BRIEF REPORT

# OSTEOPATHIC MANIPULATIVE TREATMENT FOR CHRONIC BRONCHIECTASIS: A CASE REPORT

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## KEYWORDS

Bronchiectasis

Lymphatics

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## ABSTRACT

Bronchiectasis is an uncommon chronic obstructive lung disease caused by chronic airway inflammation leading to irreversible bronchial dilation and destruction of medium-sized airways. In this case, we treated a bronchiectasis patient with a combination of osteopathic manipulative treatment (OMT) techniques including myofascial release and lymphatic techniques as adjunctive treatments in addition to other pharmacologic and nonpharmacologic therapies; OMT was shown to improve subjective symptoms of airway congestion as well as reduce frequency of emergency room visits and hospital admissions for this patient.

## INTRODUCTION

Bronchiectasis is a chronic lung disease characterized by persistent lifelong widening of bronchial airways and weakening of mucociliary transport mechanism, owing to repeated infection, thus contributing to bacterial invasion and mucus pooling throughout the bronchial tree due to neutrophilic invasion.[1] Associated comorbid illnesses include bronchitis, hemoptysis, pleuritis, and recurrent bacterial pneumonia. Chronic airway inflammation appears to have an inhibitory effect on lymphangiogenesis contributing to lymphatic blockage and stasis. The pathophysiology of lymphatic vasculature changes in the setting of lung disease is not well understood yet.[2] By directing osteopathic manipulative treatment (OMT) to dysfunctional organ systems, movement of lymphatic fluids throughout the body is encouraged using noninvasive passive soft-tissue movements and release of underlying tissue restrictions. In 2010, Noll et al[3] published “Efficacy of Osteopathic Manipulation as an Adjunctive Treatment for Hospitalized Patients With Pneumonia: A Randomized Control Trial.” Known as the Multicenter Osteopathic Pneumonia Study in the Elderly (MOPSE), this study showed a significant reduction of length-of-stay, decreased duration of intravenous antibiotics, and decreased respiratory failure or death when OMT was performed. MOPSE definitively laid the groundwork for more research in the area of respiratory diseases and OMT.

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## CASE REPORT

A 59-year-old female presented to her osteopathic physician with complaint of recurrent chest congestion and shortness of breath. Her symptoms have been chronic and ongoing for several years. Her medical history included bronchiectasis, reactive airway disease, anemia of chronic disease, morbid obesity, diabetes mellitus type 2, immunoglobulin (Ig)G subclass deficiency, chronic pain syndrome, generalized anxiety disorder, and recurrent pneumonia and *Mycobacterium avium* infection. She had recurrent hospitalizations due to her symptoms: two admissions in 2021, four admissions in 2020 (when she started receiving OMT), six admissions in 2019, andseven admissions in 2018. Her past surgical history was notable for laparoscopy, carpal tunnel surgery of bilateral wrists, and frenectomy. Her family history was noncontributory to her current symptoms. Her social history is unremarkable for alcohol, tobacco, or drug use. Her medications included tramadol extended-release 100 mg, two tablets daily; alprazolam 0.5 mg, one tablet every 6 hours as needed for anxiety; benralizumab 30-mg injection every 8 weeks; acetazolamide 150 mg, one tablet daily; and armodafinil 150 mg, one tablet daily. Her vital signs at the most recent visit were unremarkable (116/72 mm Hg, 97.9 °F, 79 bpm, 18 rpm, 97% $O_2$ saturation in room air, body mass index [BMI] 28.3 kg/m$^2$). Cardiovascular examination showed +2 left lower extremity edema. Neurologic examination revealed cranial nerves 2-12 grossly intact, 5/5 muscle strength, 2/4 deep tendon reflexes of the bilateral upper and lower extremities, and notably reduced sensation of the left lower extremity. Pulmonary function testing and other laboratory data and imaging were not available from the patient.

