A Patient-Centered Approach to Treatment of Morbid Obesity and Lower Extremity Complications: An Overview and Case Studies

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The prevalence of morbid obesity, along with related comorbidities, is dramatically increasing in the US, confounding wound care for persons at heightened risk for skin compromise. The purpose of this overview is to examine common concerns related to morbid obesity and interrelated lower extremity complications, including wound and skin infections, dermatologic conditions, lymphovenous obstruction syndromes, chronic venous insufficiency, and anatomical abnormalities such as massive localized lymphedema. Treatment may include surgery for massive lymphedema localizations, compression bandaging for chronic venous insufficiency as well as lymphedema, manual lymph drainage for lymphedema, and prompt and aggressive management of wound infection and bioburden. Case studies are presented to illustrate some lower extremity complications of morbid obesity and appropriate protocols of care. Although increasing evidence suggests that morbidly obese patients are predisposed to secondary lymphedema and that primary lymphedema can cause adult-onset obesity, the mechanisms by which these events occur remain unclear. However, unless the underlying problem of morbid obesity is addressed, the problems for which these patients seek care will continue to recur.

KEYWORDS: morbid obesity, lymphedema, chronic venous insufficiency, compression bandaging, infection

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A recent random-digit telephone survey of US households by Sturm1 (N = approximately 250,000) reported that the prevalence of morbid obesity as indicated by body mass index (BMI) >40 and >50 rose by 50% and 75%, respectively, between 2000 and 2005. This increase in the population of morbidly obese individuals is far greater than the 24% concurrently reported for the person classified as obese (BMI 30 to 40).2 Patients presenting to the authors’ clinic reflect this trend, one with major implications for healthcare.

Obesity increases body size. Limbs enlarge and redundant skin folds develop. Additional adipose tissue can interfere with the lymphatic system, exacerbating existing secondary lymphedema or triggering it. In addition, patients with lipedema (a genetically

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linked disease that involves the pathological accumulation of fat on the lower body, most commonly observed in women will eventually develop secondary lymphedema as fatty tissue occludes lymphatic channels. Also, an overhanging pannus can worsen pre-existing venous insufficiency. Irregularly shaped extremities and the reality that obese patients are usually unable to don and doff garments unaided (even if they can be fitted properly) preclude compression garment use and reduced mobility further contributes to dependent fluid collection. The net result of all these factors is the increasing enlargement of the extremities of the obese individual, with varying degrees of lymphedema and venous insufficiency. Interestingly, the association between limb enlargement and excess weight has not previously been reported in the literature.

Obesity is a known risk factor for many diseases; the importance of abdominal adiposity as a cause of metabolic syndrome and cardiovascular problems also has been recognized. However, the unique issues related to obesity that affect the skin in general and the lower extremities in particular are rarely addressed from a medical or therapeutic standpoint. The purpose of this article is to review common concerns related to morbid obesity and interrelated lower extremity complications. Clinical presentations of lower extremity problems regularly encountered among morbidly obese patients illustrate the challenges of managing these conditions. It must be emphasized that in this particular population it is especially important that healthcare processes are patient-centered. In the authors’ experience, treating disease symptoms and complications separately does not yield positive outcomes.

**Wound and Skin Infection**

**Diabetes and bacteria.** Morbidly obese patients have a 20% incidence of type 2 diabetes, which, in addition to the difficulty of maintaining adequate hygiene, increases the likelihood of bacterial and fungal infection. Because bacteria are known to contribute to the inflammatory process, excessive bioburden (organisms contaminating a wound, even in the absence of frank infection) can slow or prevent wound healing. Figure 1 shows the neon green drainage characteristic of Pseudomonas, which can be challenging to eradicate in heavily draining wounds. Figure 2 shows a morbidly obese patient with secondary lymphedema and a large pyogenic granuloma on the posterior calf.

**Lymphorrhea.** Skin breakdown increases the likelihood of lymphorrhea (lymphatic drainage through the skin), a condition that complicates the use of compression bandages and increases bacterial loads, creating a vicious cycle that can be difficult to break. Figure 3 shows the fluid from profuse lymphatic drainage that collected in a garbage bag in only a few hours.

**Immune system compromise.** Complex psychosocial issues, such as depression, anxiety, body image dissatisfaction, and physical and sexual abuse contribute to the development of morbid obesity. Subsequently, morbid obesity contributes to lymphedema, creating further complications in terms of health and well being. Lymphedema reduces local immune function, increasing the risk of cellulitis. For example, a morbidly obese married couple continued to have recurrent cellulitis in their legs, which touched in bed (see Figure 4). Not surprisingly, the same collection of
organisms was cultured from their legs. Individual, uncoordinated antibiotic treatment failed but when both were aggressively and simultaneously treated with intravenous antibiotics, the infections resolved.

