

A STUDY OF THE EFFECT OF LIPOSUCTION ON CORONARY DISEASE RISK FACTORS, INFLAMMATORY MARKERS, AND LEFT VENTRICULAR MASS IN NON-DIABETIC OBESE WOMEN

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Abstract

INTRODUCTION: Liposuction is a surgical procedure effective in reducing body fat, with growing application in conjunction with diet and exercise therapy in the treatment of obesity. In view of the positive effect of weight reduction on cardiovascular disease (CVD) risk factors, such as body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), systolic and diastolic pressure, lipid profile, fasting blood sugar, insulin resistance, inflammatory markers (e.g. chronic reactive protein: CRP), antioxidant capacity, fibrinogen and lipoprotein A (Lpa), this study was conducted to assess the effect of liposuction as a therapeutic procedure in the treatment of obesity.

METHODS: A total of 24 non-diabetic obese women (BMI>30) with a mean age of 48.7 ± 7.3 years were studied. Before liposuction, the subjects filled out questionnaires obtaining demographic information. Complete physical examination, measurement of waist and hip circumference, height, weight and calculation of WHR and BMI were performed. Fasting blood samples were taken to measure fasting blood glucose, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglyceride (TG), fibrinogen, antioxidant capacity, CRP, lipoprotein A, serum insulin, and insulin resistance. All measurements and physical examinations were repeated 12-14 weeks after liposuction. Data were analyzed with SPSS11 software using paired t-test and repeated measure ANOVA.

RESULTS: WHR, BMI and LDL decreased significantly following liposuction ($P < 0.05$). Other parameters, however, did not change significantly, although there were signs of positive changes.

DISCUSSION: Liposuction decreases BMI, WHR and LDL within 12-14 weeks of liposuction. Providing these reductions are maintained, liposuction may prove valuable in reducing CVD risk factors, besides offering a means for obesity control.

Keywords • Liposuction • Obesity

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Introduction

Body mass index, calculated according to the following formula, is used to define obesity:

$$\left[\frac{\text{Weight(kg)}}{\text{Height(m}^2\text{)}} \right]$$

Obesity is defined as body mass index (BMI) greater than 30 kg/m². Assessment of cardiovascular disease (CVD) risk factors and other obesity-associated risks must be accompanied by evaluation of regional fat distribution and other accompanying disorders.^{1,2}

Abdominal obesity is characterized by waist circumference expansion and increased subcutaneous and visceral fat.³

Several studies have shown that abdominal obesity contributes to insulin resistance, increases serum levels of free fatty acids, and considerably raises levels of pre-inflammatory markers. Increase in pre-inflammatory markers is among the underlying causes of atherosclerosis.⁴⁻¹³

Epidemiological studies have shown that insulin resistance and impaired glucose tolerance which ensue from obesity, can predispose to type II diabetes.¹⁴ Molecular mechanisms and metabolic disturbances arising from the presence of extra fat in the body are not well understood, nevertheless, multiple cytokines such as TNF- α , interleukin 6 (IL ϵ),

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soluble interleukin 6 receptor, interleukin 10 (IL₁₀), and proteins such as leptin and adiponectin synthesized by adipose tissue are presumed to be involved in these mechanisms.¹⁵⁻²⁰ Obesity is also related to fluid retention, which in turn can lead to increased end diastolic volume (EDV) and increased filling pressure. Accompanied by hypertension, these conditions can result in left ventricular hypertrophy (LVH).²¹ Weight reduction and a healthy diet can improve the metabolic complications arising from abdominal obesity. However, long-term maintenance of optimal weight following weight loss is difficult and obese individuals who loose weight through lifestyle change often regain weight over time.²² Thus, it seems practical to incorporate surgical therapeutic methods into obesity treatment strategies.²³

Four-hundred thousand cases of liposuction (otherwise known as lipoplasty and lipectomy) are performed yearly in the United States, making it the most common surgical procedure for reduction of body fat.²⁴

Recent advances in liposuction techniques have enabled the removal of considerable amounts of subcutaneous fat.²⁵

Hence, abdominal liposuction offers a good opportunity to assess the role of subcutaneous fat in the pathogenesis of insulin resistance and increased risk of coronary artery disease (CAD) in individuals with abdominal obesity, especially women. A 2003 Italian study showed a rise in adiponectin and a decrease in TNF- α levels following liposuction.²⁶

Another study demonstrated that removal of large amounts of body fat through liposuction can decrease the risk of cardiovascular diseases in obese women.²⁷ Another study conducted in 2004, however, showed that liposuction has no positive effects on cardiovascular disease risk factors, such as hypertension, diabetes, and lipid profile.²⁸ The metabolic effects of liposuction are still shrouded in ambiguity owing to the diversity of the results of various studies.²⁹⁻³¹ This study is a further effort to elucidate the effects of liposuction on cardiovascular disease risk factors, inflammatory markers, insulin resistance, and left ventricular mass. The effects of liposuction on the said risk factors were studied in non-diabetic obese Isfahani women.

