ISUOG Basic Training

Distinguishing between Normal and Abnormal Fetal Size and Growth Patterns in Singleton and Twin Pregnancies

Learning objective

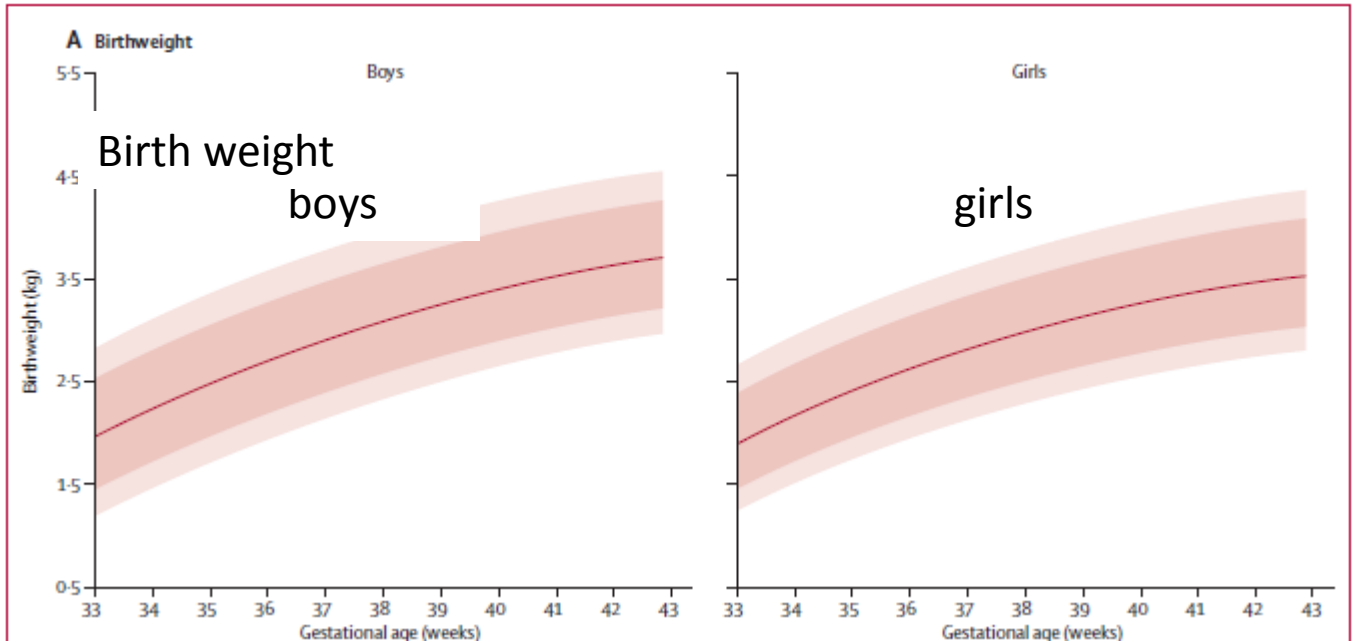
At the end of the lecture you will be able to:

- Use ultrasound to distinguish between normal and abnormal growth patterns in singleton and twin pregnancies

Key questions

- What maternal conditions are most frequently associated with abnormal fetal growth patterns?
- What measurements should be taken to assess fetal growth correctly?
- What are the typical ultrasound features of poor fetal growth?
- What are the typical ultrasound features of macrosomic fetal growth?
- How is fetal growth assessed in twin pregnancies?

Birth weight



3rd, 10th, 50th, 90th, and 97th centile curves

Villar et al Lancet 2014;384:867-68

Growth patterns

- Macrosomia
- Appropriate growth
- Fetal growth restriction (FGR)

31w 40w, 1000 gms, 40w 3150 gms

40w 3150 gms 40 w 4700 gms

Macrosomia

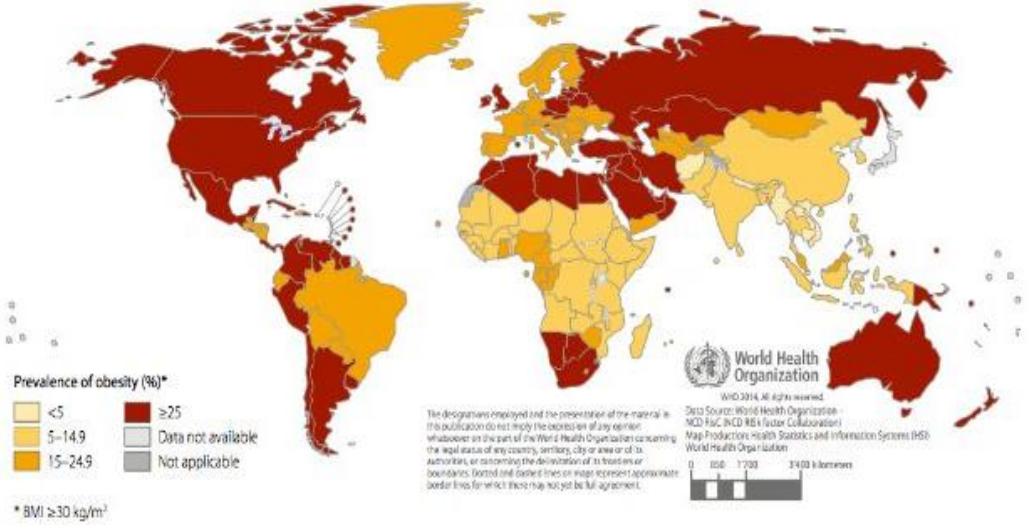
Definition	Cut-off	Prevalence
Neonate at term	> 4.5 kg	1,3 - 1,5%
Gestational age dependent	> 97th centile	
Birth weight at term	> 4 kg	7%
Gestational age dependent	> 90th centile	

Campbell S. UOG 2014; 43: 3–10

Risk factors macrosomia

- Maternal diabetes
- Gestational diabetes
- Maternal obesity
- Family history
- Genetic syndromes

Fig. 7.2 Age-standardized prevalence of obesity in women aged 18 years and over (BMI ≥30 kg/m²), 2014

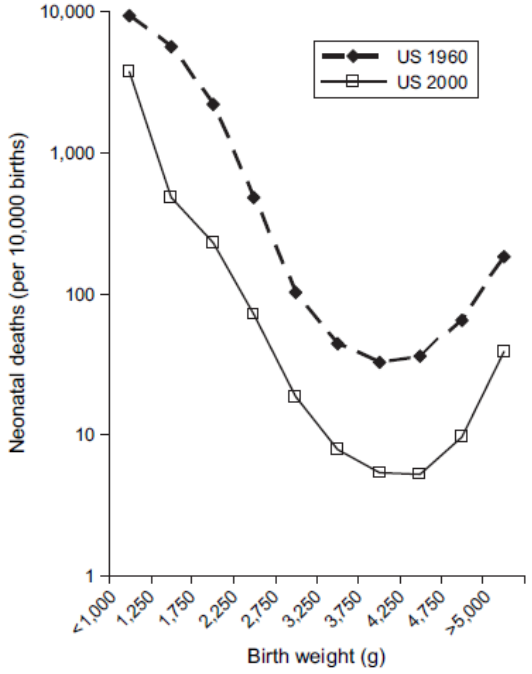


– Beckwith-Wiedemann, Simpson-Golabi-Behmel, Sotos

Okun et al. *J Matern Fetal Med* 1997;6:285–290.

