An Osteopathic Modular Approach to Asthma: A Narrative Review

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Asthma is among of the first ailments documented in the existing academic literature as being successfully managed with osteopathic manipulative treatment (OMT) techniques. Time-efficient and well-tolerated OMT techniques have been gradually added to the literature to manage this increasingly prevalent disease. In this narrative review, the authors discuss previously-published literature describing the history, diagnosis, and management of asthma related to osteopathic principles and practices and OMT application. They also present current and newly-approved medical managements, including biologics and inhaled corticosteroids. This article also includes supplemental videos showcasing OMT techniques for asthma management, which were developed by the authors based on recommendations indicated in the literature.

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Asthma and its management have been recognized for millennia and recorded in both medical and nonmedical literature. Since the oldest historical reference of the “noisy” and “troubled” breathing of patients with asthma was described by China’s Emperor Huang Ti (2698-2598 BC)¹ and Hippocrates’ description of ἀσθμα (“to exhale with an open mouth, to pant”),² our understanding of asthma has evolved to the molecular mechanisms and advanced management of today, far beyond the initial inhalation apparatuses described in *Ebers Papyrus*.³ Contemporary practice includes pharmacologic therapies like inhaled corticosteroids (ICS) and biological agents, specific to the various asthma phenotypes: early-onset allergic, late-onset eosinophilic, exercise-induced, obesity-related, and neutrophilic asthma (Table 1).⁴⁻⁵ The Global Initiative for Asthma (GINA) has recommended personalized management to control asthma symptoms and minimize future exacerbation risk, beginning with low-dose ICSs and short-acting beta-agonists (SABAs) as needed (Table 2).⁶ Biological therapy has been a topic of increasingly-frequent research and is in demand for decreasing severe airway inflammation during asthma exacerbations (Table 3).⁶⁻¹⁸

Osteopathic treatment for asthma began in the 1870s and has targeted 3 areas: addressing somatic dysfunction of thoracic spine and ribs, improving diaphragmatic function, and balancing sympathetic and parasympathetic dysregulation.¹⁹⁻²⁴ Patients with asthma have multiple systems involved in the inherent pathophysiology of their disease: biomechanical, metabolic, respiratory/circulatory, musculoskeletal, and behavioral. Early

Table 1.
Asthma Phenotypes and Clinical Characteristics

Phenotypes	Natural history and clinical characteristics	Pathology and biomarkers	Therapies
Early-onset allergic	Early onset; mild-to-severe symptoms; frequently associated with atopy	Elevated Total/Specific IgE; Th2 cytokines; thickened SBM	Monoclonal antibody to IgE, Th2-targeted CS
Late-onset eosinophilic	Adult onset; often severe symptoms; increased eosinophils in sputum; less allergic; includes AERD	CS-refractory eosinophilia; IL-5	Monoclonal antibodies to IL-5/IL-5R, IL-4R and cysteinyl leukotriene modifiers
Exercise-induced	Intermittent with exercise; mild symptoms	Mast-cell activation; Th2 cytokines; cysteinyl leukotrienes	Cysteinyl leukotriene modifiers, beta agonists, antibody to IL-9
Obesity-related	Adult onset; females; increased OCS use; nonatopic	Lack of Th2 biomarkers; oxidative stress	Weight loss, antioxidants, hormonal therapy
Neutrophilic	Low FEV ₁ ; significant air trapping; frequent OCS use	Sputum neutrophilia; Th17 pathways; IL-8	Macrolide antibiotics

Abbreviations: AERD, aspirin-exacerbated respiratory disease; CS, corticosteroids; IL, interleukin; IgE, immunoglobulin E; FEV₁, forced expiratory volume in 1 second; OCS, oral corticosteroids; SBM, subepithelial basement membrane.

