L-Carnitine: What the Studies Show

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What is it?

L-carnitine is a vitamin-like nutrient synthesized in the body using the amino acids lysine and methionine as precursors. Carnitine is the generic term for L-carnitine, acetyl-L-carnitine (ALC) and propionyl-L-carnitine. Only L-carnitine is active in the body and found in food.

Dairy, poultry and red meat contain the greatest amounts of carnitine. Rare genetic diseases can cause a carnitine deficiency that usually manifests itself by five years of age with symptoms of:

- cardiomyopathy,
- skeletal-muscle weakness and
- hypoglycemia.

Secondary carnitine deficiencies may occur in those with:

- chronic renal failure,
- diabetes and
- cirrhosis.

There have been reports of carnitine being used for:

- attention deficit disorder,
- male infertility,
- male aging and
- encephalopathy in cirrhosis patients.

Mental function

A meta-analysis of double-blind, placebo-controlled studies suggests that supplements of ALC may improve mental function and reduce deterioration in older adults with mild cognitive impairment and Alzheimer's disease. In these studies, subjects took 1.5 g q.d. to 3 g q.d. of ALC for three months to 12 months.

Cardiovascular disease

A randomized placebo-controlled trial found that those patients given L-carnitine, after an acute anterior acute MI, had reduced mortality after five days, but no difference in composite death, or heart failure at their six-month follow-up.

A double-blind, placebo-controlled, clinical trial in Italy found that patients who had suffered a first heart attack and were given supplemental carnitine intravenously for five days and then 6 g of carnitine q.d. orally for one year, had reduced heart failure and overall mortality.

Claudication

Patients with moderate-to-severe claudication who were supplemented with 2 g of propionyl-L-carnitine q.d. for 12 months significantly improved their maximal walking distance and perceived quality of life, as compared to subjects receiving placebo.

A similar trial in the US and Russia found, as compared to those taking placebo, that the same daily dose and form of carnitine administered for six months in patients with disabling claudication significantly:

- improved walking distance and speed,
- reduced bodily pain,
- enhanced physical function and
- improved one's own perceived state of health.

Fatigue in cancer and multiple sclerosis

Terminal cancer patients who are deficient in carnitine and were supplemented with 250 mg to 3 g of carnitine each day experienced less fatigue and improved quality of sleep compared to those given placebo.

In another study, chemotherapy-treated patients who were carnitine deficient, taking 4 g of carnitine q.d. for one week, saw an improvement in their level of fatigue, as well as restored normal blood levels of carnitine.

In a randomized, double-blind, crossover study, 36 patients with multiple sclerosis (MS) presenting with fatigue were given either 100 mg of amantadine b.i.d. or 1 g of ALC b.i.d. for three months. After a three month washout period, they crossed over to the alternative treatment for another three months.

ALC was found to be more effective and better tolerated than amantadine for the treatment of MS-related fatigue.

Diabetes

Three hundred and thirty three patients with diabetic neuropathy received 1000 mg of ALC q.d. intramuscularly for 10 days and continued this treatment or placebo, orally, at a dosage of 2000 mg q.d. for the remainder of the 355-day study. Among the 294 patients with impaired electrophysiological parameters at baseline, those treated with ALC showed a statistically significant improvement in mean nerve conduction velocity and amplitude compared with placebo. After 12 months of treatment, mean scores for pain were significantly reduced from baseline by 39% in ALC-treated patients compared with 8% in placebo recipients.

Two 52-week randomized placebo-controlled clinical diabetic neuropathy trials, which tested 500 mg t.i.d. and 1,000 mg of ALC t.i.d showed significant improvements in:

- sural nerve fiber numbers,
- the regeneration of nerve fiber clusters,
- vibration perception and
- pain.

Twenty two male and 13 female Type 2 diabetic patients were randomly assigned to receive 1 g of L-carnitine or placebo orally t.i.d. for a period of 12 weeks. Fasting plasma glucose decreased significantly in the L-carnitine group. There was a significant increase in triglycerides, apolipoprotein (apo) A1 and apo B100. There was no significant change in LDL-cholesterol, HDL-cholesterol, HemoglobinA1C, lipoprotein (A) or total cholesterol.

Chronic renal failure and dialysis

Although there is some evidence that carnitine is beneficial in dialysis patients, the trials that were done were not of sufficient size and quality to reach any firm conclusions about its routine use.

Positive outcomes

In a double-blind, randomized, controlled trial, 50 hemodialysis patients were treated with either 2 g of carnitine or placebo intravenously for 24 weeks. Although there was a large dropout, there were improvements in the Medical Outcomes Short Form-36 scores. It was also found that lower doses of erythropoietin were needed in the treatment group than compared to those in the controlled group.

In the end-stage of renal disease, carnitine insufficiency may contribute to impaired exercise tolerance and functional capacities. In one study, patients were administered 20 mg/kg of L-carnitine or placebo intravenously at the conclusion of each thrice-weekly dialysis session for 24 weeks. In another study, patients were given 10 mg/kg, 20 mg/kg, or 40 mg/kg of L-carnitine, or placebo intravenously. Intravenous L-carnitine treatment increased plasma carnitine concentrations, improved patient-assessed fatigue and seemed to prevent the decline in peak-exercise capacity.

Negative outcomes

Sixteen patients were randomized to receive either 20 mg/kg of L-carnitine or placebo after each dialysis session for 12 weeks, followed by a six-week washout and then crossover therapy for 12 weeks.

There was no significant effect of L-carnitine on quality of life, irrespective of treatment order. Also, no differences were found in any of the secondary outcomes, including:

- incidence of muscle cramping,
- intradialytic hypotension,
- erythropoetin requirements or
- hemoglobin.

Adverse effects consisted of GI symptoms, with a similar incidence between L-carnitine and placebo. Dx

For resources, please contact **diagnosis@sta.ca**.

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Resources

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