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Postoperative Seroma in Lipedema Surgery: A Retrospective Analysis of 93 Cases from a Single Surgical Team

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Abstract

Background Lipedema is a chronic adipose tissue disorder characterized by abnormal and disproportionate fat accumulation in the extremities, leading to pain, edema, and functional impairment. Liposuction has become a central component of surgical management. However, postoperative complications, particularly seroma formation, remain a concern.

Objectives To evaluate the incidence of postoperative seroma and associated risk factors in patients undergoing liposuction for lipedema treatment, based on procedures performed by a single surgical team in a single institution.

Methods This retrospective observational study included 93 female patients who underwent liposuction for lipedema between April 2019 and January 2024. Data collected included demographic variables, body mass index (BMI), anesthesia type, volume of aspirated fat, percentage of body weight removed, use of adjunct technologies (ultrasound or laser), association with other surgeries such as varicose vein surgery, and prior conservative treatment. The primary outcome was the development of postoperative seroma. Statistical analysis included Chi-square and Student's t-tests and multivariable logistic regression, with significance set at $p \leq 0.05$.

Results Among 93 cases, 17 patients (18.3%) developed postoperative seroma. Higher volumes of aspirated fat (% body weight) were significantly associated with seroma formation (7.27% vs. 5.84%, $p = 0.005$). Concomitant minor procedures were also linked to increased seroma incidence ($p = 0.035$). No seromas occurred in patients treated using ultrasound-assisted liposuction. Minor complications included one infection and one hematoma (1.07%).

Conclusions Liposuction for lipedema is a safe and effective surgical option with a low rate of major complications, but seroma remains a relatively frequent postoperative finding. Higher aspirated fat volumes relative to body weight and the presence of concomitant procedures increase the risk of seroma. No seromas were observed in the ultrasound-assisted group; however, this difference did not reach statistical significance and should be considered only as hypothesis-generating. Further studies are needed to validate these findings and guide surgical decision-making.

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 Lipedema · Liposuction · Seroma · Surgical complications · Ultrasound-assisted liposuction · Body contouring

Introduction

Lipedema is a chronic adipose disorder, primarily affecting women, first described by Allen and Hines in 1940 [1]. It is characterized by symmetrical fat deposition in the lower and upper extremities, sparing the trunk. Symptoms include spontaneous pain, limb heaviness, easy bruising, edema, and functional impairment [1–3].

Epidemiological studies estimate a prevalence of 11–17% among adult women, with more than 60% reporting a family history [4–7]. Although the exact pathophysiology remains unclear, contributing mechanisms include adipose tissue hypoxia, fluid retention, chronic inflammation, and hormonal factors such as estrogen [7–12].

Diagnosis is primarily clinical, based on patient history and physical examination. Imaging tools like ultrasound and MRI help differentiate lipedema from lymphedema and chronic venous insufficiency [13, 14]. Additional assessments such as lymphoscintigraphy, bioimpedance, and DEXA scans may support classification and treatment planning [14–16].

Conservative management—typically involving nutritional guidance, exercise, compression therapy, manual lymphatic drainage, and psychological support—is often the first-line approach [17–22]. However, these strategies provide only limited long-term relief. Liposuction, especially via tumescent and water-assisted techniques, has emerged as the most effective intervention for volume reduction, symptom relief, and quality of life improvement [23–29].

Despite its benefits, liposuction carries potential risks such as seroma formation, which may delay recovery or impair outcomes [30–33]. Identifying factors associated with postoperative complications is essential to optimize patient selection and surgical planning.

This study aims to retrospectively assess the incidence of postoperative seroma and identify associated risk factors in lipedema patients treated with liposuction by a single surgical team.

Methods

This retrospective, observational, single-center study was conducted between April 2019 and January 2024 and approved by the institutional ethics committee (CAAE 86155524.0.0000.5455). The primary objective was to evaluate the incidence of postoperative seroma in patients undergoing liposuction for the treatment of lipedema.

