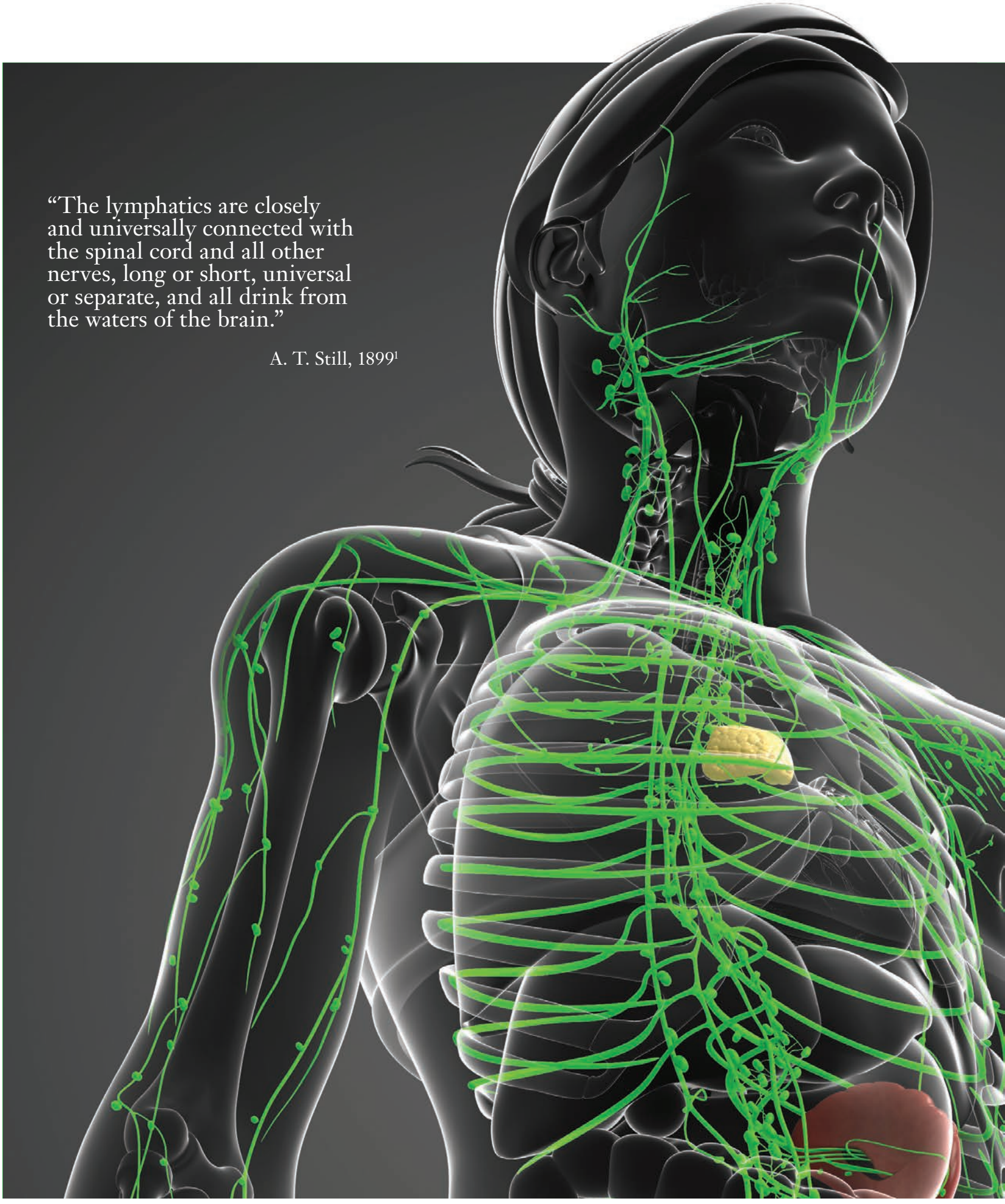
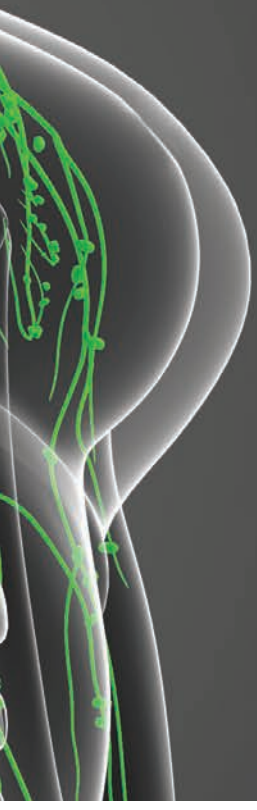

