



**ASSESSMENT OF
FETAL WELL-BEING**

**ANTEPARTUM
FETA
MONITORING**

ANTEPARTUM FETAL MONITORING

- ▶ Two thirds of fetal deaths occur before the onset of labor.
- ▶ Many antepartum deaths occur in women at risk for utero placental insufficiency.
- ▶ Ideal test: allows intervention before fetal death or damage from asphyxia.
- ▶ Preferable: treat disease process and allow fetus to go to term.

ANTEPARTUM FETAL MONITORING

▶ Utero placental insufficiency

- ▶ Inadequate delivery of nutritive or respiratory substances to appropriate fetal tissues.
- ▶ Inadequate exchange within the placenta due to decreased blood flow, decreased surface area or increased membrane thickness.
- ▶ Inadequate maternal delivery of nutrients or oxygen to the placenta or to problems of inadequate fetal uptake.

Stages in fetal surveillance

- ▶ Antepartum fetal monitoring is done in two stages.
 - Stage 1—assigning risk: finding normal babies developing in an abnormal situation.
 - Stage 2—timing delivery:
 - preterm babies should be delivered only if they show signs of distress, ensuring maximum maturity while avoiding any harm.
 - after 36wks babies at high risk should be delivered.

Assigning risk :

- No method of antenatal monitoring is perfect—all ‘miss’ affected fetuses (false negatives) and ‘pick up’ normal fetuses (false positives).
- Potential problems with such screening include increasing the rate of major interventions (such as CS) without benefit.
- Given the low prevalence of fetal compromise, the +ve predictive value of all tests when applied to low-risk populations is poor, but they perform better when applied to high-risk populations and therefore an estimation of the background risk must be made.
- Risk is assigned considering the mother’s health (e.g. pre-eclampsia) and the outcome of any previous pregnancy.
- In the future, screening for placental function using serum markers, history, and ultrasound could establish itself as a routine test .

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Theoretical scheme of fetal deterioration

- ▶ Fetal well being (Nutritional compromise)
- ▶ Fetal growth retardation (Marginal placental respiratory function)
- ▶ Fetal hypoxia with stress (Decreasing respiratory function)
- ▶ Some residual effects of intermittent hypoxia (profound respiratory compromise)
- ▶ Asphyxia
- ▶ Death

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- ▶ **Conditions placing the fetus at risk for UPI**
 - ▶ Preeclampsia, chronic hypertension,
 - ▶ Collagen vascular disease, diabetes mellitus, renal disease,
 - ▶ Fetal or maternal anemia, blood group sensitization,
 - ▶ Hyperthyroidism, thrombophilia, cyanotic heart disease,
 - ▶ Postdate pregnancy,
 - ▶ Fetal growth restriction

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- ▶ When to begin testing
 - ▶ Single factors with minimal to moderate increased risk for antepartum fetal death: 32 weeks.
 - ▶ Highest maternal risk factors: 26 weeks.
 - ▶ When estimated fetal maturity is sufficient to expect a reasonable chance of survival should intervention be necessary.

ANTEPARTUM FETAL MONITORING

- ▶ Methods for antepartum fetal assessment
 - ▶ Fetal movement counting
 - ▶ Assessment of uterine growth
 - ▶ Antepartum fetal heart rate testing
 - ▶ Biophysical profile
 - ▶ Doppler velocimetry

ANTEPARTUM FETAL MONITORING

Fetal movement count :

Measurement of fundal height

- ▶ Contraction stress test
 - ▶ Much less used now .
 - ▶ Increase in time, cost and inconvenience
- ▶ Nonstress test
- ▶ Biophysical profile, modified biophysical profile
- ▶ Doppler velocimetry

