Decongestive Lymphatic Therapy in Postfilarial Lymphedema: A Prospective Study

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Abstract

Context: In a filariasis endemic country like India, the need for an effective and consistent treatment for filarial lymphedema has long been recognized. In this study, we set out to evaluate decongestive lymphatic therapy (DLT) for postfilarial lymphedema. Aims: The aims of this study are to determine the efficacy of DLT in the management of postfilarial lymphedema of extremities. Settings and Design: This is a one prospective study from April 1, 2010, to March 30, 2011 included twenty patients with the diagnosis of lymphedema of the extremities. After the Institutional Review Board approval, consent was taken. Subjects and Methods: Patients with unilateral postfilarial lymphedema were included in the study. Exclusion Criteria: (1) Other forms of lymphedema, (2) Clinical evidence of local infection, (3) Severe cardiac disease, (4) Uncontrolled hypertension, (5) Malignancy. The clinical profile of the patient was recorded and was noted. Limb circumferences were measured at axial intervals of 10 cm for the entire limb length. Each segment’s volume was calculated with the truncated cone formula \( H \times (C^2 + Cc + c^2)/12 \Pi \), \( H = \) height, \( C = \) circumference at the top of the cone, \( c = \) circumference at the base of the cone. Total limb volume was acquired by adding the segments. Patients were subjected to daily DLT which included manual lymphatic drainage, low-stretch compression bandaging, and skin care and exercises and volume reduction measured. The patients were followed up for 1 year. Statistical Analysis Used: Spearman’s rank correlation coefficient, one sample \( t \)-test, Mann–Whitney U-test. Results: The mean reduction in the volume of the affected limb was 63.12% with standard deviation of 11.38 and \( P < 0.001 \). Long-term therapeutic benefits were maintained through self-massage, self-bandaging, exercise, and consistent use of compressive garments. The average volume of the affected limb at presentation was 10067.45 ml \( \pm \) 3768.42. After DLT, the average volume was 7860.4 ml \( \pm \) 2617.36. The average volume after 1-year follow-up was 8109.3 ml \( \pm \) 2438.4. There was no correlation between the severity of pretreatment limb volume and the extent of reduction after DLT. No complications were seen during the course of the study. Conclusions: DLT is an effective and safe modality for the treatment of lymphedema of the extremities. It has wide applicability, especially in postfilarial lymphedema.

Keywords: Compression therapy, decongestive lymphatic therapy, lymphatic therapy, postfilarial lymphedema

INTRODUCTION

Lymphedema is a common but often neglected health problem. Although there are multiple causes for lymphedema, filariasis remains the most common in India. Lymphatic filariasis (LF) caused by Wuchereria bancrofti and Brugia malayi is an important public health problem in India where about a third of the global population lives at risk of this disease. In India, description of a disease that resembles filariasis was found in Chapter 12 of the “Sushruta Samhita,” 6th century BC.[1] A plethora of management options including a variety of surgical options has been advocated for the management of postfilarial lymphedematous limb.[2–8] The mere presence of such a variety of options probably points to the lack of common consensus in the management of such limbs. This is especially true for postfilarial lymphedema where systematic randomized trials are lacking in the Indian setting. The efficacy of complex decongestive therapy in decreasing and limiting lymphedema was proven in a clinical trial conducted at Brazil by Soares et al. in 2016.[9]

One widely advocated therapeutic regimen for the management of lymphedematous limbs is decongestive lymphatic

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therapy (DLT). DLT typically combines manual lymphatic drainage (MLD), an exercise regimen, scrupulous skin care, and short-stretch compression bandages. This approach is widely used in Europe, Australia, and the USA. Such DLT protocols have not been widely used in India, and hence, conservative therapy for postfilarial lymphedema though logical has not been met with the same enthusiasm.

To evaluate the efficacy of DLT in a hospital-based lymphedema treatment program, we performed a prospective study of the efficacy of short-term DLT in patients with postfilarial lymphedema. DLT was coupled with intensive patient education in all aspects of lymphedema with special emphasis on home care after termination of hospital-based program.

