

Estimation of fetal size and age (fetal biometry)

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Outline of my presentation

- ✓ Introduction.
- ✓ Crown-rump length measurement (CRL).
- ✓ Biparietal diameter.
- ✓ Head circumference.
- ✓ Abdominal circumference.
- ✓ Fetal Long bone measurements.
- ✓ What is the ultrasound-determined gestational age?

Introduction:



Fetal biometric parameters are antenatal ultrasound measurements that are used to indirectly assess and estimate the fetal growth and age.

Standard parameters Assessed and reported on a routine 2nd-trimester scan or when growth reassessment is required in the second or third trimester.

- Crown Rump length (CRL) (7-11)
- Biparietal diameter (BPD) (12-26)
- Head circumference (HC) (the shape of the head is abnormal)
- Abdominal circumference (AC)
- Femur length (FL) (13), 3rd trimester.

Crown-rump length measurement (CRL)



The crown-rump length is the most reliable parameter for estimating gestational age up to the eleventh week. After that. the curvature of the fetus affects the reliability of the measurement.

From the twelfth week onwards. the biparietal diameter is more accurate.

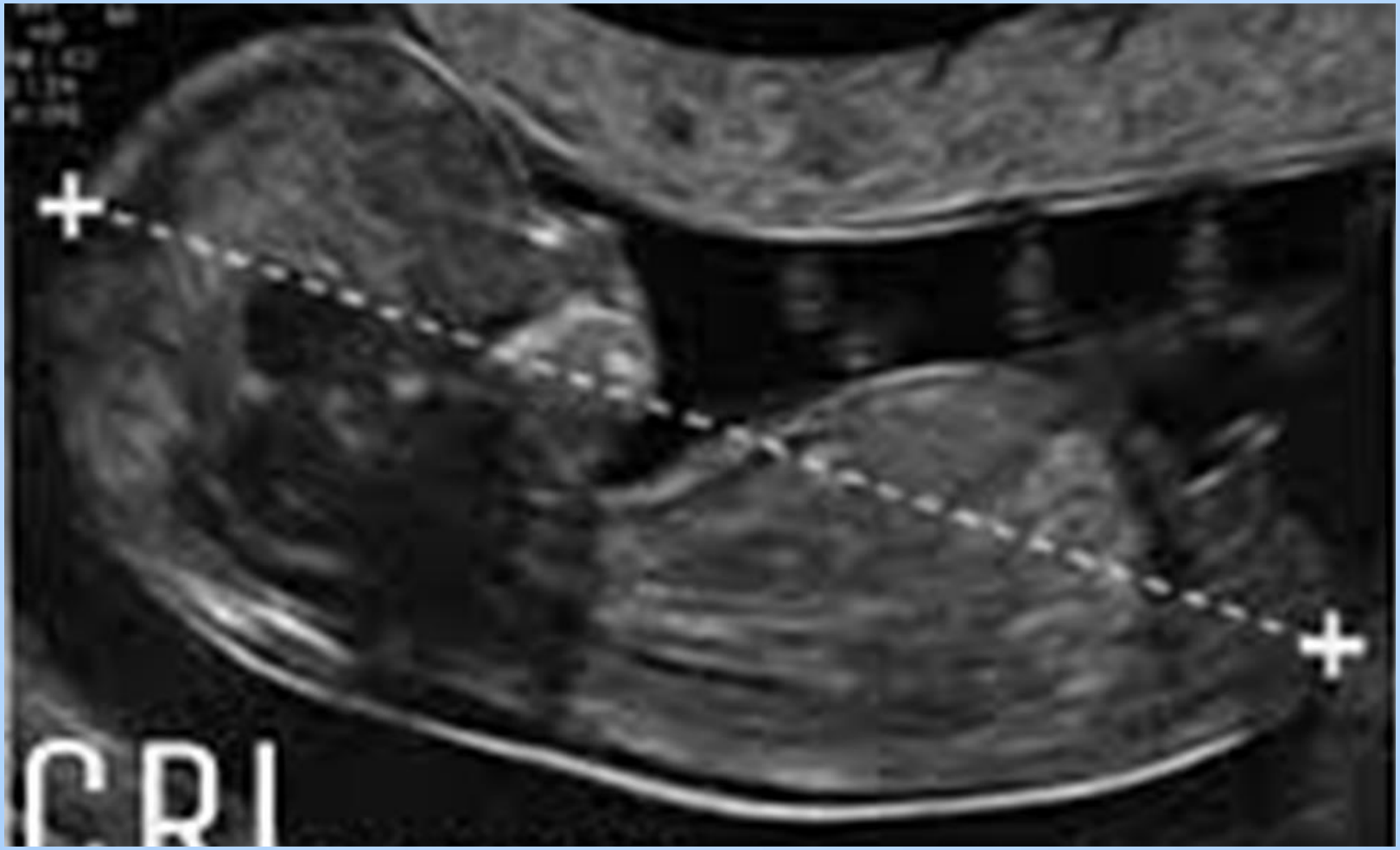
There is excellent correlation between the crown-rump length and gestational age from the seventh to the eleventh week of pregnancy:

biological variability is minimal and growth is not affected by pathological disorders.

