

# ULTRASOUND LECTURE SERIES

— Presented by —

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# Common Methods of Ultrasound Dating in Pregnancy

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# *Agenda*

## Areas to Be Covered

- Methods for estimating gestational age
- Biometric variation
- Other biometric parameters
- Clinical correlation

# Definition

- **Menstrual age:** first day of the last menstrual period (most commonly used)
- **Fetal age:** begins at conception

# Importance

- Knowledge of gestational age is important for many reasons.
  - Accurate dating is necessary for:
    - Timing of invasive procedures
      - Chorionic villus sampling, amniocentesis
    - Treatment of preterm delivery or post-term pregnancy
    - Management of maternal or fetal complications
    - Interpretation of serum screening results
    - Evaluation of growth



38363-09-02-24-1

RIC 5-9/GYN

6.5cm / 60Hz

MI 0.6

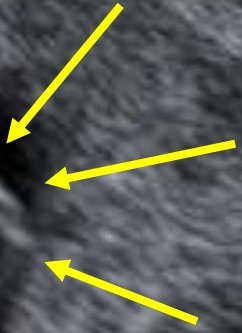
TIs 0.1

CMC WOMEN

02/24/2

GE

**Yolk Sac**



# First Trimester

## Yolk Sac

- Yolk sac (YS): first anatomic structure to appear within the gestational sac (GS)
- Confirms intrauterine pregnancy
- Suspicious if GS  $>8$  mm and no YS



38363-09-02-24-1

RIC 5-9/GYN

MI 0.6

CMC WOMEN

6.5cm / 60Hz

TIs 0.1

02/24/2

GE



**Yolk Sac**

# First Trimester

- By the 6th menstrual week, the early embryo can be identified.
  - Usually with cardiac activity
  - The crown-rump length (CRL) is the best estimation of GA once appears.



14028-09-02-18-1

RIC 5-9H/OB

MI 0.8

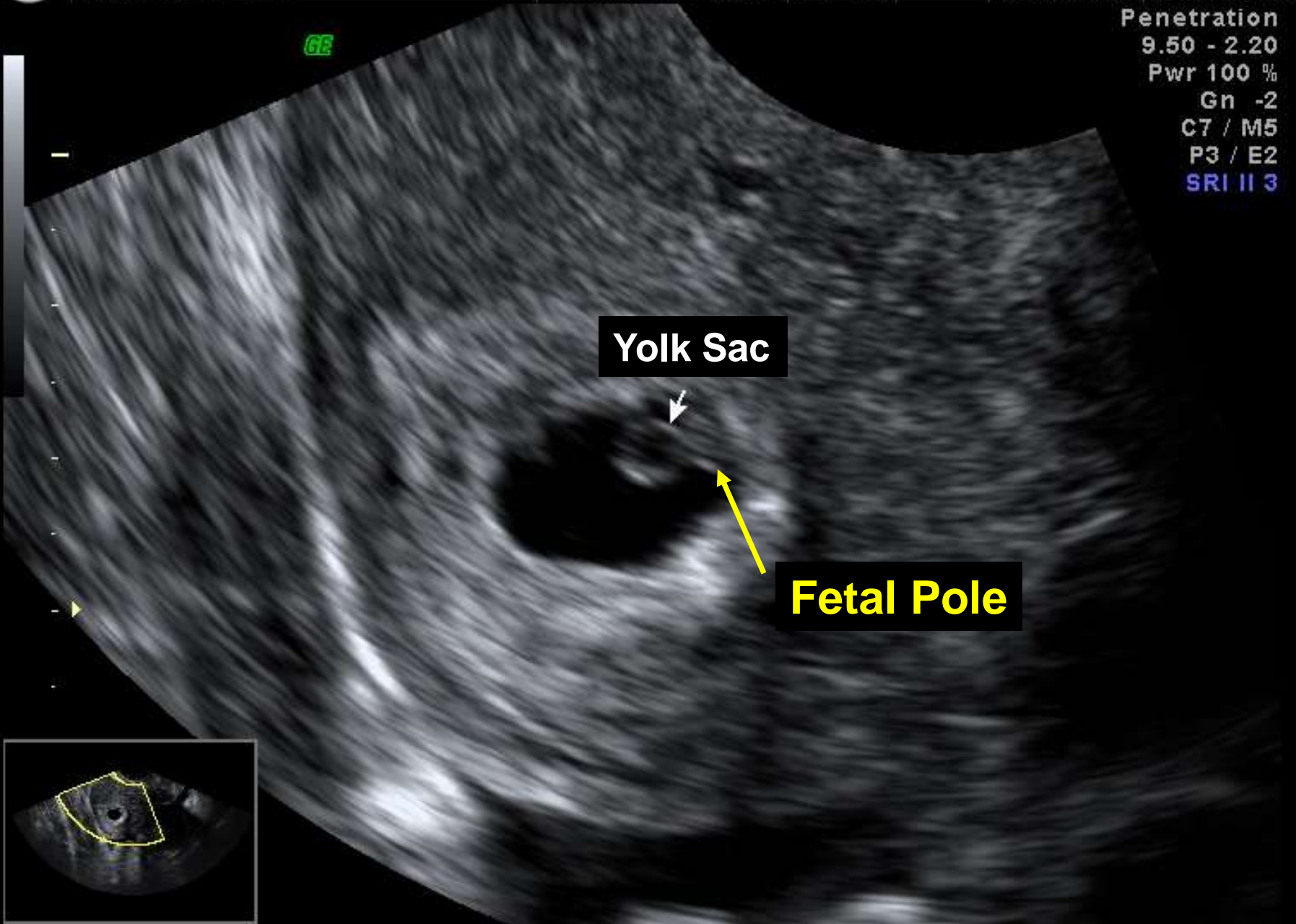
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1.1/ 6.7cm / 55Hz

