Journal of Recent Advances in Medicine

JRAM
Journal of Recent Advances in Medicine
مجلة التطورات الحديثة في الطب
Print ISSN 2636-252X - Online ISSN 2636-2538

Original Article

Lung silhouette method in assessment of chronic obstructive pulmonary disease by transthoracic ultrasound

Pulmonology

Rana S. Abdelrahman[1], Magd M. Galal[1], Heba H. Eltrawy[1], Heba M. Galal[2]

[1]Chest Diseases Department, Faculty of Medicine for Girls, Cairo, Al-Azhar University, Egypt.

[2] Radiology Department, Faculty of Medicine for Girls, Cairo, Al-Azhar University, Egypt.

ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a disease characterized by progressive airflow limitation with subsequent impairment of respiratory mechanics. The assessment of diaphragmatic function is crucial for understanding the disease impact on respiratory health.

Objective: to evaluate the relationship between COPD severity and diaphragmatic function measured by ultrasound using lung silhouette (LS) method in stable COPD patients.

Methods: A case-control study was conducted on fifty stable COPD patients and fifty healthy controls. All of them subjected to medical history, pulmonary function tests, and diaphragmatic assessment using the lung silhouette method (the vertical displacement of the LS was evaluated during maximal inhalation and exhalation).

Results: The COPD patients exhibited significantly reduced right and left LS (mm) [42.85 (30.6-44.7)] and [43.8 (31.7-46.2)] respectively, compared to of right and left LS (mm) of control group [67.35 (64.2-69.6)] and [68 (6 5.4-71.3)] respectively. Moreover, the RLS (mm) and LLS (mm) were decreased significantly in patients with GOLD E compared to those with either GOLD A or B, and in patients with GOLD B compared to those with GOLD A ($p<0.05$). A significant positive correlation was established between right and left lung silhouette and FEV_1%. Additionally, both right and left LS were positively correlated with motion mode left and right diaphragmatic excursion.

Conclusion: The LS method could be a reliable technique for assessing diaphragmatic function in patients with COPD. It is important to emphasize that the anterior axillary approach and LS method offer alternative approaches to evaluate COPD progression. Its integration into clinical practice can enhance the understanding of respiratory mechanics.

JRAM 2025; 6 (1): 54-61

Keywords: COPD; diaphragmatic functions; thoracic ultrasound; lung silhouette method; respiratory mechanics.

Submission Date: 7 December 2024 **Acceptance Date:** 1 January 2025

Corresponding author: Rana Safwat S. Abdelrahman, Chest diseases, faculty of medicine for girls, Cairo, Al-Azhar University, Egypt. Tel: 01015626414. E-mail: rana.safwat55@gmail.com

Cite: Abdelrahman RS, Galal MM, Eltrawy HH, Galal HM. Lung silhouette method in assessment of chronic obstructive pulmonary disease by transthoracic ultrasound. JRAM 2025; 6 (1): 54-61. DOI: 10.21608/jram.2025.341879.1269

INTRODUCTION

Chronic Obstructive pulmonary disease (COPD) is a progressively worsening airflow limitation. This heterogeneous disease imposes a substantial global burden, contributing to significant morbidity, mortality, and socioeconomic challenges [1][2]. Previous research has established that FEV_1% alone is insufficient for accurately determining COPD severity. In response, the 2023 Chronic Obstructive Lung Disease Global Initiative (GOLD) guidelines announced a novel approach emphasizing inflammation and phenotypes to classify disease progress, guide management, and predict COPD prognosis [3].

Diaphragmatic dysfunction in COPD patients results from multiple factors, including airway obstruction, muscle weakness induced by systemic inflammation, and mechanical limitations imposed by lung hyperinflation [4]. Currently, a lack of appropriate functional tests hinders the diagnosis of diaphragmatic dysfunction, leading to under recognition. Nevertheless, assessing diaphragmatic function is crucial for both hospitalized and outpatient populations, particularly in critical care settings [5]. Numerous techniques exist for assessing diaphragmatic function, with transdiaphragmatic pressure measurement considered the gold standard diagnostic method [6].

The application of ultrasound (US) for both structural and functional diaphragm evaluation has expanded for monitoring disease grade and consequences in patients with obstructive lung diseases by examining the diaphragm [7]. The Lung Silhouette (LS) method is an US measurement of vertical displacement of the lung along the scapular line while the patient exhale

completely to residual volume then inhale deeply to total lung capacity [8]. This work is aimed to evaluate relationship between COPD severity and diaphragmatic function measured by US using LS method in stable COPD patients.