**Fungal infection.** *Candida albicans* can be particularly challenging to eradicate in morbidly obese patients. Fungal infections favor the conditions created underneath redundant skin folds that are common in obese patients (see Figure 5). Maintaining adequate hygiene can be difficult for patients with limited mobility or flexibility; keeping these areas free from moisture is nearly impossible because perspiration collects in intertriginous areas.

**Dermatologic Conditions**

A basic feature of lymphedema is inflammation of the skin, subcutaneous tissue, lymph nodes, and the lymphatic system. This can lead to recurrent cellulitis, which further decreases lymphatic transport, making the patient even more vulnerable to future episodes of cellulitis. Subsequent lymphostasis results in the accumulation of protein in the interstitial space. A progressive infiltration of neutrophils, macrophages, and fibroblasts ensues, leading to the deposition of collagen and further destruction of lymphatics as their delicate...

**Figure 2.** A morbidly obese 22-year-old man with secondary lymphedema and a large pyogenic granuloma on the posterior calf.

**Figure 3.** Fluid due to profuse lymphatic drainage collected in a garbage bag in only a few hours from a 57-year-old woman with lymphorrhea.

**Figure 4.** Recurrent cellulitis observed in a morbidly obese married couple whose legs touch each other in bed.

**Figure 5.** *Candida* infection in the redundant skin fold of the abdomen in a morbidly obese man with type 2 diabetes.
structures fibrose, causing chronic pain and functional impairment. Most of these changes occur in the subcutaneous tissue and manifest in the skin as hyperkeratosis (see Figure 6), lymphangiomas, and papillomas and fibromas that can be very large (see Figures 7 and 8). Hence, morbidly obese persons may experience significant dermatological changes in their lower extremities. Figure 9 shows a dramatic case of elephantiasis verrucous nostra (the final phase of elephantiasis). By the time this occurs, patients can suffer from profound lymphorrhea, pressure ulcers from the weight of the extremity (see Figure 10), and an inability to heal traumatic wounds. Spontaneous wounds may develop due to the sclerotic nature of their skin and low tissue oxygen levels caused by the edema (see Figure 11).
Lymphovenous Obstructive Syndromes

Venous insufficiency is common in patients with morbid obesity, although the exact relationship remains unclear. For example, in a recent cross-sectional study (N = 40,095) conducted in Poland, obesity was found to be strongly associated with chronic venous insufficiency (CVI); the strength of the association was slightly higher for women than men. However, in a retrospective study of morbidly obese patients, Padberg et al. found that while CVI severity correlated with increasing BMI, only one third of the examined limbs had evidence of venous disease despite the fact that the majority of limbs exhibited symptoms typical of CVI.

Figure 12 shows a 500-lb patient with severe venous insufficiency. A tugboat captain, he is at sea more than 70% of the time and required to remain standing for intervals as long as 14 hours. Profound hemosiderin deposits and the creases at his ankles left by his socks are visible. He is neither able to be fitted with (or to self-apply) compression stockings due to his abdominal girth nor to obtain stockings that provide sufficient support. Farrow wraps (Farrow Medical Innovations, Bryan, Texas) provided a solution—he was able to apply these wraps independently while at sea and be afforded sufficient compression.

A Farrow wrap is a custom or off-the-shelf short-stretch compression garment designed for the upper or lower extremities. The garment consists of a liner and limb components designed to work together. The components are made with multiple overlapping, interconnected short-stretch bands and engineered so patients with bad backs, large abdomens, weak hand strength, or abnormally shaped limbs find them easy to apply. The garment can be worn day or night, unlike high stretch garments or bandages, which are contraindicated for night wear due to their high “resting pressure” against the skin and the subsequent risk of tissue ischemia. The user determines the compression level near the end-stretch of the material; the wrap should provide consistent low resting and higher working compression levels.

An overhanging pannus also can obstruct venous return. Figure 13a,b shows a woman before and after pannectomy. Removing the pressure from her abdomen facilitated a dramatic change in her bilateral leg edema.

Anatomical Abnormalities

Although the etiology, presentation, and treatment of lymphedema are addressed in the literature, many unanswered questions remain regarding why some morbidly obese patients develop profound lymphedema and others seem minimally affected, as well as how massive localized lymphedema (MLL) (see Figures 14a-c) originates. On-going research involving breast cancer patients suggests that variations in lymphatic transport capacity might be partially controlled by genetics. As part of these efforts, Ferrell proposed that secondary lymphedema development, whether
due to cancer, trauma, or heredity might be controlled by the same set of genes. Therefore, it is not unreasonable to assume that genetic factors at least partially control the development of lymphedema in persons who are obese.