TIs 0.0

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Penetration  
9.50 - 2.20  
Pwr 100 %  
Gn -2  
C7 / M5  
P3 / E2  
SRI II 3



# First Trimester

## Crown-Rump Length

- CRL measured from 7-13 weeks:
  - Straight line measurement: maximum length.
  - Use average of 3.
  - Early studies suggest accuracy of 3-5 days.

*Robinson HP, et al. BMJ 1973; 4:281*

*Robinson HP, et al. Br J Obstet Gynecol 1975; 82:702*



0005264719

AB 2-7/OB  
12.0cm / 56Hz

MI 1.2  
TIs 0.2

CMC WOMEN'S INSTITUTE

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Fet. Cardio

Har-mid

Pwr 97 %

Gn -5

C8 / M7

E1

SRI II 3 / CRI 2



CRL 6.69cm  
GA 13w0d

# Second Trimester

## Measurements Used

- At 13-14 weeks CRL replaced by: biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL)

# Second Trimester

## Biparietal Diameter

- Can be performed between 14-42 weeks
- Measurement:
  - Highly reproducible
  - $\pm 7$  days between 14-20 weeks

*de Crespigny, LC et al. Obstet Gynaecol 1989*  
*Hadlock FP, et al. Am J Roentgenol 1982*

# Second Trimester

## Measurement of BPD

- **Plane:**
  - Through third ventricle and thalami
  - Perpendicular to the parietal bones:
    - Calvaria should be symmetrical:
      - Symmetry is important to ensure correct plane
  - Outer edge of near calvarium to inner edge of far calvarium



ANATOMY  
0000000

SCAN

AB 2-7/OB

1.9/ 9.5cm / 68Hz

MI 1.3  
TIs 0.5

Carolinas Healthcare System

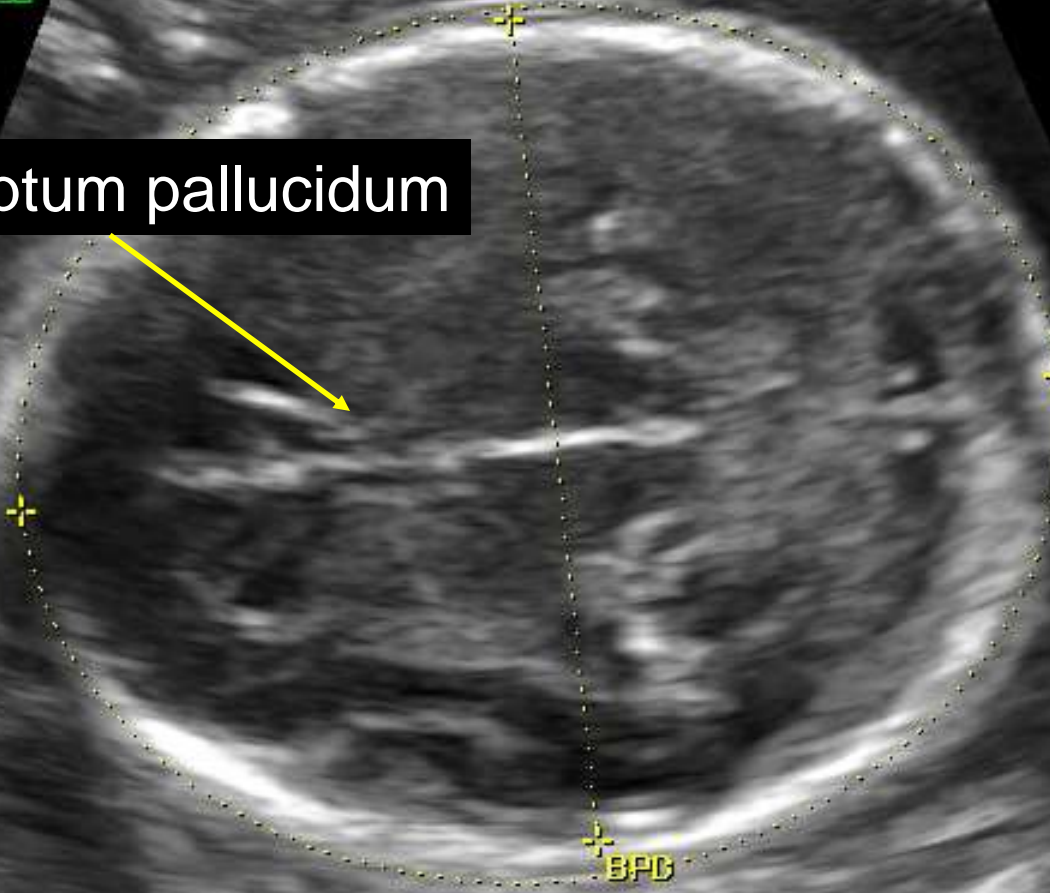
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Routine  
Har-mid  
Pwr 100 dB  
Gn 3  
C6 / M5  
E2  
SRI II 3 / CRI 1

