Reviewed By
RAAOUM M. JABOR

Video Case

Preconception, Antenatal, Intrapartum, and Postpartum Care

Lectures:

- ➔ Preconception care
- ➔ Antepartum care
- ➔ Intrapartum care
- ➔ Postpartum care

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Video Case

Preconception Care

Objectives:

- ➔ Define preconception care and list its components.
- ➔ Describe how certain medical conditions affect pregnancy.
- ➔ Describe how pregnancy affects certain medical conditions.
- ➔ Assess a patient's genetic risk as well as father's genetic risk with regard to pregnancy.
- ➔ Describe genetic screening options in pregnancy.
- ➔ Recognize a patient's risk of substance abuse and intimate partner violence and explain how this would be addressed with a patient.
- ➔ Appraise a patient's nutritional status and make recommendations to the patient on nutrition and exercise.
- ➔ Assess a patient's medications, immunizations and environmental hazards in pregnancy.
- ➔ Identify appropriate folic acid intake.
- ➔ Identify ethical issues associated with prenatal genetic screening and diagnostic tests.
- ➔ Describe tests to confirm pregnancy and determine viability.
- ➔ Estimate gestational age and expected date of confinement.

- → Slides
- → Important
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- → 441 Female Presentation
- → Reference

Female presentation

Video Case | Editing File

Preconception Care

Definition

Preconception care: the process of identifying behavioral, environmental, biomedical, and social risks to an individual's fertility and pregnancy outcome with the goal of reducing these risks through education, counseling, and appropriate intervention.

Goals

The three major goals of preconception care are to:

- Identify potential risks to the mother, fetus, and pregnancy.
- Educate the individual about these risks, options for intervention and management to reduce risk, and reproductive alternatives.
- Initiate interventions to provide optimum maternal, fetal, and pregnancy outcomes. Interventions include motivational counseling, disease optimization, and specialist referral.

Target population

Preconception care should be an essential part of primary and preventive care for all females of childbearing potential who present for a periodic health exam, whether or not they are currently interested in conceiving.

Components

Several models of preconception care have been developed. According to one model, the major components of preconception care include:

12 Risk assessments	6 Health promotions
• Reproductive life plan • Past reproductive history • Past medical history • Medications • Infections & immunizations • Genetic screening & family history • Nutritional assessment • Substance abuse • Toxins and teratogens • Psychosocial concerns • Physical examination • Laboratory tests	• Family planning • Healthy weight and nutrition • Health behaviors • Stress resilience • Healthy environments • Interconception care

Risk Assessment

Reproductive life plan

Ask your patient if she plans to have any (more) children, and how long she plans to wait until she (next) becomes pregnant. Help her develop a plan to achieve those goals.

Past reproductive history

Review prior adverse pregnancy outcomes, such as fetal loss, birth defects, low birthweight, and preterm birth, and assess ongoing biobehavioral risks that could lead to recurrence in a subsequent pregnancy.

Past obstetric history (for each pregnancy)	Gynecological history
• Date and location of delivery • Gestational age (GA) at delivery • Sex of child • Birth weight and percentile for GA • Mode of delivery (vaginal, cesarean, assisted) • Type of analgesia and anesthesia • Length of labor • Outcome (live birth, stillbirth) • Details (eg, type of incision, forceps, vacuum, etc) • Complications (eg, preterm birth, preeclampsia, gestational diabetes, previa, abruption)	• Age at menarche • Date of LMP • Date of previous menstrual period • Cycle length and duration • Type of contraception • STIs • Gynecologic surgery or disorders (eg, endometriosis, fibroids) • Miscarriage • Pregnancy termination • Ectopic pregnancy

Past medical history

- If the patient has medical issues we need to optimize control of disease processes.
- Ask about past medical history, such as rheumatic heart disease, thromboembolism, or autoimmune diseases that could affect future pregnancy.
- Screen for ongoing chronic conditions such as hypertension and diabetes.

Medications

- Review current medication use, including OTC medications, herbs, and supplements.
- Avoid **category X drugs** and most **category D drugs** unless potential maternal benefits outweigh fetal risks.

Risk Assessment

Infections & immunization

- Screen for **periodontal, urogenital, and STIs** as indicated.
- Discuss **TORCH** (toxoplasmosis, other, rubella, cytomegalovirus, and herpes) infections.
  - **Toxoplasmosis:** woman who are trying to conceive should minimize exposure to outdoor cat feces secondary to the risk of exposure to toxoplasmosis.
- Update **immunization** for hepatitis B, MMRV (mumps, measles, rubella, varicella), Tdap (combined tetanus, diphtheria, and pertussis), human papillomavirus, and influenza vaccines as needed.
  - Ideally, patients should be vaccinated according to the recommended adult immunization schedule.
  - **Live vaccines (e.g. MMRV) cannot be administered during pregnancy, so the preconception visit is the ideal time to offer these vaccinations if a woman is not immune. Advise women to avoid conceiving for 1-3 m after receiving live vaccines.**
  - **Pregnant pts without evidence of immunity to rubella should receive the vaccine postpartum.**
  - HPV is not recommended during pregnancy due to limited data on vaccine safety.
  - **The annual inactivated influenza vaccine is safe and recommended in all trimesters.**

Mnemonic: RST3H (Rubella, Syphilis, Toxoplasmosis, Hep B, Hep C, HIV)

Genetic screening and family history

- Assess risk for chromosomal or genetic disorders (sickle hemoglobinopathies, thalassemia, Tay-Sachs disease, Canavan disease) based on family history, ethnic background, & age.
- Offer cystic fibrosis screening (autosomal recessive disorder) through two options:
  - **Preimplantation genetic diagnosis:** a process in which in-vitro fertilization is used to create embryo which can be tested for CF prior to being implanted.
  - **Chorionic villus sampling or amniocentesis:** the parents can conceive naturally and the fetus can be tested for CF, leading to wrenching decisions for parents about whether to carry or terminate a pregnancy if the fetus is found to be affected.

Nutritional assessment

- Assess anthropometric (BMI), biochemical (eg, anemia), clinical, and dietary risks.
- **Preconception folic acid supplementation may decrease incidence of NTD & congenital CHD.**
  - **All women should take at least 0.4 mg of folic acid daily beginning at least 1 month prior to conception and continuing throughout pregnancy.**
  - **Women with high risk for NTD should take 4 mg of folic acid daily.**
- Screen for sufficient intake of macronutrients and micronutrients.
- Megavitamins, nonessential dietary supplements, and herbal preparations should be discontinued, given that the risk to the fetus from such substances has generally not been evaluated.
- Ensure vitamin A is not taken in excess as megadoses of vitamin A during early pregnancy have been associated with congenital anomalies.

Risk Assessment

Substance abuse

- Ask about smoking, alcohol, drug use.
- Use **T-ACE** (tolerance, annoyed, cut down, eye opener) or **CAGE** (cut-down, annoyed, guilty, eye-opener) questions to screen for alcohol and substance abuse.

Toxins and teratogens

Review potentially toxic exposures at home, neighborhood, and work such as mercury, lead, pesticides, air pollution, household cleaning products, unsafe sources of water, plastics, and infection.

Psychosocial concerns

- Screen for depression, anxiety, intimate-partner violence, and major psychosocial stressors.
- Drugs used to treat psychiatric disease can affect the fetus and neonate. Females who have been on medication and have mild or no symptoms for six or more months may be considered for medication taper and discontinuation.

Physical examination

Focus on periodontal, thyroid, heart, breasts, and pelvic examination as well as BMI and BP.

Laboratory tests

- Check CBC, blood type & antibody screen, urinalysis, rubella, syphilis, hep B, HIV, and cervical cytology.
- Screen for gonorrhea, chlamydia, and diabetes in selected populations.
- Consider TSH.

Health Promotion

Family planning

Promote family planning based on a woman's reproductive life plan. For women who are not planning on getting pregnant, promote effective contraceptive use and discuss emergency contraception.

Healthy weight and nutrition

Promote healthy pre-pregnancy weight through exercise and nutrition. Discuss macronutrients and micronutrients, including 5-a-day and daily intake of multivitamin containing folic acid.

Health behavior

Promote such health behaviors as nutrition, exercise, safe sex, effective use of contraception, dental flossing, and use of preventive health services. Discourage risk behaviors such as douching, nonuse of seat belt, smoking, and alcohol and substance abuse.

Stress resilience

Promote healthy nutrition, exercise, sleep, and relaxation techniques; address ongoing stressors such as intimate partner violence; identify resources to help patient develop problem-solving and conflict resolution skills, positive mental health, and relational resilience.

Health environment

Discuss household, neighborhood, and occupational exposures to metals, organic solvents, pesticides, endocrine disruptors, and allergens. Give practical tips such as how to reduce exposures during commuting or picking up dry cleaning.

Interconception

Promote breastfeeding, back-to-sleep, positive parenting behaviors, interconception care and reduce ongoing biobehavioral risks.

Pregnancy & Medical Conditions

How certain medical conditions affect pregnancy

Example: DM

Fetal & neonatal risks

- Directly related to glycemic control throughout pregnancy:

A1C	Fetal malformation rate
< 7	Baseline
7.2 - 9.1	14%
9.2 - 11.1	23%
> 11.2	25%

- Congenital malformations:
  - **Congenital heart disease (most common)**
  - CNS anomalies (2nd most common)
  - GI & GU anomalies
  - Skeletal malformations

  **Remember that organ formation occurs at 3-10 weeks EGA, and that < 30% of diabetic women seek preconception counseling.*

Q) Can GDM cause anomalies?
No, it develops in the 2nd trimester; DM T1 + T2 can lead to anomalies.

- Miscarriage: if a diabetic woman's A1C is 11, there is a 44% miscarriage rate.
- Perinatal mortality: decreased markedly in recent years because of the ability to achieve glucose control with medical therapy, either with insulin or oral hypoglycemic agents.
- Preterm birth, macrosomia.

Preconception management

- **Contraception:** recommended until glycemic control is achieved.
- **Lab evaluation:** A1C, serum creatinine, eGFR, AST, ALT, TSH, and ACR.
- **Folic acid supplementation:** 400 mg/day.
- **Pharmacotherapy:** insulin is the preferred treatment in pregnancy.

Pregnancy & Medical Conditions

How certain medical conditions affect pregnancy

DM

Maternal risks: diabetes can lead to organ damage, that leads to life-threatening diabetic nephropathy, diabetic retinopathy, diabetic neuropathy, CVD, hypoglycemia, DKA.

Obstetric risks: preeclampsia, gestational HTN, polyhydramnios, and cesarean birth.

HTN

Classification

- **Normal: <140/90**
- **Mild to moderate: 140-159/90-109 → unclear benefit of treatment because lowering maternal BP too much reduces placental perfusion**
- **Severe: >160/90 → treatment leads to reduction of stroke risk**

Treatment

- **Safe during pregnancy:** methyldopa, labetalol
- **Contraindicated during pregnancy:** ACEIs, ARBs, direct renin inhibitors

Pregnancy risks

1. Superimposed preeclampsia
2. Placental abruption
3. Fetal growth restriction

SLE

- Pregnancy should occur in a period of disease quiescence (inactivity) for at least 6 months prior to conception.
- If SLE is active at the time of conception this is a strong predictor of adverse maternal and obstetrical complications.
  - Women who are primigravidas and women with a history of lupus nephritis or active nephritis are at highest risk of flare. Higher rates of complications such as preeclampsia, preterm birth, fetal loss, growth restriction, and neonatal lupus syndromes are seen in lupus pregnancy.
- All medications should be reviewed and adjusted prior to conception.

Teaching Case

You have been Mary's doctor for the past 3 years. She is a 39-year-old Caucasian woman with a BMI of 32.9 who sees you primarily for her idiopathic chronic hypertension, which is well controlled on an ACE inhibitor. She has smoked 1 pack of cigarettes per day for the past 20 years. She is in today for her annual exam and mentions that she is getting married in a few months and would like to start a family. She has never been pregnant before. On physical exam, her BP = 138/84, Ht = 5' 2", Wt =180 lbs. Otherwise, her exam is unremarkable.

- In the OSCE you will have a scenario like that and you will be asked to council the patient. Use every single information given (DM, HTN, smoker, OCP).
- When providing contraceptive counseling, it is important to consider the following regarding OCPs:
  - **Smoker and over 35:** absolute contraindication
  - **Smoker and below 35:** relative contraindication
  - **Non-smoker and over 35:** relative contraindication

Q1: What is the goal of counseling a woman about pregnancy prior to conception?

This type of counseling is often referred to as preconception care or counseling. The goal is to optimize, whenever possible, a woman's health and knowledge before planning and conceiving a pregnancy in order to eliminate, or at least reduce, the risk associated with pregnancy for the woman and her future baby. In addition, if pregnancy is not desired, then current contraceptive use and options can be discussed to assist the patient in identifying the most appropriate method for her and to reduce the potential for an unplanned pregnancy.
Some diseases # pregnancy e.g. Pulmonary HTN > 50% mortality rate.
So what to do? Advise them not to get pregnant and prescribe OCP.

Q2: What are the major topics that should be discussed or addressed with any woman prior to conception?

- Identify undiagnosed, untreated or poorly controlled medical conditions
- Review immunization history and recommend appropriate immunizations
  - Q) In counseling; if she is not immune against rubella and:
    - **Not pregnant:** vaccinate but she can't get pregnant for 3 m to prevent congenital rubella syndrome
    - **Pregnant:** after delivery (vaccinate + OCP for 3 months)
- Risks of medication and radiation exposure in early pregnancy
- Nutritional issues
- Family history and genetic history including racial/ethnic background and specific genetic risks.
  - Cystic fibrosis genetic screening options:
    - Preimplantation genetic diagnosis (IVF)
    - Chorionic villus sampling -1st trimester (12-13 w)
    - Amniocentesis (2nd trimester)
    - Non-invasive by DNA in maternal serum
- Tobacco, alcohol, & substance abuse and other high-risk behaviors (such as sexual activity & risk for STIs)
- Occupational and environmental exposures
- Social issues and
- Mental health issues and intimate partner violence issues

A provider who is skilled in the care of obstetric patients may perform counseling. However, the assistance of a maternal-fetal medicine specialist or genetic specialist may be necessary in certain circumstances.

Teaching case

Q3: For the patient in this case, what specific topics need to be addressed?

You need to know each disease, its effect on mother & fetus, and the effect of pregnancy on the disease.

Mary will need to be counseled regarding several preconception issues, including:

- **Weight loss and exercise:** Mary's BMI is 32.9 and she is obese [BMI ≥ 30]; weight loss in obese non-pregnant women has proven health benefits. Mary, may see improvement in her BP and decrease the need for antihypertensive therapy; obesity in pregnancy is associated with increased risks including higher rates of gestational diabetes, preeclampsia, cesarean delivery, wound infection, anesthesia complications, and post-operative complications (thrombosis). You cannot do proper examination on an obese women.

- **The effect of chronic medical disease** (idiopathic hypertension) on pregnancy (increased risk of preeclampsia, fetal growth restriction (placental insufficiency), abruption and recommendations for heightened maternal and fetal surveillance in pregnancy).

- **Need to modify antihypertensive therapy:** ACE inhibitors are contraindicated in pregnancy due to risks for fetal renal dysgenesis and dysfunction. Suggest methyldopa and labetalol instead. In mild to moderate HTN we don't give antihypertensive medications because it may decrease the blood flow to the placenta. Use of antihypertensive medications is usually for the benefit of the maternal (no benefit for the fetus).

- **Effect of smoking on pregnancy** (increased risk of fetal growth restriction) → + DVT (polycythemia vera vascular stasis + endothelial injury)

- **Offer cystic fibrosis carrier testing** (carrier prevalence increased in Caucasians) and discuss any family history of birth defects or genetic disorders: referral for genetic counseling may be warranted if issues are identified.

- **Discussion of increased risk of Down's Syndrome** and other trisomies based on current age of 39 (the risk increase with the age) and probable older age when she conceives. Screening options may include cell free fetal DNA (from maternal serum), nuchal translucency (11-13 wk) and first trimester screening, quadruple screen and integrated/sequential techniques.

- **Begin prenatal multivitamins** or at least folic acid supplementation (0.4 mg per day) for the prevention of fetal neural tube defects (spina bifida, anencephaly) and 4 mg/day if they have had a prior child/pregnancy with a neural tube defect.

- **Accurate recording of LMP** and cycle length in order to assist in dating her pregnancy and allow her to present early for prenatal care when she does conceive. Important to confirm the GA, because there are some tests depend on the gestational age.

- **Review immunization history**; employment, medical or behavioral risk factors for infections against which effective vaccines are available; and test for evidence of immunity against rubella: recommended immunizations based on your review.

Doctor's Notes

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Mnemonic from the doctor: look for 4Ds

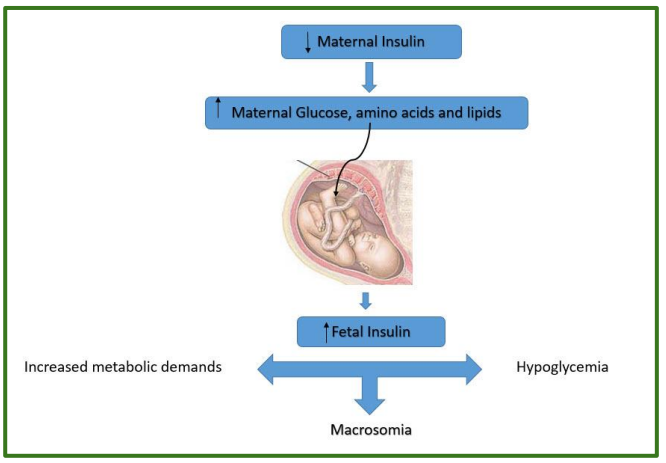
1. Defect: screen for inherited anomalies and diseases as cystic fibrosis, Tay-Sachs disease, hemoglobinopathies (sickle cell disease, thalassemia)
2. Disease: including screening for chronic diseases as HTN, DM, hypo-hyperthyroidism as well as screening for infectious diseases with reviewing the vaccinations status
3. Diet: weight loss in case of obesity with the adjustment of nutrition
4. Daily activity
5. Drugs and vaccines

Folic acid supplementation:

- When to stop folic acid supplementation?
  After fetal organogenesis period which is after the first 4 months (12 week).
- In case she was diabetic or she received a previous chemotherapy with methotrexate we should increase the dose (because DM increases the risk of NTD and MTX decreases folic acid levels).

Problems of diabetes in pregnancy:

- Macrosomia (a newborn with an excessive birth weight)
- Preeclampsia
- Early (preterm) birth
- Fetal hypoglycemia will cause brain damage leading to death
- Miscarriage or stillbirth



438-439

- **Regarding the previous case:** She has 3 risk factors that increases her chance of developing preeclampsia and other vasculopathies (obesity, HTN, and smoking) so we should prescribe her aspirin that must be stopped at 36 weeks to prevent PDA.
- **How to screen for genetic diseases in relative couples?** Either by IVF with pre-genetic diagnosis (prior to implantation) or by using chorionic villus sampling or amniocentesis (after implantation) then if the test was positive for the disease they decide whether to terminate the pregnancy or not.
- **When do we screen for GDM?** Between week 24 to 28 but if she was a high risk lady (obese, previous GDM or macrosomia) we should screen in the first visit after pregnancy.
- **Infections that must be screened prior to conception:** HIV, HBV, Rubella, Toxoplasmosis, Syphilis, and CMV if she had multiple miscarriages.

Reference

CHAPTER 7

Antepartum Care

Preconception and Prenatal Care, Genetic Evaluation and Teratology, and Antenatal Fetal Assessment

CALVIN J. HOBEL • JOHN WILLIAMS III

CLINICAL KEYS FOR THIS CHAPTER

- Preconception counseling is an important component of preventive care for couples that are considering pregnancy. It can identify risks related to family history, maternal medical conditions, and fetal and maternal chromosomal/genetic disorders that may result in congenital abnormalities. A simple screening tool called *Before Pregnancy* is available electronically at StudentConsult.com to facilitate the process of preconception assessment and counseling.

Pregnancy, to many women, is one of the greatest experiences of their lives. Even before conceiving, a woman may contemplate or ask whether her child will be normal at birth and whether pregnancy will be safe for her. Preconception and prenatal counseling by the well-informed health care professional can offer a sense of security to these women and deliver some of the most cost-effective preventive measures in all of health care. The purpose of this chapter is to provide the reader with a basic understanding of the appropriate evaluation and the optimal care that should be provided when a woman is thinking of trying to conceive, or has become pregnant.

Preconception Care

Ideally, "prenatal care" should begin before pregnancy. Organogenesis begins early in pregnancy and placental development starts with implantation, about 7 days after conception. **Poor placental development has been linked to preeclampsia, preterm birth, and intrauterine growth restriction (IUGR), all of which are associated with low birth weight (<2500 grams), and may play a role in fetal programming of chronic diseases later in life.** This is known as the **Barker hypothesis** (see Chapter 1). In addition, **obesity has become a world-wide problem** associated with metabolic dysregulation, and must be addressed before pregnancy if outcomes are to be improved.

By the time most pregnant women have their first prenatal visit, it is too late to address the risk of low birth weight and obesity, and to reduce the risk of some birth defects. The growing recognition of the importance of women's health before pregnancy has drawn increasing attention to the need for more effective and timely preconception care. **Several models of preconception care have been developed.** According to one model, the major components of preconception care include 12 risk assessments and 6 health promotions and these are summarized in Table 7-1. To cover each of the 18 components would require multiple visits to a health care provider, and this is often not acceptable to young women.

The major problem associated with the implementation of preconception care is a lack of consensus on the necessary components of the care. **For some, preconception care means a single prepregnancy check-up a few months before couples attempt to conceive.** A single visit, however, may be inadequate to address some problems such as smoking cessation or attaining and maintaining a healthy weight.

For others, preconception care should become an important part of comprehensive well-woman care, universally implemented from prepubescence to menopause. In practice, however, asking providers to squeeze more into their already hurried visits may not be practical, and some components (e.g., genetic screening or laboratory testing) may not be indicated for every woman. Absence of any preconception care will miss all of those pregnancies that are unintended at the time of conception (50% in the United States) but are continued despite a lack of planning.

In order to address these issues, ***Before Pregnancy*** **is available electronically at** StudentConsult.com and may be used to evaluate women who are planning a pregnancy. **This type of preconception care should be started, especially in high-risk women (e.g., women with obesity, diabetes, or hypertension), 6 months to 1 year before conception is attempted.** A more ambitious goal is for all women to participate, because not all "at risk" women will be identified by obvious existing comorbidities.

