A New Approach to Manual Lymphatic Drainage

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WE dedicate this work to our children
Ana Carolina, Lívia Maria and Henrique José
and to our parents
Perceu e Olívia, Manoel (*in memoriam)* and Aparecida

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PREFACE

For me, it was a great pleasure to receive the honour of Dr. Maria de Fátima Guerreiro Godoy and Dr. José Maria Pereira de Godoy, to be responsible by the peambule of the english translation of this important book about the Manual Lymphatic Drainage. For this achievement we wish the better success and difusion all over the world, that is affected by millions of peoples with the lymphedemas. Theses patients are unable, in the great number, to receive the better methods of treatment and mainly economic methods to be cured, as they are presented by the authors of the small book, so well written for everybody understand, and, the most important, is the presented with a so beautiful collection of colour photos to teach the minimal details necessary to cure without produce any damages on the lymphatic system.

The first pages are for the indispensable knowledge of the lymphatic anatomy, that is minutely writen from the feet up the head to make salient where we must begin to make first the massages for Lymphatic Manual Drainage by the cervical region, and only after cross to the all the trunk far from the part affected by lymphedemas. These massages must be done first on the no affected side and secondly on the affected side.

The second part analyse the fundamental physiology of the lymphatic circulation since the Casley Smith Studies well known, about the propulsive function of the heart and lymphagions, as are cited the micro-hearts around all the lymphatic system, with their important functions for the transport and lymph formation to bring back to the heart and to replace the plasmatic proteins that are lost daily, from the arteries and veins known as proteic cargo.

The lymphonodos are responsible to enrich the cells with immunologic function and plasmocytes. The lymphatic system helps the venous system to return the components of the blood from the interstice and products that were not possible return by the venous capillaries.

The third point is to describe the physiopathology of the lymphatic system, where together with the lymphatic insufficiency of drainage,

there is also the insufficient associated the proteolyse lymlymphatic of the protein from the cellular instertice. The opinion of Foldi about the lymphatic insufficiency dynamic, comparing to the heart, is discussed when are necessary to talk of the collateral vessels and lymphovenous anastomosis that appear to help the lymphatic flux and increase number of monocytes as macrophages for absorption of the proteins. The main etiology of lymphedemas well studied by Casley Smith are described mainly as pump of initial lymphatics on the primary lymphedemas and also secondary lymphedemas after resection of lymphonodes, filariosis and traumas, as mechanical types. Theses rich in protein lymphedemas are propitious to infection justifying the maximum cares on the hygiene of the skin and also the use of benzopyrones, diosmine and flavonoides drugs for the patients, together with special exercises with bandages to increase the back flow of the lymph.

The end of the book has printed in colour to present on the minimum but fundamental details on the techniques of Manual Lymphatic Drainage used by Vodder since 1936 in Paris, and now developed by Foldi in Germany and by Casley Smith in Australia and used wordly- wide successfully. The important is remove the excess of protein plasmatic of the interstice cellular to replace the equilibrium of the proteic cargo and capacity of transport of lymphatic system. Emphasize that massage must be delicate and superficial, to avoid compression of the muscles and produce lymphatic collapse without strong movements of compression and decompression, must begin by the neck with maximum care with the carotid glomus, up the limbs roots healty distaly. With this acts to sympathetic nervous system releasing, antalgic action, increase on the immunologic action over the lymphonodes and has a fundamental effect on lymphedemas when realize adequately by physiotherapists well trained.

The technique utilize enough delicate flexions over the lymph vessels with massages and possibilities to drain effective which slides over the lymphatics vessels, thanks one external massage and continues, which mobilize the lymph.

The rich color iconographies shows how must be done from

the head up the feet, by the front and dorsal of the trunk and also the genitalia.

We must avoid circular massages contrary movements to these reflux of the lymph. The anatomic knowledge is important mainly on the neck to avoid the carotid glomus important.

Now, we are able to speak to patients with lymphedemas that is possible to cure, if they follow correctly the lessons so clear in this book, using always bandages, hygiene severe and after to follow the Manual Drainage Lymphatic and exercise with adequate elastic bandages around the legs under a supervisor of the lymphologist and therapists well trained.

This small book very much useful for people with lymphedemas problems to be well treated in any part of the body. For these patients without possibility and economical conditions disposable to be perfectly treated is the better published in english and the original in Brasilian language.

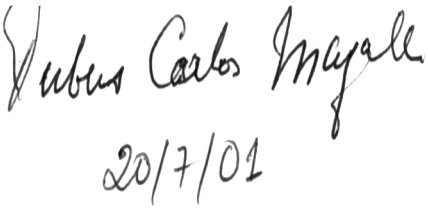
After a short internal hospital of two weeks, a patients well trained will be able with the help of a kins man, at home to follow alone, all the basic rules and fundamental to be cured by the medical conservative specialised treatment of the first degrees of lymphedemas any conservative treatment more specialised and of surgical including the microlymphatic surgery will be now possible in somes cities of Brazil, Argentina, France, Italy, Belgium and U.S.A were I have visited, that include now São José do Rio Preto. With Dr. Godoy and his wife, occupational therapist are working.

The method proposed inthis book it is without arm' s reach recommended for everybody and paid by any social insurance company modern shape. The necessary material indispensable easily found in Brazil, mainly in São José do Rio Preto, where the book was printed by Lin Comunicação, as editor Rua Luiz Edmundo Galo 471,São José do Rio Preto - São Paulo - Brazil, where Dr. Godoy and Dr. Maria de Fátima are members of the big hospital of 1000 beds of the School of Medicine very well equiped in vascular diseases and surgery will all theses humans elements at disposition, the medical and surgical of the lymphedemas are predestinate for the maximum

success how was possible to verify in the minimum details, in loco, and all teams of the diferentt services of the hospital.

As a veteran of 60 years of angiology and 50 years interested on lymphology it was a great pleasure to visit and know all this progress in the hinterland of Brazil.

This was na example of the high capacity to be followed by everybody interested on lymphatics problems that are helping to find better methods and for economical ways to be treated.



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SUMMARY

INTRODUCTION

Manual lymphatic drainage is little known in Brazil even by angiologists and vascular surgeons; consequently it is almost never performed. Few clinicians are interested in the treatment of lymphedema, thus leaving patients without adequate treatment of this condition.

I met with many difficulties to master this technique. However, colleagues such as Dr. Mauro Figueiredo and Dr. Daniel Vogelfang stimulated me to study lymphatic vessels. Such motivation led me to look for courses outside Brazil; I thus had the opportunity of getting to know the work of doctors Földi, Casley-Smith, Blanc, Leduc and others all of whom contributed towards my formation. After getting to know the approaches of different schools of lymphology, in collaboration with my wife Fátima, an occupational therapist, we developed a new technique of approaching lymphatic drainage, which was evaluated during the last two years.

Lymphatic drainage is performed by medical doctors, physiotherapists, occupational therapists, nurses . Professionals of correlated areas have performed this technique at times, under the supervision of specialized doctors in Brazil and all over the world. It is important for these professionals to recall the knowledge of human anatomy and physiology acquired during their college years, in order to better assimilate the technique. However, approach to this treatment as well as responsibility for it, belongs to the doctor who should accompany its evolution step by step. It is known that lymphatic drainage performed in an inadequate way can bring complications to the patient, becoming in such cases, more damaging than if it had not been performed.

The objective of this book is to divulge a new technique of lymphatic drainage, easy to understand and to perform, aimed at safety in its application and bringing benefits to lymphedema patients.

The technique described here can even be performed by the patient himself, under medical guidance, which renders it a technique of lymphatic auto-drainage.

ANATOMY OF THE LYMPHATIC SYSTEM

The lymphatic system is a part of the circulatory system, made up by an extended network of capillaries, vessels, trunks, ducts, as well as other aggregated structures like lymph nodes, the spleen and the thymus.

It is a low-pressure drainage system, similar to the venous one, having two important functions: as part of the circulatory system, one is to carry lymph; the other is an immunological function.

The lymphatic system spreads as a network over the whole body; it is initiated by lymph capillaries that join with each other to form the pre-nodal collectors. Several of these collectors (afferent vessels) progress towards the lymph nodes; upon leaving them (post-nodal) they are called efferent collectors, which normally are in a lesser number than the afferents reaching the lymph nodes. The efferent collectors progress to form the lymphatic trunks that will constitute the lymphatic ducts. These ducts are vessels of the final part of the lymphatic drainage system, which flows into the venous system at the level of the subclavian-jugular junction.

