



Medical studies department

PREDICTIVE VALUE OF CRANIAL ULTRASONOGRAPHY IN NEONATAL INTENSIVE CARE UNIT (NICU)

Thesis

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Contents

	Pages
• List of Abbreviation.....	I
• List of Tables.....	V
• List of Figures.....	IX
• Introduction	1
• Aim of the Work	3
• Review of Literature	4
Brain Development	4
Cognitive Development.....	17
The high-risk newborn.....	22
Follow-Up of the NICU Graduates.....	34
Cranial Ultrasonography.....	49
Developmental Delay.....	66
Developmental Follow-Up	73
Developmental Assessment.....	85
• Patients and Methods.....	99
• Results.....	109
• Discussion.....	138
• Summary.....	161
• Conclusions.....	166
• Recommendations.....	168
• References.....	170
• Appendix.....	208
• Arabic Summary.....	

No. of Tables		LIST OF TABLES	Page
Table (1)	:	Average brain weights (BW) at different times of development	4
Table (2)	:	Cognitive development	20
Table (3)	:	Examples of causes of abnormal development	23
Table (4)		Examples of disorders intrinsic to the fetus.	24
Table (5)	:	Examples of in utero insults to the fetus	25
Table (6)	:	Examples of peripartum and postnatal insults	26
Table (7)	:	The Most Common Cranial Ultrasound Abnormalities	50
Table (8)	:	Cranial Ultrasonography: Technical Aspects	51
Table (9)	:	Performing Cranial Ultrasound Examinations	56
Table (10)	:	CUS screening program	58
Table(11)	:	Adaptations of Ultrasound Examinations, Depending on Diagnosis	60
Table (12-a)	:	Grading Score of IVH-PVH (Intraventricular Hemorrhage-Periventricular Hyperechogenicity)	61
Table(12b)		Classification of IVH	61
Table (13)	:	Detailed Cognitive-Neuropsychological Protocols	82
Table (14)	:	Scaled-Down Cognitive-Neuropsychological Protocols	83
Table (15)	:	Rethinking the Brain: New Insights into Early Development.	96
Table (16)	:	Table summarize the procedures applied to both the study and control group at the stages of the study	100
Table (17)	:	The BSID-II specifies sets of items to administer to a child depending on his or her chronological age .	103

Table (18)	:	Basal and ceiling rules for mental and motor scales per item set:	104
Table (19)	:	Classification of developmental index score..	105
Table (20)	:	Relation of mental and psychomotor index scores to standard deviations from the mean and percentile rank equivalents	106
Table (21)	:	Frequency of cranial ultrasonographic findings of the study group neonates on admission	109
Table (22)	:	Description of the neonates with major abnormal cranial ultrasonographic finding who died shortly after admission in the neonatal intensive care unit.	110
Table (23)	:	Descriptive data of the studied groups	110
Table (24)	:	Descriptive analysis of the maternal history during pregnancy in both the study& control groups.	111
Table (25)	:	Comparison between both the study& control groups as regard the main causes of admission.	112
Table (26)	:	Sex distribution in both, the study &the control groups.	113
Table (27)	:	The modes of delivery in both, the study &the control groups.	114
Table (28)	:	Description of the maneuvers used during resuscitations of the neonates in the delivery room in both; the study &the control groups.	115
Table (29)	:	Apgar score at 1 st &5 th minutes in both, the study & control groups.	116
Table (30)		The body weight (BW) in Kg of the neonates on admission& on discharge in both, the study & control groups.	117
Table (31)		Gestational age (in weeks) of the neonates and the period of their admission (in the intensive care unit, in days) in both, the study & control groups.	118
Table (32)		Major intervention therapy during hospitalization	119
Table (33)		The mode of ventilation therapy in both the study and control groups during treatment	120

