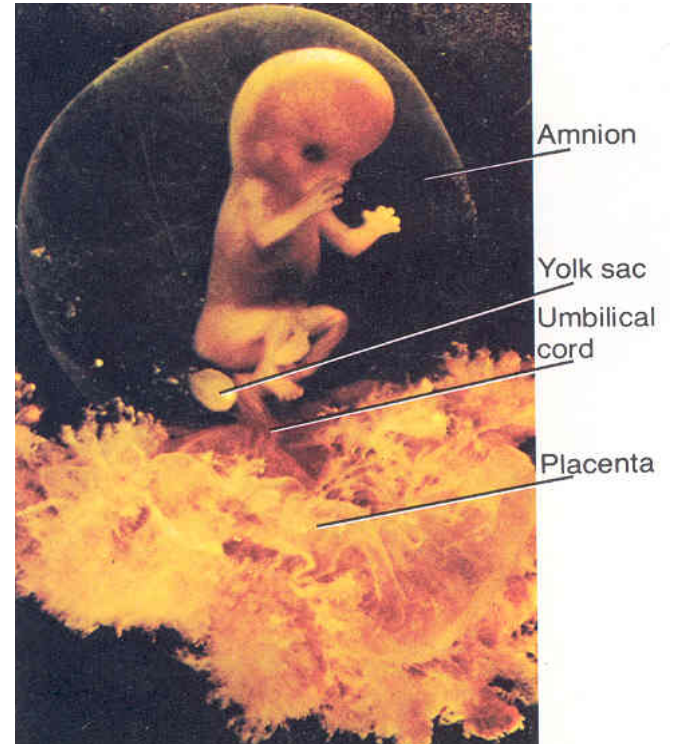
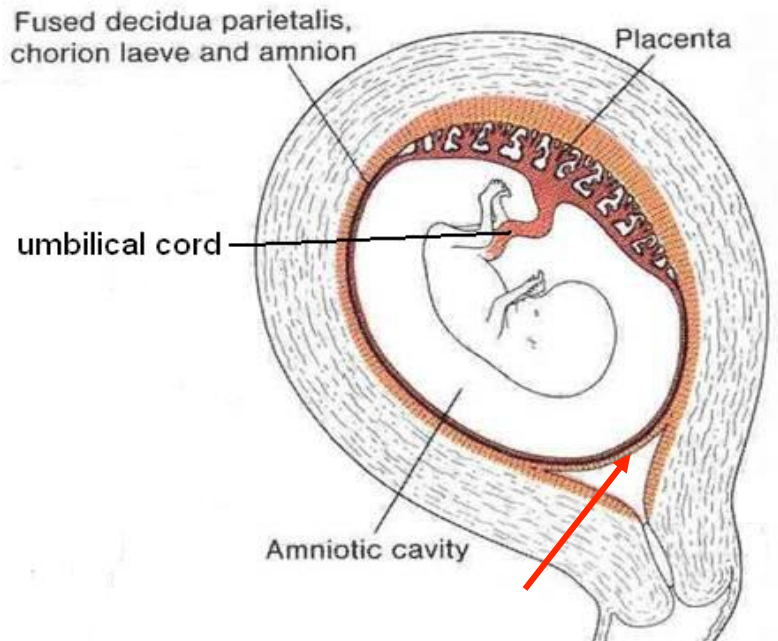
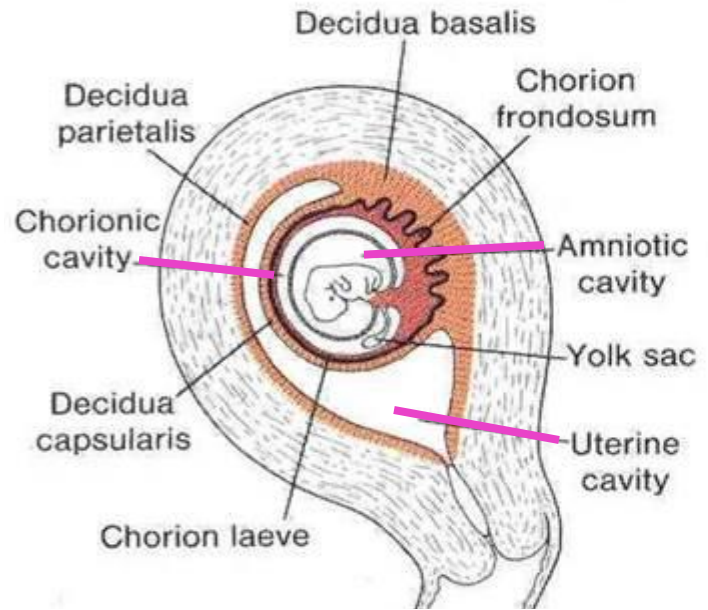


