ORIGINAL ARTICLE

Effect of Levocarnitine Administration for Management of Dyslipidaemia in Levothyroxine-treated Hypothyroid Patients

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Abstract

Introduction: *Hypothyroidism is the one of the common chronic diseases and patients suffering from this disease show hyperlipidaemia inspite of receiving thyroid hormone replacement.Thyroid hormone play an important role in carnitine-dependent long chain fatty acid transport and oxidation. L-carnitine (LC) plays an important physiologic role in lipid metabolism. It appears rational if such patients are treated with l-carnitine in addition to receiving l-T_4. The present study was conducted to evaluate the effect of levocarnitine administration on lipid level and thyroid hormone level in hypothyroid patients.*

Methods: *The present randomized control trial was carried out in the Department of Pharmacology and Department of Endocrinology of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from September 2016 to February, 2018. The study included a total of 71 hypothyroid patients receiving levothyroxine replacement therapy. Patients were randomly divided into Group A (Control group, n = 35) and Group B (Experimental group, n = 36). Blood was collected for baseline measurement of thyroid hormone levels and serum lipid profile. Group A patients were treated with l-T_4 and Group B patients were treated with l-carnitine 2g/day for 8 weeks in addition to l-T_4 therapy. After 8 weeks, blood was collected from both groups again to measure the same parameters as were measured at baseline.*

Results: *The baseline characteristics of Group A and Group B were almost identical. The total cholesterol levels significantly increased in Group A (106.52 ± 21.79 mg/dL to 132.11 ± 36.26 mg/dL, P = 0.001) and significantly decreased in Group B (141.69 ±54.41 mg/dL to 123.83 ± 32.76 mg/dL, P = 0.017) after 8 weeks. No significant difference (P = 0.317) was observed between two groups. In Group A (Control group), serum TG levels (132.11 ± 72.98 mg/dL to 149.06 ± 58.54 mg/dL, P = 0.129) was not significantly changed but significant reduction (179.12 ± 103.28 mg/dL to 129.51 ± 59.23 mg/dL, P = 0.007) was observed in serum TG levels in Group B (Experimental group). Intergroup difference was not significant (P = 0.166). There was no significant change in the level of plasma HDL-C, which changed from 23.43 ± 5.64 mg/dL to 21.71 ± 7.57 mg/dL (P = 0.250) in Group A and from 22.67 ± 10.09 mg/dL to 26.28 ± 8.43 mg/dL (P = 0.079) in Group B but significant difference (P = 0.019) was observed between the groups after 8 weeks. In Group A, plasma LDL-C level was significantly increased (56.96 ± 23.17 mg/dL to 80.46 ± 34.00 mg/dL, P = 0.001) and decreased (83.78 ± 45.21 mg/dL to 71.67 ± 31.49 mg/dL P = 0.061) in Group B. No significant difference (P = 0.263) was observed between the Control and Experimental group.*

Conclusion: *The results suggest that, administration of l-carnitine in hypothyroid patients being treated with thyroid hormone (l-T_4) replacement had produced significant increase of HDL-C level compared to the group of hypothyroid patients who were treated with l-T_4 alone without significant changes in levels of other serum lipids.*

Keywords: *Dyslipidaemia, Levocarnitine, Lipid metabolism, Hypothyroidism, Levothyroxine*

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Introduction:

Thyroid diseases namely hypothyroidism and hyperthyroidism constitute common endocrine abnormalities in Bangladesh and around the world. Hypothyroidism is more common compared to hyperthyroidism (prevalence rate of 0.3%-5%).[1,2] According to the 6 years duration NHANESIII (National Health and Nutrition Examination Survey-III) study in USA conducted in the years of 1988-1994, the prevalence rate of hypothyroidism was 4.6% (0.3% clinical and 4.3% subclinical).[3] There is no satisfactory data regarding the total number of patients suffering from thyroid dysfunction in Bangladesh. Yet thyroid dysfunction, specially hypothyroidism affects a significant percentage of population throughout Bangladesh. Male and Female both are affected, although the percentage of females affected are higher.[4]Diffuse goitre occupies the highest incidence (7.35%) followed by subclinical hypothyroidism (6.59%) and clinical hypothyroidism(4.97%).[5] The prevalence of subclinical hypothyroidism was 15%.[6] A recent survey in Bangladesh has reported that, the prevalence rate of hypothyroidism was 48% among all the thyroid disorders.[7] All these data suggest that a significant percentage of the population suffer from hypothyroidism who require replacement therapy with thyroid hormone.