ANTEPARTUM FETAL MONITORING

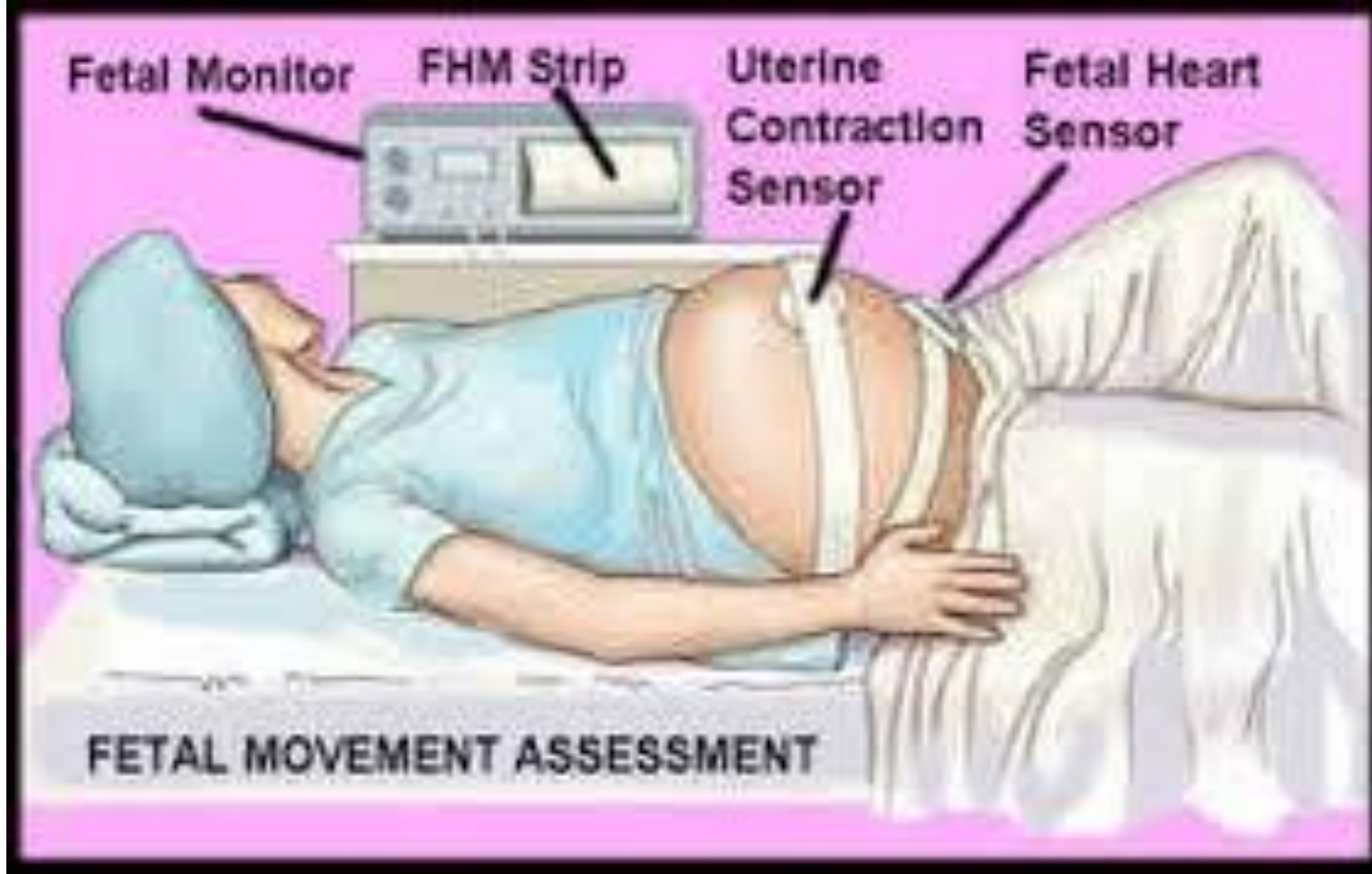
▶ Fetal movement counting

- ▶ Maternal perception of a decrease in fetal movements may be a sign of impending fetal death.
- ▶ It costs nothing.
- ▶ In a systematic fashion, especially in low risk populations, may detect unsuspected fetal jeopardy.

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▶ Fetal movement counting

- ▶ 3 movements in 30 minutes .
- ▶ Elapsed time to register 10 fetal movements .
- ▶ normal fetus has 10 movement / 10hour





Auscultation of the fetal heart

- ▶ Auscultation of the fetal heart merely confirms the fetus is alive.
- ▶ It provides no predictive information done (with hand-held Doppler or a Pinard stethoscope) as part of a standard antenatal examination.

