THE MOBILE PNEUMATIC ARM SLEEVE: A NEW DEVICE FOR TREATMENT OF ARM LYMPHEDEMA

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ABSTRACT

A new simple and inexpensive device for treatment of upper limb lymphedema is described. Two days of application (≈12 hours) in 20 patients who otherwise maintained normal activities achieved a mean reduction of 21% of tissue swelling.

Lymphedema of the upper limb still poses a major therapeutic problem. Although classic radical mastectomy, once a major cause of arm lymphedema, is no longer the preferred operation for cancer of the breast, lymphedema appears after modified radical mastectomy or other ablative operations of lymph glands in the axilla. Operations for treatment of upper limb lymphedema have largely been abandoned. Excisional procedures are of limited usefulness while creation of lymphatic-venous shunts are controversial with few long-term studies.

Nonoperative treatment, on the other hand, relies primarily on intermittent pneumatic compression. This technique is embodied in the unit known as “Lymphapress” (1) which achieves by sequential pneumatic compression optimal results in lymphedema reduction (1-5). However, pneumatic compression has certain disadvantages, among them the need for repetitive treatment, dependence on a heavy, cumbersome and in general immobile machine, and considerable expen-

diture to acquire the apparatus. Prompted by these limitations we developed a simplified closed apparatus in the form of a hollow arm sleeve (patent pending) which utilizes muscle movements of the affected limb to create air pressure gradients by entrapped air. The device thereby exerts a continuous massage action over the limb resulting in volume reduction.

TECHNICAL DETAILS:

The principal unit is an inflatable hollow sleeve which is adjusted to the upper limb. After slipping it over the arm, the patient auto-inflates the sleeve through a one-way valve located in the upper portion to a pressure of 30-35mmHg. Two

Fig. 1: Patient wearing a mobile sleeve.
squeezable air reservoirs with continuous bidirectional communication with the inflatable cell are located within the sleeve at the dorsal distal end and in the “fist”. As the hand is opened and closed the reservoir air bags push air into the long sleeve cell creating an air wave up and down the arm. As the bags of air are squeezed, pressure increases to 50mmHg. Activation is enhanced by arm movement as sleeve-effective volume diminishes (Fig. 1).

CLINICAL EXPERIENCE:
Twenty patients, (average age 52 years), 17 women with post mastectomy lymphedema and three males with idiopathic lymphedema of the arm, were studied. Lymphedema was assessed according to four parameters: a) volume measurement by water displacement; b) limb transport of radio-iodinated albumin; c) clinical impression of limb consistency; d) subjective feeling of the patient. These parameters were evaluated before and after treatment which consisted of wearing the sleeve five to six hours for two consecutive days. In the interim, the patients carried out normal activities.

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Table 1.
Lymphedema arm volume before and after 2 days of treatment (12 hours)
RESULTS:

Using water displacement (see Table 1), the mean reduction in 20 patients was 21.4% with a range of 0-63%. In fourteen patients (70%) volume reduction was less than 20%, and in five patients reduction was greater than 40%.

Radioactive Albumin “Clearance”

Figure 2 demonstrates that tissue transport of radioactive albumin during treatment was greater than that achieved physiologically as represented by the normal arm.

![Graph showing degradation curve of radiolabelled albumin](image)

Fig. 2: Degradation curve of radiolabelled albumin of tissues during treatment. Note accelerated “clearance” of lymphedematous arm after six hours of therapy.

Eighteen hours after radiolabelled albumin was injected into the affected arm 38% of it was “cleared,” while 64% was “cleared” from the normal arm. After six hours of treatment the lymphedematous arm “cleared” 72% (an augmentation of 34% in six hours), whereas the normal and physiologic clearance of iodinated albumin in the normal arm reached 70%, a further clearance of only 6%.

Consistency of the Arm

Marked improvement after treatment was noted in fourteen patients. Four achieved moderate improvement and two patients showed no change.

Subjective Feeling

Fifteen patients were motivated to acquire the sleeve for daily use. We interpret this action as a subjective sign of satisfaction with the device.

COMMENT

In management of lymphedema, sequential intermittent pneumatic compression has proved to be the best method of nonoperative treatment. While effective it requires use of a relatively expensive device, considerable time, and interrupts the everyday routine of patients. Considering these disadvantages, we designed a simplified and inexpensive device based on the massaging effect of trapped air in a hollow arm sleeve. Air pressure is changed by movement of hand and arm muscles.

Results of two days of treatment in 20 patients with lymphedema demonstrated a salutary benefit in volume reduction accompanied by greater tissue clearance of radioactive albumin, softening of edema and overall improved well-being. Most of the patients expressed a desire to continue treatment with this device. A notable advantage was that patients were able to work without being connected to an immobile unit. The new mobile pneumatic arm sleeve is recommended for use between conventional treatments with intermittent pneumatic compressors with the anticipation that frequency of treatments with the immobile units can be reduced.

REFERENCES:

1. Zelkovski A, Mansch M, Giler Sh, Urca
   1."Lympha-Press" — a new pneumatic device for the treatment of lymphedema of the limbs.
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