Chronic Lower Limb Edema

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9.1 Introduction

Although edema is the most prevalent cause of leg swelling, an increase in any region of the tissue can cause the limb to expand completely or partially [1]. An accurate diagnosis must be made, irrespective whether the swelling is acute or chronic, symmetrical or asymmetrical, localized or generalized, congenital or acquired. Asymmetrical lower limb swelling indicates a sign of chronic edema arising from venous or lymphatic disease, whereas symmetrical lower limb swelling implies a systemic or more central cause of edema, such as heart failure or nephrotic syndrome. Edema develops when the rate of capillary filtration (lymph generation) exceeds the rate of lymphatic drainage, either due to excessive transcapillary filtration, inadequate lymphatic flow, or both. The lymphatic system regulates the amount of extracellular fluid, which normally compensates for increased capillary filtration [2]. The lymph drainage system is overburdened by filtration, which causes most edemas. Increased capillary filtration can occur as a result of increasing venous pressure, hypoalbuminemia, or increased capillary permeability as a result of local inflammation [3].

An increase in fluid volume in the interstitial space causes edema, which is a perceptible swelling. In order to clarify the etiology and diagnosis, the care of a patient with edema should be based on epidemiology, previous medical history, and physical examination. In addition, recommendations and criteria for stratifying clinical risk and guiding hospitalization decisions should be proposed [4]. Chronic edema is defined as a persistent, abnormal swelling of the legs that does not go away overnight or with elevation and lasts more than 3 months [5].

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9.2 Pathophysiology

A capillary leak with fluid translocation to the interstitial space, renal water and sodium reabsorption might both be used to determine fluid retention, resulting in an endocrine salt retention mechanism. If the accumulation of hydro-saline is the major cause of edema, the fluid excess appears to be intravascular as well as extravascular (the so-called overfilling seen in primary nephropathies) [5].

9.3 Classification

There are two types of leg edema: venous edema and lymphedema . Due to enhanced capillary filtration, venous edema is a deposit of low viscosity, protein-poor interstitial fluid that cannot be accommodated by the regular lymphatic system. Lymphedema is characterized by an accumulation of protein-rich interstitial fluid in the skin and subcutaneous tissue as a result of lymphatic malfunction. Lipidemia, a third variety is more correctly described as a sort of fat maldistribution than real edema [6]. Various common and the less common cause of leg edema are shown in Table 9.1 and 9.2.

Table 9.1 Common causes of leg edema

Unilateral		Bilateral	
Acute (<72 h)	Chronic	Acute (<72 h)	Chronic
Deep vein thrombosis	Venous insufficiency		Venous insufficiency
			Pulmonary hypertension
			Heart failure
			Idiopathic edema
			Lymphedema
			Drugs
			Premenstrual edema
			Pregnancy
			Obesity

Table 9.2 Less common causes of leg edema

Unilateral		Bilateral	
Acute (<72 h)	Chronic	Acute (<72 h)	Chronic
Ruptured Baker's cyst	Secondary lymphedema (tumor, radiation, surgery, bacterial infection)	Bilateral deep vein thrombosis	Renal disease (nephrotic syndrome, glomerulonephritis)
Ruptured medial head of gastrocnemius	Pelvic tumor or lymphoma causing external pressure on veins	Acute worsening of systemic cause (heart failure, renal disease)	Liver disease

Table 9.2 (continued)

Unilateral		Bilateral	
Acute (<72 h)	Chronic	Acute (<72 h)	Chronic
Compartment syndrome	Reflex sympathetic dystrophy		Secondary lymphedema (secondary to tumor, radiation, bacterial infection, filariasis)
			Pelvic tumor or lymphoma causing external pressure
			Dependent edema
			Diuretic-induced edema
			Preeclampsia
			Lipidemia
			Anemia

9.4 Assessment of Edema

Edema is almost always diagnosed clinically. The commencement of swelling, the look of the limb, the existence of pain with pressure, and the impact of passive leg elevation on edema can all help you diagnose edema. A complete medical history and physical examination are required for evaluation.

