Obstetrics

(Surgical specialty dealing with the care of women and their children during pregnancy)

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Obstetrics

Obstetrician	
Occupation	
Names	Doctor, consultant, medical specialist
Type	Specialty
Activity sectors	Medicine and surgery
Description	
Education required	Medical training and specialised postgraduate training
Fields of employment	Hospitals, clinics

Obstetrics (from the Latin *obstare*, "to stand by") is the surgical specialty dealing with the care of women and their children during pregnancy (prenatal period), childbirth and the postnatal period. Midwifery is the non-surgical equivalent. Veterinary obstetrics is the same concept for veterinary medicine. Almost all modern obstetricians are also gynaecologists.

Prenatal care

Prenatal care is important in screening for various complications of pregnancy. This includes routine office visits with physical exams and routine lab tests:

3D ultrasound of 3-inch (76 mm) fetus (about 14 weeks gestational age)

Fetus at 17 weeks

Fetus at 20 weeks

First trimester

- Complete blood count (CBC)
- Blood type
- General antibody screen (indirect Coombs test) for HDN
    - Rh D negative antenatal patients should receive RhoGam at 28 weeks to prevent Rh disease.
- Rapid plasma reagent (RPR) which screens for syphilis
- Rubella antibody screen
- Hepatitis B surface antigen
- Gonorrhea and Chlamydia culture
- PPD for tuberculosis
- Pap smear
- Urinalysis and culture
- HIV screen
- Group B Streptococcus screen – will receive IV penicillin or ampicillin (it is much cheaper and has a wider coverage)if positive (if mother is allergic, alternative therapies include IV clindamycin or IV vancomycin)

genetic screening for downs syndrome (trisomy 21) and trisomy 18 the national standard in the United States is rapidly evolving away from the AFP-Quad screen for downs syndrome- done typically in the second trimester at 16–18 weeks. The newer integrated screen (formerly called F.A.S.T.E.R for First And Second Trimester Early Results) can be done at 10 plus weeks to 13 plus weeks with an ultrasound of the fetal neck (thick skin is bad) and two chemicals (analytes) Papp-a and bhcg (pregnancy hormone level itself). It gives an accurate risk profile very early. There is a second blood screen at 15 to 20 weeks which refines the risk more accurately. The cost is higher than an "AFP-quad" screen due

to the ultrasound and second blood test but it is quoted to have a 93% pick up rate as opposed to 88% for the standard AFP/QS. This is an evolving standard of care in the United States.

Second trimester

- MSAFP/quad. screen (four simultaneous blood tests) (maternal serum alpha-fetoprotein; inhibin; estriol; bhcg or free bhcg) - elevations, low numbers or odd patterns correlate with neural tube defect risk and increased risks of trisomy 18 or trisomy 21
- Ultrasound either abdominal or trannsvaginal to assess cervix, placenta, fluid and baby
- Amniocentesis is the national standard for women over 35 or who reach 35 by mid pregnancy or who are at increased risk by family history or prior birth history

Third trimester

- Hematocrit (if low, mother will receive iron supplementation)
- Glucose loading test (GLT) - screens for gestational diabetes; if > 140 mg/dL, a glucose tolerance test (GTT) is administered; a fasting glucose > 105 mg/dL suggests gestational diabetes.

Most doctors do a sugar load in a drink form of 50 grams of glucose in cola, lime or orange and draw blood an hour later (plus or minus 5 minutes) ; the standard modified criteria have been lowered to 135 since the late 1980s

Antenatal record

On the first visit to her obstetrician or midwife, the pregnant woman is asked to carry out the antenatal record, which constitutes a medical history and physical examination. On subsequent visits, the gestational age (GA) is rechecked with each visit.

Symphysis-fundal height (SFH; in cm) should equal gestational age after 20 weeks of gestation, and the fetal growth should be plotted on a curve during the antenatal visits. The fetus is palpated by the midwife or obstetrician using Leopold maneuver to determine the position of the baby. Blood pressure should also be monitored, and may be up to 140/90 in normal pregnancies. High blood pressure indicates hypertension and possibly pre-eclampsia, if severe swelling (edema) and spilled protein in the urine are also present.

Fetal screening is also used to help assess the viability of the fetus, as well as congenital problems. Genetic counseling is often offered for families who may be at an increased risk to have a child with a genetic condition. Amniocentesis at around the 20th week is sometimes done for women 35 or older to check for Down's Syndrome and other chromosome abnormalities in the fetus.

Even earlier than amniocentesis is performed, the mother may undergo the triple test, nuchal screening, nasal bone, alpha-fetoprotein screening and Chorionic villus sampling, also to check for disorders such as Down Syndrome. Amniocentesis is a prenatal genetic screening of the fetus, which involves inserting a needle through the mother's abdominal wall and uterine wall, to extract fetal DNA from the amniotic fluid. There is a risk of miscarriage and fetal injury with amniocentesis because it involves penetrating the uterus with the baby still in utero.

Imaging

A dating scan at 12 weeks.

Imaging is another important way to monitor a pregnancy. The mother and fetus are also usually imaged in the first trimester of pregnancy. This is done to predict problems with the mother; confirm that a pregnancy is present inside the uterus; estimate the gestational age; determine the number of fetuses and placentae; evaluate for an ectopic pregnancy and first trimester bleeding; and assess for early signs of anomalies.

X-rays and computerized tomography (CT) are not used, especially in the first trimester, due to the ionizing radiation, which has teratogenic effects on the fetus. No effects of magnetic resonance imaging (MRI) on the fetus have been demonstrated, but this technique is too expensive for routine observation. Instead, ultrasound is the imaging

method of choice in the first trimester and throughout the pregnancy, because it emits no radiation, is portable, and allows for realtime imaging.

Ultrasound imaging may be done at any time throughout the pregnancy, but usually happens at the 12th week (dating scan) and the 20th week (detailed scan).

A normal gestation would reveal a gestational sac, yolk sac, and fetal pole. The gestational age can be assessed by evaluating the mean gestational sac diameter (MGD) before week 6, and the crown-rump length after week 6. Multiple gestation is evaluated by the number of placentae and amniotic sacs present.

Complications and emergencies

The main emergencies include:

- Ectopic pregnancy is when an embryo implants in the Fallopian tube or (rarely) on the ovary or inside the peritoneal cavity. This may cause massive internal bleeding.
- Pre-eclampsia is a disease which is defined by a combination of signs and symptoms that are related to maternal hypertension. The cause is unknown, and markers are being sought to predict its development from the earlist stages of pregnancy. Some unknown factors cause vascular damage in the endothelium, causing hypertension. If severe, it progresses to *eclampsia*, where a convulsions occur, which can be fatal. Preeclamptic patients with the HELLP syndrome show liver failure and Disseminated intravascular coagulation (DIC).
- Placental abruption where the patient can bleed to death if not managed appropriately.
- Fetal distress where the fetus is getting compromised in the uterine environment.
- Shoulder dystocia where one of the fetus' shoulders becomes stuck during vaginal birth, especially in macrosomic babies of diabetic mothers.
- Uterine rupture can occur during obstructed labor and endangered fetal and maternal life.
- Prolapsed cord refers to the prolapse of the fetal cord during labor with the risk of fetal suffocation.
- Obstetrical hemorrhage may be due to a number of factors such as placenta previa, uterine rupture of tears, uterine atony, retained placenta or placental fragments, or bleeding disorders.
- Puerperal sepsis is a progressed infection of the uterus during or after labor.

Fetal assessments

Ultrasound is routinely used for dating the gestational age of a pregnancy from the size of the fetus, the most accurate dating being in first trimester before the growth of the fetus has been significantly influenced by other factors. Ultrasound is also used for detecting congenital anomalies (or other fetal anomalies) and determining the biophysical profiles (BPP), which are generally easier to detect in the second trimester when the fetal

structures are larger and more developed. Specialised ultrasound equipment can also evaluate the blood flow velocity in the umbilical cord, looking to detect a decrease/absence/reversal or diastolic blood flow in the umbilical artery.

Other tools used for assessment include:

- Fetal karyotype can be used for the screening of genetic diseases. This can be obtained via amniocentesis or chorionic villus sampling (CVS)
- Fetal hematocrit for the assessment of fetal anemia, Rh isoimmunization, or hydrops can be determined by percutaneous umbilical blood sampling (PUBS) which is done by placing a needle through the abdomen into the uterus and taking a portion of the umbilical cord.
- Fetal lung maturity is associated with how much surfactant the fetus is producing. Reduced production of surfactant indicates decreased lung maturity and is a high risk factor for infant respiratory distress syndrome. Typically a lecithin:sphingomyelin ratio greater than 1.5 is associated with increased lung maturity.
- Nonstress test (NST) for fetal heart rate
- Oxytocin challenge test

Childbirth

Induction

Induction is a method of artificially or prematurely stimulating labour in a woman. Reasons to induce can include pre-eclampsia, placental malfunction, intrauterine growth retardation, and other various general medical conditions, such as renal disease. Induction may occur any time after 34 weeks of gestation if the risk to the fetus or mother is greater than the risk of delivering a premature fetus regardless of lung maturity.

Induction may be achieved via several methods:

- Pessary of *Prostin* cream, prostaglandin E_2
- Intravaginal or oral administration of misoprostol
- Cervical insertion of a 30-mL Foley catheter
- Rupturing the amniotic membranes
- Intravenous infusion of synthetic oxytocin (Pitocin or Syntocinon)

Labor

During labor itself, the obstetrician/doctor/intern/medical student under supervision may be called on to do a number of tasks. These tasks can include:

- Monitor the progress of labor, by reviewing the nursing chart, performing vaginal examination, and assessing the trace produced by a fetal monitoring device (the cardiotocograph)

- Accelerate the progress of labor by infusion of the hormone oxytocin
- Provide pain relief, either by nitrous oxide, opiates, or by epidural anesthesia done by anaesthestists, an anesthesiologist, or a nurse anesthetist.
- Surgically assisting labor, by forceps or the Ventouse (a suction cap applied to the fetus' head)
- Caesarean section, if there is an associated risk with vaginal delivery, as such fetal or maternal compromise supported by evidence and literature. Caesarean section can either be elective, that is, arranged before labor, or decided during labor as an alternative to hours of waiting. True "emergency" Cesarean sections include abruptio placenta, and are more common in multigravid patients, or patients attempting a Vaginal Birth After Caeserean section (VBAC).

Postnatal

A woman in the Western world who is delivering in a hospital may leave the hospital as soon as she is medically stable and chooses to leave, which can be as early as a few hours postpartum, though the average for spontaneous vaginal delivery (SVD) is 1–2 days, and the average caesarean section postnatal stay is 3–4 days. During this time the mother is monitored for bleeding, bowel and bladder function, and baby care. The infant's health is also monitored.

Post-Natal Care

• Care provided to the mother following parturition. Certain things must be kept in mind as the physician proceeds with the post-natal care.

1. General Condition of the patient.
2. Check for Vital Signs (Pulse, Blood Pressure, Temperature, Respiratory Rate, (Pain) at times)
3. Palor?
4. Edema?
5. Dehydration?
6. Fundus (height following parturition, and the feel of the fundus) (Per Abdominal Examination)
7. If an Episiotomy or a C-Section was performed, check for the dressing. Intact, pus, oozing, haematomas?
8. Lochia (colour, amount, odour)?
9. Bladder (keep the patient catheterized for 12 hours following local anaesthesia and 24-48 hours after general anaesthesia) ? (check for bladder function)
10. Bowel Movements?
11. Follow up with the neonate to check if they’re healthy.

Salary

The salary of a obstetrician varies by country. In the United States, the salary ranges from $200,000 to $339,738.

Country	Annual salary (US$)
United Kingdom	187,771
United Arab Emirates	231,809
United States	236,411

Chapter 2

Prenatal Care

A doctor performs a prenatal exam.

Prenatal care refers to the medical and nursing care recommended for women before and during pregnancy. The aim of good prenatal care is to detect any potential problems early, to prevent them if possible (through recommendations on adequate nutrition, exercise, vitamin intake etc), and to direct the woman to appropriate specialists, hospitals, etc. if necessary. The availability of routine prenatal care has played a part in reducing maternal death rates and miscarriages as well as birth defects, low birth weight, and other preventable infant problems. Animal studies indicate that mothers' (and possibly fathers') diet, vitamin intake, and glucose levels *prior* to ovulation and conception have long-term effects on fetal growth and adolescent and adult disease.

While availability of prenatal care has considerable personal health and social benefits, socioeconomic problems prevent its universal adoption in many developed as well as developing nations.

One prenatal practice is for the expecting mother to consume vitamins with at least 400 mcg of folic acid to help prevent neural tube defects.

Prenatal care generally consists of:

- monthly visits during the first two trimesters (from week 1–28)
- biweekly from 28 to week 36 of pregnancy
- weekly after week 36 (delivery at week 38–40)
- Assessment of parental needs and family dynamic

Physical examination

Physical examinations generally consist of:

- Collection of (mother's) medical history
- Checking (mother's) blood pressure
- (Mother's) height and weight
- Pelvic exam
- Doppler fetal heart rate monitoring
- (Mother's) blood and urine tests
- Discussion with caregiver

Ultrasound

Obstetric ultrasounds are most commonly performed during the second trimester at approximately week 20. Ultrasounds are considered relatively safe and have been used for over 35 years for monitoring pregnancy.

Among other things, ultrasounds are used to:

- Diagnose pregnancy (uncommon)
- Check for multiple fetuse
- Assess possible risks to the mother (e.g., miscarriage, blighted ovum, ectopic pregnancy, or a molar pregnancy condition)
- Check for fetal malformation (e.g., club foot, spina bifida, cleft palate, clenched fists)
- Determine if an intrauterine growth retardation condition exists
- Note the development of fetal body parts (e.g., heart, brain, liver, stomach, skull, other bones)
- Check the amniotic fluid and umbilical cord for possible problems
- Determine due date (based on measurements and relative developmental progress)

Generally an ultrasound is ordered whenever an abnormality is suspected or along a schedule similar to the following:

- 7 weeks — confirm pregnancy, ensure that it's neither molar or ectopic, determine due date
- 13–14 weeks (some areas) — evaluate the possibility of Down Syndrome
- 18–20 weeks
- 34 weeks (some areas) — evaluate size, verify placental position

Prenatal Care and Race in the USA

Many health professionals consider prenatal care a nearly essential practice for pregnant women; however, there are wide gaps in the American population regarding who has access to these services and who actually utilizes these services. For example, African-American expectant mothers are 2.8 times as likely as non-Hispanic white mothers to begin their prenatal care in the third trimester, or to receive no prenatal care during the entirety of the pregnancy. Similarly, Hispanic expectant mothers are 2.5 times as likely as non-Hispanic white mothers to begin their prenatal care in the third trimester, or to receive no prenatal care at all. The following factors impact a woman's likelihood of acquiring prenatal care:

- *Health Insurance:* 13% of women who become pregnant every year in the United States are uninsured, resulting in severely limited access to prenatal care. According to Children's Defense Fund's website, "Almost one in every four pregnant Black women and more than one in three pregnant Latina women is uninsured, compared with one in nearly seven pregnant White women. Without coverage, Black and Latina mothers are less likely to access or afford prenatal care." Currently, pregnancy is considered a "pre-existing condition," making it much harder for uninsured pregnant women to actually be able to afford private health insurance.

- *Formal Education:* Oftentimes, Black and Hispanic pregnant women have fewer years of formal education, which sparks a large domino effect of consequences related to prenatal care. A lack of formal education results in less knowledge about pregnancy appropriate prenatal healthcare as a whole, fewer job opportunities, and a lower level of income throughout their adult life.

- *Trust & Comfort with Healthcare Industry:* Many minority women have limited experience with the healthcare industry on a whole, as compared to their Caucasian counterparts. Consequently, there is a lower level of trust with physicians, nurses, and the entire care regimen. Many women who are distrustful of biomedicine will decline certain prenatal tests, citing their own bodily knowledge as more trustworthy than their doctor's high-tech interpretations. Even worse, some minority women may opt to avoid the distress and discomfort of the medical industry and refuse prenatal care entirely.

- *Understanding of Prenatal Testing:* Many ethnic/racial minority mothers are referred to genetic counseling and prenatal testing centers after being declared "at-risk" for birth defects after initial screenings. However, few testing centers

effectively communicate what occurs during the various tests, what the test is looking for, or what the various results could mean for the remainder of the pregnancy. Therefore, some mothers are quite uncomfortable with this lack of clearly-communicated information and are consequently hesitant to pursue prenatal testing and counseling that health professionals would consider recommendable.

Consequences of Minorities' Limited Access to Prenatal Care

Without timely, thorough, and appropriate prenatal care, the racial minorities of the United States continue to face severe consequences for the birth outcome of both infant and mother.

- *Delivery Complications:* In one study, researchers found that all minority races experienced higher rates of complications such as: intrauterine growth restriction, preeclampsia, preterm premature rupture of membranes, gestational diabetes, placenta previa, and preterm birth.

- *Low Birth Weight:* Black infants are almost twice as likely to be born at a low birth weight as White babies. This birth complication is ranked as the most prevalent cause of death among African American infants, claiming 1780 lives in 2005.

- *Congenital Malformations:* Any genetic factor or prenatal event that adversely affects the development of the fetus in utero can result in a congenital malformation. Some commonly known congenital malformations are cleft palate, heart defects, and Down syndrome. As of 2005, congenital malformations are the leading cause of death among Hispanic infants, claiming 1373 lives.

- *Infant Mortality:* In the United States, the non-Hispanic white population experiences an infant mortality rate of 5.8 deaths per every 1000 live births. The African-American population's infant mortality rate is 2.3 times greater (13.6 deaths per 1000 live births).

- *Impact of Prenatal Care on Birth Outcomes:* When women utilize prenatal care appropriately, many of them increase their chances of having a successful birth outcome. For example, prenatal care includes discussions with physicians about what lifestyle changes should be made during pregnancy (such as tobacco or alcohol cessation); if these changes do not occur, the pregnancy is more likely to be problematic or result in an infant with a defect or prone to early mortality. Additionally, doctors can provide prescriptions for specific prenatal vitamins and supplements to ensure a healthy mother and infant. Finally, specific prenatal tests screen for genetic abnormalities, and expectant mothers can learn if their fetuses have any significant defects prior to delivery; in these situations, physicians and genetic counselors can help advise mothers about their options for continuing the pregnancy. While some poor birth outcomes cannot be entirely avoided through

prenatal care, the pregnant woman can receive important information, advice, and guidance about her own individual situation, rather than being surprised in the delivery room with some unexpected news.

- *Pregnancy and Exercise:* Updated recommendations by the American College of Sports Medicine suggest at least 2-1/2 hours of moderate-intensity aerobic activity spread throughout the week for pregnant and postpartum women. Women who regularly engage in high-intensity or higher amounts of activity may continue under the counsel of their health care professional provided their condition remains unchanged.

Prenatal Care Improvements for Minorities

Although minorities continue to face decreased access to high-quality prenatal care, there are specific improvements the biomedical field can make to fix this disparity.

- *Connect physicians and patients on a cultural level:* For many minority patients, it is difficult to develop a long-standing and trusting relationship with healthcare providers of different cultural backgrounds, as each culture has its own priorities, values, and goals. In traditionally underserved communities with sizeable minority populations, healthcare providers should strive to offer physicians and nurses who match the racial background of the patients they are working to serve.

- *Improve all providers' cultural awareness and sensitivity:* If patients cannot be matched with healthcare providers culturally, then they should at least be able to visit a physician who is trained specifically to deal with cultural differences. This awareness and sensitivity can come in many forms, such as a familiarity with a foreign language, an understanding of how a specific ethnicity views mothers, or knowing how family networks play into the mothers' decision-making process. All of these options have the potential to improve doctor-patient relationships, and this sort of education can be implemented in medical training programs both in medical school settings and on-site training programs.

- *Community Outreach Programs:* Because hospitals and doctors' offices are unfamiliar and unwelcoming places for some individuals, the healthcare industry should establish a multifaceted community outreach program in large cities. These programs would train members of the minority population in basic health education; then these community health workers would help to facilitate connections between expectant mothers and local healthcare establishments. The community health workers could even continue their relationship throughout the duration of the pregnancy, serving as a patient liaison during the various tests, appointments, and conversations.

Chapter 3

Prenatal Diagnosis

Prenatal diagnosis or **prenatal screening** is testing for diseases or conditions in a fetus or embryo before it is born. The aim is to detect birth defects such as neural tube defects, Down syndrome, chromosome abnormalities, genetic diseases and other conditions, such as spina bifida, cleft palate, Tay Sachs disease, sickle cell anemia, thalassemia, cystic fibrosis, and fragile x syndrome. Screening can also be used for prenatal sex discernment. Common testing procedures include amniocentesis, ultrasonography including nuchal translucency ultrasound, serum marker testing, or genetic screening. In some cases, the tests are administered to determine if the fetus will be aborted, though physicians and patients also find it useful to diagnose high-risk pregnancies early so that delivery can be scheduled in a tertiary care hospital where the baby can receive appropriate care.

Fetal screening has also been done to determine characteristics generally not considered birth defects, and avail for e.g. sex selection. The rise of designer babies and parental selection for specific traits raises a host of bioethical and legal issues that will dominate reproductive rights debates in the 21st century.

Invasiveness

Diagnostic prenatal testing can be by invasive or non-invasive methods. An invasive method involves probes or needles being inserted into the uterus, e.g. amniocentesis, which can be done from about 14 weeks gestation, and usually up to about 20 weeks, and chorionic villus sampling, which can be done earlier (between 9.5 and 12.5 weeks gestation) but which may be slightly more risky to the fetus. However since chorionic villus sampling is performed earlier in the pregnancy than amniocentesis, typically during the first trimester, it can reasonably be expected that there will be a higher rate of miscarriage after chorionic villus sampling than after amniocentesis. Non-invasive techniques include examinations of the woman's womb through ultrasonography and maternal serum screens (i.e. Alpha-fetoprotein) and also genetic analysis on fetal cells isolated from maternal blood. Non-invasive genetic tests for Down Syndrome, Trisomy 18, and Trisomy 13 fetal DNA present in maternal blood are in development. If an elevated risk of chromosomal or genetic abnormality is indicated by a non-invasive screening test, a more invasive technique may be employed to gather more information.

In the case of neural tube defects, a detailed ultrasound can non-invasively provide a definitive diagnosis.

A journal released at January 2011 stated that a new DNA blood test to detect Down syndrome can cut the need for invasive tests by up to 98 percent. The test is highly accurate in detecting whether a fetus carries an extra copy of chromosome 21, and it produces virtually no false negative result, but the test is expensive and does not eliminate the problem of false positives.

Fetal versus maternal

Some screening tests performed on the woman are intended to detect traits or characteristics of the fetus. Others detect conditions in the woman that may have an adverse effect on the fetus, or that threaten the pregnancy. For example, abnormally low levels of the serum marker PAPP-A have been shown to correspond to an increased risk of pre-eclampsia, in which the mother's high blood pressure can threaten the pregnancy, though many physicians find regular blood-pressure monitoring to be more reliable.

Reasons for prenatal diagnosis

There are three purposes of prenatal diagnosis: (1) to enable timely medical or surgical treatment of a condition before or after birth, (2) to give the parents the chance to abort a fetus with the diagnosed condition, and (3) to give parents the chance to "prepare" psychologically, socially, financially, and medically for a baby with a health problem or disability, or for the likelihood of a stillbirth.

