Sudan University of Science and Technology

College of Graduate Studies

Measurement of Amniotic Fluid correlated with gestational age during Second and Third Trimester using Ultrasonography

قياس السائل الأمنيوني وعلاقته بعمر الجنين خلال الثلثين الثاني والثالث من الحمل باستخدام الموجات فوق الصوتية

A Thesis Submitted for Partial Fulfillment of the Requirements of M.sc Degree in Medical Diagnostic Ultrasound

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2017

الآية

بسم الله الرحمن الرحيم

قال تعالى:

((إقرأ بإسم ربك الذي خلق (1) خلق الإنسان من علق (2) إقرأ وربك الأكرم (3) الذي علم بالقلم (4) علم الإنسان ما لم يعلم (5)))

صدق الله العظيم

سورة العلق

العلق: ١ - ٥

سورة العلق

Dedication

To My father

My mother

My wife

My teachers

My friends and colleagues

Acknowledgment

My acknowledgement and great fullness at the beginning and end to ***Allah***.
My special gratitude to my supervisor ***Dr. Mona Ahmed Mohammed*** who do her best helping and guiding me this thesis.

I express my deepest gratitude to ***Dr. Asma Ibrahim Ahmed Alamin*** the coordinator of the program for her help, useful advice and sport despite her heavy responsibilities.

I express my respect and acknowledgement to all teachers those I learned on their hands during my education levels

My great thanks to my colleagues in Bashair teaching hospital and Friendship Chinese hospital.

Finally I would like to express my sincere thanks and gratefulness to my colleague ***Mohammed Elhaj Babiker*** for his help me a lot in the preparation and improvement of this thesis.

Abstract

This is a descriptive cross-sectional study conducted in Khartoum state, in departments of ultrasound such as Al Bashaer teaching Hospital, Friendship Chinese Hospital and other clinical centers (Jiraf West clinic center), the duration of study was 6 months from June 2016 to December 2016

The data of this study was collected from 60 pregnant women were scanned in their second and third trimester in group of age 16 – 40 years by using ultrasound machines such as MINDRAY Dp 10, Toshiba and Alpinion E-CUBE 7 with TAS probe 3.5 MHz. The results were analyzed using Statistical Package for Sciences Program System Social (SPSS)

In this study we measure the large single pocket (LSP) and the other four pockets assume together to make amniotic fluid index (AFI), Beside the study results connected the gestational age in second and third trimester with the (LSP) range between (4.5 – 7.6) cm and main is (6.2) cm . Also amitotic fluid index (AFI) range between (8 - 16) cm and main is (11.09) cm

The study found that there is strong negative correlation between GA in weeks and AFI correlation -0037 p – value =(0.008) as the index peak in 28 week and reduce gradualy to term

Finally the study recommended that further studies should be done with larger sample volume to correlate AFL with gestation age

الخلاصة

هذا دراسة وصفية مقطعية أجريت في ولاية الخرطوم، في إدارات مثل البشاير المستشفى التعليمي ومستشفى الصداقة الصينية وغيرها من المراكز السريرية (مركز عيادة الغرب جراف) بالموجات فوق الصوتية، وكانت مدة الدراسة 6 أشهر من حزيران/يونيه عام 2016 إلى كانون الأول/ديسمبر عام 2016

تم جمع البيانات الخاصة بهذه الدراسة من 60 النساء الحوامل تم مسحها ضوئيًا في الثانية والربع الثالث في المجموعة في سن 16 – 40 سنة باستخدام آلات الموجات فوق الصوتية مثل MINDRAY 10 موانئ دبي، توشيبا و 7 هـ-مكعب البينيون مع TAS التحقيق 3.5 ميجاهرتز. تم تحليل النتائج باستخدام "الحزمة الإحصائية" للعلوم البرنامج النظام الاجتماعي (SPSS)

في هذه الدراسة يمكننا قياس جيب واحد كبير (LSP) وأربعة جيوب أخرى تحمل معا لجعل السائل السلوى متصلة الفهرس (AFI)، إلى جانب نتائج الدراسة العمر الحملي في الثانية والربع الثالث مع المجموعة (LSP) بين (4.5-7.6) سم والرئيسية (6.2) سم. كما هو أميتوتيك مؤشر السائل (AFI) يتراوح بين (8-16) سم والرئيسية (11.09) سم

ووجدت الدراسة أن هناك قوي الارتباط السلبي بين ألجأ في أسابيع وارتباط AFI ف-0037-=(0.008) القيمة كمؤشر الذروة في الأسبوع 28 والحد من جرادوالي لمدة

وأخيرًا أوصت الدراسة بأنه ينبغي أن يتم إجراء المزيد من الدراسات مع حجم العينة أكبر للربط بين القوات المسلحة الليبيرية مع سن الحمل

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List of Abbreviations

AF	Amniotic fluid
AC	Amniotic cavity
AFI	Amniotic fluid index
AFV	Amniotic fluid volume
AS	Amniotic sac
ACOG	American College of Obstetricians and Gynecologists
BMI	Body mass index
GA	Gestation age
ER	Emergency room
IV	Intravenous
MAS	Meconium Aspiration Syndrome
RCTs	randomized control trials
SDP	Single deepest pool
PA	Placenta appearance
pH	Potential of Hydrogen
TAS	Trans Abdominal Sonography

CHAPTER ONE

THE INTRODUCTION

Chapter One

Introduction

1.1 Introduction:

Amniotic fluid is present from the formation of the gestational sac. Amniotic fluid is present in the amniotic sac. It is generated from maternal plasma, and passes through the fetal membranes by osmotic and hydrostatic forces. When fetal kidneys begin to function in about week 16, fetal urine also contributes to the fluid this fluid is absorbed through the fetal tissue and skin. After the 20th-25th week of pregnancy when the keratinization of an embryo's skin occurs, the fluid is primarily absorbed by the fetal gut.(Larsen etal., 2001).

Amniotic fluid provides an ideal environment for normal fetal growth and development. It provides the fetus with a source of water, protects the fetus from trauma, allows for normal movements critical for anatomic development, and contributes to the development of the fetal lung (Beall MH etal., 2007).

During the second half of pregnancy, amniotic fluid is made up of the baby's urine and lung secretions. This liquid originally came from the mother, and then flowed through the placenta, to the baby, and out through the baby's bladder and lungs (Brace etal., 1997).

Ultrasound visualization of the amniotic fluid permits both subjective and objective estimates of the amniotic fluid. Subjective evaluation of the amniotic fluid is usually performed in pregnancies less than 20 weeks' gestation (Marino T. 2004).

Semi quantitative methods include estimates of the deepest vertical pool and the amniotic fluid index. Amniotic fluid index, which summates the deepest vertical pool in each of four quadrants, might be referred to as a more sensitive estimate of amniotic fluid volume throughout gestation (Moore TR etal., 1990).

1-2. Problem of study:

There was no standard measurement of amniotic fluid on the second & third trimesters

1-3. Objectives of the study:

1-3-1. General objective:

To Measure the amniotic fluid volume correlated to gestational age in second and third trimester of pregnancy using Ultrasonography.

1-3-2. Specific objective:

1-To measure amniotic fluid. In second & third trimester

2- To correlate between the amniotic fluid and GA.

1- 4. Overviews of the study:

This study consisted of five chapters. Chapter one is an introduction which include: problem, objective of the study, importance of the study and overview of the study. Chapter two is anatomy , physiology , pathology , ultrasound physics, technique and previous studies. Chapter three deal with material and methods. Chapter four deal with results . Chapter five is discussion, conclusions and recommendations.

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CHAPTER TWO

LITERATURE REVIWO & PREVIOUS STUDIES

CHAPTER TWO

Literature Review and Previous Studies

2-1 Anatomy:

2-1-1 The amnion:

The amnion is a membranous sac which surrounds and protects the embryo. It is the first of the three cavities (amnion, chorion and yolk sac) in the embryo and is formed on 8 dpc .The amniotic cavity is roofed in by a single stratum of flattened, ectodermal cells, the amniotic ectoderm, and its floor consists of the ectoderm of the embryonic disc. A thin layer of mesoderm, continuous with that of the somatopleure, is located just outside the amniotic ectoderm, and is connected to the mesodermal lining of the chorion by the body stalk (El-Rakhawy. 2008) .

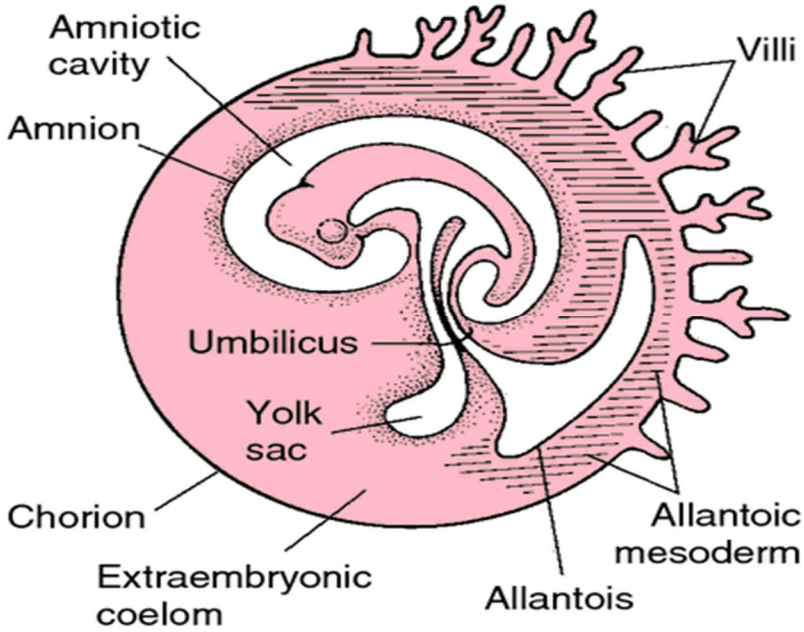


Figure (2-1): Amnion, chorion, and other embryonic membranes surrounding the embryo of a placental mammal. (Dorland's.2000)

2-1-2 Amniotic Fluid (AF):

The amniotic fluid, in which the fetus is suspended in during pregnancy, is situated between the two fetal membranes, the amnion and the chorion. This fluid is a clear, water-like fluid which appears around the 7th week of pregnancy and is filtered out of the maternal blood via the amniotic epithelium into the amniotic cavity. The interior of the amniotic sac is filled with this fluid, which creates the proper environment in the womb, allowing the fetus to move freely and creating a shock- absorbent barrier protecting the fetus from mechanical injury. The fluid also protects the fetus from drying out, and from temperature fluctuations, and it also enables metabolism of the fetus to allow the transport of nutrients. At first it is mainly water with electrolytes, but around the 12-14th week the fluid also contains proteins, carbohydrates, lipids, phospholipids, and urea, which supports the growth of the fetus. The amniotic fluid contains many cell types (i.e., amniocytes) that arise from the developing fetus (derived from the skin, the digestive tract of the developing embryo/fetus, and from the amniotic membrane). Amniotic fluid is obtained from week 14 until the end of the pregnancy. The composition and origin of cells in the amniotic fluid vary as the pregnancy progresses, yielding a heterogeneous population. Both the amniotic membrane and the amniotic fluid contain cells that may be of therapeutic interest (Witkowska etal., 2011).

