New Zealand Obstetric Doppler Guideline

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This is a New Zealand guideline for the performance of obstetric Doppler examinations. The guideline incorporates detailed notes on correct Doppler technique, interpretation and reference charts for each of commonly used obstetric Doppler examinations. All health practitioners involved in the performance and interpretation of obstetric ultrasound examinations are encouraged to use this document and incorporate the principles and reference values into their clinical practice.

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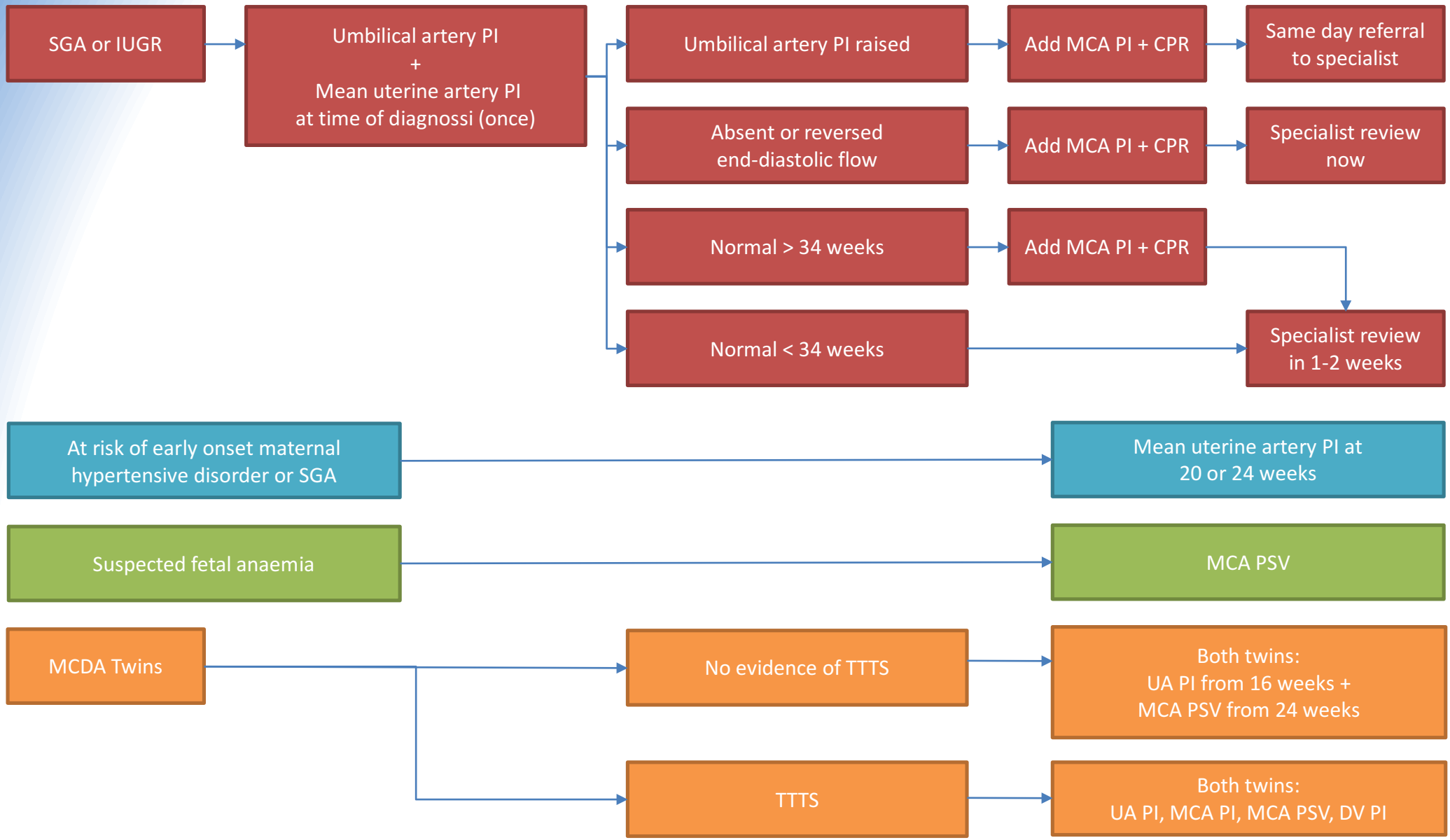
Contributors: Martin Necas, Dr Emma Parry, Professor Lesley McCowan

Which Doppler Test When?



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Umbilical Artery Pulsatility Index (UA PI)

Indications:

- Suspected or known small for gestational age (SGA) fetus
- The estimated fetal weight on the GROW chart is <10th percentile
- The estimated fetal weight on the GROW chart is dropping percentiles by ≥30%
- The abdominal circumference on the population scan chart is < 5th percentile
- Discrepancy (≥30%)between the head and abdominal circumference percentile with lower AC percentile
- Maternal hypertensive disorders e.g. preeclampsia
- Decreased fetal movements

Not indicated:

- Routine screening of normal pregnancies with no maternal or fetal risk factors

How to perform the test:

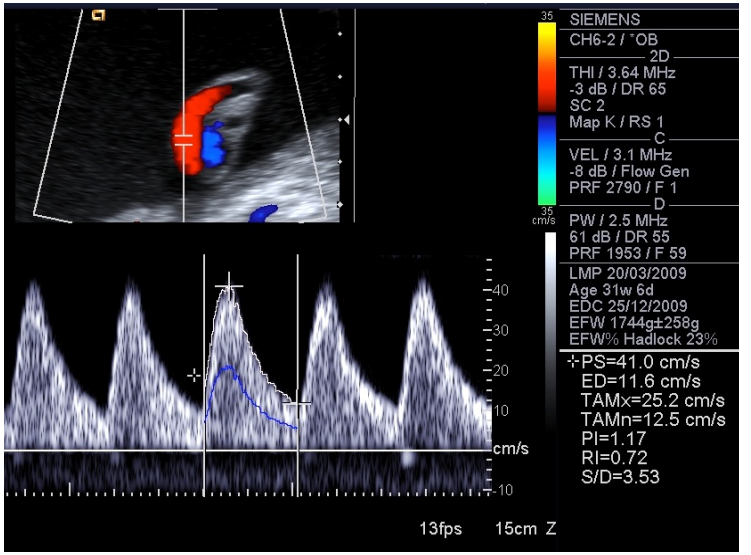
- Perform assessment during fetal quiescence
- Always keep TIb<0.5 if possible or at least <1 by reducing the acoustic output power
- Identify a free loop of umbilical cord on colour Doppler
- Use high colour PRF to avoid aliasing and conservative gain to avoid colour bleeding
- Position the sample volume in a portion of the cord coursing parallel to Doppler beam
- Avoid sampling in such a way that the Doppler beam is directed towards fetal eyes
- Optimise the spectral Doppler baseline, PRF and sweep speed to get a large waveform
- If the EDV is near the baseline, ensure wall filter is sufficiently low to display EDV
- If the PI is within normal range, only sample one of the umbilical arteries
- If the PI is abnormal, sample both umbilical arteries and use the more normal (lower) value
- If the end-diastolic flow is absent or reversed, comment on this finding in the report

