

# Prenatal genetic screening and diagnosis

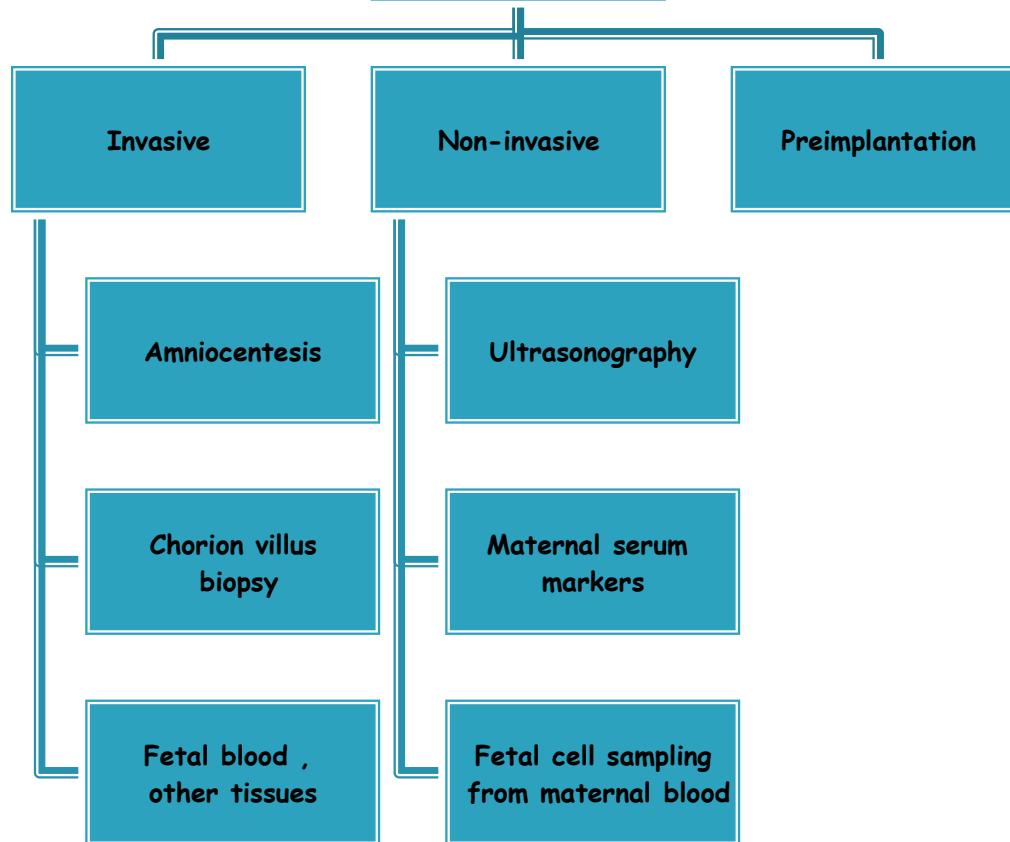
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Training Course in Sexual and Reproductive Health Research  
Geneva 2015



While it is never easy for a couple to decide to pursue prenatal diagnosis because of the possibility of subsequently having to consider termination of pregnancy, prenatal diagnosis is an option that is chosen by many couples at high risk of having a child with a serious congenital disorder.