"The lymphatics are closely and universally connected with the spinal cord and all other nerves, long or short, universal or separate, and all drink from the waters of the brain."
A. T. Still, 1899[1]

Lymph in the Brain

New Scientific Paradigms About the Brain, Cerebrospinal Fluid Dynamics, Lymph, and Their Applications for Manual Therapy



By Bruno Chikly, MD, DO, and Alaya Chikly

Recent scientific breakthroughs in how we look at the lymph system and the circulation of cerebral spinal fluid are causing gradual shifts in massage therapy.

Let's look briefly at the historical journey of our ongoing understanding of fluid dynamics, unveil some of the newest and most exciting discoveries concerning the circulation of lymph and cerebrospinal fluid (CSF), and then offer some effective manual therapy techniques for lymph drainage that can help facilitate the natural exchanges between these fluids.

NEW AND OLD CSF HYDRODYNAMICS

The lymphatic system was discovered somewhat late in history,[2] but the identification of CSF came even later. In ancient times, Hippocrates and Galen recognized fluids in the brain, but even at the time of French philosopher and scientist René Descartes (1596–1650), the brain was still considered to be merely a hydraulic pump moving fluid through the nerves to animate the muscles.

The scientific discovery of CSF is attributed to Swedish scientist, philosopher, and visionary Emanuel Swedenborg (1688–1772).[3] His career was exceptionally prolific—he wrote approximately 40,000 pages on scientific and mystical topics throughout his life. In 1741, he described the expansion and contraction of the brain, and its production of an extremely refined substance, a "highly gifted juice," which he called the "spirituous essence," the "spirituous fluid," that was present in CSF.[4] He said this refined fluid traveled throughout the entire body and was returned to the blood by lymph.[5]

In his description, Swedenborg may have made the first connection between CSF and the lymphatic system. He also stated, for the first time, that CSF is "secreted by the blood vessels in the brain," a concept that has just recently been confirmed by scientific investigations, as we will discuss later. A man ahead of his time, Swedenborg likely had an influence on the development of cranial osteopathy, potentially influencing W. G. Sutherland (1873–1954), the originator of cranial osteopathy, which is the foundation of craniosacral therapy.

For more than 100 years, the classical understanding of the physiology of CSF has remained unchallenged, until recently.

The Old Model: The Three Falling Pillars of CSF Physiology

If you understand a little about CSF physiology, you know it has traditionally been based on three main points that experts universally accepted as the unquestioned truth:

- Production. Since 1919, schools have taught that CSF is mainly formed by the choroid plexi inside the brain ventricles; it then circulates within the ventricular system, eventually to be passively absorbed into the venous sinuses, and/or into the lymph system.[6]
- Circulation. In the classical model, it was also believed that CSF flows unilaterally (from the lateral ventricles to the third and fourth ventricles), eventually reaching the spaces around the brain.
- Reabsorption. The old CSF model attributed the fluid's reabsorption only to the veins and lymphatics. In 1869, G. Schwalbe injected Berlin Blue dye into the most external cerebrospinal spaces (the subarachnoid space or SAS) of dogs and found that he could follow the dye from the central nervous system (CNS) into the lymph nodes of the neck. Schwalbe made the very first statement that the lymphatic pathways are the major pathways, outside of the CNS, for CSF reabsorption.[7] However, it was not clear exactly what pathway the blue dye took to get from the CSF to the nodes in the neck. A little later, in 1872, H. Quincke demonstrated that the CSF could leave the CNS through little spaces surrounding the cranial and spinal nerves.[8] Numerous researchers have demonstrated these pathways and shown that some constituents of the CSF drain into lymph nodes in the neck (cervical lymph nodes), using the lymph pathways to exit the CNS.[9] T. Brinker, and others, showed that at least 50 percent of CSF is reabsorbed through the lymphatics rather than the veins.[10]

Today, these three pillars of the physiology of CSF are losing their ground as fundamental principles. Even though this is what most physiology and neurobiology books still describe today, recent research shows there is now little convincing evidence to support this exact model.[11]

The New Scientific Model

With the three main pillars of conventional CSF physiology—production, circulation, and reabsorption—being critically challenged, a reformulation of this old theory may change applications in research, as well as applications to manual treatments. Let's look at the changes in conventional thinking regarding CSF physiology.