Having this information in advance of the birth means that healthcare staff as well as parents can better prepare themselves for the delivery of a child with a health problem. For example, Down Syndrome is associated with cardiac defects that may need intervention immediately upon birth.

Many expectant parents would like to know the sex of their baby before birth. Methods include amniocentesis with karyotyping, and prenatal ultrasound. In some countries, health care providers are expected to withhold this information from parents, while in other countries they are expected to give this information.

Qualifying risk factors

Because of the miscarriage and fetal damage risks associated with amniocentesis and CVS procedures, many women prefer to first undergo screening so they can find out if the fetus' risk of birth defects is high enough to justify the risks of invasive testing. Since screening tests yield a risk score which represents the chance that the baby has the birth defect, the most common threshold for high-risk is 1:270. A risk score of 1:300 would therefore be considered low-risk by many physicians. However, the trade-off between risk of birth defect and risk of complications from invasive testing is relative and subjective; some parents may decide that even a 1:1000 risk of birth defects warrants an

invasive test while others wouldn't opt for an invasive test even if they had a 1:10 risk score.

ACOG guidelines currently recommend that all pregnant women, regardless of age, be offered invasive testing to obtain a definitive diagnosis of certain birth defects. Therefore, most physicians offer diagnostic testing to all their patients, with or without prior screening and let the patient decide.

The following are some reasons why a patient might consider her risk of birth defects already to be high enough to warrant skipping screening and going straight for invasive testing.

- Women over the age of 35
- Women who have previously had premature babies or babies with a birth defect, especially heart or genetic problems
- Women who have high blood pressure, lupus, diabetes, asthma, or epilepsy
- Women who have family histories or ethnic backgrounds prone to genetic disorders, or whose partners have these
- Women who are pregnant with multiples (twins or more)
- Women who have previously had miscarriages

Methods of prenatal screening and diagnosis

There are multiple ways of classifying the methods available, including the invasiveness and the time performed.

Invasiveness	Test	Comments	Time
Non-invasive	Fetal Cells in Maternal Blood (FCMB)	Based on enrichment of fetal cells which circulate in maternal blood. Since fetal cells hold all the genetic information of the developing fetus they can be used to perform prenatal diagnosis.	First trimester
Non-invasive	Preimplantation Genetic Diagnosis (PGD)	During in vitro fertilization (IVF) procedures, it is possible to sample cells from human embryos prior the implantation. PGD is in itself non-invasive, but IVF usually involves invasive procedures such as transvaginal oocyte retrieval	prior to implantation
Non-invasive	External examination	Examination of the woman's uterus from outside the body.	First or second trimester
Non-invasive	Ultrasound detection	Commonly *dating scans* (sometimes known as *booking scans*) from 7	First or second

		weeks to confirm pregnancy dates and look for twins. The specialised nuchal scan at 11–13 weeks may be used to identify higher risks of Downs syndrome. Later *morphology scans* from 18 weeks may check for any abnormal development.	trimester
Non-invasive	Fetal heartbeat	Listening to the fetal heartbeat	First or second trimester
Non-invasive	Non-stress test	Use of cardiotocography during the third trimester to monitor fetal wellbeing	Third trimester
Less invasive	Maternal serum screening (triple test)	Second trimester maternal serum screening (AFP screening, triple screen, quad screen, or penta screen) can check levels of alpha fetoprotein, β-hCG, inhibin-A, estriol, and h-hCG (hyperglycosolated hCG) in the woman's serum.	Second trimester
Less invasive	Transcervical retrieval of trophoblast cells	Cervical mucus aspiration, cervical swabbing, and cervical or intrauterine lavage can be used to retrieve trophoblast cells for diagnostic purposes, including prenatal genetic analysis. Success rates for retrieving fetal trophoblast cells vary from 40% to 90%. It can be used for fetal sex determination and identify aneuploidies. Antibody markers have proven useful to select trophoblast cells for genetic analysis and to demonstrate that the abundance of recoverable trophoblast cells diminishes in abnormal gestations, such as in ectopic pregnancy or anembryonic gestation.	First trimester
Less invasive	Maternal serum screening (triple test)	First trimester maternal serum screening can check levels of free β-hCG, PAPP-A, intact or beta hCG, inhibin-A, or h-hCG in the woman's serum, and combine these with the measurement of nuchal translucency (NT). Some institutions also look for the presence of a fetal nasalbone on	First trimester

		the ultrasound.	
Less invasive	Detection of fetal blood cells in maternal blood	With this technique, it is technically possible to obtain a sample of fetal DNA using blood cells from the fetus that have made their way into the woman's bloodstream. Tests such as Baby Gender Mentor allegedly use this method to determine the sex of a fetus as early as six weeks into a pregnancy. Recent developments have also allowed such testing to be used to detect fetal aneuploidy. However, fetal blood cells in maternal blood are extremely rare and very fragile, making it very hard to handle and analyze them. Several companies continue to develop technologies that may someday offer a new way to screen or even diagnose chromosomal abnormalities.	
More invasive	Chorionic villus sampling	Involves getting a sample of the chorionic villus and testing it. This can be done earlier than amniocentesis, but may have a higher risk of miscarriage, estimated at 1%.	After 10 weeks
More invasive	Amniocentesis	This can be done once enough amniotic fluid has developed to sample. Cells from the fetus will be floating in this fluid, and can be separated and tested. Miscarriage risk of amniocentesis is commonly quoted as 0.5% (1:200). By amniocentesis is also possible to cryopreserve amniotic stem cells.	After 15 weeks
More invasive	Embryoscopy and fetoscopy	Though rarely done, these involve putting a probe into a women's uterus to observe (with a video camera), or to sample blood or tissue from the embryo or fetus.	
More invasive	Percutaneous umbilical cord blood sampling		

Advances in Prenatal Screening

Measurement of fetal proteins in maternal serum is a part of standard prenatal screening for fetal aneuploidy and neural tube defects. Computational predictive model shows that extensive and diverse feto-maternal protein trafficking occurs during pregnancy and can be readily detected non-invasively in maternal whole blood. This computational approach circumvented a major limitation, the abundance of maternal proteins interfering with the detection of fetal proteins, to fetal proteomic analysis of maternal blood. Entering fetal gene transcripts previously identified in maternal whole blood into a computational predictive model helped develop a comprehensive proteomic network of the term neonate. It also shows that the fetal proteins detected in pregnant woman's blood originate from a diverse group of tissues and organs from the developing fetus. Development proteomic networks dominate the functional characterization of the predicted proteins, illustrating the potential clinical application of this technology as a way to monitor normal and abnormal fetal development.

Typical screening sequence

California provides a useful guide to most of the currently available screening paradigms.

At early presentation of pregnancy at around 6 weeks, early dating ultrasound scan may be offered to help confirm the gestational age of the embryo and check whether a single or twin pregnancy, but such a scan is unable detect common abnormalities. Details of prenatal screening and testing options may be provided.

Around weeks 10-11, nuchal thickness scan (NT) may be offered which can be combined with blood tests for PAPP-A and beta-hCG, two serum markers that correlate with chromosomal abnormalities, in what is called the First Trimester Combined Test. The results of the blood test are them combined with the NT ultrasound measurements, maternal age, and gestational age of the fetus to yield a risk score for Down Syndrome, Trisomy 18, and Trisomy 13. First Trimester Combined Test has a sensitivity (i.e. detection rate for abnormalities) of 82-87% and a false-positive rate around 5%.

Alternatively, a second trimester Quad blood test may be taken (the triple test is widely considered obsolete but in some states, such as Missouri, where Medicaid only covers the Triple test, that's what the patient typically gets). With *integrated screening*, both a First Trimester Combined Test and a Triple/Quad test is performed, and a report is only produced after both tests have been analyzed. However patients may not wish to wait between these two sets of test. With *sequential screening*, a first report is produced after the first trimester sample has been submitted, and a final report after the second sample. With *contingent screening*, patients at very high or very low risks will get reports after the first trimester sample has been submitted. Only patients with *moderate risk* (risk score between 1:50 and 1:2000) will be asked to submit a second trimester sample, after which they will receive a report combining information from both serum samples and the NT measurement. The First Trimester Combined Test and the Triple/Quad test together have a sensitivity of 88-95% with a 5% false-positive rate for Down Syndrome, though they

can also be analyzed in such a way as to offer a 90% sensitivity with a 2% false-positive rate.

Finally for patients who do not receive an NT ultrasound in the 1st trimester may still receive a Serum Integrated test involving measuring PAPP-A serum levels in the 1st trimester and then doing a Quad test in the 2nd trimester. This offers an 85-88% sensitivity and 5% false-positive rate for Down Syndrome. Also, patient may skip 1st trimester screening entirely and receive only a 2nd trimester Quad test, with an 81% sensitivity for Down Syndrome and 5% false-positive rate.

Conditions typically tested for

Use of NT ultrasound will screen for Down Syndrome (Trisomy 21), Edwards Syndrome (Trisomy 18), and Patau Syndrome (Trisomy 13), whilst screens that only use serum markers will screen for Down Syndrome and Trisomy 18, but not Trisomy 13. Considering that Trisomy 13 is extremely rare, maybe 1:5000 pregnancies and 1:16000 births, this difference is probably not significant. The AFP marker, whether alone or as part of the Quad test, can identify 80% of spina bifida, 85% of abdominal wall defects, and 97% of anencephaly. Frequently women will receive a detailed 2nd trimester ultrasound in Weeks 18-20 (Morphology scan) regardless of her AFP level, which makes the AFP score unnecessary. Morphology ultrasound scans being undertaken on larger sized fetuses than in earlier scans, detect other structural abnormalities such as cardiac and renal tract abnormalities.

Rarer conditions also detected

In addition to the direct seeking of chromosomal abnormalities and spina bifida, the blood tests can suggest additional conditions:

- Very low estriol level (part of Quad test) can indicate a risk of Smith-Lemli-Opitz Syndrome (SLOS), an extremely rare (1:100,000) genetic disorder which can then only be confirmed with an amniocentesis. However with a 0.3% false-positive rate, 300 women would be told they are at high-risk of SLOS for every 1 affected pregnancy. Most physicians would agree that subjecting 300 women to an amniocentesis to diagnose 1 case of SLOS is not prudent.
- A low PAPP-A reading from a 1st Trimester serum test could also indicate a risk for pre-eclampsia, intrauterine growth restriction (IUGR), or early fetal demise (i.e. miscarriage). However, because PAPP-A only weakly correlates with these conditions and, in any case, there's little that one can do about them (except for pre-eclampsia, though that is better identified by other means), a PAPP-A test makes little sense except as a component of Down Syndrome screening.

Ethical and practical issues

Ethical issues of prenatal testing

- The option to continue or abort a pregnancy is the primary choice after most prenatal testing. Rarely, fetal intervention corrective procedures are possible.
- Are the risks of prenatal diagnosis, such as amniocentesis worth the potential benefit?
- Some fear that this may lead to being able to pick and choose what children parents would like to have. This could lead to choice in sex, physical characteristics, and personality in children. Some feel this type of eugenic abortion is already underway (for example, sex selection).
- Knowing about certain birth defects such as spina bifida and teratoma before birth may give the option of fetal surgery during pregnancy, or assure that the appropriate treatment and/or surgery be provided immediately after birth.
- Questions of the value of mentally or physically disabled people in society.
- How to ensure that information about testing options is given in a non-directive and supportive way.
- That parents are well informed if they have to consider abortion vs. continuing a pregnancy.

Will the result of the test affect treatment of the fetus?

In some genetic conditions, for instance cystic fibrosis, an abnormality can only be detected if DNA is obtained from the fetus. Usually an invasive method is needed to do this.

If a genetic disease is detected, there is often no treatment that can help the fetus until it is born. However in the US, there are prenatal surgeries for spina bifida foetus. Early diagnosis gives the parents time to research and discuss post-natal treatment and care, or in some cases, abortion. Genetic counselors are usually called upon to help families make informed decisions regarding results of prenatal diagnosis.

False positives and false negatives

Ultrasound of a fetus, which is considered a screening test, can sometimes miss subtle abnormalities. For example, studies show that a detailed 2nd trimester ultrasound, also called a level 2 ultrasound, can detect about 97% of neural tube defects such as spina bifida. Ultrasound results may also show "soft signs," such as an Echogenic intracardiac focus or a Choroid plexus cyst, which are usually normal, but can be associated with an increased risk for chromosome abnormalities.

Other screening tests, such as the Quad test, can also have false positives and false negatives. Even when the Quad results are positive (or, to be more precise, when the Quad test yields a score that shows at least a 1 in 270 risk of abnormality), usually the pregnancy is normal, but additional diagnostic tests are offered. In fact, consider that

Down Syndrome affects about 1:400 pregnancies; if you screened 4000 pregnancies with a Quad test, there would probably be 10 Down Syndrome pregnancies of which the Quad test, with its 80% sensitivity, would call 8 of them high-risk. The quad test would also tell 5% (~200) of the 3990 normal women that they are high-risk. Therefore, about 208 women would be told they are high-risk, but when they undergo an invasive test, only 8 (or 4% of the high risk pool) will be confirmed as positive and 200 (96%) will be told that their pregnancies are normal. Since amniocentesis has approximately a 0.5% chance of miscarriage, one of those 200 normal pregnancies might result in a miscarriage because of the invasive procedure. Meanwhile, of the 3792 women told they are low-risk by the Quad test, 2 of them will go on to deliver a baby with Down Syndrome. The Quad test is therefore said to have a 4% positive predictive value (PPV) because only 4% of women who are told they are "high-risk" by the screening test actually have an affected fetus. The other 96% of the women who are told they are "high-risk" needlessly worry until they get the results back from their invasive procedure and find out that their pregnancy is normal.

By comparison, in the same 4000 women, a screening test that has a 99% sensitivity and a 0.5% false positive rate would detect all 10 positives while telling 20 normal women that they are positive. Therefore, 30 women would undergo a confirmatory invasive procedure and 10 of them (33%) would be confirmed as positive and 20 would be told that they have a normal pregnancy. Of the 3970 women told by the screen that they are negative, none of the women would have an affected pregnancy. Therefore, such a screen would have a 33% positive predictive value. It's still unfortunate that 20 false-positive women have had to undergo an invasive procedure to find out they have a normal pregnancy, but it's still better than 200 false-positives with the Quad test.

The real-world false-positive rate for the Quad test (as well as 1st Trimester Combined, Integrated, etc.) is greater than 5%. 5% was the rate quoted in the large clinical studies that were done by the best researchers and physicians, where all the ultrasounds were done by well-trained sonographers and the gestational age of the fetus was calculated as closely as possible. In the real world, where calculating gestational age may be a less precise art, the formulas that generate a patient's risk score are not as accurate and the false-positive rate can be higher, even 10%.

Because of the low accuracy of conventional screening tests, 5-10% of women, often those who are older, will opt for an invasive test even if they received a low-risk score from the screening. A patient who received a 1:330 risk score, while technically low-risk (since the cutoff for high-risk is commonly quoted as 1:270), might be more likely to still opt for a confirmatory invasive test. On the other hand, a patient who receives a 1:1000 risk score is more likely to feel assuaged that her pregnancy is normal.

Both false positives and false negatives will have a large impact on a couple when they are told the result, or when the child is born. Diagnostic tests, such as amniocentesis, are considered to be very accurate for the defects they check for, though even these tests are not perfect, with a reported 0.2% error rate (often due to rare abnormalities such as

mosaic Down Syndrome where only some of the fetal/placental cells carry the genetic abnormality).

A higher maternal serum AFP level indicates a greater risk for anencephaly and open spina bifida. This screening is 80% and 90% sensitive for spina bifida and anencephaly, respectively.

Amniotic fluid acetylcholinesterase and AFP level are more sensitive and specific than AFP in predicting neural tube defects.

Many maternal-fetal specialists do not bother to even do an AFP test on their patients because they do a detail ultrasound on all of them in the 2nd trimester, which has a 97% detection rate for neural tube defects such as anencephaly and open spina bifida.

No prenatal test can detect *all* forms of birth defects and abnormalities.

Societal Pressures on Prenatal Testing Decisions

Amniocentesis has become the standard of care for prenatal care visits for women who are "at risk" or over a certain age. Most obstetricians (depending on the country) offer patients the AFP triple test, HIV test, and ultrasounds routinely. However, almost all women meet with a genetic counselor before deciding whether to have prenatal diagnosis. It is the role of the genetic counselor to accurately inform women of the risks and benefits of prenatal diagnosis. Genetic counselors are trained to be non-directive and to support the patient's decision. Some doctors do advise women to have certain prenatal tests and the patient's partner may also influence the woman's decision.

Informed consent and medical malpractice

Obstetricians have an ethical duty to properly inform patients of their options, specifically the availability of screening and diagnostic testing. Physicians have been successfully sued by women who gave birth to babies with abnormalities that could have been detected had they known about their screening options, though the plaintiff must also prove that she would have elected to terminate the pregnancy in the event of a positive finding. Also, physicians who fail to inform their patients of the risks of amniocentesis and CVS might be found guilty of negligence informed consent in the event that the patient sues after a procedure-related miscarriage or fetal damage.

There is a misconception that a physician only needs to do what other physicians typically do (i.e. standard of care). However, in the case of informed consent, the legal standard is more commonly defined as what a reasonable patient would elect to do if she is informed. So if a reasonable patient would want to be screened if only she is informed or if a reasonable patient would want to receive an amniocentesis if only she is informed of that option, then a physician is legally obligated to inform the patient of these options.

As newer, more accurate screening tests emerge, physicians may need to quickly get up to speed on the most recent data and start informing their patients of the existence of these tests. Failure to inform patients of the available of these more accurate screening tests might result in a wrongful birth or wrongful miscarriage lawsuit if the patient can demonstrate that she would have chosen the newer test, if she had known about it, to avoid the unfortunate outcome that resulted from receiving a conventional screening test or invasive procedure.

Chapter 4

Obstetric Ultrasonography

Obstetric sonogram of a baby at 16 weeks. The bright white circle center-right is the head, which faces to the left. Features include the forehead at 10 o'clock, the left ear toward the center at 7 o'clock and the right hand covering the eyes at 9:00.

Obstetric sonography (ultrasonography) is the application of medical ultrasonography to obstetrics, in which sonography is used to visualize the embryo or foetus in its mother's uterus (womb). The procedure is often a standard part of prenatal care, as it yields a variety of information regarding the health of the mother and of the fetus, as well as regarding the progress of the pregnancy.

Types

Traditional obstetric sonograms are done by placing a transducer (a device that converts one type of energy into another) on the abdomen of the pregnant woman. One variant, a *transvaginal sonography,* is done with a probe placed in the woman's vagina. Transvaginal scans usually provide clearer pictures during early pregnancy and in obese women. Also used is *Doppler sonography* which detects the heartbeat of the fetus. Doppler sonography can be used to evaluate the pulsations in the fetal heart and bloods vessels for signs of abnormalities.

Early pregnancy

The gestational sac can sometimes be visualized as early as four and a half weeks of gestation (approximately two and a half weeks after ovulation) and the yolk sac at about five weeks gestation. The embryo can be observed and measured by about five and a half weeks. The heartbeat may be seen as early as 6 weeks, and is usually visible by 7 weeks gestation.

Dating and growth monitoring

Gestational age is usually determined by the date of the woman's last menstrual period, and assuming ovulation occurred on day fourteen of the menstrual cycle. Sometimes a woman may be uncertain of the date of her last menstrual period, or there may be reason to suspect ovulation occurred significantly earlier or later than the fourteenth day of her cycle. Ultrasound scans offer an alternative method of estimating gestational age. The most accurate measurement for dating is the crown-rump length of the fetus, which can be done between 7 and 13 weeks of gestation. After 13 weeks gestation, the fetal age may be estimated by the biparietal diameter (the transverse diameter of the head), the head circumference, the length of the femur (the longest bone in the body), and the many more fetal parameters that have been measured and correlated with age over the last 30 years. Dating is more accurate when done earlier in the pregnancy; if a later scan gives a different estimate of gestational age, the estimated age is not normally changed but rather it is assumed the fetus is not growing at the expected rate.

Not useful for dating, the abdominal circumference of the fetus may also be measured. This gives an estimate of the weight and size of the fetus and is important when doing serial ultrasounds to monitor fetal growth.

Fetal sex determination

Sonogram of male baby, with scrotum and penis in center of image

The sex of the baby can usually be determined by ultrasound at any time after 16 weeks, often at the dating scan around 20 weeks into the pregnancy depending upon the quality of the sonographic machine and skill of the operator. This is also the best time to have an ultrasound done as most infants are the same size at this stage of development. Depending on the skill of the sonographer, ultrasound may suffer from a high rate of false negatives and false positives. This means care has to be taken in interpreting the accuracy of the scan.

Ultrasonography of the cervix

Baby at 14 weeks (profile)

Obstetric sonography has become useful in the assessment of the cervix in women at risk for premature birth. A short cervix preterm is undesirable: At 24 weeks gestation a cervix length of less than 25 mm defines a risk group for preterm birth, further, the shorter the cervix the greater the risk. It also has been helpful to use ultrasonography in women with preterm contractions, as those whose cervix length exceed 30 mm are unlikely to deliver within the next week.

Abnormality screening

In some countries, routine pregnancy sonographic scans are performed to detect developmental defects before birth. This includes checking the status of the limbs and vital organs, as well as (sometimes) specific tests for abnormalities. Some abnormalities detected by ultrasound can be addressed by medical treatment in utero or by perinatal care, though indications of other abnormalities can lead to a decision regarding abortion.

Perhaps the most common such test uses a measurement of the nuchal translucency thickness ("NT-test", or "Nuchal Scan"). Although 91% of fetuses affected by Down

syndrome exhibit this defect, 5% of fetuses flagged by the test do not have Down syndrome.

Ultrasound may also detect fetal organ anomaly. Usually scans for this type of detection are done around 18 to 20 weeks of gestational age.

History

Scottish physician Ian Donald was one of the pioneers of medical use of ultrasound. His article "Investigation of Abdominal Masses by Pulsed Ultrasound" was published in *The Lancet* in 1958. Donald was Regius Professor of Midwifery at the University of Glasgow.

In 1962, after about two years of work, Joseph Holmes, William Wright, and Ralph Meyerdirk developed the first compound contact B-mode scanner. Their work had been supported by U.S. Public Health Services and the University of Colorado. Wright and Meyerdirk left the university to form Physionic Engineering Inc., which launched the first commercial hand-held articulated arm compound contact B-mode scanner in 1963. This was the start of the most popular design in the history of ultrasound scanners.

Obstetric ultrasound has played a significant role in the development of diagnostic ultrasound technology in general. Much of the technological advances in diagnostic ultrasound technology are due to the drive to create better obstetric ultrasound equipment. Acuson Corporation's pioneering work on the development of Coherent Image Formation helped shape the development of diagnostic ultrasound equipment as a whole.

Safety issues

Current evidence indicates that diagnostic ultrasound is safe for the unborn child, unlike radiographs, which employ ionizing radiation. However, no randomized controlled trials have been undertaken to test the safety of the technology, and thus ultrasound procedures are generally not done repeatedly unless medically indicated.

