الآية

قال تعالى:

"الـذيـن يـذكـرون الله قـيـامـا وقـعـودا وعـلـى جـنـوبـهـم ويـتـفـكـرون فـي خـلـق الـسـمـوات والأرض ربـنـا مـاخـلـقـت هـذا بـاطـلاً سـبـحـانـك فـقـنـا عـذاب الـنـار"

(سورة آل عمران: الآية 191)

Dedication

To my family

My teachers

And my friends

Acknowledgement

I wouldtothank Allah for giving me strong well throughout my life to look always for the best.

My appreciation to my supervisor Dr. Ahmed Mostafa Abukonna, for his great effort in the advising and teaching me during this research.

Special thanks to the ultrasound department of Omdurman Maternity and Bashair hospitalsforgiving me chance to collect the research data.

Abstract

The cerebellum, the largest part of hind brain, lies in the posterior cranial fossa.In the embryo cerebellum appears at the end of the fifth week as a swelling overriding the fourth ventricle. Assessment of gestational age (G.A.) is important in the management of pregnancy.

This is descriptive, cross sectional study was carried out on ultrasound department in Omdurman maternity hospital and Bashair hospital. The study aim to assess the reliability of trans-cerebellum diameter in compare with the femur length and BPD in predicting gestational age. Fifty pregnant women presented to the Omdurman maternity hospital and Bashair hospital for routine ultrasound examination were selected and gestational age using the femur length and the BPD and Trans-cerebellum diameter was calculated.

The result of the study revealed that is there is no significant difference between gestational age obtained with femur length and BPD and thetrans-cerebellum diameter .The study recommended that the trans-cerebellum diameter can be used as routine measurement in estimation of the gestational age in the second and third trimester.

ملخص البحث

المخيخ هو أكبر جزء من الدماغ الخلفي و يقع في الحفرة القحفية الخلفية. يظهر مخيخ الجنين في نهاية الأسبوع الخامس متجاوزا البطين الرابع. أن تقييم العمر الحملي مهم لمتابعة و رعاية الحمل.

هذه دراسة وصفية مقطعية , تم عملها في قسم الموجات فوق الصوتية بمستشفي امدرمان لامراض النساء والتوليد ومستشفى بشائر. هدف هذة الدراسة دراسة دقة قياس عمر الجنين باستخدام قياس قطر المخيخ مقارنة بعمر الجنين باستخدام طول عظم الفخذ وقياس عرض راس الجنين . المواصفات التي تم عليها تحديد النساء الحوامل لتشملهم الدراسة, هي ان يكون عمر المراة مابين 18-42 سنة , الصفة الثانية هي ان تكون السيدة في الثالوث الثاني اوالثالث. عينة البحث هي خمسين سيدة حامل حضرت الي قسم الموجات الصوتية بمستشفي امدرمان لامراض النساء والتوليد ومستشفى بشائر للكشف الروتيني , وتم قياس عمر الجنين بواسطة قياس طول عظم الفخذ و عرض راس الجنين وقياس قطر المخيخ للجنين , ثم تم تحليل البيانات بواسطة برنامج التحليل الاحصائي . نتيجة البحث هي انه لا يوجد فرق بين عمر الجنين الماخوذ بواسطة طول عظم الفخذ و عرض راس الجنين وقطر المخيخ.

List of contents

List of tables

List of figures

List ofabbreviations

Abbreviations	Meaning
AC	Abdominal circumference
BPD	Biparietal diameter
EDD	Expected date of delivery
FL	Femur length
GA	Gestational age
HC	Had circumference
IUGR	Intrauterine growth retardation
LMP	Last menstrual period
MHz	Mega hertz
SD	Standard deviation
SFD	Small for date
U.S	Ultrasound

Chapter one

1. Introduction

1.1 Introduction:

The cerebellum, the largest part of hind brain, lies in the posterior cranial fossa. It lies dorsal to the pons and the medulla, separated from them by fourth ventricle. Cerebellum is separated from the cerebrum by a fold of duramatercalled the tentorium cerebelli. The cerebellum consists of a midline part called the vermis and two lateral hemispheres. It is roughly spherical but somewhat constricted in its median region and flattened, the greatest diameter being transverse(Herschorn, 2004). The cerebellum develops from the dorsolateral part of the alar lamina of the metencephalon. In the embryo cerebellum appears at the end of the fifth week as a swelling overriding the fourth ventricle. Assessment of gestational age (G.A.) is important in the management of pregnancy. The most frequently used biometric parameters for the estimation of gestational age are the fetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). These parameters have few limitations as conditions altering the shape of skull will affect the BPD which is a well-accepted indicator of GA. So transverse cerebellar diameter (TCD, developed as an alternative parameter of fetal brain growth and for estimation of gestational age.Since cerebellum lies in the posterior cranial fossa, surrounded by the dense petrous ridges and the occipital bone so it can withstand deformation by extrinsic pressure better than the parietal bones. The fetal cerebellum can be visualized with ultrasound easily therefore imaging the posterior fossa is becoming an integral part of many routine fetal sonograms(Herschorn, 2004). Several authors working on transverse cerebellar diameter (TCD) have correlated it well with gestational age, even in the presence of growth retardation and found it as a better marker for GA estimation as compared to other clinical and biometric parameters(Papageorghiou et al., 2016).In the present study, an attempt has been made to evaluate the fetal cerebellar developmentultrasonographically which in turn is helpful in assessing the fetal gestational age.

1.2 Problem of the study:

The main problem is the difficulty to measurement of BPD in fetus with abnormal skull shape, such as dolichocephaly or brachycephaly and Femur length varies somewhat with ethnicity and congenital anomalies of skeleton.

1.3 Objectives:

3.1.1 General objective:

The general objective of this study was to estimate gestational age using trans-cerebellum diameter in ultrasonography.

