National Ribat University
Faculty of Graduate Studies & Scientific Research

Accuracy of the ultrasound in estimation of fetal weight

Research Submitted for Partial Fulfillment for the Award of M.Sc Degree in Diagnostic Medical Ultrasound

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بِسْمِ اللّهِ الرَّحْمَنِ الرَّحِيمِ

أَلَمْ نَشْرَحْ لَكَ صَدْرَكَ١ وَوَضَعْنَا عَنكَ وُزْرَكَ٢ أَلَّذِي أَنقَضَ ظَهْرَكَ٣ وَرَفَعْنَا لَكَ ذِكْرَكَ٤ فَإِنَّ مَعَ الْعُسْرِ يُسْرًا٥ إذَا فَرَغْتَ فَانْصَبْ٦ وَإِلَى رَبِّكَ فَارْغَبْ٧ صَدِقُ اللّهِ العظِيم٧٨

الشرح

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١٢٣٤٥٦٧٨
Dedication

************

I would like to dedicate my work to who give me his name, to soul of my ***father Hamid Abd-Elhade taha***

And gratefulness and warmest regard, I dedicate this work to ***My Father Omer Sharf Aldeen***

To mom, who took me to the right way and support me in everything.....

To my lovely sisters and friends and all my family

Special thanks to my brother and my teacher who supported me:

Ibrahim Hamid
Acknowledgement

First of all I thank Allah for helping me to complete this work
And To those who planted the optimism in our path and gave us aid, perhaps without, in turn, they have all thanked me,

Dr. Elsir Ali SAEED

Dr. Mohmmmed Elfadil Mohammed
Abstract

This is analytic, cross-sectional study was performed at Haj-alsafi hospital in North Khartoum and Maternity woman at Omdurman hospital during the period from November 2015 to April 2016. The purpose of the study, to determine the Accuracy of the ultrasound in estimation of fetal weight, the study deals with 100 Sudanese pregnant singleton women were examined having gestational age of (37 to 40±2 weeks) healthy women, and with normal fetal growth. Obstetrical ultrasound was done using 3.5MHz convex transducer on Mindary ultrasound scanner, measurement of biparietal diameter (BPD), femur length (FL), and abdominal circumference (AC), and head circumference (HC) these parameters where used to estimate the gestational age and estimation of fetal weight that calculated by hadlock formula. The data was collected, classified analyzed by using SPSS. The analysis of the result found that estimated fetal weight ranged from (2.7-4.2k.g) with mean (3.37K.g) and the Actual fetal weight ranged from (2.8-3.9kg) with mean (3.35K.g). The study concluded that ultrasound method error values of estimation fetal weight and actual fetal weight calculated by regression formula equal 0.2k.g the study found there is no significance different between estimated fetal weight and actual fetal weight. the ultrasound method is generally a better predictor of the estimation fetal weight,
ملخص الدراسة

هذه الدراسة تحتلِ مُستُرِعَةِ اجْرِيَتِ فيِ مِسْتَشَفيِ حَاجِ الصَّفِيفِ (بَحْريِ) وَمِسْتَشَفيِ اِمْدِرْمانِ (الدَّابِيَاتِ) فيِ الْفَرْتِةِ مِنْ نُوْفِوْرْمِ ٢٠١٥ الَيْ أُبْرِيلِ ٢٠١٦ِ.

الغرض منِ الْدِرَاسَةِ تَحْدِيدُ دِقَةِ المَوجَاتِ فوقِ الصوِطِيَّةِ فيِ تَقْدِيرِ وزْنِ الْجَنِينِ وَاِجْرِيَتِ هذِهِ الْدِرَاسَةِ عَلَىِ ١٠٠ أَمِرَاءٍ حَاِمِلٍ فِيِ الْإِسْبَابِيِّ الْأَخِيَرِ مِنِ الْحُمْلِ (١٧٦٠ -٤٠ ٤٠) أَسْبَعِ ٢٤٠ يَمْتَعِن بِصَحةِ جِيِدَةِ وَنْمُ الْجَنِينِ كَانُ طَبِيعِيَاً. تَمْ فَحْصَ جِمْعُ الْحَوَاحِلِ بَعْضَ الْمَوجَاتِ الفَوقِيَّةِ قِبَلِيَّةِ بَعْدَ إِسْتَخْدَامِ جِهازِ المَوجَاتِ الفَوقِيَّةِ بَعْدَ إِسْتَخْدَامِ ٣٥ مِيْغاً هِيرْتِزِ. تَمْ اِسْتَخْدَامِ الْقِيَاسَاتِ التَّالِيَةِ:

- مُحِيِّطُ الرَّآَسِ، طُولُ عُظْمِ الفَخْذِ، مُحِيِّطُ البَطِنِ، جَانِبِيِ الرَّاسِ. هذِهِ الْقِيَاسَاتِ اِسْتَخْدَامِ تَقْدِيرِ عَمْرُ وَوَزْنُ الْجَنِينِ الَّذِيِ مَهْسَبَهَا بِصِيَغَةِ هَادَلُوكِ.

تَمْ جَمعُ الْبَيَانَاتِ وَتَصْنِيفِها وَتَحْلِيْلِها بَعْدَ اِسْتَخْدَامِ بِرَنْمَةِ التَّحْلِيْلِ الْإِحْصَائِيِ وَوُجِدَتِ الْدِرَاسَةُ أَنَّ الْوَزْنِ المِقْدَرِ لِلْجَنِينِ يَتْرَاحُ بَيْنِ (١٦.٢ -٤٢٣ كَجِمْ) كَانَ الْمُعْدِلُ (٣٧٣.٣ كِليْوْجِرامِ) وَ الْوَزْنِ الفَلِيميِ لِلْجَنِينِ يَتْرَاحُ بَيْنِ (٨٢.٦ -٣٣٣ كَجِمْ) وَمَعْدُلُ الْوَزْنِ (٣٥٣.٣ كِليْوْجِرامِ).

