

Chelsea and Westminster Hospital MES

NHS Foundation Trust

Doing a Doppler! Uterine artery Doppler in pregnancy.

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Aims:

- Understanding the physiology of the uterine artery.
- Scan technique for performing uterine artery Doppler.
- Correct interpretation of uterine artery waveform.

Saving Babies' Lives v.3

- SBL v.3 (June 2023): a care bundles to reduce perinatal mortality.
- The 'Saving Babies' Lives' appears to have contributed to the stillbirth rate falling in England.
- The NHS plan is to reduce stillbirth by 50% and preterm birth rate from 8% to 6% by 2025.



Saving Babies' Lives v.3

There are now 6 elements of care in SBL v.3:

- Reducing smoking in pregnancy.
- Fetal growth: risk assessment, surveillance and management.
- Raising awareness of reduced fetal movements.
- Effective fetal monitoring during labour.
- Reducing preterm birth.
- Management of pre-existing diabetes in pregnancy

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Saving Babies' Lives v.3

Risk assessment Identification of early onset FGR Identification/surveillance **Reassess at** Prevention Perform at booking and mid-trimester anomaly 28 weeks and and triage to pathway pathway for FGR/SGA scan) after any antenatal _ow Serial measurement of No risk factors Nil Anomaly scan and EFW ≥10th centile[±] SFH admission Moderate risk factors Obstetric history Previous SGA Previous stillbirth, AGA birthweight Assess for Current risk factor Assess for history complications Current smoker/e-cigarette user at Serial USS from 32 weeks of placental developing in booking (any) Anomaly scan and EFW ≥10th centile every 4 weeks* until dysfunction and ate Drug misuse pregnancy, e.g. delivery consider aspirin Women ≥40 years of age at hypertensive 150mg at night booking disorders or BMI >18.5 kg/m² & other features <16 weeks as significant bleeding Gastric Bypass surgery appropriate. Previous PTB/ Second T misc (placental mediated) Additional uterine artery Doppler Serial USS from 32 weeks every 2-4 weeks* until Normal uterine artery Doppler High risk factors delivery Medical history Maternal medical conditions [chronic kidney disease, hypertension, autoimmune Assess for history disease (SLE, APLS), post Fontan Serial USS from 28 weeks of placental Obstetric history every 2-4 weeks* until 1st dysfunction and Abnormal uterine artery Doppler and EFW ≥10th centile Previous FGR delivery consider aspirin Hypertensive disease in previous High pregnancy 150mg at night Serial USS Previous SGA stillbirth <16 weeks as Current pregnancy from appropriate. PAPPA <5th centile diagnosis Discussion with fetal Echogenic bowel Abnormal uterine artery Doppler and AC or EFW <10th until delivery* Significant bleeding medicine centile EFW <10th centile Single Umbilical Artery Serial USS from 28 weeks for uterine anomalies and 32 weeks for BMI and Not suitable for SFH measurement fibroids every 4 weeks* until (e.g. BMI ≥35kg/m²) Nil Anomaly scan and EFW ≥10th centile[‡] Fibroids The risk factors listed here constitute those routlinely assessed at booking, other risk factors exist and risk assessment must always be individualised taking into account previous medical and obstetric history and current pregnancy history. For women with maternal medical conditions and individuals with disease progression or institution of medical therapies may increase an individual's risk and necessitate monitoring with serial scanning. For women with a previous stillbirth, management must be tailored to the previous history i.e. evidence of placental dysfunction or maternal medical conditions. Serial measurement should be performed as per NICE antenatal care guideline ¹AC and/or EFW <10th centile at the anomaly scan is a high risk factor. * Refer to risk assessment and identification section for advice on scan interval

