Immunological effects of osteopathic techniques

Doctor of Osteopathy

Name: Jianrong Zheng
Student number: S1809013
Date of submission: 5th June, 2020
E-mail: coachjalenz@gmail.com
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**Introduction**

As a student of osteopathic science, it has been loud and clear since day 1 that osteopathy is more than its treatment methods. Instead, it is a holistic treatment philosophy that regard the human body as a unit. Shoulder pain can be traced back to the problematic spleen or gall bladder, numbness or tingling of the fingers and toes can be coming from abnormal spinal alignment and movement at a certain section, etc.

Theoretically, the osteopathic treatment system is complete and flawless as it can be, what a person can get from it should not just be the “problem solving fix”, but an overall health improvement. However, theory will only be available and contributable to the advance of the human society when it’s proved by the ironclad evidence.

This thesis will look into a very specific, yet, one of the most important aspects of the overall health parameters, immunological health, and by reviewing most recent researches, the goal is to find out the effectiveness of osteopathic techniques for improving immunological health.

**Definition of immunological health**

The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease. To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue. In many species, there are two major subsystems of the immune system: the innate immune system and the adaptive immune system. Both subsystems use humoral immunity and cell-mediated immunity to perform their functions. In humans, the blood–brain barrier, blood–cerebrospinal fluid barrier, and similar fluid–brain barriers separate the peripheral immune system from the neuroimmune system, which protects the brain.

Pathogens can rapidly evolve and adapt, and thereby avoid detection and neutralization by the immune system; however, multiple defense mechanisms have also evolved to recognize and neutralize pathogens. Even simple unicellular organisms such as bacteria possess a rudimentary immune system in the form of enzymes that protect against bacteriophage infections. Other basic immune mechanisms evolved in ancient eukaryotes and remain in their modern descendants, such as plants and invertebrates. These mechanisms include phagocytosis, antimicrobial peptides called defensins, and the complement system. Jawed vertebrates, including humans,
have even more sophisticated defense mechanisms, including the ability to adapt over time to recognize specific pathogens more efficiently. Adaptive (or acquired) immunity creates immunological memory after an initial response to a specific pathogen, leading to an enhanced response to subsequent encounters with that same pathogen. This process of acquired immunity is the basis of vaccination.

Disorders of the immune system can result in autoimmune diseases, inflammatory diseases and cancer. Immunodeficiency occurs when the immune system is less active than normal, resulting in recurring and life-threatening infections. In humans, immunodeficiency can either be the result of a genetic disease such as severe combined immunodeficiency, acquired conditions such as HIV/AIDS, or the use of immunosuppressive medication. In contrast, autoimmunity results from a hyperactive immune system attacking normal tissues as if they were foreign organisms. Common autoimmune diseases include Hashimoto's thyroiditis, rheumatoid arthritis, diabetes mellitus type 1, and systemic lupus erythematosus. Immunology covers the study of all aspects of the immune system.

**The lymphatic system**

The lymphatic system, or lymphoid system, is an organ system in vertebrates that is part of the circulatory system and the immune system. It is made up of a large network of lymphatic vessels, lymphatic or lymphoid organs, and lymphoid tissues. The vessels carry a clear fluid called lymph (the Latin word lympha refers to the deity of fresh water, "Lympha") towards the heart.

Unlike the cardiovascular system, the lymphatic system is not a closed system. The human circulatory system processes an average of 20 litres of blood per day through capillary filtration, which removes plasma from the blood. Roughly 17 litres of the filtered plasma is reabsorbed directly into the blood vessels, while the remaining three litres remain in the interstitial fluid. One of the main functions of the lymphatic system is to provide an accessory return route to the blood for the surplus three litres.

The other main function is that of immune defense. Lymph is very similar to blood plasma, in that it contains waste products and cellular debris, together with bacteria and proteins. The cells of the lymph are mostly lymphocytes. Associated lymphoid organs are composed of lymphoid tissue, and are the sites either of lymphocyte production or of lymphocyte activation. These include the lymph nodes (where the highest lymphocyte concentration is found), the spleen, the thymus, and the tonsils. Lymphocytes are initially generated in the bone marrow. The
lymphoid organs also contain other types of cells such as stromal cells for support. Lymphoid tissue is also associated with mucosas such as mucosa-associated lymphoid tissue (MALT).