Amniotic Fluid



The Amnion & the Amniotic Fluid





Amniochorionic membrane

Amniotic Fluid

The amniotic fluid is that fluid surrounding the developing fetus that is found within the amniotic sac contained in the mother's womb.

- **Physical characteristics** ; - It is clear pale yellow fluid.
 - pH of is around 7.2.
 - Specific gravity of 1.0069 – 1.008.
 - Volume depends on gestation , 400ml at mid pregnancy and reaches about 1000ml at 36-38 weeks .
 - High volume of amniotic fluid i.e. more than 2000 ml is called **Polyhydramnios**. It results when the fetus does not swallow the usual amount of amniotic fluid e.g. in esophageal atresia
 - Low volume of amniotic fluid i.e. less than 400 ml is called **Oligohydramnios**.
 - **Oligohydramnios**.; It can develop at any stage in pregnancy , although it is more common in the last trimester especially in those women whose pregnancy extends beyond the 40 weeks since the amniotic fluid tends to decrease at that time.
- Causes:** Renal agenesis (failure of fetal kidney formation) is the main cause of oligohydramnios ,
- it can also be caused by certain maternal conditions such as DM , high blood pressure.

Amniotic Fluid

- **Amniotic fluid production;**

- At very early stages the amniotic fluid is secreted by the amniotic cells .
- Later most of it is derived from the maternal tissue fluid by diffusion, across the amniochorionic membrane and from the placenta.
 - A little is contributed by fetal respiratory secretions through the skin which becomes less later in progressed pregnancy since the fetal skin becomes less permeable .
 - By 11th week, fetus contributes to amniotic fluid by urinating into the amniotic cavity;
 - After about 20 weeks, fetal urine makes up most of the fluid.

Amniotic Fluid: Functions

- The fetus floats in the amniotic fluid. It allows fetus to move freely, aiding development of muscles and bones.
- Acts as a cushion to protect embryo from mechanical injuries.
- Acts as a barrier to infection ,(transferrin in the amniotic fluid binds iron needed by some bacteria and fungi ,fatty acids have a detergent effect on bacterial membranes and contains Ig and lysozymes that also help in fighting pathogens).

Permits normal fetal development.

Assists in regulation of fetal body temperature

Amniotic fluid function:

- Allow room for fetal growth, movement and development.
- Ingestion into GIT → growth and maturation.
- Fetal pulmonary development (20 weeks).
- Protects the fetus from trauma.
- Maintains temperature.
- Contains antibacterial activity.
- Aids dilatation of the cervix during labour.

Amniotic Fluid

-
- **Chemical composition:**

The composition of the amniotic fluid changes with gestation in early pregnancy it is similar to maternal and fetal serum.

 - 98-99% of the amniotic fluid is water.
 - A large number of dissolved substances such as creatinine, urea, bile pigments, renin, glucose, fructose, proteins (albumin and globulin), lipids, hormones (estrogen and progesterone), enzymes, minerals (Na^+ , K^+ , Cl^-).
 - suspended in it are some undissolved material such as some fetal epithelial cells.
- , during the second half of gestation its osmolarity decreases and is close to dilute fetal urine with added phospholipids and other substances from fetal lung and other metabolites.

