

# Current Concepts in the Evaluation of Impaired Placentation and Placenta-Related Complications of Pregnancy

- First Trimester Preeclampsia Screening
- Invasive placentation
- IUGR
  - extreme trendings of maternal biochemical analytes
  - uterine and middle cerebral artery Doppler
  - placenta MR

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# First Trimester Screening for early onset preeclampsia

- Maternal gestational hypertensive disorders and their complications have ranked consistently as the primary cause of adverse maternal and neonatal outcome since the institution of prenatal care (Baschat, *Ultrasound Obstet Gynecol* 2015; 45: 119-129)

# First Trimester Screening for early onset preeclampsia

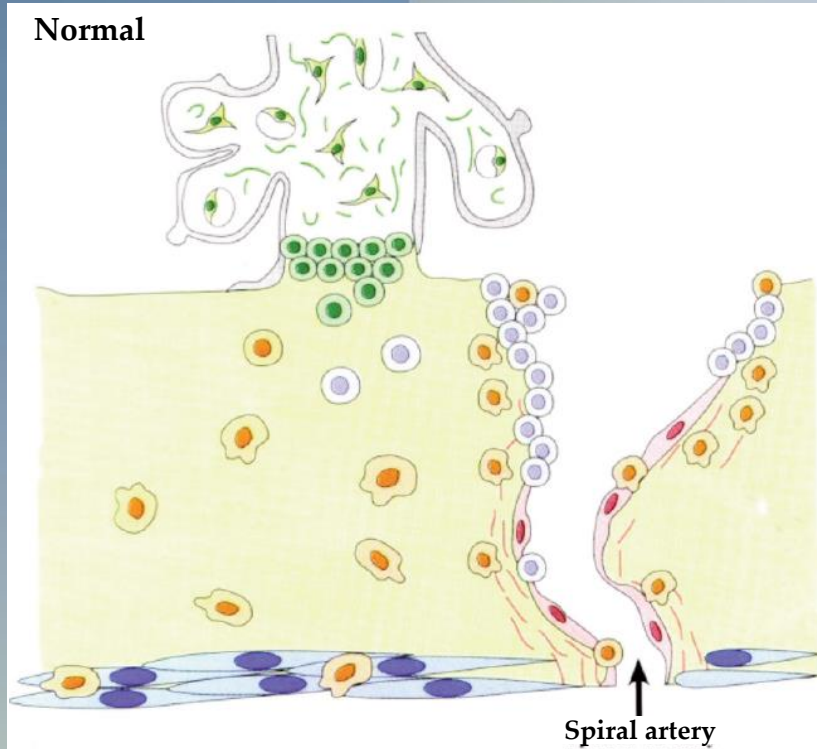
- Preeclampsia (PE) is a major cause of maternal and perinatal morbidity and mortality and is thought to be predominantly as the consequence of impaired placentation
- There is extensive evidence that the risk of adverse outcome in relation to PE is much higher when the disease is severe and of early onset requiring delivery before 34 weeks' gestation, then that at term
- A major challenge in modern obstetrics is early identification of pregnancies at high risk of early onset PE and undertaking the necessary measures to improve placentation and reduce the prevalence of the disease (Poon, *Prenatal Diagnosis* 2014; 34: 618-627)

# First Trimester Screening for early onset preeclampsia

- Preeclampsia confers significant increased long term health risks for mother and fetus including obesity, cardiovascular disease, hypertension & diabetes.
- The 1:200 incidence of early on set preeclampsia is more common than spina bifida and down syndrome.
- Current clinical screening guidelines identifies only 30% of patients who will develop early onset preeclampsia.

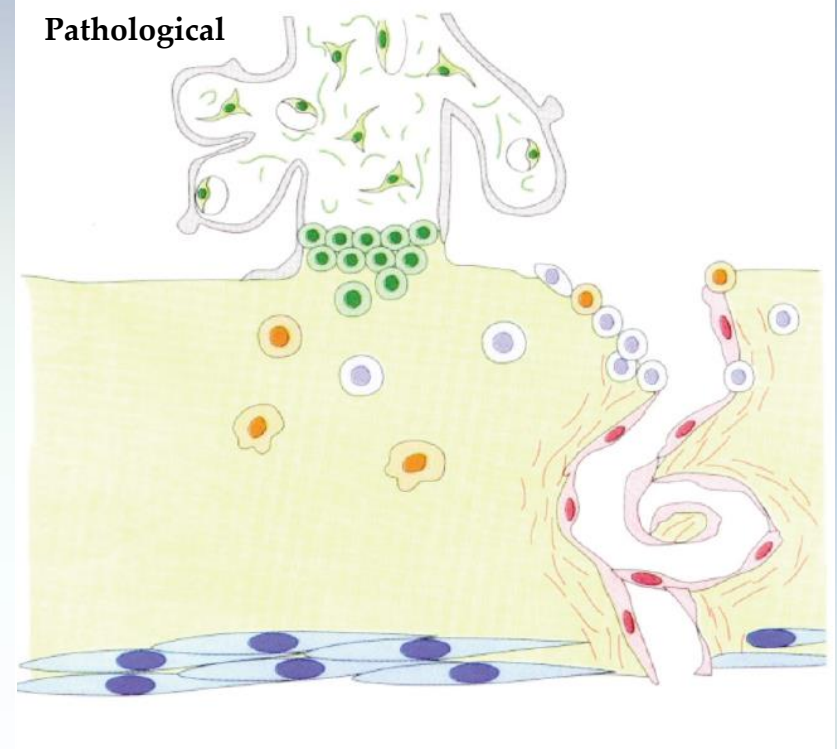
# Failed Transformation of the Uterine Spiral Arteries Leads to Poor Placental Perfusion and Plays a Critical Early Role

## Normal Pregnancy<sup>1</sup>



- Spiral arteries normally remodeled into vessels with much larger diameters, allowing  $>10X$  blood flow<sup>2</sup>
- **Natural killer (NK) cells** play crucial if poorly understood role in remodeling by encouraging trophoblast invasion and inducing apoptosis in critical cells<sup>2</sup>

## Pathological Pregnancy<sup>1</sup>



- Reduced number of NK cells?<sup>2</sup>
- Reduced functionality of NK cells?<sup>2</sup>
- Incomplete remodeling and trophoblast invasion leads to pathologic increase in vascular resistance<sup>2</sup>

Figures reproduced from: 1. Monte S. *Journal of Prenatal Medicine* 2011;5 (3):69-77 with permission; 2. Fraser R, et al. *J Pathol.* 2012 Nov;228(3):322-32.

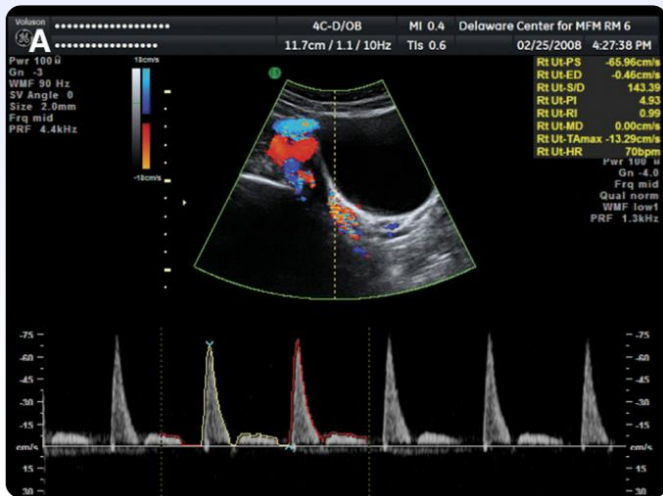
## PreeclampsiaScreen™ | T1

- First of its kind serum screening test for **early onset preeclampsia**
- Quantitates demographic and historical factors in a risk algorithm
  - Body mass index (BMI)
  - Ethnicity
  - Patient history, including
    - Previous delivery  $\geq 24$  weeks
    - Maternal and personal history of preeclampsia
    - History of chronic hypertension
- Measures three biochemical markers in maternal serum
  - PAPP-A (pregnancy-associated plasma protein-A)
  - PIGF (placental growth factor)
  - AFP (alpha fetoprotein)
- Two biophysical markers
  - MAP
  - UtAD-PI

