

Chapter 14

AMNIOTIC FLUID ANALYSIS

Amniotic Fluid

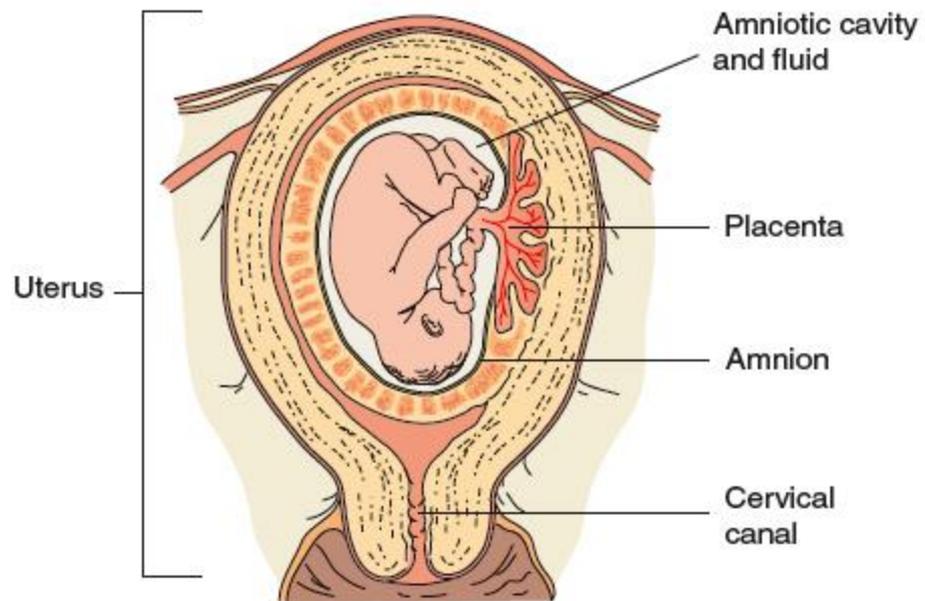
Contained within the amnion membrane

Protects fetus while enabling movement

Produced by amnion and placenta initially

Later, fetus plays an active role in composition of fluid by swallowing, respiration, and urination

Volume increases through pregnancy from 25 to 50 mL at 12 weeks to 800 to 1200 mL at 37 weeks



Amniocentesis

Collection

- Transabdominally or vaginally with simultaneous ultrasound examination
- Transabdominal most common

Reasons

- Diagnosis of genetic and congenital disorders early in gestation (15 to 18 weeks)
- Assessment of fetal lung maturity (32 to 42 weeks)
- Estimate and monitor degree of fetal distress

Collection and Transport

Aseptic technique with long sterile needle

10 to 20 mL of fluid collected by physician into numbered syringes

Transferred to sterile plastic containers

- Cells adhere to glass container walls

Protect from light

- Bilirubin is light sensitive

Transport to laboratory immediately

Differentiation from Urine

Amniotic fluid

- Glucose
- Protein 2 to 8 g/L
- Creatinine similar to plasma

Normal urine

- Essentially no glucose or protein
- High creatinine
- High urea

Although normal urine has essentially no glucose or protein, diabetes or kidney disease could cause these to appear; urea or creatinine are better indicators

Physical Examination

Normal amniotic fluid is colorless or pale yellow

- Yellow or amber: bilirubin
- Green: meconium from fetal intestine
- Pale pink to red: blood or hemoglobin

All amniotic fluid is somewhat turbid

- Early pregnancy: little particulate matter
- Late pregnancy: more turbid; increased fetal cells, hair, and vernix in fluid

Chemical Examination of Fetal Lung Maturity (FLM)

Pulmonary system, one of the last organ systems to mature

Testing of no value at less than 32 weeks

- All FLM tests indicate immaturity at that stage

Testing used to assess viability of fetus outside uterus

Respiratory distress syndrome (RDS) most common cause of death in newborn

RDS results from insufficient production of surfactant in newborn's lungs

Probability of Respiratory Distress Syndrome (RDS)

Correlation between fetal lung maturity and level of specific phospholipids in amniotic fluid

Probability of RDS determined from two factors:

- Results of FLM tests
- Gestational age of fetus at time of testing

Recommended testing is a cascade approach, where a series of FLM tests are performed until a mature result is obtained or all tests have been performed

Lecithin/Sphingomyelin (L/S) Ratio

Phospholipids are required in fetal lungs to decrease surface tension (surfactants)

Lecithin—major pulmonary surfactant

Sphingomyelin—phospholipid in cell membranes; role yet to be established

Until 33 weeks, both are produced in equal amounts

At 34 to 36 weeks, lecithin increases, and sphingomyelin stays constant or decreases

Lecithin/Sphingomyelin (L/S) Ratio (Cont.)