تَمْ تَحْدِيدُ نِسْبَةُ الْخَطَأِ لِلْوَزْنِ الفَلِيميِ وَالْوَزْنِ المِقْدَرِ بِالْمَوجَاتِ الصوِطِيَّةِ بَعْدَ إِسْتَخْدَامِ مَعَادِلَةِ الْإِنْتِهَادِ يَسَاهُمُ ٢ كِليْوْجِرامِ. وَوُجِدَتِ الْدِرَاسَةُ أَنَّ لَيْسَ هُنَاكَ اِخْتِلَافًا كَثِيرًا بَيْنِ الْوَزْنِ الفَلِيميِ لِلْجَنِينِ مَعَ الْوَزْنِ المِقْدَرِ لِلْجَنِينِ.

تَشْكِلُ المَوجَاتِ الصوِطِيَّةِ فِيِ أَفْضِلِ طَريْقَةِ لِقِياَسِ وزْنِ الْجَنِينِ، وَبَالْتَالِي يَنْبِغِي أَنْ تَعْدِمَنَّ أَنْ تَعْدِمَنَّ فِيِ تَقْدِيرِ الْوَزْنِ الفَلِيميِ عَنْدَ الْوَلَادَةِ.
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<td>Cesareans section</td>
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<td>IUGR</td>
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<td>LGA</td>
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4.1 Results

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Chapter One
**1-1 Introduction:**

Ultrasound scanning helps to provide estimation of fetal weight and important information about the fetal growth. Multiple frequently fetal biometric parameters used for prediction of GA to determine the estimated fetal weight include measurement of fetal Biparietal Diameter (BPD), femur length (FL), abdominal Circumference (AC), Head Circumference (HC).\(^{(1)}\)

The BPD is useful for dating a pregnancy in estimating intrauterine fetal weight in weight equation, stands for Biparietal diameter and is an ultrasound measurement taken of the baby's head (from side to side), Along with the femur length (FL) and abdominal circumference (Ac) it is used to estimate the fetal weight.\(^{(2)}\)

The Head Circumference is used in third trimester along with other parameters, the accuracy of this parameter is ±2-3 weeks with 95% confidence interval.\(^{(3)}\)

FL is a very useful biometric parameter used in third trimesters of pregnancy, Often is measured along with AC and BPD measurements, and the femur is the longest bone in the body and measurement of this bone taken to estimation of fetal weight.\(^{(4),(5)}\)

Abdominal circumference measures the mother's belly in cross section. Especially later in pregnancy, it is used as an indicator of fetal weight and growth, more used for monitoring fetal growth, especially in the third trimester and for estimation of fetal weight.\(^{(6)}\)

These parameters are most frequently used for estimation of GA considered as the ‘gold standard’ to accuracy in estimation of fetal weight.
1-2 Problem of the study:-

The Estimation of fetal weight have variable dimension in ultrasound stander ranger where use to compare actual birth weight, this stander come from Europe stander and other study might not suit the Sudanese measurement.

Objectives:-

1-3-1 Genral Objective:-

The general objective of this study to evaluate the accuracy of the ultrasound in estimation of fetal weight.

1-3-2 Specific objectives:-

1. To estimate the gestational age
2. To estimate the fetal weight by using BPD and Ac and FL and HC measurement.
3. To demonstrate the actual fetal weight
4. To correlate the estimation fetal weight and actual fetal weight.
Chapter TWO
Literature review

2-1 Estimation fetal weight at the third trimester:

The third trimester is a period of development when the fetus slows in growth in length and begins to increase substantially in weight, this is also the time where Individual variations increase, fetal development continues during the third trimester. Fetus gain more weight, and prepare for delivery. (7)

Fetal at 28 week gaining weight and might be nearly 10 inches (250 millimeters) long from crown to rump and weigh nearly 2¼ pounds (1Kg), Fetal at 29-30 weeks, Fetus bones are fully developed and eyes are wide open, Red blood cells are now forming in Fetus bone marrow. Fetus might be more than 10½ inches (270 millimeters) long from crown to rump and weigh nearly 3 pounds (1, 3Kg) and in 31 week fetal central nervous system has matured to the stage, 32 week Fetus lungs aren't fully formed, and begin absorbing vital minerals, Fetus might be 11 inches (280 millimeters) long from crown to rump and weigh 3¾ pounds (1.7Kg), Fetus at week (34-35) might be nearly 12 inches (300 millimeters) long from crown to rump.

Fetus limbs are becoming chubby at 35 week and Fetus is gaining weight rapidly about ½ pound (230 grams)(2.3Kg), at (36-37) week takes up most of the amniotic sac, Fetus will be considered early term. Fetus organs are ready to function on their own, to prepare for birth, And fetal Size: Length, 14 inches, crown to rump; total length 21 inches. Weight, 6 1/2 pounds, at 38 week fetal developing a firm grasp and Fetus toenails have reached the tips of toes. His or her brain might weigh about 14 ounces (400 grams) after birth, Fetus brain will continue to grow. Fetus might weigh about (2,9Kg). At Thirty-nine weeks or 37 weeks after conception, fetus chest is becoming more prominent. For boys, the testes continue to descend into the scrotum, fetal weight, around 7 pounds, Forty weeks of pregnancy, or 38 weeks after conception, fetus might be about 18 to 20 inches (450 to 500 millimeters) long and weigh 6½ pounds (2,9Kg) or more. (7)
2-2 Estimation of fetal weigh technique

