UPDATE

1

OB/GYN SONOGRAPHY

An Illustrated Review

Study Alert for RDMS Candidates

DAVIES PUBLISHING INC.

Ob/Gyn Sonography Study Update

UPDATED SEPTEMBER 4, 2014

Marie De Lange, BS, RT, RDMS, RVT, FSDMS, and Glenn A. Rouse, MD

Phone 626-792-3046 • Fax 626-792-5308

Contents

Notes to the First Edition

Chapter 1

Notes on the Text

Beta-hCG measurements and Four-Chamber View of the Heart (Figures 138 & 139)

The units of measure for hCG, as used in the text, are clarified below, as are two of the illustrations in the text—figures 138 (normal four-chamber view of the heart) and 139 (sonographic views and approaches to the fetal heart and great vessels) .

Beta–Human Chorionic Gonadotropin (beta-hCG)

The correlation between serum levels of beta–human chorionic gonadotropin (beta-hCG) and sonographic findings is explained on page 15 of the text in the chapter on The First Trimester and applied in several sections of the book, including Case Studies for Self-Assessment on page 295. The units of measure for hCG, as used in the text, require clarification:

Important Notes: On page 15 of the text there is a statement that "the numerical result using the SIS system will be approximately double the result using the IRP system." ***This is incorrect.*** **It should read:**

The numerical result using the SIS system will be approximately half the result using the IRP system.

Please make this correction in your text. Also note that the units of measure in the short table on the same page should be **mIU/ml**, not IU/ml, for IRP, 3IS, and SIS. This table correlates the sonographic identification of the gestational sac in early pregnancy with maternal serum beta-hCG., as follows:

Sonographic Technique	IRP or 3IS	SIS
Endovaginal sonography	**1000–2000 mIU/ml**	**500–1000mIU/ml**
Transabdominal sonography	**3600 mIU/ml**	**1800 mIU/ml**

Please make this correction in your text to avoid any confusion. The correlation of serum beta-hCG with sonographic visualization of the gestational sac in normal early pregnancy and the units of measure used to express beta-hCG levels are important and likely to be on the ARDMS exam.

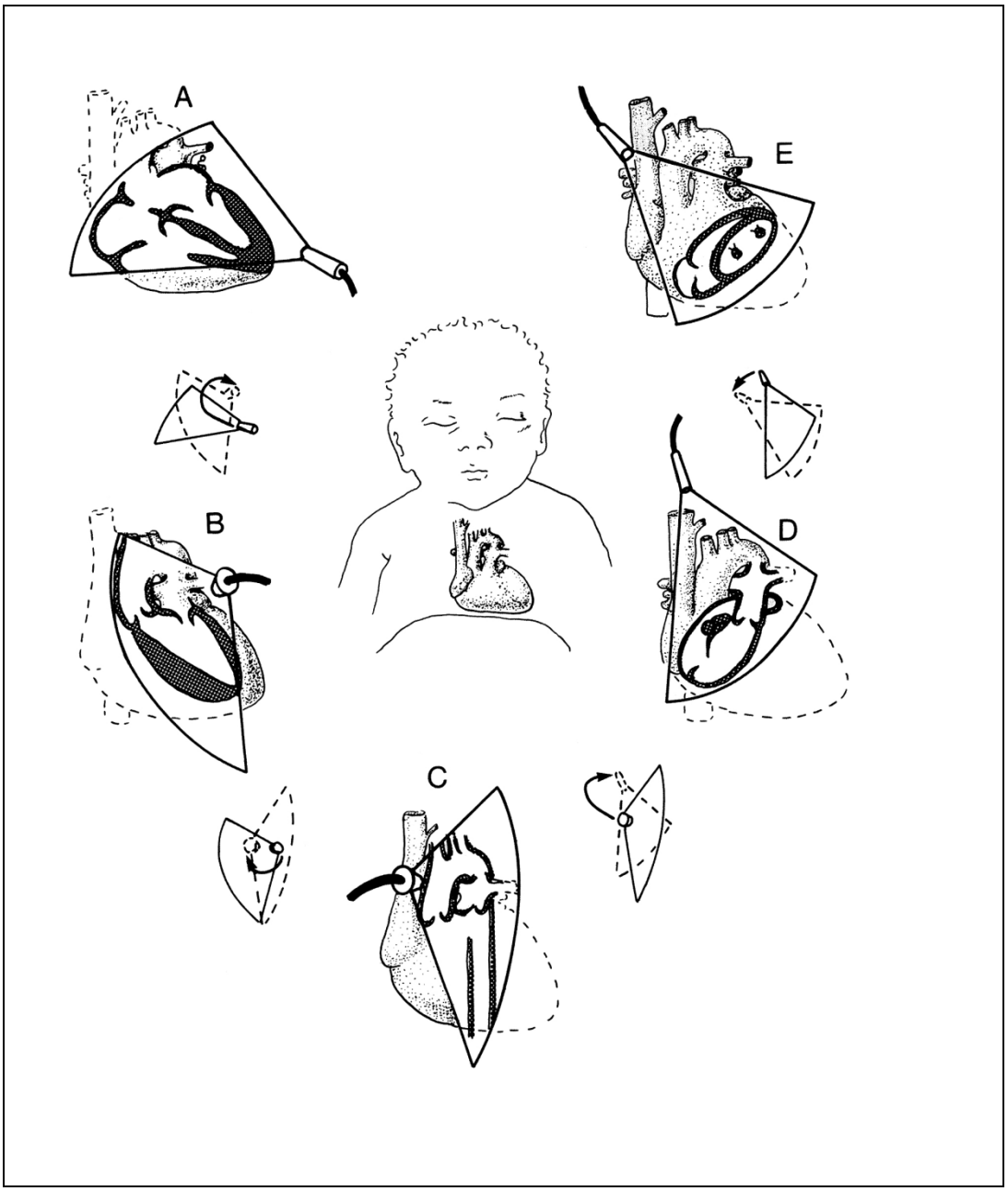
Four-Chamber View of the Heart

Cardiac abnormalities of the fetal heart are reviewed on pages 189–201, as are the standard four-chamber view of the heart, the components of a complete fetal echocardiographic exam, and sonographic findings in both the normal and abnormal fetal heart.

