ORIGINAL ARTICLE

New Insights into the Role of Coenzyme Q10 in Serum LDL-Cholesterol Reduction

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ABSTRACT

Objective: To explore effect of Coenzyme Q10 (Co Q10) on serum LDL-Cholesterol and compare its hypolipidemic efficacy with the normal control.

Study Design: Randomized control trial.

Place and Duration of Study: The study was conducted from 1st February 2013 to 30th June 2013 at the department of chemical pathology, Army Medical College and National Institute of Health Sciences (NIH) Islamabad.

Materials and Methods: Eighteen rabbits were divided into three groups of six rabbits each. Base line lipid profile was estimated for serum LDL cholesterol in mmol/L. Leaving one group as normal control, the other two groups were given high cholesterol diet to produce hyperlipidemia. Of the two hyperlipidemic groups, one group was treated with CoQ10 orally for 30 days. Blood samples were drawn for lipid biochemistry, 24 hours after administration of the last dose. The means of serum analysis were calculated and compared using SPSS version 20.

Results: Serum LDL-cholesterol (LDL-C) was reduced in the group taking CoQ10 as compared to the group with no CoQ10 treatment. The p value was significant for LDL-C in treatment group, ($p<0.0001$).

Conclusion: It is concluded that Coenzyme Q10 plays a vital role in hyperlipidemic rabbits in reducing serum LDL cholesterol levels.

Key Words: *CoQ10, Hyperlipidemia, LDL-Cholesterol.*

Introduction

The increasing incidence of deaths due to cardiovascular diseases (CVD) have become a foremost current health issue and are accountable for 76 percent of deaths and disabilities due to myocardial infarction, atherosclerosis and stroke.[1] The most vital risk factor for coronary heart disease is high blood LDL-C levels that accumulate on the walls of the arteries.[2,3] Trials have shown that there is 30 percent decline in the risk of CVD by pharmacologically lowering serum LDL cholesterol. Therefore it has been stressed that lowering the blood lipids are beneficial in cardiovascular patients.

Blood cholesterol levels are maintained within normal range via antihyperlipidemic drugs exhibiting different lipid lowering mechanisms.[4] Therefore majority of patients need a combination of two or more agents to cope with the major determinant of CVD i.e. hyperlipidemia.[5] In order to prevent the unavoidable adverse reactions with traditional antihyperlipidemic agents, monodrug therapy with vitamin like substance exhibiting properties of controlling blood cholesterol in addition to acting as supernutrient may offer valuable consequences.[6]

Coenzyme Q10 (CoQ10) is a fat soluble, vitamin like enzyme and is an important supernutrient. It is synthesized in all the tissues of body especially liver.[7] CoQ10 is recommended to prescribe nowadays along with the conventional treatment of cardiovascular diseases as a supplement.[8,9] CoQI0 is found in wide variety of foods and is richly present in meat, poultry, fish products, nuts, broccoli, soy bean and spinach.[10]CoQ10 is available in different formulations like tablet, gel, capsules as well as in injection form. CoQ10 is a large molecular weight substance and is hydrophobic in nature.[11] Absorption of dietary CoQ10 is slow and limited but increases with meal.[12] Solubilized formulations show enhanced bioavailability with Tmax of approx. 6 hrs.[13]It has elimination half-life of 33 hours.[14] CoQ10 is taken up by all the tissues including heart and brain mitochondria.[15] It also undergoes enterohepatic circulation as it is reabsorbed from small intestine

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instead of exceretion.[16] CoQ10 is incorporated in its reduced form i.e. ubiquinol, into the mitochondria of almost all the body tissues especially brain and heart mitochondria and allow these tissues to produce more energy in the form of ATP.[17,18] This energy is required to maintain basic metabolic functions such as to take up and utilize nutrients, to synthesize new proteins and to discard waste materials. CoQ10 also acts as a potent antioxidant by mopping up potentially harmful free radicals.[19] Unstable free floating electrons when not attached to other molecules are capable of causing damage to cell membranes. As an antioxidant, it causes the regeneration of vitamin E and vitamin C and prevents prooxidant effects of vitamin E. Once it gives up its free electron to stabilize a free radical, it needs to be regenerated in order to become functional again. For this, drug hands over electrons to oxidized version of vitamin E and C, and thus converts back to its reduced form, ubiquinol (reduced CoQ10).[20] In this way it protects mitochondrial DNA from oxidative stress. An important mechanism of action of CoQ10 involves the decrease in the oxidation of LDL cholesterol thereby reducing the risk of developing atherosclerosis and other cardiovascular diseases.[21,22]

Unlike traditional antihyperlipidemics, no adverse drug reactions have been documented with CoQ10 so far, the objective of my study is to observe the potential of Coenzyme Q10 in LDL-Cholesterol reduction in hyperlipidemic rabbits to see wheather this provitamin can be used in cardiovascular patients effectively.

Materials and Methods

It was a randomized control study. The approval for the study was sought from the Ethics committee of Centre for Research in Experimental and applied Medicine (CREAM). The study was conducted from 1st February 2013 to 30th June 2013 at the department of chemical pathology, Army Medical College and National Institute of Health Sciences (NIH) Islamabad.

