الآيـــــة

((رَبِّ إِنِّي وَهَنَ الْعَظْمُ مِنِّي وَاشْتَعَلَ الرَّأْسُ شَيْبًا وَلَمْ أَكُن بِدُعَائِكَ رَبِّ
وَإِنِّي خِفْتُ الْمَوَالِيَ مِن وَرَائِي وَكَانَتِ امْرَأَتِي عَاقِرًا فَهَبْ لِي مِن
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صدق الله العظيم

سورة مريم الاية

DEDICATION

This research dedicated to my family for the encouragement which helped me in completion of this step, may beloved and supportive husband, who is always by my side when times I needed his most and helped me a lot in making this study. And my lovable son who served as my inspiration to pursue this undertaking.

ACKNOWLEDGEMENT

This thesis becomes a reality with the kind support and help of many individuals. I would like to extend my sincere thanks to all of them.

I would like to express my gratitude to words I am high indebted to staff of College of Medical Radiological Science for their guidance and for providing necessary information regarding this research.

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My thanks and appreciation also go to my sister who has willing helped me out with abilities.

Abstract

Fetal weight is undoubtedly one of the most significant determinants of neonatal survival. It has become increasingly important, especially for the prevention of prematurity, evaluation of pelvic disproportion before induction of labor and detection of Intra Uterine Growth Restriction.

The aim of this study was to evaluate the validity and efficiency of prediction of fetal birth weight by measuring fetal kidney length. The study conducted at Academy Charity Hospital at Khartoum state, 50 pregnant women were enrolled in the study and their fetal biometry was measured. Fetal both kidneys' length were measured and correlated to fetal weight.

The result of the study showed that there was linear and strong correlation between right kidney length and fetal weight ($p< 0.05$). This correlation was also noticed at the left kidney, but was not strong and non-significant.

The model derived from this study indicated that the fetal kidney length can be used to estimate fetal weight in combination with biparietal diameter and femur length.

ملخص الدراسة

وزن الجنين هو بلا شك واحد من أهم المحددات الهامة لبقاء الأطفال حديثي الولادة. وقد أصبح من المهم على نحو متزايد، وخاصة للوقاية من الولادة المبكر ة، وتقييم تناسب الحوض قبل تحريض المخاض والكشف عن تقييد النمو داخل الرحم.

كان الهدف من هذه الدراسة هو تقييم صلاحية وكفاءة التنبؤ بوزن الجنين عند الولادة عن طريق قياس طول كلية الجنين. أجريت هذه الدراسة في المستشفى الأكاديمي الخيري في ولاية الخرطوم، تم تسجيل 50 امرأة حامل في الدراسة و تم قياس طول كلية الجنين ووزنه.

وأظهرت نتائج الدراسة أن هناك ارتباط خطي قوي بين طول الكلية اليمني ووزن الجنين ($p<0.05$). وقد لوحظ هذا الارتباط أيضا في الكلية اليسرى ولكن لم يكن قويا.

خلصت هذه الدراسة أن طول كلى الجنين يمكن أن يستخدم لتقدير وزن الجنين يالاضافة الي قطر الرأس وطول عظم الفخذ.

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CHAPTER ONE

1.1 Introduction:

The correct determination of the fetal weight prior to delivery is most important and greatly influence the clinical management, the outcome of pregnancy, delivery and survival of the newborn, especially in case such as fetal macrosomia, fetal growth restriction, breech presentation or in a trail of vaginal birth after previous cesarean section. Fetal weight estimation has a significant bearing on management decisions on labor, therapy markedly improving perinatal outcome (Briceno et al., 2013).

Many of the critical measurements of growth are now carried out by ultrasound and this period ends at birth. Many different systems formed in the embryonic period (organogenesis) grow and do so at different times.

It is essential to obtain an accurate assessment of antenatal fetal weight owing to potential complications that can arise from low and excessive fetal birth weight during labor and the puerperium (el-Galley and Keane, 2000).

Obstetric sonographic assessment for obtaining fetal biometric measurements to predict fetal weight has been integrated into the mainstream of obstetric practice in the last quarter of a century. Estimation of fetal weight based on ultrasound images plays a key role in prenatal care. Ultrasound is a major tool for fetal weight estimation, due to it is noninvasiveness, portability and relatively low cost.

These measurements are entered into a mathematical formula that's used to calculate the estimated fetal weight. There are many different formulas for weight estimation, and even the best ones have a 15% margin of error in 85% of all fetuses. In other words about one in seven fetuses will weight 15% more or less than estimated (Briceno et al., 2013).

Kidneys in the second and third trimesters typically have the same configuration as in postnatal life. The fetal kidney is easy to identify and measure but has not been studies extensively as a biometric index for fetal weight estimation (Chitty and Altman, 2003).

The purpose of this study is to use ultrasound to measure the fetal kidney length among population of healthy Sudanese women and to evaluate the validity and efficiency of fetal kidney length for fetal weight estimation.

1.2 Problem of the study:-

It has been shown that the standard set of parameters such as (BPD, HC, AC, and FL) does not significantly improve weight estimations alone. It appears that the error inherent in obtaining the basic measurements (especially the AC) is great enough to obscure any refinement in accuracy that might be gained from additional measurements.

1.3 Objective of the study

1.3.1 General objective:

To measure of fetal kidney length as parameter for fetal weight estimation for Sudanese population

1.3.2 Specific objectives

- To estimate fetal weight by fetal kidney length.
- To correlate the fetal kidney length with other fetal parameter.
- To correlate the fetal kidney length in normal Sudanese pregnant women with the standard measurement.

CHAPTER TWO

Theoretical Background and Literature review

2-1 Development of kidneys:

Three slightly over lapping kidney systems are formed in a cranial to caudal sequence during intrauterine life in humans; the pronephros, mesonephros, and metanephros. The first of these systems is rudimentary and nonfunctional, the second may function for a short time during the early fetal period; the third forms the permanent kidney (Vlajkovic et al., 2006).

2-1-1 Pronephros:

At the beginning of the forth week, the pronephros is represented by7 to 10 solid cell groups in the cervical region. these groups form vestigial excretory units, nephrotomes , that regress before more caudal ones are formed .by the end of the fourth week , all indication of the pronephric system have disappeared (Vlajkovic et al., 2006).

2-1-2 Mesonephros:

The mesonephros and mesonephric ducts are derived from intermediate mesoderm from upper thoracic to upper lumbar (L3) segments. Early in the fourth week of development, during regression of the pronephric system, the first excretory tubules of the mesonphros appear. They lengthen rapidly, from and S-shaped loop, and acquire a tuft of capillaries that well form a glomerulus at their medial extremity. Around the glomerulus, the tubules form Bowman's capsule and together these structures constitute a renal corpuscle. Laterally, the tubule enters the longitudinal collecting duct known as the mesonephric or Wolffian duct. In the middle of the second month, the

mesonephros forms a large ovoid organ on each side of the mid line. Because the developing gonad is on its medial side, the ridge formed by both organs is known as the urogenital ridge. While caudal tubules are still differentiating, cranial tubules and glomeruli show degenerative changes and by the end of the second month the majority have disappeared. In the mal a view of the caudal tubules and the mesonephric duct persist and participate in formation of the genital system but they disappear in the female (el-Galley and Keane, 2000).

2-1-3 Metanephros: The definitive kidney:

The third urinary organ, the metanephros or permanent kidney appears in the fifth week. Its excretory units develop from metanephric mesoderm. In the same manner as in the mesonephric system. The development of the duct system differs from that of the other kidney systems (el-Galley and Keane, 2000).