Management of this patient was multifaceted and employed chest physiotherapy to improve airway clearance, pharmacologic treatments such as benralizumab (an immunosuppressant) and acetazolamide (correcting underlying metabolic alkalosis) to minimize recurrent infection and to maintain airway patency, and OMT. As described previously,4 a comprehensive examination of 10 body regions of somatic dysfunction—head, cervical, thoracic, lumbar, sacrum, pelvis, lower extremity, upper extremity, ribs, and abdomen—was performed. Affected areas included cervical, thoracic, ribs, and lower extremity regions. The following somatic dysfunctions and structural abnormalities were identified over the course of several visits: 1) C2-C7 RRSR, 2) T1-T5 NSLRR, 3) left rib 1 exhalation dysfunction, 4) right ribs 2-5 inhalation dysfunction, 5) left ribs 6-10 exhalation dysfunction, 6) right ribs 11-12 exhalation dysfunction, and 7) +1 to +2 bilateral lower extremity edema. Osteopathic manipulative medicine was employed as an adjunctive treatment modality for this patent's somatic dysfunction and bronchiectasis, in addition to pharmacologic therapies. Pharmacologic therapy was provided by the patient's primary care physician and pulmonologist. Treatments were performed twice monthly for 2 years. The autonomic dysfunctions were treated with OA release to normalize parasympathetic tone of the vagus nerve and rib raising.[3] Biomechanical considerations were directed toward the thoracic and lumbar spines and included myofascial release of paraspinal musculature as well as muscles of exhalation, specifically targeting the scalenes, pectoralis minor, serratus anterior, latissimus dorsi, and quadratus lumborum. Lymphatic techniques were directed toward symptomatic relief. Fascial torsions owing to hypertonic musculature can directly decrease lymphatic flow through the fascia by compressing lymphatic vessels. Other treatment techniques used include the splenic pump, effleurage, and petrissage. Treatment techniques were applied in a cephalad to caudad fashion.

Frontal/temporal/mandibular drainage, mandibular distraction (the Galbreath technique), pectoral traction, Miller thoracic pump, pedal pump (also called the Dalrymple pump), and lower extremity effleurage/petrissage treatment techniques were performed.[5-7]

Use of OMT in this patient was shown to subjectively improve her symptoms of airway congestion as well as objectively reduce the frequency of emergency room visits and hospitalizations. However, despite subjective relief and decreased hospitalizations, objective improvement via pulmonary function testing[8] (PFT; Figure 1)—specifically FEV1/FVC—did not consider the subjective and symptomatic benefits derived from OMT. These treatments provided relief and were targeted to affected autonomic, biomechanical, and lymphatic dysfunctions.4 FEV1/FVC represents the proportion of the patient's vital capacity that they are able to expire in the first second of forced expiration compared to the full forced vital capacity.

FIGURE 1:

Pulmonary function test data

| Component<br>Ref Range & Units | 8 d ago<br>(3/2/22) | 1 yr ago<br>(11/25/20) | 2 yr ago<br>(7/30/19) | 2 yr ago<br>(3/25/19) | 3 yr ago<br>(1/29/19) |
|---|---|---|---|---|---|
| **FVC Pred**<br>0.05 - 9.99 Liters | 3.06 | 2.96 | 3.10 | 3.14 | 3.01 |
| **FVC Pre**<br>0 - 12 Liters | 3.13 | 3.10 | 2.78 | 2.36 | 2.69 |
| **FVC %Pre Pred**<br>0 - 300 % | 103 | 105 | 90 | 75 | 89 |
| **FEV1 Pred**<br>0.05 - 9.99 Liters | 2.41 | 2.35 | 2.46 | 2.50 | 2.40 |
| **FEV1 Pre**<br>0 - 12 Liters | 2.71 | 2.69 | 2.44 | 2.07 | 2.32 |
| **FEV1 % Pre Pred**<br>0 - 300 % | 112 | 115 | 99 | 83 | 97 |
| **FEV1/FVC Pred**<br>1 - 99% | 79 | 80 | 80 | 80 | 80 |
| **FEV1/FVC Pre**<br>0 - 12% | 86 | 87 | 88 | 88 | 86 |
| **FEF25-75% Pred**<br>0 - 12 L/sec | 2.22 | 2.21 | 2.33 | 2.35 | 2.29 |
| **FEF25-75% Pre**<br>0 - 12 L/sec | 4.23 | 4.34 | 4.15 | 3.29 | 3.60 |
| **FEF25-75% %Pre Pred**<br>0 - 300% | 190 | 197 | 178 | 140 | 157 |
| **FEF50% PRE**<br>0 - 12 L/sec | 5.03 | 5.8 | 6.44 | 6.02 | 4.68 |
| **FET100% PRE**<br>Sec | 7.94 | 9.04 | 8.16 | 7.22 | 8.39 |

