Sudan University of Science and Technology

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Assessment of Amniotic Fluid Volume in Second and Third Trimesters using Ultrasonography

تقييم حجم السائل الأمنيوني في الثلث الثاني و الثالث من الحمل باستخدام التصوير بالموجات فوق الصوتية

A Thesis Submitted for Partial Fulfillment for the Requirement of (M.Sc.) Degree in Medical Diagnostic Ultrasound

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الآيـة

قال الله تعالى

((خَلَقَكُم مِّن نَّفْسٍ وَاحِدَةٍ ثُمَّ جَعَلَ مِنْهَا زَوْجَهَا وَأَنزَلَ لَكُم مِّنَ الْأَنْعَامِ ثَمَانِيَةَ أَزْوَاجٍ ۚ يَخْلُقُكُمْ فِي بُطُونِ أُمَّهَاتِكُمْ خَلْقًا مِّن بَعْدِ خَلْقٍ فِي ظُلُمَاتٍ ثَلَاثٍ ۚ ذَٰلِكُمُ اللَّهُ رَبُّكُمْ لَهُ الْمُلْكُ ۖ لَا إِلَٰهَ إِلَّا هُوَ ۖ فَأَنَّىٰ تُصْرَفُونَ))

الاية 6 من سورة الزمر

Dedication

To my Parents who have always been there for me

To my husband for continuous support and advice

To my sons and daughters

To my friends who always guide and advise me to success

Acknowledgement

I would like to thank Dr. Ahmed Abukonna my supervisor for his kind advice in my study. My thanks extend to the Ultrasound department of Bahri Teaching Hospital; thank them for their good support during collection of data.

Abstract

The study aimed to identify normal values of amniotic fluid index in second and third trimester as well as to a detect causes of polyhydrominios and oligohydromnios and correlate gestation age to normal amniotic fluid volume.

The study was conducted on 50 pregnant women during their second and third trimester in the period from April to July 2017, in Bahri Teaching Hospital. Based on the international study protocol in obstetrical scanning; all pregnant women were examined by ultrasound using Mindray scanner with 3.5MHz convex probe. Trans-abdominal scanning was performed for all pregnant women and the amniotic fluid volume was measured using the four-quadrant amniotic fluid index (AFI) method.

The study revealed that the majority of pregnant women have normal amniotic fluid (86.0%) and few others pregnant women have an abnormal amniotic fluid (14%). it showed that the mean of normal amniotic fluid index minimal value obtained at 13 week then increase gradually and reached its peak at 40week.

The study recommended that the assessment of amniotic fluid volume by ultrasound is an essential parameter of the antenatal care. For better interpretation of amniotic fluid index normal reference values in various weeks of pregnancy is recommended. The study also recommended facilitating ultrasound machine in every hospital and medical health care centers.

ملخص الدراسة

هدفت الدراسة لتحديد القيمة الطبيعية لمؤشر السائل الأمنيوني للنساء الحوامل في الفترة الثانية والثالثة من الحمل ومعرفة الأسباب التي تؤدي إلى التغيرات غير الطبيعية زيادةً أو نقصان ومقارنة حجم السائل الأمنيوني الطبيعي بعمر الجنين .

شملت هذه الدراسة خمسون امرأة حامل في الفترة الثانية والثالثة من الحمل, وأجريت في مستشفى بحري في الفترة بين ابريل ويوليو من العام 2017 ، اعتمدت هذه الدراسة على النظام العالمي لعمل الموجات الصوتية للنساء الحوامل. تم إجراء الفحص لهؤلاء النساء باستخدام جهاز مندري للكشف بالموجات فوق الصوتية مع مسبار محدب تردده 3.5 ميقا هيرتز ,اجري المسح عن طريق البطن لكل النساء الحوامل، وتم قياس حجم السائل الأمنيوني باستخدام طريقة قياس أربعة جيوب أو أجزاء للسائل الأمنيوني وجمعها ببعض .

توصلت الدراسة إلى أن 86% من النساء الحوامل لديهن كمية سائل طبيعية ,بينما 14% منهن لديهن كمية سائل غير طبيعية، وأوضحت الدراسة أن كمية السائل الأمنيوني يكون في أقل كمية له في الأسبوع الثالث عشر وتزداد كميته تدريجيا حتى تصل إلى ذروتها في الأسبوع الأربعين.

أوصت الدراسة بضرورة قياس حجم السائل الأمنيوني حول الجنين بواسطة الموجات فوق الصوتية أثناء فترة الحمل وبإجراء فحوصات متعددة لوضع قيمة طبيعية ومرجعية لكمية السائل الأمنيوني للنساء الحوامل في السودان وإلى الدقة في قياس السائل الأمنيوني حول الجنين للوصول إلى نتائج مرضية وصحيحة، كما أوصت بتوفر أجهزة التشخيص بالموجات فوق الصوتية في جميع المستشفيات ومراكز الرعاية الصحية الأولية.

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Abbreviations

3D	Three dimension
A.A	Artery – artery
A.V	Artery vein
AC	Abdominal circumference
AFI	Amniotic fluid index
AFV	Amniotic fluid volume
BRA	Bilateral renal agenesis
CD	Color Doppler
DC	Dichorionic
DCDA	Dichorionic diamniotic
EVS	Endo vagnial sonography
GU	Genito urinary
HC	Head circumference
IDDM	Insulin dependent diabetes mellitus
IPKD	Infantile poly cystic kidney disease
IUGR	Intra uterine growth retardation
IVC	Inferior Vena Cava
KC	kidney circumference
Mc	Mono chorionic
MCDA	Mono chorionic diamniotic
MCDK	Multi cystic dysplastic kidney
NIDDM	Non-insulin dependent diabetes mellitus
PROM	Premature rupture of membrane
PUV	Posterior urethral valve
TA	Transabdominal

TTT	Twin to Twin transfusion syndrome
U/S	Ultrasound
UPJ	Utero pelvic junction
V.V	vein – vein

Chapter One

1.1 Introduction:

The amniotic fluid index (AFI), as proposed by Phelan in 1987 is one of the methods most widely used in the 1990s for the semi-quantitative determination of amniotic fluid (AF) volume (Phelan et al., 1987). One of the reasons for the great popularity of this procedure is its simplicity, which makes it easily and readily usable even by people with limited experience of ultrasound techniques; of equal importance is the availability of normal curve percentile tables which can be applied according to gestational week (Magann et al., 2000).

The AFI has undoubtedly evolved from other semi-quantitative methods, used in the main for the diagnosis of oligohydramnios. Some of these are based on the measurement of the largest vertical pocket of amniotic fluid, for which the 'normal curve' is defined by a single cut-off point, independently of gestational week: 1 cm for Manning, 2 cm for Chamberlain and 3 cm for Crowley (Magann et al., 2000).

The method proposed by Phelan is based on the subdivision of the abdomen into four quadrants, using as a reference point the maternal naval, where the nigral line and the trans-verse umbilical line intersect at right angles. Although in the third trimester the subdivision of the abdomen into four quadrants does not pose a problem, the same method is difficult to apply in the second trimester, especially before the end of the 20^{th} week. Thus, during this period the uterus can be divided into two equal parts at the nigral line, and the sum of the largest vertical pocket of AF in the two halves can then be calculated (Phelan). Alternatively, the uterus and not the abdomen can be divided into four quadrants and the AFI can be measured as after week 20. However, the validity of the measurement may be affected by the lack of precise limits between one

quadrant and another and by the frequent continuity between different amniotic pockets, linked to small fetal size. On this point, Magann reports that, at between 15 and 24 weeks' gestation, the AFI correctly identifies the quantity of AF in only 47% of cases, whereas the measurement of a single two-diameter pocket is accurate in over 85% of cases (Magann et al., 2000).

The aim of this study was to assess the amniotic fluid volume in pregnant women in second and third trimester. The study also aimed to identify normal values of amniotic fluid index in second and third trimester as well as to a detect causes of polyhydrominios and oligohydromnios and correlate gestation age to normal amniotic fluid volume.

1.2 Problem of study:

Amniotic fluid index measurements may vary with amount of pressure applied to the abdomen and with fetal position or movement. Serial measurements taken by ultrasonologist had been shown to differ from the true volume. The oligohydramnios can be difficult to confirm due to the questionable accuracy of Amniotic Fluid measurement by ultrasound, when pocket of Amniotic Fluid containing umbilical cord.

1.3 Objectives:

1.3.1 General Objective:

Assessment of amniotic fluid volume in second and third trimesters using ultrasonography

1.3.2 Specific Objectives:

- To identify normal values of amniotic fluid index in pregnant women.
- To detect common causes of polyhydramnios and oligohydramnios in pregnant women.