Fluid from circulating blood leaks into the tissues of the body by capillary action, carrying nutrients to the cells. The fluid bathes the tissues as interstitial fluid, collecting waste products, bacteria, and damaged cells, and then drains as lymph into the lymphatic capillaries and lymphatic vessels. These vessels carry the lymph throughout the body, passing through numerous lymph nodes which filter out unwanted materials such as bacteria and damaged cells. Lymph then passes into much larger lymph vessels known as lymph ducts. The right lymphatic duct drains the right side of the region and the much larger left lymphatic duct, known as the thoracic duct, drains the left side of the body. The ducts empty into the subclavian veins to return to the blood circulation. Lymph is moved through the system by muscle contractions.[7] In some vertebrates, a lymph heart is present that pumps the lymph to the veins.

The lymphatic system was first described in the 17th century independently by Olaus Rudbeck and Thomas Bartholin.

**Lymphatic pump techniques**

Lymphatic pumps are gentle passive techniques that may be used on patients in both the inpatient and outpatient clinical settings. Pumps are used to facilitate fluid movement or immune responses in patients with varying symptoms and disease states. Somatic dysfunction affecting lymphatic flow may contribute to edema, impaired clearance of infection, and altered tissue healing and immune responses. In this article, we highlight key points regarding the lymphatic system and the role of lymphatic pump treatment (LPT) in clinical care.

The lymphatic system is a secondary circulatory system composed of a complex network of lymphatic channels, capillaries, nodes, plexes, tissues, and organs. This system serves to maintain homeostasis, support the immune response, and improve fluid balance. It collects and filters fluid and proteins from interstitial tissue and absorbs and transports nutrients.

Lymphatic and venous flow is dependent on local mechanical and fluid forces as well as pressure differentials generated by muscular and diaphragmatic activity throughout the body. Large lymph vessels contain an intrinsic pump in the form of lymphangions, which are under autonomic control (both sympathetic and parasympathetic) and produce a peristaltic wave. A larger-amplitude mechanical pumping is induced by muscle pumps, intrinsic visceral motion, and the rhythmic nature of respiration.1 Breathing generates a pumping action as lymph and venous blood are drawn into the negatively pressured thoracic cavity from the positively pressured
abdominal cavity during inhalation. However, somatic dysfunction may impede lymphatic flow via fascial compression of lymphatic vessels, increased impedance in the thoracic inlet region (the terminal drainage point), and increased sympathetic tone, which can alter peristalsis and valve motion.

Thoracic and pedal pump techniques are 2 types of LPT that can be used to enhance the body's inherent physiologic pumping action. These pumping techniques have been demonstrated to increase lymphatic flow in the thoracic duct, and mechanical pumping has been shown to increase lymph uptake in rats. Furthermore, the application of LPT has been shown to boost antibody responses to vaccines (including pneumococcal and hepatitis B) and significantly increase secretory immunoglobulin A in a stressed population. Lymphatic pump techniques have also been shown to mobilize leukocytes from gut-associated lymphoid tissue, significantly increase leukocyte count, and mobilize inflammatory mediators such as interleukin 8, interleukin 6, interleukin 10, monocyte chemoattractant protein 1, granulocyte colony-stimulating factor, keratinocyte-derived chemoattractant, nitrite, and superoxide dismutase. When compared with levofloxacin plus sham treatment or levofloxacin alone given to rats infected with Streptococcus pneumoniae, the combination of LPT and levofloxacin was found to significantly reduce colony-forming units of S pneumoniae found in the lungs at 72 and 96 hours. In clinical practice, patients treated with the thoracic lymphatic pump after cholecystectomy were found to have an earlier recovery and a faster improvement of forced vital capacity than those treated with incentive spirometry.

Lymphatic pump techniques are generally well tolerated; however, there are a few absolute contraindications, including anuria and necrotizing fasciitis. Contraindications are often related to concern regarding lymphatic spread of infection or malignant cells, dislodging a deep vein thrombosis, or causing fluid disbalance in a fluid-overloaded patient. Relative contraindications include treatment localized over an area that has cancer, fracture, or active infection; overwhelming bacterial or chronic infections; coagulopathies; and unstable congestive heart failure. It is important to ensure that proximal lymphatic channels are opened before performing these techniques.

Lymphatic pump techniques can be easily and safely used in many patient presentations to enhance lymphatic fluid motion and improve immune function.

**Recent researches**

In the research by Lisa M. Hodge and her colleges in 2010, catheters were inserted into either the thoracic or mesenteric lymph ducts of dogs. To determine if LPT enhanced the release of leukocytes from the mesenteric lymph nodes (MLN) into lymph, the MLN were fluorescently labeled in situ. Lymph was collected during 4 min pre-LPT, 4 min LPT, and 10 min following cessation of LPT. LPT significantly increased lymph flow and leukocytes in both mesenteric and
thoracic duct lymph. LPT had no preferential effect on any specific leukocyte population, since neutrophil, monocyte, CD4+ T cell, CD8+ T cell, IgG+B cell, and IgA+B cell numbers were similarly increased. In addition, LPT significantly increased the mobilization of leukocytes from the MLN into lymph. Lymph flow and leukocyte counts fell following LPT treatment, indicating that the effects of LPT are transient.