Materials and methods

Twenty-four obese female liposuction candidates were selected using simple non-randomized method to be included in this analytic cross-sectional study. The subjects had a mean age of 48.7 years and their

body mass index (BMI) was greater than 30 kg/m². Abdominal obesity was defined as waist circumference (WC) greater than 100 cm, and waist-to-hip ratio (WHR) greater than 0.9.³

Inclusion criteria were BMI>30, normal diet, being off medications such as corticosteroids and hormones (HRT), and being non-diabetic (fasting blood sugar: FBS<126 mg/dl). Exclusion criteria were using anti-obesity or anti-diabetic medications, not consenting to participate in the study, or failure to refer to give future blood samples. This study was approved by the ethics committee of Isfahan University of Medical Sciences. The patients were initially briefed by the principal physician conducting the study and their written consents were obtained. The patients then responded to a questionnaire collecting demographic information, as well as disease and drug history. Using standard Seca scales, the subjects' weights were measured barefoot in light clothing. BMI was calculated according to formula. Waist and hip circumference were measured using a normal meter tape and WHR was calculated. Resting heart rate was recorded. Blood pressure was measured in sitting position after 15 minutes of rest. Systolic and diastolic blood pressures were measured twice on right hand and the average of two readings was recorded and used in the study. These examinations were conducted twice within the study's four-month duration, in addition to routine pos-op visits. The examinations were first performed one week before liposuction. Second examinations were performed 12-14 weeks after the operation. Upon every visit, 10 CC fasting blood samples were taken to measure fasting blood glucose (FBS), total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL), oxidized LDL, triglyceride (TG), fibrinogen, antioxidant capacity, chronic reactive protein (CRP), lipoprotein A, serum insulin, and insulin resistance. FBS, TC, HLD, LDL, oxidized LDL and TG were measured with enzymatic method using an Elan 2000 machine at Isfahan Cardiovascular Research Center. LDL, however, was calculated using Friedwald formula; direct measurement was conducted if TG levels exceeded 400 mg/dl.¹³

Serum fibrinogen level was determined by measuring the clotting time for isolated plasma and comparing it with the standard curve. Antioxidant capacity was calculated through red blood cell hemolysis in the presence or absence of serum plasma. Lpa was measured using Lpa measurement kit by Pars Azmun via turbidimetry method. Serum insulin level was measured using ELISA and insulin resistance

was calculated with HOMA model and the following formula:⁸

$$\frac{\text{fasting insulin level}(M/ml) \times FBS(mmol/lit)}{22.5}$$

The study participants underwent liposuction at hospitals affiliated with Isfahan University of Medical Sciences. The patients were infused with large volumes of ringer lactate and diluted epinephrine (to induce vasoconstriction) solution subcutaneously in order to reduce hemorrhage. Ultrasound and traditional liposuction of abdomen, flanks and back were conducted for all patients.

The patients remained hospitalized for 2-3 days following the operation. They were instructed to resume their normal lifestyle after recovery, to measure their weight at home every week and to continue the same dietary habits and physical activities they had before the operation. All examinations and laboratory tests were repeated 12-14 weeks after the operation. This period was allowed to eliminate the distorting effects of post-op inflammation on the overall study outcome. Statistical analyses were conducted using SPSS11 with paired t-test and repeated measure ANOVA. P values below 0.05 were considered as significant and data were expressed as mean \pm standard deviation.

Results

The study group consisted of 24 non-diabetic obese women with a mean age of 48.7 years, BMI of 35.34 ± 2.97 kg/m² and WHR of 1.15 ± 0.04 . Mean amount of aspirated fat was 5285 milliliters. BMI decreased by 2.48 (1.44 - 3.5 kg/m²) following surgery, reaching 32.8 ± 3.7 kg/m² ($P < 0.0001$).

WHR decreased by 0.08 (0.07 - 0.09), reaching 1.06 ± 0.33 after surgery ($P < 0.0001$). Post-op TC was different from pre-op levels; the difference, however, was insignificant ($P < 0.06$). Post-op LDL decreased by 23.1 mg/dl (0.5 - 45.7 mg/dl), showing a significant difference ($P < 0.04$). HDL, TG, FBS, insulin, insulin resistance, CRP, fibrinogen, Lpa and antioxidant capacity did not change significantly compared to before the operation ($P > 0.05$). Mean systolic and diastolic blood pressure did not change significantly compared to before the operation; however, the decrease in diastolic blood pressure appeared to be greater than the decrease in systolic pressure. Left ventricular mass did not change significantly after the operation. The subjects did not experience any serious complications and all of them returned to normal life ten days after the operation. Mean changes of variables before and after liposuction in subjects under study are shown in Table 1.