- Production. Today, researchers are finding that choroid plexi most likely have only a small role in CSF secretion; the major source of CSF production is in all probability the capillaries of the brain's cerebral tissue,[12] echoing the innovative

1 The lymphatic system from the classical perspective (left). Recent research shows a new model integrating the central nervous system (right). © *UVA Health.*

concept of Swedenborg, who said: "CSF is secreted by the blood vessels in the brain."

Part of that evidence came in 1969, when T. H. Milhorat removed the choroid plexi from both lateral ventricles (choroid plexectomy) in a human subject and in monkeys, and found no changes in the volume of CSF secretion, or in its composition, contradicting conventional knowledge.[13] Even after a total choroid plexectomy, the CSF still secreted at the rate of approximately 1 liter per day.[14]

- Circulation. In the classical model, we should obviously see CSF flowing through the different cavities of the ventricular system. However, when M. Klarica and a team of researchers inserted a cannula inside the *aqueduct of Sylvius* in numerous cats, they did not see any net flow of CSF via the cannula for more than three hours. This data added to their suspicion of a faulty classical model, and made these scientists wonder whether CSF really "circulated."[15]

The old model described CSF flowing unidirectionally within the brain ventricles and surrounding the brain tissue. Large molecules have been used in the past to study CSF physiology, and this may have caused numerous misconceptions about CSF circulation. In these older experiments, the injection of macromolecules into the ventricular spaces to define the circulation of CSF gave the wrong impression that the walls of the ventricles were impermeable, and that CSF is transported in a linear manner from the lateral ventricles to the third and fourth ventricles, then into the subarachnoid spaces and all the brain cisterns.[16]

Recently, the injection of marked tritium (^{3}H water) into the CSF system demonstrated water distribution in the ventricles in almost all possible directions, including a retrograde path inside the ventricles, which is opposite to the direction given by the classical model.[17] J. D. Fenstermacher led a study that also showed that marked tritium passes through the ventricular wall of the brain (ependymal), confirming that the ventricular wall is not impermeable.[18]

- Reabsorption. Under normal CSF pressure, marked tritium (^{3}H water) is reabsorbed into the brain capillaries around the ventricles (periventricular capillaries), suggesting that CSF bulk water is produced, as well as absorbed, into the brain tissue.[19]

If the CSF is not mainly produced by the choroid plexi, but locally in every aspect of the brain tissue (parenchyma), it is also reabsorbed in the same places, everywhere within the brain. In fact, CSF components can be found in spaces around major cranial and extra-cranial nerves (perineural lymphatic pathways), such as the olfactory nerves, the optic nerves, and the auditory nerves, as well as other cranial and/or spinal nerves. Once recognized, these areas can be stimulated by a trained manual therapist to facilitate reabsorption into the lymph pathways.

Today we know that in the case of hemorrhage or infection, large proteins can accumulate in the central nervous system (CNS), and the brain needs to be cleaned and drained. Previously, what system was truly responsible for this important function was a mystery. Additionally, the CNS requires fast communication pathways for circulation of immune-competent cells and stimulation of the immune system. This, too, remained misunderstood without our latest findings of a lymph system presence in the brain.