Adapted from Wenzel 2012⁴ and Tabatabaian 2019.⁵

20th-century discussions by Moore²¹ and Oium,²² a 1993 editorial by Allen and D'Alonzo,²³ a 1996 clinical practice guide by Paul and Buser,²⁴ 1999 literature reviews by W.A. and M.P. Rowane¹⁹ and Jackson and Steele,²⁰ a 2004 review by Salamon,²⁵ and a 2013 systematic review of randomized control trials (RCTs) by Piosadski et al²⁶ are among the limited osteopathic literature describing the pathogenesis and osteopathic treatment of asthma.²⁷⁻³⁰ Other studies have provided evidence of the benefit of osteopathic manipulative treatment (OMT) through pilot studies³¹⁻³² and a pediatric randomized clinical trials (RCTs),^{26,28,30} as well as evidence regarding other nonpharmacologic therapies, such as acupuncture and chiropractic manipulation,^{30,33-35} in asthma management. No animal models, nor any expansive clinical studies or RCTs, exist in the literature to further support recommendations for these adjunctive therapies. Here, we present an updated review of asthma, its pharmacologic treatments, and the most common and effective OMT techniques for managing this chronic lung disease.

Literature Search Methods

We performed a targeted search through osteopathic medical libraries and various databases, including the Museum of Osteopathic Medicine and International Center for Osteopathic History (ICOH) at A.T. Still University, PubMed, Osteopathic Medical Digital Repository (OSTMED. DR), Lippincott Williams and Wilkins Health Library/Osteopathic Health Library, Ovid, Cochrane Library, and Google Scholar. Search terms included *osteopathic manipulative treatment, OMT, osteopathic manipulative medicine, OMM, osteopathic principles and practices, OPP, asthma, bronchial asthma, chronic lung disease, COPD, and bronchitis*. Our searches were conducted without limitation on publication dates. A total of 32 manuscripts published between 1899 and 2019 contained information about osteopathic physicians' approaches to asthma.^{24-30,33-63} Several contained information about current and newly approved medical treatments, including biologics and inhalers (**Table 2, Table 3**).⁶⁰⁻⁶² We reviewed each publication for its methodology, size,

Table 2A.

Personalized Asthma Step Management for Adults and Adolescents (≥12 years old) to Control Symptoms and Minimize Future Exacerbation Risk: Preferred Controllers and Relievers*

Step	Preferred controller	Other controller	Preferred reliever	Other reliever options
1	As-needed low-dose ICS-formoterol ^a	Low-dose ICS with SABA ^b	As-needed low-dose ICS-formoterol ^a	As-needed SABA
2	Daily low-dose ICS, or as-needed low dose ICS-formoterol ^a	LTRA, low-dose ICS with SABA ^b	...	...
3	Low-dose ICS-LABA	Medium-dose ICS, or low-dose ICS +LTRA ^d	As-needed low dose ICS-formoterol for patient prescribed maintenance and reliever therapy ^c	...
4	Medium-dose ICS-LABA	High-dose ICS, add tiotropium or LTRA ^d	...	...
5	High-dose ICS-LABA, refer for phenotypic assessment and/or add therapy, e.g. tiotropium, anti-IgE, anti-IL5/5R, anti-IL4R	Low-dose OCS ^e	...	...

^aoff-label, data only with budesonide-formoterol (bud-form); ^b off-label, separate or combination ICS and SABA inhalers; ^c low-dose ICS-form is the reliever for patients prescribed bud-form or beclomethasone-dipropionate form maintenance and reliever therapy; ^d consider adding house dust mites sublingual immunotherapy for sensitized patients with allergic rhinitis and FEV1 >70% predicted; ^e consider side effects DPI.

*Refer to [Table 2B](#) for specific inhaled corticosteroid potencies and dosages.

Abbreviations: DPI, dry powder inhaler; ICS, inhaled corticosteroid; IgE, immunoglobulin E; IL, interleukin; LTRA, leukotriene-receptor antagonist; LABA, long-acting β_2 -agonist; OCS, oral corticosteroids; SABA, Short-acting β_2 -agonist.

Adapted from Tabatabaian 2019⁵ and Global Initiative for Asthma (GINA) 2019.⁶

Table 2B.

