Effects of Osteopathic Manipulation and Other Manual Manipulative Treatments on Cystic Fibrosis

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Abstract

Context: Cystic fibrosis (CF) is a genetic disease that affects multiple organ systems, and symptoms include chronic cough, gastrointestinal (GI) malabsorption, exercise intolerance, and chronic pain. Examples of standard treatments are nebulizers, supplementary enzymes, chest percussive therapy, respiratory therapy, and lifestyle modifications.

Objective: The purpose of the current review was to determine whether manual therapies, such as osteopathic manipulative treatment (OMT), in conjunction with standard treatments, provide symptom relief for patients with CF.

Methods: PubMed was searched to identify studies investigating the role of manual medicine in the care of CF patients. Search terms included chiropractic, physical therapy, physiotherapy, osteopathic, manipulation, massage, and manual medicine. All terms were searched in combination with cystic fibrosis. Studies investigating only exercise or chest percussive therapy as adjunctive treatments were excluded.

Results: Eight studies were found that investigated manual therapies alone or in conjunction with exercise for treatment of CF symptoms. All studies reported improvement after manual therapy in 1 or more symptoms, such as posture, GI symptoms, peak airflow, anxiety, back or chest pain, or breathing. Study types included a case study, prospective observational studies, and randomized controlled trials. Most studies were small and statistically underpowered. In an inpatient/outpatient observational study of adults with CF, patients reported a significant reduction in pain after a single physiotherapy treatment, and inpatients also reported significantly improved breathing after treatment. In a randomized controlled trial involving adult CF outpatients, there was a significant improvement in chest and back pain scores between the OMT and control groups.

Conclusions: Results of the current review suggested patients with CF can experience symptom relief after OMT and similar manual therapies. Patients subjectively reported improvement with manual therapies, and studies found statistically significant decreases in pain after a single treatment. However, larger studies with sufficient statistical power are needed to further define the role of manual therapies as adjunctive treatment for symptom relief in CF patients.

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Introduction

Cystic fibrosis (CF) is a genetic disease caused by a mutation of the cystic fibrosis transmembrane conductance regulator (CFTR) protein that affects multiple organ systems, including the gastrointestinal (GI) system, respiratory system, integumentary system, reproductive system, and musculoskeletal system. The CFTR mutation makes the body's cells unable to regulate cellular transportation of sodium and chloride and, thus, water.[1] Over 1000 mutations in the CFTR gene have been identified, and about 230 are known to cause clinical abnormalities.[1] Because mutations affect patients differently, symptoms may manifest in different organ systems to different degrees, but the majority of patients have symptoms in multiple systems.[2]

In the GI system, exocrine secretions of the pancreas become thick and are not excreted properly, resulting in pancreatic insufficiency.[2] If diagnosis and treatment are delayed, patients may have steatorrhea, poor weight gain, polyphagia, and increased flatulence.[1] Complications include meconium ileus (present in about 20% of newborns with CF), distal intestinal obstructive syndrome, rectal prolapse, and liver cirrhosis later in life.[2] For patients with CF-related diabetes, blockage of the pancreatic ducts causes scarring or autodigestion of the endocrine and exocrine pancreas.[2,3] Increased risk of gallstones occurs in about 12% of CF patients for unknown reasons,[2] and adults with CF are at greater risk of GI malignancies.[1]

In the lower respiratory tract, the lung's mucosal secretions become excessively thick, causing blockage of small bronchioles, decreased oxygenation of alveoli, and breathing difficulties.[4] Early in life, this defect causes respiratory tract infections because the secretions are too thick for passage up the normal ciliary tract and impair the immune response.[4] In the upper respiratory tract, patients have an increased frequency of sinus infections because the thick mucus secretions clog drainage passageways for the sinuses.[1,2] For currently unidentified reasons, patients with CF are prone to large nasal polyps, which also obstruct mucous drainage.[2]

In the musculoskeletal system, CF patients are prone to osteopenia, which can develop as early as the teenage years.[2,5] If not managed early, osteoporosis may develop by the time a patient reaches their 30s or 40s.[2]

