The Short-Term Effect of a Lymphatic Pump Protocol on Blood Cell Counts in Nursing Home Residents With Limited Mobility: A Pilot Study

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Context: Lymphatic pump techniques have the potential to alter blood cell counts and thus enhance immune function in elderly adults with diminished mobility.

Objective: To test whether an osteopathic manipulative treatment (OMT) protocol designed to enhance immune function will have an effect on lymphocyte and lymphocyte subset counts compared with a sham control group.

Design: The study design was a single-session, randomized, controlled clinical trial comparing a standardized lymphatic pump protocol with a light-touch protocol. Participants were assigned to 1 of 2 groups by using a 1:1 allocation ratio.

Setting: The study was conducted in 2 rural long-term care facilities in Missouri.

Participants: Residents in the long-term care facilities who were aged 60 years or older and who were confined to a bed or wheelchair for most of their waking hours. Twenty residents were recruited to participate in the study, and 10 were randomly assigned to each group.

Interventions: Baseline blood samples were obtained. Then each patient received a 6-minute study protocol treatment. Thirty minutes after completion, posttreatment blood samples were obtained. The OMT protocol consisted of 3 osteopathic techniques: myofascial release to the thoracic inlet, the splenic pump, and the pedal lymphatic pump. The light touch protocol was applied to the same body areas as the OMT protocol for 6 minutes.

Outcome Measures: A pretreatment and posttreatment lymphocyte subset panel, complete blood cell count, and automated white blood cell count differential was obtained from each participant.

Results: There was a statistically significant between-group difference in mean change for platelet counts: counts in the OMT group decreased by a mean (standard deviation) of 15,400 (7947) platelets per microliter and the light touch group increased by 4,700 (17,857) platelets per microliter (P=.004). The between-group differences for the mean (standard deviation) absolute lymphocyte cell count, red blood cell count, hemoglobin level, and hematocrit measures all decreased, but the changes were not statistically significant relative to the control group.

Conclusion: The OMT protocol used in this pilot study modestly reduced platelet counts in nursing home residents with limited mobility.

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Osteopathic manipulative treatment (OMT) was developed at the end of the 19th century. At that time, pneumonia, tuberculosis, diarrhea, and diphtheria were considered to be the leading causes of death, and life expectancy was approximately 40 years.[1,2] Standard treatments for infectious diseases were of dubious value. For example, drugs used for pneumonia included strychnine, digitalis, belladonna, ergot, and other cardiac tonics.[3] It was in this environment that Andrew Taylor Still, MD, DO, developed OMT to treat the common health problems of the day. This new approach held great appeal because it offered a way to treat infections by enhancing host immunity through what was known about anatomy and physiology. By contrast, rational antimicrobial drug therapy–based physiology and clinical science was still in its infancy. Still's innovations inspired individuals such as M.A. Lane, a distinguished researcher and professor of pathology at the American School of Osteopathy, to become evangelistic proponents of the reform movement of osteopathy.[4] While the larger biomedical community was searching for magic bullets to treat pathogens, proponents of osteopathic medicine were developing manual treatment strategies to help the body heal itself.[1,5] Techniques were developed to mobilize joints and free obstructions to nerves and circulatory vessels.[4] In the 1920s, lymphatic and splenic pump techniques were developed specifically for the treatment of infectious diseases.[6-8] The evidence for OMT's efficacy for infectious diseases, however, remained largely anecdotal. As proven, safe and effective antimicrobial agents became widely available and the use of OMT for infectious diseases declined. Today, OMT is primarily used for musculoskeletal problems with only a minority of osteopathic physicians reporting they use or plan to use OMT for nonmusculoskeletal problems.[9,10] In this era of effective antimicrobial pharmacologic agents, the usefulness of OMT to treat infectious diseases remains an open question. The question remains open because the topic remains largely unexplored from both mechanistic and clinical efficacy perspectives.

