The Circulation Between Cerebrospinal Fluid, Cerebral Interstitial Fluid and Lymph, Part Two

With Clinical Applications of Lymph Drainage Therapy for Drainage of the Central Nervous System

by Bruno Chikly, M.D.

This article, the second of two parts, will inspire massage therapists interested in lymph and cranial work, or those just seeking to deepen their knowledge of the fascinating anatomy related to the connections between the central nervous system and the periphery of the body.

The author explains how, by very gentle, non-invasive hands-on techniques, massage therapists can help enhance and optimize fluid circulation between the deepest parts of the central nervous system and the rest of the body. These specific techniques are important, yet not often addressed. Further, they can address very common conditions, such as inflammation, swelling and chronic pain; and help with immune-system function, detoxification and tissue regeneration.

These techniques may help in numerous clinical situations that are traditionally difficult to work with, such as brain- and spinal-related pathologies, including headaches, trauma, whiplash, closed head injury, cognitive behavioral dysfunctions and some birth difficulties or trauma.

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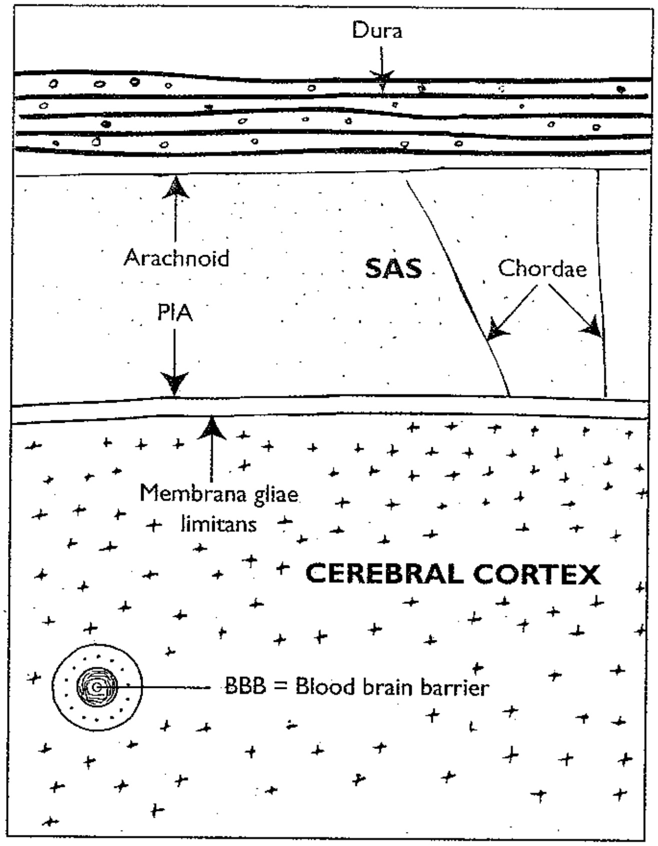


The Meninges and the Cerebral Cortex

Numerous experiments have now demonstrated that some components of the cerebrospinal fluid of mammals drain into cervical lymph nodes. For example: Passage from the cerebrospinal fluid to the deep cervical nodes occurs within one minute in the rabbit, and 30 minutes in the rat and guinea pig.

Drainage of cerebrospinal fluid components through nasal lymphatics

The historic G. Schwalbe experiment using Berlin blue dye showed that a certain amount of a cerebrospinal-fluid marker passed along nerve pathways of the olfactory bundle. It is considered that 90 percent of radio-labeled particles followed this route in the rabbit.

Carbon particles and labeled proteins follow the olfactory tracts through the cribriform plate (lamina cribrosa) to the nasal mucosa. From the nasal mucosa, the lymphatic pathways may reabsorb the marker and carry it to the retropharyngeal lymph nodes, then to the cervical (neck) lymph nodes.