-

Amniotic Fluid: Circulation

- The water content of the amniotic fluid changes every three hours
- Large volume moves in both directions between the fetal & maternal circulations mainly through the placental membrane
- It is swallowed by the fetus, is absorbed by respiratory & GIT and enters fetal circulation. It then passes to maternal circulation through placental membrane. During final stages of pregnancy fetus swallows about 400ml of amniotic fluid per day
- Excess water in the fetal blood is excreted by the fetal kidneys and returned to the amniotic sac through the fetal urinary tract

Amniotic fluid volume :

- About 500 mls enter and leave the amniotic sac each hour.
- gradual ↑ up to 36 weeks to around 600 to 1000 ml then ↓ after that.
- The normal range is wide but the approximate volumes are:
 - 500 ml at 18 weeks
 - 800 ml at 34 weeks.
 - 600 ml at term.

Oligohydramnios.

- The problems associated with oligohydramnios differ depending on the stage of the pregnancy.
- Oligohydramnios is more likely to have serious consequences if it occurs in the first half of pregnancy than if it occurs in the last trimester. These consequences include :
- Birth defects(too little amniotic fluid early in pregnancy can lead to compression of fetal organs, resulting in lung and limb defects)
- Miscarriage
- Premature birth
- Still birth (due to compression of the umbilical cord).

polyhydramnios

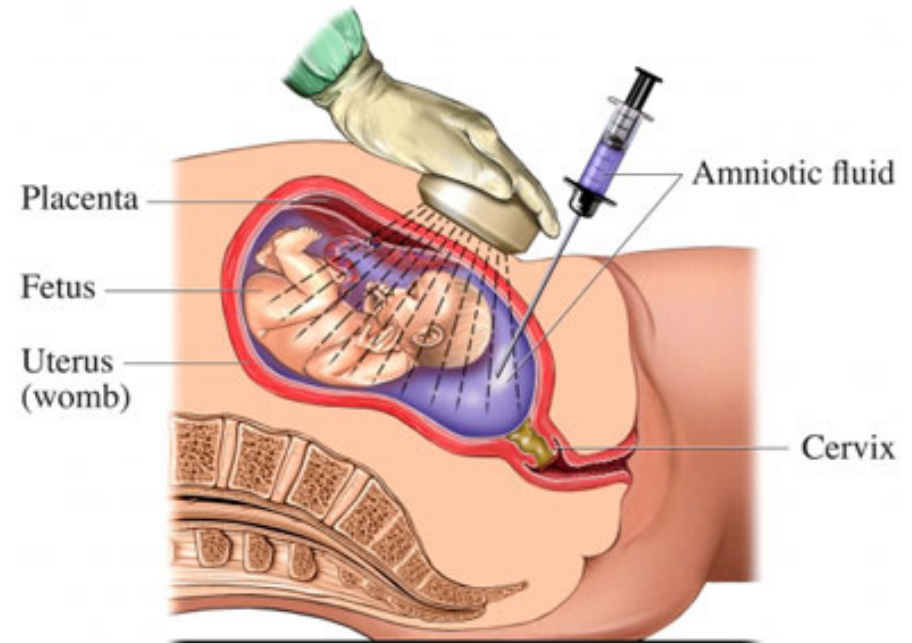
- About 1 percent of pregnant women have too much amniotic fluid .
- Most cases are minor and result from a **gradual build up of excess fluid** in the second half of pregnancy.
- However, a small number of women have a rapid build up of fluid occurring as early as 16 weeks of pregnancy that usually results in very early delivery
- **What causes polyhydramnios?**
- The most common birth defects that cause polyhydramnios are those that **affect fetal swallowing**, such as birth defects involving the gastrointestinal tract and central nervous system ,(normally, swallowing by the fetus, balanced by the production of fluid, maintains the fluid at a steady level).
- **What complications can polyhydramnios cause for mother and baby?**
- Premature delivery
- Placental abruption(the placenta partially or completely peels away from the uterine wall before delivery)
- Stillbirth
- Postpartum hemorrhage (severe bleeding after delivery)
- Fetal malposition (the baby is not lying in a head-down position and may need to be delivered by cesarean section)

Clinical importance of AF:

- **Screening for fetal malformation** (serum α -fetoprotein).
- **Assessment of fetal well-being** (amniotic fluid index).
- **Assessment of fetal lung maturity** (L/S ratio).
- **Diagnosis and follow up of labour.**
- **Diagnosis of PROM** (ferning test).