Table (34)	Comparison between both the study and the control groups as regard the mental developmental index (MDI) & psychomotor developmental index (PDI) at 6 month & at one year.	121
Table (35)	Comparison between the mental (MDI) and motor(PDI) indices within each group	122
Table (36)	classifications of infants according to their mental performance at 6 month & at 12 month within each group.	123
Table (37)	Classification of infants according to their motor development at 6 month & at 12 month within each group	124
Table (38)	Comparison of mental performance (MDI) at 6 month between both the study and the control groups.	125
Table (39)	Comparison of the mental performance (MDI) at one year between both the study and the control groups.	125
Table (40)	Comparison of motor developmental (PDI) at 6 month between both the study and the control groups.	126
Table (41)	Comparison of motor developmental (PDI) at one year between both the study and the control groups.	127
Table (42)	Comparison between the results of 2nd cranial ultrasound (Cr. U/S) at 6month regarding MDI & PDI at 6 month & at one year within the study group.	128
Table (43)	Comparison between the results of 2nd cranial ultrasound (Cr. U/S) at 6month regarding the mental performance (MDI) at 6 month within the study group.	129
Table (44)	Comparison between the results of 2nd cranial ultrasound (Cr. U/S) at one year regarding the mental performance (MDI) within the study group.	129
Table (45)	Comparison between the results of 2nd cranial ultrasound (Cr. U/S) at 6month regarding motor development (PDI) at 6 month within the study group.	130

Table (46)	Comparison between the results of 2nd cranial ultrasound (Cr. U/S) at 6month regarding the motor development (PDI) at one year within the study group.	130
Table (47)	Comparison between sex distribution as regard MDI& PDI at 6 month & at one year, within each of both groups.	131
Table (48)	Comparison between mode of delivery as regard MDI& PDI at 6 month & at one year, within each of both; the study and the control groups.	132
Table (49)	Comparison between the mode of ventilation therapy regarding MDI& PDI at 6 month & at one year, within each of both; the study and the control groups.	133
Table (50)	Correlation between the gestational age (GA) to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	134
Table (51)	Correlation between the Apgar score at 5 th minute to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	135
Table (52)	Correlation between the body weight (B.W) on discharge to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	135
Table (53)	Correlation between the period of admission in the NICU to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	136
Table (54)	Correlation between the duration of phototherapy to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	136
Table (55)	Correlation between duration of oxygen therapy to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	137
Table (56)	Correlation between the duration of ventilation therapy to MDI and PDI at 6 month & at one year within each of both the study and the control groups.	137

No. of Figures	LIST OF FIGURES	Pages
Fig.(1-a)	The brain weights of males and females at different ages. The bottom graph	4
Fig. (1-b)	the brain weight to total body weight ratio (expressed as a percentage)	5
Fig. (2)	Brain Components & Functions	6
Fig. (3)	The acoustic windows. AF anterior fontanel, PF posterior fontanel, MF mastoid (or postero-lateral) fontanel, TW temporal window	53
Fig. (4)	Description of the maternal history during pregnancy in both the study& control groups	111
Fig. (5)	Comparison between both the study& control groups as regard the main causes of admission	112
Fig. (6)	Sex distribution in both, the study &the control groups.	113
Fig.(7)	The modes of delivery in both, the study &the control groups.	114
Fig. (8)	Description of the maneuvers used during resuscitations of the neonates in the delivery room in both; the study &the control groups.	115
Fig. (9)	Apgar score at 1st &5th minutes in both, the study & control groups.	116
Fig. (10)	The body weight (BW) in Kg on admission& on discharge in both, the study & control groups.	117
Fig. (11)	Gestational age and the period of admission (in the intensive care unit, in days) in both, the study & control groups.	118
Fig. (12)	Comparison between both the study and the control groups as regard the Major intervention treatment therapy during their admission in the neonatal intensive care unit.	119
Fig. (13)	The mode of ventilation therapy in both the study and control groups during treatment.	120
Fig. (14)	Comparison between both the study and the control groups as regard the mental developmental index (MDI) & psychomotor developmental index (PDI) at 6 month & at one year.	121

No. of Figures	LIST OF FIGURES	Pages
Fig. (15)	Comparison between both the study and the control groups as regard the mental developmental index (MDI) & psychomotor developmental index (PDI) at 6 month & at one year.	127
Fig. (16)	Comparison between the results of cranial ultrasound (Cr. U/S) at 6month regarding MDI & PDI at 6 month & at one year within the study group.	128
Fig. (17)	Comparison between sex distribution as regard MDI& PDI at 6 month & at one year, within each of both; the study and the control groups.	131
Fig. (18)	Comparison between mode of delivery as regard MDI& PDI at 6 month & at one year, within each of both; the study and the control groups.	132
Fig. (19)	Comparison between the mode of ventilation therapy regarding MDI& PDI at 6 month & at one year, within each of both; the study and the control groups.	133

INTRODUCTION

RATIONAL BACKGROUND

Cranial US was introduced in the late 1970s and was largely performed by pediatricians specializing in neonatology (*Mercuri, et al., 1998*). Over the years it has become a routine technique, now performed by consultant and middle grade pediatric staff on most infants admitted to neonatal units, and on any with neurological abnormality. These staff is expected to be familiar with the US appearances of normal variations, developmental anomalies, and many types of pathology, as well as their prognostic significance in both preterm and term infants (*Reynolds, et al., 2001*).

