

Preliminary Report

Impact of Large-Volume Liposuction on Inflammatory Cytokine Interleukin-6 Levels: A Cross-Sectional Study

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Abstract

Background: Liposuction is a widely performed surgical procedure for fat removal, showing increasing popularity for body sculpting purposes. Surgical interventions typically trigger an inflammatory response, but in the context of overweight and obesity, excess adipose tissue can perpetuate systemic inflammation. Adipose tissue, recognized as an endocrine organ, secretes adipokines, influencing metabolic and inflammatory processes. Interleukin-6 (IL-6) is a key cytokine involved in inflammation, notably elevated in obese individuals.

Objectives: The aim of this study is to understand the impact of liposuction on IL-6 levels and its correlation with different follow-up points.

Methods: This cross-sectional study involved patients undergoing liposuction between January and December 2023. Exclusion criteria included metabolic or chronic diseases. IL-6 levels were measured preoperatively and at 1, 3, and 6 months postsurgery. Data on liposuction volume, BMI, and demographic variables were collected.

Results: Twenty-seven patients participated, predominantly female (21/6) with a mean age of 36.42 years. Significant reductions in BMI were observed postoperatively, with a notable increase in IL-6 levels immediately postsurgery followed by a decline at 1 month. IL-6 levels remained stable and were significantly lower than the baseline preoperative levels on the third and sixth follow-up visits.

Conclusions: Liposuction induces a temporary inflammatory response, as evidenced by elevated IL-6 levels postsurgery, which subsequently normalize within the first month. Although liposuction may offer short-term improvements in inflammatory response, larger studies are needed to understand its long-term impact on inflammation and metabolic health.

Level of Evidence: 2 (Risk)

Liposuction is among the most commonly performed surgical procedures globally, with an incidence rate of 24.8% and a growing trend.¹ Although it was traditionally used to remove excess fat from areas like the waist, abdomen, hips, and buttocks, it is now also applied for smaller scale fat removal and body sculpting, including procedures targeting the neck and chin. On the other hand, the American Society of Plastic Surgery defines an aspirate volume >5 L as large-volume liposuction.²

All surgical procedures induce an inflammatory response in the body, evidenced by elevated levels of acute inflammatory markers, like C-reactive protein (CRP), white blood cell count, and cytokines.³ These levels tend to decrease as the healing process progresses.

However, excess weight and fat-tissue accumulation are also associated with an inflammatory state and oxidative stress in the organism, driven by various mediators and biological pathways.

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Table 1. Demographic and Intraoperative Variables of the Study Group

Variables	Baseline
Age (years)	36.42 ± 5.14
F/M	21/6
Aspirated fat volume (mL)	3943 ± 1524
Tumescent solution volume (mL)	7358 ± 2354

Recently, adipose tissue has been recognized as an endocrine organ owing to its ability to produce adipocytokines, proteins related to the obesity-associated complications.^{4,5} Moreover, elevated levels of several cytokines and CRP in circulation have also been linked to an elevated risk of cardiovascular disease and thrombotic cardiovascular incidents.^{6,7}

It has been suggested that weight loss leads to alterations in inflammatory status and adipokine levels.^{8,9} Therefore, reducing adipose tissue through liposuction might impact adipokine secretion and subsequently influence the metabolic profile.

Interleukin-6 (IL-6) is a 184–amino acid protein cytokine that serves as an acute mediator during the inflammatory response, exhibiting a rapid surge following injury to the body.¹⁰

IL-6 is generated by numerous cell types and is released in reaction to different forms of cellular stress, including inflammation, infection, and cancer. Surgical procedures have been demonstrated to increase circulating IL-6 levels, correlating with the extent of surgical stress.¹¹

Hence, the aim of the present study was to investigate the role of liposuction on IL-6 levels on different time points, and its correlation with the preoperative and postoperative weight and obtained adipose-tissue volume.

METHODS

Study Design and Population

This is a cross-sectional study of patients that was conducted at a single plastic surgery clinic. Patients who underwent liposuction and volunteered for the study between January and December 2023 were included.

Inclusion criteria were as follows: aged 18 years or older, willing for the testing of IL-6 on the study follow-up points, and patients who underwent a primary liposuction procedure. The patients with a metabolic disease, obesity, hypertension, chronic or autoimmune disease, and patients who underwent a previous bariatric surgery procedure were excluded.

Study variables were age, gender, serum IL-6 levels, and BMI. IL-6 levels were analyzed on the predetermined follow-up points: preoperative, after the surgery, on the first, third, and sixth months postsurgery.

