The association for medical ultrasound
aium®
AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE

Standard Presentation and Labeling of Ultrasound Images

SIXTH EDITION

Table of Contents

Glossary of Terms

2D-SWE Two-Dimensional Shear Wave Elastography, a noninvasive method to quantitatively measure tissue stiffness, displayed as a 2-dimensional color map.

CEUS Contrast-Enhanced Ultrasound, an imaging method utilizing the intravenous (and sometimes intra-cavitary) administration of a microbubble-based ultrasound contrast agent (UCA).

DICOM Digital Imaging and Communications in Medicine, the standard for the communication and management of medical imaging information and related data.

HIPAA Health Insurance Portability and Accountability Act of 1996, provides the ability to and rules for transferring health care information, and how to handle confidential protected health information.

IQR/M Interquartile Range divided by Median, a mathematical representation of measurement variability often used for reporting quality of shear wave elastography (SWE) measurements.

kPa Kilopascals, generally referring to a unit of pressure, but in this context, it is used as the unit quantifying the elastic modulus (ie, the stiffness) of "soft" tissue.

PACS Picture Archival and Communication System, medical imaging technology that provides economical storage and convenient access to images from multiple modalities.

PHI Protected Health Information, certain identifiable data elements specific to a particular patient, as defined by the HIPAA Privacy Rule.

pSWE Point Shear Wave Elastography, a noninvasive method to quantitatively measure tissue stiffness within a small ROI.

RIS Radiology Information System, a component of the electronic medical record involved in the ordering, protocolling, scheduling, reporting, and billing of imaging examinations.

ROI Region Of Interest, a specific area within an image, usually delineated by a line box or circle marker.

SWE Shear Wave Elastography, a noninvasive method to quantitatively measure tissue stiffness using shear waves induced by acoustic radiation force or mechanical vibration.

TSC AIUM Technical Standards Committee

UCA Ultrasound Contrast Agent, typically a suspension of small particles of fluorocarbon gas encased in a lipid or protein shell, each measuring 2–8 micrometers in diameter.

Preface

The 6th edition of the AIUM Standard Presentation and Labeling of Ultrasound Images builds upon the previous 5 editions. Since its 1st edition, in 1978, this standard has been available to sonographers and practitioners of ultrasound as a reference for the presentation and labeling of ultrasound images, and for improving communication between sonographer and downstream image interpreters. Goals for the adoption of uniform presentation and labeling include less confusion in interpreting sonograms, more efficient examination flow, more accurate diagnostic interpretation, and more reliable communication.

The field of diagnostic ultrasound has evolved significantly since its introduction. Today, there is an ever-increasing constellation of diagnostic procedures. Standardization of presentation and labeling of images continues to be an indispensable component of the practice of diagnostic ultrasound. Thus, the AIUM Technical Standards Committee (TSC) periodically reviews the Standard Presentation and Labeling of Ultrasound Images recommendations to address new and emerging diagnostic ultrasound techniques. This new edition has been streamlined to remove redundant information and present the information in a concise and consistent manner. All illustrations have been updated to a more modern, clear design. New in this edition is expanded information on musculoskeletal ultrasound and new sections on contrast-enhanced ultrasound and elastography, both of which have rapidly gained clinical interest. Some new procedures may necessitate new requirements for standardization of positioning and labeling, for which the TSC welcomes suggestions from the AIUM members for improving this current edition. Please forward your comments and suggestions to the Chair of the AIUM TSC.

We wish to acknowledge the many previous authors of this standards document. Prior authors have made significant improvements with each successive edition, onto which this edition's changes have been added. As with the previous editions, we hope this standards document will be helpful for sonographers and practitioners of ultrasound in their daily clinical practice.

The Current TSC Subcommittee:

- Tobias Kummer, MD, RDMS, Chair
- David Fetzer, PhD
- Pamela Foy, MS, RDMS
- Brian Garra, MD, PhD
- Bruce Gilbert, MD, PhD
- Kathleen Sagash, RDMS, RMSKS

Acknowledgments

The original standard, the 1st edition, published in 1976, was developed over a period of several years by a subcommittee of the AIUM Standards Committee under the Chairmanship of Paul L. Carson, PhD. It was adopted as an interim standard by the AIUM on August 3, 1976. Other members of the subcommittee were W.J. Bean, MD; A.R. Freimanis, MD; J. Gesner; and P. Goovars.

The 2nd edition, published in 1986, was prepared by the then-current members of the Standard Presentation and Labeling Subcommittee under the chairmanship of David P. Weinstein, MD. The other members of this subcommittee were Paul L. Carson, PhD, Vice Chair; Kenneth R. Gottesfield, MD; Irwin Kuperberg, RDMS; G. Leland Melson, MD; and Gary A. Thieme, MD. In addition, the following AIUM members assisted in the preparation of this standard: Beresford W. Buttery, MBBS; Catherine M. Cole-Beuglet, MD; Arthur C. Fleischer, MD; Rudy E. Sabbagha, MD; and Barbara J. Weinstein, MD.

In the 3rd edition, published in 1995, an endocavitary section was developed jointly by the AIUM Technical Standards Committee and the Ultrasound Practice Committee, headed by Brian S. Garra, MD, PhD.

The 4th edition, published in 1998, was updated by the following members of a subcommittee of the AIUM Technical Standards Committee under the chairmanship of Karen Ophir, BS, RDMS: Sharon Schechter, BS, RDMS, RVT; Terry J. DuBose, MS, RDMS; and Larry D. Waldroup, BS, RDMS. In addition, the following AIUM members assisted in the preparation of the 1998 standard: Chad Hallin, RDMS, RVT; Jon W. Meilstrup, MD; Douglas (Rusty) Brown, MD; Wesley Lee, MD; Jonathan Ophir, PhD; Henrietta Kotlus Rosenberg, MD; and Luis A. Izquierdo, MD, RDMS.

The 5th edition, published in 2013, was updated by the following subcommittee of the AIUM TSC under the chairmanship of Marvin C. Ziskin, MD: Jennifer Bagley, MPH, RDMS, RVT; Paul L. Carson, PhD; and Jean Lea Spitz, MPH, RDMS.

A grateful acknowledgement goes to Victoria Alderman, MA, RDMS, who volunteered her time to prepare more than 60 original illustrations as well as Scott A. Weldon, MA, CMI, FAMI, who has beautifully updated all illustrations for the current edition.

Introduction

In 1976, the American Institute of Ultrasound in Medicine adopted a standard on presentation and labeling of ultrasound images (sonograms). At that time, static B-mode images were acquired with an articulated arm scanner allowing precise and unique labeling of image planes. The 1976 standard was designed for systems with fixed geometry and often automatic scan labeling.[1,2]

However, the 1976 standard was not widely employed clinically due in part to its complexity and requirement of mathematical notation. In addition, the development and rapid adoption of real-time instrumentation allowed for unconstrained transducer placement, and lacked automatic scan labeling, making the 1976 labeling system difficult to use.

The 1986 edition was redesigned to be a more clinically oriented presentation and labeling system, based on a transducer frame of reference. The nomenclature was chosen based on survey results from clinical ultrasound laboratories, and allowed for precise qualitative labeling of image planes.

In 1995, a section was added on the proper labeling and presentation of endocavitary images for endovaginal and endorectal scanning. This addition was developed jointly by the AIUM Technical Standards Committee and the AIUM Ultrasound Practice Committee.

The 1998 edition provided many new improvements including updated illustrations. This edition included the previously employed transducer-based system of the 1986 standard, as well as adopted methods of anatomic labeling. With free-hand scanning techniques, quantitative labeling was not possible, and images from one sonographer to another and one patient to another were difficult to reproduce. Standard anatomic labeling was then adopted and has become the primary method in clinical use today. In addition, the endocavitary information has been incorporated into the body of this edition.

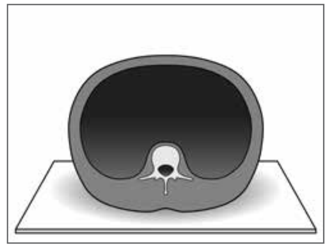
The 2013 edition was organized into 4 sections covering patient position, standard planes, image presentation, and image labeling (including recommended abbreviations), reflecting common practices in the United States. Some practices in Europe and other parts of the world may differ.

This standard is concerned with parts of the body other than the eye, blood vessels, breast, adult brain, and heart, which have their own labeling systems. Diagrams in this document are for illustrative purposes and are not drawn to scale. As in previous editions, this updated standard attempts to simplify presentation and labeling for universal understanding from clinic to clinic, patient to patient, and sonographer to sonographer.

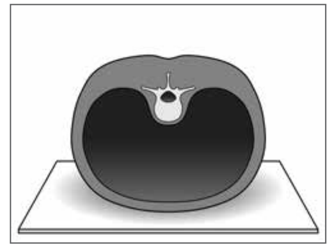
Patient Position

RECUMBENT

The patient position is named without regard to the anatomic area being scanned since several areas can be examined with the patient in any single position. Other positions not included in this document should be described on the image. Most patient positions in this section are presented as viewed from the patient's feet, unless otherwise specified.



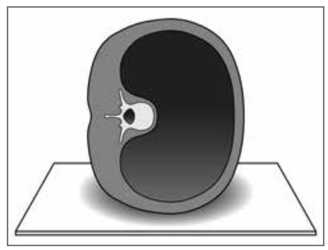
Supine



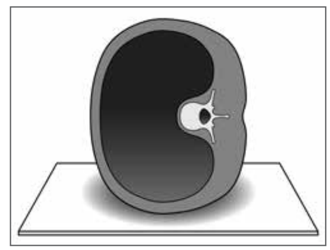
Prone

Lateral Positions

The lateral recumbent positions are named according to the body side nearest the table.



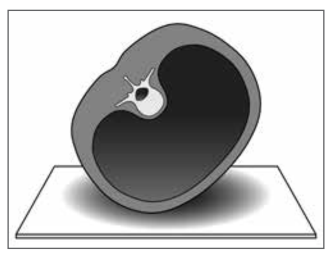
Left Lateral Decubitus



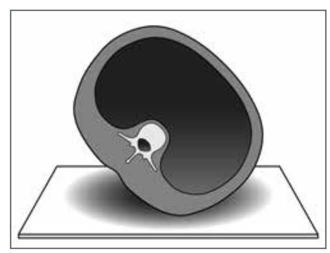
Right Lateral Decubitus

Oblique Positions

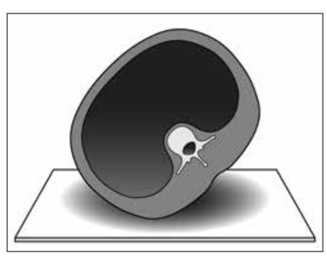
The oblique recumbent, or decubitus positions are named according to the body side nearest the table.



