



Fetal Care Center of Cincinnati  
Comprehensive Diagnosis & Treatment

# Basic Doppler – Assessment of Fetal Distress

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No Relevant Disclosures



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# Basic Doppler – Assessment of Fetal Distress

## Introduction

- Ultrasound in general, like fetal heart rate monitoring of the fetus during labor, has become one of the staples in the evaluation of the *in utero* environment.
- But, like monitoring, few studies show clear benefit when measuring outcomes of neonatal survival or improved health.

# Basic Doppler – Assessment of Fetal Distress

## Introduction

- There has long been evidence that an ultrasound determined AFI at the onset of labor can predict the risk for fetal distress and Cesarean
- It led to the common practice of amnioinfusion
- This has been extrapolated to the antepartum period.

Sarno. J Rep Med 1990; Vol35, No7: 719-23

# Basic Doppler – Assessment of Fetal Distress

## Introduction

- There are clear clinical scenarios such as confirming fetal death that allows the provider an opportunity to initiate labor regardless of gestational age.

# Basic Doppler – Assessment of Fetal Distress

## Introduction

- Using ultrasound to follow the growth of at-risk pregnancies can also be clinically helpful.
- For instance, in a pregnancy at term, if the fetal growth compared to an earlier exam has failed, initiating labor is a logical step to reduce the risk of unexpected stillbirth.

# Basic Doppler – Assessment of Fetal Distress

## Introduction

- In a twin gestation, if ultrasound performed at 34 weeks or greater shows no interval growth, or an amniotic fluid deepest vertical pocket is  $<2$  cm, most providers would even advise accepting the risk of prematurity to the normally growing twin to prevent unexpected stillbirth in the affected twin.



# Basic Doppler – Assessment of Fetal Distress

## Introduction

- In diabetic pregnancies, the role is less clear.
- Many providers commonly use ultrasound estimations of fetal weight (EFW) to time the elective induction of labor
- If the EFW is at or above 4 kg, initiation of labor commences to reduce the risk of shoulder dystocia and, ostensibly, to prevent excess neonatal morbidity and mortality

# Basic Doppler – Assessment of Fetal Distress

## Introduction

- This is logical, thoughtful and noble, but has not been shown to work predictably
- The best data allow for recommending primary Cesarean in diabetics whose EFW is  $>4.5$  kg or in non-diabetics whose EFW is  $>5$  kg



# Basic Doppler – Assessment of Fetal Distress

## Introduction

- If we move away from these abstract or general concepts, the value of ultrasound becomes even less helpful, predictably, unless we start to apply it in specific situations and by specific providers who have knowledge and expertise in the clinical practice of complicated obstetrics

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses

- The most productive body of literature for study involves evaluation of fetuses
  - in IUGR pregnancies
  - In multiple gestations

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses

Regarding IUGR, the population is

- Defineable
- Antenatally studied
- Postnatally studied
- Universally experienced

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses

It is easy to exclude etiologies such as

- Viral
- Genetic
- Aneuploidy

The data is comparable due to

- Common definitions
- Anatomical Reference Points
- Standard Technology
- Standard Technique



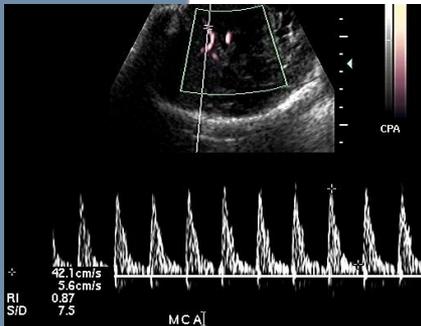
# Basic Doppler – Assessment of Fetal Distress

## Specific Uses

The ability to diagnose IUGR or conversely to exclude IUGR can be done by evaluation of the cerebroplacental ratio (CPR).

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation



- Cerebroplacental Ratio (CPR) using RI or PI
- $RI = 0.87$  v.  $RI = 0.8$
- If the CPR is  $\geq 1$  (using RI), this is normal and the NPV = 97%.
- If the CPR is  $< 1$ , the PPV = 88%.
- This is referred to as cephalization or redistributed flow



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study

- 110 IUGR fetuses
- Defined as AC <5<sup>th</sup>%
- All between 24 and 34 weeks EGA
- No intervention under 24 weeks
- No reason to deliberate after 34 weeks

Hecher. Ultrasound Obstet Gynecol 2001; 18: 564-70

# Basic Doppler – Assessment of Fetal Distress

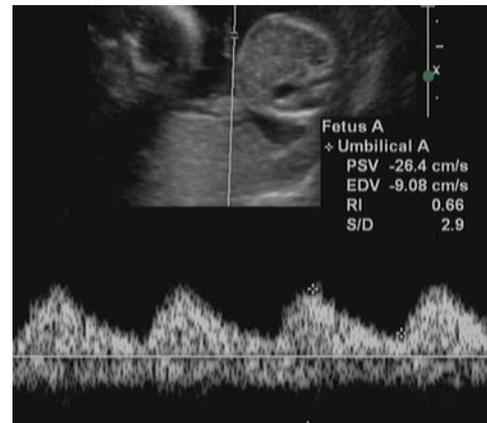
Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study

