FETAL BIOMETRY

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• Obstetric sonography - accurate determination of gestational age
• By convention, gestational age used interchangeably with menstrual age
• Conceptional age
• Established menstrual age should never be changed later in pregnancy
• Subsequent fetal measurements – index of fetal growth rather than menstrual age
Fetal biometry???

Early pregnancy

- Scheduling of invasive procedures
- Interpretation of biochemical tests

Late pregnancy

- Evaluating fetal growth
- Spontaneous or planned elective delivery
• Accuracy of biometry in predicting GA

- First trimester  → ± 3 - 5 days
- 12 to 18 wks   → ±1 week
- Third trimester → ± unreliable
Gestational sac

- earliest sonographic sign of pregnancy
- precise term-chorionic sac
- Chorionic villi – echogenic ring
- Fluid within the sac – chorionic fluid in early pregnancies
- TVS probes – seen by 5 menstrual week
Gestational sac
Gestational sac

- **Intra decidual sign**
- Chorionic sac displaces the endometrial stripe
- Actually resides in decidua not in endometrial cavity
- TVS- 4.5-5 wks of GA
Intradecidual sign—an echogenic area embedded in the thickened decidua that is eccentrically located on one side of the uterine cavity, which appears as a well-defined endometrial stripe.
Intra decidual sign

Myometrium

Endometrial stripe

Faint yolk sac ("cheerio") within gestational sac
Gestational sac

- **Double decidual sac sign**
- Sonographic visualisation of three layers of decidua
- 2 echogenic layers
  - Inner ring-gestational sac & its echogenic outer layer of chorion
  - Outer ring-echogenic endometrium with decidual reaction
- **Marker of intrauterine pregnancy**
Double decidual sac sign
The double decidual sac sign is useful in distinguishing between an early intrauterine pregnancy (IUP) and a pseudogestational sac.
Mean sac diameter

- MSD
- Mean internal diameter of sac
- Obtained from the interface of chorionic villi and chorionic fluid
- Wall of the sac not included
MSD

- Mean of AP, transverse, longitudinal diameter
- length & depth measured in long. Image, width in transverse image
MSD

• 2-3 mm – when first observed
• Increases 1 mm /day in early gestation

• 2mm at 4-4.5 wks
• 5mm at 5 weeks

• Until MSD of 25
  – GA in days calculated by adding 30 to MSD
  – Eg; MSD of 5 mm = 35 days/5 wks
MSD

- 5.5 wks yolk sac appears
- 6 wks embryo appears
- MSD of 2-14 mm highly reliable
- Accuracy deteriorates after 14 mm
- MSD less reliable in late 1\textsuperscript{st} trimester

Watch carefully if
- MSD > 8 mm without yolk sac
- MSD > 16 mm without embryo
Yolk sac

• First structure seen in gestational sac

• Diagnostic of intrauterine gestation

• Connected to mid gut by vitelline duct

• Grows at rate of 0.1 mm / mm growth of MSD until MSD < 15 mm

• Upper limit – 5.6 mm b’n 5 & 10 wks
YS
CRL

• If the embryo is visualised, measurement of choice is CRL

• MSD equals 14 mm when CRL measures 5 mm
  – Embryo in a saggital section
  – Measure from the tip of the cephalic pole – crown to the tip of the caudal pole – rump
CRL
CRL

• Maximal straight line length of the fetus
• Average CRL measurement from 3 satisfactory images
• Optimal time for prediction of GA from CRL - 6-9 WKS
• Predictability +/- 3-5 days
• Decreases as the pregnancy progresses
• BPD is superior than CRL at 12-14 wks
CRL

- Pitfalls:
  - Faulty measurements due to:
    - **Fetal Position**
    - Excessive flexion or hyperextension = underestimation
  - Poor measurement plane
  - Inclusion of YS in CRL measurement in early pregnancy
• Transition b’n 1\textsuperscript{st} & 2\textsuperscript{nd} trimester (13 -14 weeks) appropriate time to make transition from CRL to BPD, HC, AC, & FL
BPD

- Accurate predictor of menstrual age before 20 weeks
- B’n 14 & 20 wks, variability: +/- 1 wk
- After 20 wks variability: +/- 3.5 wks
BPD

