



Comprehensive Approach to Management of Lipedema

Anand Athavale¹ · Eri Fukaya¹ · Aaron W. Aday²

Received: 20 August 2025 / Accepted: 10 September 2025

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2025

Abstract

Purpose of the Review This article aims to summarize contemporary understanding and management strategies of lipedema. It will elucidate recent advancements in diagnostic methodologies, the role of imaging technologies, and evolving therapeutic interventions. The article will further delineate critical areas that warrant further investigation.

Recent Findings Lipedema, often termed a loose connective tissue disorder, is characterized by a disproportionate accumulation of adipose tissue in the lower body. The pathophysiology may include abnormalities in the interstitial fluid and extracellular matrix, along with fibrosis, inflammation, and endothelial dysfunction. Diagnostic imaging may be useful in differentiating from phenotypically similar conditions. In the absence of coexisting lymphatic dysfunction, the role of compression and manual lymphatic drainage is unclear. The optimization of nutrition and the incorporation of an exercise regimen are crucial to managing patient symptoms. Evidence-based weight loss strategies, including medical therapy, should be considered in individuals with concomitant obesity. Bariatric surgery and liposuction may be considered in select patients who have ongoing symptoms despite the optimization of conservative measures.

Summary Since it was first described, lipedema management strategies have largely mirrored lymphedema management. However, robust clinical evidence regarding efficacy is lacking. Rigorous clinical trials of lipedema therapies are essential to further our understanding of this disease and ultimately improve the lives of patients.

Keywords Lipedema · Lymphedema · Manual lymphatic drainage · Liposuction

Opinion Statement

No definitive biomarker or imaging test is available for lipedema. Therefore, the diagnosis is made based on clinical signs and symptoms. Our practice is to rule out other causes of extremity enlargement and assess for phenotypically similar conditions, such as venous disease and lymphedema, largely based on the clinical history and physical exam. When there is ongoing suspicion of chronic venous disease or lymphedema, imaging studies may be considered, although these are not necessary in most patients. Establishing the diagnosis itself can be a source of relief for many patients, and providing long-term emotional and psychosocial support is an important component of their care. No directed medical therapy is available, but there are several options that may improve symptoms and quality of

life. Historically, compression therapy has been recommended, and some patients with dynamic changes in limb symptoms, such as with heat or dependency, and even minimal edema may report improvements in symptoms. We refer such patients for complete decongestive therapy, and they may also benefit from compression garments and a vasopneumatic pump if they experience symptoms improvement or limb volume reduction with complete decongestive therapy. Generalized obesity is also often present, and some patients may experience an improvement in symptoms and/or mobility with weight loss. Our practice is to collaborate with weight loss specialists to achieve weight loss in a healthy manner. A multifaceted approach targeting nutrition, exercise, behavioral interventions, and medical therapy is considered. Emerging anti-obesity medications hold promise; however, their direct role in lipedema is unknown and warrants

✉ Anand Athavale
athavale@stanford.edu

¹ Division of Vascular Surgery, Stanford University School of Medicine, Palo Alto, CA, USA

² Vanderbilt Translational and Clinical Cardiovascular Research Center, Division of Cardiovascular Medicine, Vanderbilt University Medical Center, Nashville, TN, USA

rigorous investigation. Bariatric surgery for weight loss may be offered to appropriate candidates. Some patients with persistent symptoms or decreased functional status may benefit from surgical debulking procedures. A more thorough understanding of the pathophysiology of lipedema may foster the development of specifically directed therapy.

Introduction

The term lipedema was first used in the 1940s to describe lower extremity enlargement due to subcutaneous deposition of fat and accumulation of fluid in the legs [1]. It was noted to occur almost exclusively in women who were generally overweight and had a family history of enlarged legs. In the original case series, the age at which symptoms were first noted ranged from less than 10 years to the 8th decade of life. The enlargement was symmetrical in the bilateral lower extremities and was most commonly associated with tenderness and minimal pitting edema that did not resolve with limb elevation [1].

Although adipose deposition is clearly a feature of lipedema, the U.S. standard of care document highlights that it is also a loose connective tissue (LCT) disorder that can affect the abdomen, hips and upper extremities with the onset usually coinciding with hormonal changes such as with puberty, pregnancy, or menopause [2]. However, the presentation is variable, and objective diagnostic tools beyond the history and physical exam are lacking.

Beyond the absence of diagnostic tools, lack of clinician awareness, phenotypic proximity with other more common conditions that can cause enlarged extremities, and increased prevalence of obesity further contribute to lipedema being underrecognized and underdiagnosed. On average, patients seek medical attention approximately 17 years after symptom onset, and a diagnosis is usually made 10 years after that [2]. In this overview, we summarize the clinical presentation, diagnosis, disease mechanisms, and advances in imaging and therapy for lipedema and comment on knowledge gaps and future directions.

Epidemiology

Contemporary studies have confirmed that lipedema occurs exclusively in women, although similar presentations have been reported in men with hormonal abnormalities [3, 4]. European studies have estimated the prevalence to be up to 10% of the overall female population [5, 6]. However, these estimates are either based on extrapolations from small samples or of unclear provenance, and the true prevalence is unknown. Lack of robust epidemiologic data for lipedema remains a critical knowledge gap.

A family history of lipedema is reported in 15–80% of cases [2, 7]. In some families, autosomal dominance with sex limitation has been reported [7]. A recent genome-wide association study (GWAS) did not identify any genetic variants consistently associated with lipedema [2, 8]. A familial study of 31 individuals from 9 lipedema families yielded candidate variants in 469 genes but did not identify any potential genes consistently implicated across all the cases [2]. It is currently believed that genetic variants in several genes, along with environmental interactions, affect the development of lipedema [2, 8].