Near their origin these vessels frequently anastomose constituting a real network, becoming less frequent as their caliber increases.

Lymphatic capillaries

Lymphatic capillaries are also known as initial lymphatics. They originate in blind depths shaped like the fingers of a glove, which unite to form the afferent or pre-nodal collectors. They are 15 to 75 microns in diameter, and 0.5 mm in length and formed by a single layer of endothelial cells, presenting a discontinuous basal membrane. The cells are bound to connective tissue by small fibrils, which appear to be extensions of plasma proteins allowing their opening and facilitating the interchange between fluids and proteins.

Lymphatic collectors

Lymphatic capillaries join to form larger vessels called collectors, whose walls are more structured, showing a more developed membrane and bicuspid intralymphatic valves. The first valves are located near the beginning of the collectors. Intercellular junctions get closer, are permeable to water and small molecules, but gradually become impermeable to larger size molecules. The direction of lymph flow is ascending, passing through the cortical and medullar lymph node sinusoids and emerging from the efferent collectors constituting the post-lymph node lymphatics. As a general rule, lymph crosses one or more lymph nodes prior to entering the blood stream and tends to follow the direction of the venous drainage.

Compared to veins, lymphatic vessels have a greater amount of anastomoses, but a much smaller size. Perforating lymphatic vessels communicate these two systems at the level of the dermis. Lymphatic valves present a semilunar format, with their free concave border placed in the direction of lymph flow; in order to avoid lymph reflux they are more numerous close to the lymph nodes, specially in the limbs and neck.

Lymphatic trunks

Lymphatic trunks are formed by lymph vessels emerging from specific groups of lymph nodes, to constitute the corresponding trunks. There are eleven of them and each trunk drains a corresponding region of the body. We possess lumbar, intestinal, broncho-mediastinal, subclavian, jugular and descending intercostal trunks. Lumbar trunks for example, are responsible for the drainage of the lower limbs and other regions. These trunks drain towards vessels of a greater diameter, denominated the right lymphatic and the thoracic duct.

Lymphatic ducts

There are two lymphatic ducts: the right one drains the upper part of the right side of the body; the thoracic duct drains the left side and the remaining part of the right side of the body.

Areas of lymphatic drainage of the lymphatic ducts, right side stippled in blue, and thoracic in green lines.

These ducts are vessels of a larger caliber discharging into the venous system, carrying lymph from the whole body to the blood vessels generally at the junction of the subclavian and the jugular veins on each side. Thus, the whole system of drainage (blood and lymph returning to the heart), of all fluid and substances mobilized by the circulatory system, is completed. The ducts are around 2 mm in diameter and possess three to four valves.

Lymphangion

The vessel segment located between two valves .is called lymphangion. .One of its important characteristics is its inherent contractility that renders it capable of impelling lymph as if it were a "mini-heart". Lymph propulsion starts from near-rythmic contractions controlled by the nerve terminals in the adventitious layer of the lymphangions and by the distension of its walls.

Lymph nodes

Lymph nodes are ovoid or reniform structures one to 25 mm in length. They are formed by agglomerate of reticuloendothelial tissue

surrounded by a connective tissue capsule.

There are around 600 to 700 lymph nodes in our organism. Lymphoid tissue represents from 2 to 3% of the body's weight.

Lymph reaches the lymph nodes via afferent collectors passing through lymph follicles where it is filtered and where particles are eventually retained. During this passage, the lymph receives lymphoid cells prior to reaching the efferent vessels.

Lymph nodes perform two important functions: filtration and production of cell defense. Thus, the lymphatic system removes fluids and substances which can not return to the venous system via the lymph vessels, passing through the lymph nodes which act as filters; it also functions in the production of defense cells.

Each half of the body presents three large groups of lymph nodes, Inguinal, axillary and cervical, through which passes the drainage from three large territories.

Inguinal lymph nodes receive lymph vessels from the lower limbs, perineum, external genitalia, and the infra-umbilical trunk. Lymph vessels from the upper limbs, supra-umbilical abdomen and trunk up to the half-height of the nucha, converge to the axillary lymph nodes; cervical lymph nodes receive lymphatics from the head and the trunk.

Topography of Lymph Currents

Head Lymphatics

All lymphatic vessels of the head and neck drain, in the last instance, into the deep cervical lymph nodes by means of groups of lymph nodes constituting the so-called cervical collar, located at the level of the junction of head and neck, as shown on Figure 2.

A – Infra-orbital or maxillary lymph nodes
B – Buccal lymph nodes
C – Submental or suprahyoid lymph nodes
D - Parotid lymph nodes
E - Mandibular lymph nodes
F – Retroauricular or mastoid lymph nodes
G – Occipital lymph nodes
H - Submandibular lymph nodes

Superficial and deep lymph nodes in the region of the head (arrows indicate the direction of the lymphatic currents). Note the confluence of the lymph drainage at the level of the submandibular lymph nodes

The lymphatic drainage of the head (Figure 2) is effectuated by four main currents: anterior, parotid, occipital and retro-auricular or mastoid. The anterior or facial lymphatic is made up by three groups of lymph nodes: infra-orbital or maxillary localized in the nose, cheeks and zygomatic arches; buccal, superficial to the buccinator muscle; and mandibular at the level of the external face of the mandible, anterior to the masseter muscle. The anterior lymphatic current receives lymph afferents from the frontal and anterior facial areas which drain into the submandibular lymph nodes, except those at the regions of the chin, and the lower lip, which flow into the submental lymph nodes. The parotid lymph current drains the lateral portion of the face including eye lids, the root of the nose and the anterior area of the external acoustic meatus, reaching the superficial parotid or pre-auricular lymph

nodes which in turn, drain the deep parotid lymph nodes, and afterwards the deep cervical nodes. The retroauricular current in its turn, contains the lymph from the posterior region of the external acoustic meatus and the temporo-parietal region, draining into two mastoid or retroauricular lymph nodes located over the insertion of the sternocleidomastoid muscle and deeply, the posterior auricular muscle. In turn, the occipital lymphatic channel receives drainage from the occipital area and flows into lymph nodes of the same name, one to three of which, are found adjoining the postero-superior border of the trapezius muscle, at the level of the insertion of the semispinalis capitis muscle.

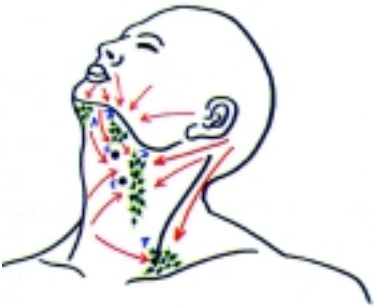
The ear has a mixed lymphatic drainage through the retroauricular, deep upper cervical and parotid lymph nodes, while the scalp is drained in the direction of several pericervical collar lymph nodes. The deep facial lymph nodes are located deep to the mandible ramus, on the external side of the lateral pterygoid muscle, in intimate relation with the maxillary artery, draining the temporal and infratemporal fossae and the anterior nasal portion of the pharynx. The lymphatics of the upper lip (and the lateral parts of the lower lip), drain into the submandibular lymph nodes, while lymph from the chin and the central area of the lower lip is discharged into the suubmental lymph nodes, which derive towards the jugulo-omohyoid lymph nodes. Two or three lingual lymph nodes are localized over the hyoglossus muscle and deep to the genioglossus muscle. They constitute lymphatic sub-stations directed towards the deep submandibular and cervical lymph nodes. One to three retropharyngeal lymph nodes are found anteriorly to the arch of the atlas, and posteriorly to the longus capitis muscle, being responsible for the lymphatic drainage of the nasal cavities, posterior nasal part of the pharynx and the auditory tubes. They drain into the deep cervical lymph nodes.

Lymphatics of the Neck

The superficial cervical lymph nodes are located alongside the external jugular vein in the posterior neck trigone, superficially to the sternocleidomastoideus muscle and along the anterior jugular vein's

course in the anterior cervical trigone, directing it's lymphatic efferent towards deep lymph nodes. Didactically, they are divided into an upper group that pierces the thyrohyoid membrane, and an inferior one.

