Neuromusculoskeletal Medicine (OMT) **Case Report**

Sylvia Marshall, OMS III, Sara Winter, PA-C, MS and John D. Capobianco*, DO, FAAO

Lymphatic osteopathic manipulative treatment reduces duration of deltoid soreness after Pfizer/BioNTech COVID-19 vaccine

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Abstract: Pfizer-BioNTech BNT162b2 is one of the three U.S. Food and Drug Administration (FDA)-approved vaccines for the prevention of COVID-19. Its most common side effect, injection site pain, occurs because of locally recruited inflammatory mediators and is mitigated by the lymphatic system. Side effects may discourage individuals from receiving vaccines; therefore, reducing the duration of injection site pain can promote vaccination compliance. Osteopathic manipulative treatments (OMT) can directly affect the physiology underlying muscle soreness; however, there is currently no literature that supports the use of OMT in this scenario. In this case report, an otherwise healthy male presented with acute left deltoid soreness after receiving the Pfizer COVID-19 vaccine. The pain began 5 h prior to the visit. Three hours after being treated with lymphatic OMT, the severity of the pain was significantly reduced and was alleviated 8h after onset in comparison to the median duration of 24–48 h. He received his second dose 3 weeks later. This case report can provide future studies with the groundwork for further investigating the role of OMT in treating postvaccination muscle soreness, which can improve patient satisfaction and potentially promote vaccination compliance.

SARS-CoV-2 is the virus responsible for causing COVID-19. The FDA has approved three vaccines for active immunity against SARS-CoV-2: Pfizer-BioNTech BNT162b2, Moderna, and Johnson & Johnson/Janssen [1]. BNT162b2 is administered as a two-dose series intramuscularly (IM) in the deltoid, and its most frequently reported side effect is injection site pain, or muscle soreness [2]. To date, more than 185 million doses of BNT162b2 have been administered [1], with this local reaction occurring in 83.1% of adults ages 18–55 and in 71.1% of adults over the age of 55 after the first dose [2]. BNT162b2 has a median duration of 1–2 days [2] and is generally managed with warm/cold compresses, pain relievers, and movement. Millions of recipients have skipped their second dose of BNT162b2 for reasons not yet elucidated [1], which is especially concerning as new SARS-CoV-2 variants emerge and spread throughout the United States. Two studies have demonstrated that side effects may negatively influence vaccination rates. A study examined whether simultaneous recommendation of the pneumococcal vaccine during an influenza immunization program affects vaccination compliance. A survey sent to 972 patients ages 65 and older determined that among the individuals who refused the pneumococcal vaccine, a fear of local side effects was a major predictor for noncompliance [3]. Similarly, a second study exploring reasons for influenza vaccine noncompliance in 350 healthcare workers determined that a fear of adverse reactions was a common motive [4]. Unease of side effects may also, in fact, contribute to the hesitancy in receiving COVID-19 vaccines. Here, we discuss muscle soreness in the context of BNT162b2. However, it is important to note that muscle soreness is a prevalent side effect of IM vaccines in general, including the Moderna vaccine (which has been administered over 135 million times [5]) and most routine immunizations.

The lymphatic system plays a significant role in acquiring vaccine-induced immunity and in resolving their local side effects [6]. Osteopathically enhancing the lymphatic system may reduce the duration of muscle soreness and ultimately improve patient satisfaction and compliance with vaccine schedules. Lymphatic osteopathic manipulative treatments (OMT) have been implemented as an adjuvant to standard therapy for a variety of disease processes including acute otitis media [7], venous

***Corresponding author: John D. Capobianco**, DO, FAAO, NYITCOM – Long Island Department of Osteopathic Medicine, Serota Room 126, Boulevard P.O. Box 8000, Old Westbury, NY 11568-8000, USA, E-mail: capobiancojcapob01@nyit.edu
Sylvia Marshall, OMS III, Academic Medicine Scholars Program, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, USA
Sara Winter, PA-C, MS, Department of PA Studies, New York Institute of Technology School of Health Professions, Old Westbury, NY, USA

stasis ulcers [8], and pneumonia [9]. In the setting of vaccines, a pilot study determined that upon receiving the hepatitis B vaccine, participants receiving concurrent lymphatic treatments (n=20) demonstrated average titers of 374 mIU/mL after 6 weeks in comparison to an average titer of 96 mIU/mL in individuals not receiving treatment (n=19) [10]. This suggests that treatment of the lymphatic system can, indeed, enhance the immune response. OMT has also been shown to be beneficial for the treatment of shoulder injury related to vaccine administration (SIRVA), a rare phenomenon thought to occur because of improper administration technique [11]. In a case report (n=1), a patient with refractory SIRVA was provided the Spencer's technique under anesthesia and demonstrated significant improvement in symptoms [11]. The implementation of OMT to specifically relieve vaccine-related muscle soreness, a reaction caused by local inflammation, has not yet been investigated. In this case report, we demonstrate that lymphatic OMT helped significantly reduce the duration of muscle soreness post-BNT162b2 vaccination from a median of 24–48 h [2] to 8 h.