Pathophysiology

The etiology of lipedema is not known. However, since the onset of lipedema is usually in women starting as early as puberty and around times of hormonal change, estrogen and its receptors in white adipose tissue are thought to play a role [5]. Affected individuals have been reported to have functionally and structurally altered subcutaneous adipose tissue consisting of hypertrophic, hyperplastic adipocytes, increased fibrosis, altered interstitial fluid, altered extracellular matrix, and elevated macrophage levels [9, 10]. Growth and expansion of this tissue depend on interaction between these components, with endothelial cells playing a prominent role. It is hypothesized that the endothelial cells regulate the volume and type of lipids stored in the tissue. Dysregulated endothelial function can lead to excessive adipose growth and a localized increase in adipokines [9].

Increased adipose tissue mass leads to hypoxia, which then leads to extracellular matrix remodeling that includes increased collagen deposition, glycocalyx disturbances, fibrosis, and microvascular dysfunction. Microvascular dysfunction via increased microvascular permeability can lead to increased protein deposition, edema, and inflammation. The excessive interstitial fluid is thought to provide additional resources for the pathological expansion of adipose cells, further contributing to increased tissue mass and hypoxia [5, 9].

Besides genetic and hormonal influences, some have implicated lymphatic dysfunction in the development of lipedema, although this remains controversial [11]. Some studies using imaging magnetic resonance imaging (MRI), computed tomography (CT), and ultrasound (US) to investigate the composition of lipedema tissue have reported homogenous adipose tissue without fluid accumulation, unlike lymphedema [12–15]. On the other hand, bioimpedance demonstrates increased extracellular fluid in the lower limbs of individuals with lipedema [16]. Increased sodium concentration in the skin and subcutaneous adipose tissue of individuals with lipedema, as noted using sodium and conventional proton MRI, is surmised to be related to lymphatic dysfunction [17]. Platelet factor 4 (PF4/CXCL4), a potential biomarker for lymphatic dysfunction, was also found to be elevated in patients with lipedema, suggesting

that lymphatic dysfunction may contribute to lipedema [18]. However, others have contended that elevated PF4 may contribute to differential inflammatory processes in lipedema and lymphedema [19]. This biomarker has insufficient discriminatory power to be deployed clinically at this time.

Similar to patients with generalized severe obesity, patients with advanced lipedema may secondarily develop lymphedema [20, 21]. Lipedema can lead to impaired mobility and disuse of the calf muscle pump, leading to local venous hypertension and edema. It is likely that the degree of lymphatic dysfunction further varies due to intrinsic differences in patients' lymphatic reserve. The contribution of lymphatic dysfunction to lipedema in its various stages remains an area of active research.

Diagnosis

The diagnosis of lipedema is made clinically based on the patient history, physical examination, assessment of comorbidities and exclusion of similar appearing disorders of the patient. Although there are no universally agreed-upon criteria for diagnosis or severity, the recent U.S. consensus statement highlights several typical features (Table 1).

Signs and Symptoms

Symptoms include painful adipose tissue in the affected area, sensitivity to pressure, easy bruising, and progressive disability and difficulty ambulating as a result. Some patients report increased joint flexibility [22]. Temperature-related leg edema and the presence of systemic symptoms such as fatigue have also been reported [22]. In our experience, many patients also report dynamic changes in leg heaviness or even size after prolonged immobility or dependency, heat exposure, or salt intake.

On physical examination, a pattern of disproportionate adipose deposition in the hips, buttocks, thighs, and lower legs that spares the feet is most commonly reported (Fig. 1A, B, C). Involvement of the upper and, in some cases, lower arms with hand sparing is also common, although this typically occurs later in life in our own experience. Cuffing at the ankles (Fig. 1A) or wrists is often apparent in those with affected lower legs or arms, although this is absent in those in whom lipedema only affects more proximal segments. The abnormal adipose tissue of lipedema causes non-pitting changes in the limb that does not change with elevation or compression, but pitting edema may also be present in the

Table 1 Signs and symptoms of lipedema

Disproportionately increased adipose tissue in legs and, in some cases, the arms
Abnormal limb adipose tissue is symmetric
Easy bruising
Affected areas can be painful and sensitive to pressure
Palpable subcutaneous nodules or a granular feel to subcutaneous tissue
Sparing of hands and feet
Joint hypermobility
Limb enlargement persists despite elevation
Symptoms begin or worsen with puberty, pregnancy, and/or menopause
Disproportionate adipose tissue does not resolve with weight loss

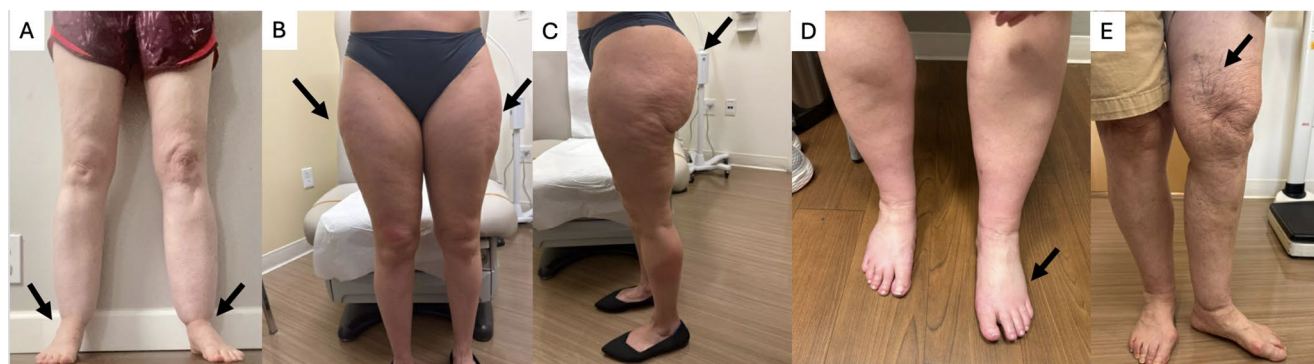


Fig. 1 Physical exam findings in patients with lipedema. **A.** Disproportionate adipose tissue deposition in the legs giving a columnar appearance with cuffing at the ankles (arrows), typical of type III lipedema. **B** and **C.** Disproportionate adipose tissue deposition in buttocks and thighs (arrows) consistent with type II lipedema. **D.** Disproportionate

