

Role of Trans Thoracic Ultrasound in Evaluation of patients with obstructive pulmonary disease

Thesis

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Contents:

Acknowledgment.....	i
Abstract.....	ii
Lists of abbreviations.....	iii
Lists of Tables.....	Vi
Lists of Figures.....	Vii
Introduction.....	1
The aim of work.....	3
Review of literature.....	
• Ch 1 chronic obstructive pulmonary disease.....	4
• Ch2 trans thoracic ultrasound.....	38
• Ch3 trans thoracic ultra sound in COPD.....	57
Subjects and methods.....	64
Results.....	70
Discussion.....	81
Summary and conclusion.....	101
Recommendation.....	103
References.....	104
Arabic summary.....	\

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Abstract

Back ground: Spirometry is regarded as the gold standard for the diagnosis of COPD, yet the condition is widely under diagnosed. Therefore, additional screening methods that are easy to perform and to interpret are needed. Trans thoracic ultrasound is now widely used in all chest fields, COPD is one of these fields in which Trans thoracic ultrasound showed a magnificent improvement and usefulness in diagnosis and severity evaluation it's fast, feasible and easy to perform.

Methods: 60 patients were included in the study; they were divided into two groups. The first group included 40 patients which were diagnosed as COPD patients using post bronchodilator spirometry; the second group included 20 normal individuals. All patients were subjected for the following: Complete history taking and clinical examination, spirometry, Trans-thoracic ultrasound Using B mode to evaluate A lines and pleural lines and M mode to assess diaphragmatic excursion, Oxygen saturation assessment by pulse oximetry and Classification according to Gold staging and NYHA classification.

Results: The result of the study revealed that there is significant diaphragmatic affection in COPD patients compared to healthy individuals which is correlated strongly with degree of airways obstruction, Gold staging and NYHA classification.

Conclusion: Trans thoracic ultrasound is a feasible method to evaluate COPD patients not only that, it also help in assessing disease progression.

Key words: COPD, Trans thoracic ultrasound, diaphragmatic excursion.

List of abbreviations

ABG: arterial blood gas

AMP: adenosine mono-phosphate

ARDS: acute respiratory distress syndrome

BALF: broncho alveolar fluid

BLUE: Bed side lung ultrasound in emergency

BODE: body weight. Obstruction, dyspnea and exercise

BMI: body mass index

CAMP: cyclic adenosine mono phosphate

CAT: COPD assessment test

CD4: cluster of differentiation 4

CD8: cluster of differentiation 8

CNB: cutting needle biopsy

COPD: chronic obstructive pulmonary disease

CT: computed tomography

DLCO: diffusing capacity for carbon monoxide

DLT: double lung transplantation

DB: deep breathing

ED: emergency department

EDEMax: maximal expiratory diaphragmatic excursion

ELVR: elective lung volume reduction

EGFR: epidermal growth factor receptor

FEDE1: forced diaphragmatic excursion at the first second

FEV1: forced expiratory volume at the first second

FEV1\FVC: forced expiratory volume at first second\ forced vital capacity

FNA: fine needle aspiration

FRC: functional residual capacity

Gold: Global Initiative for Chronic Obstructive Lung Disease

GAD: generalized anxiety disorders
H₂O₂: hydrogen peroxide
HOC1: hypochlorous acid
HBV: hepatitis B virus
HCV: hepatitis c virus
HDAC2: histone deacetylase 2
HI: heterogeneity index
HIV: human immuno deficiency virus
IL-1 β : interlukin 1 beta
IL-8: interleukin 8
LABA: long acting beta 2 agonist
Ldi: diaphragmatic length
LUS: lung ultrasound
M1: Muscrinic receptor
MIO: M mode index of obstruction
MIP: maximum inspiratory pressure
mMRC: modified medical research council
MUCs: mucus protein
MUC5B: mucin 5B
MUC5AC: mucin 5AC
MUC2: mucin 2
MHZ: Mega hertz
NADPH: Nicotinamide adenine dinucleotide phosphate
NRF2: nuclear factor E2-relatedfactor 2
NF – κ B: nuclear factor kappa-light-chain-enhancer of activated B cells
NIV: non-invasive ventilation
NPV: negative predictive value
PA: pulmonary artery
Pao₂: partial pressure of oxygen

