



REVIEW

Osteopathic lymphatic pump techniques to enhance immunity and treat pneumonia

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Abstract Pneumonia is a common cause of morbidity and mortality worldwide. While antibiotics are generally effective for the treatment of infection, the emergence of resistant strains of bacteria threatens their success. The osteopathic medical profession has designed a set of manipulative techniques called lymphatic pump techniques (LPT), to enhance the flow of lymph through the lymphatic system. Clinically, LPT is used to treat infection and oedema and might be an effective adjuvant therapy in patients with pneumonia. The immune system uses the lymphatic and blood systems to survey to rid the body of pathogens; however, only recently have the effects of LPT on the lymphatic and immune systems been investigated. This short review highlights clinical and basic science research studies that support the use of LPT to enhance the lymphatic and immune systems and treat pneumonia, and discusses the potential mechanisms by which LPT benefits patients with pneumonia.

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Introduction

Infectious diseases, such as pneumonia, are a common cause of morbidity and mortality worldwide. Antibiotics are generally effective for

the treatment of infection; however the continual emergence of antibiotic resist strains of bacteria threatens their effectiveness. The mammalian immune system has evolved to defend the body against infection. Immune cells continually recirculate from the bloodstream through the peripheral or secondary lymphoid organs, and then return to the bloodstream via the lymphatic vessels in a process termed immune surveillance.^{1,2} Innate immunity is the first line of defense against infection and includes

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complement proteins, granulocytes, mast cells, macrophages, dendritic cells, and natural killer (NK) cells. Adaptive immunity is mediated by antigen-specific B and T cells, which induce immunological memory. Together, these two components of the immune system act to survey the body for infection, propagate and activate immune cells, kill infectious organisms and mount immunological memory.¹

Furthermore, during infection, pro-inflammatory cytokines, chemokines, and reactive oxygen and nitrogen species are released from injured tissue to enter blood and lymph.² Leukocytes utilize this inflammatory tissue gradient to detect sites of infection and inflammation in the body. Once recruited, these leukocytes can directly kill pathogens and continue to release inflammatory mediators, propagating the chemo-attractive gradient and activating other cells of the immune system.² As pathogens are cleared from tissue, the inflammatory gradient subsides and the concentration of leukocytes and inflammatory mediators decreases.^{1,2}

The lymphatic system collects fluid, immune cells, antigens, pathogens and proteins from the tissue interstitial space and delivers them to regional lymph nodes.² Intrinsic physiological factors such as skeletal muscle contraction, intestinal motility, and respiratory motions facilitate the flow of lymph through lymphatic vessels.^{2,3,4,5} External forces such as exercise^{6,7} passive limb movement,⁸ and body-based manipulative medicine techniques^{6,7,9-12} have also been shown to increase lymph flow. If this circulation of lymph is restricted in any way, there could be a delay in the immune response to a pathogen, which could compromise the health of an individual.^{3,13}

The osteopathic medical profession has designed a set of osteopathic manipulative techniques (OMT), called lymphatic pump techniques (LPT), to enhance the flow of lymph through the lymphatic system.¹³⁻¹⁵ Lymphatic pumps can be applied to the thoracic cage, abdomen (splenic and liver pumps), feet and legs (pedal pumps).¹³ Clinically, LPT is used to treat infection and edema^{13,14} and might be an effective adjuvant therapy in patients with pneumonia.¹⁶⁻¹⁸ While there are few published clinical studies examining the effect of LPT on infection and immunity, recent studies in animals have shown that LPT enhances the uptake of lymph into the lymphatic system¹⁹ and increases lymph flow and leukocyte output.^{9,10,12} By enhancing the lymphatic release of immune cells, LPT may enhance immune-mediated protection against infectious disease; however, further studies are required to confirm

this theory. A better understanding of these mechanisms should provide a scientific basis for the clinical use of LPT.

Lymphatic pump techniques enhance the lymphatic and immune systems

Early studies in humans suggest LPT may enhance innate immunity in both healthy individuals^{20,21} and patients with acute infectious disease²²; however, it is important to note these were pilot studies with a limited numbers of subjects. More recently, Knott et al demonstrated that both thoracic and abdominal LPT increase thoracic duct lymph flow in dogs.⁶ Subsequently, Hodge et al found the application of LPT to the abdomen stimulates the release of immune cells from lymph nodes that directly enter lymphatic circulation.¹⁰ In this study LPT also increased lymph flow and the concentration of immune cells within the lymph of dogs.¹⁰ Table 1 illustrates the effect of four minutes of LPT on thoracic duct leukocyte flux (i.e. immune cells per minute of lymph collected) in anesthetized dogs. While the release of leukocytes into lymph during LPT was transient, four minutes of LPT produced a net increase of 6×10^8 leukocytes into thoracic duct lymphatic circulation, which included cells of both the innate and adaptive immune system. In addition, LPT had no preferential effect on any of these immune cells, since neutrophils, monocytes, total lymphocytes, CD4+ T cells, CD8+ T cells, and IgA+ and IgG+ B cell numbers were similarly increased. Similar results were seen in mesenteric lymph.¹⁰ Collectively, this data suggests application of LPT to the abdomen mobilizes immune cells from the mesentery into lymph circulation, which then delivers these cells to venous circulation.

While enhanced lymph flow and leukocyte concentrations may explain some of the clinical benefits of LPT, additional factors, such as inflammatory cytokines, chemokines and reactive oxygen and nitrogen species also influence immunity. Therefore, to determine if LPT would mobilize inflammatory mediators into lymphatic circulation, thoracic or intestinal lymph of healthy dogs was collected at resting (Pre-LPT), during 4 min of LPT, and for 10 min following LPT (Post-LPT) and measured for the concentration of IL-2, IL-4, IL-6, IL-10, IFN- γ , TNF- α , MCP-1, keratinocyte chemoattractant (KC), superoxide dismutase (SOD), and nitrotyrosine (NT).¹¹ LPT significantly enhanced the lymphatic flux of these inflammatory mediators, which may enhance protection against infection by redistributing these mediators to

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