Figure (2-2): 10-week-old human fetus surrounded by amniotic fluid within the amniotic sac(Witkowska etal., 2011).

2-1-3 Amniotic sac (AS):

The amniotic sac, commonly called the bag of waters, sometimes the membranes, is the sac in which the fetus develops in amniotes. It is a thin but tough transparent pair of membranes that hold a developing embryo (and later fetus) until shortly before birth. The inner of these fetal membranes, the amnion, encloses the amniotic cavity, containing the amniotic fluid and the fetus. The outer membrane, the chorion, contains the amnion and is part of the placenta. On the outer side, the **AS** is connected to the yolk sac, to the allantois and, through the umbilical cord, to the placenta (Larsen, WJ 2001).

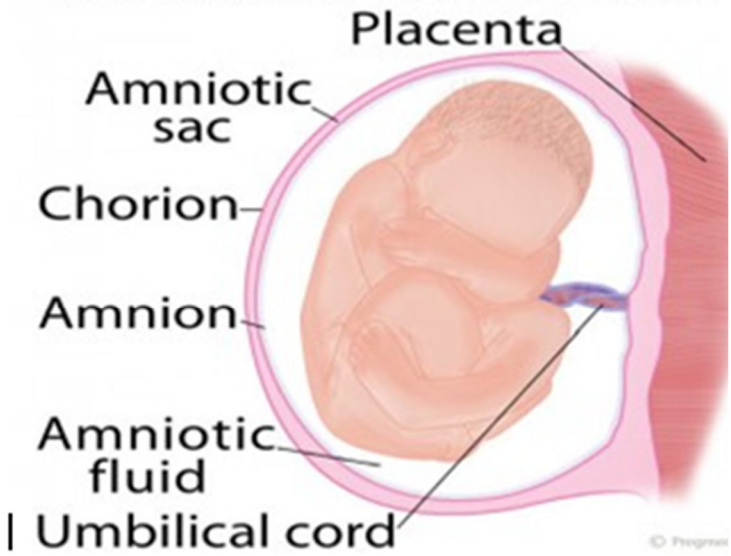


Figure (2-3): Amniotic sac in human embryo 1.3 mm. long (Larsen, WJ 2001).

2-1-4 amniotic cavity (AC):

The amniotic cavity is the closed sac between the embryo and the amnion, containing the amniotic fluid. The amniotic cavity is formed by the fusion of the parts of the amniotic fold, which first makes its appearance at the cephalic extremity, and subsequently at the caudal end and sides of the embryo. As the amniotic fold rises and fuses over the dorsal aspect of the embryo, the amniotic cavity is formed. (Larsen, WJ 2001).

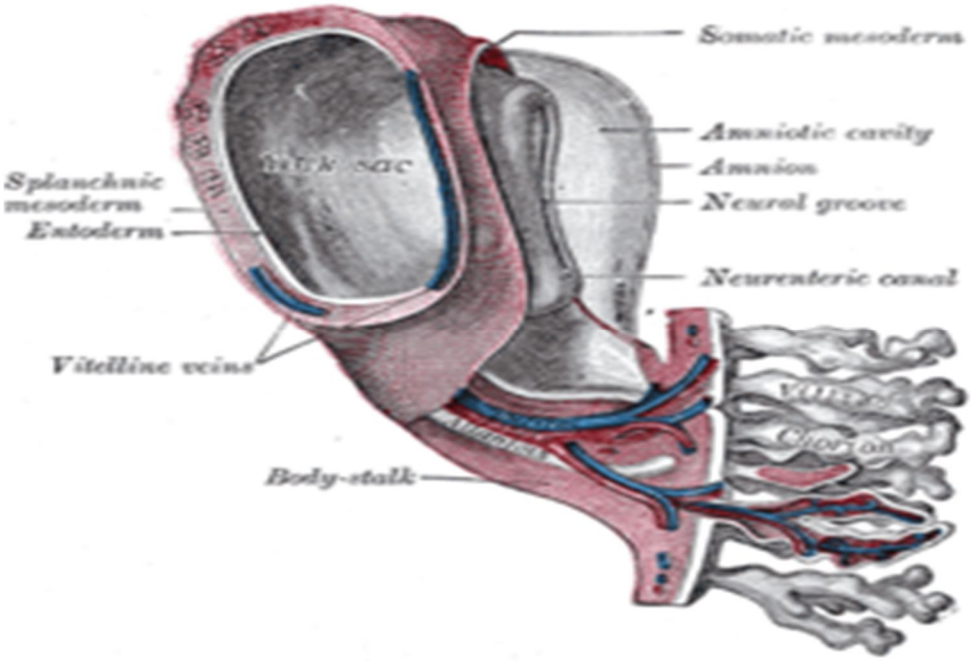


Figure (2-4) :Amniotic cavity in human embryo 1.3 mm. long (Larsen, WJ 2001).

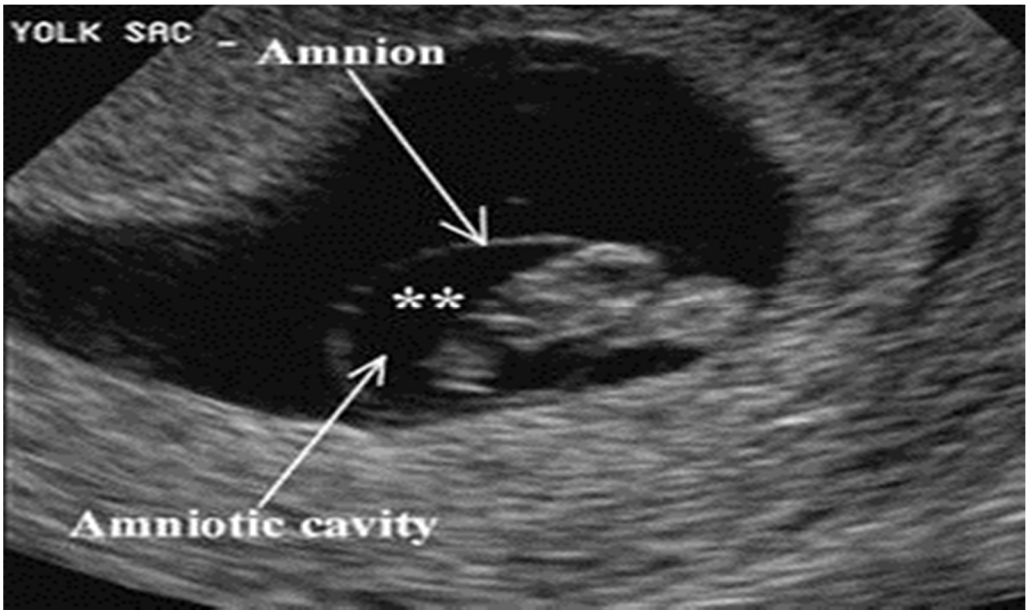


Figure (2-5): Sonographic image with amniotic cavity (Horrow MM1992).

2-2 Physiology of Amniotic fluid:

2-2-1 Amniotic fluid dynamics in the first trimester of pregnancy:

During the first trimester, the amniotic fluid composition is similar to that of fetal plasma. There is bi-directional diffusion between the fetus and the amniotic fluid across the skin that is not keratinized yet, and the surface of the amnion, placenta, and umbilical cord being freely permeable to water and solutes. The amniotic fluid serves as a physiologic buffer and an extension of the fetal extracellular compartment. Neither fetal urination nor swallowing contributes significantly to the amniotic fluid volume until 14 weeks of pregnancy (Underwood MA etal., 2005**)**

2-2-2 Amniotic fluid dynamics in the second and third trimester of pregnancy:

Keratinization of fetal skin begins at 19 to 20 weeks of gestation and is usually complete at 25 weeks after conception. Numerous factors contribute to the formation and removal of amniotic fluid, following keratinization of the fetal skin. Production of amniotic fluid is predominately accomplished by the fetal urine and lung fluid production. Fetal breathing movements contribute to the efflux of the lung secretion into the amniotic fluid. Other contributions consist of oral, nasal, and tracheal secretions (Sherer D, 2002).

Removal of the amniotic fluid is predominately accomplished by fetal swallowing. Additionally an intra-membranous pathway transfers fluid and solutes from the amniotic cavity to the fetal circulation across the amniotic membrane (across the network of blood vessels on the fetal surface of the placenta). Trans-

membranous pathway involves direct exchange across fetal membranes between the fetus and maternal blood within the uterus and affects amniotic volume only minimally (Gilbert W etal., 1993).

A fetus swallows from 200 to 450 ml/day at term, removing 50% of the amniotic fluid produced through fetal urination. This fluid is absorbed through the fetal gastrointestinal system and is either recycled through the kidneys or is transferred to the maternal compartment through the placenta (Pritchard JA 1966).

Amniotic fluid removal may be by the respiratory tract. Fetal respiratory activity has been observed as early as 11 weeks' gestation. At term, Inspiratory flow in the fetus is approximately 200 ml/kg/day, up to 600–800 ml/day. Because amniotic fluid is more hypotonic than fetal plasma, it is postulated that exposure of amniotic fluid to the fetal alveolar capillary bed results in net movement of water from the amniotic cavity into the fetus (Boddy K, etal., 1975).

AF may also potentially be removed by continuous bulk flow (i.e., via hydrostatic and oncotic forces). Exchange of fluid may take place at the chorionic plate, where exposure of the relatively hypotonic amniotic fluid to the fetal surface of the placenta may lead to net reabsorption of water by the fetus (up to 80 ml/day) (Leontic EA, et al ., 1979).

2-2-3 Normal Amniotic Fluid Volume :

Amniotic fluid volume is most predictable in the first half of pregnancy, when it correlates with fetal weight. This may relate to the predominant contribution of fetal skin dialysis to AFV between 8 and 20 weeks. At 12 weeks' gestation, the average volume is 60 ml. By 16 weeks, when genetic amniocentesis is often performed, the mean volume is 175 ml. 15 From 20 weeks on, there is greater variance of amniotic fluid volume (Abramovich DR 1970).

Amniotic fluid volume increases steadily throughout pregnancy to a maximum of 400–1200 ml at 34–38 weeks; however, wide variation does exist. Despite large fluxes of fluid between the various compartments near term (500–700 ml/day through urine; 200–450 ml/day through deglutition), the net increase of amniotic fluid is only 5–10 ml/day in the third trimester (Queenan JT, etal., 1972).

2-2-4 Role of Amniotic fluid :

The amniotic fluid provides a number of important functions to the developing fetus. It contains nutrients and growth factors that facilitate fetal growth. It provides mechanical cushioning and antimicrobial effectors that protect the fetus. Normal fluid is also important in the development of the gastrointestinal, pulmonary and musculoskeletal system, and a new source for stem cells (Holden C.etal., 2007).