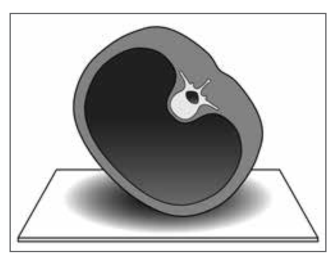
Left Anterior Oblique



Left Posterior Oblique



Right Posterior Oblique

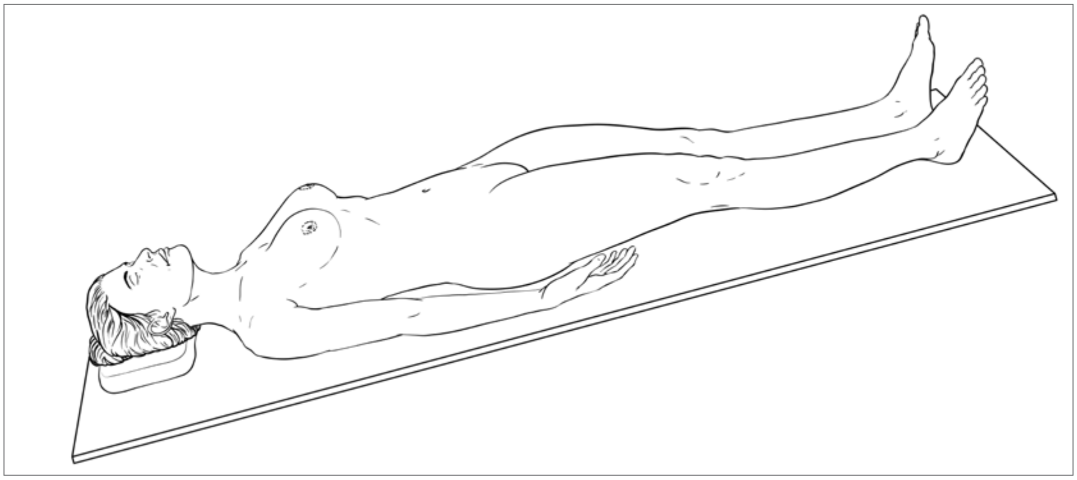


Right Anterior Oblique

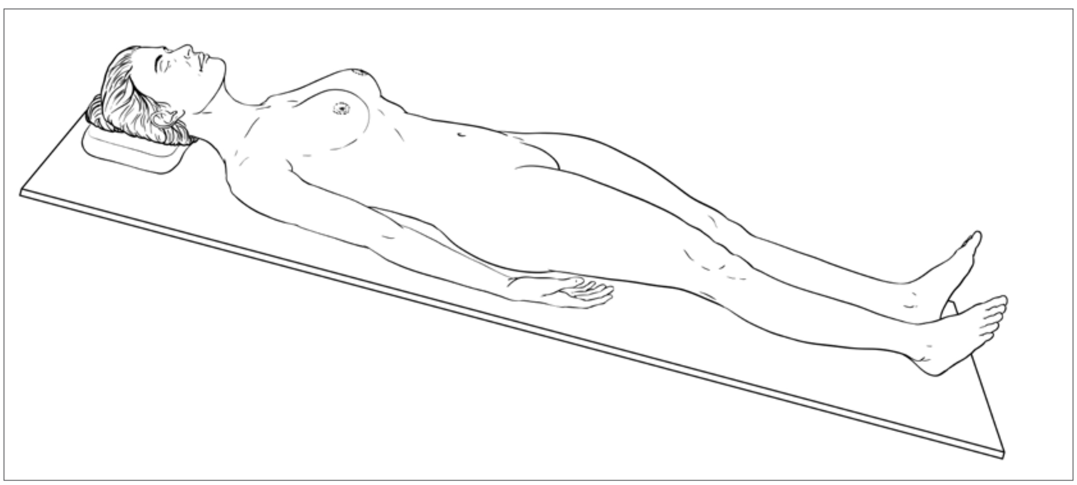
Semi-Recumbent

The semi-recumbent (inclined) positions are named according to the lower body part, either head down (Trendelenburg) or feet down (reverse Trendelenburg).

Head Down (Trendelenburg)



Feet Down (Reverse Trendelenburg or Fowler)



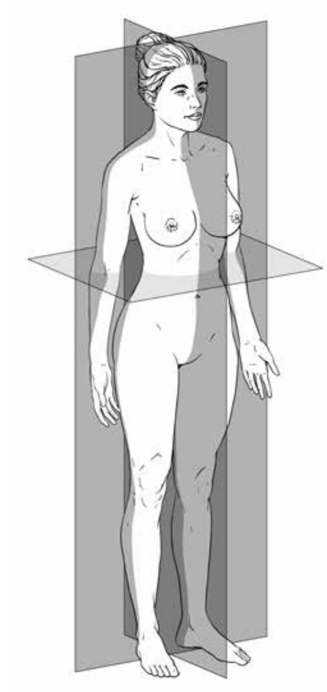
Erect (Upright)

The sitting or standing position may be noted on the image as erect or upright.

Standard Planes

In order to understand image presentation, standard planes either through the body or organ of interest are needed.

Reference to the plane as it passes through the appropriate axis of the body or organ is labeled on the image. As a general rule for body planes, the transducer indicator is directed cephalad for the longitudinal plane and to the patient's right for the axial plane, assuming standard anatomical presentation as if the patient was standing up straight.



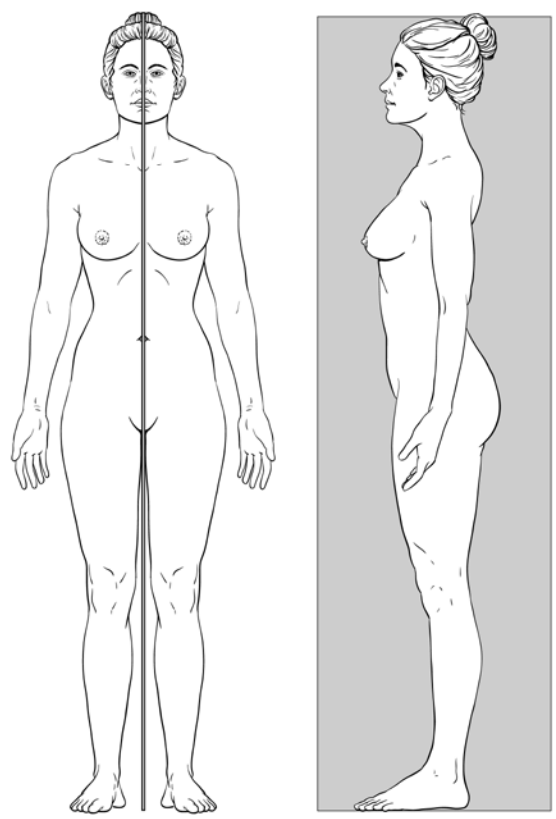
Standard body planes

Of the three standard planes discussed in this section, two follow the long axis of the body. The sagittal plane cuts through the body from anterior to posterior, separating the body in half, right and left. The coronal plane cuts through the body from one side to the other, separating the body into ventral and dorsal. The third plane is the axial plane. It follows the short axis of the body and separates the body into cranial and caudal parts. The axial plane shows cross-sectional anatomy in a presentation similar to that which computed tomography (CT) displays.

1. **Sagittal (SAG) Plane**

   The sagittal plane is defined as the anterior to posterior plane parallel to the long axis of the body and passing through the midline. Anterior to posterior planes not passing through the center of the body, parallel to midline are parasagittal planes.[3]

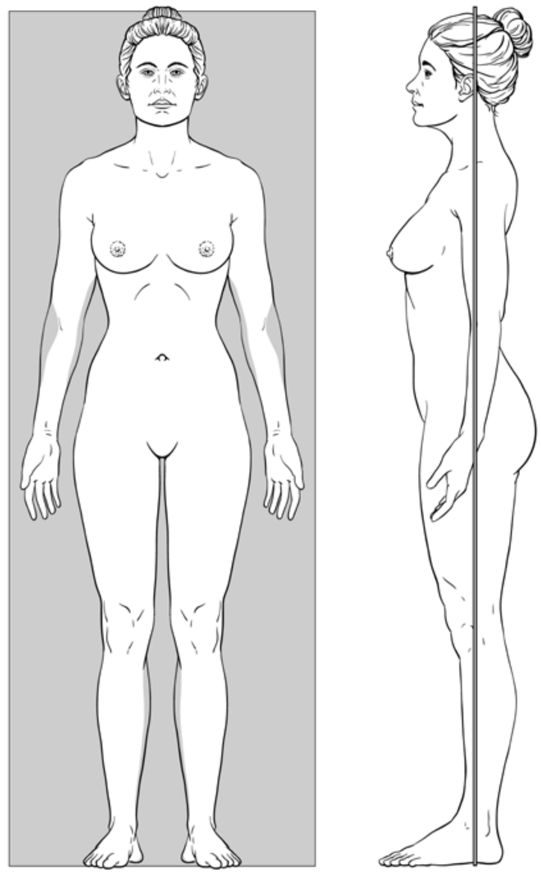
   The midline sagittal plane divides the body into right and left halves, so using right sagittal or left sagittal may be more explicit. In practical application, all sagittal and parasagittal planes may be referred to as sagittal. Sagittal and parasagittal were more appropriate when static scanning was in common use.



2. **Coronal (COR) Plane**

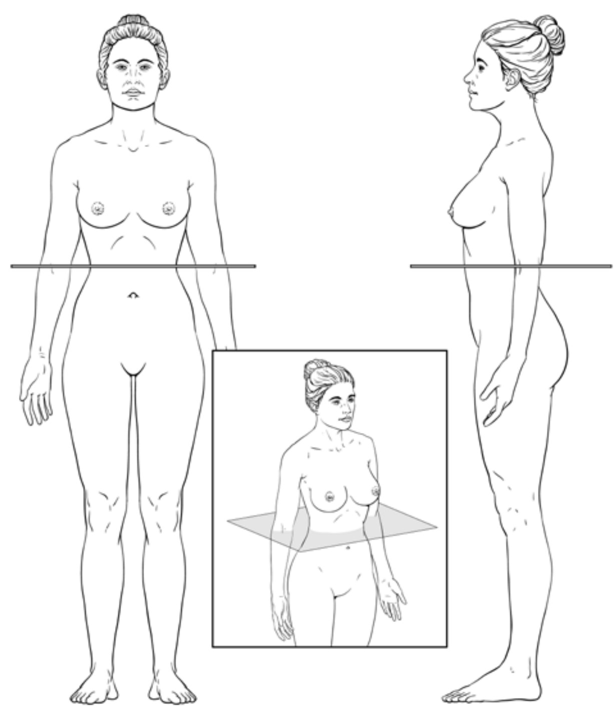
   The coronal plane is defined as any cephalic to caudal plane perpendicular to the sagittal plane and parallel to the long axis of the body. The coronal plane extends from left to right through the body[2] or right to left (ie, from one side to the other). The coronal plane divides the body into anterior and posterior regions.

