The American College of Radiology, with more than 30,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. It should be recognized, therefore, that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

The clinical aspects of this guideline (Specifications of the Examination and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR), the American Institute of Ultrasound in Medicine (AIUM), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for physician qualifications, 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 obstetrical sonographic studies. Fetal ultra-
sound 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 re-evaluation of fetal size or interval growth or to re-evaluate 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

B. Standard Second or Third Trimester Examination

A standard examination is performed during the second and third trimesters of pregnancy. It includes an evaluation of fetal presentation, amniotic fluid volume, cardiac activity, placental position, fetal biometry, and an anatomic survey. If technically feasible, the maternal cervix and adnexae are also examined.

C. Limited Examination

A limited examination is performed when a specific question requires investigation. In an emergency, for example, one could perform a limited examination to evaluate fetal heart activity in a bleeding patient. This evaluation would also be appropriate for verifying fetal presentation in a laboring patient, but 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, biophysical profile, fetal echocardiogram, or additional biometric studies.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the ACR Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examinations.

IV. SPECIFICATIONS OF THE EXAMINATION

A. First-Trimester Ultrasound Examination

1. Indications

A sonographic examination can be of benefit in many circumstances in the first trimester of pregnancy, including, but not limited to, the following indications:

a. To confirm the presence of an intrauterine pregnancy.
b. To evaluate a suspected ectopic pregnancy.
c. To define the cause of vaginal bleeding.
d. To evaluate pelvic pain.
e. To estimate gestational (menstrual\(^2\)) age.
f. To diagnose or evaluate multiple gestations.
g. To confirm cardiac activity.
h. As an adjunct to chorionic villus sampling, embryo transfer, and localization and removal of an intrauterine device (IUD).
i. To evaluate maternal pelvic masses and/or uterine abnormalities.
j. To evaluate 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

Overall 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 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

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\(^{1}\)The consensus of the committee was that the use of the terms “ultrasound” or “sonography” is at the discretion of each organization.

\(^{2}\)For the purpose of this document, the terms “gestational” and “menstrual” age are considered equivalent.
evaluated for the presence or absence of a yolk sac or embryo, and the crown-rump length should be recorded, when possible.

Comment
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 should 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 pseudo-gestational 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 5 mm or greater in length. If an embryo less than 5 mm in length is seen without cardiac activity, an additional scan at a later time may be needed to document cardiac activity.

c. Fetal number should be reported.

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

d. Evaluation of the uterus, adnexal structures, and cul-de-sac should be performed.

Comment
The presence, location, and size of leiomyomata and adnexal masses should be recorded. The cul-de-sac should be scanned for the presence or absence of fluid.

B. Second and Third Trimester Ultrasound Examination

1. Indications

Ultrasound can be of benefit in many situations in the second and third trimester, including, but not limited to, the following circumstances: (adapted from NIH publication 84-667, 1984)

a. Estimation of gestational (menstrual) age.

b. Evaluation of fetal growth.

c. Vaginal bleeding.

d. Abdominal/pelvic pain.

e. Incompetent cervix.

f. Determination of fetal presentation.

g. Suspected multiple gestation.

h. Adjunct to amniocentesis.

i. Significant discrepancy between uterine size and clinical dates.

j. Pelvic mass.

k. Suspected hydatidiform mole.

l. Adjunct to cervical cerclage placement.

m. Suspected ectopic pregnancy.

n. Suspected fetal death.

o. Suspected uterine abnormality.


q. Suspected amniotic fluid abnormalities.

r. Suspected placental abruption.

s. Adjunct to external cephalic version.

t. Premature rupture of membranes and/or premature labor.

u. Abnormal biochemical markers.

v. Follow-up evaluation of a fetal anomaly.

w. Follow-up evaluation of placental location for suspected placenta previa.

x. History of previous congenital anomaly.

y. Evaluation of fetal condition in late registrants for prenatal care.

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, number, and presentation should be reported.

Comment
Abnormal heart rate and/or rhythm should be reported.

Multiple pregnancies require the documentation of additional information: chorionicity, amnionicity, comparison of fetal sizes, estimation of amniotic fluid volume (increased, decreased, or normal) on each side of the membrane, and fetal genitalia (when visualized).

b. A qualitative or semi-quantitative estimate of amniotic fluid volume should be reported.

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

c. The placental location, appearance, and relationship to the internal cervical os should be recorded. The umbilical cord should be imaged, and the number of vessels in the cord should be evaluated when 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 if the patient complains of regular uterine contractions.

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 fetal growth abnormality, intrauterine growth restriction, or macrosomia.

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 femur shaft is most accurately measured with the beam of insonation being perpendicular to the shaft, excluding the distal femoral epiphysis.

iv. Abdominal circumference 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 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, 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, interval measurement changes should also be evaluated for growth. Scans for growth evaluation can typically be performed at least 3 weeks apart. A shorter scan interval may result in confusion as to whether anatomic 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 percent. 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 and adnexal structures should be performed.

Comment
This will allow recognition of incidental findings of potential clinical significance. The presence, location, and size of leiomyomata and adnexal masses should be recorded. It is frequently not 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 adequately be 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 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 essential 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 and neck
   Cerebellum
   Choroid plexus
   Cisterna magna
   Lateral cerebral ventricles
   Midline falx
   Cavum septi pellucidi

ii. Chest
   The basic cardiac examination includes a four-chamber view of the fetal heart.

If technically feasible, an extended basic cardiac examination can also be attempted to evaluate both outflow tracts.

iii. Abdomen
   Stomach (presence, size, and situs)
   Kidneys
   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 – presence or absence

vi. Gender
   Medically indicated in low-risk pregnancies only for evaluation of multiple gestations.

V. DOCUMENTATION

Adequate documentation of the study is essential for high-quality patient care. This should include a permanent record of the sonographic images, incorporating whenever possible the measurement parameters and anatomical findings proposed in this document. Images should be appropriately labeled with the examination date, patient identification, and, if appropriate, image orientation. A written report of the sonographic findings should be included in the patient’s medical record. Reporting should be in accordance with the ACR Practice Guideline for Communication: Diagnostic Radiology. Retention of the sonographic examination should be consistent with both clinical need and relevant legal and local healthcare facility requirements.

VI. 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.

Comment
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 trade-off 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 greater vaginal transducer may provide superior resolution while still allowing adequate penetration.

VII. FETAL SAFETY

Diagnostic ultrasound studies of the fetus are generally considered to be 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 as low as reasonably achievable (ALARA) principle.

The promotion, selling, or leasing of ultrasound equipment for making “keepsake fetal videos” is considered by the U.S. Food and Drug Administration to be an unapproved use of a medical device (9). Use of a diagnostic ultrasound system for these purposes, without a physician’s order, may be in violation of state laws or regulations.

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Equipment performance monitoring should be in accordance with the ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment.

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