2-4 Meconium Aspiration Syndrome :(MAS):

Sometimes, the baby passes their first feces (meconium) shortly before delivery which then mixes with the amniotic fluid. Meconium aspiration syndrome, occurring when the baby inhales this mixture into the lungs, can lead to various congenital conditions (chronic lung disease, hearing loss, limpness at birth) and even death of the infant (martin RJ etal., 2015).

2-5 Amniotic fluid analysis:

Involves collecting a fluid sample from the mother's abdomen (amniocentesis) to assess the genetic health of the developing baby. The fetal cells in the fluid help to determine the risk of any genetic defects. Amniocentesis test is also useful for gender determination (martin RJ etal., 2015).

2-6 Vaginal pH tests :

It can also help to detect various fetal abnormalities. The amniotic fluid pH level ideally ranges between 7.0 and 7.5 while the upper vaginal pH remains between 3.8 and 4.5. So, a pH test strip showing pH levels above 4.5 may indicate ruptured membranes. Other tests used for detecting fetal abnormalities and fluid leakage include fern test and nitrazine paper test. Regular Fundal height measurement can also help to ensure proper fetal growth and detect any change in the fluid levels (Patrica Nassos etal.,2009).

2-6 Signs of Leaking Amniotic Fluid :

Amniotic fluid leakage through the vagina can indicate certain serious complications during any pregnancy stage. A constant feeling of wetness due to continuous vaginal discharge is the main sign of leaking amniotic fluid. However, sometimes it might be quite difficult to determine whether the dampness is occurring due to fluid leakage or is simply caused by excessive sweating or urine leakage (mainly during the third trimester). The following points may help to detect a fluid leakage (Patrica Nassos etal.,2009).

- The smell of the vaginal discharge can help to determine if it is amniotic fluid as the fluid has a characteristic sweetish smell rather than the normal ammonia odor of urine.

- The amniotic fluid may be cloudy or have a light yellowish or greenish or brownish (in case of meconium syndrome) coloration which can help with the identification. Sometimes, the discharge may have a pinkish or reddish tint due to blood in the amniotic fluid, which may indicate some fetal abnormality. However, some women may

have clear amniotic fluid (which does not help with the identification of the discharge). (Patrica Nassos etal.,2009).

2-7 How to Increase Amniotic Fluid Levels:

Certain medical procedures are used for temporarily increasing the amniotic fluid levels for managing the conditions associated with low fluid amounts. (Patrica Nassos etal.,2009).

- **2-7-1 Amnioinfusion**:

It allows increasing the quantity of amniotic fluid by instilling a saline solution into the amniotic sac. (Patrica Nassos etal.,2009).

- **2-7-2 Maternal Re-Hydration**:

This procedure involves rehydrating the mother's body using oral and IV fluids. Due to this reason, pregnant women with low amniotic fluid levels are often asked by their doctors to drink lots of water. (Patrica Nassos etal.,2009).

2-8 Role of ultrasound measurement:

2-9 methods for assessing amniotic fluid volume:

2-9-1 Subjective assessment:

With experience, it is possible to classify amniotic fluid volume into the broad categories absent, low, normal, Increased and excessive. Although reliable in the hands of an experienced operator, this method has proved impossible to standardize in clinical and research terms (Trish Chudleigh, etal., 2004).

2-9-2 Single deepest pool (SDP)– (largest pocket):

The size of the deepest, cord-free pool of amniotic fluid is assessed with the

ultrasound probe perpendicular to the maternal abdomen. The vertical depth of the largest pool is measured. When this method was first introduced, a 1-cm pool was considered acceptable in normal pregnancy, but subsequent studies have suggested (Gilbert 2012).

Figure (2.6): Single deepest pool (SDP) of amniotic fluid. (Gilbert 2012).

2-9-3 Amniotic fluid index (AFI):

This is a semi quantitative technique for assessing amniotic fluid volume. Using the maternal umbilicus as a reference point, the abdomen is divided into four quarters. With the ultrasound probe held in the longitudinal axis of the mother and perpendicular to the floor, the largest vertical pool depth in each quadrant is recorded, the sum of these measurements represents the amniotic fluid index (AFI). (4) Although the AFI is known to vary with gestational age, an AFI < 5 cm is classified as oligohydramnios and an AFI > 20 cm is classified as polyhydramnios Even though this method is accepted as superior to the single deepest pool technique, considerable. (Nabhan, A. F. etal., 2009)**.**

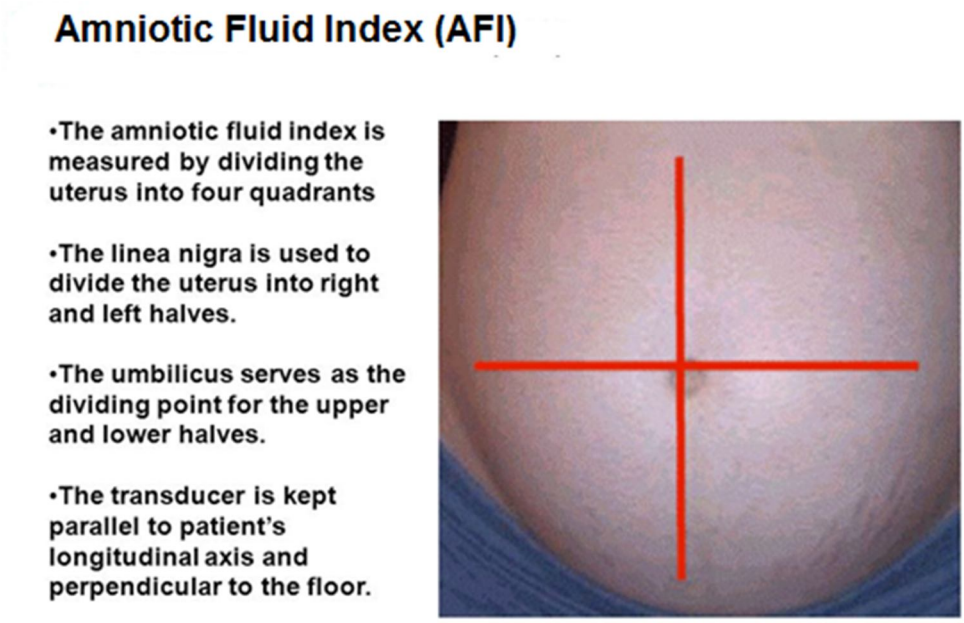


Figure (2-7):diagram divided pregnant abdomen in to four quadrance through her umbilicus (Nabhan, A. F. etal., 2009).

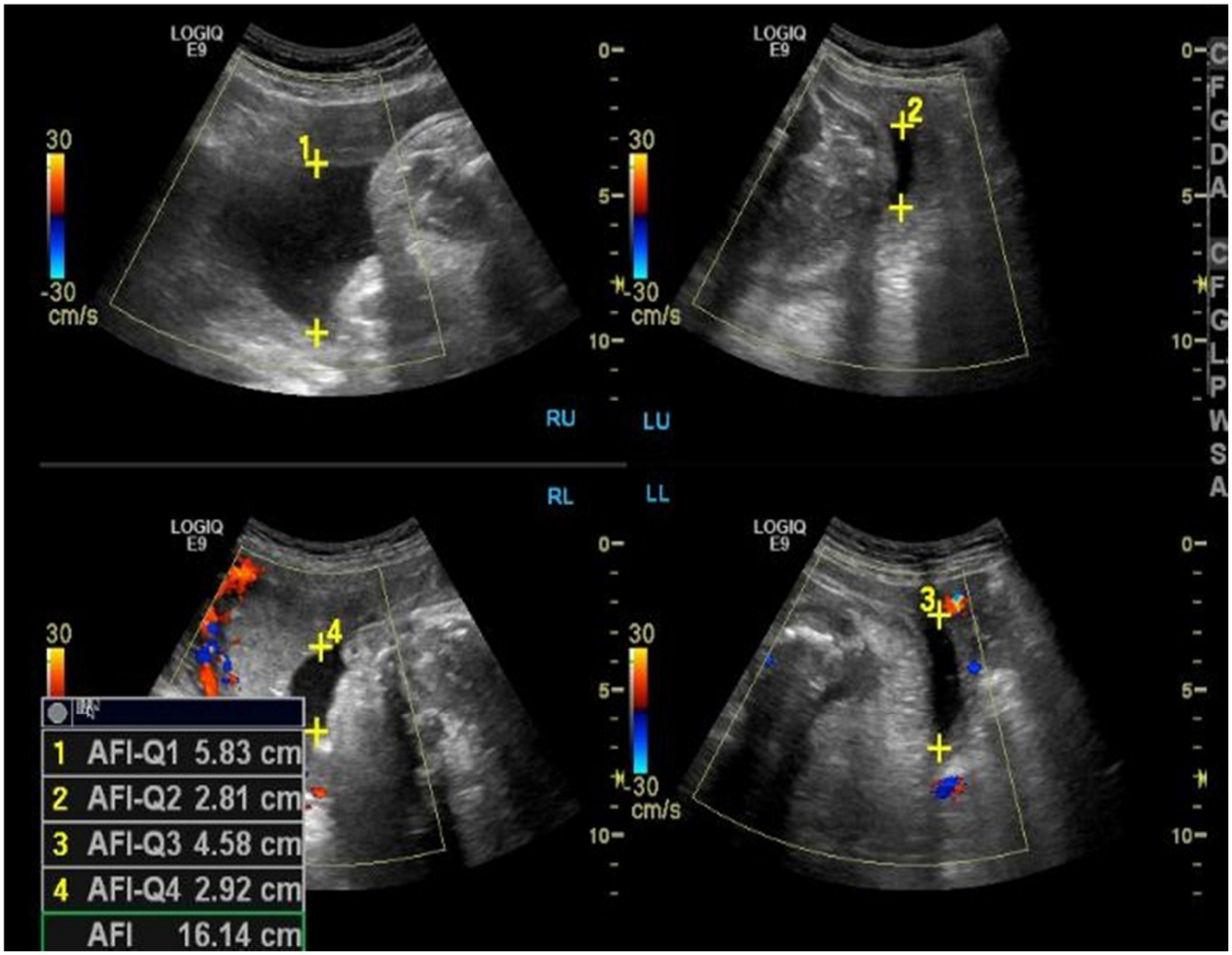


Figure (2-8): Sonographic image show four quadrant with single deepest vertical measurement for normal AFI (Nabhan, A. F. etal., 2009).

2-10 Consistency of Amniotic Fluid:

In general, amniotic fluid appears anechoic throughout pregnancy in the majority of patients at normal gain settings and transducer frequencies. Echogenic amniotic fluid at different stages of gestation can occur and is associated with different etiologies, some physiological and others pathological. In the first trimester of pregnancy, normal amniotic fluid should appear echo free. In contrast, chorionic

fluid frequently appears to have dispersed low amplitude echoes which is especially evident at higher transducer frequencies and gain settings. In the second and third trimesters of pregnancy, amniotic fluid echoes may be seen in normal pregnancies or may be associated with underlying pathological causes including anencephaly and intra-amniotic bleeding. The source of amniotic fluid debris echoes in normal pregnancies is mainly related to desquamated or exfoliated fetal skin cells and vernixcaseosa. Vernixcaseosa is the normal oily substance produced by fetal skin and covering the fetal skin to protect it in its aqueous environment (Devin Dean, .2005).