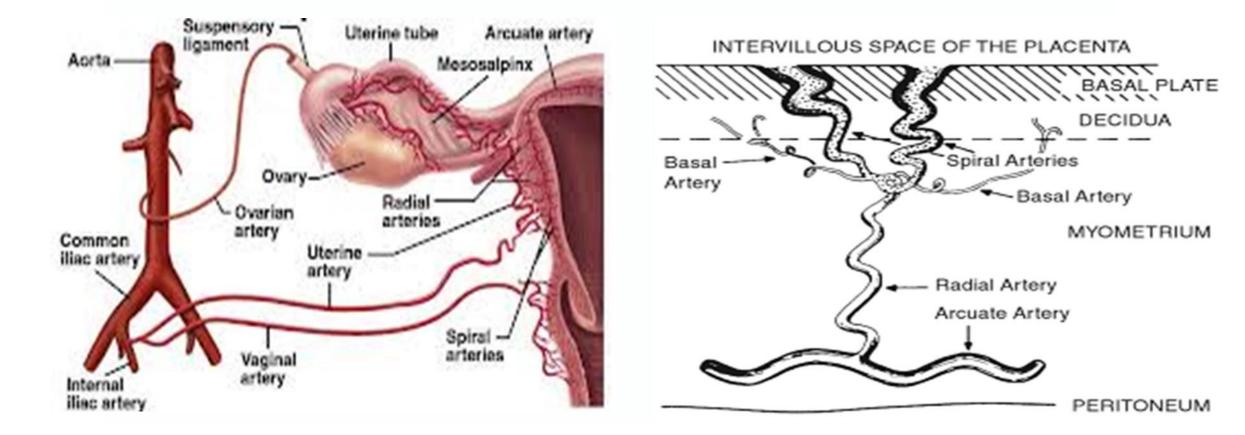
Figure 6: Algorithm for using uterine artery Doppler as a screening tool for risk of early onset FGR.

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• The main goal of the haemodynamic response to pregnancy, is to provide adequate uteroplacental perfusion and nutrition to facilitate fetal growth and development.

• Uterine artery Doppler can interrogate the uteroplacental circulation and screen for impaired placentation by detecting blood flow alterations.