adipose tissue deposition in the legs, consistent with lipedema, along with dorsal foot and toe swelling (arrow), supporting an additional diagnosis of lymphedema (lipolymphedema). **E.** Lipedema changes in the legs along with telangiectasia (arrow)

setting of generalized fluid retention, venous insufficiency, lymphatic dysfunction, or overt secondary lymphedema [5, 6, 12, 22]. Affected adipose tissue is often described as lumpy or granular, although many patients have no discernable change in adipose texture. The affected tissue is often tender to palpation. Patients may exhibit cool skin, a livedo reticular pattern, and telangiectasias (Fig. 1E) [9, 22].

Four stages of Lipedema have been described: [5]

- Stage I: Smooth texture skin with subdermal pebble-like feel.
- Stage II: Uneven skin with indentations, larger mounds of fat tissue, skin dimpling with larger (walnut-sized) and more numerous palpable nodules.
- Stage III: Increased lipedema tissue with large extrusions causing deformities. Fibrotic texture, thickened, indurated, macronodular changes.
- Some authors have described a stage IV: Severe lipedema (Stage III) with co-existing lymphedema [11]. (Fig. 1D)

However, this staging method relies entirely on appearance, is subjective, and does not necessarily inform management-related decisions. Data on progression through the stages are also lacking. A severity scoring system that incorporates physical exam findings with symptoms, functional status, and compression use may help assess the burden of disease more comprehensively, and future efforts should explore developing and validating such systems.

Laboratory Tests

There are no clinical biomarkers currently available to assist with the diagnosis of lipedema in clinical practice. However, an assessment for conditions that may contribute to lower extremity edema such as hypothyroidism, renal failure, hepatic failure, and heart failure should be conducted, and additional biomarkers for these diseases may be obtained depending on the degree of clinical suspicion. As lipedema and obesity are often coprevalent, clinicians must rely on history and examination and consider laboratory testing for diabetes, metabolic syndrome, dyslipidemia, and nonalcoholic steatohepatitis in some patients.

Imaging

At present, there is little role for routine imaging in the clinical evaluation of lipedema, although several lines of evidence suggest this may become increasingly used in the future. Ultrasonography studies have reported changes in

subcutaneous adipose tissue to discriminate lipedema from lymphedema. Some studies have recommended using ultrasound measurements of the dermis and subcutaneous tissue at predefined areas in the limbs and proposed criteria for diagnosing lipedema [23, 24]. Although many have advocated to utilize these tools in clinical practice, we lack large population data on normal values, which likely vary based on age, adiposity, history of childbirth, and menopausal status. Ultrasonography to assess for the presence of venous reflux may be considered in selected patients. However, the results should be interpreted with caution as the degree of venous reflux does not always correspond to symptoms. Additionally, generalized obesity, which often co-exists in patients with lipedema, may be the primary driver of central venous hypertension and venous reflux. Lymphoscintigraphy studies have reported a delay in lymph transportation in some (<50%), but normal flow in most patients with lipedema [24, 25]. If clinicians are unable to determine a cause of limb edema on exam, lymphoscintigraphy may be useful, but history and physical are typically sufficient.

MRI can provide information regarding the adipose tissue distribution, hypertrophy, degree of fibrosis in subcutaneous fat, and the absence of excess fluid in the subcutaneous adipose tissue [24]. Magnetic resonance lymphangiography (MRL) studies have reported the presence of enlarged lymph vessels (suggestive of lymphostasis) in patients with lipedema [24, 26]. Indocyanine green lymphography studies have demonstrated no significant lymphatic structural changes in most patients with lipedema. However, some individuals with lipedema been found to have slower lymph flow, dilatation of lymphatic vessels, and a higher number of abnormal lymphatic vessels [27, 28]. Dual-energy X-ray absorptiometry (DXA) can provide information regarding the distribution of fat, quantify total and regional fat and may have a role in staging and follow-up [24, 29]. While these modalities may play a role in lipedema diagnosis in the future, they should not be part of the routine evaluation for patients and are not used in our own clinical practices.

It is important to contextualize that sensitive imaging studies can detect abnormal lymphatic flow in patients with even subclinical chronic venous insufficiency (no edema) [30]. Hence, the clinical relevance of mildly abnormal lymphatic circulation noted in patients with lipedema cannot be determined solely based on imaging studies. This also raises a question about the threshold for lymphatic dysfunction noted on imaging beyond which lipolymphedema rather than lipedema would be a more appropriate description of the condition. Further research is needed before incorporating lymphatic imaging into routine lipedema care.

Treatment

Holistic lipedema management requires a comprehensive, multidisciplinary approach that prioritizes the preservation and enhancement of mobility, effective pain management, skin care, and nutritional optimization. This strategy also emphasizes physical and mental wellness while addressing co-morbidities like venous diseases, lymphatic disorders, and obesity, ensuring a well-rounded treatment plan that improves overall quality of life (Table 2).

Counseling

Patient validation is crucial. In our experience, confirming a diagnosis of lipedema in and of itself is often therapeutic, as patients have frequently struggled for years to find an explanation for their symptoms and disability. Education of both patients and their healthcare team members helps decrease psychological distress and frustration related to this condition. Connecting individuals to support groups, whether online or in-person, can provide a platform for sharing experiences and advice, fostering a sense of community and reducing feelings of isolation.

