Reviewed By
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Antenatal Fetal Assessment

Objectives:

- Describe how to test for each of the following
  - Fetal well-being
  - Fetal growth
  - Fetal movement
  - Amniotic fluid
  - Fetal lung maturity

- Slides
- Important
- Golden notes
- Extra
- Doctor's notes
- Previous Doctor's notes
- Reference

Kaplan Video

Editing File

Antenatal Fetal Assessment

Definition:

→ **Fetal assessment:** to identify fetuses at risk of neurologic injury or death in order to prevent it & prevent prenatal mortality & morbidity. Is it better for the fetus to stay or be delivered?
→ **Primary objective of antenatal fetal assessment:** to avoid fetal death.
  → 80% of fetal deaths occur in the antepartum period.
→ **Aims of antenatal fetal monitoring:**
  → Ensure satisfactory growth and well-being of the fetus throughout pregnancy.
  → Screen out the high-risk factors that affect the growth of the fetus.

Fetal & Neonatal Complications of Antepartum Asphyxia:

1. Stillbirth (mortality).
2. Metabolic acidosis at birth.
3. Hypoxic renal damage.
4. Necrotizing enterocolitis.
5. Intracranial hemorrhage.
6. Seizures.
7. Cerebral palsy.

Rational: *Very **IMPORTANT**, the whole point of assessment (blood supply and fetal oxygenation)*

→ **Fetal oxygenation challenged:**
  → Blood flow directed to brain, heart, adrenal & blood flow away from the kidney → ↓ fetal urine production → ↓ amniotic fluid (**AF**) **volume** (oligohydramnios).
    → **AF volume:** 1st marker in fetus chronic low oxygenation.
  → CNS hypoxia → ↓ **fetal movement**.
  → Chemoreceptors → vagally-mediated reflex → fetal heart rate abnormality (**late deceleration**).
  → **To detect hypoxia:**
    → **Closed cervix:** doppler.
    → **Open cervix (labor):** blood sample from fetus scalp to check the pH (acidosis).

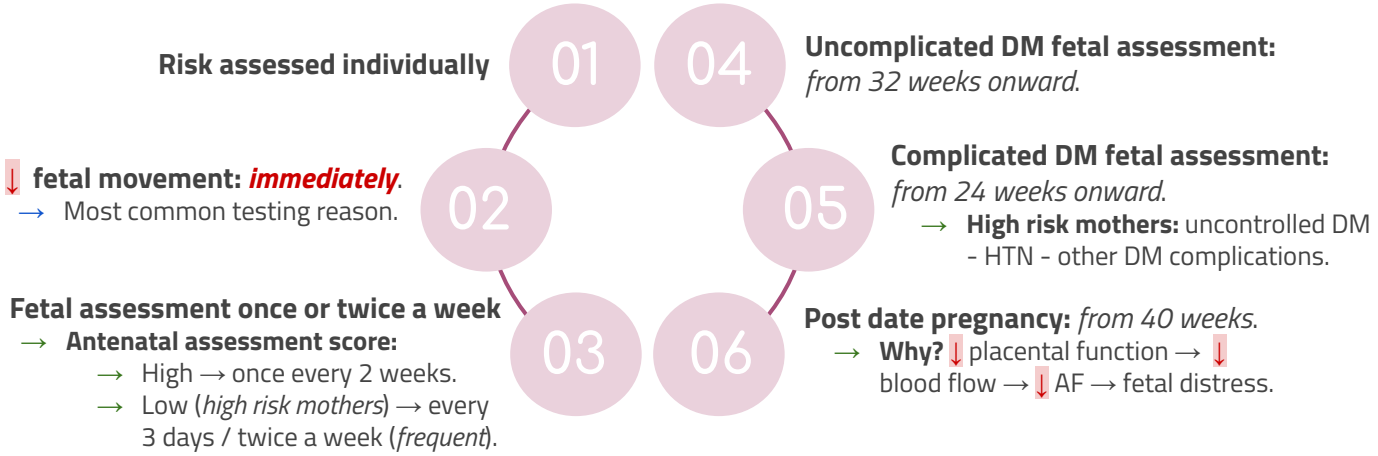
Conditions associated with ↑ perinatal morbidity & mortality:

→ **Examples of conditions you need to label the patient as a high risk and do a fetal assessment:**

01 **Small for gestational age fetus:** intrauterine growth restriction (IUGR).
02 ↓ **fetal movement.**
03 **Postdates pregnancy:** >294 days.
04 **Pre-eclampsia/chronic hypertension.**
05 **Chronic (stable) abruption.**
06 **Insulin requiring gestational diabetes.**
07 **Preterm premature rupture of membranes.**
08 **Pre-pregnancy diabetes:** affects kidney & BP → affects blood flow to fetus.

Antenatal Fetal Assessment

When to Start Antenatal Fetal Assessment: *done for high risk patients*



Indications for Antepartum Fetal Surveillance:

→ Even if the mother didn't complain.

Maternal	Pregnancy Complication
→ Antiphospholipid syndrome. → Poorly controlled hyperthyroidism. → Hemoglobinopathies. → Cyanotic heart disease. → Systemic lupus erythematosus. → Chronic renal disease. → Type 1 diabetes mellitus. → Hypertensive disorders. → Any medical illness in pregnancy can lead to fetal impairment.	→ Preeclampsia. → Decreased fetal movement. → Oligohydramnios. → Polyhydramnios. → Intrauterine growth restriction. → Postterm pregnancy. → Isoimmunization. → Previous unexplained fetal demise. → Multiple gestation.

Indications for antepartum fetal surveillance
Maternal
Antiphospholipid syndrome
Poorly controlled hyperthyroidism
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Cyanotic heart disease
Systemic lupus erythematosis
Chronic renal disease
Type 1 diabetes mellitus
Hypertensive disorders

Pregnancy complications
Preeclampsia
Decreased fetal movement
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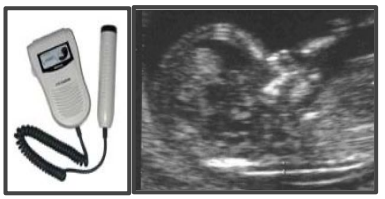
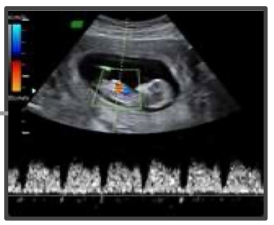
Early Pregnancy Assessment

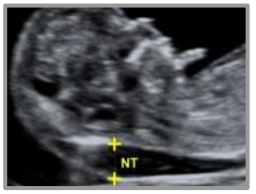
Fetal Heart Activity:



- → **Fetal auscultation:** to calculate fetal heart rate.
- → **Instrument:** special stethoscope or doppler.
- → **Time:** ~11 - 12 weeks.
  - → We can use US to detect heart rate starting from 6th week.
  - → Later on (11th week) auscultation is usually enough.
- → **Place:** clinic.
- → **Fetal heart activity:** *picture*
  - → **By:** USS.
  - → **Time:** from 6 weeks.



Nuchal Translucency:



- → A screening test which measures the fetal fluid collection behind the neck.
  - → ↑ fluid thickness → chromosomally abnormal fetus → you need further assessment.
  - → Thickened NT → ↑ likelihood for aneuploidy & cardiac disease.
- → Measurement for early screening for chromosomal abnormality.
- → **Time:** 11 - 13+ weeks
- → Has time limit.

