Second and Third Trimesters
Sabrina Tucker
Sandra Flowers
September 9, 2006

SECOND AND THIRD TRIMESTERS

1) Other Names:
NA

2) Definition/Location:

Placenta

- It functions as an organ of respiration for the fetus (Curry-Tempkin, p. 321, 1/2/4), (Curry-Tempkin, p. 321-323, Fig. 18-1, 18-2, 18-3).
- The major role - permits the exchange of oxygenated maternal blood (rich in oxygen and nutrients) with deoxygenated fetal blood (Hagen-Ansert, p. 1053, 1/1/1).
- May be located within the fundus of the uterus along the anterior, lateral, or posterior uterine walls, or it may be dangerously implanted over or near the cervix (Hagen-Ansert, p. 1053, 1/3/2), (Hagen-Ansert, p. 1053-1054, Fig. 45-61, 45-62).
- Occasionally originates in the fundus and proceeds along the anterior wall (fundal anterior placenta) or along the posterior uterine wall (fundal posterior placenta) (Hagen-Ansert, p. 1053, 1/4/1).

Amniotic Fluid

- The fetal effect on amniotic fluid volume increases with the pregnancy. (Curry-Tempkin, p. 324, 1/2/1), (Curry-Tempkin, p. 321, Fig. 18-1, 18-2), (Curry-Tempkin, p. 325, Fig. 18-4). Fetal urination into the amniotic sac accounts for nearly the total volume of amniotic fluid by the second half of pregnancy, so the quantity of fluid is directly related to kidney function (Hagen-Ansert, p. 1053, 2/1/2).
- Allows the fetus to move freely within the amniotic cavity while maintaining intrauterine pressure and protecting the developing fetus from injury (Hagen-Ansert, p. 1053, 1/5/2), (Hagen-Ansert, p. 1055, Fig. 45-63).
- Produced by the umbilical cord and membranes, lungs, skin, and kidneys (Hagen-Ansert, p. 1053, 2/1/1).
- The volume of amniotic fluid reflects the state of gestational well-being (Curry- Tempkin, p. 324, 1/2/3).
- Various methods of calculating amniotic fluid volumes (AFV) have been developed (Curry-Tempkin, p. 324, 1/2/4).
    - An alternative method, the four quadrant analysis, assesses AFV by finding the **amniotic fluid index (AFI)**. The anteroposterior diameter of the deepest amniotic fluid pocket free of cord and extremities in each quadrant is measured. These four measurements are added together to total the AFI. The sum should equal 8 cm to be considered normal (Curry-Tempkin, p. 324, 1/2/9).

Umbilical Cord

- Contains an umbilical vein and two umbilical arteries. The umbilical vein transports oxygenated blood from the placenta, whereas the paired umbilical arteries return deoxygenated blood from the iliac arteries of the fetus to the placenta for purification (Hagen-Ansert, p. 1048, 2/5/2), (Hagen-Ansert, p. 1052, Fig. 45-58).
- Identified at the cord insertion into the placenta and at the junction of the cord into the fetal umbilicus (Hagen-Ansert, p. 1048, 2/5/4).
- Surrounded by **Wharton's jelly** (material that supports the cord) (Hagen-Ansert, p. 1048, 2/3/5), (Hagen-Ansert, p. 1052, Fig. 45-59).

Fetal Presentation

Vertex

- The fetal head is visualized at this level when the fetus is in a vertex or cephalic presentation. If the fetal body is noted to follow the head, a vertex lie is confirmed (Hagen-Ansert, p. 1018, 2/1/4), (Hagen-Ansert, p. 1019-1020, Fig. 45-2A, 45-4B).
- The fetal body may lie in an oblique axis to the right or left of the maternal midline (Hagen-Ansert, p. 1018, 2/1/6).

Breech

- When the lower extremities or buttocks are found to be in the lower uterine segment and the head is visualized in the uterine fundus, a breech presentation is suspected (Hagen-Ansert, p. 1018, 2/2/1), (Hagen-Ansert, p. 1019-1021, Fig. 45-2B, 45-4A, 45-5, 45-6).