A 2006 study on mice exposed to ultrasound showed neurological changes in the exposed fetuses. Some of the rodent brain cells failed to migrate to their proper position and remained scattered in incorrect parts of the brain.

It has been shown that Low Intensity Pulsed Ultrasound does have a localized effect on growth in human beings. The 1985 FDA-allowed maximum power of 180 milliwatts per square cm is well under the levels used in therapeutic ultrasound, but still higher than the 30-80 milliwatts per square cm range of the Statison V veterinary LIPUS device. LIPUS has been shown to affect tissue growth in as little as 20 minutes of time with repeated daily applications. Adding to the similarity, LIPUS and medical ultrasound both operate in the 1 to 10MHz range.

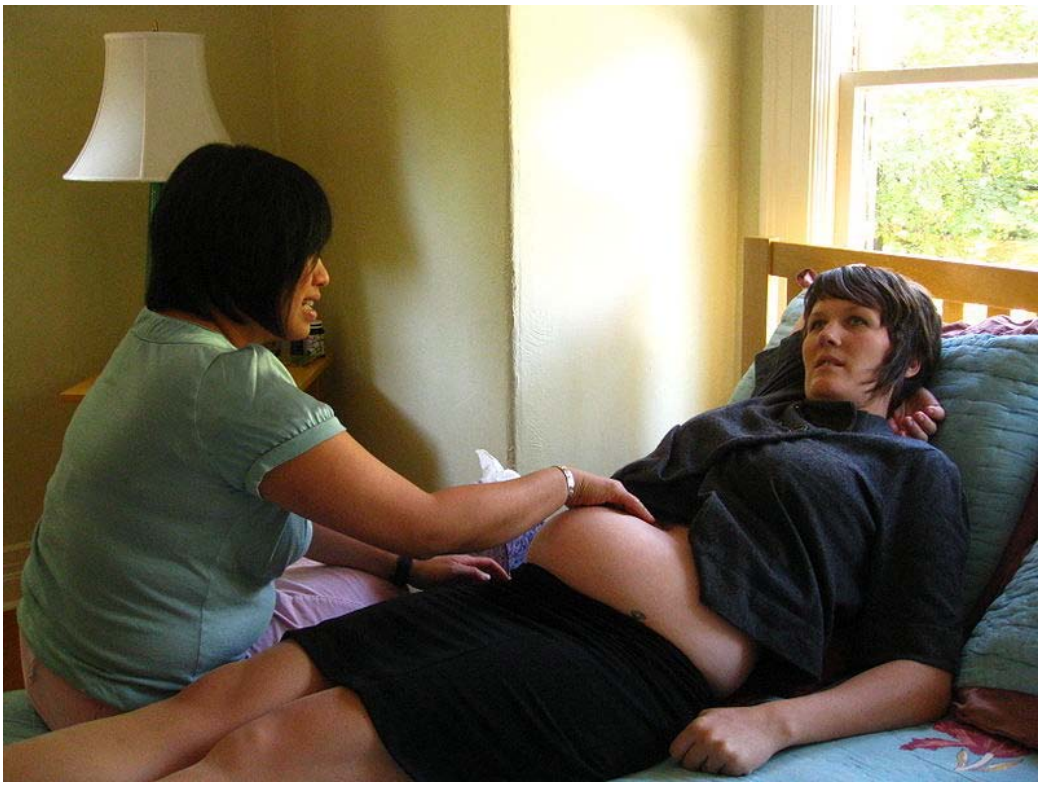
While the benefits of medical ultrasound probably outweigh any risks, vanity uses such as making 3D ultrasound movies without a doctor's order present an obviously

unnecessary, but unknown risk to a developing fetus. The FDA discourages its use for non-medical purposes such as fetal keepsake videos and photos, even though it is the same technology used in hospitals. The demand for keepsake ultrasound products in medical environments has prompted commercial solutions such as self-serve software that allows the patient to create a "keepsake" from the ultrasound imagery recorded during a medical ultrasound procedure.

Conversion of the 3D image files into standard CAD/CAM file formats allows the reconstruction of fetal and other images in a variety of materials including a 3d laser etched images in a crystal glass block or a solid cameo effect using a 3D printer.

Chapter 5

Midwifery



A midwife measures the height of the mother's fundus at about 26 weeks to determine the probable gestational age of the fetus.

Midwifery is a health care profession in which providers offer care to childbearing women during pregnancy, labour and birth, and during the postpartum period. They also care for the newborn and assist the mother with breastfeeding.

A practitioner of midwifery is known as a **midwife**, a term used in reference to both women and men, although the majority of midwives are female. In addition to providing care to women during pregnancy and birth, many midwives also provide primary care to

women, well-woman care related to reproductive health, annual gynecological exams, family planning, and menopausal care.

Midwives are autonomous practitioners who are specialists in low-risk pregnancy, childbirth, and postpartum. They generally strive to help women to have a healthy pregnancy and natural birth experience. Midwives are trained to recognize and deal with deviations from the normal. Obstetricians, in contrast, are specialists in illness related to childbearing and in surgery. The two professions can be complementary, but often are at odds because obstetricians are taught to "actively manage" labor, while midwives are taught not to intervene unless necessary.

Midwives refer women to general practitioners or obstetricians when a pregnant woman requires care beyond the midwives' area of expertise. In many jurisdictions, these professions work together to provide care to childbearing women. In others, only the midwife is available to provide care. Midwives are trained to handle certain situations that may be described as normal variations or may be considered abnormal, including breech births, twin births and births where the baby is in a posterior position, using non-invasive techniques.

Definition

A woman giving birth on a birth chair, from a work by Eucharius Rößlin.

According to the International Confederation of Midwives (a definition that has also been adopted by the World Health Organization and the International Federation of Gynecology and Obstetrics):

A midwife is a person who, having been regularly admitted to a midwifery educational program that is duly recognized in the country in which it is located, has successfully completed the prescribed course of studies in midwifery and has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery.

The midwife is recognised as a responsible and accountable professional who works in partnership with women to give the necessary support, care and advice during pregnancy, labor and the postpartum period, to conduct births on the midwife's own responsibility and to provide care for the infant. This care includes preventive measures, the promotion of normal birth, the detection of complications in mother and child, accessing of medical or other appropriate assistance and the carrying out of emergency measures.

The midwife has an important task in health counseling and education, not only for the woman, but also within the family and community. This work should involve antenatal education and preparation for parenthood and may extend to women's health, sexual or reproductive health and childcare, and to gain the knowledge to counteract the lack of pain relivers and antiseptics.

A midwife may practice in any setting including in the home, the community, hospitals, clinics or health units.

Etymology

The term *midwife* is derived from Middle English: *mid* = "with" and Old English: *wif* = "woman".

Early historical perspective

In ancient Egypt, midwifery was a recognized female occupation, as attested by the Ebers papyrus which dates from 1900 to 1550 BCE. Five columns of this papyrus deal with obstetrics and gynecology, especially concerning the acceleration of parturition and the birth prognosis of the newborn. The Westcar papyrus, dated to 1700 BCE, includes instructions for calculating the expected date of confinement and describes different styles of birth chairs. Bas reliefs in the royal birth rooms at Luxor and other temples also attest to the heavy presence of midwifery in this culture.

Midwifery in Greco-Roman antiquity covered a wide range of women, including old women who continued folk medical traditions in the villages of the Roman Empire, trained midwives who garnered their knowledge from a variety of sources, and highly trained women who were considered female physicians. However, there were certain characteristics desired in a “good” midwife, as described by the physician Soranus of Ephesus in the 2nd century. He states in his work, *Gynecology*, that “a suitable person will be literate, with her wits about her, possessed of a good memory, loving work, respectable and generally not unduly handicapped as regards her senses [i.e., sight, smell, hearing], sound of limb, robust, and, according to some people, endowed with long slim fingers and short nails at her fingertips.” Soranus also recommends that the midwife be of sympathetic disposition (although she need not have borne a child herself) and that she keep her hands soft for the comfort of both mother and child. Pliny, another physician from this time, valued nobility and a quiet and inconspicuous disposition in a midwife. A woman who possessed this combination of physique, virtue, skill, and education must have been difficult to find in antiquity. Consequently, there appears to have been three

"grades" of midwives present in ancient times. The first was technically proficient; the second may have read some of the texts on obstetrics and gynecology; but the third was highly trained and reasonably considered a medical specialist with a concentration in midwifery.

Midwives were known by many different titles in antiquity, ranging from *iatrinē* (Gr. nurse), *maia* (Gr., midwife), *obstetrix* (Lat., obstetrician), and *medica* (Lat., doctor) (. It appears as though midwifery was treated differently in the Eastern end of the Mediterranean basin as opposed to the West. In the East, some women advanced beyond the profession of midwife (*maia*) to that of gynaecologist (*iatros gynaikeios*, translated as *women's doctor*), for which formal training was required. Also, there were some gynecological tracts circulating in the medical and educated circles of the East that were written by women with Greek names, although these women were few in number. Based on these facts, it would appear that midwifery in the East was a respectable profession in which respectable women could earn their livelihoods and enough esteem to publish works read and cited by male physicians. In fact, a number of Roman legal provisions strongly suggest that midwives enjoyed status and remuneration comparable to that of male doctors. One example of such a midwife is Salpe of Lemnos, who wrote on women's diseases and was mentioned several times in the works of Pliny.

However, in the Roman West, our knowledge of practicing midwives comes mainly from funerary epitaphs. Two hypotheses are suggested by looking at a small sample of these epitaphs. The first is the midwifery was not a profession to which freeborn women of families that had enjoyed free status of several generations were attracted; therefore it seems that most midwives were of servile origin. Second, since most of these funeral epitaphs describe the women as freed, it can be proposed that midwives were generally valued enough, and earned enough income, to be able to gain their freedom. It is not known from these epitaphs how certain slave women were selected for training as midwives. Slave girls may have been apprenticed, and it is most likely that mothers taught their daughters.

The actual duties of the midwife in antiquity consisted mainly of assisting in the birthing process, although they may also have helped with other medical problems relating to women when needed. Often, the midwife would call for the assistance of a physician when a more difficult birth was anticipated. In many cases the midwife brought along two or three assistants. In antiquity, it was believed by both midwives and physicians that a normal delivery was made easier when a woman sat upright. Therefore, during parturition, midwives brought a stool to the home where the delivery was to take place. In the seat of the birthstool was a crescent-shaped hole through which the baby would be delivered. The birthstool or chair often had armrests for the mother to grasp during the delivery. Most birthstools or chairs had backs which the patient could press against, but Soranus suggests that in some cases the chairs were backless and an assistant would stand behind the mother to support her. The midwife sat facing the mother, encouraging and supporting her through the birth, perhaps offering instruction on breathing and pushing, sometimes massaging her vaginal opening, and supporting her perineum during the

delivery of the baby. The assistants may have helped by pushing downwards on the top of the mother's abdomen.

Finally, the midwife received the infant, placed it in pieces of cloth, cut the umbilical cord, and cleansed the baby. The child was sprinkled with “fine and powdery salt, or natron or aphronitre” to soak up the birth residue, rinsed, and then powdered and rinsed again. Next, the midwives cleared away any and all mucus present from the nose, mouth, ears, or anus. Midwives were encouraged by Soranus to put olive oil in the baby’s eyes to cleanse away any birth residue, and to place a piece of wool soaked in olive oil over the umbilical cord. After the delivery, the midwife made the initial call on whether or not an infant was healthy and fit to rear. She inspected the newborn for congenital deformities and testing its cry to hear whether or not it was robust and hearty. Ultimately, midwives made a determination about the chances for an infant’s survival and likely recommended that a newborn with any severe deformities be exposed.

A 2nd-century terracotta relief from the Ostian tomb of Scribonia Attice, wife of physician-surgeon M. Ulpius Amerimnus, details a childbirth scene. Scribonia was a midwife and the relief shows her in the midst of a delivery. A patient sits in the birthing chair, gripping the handles and the midwife’s assistant stands behind her providing support. Scribonia sits on a low stool in front of the woman, modestly looking away while also assisting the delivery by dilating and massaging the vagina, as encouraged by Soranus.

The services of a midwife were not inexpensive; this fact that suggests poorer women who could not afford the services of a professional midwife often had to make do with female relatives. Many wealthier families had their own midwives. However, the vast majority of women in the Greco-Roman world very likely received their maternity care from hired midwives. They may have been highly trained or only possessed a rudimentary knowledge of obstetrics. Also, many families had a choice of whether or not they wanted to employ a midwife who practiced the traditional folk medicine or the newer methods of professional parturition. Like a lot of other factors in antiquity, quality gynecological care often depended heavily on the socioeconomic status of the patient.

During the Christian era in Europe, midwives became important to the church due to their role in emergency baptisms, and found themselves regulated by Roman Catholic canon law. In Medieval times, childbirth was considered so deadly that the Christian Church told pregnant women to prepare their shrouds and confess their sins in case of death. The Church pointed to Genesis 3:16 as the basis for pain in childbirth, where Eve's punishment for her role in disobeying God was that he would "multiply thy sorrows, and thy conceptions: in sorrow shalt thou bring forth children." A popular medieval saying was, "The better the witch; the better the midwife"; to guard against witchcraft, the Church required midwives to be licensed by a bishop and swear an oath not to use magic when assisting women through labour.

Later historical perspective

In the 18th century, a division between surgeons and midwives arose, as medical men began to assert that their modern scientific processes were better for mothers and infants than the folk-medical midwives.

At the outset of the 18th century in England, most babies were caught by a midwife, but by the onset of the 19th century, the majority of those babies born to persons of means had a surgeon involved. A number of excellent full-length studies of this historical shift have been written.

German social scientists Gunnar Heinsohn and Otto Steiger theorize that midwifery became a target of persecution and repression by public authorities because midwives not only possessed highly specialized knowledge and skills regarding assisting birth, but also regarding contraception and abortion. According to Heinsohn and Steiger's theory, the modern state persecuted the midwives as witches in an effort to repopulate the European continent which had suffered severe loss of manpower as a result of the bubonic plague (also known as the black death) which had swept over the continent in waves, starting in 1348.

They thus interpret the witch hunts as attacking midwifery and knowledge about birth control with a demographic goal in mind. Indeed, after the witch hunts, the number of children per mother rose sharply, giving rise to what has been called the "European population explosion" of modern times, producing an enormous youth bulge that enabled Europe to colonize large parts of the rest of the world.

While historians specializing in the history of the witch hunts have generally remained critical of this macroeconomic approach and continue to favor micro level perspectives and explanations, prominent historian of birth control John M. Riddle has expressed agreement.

United States

There are two main divisions of modern midwifery in the US: nurse-midwives and direct-entry midwives.

Nurse-midwives

Two Certified Nurse Midwives from Colorado pose with new mother and her son, born at Presbyterian-St. Lukes Medical Center in Denver.

Nurse-midwives were introduced in the United States in 1925 by Mary Breckinridge for use in the Frontier Nursing Service (FNS). Breckinridge chose the nurse-midwifery model used in England and Scotland because she expected these nurse-midwives on horseback to serve the health care needs of the families living in the remote hills of eastern Kentucky. This combination of nurse and midwife was very successful. The Metropolitan Life Insurance Company studied the first seven years of the service and reported a substantially lower maternal and infant mortality rate than for the rest of the country. The report concluded that if this type of care was available to other women in the U.S., thousands of lives would be saved, and suggested nurse-midwife training should be made available in the U.S. Breckinridge founded the Frontier School of Midwifery and Family Nursing in 1939, the first nurse-midwifery education program in the U.S.

The Frontier School is still educating nurse-midwives and has added distance learning to its methodology. In 1989 the program became the first distance option for nurses to become nurse-midwives without leaving their home communities. The students do their academic work on-line with the Frontier School of Midwifery and Family Nursing faculty members and they do their clinical practice with a nurse-midwife in their

community who is credentialed by Frontier as a clinical faculty member. This community based model has graduated over 1200 nurse-midwives.

In the United States, nurse-midwives are variably licensed depending on the state as advanced practice nurses, midwives or nurse-midwives. Certified Nurse-Midwives are educated in both nursing and midwifery and provide gynecological and midwifery care of relatively healthy women. In addition to licensing, many nurse-midwives have a master's degree in nursing, public health, or midwifery. Nurse-midwives practice in hospitals, medical clinics and private offices and may deliver babies in hospitals, birth centers and at home. They are able to prescribe medications in all 50 states. Nurse-midwives provide care to women from puberty through menopause. Nurse-midwives may work closely with obstetricians, who provide consultation and assistance to patients who develop complications. Often, women with high risk pregnancies can receive the benefits of midwifery care from a nurse-midwife in collaboration with a physician. Currently, 2% of nurse-midwives are men. The American College of Nurse-Midwives accredits nurse-midwifery/midwifery education programs and serves as the national professional society for the nation's certified nurse-midwives and certified midwives. Upon graduation from these programs, graduates sit for a certification exam administered by the American Midwifery Certification Board.

Direct-entry midwives

A direct-entry midwife is educated in the discipline of midwifery in a program or path that does not require prior education as a nurse. Direct-entry midwives learn midwifery through self-study, apprenticeship, a private midwifery school, or a college- or university-based program distinct from the discipline of nursing. A direct-entry midwife is trained to provide the Midwives Model of Care to healthy women and newborns throughout the childbearing cycle primarily in out-of-hospital settings.

Under the umbrella of "direct-entry midwife" are several types of midwives:

A **Certified Professional Midwife** (CPM) is a knowledgeable, skilled and professional independent midwifery practitioner who has met the standards for certification set by the North American Registry of Midwives (NARM) and is qualified to provide the midwives model of care. The CPM is the only US credential that requires knowledge about and experience in out-of-hospital settings. At present, there are approximately 900 CPMs practicing in the US.

A **Licensed Midwife** is a midwife who is licensed to practice in a particular state. Currently, licensure for direct-entry midwives is available in 24 states.

The term **"Lay Midwife"** has been used to designate an uncertified or unlicensed midwife who was educated through informal routes such as self-study or apprenticeship rather than through a formal program. This term does not necessarily mean a low level of education, just that the midwife either chose not to become certified or licensed, or there

was no certification available for her type of education (as was the fact before the Certified Professional Midwife (CPM) credential was available).

The American College of Nurse-Midwives (ACNM) also provides accreditation to non-nurse midwife programs, as well as colleges that graduate nurse-midwives. This credential, called the **Certified Midwife**, is currently recognized in only three states (New York, New Jersey, and Rhode Island). All CMs must pass the same certifying exam administered by the American Midwifery Certification Board for CNMs.

The North American Registry of Midwives (NARM) is a certification agency whose mission is to establish and administer certification for the credential "Certified Professional Midwife" (CPM). The CPM certification process validates entry-level knowledge, skills, and experience vital to responsible midwifery practice. This certification process encompasses multiple educational routes of entry including apprenticeship, self-study, private midwifery schools, college- and university-based midwifery programs, and nurse-midwifery. Created in 1987 by the Midwives' Alliance of North America (MANA), NARM is committed to identifying standards and practices that reflect the excellence and diversity of the independent midwifery community in order to set the standard for North American midwifery.

Practice

Midwives work with women and their families in many different settings. While the vast majority of nurse-midwives work in hospitals, some nurse-midwives and virtually all direct-entry midwives work within the community or home. In many states, midwives form birthing centers where a group of midwives work together. Midwives generally support and encourage natural childbirth in all practice settings. Laws regarding who can practice midwifery and in what circumstances vary from state to state.

United Kingdom

Midwives are practitioners in their own right in the United Kingdom, and take responsibility for the antenatal, intrapartum and postnatal care of women, up until 28 days after the birth, or as required thereafter. Midwives are the lead health care professional attending the majority of births, mostly in a hospital setting, although home birth is a perfectly safe option for many births. There are a variety of routes to qualifying as a midwife. Most midwives now qualify via a direct entry course, which refers to a three- or four-year course undertaken at university that leads to either a degree or a diploma of higher education in midwifery and entitles them to apply for admission to the register. Following completion of nurse training, a nurse may become a registered midwife by completing an eighteen-month post-registration course (leading to a degree qualification), however this route is only available to adult branch nurses, and any child, mental health, or learning disability branch nurse must complete the full three-year course to qualify as a midwife. Midwifery students do not pay tuition fees and are eligible for financial support for living costs while training. Funding varies depending on which country within the UK the student is located and whether they are taking a degree or

diploma course. Midwifery degrees are paid for by the National Health Service (NHS). Some students may also be eligible for NHS bursaries.

All practising midwives must be registered with the Nursing and Midwifery Council and also must have a Supervisor of Midwives through their local supervising authority. Most midwives work within the National Health Service, providing both hospital and community care, but a significant proportion work independently, providing total care for their clients within a community setting. However, recent government proposals to require insurance for all health professionals is threatening independent midwifery in England.

Midwives are at all times responsible for the woman for whom they are caring, to know when to refer complications to medical staff, to act as the woman's advocate, and to ensure the mother retains choice and control over her childbirth experience. Many midwives are opposed to the "medicalisation" of childbirth, preferring a more approach to care, ensuring a satisfactory outcome for mother and baby.

Midwifery training

Midwifery training is considered one of the most challenging and competitive courses amongst other healthcare subjects. Most midwives undergo a 32 month vocational training program, or an 18 month nurse conversion course (on top of the 32 month nurse training course). Thus midwives potentially could have had up to 5 years of total training. Midwifery training consists of classroom based learning provided by select Universities in conjunction with hospital and community based training placements at NHS Trusts.

Midwives may train to be community Health Visitors (as may Nurses).

Community midwives

Many midwives also work in the community. The role of community midwives include the initial appointments with pregnant women, managing clinics, postnatal care in the home, and attending home births.

Canada

Midwifery was reintroduced as a regulated profession in Canada in the 1990s. After several decades of intensive political lobbying by midwives and consumers, fully integrated, regulated and publicly funded midwifery is now part of the health system in the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Nova Scotia, and in the Northwest Territories and Nunavut. Midwifery legislation has recently been proclaimed in New Brunswick where the government is in the process of integrating midwifery services there. Only Prince Edward Island, Yukon and Newfoundland and Labrador do not have legislation in place for the practice of midwifery.

Midwives in Canada come from a variety of backgrounds including: Aboriginal, post nursing certification, direct-entry and "lay" or traditional midwifery. However, after a process of assessment by the provincial regulatory bodies, registrants are all simply known as 'midwives', 'registered midwives' or by the French-language equivalent, 'sage femme', regardless of their route of training. From the original 'alternative' style of midwifery in the 1960s and 1970s, midwifery practice is offered in a variety of ways within regulated provinces: midwives offer continuity of care within small group practices, choice of birthplace, and a focus on the woman as the primary decision-maker in her maternity care. When women or their newborns experience complications, midwives will work in consultation with an appropriate specialist. Registered midwives have access to appropriate diagnostics like blood tests and ultrasounds and can prescribe a limited schedule of medications. Founding principles of the Canadian model of midwifery include informed choice, choice of birth place, continuity of care from a small group of midwives and respect for the woman as the primary decision maker. Midwives typically have hospital privileges and support women's right to choose where she will have her baby. As fully integrated health care providers, Canada's midwifery homebirth outcomes have been excellent.