Important Notes: The normal four-chamber view of the heart in Figure 138 on page 191 was obtained from a *postnatal*, not *fetal*, heart.

Figure 139 on page 192 is reproduced below with parts A–E labeled. The labels were inadvertently omitted from the figure in the book. The caption is included here for your convenience:

Figure 139. *Sonographic views and approaches to the fetal heart and great vessels.* The axis of the fetal heart is more horizontal compared to its postnatal lie in the chest (see drawing in center of this illustration). Although all of the views in this figure are shown as if obtained from the chest or abdominal wall, in fact it is possible to achieve all of these imaging planes from the back. **A** Four-chamber view showing both atria and the foramen ovale within the atrial septum, both ventricles, and the atrioventricular valves. **B** The long axis is obtained after slight clockwise rotation and tilt of the transducer toward the fetal left shoulder. **C** Further clockwise rotation and tilt of the transducer produces sagittally oriented planes, useful for imaging the aortic arch and the "ductus arch." **D** Short-axis views are obtained perpendicular to the long axis. At the base of the heart the aorta lies centrally and is surrounded by the structures of the right ventricle and the pulmonary



artery, as postnatally. **E** Further toward the apex, the left ventricular structure with two papillary muscles can be seen.

Reprinted with permission from Silverman NH, Schmidt KG: Ultrasound evaluation of the fetal heart. In Callen PW (ed): Ultrasonography in Obstetrics and Gynecology, 4th edition. Philadelphia, Saunders, 2000, p 380.

Endometrial Thickness Varies with Menstrual Cycle

The menstrual cycle is reviewed in Chapter 11 of the text. Normally, the thickness of the endometrium varies throughout the menstrual cycle, as does the sonographic appearance of the endometrium.

Important Notes: Table 14 on page 238 of the text provides a quick reference to how the thickness of the endometrium varies throughout the menstrual cycle. As printed, the table contains inadvertent errors. Please substitute the following table for the existing Table 14 or make corrections in the text itself:

Table 14. Normal variation in endometrial thickness throughout the menstrual cycle.

Phase of Cycle	Days of Cycle	Endometrial Thickness
Menstrual phase	**Days 1–4**	**1–4 mm**
Proliferative phase	**Days 5–14**	**4–8 mm**
Secretory phase	**Days 15–28**	**7–14 mm**

Deuel's Sign

***Deuel's sign*, also known as the *halo sign*, is the halo effect that subcutaneous scalp edema produces on radiography of the fetal head. First described by Deuel on x-ray in 1946, Deuel's sign has been associated with intrauterine death of the fetus.** We mention it here for two reasons: (1) it's on the registry exam, or at least some forms of the exam, and (2) many ultrasound professionals and even radiologists are not familiar with the term *Deuel's sign*, which appears in Kathy Gill's mock exam *Ob/Gyn Sonography Review* (a very useful companion to the text; call toll-free 1-877-792-0005 to order). Be prepared!

Color Plate 17, page xvi.

Please note color plates 17 C and D are reversed. The descriptions should read as follows:

C Sonogram and Doppler of the normal right ovary. Note normal systolic and diastolic flow.

D Sonogram and Doppler of the abnormal left ovary. Note absence of diastolic flow.

Chapter 2

Notes on the Case Studies

Case Studies 1, 2, 10, and 21; beta-hCG Units of Measurement

Chapter 17, Case Studies for Self-Assessment, contains 100 case-based exercises designed to help you evaluate your ability to apply the facts, principles, and skills reviewed in the text. Three of these exercises require clarification: Case Nos. 1, 2, 10, and 21. In addition, this section of the study alert also clarifies the units of measurement used for beta-hCG in one of these four case studies.

Case 2 Question (page 295)

Case # 2 requires that you compare two Doppler images obtained from the fetal cord and middle cerebral artery. The two images appear on the following page. They demonstrate:

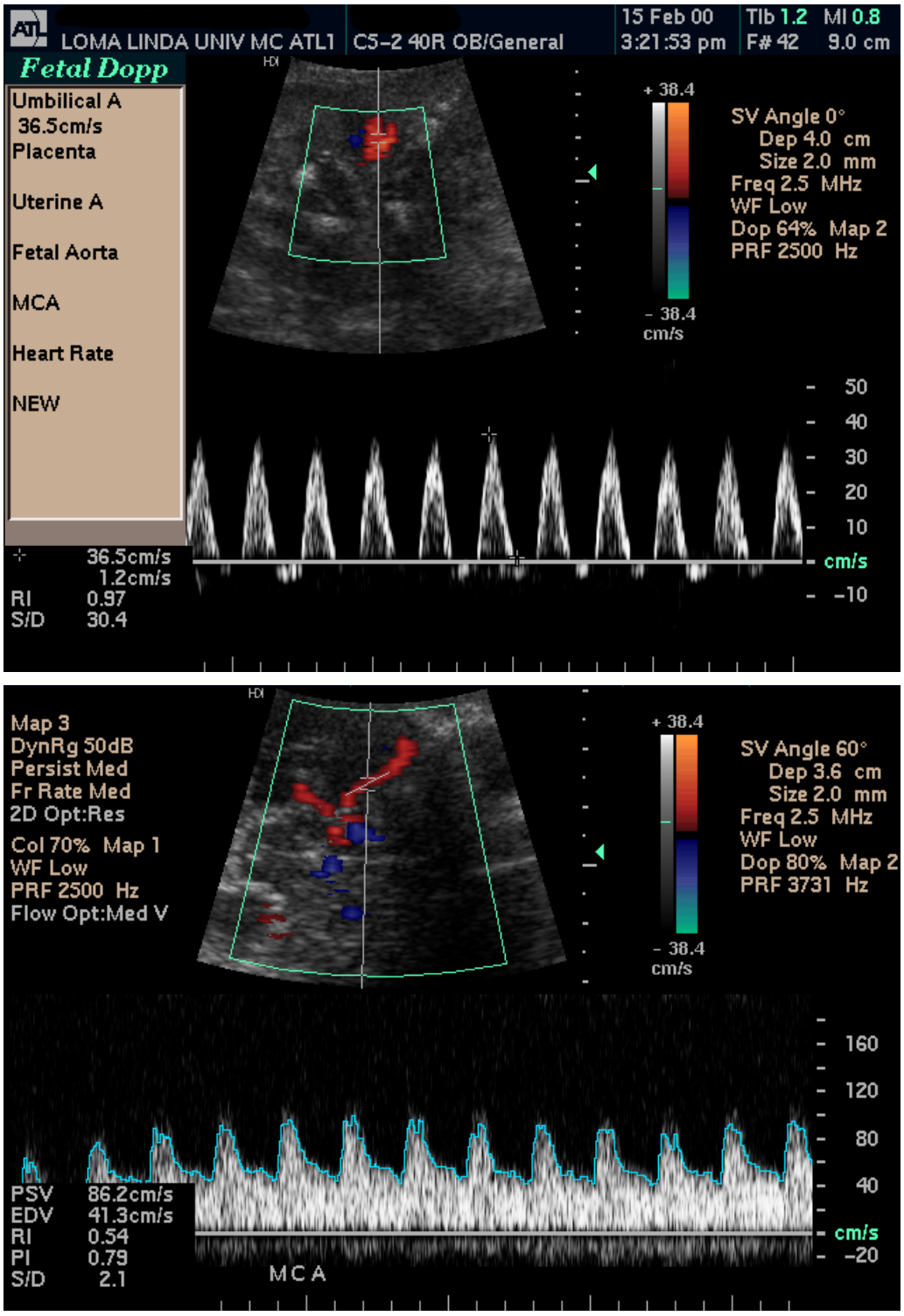
A. Normally low-resistance cord and high-resistance head Doppler.