Initially cranial US was used to detect hemorrhage and ventricular dilatation in preterm infants, but now the emphasis has moved to defining white matter injury, which is more difficult. There are concerns that infants with normal scans do not always have normal neurodevelopmental outcomes (*Jongmans, et al., 1997*). These difficulties are assumed to be due to the limitations of the technique itself. Little mention is made of the quality of the scanning (instrumentation, correct frequency, adequate coverage, correct views, optimal timing, etc) and scan interpretation as being possible components of the problem (*Reynolds, et al., 2001*).

Cranial ultrasonography may detect intraventricular bleeding but not subarachnoid bleeding; it may be preferred as a bedside test for very sick infants who cannot be moved to radiology (*M.M.D.T., 2005*).

Despite advances in perinatal medicine, periventricular hemorrhagic infarction remains an important complication of prematurity. Periventricular hemorrhagic infarction can be graded using a score system based on sonographic characteristics. Higher severity scores predict worse outcome. Such severity scoring could improve the clinician's ability to counsel parents regarding management decisions and early intervention strategies (*Bassan, et al., 2006*).

Despite recent improvements in survival rates, cerebral palsy remains highly prevalent among very preterm children. Severe cranial ultrasound abnormalities predict motor disability strongly, but one third of infants with cerebral palsy had no ultrasound abnormalities (*Ancel, et al., 2006*).

The existence of periventricular leukomalacia was the strongest risk factor for the subsequent development of cerebral palsy. The grade of periventricular leukomalacia was significantly correlated with the clinical type and severity of Cerebral palsy (*Han, et al., 2002*). U/S is highly effective in detecting severe lesions of the white matter in preterm infants, but MRI seems to be necessary for the diagnosis of less severe damage (*Debillon, et al., 2003*).

Outcome studies have primarily emphasized the incidence of major disabilities such as moderate-to-severe mental retardation, sensorineural losses (e.g., hearing loss, blindness), cerebral palsy, and epilepsy (*Debillon, et al., 2003*). Babies born with low birth weight (LBW, <2500 g) have a 6-8% incidence of developing these major disabilities. Those born at very low birth weight (VLBW, <1500 g) have a 14%-17% incidence, whereas ELBW babies (<1000 g) have a 20-25% rate. Therefore, as birth weights decline, disabilities increase (*Han, et al., 2002*). In comparison, major disabilities occur in 5% of infants born full term. These rates have remained relatively constant over the last decade (*Aylward, 2003*).

The Bayley Scales of Infant Development (BSID) are used extensively to assess the development of infants from one to three years of age. The test is given on an individual basis and takes from 45 to 60 minutes to complete. It is administered by examiners who are experienced clinicians specifically trained in BSID test procedures. The examiner presents a series of test materials to the child and observes the child's responses and behaviors (*Hall, 2004*). The test also contains items designed to identify young children at risk for developmental delay.

HYPOTHESIS:

Fine brain insult which may lead to developmental delay later in life of the infants can be diagnosed by recent advance in cranial ultrasonography and early assessment of development. This study assumes that cranial ultrasonography and developmental assessment have a diagnostic role in prediction of high risk neonates.

BRAIN GROWTH

The brain grows at an amazing rate during development. At times during brain development, 250,000 neurons are added every minute!! At birth, almost all the neurons that the brain will ever have are present. However, the brain continues to grow for a few years after birth. By the age of 2 years old, the brain is about 80% of the adult size.