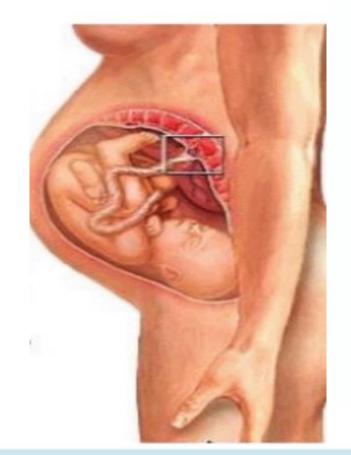
Uterine artery

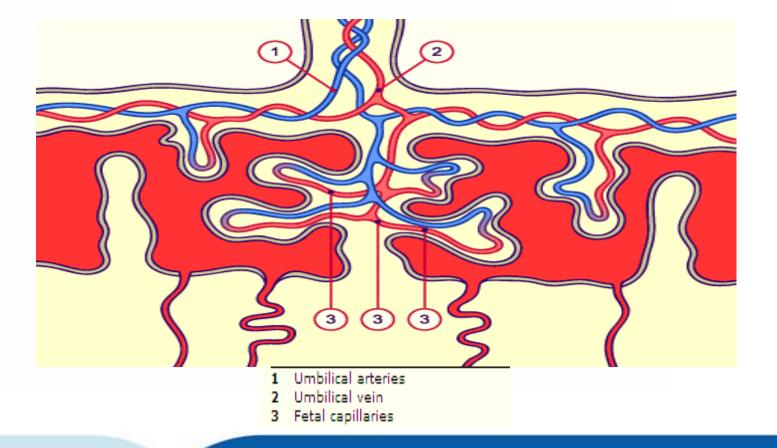


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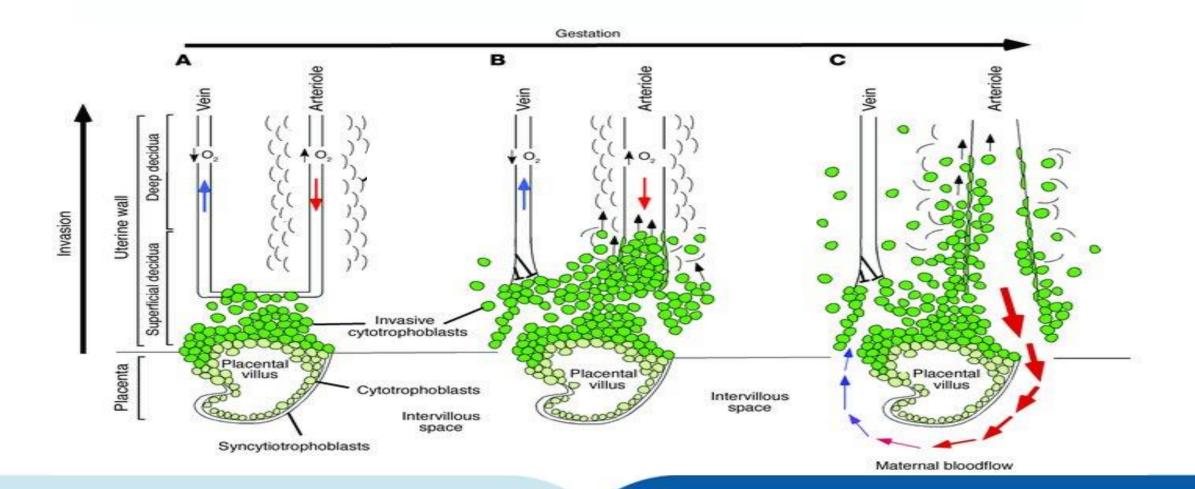
The placenta





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Trophoblastic invasion



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- Impedance to flow in uterine arteries decreases with gestation.
- From 20 weeks the fall in impedance is due to trophoblastic invasion of the spiral arteries in the placental bed, which converts them into low-resistance vessels.
- Further fall in impedance is due to a hormonal effect on the elasticity of the arterial walls.

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Trophoblastic invasion of the spiral arteries

Myometrium cytotrophobla Cytotrophoblas stem cell Cytotrophob unica media Syncytiotrophot mooth muscle Maternal blood Blood flow arter Floating villus Materna endothelia cells Anchoring ville Placenta Myometrium cytotrophoba В Cytotrophoblas column, Tunica media Cytotrophol vascular smooth muscle lave Syncytiotrophoblast Maternal blood vtotrophoblast Floating villus

Abnormal trophoblastic invasion

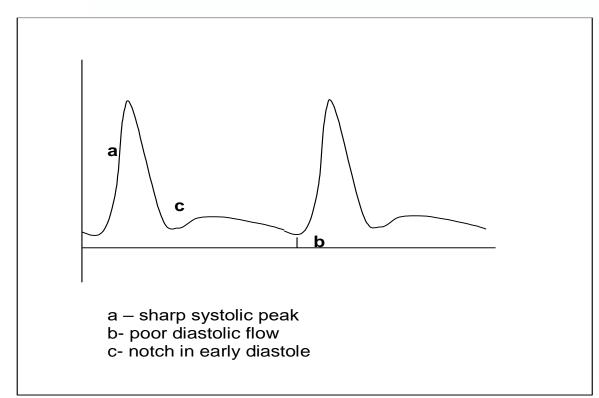
Normal trophoblastic invasion

epomedicine.com



- Failure of 2nd Trimester trophoblastic invasion causes uteroplacental insufficiency.
- Maternal spiral arteries retain: -
 - narrow bore
 - muscular walls
 - high resistance
- Flow of maternal blood to the feto-placental circulation is significantly reduced

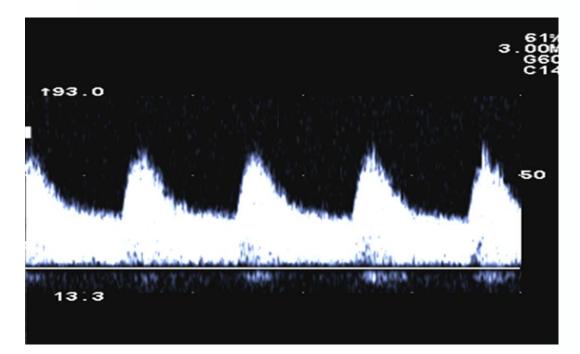
Normal Uterine Artery Waveform in a Non-pregnant Woman