Differentiation of Inhaled Corticosteroids According to Potency*

Low-dose	mcg	Medium-dose	mcg	High-dose	mcg
Beclomethasone dipropionate (HFA)	100–200	Beclomethasone dipropionate (HFA)	>200–400	Beclomethasone dipropionate (HFA)	>400
Budesonide (DPI)	200–400	Budesonide(DPI)	>400–800	Budesonide (DPI)	>800
Ciclesonide (HFA)	80–160	Ciclesonide (HFA)	>160–320	Ciclesonide (HFA)	>320
Fluticasone furoate (DPI)	100	Fluticasone propionate (DPI or HFA)	>250–500	Fluticasone furoate (DPI)	200
Fluticasone propionate (DPI or HFA)	100–250	Mometasone furoate	>220–440	Fluticasone propionate (DPI or HFA)	>500
Mometasone furoate	110–220	Triamcinolone acetonide	>1000–2000	Mometasone furoate	>440
Triamcinolone acetonide	400–1000			Triamcinolone acetonide	>2000

Abbreviations: DPI, dry powder inhaler; HFA, hydrofluoroalkane propellant.

*Refer to [Table 2A](#) for an outline of preferred controllers and relievers.

Adapted from Tabatabaian 2019⁵ and Global Initiative for Asthma (GINA) 2019.⁶

Table 3.
Biologics Targeting T2-high Asthma

Therapies	Mechanism of action	Potential biomarkers	Effect	
Omalizumab	Blocks IgE interaction with FcεRI	Elevated IgE, FeNO, blood eosinophils (>300 cells/μL)	Decrease asthma exacerbations	...
Mepolizumab	IL-5 antagonist	Peripheral eosinophil count >150 cells/μL or 300 cells/μL	Decrease asthma exacerbations	Improvement in pre-post bronchodilator FEV ₁
Reslizumab	IL-5 antagonist	Peripheral eosinophil count >400 cells/μL	Decrease asthma exacerbations	Improvement in FEV ₁
Benralizumab	IL-5 receptor; α-antagonists targeting both eosinophils and basophils	Elevated peripheral blood eosinophil count	Decrease asthma exacerbations	...
Dupilumab	Inhibits IL-13 and IL-4 by targeting IL-4-α receptor (common receptor domain for both cytokines)	Improvements in all patient; better response if peripheral eosinophil count >300 cells/μL or sputum >3%	Decrease asthma exacerbations	Improvement in FEV ₁

Abbreviations: FcεRI, high affinity receptor for the fragmented crystallizable region of immunoglobulin E; FeNO, fractional exhaled nitric oxide; FEV₁, forced expiratory volume in 1 second; IgE, immunoglobulin E; IL, interleukin. Adapted from information provided in Tabatabaian,⁵ Hanania et al,⁷ Humbert et al,⁸ Pavord et al,⁹ Haldar et al,¹⁰ Flood-Page et al,¹¹ Ortega et al,¹² Corren et al,¹³ Laviolette et al,¹⁴ Nowak et al,¹⁵ Wenzel et al,¹⁶ Castro et al,¹⁷ Busse et al¹⁸

scope, and relevance to the management of asthma for the practicing clinician. The results of these studies are discussed below by topic.

Biomechanical Mechanism of Treatment

Somatic dysfunction leading to bronchospasm, via aberrant viscerosomatic sympathetic tone, has been associated with bilateral and ipsilateral T2-T7 thoracic segments.⁴⁷⁻⁴⁹ Allen and Alonzo²³ documented common dysfunctions recognized in acute asthma, including “lesions” in the “second to fourth thoracic vertebra,” elevation of the “fourth rib of the right,” and a “lesion of the third cervical vertebrae with rotation to the left.” Asthma symptoms, including bronchospasm and increased mucus production, have also been attributed to elevated parasympathetic tone.⁵² Rib and spinal segmental dysfunction can lead to a reduction in optimal ventilation.³⁴ Musculature that supports these bony structures can become hypertonic or even fatigued to the point of failure. Direct and indirect OMT techni-

ques can help to maximize chest wall excursion in both inhalation and exhalation.²⁴

Common techniques to manage acute asthma exacerbations include various combinations of rib raising, myofascial release (MFR), balanced ligamentous tension (BLT), high velocity-low amplitude (HVLA), and thoracic pump.^{33,52} Fatigued hypertonic accessory muscle groups include the cervical strap and intercostal muscles. BLT and the other OMT techniques may be performed several times, as needed, when the patient remains dyspneic and struggles to breathe.⁵¹ Guiney et al²⁸ conducted an RCT using rib raising, muscle energy, and myofascial release in an OMT sequence that resulted in notable improvements (25%-70%) in patients' peak expiratory flow (PEF) rates in 90 female pediatric patients' peak expiratory flow rates and, ultimately, chest wall motion.³⁴

