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ORIGINAL ARTICLE

BODY CONTOURING

# The Short-Term Effect of VASER Assisted Liposuction on Lipid Profile

Hüseyin Kandulu[1]

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**Abstract**
*Objective* The presence of obesity with dyslipidemia is a worldwide health problem and one of the major risks for cardiovascular diseases. The metabolic effects of liposuction are being investigated in terms of insulin resistance and reducing cholesterol levels. We aimed to examine the metabolic effects of Vibration Amplification of Sound Energy at Resonance (VASER®)-assisted liposuction on the lipid profiles of overweight patients.
*Methods* Eighteen patients who underwent VASER®-assisted liposuction were investigated in terms of changes in lipid profiles. The total cholesterol (Total-C), triglycerides (TGs), Low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) levels were measured enzymatically. We also calculated Non-HDL Cholesterol levels and Total Cholesterol/HDL Cholesterol ratios.
*Results* We observed that Total-C ($p \leq 0.0001$), LDL-C ($p \leq 0.0001$), TGs ($p = 0.0004$), Non-HDL-C levels ($p \leq 0.0001$) and Total-C/HDL-C ratios ($p \leq 0.0001$) decreased on the third month after VASER®-assisted liposuction.
*Conclusion* We conclude that VASER®-assisted liposuction could be beneficial to regulate lipid metabolism. Especially, decrements of Non-HDL Cholesterol and Total-C/HDL-C ratio could be protective against cardiovascular diseases.

*Level of Evidence IV* This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

**Keywords** VASER · Liposuction · Ultrasound-assisted liposuction · Lipid profile

## Introduction

Dyslipidemia is defined as elevations of plasma cholesterol, triglycerides (TGs), or both, as well as decreased high-density lipoprotein cholesterol (HDL-C) levels. Dyslipidemia and obesity are the most common and modifiable risk factors for the development of atherosclerosis [1].

The most valid hypothesis in the pathogenesis of atherosclerosis is lipoprotein-derived atherosclerosis, which is an inflammatory process in which endothelial damage or dysfunction is accompanied by the sub-endothelial migration of macrophages and lipoproteins. Low-density lipoprotein (LDL) is the key conveyor of cholesterol to the impaired endothelial wall. Atherosclerosis plays a crucial role in the etiopathogenesis of cardiovascular and cerebrovascular diseases [2].

Vibration Amplification of Sound Energy at Resonance (VASER®) is an ultrasound-assisted technology that solely targets the adipocytes to reduce the number of these cells by an emulsification process [3]. VASER® is called a lipo-selective technique due to its specificity to fat cells and its competency of not damaging the surrounding tissues and vessels [4]. The technique is minimally invasive, highly-selective and utilizes three biological processes, micromechanical, thermal and micro cavitation effects to

✉ Hüseyin Kandulu
info@huseyinkandulu.com

1 Huseyin Kandulu Clinic for Plastic Surgery, Teşvikiye, Terrace Fulya Teşvikiye Mah. Hakkı Yeten Cad.No.13 Center 1 Kat 11 D.59, Istanbul, Turkey

remove the fatty tissue [5]. With this technique, the heat and energy applied to the tissues are reduced compared to other methods [6]. In addition, VASER® has fewer complications compared to the standard liposuction such as bleeding, hematoma, chronic edema, fat embolism, fibrosis and hyperpigmentation [7].

The adipose tissue is a central metabolic, energy storage and endocrine organ which regulates many physiological processes, processing excess calories and storing them in the form of neutral lipid [8]. Adipocytes regulate the mobility and storage of triglycerides and free fatty acids response to insulin, cortisol and other metabolic hormones [9]. Changes in the number of adipokines secreted by adipose tissue play a role in the development of many diseases such as type II diabetes, endocrine/metabolic syndrome and hypertension [10]. Although liposuction is generally used in cosmetic issues, it has been shown to regulate insulin and lipid metabolism via reducing the volume of the adipose tissue [11]. Studies are reporting that the removal of subcutaneous adipose tissue by liposuction might have a regulatory role in the lipid metabolism [11, 12].

Thus, the aim of our study was to investigate the metabolic effects of VASER®-assisted liposuction on the lipid profile of patients who underwent a VASER®-assisted liposuction procedure. We also aimed to discuss that whether VASER® might have beneficial effects on the cardiovascular system by regulating cholesterol levels.

## Materials and Methods

This study was conducted between January-April 2020 and involved overweight individuals. Informed consent was obtained, and the study was conducted in accordance with the Declarations of Helsinki. The study was approved by the local ethical committee.

All patients were advised to adopt a protein-rich diet prior to and at least six months following the surgery.