Macrosomia

- Risk for mother
  - Emergency CS
  - Instrumental delivery
  - Shoulder dystocia
  - Trauma to birth canal
  - Bladder, perineum & sphincter injury



- Risk for infant
  - Mortality
  - Brachial plexus injury
  - Facial nerve injury
  - Fracture humerus / clavicle
  - Birth asphyxia

Basso et al Am J Epidemiol 2006;164:303–311

Small for gestational age - SGA

- Newborn birth weight < 10th centile for gestational age
- Low-birth weight (< 2500 gms)
  - Preterm AGA: delivery < 37 weeks who are appropriate size for GA
  - Preterm and growth restricted: delivery < 37 weeks of SGA
  - Term growth restricted: newborn ≥ 37 weeks that is SGA

Risk factors FGR

Fetal:
- Chomosome anomaly
- Genetic syndrome
- Congenital anomaly

Maternal:
- Idiopathic
- Chronic disease
- Abnormal implantation

(PE, HELLP, antiphospholipid IUGR)

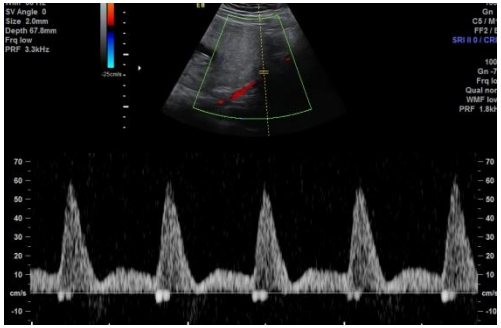
SGA / FGR

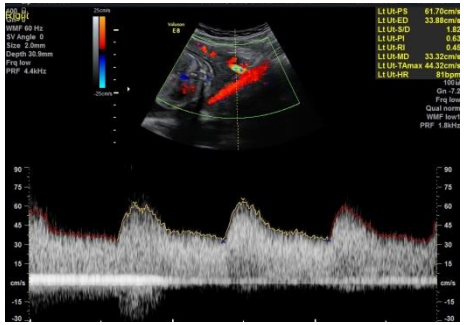
Placenta:
- Mosaicism
- Uterus anomaly
- Velamentous insertion

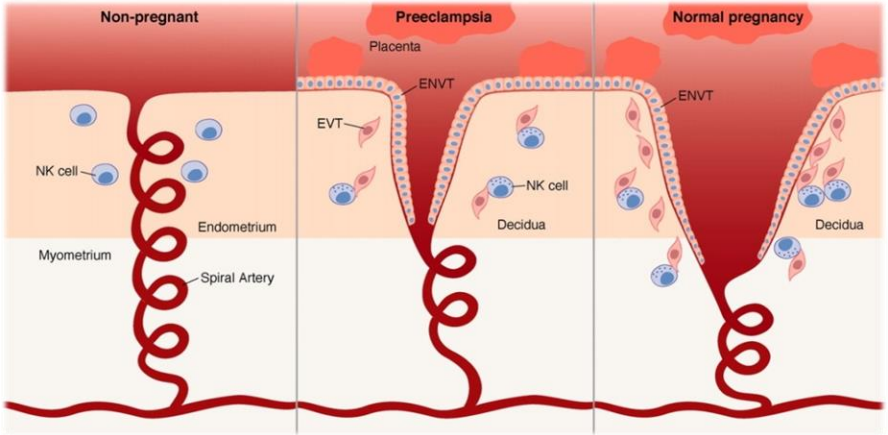
External factors:
- Smoking
- Infection
- Psycho / Social

Uterine circulation

High risk
Moderate predictive of FGR







Pijnenborg R, et al. Placenta. 2006; 27:939-58. Review.

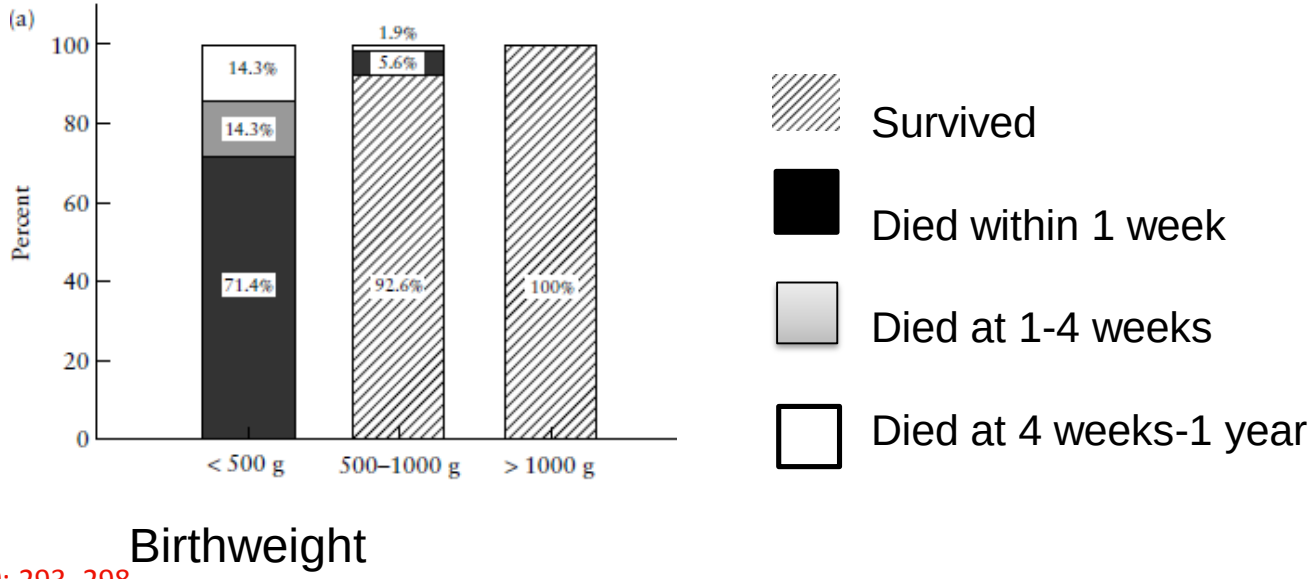
Early FGR and late FGR

Early FGR, easy to diagnose, difficult to treat

Late FGR, difficult to diagnose, easy to treat

Outcome severe FGR

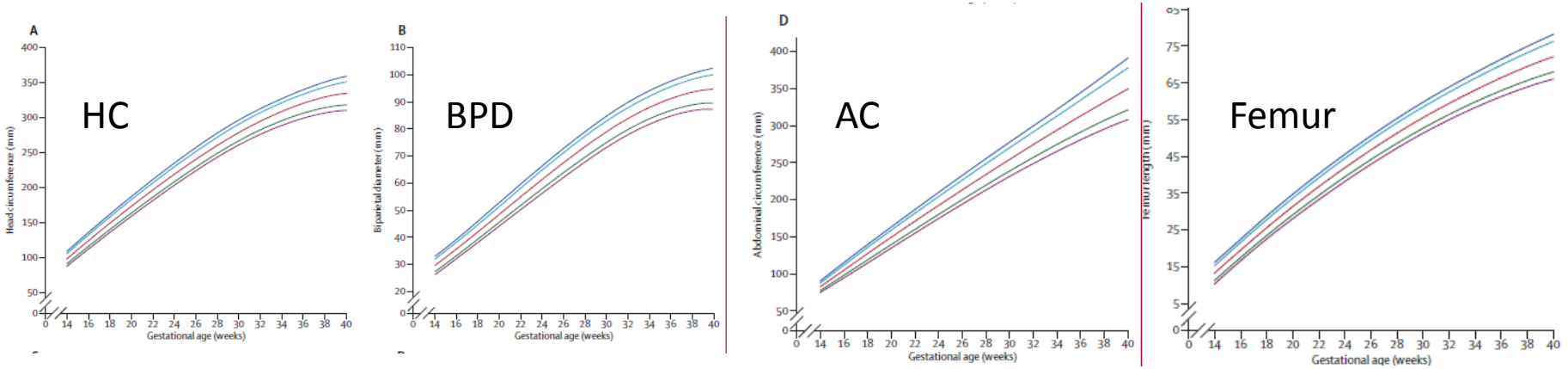
- Retrospective cohort study of 110 fetuses a very low birth weight (<1500 gms)