2-2 Collecting system:

Collecting ducts of the permanent kidney develop from the ureteric bud, an outgrowth of the mesonephric duct close to its entrance to the cloaca. The bud penetrates the metanephric tissue, which is molded over its distal end as a cap. Subsequently, the bud dilates forming the primitive renal pelvis, and splits into cranial and caudal portions, the future major calyces. Each calyx forms two new buds while penetrating the metanephric tissue. These buds continue to subdivide until 12 or more generations of tubules have formed. Meanwhile, at the periphery, more tubules form until the end of the fifth month .the tubules of the second order enlarge and absorb those of the third and fourth generations forming the minor calyces of the renal pelvis. During

further developing, collecting tubules of the fifth and successive generations elongate considerably and converge on the minor calyx, forming the renal pyramid. The ureteric bud gives rise to the ureter, the renal pelvis, the major and minor calyces, and approximately 1 to 3 million collecting tubules (Kooijman et al., 2014).

2-3 Excretory system:

Each newly formed collecting tubule is covered at its distal end by ametanephric tissue cap .under the inductive influence of the tubule, cells of the tissue cap form small vesicles, the renal vesicles which in turn give rise to small S-shaped tubules. Capillaries grow into the pocket at one end of the S and differentiate into glomeruli. These tubules together with their glomeruli form nephrons or excretory units. The proximal end of each nephron forms Bowman's capsule, which is deeply indented by a glomerulus. the distal end forms an open connection with one of the collecting tubules establishing a passageway from bowman's capsules, which is deeply indented by a glomerulus. The distal end forms an open connection with one of the collecting tubules, establishing a passageway from Bowman's capsule to the collecting unit. Continuous lengthening of the proximal convoluted tubule results in formation of the proximal convoluted tubule, loop of Henle, and distal convoluted tubule. Hence the kidney develops from two sources; metanephric mesoderm, which provides excretory units, and the ureteric bud, which gives rise to the collecting system (Marieb, 2000).

Nephrons are formed until birth, at which time there are approximately 1million in each kidney. Urine production begins early in gestation, soon after differentiation of the glomerular capillaries, which start to form by the

10^{th} week. At birth, the kidneys have a lobulated appearance, but the lobulation disappears during infancy as a result of further growth of the nephrons, although there is no increase in their number (Esin et al., 2017).

2-4 POSITION OF THE KIDNEY:

The kidney, initially in the pelvic region, later shifts to a more cranial position in the abdomen. This ascent of the kidney is caused by diminution of body curvature and by growth of the body in the lumbar and sacral regions .In the pelvis; the metanephros receives its arterial supply from a pelvic branch of the aorta. During its ascent to the abdominal level, it is vascularized by arteries that originate from the aorta at continuously higher levels .the lower vessels usually degenerate but some may remain (Marieb, 2000).

2-5 Function of the kidney:

The definitive kidney formed from the metanephros becomes functional near the 12^{th} week .urine is passed into the amniotic cavity and mixes with the amniotic fluid .the fluid is swallowed by the fetus and recycles through the kidneys .during fetal life, the kidneys are not responsible for excretion of waste products because the placenta serves this function (Silverthorn et al., 2009).

2-6 Congenital renal anomalies:

2-6-1 Renal agenesis:

Renal abnormalities are the most frequent cause of oligohydramnios. During fetal development, around 12 weeks, the fetal kidneys begin to produce urine. Urine comprises the greater part of amniotic fluid after 16 weeks.

Amniotic fluid is a substance that contains valuable proteins that are essential for normal fetal development. The fetus ingests amniotic fluid by swallowing. The fluid passes through the esophagus, into the stomach, and travels through the small bowel and into the colon, where normal absorption takes place. In circumstances in which the fetus has a renal abnormality, specifically those that are linked with bilateral renal agenesis, inadequately functioning kidneys, or obstruction of the urinary tract, oligohydramnios will be present, and in some cases anhydramnios may occur. Therefore, if a normal amount of fluid is noted during a sonogram, one can assume that there is at least one functioning fetal kidney present.

The most worrisome consequence of oligohydramnios is pulmonary hypoplasia, or underdevelopment of the lungs. In the upcoming discussion on fetal renal disease, keep in mind that while unilateral conditions carry a better prognosis, bilateral disease often leads to oligohydramnios, and is thus related to a poor outcome in most cases due to pulmonary hypoplasia. Renal Agenesis Failure of a kidney to form is referred to as renal agenesis. Renal agenesis can be unilateral or bilateral.

There are two sonographic findings that are helpful in making the sonographic diagnosis of renal agenesis (Silverthorn et al., 2009).

First, when the kidney is absent in the abdomen, the adrenal gland can be noted in a parallel, flattened position, a sonographic finding known as the "lying down" adrenal sign Secondly, color Doppler can be employed over the renal artery branches of the abdominal aorta. When there is absence of the kidney, there will be no identifiable renal artery branches

Bilateral renal agenesis, also known as Potter syndrome, is a fatal condition. Absence of both of the fetal kidneys can be difficult to detect sonographically, secondary to the lack of amniotic fluid surrounding the

fetus. Therefore, it is extremely beneficial to utilize color Doppler to investigate the renal area. Nonvisualization of the urinary bladder and kidneys, with associated severe oligohydramnios, are considered to be trustworthy findings consistent with bilateral renal agenesis. Bilateral renal agenesis may be seen in conjunction with sirenomelia and various cardiovascular malformations. Fortunately, unilateral renal agenesis is much more common than bilateral renal agenesis. Most often, with unilateral renal agenesis there is an average amount of amniotic fluid and the prognosis is good. Before making the conclusion of unilateral renal agenesis, the sonographer should always analyze the fetal pelvis for a pelvic kidney, as this is the most common location of an ectopic kidney.1 In the presence of unilateral renal agenesis, the contralateral kidney will enlarge, a condition known as compensatory hypertrophy (Geelhoed et al., 2009).

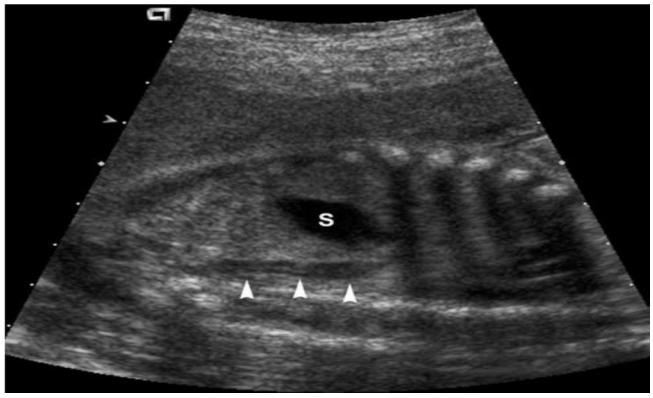


FIGURE 2-1 “Lying down” adrenal sign. Left parasagittal view of the fetal abdomen demonstrates the left adrenal gland (arrowheads) to be lying in a cephalocaudal orientation behind the stomach (S).