Four provinces offer a four year university baccalaureate degree in midwifery. In British Columbia, the program is offered at the University of British Columbia. In Ontario, the Midwifery Education Program (MEP)is offered by a consortium of McMaster University, Ryerson University and Laurentian University. In Manitoba the program is offered by University College of the North, which offers the only degree program exclusively for Aboriginal students; combining education in western and traditional Aboriginal midwifery. In Quebec, the programme is offered at the Université du Québec à Trois-Rivières. In northern Quebec and Nunavut, Inuit women are being educated to be midwives in their own communities. A Bridging program for internationally educated midwives is in place in Ontario at Ryerson University. A federally funded Multi-jurisdictional Midwifery Bridging Program is offered in Western Canada. Regulated provinces and territories admit internationally educated midwives to their regulatory body if they can demonstrate compentency through a Prior Learning and Experience Assessment (PLEA) process.

The legal recognition of midwifery has brought midwives into the mainstream of health care with universal funding for services, hospital privileges, rights to prescribe medications commonly needed during pregnancy, birth and postpartum, and rights to order blood work and ultrasounds for their own clients and full consultation access to physicians. To protect the tenets of midwifery and support midwives to provide woman-centered care, the regulatory bodies and professional associations have legislation and standards in place to provide protection, particularly for choice of birth place, informed choice and continuity of care. All regulated midwives have malpractice insurance. Any unregulated person who provides care with 'restricted acts' in regulated provinces or territories is practicing midwifery without a license and is subject to investigation and prosecution.

Prior to legislative changes, very few Canadian women had access to midwifery care, in part because it was not funded by the health care system. Legalising midwifery has made midwifery services available to a wide and diverse population of women and in many communities the number of available midwives does not meet the growing demand for services. Midwifery services are free to women living in midwifery regulated provinces.

New Zealand

Midwifery regained its status as an autonomous profession in New Zealand in 1990. The *Nurses Amendment Act* restored the professional and legal separation of midwifery from nursing, and established midwifery and nursing as separate and distinct professions. Nearly all midwives gaining registration now are direct entry midwives who have not undertaken any nursing training. Registration requires a Bachelor of Midwifery degree. this is currently a three year full time programme but is in the process of being reviewed by the New Zealand midwifery regulatory authority.

Women must choose one of a midwife, a General Practitioner or an Obstetrician to provide their maternity care. About 78 percent choose a midwife (8 percent GP, 8 percent Obstetrician, 6 percent unknown.). Midwives provide maternity care from early pregnancy to 6 weeks postpartum. The midwifery scope of practise covers normal pregnancy and birth. The midwife will either consult or transfer care where there is a departure from normal. Antenatal and postnatal care is normally provided in the woman's home. Birth can be in the home, a primary birthing unit, or a hospital. Midwifery care is fully funded by the Government. (GP care may be fully funded. Obstetric care will incur a fee in addition to the government funding.)

Netherlands

Midwives are called **vroedvrouw** (female midwives), **vroedmeester** (male midwives), or **verloskundige** (general) in Dutch. Midwives are independent specialists in physiologic birth. In the Netherlands, home birth is still a common practice, although rates have declined during the past decades. In the period of 2005-2008, 29% of babies were delivered at home rather than in a hospital. Midwives are generally organized as private practices, some of those are hospital-based. In-hospital outpatient childbirth is available in most hospitals. In this case, a woman's own midwife delivers the baby at the delivery room of a hospital, without intervention of an obstetrician. In all settings, midwives will transfer care to an obstetrician in case of a complicated childbirth or need for emergency intervention.

Apart from childbirth and immediate postpartum care, midwives are the first line of care in pregnancy control and education of mothers-to-be. Typical information that is given to mothers includes information about food, alcohol, life style, travel, hobbies, sex, etc. Some midwifery practices give additional care in the form of preconceptional care and help with fertility problems.

Education in midwifery is direct entry, i.e. no previous education as a nurse is needed. A 4-year education program can be followed at four colleges, in Groningen, Amsterdam, Rotterdam and Maastricht.

All care by midwives is legal and it is totally reimbursed by all insurance companies. This includes prenatal care, childbirth (by midwives or obstetricians, at home or in the hospital), as well as postpartum/postnatal care for mother and baby at home (*kraamzorg*).

Japan

In Japan, midwifery was first regulated in 1868. Today, midwives must pass a national certification exam. Up until March 1, 2003 only women could be midwives.

Balochistan (Tribal Pakistan)

In Balochistan, midwives are the third most powerful leaders in the community, and the most powerful among women. People say that they give life to a child as the majority of tribal areas have no doctors. Midwives also solve problems between women. If there is a conflict between a man and a woman, the man has more power, and he will go to the tribal chief instead.

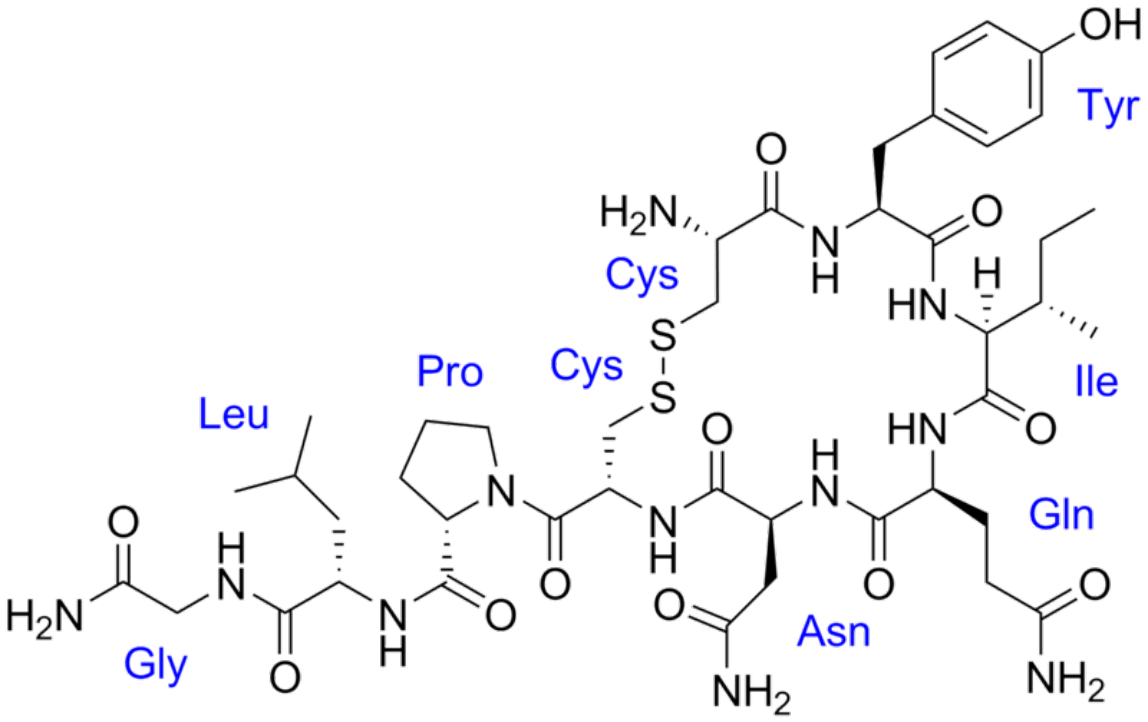
Mozambique

When a 16-year-long civil war ended in 1992, Mozambique's health care system was devastated and one in ten women were dying in childbirth. There were only 18 obstetricians for a population of 19 million. In 2004, Mozambique introduced a new health care initiative to train midwives in emergency obstetric care in an attempt to guarantee access to quality medical care during pregnancy and childbirth. These midwives now perform major surgeries including Cesareans and hysterectomies. As the figures now stand, Mozambique is one of the few countries on track to achieve the United Nations Millennium Development Goal (MDG) of reducing the maternal death rate by 75 percent by 2015.

Chapter 6

Contraction Stress Test and Labor Induction

Contraction stress test



Oxytocin

A **contraction stress test** (CST) is performed near the end of pregnancy to determine how well the fetus will cope with the contractions of childbirth. The aim is to induce contractions and monitor the fetus to check for heart rate abnormalities using a cardiotocograph.

Procedure

Nipple Stimulation

This is a procedure that relies on endogenous release of oxytocin following nipple stimulation, and is conducted by the patient. The nurse instructs the patient on the procedure, as follows. One nipple is massaged gently through clothing until a contraction begins, or for a maximum of 2 minutes. If at least 3 contractions in 10 minutes is not achieved, then the patient rests for 5 minutes and the other nipple is stimulated.

Oxytocin Challenge Test (OCT)

If adequate contractions (at least 3 in 10 minutes) cannot be achieved with nipple stimulation, an oxytocin challenge test may be performed. It involves the intravenous administration of exogenous oxytocin to the pregnant woman. The target is to achieve around three contractions every ten minutes.

Interpretation

***Positive:** presence of late decelerations with at least 50% of the contractions

***Negative:** no late or significant variable decelerations

***Equivocal—Suspicious:** presence of late decelerations with fewer than 50% of contractions) or significant variable decelerations

***Equivocal—Tachysystole:** Presence of contractions that occur more frequently than every 2 minutes or last longer than 90 seconds in the presence of late decelerations

***Equivocal—Unsatisfactory:** Fewer than three contractions occur within 10 minutes, or a tracing quality that cannot be interpreted

Results & Efficacy

The CST is used for its high negative predictive value. A negative result is highly predictive of fetal wellbeing and tolerance of labor. The test has a poor positive predictive value with false-posiive results in as many as 30% of cases.

History

The CST was the first antenatal surveillance test that was developed after the development of the cardiotocograph. The oxytocin challenge test was first described in 1972 and was standardised in 1975 when the parameters of contraction number and frequency were given.

Historically, a CST was done after a non reactive NST. Today, a biophysical profile (BPP) is usually performed.

Contraindications

This "stress test" is usually not performed if there are any signs of premature birth or placenta praevia. Other contraindications include but are not limited to previous uterine incision with scarring, previous myomectomy entering the uterine cavity, PROM and incompetent cervix.

Labor induction

Labor induction is a method of artificially or prematurely stimulating childbirth in a woman.

Indications

Common suggested reasons for induction include:

- The baby is believed to be getting too big.
- Postdate pregnancy, i.e. if the pregnancy has gone past the 42 week mark.
- Intrauterine fetal growth retardation (IUGR).
- There are health risks to the woman in continuing the pregnancy (e.g. she has pre-eclampsia).
- Premature rupture of the membranes (PROM); this is when the membranes have ruptured, but labor does not start within a specific amount of time.
- Premature termination of the pregnancy (abortion).
- Scheduling concerns.
- Fetal death in utero.
- Twin pregnancy continuing beyond 38 weeks.

Methods of induction

Methods of inducing labor include medication and processes.

If an induction causes complications during labor, a Caesarean section is almost always conducted. An induction is most likely to result in successful vaginal delivery when a woman is close to or in the early stages of labor. Signs of impending labor may include softening of the cervix, dilation and increasing frequency or intensity of contractions. The Bishop score may be used to assess the advisability of induction, and is based on such factors.

Medication

- Intravaginal, endocervical or extra-amniotic administration of prostaglandin, such as dinoprostone or misoprostol. In the few controlled trials that have been done, extra-amniotic administration appears to be more efficient than intravaginal or endocervical administration of prostaglandins in labor induction, with no differential effects on other outcome measures.
- Intravenous administration of synthetic oxytocin preparations, such as Pitocin.
- Natural Induction - Many midwives or other holistic providers practice "natural" induction, which may include use of herbs, castor oil or other medically unconventional agents to stimulate or advance a stalled labor.
- Use of mifepristone has been described.
- Relaxin has been investigated, but is not currently commonly used.

Processes

- "Membrane sweep", also known as membrane stripping, or "stretch and sweep" in Australia and the UK - during an internal examination, the midwife moves her finger around the cervix to stimulate and/or separate the membranes around the baby from the cervix. This causes a release of prostaglandins which can help to kick-start labor.
- Artificial rupture of the membranes (AROM or ARM) ("breaking the waters")

When to induce

Until recently, the most common practice has been to induce labor by the end of the 42nd week of gestation. This practice is still very common. Recent studies have shown an increasing risk of infant mortality for births in 41st and particularly 42nd week of gestation, as well as a higher risk of injury to the mother and child . The recommended date for induction of labor has therefore been moved to the end of the 41st week of gestation in many countries including Sweden and Canada.

Criticisms of induction

- Induced labor tends to be more intense and painful for the woman. This can lead to the increased use of analgesics and other pain-relieving pharmaceuticals. These interventions have been said to lead to an increased likelihood of caesarean section delivery for the baby. However, studies into this matter indicate that induction has no effect on the rates of caesarean section. Two more recent studies have shown that induction may increase the risk of caesarean section if performed before the 40th week of gestation, but it has no effect or actually lowers the risk if performed after the 40th week.

- Some feel that doctors show increasing propensity toward induction simply for personal convenience or to relieve load on hospital facilities. "[Induction] enables doctors to practice daylight obstetrics," says Dr. Marsden Wagner, a neonatologist

who served for 15 years as a director of women's and children's health in industrialized countries for the World Health Organization. "It means that as a doctor, I can come in at 9 a.m., give you the pill, and by 6 p.m. I've delivered a baby and I'm home having dinner." A growing number of pregnant women are opting to have induced labor, according to a 12-year study of women in Illinois that was published in the September 2008 issue of the journal Medical Care. The researchers say that the consequences are not clear, but some believe that elective inductions will be done for convenience reasons.

Chapter 7

Childbirth

Childbirth (also called **labour**, **birth**, ***partus*** or **parturition**) is the culmination of a human pregnancy or gestation period with the birth of one or more newborn infants from a woman's uterus. The process of normal human childbirth is categorized in three stages of labour: the shortening and dilation of the cervix, descent and birth of the infant, and birth of the placenta. In many cases, with increasing frequency, childbirth is achieved through caesarean section, the removal of the neonate through a surgical incision in the abdomen, rather than through vaginal birth. In the U.S. and Canada it represents nearly 1 in 3 (31.8%) and 1 in 4 (22.5%) of all childbirths, respectively.

Signs and symptoms

Labour is accompanied by intense and prolonged pain. Pain levels reported by labouring women vary widely. Pain levels appear to be influenced by fear and anxiety levels. Some other factors may include experience with prior childbirth, age, ethnicity, preparation, physical environment and immobility.

Psychological

Childbirth can be an intense event and strong emotions, both positive and negative, can be brought to the surface.

While many women experience joy, relief, and elation upon the birth of their child, some women report symptoms compatible with post-traumatic stress disorder (PTSD) after birth. Between 70 and 80% of mothers in the United States report some feelings of sadness or "baby blues" after childbirth. Postpartum depression may develop in some women; about 10% of mothers in the United States are diagnosed with this condition. Abnormal and persistent fear of childbirth is known as tokophobia.

Preventive group therapy has proven effective as a prophylactic treatment for postpartum depression.

Childbirth is stressful for the infant. In addition to the normal stress of leaving the protected uterine environment, additional stresses associated with breech birth, such as asphyxiation, may affect the infant's brain.

Normal human birth

Mechanism of vaginal birth

Because humans are bipedal with an erect stance and have, in relation to the size of the pelvis, the biggest head of any mammalian species, human fetuses and human female pelvises are adapted to make birth possible.

The erect posture causes the weight of the abdominal contents to thrust on the pelvic floor, a complex structure which must not only support this weight but allow three channels to pass through it: the urethra, the vagina and the rectum. The relatively large head and shoulders require a specific sequence of maneuvers to occur for the bony head and shoulders to pass through the bony ring of the pelvis. A failure of these maneuvers results in a longer and more painful labor and can even arrest labor entirely. All changes in the soft tissues of the cervix and the birth canal depend on the successful completion of these six phases:

1. **Engagement** of the fetal head in the transverse position. The baby's head is facing across the pelvis at one or other of the mother's hips.
2. **Descent and flexion** of the fetal head.
3. **Internal rotation**. The fetal head rotates 90 degrees to the occipito-anterior position so that the baby's face is towards the mother's rectum.
4. **Delivery by extension**. The fetal head passes out of the birth canal. Its head is tilted backwards so that its forehead leads the way through the vagina.
5. **Restitution**. The fetal head turns through 45 degrees to restore its normal relationship with the shoulders, which are still at an angle.
6. **External rotation**. The shoulders repeat the corkscrew movements of the head, which can be seen in the final movements of the fetal head.

The fetal head may temporarily change shape substantially (becoming more elongated) as it moves through the birth canal. This change in the shape of the fetal head is called *molding* and is much more prominent in women having their first vaginal delivery.

Latent phase

The latent phase of labor, also called prodromal labor, may last many days and the contractions are an intensification of the Braxton Hicks contractions that may start around 26 weeks gestation. Cervical effacement occurs during the closing weeks of pregnancy and is usually complete or near complete, by the end of the latent phase. Cervical effacement or cervical dilation is the thinning and stretching of the cervix. The degree of cervical effacement may be felt during a vaginal examination. A 'long' cervix implies that not much has been taken into the lower segment, and vice versa for a 'short' cervix.

Latent phase ends with the onset of active first stage; when the cervix is about 3 cm dilated.

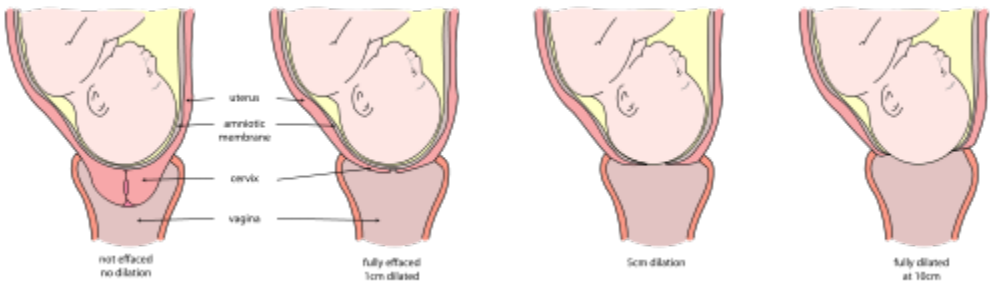
First stage: dilation

There are several factors that midwives and clinicians use to assess the labouring mother's progress, and these are defined by the Bishop Score. The Bishop score is also used as a means to predict whether the mother is likely to spontaneously progress into second stage (delivery).

The first stage of labor starts classically when the effaced (thinned) cervix is 3 cm dilated. There is a variation in this point as some women may have active contractions prior to reaching this point, or they may reach this point without regular contractions. The onset of actual labor is defined when the cervix begins to progressively dilate. Rupture of the membranes, or a blood stained 'show' may or may not occur at or around this stage.

Uterine muscles form opposing spirals from the top of the upper segment of the uterus to its junction with the lower segment. During effacement, the cervix becomes incorporated into the lower segment of the uterus. During a contraction, these muscles contract causing shortening of the upper segment and drawing upwards of the lower segment, in a gradual expulsive motion. This draws the cervix up over the baby's head. Full dilation is reached when the cervix has widened enough to allow passage of the baby's head, around 10 cm dilation for a term baby.

The duration of labour varies widely, but active phase averages some 8 hours for women giving birth to their first child ("primiparae") and 4 hours for women who have already given birth ("multiparae"). Active phase arrest is defined as in a primigravid woman as the failure of the cervix to dilate at a rate of 1.2 cm/hr over a period of at least two hours. This definition is based on Friedman's Curve, which plots an ideal rate of cervical dilation and fetal descent during active labor. Some practitioners may diagnose "Failure to Progress", and consequently, perform an unnecessary Cesarean. However, as is the case with any pre-emptive diagnosis, doing so is severely discouraged due to the extra expense and healing time involved with Cesarean operations.



Sequence of cervix dilation during labor

Second stage: fetal expulsion

This stage begins when the cervix is fully dilated, and ends when the baby is finally born. As pressure on the cervix increases, the Ferguson reflex increases uterine contractions so that the second stage can go ahead. At the beginning of the normal second stage, the head is fully engaged in the pelvis; the widest diameter of the head has successfully passed through the pelvic brim. Ideally it has successfully also passed below the interspinous diameter. This is the narrowest part of the pelvis. If these have been accomplished, what remains is for the fetal head to pass below the pubic arch and out through the introitus. This is assisted by the additional maternal efforts of "bearing down" or pushing. The fetal head is seen to 'crown' as the labia part. At this point, the woman may feel a burning or stinging sensation.

Birth of the fetal head signals the successful completion of the fourth mechanism of labour (delivery by extension), and is followed by the fifth and sixth mechanisms (restitution and external rotation).

A newborn baby with umbilical cord ready to be clamped

The second stage of labour will vary to some extent, depending on how successfully the preceding tasks have been accomplished.

Third stage: umbilical cord closure and placental expulsion

Breastfeeding during and after the third stage, the placenta is visible in the bowl to the right.

The period from just after the fetus is expelled until just after the placenta is expelled is called the *third stage of labor*.

The umbilical cord is routinely clamped and cut in this stage, but it would normally close naturally even if not clamped. A 2008 Cochrane Review looked into the timing of clamping the umbilical cord. It found that the time of clamping made no difference to the mother, but did have effects for the baby. If the chord is clamped after 2–3 minutes, the infant receives increased amounts of haemoglobin in their first months of life, but may have an increased risk of needing phototherapy to treat jaundice. Sometimes a newborn's liver is slow to break down all of the red cells they had in the womb, particularly if they are left with more fetal blood from delayed cord clamping and phototherapy helps to speed the breakdown.

Placental expulsion begins as a physiological separation from the wall of the uterus. The period from just after the fetus is expelled until just after the placenta is expelled is called the *third stage of labor*. The placenta is usually expelled within 15–30 minutes of the baby being born. Placental expulsion can be managed actively, for example by giving oxytocin via intramuscular injection followed by cord traction to assist in delivering the placenta. Alternatively, it can be managed expectantly, allowing the placenta to be expelled without medical assistance. A Cochrane database study suggests that blood loss

and the risk of postpartum bleeding will be reduced in women offered active management of the third stage of labour.

When the amniotic sac has not ruptured during labour or pushing, the infant can be born with the membranes intact. This is referred to as "being born in the caul." The caul is harmless and its membranes are easily broken and wiped away. With the advent of modern interventive obstetrics, artificial rupture of the membranes has become common, so babies are rarely born in the caul.

Fourth stage

The "fourth stage of labor" is a term used in two different senses:

- It can refer to the immediate puerperium, or the hours immediately after delivery of the placenta.
- It can be used in a more metaphorical sense to describe the weeks following delivery.

Afterwards

Many cultures feature initiation rites for newborns, such as naming ceremonies, baptism, and others.

Mothers are often allowed a period where they are relieved of their normal duties to recover from childbirth. The length of this period varies. In many countries, taking time off from work to care for a newborn is called "maternity leave" or "parental leave" and can vary from a few days to several months.

Station

Refers to the relationship of the fetal presenting part to the level of the ischial spines. When the presenting part is at the ichial spines the station is 0 (synonymous with engagement). If the presenting fetal part is above the spines, the distance is measured and described as minus stations, which range from -1 to -4 cm. If the presenting part is below the ischial spines, the distance is stated as plus stations (+1 to +4 cm). At +3 and +4 the presenting part is at the perineum and can be seen. (Edited by Dr.Avadh Sahi)

Management

Eating or drinking during labour has no harmful effects on outcomes.

