



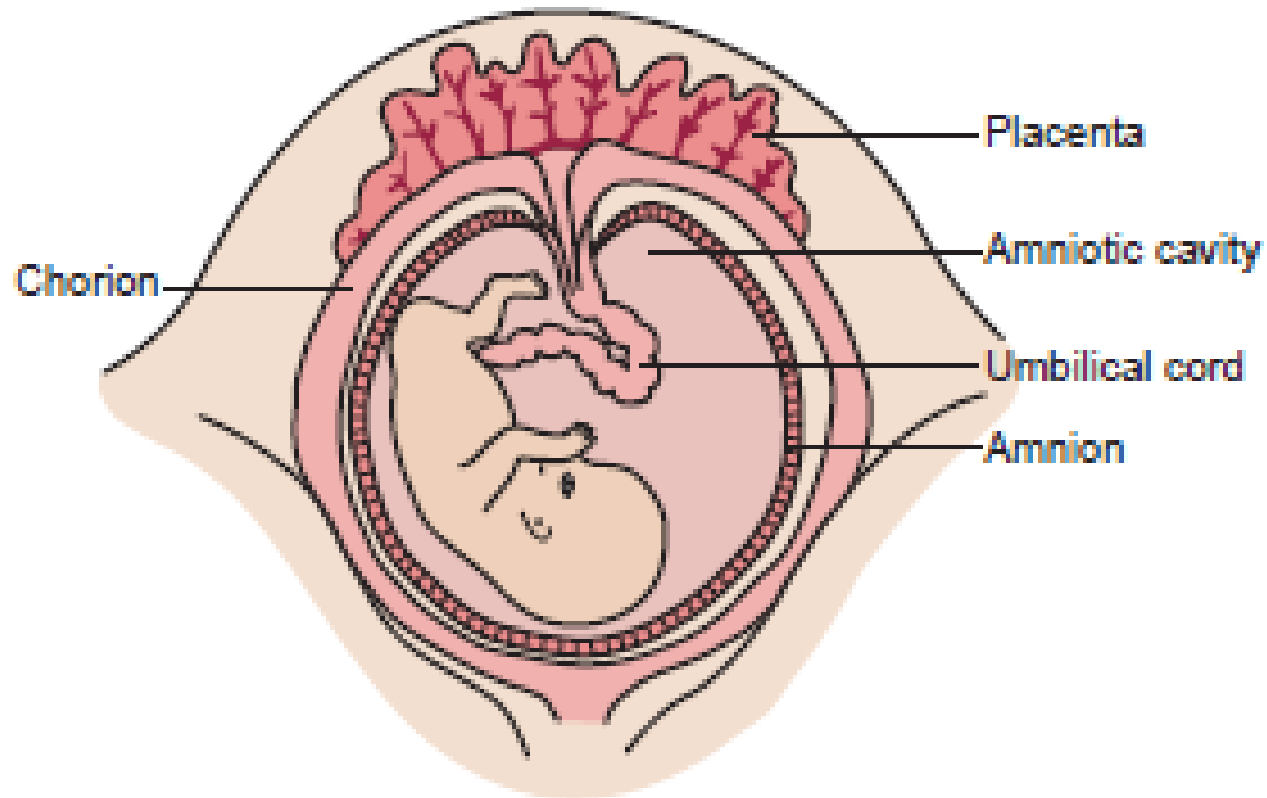
# Amniotic Fluid

## Reference Books:

- **Urinalysis and body fluids** (Susan King Strasinger- Marjorie Schaub De Lorenzo) Fifth edition

## Function

- Amniotic fluid is present in the **amnion, a membranous sac** that surrounds the fetus (Fig. 1). The primary functions of the fluid are to provide a protective cushion for the fetus, allow fetal movement, stabilize the temperature to protect the fetus from extreme temperature changes, and to permit proper lung development. Exchanges of water and chemicals also take place between the fluid, the fetus, and the maternal circulation.



**Figure 1 Fetus in amniotic sac.**

## Volume

- Amniotic fluid volume is regulated by a balance between the production of fetal urine and lung fluid and the absorption from fetal swallowing and intra-membranous (**flow is the absorption of amniotic fluid water and solutes into the fetal vascular system**) flow. The amount of amniotic fluid increases throughout pregnancy, reaching a peak of approximately 1 L during the third trimester, and then gradually decreases prior to delivery. During the first trimester, the approximately 35 mL of amniotic fluid is derived primarily from the maternal circulation.

- During the latter third to half of pregnancy, the fetus secretes a volume of lung liquid necessary to expand the lungs with growth. During each episode of fetal breathing movement, secreted lung liquid enters the amniotic fluid.
- After the first trimester, fetal urine is the major contributor to the amniotic fluid volume. At the time that fetal urine production occurs, fetal swallowing of the amniotic fluid begins and regulates the increase in fluid from the fetal urine.