2.2.1 MEASURING THE BIPARIETAL DIAMETER (BPD)

The BPD has traditionally been the most widely used ultrasound parameter in the estimation of gestational age. Although more recent data suggest that head circumference (HC) should be used in preference to BPD for dating purposes, the BPD is easy to obtain and, on a routine basis, is more accurate than the crown-rump length. A single optimal measurement of the BPD will predict the gestational age to within ± 5 days. It is more accurate at predicting the date of delivery than an optimal menstrual history. This last point has justified its use in all pregnancies. The BPD is the maximum diameter of a transverse section of the fetal skull at the level of the parietal eminences. The BPD, Occipitofrontal diameter (OFD) and head circumference can be measured from one of the following two sections:-

Lateral ventricles view: should include the following features:

- a rugby-football-shaped skull, rounded at the back (occiput) and more pointed at the front (synciput)
- a long midline equidistant from the proximal and distal skull echoes
- The cavum septum pellucidum bisecting the midline one-third of the distance from the synciput to the occiput
- The two anterior horns of the lateral ventricles, symmetrically placed about the midline
- All or part of the posterior horns of the lateral ventricles symmetrically placed about the midline. (8)
Figure (2-1) Transverse section of the fetal head demonstrating the landmarks required to measure the BPD using the lateral ventricles view. Note the rugby football shape, the centrally placed midline, the presence and position of the cavum septum pellucidum (CSP), and the appearance and position of the anterior horns (AH) of the lateral ventricles\textsuperscript{(8)}

**Thalami view: should include the following features:**

- a rugby-football-shaped skull, rounded at the back (occiput) and more pointed at the front (synciput)
- a short midline equidistant from the proximal and distal skull echoes
- The cavum septum pellucidum bisecting the midline one-third of the distance from the synciput to the occiput
- the thalami
- the basal cisterns. \textsuperscript{(8)}
Figure (2 -2 ) Transverse section of the fetal head demonstrating the landmarks required to measure the BPD using the thalami view. CP, cerebral peduncles; CSP, cavum septum pellucidum; TH, thalami. (8)

2.2.2 MEASURING THE HEAD CIRCUMFERENCE (HC)

This is measured from the same view as that used for the BPD. Required for measurement of the BPD using the lateral ventricles view. **The HC is calculated by one of three basic methods:**

1. The two-diameter method. The BPD and OFD are both measured using the outer to outer technique the machine’s software then calculate the HC using the formula.

2. The ellipse method. The first onscreen cursor is placed on the outer table of the skull at the occiput. The second cursor is then placed on the outer table of the skull at the synciput. Using the appropriate control, a ready-formed ellipse of dots is moved out from between the two cursors until it matches the outline of the fetal skull. On many machines, adjustment of the position of one or both the cursors can be made after the ellipse is formed to achieve a more exact match.
3. The plot method. The onscreen cursor marker is placed on the outer table of the skull. The correct position is then recorded in the machine’s software by pressing the caliper ‘enter’ control. Sequential marks are plotted.\(^{(8)}\)

![Image](image_url)

**Figure (2-3)** Measurement of the head circumference using the two diameter method (lateral ventricles view). The calipers are placed on the outer edge of both parietal bones to obtain the BPD and on the outer edge of the occipital and frontal bones to obtain the OFD. Both the BPD and OFD are therefore obtained using the ‘outer to outer’ technique and recorded around the whole circumference. In some equipment, a continuous trace is produced rather than a series of dots.\(^{(8)}\)
2.2.3 *MEASURING THE ABDOMINAL CIRCUMFERENCE (AC)*

**The landmark features are:**

- A circular section of the abdomen demonstrating an unbroken and short rib echo of equal size on each side.
- A cross-section of one vertebra visualized as a triangle of three white spots.
- A short length of umbilical vein.

This should be imaged so that it is centrally placed between the lateral abdominal walls and is a third of the way along an imaginary line drawn from the anterior abdominal wall to the fetal spine. The stomach, usually visualized as a hypoechoic area in the left side of the abdomen.

**Method :-**

Obtain a longitudinal view of the fetus that demonstrates both the fetal heart and the fetal bladder. Slide the transducer laterally until the fetal spine is visualized. Rotate the transducer through $90^\circ$ at the level of the fetal stomach to obtain across-section. The outline should be circular, if it is ovoid make a small adjustment of the rotation or the angle of the transducer. If the umbilical vein is not visualized as described above, make small sliding movements of the transducer to change the level of the section. Freeze the image. The circumference of the abdomen is measured in the same way as the head circumference, using the two-diameter method. The anteroposterior diameter (APAD) is measured from the fetal spine to the anterior abdominal wall. The short section of umbilical vein should lie along this axis. The transverse abdominal diameter (TAD) is measured across the widest part of the abdominal circumference section at $90^\circ$ to the APAD. Both diameters are measured using the ‘outer to outer’ technique.
Figure (2-4) Transverse section of the fetal abdomen demonstrating the landmarks required to measure the abdominal circumference. Note the appearance of the normal single vertebra (Sp), the short length of umbilical vein (UV) and its position. Note also the appearance and position of the normally sized stomach (St) (8).

Figure (2-5) Measurement of the abdominal circumference using the two diameter method. The anteroposterior diameter (APAD) is obtained by placing one caliper on the outer border of the skin directly behind the spine and the second on the outer border of the anterior abdominal wall, following the direction of the umbilical vein. The transverse abdominal diameter (TAD) is obtained by placing the calipers on the outer borders of the widest part of the fetal abdomen, at 90° to the APAD (8).
2.2.4 MEASURING THE FEMUR LENGTH (FL)

This measurement is as accurate as the BPD in the Prediction of gestational age. It is useful in confirming the gestational age estimated from BPD or HC measurements and can often be obtained when fetal position prevents measurement of the BPD or HC. As examination of intracranial anatomy is an important part of all ultrasound examinations, measurement of femur length should not replace that of the BPD or HC as the Sole predictor of gestational age. The femur can be measured from 12 weeks to term\(^{(8)}\).