Thyroid hormone is involved in fatty acid oxidation.[8] It enhances transfer of free fatty acids for delivery into the mitochondria.[9] l-carnitine, which is synthesized endogenously in the human body from the essential amino acids lysine and methionine[10] appears as an essential carrier of fatty acids to the inside of the cell.[11, 12, 13] l-carnitine transports long chain fatty acids into the mitochondria whereupon the high energy source (ATP) becomes synthesized.

Hypothyroidism is one of chronic diseases and common metabolic disorder patients suffering from this disease shows hyperlipidaemia inspite of receiving thyroid hormone replacement. Due to several changes in the synthesis, metabolism, and mobilization of lipids, total cholesterol and low-density lipoprotein (LDL) cholesterol level remain elevated in hypothyroidism. Thyroid hormones induce hydroxymethylglutaryl coenzymeA (HMG-CoA) reductase expression in liver, which results in increased cholesterol synthesis.[14] Therefore, hepatic cholesterol synthesis is decreased in hypothyroid patients. However, the expression of cell surface LDL cholesterol receptors expressed in fibroblasts, liver, and other tissues also increased by thyroid hormone. Thus the rate of LDL cholesterol clearance from the serum is increased. This thyroid hormone effect on LDL cholesterol receptor expression outweighs the effects of decreased hepatic cholesterol synthesis, leading to a net accumulation of serum LDL cholesterol in hypothyroidism. Thyroid hormones also increases the activity of lipoprotein lipase which lowers triglyceride levels through hydrolysis of triglyceride-enriched lipoproteins and thus facilitate the transfer of cholesterol from these lipoproteins to HDL cholesterol.[15] Therefore, hypertriglyceridemia may develop in hypothyroidism.

Overt hypothyroidism patientswith hyperlipidemiashould be treated with adequate l-T4 therapy following which TSH level become normal usually by 2 to 4 months.[16] Up to 30% to 50% decrease in the ratio oftotal cholesterol to HDL-C can be expectedwith L-T4 treatment.[17] If the hyperlipidemia has notresolved with l-T4 therapy alone, therapeutic lifestylechanges should be instituted and lipid-lowering medicationsshould be added as appropriate. Clinical trials to date have notshown a significant beneficial effect of l-T4 therapy onlipids in patients with subclinical hypothyroidism, mostlikely because theselipid changes are relatively subtle and according to current evidence, specific lipid-loweringtreatment should be instituted in hyperlipidemic patientswith subclinical hypothyroidism regardless of whether ornot they are treated with l-T4.[16]

L-carnitine (LC) plays an important physiologic role in lipid metabolism. In one clinical study, diabetic patients were investigated using a higher dose ofl-carnitine supplementation of 2000 mg/d (2g/day) for 12 weeks. Significant decreases in the levels of TC, TG, LDL-C, oxidized LDL-C, and Apo-B were observed after 12 weeks and increases were observed inthe levels of HDL-C and Apo-A1.[18] Oral l-carnitine supplementation can decrease TG and increase HDL levels, without significant effects on cholesterol or LDL levels in dyslipidemic ESRD (End stage renal disease) patients under continuous hemodialysis.[19] Another study was done in CAD (Coronary atherosclerotic disease) patients which concluded that, l-carnitine supplementation at a dose of 1000 mg/d (1g/day) resulted in significant increases in HDL-C and Apo A1 levels and a slight decrease in TG levels, but no other changes in other lipids.[20] Administration of 1g oral l-carnitine 3 times a week for 16 weeks has been reported to decrease serum TG and serum VLDL levels without significant changes in levels of other serum lipids.[21]

Researches have suggested that, significantly decreased levels of total carnitinein skeletal muscles due to lack of thyroid hormone in hypothyroid patients.[22] This lowering of carnitine may be explained by decreased biosynthesis

of carnitine.[23, 22] Some reports suggestthat, l-carnitine is a peripheral antagonist of thyroid hormone action.[24]

Several lines of evidence have shown an association between thyroid hormone and the l-carnitine system and those strengthen the suggestion that, Thyroid hormone increases carnitine bioavailability[23] followed by activating carnitine dependent fatty acid import into mitochondria.When hypothyroid patients receive l-T_4, thyroid hormone would promote carnitine synthesis but would also accelerate mitochondrial fatty acid oxidation which uses carnitine may future lead to relative carnitine deficiency.

