Role of Lung Ultrasound in the Diagnosis and Follow-up of Neonatal Respiratory Disorders

Thesis

Submitted for Partial Fulfillment of MD Degree in Pediatrics

By

Osama Abd-Elhady Eldafrawy

MB BCh, Master degree of Pediatrics

Supervised by

Prof. Nehal Mohamed El Raggal

Professor of Pediatrics

Faculty of Medicine- Ain Shams University

Prof. Laila Abd-Elghaffar Hegazy

Professor of Pediatrics

Faculty of Medicine- Ain Shams University

Prof. Hossam Mousssa El- Sayed Sakr

Professor of Radiodiagnosis

Faculty of Medicine- Ain Shams University

Dr. Rania Ibrahim Hossni Ismail

Assistant Professor of Pediatrics

Faculty of Medicine- Ain Shams University

Dr. Yasmin Aly Farid Mohamed Aly

Lecturer of Pediatrics

Faculty of Medicine- Ain Shams University

Faculty of Medicine- Ain Shams University

2020

سورة البقرة الآية: ٣٢

Acknowledgment

First and foremost, I feel always indebted to ALLAH, the Most Kind and Most Merciful.

I'd like to express my respectful thanks and profound gratitude to ***Prof. Nehal Mohamed El Raggal,*** *Professor of Pediatrics - Faculty of Medicine- Ain Shams University for her keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

I am also delighted to express my deepest gratitude and thanks to ***Prof. Laila Abd-Elghaffar Hegazy,*** *Professor of Pediatrics, Faculty of Medicine, Ain Shams University, for her kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

I wish to introduce my deep respect and thanks to ***Prof. Hossam Moussa El- Sayed Sakr,*** *Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for his kindness, supervision and cooperation in this work.*

I am deeply thankful to ***Dr. Rania Ibrahim Hossni Ismail,*** *Assistant Professor of Pediatrics, Faculty of Medicine, Ain Shams University, for her great help, active participation and guidance.*

I would like to express my hearty thanks ***Dr. Yasmin Aly Farid Mohamed Aly,*** *Lecturer of Pediatrics, Faculty of Medicine, Ain Shams University, for her support till this work was completed.*

Osama Abd-Elhady Eldafrawy

List of Contents

List of Tables

Table No.	Title	Page No.

List of Figures

List of Figures *(Cont...)*

List of Figures *(Cont...)*

List of Figures *(Cont...)*

List of Figures *(Cont...)*

List of Abbreviations

Abb.	Full term
BPD	*Bronco-pulmonary dysplasia*
CBC	*Complete Blood Picture*
CBG	*Capillary Blood Gases*
CDH	*Congenital diaphragmatic hernia*
CPAM	*Congenital diaphragmatic hernia*
CRP	*C - reactive protein*
CXR	*Chest X Ray*
DLP	*Double Lung Point*
DS	*Down Score*
LUS	*Lung Ultrasound*
MABP	*Mean Arterial Blood Pressure.*
MAS	*Meconium Aspiration Syndrome*
NICU	*Neonatal Intensive Care Unit*
NRDS	*Neonatal Respiratory Distress Syndrome*
PAN	*Pulmonary Atelectasis of the Newborn*
PE	*Pleural Effusion*
PIE	*Pulmonary Interstitial Emphysema*
POC-US	*Point-of-care ultrasound*
PPHN	*Persistent Pulmonary Hypertension*
RBS	*Random Blood Sugar*
SAS	*Silverman Anderson*
TTN	*Transient tachypnea of the newborn*

INTRODUCTION

Every year, an estimated 2.9 million babies die in the neonatal period (the first 28 days of life), accounting for more than half of the under-five child deaths in most regions of the world, and 44% globally. The majority (75%) of these deaths occur in the first week of life, with the highest risk of mortality concentrated in the first day of life. Ninety-nine percent of neonatal deaths occur in low- and middle-income countries; south-central Asian countries experience the highest absolute numbers of neonatal deaths, while countries in sub-Saharan Africa generally have the highest rates of neonatal mortality ***(Leigh et al., 2017).***

Respiratory distress is one of the most common problems neonates encounter within the first few days of life. According to the American Academy of Pediatrics, approximately 10% of neonates need some assistance to begin breathing at birth, with up to 1% requiring extensive resuscitation. Other reports confirm that respiratory distress is common in neonates and occurs in approximately 7% of babies during the neonatal period. Respiratory disorders are the leading cause of early neonatal mortality (0–7 days of age), as well as the leading cause of morbidity in newborn, and are the most frequent cause of admission to the special care nursery for both term and preterm infants In fact, neonates with respiratory distress are 2–4 times more likely to die than neonates without respiratory distress In the

United States, the mortality of neonatal respiratory failure is approximately 11%, and the rate can go up to 32% in China ***(Hui et al., 2018; Leigh et al., 2017).***

Respiratory disorders like Neonatal respiratory distress syndrome (NRDS) and transient tachypnea of the newborn (TTN) are the most frequent diseases. Pneumothorax, amniotic fluid aspiration, pneumonia, pulmonary hemorrhage, pleural effusions, congenital lobar emphysema, and diaphragmatic hernias are also lung conditions that lead to respiratory distress in the early neonatal period ***(Liu et al., 2014; Wood & Thomas, 2015)***.

Neonatal respiratory diseases are currently diagnosed on the basis of clinical signs and plain chest X-ray (CXR) which often does not allow an accurate diagnosis and could result in improper or delayed specific therapies ***(Francesco et al., 2013)***.

According to one study, the risk of cancer induction in infants receiving a single small dose of radiation is 2–3 times higher than the average population and 6–9 times higher than the risk from an exposure of a 60-year-old patient ***(Hui et al., 2018).***

In addition it has been estimated that the average extremely low birth weight infant will have 31 radiographs taken from birth to NICU discharge ***(Wilson et al., 1996)***.

Consequently, in the past several years lung ultrasound (LUS) has become one of the most exciting applications in the field of the neonatal point-of care ultrasound (POC-US).

Several recent articles have found ultrasound imaging to be an equal, if not a more effective diagnostic modality than X-ray. LUS is quicker, less expensive and it does not expose patients to the increased risks inherent in exposure to ionizing radiation ***(Kurepa et al., 2018; Corsini et al., 2018 & 2020).***

LUS has proved to be useful in the evaluation of many different and important neonatal diseases include respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), pneumonia of the newborn (PN), pulmonary atelectasis of the newborn (PAN) and pneumothorax ***(Copetti & Cattarossi, 2007).***

Lung ultrasound can be very useful in neonates and children. The advantage in neonates that is related to their anatomical features (thinner chest wall, smaller thoracic width, and lung mass) facilitates LUS imaging that allows an optimal, although still indirect, visualization of the lungs ***(Lichtenstein, 2014).***

Lung ultrasound imaging is especially valuable since it is a relatively easy-to-learn how to apply, is less technically demanding than other sonographic examinations and is free of radiation. In adults LUS is not only superior to the physical examination and chest X-ray, but even comparable to CT for many diagnoses. Pneumonia, pulmonary oedema, pulmonary embolism, asthma, chronic obstructive pulmonary disease and pneumothorax can be assessed with sensitivity and specificity ranging from 90 to 100% ***(Touw et al., 2015).***

Aim of the Work

This study aims to assess the diagnostic utility of lung ultrasonography (LUS) for detection, evaluation and differentiation of variable respiratory disorders of the newborn.