Direct and indirect inhibition of parasympathetic tone has been described by osteopathic physicians for over a century as an asthma management.^{26,34,53,54} Addressing

the occipitoatlantal (OA) region via decompression, the upper cervical spine via MFR and strain-counterstrain, and the vagus nerve via direct inhibition can lessen bronchoconstriction present in the asthmatic airway ([Supplemental Video 1 and Video 2](#)).²⁶ Decreased mucus production may require more time to resolve and may therefore necessitate repeated treatments.

Respiratory/Circulatory Mechanism of Treatment

The pump action of the abdominal diaphragm is not only vital for gas exchange, but it also has an integral role in lymphatic drainage and the low-pressure vascular circulatory loop in the lungs.⁶³ Although OMT did not change vital capacity or residual volume in preliminary studies reported by Allen and D'Alonzo,²³ improved work capacity, arterial carbon dioxide tension, oxygen saturation, total lung capacity, and residual volume, as well as reduced dyspnea and fewer upper respiratory tract infections, have been demonstrated from OMT elsewhere. Creasy et al⁵¹ demonstrated that diaphragmatic movement is a crucial element in maintaining lymph and vascular flow in the thoracic and abdominal spaces. In the [supplemental videos](#) accompanying this manuscript, we demonstrate thoracic pump and diaphragm doming techniques for addressing these mechanisms.

OMT techniques are helpful as an adjunct therapy for asthma exacerbations to improve mechanical functioning of the thoracic cage and balance the autonomic nervous system.⁴⁸ Guiney et al,²⁸ Bockenbauer et al,²⁷ and Allen and Kelso⁴² demonstrated direct effect of OMT on mechanical restrictions and respiratory excursion in patients with respiratory disease. Although Guiney et al²⁸ improved peak expiratory flow rates after OMT application (7-9 L/min, 22% increase), forced expiratory volume in 1 second (FEV₁), and flow-controlled ventilation (FVC) would provide a more accurate assessment of respiratory function. Regardless, OMT intervention has been beneficial for asthma management by decreasing anxiety resulting from respiratory distress and improving chest wall function.⁴⁸

Metabolic Mechanism of Management

Strides have been made in the last several years in asthma management. Inhaled corticosteroids, long-acting beta agonists, anticholinergics (including long-acting formulations now approved for asthma), arachidonic acid pathway inhibitors, and monoclonal antibodies—collectively referred to as “biologics”—are the latest evolutions in asthma treatment.⁶⁰⁻⁶² Targeted therapies using biologics to alter pathologic pathways are now approved for patients with moderate-to-severe, persistent asthma.⁶⁰⁻⁶² ([Table 3](#))

Classifying asthma phenotypes is a burgeoning approach to determine which of the 5 biologics on the market to prescribe for asthma management.⁶² Omalizumab was the first FDA-approved monoclonal antibody for asthma treatment.^{7-8,62} Its mechanism of action is binding unbound immunoglobulin E (IgE) in tissues and circulation.^{7-8,62} IgE is ligated to omalizumab, blocked from receptor binding, and prevented from receptor cross-linking, subsequently leading to granulocyte degranulation.^{7-8,62}

Mepolizumab is an interleukin (IL)-5 antagonist that has potent antieosinophilic and inflammatory action in the lungs.^{9-12,62} Elevated eosinophil levels are common in patients with moderate-to-severe persistent asthma.^{8-9,62} Reslizumab is another IL-5 antagonist, available only as an infusion and dosed by weight; thus, it is useful for patients with higher BMIs.^{13,62} Benralizumab is an IL-5 *receptor* antagonist that not only blocks the effects of eosinophils but also reduces their number and longevity.^{14-15,62}

Dupilumab is an IL-4 receptor α -subunit antagonist that works to mitigate the effects of potent inflammatory ILs, including IL-4 and IL-13.^{16-17,62} The advent of biologics is viewed as a major “game-changer” for chronic diseases across many fields.