Fetal Movement:

- → Fetal movement are usually first perceptible to mother ~17 - 20 weeks.
  - → No sensation felt in the uterus → the movement is only felt when the fetus is big enough to rub against mother abdominal wall.
  - → A sign that the fetus is growing in size.
- → Multipara → can feel fetal movement early (17 weeks).
- → Primigravida → can feel fetal movement late (20 weeks).
- → **Quickening:** the first fetal movement the mother feels.
- → **What movements does the mother perceive?**
  - → 50% of isolated limb movements.
  - → 80% of trunk and limb movements.
- → ↓ **maternal perception of fetal movements:**
  - → Fetal sleep (quiet).
  - → Fetal anomalies (CNS).
  - → Anterior placenta.
  - → Hydramnios.
  - → Obesity.
  - → Drugs (narcotics).
  - → Chronic smoking.
  - → Hypoxia.
- → Loss of fetal movements is commonly followed by disappearance of FHR within next 24 hours.

Early Pregnancy Assessment

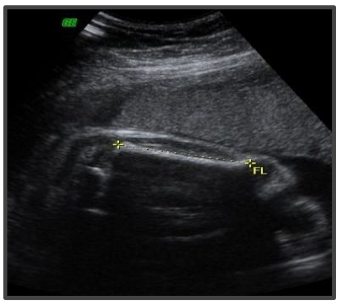
Fetal Growth:

01 Fundal height[1,2]

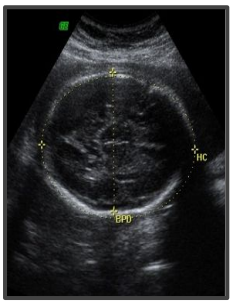
02 Ultrasound (USS)

03 **Biometry[3]**
- → Biparietal diameter (BPD)
- → Femur Length (FL)
- → Abdominal Circumference (AC)
- → Head Circumference (HC)

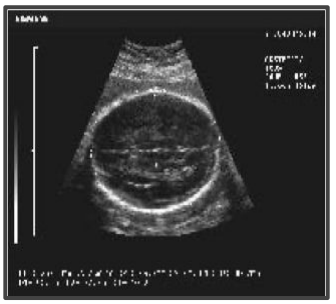
04 Amniotic fluid



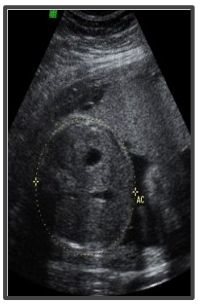
Femur Length (FL)
Usually we use femur, if there is any abnormality we assess other bones i.g, humerus



Head Circumference (HC)



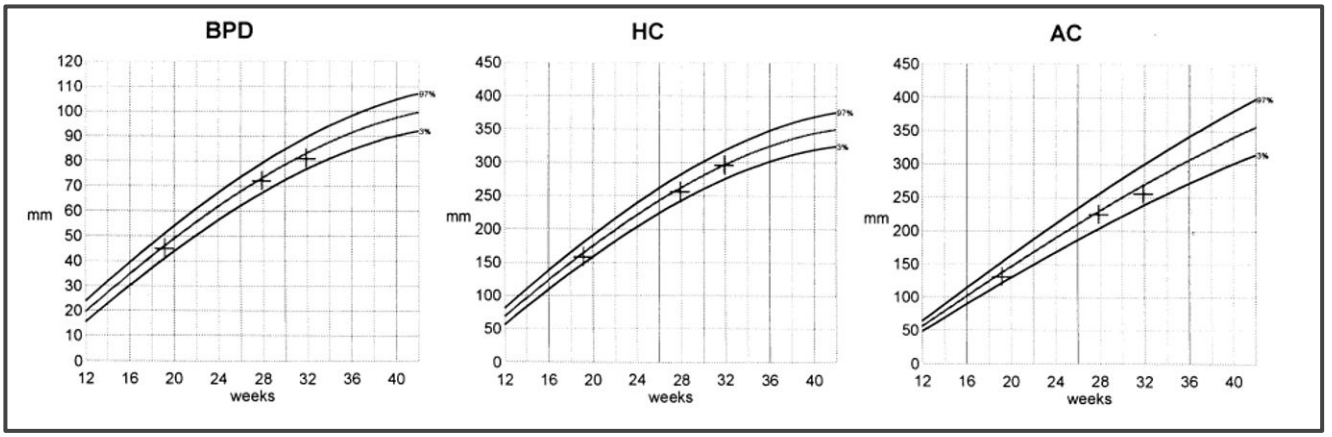
Biparietal diameter (BPD)



Abdominal Circumference (AC)

Fetal Growth Chart:

- → All US give us a growth charts for biometry.
- → **In an AC chart:**
  - → Above the 97% (3rd line) → macrosomal.
  - → Between the two line → normal.
  - → Low → IGUI.
- → We usually measure for femur → if abnormality present → measure for other bones



1. It measure from Symphysis pubis to highest part of fundus in cm and it should be equal GA of pregnancy and can be done in clinic.Each 1 cm = 1 week.
2. If the measurement falls below the 10th centile, fetal growth restriction is suspected and more specific investigation should be done.
3. In US we do these parameters (biometry) and during US we do Amniotic fluid Index, in US you will get a report that discuss the parameters and you can decide is this fetus grow as it suppose to be or not.

Late Pregnancy Assessment[1]

1. Fetal Movement Count: *Kick Chart*

- → An ideal first-line screening test both for high-risk and low-risk patients.
- → They count how many time the baby kicks.
- → **Start time in normal pregnancy:** ~ 28 weeks.
- → **Start time in high risk pregnancy:** ~ 24 weeks.
- → **Advantage:** reduces avoidable stillbirth, because the first sign mother notices is ↓ movement.

Cardiff Technique:

- → Most commonly used.
- → **Normal:** 10 movement in 12 hours
  - → She doesn't need to wait 12 hours, if she completes 10 movement (they will mostly feel it in the first 1 hour).
- → Abnormal patient → further assessment (do NST).
- → Not a good predictor for fetal well-being because half the time the fetus moves, the mother doesn't even feel it.

Sadovsky Technique:

- → For outpatient & lack for time.
- → 4 movement / hour.
  - → Not felt → another hour → still not felt → patient needs more assessment.

2. Contraction Stress Test (CST):

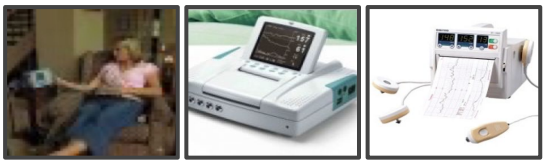
- → Old, mostly not used anymore.
- → Inducing/causing by oxytocin at least 2 uterine contractions over 20 minutes & observe fetus heart rate.
  - → **Normal:** 2 acceleration = ↑ fetal HR.
  - → **Hypoxia:** deceleration = ↓ fetal HR.
- → Tests assess the ability of the fetus to tolerate transitory decreases in the intervillous blood flow that occur with uterine contractions.
- → **Uterine contraction restrict O_2 delivery to the fetus:**
  - → **Normal fetus (negative CST):** tolerate contraction → no late decelerations.
  - → **Hypoxic fetus (positive CST):** late deceleration associated with at least 50% of contractions → (**worrisome!**).
- → **False positive rate (fetus is not hypoxemic):** ~50% (high).
- → **True negative rate:** 100%.
- → **Most common indication:** BPP of 4 or 6.
- → **Management:** prompt delivery.
- → **Contraindications:**
  - → Previous classical uterine incision.
  - → Previous myomectomy.
  - → Placenta previa.
  - → Incompetent cervix.
  - → Preterm membrane rupture.
  - → Preterm labor.
- → Rarely performed now.

