台灣周產期醫學會
TAIWAN SOCIETY OF PERINATOLOGY

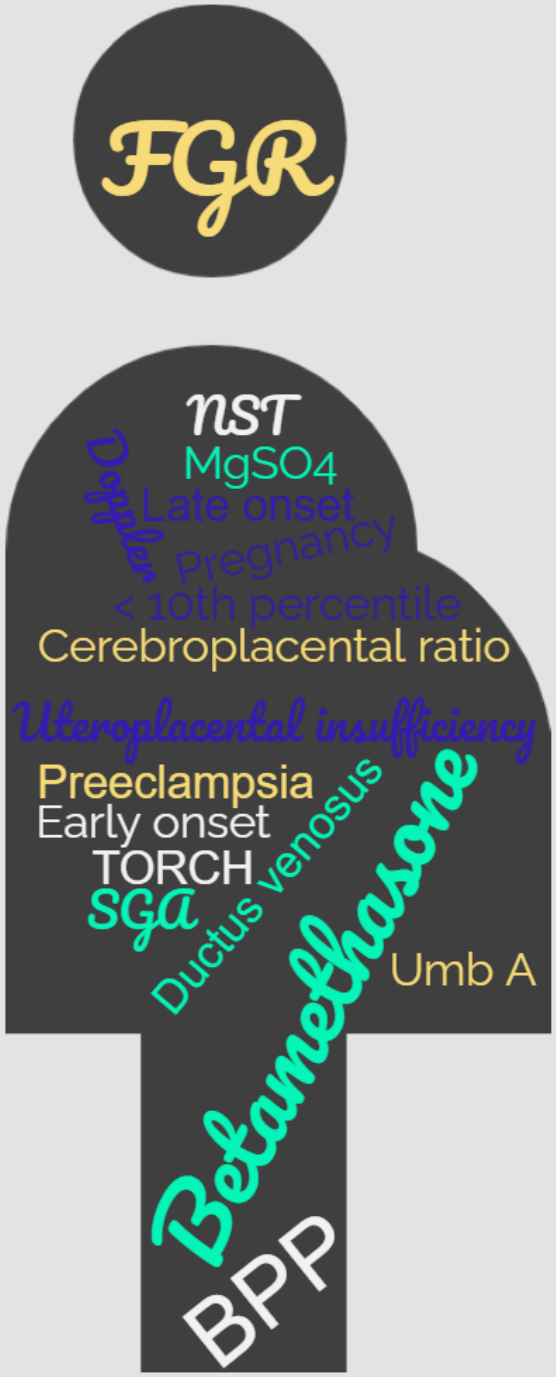
# 秋季論壇

## 降低周產期母體與新生兒死亡率：臨床處置指引與案例分享

胎兒生長遲滯

馬偕紀念醫院　鄧肇雄

**2022/09/18**




Society for Maternal-Fetal Medicine
High-risk pregnancy experts

ACOG
The American College of Obstetricians and Gynecologists

**< 10th percentile ?**

isuog.org

AJOG American Journal of Obstetrics & Gynecology

# BASIC DATA

陳ＯＯ, 34-year-old

G1P0
IUP at 29 weeks

LMP: 2021/11/04
EDC: 2022/08/11

BW 60.1 kg (Preconception BW 45 kg)
BH 156 cm

# PAST HISTORY

Medical history: nil

Surgical history: nil

Allergic history: NKDA

OBGYN history:
Unremarkable for NIPS and level II sonography

Personal history: Unremarkable
(no smoking, no alcohol or illicit drug use)

Family history: Non-contributory

# REFERRAL ON 2022/05/26

Prenatal care in Hong Kong
Visited local obstetric clinic and
was referred to MMH
due to **preeclampsia and suspected FGR**

**BP: 164/113 mmHg → 153/111 mmHg**
**Urine dipstick: Protein 3+**

# CLOSE SURVEILLANCE

**GA 29 weeks at DR**

**05/26**

Fetal monitor: Irregular uterine contraction, reactive FHB

Ultrasound:

| Date | GA (weeks) | Maternal BW | EFW | Umb artery S/D ratio | AFI (cm) | BPP score | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/05/26 | 29 | 60.1 kg | 1101 g | **6.73; 7.2** | **7.81** | 10 | 10$^{th}$ to 25$^{th}$ |

DTR: 2+; Lab check: WNL

**MgSO4** as seizure prophylactic agent and for neuroprotection

**Betamethasone** for lung maturation

Collect GBS culture and administer **ampicillin** for GBS prophylaxis

Closely monitor for **BP, FHB, BPP and Doppler flow velocimetry**

# Reference ranges for serial measurements of umbilical artery Doppler indices in the second half of pregnancy

Ganesh Acharya, MD,[a,*] Tom Wilsgaard, PhD,[b] Gro K. Rosvold Berntsen, MD, PhD,[b] Jan Martin Maltau, MD, PhD,[a] Torvid Kiserud, MD, PhD[c]

**Table IV** Reference values for serial measurements of the umbilical artery systolic:diastolic ratio

| | Percentile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gestation (wk) | 2.5th | 5th | 10th | 25th | 50th | 75th | 90th | 95th | 97.5th |
| 19 | 2.73 | 2.93 | 3.19 | 3.67 | 4.28 | 5.00 | 5.75 | 6.26 | 6.73 |
| 20 | 2.63 | 2.83 | 3.07 | 3.53 | 4.11 | 4.80 | 5.51 | 5.99 | 6.43 |
| 21 | 2.51 | 2.70 | 2.93 | 3.36 | 3.91 | 4.55 | 5.22 | 5.67 | 6.09 |
| 22 | 2.43 | 2.60 | 2.83 | 3.24 | 3.77 | 4.38 | 5.03 | 5.45 | 5.85 |
| 23 | 2.34 | 2.51 | 2.72 | 3.11 | 3.62 | 4.21 | 4.82 | 5.22 | 5.61 |
| 24 | 2.25 | 2.41 | 2.62 | 2.99 | 3.48 | 4.04 | 4.63 | 5.02 | 5.38 |
| 25 | 2.17 | 2.33 | 2.52 | 2.88 | 3.35 | 3.89 | 4.45 | 4.83 | 5.18 |
| 26 | 2.09 | 2.24 | 2.43 | 2.78 | 3.23 | 3.75 | 4.30 | 4.66 | 5.00 |
| 27 | 2.02 | 2.17 | 2.35 | 2.69 | 3.12 | 3.63 | 4.15 | 4.50 | 4.83 |
| 28 | 1.95 | 2.09 | 2.27 | 2.60 | 3.02 | 3.51 | 4.02 | 4.36 | 4.67 |
| 29 | 1.89 | 2.03 | 2.20 | 2.52 | 2.92 | 3.40 | 3.89 | 4.22 | 4.53 |
| 30 | 1.83 | 1.96 | 2.13 | 2.44 | 2.83 | 3.30 | 3.78 | 4.10 | 4.40 |
| 31 | 1.77 | 1.90 | 2.06 | 2.36 | 2.75 | 3.20 | 3.67 | 3.98 | 4.27 |
| 32 | 1.71 | 1.84 | 2.00 | 2.29 | 2.67 | 3.11 | 3.57 | 3.87 | 4.16 |
| 33 | 1.66 | 1.79 | 1.94 | 2.23 | 2.60 | 3.03 | 3.48 | 3.77 | 4.06 |
| 34 | 1.61 | 1.73 | 1.88 | 2.16 | 2.53 | 2.95 | 3.39 | 3.68 | 3.96 |
| 35 | 1.57 | 1.68 | 1.83 | 2.11 | 2.46 | 2.87 | 3.30 | 3.59 | 3.86 |
| 36 | 1.52 | 1.64 | 1.78 | 2.05 | 2.40 | 2.80 | 3.23 | 3.51 | 3.78 |
| 37 | 1.48 | 1.59 | 1.73 | 2.00 | 2.34 | 2.74 | 3.15 | 3.43 | 3.69 |
| 38 | 1.44 | 1.55 | 1.69 | 1.95 | 2.28 | 2.67 | 3.08 | 3.36 | 3.62 |
| 39 | 1.40 | 1.51 | 1.64 | 1.90 | 2.23 | 2.61 | 3.02 | 3.29 | 3.54 |
| 40 | 1.36 | 1.47 | 1.60 | 1.85 | 2.18 | 2.56 | 2.96 | 3.22 | 3.48 |
| 41 | 1.33 | 1.43 | 1.56 | 1.81 | 2.13 | 2.50 | 2.90 | 3.16 | 3.41 |

Acharya G, Wilsgaard T, Berntsen GK, Maltau JM, Kiserud T. Reference ranges for serial measurements of umbilical artery Doppler indices in the second half of pregnancy. Am J Obstet Gynecol. 2005 Mar;192(3):937-44. doi: 10.1016/j.ajog.2004.09.019. PMID: 15746695.

# SERIAL SURVEILLANCE

| Date | GA (weeks) | Maternal BW | EFW | Umb artery S/D ratio | AFI (cm) | BPP score | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/05/26 | 29 | 60.1 kg | 1101 g | 6.73; 7.2 | 7.81 | 10 | 10$^{th}$ to 25$^{th}$ |
| 2022/05/28 | 29+2 | BP control under oral Labetalol, SBP was between 145~160 mmHg | | | | | |

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|---|---|---|---|---|---|---|---|
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| 2022/05/28 | 29+2 | Minimal variability even after AST | | | | | |

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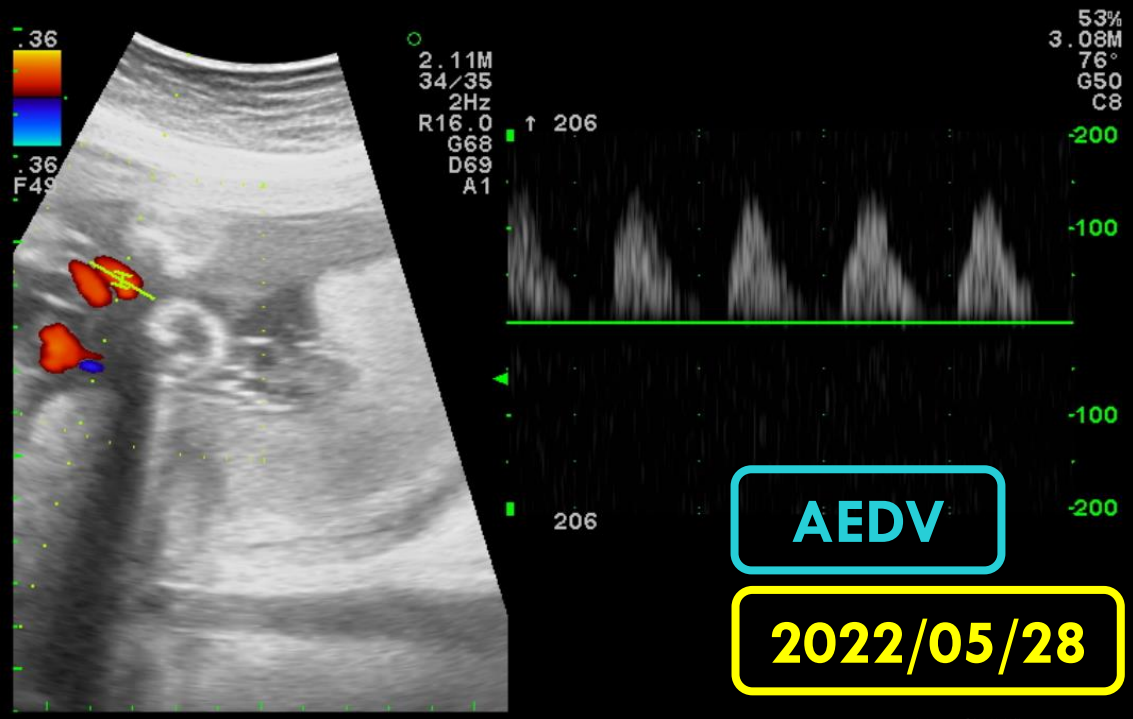
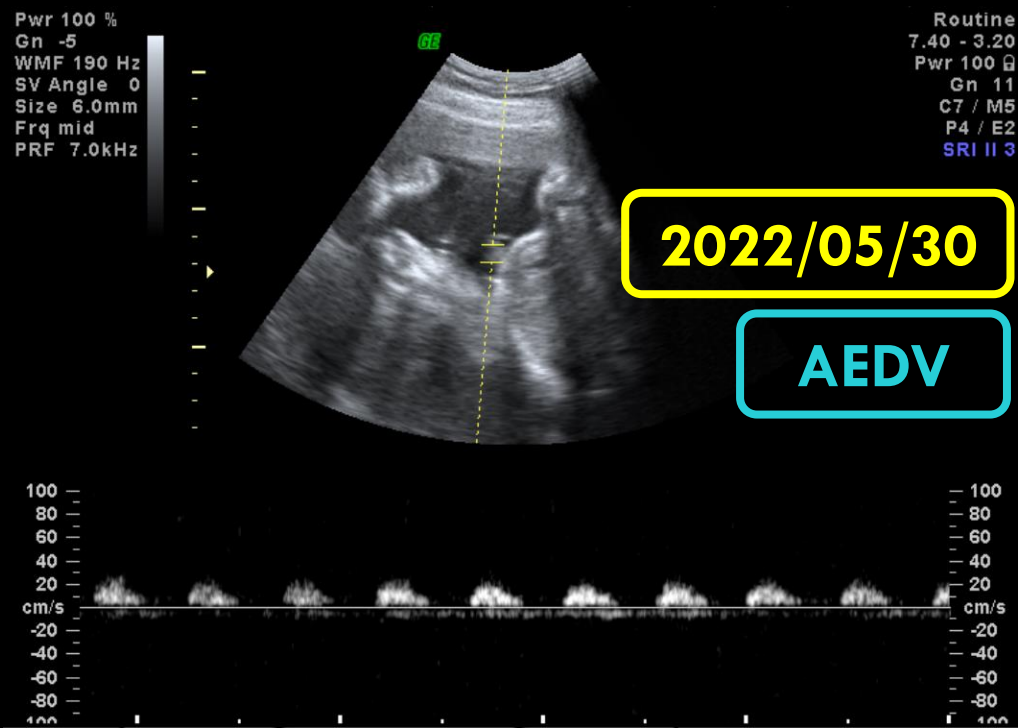
| 2022/05/26 | 29 | 60.1 kg | 1101 g | 6.73; 7.2 | 7.81 | 10 | 10th to 25th |
| 2022/05/28 | 29+2 | Minimal variability even after AST | | AEDV | | 6 (-NST, breathing) → 8 | |




AEDV

2022/05/28




2022/05/30

AEDV

# SERIAL SURVEILLANCE

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|---|---|---|---|---|---|---|---|
| 2022/05/26 | 29 | 60.1 kg | 1101 g | 6.73; 7.2 | 7.81 | 10 | 10$^{th}$ to 25$^{th}$ |
| 2022/05/28 | 29+2 | | | AEDV | | 6 (-NST, breathing) → 8 | |
| 2022/05/30 | 29+4 | | 1080 g | AEDV | 8.80 | 8 (-NST) | 10$^{th}$ |

Case scenario 1

# SERIAL SURVEILLANCE

| Date | GA (weeks) | Maternal BW | EFW | Umb artery S/D ratio | AFI (cm) | BPP score | EFW percentile |
|---|---|---|---|---|---|---|---|
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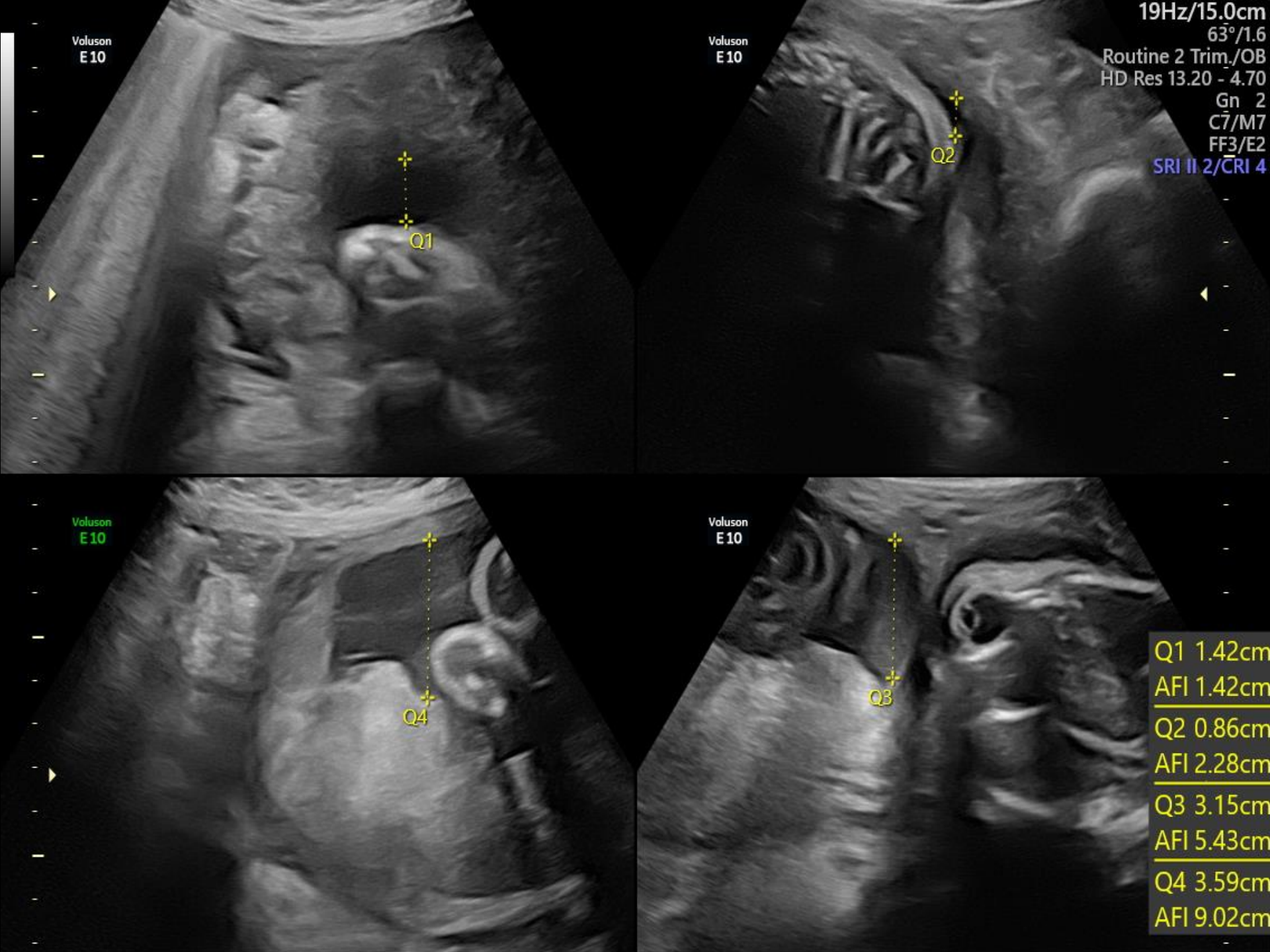
| 2022/05/28 | 29+2 | | | AEDV | | 6 (-NST, breathing) → 8 | |
| 2022/05/30 | 29+4 | | 1080 g | AEDV | 8.80 | 8 (-NST) | 10th |
| 2022/06/01 | 29+6 | | 959 g | 5.00; 4.67 | 9.02 | 8 (-NST) | 5th |

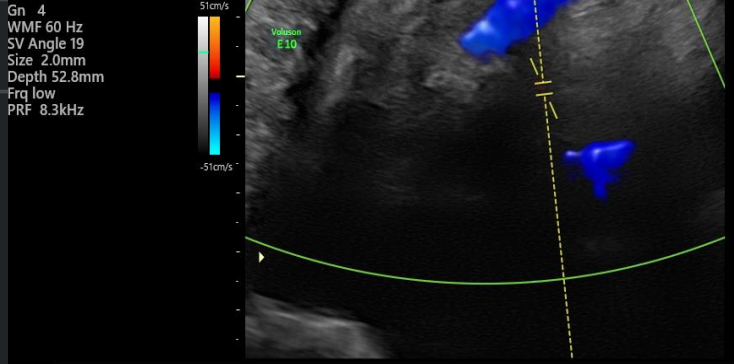
**Comprehensive Doppler flow velocimetry study**


Voluson
E10
Q1
Voluson
E10
Q2
19Hz/15.0cm
63°/1.6
Routine 2 Trim./OB
HD Res 13.20 - 4.70
Gn 2
C7/M7
FF3/E2
SRI II 2/CRI 4
Voluson
E10
Q4
Voluson
E10
Q3
Q1 1.42cm
AFI 1.42cm
Q2 0.86cm
AFI 2.28cm
Q3 3.15cm
AFI 5.43cm
Q4 3.59cm
AFI 9.02cm

| EFW (Hadlock) | Value | Range | Age | Range | GP | Hadlock |
|---|---|---|---|---|---|---|
| AC/BPD/FL/HC | 959g | ± 140g | 26w2d | | | N/A |

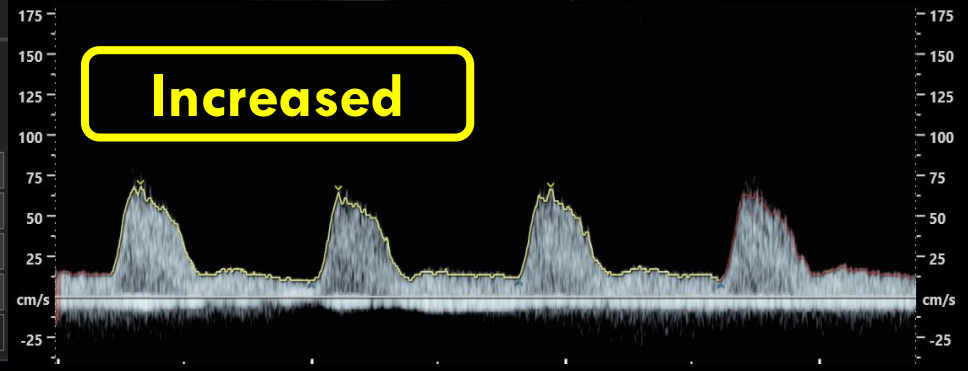
| 2D Measurements | AUA | Value | m1 | m2 | m3 | Meth. | GP | Age |
|---|---|---|---|---|---|---|---|---|
| BPD (Hadlock) | ☑ | 6.70 cm | 6.81 | 6.70 | | last | | 27w0d |
| OFD (HC) | | 8.69 cm | 8.69 | | | last | | |
| HC (Hadlock) | ☑ | 24.60 cm | 24.60 | | | last | | 26w5d |
| HC* (Hadlock) | ☐ | 24.30 cm | 24.44 | | | | | 26w3d |
| AC (Hadlock) | ☑ | 21.64 cm | 21.64 | | | last | | 26w1d |
| FL (Hadlock) | ☑ | 5.07 cm | 5.07 | | | last | | 27w1d |