As recently as 50 years ago, a diagnosis of CF meant death in infancy because the average survival age was 6 months.[5] By 1979, medical advances increased the survival age to 15 years old.[5] In 1991, it was 23 years old, and by 2003, it was 33 years old.[5] According to the Cystic Fibrosis Foundation, as of 2017, the median age of survival was 47 years old, but new medical advances may extend that age into the 50s.[2] Interestingly, there is higher morbidity and mortality in female patients.[2] This phenomenon is known as the CF gender gap and is thought to be caused by estrogen.[2] Recently, CFTR protein modifying medications, such as ivacaftor, have been used to increase the time the CFTR channel is open.[1,3] Although these medications address multiple systems affected by CF, they are mutation-specific, and though they are helpful in a majority of patients with CF, there is still a small population of patients for whom these medications are not beneficial.[1]

Although multiple systems are affected by CF, the respiratory tract is the most vital system affected, and extensive treatment is often necessary. In younger patients, chest percussion therapy (CPT) is required twice daily; in infants, parents use their hands to perform CPT, and in older children a CPT vest is used.[2] Vests use alternating puffs of air to create compressive forces on the patient's chest, breaking up the thick mucus secretions mechanically so they can be coughed out more easily.[2] Regular albuterol treatments significantly improve spirometry results and reduce hospital days by 50% when compared with placebo.[6] Therefore, infants often begin albuterol treatments before respiratory symptoms develop.[2] As symptoms develop, breathing treatments, such as inhaled steroids and hypertonic saline nebulizers, can become necessary.[1,2] Another treatment, inhaled recombinant human deoxyribonuclease, cleaves extracellular DNA in sputum, decreasing sputum viscosity.[1] When administered long term, this treatment can improve forced expiratory volume in 1 second (FEV_1) and reduce risk of acute respiratory exacerbations.[1] Coughing can also be used as a treatment. As soon as children are old enough to understand and follow directions, they can be encouraged to cough to expel the mucus from their lungs.[2] Another less physically demanding tactic is huffing, or exhaling hard multiple times in a row, which also moves mucous up the airway for expectoration.[2]

Another major system affected by CF is the GI system, and these dysfunctions are often managed with lifestyle changes to improve long-term survival and good nutritional health.[2] To manage pancreatic insufficiencies, pancreatic enzymes are replaced orally before every meal.[2] Even with replacement enzymes, patients cannot absorb all the fat from their foods, so they are encouraged to eat a high-fat diet, e.g., consuming whole milk instead of skim milk and leaving the grease on traditionally greasy foods.[2] Because the patients' bodies must constantly work to maintain airway patency and digestion, they require 1.5 to 2 times more calories than an individual of the same age and sex without CF.[2]

Since more CF patients are reaching skeletal maturity, chest pain, back pain, and other musculoskeletal complaints are becoming more prevalent[5] and have been associated with decreased quality of life.[7] Postural abnormalities, such as exaggerated spinal curvatures and forward head posture, are also common.[5] Because muscles of respiration are also used as postural muscles, respiration requires excess energetic demand, so postural muscles cannot function as well to maintain proper posture.[5] With worsening spinal deformity, CF patients experience deteriorating lung function, and those with the most sputum have more pain and spinal deformities.[8] A case study described the balance between the postural muscles, respiration, and internal organ function as analogous to an aluminum soda can.[5] The can is strong when sealed because internal pressure from carbonation provides support to the thin aluminum walls. Repetitive coughing from CF results in repetitive positive pressure, which can disrupt the structural integrity of the patient's trunk and cause urinary stress incontinence, gastroesophageal reflux, vocal fold dysfunction, weakness of abdominal musculature, and spine deformities.[5,8]

Therefore, given the relationship between structure and function with CF, osteopathic manipulative treatment (OMT), physiotherapy, and other manual therapies may have crucial roles in the treatment of CF patients. However, only 14.5% of CF patients regularly have manual therapies as an adjunctive treatment.[9] The purpose of the current review was to determine whether manual therapies, such as OMT, in conjunction with standard treatments, provide symptom relief for patients with CF.