**Subjects and Methods**

Our department had been managing lymphedema patients for the past 15 years with DLT. This systematic 1-year prospective study was conducted from April 1, 2010, to March 30, 2011 and included 20 consecutive patients with the diagnosis of postfilarial lymphedema. The diagnosis of filarial lymphedema was made by exclusion and the endemicity. No active medical therapy was given to these patients as there was no evidence of filarial parasite found on blood investigation. These patients were advised to take tablet diethylcarbamazine (DEC) (with or without albendazole) single-dose treatment (6 mg/kg) once a year as a part of mass drug administration (MDA) on National Filaria Day, i.e., on November 11. The patients were treated with DLT in the department of plastic surgery in collaboration with the physiotherapy department. The MLD was performed once a day, by one of the trained physiotherapists assigned for this study, using the same method daily in the morning. The measurements were taken daily before the MLD session was initiated. This study was approved by the Institutional Review Board. After detailed explanation of the treatment protocol, duration of treatment, probable complications, morbidity, and benefits of the treatment, an informed written consent were taken.

**Inclusion criteria**

Postfilarial lymphedema of unilateral extremities of at least 1-year duration was included from the study.

**Exclusion criteria**

Clinical evidence of local infection of lymphangitis, severe cardiac disease, uncontrolled hypertension (>160/95 blood pressure), malignancy (active), or presence of venous disorders by duplex Doppler were excluded from the study.

The clinical profiles of the patients were noted including body mass index (BMI), history of surgery, trauma, residence in a filarial endemic area, and the presence of any infection, and the severity of lymphedema was graded as per the grading by the International Society of Lymphology (Table 1). Classic water displacement method is the gold standard for the measurement of limb swelling. However, it is not possible to ensure that the limbs are submerged to the same level. Furthermore, this method is time-consuming, not portable and not completely hygienic. In one study, researchers compared the results of volumetric measurements of an extremity obtained by water displacement and various geometric measurements such as the formula for cylinder, frustum (truncated cone), rectangular solid, and trapezoidal solid. They concluded that the frustum method produced the smallest error of measurement. Similar results were reported by Stranden. In another study by Casley-Smith, they compared the volumes obtained by water displacement and compared with results by truncated cones on the legs from 1300 simultaneous estimations in unilateral filaritic lymphedema in India (S. Jamal, personal communication, 1986–1991). They found that the correlation coefficient between the two methods was very close (=0.934, P <<0.0001). Based on these, we have used the truncated cone method for measuring the limb volume. Before initiating the treatment limb, measurements were taken using a measuring tape. Limb circumferences were measured at axial intervals of 10 cm, starting from the tip of the medial malleolus. While measuring, circumference was taken at the top of the segment (top of the measuring tape). Each segment’s volume was calculated with the truncated cone formula \( V = \frac{1}{3} \pi H (C^2 + c^2 + Cc) \), where \( H \) = height, \( C \) = circumference of the top of the cone, \( c \) = circumference of the base of the cone. Total limb volume was acquired by adding the volume of each segment. The volume of both the affected and normal limbs was measured daily during treatment. Reduction in the limb volume was assessed using the formulae for the difference in edema. Formula 1 was difference in edema = Final volume/Normal – Initial volume/Normal. Formula 2 was change in edema = Difference in edema/Initial edema = (F-I)/(I-N).

Patients were subjected to daily DLT, which included MLD, low-stretch compression bandaging, skin care, and exercises. MLD was performed by physiotherapists trained in these techniques. Each session of therapy included MLD lasting around 30 min to 1 h, low-stretch compression bandaging, and decongestive exercises. Bandages were

| Grade | Features |
|-------|----------|
| 0     | Latent or subclinical condition where swelling is not evident despite impaired lymph transport, subtle alterations in tissue fluid/composition, and changes in subjective symptoms. It may exist months or years before overt edema occurs |
| 1     | Early accumulation of fluid relatively high in protein content (e.g., in comparison with “venous” edema) that subsides with limb elevation. Pitting may occur |
| 2     | Pitting may or may not occur as tissue fibrosis develops. Limb elevation alone rarely reduces tissue swelling |
| 3     | Lymphostatic elephantiasis where pitting is absent. Trophic skin changes, such as acanthosis, alterations in skin character and thickness, fat deposits and fibrosis, and warty overgrowths, often develop |

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[Table 1: International Society of Lymphology grading of lymphedema]
applied after MLD and left in place between successive daily manipulations. Therapy continued till the reduction in limb volume stabilized over a period of 3 days. The duration of DLT usually lasted around 2 weeks. The mean duration of therapy was 14.6 days. Daily therapy included a substantial and detailed component of education for the patients and caregivers. During treatment, the patients were encouraged to begin self-massage and self-bandaging under the supervision of the therapist.