SUBJECTS AND METHODS

A total of 50 stable COPD patients diagnosed according to GOLD (2022) [9] and a 50 age and sex matched healthy volunteers with normal spirometry enrolled into this case-control study. The study was conducted at department of chest diseases, Al-Zahraa University hospital, Cairo, Egypt during the period from August 2022 to February 2023.

This study was carried out after agreement of institutional review board of our institution (IRB 2019010171). The study aims and tools were clarified to the patients. Contribution was unpaid and a well-read written agreement was gained from each subject prior to enrolment into our study. Each patient can refuse to participate or withdraw from the study without disturbing their medical rights. Additionally, all participant's details were nameless and coded to guarantee privacy of participants.

Patients with chest diseases other than COPD, COPD exacerbations within the previous 3 months, recent surgical operations, patients with muscular, neural conditions, cancers, cerebral and vascular diseases were excluded from the study.

Full history taking including, age, sex, smoking index (pack/year) were reported. The COPD patients were classified according to recent GOLD 2023 guidelines into gold A, B and E [3]. Therefore, patients were subjected to: 1) Spirometry to determine the severity of airflow limitation (spirometric grade) using MEDISOFT- HYPERAIR compact + flow meter pulmonary function testing – Belgium). The following measurements were recorded: FEV_1\FVC ratio, FVC%, VC%, FEV_1%, and FEF25-75%, 2) Assessment of dyspnea using modified medical research council (mMRC) scale [10] or symptoms using COPD - assessment test (CAT) [11], 3) history of moderate or severe exacerbation (including prior hospitalization) were recorded.

For assessment of LS and diaphragm excursion by motion mode (MDE) the US machine Toshiba Xario 100 (Japan) with its curvilinear transducer (3.5-5 Mega-hertz) was used.

1. **Ultrasound measurement of LS:** the patients were examined in the seated position. The US curvilinear was held in longitudinal view at the lowermost part in scapular line (LS) bilaterally. The subject was instructed to exhale completely to the residual volume then take a deep breath to total lung capacity. Three US images was captured, and distance from uppermost to lowermost points of the LS was measured in millimeter (mm) and the average value of the three measurements were recorded [8] (figure 1).

Figure (1): Ultrasound assessment of lung silhouette in patient with COPD

A. **The patient was in the seated position and the curvilinear US probe was held in a longitudinal view at the right subscapular line.**

B. **Sonographic measurement of the upward and downward movements of the lung silhouette. E marks the lowest point of lung silhouette at maximal end expiration and I mark the lowest point of lung silhouette at maximal end inspiration. The distance between I and E (Red line) represents the RLS (= 25.7 mm). E: Expiration, I: inspiration, RLS: Right lung silhouette.**

2. **Ultrasound measurement of diaphragm excursion by motion mode (MDE):** both right and left hemidiaphragms excursion was assessed during deep breathing using motion mode US. The patient was examined in the semirecumbent position. The curvilinear US probe was held in longitudinal view, between anterior-axillary and mid-clavicular lines at subcostal view, and directed medially, dorsally and cephalic thus US rays were vertical to the posterior part of the examined hemidiaphragm

getting better scan of its dome. The subjects were instructed to take deep breath as they could. The diaphragmatic inspiratory motion amplitudes were recorded in centimeter (cm). The first point was located at bottom of inspiratory slope and second one at top of this slope [12] (figure 2).