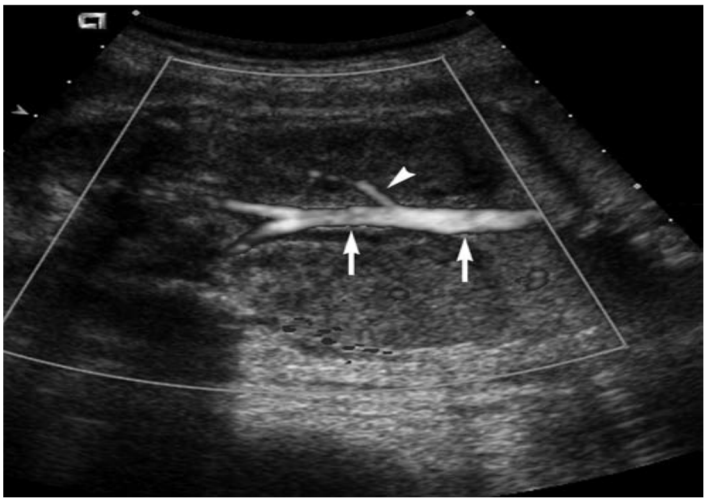


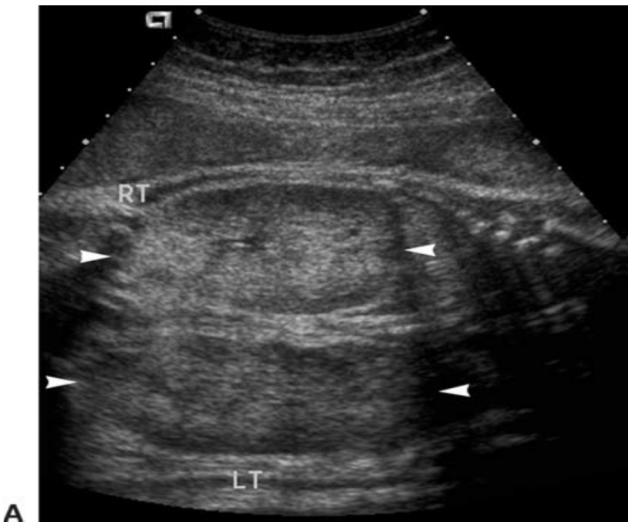
FIGURE 2-2 unilateral renal agenesis. Power Doppler demonstrates a renal artery (*arrowhead*) and no identifiable renal artery branch or kidney on the other side (*arrows*).

There are several distinct categories of fetal renal cystic disease that were formerly described by Potter; autosomal recessive polycystic kidney disease, autosomal dominant polycystic kidney disease, multicystic dysplastic kidney disease, and obstructive cystic dysplasia. In order for an autosomal recessive disease to be passed to the fetus, both parents must be carriers of the disease. Each offspring of parents, who are both carriers of an autosomal recessive disorder, has a 25% chance of being affected and a 50% chance of being a carrier (Geelhoed et al., 2009).

In the case of an autosomal dominant disease, at least one of the parents has to be the carrier of the disease and the gene must be dominant. That is to say, the dominant gene is capable of overriding the normal gene from the parent who is not a carrier. However, this does not indicate that every offspring will be affected. Each offspring of a parent who is a carrier of an autosomal dominant disease has a 50% chance of receiving the gene from their parents.

2-6-2 Autosomal Recessive (Infantile) Polycystic Kidney Disease

May also be referred to as autosomal recessive polycystic renal disease and infantile polycystic kidney disease. The typical sonographic findings of a fetus affected by ARPKD are bilateral, enlarged, echogenic kidneys, nondetectable urinary bladder, and oligohydramnios the kidneys may be as large as 3 to 10 times the normal renal size for the gestation. One condition associated with ARPKD is Meckel– Gruber syndrome, which is a fatal disorder that is associated with renal cystic disease, occipital cephalocele, and polydactyly. Fetuses with trisomy 13 and trisomy 18 may also have polycystic kidney disease. Referring to this condition as a renal cystic disease can be puzzling to a sonographer because cysts are not always perceptible with sonography. This is secondary to the size of the cysts, as the cysts with ARPKD are microscopic and not macroscopic. It is significant to appreciate the differences in the sonographic appearance of ARPKD and multicystic dysplastic kidney (MCDK) disease. Cysts are not identifiable in ARPKD but are evident in the MCDK (Geelhoed et al., 2009).



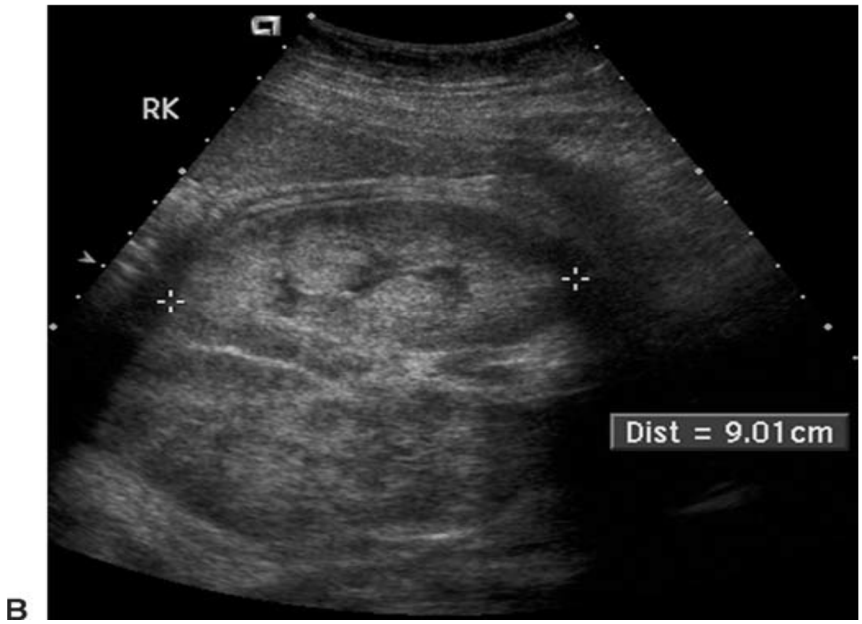


FIGURE 2-3 Autosomal recessive polycystic kidney disease in the third trimester. A. The right (RT) and left (Chitty and Altman) kidneys (arrowheads) are enlarged and have increased echogenicity at 33 weeks. B. The right kidney (RK) is visualized better and shows signs of increased echogenicity. It is enlarged and measures approximately 9 cm in length (calipers).

Multicystic Dysplastic Renal Disease Multicystic dysplastic renal disease may also be referred to as multicystic dysplastic kidney (MCDK) disease and multicystic renal dysplasia. MCDK disease is thought to be caused by an early, first trimester obstruction of the ureter. The sonographic findings of MCDK disease are the identification of unilateral or bilateral multiple, smooth-walled, noncommunicating cysts of varying sizes in the area of the renal fossa (e) there is typically no normal-functioning renal tissue present in the kidney affected by MCDK disease. Therefore, MCDK disease is fatal if bilateral, with the consistent associated findings of oligohydramnios and absent bladder. Fortunately, most cases of MCDK disease are unilateral and

consequently have a normal amniotic fluid volume.1 Fetuses with MCDK disease can also have additional related anomalies, such as abnormalities of the gastrointestinal tract and central nervous system, limb anomalies, and further renal abnormalities (Vlajkovic et al., 2006).

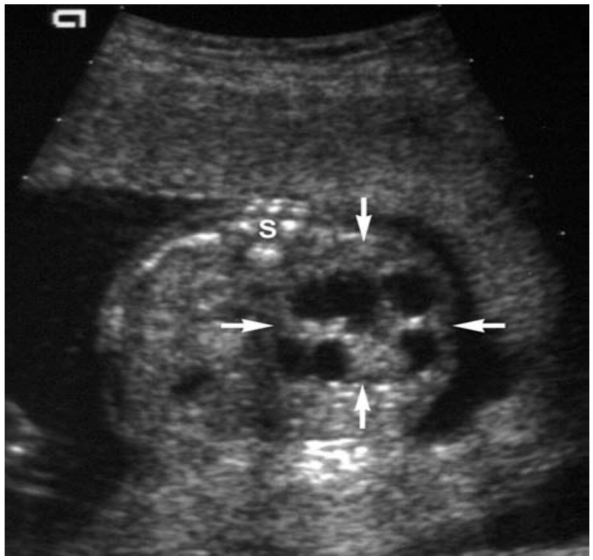


FIGURE 2-4 unilateral multicystic dysplastic kidneys. Transverse view of the fetal abdomen at the level of the kidneys reveals a mass (*arrows*) that consists of multiple cysts located adjacent to the fetal spine (*S*), representing a multicystic dysplastic kidney

Obstructive Cystic Dysplasia Obstructive cystic dysplasia, like MCDK disease, is caused by an early renal obstruction. It can be unilateral or bilateral. A ureterocele, or a severe bladder outlet obstruction, early in gestation, can lead to bilateral obstructive cystic dysplasia, in which case oligohydramnios will be present.4 Though, unilateral obstructive cystic dysplasia is most often caused by a pelviureteral junction or vesicoureteral junction obstruction.1 The kidney will appear small and echogenic and have cysts located along its margins. Often, there will be evidence of hydronephrosis and a thick-walled urinary bladder.

