



Role of High Definition Bronchoscopy And I- Scan Technology Compared To Standard White Light Bronchoscopy In Patients With Suspected Lung Cancer

Thesis

*Submitted for partial fulfillment of MD degree in
Chest Diseases & Tuberculosis*

By

Hoda Atiatullah Mohamed Mohamed

M.B., B.Ch, M Sc in Chest Diseases & Tuberculosis

Supervised by

Professor/ Yasser Mostafa Mohamed

Professor of Chest Diseases

Ain Shams University

Professor / Ashraf Mokhtar Madkour

Professor of Chest Diseases

Ain Shams University

Professor / Iman Hassan Galal

Professor of Chest Diseases

Ain Shams University

Doctor/Ashraf Abbas Elmaraghy

Assisstant Professor of Chest Diseases

Ain Shams University

Doctor/ Nermin Mohamed Abd Raboh

Lecturer of pathology

Ain Shams University

Faculty of Medicine

Ain Shams University

2018



وَقُلْ اَعْمَلُوا فَسَيَرَى اللّٰهُ
عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ

سورة التوبة الآية (١٠٥)



Acknowledgment

- ✍ First and foremost, thanks to **ALLAH**, the most merciful and the greatest beneficent.
- ✍ I would like to express my great appreciation to **Prof. Dr. Yasser Mostafa**, Professor of chest Diseases, Faculty of Medicine, Ain Shams University; for his sincere effort, valuable advice and great confidence that he gave me throughout the whole work.
- ✍ I am deeply grateful to **Prof Dr. Ashraf Madkour**, Professor of Chest Diseases, Ain Shams University; for his great directions & continuous advice all through the work. His time and effort are clear in every part of this work. Many thanks & gratitude for him.
- ✍ I would like to thank **Prof Dr Eman Hassan**, Professor of Chest Diseases, Ain shams university ; for her great help, efforts and continous advice throughout the whole work.
- ✍ I would like to express my great appreciation to **Dr. Ashraf El maraghy**, Professor of chest diseases, Faculty of Medicine, Ain Shams University; for his sincere effort, valuable advice and great confidence that he gave me throughout the whole work.
- ✍ I am very grateful to **Dr Nermeen Mohamed**, Lecturer of Pathology, Ain Shams University; for her great help, efforts and continous advice throughout the whole work.

✍ **Hoda Atiatullah Mohamed**

Contents

Subjects	Page
• List of Abbreviations.....	I
• List of Tables.....	IV
• List of Figures.....	VIII
• Introduction.....	1
• Aim of the study.....	4
• Review of Literature	
- Chapter 1: Early diagnosis of lung cancer	5
- Chapter 2: High definition bronchoscopy and I-scan.....	63
• Patients & Methods.....	82
• Results.....	91
• Discussion.....	116
• Summary.....	130
• Conclusion.....	134
• Recommendations.....	135
• References	136
• Arabic summary	

List of Abbreviations

AAH	:	Atypical adenomatous hyperplasia
AC	:	Atypical carcinoid
ACCP	:	American colleague of chest physician
AF	:	Autofluorescence
AFB	:	Autofluorescence bronchoscopy
AIS	:	Adenocarcinoma in situ
ASD	:	Angiogenic squamous dysplasia
ATS	:	American Thoracic Society
BAC	:	Bronchioloalveolar carcinoma
CCD	:	Charged couple device
CE	:	Contrast enhancement
CIS	:	Carcinoma in situ
CLE	:	Confocal laser endomicroscopy
COPD	:	Chronic obstructive lung disease
CP-EBUS	:	Convex probe endobronchial ultrasound
CSV	:	Closed Suction Valve
CT	:	Computed tomography
DICOM	:	digital imaging and communications in medicine
DIPNECH	:	Diffuse idiopathic pulmonary neuroendocrine cell hyperplasia
EBUS	:	Endobronchial ultrasound