1. How we start by doing assessment? If there is decrease in fetal movement we usually go for either contraction stress test or **non-stress test** (**CTG**), if it is impaired then we will do doppler velocimetry and amniotic fluid index.

Late Pregnancy Assessment

Non-Stress Test (NST): *IMPORTANT always comes in the exam*

- → You only connect CST to the mother without inducing contractions, only monitor fetal heart rate.
- → **Machine records:** fetal heart rate - contraction - fetal movement.
- → Reliable screening test, valuable to identify fetal wellness rather than illness.
- → Should be done twice weekly in complicated pregnancies.
- → **Assesses:** frequency of fetal movements by detecting the presence of absence of accelerations (*abrupt FHR ↑ that are unrelated to contractions*).
  - → Observed association of FHR acceleration with fetal movements → healthy fetus.
- → **Main advantage over CST:** no need for contraction.
- → **False positive rate:** higher than CST.
- → **False negative rate:** higher than CST.
- → **Baseline:** 120 - 160 beats/minute.
- → Different criteria in fetuses < 32 weeks.
  - → **< 32 weeks:** ≥ 10 beats/min ↑, lasting ≥ 10 seconds.
  - → **> 32 weeks:** ≥ 15 beats/min ↑, lasting ≥ 15 seconds.



CST Machine

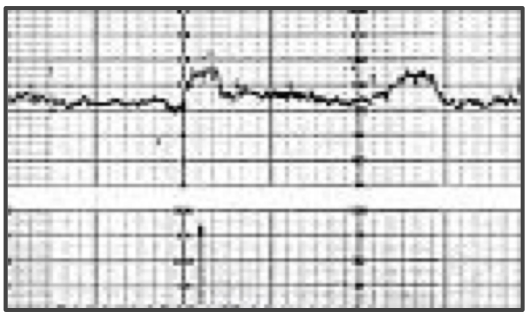
→ At least 2 accelerations from baseline of 15 bpm for at least 15 seconds within 20 minutes → reassuring & highly predictive for fetal wellbeing.

★ **Reactive**

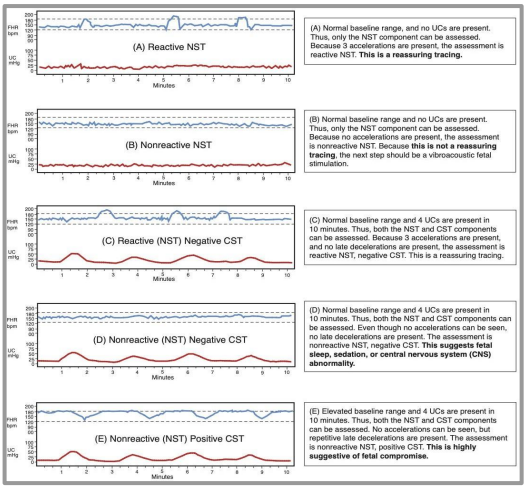
★ **Non–Reactive**

- → No acceleration after 20 minutes → proceed for another 20 minutes.
- → Non-reactive in 40 mins → proceed for CST or biophysical profile.
- → **Positive predictive value of NST to predict fetal acidosis at birth:** 55%.
- → **Assessment:** sleeping - immature / sedated fetus - acidotic - compromised fetus.

★Cardiotocography (CTG):★



- → **Abnormal bradycardia:** < 100 bpm.
- → **Moderate bradycardia:** 100 - 109 bpm.
- → **Normal baseline:** FHR 110 - 160 bpm.
- → **Moderate tachycardia:** 161–180 bpm.
- → **Abnormal tachycardia:** > 180 bpm.
- → **Normal trace:**
  - → **Baseline fetal heart rate:** 110 - 160 bpm.
  - → **Variability:** 5 - 25 bpm.
  - → At least two accelerations in a 20 minutes period.
- → **To read a CTG, comment on 5 parameters:**
  - → Baseline heart rate.
  - → Presence or absence of acceleration/deceleration.
  - → Variability.
  - → Contraction.
  - → Fetal movement.
- → **Any CTG will have 2 lines in the chart:**
  - → **1st line:** FHR.
  - → **2nd line:** basal line.
    - → No contraction → NST.
    - → Contraction → CST or active labor.
- → No OSCE exam without a CTG.



Late Pregnancy Assessment

★Cardiotocography (CTG):★

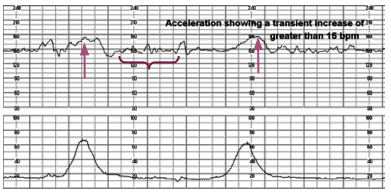
Acceleration (reactive CTG)

→ Normal temporal ↑ FHR from baseline by >15 bpm in response to the contractions for greater than 15 seconds.

Picture Key:

→ **Arrows:** multiple accelerations.

→ **Bracket:** variability.



Deceleration → ↓ HR → ↓ blood supply

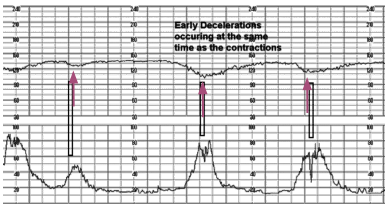
★ Early Deceleration: *Head Compression* ★

→ Deceleration correspond with uterine contraction.

→ Head compression usually seen in 2nd stage of labor during head delivery.

Picture Key:

→ **Arrows:** multiple decelerations.

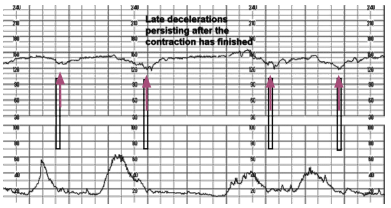


Late Deceleration: *Uteroplacental (U-P) Insufficiency / Fetal Hypoxia*

→ Peak of deceleration will be **after** peak of uterine contractions.

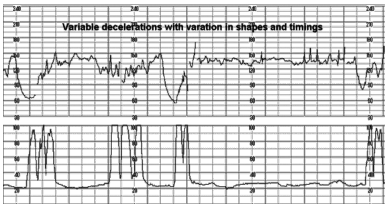
Picture Key:

→ **Arrows:** multiple decelerations.



Variable Deceleration: *Cord Compression & Primary CNS dysfunction*

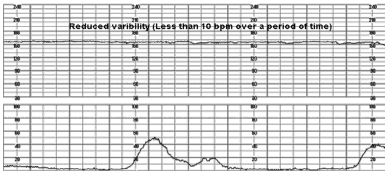
→ Decelerations that differ in the shape, size and relation to the contractions.



Reduced Variability:

→ Straight line → no reaction even with contractions.

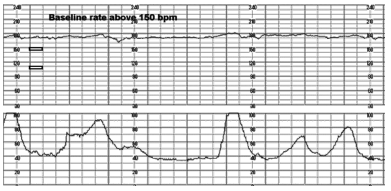
→ **Causes:** during labor or fetal hypoxia, mother is sleeping - using sedative drugs - using analgesic.



Tachycardia

→ FHR > 160 bpm (around 180 bpm) → high.

→ **Causes:** hypoxia - chorioamnionitis - maternal fever - fetal anaemia - β-mimetic drugs - sepsis - HF - arrhythmias.