2-6-3 Fetal Urinary Tract Obstruction

An obstruction of the fetal urinary tract can lead to distension of the bladder, ureters, and renal collecting system. Although physiologically fundamental, it is quite imperative for the sonographer to understand the creation and flow of urine through the urinary tract in order to determine the origin of a urinary tract obstruction. Urine is produced by the kidney, exits the kidney by means of the renal pelvis, travels down the ureter, into the bladder, and exits the body via the urethra. Any obstruction to this normal succession will result in a backup of urine. For example, if there is an obstruction at the region where the ureter meets the bladder, the ureterovesicular junction, then those structures that are positioned proximal to the obstruction will be dilated. That is to say, the entire ureter, the renal pelvis, and the renal calices will be eventually dilated and filled with urine. Conversely, if the obstruction level lies at the point at which the renal pelvis meets the ureter, the ureteropelvic Junction, then the renal pelvis and renal calices will be dilated, while the ureter and bladder will remain normal. Hydronephrosis is the most common fetal abnormality noted during an obstetric sonogram. Hydronephrosis, or pelvocaliectasis, may be described as pelviectasis or caliectasis, depending on which part of the collecting system is dilated. Enlargement of the bladder is called megacystis, while dilation of the ureter may be referred to as megaureter or hydroureter. Fetal pelviectasis, or dilation of the renal pelvis, can be established and measured with sonography by taking a renal pelvic diameter (Vlajkovic et al., 2006).

The measurement of the renal pelvis is made in the anteroposterior plane and should not exceed 10 mm after 30 weeks' gestation.3 However, it is important to note that before 30 weeks, an abnormal renal pelvis can measure between 4 and 10 mm, depending on the stage of development. The ureteropelvic

junction, the ureterovesicular junction, and the urethra are the three most common areas where obstruction occurs. The following sections will discuss these causes of fetal hydronephrosis in more detail. It is also important to note that less common causes of hydronephrosis in the fetus include ureterocele, ectopic ureter, vesicoureteral reflux, and Urethral atresia (Vlajkovic et al., 2006).

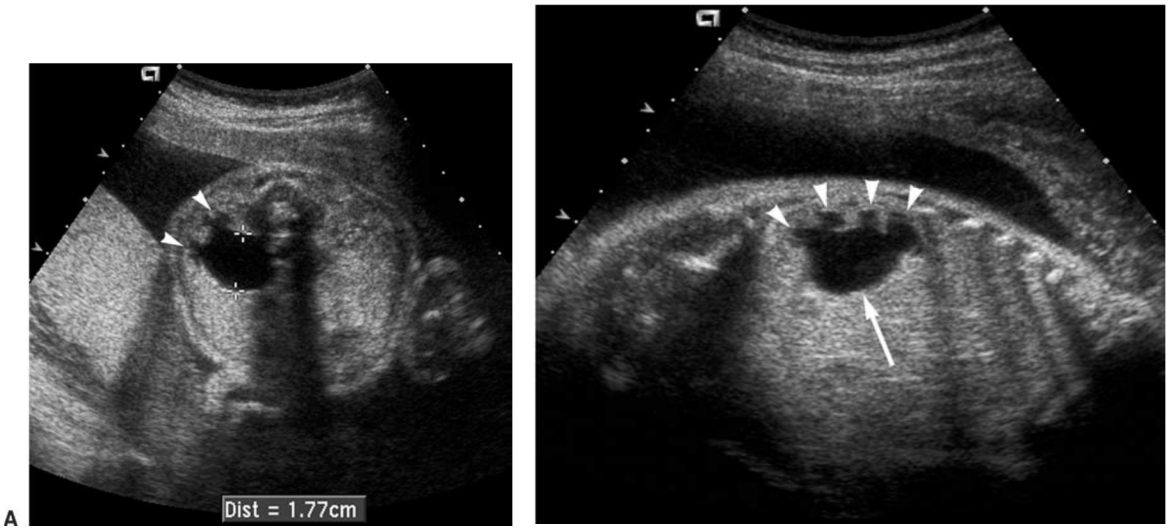


FIGURE 2-5 unilateral hydronephrosis caused by an ureteropelvic junction obstruction. **A.** Transverse view of the fetal abdomen demonstrates dilation of the right renal pelvis (*calipers*), measuring 17.7 mm in the anteroposterior diameter, as well as dilation of the calices (*arrowheads*). **B.** Longitudinal view of the abdomen better demonstrates the extent of the dilation, as the calices (*arrowheads*) are clearly visible.

Ureteropelvic Junction Obstruction Ureteropelvic junction (UPJ) obstruction is the most common cause of hydronephrosis in the neonate and the most common form of fetal renal obstruction. The UPJ is located at the junction of the renal pelvis and ureter. The cause of this abnormality may be due to irregular development of the smooth muscle in the area of the UPJ. Some authors suspect ureteral stenosis or kinks, adhesions, crossing vessels, or abnormal outlet shapes. The disease is usually unilateral and more common in

males. The sonographic appearance of a UPJ obstruction is the dilation of the renal pelvis and renal calices.

2-7 FETAL BIOMETRIES:

Fetal biometry is the sonographic measurement of fetal structure. There are three primary objectives for measuring fetal part; to assign fetal age ,to diagnose fetal growth disorders by assessing if measured fetal parts are appropriate size for GA or by estimating fetal weight and to determine the appropriateness of the dimension of fetal structure against each other (ratio) and or against GA. first trimester ultrasound is a useful and reliable modality for assessment of GA .the gestation sac mean diameter, yolk sac and Crown-Rump Length are useful because each measures a different aspect of the first trimester pregnancy and may be used at different times during the first trimester. Following sonographic parameters can be used to estimate fetal size, biparietal diameter (BPD), femur length (FL), head circumference (HC), and abdominal circumference (AC) (Wilhelm et al., 1991).

Measurements should be performed in a standardized manner on the basis of strict quality criteria. An audit of results can help to ensure accuracy of techniques with regard to specific reference tables.

2-7-1 Head circumference (HC):

The head circumference or HC measures the circumference of the fetus head the HC is usually done after 13 weeks of the pregnancy (Wilhelm et al., 1991).

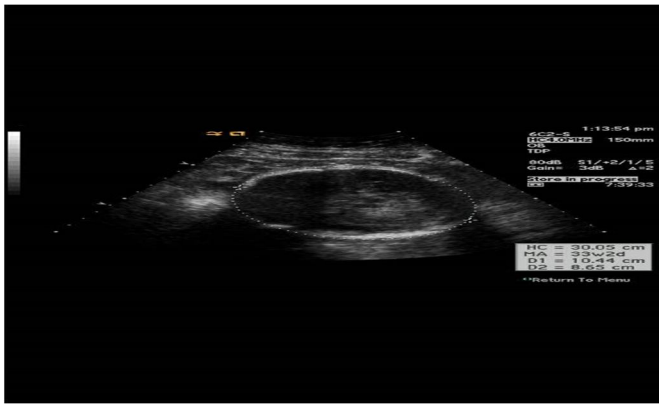


Figure 2-6 Head circumference

2-7-2Femur length (FL):

Measures the longest bone in the body and reflects the longitudinal growth of fetus. Its usefulness is similar to the BPD. It increases from about 1.5 cm at 14 weeks to about 7.8 cm at term. Similar to the BPD, dating using the FL should be done as early as is feasible (Wilhelm et al., 1991).

