Obstetric Doppler for preterm SGA/ FGR and preeclampsia assessment

Standard Operating Procedure

Purpose

This document summarises information on how to perform and interpret obstetric Doppler ultrasound in the surveillance and management for preterm small for gestational age (SGA) pregnancies and fetal growth restriction (FGR) and in screening for preterm preeclampsia.

This document has been adapted from the Wāhi Rua/New Zealand Maternal Fetal Medicine Network 'New Zealand Obstetric Doppler Guideline'. It has been developed to support hospitals and healthcare professionals to use obstetric Doppler as part of the recommendations made in Taonga Tuku Iho on SGA and FGR and preeclampsia, two of the major contributors to provider-initiated preterm birth. The recommendations, background, management algorithms and additional information for these conditions can be reviewed on the Carosika Collaborative Taonga Tuku Iho website www.bestpractice.carosikacollaborative.co.nz.

Indications for Doppler ultrasound for preterm SGA and FGR:

- Uterine (Ut) artery Doppler should be performed at 20-24 weeks as a screening test for wāhine/people with risk factors for early onset FGR
- Ut artery Doppler should be performed at the time of diagnosis of SGA and/or FGR is suspected
- Umbilical (Umb) artery Doppler should be performed once SGA is confirmed and/or FGR is suspected
- Ductus venosus (DV) Doppler should be performed in early onset FGR ($<32^{+0}$ weeks) where there is absent or reversed end-diastolic flow in the umb artery Doppler
- Middle cerebral artery (MCA) Doppler should be performed in late onset FGR ($\geq 32^{+0}$ weeks) to calculate the cerebroplacental ratio (CPR).

Indications for Doppler ultrasound for preterm preeclampsia:

- Ut artery Doppler should be performed at 20 weeks as a screening test for wāhine/people with major risk factors for preeclampsia. If abnormal it should be repeated at 24 weeks.

For more information on preterm SGA/FGR and preeclampsia including access to Taonga Tuku Iho (national best practice guide), you can access the Carosika Collaborative website ***www.carosikacollaborative.co.nz*** *or by using the QR code.*

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Uterine (Ut) artery Doppler

How to perform the test

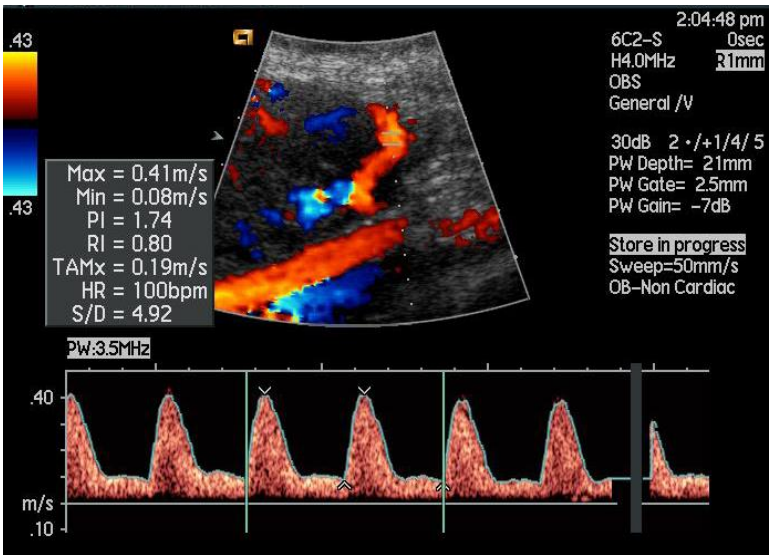
- Locate the maternal anterior superior iliac spine and angle medially
- Alternatively visualise the external iliac artery (EIA)
- The uterine artery is typically seen crossing the EIA anteriorly
- Select a portion of the uterine artery which courses at a favourable Doppler angle 0-60 degrees
- Optimise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