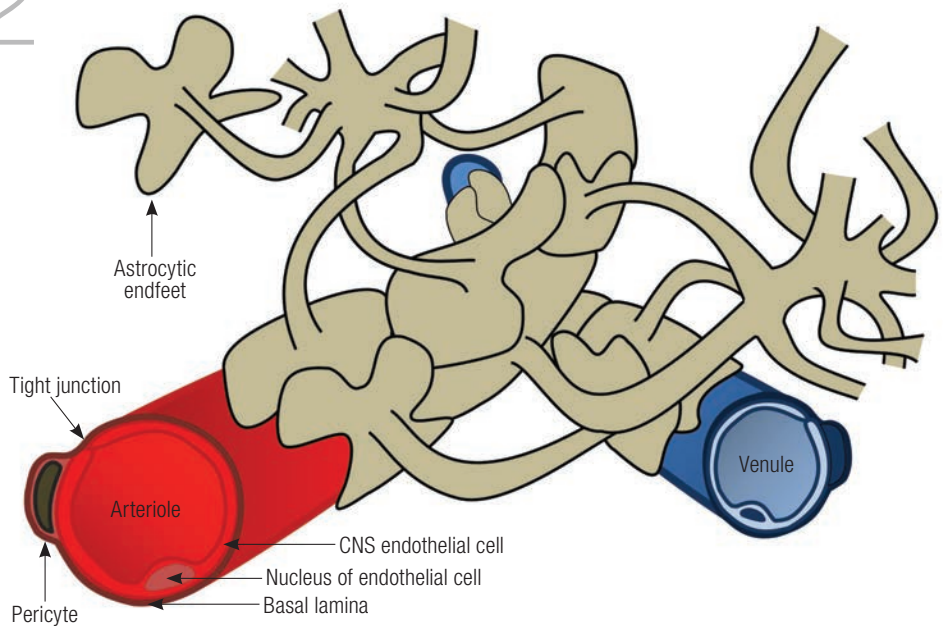
LYMPH & GLYMPH: THE GLIOVASCULAR CLEARANCE SYSTEM

Now, let's look within the brain itself—not just the pathways of the cerebrospinal fluid. In 2012, researchers demonstrated that tracers injected into the ventricular CSF of mice entered the parenchyma of the brain, and were transported into a small space between the brain capillaries and the astrocytes surrounding them.[20] Astrocytes cover approximately 99 percent of all cerebral capillaries (see Image 2, page 50).

This is a very slow clearance pathway in the CNS, present in most mammals, that facilitates the removal of CNS interstitial fluid, as well as waste products, including amyloid beta proteins that accumulate in pathologies such as Alzheimer's disease.

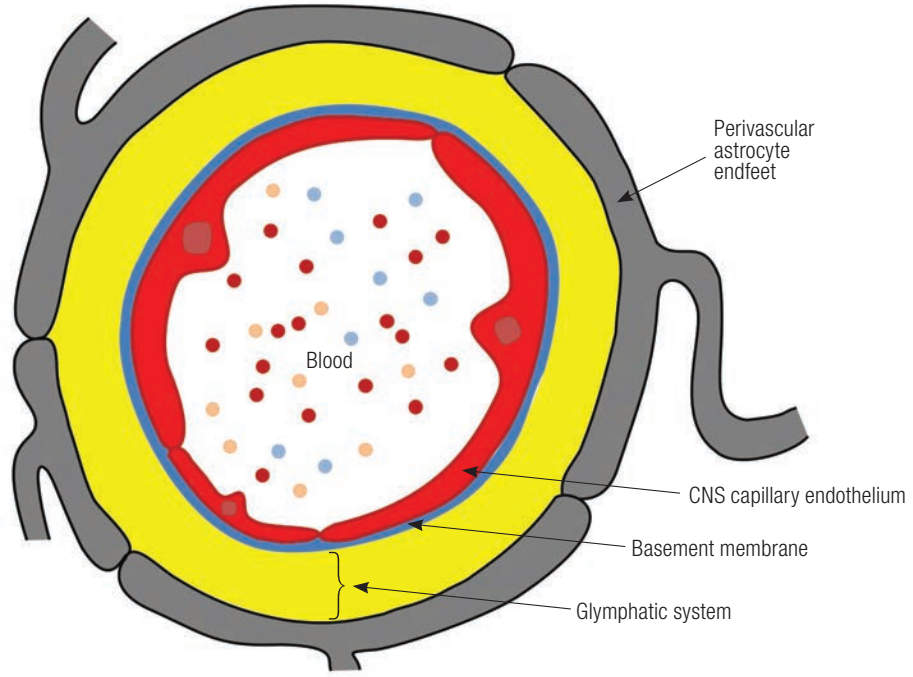
The function of the glymphatic system is lymphatic-like in the brain, but the fluid within the system is not lymph fluid, as it is not located inside the CNS lymph

2



Astrocytic endfeet. They cover approximately 99 percent of all blood capillaries in the brain. In the brain, there is a little space between the astrocytes' endfeet covering and the external aspect of the blood capillaries (see the yellow area in Image 3). This space constitutes the "glymphatic system" (gliovascular clearance system, or glymphatic clearance pathway). *© Quaghebeur Jörgen.*

3



The glymphatic system (in yellow) is located between the basement membrane of the central nervous system's blood capillaries and the astrocytes layer. *© Quaghebeur Jörgen.*

vessels. It is another newly discovered slow pathway for drainage of CSF components.