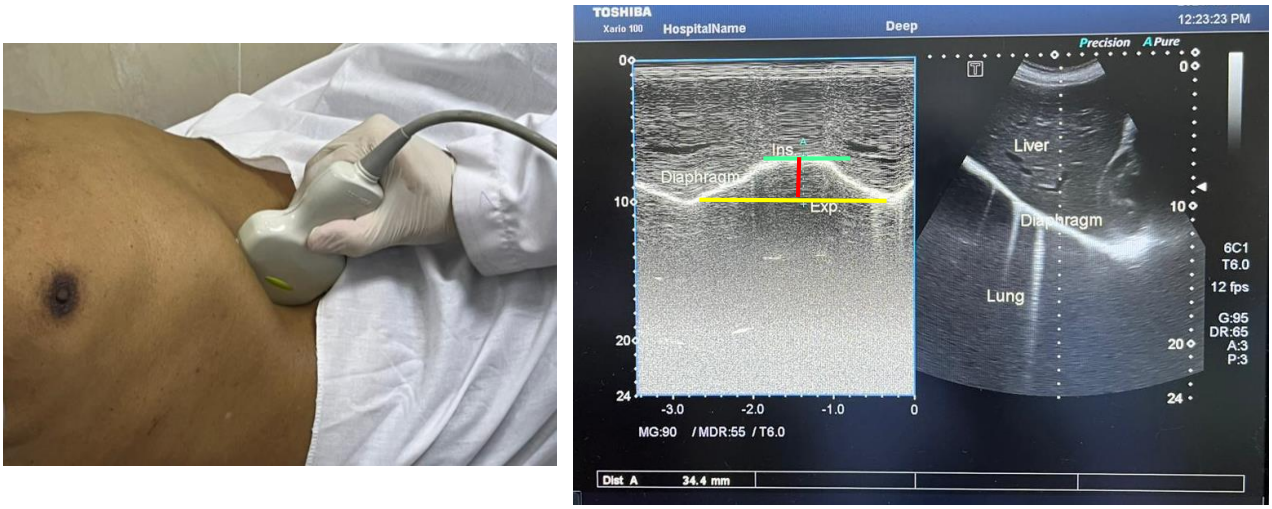

Figure (2): Ultrasound measurement of diaphragm excursion by motion mode in patient with COPD

A. The patient was in the semirecumbent position and the curvilinear US probe was held in longitudinal view, between anterior-axillary and mid-clavicular lines at subcostal view, and directed medially, dorsally and cephalic.

B. Ultrasonographic measurement of M - mode diaphragm excursion: The first point was located at top of inspiration slope on the diaphragm echoic track (green line) and second one at bottom of this slope (yellow line). The distance between these two point represent the diaphragm excursion (red line) (= 3.44 cm). Exp: Expiration, Ins: Inspiration.

Statistical analysis

Analysis of study variables was done using by statistical platform SPSS Inc., Chicago, USA) version 23.0. Distribution of numerical variables were done by Kolmogorov-Smirnov and Shapiro-Wilk test, and then offered as median and interquartile range (IQR). The non-numerical variables were expressed as number and frequency. Then proper statistical analyses were applied as; Mann Whitney (MW) U test and Kruskal Wallis test (KW) test were used for comparison of non-parametric variables between COPD group and control group, and between GOLD grades A, B, and E, respectively. The least significant difference (LSD) was used for post hoc analysis. Chi-square (X^2) test was used for comparison of non-numerical data between the studied groups. For detection of association between LS and other studied variables the Pearson correlation coefficient test (r) was used. The Discriminative performance of US LS and US MDE of COPD severity was done using ROC curve. The confidence interval was established at 95% and the margin of error was established at 5% and p-value< 0.05 was considered statistically significant.

RESULTS

Current study revealed male predominance in both groups. There was statistically significant higher smoking index in COPD group in comparison to control group (p = 0.004). There was statistically significant decrease of FEV_1/FVC, FEV_1%, VC%, FVC%, and FEF25-75% % in COPD group than control group (p < 0.05). Regarding GOLD classification; 10 patients have GOLD A (20%), 26 patients have GOLD B (52%) and 14 patients have GOLD E (28%) (table 1). The RLS, LLS and anterior right MDE, and anterior left MDE were statistically significantly decreased in COPD group than control group (p= 0.001 each) (table 2).

Table (3) showed that the RLS (mm), LLS (mm), anterior right MDE (cm), and anterior left MDE (cm) were statistically significantly decreased in patients with GOLD E than those with either GOLD A or B, and in patients with GOLD B than those with GOLD A (p<0.05).

Table (4) demonstrated that in COPD group, the RLS and LLS were negatively correlated with age and smoking index (p < 0.05), while they positively associated with FEV_1/FCV, FEV_1%, FVC%, FEF25-75%, and anterior right MDE, and anterior left MDE (cm) (p< 0.05).

Using ROC curve, table (5) figure (3) shows that the anterior right MDE can be used to distinguish severe COPD at a cutoff level of ≤ 3.88, with 96.4% sensitivity, 90.9% specificity, 93.1% PPV and 95.2% NPV (AUC = 0.98 and p = 0.001). The anterior left MDE can be used to distinguish severe COPD at a cutoff level of ≤ 3.98, with 96.4% sensitivity, 95.5% specificity, 96.4% PPV and 95.5% NPV (AUC = 0.99 and p = 0.001). The RLS at a cutoff level of ≤ 42 has 82.1% sensitivity, 100% specificity, 100% PPV and 81.5% NPV for discrimination of severe COPD (AUC = 0.94 and p< 0.001). The LLS can be used to discriminate severe COPD at a cutoff level of ≤ 43, with 82.1% sensitivity, 100% specificity, 100% PPV and 81.5% NPV (AUC = 0.95 and p= 0.001).

