Effects of Alpha-Lipoic Acid on Body Weight in Obese Subjects

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ABSTRACT

PURPOSE: Alpha-lipoic acid is an essential cofactor for mitochondrial respiratory enzymes that improves
mitochondrial function. We previously reported that alpha-lipoic acid markedly reduced body weight gain
in rodents. The purpose of this study was to determine whether alpha-lipoic acid reduces body weight in
obese human subjects.

METHODS: In this randomized, double-blind, placebo-controlled, 20-week trial, 360 obese individuals
(bmi ≥30 kg/m² or BMI 27-30 kg/m² plus hypertension, diabetes mellitus, or hypercholesterolemia) were randomized to alpha-lipoic acid 1200 or 1800 mg/d or placebo. The primary
end point was body weight change from baseline to end point.

RESULTS: The 1800 mg alpha-lipoic acid group lost significantly more weight than the placebo group
(2.1%; 95% confidence interval, 1.4-2.8; P <.05). Urticaria and itching sensation were the most common
adverse events in the alpha-lipoic acid groups, but these were generally mild and transient.

CONCLUSION: Alpha-lipoic acid 1800 mg/d led to a modest weight loss in obese subjects. Alpha-lipoic acid
may be considered as adjunctive therapy for obesity.

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KEYWORDS: Alpha-lipoic acid; Anti-obesity agent; Side effect

The prevalence of obesity is rapidly increasing around the
world.1,2 Obesity reduces life expectancy and increases the
risks of health problems, such as heart disease, type 2
diabetes, sleep apnea, certain types of cancer, and osteoarthritis.3,4 Although lifestyle modification is considered the
first-line therapy for obesity, many common methods for lifestyle modification have proven disappointing.

Two anti-obesity medications are currently approved by
the US Food and Drug Administration for long-term use:
orlistat and sibutramine. Orlistat reduces intestinal fat ab-
sorption by inhibiting pancreatic lipase, whereas sibutra-
mine decreases appetite by inhibiting deactivation of the
brain neurotransmitters norepinephrine, serotonin, and dop-
amine.5,6 Both of these drugs, however, have shown limitations in terms of efficacy and side effects.5,6

Alpha-lipoic acid, a natural short-chain fatty acid con-
taining sulfhydryl groups, is a potent antioxidant.7,8 Al-
pha-lipoic acid is an essential cofactor for mitochondrial
respiratory enzymes and improves mitochondrial function.9,10 Alpha-lipoic acid was shown to be effective in
reducing symptoms of diabetic polyneuropathy without serious adverse effects11,12 and is used in clinical practice.

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in countries such as Germany and Korea, with multicenter trials currently ongoing in Europe and North America. We previously showed that alpha-lipoic acid markedly reduces body weight gain in rodents. However, it is not known whether this drug is effective in obese humans. We therefore evaluated the efficacy and safety of alpha-lipoic acid in a randomized, double-blind, placebo-controlled trial in obese human subjects.

PATIENTS AND METHODS

Participant Recruitment
This study was conducted in accordance with the principles described in the Declaration of Helsinki. The study protocol was approved by the institutional review board at each center, and all subjects provided written informed consent.

A variety of recruitment strategies were used to attract potential participants. The sponsor company developed several materials, including brochures, posters, and newspaper advertisements. All advertisements were approved by the institutional review board at each center.

Obese subjects aged 18 to 65 years with a body mass index (BMI) of 27 to 30 kg/m² were recruited, as were subjects with a BMI of 27 to 30 kg/m² if they had hypertension, diabetes mellitus, or hypercholesterolemia. Hypertension was defined as a blood pressure of >140/90 mm Hg on 2 separate occasions or the use of antihypertensive agents. Diabetes mellitus was defined as fasting plasma glucose concentration ≥126 mg/dL on 2 separate occasions or the use of oral hypoglycemic agents. Hypercholesterolemia was defined as plasma total cholesterol concentration ≥240 mg/dL or use of lipid-lowering medications.

Exclusion criteria included pregnancy; a history of allergy to alpha-lipoic acid; recent changes in weight, diet, exercise activity, or smoking habit; and a history of bariatric surgery. Subjects with hypothyroidism, Cushing syndrome, malignant disease, hepatic disease (serum aspartate transaminase, alanine aminotransferase, or alkaline phosphatase ≥2.5× upper limit of normal), congestive heart failure, renal dysfunction (creatinine ≥2.0 mg/dL), malabsorption syndrome, pancreatic disease, psychiatric illness, or known or suspected drug abuse were also excluded. During the trial, subjects were not allowed to use glucocorticoids or any other medications that could affect body weight.