   - Modified coronal plane is the terminology used when evaluating the short axis of the pelvic organs when the endocavitary transducer is midline.



3. **Axial (AX) Plane**

   The axial plane is defined as any anterior to posterior plane perpendicular to the long axis of the body or limb. This plane extends from left to right through the body[2] or right to left (ie, from one side to the other). The axial plane divides the body into cephalic and caudal regions.



STANDARD PLANES CONTINUED

Standard organ planes

Imaged structures are often evaluated in short and long axis relative to the target instead of transducer position relative to planes of the body. It is important to remember that targets of imaging may not be in a predictable plane and/or they may change direction.

Longitudinal (LONG) Plane
Longitudinal is a more generic term used to indicate planes parallel to the long axis of an organ or area of interest and that may not be aligned with one of the long axes of the body. An example may be the kidneys, which may not be perfectly orientated cranio-caudally relative to the body.

Transverse (TRV) Plane
The transverse plane traverses through the short axis of an organ or area of interest and is in general perpendicular to the long axis.

Image Presentation on the Monitor

In most cases the transducer at the scanning surface is assigned to the top of the monitor with endorectal being the exception (see Endocavitary section). The assignment of the left side of the monitor follows the guidelines below:

1. The transducer's position on the scanning surface of the body.
2. The direction of the transducer indicator.

These assignments are independent of the patient position. In order to better understand the guidelines, remember that the transducer at the scanning surface is at the top of the monitor and that the patient is facing in the manner described below. The assignment of the left side of the image on the monitor should then be apparent.

Image presentation on the monitor will be demonstrated in terms of transducer position on the body (or organ/area of interest), ie, longitudinal (includes sagittal and coronal) and transverse. The orientation of the transducer is described relative to the transducer indicator. Transducers are usually manufactured with a notch, groove, light, or other marking for this purpose. The monitor display has a corresponding indicator, usually a dot, arrow, or letter of the manufacturer's insignia.

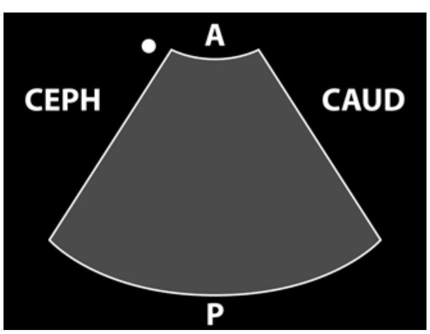
The following abbreviations are used:

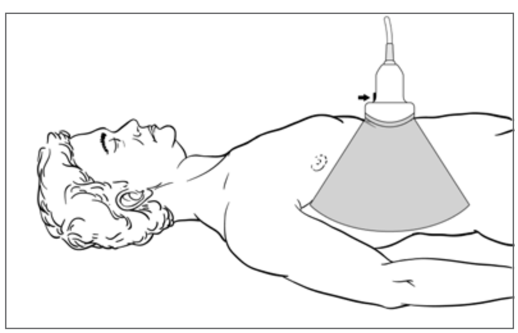
- A—anterior, P—posterior,
- RT—right, LT—left,
- CEPH—cephalic, CAUD—caudal

Special terminology for cranial planes (eg, neonatal brain examinations) and endocavitary examinations (endovaginal and endorectal) are discussed separately at the end of this section.

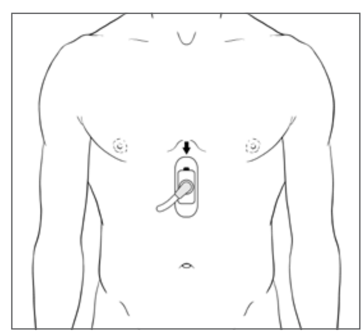
LONGITUDINAL: SAGITTAL PLANE/ANTERIOR

For image presentation on the monitor for the sagittal plane when imaging from the ANTERIOR side of the body, the indicator is always directed cephalad regardless of patient position. Thus, supine, decubitus, and oblique patient positions have the same image presentation as shown below.





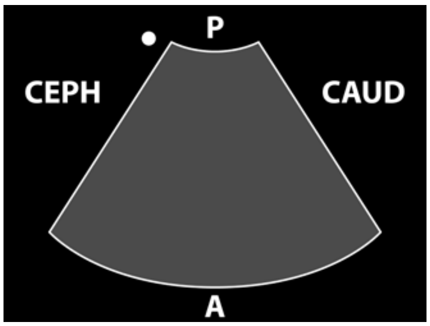
Supine Patient Position

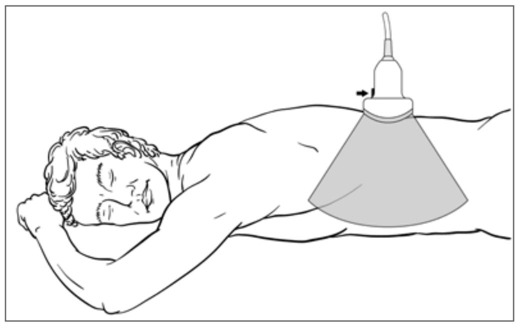


Anterior Transducer

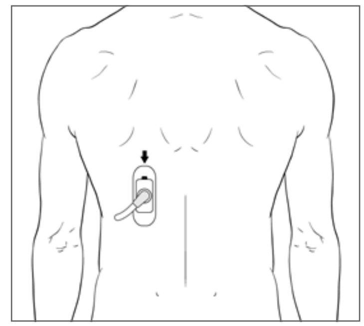
LONGITUDINAL: SAGITTAL PLANES/POSTERIOR

For image presentation on the monitor for the sagittal plane when imaging from the POSTERIOR side of the body, the indicator is, again, always directed cephalad regardless of patient position. Thus, prone, decubitus, and oblique patient positions have the same image presentation as shown below.





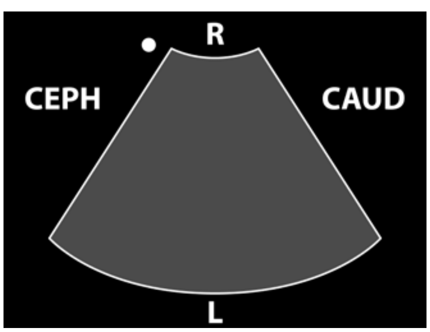
Prone Patient Position

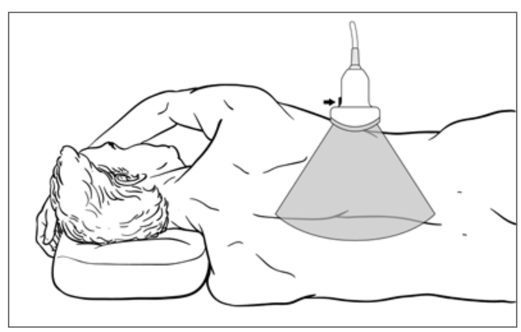


Posterior Transducer

LONGITUDINAL: CORONAL PLANES/RIGHT SIDE

For image presentation on the monitor for the coronal plane when imaging from the RIGHT side of the body, the indicator is always directed cephalad regardless of patient position. Thus, left decubitus and oblique patient positions have the same image presentation as shown below.

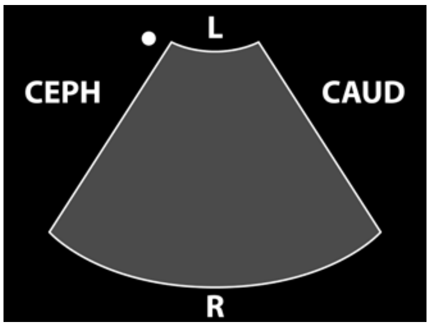


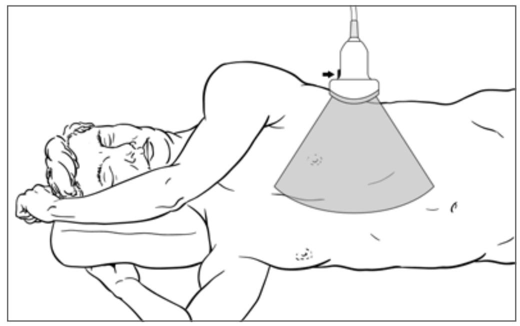


Left Lateral Decubitus Patient Position

LONGITUDINAL: CORONAL PLANES/LEFT SIDE

Likewise, for image presentation on the monitor for the coronal plane when imaging from the LEFT side of the body, the indicator is directed cephalad regardless of patient position. Thus, right lateral decubitus and oblique patient positions have the same image presentation as shown below.

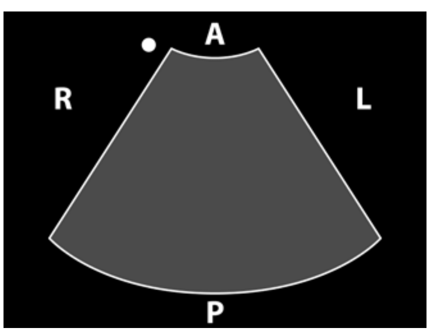


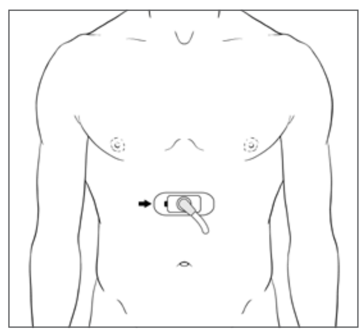


Right Lateral Decubitus Patient Position

AXIAL PLANES

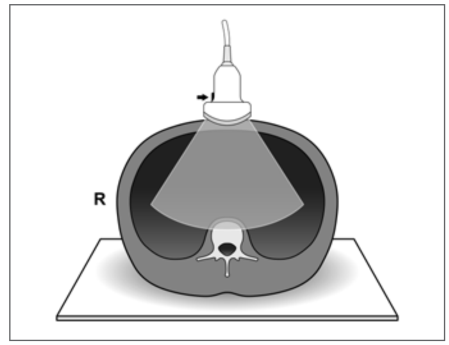
Axial images are presented as viewed from the patient's feet.