3.1.2 Specific objectives:

- To predict the accurate measurement ofTCD in second and third trimester.
- To comparegestational age estimated by the TCD with FL and BPD.
- To determine if TCD can be used correctly for GA estimation in the second and third trimesters of pregnancy.

1.4 Overview of the study:

This study falls into five chapters, Chapter one, which is an introduction, It presents the statement of the study problems, objectives of the study. Chapter two contains the background material. Specifically it discusses the anatomy and physiology as well as embryology of the cerebellum. This chapter also includes a summary of previous work performed in this field. Chapter three describes the materials and a method used. Chapter four deals with the results, while Chapter five contains discussion, conclusion and recommendations.

Chapter Two

2. Literature review and back ground studies

2.1 Anatomy:

The cerebellum (Latin for "little brain") is a region of the brain that plays an important role in motor control. It may also be involved in some cognitive functions such as attention and language, and in regulating fear and pleasure responses(Perez et al., 2013). But its movement-related functions are the most solidly established. The cerebellum does not initiate movement, but contributes to coordination, precision, and accurate timing. It receives input from sensory systems of the spinal cord and from other parts of the brain, and integrates these inputs to fine-tune motor activity. Cerebellar damage produces disorders in fine movement, equilibrium, posture, and motor learning(Perez et al., 2013).

Anatomically, the cerebellum has the appearance of a separate structure attached to the bottom of the brain, tucked underneath the cerebral hemispheres. Its cortical surface is covered with finely spaced parallel grooves, in striking contrast to the broad irregular convolutions of the cerebral cortex. These parallel grooves conceal the fact that the cerebellar cortex is actually a continuous thin layer of tissue tightly folded in the style of an accordion. Within this thin layer are several types of neurons with a highly regular arrangement, the most important being Purkinje cells and granule cells. This complex neural organization gives rise to a massive signal-processing capability, but almost all of the output from the cerebellar cortex passes through a set of small deep nuclei lying in the white matter interior of the cerebellum(Mayor et al., 2011).

In addition to its direct role in motor control, the cerebellum is necessary for several types of motor learning, most notably learning to adjust to changes in sensorimotor relationships. Several theoretical models have been developed to explain sensorimotor calibration in terms of synaptic plasticity within the cerebellum. These models derive from those formulated by David Marr and James Albus, based on the observation that each cerebellar Purkinje cell receives two dramatically different types of input: one comprises thousands of weak inputs from the parallel fibers of the granule cells; the other is an extremely strong input from a single climbing fiber(Mayor et al., 2011).The basic concept of the Marr–Albus theory is that the climbing fiber serves as a "teaching signal", which induces a long-lasting change in the strength of parallel fiber inputs. Observations of long-term depression in parallel fiber inputs have provided support for theories of this type, but their validity remains controversial(Mayor et al., 2011).

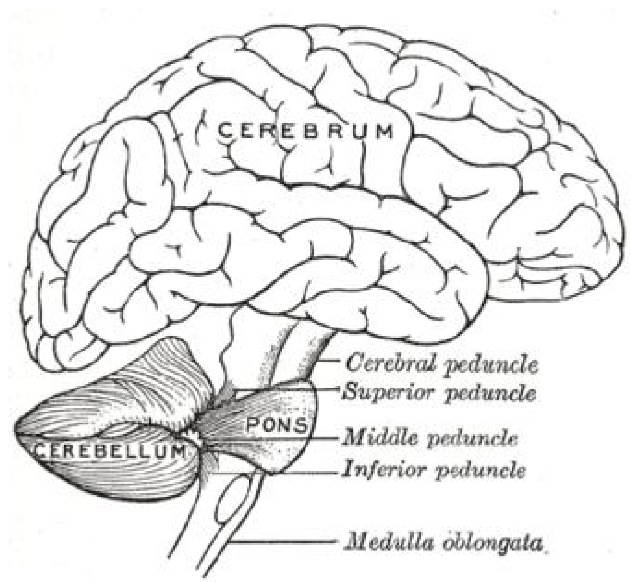

Figure 2-1:show the anatomy of brain(Mayor et al., 2011).

At the level of gross anatomy, the cerebellum consists of a tightly folded layer of cortex, with white matter underneath and a fluid-filled ventricle at the base. Four deep cerebellar nuclei are embedded in the white matter. Each part of the cortex consists of the same small set of neuronal elements, laid out in a highly stereotyped geometry. At an intermediate level, the cerebellum and its auxiliary structures can be separated into several hundred or thousand independently functioning modules called "microzones" or "microcompartments"(Mayor et al., 2011).

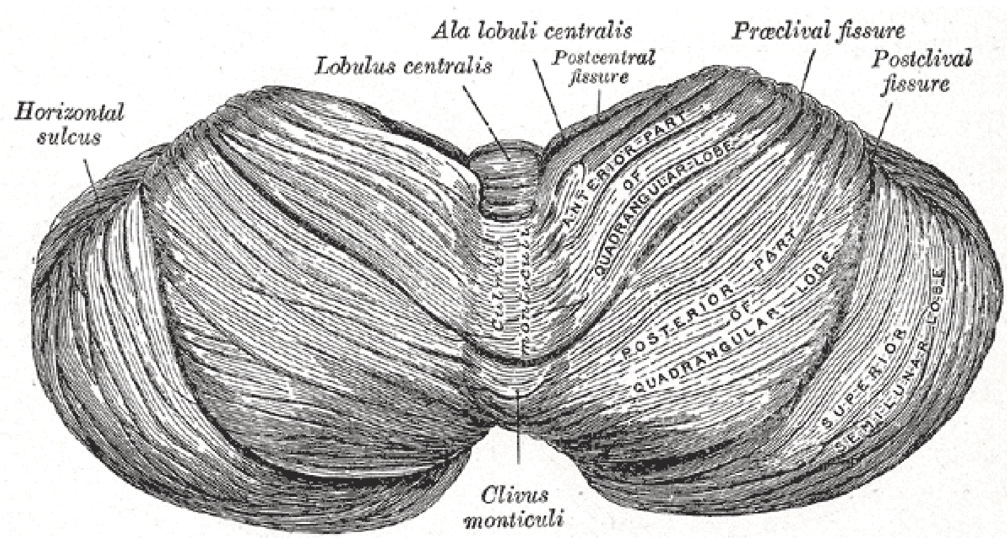

Figure 2.2: show View of the cerebellum from above and behind(Mayor et al 2011).