There is a small but growing body of literature on possible mechanisms for how the splenic pump and lymphatic pump techniques might improve host defenses. In the 1930s, Castlio and Ferris-Swift published the results of 2 mechanistic studies that investigated the effect of the splenic pump technique on blood cell counts and other immune function measures.[11,12] Modern statistical analysis of the raw data[8,13] supports their findings: that the splenic pump technique causes a modest increase in leukocytes, a decrease in erythrocytes, a decrease in the Arneth index, and an improvement in immune function test results (ie, phagocytic index, opsonic index, serum agglutinative power, and bacteriolytic power). In the 1980s, Measel[14] reported that use of the lymphatic pump technique could improve the antibody response to pneumococcal polysaccharide. From 2000 on, animal models have shown that lymphatic pumping techniques increase the circulation of lymphatic fluids.[15,16] In both dog and rat models, the lymphatic pump technique increases both thoracic duct lymph flow and the leukocyte count in the lymph, thus greatly increasing lymphatic leukocyte flux.[17,18]

Immobile senior citizens in nursing homes represent a population likely to benefit from new methods to enhance host immunity. It is well known that this population experiences reduced mobility, diminished immune function, and high infectious disease rates.[19] A study evaluating factors influencing prognosis of pneumonia in the elderly[20] found that immobilization syndrome was highly predictive of mortality (odds ratio, 9.36). Early mobilization—the simple act of encouraging patients to get out of bed from the first day of hospitalization—was shown to modestly reduce length of hospital stay for pneumonia patients aged 18 years or older.[21] Several well-designed clinical trials[22-25] demonstrated that OMT is well tolerated and reduces the length of hospital stay in the elderly. The long-term–care setting also affords the opportunity to treat individuals for longer time spans than does the hospital setting.[23]

Therefore, an exploratory mechanistic study was

conducted evaluating the effect of an OMT protocol on blood cell counts in elderly nursing home patients who have reduced mobility. The hypothesis for this study is that an OMT protocol designed to enhance immune function will have an effect on lymphocyte and lymphocyte subset counts relative to a sham control group. The treatment protocol will change other blood cell counts; specifically, it will reduce red blood cell and platelet counts, presumably because the protocol incorporates the splenic pump technique.

Methods

General Information

The study design was a single session randomized controlled clinical trial that used a light touch protocol as a sham control. Participants were assigned to 1 of 2 groups by use of a 1:1 allocation ratio. There were no important changes in the study design after participants were recruited. Informed consent was obtained in accordance with the Institutional Review Board standards of the Kirksville College of Osteopathic Medicine. All participants received a written and verbal explanation of the nature of the study, study objectives, and the procedures, including the obtaining of blood samples and the treatment protocols. Consent was obtained directly from all participants who retained the capacity to fully understand the nature of the study and the study procedures. If there was any doubt about a participant's capacity to give full informed consent because of cognitive impairment on the basis of clinical judgment of the investigators, then informed consent was obtained from the legal guardian, person with durable power of attorney, or closest relative. The project started in the fall of 2001 and continued through the winter of 2001-2002 until 20 participants completed the study. The demographic information for age, sex, race, and ambulatory status was collected. Study participants were not told the group to which they were randomly assigned. The researchers who collected the blood samples and processed the blood tests were blinded to group assignment and did not witness the protocol treatments. The effectiveness of the sham protocol to blind participants to group assignment was not assessed.

Patient Population

Elderly nursing home residents who were confined to a bed or a wheelchair for most of their waking hours were recruited to participate in the study. Inclusion criteria also included an age of 60 years or older. Exclusion criteria were cognitive impairment or combative behavior, acute illness, acute vertebral or rib fracture, or risk of pathologic fractures. Participants with a malignant cancer, splenomegaly, or a history of splenectomy were also excluded. The project was conducted in 2 community long-term care facilities in the area of Kirksville, Missouri. All of the protocol treatments were performed in the nursing home facilities.