Late Pregnancy Assessment

★Biophysical Profile (BPP):★

- → Combines NST (FHR monitoring) + USS estimation → **5 components:** amniotic Fluid volume (AFV) + fetal breathing + body movement + reflex / tone / extension-flexion movement.
- → A scoring system.
  - → Score is out of 10, every parameter is scored 2.
    - → Yes = 2.
    - → No = 0.
  - → No CTG → give score out of 8.
  - → With NST → give score out of 10.
- → Done over 30 minutes.
- → **Measures acute hypoxia:** NST - body movement - breathing.
- → **Measures chronic hypoxia:** ↓ AFI.
- → Used to assess fetal well being in case of intrauterine growth restriction
- → **Risk of fetal death within 1 week if BPP is low normal:** ~ 1/1300.
- → **Modified BPP (mBPP):** NST + AFI
- → **False negative:** 0.8/1000 (low).
- → **False positive:** ~60% (high).
- → **Indications:** non-reactive NST - high-risk pregnancy.
- → **Test frequency:** normal NST → weekly | abnormal test → twice weekly.

Fetal Biophysical Profile / NST+:

★ Biophysical Variable ★	Normal (score = 2)	Abnormal (score = 0)
Fetal Breathing *Chest Wall Movements*	1 episode FBM of at least 30 seconds duration in 30 minutes.	Absent FBM **or** no episode > 30 seconds in 30 minutes.
Fetal Movements	3 discrete body / limb movements in 30 minutes. Usually fetal trunk rotate.	2 or fewer body/limb movements in 30 minutes.
Fetal Tone	→ 1 episode of active extension with return to flexion or vice versa of fetal limb(s) or trunk. → Opening & closing of hand → normal tone.	Either slow extension with return to partial flexion **or** movement of limb in full extension → absent fetal movement.
Amniotic Fluid Volume	1 pocket of AF that measures at least 2 cm in 2 perpendicular planes.	Either no AF pockets **or** a pocket < 2 cm in 2 perpendicular planes.
Fetal Heart Rate	→ **Normal:** FHR ~ 110 - 160.	

Late Pregnancy Assessment

Biophysical Profile (BPP):

- → **Score interpretation:**
  - → Score ≤ 4 → abnormal → associated with fetal acidemia.
  - → Abnormal BPP → high risks of stillbirth and perinatal mortality.

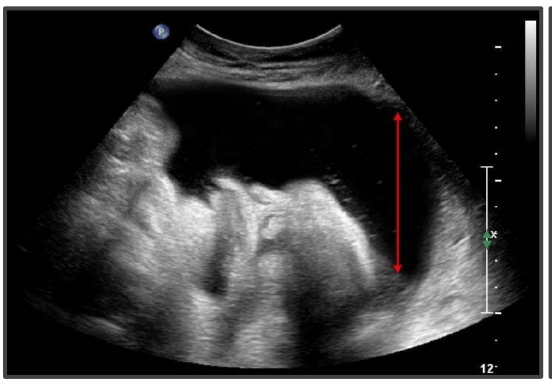
	8 or 10	4 or 6	0 or 2
Interpretation	→ Reassuring of fetal well-being.	→ Worrisome → suspect chronic asphyxia.	→ Predictive of fetal hypoxia + low false positive probability.
Management	→ Repeat the test weekly or as indicated.	→ ≥ 36 weeks → deliver. → < 32 weeks → repeat testing in 4 - 6 hours for 120 minutes. → Persistent score ≤ 4 → deliver regardless of gestational age.	→ Prompt delivery regardless of gestational age.

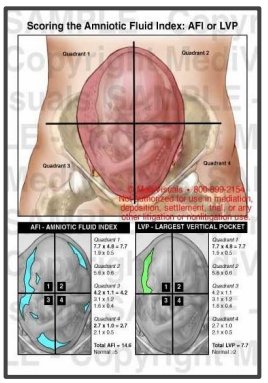
Ultrasonic Assessment:

- → **Ultrasound examination:** the main diagnostic tool to assess fetal growth.
- → High predictive value.
- → IUGR can be diagnosed accurately with serial measurement of BPD, AC, HC, FL & amniotic fluid volume.

Amniotic Fluid Index / Volume (AFI):

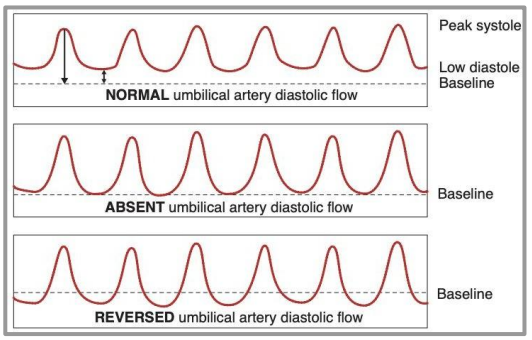
- → **Amniotic fluid index (AFI):** the sum of maximum vertical fluid pocket diameter in four quarters.
  - → You will put the probe in the 4 abdominal quarts and measure the vertical line in each quarter and sum them up.
  - → We can measure one quarter and the cutoff start from 2 cm.
- → **Normal value:** 5 - 25 cm.
- → **Oligohydramnios:** < 5 cm.
  - → IUGR.
  - → Placental insufficiency.
- → **Polyhydramnios:** > 24 cm.
  - → GI abnormalities.
  - → DM.
  - → CNS insufficiency.
  - → Encephalopathy.



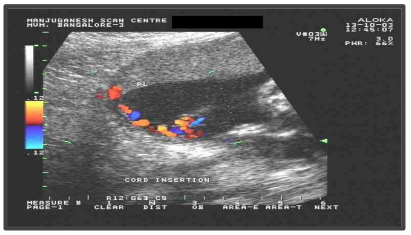


Late Pregnancy Assessment

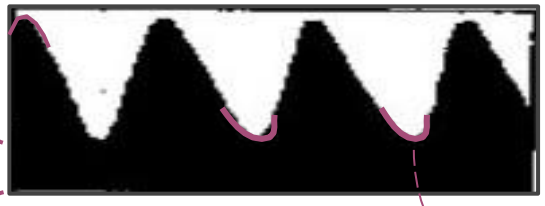
Doppler Velocimetry (UAV):



- → Measurement of blood flow velocities in maternal & fetal vessels.
- → **Reflect:** feto-placental circulation.
- → Doppler indices from umbilical artery (UA), uterine artery & middle cerebral artery (MCA) of fetus.
- → Doppler studies is mostly valuable in IUGR.
  - → **IUGR:** absent or reversed end diastolic flow (EDF) associated with fetal hypoxia.
- → Primigravida at 34 weeks of gestation known case of preeclampsia having oligohydramnios and fetal growth percentile less than 6% what is the next step? BPP & doppler.
- → Umbilical artery (UA) significant for pre-eclampsia, ↑ resistance → IUGR.
- → Measures the ratio of systolic & diastolic blood flow in the umbilical artery.
- → **Normal:** umbilical circulation has low resistance → significant diastolic blood flow.
- → **Normal:** ↓ systolic/diastolic (S/D) ratio throughout pregnancy.
- → Predictive of poor perinatal outcome only in IUGR fetuses.
- → **Nonreassuring findings → need for delivery:**
  - → Absent diastolic flow.
  - → Reversed diastolic flow.



★ Umbilical Artery Waveform: ★



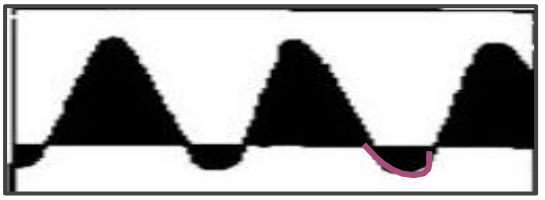
Normal Pregnancy

Absent End Diastolic Velocity

- → No flow between the fetus & the mother during diastole.
- → **Example:** IUGR associated with fetal hypoxia.