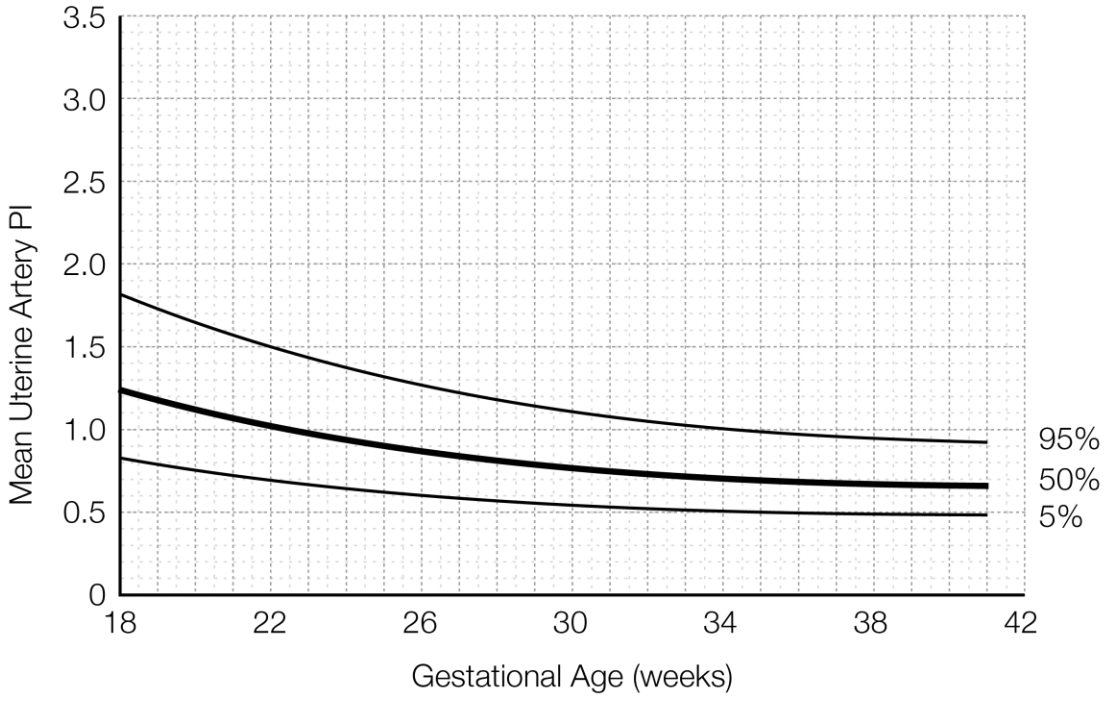
Common Pitfalls

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

Abnormal Ut Doppler result

- Mean PI >95th percentile
- Bilateral notching



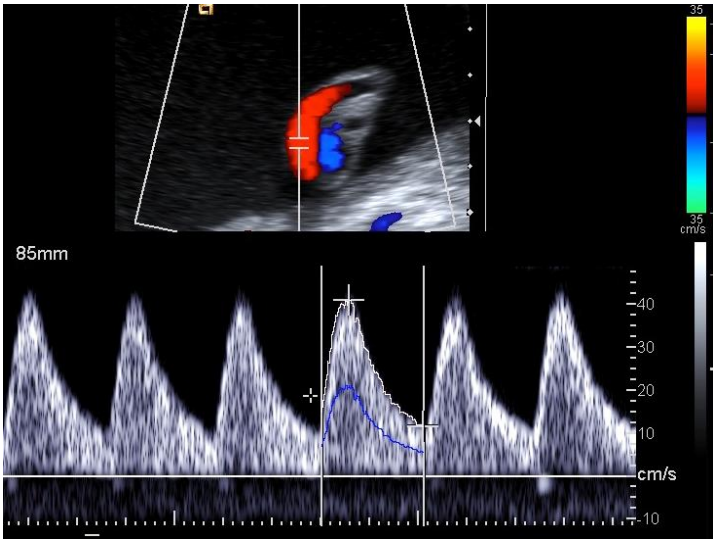


Reference: Gomez. Reference ranges for uterine mean pulsatility index at 11-41 weeks of gestation. Ultrasound Obstet Gynecol 2008; 32: 128-132. DOI: 10.1002/uog.5315