- To correlate gestation Age with amniotic fluid volume in pregnant women.

1.4 Overview of study:

This study consists of five chapters: Chapter one Included (introduction, problem of study and objectives), Chapter two include Literature review (anatomy, physiology and pathology) and previous studies, Chapter three was materials and methods, Chapter four Results and Chapter five Discussion, Conclusion and Recommendation

Chapter Two

Literature Review

2.1Anatomy:

2.1.1 Embryology of amniotic fluid:

Amniotic fluid is the protective liquid contained by the amniotic sac of agravid amniotes. This fluid serves as a cushion for the growing fetus, but also serves to facilitate the exchange of nutrient, water, and biochemical products between mother and fetus. At first, amniotic fluid mainly water with electrolytes, but by the 12-14th week the liquid also contains proteins, carbohydrates, lipids and phospholipids, and urea, all of which aid in the growth of the fetus (Rossant, 2016).

Amniotic sac is the sac in which the fetus develops in amniotes it is taught but thin transparent pair of membranes, which hold developing embryo and fetus until later before birth. The inner membrane, the amnion, contains amniotic fluid and the fetus. The outer membrane, the chorion, contains the amnion and is part of the placenta, by 12 week of gestation the amnion comes into contact with the inner surface of the chorion. At the beginning of the second week, a cavity appears within the inner cell mass and when it enlarges is becomes the amniotic cavity. The floor of amniotic cavity is formed by epiblast. Epiblast migrates between the epiblast disc and trophoblast, in this way the epiblastic cells migrate between the embryoblast and trophoblast. The epiblast transforms to ectoderm while the remaining cells which are present between embryoblast and trophoblast are called amnioblaststs (flattend cell), these cells are also derived from epiblast which is transform into ectoderm (Maheshwari et al, 2016).

The amniotic cavity is surrounded by a membrane, called amnion. As the implantation of the blastocyst progress, a small space appears in the

embryoblast, which is primordium of amniotic cavity. Soon amniogenic (amnion forming cells) amnioblasts separate from the epiblast and line the amnion, which encloses the amniotic cavity. Amniotic fluid in the amniotic cavity completely surround the embryo after the 4th week of pregnancy, this firstly water like fluid originate from fetal plasma and passes through membrane by osmotic and hydrostatic forces (Sant, 2008).

2.1.2 Important of amniotic fluid:

Amniotic fluid is vital to the well-being of the fetus, it cushions the fetus from injury, helps prevent compression of the umbilical cord, and allows room for it to move and grow. In addition, its bacteriostatic action helps prevent infection of the intra-amniotic environment. The quantity of amniotic fluid at any time in gestation is the product of water exchange between the mother, fetus and placenta, and is maintained within a relatively narrow range. Disorders of this regulatory process can lead to either polyhydramnios or oligohydraminos, in which too much or too little fluid exists, respectively. These disorders may result from abnormal fetal or maternal conditions and, conversely, may be responsible for alterations of fetal well-being as well, with the advent of real-time ultrasonography, assessment of amniotic fluid has been possible, resulting in earlier recognition of abnormal conditions and possible intervention. Because precise quantification of amniotic fluid volume is not possible with ultrasonography, various techniques for both qualitative and semiquantitative assessment have been proposed (Gramellini et al, 2004).

2.2 Physiology of amniotic fluid:

2.2.1Amniotic fluid production:

In the first half of pregnancy, amniotic fluid is derived from fetal and possibly maternal compartments. Water and solutes freely traverse fetal skin and may

diffuse through the amnion and chorion as well. Thus amniotic fluid in early gestation is a dialysate that is identical to the fetal and maternal plasma, but with a lower protein concentration. Active secretion of fluid from the amniotic epithelium had been previously suggested to play a role in early amniotic fluid formation, but this has not been demonstrated (Brace, 1997).

By the second trimester, the fetal skin becomes keratinized, making it impermeable to further diffusion. At this time, a fetus contributes to amniotic fluid volume and composition almost exclusively through urination. Urine has been observed in the fetal bladder as early as 11 weeks transabdominally. And 9 weeks trans vaginally. By term, a fetus produces on average from 500 to 700 ml/day with a slight decline in hourly fetal urine production after 40 weeks gestation (Mansfield et al, 2011).

2.2.2 Amniotic fluid elimination:

Amniotic fluid is eliminated by at least three mechanisms. The primary source of elimination is through fetal swallowing, which has been observed as early as 16 weeks. 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 id either recycled through the kidneys or is transferred to the maternal compartment through the placenta (Kumar and Fisk, 2003).

A second, more debatable means of amniotic fluid removal may be 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. Although radioisotopes have been discovered in fetal lungs after intra- amniotic instillation, this quantity has been small and inconsistent. Leading investigators to question the actual contribution of fetal respiration to amniotic fluid removal. In fact, surface active phospholipids originating from the fetal alveoli are found in the amniotic cavity, leading to suggestions that the fetal lungs may actually be a net contributor to amniotic fluid volume (Brace et al., 2014).

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

Transport across the amnion may occur through intercellular channel between amniotic epithelial cells and may be modulated by amniotic fluid prolactin levels. Hebertson and collogues provided presumptive evidence for the regulatory role of the amniotic epithelium in the transport of fluid. They observed ultra-structural changes in the amnion of pregnancies complicated by disorders of amniotic fluid volume. Whether these changes reflect a causative role in these disorders or rather a response to long – standing fluid imbalance remains to be determined (Hilliard et al., 2016).

A final, perhaps underestimated, pathway for volume regulation may occur within the placenta itself. The large surface area of the fetal capillary/ intervillous interface could magnify small osmolar gradients between a mother and fetus, resulting in large volume of net water transfer (Magann et al, 2012).

Exchange of water at this level would influence fetal intravascular volume and potentially affect renal blood flow and urine production.

In addition to bulk flow of fluid, which occurs through pathways that are both phasic (micturition and swallowing) and nonphasic (mediated by hydro static and oncotic gradients), there is also bidirectional flow of water between the amniotic and maternal compartments. This process occurs by diffusion, but with net change in fluid volume. At term may leave the amniotic cavity at rate of 400 -500 ml/ hour by diffusion plus flow (Hilliard et al, 2016).

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 amniotic fluid volume 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. From 20 weeks on, there is greater variance of amniotic fluid volume increases steadily throughout pregnancy to maximum of 400 – 1200 ml at 34 -38 weeks; however, wide variation does exist (Patriota et al, 2014).

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 are only 5–10 ml/day in the third trimester. After 38 weeks, fluid volume declines by approximately 125 ml/week, to an average volume of 800 ml at 40 weeks. After 43 weeks, this volume is reduced to 250 ml. 16 in some instances, and this reduction may possibly reflect a shift of cardiac output away from the kidneys as a result of a relative uteroplacental insufficiency (Manikandan and Raghavan, 2014).

2.2.4 Amniotic fluid function:

Allow room for fetal growth, movement and development, ingestion in to GIT growth and maturation ,fetal pulmonary development (20 weeks), protects the

fetus from trauma, maintains temperature, contains anti-bacterial activity prevent intra amniotic environment from infection and aid dilatation of cervix during labour (Prior et al, 2014).

2.3 Methods and technique for assessment of AFV by U/S:

The U/S image had been obtained by using convex probe with high frequency (3-5 MHZ) and gel with patient in supine position. Each patient had been scanned twice, in an international scan guideline and protocols .Firstly by researcher then by a qualified sonologist to confirm the finding and diagnosis (Magann et al, 2015).

2.3.1Subjective Assessment:

-The fetus occupies less than half of the intrauterine volume until approximately 22 weeks in the pregnancy .There after the fetus progressively occupies a larger portion of intra uterine volume. - This is a qualitative assessment of AFV and is therefore not standardized (Magann et al, 2015).

2.3.2: Quantitative Assessment:

2.3.2.1: Single Deepest Pocket Measurement:

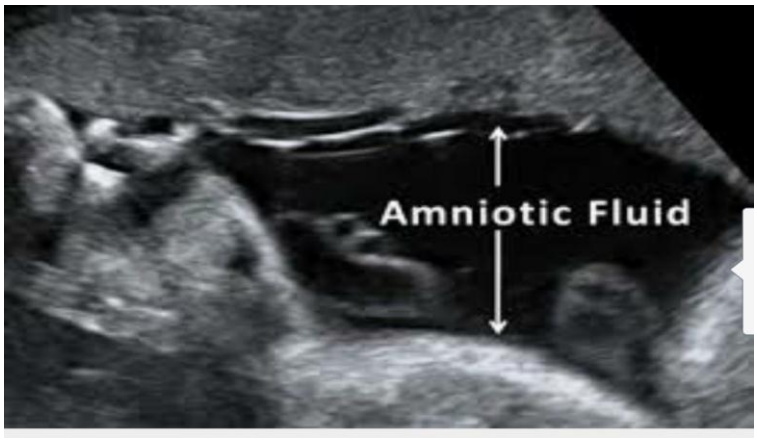

Figure (2.2) measure the dimension of the largest vertical pocket of AF (Devin; 2005).