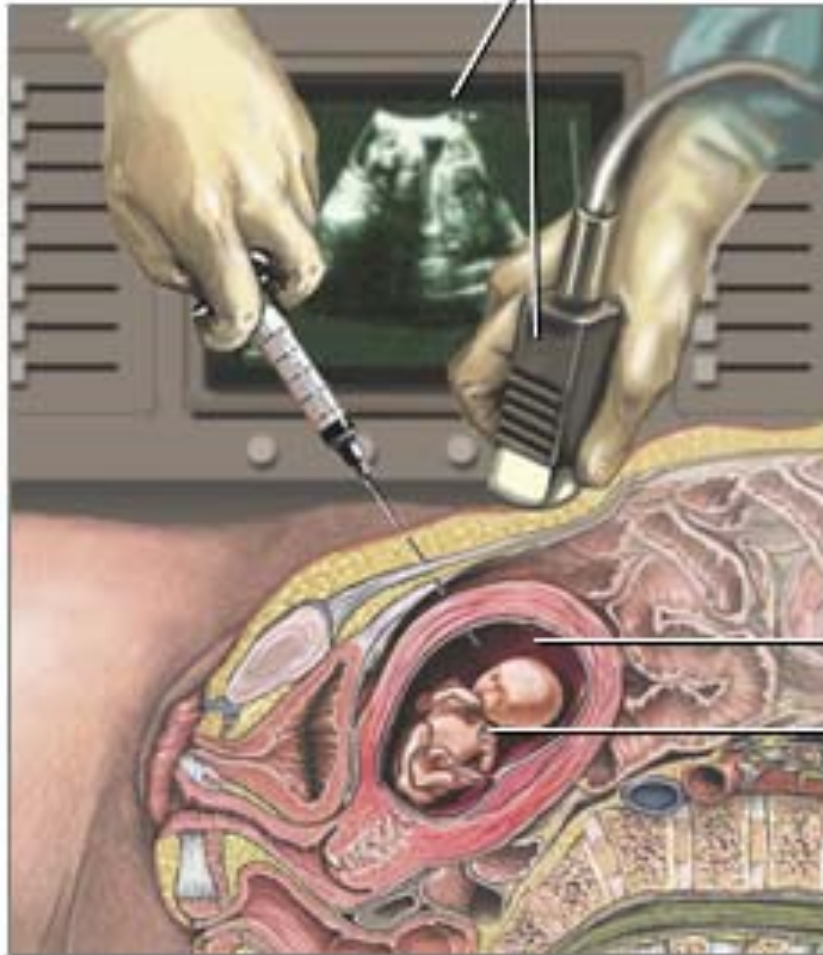
Amniocentesis

- Amniocentesis is the removal of a small amount of amniotic fluid from the sac around the baby.
- This is usually performed at 16 weeks in pregnancy.
- A fine needle is inserted under ultrasound guidance through the mothers' abdomen into a pool of amniotic fluid.



Amniocentesis

Ultrasound equipment



In amniocentesis, a hollow needle is inserted through the mother's abdomen into the uterus, and amniotic fluid is drawn for analysis

Amniotic fluid

Fetus

Amniotic Fluid

- examples of Other Tests performed on the amniotic fluid ;
 - a) Measurement of the lecithine/sphingomyelin ratio (as the lung matures the concentration of phospholipids especially lecithin increases since it is the major lung surfactant). This test is done to assess the maturation of the fetal lungs , a ratio 4/1 indicates mature lungs and a ratio less than 4/1 indicates immature lungs.
 - b) Measurement of bilirubin indicates the degree of fetal red blood cell destruction ,where abnormally high levels could indicate serious cases such as mother fetal blood incompatibility

Amniocentesis

Studies of the cells obtained from the amniotic fluid permit:

- 1- Chromosomal analysis of the cells which can be performed to investigate the following;
 - Diagnosis of sex of the fetus
 - Detection of chromosomal abnormalities e.g. trisomy 21 (Down's syndrome)
 - DNA studies
- 2- The cells may be cultured and analyzed for enzymes, or for other materials that may indicate genetically transmitted diseases(Inherited disorders e.g Cystic Fibrosis).
- 3-To check for developmental problems e.g. Spina Bifida . Babies born with spina bifida have a backbone that did not close properly. Serious complications of spina bifida can include leg paralysis, bladder and kidney defects, brain swelling (hydrocephalus), and mental retardation.
- 3- Other studies can be done directly on the amniotic fluid including measurement of alpha-fetoprotein where high levels of alpha-fetoproteins in the amniotic fluid indicate the presence of a severe neural tube defect whereas low levels of alpha-fetoproteins may indicate chromosomal abnormalities .