Transverse

- When a transverse cross-section of the fetal head or body is noted in the sagittal plane, a transverse lie is suspected (Hagen-Ansert, p. 1020, 2/1/1), (Hagen-Ansert, p. 1019, Fig. 45-2C, D), (Hagen-Ansert, p. 1021, Fig. 45-7).

Situs

- In addition to determining fetal lie, the right and left sides of the fetus need to be conceptualized to ensure normal situs (positioning) of fetal organs (Hagen-Ansert, p. 1022, 1/1/1), (Hagen-Ansert, p. 1020, Fig. 45-3).

Face

- By understanding the normal appearance of the developing face, the sonographer may recognize when it is deformed (Hagen-Ansert, p. 1029, 2/2/3), (Hagen-Ansert, p. 1030-1032, Fig. 45-19. 45-20, 45-21, 45-22, 45-23).
- Facial morphology becomes more apparent in the second trimester, but visualization is heavily dependent on fetal positioning, adequate amounts of amniotic fluid, and excellent acoustic windows (Hagen-Ansert, p. 1030, 1/1/2).

- Views of the fetal forehead and facial profile are achieved by imaging the facial profile. In this view, the contour of the frontal bone, the nose, the upper and lower lips, and the chin may be assessed (Hagen-Ansert, p. 1030, 1/2/1).

Genitalia

- Seen if fetal legs are abducted and a sufficient quantity of amniotic fluid is present (Hagen-Ansert, p. 1045, 2/5/3).
- To localize, the sonographer should follow the long axis of the fetus toward the hips. The bladder is a helpful landmark within the pelvis by which to identify the anteriorly located genital organs (Hagen-Ansert, p. 1047, 1/1/1).
- Can be seen as early as 12 to 16 weeks of gestation, although clear delineation may not be possible until the 20^{th} to 22^{nd} week. When the fetus is in a breech position, gender may be impossible to determine (Hagen-Ansert, p. 1047, 1/1/4).
- Female genitalia may be seen in a transverse plane. The labia may appear edematous and swollen. This normal finding should not be confused with the scrotum (Hagen-Ansert, p. 1047, 1/2/1), (Hagen-Ansert, p. 1047, Fig. 45-48, 45-49).
- The male genitalia may be differentiated as early as the 12^{th} week of pregnancy. The scrotal sac is seen as a mass of soft tissue between the hips, with the scrotal septum and testicles. Fluid around the testicles (hydrocele) is a common benign finding during intrauterine life (Hagen-Ansert, p. 1047, 2/1/1), (Hagen-Ansert, p. 1048, Fig. 45-50).

Organ Systems

Musculoskeletal System

- The fetal skeleton is seen earlier and more consistently than any other organ system. The axial skeleton begins to form between the sixth and eighth menstrual weeks, beginning with the vertebrae and ribs, followed by the skull and sternum. The appendicular skeleton also begins to form during the sixth menstrual week. This is followed by formation of pectoral and pelvic girdles. The soft tissues of the skeleton develop in a similar sequence to that of the skeletal structures (Curry-Tempkin, p. 324, 2/2/1), (Curry-Tempkin, p. 325-330, Fig. 18-4, 18-5, 18-6, 18-7, 18-8, 18-9, 18-10), (Hagen-Ansert, p. 1033-1035, Fig. 45-24, 45-25, 45-26, 45-27), (Hagen-Ansert, p. 1037, Fig. 45-29, 45-30).

Cardiovascular System

- The fetal vascular system has some unique features that do not exist after birth. Following birth, the umbilical vein closes off, and eventually becomes the **ligamentum teres** (Curry-Tempkin, p. 330, 1/3/3).
- The **ductus venosus**, which shunts oxygenated blood into the inferior vena cava, originates from the **pars transversa**. Shortly before birth, the **ductus venosum** closes and becomes the fibrous **ligamentum**

venosum, marking the left anterolateral border of the caudate lobe of the liver (Curry-Tempkin, p. 331, 1/1/1), (Curry-Tempkin, p. 331, Fig. 18-11, 18-12).