We excluded individuals who took any medication or supplements or applied a special dietary plan for weight loss. We also excluded patients with a history of chronic diseases including diabetes mellitus, anemia, or diseases of the cardiovascular, renal and hepatopancreaticobiliary systems.

Inclusion criteria were the female patients who underwent VASER®-assisted liposuction procedure, without the co-morbidities given in the exclusion criteria, and requested a blood lipid profile control before and after the procedure.

The definition overweight was used for the individuals with a BMI greater than or equal to 25; and obesity was defined as a BMI greater than or equal to 30 according to the World Health Organization criteria [13].

After surgical preparation with povidone-iodine solution, the patient was covered with a sterile drape in the prone position. A tumescent solution composed of 1000 mL of lactated Ringer's solution including 1 mg adrenaline and 5 mL of 1% lidocaine was infiltrated in the areas of liposuction and fat harvesting.

All patients underwent third generation VASER®-assisted liposuction procedure involving multiple aspiration areas, mainly abdomen, gluteal region, arms, flanks, back and thighs under general anesthesia. VASER® cannulas with dimensions of 3.7, 2.9 and 2.2-mm were used in both continuous and pulse modes. The VASER mode was set to 100% C using a 3.7 mm 5-groove probe, with a rate of 100 ml of infiltration per minute, allowing the fat emulsification.

The liposuction was performed by the conventional technique using 16-gauge multiple hole infiltration cannulas (1.2 mm of inner diameter) and 50 mL syringes on selected regions with a flow rate of 5.5 ml/s.

Patients were given prophylactic antibiotherapy with a single-dose of the first generation cephalosporins prior to, and pain medication with NSAIDs such as acetaminophen or ibuprofen after the procedure.

All patients were asked for a follow-up visit three months following the procedure, and blood samples were drawn in order to investigate lipid profiles in fasting conditions from eighteen out of fifty-nine patients who came for the control visit.

Venous blood samples were drawn before and after the VASER®-assisted liposuction procedure to evaluate Total-C, TGs, HDL-C and LDL-C levels. Biochemical parameters were measured spectrophotometrically and enzymatically with Siemens Dimension® EXL™ 200 Integrated Chemistry System (Siemens, Erlangen, Germany). We also calculated Non-HDL cholesterol (Non-HDL-C) levels and Total Cholesterol / HDL cholesterol ratios (Total C/HDL-C).

The SPSS 21.0 program (SPSS Inc., Chicago, IL, USA) was used for the statistical comparisons of the groups. Paired t-test, Post-Hoc test and Kruskal-Wallis test were performed to show the significance of difference among the groups for related lipid profile variables.

## Results

Baseline characteristics of the patient group are summarized in Table 1.

A comparison of the lipid profile variables before and after the procedure is given in Table 2. Total-C ($p \leq 0.0001$), LDL-C ($p \leq 0.0001$), TGs ($p = 0.0004$), Non-

**Table 1** Baseline characteristics of the patient group.

| Characteristics | VASER liposuction ($n$ = 18) | |
|---|---|---|
| | Mean ± SD | Min–max |
| Age (years) | 33.7 ± 7.53 | 20–45 |
| Gender (male/female) ($n$; %) | (9/9; 50/50) | |
| BMI (kg/m$^2$) | 26.47 ± 2.48 | 20.48–29.64 |
| Number of aspirated regions | 8 ± 2.6 | 3–12 |
| Volume of total aspirate (mL) | 9033 ± 1504 | 5900–11600 |
| Duration of VASER (min) | 81.1 ± 22.4 | 42–123 |
| Volume of supranatant fat (mL) | 5467 ± 1704 | 2600–8450 |

**Table 2** Comparison of the lipid profile variables before and after the procedure.

| Variables | VASER liposuction ($n$ = 18) | | |
|---|---|---|---|
| | Preoperative | Postoperative | $p$ value |
| Total cholesterol (mg/dL) | 211.6±39.31 | 155.8±36.23 | **< 0.0001*** |
| LDL-C (mg/dL) | 125.2±36.10 | 93.35±29.27 | **< 0.0001*** |
| HDL-C (mg/dL) | 58.39±13.60 | 53.40±9.515 | **0.0013*** |
| Triglycerides (mg/dL) | 111.2±57.13 | 53.07±23.37 | **0.0004*** |

* Statistically significant

HDL-C levels ($p \leq 0.0001$) and Total-C/HDL-C ratio ($p \leq 0.0001$) were found to be significantly decreased on the third month after liposuction.

