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Effect of Kinesotaping on Vital Capacity in Patient with Chronic Obstructive Pulmonary Disease

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Abstract

Background: Pulmonary Disease (COPD) cause ventilatory limitation and dyspnea, which then result in a reduction on ventilatory function. Kinesio Taping (KT) is a rehabilitative technique performed by the cutaneous application of a special elastic tape, thus increasing muscle activation and blood circulation

Aim of Study: To detect the effect of kinesotaping in patient with vital capacity in chronic obstructive pulmonary disease.

Material and Methods: In total, 40 COPD patients (20 in KT group, 20 in control group) were included. KT was applied to facilitate the diaphragm muscle and inhibit sternocleidomastoid muscle for KT group. Breathing exercises were applied to both groups. Kineso tape were changed every fifth day through 4 weeks. Ventilatory function test and Severity of dyspnea were assessed with Modified Medical Research Council dyspnea scale.

Results: There was a significant increase in FEV1, FVC and FEV1/FVC post treatment compared with that pre treatment in the study and control groups (p>0.001). The percent of increase in FEV1, FVC and FEV1/ FVC in the study group were 31.74, 14.31 and 15.57% respectively, while that in the control group were 14.48, 4.54 and 9.52% for FEV1, FVC and FEV1/ FVC respectively.

Conclusions: Kineso tape beneficial for improving vital capacity and dyspnea in patients with chronic obstructive pulmonary disease.

Key Words: *COPD – Kinesio Taping – Vital capacity – Breathing exercise – Respiratory muscle dysfunction.*

Introduction

CHRONIC Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development. Significant comorbidities may have an impact on morbidity and mortality [1].

Disturbed ventilation and gas exchange, dysfunctional peripheral and respiratory muscles, reduction in the capacity of oxygen consumption, and shortness of breath and decrease in exercise capacity developing as a result of the combined effects of the above changes are observed in COPD [2].

The purpose of medical treatment of COPD is to reduce the frequency and severity of the symptoms and to improve the functional capacity and the quality of life **[3]**.

Pulmonary rehabilitation (PR) is described in the update of ATS/ERS in 2013 as a comprehensive modality that aims to improve the physical and emotional status of COPD patients and involves individualized exercise training and behavioral modifications **[4]**.

Pulmonary function tests are valuable investigations in the management of patients with suspected or previously diagnosed respiratory disease. They aid diagnosis, help monitor response to treatment and can guide decisions regarding further treatment and intervention **[5]**.

Spirometry is simple is a measure of volume against time. It is a simple, easy to use, quick modality to measure lung volumes and capacities including, Forced expiratory volume in first second (FEV1), Forced vital capacity (FVC), The ratio of

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the two volumes (FEV1/FVC), FEV1/FVC <70% in COPD **[6]**.

Kinesiotherapy (KT) employs a cotton tape with a layer of hypoallergenic adhesive which can stretch upto 140% of its original length. It is known to have a mechanism of action exerted through a combination of its biomechanical, exteroceptive, circulatory, and analgesic effects **[7]**.

Kinesiologic taping is currently used in several musculoskeletal system problems as well as in the rehabilitation of the patients with central nervous system disorders such as hemiplegia, cerebral palsy, multiple sclerosis, and also in nerve entrapment and peripheral nerve injuries including the brachial plexus. It has also been employed in headache, constipation, torticollis, temporoman-dibular joint disorders, asthma, and for the purpose of increasing the respiratory capacity **[8]**.

The purpose of the study was be to detect the effect of kinesotaping with ventilatory function in patient with chronic obstructive pulmonary disease.

Material and Methods

Patients recruited from chest hospital at El-Mansoura from August 2019 till April 2020 and assessed for eligibility. Inclusion criteria COPD patients (men and women), Duration of disease will be more than 5 years, their age between 40 and 55 years old. Not participate in any kind of pulmonary rehabilitation program, they are under full medical control. Exclusion criteria were COPD exacerbation period, cardiovascular disease (coronary artery disease – peripheral vascular insufficiency), Uncontrolled hypertension, Metabolic disorder (diabetes mellitus), Peripheral and central nervous system diseases, Polyneuropathy, Scar, lesion or incision in the area of kinesio tape application, Skin sensitivity against kinesio tape.