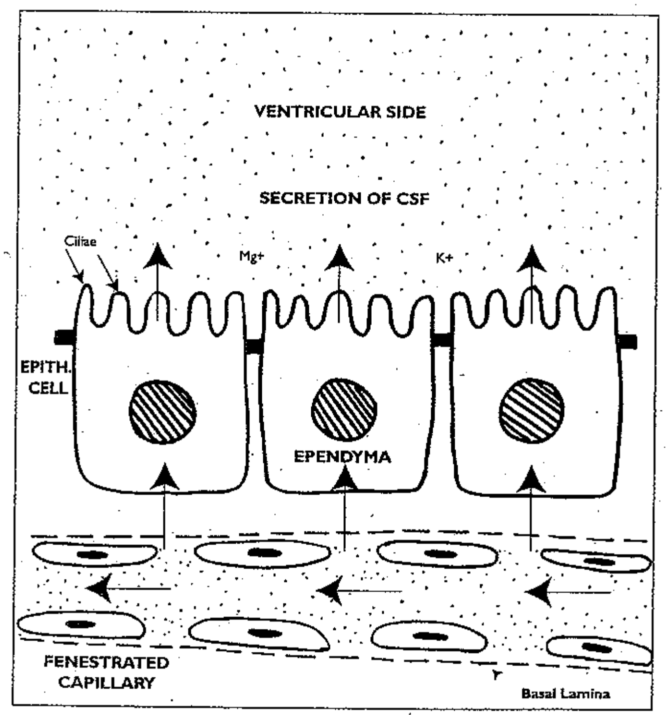
A brief review here of the body's anatomy reminds us that the perineurium is a sheath of tissue that surrounds a bundle of axons; the epineurium is the connective-tissue layer wrapped around the entire nerve root; and the endoneurium is the layer wrapped around an individual axon. The perineurium space seems to communicate freely with the loose interstitial tissue of the submucosa (passive escape, pressure-dependent, no tight junctions). The layers of dura and arachnoid fuse, becoming continuous with the one-layer-thick perineurium of the fila olfactoria (olfactory nerve bundle) passing through the cribriform plate.

Others suggest the presence of pinocytosis. Adjacent lymphatic vessels can easily reabsorb constituents of the cerebrospinal fluid that have escaped into the nasal mucosa. We can use our hands to stimulate drainage of the intranasal and intraoral lymphatic circulation—including the soft and hard palates, the palatoglossal and palatopharyngeal arches, and the subglossal and deep cervical lymph circulation.

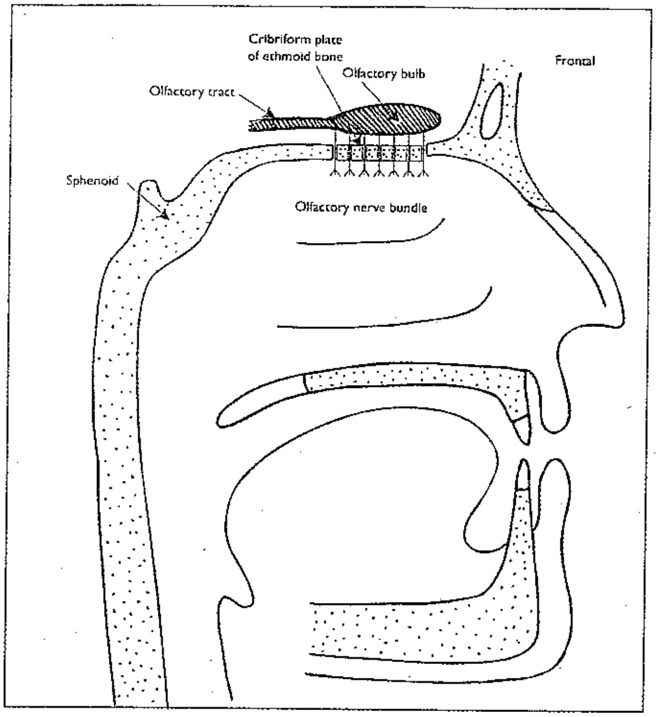
Drainage of cerebrospinal fluid components through optic nerve pathways

