SCANDINAVIAN JOURNAL OF Plastic and Reconstructive Surgery

Vol. 20 1986

INDEX

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Scand J Plast Reconstr Surg 20: 141–146, 1986

A MICROSURGICAL METHOD FOR RECONSTRUCTION OF INTERRUPTED LYMPHATIC PATHWAYS:

Autologous Lymph-vessel Transplantation for Treatment of Lymphedemas

R. G. Baumeister, S. Siuda, H. Bohmert and E. Moser

From the Department of Surgery (Head: G. Heberer), and the Department of Radiology (Head: J. Lissner), Division of Nuclear Medicine, University of Munich, Klinikum Grosshadern, München, West Germany

Abstract. Refinements in microsurgery have made it possible to perform causal therapy on lymphedemas due to a local blockade of lymphatic pathways through transplantation of the patient's lymph collectors. End-to-end anastomoses with lymphatics before and after the blockade or crossing to the opposite side are performed under 40-fold magnification. Between July 1980 and February 1985 32 patients received this treatment. 23 patients had postmastectomy edema, and 9 patients had unilateral edema of the lower limb (2 primary, 7 secondary edemas). The lasting result was that the volume difference between the affected and the healthy limb decreased to about 65%. Lymphatic scintiscans showed improved lymphatic transport capacity with increasing time from surgery and long patency of the grafts.

Key words: Lymphedema, microsurgery, lymph vessels, transplantation, angiology, plastic surgery.

Lymphedemas have been surgically treated in many ways, ranging from resectional methods to lymph draining methods, including lymphovenous shunts (8, 9, 14). There is no causal therapy for the repair of locally damaged lymph collectors.

Refined microsurgical techniques are comparable to grafting and bypasses in cases of obstructed arteries. Lymphedemas due to local blockade can be treated in this way.

In Europe most lymphedemas are secondary iatrogenic ones, such as postmastectomy edemas. Primary lymphedemas with unilateral atresia in the pelvic region can also be treated with this method.

After animal experiments with lympho-lymphatic anastomoses and lymphatic grafts (1, 3, 5, 6) lymph-vessel transplantation in man has been performed since 1980 (2, 4, 7).

Transplanted collectors can increase diminished lymphatic transport capacity (10) which may be caused by numeric reduction of lymph-transporting collectors in the region of the blockade. This raises the lymphatic transport-capacity, and causal therapy through direct lymph vessel reconstruction is achieved.

MATERIAL AND METHODS

Lymphatic grafts are taken from the inner aspect of the thigh. Within the ventro-medial bundle 6–17 superficial lymph collectors can be found (13). In most cases 2 of them are used as grafts and are harvested between the narrowings of the lymphatic system at the leg, the knee and the groin with lengths of up to 30 cm (Fig. 1). Subcutaneous application of Patent Blue® V facilitates preparation in the donor region. In postmastectomy edemas, a short longitudinal incision at the upper arm is made and then ascending collectors are sought microscopically, without application of patent blue. Lymph vessels are found subfascially around the brachial vein and epifascially at the inner aspect of the upper arm.

In longstanding edemas the deep lymph vessels may especially have thickened walls with very small lumens. The superficial ones may be very thin. A short incision is performed at the neck parallel to the lateral border of the sternocleidomastoideus muscle. Deep descending lymphatics, generally thin-walled, can be found there.

A tunnel with a plastic tube is made in the subcutaneous tissue between the two incisions. The grafts are pulled through and the tube is then removed (Fig. 1). With 40-fold magnification lympho-lymphatic anastomoses are performed in the upper arm and the neck using the "tension free anastomosing technique" (5).

The lymph vessels are not turned around the corner stitches. Instead, the vessel ends are allowed to remain lying opposite to one another. The first stitch is made in the part of the vessel that is farthest from the surgeon, and the back wall of the vessel is sutured by simply lifting the