Method:

Eligible patients were randomly allocated to Kinesio Taping Group (KTG), or Control Group (CG). CG received deep breathing exercises, each consisting of three sets of 10 repetitions, with 30 seconds of rest between each set.

KTG received deep breathing exercises plus thoracic KT application. The kineso tape wlastic adhesive tape, unit size 5m. (2.5 inch*16.4ft), made in korea sites were chosen according to techniques and principles described by saniye **[2]**.

Kinesio tape will applied to the diaphragm from the back and abdomen Muscle facilitation technique was applied to the diaphragmatic muscle from proximal to distal with 10-15% tension) the taping on the diaphragm from the abdomen will performed when the participant will standing and breathed-out and the body will in extension. The base of the tape will about 1 inch below the xiphoid process area. Then the arms will lifted above the head and, with maximum deep inspiration and after maximum rib cage expansion, the tails will applied with 10% tension on the rib cage. The standing patient with the arms fully extended and scapulae retracted so as to narrow the space around the 12th thoracic vertebra will asked to take a deep breath and slowly bend forward and adduct with the arms being crossed. While the patient is holding breath with maximum deep inspiration in this position, the tail of the tape was affixed to the subcostal area. Additionally sternocleidomastoid taping Measured a length of tape from the mastoid process to the sternum. Participants were performed kinesiology taping on supine position. The neck was rotated to the opposite side and laterally flexed toward the same side. 'I' strip was applied from insertion to origin; mastoid process to sternoclavicular joint on the affected side with 10-15% tension using muscle-relaxing technique.

Kinesio tape will changed on every fifth day. The patients will instruct not to take the tapes off at any time but they will allow taking showers.

Outcome measures:

The outcome measures were pulmonary function forced vital capacity (FVC) forced expiratory volume in one second (FEV1), percentage of FEV1/FVC, severity of dyspnea Severity of dyspnea was measured using Modified Medical Research Council (mMRC) scale, All outcomes were assessed both before and after the treatment (at the end of forth week).

Statistical analysis:

Descriptive statistics and Unpaired *t*-test were conducted for comparison of subject characteristics between both groups. Chi-squared was carried out for comparison of sex distribution between groups. Unpaired *t*-test was conducted to compare the mean values of FEV1, FVC and FEV1/FVC ratio between the study and control groups. Paired *t*-test was conducted for comparison between pre and post treatment in each group. mMRC scale were compared between groups by Mann-Whitney U test and between pre and post treatment in each group by Wilcoxon Signed Ranks. The level of significance for all statistical tests was set at $p<0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics:

Table (1) showed the subject characteristics of the study and control groups. There was no significant difference between both groups in the mean age and BMI (p>0.05). Also, there was no significant difference in sex distribution between groups (p>0.05).

Table (1): Comparison of subject characteristics between study and control groups.

	X ± SD		MD	*t*-value	*p*-value
	Study group	Control group			
Age (years)	51±3.35	51.5±3.03	–0.5	–0.49	0.62
BMI (kg/m^2)	24.42±1.84	24.06±1.63	0.36	0.65	0.51
Sex:					
Females	4 (20%)	5 (25%)		(X^2= 0.7	
Males	16 (80%)	15 (75%)		0.14)	

X : Mean. X^2: Chi squared value.
SD : Standard deviation. *p*-value: Probability value.
MD: Mean difference.

Effect of treatment on FEV1, FVC and FEV1/ FVC ratio:

- *Within group comparison:*

There was a significant increase in FEV1, FVC and FEV1/ FVC post treatment compared with that pre treatment in the study and control groups (p> 0.001). The percent of increase in FEV1, FVC and FEV1/FVC in the study group were 31.74, 14.31 and 15.57% respectively, while that in the control group were 14.48, 4.54 and 9.52% for FEV1, FVC and FEV1/FVC respectively. (Table 2, Fig. 1).

- *Between groups comparison:*

There was no significant difference in FEV1, FVC and FEV1/FVC between both groups pre-treatment (p>0.05). Comparison between both groups post treatment revealed a significant increase in FEV1, FVC and FEV1/FVC of the study group compared with that of the control group (p>0.05). (Table 2, Fig. 1).

Effect of treatment on mMRC scale:

There was a significant decrease in mMRC scale post treatment in the study and control groups compared with that pre treatment (p>0.001). (Table 3, Fig. 2).