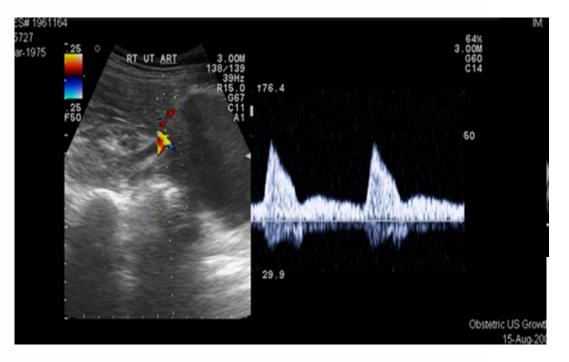
- As pregnancy progresses the early diastolic notch should disappear by 18-20 weeks.
- There is an increase in diastolic flow, which leads to a fall in resistance.

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Normal Uterine Artery Doppler @20 weeks



Abnormal Uterine Artery Doppler @ 20 weeks



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If there is defective trophoblast invasion, which leads to impaired placentation, this can result in the following obstetric complications:

- Pre-eclampsia
- Early onset FGR

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Maternal diseases:

• Heart disease

The partial pressure of oxygen in the maternal blood may be decreased.



- Pre-existing Insulin-dependent diabetes
 - Diabetic vasculopathy
- Gestational diabetes

Fetal macrosomia



Autoimmune disease (SLE and APLS)



Arterial and venous thrombosis of the uteroplacental vasculature and placental infarction.

• Chronic renal impairment

Renal impairment can cause increased maternal blood pressure, which can lead to pre-eclampsia and FGR.



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Qualitative Information:

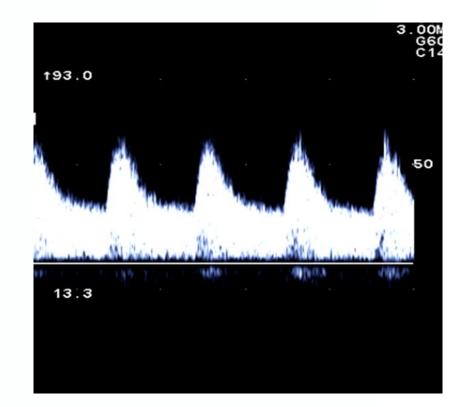
- Presence/absence of flow
- Direction of flow
- Quality of flow: laminar or turbulent
- Organ perfusion
- Waveform shape: low resistance

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- high resistance

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- early diastolic notch



Quantitative Information: (velocity measurement indices)

Pulsatility index:

(peak systole – minimum diastole)

mean value

Resistance index:

(peak systole – minimum diastole)

peak systole

Systolic/Diastolic ratio:

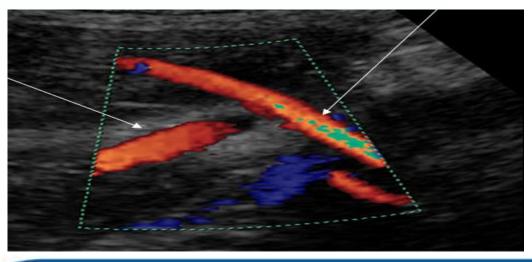
peak systole

minimum diastole

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Uterine artery technique:

Ultrasound image with colour Doppler showing the uterine artery and the external iliac artery.