Umbilical (Umb) artery Doppler

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 end diastolic velocity (EDV) is near baseline, ensure wall filter is low enough 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 PI is abnormal, assess waveform for absence or reversal of end-diastolic flow (EDF)

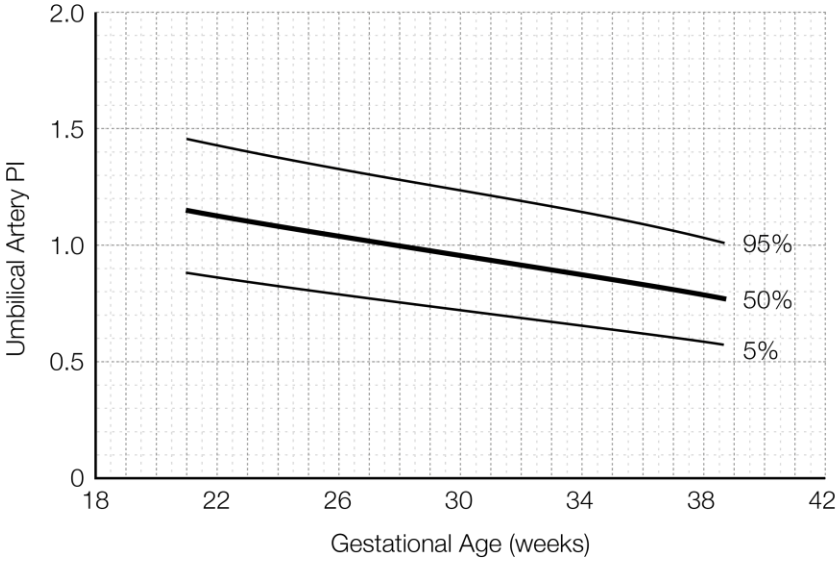


Common Pitfalls

- Poor Doppler angle and poor optimisation leading to fuzzy waveform which is hard to measure
- EDF is not visualised due to high wall filter setting
- EDF is not well visualised when EDV is near baseline because of venous contamination - readjust sampling to avoid capturing adjacent umbilical vein

Abnormal Umb Doppler result

- PI >95th percentile
- Absent end-diastolic flow
- Reversed end-diastolic flow



Reference: Acharya. 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. DOI: 10.1002/uog.1902

