

Observations on the Deep Lymphatic Circulation of the Limbs and on its Function

(The Deep Lymphatic Vessels in the Post-phlebotic Syndrome of the Lower Extremities)

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Summary

In 60% of patients with post-phlebotic syndrome lymphography of the lower extremity shows involvement of the deep system. In 77% of the patients there was increase in the number and caliber of the deep lymphatic vessels. They frequently appear elongated, tortuous, and ectatic but usually do not show signs of insufficiency. It appears as if these vessels act as collaterals and compensate for deficiencies of the deep venous circulation. Multiple lympholymphatic and lymphovenous communications have been observed.

Mascagni (2) in 1787 was the first to study the deep lymphatic system. He used extremities of cadavers. Mercury was used as contrast medium. Renewed interest in the deep lymphatic system arose approximately a century later as the result of the work by the French anatomists, and many investigators studied this system from different perspectives (10, 11, 12, 16, 17, 18, 19, 20, 21). Most of the studies were performed on cadavers and the reports utilized drawings of these observations. In 1956 one of us (E. T.) was able to radiograph the limbs which *Mascagni* prepared nearly two centuries ago. The specimen has been preserved at the Anatomical Museum of Siena. To our knowledge these are the first radiographic demonstration of the deep lymphatic system (Fig. 1).

In 1956 we described a technique allowing isolation of the lymphatics feeding the deep system of the leg. An incision is made posterior to the lateral malleolus (Fig. 2). In this area the lateral cutaneous dorsal nerve and a branch of the lesser saphenous vein are found

together with a large lymphatic vessel which at this point is fairly superficial but traverses into the deeper structures at a somewhat more proximal point. This vessel is straight and can

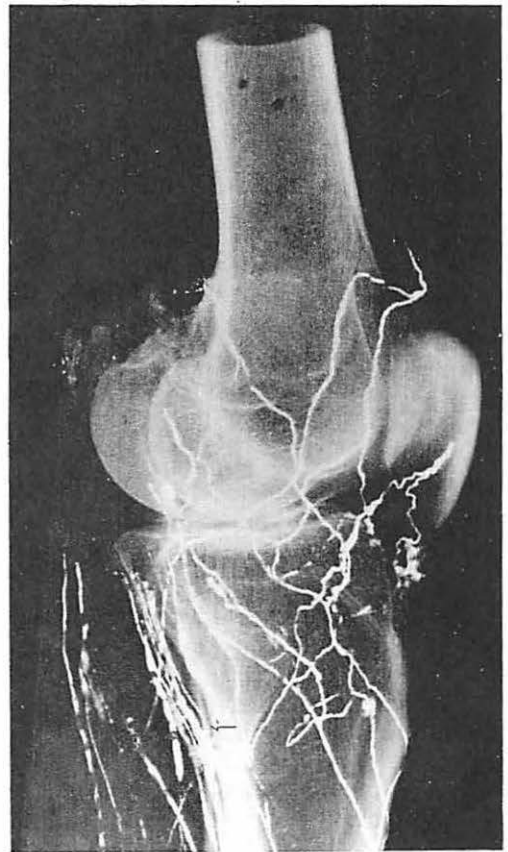


Fig. 1 Radiograph of the anatomic preparation of *Mascagni* prepared about 200 years ago. The lymphatic vessels have been filled with mercury.

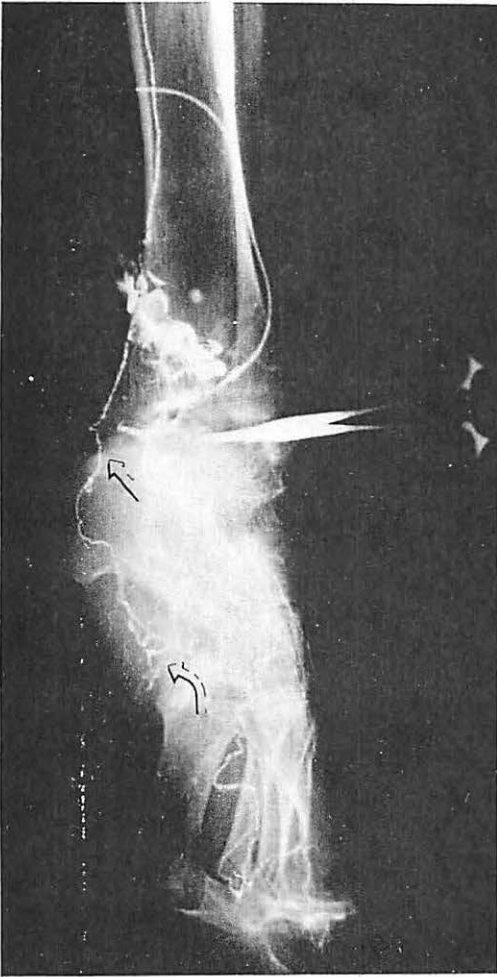


Fig. 2 Films taken at the end of injection of a deep lymphatic. There is some retrograde flow towards the toes (arrows).