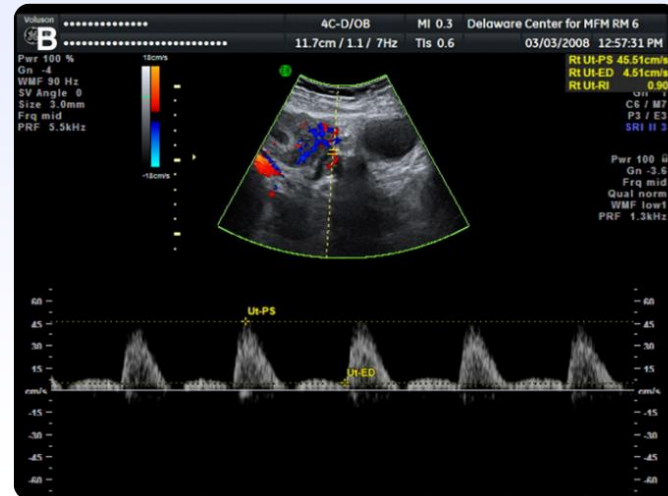


# Evolving UtAD in Nonpregnant and Pregnant Women

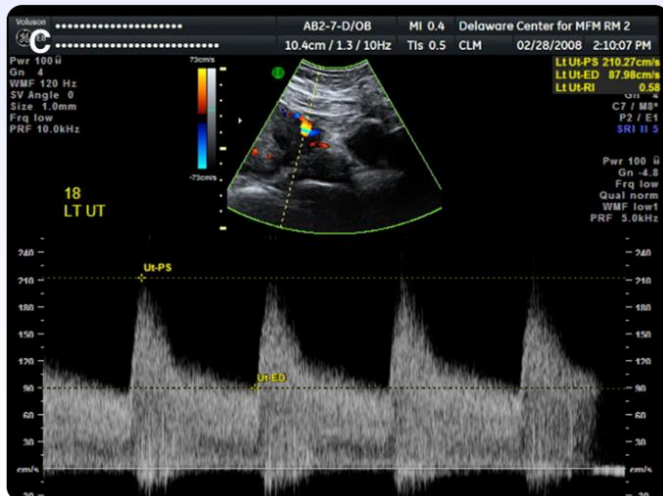
## Nonpregnant Patient



## Normal First Trimester



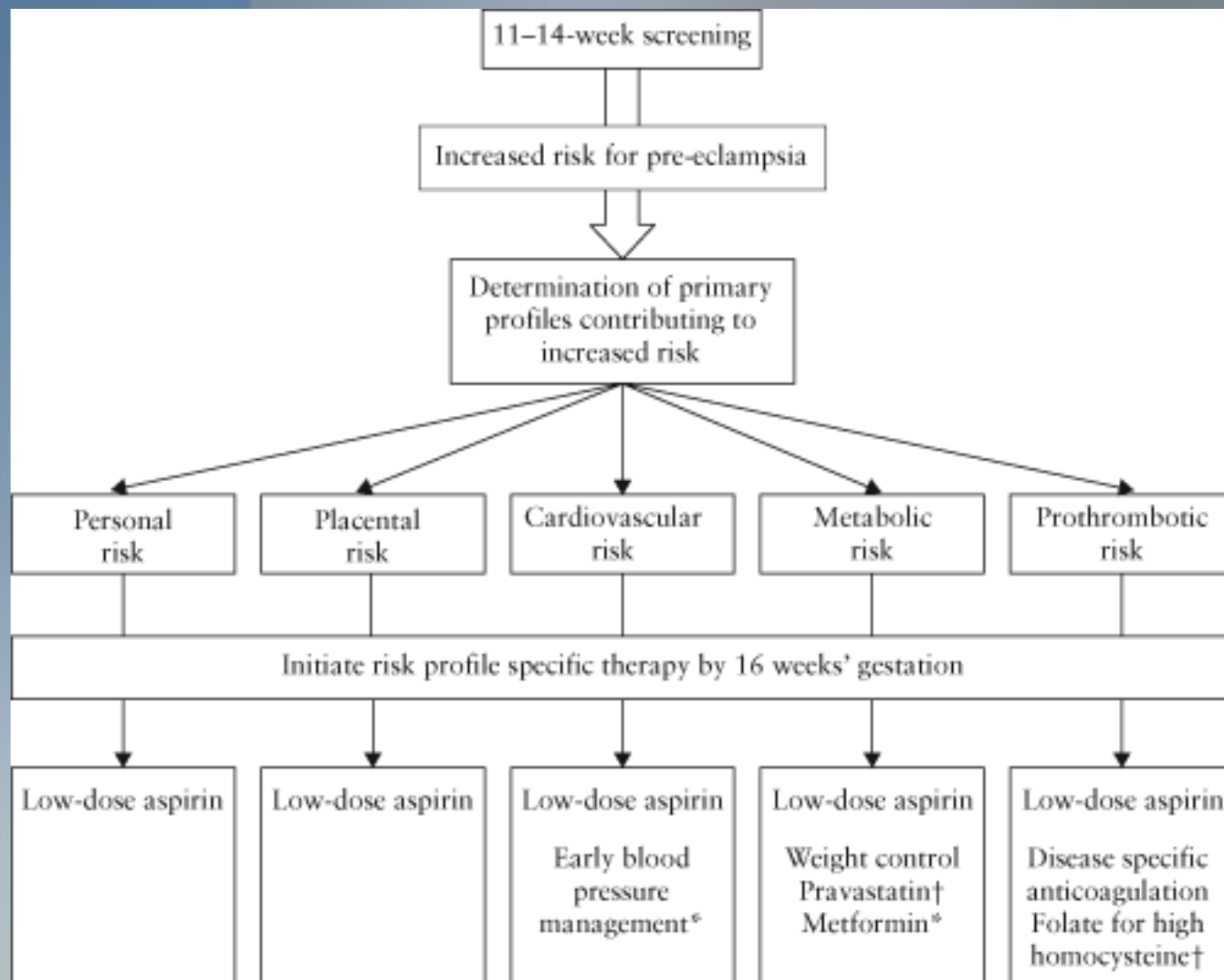
## Normal Second Trimester



## Abnormal UtAD Demonstrating High Resistance



Reproduced from: Sciscione AC, et al. *Am J Obstet Gynecol.* 2009 Aug;201(2):121-6 with permission from Elsevier.



Personalized pre-eclampsia prevention: \*Randomized trials are needed. †Randomized trials are currently underway. (Baschat. Ultrasound Obstet Gynecol 2015; 45: 119-129.)



# ACOG OCTOBER 2013 TASK FORCE HYPERTENSION IN PREGNANCY

- “In general, uterine artery Doppler studies are better in predicting early preeclampsia than term preeclampsia.” Pg. 22
- “Biomarkers for the prediction of preeclampsia are integral to disease stratification and targeted therapy.” Pg. 22
- “Current evidence suggests that a combination of biomarkers along with uterine artery Doppler studies may provide the best predictive accuracy for the identification of early onset preeclampsia.” Pg. 23
- “Low dose aspirin appears to be safe with no major adverse effects or evidence of increase bleeding or abruption.” Pg. 27

# Prediction and prevention of early onset preeclampsia: The impact of aspirin after first trimester screening

- **Introduction:**

- Pre-eclampsia continues to be a significant cause of maternal and fetal mortality
- Several recent studies have shown that the early onset form of disease (ePET), leading to delivery on maternal grounds <34 weeks gestation, can often be predicted at 11-13+6 weeks' gestation
- We examined **the effect of the combination of screening and treatment with low dose aspirin on the rate of ePET**

Park. doi: 10.1002/Ultrasound Obst Gyn.14819

# Prediction and prevention of early onset preeclampsia: The impact of aspirin after first trimester screening

- **Study Design:**

- This study involved retrospective analysis of two consecutive cohorts of women screened for ePET
- The first cohort was observed, to determine whether algorithms developed to screen for pre-eclampsia at 11-13+6 weeks' gestation could be applied to our population
- High-risk women in the second cohort were advised of their risk and offered aspirin (150mg **at night**) with treatment starting immediately after screening
- The prevalence of ePET and PET at 34-37 weeks' gestation was compared between these cohorts.

Park. doi: 10.1002/Ultrasound Obst Gyn.14819

# Prediction and prevention of early onset preeclampsia: The impact of aspirin after first trimester screening

- **Results:**

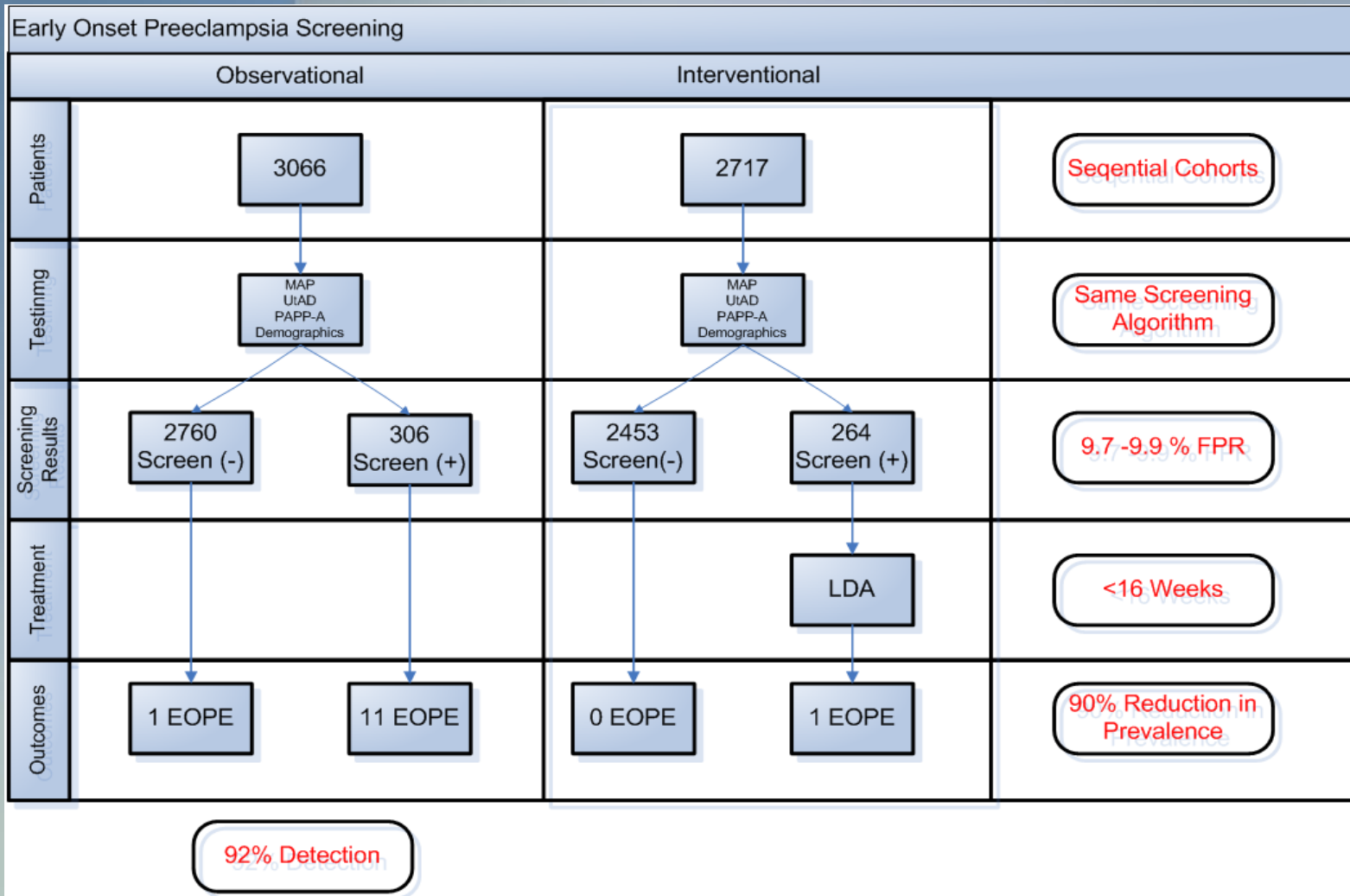
- 3066 and 2717 women were screened respectively in the observational and interventional cohorts
- There were twelve cases (0.4%) of ePET in the observational cohort and one (0.04%) in the interventional cohort ( $p=0.01$ )
- For all preterm PET (<37 weeks) there were 25 cases (0.83%) in the observational cohort and 10 (0.37%) in the interventional cohort ( $p=0.03$ )

- **Conclusions:**

- A strategy of first trimester screening for ePET coupled with prescription of aspirin to the high-risk group appears to be effective in reducing the prevalence of ePET.