Neurologic Mechanism of Treatment

In the early 20th century, Coffman argued against the popular belief that asthma was not a primary neurosis manifested solely by psychological perturbations.⁵² He stated that the neurologic component of asthma was an

integral part of the disease pathophysiology, but was not “all in the head” of the patient.⁵² He reasoned that any neurosis was secondary “to a disturbance of the muscles of the bronchi, producing dyspnae,” leading to anxiety associated with shortness of breath.⁵² Henley et al emphasized OMT to address the adversarial roles of the sympathetic chain (T1-T6) and parasympathetics (vagus nerve) that innervate bronchial smooth muscles.⁵³ Management that helps normalize sympathetic tone by addressing somatic dysfunctions can be used.^{19,49} Rib raising and thoracic HVLA are 2 common OMT techniques that may occupy a few minutes at the end of the physical examination ([Supplemental Videos 1 and 2](#)). Gentle craniosacral techniques are additionally proposed to address common conditions, as well as asthma symptoms.⁴²

Osteopathic interventions that improve thoracic mobility favorably affect the regulatory mechanisms of the autonomic nervous system.²⁷ Parasympathetic innervation sets the tone in the bronchial smooth muscles. Increased parasympathetic expression can lead to bronchoconstriction. Parasympathetic signaling also increases secretory function in many tissues that may instigate mucus hypersecretion in the lungs. Pathologic deviations in parasympathetic tone have been associated with reduced response to adrenergic agonists and exaggerated responses to cholinergic medications that lead to increased parasympathetic tone.⁶⁴ Oium²² substantiated the application of OA decompression and direct vagal inhibition address this parasympathetic tone. These techniques aim to inhibit parasympathetic tone, thereby allowing bronchodilation and decreasing mucus production thereafter. In 2008, through position changes with a tilt table, Henley et al⁵³ demonstrated that parasympathetic responses overcome sympathetic tone.

Behavioral Mechanism of Treatment

Failure to evaluate and manage existing psychodynamic issues may exacerbate the symptom complex of asthma.⁶⁵⁻⁶⁸ Patients with asthma are at higher risk for mood disorders and anxiety.⁶⁵⁻⁶⁸ This risk is even

higher in pediatric and adolescent patients, who may feel ostracized because of their physical limitations and frequent absenteeism.⁶⁸ Depression and anxiety affect medication compliance and thus worsen disease. Choi et al⁶⁵ provided evidence of bi-directionality between the presence or development of asthma in adults and depression and anxiety. The core osteopathic tenets, of course, emphasize this equilibrium: “(1) The human being is a dynamic unit of function, (2) the body possesses self-regulatory mechanisms that are self-healing in nature, (3) structure and function are interrelated at all levels, and (4) rational treatment is based on these principles.”⁶⁹ The ubiquitous Asthma Control Test and other asthma symptom questionnaires have been suggested to detect emotional issues through lower scores.²⁸ A preliminary study by D’Ippolito et al³¹ documented significant improvement in depression and anxiety symptoms among 11 patients with high-frequency migraine and comorbid mood disorders after 4 OMT sessions ($P < .05$). Wiegand et al³² conducted a randomized, controlled pilot study that indicated statistically significant decrease in self-perceived fatigue among 1st-year osteopathic medical students receiving direct OMT. Blumer and Blumer⁷⁰ proposed the following OMT sequence for anxiety disorder management: cervical soft tissue/long axis kneading, cervical high velocity/low amplitude, sacral decompression, suboccipital/occipitoatlantal decompression, doming of the respiratory diaphragm, and compression of the fourth ventricle. Relaxation techniques, diaphragmatic breathing, biofeedback, psychological counseling, and patient and family education may also decrease asthma morbidity from depression and anxiety.⁷¹

Conclusion

Asthma is among the first ailments successfully managed with OMT in the literature. However, extensive, controlled studies and RCTs applying OMT as an adjunctive therapy asthma management have not been pursued. OMT recommendations have been gradually added to the literature to manage this increasingly

prevalent disease, but further larger-scale studies are warranted to verify their efficacy. The whole-person philosophy, including psychological and behavioral management for asthma, is not a novel concept in osteopathic medicine; the application of these treatment approaches will continue to yield improvements in asthma management.

Author Contributions

All authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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