- *Between groups comparison:*

There was no significant difference in mMRC scale between both groups pre-treatment (p>0.05). Comparison between the study and control groups post treatment revealed a significant decrease in mMRC scale of the study group compared with that of the control group (p=0.03). (Table 3, Fig. 2).

Table (2): Mean FEV1, FVC and FEV1/FVC ratio pre and post treatment of the study and control groups.

	Study group	Control group	MD	*t*-value	*p*-value
	X ± SD	X ± SD			
FEV1 (%):					
- Pre treatment	37.56±3.64	38.05±5.16	–0.49	–0.35	0.72
- Post treatment	49.48±4.06	43.56±5.31	5.92	3.95	0.001**
- MD	–11.92	–5.51			
- % of change	31.74	14.48			
- *t*-value	–17.05	–14.7			
	p=0.001**	*p*=0.001**			
FCV (%):					
- Pre treatment	68.97±4.13	69.83±3.01	–0.86	–0.75	0.45
- Post treatment	78.36±4.78	73±3.55	5.36	4.02	0.001**
- MD	–9.4	–3.17			
- % of change	14.31	4.54			
- *t*-value	–11.45	–12.07			
	p=0.001**	*p*=0.001**			
FEV1/FVC (%):					
- Pre treatment	54.65±6.33	54.4±6.09	0.25	0.12	0.9
- Post treatment	63.16±3.94	59.58±5.68	3.58	2.31	0.02**
- MD	–8.51	–5.18			
- % of change	15.57	9.52			
- *t*-value	–7.75	–9.86			
	p=0.001**	*p*=0.001**			

X : Mean. *p*-value: Probability value.
SD : Standard deviation. **: Significant.
MD: Mean difference.

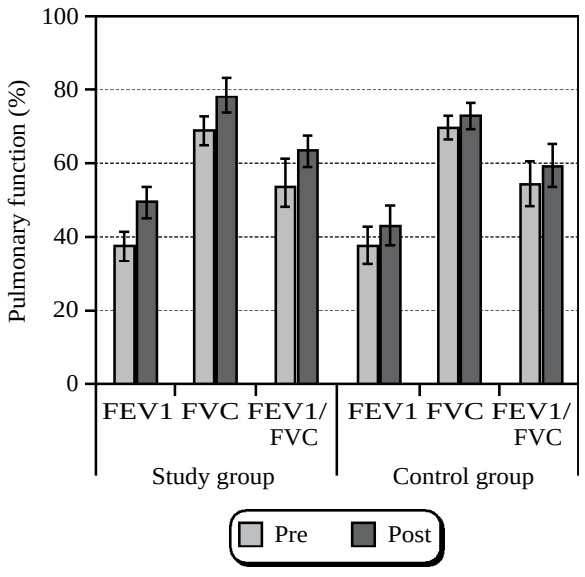

Fig. (1): Mean FEV1, FVC and FEV1/ FVC ratio pre and post treatment of the study and control groups.

Table (3): Median values of mMRC scale pre and post treatment of study and control groups.

	Study group	Control group	U-value	*p*-value
	Median	Median		
Pre treatment	3	3	158	0.2
Post treatment	2	2.5	100	0.004**
Z-value	–4.09	–3.74		
	p=0.001**	*p*=0.001**		

U-value: Mann-Whitney test value.
Z-value: Wilcoxon signed ranks test value.
p-value: Level of significance.
** Significant.

Discussion

The aim of the present study was to investigate the KT application on ventilatory function and severity of dyspnea in patients with COPD. The results of this study showed that four-week KT applied together with deep breathing exercises significantly improved ventilatory function and severity of dyspnea in patients with COPD.

Skeletal muscle dysfunction seen in patients with COPD directly affects functional exercise capacity **[3,9]**. Since respiratory muscles are also striated muscles structurally, they become fatigued after overwork. The ongoing fatigue leads to inhibitor signal generation and a reduction in motor commands, which then results in respiratory insufficiency in patients with COPD **[10]**. Dynamic hyperinflation is also a major contributor to functional exercise limitation in COPD **[6]**. Increased lung volume reduces the length of inspiratory muscles and causes functional muscle weakness. Especially, the action of the diaphragm on the rib cage is affected negatively **[11]**.

