ORIGINAL ARTICLE

DOI: 10.4274/nkmj.galenos.2024.59354
Nam Kem Med J 2024;12(1):61-66

Evaluation of Postoperative Complications in VASER®-assisted Liposuction: A Retrospective Study of 1,486 Cases

VASER® Destekli Liposuctionda Postoperatif Komplikasyonların Değerlendirilmesi: 1.486 Olgunun Retrospektif Çalışması

Hüseyin KANDULU

Hüseyin Kandulu Clinic for Plastic Surgery, İstanbul, Turkey

ABSTRACT

Aim: Liposuction is a popular plastic surgery procedure with a growing number of cases. Despite advancements, complications remain a significant concern. Modifications like ultrasound-assisted techniques aim to improve safety and efficacy. The aim of this study was to assess the postoperative complications in patients who underwent a vibration amplification of sound energy at resonance (VASER®)-assisted liposuction (VAL) procedure.

Materials and Methods: A retrospective study of 1,486 VAL cases was conducted. Patient demographics, surgical procedures, postoperative care, and complications were recorded.

Results: Of 1,486 patients, 45 (3.02%) experienced minor complications including loss of sensitivity, tissue stiffness, seroma, hyperpigmentation, and prolonged edema. No major complications or fatalities were observed. There was no significant correlation between fat aspirate volume and complications.

Conclusion: VAL demonstrates safety and effectiveness, with a relatively low complication rate. Sensory loss and tissue stiffness were the most common complications. Hyperpigmentation was transient and resolved with postoperative care. Attention to patient selection, meticulous technique application, fluid management, and postoperative care is crucial to minimize complications in VAL procedures. Further studies are required to explore the specific impacts of ultrasound-assisted liposuction on patient outcomes.

Keywords: Liposuction, vibration amplification of sound energy at resonance (VASER®), complications, patient safety

ÖZ

Amaç: Liposuction, giderek artan sıklıkla gerçekleştirilen bir plastik cerrahi işlemidir. Ancak, bu alandaki güncel gelişmelere rağmen komplikasyonlar hala önemli bir endişe kaynağıdır. Ultrason destekli teknikler gibi modifikasyonlar güvenliği ve etkinliği artırmayı amaçlamaktadır. Bu çalışmanın amacı, rezonansta ses enerjisinin titreşim amplifikasyonu (VASER®) destekli liposuction (VAL) prosedürü uygulanan hastalarda postoperatif komplikasyonları değerlendirmektir.

Gereç ve Yöntem: 1.486 VAL olgusu retrospektif olarak incelendi. Hastaların demografik özellikleri, cerrahi prosedürler, postoperatif bakım ve komplikasyonlar kaydedildi.

Bulgular: 1.486 hastanın 45'inde (%3,02) hassasiyet kaybı, doku sertliği, seroma, hiperpigmentasyon ve uzun süreli ödem gibi minör komplikasyonlar görüldü. Majör bir komplikasyon veya ölüm gözlenmedi. Aspire edilen yağ hacmi ile komplikasyonlar arasında anlamlı bir ilişki bulunamadı.

Sonuç: VAL nispeten düşük komplikasyon oranıyla güvenli ve etkin bir yöntem olma özelliği göstermektedir. Serimizde, duyu kaybı ve doku sertliği en sık görülen komplikasyonlardı. Hiperpigmentasyon geçiciydi ve ameliyat sonrası bakımla çözüldü. VAL işlemlerinde komplikasyonları en aza indirmek için hasta seçimine, titiz teknik uygulamasına, sıvı yönetimine ve ameliyat sonrası bakıma dikkat edilmesi çok önemlidir. Ultrason destekli liposuctionın hasta sonuçları üzerindeki spesifik etkilerini araştırmak için daha ileri çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Liposuction, rezonansta ses enerjisinin titreşiminin yükseltilmesi (VASER®), komplikasyonlar, hasta güvenliği

Address for Correspondence: Hüseyin KANDULU MD, Hüseyin Kandulu Clinic for Plastic Surgery, İstanbul, Turkey
Phone: +90 506 503 06 80 **E-mail:** info@kandulu.com **ORCID ID:** orcid.org/0000-0002-8011-8839
Received: 04.01.2024 **Accepted**: 01.02.2024

INTRODUCTION

As of 2021, liposuction stands out as the most prevalent plastic surgery procedure, for both women and men, with an increasing popularity, boasting a 25% increase, which corresponds to approximately two million cases in the United States alone[1]. Furthermore, the report also describes the liposuction as the second most common plastic surgery procedure, accounting for 59,696 cases, which is 12.9% of all cases.