Pain control

Non pharmaceutical

Some women prefer to avoid analgesic medication during childbirth. They can still try to alleviate labor pain using psychological preparation, education, massage, hypnosis, or water therapy in a tub or shower. Some women like to have someone to support them during labor and birth, such as the father of the baby, the woman's mother, a sister, a close friend, a partner or a doula. Some women deliver in a squatting or crawling position in order to more effetively push during the second stage and so that gravity can aid the descent of the baby through the birth canal.

The human body also has a chemical response to pain, by releasing endorphins. Endorphins are present before, during, and immediately after childbirth. Some homebirth advocates believe that this hormone can induce feelings of pleasure and euphoria during childbirth, reducing the risk of maternal depression some weeks later.

Water birth is an option chosen by some women for pain relief during labor and childbirth, and some studies have shown waterbirth in an uncomplicated pregnancy to reduce the need for analgesia, without evidence of increased risk to mother or newborn. Hot water tubs are available in many hospitals and birthing centres.

Meditation and mind medicine techniques are also used for pain control during labour and delivery. These techniques are used in conjunction with progressive muscle relaxation and many other forms of relaxation for the mind and body to aid in pain control for women during childbirth. One such technique is the use of hypnosis in childbirth. There are a number of organizations that teach women and their partners to use a variety of techniques to assist with labor comfort, without the use of pharmaceuticals.

A new mode of analgesia is sterile water injection placed just underneath the skin in the most painful spots during labor. A control trial in Iran of 0.5mL injections was conducted with normal saline which revealed a statistical superiority with water over saline.

Pharmaceutical

Different measures for pain control have varying degrees of success and side effects to the woman and her baby. In some countries of Europe, doctors commonly prescribe inhaled nitrous oxide gas for pain control, especially as 50% nitrous oxide, 50% oxygen, known as Entonox; in the UK, midwives may use this gas without a doctor's prescription. Pethidine (with or without promethazine) may be used early in labour, as well as other opioids such as fentanyl, but if given too close to birth there is a risk of respiratory depression in the infant.

Popular medical pain control in hospitals include the regional anesthetics epidural blocks, and spinal anaesthesia. Epidural analgesia is a generally safe and effective method of relieving pain in labour, but is associated with longer labour, more operative intervention (particularly instrument delivery), and increases in cost. Generally, pain and cortisol increased throughout labor in women without EDA. Pain and stress hormones rise throughout labor for women without epidurals, while pain, fear, and stress hormones

decrease upon administration of epidural analgesia, but may rise again later. Medicine administered via epidural can cross the placenta and enter the bloodstream of the fetus. Epidural analgesia has no statistically significant impact on the risk of caesarean section, and does not appear to have an immediate effect on neonatal status as determined by Apgar scores.

Augmentation

Augmentation is a procedure which attempts to speed up the process of labour. Oxytocin has been used to increase the rate of vaginal delivery in those with a slow progress of labor.

Instrumental delivery

Obstetric forceps or ventouse may be used to facilitate childbirth.

- The woman will have her legs supported in stirrups.
- If an anaesthetic is not already in place it will be given.
- Episiotomy might be needed.
- A trial forceps might be performed, which is abandoned in favor of a caesarean section if delivery is not optimal.

Multiple births

Twins can be delivered vaginally. In some cases twin delivery is done in a larger delivery room or in the theatre, just in case complications occur e.g.

- Both twins born vaginally - this can occur both presented head first or where one comes head first and the other is breech and/or helped by a forceps/ventouse delivery
- One twin born vaginally and the other by caesarean section.
- If the twins are joined at any part of the body - called conjoined twins, delivery is mostly by caesarean section.

Support

Baby on warming tray attended to by her father.

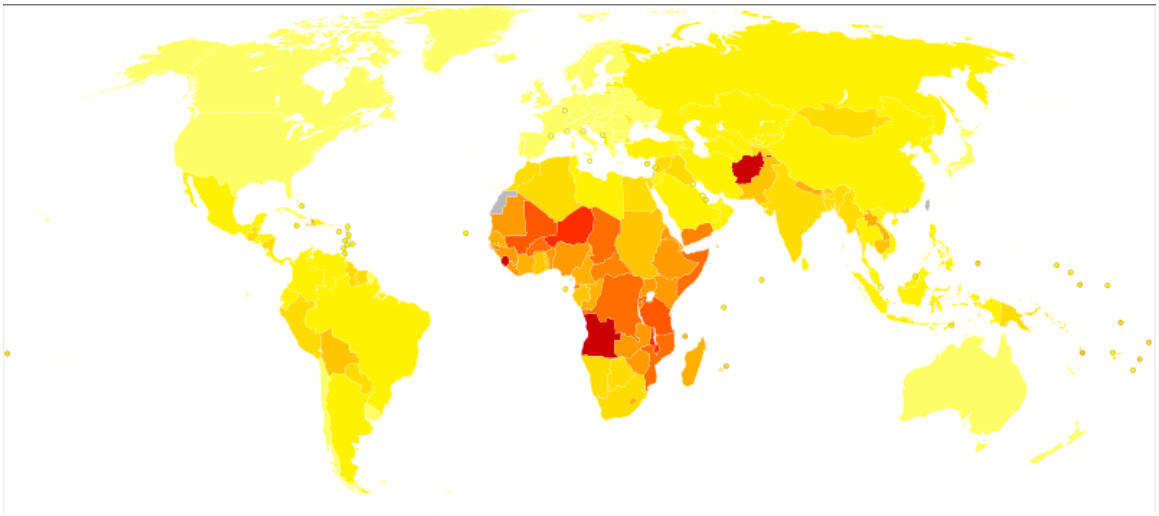
There is increasing evidence to show that the participation of the woman's partner in the birth leads to better birth and also post-birth outcomes, providing the partner does not exhibit excessive anxiety. Research also shows that when a labouring woman was supported by a female helper such as a family member or doula during labour, she had less need for chemical pain relief, the likelihood of caesarean section was reduced, use of forceps and other instrumental deliveries were reduced, there was a reduction in the length of labour, and the baby had a higher Apgar score (Dellman 2004, Vernon 2006). However, little research has been conducted to date about the conflicts between partners, professionals, and the mother.

Collecting stem cells

It is possible to collect two types of stem cells during childbirth: amniotic stem cells or umbilical cord blood stem cells. To collect amniotic stem cells, it is necessary to do amniocentesis before or during the birth. Amniotic stem cells are multipotent and very active, useful for both autologous or donor use. There are private banks in US; the first is Biocell Center in Boston.

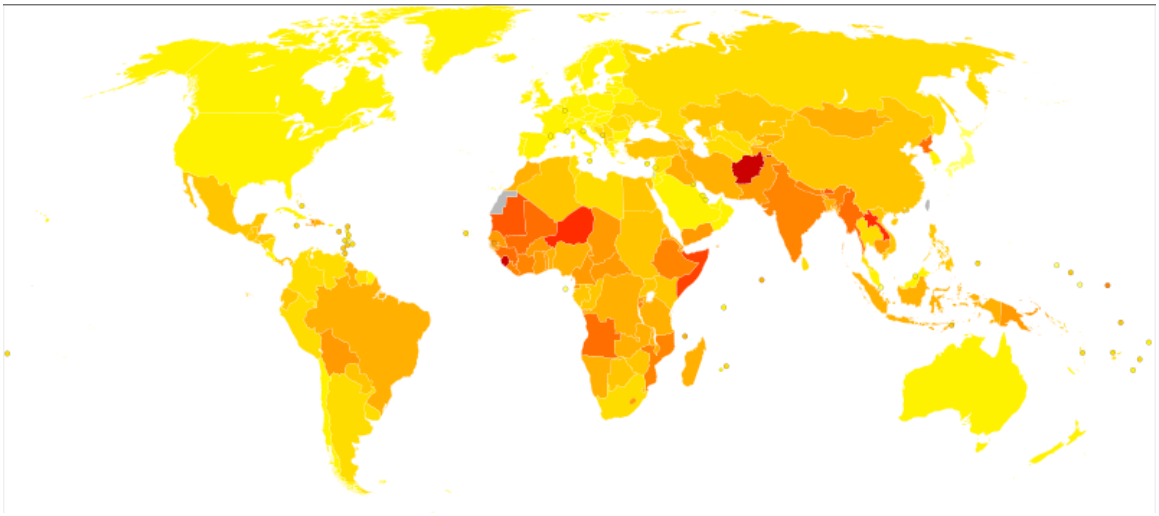
Umbilical cord blood stem cells are also active, but less multipotent than amniotic stem cells. There are a lot of banks of cord blood, both private and public and for autologous or eterologous use.

Complications



Disability-adjusted life year for maternal conditions per 100,000 inhabitants in 2002.

- no data
- less than 100
- 100-400
- 400-800
- 800-1200
- 1200-1600
- 1600-2000
- 2000-2400
- 2400-2800
- 2800-3200
- 3200-3600
- 3600-4000
- more than 4000



Disability-adjusted life year for perinatal conditions per 100,000 inhabitants in 2002.
no data
less than 100
100-400
400-800
800-1200
1200-1600
1600-2000
2000-2400
2400-2800
2800-3200
3200-3600
3600-4000
more than 4000

Childbirth is an inherently dangerous and risky activity, subject to many complications. The "natural" mortality rate of childbirth—where nothing is done to avert maternal death—has been estimated as being 1500 deaths per 100,000 births.. Modern medicine has greatly alleviated the risk of childbirth. In modern Western countries, such as the United States or Sweden, the current maternal mortality rate is around 10 deaths per 100,000 births.

Birthing complications may be maternal or fetal, and long term or short term.

Labor complications

The second stage of labor may be delayed or lengthy due to:

- malpresentation (breech birth (i.e. buttocks or feet first), face, brow, or other)
- failure of descent of the fetal head through the pelvic brim or the interspinous diameter

- poor uterine contraction strength
- active phase arrest
- cephalo-pelvic disproportion (CPD)
- shoulder dystocia

Secondary changes may be observed: swelling of the tissues, maternal exhaustion, fetal heart rate abnormalities. Left untreated, severe complications include death of mother and/or baby, and genitovaginal fistula. These are commonly seen in Third World countries where births are often unattended or attended by poorly trained community members.

Maternal complications

Vaginal birth injury with visible tears or episiotomies are common. Internal tissue tearing as well as nerve damage to the pelvic structures lead in a proportion of women to problems with prolapse, incontinence of stool or urine and sexual dysfunction. Fifteen percent of women become incontinent, to some degree, of stool or urine after normal delivery, this number rising considerably after these women reach menopause. Vaginal birth injury is a necessary, but not sufficient, cause of all non hysterectomy related prolapse in later life. Risk factors for significant vaginal birth injury include:

- A baby weighing more than 9 pounds.
- The use of forceps or vacuum for delivery. These markers are more likely to be signals for other abnormalities as forceps or vacuum are not used in normal deliveries.
- The need to repair large tears after delivery.

Pelvic girdle pain. Hormones and enzymes work together to produce ligamentous relaxation and widening of the symphysis pubis during the last trimester of pregnancy. Most girdle pain occurs before birthing, and is known as diastasis of the pubic symphysis. Predisposing factors for girdle pain include maternal obesity.

Infection remains a major cause of maternal mortality and morbidity in the developing world. The work of Ignaz Semmelweis was seminal in the pathophysiology and treatment of puerperal fever and saved many lives.

Hemorrhage, or heavy blood loss, is still the leading cause of death of birthing mothers in the world today, especially in the developing world. Heavy blood loss leads to hypovolemic shock, insufficient perfusion of vital organs and death if not rapidly treated. Blood transfusion may be life saving. Rare sequelae include Hypopituitarism Sheehan's syndrome.

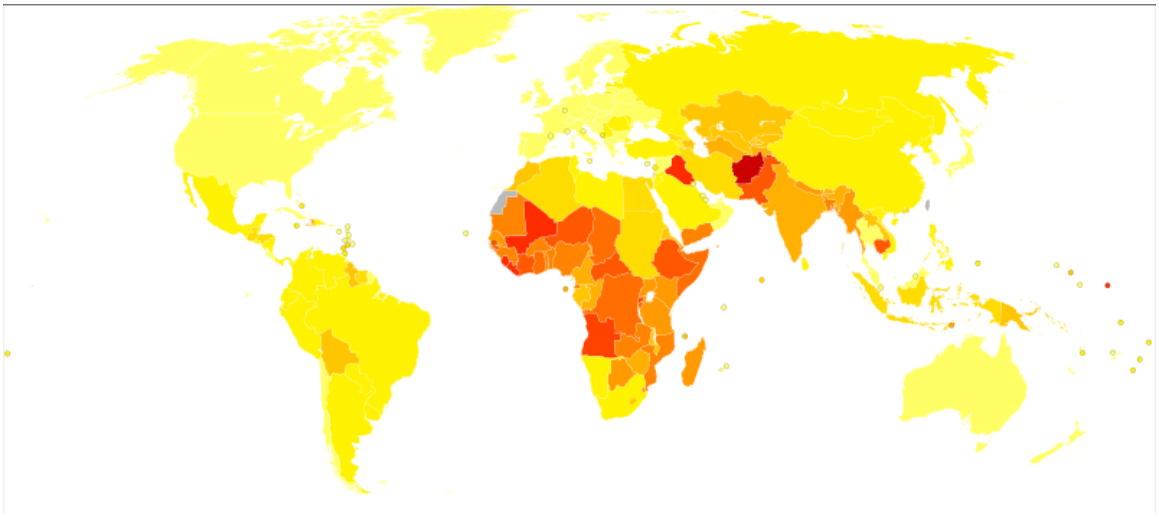
The maternal mortality rate (MMR) varies from 9 per 100,000 live births in the US and Europe to 900 per 100,000 live births in Sub-Saharan Africa. Every year, more than half a million women die in pregnancy or childbirth.

Fetal complications

Mechanical fetal injury

Risk factors for fetal birth injury include fetal macrosomia (big baby), maternal obesity, the need for instrumental delivery, and an inexperienced attendant. Specific situations that can contribute to birth injury include breech presentation and shoulder dystocia. Most fetal birth injuries resolve without long term harm, but brachial plexus injury may lead to Erb's palsy or Klumpke's paralysis.

Neonatal infection



Disability-adjusted life year for neonatal infections and other (perinatal) conditions per 100,000 inhabitants in 2004. Excludes prematurity and low birth weight, birth asphyxia and birth trauma which have their own maps/data.

- no data
- less than 150
- 150-300
- 300-450
- 450-600
- 600-750
- 750-900
- 900-1050
- 1050-1200
- 1200-1350
- 1350-1500
- 1500-1850
- more than 1850

Neonates are prone to infection in the first month of life. Some organisms such as S. agalactiae (Group B Streptococcus) or (GBS) are more prone to cause these occasionally fatal infections. Risk factors for GBS infection include:

- prematurity (birth prior to 37 weeks gestation)
- a sibling who has had a GBS infection
- prolonged labour or rupture of membranes

Untreated sexually transmitted infections are associated with congenital and perinatal infections in neonates, particularly in the areas where rates of infection remain high. The overall perinatal mortality rate associated with untreated syphilis, for example, approached 40%.

Neonatal death

Infant deaths (*neonatal deaths* from birth to 28 days, or *perinatal deaths* if including fetal deaths at 28 weeks gestation and later) are around 1% in modernized countries.

The most important factors affecting mortality in childbirth are adequate nutrition and access to quality medical care ("access" is affected both by the cost of available care, and distance from health services). "Medical care" in this context does not refer specifically to treatment in hospitals, but simply routine prenatal care and the presence, at the birth, of an attendant with birthing skills.

A 1983-1989 study by the Texas Department of State Health Services highlighted the differences in neonatal mortality (NMR) between high risk and low risk pregnancies. NMR was 0.57% for doctor-attended high risk births, and 0.19% for low risk births attended by non-nurse midwives. Conversely, some studies demonstrate a higher perinatal mortality rate with assisted home births. Around 80% of pregnancies are low-risk. Factors that may make a birth high risk include prematurity, high blood pressure, gestational diabetes and a previous cesarean section.

Intrapartum asphyxia

Intrapartum asphyxia is the impairment of the delivery of oxygen to the brain and vital tissues during the progress of labour. This may exist in a pregnancy already impaired by maternal or fetal disease, or may rarely arise *de novo* in labour. This can be termed *fetal distress*, but this term may be emotive and misleading. True intrapartum asphyxia is not as common as previously believed, and is usually accompanied by multiple other symptoms during the immediate period after delivery. Monitoring might show up problems during birthing, but the interpretation and use of monitoring devices is complex and prone to misinterpretation. Intrapartum asphyxia can cause long-term impairment, particularly when this results in tissue damage through encephalopathy.

Professions associated with childbirth

Model of pelvis used in the beginning of the 20th century to teach technical procedures for a successful childbirth. Museum of the History of Medicine, Porto Alegre, Brazil

Childbirth educators are instructors who have certified to educate pregnant women and their partners about the nature of pregnancy, labor signs and stages, techniques for giving birth, breastfeeding and newborn baby care. Classes can be found in hospital settings or through many independent certifying organizations such as Birthing From Within, BirthWorks, Brio Birth, CAPPA, HypBirth, HypnoBabies, HypnoBirthing, ICTC, ICEA, Lamaze, The Bradley Method, etc. Each organization teaches its own standardized curriculum and each emphasizes different techniques. Information about each can be obtained through their individual websites.

Doulas are assistants who support mothers during pregnancy, labour, birth, and postpartum. They are not medical attendants; rather, they provide emotional support and non-medical pain relief for women during labour.

Book about natural childbirth.

Midwives provide care to low-risk pregnant mothers. Midwives may be licensed and registered, or may be lay practitioners. Jurisdictions with legislated midwives will typically have a registering and disciplinary body, such as a College of Midwifery. Registered midwives are trained to assist a mother with labour and birth, either through direct-entry or nurse-midwifery programs. Lay midwives, who are usually not licensed or registered, typically gain experience through apprenticeship with other lay midwives.

Medical doctors who practice obstetrics include categorically specialized obstetricians; family practitioners and general practitioners whose training, skills and practices include obstetrics; and in some contexts general surgeons. These physicians and surgeons variously provide care across the whole spectrum of normal and abnormal births and pathological labour conditions. Categorically specialized obstetricians are qualified surgeons, so they can undertake surgical procedures relating to childbirth. Some family practitioners or general practitioners are also privileged to perform obstetrical surgery. Obstetrical procedures include cesarean sections, episiotomies, and assisted delivery. Categorical specialists in obstetrics are commonly dually trained in obstetrics and gynecology (OB/GYN), and may provide other medical and surgical gynecological care, and may incorporate more general, well-woman, primary care elements in their practices. Maternal-fetal medicine specialists are obstetrician/gynecologists subspecialized in managing and treating high-risk pregnancy and delivery.

Obstetric nurses assist midwives, doctors, women, and babies prior to, during, and after the birth process, in the hospital system. Some midwives are also obstetric nurses. Obstetric nurses hold various certifications and typically undergo additional obstetric training in addition to standard nursing training.

Society and culture

Childbirth routinely occurs in hospitals in much of Western society, although prior to the 20th century and in some countries to the present day has more typically occurred at home.[1]

In Western and other cultures, age is reckoned from the date of birth, and sometimes the birthday is celebrated annually. East Asian age reckoning starts newborns at "1", incrementing each Lunar New Year.

Some families view the placenta as a special part of birth, since it has been the child's life support for so many months. Some parents like to see and touch this organ. In some cultures, parents plant a tree along with the placenta on the child's first birthday. The placenta may be eaten by the newborn's family, ceremonially or otherwise (for nutrition; the great majority of animals in fact do this naturally). Most recently there is a category of birth professionals available who will encapsulate placenta for use as placenta medicine by postpartum mothers. The placenta is believed to provide hormones which ease the emotional roller coaster of the postpartum period and even prevent some cases of postpartum depression. The placenta is steamed and then dried in a dehydrator, after which it is made into gel caps that are taken for weeks or months. There is some research showing benefits for milk production in women and other positive studies in animal populations. Anecdotal reports suggest that women say that they suffer less postpartum blues, depression and anxiety using placenta medicine.

Chapter 8

Complications of Pregnancy

Complications of pregnancy

ICD-10	O00.-O48.
ICD-9	630-648
MeSH	D011248

Complications of pregnancy are the symptoms and problems that are associated with pregnancy. There are both routine problems and serious, even potentially fatal problems. The routine problems are normal complications, and pose no significant danger to either the woman or the fetus. Serious problems can cause both maternal death and fetal death if untreated.

Maternal routine problems

Back pain

- Common, particularly in the third trimester when the patient's center of gravity has shifted.
- *Treatment*: mild exercise, gentle massage, heating pads, paracetamol (acetaminophen), and (in severe cases) muscle relaxants or narcotics

Carpal tunnel syndrome

- Occurs in between an estimated 21% to 62% of cases, possibly due to edema.

Constipation

- *Cause*: decreased bowel motility secondary to elevated progesterone (normal in pregnancy), which can lead to greater absorption of water.
- *Treatment*: increased PO fluids, stool softeners, bulking agents Drinking plenty of water and eating fruit and fiber enriched foods often help

A woman experiencing sudden defecation should report this to her practitioner.

Contractions

- occasional, irregular, painless contractions that occur several times per day are normal and are known as Braxton Hicks contractions
- *Caused by*: dehydration
- *Treatment*: fluid intake
- regular contractions (every 10-15 min) are a sign of preterm labor and should be assessed by cervical exam.

Dehydration

- *Caused by*: expanded intravascular space and increased Third spacing of fluids
- *Treatment*: fluid intake
- *Complication*: uterine contractions, which may occur because dehydration causes body release of ADH, which is similar to oxytocin in structure. Oxytocin itself can cause uterine contractions and thus ADH can cross-react with oxytocin receptors and also cause contractions.

Edema

- *Caused by*: compression of the inferior vena cava (IVC) and pelvic veins by the uterus leads to increased hydrostatic pressure in lower extremities.
- *Treatment*: raising legs above the heart, patient sleeps on her side

Gastroesophageal Reflux Disease (GERD)

- *Caused by*: relaxation of the lower esophageal sphincter (LES) and increased transit time in the stomach (normal in pregnancy)
- *Treatment*: antacids, multiple small meals a day, avoid lying down within an hour of eating, H2 blockers, proton pump inhibitors

Hemorrhoids

- *Caused by*: increased venous stasis and IVC compression leading to congestion in venous system along with increased abdominal pressure secondary to constipation.
- *Treatment*: topical anesthetics, steroids, treatment of constipation

Pica

- cravings for nonedible items such as dirt or clay. Commonly, avoid ice chips; it may worsen anemia

Caused by Iron deficiency which is normal during pregnancy and can be overcome with Iron supplements or prenatal vitamins.

Lower abdominal pain

- *Caused by*: rapid expansion of the uterus and stretching of ligaments such as the round ligament.
- *Treatment*: paracetamol (acetaminophen)

Increased urinary frequency

- *Caused by*: increased intravascular volume, elevated GFR (glomerular filtration rate), and compression of the bladder by the expanding uterus. Patients are advised to continue fluid intake despite this. Urinalysis and culture should be ordered to rule out infection, which can also cause increased urinary frequency but typically is accompanied by dysuria (pain when urinating).