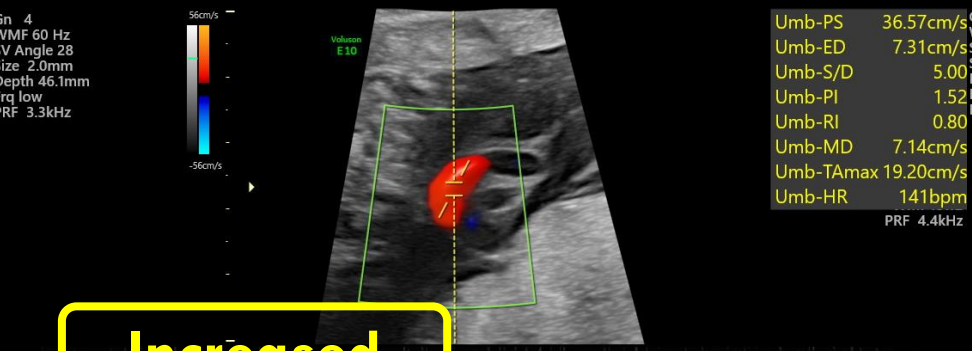
| 2D Measurements | Value | m1 | m2 | m3 | m4 | m5 | m6 | Meth. |
|---|---|---|---|---|---|---|---|---|
| AFI | | | | | | | | |
| Q1 | 1.42 cm | 1.42 | | | | | | avg. |
| Q2 | 0.86 cm | 0.86 | | | | | | avg. |
| Q3 | 3.15 cm | 3.15 | | | | | | avg. |
| Q4 | 3.59 cm | 3.59 | | | | | | avg. |
| AFI | 9.02 cm | 9.02 | | | | | | |




| | |
|---|---|
| Rt Ut-PS | 65.87cm/s |
| Rt Ut-ED | 10.65cm/s |
| Rt Ut-S/D | 6.18 |
| Rt Ut-PI | 2.01 |
| Rt Ut-RI | 0.84 |
| Rt Ut-MD | 10.31cm/s |
| Rt Ut-TAmax | 27.45cm/s |
| Rt Ut-HR | 75bpm |

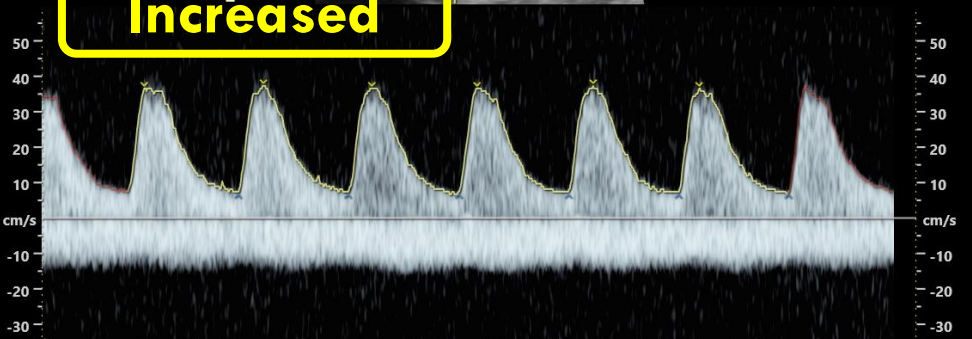
PRF 4.0kHz

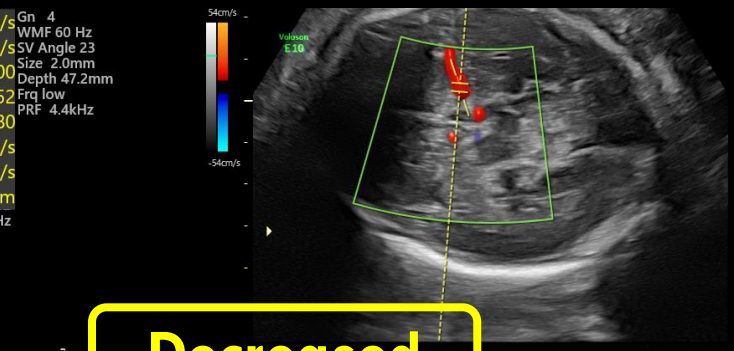



| | |
|---|---|
| Umb-PS | 36.57cm/s |
| Umb-ED | 7.31cm/s |
| Umb-S/D | 5.00 |
| Umb-PI | 1.52 |
| Umb-RI | 0.80 |
| Umb-MD | 7.14cm/s |
| Umb-TAmax | 19.20cm/s |
| Umb-HR | 141bpm |

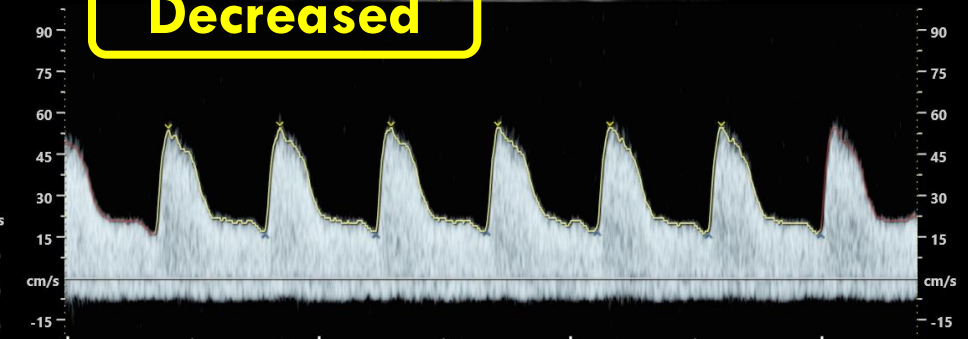
PRF 4.4kHz

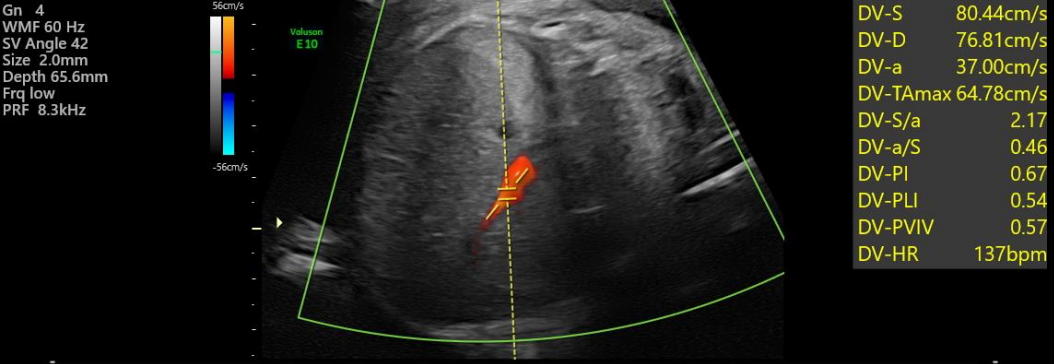


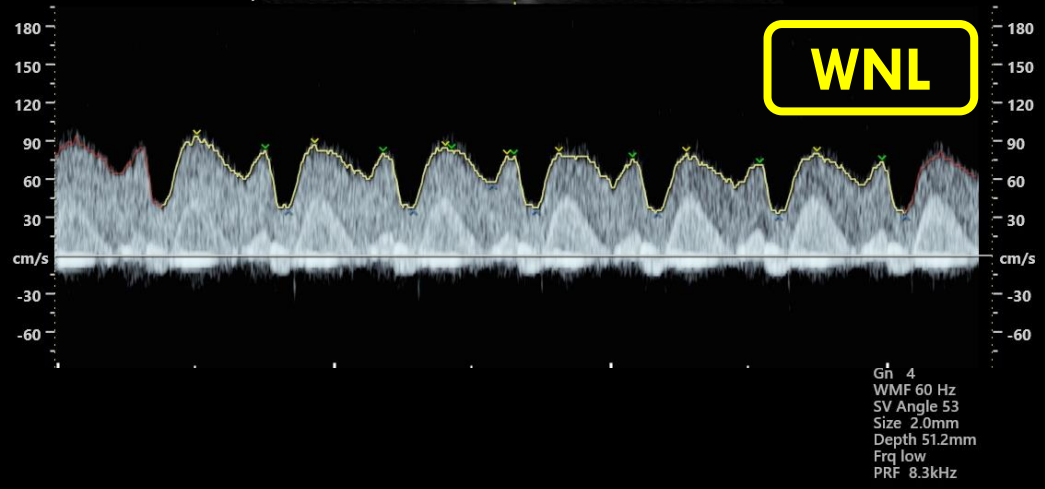



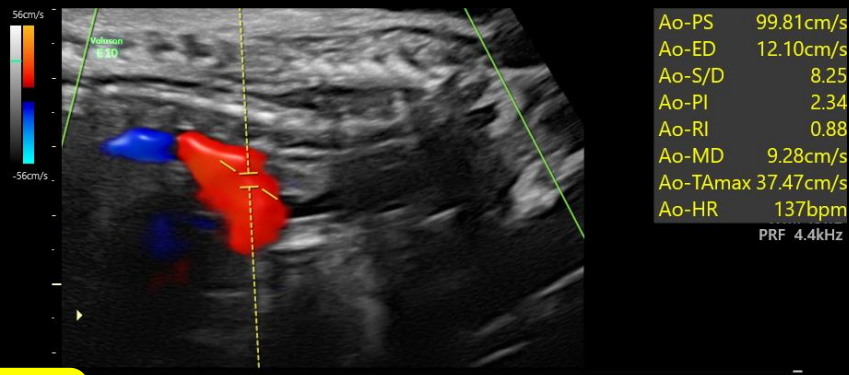

| | |
|---|---|
| Lt MCA-PS | 54.20cm/s |
| Lt MCA-ED | 17.41cm/s |
| Lt MCA-S/D | 3.11 |
| Lt MCA-PI | 1.19 |
| Lt MCA-RI | 0.68 |
| Lt MCA-MD | 17.05cm/s |
| Lt MCA-TAmax | 30.84cm/s |
| Lt MCA-HR | 136bpm |

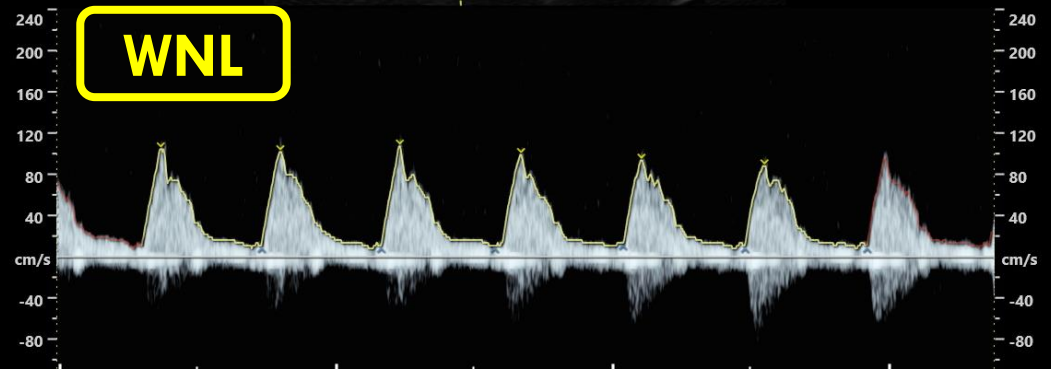
PRF 4.3kHz




Gn 4
WMF 60 Hz
SV Angle 42
Size 2.0mm
Depth 65.6mm
Frq low
PRF 8.3kHz
56cm/s
-56cm/s
Voluson
E10
DV-S 80.44cm/s
DV-D 76.81cm/s
DV-a 37.00cm/s
DV-TAmax 64.78cm/s
DV-S/a 2.17
DV-a/S 0.46
DV-PI 0.67
DV-PLI 0.54
DV-PVIV 0.57
DV-HR 137bpm


WNL
180
150
120
90
60
30
cm/s
-30
-60
Gn 4
WMF 60 Hz
SV Angle 53
Size 2.0mm
Depth 51.2mm
Frq low
PRF 8.3kHz


56cm/s
-56cm/s
Voluson
E10
Ao-PS 99.81cm/s
Ao-ED 12.10cm/s
Ao-S/D 8.25
Ao-PI 2.34
Ao-RI 0.88
Ao-MD 9.28cm/s
Ao-TAmax 37.47cm/s
Ao-HR 137bpm
PRF 4.4kHz


WNL
240
200
160
120
80
40
cm/s
-40
-80

# COMPREHENSIVE DOPPLER STUDY

**GA 29+6 weeks**

Fetal size= 26+5 wks **(5th percentile)**, FHB: OK,
Active female fetus, vertex presentation
Normal liquor volume (AFI = 9.02 cm)
BPP score: 8 (under ultrasound)

**06/01**

Uterine artery PI: **(> 95th percentile)**
Right: 2.01, notch (-); Left: 1.73, notch (-)
Umbilical artery S/D: 5.00, 4.67 **(> 95th percentile)**
PI: 1.52, 1.49 **(> 95th percentile)**
MCA PI: 1.23, 1.19 **(< 5th percentile)** with **brain sparing effect**
CPR: 0.81 **(< 5th percentile)**
DV PVIV: 0.57 (WNL) without reversed a wave
Aol PI: 2.34 (WNL)

Suggest close follow-up

# SERIAL SURVEILLANCE

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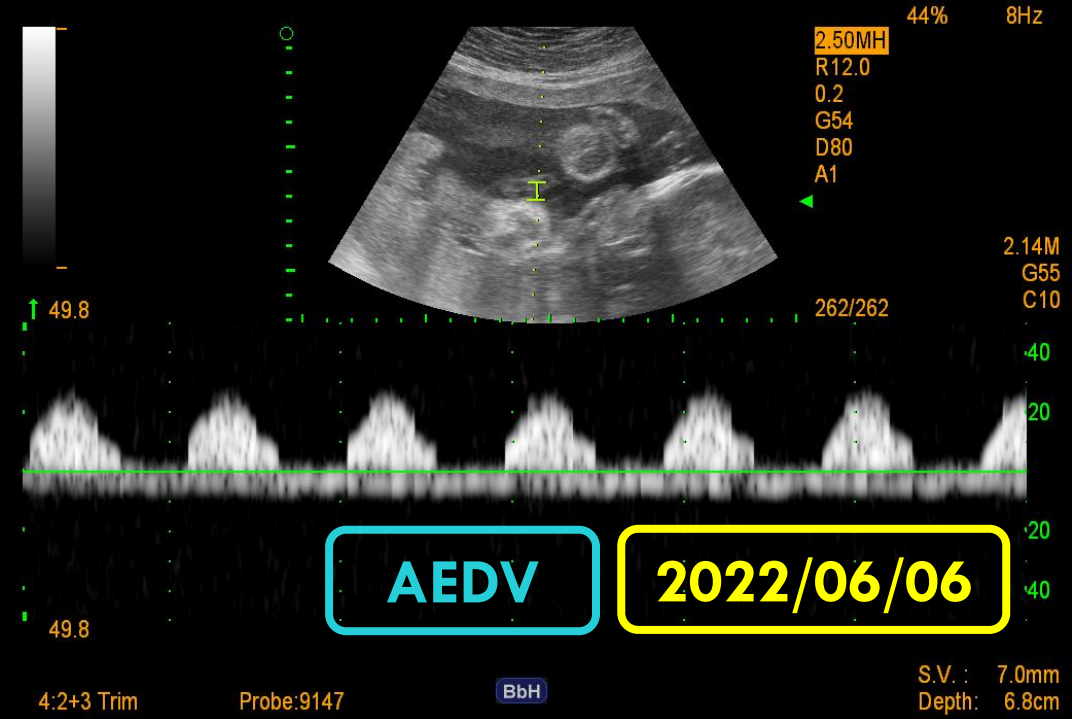
| 2022/05/28 | 29+2 | | | AEDV | | 6 (-NST, breathing) → 8 | |
| 2022/05/30 | 29+4 | | 1080 g | AEDV | 8.80 | 8 (-NST) | 10th |
| 2022/06/01 | 29+6 | | 959 g | 5.00; 4.67 | 9.02 | 8 (-NST) | 5th |
| 2022/06/04 | 30+2 | | | AEDV | | 8 (-NST) | |


44%
8Hz
2.50MH
R12.0
0.2
G54
D80
A1
2.14M
G55
C10
49.8
262/262
40
20
20
40
49.8
AEDV
2022/06/06
4:2+3 Trim
Probe:9147
BbH
S.V. : 7.0mm
Depth: 6.8cm

Case scenario 1

# SERIAL SURVEILLANCE

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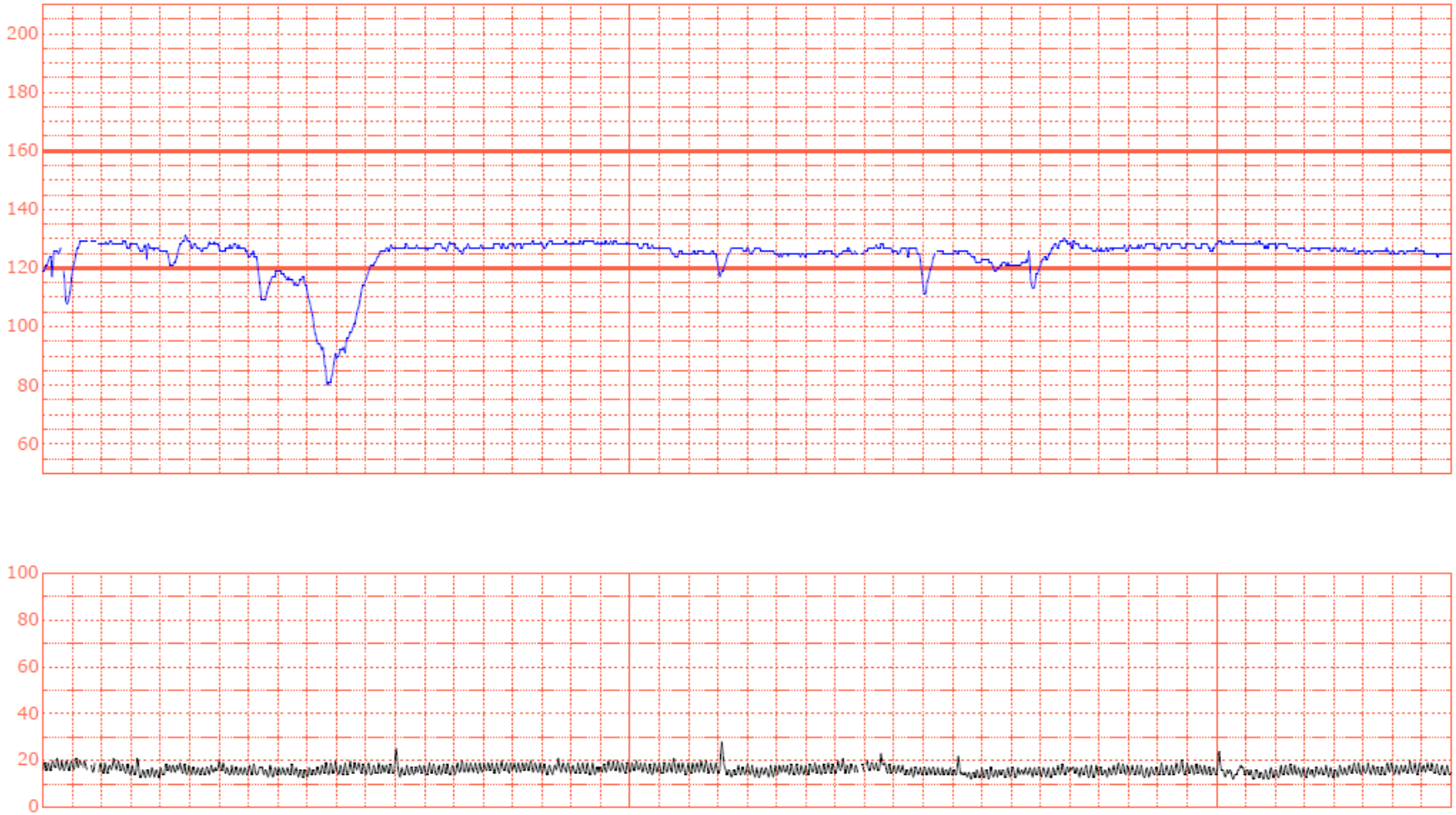
| 2022/06/01 | 29+6 | | 959 g | 5.00; 4.67 | 9.02 | 8 (-NST) | 5th |
| 2022/06/04 | 30+2 | | | AEDV | | 8 (-NST) | |
| 2022/06/06 | 30+4 | | 976 g | AEDV | 5.10 | 8 (-NST) | < 5th |
| 2022/06/07 | 30+5 | Spontaneous deceleration | | | | | |