2-11 Ultrasound Technique:

2-12 Amniotic Fluid Index (AFI):

An ultrasound procedure used to asses the amount of amniotic fluid. The amniotic fluid index is measured by dividing the uterus into four imaginary quadrants. The linea nigra is used to divide the uterus into right and left halves. The umbilicus serves as the dividing point for the upper and lower halves. The transducer is kept parallel to the patient's longitudinal axis and perpendicular to the floor. The deepest, unobstructed, vertical pocket of fluid is measured in each quadrant in centimeters. The four pocket measurements are then added to calculate the AFI. Normal AFI values range from 5 to 25 cm. Based on available data from randomized control trials (RCTs) the American College of Obstetricians and Gynecologists (ACOG) supports the use of the deepest vertical pocket of amniotic fluid volume of 2 cm or less to diagnose oligohydramnios rather than an amniotic fluid index of 5 cm or less (Magann EF, et al 2002).

3-13 Previous studies:

Amniotic fluid is present from the formation of the gestational sac. Amniotic fluid is present in the amniotic sac. It is generated from maternal plasma, and passes through the fetal membranes by osmotic and hydrostatic forces. When fetal kidneys begin to function in about week 16, fetal urine also contributes to the fluid this fluid is absorbed through the fetal tissue and skin. After the 20th-25th week of pregnancy when the keratinization of an embryo's skin occurs, the fluid is primarily absorbed by the fetal gut.(Larsen etal., 2001).

Amniotic fluid provides an ideal environment for normal fetal growth and development. It provides the fetus with a source of water, protects the fetus from trauma, allows for normal movements critical for anatomic development, and contributes to the development of the fetal lung (Beall MH etal., 2007).

During the second half of pregnancy, amniotic fluid is made up of the baby's urine and lung secretions. This liquid originally came from the mother, and then flowed through the placenta, to the baby, and out through the baby's bladder and lungs (Brace etal., 1997).

Ultrasound visualization of the amniotic fluid permits both subjective and objective estimates of the amniotic fluid. Subjective evaluation of the amniotic fluid is usually performed in pregnancies less than 20 weeks' gestation (Marino T. 2004).

Semi quantitative methods include estimates of the deepest vertical pool and the amniotic fluid index. Amniotic fluid index, which summates the deepest vertical pool in each of four quadrants, might be referred to as a more sensitive estimate of amniotic fluid volume throughout gestation (Moore TR etal., 1990).

Intensive studies in the Measurement of Amniotic Fluid correlated with gestational age were conducted in the world. All These studies are considered similar to the current study, and these similar studies have reached conclusions can be summarized as follows.

Sonographic evaluation of the Amniotic Fluid Index in normal singleton pregnancies in a Nigerian population. This study has established the range of amniotic fluid index in this environment which will be a useful guide in the assessment of amniotic fluid volumes. The values are comparable to those found in south western Nigeria but at variance with that in Northern Nigeria. We have also shown that, in this environment, the amniotic fluid index does not change much from about the 25th gestational week to term and it does not correlate with the GA as in other studies in literature. (Igbinidu E etal., 2013).

Sonographic Measurement of Amniotic Fluid Volume in the First Trimester of Pregnancy. This study assume that nomograms of amniotic fluid quantity in the first trimester of pregnancy, calculated from sonographic data. These data can be used in future projects studying amniotic fluid dynamics and pathophysiology in complicated early pregnancies and evaluating fetal well-being asearly as in the first trimester.(WEISSMAN etal., 1996).

Sonographic assessment of amniotic fluid volume between 11 and 24 weeks of gestation: construction of reference intervals related to gestational age . This study assume that the use of an ultrasound semi quantitative method based on the measurement of a single amniotic fluid pocket and involving normal reference intervals according to gestational age could improve the early diagnosis of amniotic fluid variations during the second trimester, although this has yet to be confirmed by extensive clinical trials. (Gramellini et al.2001).

Assessment of Amniotic Fluid Volume in Second and Third Trimester by Ultrasound in Pregnant Women .This study assume that that most pregnant women have normal amniotic fluid volume and abnormal amniotic fluid volume is not common finding. The study shows that the mean of normal AFI from 24 weeks gestational age to 40 weeks gestation age in pregnant women, is 14.33 cm at 24 weeks gestation then it reach it peak of 14.67 cm at 26 weeks gestation and gradually declined to a mean of 8.33 cm at 40 week gestation. Normal amniotic fluid in 88.9% and abnormal occurs in 11.1%. In abnormal amniotic fluid Polyhydramnios occurs in 4.4% and oligohydramnios occurs in 6.7% of 90 pregnant women. The study shows that most causes of Polyhydramnios are of unknown reason and most causes of oligohydramnios are due to Preterm Premature Rupture of Membranes. Mild and moderate types of Polyhydramnios are common types and severe form is the common type of oligohydramnios (ElAwni 2016).

Ultrasonographic Assessment of Normal Amniotic Fluid Index in a Group of Iranian Women .This study determined the curve of normal values of AFI for each gestational age and the upper and lower normal limits in a group of Iranian women. reported an AFI curve for a group of Iranian women with normal pregnancies through a cross-sectional study in our university-affiliated hospital. Our study showed that AFI rises to its peak at the 27th week of pregnancy and gradually falls from the 28th to 42nd week of gestation. Other studies reported an initial peak at the 26th week.(Sh. Birang MD2008).

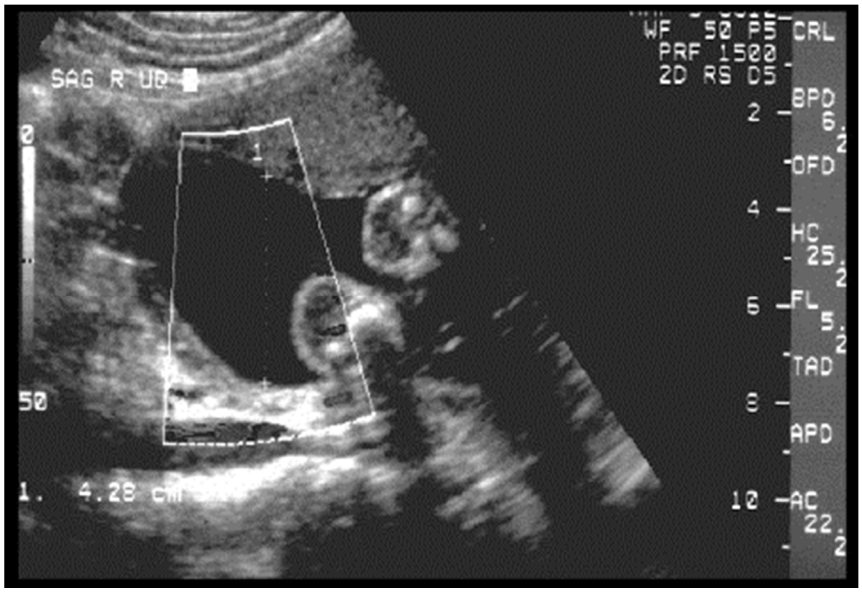


Figure (2-9): Measure the dimensions of the largest vertical pocket of amniotic fluid. (Manning et.al.1981).

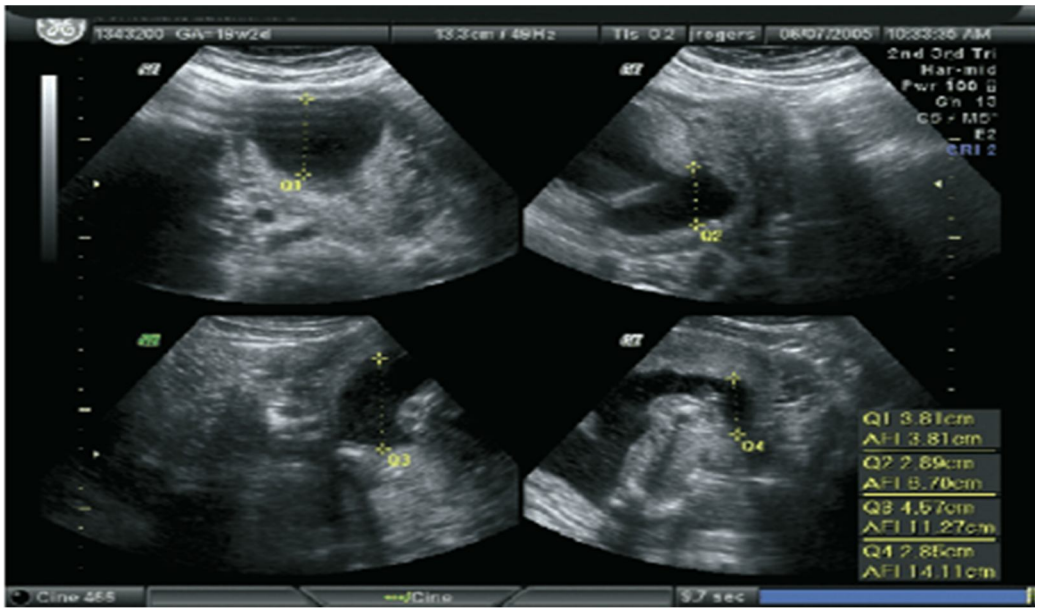


Figure (2-10): Amniotic fluid index calculation in a 19-week gestation pregnancy (Nabhan, A. F. etal., 2009).

Figure (2-11): Profile view of a 20-week fetus with a normal amniotic fluid. (Manning et.al.1981).

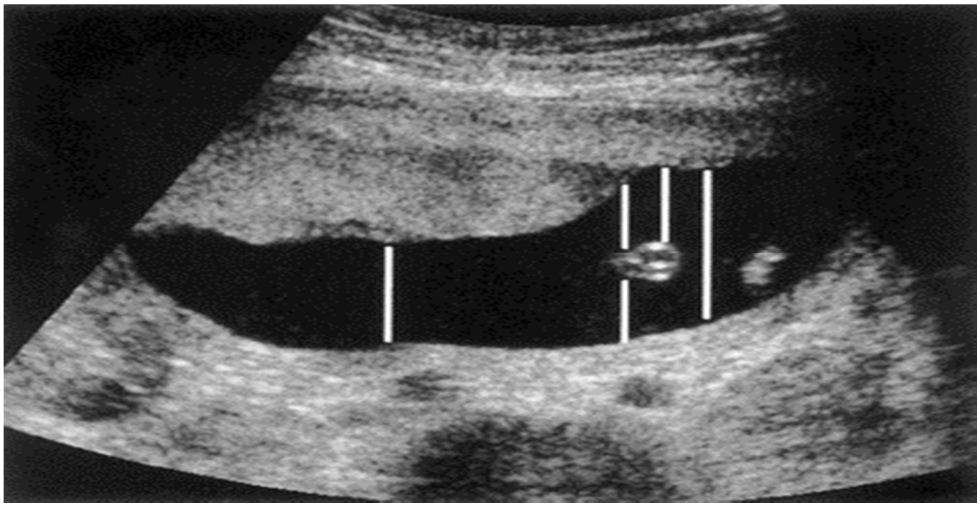


Figure (2-12): Sonogram of a second trimester pregnancy. Measurements of this amniotic fluid pocket measurement(Manning et.al.1981).