Study Design
This randomized, double-blind, placebo-controlled 20-week trial was conducted at 3 university hospitals in the Republic of Korea. The study consisted of a 4-week run-in phase followed by a 20-week treatment phase. All potentially eligible subjects (n = 539) underwent the 4-week run-in phase, during which they received placebo (3 tablets 30 minutes before each meal). The purpose of this phase, as explained to all potential participants, was to identify willing and eligible individuals who demonstrated good compliance, defined as taking >80% of study tablets during that interval. Only subjects who successfully completed the run-in phase were randomized.

During the run-in phase of the trial, all potential participants received dietary instructions from registered dietitians, with the goal of reducing total daily caloric intake by 600 kcal/d. Additional dietary instructions were provided at predetermined intervals during the study. The diet was composed of 55% to 60% carbohydrates, 20% to 25% fat, and 15% to 20% protein, with a minimum total calorie intake of 1200 kcal/d. After the run-in phase, the 360 selected participants were randomized into 3 groups. To reduce the unpredictability of randomization, block randomization, with a block size of 9 or 12, was used to ensure that at no time during the study would there be a large imbalance among the groups. A stratified block randomization list based on 1 stratification factor, BMI 27 to 30 kg/m² or ≥30 kg/m², was used to assign all eligible subjects to treatment with 1200 or 1800 mg/d oral alpha-lipoic acid or placebo. The placebo tablets were composed primarily of lactose and cellulose and were indistinguishable from the alpha-lipoic acid tablets. Each center was expected to receive the same number of blocks.

All subjects were instructed to take 9 tablets per day (3 tablets 30 minutes before each meal), with subjects in the placebo group taking 3 placebo tablets, subjects in the 1200 mg/d group taking two 200 mg alpha-lipoic acid tablets and 1 placebo tablet, and subjects in the 1800 mg/d group taking three 200 mg alpha-lipoic acid tablets before each meal. Alpha-lipoic acid and placebo tablets were packaged indistinguishably and labeled with a subject number. Only 1 clinical pharmacist who was independent of this study was aware of the medication assignment code, which was kept in a sealed envelope for emergency access. None of the research personnel who enrolled, treated, or assessed the subjects were aware of subject assignments until the study was completed. All study drugs and study-supplied concomitant medications were kept in a secure, safe area under recommended storage conditions. Efforts were made by the study coordinators to maintain adherence to study visits and study medication administration. Subjects received telephone calls every week. Subjects were instructed to bring all remaining drugs at each visit and were withdrawn from the study when drug consumption was <80% of prescribed dose. Subjects were also withdrawn if they did not complete the scheduled routine visit within 3 days.

CLINICAL SIGNIFICANCE

- Alpha-lipoic acid at a dosage of 1800 mg/d led to a modest weight loss in obese subjects.
- Differences in side effects compared with currently used anti-obesity drugs suggest that alpha-lipoic acid may be an adjunctive treatment for obesity.
At each visit, subjects were asked whether they had experienced an adverse event. The study investigators evaluated the severity and potential relationship between the adverse event and alpha-lipoic acid use. Adverse events and serious adverse events, defined according to the Food and Drug Administration Code of Federal Regulations part 312, included death, a life-threatening adverse drug experience, inpatient hospitalization, prolongation of existing hospitalization, a persistent or significant disability/incapacity, or a congenital abnormality/birth defect.

The authors designed the study, gathered and analyzed the data, and vouch for the completeness and accuracy of the data and the analysis. The sponsor had no role in the design of the study; the collection, management, analysis, or interpretation of the data; or the preparation of the manuscript.

**Assessments**

Before enrollment, all subjects underwent a comprehensive medical evaluation, which included medical history, a physical examination, an electrocardiogram assessment, laboratory tests, and a urinary pregnancy test for women of childbearing potential. The primary outcome was change in body weight (end point minus baseline). Secondary outcomes were mean changes in waist circumference, body fat (measured by impedance meter, TANITA TBF 521, Tokyo, Japan), blood pressure, and fasting plasma glucose, total cholesterol, triglyceride, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol levels. Safety assessments included the incidence and severity of treatment-related adverse events during the 20-week treatment period.