The amount of the edema should be determined first in the initial assessment. Unilateral edema indicates a compression of the venous or lymphatic vessels caused by an intravascular or extrinsic process. Congestive heart failure, chronic liver failure, renal illness and hypoalbuminemia are all causes for generalized edema [Table 9.3]. Many different drugs have been linked to the development of edema [Table 9.4], and stopping these medications should be part of the first treatment regimen. Based on the history and physical examinations, laboratory and other diagnostic procedures should focus on the most likely causes.

9.4.1 Diagnostic Studies

The majority of individuals with leg edema over the age of 50 have venous insufficiency, but if the cause is unknown, a brief list of laboratory tests can help rule out systemic disease: complete blood count, urinalysis, electrolytes, creatinine, blood sugar, thyroid-stimulating hormone, and albumin.

In lymphedema, ultrasonography can accurately measure soft tissue changes in the superficial and deep layers, but it does not provide adequate information on anatomical structure [7]. For identifying the location and extent of venous reflux and deep venous thrombosis, duplex venous ultrasonography is regarded the most accurate noninvasive method. In assessing calf vein and iliac-vein thrombosis, this approach is less accurate. Ultrasound can be used to detect both popliteal aneurysms and cysts.

Table 9.3 Rare causes of leg edema

Unilateral		Bilateral	
Acute (<72 h)	Chronic	Acute (<72 h)	Chronic
	Primary lymphedema (congenital lymphedema, lymphedema praecox, lymphedema tarda)		Primary lymphedema (congenital lymphedema, lymphedema praecox, lymphedema tarda)
	Congenital venous malformations		Protein losing enteropathy, malnutrition, malabsorption
	May-Thurner syndrome (iliac-vein compression syndrome)		Restrictive pericarditis
			Restrictive cardiomyopathy
			Beri Beri
			Myxedema

Table 9.4 Medicines most commonly implicated in edema and their causative mechanisms

Drug class	Mechanism
Calcium channel blockers	Increased hydrostatic pressure resulting from an increase in capillary blood flow as a result of dilation of the small arteries
Corticosteroids	Increased hydrostatic pressure resulting from fluid retention
Nonsteroidal anti-inflammatory drugs	
Sex hormones and related compounds	

In the case of suspected DVT, venous ultrasonography is the imaging modality of choice. For proximal thrombosis, compression ultrasonography with or without Doppler waveform analysis has a high sensitivity (95%) and specificity (96%); however, the sensitivity is lower for calf veins (73%). The diagnosis of chronic venous insufficiency can also be confirmed with duplex ultrasonography.

Ultrasonography is unable to detect lymph flow. When a clinical diagnosis of lymphedema cannot be made, indirect radionuclide lymphoscintigraphy, which demonstrates absence or delayed filling of lymphatic channels, is the method of choice for evaluating lymphedema [8].

In cases of indeterminate lymphoscintigraphy interpretation or in individuals whom lymphedema is likely to be treated surgically, radio contrast lymphography is now reserved. This approach solely gives static anatomical data. It is invasive, is difficult to conduct, and has the potential to affect underlying lymphatic vessels, aggravating lymphedema [9].

CT scans can reveal structural changes in soft tissues as well as fluid volume alterations between compartments. On CT, lymphedema can be distinguished from venous edema by the appearance of edema restricted to the skin and subcutaneous tissue, with sparing of the underlying muscle.

If the clinical suspicion for DVT remains high, patients with unilateral lower extremity edema who do not show a proximal thrombus on duplex ultrasonography

may require further imaging to diagnose the etiology of edema. To assess for intrinsic or extrinsic pelvic or thigh DVT, magnetic resonance angiography with venography of the lower extremities and pelvis might be employed [10]. The diagnosis of musculoskeletal etiologies such as a gastrocnemius rupture or a popliteal cyst may be aided by magnetic resonance imaging. When lymphedema is suspected, T1-weighted magnetic resonance lymphangiography can be performed for direct visualization of the lymphatic pathways [11].

