Amniotic fluid and its abnormality

**Definition:**

Amniotic fluid is a clear, slightly yellowish liquid that surrounds the unborn baby (fetus) during pregnancy. It is contained in the amniotic sac.

**Characteristics of amniotic fluid:**

Amniotic fluid surrounds the fetus in intrauterine life, providing protected, low-resistance space suitable for growth and development.

1- **Water content and osmolality:** at first trimester, amniotic fluid has an electrolyte composition and osmolality similar to that of fetal and maternal blood. As fetal urine begins to enter the amniotic cavity, amniotic fluid osmolality decreases compared with fetal blood.

At term it contains 99% water. The osmolality, sodium, urea and creatinine is not significantly different from the maternal serum. The osmolality is lowest at term (250-260mOsml/kg) compared with fetal blood osmolality of 280mOsml/kg water. This is a result of extremely hypotonic fetal urine (60-140mOsml/kg water) in combination of lesser volume of lung fluid.

2- **Colure:** it’s slightly turbid, but may be greenish-brownish if contaminated with any meconium, or blood stained if any blood passed to it.

3- **Constituents of the fluid:** In early pregnancy, amniotic fluid is an ultra filtrate of maternal plasma. By the beginning of second trimester, it consist largely of extracellular fluid which diffuse through the fetal skin, and therefore reflects the composition of fetal plasma it contains

a- Organic, inorganic and cellular constituent.

b- It contains traces of steroid and non-steroid hormones.

c- It’s mildly bacteriostatic.

The solid constituents are:

- Lanugos hair.
- Epithelial cells
- Sebaceous material from fetal skin.
- Amniotic epithelial cell

**Physiology of amniotic fluid:**

The maintenance of amniotic fluid is a dynamic process throughout pregnancy but with differing origins for the amniotic fluid at advancing gestational age.

**Origin:** the amniotic fluid is initially secreted by the amnion. In the late first trimester (by 10 weeks), its mainly transudate of the fetal serum via the skin and umbilical cord.

From 20 weeks onward the fetal skin become impermeable to water and the increased creatinin and urea concentration of amniotic fluid indicate a shift toward fetal urine production being the main contributor. However, in addition to fetal urine, there is an additional fetal component in later gestation which is the production of fetal lung secretion and the net increase in amniotic fluid is through a small imbalance between the contributions of fluid through the kidney and lung fluids and removal by fetal swallowing.

**Volume:** there is a wide variation of amniotic fluid volume throughout gestation, with gradual increase as pregnancy progresses before decreasing after 36 weeks gestation.

- At 10 weeks is about 30 ml.
- At 20 weeks is about 300ml.
- At 30 weeks is about 600ml.
- At term is about 800-1000ml, this means that the rate is increase by 30 ml/week.

The amniotic fluid volume is increases until about 32 weeks when it measures a little less than 1000cc; after that time the level stays the same (38-40weeks) then begins to reduce gradually.

The amniotic fluid space is not a static collection of fluid but rather one whose volume is maintained by a circulatory process with fetal urine and lung fluid production being balanced by fetal swallowing and absorption of fluid through the gastrointestinal tract as well as absorption directly across the amnion and into the fetal circulation. The swallowing of the fetus reaches about 400-500ml per day.

**Function of amniotic fluid:**

1- Allows plenty of space for fetal movement.
2- Guards the fetus against mechanical shocks.
3- Maintain the temperature of the fetus.

4- May be a source of fetal nutrient.

5- Early in pregnancy, it’s essential for fetal lung development.

6- Equalize the pressure exerted by uterine contraction.

7- During labor, the amniotic fluid contained in the bag of fore water forms a fluid wedge which, with uterine contractions, dilates the internal os and cervical canal.

8- Also during labor, when membranes rapture during , fluid flushes the lower genital tract which is aseptic and bacteriostatic.

9- Prevent adherence of the embryo to the amnion.

**Assessment of amniotic fluid volume:**

In current practice, the volume of amniotic fluid is determined non-invasively by ultrasound.

A variety of ultrasound tools to determine the volume of amniotic fluid have been used. The main stay of practice is to use the following methods:

1- Single deepest maximum pool or pocket of amniotic fluid or deepest vertical pool (DVP): this pocket should be free of fetal limbs and the normal value is 2-8cm.

2- Amniotic fluid index (AFI): this the total of the DVPs in each of the four uterine quadrants and a more sensitive indicator of AFV throughout gestation. The normal value is 5-25 ml.

**Oligohydramnios:**

Oligohydramnios is defined as DVP of less than 2 cm, its either due to the loss of fluid from the amniotic sac or a reduction in the production of fluid although, in a proportion of cases, the cause may remain undefined (10% idiopathic).

**Incidence:** it complicates approximately 3.9 per cent of pregnancies. Oligohydramnios late in pregnancy is associated with poor outcome and increased perinatal mortality rate approaching 90%. This increased perinatal mortality is mainly related to the underlying etiology and gestational age.

**Causes:**

1- Preterm premature rapture of membrane: perhaps the most common causes of oligohydramnios is PPROM. It should be remembered that not in all cases of PPROM will the AFI be less than normal.
2- Post maturity.

3- Placental insufficiency or intrauterine growth restriction.

4- Fetal causes: a reduction in the production of amniotic fluid in the second and third trimester is mediated primarily through a reduced or absent fetal urine output. This is in turn is the consequence of an abnormality in fetal urinary tract like:

- Renal agenesis.
- Bladder outlet obstruction.
- Renal dysplasia
- Polycystic or multicystic kidney disease.

**Complications:**

1- **Fetal risks:**

The main fetal risks relate primarily to pulmonary hypoplasia, skeletal abnormality, chorioamnionitis subsequent to PPROM, and prematurity. In addition perinatal mortality is increased largely due to prematurity and the association with prematurity.