There is much new evidence describing the essential function of sleep in activating this glymphatic pathway that helps to maintain metabolic homeostasis. It seems that the clearance of potentially neurotoxic waste products is increased during sleep by the expansion of these extracellular spaces in the brain (a 60 percent increase in the glymphatic pathways).[21] An alternative important function of the glymphatic system may be to transport small lipid molecules in the CNS.[22]

LYMPH IN THE BRAIN PROVEN

Still, glymphatic pathways are not lymphatic pathways. For decades, researchers tried to understand the mechanisms directing the entrance and exit of immune cells in the CNS and finally did so in 2015. Two separate teams of researchers, one team at the University of Virginia[23] and one team at the University of Helsinki[24] in Finland, independently found typical lymph vessels in the brain.

These vessels, which line the dural sinuses in the brain, carry lymphatic fluid (and immune cells) toward deep nodes of the neck (cervical lymph nodes). We can postulate that manual activation of the lymph flow in the numerous nodes of the neck may stimulate drainage of CNS fluid and waste products, and facilitate transportation of immune cells/antigen-presenting cells to the nodes.

Until now, no lymph vessels had been officially found in the brain itself, so manual lymphatic techniques could not be appropriately applied to this region. With the discovery of lymph vessels in the meninges (the cover of the brain), manual lymphatic techniques can now be applied to the dura matter, the external and thicker layer of the brain.

"… Your patient had better save his life and money by passing you by as a failure, until you are by knowledge qualified to deal with the lymphatics."
A. T. Still, 1899[25]

"DRAIN YOUR BRAIN"

The use of very specific manual techniques to activate the lymphatic flow began, as far as we know, at the beginning of the 20th century[26] when traditional osteopaths C. E. Miller (1920) and F. P. Millard (1922) first documented specialized techniques to work on the lymphatic system.[27]

There are scientific descriptions of the lymphatic rhythm in humans, but very few practitioners are working at stimulating lymph circulation in a direct and precise manner with this rhythm. Lymph Drainage Therapy (LDT) was developed to manually attune to the specific rhythm, the direction, the depth, and the quality of the lymph flow, consistent with these recent scientific discoveries. LDT teaches practitioners how to work with lymph and interstitial fluid on skin and mucosa, muscles, fascia, tendons, the chambers of the eyes, periosteum, most viscera, the dura, and the pia.[28]

LDT explains how to manually map the lymphatic pathways with the hands (Manual Lymphatic Mapping), how to identify precise areas of the body where there is fluid stagnation or fibrosis, and how to find the most appropriate pathways for drainage.

LDT approaches are gentle techniques that work through the interstitial and lymphatic systems of the body to activate the body's circulatory and immune systems.

The work is typically done from proximal (the location where the fluid ends up), to distal (away from this location). To stimulate CSF circulation and drainage of the brain, the practitioner needs to start at the clavicles (supraclavicular nodes) and work his way up to the numerous nodes of the neck (approximately 300).

Once the neck sequence is complete, some techniques can address the cerebral interstitial fluid, and then the area of cranial (and spinal) nerves can be specifically addressed. As an example, lymphatic drainage of the sciatic nerve (an advanced training of LDT) can be very efficient. In the few minutes it takes to accomplish the protocol, the client can be completely released, or freed enough to lie down calmly on the therapeutic table so other complementary approaches can be easily used.

Let's now look at the specific rhythm, direction, depth, and quality of the lymph flow as part of the LDT protocol.

The Lymphatic Rhythm

The lymphatic rhythm in humans was scientifically described by A. Engeset and W. Olszewski more than 30 years ago.[29] The main vessels of the human lymphatic system (lymphatic collectors) present two or three layers of spiral muscles that have peristaltic (wavelike) contractions controlled by the autonomic nervous system.[30]

Contrary to what is sometimes taught, the lymphatic system is not a passive system only stimulated by respiration—and lymph doesn't need to be forcefully pushed with our fingers. The intrinsic motility of the lymph fluid is generated by the contraction of little muscular units located in the collector vessels between two valves. These contractile units, called "lymphangions" or "little lymphatic hearts," were discovered long ago, but were not recognized by the scientific community until recently.[31]

LDT practitioners learn how to apply the right pressure and attune to the deep rhythm of the lymph. Then the right pressure and proper rhythm can be applied in synchrony with the whole system, attuning to and supporting the specific lymphatic rhythm of each client.

