Title: Osteopathic Approach to Asthma Management with Adjunctive Foam-Roller Exercises: A Case Presentation of a 69-year-old Female with Chronic Asthma Exacerbations

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ABSTRACT

INTRODUCTION: Asthma affects nearly 25 million people in the United States and its territories, making up 7.7% of the total population. In 2021 it was estimated that a total of 39.4% of persons with asthma had an asthma attack within the last 12 months. Asthma exacerbations are reported highest in American Indian/Alaskan Native (43.1%), followed by White Americans (42.0%). Additionally, individuals who are 100% below the poverty threshold represent a higher prevalence of asthma than the national average at 10.4%. Symptoms of asthma include wheezing, breathlessness, chest tightness, and coughing, mostly at night. An asthma exacerbation will present similar to the symptoms listed above, but more severe and can lead to hospitalization [1].

CASE PRESENTATION: A 69-year-old female with a chronic history of asthma presents to her primary care physician for the management of her symptoms on March 25, 2024, October 28, 2024, and December 2, 2024. The patient's asthma was previously managed with albuterol 2.5/3mL nebulizer solution and 90mcg/actuation inhaler, as needed every four hours for asthma exacerbations, montelukast 10 mg tablet daily, and fluticasone-umeclidinium-vilanterol 200-62.5-25 mcg inhalation blister for maintenance. For allergies, the patient is managed with each fexofenadine 180 mg tablets and fluticasone 50mg/actuation nasal spray. The patient reports adherence to all medications. Her main symptom is a dry cough that wakes her at night, palpitations, headache, dizziness, nausea, and vomiting. The patient denies fever, chills, productive cough, chest pain, palpitations, dizziness, nausea, and vomiting. Osteopathic manipulation was offered, and home foam-roller exercises were prescribed, on these visits. At each appointment, the patient was amenable to osteopathic manipulation and home foam-

roller exercises. After 9 months of home exercise prescription, the patient reported decreased night-time awakenings, less short-acting beta-agonist use, and reduced inflammatory responses. CONCLUSION: This is a single patient case of self-applied foam roller exercises at home in addition to management of asthma with pharmacotherapy and OMT. Improvements were noted with infrequent use of the exercises which were further tailored into a daily patient regimen with added home symptom tracking. More research is necessary to explore the processes producing improvements seen in this patient.

INTRODUCTION

Nationwide Prevalence of Asthma

Asthma affects nearly 25 million people in the United States and its territories (US), making up 7.7% of the total population, according to the National Asthma Data presented by the U.S. Centers for Disease Control and Prevention (CDC) [1]. It is estimated that a total of 39.4% of persons with asthma had an asthma attack within the last 12 months of when the data was recorded in 2021. Within sub populations with asthma, asthma disproportionately affects those who self-identify as American Indian/Alaskan Native, affecting 13.3% of the total sub population, those who are of multiple races (13.2%), or Black Americans (10.7%). Asthma exacerbations are reported highest in American Indian/Alaskan Native (43.1%), followed by White Americans (42.0%). Furthermore, Black adults have the highest total mortality estimated to be 24.4 deaths per 1 million. Additionally, individuals who are 100% below the poverty threshold and those within 100-250% of the poverty threshold represent a higher prevalence than the national average at 10.4% and 8.2%, respectively.

According to an estimated report in 2024, healthcare costs, both direct and indirect, associated with asthma are estimated at $80 billion [2]. The CDC estimates the total number of ED visits in 2020 was 29.8 visits per 10,000 and approximately 10% of which resulted in inpatient admissions [1].

Arizona Asthma Data

Of the available data from 2021, Arizona is number 35 of 53 in US with asthma prevalence in the state's population (9.4%) and 17th compared to states and territories that track mortality rate (10.3/million) [3].

Asthma Standard of Care

Current standard of care for individuals with asthma is based on a stepwise pharmaceutical regiment that consists of a short-acting beta-blocker or long-acting beta-blocker, aimed to reduce bronchospasms, and the addition of a corticosteroid to reduce airway inflammation [4, 5].

Exploring Alternative Therapies

Patients and clinicians, alike, seek adjunctive therapies for treating asthma [6], such as in the presented case, and having additional options for a patient establishes a 'whole person' approach to care that simultaneously explores the physiological, physical, and psychosocial models of care. One such alternative is osteopathic manipulative therapy (OMT), a clinician-provided manual therapy.