TABLE 7-1

ELEMENTS OF PRECONCEPTION COUNSELING AND CARE

Major Components of Preconception Care	Risk Assessment
Reproductive life plan	Ask your patient if she plans to have any (more) children, and how long she plans to wait until she (next) becomes pregnant. Help her develop a plan to achieve those goals.
Past reproductive history	Review prior adverse pregnancy outcomes, such as fetal loss, birth defects, low birthweight, and preterm birth, and assess ongoing biobehavioral risks that could lead to recurrence in a subsequent pregnancy.
Past medical history	Ask about past medical history, such as rheumatic heart disease, thromboembolism, or autoimmune diseases that could affect future pregnancy. Screen for ongoing chronic conditions such as hypertension and diabetes.
Medications	Review current medication use. Avoid category X drugs and most category D drugs unless potential maternal benefits outweigh fetal risks (see Box 7-3). Review use of over-the-counter medications, herbs and supplements.
Infections and immunizations	Screen for periodontal, urogenital, and sexually transmitted infections as indicated. Discuss TORCH (toxoplasmosis, other, rubella, cytomegalovirus, and herpes) infections and update immunization for hepatitis B, rubella, varicella, Tdap (combined tetanus, diphtheria and pertussis), human papillomavirus, and influenza vaccines as needed.
Genetic screening and family history	Assess risk of chromosomal or genetic disorders based on family history, ethnic background, and age. Offer cystic fibrosis screening. Discuss management of known genetic disorders (e.g., phenylketonuria, thrombophilia) before and during pregnancy.
Nutritional assessment	Assess anthropometric (body mass index), biochemical (e.g., anemia), clinical, and dietary risks.
Substance abuse	Ask about smoking, alcohol, drug use. Use T-ACE (tolerance, annoyed, cut down, eye opener) or CAGE (cut-down, annoyed, guilty, eye-opener) questions to screen for alcohol and substance abuse.
Toxins and teratogens	Review exposures at home, neighborhood, and work. Review Material Safety Data Sheet and consult local Teratogen Information Service as needed.
Psychosocial concerns	Screen for depression, anxiety, intimate-partner violence, and major psychosocial stressors.
Physical examination	Focus on periodontal, thyroid, heart, breasts, and pelvic examination.
Laboratory tests	Check complete blood count, urinalysis, blood type and antibody screen, rubella, syphilis, hepatitis B, HIV, cervical cytology; screen for gonorrhea, chlamydia, and diabetes in selected populations. Consider thyroid-stimulating hormone.
Major Components of Preconception Care	**Health Promotion**
Family planning	Promote family planning based on a woman's reproductive life plan. For women who are not planning on getting pregnant, promote effective contraceptive use and discuss emergency contraception.
Healthy weight and nutrition	Promote healthy prepregnancy weight through exercise and nutrition. Discuss macro- and micronutrients including 5-a-day and daily intake of multivitamin containing folic acid (see www.fns.usda.gov/5day).
Health behaviors	Promote such health behaviors as nutrition, exercise, safe sex, effective use of contraception, dental flossing, and use of preventive health services. Discourage risk behaviors such as douching, nonseatbelt use, smoking, alcohol and substance abuse.
Stress resilience	Promote healthy nutrition, exercise, sleep, and relaxation techniques; address ongoing stressors such as intimate partner violence; identify resources to help your patient develop problem-solving and conflict resolution skills, positive mental health, and relational resilience.
Healthy environments	Discuss household, neighborhood, and occupational exposures to metals, organic solvents, pesticides, endocrine disruptors, and allergens. Give practical tips such as how to reduce exposures during commuting or picking up dry cleaning.
Interconception care	Promote breastfeeding, back-to-sleep, positive parenting behaviors, and reduce ongoing biobehavioral risks.

Med 441 Team:

Leaders:

Leen Alrajhi - Yara Almufleh

Members:

Ftoon Alenazi

Organizer:

Arwa Mobeirek

Good Luck!

Med 438 Team:

Leaders:

Ateen Almutairi - Lama ALzamil - Lina Alosaimi

Members:

Shahad Aldumkh - Taif alotaibi - Sarah Alhelal - Ateen Almutairi

Med 439 Team:

Leader:

Bushra Alotaibi - Renad Alhomaidi

Members:

Fatimah Alhelal - Rima Alomar

Reviewed By
RAAOUM M. JABOR

Video Case

Antepartum Care

Objectives:

- → Diagnose pregnancy.
- → Determine gestational age.
- → Assess risk factors for pregnancy complications, including screening for intimate partner violence.
- → Describe appropriate diagnostic studies and their timing for a normal pregnancy.
- → List the nutritional needs of pregnant women.
- → Identify adverse effects of drugs and the environment on pregnancy.
- → Perform a physical examination on obstetric patients.
- → Discuss answers to commonly asked questions concerning pregnancy, labor and delivery.
- → Describe approaches to assessing the following: fetal well-being, fetal growth, amniotic fluid volume and fetal lung maturity.
- → Describe the impact of pregnancy on medical problems and the impact of medical problems on pregnancy.

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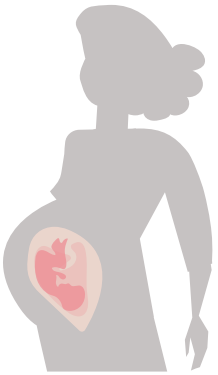
Antepartum Care

Introduction

- **Antepartum care**, also known as antenatal care or prenatal care, refers to care before labor and delivery and begins with the first prenatal visit.
- Women who receive antepartum care during the first trimester have better pregnancy outcomes.



Goals

The goals of prenatal care are:

1. Early and continuous risk assessment
2. Health promotion
3. Medical and psychosocial intervention and follow-up

Timing

Initial visit

- For low-risk women, the initial prenatal visit will be an **intake visit at 6-8 weeks, followed by the first prenatal visit before <12 weeks.**
- It is usually when a woman notices that she missed a period.
- Most women will then do a home pregnancy test **(positive when beta-HCG is above 25)**.
- Early pregnancy symptoms include: fatigue, NV, breast tenderness, and frequent urination.

Follow-up visits

- The typical intervals for prenatal visits for nulliparous pts with low-risk pregnancies are **every 4 weeks until 28 weeks, then every 2 weeks from 28 to 36 weeks, and then weekly until delivery.** Patients at risk may require additional visits to assess S&S of preterm labor.
- During each visit, the clinician should have a weight, BP, and fetal assessment.

Components of the initial prenatal visit

- History
- Determining the GA & EDD
- Physical examination
- Ultrasound examination
- Screening for genetic & anatomic abnormalities
- Laboratory tests

The Initial Prenatal Visit

History

- **Personal medical history**
- **Past obstetric history**
- **Menstrual and gynecologic history**
- **Genetic screening issues**
- **Psychosocial history**
  - Smoking (increases the risk of miscarriage, placental abruption, **fetal growth restriction (IUGR)**, birth defects, preterm delivery, and sudden infant death syndrome)
  - Alcohol (increases the risk of mental retardation, developmental delay and birth defects)
  - Drugs (cocaine exposure, in addition to teratogenic drugs as methotrexate, warfarin, diphenylhydantoin, valproic acid, carbamazepine, phenobarbital, and isotretinoin)
  - Environmental and health hazards
  - Domestic violence (8-10% of pregnant women are physically abused during pregnancy)
  - Seatbelt use

Determining the GA & EDD

Gestational age (GA)	Calculated from the first day of the last menstrual period (LMP).
Estimated date of delivery (EDD)	Calculated by adding 40 weeks to the first day of the LMP if the woman has regular 28-day cycles **or** vaginal ultrasound if the cycles are irregular and to confirm the EDD if the patient's cycles are regular.

The accuracy of US dating is GA-dependent; earlier sonograms are more accurate than later ones.

- If the difference between menstrual dates and ultrasound dates is within the normal range of variation, use the menstrual dates.
- If the difference between menstrual dates and ultrasound dates is outside the normal range of variation, use the ultrasound dates.

Physical examination

Complete PE with special attention to uterine size & shape and evaluation of the adnexa.

- **Fundal height:** the most commonly used assessment for fetal growth; done by measuring the distance from the pubic symphysis to top of fundus, where the height = the number of weeks gestational (only if it is > 20 weeks).
- **Fetal HR:** assessed by hand-held Doppler ultrasound device at 12 weeks.

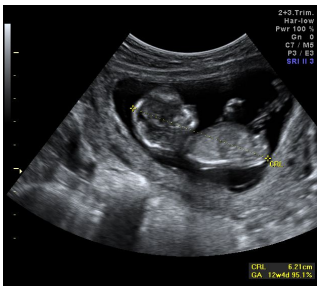
Note: When the uterine size on PE differs from that predicted by menstrual dating, early sonographic assessment is indicated. Causes for a discrepancy between the actual uterine size and that predicted by the LMP include: uterine fibroids, uterine malposition (eg, retroverted uterus), multiple gestation, and incorrect last menstrual date.

→ For more details, refer to HT & PE lecture here
→ YouTube video on obstetric examination here

The Initial Prenatal Visit

Ultrasound examination

- Performed between 18-20 weeks.
- **Indications:**
  - Confirmation of pregnancy & its location and determining viability.
  - Determination of GA & EDD (provides a better estimation than LMP).
    - **Weeks 6-11:** via measurement of fetal **crown-rump length (CRL).**
    - **Weeks 12-20:** via the average of multiple measurements (biparietal diameter, femur length, abdominal & head circumferences).
    - **Thereafter:** measurements become less reliable.
  - Detection of multiple gestation.
  - Measurement of nuchal translucency as part of aneuploidy screening.



Screening for genetic & anatomic abnormalities

- **Aneuploidy screening & diagnosis** (discussed later)
- **Fetal anatomy scan:** performed between 18-20 weeks to detect anomalies.
- **Genetic carrier screening** (e.g. cystic fibrosis, hemoglobinopathy)

Laboratory tests

- **Confirmation of pregnancy (beta-hCG):**
  - In the absence of diagnostic physical findings of pregnancy (ie, an ultrasound image of the gestational sac/embryo/fetus or auscultation of fetal heart activity by a hand-held Doppler device), suspected pregnancy should be confirmed by detection of the beta-hCG in blood or urine.
  - It is important to differentiate a normal pregnancy from a nonviable or ectopic pregnancy. In the first 30 days of a normal gestation, the level of hCG doubles every 2.2 days. In patients whose pregnancies are destined to abort, the level of hCG rises more slowly, plateaus, or declines.

- **Standard panel:**
  1. **CBC**
  2. **Blood typing & antibody screening**
  3. **Urinalysis and urine culture**
  4. **Rubella immunity**
  5. **Screening for STIs and bloodborne pathogens**

- **Selective screening:**
  1. **Thyroid function**
  2. **T2DM**
  3. **Cervical cancer screening**
  4. **Latent TB**

The Initial Prenatal Visit

Standard panel of laboratory tests

1 CBC

Hematocrit or hemoglobin	To screen for anemia, which is generally defined by Hb <11 g/dL (Hct <33%) in the first and third trimesters and <10.5 g/dL (Hct <32%) in the second trimester.
MCV	• Because hemoglobin and hematocrit reflect pregnancy dilution, MCV may be the most reliable predictor of true anemia. • A low hemoglobin and **low MCV** (<80) most commonly suggests iron deficiency, but may also be caused by thalassemia. • A low hemoglobin and **high MCV** (>100) suggests folate deficiency or, rarely, vitamin B12 deficiency.
Platelets	• A low platelet count (<150,000) is most likely indicative of gestational thrombocytopenia (no need for medication). • Preeclampsia with severe features and idiopathic thrombocytopenic purpura (need medication) are uncommon causes of low platelets. DIC is rare.
Leukocytes	• Normal pregnancy WBC count in pregnancy is up to 16,000. • Leukopenia suggests immune suppression or leukemia.

2 Blood typing & antibody screening

Direct Coombs test	• To determine ABO group and Rh type. • If the patient is Rh-negative, she is at risk for anti-D isoimmunization.
Indirect Coombs test	• To detect the presence of atypical RBC antibodies. • Isoimmunization is identified if atypical antibodies are present. • Follow-up testing is necessary to identify whether the fetus is at risk.

3 Urinalysis & urine culture

Urinalysis	Assessment of proteinuria, ketones, glucose, leukocytes, and bacteria is important to screen for underlying renal disease, diabetes, and infection.
Urine culture	Assessment of proteinuria, ketones, glucose, leukocytes, and bacteria is important to screen for underlying renal disease, diabetes, and infection.

The Initial Prenatal Visit

4 Rubella immunity

- Rubella IgG testing is performed unless the pt is known to be immune by previous serologic testing.
- If nonimmune, the patient should be counseled to avoid exposure to individuals with rubella and receive postpartum immunization. The rubella vaccine is a live vaccine and thus C.I. during pregnancy.
- Avoid pregnancy for 3 months following vaccination.

5 Screening for STIs & bloodborne pathogens

HIV	• Medical organizations generally support universal HIV testing of pregnant patients early in each pregnancy using an **"opt-out" approach**, where a patient is tested unless she refuses. Retesting should take place in the third trimester in areas of high HIV prevalence or an at-risk patient.
	• **HIV tests:**
	  ○ **ELISA (screening test):** assesses presence of detectable HIV antibodies. A three-month lag exists between HIV infection and a positive ELISA test. All babies born to HIV-positive women will be HIV-antibody positive from passive maternal antibodies.
	  ○ **Western blot test (definitive test):** identifies the presence of HIV core and envelope antigens. Triple antiviral therapy is recommended for all HIV-positive women starting at 14 weeks and continuing through delivery. With cesarean delivery and triple antiviral therapy, transmission rates are as low as 1%.

Syphilis	• **VDRL & RPR (non-treponemal screening tests):** for all pregnant women. • **MHA-TP & FTA (treponemal tests):** for women with positive screening tests. • Tx of syphilis in pregnancy requires penicillin to ensure adequate fetal treatment.
Chlamydia & gonorrhea	Cervical cultures for chlamydia and gonorrhea will identify whether the fetus is at risk from delivery through an infected birth canal.
Hepatitis B	• **Anti-HBs:** expected from a successful vaccination. • **HBsAg:** represents either a previous or current infection. ○ Pregnant people who carry HBsAg can transmit HBV to the fetus, typically during birth. Passive and active immunization of the newborn within 12 hours of birth can reduce the risk of HBV transmission by >95%. • **HBeAg:** signifies a highly infectious state.
Hepatitis C	• **Anti-HCV**

Selective screening

- **Thyroid function (TSH):** for pregnant people with S&S of thyroid disease.
- **Testing for T2DM (FPG, A1C, RPG):** for pts at increased risk of diabetes.
- **Cervical cancer screening (pap smear, HPV DNA testing):** for pts due for cervical cancer screening.
- **Screening for latent TB:** for pts with risk factors for TB.

Second & Third Trimesters Visits

Alarm S&S

Pregnant patients should be counseled about S&S that should be reported to their health care provider promptly because of potential serious maternal or fetal consequences. These include:

1. **Vaginal bleeding**
2. **Leakage of fluid per vagina**
3. **Decreased fetal activity**
4. **Abdominal pain**
5. **S&S of preterm labor**
6. **S&S of preeclampsia**
7. **S&S suggestive of a medical or surgical disorder**

Routine ongoing assessments

History

- Assess maternal perception of fetal activity at every visit.
- Review of S&S of potential pregnancy problems at every visit.
- Assess for significant events since the prior visit, such as recent travel, illness, stressors, or exposure to infection.

Physical and laboratory examination

- Measure BP and weight at every visit.
- Document fetal HR at every visit.
- Dipstick the urine to check for protein.
- Assess fetal growth either through measuring fundal height at every visit
- Determine fetal presentation (starting at ≥34 weeks).

Periodic assessments and procedures

Second trimester	**15 to 24 weeks**	• Screen for NTDs and congenital anomalies. • Screen for aneuploidies if not done at an initial visit. • Screen for short cervix by transvaginal ultrasound.

	24 to 28 weeks	• **Screen for gestational diabetes (1-h 50-g OGTT test).**
		  ○ For obese pts, screening should be done at the first visit.
		• Before giving anti-D immunoglobulin to an Rh-negative woman, repeat indirect Coombs test at 28 weeks to ensure she has not become isoimmunized since her previous negative AAT.
		  ○ If it is discovered that the patient already has anti-D antibodies, administration of RhoGAM is futile.
		• Screen for anemia.

Third trimester	**28 to 36 weeks**	• Screen for STIs in pts with increased risk. • US assessment of fetal growth in pregnancies at high risk of IUGR. • Antenatal fetal testing in pregnancies at increased risk of IUF. • Offer ECV at 36 weeks if fetus is noncephalic. • Work with the pt to prepare for labor and the postpartum period.

Aneuploidy Screening & Diagnosis

Screening tests

1. **Serum biochemical marker-based tests**
To screen for trisomy 21 (Down syndrome) and trisomy 18 (Edwards syndrome).

First-trimester (10-13 weeks)	**Combined test**	• Includes US assessment of NT and a maternal serum test of PAPP-A & free-beta HCG. • Best option for pts who want to estimate the risk of Down syndrome early in pregnancy.
Second-trimester (15-20 weeks)	**Triple test**	AFP, estriol, and HCG in maternal serum
	Quadruple test	AFP, estriol, HCG, and inhibin A in maternal serum

2. **Cell free DNA:**
To screen for trisomy 21, trisomy 18, trisomy 13, and sex chromosome aneuploidies.

Findings

Aneuploidy	MS-AFP	Estriol	hCG	Inhibin-A
Trisomy 21	↓	↓	↑	↑
Trisomy 18	↓	↓	↓	↓

Diagnostic tests

- **First trimester:** chorionic villus sampling and karyotype.
- **Second trimester:** amniocentesis and karyotype.

Antenatal Fetal Assessment

Antenatal fetal assessment is indicated in pregnancies in which **the risk of antepartum fetal demise is increased** (eg, IUGR, hypertensive disorders, pregestational diabetes or gestational diabetes treated with medication, sickle cell disease, renal insufficiency, multiple gestation, SLE). There is a whole lecture on this topic; this is just an overview.

Maternal kick counts	• **At 32 weeks** • If the pregnant woman is concerned about the fetal well-being (e.g. decreased fetal movement), she should lay on her side and feel 5 movement in 1 hour, or 10 movement in 2 hours.
Nonstress test	• Performed when there is a concern about the fetus for conditions such as maternal diabetes, hypertension or fetal growth restriction. • Measures the fetal HR, patterns and accelerations by an external transducer for at least 20 min. • Considered reactive if there is at least 2 accelerations over the 20 min period.
Amniotic fluid volume	• Assessed by the **amniotic fluid index**, which is a four-quadrant assessment of amniotic fluid pockets. • Decreased amniotic fluid is secondary to the fetus shunting blood away from the kidneys to the brain which leads to decreased urine output.
Fetal lung maturity	• Done by amniocentesis and checking markers of lung maturity • The respiratory system is the last system to mature functionally, so it is important to assess it in case of preterm delivery.

Nutritional Needs During Pregnancy

Folic acid

- **At least 0.4 mg/day daily to reduce the risk of NTDs.**
- **In high risk women (previous NTD,** DM, antiepileptic med**) → give 4 mg/day**.

Weight

- Recommendations are based on pre-pregnancy BMI (table).

Pre-pregnancy BMI	Estimated weight gain
< 18.5	12-18 kg
18.5 – 24.9	11-15 kg
25 – 29.9	6-11 kg
> 30	5-9 kg

- **Complications associated with excessive weight gain:**
  - Macrosomia
  - Postpartum obesity
- **Complications associated with inadequate weight gain:**
  - Preterm delivery
  - IUGR
  - Low birth weight

Food with specific risks

- **Unpasteurized milk & cold lunch meats** could carry listeriosis which increases the risk of IUFD.
- **Large fish** (tuna, shark, king mackerel) have higher mercury and should be avoided during pregnancy.
- **Herbal remedies** are not regulated, so pregnant women should be advised to consider avoiding them.

Frequently Asked Questions

Can women exercise during pregnancy?

Yes, but any exercise that might carry a risk of falling or abdominal trauma should be avoided. It is also advisable for pregnant women to refrain from starting any new strenuous exercises during pregnancy that they did not engage in before becoming pregnant. Balance exercises as yoga should be avoided.

Can pregnant women have sex?

Yes, except in the presence of abnormal conditions such as placenta previa and PROM.

Can pregnant women travel by airplanes?

Yes up to 36 weeks of pregnancy, but she should wear the seatbelt low on her hip bones. She also should walk every 1-2 hours to to promote circulation (to avoid the risk of DVT).

What teratogens should pregnant women avoid ?

- **Medications** such as ACEIs, coumadin and isotretinoin
- **Ionizing radiation:** limit exposure to the fetus to < 5 rads (gray = rad x 10)
  - **CT scan:** has 3.5 rads for abdomen & pelvis and <1 rad for head
  - **X ray:** has 100-200 milirads for abdomen and 0.02-0.07 milirads for chest

Teaching Case

A 24-year-old woman presents to the office for her routine prenatal visit. She appears anxious. She denies fever, chills, abdominal pain or cramping. She says that she has been urinating more frequently than usual, without pain, and notes fatigue that she attributes to stress at her work. Her last menstrual period was 7 weeks ago, and she typically has 28-day cycles. She has never been pregnant. She tells you that she and her boyfriend plan to marry in the next year. Her medical history is only significant for a hyperthyroid disorder, which she has had for over 10 years. Her last check up was about 6 months ago. She takes methimazole. Otherwise, she has had routine gynecologic follow-up, with normal pap smears, and she has never been diagnosed with a sexually transmitted infection. The patient is 170 pounds (77 kg) and is 5'5" tall (1.65 m). On physical exam, her vital signs include a pulse of 85 and a blood pressure of 115/70. Speculum exam reveals normal-appearing vaginal epithelium and cervix. The cervical os is closed. Bimanual exam reveals a slightly enlarged and globular uterus consistent with a 7-week-sized pregnancy; the adnexae are without masses and tenderness.

Q1: What are the first steps in the assessment of this patient?

- If not confirmed, urine or serum HCG to determine if pregnant.
- Evaluate the early gestation with ultrasound (transabdominal or transvaginal) to determine location of pregnancy, confirm due date and number of embryos. Fetal cardiac activity visualized on ultrasound usually confirms early viability.
- Ultrasound done mainly once in each trimester:
  - 1st trimester for confirming GA
  - 2nd trimester for placental location, fetal anomalies and amniotic fluid assessment
  - 3rd trimester for fetal growth assessment
- GA can be determined from her LMP, and compared to her early ultrasound. Consideration to changing her GA on ultrasound criteria would be:
  - If less than 12 weeks, would use the ultrasound date if off by more than 5 days.
  - If between 12 and 16 weeks, would use the ultrasound date if off by more than 7 days.
- Address her visible anxiety:
  - Related to viability?
  - Related to her medical issues with thyroid disease and medications?
- Help schedule her for follow up with maternal fetal medicine service, as well as an endocrinologist.

Q2: With routine prenatal care, what factors need to be discussed with this patient?

- **Nutrition and weight gain counseling:** recommended weight gain based on pre-pregnancy BMI < 18.5.
- **Sexual activity:** is not restricted during pregnancy, unless conditions such as preterm labor, placenta previa or preterm premature rupture of membranes is present.
- **Exercise:** up to 30 min of moderate exercise per day is encouraged, as permitted by personal tolerance.
- **Travel:** without complication, air travel is generally safe up to 36 weeks. However, prolonged periods of inactivity (sitting) should be avoided.
- **Environmental and work hazards**
- **Tobacco and alcohol use**
- **Substance abuse**
- **Medication use**
- **Intimate partner violence**

Q3: What are the routine laboratory studies collected at the first prenatal visit?

- Blood & Rh typing
- Hepatitis and rubella titers
- Antibody screening
- HIV antibodies screening
- Screening for chlamydia & gonorrhea
- Toxoplasmosis
- Syphilis
- Urine culture
- Consider screening for hemoglobinopathies (with hemoglobin electrophoresis) and cystic fibrosis

Q4: What additional screening tests does she require with her thyroid disease?