To be able to palpate the lymphatic flow requires time and dedication. Nevertheless, it is an effort that is worthwhile because it is a doorway to the fluid body, an inner realm that holds great potential.

However, this does not make the lymphatic flow easily palpable in all cases. This type of training, as with many other professional manual techniques, requires time and dedicated effort.

Direction of the Lymph Flow

Advanced LDT practitioners use Manual Lymphatic Mapping to manually assess the specific direction of the lymphatic flow and find areas of fluid retention, edemas, or fibrosis.

Heightened palpation skills enable practitioners to discern normal flow from disturbed or pathological flow patterns. A practitioner is then able to support the client in self-correction, allowing the intelligence of the body to express its own ability to heal itself.

In cases of fluid obstruction, these tools are very important in order to find the most accurate alternate lymphatic pathways in different areas of the body. At the beginning of a manual therapy session, an initial assessment of the areas of fluid stagnation can be made with a trained hand. The therapist can then determine the areas that need the most work, and perform that work. They can then manually recheck if the lymph flow has been efficiently and noninvasively rerouted. Verifying the results can help the practitioner select an effective treatment protocol.

Depth and Pressure

The LDT touch is gentle, relaxed, and flowing. A rhythmic, loving hand is always required. This ensures a noninvasive, respectful touch throughout every treatment.

The hand surrenders to the movement and depths of the waters of the body. The depth is determined by whether you are in superficial lymph, deep interstitial fluid, intracellular fluid, superficial (epifascial)

circulation, or lymph circulation below the fascia, muscles, intercostal spaces, viscera, or periosteum. Each has a special quality that is palpable. As you become more attuned to the fluid dynamics of the body, you are better able to read and discern the signs of both pathologic and healthy tissue. This gives the practitioner an important skill that heightens the effectiveness of his treatment. It can clearly indicate and direct attention to the areas of the body that are pathological, which can easily be overlooked.

The ideal pressure has been calculated, and has been suggested to be no more than 33 millimeters of mercury per square centimeter.[32] The standard pressure used is often similar to the pressure applied in craniosacral work. This pressure can change in different areas of the body and in different conditions.

Quality

An assessment of lymph quality is another important element of LDT. Lymph is usually watery, but it can also be quite viscous in cases of chronic lymph retention, such as those caused by allergies, fibromyalgia, chronic fatigue syndrome, chronic inflammation, leaky gut syndrome, etc. Recognizing the quality of lymph can bring a deeper awareness of the conditions a client may be challenged with, or suffering from.

Emotions can also affect the natural fluidity in lymph. When we are unable to process our emotions, they are unable to flow. This can have a direct effect on our lymph, creating a feeling of fatigue and physical heaviness. A treatment can help the client release emotional duress and stress, and return to a calmer and more balanced state of being. We are becoming more aware of the direct relationship between our emotions and our fluid—a true physical expression of our emotional body.

Application of LDT to the CNS

A 1994 study showed LDT has a real influence on CNS, and can reduce intracranial pressure dramatically.[33]

Our vision and understanding of lymphatics has profoundly expanded, giving us entry into deeper levels of healing, which now includes the brain.

The stimulation of lymph flow through the lymphatic nodes also activates the immune system, increasing the production of lymphocytes by about 30 percent.

Lymphocytes are important in sustaining a healthy immune system, and there are two main types: B cells and T cells. The B cells make antibodies that can handle toxins and aggressive bacteria, while the T cells attack body cells themselves. Lymphocytes are often present at sites of chronic inflammation, so a 30 percent increase can certainly be a great advantage to sustaining or reinstating health.

LDT can help with reabsorption and cleansing of some constituents of CSF through the perineural lymphatic pathways. This has become more important as our environment and food become increasingly more toxic and our bodies are being challenged more than ever. LDT is a valuable tool that can sustain a balance of health as it deeply cleanses overloaded tissue.

One of the benefits of manual LDT is its gentleness and noninvasiveness, which gives the client an opportunity to deeply rest and receive. The touch itself stimulates the parasympathetic system, opening the possibilities for deeper healing. As the hand becomes more trained in the realm of fluid dynamics, it is able to address a number of potential systems and pathologies, beginning with inflammation, chronic pain, swelling, and/or detoxification. It can also be seen as a very effective preventive approach.

AN OPPORTUNITY FOR DEEPER HEALING

It is so exciting that the classical models of CSF physiology and the lymphatic anatomy in the CNS have both been dramatically updated with recent research. Our vision and understanding of lymphatics has profoundly expanded, giving us entry into deeper levels of healing, which now includes the brain.