Case description

A 58-year-old man with no significant medical history presented in March 2021 to an OMT clinic with a chief complaint of left shoulder pain after receiving the first dose of BNT162b2. The onset was gradual and was first noticed 5 h prior to the visit. The pain was described as a nonradiating, dull, achy muscle soreness. It was rated a 0/10 on the pain scale with nonmovement and 8/10 with movement, where 0 is no pain and 10 is extreme pain. It remained constant after onset and increased with shoulder abduction. The patient denied taking any pain medication, and there were no other therapies self-administered including icing or slinging. He denied having any fevers, chills, night sweats, or malaise, and he was afebrile to the touch. Physical examination showed tissue tenderness and bogginess in the left deltoid region and decreased range of motion in left shoulder abduction secondary to subjective pain. Erythema, edema, and induration were absent at the site of injection. A focused osteopathic structural examination and osteopathic treatment were performed by a third-year osteopathic medical student in the Academic Medicine Scholars program under direct supervision of a board-certified osteopathic physician. Palpation showed significant tissue congestion of the anterior axillary region on the left more than the right, and through motion testing, his superior thoracic inlet was diagnosed as FS_LR_L.

The patient was educated on the potential benefits of OMT as an adjuvant to standard therapy, including application of ice or heat, pain relievers, and movement, as well as the risk of a posttreatment reaction. The techniques utilized during the OMT session were performed on the ipsilateral side of vaccine administration, except the thoracic inlet release, which was performed bilaterally. The five osteopathic lymphatic techniques utilized during this treatment are described as follows (note, the figure referenced below demonstrates the positional setup for each technique and does not portray the actual patient):

1) **Supine thoracic inlet release utilizing balanced ligamentous tension (BLT) [12] (Figure 1A)**
The patient is supine. The physician monitors the thoracic inlet by placing their hands on the shoulders. Index fingers monitor the anterior aspect of rib one, the middle and ring fingers drape over the clavicles, and the thumbs monitor the posterior aspect of rib one. The three primary motions of the cervicothoracic region are assessed: flexion/extension, side bending, and rotation. With respiratory assistance, the pattern of motion (direct or indirect) that promotes tissue relaxation is encouraged.
2) **Anterior axillary fold release [13] (Figure 1B)**
The patient is supine. Standing on the ipsilateral side of the affected arm, a deep and constant inhibitory pressure is applied at the musculotendinous junction by squeezing the tissues between the thumb and index finger.
3) **Modified upper-extremity lymphatic pump [12] (Figure 1C)**
The patient is supine. The patient's affected shoulder is flexed and slightly abducted, and the elbow is flexed to approximately 90°. Holding the patient's elbow with the cephalad hand and the patient's hand with the caudad hand, an oscillatory traction is applied.
4) **Spencer's step 7 (lymphatic pump) [14] (Figure 1D)**
The patient is lying in the lateral recumbent position with the affected arm up. The patient's hand is placed on the physician's shoulder. The physician places their interlaced fingers over the deltoid muscle and leans back to induce a traction and pumping motion, and then releases. This is repeated 5–10 times as needed.
5) **Thoracic duct siphoning [12] (Figure 1E)**
The patient is supine. The patient's abdomen is contacted below the costal margin to induce a vibration directed toward the cisterna chyli utilizing the hand-over-hand method. A vibration is then induced over the proximal thoracic duct located at the second or third intercostal space near the midclavicular line, utilizing the hand-over-hand method.

Figure 1: Demonstration of the positional setup for the five lymphatic osteopathic treatments utilized, including (A) thoracic outlet release utilizing balanced ligamentous tension (BLT), (B) anterior axillary fold release, (C) upper extremity lymphatic pump, (D) Spencer's step 7 (lymphatic pump), and (E) thoracic duct siphoning. These images feature a representative male subject, not the patient described in this case report.

After treatment, the superior thoracic inlet became more symmetrical, and palpation of the anterior axillary region showed decreased tissue congestion. The patient reported left arm pain of 2/10 with arm abduction immediately after treatment. A follow-up phone call was made by the rendering medical student, with the patient reporting reduction of pain to 0/10 at 3 h posttreatment. Upon further questioning, the patient stated that he felt more satisfied and relieved than before the visit. Another phone call to the patient 3 weeks later confirmed that he had received his second dose, and the patient was instructed to follow up as needed.