Patients with obstructive sleep apnea and edema should get an echocardiogram to check their pulmonary arterial pressures. 93 percent of obstructive sleep apnea patients with edema reported higher right atrial pressures in one report [12]. Edema linked with obstructive sleep apnea has long been assumed to be caused by pulmonary hypertension [13].

9.5 Therapeutic Options

9.5.1 Conservative and Skin Care Treatment

Leg edema that is persistent and uncontrolled leads to induration of the subcutaneous tissues, exudation, and eventually ulceration. This procedure also promotes the spread of bacterial and fungal infections, which impair the limb's overall health in the long run [14]. Patients with this problem require a thorough explanation of the importance of lowering edema and subsequent prevention. Other factors that can help to prevent the long-term consequences of leg swelling include skin care and general hygiene, boosting mobility, discouraging unsupported limb reliance, and weight management [14]. Because many of these patients are physically unable to care for their own feet due to obesity, degenerative musculoskeletal problems, and concurrent systemic conditions, the podiatrist serves a vital role in ensuring sufficient foot care.

Some individuals' skin may be thick, causing dryness, hyperkeratosis, and even ulceration. To lubricate their skin, all patients will require effective washing, drying, and emollient therapy. Emollients calm, smooth, and lubricate the skin and are recommended when the skin is dry or has scaling/hyperkeratosis [15].

9.5.2 Compression Therapy

The term "passive vascular exercise" became popular in the early 1900s. Blood flow was thought to be improved by passive stretching of the muscular layers of blood vessels. Another notion considered was to use alternating cycles of suction and compression to increase pressure gradients in vessels. By expanding the walls during suction and entirely emptying the venous bed during compression, this also increases the capacity of the venous system. Local and systemic effects of compression therapy are thought to exist. It is more complicated than merely stretching the

vessel wall's muscular layers. This explains why a variety of illnesses react to compression therapy, including occlusive arterial disease, venous ulcers, and lymphedema.

9.5.3 Types of Compression

9.5.3.1 Hosiery

Compression stockings are a practical way to treat individuals with swollen limbs. They are useful in avoiding venous stasis by increasing venous outflow and exerting sustained pressure [16]. Graduated compression stockings are available from a variety of manufacturers and are categorized as above or below the knee.

As a result, there is some evidence that employing progressive compression stocking therapy in the swollen limb has its downsides [17]. Another type of compression therapy, such as intermittent pneumatic compression, will be beneficial to a considerable proportion of patients. It is possible that if this type of compression is performed and overseen in patient or home-based treatment, compliance will improve. Finally, there are a variety of compression techniques to choose from, and therapy must be tailored to the patient's condition and circumstances.

9.5.3.2 Bandages

Bandages can be inelastic or elastic, and they can be single or multilayered. Venous ulcers have been proven to benefit from multilayer bandage treatments. The "four-layer" technique has long been considered the gold standard for venous leg ulcer healing; however, additional research suggests that "short stretch" bandages may be just as effective. The success of bandages is based on the experience of the nurse or caregiver using the bandage system. There are various bandaging systems with varied qualities and acting on different scientific concepts.

9.5.3.3 Intermittent Pneumatic Compression [IPC]

IPC is the use of compressed air generated by a specifically constructed pump to apply regulated pressure to the extremities via garments fitting the limb. These devices are made by a variety of companies and can be used on the entire limb, the calf and foot, the calf alone, or the foot alone [18]. The pressure, cycle time, inflation and deflation time, and hold time are among the settings that can be changed. The garments can be single or multicell, and the pressures created range from 20 to 140 mm Hg. The multicell garments, acts by a "milking action" from the distal to the proximal limb when applied.

9.5.4 Exercise and Positional Therapy

- During long flights and vehicle or train travel, the patient is encouraged to move his or her feet and walk occasionally.