Table 3 shows lipid profiles changes after operation based on gender. Total-C, LDL–C, TGs, Non-HDL-C levels and Total-C/HDL-C ratio were found significantly decreased for the two genders. However, HDL-C levels ($p$ = 0.007) were found to be significantly decreased in female individuals.

Figure 1 demonstrates the comparison of lipid profile variables before and after the liposuction procedure.

## Discussion

Obesity is strongly associated with atherogenic dyslipidemia in terms of developing cardiovascular diseases. The purpose of the present study was to evaluate changes in lipid profiles of patients who underwent a VASER®-assisted liposuction procedure. There are multiple studies conducted on the effects of liposuction on carbohydrate and lipid metabolism and insulin resistance [8, 11, 14].

Doucas et al. investigated lipid profiles of patients with antiretroviral (ARV) drug-induced lipodystrophy who underwent liposuction. They observed a significant decrease in postoperative Total-C, TGs and LDL-C levels. In similar to our study, there was no alteration in the HDL-C levels [15]. On the other hand, although the mean resection volume of our study is up to sixfold higher than reported by Doucas et al., they analyzed the lipid profile of patients 12 months after liposuction, whereas our follow-up time was shorter. However, in our study, we also calculated the Non-HDL-C levels and Total-C/HDL-C ratio, which are strong predictors of cardiovascular disease, and we suggest that the evaluation of Non-HDL-C levels would be more beneficial in the assessment of the regulation of lipid metabolism following the liposuction.

In another study, Rania et al. reported that TGs, LDL-C and Total-C levels were found to be decreased and HDL-C levels increased after abdominal lipo-cavitation. They observed a decrement in lipid levels on the fourth week, and decreasing trend persisted following the sixth week

**Table 3.** Comparison of the lipid profile variables before and after the procedure depending on gender.

| | Variables | Preoperative | | | | | Postoperative | | | | | $p$ value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Min | Max | Median | Mean | SD | Min | Max | Median | |
| Female | Total cholesterol (mg/dL) | 218.2 | 34.2 | 173.8 | 275.2 | 214.0 | 158.2 | 26.3 | 118.9 | 189.3 | 159.5 | **0.0003*** |
| | LDL-C (mg/dL) | 134.6 | 29.4 | 98.60 | 181.3 | 130.7 | 93.1 | 22.7 | 62.3 | 121.0 | 92.8 | **0.0003*** |
| | HDL-C (mg/dL) | 65.1 | 14.7 | 49.00 | 95.0 | 60.5 | 55.3 | 9.1 | 41.0 | 72.0 | 54.5 | **0.007*** |
| | Triglycerides (mg/dL) | 107.6 | 63.6 | 48.00 | 243.0 | 88.0 | 51.3 | 20.4 | 35.0 | 76.0 | 42.0 | **0.02*** |
| | BMI (kg/m$^2$) | 24.73 | 2.17 | 20.48 | 27.43 | 25.24 | 20.17 | 1.42 | 17.54 | 22.32 | 21.22 | **0.015*** |
| Male | Total cholesterol (mg/dL) | 205.1 | 45.1 | 115.0 | 266.5 | 208.7 | 153.5 | 46.2 | 75.0 | 214.0 | 158.7 | **0.0002*** |
| | LDL-C (mg/dL) | 117.7 | 40.6 | 29.00 | 171.0 | 127.9 | 93.7 | 37.4 | 28.2 | 139.0 | 99.7 | **0.0001*** |
| | HDL-C (mg/dL) | 53.0 | 10.4 | 38.00 | 66.0 | 56.50 | 51.3 | 10.3 | 36.0 | 66.0 | 52.0 | 0.08 |
| | Triglycerides (mg/dL) | 114.9 | 54.7 | 51.00 | 194.0 | 118.0 | 54.8 | 27.6 | 33.0 | 109.0 | 43.0 | **0.0088*** |
| | BMI (kg/m$^2$) | 27.87 | 1.77 | 24.54 | 29.64 | 28.39 | 23.31 | 1.18 | 21.68 | 24.56 | 22.95 | **0.022*** |

* Statistically significant

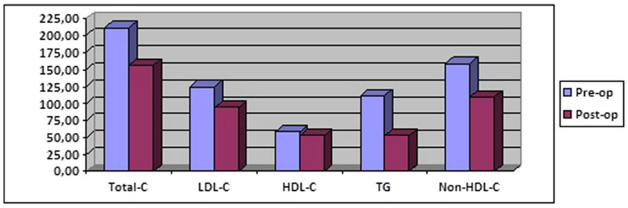


**Fig. 1** Comparison of mean values of the lipid profile variables after liposuction procedure

after the procedure [16]. They concluded that a low degree of LDL-C turnover might decrease the synthesis of very-low-density lipoproteins (VLDL), and that abdominal fat mass and central obesity could lead to abnormalities in lipoprotein metabolism.