List of Abbreviations

eCLE	:	Endoscopic Confocal laser endomicroscopy
EGFR	:	Epithelial derived growth factor
ENB	:	Electromagnetic Navigation Bronchoscopy
ERS	:	European Respiratory Society
EWC	:	Extended working channel
FD-OCT	:	Fourier domain Optical Coherence Tomography
HD	:	High definition
HDWLE	:	high-definition white light endoscopy
HMB	:	High Magnification Bronchovideoscopy
IASLC	:	International Association for the Study of Lung Cancer
LDCT	:	Low dose computed Tomography
LIFE	:	Light imaging fluorescence endoscope
LPA	:	Lepidic predominant adenocarcinoma
MIA	:	Minimally invasive adenocarcinoma
mSv	:	Millisievert
NBI	:	Narrow Band Imaging
NCI	:	National cancer institute
OCT	:	Optical Coherence Tomography
pCLE	:	Probe-based Confocal laser endomicroscopy
PCR	:	Polymerase chain reaction
PDT	:	Photodynamic therapy

List of Abbreviations

PIU	:	Probe interface unit
RAR	:	Retinoic acid receptor
RCH	:	Reserve cell hyperplasia
RGB	:	Red Green Blue
ROSE	:	Rapid on-site evaluation
RP-EBUS	:	Radial probe endobronchial ultrasound
SAFE	:	System of autofluorescence endoscopy
SCC	:	Squamous cell carcinoma
SE	:	Surface enhancement
TC	:	Typical carcinoid
TD-OCT	:	Time-domain Optical Coherence Tomography
TE	:	Tone enhancement
VATS	:	Video assisted thoracoscopy
WLB	:	White Light Bronchoscopy

List of Tables

Table No.	Title	Page
Table (1)	Histologic classification of lung cancer.	7-8
Table (2)	Endobronchial findings during autofluorescence.	30
Table (3)	HD video bronchoscopic series technical specifications.	66
Table (4)	Number of sites detected by different techniques.	75
Table (5)	I-scan image enhancement technology settings.	86
Table (6)	White Light Bronchoscopic Image Scoring.	89
Table (7)	I-scan image Scoring.	89
Table (8)	Demographic characteristics of the studied patients.	91
Table (9)	Patient types among the studied patients..	92
Table (10)	Chest CT findings in the studied patients..	92
Table (11)	Site and Location of Masses by CT in the studied patients.	93
Table (12)	The Type of Anesthesia used in the study.	93
Table (13)	Bronchoscopy procedures, post bronchoscopic Complications in the studied patients.	94

☞ List of Tables ☜

Table No.	Title	Page
Table (14)	Visual findings of Primary suspected lesion by HDWLB.	95
Table (15)	Visual findings of primary suspected lesion by I-scan1, I-scan 2, I-scan 3.	95
Table (16)	Visual findings of area surrounding the primary lesion by HDWLB.	96
Table (17)	Visual findings of area surrounding the primary lesion by I-scan 1, I-scan 2, I-scan 3.	96
Table (18)	Visual findings of normal non suspected area by HDWLB.	97
Table (19)	Visual findings of normal non suspected area by I-scan1, I-scan 2, I-scan 3.	97
Table (20)	Pathological results of endobronchial biopsies from the primary suspected lesion.	98
Table (21)	Pathological results of endobronchial biopsies from Diagnosed lung cancer patients.	98
Table (22)	Pathology results of endobronchial biopsies from the surrounding area to the primary suspected lesion.	99
Table (23)	Pathology results of endobronchial biopsies from the normal non suspected area.	99
Table (24)	Comparison between CT finding and visual findings of HDWLB.	100

List of Tables

Table No.	Title	Page
Table (25)	Comparison between HDWLB findings among the two types of patients.	102
Table (26)	Comparison between smoking status as regard conventional bronchoscopy findings.	103
Table (27)	Comparison between visual findings by HDWLB versus i-scan 1,2&3 bronchoscopy as regards primary suspected lesion.	104
Table (28)	Comparison between visual findings by HDWLB versus i-scan 1,2&3 bronchoscopy as regards the surrounding area of primary suspected lesion.	105
Table (29)	Comparison between sex as regard lung cancer pathology.	106
Table (30)	Comparison between different smoking status as regard lung cancer pathology.	107
Table (31)	Comparison between age as regard lung cancer pathology.	108
Table (32)	Comparison between visual findings by HDWLB as regards pathology of primary suspected lesion.	109
Table (33)	Comparison between visual findings by HDWLB as regards pathology of the surrounding area to primary suspected lesion.	111

