Dynamic lymph flow imaging in patients with oedema of the lower limb for evaluation of the functional outcome after autologous lymph vessel transplantation: an 8-year follow-up study

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Abstract. The purpose of this study was to monitor the functional outcome of microsurgical intervention on lymph drainage by means of non-invasive, readily available lymphoscintigraphy. Eight patients with primary or secondary lymphoedema of the lower limb were investigated before and for 8 years after autologous lymph vessel transplantation. For scintigraphy, technetium-99m labelled nanocolloid was subcutaneously injected into the first interdigital space of the affected limb. Sequential images were acquired up to 6 h p.i.; for semiquantitative evaluation a numerical transport index was established by assigning scores of up to 9 on each of five criteria: lymphatic transport kinetics, distribution pattern of the radiopharmaceutical, time to appearance of lymph nodes, visualisation of lymph nodes and visualisation of lymph vessels/grafts. Ti values <10 were considered normal. In all eight patients, lymphatic function significantly (P≤0.01) improved after microsurgical treatment. Permanent function of vessel grafts was indicated by persistently low Ti values during the entire observation period, impressively demonstrating the success of this complex microsurgical technique. Patients with scintigraphic visualisation of the vessel graft (n=2/8) showed a substantially better postoperative outcome than those without visualisation of the vessel graft. The findings indicate that lymph vessel transplantation significantly improves lymph drainage in patients with primary or secondary lymphoedema of the lower limb. Thus, lymphoscintigraphy is helpful not only in planning microsurgical treatment but also in monitoring the postoperative outcome.

Keywords: Lymphoedema – Scintigraphy – Transplantation – Lymph drainage

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Introduction

Lymphoscintigraphy is based on the physiological transport of radiotracers. This non-invasive procedure allows evaluation of the function of the lymphatic system of the lower limbs (Fig. 1). In the present investigation this technique was used to monitor the functional outcome after autologous lymph vessel transplantation, based on the use of visual and semiquantitative criteria.

Materials and methods

A total of eight consecutive patients aged between 29 and 70 years (mean 56 years) who presented with peripheral lymphoedema and swelling of the lower limb were included in the study. The duration of their diseases ranged from several months to many years. All of them underwent a scintigraphic baseline study and follow-up once a year for a period of 8 years after microsurgical treatment. Preoperatively lymphoscintigraphy was performed to prove that the lymphatic transport of the donor limb was absolutely normal, thereby precluding any preclinical lymphatic flow disturbances and the risk of postoperative swelling.

Each patient’s own lymphatic vessels were transplanted; therefore no postoperative rejections occurred. Two to three lymphatic grafts with possible additional peripheral branches were harvested from the patient’s thigh. These grafts were taken from among the approximately 15 lymphatics of the ventromedial bundle of the opposite (unaffected) leg, and had a length of up to 30 cm [1]. Care was taken to avoid the narrowings of the lymphatic system at the inner aspect of the knee or the groin. In these patients with
unilateral lower limb oedema, the grafts remained attached at the inguinal lymph nodes of the donor leg and were transferred with the peripheral ending via a subcutaneous tunnel above the symphysis to the affected limb. In this example, lymph drainage without pathological findings and clearly visible inguinal lymph nodes in the right leg are demonstrated. In contrast, the left leg shows diffuse distribution of the radiopharmaceutical in the lower leg (➔) and absent inguinal lymph nodes (●).

Table 1. Calculation of the transport index (Ti)

<table>
<thead>
<tr>
<th>Ti (points)</th>
<th>Kinetics</th>
<th>Distribution</th>
<th>Time</th>
<th>Visualisation of nodes/visualisation of vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No delay</td>
<td>Normal</td>
<td>0.04 × (minutes)</td>
<td>Clearly demonstrated</td>
</tr>
<tr>
<td>3</td>
<td>Low-grade delay</td>
<td>Partially diffuse</td>
<td></td>
<td>Faint visualisation</td>
</tr>
<tr>
<td>6</td>
<td>Extreme delay</td>
<td>Diffuse</td>
<td></td>
<td>Hardly recognisable</td>
</tr>
<tr>
<td>9</td>
<td>Absence of transport</td>
<td>Transport stopped</td>
<td></td>
<td>No appearance</td>
</tr>
</tbody>
</table>

Each parameter (lymphatic transport kinetics, distribution pattern of the radiopharmaceutical, time to appearance of lymph nodes, visualisation of lymph nodes and visualisation of lymph vessels/grafts) was scored on a scale of 0–9 points. Thus the resulting transport index ranged from 0 to 45 points [5, 6].

Additionally all patients were treated conservatively for at least 6 months prior to the operation. Following lymph vessel transplantation, the patients received antibiotics and low molecular weight dextran for the first week. Thereafter in most cases prophylaxis against erysipelas was performed by long-term penicillin for 6 months and use of elastic bandages. Volume assessments were performed by measuring several circumferences of the affected limb before and after surgery, as previously described [5].

In accordance with our in-house guidelines, 90–110 MBq of technetium-99m labelled nanocolloid (human serum albumin, volume <1 ml) was injected into the subcutaneous tissue of the first interdigital web on the dorsum of the affected leg, strictly avoiding intravascular application. Thin insulin needles were used to ensure...