**Methods used for prenatal diagnosis of congenital disorders**

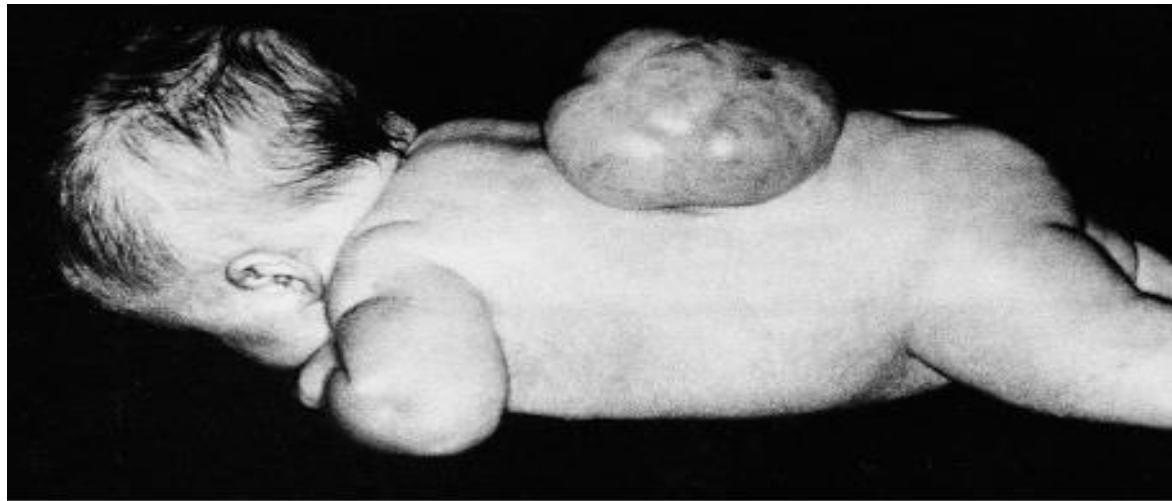


# Prenatal genetic screening

- ▶ For most women, prenatal genetic screening involves a blood test for maternal serum markers and a special ultrasound done in the first trimester.
- ▶ Abnormal results could point to the possibility that the fetus has:
  1. Down syndrome
  2. Other chromosomal abnormalities such as Trisomy 18 and Turner syndrome
  3. Open neural tube defect (ONTD)
  4. Other conditions

# Neural tube defect

Spina bifida indicates a defect in the closure of the vertebral column leading to protrusion of the meninges/spinal cord. Severe conditions lead to lower limb paralysis and incontinence.



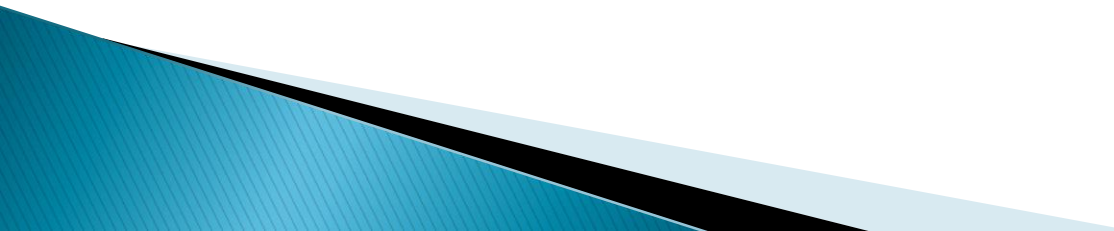
- ▶ The observation that increased nuchal translucency (NT) is seen in fetuses who are subsequently born with Down syndrome, has resulted in the introduction of measurements of nuchal pad thickness in the first trimester as a screening test for Down syndrome.

Ultrasound offers a valuable means of prenatal diagnosis. It can be used not only for obstetric indications, such as placental localization and the diagnosis of multiple pregnancies, but also for the prenatal diagnosis of structural abnormalities that are not associated with known chromosomal, biochemical or molecular defects. Ultrasound is particularly valuable because it is non-invasive and conveys no known risk to the fetus or to the mother. It does, however, require specialized expensive equipment and a skilled and experienced operator.