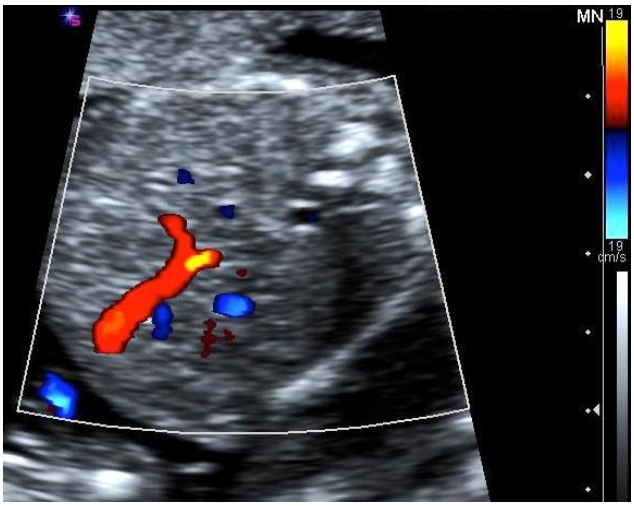
Ductus venosus (DV) Doppler

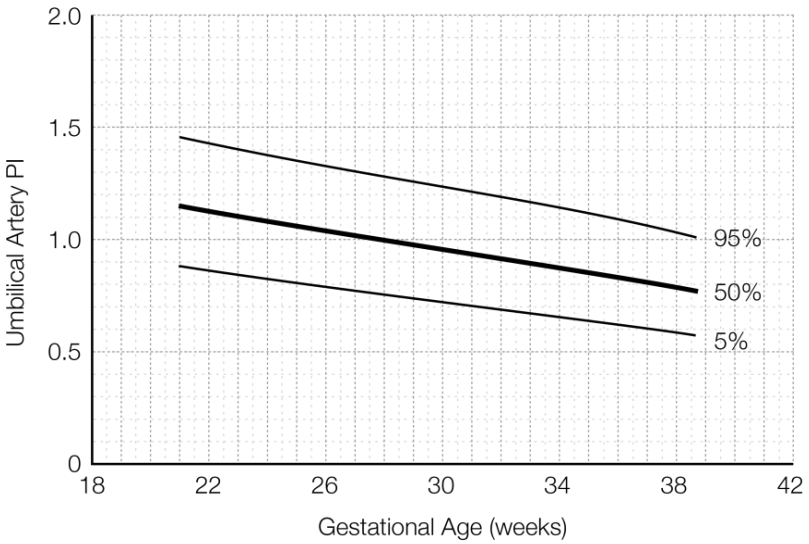
How to perform the test

- 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 umbilical vein
- 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 for absence or reversal of a wave and umbilical vein pulsatility

Common Pitfalls

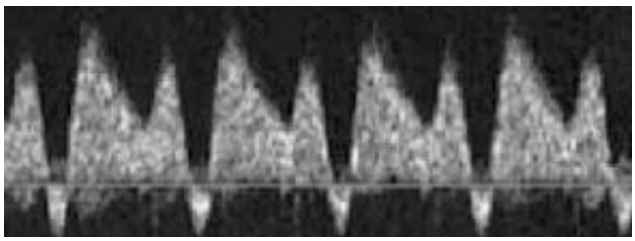
- Colour PRF too low and gain too high leading to difficulty in DV identification amongst other vessels
- Sample size too large, leading to contamination from other vessels
- Sample not placed at inlet of the DV
- Adjacent hepatic vein or celiac axis misidentified as DV
- Poor Doppler angle and poor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





Abnormal DV Doppler result

- PI >95th percentile
- Absent a wave
- Reversed a wave



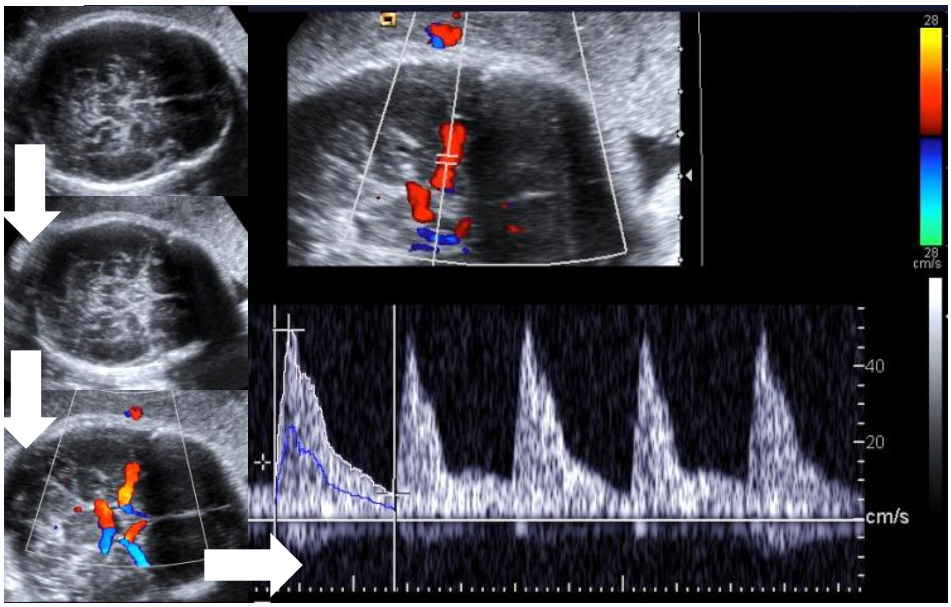
Example image of DV reversed a wave

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. DOI:10.1002/uog.3857

Middle cerebral artery (MCA) Doppler and cerebroplacental ratio (CPR)

