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Types of Collateral Lymphatic Circulation

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Summary

Types of collateral lymphatic circulation depend mainly on the topographic localization of lymphatic obstruction. We describe the main types of collateral lymphatic circulation and demonstrate some of them on the lymphograms.

Obstruction of the lymphatic circulation may result in different types of collaterals. Roentgenological signs of collateral circulation and of retrograde flow of contrast agent as seen on the lymphogram are: Filling of lymphatics in unaffected areas, delayed filling on the affected side, localized dilatation of afferent lymphatics, filling of subcutaneous, interstitial and deep lymphatics, ones which are usually not visualized, dermal back flow, filling of the parietal lymphatics, filling of the visceral lymphatics (leading to the opposite side), direct communications with the caval or the portal system, filling of the lymphatics which by-pass the obstruction, and extravasation of contrast media.

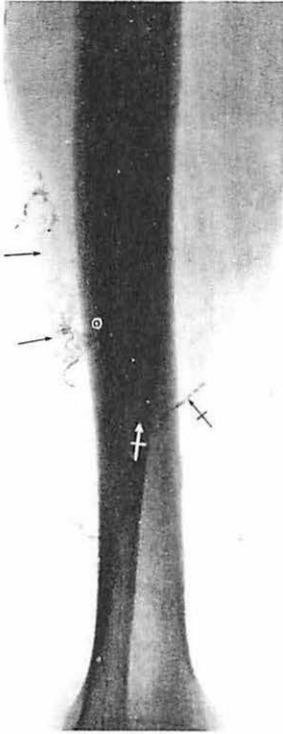


Fig. 1 SF, 59 years, following radiotherapy for carcinoma of the cervix. Patient developed thrombophlebitis of the lower extremity. Lymphatic obstruction. Cutaneous and subcutaneous collaterals filled (→). Filling of lymph vessels in unaffected areas. Flow toward the region of saphena parva (↗). Obstruction (O).

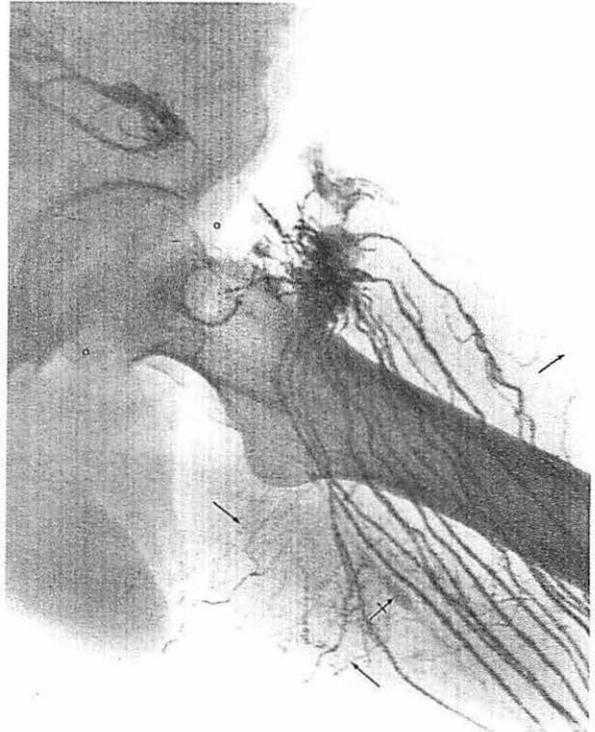


Fig. 2 CV, 32 years, following radiotherapy for carcinoma of the penis. Almost complete obstruction in the inguinal area (O). Dermal backflow with filling of the subcutaneous, interstitial (→) and deep lymphatics (↗).

The type of collateral lymphatic circulation depends on the topographic localization of lymphatic obstruction and on the anatomic variation of the lymphatic system in the individual patient (1, 2, 4, 6, 7, 12).

We shall describe the types of the lymphatic obstructions and the collateral lymphatic circulation which is most commonly associated with the lesions. We shall demonstrate these changes on the lymphograms.