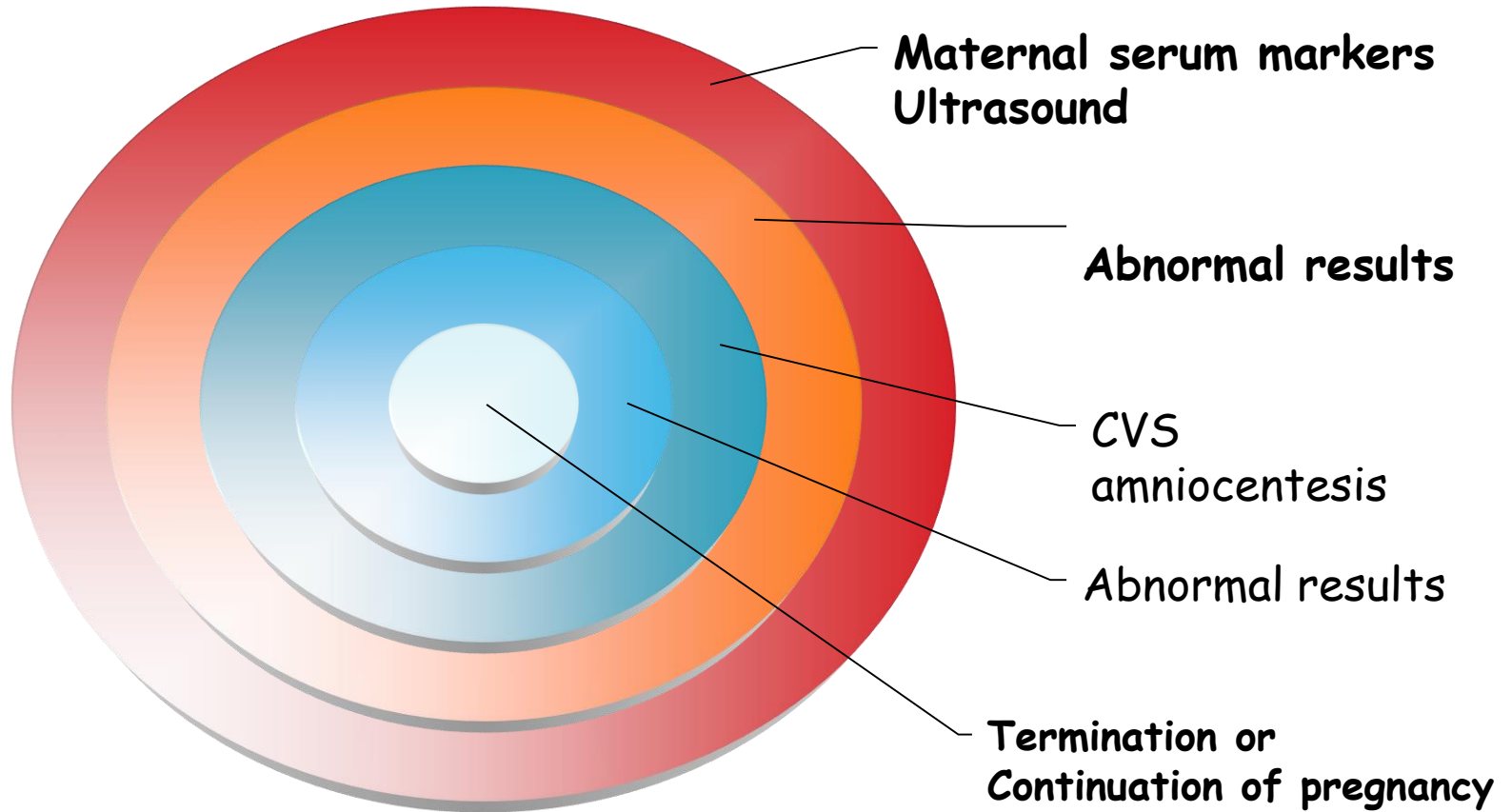
Detailed 'fetal anomaly' scanning is being offered routinely to all pregnant women at around 18 weeks gestation as a screening procedure for structural abnormalities such as cardiac and other congenital malformations.



First trimester risk assessment using the double test (pregnancy-associated plasma protein A (PAPP-A) and free beta-human chorionic gonadotropin (hCG) and nuchal translucency thickness in combination with maternal age has been shown to be very efficient giving a detection rate of 90% for Down syndrome and for a 5% false-positive rate.