Numerous studies also identify the optic pathways as a route for the cerebrospinal fluid to be reabsorbed. Markers injected into the subarachnoid space have been shown to reach the retro-orbital connective tissue. In 1985 J.Y. Shen found some arachnoidal trabecular networks at transitional areas at the end of the subarachnoid spaces and the posterior uveal/periorbital compartment. Lymphatic drainage of the orbits and periorbital tissues to the temporal and parotidian lymph nodes will help stimulate this circulation.

Clinically, activation of lymph flow through drainage of the preauricular and postauricular lymph nodes, external auditory meatus, and auricle of the ears can activate this reabsorption. Other nerve pathways include the trigeminal nerves, facial nerves and other cranial nerves.



Blood CSF-barrier



The Olfactory Nerve Bundle Pathway

In 1972 W. Arnold used different tracers in guinea pigs to demonstrate the circulation in trigeminal, facial and other cranial nerves. In practice, extensive lymphatic drainage of the neck and face can activate this pathway.

The spinal nerve root

In 1928 I. Pigalew injected a tracer in the lumbar dural space and detected it in the abdominal and pelvic lymphatic vessels, as well as in the pancreas, suprarenal glands and paraaortal lymph nodes. Similar experiments found the marker in the lumbar and sacral-nerve roots, and, in 1993, Kida found the marker in the lumbar paraaortic lymph nodes.

Clinically, lymphatic drainage of the spine is accessible following deep or superficial lymphatic pathways. The superficial drainage of the spine follows three distinct lymph territories, or lymphotomes, that drain to the cervical, axillary or inguinal lymph nodes. Deep lymphatic drainage utilizes pathways through the intercostal nodes to the paraspinal nodes, or through the quadratus lumborum muscle. All these territories can be drained by a manual therapist with training in Lymph Drainage Therapy.

The direct dural pathway

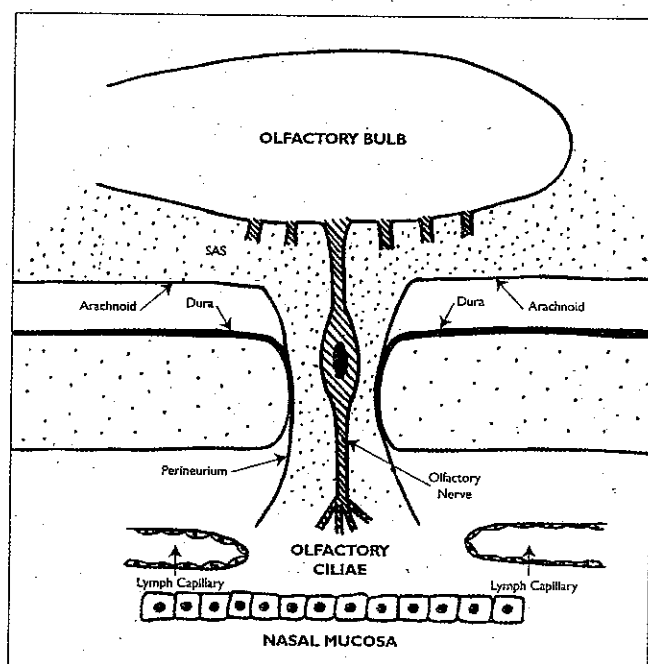
Under very high, nonphysiological pressure, the cerebrospinal fluid may escape from the disrupted arachnoid barrier and get reabsorbed by the lymphatics of the dura. In summary, cerebrospinal fluid may be reabsorbed through any one of these structures: the perineuro-lymphatic pathways (cranial or spinal nerve-root sleeves); the choroid plexus; the arachnoid villi; or, in some cases, cerebrospinal fluid also may follow a direct passage through the dural membrane.