**Statistical Analysis**

All data were analyzed using the Statistical Package for the Social Sciences (version 17.0; SPSS Inc, Chicago, IL). Data were compared using analysis of variance and post hoc analysis (Duncan). A *P* value <.05 was defined as statistically significant. Intent-to-treat analysis included all randomized subjects who received at least 1 dose of study medication. Missing data for subjects in the intent-to-treat population were imputed using the last observation carried forward method. The populations of per-protocol completers, defined as subjects who completely finished the 20-week double-blind treatment without major protocol deviations, were included for analyses of primary and secondary outcomes. Laboratory parameters and vital signs were analyzed among the per-protocol completers. Changes in body

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### Table 1 Clinical Characteristics at Randomization

<table>
<thead>
<tr>
<th></th>
<th>Placebo (n = 120)</th>
<th>ALA 1200 mg (n = 120)</th>
<th>ALA 1800 mg (n = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>40.7 ± 1.1</td>
<td>41.6 ± 1.1</td>
<td>41.4 ± 1.0</td>
</tr>
<tr>
<td>Gender, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>46 (38%)</td>
<td>41 (34%)</td>
<td>38 (31%)</td>
</tr>
<tr>
<td>Male</td>
<td>74 (62%)</td>
<td>79 (66%)</td>
<td>82 (69%)</td>
</tr>
<tr>
<td>Anthropometric measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>89.6 ± 15.7</td>
<td>89.2 ± 14.9</td>
<td>88.8 ± 15.9</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>33.1 ± 4.0</td>
<td>33.2 ± 4.2</td>
<td>33.3 ± 4.0</td>
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<tr>
<td>Waist circumference (cm)</td>
<td></td>
<td>103.5 ± 10.0</td>
<td>103.8 ± 9.5</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>41.9 ± 8.4</td>
<td>42.3 ± 7.7</td>
<td>43.6 ± 6.8</td>
</tr>
<tr>
<td>Vital signs</td>
<td></td>
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<tr>
<td>SBP (mm Hg)</td>
<td>133.0 ± 13.0</td>
<td>133.0 ± 14.0</td>
<td>133.0 ± 13.0</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>82.0 ± 9.0</td>
<td>82.0 ± 10.0</td>
<td>81.0 ± 9.0</td>
</tr>
<tr>
<td>Heart rate (beats/min)</td>
<td>75.0 ± 11.0</td>
<td>75.0 ± 10.0</td>
<td>75.0 ± 10.0</td>
</tr>
<tr>
<td>Laboratory data*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol (mg/dL)</td>
<td>182.9 ± 3.2</td>
<td>186.0 ± 3.3</td>
<td>188.2 ± 3.2</td>
</tr>
<tr>
<td>Triglyceride (mg/dL)</td>
<td>145.8 ± 7.3</td>
<td>150.4 ± 7.6</td>
<td>144.6 ± 6.8</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dL)</td>
<td>48.7 ± 0.9</td>
<td>48.6 ± 0.9</td>
<td>48.6 ± 0.9</td>
</tr>
<tr>
<td>Triglyceride/HDL cholesterol ratio</td>
<td>3.2 ± 0.2</td>
<td>3.4 ± 0.2</td>
<td>3.3 ± 0.2</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dL)</td>
<td>108.7 ± 3.1</td>
<td>110.9 ± 3.0</td>
<td>114.3 ± 3.1</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>108.9 ± 2.4</td>
<td>112.1 ± 3.4</td>
<td>109.2 ± 2.1</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>6.0 ± 0.1</td>
<td>6.1 ± 0.1</td>
<td>6.1 ± 0.1</td>
</tr>
<tr>
<td>Comorbidities, No.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>32</td>
<td>44</td>
<td>33</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>31</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>27</td>
<td>26</td>
<td>25</td>
</tr>
</tbody>
</table>

*Data are given as mean ± standard deviation.

*Data are given as mean ± standard error of the mean.

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AL = alpha-lipoic acid; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; HbA1c = hemoglobin A1c.
weight from baseline to each visit were analyzed using paired \( t \) tests. Subgroup analyses were performed on subjects with hypertension, diabetes mellitus, or hypercholesterolemia. Differences in the percentage of responders, defined as subjects who achieved ≥5% weight loss from baseline over 20 weeks, were analyzed using chi-square tests. All parameters are reported as mean ± standard error of the mean, whereas demographic data are reported as mean ± standard deviation.