Maintaining an honest discussion about the gaps in current evidence is imperative. By openly communicating what is known and what is unknown about lipedema, clinicians can set realistic expectations, encourage patients to participate in research, and highlight the need for further studies to bridge these knowledge gaps. There are no large, randomized, placebo-controlled trials of lipedema therapies, and most of the evidence is derived from small studies or expert recommendations. It is common to find strong, contradictory expert opinions regarding the efficacy (or lack thereof) of a particular treatment modality, even in relatively recent literature. There is no cure for lipedema, and treatment often focuses on optimizing mobility, improving symptoms, and helping patients coordinate whether and when to pursue surgery as care of their care. Unfortunately, patients still face several potential barriers to optimal lipedema care, including limited mobility, social stigma, lack of social support, inconsistent insurance coverage, affordability of services, and associated anxiety and depression [6].

Compression Therapy

When this condition was first described in the 1940s, the authors noted that an individual with lipedema who had worn old-fashioned high shoes had no excess fat accumulation or edema in the areas covered by the shoes. They speculated that external pressure from fitting shoes may have prevented fat accumulation in those areas and recommended a trial of elastic stockings for symptomatic individuals with lipedema [1]. Seventy-five years later, compression remains a commonly recommended component of lipedema management.

Unlike lymphedema and chronic venous disease, which are characterized by excessive interstitial fluid accumulation or venous hypertension, lipedema is a mechanistically different condition. It is unclear what compression or “decongestion” targets in patients with lipedema. Some patients with lipedema experience symptomatic benefit from compressive therapies even in the absence of a reduction in limb circumference or volume, although it is challenging to predict such a response. It has been hypothesized that compression therapy may be beneficial due to its anti-inflammatory effects on the subcutaneous tissue, as is seen with compression use for other indications, such as chronic venous disease [12]. However, this has not been demonstrated in lipedema.

In our own practice, patients with dynamic changes in limb symptoms, such as progressive swelling or heaviness over the course of the day, or those with evidence of even modest degrees of pitting edema on exam, are mostly likely to benefit from compressive therapies. In such patients, we initially refer for a formal course of complete decongestive therapy (CDT). This consists of manual lymphatic drainage, exercise, compression, and skincare and is delivered by a trained physical or occupational therapist [31]. Small clinical trials of patients with lipedema suggest CDT may reduce capillary fragility, pain, decreased lower extremity volume, and MRI measures of tissue sodium [32–41]. It is also possible that individuals with advanced lipedema may have more secondary lymphatic abnormalities and may benefit more from using these therapies compared to individuals in the early stages of lipedema. It is worth noting that CDT is resource-intensive and requires skilled personnel and significant commitment of time and effort by the patient.

Table 2 Components of lipedema therapy

Patient validation, emotional support and connection to web-based or in-person support groups, and honest discussion about gaps in evidence
Compression, manual lymphatic drainage, and vaso-pneumatic pump use in select patients
Guidance of weight management, nutrition and exercise
Medical and surgical management of concomitant obesity
Management of venous and lymphatic disease when appropriate
Referral to surgical centers with expertise in lipedema care after optimization of conservative management

In patients who have a positive response to CDT, we recommend use of vasopneumatic pumps for Maintenance therapy. A small prospective, randomized controlled trial reported improved limb circumference, bioimpedance parameters, and pain scores in patients with lipedema and secondary lymphedema over a follow up period of 12 weeks when pneumatic compression pumps were used in addition to CDT compared to CDT alone [35]. Compression garments are also helpful in preventing reaccumulation of swelling. Patients often report that compression garments also help them feel more secure and contained, particularly in more advanced presentations. Compression garments should be appropriately sized, with tolerable compression as donning and doffing have been reported to be a significant barrier to regular use [42]. Garments only covering the lower limbs are rarely appropriate, as they often cannot accommodate the shape of limbs with lipedema and will not stay in place. More commonly, patients use high-waisted leggings, sleeves, vests, or shoulder wraps. Large randomized controlled trials assessing the efficacy of these measures in lipedema are lacking, and there are also no data clearly demonstrating that compression alters disease progression.

Weight Management

Individuals with lipedema are at an increased risk of obesity, and 50–80% of patients with lipedema qualify as obese [5, 12, 39]. A commonly held belief regarding lipedema is that the fat deposits in extremities are resistant to generalized fat loss efforts such as nutrition and exercise. However, some clinicians report a decrease in fat volume in the extremities of patients with lipedema during periods of generalized weight loss achieved via diet and exercise. Additionally, there are reports of significant and sustained fat loss in the extremities with improvement in symptoms of individuals with lipedema and obesity (body mass index [BMI] > 40 kg/m²) who undergo gastric bypass surgeries, albeit with persistent disproportionate fat distribution [12]. Outside of lipedema-related effects, weight loss has a positive impact on blood pressure, glycemic control, lipid sub-fractions, and all-cause mortality in obese individuals [43]. Therefore, weight loss is an important therapy for many patients with lipedema.

Many patients with lipedema and overweight or obesity also benefit from medical weight loss therapy. Metformin may be helpful in patients with lipedema, although it is unclear if its benefit extends beyond its modest weight loss effects [6]. With the advent of glucagon-like peptide-1 (GLP-1) receptor agonists, there is growing interest in using these drugs for lipedema treatment. In the Semaglutide Treatment Effect in People with Obesity (STEP) trial,

which randomized people with obesity to lifestyle intervention and either the GLP-1 receptor agonist semaglutide or placebo, active therapy led to 12.7 kg more weight loss over 68 weeks compared to placebo [44]. In the SURMOUNT-1 trial, patients with overweight or obesity treated with tirzepatide, a glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 agonist, had a dose-dependent 15.0–20.9% weight loss over 72 weeks compared to 3.1% with placebo [45]. Medications in these classes are important adjunctive therapies, in addition to dietary and exercise interventions, to achieve and sustain weight loss in patients with lipedema and obesity. Whether these medications have a role in lipedema treatment independent of weight loss remains unknown.