B. Abnormally high-resistance cord and low-resistance head Doppler.

C. Normally low-resistance cord and head Doppler.

D. Abnormally high-resistance cord and head Doppler.

Images appear on the next page. The top image is of the umbilical artery and the second of the MCA.



B is correct. See page 327 of the text for more information.

Case 1 Answer (Page 326)

C is correct. *Intrauterine growth restriction (IUGR).* **A, B, and D are most likely associated with placentas > 5 cm in thickness.** IUGR is most commonly associated with placental insufficiency. Thin placentas are commonly associated with IUGR, maternal hypertension, toxemia, chromosomal anomalies, severe intrauterine infections, and pregestational diabetes.

Case Study 10 Answer (page 328)

C is correct. ***The embryo is not visible when the gesta-tional sac is > 16 mm by endovaginal sonography***.

Beta–Human Chorionic Gonadotropin (Beta-hCG)

As noted in the text, serum beta-hCG levels correlate with sonographic findings in early pregnancy. Two different systems have been used to measure serum beta-hCG. In this text we use the original (i.e., first) International Reference Preparation (IRP) system, which expresses the concentration of serum beta-hCG in International Units per milliliter (IU/ml or mIU/ml). **Important Note: The beta-hCG levels cited on page 331 (Case Study answer #21) should be stated in mIU/ml rather than IU/ml. In addition, peak levels hGC are seen between 7 and 12 weeks. In your text, please change the explanation for Case Study answer #21 to read as follows:**

Page 331 #21 . . .

The hCG level normally doubles every 2 days and peaks between 7 and 12 weeks at 200,000–300,000 mIU/ml. Reference: Braunstein GD, Rasor J, Adler D, et al: Serum human chorionic gonadotropin levels throughout normal pregnancy. Am J Obstet Gynecol 126:678–681, 1976.

AIUM Practice Guideline for the Performance of Obstetric Ultrasound Examinations

The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of guidelines, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Radiology (ACR) and the American College of Obstetricians and Gynecologists (ACOG), this AIUM Practice Guideline for the Performance of Obstetric Ultrasound Examinations. We are indebted to the many volunteers who contributed their time, knowledge, and energy to bringing this document to completion.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine for more than 50 years. This document and others like it will continue to advance this mission.

Practice guidelines of the AIUM are intended to provide the medical ultrasound community with guidelines for the performance and recording of high-quality ultrasound examinations. The guidelines reflect what the AIUM considers the minimum criteria for a complete examination in each area but are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the guidelines with recognition that deviations from these guidelines will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the guidelines to provide additional service and information as needed.

I. Introduction

The clinical aspects of this guideline (Classification of Fetal Sonographic Examinations, Specifications of the Examination, Equipment Specifications, and Fetal Safety) were revised collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for personnel qualifications, written request for the examination, procedure documentation, and quality control vary among these organizations and are addressed by each separately.

This guideline has been developed for use by practitioners performing obstetric sonographic studies. Fetal ultrasound should be performed only when there is a valid medical reason, and the lowest possible ultrasonic exposure settings should be used to gain the necessary diagnostic information. A limited examination may be performed in clinical emergencies or for a limited purpose such as evaluation of fetal or embryonic cardiac activity, fetal position, or amniotic fluid volume. A limited follow-up examination may be appropriate for reevaluation of fetal size or interval growth or to reevaluate abnormalities previously noted if a complete prior examination is on record.

While this guideline describes the key elements of standard sonographic examinations in the first trimester and second and third trimesters, a more detailed anatomic examination of the fetus may be necessary in some cases, such as when an abnormality is found or suspected on the standard examination or in pregnancies at high risk for fetal anomalies. In some cases, other specialized examinations may be necessary as well. While it is not possible to detect all structural congenital anomalies with diagnostic ultrasound, adherence to the following guidelines will maximize the possibility of detecting many fetal abnormalities.

II. Classification of Fetal Sonographic Examinations

A. First-Trimester Ultrasound Examination

A standard obstetric sonogram in the first trimester includes evaluation of the presence, size, location, and number of gestational sac(s). The gestational sac is examined for the presence of a yolk sac and embryo/fetus. When an embryo/fetus is detected, it should be measured and cardiac activity recorded by a 2-dimensional video clip or M-mode imaging. Use of spectral Doppler imaging is discouraged. The uterus, cervix, adnexa, and cul-de-sac region should be examined.

B. Standard Second- or Third-Trimester Examination

A standard obstetric sonogram in the second or third trimester includes an evaluation of fetal presentation, amniotic fluid volume, cardiac activity, placental position, fetal biometry, and fetal number, plus an anatomic survey. The maternal cervix and adnexa should be examined as clinically appropriate when technically feasible.

C. Limited Examination

A limited examination is performed when a specific question requires investigation. For example, in most routine nonemergency cases, a limited examination could be performed to confirm fetal heart activity in a bleeding patient or to verify fetal presentation in a laboring patient. In most cases, limited sonographic examinations are appropriate only when a prior complete examination is on record.