< 1cm = oligohydramnios.

1-2cm = decreased fluid.

2-8 cm = normal

> 8 = polyhydrominios (Chamberlain, et.al.2003)

Many authors question the 1cm rule as being too restrictive. Controversies in cut- off criteria for oligoydramnios (Sherer .2001):

< 0.5 mm (Mercer.1984) 10

< I cm (Chamberlain .2003)

< 2cm (Manning .1990)

< 3 cm (Halperin.1985)

2.3.2.2. Amniotic fluid index Technique:

a. Divided the uterus in to four quadrants using the lineanigra as the vertical axis the umbilicus as the horizontal axis

b. The pocket with largest vertical dimension is measured in each quadrant.

c. Sum of all four measurements = AFI

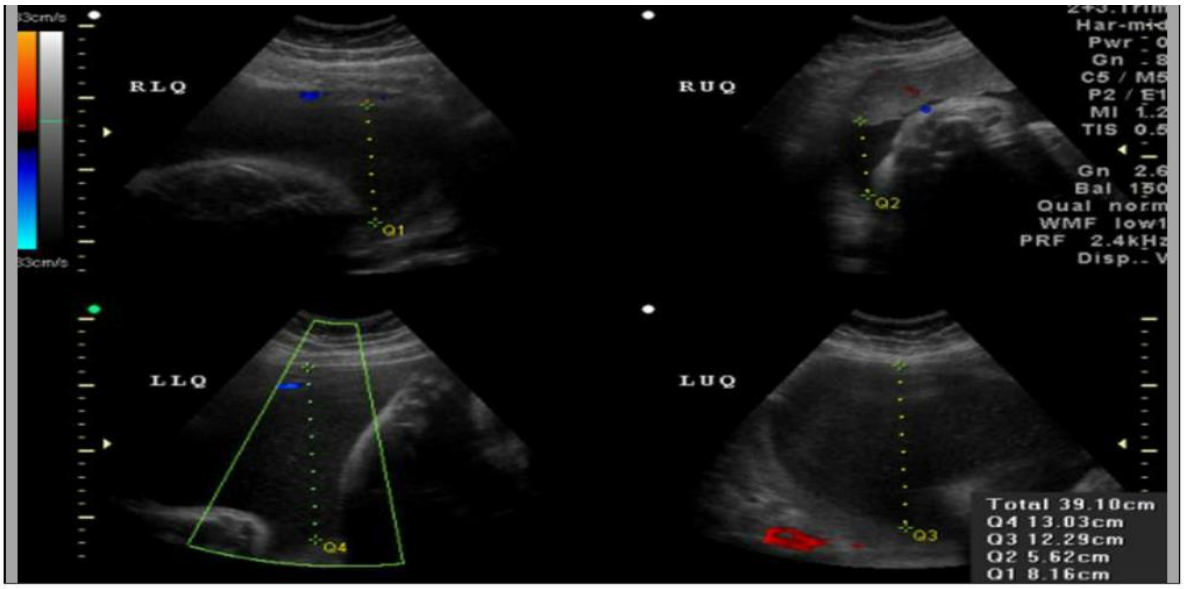

Figure: (2.3): four pocket Measurement of AFI (.Trish, et.al.2004)

Values

< 5 cm =very low (oligohydramnios)

5.1 – 8cm = low

8.1 – 25 cm = normal.

> 25 cm = polyhdramnios.

2.3.3: Advantages and disadvantages

2.3.3.1 Advantages:

Easy to perform.

More subjective approach than AF assessment.

Requires little training to perform and is ideally suited to real time ultrasound.

Provides a frame of reference for the inexperienced sonographer.

Gives a better assessment of AFV than dose the single deepest pocket measurement, as the sum of all four quadrants correlate more closely with volume than by using a single measurement.

2.3.3.2 Disadvantages:

-Wide intra observer & inter observer error (Rumack, et.al.2005).

AFI < 5cm - interobserver error = 2cm.

AFI > 20 cm - interobserver error = 5cm.

-Technical Limitation.

Heavy pressure applied by the sonographer with the transducer on the patients abdomen can decrease the height of a pocket fluid.

Artifact, especially anterior reverberation artifacts may obscure AF situated anteriorly. It may also be difficult to visualize lateral pockets due to the position of the transducers.

-Overestimation .

In the third trimester the umbilical cord may be extremely lucent and without duplex or color Doppler, cord filled pockets of AF may be included in the measurement.

-Fetal movement:

Rapid movement may be a problem as large pockets may be replaced by multiple small pockets between the extremities. Pockets with large vertical dimension and small width's will exaggerate the AFI.

-Full fetal bladder with oligohydramnios. This fluid should be included in AFI estimation because it will ultimately be excreted and form part of the fluid estimation (Sherer et al., 1998).

2.3.4 Chamberlain method single vertical pocket measurement:

> 1 cm is severe oligohydramnios.

1- 2 cm is significant oligohydramnios.

2- 8 cm is normal.

8- 11 cm is mild polyhydrominios.

12- 16 cm is moderate polyhydrominios.

< 16 cm is serve polyhydrominios.

2.3.5 The phelan or four- quadrant amniotic fluid index method:

This method consists of dividing the uterus into four quadrants and measuring the largest vertical pocket of amniotic fluid in each quadrant.

The four values obtained are added together to produce an index of amniotic fluid volume. Values between 8.0 cm and 24.0 cm considered normal. Refer to the following table for the significance of values less than 8.0 cm and greater than 24.0 cm (Devin, 2005).

The Phelan or four- quadrant amniotic fluid index method:

> 5 cm is severe oligohydramnios.

5.1 - 8 cm is significant oligohydramnios.

8 - 24 cm is normal.

< 24 cm is polyhydramnios.

25- 30 cm is mild polyhydramnios.

30.1- 35 cm is moderate polyhydramnios.

< 35.1 cm is serve polyhydramnios

2.4 Amniotic Fluid Echogenicity:

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. Echogenic amniotic fluid in the first trimester is rare and has been associated as an indirect sign of acrania-anencephaly sequence (A A S) secondary to exfoliation (sloughing) of fetal brain tissue in the amniotic fluid and related bleeding (Trish,et.al2004).

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 Dregnancies is mainly related to desquamated or exfoliated fetal skin cells and vernix caseosa. Vernix caseosa is the normal oily substance produced by fetal skin and covering the fetal skin to protect it in its aqueous environment (Trish,et.al 2004).

Near term, meconium released into the amniotic fluid by the fetus may be another source of amniotic fluid debris echoes. Under ordinary circumstances, meconium is usually not released in utero although it may be a normal event that occurs with progressive fetal maturation, without evidence of fetal distress

or poor outcome. Other causes associated with meconium passage in utero include hypoxia-induced peristalsis and sphincter relaxation, and umbilical cord compression-induced vagal stimulation in mature fetuses. There appears to be a link between gestational age and meconium passage after the 38th week. The cause of the meconium passage may vary from patient to patient, and in some patients may result from a combination of causes which may explain why there has not been a clear relationship demonstrated between its passage in utero and fetal outcome (Devin,2005).

Other potential causes of amniotic fluid debris echoes include fetal bleeding associated with percutaneous umbilical cord sampling, rupture of an umbilical vessel associated with velamentous insertion of the umbilical cord, chorioamnionitis, and idiopathic causes. (Devin, 2005)

2.5 Pathology of amniotic fluid:

2.5.1 Oligohydramnios:

Oligohydramnios is defined as decreased amount of amniotic fluid. Anhydramnios is defined as severe oligohydramnios it may be either acute or chronic, acute is most commonly result of membrane rupture and chronic may result from abnormality of the fetal urinary tract and fetal hypoxia, and is indicated when there is no detectable amniotic fluid pockets on ultrasound examination. There are no associated maternal risk oligohydramnios may be suspected clinically if the measured uterine fundal height is small- for dates with the Chamberlain method oligohydramnios is indicated if the single largest pocket of amniotic fluid measure is less than 2cm with the Phelan method, oligohydramnios is indicated if the sum of the four measured pocked of amniotic is 8 cm or less (Ted Rosenkrantz, 2012).