- 93 of 110 were studied within 24 hours of delivery or IUFD
- The purpose was to define the order of developing Doppler ultrasound abnormalities
- The time to delivery shortened as the progression of abnormalities were seen in the UA(AFI), MCA, TA, STV(FHR), DV and IVC

Hecher. Ultrasound Obstet Gynecol 2001; 18: 564-70

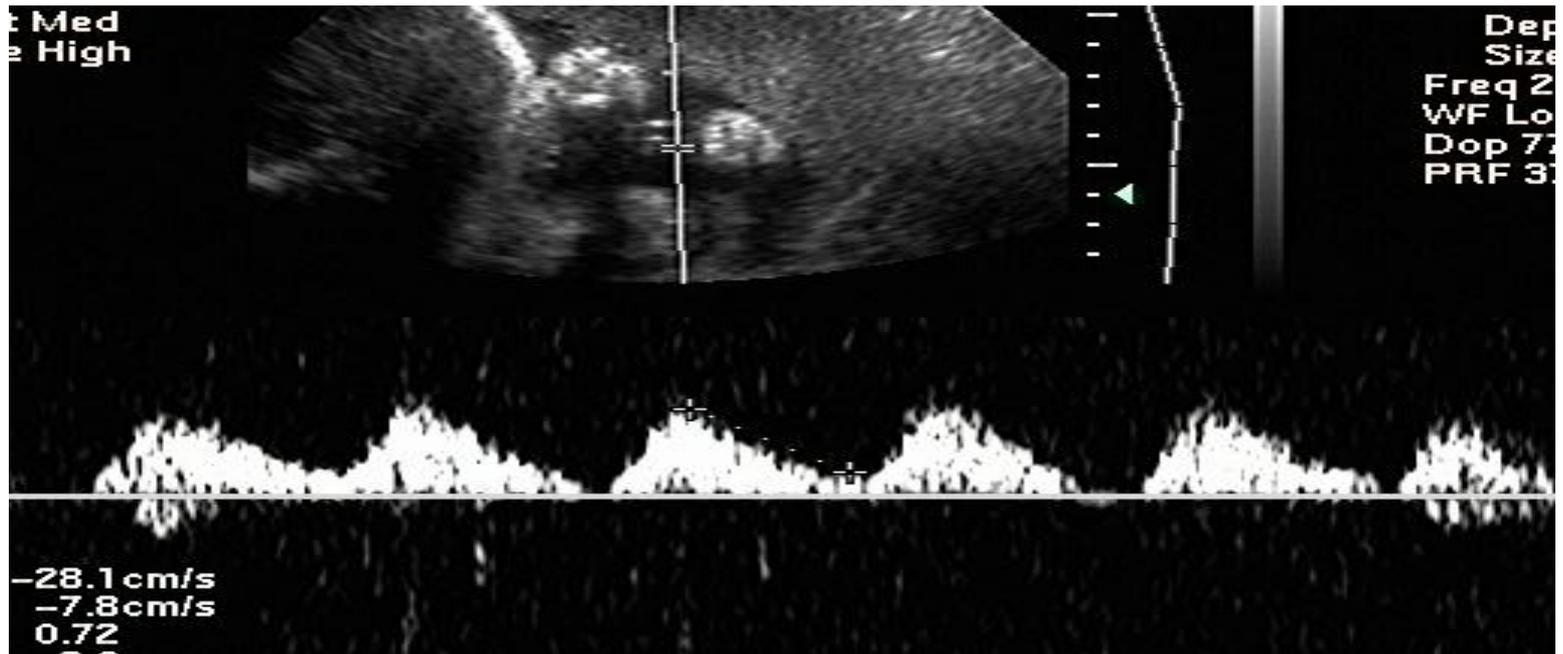
# Normal Umbilical Artery

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



# Abnormal Umbilical Artery: IAEDF

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



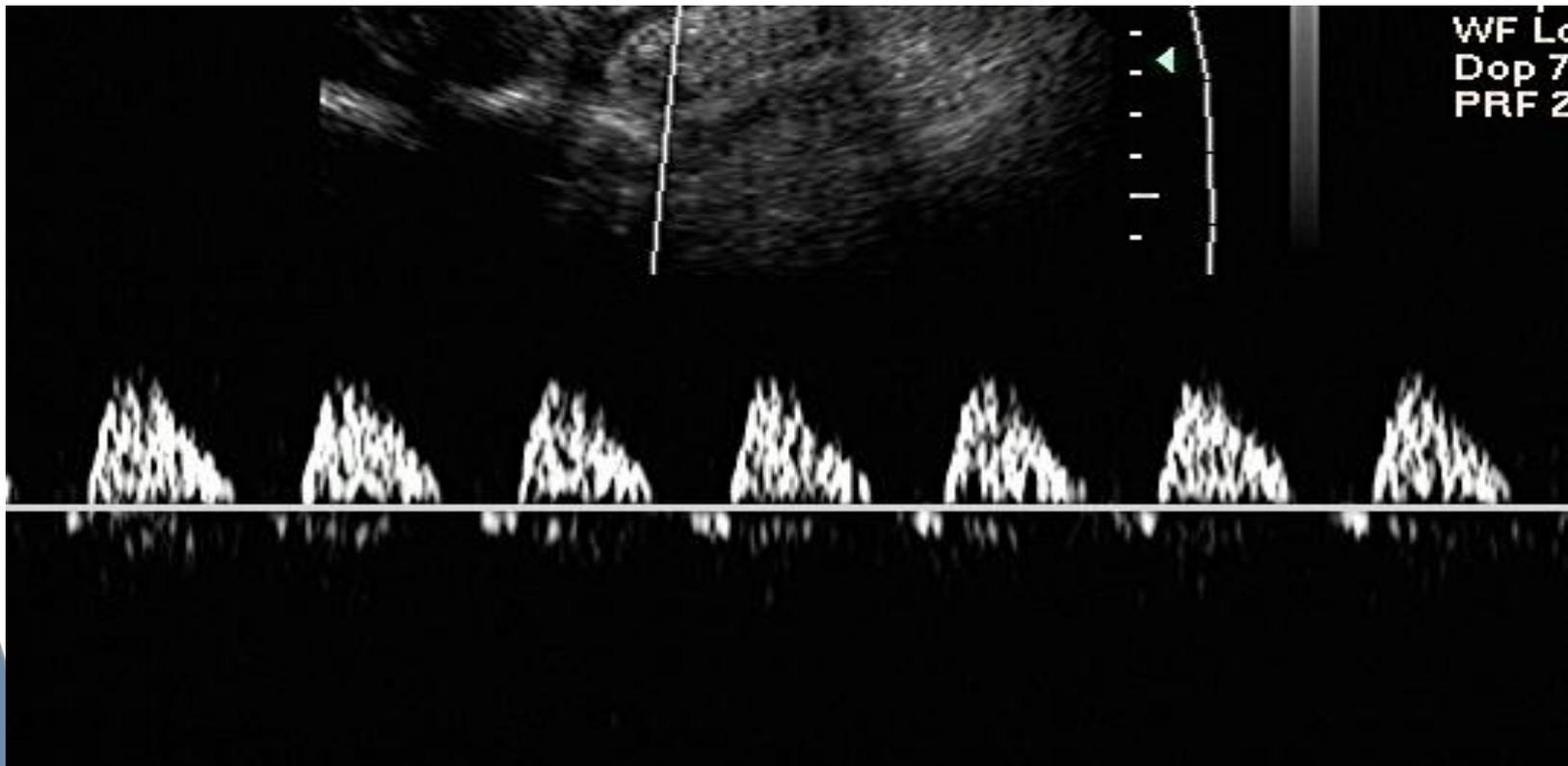
# Abnormal Umbilical Artery: ADF

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



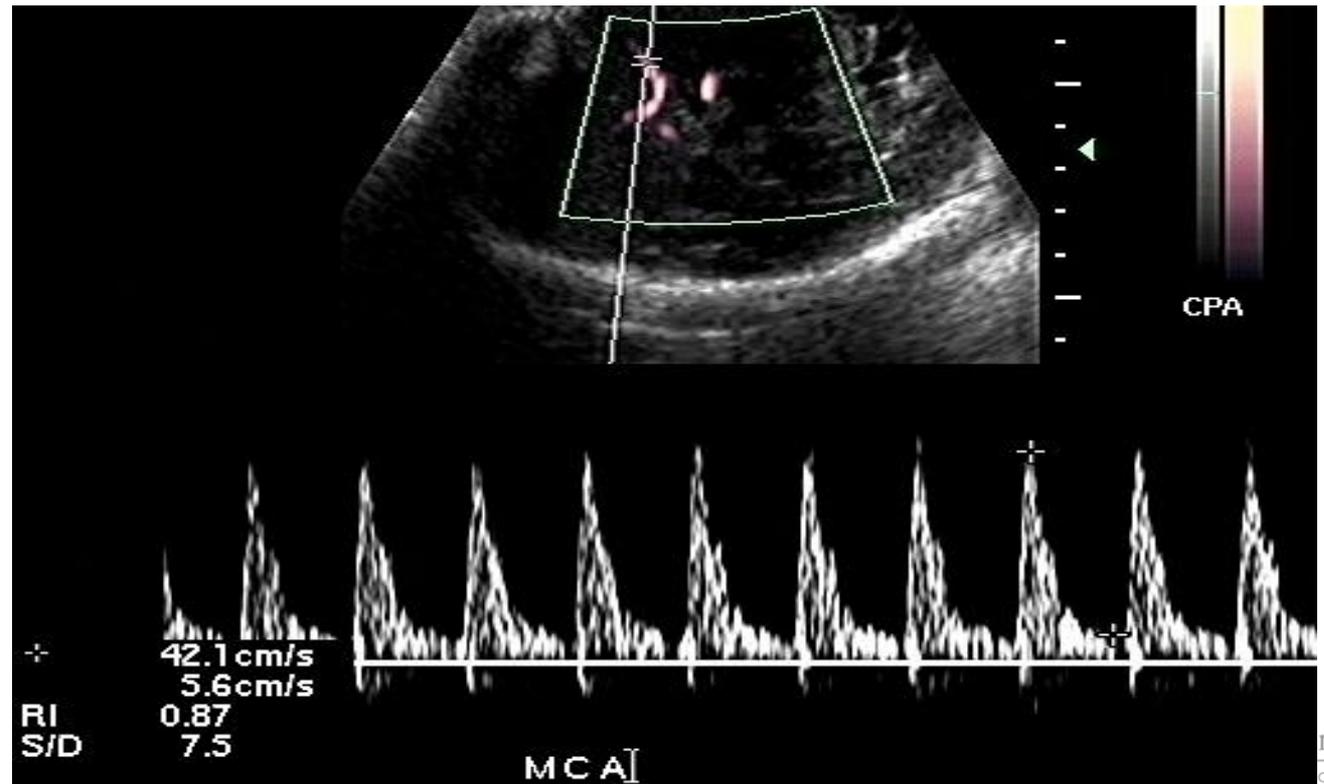
# Abnormal Umbilical Artery: RDF

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



# Normal MCA Doppler

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



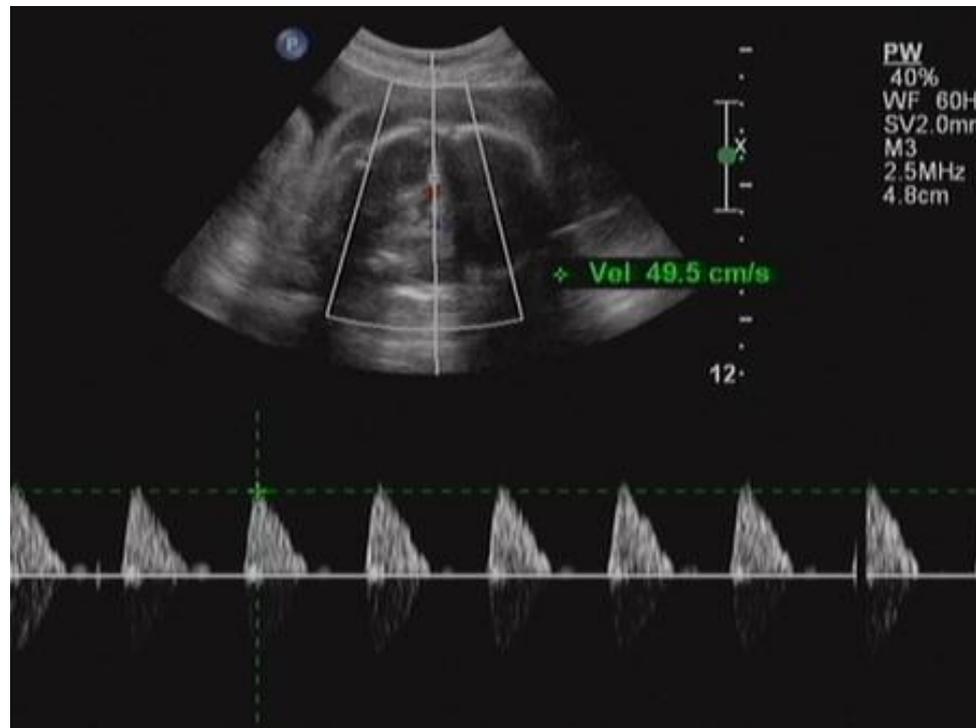
# Abnormal MCA Doppler

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



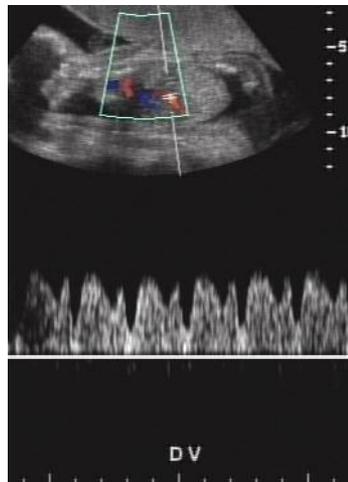
# Abnormal MCA Doppler

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