D. Specialized Examinations

A detailed anatomic examination is performed when an anomaly is suspected on the basis of history, biochemical abnormalities, or the results of either the limited or standard scan. Other specialized examinations might include fetal Doppler sonography, biophysical profile, a fetal echocardiogram, or additional biometric measurements.

III. Qualifications and Responsibilities of Personnel

See the AIUM Official Statement *Training Guidelines for Physicians Who Evaluate and Interpret Diagnostic Ultrasound Examinations* and the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

IV. Written Request for the Examination

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider or under their direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient's clinical situation and should be consistent with relevant legal and local health care facility requirements.

V. Specifications of the Examination

A. First-Trimester Ultrasound Examination

1. Indications

   Indications for first trimester (1 week to 13 weeks 6 days) sonography include but are not limited to:

   a. Confirmation of the presence of an intrauterine pregnancy.
   b. Evaluation of a suspected ectopic pregnancy.
   c. Defining the cause of vaginal bleeding.

d. Evaluation of pelvic pain.
e. Estimation of gestational (menstrual; considered equivalent to gestational) age.
f. Diagnosis or evaluation of multiple gestations.
g. Confirmation of cardiac activity.
h. Imaging as an adjunct to chorionic villus sampling, embryo transfer, and localization and removal of an intrauterine device.
i. Assessing for certain fetal anomalies, such as anencephaly, in high-risk patients.
j. Evaluation of maternal pelvic masses and/or uterine abnormalities.
k. Measuring the nuchal translucency (NT) when part of a screening program for fetal aneuploidy.
l. Evaluation of a suspected hydatidiform mole.

Comment
Limited examination may be performed to evaluate interval growth, estimate amniotic fluid volume, evaluate the cervix, and assess the presence of cardiac activity.

2. Imaging Parameters

Comment
Scanning in the first trimester may be performed either transabdominally or transvaginally. If a transabdominal examination is not definitive, a transvaginal scan or transperineal scan should be performed whenever possible.

a. The uterus, including the cervix, and adnexa should be evaluated for the presence of a gestational sac. If a gestational sac is seen, its location should be documented. The gestational sac should be evaluated for the presence or absence of a yolk sac or embryo, and the crown-rump length should be recorded, when possible.

Comment
A definitive diagnosis of intrauterine gestational pregnancy can be made when an intrauterine gestational sac containing a yolk sac or embryo/fetus with cardiac activity is visualized. A small, eccentric intrauterine fluid collection with an echogenic rim can be seen before the yolk sac and embryo are detectable in a very early intrauterine pregnancy. In the absence of sonographic signs of ectopic pregnancy, the fluid collection is highly likely to represent an intrauterine gestational sac. In this circumstance, the intra-decidual sign may be helpful. Follow-up sonography and/or serial determination of maternal serum human chorionic gonadotropin levels are/is appropriate in pregnancies of undetermined location to avoid inappropriate intervention in a potentially viable early pregnancy.

The crown-rump length is a more accurate indicator of gestational (menstrual) age than is mean gestational sac diameter. However, the mean gestational sac diameter may be recorded when an embryo is not identified.

Caution should be used in making the presumptive diagnosis of a gestational sac in the absence of a definite embryo or yolk sac. Without these findings, an intrauterine fluid collection could represent a pseudogestational sac associated with an ectopic pregnancy.

b. Presence or absence of cardiac activity should be reported.

Comment
With transvaginal scans, cardiac motion is usually observed when the embryo is 2 mm or greater in length. If an embryo less than 7 mm in length is seen without cardiac activity, a subsequent scan in 1 week is recommended to ensure that the pregnancy is nonviable.

c. Fetal number should be documented.

Comment
Amnionicity and chorionicity should be documented for all multiple gestations when possible.

d. Embryonic/fetal anatomy appropriate for the first trimester should be assessed.

e. The nuchal region should be imaged, and abnormalities such as cystic hygroma should be documented.

Comment
For those patients desiring to assess their individual risk of fetal aneuploidy, a very specific measurement of the NT during a specific age interval is necessary (as determined by the laboratory used). See the section entitled *Guidelines for NT Measurement*. Nuchal translucency measurements should be used (in conjunction with serum biochemistry) to determine the risk for having a child with aneuploidy or other anatomic abnormalities such as heart defects. In this setting, it is important that the practitioner measure the NT according to established guidelines for measurement. A quality assessment program is recommended to ensure that false-positive and -negative results are kept to a minimum.

Guidelines for NT Measurement
i. The margins of the NT edges must be clear enough for proper placement of the calipers.
ii. The fetus must be in the midsagittal plane.
iii. The image must be magnified so that it is filled by the fetal head, neck, and upper thorax.
iv. The fetal neck must be in a neutral position, not flexed and not hyperextended.
v. The amnion must be seen as separate from the NT line.
vi. The (+) calipers on the ultrasound must be used to perform the NT measurement.
vii. Electronic calipers must be placed on the inner borders of the nuchal space with none of the horizontal crossbar itself protruding into the space.
viii. The calipers must be placed perpendicular to the long axis of the fetus.
ix. The measurement must be obtained at the widest space of the NT.

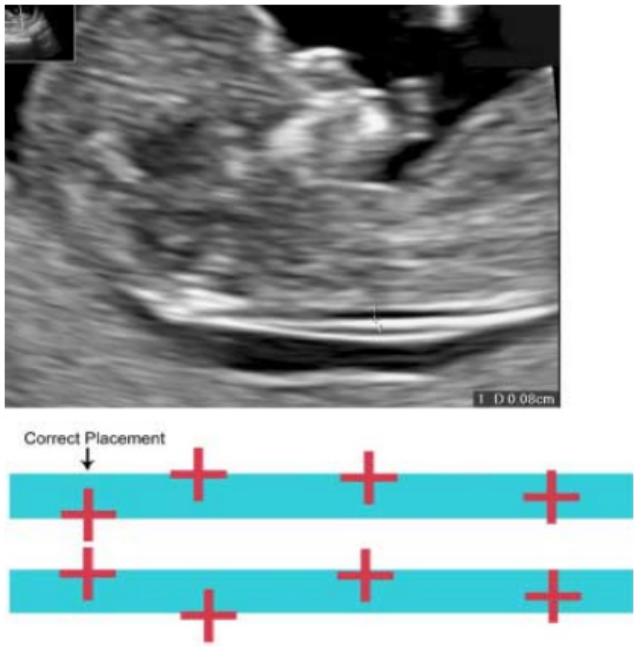


Diagram for the NT measurement.

f. The uterus, including the cervix, adnexal structures, and cul-de-sac, should be evaluated. Abnormalities should be imaged and documented.