Visual ultrasound features of oligohydramnios include:

- lack of an amniotic fluid space between the anterior uterine wall and the fetal body
- relative crowding of fetal parts
- Difficulty outlining the umbilical cord (Eberhard Merz, 2003).

2.5.1.1 Most Common Causes of Oligohydramnios

- Premature rupture of membranes
- Chronic fetal death
- postterm pregnancy
- advanced intrauterine growth retardation
- Fetal genitourinary (GU) tract anomalies associated with decreased renal function and diminished urinary output or anomalies compromising the flow of urine into the ureters, bladder, or urethra:
- bilateral renal agenesis (Potter's syndrome)
- bilateral uroteropelvic junction obstruction
- bilateral multicystic dysplastic kidneys
- infantile polycystic kidneys
- posterior urethral valves 15
- urethral agenesis -
- Chromosome defects (especially triploidy)
- Twin-to-twin transfusion syndrome (associated with the growth-retarded donor twin).(Devin,2005)

2.5.1.2 Premature rupture of membrane (PROM):

PROM is defined as rupture of amniocherionic membrane prior to the onset of labor.

Ruptured membranes are signified at any time to during pregnancy by either a sudden gush or a steady trickle of clear fluid from vagina, in term pregnancy, labor usually ensues within 24 hours of membrane rupture.

The main concern is chorioamnionitis may cause fetal death and maternal death, although very uncommon may also occur if a serious maternal septicemia develops (Ted Rosenkrantz 2012).

The causes of PROM have not been clearly identified. Some risk factors include smoking, multiple pregnancies (twins, triplets, etc), and excess amniotic fluid (polyhydromnios). Certain procedures carry an increased risk of PROM, including amniosentasis (a diagnostic test involving extraction and examination of amniotic fluid) and cervical cereluge (a procedure in which the uterus is sewn shut to avoid premature labor). A condition called placenta abruption is also associated with PROM, although is it not known which condition occurs first. In some cases of preterm PROM, it is believed that bacterial infection of the amniotic membrane causes it to weaken and then break. However, most cases of PROM and infection occur in the opposite order, with PROM occurring first followed by an infection.

The main symptom of PROM is fluid leaking from the vagina. It may be sudden, large gush of fluid, or it may be as low, constant trickle of fluid.

The complication that may follow PROM include premature labor and delivery of the fetus, infections of the mother, and/ or of the fetus, and compression of the umbilical card (leading to oxygen deprivation in the fetus).

Treatment of PROM depend on the stage of the patients pregnancy (Ted Rosenkrantz, 2012).

2.5.1.3 Fetal death:

Second and third trimester fetal demise can be attributed to many different single causes, or to a combination of causes. They are acute etiologies such as

abruption or umbilical cord complication; sub-acute etiologies, such as infections or uteroplacental insufficiency and chronic etiologies, such as long uteroplacental insufficiency, diabetes or immunologic rejection (Eberhard Merz, 2003)

2.5.2 Polyhydramnios :

Polyhydramnios or hydramnios is an abnormal or excessive amount of amniotic fluid. Prior to the widespread use of ultrasound in obstetrics, polyhydramnios was defined as an amniotic fluid greater than 2,000 milliliters based on dye dilution techniques. Based on ultrasound technique, the overall incidence of polyhydramnios is estimated to be about 1 %.(Devin, 2005)

From a clinical perspective, polyhydramnios may be suspected when the uterus is large-for-dates (abnormal increase in uterine symphysis-fundal height) in association with difficulty in palpating fetal small parts and in hearing fetal heart tones. In severe cases, the uterine w may be so tense that the obstetrician cannot palpate any part of the fetus, Polyhydramnios is most frequently gradual or progressive however its onset may be acute and cause sudden distention of the uterus (acute polyhydramnios). In general, the more severe the polyhydramnios, the higher is the perinatal mortality rate, so that the prognosis for the infant in major degrees of polyhydramnios is poor. In large part, fetal mortality in cases s of severe polyhydramnios is related to fetal anomalies and fetal respiratory distress syndrome (the incidence of premature deliveries in polyhydramnios is about twice the overall rate). Minor and moderate degrees of polyhydramnios can usually be managers without intervention until labour starts or until the membranes rupture spontaneously. There is no satisfactory treatment for symptomatic polyhydramnios other than removal of some of the excessive amniotic fluid by amniocentesis. The main objective of therapeutic

amniocentesis is relief of the mother's respiratory distress, and to that end it is successful. The major risk of therapeutic amniocentesis is premature labour and premature rupture of membranes (and the associated risk of chorioamnionitis) (Devin, 2005).

2.5.2.1 Type of polyhydramnios:

1. Mild polyhydramnios (80%).

A pocket of amniotic fluid measuring 8-11 cm or four pocket measuring 25 – 30 cm.

2. Moderate polyhdramnios:

A pocket of amniotic fluid measuring 12-15 cm or four pocket measuring 30.1 – 35 cm

3. Serve polyhydromnios:

A pocket of amniotic fluid measuring 16 cm or more or four pocket measuring <35.1 cm (Rumack, et.al, 2005).

2.5.2.2 Maternal complication of polyhydramnios:

The major symotoms accompanying polyhydramnios arise from purely mechanical causes and result chiefly from the pressure exerted from the overdistended uterus upon adjacent organs. Polyhydramnios may cause maternal respiratory distress. When uterine distention is excessive, the mother may suffer from severe dyspnea and in extreme cases she may be able to breathe only in the upright position. Edema, especiially of the lower extremities, is the consequence of compression of major venous systems by the very large uterus. Rarely, severe maternal oliguria may also result from obstruction of the maternal urinary tract by the very large uterus (Ted Rosenkrantz, 2012).

2.5.2.3 Most Common Causes of Polyhydramnios:

Diabetes mellitus.

Fetal anomalies:

central nervous system, e.g. anencephaly

cardiovascular, e.g. arrhythmias

thoracic, e p. congenital diaphragmatic hernia

upper GI tract obstruction, e.g. duodenal atresia

lethal skeletal dysplasias, e.g. thanatophoric dwarfism

chromosome defects

Immune and nonimmune fetal hydrops

twin-to-twin transfusion syndrome (associated with the recipient twin)

Placental choroangioma

The various clinical and sonographic causes of polyhydramnios are covered in other sections of the course. In general, the greater the degree of - polyhydramnios, the greater the likelihood of finding a major fetal anomaly and an accompanying chromosome abnomality. The combination of polyhydramnios and early onset IUGR has been reported as a sign of trisomy 18 (although oligohydramnios may also be seen with trisomy 18). With gross polyhydramnios, the placenta may appear thin on ultrasound examination owing to excessive uterine distention (Trish Chudleigh, et.al, 2004).

2.5.2.3.1 Diabetes mellitus:

Diabetes mellitus is a medical disease that leads to hyperglycemia (an abnormal elevation of blood glucose level) and glycosuria (glucose in urine) as the hyperglycemia increases. Diabetes is made worse by pregnancy and that increases the risks of pregnancy complication.

Diabetes mellitus (DM) classified into:

Insulin dependent diabetes (IDDM).

Non- insulin dependent diabetes (NIDDM).

Gestational diabetes (GDM).

Impaired glucose tolerance (IGT)

Diabetes associated with certain known condition and symptoms (pancreatic disease changes in hormones beside insulin, the administration of various drugs and chemical agents, insulin receptor abnormalities, genetic syndrome and malnutrition (Eberhard Merz, 2003).

2.5.2.3.2 Fetal anomalies:

Anencephaly is defined as absence of cranial vault higher brain (cerebrum).

It is the most common anomaly of the neural tube and results from failure of the neural tube to completely close at its cephalic and closure of the neural tube occurs between the second and third trimester weeks. After 20 to 24 weeks of the gestation, polyhydramnios is associated with about one-half of cases probably due to centrally mediated reduction in fetal swallowing, fetal polyuria resulting from insufficient production of vasopression from the fetal pituitary and transudation of fluid across the uncovered meninges(Devin ,2005).

Fetal arrhythmias:

The arrhythmias are abnormal heart beat; any beat less than 60 beats per minute or more than 100 beats per minute. Less than about 1 minute episodes or bradycardia are common in the fetus and are not usually significant. A side from evaluating the arrhythmias one should evaluate for sign of congestive heart failure and hydrops fetalis.

Alcohole, tobacco and stress is most common causes of arrhythmias (Rumach, et.al, 2005).