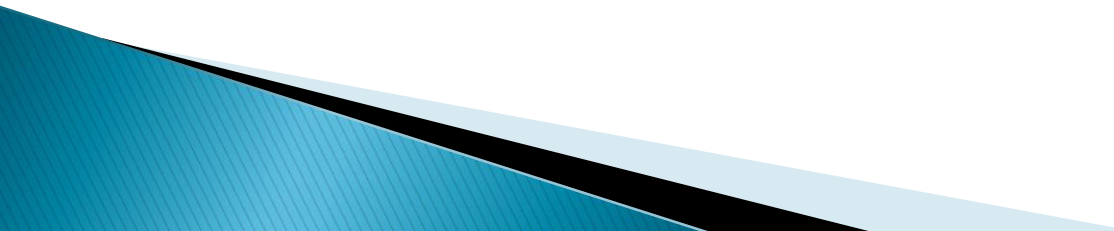
- ▶ A screening test does not give a yes or no answer but identifies increased risk for certain disorders so that definitive diagnostic tests can be offered.
  - ▶ If the risk is considered high, then diagnostic tests could be done by obtaining fetal tissues either through chorion villus sampling or amniocentesis.
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# Progression of Prenatal screening



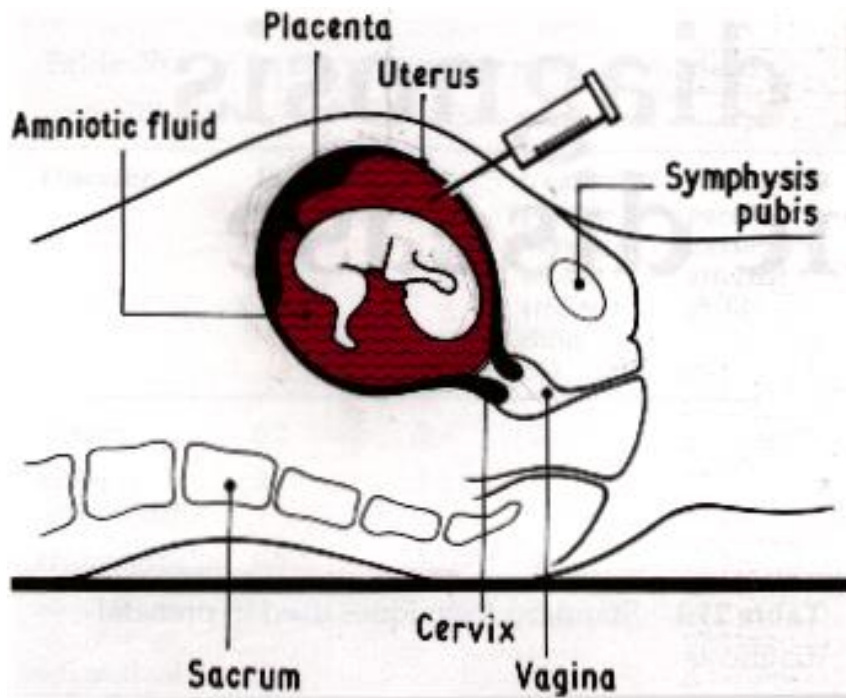
A fundamental difference between prenatal and other types of screening is that when prenatal screening leads to the diagnosis of an abnormality in the fetus there is frequently no treatment available before birth. Women are left with the choice between continuing the pregnancy knowing the infant will be born with the condition identified or abortion to prevent the birth of an affected child.