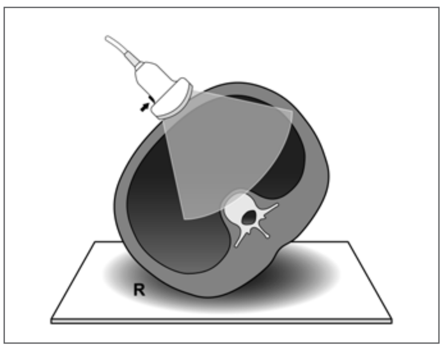


ANTERIOR

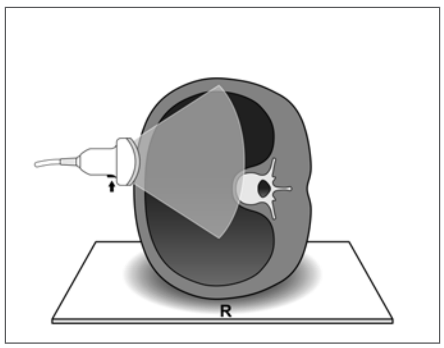
For image presentation on the monitor for the axial plane when imaging from the ANTERIOR side of the body, the indicator is directed to the RIGHT side of the body regardless of patient position. Thus, supine, decubitus, and oblique patient positions have the same image presentation.



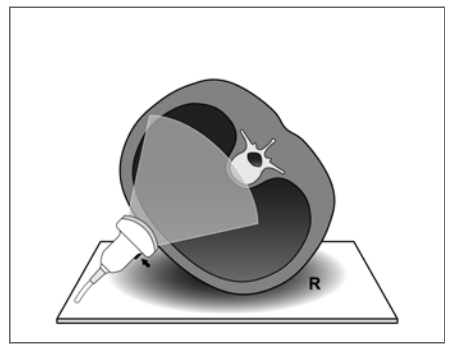
Supine



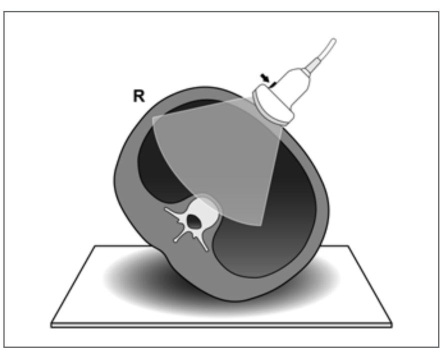
RPO



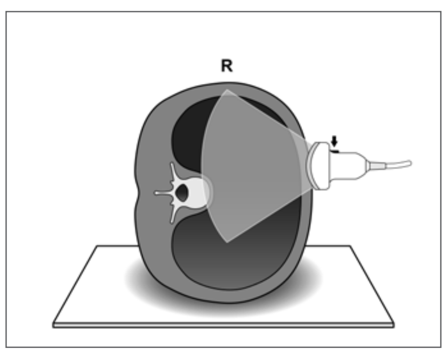
RLD



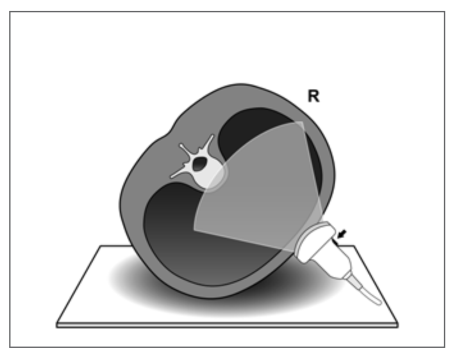
RAO



LPO



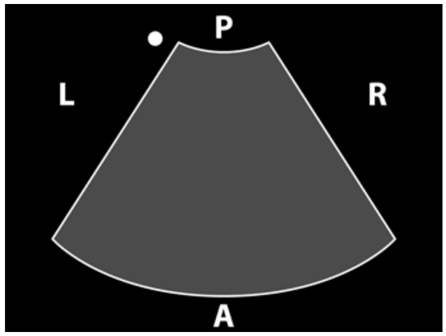
LLD

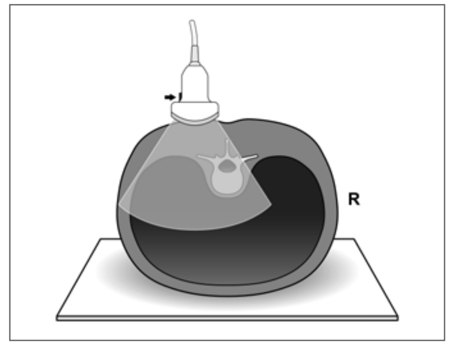


LAO

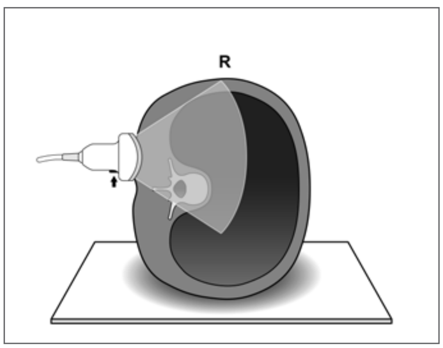
POSTERIOR

For image presentation on the monitor for the axial plane when imaging from the POSTERIOR side of the body, the indicator is directed to the LEFT side of the body regardless of patient position. Thus, prone, decubitus, and oblique patient positions have the same image presentation.

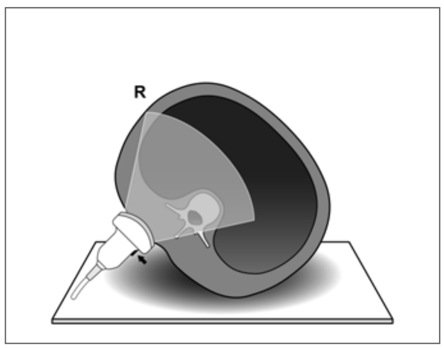




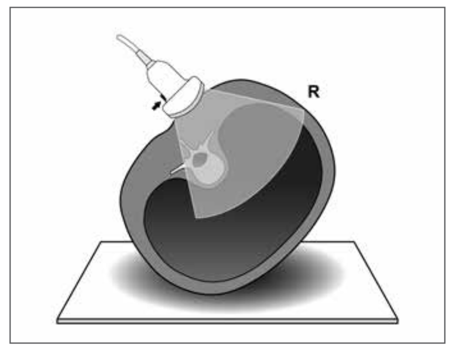
Prone



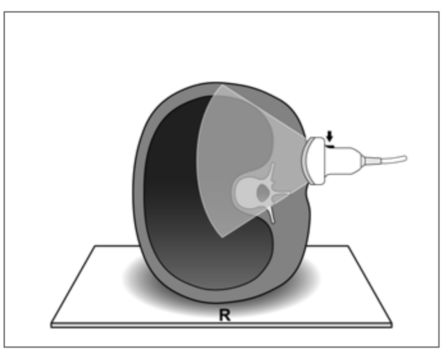
LLD



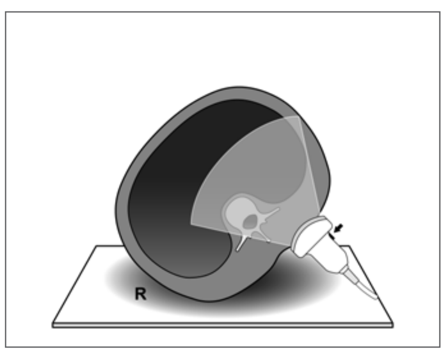
LPO



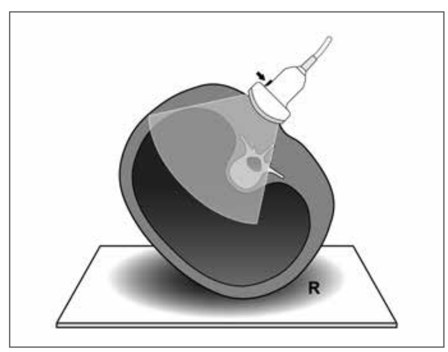
LAO



RLD



RPO

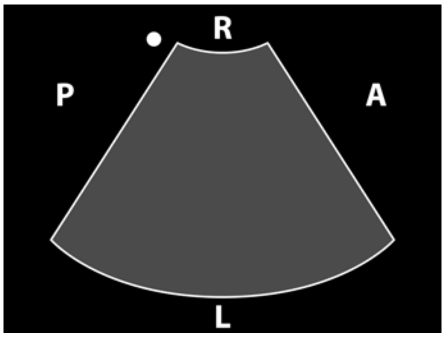


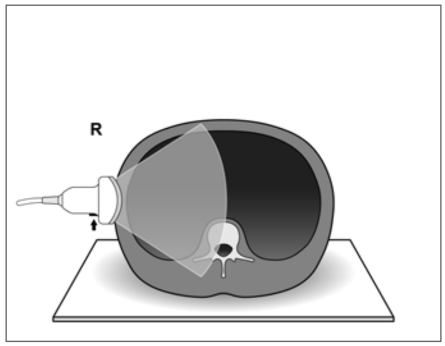
RAO

IMAGE PRESENTATION ON THE MONITOR CONTINUED

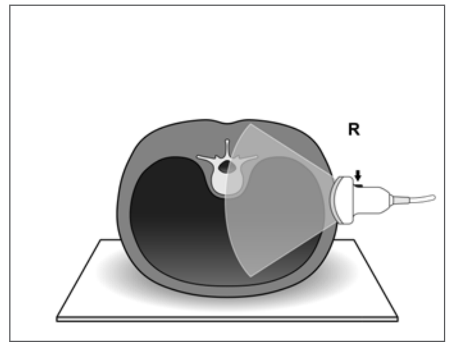
Right Side

For image presentation on the monitor for the axial plane when imaging from the RIGHT side of the body, the indicator is directed to the POSTERIOR side of the body regardless of patient position. Thus, supine, prone, left decubitus, and oblique patient positions have the same image presentation.