Congenital diaphragmatic hernia (CDH):

CDH is the presence of abnormal viscera in the thoracis cavity due to congenital defect in the diaphragm. The size of the defect varies from a tiny opening to complete absence of the hemidiaphragm. 21

CDH may be unilateral or bilateral (rare). The most common defects occur on the left side posteriorly and involve herniation of the stomach and small- bowel into the left chest (90% of the cases) (Ted Rosenkrantz, 2012).

The typical sonographic feature of left sided (CDH) include:

a. Dextropostion of the heart, in the absence of a fluid- filled stomach or bowel in the chest cardiac or mediastinal shift may be the only clear cut detectable abnormality in such cases, the stomach may not be visualized in the upper quadrant of the abdomen and there may be evidence of bowel peristalsis in the left chest supporting the diagnosis of CDH. b. Visualization of the fluid-filled stomach and/ or obstructed fluid – distended loops of bowel in the left chest. In some cases the stomach may be seen to cross the diaphragm. c. Abnormally small abdominal circumference, typically less than 10th percentile for gestational age. d. Polyhydramnios is typically mild or intermittent in the second trimester (Ted Rosenkrantz, 2012).

Upper GI obstruction: duodenal atresia:

The normal duodenum is usually collapsed and sonographically unremarkable, with duodenal stenosis, the portion of the duodenum proximal to the offending lesion fills with fluid and is seen a fluid- filled tubular structure which communicates with the stomach. Duodenal atresia is the most common site of intestinal atresia and is associated with the usual cause of duodenal obstruction associated with the characteristic sonographic (double bubble) sign (Trish Chudleigh, et.al, 2004).

Esophageal atresia (EA):

EA is congenital absence of a segment of the esophagus. When EA occurs, it is most often accompanied by tracheoesophageal fistula (TEF) (Eberhard Merz, 2003).

Immune and non-immune fetal hydrops:

Fetal hydrops or fetalis defines as a fetus with pathological accumulation of fluid in two or more body cavities or tissues including subcutaneous edema (thick skin), placental edema (thick placental), peritoneal cavity (ascites), pleural space (plural effusion or hydrothorax), pericardial space (pericardial effusion), and polyhydramnios (Devin,2005).

2.5.2.4 Treatment of polyhydramnios:

When routine ultrasound examination shows evidence of polyhydramnios, a women's health care provides may recommend aspiration of amniotic fluid (amniocentesis) under direct continuous real time ultrasound monitoring in order visualize the path of the long 20 gauge needle during insertion and to monitor the location of needle tip in selected pocket of amniotic fluid, it take over 30 to 45 minutes. In many cases slight polyhydrominios goes away without treatment. In other cases, it may resolve when the problem causing it corrected.

Health care provides usually closely monitor women with polyhydrominios weekly, ultrasound examination to check amniotic fluid levels. Test of fetal well-being also are recommended to check for signs of fetal difficulties.

If the pregnant women becomes too uncomfortable because of the extremely large volume of fluid, her provides may recommended treatment with indomethacin. This drugs helps reduce fetal urine production and reduces amniotic fluid level.

If the test show that the mother and baby are healthy, a women with slight polyhydrominios near term usually does not need treatment. Early studies suggested the therapeutic benefit of indomethacin in treatment of polyhydrominios, not typically used in third trimester due to affects of in-utero narrowing of the fetal ductus arteriosus which result in pulmonary hypertension postnatally(Devin,2005).

2-6 Previous Studies:

Hinh ND,et al 2005 study amniotic fluid index measurements in normal pregnancy after 28 gestational weeks ,the study was aimed to established a normative scale of amniotic fluid index AFI in uncomplicated singleton pregnancies, and to identify the upper and lower limits for each gestational week.Study was used One hundred seventeen uncomplicated singleton pregnancies were examined every 4 weeks between 28 and 42 weeksgestation.The uterine cavity was divided into four quadrantsWith the of linear- array ,real timeB scanning , the vertical diameter of the largest pocket in each quadrant was measured .The amniotic fluid index is the sum of these four quadrants.

The study result is the amniotic fluid index observation from regression equation curve were stratified in week-specific normative curves .The variation between mean AFI of total population and the mean of preterm was significantly greater than term pregnancies ($p<05$).The AFI 2.5% ,5% ,10% ,90% ,95% and 97.5% limits about the 50^{th}(124mm) were 68, 81, 90 135. 144 and 145 mm ,respectively , in term gestation .The 5 th and 95 th percentile serves as lower and upper limits of normal ,respectively for 28-42 weeks gestation. The study was conclude that the gestational age-specific values of AFI were established ,determining the significant trends of changes in the amniotic fluid volume with gestation. The norm gram may have a clinical benefit to accurate , reliable andsemiquantitive diagnosis of oligohydraminos and polyhydrominios.

Habiba, 2005 Study of 400 Pakistanie women the antenatal clinic at Kharadar General Hospital, from March 2004 August 2005, these women came for routine cheek ups. Obstetric history of all women was taken on a prescribed form , Gestation age was estimated , on the basis of last menstrual period and

U/S scan ,inclusion criteria were singleton gestation with no fetal anomalies and gestational age between 20 -41 weeks , no women with medical (chronic hypertension , diabetes mellitus , collagen vascular disease, twin hemoglobinopathy) or obstetric(preterm labour , preterm rupture of membrane , gestational diabetes , preeclampsia intra-uterine growth retardation , gestational age less than 60 week) each patients underwent a single ultrasonic examination , all AFI estimation was done by the same ultrasonologist and a single obstetrician to eliminate inter-observational error. The technique of Moore and Cayle were used to measured AFI , patients were examined in supine positional, the uterus was divided in to four quadrants , the U/S probe kept perpendicular to the plan of floor and longitudinally with maternal spine , vertical depth of the largest clear AF pool was taken which was free of umbilical cord or foetal limbs , the pool measurement was done in cm from each quadrant of uterus , AFI estimated by adding four quadrant depth ultrasonic examination was performed using ultrasonic with 3.5 MHz linear transducer.

The study was shows that 134 were primigravida and 266 were multigravida. Age of women ranged from 18 to 40 years, and in patients with preterm and term gestation. The AFI values were higher in the preterm gestations compared to those obtained in term gestation ($p < 0.0001$), the mean AFI was 12.8cm. The data was normally distributed with mean and median almost the same, the 5th percentile was taken as lowered limit and 95th percentile was taken as upper limit of normal AFI, 7cm AFI as lower limit of normal and 18cm AFI as upper limit of normal at term. For preterm gestational period the upper and lower limit of normal AFI were 10cm to 20cm respective by higher than that in the term gestational.

Hala 2015 was study amniotic fluid volume in second and third trimester by ultrasound in pregnant women , The study aimed to identify normal values of amniotic fluid index in pregnant women in second and third trimester, to a detect causes of polyhydramnios and oligohydramnios and to correlate gestation age with normal amniotic fluid volume. The study was conducted on 90 pregnant women their second and third trimester over a period from August 2015 to December 2015, in Kosti Teaching Hospital, depended on the international study protocol in obstetrical scanning. All pregnant women were subjected to be examined by U/S scanning using Toshiba and General Electric scanner with 3.5MHz convex probe. Transabdominal scanning were performed for all pregnant women and measure the amniotic fluid volume by using, the four –quadrants amniotic fluid index (AFI) and the deepest pocket (large pocket) methods. The problem of study is that the difficult measurement of oligohydramnios by ultrasound. The study found that most of the pregnant women have normal amniotic fluid (88.9%) and few others pregnant women have an abnormal amniotic fluid (11.1%). The study showed the normal range of amniotic fluid index in pregnant women from 24-40 weeks, it showed that the mean of normal amniotic fluid index reach its peak at 26 week gestation and gradually declined at 40 week gestation . The study recommended that assessment of amniotic fluid volume by ultrasound is an essential parameter of the antenatal care. For better interpretation of amniotic fluid index normal reference values in varies weeks of pregnancy in pregnant women in Sudan is recommended. The study also recommended facilitating ultrasound machine in every hospital and medical health centers.

Another study done by Ali 2009 study the Assessment of amniotic fluid index in normal pregnancy, he study was aimed to establish a normative scale of amniotic fluid index throughout gestation in uncomplicated singleton

pregnancies, and to identify the lower and upper limits for each gestational week. The study was conducted in a private tertiary care hospital from Jan 2004 to April 2005.Amniotic fluid index was calculated in 400 women attending20-40 weeks. Women with fatal anomalies, pregnancy induced Hypertension, Diabetes Mellitus and other maternal complication were excluded from study. The median ,mean 5^{th} ,50 th, and 95th percentile were calculated for each gestation .The study was resulted that the mean amniotic fluid index of preterm was significantly greater than mean of term gestation ($p<0.05$).his median reached peak at 30-31 week. The value then begins a gradual fall to 40 weeks gestation. The study was conclude that the gestational age specific values of AFI were Established, showing significant trends of changes in the amniotic fluid volume with gestation.