**Method**

Measuring the femur is ideally undertaken after the AC has been measured. Slide the probe caudally from the AC section until the iliac bones are visualized. At this point, a cross-section of one or both femurs is usually seen. The upper femur should be selected for measurement. The lower femur is frequently difficult to image clearly because of acoustic shadowing from fetal structures anterior to it. Keeping the echo from the anterior femur in view, rotate the probe slowly until the full length of the femur is obtained. You might need to make a small sliding movement after each rotational movement to bring the probe back onto the femur. To ensure that you have the full length of the femur and that your section is not oblique, soft tissue should be visible beyond both ends of the femur and the bone should not appear to merge with the skin of the thigh at any point, The end-points of the femur are often difficult to define when the femur is imaged lying horizontally but are much easier to define when the bone lies at a slight angle (5–15° to the horizontal). The angle of the bone relative to the horizontal can be manipulated by dipping one end of the probe gently into the maternal abdomen\(^{(8)}\).
The measurement of the femur is made from the center of the ‘U’ shape at each end of the bone. This represents the length of the metaphysis. It is good practice to obtain measurements from three separate images of the same femur. These should be within 1 mm of each other.\(^8\)

Figure (2-6) Measurement of the fetal femur. Note that soft tissue is visible beyond both ends of the bone. The femur length is the distance between the caliper markers.\(^8\)
2-3 Previous studies:-

1. Abd-elmoneim Suliemanan (et-al Jan 2014) accuracy of the ultrasound in estimation fetal weight This study aimed to evaluate the accuracy of Ultrasonography in estimating fetal weight among Sudanese as comparing the results with the International Standards. The result showed the mean estimated birth weight is 3.13g and standard deviation between mean EFW and actual birth weight was 472g and the range of actual birth weight was from 2000-4400 gram. (9)

2. Akinola S. Shittu,1 Oluwafemi Kuti,1 Ernest O. Orji, 1 Niyi O. Makinde,1 Solomon O. Ogunniyi,1 Oluwagbemiga O. Ayoola,2 and Salami S. Sule3 (Mar 2007) Clinical versus Sonographic Estimation of Foetal Weight in Southwest Nigeria the purpose of study accuracy of clinical and ultrasonographic estimation of foetal weight at term. The result showed The mean actual birth weight of the study population was 3,254±622 (range 2,150–4,950) g. (12%) had birth weight of <2,500 g, 71% had birth weight of 2,500-<4,000 g, while 17% weighed >4,000 g. (10)

3. Bajracharya J, Shrestha NS, Karki C, KATHMANDU UNIVERSITY MEDICAL JOURNAL (Dec 2015), purpose Accuracy of Prediction of Birth Weight by Fetal Ultrasound the result showed The study included 150 patients. The gestational age was between 37 weeks and 42 weeks. The age range of patients was between 18-40 years, with a mean of 25.51 years. The range of actual birth weight was between 2.11-4.9 kg with a mean of 3.07 kg (Table 1). The mean error in the estimation of birth weight was 290gm (CI: 250-330 gm). (11)

fetal weight with actual birth weight in a tertiary hospital in Lagos, Nigeria. The purpose of the study was to sonographically estimate fetal weight at term and to compare estimated with actual birth weights to determine the validity of estimated fetal weights. His results found that the mean estimated and actual birth weights were 3378±40g and 3393±60g respectively. The difference between the two means was not significant. Eleven percent of fetuses were sonographically estimated to be microsomic while 14.5% were microsomic at birth; 12.1% were sonographically estimated to be macrosomic but 15.2% were macrosomic at birth. Most macrosomic fetuses were delivered through cesarean section (CS) and fetal weights increased with maternal age and parity. (12)
Chapter three
Chapter Three Research methodology

3-1 Study design:-
This is analytic, cross-sectional study, deals with singleton pregnancy Sudanese maternity ladies.

3-1-2 Study area and duration:-
The study conducted in (Hag Elsafe, Khartoum north) and maternity woman at Omdurman) hospital, in the ultrasound departments from Nov 2015 to Apr 2016.

3-1-3 Study population:
Pregnant women at the third trimester (37weeks to 40 weeks ±2weeks with Singleton fetal and normal healthy women and fetus.

3-1-4 Sampling of the data:-
They were 100 cases from pregnant singleton women in the third trimester for gestational age.

3-1-5 Inclusion criteria

1. Normal Pregnant woman in 3\textsuperscript{rd} trimester (37weeks to 40 weeks ±2weeks).pose of dating the pregnancy.
2. Well defined last menstrual period and conformation with early ultrasound is appropriate for purpose of dating the pregnancy.
3. Healthy woman and singleton.
4. Fetal condition :-
   Single, alive fetal, Normal placenta, Normal amniotic fluid
   No gross fetal anomaly
3-1-6 Exclusion criteria

1- Pregnant woman suffers of any disease.

2- Fetal abnormality

3-1-7 Data collection:-

1. The data collection carried out by data collection sheets and direct ultrasound examination of population of the study and Data collected for all singleton pregnant woman only women with 37 - 40±2 weeks with different woman in age and parity.