Comment

The presence, location, and size of adnexal masses should be documented. The presence and number of leiomyomata should be documented. The measurements of the largest or any potentially clinically significant leiomyomata may be documented. The cul-de-sac should be evaluated for the presence or absence of fluid. Uterine anomalies should be documented.

B. Second- and Third-Trimester Ultrasound Examination

1. Indications

Indications for second- and third-trimester sonography include but are not limited to:

a. Screening for fetal anomalies.
b. Evaluation of fetal anatomy.
c. Estimation of gestational (menstrual) age.
d. Evaluation of fetal growth.
e. Evaluation of vaginal bleeding.
f. Evaluation of abdominal or pelvic pain.
g. Evaluation of cervical insufficiency.
h Determination of fetal presentation.
i. Evaluation of suspected multiple gestation.
j. Adjunct to amniocentesis or other procedure.
k. Evaluation of a significant discrepancy between uterine size and clinical dates.
l. Evaluation of a pelvic mass.
m. Evaluation of a suspected hydatidiform mole.
n. Adjunct to cervical cerclage placement.

o. Suspected ectopic pregnancy.
p. Suspected fetal death.
q. Suspected uterine abnormality.
r. Evaluation of fetal well-being.
s. Suspected amniotic fluid abnormalities.
t. Suspected placental abruption.
u. Adjunct to external cephalic version.
v. Evaluation of a premature rupture of membranes and/or premature labor.
w. Evaluation of abnormal biochemical markers.
x. Follow-up evaluation of a fetal anomaly.
y. Follow-up evaluation of placental location for suspected placenta previa.
z. History of previous congenital anomaly.
aa. Evaluation of fetal condition in late registrants for prenatal care.
bb. Assessment for findings that may increase the risk for aneuploidy.

Comment
In certain clinical circumstances, a more detailed examination of fetal anatomy may be indicated.

2. Imaging Parameters for a Standard Fetal Examination
   a. Fetal cardiac activity, fetal number, and presentation should be documented.

   Comment
   An abnormal heart rate and/or rhythm should be documented. Multiple gestations require the documentation of additional information: chorionicity, amnionicity, comparison of fetal sizes, estimation of amniotic fluid volume (increased, decreased, or normal) in each gestational sac, and fetal genitalia (when visualized).

   b. A qualitative or semiquantitative estimate of amniotic fluid volume should be reported.

   Comment
   Although it is acceptable for experienced examiners to qualitatively estimate amniotic fluid volume, semiquantitative methods have also been described for this purpose (e.g., amniotic fluid index, single deepest pocket, 2-diameter pocket).

   c. The placental location, appearance, and relationship to the internal cervical os should be documented. The umbilical cord should be imaged, and the number of vessels in the cord documented. The placental cord insertion site should be documented when technically possible.

   Comment
   It is recognized that apparent placental position early in pregnancy may not correlate well with its location at the time of delivery.

   Transabdominal, transperineal, or transvaginal views may be helpful in visualizing the internal cervical os and its relationship to the placenta.

   Transvaginal or transperineal ultrasound may be considered if the cervix appears shortened or cannot be adequately visualized during the transabdominal sonogram. A velamentous (also called membranous) placental cord insertion that

crosses the internal os of the cervix is vasa previa, a condition that has a high risk of fetal mortality if not diagnosed before labor.

d. Gestational (menstrual) age assessment.
First-trimester crown-rump measurement is the most accurate means for sonographic dating of pregnancy. Beyond this period, a variety of sonographic parameters such as biparietal diameter, abdominal circumference, and femoral diaphysis length can be used to estimate gestational (menstrual) age. The variability of gestational (menstrual) age estimations, however, increases with advancing pregnancy. Significant discrepancies between gestational (menstrual) age and fetal measurements may suggest the possibility of a fetal growth abnormality, intrauterine growth restriction, or macrosomia.

Comment
The pregnancy should not be redated after an accurate earlier scan has been performed and is available for comparison.

i. Biparietal diameter is measured at the level of the thalami and cavum septi pellucidi. The cerebellar hemispheres should not be visible in this scanning plane. The measurement is taken from the outer edge of the proximal skull to the inner edge of the distal skull.

Comment
The head shape may be flattened (dolichocephaly) or rounded (brachycephaly) as a normal variant. Under these circumstances, certain variants of normal fetal head development may make measurement of the head circumference more reliable than biparietal diameter for estimating gestational (menstrual) age.

ii. Head circumference is measured at the same level as the biparietal diameter, around the outer perimeter of the calvarium. This measurement is not affected by head shape.

iii. Femoral diaphysis length can be reliably used after 14 weeks' gestational (menstrual) age. The long axis of the femoral shaft is most accurately measured with the beam of insonation being perpendicular to the shaft, excluding the distal femoral epiphysis.

iv. Abdominal circumference or average abdominal diameter should be determined at the skin line on a true transverse view at the level of the junction of the umbilical vein, portal sinus, and fetal stomach when visible.

Comment
Abdominal circumference or average abdominal diameter measurement is used with other biometric parameters to estimate fetal weight and may allow detection of intrauterine growth restriction or macrosomia.

e. Fetal weight estimation.
Fetal weight can be estimated by obtaining measurements such as the biparietal diameter, head circumference, abdominal circumference or average abdominal diameter, and femoral diaphysis length. Results from various prediction models can be compared to fetal weight percentiles from published nomograms.

Comment

If previous studies have been performed, appropriateness of growth should also be documented. Scans for growth evaluation can typically be performed at least 2 to 4 weeks apart. A shorter scan interval may result in confusion as to whether measurement changes are truly due to growth as opposed to variations in the measurement technique itself.