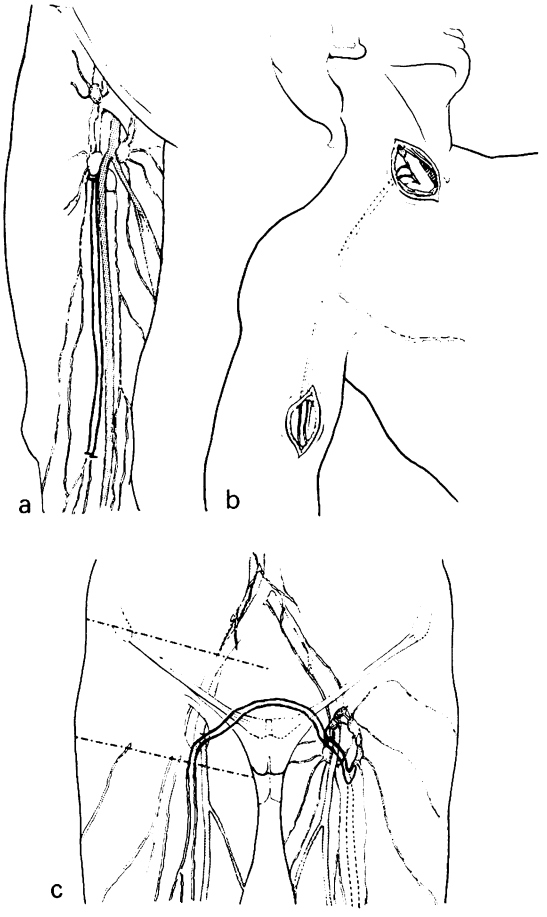


Fig. 1. (*a*) Harvesting of lymph collectors (dark) of the ventromedial bundle at the thigh. (*b*) Interposing of transplanted lymph collectors between ascending lymph vessels at the upper arm and descending lymph vessels at the neck in the case of a postmastectomy edema. (*c*) Transposing of lymphatic grafts via the symphysis in the case of a blockade at the right groin or the pelvic region.

vessel to make room for the needle, without turning. The stitching is knotted on the outside of the vessel.

The corner closest to the surgeon and the front wall are also sutured by single stitches. Generally 6–8 stitches are necessary for the anastomosis. 11–12×0 absorbable suture material has given the best results (6).

No clamps are used. In some animal experiments we have seen an obliteration at the site of the pressure. In the case of unilateral edema of the lower leg, the grafts at the donor site remain connected with their lymph nodes at the groin. Ascending collectors are sought on the thigh of the affected limb. A tunnel is made above the symphysis and the transplants are pulled through a tube which is then removed. This allows lymph to flow from the affected side to the lymph nodes at the groin of the opposite leg (Fig. 1).

In the case of localised lymphedema caused by a peripheral lymphatic blockade at an extremity collectors are sought in front and behind the blockade. Sometimes a direct anastomosis is possible after mobilisation; otherwise short grafts are used to bridge the defects.

Preoperative investigations must clearly exclude blockades due to tumor development or tumor recurrency. Transient edemas are excluded by waiting several months. Conservative treatment should always precede surgery. However, if conservative therapy shows no lasting success without continuous treatment, surgical improvement of lymphatic transporting capacity should not be postponed indefinitely.

The donor leg has to have normal lymphatic transport as proved by lymphatic scintiscans to minimize the risk of a

Table I. *Patients treated by autologous lymph-vessel transplantation for the treatment of primary and secondary lymphedema*

Patients		32
Edema of the arm		23
Edema of the leg		9
Primary	2	
Iatrogen	6	
Post-traumatic	1	

Table II. *Patients with postmastectomy edema*

$n=23$

Age	
Mean	53 (40–70) years
Affected arm	
Right	12
Left	11
Duration from mastectomy to lymphatic grafting	
Mean 7 years (17 months – 19 years)	
Duration from beginning of the edema to lymphatic grafting	
Mean 5 years (12 months – 14 years)	