Methods

For the current narrative review, we conducted a search of the PubMed database to find articles published through May 2020 related to the role of manual medicine in the care of CF patients. Search terms used included chiropractic, physical therapy, physiotherapy, osteopathic,

manipulation, massage, and manual medicine. These terms were searched separately in combination with cystic fibrosis. Abstracts were reviewed to assess inclusion or exclusion before entire articles were read. Because CPT is already a standard treatment of CF, articles involving various methods of CPT were excluded. Studies investigating exercise therapies without hands-on manual therapies or specific observed interventions were also excluded.

Studies were read and analyzed by considering the study population, namely, inpatient versus outpatient and pediatric versus adult patients. Significance of results was noted, as was type of manual medicine used. Results of our narrative review are reported below based on type of study.

Results

Nine studies fit our search criteria, but only 8 involved CF and did not include other respiratory illnesses.[4,5,10-15] Study types included a case study, prospective observational studies, and randomized controlled trials. Studies involving manual medicine as an adjunctive treatment for symptom relief for patients with CF included home stretching and core strengthening exercises;[5] massage therapy;[10,15] postural awareness, education, and advice;[5,14] rib mobilization by a physical therapist;[12,14] and OMT.[4,11-13] The OMT studies included treatment of the thoracic spine and ribs,[11-13] soft tissue, lymphatic treatments, and suboccipital release.[4,12,13] Table 1 presents a brief summary of the reviewed studies.

Case Study

A single case study by Massery[5] involved a 9-year-old female with CF who was receiving individualized physical therapy for 4 months. Specifically, the patient's musculoskeletal dysfunctions were treated to determine whether it would affect the child's overall posture and health.[5] Physical therapy included manual mobilization of restricted joints and neuromuscular retraining and strengthening of muscles to maintain the child's improved posture.[5] Treatment resulted in great improvement in the child's overall posture, pulmonary function testing, and weight gain.[5] In addition, there were no acute CF respiratory exacerbations during the 4 months.[5]

Prospective Studies

In a pilot crossover study by Modlin et al,[13] 16 outpatient adults with CF and chronic constipation were divided into 2 groups. Group 1 received OMT once a month for 4 months and then had no OMT for 4 months as a control.[13] Group 2 followed the opposite order, ie, no OMT the first 4 months and then 4 months of OMT.[13] Participants completed an initial intake survey at the start of the study, and weekly surveys about their symptoms and hospitalizations after that.[13] The OMT protocol included an osteopathic structural examination before treatment, and the OMT techniques used included rib raising, suboccipital release, lumbosacral decompression, and ligamentous articular release or myofascial release to the thoracic inlet, thoracoabdominal diaphragm, sacrum, pelvis, and 3 to 5 segments in the spine and ribs with significant dysfunction.[13] During the 4 months with no OMT, participants used only supplementary pancreatic enzymes (standard of care).[13] Only 5 participants completed the study.[13] However, most participants reported decreased pain, increased satisfaction with bowel movements, and reduction in use of laxatives after OMT.[13]

In a pediatric outpatient study by Hernandez-Reif et al,[10] the authors investigated the benefit of training parents of CF patients to perform soft tissue techniques on their children for 30 days. Participants and their parents were randomly assigned to 20 minutes of reading or 20 minutes of parent-performed massage.[10] Parents in the massage group were taught a 20-minute massage therapy treatment that they performed daily with their child before bed.[10] Twenty participants completed the study.[10] After 30 days, the massage group reported decreased anxiety for the parents and patients and increased peak airflow in the patients.[10]

A prospective observational study by Lee et al[12] investigated adults with CF who were inpatients admitted to the hospital with an acute exacerbation of CF (n=70) or recently discharged outpatients (n=35). A single physiotherapy treatment was performed on all participants and included intercostal and spinal joint mobilization, soft tissue therapy, and remedial massage.[12] After treatment, both groups reported statistically significant reductions in pain.[12] The inpatients also reported significantly improved breathing after treatment.[12]

Randomized Controlled Trials

Hubert et al[11] performed a randomized controlled trial (RCT) of adult CF outpatients comparing pain and analgesic use in various areas of the body and looking at quality of life indicators and need for analgesics. The 32 study participants were divided into 3 groups: OMT, sham, and control.[11] The OMT group received monthly OMT for 6 months, the sham group received light touch to the sacrum and skull, and the control group received standard care only.[11] Results showed a statistically significant improvement in the chest and back pain scores between the OMT and control groups ($P<.002$) and between the sham and control groups ($P=.006$).[11] No significant effects were found for quality of life, headaches, need for analgesics, or neck pain.[11]