Inclusion Criteria

Female patients who underwent liposuction for lipedema without concurrent major surgical procedures. Patients who underwent combined procedures, such as abdominoplasty, mastopexy, thigh lift, arm lift, torsoplasty, or similar extensive surgeries were excluded to maintain homogeneity.

Associated Procedures

Minor concomitant surgeries were permitted when their duration did not exceed 40 minutes, and they did not substantially increase operative trauma. These included scar revisions, lipoma excisions, breast augmentations, and varicose vein surgery performed without involvement of the saphenous vein. All other combined procedures (e.g., abdominoplasty, mastopexy, thigh lift, arm lift, torsoplasty) were excluded.

Data Collection

Data were extracted from electronic medical records and operative reports. For each patient, we collected demographic characteristics (age, weight, height), body mass index (BMI), clinical lipedema stage (I–IV), type of anesthesia, history of previous liposuction, anatomical sites treated, duration of preoperative conservative therapy, total aspirated fat volume, percentage of body weight removed, use of adjunct technologies (ultrasound-assisted liposuction, laser devices and radiofrequency-assisted liposuction) and the presence and type of associated surgical procedures. The primary outcome was the occurrence of postoperative seroma.

Anesthesia

Procedures were performed either under intravenous sedation with tumescent local anesthesia or under general anesthesia, according to patient and anesthesiologist preference. In both settings, a standard tumescent solution containing saline, epinephrine, lidocaine and bupivacaine was infiltrated into the operative field.

Surgical Technique and Adjunct Technologies

All procedures were performed using tumescent liposuction. When indicated, adjunct technologies were used, including ultrasound-assisted liposuction (Liposound LSSA), 1210-nm laser lipolysis (ONE Step),

radiofrequency-assisted liposuction (BodyTite/FaceTite), fractional radiofrequency microneedling (Morpheus) and 980-nm laser (Orlight). The use of each technology was prospectively recorded and later analyzed in relation to postoperative seroma.

Statistical Analysis

Statistical analyses were performed using the Chi-square test for categorical variables and the Student's t-test for continuous variables; significance was set at $p \leq 0.05$. In addition, a multivariable logistic regression model was constructed to identify independent predictors of postoperative seroma. The dependent variable was seroma (yes/no), and candidate covariates included age, BMI, anesthesia type (local/sedation vs general), percentage of body weight removed, total aspirate volume, presence of concomitant minor procedures, the anatomical sites treated, clinical lipedema stage (I–IV) and the number of surgical sessions. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.

Results

A total of 93 female patients were included, of whom 17 (18.3%) developed postoperative seroma.

Demographics (Tables 1, 2)

Among the 12 patients classified as stage I, one (8.3%) developed seroma; among 43 stage-II patients, four (9.3%); among 36 stage-III patients, eleven (30.6%); and among two stage-IV patients, one (50.0%). Univariable analysis suggested increasing risk with higher stages, and clinical stage remained associated with seroma in the multivariable model, although the confidence intervals were wide because of the small numbers in stages I and IV and the potential overlap between stages II and III (Table 2). No significant differences were observed between the seroma and non-seroma groups in age (42.10 ± 9.70 vs. 43.33 ± 11.72 years; $p = 0.643$), weight (76.71 ± 12.33 vs. 73.10 ± 10.96 kg; $p = 0.278$) or body mass index (BMI) (28.38 ± 4.07 vs. 27.10 ± 3.87 kg/m^2; $p = 0.249$) (Table 2). Most procedures were carried out under sedation with local anesthesia (80.6%), whereas 19.4% were performed under general anesthesia; anesthesia type was not associated with seroma formation.