Currently, even the best fetal weight prediction methods can yield errors as high as ±15%. This variability can be influenced by factors such as the nature of the patient population, the number and types of anatomic parameters being measured, technical factors that affect the resolution of ultrasound images, and the weight range being studied.

f. Maternal anatomy.
Evaluation of the uterus, adnexal structures, and cervix should be performed when appropriate. If the cervix cannot be visualized, a transperineal or transvaginal scan may be considered when evaluation of the cervix is needed.

Comment
This will allow recognition of incidental findings of potential clinical significance. The presence, location, and size of adnexal masses and the presence of at least the largest and potentially clinically significant leiomyomata should be documented. It is not always possible to image the normal maternal ovaries during the second and third trimesters.

g. Fetal anatomic survey.
Fetal anatomy, as described in this document, may be adequately assessed by ultrasound after approximately 18 weeks' gestational (menstrual) age. It may be possible to document normal structures before this time, although some structures can be difficult to visualize due to fetal size, position, movement, abdominal scars, and increased maternal abdominal wall thickness. A second- or third-trimester scan may pose technical limitations for an anatomic evaluation due to imaging artifacts from acoustic shadowing. When this occurs, the report of the sonographic examination should document the nature of this technical limitation. A follow-up examination may be helpful.

The following areas of assessment represent the minimal elements of a standard examination of fetal anatomy. A more detailed fetal anatomic examination may be necessary if an abnormality or suspected abnormality is found on the standard examination.

i. Head, face, and neck
Lateral cerebral ventricles
Choroid plexus
Midline falx
Cavum septi pellucidi
Cerebellum
Cisterna magna
Upper lip

Comment
A measurement of the nuchal fold may be helpful during a specific age interval to assess the risk of aneuploidy.

ii. Chest
Heard
Four-chamber view
Left ventricular outflow tract
Right ventricular outflow tract

iii. Abdomen
Stomach (presence, size, and situs)
Kidneys
Urinary bladder
Umbilical cord insertion site into the fetal abdomen
Umbilical cord vessel number

iv. Spine
Cervical, thoracic, lumbar, and sacral spine

v. Extremities
Legs and arms

vi. Sex
In multiple gestations and when medically indicated.

VI. Documentation

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient's medical record. Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements.

Reporting should be in accordance with the *AIUM Practice Guideline for Documentation of an Ultrasound Examination*.

VII. Equipment Specifications

These studies should be conducted with real-time scanners, using a transabdominal and/or transvaginal approach. A transducer of appropriate frequency should be used. Real-time sonography is necessary to confirm the presence of fetal life through observation of cardiac activity and active movement.

The choice of transducer frequency is a tradeoff between beam penetration and resolution. With modern equipment, 3–5 MHz abdominal transducers allow sufficient penetration in most patients while providing adequate resolution. A lower-frequency transducer (2–2.25 MHz) may be needed to provide adequate penetration for abdominal imaging in an obese patient. During early pregnancy, a 5 MHz abdominal transducer or a 5–10 MHz or higher vaginal transducer may provide superior resolution while still allowing adequate penetration.

VIII. Fetal Safety

Diagnostic ultrasound studies of the fetus are generally considered safe during pregnancy. This diagnostic procedure should be performed only when there is a valid medical indication,

and the lowest possible ultrasonic exposure setting should be used to gain the necessary diagnostic information under the ARALA (as low as reasonably achievable) principle.

A thermal index for soft tissue (Tis) should be used at earlier than 10 weeks' gestation, and a thermal index for bone (Tib) should be used at 10 weeks' gestation or later when bone ossification is evident. In keeping with the ALARA principle, M-mode imaging should be used instead of spectral Doppler imaging to document embryonic/fetal heart rate.

The promotion, selling, or leasing of ultrasound equipment for making "keepsake fetal videos" is considered by the US Food and Drug Administration to be an unapproved use of a medical device. Use of a diagnostic ultrasound system for these purposes, without a physician's order, may be in violation of state laws or regulations.

IX. Quality Control and Improvement, Safety, Infection Control, and Patient Education

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

Equipment performance monitoring should be in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

X. ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication *Medical Ultrasound Safety*, Second Edition.

References

American Institute of Ultrasound in Medicine. AIUM practice guideline for the performance of obstetric ultrasound examinations. J Ultrasound Med 32:1083–1101, 2013. Doi:10.7863/ultra.32.6.1083.

AIUM Practice Guideline for Ultrasound of the Female Pelvis

I. Introduction

The clinical aspects contained in specific sections of this guideline (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), the American College of Obstetricians and Gynecologists (ACOG), and the Society of Radiologists in Ultrasound (SRU). Recommendations for physician requirements, the written request for the examination, documentation, and quality control vary among these organizations and are addressed by each separately.

This guideline has been developed to assist physicians performing sonographic studies of the female pelvis. Ultrasound examinations of the female pelvis should be performed only when

there is a valid medical reason, and the lowest possible ultrasonic exposure settings should be used to gain the necessary diagnostic information. In some cases, additional or specialized examinations may be necessary. Although it is not possible to detect every abnormality, adherence to the following guideline will maximize the probability of detecting most abnormalities.

II. Indications

Indications for pelvic sonography include but are not limited to the following:

1. Evaluation of pelvic pain
2. Evaluation of pelvic masses
3. Evaluation of endocrine abnormalities, including polycystic ovaries
4. Evaluation of dysmenorrhea (painful menses)
5. Evaluation of menorrhea
6. Evaluation of abnormal bleeding
7. Evaluation of delayed bleeding
8. Follow-up of a previously detected abnormality
9. Evaluation, monitoring, and/or treatment of infertility patients
10. Evaluation in the presence of a limited clinical examination of the pelvis
11. Evaluation for signs or symptoms of pelvic infection
12. Further characterization of a pelvic abnormality noted on another imaging study
13. Evaluation of congenital uterine and lower genital tract anomalies
14. Evaluation of excessive bleeding, pain, or signs of infection after pelvic surgery, delivery, or abortion
15. Localization of an intrauterine contraceptive device
16. Screening for malignancy in high-risk patients
17. Evaluation of incontinence or pelvic organ prolapse
18. Guidance for interventional or surgical procedures.
19. Preoperative and postoperative evaluation of pelvic structures.