The management of obesity necessitates a multifaceted approach, encompassing interventions in nutrition, physical activity, behavioral modifications, pharmacological treatments, and surgical options. Our practice is to work closely with weight loss specialists to focus on healthy weight loss for patients who have excess non-lipedema adiposity [43].

Nutrition

A reduced calorie intake (by about 500–750 kcal/day depending on the individual) has been recommended to help achieve weight loss. Strategies such as portion control, reduced consumption of ultra-processed foods, and increased consumption of whole fruits and vegetables may help decrease overall calorie intake [43]. Some have recommended using protein shakes or bars to replace 1–2 meals/day⁴³ [46]. While vegan/vegetarian and Mediterranean diet have been endorsed by clinical practice guidelines, other approaches such as time-restricted eating, ketogenic diet have not [43]. A small pilot study reported improvements in perceived pain and quality of life of patient with lipedema with a low-carbohydrate, high-fat diet over a short period of time. However, besides the need to replicate these findings in large trials, such diets may not be sustainable and may lead to cycles of weight loss and gain, as mentioned above [12]. Although “fat-burning supplements” such as green tea, caffeine, carnitine, chromium, or conjugated linoleic acid are often recommended in conjunction with other lifestyle changes, their use in lipedema remains an evidence-free area [12, 47].

Behavioral Interventions

Behavioral intervention strategies that include goal setting, self-monitoring of food intake, physical activity, tracking weight, stimulus control, stress Management, adequate sleep, cognitive therapy have been recommended. These

interventions May be combined and delivered by trained personnel over 1–2 years in structured programs [43].

Exercise

Exercise remains a critical component of lipedema care to improve cardiovascular fitness and prevent deconditioning and muscle loss due to immobility. Incorporating an exercise regimen in addition to CDT and compression has been further reported to decrease severity of symptoms and improve limb volume, physical function and quality of life in small studies [34, 40, 41]. Individuals with lipedema may have flat feet or altered walking patterns due to excessive adipose tissue in the lower extremities and may benefit from working with a physical therapist to improve gait and functional ability. Patients with lipedema have also reported joint hypermobility in surveys, which may affect their functional capacity and gait [22]. Upon a baseline assessment of functional status and the ability to perform activities of daily living, a structured incremental exercise program that includes aquatic exercises, postural/core strengthening exercises, flexibility, and gait training may be implemented [12, 48]. Aquatic exercises such as swimming, aqua jogging, water aerobics allow patients to accrue cardiovascular benefits, can contribute to calorie expenditure while avoiding excessive stress on the joints, and may also help decrease orthostasis-related lower extremity edema [48].

Other Medical Therapies

It is generally recommended that medications that can promote edema or weight gain such as beta-blockers, calcium channel blockers, corticosteroids, progesterone-based contraceptives, certain antidepressants, antihyperglycemic agents, antipsychotics, and anti-epileptic medications should be avoided if alternative medications with similar efficacy are available [6, 43]. Sympathomimetic amines and diosmin are often utilized in patients with lipedema. Micronized Purified Flavonoid Fraction (MPFF), which consists of diosmin and hesperidin has been reported to improve symptoms such as pain, heaviness, burning, discomfort, pruritus, cramping and edema, by reducing oxidative stress in patients with chronic venous disease [6, 49]. While patients may report symptomatic improvement with diosmin or MPFF, clinical data on their role in lipedema are limited. Diuretics have no role in the management of lipedema.

Bariatric Surgery

Individuals with lipedema and severe obesity who achieve and sustain weight loss following bariatric surgery may also

experience significant and sustained improvement in their limb volumes and symptoms, including complete resolution of pain in some cases [12, 50]. Besides improvement in other comorbidities, such as impaired glycemic control and hypertension, patients with lipedema may also experience improved mobility and quality of life [12]. After consideration of individual procedural risk, and region-specific guidelines, bariatric surgery may be offered to individuals with co-existing lipedema and obesity with an understanding that the primary driver in pursuing such therapy is to treat obesity and obesity-related complications.

Liposuction

If patients experience persistent symptoms affecting QOL despite the use of conservative measures, liposuction may be considered for pain relief and improved mobility. Importantly, this is not curative, and lipedema adipose tissue can recur. Predictive tools for response and recurrence are lacking. These surgeries aim to remove LCT while sparing blood and lymphatic vessels. Commonly used liposuction methods for lipedema use local tumescent anesthesia, obviating the need for general anesthesia. Some studies assert that water-jet assisted liposuction (WAL) minimize injury to the vascular tissue and connective tissue framework thereby optimizing recover [51]. However, objective data supporting these claims are minimal, and there are no head-to-head trials supporting one liposuction therapy over another for patients with lipedema.

Observational studies have reported sustained improvement in lipedema symptoms and limb circumference following liposuction with comparable adverse events to patients without lipedema [12]. The clinical trials performed thus far have been single-arm, non-randomized studies reporting patient's self-assessment data using unvalidated assessment tools [52]. Some studies measure the lack of necessity for continued compression or CDT post-surgery as a criterion (sometimes the only criterion) for a successful outcome. However, these studies are often plagued by a lack of reproducibility or inadequate follow-up. There are also concerns regarding the longevity of the results reported, especially in the context of co-existing obesity, since the risk factors that resulted in the development of lipedema can persist despite surgery [12]. In our experience, post-operative prevention of weight gain is crucial in sustaining the positive benefits of liposuction therapy.