The liposuction is briefly defined as a suction-assisted removal of fat tissue using various cannulas, and the procedure can be conducted under either general or local anesthesia. The amount of adipose tissue removed during liposuction can vary significantly, ranging from a few hundred milliliters to several liters.

However, irrespective of the surgeon's expertise and the utilized technique, the procedure causes significant complications due to several factors such as inappropriate selection of patients, disturbances in the perioperative and postoperative care, and several unpredictable issues[2].

In order to overcome these challenges and possible complications, several modifications, including ultrasound-assisted liposuction (UAL), the injection of a tumescent solution into the targeted area, a subdermal or superficial approach, and the utilization of a wide-range of cannulas, have been suggested. All these modifications aim to enhance the safety and efficacy of the liposuction procedure.

In the existing literature, the overall complication rate associated with liposuction has been documented within the range of 8.6-20%. The most prevalent complication is contour deformity, which has been reported in approximately 20% of cases. Other complications include seroma, hyperpigmentation, asymmetry, and hypertrophic scar, but these are less common[3,4].

Major or life-threatening complications, including skin necrosis, infection, necrotizing fasciitis, pulmonary embolism, and fatal outcomes, have been documented in approximately 0.02-0.25% of liposuction cases[5,6].

In this article, we briefly reviewed and discussed the postoperative complications in our patients who underwent a vibration amplification of sound energy at resonance (VASER®)-assisted liposuction (VAL) procedure.

MATERIALS AND METHODS

The study cohort comprised 45 patients in 1,486 VAL cases, who experienced complications following the procedures performed between January 2018 and February 2023. All patients provided informed consent, and the study was conducted in accordance with the Declaration of Helsinki. Ethical approval for the study was granted by the İstanbul Atlas University Local Ethics Committee (document no: 27247, date: 10.05.2023).

Patients with pre-existing chronic medical conditions such as diabetes mellitus, anemia, or disorders affecting the cardiovascular, renal, or hepatopancreaticobiliary systems were excluded for liposuction procedures.

The inclusion criteria encompassed patients who had undergone VAL procedures, did not exhibit the aforementioned exclusion criteria, and had developed postoperative complications. These patients were closely monitored until the resolution of their complications.

All operations were performed by the same board-certified plastic surgeon under general anesthesia. Prior to surgery, the patient's surgical site was prepared with a povidone-iodine solution, and the patient was draped in a sterile manner and given the prone position. A tumescent solution prepared with 1 mg adrenaline and 10% anti-arrhythmic (lidocaine hydrochloride) into each 1000 mg Ringer's lactate solution was infiltrated in the areas of liposuction and fat harvesting.

The liposuction procedures employed third-generation VASER® technology and encompassed multiple areas of aspiration, including the abdomen, gluteal region, arms, flanks, back, and thighs. During the procedure, VASER® cannulas with dimensions of 3.7, 2.9, and 2.2 mm were employed, operating in both continuous and pulse modes. The VASER® mode was configured at 100% energy (C) using a 3.7 mm 5-groove probe, with an infiltration rate of 100 mL per minute, allowing the fat emulsification.

The liposuction was performed using the conventional technique, employing 3-4, and 5 mm reverse triangular cannulas on specific regions and maintaining a flow rate of 24-26 mmHg per second.

Patients were given prophylactic antibiotherapy with a single dose of the first-generation cephalosporins prior to, and pain medication with non-steroidal anti-inflammatory drugs such as acetaminophen or ibuprofen after the procedure. Patients were advised to wear compression garments for a minimum of one-month post-surgery and to undergo regular lymph drainage massage for at least 15 days.

To ensure proper postoperative care, all patients were scheduled for follow-up visits, including check-ups, and photographs were taken of those residing abroad.