Cavum septum pallucidum

62



HC

BPD



BPD measured from outer to inner

BPD	4.57cm
GA	19w6d
OFD (HC)	5.79cm
HC	16.72cm
GA	19w3d



0004754431 GA=35w6d

RAB 4-8L/OB

15.4cm / 28Hz

MI 0.9

TIs 0.1

Carolinas Healthcare System

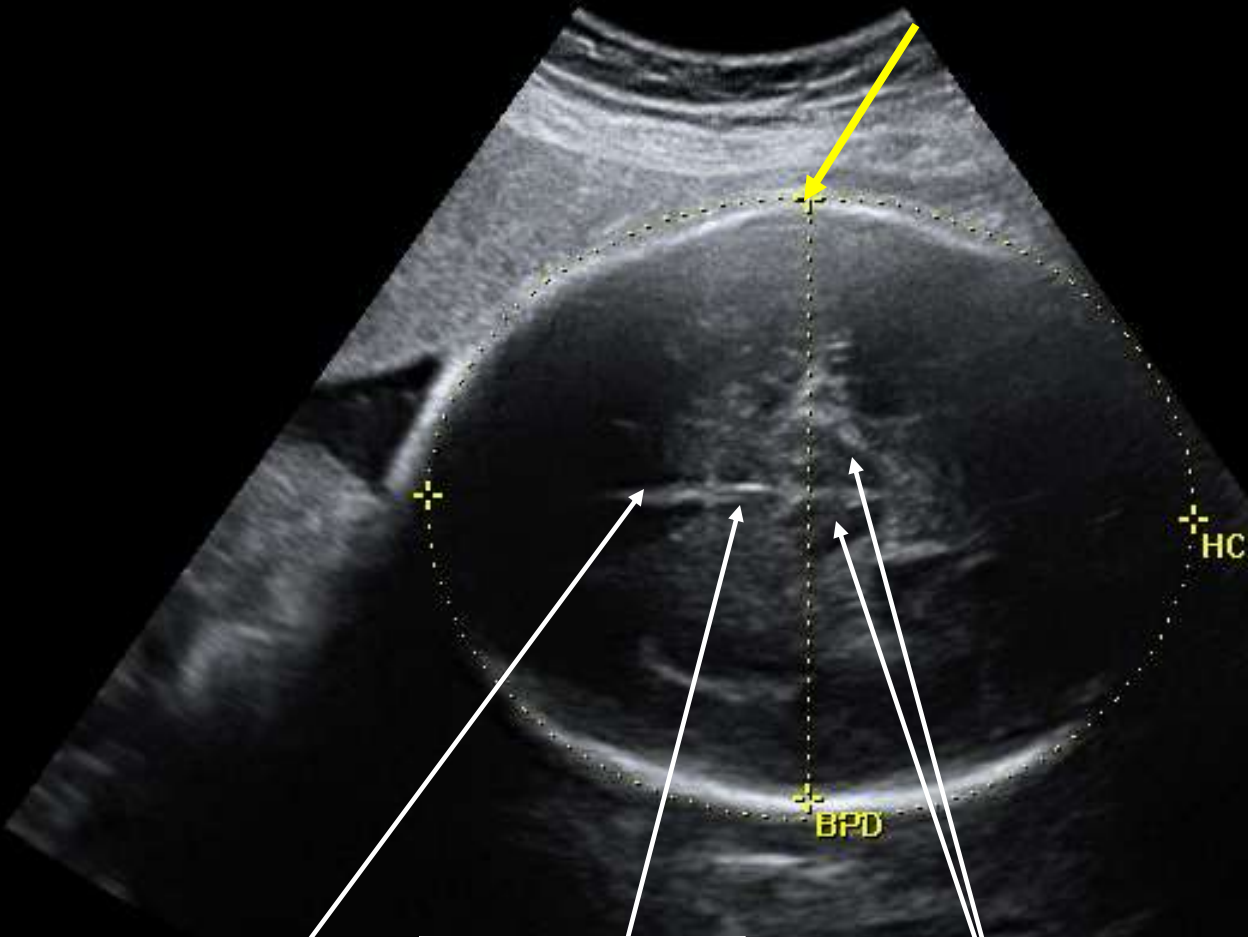
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2+3 Trim.  
Har-low  
Pwr 97 %  
Gn 12  
C7 / M7  
P3 / E2  
SRI II 3