Chapter three

Materials and Methods

3.1 Materials:

3.1.1 Machines used:

Mindray, transabdominal Convex probe 3.5MHz,

Figure (3.1). Shows Mindray Dp machine

3.1.2 Population:

The study population was composed of 50 pregnant women in their second and third trimester presented to the ultrasound section in bahri Teaching hospital, during the period from April to July 2017.

3.1.3 Included criteria:

The patient were scanned in second and third trimester with normal and abnormal AFV.

3.1.4 Excluded criteria:

All pregnant women in first trimester and multiple pregnancy were excluded.

3.2 Methods:

3.2.1 Patient preparation:

This procedure requires little to no special preparation .Since only lower abdominal area needs to be exposed for this exam, the patient may want to wear a loose-fitting, the piece of outfit. The case examined while reclining with the abdomen exposed particularly late in pregnancy, this may not be a comfortable position for the client who can experience. Woman in this position should be watched carefully for agitation shortness of breath, dizziness or faintness. Should any of these symptoms occurs role the patient on to her side and the symptoms will usually disappear within a few seconds .Once she feels better you can have her rule back ,or partially back to continue the scan .

3.2.2 Technique and Methods of assessment:

The U/S image had been obtained for all pregnant women in second and third trimester come to obstetric and gynecological department.

- Patient position supine. - Apply coupling agent (gel). - Use high frequency 3.5 MHz transducer. - Ultrasound procedure used to assess the amount of amniotic fluid.The AFI is measured by dividing the uterus in to right and left halves. The umbilicus serves as the dividing point for the upper and lower halves .(Figure 3-2) 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 .

Figure 3.2 Shows AFI measurement

3.3 Data analysis:

The data were analyzed using SPSS statistics.

Chapter Four

Result

Table (4-1) Age distribution

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 20	10	20.0	20.0	20.0
	21 -30	37	74.0	74.0	94.0
	31 - 40	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

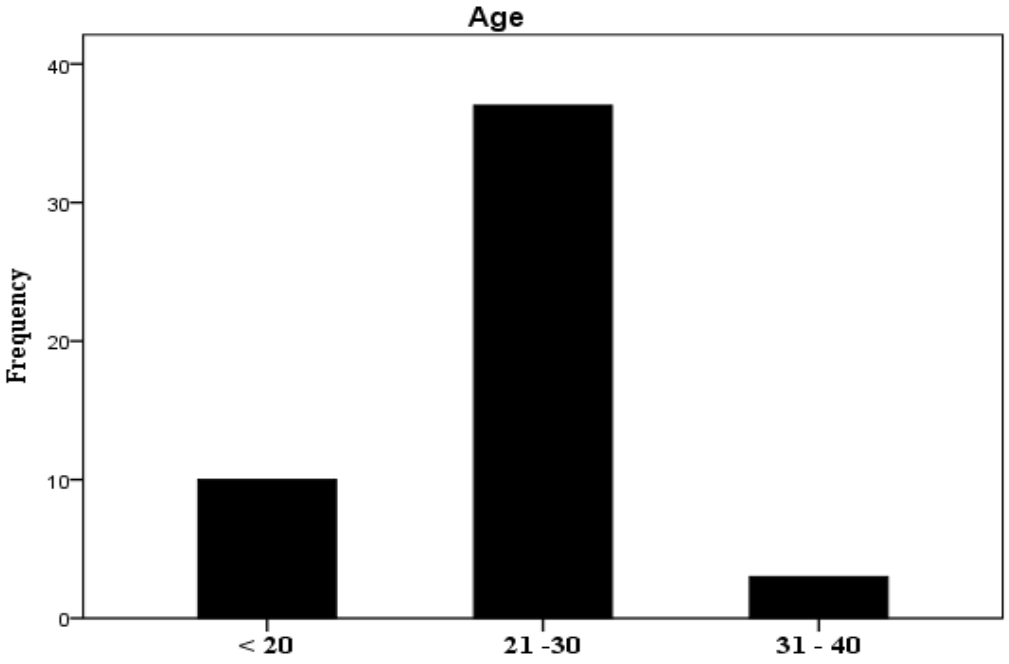

Figure (4 -1) Age Distribution

Table (4-2) Occupation distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Employee	4	8.0	8.0	8.0
Housewife	44	88.0	88.0	96.0
Others	2	4.0	4.0	100.0
Total	50	100.0	100.0	

Figure (4-2) Occupation distribution

Table (4-3) Parity Distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Primigravida	12	24.0	24.0	24.0
Para	25	50.0	50.0	74.0
Multigrandpara	13	26.0	26.0	100.0
Total	50	100.0	100.0	

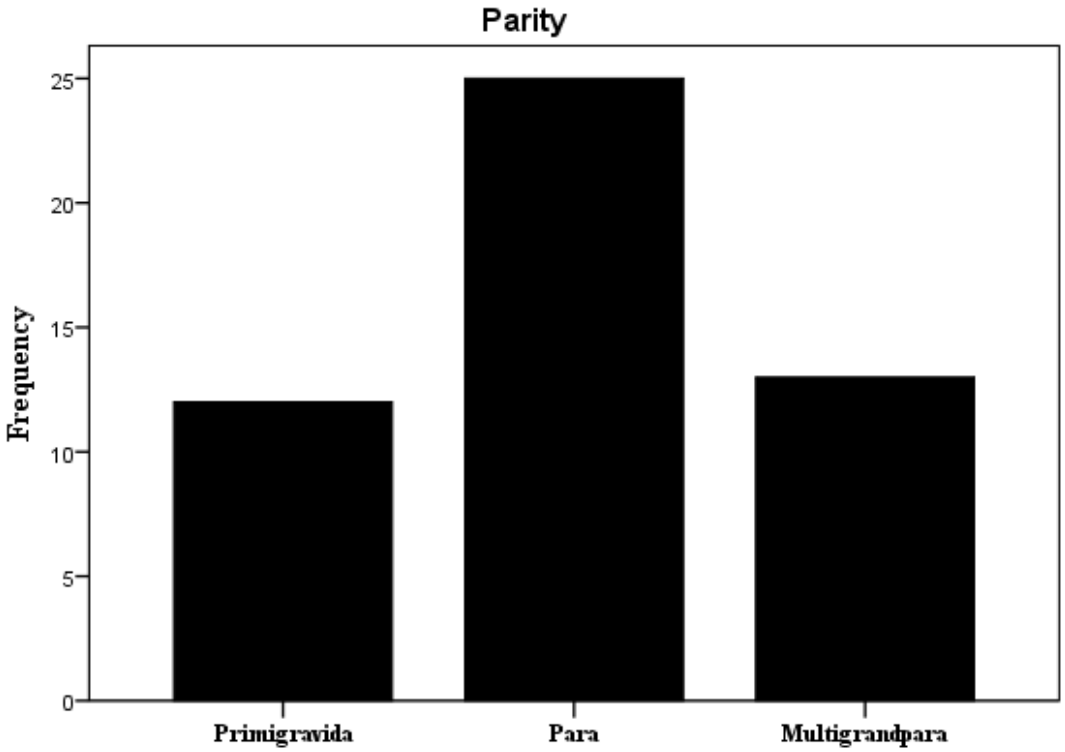

Figure (4-3) Parity Distribution

Table (4-4)Amniotic Fluid volume distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	43	86.0	86.0	86.0
	Increased	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