**RESULTS**

**Clinical Characteristics**

Of the 539 recruited subjects, 360 were randomly assigned to the 3 groups; there were no differences in baseline characteristics among the 3 groups (Table 1). Of the 360 randomized subjects, 228 completed the 20-week double-blind trial (Figure 1). There were no significant differences in baseline clinical or laboratory characteristics between subjects who completed the study and those who were withdrawn (data not shown). Overall withdrawal rates did not differ among the 3 groups, and alpha-lipoic acid treatment was not associated with increased withdrawal rates because of adverse events. The primary reasons for premature withdrawal are shown in Figure 1.

**Body Weight**

Changes in body weight during the 20-week treatment period are shown in Figures 2 and 3 and Table 2. In both the 1200 and 1800 mg/d alpha-lipoic acid groups, average weight decreased significantly from baseline, starting as early as 4 weeks (Figure 2). At 20 weeks, the mean body weight reduction was significantly greater in the 1800 mg/d alpha-lipoic acid group than in the placebo group. Similarly, analyses of both the intent-to-treat and per-protocol completer populations showed that weight loss at 20 weeks was significantly greater in the 1800 mg/d alpha-lipoic acid group than in the placebo group. The primary reasons for premature withdrawal are shown in Figure 1.

![Figure 1](https://example.com/figure1.png)

**Figure 1** Disposition of subjects enrolled in the study. LA = alpha-lipoic acid.

![Figure 2](https://example.com/figure2.png)

**Figure 2** Mean change in body weight from baseline during 20 weeks of treatment with placebo or 1200 or 1800 mg/d alpha-lipoic acid (intent-to-treat subjects). Data are reported as mean ± standard error of the mean. *\( P < .05 \) vs baseline for that group; **\( P < .05 \) vs placebo. LA = alpha-lipoic acid.
mg/d alpha-lipoic acid group than in the placebo group (Table 2; Figure 3). The average weight loss in the 1200 mg/d alpha-lipoic acid group was between that of the placebo and the 1800 mg/d alpha-lipoic acid groups, but the mean weight loss in this group did not differ significantly from that in the placebo group (Table 2).

Analyses of the intent-to-treat and per-protocol completer populations showed that reduction in BMI was significantly greater in the 1800 mg/d alpha-lipoic acid group than in the placebo group. Moreover, analysis of per-protocol completers showed that reduction in waist circumference was significantly greater in the 1800 mg/d alpha-lipoic acid group than in the placebo group (Table 2), as was the percentage of subjects who achieved a ≥5% reduction in baseline body weight (21.6% vs 10.0%, P < .01) (Figure 4). No significant changes were observed in triglyceride concentrations and triglyceride/high-density lipoprotein cholesterol ratios among the 3 groups (Table 2). When responders were compared with non-responders (ie, those with <5% weight loss or positive weight change), we observed no significant differences in initial clinical or laboratory parameters (data not shown).

**Subgroup Analyses**

We separately analyzed the results in subjects with BMI 27 to 30 kg/m² plus additional risk factors, such as hypertension, diabetes, or hypercholesterolemia. Although the number of subjects in each subgroup was relatively small, the reductions in body weight and BMI were significantly greater in those treated with 1800 mg/d alpha-lipoic acid than in those treated with placebo. Subjects with diabetes randomized to 1800 mg/d alpha-lipoic acid showed a mean 0.38% reduction from baseline in hemoglobin-A1c level (P < .05). Treatment with alpha-lipoic acid, however, was not associated with significant reductions in blood pressure or fasting plasma glucose and cholesterol concentrations (Table 3).

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**Safety**

Consistent with previous findings, itching sensation or urticaria was the most common adverse event in subjects treated with alpha-lipoic acid (Table 4). However, the degree of body weight reduction was not related to itching sensation or urticaria, and body weight change did not differ between patients who did and did not report skin symptoms. One subject in the 1800 mg/d alpha-lipoic acid group and 3 subjects in the 1200 mg/d alpha-lipoic acid group withdrew because of itching sensation.

Overall, the percentage of subjects with at least 1 adverse event during the treatment did not differ among the 1200 and 1800 mg/d alpha-lipoic acid groups and placebo group (24%, 24%, and 20%, respectively). A total of 16 subjects withdrew because of adverse events, 9 in the placebo group, 3 in the 1200 mg/d alpha-lipoic acid group, and 4 in the 1800 mg/d alpha-lipoic acid group (Table 4). Two subjects in the placebo group and 1 subject in the 1800 mg/d alpha-lipoic acid group withdrew because of intercurrent illnesses, but these illnesses were not considered related to study medication.