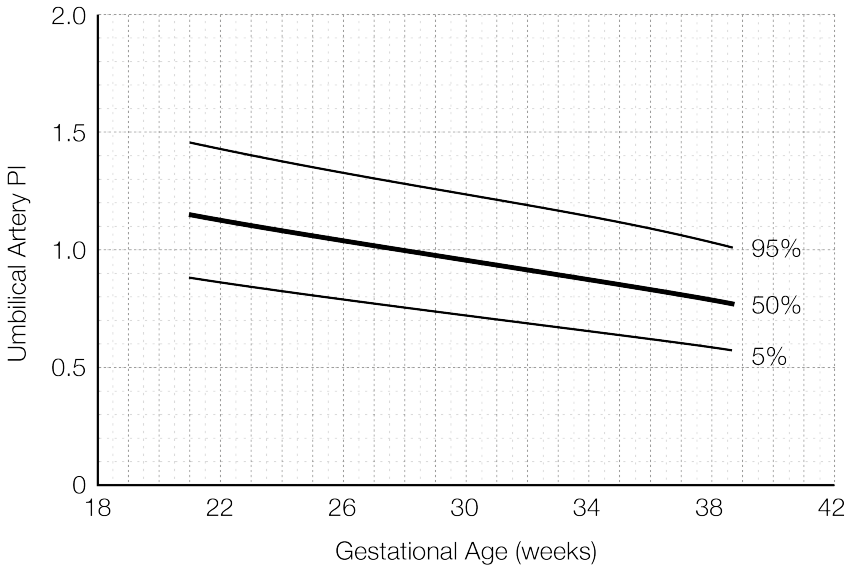
How to interpret the test:

- >95th percentile is abnormal

Common pitfalls:

- Poor Doppler angle and poor optimisation leading to fuzzy waveform which is hard to measure
- End-diastolic flow is not visualised due to high filter setting
- End-diastole is not well visualised when EDV is near baseline because of venous contamination - readjust sampling to avoid capturing adjacent UV





Reference: Ebbing, C., Rasmussen, S., & Kiserud, T. Middle cerebral artery blood flow velocities and pulsatility index and the cerebroplacental pulsatility ratio: longitudinal reference ranges and terms for serial measurements. Ultrasound Obstet Gynecol, 2007. 30(3): p. 287-96.

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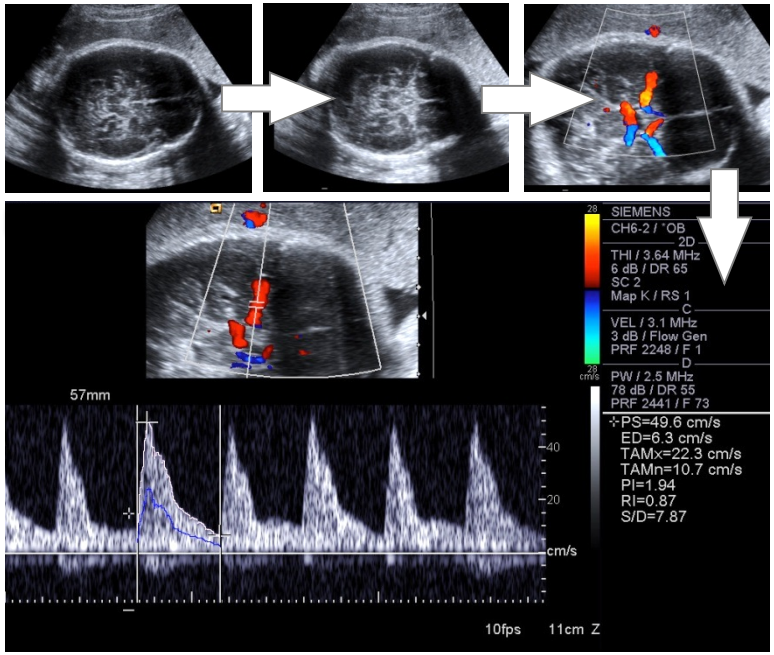
Middle Cerebral Artery Pulsatility Index (MCA PI)

Indications:

- SGA with abnormal UA PI at any gestational age
- SGA with normal UA PI after 34 weeks gestational age
- MCDA twin gestation with TTTS

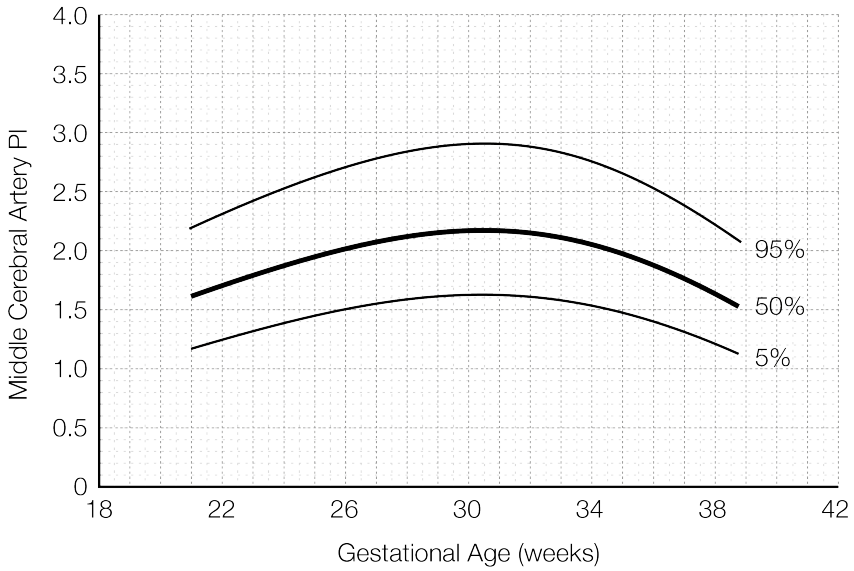
How to perform the test:

- Perform assessment during fetal quiescence
- Always keep TIb<0.5 if possible or at least <1 by reducing the acoustic output power
- Start with the BPD view
- Move caudally to visualise the butterfly shape of suprasellar cisterns and the sphenoid
- Use the coronal suture/sphenoidal fontanelle as an acoustic window
- Use high definition (write) zoom
- Activate colour Doppler to visualise the MCA
- Assess the MCA which is closer to the transducer
- Move anteriorly and angle back to align the MCA flow direction with the Doppler beam
- Position a small (0.5-1mm) sample volume 2mm beyond from the MCA origin
- Optimise the spectral Doppler baseline and PRF to get a large waveform



How to interpret the test:

- <5th percentile is abnormal



Common pitfalls:

- Poor Doppler angle and poor optimisation leading to fuzzy waveform which is hard to measure
- Gate too close to MCA origin where multidirectional contamination from ACA and PCoA occurs
- Sample positioned too peripherally in the MCA where velocities fall
- PCA misidentified as MCA
- Poor visualisation due to inadequate zoom

Reference: Ebbing, C., Rasmussen, S., & Kiserud, T. Middle cerebral artery blood flow velocities and pulsatility index and the cerebroplacental pulsatility ratio: longitudinal reference ranges and terms for serial measurements. Ultrasound Obstet Gynecol, 2007. 30(3): p. 287-96.

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Cerebroplacental Ratio (CPR)

Indications:

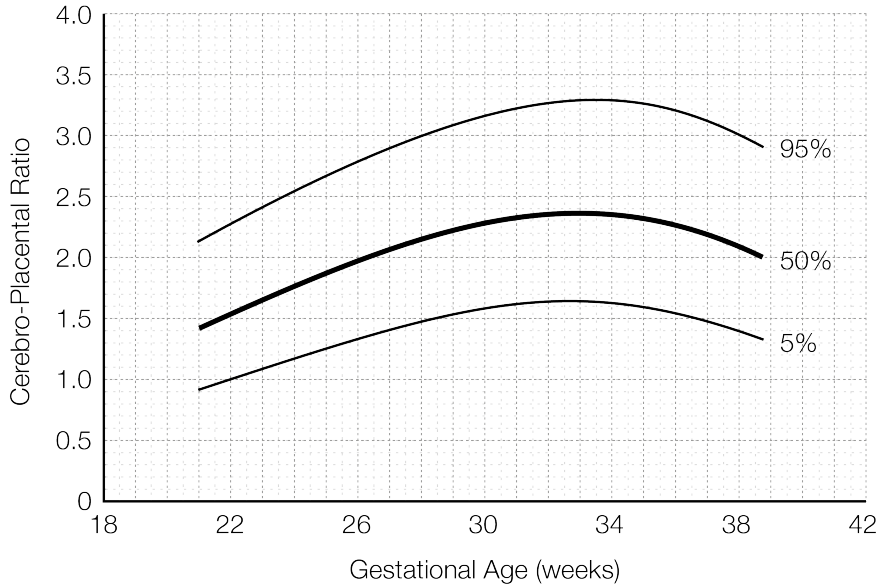
- If MCA PI assessment was performed, the CPR should be calculated and recorded