In their study on investigation of the lipid profile, and insulin resistance in obese women on 10th, 27th and 84th–208th weeks following large-volume abdominal liposuction, Mohammed et al. observed changes in lipid profiles of patients in the 10th week but no changes were present in the long-term. They emphasized that decreasing body fat by generating a negative energy balance would be more beneficial than surgical fat aspiration to improve the metabolic markers; however, a large-volume liposuction of different locations might still ameliorate the metabolic profile [17].

Lubkowska et al. observed no changes in levels of total cholesterol, HDL-C, TGs, ApoA, ApoB and ApoE levels 12 weeks after small-volume liposuction in the gluteal-femoral region, and concluded that liposuction lacks a regulatory effect on lipid metabolism but reduces insulin resistance [8]. Similar to this study, Habib et al. reported that large-volume liposuction could improve insulin sensitivity and fasting insulin levels, reverting back the metabolic syndrome pathogenesis by decreasing the adipose tissue volume [14].

Davis et al. investigated insulin sensitivity and cardiovascular risk in fifteen overweight and obese premenopausal women who underwent small-volume liposuction with a mean level of $1880 \pm 213$ ml, and reported that free fatty acid and TGs levels were decreased significantly 1 month after the procedure. They also observed that long-term (3–6 months) effects of small-volume liposuction on the inflammatory mediators adiponectin, TNF-α, IL-6, or C-reactive protein are controversial since studies report conflicting results with or without alterations on the levels of these markers [18]. They explained this controversy by the diversity of resection volumes between studies.

VASER is a minimally invasive method, which, selectively shatters adipocytes localized below the superficial subdermal fascia. This large group of adipocytes, also known as the subcutaneous white adipose tissue, and, are responsible for the poor metabolic profile of overweight and obese individuals while their secretion and cell signaling capacity of adiponectin, insulin, and leptin have deteriorated. Furthermore, an altered imbalance of lipid oxidation, glucose uptake, energy production and consumption are the underlying metabolic factors for the inflammatory effects of lipodystrophies [19, 20].

Ultrasonic methods including the VASER have been shown to have no damaging effects on the stromal fraction of the adipose tissue, and on the contrary, enhance the functionality of mesenchymal stem cells, and allow increased harvesting of adipose tissue mesenchymal stem cells. Thus, an improved regeneration and differentiation capacity of adipocytes result in decreased lipid accumulation, adipogenesis and adipocyte hypertrophy [21, 22]. We suggest that the metabolic effects in our study following a combined application of VASER and liposuction might play a role in the physiology of improved lipid profile.

Although an increased lipoaspirate volume has been associated with increased complication rates including massive blood loss, deep vein thrombosis, pulmonary edema and embolism, and skin necrosis, the tumescent technique overcomes these major complications, and according to recent reports the 1% of the aspirate volume consisted of blood, and this amount might be negligible [23, 24]. In our cases, the intra and postoperative fluid intake, urine output and cardiac and renal markers were frequently checked by the anesthesiology team, and none of the cases experienced fluid overload or dehydration. None of our cases received a blood transfusion during the operation and recovery period, and clinical and laboratory parameters of body fluid imbalance were closely monitored.

The major limitation of our study is the small sample size, and although 59 patients enrolled in the study, we could only draw blood from 19 patients on the control day. We had to exclude volunteers who did not attend to control appointment, and whose fasting status was not appropriate. However, we included both female and male patients, and none of the patients took medications that might affect the lipid metabolism.

In conclusion, despite the controversies in the literature, we observed that TG, total cholesterol, Non-HDL-C levels and Total-C/HDL-C ratios were significantly decreased following the third month after VASER® Liposuction. We also conclude that the reductions in Non-HDL-C levels and Total-C/HDL-C ratios are promising for the prevention of cardiovascular diseases in the lifetime. Although VASER® Liposuction should not be the sole method in prevention of cardiovascular diseases, inclusion of the procedure in the management of metabolic diseases in a multidisciplinary manner might yield beneficial outcomes. Sample size, resection volumes, control periods, study design, inclusion/

exclusion criteria, patient and control group differences, age and environmental factors might be the underlying cause of discordant results between the studies, and follow-up studies involving larger number of patients and control groups are needed.

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**Declarations**

**Conflict of interest** The author declares that he has no conflict of interest to disclose.

**Human Participants or Animals Statement** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed Consent** Informed consent was obtained from all study participants.

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