A single-blind RCT by Swender et al[4] compared OMT with sham therapy in 36 adults hospitalized for acute respiratory exacerbations from CF. The OMT protocol included rib raising, abdominal diaphragm release, thoracic inlet myofascial release, thoracic lymphatic pump, and suboccipital decompression.[4] The sham protocol involved the clinician placing their hands near the locations of the OMT techniques.[4] Outcome measures were spirometry values and patient perceptions of breathing, pain, and anxiety levels.[4] More patients in

Table 1. Reviewed Studies Involving Manual Medicine as an Adjunctive Treatment for Symptom Relief in Patients with Cystic Fibrosis (CF)

Study	Manual Therapy Used	Clinical Setting	Patient Type	Main Findings
Hernandez-Reif et al[10]	Massage therapy	Outpatient	Pediatric	Massage therapy increased peak air flow readings ($P<.05$) and decreased anxiety and improved mood ($P<.05$)
Hubert et al[11]	OMT	Outpatient	Adult	OMT improved chronic musculoskeletal back and chest pain associated with CF ($P<.002$) and may improve pain in other areas
Lee et al[12]	Physiotherapy and massage	Outpatient and inpatient	Adult	Joint mobilization and massage decreased pain ($P<.001$) and increased ease of breathing ($P<.001$)
Massery[5]	PT	Outpatient	Pediatric	Guided PT and stretching may improve posture
Modlin et al[13]	OMT	Outpatient	Adult	OMT may be beneficial in treatment of GI symptoms of CF
Sandsund et al[14]	Physiotherapy	Outpatient	Adults	Manual medicine resulted in nonsignificant improvements in thoracic index and movement at third rib
Swender et al[4]	OMT	Inpatient	Adult	OMT may decrease subjective difficulty for breathing, pain, body temperature, and anxiety
Zink et al[15]	Massage therapy	Outpatient	Pediatric and adult	Massage therapy usage was limited but decreased NRS score for muscle tightness ($P=.048$) and may reduce musculoskeletal pain, increase ease of relaxation, and increase upper and lower thoracic excursion

Abbreviations: GI, gastrointestinal; NRS, numeric rating scale; OMT, osteopathic manipulative treatment; PT, physical therapy.

the OMT group reported improved breathing than those in the sham group.[4] The OMT group also had a nonsignificant trend of improved FEV_1/forced vital capacity (FVC) and forced expiratory flow at 25% to 75% of vital capacity than the sham group.[4]

A single-blind RCT by Sandsund et al[14] compared adult outpatient CF participants receiving standard medical care plus physiotherapy (control group) for 6 weeks (n=10) with a treatment group who received physiotherapy plus weekly manual medicine but additionally had postural awareness education and training for 6 weeks (n=10). Manual medicine techniques included dysfunction-specific mobilization of the rib cage and thoracic spine and treatment of tight muscle groups.[14] The treatment group had nonsignificant improvements in the thoracic index and chest wall excursion at the third rib, which are closely correlated with FEV_1 and FVC.[14]

A randomized study by Zink et al[15] compared outpatient pediatric CF participants receiving massage therapy (n=12) with a control group receiving treatment as usual (n=12). The massage group received 3 to 5 standardized massage treatments, lasting 60-90 minutes, over 10 to 12 weeks.[15] The massage protocol included stretching, pétrissage, and trigger point release to the shoulders, upper trunk, posterior neck, abdomen, thighs, spinal musculature, and upper back.[15] All treatments ended with effleurage of the back to induce relaxation.[15] No significant differences were found between groups for changes in quality of life or pulmonary function, but the massage therapy group had nonsignificant improvements in pain reduction and thoracic excursion.[15] Massage was also associated with significantly decreased muscle tightness ($P=.048$).[15]