Varicose veins

- *Caused by*: relaxation of the venous smooth muscle and increased intravascular pressure.
- *Treatment*: elevation of the legs, pressure stockings
- relieve swelling and pain with warm sitz bath.
- Avoid obesity, lengthy standing or sitting, constrictive clothing and constipation and bearing down with bowel movements

Diastasis recti or abdominal separation

- *Caused by*: excessive stretching of the abdominal muscles.
- *Treatment*: paliative care, surgery and/or rehabilitation after childbirth

Serious maternal problems

The following problems originate mainly in the mother.

Pelvic girdle pain (PGP)

- *Caused by*: PGP disorder is complex and multi-factorial and likely to be represented by a series of sub-groups with different underlying pain drivers from peripheral or central nervous system, altered laxity/stiffness of muscles, laxity to injury of tendinous/ligamentous structures to ‘mal-adaptive’ body mechanics.

Musculo-Skeletal Mechanics involved in gait and weightbearing activities can be mild to grossly impaired. PGP can begin peri or postpartum. For most women PGP resolves in weeks after delivery but for some it can last for years resulting in a reduced tolerance for weightbearing activities.

- *Treatment*: The degree of treatment is based on the severity. A mild case would require rest, rehabiltation therapy and pain is usually manageable. More severe cases would also include mobility aids, strong analgesics and sometimes surgery. One of the main factors in helping women cope is with education, information and support. Many treatment options are available.

Severe hypertensive states

Potential severe hypertensive states of pregnancy are mainly:

- Preeclampsia = gestational hypertension, proteinuria (>300 mg), and edema. Severe preeclampsia involves a BP over 160/110 (with additional signs)
- Eclampsia = seizures in a preeclamptic patient
- HELLP syndrome = Hemolytic anemia, Elevated liver enzymes and low platelet count
- Acute fatty liver of pregnancy is sometimes included in the preeclamptic spectrum.

Deep vein thrombosis

Deep vein thrombosis (DVT) has an incidence of 0.5 to 7 per 1,000 pregnancies, and is the second most common cause of maternal death in developed countries after bleeding.

- *Caused by*: Hypercoagulability as a physiological response to potential massive bleeding at childbirth.
- *Treatment*: Prophylactic treatment, e.g. with low molecular weight heparin may be indicated when there are additional risk factors for deep vein thrombosis.

Serious fetal problems

The following problems occur in the fetus or placenta, but may have serious consequences on the mother as well.

Ectopic pregnancy (implantation of the embryo outside the uterus)

- *Caused by*: Unknown, but risk factors include smoking, advanced maternal age, and prior damage to the Fallopian tubes.
- *Treatment*: If there is no spontaneous resolution, the pregnancy must be aborted either surgically or by the drug methotrexate.

Placental abruption (separation of the placenta from the uterus)

- *Caused by*: Various causes; risk factors include maternal hypertension, trauma, and drug use.
- *Treatment*: Immediate delivery if the fetus is mature (36 weeks or older), or if a younger fetus or the mother is in distress. In less severe cases with immature fetuses, the situation may be monitored in hospital, with treatment if necessary.

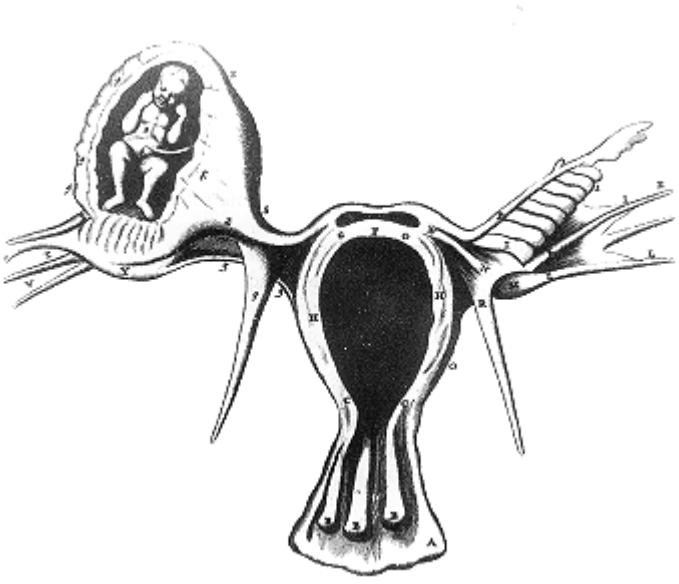
Multiple pregnancies

Multiples may become monochorionic, sharing the same chorion, with resultant risk of twin-to-twin transfusion syndrome. Monochorionic multiples may evenbecome monoamniotic, sharing the same amniotic sac, resulting in risk of umbilical cord compression and entanglement. In very rare cases, there may be conjoined twins, possibly impairing function of internal organs.

Chapter 9

Ectopic Pregnancy

Ectopic pregnancy



Ectopic by Reinier de Graaf

ICD-10	O00.
ICD-9	633
DiseasesDB	4089
MedlinePlus	000895
eMedicine	med/3212 emerg/478 radio/231
MeSH	D011271

An **ectopic pregnancy**, or **eccysis**, is a complication of pregnancy in which the pregnancy implants outside the uterine cavity. With rare exceptions, ectopic pregnancies

are not viable. Furthermore, they are dangerous for the mother, internal bleeding being a common complication. Most ectopic pregnancies occur in the Fallopian tube (so-called **tubal pregnancies**), but implantation can also occur in the cervix, ovaries, and abdomen. An ectopic pregnancy is a potential medical emergency, and, if not treated properly, can lead to death.

In a normal pregnancy, the fertilized egg enters the uterus and settles into the uterine lining where it has plenty of room to divide and grow. About 1% of pregnancies are in an ectopic location with implantation not occurring inside of the womb, and of these 98% occur in the Fallopian tubes.

Detection of ectopic pregnancy in early gestation has been achieved mainly due to enhanced diagnostic capability. Despite all these notable successes in diagnostics and detection techniques ectopic pregnancy remains a source of serious maternal morbidity and mortality worldwide, especially in countries with poor prenatal care.

In a typical ectopic pregnancy, the embryo adheres to the lining of the fallopian tube and burrows into the tubal lining. Most commonly this invades vessels and will cause bleeding. This intratubal bleeding hematosalpinx expels the implantation out of the tubal end as a tubal abortion. Tubal abortion is a common type of miscarriage. There is no inflammation of the tube in ectopic pregnancy. The pain is caused by prostaglandins released at the implantation site, and by free blood in the peritoneal cavity, which is a local irritant. Sometimes the bleeding might be heavy enough to threaten the health or life of the woman. Usually this degree of bleeding is due to delay in diagnosis, but sometimes, especially if the implantation is in the proximal tube (just before it enters the uterus), it may invade into the nearby Sampson artery, causing heavy bleeding earlier than usual.

If left untreated, about half of ectopic pregnancies will resolve without treatment. These are the tubal abortions. The advent of methotrexate treatment for ectopic pregnancy has reduced the need for surgery; however, surgical intervention is still required in cases where the Fallopian tube has ruptured or is in danger of doing so. This intervention may be laparoscopic or through a larger incision, known as a laparotomy.

Classification

Tubal pregnancy

The vast majority of ectopic pregnancies implant in the Fallopian tube. Pregnancies can grow in the fimbrial end (5% of all ectopics), the ampullary section (80%), the isthmus (12%), and the cornual and interstitial part of the tube (2%). Mortality of a tubal pregnancy at the isthmus or within the uterus (interstitial pregnancy) is higher as there is increased vascularity that may result more likely in sudden major internal hemorrhage. A review published in 2010 supports the hypothesis that tubal ectopic pregnancy is caused by a combination of retention of the embryo within the fallopian tube due to impaired

embryo-tubal transport and alterations in the tubal environment allowing early implantation to occur.

Nontubal ectopic pregnancy

Two percent of ectopic pregnancies occur in the ovary, cervix, or are intraabdominal. Transvaginal ultrasound examination is usually able to detect a cervical pregnancy. An ovarian pregnancy is differentiated from a tubal pregnancy by the Spiegelberg criteria.

While a fetus of ectopic pregnancy is typically not viable, very rarely, a live baby has been delivered from an abdominal pregnancy. In such a situation the placenta sits on the intraabdominal organs or the peritoneum and has found sufficient blood supply. This is generally bowel or mesentery, but other sites, such as the renal (kidney), liver or hepatic (liver) artery or even aorta have been described. Support to near viability has occasionally been described, but even in third world countries, the diagnosis is most commonly made at 16 to 20 weeks gestation. Such a fetus would have to be delivered by laparotomy. Maternal morbidity and mortality from extrauterine pregnancy is high as attempts to remove the placenta from the organs to which it is attached usually lead to uncontrollable bleeding from the attachment site. If the organ to which the placenta is attached is removable, such as a section of bowel, then the placenta should be removed together with that organ. This is such a rare occurrence that true data are unavailable and reliance must be made on anecdotal reports. However, the vast majority of abdominal pregnancies require intervention well before fetal viability because of the risk of hemorrhage.

Heterotopic pregnancy

In rare cases of ectopic pregnancy, there may be two fertilized eggs, one outside the uterus and the other inside. This is called a heterotopic pregnancy. Often the intrauterine pregnancy is discovered later than the ectopic, mainly because of the painful emergency nature of ectopic pregnancies. Since ectopic pregnancies are normally discovered and removed very early in the pregnancy, an ultrasound may not find the additional pregnancy inside the uterus. When hCG levels continue to rise after the removal of the ectopic pregnancy, there is the chance that a pregnancy inside the uterus is still viable. This is normally discovered through an ultrasound.

Although rare, heterotopic pregnancies are becoming more common, likely due to increased use of IVF. The survival rate of the uterine fetus of an ectopic pregnancy is around 70%.

Successful pregnancies have been reported from ruptured tubal pregnancy continuing by the placenta implanting on abdominal organs or on the outside of the uterus.

Persistent ectopic pregnancy

A persistent ectopic pregnancy refers to the continuation of trophoplastic growth after a surgical intervention to remove an ectopic pregnancy. After a conservative procedure that

attempts to preserve the affected fallopian tube such as a salpingotomy, in about 15-20% the major portion of the ectopic growth may have been removed, but some trophoblastic tissue, perhaps deeply embedded, has escaped removal and continues to grow, generating a new rise in hCG levels. After weeks this may lead to new clinical symptoms including bleeding. For this reason hCG levels may have to be monitored after removal of an ectopic to assure their decline, also methotrexate can be given at the time of surgery prophyllactically.

Signs and symptoms

Early symptoms are either absent or subtle. Clinical presentation of ectopic pregnancy occurs at a mean of 7.2 weeks after the last normal menstrual period, with a range of 5 to 8 weeks. Later presentations are more common in communities deprived of modern diagnostic ability.

Early signs include:

- Pain in the lower abdomen, and inflammation (Pain may be confused with a strong stomach pain, it may also feel like a strong cramp)
- Pain while urinating
- Pain and discomfort, usually mild. A corpus luteum on the ovary in a normal pregnancy may give very similar symptoms.
- Vaginal bleeding, usually mild. An ectopic pregnancy is usually a failing pregnancy and falling levels of progesterone from the corpus luteum on the ovary cause withdrawal bleeding. This can be indistinguishable from an early miscarriage or the 'implantation bleed' of a normal early pregnancy.
- Pain while having a bowel movement

Patients with a late ectopic pregnancy typically experience pain and bleeding. This bleeding will be both vaginal and internal and has two discrete pathophysiologic mechanisms:

- External bleeding is due to the falling progesterone levels.
- Internal bleeding (hematoperitoneum) is due to hemorrhage from the affected tube.

The differential diagnosis at this point is between miscarriage, ectopic pregnancy, and early normal pregnancy. The presence of a positive pregnancy test virtually rules out pelvic infection as it is rare indeed to find pregnancy with an active Pelvic Inflammatory Disease (PID). The most common misdiagnosis assigned to early ectopic pregnancy is PID.

More severe internal bleeding may cause:

- Lower back, abdominal, or pelvic pain.

- Shoulder pain. This is caused by free blood tracking up the abdominal cavity and irritating the diaphragm, and is an ominous sign.
- There may be cramping or even tenderness on one side of the pelvis.
- The pain is of recent onset, meaning it must be differentiated from cyclical pelvic pain, and is often getting worse.

Ectopic pregnancy can mimic symptoms of other diseases such as appendicitis, other gastrointestinal disorder, problems of the urinary system, as well as pelvic inflammatory disease and other gynaecologic problems.

Causes

There are a number of risk factors for ectopic pregnancies. However, in as many as one third to one half of ectopic pregnancies, no risk factors can be identified. Risk factors include: pelvic inflammatory disease, infertility, use of an intrauterine device (IUD), endometriosis, those who have been exposed to DES, tubal surgery, intrauterine surgery (e.g. D&C), smoking, previous ectopic pregnancy, and tubal ligation.

Cilial damage and tube occlusion

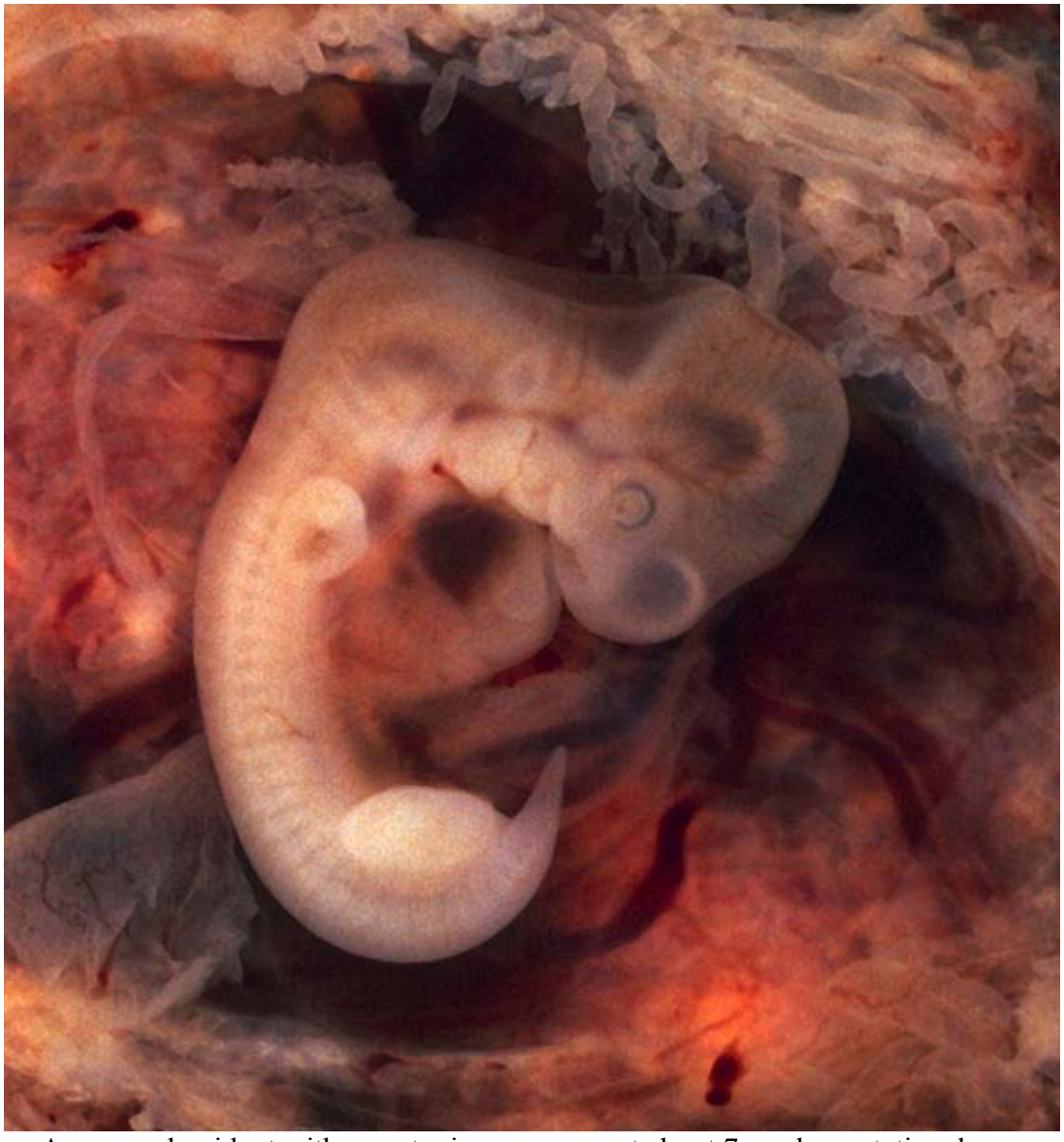
Hair-like cilia located on the internal surface of the Fallopian tubes carry the fertilized egg to the uterus. Fallopian cilia are sometimes seen in reduced numbers subsequent to an ectopic pregnancy, leading to a hypothesis that cilia damage in the Fallopian tubes is likely to lead to an ectopic pregnancy. Women with pelvic inflammatory disease (PID) have a high occurrence of ectopic pregnancy. This results from the build-up of scar tissue in the Fallopian tubes, causing damage to cilia. If however both tubes were completely blocked, so that sperm and egg were physically unable to meet, then fertilization of the egg would naturally be impossible, and neither normal pregnancy nor ectopic pregnancy could occur. Tubal surgery for damaged tubes might remove this protection and increase the risk of ectopic pregnancy. Intrauterine adhesions (IUA) present in Asherman's syndrome can cause ectopic cervical pregnancy or, if adhesions partially block access to the tubes via the ostia, ectopic tubal pregnancy. Asherman's syndrome usually occurs from intrauterine surgery, most commonly after D&C. Endometrial/pelvic/genital tuberculosis, another cause of Asherman's syndrome, can also lead to ectopic pregnancy as infection may lead to tubal adhesions in addition to intrauterine adhesions.

Tubal ligation can predispose to ectopic pregnancy. Seventy percent of pregnancies after tubal cautery are ectopic, while 70% of pregnancies after tubal clips are intrauterine. Reversal of tubal sterilization (Tubal reversal) carries a risk for ectopic pregnancy. This is higher if more destructive methods of tubal ligation (tubal cautery, partial removal of the tubes) have been used than less destructive methods (tubal clipping). A history of a tubal pregnancy increases the risk of future occurrences to about 10%. This risk is not reduced by removing the affected tube, even if the other tube appears normal. The best method for diagnosing this is to do an early ultrasound.

Other

Although some investigations have shown that patients may be at higher risk for ectopic pregnancy with advancing age, it is believed that age is a variable which could act as a surrogate for other risk factors. Also, it has been noted that smoking is associated with ectopic risk. Vaginal douching is thought by some to increase ectopic pregnancies. Women exposed to diethylstilbestrol (DES) in utero (aka "DES Daughters") also have an elevated risk of ectopic pregnancy, up to 3 times the risk of unexposed women. It has also been suggested that pathologic generation of nitric oxide through increased iNOS production may decrease tubal ciliary beats and smooth muscle contractions and thus affect embryo transport, which may consequently result in ectopic pregnancy.

Diagnosis



An opened oviduct with an ectopic pregnancy at about 7 weeks gestational age.

An ectopic pregnancy should be considered in any woman with abdominal pain or vaginal bleeding who has a positive pregnancy test. An ultrasound showing a gestational sac with fetal heart in the fallopian tube is clear evidence of ectopic pregnancy.

An abnormal rise in blood β-human chorionic gonadotropin (β-hCG) levels may indicate an ectopic pregnancy. The threshold of discrimination of intrauterine pregnancy is around 1500 IU/ml of β-hCG. A high resolution, transvaginal ultrasound showing no intrauterine pregnancy is presumptive evidence that an ectopic pregnancy is present if the threshold of discrimination for β-hCG has been reached. An empty uterus with levels higher than 1500 IU/ml may be evidence of an ectopic pregnancy, but may also be consistent with an intrauterine pregnancy which is simply too small to be seen on ultrasound. If the diagnosis is uncertain, it may be necessary to wait a few days and repeat the blood work. This can be done by measuring the β-hCG level approximately 48hrs later and repeating the ultrasound. If the β-hCG falls on repeat examination, this strongly suggests a spontaneous abortion or rupture.

A laparoscopy or laparotomy can also be performed to visually confirm an ectopic pregnancy. Often if a tubal abortion or tubal rupture has occurred, it is difficult to find the pregnancy tissue. A laparoscopy in very early ectopic pregnancy rarely shows a normal looking fallopian tube.

Culdocentesis, in which fluid is retrieved from the space separating the vagina and rectum, is a less commonly performed test that may be used to look for internal bleeding. In this test, a needle is inserted into the space at the very top of the vagina, behind the uterus and in front of the rectum. Any blood or fluid found may have been derived from a ruptured ectopic pregnancy.

Cullen's sign can indicate a ruptured ectopic pregnancy.

Treatment

Medical

Early treatment of an ectopic pregnancy with methotrexate is a viable alternative to surgical treatment since at least 1993. If administered early in the pregnancy, methotrexate terminates the growth of the developing embryo; this may cause an abortion, or the tissue may then be either resorbed by the woman's body or pass with a menstrual period. Contraindications include liver, kidney, or blood disease, as well as an ectopic mass > 3.5 cm.

Surgical

If hemorrhage has already occurred, surgical intervention may be necessary. However, whether to pursue surgical intervention is an often difficult decision in a stable patient with minimal evidence of blood clot on ultrasound.

Surgeons use laparoscopy or laparotomy to gain access to the pelvis and can either incise the affected Fallopian and remove only the pregnancy (salpingostomy) or remove the affected tube with the pregnancy (salpingectomy). The first successful surgery for an ectopic pregnancy was performed by Robert Lawson Tait in 1883.

Complications

The most common complication is rupture with internal haemorrhage which may lead to hypovolaemic shock. Death from rupture is rare in women who have access to modern medical facilities. Infertility occurs in 10 - 15% of women who have had an ectopic pregnancy.

Prognosis

Future fertility

Fertility following ectopic pregnancy depends upon several factors, the most important of which is a prior history of infertility. The treatment choice, whether surgical or nonsurgical, also plays a role. For example, the rate of intrauterine pregnancy may be higher following methotrexate compared to surgical treatment. Rate of fertility may be better following salpingostomy than salpingectomy.

Cases with live birth

There have been cases where ectopic pregnancy lasted many months and ended in a live baby delivered by laparotomy.

On 19 April 2008 an English woman, Jayne Jones (age 37) who had an ectopic pregnancy attached to the omentum, the fatty covering of her large bowel, gave birth. The baby was delivered by a laparotomy at 28 weeks gestation. The surgery, the first of its kind to be performed in the UK, was successful, and both mother and baby survived.