The cerebellum is located in the posterior cranial fossa. The fourth ventricle, pons and medulla are in front of the cerebellum, it is separated from the overlying cerebrum by a layer of leathery dura mater, the tentorium cerebelli; all of its connections with other parts of the brain travel through the pons. Anatomists classify the cerebellum as part of the metencephalon, which also includes the pons; the metencephalon is the upper part of the rhombencephalon or "hindbrain". Like the cerebral cortex, the cerebellum is divided into two hemispheres; it also contains a narrow midline zone (the vermis). A set of large folds is, by convention, used to divide the overall structure into 10 smaller "lobules". Because of its large number of tiny granule cells, the cerebellum contains more neurons than the total from the rest of the brain, but takes up only 10% of the total brain volume. The number of neurons in the cerebellum is related to the number of neurons in the neocortex. There are about 3.6 times as many neurons in the cerebellum as in the neocortex, a ratio that is conserved across many different mammalian species(Herculano-Houzel, 2010).

The unusual surface appearance of the cerebellum conceals the fact that most of its volume is made up of a very tightly folded layer of gray matter: the cerebellar cortex. Each ridge or gyrus in this layer is called a folium. It is estimated that, if the human cerebellar cortex were completely unfolded, it would give rise to a layer of neural tissue about 1 meter long and averaging 5 centimeters wide—a total surface area of about 500 square cm, packed within a volume of dimensions 6 cm × 5 cm × 10 cm. Underneath the gray matter of the cortex lies white matter, made up largely of myelinated nerve fibers running to and from the cortex. Embedded within the white matter—which is sometimes called the *arbor vitae* (tree of life) because of its branched, tree-like appearance in cross-section—are four deep cerebellar nuclei, composed of gray matter; *c*onnecting the cerebellum to different parts of the nervous system are three paired cerebellar peduncles. These are the superior cerebellar peduncle, the middle cerebellar peduncle and the inferior cerebellar peduncle, named by their position relative to the vermis(Platel, 1989).

The superior cerebellar peduncle is mainly an output to the cerebral cortex, carrying efferent fibers to upper motor neurons in the cerebral cortex. The fibers arise from the deep cerebellar nuclei. The middle cerebellar peduncle is connected to the pons and receives all of its input from the pons mainly from the pontinenuclei. The input to the pons is from the cerebral cortex and is relayed from the pontine nuclei via transverse pontine fibers to the cerebellum. The middle peduncle is the largest of the three and its afferent fibers are grouped into three separate fascicles taking their inputs to different parts of the cerebellum. The inferior cerebellar peduncle receives input from afferent fibers from the vestibular nuclei, spinal cord and the tegmentum. Output from the inferior peduncle is via efferent fibers to the vestibular nuclei and the reticular formation. The whole of the cerebellum receives modulatory input from the inferior olivary nucleus via the inferior cerebellar peduncle(Herculano-Houzel, 2010).

2.2 Embryology of the cerebellum:

Although it is easiest to consider how developmental phases fit together in the mammal, it is important to recognize that, beyond the stereotyped neuronal Purkinje-granule cell circuit, evolutionary variability in cerebellum form reflects variability in how these phases are deployed in the embryo. Thus, the territory that will generate the cerebellum – its ‘anlage’ – is allocated during the early embryonic segmental phase of hindbrain development [in mouse, at approximately embryonic day close to the boundary (the ‘isthmus’) between the hindbrain and the midbrain. However, as we will describe, regulation of patterning in this earliest phase seems particularly important for the development of the uniquely mammalian midline expanded region of the cerebellum known as the ‘vermis’ (Simon et al., 1995).

Lagging behind the establishment of rhombomere boundaries, specific cell types are allocated along the dorsoventral axis. For glutamatergic cells of the cerebellum, this is a remarkably prolonged and, importantly, a dynamic process that takes place at the most dorsal interface between neural and non-neural ‘roof plate’ tissue: the rhombic lip. This phase generates the basic dichotomy between GABAergic and glutamatergic cell types that underlies the conserved Purkinje-granule cell circuit, but, as we will see, it is also responsible for the diversity of cerebellum output connectivity across species(Simon et al., 1995).

Cell type allocation precedes a third, distinct temporal phase of development that extends into early prenatal life (postnatal day 21 in mouse and up to 2 years in humans). Here, the principal derivative of the rhombic lip, the granule cell precursor, accumulates over the surface of the cerebellum and undergoes further rounds of symmetric divisions in a process of transit amplification that exponentially expands its numbers. Growing evidence suggests that this most investigated phase of cerebellum development is substantially reduced or absent in aquatic vertebrates. Because the final form of the mammalian cerebellum is so much a product of the first and third phases of development, we will consider these first before looking at the less well-understood process of cell type allocation(Simon et al., 1995).