Comment

The current review investigated whether manual therapies, such as OMT, in conjunction with standard treatments, provide symptom relief for patients with CF. A total of 8 studies[4,5,10-15] were reviewed, and our results suggested that OMT and similar manual therapies led to measurable improvements in symptoms experienced by patients with CF. In the inpatient setting, the inclusion of manual techniques resulted in statistically significant improvements in patient-reported outcomes of improved ease of breathing and decreased pain.[4,12] Many of the studied outcomes demonstrated nonsignificant trends toward improvements.[4,5,10,13-15] These trends included larger fever reduction, improved FEV_1/FVC ratio, and improved forced expiratory flow.[4] However, given the small sample sizes of these studies (16-70 patients per study), future inpatient studies should include a larger number of participants to provide more statistical power and increase the likelihood of finding statistically significant improvements in objective outcome measures.

The outpatient studies included in the current review also found improvements in symptoms experienced by patients with CF after manual medicine treatments. Statistically significant reductions were found for chest and back pain[11,12] and for muscle tightness.[15] Nonsignificant trends indicated improvements in pain, the thoracic index, and thoracic excursion;[14,15] increased satisfaction with bowel movements; and a reduction in the need to use laxatives.[13] Research suggests that improvements in thoracic index and chest wall excursion directly correlate to pulmonary function testing performance.[16] However, the small sample sizes of these studies did not provide adequate statistical power to find outcome measures that were statistically significant.

Investigation of other chronic respiratory conditions may also indicate efficacy of manual therapies for symptom relief of CF. A review by Huth et al[17] described 4 studies assessing manual therapies that could affect the lung function of CF patients. Two studies investigated pediatric patients with asthma, 1 investigated pediatric CF patients,[10] and 1 investigated adults with chronic lung disease. Manual therapies included massage therapy, physical therapy, and progressive muscle relaxation. Overall, results indicated decreased anxiety, increased peak air flow measurements, improved mood, increased FVC, decreased resting respiratory rate, increased chest expansion, and decreased salivary cortisol levels.[17] These results suggest that symptom improvement after manual therapy in patients with chronic lung disease and severe asthma may be applicable to patients with CF; however, additional research is required.

Other treatments for symptom relief in relation to cost effects could also be investigated. Ledger et al[18] studied the effects of personalized dietary, cardiovascular, and stretching regimens in 14 CF patients aged 4-15 years who had required intravenous antibiotics within the previous year. Their alternative treatment regimen was associated with reduced antibiotic usage that resulted in a mean cost savings of over $7600 per patient per year.[18] Future studies investigating the effect of manual medicine on CF symptoms should include calculations of estimated cost savings per patient in their analyses to show not only improvements in symptoms but also decreased healthcare expenditures.

Most manual medicine studies have several limitations in common, and the reviewed studies were no exception. One limitation was the small number of participants: the largest number of participants was 105,[12] but most reviewed studies had 15-35 participants. Because of this small sample size, statistical significance was difficult to achieve. Another limitation is that the nature of manual medicine makes it difficult to perform a double-blinded study. The treatment provider will always know the group assignment of the patient. The length of the study was also a limitation. The reviewed studies were mostly short term with the longest study lasting only 2 years. Longer duration studies are needed to determine the long-term results of manual treatments.[18] Another limitation of the current review was using a single database for the literature search; there may be other articles that are not included in this database. Also, our review did not consider studies in the process of publication that are not yet published. Given these limitations, future studies should include more participants for longer periods to fully understand the effects of OMT and similar manual therapies on symptom relief in patients with CF.

Conclusion

Results from the current review suggested patients with CF may benefit from OMT and similar manual therapies. Patients subjectively reported that manual therapies were beneficial, and there were statistically significant decreases in pain after 1 treatment. Further, OMT and similar manual therapies effectively provided relief for back and chest pain, and patients felt treatments helped them breathe more easily. Manual therapies also showed improvements in rib excursion, especially at the upper rib level, which has been positively correlated with FEV_1 and FVC. These therapies have also been shown to improve posture, which can thus improve ease of breathing. Massage therapy was shown to reduce anxiety for parents and pediatric patients, improve mood in children, and increase peak airflow in patients with CF. Multiple studies also showed nonsignificant increases in FVC after massage therapy. Future studies with adequate power and cost analyses are needed to further understand the role and potential benefits of adding OMT and similar manual therapies to the management of CF patients.

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