

Overview of Treatment Options and Review of the Current Role and Use of Compression Garments, Intermittent Pumps, and Exercise in the Management of Lymphedema

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BACKGROUND. Lymphedema is a relatively frequent complication following the management of breast carcinoma. Numerous therapeutic interventions have been offered to treat this potentially disabling and disfiguring condition. Consensus has not been attained among oncologists, surgeons, psychiatrists, and physical therapists concerning the appropriate treatment of lymphedema.

METHODS. This review provides an overview of those treatment regimens that have been used in the past and, in some instances, have gone on to provide the foundation for the most widely prescribed interventions currently employed for the management of upper extremity lymphedema following breast carcinoma treatment. The use of intermittent pneumatic compression pumps as a part of an integrated multidisciplinary treatment approach incorporating garments, exercises, and massage also is discussed.

RESULTS. A review of available literature suggests that a variety of traditional and commonly available techniques, when used appropriately in a multidisciplinary fashion, may lessen the cosmetic and physical impairments associated with acquired lymphedema. The role of surgery is unclear. Pharmacotherapies are a promising adjunct to manual and mechanical therapies.

CONCLUSIONS. The appropriate use of readily available treatment approaches may lessen the severity of acquired lymphedema following breast carcinoma therapy. A comprehensive therapeutic approach should be employed in the management of lymphedema, including attention to the functional, cosmetic, and emotional sequelae of this potentially disabling condition. To that end, a recommendation for a comprehensive treatment regimen is provided. *Cancer* 1998;83:2821-7.

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Lymphedema remains an incurable consequence of axillary node surgery and radiation. It has been defined as an abnormal accumulation of tissue proteins, edema, and chronic inflammation within an extremity.¹ Persons afflicted with this condition may have significant associated problems, including pain, impaired extremity function, unsatisfactory cosmesis, and a variety of psychological and social issues.²⁻⁴ Treatment regimens have been prescribed in an effort to mitigate swelling and the protean complications of this condition. Therapeutic efforts remain focused on minimizing the edema and on reversing and restoring the functional and cosmetic nature of the limb. In addition, improved edema control also has been reported as

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a means to minimize the risk of chronic and recurrent acute infections of the affected limb.²

TREATMENT

The treatment of lymphedema is difficult, multidisciplinary in nature, and, even in the best outcomes, costly and time consuming.^{1,5-8} The goal of therapy is to ease the amount of swelling experienced by the patient in order to retain or restore function and cosmesis to the affected limb. It is important to communicate with the patient that multiple modalities and an interdisciplinary approach are needed and that a protracted course of therapy may be required to provide adequate control of swelling.

The quality of the data supporting the varied treatment options purported to be effective in the management of lymphedema is inconsistent. Certain data, specifically, those studies evaluating pump use, at least in some instances, are controlled. However, the majority of reports advocating certain therapeutic options appear to have been obtained by means of uncontrolled, nonrandomized trials or by anecdotal experience. Despite this, a rational assessment of treatment options may permit the prescription of safe and potentially effective interventions.⁵

The therapies available for edema reduction may be divided into three general categories: rehabilitative interventions, pharmacologic therapies, and surgery. Complex decongestive therapies, a multidisciplinary and comprehensive treatment approach incorporating specialized massage, skin care, bandaging, and exercise, will be addressed in a separate section of this supplement.

REHABILITATIVE THERAPIES

There are several common rehabilitative interventions that are used to try to reduce edema. These include elevation, massage, and the application of external pressure. Rehabilitation interventions typically are applied at therapy centers by certified therapists, such as physical and occupational therapists, generally in concert with a prescribing physician. Other individuals, including nurses and licensed massage therapists, may employ these techniques as well. In addition to direct edema reduction, therapists may perform functional assessments and, thus, identify and address issues such as limitations in range of motion, pain, and impaired activities of daily living.

Elevation

Elevation, which typically is not thought of as a form of rehabilitation, is among the first interventions generally recommended by physiatrists, oncologists, and surgeons.^{6,7,9} The mechanism of action of elevation in

the management of lymphedema is unclear. It has been suggested that elevation of an extremity reduces intravascular hydrostatic pressure, thereby decreasing those intravascular forces responsible in part for production of lymph.^{8,10}

There are no data on the efficacy of elevation in the treatment of lymphedema. Recommended guidelines are not available, and most clinicians appear to base their continued prescription of elevation on personal or anecdotal experience. Compliance with elevation is untenable: Continuous elevation during the course of the day can impede the function of the individual perhaps more severely than the edema itself. Efforts may be made to elevate the affected limb at night during sleep; however, clinical experience suggests that this is virtually impossible and inevitably will fail. Therefore, elevation may be warranted as an adjunct to therapies, but it is not to be considered a mainstay of edema therapies.