- Walking and other forms of physical activity increases muscle pumping and develop leg muscles.
- The patient should alternate between standing on tiptoes and heels. The exercise is done 15 times in each cycle, a few times a day.
- The patient should lie down many times a day with legs elevated and knees gently bent.

9.6 Surgical Management of the Swollen Lower Limb

The cause of a unilaterally swollen limb determines whether surgery is required or not. In uncomplicated varicose veins with simple sapheno-femoral incompetence, significant limb swelling is uncommon. Minor edema can be easily alleviated by ligating the high saphenous vein and stripping the long saphenous vein. If there is substantial edema with varicose veins, it is likely that the deep system of veins has either perforator incompetence or valve incompetence. Importantly, individuals with recurrent varicose veins after varicose vein surgery, persistent or recurrent sapheno-femoral incompetence, or improperly performed surgery may experience leg edema, which can progress to CVI, and are therefore candidates for additional treatment. Deep venous disease that was previously undiagnosed could be present as a result of a previous venous ailment, such as deep venous thrombosis, which could have occurred as a result of trauma [19].

Patients with sapheno-femoral or sapheno-popliteal reflux disease who do not have deep venous disease should have surgery. In both primary and secondary lymphedema, there are insufficient lymphatic channels, causing lymphatic fluid to pool in the subcutaneous tissue. The procedure leaves you with a limb that is prone to recurrent infections and injuries, as well as a poor cosmetic result. There are a variety of surgical procedures for treating lymphedema, but they all require a high level of competence [20]. Due to lack of a clearly defined selection method to determine which patients may benefit from surgery, the majority of lymphedema patients are treated conservatively with combined approach of infection management, massage, elastic clothing, and elevation [21].

There are two types of surgical intervention:

1. Physiological: Efforts are made to restore function; those with obstructive primary lymphedema may benefit from this. Subcutaneous tunnels, buried dermal flaps, lympho-venous shunts and mental transposition have all been explored with varied degrees of success.
2. Excisional: Efforts are focused on minimizing the size of the limb to improve symptoms; this is ideal for those with obliterative lymphedema or secondary lymphedema. The majority of excisional procedures include the removal of subcutaneous tissue blocks, either with or without the overlying skin. Defects are either closed with split skin grafts, as described by Homans and Charles. Many procedures exist that are all weakly supported by data; this could be one of the reasons why surgery is only performed on a small percentage of patients.

9.7 Common Causes of Leg Edema

9.7.1 Lymphedema

Lymphedema affects the upper and lower extremities and is highly frequent following breast cancer surgery due to poor local lymphatic drainage, fluid overload, and increased interstitial lymphatic volume. Skin may also crack and lymph may leak, exposing the skin to bacterial infection and increasing lymphatic drainage, producing a vicious cycle [22].

The goal is to slow the disease progression, reduce the size of the affected extremities, alleviate symptoms, and lower the risk of infection. Patients with lymphedema should be treated conservatively at first, using various compression techniques, and subsequently, if issues persist, a new surgical modality should be considered.

9.7.2 Varicose Vein

Varicose veins can affect anywhere from 10 to 30% of people. Family history, age, and pregnancy are all risk factors for varicose veins, as is standing for lengthy periods of time. Varicose veins can cause a variety of symptoms, including discomfort, aching, soreness, itching or dermatitis, as well as deep vein thrombosis (DVT) [23]. Clinical manifestations and ultrasonography are used to diagnose varicose veins. The gold standard for diagnosing superficial venous incompetence is duplex ultrasonography.

9.7.3 CEAP Classification: C (Clinical Component)

C0	No visible or palpable signs of venous disease
C1	Telangiectases (dilated interdermal venules <1 mm) or reticular veins (nonpalpable subdermal veins 1–3 mm)
C2	Varicose veins (diameter of vein >3 mm)
C3	Edema
C4a	Pigmentation or eczema
C4b	Lipodermatosclerosis
C5	Healed venous ulcer
C6	Active venous ulcer

Conservative treatment with stockings and external compression is an acceptable option to surgery, but if cutaneous abnormalities or symptoms deteriorate despite these efforts, surgery is usually required. However, a patient's preference for surgery over conservative care or for cosmetic reasons alone are both legitimate relative justifications for surgery. Multimodality treatments for varicose veins are the most effective, incorporating modern minimally invasive to endovascular procedures, as well as compression. However, there is no single best accessible treatment option for varicose veins.