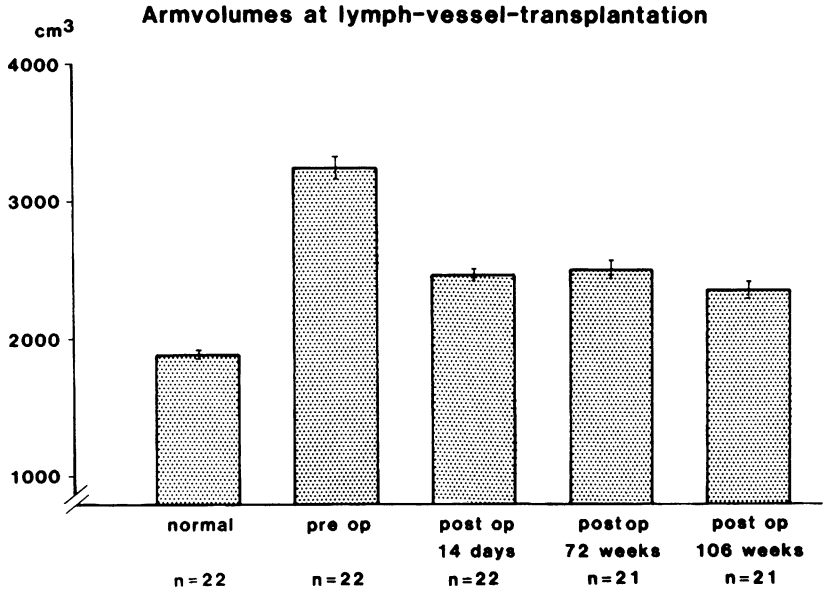
Table III. *Arm volumes in patients with postmastectomy edemas; preop. versus postop. values compared to the contralateral extremities*

Arm volumes at lymph-vessel transplantation

	n	cm^3
Normal	22	1 878±55
Preop.	22	3 250±140
Postop.		
14 days	22	2 464±88*
72 weeks	21	2 486±126*
106 weeks	21	2 365±120*

* $p<0.001$ to preop. values.

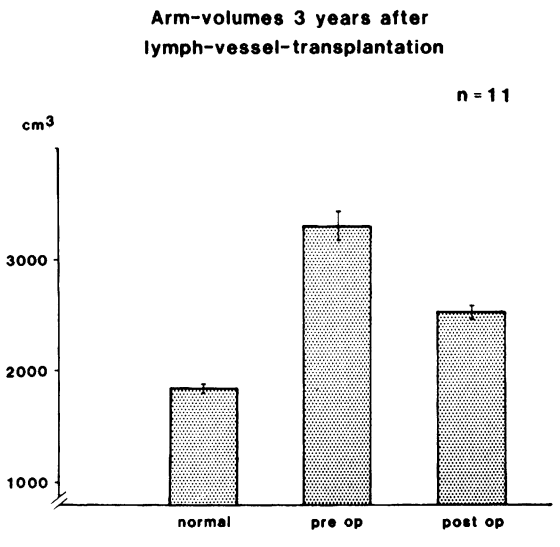
Table IV. *Behaviour of arm volumes after lymph-vessel transplantation with increasing time from surgery*



postoperative swelling. In the affected limb the rate of the blockade should be estimated (12) by measuring the transport index.

Lymphatic scintiscans enable us to measure the benefit of the operation and to demonstrate the patency of the collectors. As postoperative management the patients receive low molecular dextrane and antibiotics for one week. As prophylaxis against erysipelas Penicillin (Tardocillin 1200®) is given monthly for 1 year.

Table V. *Arm volumes in 11 postmastectomy edemas with a mean time from surgery of 3 years*



During the approximately 14-day hospital stay the arm is elevated and a light dressing is applied. Elastic stockings are generally worn postoperatively for 6 months.

Indication

Secondary lymphedemas due to a local blockade of the lymphatic system are most suitable for lymph-vessel transplantations. Postmastectomy edemas, edemas after lymph-node dissection at the groin or wide preparations at the inner aspect of the knee are the most frequent types. Traumas in these regions may also cause edema requiring this treatment. Unilateral primary lymphedemas due to lymphatic hypoplasia in the pelvic region can be treated with lymph-vessel transplantation.

RESULTS

The first lymph-vessel transplantation in man was performed in June 1980. By February 1985 32 patients were treated. Most patients (23) suffered from postmastectomy edema. Two of the nine patients with edema of the leg had primary edema, six had secondary iatrogenic edema and 1 had secondary posttraumatic edema (Table I). The mean age of the patients with postmastectomy edemas was 53, the youngest was 40 and the oldest patient 70 years old. There was no preference for one side. The mean time between mastectomy and lymphatic grafting was 7 years, the shortest time 17 months, the longest 19 years. The time between the occurrence of the edema and surgery was a mean of 5 years. 12 months

Table VI. *Decrease of lymphatic transport index, i.e. elevation of lymphatic transport capacity after lymph-vessel transplantation*

Lymphatic scintiscan in postmastectomy edema ($n=10$)

Transport-index		
Preop.	Postop. (14 days)	Postop. (21 months)
35.4	32.6	19.8
	$p<0.01$	

was the shortest time, 14 years the longest (Table II).