Their research showed that LPT mobilizes leukocytes from GALT, and these leukocytes are transported by the lymphatic circulation. This enhanced release of leukocytes from GALT may provide scientific rationale for the clinical use of LPT to improve immune function.

In the research by Caitlin Creasy and her colleges in 2013, Rats were nasally infected with S. pneumoniae and received either control, sham, Ab-LPT, or Th-LPT once daily for 3 consecutive days. On day 4 post-infection, lungs were removed and bacteria were enumerated. Three daily applications of either Ab-LPT or Th-LPT were able to significantly (p<0.05) reduce the numbers of pulmonary bacteria compared to control and sham. There were no significant differences in the percentage or concentration of leukocytes in blood between groups, suggesting neither Ab-LPT nor Th-LPT release leukocytes into blood circulation.

Their research showed that LPT may protect against pneumonia by inhibiting bacterial growth in the lung; however, the mechanism of protection is unclear. Once these mechanisms are understood, LPT can be optimally applied to patients with pneumonia, which may substantially reduce morbidity, mortality, and frequency of hospitalization.

In the research by Carmen Villaverde-Gutiérrez and Manuel Arroyo-Morales in 2013, thirty-nine healthy male volunteers were randomly assigned to an experimental or control group. The experimental group underwent three manual therapy modalities: suboccipital muscle release, so-called fourth intracranial ventricle compression, and deep cervical fascia release. The control group remained in a resting position for the same time period under the same environmental conditions. They measured changes in counts of CD3, CD4, CD8, CD19, and natural killer (NK) cells (as immunological markers) between baseline and 20 minutes post-intervention.

As it turned out, repeated-measures ANOVA revealed a significant time×groups interaction (F1,35=9.33; p=0.004) for CD19. There were no significant time×group interaction effects on CD3, CD4, CD8, or NK cell counts. Intrasubject analyses showed a higher CD19 count in the experimental group post-intervention versus baseline (t=−4.02; p=0.001), with no changes in the control group (t=0.526; p=0.608). A major immunological modulation, with an increased B lymphocyte count, was observed at 20 minutes after the application of craniocervical myofascial induction techniques.

In the research by Lisa M. Hodge and her colleges in 2007, Lymph flow was measured by timed collection or ultrasonic flowmeter, and lymph was collected over ice under 1) resting (baseline)
conditions, and 2) during application of LPT. The baseline leukocyte count was $4.8 \pm 1.7 \times 10^6$ cells/ml of lymph, and LPT significantly increased leukocytes to $11.8 \pm 3.6 \times 10^6$ cells/ml. Flow cytometry and differential cell staining revealed that numbers of macrophages, neutrophils, total lymphocytes, T cells and B cells were similarly increased during LPT. Furthermore, LPT significantly enhanced lymph flow from $1.13 \pm 0.44$ ml/min to $4.14 \pm 1.29$ ml/min. Leukocyte flux, computed from the product of lymph flow and cell count, was increased by LPT from $8.2 \pm 4.1 \times 10^6$ to $60 \pm 25 \times 10^6$ total cells/min. Similar trends were observed in macrophages, neutrophils, total lymphocytes, T cells and B cells during LPT.

Their findings showed that LPT significantly increased both thoracic duct lymph flow and leukocyte count, so lymph leukocyte flux was markedly enhanced. Increased mobilization of immune cells is likely and important mechanism responsible for the enhanced immunity and recovery from infection of patients treated with LPT.

**Conclusion**

Despite of all the anecdotal evidence from practitioners, there’re still lack of researches and proves that soft tissue mobilization and lymphatic pump technique help improving the immunological health. Of all 4 researches which are cited in this thesis, only 1 involved actual human experiment, and all these researches were published more than 7 years form present date (at least).

The limitation in this field of study is quite clear. However, the room for improvement should contain more than just the devotion of experimental fund and time, the overall direction and methodology can also benefit from some innovation. For example, there seems to be lack of research in the effectiveness of muscle energy technique, joint mobilization, manipulative technique, visceral manipulation, cranial manipulation on immunological health, despite of fact that also these techniques are theoretically related to contribute to a healthy and robust immune system.
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