Severe unexpected adverse events were not observed, as determined by physical examination, clinical laboratory tests, and electrocardiograms. No deaths occurred during this study.

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**DISCUSSION**

To our knowledge, this is the first study to show that alpha-lipoic acid treatment led to a significant weight reduction in obese human subjects. Subjects who completed 20 weeks of treatment with 1800 mg/d alpha-lipoic acid showed modest but statistically significant reductions in body weight and BMI. Moreover, the percentage of subjects with a ≥5% loss in initial body weight was significantly higher in the 1800 mg/d alpha-lipoic acid group than in the placebo group.

Alpha-lipoic acid was generally well tolerated with no serious adverse effects. As previously reported, we found that the most common adverse effects of alpha-lipoic acid
Thus, the dosages used in this study were not well defined, a recent study has suggested that the tolerated dose of alpha-lipoic acid in human subjects has been approximately 30% to 40% of an oral dose of racemic alpha-lipoic acid. Plasma alpha-lipoic acid concentration generally peaks within 1 hour after administration and then declines rapidly. Thus, after oral administration, the maximum plasma concentration of alpha-lipoic acid may rapidly decrease without reaching an effective therapeutic concentration. Additional studies are needed to evaluate the dose of alpha-lipoic acid that can lead to weight loss and assess the long-term safety and efficacy of this dosage.

We and others have found that alpha-lipoic acid significantly improves insulin sensitivity and prevents vascular treatment were allergic skin reactions, including urticaria and itching sensation, but these skin lesions were not a major reason for withdrawal from this drug. Although gastrointestinal symptoms, including abdominal pain, nausea, vomiting, and diarrhea, have also been reported, we found no differences in the incidences of gastrointestinal symptoms among the placebo and treatment groups. The main adverse effects of orlistat are gastrointestinal, whereas those of sibutramine are increased blood pressure and pulse. Thus, the side effects of alpha-lipoic acid differ from those of currently used anti-obesity drugs.

Clinical trials in patients with diabetic peripheral neuropathy have shown that administration of oral racemic alpha-lipoic acid, at concentrations as high as 1800 mg/d for 6 months and as high as 1200 mg/d for 2 years, did not result in serious adverse effects. Because the usual dosage of alpha-lipoic acid (600 mg/d) used to treat peripheral neuropathy does not result in weight loss, we selected the 2 higher dosages (1200 and 1800 mg/d) for a first test in human subjects. Although the maximum tolerated dose of alpha-lipoic acid in human subjects has not been well defined, a recent study has suggested that humans can tolerate several grams per day of oral alpha-lipoic acid. Thus, the dosages used in this study were lower than those previously found to be tolerated by human subjects.

In this study, we used racemic alpha-lipoic acid. Only the R-isomer of alpha-lipoic acid is synthesized naturally, whereas conventional chemical synthesis results in a 50/50 (racemic) mixture of the 2 optical isomers, R- and S-alpha-lipoic acid. Pharmacokinetic studies have shown that humans absorb approximately 30% to 40% of an oral dose of racemic alpha-lipoic acid. Pharmacokinetic studies have shown that humans absorb approximately 30% to 40% of an oral dose of racemic alpha-lipoic acid.

In this regard, it is noteworthy that patients with diabetes are needed to determine the effects of alpha-lipoic acid on hemoglobin-A1c.

**LIMITATIONS**

Our study has several limitations. The length of the trial (20 weeks) was relatively short. Moreover, because all participants were prescribed a hypocaloric diet, our findings may be applicable only in the context of energy restriction. It should also be highlighted that our study

**Table 3** Changes in Body Weight and Parameters of Cardiovascular Risk Factors in Obese Subjects with Additional Risk Factors