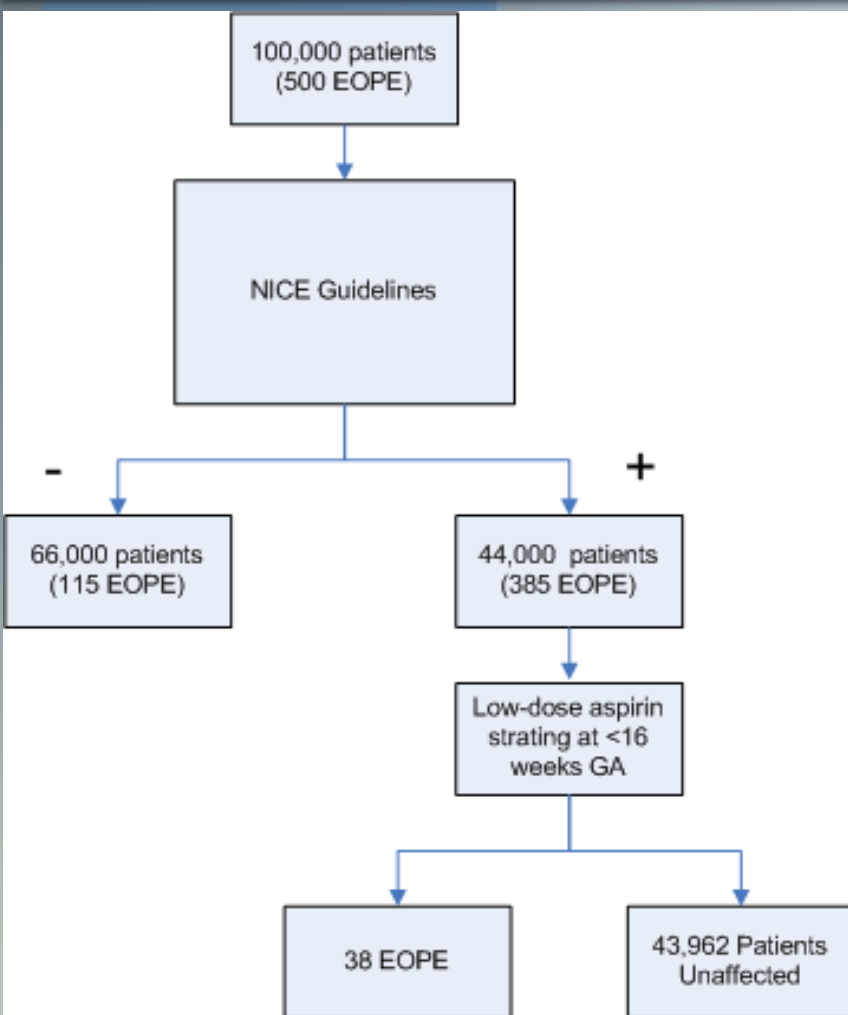
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# Prediction and prevention of early onset preeclampsia: The impact of aspirin after first trimester screening



Park, F et. al. Obstet. Gynecol. doi: 10.1002/uog.14819

# Preeclampsia Screening Based on Previous History and Clinical Risk Factors



## Screening/Treatment Parameters based on NICE Parameters

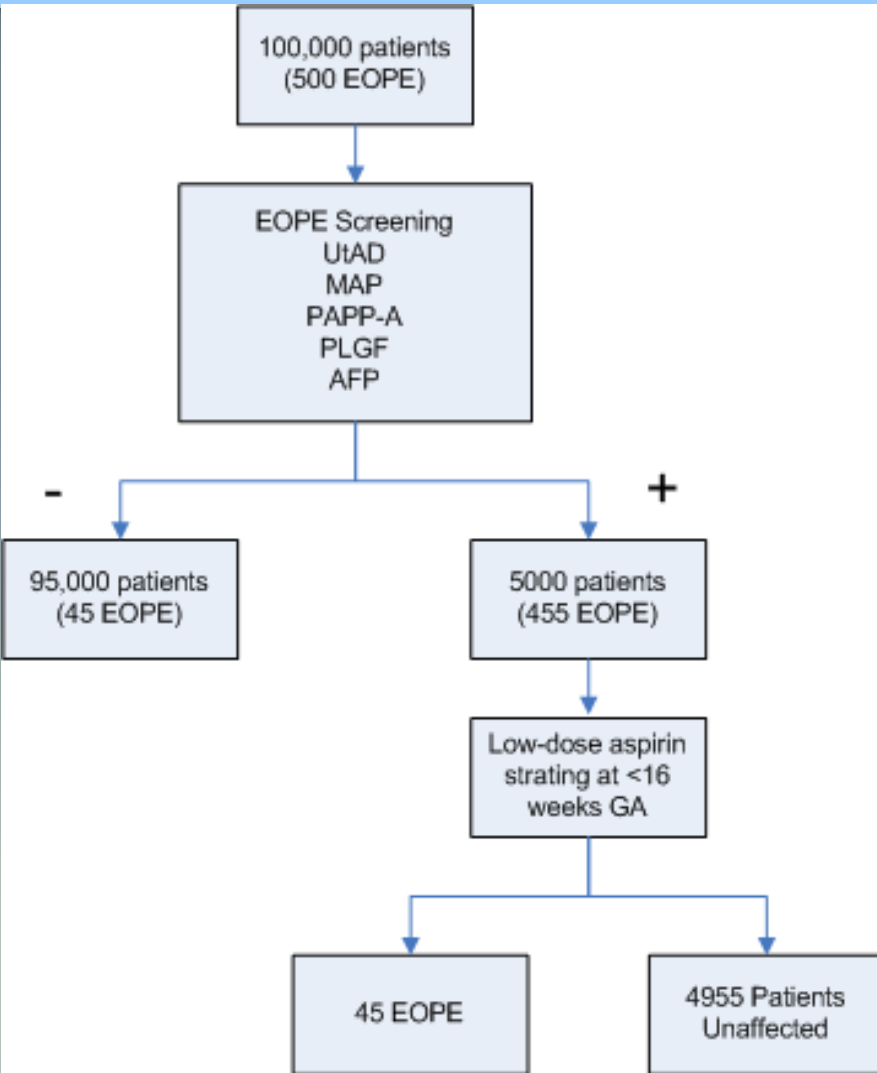
- 0.5% Incidence of EOPE
- 44% Screen Positive Rate
- 77% Detection Rate
- 90% Reduction in EOPE w/ LDA

69% Theoretical Reduction in Incidence of EOPE

347/500 EOPE cases prevented



# Screening for Early Onset Preeclampsia in 100,000 Patients



## EOPE Screening/Treatment Parameters

- 0.5% Incidence of EOPE
- 5% Screen Positive Rate
- 91% Detection Rate
- 90% Reduction in EOPE w/ LDA

**82% Theoretical Reduction in Incidence of EOPE**

(410/500 EOPE cases prevented)

# Placental Magnetic Resonance Imaging (MR)

- adherent placentation – increta, percreta
- “extreme” placental pathologies and early onset of unexplained IUGR.
  - massive villous fibrin deposition  
(maternal floor infarction)
  - fetal-maternal thrombotic vasculopathy
  - maternal arterial malperfusion
  - villitis of unknown etiology

- Frequency of adherent placentation has increased ten-fold over the last twenty years and is now observed in approximately 9% of women with placenta previa or 1 per 500 deliveries.
- Cesarean delivery is the most common cause of decidual defects.
- In patients with prior cesarean deliveries who have placenta previa or low lying anterior placenta the risk of adherent placentation increases from 24% for one prior C-section to 67% for four prior C-sections.
- Incidence of placenta previa with at least one C-section is 10%

## OTHER RISK FACTORS FOR CLINICALLY SIGNIFICANT ADHERENT PLACENTATION

- Subserosal uterine myomas
- Prior myomectomy
- Asherman's syndrome
- Maternal age over 35 years of age
- Smoking
- Elevated alpha fetoprotein levels
- PAPP-A > 3.0 MOM

## OBSTETRIC MR

### Imaging assessment of adherent placentation – 2D US, Color Doppler US, MR

- Identification of clinical risk factors: AMA, prior CS, placenta previa, prior uterine surgery, multiple D&C.
- Placenta lacunae – number, morphology, Doppler flow patterns.
- Placenta/myometrial interface – 2D and MR
- Bizarre vascularity – color flow mapping
- MR - posterior placenta; extent of percreta – vascular encasement , abdominal wall, intestinal involvement.

