Abstract The collateral lymphatic circulation is a very important clinical pathophysiological phenomenon. The presence of a collateral lymphatic circulation is a sign of an obstructed lymph outflow and depends on location of the obstruction and on developmental anatomy of the lymphatic system. Direct lymphography is the method of choice to study lymphatic pathways. The collateral lymphatic circulation was studied in patients with malignant metastatic lymph node involvement, in primary lymphomas, in filariasis, in protein losing enteropathy, and in patients with secondary postoperative and/or postirradiation therapy. The collateral lymphatic circulation demonstrated by direct lymphography shows various types of collaterals. We have divided them into the typical collaterals (cutaneous, subcutaneous, parietal, perivisceral) and atypical collaterals (lymphovenous communications, extravasation into cavities, internal lymphatic fistula). The various collaterals are described and demonstrated in this paper. Of special importance for surgeons and physiotherapists, are the cutaneous and subcutaneous collaterals crossing lymphoshed borders. The main goal for the surgeon is to recognize preoperatively not only lymphatic obstruction, but also existing lymphatic collateral pathways, and to try to preserve them.

Key words Lymphatic system · Lymphedema · Collateral lymph circulation · Lymphography

Introduction

The collateral lymphatic circulation is not only interesting from a radiological point of view; it also has significant clinical importance. So far, little consideration has been given to the importance of this pathophysiological phenomenon. The presence of the collateral lymphatic circulation is usually a sign and a result of an obstruction of lymph nodes or of lymphatic channels, or both. The most common cause of the lymphatic collateral circulation is metastatic involvement of lymph nodes; in the tropics and subtropical zones it is filariasis, due to Wuchereria Bancrofti and Malay infection [1,8,16]. Less frequently, lymphatic collateral circulation is due to congenital lymphatic anomalies [11], retroperitoneal fibrosis, primary tumors (especially non-Hodgkin lymphomas), or as an iatrogenic consequence of surgical interference with the lymphatic system, and also radical radiation therapy [2,3,9,12,13,15]. Direct lymphography is the method of choice, and also the most accurate type of examination for the study of collateral lymphatic circulation. We shall demonstrate some of the lymphatic collaterals in the region of the extremities and we shall also summarize collateral pathways in the pelvis and abdomen.

Materials and methods

From a total of 3000 extremity lymphographies, more than half (52%) of the patients were sent for investigation of a suspected malignant metastatic lymph node involvement. One-third of patients was referred as lymphomas (26%) or as a lymph node syndrome (7%). Various types of extremity edema represent the third most common indication for lymphography (9%). Only 6% of patients had lymphography for other reasons: extrapulmonary tuberculosis, trauma, chylolithiasis, chylourine, chyluria without filariasis, and protein-losing enteropathy.

The conventional direct lymphography, using the dorsum of the foot was performed by injection of 6–8 ml of Lipiodol-Ultrafluide (Byk-Gulden, Konstanz, Germany) or 4–5 ml in the upper extremity. A water-soluble non-ionic contrast medium (Iopamiro Bracco or Omnipaque Nycomed) was used at first in some cases with prominent extremity edema, to prove the patency of subcutaneous collectors and to avoid any damage of lymphatics and further impairment of lymph outflow. In primary lymphedema, we consider direct lymphography as a relatively contraindicated examination, unless it would result in an indication for surgery. Lymphangiograms and fluoroscopy were performed immediately after administration of contrast medium, and lymph flow was followed minimally to the area of regional lymph nodes. After 24 h, control lymphograms and chest X-rays were taken to evaluate the lymph nodes and to exclude rare pulmonary oil embolization.
Fig. 1 Secondary lymphedema of lower extremity. Xerolymphangiogram in negative mode shows occlusion of one collector and local cutaneous collaterals (dermal back flow). Also visible, typical lymphedematous subcutaneous tissues enlargement, with so called “honeycomb pattern”

Fig. 2 CT lymphangiogram of secondary lymphedema demonstrates dilated subcutaneous collectors and localized cutaneous collaterals (dermal back flow). There is also visible thickening of the skin and subcutaneous tissues and high density of affected subcutaneous fatty tissue (6.2 HU)

Fig. 3 Secondary arm lymphedema post mastectomy. Xerolymphangiogram shows occlusion and narrowing of subcutaneous collectors and diffuse dermal back flow, with transverse collaterals

Fig. 4 Secondary lymphedema. Xerolymphangiogram shows tiny cutaneous collaterals bridging obstructed subcutaneous collectors

Fig. 5 Secondary lymphedema post mastectomy, axillary dissection and irradiation. Xerolymphangiogram shows droplets of the contrast agent in brachial vein valves as a sign of lymphovenous communications