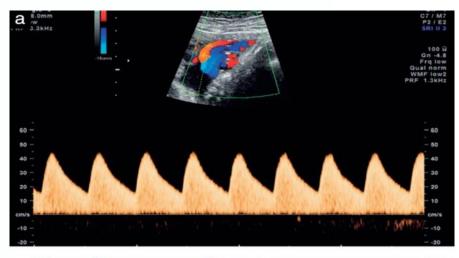


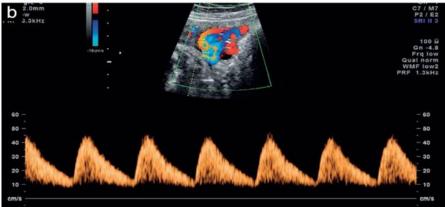
•www.centrus.com.br/DiplomaFMF/seriesFMF/doppler/capitulos-html/chapter_03.htm

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- Angle of insonation should be < 30 degrees
- Generate a Maximum velocity envelope (MVE) measurement to show the whole spectral Doppler waveform.
- Make sure your wall motion filter is not too high or too low
- Measure three separate spectral traces.

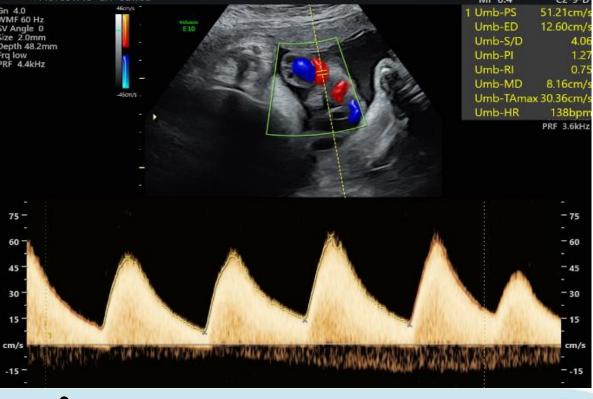




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Good Doppler technique:



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- The sample gate size should match the vessel size (approximately 2mm)
- Use correct sweep speed.
- Ideally you should see five waveforms and measure the best three.

Uterine Artery Technique:



Measure 3 best waveforms

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Uterine artery Doppler assessment:

• Scan both left and right uterine arteries

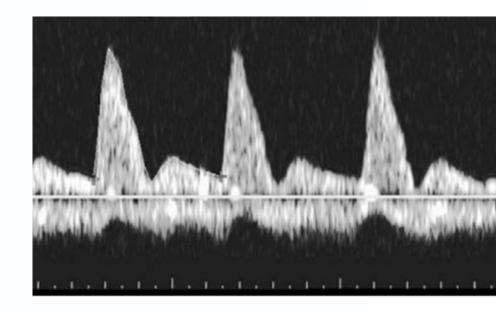
• Report the mean P.I. from both uterine arteries.

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Abnormal findings of the uterine artery Doppler:

• Mean P.I. above the normal range

• Diastolic notch in one or both uterine arteries.



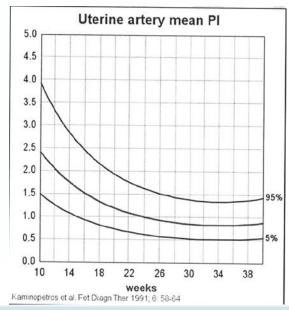
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Abnormal findings of the uterine artery Doppler:

• Mean Uterine Artery P.I. above the normal range



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Ultrasound Obstet Gynecol 2003; 21: 170–173 Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/uog.30

Comparison of color Doppler uterine artery indices in a population at high risk for adverse outcome at 24 weeks' gestation

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"This removes the operator dependent assessment of a notch, and allows an objective method of calculating a woman's individual level of risk for adverse outcome."

- Abnormal Doppler waveform: 50% of patients will develop complications .
- Normal Doppler waveform: less then 2% of patients will develop complications.

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Patient management

Management of patient following abnormal uterine artery waveforms:

• Follow SBL v.3 flow chart for management

• Arrange serial growth scans at 28, 32, 36 and 40 weeks.

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Take home points

- Use a standardized technique to carry out your uterine artery Doppler.
- Use the mean P.I. as an objective measure to determine if the uterine artery is normal or abnormal.
- Consider adding uterine artery Doppler to the anomaly scan:

Advantages:

- prevents bringing women back at 24 weeks
- prevents having to repeat fetal biometry at 24 weeks
- prevents having to confirm fetal sex again!

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Thank you for listening



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