## **HVRA census increta/percreta. 2008-2015: 158 cases**

- gravid patients at risk for clinically significant adherent placentation.
- referred by MFMs who desired second opinion after their own ultrasound studies.
- all patients had MR followed by transabdominal, transvaginal color Doppler ultrasound studies.
- all patients had MD performed US scanning and MR interpretation by one radiologist (DJC).
- delivery, operative and pathology reports reviewed for all patients



## HVRA's increta/percreta study - 158 cases

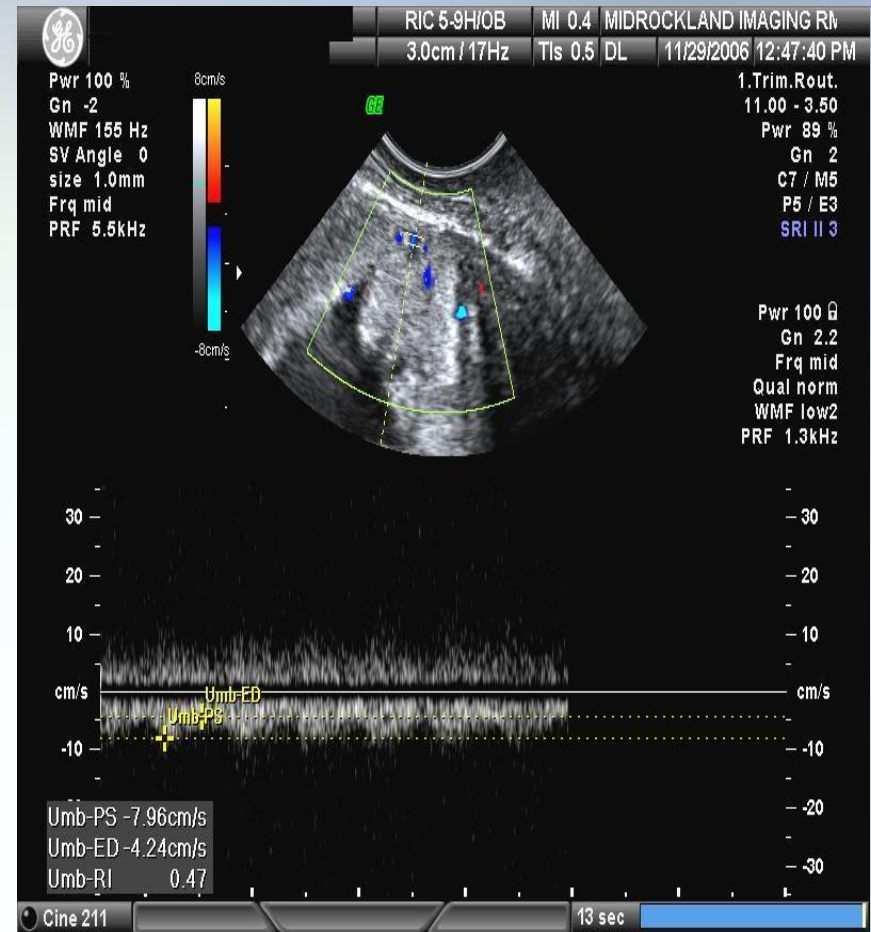
### *Interpretive endpoint*

- “High-risk” categorization – patient at high-risk for increta/percreta or patterns of accreta that might result in hysterectomy.
- “Low-risk” – no signs of percreta/increta. Accreta of a type that might result in hysterectomy unlikely, but cannot be entirely excluded.

# HVRA's Imaging Census for Placenta Increta/Percreta from January 2008 through May 18, 2015. 158 patients studied.

	<u>No. of pts</u>
True positive:	47
True negative:	95
False positive:	10
False negative:	6
Sensitivity	89%
Specificity	90%
Positive Predictive Value	82%
Negative Predictive Value	90%
False Positive Rate	9.5%
False Negative Rate	11.3%
Accuracy	90%

# First trimester diagnosis of placenta increta in CS scar



# Placenta percreta – probable C-section scar pregnancy.

33-week gestation, one prior C-section. MFM ultrasound demonstrated persistent marginal previa with new onset of hypervascularity. Unexplained elevated maternal serum AFP 3.32 MoM. No extreme biochemical trending from first trimester aneuploidy screening.

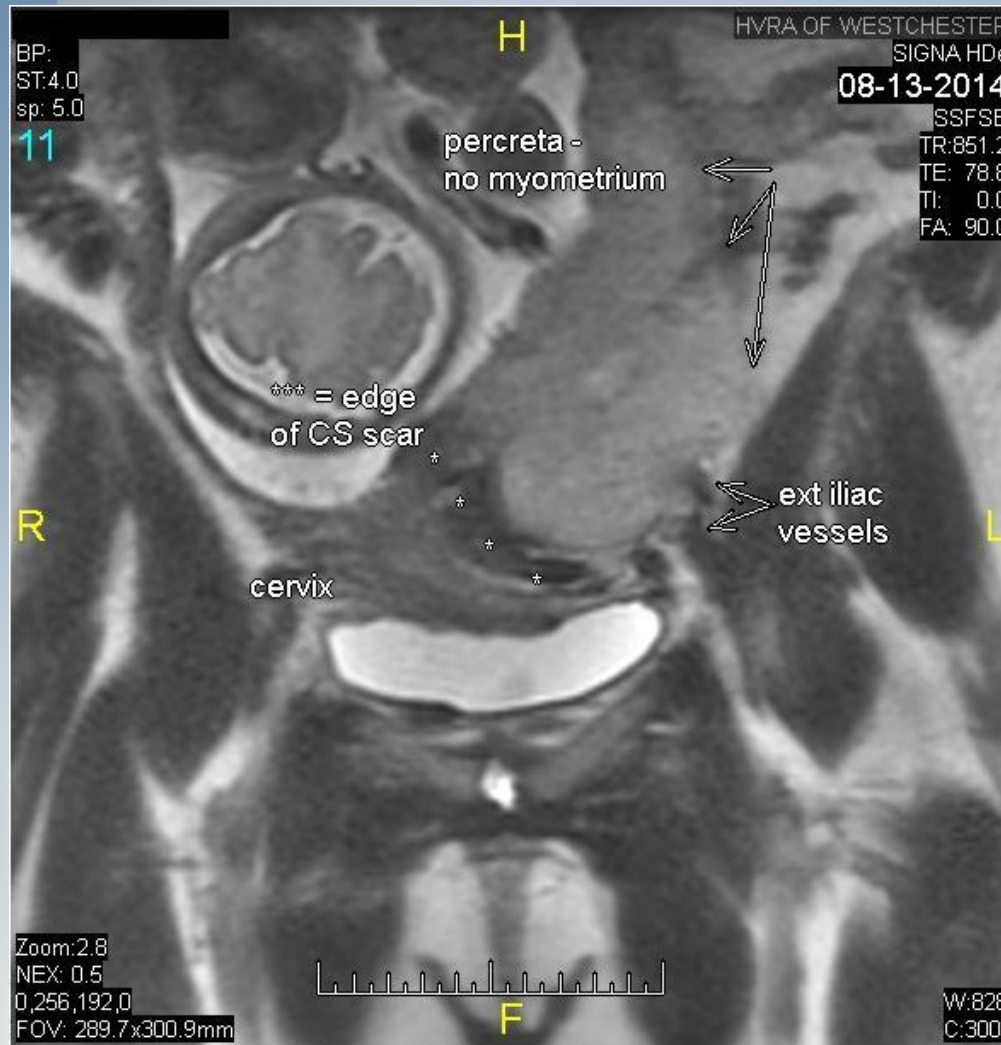
Imaging findings – left lateral placenta percreta abutting pelvic sidewall vessels. Doppler demonstrates huge volume of high-velocity low-resistive vascularity. Imaging evidence to suggest epicenter of implantation is C-section scar –

- Sharp rightward deviation of cervix.
- Sharp abrupt marginal terminations to the myometrium within the lower uterine segment.

Clinical management – radiologist facilitated late Friday afternoon transfer of care and admission to tertiary care center.

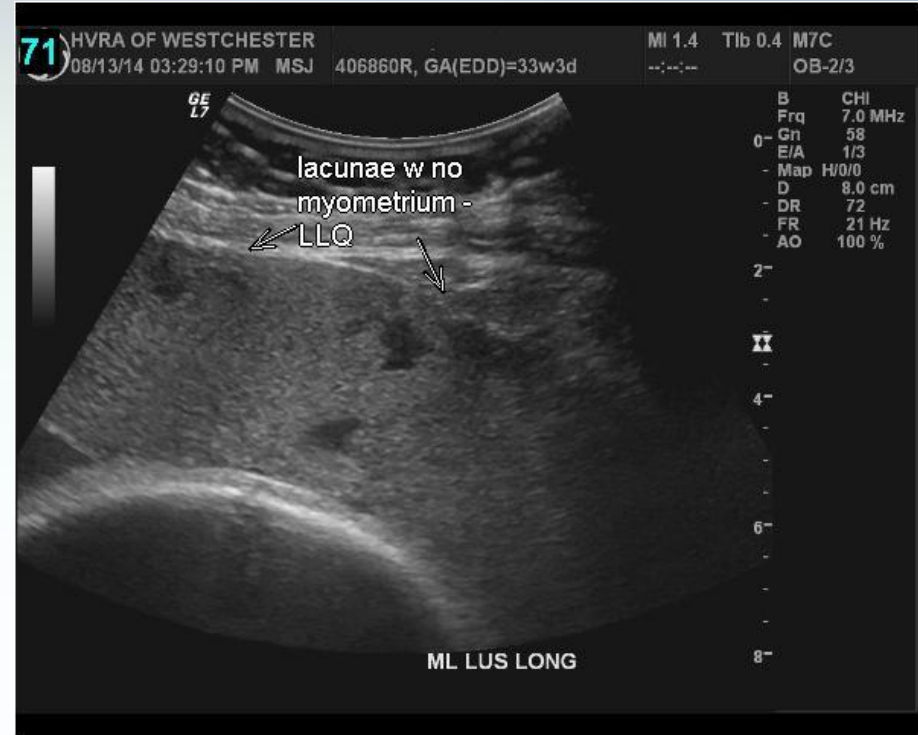
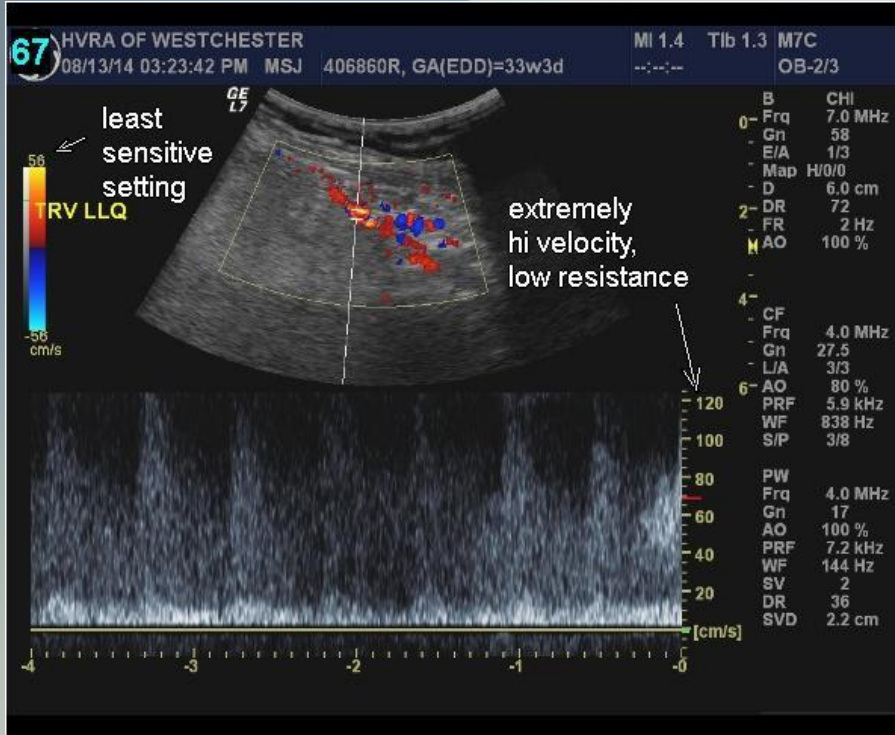
Elective C-section with interventional radiology embolization. Placenta and uterus left in situ. At 10 weeks post delivery awaiting repeat embolization and final surgery.