Table (1): Comparisons of demographic data, comorbidities and spirometric data between COPD group and control group

Variables		COPD group n = 50)	Control group n = 50	Stat. test	p-value
Age (years)	**Median (IQR)**	58 (45-63)	50 (45-61)	MW= 128.5	0.401
Sex	**Male**	45 (90%)	41 (82%)	X^2 = 1.32	0.249
	Female	5 (10%)	9 (18%)		
Smoking index (pack/year)	**Median (IQR)**	34 (25-56.75)	15.5(8-39)	MW= 316	0.004*
FEV_1/FVC ratio	**Median (IQR)**	64.35(55.6-67.7)	88(84-94)	MW= 0.0	0.001*
FEV_1%	**Median (IQR)**	48.5(28.8-64.7)	83.75(81.9-88)	MW= 0.0	0.001*
FVC%	**Median (IQR)**	75.25(66.1-84.6)	87.9(85.4-89.4)	MW= 274	0.002*
VC%	**Median (IQR)**	80.4(70.8-86.6)	90.7 (87.9-93.5)	MW= 346	0.001*
FEF25-75%	**Median (IQR)**	43.5(29.5-53.1)	71(68-75.07)	MW= 3	0.003*
GOLD grades	**GOLD A**	10 (20 %)			
	GOLD B	26 (52%)			
	GOLD E	14 (28%)			

COPD: Chronic obstructive pulmonary disease, IQR: Interquartile range, DM: Diabetes mellitus, HTN: Hypertension, RFH, Right heart failure, MW: Mann Whitney U test, X^2: Chi-square test, FEV_1%: Forced expiratory volume in first-second, FVC%: Forced vital capacity, VC%: Vital capacity, FEF25-75%: Forced expiratory flow 25-75%, mMRC: Modified medical research council, CAT score: COPD assessment test, *: Significant p-value (< 0.05).

Table (2): Comparisons of ultrasound lung silhouette and diaphragm excursion between COPD group and control group

Variables		COPD group n = 50)	Control group n = 50	Stat. test	p-value
RLS (mm)	**Median (IQR)**	42.85 (30.6-44.7)	67.35 (64.2-69.6)	MW=0.0	0.001*
LLS (mm)	**Median (IQR)**	43.8 (31.7-46.2)	68 (6 5.4-71.3)	MW=0.0	0.001*
Anterior right MDE (cm)	**Median (IQR)**	3.80 (3.3-4.2)	6.72 (5.9-7.4)	MW=0.0	0.001*
Anterior left MDE (cm)	**Median (IQR)**	3.90 (3.3-4.3)	6.89 (6.29-7.7)	MW=0.0	0.001*

COPD: Chronic obstructive pulmonary disease, MDE: Diaphragm excursion by motion mode, cm: Centimeter, RLS: Right lung silhouette, LLS: Left lung silhouette, mm: millimeter, MW: Mann Whitney U test, *: Significant p-value (< 0.05).

Table (3): Comparisons of ultrasound lung silhouette and diaphragm excursion between GOLD grades in COPD

COPD group		GOLD grades			KW	p-value	LSD
		GOLD A (n = 10)	GOLD B (n= 26)	GOLD E (n= 14)			
RLS (mm)	**Median (IQR)**	47.65 (45.6-50.2)	43 (36.6-44.5)	28.5 (26.8-31.5)	KW=30.8	0.001*	P1 0.001* P2 0.001* P3 0.001*
LLS (mm)	**Median (IQR)**	49.05 (46.8-52.8)	44.25(38.7-45.7)	29.6 (27.9-32.5)	KW=29.9	0.001*	P1 0.001* P2 0.001* P3 0.001*
Anterior right MDE (cm)	**Median (IQR)**	4.3 (4.1-4.4)	386 (3.6-4.1)	3.225 (2.8-3.4)	KW=25.3	0.001*	P1 0.005* P2 0.004* P3 0.001*
Anterior left MDE (cm)	**Median (IQR)**	4.56 (4.3-4.6)	3.97(3.7 - 4.2)	3.24 (2.9 - 3.4)	KW=29.4	0.001*	P1 0.002* P2 0.001* P3 0.011*

MDE: Diaphragm excursion by motion mode, cm: Centimeter, RLS: Right lung silhouette, LLS: Left lung silhouette, mm: millimeter, KW: Kruskal Wallis test, LSD: Least significant difference, *: Significant p-value (< 0.05), P1: GOLD A vs GOLG B, P2: GOLD A vs GOLG E: P3: GOLD B vs GOLG E.