The present study is an attempt to investigate lipid lowering effect of l-carnitine in hypothyroid patients by administering l-carnitine. A large number of patients in this country are suffering from hypothyroidism related hyperlipidaemia although getting adequate l-T_4 therapy. So far as the research is informed, adequate study has not been carried out in this country to detect the claimed benefit of l-carnitine on lipid level of hypothyroid patients. So, the present study has been designed to asses ameliorating effects of l-carnitine in the management of hyperlipidaemia in levothyroxine treated hypothyroid patients.

Methods:

Being a randomized controlled trial, the present study was carried out in the Department of Pharmacology and Department of Endocrinology of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from September 2016 to February, 2018. The research protocol was reviewed and approved by the IRB of BSMMU on 15th March, 2017. An approval number was collected (No. BSMMU/2017/2668). This study was also registered in Clinical Trial.gov and the ID number was (NCT03372772). All participants (patients) included in the study were informed about the nature and purpose of the study. A written consent was obtained from each person included in the study.

Enrolment of patients were performed by following specific inclusion criteria: clinical diagnosis of primary hypothyroid patients, Age: 20-50 years, both sexes,levothyroxine treatment receiving for last 6 months,serum FT_4 level (0.80-1.80 ng/dL)and serum TSH level (0.35-5.50 μIU/mL) were within normal reference range. Patients with following characteristics were excluded from the study: acute or chronic liver diseases, anaemia, clinical diagnosis of diabetes mellitus, cardiovascular disease (such as heart failure, arrhythmia and uncontrolled hypertention), patients with psychological disorders (such as depression, anxiety disorder, schizophrenia, alchoholism or fatigue disorder due other systemic diseases), patients having serious infections or terminal illness (such as tuberculosis, HIV or malignant tumour), autoimmune diseases (such as rheumatoid arthritis, SLE or multiple sclerosis), patients with impaired renal function, pregnant or expecting mothers,nursing mothers, patients receiving drugs eg. corticosteroid, iron, calcium, amantadine, lithium, carbamazepine, phenobarbiton, beta-blocker.

92 patients were enrolled and were randomized into Control group (Group A, n=49) and Experimental group (Group B, n=43). 14 patients from Group A and 7 patients from Group B had dropped out from the experiment due to personal reasons, delaying in follow up or not willing to continue the treatment. Therefore, 35 patients from the Group A and 36 patients from Group B remained to complete the study. Patients body weight, blood pressure and pulse rate were obtained at the time of enrolment in the study (baseline). 6 mL blood were collected following overnight fasting for the baseline measurement of serum TSH and serum T_4 level and lipid levels (serum cholesterol, triglyceride, HDL-C, LDL-C level). Group A patients were treated with L-T_4 only at appropriate dose orally once daily for 8 weeks and Group B patients were treated with L-carnitine at a dose of 2 gram oral solution daily in two divided dose for 8 weeks in addition to L-T_4 therapy. Compliance sheets were provided for each patients. Consumption of medicine was ensured by telephone and return of empty vial and also from the patient's compliance sheet. After 8 weeks, blood was collected again from both groups to measure the same parameters as were measured at baseline. Patients were asked to report for any adverse effects (if observed) of the medication given during the period of study.

Estimation of plasma cholesterol by enzymatic (CHOD-PAP) method;[25] plasma triglycerides by enzymatic (GPO-PAP) method;[26]plasma high density cholesterol (HDL-C) by enzymatic (CHOD-PAP) method, after precipitation;[27, 28] plasma low density lipoprotein cholesterol (LDL-C) by Friedewald equation.

Estimation of serum TSH and freeT_4 level: Was estimated by automated analyser (Unicel DXI-600).

The data was analysed using SPSS (Statistical Package for Social Sciences) software, version: 19.0. The quantitative variables were expressed as mean ± SD. The 'P' value less than 0.05 considered statistically significant.

Results:

All participants were non-smoker, non-hypertensive and non-diabetic. In Group A, the age was 33.51 ± 8.08 years (mean ± SD) and in Group B, the age was 35.42 ± 7.52 years

(mean ± SD). No significant difference between the two groups could be obtained statistically. In Group A, one out of 35 patients was male and 34 were female while in Group B, two out of 36 patients were male and 34 were female. The body weight was 61.54 ± 9.58 kg in Group A and in Group B the body weight was 62.50 ± 8.18 kg. Again there was no significant difference between the two groups.