Figure (2-13): Visually normal amniotic fluid volume at 18 weeks' gestation ((Manning et.al.1981).

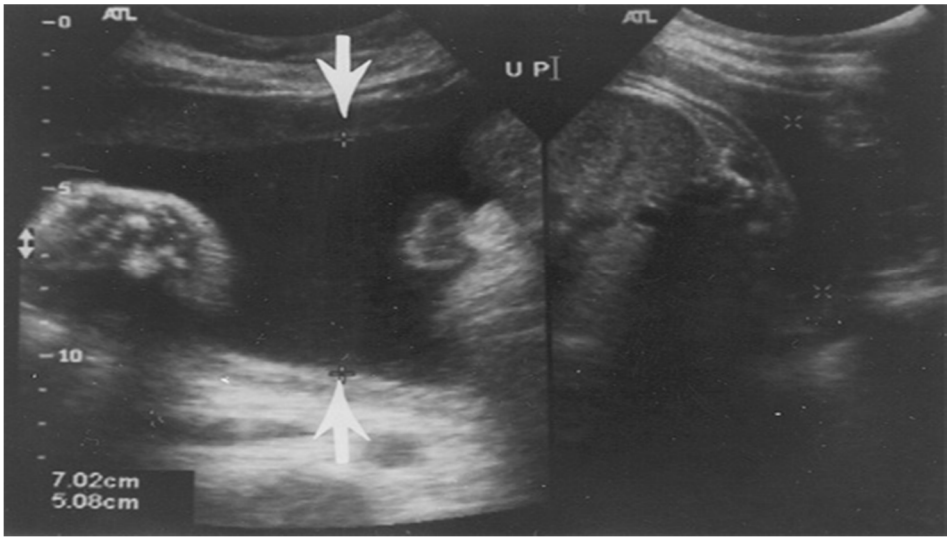


Figure (2-14): 30 week gestation. A single deepest pocket of amniotic fluid (7 cm), indicating a normal amniotic fluid volume. (Manning et.al.1981).

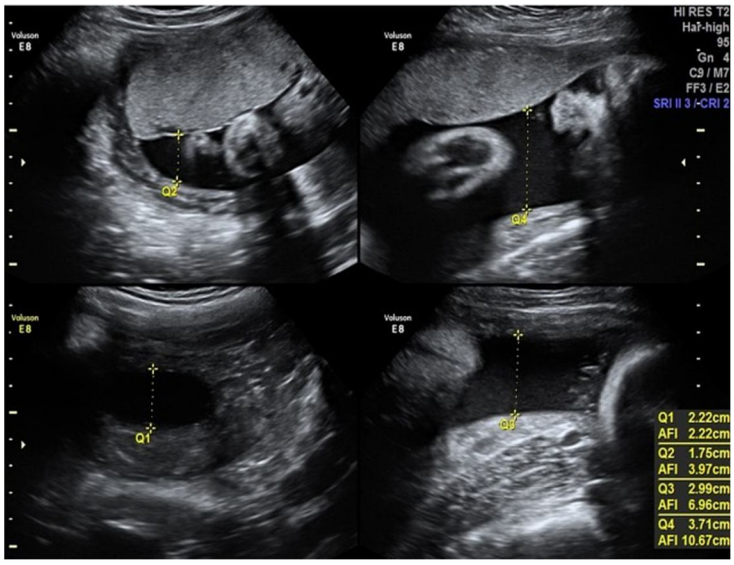


Figure (2-15): Female 25 y Representative image of amniotic fluid index (AFI) measuring AFI is normal. (Manning

CHAPTER THREE

MATERIAL & METHODS

Chapter three

Material and Methods

3.1 Study design:

This study was analytical and descriptive study deal with the role of ultrasound in evaluation of amniotic fluid volume and it's consistency in normal pregnant women among Sudanese population .

.3.2 Study area:

The study was conducted in:

-Bashair Teaching Hospital.

-Chainse Friendship Hospital Omdurman

-West- Geraf clinic center.

3.3 Study duration:

The study was carried out From June 2016 to December 2016.

3.4 Study population:

60Sudanese pregnant women in second and third trimesters.

3.5 Inclusion criteria:

All normal pregnant women in 2^{nd} and 3^{rd} trimesters.

3.6 Exclusion criteria:

twins pregnant.

diabetes pregnant

3.7 Study variables:

This study will be collected using the following variables; Age (maternal age), Body mass index, Gestational age, SLP (single largest pocket), AFI (amniotic fluid index), PA (Placenta appearance) and consistency of amniotic fluid.

3.8 Tool of data collection:-

The data was collected by using ultrasound machine, data collection sheet and Questionnaire.

3.9 Equipments:

Different types of ultrasound machines were used:

1- MINDRAY Dp 10 with TAS probe 3.5 MHZ, made of manufacturing: china.

2- Toshiba Japanese ultrasound device

3- Alpinion E-CUBE 7 ultrasound machines

3.10 Sonographic technique:

Pregnancy patient comes to the obstetrics department and the technique for all examinations as follow :-

Patient position is generally performed with the patient in Supine position. with Trans Abdominal Sonography (TAS) . A copious amount of scanning gel is applied to the transducer tip to ensure good transducer skin contact and easy movement of the transducer. We use 3.5 MHz trans abdominal transducer or 5 MHz for thin women.

3.11 Ultrasound procedure:

An ultrasound procedure used to assess the amount of amniotic fluid. The single largest pocket measured the normal values range from 3 to 8 cm then the amniotic fluid index is measured by dividing the uterus into four imaginary quadrants. The linea nigra is used to divide the uterus into right and left halves. The umbilicus serves as the dividing point for the upper and lower halves. The transducer is kept parallel to the patient longitudinal axis and perpendicular to the floor. The deepest, unobstructed, vertical pocket of fluid is measured in each quadrant in centimeters . The four pocket measurements are then added to calculate the AFI. Normal AFI values range from 5 to 20 cm Each patient will be scanned

twice, in an international scan guidelines and protocols. Firstly by the researcher then by a qualified sinologist to confirm the findings and diagnosis.

3.12 Data analysis:

-The data analyzed by statistically package for social sciences (SPSS)

3.13 data storage:

-The data was stored on personal computer and compact disk.

3.14 Ethical consideration:-

- Data was collected from different patient with maintain privacy and confidentiality.

-No patient information was published throughout this study

CHAPTER FOUR

THE RESULTS

Chapter Four

The Results

This chapter consists the results of measurements of amniotic fluid & GA in normal pregnancy during second & third trimester of pregnancy by using Ultrasonography, and the following tables demonstrate the data which collected from the patients.

Table (4.1) frequency distribution of age of pregnant women's

Age of mothers	Frequency	Percent	Valid Percent	Cumulative Percent
15-25 years	26	43.3	43.3	43.3
26-36 years	25	41.7	41.7	85.0
more than 36 years	9	15.0	15.0	100.0
Total	60	100.0	100.0	

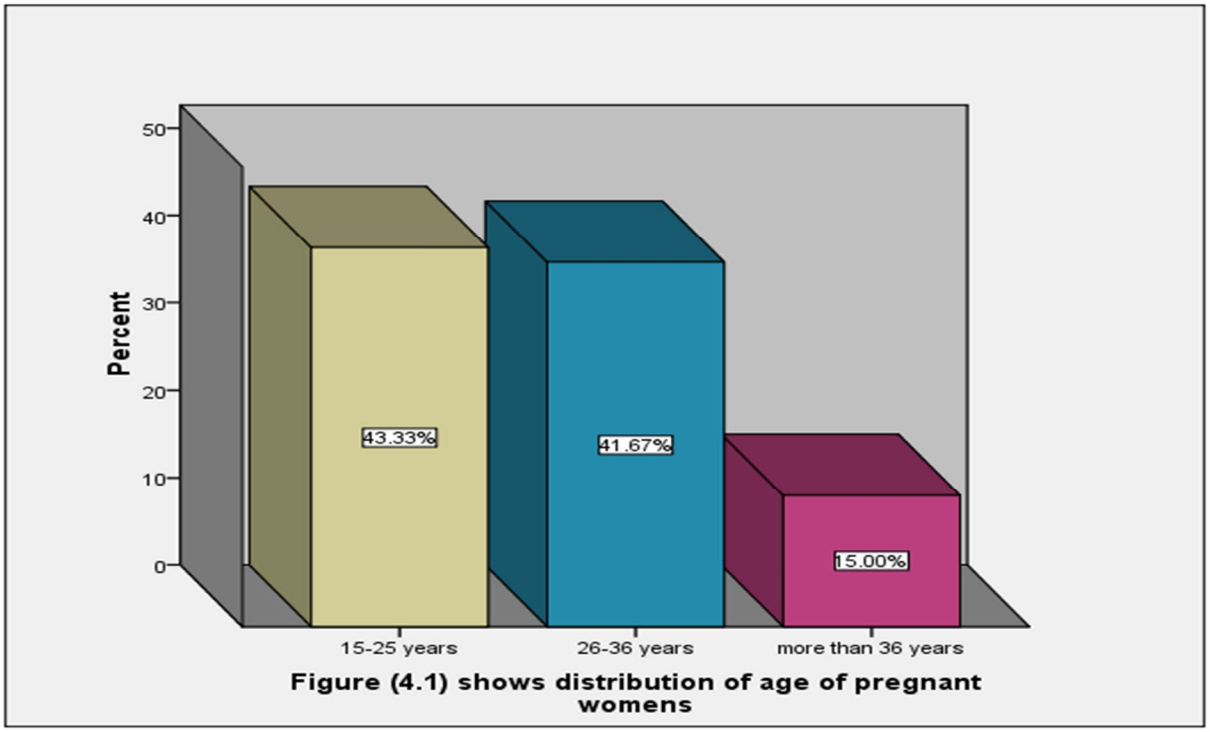


Figure (4.1) shows distribution of age of pregnant womens

Table (4.2) shows descriptive statistic of age, weight, height, BMI of mothers and amniotic fluid measurement (LSP &AFI), mean, minimum, maximum and std. Deviation

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age of mother	60	16.00	42.00	27.2167	6.83979
Weight of mother	60	58.00	85.00	68.5667	4.54073
Height of mother	60	154.60	176.00	164.392	54.4740
BMI of mother	60	22.57	29.38	25.3810	1.52664
Larger Single Pocket	60	4.50	7.60	6.1867	.56041
Amniotic Fluid Index	60	8.00	16.00	11.0983	1.75448
Gestational age	60	15.57 (15wks4d)	38.86 (38wks6d)	28.1238 (28wks1d)	6.87676
Valid N (listwise)	60				