63

**BPD**



Falx

3<sup>rd</sup> ventricle

Thalami

BPD	9.12cm
GA	37w0d 85.2%
OFD (HC)	11.65cm
HC	33.23cm
GA	37w6d 69.9%

# Second Trimester

## Head Circumference

### Plane of measurement:

- Parallel to the base of the skull
- Through the third ventricle
- Thalami located centrally
- Cavum septi pellucidi, anteriorly

# Second Trimester

## HC Measurement

- **Placement of calipers:**  
Outer margin of calvarium:
  - Must readjust calipers from BPD measurement.
  - Do not include skin.



ANATOMY  
0000000

SCAN

AB 2-7/0B

1.9/ 9.5cm / 68Hz

MI 1.3  
TIs 0.5

Carolinas Healthcare System

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Routine  
Har-mid  
Pwr 100 dB  
Gn 3  
C6 / M5  
E2  
SRI II 3 / CRI 1

Thalami (heart shaped)

Cavum septum pallucidum

HC

BPD



Note: HC measured on the outside

BPD	4.57cm
GA	19w6d
OFD (HC)	5.79cm
HC	16.72cm
GA	19w3d

# Second Trimester

## Femur length

- Align transducer with long axis of bone.
- Measure only the ossified portions of the femur.



AB 2-7/0B

MI 1.3

The Women's Institute

2.6/ 9.7 cm / 73Hz

TIs 0.5

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2+3.Trim.  
Har-mid  
Pwr 100 dB  
Gn -6  
CR / M5  
E2  
CRI 1

GE

Femur should be measured parallel to the probe for most accurate measurement

TW A B

FL



Only ossified bone is measured



B FL 2.43cm  
B GA 17w2d 47.0%

Cine 253

Cine

3.5 sec

# Second Trimester

## Abdominal Circumference

- Measured at the level of the liver.
- Right and left portal veins meet.
- Ellipse is fit to the outer skin edges.



0004715336 GA=18w6d

AB 2-7/OB

MI 1.3

CMC WOMEN'S INSTITUTE

3.6/11.4cm / 43Hz

TIs 0.4

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2+3.Trim.

Har-mid

Pwr 100 %

Gn -6

C8 / M5

P4 / E2

SRI II 3

Umbilical vein- "hockey stick"

