Medical studies department

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

Thesis

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By

Abeer El-Sayed Hamed Mahmoud

M.B.B.Ch, M.Sc. (Pediatrics), Cairo University

Supervisors

Prof. Medhat Hassan Shehata

Professor of Pediatrics
Institute of Postgraduate Childhood Studies
(Medical Studies Department)
Ain Shams University

Prof. Heba Farid Shafei

Professor of Child Health- National Research Center

Dr. Amr Mohamed Kamal El-Khashab

Assistant Consultant of Pediatrics, M.D. Al-Galaa Teaching Hospital

Dr.Eman Anwar Ahmed El-Abd

Fellow of Pediatrics- M.D. (Pediatrics)
Faculty of Medicine, Cairo University

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Ain Shams University

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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

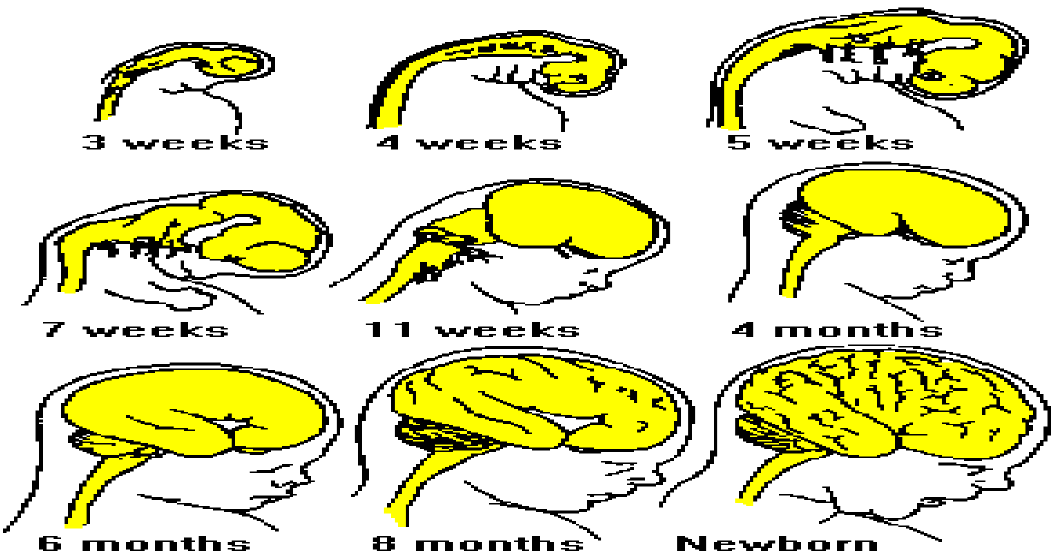


Figure (1-a) shows the brain weights of males and females at different ages.

