Pathophysiology of Lymphedemas with Respect to Surgery

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1.1 Pathophysiology of Fluid Content

One essential element with respect to pathophysiology of lymphedema respects the fluid transport mechanisms within the lymphatic system. Lymphedemas are caused by an imbalance between the lymphatic fluid, which has to be cleared within a tissue area, e.g., an extremity, and the possibilities to transport this amount fluid out of the same area. Foeldi introduced the terms of the lymphatic load (LL) and the lymphatic transport capacity (LTC) (Földi 1971, 1985, Földi and Földi 2006).

Under normal circumstances, the lymphatic transport capacity surmounts the lymphatic load by far (Fig. 1.1). Therefore, damages to the lymphatic vessels are often without clinical consequences. There exist however regions, like narrowings or bottlenecks of the lymphatic system, where minor damages may result in a relatively large restriction on the lymphatic transport capacity (LTC). These are, for example, the axilla, the inguinal region, and the inner aspect of the knee. Furthermore danger for development of lymphedema occurs in cases of a diminished number of lymph nodes and lymphatic vessels like aplasias and atresias which may be the case in some primary lymphedemas (Kubik 1975, 1989; Brunner 1969). The ability to transport lymph is furthermore diminished by aging processes, perivascular fibrosis caused by radiation (Rubin and Casarett 1968), and by infectious alteration of lymphatic vessels. The other variable, the lymphatic load (LL), will be increased by infections, increased influx after venous compression, or an enforced working load. A sudden onset of lymphedema may be seen therefore years after the original trauma.

The pathophysiologic concept of the diminished transport (LTC) as origin for lymphedema leads to the surgical concept to overcome the diminished transport due to a localized lymphatic narrowing using a bypass procedure, an established method within vascular surgery (Fig. 1.2).

1.2 Pathophysiology of Non-soluble Contents

Imbalance between input and output of fluid is the primary origin of lymphedema. The disturbed function thereafter causes an alteration of the tissue composition within the affected area. Long time, mainly fibrotic tissue changes were mentioned as result of lymph stasis (Földi 1985; Földi and Földi 2006). However, the growth of fat tissue too was recognized as consequence of the lymph stasis. It is thought that lymphedema encourages lipid uptake (Ryan 1995).

The importance of fat was underlined by the clinical findings in long-standing lymphedema after decongestive treatment which showed almost only adipose tissue when collecting the suctioned material during treatment in lymphedema (Brorson and Svensson 1997).

Open surgical resection treatment procedures focus on the surplus of tissue and improve the shape of the edematous part by wide resections, including the skin, subcutaneous tissue, and optionally the fascia.

Modern strategies remove the surplus of adipose tissue by less-invasive methods like liposuction. The underlying disturbance of the fluid management of the lymphatic system is not corrected. Therefore recurrence has to be prevented by wearing elastic stockings continuously (Brorson and Svensson 1998).

Taking into account the vascular surgical option, it is possible to respecting the different aspects of lymphatic pathophysiology. This means first to restore the diminished lymphatic transport capacity, using the patient's own lymphatic vessels as graft, and second to resect the accumulated adipose tissue with the help of lymphatic vessel-sparing liposuction, if necessary and wished by the patient. This specific type of liposuction means that suctioning is only performed in longitudinal direction within an extremity, parallel to the direction of the main lym-

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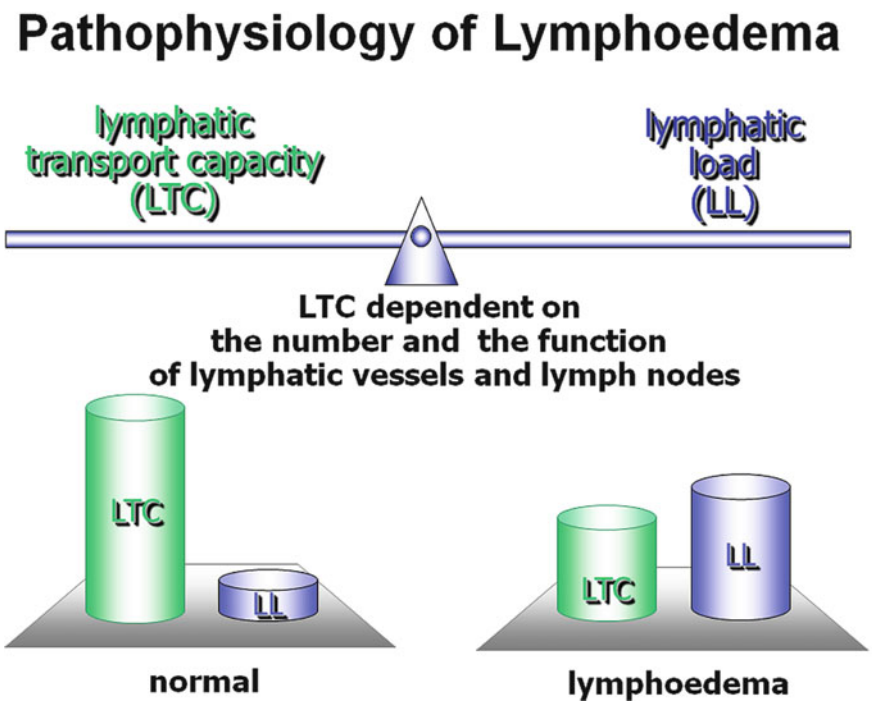

Fig. 1.1 Balance and imbalance of lymphatic fluid

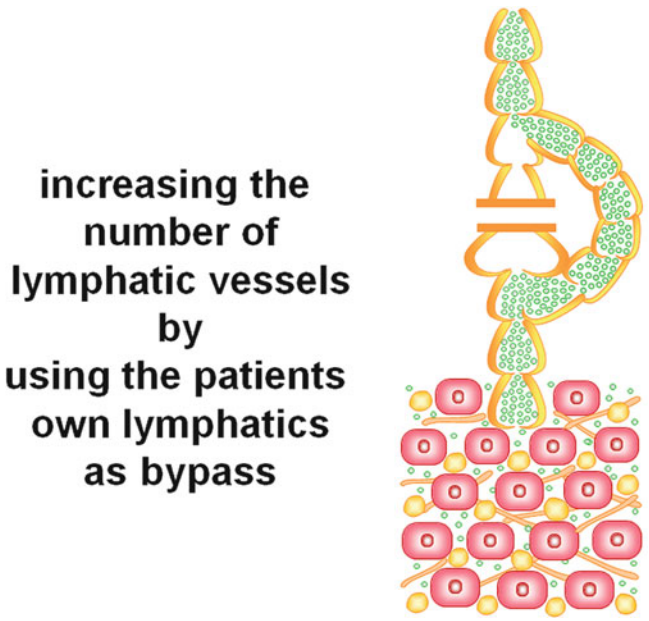

Fig. 1.2 Correcting the diminished lymphatic flow by a lymphatic bypass

phatic collectors. Extensive experimental studies have shown only minimal risk for the lymph vessels using the lymphatic vessel-sparing technique, especially in combination with a wet technique (Frick et al. 1999, 2006; Hoffmann et al. 2004).

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