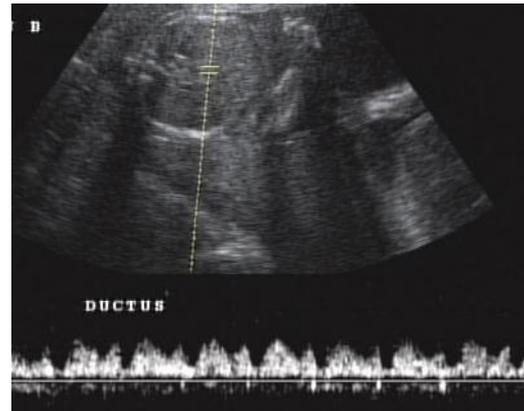
# Normal Ductus Venosus

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



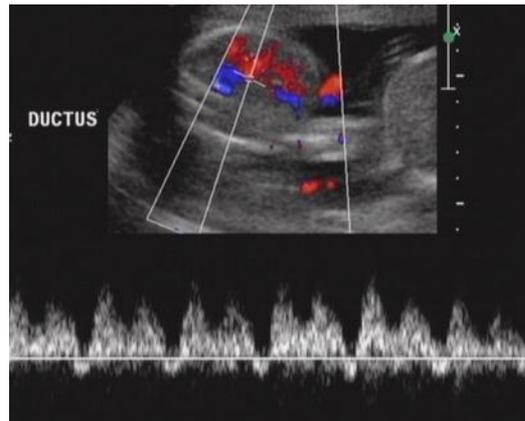
# Abnormal Ductus Venosus: DA

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



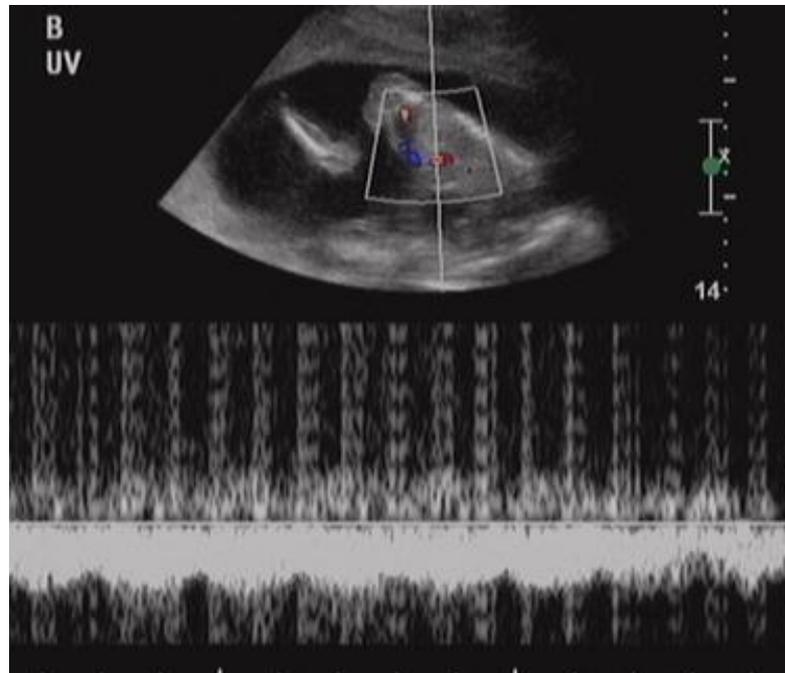
# Abnormal Ductus Venosus: RA

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



# Abnormal Umbilical Vein Doppler

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study

- There were 33 perinatal deaths and 6 IUFDs
- In all, both the DV and STV were abnormal
- If only one of the parameters were abnormal, far fewer, 4/60 newborns died

Hecher. Ultrasound Obstet Gynecol 2001; 18: 564-70



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Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study

## Predictions?

- Using a 50% probability of an abnormal finding taken as a reference point, low STV followed an abnormal MCA PI by 3 weeks
- Given all babies are delivered for persistent FHR abnormalities, they opined they waited too long, rather better to deliver when one of these becomes persistently abnormal or at the first sign of the second abnormality



