Role of Chest Ultrasonography in Assessment of Diaphragmatic Mobility in COPD Patients on Pulmonary Rehabilitation Program

Thesis

Submitted for Partial Fulfillment of the MD Degree in Chest Diseases

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بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

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List of Abbreviations

Abb.	Full term
%	Percentage
>	More than
2D	Two dimentional
^{31}P- MRS	Phosphorous magnetic resonance spectroscopy
6MWD	Six minute walking distance
6MWT	Six minute walk test
ACLS	Advanced Cardiac Life Support
ACSM	American College of Sports Medicine
ALT	Alanine aminotransferase
ANOVA	Analysis of variance
AST	Aspartate aminotransferase
ATP	Adenosine triphosphate
ATS	American Thoracic Society
BCLS	Basic Cardiac Life Support
BD	bronchodilator
BUN	Blood urea nitrogen
CAT	COPD assessment test
CBC	Complete blood count
CCQ	Clinical COPD questionnaire
CD	Cluster of differentiation
COPD	Chronic obstructive pulmonary disease
CRQ	Chronic respiratory questionnaire
CSF	Colony stimulating factor
DE	Diaphragmatic excursion
DLCO	Diffusion lung capacity for carbon monoxide
ECG	Electrocardiogram
ERS	European Respiratory Society
FEV1	Forced expiratory volume in 1^{st} second
Fig	Figure
FRC	Functional residual capacity
FVC	Forced vital capacity
GOLD	Global initiative for chronic obstructive pulmonary disease

List of Abbreviations cont…

Abb.	Full term
h	hour
H^+	Hydrogen ion
HIV	Human immunodeficiency virus
HRQoL	Health care related quality of life
HS	Highly statistically significant
ICU	Intensive care unit
IGF	Insulin like growth factor
IL8	Interleukin 8
IMP	Inosine monophosphate
K^+	Potassium ion
Kg	Kilogram
L	Liter
LTB4	Leukotriene B
m	Meter
mg	Milligram
MHZ	Mega Hertz
mm	Millimeter
mMRC	Modified medical research council
N	Number
NHANES	National Health And Nutrition Examination Survey
NO	nitric oxide
NS	Non statistically significant
O_2	Oxygen
PC	Personal computer
PCO2	Partial pressure of carbon dioxide
Pe MAX	Maximal expiratory pressure
PFT	Pulmonary function tests
Pi MAX	Maximal inspiratory pressure
PR	Pulmonary rehabilitation
R	correlation
ROI	Reactive oxygen intermediates
RV	Residual volume

List of Abbreviations cont…

Abb.	Full term
S	Statistically significant
SD	Standard deviation
SGRQ	Saint George RespiratoryQuestionnaire
SID	Strong ion difference
Sig	Significance
SPSS	Statistical package for social science
Tdi	Diaphragmatic thickness
TF	Thickening factor
T_i	Inspiratory time
TLC	Total lung capacity
US	Ultrasound
V_E	Minute ventilation
V_T	Tidal volume
YLD	Years of living with disability

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by chronic inflammation of the lung tissues accompanied by irreversible airflow limitation, and has emerged as a leading cause of chronic morbidity and disability worldwide ***(Rabe et al., 2007).*** Patients with COPD often experience dyspnea, decreased exercise capacity, and impairment of health-related quality of life (HRQoL) ***(Chaouat et al., 2011).*** The occurrence of exercise intolerance is frequently cited as the major determinant of impaired quality of life by COPD patients, and improvement in exercise capacity is a key goal of COPD disease management ***(Moullec et al., 2011).***

Pulmonary rehabilitation (PR) is considered one of the most important non pharmacological treatments for COPD and addresses both the chronic and progressive features of this disease. Combined PR interventions include behavior modification (smoking cessation and physical exercise), careful review and modification in medications and regimens, and psychological support (patient education, psychological and social support), and are carried out with the overall goal of achieving and maintaining the individual's maximum level of independence and ability to function in society ***(Puhan et al., 2011).***

Currently, most pulmonary rehabilitation programs are multidisciplinary and are carried out in hospital settings or physical therapy facilities ***(Ries, 2005).*** Despite the recognized benefits of such programs to COPD patients, they are largely underutilized, with participation rates as low as 1–2% being reported ***(Brooks et al., 2007; Oh, 2003; Yohannes and Connolly, 2004).*** Several factors have been proposed to explain this phenomenon, such as the inconvenience and cost of traveling to specialized rehabilitation centers, which directly affects patient compliance ***(Fernandez et al., 2009).*** In addition, the rehabilitation centers represent high set-up and running costs to the host facility, which may not recuperate the cost ***(Griffiths et al., 2001).*** Another challenge facing the on-site rehabilitation programs is demonstrated failure of patients to maintain the intervention regimen, and its benefits, after the rehabilitation program has been completed ***(Hernandez et al., 2000).***

Home-based pulmonary rehabilitation is a promising alternative to the outpatient or hospital-based rehabilitation programs ***(Maltais et al., 2008)***. This type of program is preferred by patients as they can spend less time away from work or their families, do not have the added cost or hassle of travel, and can apply the practices in a setting that incorporates the normal routine of their daily life. If such a program were shown to effectively reduce disability in patients with COPD, the benefit of pulmonary rehabilitation could be made accessible to more of the patients, especially to those with severe COPD who are housebound or who cannot afford or reject hospitalization. Moreover, the cost of delivering a self-monitored, home-based pulmonary rehabilitation program is estimated to be much less than that of hospital-based programs ***(Busch and McClements, 1988).*** Although many studies, to date, have investigated the efficacy of pulmonary rehabilitation, the majority have been carried out with patients receiving treatment in a hospital setting or other treatment facilities. In addition, the studies on pulmonary rehabilitation programs administered in the home setting have utilized small sample sizes ***(Fernandez et al., 2009; Hernandez et al., 2000; Oh, 2003).*** Thus, the efficacy of in-home pulmonary rehabilitation programs for COPD patients remains unclear ***(Puhan et al., 2011).***

Since diaphragmatic motion plays a prominent role in spontaneous respiration, observation of the diaphragm kinetics seems essential. The use of tools previously available for this purpose is limited due to the associated risks of ionizing radiation (fluoroscopy, computed tomography) or due to their complex and/or highly specialized nature, requiring a skilled operator (trans-diaphragmatic pressure measurement, diaphragmatic electromyography, phrenic nerve stimulation, magnetic resonance imaging) ***(Ayoub et al., 2002).***

Sonographic evaluation of the diaphragm has recently started to gain popularity in the ICU as specific needs for assessing diaphragmatic function arise in many clinical situations. Abnormal diaphragmatic motion is observed in conditions such as phrenic nerve injury, neuromuscular diseases, after abdominal or cardiac surgery and in critically ill patients under mechanical ventilation ***(Grosu et al., 2012).***

AIM OF THE WORK

The aim of this study is to evaluate chest ultrasound as a simple, non-invasive test in assessment of diaphragmatic mobility and thickness in COPD patients undergoing pulmonary rehabilitation program and its correlation with maximal inspiratory pressure (Pi MAX), maximal expiratory pressure (Pe MAX), six- minute walk test (6MWT) and symptoms evaluation by clinical COPD questionnaire (CCQ) and modified medical research council (mMRC) dyspnea scale.