- Failure of the fetus to begin swallowing results in excessive accumulation of amniotic fluid (*polyhydramnios*) and is an indication of fetal distress, often associated with neural tube disorders. Polyhydramnios may be secondarily associated with fetal structural anomalies, cardiac arrhythmias, congenital infections, or chromosomal abnormalities.
- Increased fetal swallowing, urinary tract deformities, and membrane leakage are possible causes of decreased amniotic fluid (*oligohydramnios*). Oligohydramnios may be associated with umbilical cord compression, resulting in decelerated heart rate and fetal death

## Chemical Composition

- The placenta is the ultimate source of amniotic fluid water and solutes. Amniotic fluid has a composition similar to that of the maternal plasma and contains a small amount of sloughed fetal cells from the skin, digestive system, and urinary tract. The fluid also contains biochemical substances that are produced by the fetus, such as bilirubin, lipids, enzymes, electrolytes, nitrogenous compounds, and proteins that can be tested to determine the health or maturity of the fetus.



- The chemical composition of the amniotic fluid changes when fetal urine production begins. The concentrations of creatinine, urea, and uric acid increase, whereas glucose and protein concentrations decrease. Concentrations of electrolytes, enzymes, hormones, and metabolic end products also vary but are of little clinical significance. Measurement of amniotic fluid creatinine has been used to determine fetal age. Prior to 36 weeks' gestation, the amniotic fluid creatinine level ranges between 1.5 and 2.0 mg/dL. It then rises above 2.0 mg/dL, thereby providing a means of determining fetal age as greater than 36 weeks

# Specimen Collection

## Indications for Amniocentesis

Amniocentesis is recommended when screening blood tests such as the maternal serum alpha fetal protein test, the triple screening test (tests for maternal alpha fetal protein **[AFP]**, human chorionic gonadotropin **[hCG]**, and **unconjugated** estriol **[UE3]**), or the **quadruple screening test (AFP, hCG, UE3, and inhibin A)** yield results that are abnormal.

## Indications for Performing Amniocentesis

Amniocentesis may be indicated at 15 to 18 weeks of gestation for the following conditions to determine early treatment or intervention:

- Mother's age of 35 or more at delivery
- Family history of chromosome abnormalities, (Down syndrome)
- Parents carry an abnormal chromosome rearrangement
- Earlier pregnancy or child with birth defect
- Parent is a carrier of a metabolic disorder
- Elevated maternal serum alpha fetoprotein

- History of genetic diseases such as hemophilia, muscular dystrophy and sickle cell anemia,
- Abnormal triple marker screening test
- Previous child with a neural tube disorder such as spina bifida, or ventral wall defects (gastroschisis)
- Three or more miscarriages

Evaluation of amniocentesis is indicated later in the pregnancy (<20 weeks) to evaluate:

1- Fetal lung maturity

2- Fetal distress

3- Hemolytic disease of the newborn caused by Rh blood type incompatibility

4- Infection

## Collection

- Amniotic fluid is obtained by needle aspiration into the amniotic sac, a procedure called *amniocentesis*.
- Amniocentesis is a safe procedure, particularly when performed after the 14th week of gestation.
- Fluid for chromosome analysis is usually collected at approximately 16 weeks' gestation, whereas tests for fetal distress and maturity are performed later in the third trimester.
- A maximum of 30 mL of amniotic fluid is collected in sterile syringes.

## Color and Appearance

### Amniotic Fluid Color

Color	Significance
Colorless	Normal
Blood-streaked	Traumatic tap, abdominal trauma, intra-amniotic hemorrhage
Yellow	Hemolytic disease of the newborn (bilirubin)
Dark green	Meconium
Dark red-brown	Fetal death

## Hemolytic Disease of the Newborn

- The measurement of amniotic fluid bilirubin is performed by spectrophotometric analysis.
- Specimens must be protected from light at all times. Markedly decreased values will be obtained with as little as 30 minutes of exposure to light.
- Care must be taken to ensure that contamination of the fluid by cells, hemoglobin, meconium, or other debris does not interfere with the spectrophotometric analysis. Specimens should be immediately centrifuged to remove particulate interference.

## Neural Tube Defects

Increased levels of alpha-fetoprotein (AFP) in both the maternal circulation and the amniotic fluid can be indicative of fetal neural tube defects, such as anencephaly and spina bifida. AFP is the major protein produced by the fetal liver during early gestation (prior to 18 weeks). It is found in the maternal serum due to the combined fetal-maternal circulations and in the amniotic fluid from diffusion and excretion of fetal urine. Measurement of amniotic fluid AFP levels is indicated when maternal serum levels are elevated or a family history of previous neural tube defects exists.