# FETAL MONITOR



Case scenario 1

# SERIAL SURVEILLANCE

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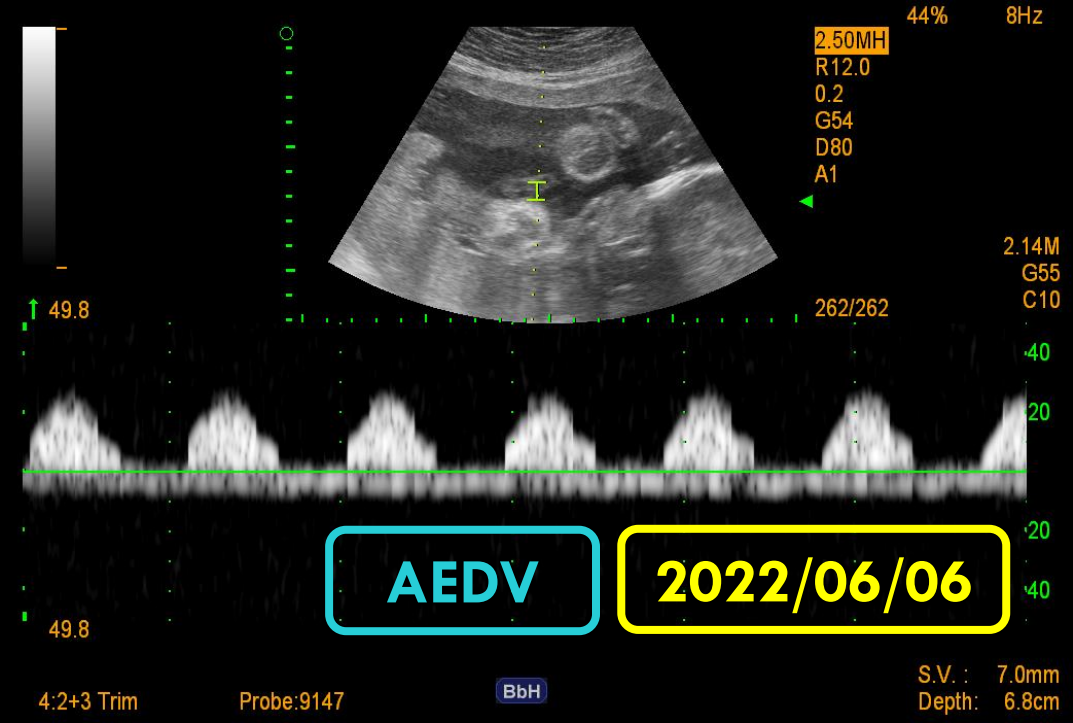
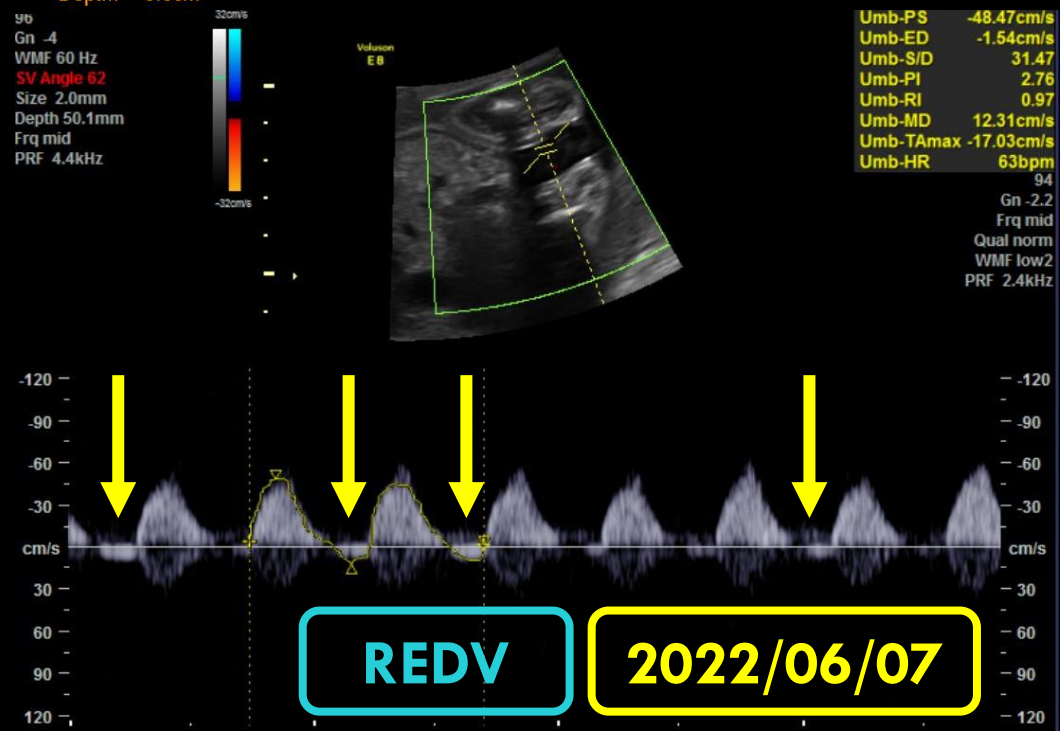
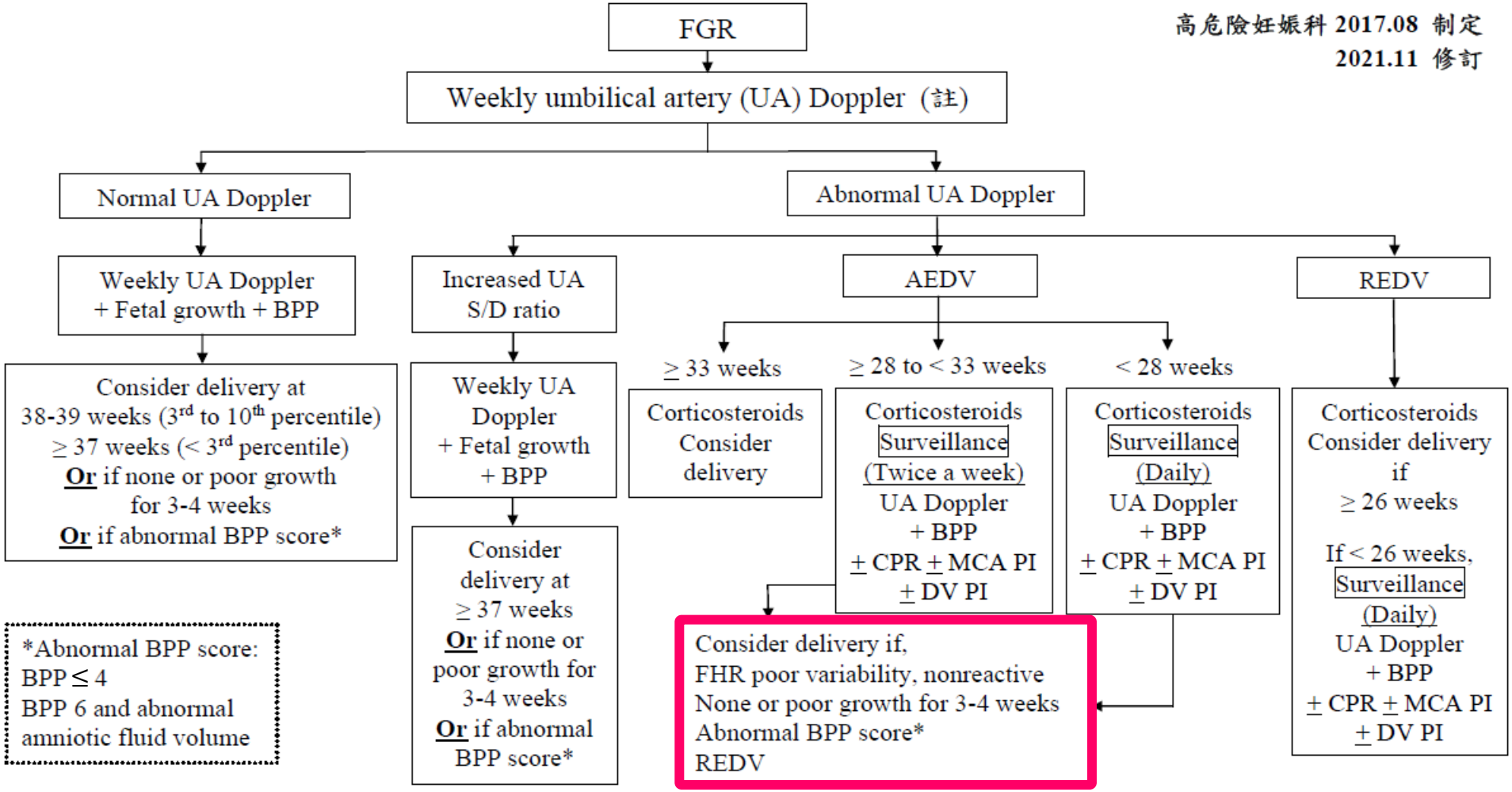
| 2022/05/30 | 29+4 | | 1080 g | AEDV | 8.80 | 8 (-NST) | 10th |
| 2022/06/01 | 29+6 | | 959 g | 5.00; 4.67 | 9.02 | 8 (-NST) | 5th |
| 2022/06/04 | 30+2 | | | AEDV | | 8 (-NST) | |
| 2022/06/06 | 30+4 | | 976 g | AEDV | 5.10 | 8 (-NST) | < 5th |
| 2022/06/07 | 30+5 | Spontaneous deceleration | | REDV | | 4 (-NST, breathing, movement) | |


44%
8Hz
2.50MH
R12.0
0.2
G54
D80
A1
2.14M
G55
C10
49.8
262/262
40
20
20
40
49.8
AEDV
2022/06/06
4:2+3 Trim
Probe:9147
BbH
S.V. : 7.0mm
Depth: 6.8cm


Gn -4
WMF 60 Hz
SV Angle 62
Size 2.0mm
Depth 50.1mm
Frq mid
PRF 4.4kHz
Umb-PS -48.47cm/s
Umb-ED -1.54cm/s
Umb-S/D 31.47
Umb-PI 2.76
Umb-RI 0.97
Umb-MD 12.31cm/s
Umb-TAmax -17.03cm/s
Umb-HR 63bpm
Gn -2.2
Frq mid
Qual norm
WMF low2
PRF 2.4kHz
-120
-90
-60
-30
cm/s
30
60
90
120
REDV
2022/06/07

# 胎兒生長遲滯 (Fetal growth restriction, FGR) 臨床處理建議流程

高危險妊娠科 2017.08 制定
2021.11 修訂




註: 可加作 MCA (middle cerebral artery) PI, CPR (cerebroplacental ratio), DV (ductus venosus) PI 等作為參考。

編輯人: Fellow 蘇伶澄/鄧肇雄


參考資料:

(1) Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. Obstet Gynecol 2021;138:e35-e39.
(2) Doppler assessment of the fetus with intrauterine growth restriction, SMFM Clinical Guideline. Am J Obstet Gynecol 2012;206:300-308.
(3) Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol. Fetal Diagn Ther 2014;36:86-98.
(4) Intrauterine growth restriction: new concepts in antenatal surveillance, diagnosis, and management. Am J Obstet Gynecol 2011;204:288-300.
(5) Evidence-based approach to umbilical artery Doppler fetal surveillance in high-risk pregnancies: an update. Clin Obstet Gynecol 2010;53:869-878.
(6) Williams Obstetrics, 26th edition.

# DELIVERY

**GA 30+5 weeks**

**06/07**

BP: 145-155 mmHg
Fetal monitor: Minimal variability with spontaneous deceleration
Ultrasound:

| Date | GA (weeks) | Maternal BW | EFW | Umb artery S/D ratio | AFI (cm) | BPP score | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/06/07 | 30+5 | Spontaneous deceleration | | REDV | | 4 (-NST, breathing, movement) | |

Emergent C/S due to fetal distress

A living female baby was delivered via LST C/S in LOP position
**BW: 929 g**, BL: 35.5 cm,
APGAR score: 8 (-skin color, breathing) → 9 (-breathing)

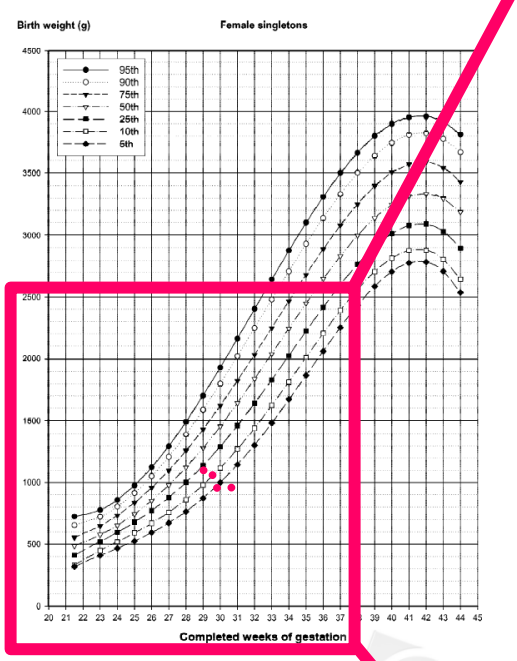



Fig. 4. Illustration of smoothed birth weight percentiles for each completed week of gestation in female singleton births in Taiwan between 1998 and 2002 by the polynomial smoothing meth

Loss of growth potential

Completed weeks of gestation

# NEONATAL OUTCOME

Prematurity, GA 30+5 weeks, BW 929 g,
**small for gestational age**

Bilateral mild periventricular encephalomalacia

Respiratory distress syndrome, grade I

Functional GI motility disorder

Retinopathy of prematurity, stage 1 zone II

Anemia of prematurity

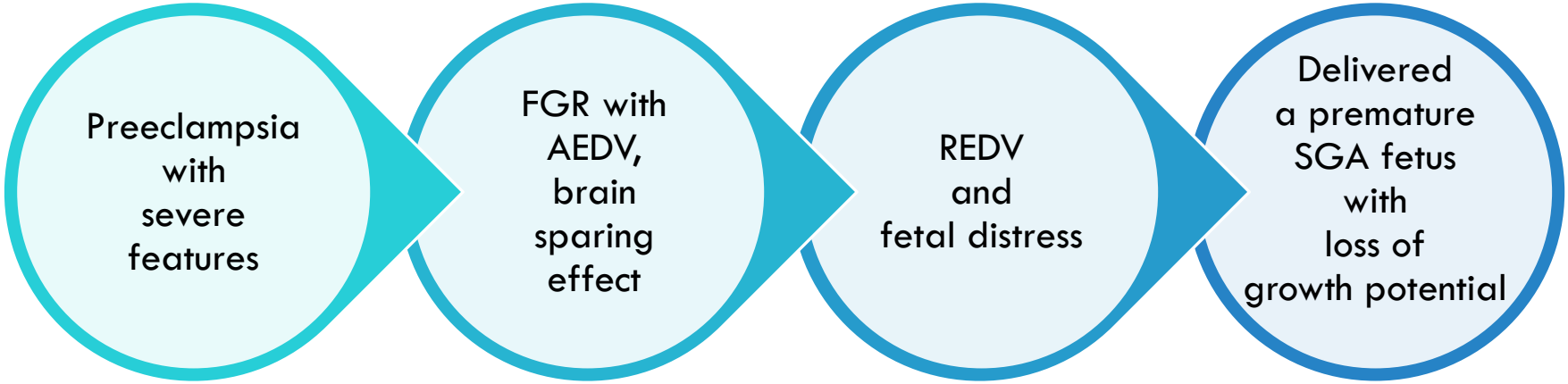
Bilateral inguinal hernia and umbilical hernia
s/p herniorrhaphy on 2022/08/12

Case scenario 1

# INFANTILE GROWTH

| Date | PMA (weeks) | BW (g) | BW percentile | BL percentile | HC percentile |
|---|---|---|---|---|---|
| 2022/06/07 | 30+5 | 929 | 3rd to 10th | 3rd | < 3rd |
| 2022/06/12 | 31+3 | 850 | < 3rd | < 3rd | < 3rd |
| 2022/06/19 | 32+3 | 973 | < 3rd | < 3rd | < 3rd |
| 2022/06/26 | 33+3 | 1150 | < 3rd | < 3rd | < 3rd |
| 2022/07/03 | 34+3 | 1268 | < 3rd | < 3rd | < 3rd |
| 2022/07/10 | 35+3 | 1390 | < 3rd | < 3rd | < 3rd |
| 2022/07/17 | 36+3 | 1578 | < 3rd | < 3rd | < 3rd |
| 2022/07/24 | 37+3 | 1631 | < 3rd | < 3rd | < 3rd |
| 2022/07/31 | 38+3 | 1804 | < 3rd | < 3rd | < 3rd |
| 2022/08/07 | 39+3 | 2042 | < 3rd | < 3rd | < 3rd |
| 2022/08/14 | 40+3 | 2252 | < 3rd | < 3rd | < 3rd |

# SUMMARY


Preeclampsia with severe features
FGR with AEDV, brain sparing effect
REDV and fetal distress
Delivered a premature SGA fetus with loss of growth potential

# BASIC DATA

魏ＯＯ, 31-year-old

G1P0
Prenatal care at MMH

LMP: 2021/06/18
EDC: 2022/03/25

Preconception BW 59 kg
BH 165 cm

# PAST HISTORY

Medical history: nil

Surgical history: nil

Allergic history: NKDA

OBGYN history: Unremarkable

Personal history: Unremarkable
(no smoking, no alcohol or illicit drug use)

Family history: Non-contributory

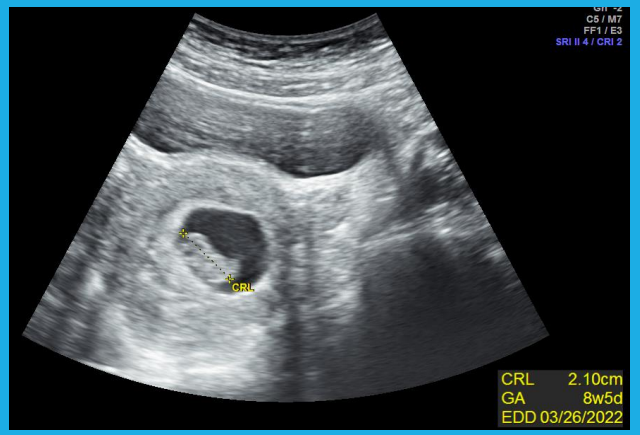
# REGULAR PRENATAL CARE

**08/19**

Self pregnancy test kit (+)

Ultrasound:

| Date | GA (weeks) | Maternal BW (kg) | EFW |
|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm |



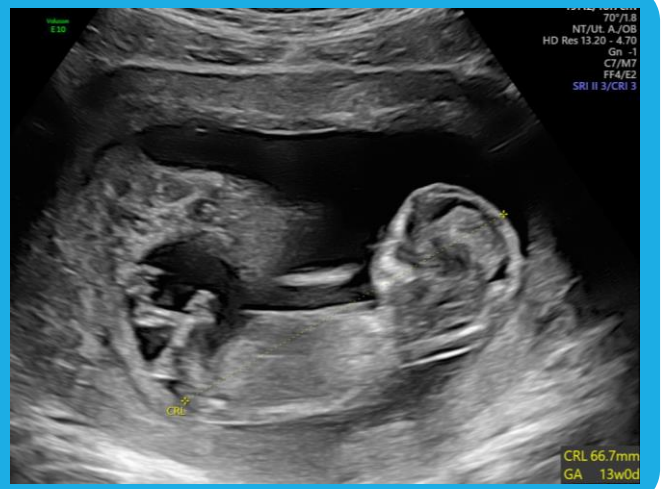

**09/16**

Ultrasound:

| Date | GA (weeks) | Maternal BW (kg) | EFW |
|---|---|---|---|
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm |

cFTS: Low risk for T13, T18 and T21

FMF Triple test: Low risk



| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |

**Level II ultrasonography:**
**Unremarkable except for suspected FGR**

# Reference ranges for serial measurements of umbilical artery Doppler indices in the second half of pregnancy

Ganesh Acharya, MD,[a,*] Tom Wilsgaard, PhD,[b] Gro K. Rosvold Berntsen, MD, PhD,[b] Jan Martin Maltau, MD, PhD,[a] Torvid Kiserud, MD, PhD[c]

**Table IV** Reference values for serial measurements of the umbilical artery systolic:diastolic ratio

| | Percentile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gestation (wk) | 2.5th | 5th | 10th | 25th | 50th | 75th | 90th | 95th | 97.5th |
| 19 | 2.73 | 2.93 | 3.19 | 3.67 | 4.28 | 5.00 | 5.75 | 6.26 | 6.73 |
| 20 | 2.63 | 2.83 | 3.07 | 3.53 | 4.11 | 4.80 | 5.51 | 5.99 | 6.43 |
| 21 | 2.51 | 2.70 | 2.93 | 3.36 | 3.91 | 4.55 | 5.22 | 5.67 | 6.09 |
| 22 | 2.43 | 2.60 | 2.83 | 3.24 | 3.77 | 4.38 | 5.03 | 5.45 | 5.85 |
| 23 | 2.34 | 2.51 | 2.72 | 3.11 | 3.62 | 4.21 | 4.82 | 5.22 | 5.61 |
| 24 | 2.25 | 2.41 | 2.62 | 2.99 | 3.48 | 4.04 | 4.63 | 5.02 | 5.38 |
| 25 | 2.17 | 2.33 | 2.52 | 2.88 | 3.35 | 3.89 | 4.45 | 4.83 | 5.18 |
| 26 | 2.09 | 2.24 | 2.43 | 2.78 | 3.23 | 3.75 | 4.30 | 4.66 | 5.00 |
| 27 | 2.02 | 2.17 | 2.35 | 2.69 | 3.12 | 3.63 | 4.15 | 4.50 | 4.83 |
| 28 | 1.95 | 2.09 | 2.27 | 2.60 | 3.02 | 3.51 | 4.02 | 4.36 | 4.67 |
| 29 | 1.89 | 2.03 | 2.20 | 2.52 | 2.92 | 3.40 | 3.89 | 4.22 | 4.53 |
| 30 | 1.83 | 1.96 | 2.13 | 2.44 | 2.83 | 3.30 | 3.78 | 4.10 | 4.40 |
| 31 | 1.77 | 1.90 | 2.06 | 2.36 | 2.75 | 3.20 | 3.67 | 3.98 | 4.27 |
| 32 | 1.71 | 1.84 | 2.00 | 2.29 | 2.67 | 3.11 | 3.57 | 3.87 | 4.16 |
| 33 | 1.66 | 1.79 | 1.94 | 2.23 | 2.60 | 3.03 | 3.48 | 3.77 | 4.06 |
| 34 | 1.61 | 1.73 | 1.88 | 2.16 | 2.53 | 2.95 | 3.39 | 3.68 | 3.96 |
| 35 | 1.57 | 1.68 | 1.83 | 2.11 | 2.46 | 2.87 | 3.30 | 3.59 | 3.86 |
| 36 | 1.52 | 1.64 | 1.78 | 2.05 | 2.40 | 2.80 | 3.23 | 3.51 | 3.78 |
| 37 | 1.48 | 1.59 | 1.73 | 2.00 | 2.34 | 2.74 | 3.15 | 3.43 | 3.69 |
| 38 | 1.44 | 1.55 | 1.69 | 1.95 | 2.28 | 2.67 | 3.08 | 3.36 | 3.62 |
| 39 | 1.40 | 1.51 | 1.64 | 1.90 | 2.23 | 2.61 | 3.02 | 3.29 | 3.54 |
| 40 | 1.36 | 1.47 | 1.60 | 1.85 | 2.18 | 2.56 | 2.96 | 3.22 | 3.48 |
| 41 | 1.33 | 1.43 | 1.56 | 1.81 | 2.13 | 2.50 | 2.90 | 3.16 | 3.41 |

Acharya G, Wilsgaard T, Berntsen GK, Maltau JM, Kiserud T. Reference ranges for serial measurements of umbilical artery Doppler indices in the second half of pregnancy. Am J Obstet Gynecol. 2005 Mar;192(3):937-44. doi: 10.1016/j.ajog.2004.09.019. PMID: 15746695.