The upper tissues of the neck are drained towards three to six submandibular, submental and occipital lymph nodes, and towards



Superficial and deep lymph nodes of the neck

A – Submental or suprahyoid lymph nodes
B - Submandibular lymph nodes
C - Digastric-jugulo lymph node
D - Deep superior cervical lymph nodes
E - Jugulo-omohyoid lymph nodes
F – Deep inferior cervical lymph nodes

the superficial and deep cervical lymph nodes.

The deep lymph nodes of the neck are localized near the internal jugular vein, deep to the sternocleidomastoid muscle, presenting a posterior direction to the course of the inferior accessory nerve following the subclavian vessels. The jugulo-digastric lymph node is found inferiorly to the posterior bulge of the digastric muscle, at the level of the larger horn of the hyoid bone; it receives numerous lymphatic affluents from the posterior third of the tongue and the palatine tonsil.

Thje jugulo-omohyoid lymph node is situated above the internal jugular vein, superiorly to the intermediary tendon of the omohyoid muscle, receiving lymphatic efferents from the tongue and the submandibular, submental and deep cervical upper lymph nodes. The deep cervical lymph nodes localized above the internal jugular vein, and mainly the jugulo-digastric lymph node, coexist at the site of convergence of efferent lymph nodes from parotid, retromandibular, occipital, submandibular and submental lymph vessels.

A group of deep lymph nodes called supraclavicular, located in the occipital cervical trigone, follows the course of the transversal artery of the neck. Other neck lymph nodes include the pre-tracheal and pre-laringeal nodes (both receiving lymph vessels which cross the elastic cone of the larynx, paratraqueals and retropharyngeals). The

lymphatic vessels of the upper portion of pharynx, go to the retropharyngeal lymph nodes, while those of the lower region, disembogue into deep cervical lymph nodes. The thyroid gland presents a double drainage, through deep cervical upper cervical lymph nodes and pretraqueal and paratraqueal lymph nodes. The final collector trunk of the head and neck regions is called the jugular lymphatic trunk and consists of the union of lymphatic vessels coming from deep cervical nodes which discharge at the side or the right antimere, at the level of the right lymphatic duct and, on the left side, into the thoracic duct, even though variations of the outlet of lymphatic trunks at the level of the neck, are frequently found.

Lymphatics of the Upper Limbs

Lymphatic drainage of the upper limbs (Figure 4) is mainly effected through the superficial system via the lymphatic currents. These currents can be divided into six groups, located in the proximal region of the upper limb (shoulder and arm), and four groups found more distally in the forearm and hand. The six lymphatic currents of the proximal portion are subdivided into three anterior (basilic, cephalic and pre-bicipital), and three posterior (posterior, postero-lateral and postero-medial) portions. In the distal region of the upper limbs. the four lymphatic currents are regrouped in two anterior (anterior radial and anterior ulnar), and two posterior (posterior radial and posterior

A – Ulnar lymph nodes
B – radial lymph nodes
C – Interosseous lymph nodes (anterior and posterior)
D – Supratrochlear lymph nodes
E – Brachial lymph nodes
F – Deltopectoral lymph nodes

Lymphatic ways (superficial and deep) and lymph nodes of the upper limbs. Arrows point in the direction of lymph flow towards the region of the axilla and the shoulder.

ulnar) currents.

The deep lymphatic drainage possesses six currents: two in the proximal brachial and deep brachial and four inclines in its proximal deep ulnar, deep radial, anterior osseous and posterior osseous regions.

The superficial lymph nodes of the upper limbs can be found at the level of the arm (one or two supratrochlear lymph nodes) along the basilic vein and in the shoulder (one or two deltopectoral lymph nodes, adjacent to the cephalic vein in the deltopectoral cleft). The superficial lymph nodes reach the axilla, where they pierce the deep fascia, the same occurring with the deep chain.

The deep lymph nodes are located in the arm, in intimate contact with the brachial vessels, are therefore called brachial and deep brachial lymph nodes. In the forearm they are anteriorly, posterior radial, ulnar and interosseous, and posteriorly, posterior interosseous lymph nodes. The twenty to thirty lymph nodes of the axillar region, can be mainly found against the lateral face of the thoracic wall and are divided into five draining groups, responsible for lymphatic afferents of the whole upper limb, most from the mamma, the skin of the ipsilateral hemithorax, the supraumbilical portion of the abdomen and

A-Anterior or thoracic and apical group
B-Lateral group
C-Posterior or subscapular group
D-Central or intermediary group
E-Medial or apical group

Groups of lymph nodes of the axilla. The importance of the terminal lymphatic affluence towards central and apical axillar lymph nodes is brought out.

the dorsum.

The anterior lymph node, or lateral thoracic or pectoral group, is placed along the lateral or inferior border of the pectoralis major muscle and the lateral thoracic veins. It consists of three to five lymph nodes and receives lymph from the supra-umbilical abdominal region and the greater part of the mamma. The posterior or subscapular group with six or seven lymph nodes, is localized anteriorly to the subscapular muscle and vein (at the level of the lateral border of the scapula) and performs lymphatic draining of the muscles of the neck, the upper part of the shoulder and the dorsum. The lateral lymph node group has three or four lymph nodes, is found posteriorly to the axillary vein and is responsible for receiving the lymph of the upper limb. The intermediary or central group, placed medially to the lateral group, establishes connections with anterior, posterior and lateral groups, forming the most numerous and palpable group of axillary lymph nodes. Finally, the medial or apical group with up to six to 12 lymph nodes, is found above the superior border of the pectoralis minor muscle, medially to the axillary vein and posteriorly to the clavipectoral fasciae, receiving lymph vessels from the other groups and eventually, the mamma. The apical lymph nodes unite to form two or three subclavian trunks which discharge to the right, into the right lymphatic duct, and to the left, into the thoracic or eventually, into deep inferior lymph nodes. Generically, the lateral and central groups present from 10 to 14 lymph nodes each, while the other groups are made up of one to seven lymph nodes each. At the level of the upper and lower limbs there are lymph currents which do not drain into axillary lymph nodes, being called derivative ways. In the upper limb they may be found at the level of the cephalic vein, the cephalic current and in the direction of subclavicular and posterior scapular lymph nodes or posterior current. Another derivative way consists of a group of infraclavicular lymph nodes arranged over the cephalic vein, occasionally responsible for the lymphatic drainage of the shoulder or communication with the deep, inferior cervical lymph nodes. Lymphatic ways of the mamma at the skin level or at the pectoral fasciae, may reach the opposite axilla via parasternal

lymphatics, or establish connections with the subperitoneal and subphrenic plexuses, with lymphatics of the rectus abdominis sheath, with apical lymph nodes through the pectoral muscles and the internal thoracic lymph nodes.

Lymphatics of the Lower Limbs

Superficial lymphatic drainage of the lower limbs is distributed in the subcutaneous screen in the form of its six currents: four proximal routes at the level of the thigh (which subdivides into two anterior currents, that of the saphena magna or anteromedial vein and that of the anterior accessory saphenous or anterolateral vein originating exclusively in the thigh, and of two posterior currents, posteromedial and posterolateral of the thigh). The two superficial distal lymphatic routes along the foot and the leg, constitute currents of the saphena magna and saphena parva of the leg, the later presenting one or two trunks. The current of the saphena magna or anteromedial of the leg, ascends medially receiving from three to seven lymphatic affluents, including those from the posterolateral current of the leg at the site of the femur's medial condyle, from where it proceeds as an antero-medial current of the thigh. The deep lymphatic currents in turn, ascend along the blood vessels (two or three lymphatic vessels for each artery), presenting two proximal branches in the thigh and three distal ones, an anterior or anterior tibial current and two posteriors, tibial posterior and fibular, located in the foot and the leg.

The superficial lymph nodes of the lower limbs are more numerous than the deep ones, being composed of three to 14 units or even 20 nodes. They are situated at the level of the subcutaneopus screen, in parallel and 1.00 cm distal of the inguinal ligament and along

A - Anterior tibial lymph node
B - Popliteal lymph node
C - Saphena magna lymph node
D - Intersaphenous lymph node
E - Lateral accessory saphenous lymph node
F - Superficial circumflex ileum lymph node
G - Superficial epigastric lymph node
H - External pudendal lymph node
I - Cloquet's lymph node

Lymphatic drainage (superficial and deep) of the lower limbs, anterior view.

the proximal portion of the saphena magna vein, relating to the inguinal and popliteal regions and their respective vessels.