How to calculate CPR:

- The CPR is defined the ratio of MCA PI and UA PI

How to interpret the test:

- <5th percentile is abnormal
- Note: It can be helpful to plot the MCA and CPR results on serial assessments to determine the trend



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Ductus Venosus Pulsatility Index (DV PI)

Indications:

- Markedly raised UA PI (>>95th) and reduced MCA PI in preterm SGA
- MCDA twin gestation with TTTS or selective IUGR

How to perform the test:

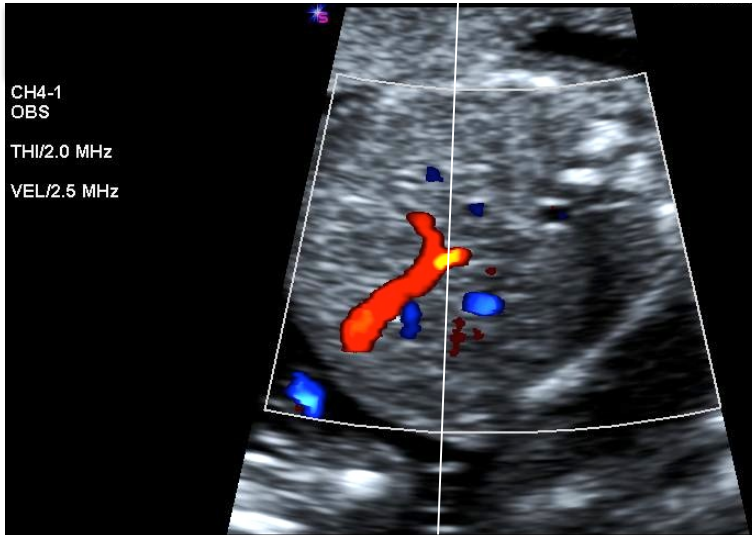
- Perform assessment during fetal quiescence
- Always keep TIb<0.5 if possible or at least <1 by reducing the acoustic output power
- Sagittal and transverse approaches are acceptable as long as Doppler angle is 0-60 degrees
- Activate colour Doppler to identify DV at the end of UV
- Enlarge the image
- 0.5-1mm gate placed in the inlet of DV
- Set wall filter low, sweep speed high
- Optimise the spectral Doppler baseline and PRF to get a large waveform
- If PI>95th percentile, assess umbilical vein for pulsatility

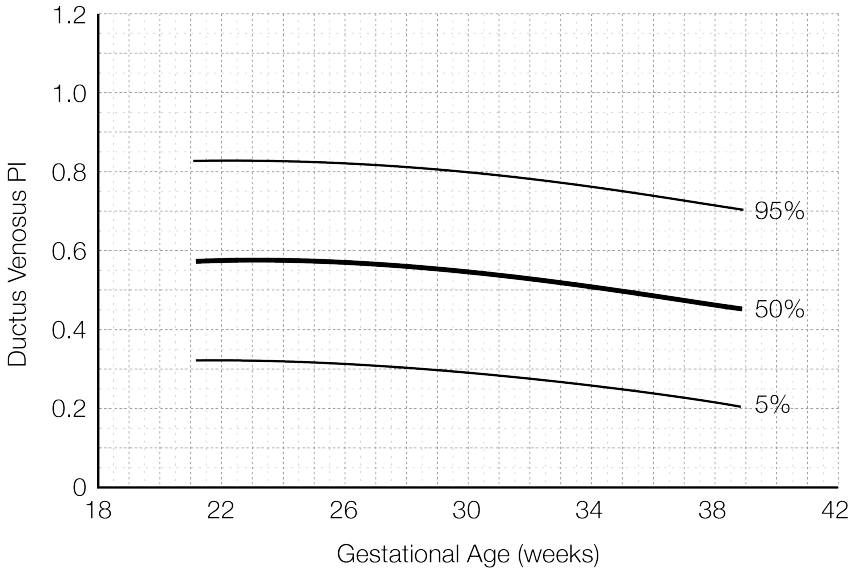
How to interpret the test:

- >95th percentile is abnormal

Common Pitfalls

- Colour PRF too low and gain too high leading to difficulty in DV identification amongst other vessels
- Sample size too large, leading to contamination from other vessels
- Sample not placed at the inlet of the DV
- Adjacent hepatic vein or celiac axis misidentified as DV
- Poor Doppler angle and poor optimisation leading to fuzzy waveform which is hard to measure
- Fetal breathing activity may result in false impression of absent A wave





Reference: Kessler, J., Rasmussen, S., Hnson, M., & Kiserud, T. Longitudinal reference ranges for ductus venosus flow velocities and waveform indices. Ultrasound Obstet Gynecol, 2006. 28: 890-898.

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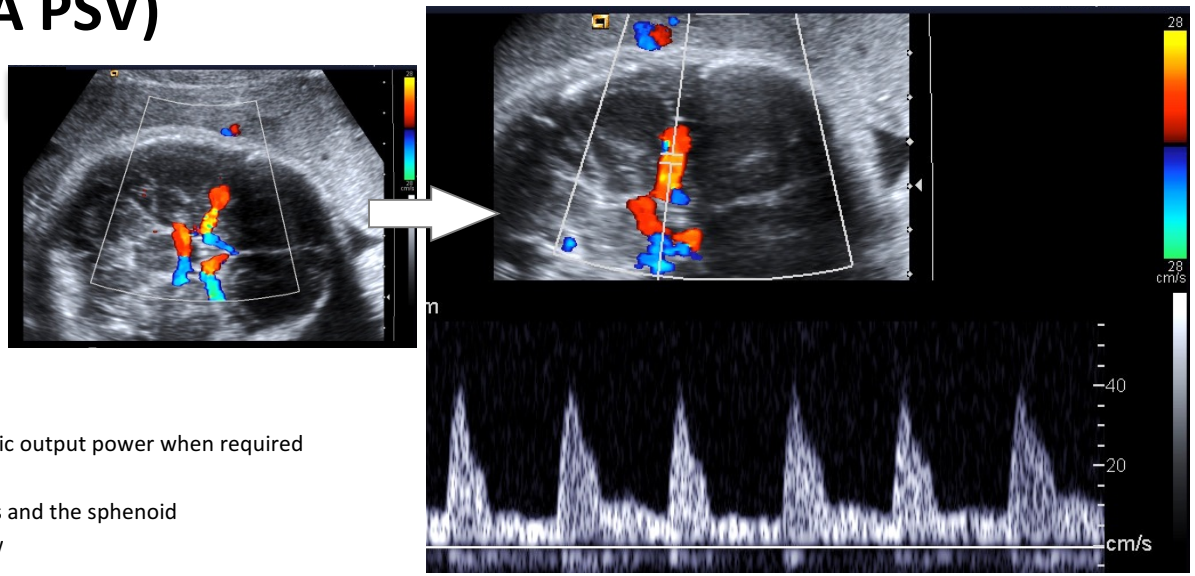
MCA Peak Systolic Velocity (MCA PSV)



Indications:

- Maternal-fetal isoimmunisation
- Any suspicion of fetal anaemia
- Unexplained hydrops
- MCDA twins >24 weeks gestational age
- MCDA twins with known or suspected of TTTS or TAPS

How to do perform the test:

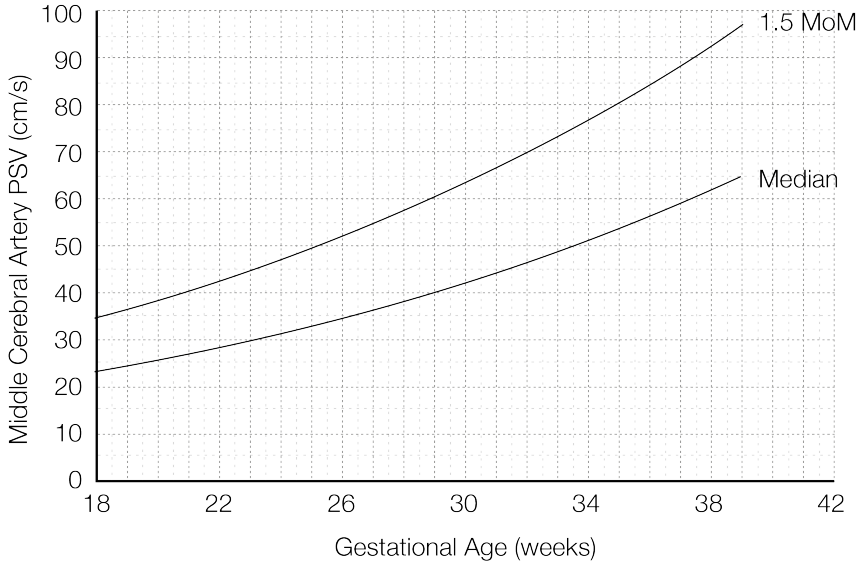
- Perform assessment during fetal quiescence
- Always keep TIb<0.5 if possible or at least <1 by reducing the acoustic output power when required
- Start with the BPD view
- Move caudally to visualise the butterfly shape of suprasellar cisterns and the sphenoid
- Use the coronal suture/sphenoidal fontanelle as an acoustic window
- Use high definition (write) zoom
- Activate colour Doppler to visualise the MCA and assess the MCA which is closer to the transducer
- Move anteriorly and angle back to align the MCA flow direction with the Doppler beam
- Ideal interrogation angle is 0 degrees but 30 degrees or less is acceptable
- Position a small (0.5-1mm) sample volume 2 mm beyond from the MCA origin
- Optimise the spectral Doppler baseline and PRF to get a large waveform
- If the Doppler angle is not zero, angle correction must be used
- If PSV>1.5 multiples of the median (MoM), obtain 3 high quality samples and use the highest value

How to interpret the test:

- >1.5MoM is abnormal

Common Pitfalls:

- Poor Doppler angle and poor optimisation leading to fuzzy waveform which is hard to measure
- Gate too close to MCA origin where multidirectional contamination from ACA and PCoA occurs
- Sample positioned too peripherally in the MCA where velocities fall
- PCA misidentified as MCA
- Failure to angle-correct at angles other than 0 leading to underestimation of PSV
- Poor visualisation due to inadequate zoom



References:

Mari, G. Noninvasive Diagnosis by Doppler ultrasonography of fetal anemia due to maternal red-cell alloimmunization. N Engl J Med 2000; 342:9-14, p 9-14.

Mari, G. Middle cerebral artery peak systolic velocity for the diagnosis of fetal anemia: the untold story. Ultrasound Obstet Gynecol 2005 Apr;25(4):323-30.

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Mean uterine Artery Pulsatility Index

Indications:

- Screen patients at high risk of early preeclampsia or early SGA at 20 or 24 weeks
- If abnormal at 20 weeks, repeat at 24 weeks
- Early onset IUGR
- Current hypertensive disorder in pregnancy
- Full assessment of suspected SGA pregnancy

How to perform the test:

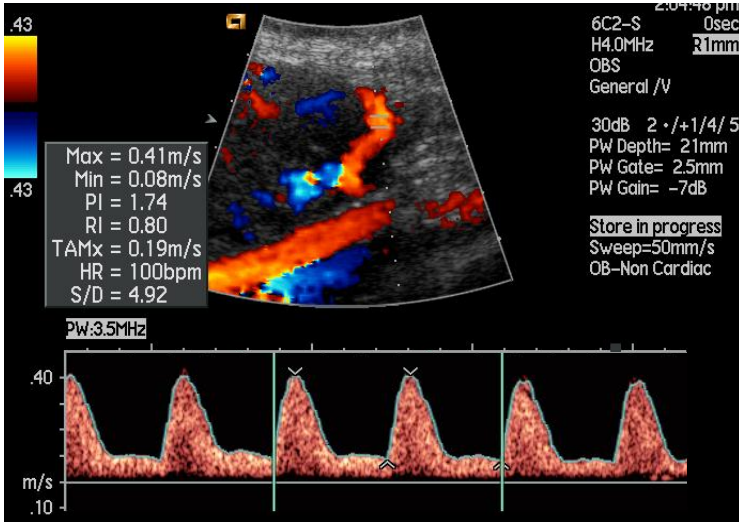
- Locate the maternal anterior superior iliac spine and angle medially
- Alternatively visualize the external iliac artery (EIA)
- The uterine artery is typically seen crossing the EIA anteriorly
- Select a portion of the uterine artery which courses at a favourable Doppler angle 0-60 degrees
- Optimise the spectral Doppler baseline and PRF to get a large waveform
- Measure the right and left PI and calculate the mean value

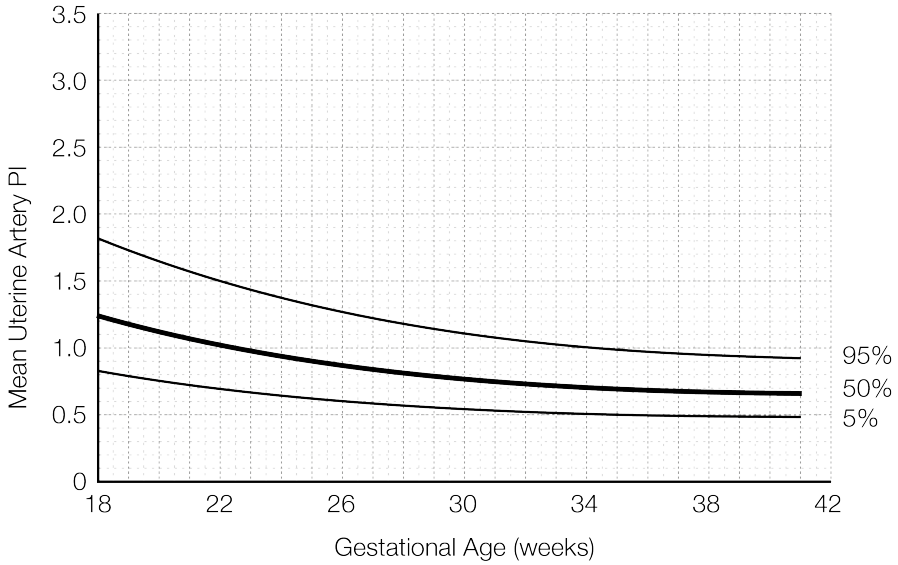
How to interpret the test:

- >95th percentile is abnormal
- Bilateral notching after 24 weeks is abnormal

Common Pitfalls:

- Failure to identify the uterine artery by not scanning inferiorly enough





Reference:

Gomez O., et al. Reference ranges for uterine mean pulsatility index at 11-41 weeks of gestation. Ultrasound Obstet Gynecol 2008; 32: 128-132.