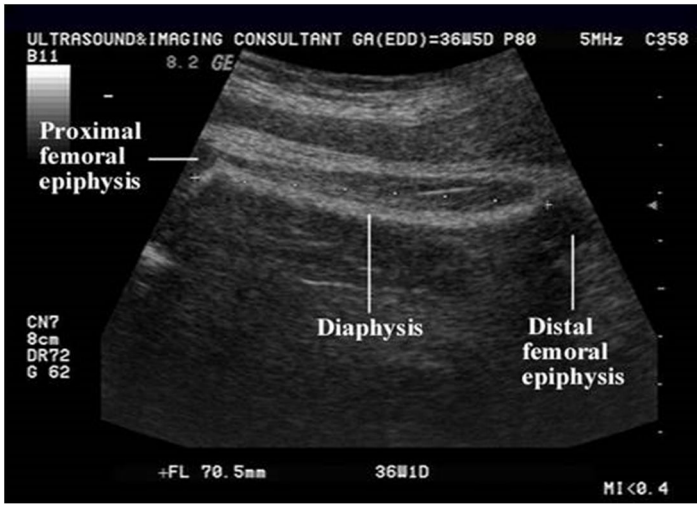


Figure 2-7 Femur length

2-7-3 abdominal circumferences (AC):

The single most important measurement to make in late pregnancy. It reflects more of fetal size and weight rather than age. Serial measurements are useful

in monitoring growth of the fetus AC measurements should not be used for dating a fetus (Wilhelm et al., 1991).

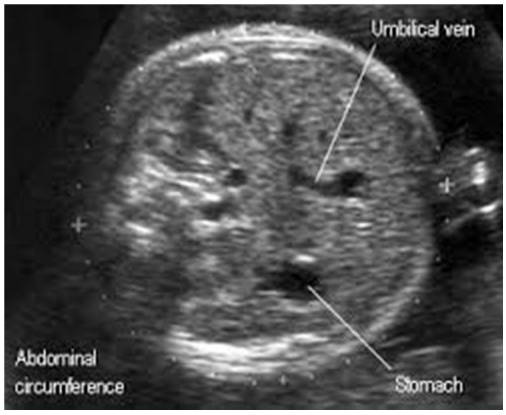


Figure 2-8 abdominal circumferences

2-7-4 Biparietal diameters (BPD):

The diameter between the 2 sides of the head. This is measured after 13 weeks. It increases from about 2.4 cm at 13 weeks to about 9.5 cm at term. Different babies of the same weight can have different head size, therefore dating in the later part of pregnancy is generally considered unreliable. (Chart and further comments) Dating using the BPD should be done as early as is feasible (Wilhelm et al., 1991).

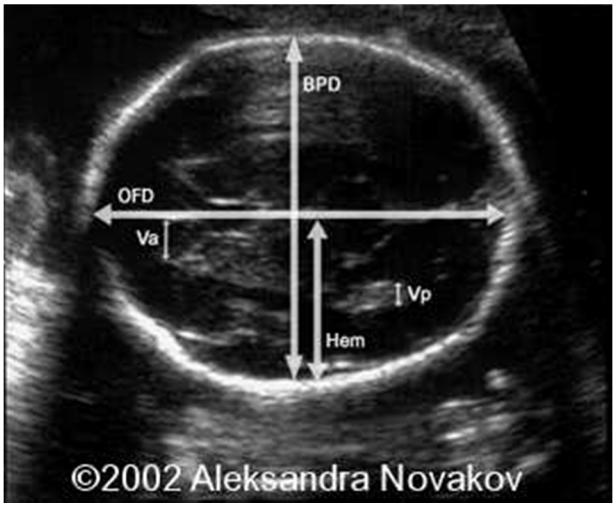


Figure 2-9 measurement of Biparietal diameters

CHAPTER THREE

Materials and Method

3-1 Materials:

3-1-1 Subjects:

The study conducted at Academic Charity Hospital in the period from November 2016 to March 2017. 50 Pregnant women in gestation age in the range between 14- 40 weeks, the age ranged between (15- 45) years, presented to ultrasound department at the area of study. Single gestation, viable fetus with Gestational age from 13 weeks and above was included. Maternal with Diabetes mellitus, multiple pregnancies, Hypertensive, Intra uterine growth restricted, chronic renal diseases and fetal anomalies were excluded. Subjects agreed verbally to use their data in the study; no patient identification or individual patient will be published.

3-1-2 Machine Used:

Xario 100 Scanner with 3,5 MHZ convex array transducer.

3-2 Method:

3-2-1 Technique used:

Prior to the examination, pregnant women were instructed to drink three or four glasses of water to achieve maximum bladder distention during the procedure .cases were examined in supine position .multiple cross sections of the uterus made in longitudinal and transverse direction.in the course of ultrasonography the fetal position and BPD were determined. these lengths of

the kidneys were analyzed in relation to the fetal weight estimation determined on the basis of BPD, FL, AC and HC.

3-2-2 Measurements of the kidneys:

The kidneys are located on either side of the spine in the posterior abdomen and are apparent as early as the 13th week of pregnancy. The appearance of the developing kidney changes with advancing GA. In the second trimester of pregnancy, the kidneys appear as ovoid retroperitoneal structures that lack distinctive borders .The pelvicaliceal center may be difficult to define in early pregnancy whereas with continued maturation of the kidneys, the borders become more defined and the renal pelvis become more distinct. The renal pelvis appears as an echo-free area in the center of the kidney. The kidneys appear as elliptic structure when scanning in the longitudinal axis and appear circular in their retroperitoneal location adjacent to the spine in the transverse views, commonly, in a transverse position, the acoustic spine may shadow the bottom or distal kidney. Rotating to the sagittal plane may image the distal kidney. With the fetus in the spine-up or spine-down position, the kidneys are observed lateral to the spine.

The measurement BPD is made in transverse axial plane .intracranial landmark utilized for the BPD include visualization of falx cerebri posteriorly,the cavum septi pellucidi anteriorly and paired thalami in the midline with asylvian fissure laterally.

The FL was measured with the bone across the beam axis.the strong acoustic shadow behind the femoral shaft and the visualization of both cartilaginous ends indicated the image plane is on the longest axis.

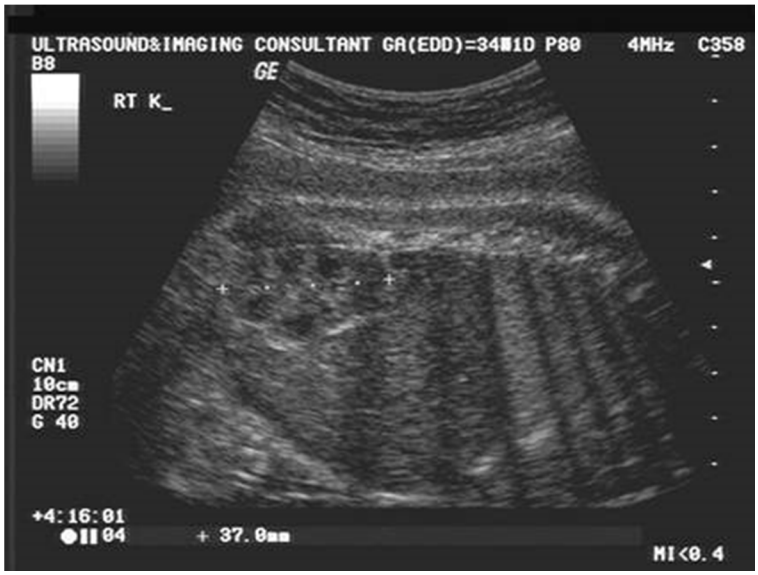


Figure 3-1 longitudinal plane of the fetal kidney

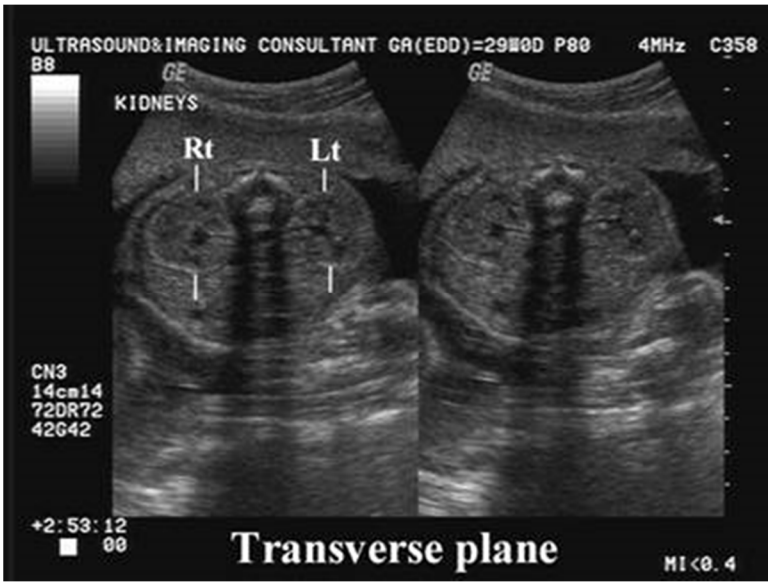


Figure 3-2 Transverse plane of the fetal kidney

3-2-3 Data collection:-

The data were collected in a data collection sheet (which is designed especially for the study).