Reduced End Diastolic Velocity

- → Repeat it every 3 - 4 days to make sure if:
  - → Baby is going to the normal side.
  - → Deteriorating ↓ oxygenation.



Reversed End Diastolic Velocity

- → Blood goes from fetus to mother.
- → **Cause:** hypoxic fetus → asphyxia → ↑ resistance → blood enter fetal circulation → blood returns to mother.
- → Stage before fetal death → serious!!
- → **Example:** IUGR associated with fetal hypoxia.

Late Pregnancy Assessment

How do we Progress in Fetal Assessment?

1. **Counting fetal movements:** abnormal → go to step 2.
2. **NST or Stress test:** abnormal → go to step 3
3. **BPP:** abnormal → go to step 4.
4. UAV.

Antenatal Testing Methodologies: *Summary from Dr's Slides*

Antenatal testing methodologies

Name	Components	Results/scoring	False negative	False positive	References
Contraction stress test (oxytocin challenge test)	Continuous FHR monitoring At least 3 contractions of ≥40s duration within 10 min	**Negative:** no late or significant variable decelerations **Positive:** late decelerations following ≥50 percent of contractions, even if there are <3 contractions in 10 min **Equivocal - suspicious:** intermittent late decelerations or significant variable decelerations **Equivocal - hyperstimulatory:** decelerations with contractions occurring more frequently than q 2 min. or lasting >90s **Unsatisfactory:** <3 contractions in 10 min. or uninterpretable FHR tracing	0.04 percent	35-65 percent	[1,2]
Nonstress Test	Continuous FHR monitoring FHR accelerations: ≥32w: reaching 15 bpm above baseline and lasting ≥15s	**Reactive:** ≥2 accelerations within 20 min (may be extended to 40 min) **Nonreactive:** <2 accelerations in 40 min	0.2-0.65 percent	55-90 percent	[3-8]
Biophysical profile	Presence or absence of 5 components within 30 min: • Reactive NST • ≥1 episode of fetal breathing movements lasting ≥30s • ≥3 discrete body or limb movements • ≥1 episode of extremity extension with return to flexion or opening or closing of a hand • Maximum vertical AF pocket >2 cm or AFI >5 cm	Each component present is assigned score of 2 points; maximum score is 10/10 • **Normal:** ≥8/10 or 8/8 excluding NST • **Equivocal:** 6/10 • **Abnormal:** ≤4/10	0.07-0.08 percent	40-50 percent	[9-11]
Modified biophysical profile	NST AFI	**Normal:** Reactive NST *and* AFI >5 cm **Abnormal:** Nonreactive NST *and/or* AFI ≤5 cm	0.08 percent	60 percent	[12-15]

s=seconds; NST=nonstress test; AFI=amniotic fluid index; FHR=fetal heart rate; w=weeks

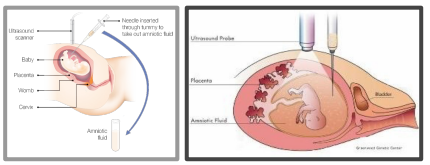
Antenatal Fetal Assessment

Invasive Fetal Assessment: *in general, done rarely due complications*

→ Nowadays it's replaced by non invasive fetal assessment (fetal DNA in maternal blood).

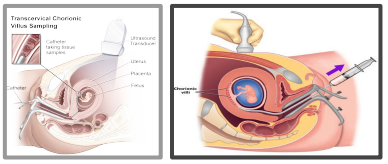
Amniocentesis:

→ Obtaining a sample of amniotic fluid from amniotic sac during pregnancy by US guidance.
→ Contains floating amniocytes (living fetal cells).
→ **Time:** can be done after 11 weeks, usually after 15 weeks.
  → **Don't do before 15 weeks:** earlier = ↑ fetal loss + complication rate + **limb deformity**.
→ **Indications:**
  → Genetic (karyotype).
  → **Bilirubin level (Rh-isoimmunisation):** in Rh sensitized pregnancy → obtain fetal blood type or detect fetal hemolysis.
  → Evaluation of fetal lung maturity (L/S).
  → **Polyhydramnios:** ↓ amniotic fluid amount (**therapeutic**).
→ **Risks (complications):**
  → **Infection:** 1/1000. → **ROM:** ~1%. → **Abortion:** 0.5%.



Chorionic Villus Sampling (CVS):

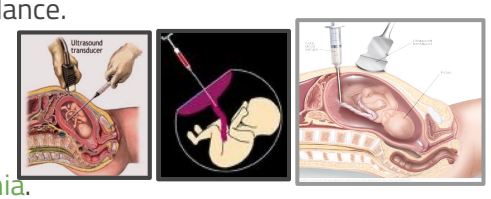
→ Procedure of choice for **first trimester** prenatal diagnosis of **genetic** disorders.
  → Chromosomes of the chorionic villi are almost always identical to those of the embryo.
  → **Why we prefer to do it in 1st trimester?**
    → Results will take 1 to 2 weeks → we can abort if abnormal.
    → 1st trimester pregnancy termination → less complications.
    → Less maternal bonding.



→ **Time:** usually done after 10 weeks.
  → Better to do it in the 10th and 11th only, after that it's preferred to do other tests.
  → Done early → abnormal → may terminate pregnancy.
→ **How is it performed?** transvaginally by inserting a speculum and suction of chorionic villi
→ **Complications:** depends on operator experience.
  → **Fetal loss:** 0.7% within 14 days of a TA CVS procedure - 1.3% within 30 days.
  → Procedure induced limb defects.
→ **Second trimester amniocentesis:**
  → Lowest risk of pregnancy loss.
  → Safer CVS than earlier (before 15 weeks) amniocentesis.

Cordocentesis:

→ Taking a sample of fetal blood from umbilical cord with US guidance.
→ **Indication:**
  → Rapid karyotyping.
  → Diagnosis of inherited disorders.
  → Fetal HB assessment.
  → **Fetal platelet level:** in case of maternal thrombocytopenia.
  → **Fetal blood transfusion:** in case of severe anemia or Rh immunization.

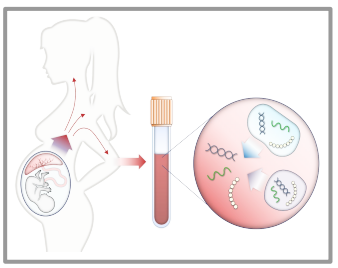


→ **Complication:** done in delivery room.
  → Infection. → **Bleeding** → **Bradycardia** → **Fetal Death**

Non-Invasive Fetal Assessment:

★ **Fetal DNA In Maternal Blood (NIPT):** ★

→ Simple blood test from the mother.
→ Avoid the need for invasive procedures and its complication.
→ **Time:** 10 weeks onward.
→ Can replace all of them.
→ Costy.



Fetal Lung Maturity

Fetal Lung Maturity (FLM):

- → **Fetal Lung Maturity (FLM):** a test performed before semi-elective but medically indicated births < 39 weeks.
  - → We used to do it to know if the baby developed a good surfactant → no ICU needed in case of premature delivery.
- → **Time:** generally not before 32 weeks of gestation.
- → **Lecithin–sphingomyelin (L/S) ratio:** most commonly used.
  - → **Normal L/S ratio: 2 : 1.**
  - → Less → lung is immature.
  - → Perform amniocentesis → measure L/S ratio → determine if it is mature or not.
- → Not done anymore, replaced with giving steroids.
  - → **Currently:** to deliver preterm fetus (< 32 weeks) → give dexamethasone or betamethasone → induced lung maturity + release surfactant.
- → **Respiratory distress syndrome (RDS):** a syndrome that develops as a consequence of surfactant deficiency & immature lung development.