Table (4.3) frequency distribution of larger single pocket (LSP) cm

Larger single pocket	Frequency	Percent	Valid Percent	Cumulative Percent
4-5 cm	2	3.3	3.3	3.3
5.1-6 cm	26	43.3	43.3	46.7
6.1-7cm	29	48.3	48.3	95.0
7.1-8 cm	3	5.0	5.0	100.0
Total	60	100.0	100.0	

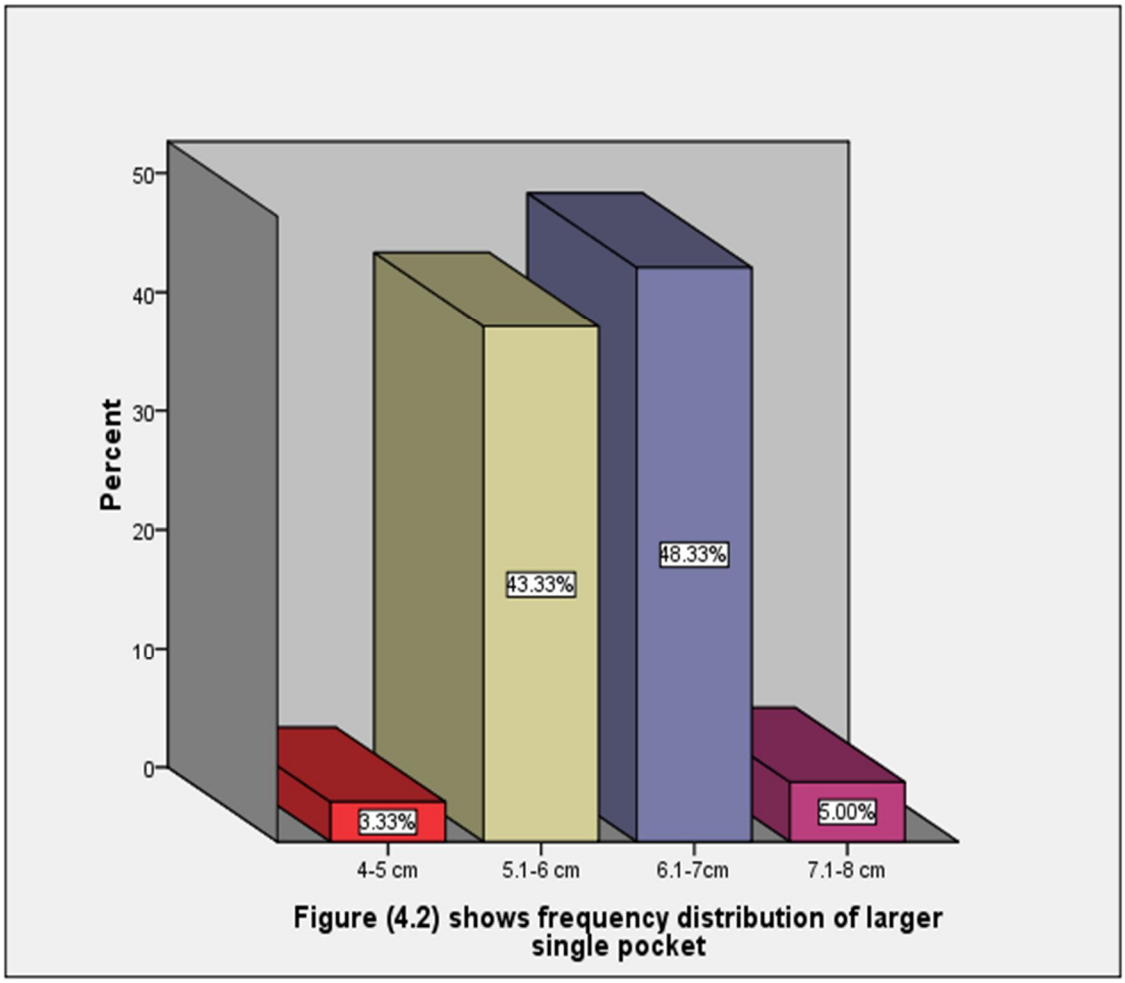


Figure (4.2) shows frequency distribution of larger single pocket

Table (4.4) frequency distribution of amniotic fluid index (AFI) cm

AFI	Frequency	Percent	Valid Percent	Cumulative Percent
8-10 cm	17	28.3	28.3	28.3
10.1- 12 cm	27	45.0	45.0	73.3
12.1-14 cm	13	21.7	21.7	95.0
14.1-16 cm	3	5.0	5.0	100.0
Total	60	100.0	100.0	

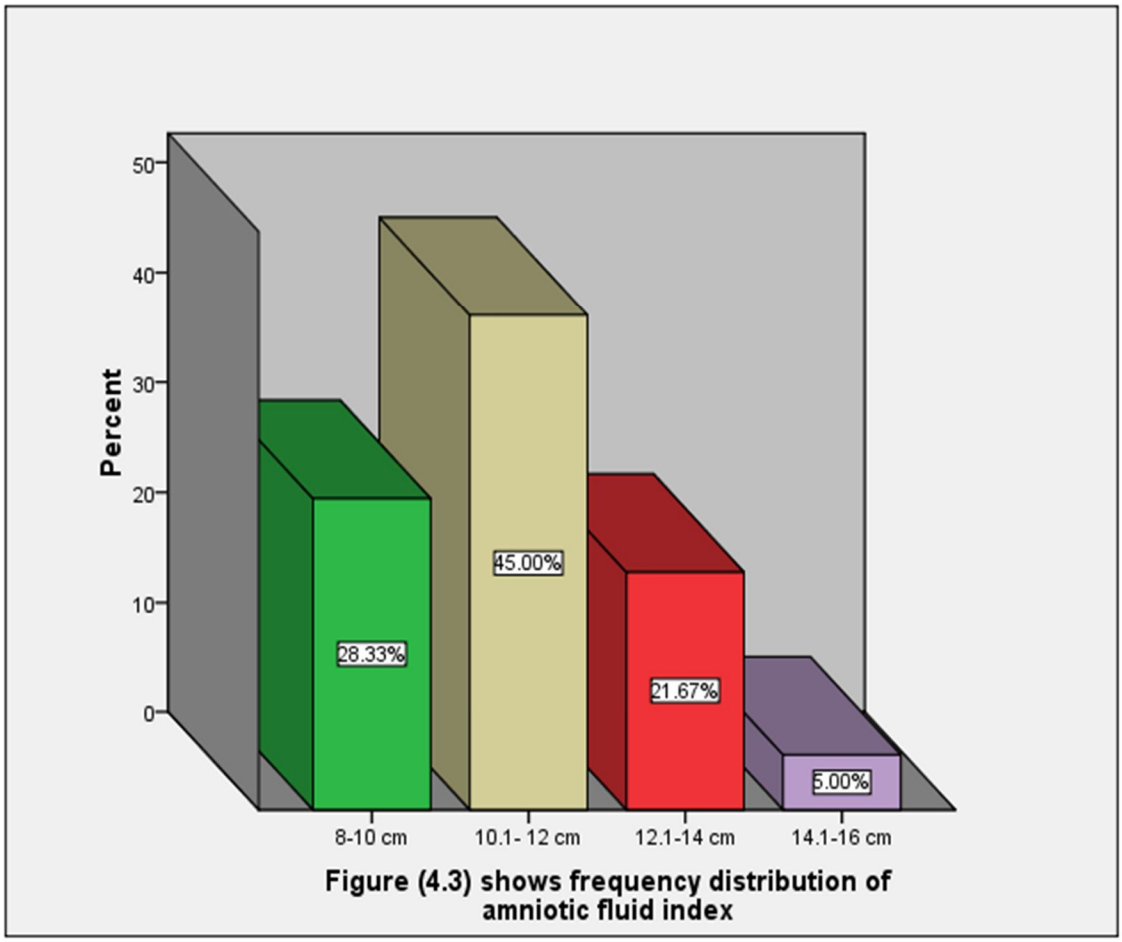


Figure (4.3) shows frequency distribution of amniotic fluid index

Table (4.5) frequency distribution of gestational age per weeks

Gestational age per weeks	Frequency	Percent	Valid Percent	Cumulative Percent
15- 22 weeks	16	26.7	26.7	26.7
22w1d -28 weeks	13	21.7	21.7	48.3
28w1d-34 weeks	17	28.3	28.3	76.7
34w1d-40 weeks	14	23.3	23.3	100.0
Total	60	100.0	100.0	

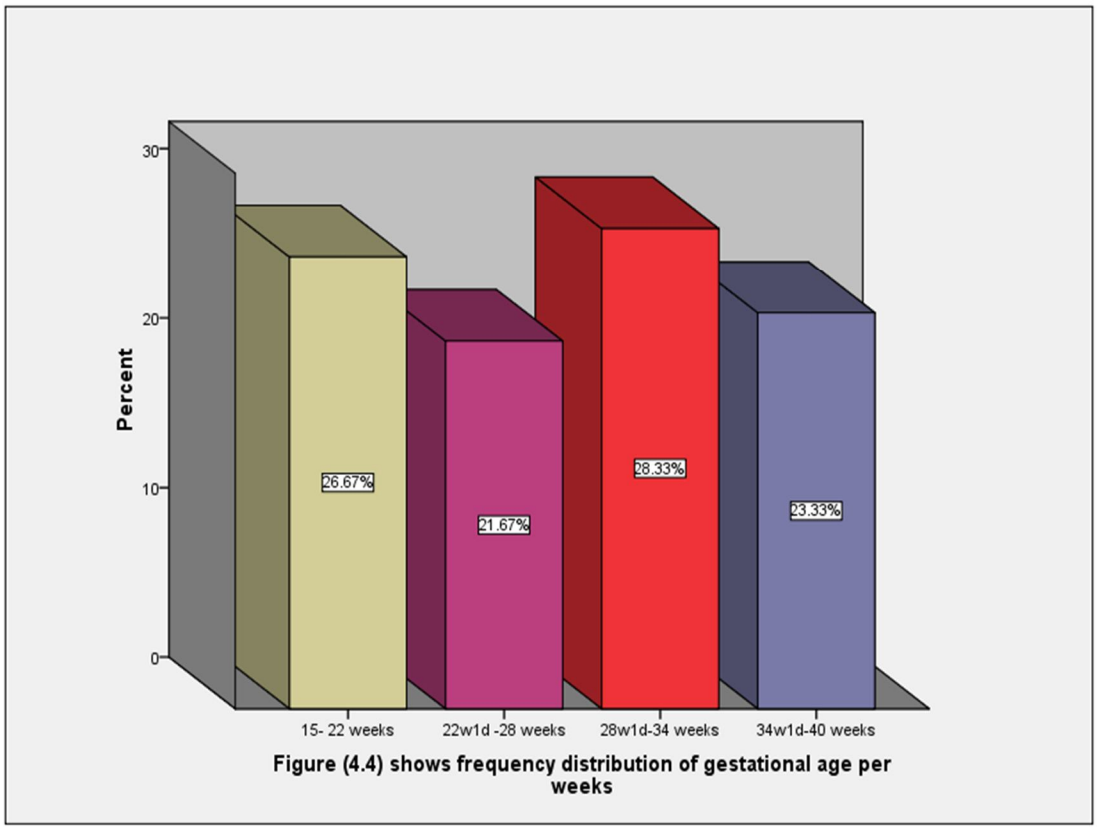


Figure (4.4) shows frequency distribution of gestational age per weeks

Table (4.6) cross tabulation gestational age per weeks and LSP

GA	LSP				Total
	4-5 cm	5.1-6 cm	6.1-7cm	7.1-8 cm	
15- 22 weeks	1	8	7	0	16
22w1d -28 weeks	0	4	8	1	13
28w1d-34 weeks	0	6	10	1	17
34w1d-40 weeks	1	8	4	1	14
Total	2	26	29	3	60
P value =0.666					