Massage Therapies

Traditional massage techniques, including self-administered retrograde massage, are prescribed routinely as part of a multidisciplinary treatment approach to lymphedema.^{1,2,5,9,11} Effleurage, a classical form of massage, retrograde self-massage, and stroking may produce a mild pressure gradient, acting to remove edema from the limb. They also may stimulate inherent mechanisms within the limb to aid in the removal of lymphatic fluid. These traditional techniques may be administered by a certified therapist, by the spouse of a patient, or by the patient themselves after proper instruction.

Vodder developed manual lymphatic drainage as a specific technique for the treatment of lymphedema.¹² Manual lymphatic drainage has been reported to be effective when used in combination with other antiedema efforts, such as complex decongestive therapies, as well as in combination with an intermittent compression pump and complex decongestive therapies. Manual lymphatic drainage is a specialized, distinct form of massage, incorporating regional massage as well as treatment of the affected limb.

Exercise

Exercise is an integral component of virtually all rehabilitation. The role of exercise in the management of upper extremity lymphedema is not well defined. Data supporting exercise programs are lacking. Specifically, the type, intensity, frequency, and under what conditions exercise may be employed safely to reduce swelling have not been defined fully.

Data support the benefits of exercise in enhancing lymph flow^{13,14} as well as improving protein resorb-

tion,¹⁵ both of which are integral in lymphedema management. Lymph flow occurs as a result of inspiratory reduction in the intrathoracic pressure associated with inspiration,¹⁶ leading to speculation that increased pulmonary work associated with various forms of exercise may assist in the management of swelling. It has also been found that compromise in upper extremity venous drainage is noted frequently in individuals with lymphedema.¹⁷ It has therefore been suggested that flexibility training may lessen the role that soft tissue contracture might play in impeding blood and lymphatic drainage.

Clinical experience suggests and it has been reported that combinations of flexibility, aerobic training, and strengthening in combination with the use of compression wrapping, manual lymphatic drainage, and compression pumps have produced significant benefits in women with lymphedema.¹⁸ In addition, such a program also enhances the overall level of function of the extremity and the patient.^{19,20}

All exercise regimens require individualization. Proper assessment of flexibility, strength, and aerobic capacity should be performed prior to instituting treatment.²¹ Gradual progression of exercises, both aerobic and strengthening, should be expected. However, frequent reassessment of the extremity is mandated to assure that worsening edema does not develop. All resistance and aerobic exercises should be done when the patient either is wrapped appropriately or is wearing a well-fitting compression garment.

Contraindications to exercises are few. Cardiac and pulmonary disease should be considered relative contraindications. Complications include muscle pain and, occasionally, worsening of edema. Patients should be counseled concerning both of these prior to instituting any treatment program.

External Compression

External compression is defined as the application of any external pressure to the limb. External compression in the management of edema is used for two reasons: to try to reduce edema formation and to aid in the removal of excess lymph fluid already accumulated within the limb. Compression may be realized through a variety of techniques and technologies.

Compression garments

Compression garments are used widely in the management of lymphedema. Garments are available in both custom-made and prefabricated varieties. Also, garments may be obtained in a gradient format in which distal compression is greater than proximal compression.²² In addition, sleeves have been intro-

duced recently that permit manual, inflatable pressures against the limb.

There are data supporting the use of garments in the management of lymphedema.^{22,23} The mechanism of action of garments remains unclear. It is likely that garments aid in reducing swelling by lessening the amount of edema formed within the involved extremity. It remains unclear whether garments actually reduce the existing edema within the limb. In addition, garments lend a measure of protection against external incidental trauma, such as burns and lacerations. They also may protect against intrinsic trauma to the limb that occurs as a result of chronically increased interstitial pressures.¹ It has been suggested that this increased pressure is exerted against the skin and other subcutaneous tissues that aid in maintaining interstitial fluid homeostasis.^{1,2,4,12,24} These tissues ultimately will stretch as a result of this relentless force. Use of a garment or other type of wrap, such as a bandage, likely relieves the skin and subcutaneous tissues from bearing this increased pressure. This shift of pressure bearing from the skin to the garment protects these tissues from eventual stretching.