Statistical Analysis

Descriptive statistics were conducted using the Statistical Package for the Social Sciences (SPSS) 21.0 program (SPSS Inc., Chicago, IL, USA). To assess the relationships between variables, a correlation analysis was performed and Pearson correlation

coefficients were calculated. A statistical significance level of <0.05 was considered as indicative of a significant correlation between variables.

RESULTS

During the study period, a total of 1,486 patients underwent VAL procedures targeting various areas such as the flanks, hips, waist, abdomen, neck, upper arms, chest (in male patients), medial and lateral thighs, and knees. Among 1,486 cases, 45 (3.02%) patients developed minor complications including loss of sensitivity, tissue stiffness, seroma, hyperpigmentation, and prolonged edema.

The patient group had a mean age of 36.4±6.28 years, ranging from 23 to 48 years, with a male-to-female ratio of 5/40. The mean body mass index (BMI) was 27.16±1.89 kg/m², ranging from 19.88 to 31.33 kg/m². The average volume of the total aspirate was 7833±1821 mL, ranging from 5450 to 10280 mL. The total number of aspirated regions was 5±2.8 (range 3-9), while the duration of VASER® was 72.4±18.6 minutes (range 34-98) (Table 1). Figure 1 shows the total volume of the tumescent solution given, and the aspirated fat tissue.

Table 1. Demographics and intraoperative data of the study profile

	Patients with complications (n=45)	
Characteristics	**Mean±SD**	**Minimum-maximum**
Age (years)	36.4±6.28	23-48
Gender (male/female) (n; %)	(5/40; 11.11/88.89)	
BMI (kg/m²)	27.16±1.89	19.88-31.33
Volume of total aspirate (mL)	7833±1821	5450-10280
Volume of tumescent solution (mL)	11430±1836	8650-13920
Number of aspirated regions	5±2.8	3-9
Duration of VASER® (min)	72.4±18.6	34-98

VASER®: Vibration amplification of sound energy at resonance, SD: Standard deviation, BMI: Body mass index

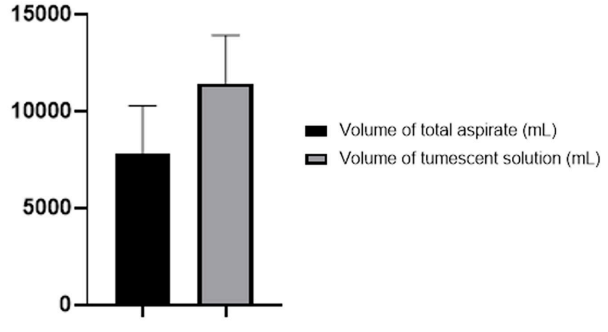

Figure 1. The total volume of the tumescent solution, and the aspirated fat tissue

Among the 41 patients, a total of 71 complications were recorded. The most common complication was the loss of sensitivity, observed in 34 cases (47.88%), followed by tissue stiffness in 26 cases (36.61%). Seroma occurred in 15 patients (21.12%), hyperpigmentation in 5 patients (7.04%), and prolonged edema in one patient (1.40%). Within the overall patient group consisting of all 1,486 cases, the most prevalent complication was loss of sensitivity (2.28% of cases), followed by tissue stiffness (1.74%), seroma (1.00%), hyperpigmentation (0.33%), and prolonged edema (0.06%) (Table 2).

Multiple complications were present for some patients. Specifically, 14 cases (31.11%) experienced both the loss of sensitivity and tissue stiffness, while 6 patients (13.33%) had seroma in addition to these complications. Four cases (8.88%) had both seroma and loss of sensitivity, and one patient (2.22%) exhibited tissue stiffness along with hyperpigmentation. In the overall patient group, complications included a combination of loss of sensitivity and tissue stiffness in 14 cases (0.94%), seroma along with loss of sensitivity and tissue stiffness in 6 cases (0.40%), seroma combined with loss of sensitivity in 4 cases (0.26%), and a combination of tissue stiffness and hyperpigmentation in 1 case (0.06%) (Table 3).

Notably, there was no significant correlation between the volume of aspirate and the number of complications per patient (r=0.12, p=0.67).