Paco₂: partial pressure of carbon dioxide

PI: protease inhibitor

PPV: positive predictive value

Rho kinase :Rho associated protein kinase

QB: quiet breathing

RV: residual volume

SABA: short acting beta 2 agonist

SBT: spontaneous breathing trial

SLT: single lung transplantation

Tdi: diaphragmatic thickness

TF: diaphragmatic thickening fraction

TGF- β : transforming growth factor β

TC1 lymphocytes: T cytotoxic lymphocytes

TLC: total lung capacity

T min: diaphragmatic thickness at the end of expiration

T max: diaphragmatic thickness at the end of maximum inspiration

TTFNA: trans thoracic fine needle aspiration

US: ultrasound

V\Q: ventilation \ perfusion

VS: voluntary sniffing

VENT: Valve for Emphysema Palliation Trial

α 1-AT: Alpha one anti-trypsin deficiency

4-HNE: 4-hydroxy-2nonenal

8-OHdG: 8-hydroxy-2'-deoxyguanosine

Δ Tdi : diaphragmatic thickening fraction

List of Tables

NO.	Title	Page
1	showing dyspnea classification according to modified British medical research council	19
2	classification of COPD based on post-bronchodilator FEV1	20
3	treatment options in stable COPD	25
4	NYHA classification of dyspnea	68
5	Classification of COPD patients according to the severity using FEV1.	70
6	demographic data of the COPD patients and control individuals	71
7	classification of COPD according to Gold staging	72
8	the classification of patients' dyspnea according to NYHA, previous admission and frequency of exacerbations	72
9	co-morbidities associated with COPD	73
10	ultra sound findings (pleura line, A lines and diaphragmatic excursion) between COPD and control	74
11	correlation between Gold staging and: pleura line-A-lines-diaphragmatic excursion-NYHA dyspnea classification	75
12	correlation between NYHA scoring and: A-lines-diaphragmatic excursion-Gold staging-pleura line	76
13	correlation between oxygen saturation and: A lines-diaphragmatic excursion-Gold staging-NYHA classifications-pleura line	77
14	correlation between FEV1classification of COPD and diaphragmatic excursion	78

List of Figures

NO.	Title	Page
1	inflammatory and immune cells in COPD	12
2	Combined COPD assessment	21
3	ultra –sound device	38
4	showing ultrasound prob	39
5	showing normal appearance of lung	42
6	Ultrasound appearance of pleural effusion	43
7	Ultrasound appearance of septated effusion	44
8	Ultrasound appearance of plankton sign	44
9	Ultrasound appearance of lung sliding	47
10	Ultrasound showing difference between normal lung and pneumothorax	49
11	showing A lines appearance by ultrasound	49
12	Showing B lines appearance by ultrasound	50
13	Lung Consolidation by ultrasound	52
14	ultrasound thoracocentesis	54
15	pleural biopsy by ultrasound	55
16	comet tail artifact	63
17	ZAN 100 spirometry	65
18	Transthoracic ultrasound	66
19	Pulse oximetry	68
20	shows ROC curve diaphragmatic excursion and FEV1	79
21	shows ROC curve diaphragmatic excursion and Gold staging	80

Introduction

COPD is a common preventable and treatable disease characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and co-morbidities contribute to the overall severity in individual patients (***GOLD; 2015***).

Early diagnosis and intervention is necessary to prevent a further decline of lung function in these patients. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommends spirometry as the gold standard for the diagnosis of COPD, since it is the most reproducible, standardized and objective way of measuring airflow limitation (***Gold ; 2009***).

However, to perform spirometry, experienced and regularly trained medical assistants are needed as well as physicians for interpreting the results. Possibly due to these problems, spirometry is not frequently used by general practitioners and under diagnosis of COPD is widespread (***Hill et al; 2010***).

In the last 15 years, a new imaging application of sonography has emerged in the clinical arena: lung ultrasound (LUS). From its traditional assessment of pleural effusions and masses, LUS has moved towards the revolutionary approach of imaging the pulmonary parenchyma, mainly as a point-of-care technique. Although limited by the presence of air, LUS has proved to be useful in the evaluation of many different acute and chronic conditions, from cardiogenic pulmonary edema to acute lung injury, from pneumothorax to pneumonia, from interstitial lung disease to pulmonary infarctions and contusions (***Longo et al;2008***), It is quick to perform, portable, repeatable, non-ionizing, independent

from specific acoustic windows, and therefore suitable for a meaningful evaluation in many different settings, both inpatient and outpatient, in both acute and chronic conditions (*Volpicelli et al;2013*).

Therefore, an additional screening method that is easier to perform and to interpret is needed; Conventional ultrasound with frequencies ranging from 2 to 10 MHz is increasingly used for the diagnosis of pulmonary diseases including pneumothorax, pleural effusion, alveolar-interstitial syndrome and lung consolidation. However, its application is restricted to superficial examination and to abnormally dense lungs (*Colmenero et al; 2010*).

Ultrasound can measure the diaphragmatic dysfunction. There are various sonographic methods: for example, measurement of the increasing thickening of the diaphragm in the lung apposition zone during contraction; the downward movement of the left portal vein during inspiration; and the direct visualization of the diaphragm from anterior with the liver or the spleen used as ultrasound windows. The main disadvantages of all these sonographical methods are that they need the patient's cooperation and that they have not really been evaluated. Which method of the sonographical ones might be the best has not yet been defined (*Boussuges et al; 2009*).