- The fetal heart contains two unique features, the **foramen ovale** and the **ductus arteriosus**. The fetal heart allows blood to move from right to left in the atrial chambers via the foramen ovale. The ductus arteriosus allows blood to move from the pulmonary artery to the aorta; it closes at (or shortly after) birth (Curry-Tempkin, p. 333, 1/1/2), (Curry-Tempkin, p. 333-336, Fig. 18-14, 18-15, 18-17, 18-18) (Hagen-Ansert, p. 1036, Fig. 45-28), (Hagen-Ansert, p. 1038-1039, Fig. 45-31, 45-32, 45-33, 45-34).
- During the second trimester the superior vena cava, thoracic aorta, and pulmonary artery appear in the upper mediastinum, just superior to the heart (Curry-Tempkin, p. 337, 1/1/1).

Respiratory System

- The lungs begin development during the fifth menstrual week (Curry-Tempkin, p. 337, 1/2/1), (Curry-Tempkin, p. 338, Fig. 18-19), (Hagen-Ansert, p. 1042, Fig. 45-40).
- The primitive lungs mature and become capable of functioning sometime after 25 weeks' gestation. The lungs grow until they nearly fill the thoracic cavity (Curry-Tempkin, p. 337, 1/2/5).

Gastrointestinal System

- During the fourth gestational week, the **foregut** and **hindgut** develop from embryonic folds. The **midgut** is connected to the yolk sac. The foregut divides into the esophagus, stomach, and duodenum in the fifth week. The liver, gallbladder, pancreas, and spleen arise as diverticula from the primitive alimentary tube. The midgut splits into the remainder of small bowel, ascending colon, and a portion of transverse colon. The hindgut differentiates into the remainder of transverse colon, descending colon, and rectum (Curry-Tempkin, p. 337, 2/1/1), (Hagen-Ansert, p. 1039, Fig. 45-35), (Hagen-Ansert, p. 1043-1044, Fig. 45-42, 45-43, 45-44).
- In the second trimester, bidirectional bowel peristalsis occurs. By the third trimester, peristalsis is unidirectional from the esophagus to the anus (Curry-Tempkin, p. 337, 2/1/6), (Curry-Tempkin, p. 339-342, Fig. 18-20, 18-21, 18-22, 18-23, 18-24).

Genitourinary System

- Consists of the kidneys, ureters, urinary bladder, urethra, and genitalia. The kidneys which form in association with urethra buds, develop between 7 and 9 weeks of gestation and become functional at approximately 10 weeks of menstrual age. The bladder and ureters are formed at approximately 6 menstrual weeks of development (Curry-Tempkin, p. 339, 2/2/1), (Curry-Tempkin, p. 343-345, Fig. 18-25, 18-

26, 18-27, 18-28), (Hagen-Ansert, p. 1045- 1046, 45-45, 45-46, 45-47).

Central Nervous System

- Consists of the brain and the spinal cord. It arises from the posterior surface of the embryo (**ectoderm**). A linear depression is formed along the midline of the early embryo. The borders of the depression fold over to form the neurotube that gives rise to the spinal cord and the brain (Curry-Tempkin, p. 344, 1/1/1), (Curry-Tempkin, p. 347-348, Fig. 18-29, 18-30), (Hagen-Ansert, p. 1023-1028, Fig. 45-8, 45-9, 45-10, 45-11, 45-12, 45-13, 45-14, 45-15).
- The brain is composed of three elements: the **brain stem**, the **cerebrum**, and the **cerebellum**. Membranes known as **meninges** surround these elements and the spinal cord (Curry-Tempkin, p. 344, 1/1/6).
- **Cerebrospinal fluid** fills the central canal of the spinal cord, the ventricles of the brain, and the subarachnoid space. It acts as a protective cushion encasing the brain and spinal cord, and regulates the pressure within the spaces that it fills (Curry-Tempkin, p. 346, 1/4/2).
- **Ventricles** of the brain are part of a system that helps manufacture and distribute CSF (Curry-Tempkin, p. 346, 1/5/1).
- The **choroid plexus** is found in the lateral ventricles (with exception of the frontal and occipital horns) and the third and fourth ventricles. It is a highly vascularized tissue that develops from the pia mater that secretes CSF (Curry-Tempkin, p. 346, 2/1/1).
- Two internal carotid arteries and two vertebral arteries supply the circulatory system of the brain. The veins draining the brain are all tributaries of the dural sinuses and drain into the internal jugular (Curry-Tempkin, p. 346, 2/2/1).