The European Lipedema Forum recommends careful patient selection with criteria that include considerable functional impairment, demonstration of weight stability over a year, a BMI of $<35 \text{ kg/m}^2$, and assessment for eating disorders and other behavioral health conditions [12]. Surgical risks and risk for lymphatic injury should be carefully

considered [6]. The LIPLEG trial aims to evaluate the efficacy and safety of liposuction compared to standard CDT with leg pain reduction by ≥ 2 points on a visual analog scale ranging 0–10 at 12 months on CDT or post-completion of liposuction being the primary outcome, and outcomes from this trial have not been released [53].

Some patients with advanced lipedema and lymphedema may have large lobules that can cause pain or get infected. Targeted liposuction or open surgical debulking may be appropriate for these patients. Our practice collaborates with experienced surgical specialists in lipedema to develop comprehensive surgical plans and ensure thorough postoperative care.

Assess for Comorbidities

Patients with lipedema should be screened for phenotypically similar conditions such as lymphedema, chronic venous disease, and generalized obesity. Patients with lipedema may also have obstructive sleep apnea, and a sleep study should be considered, particularly in those with obesity or signs or symptoms of sleep apnea [6].

Prognosis

Long-term epidemiologic data are lacking. Factors such as age of onset, comorbidities such as obesity, lymphedema, venous disease, sleep apnea, behavioral health disorders, activity level, and individual variation in pain sensitivity likely influence prognosis. It is unclear whether medical or surgical interventions alter the disease course or prognosis. In our experience, the prognosis is variable and challenging to predict. While some clinicians believe that lipedema is progressive, others contend that it may remain stable if the patient's overall weight remains stable [5, 12]. Our experience suggests that maintaining healthy weight helps preserve physical function and may help manage symptoms; however, this is a critical knowledge gap in the management of lipedema.

Conclusions

Lipedema is a poorly understood and recognized condition with an unknown prevalence. The current understanding points towards a multifactorial origin involving changes in subcutaneous tissue, microvasculature, and the development of fibrosis. Yet, lipedema management has seen little innovation, largely mirroring strategies established decades ago. This stagnation underscores the urgent need for intensified research. By deepening our

knowledge of lipedema, we pave the way for more effective, targeted therapies that could improve the quality of life for those affected.

Key References

- Bertsch T, Erbacher G, Elwell R. Lipoedema: a paradigm shift and consensus. *J Wound Care*. Nov 01 2020;29(Sup11b):1-51. doi:10.12968/jowc.2020.29.Sup11b.1

This paper challenges conventional beliefs regarding the pathophysiology of lipedema while also detailing a clinical management approach and providing broader context.

- Aday AW, Donahue PM, Garza M, et al. National survey of patient symptoms and therapies among 707 women with a lipedema phenotype in the United States. *Vasc Med*. Feb 2024;29(1):36-41. doi:10.1177/1358863X231202769

This analysis of nationwide survey data from patients with lipedema shows the extent of symptoms patients experience beyond what is reported in the classical definition of the disease.

Author Contributions All authors contributed equally to researching the topic, writing and proof reading.

Funding None.

Data Availability No new data is provided in this manuscript. Statements have supporting references as listed below.

Declarations

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Competing interests The authors declare no competing interests.

References

1. Wold LE, Hines EA, Allen EV. Lipedema of the legs; a syndrome characterized by fat legs and edema. *Ann Intern Med*. 1951;34(5):1243–50. <https://doi.org/10.7326/0003-4819-34-5-1243>.
2. Morgan S, Reid I, Bendon C, et al. A Family-Based study of inherited genetic risk in lipedema. *Lymphat Res Biol*. Apr. 2024;22(2):106–11. <https://doi.org/10.1089/lrb.2023.0065>.
3. Zechner U, Kohlschmidt N, Kempf O, et al. Familial sotos syndrome caused by a novel missense mutation, C2175S, in NSD1