Aim of work

- To verify the usefulness of Trans thoracic ultrasound in evaluating obstructive lung diseases severity.
- To correlate the ultrasound findings with the spirometry findings in patients with obstructive lung diseases.

Chronic Obstructive Pulmonary Disease

Definition:

A common preventable and treatable disease characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and co-morbidities contribute to the overall severity in individual patients (*GOLD, 2015*).

Epidemiology of COPD:

COPD is a major health problem worldwide (*Buist et al; 2007*) its prevalence is being recognized increasingly in countries at all levels of development (*Kurmi et al; 2012*) an ever-increasing number of smokers and an expanding number of elderly people are major factors in the surge in the worldwide prevalence of COPD. Studies from the last two decades indicate that 4–6% of the adult European population suffered from clinically relevant COPD. The prevalence largely increases with age and recent surveys show signs of diminishing differences between the two genders in this still predominantly male-related disease (*Huddersfield et al; 2003*). In large areas of the world where indoor air pollution is generated by burning biomass for heating and cooking, COPD is prevalent among nonsmokers, especially women (*Salvi et al; 2009*). Moreover, COPD is not restricted to smokers in developed countries. Of 4291 never-smokers over age 40, involving 14 developed countries, 5.6% met criteria for moderate to severe COPD, of whom 81.2% were undiagnosed (*Lamprecht et al; 2011*). The 2010 National Health Interview Survey of approximately 27,000 adults in US households, yielded an estimate of 5 million adults in the United States with emphysema and 10 million with chronic bronchitis, not all of whom may have airflow

obstruction (*Schiller et al; 2012*). The number of deaths due to COPD in the United States has been rising. In 2008, COPD was the primary cause of death in 141,090 Americans and was co morbidity in many other deaths (*Minino et al; 2011*).

Burden of COPD:

Chronic obstructive pulmonary disease (COPD) is the third most common cause of death in the USA, in 2010, the cost of COPD in the USA was projected to be approximately US\$50 billion, which includes \$20 billion in indirect costs and \$30 billion in direct health care expenditures. These costs can be expected to continue to rise with this progressive disease. Costs increase with increasing severity of disease, and hospital stays account for the majority of these costs (*Anthony et al; 2013*). As COPD is a progressive disabling disease with little reversibility; it is not surprising that this disease is accompanied by a considerable psychological burden, it was found that anxiety disorders occur more frequently in patients with COPD compared to the general population. The prevalence of generalized anxiety disorders (GAD) in patients with COPD appears to vary between 10 and 16 per cent, while prevalence of GAD in the normal population usually does not exceed 5 per cent. The occurrence of anxiety symptoms without a specific diagnosis is even higher (between 13 and 51 per cent). Panic attacks also occur often in patients with COPD. Prevalence rates of panic attacks appear to vary between 8 and 37 percent (*Brenes et al; 2003*). Nearly half of the patients with COPD stated to have problems with fatigue every day, compared to 13 percent of the age- and sex-matched control group. Furthermore, the fatigue lasted for more than 6 hours per day in 53 per cent of the patients with COPD, compared to 19 per cent of the healthy controls (*Theander et al; 2004*).

COPD is a systemic disease, which means that its effects can be found beyond pulmonary malfunctioning. Most frequent effects are abnormal systemic inflammation, nutritional abnormalities (changes in metabolism), weight loss and skeletal muscle dysfunction (*Agustí et al., 2003*). Osteoporosis is also frequently found in patients with COPD. As it increases the chance of fractures, it is a secondary cause of disability and mortality in COPD patients (*Ionescu et al; 2003*).

Risk factors:

1-Cigarette and Shisha smoking:

Among people with the same smoking history, not all will develop COPD due to difference in genetic predisposition to the disease (*Behrendt et al; 2005*).

shisha smokers often inhale more smoke than cigarette smokers because of the length of time a shisha session lasts. One session can last up to an hour during which shisha smokers will inhale a large amount of tobacco smoke as well as the second-hand smoke of others. A report from The World Health Organization (WHO) noted that the smoke inhaled in a typical one-hour hookah session can equal 100 cigarettes or more. The WHO report also claims that even after it has been passed through water, shisha tobacco smoke still contains high levels of cancer-causing chemicals. Shisha smoke may also contain combusted charcoal or wood which can increase the chemicals in the smoke that cause cancer and heart disease, Shisha contains up to 36 times more carcinogenic tar than cigarette smoke, up to 15 times more carbon monoxide, higher levels of lead, nickel and arsenic, hydrogen cyanide and a whole bunch of potent carcinogens, nicotine, a chemical that causes an addictive effect (*Dorausch et al; 2015*).