3-2-4 Data Analysis:-

The data were analyzed using (SPSS) software; descriptive statistics as well as correlations were performed.

CHAPTER FOUR
RESULTS

Table 4-1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Fetal Weight	50	144	4143	1731.6	854.092
Fetal LT kidney Length	50	3.6	42.0	28.276	8.1075
Fetal RT kidney Length	50	3.0	42.0	27.686	8.2437

Table 4-2 Age Group

	Frequency	Percent	Valid Percent	Cumulative Percent
15 – 25	15	30.0	30.0	30.0
25 – 35	32	64.0	64.0	94.0
35 – 45	3	6.0	6.0	100.0
Total	50	100.0	100.0	

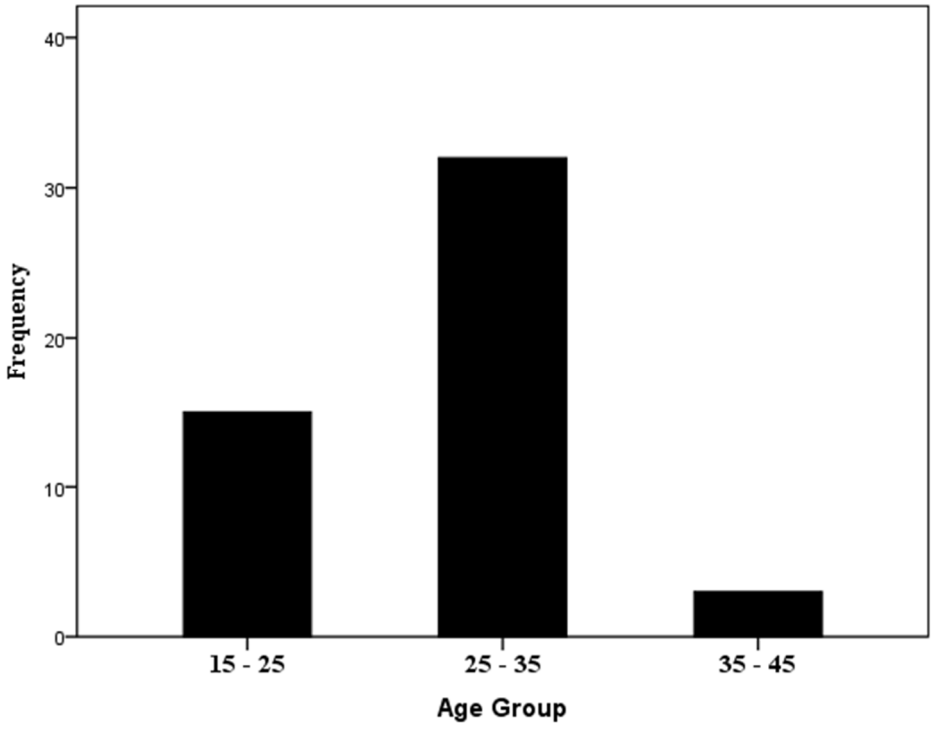


Figure 4-1 Age group

Table 4-3 Correlation between fetal weight and fetal kidney length

		Fetal Weight	Fetal LT kidney Length	Fetal RT kidney Length
Fetal Weight	Pearson Correlation	1	.278	.282*
	Sig. (2-tailed)		.050	.047
	N	50	50	50
Fetal LT kidney Length	Pearson Correlation	.278	1	.992**
	Sig. (2-tailed)	.050		.000
	N	50	50	50
Fetal RT kidney Length	Pearson Correlation	.282*	.992**	1
	Sig. (2-tailed)	.047	.000	
	N	50	50	50

*. Correlation is significant at the 0.05 level (2-tailed).

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

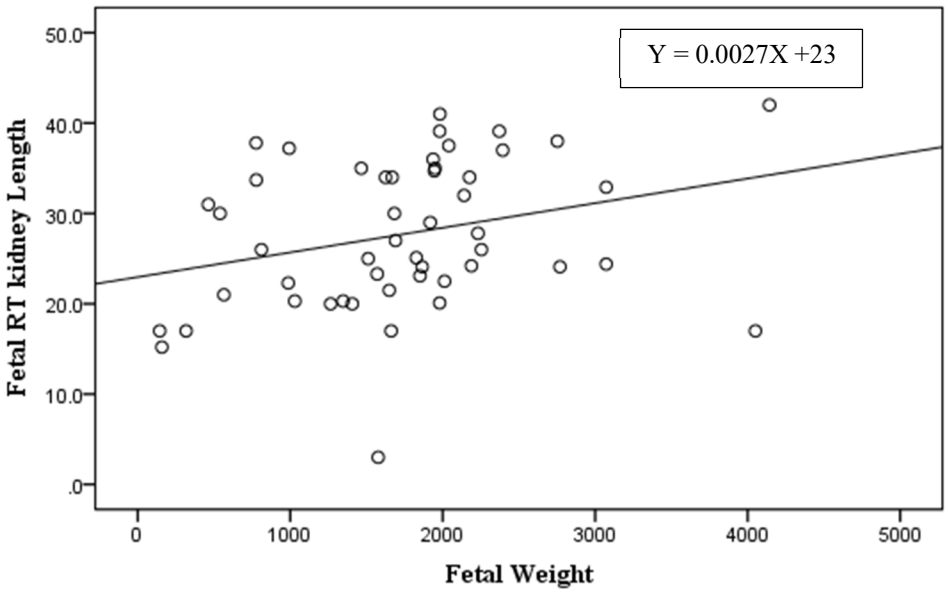


Figure 4-3 Correlation between fetal weight and fetal kidney length

CHAPTER FIVE

Discussion, Conclusion and Recommendation

5-1 Discussion:

Accurate sonographic EFW can be an intangible objectively for any sonographer because the endpoint or the ultrasound estimated fetal weight will lead to a management decision that will have a direct impact on the mother and fetus. Polyhydramnions, oligohydramnios. Fetal macrosomia, and intrauterine growth restriction can lead to potential complications affecting management decisions for patients that are frequently determined by sonography play a major role in obstetric decision making and management. Both low associated with an increased risk weight at delivery are associated with an increased risk of newborn complications during labor and delivery.

This estimation fetal weight calculator will calculate percentiles as well as the estimated fetal weights based ultrasound data and on many published formulas formula include those by hadlocks, shepard, woo, shinozuka, oh, comts, warsof, compbell, and many others. Calculations are based on the 4 common fetal mesurements, biparietal diameter (BPD), head circumference (HC) , femur length (FL), and abdomen circum ference (AC) Many studies have devised different formulas (Wilhelm et al., 1991).

In practice the most common equations for calculating the estimated fetal weight (EFW) are reported to be the shepard and hadlock formulas.