easily be cannulated. The vessel then traverses along the tibia and reaches the popliteal lymphatics and nodes. Generally this is the only node filled. In patients with lymphedema it is conceivable that additional small glands (14, 15) may be filled. In a case studied by us, these nodes filled but all superficial lymphatics were blocked due to chronic inflammation (Fig. 3). The communications between the deep and superficial lymphatics are not clear although connections definitely exist. There is also some evidence to suggest

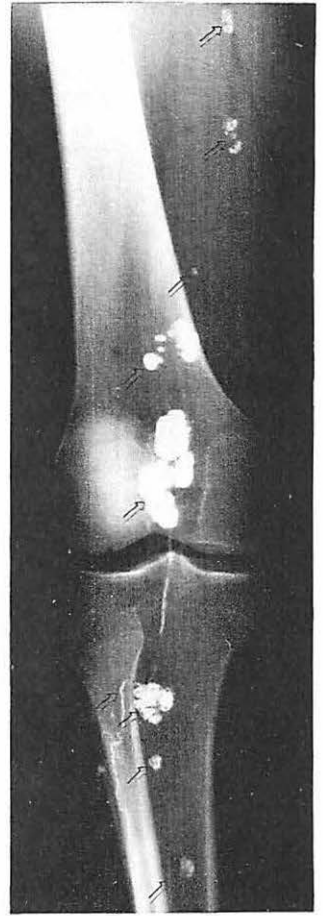


Fig. 3 "Ganglions interrupteur" of Rouvier's (arrows).

communication between the lymphatic system and the deep venous system in the calf (8).

Some confusion as to the terminology of the superficial-deep system exists. We designated these systems as superficial and suprafascial (E. T. 1956). *Kinmonth* (3, 4) described them as the deep system. The superficial or "suprafascial" lymphography has been performed for the past two decades yet little attention has been given to study of the "deep" lymphatic vessels of the leg in the post-



Fig. 4 Lymphogram of the deep system in a patient with post-phlebitic syndrome stage II. The popliteal gland appears enlarged and suggests a pattern seen in reactive hyperplasia.