OMT Protocol

The treatment group received a 1-time standardized OMT protocol intended to boost host immunity, given for a total duration of 6 minutes. One operator (D.R.N.) gave all the protocol treatments. The OMT protocol consisted of 3 osteopathic techniques: myofascial release to the thoracic inlet, the splenic pump, and the pedal lymphatic pump. Approximately 2 minutes was allotted for each technique.

The myofascial release technique was applied to the thoracic inlet. The operator stood at the head of the bed and placed his hands on the thoracic inlet. The operator palpated in the preferred direction of myofascial tension and moved the tissues to a point of balance until a release in tissue tension was observed. For the splenic pump technique, the operator sat or stood at the left side of the participant, with the participant laying supine in bed. The operator placed one hand on the anterior and the other hand on the posterior aspects of the left lower rib cage over and under the spleen. The splenic pump

technique consisted of rhythmic anterior-posterior compressions of the splenic area. For the pedal lymphatic pump technique, the operator stood at the head of the bed with the patient supine. The operator's hands grasped the participant's feet (modified to hands on the legs in case of amputation or severe arthritis). The feet were gently and rhythmically dorsiflexed, sending a "wave of motion" up the longitudinal axis of the body. This motion "sloshes" the contents of the abdominal cavity up against the diaphragm as the wave moves up the longitudinal axis of the body. As the rebound wave comes back down the body and reaches the feet, the feet are again dorsiflexed, creating a rhythmic oscillation throughout the longitudinal axis. When possible, the operator engaged the participant in conversation during the treatment session.

Sham Protocol

The control group received a standardized light touch sham treatment protocol for a total of 6 minutes. The operator's actions for the sham protocol mirrored the OMT protocol: the operator touched the same areas of the participant's body and applied light touch for the same duration as the treatment protocol. As in the OMT protocol, the operator engaged the participant when possible in conversation throughout the treatment session.

Outcome Measures

The outcome measure for this pilot project was a pretreatment and posttreatment lymphocyte subset panel. The panel measured the percentage and absolute cell numbers for CD3 (mature T) cells, CD4 (helper) cells, and CD8 (cytotoxic) cells; CD4/CD8 ratio; and absolute lymphocytes. The other outcome measures were a pretreatment and posttreatment complete blood cell count and manual white blood cell count with an automated differential. Pretreatment blood samples were taken before administering the treatment protocol, and the posttreatment blood samples were obtained approximately 30 minutes after treatment. Basic demographic information was collected from the participant's medical record.

Statistical Analysis

For this exploratory project, the sample size was pragmatically determined on the basis of resources available to evaluate 20 participants, 10 participants in each group, before recruitment. For randomization, all participants were stratified by age and immobility. The strata for age were 65 to 84 years and 85 or more years. To stratify by immobility, participants were classified as primarily wheelchair bound or primarily bed bound during most of the day. Stratified randomization assigned participants to either the OMT protocol group or the control group. The computer-generated allocation sequences were placed in sealed envelopes by the study's statistician. The envelopes were not opened until after recruitment and receipt of informed consent. A nurse practitioner recruited and obtained informed consent from the participants, and the treatment protocols were performed by the principal investigator (D.R.N.). The change from baseline for each outcome measure was calculated. The between-group differences were analyzed using analysis of variance (ANOVA).

Results

Twenty nursing home residents were recruited and enrolled in the study. Ten of the patients were randomly assigned to the OMT group and 10 to the light touch group. The mean age of the patients was 84 years in the OMT group and 82 years in the light touch group. In the OMT group, all 10 participants were women. In the light touch group, 3 were men and 7 were women. All participants in both groups were white. The OMT group had 3 bed-bound participants and 7 primarily wheelchair-bound participants; the light touch group had 2 bed-bound and 8 wheelchair-bound participants.