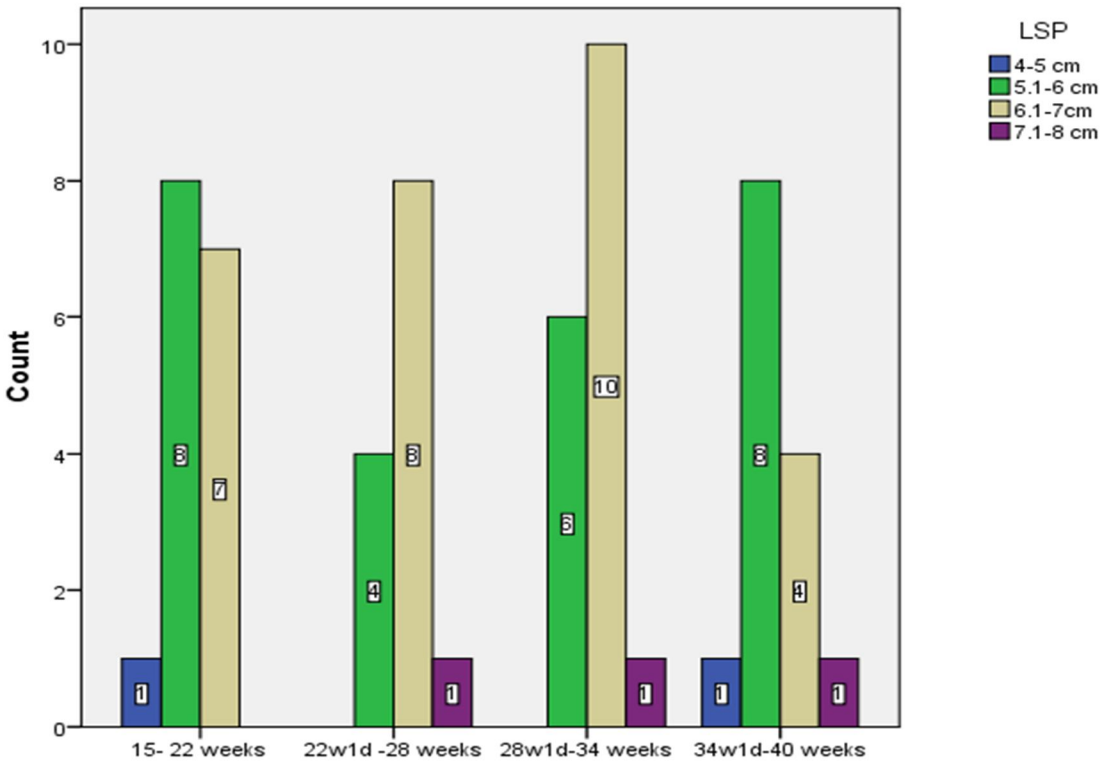
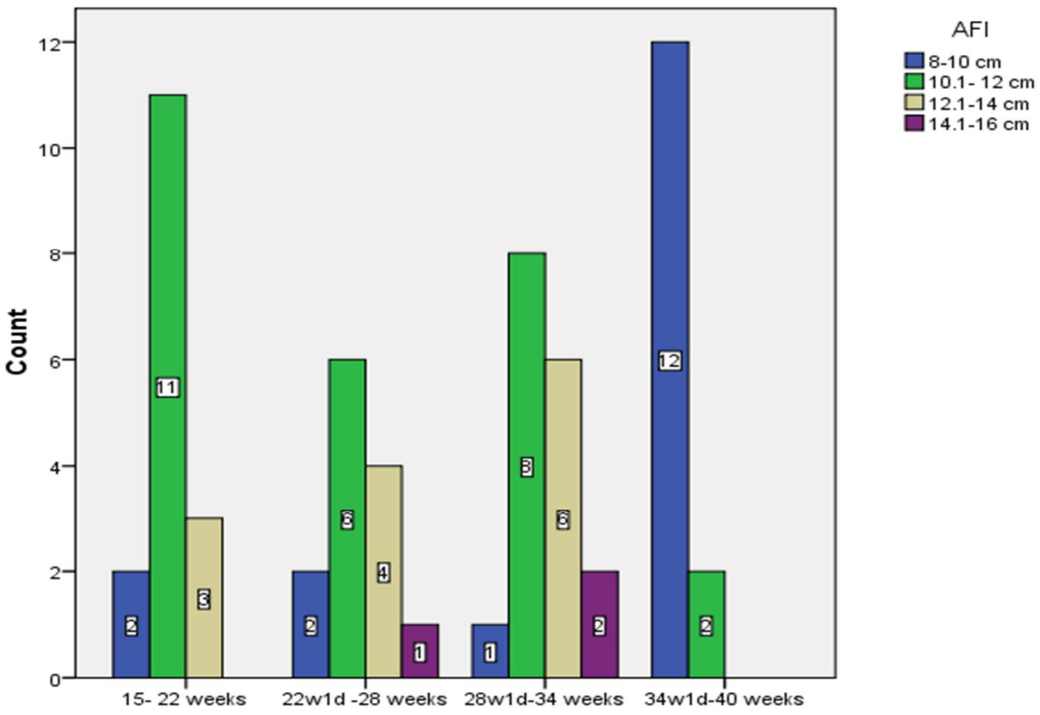


Figure (4.5) cross tabultaion GA and LSP

Table (4.7) cross tabulation gestational age per weeks and AFI

GA	AFI				Total
	8-10 cm	10.1- 12 cm	12.1-14 cm	14.1-16 cm	
15- 22 weeks	2	11	3	0	16
22w1d -28 weeks	2	6	4	1	13
28w1d-34 weeks	1	8	6	2	17
34w1d-40 weeks	12	2	0	0	14
Total	17	27	13	3	60
P value = 0.000					



Figure(4.6) cross tab GA and AFI

Table (4.8) correlation of age ,weight ,highet ,BMI of women with gestational age per weeks ,LSP and AFI measurement

Variables		Age of mother	Weight of mother	Height of mother	BMI of mother	LSP	AFI	Gestational age
Age	Pearson Correlation	1	.495**	.223	.295*	.175	.157	.117
	Sig. (2-tailed)		.000	.087	.022	.182	.232	.373
	N	60	60	60	60	60	60	60
Weight	Pearson Correlation	.495**	1	.578**	.456**	.240	.108	.337**
	Sig. (2-tailed)	.000		.000	.000	.064	.413	.009
	N	60	60	60	60	60	60	60
Height	Pearson Correlation	.223	.578**	1	-.460**	.171	-.043	.270*
	Sig. (2-tailed)	.087	.000		.000	.191	.743	.037
	N	60	60	60	60	60	60	60
BMI	Pearson Correlation	.295*	.456**	-.460**	1	.067	.157	.089
	Sig. (2-tailed)	.022	.000	.000		.613	.230	.498
	N	60	60	60	60	60	60	60
LSP	Pearson Correlation	.175	.240	.171	.067	1	.199	.021
	Sig. (2-tailed)	.182	.064	.191	.613		.127	.875
	N	60	60	60	60	60	60	60
AFI	Pearson Correlation	.157	.108	-.043	.157	.199	1	-.342**
	Sig. (2-tailed)	.232	.413	.743	.230	.127		.008
	N	60	60	60	60	60	60	60
Gestational age	Pearson Correlation	.117	.337**	.270*	.089	.021	-.342**	1
	Sig. (2-tailed)	.373	.009	.037	.498	.875	.008	
	N	60	60	60	60	60	60	60
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

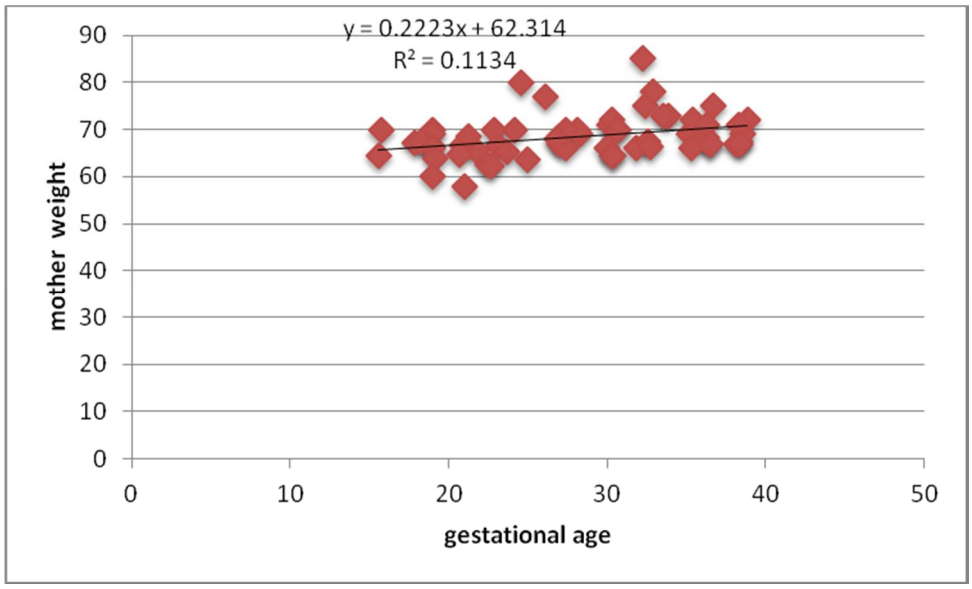


Figure (4.7) scatter plot shows correlation between amniotic fluid largest pocket measurement and gestational age per weeks