Table 2. Overall evaluation of the complications

Type of complication	Overall patient group (n=1,486) (n; %)	Complication group (n=45) (n; %)
Loss of sensitivity	34; 2.28	34; 47.88
Tissue stiffness	26; 1.74	26; 36.61
Seroma	15; 1.00	15; 21.12
Hyperpigmentation	5; 0.33	5; 7.04
Prolonged edema	1; 0.06	1; 1.40

Table 3. Patients with multiple complications

Type of complication	Overall patient group (n=1,486) (n; %)	Complication group (n=45) (n; %)
Loss of sensitivity + tissue stiffness	14; 0.94%	14; 31.11%
Seroma + loss of sensitivity + tissue stiffness	6; 0.40%	6; 13.33%
Seroma + loss of sensitivity	4; 0.26%	4; 8.88%
Tissue stiffness + hyperpigmentation	1; 0.06%	1; 2.22%

All of the complications were resolved within 3.2±2.8 months (range 2-8 months).

We did not observe other complications, including contour irregularities, chronic induration, infection, operation site burn or distant site burn, and skin necrosis in our patient group. Furthermore, there were no major life-threatening complications or fatalities.

Figure 2 shows the preoperative and postoperative pictures of a female patient.

DISCUSSION

Since the introduction of liposuction, the procedure has undergone several modifications over time to maximize patient safety and decrease the occurrence of complications. Complications stemming from a liposuction procedure liposuction can be broadly classified into three subcategories:

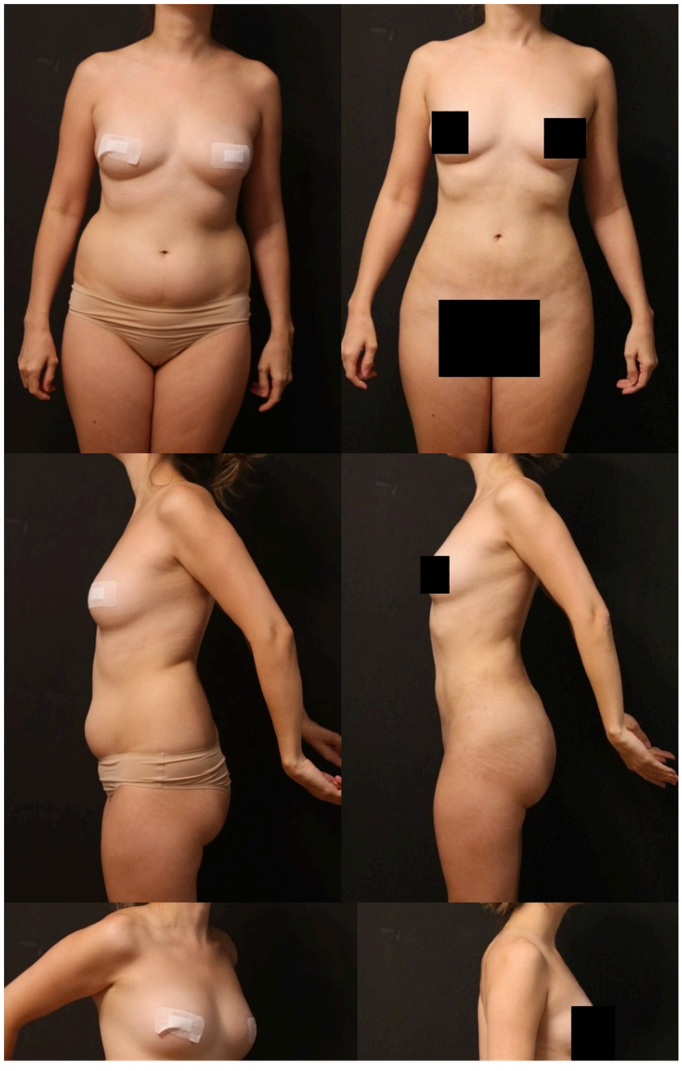

Figure 2. Pre- and post-operative photographs of a female patient who underwent VAL procedure

VAL: VASER®-assisted liposuction

local and systemic complications, alongside patient dissatisfaction[4].

Third-generation VAL emerges as a safe and effective technique for body contouring, enabling surgeons to more precisely target the superficial fat layer and promote skin tightening while maintaining a relatively low rate of complications and achieving higher levels of patient satisfaction[7,8].