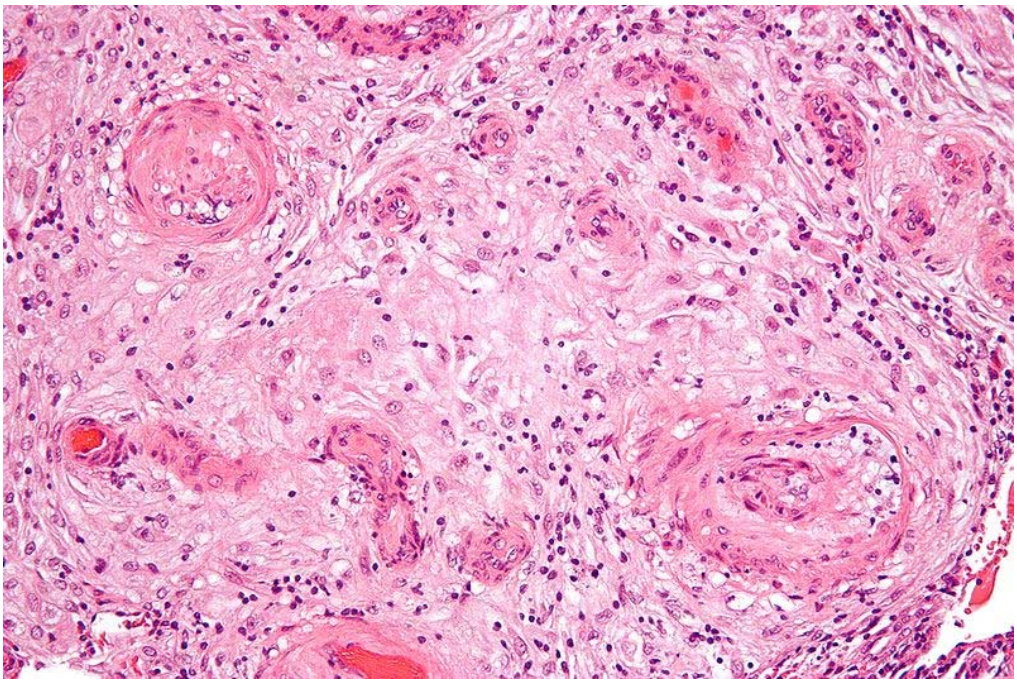
On May 29, 2008 an Australian woman, Meera Thangarajah (age 34), who had an ectopic pregnancy in the ovary, gave birth to a healthy full term 6 pound 3 ounce (2.8 kg) baby girl, Durga, via Caesarean section. She had no problems or complications during the 38-week pregnancy.

The case of Olivia, Mary and Ronan had an extrauterine fetus (Ronan) and intrauterine twins. All three survived. The intrauterine twins were taken out first.

Chapter 10

Pre-Eclampsia

Pre-eclampsia



Micrograph showing hypertrophic decidual vasculopathy, a histomorphologic finding seen in gestational hypertension - a component of preeclampsia. H&E stain.

ICD-10	O11., O13., O14.
ICD-9	642.4-642.7
DiseasesDB	10494
MedlinePlus	000898
eMedicine	med/1905 ped/1885

MeSH D011225

Pre-eclampsia is a medical condition in which hypertension arises in pregnancy (pregnancy-induced hypertension) in association with significant amounts of protein in the urine.

Pre-eclampsia refers to a set of symptoms rather than any causative factor, and there are many different causes for the condition. It appears likely that there are substances from the placenta that can cause endothelial dysfunction in the maternal blood vessels of susceptible women. While blood pressure elevation is the most visible sign of the disease, it involves generalized damage to the maternal endothelium, kidneys, and liver, with the release of vasoconstrictive factors being secondary to the original damage.

Pre-eclampsia may develop from 20 weeks gestation (it is considered early onset before 32 weeks, which is associated with increased morbidity). Its progress differs among patients; most cases are diagnosed pre-term. Pre-eclampsia may also occur up to six weeks post-partum. Apart from Caesarean section or induction of labor (and therefore delivery of the placenta), there is no known cure. It is the most common of the dangerous pregnancy complications; it may affect both the mother and the unborn child.

Diagnosis

Pre-eclampsia is diagnosed when a pregnant woman develops high blood pressure (two separate readings taken at least 6 hours apart of 140/90 or more) *and* 300 mg of protein in a 24-hour urine sample (proteinuria). A rise in baseline blood pressure (BP) of 30 mmHg systolic or 15 mmHg diastolic, while not meeting the absolute criteria of 140/90, is still considered important to note, but is not considered diagnostic. Swelling or edema (especially in the hands and face) was originally considered an important sign for a diagnosis of pre-eclampsia, but in current medical practice only hypertension and proteinuria are necessary for a diagnosis. Pitting edema (unusual swelling, particularly of the hands, feet, or face, notable by leaving an indentation when pressed on) can be significant, and should be reported to a health care provider.

"Severe preeclampsia" involves a BP over 160/110, and additional symptoms.

Pre-eclampsia may progress to eclampsia, characterized by the appearance of tonic-clonic seizures. This happens only very rarely with proper treatment.

Although eclampsia is potentially fatal, pre-eclampsia is often asymptomatic, and so its detection depends on signs or investigations. Nonetheless, one symptom is crucially important because it is often misinterpreted. The epigastric pain, which reflects hepatic involvement and is typical of the HELLP syndrome, may easily be confused with heartburn, a very common problem of pregnancy. It can be distinguished from heartburn when it is not burning in quality, does not spread upwards towards the throat, is associated with hepatic tenderness, may radiate through to the back, and is not relieved

by giving antacids. It is often very severe, described by sufferers as the worst pain they have ever experienced. Affected women are not uncommonly referred to general surgeons as suffering from an acute abdomen (for example, acute cholecystitis).

In general, none of the signs of pre-eclampsia are specific, and even convulsions in pregnancy are more likely to have causes other than eclampsia in modern practice. Diagnosis, therefore, depends on finding a coincidence of several pre-eclamptic features, the final proof being their regression after delivery.

Some women develop high blood pressure without proteinuria (protein in urine), which is called pregnancy-induced hypertension (**PIH**) or gestational hypertension. Both pre-eclampsia and PIH are regarded as very serious conditions and require careful monitoring of mother and fetus.

Epidemiology

Pre-eclampsia occurs in as many as 10% of pregnancies, usually in the second or third trimester and after the 32nd week. Some women will experience pre-eclampsia as early as 20 weeks, though this is rare. It is much more common in women who are pregnant for the first time, and its frequency drops significantly in second pregnancies. While change of paternity in a subsequent pregnancy is now thought to lower risk except in those with a family history of hypertensive pregnancy, since increasing maternal age raises risk, it has been difficult to evaluate how significant paternity change actually is and studies are providing conflicting data on this point.

Pre-eclampsia is also more common in women who have preexisting hypertension, diabetes, autoimmune diseases such as lupus, various inherited thrombophilias such as Factor V Leiden, renal disease, women with a family history of pre-eclampsia, obese women, and women with a multiple gestation (twins or multiple birth). The single most significant risk for developing pre-eclampsia is having had pre-eclampsia in a previous pregnancy.

Pre-eclampsia may also occur in the immediate post-partum period. This is referred to as "postpartum pre-eclampsia". The most dangerous time for the mother is the 24–48 hours postpartum and careful attention should be paid to pre-eclampsia signs and symptoms.

Causes

The pre-eclampsia syndrome is thought in many cases to be caused by a shallowly implanted placenta which becomes hypoxic, leading to an immune reaction characterized by secretion of upregulated inflammatory mediators from the placenta, and acting on the vascular endothelium. The shallow implantation is thought to stem from the maternal immune system's response to the placenta. This theory emphasizes the role of the maternal immune system, and refers to evidence suggesting a lack of established immunological tolerance in pregnancy, resulting in an immune response against paternal antigens from the fetus and its placenta. In some cases of pre-eclampsia it is thought that

the mother lacks the receptors for the proteins the placenta is using to downregulate the maternal immune system's response to it. This view is also consistent with evidence showing many miscarriages to be an immunological disorder where the mother's immune system "unleashes a destructive attack on the tissues of the developing child."

In many cases of the pre-eclampsia syndrome, however, the maternal response to the placenta appears to have allowed for normal implantation. It is possible that women with higher baseline levels of inflammation stemming from underlying conditions such as chronic hypertension or autoimmune disease may have less tolerance for the inflammatory burden of pregnancy.

If severe, pre-eclampsia progresses to *fulminant pre-eclampsia,* with headaches, visual disturbances, and epigastric pain, and further to HELLP syndrome and eclampsia. Placental abruption is associated with hypertensive pregnancies. These are life-threatening conditions for both the developing baby and the mother.

Many theories have attempted to explain why pre-eclampsia arises, and have linked the syndrome to the presence of the following:

- endothelial cell injury
- immune rejection of the placenta
- compromised placental perfusion
- altered vascular reactivity
- imbalance between prostacyclin and thromboxane
- decreased glomerular filtration rate with retention of salt and water
- decreased intravascular volume
- increased central nervous system irritability
- disseminated intravascular coagulation
- uterine muscle stretch (ischemia)
- dietary factors, including vitamin deficiency
- genetic factors
- air pollution
- obesity

The current understanding of the syndrome is as a two-stage process, with a highly variable first stage which predisposes the placenta to hypoxia, followed by the release of soluble factors which result in many of the other observed phenomena. Many of the older theories can be subsumed under this umbrella, as the soluble factors have been shown to cause, for example, endothelial cell injury, altered vascular reactivity, the classic lesion of glomerular endotheliosis, decreased intravascular volume, inflammation, etc. Underlying maternal susceptibility to the damage is likely implicated as well.

Pathogenesis

Although much research into the etiology and mechanism of pre-eclampsia has taken place, its exact pathogenesis remains uncertain. Some studies support notions of

inadequate blood supply to the placenta making it release particular hormones or chemical agents that, in mothers predisposed to the condition, leads to damage of the endothelium (lining of blood vessels), alterations in metabolism, inflammation, and other possible reactions.

Abnormalities in the maternal immune system and insufficiency of gestational immune tolerance seem to play major roles in pre-eclampsia. One of the main differences found in pre-eclampsia is a shift toward Th_1 responses and the production of IFN-γ. The origin of IFN-γ is not clearly identified and could be the natural killer cells of the uterus, the placental dendritic cells modulating responses of T helper cells, alterations in synthesis of or response to regulatory molecules, or changes in the function of regulatory T cells in pregnancy. Aberrant immune responses promoting pre-eclampsia may also be due to an altered fetal allorecognition or to inflammatory triggers. It has been documented that fetal cells such as fetal erythroblasts as well as cell-free fetal DNA are increased in the maternal circulation in women who develop pre-eclampsia. These findings have given rise to the hypothesis that pre-eclampsia is a disease process by which a placental lesion such as hypoxia allows increased fetal material into maternal circulation that leads to an immune response and endothelial damage ultimately resulting in pre-eclampsia and eclampsia.

Some studies suggest that hypoxia resulting from inadequate perfusion upregulates sFlt-1, a VEGF and PlGF antagonist, leading to a damaged maternal endothelium and restriction of placental growth. In addition, endoglin, a TGF-beta antagonist, is elevated in pregnant women who develop pre-eclampsia. Soluble endoglin is likely upregulated by the placenta in response to an upregulation of cell-surface endoglin produced by the maternal immune system, although there is also the potential that sEng is produced by the maternal endothelium. Levels of both sFlt-1 and sEng increase as severity of disease increases, with levels of sEng surpassing levels of sFlt-1 in HELLP syndrome cases. Recent data indicate that Gadd45a stress signaling regulates elevated sFlt-1 expression in pre-eclampsia.

Both sFlt-1 and sEng are upregulated in all pregnant women to some extent, supporting the idea that hypertensive disease in pregnancy is a normal pregnancy adaptation gone awry. As natural killer cells are intimately involved in placentation and as placentation involves a degree of maternal immune tolerance for a foreign placenta which requires maternal resources for its support, it is not surprising that the maternal immune system might respond more negatively to the arrival of some placentae under certain circumstances, such as a placenta which is more invasive than normal. Initial maternal rejection of the placental cytotrophoblasts may be the cause of the inadequately remodeled spiral arteries in those cases of pre-eclampsia associated with shallow implantation, leading to downstream hypoxia and the appearance of maternal symptoms in response to upregulated sFlt-1 and sEng.

Differential diagnosis

Pre-eclampsia-eclampsia can mimic and be confused with many other diseases, including chronic hypertension, chronic renal disease, primary seizure disorders, gallbladder and pancreatic disease, immune or thrombotic thrombocytopenic purpura, antiphospholipid syndrome and hemolytic-uremic syndrome. It must always be considered a possibility in any pregnant woman beyond 20 weeks of gestation. It is particularly difficult to diagnose when preexisting disease such as hypertension is present.

Complications

Eclampsia can occur after the onset of pre-eclampsia. Eclampsia, which is a more serious condition, complicates 1 in 2000 maternities in the United Kingdom and carries a maternal mortality of 1.8 percent. The HELLP syndrome is more common, probably about 1 in 500 maternities, but may be as dangerous as eclampsia itself. These two major maternal crises can present unheralded by prodromal signs of pre-eclampsia.

Cerebral hemorrhage is a lesion that can kill with pre-eclampsia or eclampsia. In that cerebral hemorrhage is a known complication of severe hypertension in other contexts, it must be assumed that this is a major predisposing factor in this situation, although this has not been proven. Adult respiratory distress syndrome appears to have become more common, it is not known whether this is a consequence of modern methods of respiratory support rather than of the disease itself.

Uric acid levels may help to predict maternal complications among patients with pre-eclampsia according to a systematic review and decision analysis. In this study, the sensitivity was 68% and specificity was 68%. In this study which assumed a prevalence of maternal complications was 5%, the positive predictive value of 6.2% and negative predictive value of 98.6% (click here to adjust these results for patients at higher or lower risk of maternal complications). In their clinical decision analysis, they presumed initially a distress ratio of 10 (defined as being the expected distress of severe complications valued as 10 times worse than the expected distress of a caesarean section), and under these assumptions, they concluded that there would be the least expected distress from using serum uric acid for clinical decision making. The writers of this study acknowledged that there were significant limitations to their review due to heterogeneity of the individual studies they examined with regards to several variables.

Treatment and prevention

The only known treatments for eclampsia or advancing pre-eclampsia are abortion or delivery, either by labor induction or Caesarean section. However, post-partum pre-eclampsia may occur up to 6 weeks following delivery even if symptoms were not present during the pregnancy. Post-partum pre-eclampsia is dangerous to the health of the mother since she may ignore or dismiss symptoms as simple post-delivery headaches and edema. Hypertension can sometimes be controlled with anti-hypertensive medication, but any effect this might have on the progress of the underlying disease is unknown.

Women with underlying inflammatory disorders such as chronic hypertension or autoimmune diseases would likely benefit from aggressive treatment of those conditions prior to conception, tamping down the overactive immune system.

Thrombophilias may be weakly linked to pre-eclampsia. There are no high quality studies to suggest that blood thinners will prevent pre-eclampsia in thrombophilic women.

Smoking may reduce risk of pre-eclampsia (although this association was not significant when other patient factors are taken into account) (though smoking is discouraged in pregnancy in general.)

Antihypertensive therapy

Antihypertensives may reduce maternal and fetal mortality among pregnancy patients with hypertension as compared to placebo according to a randomized controlled trial . Overall, after three weeks of treatment, MAP was lower in the isradipine group, but when compared with the placebo group, the difference in MAP did not have statistical significance. After treatment with isradipine, those patients with no proteinuria experienced a decrease of between 8.5 and 11.3 mmHg, whereas those with proteinuria experienced about only 1 mmHg difference in systolic blood pressure. Those treated with placebo in both groups did not experience much change in systolic blood pressure, regardless of proteinuria being present or not. Therefore, the authors concluded proteinuric patients may respond differently from nonproteinuric patients to this treatment, where the nonproteinuric patients responded the most to treatment with isradipine.

Labetolol or Nicardipine are also often times the antihypertensives of choice for eclampsia or pre-eclampsia according to the CHEST 2007 study. Especially Labetolol as it has little placental transfer.

Magnesium sulfate

In some cases, women with pre-eclampsia or eclampsia can be stabilized temporarily with magnesium sulfate intravenously to forestall seizures while steroid injections are administered to promote fetal lung maturation. Magnesium sulfate as a possible treatment was considered at least as far back as 1955, but only in recent years did its use in the UK replace the use of diazepam or phenytoin. Evidence for the use of magnesium sulfate came from the international MAGPIE study. When induced delivery needs to take place before 37 weeks gestation, it is accepted that there are additional risks to the baby from premature birth that will require additional monitoring and care.

Dietary and nutritional factors

Studies of protein/calorie supplementation have found no effect on pre-eclampsia rates, and dietary protein restriction does not appear to increase pre-eclampsia rates. No

mechanism by which protein or calorie intake would affect either placentation or inflammation has been proposed.

Studies conducted on the effect of supplementation with antioxidants such as vitamin C and E found no change in pre-eclampsia rates. However, Drs. Padayatty and Levine with the NIH criticized the studies for overlooking several key factors that would have been important to the success of the supplementation.

Low levels of vitamin D may be a risk factor for pre-eclampsia, and calcium supplementation in women with low-calcium diets found no change in preeclampsia rates but did find a decrease in the rate of severe preeclamptic complications. Low selenium status is associated with higher incidence of pre-eclampsia. Some other vitamin may also play a role.

Aspirin supplementation

Aspirin supplementation is still being evaluated as to dosage, timing, and population and may provide a slight preventative benefit in some women; however, significant research has been done on aspirin and the results thus far are unimpressive.

Exercise

There is insufficient evidence to recommend either exercise or bedrest as preventative measures.

Induction of paternal tolerance

Many studies have also suggested the importance of a woman's immunological tolerance to her baby's father, whose genes are present in the young fetus and its placenta and which may pose a challenge to her immune system. As the theory is further investigated, researchers are increasingly studying the importance of a woman's continued exposure to her partner's semen as early as several years before conception. One study published in the American Journal of Obstetrics and Gynecology involved several hundreds of women and found that "women with a short period of cohabitation (less than 4 months) who used barrier methods for contraception had a substantially elevated risk for the development of pre-eclampsia compared with women with more than 12 months of cohabitation before conception". However, the results from a study conducted in 2004 show that the theory is still not conclusive. In that study, the researchers found that after adjustment and stratification, the effect of barrier contraceptive use on the development of pre-eclampsia had disappeared, with both arms having identical rates of pre-eclampsia. Although the study has since then been criticized for its subjective adjustment of data, it remains important because it demonstrates that there is still some contention over the degree to which failure of tolerance induction can be attributed to prior exposure to the partner's sperm.

Continued exposure to a partner's semen has a strong protective effect against pre-eclampsia, largely due to the absorption of several immune modulating factors present in seminal fluid.

Long periods of sexual cohabitation with the same partner fathering a woman's child significantly decreased her chances of suffering pre-eclampsia. As one early study described, "although preeclampsia is a disease of first pregnancies, the protective effect of multiparity is lost with change of partner". The study also concluded that although women with changing partners are strongly advised to use condoms to prevent sexually transmitted diseases, "a certain period of sperm exposure within a stable relation, when pregnancy is aimed for, is associated with protection against preeclampsia".

Several other studies have since investigated the strongly decreased incidence of pre-eclampsia in women who had received blood transfusions from their partner, those with long, preceding histories of sex without barrier contraceptives, and in women who had been regularly performing oral sex, with one study concluding "induction of allogeneic tolerance to the paternal human leukocyte antigen (HLA) molecules of the fetus may be crucial. Data collected strongly suggest that exposure, and especially oral exposure to soluble HLA from semen can lead to transplantation tolerance."

Other studies have investigated the roles of semen in the female reproductive tracts of mice, showing that "insemination elicits inflammatory changes in female reproductive tissues", concluding that the changes "likely lead to immunological priming to paternal antigens or influence pregnancy outcomes". A similar series of studies confirmed the importance of immune modulation in female mice through the absorption of specific immune factors in semen, including TGF-Beta, lack of which is also being investigated as a cause of miscarriage in women and infertility in men.

According to the theory, the fetus and placenta both contain "foreign" proteins from paternal genes, but regular, preceding and coincident exposure to the father's semen may promote immune acceptance and subsequent implantation, a process which is significantly supported by as many as 93 currently identified immune regulating factors in seminal fluid.

Having already noted the importance of a woman's immunological tolerance to her baby's paternal genes, several Dutch reproductive biologists decided to take their research a step further. Consistent with the fact that human immune systems tolerate things better when they enter the body via the mouth, the Dutch researchers conducted a series of studies that confirmed a surprisingly strong correlation between a diminished incidence of pre-eclampsia and a woman's practice of oral sex, and noted that the protective effects were strongest if she swallowed her partner's semen. The researchers concluded that while any exposure to a partner's semen during sexual activity appears to decrease a woman's chances for the various immunological disorders that can occur during pregnancy, immunological tolerance could be most quickly established through oral introduction and gastrointestinal absorption of semen. Recognizing that some of the studies potentially included the presence of confounding factors, such as the possibility that women who

regularly perform oral sex and swallow semen also engage in more frequent intercourse, the researchers also noted that, either way, "the data still overwhelmingly supports the main theory" behind all their studies—that repeated exposure to semen establishes the maternal immunological tolerance necessary for a safe and successful pregnancy.

A team from the University of Adelaide has also investigated to see if men who have fathered pregnancies which have ended in miscarriage or pre-eclampsia had low seminal levels of critical immune modulating factors such as TGF-Beta. The team has found that certain men, dubbed "dangerous males", are several times more likely to father pregnancies that would end in either pre-eclampsia or miscarriage. Among other things, most of the "dangerous males" seemed to lack sufficient levels of the seminal immune factors necessary to induce immunological tolerance in their partners.

Administration of immune factors

As the theory of immune intolerance as a cause of pre-eclampsia has become accepted, women who suffer repeated pre-eclampsia, miscarriages, or In Vitro Fertilization failures could potentially be administered key immune factors such as TGF-beta along with the father's foreign proteins, possibly either orally, as a sublingual spray, or as a vaginal gel to be applied onto the vaginal wall before intercourse.

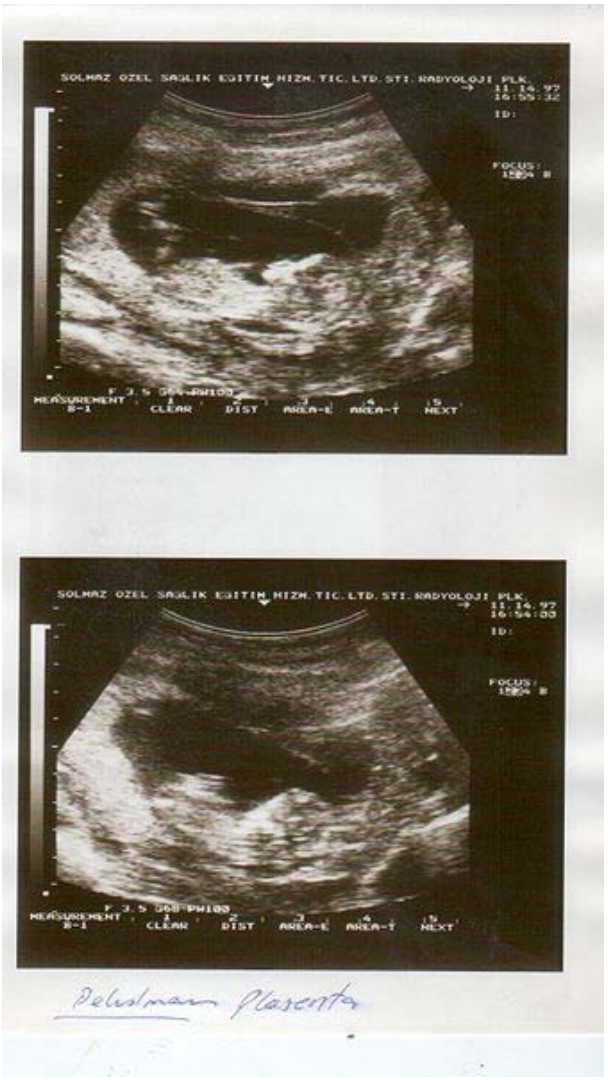
In 2006, researchers at the University of Adelaide developed a gel containing TGF-Beta for use in human populations. Later, GroPep, the company which was awarded the patent on a TGF-Beta3 variant, conducted trials where the miscarriage rate was halved in the mice studied. According to a GroPep news release later published, "a faulty immune response is implicated in the etiology of as many as 50% of all miscarriages." Their drug, PV903, was "targeted to treat recurrent miscarriages caused by an abnormal immune response to the foetus, a condition for which there is no current [drug] treatment." Stage I clinical trials of their vaginal gel were partly successful, succeeding in establishing the safety of the drug, but failing in their aim of increasing the number of specific immune cells measured in circulation, the necessary condition for affecting a desired immunological desensitization. The trials were later criticized for failing to recognize the synergistic effects of a large variety of immune factors naturally present in seminal fluid, which, acting together and with the localized presence of the foreign paternal proteins, modulate the female immune response so as to allow for implantation, and then the subsequent immune acceptance of the (foreign) fetus throughout a successful pregnancy. GroPep was later acquired by the biotechnology giant, Novozymes. The development of the PV903 drug has since then been placed on hold.