1. Lymphatic obstruction in the *region of extremities* leads to the formation of collaterals in uninvolved areas. Complete obstruction of the superficial lymphatic trunk of the anterior compartment results in opacification of the deeper posterior channels. They fill via dermal and subcutaneous networks (12). Obstruction of the lymphatics of the saphena magna

region results in lymphatic collaterals in the saphena parva region and vice versa. Cutaneous, subcutaneous, interstitial and deep collateral lymphatics are commonly filled with contrast material (4) (Fig. 1).

2. Lymphatic obstruction in the *inferior inguinal area* causes usually complete blockage with the significant lymphedema of lower extremity. Lymphographic findings: Dermal backflow, extravasation of contrast agent, filling of the subcutaneous, interstitial and deep lymphatics of the thigh. Fig. 2 and 3.

3. Lymphatic obstruction in the *superior inguinal area* leads to collateral circulation via subcutaneous lymphatics of the thigh, of the external genital organs, mons veneris, anterior abdominal wall. The interstitial and deep lymphatics of the thigh are frequently filled, dermal backflow and extravasation of contrast agent are present.

4. Lymphatic obstruction in the *anterior pelvic area* leads to collateral lymphatic circulation via the subcutaneous and anterior wall of pelvic lymphatics and via the deep lymphatics of the perineum going to the opposite side. Interruption of the lymphatic circulation in one of the external iliac lymph nodechains may lead to the development of collateral circulation via remaining patent external iliac lymphatics. Lymph vessels situated medially serve as collaterals to the contralateral side (4, 7). Lymphatics of the anterior abdominal wall, dermal backflow and extravasations can be observed (Fig. 4 and 5).

5. Collateral circulation to lymphatic obstruction in the *posterior pelvic area* is via perivisceral lymphatics (perivesical, perirectal, periuterine) or the parietal lymphatics of the posterior wall of the pelvis — praesacral and the lower lumbar collectors (4, 7, 12). Extravasation of contrast media into the abdominal cavity and into the lumen of pelvic organs may occasionally be demonstrated by lymphography. In rare cases direct collaterals to the axillary region are formed (9). In some instances lymphatico-venous anastomoses are present (10, 11). Retroperitoneal lymph vessels and lymph nodes in the parietal lumbar region act as collaterals in the subtotal and total blockage of the posterior pelvic area. Fig. 6, 7 and 8.



Fig. 3 HM, 43 years. Patient with carcinoma of the sigmoid colon. Films taken 24 hr after lymphogram. Complete lymphatic obstruction in the inferior inguinal area. Extravasation of the contrast agent (→) and poor emptying of the contrast agent from the lymph vessels (⇔).

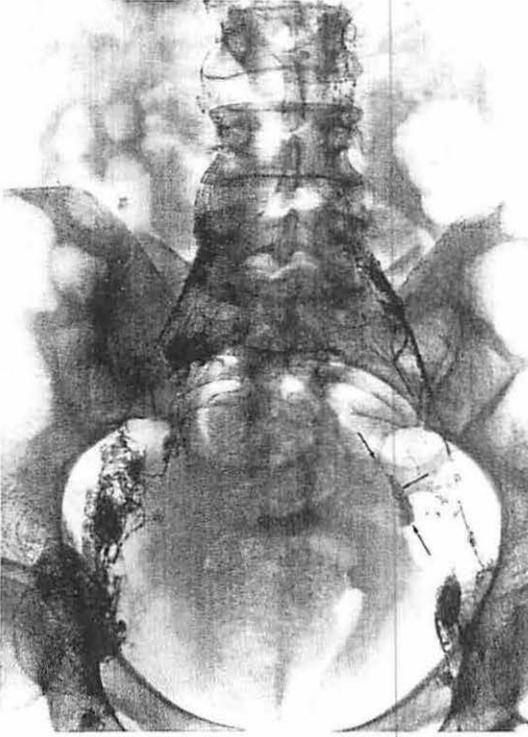


Fig. 4 SH, 47 years. Status after radiotherapy for carcinoma of the cervix. Partial obstruction in the anterior pelvic area. Extravasation of contrast agent into the abdominal cavity – the typical droplets of oil extravasation (→).