Lymphatic drainage of cerebral interstitial fluid

The connections between the brain, the external layer of large arteries (adventitia or tunica externa) and the cervical lymphatics were first demonstrated in 1939-1940 by H. Dubois-Ferriere in experiments involving injected brain tissue. Subsequent studies by Kozma, J.R. Casley-Smith and others showed that carbon-particle markers injected into the cerebral cortex were detected in the adventitia of cerebral blood vessels, both intra- and extracranially. More specifically, markers were found in the adventitia of the cerebral arteries—namely the vertebral arteries, circle of Willis, internal carotid arteries, cerebellar arteries, basilar arteries, nasal-olfactory arteries, and in the vasa vasorum of the extracerebral arteries—before being found in the cervical lymph nodes.

In other experiments, it was found that passage from the brain to the deep cervical nodes takes place in three hours in rabbits and eight hours in cats and sheep. H.F. Cserr found that as much as 50 percent of the labeled fluid microinjected into the caudate nucleus of rabbits is drained into the deep cervical lymph nodes.

R. Virchow (1851) and C. Robin (1859) described spaces located inside the main cerebral blood vessels between the basement membrane of the external glial limitans and the tunica media (smooth muscle-fibers layer).



The Meninges in relationship to the Olfactory Nerve

Glossary

Adventitia: external layer of a blood vessel

Anastomosis: a communication between two vessels of the body

Antigen: any substance recognized by the organism as an aggressor, a foreign substance. Antigens stimulate an immune response from the body.

Atrophy: decrease in the size of a tissue or organ.

Benign: not malignant (cancerous) tumor

Cervical: a) related to the neck b) related to the cervix of an organ.

Diffusion: the natural, random migration of the particles of a substance diffuses naturally from an area of higher concentration to an area of lower concentration. It is a process that doesn't require external energy.

Edema: defined by a condition where there is an excessive accumulation of tissue fluid (hydro-colloid) in a local or generalized part of the body.

Endothelium: the epithelium that cover the internal layer of a vessel or organ.

Epineurium: connective tissue sheath of a nerve.

Epithelium: surface layer of a tissue, i.e., epidermis of the skin.

Evagination: emergence or protrusion of a tissue or organ from its regular location.

Etiology: the cause, origin of disease.

Filtration: process that transports a substance through a semi-permeable membrane.

Hydrostatic pressure: the pressure of fluid in equilibrium.

Hyperemia: increase in the quantity of blood flowing in an area. Usually the region becomes more red and warmer.

Hypertrophy or hypertrophia: increase in the size of a tissue or organ.

Intercellular spaces or interstitium: the potential space between cells in the organs and tissues of the body.

Lumen of a vessel: the space within a vessel.

Lymphocyte: lymph cell, part of the white cells of the body.

Lymphoid: something that resembles lymph or lymphatic system.

Lymphology: the science that studies the lymphatic system.

Lymphotome (sometimes called territories): a segmental area of the skin that is drained by the same node group. The lymphotome are separated by watersheds.

Malignant: usually cancerous or deadly.

Osmosis: the simple diffusion of water through a semi-permeable membrane (a membrane that is not totally permeable to at least one solute substance) between two solutions of different concentrations. It is comparable to diffusion but migrates in one specific direction.

Perineurium: sheath of connective tissue around the fasciculus, or bundle of nerve fibers.

Periorbital: surrounding the socket of the eye.

Periosteum: fibrous membrane that covers the outer aspect of a bone except at the cartilaginous articulations.

Peristaltism: smooth, muscular synchrone wave-like movement (e.g. in the intestinal tract).

Phagocytosis ("cell eating"): ingestion and digestion of a substance. The substance is surrounded by a huge "seizing foot" and becomes enclosed inside a membrane. Example: the trapping of exterior substances by macrophages.

Pinocytosis ("cell drinking"): a substance is contained and solute in a fluid-filled vesicle.

Polypoid: in the shape of a polyp; tumor with a pedicule.