3-1-8 Materials and Methods:-

Obstetrical ultrasound was done using 3.5MHz convex transducer. Measurement of Biparietal Diameter (BPD), and Head Circumference (HC) femur Length (FL) and abdominal Circumference (AC) was done as per standard protocol for estimation fetal weight.
3-2 Technique of estimation fetal weight:

3-2-1 Patient position:-
- The patient is usually scanned while lying comfortably on her back [supine]
- The patient after the preliminary scans, apply coupling agent liberally to the lower abdomen.

3-2-2 Choice of Transducer:-
- TAS is the main technique to evaluate third Trimester pregnancy
- Use 3.5 MHz Transducer

3-3 Approach to estimated fetal weight:
The weight of the singleton fetus at any gestation can also be estimated with great accuracy using polynomial equations containing the BPD, FL, and AC and HC, Computer software and lookup charts are readily available.

3-4 Equation:
Regression Coefficient:-
\[ Y = BX + C \]
- \( C \) = Intercept
- \( X \) = changes
\[ R^2 \] = Power of X to explain changes in why X can explain Y or predict Y by success note.

3-5 Formula using for estimating the fetal weight':
\[ (AC*0.245) + (par*0.034) - 5.096 \]
3-6 Scanning technique:-
The BPD should be measured on an axial plane that traverses the thalami, and cavum septum pellucidum. The transducer must be perpendicular to the central axis of the head, and thus the hemispheres and calvaria should appear symmetric.

The calipers should be placed at the:

- outer edge of the near calvarial wall
- inner edge of the far calvarial wall

The cerebellar hemispheres should not be in the plane of the image

- HC is measured on the same plane as BPD that is on an axial plane that traverses the thalami and cavum septum pellucidum.
- Transducer must be perpendicular to the central axis of the head, and thus the hemispheres and calvaria should appear symmetric.
- Cerebellar hemispheres should not be in the plane of the image, or the probe is too caudal giving an inaccurate size of the fetal head.

Fig (3-1) BPD and HC measurement technique\(^{(13)}\)
**AC measurement** should not be taken on a foreshortened abdomen and the calipers should be on the skin surface (skin surface should be visible). The kidneys and cord insertion should not be visible. The umbilical vein should not be seen up to the skin line; the gallbladder may sometimes be seen.

Transverse section through the upper abdomen, which should demonstrate the following fetal landmarks:

- fetal stomach
- umbilical vein
- portal sinus

![Diagram showing fetal stomach, umbilical vein, and portal sinus](image)

**Fig (3-2) AC measurement**

---

---
**FL Measurement**

- Identify femur close to fetal bladder/pelvis
- Slide probe so that femur is central
- Rotate probe to obtain full length image of femur

**Fig (3-3) FL measurement**
Chapter Four

Results
4.1 Frequency distribution

Table (4-1): Frequency distribution of patients according to mother’s age

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>21-25</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>26-30</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>31-35</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>36-40</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>41-45</td>
<td>1</td>
<td>²</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Mean±SD: 27.87±5.91

Range: 16-42

Figure (4-1): Frequency distribution of patients according to mother’s age
Table (4-2): Frequency distribution of mothers according to parity

<table>
<thead>
<tr>
<th>Parity</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Para 0</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Para 1</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Para 2</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Para 3</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Para 4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Para 5</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Para 6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>1.77±1.62</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0-6</td>
<td></td>
</tr>
</tbody>
</table>

Figure (4-2): Frequency distribution of mothers according to parity
Table (4-3): Frequency distribution of patients according to labour of mothers

<table>
<thead>
<tr>
<th>Labour of patients</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/S</td>
<td>48</td>
<td>48%</td>
</tr>
<tr>
<td>N.D</td>
<td>52</td>
<td>52%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure (4-3): Frequency distribution of patients according to labour of mothers
Table (4-4): Frequency distribution according to fetal gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Females</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure (4-4): Frequency distribution according to fetal gender
Table (4-5): Frequency distribution according to fetal weight before birth

<table>
<thead>
<tr>
<th>F.W (kgs)</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5-2.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.1-2.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.6-3.0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.1-3.5</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>3.6-4.0</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>4.1-4.5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Mean±SD 3.38±0.28

Range 2.7-4.2

Figure (4-5): Frequency distribution according to fetal weight before birth
Table (4-6): Frequency distribution according to fetal weight after birth

<table>
<thead>
<tr>
<th>F.W (kg)</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5-2.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.1-2.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.6-3.0</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>3.1-3.5</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>3.6-4.0</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>4.1-4.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>3.39±0.35</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>2.8-3.9</td>
<td></td>
</tr>
</tbody>
</table>

Figure (4-6): Frequency distribution according to fetal weight after birth
## 4.2 Relationships

### Table (4-7) Statistics

<table>
<thead>
<tr>
<th>Statistics</th>
<th>GA_BPD</th>
<th>GA_HC</th>
<th>GA_AC</th>
<th>GA_LMP</th>
<th>EFW_Kg</th>
<th>Real_FW_Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>38.2143</td>
<td>38.1614</td>
<td>38.1014</td>
<td>38.0957</td>
<td>3.3776</td>
<td>3.3595</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.97812</td>
<td>1.00620</td>
<td>.99334</td>
<td>1.00073</td>
<td>.28195</td>
<td>.33527</td>
</tr>
<tr>
<td>Minimum</td>
<td>36.57</td>
<td>36.57</td>
<td>36.43</td>
<td>36.71</td>
<td>2.70</td>
<td>2.40</td>
</tr>
<tr>
<td>Maximum</td>
<td>41.14</td>
<td>41.29</td>
<td>40.57</td>
<td>41.14</td>
<td>4.20</td>
<td>4.05</td>
</tr>
</tbody>
</table>