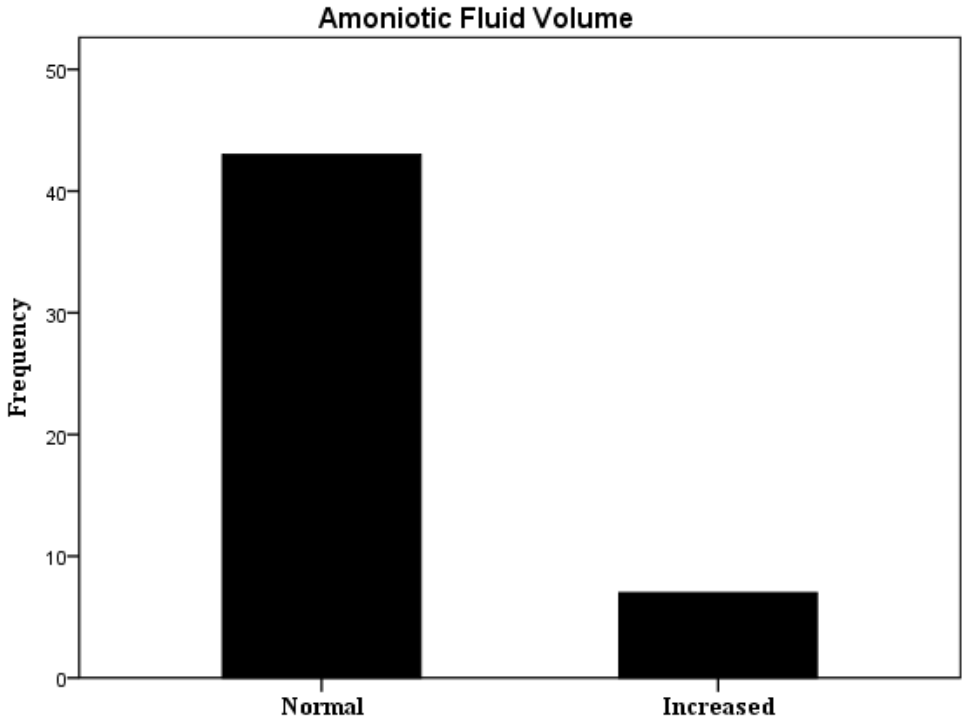

Figure (4-4)Amniotic Fluid Volume distribution

Table (4-5) Causes of polyhydrominios

	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	43	86.0	86.0	86.0
Diabetes	4	8.0	8.0	94.0
Unknown	3	6.0	6.0	100.0
Total	50	100.0	100.0	

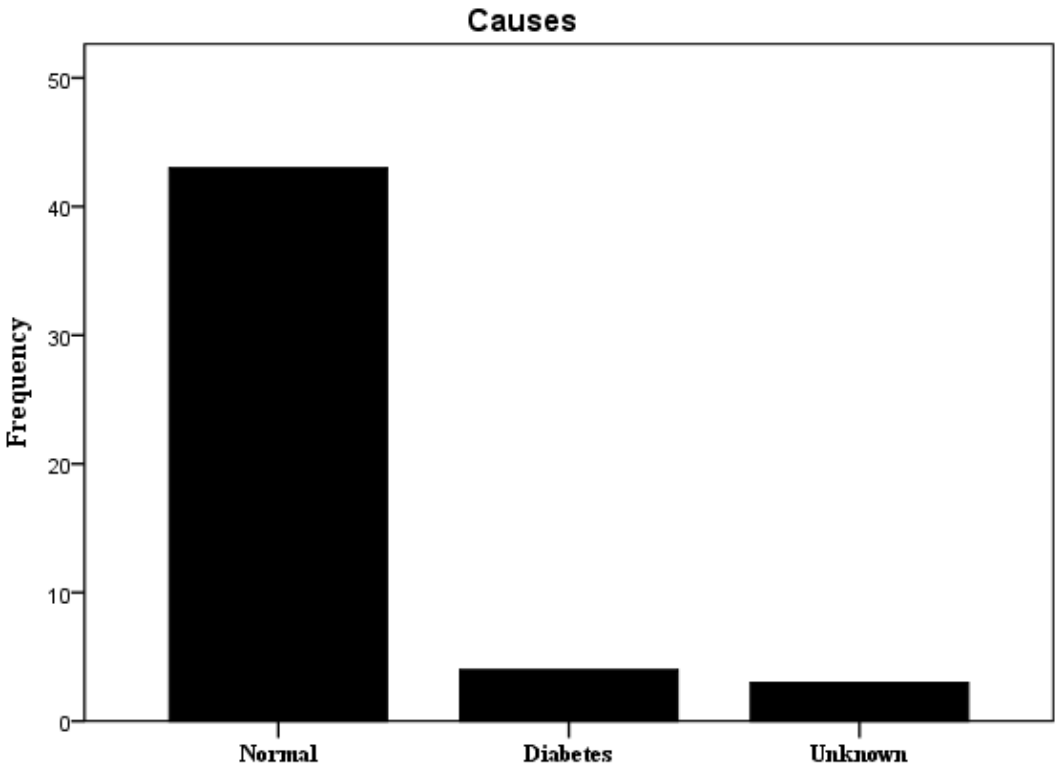

Figure (4-5) Causes of polyhydrominios

Table (4-6) Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Gestational Age	50	13	40	31.68	6.523
Amniotic Fluid Index	50	7.4	30.0	17.174	5.0478
Valid N (listwise)	50				

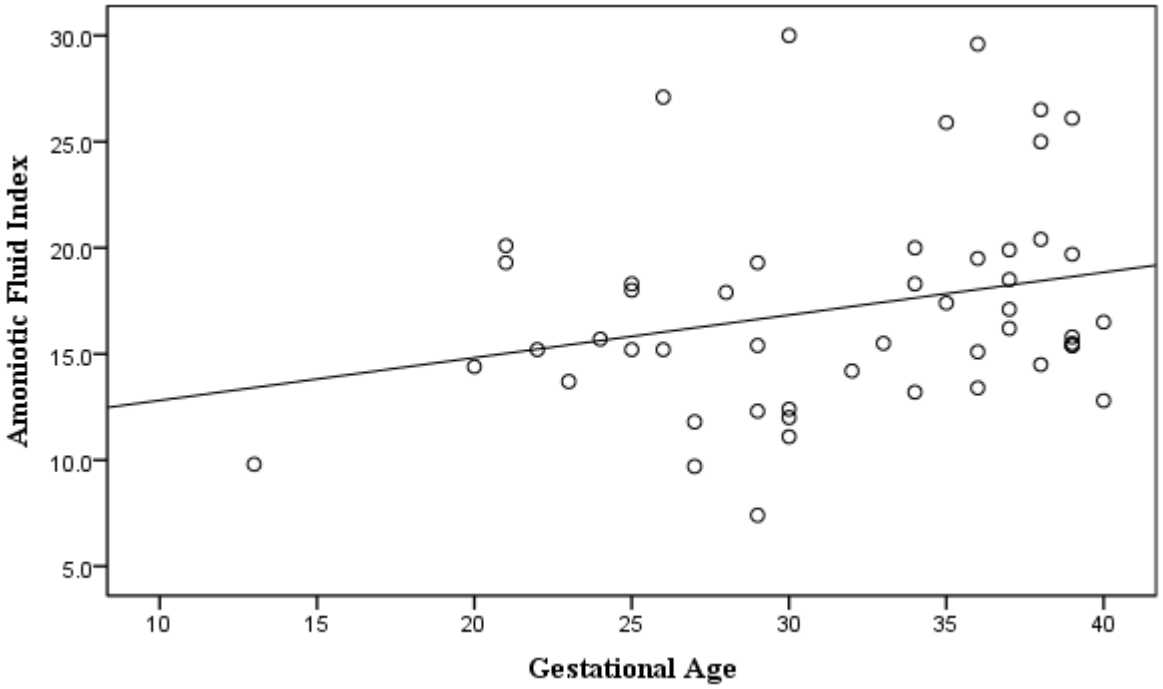

Figure (4 -6) correlation between Gestational Age and AFI

Table (4-7) Group Statistics

	Amniotic Fluid Volume	N	Mean	Std. Deviation	Std. Error Mean
Amniotic Fluid Index	Normal	43	15.547	3.1364	.4783
	Increased	7	27.171	1.9076	.7210

Chapter Five

Discussion, conclusion and Recommendation

5.1 Discussion:

This study aimed to assessment of amniotic fluid index in second and third trimester using ultrasound, The study was performed at Bahri Teaching Hospital , during the period April to July 2017

As shown in table (4-1) Figure (4-1).out of 50 cases in this study 10 cases (20%) their age is less than 20 years , 37 cases (74%) their age group between (21-30) years , 3 cases (6%) their age group between (31-40)years .

Table (4-2) Figure (4-2). Shows that 4 pregnant women (8%) were employee, 44 pregnant women (88%) werehouse wife, 2 pregnant women (4%) others. This result agree with study of Hala 2015 that shown the most pregnant women in her study are housewife (80%) .

The table (4-3) Figure (4-3) illustrates that out of 50 cases in this study12 (24%) were primigravida , 25 (50%) were para,13 (26%) were multi para.

Table (4-4) Figure (4-4) indicates that out of 50 pregnant women in this study 43 pregnant women were normal AVF (86%), 7 pregnant were increase in AFV (14%) .

In this study diabetes (maternal causes) reason of polyhydramnios is the most common cause (8%), however unknown is (6%) , This result shown at table and figure (4-5). This disagree with study of Hala 2015 which the study represent the most common cause of polyhydrmios is unknown.