Proteolytic: the lyse or dissolve proteins.

Reabsorption (or resorption): absorption of a substance that has usually been filtrated previously.

Sclerosis: fibrous process taking place in a tissue or an organ that hardens its constitution.

Tunica media: intermediary layer of a blood vessel, made of smooth muscle cells.

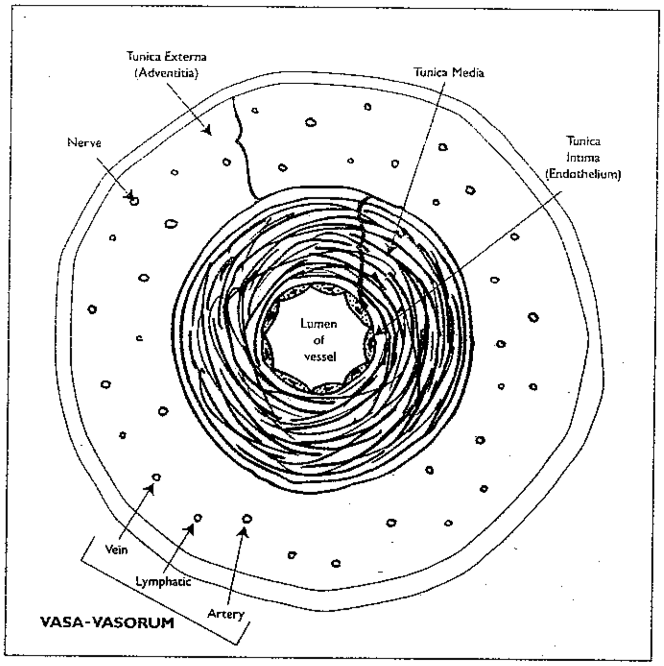
Ultrafiltration: filtration in which some substances, but not the liquid, are held back on one side of a membrane.

Uvea: middle layer of the eye.

Vasa-vasorum: "vessels inside a vessel." The little vessels present in the wall (adventitia) providing nutriments to the vessel and disposing of metabolic wastes.

Watershed: the separation lines between lymphatic draining in different territories.

—Bruno Chikley, M.D., D.O. (hon.)



Large Extracranial Blood Vessel

These spaces have since been called perivascular or, more appropriately, intraadventitial.

Circulating in the adventitia (tunica externa), or extracerebral blood vessels, are minute arteries, veins, lymphatic vessels and nerves that vascularize the large blood vessels. These minute vessels are called the vasa vasorum, or minute vessels in the vessel.

After they pass intracranially through the layer of dura mater, cerebral vessels no longer have vasa vasorum in the adventitia, and their endothelial cells (innermost layer) are joined by tight junctions.

Nevertheless, the surface of the adventitia present many circular openings of one to three microns (stomata) in size. On one side, the openings communicate with the intraadventitial spaces, and on the other with the cerebrospinal fluid. Several authors also suggested the presence of a free communication pattern between perivascular pathways and subarachnoid spaces.

There is a current debate taking place between two schools of thought regarding the layer of delicate pia mater, which comprises one to three layers of cells. Namely: Does the pia mater continue to coat the blood vessels when they enter the cerebral tissue? And is there continuity between the subarachnoid spaces and perivascular spaces?

Several investigators shared the viewpoint that the pia mater follows the blood vessels in the subarachnoid spaces that enter the cerebral parenchyma. E.T. Zhang showed that intracortical arteries are coated at their beginning by a sheath of cells derived from the pia mater, while veins are incompletely covered by some pial cells. Other studies concluded that the pia mater does not accompany the blood vessels in the cerebral tissue.