- TSH levels
- Free T4 levels

Q5: What additional concerns should be discussed with the patient regarding management of her pregnancy?

- With poorly controlled thyroid disease, there may be increased need for medically indicated preterm delivery.
- Slight increased risks in intrauterine growth restriction and fetal loss, requiring antenatal testing in the third trimester, or sooner with more severe disease.
- Increased risks of fetal heart rate abnormalities.
- Increased risks of preeclampsia.

Q6: What concerns are there for medication use for hyperthyroidism in pregnancy?

- **Propylthiouracil** generally safe in pregnancy, but small amounts cross into breast milk.
- **Methimazole** thought to have increased risk of fetal aplasia cutis (recently refuted), also has higher secretion into breast milk, but generally considered safe.

Q7: How can this patient be followed for fetal well being in the third trimester?

- Initial development can be evaluated with anatomic survey (scheduled in 16-20 weeks).
- Fetal growth can be measured monthly with ultrasound.
- Well-being can be assessed with either non-stress tests (twice a week) or biophysical profiles (once a week).

  → **Biophysical profile** includes:
  - **Fetal movement:** three or more discrete body/limb movements in 30 minutes.
  - **Fetal tone:** one or more episodes of extremity extension/flexion, or open/close of hand.
  - **Fetal breathing movements:** episode of rhythmic fetal breathing for 30 seconds.
  - **Amniotic fluid volume:** pocket of fluid that measures at least 2 cm in 2 perpendicular planes.

441 Doctor's Notes

What are the first steps in the assessment?

1. **History:**

- **Gravidity:** number of pregnancies including the current one.
- **Parity:** number of pregnancies carried out to the age of viability.
- **LMP**: first day of last period. If the patient is not sure, you rely on ultrasound, you do it at as soon as possible; the earlier the better and more accurate. If patient is expecting her period today and she did not get her period and the pregnancy test is +ve then she will be 4 weeks pregnant only.
- **GA**
- **EDD:** obtain the LMP, add 7 days and subtract 3 months then add 1 year (if LMP is at the beginning of the year e.g. January you don't need to add 1 year).
- **History of current pregnancy**
- **Past obstetric history**: mode of delivery, complications during or after the pregnancy (e.g. fever or hemorrhage), baby condition and weight, abortions and evacuation.

1. **Physical examination:**

- **General examination and vital signs**
- **Weight:** depends on previous pregnancies but the average is 10-12 kg. Obese women tend to gain less whether thin women tend to gain less.
- **Obstetric examination:** fundal height (Leopold's maneuver)
  - Above symphysis pubis = 13 weeks
  - Halfway between the pubic bone and the umbilicus = 15-16 weeks
  - At the umbilicus = 22 weeks
  - After 22 weeks, fundal height often matches the number of weeks of pregnancy (1 cm = 1 week)

1. **Investigations:**

- **Beta-HCG**
  - What's the difference between serum HCG and urine HCG? Both can detect the beta-HCG level but the serum is more accurate as it can detect beta HCG earlier; it detects beta-HCG even before the missed period (1 week after implantation you can detect it in the serum). While urine HCG test can detect it at the time of the missed period, it's also pretty accurate (in case of a patient coming because of a missing period you can already detect the beta HCG level accurately in the urine and you don't need to wait). Serum level can give you **quantitative** information while urine only qualitative, serum can measure how many international unit of beta-HCG are there (level of HCG) and this is important if we're following up with a patient (e.g. if this patient started to bleed and you don't know if she's going to abort or not, not sure whether it's ectopic pregnancy or normal pregnancy) so you need to use serum beta HCG.
  - In how many days does the HCG serum level double in normal pregnancy (in repeated test)? Doubles every 48 hours, if it didn't double then there might be an abnormality such as abortion.

- **Ultrasound**
  - What do you measure in early pregnancy ultrasound? We measure the **CRL** = crown-rump length (at 6 weeks until 12 weeks), it's the most accurate in early pregnancy and it give you the (location; intra or extrauterine, viability and pulsation, number of embryos and the gestational age). The most accurate time to do ultrasound is at the 6^{th} week because at the 4^{th} week there is nothing and at the 5^{th} week there is only the gestational sac.
  - How many times we do ultrasound in pregnancy?
    - **In first trimester**: for GA.
    - **In weeks 11-13**: assessing the nuchal translucency to helps assess the risk for Down syndrome.
    - **In second trimester (weeks 18-22)**: for fetal anatomy, anomalies, biometry (measure the baseline for further measurements), location of placenta (low lying placenta, if after 24 wks placenta previa).
    - **In third trimester**: for fetal growth for high risk patients of IUGR.

441 Doctor's Notes

3. Investigations (continued)

- **Urine**
  - **Culture:** for asymptomatic bacteriuria to prevent pyelonephritis.
  - **Analysis:** protein and glucose.

- **Blood**
  - CBC (Hb, platelets, leukocytosis)
  - Thyroid
  - GTT (diagnostic test): we do it in early in pregnancy, if negative, we repeat it at 24-28 week (it will be the maximal amount of glucose increase)
  - Rh isoimmunization:
    - If patient is 7 weeks pregnant and she's Rh -ve do you give her anti D immunoglobulin? No, we have to check the father blood group, if the father is also -ve you don't have to worry, if the father is +ve and the mother is -ve then in this case we do give anti D immunoglobulin in 3rd trimester- around 28-30 weeks- and we give it again after birth, the highest risk of fetal blood transmission to the mother is during delivery (Note: we don't do fetal blood sampling cause it's invasive, you can check the blood group after delivery, if baby is +ve then we give anti D to the mother).
    - What additional test that you would do before giving anti D? Coombs' test, to know if there's any antibodies (made by the mother) that had been transferred by the placenta to her baby.
  - Hepatitis:
    - What hepatitis you well screen for in a pregnant woman? Hepatitis B = screen for surface antigen / Hepatitis C = screen for antibodies
  - Rubella
    - What do we check for Rubella? Antibodies IgG (immunity or past infection) if patient negative for IgG we give her vaccination after delivery because it's live attenuated vaccine and **advise her to use contraception for 3 months after taking the vaccination.** We don't do IgM since it indicates recent infection, we don't need it because if she has it now she will already show symptoms (e.g. fever, rash etc..) so no need to do it if she's asymptomatic.
  - HIV:
    - What do we check in HIV? Antibodies for HIV.
  - Syphilis:
    - What do you check for syphilis? RPR/VRDL (screening test) **or** do straight away syphilis Abs.
  - Toxoplasmosis: What do you check for toxoplasmosis? We need to do both IgG and IgM, because the mother can still has the infection while being asymptomatic (silent infection). **+ve IgM = increase risk of fetal Intracranial calcification**

4. Management:

- **Nutrition:**
  - Patient should avoid unpasteurized milk products & undercooked meat (risk of toxoplasmosis and brucellosis), avoid tuna and other fish products that have high level of mercury, and avoid smoking and alcohol. In general she should follow a healthy diet (that contains everything such as carbs-proteins-fat etc..) and avoid reducing weight during pregnancy.
  - In addition, patient should take 0.4-0.5 mg **folic acid** daily to prevent NTD, if she doesn't have history of NTD (it's recommended to start folic acid 3 months before pregnancy and continue for the first 3 months) and at the 2nd trimester (around week 13) we will advice patient to take prenatal **vitamins** which are multivitamins plus iron and calcium. Patient who don't drink enough milk (at least 4 cups of milk a day) will be advised to take extra calcium supplements to avoid osteoporosis/osteopenia especially if there are multiple pregnancy before (multivitamins doesn't contain enough calcium). If patient is anemic then will be advised to take extra iron supplements.
  - Don't take iron and calcium supplements together there should be at least 4 hours period between them. Avoid drinking tea with iron.
  - Multivitamins has vit A and it's teratogenic that's why we don't give prenatal vitamins in the 1st trimester even though it has only a small amount of vit A. Best to avoid any drugs at the first trimester.

4. Management (continued)

- **Sexual activities:**
  - In early pregnancy (e.g. 7th week) if there's vaginal bleeding = threatened abortion, we advise to avoid intercourse until bleeding is settled
  - In advanced pregnancy (e.g. 28th week) if patient has history of preterm labor we won't tell her to avoid intercourse completely, it depends on her history if she said having intercourse induce abdominal pain and contraction then we will tell her to avoid it otherwise she can have intercourse
  - If she has PROM premature rupture of membrane, we will tell her to avoid it because it can introduce infections.
  - Placenta previa

- **Exercise:** avoid exercise that might carry risk of fall (balance exercise e.g. yoga) or abdominal wall trauma (e.g. kickboxing)

- **Travel**
  - Most airlines allow travel up to 36 weeks and not more than that because of risk of delivery on board (that's only if she doesn't have any complication), if she has threatened preterm labor or vaginal bleeding then the doctor her/himself should not allow travel.
  - + Risk of DVT: patients need to move around. Take low dose aspirin before the trip, move her legs even while sitting and drink a lot of fluids.

5. Follow-up

- **Routine:** every 4 weeks until 28 weeks THEN every 2 weeks until 36 weeks THEN every week until delivery.
- If she's at low risk we might increase the spacing between the visits due to busy clinics.

6. Fetal wellbeing

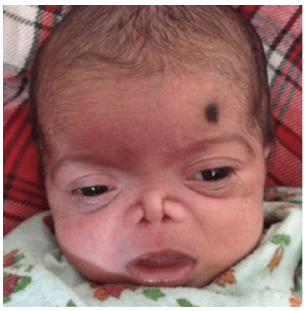
- **Fetal movement:** we tell the patient to lie on her side and count 5 movements in 1 hour or 10 movements in 2 hours), if it's less then it's not normal and need to do CTG. If CTG is not normal then you can do **biophysical profile** (done by ultrasound to check fetal movement, fetal tone, AFV, fetal breathing).

- **Doppler** (for the umbilical artery) for high-risk patients:
  - Pulsatility index
  - Resistance index
  - Reverse end diastolic flow

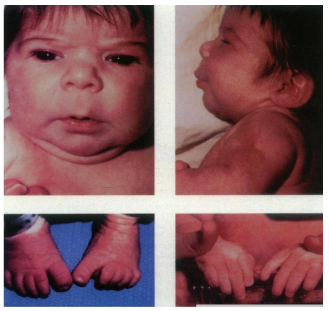
Female Students Presentation

Adverse effects of drugs and the environment on pregnancy:

- **Cocaine**: associated with genitourinary tract anomalies, and behavioral abnormalities.
- **Infectious agents**: can lead to fetal death, growth delay, congenital malformations, and mental deficiency.
- **Radiation**: can lead to teratogenesis, mutagenesis, and carcinogenesis.
- **Tobacco smoking:** maternal tobacco smoking interferes with prenatal growth, including birth weight, birth length, and head circumference.
- **Warfarin (anticoagulant): during the first trimester is associated with:**
  - Spontaneous abortion
  - IUGR
  - Central nervous system
  - Defects (including mental retardation)
  - Stillbirth
  - Fetal warfarin syndrome
- **Phenytoin (anti-epileptic):**
  - Fetal hydantoin syndrome
- **Valproic acid (anti-epileptic):**
  - Can lead to open spina bifida
- **Androgenic progestins:**
  - Can lead to masculinization of the external genitalia in female fetuses



fetal warfarin syndrome



hydantoin syndrome

Risk factors for pregnancy complications:

- **Infection:**
  - Listeria, or Toxoplasma should be specifically sought in women with recurrent abortions because despite being found infrequently, they are all treatable with antibiotics
- **Psychosocial stress:**
  - Domestic violence and other forms of stress are associated with a greater risk of pregnancy complications such as spontaneous abortion, preterm birth, and low birth weight.
- **Maternal age:**
  - The probable explanation is the increased incidence of chromosomally abnormal fetuses in older women.
- **Placental Factors:**
  - Women with obesity during pregnancy have a greater risk of developing leptin (a placental peptide) resistance that leads to a greater risk of fetal IUGR.
- **Immunologic Factors:**
  - The innate immune system is activated in early pregnancy with the production of specific cytokines that prevent early rejection of the fetus. Subsequently during the second half of pregnancy the adaptive portion of the immune system is activated to downregulate the innate immune system to support the developing fetus.

Reference

CHAPTER 7

Antepartum Care

Preconception and Prenatal Care, Genetic Evaluation and Teratology, and Antenatal Fetal Assessment

CALVIN J. HOBEL • JOHN WILLIAMS III

CLINICAL KEYS FOR THIS CHAPTER

- Adequate prenatal care, including nutritional counseling, is essential for obtaining the best pregnancy outcomes. Early pregnancy complications, secondary to factors related to the mother, her fetus, or the placenta, occur in some pregnancies. Early recognition and management of these problems is vital for the success of the pregnancy. During follow-up visits, it is important to reassure women that their pregnancy is progressing normally or initiate appropriate testing when necessary.
- Traditionally, women older than 34 years of age have been advised to have prenatal testing because they are at increased age-related risk for having offspring with chromosomal and genetic abnormalities and the risk of the more invasive techniques is less than the risk of finding abnormalities. Recently, microarray comparative genomic hybridization (microarray-CGH) has been introduced into clinical practice. There are many submicroscopic chromosomal abnormalities that can now be detected with microarray-CGH that are not maternal age-related. Current guidelines therefore recommend that prenatal diagnostic testing with amniocentesis or chorionic villus sampling (CVS) be offered to all pregnant women regardless of their age.
- A number of noninvasive tests are available for screening for fetal chromosomal abnormalities. These include second-trimester maternal serum screening (Quad-Screen), which offers a trisomy 21 detection rate of 81%; first-trimester serum screening combined with ultrasonic measurement of nuchal translucency and visualization of nasal bone, which has a Down syndrome detection rate of 93%, and integrated first- and second-trimester screening, which increases the detection rate to 95%. Recently, noninvasive prenatal testing (NIPT) using cell-free fetal DNA from maternal plasma has been introduced. This less invasive type of prenatal testing has been reported to have a detection rate of ≥99% for trisomy 21 and trisomy 18. False positive rates for these screening tests have been reported and they should not be considered diagnostic. CVS or amniocentesis is required for confirmation (see Chapter 17).
- Evaluation of fetal well-being during pregnancy starts with the mother's "kick count." When <10 fetal movements are detected in 1 hour on two separate occasions, nonstress testing (NST) and ultrasonic assessment should be performed. When the amniotic fluid index (AFI), determined by ultrasonic measurement, is combined with fetal movements, an NST, and evaluation of fetal tone, the assessment is referred to as a biophysical profile. These techniques have largely replaced the contraction stress test for antenatal fetal assessment.

Prenatal Care

The three basic components of prenatal care are (1) early and continuing risk assessment, (2) health promotion, and (3) medical and psychosocial interventions and follow-up. Risk assessment includes a complete history, a physical examination, laboratory tests, and assessment of gestational age and well-being of the mother and her fetus(es). Health promotion consists of providing information on proposed care, enhancing general knowledge of pregnancy and parenting, and boosting and supporting healthful behaviors. Interventions include the management and treatment of any existing illness, provision of social and financial resources if required, and referral to and consultation with other specialized providers.

THE FIRST PRENATAL VISIT

The first prenatal visit provides an opportunity to review medical, reproductive, family, genetic, nutritional, and psychosocial histories. Women whose health may be seriously jeopardized by the pregnancy, such as those with Eisenmenger syndrome or a history of peripartum cardiomyopathy, should be counseled about the option of terminating the pregnancy. Reproductive histories that include preterm birth, low birth weight, preeclampsia, stillbirth, congenital anomalies, and gestational diabetes are important to record because of the substantial risk of recurrence. Women with prior cesarean delivery should be asked about the circumstances of the delivery, and discussion about options for the mode of delivery for the current pregnancy should be initiated. Additionally, **the importance of screening women for domestic violence cannot be overemphasized.** As many as 8% of pregnant women are physically abused during pregnancy, making domestic violence more common than preeclampsia, diabetes, HIGH, and placenta previa.

Standardized forms have been developed to facilitate overall prenatal risk assessment and this technology has been incorporated into electronic health records at some institutions. **A complete physical examination should be performed including assessment of the patient's body mass index (BMI).** A woman's BMI can increase between pregnancies by 20-30% because of excessive weight gain in the first pregnancy. Clinicians should be familiar with physical findings associated with normal pregnancy, such as systolic murmurs, exaggerated splitting and S_3 during cardiac auscultation, or spider angiomata, palmar erythema, linea nigra, and striae gravidarum on inspection of the skin. During the breast examination, clinicians should **initiate discussion about breast-feeding.** A pelvic examination should be performed, and the appearance and length of the cervix and the status of the last **Papanicolaou (Pap) smear should be documented, or a new Pap smear obtained.**

Prenatal laboratory testing should be undertaken as outlined in Table 7-1 if not done during preconception care. Screening for, and treatment of asymptomatic bacteriuria significantly reduces the risk of pyelonephritis and preterm delivery.

Women who are Rh-negative should receive Rh_o(D) immune globulin (Rh_o-GAM) at 28 weeks' gestation and postpartum, and at any point of care when sensitization may occur (e.g., threatened abortion or invasive procedures such as amniocentesis and chorionic villus sampling (CVS)). **Rubella vaccination is contraindicated during pregnancy,** and pregnant women who are found to be seronegative should be vaccinated immediately postpartum. **Testing for syphilis is mandated by law in virtually all states.** Early diagnosis and treatment of syphilis can reduce perinatal morbidity. Women who test negative for **hepatitis B surface antigen** and are at high risk for hepatitis B infection (e.g., health care workers) are candidates for vaccination before and during pregnancy. Infants born to women who test positive for hepatitis B surface antigen should receive both hepatitis B immune globulins (HBIG) and hepatitis B vaccine within 12 hours of birth, followed by two more injections of hepatitis B vaccine in the first 6 months of life. With the increasing incidence of whooping cough (pertussis) and serious complications in young children, secondary vaccination with Tdap (tetanus, diphtheria and acellular pertussis) vaccine should be given, ideally between 27 and 36 weeks of pregnancy.

Voluntary and confidential **human immunodeficiency virus (HIV) counseling and testing** should be offered and documented in the medical record. Diagnosis and treatment significantly reduce the risk of vertical transmission. Other tests such as screening for sexually transmitted infections (STIs) like **gonorrhea and chlamydia are generally considered routine.** All pregnant women at high risk for **tuberculosis** (TB) should be screened with a purified protein derivative (PPD) skin test when they begin prenatal care. For women who have received BCG (bacillus Calmette-Guérin) immunization (which can cause a positive test in the absence of TB), a blood test is available called the Interferon Gamma Release Assay (IGRA). A positive test implies that the person has been infected with TB bacteria. HIV and other perinatal (TORCH) infections are also discussed in Chapter 22.

Additionally, the clinician should use the first prenatal visit to confirm pregnancy and determine viability, estimate gestational age and due date, diagnose and deal with early pregnancy loss, provide genetic counseling and information about teratology, and provide advice on gluten-sensitive enteropathy symptoms during pregnancy. Information about nutrition, behavioral changes to expect, and the benefits of breastfeeding should be provided as prenatal care progresses. **Clinical pelvimetry should be performed sometime before labor begins** (see Chapter 8).

Confirming Pregnancy and Determining Viability

About 30-40% of all pregnant women will have some bleeding during early pregnancy (e.g., **implantation bleeding**), which may be mistaken for a period. Therefore, a pregnancy test should be performed in all women of reproductive age who present with abnormal vaginal bleeding.

The pregnancy test detects human chorionic gonadotropin (hCG) in the serum or the urine. The most widely used standard is the First International Reference Preparation (1st IRP). The hCG molecule is first detectable in serum 6 to 8 days after ovulation. A titer of less than 5 IU/L is considered negative, and a level above 25 IU/L is a positive result. Values between 6 and 24 IU/L are considered equivocal, and the test should be repeated in 2 days. A concentration of about 100 IU/L is reached about the date of expected menses. Most qualitative urine pregnancy tests can detect hCG above 25 IU/L.

It is important to differentiate a normal pregnancy from a nonviable or ectopic gestation. In the first 30 days of a normal gestation, the level of hCG doubles every 2.2 days. In patients whose pregnancies are destined to abort, the level of hCG rises more slowly, plateaus, or declines.

The use of transvaginal ultrasonography has improved the accuracy of predicting viability in early pregnancies. Using transvaginal ultrasonography, the gestational sac should be seen at 5 weeks' gestation or a mean hCG level of about 1500 IU/L (1st IRP). The fetal pole should be seen at 6 weeks or a mean hCG level of about 5200 IU/L. Fetal cardiac motion should be seen between 6 and 7 weeks or a mean hCG level of about 17,500 IU/L. **The presence of a gestational sac of 8 mm (mean sac diameter) without a demonstrable yolk sac, 16 mm without a demonstrable embryo, or the absence of fetal cardiac motion in an embryo with a crown-rump length of greater than 5 mm indicates probable embryonic demise.** When there is any doubt about these measurements, it is best to repeat the evaluation in 1 week before terminating the pregnancy. Using pulse wave Doppler of the heart to determine heart rate is not recommended.

Many of the **congenital abnormalities of the uterus** can now be diagnosed using pelvic ultrasonography and may no longer require laparotomy for repair. **Cervical incompetence** is managed by the placement of a cervical suture (cerclage) at the level of the internal os; this suture is best placed in the first trimester, once a live fetus has been demonstrated on ultrasonography. **The effectiveness of prophylactic cervical cerclage in preventing recurrent loss from cervical incompetence has not been conclusively established** (see Chapter 17).

Estimating Gestational Age and Date of Confinement

Gestational age should be determined during the first prenatal visit. Accurate determination of gestational age may become important later in pregnancy for the management of obstetric conditions such as preterm labor, IUGR, and postdate pregnancy. Clinical assessment to determine gestational age is usually appropriate for the woman with regular menstrual cycles and a known last menstrual period that was confirmed by an early examination. Estimated date of confinement (EDC) or "due date" may be determined by adding 9 months and 7 days to the first day of the last menstrual period.

Ultrasonography may also be used to estimate gestational age. Measurement of **fetal crown-rump length between 6 and 11 weeks' gestation** can define gestational age to within 7 days. At 12 to 20 weeks, gestational age can be determined within 10 days by the average of multiple measurements (e.g., biparietal diameter, femur length, abdominal and head circumferences). Thereafter, measurements become less reliable with advancing gestation (≥3 weeks in the third trimester).

Patients Who Require Genetic Counseling

Ideally, couples should receive preconception counseling before they decide to have children, so that genetic disease in the couple or their families may be identified. Traditionally, the major reason couples have been referred for prenatal diagnosis is advanced maternal age. However, **current clinical guidelines recommend that genetic counseling and invasive prenatal diagnostic testing for chromosomal abnormalities be offered to all couples regardless of maternal age.** A woman's choice of whether to have a diagnostic test or a screening test is based on many factors, including the risk that the fetus will be affected with a chromosomal abnormality, the risk of miscarriage from an invasive procedure, and the perceived burden of having an affected child. Women's concerns and preferences vary based on their personal beliefs. Therefore, the decision to offer prenatal screening and diagnosis should no longer be based on maternal age alone.

Additional indications for genetic counseling and prenatal diagnosis are listed in Box 7-1.

