

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 "Lympha Press" (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.

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

Patient #	BEFORE TREATMENT			AFTER TREATMENT		EDEMA LOSS	
	Lymphedema arm (ml)	Normal arm (ml)	Edema volume (ml)	24 Hours (ml)	48 Hours (ml)	ml	%
1	2850	2150	700	2650	2450	400	57
2	6260	2650	3610	5950	5600	660	18
3	4750	2100	2650	4550	4600	150	6
4	2850	2070	780	2550	2490	360	46
5	4350	2730	1620	4400	4250	100	6
6	4900	2450	2450	4900	4580	320	13
7	3500	2940	560	3460	3270	230	41
8	4130	2440	1690	3880	3830	300	18
9	3600	2400	1200	3600	3550	50	4
10	3140	2580	560	3000	3060	80	14
11	4400	2150	2250	4350	4370	30	1
12	2800	1740	1060	2800	2800	0	0
13	3400	1750	1650	3300	3200	200	12
14	3860	2430	1430	3730	3670	190	13
15	3720	2360	1360	3320	3640	80	6
16	3420	2070	1350	3310	3200	220	16
17	4050	2670	1380	3600	3700	350	25
18	4400	3600	800	4150	3900	500	63
19	3000	2450	500	2730	2720	280	51
20	3450	2000	1455	3300	3200	255	18

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.

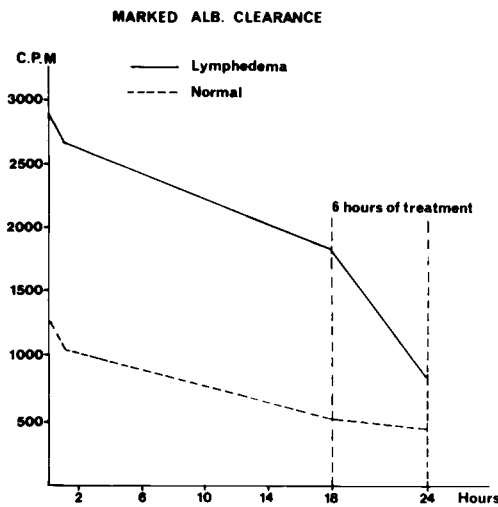


Fig. 2: Degradation curve of radiolabelled albumin of tissues during treatment. Note accelerated "clearance" of lymphedematous arm after six hours of therapy.

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:

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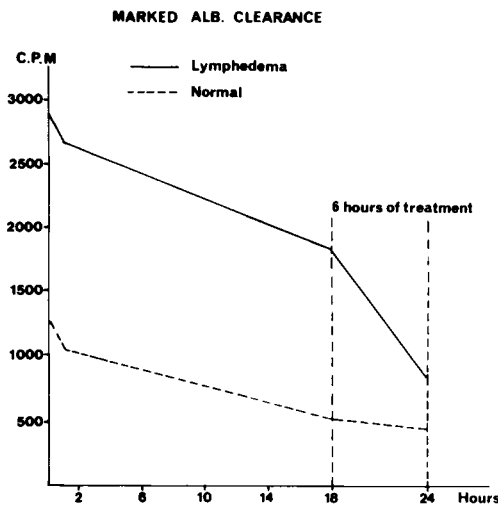


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