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
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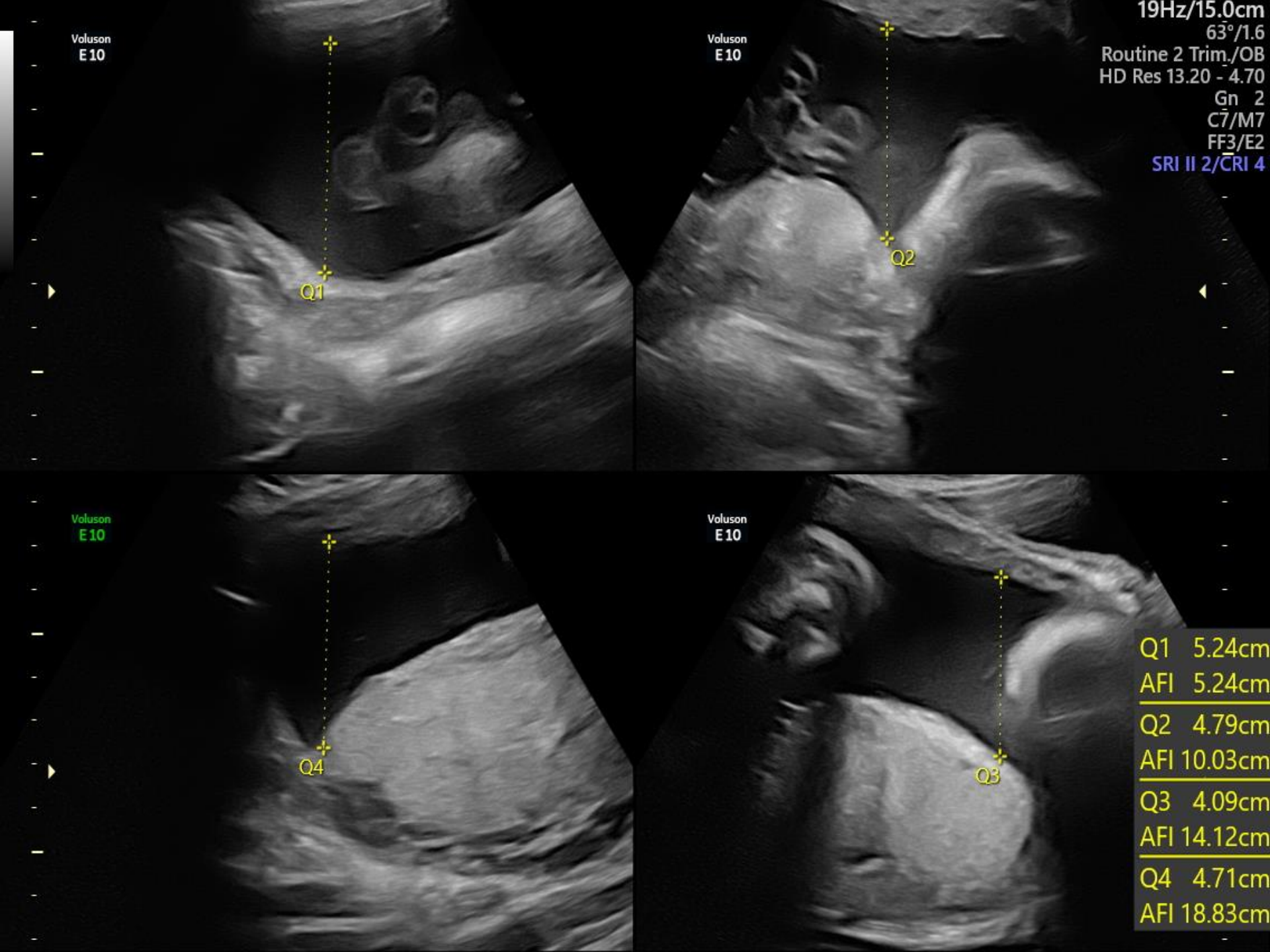
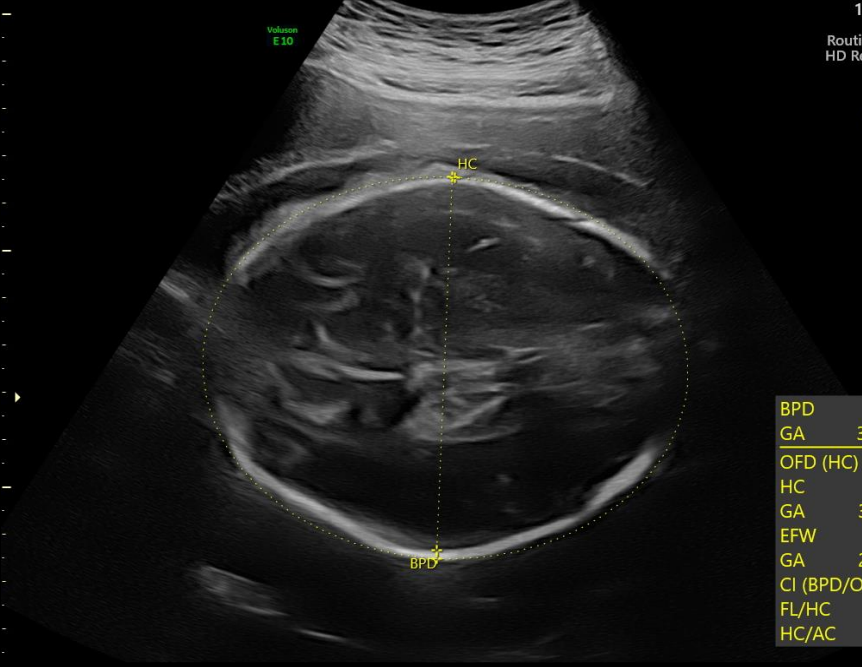
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5th |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50th to 75th |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5th to 10th |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5th |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3rd to 5th |

**Comprehensive Doppler flow velocimetry study**

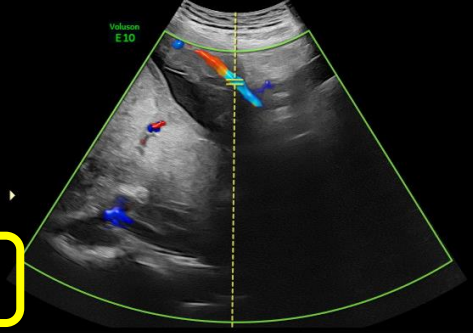

Voluson
E10
Q1
Voluson
E10
Q2
19Hz/15.0cm
63°/1.6
Routine 2 Trim./OB
HD Res 13.20 - 4.70
Gn 2
C7/M7
FF3/E2
SRI II 2/CRI 4
Voluson
E10
Q4
Voluson
E10
Q3
Q1 5.24cm
AFI 5.24cm
Q2 4.79cm
AFI 10.03cm
Q3 4.09cm
AFI 14.12cm
Q4 4.71cm
AFI 18.83cm




19Hz/15.0cm
65°/1.6
Routine 2 Trim./OB
HD Res 13.20 - 4.70
Gn 2
C7/M7
FF3/E2
SRI II 2/CRI 4

Gn 4
WMF 60 Hz
SV Angle 0
Size 2.0mm
Depth 31.3mm
Frq low
PRF 8.3kHz

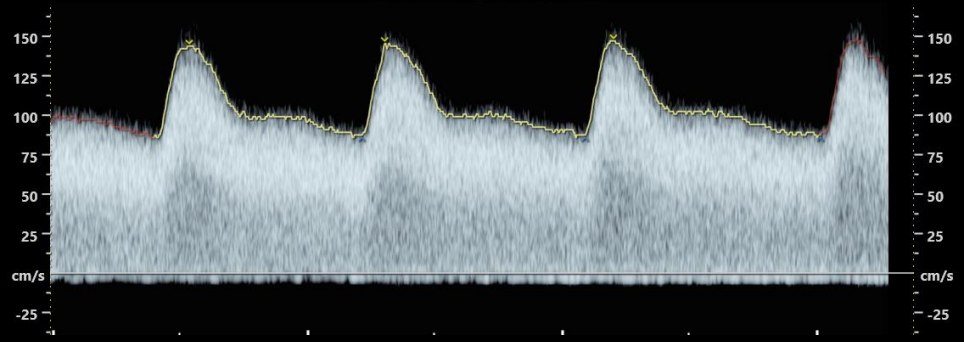
| | |
|---|---|
| BPD | 7.89cm |
| GA | 31w5d 3.5% |
| OFD (HC) | 10.05cm |
| HC | 28.52cm |
| GA | 31w2d <1% |
| EFW | 1429g |
| GA | 29w2d <1% |
| CI (BPD/OFD) | 74.93% |
| FL/HC | 0.21 |
| HC/AC | 1.19 |



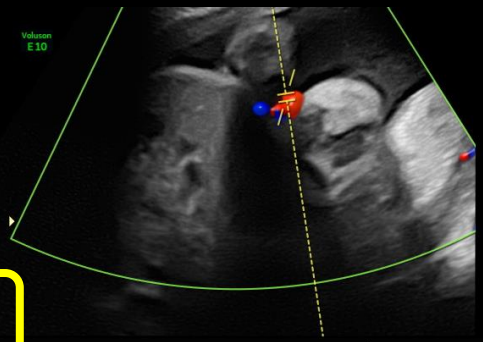
| | |
|---|---|
| Rt Ut-PS | 144.48cm/s |
| Rt Ut-ED | 87.43cm/s |
| Rt Ut-S/D | 1.65 |
| Rt Ut-PI | 0.54 |
| Rt Ut-RI | 0.39 |
| Rt Ut-MD | 86.31cm/s |
| Rt Ut-TAmax | 105.99cm/s |
| Rt Ut-HR | 68bpm |

PRF 4.4kHz

WNL



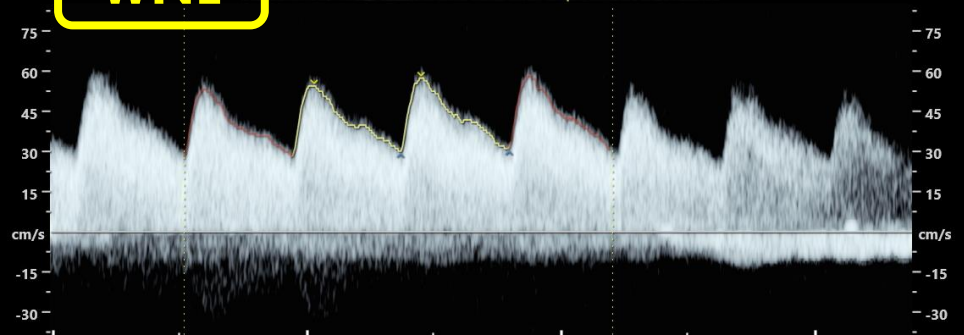

Gn 4
WMF 60 Hz
SV Angle 25
Size 2.0mm
Depth 48.4mm
Frq low
PRF 4.4kHz



| | |
|---|---|
| Umb-PS | 56.03cm/s |
| Umb-ED | 30.62cm/s |
| Umb-S/D | 1.83 |
| Umb-PI | 0.60 |
| Umb-RI | 0.45 |
| Umb-MD | 29.53cm/s |
| Umb-TAmax | 42.48cm/s |
| Umb-HR | 141bpm |

PRF 4.4kHz

WNL

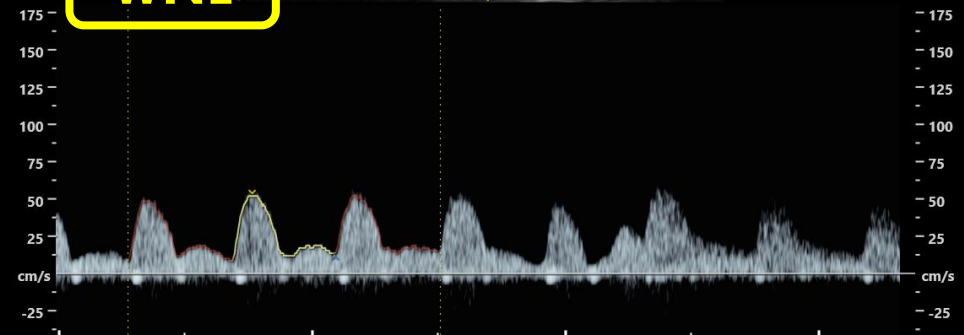


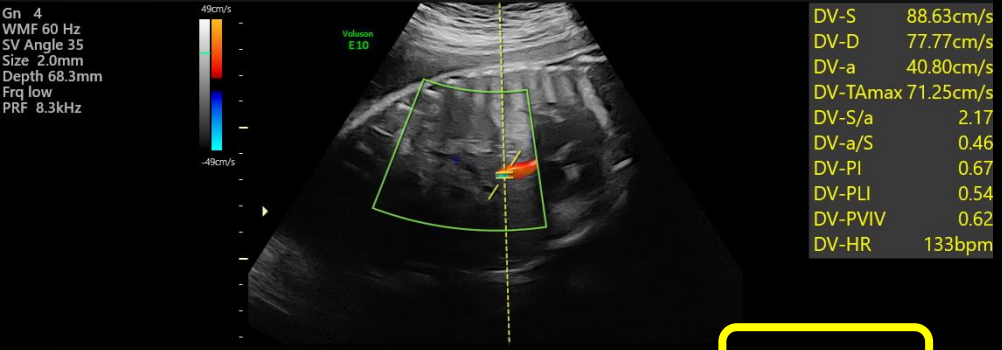

Gn 4
WMF 60 Hz
SV Angle 18
Size 2.0mm
Depth 48.7mm
Frq low
PRF 8.3kHz

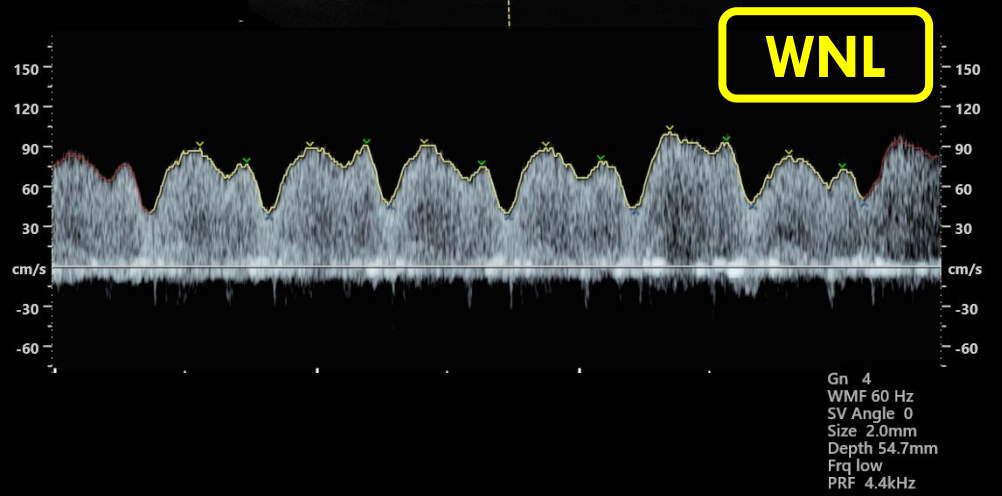
| | |
|---|---|
| Rt MCA-PS | 52.66cm/s |
| Rt MCA-ED | 13.21cm/s |
| Rt MCA-S/D | 3.99 |
| Rt MCA-PI | 1.49 |
| Rt MCA-RI | 0.75 |
| Rt MCA-MD | 10.26cm/s |
| Rt MCA-TAmax | 26.49cm/s |
| Rt MCA-HR | 148bpm |

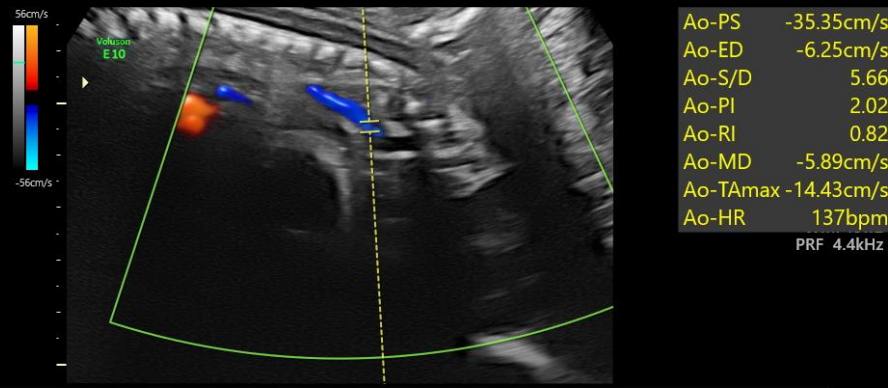
PRF 4.4kHz

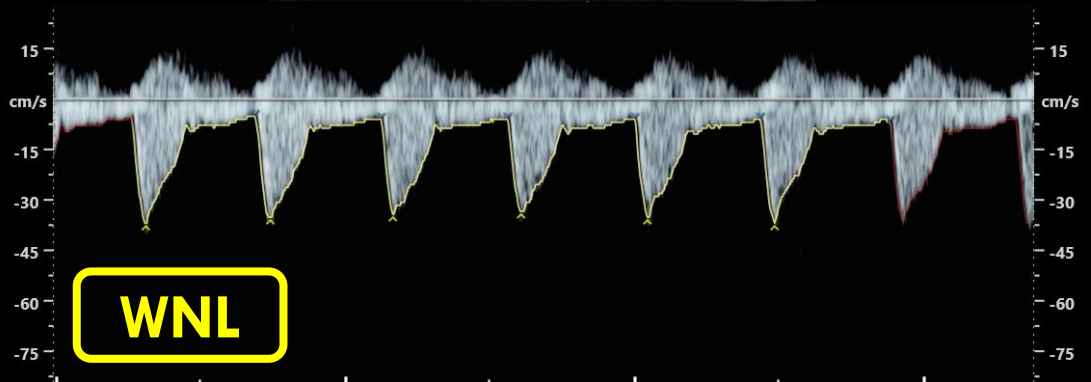
WNL




Gn 4
WMF 60 Hz
SV Angle 35
Size 2.0mm
Depth 68.3mm
Frq low
PRF 8.3kHz
49cm/s
-49cm/s
Voluson
E10
DV-S 88.63cm/s
DV-D 77.77cm/s
DV-a 40.80cm/s
DV-TAmax 71.25cm/s
DV-S/a 2.17
DV-a/S 0.46
DV-PI 0.67
DV-PLI 0.54
DV-PVIV 0.62
DV-HR 133bpm


WNL
150
120
90
60
30
cm/s
-30
-60
Gn 4
WMF 60 Hz
SV Angle 0
Size 2.0mm
Depth 54.7mm
Frq low
PRF 4.4kHz


56cm/s
-56cm/s
Voluson
E10
Ao-PS -35.35cm/s
Ao-ED -6.25cm/s
Ao-S/D 5.66
Ao-PI 2.02
Ao-RI 0.82
Ao-MD -5.89cm/s
Ao-TAmax -14.43cm/s
Ao-HR 137bpm
PRF 4.4kHz


15
cm/s
-15
-30
-45
-60
-75
WNL

# COMPREHENSIVE DOPPLER STUDY

**GA 33+5 weeks**

Fetal size= 29+2 wks **(3rd to 5th percentile)**, FHB: OK
Active female fetus, vertex presentation
Normal liquor volume (AFI = 18.83 cm)
BPP score: 8 (under ultrasound)

**02/09**

Uterine artery PI: (WNL)
Right: 0.54, notch (-); Left: 0.79, notch (-)
Umbilical artery S/D: 1.71, 1.83 (WNL)
PI: 0.60, 0.65 (WNL)
MCA PI: 1.49, 1.56 (WNL)
CPR: 2.48 (WNL)
DV PVIV: 0.62 (WNL) without reversed a wave
Aol PI: 2.02 (WNL)

Suggest close follow up

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5th |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50th to 75th |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5th to 10th |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5th |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3rd to 5th |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3rd |

02/21

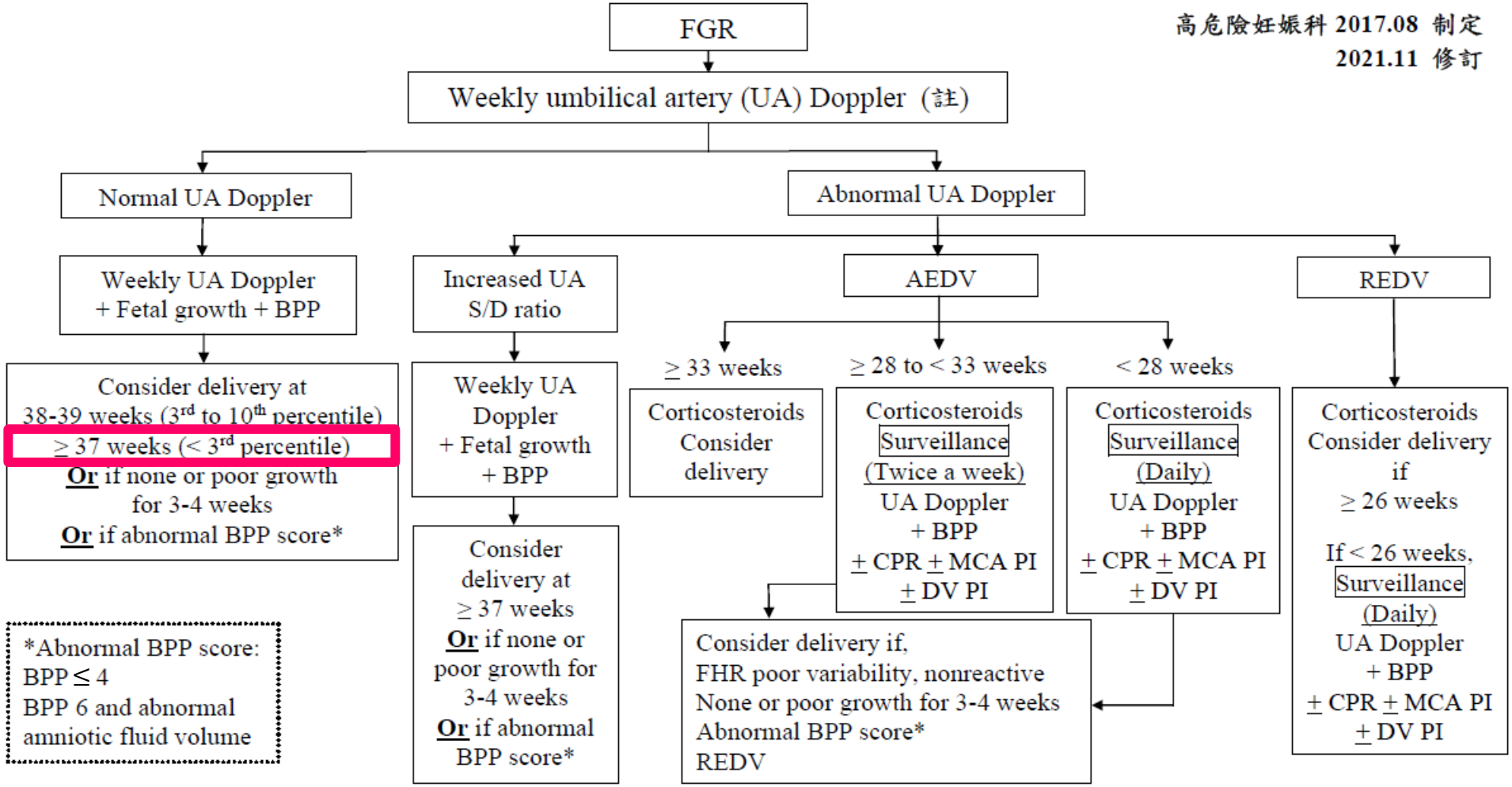
SOFIVA NIPS v3.0:
Unremarkable for chromosomal and common CNV abnormalities

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3$^{rd}$ to 5$^{th}$ |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3$^{rd}$ |
| 2022/02/24 | 35+6 | 69.0 | 1580 g | 2.42; 1.90 | 11.70 | 8 | < 3$^{rd}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3$^{rd}$ to 5$^{th}$ |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3$^{rd}$ |
| 2022/02/24 | 35+6 | 69.0 | 1580 g | 2.42; 1.90 | 11.70 | 8 | < 3$^{rd}$ |
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3$^{rd}$ |

# 胎兒生長遲滯 (Fetal growth restriction, FGR) 臨床處理建議流程

高危險妊娠科 2017.08 制定
2021.11 修訂




註: 可加作 MCA (middle cerebral artery) PI, CPR (cerebroplacental ratio), DV (ductus venosus) PI 等作為參考。

編輯人: Fellow 蘇伶澄/鄧肇雄


參考資料:

(1) Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. Obstet Gynecol 2021;138:e35-e39.
(2) Doppler assessment of the fetus with intrauterine growth restriction, SMFM Clinical Guideline. Am J Obstet Gynecol 2012;206:300-308.
(3) Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol. Fetal Diagn Ther 2014;36:86-98.
(4) Intrauterine growth restriction: new concepts in antenatal surveillance, diagnosis, and management. Am J Obstet Gynecol 2011;204:288-300.
(5) Evidence-based approach to umbilical artery Doppler fetal surveillance in high-risk pregnancies: an update. Clin Obstet Gynecol 2010;53:869-878.
(6) Williams Obstetrics, 26th edition.