# Indications for prenatal diagnosis

- ▶ Abnormal results in prenatal screening
  - ▶ Previous child with a chromosome abnormality (probability of translocation carrier in parents)
  - ▶ Family history of a chromosome abnormality
  - ▶ Family history of a single gene disorder
  - ▶ Family history of neural tube defect or other congenital abnormalities
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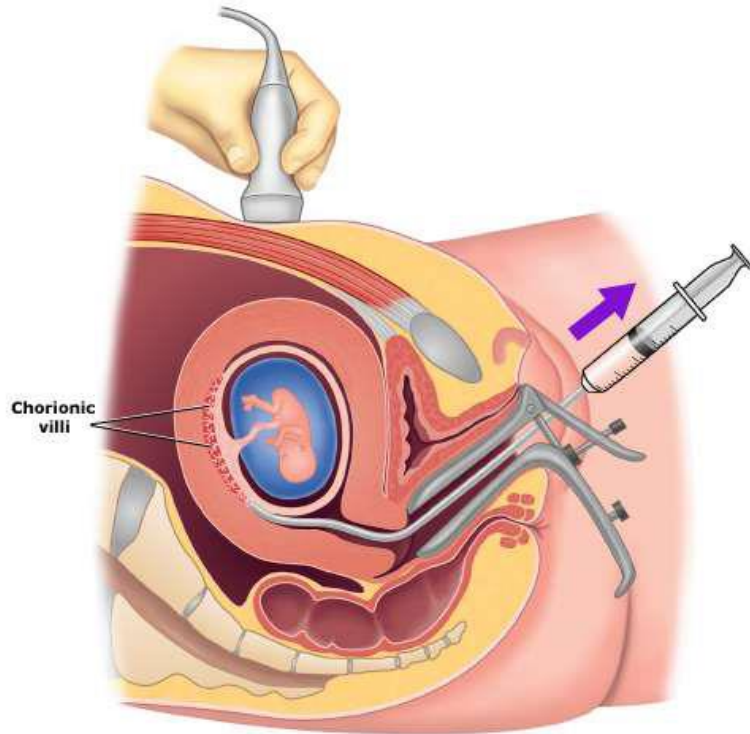
Advanced maternal age, usually defined as 35 years or more, used to be the most common indication for invasive prenatal diagnosis. In many countries, this indication has been replaced by an individualised risk assessment for Down's syndrome based on maternal age, gestational age, and a combination of ultrasonic and biochemical markers.