This new scientific evidence also opens the way for new manual techniques to arise that are more consistent with this evidence, giving the practitioner's work a higher level of credibility and acceptance in the health-care field.

The new scientific findings concerning the CNS, lymph, and the glymphatic system reveal far-reaching and exciting benefits for the lymphatic system and its manual treatment.

We are in awe at the new potential that has opened to us. These new models, along with more precise anatomical maps, will be able to take our awareness and attention to much more refined levels. The world of our inner fluid dynamics is wide open. m&b

Notes

1. A. T. Still, *Philosophy of Osteopathy* (1899): 105.

2. G. Aselli, "De Lactibus Seu Lactis Venis, Quarto Vasorum Mesaraicorum Genere Novo Inventa," *Dissertatio Mediolan* (1627).

3. S. Hajdu, "A Note from History: Discovery of the Cerebrospinal Fluid," *Annals of Clinical and Laboratory Science* 33, no. 3 (2003).

4. E. Swedenborg, *The Brain, Considered Anatomically, Physiologically and Philosophically, Vol. 1* (London: James Speirs, 1882).

5. E. Swedenborg, *The Economy of the Animal Kingdom, Considered Anatomically, Physiologically and Philosophically, Vol. 1* (London: W. Newberry, 1845): 42.

6. W. E. Dandy, "Experimental Hydrocephalus," *Annals of Surgery* 70, no. 2 (1919): 129–42.

7. G. Schwalbe, "Der Arachnoidalraum Ein Lympharaum Und Sein Zusammenhang Mir Den Perichoroidalraum," *Zentralbl Med Wiss* 7 (1869): 465.

8. H. Quincke, "Zur Physiologie der Cerebrospinal Flussigkeit," *Archives of Anatomy and Physiology* (1872): 153.

9. B. Chikly, "Is Human Cerebrospinal Fluid Reabsorbed by Lymph? Lymph Drainage Therapy and Manual Drainage of the Central Nervous System," *American Academy of Osteopathy* 8, no. 2 (1998): 28–34.

10. T. Brinker, M. Boker, and M. Foldi, "Manual Lymphatic Drainage of the Head and the Neck for Treatment of Increased Intracranial Pressure," *Progress in Lymphology* XIV, ed. M. H. Witte and C.L. Witte, in *Lymphology* 27 (1994): 614–17.

11. B. Chikly and J. Quaghebeur, "Reassessing Cerebrospinal Fluid (CSF) Hydrodynamics: A Literature Review Presenting a Novel Hypothesis for CSF Physiology," *Journal of Bodywork & Movement Therapies* 17, no. 3 (2013), DOI: 10.1016/j.jbmt.2013.02.002: 344–54.

12. D. Orešković et al., "Fluid Perfusion as a Method of Cerebrospinal Fluid Formation Rate-Critical Appraisal," *Collegium Antropologicum* 32 Suppl 1 (January 2008): 133–7.

13. T. H. Milhorat, "Choroid Plexus and Cerebrospinal Fluid Production," *Science* 166 (1969): 1514–16; M. K. Hammock and T. H. Milhorat, 1973: Recent Studies on the Formation of Cerebrospinal Fluid," *Developmental Medicine and Child Neurology* Supplement (1973): 27–34; T. H. Milhorat, "Structure and Function of the Choroid Plexus and Other Sites of Cerebrospinal Fluid Formation," *International Review of Cytology* 47 (1976): 225–88.

14. G. Tamburrini et al., "The Role of Endoscopic Choroid Plexus Coagulation in the Surgical Management of Bilateral Choroid Plexuses Hyperplasia," *Child's Nervous System* 22, no. 6 (June 2006): 605–8.

15. D. Orešković, M. Klarica, and M.Vukić, "Does the Secretion and Circulation of the Cerebrospinal Fluid Really Exist?" *Medical Hypotheses* 56, no. 5 (May 2001): 622–24; M. Klarica et al., "New Experimental Model of Acute Aqueductal Blockage in Cats: Effects on Cerebrospinal Fluid Pressure and the Size of Brain Ventricles," *Neuroscience* 158, no. 4 (2009): 1397–1405.

