

Assessment of Diaphragmatic Mobility by Chest Ultrasonography in Patients Undergoing Pleurodesis

Thesis

*Submitted for Partial Fulfillment of the Master
Degree in Chest Diseases*

By

Amr Mohamed Attiya Mostafa

M.B., B.CH.

Under Supervision of

Prof. Adel Mohamad Saeed

Professor of Chest Diseases

Faculty of Medicine

Ain Shams University

Dr. Ashraf Adel Gomaa

Assistant Professor of Chest Diseases

Faculty of Medicine

Ain Shams University

Faculty of Medicine

Ain Shams University

2018

Acknowledgment

First of all thanks to **ALLAH** for helping me to achieve this work.

I would like to express my appreciation and gratitude to *Prof. Adel Mohamad Saeed*; Professor of Chest Diseases; Ain Shams University, for his continuous encouragement, excellent assistance, valuable guidance and generous support through this work. No words can express my deepest thanks for all he did to complete this work.

I'm really grateful to *Dr. Ashraf Adel Gomaa*; Assistant Professor of Chest Diseases; Ain Shams University, for his kind supervision, patience and moral support through this work.

I'm really thankful for all the members of the Abbassia Chest Hospital, for their cooperation and support.

Finally, I would like to thank all my family for their help and love.

Amr M. Attiya

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسبب انك لا تعلم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

List of Contents

Title	Page No.
List of Tables	5
List of Figures	7
List of Abbreviations	11
Introduction	1
Aim of the work	15
Review of Literature	
▪ Malignant Pleural Effusion	16
▪ Pleurodesis in Malignant Pleural Effusion	31
▪ Thoracic Ultrasound	38
▪ Ultrasound and the Diaphragm.....	57
Subjects and Methods	72
Results	79
Discussion	100
Summary	109
Conclusion.....	111
Recommendations	112
References	113
Arabic Summary	—

List of Tables

Table No.	Title	Page No.
Table (1):	Routine Pleural Fluid Tests for Pleural Effusion.	20
Table (2):	Optional Pleural Fluid Tests for Pleural Effusion.	21
Table (3):	Characteristics of chemical pleurodesis agents.....	34
Table (4):	Comparison between patient and control groups as regard age and DE.	80
Table (5):	Comparison between patient and control groups as regard sex.....	82
Table (6):	Comorbidity on the patient group.....	83
Table (7):	DE before and after pleurodesis.	85
Table (8):	Comparison between DE before and after 1 day pleurodesis.	85
Table (9):	Comparison between DE before and after 2 weeks pleurodesis.	86
Table (10):	Comparison between DE before and after 1 month pleurodesis.....	86
Table (11):	Pair wise comparison between the DE before and after pleurodesis at different time.	88
Table (12):	Comparison between the male and female groups as regarding the DE before and after pleurodesis at different time of measurement.	90
Table (13):	Comparison between diabetic and non diabetic patients as regard DE before and after at different times.....	92
Table (14):	Comparison between hypertensive and non hypertensive patients as regarding DE/cm before and after pleurodesis at different times of measurement.....	94

List of Tables Cont...

Table No.	Title	Page No.
Table (15):	Comparison between IHD and non IHD patients as regard DE/cm before and after pleurodesis at different times of measurement.	96
Table (16):	Comparison between smoker, ex-smoker and non-smoker as regard DE/cm before pleurodesis.....	97
Table (17):	Comparison between smoker, ex-smoker and non-smoker as regard DE/cm after differenct time of pleurodesis.....	98