List of Tables

Table No.	Title	Page
Table (34)	Sensitivity and specificity of WLB and i-scan 1,2,3 in comparison to endobronchial biopsies results.	113
Table (35)	Sensitivity and specificity of i-scan 1,2,3 in prediction of HDWLB (suspected area).	113
Table (36)	Sensitivity and specificity of i-scan 1,2,3 in prediction of HDWLB(the surrounding).	114
Table (37)	Diagnostic accuracy of I scan in prediction of HDWLB results.	114

List of Figures

Figure No.	Title	Page
Figure (1)	Auto fluorescence bronchoscopy images.	31
Figure (2)	Zoom endoscopes optical zoom by AF.	35
Figure (3)	Electronic magnification simply moves the image closer on the display.	35
Figure (4)	Magnified view of the bronchial mucosa by high magnification bronchovideoscopy.	36
Figure (5)	NBI technique overview.	38
Figure (6)	White light bronchoscopy and narrow band imaging.	38
Figure (7)	NBI, tortuous blood vessels-squamous cell lung cancer.	39
Figure (8)	NBI, abrupt ending blood vessels-squamous cell lung cancer.	40
Figure (9)	NBI dotted vascular pattern-adenocarcinoma of the lung.	40
Figure (10)	Radial EBUS, snow storm pattern of normal EBUS image in lung periphery.	41
Figure (11)	Radial EBUS, image of the peripheral pulmonary lesion.	42
Figure (12)	Schematic of confocal laser endomicroscopy principles.	44

Figure No.	Title	Page
Figure (13)	Endoscope-based confocal laser endomicroscope.	45
Figure (14)	Probe-based confocal laser endomicroscopy (pCLE) system.	46
Figure (15)	Bronchial confocal microendoscopy imaging.	48
Figure (16)	TD-OCT. and FD-OCT.	51
Figure (17)	OCT unit.	51
Figure.(18)	Bronchoscopic and OCT images of squamous cell carcinoma in the left upper lobe.	52
Figure.(19)	Components of ENB.	53
Figure.(20)	ENB procedure overview	54
Figure.(21)	Latest Pentax HD bronchoscope EB-1990i.	66
Figure.(22)	Instrument channel and lenses of HD bronchoscope.	67
Figure (23)	Principle of surface enhancement (SE).	70
Figure (24)	Principle of CE.	71
Figure (25)	Principles of tone enhancement.	71
Figure (26)	PENTAX Medical –The ultimate video processor: EPK-i7000.	72

List of Figures

Figure No.	Title	Page
Figure (27)	i-scan EPK-i5000 High-Definition Video Processor with HD bronchoscope.	72
Figure (28)	HD and I-scan1 images of bronchial mucosa	73
Figure (29)	I-scan 2 and 3 images of vascular changes in bronchial mucosa.	74
Figure (30)	Representative bronchoscopy images from two patients using normal white light videobronchoscopy; HD-bronchoscopy HD+ i-scan.	77
Figure (31)	Barrett's esophagus with nodularity and high-grade dysplasia.	79
Figure (32)	HD bronchoscope PENTAX 3.2 Medical 70K Series	85
Figure (33)	PENTAX i-SCAN™, EPK-i®5000 videoprocessor	86
Figure (34)	High grade dysplasia on top of squamous metaplasia by histopathological examination of one of the specimens.	115
Figure (35)	Squamous metaplasia, dysplasia as illustrated by histopathological examination of the specimens.	115

Introduction

Lung cancer is the leading cause of cancer mortality worldwide. Despite evolving knowledge of lung cancer, molecular genetics, and improved technology for the detection of lung cancer, the overall survival for lung cancer is still quite poor (5 year survival 17%) (*Siegel et al., 2012*).

Worldwide, lung cancer is the most common cancer among men in terms of both incidence and mortality, and among women has the third highest incidence, and is second after breast cancer in mortality (*World Cancer Report, 2014*).

Unfortunately, the majority of patients with recently diagnosed lung cancer are not operable. Patients presenting with inoperable non-small cell carcinoma of the lung associated with severe bronchial obstruction are at a high risk for developing post-obstructive pneumonia, respiratory failure or both. This often leads to death in weeks to months (*Celikoglu et al., 2008*).

Early detection and surgical resection is essential for the treatment of lung cancer. Although the introduction of