Informed consent was obtained, and the study was conducted in accordance with the Declaration of Helsinki.

Height and weight measurements were collected with participants wearing light clothing and no shoes, using the same scale for all measurements. BMI was calculated as weight in kilograms divided by the square of height in meters.

Table 2. Comparison of Study Variables on the Follow-up Points

Variables	Mean ± SD	P-value ^a	P-value ^b
BMI (kg/m ²)			
Preoperative	28.14 ± 5.46	<.001	.381
Postoperative	25.76 ± 2.99	<.001	.217
Postoperative first month	25.58 ± 2.28	<.001	.284
Postoperative third month	23.44 ± 1.89	<.001	
Postoperative sixth month	24.75 ± 3.08		
IL-6 (pg/mL)			
Preoperative	6.301 ± 9.466	.0002	<.0001
Postoperative	27.57 ± 12.08	.3804	.4034
Postoperative first month	3.349 ± 1.739	.043	.2327
Postoperative third month	2.423 ± 1.058	.031	
Postoperative sixth month	2.375 ± 0.035		

IL-6, interleukin-6.^aDifference with preop.^bDifference with previous measurement.

Standard, ultrasound-assisted liposuction, using a tumescent solution, was performed under general anesthesia. Liposuction was performed in 1 or more anatomical sites, including abdomen, hips, waist, and thighs. The volumes of fat aspirated and tumescent solution used were quantified and recorded.

Venous blood samples for IL-6 analysis were stored at 2°C to 8°C and transported to the laboratory within the same day of sampling while maintaining a cold chain. Serum concentrations of IL-6 were measured using the e UniCel DxI 800 Product Access IL-6, Interleukin-6 Reagent Pack assay (Beckman Coulter, Inc., Brea, CA).

Statistical Analysis

Categorical variables were presented as frequency and percentages, whereas numerical variables were presented as mean ± standard deviation. A paired Student's *t* test was used for the comparison of variables between follow-up time points. A Pearson's correlation coefficient analysis was performed between the study variables. Analysis was performed using the IBM SPSS software version 17.0 (IBM Corp., Armonk, NY). A *P* value <.05 was determined for the statistical significance.

RESULTS

A total of 27 patients were included in the study, with a mean age of 36.42 ± 5.14 years, and female-to-male ratio of 21/6. The mean aspirated fat volume at the surgery was 3943 ± 1524 mL, whereas the mean volume of tumescent solution used was 7358 ± 2354 mL (Table 1).

None of the patients developed a postoperative complication which would affect the inflammatory status.

IL-6 and BMI levels were measured before surgery and at 1, 3, and 6 months after surgery (Table 2, Figure 1). A significant reduction in BMI was observed at all postoperative intervals compared with

Table 3. Correlation With the Weight Change and IL-6 Levels

	Preoperative IL-6	Postoperative IL-6	Postoperative first-month IL-6	Postoperative third-month IL-6	Postoperative sixth-month IL-6	Preoperative weight	Preoperative BMI	Postoperative first-month weight	Postoperative first-month BMI	Liposuction volume
Preoperative IL-6	1.00									
Postoperative IL-6	0.006	1.00								
Postoperative first-month IL-6	−0.289	−0.382	1.00							
Postoperative third-month IL-6	0.0303	0.0152	0.019	1.00						
Postoperative sixth-month IL-6	0.091	0.0131	0.057	0.041	1.00					
Preoperative weight	−0.162	0.186	−0.402	0.089	0.097	1.00				
Preoperative BMI	−0.221	0.337	−0.414	−0.179	−0.085	0.837 ^a	1.00			
Postoperative first-month weight	−0.176	0.165	−0.401	0.267	0.012	0.998 ^a	0.822 ^a	1.00		
Postoperative first-month BMI	−0.24	0.309	−0.423	−0.087	−0.082	0.876 ^a	0.995 ^a	0.864 ^a	1.00	
Liposuction volume	−0.09	0.812 ^a	−0.421	−0.332	−0.247	0.296	0.646 ^a	0.268	0.599 ^a	1.00
Tumescent solution volume	−0.186	0.30	−0.059	−0.318	−0.216	0.258	0.681 ^a	0.234	0.631 ^a	0.705 ^a

IL-6, interleukin-6. ^a $P < 0.05$.

suction effects of liposuction cannulas during the procedure. We suggest that the acute elevation in IL-6 levels during the initial postoperative phase could be attributed to both the mechanical impact of the procedure on adipocytes and the surgical stress.