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Quick Reference Tables

Gestation Weeks	Umbilical Artery PI ◆ >95th percentile is abnormal		MCA PI ◆ <5th percentile is abnormal		Cerebroplacental Ratio (CPR) ◆ CPR = MCA PI/UA PI <5th percentile is abnormal		Mean Uterine Artery PI ✦ Mean PI=(RT PI + LT PI)/2 >95th percentile is abnormal	
	50th percentile	95th percentile	50th percentile	5th percentile	50th percentile	5th percentile	50th percentile	95th percentile
18							1.20	1.79
19	1.25*	1.63*					1.15	1.70
20	1.22*	1.59*					1.10	1.61
21	1.15	1.46					1.05	1.54
22	1.13	1.43					1.00	1.47
23	1.10	1.40					0.96	1.41
24	1.08	1.38	1.86	1.38	1.74	1.16	0.93	1.35
25	1.06	1.35	1.94	1.44	1.85	1.24	0.89	1.30
26	1.04	1.33	2.01	1.50	1.95	1.32	0.86	1.25
27	1.02	1.31	2.06	1.55	2.05	1.40	0.84	1.21
28	1.00	1.28	2.11	1.58	2.14	1.47	0.81	1.17
29	0.98	1.26	2.15	1.61	2.21	1.53	0.79	1.13
30	0.96	1.24	2.16	1.62	2.28	1.58	0.77	1.10
31	0.94	1.21	2.16	1.62	2.32	1.62	0.75	1.06
32	0.92	1.19	2.14	1.61	2.35	1.64	0.73	1.04
33	0.90	1.16	2.10	1.58	2.36	1.65	0.71	1.01
34	0.88	1.14	2.04	1.53	2.35	1.63	0.70	0.99
35	0.86	1.11	1.96	1.47	2.32	1.60	0.69	0.97
36	0.84	1.09	1.86	1.39	2.27	1.55	0.68	0.95
37	0.81	1.06	1.75	1.30	2.19	1.48	0.67	0.94
38	0.79	1.03	1.63	1.20	2.09	1.40	0.66	0.92
39	0.77	1.00	1.49	1.10	1.97	1.29	0.65	0.91
40	0.75*	1.07*	1.29※	1.02※	1.80※	1.24※	0.65	0.90

References:

* Acharya G, et al. Reference ranges for serial measurements of blood velocity and pulsatility index at the intra-abdominal portion, and fetal and placental ends of umbilical artery. Ultrasound Obstet Gynecol 2005; 26:162-169.

❖ Ebbing, C., Rasmussen, S., & Kiserud, T. Middle cerebral artery blood flow velocities and pulsatility index and the cerebroplacental pulsatility ratio: longitudinal reference ranges and terms for serial measurements. Ultrasound Obstet Gynecol, 2007. 30(3): p. 287-96.

※ Baschat AA, Gembruch U. The cerebroplacental Doppler ratio revisited. Ultrasound Obstet Gynecol 2003; 21:124-127.

✦ Gomez O, et al. Reference ranges for uterine mean pulsatility index at 11-41 weeks of gestation. Ultrasound Obstet Gynecol 2008; 32: 128-132.

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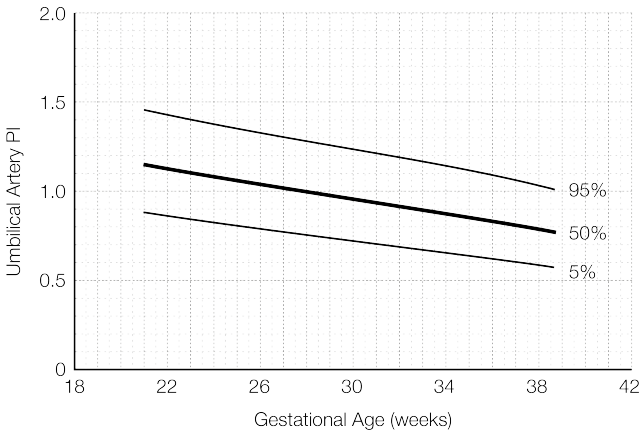
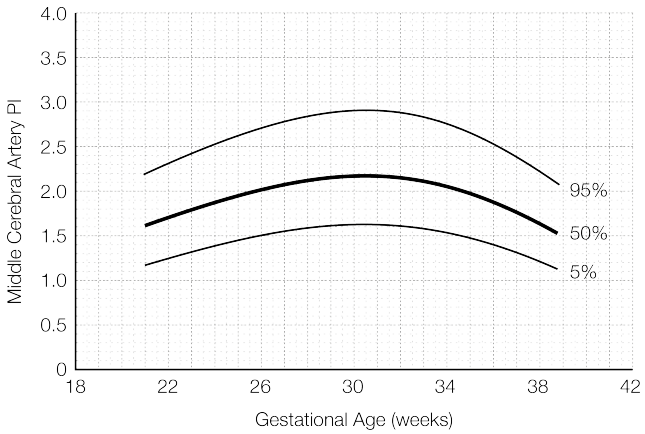
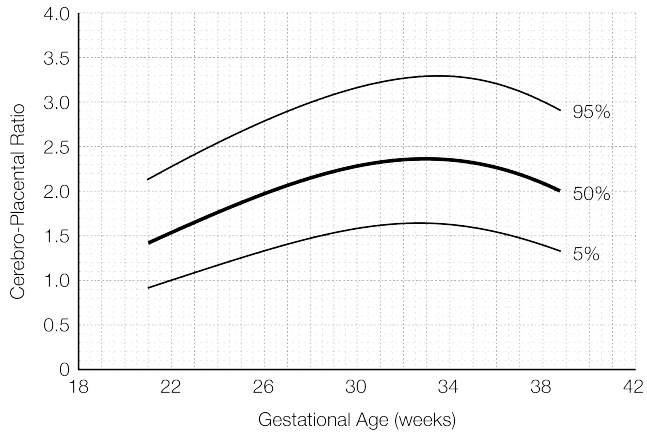
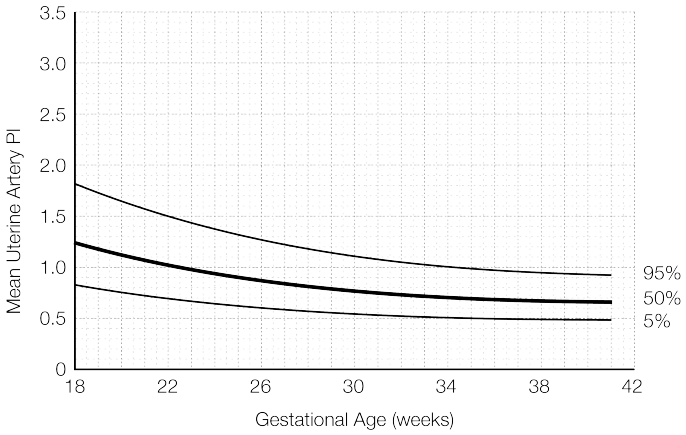
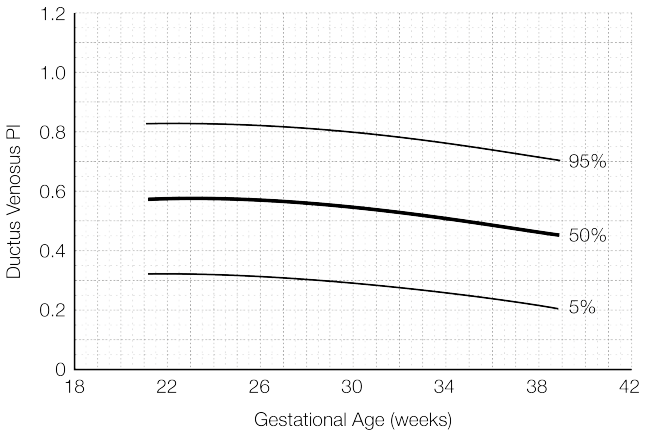
Obstetric Doppler reference charts