Table 1 summarizes the ANOVA results of the mean change from baseline to after treatment for the lympho-

Table 1.
Lymphocyte Subsets Data From Osteopathic Manipulative Treatment Group (n=10) and Light Touch Group (n=10)

	Group	
Subset	**Osteopathic Manipulative Treatment**	**Light Touch**
Absolute CD3 Cells, mm³		
Mean (SD)	−58 (162)	75 (196)
95% Confidence interval	−174 to 58	−65 to 215
P value	.12	
Absolute CD4 Cells, mm³		
Mean (SD)	−28 (114)	55 (116)
95% Confidence interval	−110 to 53	−27 to 138
P value	.12	
Absolute CD8 Cells, mm³		
Mean (SD)	−24 (56)	16 (116)
95% Confidence interval	−64 to 16	−66 to 100
P value	.33	
Helper/Suppressor Ratio		
Mean (SD)	0.10 (0.22)	0.07 (0.17)
95% Confidence interval	−0.05 to 0.26	−0.06 to 0.19
P value	.67	
Absolute Lymphocyte Cells, μL		
Mean (SD)	−117 (221)	87 (271)
95% Confidence interval	−275 to 41	−106 to 281
P value	.08	

Abbreviation: SD, standard deviation

cyte subsets for each group. There were no statistically significant differences between groups for any of the measures. However, the mean (standard deviation [SD]) change in absolute lymphocyte cells per microliter in the OMT group −117 (221) cells per microliter and in the light touch group 87 (271) cells per microliter ($P=.08$).

Table 2 summarizes the results of ANOVA of mean (SD) changes in complete blood cell counts. There was a statistically significant change in platelet counts between groups: counts in the OMT group decreased by a mean (SD) of 15,400 (7947) platelets per microliter, and counts in the light touch group increased by a mean (SD) of 4700 (17,857) platelets per microliter ($P=.004$). The between-group differences for red blood cell count, hemoglobin, and hematocrit subsets did not reach statistical significance. The results—presented in *Table 2*—demonstrate that the mean values for changes in red blood cell count, hemoglobin, and hematocrit subsets, however, all decreased in the OMT group compared with those in the sham control group. Not shown in the table, there was no statistically significant between-group changes in the mean corpuscular volume, mean corpuscular hemoglobin, or red cell distribution width measures.

Table 3 summarizes the manual white blood cell count differential findings. There were no statistically significant between-group changes in the differential cell counts.

Comment

The present study has several limitations. The small sample size means only large between-group differences were likely to be detected. The differences in red blood cell count, hemoglobin, and hematocrit measures may have been statistically significant with a larger study population. Such a study would be helpful for confirming that an OMT protocol reduces platelet counts and for determining if OMT affects other measures.

Another limitation is that the study evaluated only the short-term effect (30 minutes after treatment) of 1 protocol treatment session. The long-term effects of 1 protocol treatment or the effect of multiple treatment sessions remains unknown. The relative contribution of each of the 3 techniques used in the protocol to the final outcomes also remains unknown. At this stage in the exploratory process, the primary goal is to determine if there is an effect at all. If there is an effect, then future

projects can explore the relative contributions of individual techniques. The light touch protocol, too, may have some therapeutic effect on the outcome measures. Any beneficial effect of the light touch protocol would obscure the effect of the OMT protocol because OMT results are all measured relative to the light touch protocol group. This seems unlikely, however, because the outcome measures are objective and there is no known plausible mechanism for lightly touching a person to lower platelet counts. The major value of the control group is that it helps account for normal sample-to-sample variation in laboratory measurements.

A further limitation of this study is that the effectiveness of the light touch protocol in blinded participants was not assessed. However, because a number of participants had poor memory from dementia, the results from blinding after the light touch protocol would be less reliable.