Taking into consideration that IL-6 is also secreted by adipocytes, as well as the macrophages in the stroma, adipose tissue participates in complex crosstalk pathways. The positive correlation between the circulating IL-6 levels and adiposity has already been reported in human populations, with increased levels of IL-6 in obese patients, whereas weight loss leads to a reduction in IL-6 levels.^{18,19} Also, research indicates a decline in immune cell populations during calorie restriction. Unlike the classic inflammatory response triggered by infection, the inflammatory response in case of the presence of excess adipose tissue and obesity, termed meta-inflammation, is initiated by intrinsic signals, and endoplasmic reticulum stress through the activation of the nuclear factor-kappa B–signaling pathway.²⁰ This process leads to the production of proinflammatory cytokines, reactive oxygen species, and proinflammatory adipokines by adipocytes and immune cells within adipose tissue. Thus, adipokines play a significant role in modulating the inflammatory response in adipose tissue during obesity development and in response to infection or systemic inflammation.

Research has demonstrated that also the hypertrophied adipocytes exhibit increased expression of inflammatory genes, which can contribute to the harmful accumulation of fatty acids in the liver and muscles.^{21,22} A subcutaneous liposuction may additionally modify the proportion of visceral adipose tissue, thereby improving the metabolic profile of individuals. However, we did not employ metabolic risk profiling in the context of this study, and the initial postoperative rise in IL-6 levels are considered to be because of the effects of surgery. However, 9 out of 27 patients (30.0%) in our study group had baseline IL-6 levels surpassing clinical cut-off points. However, following surgery, IL-6 levels remained below the threshold for all individuals across all time points, which may further support the link between lipid accumulation and inflammation. In the context of this study, we did not include individuals with obesity, and all cases had a BMI <30 kg/m². Nevertheless, even in this context, removal of adipose-tissue content by liposuction was linked to the improvement of the inflammatory status.

Our study has several limitations to declare. Firstly, we focused solely on IL-6 as an inflammatory marker, and other acute-phase reactants or several indicators of oxidative stress were not included in this research. Additionally, the sample size was relatively small, and our findings are restricted to the effects of liposuction. Furthermore,

gender is a possible confounding variable/limitation of the study, because women have greater adipose tissue than men. However, our study contributes to the limited body of research investigating the impact of liposuction on inflammatory cytokine IL-6 levels, particularly in relation to surgical stress.

CONCLUSIONS

Our findings suggest that liposuction induces a transient postoperative inflammatory response, as evidenced by elevated IL-6 levels that subsequently decline and stabilize within the first-month postsurgery. Overall, although liposuction may offer improvements in inflammatory response, further research with large cohorts are needed to fully elucidate its long-term effects.