Birthweight

Chalubinski et al UOG 2012; **39**: 293–298

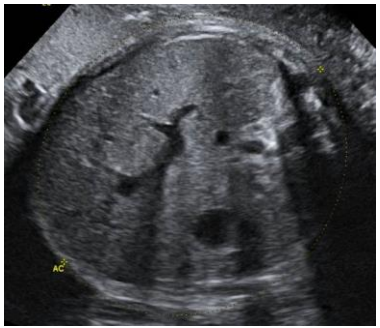
Fetal growth

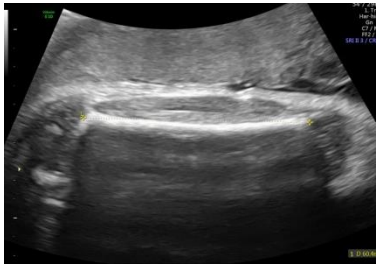


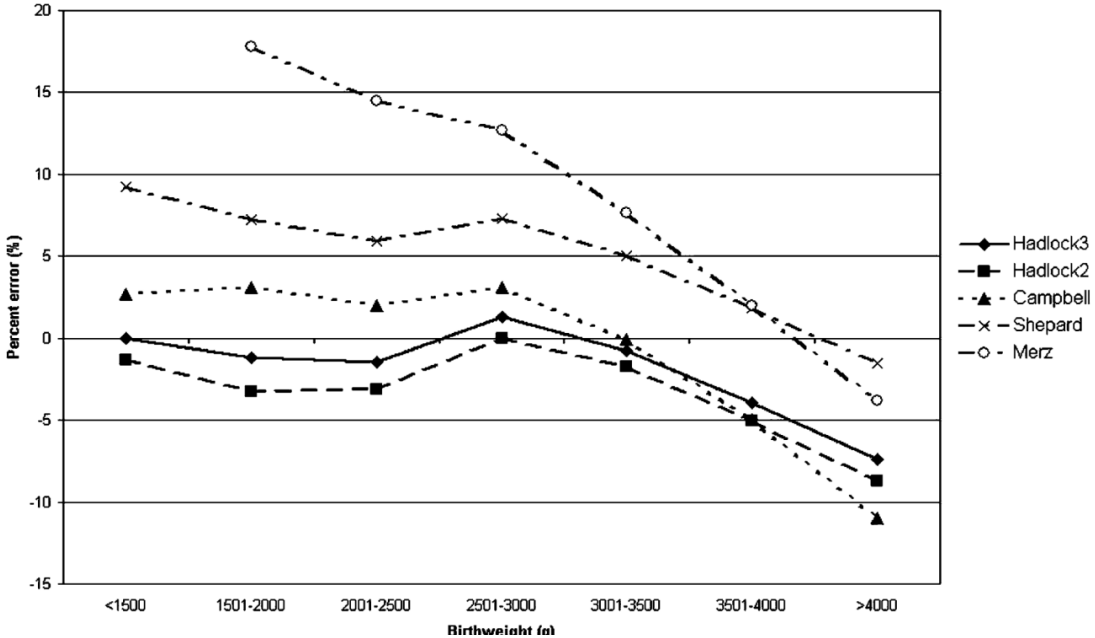
International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth Longitudinal.
Study of the INTERGROWTH-21st Project

Papageorghiou et al Lancet 2014;384:869-79

Estimated fetal weight (EFW)







Hadlock 3: most reliable formula

> 3 kg percent error increases

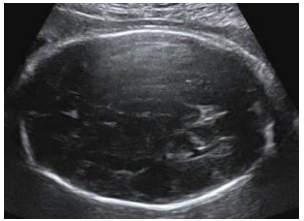
Kurmanavicius et al J Perinat Med 2004;32:155-61

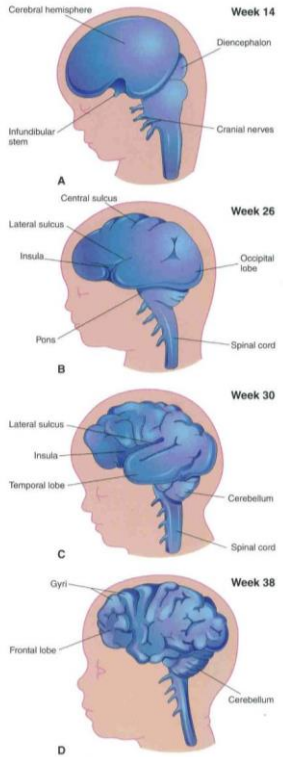
Appearance of fetal brain throughout gestation

12 w

20 w

30 w





Detecting abnormal growth

- Clinical assessment
  - Maternal risk factors
  - Measurement of fundal height
- Ultrasound
  - Biometry (AC)
  - Estimation of fetal weight (BPD, HC, AC, Femur)
  - Measurement of amniotic fluid (AFI or DP)

Ultrasound detection of macrosomia

- Assess risk factors
- US for fetal size at 32-34 weeks
- If > P90 repeat US at 38-39 weeks