3) **Ultrasound Appearance:**
Placenta

- The placenta may be sonographically visible by 10 weeks. It appears as the thickened, hyperechoic portion of the rim of tissue surrounding the gestational sac. At 12 to 13 weeks, the early placenta appears homogeneous and hyperechoic. During the second and third trimesters, the placenta's appearance becomes slightly darker. In some cases, small anechoic areas representing maternal venous lakes, or lacunae, may interrupt the otherwise homogeneous appearance (Curry-Tempkin, p. 321, 1/3/1-3, 5), (Curry-Tempkin, p. 321, Fig. 18-1).

.

The categories of placental classification are:

- **Grade 0**: Represents the normal placenta throughout pregnancy. A Grade 0 placenta has a smooth chorionic plate (sac border), a substance that is devoid of focal hyperechoic areas, and a basal layer (uterine border) that is free of hyperechoic densities as well. The placental substance (between borders) appears homogeneous, with medium-level to low-level echoes; it may be interrupted by anechoic lacunae (Curry-Tempkin, p. 322, 1/4/1-3), (Curry-Tempkin, p. 323, Fig. 18-3 B).

- **Grade I**: The chorionic plate shows some subtle indentation. The homogeneous placental substance exhibits a few scattered, hyperechoic, punctuate densities (calcifications). The basal layer of Grade I placenta appears hypoechoic to anechoic. These placental findings are considered as normal changes at any time after 34 weeks of development (Curry-Tempkin, p. 322, 2/1/1-4), (Curry-Tempkin, p. 323, Fig. 18-3 C).
- **Grade II**: This category of placenta exhibits mild or medium-sized indentations in the chorionic plate. The homogeneous substance of the placenta contains scattered, hyperechoic, "comma-like" densities (calcifications). The basal plate in a Grade II placenta contains a few small, linear, hyperechoic densities. Grade II placental findings are considered normal any time after 36 weeks of development (Curry-Tempkin, p. 322, 2/2/1-4), (Curry-Tempkin, p. 323, Fig. 18-3 D).
- **Grade III**: A Grade III placenta contains indentations in the chorionic plate that extend as far as the basal layer, dividing the placenta into segments. The otherwise homogeneous substance of the placenta may contain both highly echogenic and anechoic areas. The hyperechoic echoes will be significantly larger than the small, scattered calcifications seen in Grade I placenta, and may exhibit acoustic shadowing. The basal layer of a Grade III placenta has very long, hyperechoic, linear echoes may, in advanced stages, appear as an unbroken line. Grade III placental findings are considered normal any time after 38 weeks of development (Curry-Tempkin, p. 322, 1/3/1-5), (Curry-Tempkin, p. 323, Fig. 18-3 E).

Amniotic Fluid (aka AF)

- Amniotic fluid appears anechoic; however, it is not unusual to view free-floating particles in the fluid (Curry-Tempkin, p. 314, 4/1-2).
- Free-floating hyperechoic particles in the anechoic amniotic fluid in the early to mid second trimester of pregnancy; the particles are believed to be fetal **vernix** (flakes of skin and hair) with no pathologic significance (Curry-Tempkin, p. 324, 2/1/1)

Umbilical cord

- The cord is composed of two umbilical arteries and one umbilical vein that appear anechoic with walls that are thick and bright (Curry-Tempkin, p. 308, 2/2).

Genitalia

- Determination of the fetal gender depends on the visualization of either the male scrotum or the female labia (Curry-Tempkin, p. 342, 1/6/1), (Curry-Tempkin, p. 345, Fig. 18-27).

- Fetal male genitalia are easier to identify than female genitalia. The mid-gray to low-gray, homogeneous penis and scrotum are most apparent. It is not unusual for small, anechoic testicular hydroceles (fluid collections) to be visualized laterally. Details of the penis, including the glans, urethra, and corpora cavernosa, may also be identified; in some cases, even the foreskin is visible. The prostate cannot be visualized (Curry-Tempkin, p. 342, 2/2/1-6).
- In the fetal female, the major labia flank the minor labia; they appear more echogenic than the hypoechoic minor labia. The bright, linear, vaginal cleft lies at the midline, between the minor labia. Typically, the fetal uterus and ovaries cannot be visualized (Curry-Tempkin, p. 342, 2/3/1-4).