TABLE 1. Mean changes of variables before and after liposuction in subjects under study

Variable	Before liposuction	After liposuction	Variation (95% CI)	P value
BMI	35.3 \pm 2.9	32.8 \pm 3.7	2.4 (1.4, 3.5)	<0.0001
WHR	1.15 \pm 0.04	1.06 \pm 0.33	0.08 (0.07, 0.09)	<0.0001
Total cholesterol	220.0 \pm 68.6	195.5 \pm 24.9	24.5 (-1.1, 50.25)	0.06
LDL-C	142.5 \pm 64.4	119.3 \pm 25.9	23.1 (0.5, 45.7)	0.04
HDL-C	41 \pm 5.8	43.5 \pm 8.4	-2.5 (-6.3, 1.3)	0.19
TG	182.9 \pm 66.0	160.7 \pm 45.8	21.98 (-10.2, 47.3)	0.19
SBP	139.3 \pm 12.6	139 \pm 12.0	0.3 (-1.2, 1.8)	0.69
DBP	86.3 \pm 4.0	84.8 \pm 4.1	1.39 (-0.0, 2.7)	0.06
FBG	90.7 \pm 12.5	86.2 \pm 10.2	4.5 (-3.6, 12.6)	0.26
LV mass	152 \pm 40.2	151.6 \pm 37	0.3 (-3.5, 4.2)	0.84
Insulin	23.1 \pm 2.6	18.7 \pm 1.9	4.3 (-1.2, 19.0)	0.54
Insulin Resistance	0.28 \pm 0.03	0.21 \pm 0.02	0.07 (-0.12, 0.25)	0.42
CRP	1.8 \pm 0.48	0.99 \pm 0.40	0.09 (-0.02, 0.38)	0.52
Fibrinogen	305 \pm 108	273 \pm 81.1	32.2 (-23.0, 87.6)	0.24
Lpa	21.2 \pm 12.6	20.7 \pm 13.7	0.5 (-4.0, 5.0)	0.82
Antioxidant capacity	53.3 \pm 14.2	49.8 \pm 17.9	3.5 (-5.0, 12.0)	0.40

Discussion

The present study revealed a decrease in some obesity-related cardiovascular disease risk factors following liposuction. BMI decreased significantly in subjects after the operation. Another study conducted in 2004 showed a significant decrease in BMI in diabetic and non-diabetic obese women undergoing liposuction.²⁴ An Italian study showed a significant reduction of BMI in obese premenopausal women following liposuction.³⁰

A study in 2000 also highlighted a significant decrease in BMI following liposuction operation.³¹

In this study, WHR decreased significantly after liposuction. An Italian study,³⁰ as well as a study of WHR in two groups of diabetic and non-diabetic obese women showed a significant decrease in WHR after liposuction.²⁴

LDL decreased significantly following liposuction in this study. In two other studies, however, the decrease in LDL following liposuction was insignificant;^{24,30} this may be due to the higher mean age of women in the present study.

This study showed no significant change in TC and TG after liposuction, supporting the results of other studies.^{24,30-32} FBS, insulin, and insulin resistance did not change significantly in this study. A 2002 study, however, reported a significant decrease in FBS and insulin resistance following liposuction.²⁶ Another study reported a significant decrease in FBS following liposuction.³¹ A study conducted in 2003 did not show any significant change in FBS and insulin resistance following liposuction.³¹ Another study yielded results similar to those of the present study, showing no significant reduction of FBS and insulin resistance following liposuction.²⁴ The difference between the results of the present study and those of three earlier studies regarding FBS and insulin resistance may be explained by the lower mean age of subjects, smaller sample size, and the shorter period of time before rechecking of FBS and insulin resistance following liposuction (21-28 days compared to 12-14 weeks after liposuction). The present study did not reveal any significant reduction of CRP, fibrinogen, Lpa or antioxidant capacity after liposuction; another study, however, showed a significant reduction of CRP and a number of other inflammatory markers such as TNF- α and IL6.³⁰

A 2004 study also revealed no significant reduction in CRP, adiponectin, TNF- α and IL6 following liposuction.²⁴ CRP was the only inflammatory marker assessed in the present study.

Systolic and diastolic blood pressure did not decrease significantly after liposuction in this study; however, diastolic pressure seemed to have decreased more notably than systolic pressure. Another study revealed similar results regarding change in systolic and diastolic blood pressure following liposuction.²⁴

A study conducted in 2004 showed a significant decrease in systolic blood pressure following liposuction;³¹ this may be accounted for by the longer duration of time before rechecking of blood pressure compared to the present study (6 weeks - 4 months compared to 12-14 weeks after liposuction in the present study). It can be concluded that some cardiovascular disease risk factors (BMI, WHR, LDL) can be significantly reduced by liposuction in non-diabetic obese women 12-14 weeks after surgery. Nonetheless, liposuction had slight, yet insignificant effects on HDL, TG, FBS, insulin, TC, insulin resistance, CRP, fibrinogen, antioxidant capacity, Lpa and left ventricular mass. Liposuction did not lead to any significant reduction in diastolic and systolic blood pressure. Hence, liposuction can be effective in controlling a number of cardiovascular risk factors, besides weight and WC. Long-term effects of liposuction have yet to be addressed by further studies.

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