The patients are instructed to perform various exercises including abdominal breathing, joint rotations, head-and-neck turns, shoulder shrugs with breathing, isometric chest presses, and other breathing exercises. They are also advised correct posturing and advised to ambulate with the bandages. During DLT, meticulous foot care was taught to the patient. Regular inspection of the toes, nail beds, web spaces, and skin-fold crevices was done for any evidence of infection. Patients were taught about lymphedema management and encouraged to clarify any doubts. Photographs of the limbs were taken at the start and end of treatment for documentation and patient education. Once the volume reduction stabilized over a period of 3 days, DLT was terminated and patient fitted with a custom-made Grade III compression garments. The patient was again taught about the usage of garment and its care. Regular follow-up was advised and patients advised to watch for any signs of infection or increase in the limb volume. At the end of treatment, the limb volume reduction was noted along with adverse effects if any. All the patients were followed up for 1 year. The results were analyzed with the one sample t-test, Mann–Whitney U-test, and Spearman’s rank correlation coefficient.

### Results

#### Demographic profile

Of the 20 patients, 11 were female and 9 were male. The average age of patients was 44.1 years. Nine of the 20 were in the age group of 50–60 years. All the patients hailed from Filarial endemic areas. BMI was calculated for all the patients, and the average BMI was 30.42 [Table 2]. On statistical analysis, there was no correlation between age and sex to the extent of limb volume reduction. Although there was a positive correlation between the BMI and severity of lymphedema, it was not statistically significant (Spearman’s rank correlation coefficient). There was similar correlation between BMI and the extent of limb volume reduction following DLT [Graph 1].

All the patients presented with complaints of limb swelling along with occasional febrile episodes. The average duration of lymphedema at presentation was 13.95 years. There was no correlation between the duration of lymphedema and the extent of limb volume reduction [Graph 2]. Although the graph depicts increasing severity of lymphedema with increasing duration, there was no significant correlation on analysis with Spearman’s rank correlation coefficient. All the patients had Grade III lymphedema.

The mean duration of DLT done was 14.6 days. Although the duration of DLT correlated with the reduction in limb volume, the correlation was not statistically significant [Graph 3].

#### Soft-tissue infection

Eighteen patients (90%) had a history of soft-tissue infection (cellulitis). None of the patients had clinical evidence of active infection at the time of initial evaluation. None of the patients required oral antibiotic therapy before the initiation

| Age (years) | Gender | BMI | Duration of lymphedema (years) | Grade of lymphedema | Duration of DLT (days) |
|-------------|--------|-----|-------------------------------|---------------------|-----------------------|
| 31          | Male   | 26.9| 2                             | 3                   | 23                    |
| 25          | Male   | 21.9| 12                            | 3                   | 17                    |
| 52          | Male   | 35.6| 30                            | 3                   | 19                    |
| 47          | Female | 30.1| 2                             | 3                   | 15                    |
| 57          | Male   | 25  | 15                            | 3                   | 11                    |
| 54          | Female | 31.2| 15                            | 3                   | 18                    |
| 33          | Male   | 27.6| 15                            | 3                   | 14                    |
| 55          | Female | 30.8| 3                             | 3                   | 4                     |
| 45          | Female | 39  | 2                             | 3                   | 19                    |
| 60          | Male   | 30.8| 10                            | 3                   | 15                    |
| 58          | Female | 36.6| 4                             | 3                   | 10                    |
| 40          | Male   | 31.2| 20                            | 3                   | 17                    |
| 54          | Female | 33.3| 1                             | 3                   | 7                     |
| 54          | Male   | 30.1| 40                            | 3                   | 10                    |
| 16          | Female | 19.9| 12                            | 3                   | 18                    |
| 36          | Female | 26.7| 15                            | 3                   | 18                    |
| 48          | Female | 36.9| 25                            | 3                   | 11                    |
| 46          | Female | 33.6| 23                            | 3                   | 22                    |
| 53          | Female | 30.9| 30                            | 3                   | 10                    |
| 18          | Male   | 30.4| 3                             | 3                   | 14                    |

BMI: Body mass index, DLT: Decongestive lymphatic therapy
of DLT. None developed infection during treatment or follow-up.