Thus, there are found lymph nodes of the intersaphenous, of the saphena magna, of the lateral accessory saphena, of the superficial ileal circumflex, of the superficial epigastric and of the external pudendal. The superficial lymphatic drainage is preferentially directed towards the intersaphenous, the saphena magna and the lateral accessory lymph nodes or inferior lymph nodes, normally the only ones. In contrast, the usually multiple upper lymph nodes, consisting of the superficial circumflex chain of the ileum, the superficial epigastric chain and the external pudendal chain, are responsible for receiving lymphatic drainage from the gluteal, infraumbilical portion of the abdominal wall, anus and the anterior and lateral sites of the external genitalia. At the popliteal fossa, the superfical, frequently odd numbered superficial popliteal lymph nodes are found; they receive lymph coming from the lymphatic current of the saphena parva.

The deep lymph nodes of the lower limbs (one to three nodes), are found in the leg, the popliteal fossa deeply to the outlet of the saphena parva vein and in the inguinal region at the medial face of the

femoral vein, deeply from the fascia lata. The deep inguinal face which has few lymph nodes, receives lymph from the efferent lymphatic vessels adjacent to the femoral and popliteal veins and shows laterally to the lacunar ligament, at the femoral annulus, the deep, constant or Cloquet's lymph node. In the leg, the lymph nodes are juxtaposed to the arteries. Thus, one sees the small and inconstant anterior tibial, the posterior tibial and fibular nodes receiving lymph deeply from the foot and the leg. There are one to five, or at most, seven to 10 deep popliteal lymph nodes, localized deeply to the popliteal fascia, containing deep lymph originating from the foot, leg and thigh.

Three subdivisions of retro-popliteal nodes, posterior to the popliteal vein, are localized inferior-and superiorly to the outlet of the saphena parva vein; another, more proximal relative to the anterior, is also seen. The other six lymph nodes of the fossa poplitea (three laterals and three medial ones) follow the genicular arteries and are denominated medial and lateral popliteal lymph nodes. The remaining lymph node (the only one), is placed anteriorly to the popliteal artery, the anterior or pre-arterial popliteal lymph node. All lymphatic popliteal efferents follow the femoral vessels, and end at the deep inguinal lymph nodes.

Paths of communication between superficial and deep lymph drainage of the lower limbs occur through perforating lymphatic rami as well as via communicating rami existing between superficial inguinal lymph nodes for lymph drainage of the vulva. Approximately 24 efferent lymphatic vessels leave the superficial and deep inguinal lymph nodes. Those from the lower limbs drain in a last analysis into the external illiac and common lymph nodes, reaching aortic lumbar nodes, which in turn form the lumbar trunks which end by draining into the thoracic duct.

Fernando Batigália
José Maria Pereira de Godoy

PHYSIOLOGY OF THE LYMPHATIC SYSTEM

General considerations

In order to better understand the lymphatic system we will here make brief considerations about the circulatory system.

The circulatory system is a closed circuit formed by the heart, arteries, veins and lymphatic vessels, which change their sizes according to their localization and function.

Blood may be understood as a large circulatory organ, assuring nutrient supply to all cells of our organism. In addition, it removes and circulates all that has been produced at the local level, using the circulatory system as a conduit, and ventricular systoles to allow the pumping of blood.

The heart functions as "pump" which at each ventricular systole develops arterial pulse pressure, impelling around 70 ml of blood into the aorta and a wave of the arterial pulse propagated in the direction of the microcirculation. The return of this blood to the heart is made by the venous system (veins) aided by the lymphatic system which while carrying not blood, but lymph, acts at the absorption of liquids and proteins, thus completing this circuit.

An irrigation system (arterial system) and two draining systems represented by the venous and lymphatic systems, and two types of circulating fluids, blood and lymph, should therefore be observed here. We also have the cell interstitium, which functions as an interface for the exchange of fluids and nutrients between cells and the blood current. Everything that leaves and enters the vessel passes through the interstitium.

Interstitial tissue is made up by a fibrillar structure of elastic, reticular fibers, and collagen. Between them exists the matrix, formed by a the ground substance, composed of a "gel" phase rich in colloids, and another phase of "sol" form rich in water and small diluted molecules. The ground substance is basically made up of

mucopolysaccharides called glucosaminoglycans (hyaluronic acid, chondroitin and dermatan sulfates and keratosulfates). The liquid of the intersititum is supplied by the blood vessels. Molecules leaving the blood capillaries reach the lymphatic system after passing through three barriers: capillary endothelial, interstitial space and endothelium of the lymphatic capillary.

The endothelial barrier is very tenuous in its terminal portion, behaving as a semipermeable membrane, permitting the outflow of water and small molecules, mainly of a liposoluble nature.

In 1978, Casley-Smith observed the formation of endothelium-free channels in the cell interstitium, called pre-lymphatic.

Another important components present in the interstititum are the macrophages which phagocytize surplus protein. The pressure of the interstitium depends on its physicochemical state, liquid volume and lymphatic and venous drainage.

Vessels of a greater caliber have basically a transport function the objective of the circulation being metabolic exchange, occurring only at the microcirculatory level, more specifically, at the capillaries.

The circulatory system contains around five or six liters of blood, 80% of which in veins, 15% in arteries and 5% in the capillaries. The term microcirculation refers to the vessels which are visibly under the microscope and whose function is the distribution of blood to the tissues, according to metabolic necessity, as well as the autoregulation of local flow. It contains the terminal vessels of the arterial part and of the initial part of veins and lymphatics of the circulation. The term macrocirculation refers to the conduction vessels. The major function of the microcirculation is the exchange of gases (by diffusion) and of fluids (by filtration), and of all other nutrients and metabolites required for local cell metabolism.

In order to perform the exchanges, the system has to be moving; this is achieved thanks to differences in pressure between the circulatory system and the interstitium. According to Starling, in the arterial capillaries there exists a positive hydrostatic pressure of around 30 mmHg, and two negative pressures, the oncotic pressure of 20-25 mmHg, due to the proteins, and the pressure of the interstitium of 2-4 mmHg.

The hydrostatic pressure of 30 mmHg in the arterial capillaries is higher than the negative oncotic pressure, thus leading to the outflow of fluids and nutrients to the interstitial space. From the venous side, the positive hydrostatic pressure of 15 mmHg and the negative oncotic pressure of around 20 mmHg, lead to the reabsorption of fluids and substances from the cellular interstitium. The reabsorption performed by the venous capillaries represents approximately 90% of the filtrate; the remaining 10% are reabsorbed by the lymphatic system, which functions as a safety valve, removing macromolecules and excess fluid. About 50-75% of the blood that passes to the microcirculation, does not reach the capillaries which perform metabolic exchange, but traverses arteriovenous anastosomoses. Only around 25% of the blood of the microcirculation effectively performs local exchange.

In summary, heart and "lymphangions" are propulsive structures of two types of circulatory fluids, blood and lymph; conducting circuits are represented by arterial, venous and lymph vessels; vessels of greater caliber (macrocirculation) are functional in conduction; those of smaller caliber (microcirculation) have a nutritive function; the cellular interstitium functions as an interface for the exchange of nutrients and catabolites between blood and cells; hydrostatic and colloidal osmotic pressures permit liquid displacement.

Lymphatic System

The major function of the lymphatic system is the absorption of plasma proteins filtered from arterial capillaries and which could not return via the venous capillaries. Lymphatics thus return to the blood around 100g / day of the proteins which leave the arteries and do not return via the veins; they constitute the protein load of lymphatic function. Approximately 2000 mL of lymph reach the venous system daily.

Another important lymph function is immunological: filtration at the lymph nodes prior to reaching the venous system. The lymph is initially poor in cells but during the passage through the lymph nodes is enriched in cells having immunological functions (monocytes, plasmacytes).

The system also functions as a safety valve, removing excess liquid entering the interstitium.

Lymph is formed from products filtered by arterial capillaries, as well as cell and interstitial products. This fluid, after entering the lymphatic vessels is called lymph, and while still in the interstitial space is known interstitial liquid.

Lymph plasma is more dilute than blood plasma. Like blood it can also coagulate, although with greater difficulty. Its composition varies according to the site where it is formed. For example, lymph draining the small intestine presents high concentrations of fatty acids, while lymph from the lower limbs is low in these substances.

It is fundamental for equilibrium between fluid leaving (filtration), and entering the vessels (reabsorption), to exist. Excess fluid or protein can lead to disequilibrium, causing limb edema.