# Amniocentesis



- ▶ Done around the 16th week of gestation
- ▶ Aspiration of 20 ml of amniotic fluid through the abdominal wall under ultrasound guidance
- ▶ 0.5-1% risk of miscarriage

# Chorion villus sampling



- ▶ Usually performed at 11-12 weeks gestation
- ▶ Transcervical aspiration of chorionic villi under ultrasound guidance
- ▶ Around 1% risk of miscarriage



# Fetal risks following amniocentesis

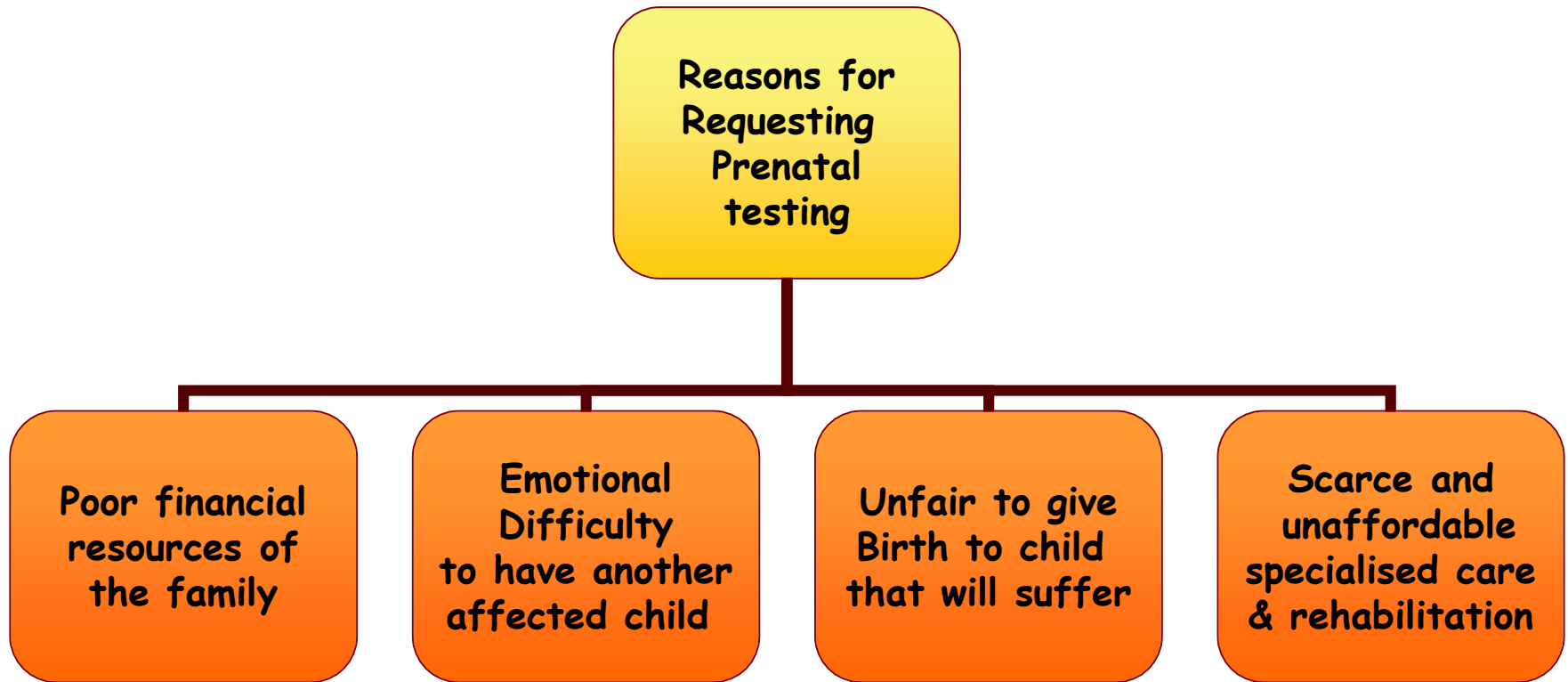
- ▶ The earlier the amniocentesis is performed, the higher the risk of amniotic fluid leakage and the higher the risk for foot deformities.
- ▶ It is advisable not to perform amniocentesis before 15 weeks gestation.