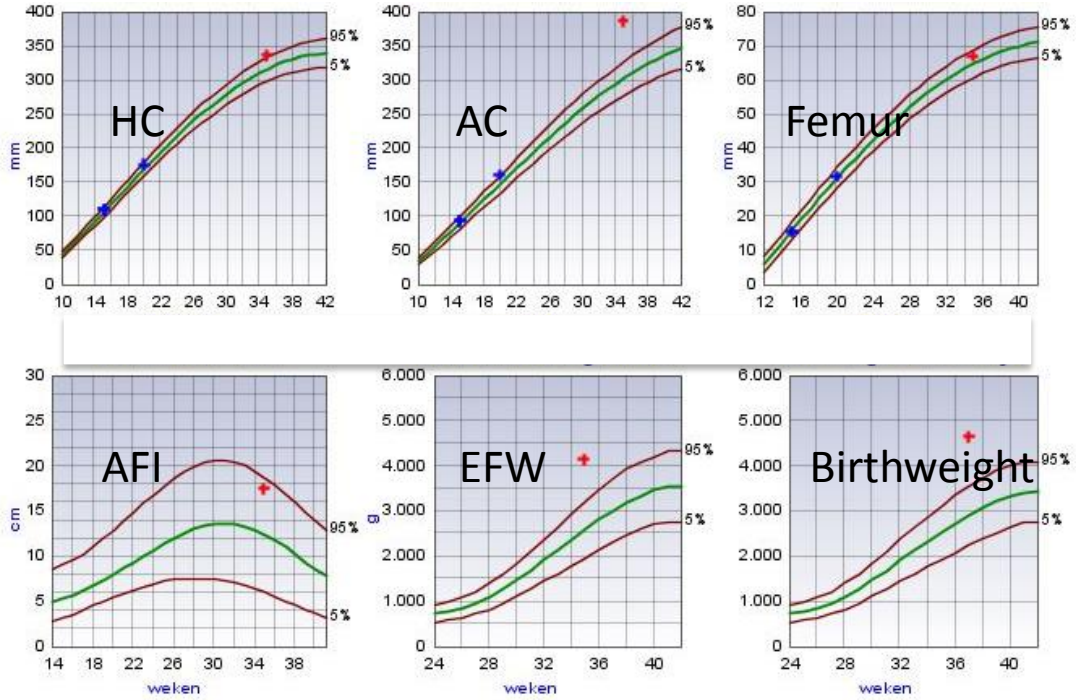
Campbell UOG 2014; 43: 3–10

Detecting macrosomia

Mother - Diabetes

1st 38w 3800 gm

2nd 37w 4100 gm



Induced 37w

Vaginal delivery

Girl 4648 gm

Boulvain et al Lancet 2015; 385: 2600–05

Detecting macrosomia

IVF pregnancy

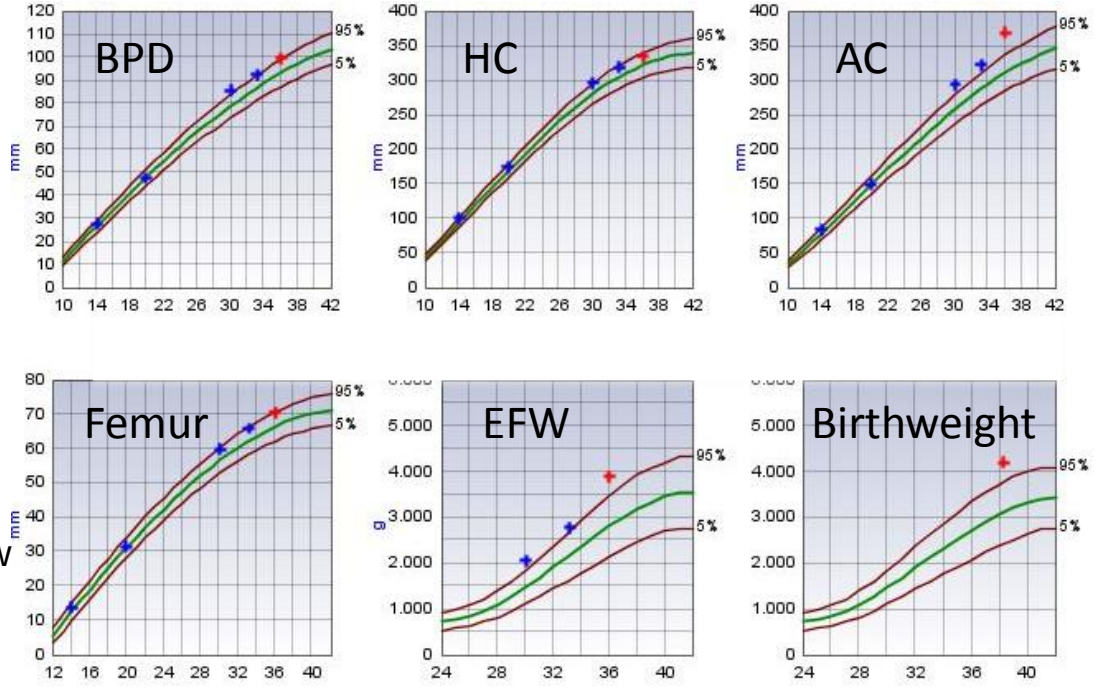
BMI 28.6

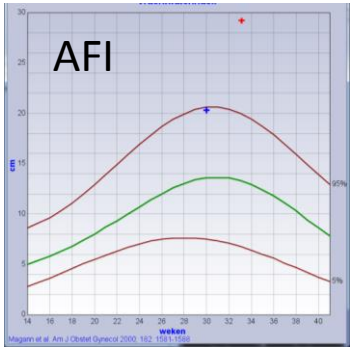
Clinically large 30w

Induced delivery 38w

Girl 4205 gms

No anomalies



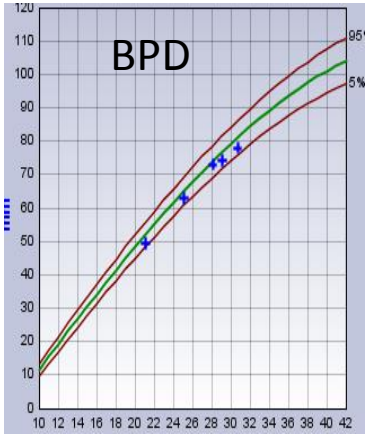


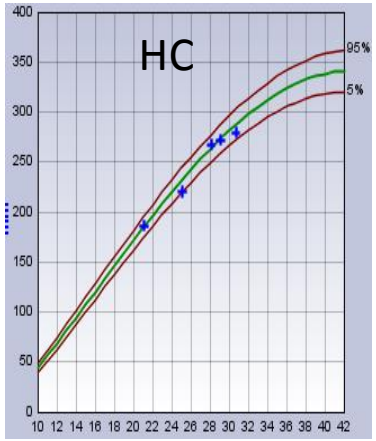
Ultrasound Detection of FGR

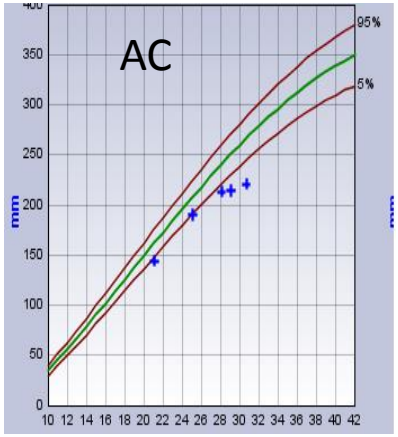
- Serial measurements of AC and EFW are superior to single estimates in the prediction of IUGR
  - 2-4 weeks
  - Fetal growth interval < 2 wks -> high FP rate
    - Reduced amniotic fluid

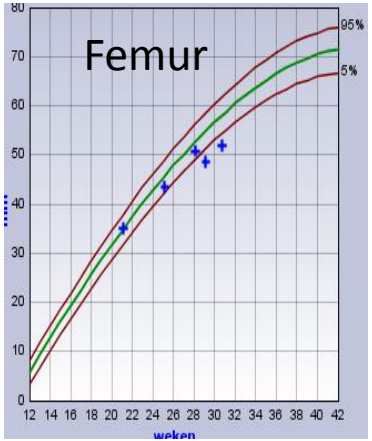
- Routine ultrasound after 24 weeks in low-risk pregnancy does not improve perinatal outcome