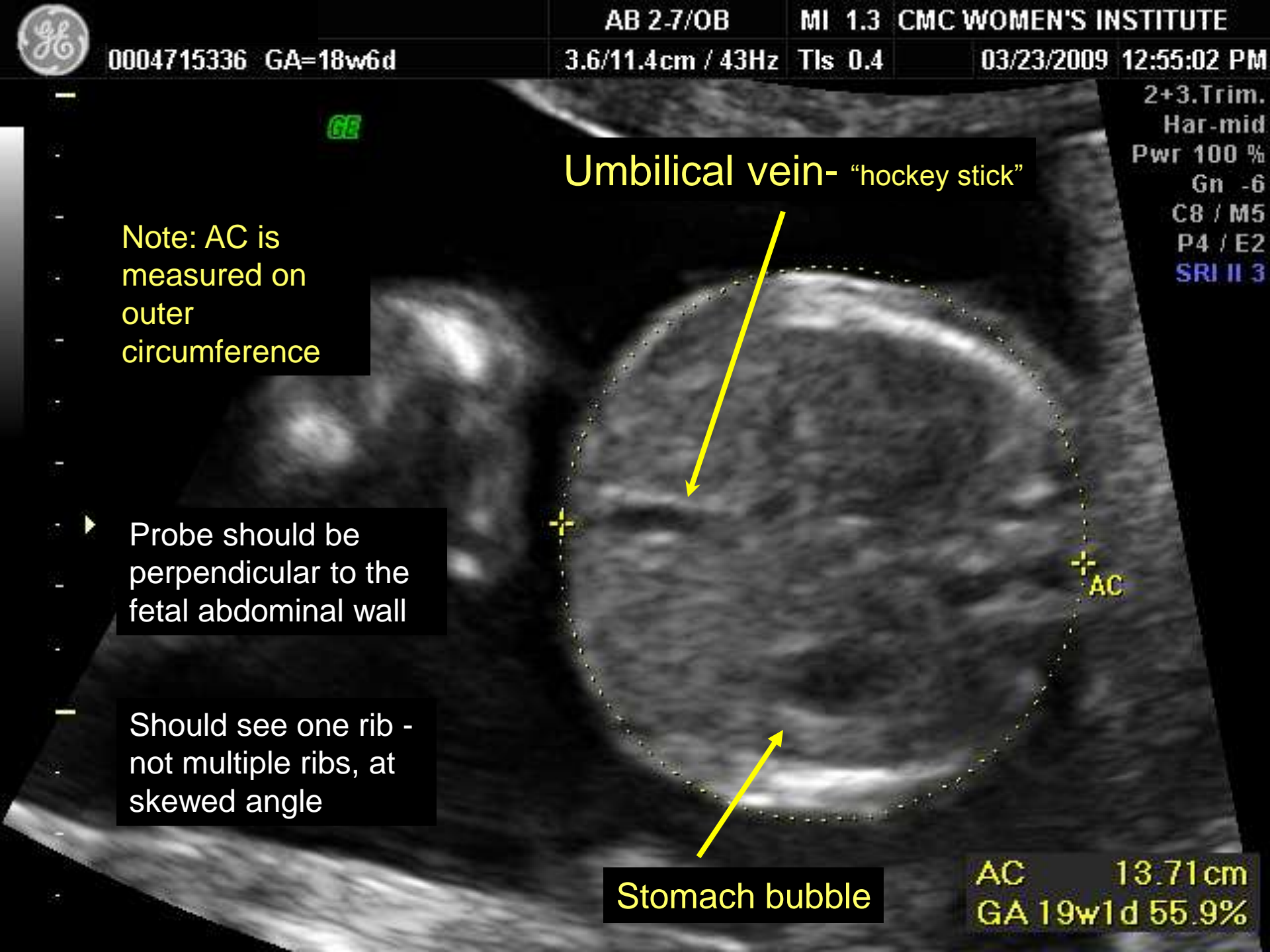
Note: AC is measured on outer circumference

Probe should be perpendicular to the fetal abdominal wall

Should see one rib - not multiple ribs, at skewed angle

Stomach bubble

AC 13.71 cm  
GA 19w1d 55.9%



# Variability of Ultrasound Biometry

# Second Trimester (14-20 Weeks)

## Variability of Ultrasound Measurements in Weeks

Measurement	<i>Hadlock, 1992</i>	<i>Benson, 1991</i>
BPD	0.94	1.40
HC	0.84	1.20
AC	1.04	2.10
FL	0.96	1.40

*Hadlock FP et al. J Ultrasound Med 1992*

*Benson C, Doubilet P. Am J Roentgenol 1991*

# Later Pregnancy (20-42 Weeks)

## Variability of Ultrasound Measurements in weeks

Measurement	20-26 wks	26-32 wks	32-42 wks
BPD	2.1	3.8	4.1
HC	1.9	3.3	3.8
AC	3.7	3.0	4.5
FL	2.5	3.1	3.5

*Benson CB, Doubilet PM. Am J Roentgenol 1991*

# Redating Based on Ultrasound

## Discrepancy Between Ultrasound and LMP

Timing, weeks	<i>Discrepancy,</i> >
7-10	3 days
10-14	5 days
15-20	7 days
<26	10 days
26-30	2 weeks
>30	3 weeks