BOX 7-1

INDICATIONS FOR GENETIC COUNSELING AND PRENATAL DIAGNOSIS OTHER THAN AGE

1. A previous child with or a family history of birth defects, chromosomal abnormality, or known genetic disorder
2. A previous child with undiagnosed mental retardation
3. A previous baby who died in the neonatal period
4. Multiple fetal losses
5. Abnormal serum marker screening results
6. Consanguinity
7. Maternal conditions predisposing the fetus to congenital abnormalities
8. A current pregnancy history of teratogenic exposure
9. A fetus with suspected abnormal ultrasonic findings
10. A parent who is a known carrier of a genetic disorder

CONGENITAL AND HEREDITARY DISORDERS

Chromosomal Disorders

Chromosomal abnormalities occur in 0.5% of live births, but the incidence associated with spontaneous abortions is much higher and is estimated to be approximately 50%. The most common chromosomal abnormalities among live births are sex chromosomal aneuploidies (e.g., Turner syndrome [45,X], Klinefelter syndrome [47,XXY]), balanced Robertsonian translocations (translocations within group D or between groups D and G), and autosomal trisomies (e.g., Down syndrome; Figure 7-1).

Women older than 34 years are at increased risk of giving birth to children with autosomal trisomies (e.g., trisomy 21, 13, or 18) or sex chromosomal abnormalities (e.g., triple X syndrome, Klinefelter syndrome). The overall risk of Down syndrome (trisomy 21) is 1 per 800 live births. It increases to about 1 per 300 live births for women who are 35 to 39 years of age and to about 1 in 80 for those 40 to 45 years of age. The incidence of Down syndrome diagnosed at the time of CVS or amniocentesis is considerably higher. In women 35 to 39 years of age, the rate is about 1 in 125; in those 40 to 45, it is about 1 in 20. The discrepancy between the rate of occurrence at delivery and that at prenatal diagnosis is believed to be due in part to fetal loss in the second and third trimester.

Ninety-five percent of cases of Down syndrome are due to meiotic nondisjunctional events leading to 47 chromosomes with an extra copy of chromosome number 21, whereas 4% are due to an unbalanced translocation. Parents of a child with translocation

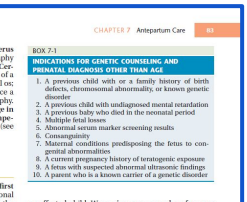


FIGURE 7-1 Karyotype of a patient with Down syndrome (47,XX + 21).

Down syndrome have rearrangements between chromosome 21 and chromosomes 14, 15, 21, or 22. The remaining 1% of individuals with Down syndrome have the mosaic type, which consists of two populations of cells, one with 46 and one with 47 chromosomes.

A couple who has previously had a child with trisomy 21 (Down syndrome) or with a meiotic nondisjunctional type of chromosomal abnormality is believed to be at a small but definite increased risk (about 1%) of giving birth to another child with a chromosomal abnormality and should be referred for prenatal diagnosis.

Approximately 1 in 500 individuals carries a balanced structural chromosomal rearrangement such as a translocation or inversion. Blood chromosomal studies should be performed on a couple after three or more spontaneous abortions because in approximately 3-5% of such couples, one member is a carrier of a balanced rearrangement. The recurrence risk for spontaneous abortions, abnormal offspring, or both is greatly increased among translocation carriers, and it can be estimated according to the type of translocation and which parent carries the translocation. For example, if the mother carries a balanced 14; 21 Robertsonian translocation, the risk for a child with an unbalanced translocation resulting in Down syndrome is 10-15%. However, if the father carries the translocation, the risk for an affected child is 2-3%. These couples should be alerted to the advisability of prenatal diagnosis because of their increased risk for having live born children with unbalanced translocations.

Using fluorescence in situ hybridization (FISH), a labeled chromosome-specific DNA segment or probe is hybridized to metaphase, prophase, or interphase chromosomes and visualized with fluorescent microscopy. FISH analysis has led to the identification of a number of genetic syndromes that could not previously be detected because the chromosomal deletion in these syndromes is beyond the resolution of banded chromosomal analysis. Syndromes that can be identified by FISH analysis include Prader-Willi, Angelman, DiGeorge, and Williams syndromes. Trisomies can also be identified in interphase cells with FISH probes.

Recently, microarray comparative genomic hybridization (microarray-CGH) has been introduced into clinical use. Microarray-CGH is a laboratory technique that quickly scans through the entire genome. With this technique, the patient's DNA and DNA from a normal control are labeled with fluorescent dyes and applied to a microarray chip with oligonucleotide probes. A microarray scanner then measures the fluorescent signals to detect a gain or loss of patient DNA. Microarray-CGH can detect all unbalanced chromosomal abnormalities, including trisomies that are visible with light microscopy, as well as minute chromosomal alterations (microdeletions and microduplications), also known as copy number variants (CNV) as small as 200 kb. In comparison, deletions and duplications smaller than 5 mb are not visible under standard light microscopy used in karyotyping. It has been shown that 10-15% of children with normal karyotypes who have intellectual disability, autism spectrum disorder, behavioral disorders, or congenital anomalies also have a significant CNV. **In a recent blinded comparison between standard karyotyping and microarray-CGH in women undergoing prenatal diagnosis with CVS or amniocentesis, 1.7% of pregnancies with a normal karyotype and normal ultrasonic findings had a significant CNV.** In the future, microarray-CGH may replace standard karyotype in prenatal diagnosis testing.

Single Gene Disorders

Single gene disorders are relatively uncommon. They follow the laws of mendelian inheritance, and may be passed from generation to generation, as with autosomal dominant disorders, or affect siblings without any family history, as in autosomal recessive disorders. Males may be affected as a result of healthy females transmitting the abnormal gene, as in X-linked recessive disorders.

Autosomal Dominant Disorders

In autosomal dominant disorders, only one abnormal gene is necessary for disease manifestation. The affected individual has a 50% chance of passing the gene and the disorder on to offspring. The unaffected offspring cannot pass on the gene or the disorder. The occurrence and transmission of the genes are not influenced by gender. A spontaneous mutation of genetic material in the germ cells of clinically normal parents can also result in an affected offspring.

The hallmark of autosomal dominant disease is the variable expressivity. It is important to determine whether a child is affected by a spontaneous mutation or is the product of a parent with minimal expression of the same gene. A careful history and physical examination of family members, in addition to biochemical, radiologic, or histologic testing, may be necessary to determine the parents' genetic status.

Some of the common autosomal dominant disorders include tuberous sclerosis, neurofibromatosis, achondroplasia, craniofacial synostosis, adult-onset polycystic kidney disease, and several types of muscular dystrophy.

Autosomal Recessive Disorders

With autosomal recessive disorders, two affected genes must be present for manifestation of the disease. Usually there is no family history, but if a family history exists, siblings of either sex are equally likely to be affected. Consanguineous couples are at an increased risk for having a child who is homozygous for a deleterious recessive gene, with subsequent pregnancies being at 25% risk for producing a similarly affected child.

The majority of autosomal recessive disorders (e.g., Tay-Sachs disease, sickle cell disorders, alpha- and beta-thalassemia, cystic fibrosis, and spinomuscular atrophy, etc.) can be diagnosed prenatally by DNA analysis from amniocytes or chorionic villus cells.

GENETIC SCREENING FOR AUTOSOMAL RECESSIVE DISORDERS

Carrier screening programs for autosomal recessive disorders have traditionally focused on high-risk populations, in which the frequency of heterozygosity is greater than in the general population. Screening for Tay-Sachs disease among Eastern European Jewish and French Canadian populations has proved to be particularly successful in the recognition of couples at 25% risk for having offspring affected with this fatal disease. Table 7-2 lists selected autosomal recessive disorders for which genetic screening has been initiated.

The most common gene carried by North Americans is the cystic fibrosis (CF) gene (carrier frequency, 1/25). With the use of recombinant DNA technology, the CF gene has been mapped to chromosome 7, and a gene deletion (AF508) has been found in approximately 70% of cases; more than 1500 mutations have been identified in the CF gene. Genetic counseling is essential in offering CF carrier detection because 15% of carriers (and maybe more depending on ethnic group) remain undetected, and the limitations of the testing must be explained. At present, it is recommended that carrier detection for CF be offered to all pregnant women. Individuals with a family history of CF, partners of identified CF carriers, parents of a fetus with ultrasonic findings of an echogenic bowel, and those who donate sperm should be encouraged to undergo carrier testing.

TABLE 7-2

SELECTED AUTOSOMAL RECESSIVE DISEASES IN DEFINED ETHNIC GROUPS

Disease	Ethnic Group	Carrier Frequency
Sickle cell disease	Blacks	1/10
Cystic fibrosis	Whites	1/25
Tay-Sachs disease	Jews, French Canadians	1/30
Thalassemia	Mediterraneans, Southeast Asians	1/25

Sex-Linked Disorders

Sex-linked disorders, caused by recessive genes located on the X chromosome, primarily affect males, whereas unaffected (or mildly affected) females carry the deleterious gene. There is no male-to-male transmission of X-linked disorders. Using gene mapping technology, many sex-linked disorders such as Duchenne muscular dystrophy (DMD) or fragile X syndrome can now be diagnosed by CVS or amniocentesis. X-linked disorders can occur because of new mutations of genetic material as a sporadic event, or from the inheritance of the X-linked recessive gene from the carrier mother.

Fragile X syndrome is an X-linked disorder that is the second most common cause of developmental delay after Down syndrome, and the most common form of inherited cognitive delay. It has an incidence of 1 per 1000 males and 1 per 2500 females. Mental impairment is variable in heterozygous females. The fragile X syndrome is caused by triplet repeat expansion in the long arm of the X chromosome. Using molecular genetic techniques, the number of triplet repeats can be measured in affected individuals to confirm a suspected diagnosis of fragile X or fragile X carrier status. In women who have a family history of developmental delay, genetic counseling is recommended for consideration of fragile X testing in the patient or family member.

Multifactorial Disorders

Many birth defects are inherited in a multifactorial fashion, which means that both genes and the environment play a role. Common multifactorial disorders include cleft lip or palate, neural tube defects (spina bifida or anencephaly), congenital heart defects, and pyloric stenosis.

Neural tube defects occur in about 1 per 1000 births in the United States. In Northern Ireland, Wales, and Scotland, the incidence of neural tube defects is 6 to 8 per 1000 births. Both anencephaly (congenital absence of the forebrain) and spina bifida (open spine)

are believed to occur before 30 days' gestation because of failure of the neural tube to close. Newborns with anencephaly are stillborn or die within the first few days of life. Newborns with spina bifida have a variable course, depending on the site of the lesion and whether it is a meningocele (herniation of the meninges through an open spinal defect with cord remaining in its usual position) or a myelocele (herniation of the spinal cord). Folic acid has been shown to lower the risk of neural tube defects, and women who have had an infant with a neural tube defect should take vitamins plus **4 mg of folic acid daily before conception. Because neural tube closure is complete by 28 days post-conception, initiating folic acid after the first 28 days has no prophylactic value.**

With multifactorial disorders in general and with neural tube defects in particular, a couple who has had one affected child has an increased risk of approximately 3% of having another similarly affected child.

Maternal Ultrasonic and Serum Marker Screening

There are multiple approaches available for maternal screening for fetal aneuploidy. Traditionally, second-trimester screening has been the standard approach. First-trimester aneuploidy screening was introduced in the late 1990s. **First- and second-trimester screening for aneuploidy using cell-free fetal DNA obtained from maternal plasma was introduced in 2012.**

FIRST-TRIMESTER SCREENING

A combination of maternal age, fetal nuchal translucency (NT) thickness and maternal serum-free β-human chorionic gonadotropin (β-hCG) and pregnancy-associated plasma protein-A (PAPP-A) are included in the first-trimester screen. Maternal age alone has only a 30% detection rate. In the early 1990s an association was reported between fetal chromosomal abnormalities and the finding of an abnormally increased nuchal translucency (an echo-free area at the back of the fetal neck) between 10 and 14 weeks' gestational age (Figure 7-2). Increased nuchal translucency has been associated with both chromosomal abnormalities and other congenital anomalies. **Elevated levels of free β-hCG and low levels of plasma protein-A are associated with an increased risk for Down syndrome.** A multicenter study in the United States reported that combining first-trimester maternal serum screening markers with nuchal translucency and maternal age showed a detection rate for Down syndrome of 79%, with a positive screening rate of 5%. Anatomic and radiographic studies have shown absence or hypoplasia of the nasal bones in fetuses with Down syndrome. **Visualization of the nasal bone on first-trimester ultrasound has been shown to reduce the risk for Down syndrome, whereas nonvisualization (absence) has been associated with an increased risk.** The addition of nasal bone assessment to nuchal lucency measurement and serum biochemistry can increase the Down syndrome detection rate to 93% with a screening rate of 5%.

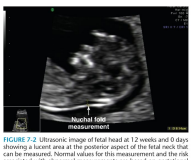


FIGURE 7-2 Ultrasonic image of fetal head at 12 weeks and 0 days showing a lucent area at the posterior aspect of the fetal neck that can be measured. Normal values for this measurement and the risk associated with abnormal measurements are based on gestational age as determined by crown-rump length.

SECOND-TRIMESTER SCREENING

Traditionally, a woman was offered the serum triple screening test that measures α-fetoprotein (AFP), hCG, and unconjugated estriol (UE3) at 16 to 20 weeks' gestation. Amniotic fluid AFP levels are frequently elevated in blood samples of women carrying fetuses affected with neural tube defects. Approximately 80-85% of all open neural tube defects can be detected by maternal serum AFP (MSAFP). In addition to open neural tube defects, ventral wall defects (gastroschisis or omphalocele) can cause elevations of MSAFP.

If the MSAFP level is elevated, an ultrasound should be done to rule out multiple gestation, fetal demise, or inaccurate gestational age (all of which can give false-positive results). **If none of these factors are present, amniocentesis is recommended to determine the amniotic fluid AFP level and to measure acetylcholinesterase** (AChE). Acetylcholinesterase is a protein that is present only if there is an open neural tube defect.

An association between low maternal serum AFP and Down syndrome has been noted. The combination of low MSAFP, elevated hCG, and low UE3 levels (triple screen) has a detection rate for Down syndrome of approximately 70%, with a positive screen result in approximately 5% of all pregnancies. Low MSAFP, low hCG, and low UE3 levels can also be used to screen for trisomy 18. With the addition of inhibin-A (increased with Down syndrome), the quadruple screen increases the Down syndrome detection rate to 81% with a positive screen result in 5% of pregnancies.

COMBINED FIRST- AND SECOND-TRIMESTER SCREENING

In an attempt to improve the detection rate and minimize the screen positive rate and the number of invasive procedures, a few studies have been conducted to evaluate the concept of combining first- and second-trimester screening. **The approaches that have been proposed include integrated screening and sequential screening.**

INTEGRATED SCREENING. With integrated screening, the first- and second-trimester results are combined into a single risk calculation, and one report issued after the second-trimester results are available. This approach has been found to have the highest sensitivity and to be the most cost effective.

SEQUENTIAL SCREENING. This involves performance of both first- and second-trimester screening, with disclosure of the first-trimester results for clinical management.

It is not uncommon for one or more of the biomarkers to be abnormal in the presence of a chromosomally normal fetus. An elevated level of β-hCG or AFP and low levels of PAPP-A or estriol (UE3) are associated with complications of pregnancy such as preterm birth, IUGR, and preeclampsia. Thus, these pregnancies require close follow up.

Noninvasive prenatal testing (NIPT) using cell-free fetal DNA from maternal plasma: The quest to develop an early definitive prenatal diagnostic test that is noninvasive has been ongoing for more than 40 years. Initial efforts for noninvasive prenatal diagnosis were directed at isolation of intact fetal cells from maternal blood, which can be achieved as early as 10 weeks' gestational age. However, very few fetal cells are present (1 fetal cell per 10^7 to 10^7 maternal cells), and in most studies, the fetal cell yield has been inconsistent. Although basic work has demonstrated the biologic availability of fetal cells for prenatal diagnosis, a practical technology for consistent recovery and assay has not yet been developed.

The presence of cell-free fetal DNA (ffDNA) in maternal plasma was first reported in 1997. The source of ffDNA is from apoptosis of trophoblast cells that have entered the maternal circulation. **Detection of ffDNA in maternal plasma can be done as early as 9 to 10 weeks.** It comprises 3-10% of total maternal plasma DNA at the end of the first trimester. A variety of methods are available for detection of fetal trisomy with ffDNA. **Detection rates of 99.4%, 99.1%, and 91.7% have been reported for trisomy 21, trisomy 18, and trisomy 13, respectively. Detection rates of 96.2% have been reported for sex chromosome abnormalities** (45,X; 47,XXX; 47,XXY; 47,XYY). There are many other cytogenetic abnormalities that may be present in addition to those abnormalities that can be detected with NIPT. **False positive rates for NIPT have been reported** to be as high as 7% for trisomy 21, 36% for trisomy 18, 56% for trisomy 13, and 60% for the sex chromosomal abnormalities. **Thus, a positive NIPT result must be confirmed by a diagnostic test (amniocentesis or CVS).** Diagnostic tests provide a full karyotype analysis. A karyotype is a genome-wide test that evaluates all 23 pairs of chromosomes for size, shape, and banding patterns, to detect numerical and structural chromosomal abnormalities. The karyotype detects a much broader spectrum of chromosomal abnormalities than a specific test for trisomy 21, 18, or 13. Although diagnostic tests are associated with a risk for pregnancy loss, this risk is quite low in the hands of experienced operators.

In summary, NIPT screening can be offered to women who are at risk for fetal aneuploidy. However, it should only be offered to the patient after pretest counseling that includes a discussion of the advantages and disadvantages of screening and diagnostic tests. In addition, a family history should be obtained to determine if the patient needs a prenatal diagnostic test for an inherited genetic disorder.

Genetic counseling is an essential component of screening programs. It provides education and alleviates anxiety in patients with abnormal test results. Patients must be informed of the differences between screening results and diagnostic testing.

Diagnostic Procedures

Recombinant DNA technology coupled with first-trimester fetal tissue sampling has enhanced the growth and development of prenatal diagnosis. Obstetric procedures, such as ultrasonography, amniocentesis, CVS, and cordocentesis (percutaneous umbilical blood sampling [PUBS]) are currently used during prenatal diagnosis. These procedures are described and discussed in Chapter 17.

Teratology

A teratogen is any agent or factor that can cause abnormalities of form or function (birth defects) in an exposed fetus. Such abnormalities include fetal wastage and IUGR, malformations due to abnormal growth and morphogenesis, fetal and placental endocrine disruption, and abnormal central nervous system performance.

It was not until the teratogenic effects of rubella infection were demonstrated in 1941 that any notable consideration was given to environmental factors and their potentially deleterious effects on human pregnancy. In the succeeding decades, the susceptibility of

the fetus to many environmental factors has been appreciated.

Probably the best known teratogen is thalidomide, which has been shown to cause phocomelia and other malformations in the offspring of mothers who had been given the drug during pregnancy. It is the only example of a teratogen that, when introduced to the pregnant population, led to a dramatic epidemic of a specific malformation; withdrawal of the drug led to a virtual disappearance of the malformation.

Although drugs are the most obvious source for teratogenic exposure, chemical waste disposal, alcohol, tobacco, cosmetics, and occupational agents contain substances that individuals are exposed to, such as fertilizers and insecticides. Some of these agents are known teratogens, whereas the fetal effects of others are not known.

EXPOSURE

Results of the Collaborative Perinatal Project indicate that more than 900 different drugs are taken by pregnant women in the United States and that 40% of women take medication during the first trimester, when organogenesis is occurring. During the first trimester alone, as many as 32% of pregnant women are exposed to analgesics (mostly aspirin), 18% to immunizing agents, 16% to antimicrobial and antiparasitic agents, and 6% to sedatives, tranquilizers, and antidepressants.

PRINCIPLES OF TERATOLOGY

Fetal Susceptibility

The efficacy of a particular teratogen is, in part, dependent on the genetic makeup of both mother and fetus, as well as on a number of factors related to the maternal-fetal environment. For instance, many congenital abnormalities, such as oral clefts, congenital heart disease, and neural tube defects, are inherited through multifactorial inheritance.

Dose

Depending on the particular teratogen, there may be (1) no apparent effect at a low dose, (2) an organ-specific malformation at an intermediate dose, or (3) a spontaneous abortion at a high dose. Additionally, smaller doses administered over several days may produce a different effect from a single large dose.

Timing

Three stages of teratogenic susceptibility may be identified on the basis of gestational age. Before implantation (1 week postovulation in humans), there is no demonstrable teratogenic insult. The most vulnerable stage is between day 17 to day 56 postconception or from approximately 4 weeks to 10 weeks by gestational age, during the period of organogenesis. **The timing determines which organ system or systems are affected.** Unfortunately, most women do not realize they are pregnant until this critical period of development is well under way. From about the fourth month of pregnancy to the end of gestation, embryonic development consists primarily of increasing organ size. With the exception of a limited number of tissues (brain and gonads), teratogenic exposure after the fourth month usually causes decreased growth without malformation. Very little attention has been directed toward the role of a combination of factors such as a deficiency in folic acid along with the presence of a drug or chemical substance.

Nature of Teratogenic Agents

Although few agents are known to cause serious malformations in a large proportion of exposed individuals, **there are probably hundreds of potentially teratogenic agents, given the right set of circumstances** (unusual genetic milieu, embryologically vulnerable period, large teratogenic dose). Furthermore, certain drugs combined with other drugs may be capable of producing malformations, although neither agent would be teratogenic when taken alone.

TERATOGENIC AGENTS

Teratogens may be assigned to three broad categories: (1) drugs and chemical agents, (2) infectious agents, and (3) radiation. The list that follows is far from exhaustive.

Alcohol

The adverse effects of ethyl alcohol on fetal development were not fully realized until the 1970s. The frequency of the fetal alcohol syndrome runs as high as 0.2%, whereas an additional 0.4% of newborns show less severe features of the disorder (Box 7-2).

Antianxiety Agents

Antianxiety agents are currently used by a significant number of pregnant women. Data regarding their teratogenicity are conflicting, although **exposure to meprobamate or chlordiazepoxide has been associated with a greater than fourfold increase in severe congenital anomalies.** Fluoxetine is now the drug of choice for anxiety and depression during pregnancy and is considered safe to continue even in women who breastfeed. The risk of recurrence of significant depression during pregnancy is too great to routinely discontinue treatment during pregnancy. The recent data suggesting that there is an association between vitamin D deficiency and the risk of postpartum depression suggests that supplementation with vitamin D3 during pregnancy may reduce the use of antianxiety agents.

Antineoplastic Agents

Aminopterin and methotrexate, both of which are folic acid antagonists, have been clearly established

Reference

the fetus to many environmental factors has been appreciated.

Probably the best known teratogen is thalidomide, which has been shown to cause phocomelia and other malformations in the offspring of mothers who had been given the drug during pregnancy. It is the only example of a teratogen that, when introduced to the pregnant population, led to a dramatic epidemic of a specific malformation; withdrawal of the drug led to a virtual disappearance of the malformation.

Although drugs are the most obvious source for teratogenic exposure, chemical waste disposal, alcohol, tobacco, cosmetics, and occupational agents contain substances that individuals are exposed to, such as fertilizers and insecticides. Some of these agents are known teratogens, whereas the fetal effects of others are not known.

