Effects of Osteopathic Manipulative Treatment Alone or in Combination With Respiratory Training on Chest Wall Expansion, Functional Mobility, and Dyspnea Level in Patients With Pulmonary Arterial Hypertension

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RATIONALE: While exercise training has been extensively investigated for nonpharmacologic treatment of pulmonary arterial hypertension (PAH), osteopathic manipulative treatment (OMT) has not been adequately examined. The purpose of this study was to explore the efficacy of OMT alone or in association with respiratory training on chest wall expansion, functional mobility, and dyspnea level in patients with PAH. METHODS: 48 patients under PAH-targeted medical therapy for at least 3 months, between the ages 20-74 (mean [SD] age: 48.4 [12.1] years) and with the World Health Organization functional class I to III were involved in the study. Chest wall expansion was evaluated with a cloth tape measure at maximal inhalation and exhalation at 3 levels of the rib cage (axillary line, xiphoid process, lateral lower edge of the tenth costae) by subtracting the end-expiratory diameter from the end-inspiratory diameter. Functional mobility was assessed using 5-repetition sit-to-stand test. Dyspnea level was determined with the modified Medical Research Council scale. Patients were divided into OMT, combined intervention, and control groups, with 18 patients in each group. Rib raising, diaphragm release, suboccipital decompression, first rib mobilization, mediastinum mobilization and thoracic inlet myofascial release techniques were applied to the OMT group twice weekly for 8 weeks. In addition to OMT, a yoga respiratory training session including nadishodhana, ujjayi, and bhramari pranayama was undertaken by the combined intervention group. The breathing exercises were also performed once daily for the remaining days as home exercises. Control group received no additional intervention. All patients received an educational lecture. For between-group comparisons and within-group differences of baseline with 8 weeks, one-way ANOVA with between-subject factor and the paired samples t test were used, respectively. Pairwise multiple comparisons were conducted using Bonferroni post hoc tests.RESULTS: All outcome measures improved significantly in both intervention groups ($p<0.01$), whereas the control group showed no significant difference ($p>0.05$). Improvements for functional mobility and all the chest wall expansion data were significantly higher in combined intervention group than other groups, and also in OMT group than control group ($p<0.05$) (Table 1). Improvement for dyspnea level was significantly higher in both intervention groups compared with the control group ($p<0.05$) (Table 1). CONCLUSION: This study demonstrated that the addition of respiratory training to OMT revealed further benefit to chest wall expansion and functional mobility compared to OMT alone and that the OMT might be an effective therapeutic method for dyspneic patients having difficulties in participating cardiopulmonary rehabilitation programs.

Table 1. Assessment of chest wall expansion, functional mobility, and dyspnea level at baseline and 8 weeks for each group

Outcome variable	Group	Baseline mean (SD)	Week 8 mean (SD)	Change mean (95% CI)	Between-group p value[a]	Pairwise comparison p value[b]
Chest wall expansion						
Axillary (cm)	OMT	5.16 (0.51)	5.63 (0.53)	0.47 (0.22)	**<0.001**	**<0.001***
	Combined	4.91 (0.58)	5.72 (0.45)	0.81 (0.25)		**<0.001#**
	Control	5.25 (0.37)	5.31 (0.40)	0.06 (0.40)		**0.002$**
Xiphoid (cm)	OMT	4.56 (0.44)	5.00 (0.52)	0.43 (0.25)	**<0.001**	**<0.001***
	Combined	4.38 (0.62)	5.16 (0.60)	0.78 (0.26)		**<0.001#**
	Control	4.75 (0.32)	4.66 (0.35)	-0.09 (0.32)		**0.003$**
Subcostal	OMT	3.53 (0.56)	4.28 (0.36)	0.75 (0.37)	**<0.001**	**<0.001***
	Combined	3.63 (0.43)	4.69 (0.51)	1.06 (0.36)		**<0.001#**
	Control	3.84 (0.53)	3.90 (0.52)	0.06 (0.31)		**0.042$**
Functional mobility						
5-STST (s)	OMT	12.94 (1.30)	12.05 (1.29)	-0.89 (0.38)	**<0.001**	**<0.001***
	Combined	12.88 (1.68)	11.22 (1.70)	-1.66 (0.27)		**<0.001#**
	Control	12.63 (1.76)	12.80 (1.77)	0.17 (0.37)		**<0.001$**
Dyspnea level	OMT	2.06 (0.57)	1.69 (0.60)	-0.37 (0.50)	**0.001**	**0.041***
mMRC (0-4)	Combined	2.13 (0.50)	1.50 (0.52)	-0.63 (0.50)		**0.001#**
	Control	18.94 (5.85)	18.63 (5.96)	-0.31 (-0.48, -0.15)		0.447$

Data are presented as mean (SD); significance at $p<0.05$

Combined: Osteopathic manipulative treatment + Respiratory training; 5STST: Five-Repetition Sit-to-Stand test; mMRC: modified Research Council Scale; OMT: Osteopathic manipulative treatment; SD: Standard deviation

[a]Analyzed by one-way ANOVA with between-subject factor; [b]Analyzed by Bonferroni post-hoc tests; *Difference between OMT vs control; #Difference between combined vs control; $Difference between OMT vs combined

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