The results from this exploratory project are interesting when compared with the few published studies in this topic area. In the 1930s, Castlio and Ferris-Swift[12] published a series of experiments on the effect of the splenic pump technique in persons hospitalized with acute infections. Noll et al[8] used modern statistical analysis of Castlio and Ferris-Swift's raw data[12] as a means to confirm the latter's findings that the splenic pump technique increases white blood cell counts and decreases red blood cell counts. In the present study, no change in white blood cell counts or red blood cells counts was found. However, similar to the Castlio and Ferris-Swift study[12] and its stastistical intrpretation by Noll et al,[8] in the present study the absolute mean values for red blood cell counts were found to be lower after treatment. Likewise, in the present study the hemoglobin and hematocrit levels, which are closely related to the red blood cells, deceased in a similar way. These observations do not establish an effect since they are not statistically significant, but they are encouraging for a larger study finding an effect. Neither Castlio and Ferris-Swift[8,12] nor the findings of the present study demonstrated a statistically significant change in the leukocyte differential cell counts. A small, uncontrolled study that used pectoral traction plus splenic pump technique[26] did report a transient rise in the percentage of circulating basophils compared with the percentage at baseline. In the present study, however, absolutely no change in the percentage of circulating basophils was observed relative to the light touch control group. One other study,[27] to my

Table 2.
Complete Blood Count Data From Osteopathic Manipulative Treatment Group (n=10) and Light Touch Group (n=10)

	Group	
Subset	**Osteopathic Manipulative Treatment**	**Light Touch**
White Blood Cell Count μL		
Mean (SD)	−470 (497)	−280 (444)
95% Confidence interval	−825 to −115	−598 to 38
P value	.38	
Red Blood Cell Count, ×10⁶/L		
Mean (SD)	−.14 (.13)	−.02 (.15)
95% Confidence interval	−0.24 to −0.05	−0.13 to −0.09
P value	.07	
Hemoglobin, g/dL		
Mean (SD)	−0.43 (0.40)	−0.07 (0.39)
95% Confidence interval	−0.72 to −0.14	−0.35 to −0.21
P value	.06	
Hematocrit, %		
Mean (SD)	−1.27 (1.28)	−0.21 (1.32)
95% Confidence interval	−2.19 to −0.35	−1.16 to 0.74
P value	.09	
Platelet Count, μL		
Mean (SD)	−15,400 (7947)	4700 (17,857)
95% Confidence interval	−21,084 to −9715	−8075 to 17,475
P value	.004	

Abbreviation: SD, standard deviation

Table 3.
Manual White Blood Cell Count Differential Data From Osteopathic Manipulative Treatment Group (n=10) and Light Touch Group (n=10)

	Group	
Subset	Osteopathic Manipulative Treatment	Light Touch
Neutrophils-Segmented, %		
Mean (SD)	−0.6 (8.36)	1.2% (8.70)
95% Confidence interval	−6.6 to 5.4	−5.0 to 7.4
P value	.64	
Neutrophils-Bands, %		
Mean (SD)	0.1 (0.74)	0.3% (1.06)
95% Confidence interval	−0.4 to 0.6	−0.5 to 1.1
P value	.63	
Lymphocytes, %		
Mean (SD)	1.1 (5.84)	−1.7 (6.91)
95% Confidence interval	−3.1 to 5.3	−6.6 to 3.2
P value	.34	
Monocytes, %		
Mean (SD)	0.7 (4.30)	0.2 (3.77)
95% Confidence interval	−2.4 to 3.8	−2.5 to 2.9
P value	.79	
Eosinophils, %		
Mean (SD)	−1.4 (3.78)	−0.2 (2.44)
95% Confidence interval	−4.1 to 1.3	−1.9 to 1.5
P value	.41	
Basophils, %		
Mean (SD)	0.0 (0.47)	0.0 (0.47)
95% Confidence interval	−0.3 to 0.3	−0.3 to 0.3
P value	1.000	

Abbreviation: SD, standard deviation.

knowledge, reported the effect of a lymphatic pump protocol on blood cell counts and also found no change in basophil counts.