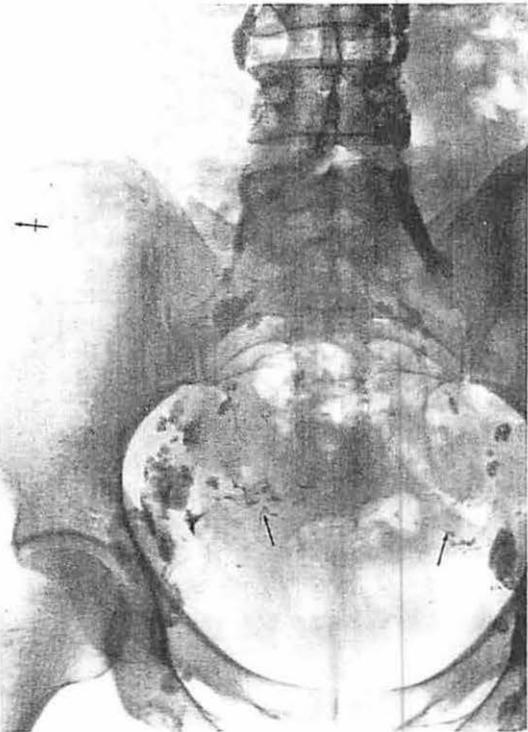


Fig. 5 Same patient 24 hr later. Contrast agent can be seen in the abdominal cavity between intestinal loops (→) and along the lateral wall of abdominal cavity (↔).

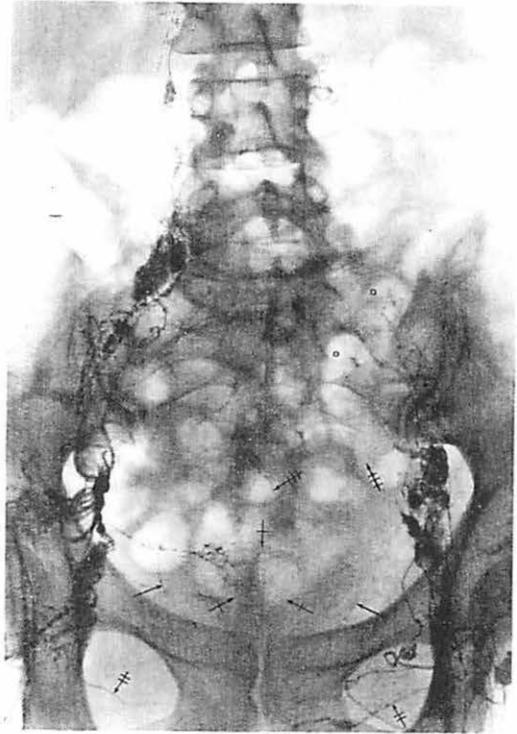


Fig. 6 53 years old female with carcinoma of the cervix, status after radiotherapy. Lymphatic obstruction in the posterior pelvic area of the left side (O). Visceral lymphatics – perivesical (→) and peri-uterine (↔), dorsal parietal (↔) and abdominal collateral pathways (⇔).