Clinician-Provided Manual Therapy: Rib-Raising and Suboccipital Release

Rib-raising and suboccipital release are clinician-provided manual therapies, often provided by those trained in osteopathic medicine, and used as a manual therapy to target the autonomic nervous system, more specifically, rib-raising is theorized to inhibit the sympathetic nervous system [8–10], while suboccipital release is theorized to balance the parasympathetic system [8]. With respect to the patient with asthma, by inhibiting the sympathetic nervous system (bronchodilation and vasoconstriction), special consideration must be given to the effects of increased parasympathetic activity (the reverse of the sympathetic system, in other words, vasodilation and *bronchoconstriction*) [11]. Though, it may seem contradictory to increase parasympathetic activity, it must be noted that the parasympathetic system is also responsible for thinning bronchial mucous secretions, thus emphasizing that both systems of the autonomic

nervous system are equally important for proper lung function, especially in the patient with asthma. This is why both systems are targeted during manipulative treatment: By targeting both autonomic systems, the clinician trained with osteopathic principles seeks to restore balance [9–11]. To improve homeostasis, autonomic balance, and decrease office visit frequency, home exercise adaptations can be considered to address areas of dysfunction at an appropriate frequency and level of tolerance. In this case, specific patient-administered foam-roller exercises were applied in a similar manner as some forms of OMT to target the autonomic nervous system and improve range of motion in the axial spine.

Foam Rolling

Foam rolling, also known as, roller-massage or self-myofascial release [11–24] is a well-studied and supported modality for its use in improving athletic performance [11–20, 23, 24], with most of its benefits improving range of motion (ROM) and flexibility while also reducing recovery time without hindering performance. Though it should be mentioned that the improvements seen in performance have been reported as lasting acutely [12, 13, 20]. For the clinical case presentation, the authors hypothesized that routine foam-rolling may help to reduce the number of acute exacerbations secondary to the physiological effects of this modality.

Physiological Response to Foam Rolling

Though there is still significant research needed to support the exact mechanisms of which foam-rolling has an effect, many mechanisms have been suggested and meticulously reviewed [11–20, 23, 24], specifically that of fascia. Some of the proposed mechanisms include those of physiological, neurological, and biomechanical changes [12, 15, 19, 24].

The physiological changes from a bout of foam rolling have been illustrated in the arteriovenous system as a decrease in arterial stiffness, an increase in vascular endothelial function highlighted by a rise in plasma nitic oxide concentration [12], and an increase in VEGF-A serum levels [22] following foam-rolling activities.

The neurological mechanism proposed to explain the benefits of foam-rolling consists of two main branches of effect by fascia – the Golgi reflex arc model and that of mechanoreceptors, both causing a reflexive decrease in muscle tension – and the consequence created by the influence on the autonomic nervous system [12, 13], which is described as a decrease in sympathetic response and/or an increase in parasympathetic activation.

The hypothesized biomechanical mechanisms causing fascial tissue to respond to a bout of foam-rolling includes thixotropy (a momentary process of fluid thinning following the application of pressure) and piezoelectricity (the change in electric polarization following mechanical stress), and changes in fascia via adhesions, tensegrity (the three-dimensional balance of forces), and fluid flow [12]. However, it is not clear if the theorized biomechanical mechanisms can be achieved with the level of pressure applied by a foam roll and the term 'self-myofascial release' may not be accurate [12, 13].

Thus, it is hypothesized by the authors of this clinical case presentation that foam rolling may act more closely to a self-applied form of rib-raising, if the foam roll is applied to the posterior thoracic wall, and sub-occipital release, if the foam roll is applied to the suboccipital region. It is because the patient of this case presentation often described her symptoms as having significant improvement after osteopathic manipulative treatment (OMT), which included rib-raising and suboccipital release, that foam rolling exercises were recommended.

The protocol for the foam-rolling for treatment dosing was based on a review of current literature surrounding foam-rolling exercise: *Foam roll to thoracic spine* – The application of the foam roll was down the length of the thoracic spine using a transverse axis causing treatment in the sagittal plane. Each roll to be completed in 2-4 seconds. Each set lasted for 30-120 seconds for a target of 1-3 sets [13, 21]. *Foam roll to the suboccipital musculature* – The application of the foam roll to be stationary behind the occiput and upper cervical region, with the head slowly rotating from side to side to mimic the rhythmic inhibitory motion that may be applied when performing the technique by a clinician for up to 2 minutes [25]. These exercises were to be completed together daily, with a day of rest per week if necessary.

