LOCAL TISSUE WATER CHANGES ACCOMPANYING A SINGLE MANUAL LYMPHATIC DRAINAGE (MLD) TREATMENT IN PATIENTS WITH LOWER EXTREMITY LYMPHEDEMA

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BACKGROUND and GOALS

Methods to assess overall limb lymphedema include limb volumes determined either manually, aided by using now available economical software[1], or via automation[2] and by measuring electrical impedance as an index of fluid volume[3]. Though these are useful methods, they are not generally suitable to determine local edema/lymphedema or edema in body parts other than limbs. Quantitative assessment of local edema could provide valuable information to help initially detect, assess and track edema or lymphedema progression in many body parts or anatomical regions.

Recent work[4] has shown that local tissue water (LTW), assessed by a tissue dielectric constant (TDC) method, can quantify LTW in arms of patients with breast cancer treatment-related lymphedema (BCRL) to provide a useful discrimination for the presence of lymphedema. It has also been used to evaluate hormone related changes in LTW in arms of pre- and post menopausal women[5].

The present study sought to determine if this method could detect changes in LTW associated with manual lymphatic drainage in patients with lower extremity lymphedema and to characterize the amount of such change attributable to a single MLD session. The null hypothesis was that there would be no significant difference between pre-treatment and post-treatment TDC values.

SUBJECTS

A total of 18 persons (10 male, 8 female) with ages (mean±SD) of 74.1±13.3 years (range 36 to 88 years), were evaluated after signing an IRB approved informed consent. Of the 18 participants, 9 had lymphedema involvement of both legs and 9 had involvement of one leg; all legs (n=36) were evaluated. The entry requirements were that they were at least 21 years of age and were about to receive MLD therapy for their condition. Lymphedema duration and its extent were not factors that affected participation since the goal of this initial study was to determine the suitability of the method for assessing localized changes in a broad population.

REFERENCES

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TDC MEASUREMENTS

The device used to measure TDC was the MoistureMeter-D, (Delfin Technologies Ltd, Kuopio Finland). It consists of a probe connected to a control unit that displays the TDC value when the probe contacts the skin. The physics and principle of operation has been described[6]. In brief, a 300 MHz signal is generated within the control unit and is transmitted to the tissue via the probe that is in contact with the skin. The portion of the incident electromagnetic wave that is reflected depends on the dielectric constant of the tissue, which itself depends on the amount of free and bound water in the tissue volume through which the wave passes (pure water has a value of about 78.5). Effective penetration depth depends on probe dimensions. In this study the probe used had an effective penetration depth of 2.5 mm.

Probe in contact with the target site on lymphedematous on leg

Girth measured at target site on lymphedematous leg

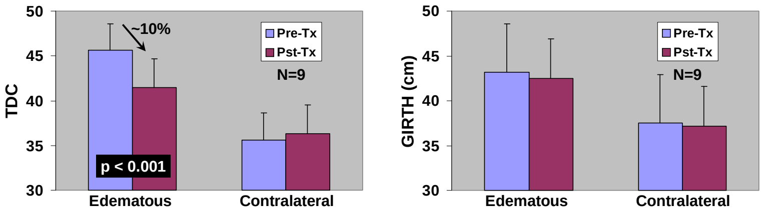
MEASUREMENT PROCEDURES

Measurements were done by two experienced and certified lymphedema therapists. For bilateral lymphedema cases, sites on each limb identified as sites of maximum swelling were marked with a surgical pen. For unilateral cases the site of maximum swelling on the affected limb and a corresponding anatomical site on the contralateral limb were marked. For TDC measurements, the probe was placed in contact with the skin and held in position using gentle pressure. The time required to obtain a single measurement, once the probe was placed in contact with the skin, was about 10 seconds. Each TDC measurement was done four times with the average value of the four used to characterize the site average TDC value. TDC measurements were made prior to the start of the patient's MLD therapy session and at the end of the session about one hour later. Subsequent determinations of the coefficient of variation among the four measured TDC values showed a slightly larger overall value for edematous legs (5.10 ± 2.95%) than for non-edematous legs (4.48 ± 3.01%) but the difference was not statistically significant (p>0.40).

Limb girth (circumference) at sites of TDC measurements were determined using a Gulick tape measure. Girth measurements were made prior to starting the therapy session and at the end of the session immediately after the TDC measurements.

MAIN RESULTS

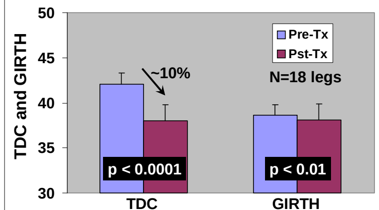
Unilateral Lymphedema



Significant reductions in TDC of the treated leg

No significant detectible changes in girth

Bilateral Lymphedema



Bilateral group results: One MLD treatment of both legs significantly reduced LTW with a TDC decrease (mean ± SD) of -9.69 ± 5.45% (p<0.0001) with a small decrease in girth (-1.38±1.98%, P<0.001). Considering all treated legs (n=27), pre-treatment values for TDC and girth were respectively 43.2 ± 6.5 and 40.2 ± 10.5 cm. Corresponding % changes produced by one MLD treatment were -9.75 ± 5.64% and -1.50 ± 1.93% respectively with the differential effect highly significant (p<0.0001). Regression analysis of paired TDC vs. girth changes for these treated legs showed no significant correlation (R^2=0.07, p>0.2).

DISCUSSION AND CONCLUSIONS

The present study is the first to investigate the possibility of using this tissue dielectric constant method and device to evaluate leg tissue water and therapy-related changes in local tissue edema in patients with lower extremity lymphedema. Results demonstrate that TDC values of lymphedematous legs are significantly greater than for non-edematous legs with values found for lymphedematous legs (43.2 ± 6.5) being similar to those previously reported for 18 lymphedematous arms (41.2 ± 7.9)[4]. The results further show that a single MLD treatment resulted in slightly less than a 10% reduction in TDC for both unilateral and bilateral leg conditions whereas percentage reductions in girth were 1.5%. We believe that since TDC measurements reflect changes to a depth of about 2.5 mm whereas girth measurements reflect conditions of the entire cross-section, it is likely that the TDC assessment is more sensitive to the immediate effects of MLD treatment. The substantial percentage change in TDC as a reflection of local tissue water, but much smaller change in girth, are consistent with this and suggest that TDC measurements may be useful as complementary or perhaps an independent assessment method of edema/lymphedema and treatment-related changes.

This approach to characterizing edema and its change has a number of advantages. Its simplicity of use and rapidity of data acquisition are clearly positive features. In view of its ability to measure locally and the fact that different tissue depths can be investigated with different size probes, new basic research becomes possible. One major clinical advantage is its ability to assess local areas such as those associated with localized limb edema or areas for which intensive therapy is being focused. Perhaps though its greatest advantage is the fact that assessments can be made in any body area or part since the measurement method is not limited to limbs as are most if not all other methods.

Dr. Mayrovitz invites you to e-mail him at mayrovit@nova.edu with any questions or comments.