EXPOSURE

Results of the Collaborative Perinatal Project indicate that more than 900 different drugs are taken by pregnant women in the United States and that 40% of women take medication during the first trimester, when organogenesis is occurring. During the first trimester alone, as many as 22% of pregnant women are exposed to analgesics (mostly aspirin), 18% to immunizing agents, 16% to antimicrobial and antiparasitic agents, and 6% to sedatives, tranquilizers, and antidepressants.

PRINCIPLES OF TERATOLOGY

Fetal Susceptibility

The efficacy of a particular teratogen is, in part, dependent on the genetic makeup of both mother and fetus, as well as on a number of factors related to the maternal-fetal environment. For instance, many congenital abnormalities, such as oral clefts, congenital heart disease, and neural tube defects, are inherited through multifactorial inheritance.

Dose

Depending on the particular teratogen, there may be (1) no apparent effect at a low dose, (2) an organ-specific malformation at an intermediate dose, or (3) a spontaneous abortion at a high dose. Additionally, smaller doses administered over several days may produce a different effect from a single large dose.

Timing

Three stages of teratogenic susceptibility may be identified on the basis of gestational age. Before implantation (1 week postovulation in humans), there is no demonstrable teratogenic insult. The most vulnerable stage is between day 17 to day 56 postconception or from approximately 4 weeks to 10 weeks by gestational age, during the period of organogenesis. **The timing determines which organ system or systems are affected.** Unfortunately, most women do not realize they are pregnant until this critical period of development is well under way. From about the fourth month of pregnancy to the end of gestation, embryonic development consists primarily of increasing organ size. With the exception of a limited number of tissues (brain and gonads), teratogenic exposure after the fourth month usually causes decreased growth without malformation. Very little attention has been directed toward the role of a combination of factors such as a deficiency in folic acid along with the presence of a drug or chemical substance.

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Although few agents are known to cause serious malformations in a large proportion of exposed individuals, **there are probably hundreds of potentially teratogenic agents, given the right set of circumstances** (susceptible fetus, embryologically vulnerable period, large teratogenic dose). Furthermore, certain drugs combined with other drugs may be capable of producing malformations, although neither agent would be teratogenic when taken alone.

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Antineoplastic Agents

Aminopterin and methotrexate, both of which are folic acid antagonists, have been clearly established as teratogens. Exposure before 40 days' gestation is lethal to the embryo; later exposure during the first trimester produces fetal effects, including IUGR, craniofacial anomalies, abnormal positioning of extremities, mental retardation, early miscarriage, stillbirth, and neonatal death.

Alkylating agents, including busulfan, chlorambucil, cyclophosphamide, and nitrogen mustard, **have been associated with fetal anomalies** such as severe IUGR, fetal death, cleft palate, microphthalmia, limb reduction anomalies, and poorly developed external genitalia. **During the first trimester, the teratogenic risks may be as high as 30%.**

Anticoagulants

COUMARIN DERIVATIVES. Use of warfarin (Coumadin) during the first trimester is associated with an increased risk of spontaneous abortion, IUGR, central nervous system defects (including mental retardation), stillbirth, and a characteristic syndrome of craniofacial features known as the fetal warfarin syndrome. Embryologically, the most vulnerable time appears to be between 6 and 9 weeks after conception. Warfarin easily crosses the placenta, causing bleeding problems in the fetus, and is excreted in breast milk.

HEPARIN. Heparin has major advantages over Coumadin anticoagulants during pregnancy because it does not cross the placenta. Reported risks include prematurity and fetal demise. Because no specific malformation syndrome has been described, these abnormalities may be more closely related to the maternal disease necessitating the heparin use.

Anticonvulsants

Approximately 1 in 200 pregnant women is epileptic, Box 7-3 lists the etiologic factors that may play a role in the congenital abnormalities associated with in utero exposure to anticonvulsants. The complexity in providing genetic counseling for pregnant epileptic women is underscored when considering the interactive effects of combined anticonvulsant treatment, the genetic aspects of the disease itself, and the mother's epilepsy. The goals of counseling include providing the patient with the teratogenic risks of her medication, the risk of seizures during pregnancy, and the effect of pregnancy on seizures. From a medication standpoint, the benefits of seizure prevention need to be weighed against the teratogenicity of the drug.

DIPHENYLHYDANTOIN (DILANTIN). A specific syndrome, known as the fetal hydantoin syndrome, has been described, the clinical features of which include craniofacial abnormalities, limb reduction defects, prenatal-onset growth restriction, mental deficiency, and cardiovascular anomalies. Approximately 10% of exposed fetuses demonstrate fetal hydantoin syndrome, whereas an additional 30% may have isolated features of the syndrome.

OXAZOLIDINEDIONE ANTICONVULSANTS. Trimethadione (Tridione) and paramethadione (Paradione), used to treat petit mal epilepsy, have been associated with a characteristic malformation syndrome in exposed fetuses. The clinical features include craniofacial abnormalities, prenatal-onset growth restriction, an increased frequency of mental retardation, and cardiovascular abnormalities. Because of this serious teratogenic potential and because petit mal epilepsy is rare during reproductive years, **oxazolidinedione anticonvulsants are contraindicated during pregnancy.**

VALPROIC ACID. Valproic acid use during pregnancy is associated with a 1-2% risk of open spina bifida,

BOX 7-2

CLINICAL FEATURES OF FETAL ALCOHOL SYNDROME

Craniofacial
Eyes: Short palpebral fissures, ptosis, strabismus, epicanthic folds, myopia, microphthalmia
Ears: Poorly formed concha, posterior rotation
Nose: Short, hypoplastic philtrum
Mouth: Prominent lateral palatine ridges, micrognathia, cleft lip or palate, faulty enamel
Maxilla: Hypoplastic

Cardiac
Murmurs, atrial septal defect, ventricular septal defect, tetralogy of Fallot

Central Nervous System
Mild-to-moderate mental retardation, microcephaly, poor coordination, hypotonia

Growth
Prenatal-onset growth deficiency

Muscular
Hernias of diaphragm, umbilicus, or groin

Skeletal
Pectus excavatum, abnormal palmar creases, nail hypoplasia, scoliosis

BOX 7-3

ETIOLOGIC FACTORS THAT MAY PLAY A ROLE IN ANTICONVULSANT TERATOGENICITY

Antiepileptic Drugs
Dose, serum levels, metabolism, teratogenicity, metabolic interactions

Genetic Predisposition
Maternal, paternal, and fetal metabolism

Maternal Disease
Teratogenicity, underlying disease, seizures

Other findings reported to be associated with valproic acid exposure include cardiac defects, skeletal defects, and craniofacial malformations.

CARBAMAZEPINE. As with valproic acid, carbamazepine (Tegretol) exposure during pregnancy is associated with an increased risk for fetal spina bifida and is an indication for amniotic fluid AFP analysis. Some studies have reported a specific malformation pattern that includes minor **craniofacial** defects, fingernail hypoplasia, and developmental delay, which are features that would be unlikely to be detected prenatally.

PHENOBARBITAL. The true teratogenicity of phenobarbital is difficult to assess because other drugs are usually taken in combination with this agent, but the risk appears to be very low. **Potential complications of phenobarbital include neonatal withdrawal symptoms and neonatal hemorrhage.**

Hormones

ESTROGEN/PROGESTIN COMBINATIONS. A large number of pregnant women are exposed to progestins or progestin/estrogen combinations because they continue taking birth control pills, unaware that they are pregnant. Recent analyses have failed to confirm any teratogenicity, and the United States Federal Drug Administration (FDA) has removed the product insert warnings. **The main abnormality associated with the use of strongly androgenic progestins during pregnancy is masculinization of the external genitalia in female fetuses, with a risk of up to 2%.**

Miscellaneous Agents

RETINOIDS. Isotretinoin (Accutane) is prescribed for cystic acne or for acne that has not responded to other forms of treatment. **Exposure during pregnancy is clearly associated with a specific malformation pattern that includes central nervous system, cardiovascular, and craniofacial defects (especially ear abnormalities).** The central nervous system findings include hydrocephaly, facial nerve palsies, and cortical blindness. Microcephaly, with severe ear anomalies, microtia, and cleft palate are common findings. **The risk of spontaneous abortion or congenital malformations is greater than 50% in patients who take isotretinoin throughout the first trimester.**

Etretinate, used for severe psoriasis, has been similarly associated with a characteristic malformation pattern. However, unlike isotretinoin, which has a half-life of less than 1 day, etretinate has a half-life of months, leading to a longer risk period even after the agent has been discontinued.

TOBACCO SMOKING. Maternal tobacco smoking interferes with prenatal growth, including birth weight, birth length, and head circumference. The teratogenic effects are related to the extent of maternal exposure to tobacco and include an increased risk for spontaneous abortion, fetal death, neonatal death, and prematurity. Pregnant women should be strongly encouraged to avoid smoking (or second-hand smoke). They should continue to abstain after delivery because second-hand smoke exposure is associated with an increased risk of respiratory diseases in infants and children.

ILLICIT DRUGS. Prenatal cocaine exposure, particularly among chronic abusers, has been associated with fetal malformations, particularly genitourinary tract anomalies, and behavioral abnormalities have also been documented in such fetuses.

INFECTIOUS AGENTS. The exact frequency of significant infection during pregnancy is not known, but it is probably between 15% and 25%. **Viruses, bacteria, and parasites may have serious effects on the fetus, including fetal death, growth delay, congenital malformations, and mental deficiency.** In more recent years, the AIDS epidemic has had a significant impact on pregnancy management. With the now known association between vitamin D deficiency and risk of infections, vitamin D deficiency should be considered as an associated factor in the risk of malformations.

RADIATION. Prenatal ionizing radiation exposure occurs frequently as a result of therapeutic or diagnostic medical and dental procedures. **The medical effects of ionizing radiation are dose-dependent and include teratogenesis, mutagenesis, and carcinogenesis.** The most critical period appears to be from about 2 to 6 weeks after conception. Exposures before 2 weeks will either produce a lethal effect or produce no effect at all. Teratogenicity is still a possibility after 5 weeks, but the risk for deleterious consequences is relatively small. **Diagnostic levels of radiation do not produce a teratogenic risk in the developing fetus.**

Advice during Pregnancy

One of the most important functions of prenatal care is to provide information and support to the woman for self-care. The Cochrane pregnancy and childbirth database (www.cochrane.org) has compiled systematic reviews on the effectiveness of advice and interventions during pregnancy and can be a useful source of information for prenatal care providers. The following sections will examine advice given on alleviating unpleasant symptoms, nutrition, lifestyle, and breastfeeding.

ALLEVIATING UNPLEASANT SYMPTOMS

Nausea and vomiting complicate up to 70% of pregnancies. Eating small, frequent meals, and avoiding greasy or spicy foods may help. Also, having protein snacks at night, saltine crackers at the bedside, and

room-temperature sodas are nonpharmacologic approaches that may provide some relief. **Where medication is deemed necessary, antihistamines appear to be the drug of choice,** though no single product has been satisfactorily tested for efficacy and safety. **Vitamin B6 (pyridoxine) and accupressure ("sea sickness arm bands") may be effective.** Patients with dehydration and electrolyte abnormalities from vomiting (hyperemesis gravidarum) should be evaluated for possible secondary causes, and they may need hospitalization for rehydration and antiemetic therapy.

Heartburn affects about two-thirds of women at some stage of pregnancy, resulting from progesterone-induced relaxation of the esophageal sphincter. Avoiding lying down immediately after meals and elevating the head of the bed may help reduce heartburn. When these simple measures fail, antacids, such as calcium carbonate, should be used.

Constipation is a troublesome problem for many women in pregnancy, secondary to decreased colonic motility. Dietary modification, including increased fiber and water intake, can help lessen this problem. Stool softeners may be used in combination with bulking agents. Irritant laxatives should be reserved for short-term use in refractory cases.

Hemorrhoids are caused by increased venous pressure in the rectum. Increased rest, with elevation of the legs, and avoidance of constipation are recommended.

Leg cramps are experienced by almost half of all pregnant women, particularly at night and in the later months of pregnancy. Massage and stretching may afford some relief during an attack. Both calcium and sodium chloride supplementation appear to help reduce leg cramps in pregnancy. Recently, vitamin D deficiency in both men and women has been associated with leg cramps and muscle pain. Because recent evidence suggests at least 40% of women during pregnancy are vitamin D deficient, vitamin D supplementation at 1000 to 2000 IU/day is recommended. Daily requirements are 400 to 600 IU/day, which is the amount of vitamin D in prenatal vitamins, so prenatal vitamins will not correct the deficiency.

Backaches are common during pregnancy and are lessened by avoiding excessive weight gain. Additionally, exercise, sensible shoes, and specially shaped pillows can offer relief. In cases of muscle spasm or strain, analgesics (such as acetaminophen), rest, and heat may lessen the symptoms.

NUTRITIONAL COUNSELING

While the nutritional care plan should be individualized, every woman can benefit from nutritional education that includes counseling on weight gain, dietary guidelines, physical activity, avoidance of harmful substances and unsafe foods, and the importance of breastfeeding.

TABLE 7-3

APPROPRIATE WEIGHT GAIN IN PREGNANCY

BMI	Recommended Weight Gain (lb)
Underweight <19	28-40
Normal 19-25	25-35
Overweight 25-29.5	15-25
Obese ≥30.0	11-20

Institute of Medicine of the National Academies of Science: Weight gain during pregnancy: reexamining the guidelines, May 28, 2009, Available at www.iom.nationalacademies.com/weightgainduringpregnancy.
BMI, Body mass index.

The appropriate weight gain range (based on pre-pregnancy BMI) during the second and third trimesters of pregnancy is listed in Table 7-3.

Inadequate weight gain has been associated with low birth weight. Women should avoid fasting (>13 hours without food) or skipping meals. This behavior is associated with accelerated ketosis and a greater risk of preterm delivery. They should eat five times per day (breakfast, lunch, afternoon snack, dinner, and bedtime snack). Pregnant women should never skip breakfast. **Excessive weight gain has been associated with fetal macrosomia.** Maternal obesity may occur over time between pregnancies because of the difficulty that some women have returning to prepregnancy body weight. This is especially true when a woman chooses not to breastfeed her infant.

Although weight gain is an important consideration during pregnancy, **the clinician should emphasize the "right amount of nutrition" over the "right amount of weight gain."** Normal pregnancy requires an increase in daily caloric intake of 300 kcal.

LIFESTYLE ADVICE

Women should be advised to rest when tired and reassured that the fatigue usually abates by the fourth month of pregnancy. Normal prepregnancy activity levels are usually acceptable. Advice regarding work should be individualized to the nature of the work, the health status of the woman, and the condition of the pregnancy. Work that requires prolonged standing, shift or night work, and high cumulative occupational fatigue has been associated with an increased risk for low birth weight and prematurity. **Where working conditions involve occupational fatigue or stress, a change in work conditions during pregnancy should be recommended.**

The increase in the use of mobile devices has allowed women to network and access mobile applications **(APPs)** which can provide information about pregnancy. In addition, **establishing a network of friends** before pregnancy allows women to share information

about pregnancy, and provide psychosocial support to reduce pregnancy-specific stress.

Women should be advised to continue to exercise during pregnancy, unless there is hypertension, preterm labor, rupture of the membranes, IUGR, an incompetent cervix, persistent second- or third-trimester bleeding, or medical conditions that severely restrict physiologic adaptations to exercise during pregnancy. They should avoid exercising in the supine position after the first trimester, and should modify the intensity of their exercise according to maternal symptoms. **Any type of exercise involving the potential for loss of balance or even mild abdominal trauma should be avoided.**

Travel is acceptable under most circumstances. Prolonged sitting increases the risk of thrombus formation and thromboembolism. Pregnant women should be encouraged to ambulate periodically when taking a long flight or car ride. Support stockings may help reduce lower limb edema and varicose veins. International travel that places the patient at a high risk of exposure to infectious disease should be avoided, whenever possible. When such travel cannot be avoided, appropriate vaccinations should be administered. Specific recommendations are available at www.cdc.gov; select "Traveler's Health." Live attenuated virus vaccinations are generally contraindicated in pregnancy, but inactivated virus vaccines may be acceptable.

Increased, unchanged, and decreased levels of sexual activity can all be normal during pregnancy. Abstinence or condom use may be advisable if there is an increased risk of preterm labor or repeated pregnancy loss, or in women with a history of persistent second- or third-trimester bleeding.

BREASTFEEDING

Breastfeeding has been shown to significantly reduce morbidity and improve cognitive development during infancy and childhood. Providers should initiate discussion with the pregnant woman and her family regarding breastfeeding during the first visit, including possible barriers to breastfeeding, such as previous poor experiences, misinformation, or nonsupportive work environment. Clinicians should emphasize that weight gain during pregnancy is to support fetal growth and for development of nutritional reserve to support effective breastfeeding. **Breastfeeding for at least 6 months will facilitate complete loss of the required weight gain during pregnancy.** This behavior reduces the risk of postpartum weight retention and the risk of developing obesity. Partners, peers, family members and friends/support groups may also exert an important influence on a woman's decision to breastfeed. Referral to a childbirth preparation class or a lactation consultant may provide additional encouragement to initiate and support breastfeeding.

FOLLOW-UP VISITS

Prenatal visits should be scheduled every 4 weeks until 28 weeks' gestation, every 2 to 3 weeks until 36 weeks, and then weekly until delivery. The schedule of these follow-up visits, however, should be tailored to the needs of individual patients. Women should be screened for depression early in pregnancy, during the third trimester and again postpartum. A simple self-administered 10 question screening tool, the **"Edinburgh Postnatal Depression Scale"** (EPDS), is available at www.fresno.ucsf.edu/pediatrics/downloads/edinburghscale.pdf. **The incidence of depression during pregnancy and the postpartum period is as high as 20%. Multiple studies have shown a significant relationship between vitamin D deficiency and depression.**

During each regularly scheduled visit, the clinician should evaluate blood pressure, weight, urine protein and glucose, uterine size for progressive growth, and fetal heart rate. After the woman reports quickening (first sensation of fetal movement, on average at 20 weeks' gestation) and at each subsequent visit, she should be asked about fetal movement. Between 24 and 34 weeks, women should be taught the warning symptoms of preterm labor (uterine contractions, leakage of fluid, vaginal bleeding, low pelvic pressure, or low back pain). Patients at risk may require additional visits to assess signs and symptoms of preterm labor. Beginning in the late second trimester, they should also be taught to recognize the warning symptoms of preeclampsia (frontal headache, visual changes, hand or facial swelling, epigastric or right upper quadrant pain). Near term, they should be instructed on the symptoms of labor.

Beginning at 28 weeks, systematic examination of the abdomen should be carried out at each prenatal visit to identify the lie (e.g., longitudinal, transverse, oblique), presentation (e.g., vertex, breech, shoulder), and position (e.g., flexion, extension, or rotation of the occiput) of the fetus. This can be accomplished by the maneuvers of Leopold. The **first maneuver** involves palpating the fundus to determine which part of the fetus occupies the fundus. The head is round and hard, whereas the breech is irregular and soft. The **second maneuver** involves palpating either side of the abdomen to determine on which side the fetal back lies. The fetal back is linear and firm, whereas the extremities have multiple parts. The **third maneuver** involves grasping the presenting part between the thumb and third finger just above the pubic symphysis to determine the presenting part. The **fourth maneuver** involves palpating for the brow and the occiput of the fetus to determine fetal head position when the fetus is in a vertex presentation. This is best accomplished with the examiner facing the patient's feet and placing both hands on either side of the lower abdomen just above the inlet. By exerting pressure in

the direction of the pelvic inlet, the hand running along the back will bump into the occiput if the head is extended, whereas the hand on the same side of the small parts will bump into the brow if the head is flexed. **If there is a question about the presentation of the fetus a real time ultrasound may be performed.**

Depending on the practice setting and population, either universal or selective **screening for gestational diabetes should be performed between 24 and 28 weeks' gestation. Risk factors for selective screening include family history of diabetes; previous birth of a macrosomic, malformed, or stillborn baby; hypertension; glycosuria; maternal age of 28 years or older; or previous gestational diabetes.** Repeat measurements of hemoglobin or hematocrit levels early in the third trimester have been recommended. Tests for sexually transmitted infections (e.g., syphilis) may also be repeated at 32 to 36 weeks if the woman has specific risk factors for these diseases. The Centers for Disease Control and Prevention recommend **universal screening for maternal colonization of group B streptococcus at 35 to 37 weeks' gestation.** The value of selective ultrasound for specific indications has been clearly established; the value of routine ultrasound in low-risk pregnancies remains undetermined. Ultrasonic examination during pregnancy is not harmful, but **controlled trials have failed to demonstrate that routine ultrasonic examinations for dating in early pregnancy, anatomic survey in mid-pregnancy, or assessment of fetal growth in late pregnancy improve perinatal outcome.**

Med 441 Team:

Leaders:

Leen Alrajhi - Yara Almufleh

Members:

Razan Alsuwailem

Organizer:

Arwa Mobeirek

Good Luck!

Med 438 Team:

Leaders:

Ateen Almutairi - Lama ALzamil - Lina Alosaimi

Members:

Ajeed Al Rashoud - Sarah Alflaij - Nouf Alhussaini - Noura Alturki - Ateen Almutairi

Med 439 Team:

Leader:

Bushra Alotaibi - Renad Alhomaidi

Members:

Ghaida alassiry - Reem Alqahtani

Video Case

Intrapartum Care

Objectives:

- → Differentiate between the signs and symptoms of true and false labor.
- → Perform the initial assessment of a laboring patient.
- → Describe the four stages of labor and recognize common abnormalities.
- → Explain pain management approaches during labor.
- → Describe methods of monitoring the mother and fetus.
- → Describe the steps of a vaginal delivery.
- → List indications for an operative delivery.
- → Identify maternal risks specific to delivery in developing countries.

- → Slides
- → Important
- → Golden notes
- → Extra
- → 439 Doctor's notes
- → 441 Doctor's notes
- → 441 Female Presentation
- → Reference

Female presentation

Video Case | Editing File

Labor

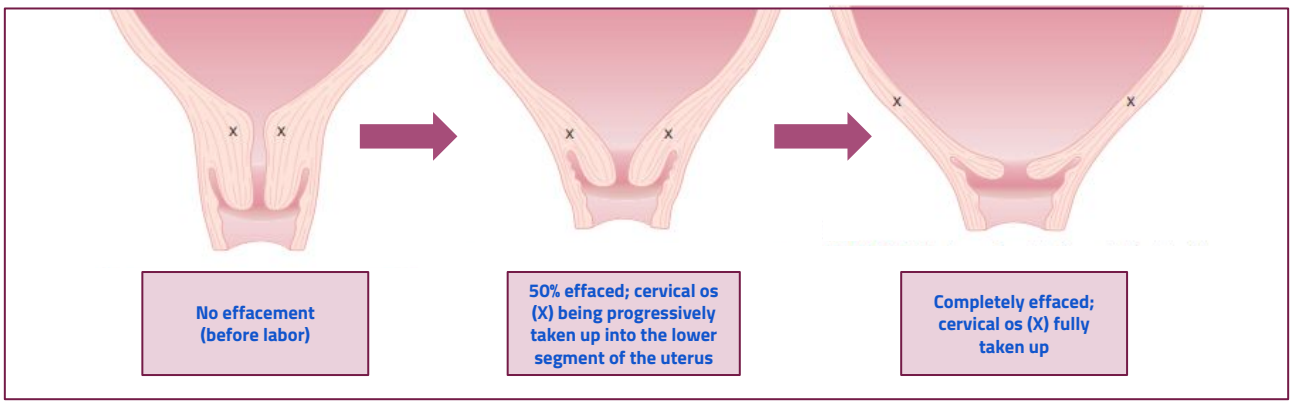
True labor vs. false labor

True labor	False labor (Braxton-Hicks contractions)
Painful uterine contractions that cause progressive dilation & effacement of the cervix.	**Spontaneous contractions, described as tightening of the uterus, not associated with progressive cervical dilation or effacement. Relieved by rest, hydration, or sedation.**

Physiology of labor

An event of increasing levels of **oxytocin & prostaglandins** along with multiplication of specific receptors leads to increasing frequency of contractions that is associated with the formation of gap junctions between uterine myometrial cells. Contractions will occur at least every 5 min lasting 30 s.