### Paired samples test:

**Table (4-8)**

<table>
<thead>
<tr>
<th>Paired sample</th>
<th>correlation</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA_BPD &amp; GA_LMP</td>
<td>.974</td>
<td>.000</td>
</tr>
<tr>
<td>GA_HC &amp; GA_LMP</td>
<td>.983</td>
<td>.000</td>
</tr>
<tr>
<td>GA_AC &amp; GA_LMP</td>
<td>.984</td>
<td>.000</td>
</tr>
<tr>
<td>GA_FL &amp; GA_LMP</td>
<td>.989</td>
<td>.000</td>
</tr>
<tr>
<td>EFW_(Kg) &amp; Real_FW_(Kg)</td>
<td>.765</td>
<td>.000</td>
</tr>
</tbody>
</table>

### Table (4-9)

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>correlation</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA_BPD - GA_LMP</td>
<td>5.181</td>
<td>.000</td>
</tr>
<tr>
<td>GA_HC - GA_LMP</td>
<td>3.543</td>
<td>.001</td>
</tr>
<tr>
<td>GA_AC - GA_LMP</td>
<td>.319</td>
<td>.751</td>
</tr>
<tr>
<td>GA_FL - GA_LMP</td>
<td>6.935</td>
<td>.000</td>
</tr>
<tr>
<td>EFW_(Kg) &amp; Real_FW- (Kg)</td>
<td>.833</td>
<td>.407</td>
</tr>
</tbody>
</table>
(Fig 4-7): Relationship between GA—LMP (weeks) and fetal GA- BPD (weeks)

\[ y = 0.9515x + 1.9661 \]
\[ R^2 = 0.9477 \]

(Fig 4-8): Relationship between GA—LMP (weeks) and fetal HC (weeks)

\[ y = 0.9883x + 0.5113 \]
\[ R^2 = 0.9662 \]
(Fig 4-9): Relationship between GA—LMP (weeks) and fetal AC (weeks)

\[ y = 0.9766x + 0.8972 \]
\[ R^2 = 0.968 \]

(Fig 4-10): Relationship between GA—LMP (weeks) and fetal FL (weeks)

\[ y = 0.9776x + 0.9583 \]
\[ R^2 = 0.9774 \]
Statistics:

Table (4-10)

<table>
<thead>
<tr>
<th>GA</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA_LMP</td>
<td>38.0957</td>
<td>1.00073</td>
</tr>
<tr>
<td>GA_BPD</td>
<td>38.2143</td>
<td>.97812</td>
</tr>
<tr>
<td>GA_HC</td>
<td>38.1614</td>
<td>1.00620</td>
</tr>
<tr>
<td>GA_AC</td>
<td>38.1014</td>
<td>.99334</td>
</tr>
<tr>
<td>GA_FL</td>
<td>38.2000</td>
<td>.98954</td>
</tr>
<tr>
<td>EFW_Kg</td>
<td>3.3776</td>
<td>.28195</td>
</tr>
<tr>
<td>Real_FW_Kg</td>
<td>3.3595</td>
<td>.33527</td>
</tr>
</tbody>
</table>
(Fig 4-11):- Relationship between BPD (weeks) and fetal GA (weeks)

\[
y = 4.4479x - 3.4877 \\
R^2 = 0.9661
\]

(Fig 4-12):- Relationship between HC (weeks) and fetal GA (weeks)

\[
y = 1.5194x - 12.559 \\
R^2 = 0.9845
\]
(Fig 4-13): Relationship between AC (weeks) and fetal GA (weeks)

![Graph showing relationship between AC (cm) and GA (weeks)]

\[ y = 0.9644x + 5.1171 \]

\[ R^2 = 0.921 \]

(Fig 4-14): Relationship between FL (weeks) and fetal GA (weeks)

![Graph showing relationship between FL (cm) and GA (weeks)]

\[ y = 4.9043x + 1.6381 \]

\[ R^2 = 0.9414 \]
Figure (4-15): Relationship between AC-(cm) and Actual fetal weight (Kg)

Figure (4-16): The scatter diagram of clinical fetal weight estimation and actual birth weight. Clinical fetal weight estimation showed positive correlation with the actual birth weight.
Table (4-11) explain the Statistics of the relationship between AC (cm) and parity

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-5.096</td>
<td>-6.312</td>
<td>.000</td>
</tr>
<tr>
<td>AC_cm</td>
<td>.245</td>
<td>10.417</td>
<td>.000</td>
</tr>
<tr>
<td>Parity</td>
<td>.034</td>
<td>2.372</td>
<td>.020</td>
</tr>
</tbody>
</table>

Coefficients\(^a\)

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(Constant)</td>
<td>-5.116</td>
<td>-6.425</td>
</tr>
<tr>
<td></td>
<td>AC_cm</td>
<td>.246</td>
<td>10.588</td>
</tr>
<tr>
<td></td>
<td>Parity</td>
<td>.034</td>
<td>2.376</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Real_FW_Kg

Table (4-12) explain the relationship between AC (cm) and parity. Study found there are relationship between AC (cm) and Parity, the AC diameter increase with increase of parity and vice versa. The error is calculated by equation equal 0.2
### 4.3 Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.738b</td>
<td>0.545</td>
<td>0.536</td>
<td>0.23027</td>
</tr>
</tbody>
</table>

b. Predictors: (Constant), AC_cm, Parity

Table (4-13) explain the error of the estimation fetal weight by use this equation \((AC \times 0.245) + (par \times 0.034) - 5.096\). and study found that have positive relation between AC(cm) & parity, The equation found error equal ±0.2Kg
Chapter Five

5-1Discussion
This is analytic, cross-sectional study deals with 100 pregnant singleton women to determine the accuracy of ultrasound in estimation fetal weight, many workers have used different methods to achieve this. Of the various methods, the most-commonly used are the clinical and ultrasonographic methods. Only a few studies have compared the accuracy of fetal weight by clinical and ultrasonic measurements. In this study found that the 100 pregnant singleton women at 37 to 40 ±2 weeks, most common aged from 26-30 years (41%) followed by 21-25 years (20%) , Mean±SD of age 27. 87 ± 5.91 years , there were 15 (15%) nulliparous women and 85 (85%) multiparous women, A total of 48(48%) delivered by caesarean section, while 52 (52%) delivered vaginally.