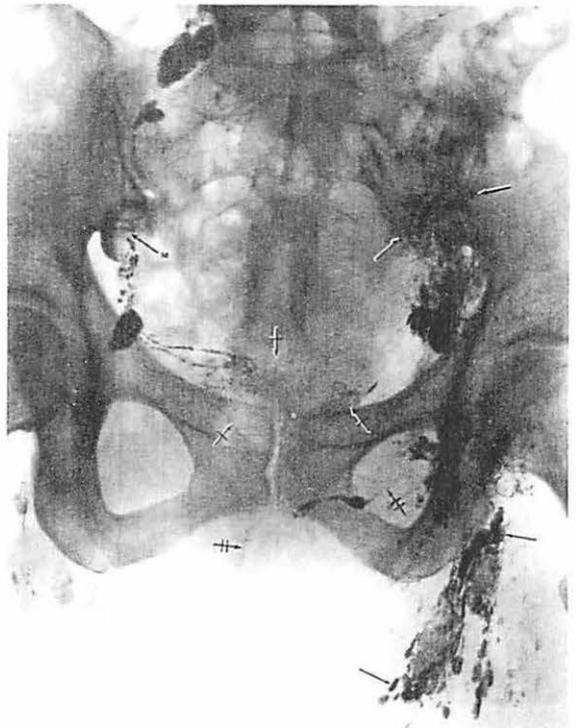


Fig. 7 24 hr films. Extravasation (→), contrast filling persists in the visceral (↔) and abdominal (labial) collateral pathways (⇔). Lymph node metastases (M).



Fig. 8 TŠ, 68 years old female following radiotherapy for recurrent carcinoma of the cervix. Complete lymphatic obstruction in the posterior pelvic area on the right side. There is also almost complete obstruction of the left side. Parietal presacral lymphatics (\rightarrow), lumbal paravertebral lymphatics (\leftrightarrow), peritumoral and perirectal lymphatics (\ast), extravasation into the abdominal cavity ($\ast\ast$).

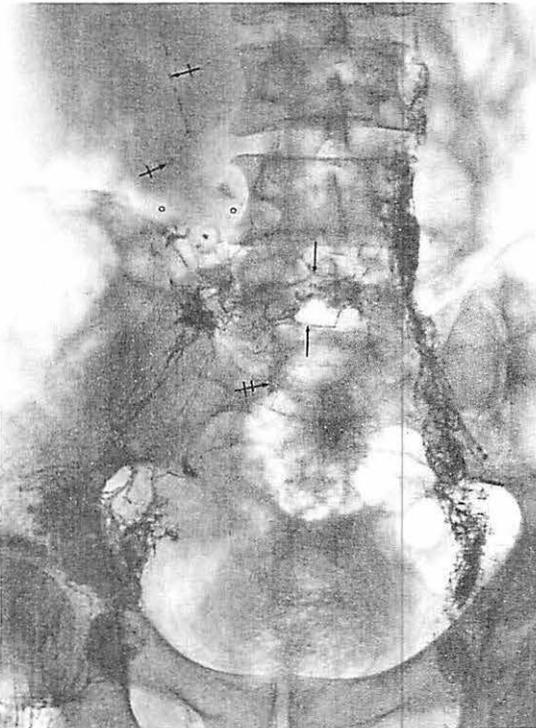


Fig. 9 KK, 50 years male with seminoma of the left testis. Patient was treated with orchietomy. Partial lymphatic obstruction in the right aortic region. Collateral circulation to the contralateral side (\rightarrow), filling of the deep parietal lumbal collaterals (\leftrightarrow) and initial filling of presacral pathways (\ast).

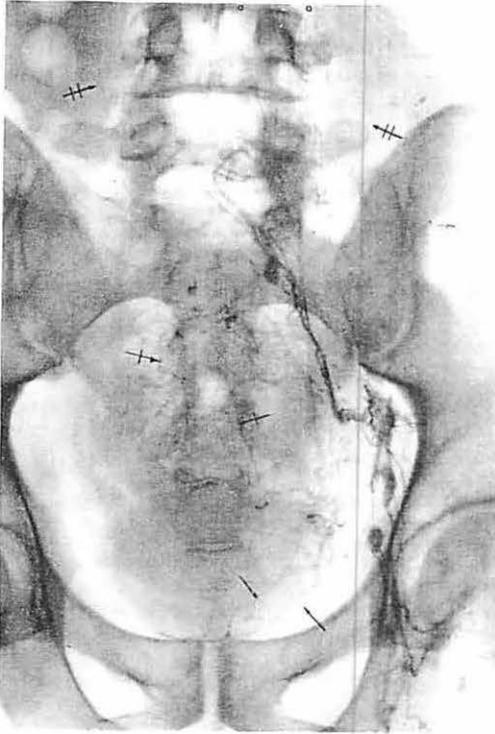


Fig. 10 KM, 27 years, with malignant lymphoma of the neck and retroperitoneum. Lymphatic obstruction in the left aortic region (O). Collateral circulation to the contralateral side via perivisceral (⇔) and parietal (→) lymphatics. Deep lumbar collateral pathways on both sides (**).