Table (4): Correlation of ultrasound right and left lung silhouette (mm) with studied variable in COPD and control group

Item	RLS (mm)		LLS (mm)	
	r	p-value	r	p-value
Age (years)	-0.91	0.001*	-0.92	0.001*
Smoking index (pack/ year)	-0.43	0.003*	-0.48	0.002*
FEV_1/FCV ratio	0.74	0.002*	0.75	0.002*
FEV_1%	0.89	0.001*	0.89	0.001*
FVC%	0.92	0.001*	0.93	0.001*
FEF 25-75 %	0.92	0.001*	0.92	0.001*
Anterior right MDE (cm)	0.91	0.001*	0.91	0.001*
Anterior left MDE (cm)	0.94	0.001*	0.94	0.001*

MDE: Diaphragm excursion by motion mode, cm: Centimeter, RLS: Right lung Silhouette, LLS: Left lung Silhouette, mm: millimeter, FEV_1%: Forced expiratory volume in first-second, FVC%: Forced vital capacity, VC%: Vital capacity, FEF25-75%: Forced expiratory flow 25-75%, r: Spearmen correlation coefficient, MW: Mann Whitney U test, *: Significant p-value (< 0.05)

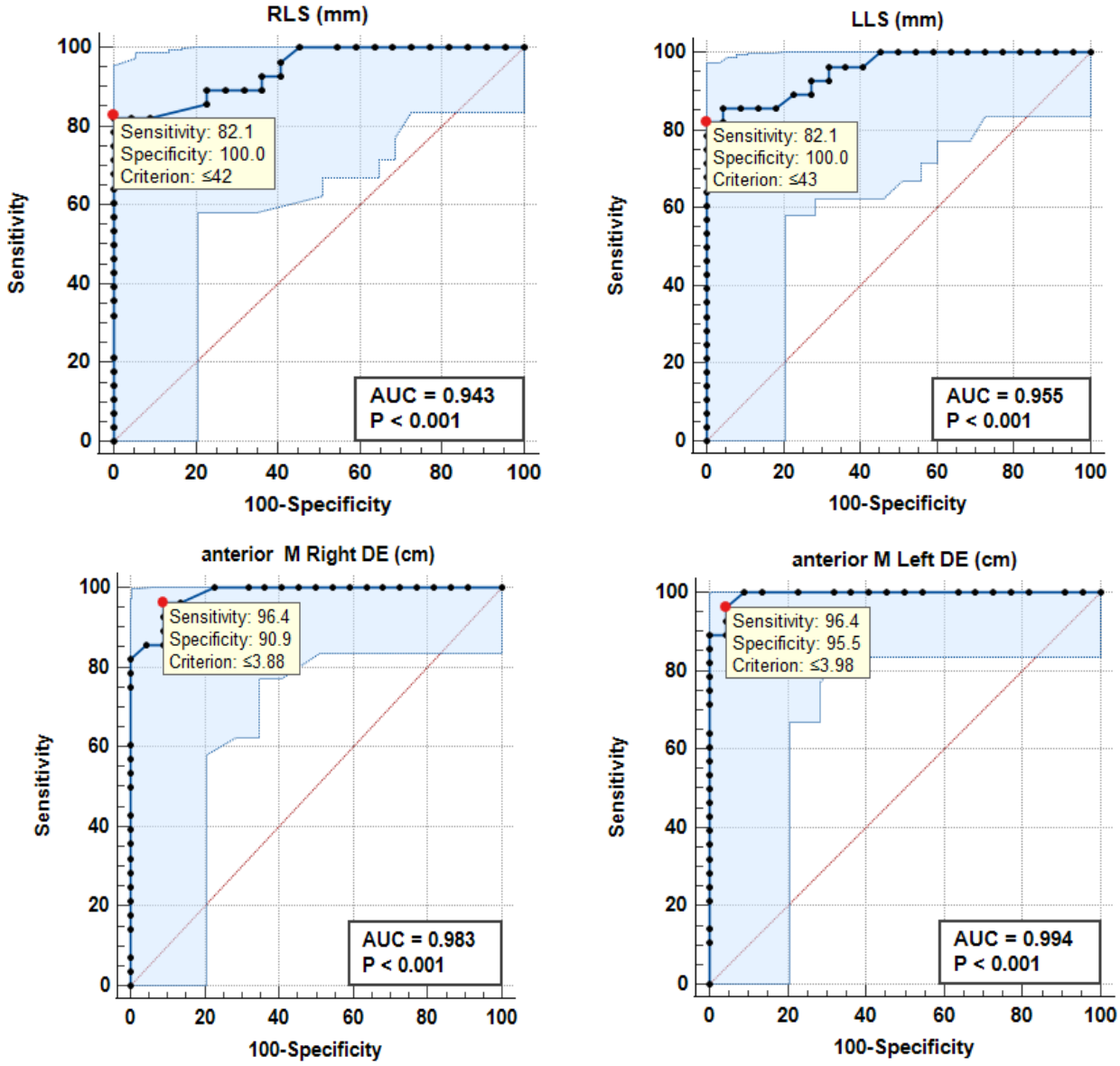

Figure (3): ROC curve of ultrasound right and lung silhouette, and right and left anterior M-mode diaphragm excursion in discrimination of COPD severity

RLS: Right lung silhouette, AUC: Area under curve, LLS: left lung silhouette, DE: Diaphragm excursion, AUC: Area under curve, AUC: Area under curve.