Amniocentesis

Who is the proper candidate for an **Amniocentesis** investigation?

- 1-Those whom are suspected to have possible problems indicated by certain tests conducted previously,(e.g If pregnancy is complicated by a condition such as Rh-incompatibility,the doctor can use amniocentesis to find out if the baby's lungs are developed enough to endure an early delivery).
- 2- Family history of genetic abnormalities (in this case would be advisable to seek genetic counseling before becoming pregnant)
- 3-Those that have been exposed to certain risk environmental factors that might lead to fetal abnormalities .



Down
syndrome

Spina
bifida



Fetal lung
maturity



Cordone ombelicale



Il **funicolo ombelicale** è un cordone che collega [feto](#) e [placenta](#).

A termine è lungo circa 55 cm e largo un dito e presenta una quindicina di volute attorno al suo asse lungo.

È liscio, lucente, semirigido, flessibile e molto resistente



UMBILICAL CORD STEM CELLS



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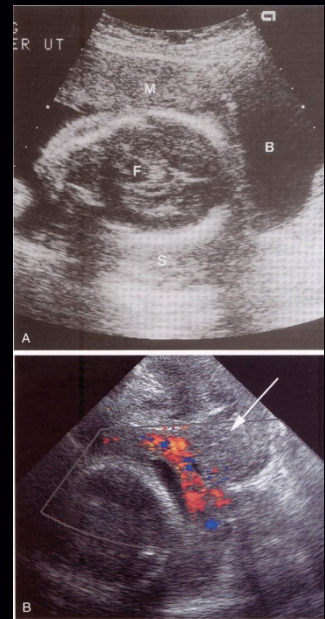
Email: yadavhariom@gmail.com

Umbilical Cord Abnormalities

Abnormalities of Cord insertion

Vasa Previa

- Associated with velamentous insertion when some of the fetal vessels in the membranes cross the region of the cervical os below the presenting fetal part
- Incidence : 1/5200 pregnancies
 - 1/2 : associated with velamentous insertion
 - 1/2 : marginal cord insertions and bilobed, succenturiate-lobed placentas
- Risk factors
 - bilobed , succenturiate or low-lying placenta
 - Multifetal pregnancy
 - Pregnancy resulting from in vitro fertilization



Umbilical Cord Abnormalities

Abnormalities of Cord insertion

- **Diagnosis**

- : color Doppler examination (low sensitivity with ultrasound)

- Perinatal diagnosis : associated with increased survival (97:44)

- Antenatal diagnosis : associated with decreased fetal mortality compared with discovery at delivery

- Hemorrhage antepartum or intrapartum

- : vasa previa and a ruptured fetal vessel exists

- Detecting fetal blood

- Apt test

- Wright stain : to smear the blood on glass slides stain the smears with Wright stain and examine for nucleated RBC

- normally are present in cord blood but not maternal blood

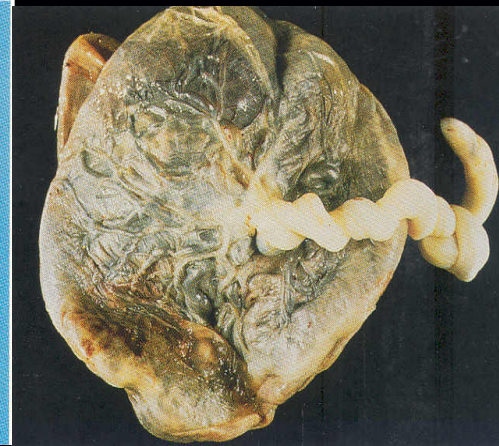
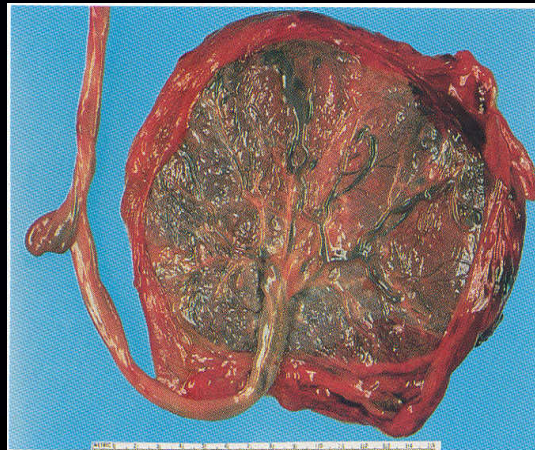
- - risk of low lying placenta : 80%