Using scans in different directions. the longest length of the embryo should be found, and a measurement made from the head (the cephalic pole) to the outer edge of the rump. The yolk sac should not be included.

Crown-rump length measurement (CRL)





Biparietal diameter



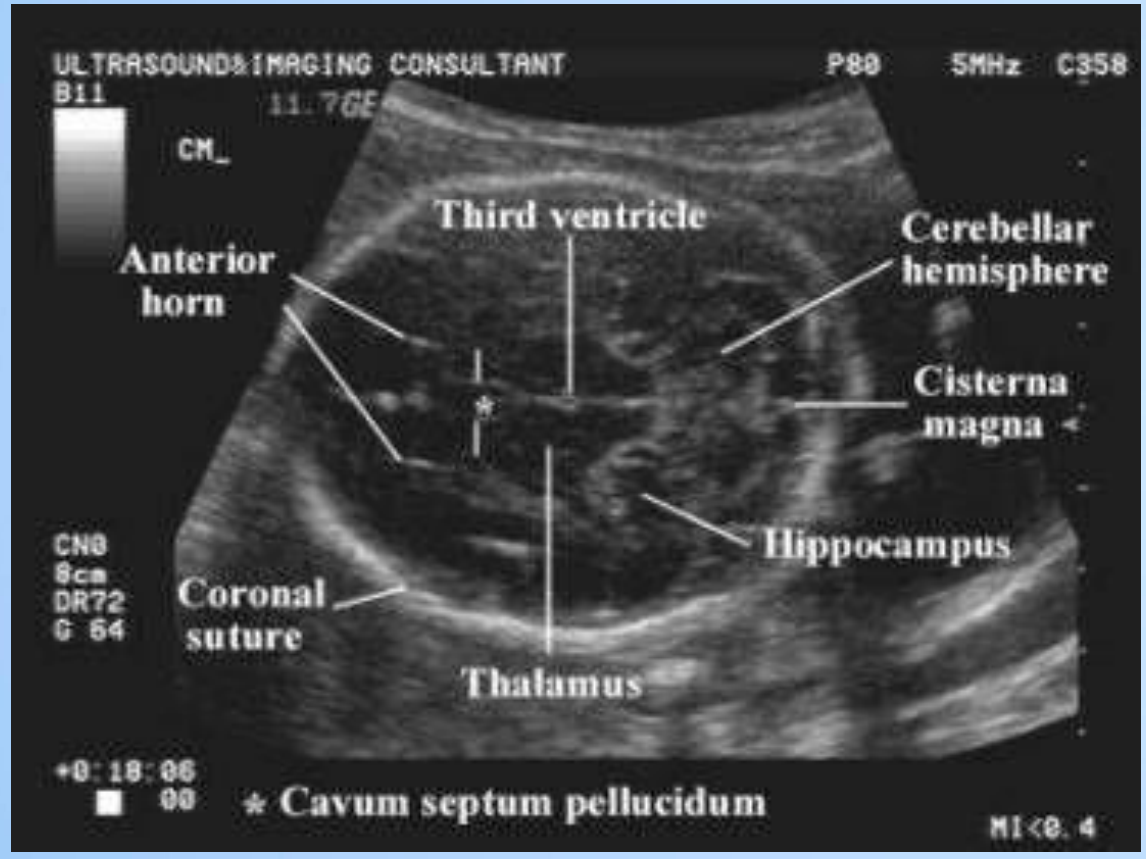
This is the most reliable method of estimating gestational age between the 12th and the 26th weeks. After that. its accuracy may be lessened by pathological disorders and biological variations that affect fetal growth. It must be considered together with other measurements. Such as femoral length and abdominal circumference .

The biparietal diameter (BPO) is the distance between the parietal eminences on either side of the skull and is, therefore, the widest diameter of the skull from side to side. Using scans at different angles, the transverse section will be recognized when the shape of the fetal skull is ovoid and the midline echo from the falx cerebri is interrupted by the cavum septi pellucidi and the thalami .