Table (1) Average brain weights (BW) at different times of development: (Dekaban& Sadowsky, 1978)

AGE	Brain Weight Male (grams)	Brain Weight Female (grams)
-----	-----	-----
Newborn	380	360
1 year	970	940
2 years	1,120	1,040
3 years	1,270	1,090
10-12 years	1,440	1,260
19-21 years	1,450	1,310
56-60 years	1,370	1,250
81-85 years	1,310	1,170

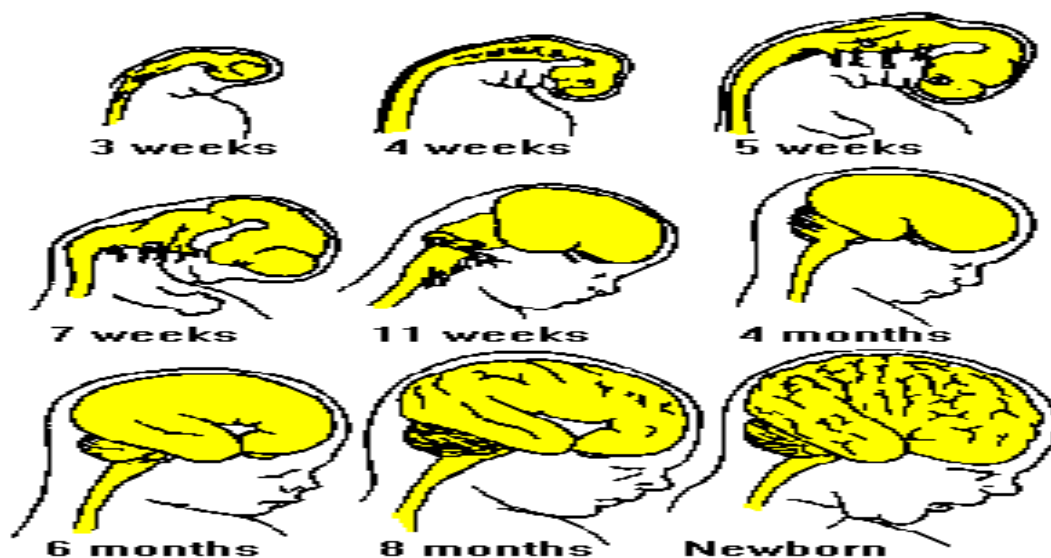


Figure (1-a) shows the brain weights of males and females at different ages.