The major factors influencing lymph fluid are rhythmic contractions of the vessels, variations in pressure at their walls associated with vessel beats, muscle compression and variation of thoracic and abdominal pressure.

Lymphangion

The portion of a lymph vessel situated between two valves, having the capacity to contract, is called lymphangion. It represents a functional unit, whose valves by preventing reflux, allow lymph to circulate in the ascending direction. Lymphangions therefore act as true microhearts, at six to 12 contractions per minute. These contractions independ from other lymphangions. Each lymphangion possesses a pacemaker similar to that of the heart. The most important stimulus for its contraction is increase in volume with distension of its wall. Other stimuli like alpha-adrenergic drugs, prostaglandins, histamine and bradykinin can also set off these contractions, which allow pressures of 10 to 55 mmHg, up to 120 mmHg to be reached in the lower extremities. This peculiarity is important because the system itself is capable to direct flow and promote lymph dislocation.

In summary, the lymphatic system is a system of drainage that aids the venous system in the return of components of the blood. It

reabsorbs liquid and products that have left the blood and interacted with the local environment, mainly cells, which could not return via the venous capillaries. This absorbed fluid is called lymph. Passing though the lymph nodes, lymph is filtered and receives cells (monocytes, plasmacytes) acting as a real "dust bin" of the organism. The products which have been left in the interstitium are removed, filtered and returned to the blood, besides assuring a role in the immunological protection of the individual.

PHYSIOPATHOLOGY OF THE LYMPHATIC SYSTEM

The term lymphedema refers to the type of edema decurrent from the abnormal accumulation of liquid in the tissues, resulting from a failure in draining by the lymph system, associated to an insufficiency of extralymphatic proteolysis of the proteins of the cellular interstitium.

Földi has compared the lymphatic system to the heart, and established the concepts of lymphatic sufficiency and insufficiency. The system is sufficient when its transport capacity is higher than required. This capacity may be defined as the amount the organism can actively transport i.e., around 20 liters per day in a healthy individual. Normally, this volume is approximately two to four liters/day; the difference being considered a functional reserve.

In lymphatic insufficiency, the draining capacity of the lymph system is surpassed leading to lymphedema.

Dynamic insufficiency is recognized when the lymph system is integral but the volume to be drained exceeds the draining capacity. Mechanical insufficiency of the lymph system occurs when there is a reduction of the capacity of the vessels to perform drainage, but the volume to be drained remains normal. An example of dynamic insufficiency is observed in hypoproteinemia, where increase in interstitial fluid is caused by lack of its absorption by the venous system due to a decrease in intravascular oncotic pressure. In other examples, such as deep venous thrombosis or chronic venous insufficiency, edema is due to a difficulty in the reabsorption of liquid by the venous system consequent to its vessel alterations. In these three cases, edema occurs even though the lymphatic system retains its integrity, but its functional capacity is surpassed, and it is working at hypermotility. At a concentration of around 0.1-0.5g/dl, this type of edema is poor in proteins. In mechanical lymphatic insufficiency in contrast, the volume to be drained is normal, but the lymphatic system cannot absorb this fluid and its macromolecules; there remains therefore a fluid of high protein concentration.

Both forms of insufficiency, dynamic and mechanical, can occur in the same patient.

When the draining capacity is surpassed and transport capacity of transport is reduced, the edema can become serious with a failing valve safety factor and possible tissue necrosis.

During mechanical obstruction there exist the following possibilities of effecting drainage:

a - an option for collateral ways, similar to what occurs in the arterial and venous systems;

b - lympho-venous anastomoses which arise from trying to ease lymph outflow;

c - via lympho-lymphatic anastomoses;

d - via perilymphatic channels, at the level of the interstitium;

e - increase in the number of monocytes which change into macrophages to absorb proteins.

The accumulation of liquid in the interstitium leads to increase interstitial pressure on adjacent structures and lymphatic capillaries. This causes the separation of its fixating filaments, distending the endothelial cells and opening intercellular spacings. Increase pressure on lymphatics provokes increased frequency and lymphatic flow. The collectors end up by dilating to a marked extent and their valves loose the capacity to avoid reflux. The pumping activity of the lymphangions is also impaired, causing stasis and lymphedema. The veins can drain part of the liquid. However proteins, mainly of higher molecular weight cannot return to the vessels and accumulate in the interstitium, stimulating macrophage activity in an attempt to eliminate them. Excess protein in the interstitium also stimulates fibroblasts, capable of causing fibrosis. The persistence of lymphedema propitiates the degeneration of the walls of the lymphatic collectors, leading to loss of motility, further aggravating lymph stasis.

Lymphangiosarcoma, Stewart Treves's Disease, may occur in lymphedema of long standing.

According to Casley-Smith the main structural causes of lymphedema are as follows:

a - narrow or abnormally scanty tissue channels;

b - abnormally scanty initial lymphatics;

c - incompetence if the initial valve system;

d - separation of the fixation bands of the lymphatics;

e - hypoplasia and obstruction of the collectors.

Related to functional causes, are lack of variation of tissue pressure, decreasing the flow in tissue channels and reduction of the pumping mechanism in the initial lymphatics. Other causes are paralysis and vessel spasm, hampering collector contraction. These alterations occur in primary lymphedema. In secondary lymphedema, the initially intact lymphatic system is destroyed, as for example in surgery (lymph node emptying), filariasis and trauma. Mechanical lymphedema occurs in these cases.

Such infirm tisssues, rich in proteins are propitious for the installation of infection, as by streptoccoci, which will further lesion vessels decreasing functional reserves.

These patients should be evaluated by a specialist, to identify the type of lesion and the best therapeutic approach to be used. Lymphatic drainage is one of the most important therapeutic measures and it is up to the specialist to direct and follow the whole evolution of this treatment. Hygienic care, the prevention and treatment of infections, the use of drugs like benzopyrone and lymphokinetic exercises, are part of the therapeutic approach to these patients.

Treatment of Lymphedema

Prophylactic measures like hygienic care, prevention of infection and lymphokinetic exercises contribute to a better result of lymphedema treatment. Lymphatic drainage, bandages, elastic stockings and drugs, complement the main forms of approaching the treatment of these patients. Alongside, directioning on care in daily life should be emphasized, since patients may have many doubts and can benefit from day-by-day resolutions.

Pharmacological measures are part of the general context of lymphedema treatment. Prophylactic and therapeutic antibiotic treatment is indicated in infectious processes. Benzopyrones are drugs that can reduce protein-rich edema by increasing tissue proteolytic activity. Flavonoids like diosmine, rutine, hesperidine are examples of these drugs.

Lymphatic drainage is indicated in nearly all types of lymphedema. In summary, the association of these measures propitiates a better result in the treatment of these patients.

MANUAL LYMPHATIC DRAINAGE

Manual lymphatic drainage is one of the pillars of the complex physical therapy proposed by Földi, and known as the Földi method. It is a medical treatment indicated for any degree of lymphedema. Its final objective is the removal of excess plasma proteins from the cellular interstitium, restoring the equilibrium between the lymphatic protein load and the transport capacity of the lymphatic system.

Dr. Vodder published the technique of manual lymphatic drainage in Paris in 1936; during the following six decades several contributions were added to it.

Based on his clinical experience in massage, Vodder observed the clinical improvement of lymph nodes in the cervical region following their manual stimulation. These findings represented the beginning of work which led to the systematization of a technique christened, manual lymphatic drainage.

It is of importance to point out that the term massage comes from the Greek (amasar), defined as press with the hands, kneading different parts of the body in order to relax muscles. Drainage is a word of English origin belonging to the hydrology vocabulary: It consisted in the evacuation of a swamp from excess of water by means of small channels leading to a bigger collector, which in turn, disembogues in a well or a current of water. The analogy is clear. In manual lymphatic drainage maneuvers are suave and superficial, not requiring compression of muscles but rather, mobilizing a current of liquid within a lymphatic vessel at a superficial level and above an aponeurosis. It is universally recognized that the pressure of the hand on the body should be light so as not to produce lymphatic collapse. The suggested value runs at around 30-40 mmHg.

It should be observed that manual lymphatic drainage and massage are two distinct things. Therefore, in order to perform manual lymphatic drainage it must be borne in mind that one is draining: for this, strong movements of compression are not required.

