

# Treatment of post-lymphadenectomy and radiotherapy lymphedema of limbs by bypassing the lymph flow obstruction site with implanted silicone tubes

Waldemar L. OLSZEWSKI, Marzanna ZALESKA<sup>1</sup>

## Introduction

Patients treated for breast and uterine cancer, melanoma and seminoma are facing a life-time risk of developing lymphedema in at least 40% of this population. In advanced cases of lymphedema the main lymphatics become obstructed at their whole length and tissue fluid accumulates in the interstitial spaces forming fluid “lakes” and “channels”. The only solution for fluid drainage would be creating artificial channels for flow away to the non-obstructed edema fluid absorption regions.

We propose a novel method of forming artificial pathways for edema fluid flow by subcutaneous implantation of silicone tubes into the swollen limb bypassing the obstruction site (1). As a complementary treatment stocking and long term penicillin were applied before and after surgery. Implantation was done only if that treatment didn't bring improvement.

## Implant characteristics

Sterile silicone tubes medical grade o.d. 3mm and i.d. 2mm is used. The tubes mate-

rial is hydrophobic preventing ingrowth of connective tissue into the lumen and around them. Hydrophobic properties were tried previously on rats proving easy pullout of the implanted tubes without resistance even months after implantation. The concentricity of tubes didn't change and there was no reduction of ovality. Three tubes of a length adjusted to that of the limb were tied together and multiple lateral holes were made at distances of 3cm. On a cross view a space was formed between the three tubes allowing fluid to accumulate. The accumulated fluid could move in the tubes as well as between them.

## Implantation technique

For upper limb, a 2cm long incision was made 2 cm above the radial-metacarpal joint, another above the internal aspect of arm above the elbow and the third one at the scapular region. For lower limb, a 6cm long incision was made in the groin, 2cm long above the medial ankle and 2cm in the hypogastrium. A 1.5 cm wide and 100 cm long slightly curved metal tube tunneling device was introduced deep under the skin and bluntly passed along

<sup>1</sup> Medical Research Center, Polish Academy of Sciences and Central Clinical Hospital, Ministry of Home Affairs, Warsaw, Poland.

the limb. The tubes were passed through the tunneler, after which it was removed. Fixing of tubes to the surrounding tissues was avoided to maintain the possibility of removing in case of any complication.

### Pre and postoperative evaluation

Limb circumference and volume as well as tissue tonometry were done. Moreover, tissue fluid movement was evaluated in a two-cuffs compression test. Ultrasonography and lymphoscintigraphy were done to show accumulation of edema fluid in and around the tubes and their patency (Fig. 1).

Patients reports included heaviness in the limb, easier hand grip and flexing in elbow, as well as raising arm. In lower limbs this was easier flexing in ankle and knee joints.

### Results

The first investigated group included 25 patients with lower and 12 with upper lymphedema, stage III, with a follow-up from 6 months to 2-4 years. A fast decrease of limb circumference was observed already during the first days after implantation lasting for 2 weeks to become slower thereafter. In lower limbs circumference decreased in all patients within the first 2 weeks, differently at various levels of the limb, by -3.2% to -3.9 % with a range from +3% to -17% after 2 years ( $p < 0.05$ ). In upper limbs it was 10% in the mid-forearm and 5% in the mid-arm during week 1 to reach 15 and 10% after 6 months, respectively ( $p < 0.05$ ). Interestingly, after this rapid decrease of circumference and volume

the ultrasonography, MRI and fluid movement plethysmographic test didn't reveal any more mobile fluid. There was an evident decrease of skin and subcutis stiffness observed already on the first week to proceed for another week and level off thereafter. On lymphoscintigraphy, the tracer filled up tubes and/or space between tubes at their whole length giving a wide shadow. This could be interpreted as spread of isotope into the tissues surrounding implants (Fig. 1).

Taken together, the implanted tubes brought about fast evacuation of excess tissue fluid, b) most decrease in circumference, volume and stiffness occurred in first two weeks, c) less limb heaviness and easier hand grip, d) lymphoscintigraphy tracer accumulated in tubes and around them, e) free fluid was seen on ultrasonography at both ends of tubes and in between, e) no postoperative complications.

Conclusions. We propose a multimodal method comprising implantation, limb compression to generate fluid pressure gradient for flow and prevention of inflammation by administration of long-term penicillin. Simplicity of surgical procedure and lack of reaction to implant make the method worth applying in advanced stages of lymphedema in large cohorts of patients.

### References

1. Olszewski WL and Zaleska M. A novel method of edema fluid drainage in obstructive lymphedema of limbs by implantation of hydrophobic silicone tubes. *J Vasc Surg: Venous and Lymphatic Disorders*, 2015; 3:401-409