Goldstein SR, et al. J Ultrasound Med 1994

Hadlock FP, et al. SO Radiology 1992

# Other Useful Biometry Markers

# Transcerebellar Diameter (TCD)

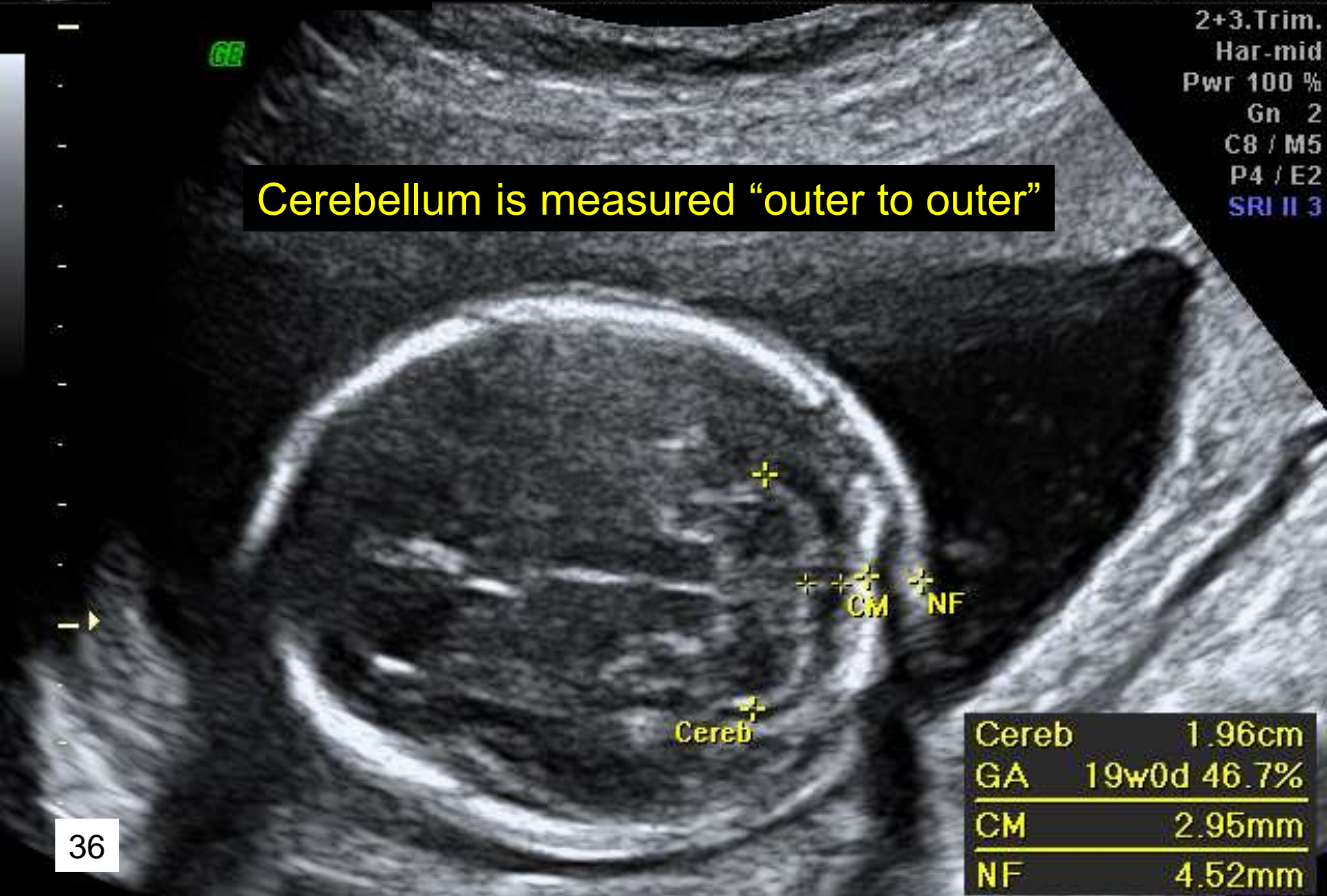
## Measurement of TCD

- Additional measurements may be useful when there are biometric discrepancies.
- Transverse cerebellar diameter (in millimeters) correlates with gestational age up to 22 weeks of gestation.
  - For example, if the TCD is 19 mm, then the gestational age is approximate to 19 weeks.



2+3.Trim.  
 Har-mid  
 Pwr 100 %  
 Gn 2  
 C8 / M5  
 P4 / E2  
 SRI II 3

Cerebellum is measured "outer to outer"