The kinesio tape is claimed to have positive effects on muscle activation, joint repositioning, circulation of blood and lymph, and pain **[12]**. Restoration of correct muscle function by supporting weakened muscles, correction of misalignment by reducing muscle spasm, removal of lymphatic fluid or haemorrhage under the skin through enhanced local circulation, reduction of pain through stimulation of sensory afferents are the proposed mechanisms of action postulated by the manufacturer and some researchers **[13,14]**. Thoracic KT was designed to assist expiratory ventilation. The kinesio tape is pulled peripherally across the natural movement of thorax during inspiration, and while exhaling, elasticity of the tape would aid expiration by countermovement. Depending on these proposed effects, we applied KT to patients with COPD and detected an increase in FEV1% values.

Effects of KT on pulmonary function and ventilator efficiency have been little investigated. Only one study conducted in patients with COPD exacerbation did investigate the effects of one-session KT application on pulmonary function and concluded that measures of FEV 1 and PEF were not significantly improved after use of KT. The authors believed that only one session of KT was not enough to create significant changes in pulmonary function of these subjects **[15]**. Our results indicated that this belief could be true, thus we found a significant increase in measures of FEV1% after four-week of KT application in patients with COPD. Results of Malehorn et al.'s study also supported our findings. They found that KT applied on the chest of healthy individuals could augment ventilatory efficiency without the participants being aware of it **[16]**.

The study conducted by Lee et al., found that KT added to inspiratory muscle training through four weeks was effective for improving MIP. However, no significant change was observed in pulmonary function (PEF, FVC, FEV1, FEV1/FVC) **[17]**. On the contrary, we found significant increase in FEV1, FEV1/FVC after use of KT. Given these results, it may be concluded that KT might be more effective when combined with pulmonary rehabilitation modalities. Whereas, it may improve MIP when combined with inspiratory muscle training, **[2-11]** and pulmonary function when combined with deep breathing exercises. However, to clearly elucidate these effects, more research is needed on this issue.

In conclusion, this study has showed kineso tape play an important role in improving vital capacity and respiratory function (FEV1, FVC, FEV1/FVC) in patient with chronic obstructive pulmonary disease.

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تأثير شريط الكاينزو على السعة الحيوية في مرضى السدة الرئوية

مرض الانسداد الرئوى المزمن يسبب خلل الجهاز التنفسى والعضلات المحيطية به ويؤدى إلى الحد من التهوية وضيق التنفس. شريط الكينزيو هو تقنية تأهيلية يتم تنفيذها من خلال التطبيق الجلدى لشريط مرن خاص، وبالتالى زيادة تنشيط العضلات والدورة الدموية ولذلك فأن هدف الرسالة هو الكشف عن تأثير شريط الكينزيو على وظائف التهوية في المرضى الذين يعانون من مرض الانسداد الرئوى المزمن وتم إجراء البحث على ٤٠ مريض من الذى يعانون من الانسداد الرئوى المزمن تتراوح أعمارهم بين (٤٤-٥٥) عاماً. (٢٠ فى مجموعة التجريبية، ٢٠ فى مجموعة الضابطة). تم تطبيق شريط الكينزيو لزيادة عمل عضلة الحجاب الحاجز وتقليل عمل عضلة القصية الترقوية الخشائية للمجموعة التجريبية. تم تطبيق تمارين التنفس على كلا المجموعتين وتغيير شريط الكينزيو كل خمسة أيام خلال ٤ أسابيع. تم تقييم اختبار وظيفة التهوية وشدة ضيق التنفس مع مقياس ضيق التنفس عن طريق البحوث الطبية المعدل قبل وبعد العلاج بأربعة أسابيع. وقد أظهرت النتائج فروق ذات دلالة إحصائية لحجم الزفير القسرى، القدرة الحيوية القسرية ونسبة بين حجم الزفير القسرى القدرة الحيوية القسرية ومقياس صعوبة التنفس بعد العلاج فى كلا المجموعتين مع وجود فروق ذات دلالة إحصائية للزيادة كبيرة فى المجموعة التجريبية عن المجموعة التجريبية عن المجموعة الضابطة. ولذلك شريط الكينزيو مفيد لتحسين التهوية وضيق التنفس لدى المرضى الذين يعانون من مرض الانسداد الرئوى المزمن.