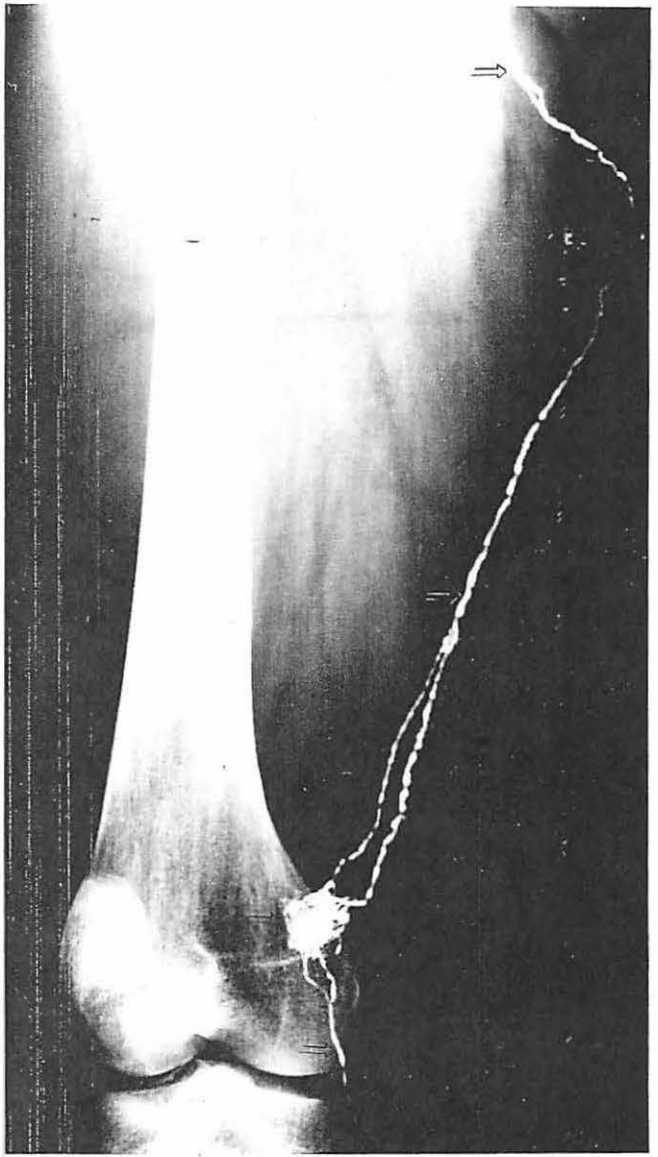


Fig. 5 Oblique view of the vessels in the thigh of a patient with post-phlebitic syndrome stage II. The vessels are dilated.



Fig. 6 Patient with stage III post-phlebotic syndrome. The single vessel of the calf bifurcates into numerous ramifications after reaching the region of the knee.

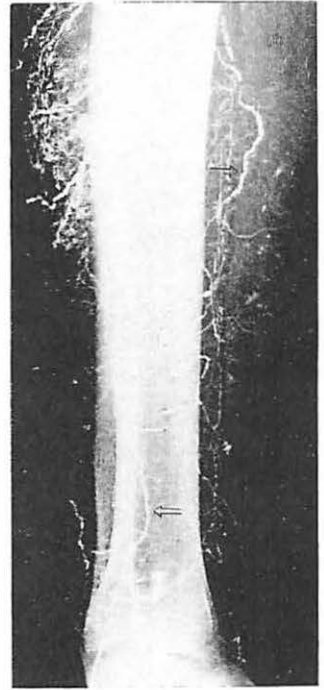


Fig. 7 Patient with post-phlebotic syndrome stage III. Numerous communications between the deep and superficial systems (arrows).

phlebotic syndrome. The purpose of this paper is to describe our results.

Materials and methods

Examinations were performed on nine patients with post-phlebotic syndrome; five males and four females. The patients ages were between 35 and 50 years. Two patients had disease stage II (Fig. 4, 5). The others were all stage III (Fig. 6, 7). Lymphography was performed by the Tosatti technique described above (4). All patients had venograms.

The lymphograms of six patients with post-phlebotic syndrome showed abnormal deep lymphatic circulation. Seven of the patients showed an increase in the number and diameter of the vessels which appeared lengthened, tortuous, and ectatic but without significant signs of insufficiency. One got the

impression that the vessels were compensating for the deficiency of the diseased venous system. Possibly because of the presence of fasciae and aponeuroses and the independence of the lymphatic system from these structures there were no clear signs of insufficiency.

Discussion

We believe that the multiple compartments of the lower leg which act as cylinders and control the hydraulic and hydrostatic pressure affect the venous and lymphatic circulation of the lower leg. It appears that the lymphatics are able to develop a compensatory collateral circulation and thereby be less affected by the rigid compartments which greatly affect the venous system.

Two additional observations were frequently made in our patients. First, the number of communications between the deep and



Fig. 8 Lymphatico venous anastomoses in patients with post-phlebitic syndrome (arrow).

superficial vessels were significantly increased in patients with the post-phlebitic syndrome. These communications are numerous and the caliber is wide (Fig. 6, 7). Second, lymphatico-venous anastomoses were frequently observed in the pelvis (Fig. 8). The superficial veins were usually abnormal and partially obstructed. The disease frequently extended into the deep system. Similarly, when these superficial lymphatic vessels were diseased the deep system was also involved. Yet in some patients, only superficial or only the deep system was involved. In some of these the deep lymphatic system remained normal but these findings are the exception to the rule.

It seems that the lymphatic system acts as a safety valve and attempts to compensate for the venous obstruction as well as for changes in the superficial lymphatic vessels. It is well known (13) that when both blood vessels and

lymphatics are obstructed edema distal to the obstruction is far more severe. Experimental work showed that if coronary arteries are ligated an infarct will develop faster than if the draining lymphatics are included in the ligature. Similarly, hydronephrosis will develop faster following ligature of the ureter containing its lymphatics or jaundice will develop quicker if the bile duct and its lymphatics are ligated. In patients with the post-phlebitic syndrome we ligated incompetent veins of the lower extremities if the pressure in these vessels was high. The rationale was to simulate the development of collateral circulation. We did notice that if the ligatures included adventitial and para-adventitial tissue the results were bad probably due to the fact that the lymphatics around these veins were inadvertently ligated. Therefore, we now take great care in isolating this adventitial tissue and not including it in the ligation.

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