The most robust finding of the present study was a statistically significant decline in platelets. Unfortunately, Castlio and Ferris-Swift[12] did not measure platelets, and thus comparative data are not available. A recent crossover, controlled clinical trial of the hematologic effects of a lymphatic pump protocol[27] measured platelet counts in 12 healthy male volunteers. A statistically significant decrease in platelet counts was observed in the lymphatic pump protocol group relative to the no treatment crossover control group. The authors of this study did not believe the observed mean decline of approximately 6000 platelets per cubic millimeter was likely to be clinically significant. For the present study, the mean decline in platelets was somewhat larger; the 95% confidence interval for the mean ranged from −21,075 to −9715 platelets per cubic millimeter. For an individual with a normal platelet count (130,000 to 400,000 platelets per cubic millimeter), these are not clinically significant changes. For individuals with marked thrombocytopenia (<40,000 platelets per cubic millimeter), however, these changes are clinically significant.

The finding that lymphatic pump techniques reduce platelet counts, however, is contradicted by an unpublished study by Harpenau et al[28] of 107 healthy adults who were administered either the splenic pump technique or a light touch sham control protocol. Harpenau et al found the splenic pump technique had no effect on platelet counts at 30 minutes and 60 minutes after treatment compared with a sham control group.[28] Important distinctions should be made among the aforementioned studies: the nursing home cohort in the present study were chronically immobile; Rivers et al[27] artificially imposed immobility in 12 healthy participants by asking them not to exercise for 3 days and to lay supine for 35 minutes before receiving treatment; and the 107 healthy subjects in the study by Harpenau et al[28] had no activity restrictions before receiving a study protocol treatment. In light of these differences, it is possible that the effects of lymphatic pump techniques are more pronounced in relatively immobile individuals. Nevertheless, the generalizability of the finding that splenic pump and lymphatic pump techniques decrease platelet counts is still

debatable. Until more studies are conducted, splenic pump and lymphatic pump techniques should be used with caution—or even avoided—in persons with marked thrombocytopenia.

Few clinical trials[29-31] have evaluated the effects of OMT in a nursing home setting. In a pilot study of preventive OMT in the nursing home,[29] treatment protocols were given twice per week for 5 months. Twenty-one participants were randomly assigned into 1 of 3 groups: 8 to the OMT group, 6 to the light touch group, and 7 to the treatment-as-usual group. The OMT protocol for this nursing home study focused on joint and tissue mobilization; it did not include a lymphatic pump technique. The results showed a reduction in hospitalizations and in median number of medications used by the OMT and light touch groups compared with the treatment-as-usual group.[29]

In another nursing home study,[30] during the 1999-2000 influenza season 22 patients received an OMT protocol that used both mobilization and lymphatic pump techniques vs a light touch protocol treatment, thus allowing researchers to observe the effect of OMT on antibody titers to the influenza vaccine.[30] There were no improvements in either immunoglobin M or immunoglobin G antibody titers in the OMT group compared with the light touch group. However, from October 1999 to March 2000, the mean (SD) number of days that patients were treated with antibiotics was 10.7 (16.1) days for the OMT group and 25.0 (20.6) days for the light touch group ($P=.03$). The mean (SD) number of febrile days for this same time period was 0.2 (0.6) days for the OMT group and 1.7 (2.6) days for the light touch group, ($P=.08$). Depression was also shown to be reduced in the OMT group by the end of week 16.[30] The light touch protocol used for this study was reasonably effective for blinding subjects to group assignment.[31] Although these 2 studies suggest some clinical benefits, the mechanism for the reduced days treated with antibiotics and reduced depression remains unclear.

Conclusion

It remains to be determined if these findings are reproducible in a larger study or if the findings are only generalizable to an immobile nursing home population. If splenic pump and lymphatic pump treatment protocols do alter blood cell counts, then this would suggest that these protocols can change human physiologic characteristics and indicate directions for future mechanistic studies. If these techniques do lower platelet and red blood cell counts, however, then splenic pump and lymphatic pump techniques might be contraindicated in persons with marked thrombocytopenia or severe anemia.

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