• Two dimensional measurement

• Any plane of section that traverses 3rd ventricle and thalamus

• Transducer
  – Perpendicular to parietal bones
  – In correct cephalo caudal position to intersect 3v & thalami

• Consistant and accurate measurement
BPD

- Three rules
- Correct plane of section thro third ventricle & thalami
- Calvaria- smooth & symmetrical bilaterally
- Positioning of cursors- proper endpoints of measurement
  - outer edge of near calvarial wall to inner edge of far calvarial wall
  - Inner edge of near calvarium to outer edge of far calvarium
  - Middle of near calvarium to middle of outer calvarium
Cephalic index

To assess head shape

- CI = BPD ÷ OFD x 100
- CI ≤ 75% = dolicocephalic
- CI ≥ 85% = brachicephalic
- OFD measured from outer to outer edge of calvaria
HC

- Three dimensional measurement
- Independent of head shape
- Predict GA to within ±1 wk before 20 wks
- Variability of ±3.8 wks in late third trimester
HC

- Obtained thro single plane of section- parallels the base of skull

Transducer

- Perpendicular to parietal bones
- In correct cephalo caudal position to intersect 3v & thalami
- Properly oriented to skull base
HC

Rules for measuring HC

- Correct plane thro 3v & thalami in centre
- Cavum septum pellucidi – anterior portion
- Tentorial hiatus – posterior portion
- Smooth & bilaterally symmetrical calvaria
HC

- Arrow sign
- Feathers-cavum septum pellucidi & frontal horns
- 3v & sylvian aqueduct-shaft
- Ambient & quadrigerminal cisterns & tentorial hiatus - arrowhead
HC

- Cursors - at outer edge of near calvarial wall & outer edge of far calvarial wall
- Computer generated ellipse fitted to calvaria
- Entire perimeter of calvaria need not be demonstrated
- Ellipse measures adequately even when the entire calvaria is not entirely imaged
HC
HC

• Proper BPD can be obtained from same image for HC MEASUREMENT
• Reverse is not true
• Properly positioned cursors for HC – inappropriate for BPD
• For HC ellipse fitted to calvaria not the skin of the scalp
HC

thalami
cerebellum
cisterna magna
FL

• Technically the easiest of common biometric measurements
• Accurate predictor of age in early 2\textsuperscript{nd} trimester($\pm$ 1 wk)
• Transducer aligned to long axis of diaphysis
• Entire femur L not measured
• Only ossified portions of diaphysis & metaphysis measured
• Cartilaginous ends excluded
FL

- Proper alignment
  - cartilaginous femoral head or greater trochanter
  - femoral condyles in same section
- Positioning cursors
  - At the junction of bone with cartilage
  - Avoid distal femoral point
FL

- Distal femoral epiphysis – appear at 34 wks in 94% of fetuses
- Proximal tibial epiphysis – appear at 37 wks in 80% of fetuses
- For confirming biometric data in late pregnancy
AC

• Three dimensional measurement

• Acutely affected by growth disturbances

• Most difficult of the four measurements
- Measured at greatest transverse diameter of liver
- Rt & Lt portal veins continuous with each other – ‘hockey stick’ appearance
AC

Rules for measurement of AC
• Perpendicular to midline
• Correct cephalo caudal plane
• Symmetric lower ribs
• Shortest L of umblical segment of Lt portal vein
• Elipse fit to skin edge
AC

- When anatomic landmarks difficult to demonstrate
- Follow the rule: “round’ Covers a multitude of sins’
- Circumference estimate –more accurate
- Avoid excessive pressure to transducer
AC
FL / AC RATIO

• FL / AC ratio = 22

• Constant from 22 wks onwards

• Helpful in diagnosing asymmetric IUGR
Transcerebellar diameter

- Not affected by growth disturbances
- Fetus in direct occipito anterior position
- Diameter in mm corresponds to GA in 1st 26 wks of pregnancy
- Cisterna magna not > than 9mm
• Dating with other measurements

• Long bones of arms & legs
• Fetal chest
• Orbital & interorbital distance
• Foot Length
• Clavicle length
conclusion

- Established menstrual age should never be changed later in pregnancy
- Subsequent fetal measurements – index of fetal growth rather than menstrual age
- Examiner should avoid the temptation to ‘massage’ the endpoints of measurements because the age computation is smaller or larger
- Instead it is crucial to learn the rules for each measurement
Thank u