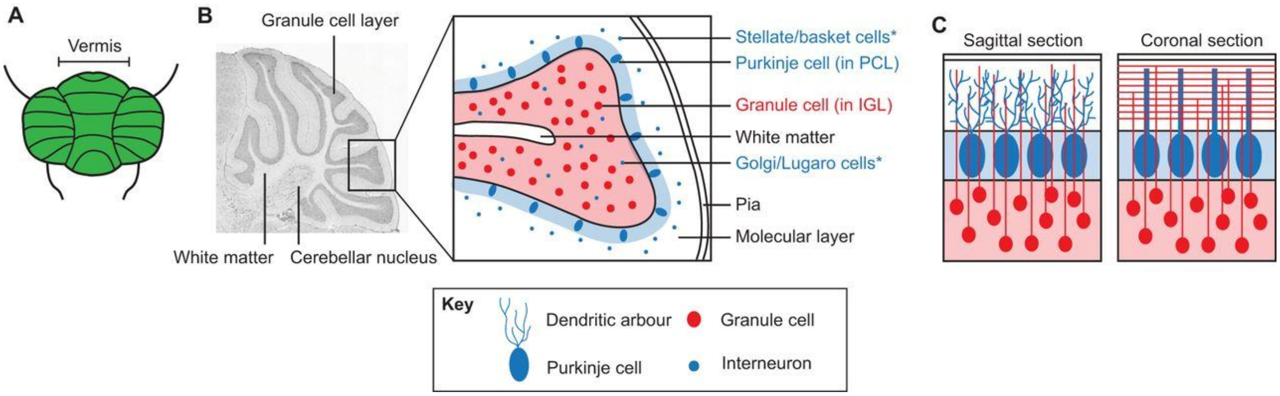

Figure 2.3 Structure of the cerebellum. (A) Viewed superficially, (B) In sagittal section, each folia comprises distinct cellular layers with white matter beneath. (C) Schematic magnified views (sagittal and coronal sections) of the molecular layer of the cerebellum. Granule cell axons form parallel fibers arranged orthogonally to Purkinje cell dendritic arbours.(Simon et al., 1995).

2.3 Function of the cerebellum:

The cerebellum receives information from the sensory systems, the spinal cord, and other parts of the brain and then regulates motor movements. The cerebellum coordinates voluntary movements such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity. It is also important for learning motor behaviors(Platel, 1989).

2.4 Estimation of gestational age:

Gestational age is the age of an unborn baby. It is measured in weeks and days,it is most often based on the date of your last menstrual cycle. There are three stages of pregnancy .they are called trimesters:

The first trimester is from the 1stweek through the 13weeks.

The second trimester is from the 14week through the 27weeks.

The third trimester is from the 28week to the birth of your child.

The age of fetus and due date are usually calculated from the date of the last menstrual period. The due date is estimated to be 40weeks from the day of started last period. An early exam of the uterus and an early positive pregnancy test can help check the baby's age and due date(Orji and Adeyekun, 2014).

Ultrasound can be used to confirm baby's age. The baby can be measured with ultrasound as early as 5 or 6 weeks after the last menstrual period .this method is most accurate in the first half of the pregnancy(Orji and Adeyekun, 2014).

There are many reasons why it is important to know a due date and how far along a pregnancy is. Some reasons are; at specific weeks of pregnancy ,certain things are expected –for example ,hearing the baby's heart beat for the first time, and feelingthe baby's move for the first time. If these things happen when expected, they can be a sign that the baby is doing well. Checking the growth of your uterus and baby can be a done accurately only if the baby age is correctly known. Some very important testes are done only at certain times at pregnancy. It is very important to know your baby's age if there are complications with the pregnancy and the baby needs to be delivered early. Ifthe baby larger or smaller than expected for it is age, then your healthcare provider may recommend additional testing to see if everything is ok with the baby. It is important to know when a baby is overdue so the health of the baby can be watched more carefully(Papageorghiou et al., 2016).

2.4.1 Estimation of gestational age using US in second and third trimesters:

In the second and third trimesters, estimation of gestational age is accomplished by measuring the biparietal diameter,head circumference, abdominal circumference, and femurlength.

The BPD is less reliable in determining gestational age when there are variations in skull shape, such as dolichocephalyor brachycephaly; hence some authors feel that BPD is less reliable than HC(Papageorghiou et al., 2016).

Femur length varies somewhat with ethnicity. Short femurs are commonly a normal variant, however this finding may also indicate fetal growth restriction, aneuploidy, and when severely shortened—skeletal dysplasias(Papageorghiou et al., 2016).

Measurement of the transcerebellar diameter, foot length, clavicle length, intra/interorbital diameters, kidney length, sacral length, scapula length, as well as the length of other long bones of the extremity have also been evaluated to determine gestational age. Studies have not shown that these parameters improve the assessment of gestationalage beyond that achieved with standard biometry, howeverthey may be useful in clinical situations in which traditional biometry is difficult to attain (such as uteroplacentalinsufficiency) or when fetal abnormalities are present(Chavez et al., 2006).

2.4.2 Appearance of cerebellum in ultrasound:

The cerebellum on ultrasound is a dumb _bell shaped and consists of two cerebellum hemispheres and separated centrally by the more hyper echoic regular shaped vermis .the TCD has been used as one of the parameters in estimating fetal gestational age in the second trimester,it has been shown that TCD in millimeter is numerically equivalent to the number of weeks of gestational age(Adeyekun and Orji, 2014).

Grade 1: Seen predominantly up to 27 week of gestationandCerebellar hemisphere is rounded and lacked echogenicity and Vermis poorly developed giving the cerebellum the appearance of an eye glass.