In 22 postmastectomy-edemas pre- and postoperative values of volumes are comparable to the volumes of the contralateral normal extremity. The results in mean volumes and standard deviations (Table III) show a significant decrease in volume even long after the patient's return to normal life. The overall decrease of volume difference remained at about 65% (Table IV).

In 11 patients a mean observation period of 3 years after the operation was reached. A significant reduction can also be seen after this period (Table V).

As an independent and objective measurement of the lymphatic outflow, lymphatic scintiscans show a significant reduction of the transporting index, that is an improvement of the lymphatic transport capacity, after a mean period of 21 months (Table II). The data indicate that lymphatic flow continues to improve with time after the surgery.

In seven patients with edemas of the leg volume measurements have been performed (11). The data also show a marked decrease in volume after lymphatic grafting which lasted after the patient returned to normal life. In the lower extremity, however, it is more difficult to maintain the postoperative results than in the upper extremity (Table VII).

We saw a complication of erysipelas in 2 of our first patients without penicillin prophylaxis. One patient had swelling in the lower leg. There were clinical signs of deep venous thrombosis, but the patient did not permit examination by phlebography or lymphatic scintiscan.

The clinical example shows a 42-year-old patient: The lymph-vessel transplantation took place 10 years after mastectomy, axillary lymph-node dissection and radiation and 3 years after development of a marked lymphedema of the right arm (Fig. 2). 2 years after autologous lymph-vessel transplantation a constant reduction of the arm volume was achieved (Fig. 2).

The example of a lymphatic scintiscan shows a 31-year-old patient, suffering from carcinoma of the bladder with a blockade of the left pelvic lymphatic pathway after lymph-node dissection.

In the preoperative scintiscans injections were performed on both lower limbs. On the right leg a normal outflow could be seen. On the left leg a stoppage before the groin was detected (Fig. 3).

2 1/2 years after lymph-vessel transplantation injection only on the left leg was performed. The lymph flows via the transplanted collectors from the affected left leg to the right groin and from there to the right pelvic lymph nodes. The stoppage before the left groin is released and the normal collectors are visualized again. Thus patency of the transplants and functional improvement of lymphatic transport in the affected limb can be demonstrated by objective measurements (Fig. 3).

DISCUSSION

The results show that a direct reconstruction of main lymph collectors can be used to treat lymphedemas due to a local blockade of the lymphatic system. The effect is not transient, but rather lymphatic scintigraphies show an improvement of the lymphatic flow with increasing time from the lymphatic grafting.

A reduction of the affected extremity to normal size is unlikely in cases with a large amount of newly connective tissue in the edematous extremity.

After successful lymph-vessel transplantation, however, the patients, especially in postmastectomy

Table VII. *Volumes of the leg in cases of autologous lymp-vessel transplantation/transposition in lymphedemas of the leg*

	Normal	Preop.	Postop. (14 days)	Postop.
B. H.	8 618	11 552	9 563	9 872 (23 weeks)
S. M.	7 741	10 972	8 671	8 024 (109 weeks)
S. S.	5 233	6 323	5 178	5 387 (28 weeks)
S. G.	7 948	10 029	8 598	8 762 (68 weeks)
M. J.	8 816	9 616	8 411	9 367 (20 weeks)
M. D.	7 034	7 363	6 338	6 758 (59 weeks)
S. M.	5 506	8 364	6 390	6 608 (26 weeks)