Highest EFW recorded at 3.1- 3.5k.g (69%) followed by 3.6-4.0k.g (24%), the mean of estimated Fetal weight was 3, 38 ± 0.28 kg, and the ranged from 2.7- 4.2k.g, Highest frequency of actual fetal weight recorded at 3.1-3.5kg (51%) followed by 3.6- 4.0kg (25%) The mean of the actual Fetal weight was 3, 39 ± 0.35k.g and the ranged from 2.8-3.9kg, The study showed the relation between Gestational age and (BPD-HC-AC- FL-LMP) , found Mean of EFW (kg) 3.3 , SD 0.28 and minimum 2.7 and maximum 4.2 and mean of real or actual fetal weight (kg) 3.3 and SD deviation 0.3 and minimum 2.4 and maximum 4.0 , when the result was compared Estimation fetal weight and actual birth weight, it was found that actual birth weight was not significantly different, this record agree with Abdelmoneim Suleiman (et - al Jan 05,2014) they found that the Mean of Estimate Fetal Weight (EFW) among Sudanese population by using Hadlock formula is 3.205g with 432g standard deviation (SD), The actual birth weight ranges from 2000 to 4400 g with mean of 3139g, and Standard deviation of 472 g.
And this finding also agree with Akinola S. Shittu, Oluwafemi Kuti 2007 Mar; 25 Southwest Nigeria they found The mean of actual birth weight of the study population was 3,254±622 (range 2,150–4,950) g. Normal birth weight of 2,500–<4,000 g.

My finding agree with Cletus Uche Eze (et al) Correlation of ultrasonographic estimated fetal weight with actual birth weight in a tertiary hospital in Lagos, Nigeria at 2015 Dec; 15 shows that the mean sonographically EFW of fetuses in the population was 3378±40g, the mean actual birth weight of fetuses was 3393±60g, Sonographic estimation (EFW) and actual weight at birth (ABW), majority of fetus had normal weight (2500–3999 g). Strong positive correlation (r) existed between EFW and ABW while there was no statistically significant difference between mean estimated and actual birth weight of fetuses. In this study, a majority of women had sonographically estimated fetal weight of fetuses and subsequent actual birth weight within the normal range (normal fetal weight range = 2500g to 4000g; Almost result agrees with the range of normal fetal weights. The mean actual fetal weight in our study was, however, not significantly different (p > 0.05) from that recorded in an American population but is not the case with Asian and English population (p<0.05). this Study found there are relationship between AC (cm) and Parity, the AC diameter increase with increase of parity and vice versa, Error of the estimation fetal weight calculated by this equation (AC*0.245) + (par*0.034) -5.096, this study found that have positive relation between AC (cm) & parity, the equation found error equal ±0.2Kg The study showed that the mean errors for both estimation fetal weight and actual fetal weight 0.2kg ,this finding agree with Bajracharya J, Shrestha NS, Karki C, Kathmandu university medical journal at APR - JUNE2012, The mean error in the estimation of birth weight and actual fetal weight was
290gm or (0.29Kg). The relationship between the Actual fetal weight (Kg) and AC (cm) and Actual fetal weight increase by 0.244x±4.996, per AC(cm). Fig (4-15) demonstrates have appositive linear relationship between AC (cm) and Actual fetal weight. The error found by equation 0.6k.g, and the study found there was relationship between maternal parity and Actual fetal weight of the babies in this study. Ultrasound method of fetal weight estimation showed a positive correlation with the actual birth weight of the fetus after delivery. There is a linear relationship between ultrasound fetal weight estimation and actual birth weight and EFW increase by 0.643 xs±1.215, per Actual fetal weight.

The study concluded that there is no significantly different from the clinically estimated fetal weight and actual fetal weight.
5-2 conclusions

Accuracy of estimation fetal weight determined by calculating the percentage error, in this study we use the regression formula to calculated error between the Estimation fetal weigh by ultrasound and clinical actual fetal weigh. The study showed that the mean errors for both estimation fetal weight and actual fetal weight equal ±0.2k.g, by using this equation (AC*0.245) + (par*0.034) -5.096. There is no significantly different from the clinically estimated fetal weight and actual fetal weight.
5-3 **Recommendation**

AC is important in determination of gestational age and estimated the fetal weight before the birth at the third trimester. Both obstetrician and sonologist should be well trained to perform estimated fetal weight. For estimation of fetal gestational age we recommended to use this parameter biparietal diameter (BPD), femur length (FL) abdominal circumference (AC), head circumference (HC), and also for estimation of fetal weight using this equation (AC*0.245) + (par*0.034) -5.096.
5.4 References:


7. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal biparietal diameter: a critical re-evaluation of the relation to menstrual age by


10. Akinola S. Shittu,¹ Oluwafemi Kuti,¹ Ernest O. Orji,¹ Niyi O. Makinde,¹ Solomon O. Ogguniyi,¹ Oluwagbemiga O. Ayoola,² and Salami S. Sule³ (Mar 2007).


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Ultrasound department

Pt name: - ............
Age:-.................
Party:-............... 
LMP:-............... 