When this plane is found, the gain on the ultrasound unit should be reduced and measurements made from the outer table of the proximal skull (the part nearest to the transducer) to the inner table of the distal skull (the part farthest away from the transducer). The soft tissues over the skull are not included. This is the "leading-edge-to-leading-edge" technique.

Biparietal diameter







Front-occipital diameter



The fronto-occipital diameter is measured along the longest axis of the skull at the level of the biparietal diameter (BPD), from outer edge to outer edge.



Cephalic index



The BPD is a reliable estimate of gestational age except when the shape of the head is abnormal or there is an abnormality of the intracranial contents .The adequacy of the head shape is determined by comparing its short axis to its long axis-the cephalic index.

$$\text{Cephalic index} = \frac{\text{Biparietal diameter}}{\text{Fronto-occipital diameter}} \times 100$$

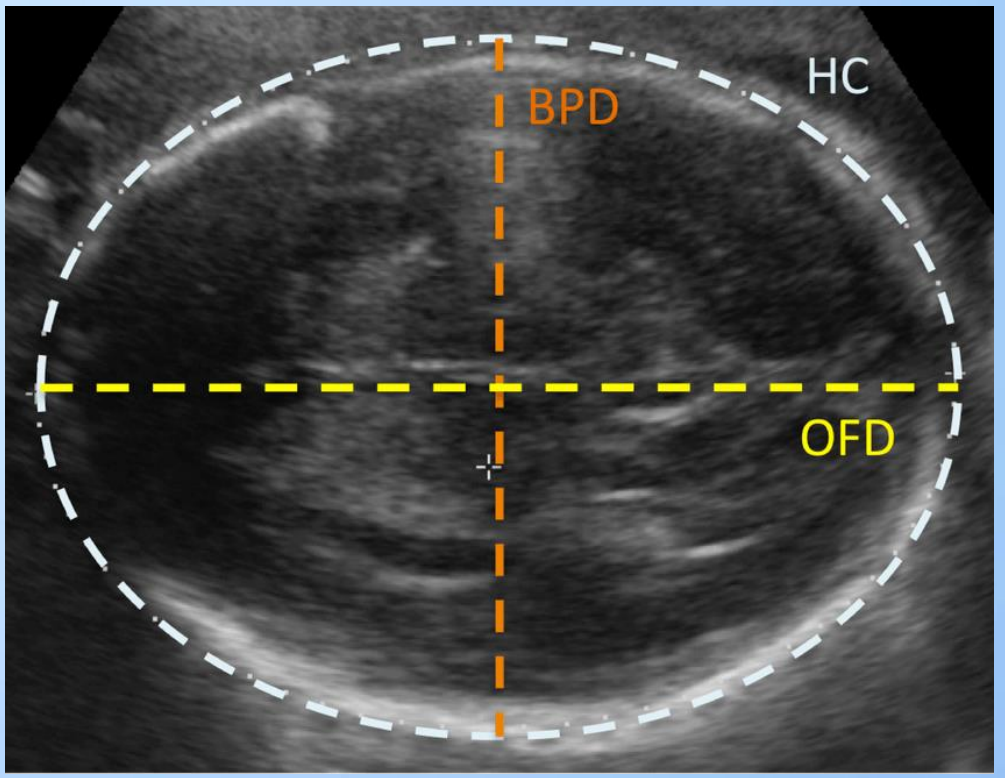
Normal range (± 2 standard deviations) = 70–86

Head circumference



If the cephalic index is within the normal range. the BPD is acceptable as an estimate of gestational age. If the cephalic index is outside this range (less than 70 or greater than 86), the measured BPD should not be used to determine the gestational age. Instead, the head circumference can be used. On some ultrasound machines, this may be measured directly. It can also be calculated

Head circumference =
(Biparietal diameter + Fronto-occipital diameter) × 1.57



Abdominal circumference



Abdominal circumference is used to detect intrauterine growth disturbances. The measurement must be taken at the level of the fetal liver. which is very sensitive to deficient nutrition. If the measurement is less than normal there has probably been intrauterine growth retardation.

Abdominal circumference



When you have a scan at the correct level, measure the antero-posterior (AP) and transverse diameters. A medium gain setting should be used and the measurement must be from the outer edge of the fetal abdomen on one side to the outer edge on the other side. Calculate the abdominal circumference by multiplying the sum of the two measurements by 1.57.

$$\text{Abdominal circumference} = (\text{Antero-posterior diameter} + \text{Transverse diameter}) \times 1.57$$

If the abdominal circumference is less than the fifth percentile. it is small. If it is greater than the 95th percentile. it is large. (With some ultrasound units it is possible to make this measurement automatically by tracing the perimeter of the abdomen.)