Asthma Action Plan

The patient received foam roller instructions and was observed using the device before self-application at home. Verification of the patient's ability to transfer comfortably from a standing to supine position on the floor was required. Safety precautions for the thoracic technique included selection of correct foam roller size, insurance of balance on the device, and adequate core muscle stabilization. For more information about the effect of core strength on balance, see the meta-analysis examining different protocols for improving core strength and the resulting improvements in balance [26].

Because it is safe to perform OMT during an acute exacerbation [10], the authors mentioned to the patient that she can trial the foam roll during an exacerbation if she can tolerate it. Although, it was stressed that if the patient needs emergency attention, she seek immediate care.

CASE PRESENTATION

Subjective: C.P. is a 69-year-old female with a chronic history and chief complaint of moderate persistent asthma. She also has a past medical history of benign hypertensive (HTN) heart disease with congestive heart failure grade I (mild/impaired relaxation) left ventricular diastolic dysfunction and known murmur, obesity, controlled type 2 diabetes (T2D), mixed hyperlipidemia (HLD) with a history of statin myopathy, obstructive sleep apnea, osteopenia, allergic rhinitis, and eczema. For her medical conditions, she is monitored every 3-6 months. She is prescribed albuterol as 2.5/3mL nebulizer solution and 90mcg/actuation inhaler, as needed every four hours for asthma exacerbations. Her daily asthma and allergy medications include montelukast 10mg daily, fexofenadine 180mg daily, fluticasone 50mg/actuation nasal spray once daily, and inhaled fluticasone-umeclidinium-vilanterol 200-62.5-25 mcg twice daily. In addition, she is taking amlodipine 10mg, losartan 50mg daily, dulaglutide 0.75mg/0.5mL injected weekly, and metformin 500mg tablet daily. She has no known allergies to medication. History reveals patient preference of inhaled albuterol avoidance due to side effects of heart palpitations. Her goals include using home remedies and allergen avoidance. Other than the albuterol, she takes her medications regularly and as directed. Review of systems include a mild headache and a dry cough. She denies fever, chills, productive cough, chest pain, palpitations, dizziness, nausea, and vomiting. Past surgical history includes cholecystectomy and tubal ligation. Finally, the patient is a non-athlete that engages in irregular mild activity, limited mostly by fear of asthma exacerbation.

Objective: Vitals for each visit are listed in sequential order: Blood pressure 134/69.138/80, 128/72; heart rate 72 bpm, 84 bpm, 78 bpm; temperature 36.7^{o} C, 36.6^{o} C,

[missing 12/2/24]; Respiratory rate 16 resp/min, 16 rep/min, 16 resp/min, O_2 saturation 95%, 97%, 95%; and BMI 39.35 kg/m^2, 38.93 kg/m^2, 38.25 kg/m^2. Physical exam for all visits: Constitutional – No acute distress, normal appearance, well-developed, non-diaphoretic. Head – Normal cephalic and atraumatic. Mouth – mucus membranes moist and without exudate. Eyes – Conjunctivae normal, pupils are equal, round, and reactive to light. Neck – Supple and without thyroid mass or thyromegaly. Cardiovascular – Normal rate and rhythm, abnormal heart sounds, systolic murmur (1/6 holosystolic), no friction rub or gallop. Abdominal – Bowel sounds normal, abdomen is soft and without mass, no abdominal tenderness or guarding. Musculoskeletal – Seated posture exam reveals level shoulders, increased thoracic kyphosis, hypertonic paravertebral musculature on right side. Structural Examination: Cervical – active patient range of motion freer in sidebending right and rotation right. Right hypertonic scalene, with myofascial restriction at the cervicothoracic junction. Thoracic – T1 through T8 neutral curve sidebending left, rotated right. Abdominal – Restricted diaphragm right. Neurological – in all extremities, deep tendon reflexes 2/4, motor strength 5/5, sensation intact to light touch. Psychiatric – Mood, affect, and behavior is appropriate to situation.

The diagnostic impression of the presented case is chronic persistent moderate asthma and somatic dysfunction of the thoracic and cervical regions. The plan was to keep the patient's pharmacological regiment the same and offer osteopathic manipulative therapy, to which the patient agreed. It was also recommended to the patient that she engage in the demonstrated foam-roller exercises to help with thoracic mobility and flexibility and potentially help with the number and severity of asthma exacerbations. At her October 28 appointment, she noted improvements in asthma exacerbations with intermittent adherence to her exercise

prescription, so she was asked to maintain a regular exercise schedule and keep a symptom journal which was reviewed at her December 2 appointment.