# Placenta percreta – probable C-section scar pregnancy





# Placenta percreta – probable C-section scar pregnancy





**HISTORY:**

23-week ultrasound demonstrates placentation upon an intrauterine membrane. s/p hysteroscopic resection of large intracavitary fibroid. Initial ultrasound demonstrates two small placental lacunae and velamentous cord insert.

Follow up ultrasound at 28 weeks demonstrates increasing number of intraplacental lacunae worrisome for potentially clinically significant adherent placentation.

**FINAL DIAGNOSIS:**

Placenta accreta requiring hysterectomy. Referring physician was prepared for this possibility.

**TEACHING POINT:**

In addition to the history of prior C-sections, unusual patterns of placentation, velamentous cord insert and intraplacental lacunae are red flags increasing risk for adherent placentation.

# Placentation upon intra uterine membrane. Placenta accreta requiring hysterectomy.



# How does MR help in the imaging risk assessment for clinically significant adherent placentation?

- MR performed and reviewed before hands-on ultrasound optimizes multimodality evaluation of suspicious areas.
- MR provides a reassuring complete multiplanar documentation of placental-myometrial interface. Especially helpful in assessing patients whose risk factors are other than C-section – myomectomy, Asherman's, septate uterus.
- Provides the most global pelvic assessment for extent of percreta – abdominal wall, intestine, sidewall vascular encasement.

# Current Concepts in the Evaluation for Placenta-Related Complications of Pregnancy

- IUGR – uterine and middle cerebral artery Doppler

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- 70% of fetuses with EFW less than the 10<sup>th</sup> percentile will be non-pathologically, constitutionally small

(Ott. The diagnosis of altered fetal growth. Obstetrics and Gynecology Clinics North America. 15:237, 1988).

*After 34 weeks—late preterm, early term – IUGR is characterized by milder placental dysfunction that can be associated with normal umbilical arterial Doppler.*

- Fetal compromise despite normal umbilical arterial Doppler waveforms is well-established. (Chang. Prediction of perinatal morbidity at term in small fetuses.

British Journal OB/GYN. 1994; 101. 422-7)

- Doppler vessels other than the umbilical artery is therefore necessary to determine whether or not placental dysfunction is a contributing factor.***

- Uterine artery Doppler abnormalities confer increased risk for IUGR and preeclampsia because both are placental-related pathologies
- Abnormal uterine artery Doppler mitigates against a constitutionally small fetus as an alternative differential possibility.
- When an SGA fetus is first identified, an abnormal uterine artery Doppler – even with normal umbilical and middle cerebral arterial Dopplers and normal amniotic fluid volume – identifies a pregnancy at significant increased risk for placental-related complications (Ultrasound OB/GYN 2012. Espinosa), in particular for their early-onset less than 34 week patterns of presentation.
- When abnormal uterine artery Dopplers persist after 26 weeks even in low-risk nulliparous patients, there is increased risk for preeclampsia, IUGR and NICU admission (Ghi. Ultrasound Obstetrics and Gynecology 2010).
- Third trimester abnormal maternal uterine artery Dopplers are associated with more adverse perinatal outcomes – incr. rates of C-section, SGA neonates, preterm delivery, low APGARs – in both low-risk and high-risk patients (Schwarzman. Journal of Ultrasound in Medicine 2013).



## **Uterine artery Doppler at the time of midtrimester ultrasound can assist in risk assessment for uteroplacental vascular insufficiency and when abnormal potentiates its risk for occurrence.**

- Sciscione. Uterine artery Doppler Flow studies in obstetric practice. American Journal of Obstetrics and Gynecology. August 2009. p 121-126.
- Harrington. Value of uterine artery Doppler in the prediction of uteroplacental complications in multiparous women. Ultrasound Obstetrics and Gynecology 2004; 23:50-5.
- Papageorghiou. Role of uterine artery Doppler in predicting adverse pregnancy outcome. Best Prac Res Clin Obstet Gynaecol. 2004; 18:383-96.



Although the predictive value for uterine artery Doppler is low in the low-risk population, uterine artery Doppler screening of the high-risk population (chronic HTN, past history preeclampsia, IUGR stillbirth) identifies a population at significant risk for adverse pregnancy outcome (Sciscione. Am J OB/GYN 2009.)

Uterine artery Doppler at 20-24 weeks identifies approximately 76% of women at a 5% false positive rate who subsequently develop preeclampsia requiring delivery <33 weeks (Fonesca. US OB/GYN. 2006).

# **HVRA's STUDY OF SECOND TRIMESTER UTERINE ARTERY DOPPLER IN THE EVALUATION OF MULTIPAROUS 'HIGH-RISK' PATIENTS**

# HVRA's study of second trimester uterine artery Doppler in the evaluation of multiparous 'high risk' patients – does uterine artery Doppler have predictive value for preeclampsia and IUGR

**INTRODUCTION:** This project investigates the association between midtrimester mean maternal uterine artery resistive index and pregnancy outcome in multiparous patients with a past obstetrical history of uteroplacental vascular insufficiency and its spectrum of clinical expressions.

**Mean uterine artery resistive index is a Doppler measurement that reflects the placental impedance at the level of the maternal spiral arteries.**

The study population is multiparous patients who had prior pregnancies with hypertension, preeclampsia, abruption, SGA/IUGR, spontaneous premature rupture of membranes, preterm labor/delivery, HELLP.

A total of 124 patients responded who met the above pretest conditions.

The disease outcome studied is defined as:

- Delivery less than 38 weeks with preeclampsia and/or SGA
- Delivery of SGA 38-40 weeks without preeclampsia and/or NICU admission

**Total number of patients in study group, 220.  
Total number of patients responding to telephone interviews, 124.**

- **True positive            33 patients**
- **True negative            65 patients**
  
- **False positive            16 patients**
- **False negative            10 patients**
  
- **Sensitivity – 77%**
- **Specificity – 80%**
- **False Positive rate – 20%**
- **False negative rate – 23%**
- **positive LR 7.4**
- **negative LR 0.2**

HVRA's current investigation is similar in target population and methodology to the study by Harrington - Ultrasound in Obstetrics and Gynecology 2004 January; 23(1):50-55. The value of uterine artery Doppler in the prediction of uteroplacental complications in multiparous women.

HVRA's current investigation results roughly approximate those of Harrington. Harrington's use of uterine artery Doppler at a cutoff resistive index of 0.55 yielded –

	<u>Harrington</u>	<u>HVRA</u>
Sensitivity	81%	77%
Specificity	89%	80%
PPV	71%	67%
NPV	93%	87%



**Case Study:**

**Abnormal modified seq. screen-  
increased Down syndrome risk.  
NL karyotype and microarray.**

**28W with abnormal modified sequential screen**

- low AFP 1.93 MoM
- extremely low estriol 0.31 MoM
- high inhibin 2.72 MoM

EFW 25%

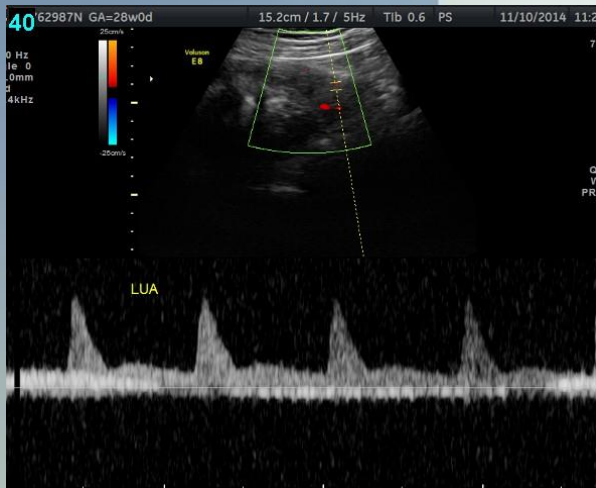
AC and FL 26W, 3%

**Clinical Course:** multiple ED visits for epigastric pain.

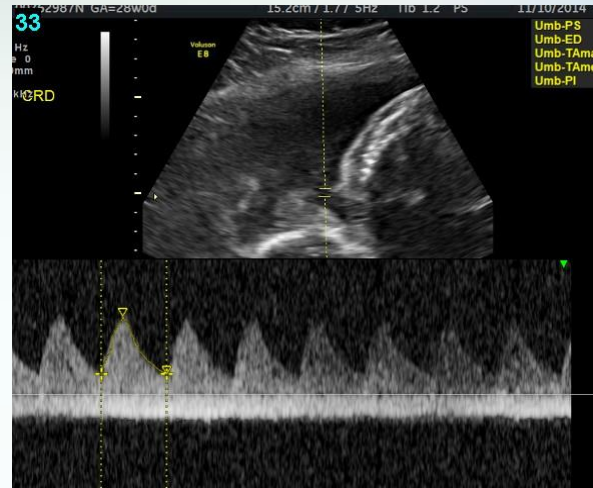
**Outcome:** CS at 31 W for HELP syndrome.