Regardless of the formula used the accuracy of the sonographic estimate of the EFW is affected by suboptimal of the EFW is affected by suboptimal imaging and biological variation. In addition the accuracy of the sonographic estimate decrease with increasing birth weight, and teds to be overestimated

in pregnancies suspected of being large for gestational age and underestimated in pregnancies with preterm premature rupture of membranes and suspected fetal growth restriction.

In this study the validity of fetal kidney length for fetal weight estimation has been found to be applicable, in which the study showed that there was a significant correlation between right kidney and fetal weight. This result was in line with previous studies.

In the present study fetal kidney length can reliably used for fetal weight estimation.

5-2 Conclusion:

This descriptive study demonstrates that fetal weight estimation could be estimated accuracy by measuring fetal kidney length.

The limitation of this study, there is no comparison between the actual birth weight and ultrasound fetal weight using fetal kidney length.

5-3 Recommendation:

- Study sample should be increased for accurate results
- Ultrasonography should be available at any level of health care
- In assessing fetal biometry, fetal kidney length should be included

References:

BRICENO, F., RESTREPO, H., PAREDES, R. & CIFUENTES, R. 2013. Charts for fetal age assessment based on fetal sonographic biometry in a population from Cali, Colombia. *J Ultrasound Med,* 32**,** 2135-43.

CHITTY, L. S. & ALTMAN, D. G. 2003. Charts of fetal size: kidney and renal pelvis measurements. *Prenat Diagn,* 23**,** 891-7.

EL-GALLEY, R. E. & KEANE, T. E. 2000. Embryology, anatomy, and surgical applications of the kidney and ureter. *Surg Clin North Am,* 80**,** 381-401, xiv.

ESIN, S., HAYRAN, M., TOHMA, Y. A., GUDEN, M., ALAY, I., ESINLER, D., YALVAC, S. & KANDEMIR, O. 2017. Estimation of fetal weight by ultrasonography after preterm premature rupture of membranes: comparison of different formulas. *J Perinat Med,* 45**,** 253-266.

GEELHOED, J. J., VERBURG, B. O., NAUTA, J., LEQUIN, M., HOFMAN, A., MOLL, H. A., WITTEMAN, J. C., VAN DER HEIJDEN, A. J., STEEGERS, E. A. & JADDOE, V. W. 2009. Tracking and determinants of kidney size from fetal life until the age of 2 years: the Generation R Study. *Am J Kidney Dis,* 53**,** 248-58.

KOOIJMAN, M. N., BAKKER, H., VAN DER HEIJDEN, A. J., HOFMAN, A., FRANCO, O. H., STEEGERS, E. A., TAAL, H. R. & JADDOE, V. W. 2014. Childhood kidney outcomes in relation to fetal blood flow and kidney size. *J Am Soc Nephrol,* 25**,** 2616-24.

MARIEB, E. N. 2000. *Essentials of Human Anatomy & Physiology*, Benjamin Cummings.

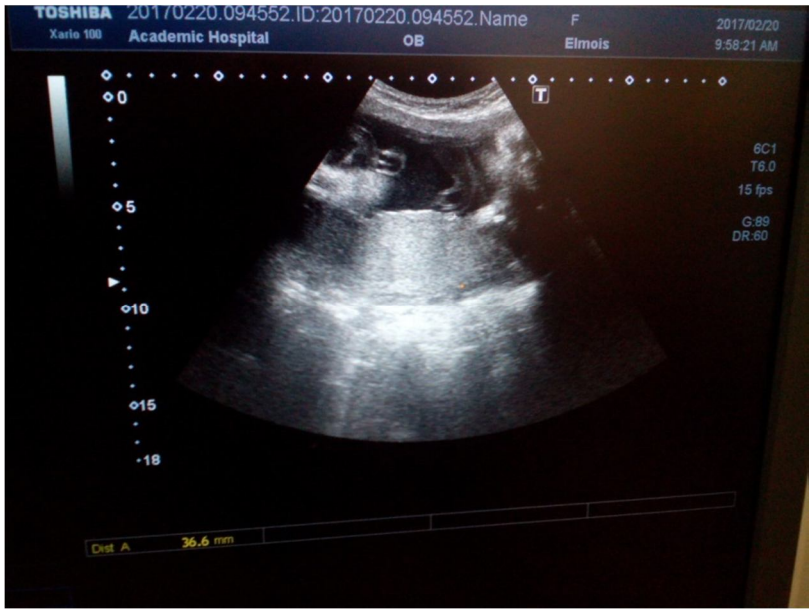
SILVERTHORN, D. U., OBER, W. C., GARRISON, C. W., SILVERTHORN, A. C. & JOHNSON, B. R. 2009. *Human physiology: an*

integrated approach, Pearson/Benjamin Cummings San Francisco, CA, USA:.

VLAJKOVIC, S., VASOVIC, L., DAKOVIC-BJELAKOVIC, M. & CUKURANOVIC, R. 2006. Age-related changes of the human fetal kidney size. *Cells Tissues Organs,* 182**,** 193-200.

WILHELM, C., PROMPELER, H., RAFLE, P. & SCHILLINGER, H. 1991. [Sonographic biometry of fetal organs]. *Z Geburtshilfe Perinatol,* 195**,** 123-30.

Appendix



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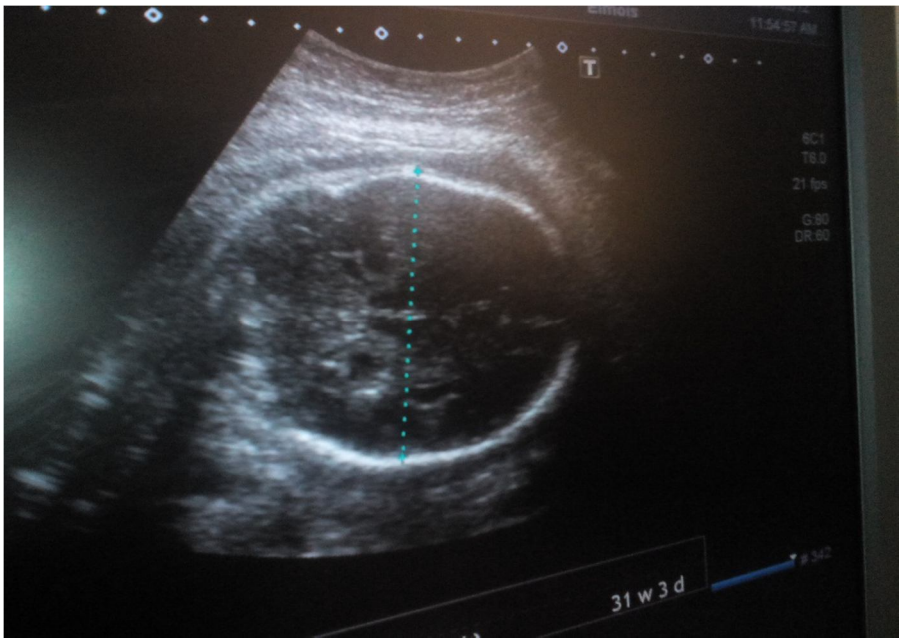