## DISCUSSION

Bronchiectasis is a chronic lung disease characterized by persistent and lifelong widening of the bronchial airways and weakening of the mucociliary transport mechanism, owing to repeated infection. It contributes to bacterial invasion and mucus pooling throughout the bronchial tree due to neutrophilic invasion including *H. influenzae* and *P. aeruginosa*. Other contributory pathogens include *Moraxella catarrhalis*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, and other Gram-negative bacteria and, less commonly, nontuberculosis *Mycobacteria species*.[9,10]

The lymphatic system allows for the flow of nutrients toward, and waste away from, individual cells. It is a passive system whose function can be influenced by external forces. Lymph is a substance that leaks out of arterial capillaries, into the interstitium, and into single-cell lymphatic vessels. Primary cells of lymph are lymphocytes, which are clear in color, contain proteins, salts, and large particles (such as bacteria and viruses) prior to filtration through a lymph node or organ.[11]

Lymphatic channels perfuse most tissues of the body. Simple squamous epithelium cells of lymphatic capillaries allow great permeability of fluids from the interstitium back into the lymphatic system. Capillaries flow into larger channels, which eventually drain into the venous system via the right lymphatic duct or thoracic duct. The right upper extremity, right chest, and right upper quadrant of the abdomen drain via the right lymphatic duct. The remaining portions of the body drain into the thoracic duct.

The functions of the lymphatic system include maintaining fluid balance in the body, purification and cleansing of tissues, defense, and nutrition. Direct external pressure on lymphatic channels increases the flow of lymph. The mechanism of lymphatic flow occurring through lymph channels is influenced by three factors: 1) interstitial fluid pressure: forces fluid into lymphatic capillaries, 2) intrinsic lymphatic pumps: channels with valves similar to the venous system that form sections that function independently and smooth muscle in the channel walls that contract when distended, allowing one to pump to the next, and 3) ionic gradients, whereby fluid goes toward higher concentrations of ions.

Specific functions with regard to applications to bronchiectasis include production of immunologic cells and antibodies, clearing of waste from fighting infections, and filtering toxins. Clearance of exudates and inflammatory mediators form the interstitium results in facile fluid movement in the lymphatics. Remnants of proinflammatory mediators lead to persistent inflammation and delayed healing. Other offending agents include fibroblasts, plasma proteins, platelets, transforming growth factor-β (TGF-β: transforms present monocytes into macrophages), and fibroblast growth factor.[7] Continued presence of these substances leads to scarring, fibrosis, and chronic inflammation. Lymphatics are the predominant means to remove inflammatory exudates and promote the healing phase of the inflammatory process.[7]

Diaphragms are muscular and fascial structures giving shape and form to the body.[7] The eight diaphragms that contribute to lymphatic flow and its obstruction are the diaphragma sellae, tentorium cerebelli, suboccipital diaphragm, thoracic inlet diaphragm, respiratory diaphragm, pelvic diaphragm, popliteal diaphragm, and plantar fascia. The respiratory diaphragm is an important external pump. Respiration causes lymph to move via pressure gradients, by which negative pressure causes fluid to move toward it and positive pressure pushes it away. The pelvic diaphragm works in synchrony with the abdominal diaphragm to maximize flow of interstitial fluid and lymph, relaxing with contraction of the abdominal diaphragm and springing back with exhalation, producing a mechanical pump for lymphatics in the pelvis and lower abdomen.

Prior to treating any lymphatic issues (i.e., edema), the diaphragms described previously must be opened. The ideal order is opening the: 1) thoracic inlet, 2) respiratory (thoracoabdominal) diaphragm, 3) pelvic (presacral) diaphragm, and, 4) popliteal diaphragm. Once the diaphragms are open, fluid mobilization can be performed. This order is utilized to promote maximum drainage of lymphatic flow clearance and to prevent any additional congestion. Failure to open the diaphragms in this manner can be counterproductive and exacerbate an already underlying problem by causing backup of fluids that cannot flow through the preceding closed diaphragm.