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▶ Assessment of uterine growth

- ▶ General rule: fundal height in centimeters will equal the weeks of gestation. Adequate fetal growth leads to increase uterine size , fundal height .
- ▶ Need serial measurement.
- ▶ Single measurement is not informative. Because it doesn't detect fetal growth restriction.
- ▶ Exceptions: maternal obesity, multiple gestation, polyhydramnios, abnormal fetal lie, oligohydramnios, low fetal station, and fetal growth restriction.
- ▶ Abnormalities of fundal height should lead to further investigation.
- ▶ Accuracy: poor?

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- ▶ **Contraction stress test (CST)**
- ▶ Uterine contractions producing an intra-amniotic pressure in excess of 30 mm Hg create an intra-myometrial pressure that exceeds mean intra-arterial pressure, therefore temporarily halting uterine blood flow.
 - ▶ A hypoxic fetus will manifest late decelerations.
 - ▶ Late decelerations correlate with stillbirth, IUGR, and low Apgar scores.
 - ▶ Oxytocin challenge test (OCT)
 - ▶ Breast (nipple) stimulation

ANTEPARTUM FETAL MONITORING

► Interpretation of the CST

- Negative: no late decelerations and adequate FHR recording
- Positive: Late decelerations present with the majority of contractions (without excessive uterine activity)
- Equivocal test results: Suspicious, hyperstimulation, unsatisfactory.

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▶ Management of CST

- ▶ Negative test: repeated weekly
- ▶ Positive test: acted on according to clinical condition
- ▶ Equivocal test: repeat test the next day

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▶ Contraindications to CST

- ▶ PROM
- ▶ Previous classical cesarean delivery
- ▶ Placenta previa
- ▶ Incompetent cervix
- ▶ History of premature labor in this pregnancy
- ▶ Multiple gestation

ANTEPARTUM FETAL MONITORING

▶ Contraction stress test

- ▶ Corrected perinatal mortality rate: 1.2 / 1000
- ▶ High equivocal rate
- ▶ False positive rate: 8 to 57%
- ▶ False negative rate: 0.4 / 1000

ANTEPARTUM FETAL MONITORING

▶ Non stress test (NST)

- ▶ Healthy fetuses display normal oscillations and fluctuations of the baseline FHR
- ▶ Absence of these patterns was associated with increase in neonatal depression and perinatal mortality.
- ▶ Accelerations of the FHR during stress testing correlated with fetal well being .

ANTEPARTUM FETAL MONITORING

▶ Nonstress test (NST)

- ▶ Accelerations of the FHR occur with fetal movement, uterine contractions, or in response to external stimuli.
- ▶ FHR accelerations appear to be a reflection of CNS alertness and activity.
- ▶ Absence of FHR accelerations relates to CNS depression caused by hypoxia, drugs, fetal sleep, or congenital anomalies.

ANTEPARTUM FETAL MONITORING

▶ Non stress test (NST)

- ▶ The endpoint of the NST is the presence or absence of FHR accelerations within a specified period of time.
- ▶ Most clinicians use 2 accelerations of 15 beats per minute (BPM) for 15 seconds in a 20-minute period.
- ▶ A healthy fetus < 32 weeks' gestation may not have the reactivity or the accelerations that meet the criteria of 15 BPM for 15 seconds.
- ▶ The more remote from term, the more likely that non reactivity will be due to fetal prematurity.

ANTEPARTUM FETAL MONITORING

▶ Performing the NST

1. External monitors for contraction OR MOVEMENT and FHR measurement applied by use of cardiotocography.
 - ▶ Patient in left lateral tilt (to minimize supine hypotension).
 - ▶ Fetal movement is recorded.

ANTEPARTUM FETAL MONITORING

▶ Interpreting the NST

- ▶ Reactive: 2 or more accelerations in 20 minutes.
 - ▶ Accelerations: an increase of at least 15 BPM above the baseline lasting at least 15 seconds.
- ▶ Fetal sound stimulation may be used to elicit a response.