2- **Maternal risks:**

Is the risk of infection due to PPROM and when fetal therapy is considered like vesicoamniotic shunt.

**Management:**

PPROM is often apparent from history and clinical examination. Clinical examination may also revel the presence of chronic hypertension or pre-eclampsia and/or symphysiofundal height that is small for gestation.

The management depends on the management of the cause, therapeutic amnioinfusion (that is by infusing normal saline into amniotic sac) can be used in early mid trimester to allow lung development. The management of fetal urinary tract anomaly depends on the type of abnormality and other associate anomaly.

**Polyhydramnios:**

Polyhydramnios is defined as a DVP more than 8cm or amniotic fluid index of more than 25cm. In general, it may be caused by increased production of urine from the renal system or by impaired swallowing and intestinal reabsorption of amniotic fluid.
Polyhydramnios has been shown to be an independent risk factor for perinatal mortality and intrapartum complications among preterm birth.

**Incidence:** It complicates about 3.5% of pregnancies, and according to severity it is divided into 3 types:

1. Mild polyhydramnios: DVP is 8-12cm.
2. Moderate polyhydramnios: DVP is 12-15cm.
3. Severe polyhydramnios: DVP is more than 15cm which occurs in only 5% of cases.

Most cases of polyhydramnios are mild with gradual accumulation of fluid in the amniotic sac, this is known as chronic polyhydramnios.

The term acute polyhydramnios refers to a sudden accumulation of amniotic fluid that the fundal height grows in excess of 1cm per a day. This is almost exclusively a manifestation of TTTS occurring before 26 weeks gestation where there is rapid fluid accumulation in the sac of recipient twin.

**Causes:**

1. Idiopathic: In two-thirds of cases no cause can be identified.

2. Maternal causes: The most important maternal cause of polyhydramnios is a pregnancy complicated by maternal diabetes; this may arise due to sub-optimal glycemic control. Maternal hyperglycemia leads, in turn to fetal hyperglycemia and fetal hyperinsulinemia. Fetal hyperglycemia, in part through an osmotic action, results in polyuria. Polyhydramnios secondary to maternal diabetes can be reduced by tight control of maternal blood sugar.

3. Placental causes: These are rare like placental tumor choriongioma and arterio-venous fistula.

4. Fetal causes:

   a. The most important fetal causes are fetal abnormalities leading to failure of absorption of amniotic fluid like in cases of gastrointestinal abnormalities as in esophageal atresia and bowel obstruction like duodenal atresia and pyloric stenosis. Presence of large head and neck masses or diaphragmatic hernia are other examples of fetal anomalies that may cause polyhydramnios.

   b. Neurological impairment of swallowing mechanism e.g. anencephaly and muscular dystrophies.

   c. Congenital heart disease.
d- Twin - twin transfusion syndrome: this complication affects identical twin pregnancies in which one baby gets too much blood flow and the other gets too little blood. This occurs due to vascular connection via their shared placenta.

e- Rh-isoinmunisation: in severe form, this leads to hydrops fetals and polyhydramnios.

**Clinical presentation:**

This is due to uterine over distension in which the mother notices that her abdomen is unduly enlarged and there is an excessive fetal movement. In more severe cases the mother feels shortness of breath and indigestion. Acute polyhydramnios may leads to abdominal pain and vomiting.

On examination: the abdomen is more distended leading to large for gestational age measurements, the fetal part is felt with difficulty, the fetal heart sound may be muffled or in audible, the presentation may be unstable and sometime there is edema of the abdominal skin and vulva.

**Complications:**

*Fetal risks:*

High perinatal mortality rate due to:

- Prematurity.
- Congenital abnormalities.
- Intrapartum complications like cord prolapse and placental abruption.

*Maternal risks:*

- PPROM and preterm delivery.
- Spontaneous rapture of membrane and cord prolaps.
- Placenta abruption.
- Higher incidence of c/s.
- Post partum hemorrhage and uterine inertia.

*Management:* the aim of the treatment is to relieve the symptom and prolong the pregnancy.

*Mild polyhydramnios:* if the growth is not affected and there is no congenital abnormalities just observation is needed, otherwise the labor should be induced. No data support the use of low salt diet and diuretic in managing polyhydramnios.
Severe polyhydramnios:

If the patient is symptomatic and near the term so delivery is best treatment.

If its preterm the following are the options:

1- Therapeutic amniocentesis (amnioraduction): a 20-22 gage spinal needle is inserted to amniotic sac under local anesthesia through the maternal abdomen under ultrasound guide.

The amniotic fluid should escape slowly to achieve a DP of less than 8 cm. Gradual large volume reduction of up to 5-10 liters can be achieved.

Complication of this procedure: rate of complication is about 1.5% and includes:

1- Premature rapture of membrane.
2- Chorioamnionitis.
3- Placental separation.
4- Perforation of amnion separating monochorionic diamniotic twins.
5- Re-accumulation of fluid rapidly.

2- Prostaglandin synthetase inhibitors.
   a- Indomethacin: maternally administered indomethacin was shown to reduce fetal urine production and amniotic fluid volume, it given in dose of 50-200mg/day depending on the fluid volume

However this drug is associated with risk of:

1- Premature closure of ductus arteriosus.
2- Cerebral vasoconstriction in the fetus.
3- Fetal renal artery stenosis.

The above mentioned risks are increased with advanced gestation that is why this drug should be stopped by 32-35 week.

b- Sulindac: this is similar to indomethacin but has lesser effects on fetal urine output. And the ductus arteriosus. So it may be a safer alternative to indomethacin. The dose is 200mg every 12 hours.