Selection of garment type and recommended guidelines for their use remain unclear. Choice of particular garments likely occurs based on clinical experience. There are no data supporting the preferential selection of either prefabricated or customized garments. Cost and patient tolerance to the garment warrant consideration when prescribing. Prefabricated garments usually are less expensive than customized garments. The use of a glove or gauntlet depends on whether the hand is involved. Hand swelling may develop or become problematic by the use of an arm sleeve. Patients should be made aware of this potential complication prior to instituting the use of a garment. Consideration should be given to either a long wrist piece gauntlet or a one-piece, customized sleeve if hand swelling persists. Customized garments may be needed for those patients who are difficult to fit or those in need of some assistive device to facilitate donning or removal. Garments typically last no more than 3-6 months; they should be replaced when they begin to lose their elasticity.

Recommended parameters for the use and prescription of garments vary. Pressures ranging from 30 mm Hg to 60 mm Hg are prescribed routinely. Garment use for 20 hours per day and longer has been suggested.^{1,5,11,12,24,25} Bertelli et al.²³ have reported statistically significant reduction of edema in patients who wore garments for 6 consecutive hours per day. A multivariate analysis noted superior reduction in those women who had not had significant weight gain following treatment for breast carcinoma. Using gar-

ments during physical activity and exercise has been advocated.^{11,12}

Compliance is difficult for patients, because even the most customized garment typically is uncomfortable, unsightly, and laborious to put on. Patient education may improve compliance with the prescribed garment.

Contraindications to the use of compression garments are few. Insensate extremities need to be inspected often to ensure skin integrity. Infections within the limb may make the use of garments more difficult because of pain. Open wounds should not be considered a contraindication. Complications from the use of compression garments include inducing or worsening hand swelling. Skin irritation may occur from contact dermatitis.

Pneumatic compression

The prescription and use of intermittent pneumatic pumps has been the mainstay of lymphedema therapy in the United States for many years. It continues to be a reimbursed therapy for lymphedema by federal and third-party payers. Several controlled studies have documented their usefulness in the treatment of this condition, thereby supporting their continued use.²⁶⁻³¹ Despite this, several important issues, such as optimum pumping pressures, the length and frequency of pumping sessions, and the need for continuation of pumping after initial reduction has been attained, have yet to be determined. In addition, misuse and the inappropriate prescription of these devices by clinicians untrained in the selection, parameters, and effective protocols has led to a perception among many practitioners and patients that pumps are ineffective.

A variety of pumps are available. They range in cost from several hundred dollars for simpler devices to several thousand dollars for more advanced units. Pumps may be single chambered or may come with several compartments. Multiple-chamber pumps typically inflate from distal to proximal, thereby producing a wave of pressure that ascends the extremity, theoretically bringing edema fluid with it. It has been suggested that this allows the retained fluid to be brought to functional lymphatics that might aid in its removal.

Guidelines for pump selection and their use are unclear. No individual pump appears to have a distinct advantage or to be inherently superior over any other.^{5,6} Likewise, patients have a wide variety of responses and tolerances to these devices. Studies assessing efficacy of certain pumps have been reported. Unfortunately, no comparative studies assessing the relative efficacy of pumps are available. One study has

found that a multichambered device was effective in a small population of patients who had not responded previously to a single-chamber device.²⁷ However, another study noted superior reduction of swelling from a single-chamber device compared with a device with multiple chambers.³¹ It has therefore been recommended that a trial comparing pumping devices be made before a unit is obtained for patients to use at home.⁵

Initial pumping sessions may be performed in either inpatient or outpatient settings.^{5,7,28} Optimal pressure ranges, inflation/deflation cycles, and the length and frequency of individual pumping sessions have not been established. In a nonrandomized study, statistically significant reduction in edema was described with a sequential gradient pump when administered over a 48-hour period. Several authors have suggested determining pumping pressures by calculating the mean arterial pressure.^{27,28} Others have recommended pressures ranging from 80 mm Hg to 110 mm Hg pumping 4-8 hours per day.²⁹ Yamakazi et al. recommended pressure settings at or near 80 mm Hg.³² Long term responses to a combination of pumping and garments have been reported, including at least partial maintenance of reduction in edema in 36 of 49 patients who were treated for lower extremity edema for a mean of 25 months.²⁹

It has been purported that pumps may be ineffective and perhaps dangerous.^{2,12,33} However, extensive clinical experience does not support these claims. Pumps used at relatively low pressures also have been advocated as part of a comprehensive program including manual lymph drainage, bandaging, and exercise.