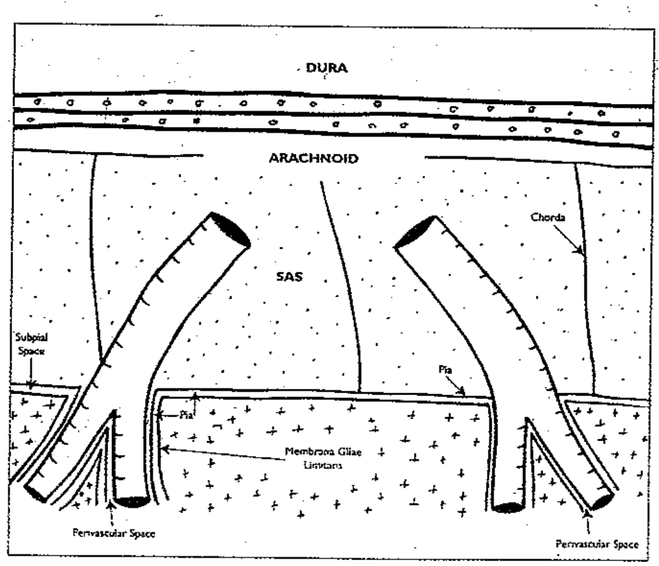
To understand the exchange between subarachnoid spaces, cerebral interstitial fluid and perivascular spaces, it is of utmost importance to understand the permeability of the pia mater layer. In cases of subarachnoid hemorrhage, it seems that the erythrocytes (red blood cells) do not penetrate the pia mater. On the contrary, macrophages, leukocytes (white blood cells) and inflammatory cells have been found in cases of inflammation in the subpial and perivascular spaces.

M. Földi and his team ligated the cervical lymphatics of animals. In his findings, he described, "We noted lymphostatic hemangiopathy characterized by spaces in the blood vessels of the neck, edema, fluid in the adventitia of intracranial-extracerebral as well as intracerebral vessels." He further noted that those spaces were six to ten times larger than usual.

Intraadventitial spaces follow the course of blood vessels and are present everywhere in the body. The fact that they don't have valves, and that retrograde lymph flow is specifically, concerning the humoral immune response to T-cell-dependent antigen, he noted, "Cervical lymph obstruction reduced the antibody response tenfold, but splenectomy had no effect on the response. These results suggest that antigen outflow along the lymphatic drainage pathway constitutes a major stimulus for humoral immunity inthis model."

Drainage of the central nervous system

The use of gentle manual techniques to activate the lymphatic flow have come into use within the past 75 years. F.P. Millard, D.O., can be credited with developing the first precise manual approach for the lymphatic system—Applied Anatomy of the Lymphatics—in 1922.



The Meninges in relationship to the Intracranial Vessels and the Brain

Between 1932 and 1936, Emil Vodder, a Danish doctor of philosophy who also practiced physical therapy on Cannes, France, developed a specerebral interstitial fluidic manual technique for lymph drainage. Because he was not a physician or a physical or massage therapist, he had difficulty authenticating and gaining recognition for his technique. It was not until the end of the 1960s that Vodder's Manual Lymph Drainage technique was scientifically tested and its effects recognized.

More recently, I expanded on these techniques through development of Lymph Drainage Therapy, a method whereby the specerebral interstitial fluidic rhythm, direction, depth and quality of the lymphatic flow could be manually assessed. Recent scientific discoveries on the physiology of the lymphatic system verify that the enhancements utilized in this process provide the precise rhythm and pressure needed to optimally activate lymph flow. Advanced practitioners can manually "map" the flow of the lymphatic circulation during sessions, assessing the specerebral interstitial fluidic direction taken by the lymph flow. From there they can choose the most accurate alternate pathways for draining lymph and interstitial fluid.

These tools are very important for finding the most accurate lymphatic pathways in different areas of the body, including those as difficult to discern as the intraoral area, the chambers of the eyes, and the deep lymphatic circulation (intercostal, viscera, etc.).

The practitioner needs to follow and activate the patient's natural lymphatic rhythm.

Applications

One of the important actions of lymph is to activate reabsorption and cleansing of the constituents of cerebrospinal fluid through some or all of the fluid pathways described above. Though it is impossible to thoroughly explain the technique here, following are some general points that must be observed in order to achieve the best results.