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation – Longitudinal Study

The key is to better define when, after the MCA abnormality, delivery should occur.

The answer depends on clinical acumen and gestational age, i.e., how much risk to take.

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- Series of 75 patients admitted with IUGR
- 26 were < 32 weeks
- AC < 2<sup>nd</sup> percentile
- They all had abnormal UA PI (inclusion) and delivered between 26 and 34 weeks

Ferrazzi. Ultrasound Obstet Gynecol 2002; 19: 140-6

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- In their series, the UA and UtA became abnormal first, followed by the MCA PI and then UA AEDF.
- These abnormalities occurred within 16 days of delivery.
- While being observed, increased DV S/a, UA RF, decreased PA PSV, DV RF, and decreased Ao PSV followed

Ferrazzi. Ultrasound Obstet Gynecol 2002; 19: 140-6

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses – IUGR Diagnosis and Evaluation

- These occurred within 6 days of delivery.
- The MGA was 29 weeks and mean birthweight was 818 grams
- There were 3 IUFDs and 9 NNDs
- Of the 14 survivors, all were >500 grams and >27 weeks.
- Over half of the perinatal deaths had late Doppler ultrasound changes

Ferrazzi. Ultrasound Obstet Gynecol 2002; 19: 140-6



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- The lesson learned, if the patient is high risk for IUGR, observation after the DV becomes abnormal is not warranted as only 6 days are predictably gained, especially if  $> 500$  grams or  $> 27$  weeks EGA

Ferrazzi. Ultrasound Obstet Gynecol 2002; 19: 140-6

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- 74 IUGR fetuses with ARED in UA
- Most had abnormal cephalization of flow
- Very high risk – PNM 19% (6 NND, 8 IUFD)
- If delivery occurred after 32 weeks, no deaths even with abnormal DV
- If DV normal after 28 weeks, no deaths

Schwarze. Ultrasound Obstet Gynecol 2005; 25: 573-9



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

If there was A/R flow in DV then PPV of death was 35% and NPV was 94%

Of note, the DV changes occur before UV pulsation so there is an opportunity to wait with intensive surveillance