ANTEPARTUM FETAL MONITORING

▶ Interpreting the NST

- ▶ Non reactive: Less than 2 accelerations in a 20-minute period.
 - ▶ may extend the testing period to 40 minutes or perform a back-up test.

ANTEPARTUM FETAL MONITORING

▶ Non stress test

- ▶ Perinatal mortality: 6.2/1000
- ▶ False positive rate: 50%
- ▶ False negative rate: 3.2 / 1000

▶ Ultrasound assessment of fetal growth

- ▶ Accurate knowledge of the age of the fetus is required .
- ▶ The fetal head circumference (HC) and abdominal circumference (AC) are measured together with the deepest pool of amniotic fluid using ultrasound and the results are charted against gestational age.
- ▶ Serial measurements are useful to assess the pattern of the fetal growth.

Late ultrasound aims to detect:

- ▶ Growth problems in the baby.
- ▶ Abnormalities in the amount of fluid around the baby.
- ▶ Problems with the placenta.
- ▶ Problems with the baby's position.
- It should be used only where growth abnormality is suspected (SFH outside the normal range) or the patient is at high risk of uteroplacental insufficiency, because its usage has not been proven to improve outcome in unselected patients.

ANTEPARTUM FETAL MONITORING

▶ Biophysical profile (BPP)

- ▶ Described by Manning (1980)
- ▶ The number of biophysical activities that could be recorded increased with real time ultrasound:
 - ▶ Fetal movement (FM)
 - ▶ Fetal tone (FT)
 - ▶ Fetal breathing movements (FB)
 - ▶ Amniotic fluid volume (AFV)
 - ▶ NST

ANTEPARTUM FETAL MONITORING

▶ Biophysical profile (BPP) - variables

- ▶ NST: reactive - as described earlier.
- ▶ FBM: present - at least 1 episode of at least 30 seconds duration (within a 30 minute period).
- ▶ FM: present - at least 3 discrete episodes.
- ▶ FT: normal - at least 1 episode of extension of extremities or spine with return to flexion.
- ▶ AFV: normal - largest pocket of fluid greater than 1 cm in vertical diameter.

Table 8.3 – Biophysical profile scoring

Biophysical variable	Normal (score 2)	Abnormal (score 0)
Fetal breathing movements	>1 episode for 30 s in 30 min	Absent/<30 s in 30 min
Gross body movements	>3 body/limb movements in 30 min	<3 body/limb movements in 30 min
Fetal tone	>1 episode body/limb extension followed by return to flexion, open–close cycle of fetal hand	Slow or absent extension–flexion of body or limbs
Reactive fetal heart rate	>2 accelerations with fetal movements in 30 min	<2 accelerations or 1 + deceleration in 30 min
Qualitative amniotic fluid	>1 pool of fluid, at least 1 cm × 1 cm	Either no measurable pool or a pool <1 cm × 1 cm

» BIOPHYSICAL PROFILE «



Choices for Follow Up Fetal Evaluations

- A. Fetal Breathing Movements –
1 episode of 30 sec. in 30 min.
- B. Fetal Tone – At least 1 episode
of extremity extension and flexion
- C. Body Movement – 3 episodes
over 30 min.
- D. Amniotic Fluid Volume –
More than 1 pocket + seen
in 2 planes
- E. Non-Stress Test – Reactive –
FHR ↑ with activity
Each has a possible
score of 2

Max Score = 10



6t

Following guidelines are useful while reading the results:-

1. Both NST and AFI are normal, continuous weekly fetal monitoring.
2. Both tests abnormal; a) >36 wks, best option is delivery
b) <36 wks, individualized treatment
3. NST reactive, but AFI low, search for causes of UPI or undiagnosed ROM.
4. AFI normal, but NST non reactive, further testing with Doppler, CST, BP