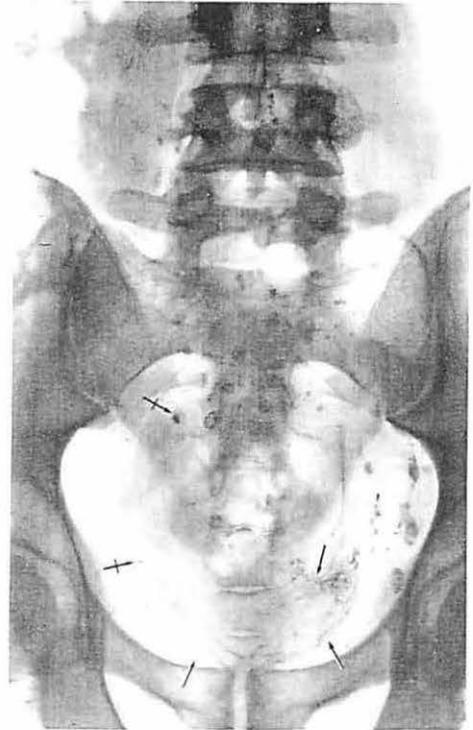


Fig. 11 Same patient 24 hr later. Contrast agent persists in the perivisceral lymphatics (→). The unaffected lymph nodes are filled (⇔). Lymphography was performed only from the left side.

6. Lymphatic obstruction in the *aortic region* is usually subtotal or partial. Unilateral obstruction of the aortic lymph vessels produces collateral lymphatic circulation to the lymph chains of the contralateral side. The unaffected lymph nodes situated distal of the malignant infiltration (of the obstruction) are frequently filled with contrast agent. Sometimes extravasation of contrast media into the abdominal cavity or into the lumen of abdominal organs occurs (4, 7). This type of lymphatic obstruction leads frequently to filling and dilatation of parietal lymph vessels. Dislocation of the lymph vessels has a limited value because of lymphatic variations and because of elongated arteriosclerotic abdominal vessels. Fig. 9, 10 and 11.

7. Lymphatic obstruction of the *thoracic duct*. Dilatation of lymph vessels causes valvular insufficiency and reflux of lymph may occur to the gastrointestinal, pleural, peritoneal, renal and hepatic lymphatics with consequent chylothorax, chylascites and chyluria which are demonstrated by lymphography. Contrast filling of collateral intercostal, mediastinal and axillary lymphatics is occasionally observed. Lymphatico-venous anastomoses to the caval or portal venous system occur. Chylous reflux is considered to be the most dramatic example of alteration of the normal lymphatic flow pattern by obstruction (12).

Discussion

The main cause of lymphatic obstruction are malignant diseases involving the lymph nodes and lymph vessels (2, 4, 7, 9, 10). Primary malignant neoplasms of lympho-reticular tissues "malignant lymphomas" may cause lymphatic obstruction in advanced stages. Surgical extirpation of lymph nodes, particularly when combined with wound infection or radiotherapy can also cause blockage with secondary lymphedema. Another cause for lymphatic obstruction is retroperitoneal fibrosis (4, 7, 12). Reactive hyperplasia of lymph nodes many rarely leads to blockage. Wallace et al. described collateral pathways in the perineural and perivascular sheath (12). It is difficult to ascertain when the contrast agent in perineural or perivascular sheath is lying primarily in a "collateral" or when it is only an extravasation. The extent of collateral formation depends mainly on the degree of obstruction (1, 2, 4, 7) and on the anatomic variation of the lymphatic system (12). The types of collateral lymphatic circulation were also studied experimentally (1, 3, 5) Belán, Mlék and Kolc demonstrated lymphatico-venous anastomoses by means of roentgen cinematography (3), Goldštejn found more easily formation of collateral circulation by acute infection or after sympatectomy (5). Collateral lymphatic circulation and lymphatic dynamics in certain states were described by the others (10, 11, 12).

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