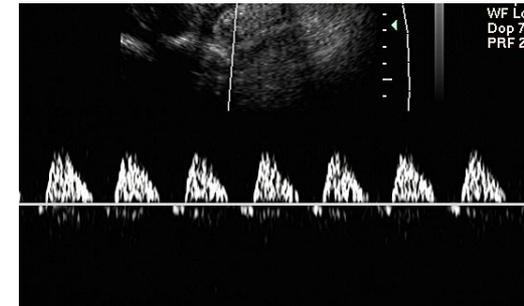
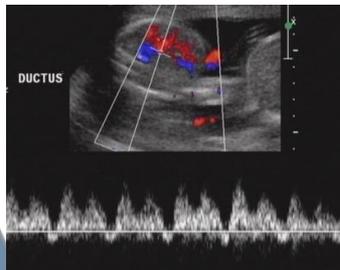
Schwarze. Ultrasound Obstet Gynecol 2005; 25: 573-9



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- In a 2005 report by Cosmi, there were 145 IUGR fetuses, 54 PND (4 IUFD)
- PNM was up to 4 times higher in the group with RDF UA or RF DV
- These changes occurred up to 8 days before abnormal BPP or FHR
- Implications for deliveries <32 weeks EGA



Cosmi. OBG 2005; 106: 1240-5

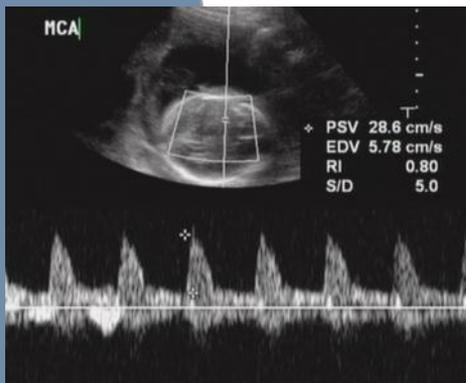


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Specific Uses – IUGR Diagnosis and Evaluation

- Mari reported 55 IUGR fetuses identified by EFW <3<sup>rd</sup> percentile and abnormal UA PI
- 6 IUFDs
- He looked beyond cephalization and studied the MCA PSV
- If normal, even if MCA PI was abnormal, there were no deaths



Mari. Ultrasound Obstet Gynecol 2007; 29: 310-6

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- If MCA PI increases (after being low) or if PSV decreases, this is too late
- 4/6 deaths occurred in this group

Mari. Ultrasound OBstet Gynecol 2007; 29: 310-6



# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- Another study that defined intervention if there was abnormal FHR or BPP  $< 4$  or if mom was sick
- No intervention if EFW  $< 500\text{g}$ . 17/41 died
- 94% of deaths were  $< 29$  weeks

Mari. J Ultrasound Med 2007; 26: 555-9

# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation

- Don't test MCA if UA is normal. There were no deaths.
- Survival increased 48% for each week gestational age between 25 and 29 weeks

Mari. J Ultrasound Med 2007; 26: 555-9

# Basic Doppler – Assessment of Fetal Distress

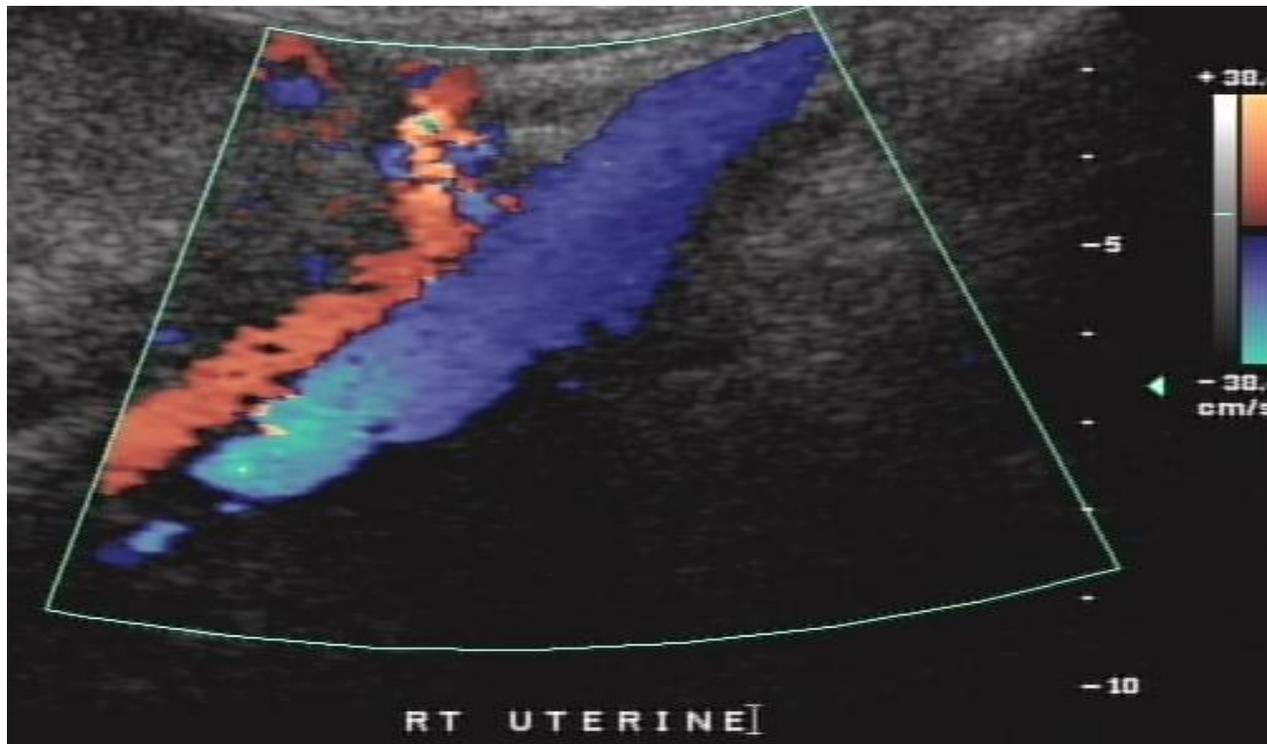
Specific Uses – IUGR Diagnosis and Evaluation