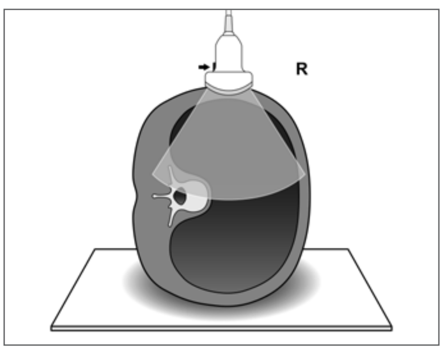




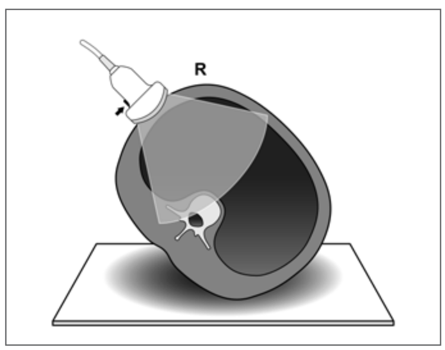
Supine



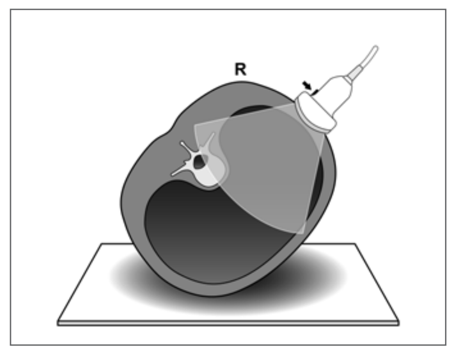
Prone



LLD



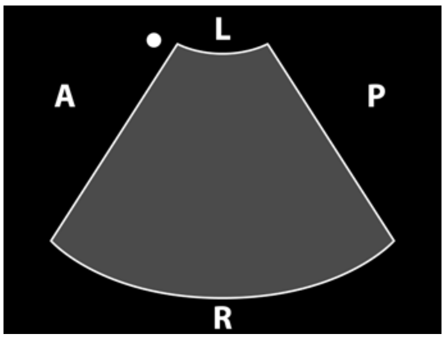
LPO

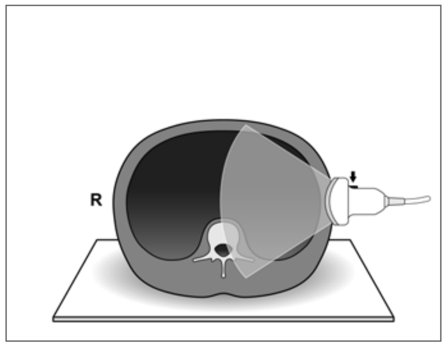


LAO

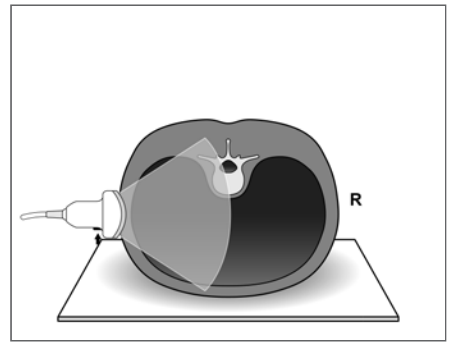
Left Side

For image presentation on the monitor for the axial plane when imaging from the LEFT side of the body, the indicator is directed to the ANTERIOR side of the body regardless of patient position. Thus, supine, prone, right decubitus, and oblique patient positions have the same image presentation.

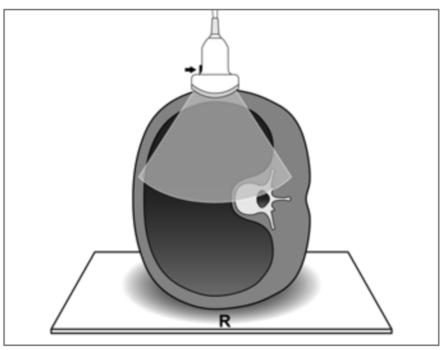




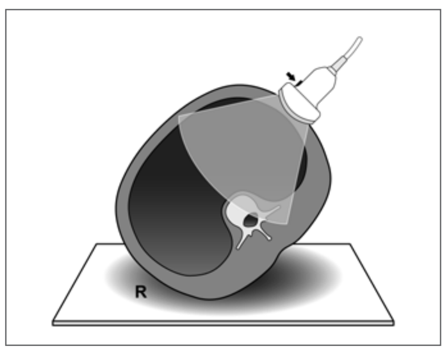
Supine



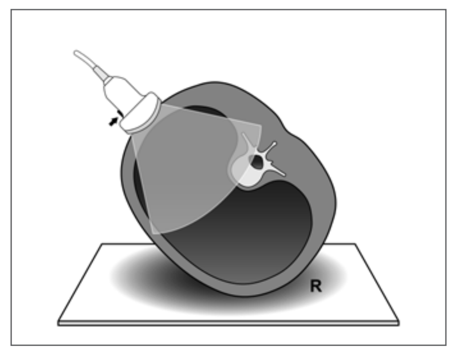
Prone



RLD



RPO



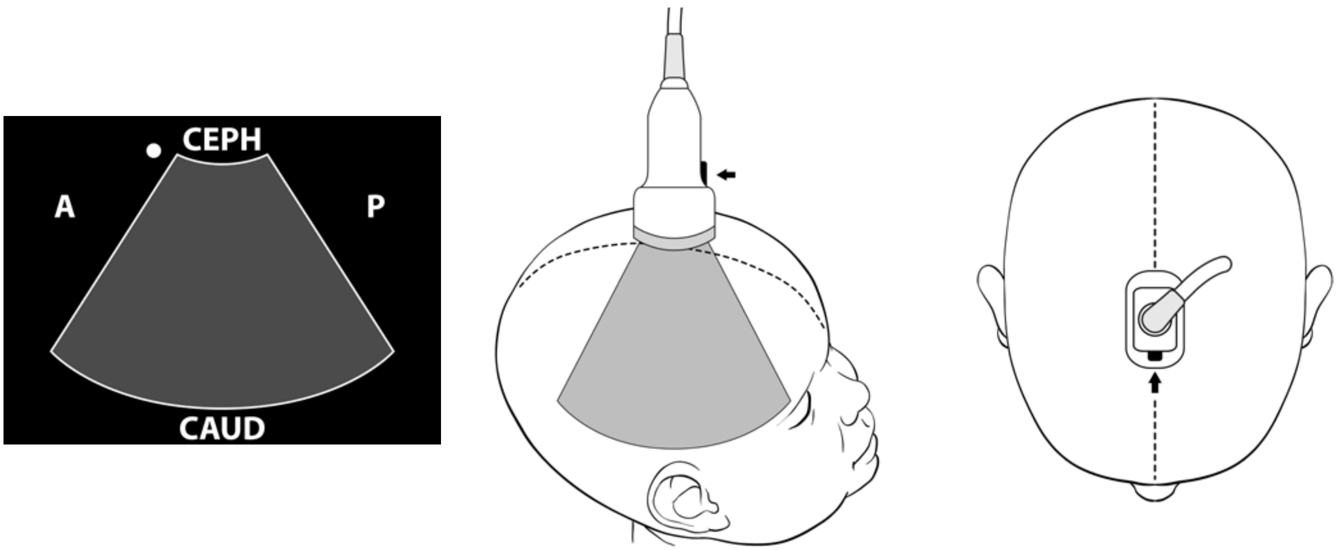
RAO

CRANIAL PLANES

The sagittal and coronal planes from the anterior fontanelle are the most commonly used planes for neonatal brain examinations. Other planes such as axial (transverse) from the sphenoidal fontanelle may also be used.

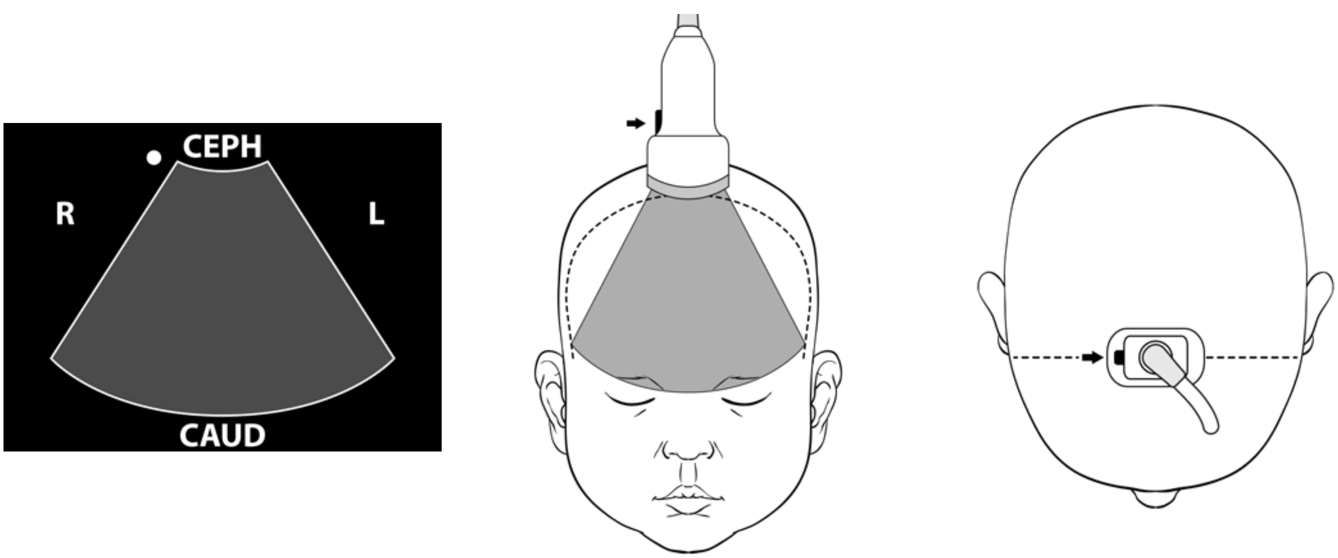
Sagittal

Image presentation on the monitor for the sagittal plane with the transducer on the open anterior fontanelle and the indicator pointing toward the forehead always indicates the ANTERIOR side of the brain and cranial vault.



Coronal

Image presentation on the monitor for the coronal plane with the transducer on the open anterior fontanelle with the indicator pointing toward the patient's right ear always indicates the RIGHT side of the brain and the cranial vault.