Several studies have demonstrated that when we utilize an inadequate technique, we may cause damage to the patient. Casley Smith reinforces the view that a poorly performed drainage is worse than doing nothing. Several techniques called lymphatic drainage, have been inadequately employed, becoming liable to inflict injury to patients. It is important for the professional worker to heed to this fact and to dominate the technique in order not to provoke lesions.

Manual lymphatic drainage consists of gliding movements over the trajectory of lymphatic vessels, and compression at the region of the lymph nodes. It is a fully systematized technique whose movements should have a correct sequence with a well-defined direction and strategy. It is a universal consensus that the lymphatic system should be centrally unblocked, and in the last instance, the affected limb. The procedure is generally initiated at the cervical region, axilla, thoracic region, abdomen, and root of the healthy limb. Following distally, and only afterwards should the affected limb be worked upon. This system creates empty reservoirs through which peripheral lymphatics may drain. In this way, lymph reaches the lymphatic declines through which it is drained. For this reason, it is indispensable to know the anatomy of the lymphatic ways.

Health professionals exert an extremely important function for lymphatic patients. However, any solitary action on part of the professional should be considered illegitimate, because the doctor is absolutely responsible for all and each of the therapeutic steps performed.

Other secondary effects caused by the drainage are:

a)an action on the vegetative nervous system producing parasympathetic stimulation leading to relaxation;

b)a sedative action of algic reflexes;

c)an action on ganglia with immunological effects.

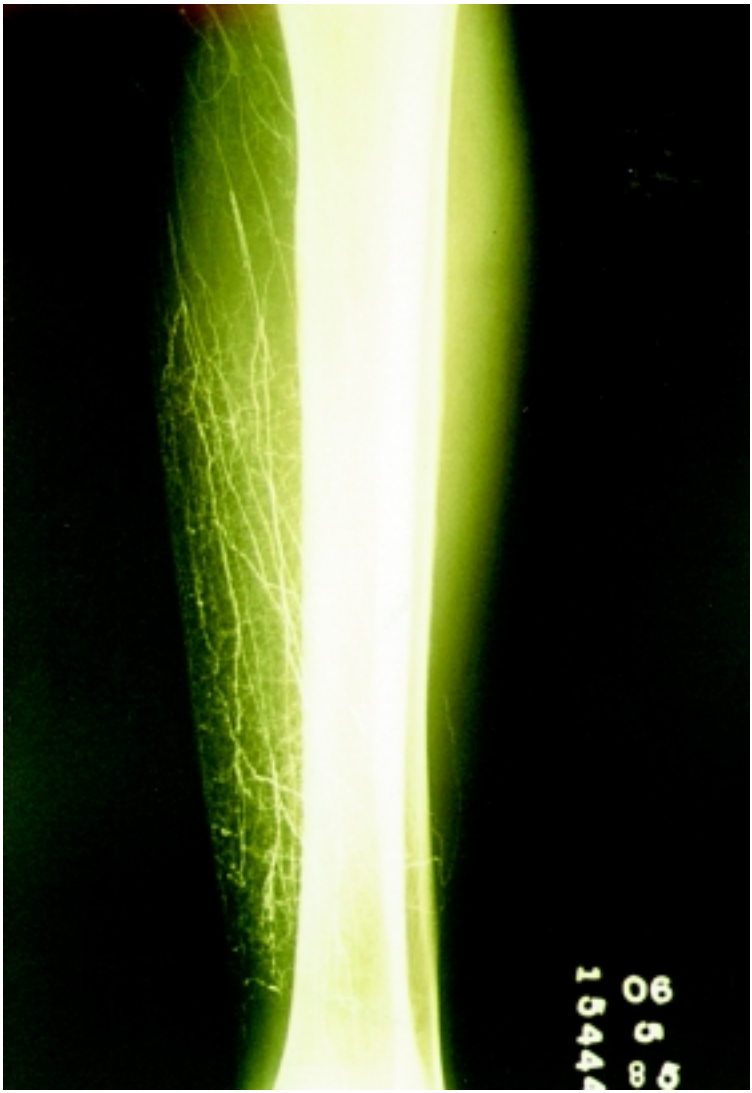
In summary, manual lymphatic drainage represents an important therapeutic instrument in lymphedema. It should however, only be performed in an adequate manner and by capacitated professionals.

A NEW TECHNIQUE OF MANUAL LYMPHATIC DRAINAGE

Among the components of the lymphatic system are the lymphatic vessels, which are no more than conduits transporting fluids, presenting certain peculiarities. The routes of these vessels are well defined and normally lead to lymph nodes at a determined region. On thinking about this system of conduits, we developed a new technique of lymphatic drainage.

This technique consists of the utilization of flexible, delicate rods which we glide, rolling them over the trajectory of lymphatic vessels allowing for an efficient drainage. The objective is to exert a continuous external pressure, utilizing the compression by these rods over the region of the trajectory of vessels in the ascending direction in order to promote lymph mobilization. The illustrations that follow demonstrate the mechanisms proposed and the measures of care to be taken.

Observe a hydrostatic model to illustrate the technique. In black, a model of a "rod" which will be used as an instrument for drainage and two tubes in white, full of liquid simulating a lymphatic vessel.



Observe a lymphography showing lymphatic vessels in lower limbs, which are nothing more than conduits which transport lymph.

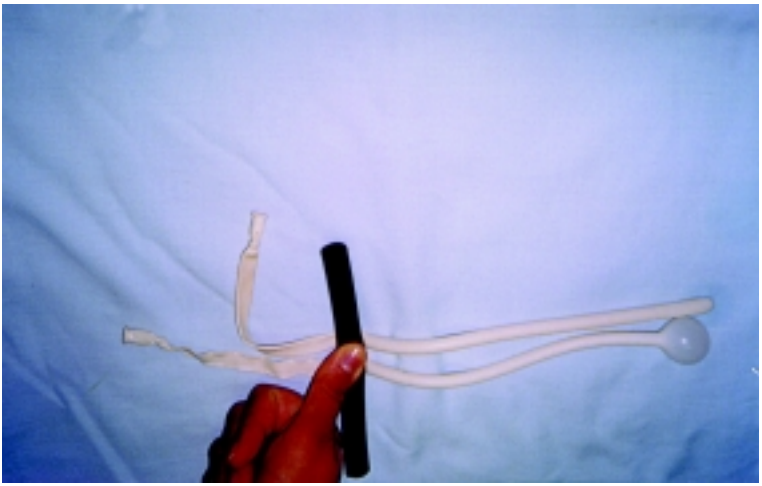
Since we are dealing with a compressible vessel, gliding by rolling the rod will allow the drainage of its content.

As observed in this illustration, gliding the rod permitted the emptying of the conduit

Observe in this illustration two conduits, one full, dilated showing in its extremity the presence of a dilatation. In the other vessel, walls are not dilated and have a normal liquid volume and pressure.

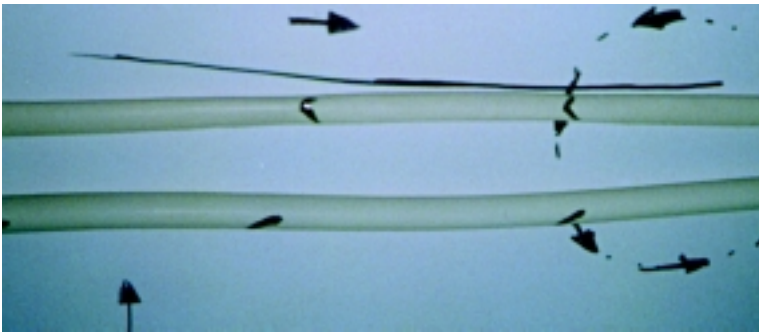
These illustrations give us an idea of the functioning of the new method of drainage and of the care to be taken in this type and any other type of lymph drainage.

In the model, we observe a system, which is occluded, capable of simulating a clogged lymphatic vessel, as for example during a mastectomy. This demonstrates that, when we utilize inadequate procedures during lymphatic drainage, we may lesion this vessel. Another conclusion is that a vessel under normal conditions runs a lesser risk of being lesioned. This demonstration emphasizes the importance of the diagnosis of the lymphatic lesion for a correct approach to lymphatic drainage.