Growth pattern



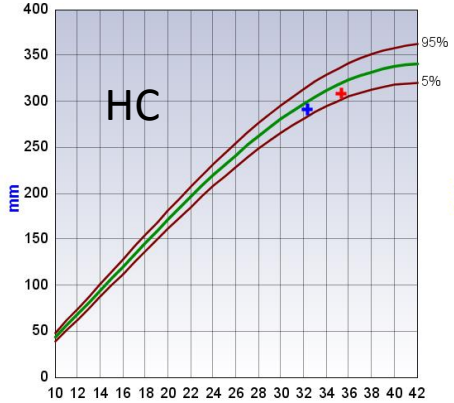


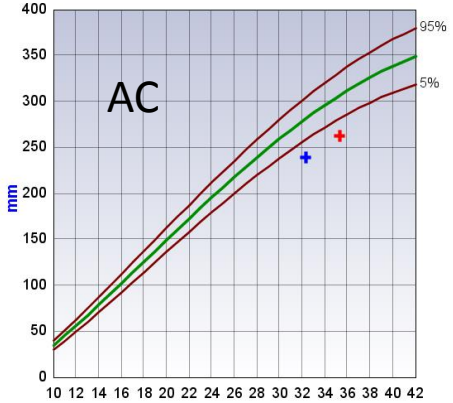


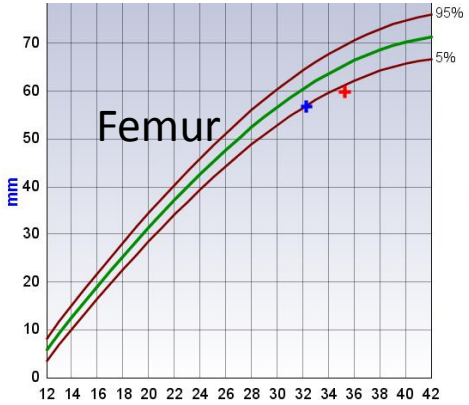


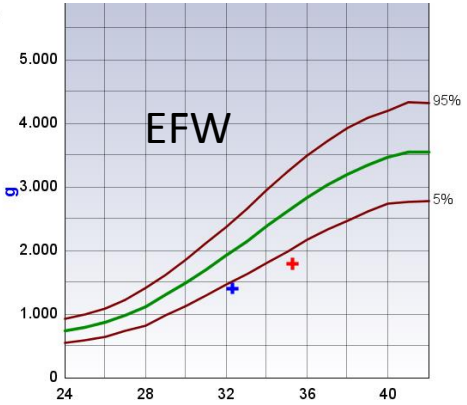
Admitted for pre-eclampsia and FGR at 29w
CS maternal indication at 32w+5d
Birthweight 1419gms (p10-16). Last EFW 1098gm (p1,2) at 30w+5d