Disclosures

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REFERENCES

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- ## REFERENCES
1. International Society of Aesthetic Plastic Surgery. ISAPS International Survey on Aesthetic/Cosmetic Procedures performed in 2021. Accessed August 2024. https://www.isaps.org/media/vdpdanke/isaps-global-survey_2021.pdf.
 2. Iverson RE, Lynch DJ; American Society of Plastic Surgeons Committee on Patient Safety. Practice advisory on liposuction. *Plast Reconstr Surg*. 2004;113:1478-1490; discussion 1491-1495. doi: [10.1097/01.PRS.0000111591.62685.F8](#)
 3. Jawa RS, Anillo S, Huntoon K, Baumann H, Kulaylat M. Interleukin-6 in surgery, trauma, and critical care part II: clinical implications. *J Intensive Care Med*. 2011;26:73-87. doi: [10.1177/0885066610384188](#)
 4. Mancuso P. The role of adipokines in chronic inflammation. *Immunotargets Ther*. 2016;5:47-56. doi: [10.2147/ITT.S73223](#)
 5. Würfel M, Breitfeld J, Gebhard C, et al. Interplay between adipose tissue secreted proteins, eating behavior and obesity. *Eur J Nutr*. 2022;61:885-899. doi: [10.1007/s00394-021-02687-w](#)
 6. Kuppa A, Tripathi H, Al-Darraj A, Tarhuni WM, Abdel-Latif A. C-reactive protein levels and risk of cardiovascular diseases: a two-sample bidirectional Mendelian randomization study. *Int J Mol Sci*. 2023;24:9129. doi: [10.3390/ijms24119129](#)
 7. Wei T, Zhu Z, Liu L, et al. Circulating levels of cytokines and risk of cardiovascular disease: a Mendelian randomization study. *Front Immunol*. 2023;14:1175421. doi: [10.3389/fimmu.2023.1175421](#)
 8. Yu D, Chen W, Zhang J, et al. Effects of weight loss on bone turnover, inflammatory cytokines, and adipokines in Chinese overweight and obese adults. *J Endocrinol Invest*. 2022;45:1757-1767. doi: [10.1007/s40618-022-01815-5](#)
 9. Baltieri L, Cazzo E, de Souza AL, et al. Influence of weight loss on pulmonary function and levels of adipokines among asthmatic individuals with obesity: one-year follow-up. *Respir Med*. 2018;145:48-56. doi: [10.1016/j.rmed.2018.10.017](#)
 10. Choy E, Rose-John S. Interleukin-6 as a multifunctional regulator: inflammation, immune response, and fibrosis. *J Scleroderma Relat Disord*. 2017;2:S1-S5. doi: [10.5301/jrsd.5000265](#)
 11. Yahara N, Abe T, Morita K, Tangoku A, Oka M. Comparison of interleukin-6, interleukin-8, and granulocyte colony-stimulating factor production by the peritoneum in laparoscopic and open surgery. *Surg Endosc*. 2002;16:1615-1619. doi: [10.1007/s00464-001-8205-8](#)
 12. Zhang S, Tao XJ, Ding S, Feng XW, Wu FQ, Wu Y. Associations between postoperative cognitive dysfunction, serum interleukin-6 and postoperative delirium among patients after coronary artery bypass grafting: a mediation analysis. *Nurs Crit Care*. 2024;29:1245-1252. doi: [10.1111/nicc.13081](#)
 13. Lubkowska A, Chudecka M. The effects of small-volume liposuction surgery of subcutaneous adipose tissue in the gluteal-femoral region on selected biochemical parameters. *Int J Environ Res Public Health*. 2019;16:3298. doi: [10.3390/ijerph16183298](#)
 14. Giugliano G, Nicoletti G, Grella E, et al. Effect of liposuction on insulin resistance and vascular inflammatory markers in obese women. *Br J Plast Surg*. 2004;57:190-194. doi: [10.1016/j.bjps.2003.12.010](#)
 15. Recinella L, Orlando G, Ferrante C, Chiavaroli A, Brunetti L, Adipokines LS. New potential therapeutic target for obesity and metabolic, rheumatic, and cardiovascular diseases. *Front Physiol*. 2020;11:578966. doi: [10.3389/fphys.2020.578966](#)
 16. Chang PY, Wu TL, Tsao KC, Sun CF, Wu LL, Wu JT. Cosmetic liposuction causes only transient elevation of acute inflammatory response and does not advance to oxidative and nitrosative stress. *J Clin Lab Anal*. 2007;21:418-425. doi: [10.1002/jcla.20211](#)
 17. Heine PA, Taylor JA, Iwamoto GA, Lubahn DB, Cooke PS. Increased adipose tissue in male and female estrogen receptor-alpha knockout mice. *Proc Natl Acad Sci U S A*. 2000;97:12729-12734. doi: [10.1073/pnas.97.23.12729](#)
 18. Werida RH, El-Gharbawy NM, Mostafa TM. Circulating IL-6, clusterin and irisin in obese subjects with different grades of obesity: association with insulin resistance and sexual dimorphism. *Arch Endocrinol Metab*. 2021;65:126-136. doi: [10.20945/2359-3997000000336](#)
 19. Kern L, Mittenbühler MJ, Vesting AJ, Ostermann AL, Wunderlich CM, Wunderlich FT. Obesity-induced TNFα and IL-6 signaling: the missing link between obesity and inflammation-driven liver and colorectal cancers. *Cancers (Basel)*. 2018;11:24. doi: [10.3390/cancers11010024](#)
 20. Chandrasekar B, Boylston WH, Venkatachalam K, Webster NJ, Prabhu SD, Valente AJ. Adiponectin blocks interleukin-18-mediated endothelial cell death via APPL1-dependent AMP-activated protein kinase (AMPK) activation and IKK/NF-κB/PTEN suppression. *J Biol Chem*. 2008;283:24889-24898. doi: [10.1074/jbc.M804236200](#)
 21. Langkilde A, Petersen J, Henriksen JH, et al. Leptin, IL-6, and suPAR reflect distinct inflammatory changes associated with adiposity, lipodystrophy and low muscle mass in HIV-infected patients and controls. *Immun Ageing*. 2015;12:9. doi: [10.1186/s12979-015-0036-x](#)
 22. Gagnon A, Foster C, Landry A, Sorisky A. The role of interleukin 1β in the anti-adipogenic action of macrophages on human preadipocytes. *J Endocrinol*. 2013;217:197-206. doi: [10.1530/JOE-12-0565](#)