9.7.4 Deep Vein Thrombosis

A symptom of venous thromboembolism (VTE) is deep venous thrombosis (DVT). Although most DVT are asymptomatic and resolves without complications, DVT-related major pulmonary embolism (PE) is responsible for up to 300,000 deaths in the USA each year [24]. Anticoagulation, different thrombolysis drugs, and endovascular and surgical treatments such as thrombectomy and inferior vena cava filters to trap venous emboli while maintaining normal venous flow are among the alternatives for treating DVT.

9.8 Filariasis

Humans and animals are both affected by filariasis. Only eight kinds of filarial parasites have been identified, out of hundreds that have been described. Lymphatic filariasis causes lymphatic damage, chronic swelling, and elephantiasis of the legs, arms, scrotum, vulva, and breasts as a result of repeated bouts of inflammation and lymphedema [25].

9.8.1 Lymphatic Filariasis

All species that cause lymphatic filariasis are intermediate hosts and vectors of mosquitoes belonging to the genera Aedes, Anopheles, Culex, or Mansonia.

Nodes in the femoral and epitrochlear areas are the most typically affected. Abscesses can arise anywhere throughout the distal vessel, including the nodes. More abscesses appear to be caused by *B. timori* infection than by *B. malayi* or *W. bancrofti* infection [26]. Microfilariae can be seen in the blood, urine, skin biopsy, and slit lamp examination of the patient's eye. Diethylcarbamazine (DEC), ivermectin, suramin, mebendazole, flubendazole, albendazole, and doxycycline are antimicrobials used to treat filariasis.

9.8.2 Cellulitis

Acute inflammatory episodes, often known as "cellulitis," are common in persons with chronic edema and should be treated with antibiotics as soon as possible, especially if systemic symptoms are evident [30]. Lower limb cellulitis affects both men and women equally, although it becomes more common with advancing age; the aging population and obesity have both contributed to an increase in the frequency of lower limb cellulitis [27].

Bacteria infiltrating a damaged skin surface is a common cause of cellulitis. Breaks in the skin, such as cracks between toes or lower leg ulcers, are common entry points for germs. To rule out other potentially serious differential diagnoses,

such as deep vein thrombosis, a prompt and accurate assessment with a diagnosis are essential. Septicemia and other problems can be avoided with early treatment.

Cellulitis should be treated with the aim of resolving symptoms, efficiently managing infection and avoiding hospitalization. Antibiotic treatment should be continued in lymphedema patients until all indications of acute inflammation have subsided, which normally takes at least 14 days after a definite clinical response has been detected. Cellulitis treatment in lymphedema patients is complicated, and help from lymphedema specialist services should be sought whenever feasible.

9.9 Summary and Recommendations

- When treating leg edema with an unknown cause, the physician should first rule out lipedema (fat maldistribution with sparing of the feet) and lymphedema (marked foot and toe involvement, verrucous thickened skin, non-pitting when chronic) because the evaluation and treatment for these disorders are different.
- Idiopathic edema (in young women) and chronic venous insufficiency (in older patients) are the most common causes of bilateral leg edema.
- In patients with persistent bilateral edema, the physician should assess the most frequent systemic causes (cardiac, renal, and hepatic) and determine which of them should be ruled out with additional testing based on the patient's history and physical examination. Pulmonary hypertension is a prevalent cause of sleep apnea and should be considered in patients who have a large neck circumference, loud snoring, or apnea observed by a sleep partner.
- A Doppler test should be used to rule out a deep vein thrombosis if the patient presents with sudden onset (<72 h) leg edema.

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