# DELIVERY

03/03

Ultrasound:

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3rd |

**Suggest admission for induction of labor**

Refused by patient

Strongly suggest fetal kick count surveillance

**Fetal doppler surveillance BIW**

| Date8 | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3$^{rd}$ to 5$^{th}$ |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3$^{rd}$ |
| 2022/02/24 | 35+6 | 69.0 | 1580 g | 2.42; 1.90 | 11.70 | 8 | < 3$^{rd}$ |
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3$^{rd}$ |
| 2022/03/08 | 37+4 | 70.6 | 2027 g | 2.06; 1.81 | 12.60 | 8 | < 3$^{rd}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3$^{rd}$ to 5$^{th}$ |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3$^{rd}$ |
| 2022/02/24 | 35+6 | 69.0 | 1580 g | 2.42; 1.90 | 11.70 | 8 | < 3$^{rd}$ |
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3$^{rd}$ |
| 2022/03/08 | 37+4 | 70.6 | 2027 g | 2.06; 1.81 | 12.60 | 8 | < 3$^{rd}$ |
| 2022/03/11 | 38 | 70.4 | 2056 g | 1.91; 1.98 | 11.60 | 8 | < 3$^{rd}$ |

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2021/08/19 | 8+6 | 59.0 | CRL: 2.10 cm | | | | |
| 2021/09/16 | 12+6 | 58.0 | CRL: 6.67 cm | | | | |
| 2021/11/17 | 21+5 | 62.5 | 360 g | 3.61; 3.48 | 19.32 | 8 | 5$^{th}$ |
| 2021/12/09 | 24+6 | 63.5 | 709 g | | 16.35 | | 50$^{th}$ to 75$^{th}$ |
| 2022/01/18 | 30+4 | 68.0 | 1136 g | 1.88; 1.96 | 15.64 | 8 | 5$^{th}$ to 10$^{th}$ |
| 2022/01/27 | 31+6 | 68.5 | 1228 g | 1.49; 1.93 | 22.66 | 8 | 5$^{th}$ |
| 2022/02/09 | 33+5 | 68.2 | 1429 g | 1.71; 1.83 | 18.83 | 8 | 3$^{rd}$ to 5$^{th}$ |
| 2022/02/17 | 34+6 | 68.5 | 1567 g | 1.69; 2.59 | 14.13 | 8 | < 3$^{rd}$ |
| 2022/02/24 | 35+6 | 69.0 | 1580 g | 2.42; 1.90 | 11.70 | 8 | < 3$^{rd}$ |
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3$^{rd}$ |
| 2022/03/08 | 37+4 | 70.6 | 2027 g | 2.06; 1.81 | 12.60 | 8 | < 3$^{rd}$ |
| 2022/03/11 | 38 | 70.4 | 2056 g | 1.91; 1.98 | 11.60 | 8 | < 3$^{rd}$ |
| 2022/03/15 | 38+4 | 70.5 | 2138 g | 1.64; 1.80 | 12.22 | 8 | < 3$^{rd}$ |

## Case scenario 2

# DELIVERY

**03/03**

Ultrasound:

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3rd |

Suggest admission for induction of labor

Refused by patient

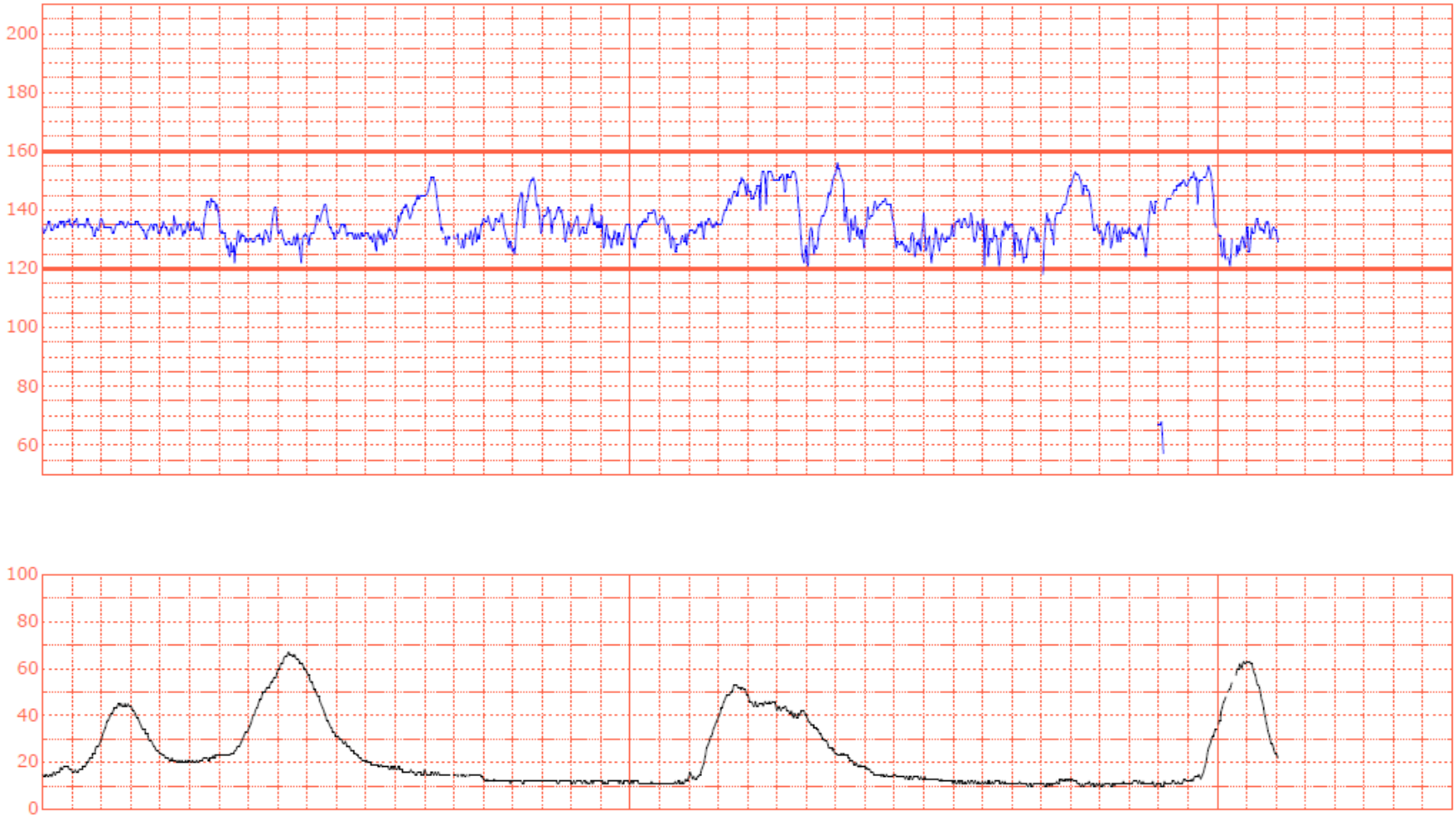
Strongly suggest fetal kick count surveillance

Fetal doppler surveillance BIW

**03/16**

Admission for induction of labor

# FETAL MONITOR



# DELIVERY

**03/03**

Ultrasound:

| Date | GA (weeks) | Maternal BW (kg) | EFW | Umb A S/D ratio | AFI (cm) | BPP | EFW percentile |
|---|---|---|---|---|---|---|---|
| 2022/03/03 | 36+6 | 70.0 | 1987 g | 2.50; 2.25 | 9.52 | 8 | < 3rd |

Suggest admission for induction of labor
Refused by patient
Strongly suggest fetal kick count surveillance
Fetal doppler surveillance BIW

**03/16**

Admission for induction of labor

**03/17**

Vaginal delivery with a living female baby in ROA position,
**BW: 1832 g**, BL: 45 cm,
APGAR score: 8 (-skin color, breathing) → 9 (-skin color)

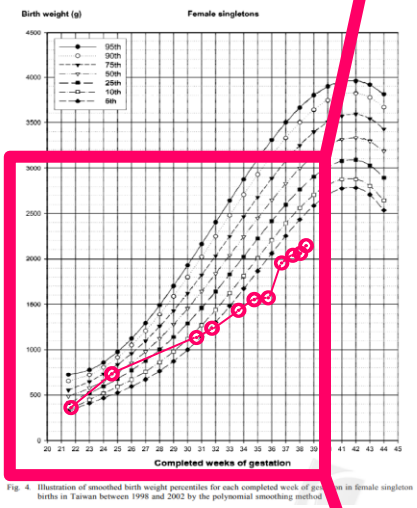



Fig. 4. Illustration of smoothed birth weight percentiles for each completed week of gestation in female singleton births in Taiwan between 1998 and 2002 by the polynomial smoothing method

3000
2500
2000
1500
1000
500
0
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Completed weeks of gestation

Suggest induction of labor

# NEONATAL OUTCOMES

**Small for gestational age,**
GA 38+6 weeks, BW: 1832 g

Transient tachypnea of newborn

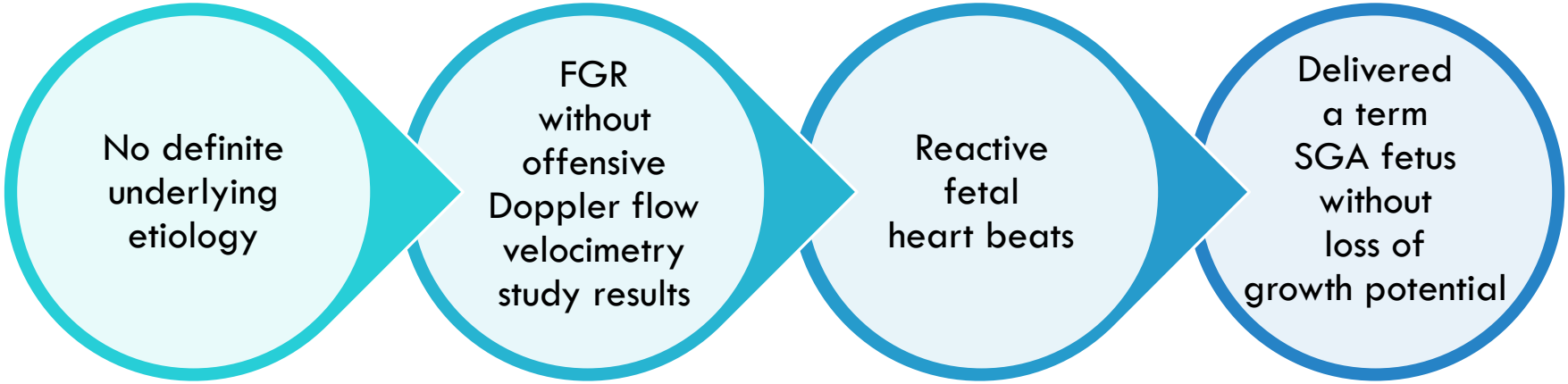
Left subependymal cyst

Case scenario 2

# INFANTILE GROWTH

| Date | PMA (weeks) | BW (kg) | BW percentile | BL percentile | HC percentile |
|---|---|---|---|---|---|
| 2022/03/17 | 38+6 | 1.832 | < 3rd | 3rd to 10th | 3rd to 10th |
| 2022/03/20 | 39+2 | 1.808 | < 3rd | 3rd to 10th | 3rd to 10th |
| 2022/03/24 | 39+6 | 1.96 | < 3rd | 3rd to 10th | 3rd to 10th |
| 2022/04/06 | | 2.4 | | | |
| 2022/04/15 | | 2.9 | | | |
| 2022/04/28 | | 3.3 | | | |
| 2022/05/19 | | 3.9 | | | |
| 2022/07/21 | | 5.3 | | | |
| 2022/08/22 | Rolling, grasping | 5.7 | 15th to 50th | 50th to 85th | 50th to 85th |

# SUMMARY


No definite underlying etiology
FGR without offensive Doppler flow velocimetry study results
Reactive fetal heart beats
Delivered a term SGA fetus without loss of growth potential

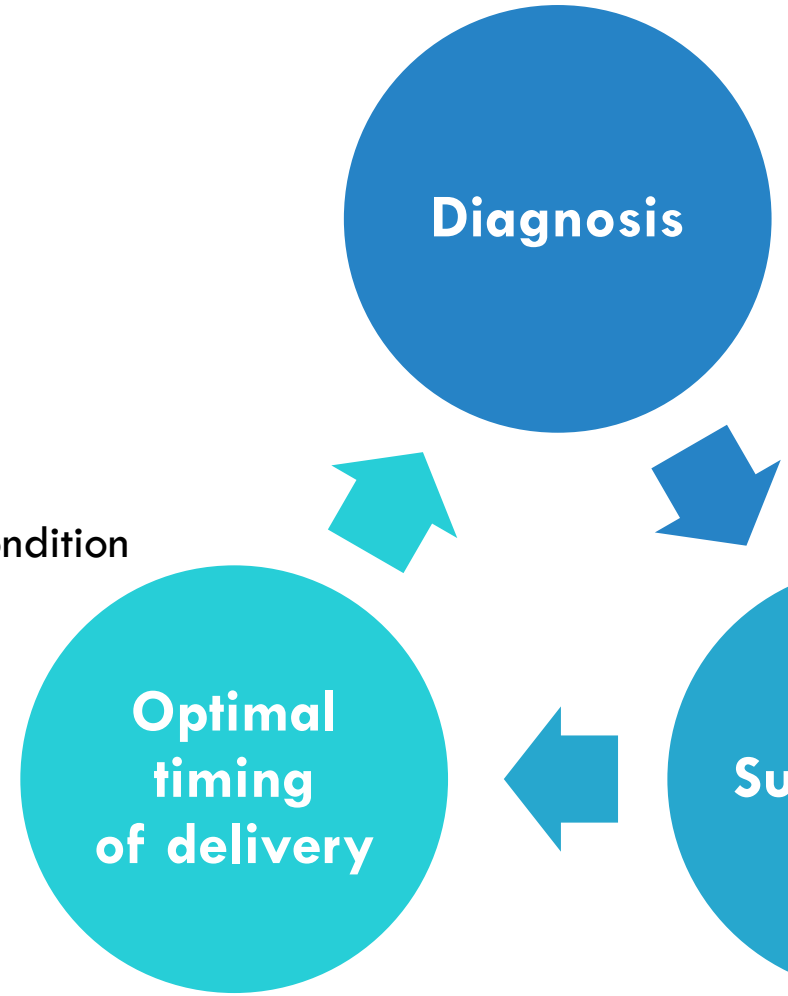
# DISCUSSION

Diagnosis

Surveillance

Optimal timing of delivery

# MAJOR ISSUES TO BE ACCOUNTED




- Threshold
- Size versus growth velocity rate
- Etiology
- Genetic counseling

- Doppler velocimetry
- Biophysical profile
- Non-stress test

- Maternal condition
- Prematurity

Discussion

# TERMINOLOGY

**Fail to achieve weight**
**within population-based norms**

## FGR

- Fetal growth restriction (Formerly known as IUGR)
- ACOG: EFW or AC < 10th percentile
- ISUOG: Delphi consensus criteria

## SGA

- Small for gestational age
- Actual birth weight < 10th percentile

# MORE THAN EFW

**TABLE 1**

**Delphi consensus criteria for the definition of early and late fetal growth restrictions[5]**

| Early FGR: GA<32 wk, in the absence of congenital anomalies | Late FGR: GA≥32 wk, in the absence of congenital anomalies |
|---|---|
| AC or EFW of <third percentile or UA-AEDF<br>Or<br>1. AC or EFW of <10th percentile combined with<br>2. Uta-PI of >95th percentile and/or<br>3. UA-PI of >95th percentile | AC or EFW of <third percentile<br>Or at least 2 of 3 of the following:<br>1. AC or EFW of <10th percentile<br>2. AC or EFW crossing percentiles of >2 quartiles on growth percentiles<br>3. CPR of <5th percentile or UA-PI of >95th percentile |

*AC*, abdominal circumference; *AEDF*, absent end-diastolic flow; *CPR*, cerebroplacental ratio; *EFW*, estimated fetal weight; *FGR*, fetal growth restriction; *GA*, gestational age; *PI*, pulsatility index; *UA*, umbilical artery; *UtA*, uterine artery.

*Lees. Diagnosis and management of suspected fetal growth restriction. Am J Obstet Gynecol 2022.*

Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

Discussion

# DETERMINE EDC

**TABLE 14-1.** Assessment of Gestational Age

| Gestational Age[a] | Parameter(s) | Threshold Value to Redate[b] |
|---|---|---|
| <9 wks | CRL | >5 d |
| 9 to <14 wks | CRL | >7 d |
| 14 to <16 wks | BPD, HC, AC, FL | >7 d |
| 16 to <22 wks | BPD, HC, AC, FL | >10 d |
| 22 to <28 wks | BPD, HC, AC, FL | >14 d |
| ≥28 wks | BPD, HC, AC, FL | >21 d |

[a]Based on last menstrual period (LMP).
[b]Ultrasound gestational age should be used if it differs from the LMP-derived gestational age by more than the threshold value.
AC = abdominal circumference; BPD = biparietal diameter; CRL = crown-rump length; FL = femur length; HC = head circumference.

# Discussion

Acta Paediatr Tw 25

## Nationwide Singleton Birth Weight Percentiles by Gestational Age in Taiwan, 1998-2002

Wu-Shiun HSIEH[1], Hui-Chen WU[2], Suh-Fang JENG[3], Hua-Fang Liao[3], Yi-Ning SU[4], Shio-Jean LIN[5], Chia-Jung HSIEH[2], Pau-Chung CHEN[2]

Departments of Pediatrics[1] and Medical Genetics[4], National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan; Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University College of Public Health[2], Taipei, Taiwan; School and Graduate Institute of Physical Therapy, National Taiwan University College of Medicine[3], Taipei, Taiwan; Departments of Pediatrics, National Cheng-Kung University Hospital, National Cheng-Kung University College of Medicine[5], Tainan, Taiwan.
Received: January 23, 2006. Revised: March 7, 2006. Accepted: March 13, 2006.
Address reprint requests to: Pau-Chung CHEN, Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University College of Public Health, 17, Syujhou Road, Taipei 100, Taiwan.

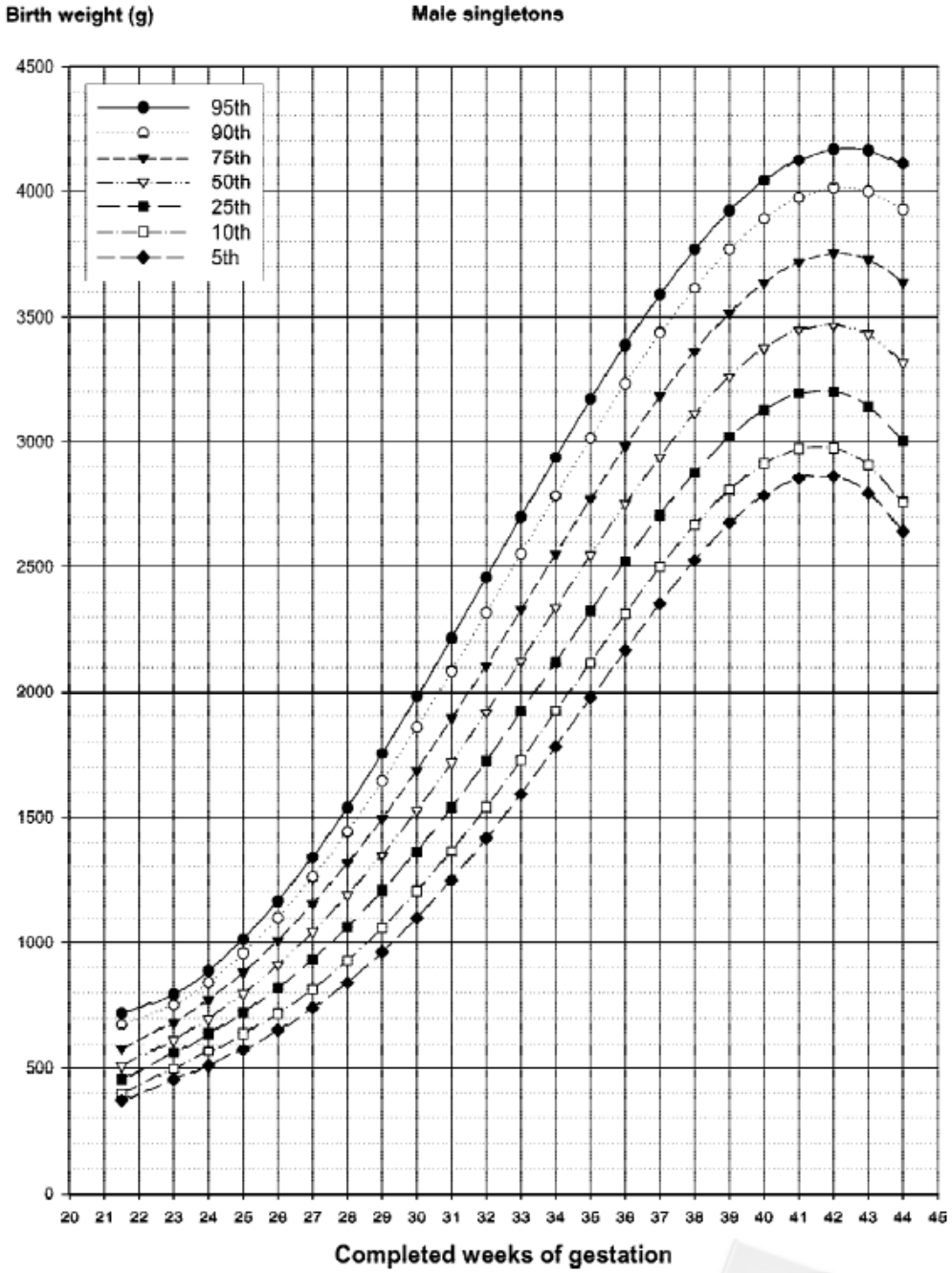



Fig. 3. Illustration of smoothed birth weight percentiles for each completed week of gestation in male singleton births in Taiwan between 1998 and 2002 by the polynomial smoothing method

Table 2. Smoothed Birth Weight Percentiles for Each Completed Week of Gestation for Male Singleton Births in Taiwan between 1998 and 2002 by the Polynomial Smoothing Method

| Completed weeks of gestation | Births | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
|---|---|---|---|---|---|---|---|---|
| 21 - 22 | 121 | 368.3 | 397.0 | 450.5 | 507.6 | 581.6 | 675.2 | 719.0 |
| 23 | 132 | 450.2 | 496.0 | 558.4 | 613.5 | 683.5 | 753.5 | 794.2 |
| 24 | 205 | 508.4 | 562.7 | 635.9 | 698.4 | 773.3 | 841.9 | 888.0 |
| 25 | 251 | 574.0 | 635.7 | 722.3 | 797.2 | 881.4 | 957.4 | 1012.9 |
| 26 | 384 | 649.9 | 719.2 | 820.8 | 911.4 | 1008.2 | 1097.9 | 1165.4 |
| 27 | 453 | 738.7 | 816.2 | 933.4 | 1041.7 | 1153.4 | 1261.0 | 1342.2 |
| 28 | 552 | 842.2 | 928.7 | 1061.5 | 1188.5 | 1316.1 | 1444.2 | 1539.6 |
| 29 | 622 | 961.7 | 1057.8 | 1205.5 | 1351.0 | 1495.0 | 1644.7 | 1753.7 |
| 30 | 836 | 1097.5 | 1203.7 | 1365.2 | 1528.2 | 1688.4 | 1859.2 | 1980.9 |
| 31 | 1132 | 1249.2 | 1365.4 | 1539.1 | 1718.2 | 1893.8 | 2084.4 | 2217.2 |
| 32 | 1717 | 1415.5 | 1541.2 | 1725.4 | 1918.6 | 2108.3 | 2316.6 | 2458.4 |
| 33 | 2594 | 1594.3 | 1728.3 | 1921.0 | 2126.0 | 2328.6 | 2551.8 | 2700.4 |
| 34 | 4536 | 1782.3 | 1922.9 | 2122.1 | 2336.8 | 2550.7 | 2785.7 | 2938.9 |
| 35 | 8951 | 1975.5 | 2120.2 | 2324.2 | 2546.5 | 2770.2 | 3013.9 | 3169.5 |
| 36 | 24772 | 2168.3 | 2314.6 | 2521.9 | 2749.9 | 2982.2 | 3231.5 | 3387.8 |
| 37 | 73876 | 2354.4 | 2499.3 | 2708.6 | 2941.1 | 3181.1 | 3433.5 | 3589.0 |
| 38 | 174659 | 2525.9 | 2666.7 | 2877.4 | 3113.9 | 3361.0 | 3614.5 | 3768.4 |
| 39 | 191122 | 2673.8 | 2808.3 | 3020.3 | 3260.9 | 3515.4 | 3769.0 | 3921.3 |
| 40 | 153105 | 2787.7 | 2914.2 | 3128.3 | 3374.5 | 3637.2 | 3890.9 | 4042.5 |
| 41 | 33583 | 2855.6 | 2974.1 | 3191.7 | 3446.2 | 3718.8 | 3974.2 | 4127.2 |
| 42 | 4088 | 2864.0 | 2976.4 | 3200.1 | 3466.8 | 3752.3 | 4012.3 | 4170.0 |
| 43 | 398 | 2798.0 | 2908.5 | 3141.9 | 3426.7 | 3728.9 | 3998.6 | 4165.7 |
| 44 | 108 | 2640.7 | 2756.9 | 3005.1 | 3315.4 | 3639.7 | 3926.0 | 4108.9 |