- Baschat in 2007 reported 604 IUGR cases with 21.5% PNM
- PNM decreased from 57% to 11% between 24-32 weeks
- If >600 grams, survival was not impacted
- PNM decreased 2% per day to 27 weeks, then 1% per day

Baschat. OBG 2007; 109: 253-61

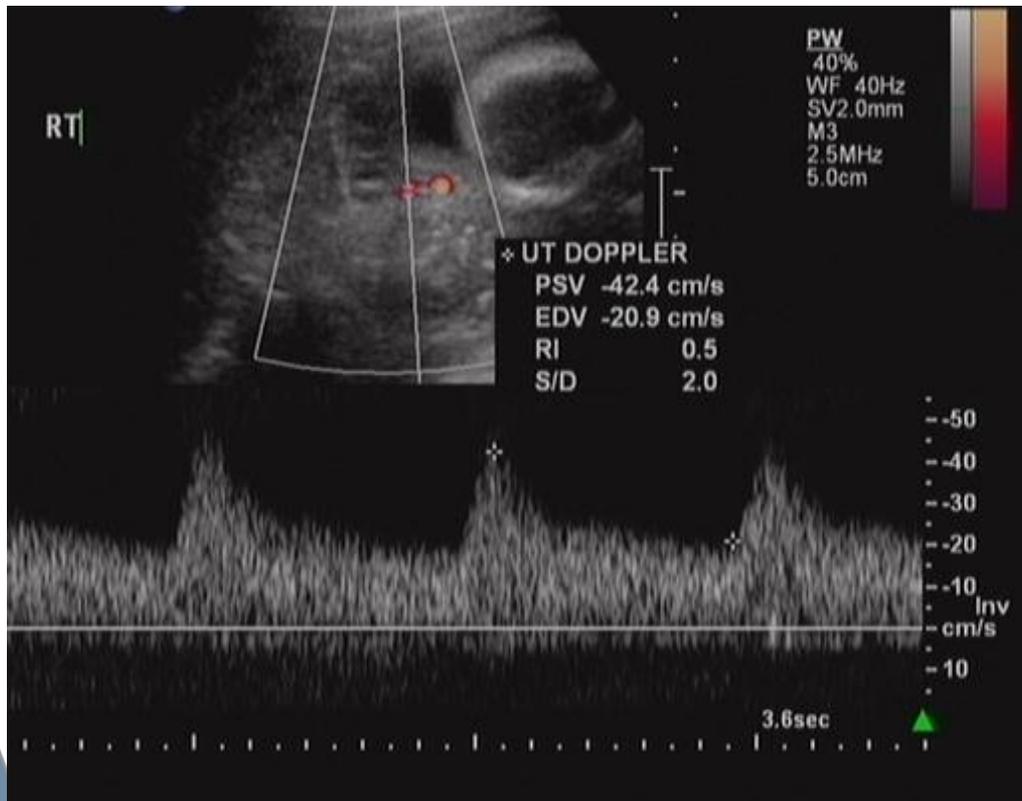
# Uterine Artery

Specific Uses – IUGR Diagnosis and Evaluation



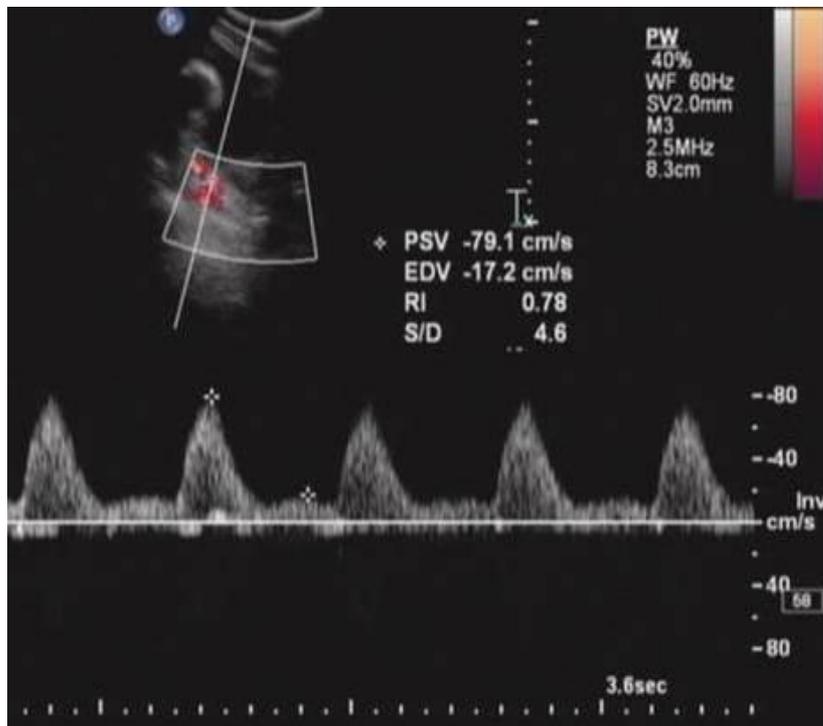
# Normal Uterine Artery Doppler

Specific Uses – IUGR Diagnosis and Evaluation



# Abnormal Uterine Artery Doppler

Specific Uses – IUGR Diagnosis and Evaluation

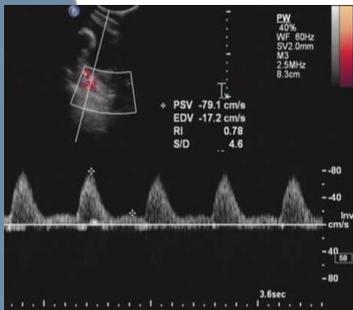


# Basic Doppler – Assessment of Fetal Distress

Specific Uses – IUGR Diagnosis and Evaluation



- Fratelli studied 76 patients with high risk histories for PNMorbidity
- 11-14 weeks
- If Uterine artery Doppler normal, there was no preeclampsia nor PTD < 34 weeks
- 86% with Ut a RI > 0.8, had Preeclampsia or PTD
- 97% NPV 37 % PPV

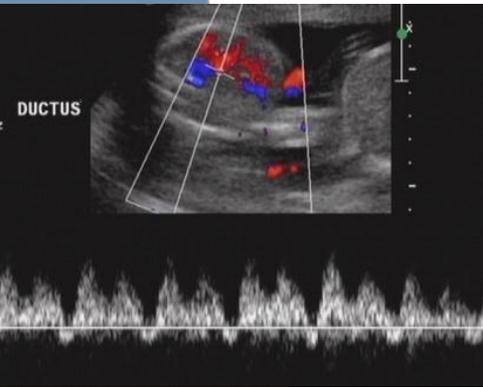


Fratelli. J MFNeon Med 2008; 21: 403-6

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses – IUGR Diagnosis and Evaluation

- Picconi in 2008 studied 19 IUGR fetuses
- High risk with 6 NND and 6 IUFD
- The DV was observed and then retested in 10 minutes
- Intermittent RF in DV 2-57 days prior to delivery with mean of 13 days
- Continuous RF 1-23 days with mean 7 days



Picconi. AmJPerinatol 2008; 25:199-204

# Basic Doppler – Assessment of Fetal Distress

## Specific Uses – IUGR Diagnosis and Evaluation

- Deliveries were all for abnormal FHR <32 weeks, do not deliver for DVRF if FHR/BPP normal

Picconi. AmJPerinatol 2008; 25:199-204

# Basic Doppler – Assessment of Fetal Distress

## Conclusions

In IUGR pregnancies, the data support some element of action based on Doppler findings.

In other pregnancies, I believe the data can be cautiously extrapolated and similarly be of help.

# Basic Doppler – Assessment of Fetal Distress

## Conclusions

When the umbilical artery flow patterns are abnormal and one is following the venous physiology, serial measurements are best and recent data cautions us to discriminate persistent from intermittent flow changes.