Growth pattern









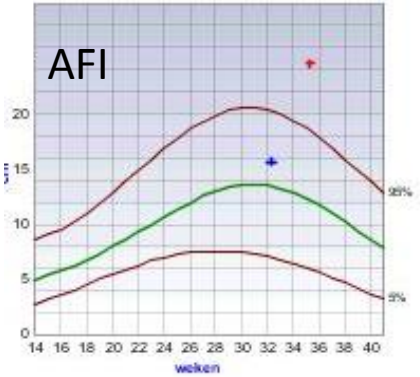
2 vessel cord

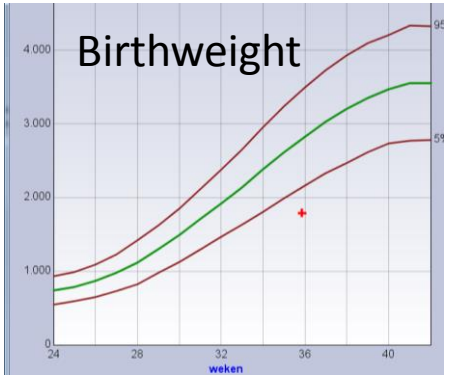
Esophageal atresia

Multicystic kidney

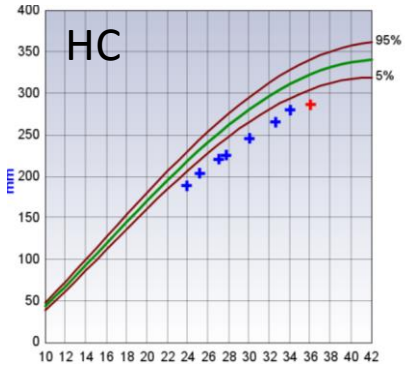
FGR

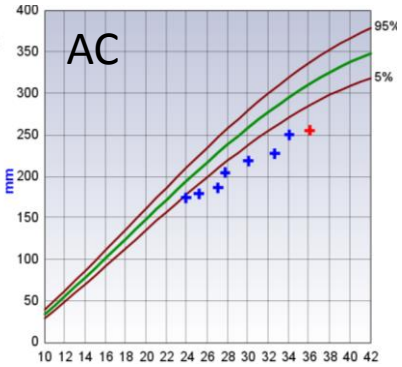
Normal array

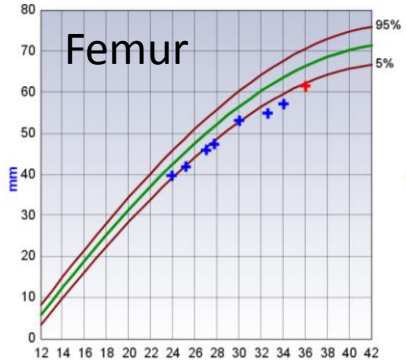


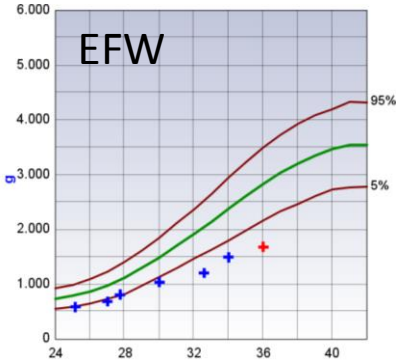


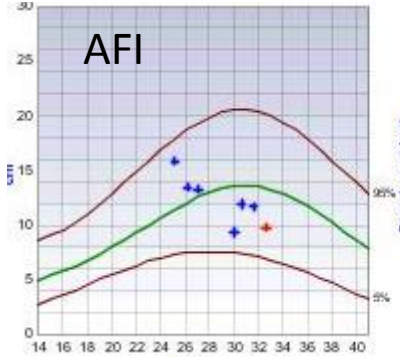
Growth pattern

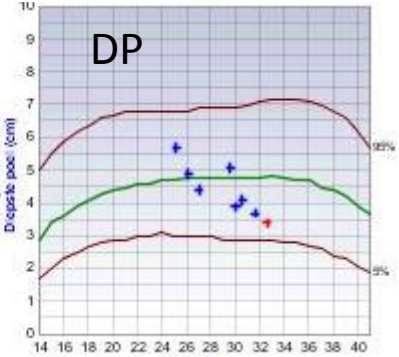




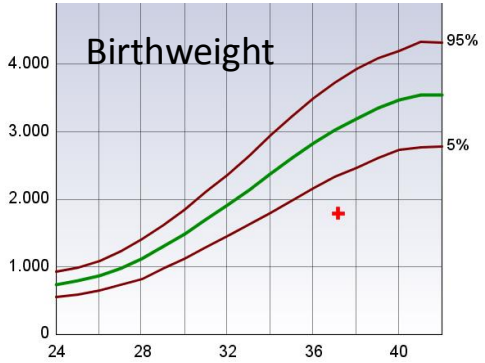




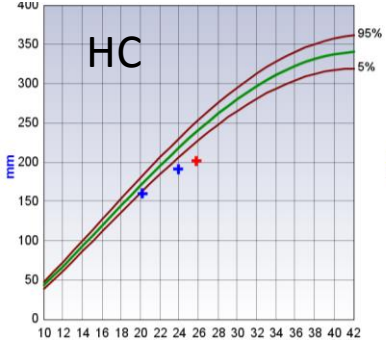


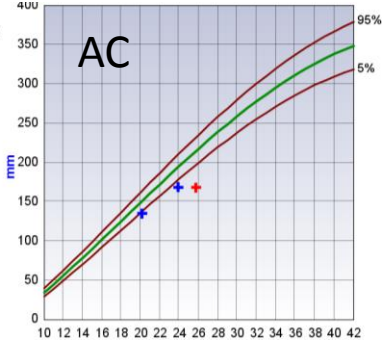


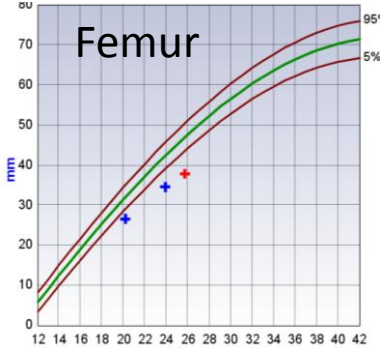
37w1d SC 1790 gms
Failure to thrive
Microcephaly
Multiple cafe-au-lait spot
Array mosaicism 15%
Monosomy 7

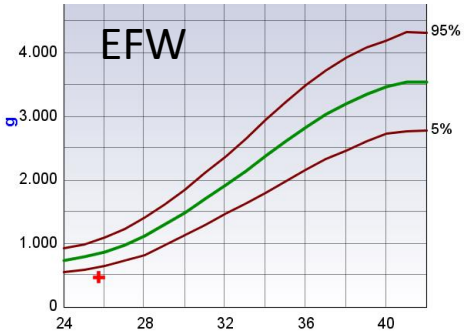


Growth pattern

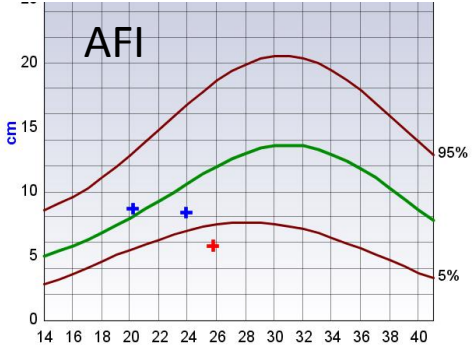


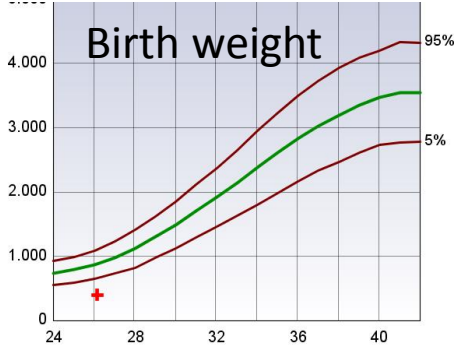




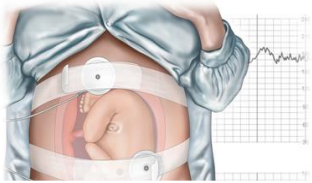


Early pre-eclampsia
SC 26w1d
NND 3 w



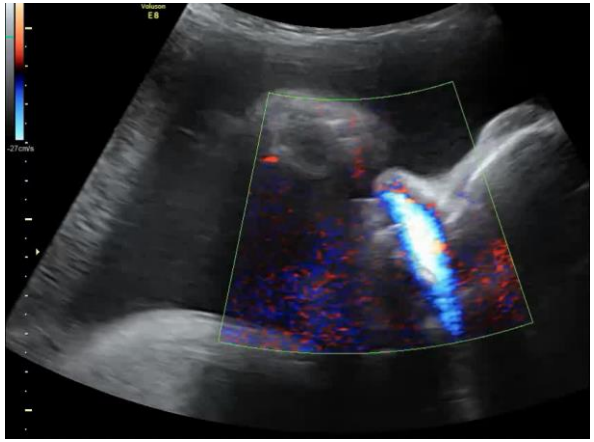


Fetal monitoring

Biophysical profile variable	Normal score (2)	Abnormal score (1)
Fetal breathing movement	1 episode fetal breathing 30 s	Absent or < 30 s
Gross fetal movement	3 discrete body/limb movements	2 or less
Fetal tone	1 episode active extension with return to flexion of fetal limbs / trunk.	Slow extension with partial flexion or limb movement without flexion or none
Fetal heart rate reactivity 	< 26 w ga: 2 accelerations of ≥ 10 beat 2 of ≥10 s 26–36 w ga: 2 accelerations of ≥10 beat ≥15 s ≥ 36 w ga: 2 accelerations of ≥20 beat ≥20 s	Less than two episodes of accelerations and durations as specified
Amniotic fluid volume	Pocket 2 x 2 cm	< 2 x 2 cm

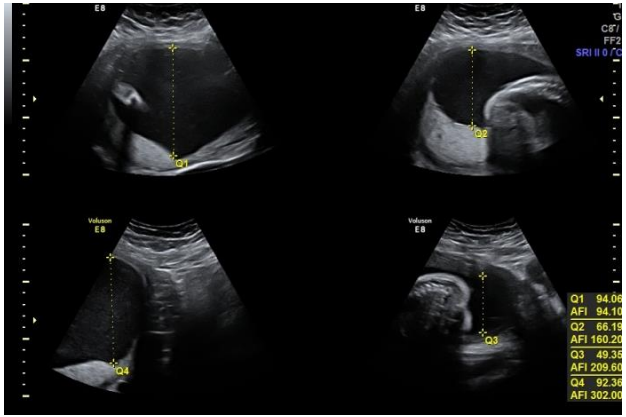
Baschat UOG 2001; 18: 571–577 Manning FA. Obstet Gynecol Clin North Am 1999; 26: 557–77

