 appears to be a good migraine preventive. Placebo-controlled trials are now necessary to determine the true efficacy of coenzyme Q10 in migraine prevention.

Dosage and potential side effects:

The dosage recommended and used in the study is 150 mg of coenzyme Q10 daily. As for potential side effects, the study showed:

"In most instances coenzyme Q10 administration has been very well tolerated in doses up to 600mg per day, with an excellent side-effect profile. The most common side-effects pertain to the gastrointestinal system and include nausea, diarrhea, appetite suppression, heartburn and epigastric discomfort. In large studies the incidence of gastrointestinal side-effects is less than 1%.

As for side effects, coenzyme Q10 has few, and rarely is the incidence of side effects of any medication or supplement less than 1%. This is an excellent side effects profile.

Key points from the trial:

- 61.3% of the patients in the trial achieved at least a 50% reduction in frequency of Migraine attacks by the end of the four-month trial.
- As with most Migraine preventives, it takes time to achieve optimum results. Data from the study suggest that it takes five to 12 weeks to achieve more than a 50% reduction.
- Coenzyme Q10 is effective for both Migraine without aura and Migraine with aura.

The bottom line from this study:

"Coenzyme Q10 looks to be an excellent choice for initial therapy for prevention of episodic migraine if confirmed by controlled studies of efficacy. It can be given to almost any age group without fear of significant side-effects."

Hershey et al Study

Hershey et al conducted a study with the stated objective to, "This study documents the prevalence of CoQ10 deficiency in migraine headache and examines the potential effectiveness of supplementation." They found CoQ10 deficiency to be common in pediatric and adolescent Migraineurs and supplementation to be beneficial.
Summary:
Although research and development of Migraine abortives has made great strides in recent years, work on preventives has been woefully lacking. None of the medications used for Migraine prevention were originally developed specifically for that purpose, and trials of drugs being used off-label for Migraine prevention have been so few that only one drug has actually been approved by the FDA for Migraine prevention (Depakote). This trial of coenzyme Q10 is important because of its excellent results and because it is for a Migraine preventative rather than another Migraine abortive.

Efficacy of Ginkgolide B in the prophylaxis of migraine with aura

Abstract
In a multicentric, open, preliminary trial, we evaluated the use of ginkgolide B, a herbal constituent extract from Ginkgo biloba tree leaves, in the prophylactic treatment of migraine with aura (MA). Fifty women suffering from migraine with typical aura, or migraine aura without headache, diagnosed according to International Headache Society criteria, entered a six-month study. They underwent a two month run-in period free of prophylactic drugs, followed by a four month treatment period (subdivided into two bimesters, TI and TII) with a combination of 60 mg ginkgo biloba terpenes phytosome, 11 mg coenzyme Q 10, and 8.7 mg vitamin B2 (Migrasoll), administered twice daily. A detailed diary reporting neurological symptoms, duration, and frequency of MA was compiled by patients throughout the trial. The number of MA significantly decreased during treatment (from 3.7 +/- 2.2 in the run-in period, to 2.0 +/- 1.9 during TI and to 1.2 +/- 1.6 during TII; Anova for repeated measures: P < 0.0001). There was also a statistically significant decrease in the average MA duration, which was 40.4 +/- 19.4 min during run-in, 28.2 +/- 19.9 during TI, and 17.6 +/- 20.6 during TII. Total disappearance of MA was observed in 11.1% patients during TI and in 42.2% of patients during T2. No serious adverse event was provoked by Migrasoll administration. Ginkgolide B is effective in reducing MA frequency and duration. The effect is clearly evident in the first bimester of treatment and is further enhanced during the second.

Ginkgolide B complex efficacy for brief prophylaxis of migraine in school-aged children: an open-label study

Abstract
Primary headaches (migraines and tension-types headaches) are very common in school-aged children. Ginkgolide B, a herbal constituent extract from Ginkgo biloba tree leaves, was considered as a promising pharmacological aid for the treatment of migraine in adult patients because of its modulation of the glutamatergic transmission in the CNS and on antiplatelet activating factor (PAF). The aim of study is to verify the effectiveness and safety of association of Ginkgolide B/Coenzyme Q10/Riboflavin/Magnesium complex for brief prophylaxis in a population of school-aged children with migraine. In our sample after 3 months of treatment with association of Ginkgolide B/Coenzyme Q10/Riboflavin/Magnesium complex, the mean frequency per month of migraine was significantly decreased (9.71 ± 4.33 vs. 4.53 ± 3.96 attacks; p < 0.001). Our findings suggest that in childhood headache management, the use of alternative treatments must be considered not to evoke a placebo effect, but as soft therapy without adverse reactions.
Role of Magnesium, Coenzyme Q10, Riboflavin, and Vitamin B12 in migraine prophylaxis

Abstract

Migraine is a neurovascular syndrome characterized by recurrent headache associated with other symptoms, eventually preceded by aura. This chapter reviews the involvement of some mineral, coenzyme, and vitamin defects in the pathogenesis of migraine headaches and focuses on their potential therapeutic use in the preventive treatment for migraine. The therapeutic potential of magnesium, coenzyme Q(10), riboflavin, and vitamin B(12) can be cautiously inferred from some published open clinical trials; it should, however, be considered that double-blind randomized larger studies are needed to correctly estimate the impact of the placebo effect in these promising therapies.

References:

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3 Coenzyme Q10 (PDQ®). National Cancer Institute.

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7 Bianchi A1, Salomone S, Caraci F, Pizza V, Bernardini R, D'Amato CC. Department of Pharmaceutical Sciences, University of Salerno, 84084 Fisciano, Italy.

Summary:

Ubiquinone is manufactured by the body with the help of **Pyridoxyl-5'-Phosphate**. Ubiquinol is not manufactured directly by the body, but is produced by the breakdown of Ubiquinone as part of the **Q cycle**.

In spite of what the promoters of Ubiquinol claim there has been very little scientific evidence that Ubiquinol supplements are equal to, much less better than Ubiquinone in terms of biological activity or therapeutic benefit. Ubiquinol became commercially available in 2006, and to date there have been no clinical studies in human beings comparing Ubiquinone to Ubiquinol that have been published in peer reviewed scientific literature.

The most critical aspect of CoQ10 supplementation is absorption. Ubiquinone formulas that incorporate synergists such as **Pyridoxyl-5'-Phosphate** and **Phosphatidylcholine**, and use the new **DRcaps** for enhanced intestinal absorption offer the most biologically active and cost effective way to CoQ10 supplementation and should be the supplement of choice.

**Note:** in all of these studies Ubiquinone, not Ubiquinol was used.