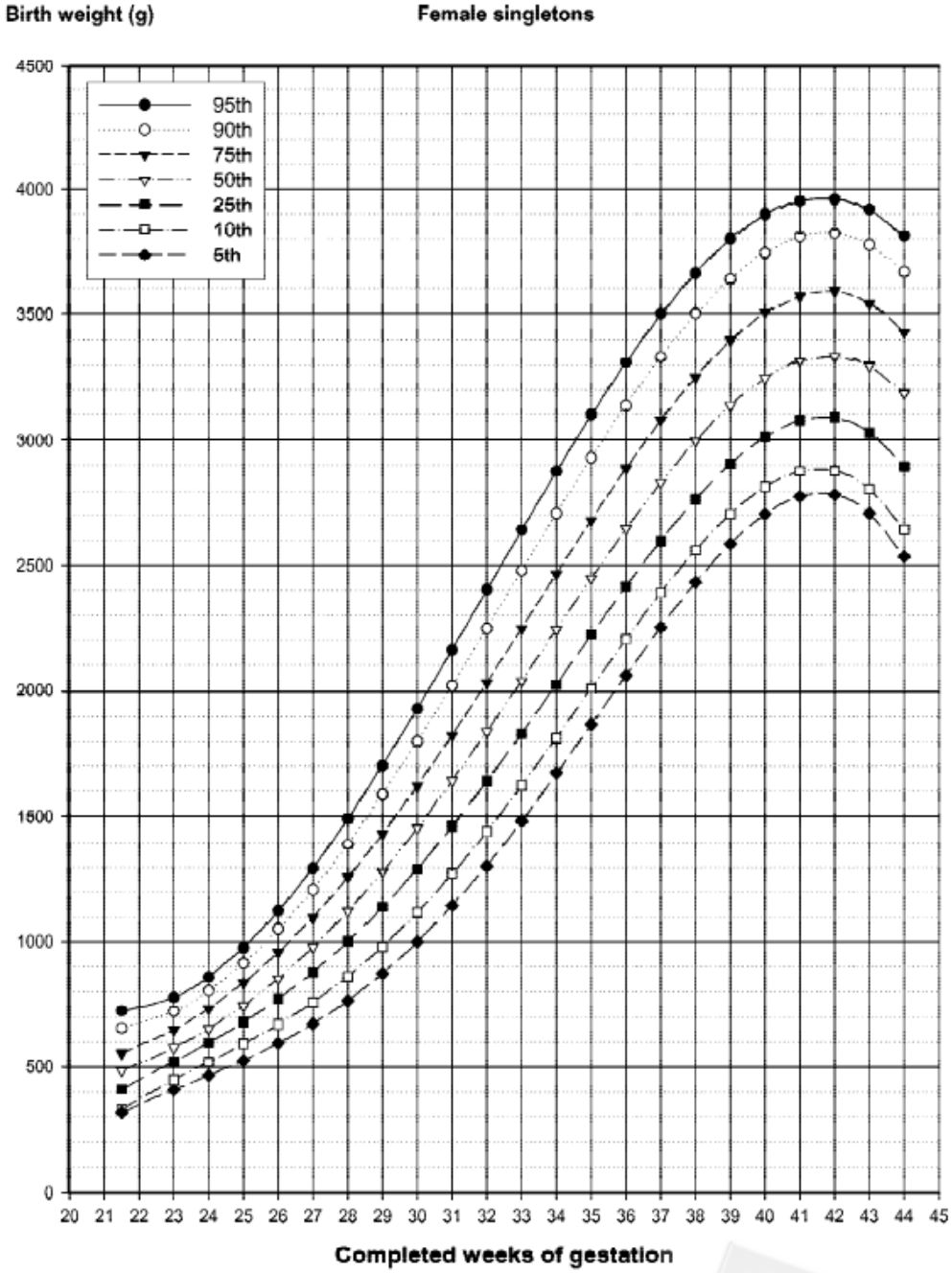



Table 3. Smoothed Birth Weight Percentiles for Each Completed Week of Gestation in Female Singleton Births in Taiwan between 1998 and 2002 by the Polynomial Smoothing Method

| Completed weeks of gestation | Births | 5th | 10th | 25th | 50th | 75th | 90th | 95th |
|---|---|---|---|---|---|---|---|---|
| 21 - 22 | 98 | 318.2 | 330.2 | 413.4 | 485.0 | 553.7 | 655.0 | 724.2 |
| 23 | 104 | 409.1 | 448.8 | 520.9 | 575.6 | 648.6 | 722.2 | 777.4 |
| 24 | 165 | 466.0 | 519.3 | 595.9 | 652.7 | 733.3 | 804.4 | 860.3 |
| 25 | 232 | 526.0 | 591.0 | 678.5 | 745.1 | 836.4 | 914.5 | 976.8 |
| 26 | 287 | 593.4 | 669.3 | 772.1 | 854.0 | 958.1 | 1050.3 | 1123.2 |
| 27 | 322 | 672.0 | 758.4 | 879.0 | 979.8 | 1098.4 | 1209.5 | 1295.6 |
| 28 | 459 | 764.7 | 861.6 | 1000.9 | 1122.4 | 1256.5 | 1389.2 | 1490.1 |
| 29 | 459 | 873.7 | 981.0 | 1138.5 | 1281.0 | 1431.1 | 1586.5 | 1702.3 |
| 30 | 640 | 1000.0 | 1117.5 | 1291.5 | 1454.1 | 1620.3 | 1798.1 | 1928.1 |
| 31 | 830 | 1144.0 | 1270.8 | 1458.9 | 1640.0 | 1821.7 | 2020.2 | 2163.0 |
| 32 | 1280 | 1304.8 | 1439.7 | 1638.9 | 1835.9 | 2032.3 | 2249.0 | 2402.5 |
| 33 | 1882 | 1480.7 | 1621.7 | 1828.7 | 2038.6 | 2248.6 | 2480.2 | 2642.0 |
| 34 | 3383 | 1668.4 | 1813.1 | 2024.6 | 2244.3 | 2466.5 | 2709.2 | 2876.6 |
| 35 | 6724 | 1863.7 | 2009.3 | 2222.1 | 2448.5 | 2681.4 | 2931.4 | 3101.5 |
| 36 | 18710 | 2061.0 | 2204.4 | 2415.8 | 2646.3 | 2888.0 | 3141.4 | 3311.6 |
| 37 | 57410 | 2253.3 | 2391.3 | 2599.5 | 2832.0 | 3080.6 | 3334.0 | 3501.7 |
| 38 | 147786 | 2431.9 | 2561.9 | 2766.1 | 2999.2 | 3252.8 | 3503.2 | 3666.5 |
| 39 | 180871 | 2587.0 | 2706.9 | 2907.6 | 3141.1 | 3397.7 | 3643.2 | 3800.7 |
| 40 | 156201 | 2706.6 | 2816.0 | 3015.1 | 3250.2 | 3507.9 | 3747.4 | 3898.6 |
| 41 | 37300 | 2777.4 | 2877.5 | 3078.8 | 3318.4 | 3575.5 | 3809.4 | 3954.5 |
| 42 | 4578 | 2784.1 | 2878.9 | 3088.3 | 3337.0 | 3591.7 | 3822.2 | 3962.8 |
| 43 | 400 | 2709.3 | 2806.3 | 3032.0 | 3296.6 | 3547.6 | 3778.4 | 3917.4 |
| 44 | 107 | 2534.0 | 2644.7 | 2897.7 | 3187.3 | 3433.4 | 3670.6 | 3812.2 |

Fig. 4. Illustration of smoothed birth weight percentiles for each completed week of gestation in female singleton births in Taiwan between 1998 and 2002 by the polynomial smoothing method

# THRESHOLD

**TABLE 1**

**Delphi consensus criteria for the definition of early and late fetal growth restrictions[5]**

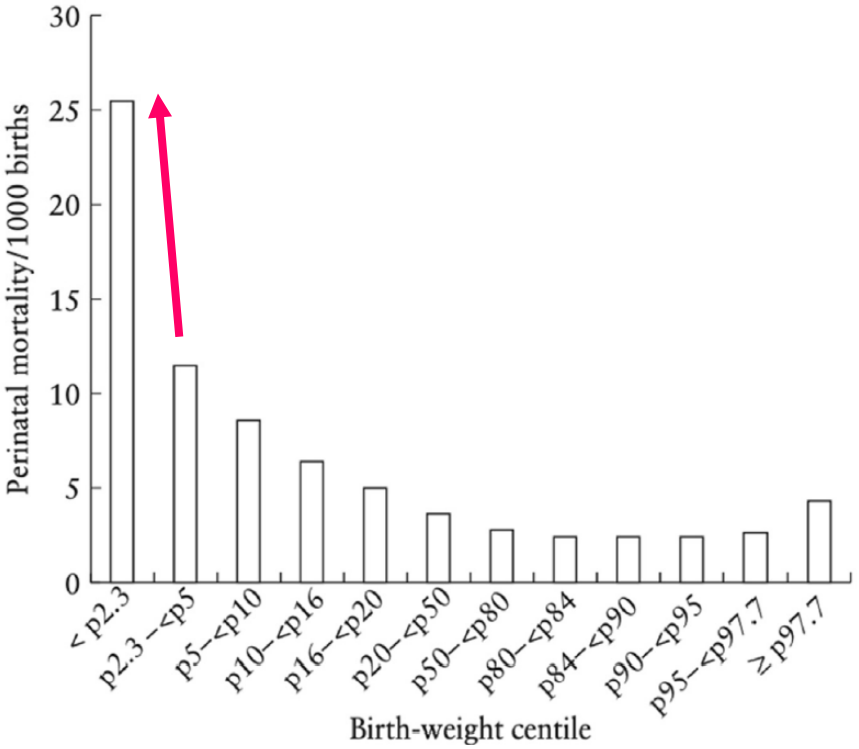
| Early FGR: GA<32 wk, in the absence of congenital anomalies | Late FGR: GA≥32 wk, in the absence of congenital anomalies |
|---|---|
| AC or EFW of <third percentile or UA-AEDF<br>Or<br>1. AC or EFW of <10th percentile combined with<br>2. Uta-PI of >95th percentile and/or<br>3. UA-PI of >95$^{th}$ percentile | AC or EFW of <third percentile<br>Or at least 2 of 3 of the following:<br>1. AC or EFW of <10th percentile<br>2. AC or EFW crossing percentiles of >2 quartiles on growth percentiles<br>3. CPR of <5th percentile or UA-PI of >95th percentile |

*AC*, abdominal circumference; *AEDF*, absent end-diastolic flow; *CPR*, cerebroplacental ratio; *EFW*, estimated fetal weight; *FGR*, fetal growth restriction; *GA*, gestational age; *PI*, pulsatility index; *UA*, umbilical artery; *UtA*, uterine artery.

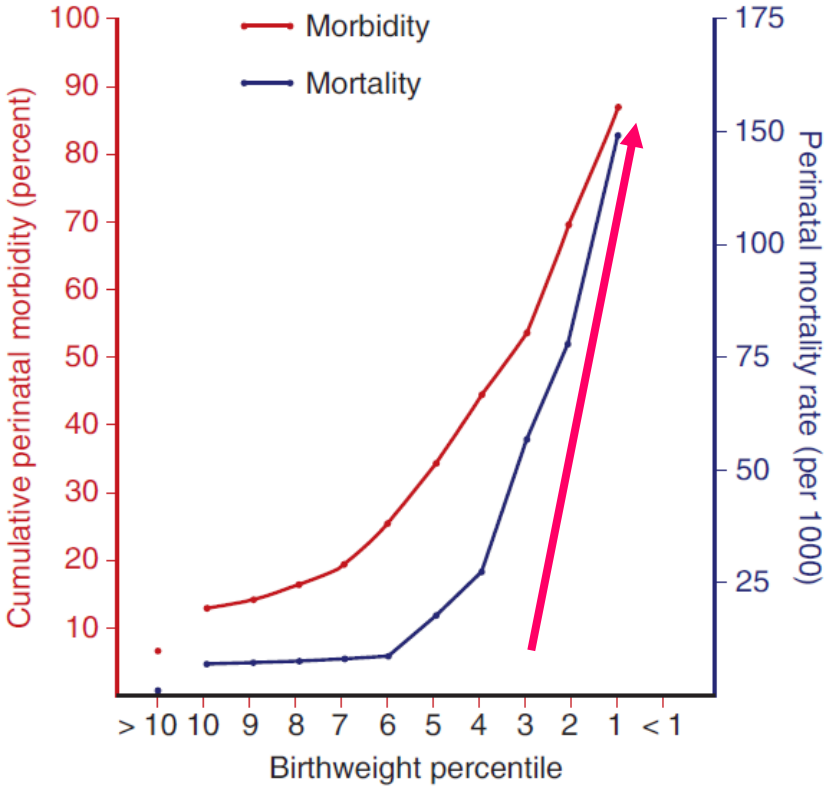
*Lees. Diagnosis and management of suspected fetal growth restriction. Am J Obstet Gynecol 2022.*

Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

**FIGURE 1**
**Perinatal mortality according to birthweight percentile**




Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.




F. Gary Cunningham, Kenneth J. Leveno, Jodi S. Dashe, Barbara L. Hoffman, Catherine Y. Spong, Brian M. Casey - Williams Obstetrics, 26th Edition 2022. Fetal growth restriction.

Vasak et al. Human fetal growth is constrained below optimal for perinatal survival. Ultrasound Obstet Gynecol 2015;45:162–7.

**Netherland population**

McIntire et al. Birth weight in relation to morbidity and mortality among newborn infants. N Engl J Med 1999;340:1234–8.

**British population**

Unterscheider J, et al. Optimizing the definition of intrauterine growth restriction: the multicenter prospective PORTO study. Am J Obstet Gynecol 2013;208:290. e1–6.

**Irish population**

Discussion

# SIZE VS GROWTH

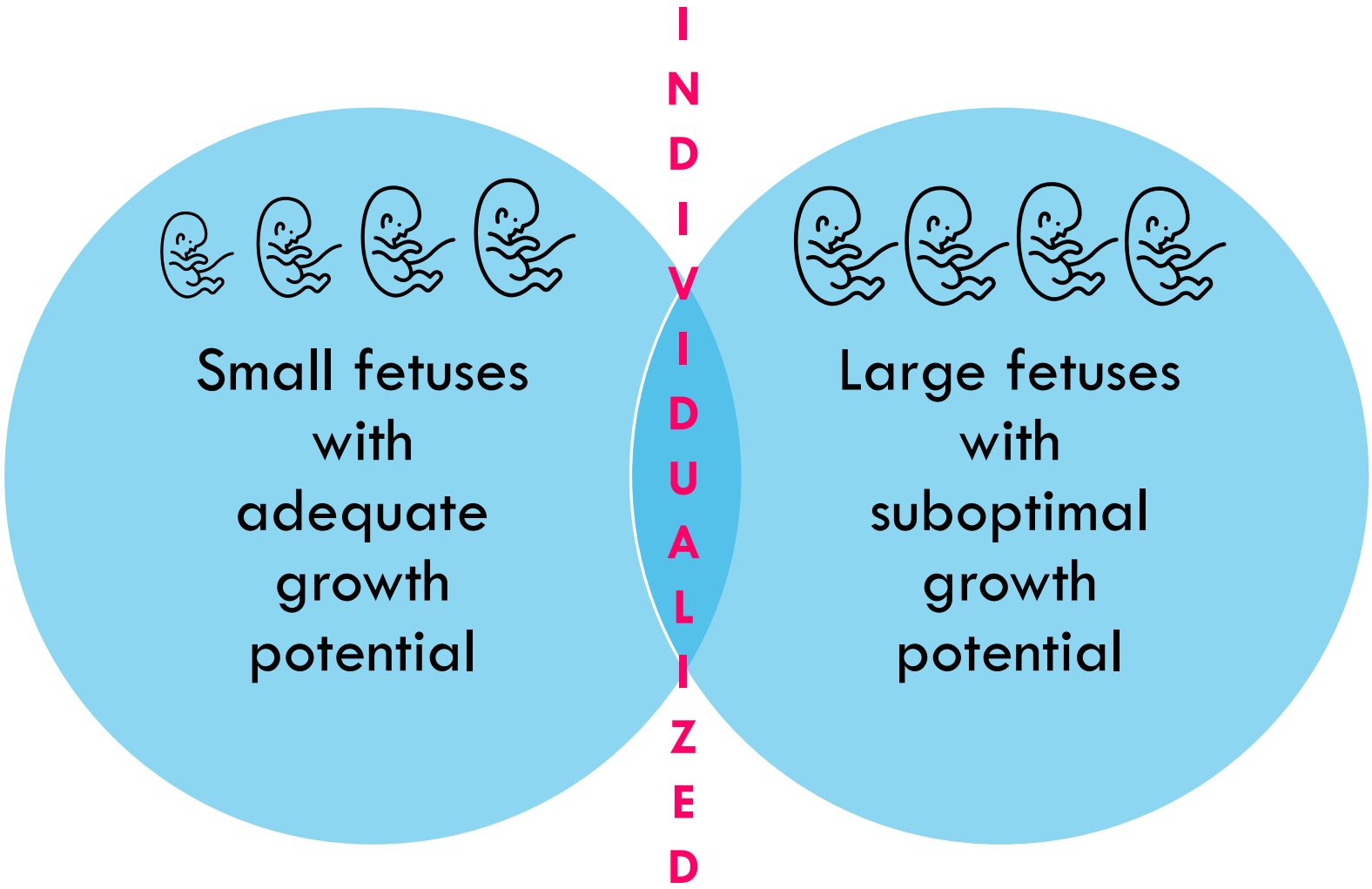
A diagnosis based on
EFW alone
does not indicate disease
**but fetus at-risk category**

**False-positive**

**False-negative**

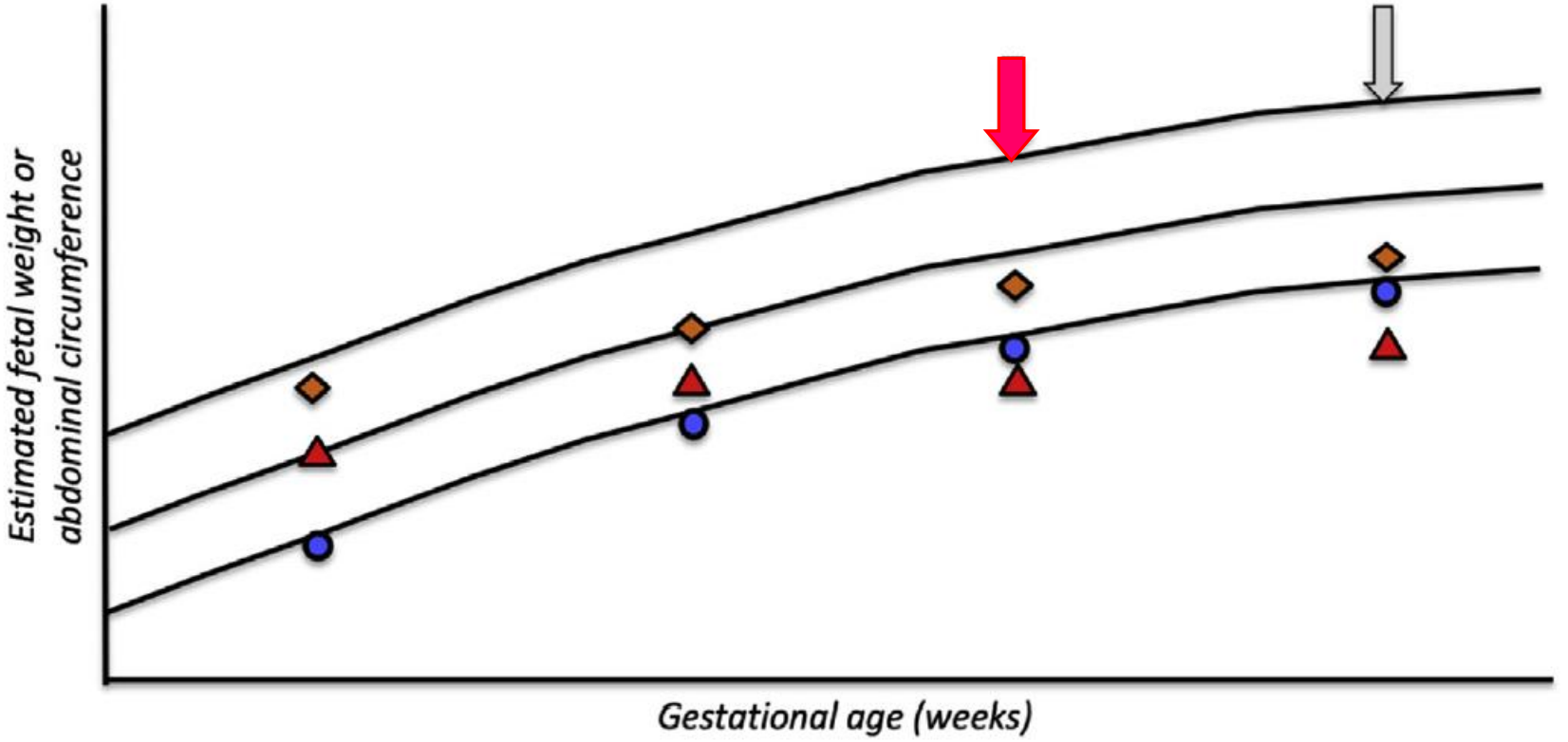
Discussion

# GROWTH POTENTIAL



# LONGITUDINAL EVALUATION

**FIGURE 2**
**Patterns of fetal growth in SGA and FGR**




Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

# SCREENING

**Fundal height**

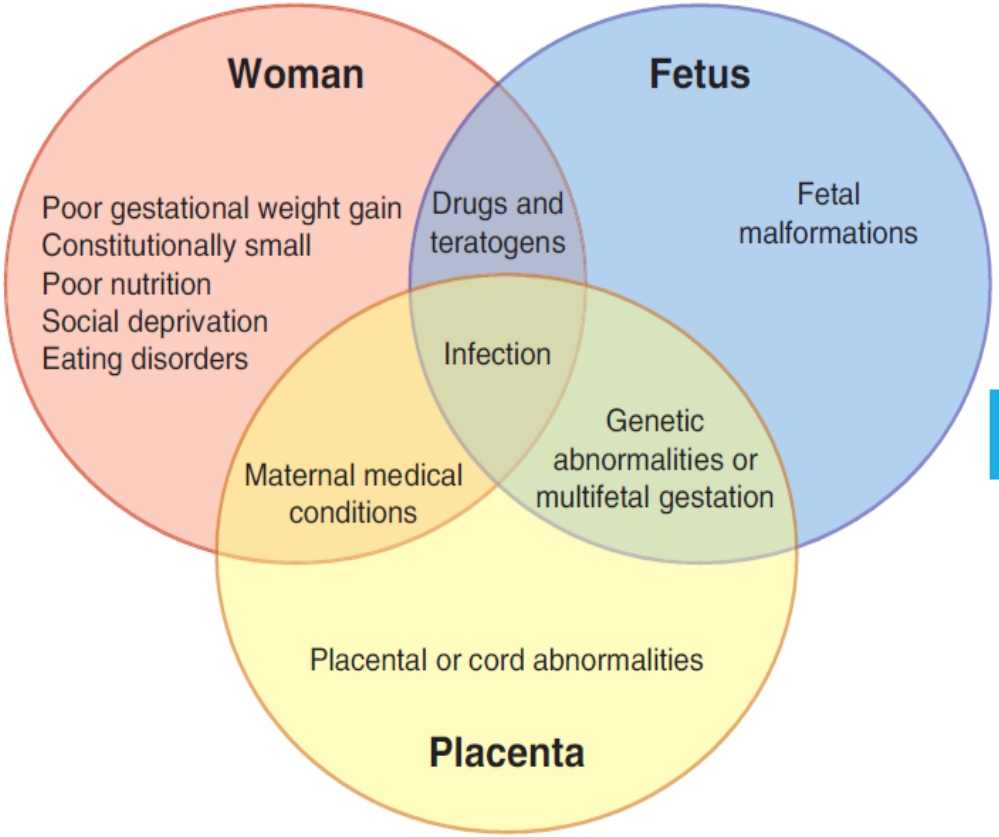
- Between 24-38 weeks
- Further assessment if discrepancy of greater than 3 cm
- Less accurate if maternal obesity, uterine leiomyoma or multiple gestation

**Ultrasound**

- BPD, HC, AC, FL
- Further evaluation if EFW or AC < 10$^{th}$ percentile
- AFI
- Doppler flow velocimetry

Discussion

# RISK FACTORS




Suboptimal uterine-placental perfusion and fetal nutrition

F. Gary Cunningham, Kenneth J. Leveno, Jodi S. Dashe, Barbara L. Hoffman, Catherine Y. Spong, Brian M. Casey - Williams Obstetrics, 26th Edition 2022. Fetal growth restriction.