Value of FLM in Clinical Situations:

- → **Premature rupture of membranes (≥ 32 weeks):** if FLM test is mature, delivery is likely safer than "wait and see" approach.
- → **Assessment of NICU need:** only possible if early delivery has medical mandate & time allows for FLM testing.
- → In selected at-risk late preterm and early preterm pregnancy issues, FLM guide the management.

FLM Laboratory Testing Options:

- → All tests require **amniocentesis** for obtaining amniotic fluid.

Lamellar body count (LBC)	Phosphatidylglycerol (PG)	Lecithin-sphingomyelin ratio (L/S)
→ **Initial** FLM of choice. → Rapid. → Sensitive. → **New data:** "can **estimate risk of RDS** as a function of LBC + gestational age".	→ Not useful unless gestational age ≥35 weeks. → Not useful. → Limited availability. → Sensitive.	→ Most common used. → **Main role:** adjudication of immature LBC or PG. → Last test of choice. → Labor intensive. → Imprecise. → Limited availability. → Results take > 24 hours unless performed at a local laboratory.

439 Summary

Antenatal fetal assessment

Overview

The following tests are performed in high-risk pregnancies to assess the risk of neurological injury or antenatal fetal death to prevent perinatal morbidity and mortality.

High risk patients

Maternal	Pregnancy complication
• Hypertension • Pre-gestational diabetes • Insulin required gestational diabetes • Antiphospholipid syndrome	• Preeclampsia • Decreased fetal movement • Oligohydramnios/polyhydramnios • IUGR • Postterm pregnancy • Preterm premature rupture of membranes (pPROM)

Complications of antepartum asphyxia (injuries we're afraid/looking for)

1. Stillbirth (Mortality)
2. Metabolic acidosis at birth
3. Hypoxic renal damage
4. Necrotizing enterocolitis
5. Intracranial hemorrhage
6. Seizures
7. Cerebral palsy

Signs of fetal deoxygenation

1. Decreased amniotic fluid volume
2. Decreased fetal movement
3. Late deceleration

Outline of Fetal assessment techniques

- Noninvasive techniques

Early pregnancy assessment	Late pregnancy assessment
1. FHR 2. Nuchal translucency 3. Fetal movement 4. Fetal growth	1. Fetal kicks 2. NST 3. CST 4. Amniotic fluid volume 5. Biophysical profile 6. Umbilical artery doppler assessment

- Invasive techniques:
  - Amniocentesis
  - Chorionic villus sampling (CVS)
  - Cordocentesis
- Rarely/not done anymore:
  - Fetal Lung Maturity

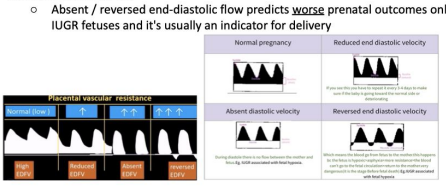
Early pregnancy assessment of fetal well-being

FHR	• Fetal heart activity can be detected by ultrasound from week 6 of gestation • Auscultation (special stethoscope or Doppler) ~ 12 weeks.
Nuchal translucency (NT)	• Timing: 11 weeks - 13 weeks • A screening test which measures the fetal fluid collection behind the neck • A **thickened NT** increases the likelihood for aneuploidy and cardiac disease
Fetal movement	• Timing: 17 weeks - 20 weeks
Fetal growth	1. Fundal height: measured from symphysis pubis to the highest part of fundus. Done in the clinic a. Size > dates: suspect large-for-gestational-age fetus b. Size < dates: suspect small-for-gestational-age fetus 2. Ultrasonography: Using US we measure the following parameters a. Biometry i. Biparietal diameter (BPD) ii. Abdominal Circumference (AC) iii. Femur Length (FL) iv. Head Circumference (HC) b. Amniotic fluid

Late pregnancy assessment

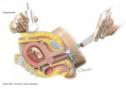
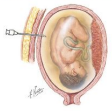
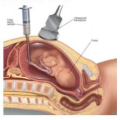
- **Fetal well-being assessment**

Fetal kicks	• Fetal kick counts assessed by mother; can reduce avoidable stillbirth ○ Timing: **28 weeks in normal** pregnancy. **24 weeks in high-risk** pregnancy. ○ Posture: lying on her left side. ○ Approach: ■ recognize 10 movements in 1 hr, not felt? → Retest in 1 hour, not felt? → Call the doctor. **Arrange for a nonstress test** and ultrasonic assessment.
Nonstress test (NST)	• First step in assessing fetal well-being • Posture: mother resting in the left lateral supine position. • Procedure: using external doppler equipment, **a continuous FHR tracing is obtained.** Mother should report each fetal movement felt. Effects of fetal movement on FHR are determined. **A fetal movement corresponds with an acceleration in FHR** of: ○ If <32 weeks: 10 bpm above baseline for at least 10 secs. ○ If >32 weeks: **15 bpm above baseline for at least 15 secs.** • Reactive NST (normal/healthy activity): ≥ 2 FHR accelerations in a 20-minute interval. ○ Approach: ■ No acceleration after 20 minutes? → proceed for another 20 mins. **Non-reactive in 40mins? → proceed for contraction stress test or biophysical profile** • Nonreactive NST: < 2 FHR accelerations in 20 mins ○ Causes of nonreactive NST: sleeping, immature or sedated fetus; acidotic, compromised fetus
Contraction stress test (CST)	• **Measures FHR reactivity in response to uterine contractions** • Contractions are stimulated with oxytocin administration. • Contraindications to test: previous classical uterine incision, previous myomectomy, placenta previa, incompetent cervix, preterm membrane rupture, and preterm labor. • Negative CST: ○ No late decelerations. Fetus can tolerate contraction and doesn't become hypoxic. • Positive CST: ○ Presence of late deceleration. Indicating a hypoxic fetus. ○ Management: prompt delivery.

Ultrasound exams	• Determines adequacy of amniotic fluid volume ○ Amniotic fluid volume is assessed by the Amniotic fluid index (AFI). Important values: ■ Normal: 5-25cm ■ Oligohydramnios: <5cm. Suggests fetal compromise likely as a result of umbilical cord compression. ■ Polyhydramnios: >23cm. Suggests poor control in diabetic pregnancy or can indicate an anomaly • Fetal breathing (chest wall movement) ○ Healthy/normal: 30 breathing movements in 10 mins. • Fetal movement (stretching and rotational movement) ○ Healthy/normal: 3 body movements in 10 mins.
Doppler velocimetery	• Used to assess fetal artery vascular resistance. Most common arteries: umbilical artery, uterine artery, and middle cerebral artery. • Can help predict fetuses at increased risk of poor fetal outcome ○ **Umbilical artery systolic/diastolic ratio:** ↑vascular placental resistance→ ↓diastolic pressure→ **↑S/D ratio** • **Most valuable in IUGR.** ○ Absent / reversed end-diastolic flow predicts worse prenatal outcomes only in IUGR fetuses and it's usually an indicator for delivery 
Biophysical profile	Assesses 5 parameters over 30 mins. **Each parameter is given a score of 2** (yes= 2, no=0). **Biophysical Variable** / **Normal (score=2)** / **Abnormal (score= 0)** **Fetal breathing movements**: 1 episode FBM of at least 30 s duration in 30 min / Absent FBM or no episode >30 s in 30 min **Fetal movements**: 3 discrete body/limb movements in 30 min / 2 or fewer body/limb movements in 30 min **Fetal tone**: 1 episode of active extension with return to flexion of fetal limb(s) or trunk . Opening and closing of the hand considered normal tone / Either slow extension with return to partial flexion or movement of limb in full extension Absent fetal movement **Amniotic fluid volume**: 1 pocket of AF that measures at least 2 cm in 2 perpendicular planes / Either no AF pockets or a pocket<2 cm in 2 perpendicular planes **Fetal Heart Rate**: If FHR about 110- 160= Normal / -