# Basic Doppler – Assessment of Fetal Distress

## Conclusions

### If the DV is abnormal

- 6-8 days to abnormal FHR.
- This was seen in 3 different studies.
- The PPV for PNM is 35%.
- Conversely, the NPV was 94% if the DV was normal. Waiting is clearly supported in that setting.

# Basic Doppler – Assessment of Fetal Distress

## Conclusions

If the Doppler waveforms are abnormal, there were no deaths after 32 weeks implying a selection of healthier babies that could achieve this gestational age.

Older babies can be managed a little more conservatively as it relates to delivery plans.

If already after 32 weeks; however, there is little to be gained except exposure to antenatal steroids.

# Basic Doppler – Assessment of Fetal Distress

## Conclusions

Because there were no deaths after 32 weeks (assuming always normal FHR), and the absolute PNM drops 2% per day to 27 weeks and 7% per week after that (relative survival 48% per week up to 29 weeks), it would be appropriate to wait, if remote from term.



# Basic Doppler – Assessment of Fetal Distress

## Conclusions

Because the intact survival rate does not seem to be influenced by weight gain above 800 grams in this population, there is little to gain by watching the growth pattern.

Gestational age and FHR are more important.



# Basic Doppler – Assessment of Fetal Distress

## Conclusions

The MCA PSV, especially if serially measured, can be a further discriminator.

If there is cephalization and abnormal changes in the DV and remote from term with reassuring FHR tracing (highest risk with daily testing and inpatient care), then as soon as the PSV begins to drop, delivery is indicated.



# Basic Doppler – Assessment of Fetal Distress

## Conclusions

Early ultrasound screening with Doppler can help identify high-risk groups or reassure patients with risk factors based on their obstetric histories.

This is particularly valuable in counseling, planning follow-up care, and triaging resources.



# Basic Doppler – Assessment of Fetal Distress

## Conclusions

Thank you to my patients and colleagues for providing these Doppler images.

Thank You  
Discussion?



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