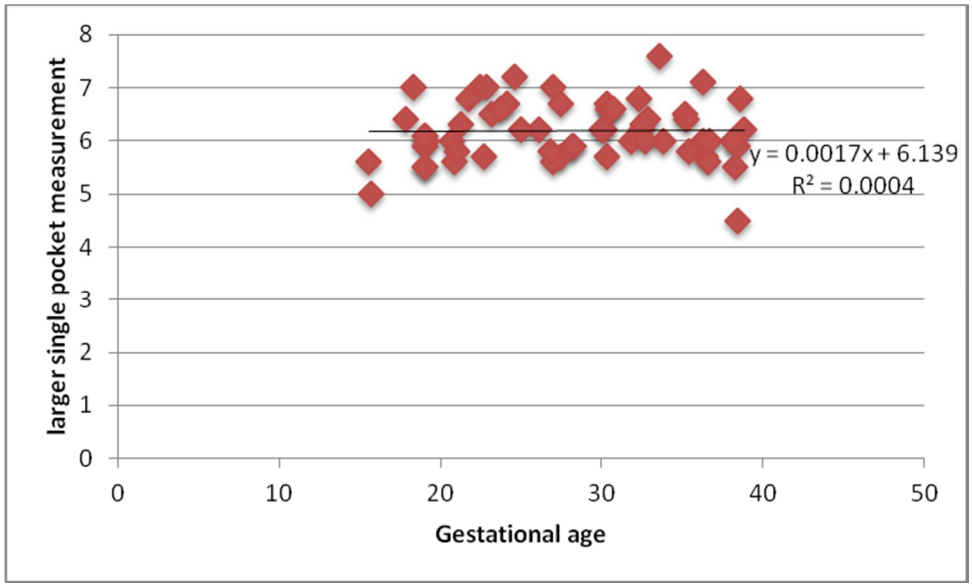


Figure (4.8) scatter plot shows correlation between amniotic fluid largest pocket measurement and gestational age per weeks

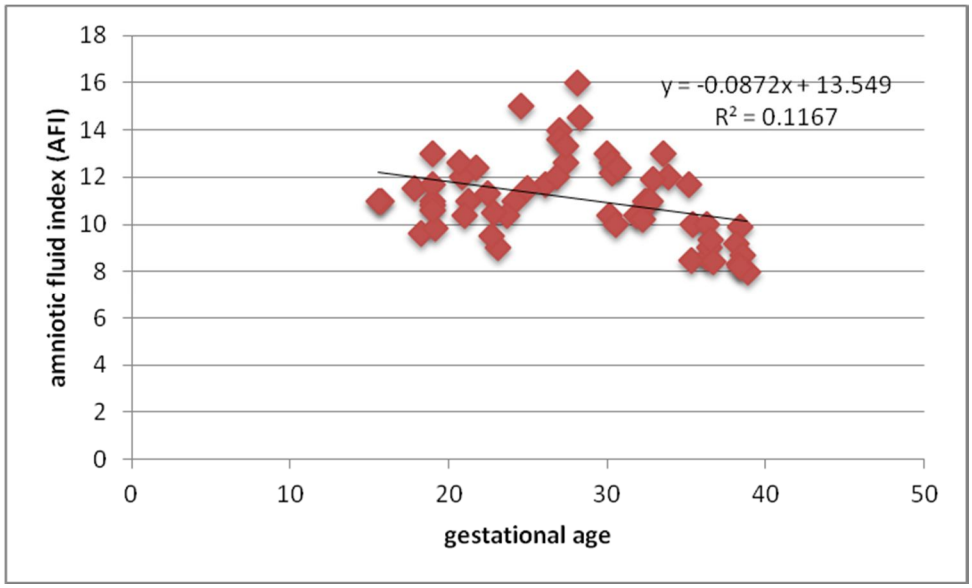


Figure (4.9) scatter plot shows correlation between amniotic fluid index measurement and gestational age per weeks

CHAPTER FIVE

DISCUTION, CONCLUSION & RECOMMENDATION

Chapter five

Discussion, Conclusion and Recommendations

5- 1 Discussion

This study has been carried out at Bashair Teaching Hospital, Chainse Friendship Hospital Omdurman and (West- geeraf clinic center). From findings this study , . The sonographic finding , Data analysis performed by SPSS . documented and analyzed as follow

Table (4.1) and figure (4.1) frequency distribution of age of pregnant women's 26 mothers represent high age range between (15 to 25) year's percentage is 43.3 %. 9 mothers their ages above 36 year percentage lower to 15.0%.

Table (4.3) and figure (4.2) frequency distribution of larger single pocket (LSP) cm 29 ladies with high percentage 48.3% showed in (LSP) group (6.1 -7) cm . And 5.0% in 3 ladies group (7.1 - 8) cm.

Table (4.4) and figure (4.3) frequency distribution of amniotic fluid index (AFI) cm, 27 ladies with high percentage 45.0% is showed in AFI level group (10.1 - 12) cm ., and 3 ladies with lower percentage 5.0% in AFI level group (14.1 - 16)cm .

Table (4.5) and figure (4.4) showed that frequency distribution of GA per weeks. 17 ladies with 28.33% percentage at GA group (28w 1d - 34) weeks peak among all pregnancy and gradually falls to 23.33%. At GA group (34w 1d - 40) weeks by 14 ladies.

Table (4.6) and figure (4.5) cross tabulation gestational age per weeks and LSP 10 ladies there level SDP between (6.1 -7)cm in GA group (28w 1d - 34) weeks increased by 58.8% and 4 ladies there SDP level between (6.1 -7)cm decrease to 28.6% in GA group (34w 1d - 40) weeks at end of pregnant there is

one lady in both groups there SDP level between (7.1 – 8) cm reduced percentage to 5.9% and 7.6% respectively. It is same with Amniotic Fluid Volume Assessment Using the Single Deepest Pocket Technique in Bangladesh (Rashid SQ etal. 2015)

In table and figure (4.7) & (4.6) explain cross tabulation between gestational age and AFI as AFI level (10.1 - 12)cm in 6 ladies with GA group (22w 1d - 28)weeks there percentage is 23.3. % , 8 ladies with GA group (28w1d 34) weeks increase AFI to 39.6% and 2 ladies with GA group (34w1d - 40) weeks decrease to 7.4% respectively . As AFI level (12.1 - 14) cm showed 4 ladies with GA group (22w 1d - 28) weeks there percentage is 30.8%, 6 ladies with GA group (28w 1d -34) weeks AFI percentage increase to 46.2% And reduce AFI level (12.1 - 14) cm to 00.0? % at 40 week, this explanation as similar study of (Goldstein RB., 1988)

5-2 Conclusion:

There is clear reverise relationship between gestational age and amniotic fluid index , when increased the amniotic fluid graduly decrease volume

In AFI level (10.1 - 12) cm was identified and compared with gestational age GA (28w 1d - 34) weeks is peak, and same AFI level is low at last end GA (34w 1d - 40) weeks. It also was concluded that higher in mid second trimester associated with lower level at end term of pregnancy gradually 29.6% to 7.4%

A study was conducted to determine the normal values level of SDP range minimum more 3 cm maximum is 8 cm & AFI normal normal values is minimum is 5 cm and maximum is 20 cm during normal pregnancies if its less than minimun is ologohydramnios , and if its grater than maximum is polyhydramnios .

. In conclusion, Ultrasonography are sufficiently encouraged the performance for preclinical detection normal finding and abnormal such as polyhdramniosis and ologohydramnionis

5-3 Recommendations:

- Further studies shuid be done with larger sample volume
- Further studies should be done to assess AFI with (international) such Diabtic and hypertensive

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APPENDICES

Appendices

Appendix (1)

image (1) larger Single pocket of AF measured for lady with 26 week GA by portable U\S in Basher Hospital.

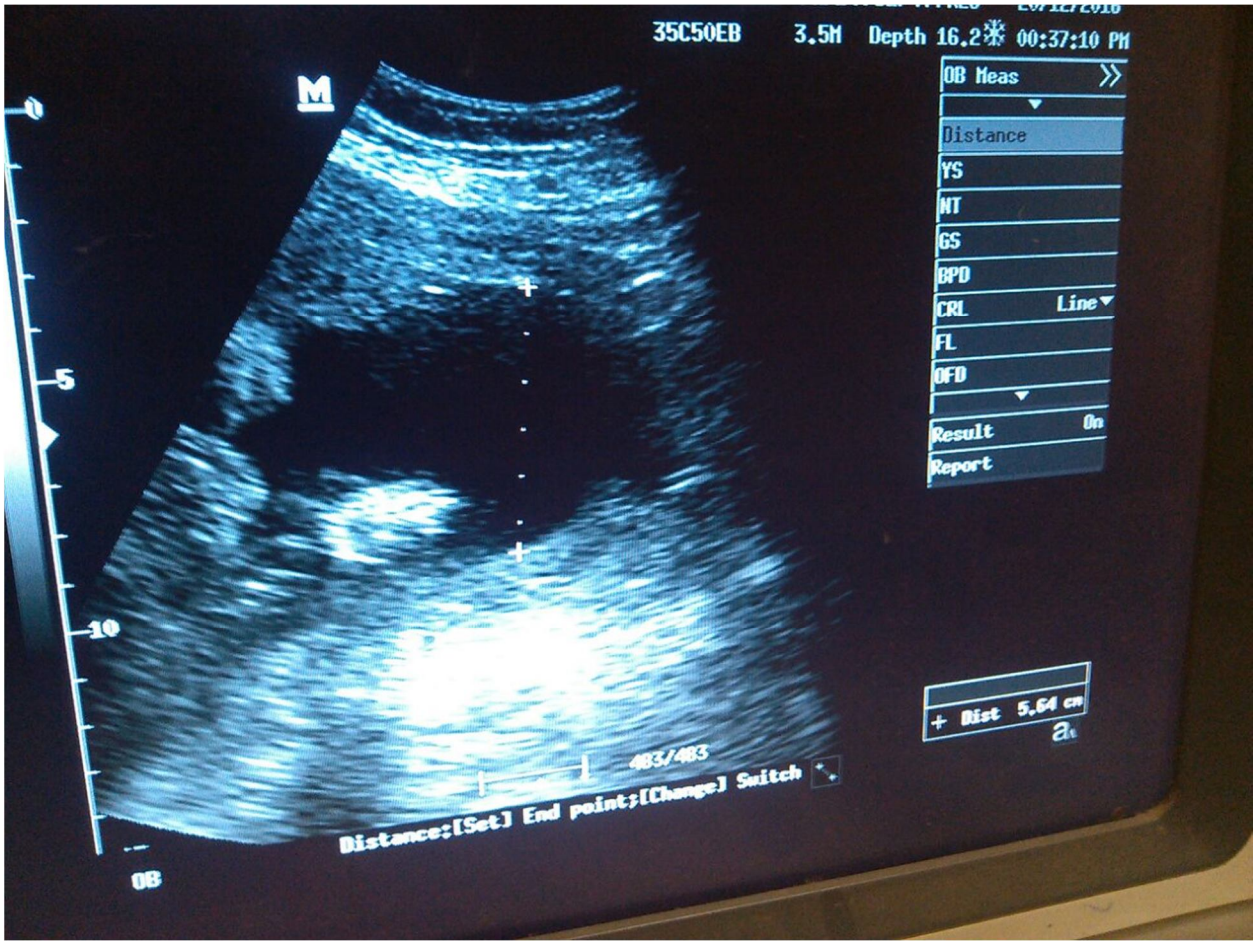

Image (2) Single largest pocket is 5.64 cm to lady Pregnant pt came to u\s dept in bashaeir and has GA of fetus 22 w + 5d

Appendix (2)

Data master sheet:

No.	age	high	Weight	BMI	SLP	AFI	GA