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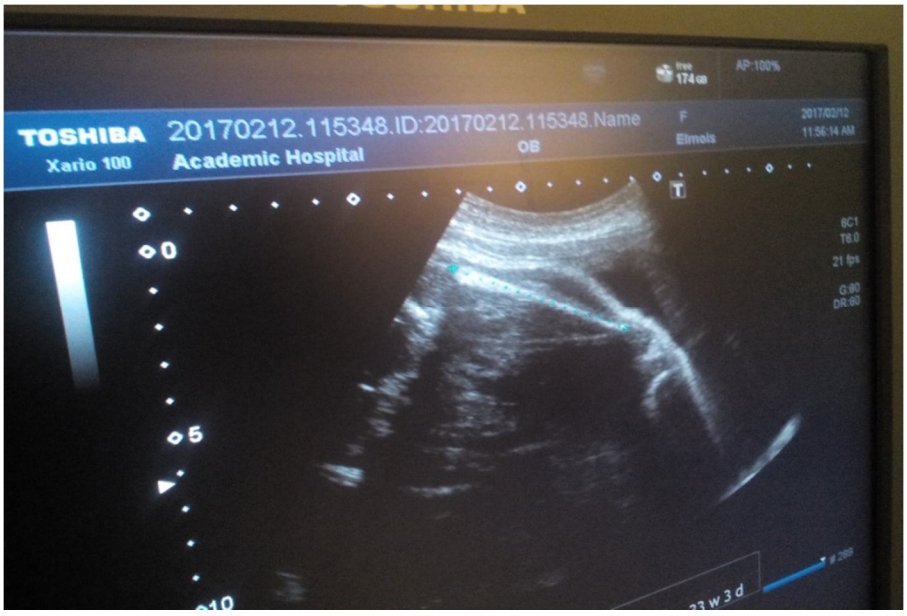

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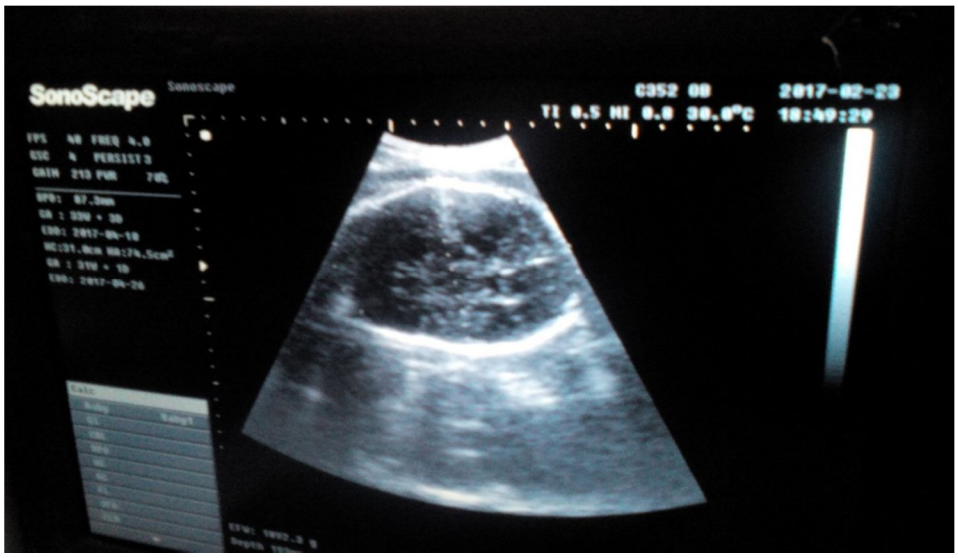

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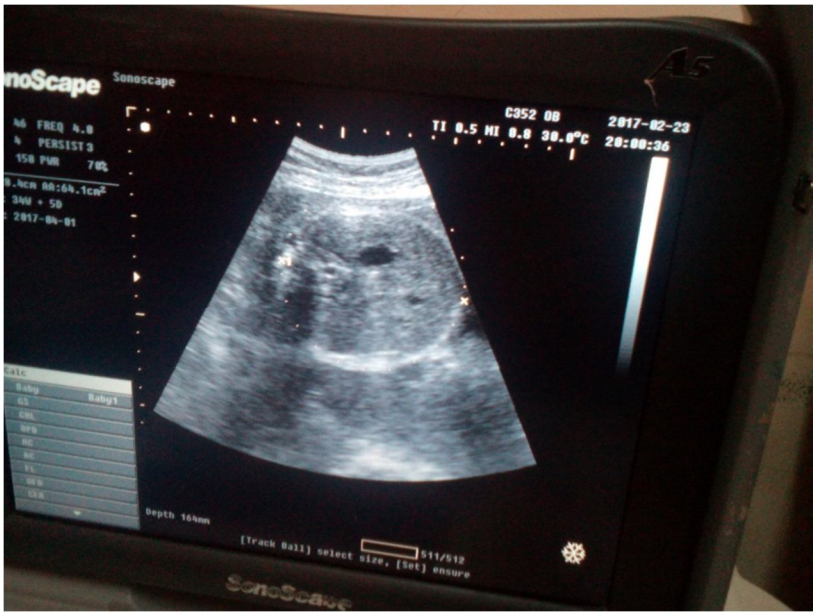

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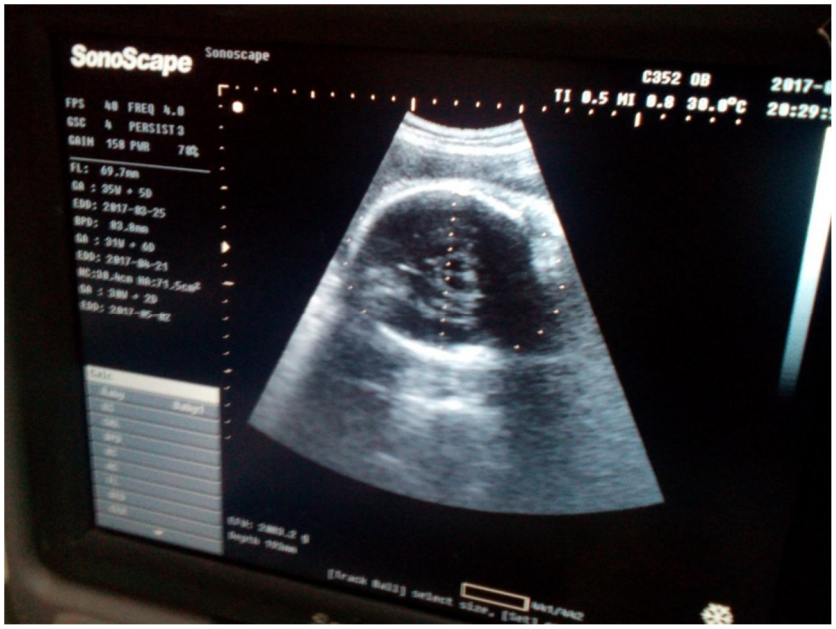

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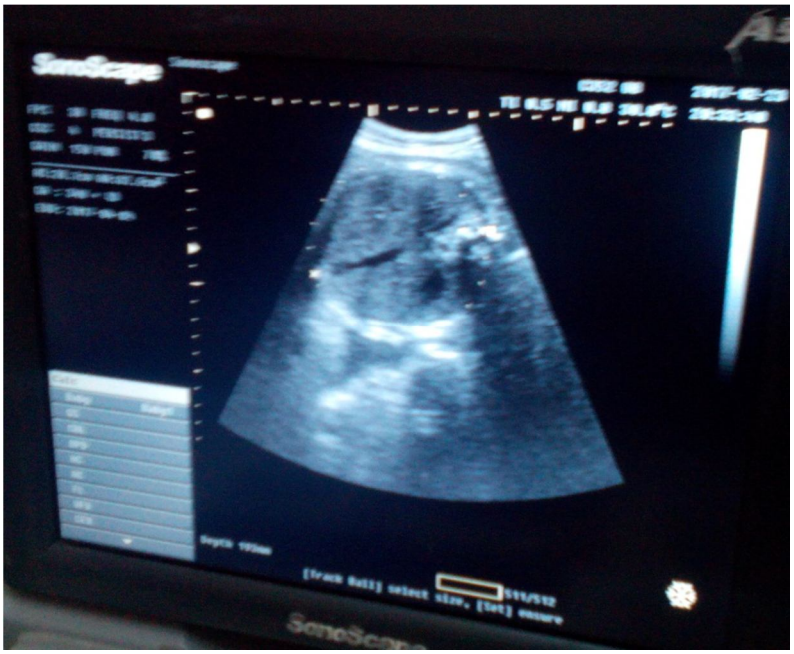

Image 7