A PILOT STUDY OF THE EFFECTS OF PULSED RADIO FREQUENCY ENERGY ON POST-MASTECTOMY LYMPHEDEMA

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INTRODUCTION

BACKGROUND and OBJECTIVES

If arm lymphedema occurs after mastectomy and related cancer treatment, it often develops gradually, and if untreated tends to worsen[1]. There is compelling evidence that complete decongestive therapy (CDT) is highly effective in reducing lymphedema and in reversing its potentially progressive course in many patients[2-4]. Although the details of application vary somewhat, the four principle components are skin care, lymph drainage via manual massage, compression and exercise, with emphasis on prevention. One physiological aspect of properly applied massage is its promotion of lymphatic drainage by the expansion of collateral lymphatic channels that connect to normally functioning lymphatic collectors. This then provides useful alternative lymphatic pathways to accommodate drainage of excess lymph that is blocked from its normal routes.

It was reasoned that if a simple method were available to facilitate collateral lymphatic enlargement then it might initially augment CPT outcomes and possibly provide patients with a longer-term continuous therapy option. Since a few reports[5-6] have described good adjunctive results using microwave treatments, it was reasoned that an alternate form of electromagnetic therapy might also be effective. Because previous work[7-8] showed that low-energy pulsed radio-frequency therapy at 27.12 MHz increased skin blood flow, likely due to enlargement of vascular channels, it was hypothesized that this approach might also serve to similarly affect lymphatic channels. We therefore sought to determine if such short-wave diathermy might also have a positive impact on lymphedema reduction. Because this form of therapy has not been previously reported, the present research effort was exploratory, with its main goal to determine if such treatments alone would provide evidence of potential efficacy. The specific objective of this part of the research was to to determine if low energy pulsed short-wave diathermy at 27.10 MHz, used as the sole therapy, would reduce arm lymphedema as determined by arm volume measures

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METHODS

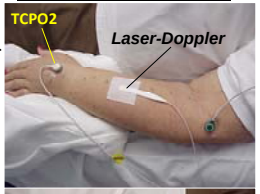
Arm Volumes and Calculations (FIG 1)

Arms were measured before starting treatment and then prior to the start of each follow-up treatment. Circumferences (C) were measured at separations of L = 4 cm starting from the wrist.

Segmental volumes, Vs within adjacent circumference measurement sites (C_1 & C_2) was calculated using a truncated cone model $Vs = (L/12\pi)(C_1^2+C_2^2+C_1C_2)$ The total arm volume was determined by summing all segmental volumes.

Edema volume was calculated as the difference between the affected arm volume and the contralateral arm volume. Percent Edema was calculated as Edema Volume divided by control arm volume

Physiological Measures

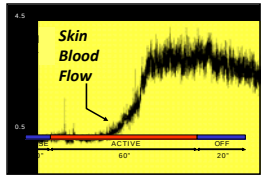


Skin blood flow (SBF) was monitored with a Laser Doppler probe on the affected forearm. Transcutaneous oxygen tension (PO2) was monitored with PO2 probes placed on upper arm and hand of the affected limb and a probe placed at a corresponding proximal site on control arm. Skin temperature was measured prior to and after each treatment interval.

Subjects and Treatments (FIG 2)

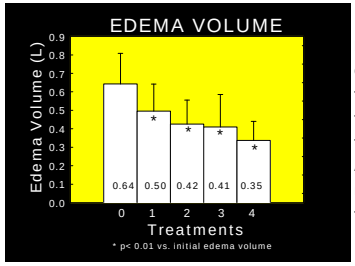
Women (N=7, age 37-78) with arm lymphedema (grade 2) for 0.7 to 10 yrs who were 3-23 yrs post breast cancer surgery Were included. All had prior CDT treatments (0.5 - 4 years ago) but were not now being treated. Each had 4-6 study treatments over a 2-week interval with no other treatment provided. Research treatment was given For 60 min. with patients supine and lightly covered. Dual heads of the device (Magnatherm) were placed to encompass all, or nearly all of the affected arm. Power levels were standardized to device max peak power and min repetition rate. Average power was estimated to be ~ 12% of max. Excitation at these settings consists of radio frequency energy (27.120 MHz) pulsed on for 95 msec at a rate of 700 pulses per second. This modality is also referred to as short wave diathermy.

Example LDF Response

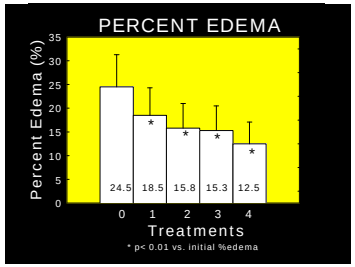


Typical SBF increase during active treatment is maintained for some time after turning off excitation. Increases in mean and pulse SBF are both observed

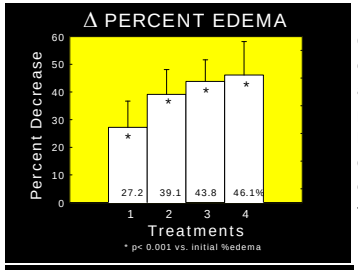
RESULTS



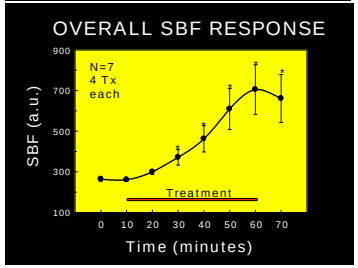
Initial edema volume decreased after one treatment (TX), with further decreases through the 4th TX. All seven patients received at least four treatments



Similar patterns of change occurred for percentage edema. By the 4th treatment, it was ~ ½ that prior to TX start. But, main change occurred early in the treatment sequence



Calculations of change in %edema also indicates a progressive decrease but again the most dramatic decrease occurs early in the treatment sequence



Adjacent figure shows average skin blood flow response to TX. SBF becomes greater than baseline (p=0.018) after 30 minutes of treatment. Relative increase by 60 minutes was 4.10 times greater than baseline.

CONCLUSIONS

Limb volume findings indicate a potentially beneficial effect of pulsed radio frequency energy to reduce arm lymphedema.
These initial findings are especially encouraging since the women included in this pilot study had already received CDT therapy and had long standing residual lymphedema.
The treatment related reduction in the percentage of lymphedema, was rapid, significant, and associated with a single treatment power level, which was deliberately maintained low at about 12% of the total device power. It is unknown whether increased power levels would improve the short-term outcome herein observed.

Although these initial volume findings are encouraging and the method tested may prove to be a useful compliment to current therapeutic practice, final conclusions must await further and expanded placebo controlled, blinded tests.

Findings of Physiological measures indicate a significant increase in SBF due to application of pulsed radio frequency energy to arms with long-standing post-mastectomy related lymphedema The increase in SBF occurred after 30-40 minutes of TX and SBF remained elevated compared with its pre-treatment baseline for at least 20 min. after treatment was stopped. Contrastingly, the findings indicate that transcutaneous oxygen tension (PO2), which was normal in both affected and control arms of the present study group, was not significantly affected by treatment. The role of the SBF increase during TX in mediating the TX-related reduction in lymphedema is unknown. But, an intriguing possibility is that mechanisms similar to those that cause SBF to increase, also act to increase lymphatic flow, either by expanding collateral channels or by enhancing functional activity of lymph vessels.

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