16. N. Strikić et al., "Effect of Active Transport on Distribution and Concentration Gradients of [3H] Benzylpenicillin in the Cerebrospinal Fluid," *Neuroscience Letters* 169, no. 1–2 (March 1994): 159–62; A. Vladić, M. Klarica, and M. Bulat, "Dynamics of Distribution of 3H-inulin Between the Cerebrospinal Fluid Compartments," *Brain Research* 1248 (January 2009): 127–35.

17. M. Bulat and M. Klarica, "Recent Insights Into a New Hydrodynamics of the Cerebrospinal Fluid," *Brain Research Reviews* 65, no. 2 (January 2011): 99–112.

18. J. D. Fenstermacher and T. Kaye, "Drug "Diffusion" Within the Brain," *Annals of the New York Academy of Sciences* 531 (1988): 29–39; L. B. Flexner, "The Water of the Cerebrospinal Fluid: Variations of Its Rate of Flow with Variation of Ventricular Pressure," *American Journal of Physiology* 106, no. 1 (1933): 170–74.

19. M. Bulat and M. Klarica, "Fluid Filtration and Reabsorption Across Microvascular Walls: Control by Oncotic or Osmotic Pressure?" *Periodicum Biologorum* 107, no. 2 (2005): 147–52; M. Bulat et al., "Transventricular and Transpial Absorption of Cerebrospinal Fluid into Cerebral Microvessels," *Collegium Antropologicum* 32, Supplement 1 (January 2008): 43–50.

20. J. J. Iliff et al., "A Paravascular Pathway Facilitates CSF Flow Through the Brain Parenchyma and the Clearance of Interstitial Solutes, Including Amyloid β," *Science Translational Medicine* 4, no. 147 (August 2012): 147ra111.

21. L. Xie et al., "Sleep Drives Metabolite Clearance From the Adult Brain," *Science* 342, no. 6156 (October 2013): 373–7.

22. V. Rangroo Thrane et al., "Paravascular Microcirculation Facilitates Rapid Lipid Transport and Astrocyte Signaling in the Brain," *Scientific Reports* 3 (2013): 2582.

23. A. Louveau et al., "Structural and Functional Features of Central Nervous System Lymphatic Vessels," *Nature* 523, no. 7560 (July 2015): 337–41.

24. A. Aspelund et al., "A Dural Lymphatic Vascular System that Drains Brain Interstitial Fluid and Macromolecules," *Journal of Experimental Medicine* 212, no. 7 (June 2015): 991–9.

25. A. T. Still, *Philosophy of Osteopathy* (1899): 105.

26. B. Chikly, "Manual Techniques: Addressing the Lymphatic System: Origins and Development," *Journal of the American Osteopathic Association* 105, no. 10 (October 2005): 457–64.

27. C. E. Miller, "Osteopathic Treatment of Acute Infections by Means of the Lymphatics," *Journal of the American Osteopathic Association* 19 (1920): 494–9; F. P. Millard, *Applied Anatomy of the Lymphatics* (Kirksville, MO: The Journal Printing Company, 1922).

28. B. Chikly, *Silent Waves: Theory and Practice of Lymph Drainage Therapy, an Osteopathic Lymphatic Technique*, 2nd ed. (Upledger Institute, 2005).

29. A. Engeset et al., "Twenty-Four Hour Variation in Flow and Composition of Leg Lymph In Normal Men," *Acta Physiologica Scandinavica* 99, no. 2 (1977): 140–8; W. L. Olszewski and A. Engeset, "Characteristics of Lymph Flow in Lower Limbs Under Normal Conditions," *Progress in Lymphology* XII (1990): 213.

30. D. C. Zawieja, "Contractile Physiology of Lymphatics," *Lymphatic Research and Biology* 7, no. 2 (2009): 87–96.

31. H. Mislin and D. Rathenow, "Beeinflussung Des Spontanrhythmik Der Isolierten Mesenterialen Lymphgefässe (Lymphangion) Durch Diverse Pharmaka," *Helvetica Physiologica et Pharmacologica Acta* 19 (1961): 87.

32. J. Asdonk, "Lymphdrainage Und Molekularmassage," *Physikalische und Rehabilitative Medizin, Heft* 10 (1967).

33. T. Brinker, M. Boker, and M. Foldi, "Manual Lymphatic Drainage of the Head and the Neck for Treatment of Increased Intracranial Pressure," *Progress in Lymphology* XIV, in *Lymphology* 27, eds. C. L. Witte and M. H. Witte (1994): 614–17.

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