List of Figures

Fig. No.	Title	Page No.
Figure (1):	A. Posteroanterior chest radiograph in a patient with malignant pleural mesothelioma demonstrating significant right-sided pleural effusion and diffuse pleural thickening associated with marked volume loss of the right hemithorax. B. Computed axial tomographic image from a patient with pleural mesothelioma, illustrating complete encasement of the ipsilateral lung with a thick rind of tumor, neoplastic invasion of the interlobar fissures, small residual pleural effusion, and marked unilateral volume loss	25
Figure (2):	Chest x ray showing massive right sided pleural effusion with shift of the mediastinum to the left side.....	27
Figure (3):	Metastatic adenocarcinoma.....	28
Figure (4):	Axial CT scan shows mesothelioma of the right chest with effusion and thickened visceral pleura with underlying pulmonary atelectasis (arrowheads)	28
Figure (5):	(a) A 3.5C (bandwidth 2–5MHz) convex phased array probe. (b) An M12L linear array probe (bandwidth 5– 13MHz)	39
Figure (6):	US examination of the chest	40
Figure (7):	a: Linear probe placed intercostally in an oblique view. b: corresponding sonographic view “sliding line of the visceral pleura	41
Figure (8):	a: Convex probe placed subcostally from the right. b: Corresponding sonographic image, Lung is indicated as a mirror artifact above the diaphragm.....	42

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (9):	Examination of the supra clavicular region.....	43
Figure (10):	Horizontal line.....	44
Figure (11):	Vertical lines.....	45
Figure (12):	Normal ultrasound images of the chest.....	46
Figure (13):	Chest wall with normal smooth visceral pleura.....	47
Figure (14):	Seashore sign.....	48
Figure (15):	(a) Malignant mesothelioma. CT scan shows lobulated pleural masses, with an area of chest wall invasion. (b) On the US scan, the pleural masses with chest wall infiltration (arrows) are clearly depicted	49
Figure (16):	(A) CT scan shows a soft tissue tumor with rib destruction (arrowheads). (B) Ultrasound reveals a well-defined, hypoechogenic mass within the chest wall	50
Figure (17):	US demonstrates pleural thickening as a hypoechoic band.....	53
Figure (18):	Ultrasound guided needle biopsy from a tumor tissue	55
Figure (19):	An intense pleural effusion (E) can be seen	56
Figure (20):	A) Probe position for B and M mode diaphragmatic excursion measurements with 3.5–5 MHz probe. B) B-mode diaphragm sonography. The bright line reflects the diaphragm. C) M-mode diaphragm sonography.....	61

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (21):	A) Probe position for B and M mode diaphragmatic thickness measurements in the zone of apposition with 10–12 MHz probe. B) B-mode sonography of the diaphragm in the zone of opposition	62
Figure (22):	Right hemidiaphragmatic excursion during a quiet breath.....	63
Figure (23):	Sonography of the diaphragm in the zone of opposition, in B-mode (right) and M-mode (left) during quiet breathing.....	64
Figure (24):	Anterior subcostal approach.	75
Figure (25):	A subcostal approach.	76
Figure (26):	(A) Measurement of diaphragmatic excursion (DE) during quiet breathing on the M-mode screen.	76
Figure (27):	DE in control group and the patient group.....	81
Figure (28):	Sex distribution among the patient and control groups.	82
Figure (29):	DM in patient group.....	83
Figure (30):	HTN in patient group.	84
Figure (31):	IHD in patient group.	84
Figure (32):	Comparison between DE at different time of measurements.....	87
Figure (33):	Comparison between DE at different time of measurements.....	89
Figure (34):	DE before and after pleurodesis in the different sex groups.....	91
Figure (35):	DE before and after pleurodesis in diabetic and non diabetic patients.....	93

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (36):	DE before and after pleurodesis in hypertensive and non hypertensive patients.	95
Figure (37):	DE before and after pleurodesis in the 3 smoking status.	99