Lymphatic rhythm

The practitioner needs to follow and activate the patient's natural lymphatic rhythm. To understand how the lymphatic rhythm is produced, we must first look at the anatomy and physiology of the lymphatic system. It is composed of lymph capillaries (or initial lymphatics) that carry the fluid from the interstitial spaces to precollectors, then to larger lymph vessels called the lymph collectors. The lymph collectors have muscular units called lymphangions, which work much like small pacemakers.

After specific, the practitioner is able to follow the lymphatic rhythm, and can move his or her hands at the right time and in the right direction.

Direction of the flow of drainage

The lymph has to be sent following the specific direction of drainage, which is usually toward a specific node group. In the case of local edema or fluid stagnation, the therapist should be able to find where the most accurate alternate pathway is to send lymph and interstitial fluids.

Hand pressure

The therapist's hand pressure is very light. The calculated ideal pressure is usually a maximum one-half to one ounce/cm2—which is about eight ounces per square inch. Pressure can be heavier if the practitioner wants to access the deeper lymph circulation or the different layers of lymphatics under the fascia or in the intercostal spaces.

Quality of the lymph flow

Quality of lymph also needs to be assessed. Lymph can be quite viscous in cases of chronic lymph retention, such as allergies, fibromyalgia, chronic fatigue syndrome and chronic inflammation.

Hand techniques

Wrists are a very good indicator of movement. The wrist movement gives the impulse that can efficiently activate lymph flow. Only the soft pads of the hands are used, not the bonier part, so the therapist should experience the feeling of "water touching water."

Lymph Drainage Therapy maneuvers should never be aggressive or painful. Some general contraindications and precautions need to be respected, including: fever; heart or thyroid conditions; and bleeding. A physician needs to be consulted if there are any doubts.

For drainage of the central nervous system, the main goal of Lymph Drainage Therapy is to activate reabsorption and cleansing of some constituents of cerebrospinal fluid through the neurolymphatic or aemangiolymphatic pathways. A small study showed that lymphatic drainage techniques can reduce intracranial pressure dramatically.

Lymph Drainage Therapy also can be applied for different clinical cases. Lymph-flow stimulation activates all other fluid fluctuations of the body; it locally decreases chronic pain, spasms and chronic inflammations; and it drains toxins, fat, and macro-molecules (proteins) away from tissues. Activation of lymph flow through the lymphatic nodes also stimulates the immune system, increasing production of lymphocytes.

To a patient, these lymphatic techniques may seem very light and gentle, quite similar to cranial techniques, since each involves a very light touch, a very slow rhythm, and stimulation of the parasympathetic tone. The overall quality of the lymphatic stroke is very often described as a "love touch." M

Bruno Chikly, M.D., D.O. (hon.), of France, has trained extensively in both traditional medicine and complementary techniques. He earned the prestigious Medal of the Medical Faculty of Paris VI for his research on the lymphatic system and lymph-drainage technique. He has conducted workshops and lectured on lymph-drainage therapy in France, Belgium, Switzerland, Tunisia, Israel, Canada, Brazil, China and the United States. Dr. Chikly is a member of the International Society of Lymphology and an associate member of the American Academy of Osteopathy and The Cranial Academy.

This article contains excerpts from *Silent Waves: Theory and Practice of Lymph Drainage Therapy*, by Bruno Chikly, M.D. (The Upledger Institute, 2001.)

To learn more...

