EFFECTS OF PULSED RADIO FREQUENCY ENERGY ON ARM SKIN BLOOD PERFUSION AND TRANSCUTANEOUS OXYGEN IN POST-MASTECTOMY LYMPHEDEMA

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INTRODUCTION

BACKGROUND

If arm lymphedema occurs after mastectomy and related cancer treatment, it often develops gradually, and if untreated tends to worsen[1]. There is now compelling evidence that complete decongestive therapy or alternatively, complex physical therapy (CPT), 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.

Results presented in a companion presentation do show a reduction in lymphedema associated with this short-wave diathermy therapy. Herein, the findings with regard to the effects on skin blood perfusion (SBF) and transcutaneous oxygen tension (PO2) determined during the course of treatment are presented.

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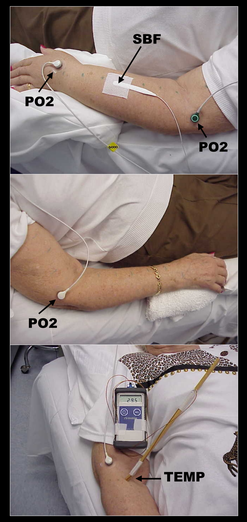
OBJECTIVES

The specific objective of this part of the research was to to determine the effects of low energy pulsed short-wave diathermy at 27.10 MHz on skin blood perfusion and transcutaneous oxygen tension during treatment

METHODS

Physiological Measurements



Skin blood perfusion (SBF) was monitored with a laser-Doppler probe placed onto the affected arm at a standardized site

Transcutaneous oxygen tension (PO2) was monitored with two PO2 probes placed onto the affected limb at standardized distal and proximal sites.

PO2 of the control arm was monitored with a probe placed at a corresponding proximal site

Skin temperature was measured prior to and after each treatment interval on both arms

Findings with regard to to arm lymphedema changes with treatment are presented in a companion presentation

Subjects and Treatments

Seven post-mastectomy patients were included in this pilot study and were treated between 4-6 times over a 2-week interval. During this interval, no other treatment was provided

Each treatment was given for 60 minutes with the patient supine and lightly covered.

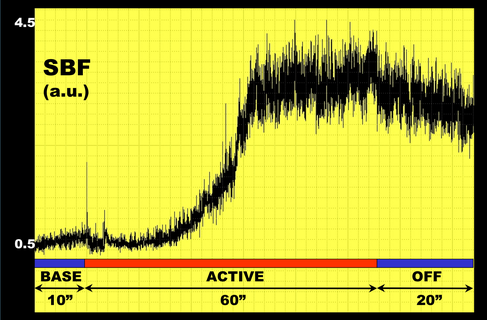
The dual heads of the device (Magnatherm) were placed so as to encompass all, or nearly all of the affected arm

Treatment power levels were standardized to the device maximum peak power and minimum repetition rate. At these settings the device average power was estimated to be about 12% of maximum

The excitation pattern at these settings consists of radio frequency energy (27.120 MHz) pulsed on for 95 sec at a rate of 700 pulses per second. This modality is also referred to as short wave diathermy

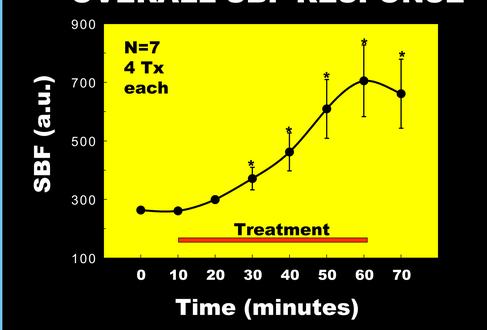
RESULTS

EXAMPLE SBF RESPONSE



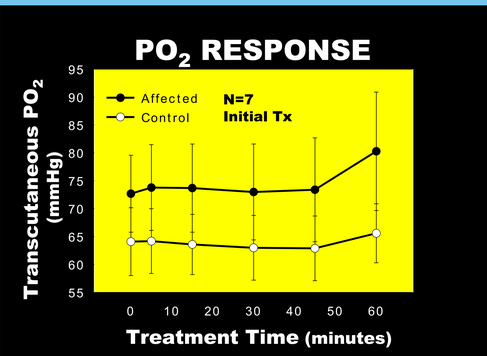
The example response shows a typical SBF increase during a treatment that is maintained for some time after turning off the excitation. Increases in both mean and pulse SBF are observed

OVERALL SBF RESPONSE



The overall SBF response to treatment includes data for all seven subjects each of which were treated four times. Results show an SBF increase relative to baseline which becomes significant (p=0.018) after 30 minutes of treatment. On average the relative increase by 60 minutes was 4.10 times greater than baseline.

PO_2 RESPONSE



Data shown is for initial treatments. No significant differences were detected between affected and control arms before or during treatment.

Similar results were found for subsequent treatments with no significant differences between arms for any treatment.

CONCLUSIONS

The main findings of this part of the study indicate a significant increase in skin blood perfusion (SBF) that is associated with the application of pulsed radio frequency energy to arms with long-standing post-mastectomy related lymphedema

The increase in SBF occurs after 30-40 minutes of treatment and SBF remains elevated as compared with its pre-treatment baseline for at least 20 minutes after treatment is stopped.

Contrastingly, the findings indicate that transcutaneous oxygen tension (PO2), which was normal in both the affected and control arms of the present study group, was not significantly affected by treatment.

The role of the observed SBF increase during treatment in mediating the treatment related reduction in arm lymphedema (summarized below and reported in detail in an accompanying presentation) is as yet unknown.

However 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.

The main findings of the companion part of the study indicate a significant increase in skin blood perfusion (SBF) that is associated with the application of pulsed radio frequency energy.

The increase in SBF occurs after 30-40 minutes of treatment and SBF remains elevated as compared with its pre-treatment baseline for at least 20 minutes after treatment is stopped.

The role of the observed SBF increase during treatment in mediating the treatment related reduction in arm lymphedema (summarized above) is as yet unknown.