Cereb

CM

NF

Cereb	1.96cm
GA	19w0d 46.7%
CM	2.95mm
NF	4.52mm

# Foot Length

## Measurement

- **The foot length is measured from heel to toe.**



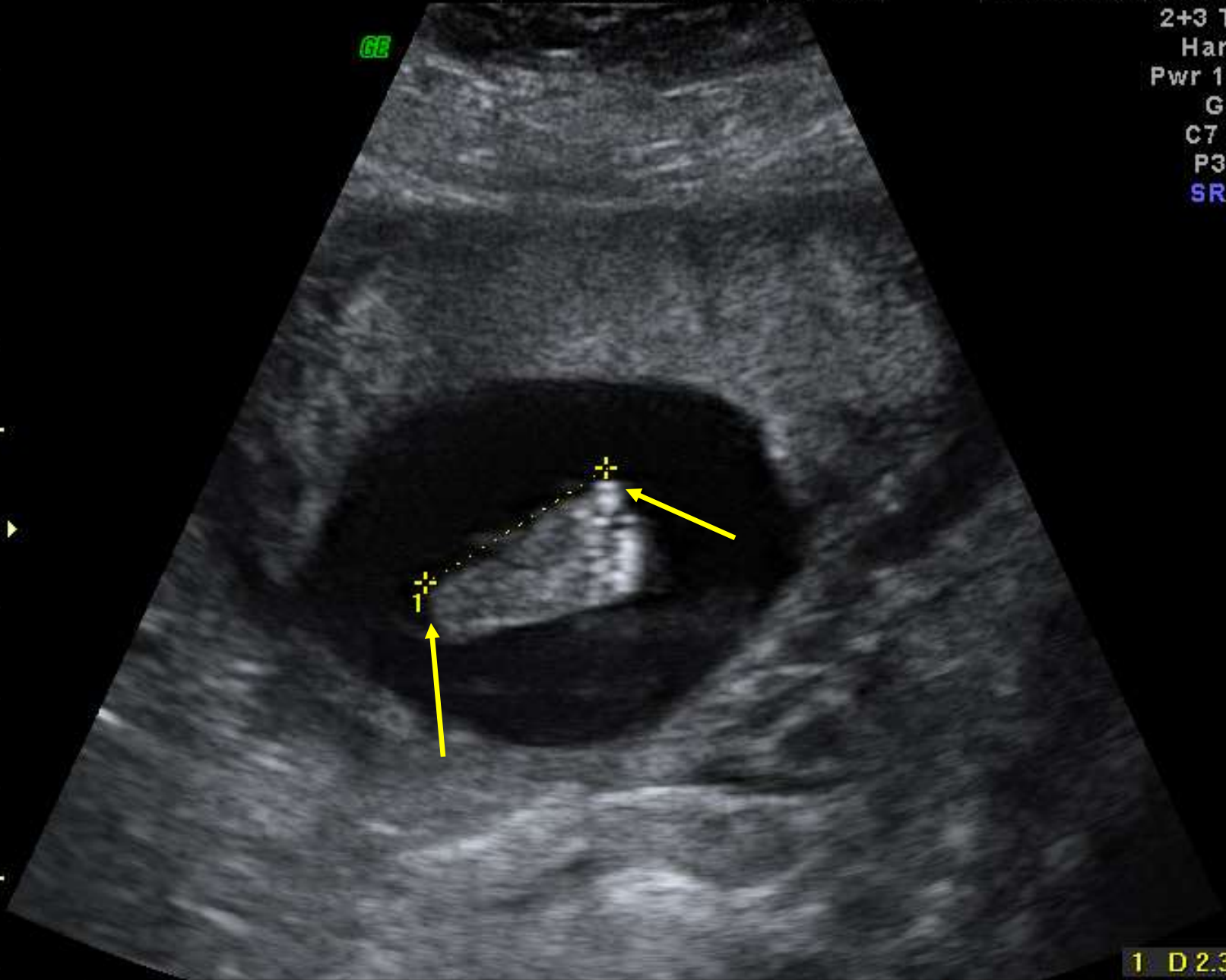
RAB 4-8L/OB  
11.8cm / 46Hz

MI 1.1  
TIs 0.2

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2+3 Trim.  
Har-low  
Pwr 100 %  
Gn -2  
C7 / M7  
P3 / E2  
SRI II 3

GE



1 D 2.38cm

# Foot Length

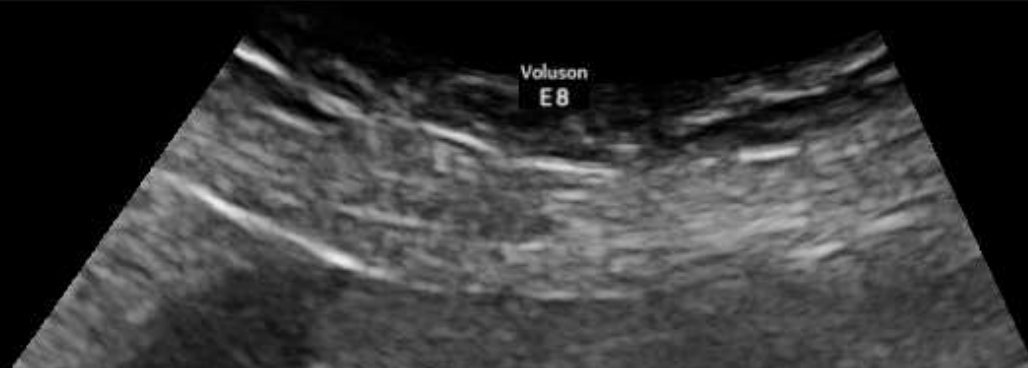
Gestational Age, weeks	<i>-2 SD</i>	<i>Predicted Value</i>	<i>+2 SD</i>
12	7	8	9
16	19	21	23
20	30	33	37
24	40	45	50
28	49	55	58
32	58	65	72
36	66	74	82
40	72	81	90