III. Qualifications of Personnel

See the AIUM Official Statements including *Training Guidelines for Physicians Who Evaluate and Interpret Diagnostic Ultrasound Examinations* and the AIUM *Standards and Guidelines for the Accreditation of Ultrasound Practices*

IV. Written Request for the Examination

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider or under their direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient's clinical situation and should be consistent with relevant legal and local health care facility requirements.

V. Specifications of the Examination

The following sections detail the examination to be performed for each organ and anatomic region in the female pelvis. All relevant structures should be identified by a transabdominal and/or transvaginal approach. A transrectal or transperineal approach may be useful in patients who are not candidates for introduction of a vaginal probe and in assessing the patient with pelvic organ prolapse. More than 1 approach may be necessary.

A. General Pelvic Preparation

For a complete transabdominal pelvic sonogram, the patient's bladder can be distended if necessary to displace the small bowel from the field of view. Occasionally, overdistention of the bladder may compromise the evaluation. When this occurs, imaging may be repeated after partially bladder emptying. If an abnormality of the urinary bladder is detected, it should be documented and reported.

For a transvaginal sonogram, the urinary bladder is preferably empty. The patient, the sonographer, or the physician may introduce the vaginal transducer, preferably under real-time monitoring. Consideration of having a chaperone present should be in accordance with local policies.

B. Uterus

The vagina and uterus provide anatomic landmarks that can be used as reference points for the other pelvic structures, whether normal or abnormal. In examining the uterus, the following should be evaluated: (1) the uterine size, shape, and orientation; (2) the endometrium; (3) the myometrium; and (4) the cervix. The vagina may be imaged as a landmark for the cervix and lower uterine segment. The overall uterine length is evaluated in the sagittal view from the fundus to the cervix (to the external os, if it can be identified). The depth of the uterus (anteroposterior dimension) is measured in the same sagittal view from its anterior to posterior walls, perpendicular to the length. The maximum width is measured in the transverse or coronal view. If volume measurements of the uterine corpus are performed, the cervical component should be excluded from the uterine length measurement.

Abnormalities of the uterus should be documented. The myometrium and cervix should be evaluated for contour changes, echogenicity, masses, and cysts. Masses that may require follow-up or intervention should be measured in at least 2 dimensions, acknowledging that it is not usually necessary to measure all fibroids. The size and location of clinically relevant fibroids should be documented.

The endometrium should be analyzed for thickness, focal abnormalities, echogenicity, and the presence of fluid or masses in the cavity. The thickest part of the endometrium should be measured perpendicular to its longitudinal plane in the anteroposterior diameter from echogenic to echogenic border (see Figure 1, following page). The adjacent hypoechoic myometrium and fluid in the cavity should be excluded (see Figure 2, following page). Assessment of the endometrium should allow for variations expected with phases of the menstrual cycle and with hormonal supplementation. It should be reported if the endometrium is not adequately seen in its entirety or is poorly defined. Sonohysterography may be a useful adjunct to evaluate the patient with abnormal uterine bleeding or to further clarify an abnormally thickened endometrium. (See the *AIUM Practice Guideline for the Performance of Sonohysterography*.) If the patient has an intrauterine contraceptive device, its location should be documented.

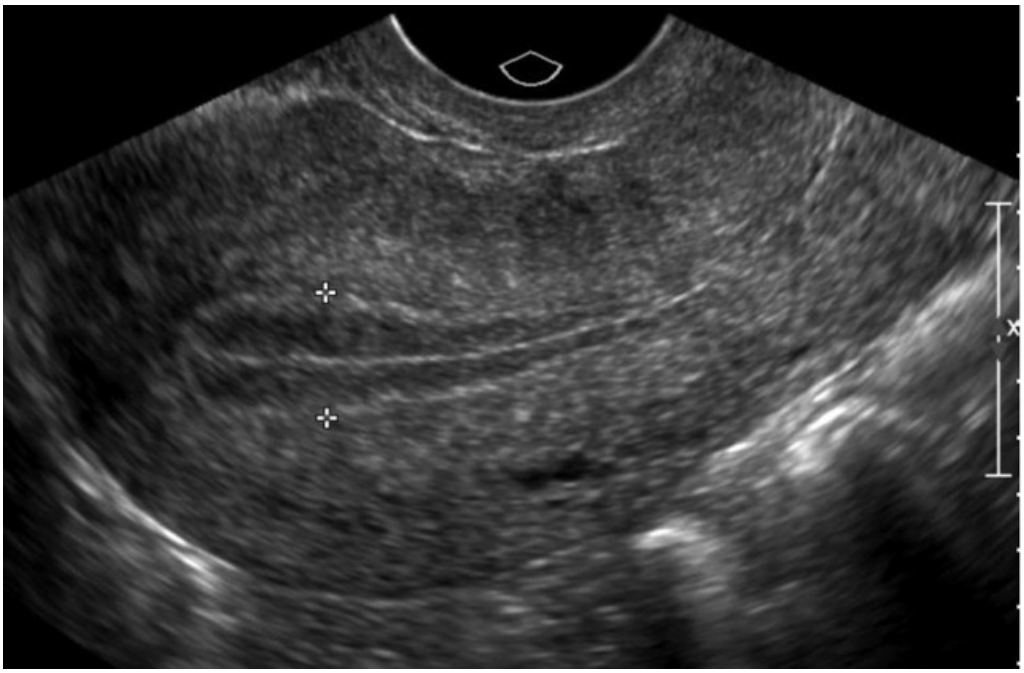


Figure 1: Measurement of endometrial thickness. The endometrial thickness is measured in its thickest portion from echogenic to echogenic border (calipers) perpendicular to the midline longitudinal plane to the uterus.