- and associated with normal intelligence, insulin dependent diabetes, bronchial asthma, and lipedema. *Eur J Med Genet* Sep-Oct. 2009;52(5):306–10. <https://doi.org/10.1016/j.ejmg.2009.06.001>.
4. Herbst KL. Rare adipose disorders (RADs) masquerading as obesity. *Acta Pharmacol Sin.* 2012;33(2):155–72. <https://doi.org/10.1038/aps.2011.153>.
 5. Kruppa P, Georgiou I, Biermann N, Prantl L, Klein-Weigel P, Ghods M. Lipedema-Pathogenesis. Diagnosis, and treatment options. *Dtsch Arztebl Int Jun.* 2020;01(22–23):396–403. <https://doi.org/10.3238/arztebl.2020.0396>.
 6. Herbst KL, Kahn LA, Iker E, et al. Standard of care for lipedema in the united States. *Phlebology.* 2021;36(10):779–96. <https://doi.org/10.1177/02683555211015887>.
 7. Child AH, Gordon KD, Sharpe P, et al. Lipedema: an inherited condition. *Am J Med Genet A Apr.* 2010;152A(4):970–6. <https://doi.org/10.1002/ajmg.a.33313>.
 8. Grigoriadis D, Sackey E, Riches K, et al. Investigation of clinical characteristics and genome associations in the ‘UK lipedema’ cohort. *PLoS ONE.* 2022;17(10):e0274867. <https://doi.org/10.1371/journal.pone.0274867>.
 9. Poojari A, Dev K, Rabiee A, Lipedema. Insights into morphology, pathophysiology, and challenges. *Biomedicines.* 2022;30(12). <https://doi.org/10.3390/biomedicines10123081>.
 10. Suga H, Araki J, Aoi N, Kato H, Higashino T, Yoshimura K. Adipose tissue remodeling in lipedema: adipocyte death and concurrent regeneration. *J Cutan Pathol Dec.* 2009;36(12):1293–8. <https://doi.org/10.1111/j.1600-0560.2009.01256.x>.
 11. Buso G, Depairon M, Tomson D, Raffoul W, Vettor R, Mazzolai L. Lipedema: A call to action!. *Obesity (Silver Spring).* 2019;27(10):1567–76. <https://doi.org/10.1002/oby.22597>.
 12. Bertsch T, Erbacher G, Elwell R. Lipedema: a paradigm shift and consensus. *J Wound Care Nov.* 2020;01(Sup11b):1–51. <https://doi.org/10.12968/jowc.2020.29.Sup11b.1>.
 13. Warren Peled A, Kappos EA. Lipedema: diagnostic and management challenges. *Int J Womens Health.* 2016;8:389–95. <https://doi.org/10.2147/IJWH.S106227>.
 14. Cellina M, Gibelli D, Soresina M, et al. Non-contrast MR lymphography of lipedema of the lower extremities. *Magn Reson Imaging.* 2020;71:115–24. <https://doi.org/10.1016/j.mri.2020.06.010>.
 15. Monnin-Delhom ED, Gallix BP, Achard C, Bruel JM, Janbon C. High resolution unenhanced computed tomography in patients with swollen legs. *Lymphology.* 2002;35(3):121–8.
 16. Crescenzi R, Donahue PMC, Weakley S, Garza M, Donahue MJ, Herbst KL. Lipedema and dercum’s disease: a new application of bioimpedance. *Lymphat Res Biol.* 2019;17(6):671–9. <https://doi.org/10.1089/lrb.2019.0011>.
 17. Crescenzi R, Marton A, Donahue PMC, et al. Tissue sodium content is elevated in the skin and subcutaneous adipose tissue in women with lipedema. *Obesity.* 2018;26(2):310–7. <https://doi.org/10.1002/oby.22090>.
 18. Ma W, Gil HJ, Escobedo N, et al. Platelet factor 4 is a biomarker for lymphatic-promoted disorders. *JCI Insight.* 2020;09(13). <https://doi.org/10.1172/jci.insight.135109>.
 19. Rasmussen JC, Aldrich MB, Fife CE, Herbst KL, Sevic-Muraca EM. Lymphatic function and anatomy in early stages of lipedema. *Obesity.* 2022;30(7):1391–400. <https://doi.org/10.1002/oby.23458>.
 20. Greene AK, Grant FD, Slavin SA. Lower-extremity lymphedema and elevated body-mass index. *N Engl J Med.* 2012;31(22):2136–7. <https://doi.org/10.1056/NEJMc1201684>.
 21. Greene AK, Grant FD, Maclellan RA. Obesity-induced lymphedema nonreversible following massive weight loss. *Plast Reconstr Surg.* 2015;3(6):e426. <https://doi.org/10.1097/GOX.0000000000000398>.
 22. Aday AW, Donahue PM, Garza M, et al. National survey of patient symptoms and therapies among 707 women with a lipedema phenotype in the United States. *Vasc Med.* 2024;29(1):36–41. <https://doi.org/10.1177/1358863X231202769>.
 23. Amato ACM, Saucedo DZ, Santos KDS, Benitti DA. Ultrasound criteria for lipedema diagnosis. *Phlebology.* 2021;36(8):651–8. <https://doi.org/10.1177/02683555211002340>.
 24. van la Parra RFD, Deconinck C, Krug B. Diagnostic imaging in lipedema: a systematic review. *Obes Rev.* 2024;25(1):e13648. <https://doi.org/10.1111/obr.13648>.
 25. Forner-Cordero I, Oliván-Sasot P, Ruiz-Llorca C, Muñoz-Langa J. Lymphoscintigraphic findings in patients with lipedema. *Rev Esp Med Nucl Imagen Mol (Engl Ed).* 2018;37(6):341–8. <https://doi.org/10.1016/j.remnm.2018.06.008>.
 26. Lohrmann C, Foeldi E, Langer M. MR imaging of the lymphatic system in patients with lipedema and lipo-lymphedema. *Microvasc Res.* 2009;77(3):335–9. <https://doi.org/10.1016/j.mvr.2009.01.005>.
 27. Zaleska MT, Olszewski WL, Krzesniak NE. Lower limb lipedema-superficial lymph flow, skin water concentration, skin and subcutaneous tissue elasticity. *Lymphat Res Biol.* 2023;21(1):60–9. <https://doi.org/10.1089/lrb.2022.0010>.
 28. Buso G, Favre L, Maufus M, et al. Indocyanine green lymphography as novel tool to assess lymphatics in patients with lipedema. *Microvasc Res.* 2022;140:104298. <https://doi.org/10.1016/j.mvr.2021.104298>.
 29. Dietzel R, Reissshauer A, Jahr S, Calafiore D, Armbrrecht G. Body composition in lipoedema of the legs using dual-energy X-ray absorptiometry: a case-control study. *Br J Dermatol.* 2015;173(2):594–6. <https://doi.org/10.1111/bjd.13697>.
 30. Rasmussen JC, Aldrich MB, Tan IC, et al. Lymphatic transport in patients with chronic venous insufficiency and venous leg ulcers following sequential pneumatic compression. *J Vasc Surg Venous Lymphat Disord.* 2016;4(1):9–17. <https://doi.org/10.1016/j.jvsv.2015.06.001>.
 31. Canning C, Bartholomew JR. Lipedema. *Vasc Med.* 2018;23(1):88–90. <https://doi.org/10.1177/1358863X17739698>.
 32. Szolnoky G, Nagy N, Kovács RK, et al. Complex decongestive physiotherapy decreases capillary fragility in lipedema. *Lymphology Dec.* 2008;41(4):161–6.
 33. Szolnoky G, Borsos B, Bársony K, Balogh M, Kemény L. Complete decongestive physiotherapy with and without pneumatic compression for treatment of lipedema: a pilot study. *Lymphology Mar.* 2008;41(1):40–4.
 34. Czerwińska M, Teodorczyk J, Spychała D, Hansdorfer-Korzon R. The usefulness of the application of compression therapy among lipedema Patients-Pilot study. *Int J Environ Res Public Health.* 2023;04(2). <https://doi.org/10.3390/ijerph20020914>.
 35. Wright T, Scarfino CD, O’Malley EM. Effect of pneumatic compression device and stocking use on symptoms and quality of life in women with lipedema: a proof-in-principle randomized trial. *Phlebology.* 2023;38(1):51–61. <https://doi.org/10.1177/02683555221145779>.
 36. Volkan-Yazici M, Esmer M. Reducing circumference and volume in upper extremity lipedema: the role of complex decongestive physiotherapy. *Lymphat Res Biol.* 2022;20(1):71–5. <https://doi.org/10.1089/lrb.2020.0128>.
 37. Volkan-Yazici M, Yazici G, Esmer M. The effects of complex decongestive physiotherapy applications on lower extremity circumference and volume in patients with lipedema. *Lymphat Res Biol.* 2021;19(1):111–4. <https://doi.org/10.1089/lrb.2020.0080>.
 38. Szolnoky G, Varga E, Varga M, Tucza M, Dósa-Rács E, Kemény L. Lymphedema treatment decreases pain intensity in lipedema. *Lymphology.* 2011;44(4):178–82.
 39. Langendoen SI, Habbema L, Nijsten TE, Neumann HA. Lipodema: from clinical presentation to therapy. A review of the literature. *Br J Dermatol.* 2009;161(5):980–6. <https://doi.org/10.1111/j.1365-2133.2009.09413.x>.