Uterine changes	• **Upper segment:** mostly smooth muscle fiber. The contractile segment becomes thicker as labor progresses, exerting forces that expel the fetus down the birth canal. • **Lower segment:** mostly collagen fibers, passively thins out with contractions of the upper segment.
Cervical changes	• **Softening:** occur as increasing levels of oxytocin & PGs lead to breakage of disulfide linkages of collagen fibers, resulting in increasing water content. • **Effacement:** is often expressed in percentages with the uneffaced (0%) cervix assumed to be 2 cm long and 2 cm wide. Progressive shortening and thinning lead to full effacement (100%) in which the cervix has no length and is paper-thin. Effacement is when the distance between the internal OS & external OS is zero • **Dilation:** in early labor (latent phase), the rate of dilation is slow, but at 6 cm of dilation, the rate accelerates to a maximum rate in the active phase of labor. Complete dilation is expressed as 10 cm.

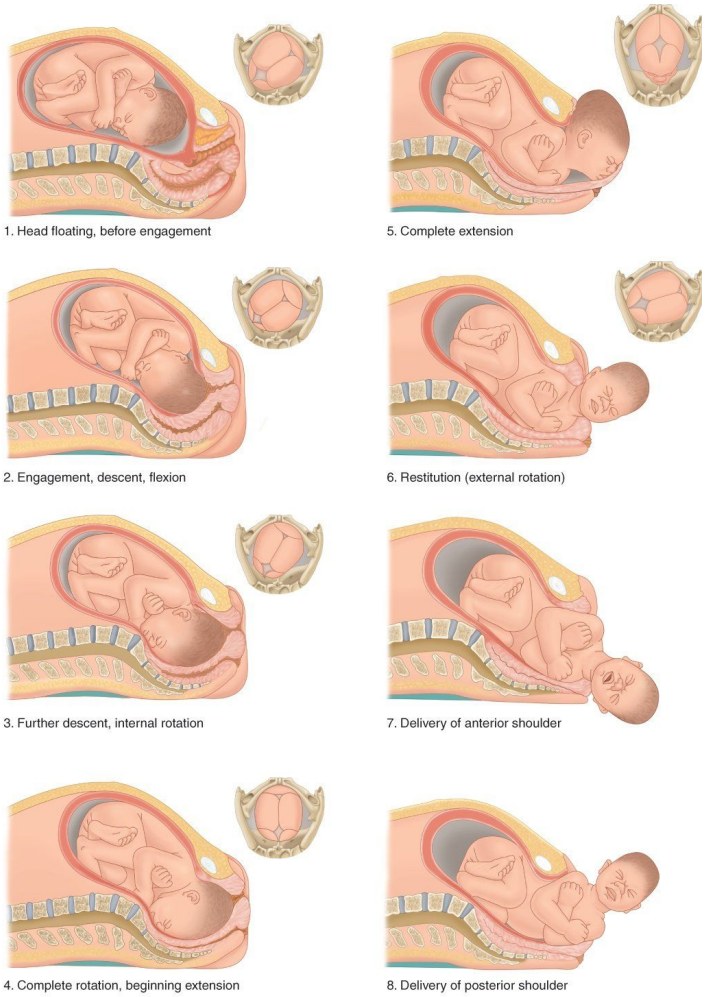


Labor

Cardinal movements of labor (IMPORTANT)

Seven movements of the baby enable it to adapt to the maternal pelvis:

1. **Engagement:** movement of the presenting part below the plane of the pelvic inlet.
2. **Descent:** movement of the presenting part down through the curve of the birth canal.
3. **Flexion:** placement of the fetal chin on the thorax.
4. **Internal rotation:** rotation of the fetal head in the mid pelvis from transverse to anterior-posterior.
5. **Extension:** movement of the fetal chin away from the thorax.
6. **External rotation:** head rotation outside the mother as the head passes through the pelvic outlet.
7. **Expulsion:** delivery of the fetal shoulders and body.



Labor

Stages of labor (IMPORTANT)

Stage		Characteristics
First stage of labor	Latent phase	• From the onset of labor to ~4 cm of cervical dilation. • Characterized by gradual cervical dilation (< 1 cm/hr).
	Active phase	• Begins when the cervix is dilated at ~4 cm and ends with complete cervical dilation (~10 cm). Recent guidelines suggest that the active phase may not begin until 6-cm dilation. • Characterized by more rapid & predictable cervical dilation (1-1.2 cm/hr).
Second stage of labor		• From complete cervical dilation to delivery of the infant.
Third stage of labor		• From delivery of the infant to delivery of the placenta.
Fourth stage of labor		• The immediate postpartum period of ~2 h after delivery of the placenta. • Not an official stage but rather a critical 2-h period of close observation of the pt immediately after delivery (BP, HR, and uterine blood loss).

Duration of each stage

	Primipara	Multipara
Stage 1	6-18 h	2-10 h
Stage 2	2-3 h	5-30 min
Stage 3	0-30 min	

S&S of labor

Six signs that labor is within a few days or weeks:

1. **Lightening:** the mother is relieved when the fetus is engaged.
2. **Bloody show:** loss of mucus plug.
3. **Rupture of membranes:** water breaks.
4. **Nesting:** a burst of energy.
5. **Effacement:** thinning of the cervix.
6. **Dilation:** opening of the cervix.

It is essential to counsel pregnant women on signs that may require immediate medical attention:

1. Leakage of fluid
2. Vaginal bleeding
3. Painful contractions every 5 min for 1 h
4. Decrease in fetal movements

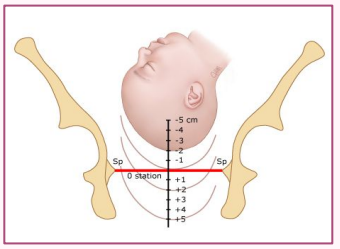
One SURE sign that labor is really happening: consistent contractions

Management of Labor

Management of the first stage

- **Admission vital signs**
- **Fetal HR monitoring:** done by either electronic fetal monitoring or intermittent auscultation (refer to "intrapartum fetal surveillance" lecture).
- **Assessment of uterine activity:** by an external tocometer
- **Physical examination:** to assess the following

  - **Cervical dilation:** complete dilation is 10 cm.
  - **Cervical effacement:** it is when the body length between external os and internal os is decreased; expressed in percentage or cm:
    - 0% non-effaced (2 cm long and 2 cm wide).
    - 100% full effacement (no length or paper thin).
  - **Station:** describes the fetal presenting part, usually the vertex, in relation to ischial spine.
    - **At the level of ischial spine:** 0 station
    - **Above the ischial spine:** **-1,-2,-3,-4,-5**
    - **Below the ischial spine:** **+1,+2,+3,+4,+5**

  - **Fetal lie, presentation, and position:** if it cannot be determined by examination, perform US.

- **Laboratory tests:** hematocrit or hemoglobin, blood type and screen, and hepatitis B status.
- **Oral intake:** because of ↓ GI peristalsis, pts should limit solid food intake as it can lead to NV.
- **IV fluids:** placement of a 16- to 18-gauge venous catheter is advisable during the active phase of labor to hydrate the patient with crystalloids and provide calories during labor, to administer oxytocin after the delivery of the placenta, and for the treatment of any emergencies.
- **Physical activity:** walking is generally more comfortable than lying supine.
- **Pain management** (discussed later)

Management of Labor

Management of the second stage

- **Maternal position:** with the exception of avoiding the supine position, the mother may assume any comfortable position for effective bearing down.

- **Bearing down:** with each contraction, the mother should be encouraged to hold her breath and bear down with expulsive efforts. This is particularly important for pts with regional anesthesia because their reflex sensations may be impaired.

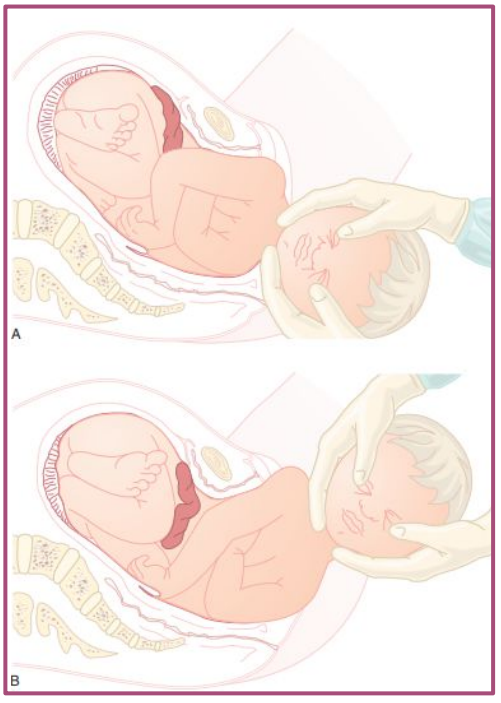
- **Fetal HR monitoring**

- **Vaginal examination:** progress should be recorded every 30 min.
  - Particular attention should be paid to the development of molding or caput (localized edematous swelling of the scalp) which can create a false impression of fetal descent.

- **Delivery of the fetus:**
  - Pt is usually placed in the lithotomy position.
  - Episiotomy may be performed to prevent perineal lacerations.
  - **Ritgen maneuver:** holding the head and the perineum together to offer more support **(Fig 1)**.
  - Once the head is delivered, the airway is cleared of blood & amniotic fluid using a bulb suction device.
  - An index finger is used to check whether the umbilical cord encircles the neck.
  - The shoulders are then delivered.
    - Delivery of the anterior shoulder: aided by gentle downward traction on the head **(Fig 2A)**.
    - Delivery of the posterior shoulder: by elevating the head **(Fig 2B)**.
  - Finally, the body is slowly extracted by traction on the shoulders.

- **Maternal-newborn interaction:** skin-to-skin contact and early initiation of breastfeeding.

(1) Ritgen maneuver



(2) Delivery of the shoulders

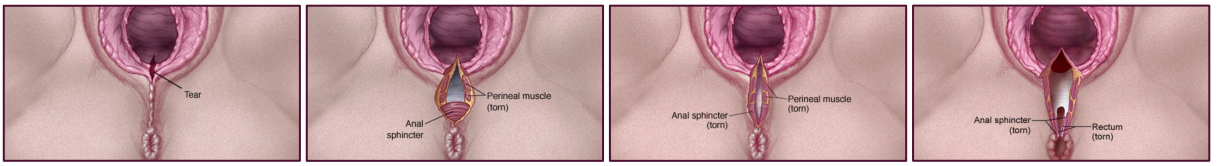
Management of Labor

Management of the third stage

- **Cord clamping:** delayed cord clamping is recommended for 1-2 min.
- **Inspection:** the cervix, vagina and perineum are thoroughly inspected for lacerations, and surgical repair should be performed when necessary.

Obstetric lacerations

First degree	Second degree	Third degree	Fourth degree
Involve the skin or SC tissue of the perineum and vaginal epithelium.	Extend to the fascia and musculature of the perineal body.	Extend to the anal sphincter.	Extend to the rectal mucosa.



- **Active management:** decreases the risk of postpartum hemorrhage.
  - **Fundal massage**
  - **IV or IM oxytocin**
  - **Gentle cord traction**

- **Delivery of the placenta:**
  - **Placental separation:** occurs within 2-10 min

    Signs of placental separation:
    1. **Gush of blood**
    2. **Lengthening of the umbilical cord**
    3. **The fundus rises up**
    4. **The uterus becomes firm and globular** قاسي تحسينه
  - **Cord traction:** when these signs appear, the assistant attempts gentle traction on the cord with counterpressure between the symphysis and fundus to prevent descent of the uterus.
  - **Placental expulsion:** as the placenta emerges from the vagina, the membranes flow behind it. Slowly rotating the placenta in circles as it is delivered or grasping the membranes with a clamp helps prevent them from tearing and possibly being retained in the uterine cavity.

- **Examination of the placenta, umbilical cord, & fetal membranes:** to ensure complete removal of the placenta (no missing cotyledons), detect placental abnormalities, and record the number of vessels in the cord (one vein, two arteries).

Management of the fourth stage

- Close monitoring of the mother (BP, HR uterine blood loss).
- Instruct the pt on massaging the uterus to maintain its tone.
- Some women have frequent bleeding up to 10 days postpartum, usually because of uterine relaxation, retained placental fragments, or unrepaired lacerations.

Management of Labor

Pain management in labor

Pain pathways

- Uterine contractions and cervical dilation result in visceral pain (T10 - L1) **[stage 1]**
- Descent of the fetal head and subsequent pressure on the pelvic floor, vagina, and perineum generate somatic pain transmitted by the **pudendal nerve (S2-4) [stage 2]**

Pain control options

- **Epidural block:** the most effective form of intrapartum pain relief in the 1st stage labor, 2nd stage you can feel the pain mildly.
- **Pudendal nerve block:** anesthetizes somatic afferent nerve fibers entering the spinal cord at sacral segments S2 to S4. It is usually effective at relieving the perineal pain of the second stage of labor.
- **IV opioids:** include opioid agonists & antagonists. The primary mechanism of pain relief is via sedation. They work best in the early first stage when the pain is primarily visceral and less intense (all opioids readily cross the placental barrier).
- **Nonpharmacologic methods:**
  1- Education, emotional support
  2- Psychoprophylaxis (Lamaze method; uses controlled breathing and relaxation as tools to help people cope with labor)

Episiotomy

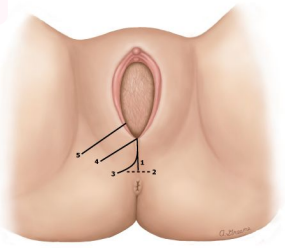
A surgical incision made in the perineum to enlarge the vaginal opening and assist in childbirth. Performed prior to fetal crowning. Only done for a reason; usually primigravida need it.

Possible indications

- Shoulder dystocia
- Non-reassuring fetal monitor tracing
- Forceps or vacuum extractor vaginal delivery
- Vaginal breech delivery
- Narrow birth canal

Types of incisions

- 1 = median incision
- 1+2 = "T" incision
- 3 = 'J' incision
- 4 = Mediolateral incision
- 5 = Lateral incision



Disadvantages

- More perineal pain than with lacerations
- Longer return to sexual activity
- More extensions into the anal sphincter & rectum

- **Right mediolateral episiotomy** is best to avoid tear up to the anal sphincter.
- **Median episiotomy** is best for recovery and less painful but with high risk of anal sphincter tears.

Abnormal Labor

Etiology

Abnormalities of the 3 P's of labor:

- Pelvis: size and shape of the maternal pelvis (e.g. small bony pelvis).
- Passenger: size and position of the infant (e.g. fetal macrosomia or abnormal orientation).
- Power: strength and frequency of contractions (e.g. dysfunctional contractions).

Abnormal labor stages

Stage	Definition	Management
Prolonged latent phase	Slow progression with a cervical dilation ≤ 6 cm and a duration of > 20 h in nullipara and > 14 h in multipara.	• Rest, hydration, and adequate analgesia • Oxytocin may be considered in well-rested mothers if the previous measures have been implemented. • Other: amniotomy, cervical ripening
Prolonged active phase	• ≥ 6 cm cervical dilation without adequate dilation (< 1 cm/2h) • Usually due to abnormalities of the 3 P's	• Augmentation of labor with oxytocin for hypotonic contractions • Analgesia for hypertonic contractions • Amniotomy • Cesarean delivery if previous measures are ineffective

Arrested active phase	• ≥ 6 cm cervical dilation with ruptured membranes and no cervical change after one of the following:
	  ○ ≥ 4 h of adequate contractions
	  ○ ≥ 6 h of oxytocin administration with inadequate contractions
	• Usually due to abnormalities of the 3 P's
		Cesarean delivery

Prolonged second stage	• Arrest of fetal descent occurring after complete cervical dilation (> 10 cm) and effacement (100%)
	• Usually due to abnormalities of the 3 P's
		• If contractions are inadequate → oxytocin
		• If contractions are adequate:
		  ○ Fetal head engaged → forceps or vacuum
		  ○ Fetal head not engaged → CS

Prolonged third stage of labor	• Placenta has not been delivered 30 minutes after the birth • Inadequate contractions or retained placenta (e.g., abnormal placental implantation such as placenta increta, placenta percreta, placenta accreta)	• Manual removal of the placenta • Hysterectomy if the above approach fails

Abnormal Labor

Operative deliveries

- Operative deliveries are accomplished by applying direct traction to the fetal skull with **forceps** or by applying traction to the fetal scalp with a **vacuum extractor**.

- **The general indications are:**
  - Prolonged or arrested second stage
  - Suspicion of immediate or potential fetal compromise
  - Shortening of the second stage for maternal benefit

(See "Operative Deliveries & Caesarean Section" lecture)

Maternal risks specific to delivery

- In low-resource settings, there are a multitude of risks of labor & delivery.
- 99% of maternal deaths occur in developing countries.
- Every day 800 women die from preventable causes related to pregnancy and childbirth; more than half of these deaths occur in sub-saharan Africa and another one-third occur in Southeast Asia.
- The highest risk is for adolescent girls.
- The major complications that account for 75% of maternal deaths are bleeding, infection, high blood pressure, complications from delivery and unsafe abortion.

Female Students Presentation

Clinical management of the first stage of labor:
- Maternal Position: lateral recumbent
- 10% dextrose (D) in normal saline
- Analgesia

Clinical management of the third stage of labor:
- IV infusion of Pitocin (Oxytocin)
- Gentle traction
- Uterine massage

Indications of operative deliveries:
- Operative delivery: an obstetric procedure in which active measures are taken to accomplish delivery.
- Operative delivery can be divided into operative vaginal delivery and caesarean delivery.
- The incidence of operative obstetric delivery in the United States today is approximately 35 -40%, of which 10-15% are operative vaginal deliveries using either a forceps or a vacuum device. Approximately 25-30% of all deliveries are cesarean deliveries.

Indications for an operative vaginal delivery:
- Prolonged second stage of labor.
- To shorten the second stage of labor for maternal benefit.
- Suspicion of immediate or impending fetal compromise.
- To stabilize the after-coming head during a breech delivery.

Indications for caesarean section:
Four indications of the marked increase in cesarean deliveries over the past 40 years:
- Cephalopelvic disproportion (dystocia) (30%).
- Repeat cesarean (25-30%).
- Breech presentation (10-15%).
- Fetal distress (10-15%).

Intermittent fetal monitoring:
Benefits:
- The mother can move around and will only be limited when the baby's heartbeat needs to be listened to.
- The mother can use the pool for labour.
- When pregnancy has been straightforward intermittent monitoring

reduces the chances of unnecessary intervention.
If there is a concern about the baby's heart rate continuous electronic heart monitoring is advised in such cases

439 Doctor's Notes

- If a patient comes to the ER with painful contractions, closed, thick and uneffaced cervix, we manage by giving **IV fluids**, because prostaglandins are released with of dehydration.
- **Braxton hicks contractions are relieved by rest, analgesia and hydration.**
- ER instructions: come if 1- Bleeding 2- Leakage of fluids 3- Painful, regular (every 5 min contractions).
- If there's no US, determining fetal positions is done by Leopold's maneuver.
- We check for 3 things: 1- Dilation 2- Effacement 3- Station
- Zero station = engaged head
- Delivery of placenta (3rd stage of labor) takes 30 min, if more than that it's retained placenta.
- In cases of retained placenta, the patient is taken to the OR for manual removal.
- Pain in stage 1 is visceral and is due to uterine contractions, epidural is given in this stage.
- Pain in stage 2 is somatic pain, pudendal block can be given in this stage.
- Crowning: maximum stretch to the perineum, episiotomy is done at crowning.
- Ritgen maneuver: holding the head and the perineum together to offer more support; best for the mother and baby we always used it.
- The placenta shouldn't be pulled immediately after the infant delivery, we have to wait for the signs of separation: 1- Gush of blood 🩸 2- Cord lengthening.
- The aim of operative delivery: decreasing 2nd stage of labor.
- Bloody show: mucus discharge associated with streaks of blood.

Teaching case

A 23-year old G1P0 woman at 38 weeks gestation comes to Labor and Delivery complaining of a 5-hour history of painful contractions occurring every 5 minutes and lasting 45-60 seconds in duration. She denies leaking of fluid per vagina, but has noted bloody show. She reports normal fetal movement. In reviewing her chart, you find that she has had an uncomplicated prenatal course. She had an ultrasound at 17 weeks that revealed a male fetus and was consistent with her last menstrual period dating. A screening culture at 36 weeks was positive for group B streptococcus. The cervical exam at the 36-week visit was closed and long. Her blood pressure is 96/54, pulse 92 beats per minute, respirations are 20/minute and oral temperature is 98° F. Leopold's maneuver reveals the fetal back is palpable at the right side of the maternal abdomen and the vertex is palpable through the maternal abdomen just below her symphysis pubis. Fetal heart rate (FHR) is in the 150s with moderate variability, with accelerations and no decelerations. Contractions are noted on the external monitor every 3 minutes. The patient's cervix is 3 cm dilated, 50% effaced with the fetal vertex at 0 station. The remainder of the physical exam is unremarkable

Q1: Is this patient in labor? What elements of the case history support a diagnosis of labor?

- **True labor** is defined as progressive dilation and effacement of the cervix in response to regular uterine contractions.
- **False labor** is defined as contractions at term that do not result in cervical change and are termed "Braxton-Hicks" contractions.

Q2: In addition to determining whether this patient is in labor or not, what should be included in the initial evaluation of a patient who presents in labor?

- Establish the gestational age through comparison of available dating criterion such as last menstrual period, sonography, and physical exam (e.g. fundal height).
- Identify any maternal medical or obstetrical complications of pregnancy by review of patient records and focused history and physical exam. Approach: first ask about her age past medical history (diabetes, heart condition allergies ,blood transfusion) current antenatal abnormalities. Obstetric History para and Gravida score if she have previous delivery was it vaginal or C.S in previous delivery Is baby born term or preterm does baby need ICU and why and for how long.
- Identify any fetal conditions by review of patient records and focused history and physical exam.
- Review routine screenings tests (e.g. group B streptococcus)
- Identify any new maternal conditions that may impact labor management (e.g. preeclampsia, chorioamnionitis). Chorioamnionitis is bleeding for long time and abdominal tenderness and offensive smell.
- Establish fetal viability using either external ultrasound Doppler or bedside sonography.
- Evaluate the fetal presentation and estimated fetal weight using either **Leopold's maneuvers** to know the fetus lie (this maneuver may come in OSCE), vaginal exam, or bedside sonography.
- Assess the adequacy of the maternal pelvis through physical examination (clinical pelvimetry) and review of patient's prior labor outcomes, if applicable.
- Assess the cervical status and membrane status. In the pelvic examination, we should assess the effacement, dilation, position of the cervix and station.
- Always start with SOAP:
- Subjective patient tell about her symptom (abdominal pain for how long? Every?, leakage , bleeding, decreased fetal movement)
- Objective 1- Leopold's maneuver -fetal harts by Doppler or CTG -vital sign 2-vaginal examination 3-abdominal examination 4-labs (hemoglobin if low we will be ready for blood transfusion,coagulation profile if she needs epidural block')infection (GBS we do vaginal swab from vagina to rectum between 35 and 38 weeks , or other infections like rubella hepatitis HIV

Teaching case

Q3: What is the stage and phase of labor for this patient?