Books:

Silent Waves: Theory and Practice of Lymph Drainage Therapy, by Bruno Chikly, M.D. (The Upledger Institute, 2001)

Milady's Guide to Lymph Drainage Massage, by Ramona Moody French (Milady Publishing Co., 2003)

The Lymphatic System (Systems of Human Anatomy), by Thomas Braem (Bryan Edwards Publishing, 1994)

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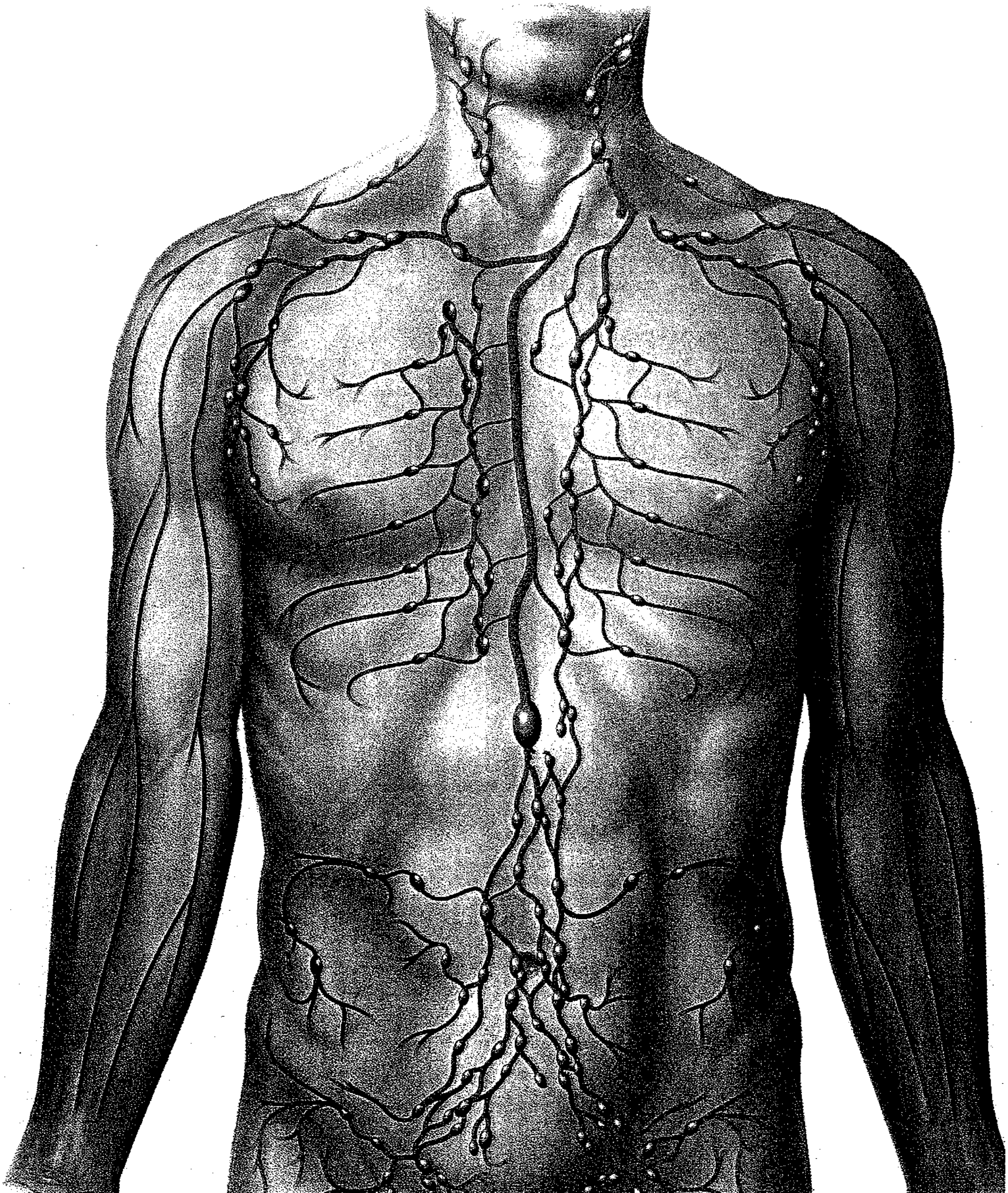

The lymph system