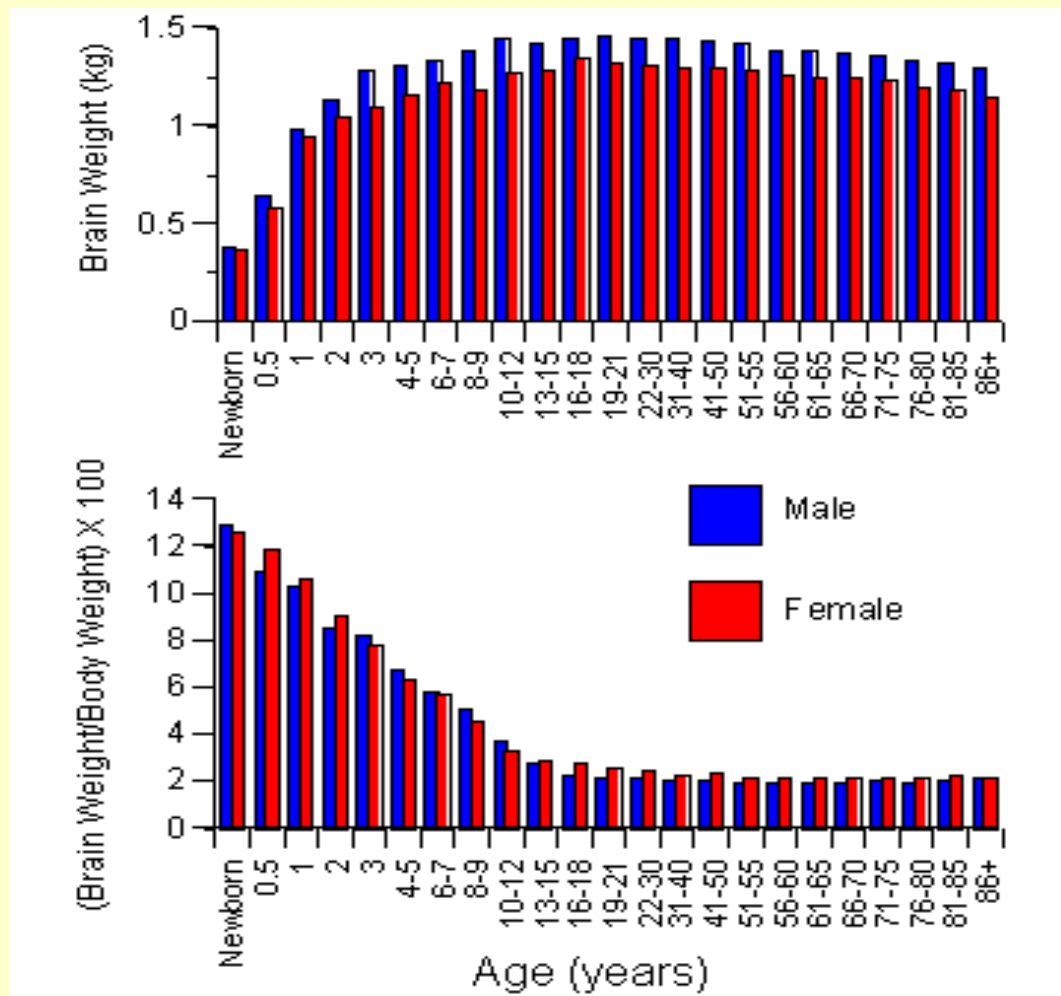
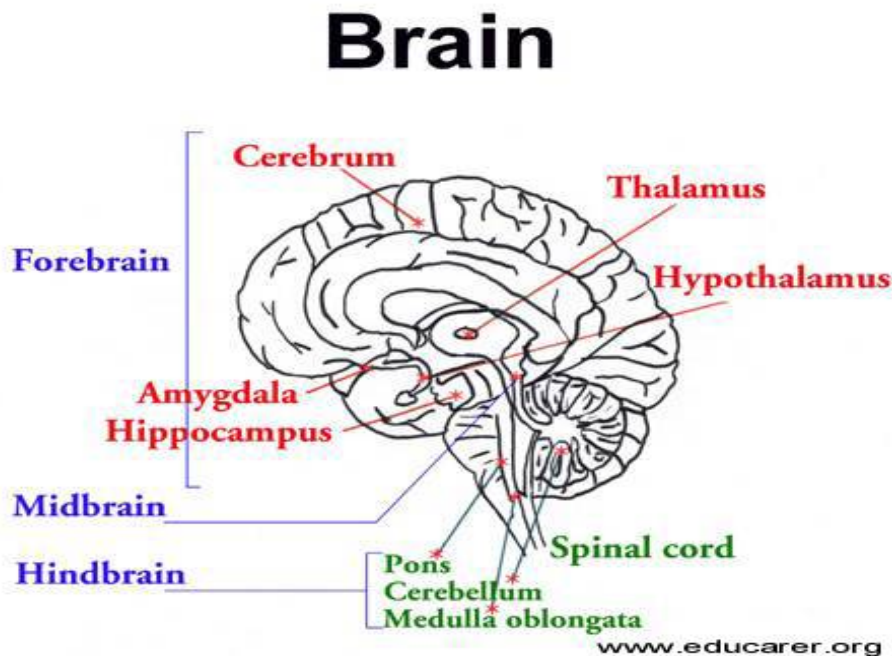


Figure (1-b) shows the brain weight to total body weight ratio (expressed as a percentage). The adult brain makes up about 2% of the total body weight (*Dekaban & Sadowsky, 1978*).

Figure(2) BRAIN COMPONENTS & FUNCTIONS



Brain Structure

The brain is part of the central nervous system, and plays a decisive role in controlling many bodily functions, including both voluntary activities (such as walking or speaking) and involuntary ones (such as breathing or blinking) (*Graham, 2007*).

The brain has two hemispheres, and each hemisphere has four lobes. Each of these lobes has numerous folds. These folds do not all mature at the same time. The chemicals that foster brain development are released in waves; as a result, different areas of the brain evolve in a predictable sequence. The timing of these developmental changes explains, in part, why there are “prime times” for certain kinds of learning and development (*Shore -1, 1997*)

Different parts of the brain control different kinds of functions. Most of the activities that we think of as “brain work,” like thinking, planning or remembering, are handled by the cerebral cortex, the uppermost, ridged portion of the brain. Other parts of the brain also play a