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 biparietal diameter 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



Common Pitfalls

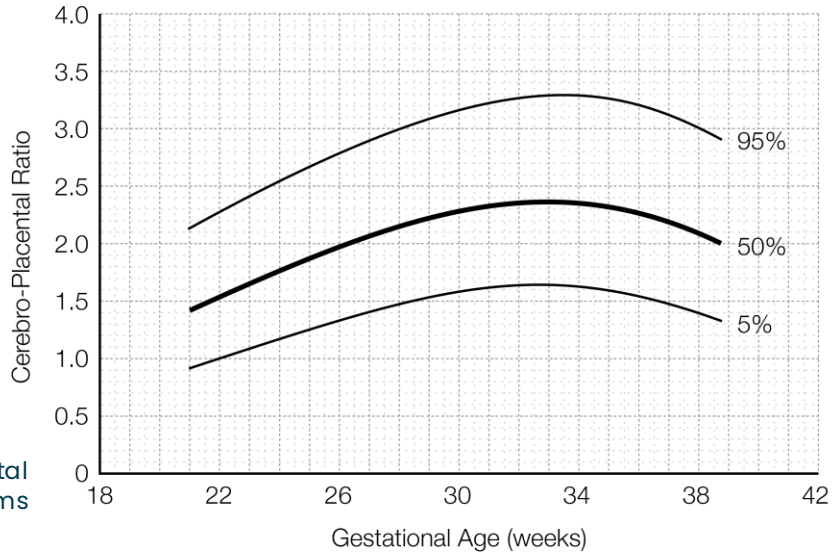
- Poor Doppler angle and poor optimisation leading to hard to measure fuzzy waveform
- Gate too close to MCA origin where multidirectional contamination from ACA and PCoA occurs
- Sample positioned too peripherally in the MCA where velocities fall
- PCA misidentified as MCA
- Poor visualisation due to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

Calculate CPR

MCA PI / Umb PI

Abnormal CPR result

<5th percentile



Reference: Ebbing. 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. DOI: 10.1002/uog.4088

Quick reference tables for Ut and Umb artery Doppler PI and CPR percentiles

Gestation Weeks	Umbilical Artery PI ❖ >95th percentile is abnormal: 50th percentile	95th percentile	Cerebroplacental Ratio (CPR) ❖ CPR = MCA PI/UA PI <5th percentile is abnormal: 50th percentile	5th percentile	Mean Uterine Artery PI ✦ Mean PI=(RT PI + LT PI)/2 >95th percentile is abnormal: 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	1.74	1.16	0.93	1.35
25	1.06	1.35	1.85	1.24	0.89	1.30
26	1.04	1.33	1.95	1.32	0.86	1.25
27	1.02	1.31	2.05	1.40	0.84	1.21
28	1.00	1.28	2.14	1.47	0.81	1.17
29	0.98	1.26	2.21	1.53	0.79	1.13
30	0.96	1.24	2.28	1.58	0.77	1.10
31	0.94	1.21	2.32	1.62	0.75	1.06
32	0.92	1.19	2.35	1.64	0.73	1.04
33	0.90	1.16	2.36	1.65	0.71	1.01
34	0.88	1.14	2.35	1.63	0.70	0.99
35	0.86	1.11	2.32	1.60	0.69	0.97
36	0.84	1.09	2.27	1.55	0.68	0.95
37	0.81	1.06	2.19	1.48	0.67	0.94
38	0.79	1.03	2.09	1.40	0.66	0.92
39	0.77	1.00	1.97	1.29	0.65	0.91
40	0.75*	1.07*	1.80*	1.24*	0.65	0.90

References

Acharya. Ultrasound Obstet Gynecol 2005; 26:162-169. DOI: 10.1002/uog.1902
Ebbing. Ultrasound Obstet Gynecol, 2007. 30(3): p. 287-96. DOI: 10.1002/uog.4088
Gomez. Ultrasound Obstet Gynecol 2008; 32: 128-132. DOI: 10.1002/uog.5315

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