The consequence of decreased lymphatic function is edema: buildup of excess interstitial fluid caused by either too much fluid going into the interstitium or too little getting out. Conditions that overload the interstitium override the absorptive capabilities of the lymphatic system. Excessive interstitial fluid increases interstitial pressure and collapses lymph capillaries resulting in further edema and congestion. Edema also causes dilation of lymph capillaries causing valves not to function and the intrinsic pump to shut down. Conditions of increased venous pressure are associated with increased capillary filtration rates and tend to produce edema. These include congestive heart failure (both systolic and diastolic),incompetent heart valves, venous obstruction (i.e., bronchiectasis), and gravity. Conditions that decrease osmotic gradients across the capillary, such as cirrhosis and starvation, decrease lymphatic function and lead to edema.

Inadequate drainage, from conditions such as posttraumatic or postsurgical scarring, may lead to edema. Edema causes compression, not only of lymphatic structures but also vascular and neurologic structures, leading to decreased functional ability. Edema causes further fluid stasis, which causes buildup of waste products and decrease in nutrient delivery, and can further affect bioavailability of drugs and hormones, decreasing their respective functions.

Treatment goals of lymphatic techniques include opening myofascial pathways at transitional areas (i.e., diaphragms) of the body, normalizing diaphragmatic motions, increasing pressure differentials to augment fluid flow beyond normal levels, and mobilizing targeted tissue fluids into the lymphatic system.[4-7] Emphasis on removing impedances to lymphatic flow and improving and augmenting the flow of lymph is apparent. Techniques that remove somatic dysfunction, which causes decreased efficiency of respiration, diaphragmatic excursion or motion, or fascial torsion, will improve lymphatic function. The goal is to have a balanced well-functioning system without edema. The low-pressure lymphatic system is dependent on motion and drainage of lymph for optimal function. As a result of OMT, the patient reported significant symptomatic relief at subsequent visits as well as decrease in the number of emergency room visits and subsequent hospital admissions.

This case is applicable to the osteopathic family physician in that treatment techniques used to manage symptoms—in addition to chest physiotherapy and pharmacologic treatment—do not require a large amount of time to perform and can be done in the office. Additionally, use of OMT in the treatment of this patient may allow for longer intervals between follow-up appointments. The techniques discussed here will also have application to other respiratory illnesses such as chronic obstructive pulmonary disease (COPD), reactive airway disease, and other pulmonary diseases characterized by recurrent mucus plugging and airway obstruction.

## CONCLUSION

Bronchiectasis is a chronic lung disease characterized by persistent and lifelong widening of bronchial airways and weakening of the mucociliary transport mechanism, owing to repeated infection. Bronchiectasis contributes to bacterial invasion and mucus pooling throughout the bronchial tree.[1] Recurrent inflammation, due to inflammation and mucus trapping, results in airway dilation and dysfunction of the mucociliary system. Sequelae include persistent cough, dyspnea, and excessive sputum production. Many of these symptoms are largely due to mucus trapping and dysfunction of lymphatic channels in lung parenchyma. OMT provides a passive mechanical method to promote mechanical airway clearance by disrupting mucus plugging and occlusion within the lungs. By considering the intersectionality of these simultaneous conditions in addition to a patient's goals of care (maximize functional capacity and decrease hospitalization), OMT directed at autonomics, biomechanics, and lymphatics/circulation can aid in achievement of this patient's treatment goals.

TABLE 1:
Summary of myofascial release (MFR) and lymphatic techniques

| TECHNIQUE | DIRECT OR INDIRECT | ACTIVE OR PASSIVE | MECHANISM OF ACTION | ABSOLUTE CONTRAINDICATIONS* | RELATIVE CONTRAINDICATIONS* |
|---|---|---|---|---|---|
| MFR | Direct or indirect | Passive | • Light, moderate, or heavy force that engages fascia vs deeper tissue with constant pressure; piezoelectric changes relax and release restricted tissues (direct)<br>• Guiding fascia along the path of least resistance until free movement is achieved (indirect) | • Treatment directly over fracture or dislocation<br>• Serious vascular compromise<br>• Local malignancy or infection | • Vascular compromise<br>• Malignancy<br>• Infection<br>• Severe osteoporosis or osteopenia<br>• Acutely injured muscles<br>• Patient intolerance |
| Lymphatics (extension of MFR) | Direct | Passive | • Mechanical compression via physician's force leads to mobilization of lymphatic fluid | • Necrotizing fasciitis | • Acute hepatitis<br>• Mononucleosis Malignancy<br>• Deep venous thrombosis<br>• Severe heart failure |

*Patient refusal or lack of somatic dysfunction is always a contraindication.

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