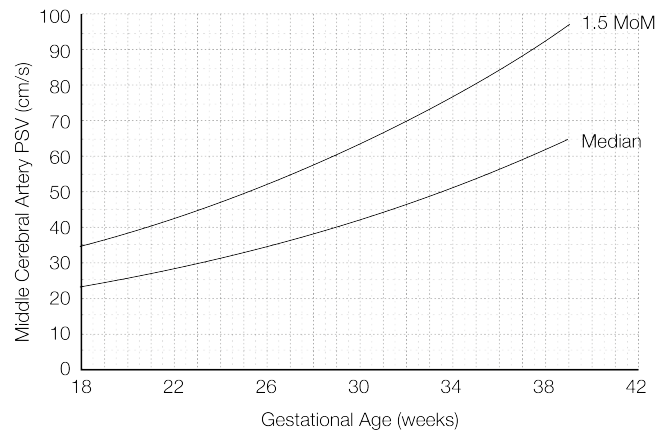












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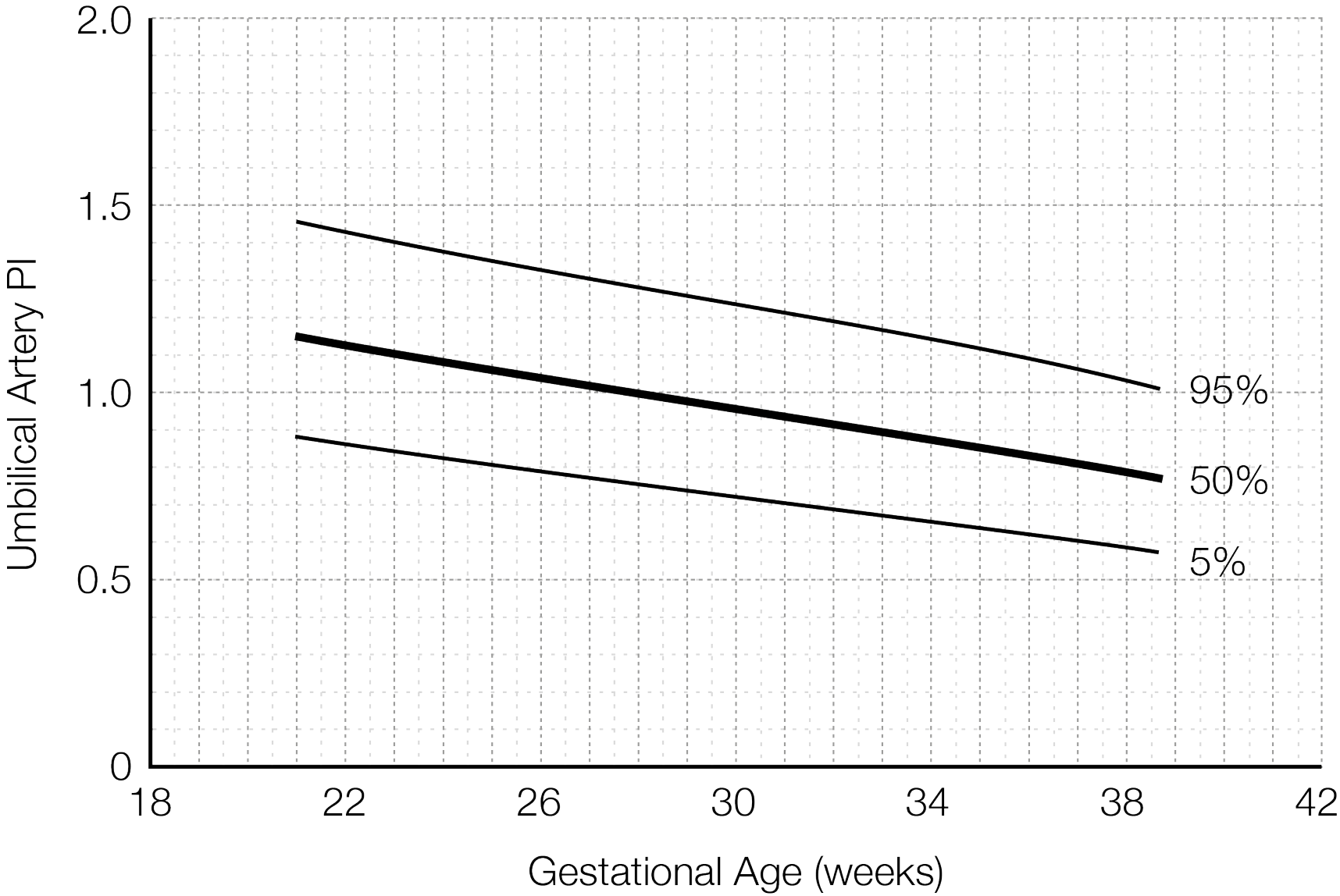

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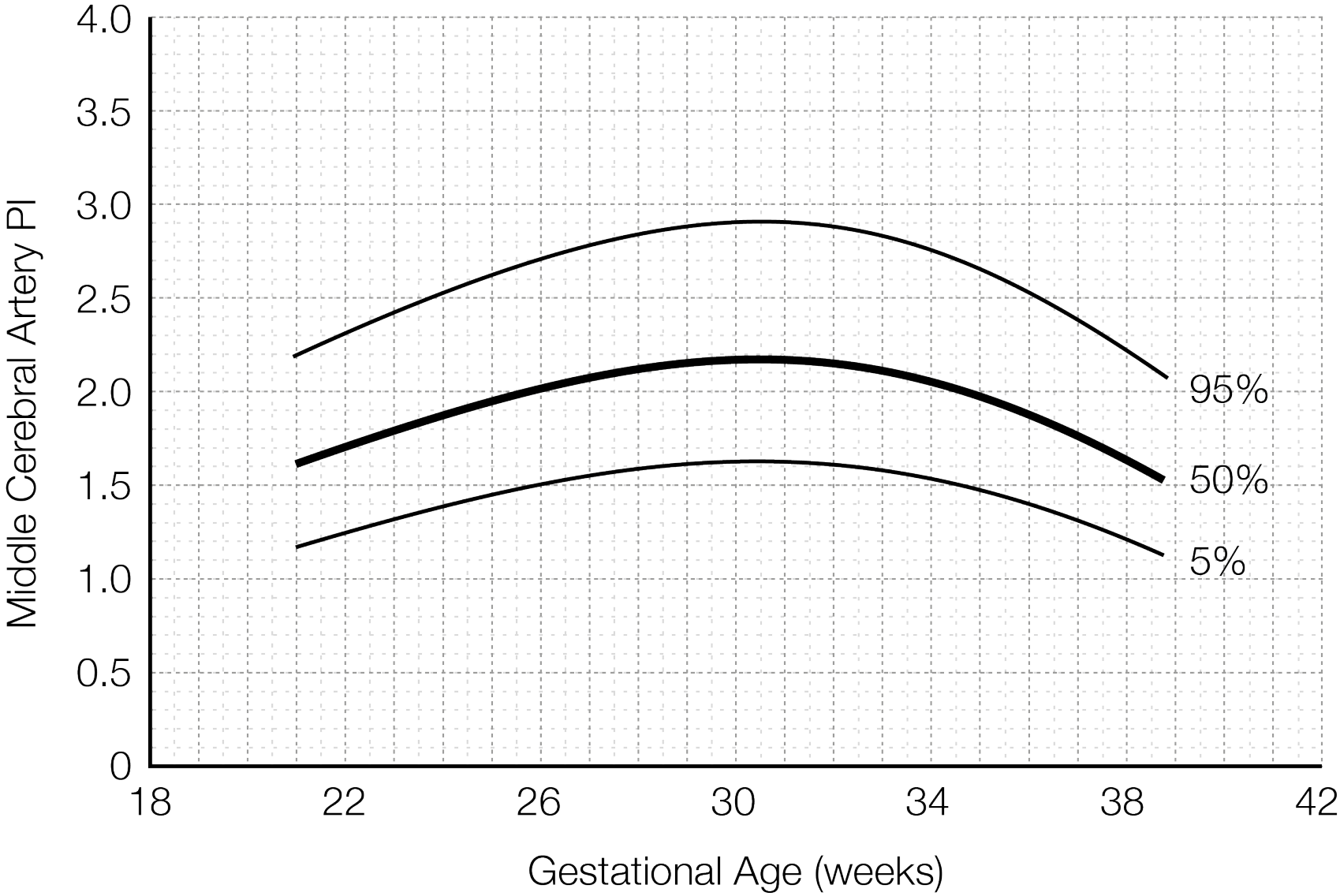