# Binocular Diameter

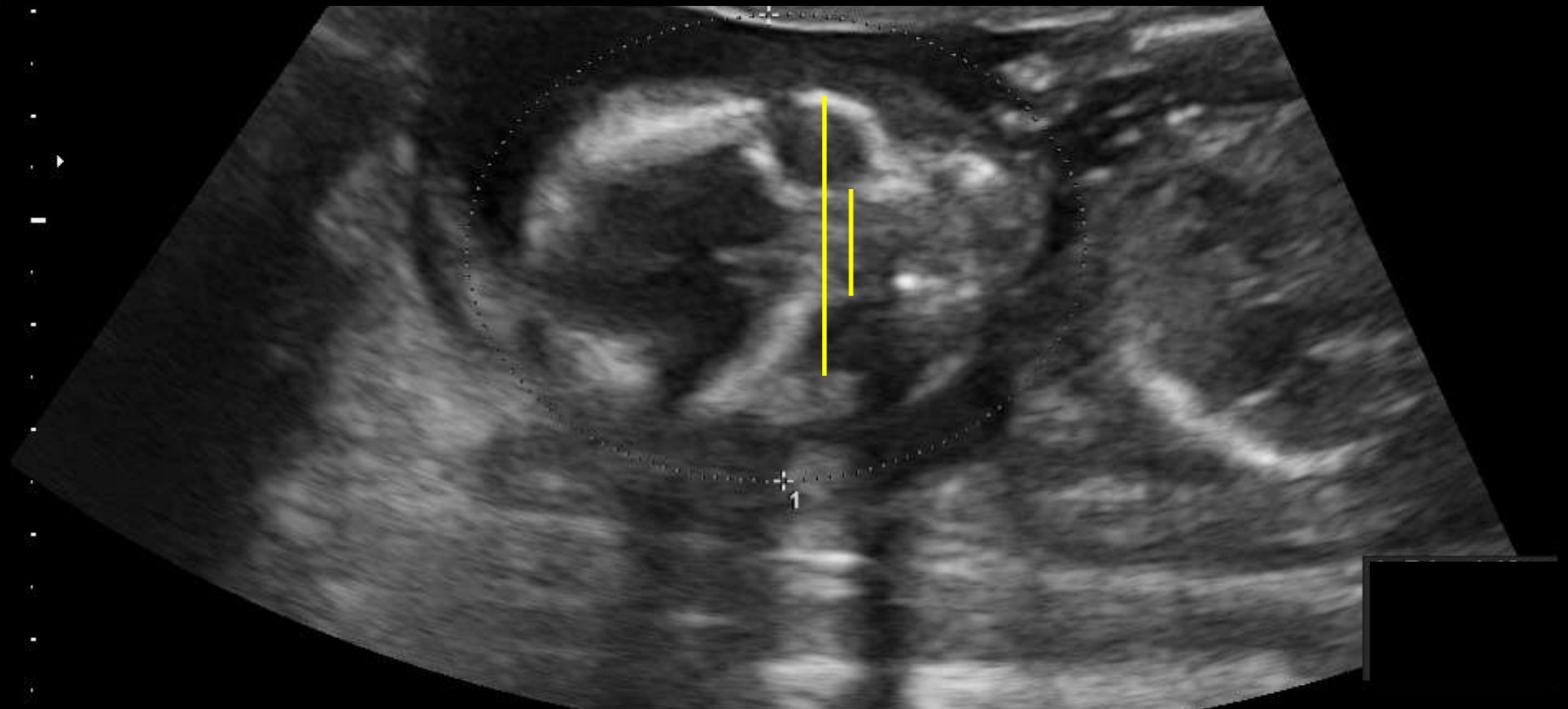
## Measurement

- When measuring the binocular diameter, the lenses in the eyes should be noted.
- The outer orbital diameter and inner orbital diameter are measured:
  - Binocular distance or outer orbital diameter = measurement between the lateral orbital rims.
  - Intraorbital distance = measurement between the inner margin of the orbits.

2+3. Trim.  
Har-low  
Pwr 100 %  
Gn -1  
C6 / M7  
P2 / E3  
SRI II 4



The extraorbital diameter should be 2 times the intraorbital diameter



# Other Useful Ultrasound Measurements

## Variability of Ultrasound Measurements in Weeks

Measurement	12-18 wk	18-24 wk	24-30 wk	30-36 wk	36-42wk
Binocular distance	1.8	2.4	3.0	4.0	4.0
TCD	1.0	1.8	2.0	2.4	3.2
Foot length	1.2	1.7	2.2	2.6	3.1

*Hill LM et al, Doubilet PM. Am J Obstet Gynecol 1992*

*Hadlock FP, et al. J Ultrasound Med 1984*

*Bovicelli L et al . J Clin Ultrasound 1981*

# Second Trimester

- Caution when changing the estimated delivery date (EDD) based on measurements obtained from an ultrasound examination performed *late* in pregnancy.
- The earliest ultrasound measurement most reliable.
- Serial measurements may be necessary :
  - Discriminate between intrauterine growth restriction and poorly dated pregnancy
  - Interval growth assessment

*Sholl JS, et al. Am J Obstet Gynecol 1982*

# Conclusions

- **Ultrasound: The earliest ultrasound assessment of gestational age is the most reliable.**
- **When gestational age is in question late in pregnancy, then serial measurements are most helpful.**

**THANK YOU**