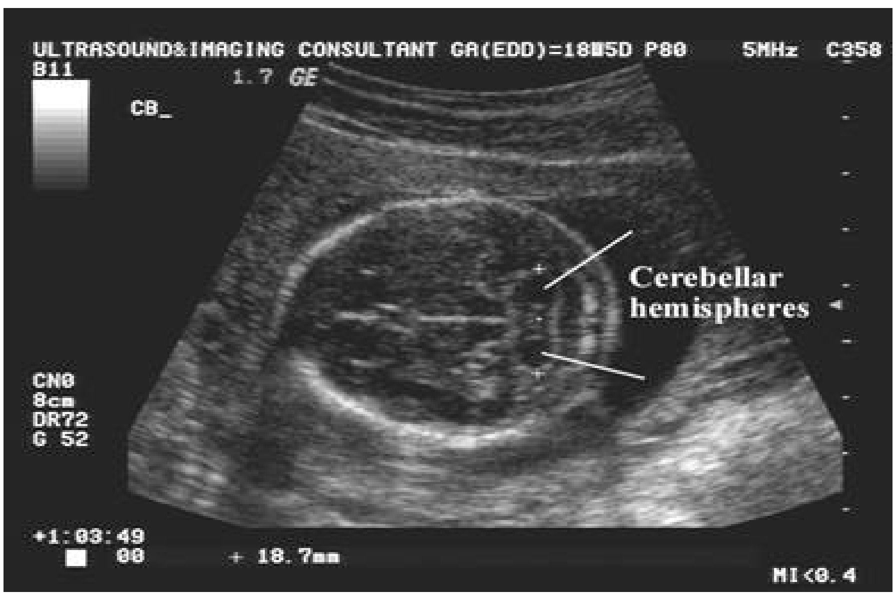

Figure2.4 show cerebellum at 19week.

Grade 2: Seen predominantly from 28-32wks of gestation.Vermis more prominent and appears as echogenic rectangular tissue connecting both hemispheres.

Cerebellar hemisphere is oval and the central portion is more echogenic than the peduncles but less echogenic than the circumferetial margin of the hemispheres.Cerebellum has “dumbbe..” appearance.

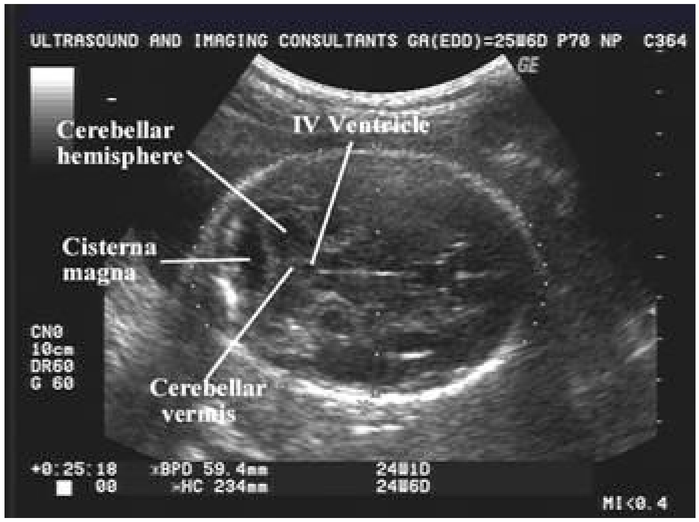

Figure 2.5 showcerebellum.

Grade 3: Seen predominantly after 32-33wks of gestation,Hemispheres become triangular or “fan-shaped”.Echo pattern from the central portion of the hemisphere is now similar to the margin of the vermis and Cerebellum now looks more solid than cystic.

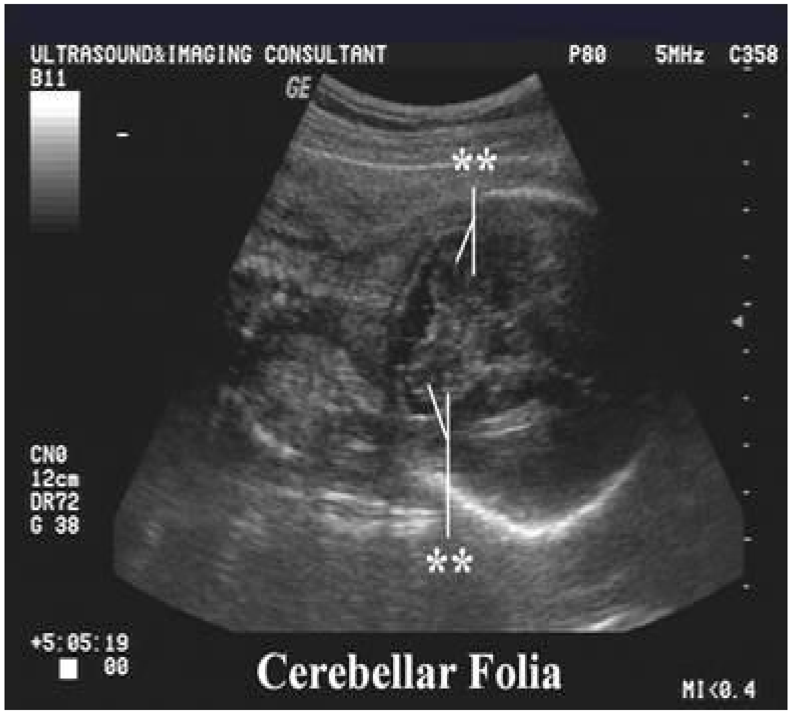

Figure2.6 show cerebellum at third trimester of pregnancy.

2.5 Malformation of cerebellum:

The cerebellar malformations were initially divided into those with hypoplasia and those with dysplasia. Hypoplasia was diagnosed according to the concepts of cerebellar atrophy and hypoplasia. We use the term cerebellar atrophy if the cerebellum was small with shrunken folia and large cerebellar fissures or if it had been shown to undergo progressive volume loss; because atrophy is considered the result of progressive metabolic injury and this study deals with anomalies, patients with cerebellar atrophy were excluded from this study. The term cerebellar hypoplasia is used for patients with a small cerebellum that had fissures of normal size compared with the folia. For the purposes of this study, hypoplasia is considered a disorder of cerebellar formation and patients with the diagnosis of hypoplasia are included. A structure was considered dysplastic if disorganized development, such as abnormal folial pattern or presence of heterotopic nodules of gray matter, was evident. We did not use the concept of hypogenesis of the vermis (formation of superior vermis but not inferior vermis, because we have been shown that it is impossible to differentiate a vermis in which inferior lobules are missing (hypogenetic) from those in which some of the middle lobules are missing (dysplastic). Next, the malformations were divided into those that were generalized (those that involved both cerebellar hemispheres and the vermis) and those that were focal (localized to either a single hemisphere or the vermis)(Nguyen et al., 2016).