Although no studies directly examine the relationship between obesity and the development of lymphedema, indirect evidence from different sources suggests a relationship exists. For example, in a study\(^\text{28}\) involving patients who had undergone mastectomy in conjunction with axillary dissection, an increased BMI predisposed to more lymph drainage. In a prospective study,\(^\text{29}\) increased BMI was found to be a risk factor in the frequency and severity of edema following radiation therapy for breast cancer. Evidence from animal models also suggests that impaired lymph drainage, stress, and inflammatory disorders are factors involved in selective hypertrophy of lymphoid tissue-associated adipose tissue.\(^\text{30}\) In addition, in a small prospective surgical study\(^\text{31}\) (N = 11) of chronic arm lymphedema following breast cancer treatment, volume-rendered computer tomography analysis of lymphedematous and unaffected arms showed that lymphedematous limbs contained a mean excess amount of 81% fat. An animal study\(^\text{32}\) that investigated the effect of the \(\text{prox1}\) master gene haploid condition in mice (ie, \(\text{prox1}^{-/-}\)) suggests that minor defects in lymphatic system development, such as the leakage of lymph from abnormally formed lymph vessels, stimulates adipocyte development (preadipocyte differentiation), which in turn promotes adult-onset obesity through site-specific fat deposition.\(^\text{32,33}\) This finding has been corroborated using transgenic mice with different defects in lymphangiogenesis.\(^\text{34}\)

Together, these studies infer that the development of secondary lymphedema is not just the result of lymphatic dysfunction but also might be linked to lipid metabolism with inflammation as a mediator. Further, under certain conditions, lymph-containing factors may stimulate fat deposition, which can lead to obesity. In a prospective imaging study (N = 55) of the functional status of epifascial and subfascial lymphatic compartments using two-compartment lymphoscintigraphy, Brautigam et al\(^\text{35}\) noted that in edema due to CVI, a high-volume lymphatic overload was present in the epifascial compartment. However, the

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**Figure 13a.** A 65-year-old woman with an overhanging pannus before surgery.

**Figure 13b.** The same patient after surgery. Note the reduction in the bilateral leg edema after the removal of the obstructing pannus.
same investigators did not see any change in lymph transport in cases of lipedema. In the authors’ experience, this is not necessarily the case; the effect on the lymphatic system seems to depend on the severity and progression of lipedema and whether other comorbidities are present. In any case, the crucial factor is the mechanism by which fatty deposits affect lymphatic function and vice versa. These questions have yet to be resolved.

Several case reports detail the surgery and outcome of patients from whom MLL collections have been removed. Although resection is usually successful, recurrence of the problem is common in the authors’ experience.

**Case Studies**

**Patient 1.** A 22-year-old African American woman presented with bilateral medial thigh MLL collections that prevented her from ambulating. Due to the effect on activities of daily living, her insurer agreed to cover surgical removal of the larger left thigh accumulation, which was performed on December 1, 2001 (see Figure 14a). By the patient’s follow-up visit on December 28, 2001, the surgical wound was healed (Figure 14b). Subsequently, the patient gained more than 125 lb and did not attend scheduled outpatient therapy sessions that would have continued her postoperative compression bandaging. She underwent a gastric bypass and returned to the authors’ clinic approximately 18 months later (May 19, 2003), requesting repeat removal of the MLL collections that had returned and which, despite a 100-lb weight loss, were larger bilaterally than at initial presentation (see Figure 14c). This case emphasizes that removal of the
MLL collections is futile unless the underlying problem of morbid obesity is addressed.

**Patient 2.** A 49-year-old morbidly obese Caucasian woman from New Orleans complained of lymphedema linked to her increasing obesity for 8 years. Her condition had led to bouts of recurrent cellulitis that worsened her lymphedema and caused dramatic anatomical changes on her legs. She was hospitalized for cellulitis when Hurricane Katrina forced her evacuation and was airlifted using a metal-mesh basket retrieval device that was too small for her extreme girth. The patient remained in the metal basket for 12 hours as a result of the evacuation chaos, during which time part of the metal frame penetrated her left lateral leg, creating a wound that reportedly measured 40 cm x 21 cm x 5 cm. The hospital to which she was transferred extracted her from the basket with cutting tools. The wound was surgically debrided and then negative pressure wound therapy (NPWT; VAC, KCI, San Antonio, Tex) was provided for 12 weeks. Wound depth reduced but when NPWT was discontinued, wound healing stalled and copious drainage continued to require the use of absorbent pads changed several times a day. No attempt was made to address the lymphedema in conjunction with local wound care.