# WORKUP

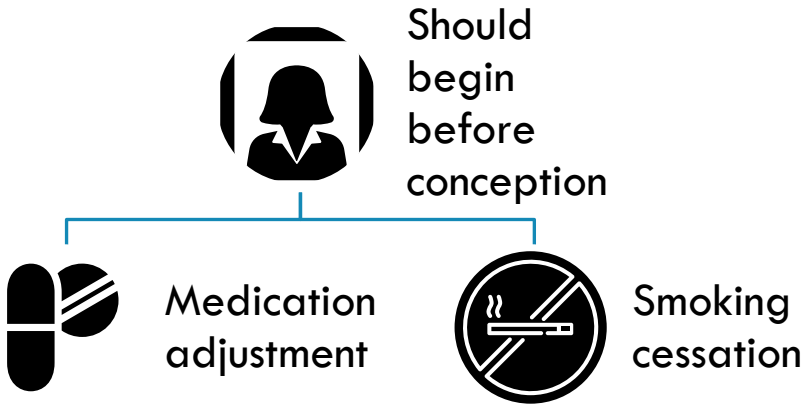
## Genetic counseling

- Early-onset FGR
- Structural abnormalities
- Polyhydramnios
- Suggest karyotyping and aCGH

## TORCH

- SMFM against screening for toxoplasmosis, rubella, or herpes in the absence of risk factors
- Amniotic fluid PCR for CMV

# TREATMENT AND PREVENTION

**TABLE**

## Main differential features between both clinical phenotypes of fetal growth restriction

| | Early FGR | Late FGR |
|---|---|---|
| Prevalence[7] | 0.5—1% | 5—10% |
| Challenge[10] | Management (gestational age at delivery) | Detection and diagnosis |
| Evidence of placental disease [1,7,a] | High<br>70% Abnormal umbilical Doppler<br>60% Association with preeclampsia<br>Severe angiogenic disbalance | Low<br><10% Abnormal umbilical Doppler<br>15% Association with preeclampsia<br>Mild angiogenic disbalance |
| Pathophysiology and oxygen delivered to brain[6] | Hypoxia +/+<br>Systemic cardiovascular adaptation | Hypoxia +/−<br>Central cardiovascular adaptation |
| Clinical impact[10] | High mortality and morbidity | Low mortality/morbidity + high prevalence = large etiological fraction of adverse outcomes |

*FGR*, fetal growth restriction.

[a] Crispi F, Dominguez C, Llurba E, Martin-Gallan P, Cabero L, Gratacos E. Placental angiogenic growth factors and uterine artery Doppler findings for characterization of different subsets in preeclampsia and in isolated intrauterine growth restriction. Am J Obstet Gynecol 2006;195:201-7.

*Figueras. Late-onset fetal growth restriction. Am J Obstet Gynecol 2018.*

Figueras F, Caradeux J, Crispi F, Eixarch E, Peguero A, Gratacos E. Diagnosis and surveillance of late-onset fetal growth restriction. Am J Obstet Gynecol. 2018 Feb;218(2S):S790-S802.e1. doi: 10.1016/j.ajog.2017.12.003. PMID: 29422212.

# DOPPLER FLOW STUDIES

Abnormal **umbilical artery** Doppler pulsatility index

- Increased impedance to flow in umbilical circulation
- Indicator of placental disease

Rate of perinatal death is reduced by **29%** when umbilical artery Doppler velocimetry is performed

AJOG American Journal of Obstetrics & Gynecology

VOLUME 211, ISSUE 4, P420.E1-420.E5, OCTOBER 01, 2014

## Objective

We sought to determine the cause of adverse perinatal outcome in fetal growth restriction (FGR) where umbilical artery (UA) Doppler was normal, as identified from the Prospective Observational Trial to Optimize Pediatric Health (PORTO). We compared cases of adverse outcome where UA Doppler was normal and abnormal.

## Study Design

The PORTO study was a national multicenter study of >1100 ultrasound-dated singleton pregnancies with an estimated fetal weight <10th centile. Each pregnancy underwent intensive ultrasound, including multivessel Doppler. UA Doppler was considered abnormal when the pulsatility index was >95th centile or end-diastolic flow was absent/reversed. Adverse perinatal outcome was defined as a composite of intraventricular hemorrhage, periventricular leukomalacia, hypoxic ischemic encephalopathy, necrotizing enterocolitis, bronchopulmonary dysplasia, sepsis, or death.

## Results

In all, 57 (5.0%) of the 1116 fetuses had an adverse perinatal outcome. Nine (1.3%) of 698 fetuses with normal UA Doppler had an adverse outcome, compared with 48 (11.5%) of 418 with abnormal UA Doppler ($P < .0001$). There were 2 perinatal deaths in the normal group and 6 in the abnormal group ($P = .01$). The perinatal deaths in the normal group were 1 case of pulmonary hypoplasia after prolonged preterm rupture of the membranes from 12 weeks' gestation and a case of placental abruption. Gestation at delivery was 33 ± 3 vs 31 ± 4 weeks ($P = .05$) and mean birthweight was 1830 ± 737 vs 1146 ± 508 g ($P = .001$) in the respective groups. Neonatal sepsis was the commonest adverse outcome in both groups: 0.1% and 0.4%, respectively ($P = .01$).

## Conclusion

Adverse perinatal outcome is uncommon in FGR with normal UA Doppler. The cases we identified were associated with heterogenous pathologies. FGR with normal UA blood flow is a largely benign condition.

O'Dwyer V, Burke G, Unterscheider J, Daly S, Geary MP, Kennelly MM, McAuliffe FM, O'Donoghue K, Hunter A, Morrison JJ, Dicker P, Tully EC, Malone FD. Defining the residual risk of adverse perinatal outcome in growth-restricted fetuses with normal umbilical artery blood flow. Am J Obstet Gynecol. 2014 Oct;211(4):420.e1-5. doi: 10.1016/j.ajog.2014.07.033. Epub 2014 Jul 25. PMID: 25068564.

AJOG American Journal of Obstetrics & Gynecology

VOLUME 218, ISSUE 2, SUPPLEMENT , S774-S782.E21, FEBRUARY 01, 2018

## Study Eligibility Criteria

The study criteria included observational cohort studies and randomized controlled trials of early-onset growth-restricted fetuses (diagnosed before 34 weeks of gestation), with information on the rate of fetal death occurring before 34 weeks of gestation and absent or reversed end-diastolic velocities in the umbilical artery and/or ductus venosus.

## Study Appraisal and Synthesis Methods

For quality assessment, 2 reviewers independently assessed the risk of bias using the Newcastle-Ottawa Scale for observational studies and the Cochrane Collaboration's tool for randomized trials. For the meta-analysis, odds ratio for both fixed and random-effects models (weighting by inverse of variance) were used. Heterogeneity between studies was assessed using $tau^2$, $\chi 2$ (Cochrane Q), and $I^2$ statistics. Publication bias was assessed by a funnel plot for meta-analyses and quantified by the Egger method.

## Results

A total o 31 studies were included in this meta-analysis The odds ratios for fetal death (random-effects models) were 3.59 (95% confidence interval, 2.3–5.6) 7.27 95% confidence interval, 4.6–11.4), and 11.6 95% confidence interval, 6.3–19.7) for growth-restricted fetuses wit umbilical artery absent end-diastolic velocities umbilical artery reversed end-diastolic velocities, and ductus venosus absent or reversed end-diastolic velocities respectively. There was no substantial heterogeneity among studies for any of the analyses.

## Conclusion

Early-onset growth-restricted fetuses with either umbilical artery or ductus venosus absent or reserved end-diastolic velocities are at a substantially increased risk for fetal death.

Caradeux J, Martinez-Portilla RJ, Basuki TR, Kiserud T, Figueras F. Risk of fetal death in growth-restricted fetuses with umbilical and/or ductus venosus absent or reversed end-diastolic velocities before 34 weeks of gestation: a systematic review and meta-analysis. Am J Obstet Gynecol. 2018 Feb;218(2S):S774-S782.e21. doi: 10.1016/j.ajog.2017.11.566. Epub 2017 Dec 9. PMID: 29233550.

AJOG American Journal of Obstetrics & Gynecology

VOLUME 218, ISSUE 2, SUPPLEMENT , S774-S782.E21, FEBRUARY 01, 2018

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## Results

A total o 31 studies w ts models) were 3.59 (95% confidence inter ce interval, 6.3–19.7) for growth-restricted f sed end-diastolic velocities, and ductus substantial heterogeneity among studies for any of the analyses.

**Stillbirth risk**

7% in Umb artery AEDV

19% in Umb artery REDV

20% in abnormal DV flow

46% in reversed a wave in DV flow

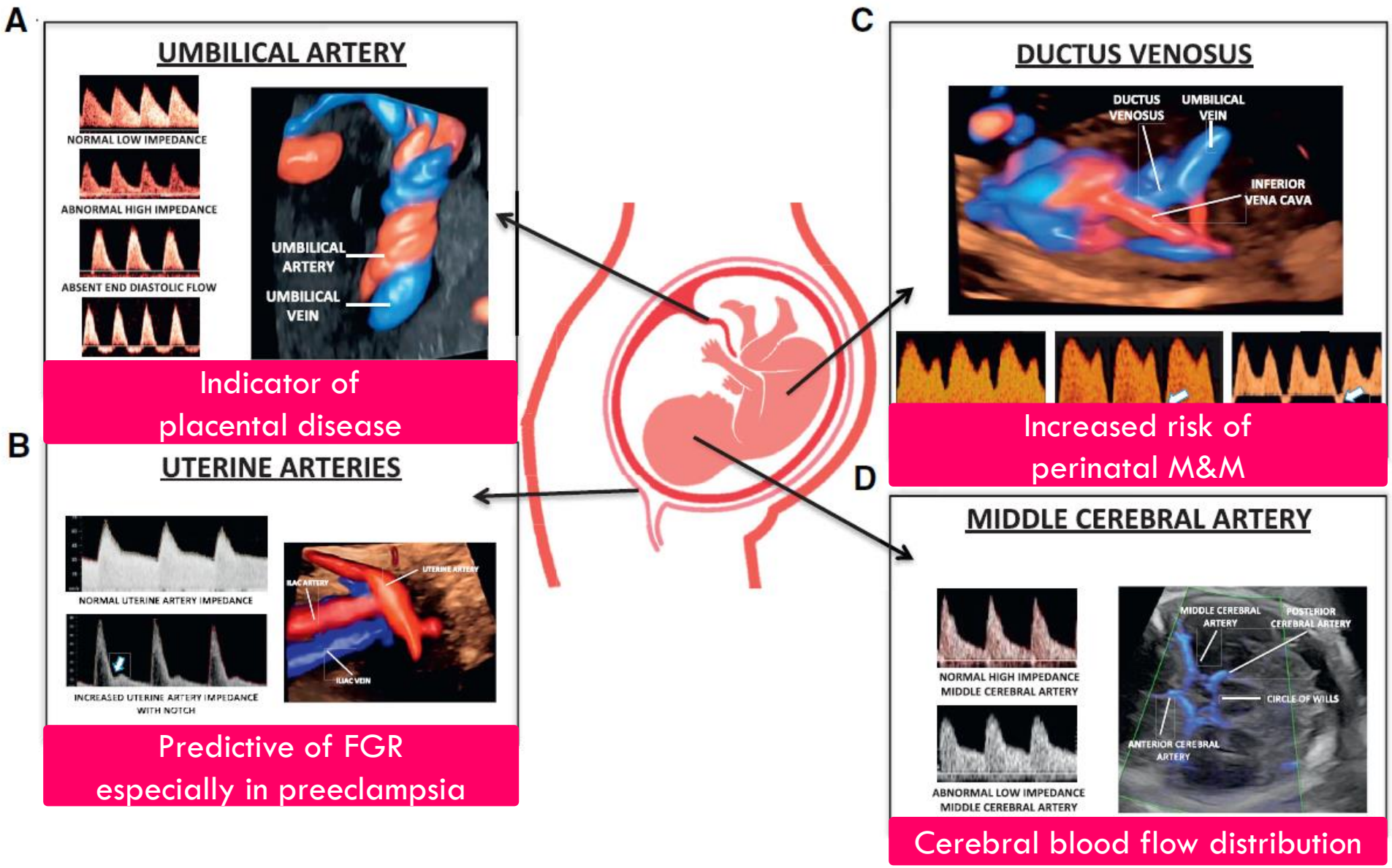
## Conclusion

Early-onset growth-restricted fetuses with either umbilical artery or ductus venosus absent or reserved end-diastolic velocities are at a substantially increased risk for fetal death.

Caradeux J, Martinez-Portilla RJ, Basuki TR, Kiserud T, Figueras F. Risk of fetal death in growth-restricted fetuses with umbilical and/or ductus venosus absent or reversed end-diastolic velocities before 34 weeks of gestation: a systematic review and meta-analysis. Am J Obstet Gynecol. 2018 Feb;218(2S):S774-S782.e21. doi: 10.1016/j.ajog.2017.11.566. Epub 2017 Dec 9. PMID: 29233550.

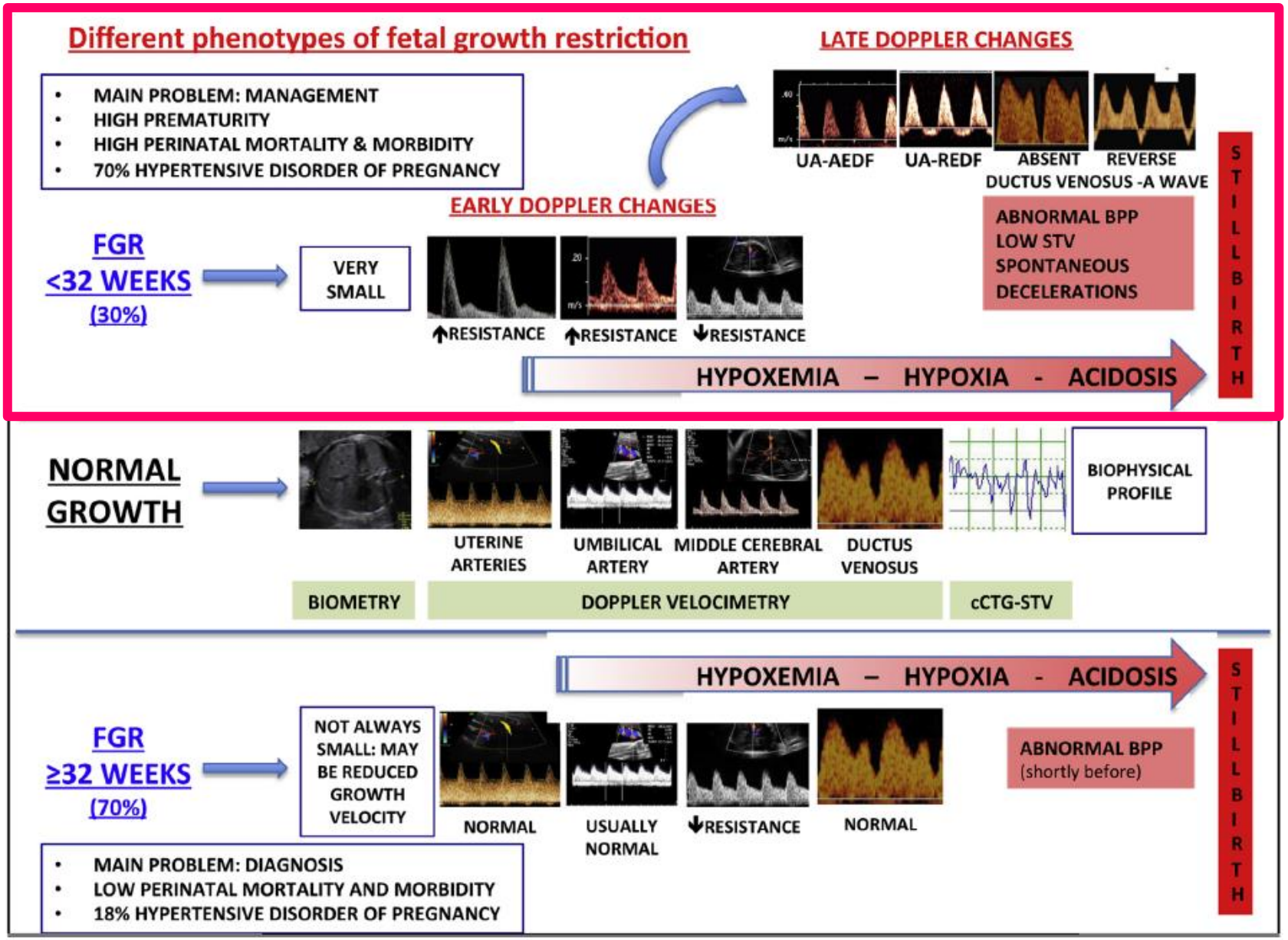
**FIGURE 3**

**Uteroplacental-fetal vascular components evaluated with Doppler velocimetry**




Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

**FIGURE 4**
**Different clinical and biophysical characteristics of early and late suspected FGR**




Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

Discussion

# TIMING OF DELIVERY

| Study trial | GRIT | DIGITAT |
|---|---|---|
| Full name | Growth Restriction Intervention Trial | Disproportionate Intrauterine Growth Intervention Trial at Term |
| Recruitment | 548 women (40% AEDV/REDV)<br>24 to 36 weeks of gestation | 321 singleton gestations<br>≥ 36 weeks of gestation |
| Arms | Randomized to early delivery group (within 48 hours) or expectant management group | Randomized to delivery or expectant management group |
| Outcomes | **No difference** in perinatal survival, cognitive, language, behavior, or motor abilities in 12-year follow-up | **No difference** in composite neonatal outcome, except for neonatal admission were lower after 38 weeks<br><br>**No difference** in neurodevelopmental and behavioral outcomes at age 2 |

# Discussion

THE LANCET

VOLUME 385, ISSUE 9983, P2162-2172, MAY 30, 2015

## 2 year neurodevelopmental and intermediate perinatal outcomes in infants with very preterm fetal growth restriction (TRUFFLE): a randomised trial

Dr Christoph C Lees, MD • Prof Neil Marlow, DM • Aleid van Wassenaer-Leemhuis, MD • Birgit Arabin, MD • Prof Caterina M Bilardo, MD • Prof Christoph Brezinka, MD • et al. Show all authors • Show footnotes

# TRUFFLE STUDY

## Objective

- To assess if fetal ductus venosus (DV) waveform could be used as indication for delivery instead of cardiotocography short-term variation (STV)

## Methods

- Prospective, multicenter RCT
- 2005 to 2010
- Singleton fetuses, 26 to 32 weeks
- EFW < 10$^{th}$ percentile and Umb A PI > 95$^{th}$ percentile
- 3 arms: Reduced STV, early DV change, late DV change
- Primary outcome
  - Survival without cerebral palsy
  - Bayley III development score < 85 at 2 y/o

# TRUFFLE STUDY

## Findings

- **Higher proportion** of survivors without neuroimpairment in **late DV change group**, but not significant (95 % vs 85%)
- Accompanied by non-significant **increase in perinatal and infant mortality**

## Why SMFM does not support

- Absent or reversed A wave of DV represents advanced stage of fetal compromise and is uncommon
- Only 41% in Umb A AEDV/REDV showed late DV change
- Delivery decision guided by DV accounted for only **11%** of pregnancy allocated to late DV change group

**TABLE 2**

**Differences between Society for Maternal-Fetal Medicine and International Society of Ultrasound in Obstetrics and Gynecology recommendations in the diagnosis, surveillance, and time of delivery decision of fetuses with suspected fetal growth restriction**

| Variable<br>Diagnosis of suspected FGR | SMFM recommendations<br>Estimated fetal weight or abdominal circumference <10th percentile | ISUOG recommendations<br>Delphi consensus criteria |
|---|---|---|
| | Surveillance | |
| UA | Yes | Yes |
| Ductus venosus | No | Yes |
| Middle cerebral artery | No | Yes |
| Cardiotocography | Yes | Yes |
| Short-term variation | No | Yes |
| | Delivery timing | |
| Ductus venosus | No | ≥26 0/7 to 31 6/7 wk: ductus venosus a-wave absent or reverse |
| UA reverse end-diastolic flow | 30–32 wk | >30 0/7 to 32 0/7 wk |
| UA absent end-diastolic flow | 33–34 wk | >32 0/7 to 34 0/7 wk |
| UA pulsatility index >95th percentile | 37 wk | ≥36 0/7 to 37 6/7 wk |
| Middle cerebral artery | No | 38 0/7 to 39 0/7 wk |
| Short-term variation | No | ≥26 0/7 to 28 6/7 wk: <2.6 ms<br>≥29 0/7 to 31 6/7 wk: <3.0 ms<br>≥32 0/7 wk: <3.5 ms<br>≥34 0/7 wk: <4.5 ms |

*FGR*, fetal growth restriction; *ISUOG*, International Society of Ultrasound in Obstetrics and Gynecology; *SMFM*, Society for Maternal-Fetal Medicine; *UA*, umbilical artery.

*Lees. Diagnosis and management of suspected fetal growth restriction. Am J Obstet Gynecol 2022.*

Lees CC, Romero R, Stampalija T, Dall'Asta A, DeVore GA, Prefumo F, Frusca T, et al. Clinical Opinion: The diagnosis and management of suspected fetal growth restriction: an evidence-based approach. Am J Obstet Gynecol. 2022 Mar;226(3):366-378. doi: 10.1016/j.ajog.2021.11.1357. Epub 2022 Jan 10. PMID: 35026129; PMCID: PMC9125563.