439 Summary

Invasive pregnancy assessment

	Timing	Procedure	Indications	Complications
Chorionic villus sampling (CVS)	**10–13 weeks**	Transvaginally by insert speculum and take suction of chorionic villi 	Genetic disorders screening (karyotype)	• Miscarriage (approximate risk: 1.3%) • Limb defects
Amniocentesis	**From the 15th** week of pregnancy onwards	AF is extracted under sonographic guidance via transabdominal puncture 	Early pregnancy: • Genetic disorders screening (karyotype) Late pregnancy: • Determination of bilirubin levels in cases of rhesus incompatibility • Estimation of lung maturity in imminent preterm delivery via lecithin-sphingomyelin ratio • Therapeutic: Drainage of excess amniotic fluid in polyhydramnios or amniotic fluid replacement in oligohydramnios	• Premature rupture of the membranes (approximate risk: 1%) • Miscarriage (approximate risk: 0.5%) • Infection • Placental abruption
Cordocentesis	After 17 weeks of gestation	Fetal blood sampling via ultrasound-guided transabdominal needle insertion into the umbilical cord 	• Identify the type of fetal hemoglobin and assess the severity of fetal anemia • Diagnose genetic defects in the fetus if amniocentesis, chorionic villus sampling, and/or fetal ultrasound are inconclusive • Diagnose fetal infections if amniocentesis is inconclusive	• Micarriage • Infection • Bleeding • Bradycardia

Fetal lung maturity

- Timing: From 32 weeks of gestation
- Procedure: through amniocentesis then measure L/S ratio. Value determines maturity.
- Indication: Performed before semi-elective but medically indicated births <39 weeks. Ex. PROM, need of NICU, early and late preterm pregnancy.
- Comparison of FLM Laboratory Testing Options:

Lamellar body count (LBC)	Phosphatidylglycerol (PG)	IMPORTANT Lecithin-sphingomyelin ratio (L/S)
• Initial FLM of choice • Rapid, sensitive •New data indicates that one can estimate risk of respiratory distress syndrome (RDS) as a function of gestational age and LBC	Not useful • Not useful unless gestational age ≥35 weeks • Limited availability • Sensitive	• Main role is in adjudication of immature LBC or PG • Last test of choice • Labor intensive, imprecise • Limited availability • Results take >24 hrs unless performed at a local laboratory

Quiz

Question 1:

→ **During monitoring fetal heart rate on labor, you noticed repetitive deceleration after uterine contraction. What is the most likely cause?**

A. Congenital fetal cardiac block
B. Cord compression
C. Head compression
D. Fetal hypoxia

Question 2:

→ **The normal amniotic fluid volume:**

A. < 5
B. 5 - 25
C. 25 - 50
D. > 50

Question 3:

→ **The normal baseline fetal heart rate:**

A. < 100
B. 100 - 109
C. 110 - 160
D. 161 - 180

Question 4:

→ **Which one of the following parameters is not included in biophysical profile (BPP):**

A. Fetal tone
B. Oxytocin challenge test
C. Fetal movement
D. Amniotic fluid index

1	2	3	4
D	B	C	B

Quiz

Question 1:

→ **A 32-year old pregnant at 33-weeks came to the clinic with reduced fetal movements. Which one of the following is the best initial management for this patient?**

A. Caesarean section
B. Induction of labor
C. Non-stress test
D. Ultrasound

Question 2:

→ **10 weeks of gestation presented to antenatal clinics for the first time. you did US which is useful for what in this stage:**

A. Gestational age
B. Congenital anomalies
C. Locate placenta
D. Amniotic fluid index

Question 3:

→ **If fetus has high risk of genetic/ chromosomal malformations what's the assessment we do it currently?**

A. CVS
B. Amniocentesis
C. Fetal DNA test in maternal blood
D. Cordocentesis

Question 4:

→ **Which one of the following will be obtained by doing a first trimester ultrasound scan for twin pregnancy?**

A. Determination of fetal presentation
B. Localization of cord insertion
C. Placental Localization
D. Determine chorionicity

C	A	C	D
1	2	3	4

Reference

Assessment of Fetal Well-Being

During the past 20 years, electronic monitoring advances have made the fetus more accessible. They have allowed visualization of the fetus and recording of intrauterine fetal activity. **A combination of maternal self-assessment, nonstress testing (NST), and real-time ultrasonic assessment is used to evaluate fetal well-being.**

MATERNAL SELF-ASSESSMENT OF FETAL WELL-BEING

A simple technique (kick counting) may be used to assess fetal well-being. The mother assesses fetal movement (kick counts) each evening while lying on her left side. She should recognize 10 movements in 1 hour and if she does not, she should retest in 1 hour. If she still does not have 10 fetal movements in 1 hour, she should contact her doctor or present herself (usually to the hospital) for an NST and an ultrasonic assessment.

NONSTRESS TEST ASSESSMENT

The first step in the assessment of fetal well-being is the NST. With the mother resting in the left lateral supine position, a continuous fetal heart rate tracing is obtained using external Doppler equipment. The mother reports each fetal movement, and the effects of the fetal movements on heart rate are determined. **A normal fetus responds to fetal movement with acceleration in fetal heart rate of 15 beats or more per minute above the baseline for at least 15 seconds** (Figure 7-3). If at least two such accelerations occur in a 20-minute interval, the fetus is regarded as being healthy, and the test is said to be reactive. A nonreactive NST is shown in Figure 7-4.

ULTRASONIC ASSESSMENT

The next step in prenatal assessment is to determine the adequacy of amniotic fluid volume by real-time ultrasonography. Reduced fluid (oligohydramnios) suggests fetal compromise. Oligohydramnios can be defined as an amniotic fluid index (AFI) of less than 5 cm. The AFI represents the sum of the linear measurements (in centimeters) of the largest amniotic fluid pockets noted on ultrasonic inspection of each of the four quadrants of the gestational sac. **When amniotic fluid is reduced, the fetus is more likely to become compromised as a result of umbilical cord compression.** Excessive amniotic fluid (polyhydramnios; AFI > 23 cm) can be a sign of poor control in a diabetic pregnancy or an indication that the fetus may have an anomaly.

Fetal breathing (chest wall movements) and fetal movements (stretching and rotational movements) are also used to assess the fetus. A fetus that has at least 30 breathing movements in 10 minutes or 3 body movements in 10 minutes is considered healthy. A combination of a reactive NST, adequate amniotic fluid, adequate fetal breathing, adequate fetal movements, and adequate tone is frequently referred to as a **normal biophysical profile.** Each parameter is given a **score** of 2. A normal profile equals 10. Table 7-4 lists the recommended frequency for biophysical profile testing based on high-risk conditions.

UMBILICAL ARTERY DOPPLER ASSESSMENT

During the ultrasonic assessment, it is relatively easy to assess the fetal umbilical artery vascular resistance. A high systolic/diastolic ratio (S/D) (Figure 7-5) suggests abnormal flow because of increased vascular resistance within the fetal/placental circulation. When the flow becomes very abnormal, diastolic flow ceases and there can be a reversal of flow (Figure 7-6) from the placenta to the fetus. When this occurs the fetus is at high risk and delivery is usually indicated.