BPP Scoring, interpretation and management

<i>BPP Score</i>	<i>Interpretation</i>	<i>Management</i>
8–10	No fetal asphyxia	Repeat testing at weekly interval or more
6	Suspect chronic asphyxia	If > 36 weeks → deliver; but If L/S < 2.0 repeat test in 4–6 hours
4	Suspect chronic asphyxia	If ≥ 36 weeks deliver, if < 32 weeks repeat testing in 4–6 hours
0–2	↓ Strongly suspect asphyxia	Test for 120 minutes → persistent score ≤ 4 → deliver regardless of gestational age

ANTEPARTUM FETAL MONITORING

▶ Biophysical profile (BPP)

- ▶ Each variable

 - ▶ When normal: 2

 - ▶ When abnormal: 0

- ▶ Highest Score: 10, Lowest Score: 0

- ▶ Accepted score more than 6

- ▶ If 6 should be repeated

- ▶ Less than 6 needs to use other test.

- ▶ Accuracy improved by increasing the number of variables assessed.

- ▶ Overall false negative rate: 0.6/1000

ANTEPARTUM FETAL MONITORING

▶ Biophysical profile (BPP)

- ▶ Acute markers of fetal compromise: NST, FT, FBM, FM
- ▶ Chronic marker of fetal compromise: AFV
- ▶ Nervous impulses that initiate fetal biophysical activities arise from different anatomic sites within the brain.

ANTEPARTUM FETAL MONITORING

- ▶ **Biophysical profile (BPP):** by U/S examination lasting for 30 mints
 - ▶ Combinations of variables increase the specificity of the testing, and increase the ability to predict the fetus in jeopardy

ANTEPARTUM FETAL MONITORING

- ▶ **Errors associated with the BPP**
 - ▶ Management decisions based on the score only.
 - ▶ Intervention based on a false positive low score
 - ▶ No intervention based on a false negative normal score
 - ▶ Management based on BPP without considering overall clinical findings.
 - ▶ Poor timing of testing.
 - ▶ Not including the NST.
 - ▶ Inexperience operators, poor technique, poor equipment.

ANTEPARTUM FETAL MONITORING

▶ Modified biophysical profile (BPP)

- ▶ A standard NST is combined with an amniotic fluid index (AFI)
- ▶ Negative: Reactive NST / AFI > 5.0 cm
- ▶ If NST is nonreactive or has decelerations, or if the AFI is ≤ 5.0 cm, then a BPP is performed.
- ▶ Negative results are repeated every 3 to 4 days.
- ▶ If the AFI > 5.0 cm, a repeat AFI may be done in one week.

ANTEPARTUM FETAL MONITORING

▶ Primary fetal surveillance

▶ NST: The most popular method

- ▶ Easy to perform, easy to interpret, has fewer equivocal results, has excellent patient and physician acceptance.

- ▶ BPP as a back up test.

▶ BPP:

- ▶ Can identify oligohydramnios and anomalous babies.

- ▶ Antepartum death rate is less than with the NST.

ANTEPARTUM FETAL MONITORING

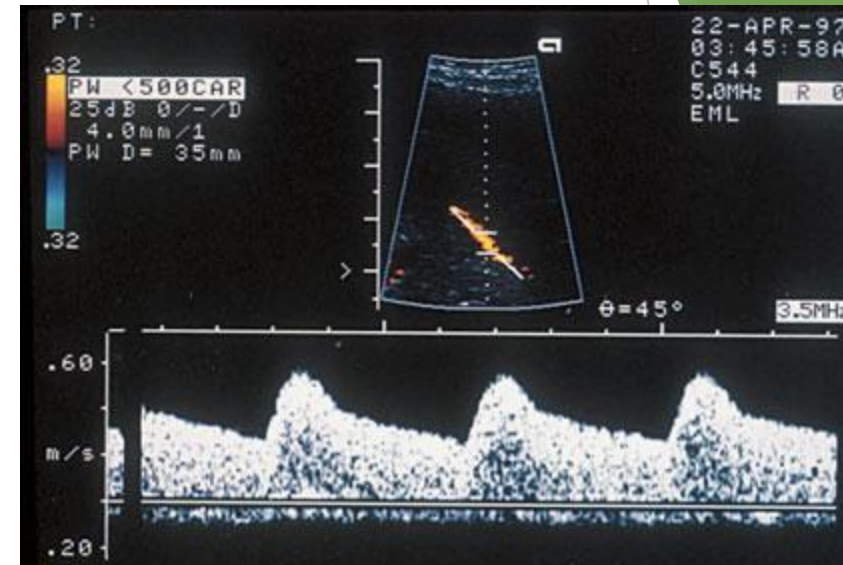
- ▶ **Doppler velocimetry of the umbilical arteries**
 - ▶ 40% of combined ventricular output is directed to the placenta by umbilical arteries.
 - ▶ Assessment of umbilical blood flow provides information on blood perfusion of the feto placental unit.
 - ▶ Volume of flow increases and vascular resistance decreases with advancing gestational age.
 - ▶ Low vascular impedance allows a continuous forward blood flow throughout the cardiac cycle.