## Case Study:

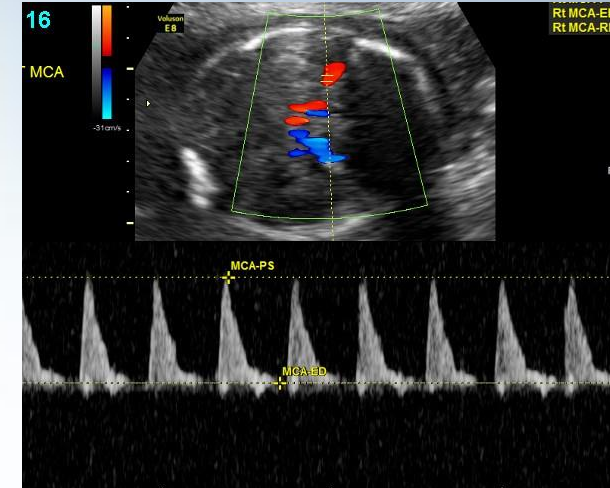
# 28W with abnormal MSS, abnormal uterine artery Doppler NL umbilical and MCA Dopplers.



MCA



Umbilical artery





Uterine artery

# When to use uterine artery Doppler?

## Optimize screening for impaired placentation

- First trimester preeclampsia screening – Fetal Medicine Foundation accreditation required.
- Level 2 OB Ultrasound exam
  - a) Optimize risk assessment for recurrent placenta related adverse obstetrical outcome – past OBHx: neonatal death, stillbirth, oligo, IUGR & preeclampsia, PTD & SPROM.
  - b) Unexplained extreme trendings of first & second trimester screening biochemical analyzes.
- Initial presentation of SGA / IUGR

# Placenta related adverse obstetrical outcomes associated with extreme trendings of maternal biochemical analytes.<sup>1,2</sup>

		
PAPP-A	yes	no
hGG	yes T1	yes T2
AFP	yes	yes
Estriol	yes	no
Inhibin	no	yes

1. Soc. ObGyn Canada. Technical Updates. JOGC. Oct. 2008
2. Goetzinger. Prenatal Diagnoses. July 2014.

# Placenta related adverse obstetrical outcomes associated with extreme trendings of maternal biochemical analytes.<sup>1,2</sup>

- Potentiators of additional risk
  - multiplicity of abnormal biochemical analytes
  - abnormal uterine artery Doppler
  - marginal/velementous cord insertion
  - abnormal placentation
    - previa; increta/percreta
    - thick placenta > 5cm; placenta < 10cm length
    - circumvallate
  - past OBHx of placenta related complications

1. Soc. ObGyn Canada. Technical Updates. JOGC. Oct. 2008
2. Goetzinger. Prenatal Diagnoses. July 2014.

# HVRA's screening and imaging guidelines for impaired placentation

- 1<sup>st</sup> TM identification and reporting of risk factors
- at the time of First Trimester NT/NB aneuploidy screening pose the question:
  - when OBHx and/or extremely low PAPP-A renders appropriate, might patient benefit from First Trimester Preeclampsia Screening?
- at anatomy scan review MSAFP and modified sequential screen results
  - uterine artery Doppler, UC Doppler identification of placental cord insertion and detailed placental ultrasound for unexplained extreme biochemical analyte trending
- fetal growth ultrasound at 32 weeks

# IUGR and placenta related adverse obstetrical outcomes

## **Umbilical artery Doppler is not enough!**

Late onset (> 34 weeks) placenta related IUGR is typically characterized by NORMAL umbilical Doppler yet still confers morbid consequences for fetus, neonate and childhood neurodevelopment.



A comparison of Doppler biophysical findings between live born and still born growth restricted fetuses.

Crimmins. Dec 2014. Am J Ob Gyn.

Objective – evaluate surveillance characteristics that precede stillbirth in 47 growth restricted fetuses.

Results – at >34 w, in 7 of 10 cases only a decline in MCA PI (intracranial shunting) was observed and 75% of stillbirths were unanticipated by BPP.

# Late onset placenta related IUGR with normal umbilical artery Doppler.

- Detection requires uterine and middle cerebral artery Doppler and cerebral to placental Pulsatility Index Ratio, (CPR) to distinguish non pathologic constitutional normal variants versus uteroplacental vascular insufficiency UPVI and its accompanying placenta related adverse obstetrical outcomes.
- Abnormal MCA Doppler identifies SGA fetuses with six – fold increased risk for emergency CS when compared to SGA fetuses with normal MCA PI.

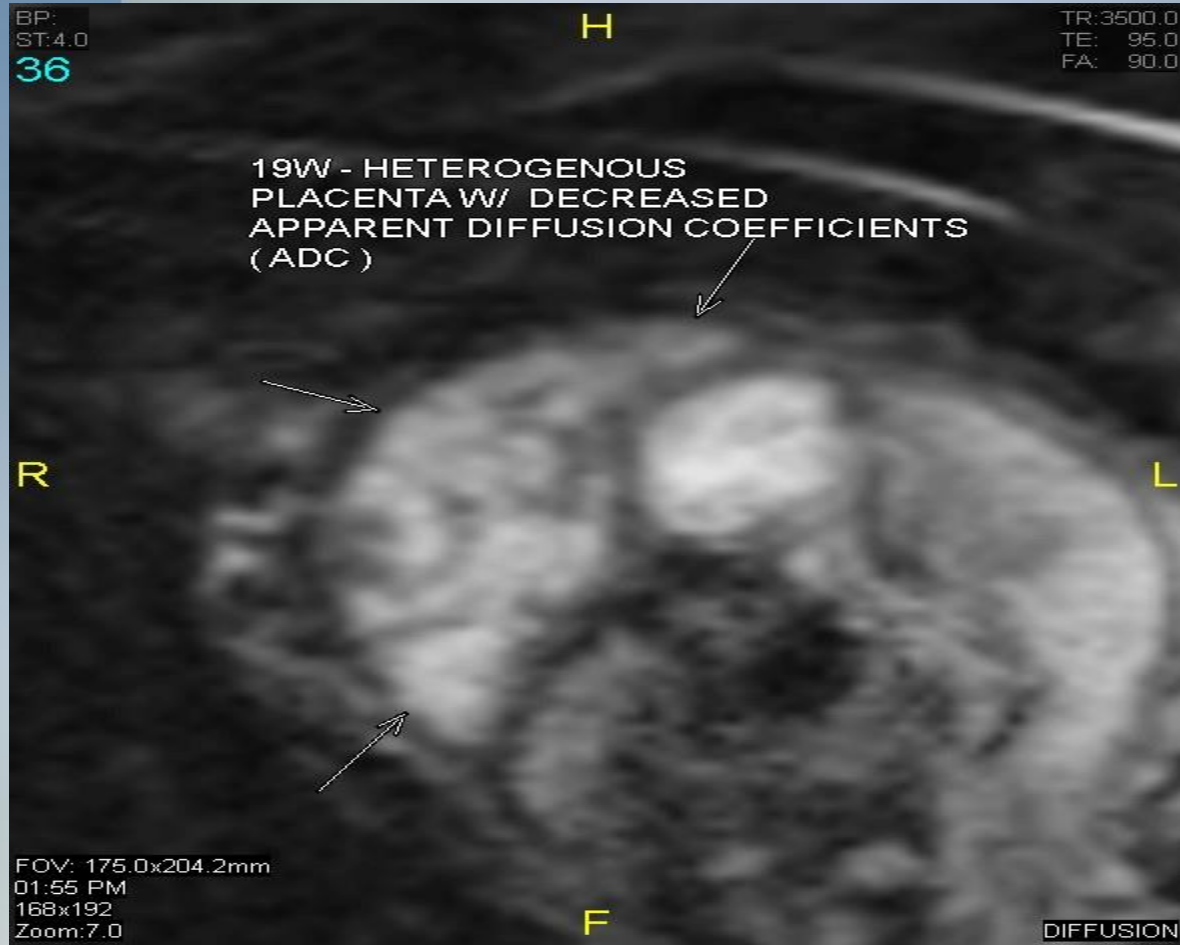
- Abnormal third trimester uterine artery and fetal middle cerebral artery Dopplers corroborate significantly with placental dysfunction and obstetrical complications even in the context of normal umbilical artery Doppler indices (Baschat. Ultrasound OB/GYN 2011. Ghi. Ultrasound Obstetrics and Gynecology 2010. Schwarzman. Severi. Ultrasound Obstetrics and Gynecology 2002).
- Abnormal MCA Doppler identifies a subset of IUGR fetuses at increased risk for C-section due to abnormal fetal heart rate pattern and/or neonatal acidosis (Society Maternal Fetal Medicine reference 21, 36).
- Abnormal MCA Doppler (intracranial shunting) in late-onset IUGR with normal UAD are associated with behavioral, psychological, and cognitive testing abnormalities (Baschat. Ultrasound OB/GYN 2011).