Table (5): Discriminative performance of ultrasound lung silhouette and ultrasound diaphragm excursion of COPD severity

Item	Cut off	AUC	Sensitivity	Specificity	PPV	NPV	p-value
RLS (mm)	≤ 42	0.94	82.1%	100%	100%	81.5%	0.001*
LLS (mm)	≤ 43	0.95	82.1%	100%	100%	81.5%	0.001*
Anterior right MDE (cm)	≤ 3.88	0.98	96.4%	90.9%	93.1%	95.2%	0.001*
Anterior left MDE (cm)	≤ 3.98	0.99	96.4%	95.5%	96.4%	95.5%	0.001*

AUC: Area under the cure, MDE: Diaphragm excursion by motion mode, cm: Centimeter, RLS: Right lung silhouette, LLS: Left lung silhouette, mm: millimeter, PPV: positive predictive value, NPV: negative predictive value.

DISCUSSION

The US LS is a technical-tool simulating percussion of lung as up and down movements of both hemi-diaphragms is assessed at scapular lines [13].

Our study is one of the first studies that classified COPD patients according to the updated GOLD classification which emphasized that COPD exacerbators phenotypes is considered more clinically significant than symptoms. Earlier studies that discussed lung US use the previous GOLD classification. We demonstrated significantly reduced diaphragmatic measurements using both methods in COPD patients than control, this decrease progress with COPD progression through GOLD grades, with GOLD E patients exhibiting the most pronounced reduction followed by GOLD B and lastly GOLD A. Moreover, the RLS and LLS were strongly correlated with all spirometric indices including FEV_1%. These findings indicate that worsened airway function with progression of COPD through GOLD grads leads to development of dynamic hyperinflation that put diaphragm at mechanical disadvantage and impair its movement. This finding was in agreement with that described in previous research that documented that one of most significant outcome was the association between scans of LS and FEV_1 [1]. Also, it was aligned with Abd El-Fattah et al. who reported reduced diaphragmatic excursion in COPD patients compared to controls and a progressive decline in diaphragmatic function with increasing disease severity [14]. Similarly, Boussuges et al. reported a lower mean diaphragmatic excursion during deep breathing in COPD patients compared to controls. However, the authors attributed this difference to potential variations in patient posture during the US examinations [8] as hyperinflation-associated shortening of the diaphragm muscle fiber has traditionally been considered a chief reason of diaphragmatic weakness [15]. These findings aligned with the results of Esmaeel et al. who observed a significant decline of diaphragmatic excursion as COPD severity progressed from GOLD group A to D. These findings collectively emphasize the association between diaphragmatic dysfunction and COPD severity [16] . Moreover, the MDE and LS were related to FEV_1 [4].

The strong correlation between LS method and anterior M-mode method found in the current study indicates that both methods offer alternative approaches for assessing diaphragmatic excursion which accommodating patients with varying physical limitations. While either method may be suitable depending on patient condition or operator preference, both are particularly useful in emergency settings where patient positioning can be challenging. This finding was in agreement with a former study that showed a comparable relationship between LS and anterior diaphragm excursion [1].

Additionally, results of this study showed that RLS and LLS negatively correlated with both increasing age and higher smoking index in COPD patients. These findings indicate that that the aging process and smoking are contributing factors to diaphragm dysfunction in COPD with reduction of its mobility, which subsequently leads to worsening of function exercise capacity. The association between reduced LS and age may be attributed to the well-known fact that age is associated with loss of muscle mass and strength. However, Hafez and Abo-Elkheir [17], and Elsawy [18] reported that the age is insignificant factor for diaphragm dysfunction in COPD patients.

The results of the current study revealed that although the anterior MDE had higher sensitivity (96.4%) for discrimination of severe COPD, the LS is more specific (100%). These findings which is limited discussed and not supported in previous researches before ours indicate that the lung hyperinflation associated with severe COPD have more effects on diaphragm mobility (putting it under mechanical disadvantage with subsequent alteration of its excursion) than structural changes of diaphragm itself. These findings collectively support the reliability of these diaphragmatic parameters as valuable tools for assessing COPD progression.