DISCUSSION

C.P., a 69-year-old female with a chronic history of asthma exacerbations, presented to her PCP on March 25, 2024, with complaints of moderate persistent asthma symptoms. Here, she received OMT and foam-roller education through online pictures with verbal instructions. A subsequent appointment on October 28, 2024, she confirmed feeling better after OMT and following her exercises but was unsure if she is doing the home exercises correctly. She further mentions preference to avoid albuterol due to palpitations. From here, the authors set a daily foam-roller prescription and re-demonstrated detailed proper use of the prescribed exercises with the patient performing the foam rolling exercises in the office, insuring patient safety, and answering her questions. She further agreed to complete a daily symptom journal at home for review at the next visit. On her December 8 appointment, review of home symptoms journal includes improvements in night- time awakenings with a reduced number of occurrences. She also noted similar trends in lung inflammatory responses, such as a reduction in wheezing with less chest constriction.

The authors of the presentation believe that foam-roller exercises could be investigated more as an adjunctive prescription to asthma treatment considering the improvement from C.P, allowing a systematic approach to the mechanisms behind this improvement. The authors hypothesize that the improvements in this patient with asthma after the use of self-applied foam-roller exercises have similar effects of OMT targeting the autonomic nervous system and increases homeostasis in the body.

Conclusion: This is a single patient case of self-applied foam-roller exercises at home in addition to management of asthma with pharmacotherapy and OMT. Improvements were noted with infrequent use of the exercises which were further tailored into a daily patient regimen with home symptom monitoring. Critical to the continued improvements noted by the patient involved steps to observe the self-applied exercise prescription with fine tuning for better patient understanding and tolerance. At the last appointment, her home symptom journal included a decrease in asthma symptoms which suggests further studies should be considered to investigate these modalities to complement asthma management in the future.

Acknowledgements/Disclosures

The authors would like to acknowledge C.P. for her detailed record keeping and willingness to perform the prescribed exercises.

Thank you, Ian Kim, M.L.I.S. and Sheila Donnelly, M.L.S. for their detailed review and edits of the references to follow this section.

The authors have nothing to disclose.

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Graphic Elements

Graphic 1 – GINA Questionnaire

Box 4. Assessment of symptom control and future risk

A. Assessment of symptom control		Level of asthma symptom control		
In the past 4 weeks, has the patient had:		**Well controlled**	**Partly controlled**	**Uncontrolled**
Daytime symptoms more than twice/week?	Yes☐ No☐	None of these	1–2 of these	3–4 of these
Any night waking due to asthma?	Yes☐ No☐			
SABA* reliever needed more than twice/week?	Yes☐ No☐			
Any activity limitation due to asthma?	Yes☐ No☐			

Description: Questionnaire from the Global Initiative for Asthma (Global Strategy for Asthma Management and Prevention, 2024. Accessed October 30, 2024. https://ginasthma.org/)

Graphic 2 – Patient Responses

Level of asthma symptom control				
In the past 4 weeks, has the patient had:				
Date		**Yes**	**No**	**Comments**
11/04/24	Daytime symptoms more than twice/week?	X		
	Any night waking due to asthma?	X		
	SABA reliever* needed more than twice/week?	X		
	Any activity limitation due to asthma?	X		
11/30/24	Daytime symptoms more than twice/week?	X		More allergy related symptoms. Less inflammation.
	Any night waking due to asthma?	X		Much less
	SABA reliever* needed more than twice/week?	X		Much less, more congestion than inflammation.
	Any activity limitation due to asthma?	X		Much less, chest less tight
12/31/24	Daytime symptoms more than twice/week?			
	Any night waking due to asthma?			
	SABA reliever* needed more than twice/week?			
	Any activity limitation due to asthma?			
01/31/25	Daytime symptoms more than twice/week?			
	Any night waking due to asthma?			
	SABA reliever* needed more than twice/week?			
	Any activity limitation due to asthma?			
02/28/25	Daytime symptoms more than twice/week?			
	Any night waking due to asthma?			
	SABA reliever* needed more than twice/week?			
	Any activity limitation due to asthma?			
03/31/25	Daytime symptoms more than twice/week?			
	Any night waking due to asthma?			
	SABA reliever* needed more than twice/week?			
	Any activity limitation due to asthma?			