Complications from pumping therapy are few. Entrapment neuropathies may become symptomatic during the course of pumping. Pain may limit the maximum pressure employed. Contraindications include infection in the limb, local or proximate malignancy, anticoagulated patients, and deep vein thrombosis. Use of palliative pumping has been described in patients with advanced carcinoma to restore function and as an adjunct to pain control.⁵

SURGICAL THERAPY

Surgical therapy for the management of lymphedema may be divided into two general categories: debulking or reduction surgery, in which the limb has excess fluid and tissues removed, and functional or physiologic surgery, in which efforts to enhance lymphatic function are undertaken. The Charles procedure, first described in 1912, is a debulking procedure. Although variations of this procedure are still performed,³⁴ significant drawbacks, including poor wound healing

and infection, have been associated with it.^{35,36} Case reports suggesting suction lipectomy as a means of reducing the size of an involved extremity in patients who have failed less aggressive interventions have been published.³⁷⁻³⁹ Long term follow-up is not available for these cases. It also has been suggested that a combination of reduction surgery and conservative interventions should be considered for certain severe cases.⁴⁰

A variety of surgical techniques have been described that are purported to enhance lymph removal from an edematous extremity. These functional or physiologic surgical procedures include lymphangioplasty,⁴¹ omental and pedicle flaps,^{35,36} and myocutaneous flaps.⁴² The microlymphatic-venous anastomosis (LVA) consists of grafts between lymphatic vessels or nodes and proximate venous systems to allow removal of lymph.⁴¹ Several studies of involved upper extremities found good relief in 50-77% of patients treated with LVA.^{41,43-49} However, the number of patients studied suffering from postbreast carcinoma therapy lymphedema was small in all of these studies. Another limitation is that recurrence of swelling to some degree was reported to have occurred in most patients undergoing this procedure.⁴⁴ O'Brien et al. have reported superior reduction in patients treated with the combined technique incorporating LVA with a reduction procedure versus those treated with LVA alone.⁴⁵

DRUG THERAPY

Pharmacotherapy has been suggested as an adjunct to the treatment of lymphedema. Coumarin, a benzopyrone, reportedly has a beneficial effect on lymphedema. This class of drug may work by stimulating proteolysis by macrophages as well as increasing the absolute number of macrophages within the edematous extremity.⁵⁰ Two randomized, placebo-controlled, cross-over studies found statistically significant benefits in patients with lymphedema who received benzopyrones for several months.^{50,51} Unfortunately, there are no data about the long term effects or potential toxicities of these agents.

Other drugs have been used routinely in the treatment of lymphedema and associated infection. No controlled data exist that support the treatment of all patients with acquired lymphedema with antibiotics. Use of antibiotics is appropriate in the treatment of acute and chronic infections, such as cellulitis and lymphangitis. Selection of antibiotics and adequate treatment course has not been elucidated. There are no data supporting the use of diuretics for long term management of this type of swelling. Some authors

suggest that use of these agents may be deleterious, although these claims are unsubstantiated.⁹

TREATMENT RECOMMENDATIONS

A rationale for a comprehensive treatment regimen may be devised from a review of those treatments available and by their cogent application in an interdisciplinary model. Physical, psychological, and functional assessment must precede the institution of any course of therapy. Likewise, comprehensive treatment by a multidisciplinary team should be employed to best meet the complex physical, functional, and emotional needs of these patients.

The daily use of compression garments, whether prefabricated or customized, together with intermittent pneumatic compression pumps has realized reasonable compliance and success. These interventions may be used to form the core of a lymphedema management program. Individualized and tailored pumping programs for patients cannot be intuited; therefore, they require an empiric basis for each woman deemed appropriate. Pump selection should be based on measurable efficacy and tolerability, as evidenced by serial assessment with each patient. After determining which device should be prescribed, thorough education in the pump's limitations and use must be undertaken to best assure continued compliance. Ongoing reassessment of the efficacy and tolerance of individual components of the treatment program should be made prior to any final determination of a home maintenance program. Exercise focusing on improving flexibility, strength, and aerobic capacity will function both to enhance lymphatic removal and to aid the patient in returning to their highest functional level. Exercise needs to be individualized to meet the specific needs of the patient and to assure safe implementation of such a program. Exercise should be done while wearing a compressive dressing, either bandaging or a well-fit garment. Retrograde massage also should be part of the daily care plan. Medical comorbidities, such as infection and skin breakdown, should be addressed appropriately. Psychiatric and/or psychological therapies and referral should be instituted as needed.

CONCLUSIONS

There is no cure for acquired lymphedema, but treatment options are available for controlling swelling. Unfortunately, the evidence supporting many of these forms of treatment is less than optimal. A multidimensional approach to care provided in an interdisciplinary team, including garments, massage, exercise, and the appropriate use of sequential pumps at a sufficient pressure, form the core program for most patients

with lymphedema. Surgery is best reserved for those individuals in whom conservative care has been ineffective. Surveillance for infection and other complications, including psychological distress, should be maintained after a patient has been placed on a home program.

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