CONCLUSION

The study concluded that the LS method, utilizing transthoracic ultrasound, could be a reliable and effective test for assessing diaphragmatic function in stable COPD. We concluded that there was strong correlation between diaphragmatic movement and COPD severity, indicating that impaired diaphragmatic function is closely linked to disease progression. This highlights the importance of incorporating ultrasound evaluations into routine clinical practice for better management of COPD, which could provide valuable insights into respiratory mechanics and guide therapeutic interventions.

Financial support: This work was not funded from any governmental or non-governmental agencies.

Conflict of interest: The authors declared that there is no direct or indirect conflict of interest**.**

REFERENCES

1. **Scheibe N, Sosnowski N, Pinkhasik A, Vonderbank S, and Bastian A.** Sonographic evaluation of diaphragmatic dysfunction in COPD patients. Int J Chron Obstruct Pulmon Dis. 2015 Sep 11; 10:1925-30.
2. **Corbellini C, Boussuges A, Villafañe JH, and Zocchi L.** Diaphragmatic mobility loss in subjects with moderate to very severe COPD may improve after in-patient pulmonary rehabilitation. Respir Care. 2018 Oct;63(10):1271-1280.
3. **Global Initiative for Chronic Obstructive Lung Disease (GOLD),** Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD), Fontana, WI, USA, 2023, http://www. goldcopd.org/.
4. **Zanforlin A, Smargiassi A, Inchingolo R, di Marco Berardino A, Valente S, and Ramazzina E.** Ultrasound analysis of diaphragm kinetics and the diagnosis of airway obstruction: the role of the M-mode index of obstruction. Ultrasound Med Biol. 2014 Jun;40(6):1065-71
5. **Yao XY, Li HM, Sun BW, Zhang YY, Feng JG, Jia J, et al.** Ultrasound assessment of diaphragmatic dysfunction in non-critically ill patients: relevant indicators and update. Front Med (Lausanne). 2024 Jun 18; 11:1389040.
6. **McCool FD and Tzelepis GE "**Dysfunction of the diaphragm," New England Journal of Medicine. 2012; 366 (10): 932-42.
7. **Okura K, Kawagoshi A, Iwakura M, Sugawara K, Takahashi H, Kashiwagura T, Homma M, et al.** Contractile capability of the diaphragm assessed by ultrasonography predicts nocturnal oxygen saturation in COPD. Respirology. 2017 Feb;22(2):301-06.
8. **Boussuges A, Gole Y, and Blanc P.** Diaphragmatic motion studied by M-mode ultrasonography: methods, reproducibility, and normal values. Chest. 2009 Feb;135(2):391-400.
9. **Global Initiative for Chronic Obstructive Lung Disease (GOLD), G**lobal Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD), Fontana, WI, USA, 2022, http://www. goldcopd.org/
10. **Gerlach Y, Williams MT, and Coates AM.** Weighing up the evidence -- a systematic review of measures used for the sensation of breathlessness in obesity. Int J Obes (Lond). 2013 Mar;37(3):341-9.
11. **Kasteleyn M, Esquinas C, and Barrecheguren M.** Identifying cut off scores for the chronic obstructive pulmonary disease assessment test (CAT) to predict exacerbations in COPD**.** European Respiratory Journal 2017 50(suppl 61): OA2918;
12. **Houston JG, Morris AD, Howie CA, Reid JL, and McMillan N.** Technical report: quantitative assessment of diaphragmatic movement--a reproducible method using ultrasound. Clin Radiol. 1992 Dec;46(6):405-7.
13. **Evrin T, Korkut S, Ozturk Sonmez L, Szarpak L, Katipoglu B, et al.** Evaluating stable chronic obstructive pulmonary disease by ultrasound. Emerg Med Int. 2019 Sep 15; 2019:5361620
14. **Abd El-Fattah SR, El Hefny RA, Fathy Y S, and Farhat ES.** Evaluation of diaphragm in patients with chronic obstructive pulmonary disease using ultrasonography in relation to disease severity in Fayoum University Hospital. The Egyptian Journal of Chest Diseases and Tuberculosis.2023; 72: (2), 239-246.
15. **Ottenheijm CA, Heunks LM, and Dekhuijzen PN.** Diaphragm muscle fiber dysfunction in chronic obstructive pulmonary disease: toward a pathophysiological concept. Am J Respir Crit Care Med. 2007 Jun 15;175(12):1233-40.
16. **Esmaeel HM, Atta KA, Khalaf S, and Gadallah D.** Clinical utility of chest sonography in chronic obstructive pulmonary disease patients focusing on diaphragmatic measurements. Tuberc Respir Dis (Seoul). 2024 Jan;87(1):80-90.
17. **Hafez MR and Abo-Elkheir OI.** Sonographic assessment of diaphragm thickness and its effect on inspiratory muscles' strength in patients with chronic obstructive pulmonary disease. Eurasian J Pulmonol 2017; 19(2): 76-83.
18. **Elsawy SB.** Impact of chronic obstructive pulmonary disease severity on diaphragm muscle thickness. Egyptian Journal of Chest Diseases and Tuberculosis. 2017; 66(4): 587-92.