**Responses to decongestive lymphatic therapy**

The comparison of mean reduction with standard reduction of 5% was assessed using one sample $t$-test for both formulae. With formula 1, the mean reduction was 33.38% with standard deviation of 22.67; with formula 2, the mean reduction was 63.12% with standard deviation of 11.38; with both formulae $P < 0.001$ [Table 3]. Spearman’s rank correlation coefficient “$r$” between pre-DLT and post-DLT volumes was 0.93. Long-term therapeutic benefits were maintained through self-massage, self-bandaging, exercise, and consistent use of compressive garments. The average volume of the affected limb at presentation was 10067.45 ml ± 3768.42. After DLT, the average volume was 7860.4 ml ± 2617.36 [Figures 1-3]. The average volume at 1-year follow-up was 8109.3 ml ± 2438.4 [Graph 4]. There was no correlation between the severity of pretreatment limb volume and the extent of reduction after DLT.

**DISCUSSION**

Filariasis continues to be a major health problem in India. LF mapping has been generated to depict the present scenario of human infection prevalence in India. The results of survey carried out in 443 districts of a total 593 districts in India at different time points up to 2006 were considered for microfilariae (mF) distribution mapping. Among the surveyed districts, 172 were found to be with over 1% mF prevalence. National level average mF rate showed a declining trend from 1.24% in 2004 to 0.63% in 2008. Although the most common manifestation of filariasis is hydrocele, postfilarial lymphedema still remains a major health concern in India.\[^{19}\]

Medical therapy plays a central role in early stages of filariasis, especially in the Indian setup where it is endemic. Drugs such as DEC, ivermectin, and albendazole are effective against the microfilaria. DEC is effective against both microfilaria and adult worms. DEC lowers the blood microfilaria levels markedly even in a single annual dose of 6 mg/kg, and this...
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Effect is sustained even at the end of 1 year. This prolonged effect makes DEC a good drug to prevent the transmission of the disease and is also the basis of MDA carried out once a year. Ivermectin, in single doses of 200–400 µg/kg, gives a similar effect at the end of 1 year. It is the drug of choice for onchocerciasis. It is also the preferred drug for filariasis, over DEC, in African countries where severe adverse reactions to DEC are observed. Albendazole is shown to destroy the adult filarial worms when given in doses of 400 mg twice daily for 2 weeks. The death of the adult worm induces severe scrotal reactions in bancroftian filariasis since this is the common site where they are lodged. It has no direct action against the microfilaria and does not immediately lower the microfilaria count. However, when given in single doses of 400 mg in combination with DEC or ivermectin, the destruction of microfilaria by these drugs becomes more pronounced. This combination is recommended in the global filariasis elimination program.

A plethora of management options including a variety of surgical options has been advanced for the management of lymphedematous limb ranging from radical excision to microvascular lymphatic anastomosis. The mere presence of such a variety of options probably points to the lack of

### Table 3: Response to decongestive lymphatic therapy

| Pre-DLT volume (ml) | Post-DLT volume (ml) | Normal limb volume (ml) | Percentage reduction formula 1 | Percentage reduction formula 2 |
|---------------------|----------------------|-------------------------|-------------------------------|-------------------------------|
| 10,280              | 8957                 | 7361                    | 17.97                         | 45.32                         |
| 7629                | 6412                 | 5015                    | 24.27                         | 46.56                         |
| 7875                | 6914                 | 5728                    | 16.76                         | 65.93                         |
| 9371                | 8540                 | 8119                    | 10.24                         | 66.4                          |
| 6015                | 5379                 | 5089                    | 12.5                          | 68.71                         |
| 16,885              | 13,262               | 10,304                  | 35.16                         | 55.05                         |
| 11,623              | 8272                 | 7653                    | 43.79                         | 84.42                         |
| 14,303              | 12,461               | 10,304                  | 17                            | 46.06                         |
| 16,526              | 9501                 | 7496                    | 93.71                         | 77.79                         |
| 13,826              | 10,413               | 7156                    | 47.69                         | 51.16                         |
| 3283                | 2655                 | 2373                    | 26.46                         | 69.02                         |
| 10,350              | 8567                 | 8006                    | 22.27                         | 76.06                         |
| 2364                | 2060                 | 1834                    | 16.58                         | 57.41                         |
| 14,334              | 9333                 | 6702                    | 74.62                         | 65.52                         |
| 8688                | 5903                 | 4674                    | 59.58                         | 69.38                         |
| 7011                | 6659                 | 5485                    | 14.27                         | 51.26                         |
| 8263                | 6957                 | 6078                    | 21.49                         | 69.38                         |
| 12,585              | 8885                 | 6494                    | 56.97                         | 59.78                         |
| 11,362              | 9204                 | 8538                    | 25.27                         | 60.74                         |
| 8776                | 6874                 | 6122                    | 31.07                         | 76.41                         |

Reduction formula 1: Difference in edema=Final volume/normal - Initial volume/normal, Reduction formula 2: Change in edema=Difference in edema/initial edema=(final-initial)/(initial-normal). DLT: Decongestive lymphatic therapy
The role of decongestive lymphatic therapy in the management of postfilarial lymphedema was evaluated in the Indian setting.