As in table and figure (4-6),The study mean amniotic fluid index of term was significantly greater than mean of preterm gestation .The minimal value obtained at 13 week then increase gradually reached peak at 40week.This disagree with our prvious study which represent the AFI at preterm is greater than the term.

This difference may be based on volume of the sample in this research compared with large volumes used in the previous studies mentioned in this research, or maybe it's because of the ethnical differentness.

The study concluded that the use of an ultrasound semiquantitative method based on the measurement of a four 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.

5.2 Conclusion:

This study shows that most pregnant women between age 21-30 , the housewife is more than employee and most of them are paragravia,the result hen show most pregnant women have normal amniotic fluid volume and abnormal amniotic fluid volume is not common finding, only the polyhydrominios is founded .

Normal amniotic fluid in 86.0% and abnormal (polyhydromnios) occurs in 14% out of 50 pregnant women. The study shows that most causes of Polyhydramnios are of diabetic reason.

5.3 Recommendations:

Amniotic fluid must be assess by ultrasound method and not depend only on the observation of the sonographer to prevent missing amniotic fluid volume abnormality.

Assessment of amniotic fluid volume is an essential for antenatal care and follow up by ultrasound should be done in all pregnant ladies to predict prenatal complication.

A single deepest pocket method should be at least used, as it is simpler to perform and less time consuming.

For better interpretation of AFI, normal reference values for this index in various weeks of pregnancy in sundaes pregnant ladies are needed.

Further studies are recommended for providing more accurate estimates of the normal range of amniotic fluid index in Sudanese

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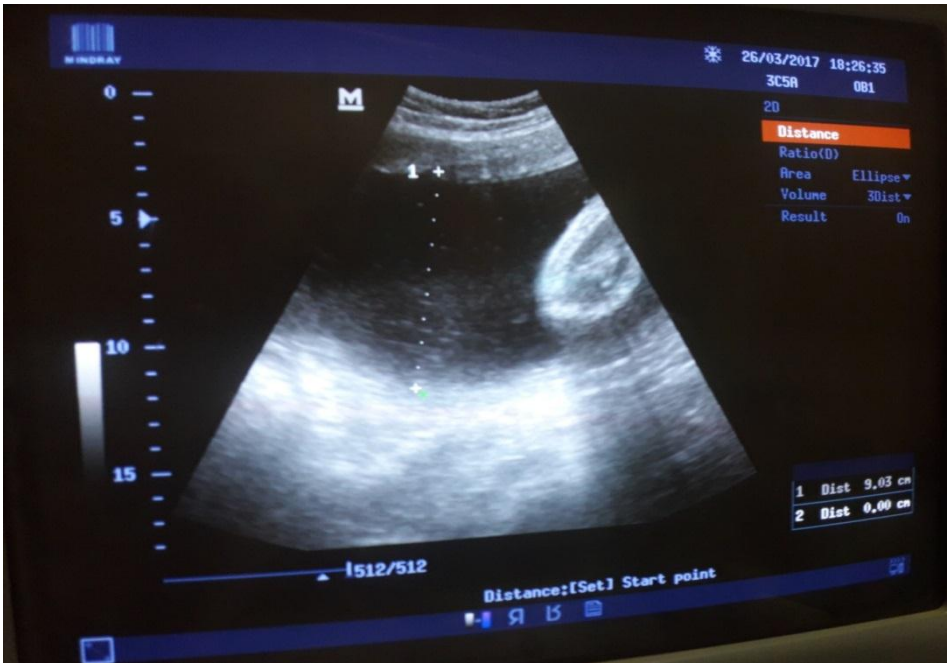
Appendix (A)

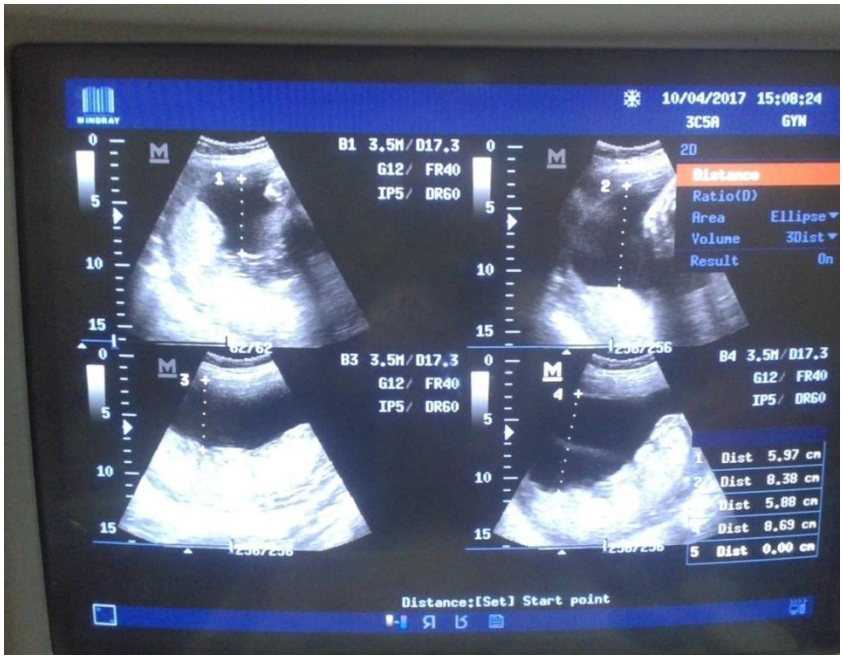
Sudan University of Science and Technology
College of Graduate studies Data Collection Sheet
Assessment of AFV in Pregnant Women in Second and Third Trimester

• Age: <20 ( ) 20-30( ) 31-40( ) 41-50 ( ) >*50* ( )
• Occupation: Employee ( ) House wife ( ) others ( )
• Parity: primigravida (para 1-4 ( ) grand multi para ( )
• LMP: GA: EDD:
• The AF is:
Normal ( ) Increase ( ) Decrease ( )
• The Measurement of AFV
AFI ( ) Cm.
• **Maternal** Cause of poly hydramnios:
1. Diabetic Mother ( )
2. Unknown reasons ( )
3. Others ( )
• **Fetal causes of poly hydramnios**
1**.** Fetal anomaly ( )
2. Fetal infection ( )
3. Twin — Twin transfusion syndrome ( )
4. Others ( )
• **Maternal causes of oligohydramnios**
1**.** Pre mature rupture of membrane ( )
2. Post term pregnancy ( )
3. Maternal health condition ( )
4. Placenta problem ( )
5. Others ( )

Appendix (B)

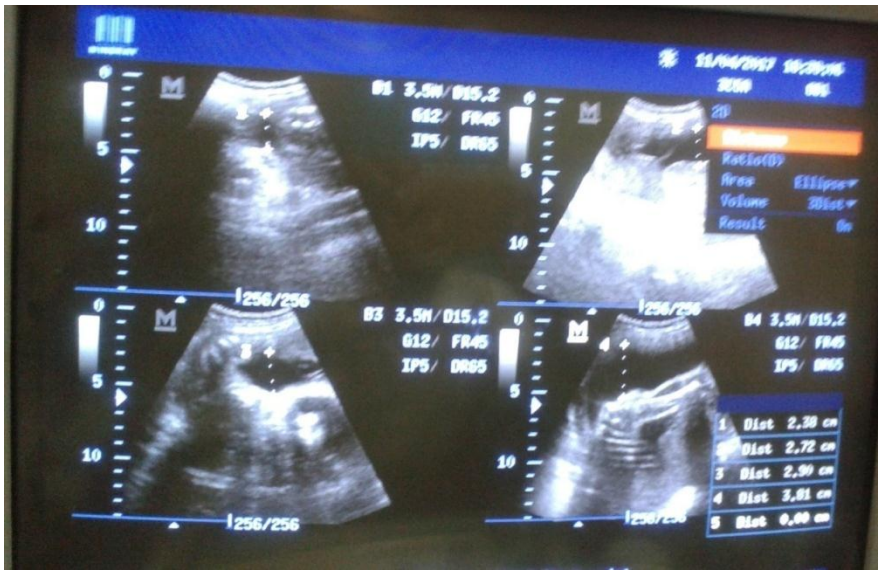


B-1 ultra sound image shows 32 years old pregnant woman with 36 weeks gestation with polyhydrominios AFV



B-2 ultra sound image shows 35 years old pregnant woman with 36 weeks gestation with polyhydrominiosAFV

B-3 ultra sound image shows 25 years old pregnant woman with 38 weeks gestation with normal AFV



B-4 ultra sound image shows 22 years old pregnant woman with 27 weeks gestation with normal AF