الملخص العربي

قياس ظل الرئة في تقييم مرض الضيق الشعبي الهوائي المزمن بالموجات فوق الصوتية عبر الصدر

رنا صفوت عبدالرحمن[1]، مجد محمد جلال[1]،هبة حامد الطراوى[1]، هبة محمد جلال[2]

[1] قسم الأمراض الصدرية، كليه طب بنات، القاهرة ، جامعة الأزهر، جمهورية مصر العربية.

[2] قسم الاشعة التشخيصية، كليه طب بنات، القاهرة ، جامعة الأزهر، جمهورية مصر العربية.

ملخص البحث:

الخلفية: يعد مرض ضيق الشعب الهوائية المزمن حالة مرضية تتفاقم تدريجياً و يتسم بتقييد تدفق الهواء مع ضعف في ميكانيكية التنفس. يعد تقييم وظيفة الحجاب الحاجز أمراً بالغ الأهمية لفهم تأثير المرض على صحة الجهاز التنفسي.

الهدف: تقييم العلاقة بين شدة مرض ضيق الشعب الهوائية المزمن ووظيفة الحجاب الحاجز باستخدام الموجات فوق الصوتية على الصدر من خلال طريقة تحديد ظل الرئة في مرضى ضيق الشعب الهوائية المزمن المستقر.

الطرق: أجريت دراسة الحالات والشواهد على خمسين مريضاً بمرض ضيق الهوائية المزمن وخمسين شخصا سليما كمجموعة ضابطة. خضعوا جميعاً لاخذ التاريخ المرضي وقياس وظائف التنفس وتقييم الحجاب الحاجز باستخدام طريقة كلا من ظل الرئة (المسافة ما بين أعلى وأدنى نقطتين لظل الرئة أثناء عملية الشهيق القصوى والزفير) و حركة الحجاب الحاجز لليسار واليمين التي تم قياسها في الوضع الحركى.

النتائج: مرضى ضيق الشعب الهوائية المزمن كان لديهم انخفاضً ذو دلالة احصائية في ظل الرئة الأيمن والأيسر (مم) [42.85 (30.6-44.7)] و [43.8 (31.7-46.2)] على التوالي، مقارنةً بظل الرئة الأيمن والأيسر (مم) في المجموعة الضابطة [67.35 (64.2 -69.6)] و [68 (6 5.4-71.3)] على التوالي. علاوة على ذلك، انخفض ظل الرئة الأيمن والأيسر (مم) بشكل احصائي في المرضى الذين صُنفوا جولد E مقارنة مع الذين صُنفوا جولد A أو B، وفي المرضى الذين صُنفوا جولد B مقارنة مع الذين صُنفوا جولد A. تناسب ظل الرئة الأيمن والأيسر ايجابياً مع الزفير القسرى في الثانية الأولى و حركة الحجاب الحاجز الأيمن والأيسر.

الاستنتاجات : يمكن أن تكون طريقة ظل الرئة طريقة تقنية موثوقة لتقييم وظيفة الحجاب الحاجز لدى مرضى ضيق الشعب الهوائية المزمن. كما يمكن التأكيد على أن قياس حركة الحجاب الحاجز في الوضع الحركة من الأمام وطريقة ظل الرئة من الخلف يقدمان طرقًا بديلة لتقييم تطور مرض ضيق الشعب الهوائية المزمن التي يمكن دمجها في الممارسة السريرية لتعزيز فهم ميكانيكا الجهاز التنفسي.

الكلمات المفتاحية:مرض ضيق الشعب الهوائية المزمن المزمن، وظيفة الحجاب الحاجز، الموجات فوق الصوتية على الصدر، طريقة ظل الرئة، ميكانيكا الجهاز التنفسي.

الباحث الرئيسي:

الأسم: رنا صفوت عبدالرحمن، قسم الأمراض الصدرية، كليه طب بنات، القاهرة ، جامعة الأزهر، جمهورية مصر العربية.

الهاتف: 01015626414.

البريد الألكترونى: rana.safwat55@gmail.com