Discussion

A sore arm after vaccine administration is a direct result of the elicited immune response. IM vaccines recruit local macrophages and dendritic cells that secrete cytokines such as IL-1, IL-6, TNF-α, and PGE2; the recruited neutrophils, lymphocytes, and monocytes secrete prostaglandins [15]. Although this results in a robust immune response, cytokines and prostaglandins increase nociception, and once it reaches a certain threshold, it manifests as muscle soreness [15]. Local edema secondary to tissue injury may also contribute [15]. The lymphatic system helps resolve this local reaction by clearing inflammatory cells, cytokines, and interstitial fluid [6], and is therefore a good target for osteopathic treatment.

The lymphatic system is composed of thin-walled vessels [16] that return lymph from the periphery to central circulation. The vessels are particularly susceptible to stress imposed by nearby myofascial structures [13] and generally rely on external forces to propel their contents [16]. The thoracic duct is the largest lymphatic vessel in the body and is responsible for draining most of the body except the right hemithorax, and the right face, neck, and arm, which drain into the right lymphatic duct [17]. Lymphatics of the upper extremity pass the axillary region before entering the thoracic or right lymphatic duct. Near their terminal ends, both ducts traverse Sibson's fascia, the connective tissue overlying the thoracic inlet, before finally draining into the left and right subclavian veins, respectively [17]. Dysfunctions in Sibson's fascia [12] and/or congestion at the anterior axillary region [13] impose myofascial restrictions that may impede proper lymphatic drainage and are therefore critical areas to address with OMT. The principle of structure and function within the Tenants of Osteopathic Medicine assumes that when the lymphatic system and its surrounding structures are optimized, so is its physiology. Lymphatic OMT applies the respiratory–circulatory model to promote lymph formation, exchange nutrients, and restore the natural flow of fluid [12]. Relieving fascial restrictions and extrinsically propelling lymphatic fluid can promote mobilization of inflammatory mediators [18] and reduce edema [19], which explains our success in reducing muscle soreness from a median of 24–48 to 8 h. Lymphatic treatments are safe, cost-effective, and well-tolerated by patients, which further supports their use in postvaccination settings.

The thoracic inlet, or Sibson's fascia, is treated first because it is the most central site of dysfunction [12], followed by the axillary and more peripheral regions [20]. This ensures that lymph from the upper extremity can drain into circulation freely. Lymph-mobilization techniques, such as the upper extremity lymphatic pump [20] and Spencer's step 7 [14], apply the respiratory–circulatory model by inducing skeletal muscle contractions that create pressure differentials and physically pump lymphatic fluid throughout the vasculature [9, 13, 14]. The upper extremity lymphatic pump required slight modification to accommodate the patient's comfort level; rather than performing this technique with the arm above the head, rapid oscillations were applied to the arm positioned at roughly shoulder level. Spencer's technique is a common shoulder articulatory technique; however, the step in which the arm is put into abduction with traction can be performed in such a way that it acts as a lymphatic pump [12, 14]. Finally, thoracic duct siphoning encourages the final drainage of lymph into the left subclavian vein [12]. This final technique was utilized because the vaccine was administered in the left deltoid, however, if it were administered in the right deltoid, the right lymphatic duct would have been targeted instead.

Our goal in this paper is to highlight the potential role of OMT for the relief of postvaccination muscle soreness. A major limitation of this case report, however, is the small sample size (n=1), which limits the generalizability of our results and hinders the potential to establish a cause-effect relationship between lymphatic OMT and the duration of muscle soreness. It also limits our ability to decipher which techniques were most helpful in resolving the chief complaint. The techniques utilized in this scenario apply basic principles of osteopathy, such as the respiratory–circulatory and "structure–function" model. There are a variety of techniques that employ these models and that could have been used for this patient; for example, the posterior axillary fold release and pectoral traction relieve myofascial impediments that hinder upper extremity lymphatic flow [12], and thoracic pumping and doming of the diaphragm are also highly efficacious in mobilizing lymphatic fluid [12]. Although it would be ideal to design a rigid standardized protocol, it is impractical considering how unique a targeted osteopathic treatment can be; OMT utilizes palpatory feedback to make real-time adjustments that are specific to each patient. This case report lays the groundwork for a future pilot study and/or randomized controlled trial to determine the combination of techniques that best reduces muscle soreness. This can then be used as a template that can be further fine-tuned to suit the patient's needs. Osteopathically addressing muscle soreness, a common complaint of vaccines, would be novel, relevant, and beneficial to patients, and could be performed by osteopathically-trained clinicians in both an inpatient and outpatient setting.

Conclusions

Intramuscular vaccines, including Pfizer-BioNTech BNT162b2, are notorious for causing muscle soreness. Unease regarding side effects can discourage individuals from getting vaccinated and is therefore important to mitigate. In this case report, a patient presenting with injection site pain post-BNT162b2 was treated with lymphatic OMT and experienced a reduced duration of deltoid soreness from a median of 1–2 days to 8 h. With more investigation of a larger patient population, OMT may have the potential to reduce this common side effect and improve patient satisfaction and compliance with vaccine scheduling.

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