PREVENTIVE HEALTH CARE

Management before and during pregnancy presents an opportunity for patient education and the practice of preventive medicine. Childbirth preparation classes for both the patient and her partner are very educational, particularly during the first pregnancy. These classes provide an important opportunity for both parents to enhance bonding to the infant before birth. **The presence and encouragement of the baby's father at these classes and during labor and delivery can be most helpful.**

Although preconception, prenatal, and obstetric information is of primary importance, **other topics that may have lifelong relevance can be introduced and emphasized during antepartum care. The pregnancy itself is frequently a strong motivator for women to eliminate potentially harmful habits, such as smoking, or to change dietary patterns** that are associated with an increased incidence of obesity. Therefore, a systematic approach to the dissemination of preventive health care information is generally well received by the pregnant woman.

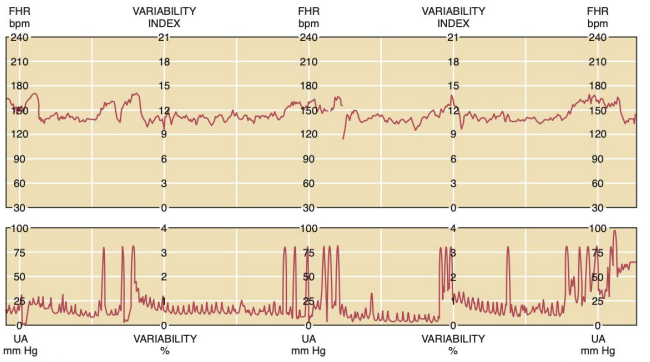


FIGURE 7-3 Reactive nonstress test. Note the fetal heart rate (FHR) accelerations with most fetal movements, denoted by spikes above 75 mm Hg in lower panel. *bpm,* Beats per minute.

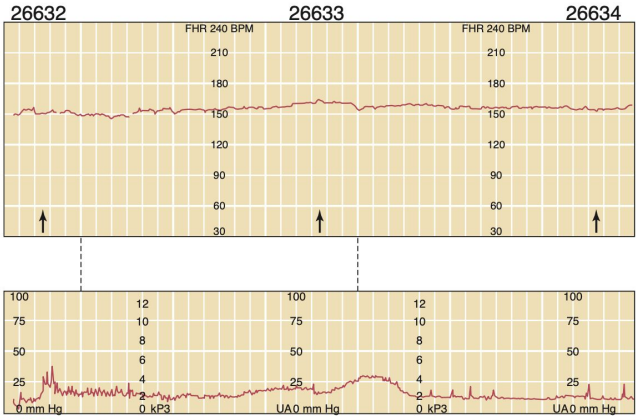


FIGURE 7-4 Nonreactive nonstress test. Note the lack of beat-to-beat variability and the lack of acceleration of the fetal heart rate (FHR) with fetal movements *(arrows). bpm,* Beats per minute.

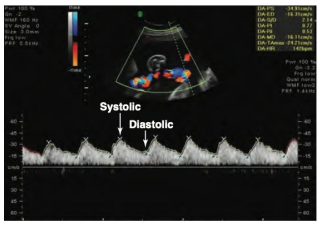


FIGURE 7-5 Fetal umbilical artery Doppler assessment at 31 weeks and 3 days showing a series of Doppler waveforms with systolic (upper) peaks marked with X (+37 cm/sec) and lower X marking diastole (at +21 cm/sec). The systolic-to-diastolic ratio is calculated as 2.14 *(upper right corner),* and normal for this gestational age is <3.2.

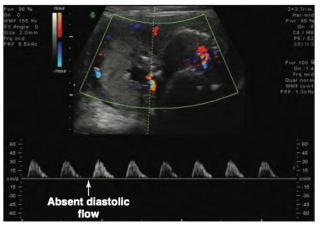


FIGURE 7-6 Fetal umbilical artery Doppler assessment at 26 weeks and 5 days in a case with reduced amniotic fluid (small lucent pocket left of midline with Doppler assessment of cord artery). The systolic-to-diastolic ratio cannot be calculated as in Figure 7-5 because of absent diastolic flow. Only systolic flow can be measured (+30 cm/sec).

TABLE 7-4

RECOMMENDED FREQUENCY FOR BIOPHYSICAL PROFILE TESTING

High-Risk Condition	Frequency
Intrauterine Growth Restriction	
Mild	Weekly
Moderate*	Twice weekly
Diabetes Mellitus	
Class A	Weekly, 37 to 40 wk
	Twice weekly, beyond 40 wk
Class B and worse	Twice weekly, beginning at 34 wk
Post-term pregnancy	Twice weekly, beginning at 42 wk
Decreased fetal movements	Weekly
Other high-risk conditions	Weekly
Maternal or physician concern	Weekly

*For severe intrauterine growth restriction, delivery is usually indicated.

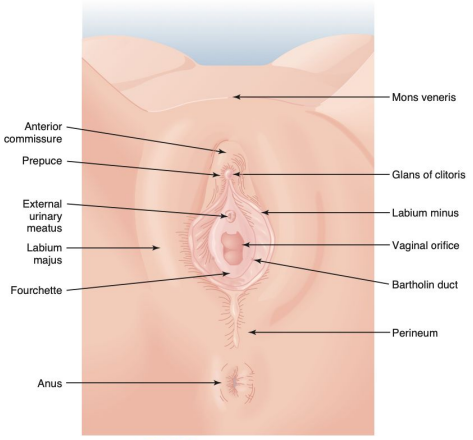


FIGURE 3-3 Female external genitalia.

may take many forms, however, such as a cribriform plate with many small openings or a completely imperforate diaphragm.

The vestibule of the vagina is that portion of the introitus extending inferiorly from the hymenal ring between the labia minora. The fourchette represents the posterior portion of the vestibule just above the perineal body. **Most of the vulva is innervated by the branches of the pudendal nerve. Anterior to the urethra, the vulva is innervated by the ilioinguinal and genitofemoral nerves.** This area is not anesthetized adequately by a pudendal block, and repair of paraurethral tears should be supplemented by additional subcutaneous anesthesia.

Internal Genital Development

The upper vagina, cervix, uterus, and fallopian tubes are formed from the paramesonephric (müllerian) ducts. Although human embryos, whether male or female, possess both paired paramesonephric and mesonephric (wolffian) ducts, **the absence of Y chromosomal influence leads to the development of the paramesonephric system** with virtual total regression of the mesonephric system. With a Y chromosome present, a testis is formed and müllerian-inhibiting substance is produced, creating the reverse situation.

Mesonephric duct development occurs in each urogenital ridge between weeks 2 and 4 and is thought to influence the growth and development of the paramesonephric ducts. **The mesonephric ducts terminate caudally by opening into the urogenital sinus.** First evidence of each paramesonephric duct is seen at 6 weeks' gestation as a groove in the coelomic epithelium of the paired urogenital ridges, lateral to the cranial pole of the mesonephric duct. **Each paramesonephric duct opens into the coelomic cavity cranially** at a point destined to become a tubal ostium. Coursing caudally at first, parallel to the developing mesonephric duct, the blind distal end of each paramesonephric duct eventually crosses dorsal to the mesonephric duct, and the two ducts approximate in the midline. **The two paramesonephric ducts fuse terminally at the urogenital septum, forming the uterovaginal primordium.** The distal point of fusion is known as the **müllerian tubercle (Müller tubercle)** and can be seen protruding into the urogenital sinus dorsally in embryos at 9 to 10 weeks' gestation (Figure 3-4). **Later**

Med 441 Team:

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Good Luck!

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