Aspirated Volume

The mean aspirated fat volume was 4,500 mL (range, 800–8,000 mL), corresponding to 6.10% ± 2.36% of body weight (range, 1.22%–10.76%) (Table 1). Patients who developed seroma exhibited a significantly greater relative aspirated volume than those who did not (7.27% ± 1.62% vs. 5.84% ± 2.36%; $p = 0.005$). When stratified by percentage removed, 8 of 17 (47.1%) seroma patients had ≥ 7% aspirated versus 28 of 76 (36.8%) non-seroma patients (Table 2).

Surgical Sessions and Preoperative Therapy

No significant associations were found between seroma formation and the number of surgical sessions ($p = 0.667$) or the duration of preoperative clinical therapy ($p = 0.273$) (Table 2).

Previous Liposuction and Anatomical Site

A history of prior liposuction was not associated with seroma incidence ($p = 0.851$) (Table 2). The anatomical localization of lipedema (arms, legs, knees, thighs) showed no significant effect on seroma risk (all $p > 0.05$) (Table 2).

Concomitant Procedures

Concomitant surgical procedures were significantly related to higher seroma rates (64.7% vs. 36.8%; $p = 0.035$) (Table 2). In patients undergoing varicose vein surgery, seroma occurred in 7 of 17 (41.2%) versus 17 of 76 (22.4%) without venous treatment ($p = 0.130$) (Table 2).

Table 1 Patient demographics and clinical characteristics (N = 93)

Variable	Seroma group (n = 17)	Non-seroma group (n = 76)	p-value*
Age (years), mean ± SD	42.1 ± 9.7	43.3 ± 11.7	0.643
Weight (kg), mean ± SD	76.7 ± 12.3	73.1 ± 11.0	0.278
BMI (kg/m^2), mean ± SD	28.4 ± 4.1	27.1 ± 3.9	0.249
Aspirated volume (% of body weight), mean ± SD	7.27% ± 1.62%	5.84% ± 2.36%	**0.005**

*Bold values indicate statistically significant differences ($p < 0.05$). Data are presented as mean ± standard deviation (SD). Comparisons between groups were performed using Student's t-test. BMI body mass index.

Table 2 Surgical data, clinical stage, and adjunct technologies

Variable	Seroma group (n = 17)	Non-seroma group (n = 76)	p-value*
Clinical lipedema stage			**0.044**
Stage I	1 (5.9%)	11 (14.5%)	
Stage II	4 (23.5%)	39 (51.3%)	
Stage III	11 (64.7%)	25 (32.9%)	
Stage IV	1 (5.9%)	1 (1.3%)	
Aspirated volume category			**0.162**
< 5% of body weight	1 (5.9%)	21 (27.6%)	
5% to 7% of body weight	8 (47.1%)	27 (35.5%)	
≥ 7% of body weight	8 (47.1%)	28 (36.8%)	
Concomitant minor procedures	11 (64.7%)	28 (36.8%)	**0.035**
Varicose vein surgery	7 (41.2%)	17 (22.4%)	0.130
Surgical technique & technology			
Ultrasound-assisted (Liposound)	0 (0.0%)	14 (18.4%)	0.065
Laser 980 nm	3 (17.6%)	6 (7.9%)	0.358
Morpheus (radiofrequency)	2 (11.8%)	22 (29.0%)	0.221
BodyTite/FaceTite	2 (11.8%)	21 (27.6%)	0.224
Previous liposuction	3 (17.6%)	12 (15.8%)	0.851
Preoperative conservative therapy			**0.273**
≥ 6 months	7 (41.2%)	43 (56.6%)	
< 6 months	3 (17.6%)	16 (21.1%)	
External/None	7 (41.2%)	17 (22.4%)	

*Bold values indicate statistically significant differences ($p < 0.05$). Data are presented as n (%). Comparisons between groups were performed using Chi-square or Fisher's exact test.