List of Abbreviations

Abb.	Full term
<i>ADA</i>	<i>Adenosine deaminase</i>
<i>BTS</i>	<i>British thoracic society</i>
<i>CHF</i>	<i>Congestive heart failure</i>
<i>CSF</i>	<i>Cerebrospinal fluid</i>
<i>CT</i>	<i>Computed Tomography</i>
<i>DE</i>	<i>Diaphragmatic Excursion</i>
<i>DUS</i>	<i>Diaphragmatic ultrasound</i>
<i>F</i>	<i>Frensh</i>
<i>LDH</i>	<i>Lactate dehydroxylase</i>
<i>LS</i>	<i>Lung sliding</i>
<i>MHz</i>	<i>Mega hertz</i>
<i>MPE</i>	<i>Malignant pleural effusion</i>
<i>NLS</i>	<i>No lung sliding</i>
<i>PET</i>	<i>Positron Emission Tomography</i>
<i>PSP</i>	<i>Primary spontaneous pneumothorax</i>
<i>SD</i>	<i>Standard deviation</i>
<i>TB</i>	<i>tuberculosis</i>
<i>TUS</i>	<i>Thoracic ultra sound</i>
<i>UP</i>	<i>Ultrasound Pattern</i>
<i>US</i>	<i>Ultrasound</i>
<i>VATS</i>	<i>Video assisted thoracoscopic surgery</i>

INTRODUCTION

The aim of pleurodesis is to achieve a symphysis between visceral and parietal pleural layers, in order to prevent accumulation of either air or fluid in the pleural space. Its main indications are malignant pleural effusions and pneumothorax (*Rodriguez and Lopez, 1989*).

Pleurodesis can be done chemically or surgically. Chemicals such as Bleomycin, Tetracycline, Povidone iodine and talc (*Chen et al., 2013*).

Chemical pleurodesis involves the intrapleural instillation of a sclerosant through a chest catheter or by thoracotomy or thoracoscopy. Chemical pleurodesis by chest catheter uses an intercostal catheter to drain pleural fluid, reexpand the lung against the chest wall, and instill a sclerosant. Large-bore (20 to 32F) surgical chest tubes have become obsolete in preference for small-bore pigtail catheters (9 to 14F), which improve patient tolerance, provide options for outpatient pleurodesis, and have equivalent rates of success (*Caglayan et al., 2008*).

Surgical pleurodesis may be performed either via thoracotomy or thoracoscopy; leading to mechanical irritation in the parietal pleura (*Warren et al., 2008*).

Pleurodesis will certainly fail if the lung cannot fully expand to the chest wall (eg, trapped or entrapped lung,

interstitial pulmonary fibrosis, endobronchial obstruction) because successful pleurodesis requires contact of the visceral and parietal pleura. Chemical pleurodesis should therefore not be attempted when full lung expansion to the chest wall does not occur after therapeutic thoracentesis. Patients whose lungs cannot fully expand usually have radiographic evidence of a pneumothorax after thoracentesis or experience chest discomfort during thoracentesis before all pleural fluid is drained (*Doelken, 2008*).

The most common adverse sequelae of chemical pleurodesis are fever, pain, and GI symptoms (*Shaw and Agarwal, 2004*).

A complete response is usually defined as no re-accumulation of pleural fluid after pleurodesis until death, and a partial response as partial re-accumulation of fluid radiographically but not requiring further pleural intervention such as aspiration. However, some studies use a 30 day cut-off (*BTS, 2009*).

Diaphragm is the principal generator of tidal volume in normal subjects at rest. Studies have shown that the impairment of diaphragm mobility might be associated with alterations in the principal pulmonary function parameters (*Yamaguti et al., 2008*).

Chest ultrasonography has many Uses, both diagnostic and interventional. It can be used in diagnosis of diseases of the

chest wall such as enlarged lymph nodes, rib abnormalities and also diaphragmatic abnormalities like diaphragmatic paralysis. Chest ultrasonography can also be used in interventional procedures of the pleural space such as thoracocentesis and pleural biopsy. In lung cancer, peripheral lung tumors that are in contact with or near the pleural surface can be safely biopsied under US guidance (*Havelock et al., 2010*).

Over the past few years, ultrasound has also been used to evaluate diaphragmatic mobility, since it offers some advantages over fluoroscopy: portability; no exposure to ionizing radiation; and direct quantification of diaphragmatic movement (*Houston et al., 1995*).

AIM OF THE WORK

To assess the diaphragmatic mobility using Chest Ultrasound in patients with malignant pleural effusion before and after pleurodesis.