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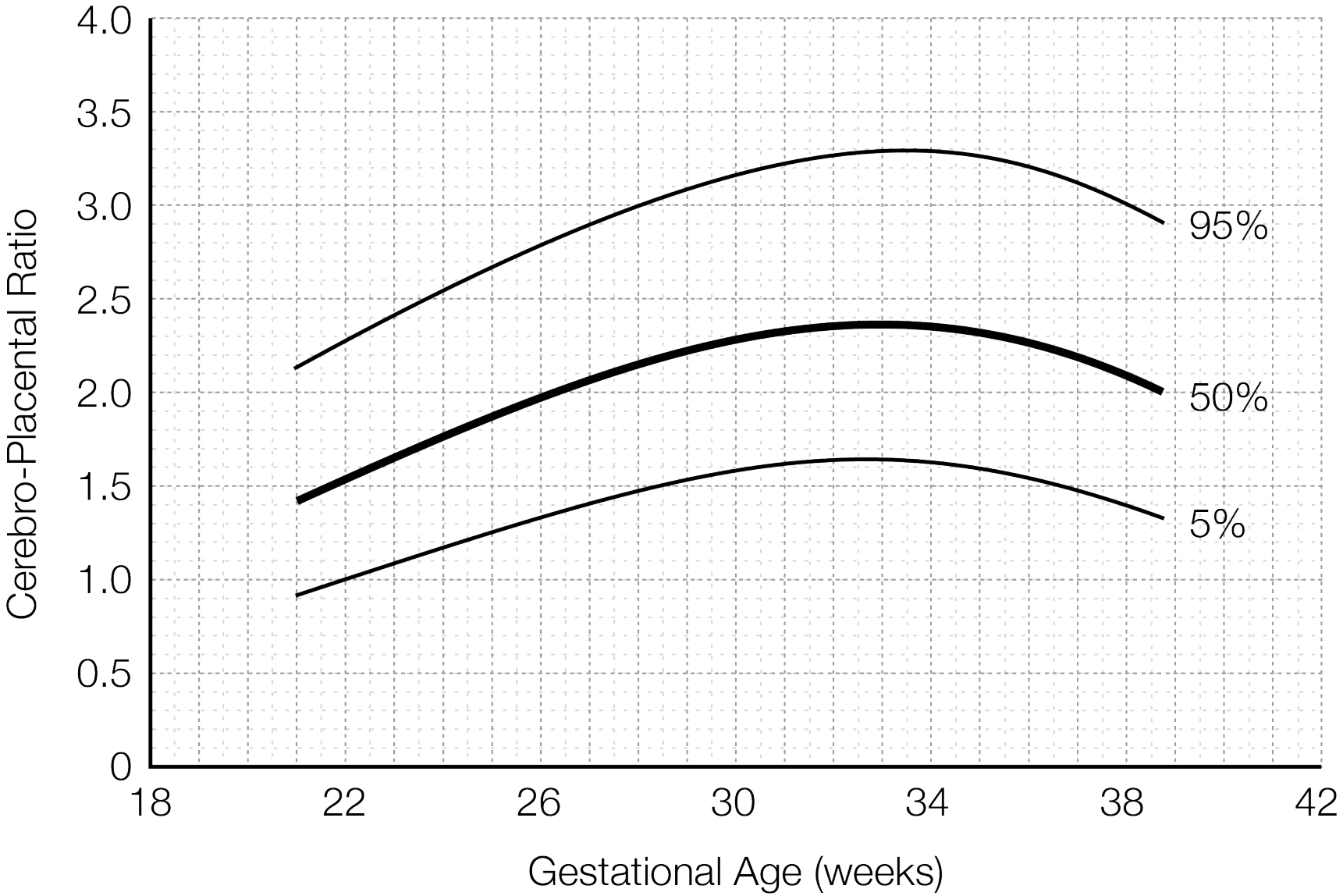

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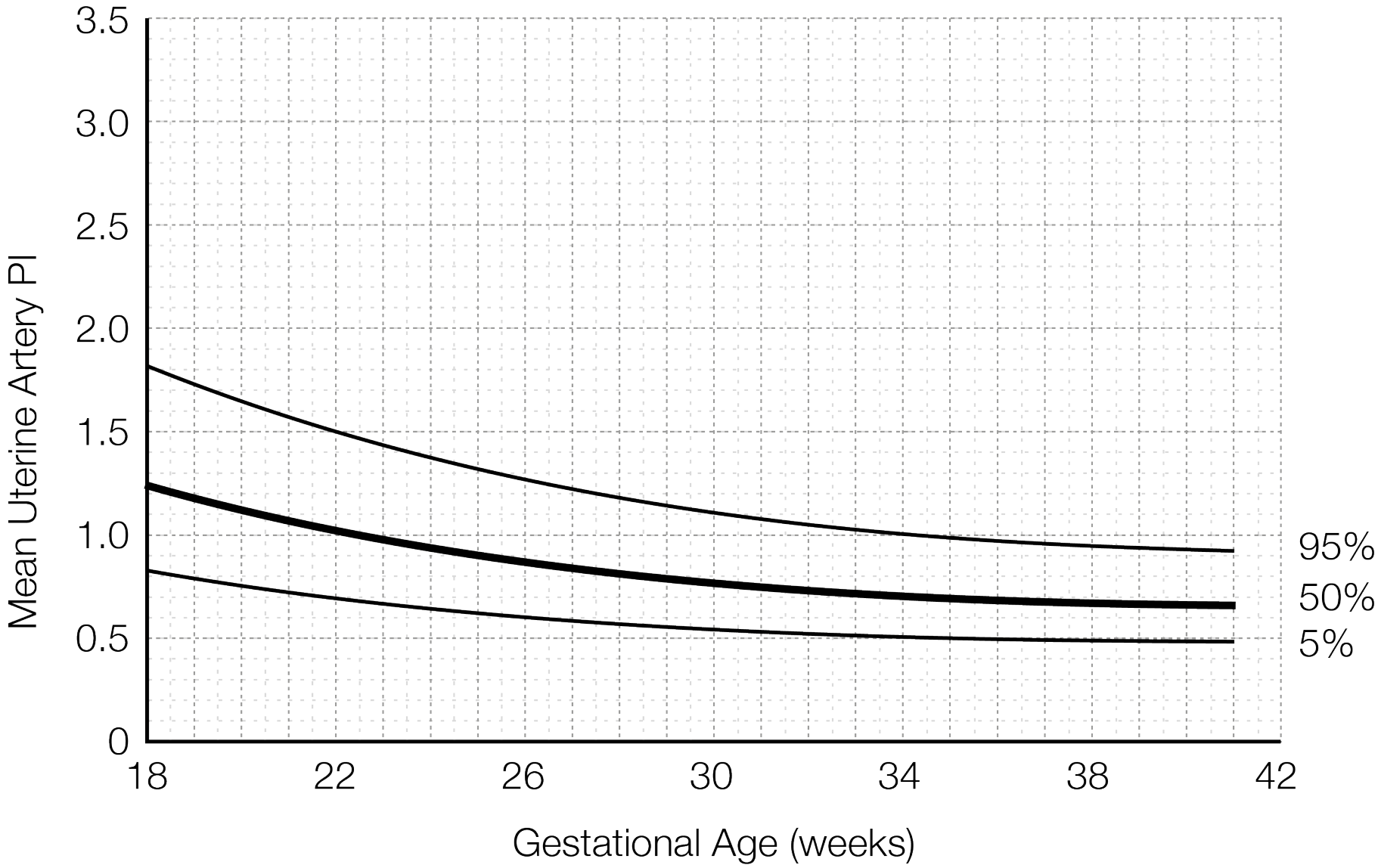