Umbilical Cord Abnormalities

Cord Abnormalities capable of impeding blood flow

■ Knots

false	Result from kinking of the vessels to accommodate to the length of the cord	
True	<ul style="list-style-type: none">■ Result from active fetal movements■ Venous stasis → mural thrombosis and fetal hypoxia, causing death or neurological morbidity	<p>Incidence : 1.1%</p> <p>Stillbirth incidence : 6% esp)</p> <p>high incidence : monoamniotic twins</p>



False knot(Lt), true knot (Rt) ♪

Umbilical Cord Abnormalities

Cord Abnormalities capable of impeding blood flow

- coiling of the cord around the neck is an uncommon cause of antepartum fetal death or neurological damage
- Entwined cords cause intrapartum complications
- As labor progresses and there is fetal descent, contractions may compress the cord vessels
 - fetal heart rate deceleration that persists until the contraction ceases
- In labor 20% of fetuses with a nuchal cord have moderate to severe variable heart rate deceleration
 - have a lower umbilical artery pH

Umbilical cord stem cells (UCS cells)

- Also Known as Wharton's Jelly
- Adult stem cells of infant origin
- Isolated prior to/ immediately following birth
- Haematopoietic stem cells (Majority)
- 100,000 stem cells per mL in UCB
- Alternate to bone marrow stem cells



Umbilical cord stem cells

Three important functions of UCS cells:

- **Plasticity:** Potential to change into other cell types like nerve cells
- **Homing:** To travel to the site of tissue damage
- **Engraftment:** To unite with other tissues

Cord blood Vs Bone Marrow

Cord Blood

- Collection is non-invasive, painless, and poses no risk to the donor.
- Greater HLA compatibility due to decreased functionality of fetal lymphocytes.
- Graft versus Host Disease (GVHD) is reduced to 10% due to the absence of antibodies in the stem cells.
- Units are processed and ready for transplant.
- Significantly less expensive

Bone Marrow

- Collection is invasive and painful. Must be performed in a hospital surgical setting.
- Due to the maturity of the stem cells, it requires a greater HLA match to perform a transplant.
- Serious GVHD occurs in 60% of all unrelated Bone Marrow transplants
- Bone Marrow is dependent on donor participation.

Applications

- Hematopoietic cell transplantation (HCT) of umbilical cord origin is curative for malignant and nonmalignant diseases like Fanconi's anemia, aplastic anemia, leukemias, metabolic and other congenital disorders.
- HLA mismatch may be better tolerated in the UCBT setting than Bone Marrow Transplantation.



Cord Blood banking

Cord blood banking involves

- Recruitment
- Consent
- Testing of maternal donors
- Collection
- Processing
- Cryopreservation
- Testing
- Releasing cord blood unit to transplant centre

Conclusions

- Unlimited source of stem cells from biological waste
- Collection of cord stem cells is painless
- Collection of cord stem cells is risk free to mother and baby
- Cord blood stem cells have a greater ability to differentiate into other cell types
- These cells have longer growth potential and have been shown to have a greater rate of engraftment

Conclusions

- Cord blood stem cells are much more tolerant to HLA tissue mismatching than bone marrow therefore leading to lower rate of GVHD
- Cord stem cells are not exposed to the toxins and radiations (we experience in everyday life)
- Cord blood stem cells are being used in the treatment of 40 medical conditions with over 72 potential disease targets
- Research should be oriented towards prolonging their storage and enhancing their expansion