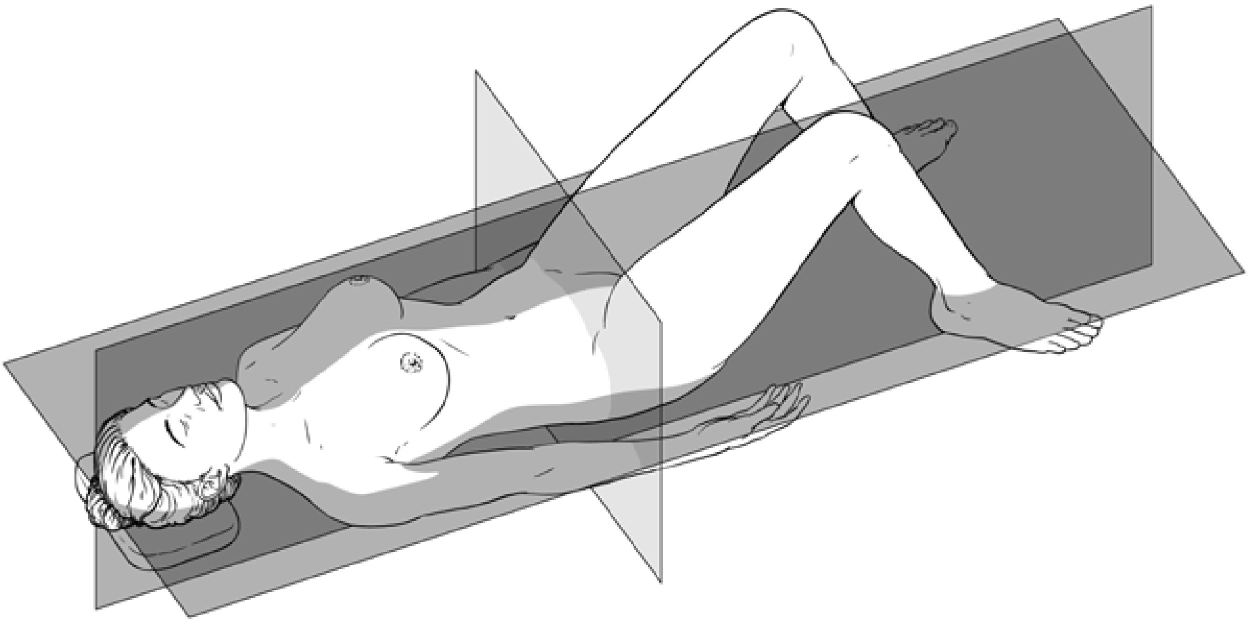


Endocavitary Planes

ENDOVAGINAL AND ENDORECTAL

Several endocavitary ultrasonographic scanning techniques are available: endovaginal, endorectal, cystosonography, and hysterosonography (endouterine). The two most widely used scanning techniques, endovaginal and endorectal, are presented here.

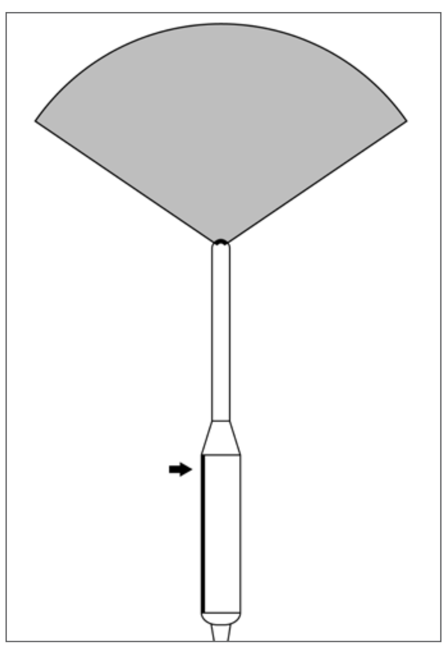
Additionally, translabial image presentation is discussed because the image presentation and transducer position is the same as endovaginal.

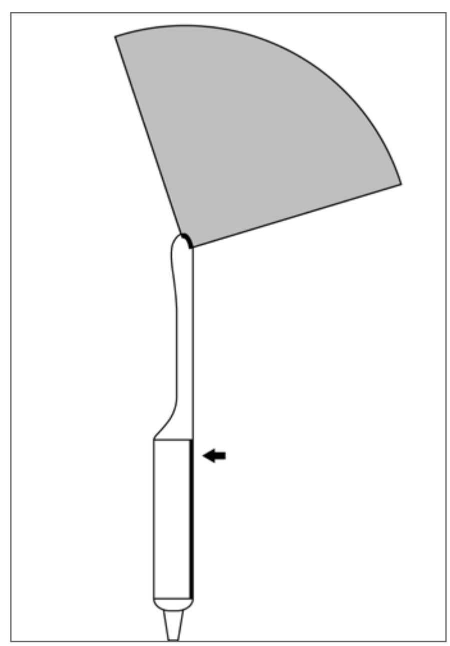


Endovaginal

Endovaginal and translabial images are most commonly acquired with the patient in the supine position. The majority of endovaginal transducers manufactured today are an end-fire design. Some endovaginal transducers have an end-fire but the manufacturers have slightly angled the transducer shaft for users that prefer the previously common side-fire transducer design.

Image presentation on the monitor is the same for both types of transducers.

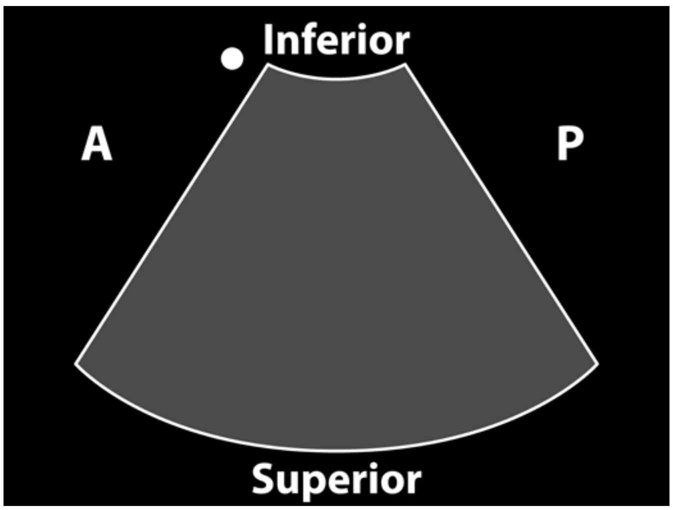


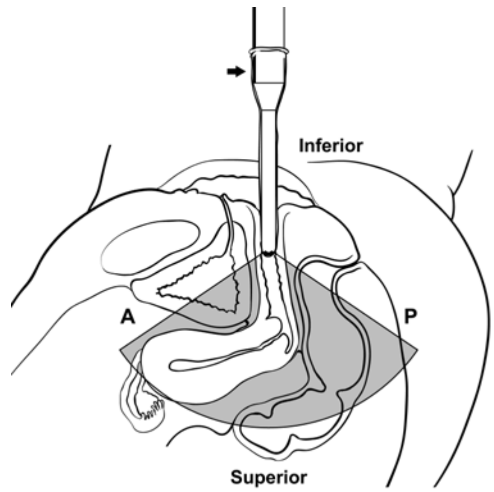


ENDOVAGINAL

Sagittal Plane

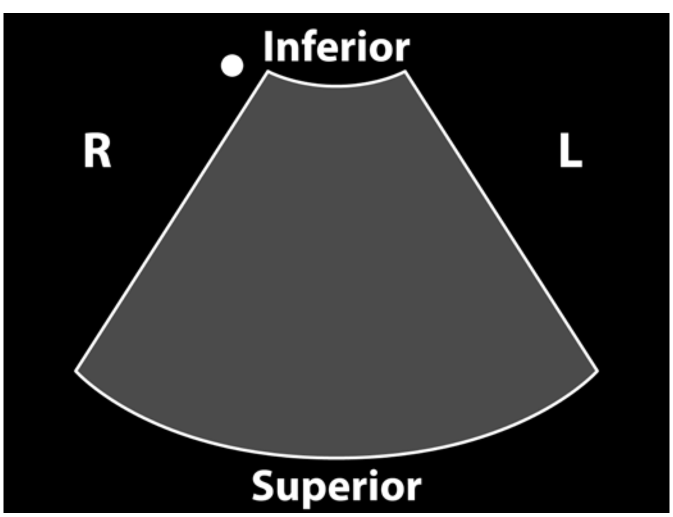
Image presentation on the monitor for the sagittal (longitudinal) plane with the transducer at the inferior aspect of the body and the indicator in the superior position always indicates the INFERIOR aspect of the body. Translabial scanning generally uses this plane only.

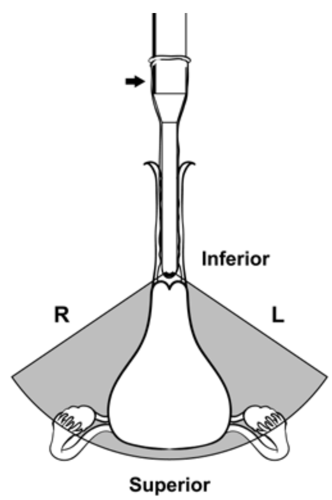




Modified Coronal Plane

Image presentation on the monitor for the modified coronal plane with the transducer at the inferior aspect of the body and the indicator toward the patient's right always indicates the RIGHT side of the body. Although the term transverse is occasionally used, modified coronal plane is correct terminology because of the relationship of the anatomy to the endovaginal transducer.

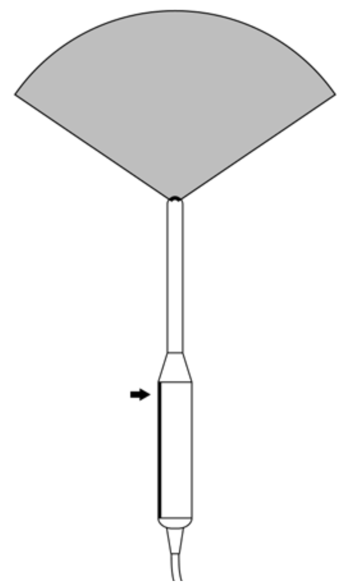




ENDORECTAL

Endorectal images are most often acquired with the patient in the supine or left lateral decubitus position. The image presentation is the same regardless of patient position. Not all endorectal transducers have indicators and therefore, it is important that the sonographer makes sure that the image on the monitor screen aligns with the representation of the organ being interrogated. There are two types of endorectal transducers commonly used: end-fire and bi-plane.

If an indicator is shown on the transducer handle, the indicator should be pointed posteriorly toward the patient's spine in the sagittal plane (it is reversed from what is shown on the abdominal or endovaginal transducers); for the coronal plane, the indicator is pointed toward the patient's right.