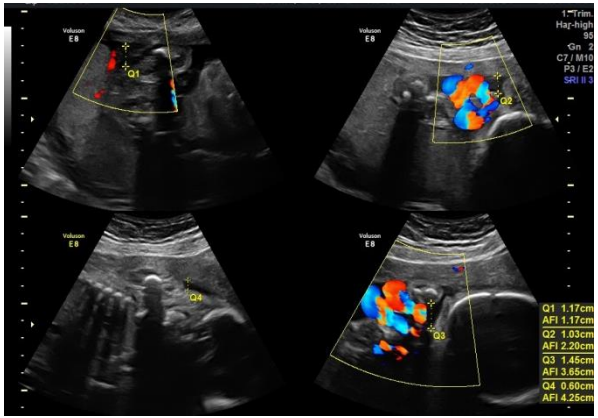
Fetal breathing movement



Polyhydramnios and oligohydramnios

	Polyhydramnios	Oligohydramnios
SDP	≥ 8	<2
AFI	≥ 24	<5



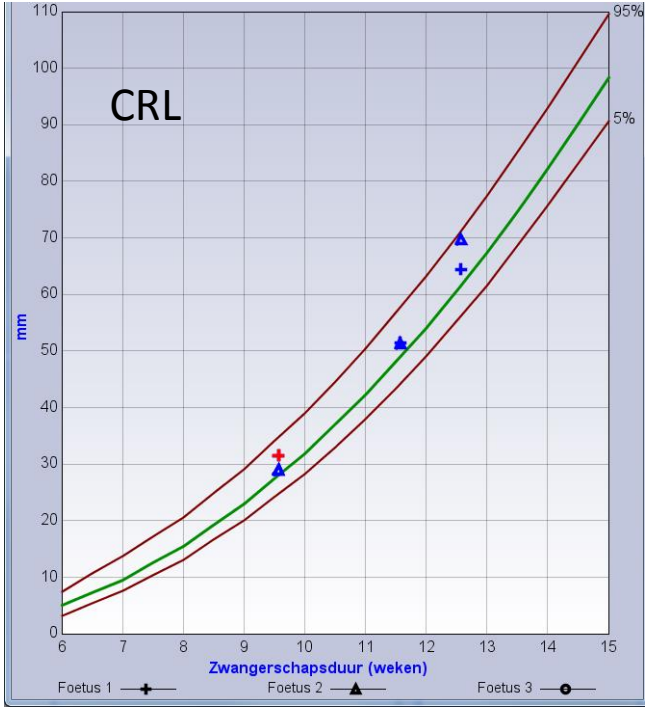


Monitoring growth in twins

- Dichorionic twins
  - US every 4 weeks from 20 weeks onwards
  - When size difference > 20% every 2 weeks
- Monochorionic twins
  - US every 2 weeks from 14 weeks onwards
    - Biometry
    - DP

Twins growth patterns

- 25% difference in growth MZ and DZ
  - DZ different in growth potential
  - MZ
    - Unequal placenta
    - Blood vessel anastomosis
    - Structural anomaly
    - Chromosomal anomaly

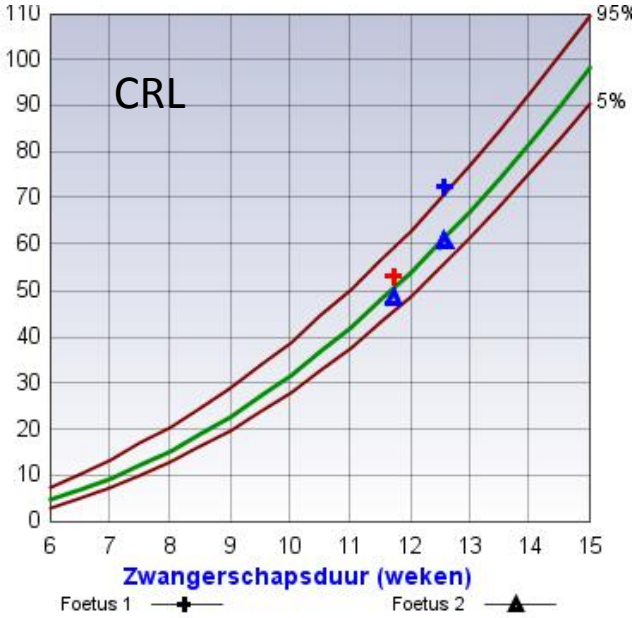


MCDA

- 36-year spontaneous pregnancy of MCA twin
- Ultrasound at 11^5 weeks:

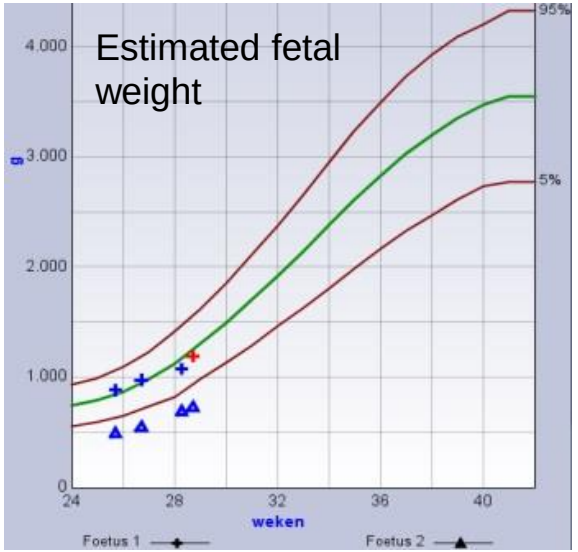
CRL 53,3 mm

CRL 48,9 mm



MCDA

- From 16 weeks onwards growth assessment
  - Selective IUGR



- Delivery 29 weeks:
- Male 1200gms (p20-50) and male 805gms (p5-10)