L/S ratio of greater than or equal to 2.0 indicates maturity of fetal lungs

Determined using a thin-layer chromatography technique

Presence of blood in specimen—decreases a mature result and increases an immature result

Meconium-contaminated specimens should not be used, as results will be unreliable

Test is a better predictor of maturity than immaturity

Phosphatidyl Glycerol (PG)

Not detectable until 35 weeks' gestation

Techniques—thin-layer chromatography or slide agglutination using anti-PG antibodies

Slide agglutination is much quicker and simpler to perform than total lung capacity (TLC)

Positive tests very specific; but many false negatives

PG tests not affected by blood or meconium

Foam Stability Index (FSI)

Also known as “shake test”

A stable foam is produced by surfactants when shaken vigorously with dilutions of ethanol

Rapid and easy to perform

Highest concentration of ethanol with a stable foam is FSI

Fetal maturity indicated by FSI of greater than or equal to 0.47

Blood and meconium produce inaccurate results

Lamellar Body Counts

Pulmonary surfactants stored in lamellar bodies

Third trimester bodies are present in amniotic fluid 50,000 to 200,000 per microliter

- Greater than 50,000 per microliter indicates FLM

Can use automated hematology counter's platelet channel to measure lamellar bodies

Cannot use bloody specimen, as it will falsely elevate lamellar count due to platelet presence

Rapid, low-cost, small sample size needed

Amniotic Fluid Bilirubin (ΔA_{450})

Normally, bilirubin undetectable in amniotic fluid

Can be increased if significant fetal red blood cell hemolysis occurs

Amount of bilirubin correlates with severity of hemolysis

Normal amniotic fluid has straight line when absorbance is scanned from 365 to 550 nm

Bilirubin causes absorbance peak at 450 nm

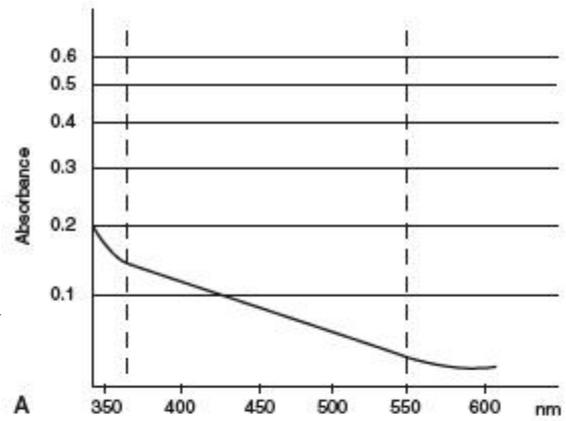
Amniotic Fluid Bilirubin (ΔA_{450}) (Cont.)

Bloody specimens not acceptable, as oxyhemoglobin absorbs at 410 to 540 nm

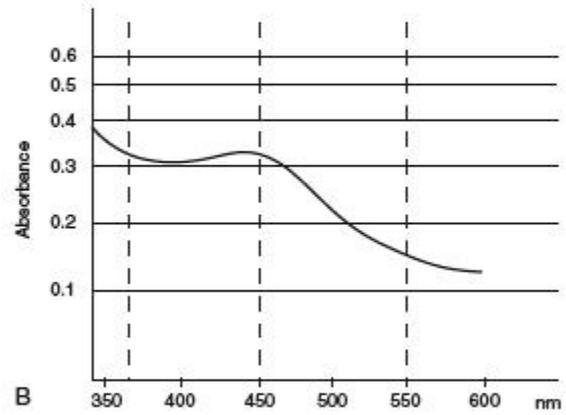
Meconium-contaminated specimen also not acceptable

- Interference with drawing baseline

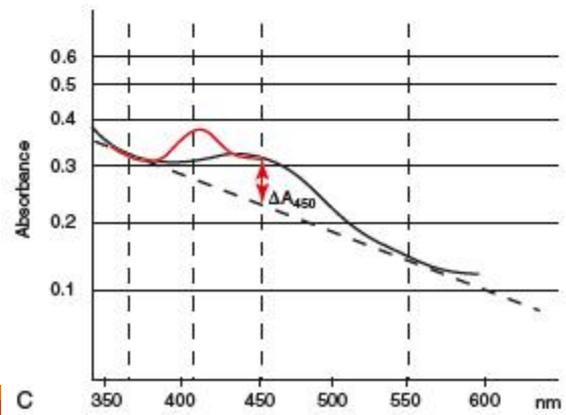
Specimens must be protected from light after collection, as bilirubin is very light sensitive