40. Atan T, Bahar-Özdemir Y. The effects of complete decongestive therapy or intermittent pneumatic compression therapy or exercise only in the treatment of severe lipedema: a randomized controlled trial. *Lymphat Res Biol*. 2021;19(1):86–95. <https://doi.org/10.1089/lrb.2020.0019>.
41. Donahue PMC, Crescenzi R, Petersen KJ, et al. Physical therapy in women with early stage lipedema: potential impact of multimodal manual therapy, compression, exercise, and education interventions. *Lymphat Res Biol*. 2022;20(4):382–90. <https://doi.org/10.1089/lrb.2021.0039>.
42. Paling I, Macintyre L. Survey of lipoedema symptoms and experience with compression garments. *Br J Community Nurs Apr*. 2020;01(Sup4):S17–22. <https://doi.org/10.12968/bjcn.2020.25.Sup4.S17>.
43. Elmaleh-Sachs A, Schwartz JL, Bramante CT, Nicklas JM, Gudzone KA, Jay M. Obesity management in adults: a review. *JAMA*. 2023;28(20):2000–15. <https://doi.org/10.1001/jama.2023.19897>.
44. Wilding JPH, Batterham RL, Calanna S, et al. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med*. 2021;18(11):989–1002. <https://doi.org/10.1056/NEJMoa2032183>.
45. Jastreboff AM, Aronne LJ, Ahmad NN, et al. Tirzepatide once weekly for the treatment of obesity. *N Engl J Med*. 2022(3). <https://doi.org/10.1056/NEJMoa2206038>.
46. Astbury NM, Piernas C, Hartmann-Boyce J, Lapworth S, Avery P, Jebb SA. A systematic review and meta-analysis of the effectiveness of meal replacements for weight loss. *Obes Rev Apr*. 2019;20(4):569–87. <https://doi.org/10.1111/obr.12816>.
47. Bonetti G, Herbst KL, Dhuli K, et al. Dietary supplements for lipedema. *J Prev Med Hyg*. 2022;63(2 Suppl 3):E169–73. <https://doi.org/10.15167/2421-4248/jpmh2022.63.2S3.2758>.
48. Annunziata G, Paoli A, Manzi V, et al. The role of physical exercise as a therapeutic tool to improve lipedema: A consensus statement from the Italian society of motor and sports sciences (Società Italiana Di scienze motorie e sportive, SISMeS) and the Italian society of phlebology (Società Italiana Di flebologia, SIF). *Curr Obes Rep*. 2024;03. <https://doi.org/10.1007/s13679-024-00579-8>.
49. Kakkos SK, Nicolaides AN. Efficacy of micronized purified flavonoid fraction (Daflon®) on improving individual symptoms, signs and quality of life in patients with chronic venous disease: a systematic review and meta-analysis of randomized double-blind placebo-controlled trials. *Int Angiol*. 2018;37(2):143–54. <https://doi.org/10.23736/S0392-9590.18.03975-5>.
50. Fink JM, Schreiner L, Marjanovic G, et al. Leg volume in patients with lipoedema following bariatric surgery. *Visc Med*. 2021;37(3):206–11. <https://doi.org/10.1159/000511044>.
51. Stutz JJ, Krah D. Water jet-assisted liposuction for patients with lipoedema: histologic and immunohistologic analysis of the aspirates of 30 lipoedema patients. *Aesthetic Plast Surg Mar*. 2009;33(2):153–62. <https://doi.org/10.1007/s00266-008-9214-y>.
52. Peprah K, MacDougall D. Liposuction for the Treatment of Lipedema: A Review of Clinical Effectiveness and Guidelines. 2019.
53. Podda M, Kovacs M, Hellmich M, et al. A randomised controlled multicentre investigator-blinded clinical trial comparing efficacy and safety of surgery versus complex physical decongestive therapy for lipedema (LIPLEG). *Trials*. 2021;30(1):758. <https://doi.org/10.1186/s13063-021-05727-2>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.