The serum TSH level in Group A and Group B were2.43 ± 1.56μIU/ml and 2.52 ± 1.38 repectively. After 8 weeks, the same parameter were 2.36 ± 1.56 (Group A) and 3.00 ± 1.49 (Group B) respectively. The change was not statistically significant (P = 0.841 and P = 0.128 respectively). The mean decrease (%) in TSH level in the Group A was 2.88% and the mean increase (%) in Group B was 19.05%. At baseline, the serum T_4 level in Group A and Group B were1.29 ± 0.21 ng/dL and 1.29 ± 0.16 ng/dLrespectively. After 8 weeks, these were 1.39 ± 0.30 (Group A) and 1.31 ± 0.18 ng/dL (Group B) respectively. The mean increase (%) in T_4 level in the Group A was 7.75% and in Group B was 1.55%. This was not significantly (P = 0.051 and P = 0.597 respectively) different.

At baseline the serum TC levelin Group A patients was 106.52± 21.79 mg/dL(mean ± SD). After 8 weeks of treatment, the serum TC level was increased to 132.11 ± 36.26mg/dL(mean ± SD). The mean increase (%) in TC level was 24.02% which was statistically significant (P = 0.001) than the previous value. On the other hand, baseline serum TC level in Group B patients was 141.69 ± 54.41 mg/dL (mean ± SD). After 8 weeks of treatment, the serum TC level was decreased to 123.83 ± 32.76 mg/dL (mean ± SD). The mean decrease (%) in TC level was 12.60% which was significantly (P = 0.017) more than the previous value. At baseline, the serumTG level in Group A patients was 132.11± 72.97 mg/dL (mean ± SD). After 8 weeks of treatment, serum TG level was increased to 149.06 ± 58.54mg/dL (mean ± SD). The mean increase (%) in TG level was 12.83%. This was not statistically significant (P = 0.129) than the previous value.On the other hand, baseline serum TG level in Group B patients was 179.12 ± 103.28 mg/dL(mean ± SD). After 8 weeks of treatment, serum TG level was significantly (P = 0.007) decreased to 129.51 ± 59.23mg/dL(mean ± SD). The mean decrease (%) in TG level was 27.69%.At the onset of study, serum HDL-C level in Group A patients was 23.43± 5.64 mg/dL(mean ± SD). After 8 weeks of treatment, serum HDL-C level was decreased to 21.71 ± 7.57mg/dL(mean ± SD). The mean decrease (%) in HDL-C level was 7.34%. This was not significantly (P = 0.250) differ from the previous value.The baseline serum HDL-C level in Group B patients was 22.67± 10.09 mg/dL (mean ± SD). After 8 weeks of treatment, plasma HDL-C level was increased to 26.28 ± 8.43mg/dL (mean ±

Serum TSH and serum FT4 levels in Group A and Group B shown in table 1at baseline and after 8 weeks

Table-I

Serum TSH and FT_4 levels at baseline and after 8 weeks

Variables	Group A Control group (L-T_4)(n=35) (mean ± SD)				Group B Experimental group (L-T_4 + L-carnitine) (n=36) (mean ± SD			
	Atbaseline	After8 weeks	Pvalue	%change	Atbaseline	After8 weeks	Pvalue	%change
Serum TSHμIU/Ml	2.43 ± 1.56	2.36 ± 1.56	0.841	↓2.88%	2.52± 1.38	3.00 ± 1.49	0.128	↑19.05%
SerumFT_4 ng/dl	1.29±0.21	1.39±0.30	0.051	↑7.75%	1.29±0.16	1.31±0.18	0.597	↑1.55%

TSH = Thyroid stimulating hormone, T_4 =Thyroxine, ↑ = Indicates increase of level,
↓ = Indicates decrease of level, Data was analysed by using **paired t-test**

Table-II

Blood lipid profile in Group A and Group B at baseline and after 8 week

Variables	Group A Control group (L-T_4)(n=35) (mean ± SD)				Group B Experimental group (L-T_4 + L-carnitine)(n=36) (mean ± SD			
	Atbaseline	After8 weeks	Pvalue	%Change	Atbaseline	After8 weeks	Pvalue	%change
Serum TC(mg/dL)	106.52±21.79	132.11±36.26	0.001	↑24.02%	141.69±54.41	123.83±32.76	0.017	↓12.60%
Serum TG(mg/dL)	132.11 ±72.97	149.06±58.54	0.129	↑12.83%	179.12±103.28	129.51±59.23	0.007	↓27.69%
Serum HDL-C (mg/dL)	23.43±5.64	21.71±7.57	0.250	↓7.34%	22.67±10.09	26.28±8.43	0.079	↑15.92%
Serum LDL-C (mg/dL)	56.96±23.17	80.46±34.00	0.001	↑43.65%	83.78±45.21	71.69±31.49	0.061	↓14.43%