Description: Patient responses to GINA questionnaire (in graphic 1). The patient recreated this table from a GINA form (Global Strategy for Asthma Management and Prevention, 2024. Accessed October 30, 2024. https://ginasthma.org/) that was provided to her at her 10/28/24 appointment.

Graphic 3 – Foam Roll (Diameter view))

TriggerPoint – GRID Foam Roller, Orange 5.5in diameter x 13in length by Implus Footcare LLC
https://www.tptherapy.com/

Graphic 4 – Foam Roll (Length view)

TriggerPoint – GRID Foam Roller, Orange 5.5in diameter x 13in length by Implus Footcare LLC
https://www.tptherapy.com/

Graphic 4 – Foam Roll Exercise Thoracic (position of foam roller)

Position for foam roller before beginning exercise
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss

Graphic 5 – Foam Roll Exercise Thoracic (starting position)

Starting position for foam roller exercise
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss

Graphic 6 – Foam Roll Exercise Thoracic (ending position)

Ending position for foam roller exercise
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss

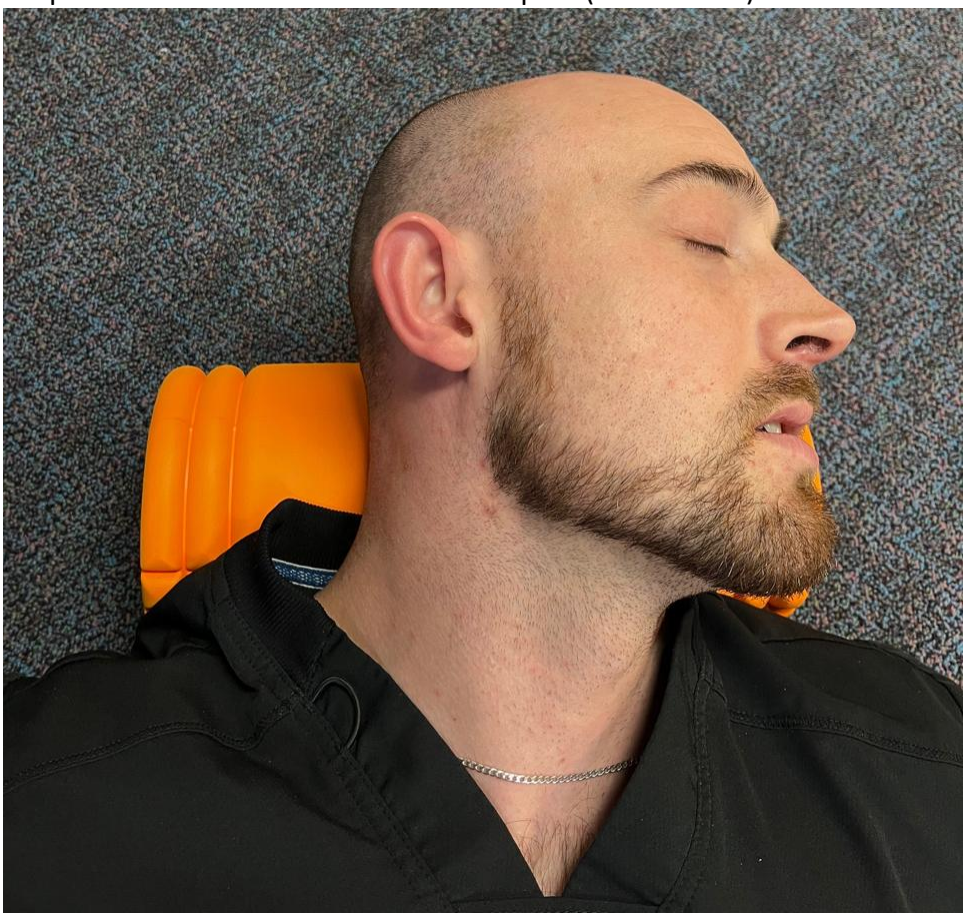
Graphic 7 – Foam Roll Exercise Suboccipital (Lateral View)

Initial position for foam roller behind neck and contacting suboccipital muscles
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss

Graphic 8a – Foam Roll Exercise Suboccipital (Side to Side)

Slow rotation side to side on foam roll.
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss

Graphic 8b – Foam Roll Exercise Suboccipital (Side to Side)



Slow rotation side to side on foam roll.
Photo taken by Marquis Mayberry, demonstrated by Anthony Enniss