ANTEPARTUM FETAL MONITORING

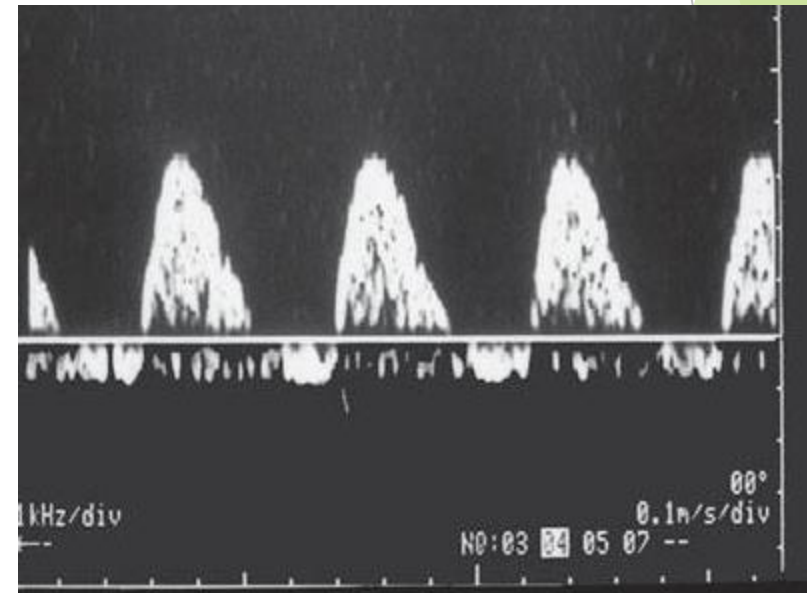
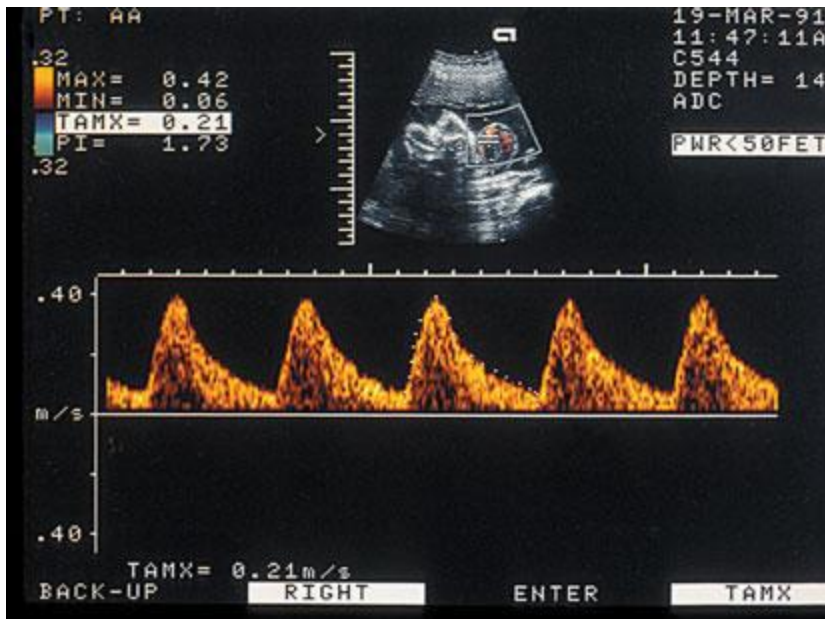
Doppler velocimetry

- ▶ An increase in the vascular resistance of the fetoplacental unit leads to a decrease in end diastolic flow velocity or its absence in the flow velocity waveform.
- ▶ Abnormal waveforms reflect the presence of a structural placental lesion.
- ▶ Abnormal Doppler results require specific management protocols and intensive fetal surveillance.