She is at latent phase of first stage because the cervical dilation is less than 6.

- **Stage 1:** is the onset of labor to full cervical dilation (10 cm) is divided into a latent and active phase.
  - Latent phase: < 4 cm dilation "it can last for days"
  - Active phase: > 4 cm dilation "1.2–1.5 cm dilation every hour"
  - New study shows: transition from latent to active phase is at 6 cm, rather than 4 cm
- **Stage 2:** starts from the complete dilation to time of delivery.
- **Stage 3:** starts from delivering thaby to the expulsion of the placenta, take up to 30 minutes.
- **Stage 4:** is the immediate postpartum period after delivering the placenta to 2 hours later.e b

Q4: What are your next steps in management of this patient?

- Appropriate prophylaxis (e.g. group B strept). Ampicillin, Amoxicillin (loading dose 2 g + maintenance dose)
- Fetal heart rate monitoring (external vs. internal and intermittent vs. continuous).
- Uterine contraction monitoring (external vs. internal).
- Serial assessment of maternal labor progress (dilation, effacement, station).
- Serial assessment of maternal pain status.

Q5: What options for pain management are available for this patient?

- **Pain pathways:**
  - Uterine contractions and cervical dilation result in visceral pain (T10 - L1).
  - Descent of the fetal head and subsequent pressure on the pelvic floor, vagina, and perineum generate somatic pain transmitted by the pudendal nerve (S2–4).
- **Analgesia and anesthesia options:**
  - Systemic narcotics Pethidine
  - Regional:
    - Local anesthetic agents
    - Pudendal block
    - Para-cervical block It causes bradycardia for the fetus so it's not used currently
  - Continuous lumbar epidural The most effective
  - Prepared childbirth (e.g. Lamaze classes) coarse about breathing and coping with pain

Q6: Describe the process by which the fetus descends through the birth canal and the steps of vaginal delivery

The fetus descends through the maternal pelvis through various flexions and rotations called the cardinal movements of labor: engagement (in the transverse diameter) - descent - flexion - internal rotation - extension - external rotation - expulsion.

Q7: What are other methods of delivery if the patient had not been able to push effectively or if fetal intolerance of labor had developed?

Modes of operative delivery:

- Operative vaginal delivery (forceps or vacuum)
- Cesarean delivery

Indications for operative delivery can be put into 4 categories:

- Maternal indications (e.g. poor expulsive effort) shortening stage 2 preferable when the patient have heart condition can't push
- Fetal indications (e.g. fetal intolerance of labor, anomalies/malformations) deceleration or bradycardia on CTG we go with operative and vaginal delivery when fetus presentation +2
- Abnormal labor (e.g. secondary arrest of dilation in the active phase)
- Elective (primary or repeat cesarean)

Reference

PREPARATION FOR LABOR

Before actual labor begins, a number of preparatory physiologic events usually occur.

Lightening

Two or more weeks before labor, the fetal head in most primigravid women settles into the brim of the pelvis. In multigravida, this often does not occur until early in labor. **Lightening** may be noted by the mother as a flattening of the upper abdomen and an increased prominence of the lower abdomen.

False Labor

During the last 4 to 8 weeks of pregnancy, the uterus undergoes irregular contractions that normally are painless. Such contractions appear unpredictably and sporadically and can be rhythmic and of mild intensity. In the last month of pregnancy, these contractions may occur more frequently, sometimes every 10 to 20 minutes, and with greater intensity. **These Braxton Hicks contractions are considered false labor in that they are not associated with progressive cervical**

dilation or effacement. They may serve a physiologic role in preparing the uterus and cervix for true labor.

Cervical Effacement

Before the onset of parturition, the cervix is frequently noted to soften as a result of increased water content and collagen lysis. Simultaneous effacement, or thinning of the cervix, occurs as the internal os of the cervix is taken up into the lower uterine segment (Figure 8-8, *B*). Consequently, patients often present in early labor with a cervix that is already partially effaced. As a result of cervical effacement, the mucous plug within the cervical canal may be released. The onset of labor may thus be heralded by the passage of a small amount of blood-tinged mucus from the vagina **("bloody show").**

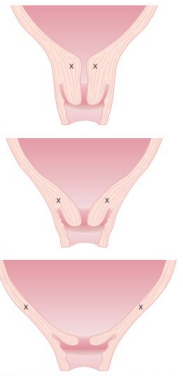


FIGURE 8-8 **A**, The absence of cervical effacement before labor (*X* shows the location of the internal os in a normal cervix). **B**, Cervical os (*X*) being progressively taken up into the lower segment of the uterus (about 50% effaced). **C**, Cervical os (*X*) fully taken up (cervix is completely effaced).

STAGES OF LABOR

There are four stages of labor, each of which is considered separately. These stages in actuality are definitions of progress during labor, delivery, and the puerperium (Table 8-5).

The **first stage** lasts from the onset of true labor to complete dilation of the cervix. The **second stage** spans from complete dilation of the cervix to the birth of the baby. The **third stage** lasts from the birth of the baby to delivery of the placenta. The **fourth stage** spans from delivery of the placenta to stabilization of the patient's condition, usually at about 6 hours postpartum.

First Stage of Labor as Defined by the Friedman Labor Curve

There is currently controversy about how to define the progress of normal labor. Because the purpose of this chapter is to define normal labor, we will use the standard definitions provided by Friedman in 1978 (Figure 8-9). The Friedman labor curve, as well as a recently suggested modification, is covered in Chapter 11.

PHASES. The first stage of labor consists of two phases: a latent phase, during which cervical effacement and early dilation occur, and an active phase, during which more rapid cervical dilation occurs (see Figure 8-9). Although cervical softening and early effacement may occur before labor, during the first stage of labor the entire cervical length (cervical os) is retracted into the lower uterine segment (see Figure 8-8).

LENGTH. The length of the first stage may vary in relation to parity; primiparous patients generally experience a longer first stage than do multiparous patients (see Table 8-5). Because the latent phase may overlap considerably with the preparatory phase of labor, its duration is highly variable. It may also be influenced by other factors, such as sedation and stress. The active phase begins when the cervix is dilated 4 cm in the presence of regularly occurring uterine contractions. The recent guidelines proposed by Zhang and colleagues regarding labor curves (see Chapter 11) suggest that the active phase may not begin until 6-cm dilation. **The minimal dilation during the active phase of the first stage is nearly the same for normal primiparous and multiparous women: 1 and 1.2 cm/hr, respectively.** If progress is slower than this, evaluation for uterine dysfunction, fetal malposition, or cephalopelvic disproportion should be undertaken.

MEASUREMENT OF PROGRESS. During the first stage, the progress of labor may be measured in terms of cervical

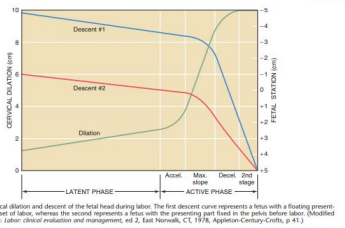


FIGURE 8-9 Cervical dilation and descent of the fetal head during labor. The first descent curve represents a fetus with a floating presenting part at the onset of labor, whereas the second represents a fetus with the presenting part fixed in the pelvis before labor. (Modified from Friedman EA: *Labor: clinical evaluation and management*, ed 2, East Norwalk, CT, 1978, Appleton-Century-Crofts, p 41.)

TABLE 8-5
CHARACTERISTICS OF NORMAL LABOR

Characteristics	Primipara	Multipara
Duration of first stage	6-18 hr	2-10 hr
Rate of cervical dilation during active phase	1 cm/hr	1.2 cm/hr
Duration of second stage	30 min to 3 hr	5-30 min
Duration of third stage	0-30 min	0-30 min

effacement, cervical dilation, and descent of the fetal head. The clinical pattern of the uterine contractions alone is not an adequate indication of progress. After completion of cervical dilation, the second stage commences. Thereafter, only the descent, flexion, and rotation of the presenting part are available to assess the progress of labor.

CLINICAL MANAGEMENT OF THE FIRST STAGE. Certain steps should be taken in the clinical management of the patient during the first stage of labor.

Maternal Position. The mother may ambulate, provided that intermittent monitoring ensures fetal well-being and the presenting part is engaged in patients with ruptured membranes. **If she is lying in bed, the lateral recumbent position should be encouraged** to ensure adequate perfusion of the uteroplacental unit. When the patient is supine (on her back), the weight of the uterus and fetus can compress the vessels supplying the uterus.

Administration of Fluids. Because of decreased gastric emptying during labor, **oral fluids are best avoided.** However, fasting results in the more rapid development of ketosis in pregnant women. Placement of a 16- to 18-gauge venous catheter is advisable during the active phase of labor. It has been shown that **giving at least 125 mL/hr of 10% dextrose (D) in normal saline (NS),** compared with 5% D/NS or just NS, **results in significantly shorter labor.** Thus, the IV route is used to hydrate the patient with crystalloids and provide calories during labor, to administer oxytocin after the delivery of the placenta, and for the treatment of any unanticipated emergencies.

Investigations. Every woman admitted in labor should have a hematocrit or hemoglobin measurement and a blood clot held in the event that a crossmatch is needed. Blood group, rhesus (Rh) type, and an antibody screen should be done if these are not known. It is also important to know the hepatitis B status of the mother so that a pediatrician can be notified if the mother is positive. Additionally, a voided urine specimen should be checked for the presence of protein and glucose.

Maternal Monitoring. Maternal pulse rate, blood pressure, respiratory rate, and temperature should be

recorded every 1 to 2 hours during normal labor and more frequently if indicated. Fluid balance, particularly urine output and fluid intake, should be monitored carefully.

Analgesia. Adequate analgesia is important during the first stage of labor (see later in this chapter).

Fetal Monitoring. The fetal heart rate should be evaluated by auscultation with a DeLee stethoscope, by external monitoring with Doppler equipment, or by internal monitoring with a fetal scalp electrode. In uncomplicated pregnancies, continuous electronic fetal monitoring is not necessary, as several studies have demonstrated that intermittent auscultation of the fetal heart rate, when performed in conjunction with a 1:1 nurse-to-patient ratio, results in comparable outcomes and may reduce the risk of cesarean delivery. Continuous fetal heart rate monitoring provides a record of the labor and may be preferred for documentation and medicolegal reasons. **In patients with no significant obstetric risk factors, the fetal heart rate should be auscultated or the electronic monitor tracing evaluated at least every 30 minutes in the active phase of the first stage of labor and at least every 15 minutes in the second stage of labor. In patients with obstetric risk factors, the fetal heart rate should be auscultated or the electronic monitoring tracing evaluated at least every 15 minutes during the active phase of the first stage of labor (immediately following a uterine contraction) and at least every 5 minutes during the second stage.**

Uterine Activity. Uterine contractions should be monitored every 30 minutes by palpation for their frequency, duration, and intensity. **For high-risk pregnancies, uterine contractions should be monitored continuously along with the fetal heart rate.** This can be achieved electronically using either an external tocodynamometer or an internal pressure catheter in the amniotic cavity. The latter is particularly of value when a patient's labor is being augmented with oxytocin (Pitocin). When an internal catheter is not used, the strength of uterine contractions should be monitored by palpation every 15 minutes.

Vaginal Examination. During the latent phase, particularly when the membranes are ruptured, vaginal examinations should be done sparingly to decrease the risk of an intrauterine infection. **In the active phase, the cervix should be assessed approximately every 2 hours to determine the progress of labor.** Cervical effacement and dilation, the station and position of the presenting part, and the presence of molding or caput in vertex presentations should be recorded.

Amniotomy. The artificial rupture of fetal membranes may increase uterine activity and may provide information on the volume of amniotic fluid and the presence or absence of meconium; however, current opinion suggests that keeping the membranes intact may be of value in supporting the normal progress of labor and **preventing umbilical cord compression or cord prolapse if the presenting part is not engaged.**

Second Stage of Labor

At the beginning of the second stage, the mother usually has a desire to bear down with each contraction. This abdominal pressure, together with the uterine contractile force, combines to expel the fetus. During the second stage of labor (Figure 8-10, *A*), **fetal descent must be monitored carefully** to evaluate the progress of labor. Descent is measured in terms of progress of the presenting part through the birth canal.

In cephalic presentations, the shape of the fetal head may be altered during labor, making the assessment of descent more difficult. **Molding** is the alteration of the relationship of the fetal cranial bones to each other as a result of the compressive forces exerted by the bony maternal pelvis. Some molding is normal. If cephalopelvic disproportion is present, the amount of molding will be more pronounced. **Caput** is a localized, edematous swelling of the scalp caused by pressure of the cervix on the presenting portion of the fetal head. The development of both molding and caput can create a false impression of fetal descent.

The second stage generally takes from 30 minutes to 3 hours in primigravid women and from 5 to 30 minutes in multigravida.

MECHANISM OF LABOR. Six movements of the baby enable it to adapt to the maternal pelvis: descent, flexion, internal rotation, extension, external rotation, and expulsion (see Figure 8-10). These movements are discussed here for both an occipitoanterior and occipitoposterior position at engagement. The mechanism of labor for other than vertex presentations is covered in Chapter 13.

Descent. Descent is brought about by the force of the uterine contractions, maternal bearing-down (Valsalva) efforts, and, if the patient is upright, gravity.

Flexion. Partial flexion exists before labor as a result of the natural muscle tone of the fetus. During descent, resistance from the cervix, walls of the pelvis, and pelvic floor causes further flexion of the cervical spine, with the baby's chin approaching its chest. **In the occipitoanterior position, the effect of flexion is to change the presenting diameter from the occipitofrontal to the smaller suboccipitobregmatic** (see Figure 8-2). In the occipitoposterior position, complete flexion may not occur, resulting in a larger presenting diameter, which may contribute to a longer labor.

Internal Rotation. In the occipitoanterior position, the fetal head, which enters the pelvis in a transverse or oblique diameter, rotates so that the occiput turns anteriorly toward the symphysis pubis. Internal rotation probably occurs as the fetal head meets the muscular sling of the pelvic floor. It is often not accomplished until the presenting part has reached the level of the

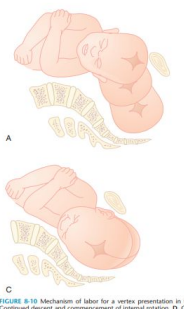


FIGURE 8-10 Mechanism of labor for a vertex presentation in the left occipitotransverse position. **A**, Flexion and descent. **B** and **C**, Continued descent and commencement of internal rotation. **D**, Completion of internal rotation to the occipitoanterior position followed by delivery of the head by extension.

ischial spines (zero station) and therefore is engaged. In the occipitoposterior positions, the fetal head may rotate posteriorly so that the occiput turns toward the hollow of the sacrum.

Extension. The flexed head in an occipitoanterior position continues to descend within the pelvis. Because the vaginal outlet is directed upward and forward, extension must occur before the head can pass through it. As the head continues its descent, there is bulging of the perineum followed by crowning (see Figure 8-10, *D*). **Crowning** occurs when the largest diameter of the fetal head is encircled by the vulvar ring. At this time, the vertex has reached station +5. When indicated, an incision in the perineum **(episiotomy)** may aid in reducing perineal resistance. **Current management is to allow the fetus to deliver without an episiotomy when possible.** Good clinical judgment is needed to avoid traumatic tears that may be more difficult to repair when they occur without an episiotomy. The head is born by rapid extension as the occiput, sinciput, nose, mouth, and chin pass over the perineum.

In the **occipitoposterior position,** the head is born by a combination of flexion and extension. At the time of crowning, the posterior bony pelvis and the muscular sling encourage further flexion. The forehead, sinciput, and occiput are born as the fetal chin approaches the chest. Subsequently, the occiput falls back as the head extends and the nose, mouth, and chin are born.

External Rotation. In both the occipitoanterior and occipitoposterior positions, the delivered head now returns to its original position at the time of engagement to align itself with the fetal back and shoulders. Further head rotation may occur as the shoulders undergo an internal rotation to align themselves anteroposteriorly within the pelvis.

Expulsion. Following external rotation of the head, the anterior shoulder delivers under the symphysis pubis, followed by the posterior shoulder over the perineal body and the body of the child.

CLINICAL MANAGEMENT OF THE SECOND STAGE. As in the first stage, certain steps should be taken in the clinical management of the second stage of labor.

Maternal Position. With the exception of avoiding the supine position, the mother may assume any comfortable position for effective bearing down.

Bearing Down. With each contraction, the mother should be encouraged to hold her breath and bear down with expulsive efforts. This is particularly important for patients with regional anesthesia because their reflex sensations may be impaired.

Fetal Monitoring. During the second stage, the fetal heart rate should be monitored continuously or evaluated every 5 minutes in patients with obstetric risk factors. Fetal heart rate decelerations (head compression or cord compression) with recovery following the uterine contraction may occur normally during this stage (see Chapter 9).

Vaginal Examination. Progress should be recorded approximately every 30 minutes during the second stage. Particular attention should be paid to the descent and flexion of the presenting part, the extent of internal rotation, and the development of molding or caput. During the second stage of labor, the retracted cervix is no longer palpable.

Delivery of the Fetus. When delivery is imminent, the patient is usually placed in the lithotomy position, and the skin over the lower abdomen, vulva, anus, and upper thighs is cleansed with an antiseptic solution. Uncomplicated deliveries, particularly in multiparous women, may be carried out with the patient in the **supine position** with the thighs flexed. The **left lateral position** may be used for delivery in patients who desire to deliver in this position, for those with hip or knee joint deformities that prevent adequate flexion, or for patients with a superficial or deep venous thrombosis in one of the lower extremities.

As the perineum becomes flattened by the crowning head, an episiotomy may be performed to prevent perineal lacerations. Some studies show that the performance of episiotomies may result in a higher proportion of lacerations that involve the anal sphincter (third degree) or anal mucosa (fourth degree).

To facilitate delivery of the fetal head, **a Ritgen maneuver** is performed (Figure 8-11). The right hand, draped with a towel, exerts upward pressure through the distended perineal body, first to the supraorbital ridges and then to the chin. This upward pressure, which increases extension of the head and prevents it from slipping back between contractions, is counteracted by downward pressure on the occiput with the left hand. The downward pressure prevents rapid extension of the head and allows a controlled delivery.

Once the head is delivered, the airway is cleared of blood and amniotic fluid using a bulb suction device. The oral cavity is cleared initially, and then the nares are cleared. Suction of the nares is not performed if fetal distress or meconium-stained liquor is present, because it may result in gasping and aspiration of pharyngeal contents. A second towel is used to wipe secretions from the face and head.

After the airway has been cleared, an index finger is used to check whether the umbilical cord encircles the neck. If so, the cord can usually be slipped over the infant's head. If the cord is too tight, it can be cut between two clamps.

Following delivery of the head, the shoulders descend and rotate into the anteroposterior diameter of the pelvis and are delivered (Figure 8-12). **Delivery of the anterior shoulder is aided by gentle downward traction on the externally rotated head. The brachial plexus may be injured if excessive force is used.** The posterior shoulder is delivered by elevating the head. Finally, the body is slowly extracted by traction on the shoulders.

After delivery, blood will be infused from the placenta into the newborn if the baby is held below the mother's introitus. **Delayed cord clamping is recommended for 1 to 2 minutes.** For the preterm infant, in particular, allowing 1 to 2 minutes provides important benefits, such as improvement in circulatory and respiratory function, a reduction in the need for blood transfusion, and reduced risk of intraventricular hemorrhage. After the cord is clamped, the newborn is given to the mother for skin-to-skin contact. If the newborn is preterm and is stable after a brief period of skin-to-skin contact, it is placed under an infant warmer to prevent hypothermia.

Third Stage of Labor

Immediately after the baby's delivery (the end of the second stage of labor), the cervix and vagina should be thoroughly inspected for lacerations, and surgical repair should be performed when necessary. The cervix, vagina, and perineum may be more readily examined before the separation of the placenta, as no uterine bleeding should be present to obscure visualization. Attention is directed to any:

1. **Perineal lacerations that continue to bleed and need repair.** Lacerations, with or without episiotomy, may be classified as follows:
   a. **First degree:** a laceration involving the vaginal epithelium or perineal skin
   b. **Second degree:** a laceration extending into the subepithelial tissues of the vagina or perineum with or without involvement of the muscles of the perineal body

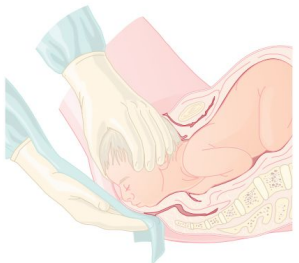


FIGURE 8-11 Ritgen maneuver. The fingers of the right hand, pressing posterior to the rectum, are used to extend the head while counterpressure is applied to the occiput by the left hand to allow a controlled delivery of the fetal head.

   c. **Third degree:** a laceration involving the anal sphincter
   d. **Fourth degree:** a laceration involving the rectal mucosa
2. **Cervical lacerations that are bleeding and need repair.**

DELIVERY OF THE PLACENTA. Separation of the placenta generally occurs within 2 to 10 minutes of the end of the second stage of labor (delivery of the baby). Squeezing the fundus to hasten placental separation is not recommended, because it may increase the likelihood of passage of fetal cells into the maternal circulation. **The initial step in the management of the third stage of labor for prevention of postpartum hemorrhage** is to begin an IV infusion of 40 U of Pitocin in 500 mL of saline at a rate of 10 mL/min for 5 minutes, followed by 1 to 2 mL/min until the patient is transferred to the postpartum unit.

Signs of placental separation are as follows: (1) **a fresh show of blood** from the vagina, (2) **the umbilical cord lengthens** outside the vagina, (3) **the fundus rises up**, and (4) **the uterus becomes firm and globular.** Only when these signs have appeared should the assistant attempt traction on the cord. With gentle traction and counterpressure between the symphysis and fundus to prevent descent of the uterus into the pelvis, the placenta is delivered.

The next appropriate step (after Pitocin infusion is started as mentioned above) is the application of uterine massage by either the physician or the nurse in attendance. If the patient is at risk for postpartum hemorrhage (e.g., because of anemia, prolonged oxytocic augmentation of labor, multiple gestation, macrosomia, or polyhydramnios), manual removal of the placenta and manual exploration of the uterus may be necessary.

Finally, the placenta should be examined to ensure its complete removal (no missing cotyledons) and to detect placental abnormalities. Dilation and curettage may be necessary to evacuate retained placental tissue that is causing hemorrhaging.