In our study, we specifically address local complications, which encompassed the following issues: loss of sensitivity, tissue stiffness, seroma, hyperpigmentation, and prolonged edema. Among the 45 patients in our study group, 25 individuals (55.56%) experienced the presence of more than one complication, and six of them (13.33%) had the occurrence of three different types of postoperative liposuction-related complications.

The overall complication rate was 3.02% in our study group, while the complication rates for liposuction were reported to be in the range of 8.6-20%[3].

Chow et al.[9] conducted a study with 4,534 patients, revealing a 1.5 percent postoperative complication rate in liposuction, identifying liposuction volume and BMI as notable independent risk factors. However, their study had limitations, as it relied on data from the American Society of Plastic Surgeons (ASPS) member database and lacked information on the specific types of liposuction procedures, potentially leading to an underrepresentation of complications and resulting in a relatively lower reported complication rate.

In a 5-year study involving 551 consecutive patients, liposuction alone had a 4.2% complication rate, and they suggest a limited epigastric ultrasound time of less than 1 minute, and liposuction time of 2 minutes minimizes the risk of seroma formation[10].

In their recent case series of 261 patients who underwent UAL, Tran et al.[11] reported an overall complication rate of 4.6%, contour irregularity being the most common complication. However, they frequently avoided large-volume liposuction and the lipoaspirate volume in their cohort was an average of 2284 mL.

It is a well-known fact that traditional suction-assisted liposuction (SAL) is linked to significant complications, some of which can be life-threatening. Since its introduction by Zocchi[12] and Kloehn[13] in 1996 and 1998, respectively, the reports have revealed lesser complication major rates with the use of UAL[14]. However, UAL is associated with an increased risk of thermal injury and skin necrosis to subdermal tissues due to the exothermic energy caused by ultrasound. In our 1,486 cases operated within five years, we did not encounter such major complications.

Despite the studies suggesting a correlation between the volume of aspirated fat tissue and an increased risk of complications, our study did not find any significant association between the types and number of complications and the volume of aspirated fat tissue.

One notable finding from our study was that the incidence of seroma, a common complication following liposuction, which is collection of serous fluid originating from the fibrous tissue, was surpassed by the occurrences of loss of sensitivity and tissue stiffness. We speculate that this finding might be attributed to the use of an ultrasound-assisted approach, which is relatively safer compared to the traditional SAL, providing better control over the shredding and flow of adipose tissue cells.

It is worth mentioning that many liposuction procedures are performed in conjunction with abdominoplasty, where the use of electrodissection and the absence of Scarpa fascia preservation can lead to higher tissue damage and seroma formation[15]. None of the patients in our study underwent additional procedures, which could explain the lower rates of seroma in our group. Furthermore, the placement of drains in the abdominal and sacral regions, along with secondary healing after drain removal, might also contribute to the lower incidence of seroma. We also advocate the use of postoperative compression garments and frequent lymph drainage massage, which could be additional factors contributing to the lower incidence of seroma and absence of hematoma in our patient group.

On the other hand, we propose that the use of a tumescent solution containing lidocaine and epinephrine could be one of the underlying reasons for the relatively higher rate of complications such as loss of sensitivity and tissue stiffness in our patient group. Supporting this hypothesis, these complications resolved shortly after the liposuction procedure in most cases. While some reports have suggested an increased incidence of these complications with a larger volume of aspirates, our study did not find a significant correlation between the volume of aspirated fat and any type of complications[9]. A report by Francis et al.[16] indicates the acidic nature of the tumescent solution, which was also enriched by lactated Ringer's solution, can be overcome by the addition of sodium bicarbonate as a buffer, which also enhances adipose stem cell viability. In addition to the tumescent solution, other factors such as the mechanical effect of the liposuction cannula and the conversion of ultrasound energy into thermal energy might also contribute to temporary postoperative neuropraxia. However, these potential confounders cannot be confirmed with absolute certainty and require further investigation through randomized and controlled studies.