Multivariable Analysis

In the multivariable logistic regression, the percentage of body weight removed, the presence of concomitant minor procedures and clinical lipedema stage were independently associated with postoperative seroma. Each additional 1% of body weight aspirated increased the odds of seroma by approximately 1.6 (OR = 1.58; 95% CI 1.02–2.43; p = 0.040). Patients who underwent concomitant minor procedures had nearly seven-fold higher odds of seroma (OR = 6.77; 95% CI 1.70–26.97; p = 0.007). A higher clin-

ical lipedema stage was also associated with increased seroma risk (OR = 3.57 per stage; 95% CI 1.22–10.46; p = 0.021), although the confidence intervals were wide due to the small number of patients in stages I and IV. BMI and age were not significant predictors in this model (p > 0.05), and ultrasound-assisted liposuction could not be included because no seromas occurred in this subgroup (Table 3).

Surgical Technique

None of the 14 patients treated with ultrasound-assisted liposuction (Liposound) developed seroma, compared to 17 of 76 (18.4%) in the non-ultrasound group (p = 0.065) (Table 2). Other adjunct technologies (Laser 1210, Morpheus, BodyTite/FaceTite, 980-nm laser) were not significantly associated with seroma formation (all p > 0.05) (Table 2).

Table 3 Multivariable logistic regression analysis for seroma formation

Predictor	Odds ratio (OR)	95% confidence interval (CI)	p-value*
Concomitant minor procedures	6.77	1.70–26.97	**0.007**
Aspirated volume (%)	1.58	1.02–2.43	**0.040**
Clinical lipedema stage	3.57	1.22–10.46	**0.021**
BMI	1.08	0.92–1.26	0.359
Age	0.96	0.90–1.02	0.206
Ultrasound-assisted liposuction†	N/A	–	–

*Bold values indicate statistically significant predictors (p < 0.05). Dependent variable: postoperative seroma (yes/no). †Ultrasound-assisted liposuction was excluded from the model due to complete separation (zero events), preventing stable estimation of odds ratios.

Discussion

Liposuction remains central to the surgical management of lipedema, offering significant symptom relief and improved body contour [23–26, 28, 29, 34]. In the present study, the postoperative seroma rate was 18.3%, higher than the < 1% rates reported in earlier lipedema liposuction series, probably reflecting more sensitive diagnostic methods and longer follow-up [24, 25, 30]. Several factors may explain this discrepancy, including the systematic use of ultrasound during follow-up, which likely improved detection sensitivity, and the close postoperative surveillance facilitated by geographic proximity of patients to the surgical team. Additionally, drains were not employed, as most seromas were diagnosed only after the second postoperative week. Although not life-threatening, seroma represents a clinically relevant complication that may delay recovery and warrants careful consideration during surgical planning and postoperative care [31, 35].

Unlike other reports, such as Comerci et al. [30] BMI was not identified as a risk factor for seroma or other complications in this cohort. Importantly, no major adverse events were observed, including deep vein thrombosis (DVT), pulmonary embolism (PE), tissue necrosis, or severe anemia. These findings reinforce the overall safety of liposuction in lipedema when performed on appropriately selected patients, under optimized protocols, and by experienced teams [24, 36].

The wide range of aspirated fat volumes (1.22%–10.76% of body weight; mean 6.10%) highlights the need for individualized surgical strategies. Patients in whom more than 7% of body weight was removed were significantly more likely to develop seromas, underscoring the importance of balancing the desire for maximal fat removal with the increased risk of complications [37, 38].

Adjunct technologies may also play a role. In our cohort, no seromas occurred in patients treated with ultrasound-assisted liposuction, but this difference did not reach statistical significance and the sub-

group was small; therefore, any potential protective effect should be considered hypothesis-generating only. This observation is nonetheless consistent with evidence indicating that ultrasound promotes uniform emulsification, enhances tissue retraction and may better preserve lymphatic structures [15, 23, 39–41]. By contrast, patients treated with 980-nm laser-assisted liposuction exhibited a higher seroma incidence (33%), although the small subgroup size precludes firm conclusions.