TC = Total cholesterol, TG = Triglyceride, HDL-C = High density lipoprotein cholesterol, LDL-C = Low density lipoprotein cholesterol, ↑ = Indicates increase of level, ↓ = Indicates decrease of level, Data was analysed by using paired t-test

SD)which was not statistically significant (P = 0.079) than the previous value. The mean increase (%) in HDL-C was 15.92%. At baseline, the plasma LDL-C level in Group A and Group B were56.96 ± 23.17mg/dL and 83.78 ± 45.21 mg/dLrespectively. After 8 weeks, the same parameter were 80.46 ± 34.00 mg/dL Group A and 71.69 ± 31.49mg/dL in Group B respectively. The mean increase (%) in LDL-C level in the Group A was 41.25% and the mean decrease (%) in LDL-C in the Group B was 14.43%. The change was statistically significant (P = 0.001) in Group A but not significant (P = 0.061) in Group B.

Baseline Comparisons of lipid profile in between Group A and Group B (shown in table 3) were statistically insignificant and Serum TSH level and serum T_4 level were within normal range.

Table-III

Distribution of thyroid function status and serum lipid levels in Control and Experimental groups at baseline

Groups Variables	Group A (n = 35)	Group B (n = 36)	P-value
Serum TSH ()	2.43±1.56	2.52±1.38	>0.05
Serum Free T_4 (ng/dL)	1.29±0.21	1.29±0.16	>0.05
Serum TC (mg/dL)	106.52±21.79	141.69±54.41	>0.05
Serum TG (mg/dL)	132.11±72.98	179.12±103.28	>0.05
Serum HDL-C (mg/dL)	3.43±5.64	22.67±10.09	>0.05
Serum LDL-C (mg/dL)	56.96±23.17	83.78±45.21	>0.05

P value = statistically significant, Data was analysed by using independent t-test

In comparing between Group A with Group B, it appeared that HDL-C in Group B significantly (P) improved compared to those in Group A.Comparisons between Group A and Group B after 8 weeks shown in table[4].

Table-IV

Distribution of thyroid function status and serum lipid levels in Control and Experimental groups after 8 weeks

Groups Variables	Group A (n = 35)	Group B (n = 36)	P-value
Serum TSH ()	2.36±1.56	3.00±1.49	>0.05
Serum Free T_4 (ng/dL)	1.39±0.30	1.39±0.30	>0.05
Serum TC (mg/dL)	132.11±36.26	123.83±32.76	>0.05
Serum TG (mg/dL)	149.06±58.54	129.51±59.23	>0.05
Serum HDL-C (mg/dL)	21.71±7.57	26.28±8.43	>0.05
Serum LDL-C (m3g/dL)	80.46±34.00	71.69±31.49	>0.05

P value = statistically significant, Data was analysed by using independent t-test

Safety and tolerability assessment during the 8 weeks trial of l-carnitine administration in hypothyroid patients treated with l-T_4

The incidence of adverse events was mild. L-carnitine was generally well tolerated and produced no severe drug-related adverse events.In the group treated with l-carnitine (Group B = 36 patients), 3 patients complained of nausea, 1 patient complained of diarrhoea and 2 patients complained of epigastric discomfort but were not so severe to stop the drug. No serious adverse effects were seen in this group that needed dose adjustment or withdrawal of drug.

Discussion:

A total of 71 patients without other co-morbidities and presented with symptoms of fatigue had been included in this study.The patients were on l-T_4 therapy for last 6 month or more and had became euthyroid as a result of l-T_4 administration. The efficacy of l-carnitine on their thyroid hormone and lipid levels were investigated.

Such patients were allocated l-carnitine administration in additional to their l-T_4 therapy (Group B, Experimental group) and was compared after 8 weeks of therapy with theother group of patients who were kept only on l-T_4 therapy (Group A, Control group). Parameters for serum lipid levels (TC, TG, HDL-C and LDL-C) and serum thyroid hormone levels (TSH and T_4) were measured.