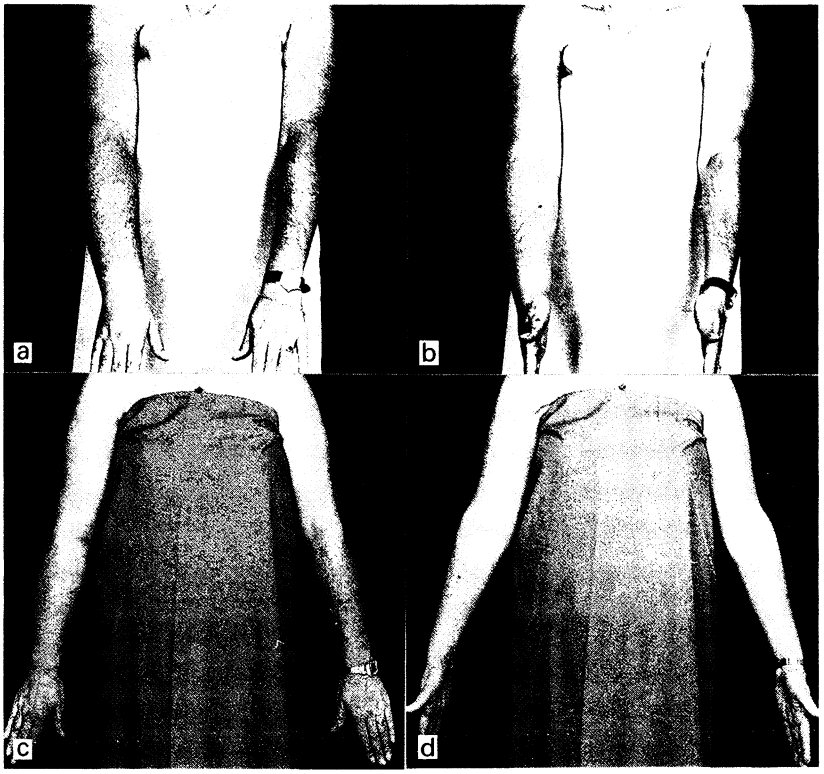


Fig. 2. (*a, b*) 42-year-old patient with a postmastectomy edema of the right arm. (*c, d*) Patient 2 years after autologous lymph-vessel transplantation.

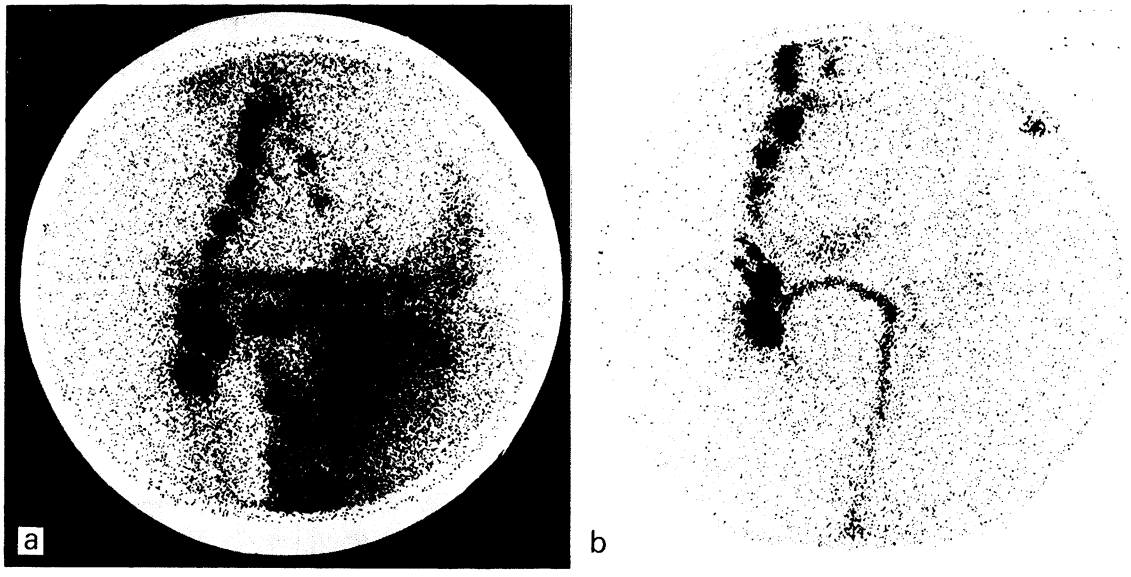


Fig. 3. (*a*) Lymphatic scintiscan of a 31-year-old patient with lymphatic blockade at the left pelvic region after lymphnode dissection. Injections in both feet, normal transport on the right side, stoppage at the left leg. (*b*) 2 1/2 years after lymph-vessel transplantation via the symphysis. Injection only at the left foot; patent transplants; lymphatic outflow through the transplants via the symphysis to the right groin and the pelvic lymph nodes; release of the stoppage.

edemas, are no longer bothered by markedly swollen hands and forearms or by having to wear elastic stockings. Using the method of lymphatic grafting instead of lymphovenous anastomoses does away with problems of pressure differences between lymph vessels and veins (15) and with the higher coagulability in the blood than in the lymph (16). The restoration takes place within the lymphatic system. The best results can be achieved when the transport capacity exceeds the lymphatic load of the edematous limb.

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