# Current Concepts in the Evaluation for Placenta-Related Complications of Pregnancy

- IUGR – placenta MR

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# 19 W IUGR. Villitis of unknown ideology



## MR of unexplained second trimester IUGR – placental insufficiency

Case presentation – SPROM/PTD at 28 weeks

- clinical outcome – euploid neonate 1 lb, 4 oz with no structural malformations nor syndromic stigmata
- placental pathology – extensive chronic villitis of unknown etiology (VUE)
  - 191 g placenta less than the third percentile for gestational age; 3rd-10th percentile for neonatal BW
  - VUE: not part of impaired maternal-fetal perfusion spectrum

# Pathologic diagnosis/clinical correlation

## Villitis of unknown etiology

- widely believed to be a host – versus – graft response by mother directed at fetal antigens in the villous stroma
- major risk factor for CNS injury and stillbirth
- significant recurrence risk 20-30%

Redline. Human Pathol. October 2007; 38 (10): 1439-1446.



# Thrombotic vasculopathy

## IUGR Twin A – abnormal placenta and adrenal hemorrhage

History: 26 week diamniotic dichorionic twinning. Twin A demonstrates IUGR and a suprarenal mass. NL fetal Doppler.

MR demonstrates a heterogeneous right adrenal mass consistent with adrenal hemorrhage. Twin A's placenta looks significantly different than co-twin – is profoundly heterogeneous – multiple T1 zones of increased signal. On T2 multilobulated patterns of hypersignal intensity with broad basal plate contiguity.

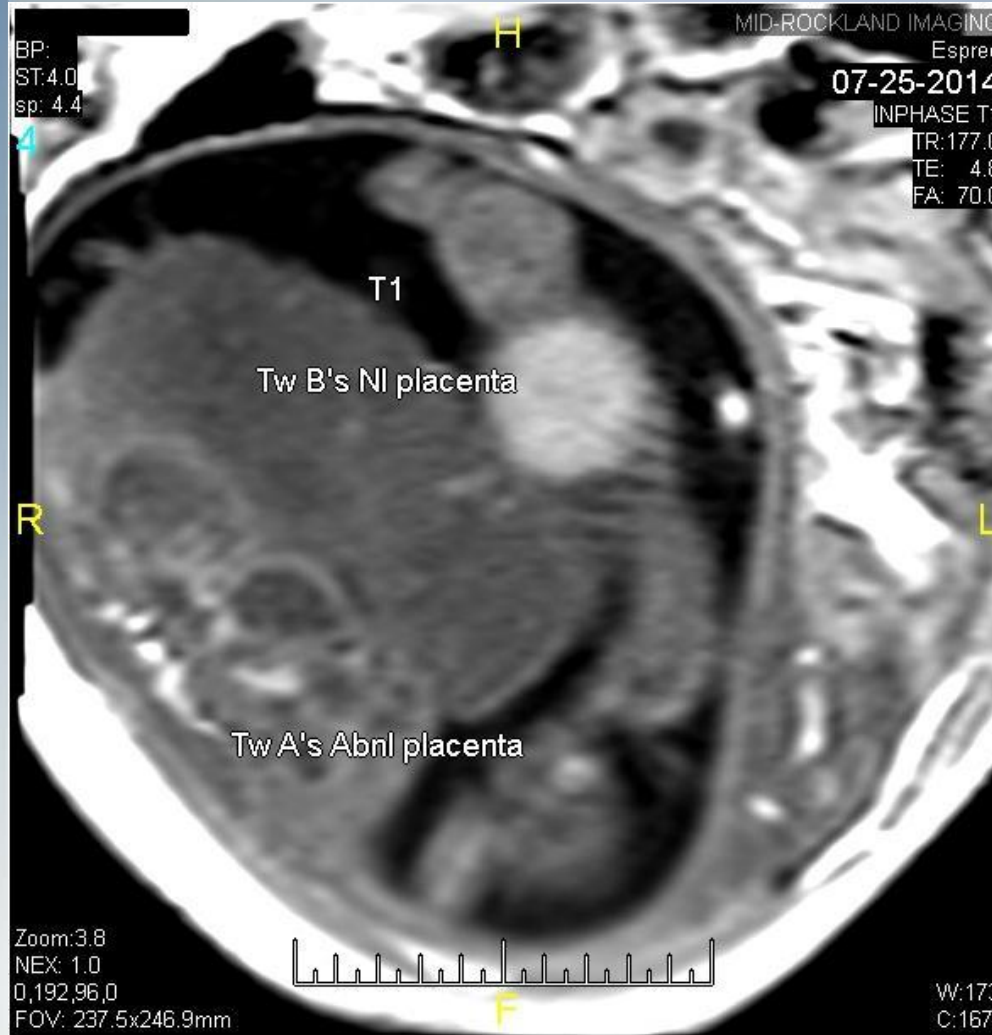
Clinical course – spontaneous premature ruptured membranes.  
Placental histopathology demonstrating ***diffuse multifocal thrombotic vasculopathy***.

***Teaching Point*** - Even with NL Doppler studies, MR diagnosed cause for IUGR and suprarenal mass and excluded neuroblastoma as a DDx possibility.

# Thrombotic vasculopathy



# Thrombotic vasculopathy with IUGR and NL fetal Doppler

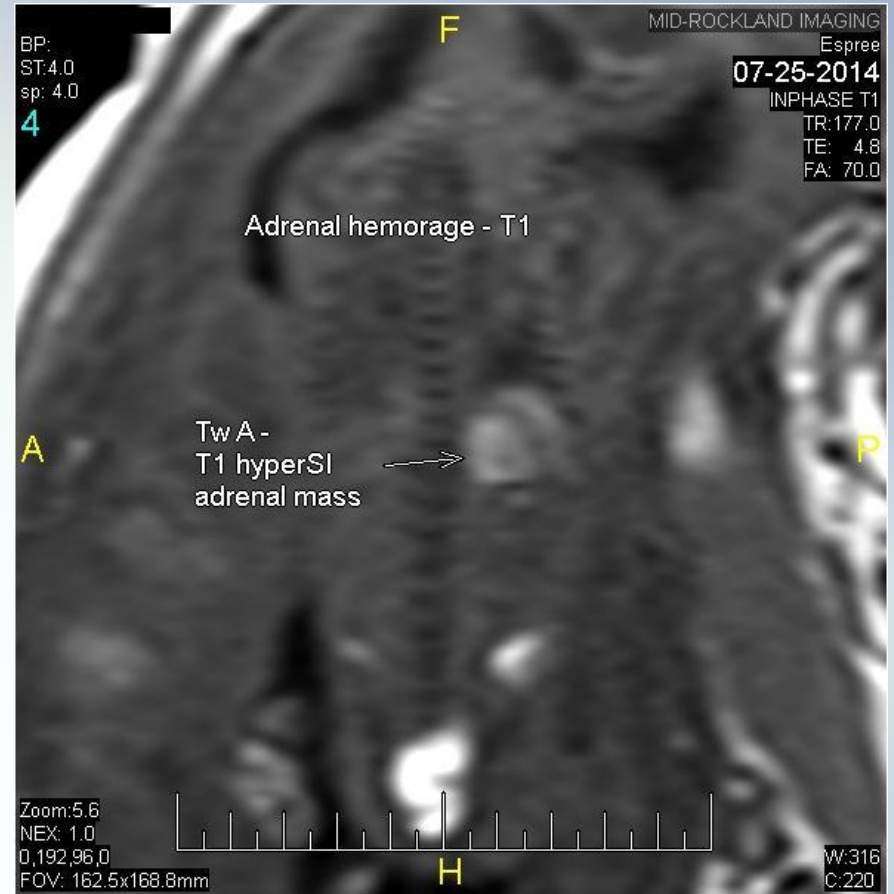
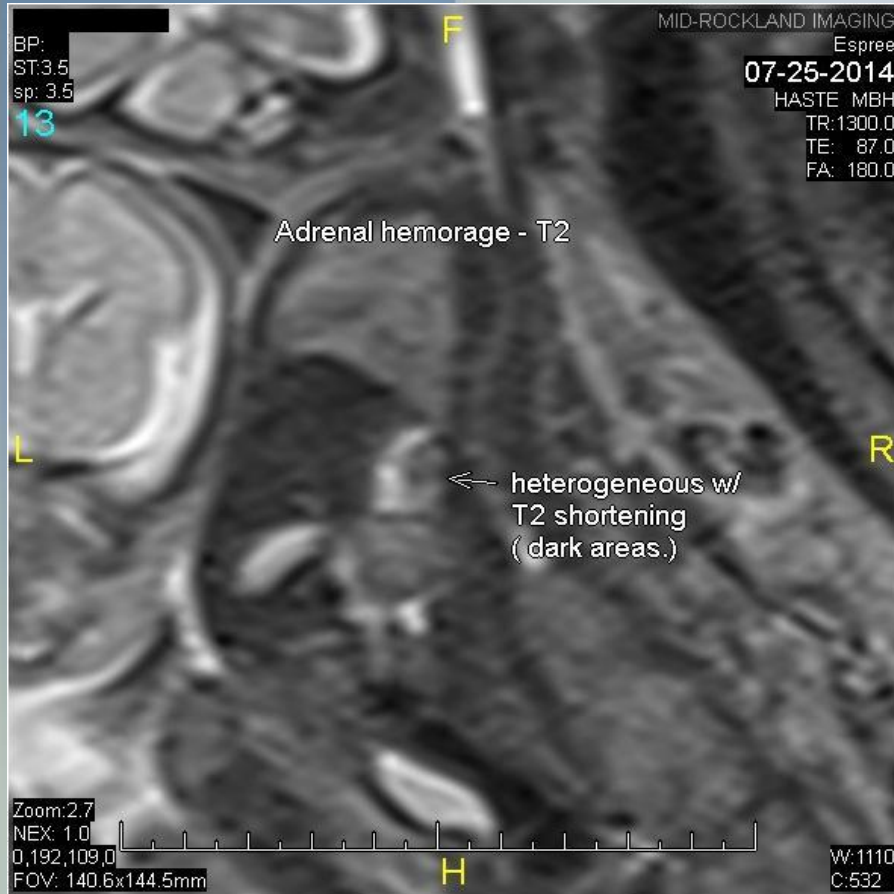


# Thrombotic vasculopathy with IUGR and NL fetal Doppler





# Adrenal hemorrhage. Thrombotic vasculopathy, IUGR NL fetal Dopplers



# Hemorrhagic thrombotic vasculopathy of fetus and placenta

Kraus. Human Pathology. Vol. 30. 1999

Placental thrombotic vasculopathy indicates significant probability of thrombi in the fetus and represents an underrecognized cause of perinatal mortality and neonatal injuries especially cerebral palsy.