A normal umbilical arterial waveform is shown in Figure . This is a plot obtained using Doppler ultrasound of velocity of blood flow against time and demonstrates forward flow of blood throughout the whole cardiac cycle, i.e. including diastole.



A measure of the amount of diastolic flow relative to systolic is provided by several indices, such as the pulsatility index or resistance index, which essentially compare the amount of diastolic flow to systolic flow. When these indices are high, this indicates high resistance to flow; when the indices are low, resistance to flow is low. Normally, diastolic flow in the umbilical artery increases (i.e. placental resistance falls) throughout gestation. Absent or reversed end-diastolic flow in the umbilical artery is a particularly serious development with a strong correlation with fetal distress and intrauterine death.



UMBILICAL ARTERY DOPPLER

- Vessel normally has forward flow throughout cardiac cycle & diastolic flow increases as gestation advances.
- So, S/D ratio decreases as gestation advances, from 4 at 20 wks to <3 by 30 wks & finally 2 at term.
- S/D ratio is taken as **abnormal** if it's above 95th percentile for gestational age OR diastolic flow is absent or reversed.
- A resistance index > 0.72 is greater than the normal limits from 26 weeks gestation onwards.



Normal pregnancy



Reduced end diastolic velocity



Absent end diastolic velocity



Reversed end diastolic velocity

- Doppler ultrasound in high risk pregnancy (especially those complicated by hypertension or presumed impaired fetal growth) was associated with a trend to a reduction in perinatal deaths.
- The use of Doppler ultrasound was also associated with fewer inductions of labour and fewer admissions to hospital without reports of adverse effects.
- The use of Doppler ultrasound in high-risk pregnancies appears therefore to improve a number of obstetric care outcomes and appears promising in helping to reduce perinatal death

Middle cerebral artery Doppler

In addition to screening for anaemia, this vessel will demonstrate a reduced resistance/pulsatility in the compromised baby as a result of head sparing.

- It may be more useful than umbilical artery Doppler at term.
- It is not usually used alone in deciding timing of delivery.

Ductus venosus Doppler

Waveform in this vein is a surrogate for cardiac function and used in monitoring for twin-twin transfusion syndrome.

- It can also be used to time delivery in severely compromised babies as an adjunct to CTGs and umbilical artery.

Monitoring the high-risk fetus: cardiotocography

CTG is the output of electronic monitoring of the fetal heart rate, correlated with any uterine contractions.

Analysis by inspecting the CTG is difficult, but it is more reproducible when done by computer systems .

Normal cardiotocography :

- ❑ The baseline fetal heart rate is between 110 and 160 beats/min and varies from that baseline by 5-25beats/min.
- ❑ The heart rate should speed up by at least 15 beats/min for at least 15s (accelerations). Two accelerations should be seen in 20min (reactive).
- ❑ There should be no slowing of the fetal heart rate from the baseline (decelerations).

- The most useful features in assessing the fetus's health are the variability and presence or absence of accelerations .

Abnormal cardiotocography

Caused by a failure of autonomic regulation of the heart rate, this is an end-stage event, so the lead-time between utero placental insufficiency causing an abnormal CTG and fetal death or long-term damage is short, and this limits its usefulness in antenatal screening.

- Routine antenatal CTG has not been found to be useful in low-risk populations

CTG is used to exclude current compromise:

- In acute conditions known to cause fetal compromise, e.g. abruption and in women reporting reduced fetal movements
 -
- Daily in the surveillance of chronic conditions that are associated with uteroplacental insufficiency such as pre-eclampsia, and in IUGR when there is AEDF.
- Because the CTG only becomes abnormal at a very late stage in IUGR, less frequent than daily CTGs should not be relied upon as a method of monitoring.