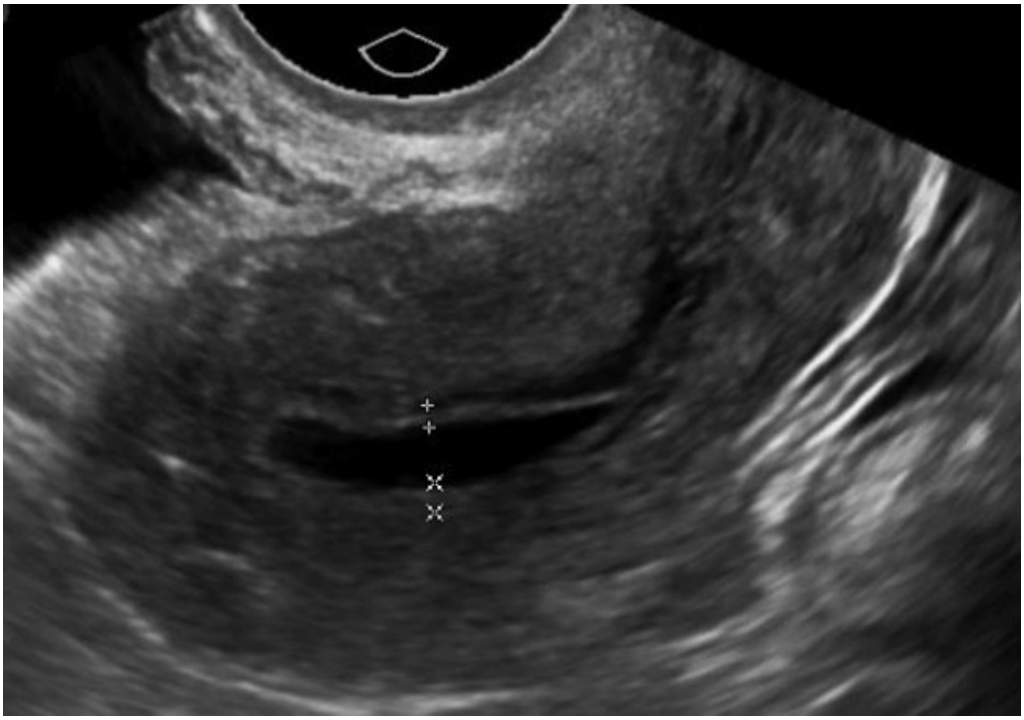


Figure 2: Measurement of endometrium with fluid in the cavity. In the presence of endometrial fluid, measurements of the 2 separate layers of the endometrium (calipers), excluding the fluid, are added to determine the endometrial thickness.

The addition of 3-dimensional to 2-dimensional ultrasound (transabdominal, transvaginal, transperineal, and/or transrectal) can be helpful in many circumstances, including but not limited to evaluating the relationship of masses with the endometrial cavity, identifying uterine congenital anomalies and a thickened and/or heterogeneous endometrium, and evaluating the location of an intrauterine device and the integrity of the pelvic floor.

C. Adnexa Including Ovaries and Fallopian Tubes

When evaluating the adnexa, an attempt should be made to identify the ovaries first, since they can serve as a major point of reference for assessing the presence of adnexal pathology. The ovarian size may be determined by measuring the ovary in 3 dimensions (width, length, and depth), on views obtained in 2 orthogonal planes. Any ovarian abnormalities should be documented.

The ovaries may not be identifiable in some patients. This occurs most frequently before puberty, after menopause, or in the presence of a large leiomyomatous uterus. The adnexal region should be surveyed for abnormalities, particularly masses and dilated tubular structures.

If an adnexal abnormality is noted, its relationship to the ovaries and uterus should be assessed. The size and sonographic characteristics of adnexal masses should be documented.

Spectral, color, and/or power Doppler ultrasound may be useful for evaluating the vascular characteristics of pelvic lesions.

D. Cul-de-sac

The cul-de-sac and bowel posterior to the uterus may not be clearly defined. This area should be evaluated for the presence of free fluid or a mass. If a mass is detected, its size, position, shape, sonographic characteristics, and relationship to the ovaries and uterus should be documented. Differentiation of normal loops of bowel from a mass may be difficult if only a transabdominal examination is performed. A transvaginal examination may be helpful to distinguish a suspected mass from fluid and feces within the normal rectosigmoid colon.

VI. Documentation

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient's medical record. Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements. Reporting should be in accordance with the *AIUM Practice Guideline for Documentation of an Ultrasound Examination*.

VII. Equipment Specifications

A sonographic examination of the female pelvis should be conducted with a real-time scanner, preferably using sector, curved linear, and/or endovaginal transducers. The transducer or scanner should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration.

VIII. Quality Control and Improvement, Safety, Infection Control, and Patient Education

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.* Equipment performance monitoring should be in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

IX. ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA (as low as reasonably achievable) principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication *Medical Ultrasound Safety, Third Edition.*

Acknowledgments

This guideline was developed by the American Institute of Ultrasound in Medicine (AIUM) in collaboration with the American College of Radiology (ACR), the American College of Obstetricians and Gynecologists (ACOG), and the Society of Radiologists in Ultrasound (SRU) according to the process described in the AIUM *Clinical Standards Committee Manual.*

REFERENCES

American Institute of Ultrasound in Medicine. AIUM practice guideline for the performance of ultrasound of the female pelvis. J Ultrasound Med 33:1122–1130, 2014. Doi:10.7863/ultra.33.6.1122.

CURRENT BIBLIOGRAPHY

Callen P: *Ultrasonography in Obstetrics and Gynecology*, 5th edition. St. Louis, Saunders Elsevier, 2008.

Fleisher AC, Toy EC, Lee W, Manning FA, Romero RJ: *Sonography in Obstetrics and Gynecology: Principles and Practices*, 7th edition. McGraw-Hill Professional, 2011.

Gill KA: *Ultrasound in Obstetrics and Gynecology: A Practitioner's Guide*. Pasadena, CA, Davies, 2014.

Hagen-Ansert SL: *Textbook of Diagnostic Ultrasonography*, 7th edition. St. Louis, Mosby Elsevier, 2011.

McGahan JP, Goldberg BB: *Diagnostic Ultrasound: A Logical Approach.* Philadelphia, Lippincott Williams & Wilkins, 1998.

Moore KL, Persaud TVN: *The Developing Human: Clinically Oriented Embryology*, 9th edition. St. Louis, Saunders Elsevier, 2013.

Nyberg DA, McGahan JP, Pretourius DH, et al: *Diagnostic Imaging of Fetal Anomalies*. Philadelphia, Lippincott Williams & Wilkins, 2003.

Rumack CM, Wilson SR, Charboneau W, Levine D: *Diagnostic Ultrasound*, 4th edition. St. Louis, Mosby Elsevier, 2011.

Stephenson SR: *Diagnostic Medical Sonography: Obstetrics and Gynecology*, 3rd edition. Philadelphia, Lippincott Williams & Wilkins, 2012.