This illustration demonstrates that the same pressure applied on the vessels evoked different reactions

In both cases drainage occurred; however, in order to continue draining we needed to apply a greater pressure on the vessel in the lower position. The possibility of reflux was also greater in this vessel if the same pressure is maintained. Therefore, if we insist in continuing the drainage we will end by lesioning the vessel.



Another important concept is that lymphatic vessels present valves and directed flow as demonstrated by the arrows.

The last illustration suggests that the direction of drainage should always be in the direction of the flow. Circular movements may go against the direction of the flow, thereby forcing the valves of the lymphatic vessels. Therefore, this type of movement is not justified.

The pressure exerted should be around 30 to 40 mmHg in order not to damage vessels and adjacent tissues. The gliding velocity of the rod must be low so as not to lead to a sudden increase of pressure in the interior of the vessel, causing possible damage.

It is an unanimous opinion that the lymphatic vessels should be centrally unblocked, and then to proceed draining more distal regions. In the last step, to follow towards the affected limb. The procedure is generally initiated by draining the cervical region, axilla, thoracic region, abdomen, root of the healthy limb, following with distal drainage. This approach creates empty reservoirs through which peripheral lymphatics may drain. In this way, lymph is taken to lymphatic declines through which it is drained. This is one of the motives demanding thorough knowledge of lymphatic ways and to how to use alternative routes of drainage in cases of lymphatic blockade.

A correct diagnosis is fundamental if an adequate approach is to be used.

CARE

IN DRAINAGE OF THE CERVICAL REGION THERE IS GREATER RISK DUE TO THE PRESENCE OF THE CAROTID GLOMUS.

Stimulation of the carotid glomus may originate cardiac arrhythmia. Doctors may use such stimulation to treat a certain type of cardiac arrhythmia, but in these cases the patient should be in the hospital and monitored.

It is not advisable to work in this region to perform either lymphatic drainage or any other type of massage without knowledge about maneuvers and risks.

Other forms of care are:

· Pressure exerted on the skin.

· Start to drain at the right place.

· Observe whether the patient has an infection or neoplasm which counter- indicates treatment.

A TECHNIQUE OF LYMPHATIC AUTODRAINAGE

The utilization of "rods" permits the own patient to perform the technique, doing what we may call a technique of lymphatic autodrainage.

The doctor or professional who will perform the treatment can draw with a pen on the patient's skin, the route over which the "rods" should be glided.

It is advisable that the patient should receive training at the clinic in order to correctly prepare him for the adequate application of the technique of autodrainage. Medical following will be necessary to evaluate the results and the correct use of the technique.

The advantages reside in offering the patients an opportunity of treatment at a lesser cost.

STEP-BY-STEP DEMONSTRATION OF THE TECHNIQUE

On the first figure observe the orientation of the illustrations. On the second, third and fourth illustrations, see the main lymph node chains which are normally drained: axillar, cervical and inguinal.

Observe in this illustration the schematic representation of lymph vessels and the direction of flow. Green symbols represent the trajectory of vessels that flow together towards the ganglia. Red arrows indicate the direction of the lymphatic flow.

Observe in this illustration the direction and final flow in common towards the supraclavicuar region, of lymph vessels of the head and neck. The vessels travel towards the lymph nodes until reaching the cervical trunk and the latter reaches the thoracic duct (left side) and the right lymphatic duct (righ side) on each side of the neck.. The ducts flow into the venous system at the junction of the subclavian veins with the jugular vein.

In this illustration observe the axillary chain and the direction of drainage of the lymph currents coming from the upper limb, anterior, lateral and posteriori thorax and supraumbilical abdomen.

Observe the lymph node chain of the inguinal region and the direction of drainage. Blue lines represent the trajectory of the saphenous vein. The lateral inguinal chain receives lymph vessels from the lower limb, infraumbilical abdominal wall, genital system, urologic system and inferior mesenteric vein.

DRAINAGE OF THE HEAD AND NECK

Lymphatic drainage of the head and neck is performed following four pathways: the anterior or of the facial vessels, the parotid, the retroauricular and the occipital. In this region, greatest care should be taken during lymphatic drainage. The supraclavicular fossa is the place of greatest proximity to the thoracic and right lymphatic ducts; therefore, it is the site at which drainage should be started, unless there exists an indication to the contrary.

All lymphatic trunks lead towards the lymphatic ducts that drain into the venous system, at the junction of the subclavian and jugular veins.

At the cervical region, the superficial cervical lymph nodes follow the trajectory of the external jugular vein over the sternocleidomastoid muscle, and drain into the lymph nodes of the deep cervical chain.

The illustration evidences the final direction of head and neck drainage.

The cervical region and the utilization of a rod as instrument of drainage are observed.

I recall attention to the positioning of the "rod", since a little above this region lies the **carotid glomus.** This is the region at which great care should be taken during the lymphatic drainage.

The drainage of the supraclavicular fossa is the place of greatest proximity to the thoracic and the right lymphatic ducts, and therefore is the site at which drainage should be started, unless an indication to the contrary exists.

Observe drainage of the anterior part of the face towards the submandibular lymph nodes.

Observe drainage of the anterior part of the face towards the submandibular lymph nodes. From these lymph nodes emerge vessels going towards deep cervical lymph nodes.

Drainage from the chin and lower lip is performed towards the submental lymph nodes. Efferent vessels going to the deep cervical lymph nodes leave from these nodes.

Observe drainage of the cervical chain in the direction of the supraclavicular fossa.

Observe the stimulation of the lymph nodes of the parotid region, These nodes release efferent vessels towards the deep cervical lymph node chain.

Observe at the lower portion of the rod, the line describing this region, which drains into the lymph nodes of the parotid region.

In the illustration, lymph nodes of the retroauricular and occipital regions send out vessels to the lymph nodes of the deep cervical chain.

This illustration serves to bring out the importance of respiratory movements in lymphatic drainage.

The chain of axillary lymph nodes drains around 10 lymphatic currents of the upper limbs from the supraumbilical portion to the clavicula and the region of the dorsum.

Observe the axillar region receiving vessels from the upper limb, and the anterior thoracic wall. Attention to the drainage of the mammae towards the axillae.

Drainage of the upper limb is initiated at the proximal region of the arm.

The basilic, pre-bicipital and cephalic currents may be drained in the anterior region.

At the level of the fold of the elbow occurs The transition between the forarm and arm

Proceed with the drainage of the upper limb by draining the anterior radial, and anterior ulnar currents of the forearm.

In this illustration I emphasize the drainage of the cephalic current, which may be maintained during mastectomy. In this maneuver the posterior and postero-lateral currents may be drained.

The drainage of the hand and dorsal part of the forearm (radial and posterior ulnar currents) are made in the ascending anterior direction.

The drainage of the dorsal region is also performed towaards the asillary lymphnodes

The lateral thoracic wall is drained towards the axillary lymph nodes.

From the height of the umbilical region on, drainage is made towards the axillary lymph nodes.

At navel height is made the transition of the direction of the drainage, above towards the axillary lymph nodes and below, towards the inguinal ones.

At the region of the abdomen, we find the union of the lumbar, mesentery and bronchomediastinal trunks to form the beginning of the lymphatic duct at a deep level.

The drainage of the abdominal wall is made towards the axillary lymph nodes. As we can observe, we have a superficial and a deep drainage going in different, but not opposite directions. We propose in this case, deep abdominal drainage using a "rod" in the region of the rectus abdominis in ascending direction, as shown in the illustration. This approach avoids the violation of the direction of the vessels of the abdominal wall.

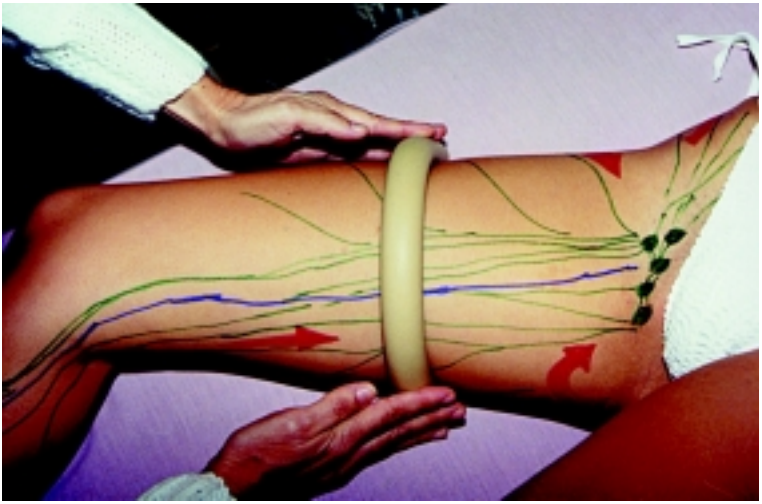
The abdominal wall is handled in the direction of the axilla.