In our patient series that experienced complications after liposuction procedures, 5 out of 45 individuals (7.04%) developed increased skin pigmentation, primarily in the abdominal and buttocks areas. Post-liposuction hyperpigmentation is a multifactorial condition with multiple potential causes, including hemosiderin deposition, excessive pressure made by the compression bandages, friction between clothing and the treated skin areas, sun exposure, and exogenous drugs such as iron supplements, hormonal therapy, and minocycline[4]. While the patients were evaluated in an attempt to find the underlying etiology, two reported intake of contraceptive pills, and two were under oral iron supplement therapy. However, the hyperpigmentation resolved in all patients within the first year after the liposuction procedure with regular use of sunscreen and topical application of hydroquinone.

Large-volume liposuction in the context of liposuction procedures is typically defined as the removal of 5000 ml or more of total aspirate during a single procedure, according to the ASPS[17]. However, some studies have set a lower threshold, considering 3500 mL or more of total aspirate volume as significant[18,19]. This volume is often considered safe to remove and is roughly equivalent to 5-8% of the patient's body weight[2].

In large-volume liposuction procedures, postoperative anemia is a significant concern and one of the most important causes of morbidity, thus it is crucial to consider the patient's physiological condition while ensuring the desired aesthetic outcomes. This necessitates a closer monitoring of patients during the preoperative and postoperative periods. In our series, which evaluated blood loss in large-volume liposuction cases using third-generation internal UAL, we observed that the amount of aspirated supernatant was responsible for 44.4% of the change in hemoglobin and 30.9% of the change in hematocrit levels after the procedure[20]. Additionally, the presence of epinephrine in the tumescent solution can have an impact on the cardiac index, heart rate, and mean pulmonary arterial pressure, and a detailed patient screening before the surgery and appropriate patient selection are also critical factors. A recent survey by the ASPS has reported a mortality rate of 19.1/100,000, corresponding to 0.019% of all liposuction procedures, defining the major cause of death as pulmonary thromboembolism[5]. However, a study focusing on tumescent liposuction reported no death in a series of 66,000 cases[21]. Major risk factors associated with severe complications included poor sterility, infiltration of large volumes of wetting solution, early postoperative discharge, selection of medically unfit patients, and procedures performed by clinicians without accreditation in plastic surgery[22].

A histopathological comparison of abdominoplasty specimens in patients who underwent both abdominoplasty and liposuction, with UAL treatment on one side and standard liposuction on the other side, revealed that disrupted collagen

and elastin structures in the treated tissues were associated with longer application times[23]. Hence, we recommend that UAL is a safe and efficient technique when performed by experienced professionals. A close monitorization of application in terms of amplitude settings, as well as paying attention to signs such as the decreased resistance of tissue to probe movement and any alterations in the color of the aspirate in favor of different shades of pink and red. Additionally, it is crucial to avoid keeping the ultrasonic probes in one place for an extended period in order to prevent prolonged contact with the dermis.

Study Limitations

This study has several limitations worth noting. Firstly, its retrospective nature may introduce biases, and the findings are based on a single liposuction method. However, the primary focus of this study was to investigate potential factors associated with the use of an ultrasound-assisted approach and to report different complication trends compared to traditional liposuction methods.

CONCLUSION

In conclusion, the choice of liposuction technique should involve careful consideration of patient selection, meticulous technique application, appropriate fluid management, postoperative care, and the surgeon's expertise with the chosen method and handling and closely monitoring the ultrasound energy, and its effects on the operation sites. These factors are crucial for minimizing undertreated cases, reducing the need for re-operation, which can increase costs, prolong recovery times, and overall pose greater risks to patients.

Ethics

Ethics Committee Approval: The study was approved by the İstanbul Atlas University of Local Ethics Committee (document no: 27247, date: 10.05.2023).

Informed Consent: Retrospective study.

Financial Disclosure: The author declared that this study received no financial support.