Fetal Long bone measurements



When measuring bone length. it is necessary to reduce the gain. It is usually easy to see fetal long bones from 13 weeks onwards. Find a projection that shows a transverse section of one of the long bones; then scan at 90 degree to this to obtain a longitudinal section. Measurements are made from one end of the bone to the other end . The femur is the easiest bone to recognize and measure. If there is any doubt. Also measure the limb on the other side.

Fetal Long bone measurements



The length of a bone. particularly the femoral length. can be used as a measure of gestational age when the head measurement is unreliable because of intracranial pathology. This occurs most frequently in the third trimester.



Measurements to assess fetal growth



A complete evaluation of fetal growth will require measurement of:

- the biparietal diameter (BPD);
- the head circumference;
- the abdominal circumference;
- the length of the femur.

What is the ultrasound-determined gestational age?



Comparison of fetal size and gestational age can provide a valuable indicator of intrauterine growth retardation. During the first routine scan, define the ultrasound gestational age based on the crown-rump length, head measurement and femur length. For follow-up studies, calculate age as the initial age (however derived) plus the number of weeks intervening.

Is the head size appropriate?



The head size (either biparietal diameter or head circumference) should be appropriate for the estimated ultrasound gestational age, i.e. the head measurement should fall within the range for the estimated gestational age.

Using the biparietal diameter alone, about 60% of growth-retarded fetuses will be detected. Using the abdominal circumference as well as other measurements, the sensitivity increases to 70-80% .

The shape of the scans from different transducers



Is the abdominal size appropriate?

Measure the abdomen and determine the appropriate percentile. An abdominal circumference less than the 5th percentile is abnormal and suggests intrauterine growth retardation.

What is the fetal weight? In what percentile does the weight fall?

Determine the fetal weight from biometric tables using at least two parameters and compare it with the standard distribution for the estimated gestational age.

Intrauterine growth is considered to be retarded when the weight is lower than the 10^{th} percentile.

Fetal head Ultrasound

can demonstrate the fetal head by the eighth week of gestation, but intracranial anatomy becomes visible only after 12 weeks.

Technique



Scan the uterus to locate the fetus and the fetal head. Position the transducer at the side of the fetal head and do axial sections from the fetal vertex down to the base of the skull.

First locate the "midline echo", a linear echo that runs from the frontal to the occipital fold of the fetal head. It is due to the falx cerebri, the midline fissure between the two halves of the brain, and to the septum pellucidum. If the scan is just below the top of the head, the midline echo appears to be continuous and is due to the falx. Lower down there is an anechogenic rectangular area anteriorly in the midline which is the first gap in the continuous midline echo. This is the cavum septi pellucidi. Just behind and below this septum are two relatively an echogenic areas, the thalami. Between them are two closely parallel lines, the lateral walls of the third ventricle (these are seen only after the thirteenth week).

Technique



At a slightly lower level, the middle of the lateral ventricle lines disappears, but the frontal and occipital horns are still visible.

The choroid plexuses will be seen as echogenic structures filling the lateral ventricles. The frontal and occipital horns of the ventricles contain fluid, but no choroid plexus.

Scan 1-3 cm lower (close to the upper part of the brain stem to locate a heart shaped structure of low echogenicity with the apex pointing occipitally. Just in front will be the pulsations of the basilar artery and further forward again the pulsating circle of Willis should be seen.

Technique



Posterior to the brain stem is the cerebellum, which is not always visible. If the obliquity of the section is changed, the falx will still be visible.

To assess the size of the ventricles, calculate the ratio of the width of the ventricle to the width of a hemisphere at the widest part of the skull. Measure the ventricle from the middle of the midline echo to the lateral wall of the ventricle (the cerebralvein). Measure the hemisphere from the midline to the inner table of the skull. The value of this ratio changes as the fetus grows, but is normal if less than 0.33. Higher values need to be compared with the normal range for the gestational age. Ventriculomegaly (usually hydrocephalus) requires further investigation and follow up ultrasound. The infant should also be evaluated in the early neonatal period.

Fetal spine



The fetal spine can usually be identified by the 12th week but can be clearly seen from the 15th week of gestation onwards. In the second trimester (12-24 weeks), the vertebral bodies have three separate ossification centres: the central one will form the anterior mass oft h e vertebra and the two posterior centres will form the laminae.

These are seen as two strongly echogenic lines.

Although transverse scans will show the three ossification centres and intact skin over the spine, longitudinal scans are needed throughout the length of the spine to exclude defects or meningocele. Coronal scans may show clearly the relationship of the posterior ossification centres.

Fetal heart



Fetal heart motion can be detected at 7- 8 weeks' gestation but detailed anatomy can be seen only after 16 -17 weeks.


Thank you