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Outcomes</th>
<th>Placebo</th>
<th>LA 1200 mg</th>
<th>LA 1800 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Weight loss, kg (%)</td>
<td>-0.00 ± 0.34</td>
<td>-0.96 ± 0.39</td>
<td>-2.73 ± 0.88*</td>
</tr>
<tr>
<td></td>
<td>Systolic blood pressure (mm Hg)</td>
<td>131.95 ± 3.03</td>
<td>137.48 ± 2.36</td>
<td>132.97 ± 2.79</td>
</tr>
<tr>
<td></td>
<td>Initial 20-wk change</td>
<td>132.30 ± 2.52</td>
<td>128.96 ± 2.27</td>
<td>129.41 ± 2.45</td>
</tr>
<tr>
<td></td>
<td>Diastolic blood pressure (mm Hg)</td>
<td>0.35 ± 3.55</td>
<td>-8.52 ± 2.84</td>
<td>-3.56 ± 2.28</td>
</tr>
<tr>
<td></td>
<td>Initial 20-wk change</td>
<td>79.95 ± 1.49</td>
<td>84.67 ± 1.59</td>
<td>82.40 ± 1.86</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Weight loss, kg (%)</td>
<td>0.38 ± 0.27</td>
<td>-0.96 ± 0.47</td>
<td>-2.20 ± 0.61*</td>
</tr>
<tr>
<td></td>
<td>Fasting serum glucose, mg/dL</td>
<td>127.58 ± 6.06</td>
<td>147.88 ± 10.81</td>
<td>130.96 ± 5.40</td>
</tr>
<tr>
<td></td>
<td>Initial 20-wk change</td>
<td>138.05 ± 7.81</td>
<td>147.12 ± 9.79</td>
<td>134.27 ± 4.91</td>
</tr>
<tr>
<td></td>
<td>HbA1c,%</td>
<td>7.21 ± 0.24</td>
<td>7.28 ± 0.30</td>
<td>7.17 ± 0.21</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>Weight loss, kg (%)</td>
<td>-0.63 ± 0.84</td>
<td>-0.27 ± 0.33</td>
<td>-3.57 ± 1.09*</td>
</tr>
<tr>
<td></td>
<td>Total cholesterol (mg/dL)</td>
<td>178.44 ± 11.26</td>
<td>189.00 ± 12.22</td>
<td>176.35 ± 9.00</td>
</tr>
<tr>
<td></td>
<td>Initial 20-wk change</td>
<td>180.13 ± 14.26</td>
<td>199.15 ± 13.16</td>
<td>188.30 ± 9.83</td>
</tr>
</tbody>
</table>

LA = alpha-lipoic acid; HbA1c = hemoglobin A1c.
All results are reported as mean ± standard error of the mean.
*P < .05 vs placebo.

Table 4 Overall Incidence of Treatment-Related Adverse Events in At Least 1% Of Subjects and Withdrawal Rates

<table>
<thead>
<tr>
<th>Event</th>
<th>Placebo (n = 120)</th>
<th>LA 1200 mg (n = 120)</th>
<th>LA 1800 mg (n = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Event</td>
<td>Withdrawal</td>
<td>Event</td>
</tr>
<tr>
<td></td>
<td>LA 1200 mg</td>
<td>LA 1800 mg</td>
<td>LA 1200 mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>3 (2.5)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fever</td>
<td>0</td>
<td>0</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>0</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>Palpitation</td>
<td>3 (2.5)</td>
<td>1</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Epigastric soreness</td>
<td>4 (3.3)</td>
<td>2</td>
<td>4 (3.3)</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>1 (0.8)</td>
<td>2</td>
<td>5 (4.2)</td>
</tr>
<tr>
<td>Urticaria</td>
<td>4 (3.3)</td>
<td>0</td>
<td>7 (5.8)</td>
</tr>
<tr>
<td>Itching sensation*</td>
<td>3 (2.5)</td>
<td>13 (10.8)*</td>
<td>3</td>
</tr>
</tbody>
</table>

LA = alpha-lipoic acid.
Some patients experienced > 1 adverse event. Data are reported as number of adverse events (%)/numbers who withdrew.
*P < .05.
was conducted in Korea. The adiposity and metabolic characteristics of Asian individuals differ from those of Western or other populations. Thus, additional studies are required to determine whether alpha-lipoic acid is effective in other populations. Finally, head-to-head comparisons are needed to compare the effects of alpha-lipoic acid with those of other anti-obesity drugs.

CONCLUSIONS

We showed that 1800 mg/d of oral alpha-lipoic acid was effective in achieving significant weight loss in obese subjects. Although the therapeutic potency of alpha-lipoic acid was modest, no serious side effects were observed. Differences in side effects from currently used anti-obesity drugs suggest that alpha-lipoic acid may be effective as an adjunctive medication for obesity. Further studies are needed to determine the adequate dosage of alpha-lipoic acid and its long-term safety and efficacy. Moreover, head-to-head comparisons are needed to compare the safety and efficacy of alpha-lipoic acid with those of other anti-obesity drugs.

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