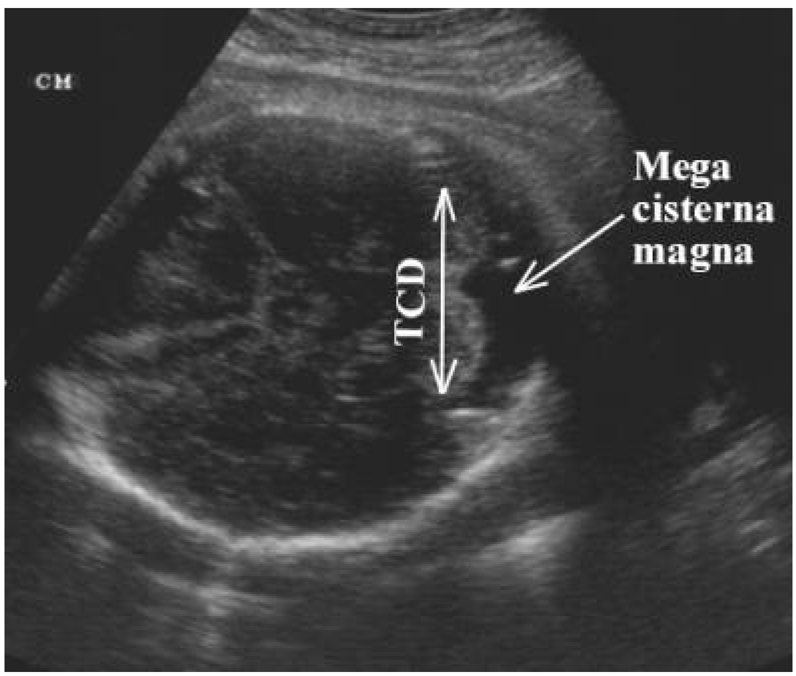

Figure 2.7: show cerebellar hypoplasia(Nguyen et al., 2016).

Previous studies:

Omer AbdElmageed-2012 study the prediction of GA by using TCD in the second and third trimester using US, the study shows that a strong correlation between TCD and expected GAregarding to the growth of cerebellum, but it also showed a significant difference between the two when considering the GA from the 15-38 WKS but it can be used to predict the GA between 15-22 weeks GA in which the TCD in mm is equal to the Gain weeks.Mona Al Sayed Elkafrawy1, Amal Abdel Mageed Ahmed2, Ahmed Hassan SolimanStudied the Correlation of Transverse Cerebellar Diameter with Gestational Age in Normal and Growth Restricted Fetuses (IUGR). This study aims toconfirm the relationship between gestational age and TCD in prediction of gestational age by TCD in normal andIUGR fetuses, and assesses the reliability of TCD measurement. This study was conductedon 330 pregnant women between 14 – 40 weeks fulfilling the inclusion criteria. 300pregnant women with normalpregnancy and 30 pregnant women with IUGR pregnancy all of them aiming for routine ultrasound and antenatalcare at Alzhraa University Hospital. Ultrasound was done for measuring of TCD, BPD, HC, AC and FL to detectgestational age and weight of the fetus, all data were collected and analyzed. The result of the study showed that in normal pregnancy TCDincreases with advancing of age, with a linear relationship between TCD and gestational age, also in pregnancy withIUGR increases with increasing gestational age. Transverse cerebellar diameter in millimeter was found equivalentto gestational age till age of 26 weeks, where the mean of TCD was 17.39mm in 14-20weeks of gestation, 24.44 mmin 21-27 weeks, 32.04mm in 28-37 weeks and 42.73 mm in 35-40 weeks of gestation. The correlation coefficientbetween gestational age and TCD in normal pregnancy was found to be 0.792 with statistically significant, and regression analysis was 85% and 84% in normal and IUGR pregnancy respectively.

Other study conducted by ORJI et.al to evaluate the usefulness of transcerebellar diameter as against the conventional parameters of biparietal diameter and femur length in normal pregnant mother between 15 to 40 weeks. To evaluate theusefulness of transcerebellar diameter in antenatal diagnosis of intrauterine growthretardation and to derive nomograms for estimating the gestational age of the fetus from the measured transcerebellardiameter.Ultrasonographic estimation of gestational age by transcerebellar diameter was done in normal and intrauterine growth retarded pregnancies in 100 pregnant women(80 normal pregnancies and 20 IUGR pregnancies) between 15 to 40 weeks of gestation.The study was conducted in the department of radiodiagnosis in Adichunchangiri Institute of Medical Sciences.Out of the 100 patients who were scanned for the trabscerebellar diameter and other parameters- biparietal diameter, head circumference, abdominal circumference and femur length 80 were of normal pregnancies and 20 were with intrauterine growth retardation. The results obtained were that the patients with normal pregnancy and those with IUGR had no statistically difference with the age and parity. It showed that in 17 out of 20 patients the TCD measurements were within the normal range(between 5th and 95th percentile) and only in 3 patients it was less than 5th percentile but BPD and FL were less than 5th percentile in 18 out of 20 patients and AC,HC measurements were less than 5th percentile in all the 20 patients. This difference was statistically significant,that is TCD measurements were within the normal range in significantly higher number of patients than other ultrasonic measurements.

Chapter Three

3. Materials and Method

3.1 Materials:

3.1.1 Subjects:

This cross sectional study was carried out in ultrasound department of Omdurman maternity hospital and Bashaier hospital. Fifty pregnant women in the second and third trimester of pregnancy were enrolled in the study. Pregnant women at risk or with fetal congenital anomalies were excluded.