Organ Systems

Muscular System

- Generally, normal fetal muscles appear hypoechoic compared with adjacent structures. However, in some cases muscles may appear so hypoechoic that they are mistaken for anechoic fluid, especially in the abdominal wall where they can mimic the appearance of ascites (abnormal fluid) (Curry-Tempkin, p. 330, 1/1-2).

Cardiovascular:

- The fetal heart can be visualized as a four-chambered structure as early as 15 weeks and certainly by 20 weeks. Chamber walls appear hyperechoic compared with the anechoic blood in them. They should appear relatively symmetric, divided by the bright antrioventricular septa, which should be "broken" only at the foramen ovale. Normally the heart should be visualized on the left side of the thorax. The axis of the fetal heart should be tilted approximately 45 degrees to the anteroposterior axis of the fetal thorax and pointed to the left (Curry-Tempkin, p. 333, 1/2/1-5), (Curry-Tempkin, p. 334, Fig. 18-15).
- Blood vessels in the fetus appear as they do after birth, bright walls and anechoic, blood-filled lumens (Curry-Tempkin, p. 333, 3/2).

Respiratory:

- The portions of the fetal upper respiratory tract that are visible with sonography include the nose, nasal cavity and septum, and the palate. The presence of amniotic fluid in portions of tract makes structures such as the pharynx, hypopharynx, piriform sinuses, and the epiglottis commonly visible (Curry-Tempkin, p. 337, 1/3/1-2).
- The homogeneous lung tissue contracts with the anechoic heart chambers. The ribs are easily recognized by their highly reflective, hyperechoic appearance. In longitudinal section, the diaphragm is seen as a hypoechoic line separating the lungs from the abdomen (Curry-Tempkin, p. 337, 1/4/1-2), (Curry-Tempkin, p. 338, Fig. 18-19).
- The lungs become more echogenic as pregnancy progresses (Curry-Tempkin, p. 337, 2/1/2).

Gastrointestinal System:

- The proximal portion of the esophagus is nearly impossible to see; however, the mid and distal portions may occasionally be visualized anterior to the descending thoracic aorta as five parallel lines. The lines are created by the hypoechoic muscular wall and hyperechoic serosa and lumen (Curry-Tempkin, p. 337, 2/5/2-3)**.**
- Because they are the only subdiaphragmatic fetal gastrointestinal system structures normally filled with fluid, the stomach and gallbladder are consistently easy to identify. The fluid filled stomach appears as an anechoic structure on the left side of the fetal abdomen (Curry-Tempkin, p. 337, 2/6/1-2), (Curry-Tempkin, p. 339, Fig. 18-20).
- The bile-filled gallbladder appears as an anechoic structure on the right side of the fetal abdomen (Curry-Tempkin, p. 337, 2/6/4), (Curry-Tempkin, p. 340, Fig. 18-21).
- By the second trimester, the homogeneous, mid-gray liver is routinely visualized occupying the right side and much of the rest of the fetal abdomen (Curry-Tempkin, p. 337, 1/7/1), (Curry-Tempkin, p. 340, Fig. 18-21).
- A normal bowel may be distinguished prenatally by observing characteristic sonographic patterns for each segment. Beyond 20 weeks of gestation, small bowel appears to occupy a central position within the lower abdomen, with a cluster appearance of the bowel loops. Peristalsis and even fluid-filled small bowel loops may be observed (Hagen-Ansert, p. 1044, 1/2/1-3), (Hagen-Ansert, p. 1043, Fig. 45-43 and 45-44).
- The large intestine with the ascending, transverse, and descending colon and rectum are identified by their peripheral locations in the lower pelvis (Hagen-Ansert, p. 1044, 1/3/1), (Hagen-Ansert, p. 1044, Fig. 45-44).