# Fetal risks following Chorion villus sampling

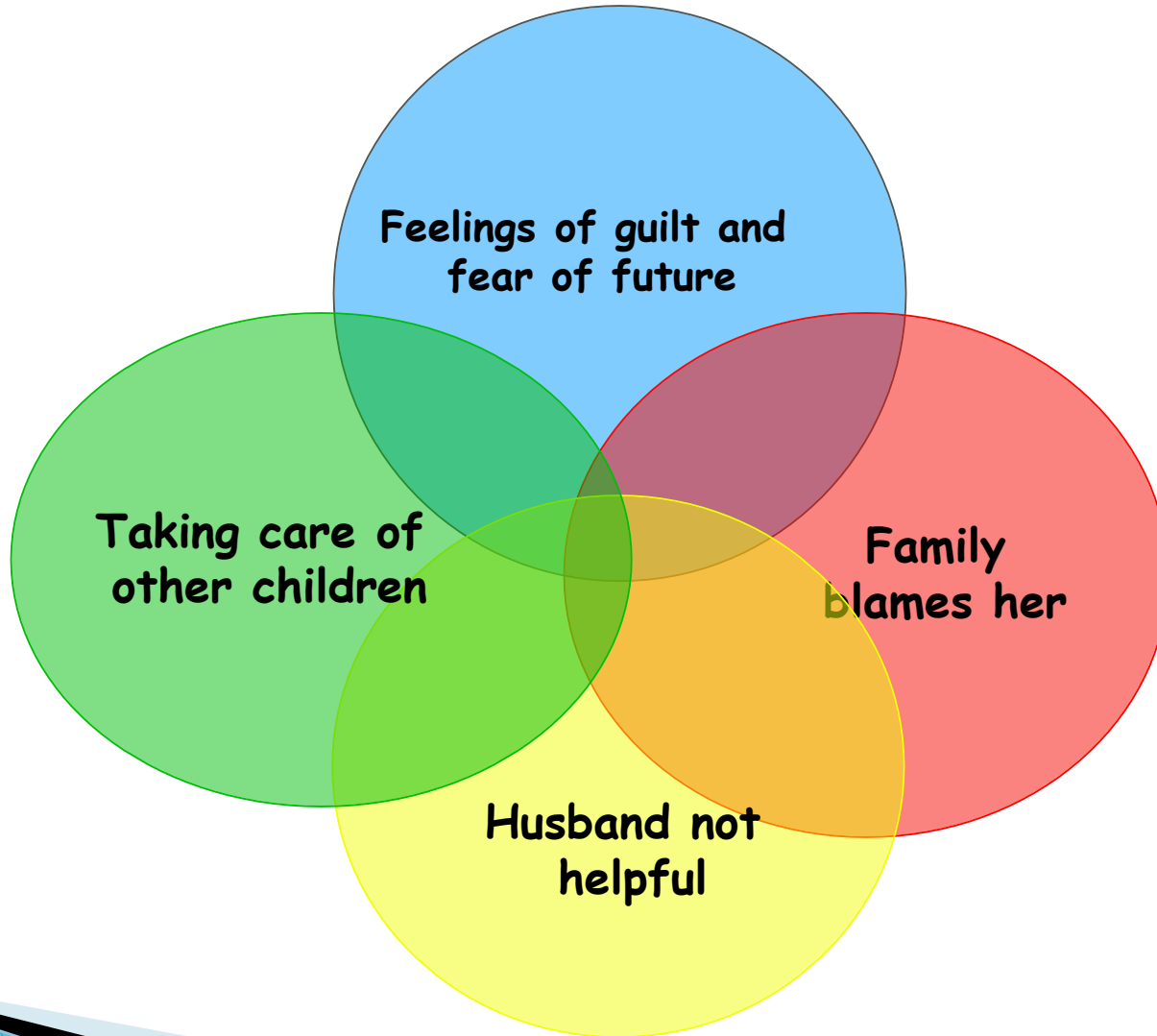
CVS should not be performed before 10 weeks due to the risk of limb reduction defects.

