# The role of cranial ultrasound in diagnosis of neonatal meningitis in correlation with laboratory results

Thesis

Submitted for partial fulfillment of master degree in pediatrics by:

Nour Mohamed Nahas

M.B.B.Ch.

Ain Shams University Supervisors:

.Dr.Safaa Shafik Emam

**Professor of Pediatrics** 

Ain Shams University

<u>.Dr.Abeer Salah El Din El Sakka</u>

Lecturer of Pediatrics Ain Shams University

.<u>Dr.Abeer Maghawry Abd El Hamid</u>

Assistant Professor of Radiodiagnosis
Ain Shams University
Faculty of Medicine
Ain Shams University
2010

### **Acknowledgment**

First, I would like to express my greatest gratitude and thanks to "ALLAH" who gives me strength and help me to accomplish this work.

He has helped me a lot. He offered me what I did not know and which I have to know. Hence, if only one to be thanked, God is the first and the last. Then those offered by God to advice and guide have to be thanked.

I would like to express my sincere gratitude and deep appreciation to Dr. Safaa Shafik Imam Professor of Pediatrics. Faculty of Medicine. Ain Shams University, for her continuous scientific guidance, enriching me with her vast experience, unlimited help, full provision of all facilities, the precious time and effort she devoted in the supervision of the present work, despite other busy tasks. I feel to her much respect and great honored to work under her supervision.

Also I would like to extend my feeling of deep respect, gratefulness and sincerest appreciation to Dr. Abeer Salah El Din El Sakka Lecturer of Pediatrics. Faculty of Medicine. Ain Shams University, for her generous assistance, kind supervision, constructive criticism, expertise, continuous unlimited support. I am greatly thankful for her valuable advice, continuous encouragement, indispensable guidance and great effect she has devoted in her supervision of this work.

My profound gratitude and respect to Dr. Abeer Maghawry Abd el Hamid Assistant Professor of Radiology, Faculty of Medicine. Ain Shams University, for her continuous help, encouragement and support and without her assistance that has made the easiest out of the most difficult, I would not have been able to start and reach the perfection of this work indeed, I am very privileged and honored to have her as my supervisor.

I am indebted to nursing and medical staff of NICU of Ain Shams University pediatric hospital for their cooperation and support during the study.

And by all means, I should express all my apprectiation and respects to the patients (the wonderful neonates) and their parents, whom without their sharing in this study, it wouldn't have appeared to the light.

Finally, I wish to express my thanks and love to my lovely mother and father, and I am greatly indebted to my supportive, caring husband and my lovely one year child for their patience and support.

# **C**ONTENTS

	Page
Introduction	1
Aim of the Work	3
Review of Literature	4
A)Neonatal sepsis	
B)Neonatal meningitis	
C)Transcranial ultrasound	
Subjects and methods	109
Results	113
Discussion	140
Summary and conclusion	152
Recommendations	157
References	158
Arabic summary	171

### **List of Abbreviations**

**AAP** American Academy of Pediatrics

**AAOG** American Academy of obstetrics and gynacelogy

AF Anterior Fontannel
AUC Area under the curve
BBB Blood brain barrier

**BAER** Brain stem auditory evoked response

**BPD** Bronchopulmonary dysplasia

**CBC** Complete blood count

**CDC** Centers for disease control and prevention

**CMV** Cytomegallo virus

**CNS** Central nervous system

C3 Complement 3
CUS Cranial ultrasound

**CRP** C-reactive protein

**CSF** Cerebrospinal fluid

**CT** Computed tomography

**DIC** Disseminated intravascular coagulation

**DNA** Deoxyribo nucleic acid

Ecoli Escherichia coli

**EDTA** Ethylene-diamine-tetra-acetic

**EEG** Electro encephalogram

**ELISA** Enzyme linked immunosorbent assay

**FDA** Food Drug Adminstration

**GA** Gestational age

GBS Group B streptococci

**G-CSF** Granulocyte colony stimulating factor

**GM-CSF** Granulocyte macrophage colony stimulating factor.

**Hgb** Haemoglobin

**Hib** Hemophlius influenza type b

**HIV** Human immunodeficiency virus

**HSV** Herpes simplex virus

**HSV-1** Herpes simplex virus type I

**HSV-2** Herpes simplex virus type II

ICP Intra cranial pressure

**IGA** Immunoglobulin A

**IGE** Immunogjobulin E

**IGG** Immunoglobulin G

**IGM** Immunoglobulin M

**IL6** Interleukin 6

IL8 Interleukin 8

**IL10** Interleukin 10

**INF** Interferone

I/T Immature/total neutrophil ratio

IVIG Intravenous Immunoglobulin

Lumber vertebra 3
Lumber vertebra 4

**LGA** Latex particle Agglutination

**Lp** Lumbar puncture

**LPS** Lipopolysaccharides

MB Mid Body widthMF Mastoid Fontannel

MHZ Mega Hertz

MRI Magnetic resonance imaging

**NEC** Necrotising Enterocolitis

**NICU** Neonatal Intensive Care Unit

**NK** Natural Killer cell

**PCR** Polymerase chain reaction

**PF** Posterior fontanel

**PLT** Platellet

**PMN** Polymorphonuclear neutrophils

**RBC** Red Blood Cell

**RDS** Respiratory Distress Syndrome

ROC Reciever operator curveRTI Respiratory tract infection

**SIADH** Syndrome of inappropriate secretion of antiduretic hormone

S.Aureus Staphylococci Aureus

**TD** Two dimensional

TNF Tumor necrosis factor
TTD Three times per day
TLC Total leukocytic count
USA United States of America
VP Ventricoloperitoneal shunt