Ultrasound finding:-

Fetal biometry:-

BPD in mm:       Gestational Age =   weeks    Day

HC in mm:        Gestational Age =   weeks    Day

AC in mm:        Gestational Age =   weeks    Day

FL in mm:        Gestational Age =   weeks    Day

GA:-

EFW:-

GENDER:-

FETAL WEIGHT

EDD:-

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Appendices:

Case NO (1):-

U/S images of estimation of fetal weight

Age: - 27                                                   Parity: - 1
LMP: - 28/4/2015                                             GA: - 38W+4D
BPD: - 9.51cm                                                  HC: - 33.73cm
AC: - 34.73cm                                                  FL: - 7.52cm
EFW: - 3.55k.g                                                  FW: - 3.5k.g
Case NO (2)

Age: - 19
LMP: - 26/4/2015
BPD: - 9.38cm
AC: - 34.40cm
EFW: - 3.4k.g

Parity: - 0
GA: - 38W+1D
HC: - 33.53cm
FL: - 7.44cm
FW: - 3.5k.g
Case NO (3):

Age: - 37
Parity: - 4

LMP: - 10/4/2015
GA: - 38W+2D

BPD: - 9.39cm
HC: - 33.49cm

AC: - 34.43cm
FL: - 7.47cm

EFW: - 3.4k.g
FW: - 3.5k.g
Case No (4):

Age: - 26
Parity: - 2

LMP: - 9/22015
BPD: - 9.65cm
AC: - 35.48cm
EFW: - 3.7k.g

GA: - 39W+3D
HC: - 34.18cm
FL: - 7.72cm
FW: - 3.7k.g
Case NO (5)

Age: - 28  
Parity: - 1

LMP: - 16/3/2015  
GA: - 37W+0D

BPD: - 9.11cm  
HC: - 32.59cm

AC: - 33.12cm  
FL: - 7.28cm

EFW: - 3.1k.g  
FW: - 3.2k.g
Case NO (6)

Age: - 19  
Parity: - 1

LMP: - 8/3/2015  
GA: - 39W+0D

BPD: - 9.56cm  
HC: - 33.99cm

AC: - 35.04cm  
FL: - 7.64cm

EFW: - 3.6k.g  
FW: - 3.5k.g
Case NO (7)

Age: - 18                                      Parity: - 0
LMP: - 28/5/2015                                GA: - 38W+0D
BPD: - 9.40cm                                    HC: - 33.30cm
AC: - 34.17cm                                    FL: - 7.41cm
EFW: - 3.38k.g                                   FW: - 3.5k.g
Case No (8)

Age: - 32                                       Parity: - 3

LMP: - 20/8/2015                                GA: - 36W+3D

BPD: - 9.02cm                                    HC: - 32.35cm

AC: - 31.87cm                                    FL: - 7.20cm

EFW: - 2.8k.g                                    FW: - 2.6k.g
Case NO (9):-

Age: - 19  
Parity: - 0

LMP: - 26/4/2015  
GA: - 38W+1D

BPD: - 9.65cm  
HC: - 34.18cm

AC:-35.48cm  
FL: - 7.72cm

EFW: - 3.7k.g  
FW: - 3.7k.g
Case NO (10):

Age: - 37  
Parity: - 6

LMP: - 18/8/2015  
GA: - 37W+4D

BPD: - 9.38cm  
HC: - 32.84cm

AC:-33.37cm  
FL: - 7.38cm

EFW: - 3.2k.g  
FW: - 3.5k.g
Case NO (11):-

Age: - 21

LMP: - 25/7/2015

BPD: - 9.27cm

AC: - 33.03cm

EFW: - 3.15k.g

Parity: - 2

GA: - 37W+3D

HC: - 32.82cm

FL: - 7.37cm

FW: - 3.0k.g
Case NO (12):

Age: - 29                      Parity: - 3
LMP: - 3/8/2015                GA: - 38W+0D
BPD: - 9.32cm                  HC: - 33.20cm
AC:-34.14cm                   FL: - 7.47cm
EFW: - 3.38k. g                FW: - 3.5k.g
Case NO (13):-

Age: - 35  Parity: - 5
LMP: - 28/4/2015  GA: - 36W+4D
BPD: - 9.06cm  HC: - 32.09cm
AC: - 32.71cm  FL: - 7.52cm
EFW: - 2.88k.g  FW: - 2.9k.g
Case NO (14):-

Age: - 30                                  Parity: - 2
LMP: - 18/6/2016                              GA: - 39W+2D
BPD: - 9.85cm                                  HC: - 34.57cm
AC: - 35.87cm                                  FL: - 7.20cm
EFW: - 3.7k.g                                  FW: - 3.5k.g
Case NO (15):

Age: - 35
Parity: - 5

LMP: - 27/7/2015
GA: - 39W+2D
BPD: - 9.65cm
HC: - 33.99cm
AC:-35.52cm
FL: - 7.68cm
EFW: - 3.7k.g
FW: - 3.5k.g
Case NO (16):-

Age: - 28 Parity: - 2
LMP: - 17/7/2015 GA: - 38W+6D
BPD: - 9.61cm HC: - 34.23cm
AC: - 34.63cm FL: - 7.49cm
EFW: - 3.5k.g FW: - 3.7k.g
Case NO (17):-

Age: - 22
Parity: - 0

LMP: - 5/6/2015
GA: - 38W+3D

BPD: - 9.46cm
HC: - 33.75cm

AC: - 34.54cm
FL: - 7.49cm

EFW: - 3.4k.g
FW: - 3.5k.g
Case NO (18):

BPD: - 9.16cm  
AC: - 33.07cm
EFW: - 3.0 g

HC: - 32.68cm  
FL: - 7.22cm
FW: - 3.3g