- Amongst 84 perinatal autopsies 19% (16) demonstrated thrombotic vasculopathy of the placenta. 6 of 16 autopsies demonstrated thrombi of fetal brain, lungs, and kidney.

**MR establishes severe placental pathology unable to be seen on ultrasound**  
**Abnormal placenta – IUFD 26w – maternal arterial malperfusion**

**History:** 20w GA referred for unexplained elevated maternal serum AFP (7.2 MoM) with outside MFM ultrasound biometry two weeks smaller than expected.  
Normal amniocentesis including microarray.  
Negative maternal workup for thrombophilia, SLE and anticardiolipin antibodies.

**MR results:** Small placenta demonstrating homogeneous diffuse decreased (dark) signal intensity.  
Echoplanar diffusion imaging demonstrated decreased apparent diffuse coefficient (ADC).

Uterine artery Doppler demonstrated bilateral early diagnostic notching with markedly elevated resistive indices for gestational age.

Umbilical arterial resistive index is 0.92 at the 4<sup>th</sup> standard deviation higher than expected for gestational age.



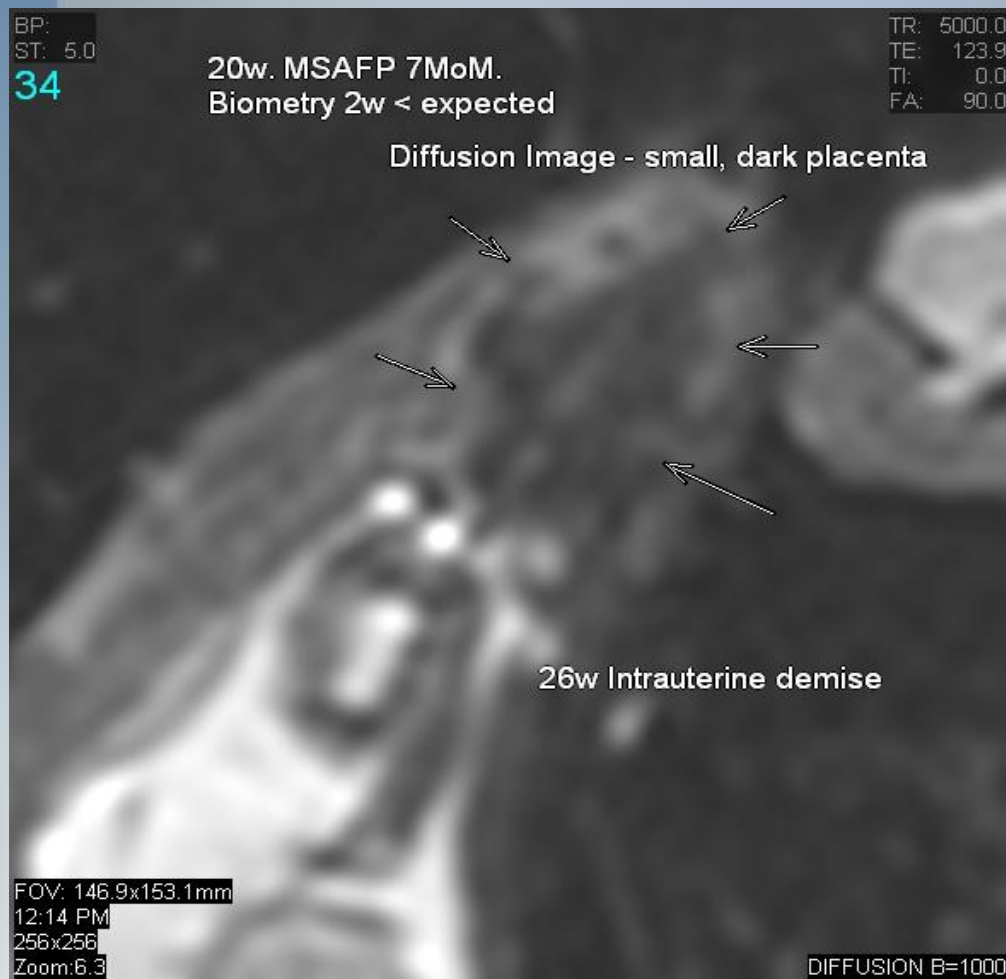
# MR establishes severe placental pathology unable to be seen on ultrasound

## Abnormal placenta – IUFD 26w – maternal arterial malperfusion



# MR establishes severe placental pathology unable to be seen on ultrasound

## Abnormal placenta – IUFD 26w – maternal arterial malperfusion



## Abnormal placenta – IUFD 26w - massive perivillous fibrin deposition

**History :** 22w GA referred for suspected placenta increta.  
Patient has unexplained elevated maternal serum AFP.

**MR:** Profoundly heterogeneous placenta with large curvilinear bands of hyposignal intense tissue. The distribution has an appearance similar in configuration to the convolutions of the cerebral cortex.

**Clinical follow up:** IUFD at 26w.

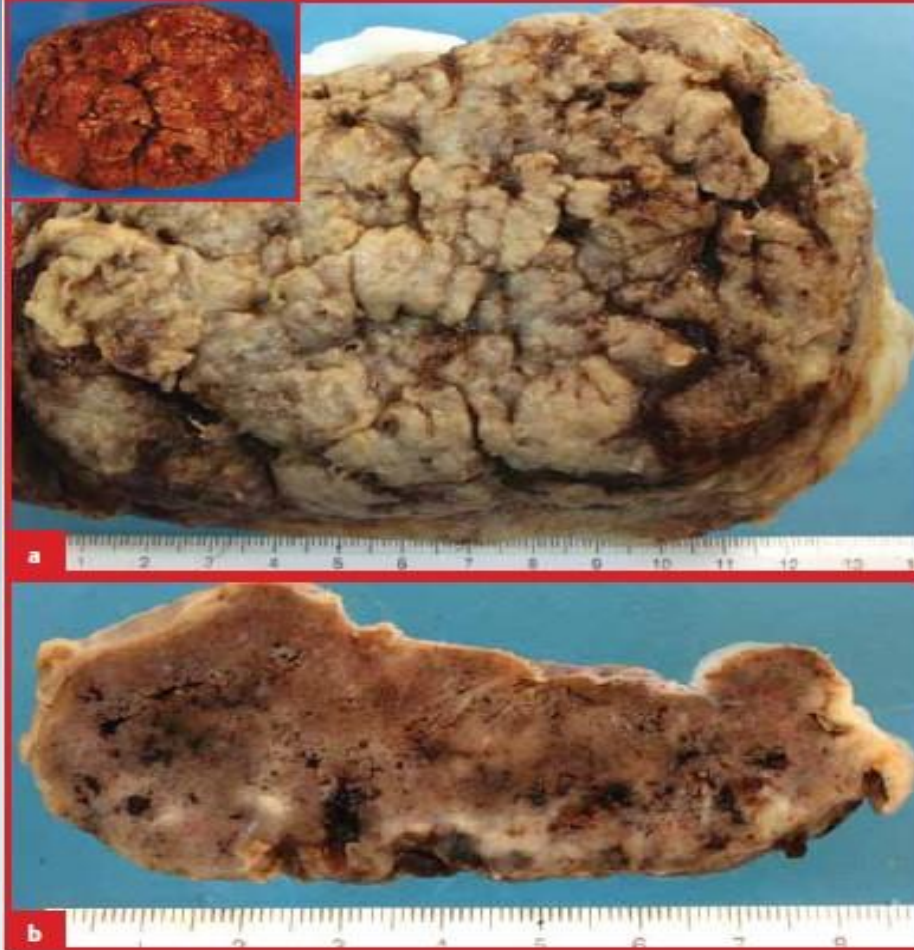
**Teaching point:** MR of the placenta can identify severe placental pathologies associated with early onset IUGR and marked morbidity/mortality such as hemorrhagic vasculopathy and massive perivillous fibrin deposition

# MR establishes severe placental pathology unable to be seen on ultrasound Abnormal placenta – IUFD 26w - massive perivillous fibrin deposition



# Abnormal placenta – IUFD 26w - massive perivillous fibrin deposition

Figure 2. a) Basal (maternal) surface of placenta showing abnormal pale tan-grey cerebriform appearance that contrasts with the normal lobulated and beefy red-purple appearance (inset). b) Cut sections of the placental disc showing diffuse deposition of waxy pale grey fibrinoid material.





# Pathologic diagnosis/clinical correlation

## Massive perivillous fibrin deposition (maternal floor infarction)

- risk factor for virtually all adverse outcomes from miscarriage to CNS injury
- recurrence risk 50-75%
- many affected women never achieve a successful pregnancy

Andres. Am J Obstet Gynecol. 1990; 163: 935-938.

# Screening for impaired placentation and placenta related adverse obstetrical outcomes:

## *Take Home Messages*

- First Trimester Preeclampsia Screening is the earliest and best test for impaired placentation upon which evidence based treatment options ( low dose ASA ) can be made.
- Uterine artery Doppler at the time of mid trimester anatomy scan for high risk pts.
- SGA fetus - *umbilical artery Doppler is insufficient!* Uterine and MCA Doppler with cerebro - placental ratio necessary to detect to distinguish constitutionally small but normal fetus from placenta related IUGR
- Placenta MR for invasive placentation and unexplained euploid IUGR.



# Current Concepts in the Evaluation of Impaired Placentation and Placenta-Related Complications of Pregnancy

- First Trimester Preeclampsia Screening
- Invasive placentation
- IUGR
  - extreme trendings of maternal biochemical analytes
  - uterine and middle cerebral artery Doppler
  - placenta MR

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