3.1.2 Machine used:

The study was performed on gray scale real time Mindry machine Aspire with a 3.5 MHz curved transducers. And hared copy print for documentation .

Method:

3.1.3 Technique used:

By convex probe 3.5 MHz the fetus examined in the following sequences, firstly the patient lie supine with exposed abdomen, then the probe is applied to the center of the abdomen vertically to determine the fetal lie and presentation, then the FL is measured and the gestational age was calculated, and BPD was measured and the resultant estimated gestational age was obtained, TCD was measured in mm which is equivalent to gestational age.

3.1.4 TCD measurement:

The TCD was measured from the suboccipitobregmatic view in winch the anterior horn of the lateral ventricles and cavum are visualized at front of the head together with the cerebellum at the back. The lateral ventricle view required for the BPD was obtained, then rotate the probe slightly downward, toward the fetal neck. The posterior horns of the lateral ventricles will disappear from view to be replaced by cerebellum. Then cerebellum is measured from one outer margin to the other outer margin in transverse.

The fractions in number will not be considered and is overcome for the expected GA, BPD, FL and TCD, assuming that, additional 1-3 days will be neglected. Additionally, days from 4-6 will be neglected and one week will be added to the original estimated week.

3.1.5 Data collection and analysis:

The data collected in the data sheet and then stored in the computer in form of Excel sheet. The collected data was analyzed using Statistical Package for the Social Sciences (SPSS). Paired samples statistics, correlation test, and the relationship between the variables were performed.

Chapter Four

Result

Table 4-1 descriptive statistics for age and TCD

	N	Minimum	Maximum	Mean	Std. Deviation
Age	50	18	42	29.18	5.054
TCD	50	16.0	39.0	31.886	6.3866

Table 4-2 Paired Samples Statistics to compare mean of GA by TCD, BPD and FL

		Mean	N	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pair 1	GA BPD	31.844	50	6.4546	.9128	.797
	TCD	31.886	50	6.3866	.9032	
Pair 2	GA FL	31.756	50	6.3866	.9032	.387
	TCD	31.886	50	6.3866	.9032	

Table 4-3: Shows the significant correlation between the GA and TCD.

		GA	TCD
GA	Pearson Correlation	1	.964**
	Sig. (2-tailed)		.000
	N	50	50
TCD	Pearson Correlation	.964**	1
	Sig. (2-tailed)	.000	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

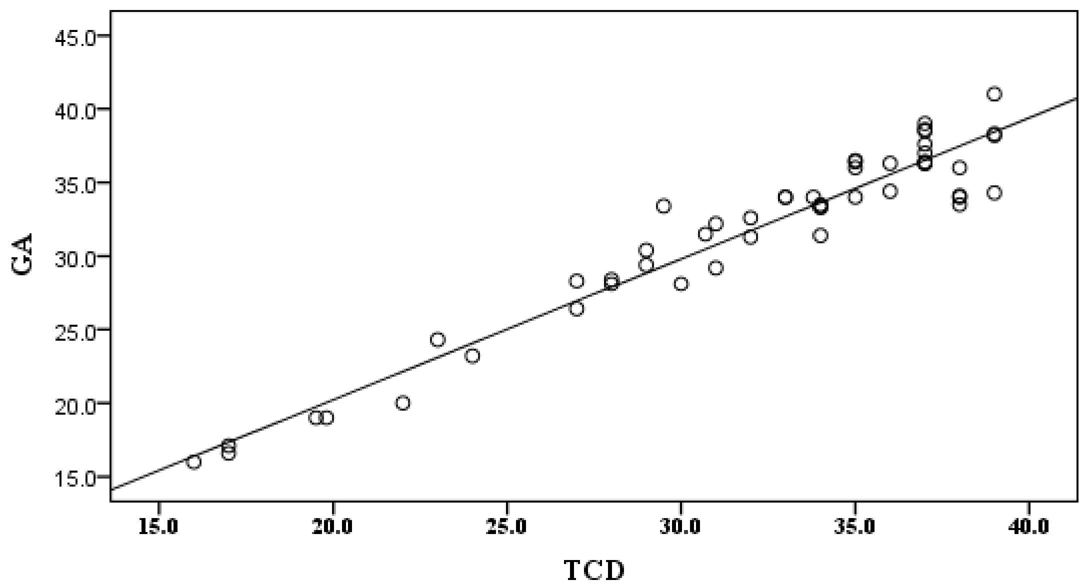

Figure 4-1. Scatter plot shows the predication system to estimate the gestational age in weeks using the TCD in mm.

Table 4-4 Shows the correlation between the gestational age using the TCD versus BPD versus FL.

Correlations

		GA	TCD	GA BPD	GA FL
GA	Pearson Correlation	1	.964**	.971**	.973**
	Sig. (2-tailed)		.000	.000	.000
	N	50	50	50	50
TCD	Pearson Correlation	.964**	1	.984**	.986**
	Sig. (2-tailed)	.000		.000	.000
	N	50	50	50	50
GA BPD	Pearson Correlation	.971**	.984**	1	.992**
	Sig. (2-tailed)	.000	.000		.000
	N	50	50	50	50
GA FL	Pearson Correlation	.973**	.986**	.992**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	50	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion:

Fifty pregnant women referred forroutine ultrasound examination in ultrasound department of Omdurman maternity hospital and Bashaier hospital were scanned, FL and BPDwas used as standard method to estimate gestational age to be compared with the other gestational age that obtained with TCD.