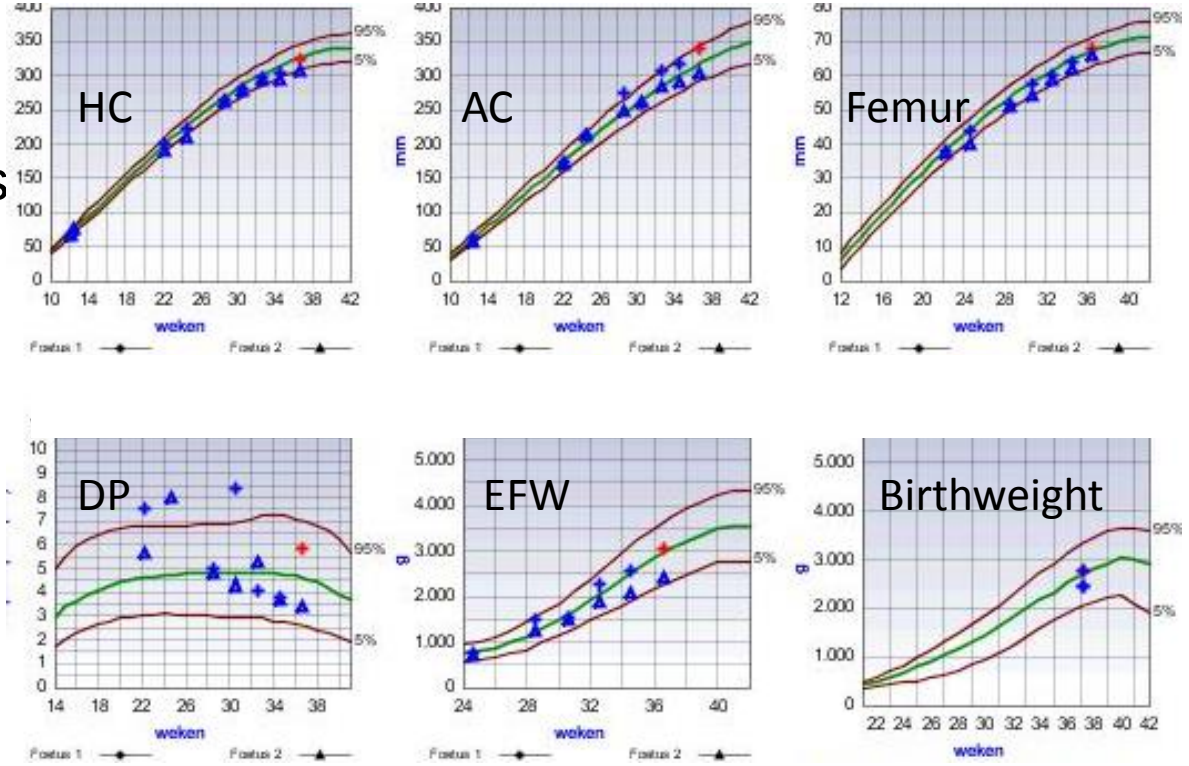
DC twins

G3P2
Previous
4500 & 3400 gms

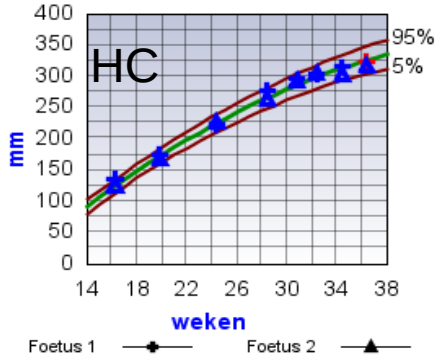
Spontaneous VD
37w 1d

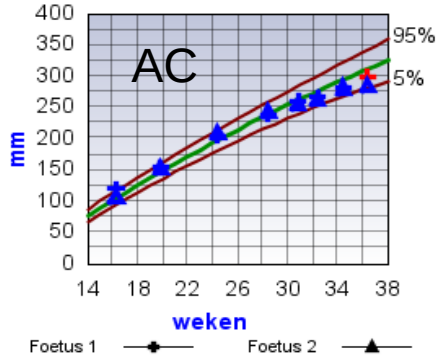
Boy 276 0 gms

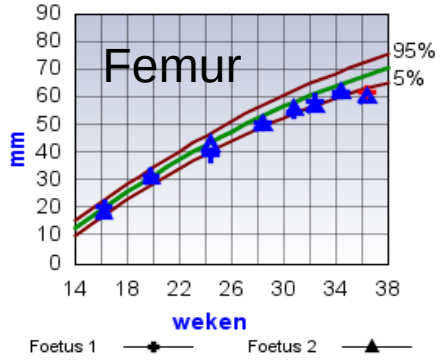
Boy 2470 gms

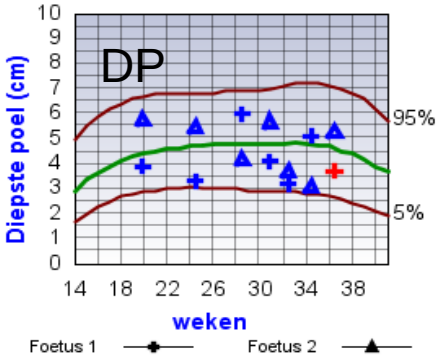


DC twins

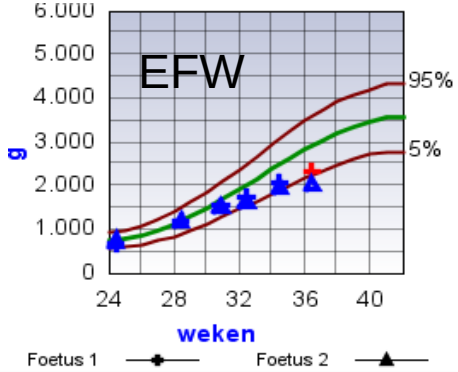


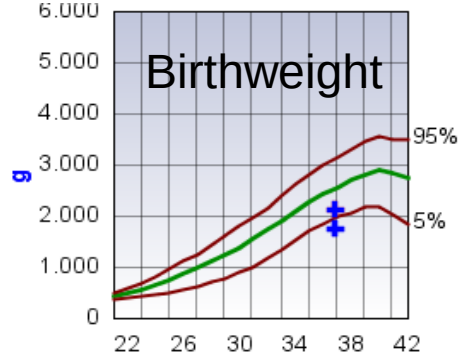




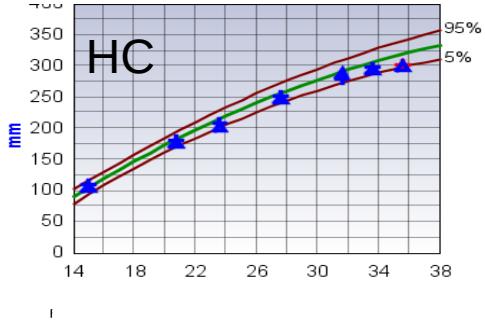


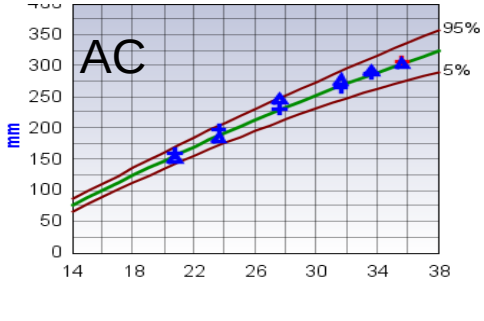
41 year G8, P2,
5 spontaneous miscarriages,
Delivery 36w6d
Girl; 2125 gms
Boy; 1750gms

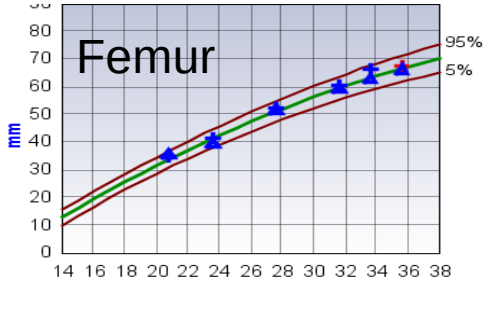


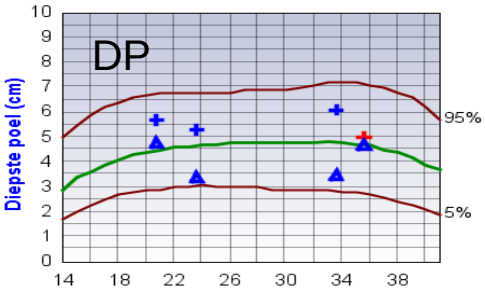


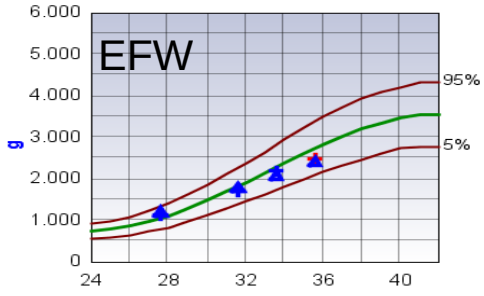
DC twin, G1

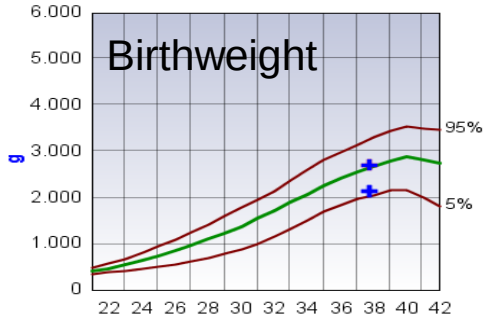












Pre-eclampsia
Prim CS 37w 5d
Girls
2715 & 2145 gms

Fetal growth assessment

- Singleton
  - Assess risk factors,
  - If risk for FGR, monitor growth from 26-28w
- DCDA twin
  - Every 4 weeks from 20 weeks
- MCDA twin
  - Every 2 weeks biometry and Doppler from 14 weeks

Key points

1. Use BPD, HC, AC, and femur length to assess EFW.
2. Leave at least 10 days between scans.
3. Beware of the causes of impaired and increased fetal growth.
4. Assess growth pattern to monitor risk of associated anomalies.
5. Start onset and frequency of growth assessment in twins depending on chorionicity.
6. Assess amniotic fluid and fetal wellbeing during scan

Conclusions

- Many causes may alter fetal growth.
- Macrosomia usually presents late in pregnancy.
- Fetal growth restriction may present from early on in pregnancy.
- Chorionicity is important to determine how to monitor growth.