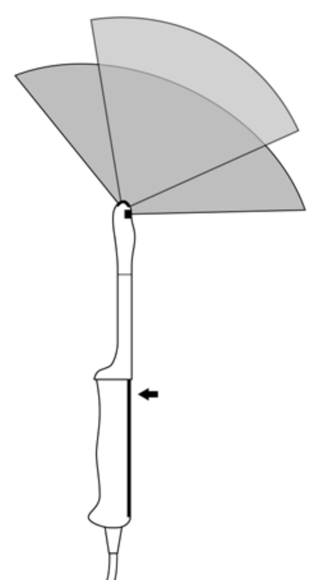


Bi-Plane

Bi-plane transducers have two faces that are on the same side with each face representing a plane of view. This makes it easy to align with the organ of interest. If an indicator is present on the transducer it will be located so that when inserting the transducer the indicator is aimed at the anterior side of the patient. Similarly, though, if there is no indicator, aiming the transducer's face (located along the axis of the instrument) to the anterior side of the patient will orient the transducer correctly. The sagittal and transverse transducer face can be active at the same time. A button on the machine, and often on the transducer itself, changes from the sagittal transducer face to the transverse transducer face, so there is no need to change the orientation of the instrument.

It is always suggested to verify with the manufacturer's manual for transducer type and orientation.

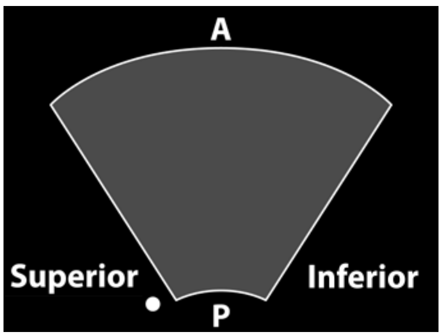
For both types of transducers, the biopsy guide is always anterior toward the prostate or organ of interest.

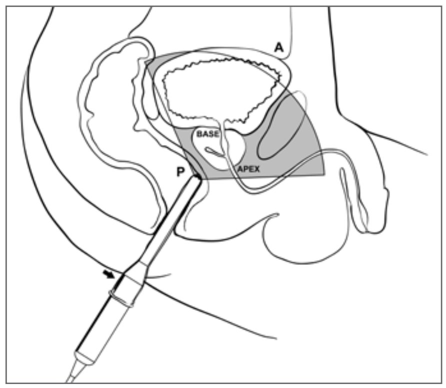


ENDORECTAL

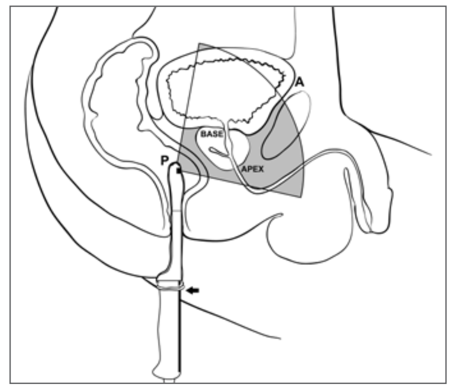
Sagittal Plane

When imaging in the sagittal (longitudinal plane), image presentation on the monitor always designates the left side of the screen as the superior aspect of the patient's body and the right side of the screen as the inferior aspect of the patient's body.





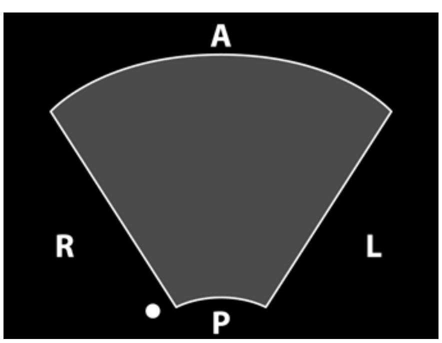
Sagittal End-Fire Transducer (Supine)

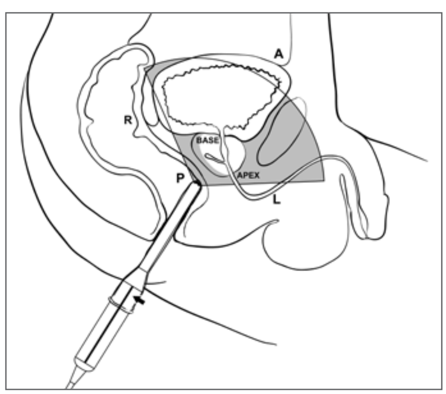


Sagittal Bi-Plane Transducer (Supine)

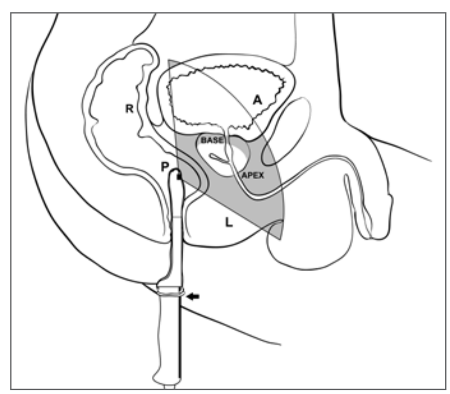
Modified Coronal Plane

When imaging in the modified coronal plane, image presentation on the monitor always indicates the right side of the patient is on the left side of the screen and the left side of the patient is on the right side of the screen. The transducer at the scanning surface (the anterior rectal wall) is assigned to the BOTTOM of the monitor. Therefore, the posterior aspect of the patient is closest to the transducer and is located at the BOTTOM of the screen while the anterior aspect of the patient is located at the TOP of the screen.





Modified Coronal End-Fire Transducer (Supine)



Modified Coronal Bi-Plane Transducer (Supine)

Labeling

The main purpose of labeling an image is to indicate the area of interest and convey how it was obtained via patient position and transducer orientation. This information provides a means for communication from one operator to another, from sonographer to image interpreter, and from one site or institution to another.

The following are recommended for universal communication, though practices may vary from one institution to another.

RECOMMENDED FORMAT OF LABEL

A minimum of the laterality (if applicable), organ/area of interest, and plane or axis is required. A recommended format is as follows (order can vary after laterality):

1. **Laterality (RT/LT/MIDLINE)**
2. **Organ or Area of Interest**

   Whether viewing an organ or area of the body, there may be other organs in the image. It may be important to describe exactly what the area of interest is for a particular image. For example, an image containing a transverse right kidney, gallbladder, liver, IVC, pancreas, and aorta may have several areas of focus, however, the intention of the image might be only to show a stone in the gallbladder, even though there may be a renal cyst in the image as well. By stating the organ or area of interest, confusion about the focus of an image is eliminated.

3. **Plane or Axis**

   This describes the transducer's relation to the axis of the organ or area of interest. SAG (sagittal to the body), COR (coronal plane), AX (axial), LONG (long axis to the organ/area of interest), and TRV (transverse axis to the organ/area of interest) are the standard names for scanning planes. For other scanning planes use the abbreviation OBL (oblique). Another identifier can be added if the oblique plane is close to a standard plane.

4. **Patient Position (if other than supine)**

   Supine (SUPN) is assumed as the standard patient position; therefore, it is only necessary to state other patient positions, which include DECUB (decubitus), ERECT, LLD (left lateral decubitus), RLD (right lateral decubitus), LPO (left posterior oblique), RPO (right posterior oblique), LAO (left anterior oblique), RAO (right anterior oblique), TRND (Trendelenburg), and RTRND (reverse Trendelenburg).

Example	
Laterality	RT
Organ or Area of Interest	LIVER
Plane or Axis	TRANS
Patient Position (if other than supine)	LLD

5. **Optional Information**

   Optional information varies from practice to practice. This information may include the following:

Example	
Exam Type	ABDOMEN
Referring Physician	Doe, Jane MD
Patient-Specific Information	POST CHOLECYSTECTOMY, 5 YRS
Additional Organ Information	RT KIDNEY UPPER POLE
Sweep of Scanning Action	LAT-MED
Scanning Surface, If Not the Standard	POSTERIOR

   a. **Patient-specific Information**

      There are times when the patient information is essential to explain the image. When a gallbladder or uterus has been surgically removed, stating this on the image may explain its absence from the image. Stating the last menstrual period, gravida/para information can explain the size of the endometrium, uterus, and ovaries.

b. Additional Organ Information

Stating which part of an organ is on the image may be helpful in locating pathology or eliminating confusion for similar-looking parts of the same organ (upper pole versus lower pole of a kidney). Some modifiers may include cephalic, caudal, superior, middle, inferior, lateral, medial, anterior, posterior, left, right, fundus, body, neck, head, tail, etc.

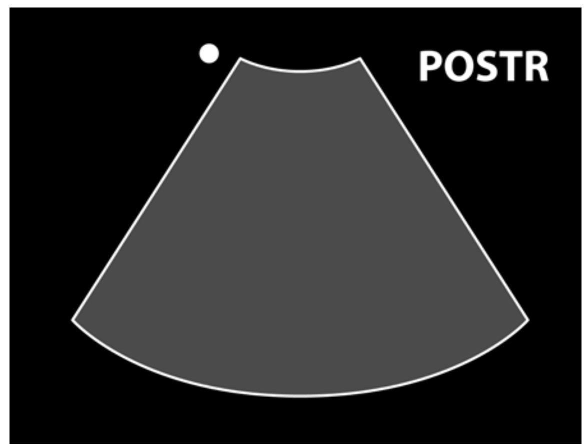
c. Sweep of Scanning Action

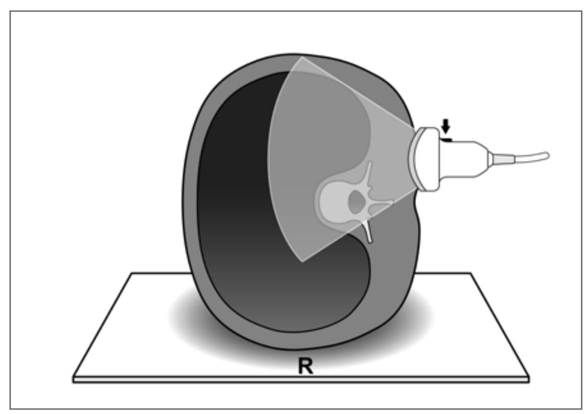
When using a series of images to sweep through an organ or area of interest (eg, kidney in a renal exam) from one end to the other, stating the direction of that sweeping action can eliminate relabeling individual images in a group of images, thus saving time. Some may include CEPH–CAUD (cephalic to caudal), I–S (inferior to superior), L–M (lateral to medial), etc.

d. Scanning Surface if Not the Standard (place near the transducer footprint at top of monitor)

If the transducer is on a surface that is not standard for a particular patient position, an organ orientation may appear unusual. Stating the scanning surface near the top of the monitor next to the transducer footprint may eliminate confusion.