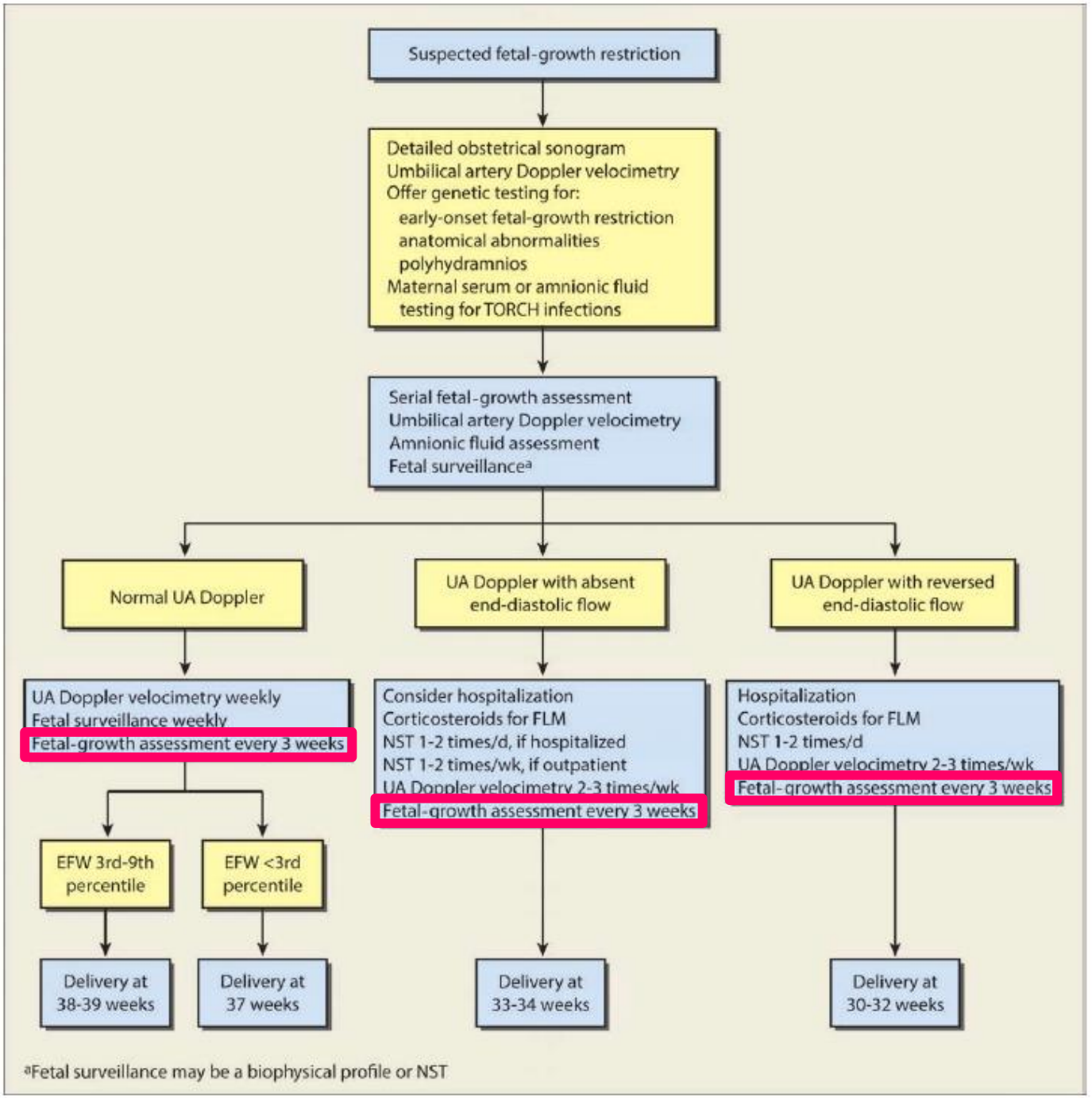
ACOG The American College of Obstetricians and Gynecologists
Society for Maternal-Fetal Medicine
VOL. 138, NO. 1, JULY 2021

# ACOG COMMITTEE OPINION

## Medically Indicated Late-Preterm and Early-Term Deliveries

| | | |
|---|---|---|
| Growth restriction (singleton) | | |
| Otherwise uncomplicated, no concurrent findings, EFW between 3rd and 10th percentile | Early term/full term | 38 0/7–39 0/7 weeks of gestation |
| Otherwise uncomplicated, no concurrent findings, EFW <3rd percentile | Early term | 37 0/7 weeks of gestation or at diagnosis if diagnosed later |
| Abnormal umbilical artery Doppler studies: elevated impedance to flow (eg, S/D ratio, pulsatility index, or resistance index greater than 95th percentile for gestational age) with end-diastolic flow still present | Early term | 37 0/7 weeks of gestation or at diagnosis if diagnosed later |
| Abnormal umbilical artery Doppler studies: absent end-diastolic flow | Preterm/late preterm | 33 0/7–34 0/7 weeks of gestation or at diagnosis if diagnosed later[§] |
| Abnormal umbilical artery Doppler studies: reversed end-diastolic flow | Preterm | 30 0/7–32 0/7 weeks of gestation or at diagnosis if diagnosed later[§] |
| Concurrent conditions (oligohydramnios, maternal comorbidity [eg, preeclampsia, chronic hypertension]) | Late preterm/early term | 34 0/7–37 6/7 weeks of gestation |
| Multiple gestations—complicated | | |
| Dichorionic-diamniotic twins with isolated fetal growth restriction | Late preterm/early term | 36 0/7–37 6/7 weeks of gestation |
| Dichorionic-diamniotic twins with concurrent condition | Late preterm | Individualized |
| Monochorionic-diamniotic twins with isolated fetal growth restriction | Preterm/late preterm | 32 0/7–34 6/7 weeks of gestation |

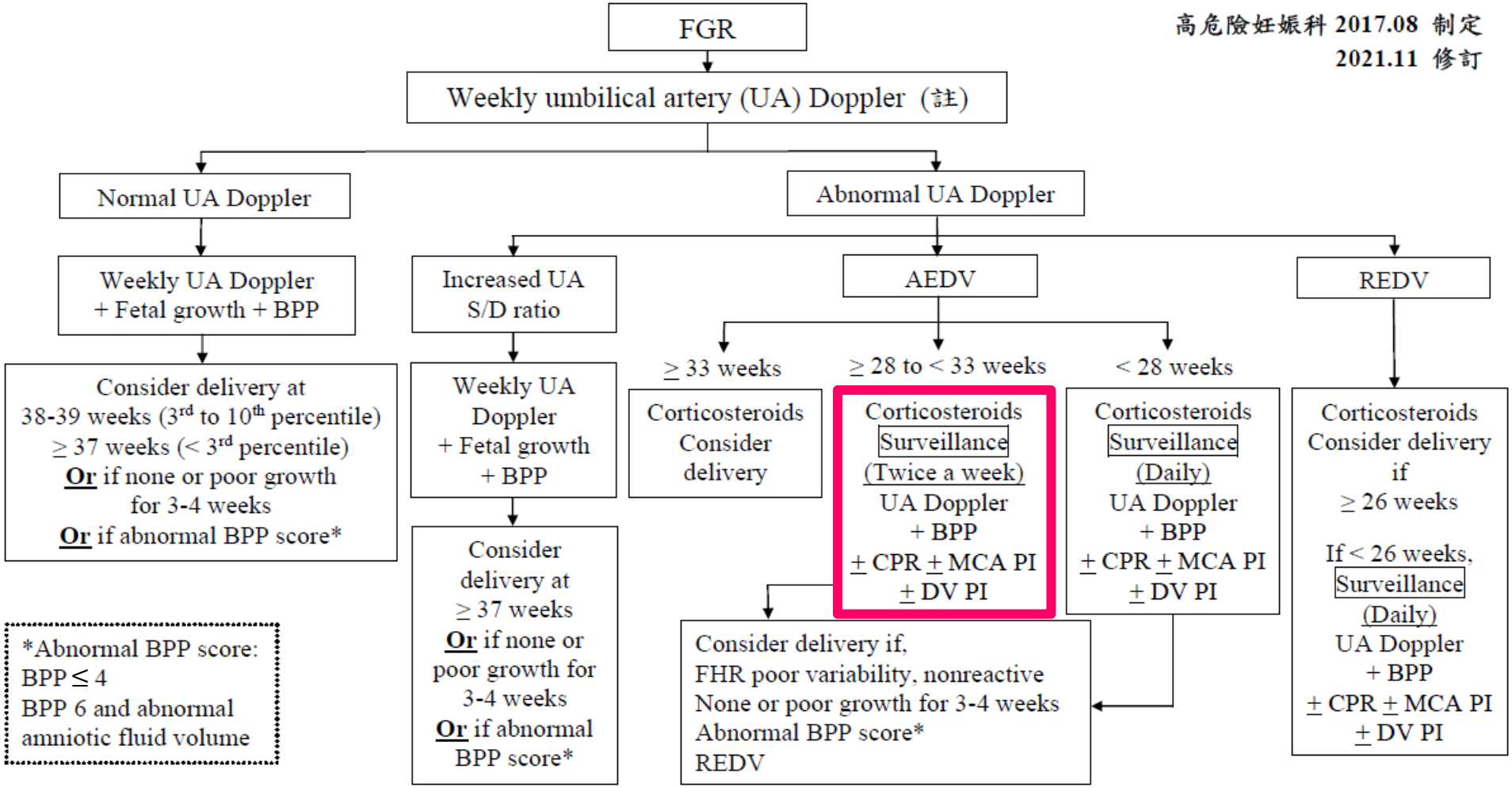
American College of Obstetricians and Gynecologists' Committee on Obstetric Practice, Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. Obstet Gynecol. 2021 Jul 1;138(1):e35-e39. doi: 10.1097/AOG.0000000000004447. PMID: 34259491.




F. Gary Cunningham, Kenneth J. Leveno, Jodi S. Dashe, Barbara L. Hoffman, Catherine Y. Spong, Brian M. Casey - Williams Obstetrics, 26th Edition 2022. Fetal growth restriction.

# 胎兒生長遲滯 (Fetal growth restriction, FGR) 臨床處理建議流程

高危險妊娠科 2017.08 制定
2021.11 修訂




註: 可加作 MCA (middle cerebral artery) PI, CPR (cerebroplacental ratio), DV (ductus venosus) PI 等作為參考。

編輯人: Fellow 蘇伶澄/鄧肇雄


參考資料:

(1) Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. Obstet Gynecol 2021;138:e35-e39.
(2) Doppler assessment of the fetus with intrauterine growth restriction, SMFM Clinical Guideline. Am J Obstet Gynecol 2012;206:300-308.
(3) Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol. Fetal Diagn Ther 2014;36:86-98.
(4) Intrauterine growth restriction: new concepts in antenatal surveillance, diagnosis, and management. Am J Obstet Gynecol 2011;204:288-300.
(5) Evidence-based approach to umbilical artery Doppler fetal surveillance in high-risk pregnancies: an update. Clin Obstet Gynecol 2010;53:869-878.
(6) Williams Obstetrics, 26th edition.

# BEFORE DELIVERY

**Magnesium sulfate**

- < 32 weeks

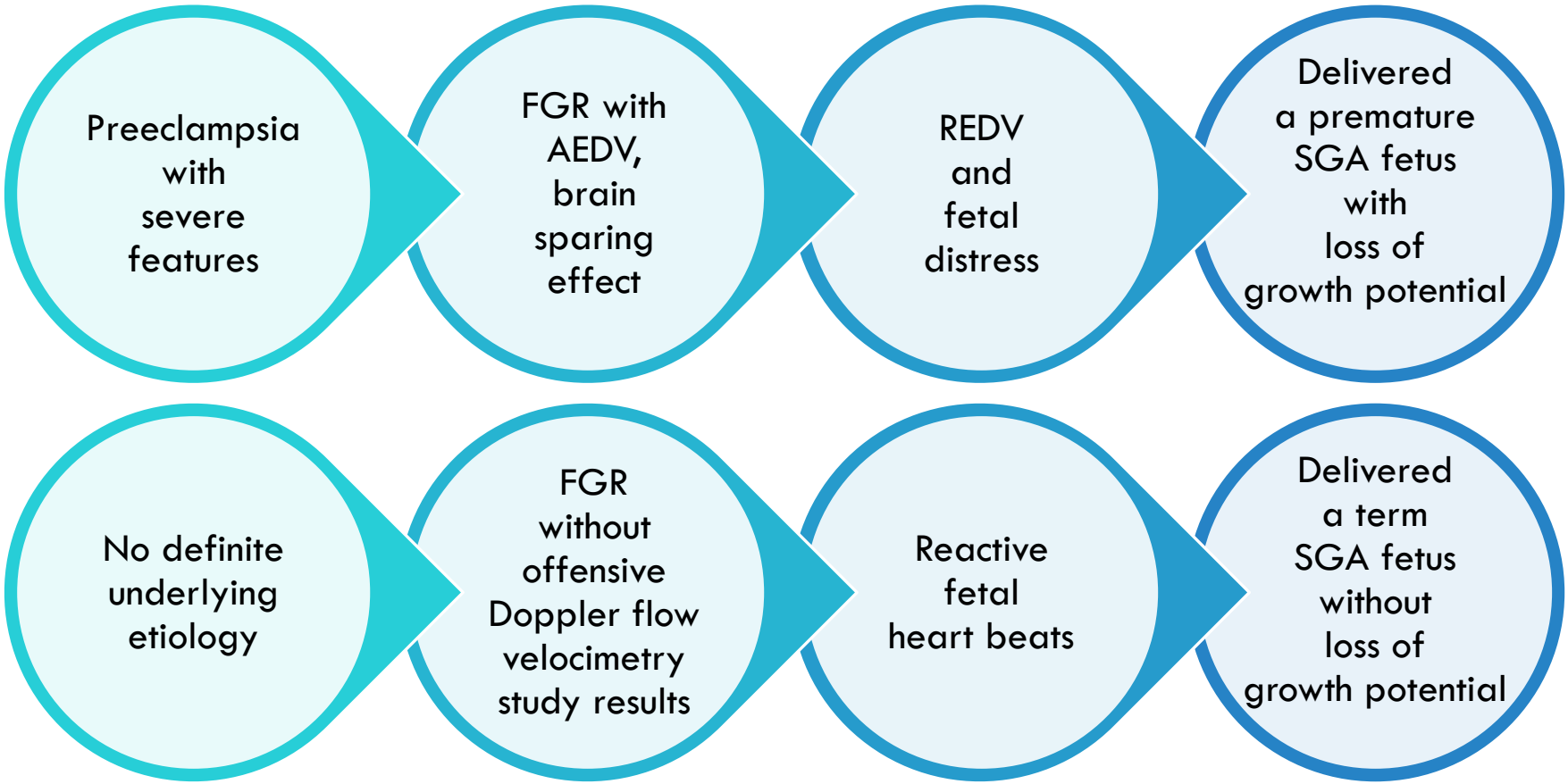
**Antenatal corticosteroid**

- < 34 weeks
- 34 to 36+6 weeks without previous course

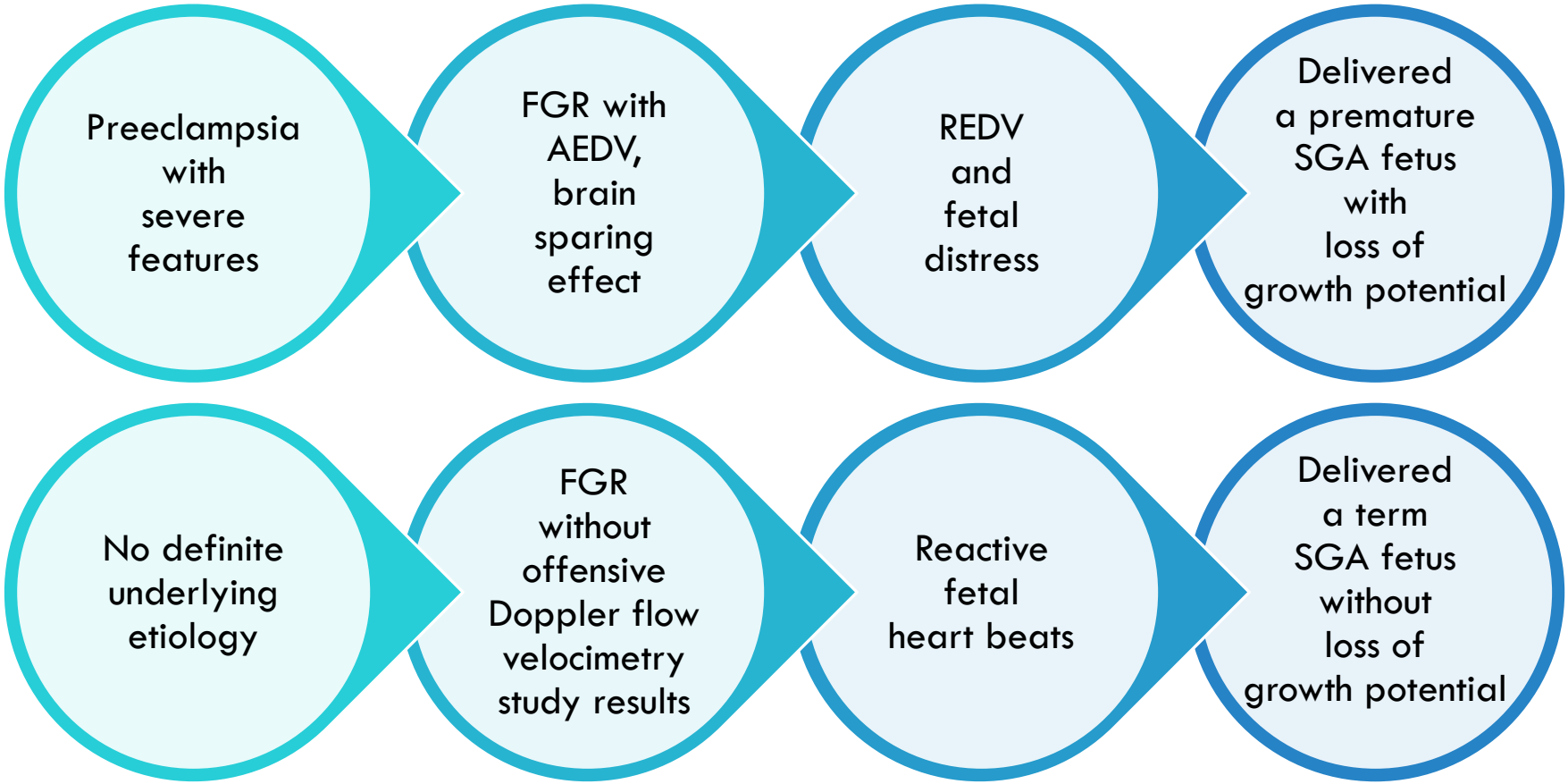
Should be planned at an institute **with NICU** if < 34 weeks

**Route of delivery depends on clinical scenario**

# TAKE HOME MESSAGES



# TAKE HOME MESSAGES



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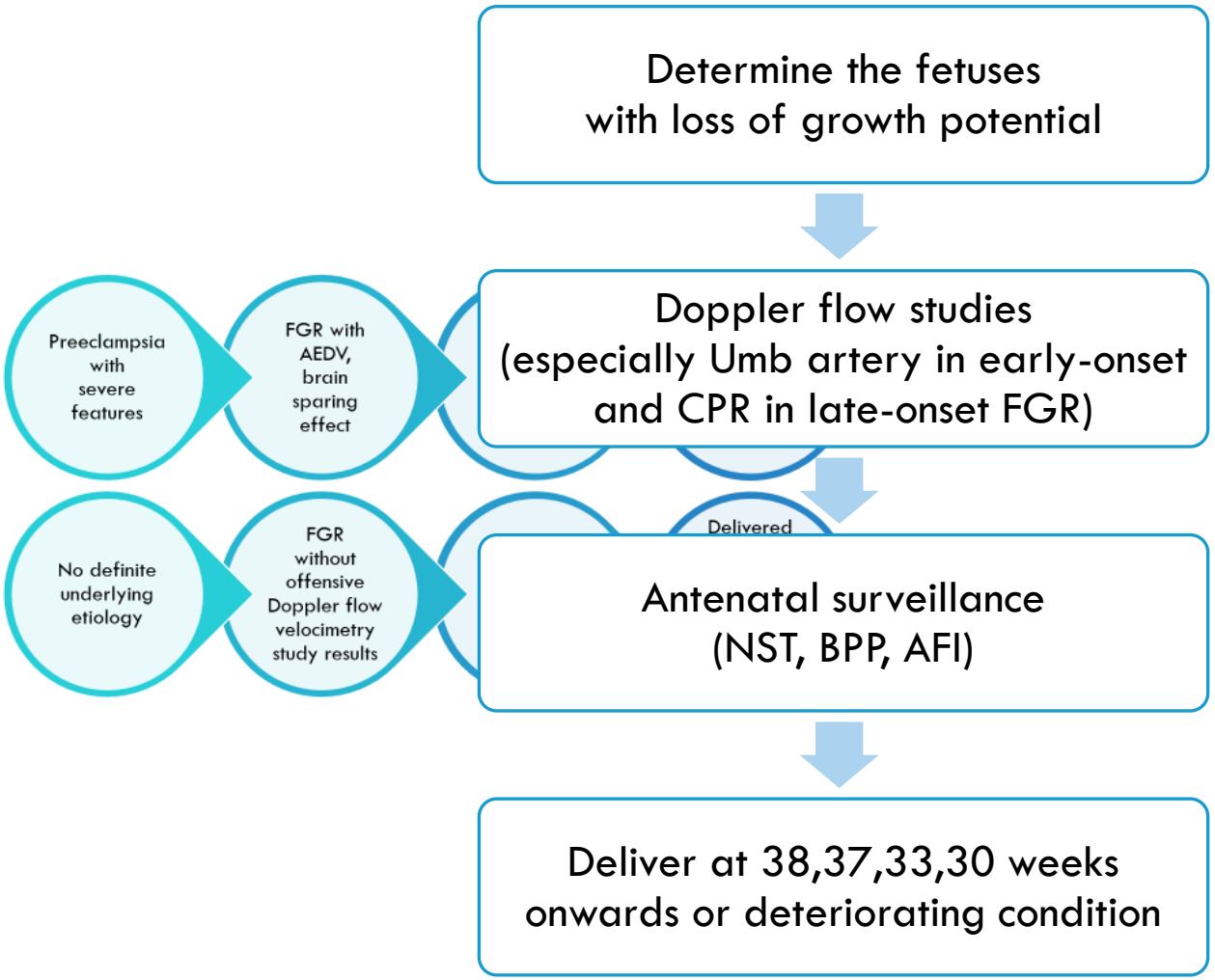

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Gordijn SJ, Beune IM, Thilaganathan B, Papageorghiou A, Baschat AA, Baker PN, Silver RM, Wynia K, Ganzevoort W. Consensus definition of fetal growth restriction: a Delphi procedure. Ultrasound Obstet Gynecol. 2016 Sep;48(3):333-9. doi: 10.1002/uog.15884. PMID: 26909664.

Figueras F, Caradeux J, Crispi F, Eixarch E, Peguero A, Gratacos E. Diagnosis and surveillance of late-onset fetal growth restriction. Am J Obstet Gynecol. 2018 Feb;218(2S):S790-S802.e1. doi: 10.1016/j.ajog.2017.12.003. PMID: 29422212.

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F. Gary Cunningham, Kenneth J. Leveno, Jodi S. Dashe, Barbara L. Hoffman, Catherine Y. Spong, Brian M. Casey - Williams Obstetrics, 26th Edition 2022. Fetal growth restriction.

Hsieh WS, Wu HC, Jeng SF, Liao HF, Su YN, Lin SJ, Hsieh CJ, Chen PC. Nationwide singleton birth weight percentiles by gestational age in Taiwan, 1998-2002. Acta Paediatr Taiwan. 2006 Jan-Feb;47(1):25-33. PMID: 17016966.

☺ Thank you for your attention ☺