Experienced operators have a higher success rate and a lower complication rate.

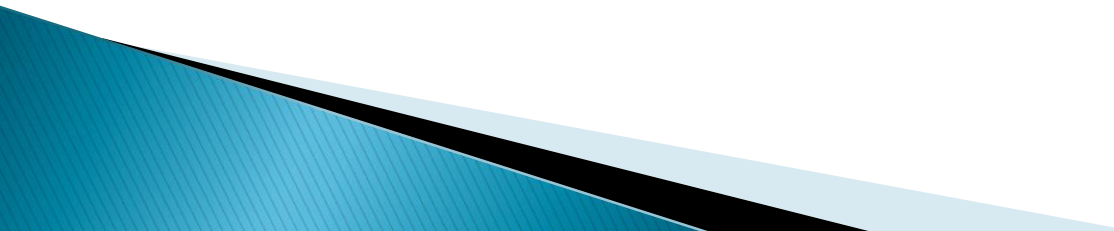
# Parents request prenatal diagnosis because they cannot have another affected child



# Problems of the mother

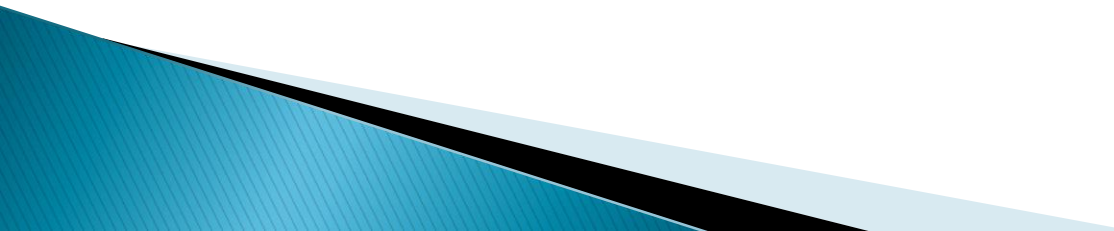


# Following the prenatal diagnosis of a fetal congenital disorder

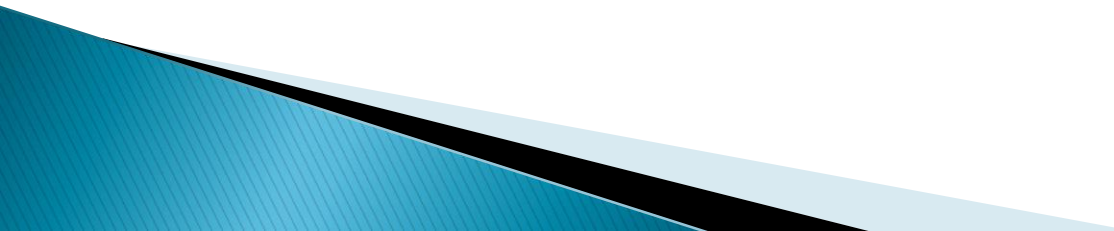
- ▶ The couple should be counseled by a genetic counselor to inform them of the test results and the risks to the fetus.
  - ▶ The couple should take an informed decision about termination or continuation of pregnancy
  - ▶ Autonomy of decision is crucial.
  - ▶ The ethical, legal, and religious issues should be respected.
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# Selective termination of pregnancy when fetus is affected?

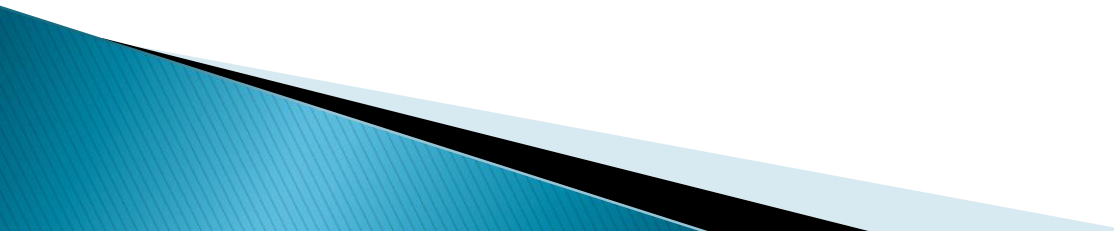
How can congenital disorders be categorized?

1. Severity of disease
  2. Survival
  3. Impact on family
  4. Impact on affected
  5. Impact on society and government
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# Preimplantation Genetic Diagnosis (PGD)

- ▶ Preimplantation Genetic Diagnosis (PGD) uses in vitro fertilisation (IVF) to create embryos.
  - ▶ Tests one or two cells from each embryo for a specific genetic abnormality.
  - ▶ Identifies unaffected embryos for transfer to the uterus.
  - ▶ The approach through PGD assists couples at risk of an inherited disorder to avoid the birth of an affected child without going through selective pregnancy termination.
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# Indications for PGD

1. To detect chromosomal disorders by fluorescence in situ hybridisation (FISH).
  2. To determine the sex of the embryo for sex linked disorders where the specific genetic defect at a molecular level is unknown, highly variable, or unsuitable for testing on single cells.
  3. To identify single gene defects such as cystic fibrosis, where the molecular abnormality is testable with molecular techniques after polymerase chain reaction (PCR) amplification of DNA extracted from single cells.
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# Things to keep in mind\*:

\* Reference Guide for Health Care Providers

Prenatal Screening Tests for the Detection of:  
Down Syndrome, Trisomy 18 and Open Neural Tube Defects

[http://www.mountsinai.on.ca/care/family-medicine-genetics-program/resources/Provider%20Mongraph%2020070930%20FINAL\\_837629127.pdf](http://www.mountsinai.on.ca/care/family-medicine-genetics-program/resources/Provider%20Mongraph%2020070930%20FINAL_837629127.pdf)

- ▶ Informed choice - Before ordering the test, discuss benefits, risks and limitations.
- ▶ Autonomy - The patient should choose whether to have prenatal screening.
- ▶ What prenatal screening options are available in your area?
- ▶ What option is most suitable for your patient?
- ▶ Which test will provide the optimal care for your patient?
- ▶ A screening test is not diagnostic.

# Prospects for the role of prenatal diagnosis in the future

- ▶ Prenatal diagnosis can be followed by intrauterine or neonatal surgery for the correction of certain congenital anomalies such as cardiac and renal defects.
  - ▶ In utero gene therapy could become a practical therapeutic option in the future for the treatment of serious monogenetic diseases.
  - ▶ Prenatal diagnosis with in-utero transplantation offers the potential to treat a large number of diseases by transplantation of healthy cells into a fetus with a birth defect.
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