WBC White Blood Cells

## **LIST OF TABLES**

Table No.	Title
1	CSF findings in CNS disorders p58
2	Normal ranges(-2SD to +2SD)for different ultrasonographic measures of the neonatal and infant brain in healthy full term infants p106
3	Comparison between the two studied groups regarding age p113
4	Comparison between the two studied groups regarding gender distribution p113
5	Initial diagnosis of our subjectsp114
6	Comparison between the two studied groups regarding laborotary parameters p115
7	Comparison between the two studied groups regarding clinical picture p116
8	Comparison between the two studied groups regarding CSF laborotary parameters p119

- 9 Comparison between the two studied groups regarding CSF findings p120
- Comparison between the two studied groups regarding transcranial ultrasound parameters p122
- 11 Comparison between the two studied groups regarding transcranial ultrasound parameters p124
- 12 Correlation between frontal gyrus thickness(mm) and other studied parameters p126
- Correlation between frontal sulcus thickness(mm) and other studied parameters p129
- 14 Area under ROC curve for assesment of frontal gyrus thickness in detection of neonatal meningitis p132
- Different cut off values of frontal gyrus thickness in in detection of neonatal meningitis p133
- Area under ROC curve for assesment of frontal sulcus thickness in detection of neonatal meningitis p134

- Different cut off values of frontal sulcus thickness in in detection of neonatal meningitis p135
- The diagnostic value of different transcranial ultrasound findings in detection of neonatal meningitis p136

### **LIST OF FIGURES**

Figure No.	e Title	
1	Bronchopneumonia	p23
2	Brain and spinal cord wit	h bacterial
	meningitis	p42

3	Meninges of the CNS p43	
4	Pathogenesis of bacterial meningitis	
	p44	
5	Bacterial invasion mechanism to CSF	
	p46	
6	Large scale inflammation during	
	meningitis p47	
7	Bulging anterior fontanel p50	
8	Structural formula of ceftriaxonep68	
9	The acoustic windows p81	
10	Probe positioning for obtaining	
	coronal planes p82	
11	Coronal planes p83	
12	Second coronal plane p84	
13	Sagittal planes p85	
14	Probe positioning to obtain sagittal	
	planes p86	
15	Second and forth parasagittal planes	
	p86	
16	Probe positioning to obtain coronal	
	planes using mastoid fontanel p87	
17	Coronal view using mastoid fontanel	
	p88	

18	Probe positioning to obtain coronal views using posterior fontanel p89	
19	Coronal view using posterior fontanel as an acoustic window p90	
20	Probe positioning using left temporal window p91	
21	Transverse view using left temporal window p92	
22	Thickened meninges p95	
23	Coronal sonogram showing thickened pia and arachnoid matter p96	
24	Coronal sonogram showing subdural effusion p97	
25	Angled sagittal sonogram showing subdural empyma p98	
26	Coronal sonogram showing ventriculitis p99	
27	Coronal sonogram showing cyst formation p101	
28	Coronal sonogram showing increased echogenecity p102	
29	Coronal sonogram showing brain edema p105	

30	Measures of the lateral	ventricles in
	healthy full term infants	s p103
31	Midline sagittal sonog postinfectious hydroceph	_
32	Showing comparison age,crp,hb between the p114	
33	Showing com	parison of
fever	,pallor,organomegally Vom	iting between the
two ş	groups	p115
34	Showing comparison of	bulging anterior
fonta	annel, Increasing	occiputofrontal
cicur	nference, seizures between	the two groups
p117		
35 more	Showing comparison su reflex between the two gro	_
36	Showing comparison of	conscious level
betw	reen the two groups	p118
37	Showing comparison of	CSF laborotory
value	es between the two groups	p118
38	Showing comparison of	CSF aspect
betw	een the two groups	p119
39	Showing comparison of	CSF colour
betw	reen two groups	p120

- 40 Showing comparison of CSF WBC type between two groups p121
- 41 Showing comparison of CSF culture between two groups p121
- 42 Showing comparison between frontal sulcus and frontal gyrus thickness between two groups p122
- 43 Showing comparison of extra axial fluid collection Irregular echogenic ependyma, intraventricular debris and standing, ventricular dilatation, and areas of abnormal echogenecity between two groups p123
- 44 Showing comparison showing correlation between frontal gyrus thickness and WBC count among all studied subjects p125
- 45 Showing comparison correlation between frontal gyrus thickness and CSF glucose among all studied subjects p127
- 46 Showing comparison between frontal gyrus thickness and CSF chloride among all studied subjects p127
- 47 Showing correlation between frontal sulcus Thickness and CSF WBC count among all studied subjects p128