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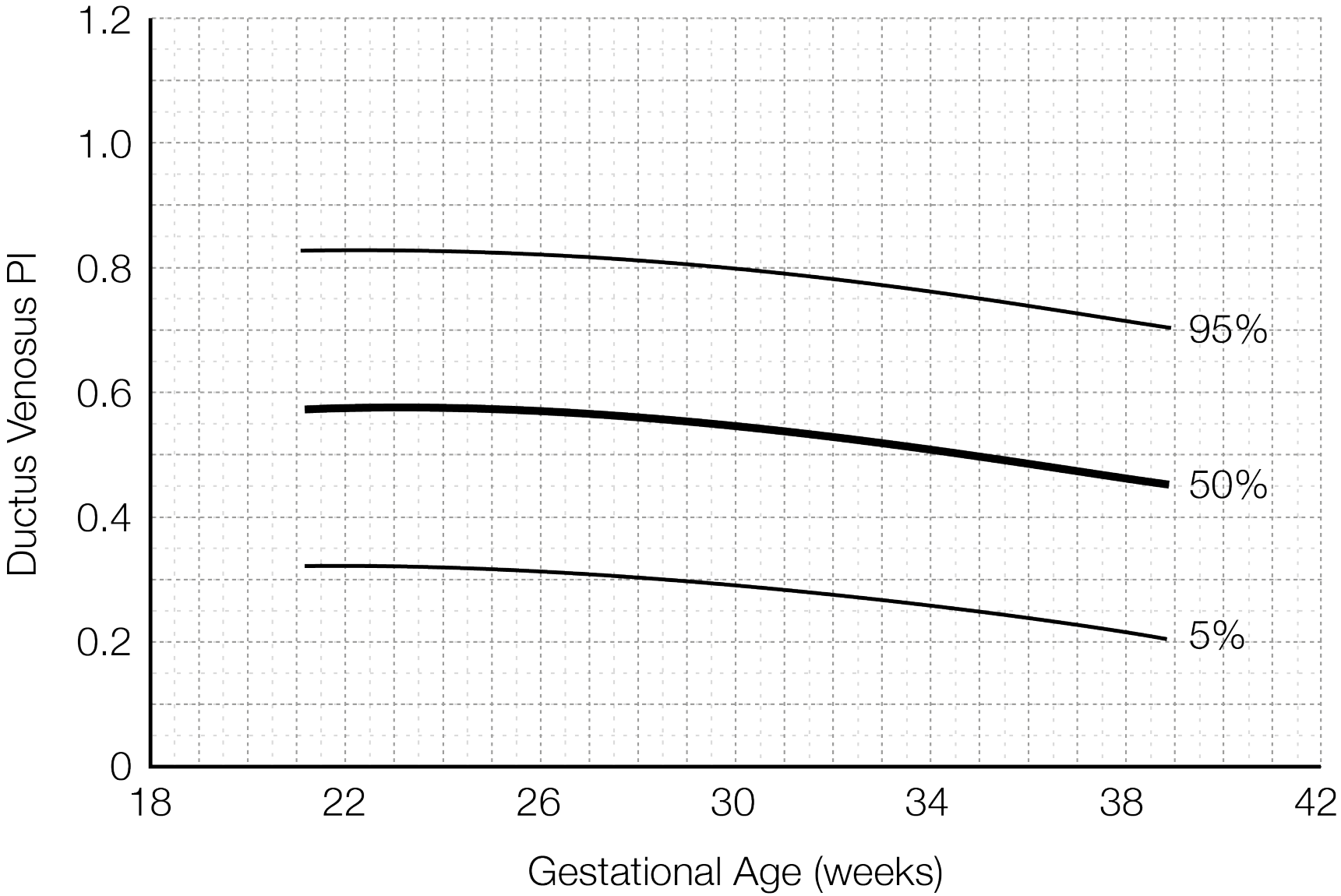

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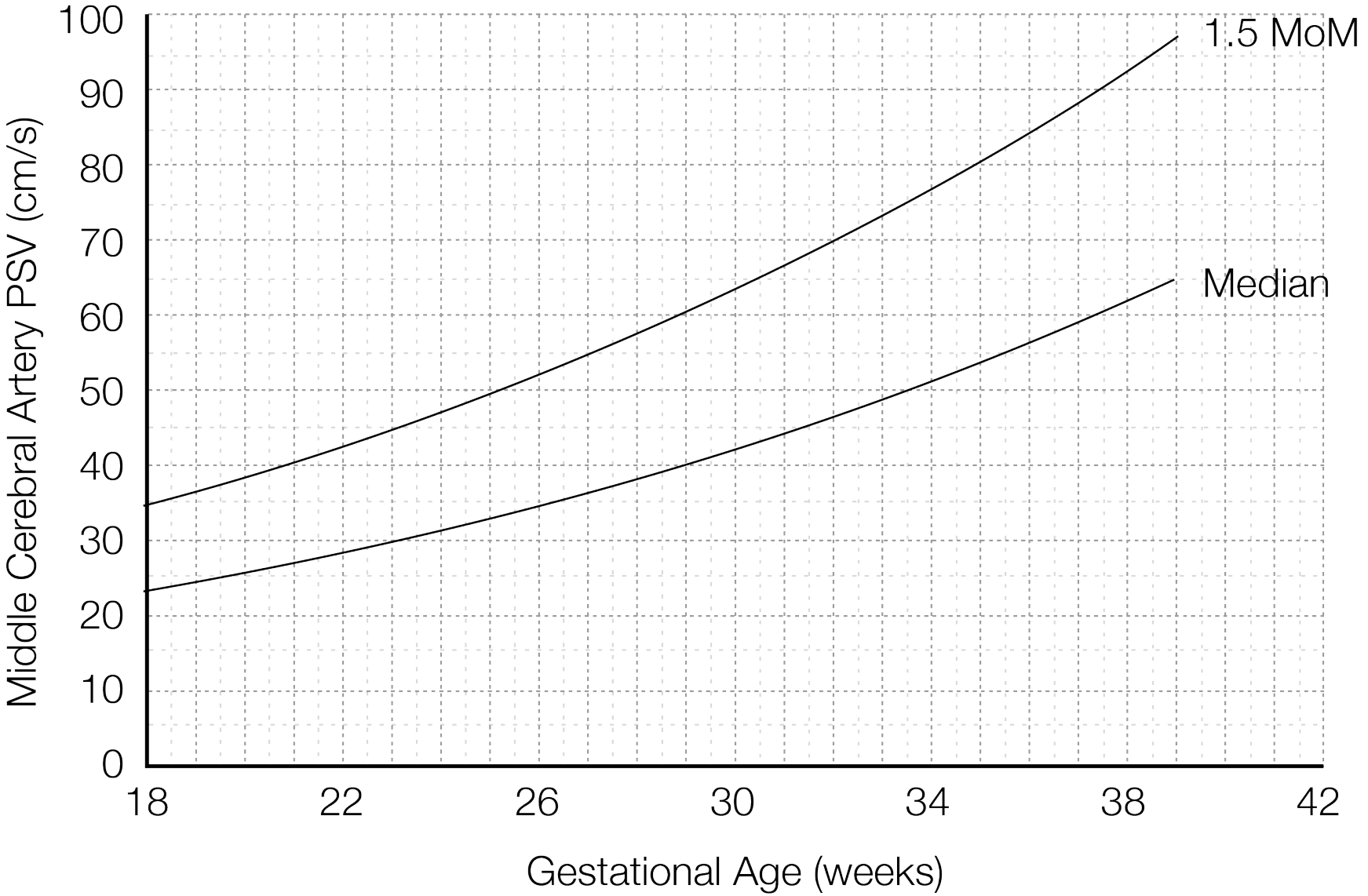

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