Genitourinary System:

- The appearance of the developing kidney changes with advancing gestational age (Hagen-Ansert, p. 1044, 2/2/2).
- Typically, consistent recognition of the kidneys begins during the twentieth week. Later in pregnancy, the bright, hyperechoic, retroperitoneal fat surrounding the kidneys makes them easier to visualize (Curry-Tempkin, p. 340, 2/1/1-2)
- The normal fetal renal cortex usually appears light gray or slightly hyperechoic to surrounding structures. It appears interrupted by the anechoic, medullary pyramids typically separated by columns of Bertin (Curry-Tempkin, p. 340, 2/3/1-2)
- The bladder wall appears thin and hyperechoic surrounding the anechoic fluid (Curry-Tempkin, p. 342, 1/3/3-4), (Curry-Tempkin, p. 344, Fig. 18-26).

- As a rule, normal fetal ureters are not visualized sonographically. In almost all cases, identification of a fetal ureter is an indication of pathologic dilation (Curry-Tempkin, p. 342, 1/3/1-2)
- While the fetal adrenal glands are not part of the genitourinary system, their close proximity to the kidneys and relatively conspicuous appearance make them a significant sonographic marker. The triangular shaped adrenals appear to “cap” the upper renal poles. High-resolution scanning reveals a low-gray organ, predominantly hypoechoic to the liver and renal cortex on the right and the spleen and renal cortex on the left (Curry-Tempkin, p. 342, 2/4/1-3), (Curry-Tempkin, p. 345, Fig. 18-28).

Central Nervous System:
Intracranial Anatomy

- By the eleventh gestational week, the ovoid appearance of the large lateral ventricles filled with highly echogenic choroids plexus is easily identified. The choroids plexus are the most prominent intracranial structures seen at this time. They are bright, drumstick-shaped structures on either side of the falx cerebri in the posterior portion of the brain. The falx is the bright, reflective fold of dura mater in the cerebral fissure that separates the cerebral hemispheres (Curry-Tempkin, p. 346, 2/4/1-4).
- The anechoic frontal horns are free of the choroids, yet are easily identified because they are filled with CSF. Except for the areas containing choroids plexus, the remaining portions of the lateral ventricles are clearly delineated by anechoic CSF (Curry-Tempkin, p. 347, 1/1/5-7).
- Ventricle walls appear vivid and hyperechoic to the CSF and mid-gray to low-gray brain matter (Curry-Tempkin, p. 347, 1/1/8).
- At this time, the homogeneous, medium-level to low-level gray appearance of the cerebrum, cerebellum, brain stem, and highly reflective third ventricle is established and will remain fairly consistent, other than developmental enlargement, throughout the gestation (Curry-Tempkin, p. 347, 1/1/9).
- The brain linings (dura-arachnoid and pia) are also established and have the distinction of appearing very bright or hyperechoic compared with adjacent structures (Curry-Tempkin, p. 347, 1/1/10).
- The falx cerebri is a significant sonographic marker because it is an extremely bright reflection. The falx is seen at right angles to the sound beam in the axial plane as a reflective line dividing the homogeneous, mid-gray to low-gray cerebrum into equal right and left halves. The cerebellar vermis often appears strikingly echogenic due to its intertwined meninges coverings; it is the reflective line dividing the homogeneous, low-gray cerebellum (Curry-Tempkin, p. 347, 2/1/1-3).

- Peripheral to the edges of the brain are subarachnoid spaces that range in appearance from anechoic to varying levels of echogenicity; some are filled with anechoic CSF and some with echogenic mater, and some with areas of both (Curry-Tempkin, p. 347, 2/2/1).
- Nuclei such as the caudate and lentiform appear as low-level, gray echoes, hypoechoic to surrounding structures with the exception if anechoic CSF. The tegmentum portion of the brain stem is also hypoechoic as opposes to the ventral area of the pons that presents an area of mid-gray or moderate echogenicity, a little brighter than the nuclei and tegmentum (Curry-Tempkin, p. 347, 2/3/3-4).
- The thalamus is a diamond-shaped area visualized in the center of an axial section taken through the temporal lobe of the brain; it appears homogeneous with medium-level to low-level echoes and is divided into two equal sections by the third ventricle, a hyperechoic line, which extends upward into the space between the two halves (Curry-Tempkin, p.348, 1/3/1), (Hagen-Ansert, p. 1025, Fig. 45-11).
- The cavumseptum pellucidum is another anechoic, fluid-containing structure seen in the midline of the brain. It appears as two small, bright lines separated by CSF, parallel to the falx (Curry-Tempkin, p. 348, 1/3/3).
- The posterior portion of the brain can be visualized in an axial section inferior to the majority of the thalamus. The cerebellum should appear symmetric, homogeneous, and of medium-level to low-level echogenicity (Curry-Tempkin, p.348, 2/2/1-2), (Curry-Tempkin, p. 347, Fig.18-29).