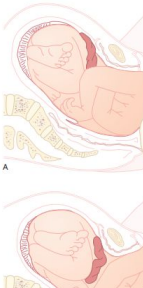


FIGURE 8-12 Delivery of the shoulders. **A**, Gentle downward traction on the head is applied to deliver the anterior shoulder. **B**, Gentle upward traction is used to deliver the posterior shoulder.

If an episiotomy has been performed (Figure 8-13), it should be repaired as illustrated in Figure 8-14. Absorbable sutures (size 00) should be used, and a rectal examination should be done to ensure that the sutures have not inadvertently transected the rectal mucosa. A third-degree tear (Figure 8-15) should be repaired as shown in Figure 8-16.

Fourth Stage of Labor

The hour immediately following delivery and the first 4 hours postpartum require continued close observation of the patient to prevent postpartum hemorrhage. Blood pressure, pulse rate, and uterine blood loss must be monitored closely, and it is important to instruct the patient on massaging the uterus to maintain uterine tone. It is during this time that serious postpartum hemorrhage most commonly occurs, but some women may have frequent bleeding for up to 10 days postpartum, usually because of uterine relaxation, retained placental fragments, **or unrepaired lacerations.** An increase in pulse rate, often out of proportion to any decrease in blood pressure, may indicate hypovolemia.

Med 441 Team:

Leaders:

Leen Alrajhi - Yara Almufleh

Members:

Arwa Awwad

Organizer:

Arwa Mobeirek

Good Luck!

Med 438 Team:

Leaders:

Ateen Almutairi - Lama ALzamil - Lina Alosaimi

Members:

Nouf ALShammari - Sarah Maghrabi

Med 439 Team:

Leader:

Bushra Alotaibi - Renad Alhomaidi

Members:

Sumo Alzeer

Reviewed By
RAAOUM M. JABOR

Video Case

Postpartum Care

Objectives:

- → Discuss the normal physiologic changes of the postpartum period.
- → Describe the components of normal postpartum care.
- → Outline topics to cover in postpartum patient counseling.
- → Describe appropriate postpartum contraception.

- → Slides
- → Important
- → Golden notes
- → Extra
- → 439 Doctor's notes
- → 441 Doctor's notes
- → 441 Female Presentation
- → Reference

Female presentation

Video Case | Editing File

The Postpartum Period

Introduction

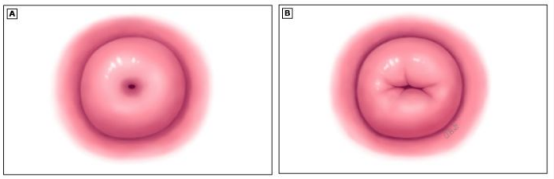
The **postpartum period** (PP), also known as the **puerperium**, consists of the period following delivery of the baby and placenta to ~6 weeks postpartum.

Anatomic & physiologic changes

During the puerperium, the reproductive organs and maternal physiology return to the prepregnancy state, although menses may not return for much longer.

Uterine involution	• The uterus contracts and returns to the pelvis by 2 weeks PP, and it attains its normal non-pregnant size by 6 weeks PP. • The weight of the uterus decreases from approximately 1000 g immediately PP to 70 g weeks later. *If the uterus is palpable abdominally by two weeks PP, it indicates incomplete regression, which can be due to fibroids, being pushed up by an ovarian mass, or secondary to infections. Breastfeeding, which stimulates the release of oxytocin, can help facilitate the return of the uterus to its normal position. *Inadequate contraction will result in atony, which the most common cause of early PPH.

Lochia	• Lochia refers to the shedding of the superficial layers of the endometrial decidua through the vagina during the first three weeks following childbirth. It is a normal vaginal discharge that occurs after delivery.
	• It goes through three phases after delivery:
	  ○ **Lochia rubra (red):** menses-like blood; lasts for the first few days after birth.
	  ■ If it continues further → secondary PPH.
	  ○ **Lochia serosa (pinkish watery):** lasts for a few weeks.
	  ○ **Lochia alba (yellowish white):** may persist for 6-8 weeks.
	These are all normal and should be distinguished from malodorous discharge concerning for infection (endometritis).

Vagina, vulva, & pelvic muscles	• The vagina and vulva will be will likely be very sore especially if the patient has had a laceration with her vaginal delivery. Most women will need some sort of regular analgesia for the pain and usually OTC medications are sufficient. • Vaginal tone and pelvic floor muscles gradually strengthen, but they may never return to the pre-pregnancy state. • Pregnancy, regardless of mode of delivery, is associated with incontinence and pelvic organ prolapse. • **Kegel or pelvic floor exercises** may help during this muscle recovery phase.
Cervix	• The small, smooth, regular circular opening of the nulligravida (A) becomes a large, transverse, stellate slit after childbirth (B). 

The Postpartum Period

Anatomic & physiologic changes (continued)

Perineal pain	Discomfort from an episiotomy or perineal lacerations can be minimized in the first 24 hours with ice packs to decrease the inflammatory response edema. A heat lamp or sitz bath is more helpful after the first day to help mobilize tissue fluids.
CVS	• Pregnancy increases cardiac output by 30-50% and circulating volume by 30%. • There is also a large fluid shift from extravascular to intravascular space, leading to diuresis and marked weight loss (1000 mL of volume is lost during delivery). • Normal cardiovascular function returns at 2-3 weeks PP.
Coagulation system	• Pregnancy is a hypercoagulable state with an increase in procoagulants to prevent excessive bleeding during delivery. **This increases the risk of VTE especially in the PP period.** Thus mothers are encouraged to walk as soon as possible and wear compression stocking. • The normal balance between procoagulants and anticoagulants is restored at 6-8 weeks PP.
Urinary tract	• **Elevated GFR:** during pregnancy, there is ↑ blood flow to the kidneys → ↑ GFR (which remains elevated for 2-3 week PP). The elevated GFR leads to ↓ blood creatinine. The creatinine of a pregnant woman is usually around 0.8 mg/dL. • **Urinary retention:** secondary to nerve compression during delivery or from the anesthetic effects of regional anesthesia • **Urinary incontinence:** 25% of women will have stress urinary incontinence during the immediate time after a vaginal delivery. • **Hypotonic bladder:** intrapartum bladder trauma can result in ↑ postvoid residual volumes. • **Dysuria:** pain with urination may be seen from urethral irritation from frequent intrapartum catheterization.
GIT	• **Constipation:** ↓ GIT motility because of perineal pain and fluid mobilization. • **Hemorrhoids:** prolonged second stage pushing efforts can exaggerate pre-existing hemorrhoids.
Breast	• **Breast engorgement:** results in breast fullness & firmness, which is accompanied by pain and tenderness. typically occurs between 24-72 hours PP due to onset of copious milk production.
Physiologic weight loss	• Mean weight loss from expulsion of the fetus, placenta, & amniotic fluid is 6 kg. • Contraction of the uterus & loss of lochial fluid and excess intra- & extracellular fluid leads to an additional loss of 2-7 kg during the puerperium. • One-half of gestational weight gain is lost in the first 6 weeks PP.

Postpartum Care

The 7 B's of postpartum care

1 Breast vs. bottle

- Encourage breastfeeding (BF) as much as possible.
- Recommendation is exclusive BF for at least 6 months.
- **Advantages to breastfeeding:**
  - Breast milk is ideal for the newborn, is inexpensive, and is usually in good supply.
  - Nursing accelerates the involution of the uterus.
  - Various types of maternal antibodies are present in breast milk (predominantly IgA), providing the infant with passive immunity against certain infectious diseases.
  - BF is a way of transferring appropriate maternal bacteria to the infant's gut.
- **Colostrum:** secreted on the 2nd day PP and is replaced by mature milk after 3-6 days.

2 Bladder

- Ask about urinary retention and incontinence.
- All woman should urinate within 6 hours of delivery or 6 hours after catheter removal.

3 Bowel

- Has your patient had a bowel movement?
- Woman taking opioid pain medications or those with a third or fourth degree laceration should be offered a stool softener.

4 Bleeding

- Ask about volume & presence of clots.
  - PPH: blood loss of ≥ 500 mL after vaginal delivery, or ≥ 1,000 mL after CS. A routine postpartum CBC is needed to check Hb and estimate blood loss (iron supplement during postpartum is important).
- Review expectations about length of bleeding & discharge.

5 Bottom

- Ask about perineal pain or irritation and examine the perineum.
- If there are any complaints ensure that appropriate pain medications are provided.
  - If severe pain 2-3 days that either could be tight sutures or hematoma → Tx painkillers, if not working heat bath or open again the sutures.
  - If severe pain 4-6 days that could be infection or abscess.

Postpartum Care

The 7 B's of postpartum care (continued)

6 Blues

- **Postpartum blues** are very common in the immediate PP time.
  - A transient condition characterized by several mild depressive symptoms (e.g. sadness, crying, irritability, anxiety, insomnia, exhaustion, and ↓ concentration & mood lability).
  - Symptoms typically resolve within 2 weeks of onset.
  - **Any prolonged episodes of depression should receive urgent attention.**

- **Postpartum depression:** see if the mother has any risk factors for developing postpartum depression such as a history of depression or poor social support, and discuss warning signs of postpartum depression.

7 Birth control

It is important to discuss this because ~15% of non-nursing women are fertile at 6 weeks and ~50% of women will resume sexual intercourse prior to the six-week follow-up visit.

1. **Breastfeeding:** partially protects against pregnancy, however the breastfeeding must be exclusive and every three hours and the patient must be amenorrheic.
2. **Combined estrogen-progesterone contraception: avoided while breastfeeding** because of the fear that it may hamper milk production, however it is considered safe for breastfeeding once milk supply has been established (not an absolute CI if lactation was done the right way).Side effect of estrogen therapy: headache/migraine.
3. **Progesterone-only forms of contraception:** including the mini-pill (micronor), Nexplanon, and progesterone IUD; will not affect milk supply so can be safely used during lactation.

If the mother is not breastfeeding then she may be placed on any contraception, however combination estrogen and progesterone she probably started 2-3 weeks PP to decrease the thromboembolic risk.

Postpartum immunization

- **RhoGAM:** if the mother is Rh(D)-negative and her baby is Rh(D)-positive, she should be administered 300 µg of RhoGAM IM within 72 hours of delivery.
- **Rubella:** if the mother is rubella IgG antibody-negative, she should be administered active immunization with the live-attenuated rubella virus. She should avoid pregnancy for one month (3 months) to avoid potential fetal infection.

Teaching case

A 22 year-old multigravida delivered her third healthy child vaginally without complication. During sign-out and hand-off, the patient is described as ready for discharge from the hospital. She is breastfeeding, as she has with all of her children, but reports difficulty latching on. Although she is not married, she is in a stable relationship. She is considering permanent sterilization and wants to discuss it at her postpartum check-up. She states that she does not want any contraception at discharge, since she is breastfeeding (should be 4 hs, frequently, enough, suckling to prevent pregnancy almost 6 months) and thinks she does not need any. On further questioning, she alludes to a vague history of a possible deep venous thrombosis (DVT) and history suggestive of postpartum depression after a prior pregnancy. Even though she is not a new mother, she asks about when she should expect her period.

- After delivery, the mother goes to the postnatal ward & gets discharged after 24 h (vaginal delivery) or 3 days (C-section).
- During her stay you must assess the 7Bs.

Q1: What are you going to tell the patient about her difficulty with latching on?

- First teach her or show a video that visualize the technique for her if she still is having difficulties discuss the indications for referral to and role of a lactation consultant prior to discharge.
- Insure that there is no problem with the nipple interfering with latching.

Q2: How are you going to answer the pt's question about resumption of menses?

- The average time to ovulation is 45 days and non-lactating woman and 189 days (6 months) in lactating women (due to the effect of prolactin on GnRH).
- The likelihood of ovulation increases as the frequency and duration of breastfeeding decreases.
- Review the Physiological basis (reactivation of the HPOA axis) for clinically relevant postpartum changes such as resumption of ovulation and menstruation.

Q3: What type of contraceptive counseling are you going to provide?

- Provide contraceptive counseling while the pt is still in the hospital. Emphasize that unless women are breast-feeding every 3-4 h around the clock they may be fertile before the 6 week postpartum checkup.
- Combined estrogen-progestin oral contraceptives should not be used during the first 21 days after delivery as there is an increased risk of VTE during this period (although can be initiated if they don't have risk factors (age over 35 years, recent cesarean section or smoking) for VTE).
- Progestin-only oral contraceptives depot medroxyprogesterone acetate injections (Provera Q6 months), implants, and mini pill may be initiated immediately postpartum whether exclusively BF or not they are not associated with an increase in complications. Progesterone drawback: unpredictable bleeding.
- Although IUD expulsion rates are higher during the first six weeks postpartum. IUD can be inserted immediately postpartum once lactation is established neither the volume nor the composition of breastmilk is adversely affected by progestin contraceptives. Contraindicated in infections.
- In summary:
  - Hormonal methods
  - IUD (risk of infection)
  - Sterilization (not the first thing to think about in all cases especially in this case she is 22 y/o and she must not take that decision in this critical period.

Teaching case

Q4: How would your contraceptive counseling change if the patient had persistently elevated blood pressure?

- Presume the patient is hypertensive and counsel according to the CDC US Medical Eligibility Criteria for contraceptive use.
- Estrogen is contraindicated in uncontrolled hypertension but progesterone and IUD are safe.

Q5: How would contraception counseling change if the patient had gestational diabetes?

- Council according to the CDC US Medical Eligibility Criteria for contraceptive use.
- Estrogen is contraindicated in uncontrolled GDM and chronic diabetes but progesterone and IUD are safe.

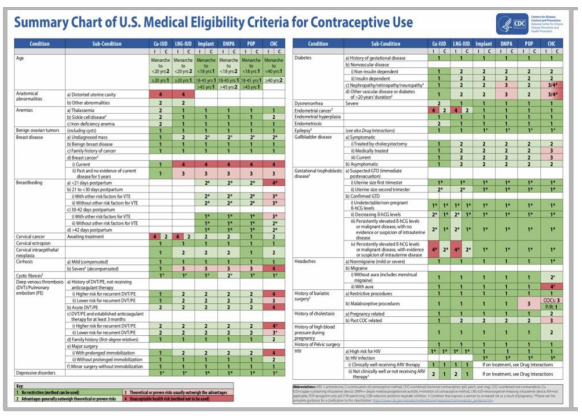
Q6: How are you going to include the history of potential postpartum depression in your management plan?

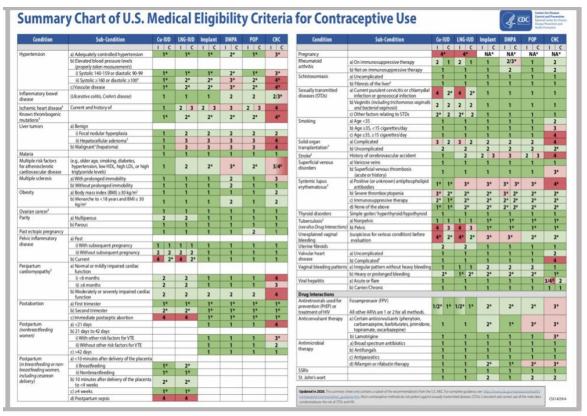
Review the risk factors for postpartum depression, screening methods (e.g. Edinburgh postnatal, depression scale https://med.stanford.edu/content/dam/sm/ppc/documents/DBP/EDPS_text_added.pdf) and indications for immediate intervention. See APGO educational topic 29, anxiety and depression.

Q7: What discharge instructions are you going to give this patient?

- Discuss the content of discharge instructions, including warning signs and symptoms and what the patient should do if she experiences them.
  - Inform the patient that 70% to 80% of women reports feeling sad, anxious or angry beginning 2-4 days after birth these postpartum blues may come and go throughout the day and are usually mild and abate within 1-2 weeks. Approximately 10% to 15% of new mothers experience postpartum depression (PPD) which is more serious disorder and usually requires medication and counseling. PPD difference from postpartum blues in the severity and duration of symptoms.
- Discuss the definitive method of contraception and emphasize the importance of immunization against Rubella.

Extra:





Reference

Puerperium

The puerperium consists of the period following delivery of the baby and placenta to approximately 6 weeks postpartum. During the puerperium, the reproductive organs and maternal physiology return to the prepregnancy state, although menses may not return for much longer.

ANATOMIC AND PHYSIOLOGIC CHANGES

Involution of the Uterus

Through a process of tissue catabolism, the uterus rapidly decreases in weight from about 1000 g at delivery to 100 to 200 g approximately 3 weeks postpartum. The cervix similarly loses its elasticity and regains its prepregnancy firmness. For the first few days after delivery, the uterine discharge (lochia) appears red **(lochia rubra),** because of the presence of erythrocytes. After 3 to 4 days, the lochia becomes paler **(lochia serosa),** and by the tenth day, it assumes a white or yellow-white color **(lochia alba).** Foul-smelling lochia suggests endometritis.

Vagina

Although the vagina may never return to its prepregnancy state, the supportive tissues of the pelvic floor gradually regain their former tone. Women who deliver vaginally should be taught and encouraged to perform Kegel exercises (intermittent tightening of the perineal muscles) to maintain and improve the supportive tissues of the pelvic floor.

Cardiovascular System

Immediately following delivery, there is a marked increase in peripheral vascular resistance because of the removal of the low-pressure uteroplacental circulatory shunt. The cardiac output and plasma volume gradually return to normal during the first 2 weeks of the puerperium. As a result of the loss of plasma volume and the diuresis of extracellular fluid, a marked weight loss occurs in the first week.

Psychosocial Changes

It is fairly common for women to exhibit a mild degree of depression a few days following delivery. The **"postpartum blues"** are probably due to both emotional and hormonal factors. **Recently, a relationship between vitamin D deficiency (<20 ng/mL) or insufficiency (20 to 29 ng/mL) and depression has been reported.** If a patient has symptoms of depression, she should be screened using the Edinburgh Postnatal Depression Scale. Vitamin D supplementation is safe, and at least 2000 to 3000 IU/day can be started following assessment of the level of the vitamin (25[OH]D) in the patient's serum. With understanding and reassurance from both family and physician, the patient's

postpartum blues usually resolve without consequence. **Any prolonged episodes of depression during or after pregnancy should receive urgent attention.**

Return of Menstruation and Ovulation

In women who do not nurse, menstrual flow usually returns by 6 to 8 weeks, although this is highly variable. Although ovulation may not occur for several months, particularly in nursing mothers, contraceptive use should be emphasized during the puerperium to avoid an undesired pregnancy.

Breastfeeding

There are many advantages to breastfeeding. **First, breast milk is the ideal food for the newborn, is inexpensive, and is usually in good supply. Second, nursing accelerates the involution of the uterus** because suckling stimulates the release of oxytocin, thereby causing increased uterine contractions. **Third,** and probably most important, **there are immunologic advantages for the baby from breastfeeding.** Various types of maternal antibodies are present in breast milk. The predominant immunoglobulin is secretory immunoglobulin A (IgA), which provides protection in the infant's gut by preventing attachment of harmful bacteria (e.g., *Escherichia coli*) to cells on the mucosal surface. This prevents the bacteria from penetrating the bowel wall. It is also thought that maternal lymphocytes pass through the infant's gut wall and initiate immunologic processes that are not yet well understood. **Breastfeeding thereby provides the newborn with passive immunity** against certain infectious diseases until its own immune mechanisms become fully functional by 3 to 4 months. **Fourth, it is a way of transferring appropriate maternal bacteria to the infant's gut.** This also occurs as the infant swallows gut bacteria during its passage through the birth canal, but this does not occur if the baby is delivered by cesarean delivery. For the preterm infant, it is especially desirable to be born vaginally. The normal bacteria obtained assist in the prevention of necrotizing enterocolitis.

LACTATION

Various hormones, such as estrogen, progesterone, human chorionic gonadotropin (hCG), cortisol, insulin,

prolactin, and placental lactogen, play an important role in preparing the breasts for lactation. **At delivery, two events are instrumental in initiating lactation. The first is the drop in placental hormones, particularly estrogen.** Before delivery, these hormones interfere with the lactogenic action of prolactin. **Second, suckling stimulates the release of prolactin and oxytocin.** The latter causes contraction of the myoepithelial cells in the alveoli and milk ducts. The suckling stimulus is thought to be important for milk production, as well as for the ejection of colostrum and milk.

On approximately the second day after delivery, colostrum is secreted. Its content is composed mostly of protein, fat, and minerals. It is the colostrum that contains secretory IgA. **After about 3 to 6 days, the colostrum is replaced by mature milk.** The content of milk varies considerably, depending on the nutritional status of the mother and the gestational age at the time of delivery. In general, the major components of breast milk are proteins, lactose, water, and fat. The major proteins synthesized in the human breast, which are unique and are not found in cow's milk, are casein, lactalbumin, and β-lactoglobulin. Essential amino acids are delivered via the mother's blood, and some of the nonessential amino acids can be synthesized in the breast. In addition, breast milk is a source of omega-3 fatty acids, which are important for early brain development.

LACTATION SUPPRESSION

When the mother chooses not to breastfeed, lactation suppression is indicated. **The simplest, and probably safest, method to accomplish this is to use a tight-fitting bra.** If breast distention does occur, pumping only makes the situation worse. Ice packs should be applied and the discomfort managed with analgesics.

COMPLICATIONS OF BREASTFEEDING

Cracked Nipples

If the nipples of the breast become fissured, nursing may become difficult. Because fissures are also a portal of entry for bacteria, they should be managed aggressively with a nipple shield and an appropriate cream, such as lanolin or Massé breast cream. Further breastfeeding should be temporarily stopped. Milk can be expressed manually until the nipples heal, at which time breastfeeding can be resumed.

Mastitis

This is an uncommon complication of breastfeeding and usually develops after 2 to 4 weeks. The first symptoms are usually slight fever and chills. These are followed by redness of a segment of the breast, which becomes indurated and painful. **The etiologic agent is usually *Staphylococcus aureus,* which originates from the infant's oral pharynx.** Milk should be obtained from the breast for culture and sensitivity, and the mother should be started on a regimen of antibiotics immediately. **Because the majority of staphylococcal organisms are penicillinase-producing, a penicillinase-resistant antibiotic, such as dicloxacillin, should be used.** Breastfeeding may be discontinued but is not contraindicated. An appropriate antibiotic should be continued for 7 to 10 days. If a breast abscess ensues, it should be surgically drained. A breast pump can be used to maintain lactation until the infection has cleared if nursing is discontinued.

Drug Passage to the Newborn

Because an infant may ingest up to 500 mL of breast milk per day, maternally administered drugs that pass into breast milk may have a significant effect on the infant. The amount of drug found in breast milk depends on the maternal dose, the rate of maternal clearance, the physicochemical properties of the drug, and the composition of the breast milk with respect to fat and protein. The gestational age of the infant may also be a determinant of the ultimate drug effect. Table 8-6 lists selected drugs with their reported newborn effects.

Med 441 Team:

Leaders:

Leen Alrajhi - Yara Almufleh

Members:

Amira Alrashedi

Organizer:

Norah Fares Alsewailem

Good Luck!

Med 438 Team:

Leaders:

Ateen Almutairi - Lama ALzamil - Lina Alosaimi

Members:

Joud Al-Otaibi - Taibah Alzaid - Razan AlRabah

Med 439 Team:

Leader:

Bushra Alotaibi - Renad Alhomaidi

Members:

Maha Alqahtani - Noura Bamarei