Lymphatic drainage of the lower limbs presents six lymphatic currents, the two distal ones called currents of the saphena magna and of the saphena parva .There are four proximal currents, two anterior, and two posterior.

Observe the inguinal chain which receives the lymph vessels of the lower limb, infraumbilical abdominal wall, genital system, urologic system and the inferior mesenteric

Observe in this illustration the drainage of the lower abdominal wall towards the corresponding inguinal lymph node chain.

Begin drainage of the lower limb by the proximal part of the limb. Observe (in blue) the trajectory of the saphenous vein, which is the same as that of the lymph vessels.



The illustration demonstrates the postero-medial and the antero-medial currents of drainage of the thigh (saphena magna).

Observe the drainage of the beginning of the postero-medial and antero-medial currents of the thigh (saphena magna).

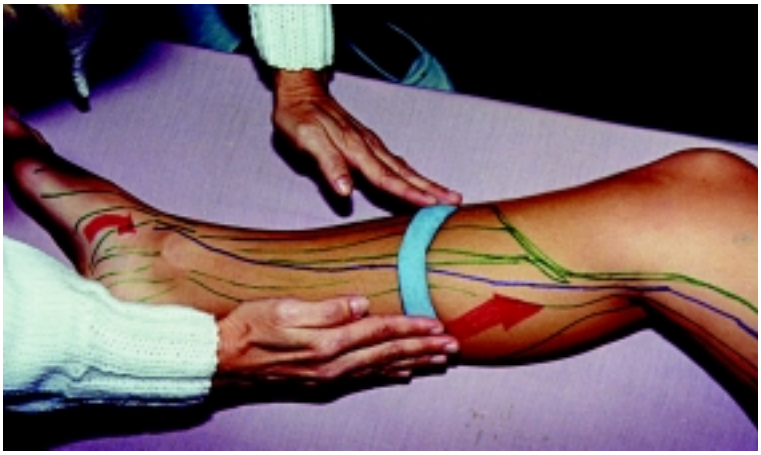
The antero-medial currents of the thigh receive vessels from the postero-lateral currents of the thigh The antero-lateral currents of the thigh or the lateral saphena originate in the thigh.

The postero-lateral currents drains in the antero-medial direction towards the inguinal region.

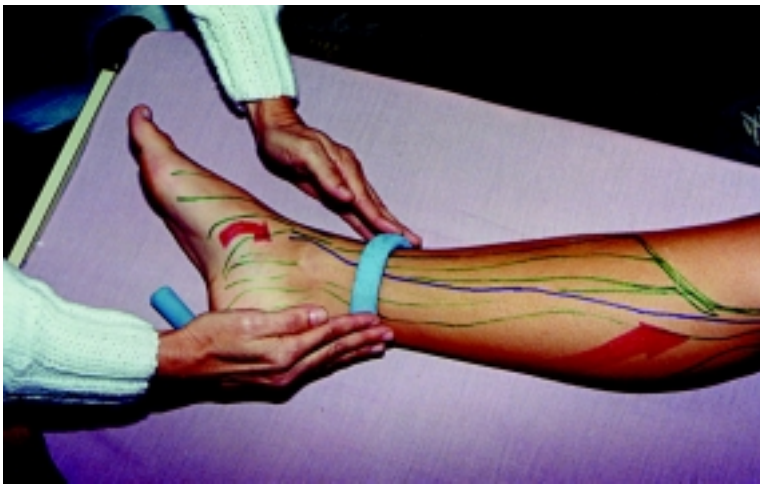
The postero-lateral currents of the thigh anastomose with the antero-medial current.

The medial region of the buttocks drains in the antero-medial direction towards the inguinal region.

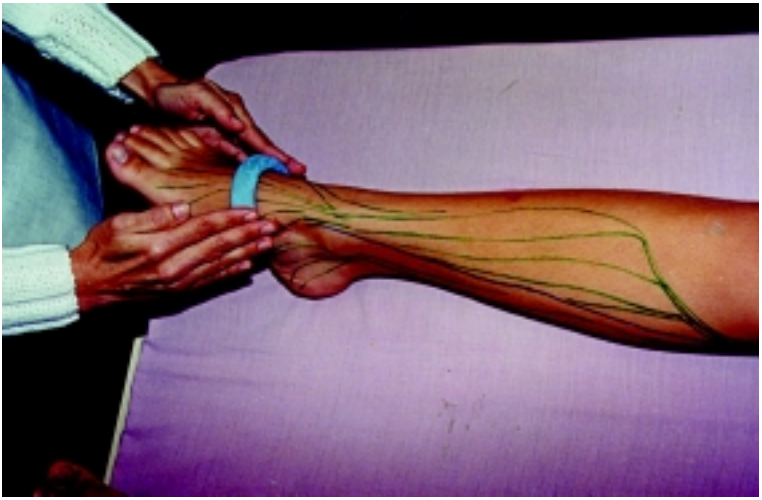
The postero-medial currents travel in the direction of the inguinal region



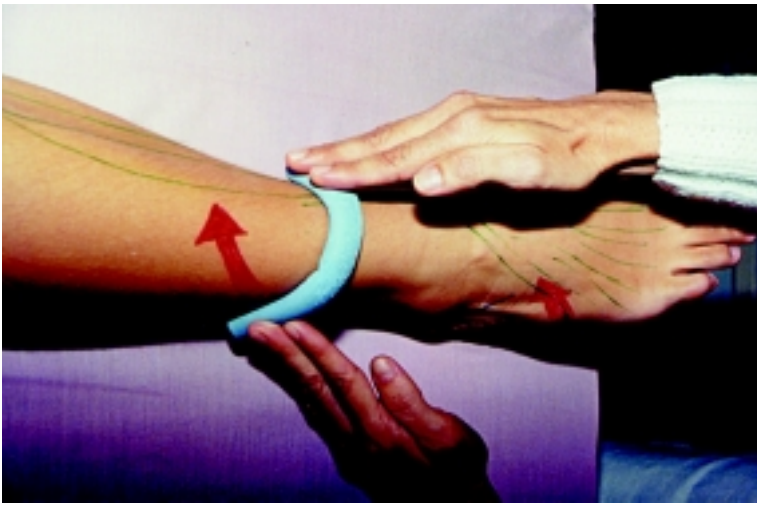
The antero-medial current of the leg (saphena magna) travels in cranial direction and reaches the medial region of the thigh, continuing as anterio-medial current of the thigh. The saphena magna current of the leg receives anastomosing vessels from the postero-lateral current of the leg (saphena parva). Other vessels of the saphena parva travel towards the lymph nodes of the popliteal region.



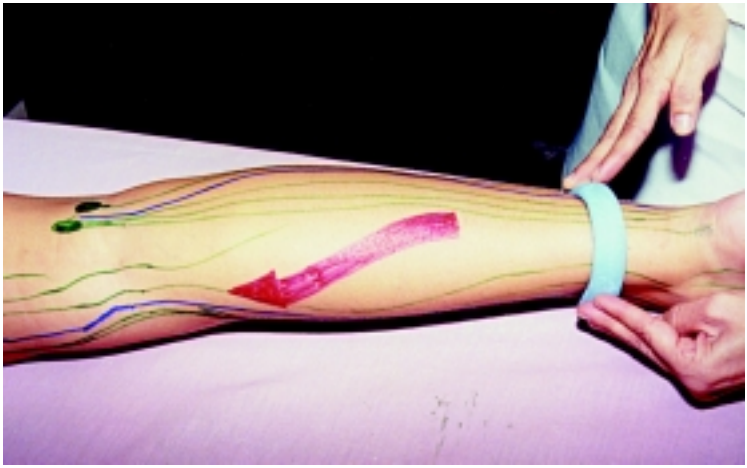
Observe the beginning of the current of the saphena magna.



The feet drain towards the saphena magna.



Postero-lateral currents of the leg (saphena parva) anastomose with the current of the saphena magna.



The drainage of the saphena parva directs towards popliteal lymph nodes and the current of the saphena magna.

Illustration of the drainage of the saphena parva current.

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