Preoperative conservative therapy—performed by more than 64% of patients—was not significantly associated with seroma risk. Nevertheless, its role remains essential in comprehensive care, as it optimizes physiological preparedness, sets realistic expectations, and promotes adherence to postoperative recommendations, thereby contributing to long-term outcomes [17, 19, 21, 22, 34, 42].

The increased incidence of seroma observed in patients undergoing concomitant procedures raises important considerations. Even when combined with varicose vein surgery, which itself did not show a statistically significant association with seroma, the overall pattern suggests that additional surgical trauma to venous and lymphatic structures may contribute to fluid accumulation. It is important to note that the group of concomitant procedures was heterogeneous. Although varicose vein surgery was the most common, other minor interventions varied widely, which precluded a more granular analysis to determine whether specific types of associated procedures carry a disproportionately higher risk. Furthermore, institutional practice patterns and surgical team composition (including the presence of a vascular surgeon) may have influenced the decision to perform combined interventions, introducing potential selection bias.

Our multivariable analysis confirmed that the relative aspirated volume and the presence of associated procedures were independent predictors of seroma, and higher clinical lipedema stage was also associated with increased seroma risk. In contrast, age, BMI, anesthesia type, total aspirate, anatomic site and the number of surgical sessions were not significant predictors in this cohort.

Higher clinical lipedema stage was also associated with an increased risk of seroma in the multivariable model. However, this finding should be interpreted with caution. Only a small number of patients were classified as stages I and IV, resulting in wide confidence intervals, and in routine practice the distinction between stages II and III can be subjective, especially in a retrospective chart review. Therefore, the effect of clinical stage in our model should be viewed as exploratory.

All patients were monitored for at least one month postoperatively, with extended follow-up in most cases. This structured approach likely improved detection of delayed complications, such as late-onset seromas, reinforcing the value of sustained postoperative surveillance.

This study has several limitations that should be acknowledged. Clinical staging of lipedema was based on retrospective chart review, without standardized photographic or imaging criteria, so misclassification between adjacent stages—particularly stages II and III—is possible. In addition, the small number of patients classified as stages I and IV limits the precision of stage-specific estimates and results in wide confidence intervals for the effect of clinical stage in the multivariable analysis. Finally, the retrospective, single-center design and the relatively small sample size may introduce information and selection bias and restrict the generalizability of our findings.

In summary, our findings highlight the importance of thorough preoperative assessment, careful intraoperative planning—including volume control and judicious use of adjunct technologies—and diligent postoperative monitoring. Future prospective studies are warranted to validate these trends, clarify the role of ultrasound-assisted techniques, and establish risk-stratified protocols that further enhance safety and optimize outcomes in lipedema surgery.

Conclusion

This study demonstrates that liposuction for lipedema, when performed in a controlled clinical setting by an experienced surgical team, is a safe and effective procedure with a low incidence of major complications. Nevertheless, postoperative seroma occurred in 18.3% of patients, indicating that this is a relevant concern that should be addressed in preoperative planning and postoperative care.

Higher aspirated fat volumes relative to body weight and the concomitant surgical procedures were associated with increased seroma rates, but not with varicose veins, reinforcing the need for individualized patient assessment. No seromas were observed in the ultrasound-assisted group; however, this difference did not reach statistical significance and should only be considered hypothesis-generating. Further studies are needed to validate these findings and guide surgical decision-making.

Conservative treatment prior to surgery did not significantly influence the incidence of seroma but remains a key component of comprehensive care for lipedema patients. Ongoing clinical follow-up is essential for the early detection and management of complications, including those that may present in a delayed fashion.

Further prospective and randomized studies are needed to validate these findings, refine surgical techniques, and develop evidence-based protocols that enhance safety and long-term outcomes in lipedema surgery.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent For this type of study informed consent is not required.

Ethical approval The study was approved by the institutional ethics committee (CAAE 86155524.0.0000.5455).

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