REFERENCES

1. ISAPS International Survey On Aesthetic/Cosmetic Procedures performed in 2021. International Society of Aesthetic Plastic Surgery. Available from: https://www.isaps.org/media/vdpdanke/isaps-global-survey_2021.pdf
2. Pacifico M, Kanapathy M, Dancey A, MacQuillan A, Ross G, Mosahebi A. Summary document on safety and recommendations for aesthetic liposuction: Joint British Association of Aesthetic Plastic Surgeons (BAAPS)/British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS) expert liposuction group. J Plast Reconstr Aesthet Surg. 2022;75:941-7.
3. You JS, Chung YE, Baek SE, Chung SP, Kim MJ. Imaging Findings of Liposuction with an Emphasis on Postsurgical Complications. Korean J Radiol. 2015;16:1197-206.
4. Dixit VV, Wagh MS. Unfavourable outcomes of liposuction and their management. Indian J Plast Surg. 2013;46:377-92.
5. Grazer FM, de Jong RH. Fatal outcomes from liposuction: census survey of cosmetic surgeons. Plast Reconstr Surg. 2000;105:436-46.
6. Kim YH, Cha SM, Naidu S, Hwang WJ. Analysis of postoperative complications for superficial liposuction: a review of 2398 cases. Plast Reconstr Surg. 2011;127:863-71.
7. Hoyos AE, Millard JA. VASER-assisted high-definition liposculpture. Aesthet Surg J. 2007;27:594-604.
8. Munir A. Abdominal VASER LipoSelection Avoiding Abdominoplasty. Biomed J Sci&Tech Res. 2018.
9. Chow I, Alghoul MS, Khavanin N, Hanwright PJ, Mayer KE, Hume KM, et al. Is There a Safe Lipoaspirate Volume? A Risk Assessment Model of Liposuction Volume as a Function of Body Mass Index. Plast Reconstr Surg. 2015;136:474-83.
10. Swanson E. Prospective clinical study of 551 cases of liposuction and abdominoplasty performed individually and in combination. Plast Reconstr Surg Glob Open. 2013;10;1:e32.
11. Tran BNN, Didzbalis CJ, Chen T, Shulzhenko NO, Asaadi M. Safety and Efficacy of Third-Generation Ultrasound-Assisted Liposuction: A Series of 261 Cases. Aesthetic Plast Surg. 2022;46:2310-8.
12. Zocchi M. Ultrasonic-assisted lipectomy. Adv Plast Reconstr Surg. 1998;11:197-221.
13. Kloehn RA. Liposuction with "sonic sculpture": six years' experience with more than 600 patients. Aesthetic Surg. Q 1996;16:123-8.
14. Nagy MW, Vanek PF Jr. A multicenter, prospective, randomized, single-blind, controlled clinical trial comparing VASER-assisted Lipoplasty and suction-assisted Lipoplasty. Plast Reconstr Surg. 2012;129:681e-9.
15. Özdoğan M, Yilimaz KB, Ozaslan C, Gürer A, Gülbahar Ö, Ersoy E. Scalpel versus electrocautery dissection: the effect on wound complications and pro-inflammatory cytokine levels in wound fluids. Turk J Med Sci. 2008;38:111-6.
16. Francis A, Wang WZ, Goldman JJ, Fang XH, Williams SJ, Baynosa RC. Enhancement of Viable Adipose-Derived Stem Cells in Lipoaspirate by Buffering Tumescent with Sodium Bicarbonate. Plast Reconstr Surg Glob Open. 2019;20;7:e2138.
17. ASAPS. Lipoplasty safety. 2000. Last accessed date: 2024 January 17. Available from: http://www.surgery.org/media/news-releases/lipoplasty-safety
18. Iverson RE, Lynch DJ. Practice advisory on liposuction. Plast Reconstr Surg. 2004;113:1478-90.
19. Sailon AM, Wasserburg JR, Kling RR, Pasick CM, Taub PJ. Influence of large-volume liposuction on metabolic and cardiovascular health: a systematic review. Ann Plast Surg. 2017;79:623-30.
20. Kandulu H. Evaluation of Blood Loss in Third-Generation Internal Ultrasound-Assisted Liposuction. Aesthetic Plast Surg. 2023:27.
21. Housman TS, Lawrence N, Mellen BG, George MN, Filippo JS, Cerveny KA, et al. The safety of liposuction: results of a national survey. Dermatol Surg. 2002;28:971-8.
22. Lehnhardt M, Homann HH, Daigeler A, Hauser J, Palka P, Steinau HU. Major and lethal complications of liposuction: a review of 72 cases in Germany between 1998 and 2002. Plast Reconstr Surg. 2008;121:396e-403e.
23. Baxter RA. Histologic Effects of Ultrasound-assisted Lipoplasty. Aesthetic Surgery Journal. 1999:109-14.