Study included eighteen healthy adult rabbits having a weight of 1.5 to 2.0 kg. They were of mixed breed with equal distribution of male and female rabbits in three different groups. Animals under 1.5 years of age and pregnant females were excluded from the study. Standard laboratory conditions were maintained in animal house of National Institute of Health and were provided with controlled environment assuring twelve hours day and night cycle and an average temperature of 24oC. Rabbits were acclimatized for one week before the study.[23] After acclimatization, the study period comprised of twenty weeks. Blood samples (n=6.0) were drawn from the dorsal surface of rabbit's marginal ear vein with the help of a 5cc syringe according to standard described techniques. All the samples were transferred to separate plain clot activator tube were centrifuged at 4500 rounds per minutes for 10 minutes. Serum was separated via an automatic micropipette and then shifted in clean dry vials for estimation of serum cholesterol, serum triglycerides and serum HDL-Cholesterol in mmol/L. All tubes were labelled accordingly.

The rabbits were randomly assigned into three groups of six animals each. Group A was the control group and received normal diet and water ad libitum for 150 days. Group B (hyperlipidemic control; n=6) animals received cholesterol powder (1g/day) mixed in a diet comprising of grain whole and wheat bran for 120 days. Cholesterol powder was excluded from the diet for the next 30 days. Rabbits were also given tap water ad libitum for drinking.

Group C (hyperlipidemic+Coenzyme Q10; n=6) animals received the high cholesterol diet (1g/day) as per group B for 120 days and then fed on normal/routine diet without cholesterol along with Coenzyme Q10 (10mg/kg) once daily via gavage for a period of 30 days.

Serum LDL was calculated in (mmol/L) by using the formula:-

LDL=TC-HDL-TG/ 2.20 + HDL – Cholesterol.[24]

The statistical analysis was carried out using SPSS version 20. The results of serum analysis were established as means + standard error of mean.[25] The difference was taken as significant for a p value of 0.05 or less.

Results

Group A (normal control) showed unchanged levels of serum LDL-C when recorded on day 120 and on day 150 in contrast to the levels recorded on day zero.

In group B (hyperlipidemic control), serum LDL-C levels on day 120 were increased significantly as compared to day zero with p=0.0005. The levels

remained unchanged on day 150 in comparison to day 120 in this group so p>0.05, but were increased on day 150 in comparison to group A (normal control) hence p<0.0005. Group C (CoQ10) LDL-C levels were also recorded on day zero and day 150. When this treatment group was compared with group B (hyperlipidemic control) to assess the post treatment reduction in serum LDL levels on day 150, a statistically remarkable decrease was recorded, i.e. group C (CoQ10) p value equal to 0.0001.

Table 1: Means ± SEM of serum LDL-C (in mmol/L) in group A, group B and group C in rabbits (n=6)

	Group A	Group B	Group C
Day 0	1.64	1.61	1.63
	±1.1	±1.1	±0.33
Day 120	1.64	3.45	3.35
	±0.8	±0.2	±1.2
Day 150	1.64	3.45	1.80
	±0.5	±0.3	±0.75
P-Value	0.006	0.0001	0.0001

[1]n=6, Results are expressed as mean ± SEM (Standard Error of Mean)

Discussion

In our study we found that CoQ10 has the ability to reduce serum LDL cholesterol significantly in high cholesterol diet fed rabbits. This favors the dual role of Coenzyme Q10, i.e. although it is a supernutrient, CoQ10 also serves as an antihyperlipidemic agent. Similar results were also shown by Ketan et al., (2006).[26] They established that CoQ10 has a potential of lowering all the parameters of lipid profile including serum total cholesterol, TGs, VLDL, and LDL with the exception of serum HDL which increases with the use of CoQ10. The only difference with our study is that, they used rats instead of rabbits as an experimental model. Our results are also consistent with the inference of Hiroshi et al., (2007). They certified from their study that treatment with CoQ10 significantly improves plasma lipid biochemistry.[27] CoQ10 has the ability to decrease even aortic cholesterol and triglycerides in trans- fatty rich diet. Singh et al., (2000) explained the reduction in aortic and coronary artery plaque sizes along with the decrease in aortic and coronary artery scars in high fat diet induced rabbits.[28] Keeping all this in view, our inference is that CoQ10 reduces the serum LDL-C in high cholesterol diet fed rabbits. Administration of this vitamin like substance can be used effectively in lowering high serum LDL-C levels in hyperlipidemia. Coenzyme Q10, a provitamin as it is a safe and highly tolerable drug, so can be used without the fear of adverse drug reactions that otherwise would occur with other traditional antihyperlipidemic agents. Future studies are required to observe the antihyperlipidemic potential of this vary super nutrient in human subjects so that it can be used to prevent or to treat cardiovascular diseases.

Conclusion

After conducting this experimental study on eighteen rabbits and assessing the results of serum analysis statistically, it is concluded that CoQ10 has a potential to reduce serum LDL-Cholesterol in hyperlipidemic rabbits. Further studies in humans are needed, however, to prove its action of improving serum lipid profile to be used effectively for the prevention and treatment of cardiovascular diseases.

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