Our study group had a common consensus in the management of such limbs in our country. This is especially true for postfilarial lymphedema where systematic randomized trials are lacking. DLT is a well-accepted treatment option for both primary lymphedema and secondary lymphedema, especially following breast cancer surgeries. Although different modes of physiotherapy have been used in India for postfilarial lymphedema, the systematic application of DLT and its effectiveness has not been proven. This study set out to evaluate the efficacy of DLT in postfilarial lymphedema patients in India.

Aggressive surgical procedures not only lead to disfigurement but are also time-consuming and do not definitely rid the patient of a limb that needs lifelong care. DLT is a simple, easily taught method and can be done on either inpatient or outpatient basis, and the home care can be easily taught to the patients’ themselves. The results of our study show that there is a significant reduction in the volume of the lymphedematous limb. This study and the observations show that DLT can effectively promote limb volume reductions in patients with postfilarial lymphedema and when combined with self-care, may result in the long-term control of lymphedema. Effective reduction of lymphedema promotes the maintenance of limb function and may reduce the incidence of recurrent infection. The therapeutic approach that we advocate should enable the current health-care delivery systems to provide adequate care to most patients with this chronic condition. It has wide applicability in an already overburdened health system like India’s, especially given the endemicity of filariasis.

Although surgery is an option in filarial lymphedema, it comes at an expense to the patient in terms of the days lost to work, probable complications, chances of injuring the remaining patent lymphatics, and its morbidity. To help develop a definitive treatment for lymphedema, additional scientific data on the causes of lymphedema and long-term response to different treatment protocols are needed. Numerous studies have provided information regarding lymphedema; however, most of the research data were obtained from clinical feedback, and basic research data on the cause of lymphedema are limited. This lack of lymphatic research is especially glaring in filarial lymphedema. These difficulties also should be taken into account while evaluating surgical options.

Results after DLT have generally shown positive results, with some trials showing as much as 40%–60% mean decrease in excess volume of the limb. In a series of 299 patients, with an average follow-up of 9 months, there were average reductions of 59% in upper extremity lymphedema volume and 68% in lower extremity volume. The Adelaide Lymphedema Clinic with the Casley-Smith method achieved an average reduction of 64% of the edema over a month’s course of treatment for consecutive 78 arms. The reduction achieved depended on the grade of lymphedema and patient compliance. These results are comparable to our study. The difference is mainly in the etiology of lymphedema. While the stated studies focused on primary or postmastectomy lymphedema, our patients were predominantly of filarial etiology.

The average duration of treatment in our study was 14.6 days. It is shorter compared to many other studies. As published in other studies, the treatment generally lasts for around a month or sometimes evens more. The effect of BMI on lymphedema is well documented. Our study group had a lower mean BMI. This probably in part explains the extent of reduction in edema. In our study, all patients had Grade III lymphedema. Patients with Grade II lymphedema would be benefitted more with decongestive therapy. However, we do not encounter many patients with Stage 2 disease as they do not present early. The patients who reported were offered decongestive therapy, but they were not willing to stay in town due to financial and time constraints. Most of them opted for local hygienic measures and compression garments. In our study, no complications were noted. This makes DLT a safe and effective option in the management of lymphedema.

MLD has a long history and a limited but growing evidence of its efficacy. This study has tried to identify some of the principles and possible effects of MLD, especially in the Indian setup. The effects and efficacy of MLD depend on various factors relating to the patient, the nature and cause of lymphedema, and the way MLD techniques in combination with other interventions such as compression therapy and self-management support are applied. There is still much to discover about how MLD should best be used to ensure effective and sustainable treatment for all individuals with filarial lymphedema. Its application on a larger scale and its feasibility need to be further assessed. Physicians should be aware of the current evidence around MLD and ensure they are appropriately educated in its applicability.

**Conclusion**

DLT is an effective and safe modality for the treatment of lymphedema of the extremities. It has wide applicability, especially in postfilarial lymphedema.
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Conflicts of interest
There are no conflicts of interest.

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