The study revealed that the mean gestational age measured using the TCD 31.88 which was less than week difference from the gestational age calculated from FL and BPD ,so this clarify that there was no significant difference between both measured gestational age in second and third trimesters using BPD and FL.This result was in line with the previous studies (Goel et al., 2010). But disagreed with other, the difference there was significant difference between the two when considering the GA from the 15-38 WKS but it can be used to predict the GA between 15-22 weeks GA in which the TCD in mm was equal to the Gain weeks.

The study also showed significant correlation between GA and TCD measurements.This result was in line with the previous studies which stated that the correlation coefficient between gestational age and TCD in normal pregnancy was found to be 0.792 with statistically significant (P <0.000), and regression analysis was 85% and 84% in normal and IUGR pregnancy respectively(Herculano-Houzel, 2010).

Use of multiple parameters method of assessing gestational age was valid when the gestational age estimated of the various ultrasound parameters are similar. If the gestational age estimates of one or several parameters was greater than 2 weeks different than the estimates of the other parameters either the abnormal ultrasound parameters should be excluded or a different method should be used to estimate gestational age .When the various ultrasound parameters predict different gestational ages the fetus should be Further evaluated to explain these differences .In this study a significant correlation was noticed between gestational age and TCD, this correlation also seen between FL and gestational age .Thus TCD can be added to the formulae that used in the estimation of gestational age .In the pregnancy with unknown menstrual datesor a discrepancy between menstrual dates and mean gestational age predicted by multiple parameters method.However, the potential error of this method in the third trimester of pregnancy may be not being acceptable.

In conclusion, assessment of gestational age was fundamental to obstetric care and should be a carefully thought.Furthermore,TCDcould be used in estimation of gestational age.

5.2 **Conclusion:**

From these results conclude that the transcerebellar diameter measurement in the second and third trimester was accurate in calculation of the gestational age in the fetus with no fetal anomalies. The gestational age calculated using the TCD was another standard parameter used in the second and third trimester to precise measurement of the gestational age. There was no significant difference between the gestational age calculated using the femur length, biparital, and the TCD.

5.3 Recommendations:

1. The gestational age that calculated by the measuring the TCD is another accurate measurement for the fetal age in the second and third trimester and should be used as standard measure when the femur length and biparital are difficult to be obtain.
2. The TCD is the best fetal measure in case of intra uterine growth retardation, because the cerebellum unique brain organ not affected.
3. The TCD is the useful tool for predicting age in diabetics mother,
4. Further studies should be conducted using the cerebellum volume to estimate the fetal weight.

References:

ADEYEKUN, A. A. & ORJI, M. O. 2014. Predictive Accuracy of Transcerebellar Diameter in Comparison with Other Foetal Biometric Parameters for Gestational Age Estimation among Pregnant Nigerian Women. *East Afr Med J,* 91**,** 138-44.

CHAVEZ, M. R., ANANTH, C. V., KAMINSKY, L. M., SMULIAN, J. C., YEO, L. & VINTZILEOS, A. M. 2006. Fetal transcerebellar diameter measurement for prediction of gestational age in twins. *Am J Obstet Gynecol,* 195**,** 1596-600.

GOEL, P., SINGLA, M., GHAL, R., JAIN, S., BUDHIRAJA, V. & BABU, C. R. 2010. Transverse cerebellar diameter-A marker for estimation of gestational age. *Journal of Anatomical Society of India,* 59**,** 158-161.

HERCULANO-HOUZEL, S. 2010. Coordinated scaling of cortical and cerebellar numbers of neurons. *Front Neuroanat,* 4**,** 12.

HERSCHORN, S. 2004. Female pelvic floor anatomy: the pelvic floor, supporting structures, and pelvic organs. *Rev Urol,* 6 Suppl 5**,** S2-S10.

MAYOR, P., BODMER, R. E. & LOPEZ-BEJAR, M. 2011. Functional anatomy of the female genital organs of the wild black agouti (Dasyprocta fuliginosa) female in the Peruvian Amazon. *Anim Reprod Sci,* 123**,** 249-57.

NGUYEN, P. H., ADDO, O. Y., YOUNG, M., GONZALEZ-CASANOVA, I., PHAM, H., TRUONG, T. V., NGUYEN, S., MARTORELL, R. & RAMAKRISHNAN, U. 2016. Patterns of Fetal Growth Based on Ultrasound Measurement and its Relationship with Small for Gestational Age at Birth in Rural Vietnam. *Paediatr Perinat Epidemiol,* 30**,** 256-66.

ORJI, M. O. & ADEYEKUN, A. A. 2014. Ultrasound estimation of foetal gestational age by transcerebellar diameter in healthy pregnant nigerian women. *West Afr J Med,* 33**,** 61-7.

PAPAGEORGHIOU, A. T., KEMP, B., STONES, W., OHUMA, E. O., KENNEDY, S. H., PURWAR, M., SALOMON, L. J., ALTMAN, D. G., NOBLE, J. A., BERTINO, E., GRAVETT, M. G., PANG, R., CHEIKH ISMAIL, L., BARROS, F. C., LAMBERT, A., JAFFER, Y. A., VICTORA, C. G., BHUTTA, Z. A. & VILLAR, J. 2016. Ultrasound-based gestational-age estimation in late pregnancy. *Ultrasound Obstet Gynecol,* 48**,** 719-726.

PEREZ, W., VAZQUEZ, N. & UNGERFELD, R. 2013. Gross anatomy of the female genital organs of the pampas deer (Ozotoceros bezoarticus, Linnaeus 1758). *Anat Histol Embryol*, 42**,** 168-74.

PLATEL, R. 1989. [Anatomy of the brain of the New Zealand Gray Sphenodon punctatus (sphenodontidae). A quantitative study of the principle subdivisions of the brain]. *J Hirnforsch*, 30**,** 325-37.

SIMON, H., HORNBRUCH, A. & LUMSDEN, A. 1995. Independent assignment of antero-posterior and dorso-ventral positional values in the developing chick hindbrain. *Current Biology*, 5**,** 205-214.