Example: Patient in the right lateral decubitus position looking at the left kidney from the patient's back (posterior surface)





e. Body and Transducer Icons

Some machines have body and transducer icons (also known as body markers) that can be placed on the image. These may more quickly and accurately convey the transducer position and patient position.

RECOMMENDED LOCATION OF LABELING

Placement of the descriptive information on the monitor should be in the black area away from the image for two reasons. First, the white lettering on the black background is easier to read and, second, the lettering will not cover anatomic or pathologic information in the image. Labels should appear in a consistent location depending on machine, institution, and other requirements.

Labels that MUST be placed in the image, eg, to point to a specific structure in the image, should be limited and not cover essential anatomy or pathology. If it is necessary to place labels in the image area, it is suggested that an additional image without the labels be included so that the interpreter may evaluate structures that were covered by the labels.

IDENTIFYING INFORMATION

Most machines provide an area for the operator to enter:

- **Operator Identification**

  Sonographer or operator identifiers may include name (example, First and Last name), initials, or facility/clinic identification number. This information allows the image interpreter to directly contact the sonographer after study completion if questions regarding the exam arise. Having the operator identifiable also helps facilitate quality improvement programs (such as peer-to-peer quality assurance).

  Example

  Doe, John/M42/MR223456/facilityN/AB

- **Patient Identifiers**

  These may include name, date of birth, age, gender, and medical record number. Study accession number may also be included.

Most facilities rely on Picture Archival and Communication Systems (PACS) and Radiology Information Systems (RIS) that adhere to the Digital Imaging and Communications in Medicine (DICOM) standard, which is modality agnostic. Electronic worklists can be queried and identifiable study and patient information can be auto-entered into the system.

NOTE: Patient identifiers MUST BE removed for public presentation of any images.

These data elements may be displayed in the header of each individual image and/or in an information-only image (sometimes referred to as a face sheet).

NOTE: With increasing concerns regarding disclosure of a patient's protected health information (PHI), consideration may be given to refraining from adding patient-specific identifiers to the individual images. Most contemporary image viewing and interpretation (PACS) systems allow for a DICOM overlay, providing the image interpreter with the necessary identifiers without having individual images permanently containing identifiable information. In so doing, a site or institution may limit the risk of a data breach if images are used for research or presentation/publication.

Special Applications

ELASTOGRAPHY

Elastography is a noninvasive method to evaluate tissue deformations from an externally applied force. There are two primary methods of performing elastography in clinical ultrasound:

1. Strain elastography (SE) and
2. Shear wave elastography (SWE).

   SWE typically utilizes a "push" pulse often referred to as ARFI (acoustic radiation force impulse). Shear wave velocity (SWV) is calculated based on measuring tissue displacement and displayed in m/s. SWV can be converted to stiffness, or elastic modulus, in kilopascals (kPa). There are two major forms of SWE: point quantification (pSWE) and 2D imaging (2D-SWE).

The below discussion highlights recommendations for image display and labeling relatively agnostic to the tissue or organ of interest.

Display and Labeling:

Strain elastography—relative indicator of stiffness, which can be displayed as follows:

Strain color maps
Within a measurement box, relative tissue displacement (or shear deformation/stiffness) is displayed as a color or grayscale map (strain image, or elastogram), scaled between soft and hard, normalized to the mean displacement within the measurement box. This color map can be displayed side-by-side with the B-mode image, or superimposed on the B-mode image with various levels of transparency. A color scale with clearly marked upper-range stiffness values (eg, Hard) and lower range (eg, Soft) should be displayed on the image.

Strain ratio
In another display mode, two ROIs can be placed in the measurement box, one in an area of interest (ROI1), and one in adjacent "normal" tissue (ROI2). The ratio between these two regions is then calculated and should be displayed on the image, with 1.0 indicating identical stiffness between the two ROIs, >1.0 indicating ROI1 being stiffer than ROI2.

E/B Side Ratio
In another display mode, the ratio between the diameter of a target lesion's area of strain in the strain image and size on the B-mode image is calculated, with 1.0 indicating identical diameters on the two imaging modes, and >1.0 indicating an area of greater stiffness relative to its measured size.

For SE, most manufacturers provide an assessment of measurement quality, either a numeric value or color scale, which should be displayed alongside the color map image of stiffness.

Shear wave elastography

Shear wave velocity (SWV) can be converted to stiffness (Young's modulus, E), expressed in kPa. Although literature for alternative techniques for measuring tissue stiffness, such as Transient Elastography (TE) for liver, reports measurements in kPa, it is recommended that SWE display shear wave speed (m/s) foremost, as this is the primary measurement. Scanner settings should allow for the additional expression of stiffness (kPa) to be provided, such as in the scanner's report page.

For pSWE, SWV is measured within an ROI, which should be clearly displayed as an overlay with the B-mode image so that a user may avoid structures that may confound results, such as masses, large vessels, dilated bile ducts, etc. No elastogram is created for this technique. However, a regional average of shear wave propagation speed should be clearly displayed on the image.

For 2D-SWE, measurements are made along multiple sequential scan lines across a measurement area, and a quantitative elastogram is generated, displayed as a color or grayscale map, scaled between slow and fast shear wave speeds. This color map can be displayed side-by-side with the B-mode image, or superimposed on the B-mode image with various levels of transparency.

For SWE, there are two major methods for assessing measurement quality: a mathematical representation of measurement variability known as Interquartile Range divided by Median (IQR/M). For pSWE, manufactures should display user feedback when measurement quality is poor, either by failing to display a stiffness value/shear wave speed or a warning message. For 2D-SWE, most manufacturers provide a quality image or "map" conveying an assessment of measurement quality. Although this is typically manufacturer-specific, a quality map should either be displayed side-by-side with the stiffness image, or captured separately as an independent image for permanent storage.

CONTRAST-ENHANCED ULTRASOUND (CEUS)

Contrast-enhanced ultrasound (CEUS) involves the intravenous (and sometimes intra-cavitary) administration of a microbubble-based ultrasound contrast agent (UCA). Unique advantages offered by CEUS include superior signal-to-noise ratio as well as the ability to assess enhancement patterns in real time, with a much higher temporal resolution than is possible with most CT and MRI techniques. In addition, the excellent safety profile of UCA, and the rapid, non-renal clearance of microbubbles from the body, allow for repeated contrast administrations in the same session.

Display

A different image hue (color tone) may be utilized for a contrast-enhanced study to help differentiate these unique contrast images from standard B-mode grayscale images. In a system's contrast mode, the ability to display both the "contrast-only" image as well as the grayscale, B-mode image in a side-by-side, dual screen mode is preferable. A single contrast and grayscale overlay image is possible on some systems, though is not commonly used.

Labeling

Contrast injection information:

1. Injection number (eg, Inj #1; Inj #2, etc);
2. Injection dose (eg, 2.0 mL);
3. Contrast agent (Optional) (eg, Lumason; Definity).

Injection timing information:

1. Use of a contrast clock or timer, activated at the end of the contrast injection (at initiation of the saline flush), is highly recommended;
2. The timer should display the minutes:seconds since injection;
3. Each subsequent image obtained then includes imbedded reference to the time since contrast injection.

Image Recording

Given the real-time nature of contrast imaging, the ability to capture and save and transmit cine clips is highly recommended.

Abbreviations

The key to abbreviating is to use as few letters as possible while maintaining clarity regarding the intended word and minimizing confusion with other words.

For example, SUP could mean superior, supine, or superficial, whereas SUPR refers most closely to superior, SUPN to supine, and SUPF to superficial.

Optional letters are shown in parentheses, eg, ANT(R).

ANT(R)	Anterior
AX	Axial
CAUD	Caudal
CEPH	Cephalad
COR(O)	Coronal
DEC(UB)	Decubitus
INF	Inferior
LAO	Left Anterior Oblique
LLD	Left Lateral Decubitus
LLQ	Left Lower Quadrant
LONG	Longitudinal/Long Axis
LPO	Left Posterior Oblique
LSAG	Left Parasagittal
LT	Left
LUQ	Left Upper Quadrant
MED	Medial
MID	Middle
ML	Midline
OBL(Q)	Oblique
POST(R)	Posterior
PT	Patient
RAO	Right Anterior Oblique
RLD	Right Lateral Decubitis
RLQ	Right Lower Quadrant
RPO	Right Posterior Oblique
RSAG	Right Parasagittal
RT	Right
RUQ	Right Upper Quadrant
SAG	Sagittal
SUPN	Supine
SUPR	Superior
TRV/TRAN(S)/TX	Transverse
UMB(IL)	Umbilicus

References

1. American Institute of Ultrasound in Medicine Standard Presentation and Labeling of Ultrasound Images. *J Clin Ultrasound* 1976;4:393–398.
2. American Institute of Ultrasound in Medicine: Standard Presentation and Labeling of Ultrasound Images. *Reflections* 1978; 4:70–75.
3. *Recommended Ultrasound Terminology*, 4th ed. Laurel, MD: American Institute of Ultrasound in Medicine; 2019.

Further Reading

Ferraiolo G, Wong VW, Castera L et al. Liver Ultrasound Elastography: an Update to the World Federation for Ultrasound in Medicine and Biology Guidelines and Recommendations. *Ultrasound Med Biol* 2018;44: 2419–2440. https://doi.org/10.1016/j.ultrasmedbio.2018.07.008.

Shiina T, Nightingale KR, Palmeri ML et al. WFUMB Guidelines and Recommendations for Clinical Use of Ultrasound Elastography: Part 1: Basic Principles and Terminology. *Ultrasound Med Biol 2018*; 41: 1126–1147. http://dx.doi.org/10.1016/j.ultrasmedbio.2015.03.009.

Dietrich CF, Bamber J, Berzigotti A, et al. EFSUMB Guidelines and Recommendations on the Clinical Use of Liver Ultrasound Elastography, Update 2017 (Long Version). *Ultraschall in Med* 2017; 38:e16–e47.

AIUM Practice Parameter for the Performance of Contrast Enhanced Ultrasound. *J Ultrasound Med* 2020; 39:421–429. doi: 10.1002/jum.15204.

Greenbaum, LD. Guidelines and Good Clinical Practice Recommendations for Contrast Enhanced Ultrasound (CEUS) in the Liver. *Ultrasound Med Biol* 2013; 39:186. doi: 10.1016/j.ultrasmedbio.2012.09.021.