At the time she was evaluated in the authors’ clinic, she weighed 413 lb and exhibited dramatic distortion of her lower limbs due to fibrosis and inflammation (see Figure 15). Perhaps most dramatic were the fibromas of her left foot (see Figure 8). The pantaloon distribution of fat on the less affected right leg, with relative sparing of the right foot, and the size incongruity between her upper and lower body were consistent with pre-existing lipedema. However, bouts of recurrent cellulitis had caused secondary lymphedema of the left leg consistent with the Stage III lymphedema (based on the International Society of Lymphology (ISL) system.40) The volume of the less affected right leg was measured by serial girth measurements using the frustum technique. Using this technique, girth measurements are made at defined intervals (the authors use 4 cm) from a bony prominence, creating a series of truncated “cones,” the volume of which can be calculated and then added together to estimate the volume of the entire limb. The volume of the right unaffected leg was 26.9 L, compared to the volume of the more affected left leg, which measured 34.5 L (a 22% difference), emphasizing the dramatic difference between the legs. The wound on the left lateral leg measured 27 cm x 4 cm (surface area 108 cm²). Despite having a clean base, copious drainage persisted and evidence of epithelialization from the margins was minimal (see Figure 16a).

Aggressive edema control was initiated by the clinical team that comprised manual lymphatic drainage therapists and nurses who provided wound care. Compression wraps were applied daily using short-stretch bandage layers applied over foam padding and covered with a layer of Elastoplast (Biersdorf, Canada) Initially, local wound care consisted of a silver-impregnated foam dressing, which was later changed to a hydrocolloid dressing. The patient was treated for a total of 4 weeks at which time limb volume was 28.5 L,
a 20% reduction. The final wound measurement was 10 cm x 4 cm (40 cm²), a decrease in surface area of 70% over only 4 weeks. The result was noteworthy in comparison to no healing observed during the preceding 8 weeks when no compression therapy was initiated (see Figure 16b). The patient returned to New Orleans so final photos were not available; during a follow-up phone call, she stated the wound had completely closed. In addition, the foot fibromas (see Figure 8) were successfully removed after her return to New Orleans.

This case illustrates a core principle of wound care — specifically, that wound healing cannot occur if edema in the affected limb is not controlled and that, even in patients with severe lymphedema, wound healing is possible with aggressive edema management.

Discussion

The majority of studies on morbid obesity and quality of life as measured by generic or disease-specific health-related quality-of-life (HRQOL) instruments show that as BMI increases, quality of life diminishes. However, it appears that BMI is only partially responsible for a decrease in health-related quality-of-life scores as rated by the patients; quality of life also is determined by the number and type of comorbidities present with the morbid obesity, many of which are related to the severity of obesity. Further, physical rather than emotional domains of HRQOL instruments reflect that patients are more affected by morbid obesity than other comorbidities, although this point probably only holds true to a certain extent. For example, Doll et al found that in obese patients with three or more chronic comorbidities, emotional health was substantially decreased. This finding is important because good emotional and psychological health is believed to have a positive influence on seeking treatment — ie, patients are motivated to do something about their obesity and comorbid conditions, rather than ignore them. Anecdotally, it has been observed that morbidly obese patients with life-threatening complications seek medical treatment because of the relatively cosmetic issue of edema, rather than for comorbid conditions that are medically far more serious. In the authors’ experience, patients initially can be reluctant to attribute the development of lymphedema to their obesity. A discussion of the combined treatment of these problems first requires a level of trust between patient and caregiver.

In the authors’ clinic, only a small proportion (7.5%) of primary lymphedema patients are morbidly obese, a fact that offers an alternative way to frame the argument...
that in the morbidly obese, it is the obesity itself that causes the lymphedema to manifest. For example, approximately 29% of the authors’ secondary lymphedema patients are morbidly obese. Whether both of these diseases (obesity and lymphedema) are mediated by similar genetic mechanisms is yet to be determined. Regardless of the mechanism, lower extremity complications are common in the morbidly obese and these patients are likely to represent an increasing percentage of individuals seeking care at wound and lymphedema centers. This “which-came-first” dilemma will be mediated with the availability of additional research; the increasing obesity epidemic will provide numerous research opportunities.

**Conclusion**

Regardless of whether lymphedema and morbid obesity are genetically linked (etiologically speaking) or whether the latter causes the former, they frequently occur together. Consequently, the secondary complications of each condition are magnified by their association. An example of such a complex clinical challenge is the increased risk of cellulitis in a lymphedematous extremity, made more dangerous by the presence of type 2 diabetes.

More research is needed to understand the specific factors in the morbidly obese patient that cause secondary lymphedema because only a small proportion of such individuals develop the disease. With more precisely defined risk factors, clinicians can better predict the prognosis of individuals affected by obesity and concomitant conditions and provide more timely advice to avert the difficult complications of lymphedema. However, once lymphedema has developed in the morbidly obese individual, management of lymphedema and its complications cannot be effective unless the obesity is addressed.

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Advancing the Practice (ATP) is Coming “Home” in the New Year

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