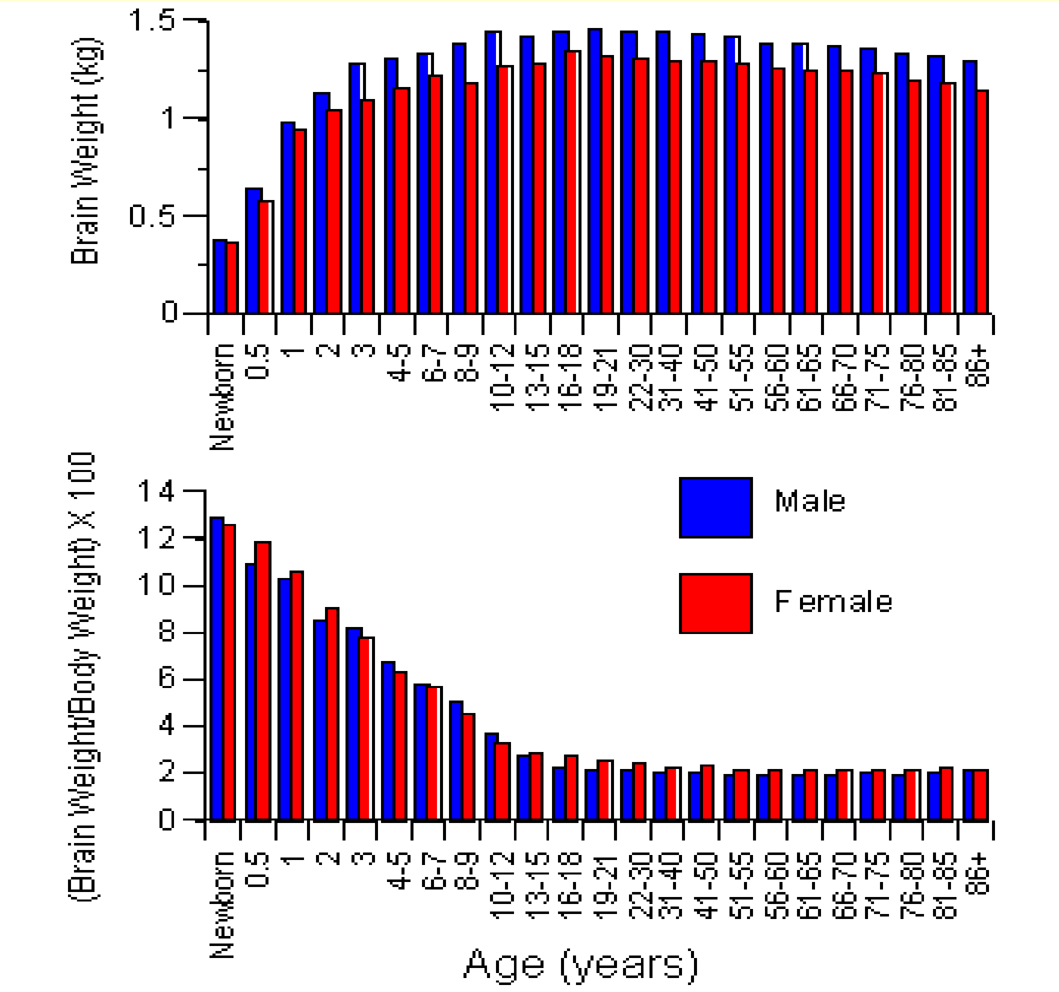
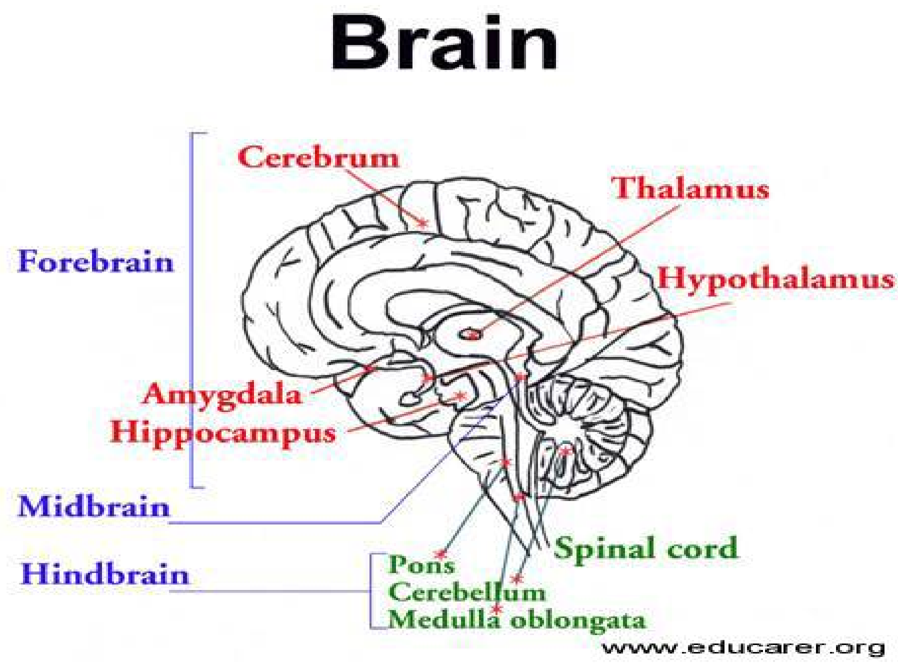


Figure (1-b) shows the brain weight to total body weight ratio (expressed as a percentage). The adult brain makes up about 2% of the total body weight ***(Dekaban& Sadowsky, 1978).***

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