Spinal Cord

- The hypoechoic spinal cord is clearly visible by the fifteenth or sixteenth week. It can best be seen in a longitudinal section, lying between the highly reflective, echogenic vertebrae (Curry-Tempkin, p.348, 2/3/1), (Hagen-Ansert, p. 1033, Fig 45-25, 45-26).

4) **Normal Size Range (s):**
NA

5) **Pertinent Lab Data:** (Curry-Tempkin, p. 318, "Laboratory Values")
- Alpha-Fetoprotein (AFP): Found in maternal blood and amniotic fluid. Elevated levels indicate fetal abnormalities or defects.
- Triple Marker Screening (AFP, uE3, hCG): Abnormal levels of alpha-fetoprotein (AFP), unconjugated estriol (uE3), and human chorionic gonadotropin (hCG) are indicators of certain embryonic/fetal abnormalities, possible multifetal gestations, and combined with maternal age, screening markers for Down syndrome.

6) **Patient Prep:**
Transabdominal (Tempkin, p. 219, "Patient Prep")

- Full urinary bladder
- 32 to 40 ounces of clear fluid should be ingested 1 hour before the exam and finished within a 15- to 20-minute time period
- If for any reason the patient cannot have fluids, sterile water can be used to fill the bladder though a Foley catheter

Endovaginal (Tempkin, p. 201, “Patient Prep”)

- Explain the examination to the patient. Inform the patient that the exam is virtually painless, that the inserted transducer feels like a tampon, and the exam is necessary for an accurate diagnosis. Verbal or written consent is required, and the exam should be witnessed by a female health care professional. Note that the initials of the witness should be included as part of the film labeling.
- Empty urinary bladder.
- The transducer may be inserted by the patient, sonographer, or physician.

7) Transducer (Probe) Frequency:

Transabdominal (Tempkin, p. 219, “Transducer”)

- 3.0 MHz or 3.5 MHz.
- 2.5 MHz for very large patients. 5.0 MHz for thinner patients or earlier gestational ages.
- Sector, curvilinear, and linear transducers may be required for an adequate examination. It is not unusual to use two or even three transducers for an obstetric ultrasound exam

Endovaginal (Tempkin, p. 201, “Transducer”)

- 5 MHz to 7.5 MHz.
- Apply gel to the end of the transducer, then cover it with a condom or sheath. Make sure there are no air bubbles at the tip, then apply additional gel to the outside of the condom before insertion. If infertility is a consideration, then water or nonspermicidal gel may be used.

8) Protocol: (Tempkin, p. 233- 255, “Required Images”)

- In longitudinal, when trimester allows a long axis image of the uterus and contents is taken. Longitudinal images are taken of the placenta, a grade 0 placenta, a grade I placenta, a grade II placenta, and a grade III placenta. A longitudinal image is taken of the cervix to include the internal os. A longitudinal translabial image of the lower uterine segment is taken. Depending on the stage of gestation, an overall longitudinal image of amniotic fluid or the largest pocket with superior to inferior measurement is taken. Longitudinal images are taken of the cervical spine, thoracic spine, lumbar spine, sacral spine, both fetal kidneys, and fetus to include diaphragm.
- In transverse, an image of placenta location is taken. Depending on the stage of gestation, an overall transverse image of amniotic fluid or the largest pocket with anterior and posterior and right to left measurements is taken.

Transverse images are taken of the cervical spine, thoracic spine, lumbar spine, and both fetal kidneys if possible.