Chapter 11

Placental Abruption and Shoulder Dystocia

Placental abruption

Placental abruption



Ultrasound showing placental abruption.

ICD-10	O45.
ICD-9	641.2
DiseasesDB	40
MedlinePlus	000901
eMedicine	med/6 emerg/12
MeSH	D000037

Placental abruption (also known as **abruptio placentae**) is a complication of pregnancy, wherein the placental lining has separated from the uterus of the mother. It is the most common pathological cause of late pregnancy bleeding. In humans, it refers to the abnormal separation after 20 weeks of gestation and prior to birth. It occurs in 1% of pregnancies world wide with a fetal mortality rate of 20–40% depending on the degree of separation. Placental abruption is also a significant contributor to maternal mortality.

The heart rate of the fetus can be associated with the severity.

Lasting effects

On the mother:

- A large loss of blood or hemorrhage may require blood transfusions and intensive care after delivery. 'APH weakens, for PPH to kill'.
- The uterus may not contract properly after delivery so the mother may need medication to help her uterus contract.
- The mother may have problems with blood clotting for a few days.
- If the mother's blood does not clot (particularly during a caesarean section) and too many transfusions could put the mother into disseminated intravascular coagulation (DIC) due to increased thromboplastin, the doctor may consider a hysterectomy.
- A severe case of shock may affect other organs, such as the liver, kidney, and pituitary gland. Diffuse cortical necrosis in the kidney is a serious and often fatal complication.
- In some cases where the abruption is high up in the uterus, or is slight, there is no bleeding, though extreme pain is felt and reported.

On the baby:

- If a large amount of the placenta separates from the uterus, the baby will probably be in distress until delivery and may die *in utero*, thus resulting in a stillbirth.

- The baby may be premature and need to be placed in the newborn intensive care unit. He or she might have problems with breathing and feeding.
- If the baby is in distress in the uterus, he or she may have a low level of oxygen in the blood after birth.
- The newborn may have low blood pressure or a low blood count.
- If the separation is severe enough, the baby could suffer brain damage or die before or shortly after birth.

Symptoms

- contractions that don't stop (and may follow one another so rapidly as to seem continuous)
- pain in the uterus
- tenderness in the abdomen
- vaginal bleeding (sometimes)
- uterus may be disproportionately enlarged
- pallor

Clinical Manifestation

- **Class 0:** asymptomatic. Diagnosis is made retrospectively by finding an organized blood clot or a depressed area on a delivered placenta.
- **Class 1:** mild and represents approximately 48% of all cases. Characteristics include the following:
    - No vaginal bleeding to mild vaginal bleeding
    - Slightly tender uterus
    - Normal maternal BP and heart rate
    - No coagulopathy
    - No fetal distress
- **Class 2:** moderate and represents approximately 27% of all cases. Characteristics include the following:
    - No vaginal bleeding to moderate vaginal bleeding
    - Moderate-to-severe uterine tenderness with possible tetanic contractions
    - Maternal tachycardia with orthostatic changes in BP and heart rate
    - Fetal distress
    - Hypofibrinogenemia (ie, 50-250 mg/dL)
- **Class 3:** severe and represents approximately 24% of all cases. Characteristics include the following:
    - No vaginal bleeding to heavy vaginal bleeding
    - Very painful tetanic uterus
    - Maternal shock
    - Hypofibrinogenemia (ie, <150 mg/dL)
    - Coagulopathy
    - Fetal death

Pathophysiology

Trauma, hypertension, or coagulopathy contributes to the avulsion of the anchoring placental villi from the expanding lower uterine segment, which in turn, leads to bleeding into the decidua basalis. This can push the placenta away from the uterus and cause further bleeding. Bleeding through the vagina, called overt or external bleeding, occurs 80% of the time, though sometimes the blood will pool behind the placenta, known as concealed or internal placental abruption.

Women may present with vaginal bleeding, abdominal or back pain, abnormal or premature contractions, fetal distress or death.

Abruptions are classified according to severity in the following manner:

- **Grade 0**: Asymptomatic and only diagnosed through post partum examination of the placenta.
- **Grade 1**: The mother may have vaginal bleeding with mild uterine tenderness or tetany, but there is no distress of mother or fetus.
- **Grade 2**: The mother is symptomatic but not in shock. There is some evidence of fetal distress can be found with fetal heart rate monitoring.
- **Grade 3**: Severe bleeding (which may be occult) leads to maternal shock and fetal death. There may be maternal disseminated intravascular coagulation. Blood may force its way through the uterine wall into the serosa, a condition known as Couvelaire uterus.

Risk factors

- Maternal hypertension is a factor in 44% of all abruptions.
- Maternal trauma, such as motor vehicle accidents, assaults, falls or nosocomial infection.
- Short umbilical cord
- Prolonged rupture of membranes (>24 hours)
- Retroplacental fibromyoma
- Maternal age: pregnant women who are younger than 20 or older than 35 are at greater risk.
- Previous abruption: Women who have had an abruption in previous pregnancies are at greater risk.
- some infections are also diagnosed as a cause
- cocaine intoxication

The risk of placental abruption can be reduced by maintaining a good diet including taking folic acid, regular sleep patterns and correction of pregnancy-induced hypertension.

Intervention

Placental abruption is suspected when a pregnant mother has sudden localized abdominal pain with or without bleeding. The fundus may be monitored because a rising fundus can indicate bleeding. An ultrasound may be used to rule out placenta praevia but is not diagnostic for abruption. The mother may be given Rhogam if she is Rh negative.

Treatment depends on the amount of blood loss and the status of the fetus. If the fetus is less than 36 weeks and neither mother or fetus are in any distress, then they may simply be monitored in hospital until a change in condition or fetal maturity whichever comes first.

Immediate delivery of the fetus may be indicated if the fetus is mature or if the fetus or mother are in distress. Blood volume replacement and to maintain blood pressure and blood plasma replacement to maintain fibrinogen levels may be needed. Vaginal birth is usually preferred over caesarean section unless there is fetal distress. Caesarean section is contraindicated in cases of disseminated intravascular coagulation. Patient should be monitored for 7 days for PPH. Excessive bleeding from uterus may necessitate hysterectomy if family size is completed.

Shoulder dystocia

Shoulder dystocia	
ICD-10	O66.0
ICD-9	660.4
DiseasesDB	12036

Shoulder dystocia is a specific case of dystocia whereby after the delivery of the head, the anterior shoulder of the infant cannot pass below the pubic symphysis, or requires significant manipulation to pass below the pubic symphysis. It is diagnosed when the shoulders fail to deliver shortly after the fetal head. In shoulder dystocia, it is the chin that presses against the walls of the perineum. Shoulder dystocia is an obstetrical emergency, and fetal demise can occur if the infant is not delivered, due to compression of the umbilical cord within the birth canal.

Signs

One often described feature is the **turtle sign**, which involves the appearance and retraction of the fetal head (analogous to a turtle withdrawing into its shell), and the erythematous, red puffy face indicative of facial flushing. This occurs when the baby's shoulder is obstructed by the maternal pelvis.

Procedures

A number of labor positions and/or obstetrical maneuvers are sequentially performed in attempt to facilitate delivery at this point, including :

- McRoberts maneuver; The McRoberts maneuver is employed in case of shoulder dystocia during childbirth and involves hyperflexing the mother's legs tightly to her abdomen. This widens the pelvis, and flattens the spine in the lower back (lumbar spine). If this maneuver does not succeed, an assistant applies pressure on the lower abdomen (suprapubic pressure), and the delivered head is also gently pulled. The technique is effective in about 42% of cases

- suprapubic pressure (or Rubin I)

- Rubin II or posterior pressure on the anterior shoulder, which would bring the fetus in an oblique position with head somewhat towards the vagina

- Woods' screw maneuver which leads to turning the anterior shoulder to the posterior and vice versa (somewhat the opposite of Rubin II maneuver)

- Jacquemier's maneuver (also called Barnum's maneuver), or delivery of the posterior shoulder first, in which the forearm and hand are identified in the birth canal, and gently pulled.

- Gaskin maneuver, named after Certified Professional Midwife, Ina May Gaskin, involves moving the mother to an all fours position with the back arched, widening the pelvic outlet.

More drastic maneuvers include

- Zavanelli's maneuver, which involves pushing the fetal head back in with performing a cesarean section. or internal cephalic replacement followed by Cesarean section

- intentional fetal clavicular fracture, which reduces the diameter of the shoulder girdle that requires to pass through the birth canal.

- maternal symphysiotomy, which makes the opening of the birth canal laxer by breaking the connective tissue between the two pubes bones facilitating the passage of the shoulders.

- abdominal rescue, described by O'Shaughnessy, where a hysterotomy facilitates vaginal delivery of the impacted shoulder

Management

Management of shoulder dystocia has become a focus point for many obstetrical nursing units in North America. Courses such as the Canadian More-OB program encourage nursing units to do routine drills to prevent delays in delivery which adversely affect both mother and fetus. A common treatment mnemonic is ALARMER

- **A**sk for help. This involves requesting the help of an obstetrician, anesthesia and pediatrics for subsequent resuscitation of the infant.
- **L**eg hyperflexion (McRoberts' maneuver)
- **A**nterior shoulder disimpaction (suprapubic pressure)
- **R**ubin maneuver
- **M**annual delivery of posterior arm
- **E**pisiotomy
- **R**oll over on all fours

The advantage of proceeding in the order of ALARMER is that it goes from least to most invasive, thereby reducing harm to the mother in the event that the infant delivers with one of the earlier maneuvers. Although this is questionable since, since the Gaskin Maneuver, or "roll over on all fours", is considered by some the most effective and least invasive maneuver, but it is rarely used in the medical setting. In the event that these maneuvers are unsuccessful, a skilled obstetrician may attempt some of the additional procedures listed below. Intentional clavicular fracture is a final attempt at nonoperative vaginal delivery prior to Zavanelli's maneuver or symphysiotomy, both of which are considered extraordinary treatment measures.

Risk factors

Although the definition is imprecise, it occurs in approximately 1% of vaginal births. There are well-recognised risk factors, such as diabetes, fetal macrosomia, and maternal obesity, but it is often difficult to predict. Despite appropriate obstetric management, fetal injury (such as brachial plexus injury) or even fetal death can be a complication of this obstetric emergency.

Recurrence rates are relatively high.

Complications

The major concern of shoulder dystocia is damage to the upper brachial plexus nerves. These supply the sensory and motor components of the shoulder, arm and hands. The aetiology of injury to the fetus is debated, but a probable mechanism is manual stretching of the nerves, which in itself can cause injury. Furthermore, excess tension may physically tear the nerve roots out from the neonatal spinal column, resulting in total dysfunction. The ventral roots (motor pathway) are most prone to injury, as they are in the plane of greatest tension (anterior, sensory nerves are somewhat protected due to the usual inward movement of the shoulder).

- Klumpke paralysis
- Erb's Palsy
- Fetal hypoxia
    - Fetal death
    - Cerebral palsy
- Maternal post partum hemorrhage

Chapter 12

Puerperal Fever

Streptococcus pyogenes (red-stained spheres) is responsible for most cases of severe puerperal fever. It is commonly found in the throat and nasopharynx of otherwise healthy carriers, particularly during winter. Details: A pus specimen, viewed using Pappenheim's stain @ 900x magnification

Puerperal fever	
ICD-10	O85.
ICD-9	672
MeSH	D011645

Puerperal fever (from the Latin *puer*, *male child (boy)*), also called **childbed fever**, can develop into **puerperal sepsis**, which is a serious form of septicaemia contracted by a woman during or shortly after childbirth, miscarriage or abortion. If untreated, it is life-threatening.

The most common infection causing puerperal fever is genital tract sepsis. Other types of infection that can lead to sepsis after childbirth include urinary tract infection, breast infection (mastitis) and respiratory tract infection (more common after anaesthesia due to lesions in the windpipe).

A famous victim of puerperal fever was Elizabeth of York, the mother of Henry VIII of England. She died one week after giving birth to a daughter. Other significant victims were Isabella Beeton and Mary Wollstonecraft (1759–1797), author of *Vindication of the Rights of Woman*, who died ten days after giving birth to William Godwin's daughter, who grew up to be Mary Shelley, author of *Frankenstein*.

Puerperal fever is now rare in the West due to improved hygiene during delivery, and deaths have been reduced by antibiotics.

Terminology

Puerperal fever is no longer favored as a diagnostic category. Instead, contemporary terminology specifies:

1. the specific target of infection: endometritis (inflammation of the inner lining of the uterus), metrophlebitis (inflammation of the veins of the uterus), and peritonitis (inflammation of the membrane lining of the abdomen)
2. the severity of the infection: (relatively) uncomplicated infection (contained multiplication of microbes), and possibly life-threatening sepsis (uncontrolled and uncontained multiplication of microbes throughout the blood stream).

Causal organisms

The most common causative agents in inflammation of the inner lining of the uterus (endometritis) are *Staphylococcus aureus* and *Streptococcus* spp.

Group A *Streptococcus* (abbreviated to GAS, or more specifically the *Streptococcus pyogenes*) is a form of *Streptococcus* bacteria responsible for most cases of severe hemolytic streptococcal illness. Other types (B, C, D, and G) may also cause infection. Group B *Streptococcus* (abbreviated to GBS, or more specifically *Streptococcus agalactiae*) usually causes less severe maternal disease.

Other causal organisms, in order of prevalence, include staphylococci, coliform bacteria, anaerobic bacteria, *Chlamydia*, *Mycoplasma* and very rarely, *Clostridium welchii*.

There are several strains of GAS. Some strains usually cause skin infections, they are more common in warm climates, and they usually cause local rather than systemic effects. Other strains, in particular *Streptococcus pyogenes*, attack the throat and cause severe infections. The human nasopharynx is the main reservoir of *S. pyogenes, and infection is more common during winter, and it is rarely found in the normal vaginal*

flora. It is likely that most puerperal hemolytic infections arise from this reservoir in the patient or attendants.

Group B Streptococcus (*Streptococcus agalactiae*) causes pneumonia and meningitis in neonates and the elderly, with occasional systemic bacteremia. They can also colonize the intestines and the female reproductive tract, increasing the risk for transmission to the infant. The American College of Obstetricians and Gynecologists, American Academy of Pediatrics and the Centers for Disease Control recommend all pregnant women between 35 and 37 weeks gestation should be tested for GBS.

Definition of puerperal fever

- A temperature rise above 100.0 °F (38°C) maintained over 24 hours or recurring during the period from the end of the first to the end of the 10th day after childbirth or abortion. (ICD-10)
- Oral temperature of 100.0 °F (38°C) or more on any two of the first ten days postpartum. (USJCMW)

Incidence

The incidence of puerperal sepsis shows wide variations among published literature — this may be related to different definition, recording etc.

Today in the United States, **puerperal infection** is believed to occur in between one and 8 percent of all deliveries. About three die from puerperal sepsis for every 100,000 deliveries. The single most important risk factor is Caesarean section.

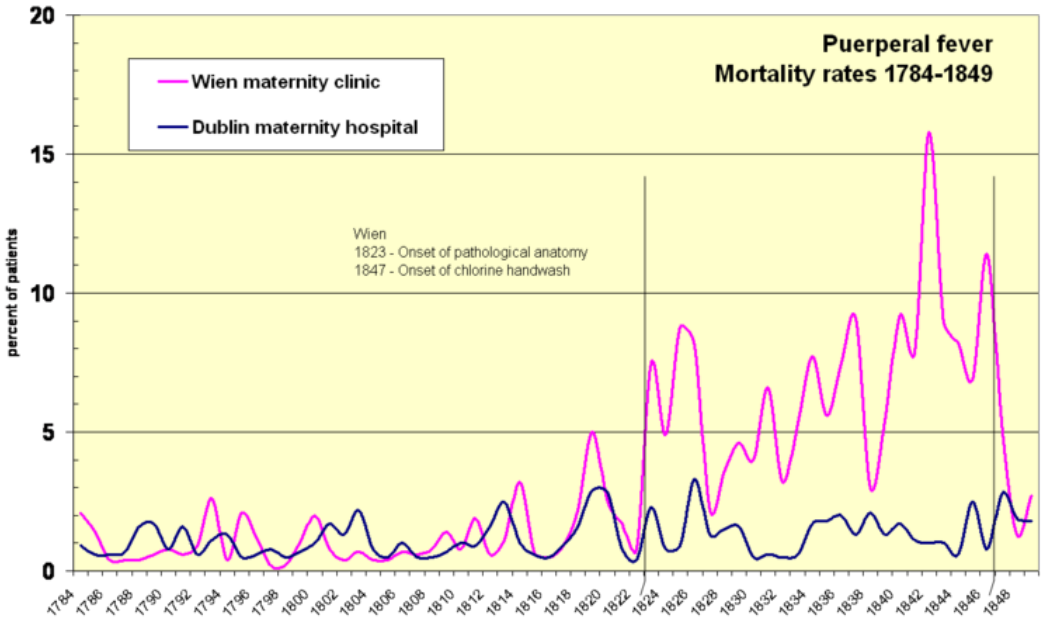
In the United Kingdom 1985-2005, the number of *direct* deaths associated with **genital tract sepsis** per 100,000 maternities was 0.40–0.85.

The incidence of **maternal deaths** in the United States is 13 in 100,000.

Puerperal fever or childbed fever in the 18th and 19th centuries affected, on average, six to 9 women in every 1000 deliveries, killing two to three of them with peritonitis or septicemia. It was the single most common cause of maternal mortality, accounting for about half of all deaths related to childbirth, and was second only to tuberculosis in killing women of childbearing age. A rough estimate is that about 250,000–500,000 died from puerperal fever in the 18th and 19th centuries in England and Wales alone.

The Confidential Enquiry into Maternal and Child Health (UK) reported, in 2003–2005, genital tract sepsis accounted for 14% of direct causes of maternal death still making puerperal fever a significant factor in maternal death.

History



In his 1861 book, Ignaz Semmelweis presented evidence to demonstrate that the advent of pathological anatomy in Vienna in 1823 (vertical line) was correlated to the incidence of fatal childbed fever there. Onset of chlorine handwash in 1847 marked by vertical line. Rates for Dublin maternity hospital, which had no pathological anatomy, is shown for comparison (view rates). His efforts were futile, however.

Hospitals for childbirth became common in the 17th century in many European cities. These "lying-in" hospitals were established at a time when there was no knowledge of antisepsis or epidemiology, and patients were subjected to crowding, frequent vaginal examinations, and the use of contaminated instruments, dressings, and bedding. It was common for a doctor to deliver one baby after another, without washing his hands or changing clothes in between.

The first recorded epidemic of puerperal fever occurred at the Hôtel-Dieu de Paris in 1646. Hospitals throughout Europe and America consistently reported death rates between 20% to 25% of all women giving birth, punctuated by intermittent epidemics with up to 100% fatalities of women giving birth in childbirth wards.

A number of physicians began to suspect contagion and hygiene as causal factors in spreading puerperal fever. In 1795, Alexander Gordon of Aberdeen, Scotland suggested that the fevers were infectious processes, that physicians were the carrier, and that "I myself was the means of carrying the infection to a great number of women." Thomas Watson, Professor of Medicine at King's College Hospital, London, wrote in 1842: "Wherever puerperal fever is rife, or when a practitioner has attended any one instance of it, he should use most diligent ablution." Watson recommended handwashing with

chlorine solution and changes of clothing for obstetric attendants "to prevent the practitioner becoming a vehicle of contagion and death between one patient and another."

Prevention via hygienic measures

In 1843, Oliver Wendell Holmes published *The Contagiousness of Puerperal Fever* and controversially concluded that puerperal fever was frequently carried from patient to patient by physicians and nurses; he suggested that clean clothing and avoidance of autopsies by those aiding birth would prevent the spread of puerperal fever. Holmes stated, ". . . in my own family, I had rather that those I esteemed the most should be delivered unaided, in a stable, by the mangerside, than that they should receive the best help, in the fairest apartment, but exposed to the vapors of this pitiless disease."

Holmes' conclusions were ridiculed by many contemporaries, including Charles Delucena Meigs, a well-known obstetrician, who stated, "Doctors are gentlemen, and gentlemen's hands are clean." Richard Gordon states that Holmes' exhortations "outraged obstetricians, particularly in Philadelphia". In those days, "surgeons operated in blood-stiffened frock coats - the stiffer the coat, the prouder the busy surgeon", "pus was as inseparable from surgery as blood", and "Cleanliness was next to prudishness". He quotes Sir Frederick Treves on that era: "There was no object in being clean...Indeed, cleanliness was out of place. It was considered to be finicking and affected. An executioner might as well manicure his nails before chopping off a head".

In 1844, Ignaz Semmelweis was appointed assistant lecturer in the First Obstetric Division of the Vienna General Hospital (Allgemeines Krankenhaus), where medical students received their training. Working without knowledge of Holmes' essay, Semmelweis noticed his ward's 16% mortality rate from fever was substantially higher than the 2% mortality rate in the Second Division, where midwifery students were trained. Semmelweis also noticed that puerperal fever was rare in women who gave birth before arriving at the hospital. Semmelweis noted that doctors in First Division performed autopsies each morning on women who had died the previous day, but the midwives were not required or allowed to perform such autopsies. He made the connection between the autopsies and puerperal fever after a colleague, Jakob Kolletschka, died of septicaemia after accidentally cutting his hand while performing an autopsy.

Semmelweis began experimenting with various cleansing agents and, from May 1847, ordered all doctors and students working in the First Division wash their hands in chlorinated lime solution before starting ward work, and later before each vaginal examination. The mortality rate from puerperal fever in the division fell from 18% in May 1847 to less than 3% in June–November of the same year. While his results were extraordinary, he was treated with skepticism and ridicule.