Hypothyroidism is a more or less genetically transmitted endocrine disease where hyperlipidaemia is significantly important complain of patients even after receiving replacement therapy.

In the present study, serum TSH and T_4 levelswere within normal reference range at baseline and after 8 weeks in both Group A (P = 0.841, and P = 0.051 respectively and in Group B (P =0.128, and P = 0.597 respectively). No statistically significant difference were observed between the two groups in case of serum TSH and T_4 level (P = 0.080 and P = 0.162 respectively) after 8 weeks.This result suggests that there may be no effect of l-carnitine on serum thyroid hormone levels.

Hypothyroidism is a common cause of secondary dyslipidemia. Perhaps the unutilized fat in hypothyroid patients which would have led to ATP formation if patients were not deprived of thyroid hormones had become accumulated. Following l-T_4 administration the accumulated body fat including cholesterol, TG and LDL underwent a process of being utilized and this would lead for the body lipid to become normalized at the physiological levels. In a study[29] this was observed that

after restoration of euthyroidism with l-T_4therapy serum levels of TC and LDL-C were significantly decreased but serum levels of HDL-C and serum TG levels remained as before.It should be mention that, in the present study serum TC levels of 64 patients out of 71 including both groups (Group A and Group B) were within normal level and serum LDL-C levels of 63 patients were also within normal level at baseline and after 8weeks. Surprisingly and unfortunately serum HDL-C level of 68 patients were below normal reference range both at baseline and after 8 weeks of intervention in Group B even. Serum TG levels were above thenormal range in 32 patients at baseline and in 24 patients after 8 weeks.These observations suggest that, perhaps the serum lipid levels were under the process of being at the physiological range following l-T_4 administration andPerhaps a longer time would produce better observations.

According to the statistical analysis of the results of the present study,it was observed that significant decreases of serum TC levels and serum TG levels (P = 0.017 and P = 0.007 respectively) were observed in Group B after 8 weeks. But there was no significant increase of HDL-C level (P = 0.079) or decrease of LDL-C level (P = 0.061). No statistically significant difference was observed among the Group A and Group B in case ofserum cholesterol level, triglyceride level and LDL-C level(P = 0.361, P = 0.166 and P = 0.263 respectively) but significant difference was observed in case of serum HDL-C level (P = 0.019) after 8 weeks. These results would perhaps suggest alleviating effects of l-carnitine upon serum lipid profiles. The observations mentioned above in the present study perhaps corresponds with the studywhere a randomized placebo-cotrolled trial conducted upon patients of chronic kidney disease and has shown that, l-carnitine administration had decreased serum TG concentrations and had significantly increased serum HDL-C concentrations. No significant effect of l-carnitine to decrease serum TC and LDL-C level could be observed in their study.[19]

Hypothyroidism is associated with increased oxidative stress[30] and plasma malondialdehyde (MDA) level which is a marker of oxidative stress are still higher in hypothyroid patients receiving replacement therapy and reached to euthyroid state.[31]Increased oxidative stress underlies the pathophysiology of hypertension[32] and atherosclerosis[33] by directly affecting vascular wall cells.l-carnitine administration has been observed to be associated with significant reduction in oxidative stress and an increased in antioxidant enzymes activities in coronary artery disease patients.[34]

But that at 8 weeks the lipids did not become completely physiological in Group A patients indicate that the alleviation did not occur at full phase. Administration of l-carnitine for 8 weeks in patients of group B has shown a improved status only regarding the serum HDL level. These observations indicate that perhaps the alleviating processes are not yet completed. Perhaps a longer time would produce better observations.

Again wide age range of the study population is a limitation of present study. The sample size was small and therefore the findings cannot be generalized to the total reference population as a whole. The serum carnitine level before and after 8 weeks of intervention were not estimated. Again different confounding factors like menopausal oestrogen level of women aged over 40 years were overlooked.In future larger-scale clinical trials with various dosage forms of L-carnitine would provide better indications about the effects of L-carnitine on lipid profileof hypothyroidism

Conclusion:

The results suggest that, administration of l-carnitine in hypothyroid patients being treated with thyroid hormone (l-T_4) replacement had produced significant improvement of levels of HDL-C, compared to the group of hypothyroid patients who were treated with l-T_4 alone. It is being concluded that thyroid hormone replacement alone in hypothyroid patients cannot significantly lower the lipid level which the patients suffer from. These could bachieved by concurrent administration of l-carnitine.

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