- An image of a four-chamber view of the fetal heart to include its location within the thorax is taken. An optional image showing the normal crossing of cardiac outflow tracts can be taken. Images are taken of the urinary bladder, umbilical cord insertion site on the anterior abdominal wall, magnified view of a cross-section of a three vessel cord, stomach if visualized, male or female genitalia, cerebellum with measurement, cisterna magnum with measurement, Nuchal fold with measurement, choroid plexus, lateral ventricle, long axis of fetal femur with measurement, humerus with measurement, lower portion of the leg, radius and ulna, hand, feet, and fetal face.
- A biparietal diameter image of the level of the thalamus and cavum septi pellucidi is taken. Measurement is from the outside of the near cranium to the inside of the far cranium. A head circumference image at the same level as the biparietal diameter is taken. Measurement is around the outline of the cranium.
- An abdominal circumference image at the level of the junction of the umbilical vein and portal vein sinus is taken. Measurement is around the outline of the abdomen.
- A coronal image of the nostrils and lips is taken.

9) Image Reference:

- Curry-Tempkin, p. 321-323, Fig. 18-1, 18-2, 18-3
- Hagen-Ansert, p. 1053-1054, Fig. 45-61, 45-62
- Curry-Tempkin, p. 321, Fig. 18-1, 18-2
- Curry-Tempkin, p. 325, Fig. 18-4
- Hagen-Ansert, p. 1055, Fig. 45-63
- Hagen-Ansert, p. 1052, Fig. 45-58
- Hagen-Ansert, p. 1052, Fig. 45-59
- Hagen-Ansert, p. 1019-1020, Fig. 45-2A, 45-4B
- Hagen-Ansert, p. 1019-1021, Fig. 45-2B, 45-4A, 45-5, 45-6
- Hagen-Ansert, p. 1019, Fig. 45-2C, D
- Hagen-Ansert, p. 1021, Fig. 45-7
- Hagen-Ansert, p. 1020, Fig. 45-3
- Hagen-Ansert, p. 1030-1032, Fig. 45-19. 45-20, 45-21, 45-22, 45-23
- Hagen-Ansert, p. 1047, Fig. 45-48, 45-49
- Hagen-Ansert, p. 1048, Fig. 45-50
- Curry-Tempkin, p. 325-330, Fig. 18-4, 18-5, 18-6, 18-7, 18-8, 18-9, 18-10
- Hagen-Ansert, p. 1033-1035, Fig. 45-24, 45-25, 45-26, 45-27
- Hagen-Ansert, p. 1037, Fig. 45-29, 45-30
- Curry-Tempkin, p. 331, Fig. 18-11, 18-12
- Curry-Tempkin, p. 333-336, Fig. 18-14, 18-15, 18-17, 18-18
- Hagen-Ansert, p. 1036, Fig. 45-28
- Hagen-Ansert, p. 1038-1039, Fig. 45-31, 45-32, 45-33, 45-34
- Curry-Tempkin, p. 338, Fig. 18-19

- Hagen-Ansert, p. 1042, Fig. 45-40
- Hagen-Ansert, p. 1039, Fig. 45-35
- Hagen-Ansert, p. 1043-1044, Fig. 45-42, 45-43, 45-44
- Curry-Tempkin, p. 339-342, Fig. 18-20, 18-21, 18-22, 18-23, 18-24
- Curry-Tempkin, p. 343-345, Fig. 18-25, 18-26, 18-27, 18-28
- Hagen-Ansert, p. 1045- 1046, 45-45, 45-46, 45-47
- Curry-Tempkin, p. 347- 348, Fig. 18-29, 18-30
- Hagen-Ansert, p. 1023-1028, Fig. 45-8, 45-9, 45-10, 45-11, 45-12, 45-13, 45-14, 45-15

10) References:

- Curry, R.A. and Tempkin, B.B. (2004). Sonography: Introduction to normal structures and function (2^{nd} ed.). St. Louis, MO: Saunders.
- Hagan-Ansert, S.L. (2006). Textbook of diagnostic ultrasonography (6^{th} ed.) (Vol.1). St. Louis, MO: Mosby.
- Tempkin, B.B. (1999). Ultrasound scanning: Principles and protocols (2^{nd} ed.). Philadelphia, PA: Saunders.