A

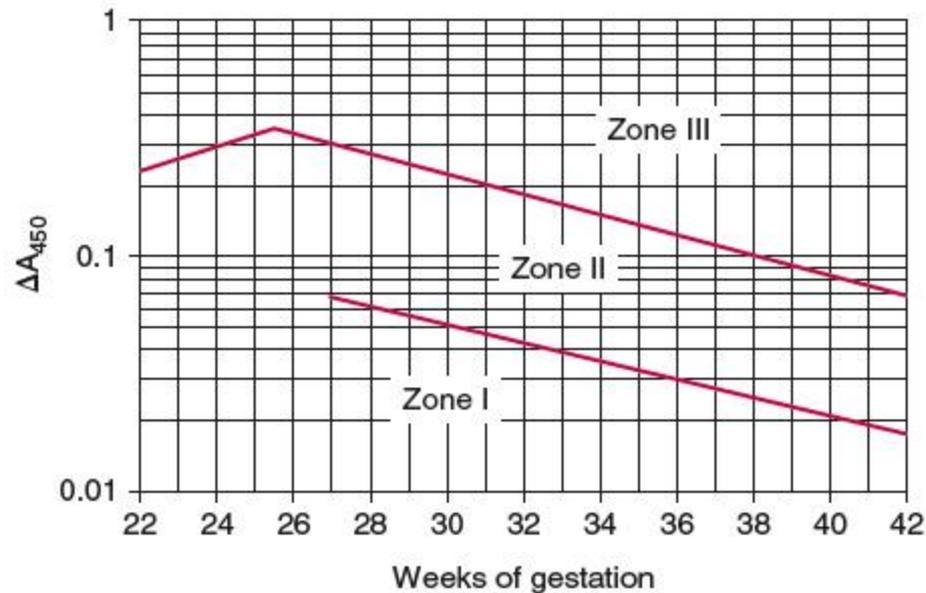


B



C

Graph Absorbance of Fluid Versus Fetal Age (Semilog Paper) to Determine Severity Zone I: normal; II: marked; III: severe

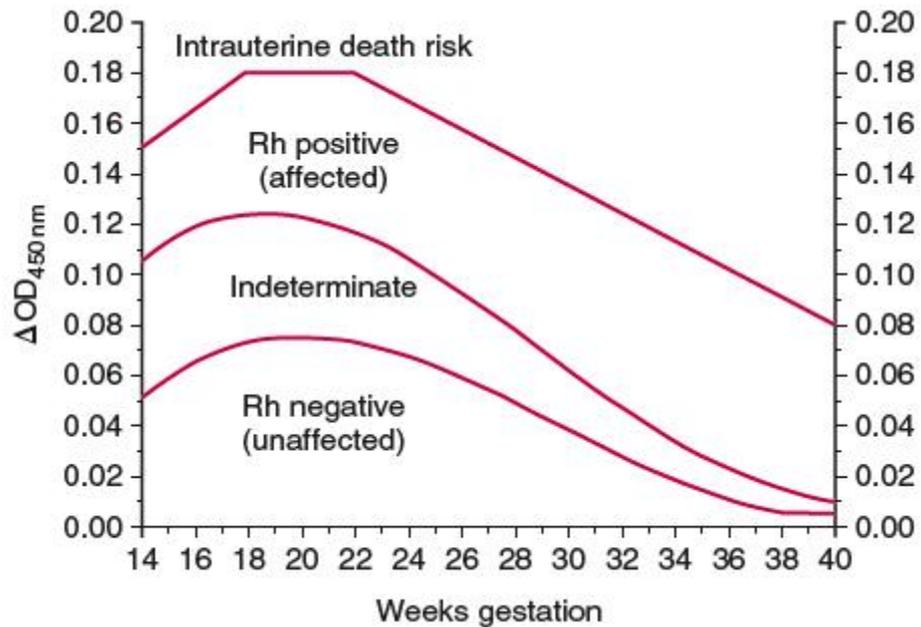


Modified from Liley AW. Liquor amnii analysis in the management of the pregnancy complicated by rhesus sensitization. Am J Obstet Gynecol 1961;82:1359-70.

Queenan Chart

Used to evaluate severity of hemolytic disease between 14 and 40 weeks' gestation

Divided into four zones indicating the severity of hemolysis



Reprinted from Queenan JT, Tomai TP, Ural SH, King JC. Deviation in amniotic fluid optical density at a wavelength of 450 nm in Rh-immunized pregnancies from 14 to 40 weeks' gestation: a proposal for clinical management. *Am J Obstet Gynecol* 1993;168:1370-6.