1

Introduction

Introduction

Chapter 1 is the foundation for subsequent chapters in this guidebook, because it includes a detailed explanation of what the learner needs to know before proceeding. This chapter helps the reader understand the presentation format, language, and terminology used in this guidebook. Topics such as terminology and abbreviations used in this guidebook, orientation markers on the ultrasound transducer and image display, scan plane orientations, image annotations, explanation of window diagrams, transducer manipulation techniques and how they correspond to the orientation in the field of view, and clockface symbols are explained in length in this chapter. It is strongly recommended that the reader spends a significant amount of time becoming familiar with this chapter before continuing to the next chapters.

1.1 Common Terminology Used in This Guidebook

"Reader," "user," "operator," or "learner" may refer to a sonographer, sonologist, or ultrasound operator. In other words, the person who performs/will perform the ultrasound examinations.

The term "transducer" may also be referred to as "probe."

The part of the transducer that is in contact with the patient is referred to as either the transducer head or the transducer's face.

The term "axial" may refer to either the transaxial or transverse plane or view.

The term "short axis" may be used for the transverse axis or view.

The term "long axis" may be used for the sagittal axis or view.

"Windows" or "acoustic windows" refer to the location on the patient's body where the transducer face is in contact with to obtain the required ultrasound imaging of a specific organ or structure. It is important to stress that these windows heavily rely on the knowledge of human anatomy.

"Sweeps" refer to the action performed with the transducer to survey and assess an organ or structure (see Figures 1.24–1.27). For example, these sweeps provide an initial exploration to determine the anatomy, anatomical orientation, sonographic features, and landmarks. This initial exploration then allows the ultrasound user to determine whether the organ is normal or abnormal. These sweeps also allow the user to attempt different windows and thus, select the best one to obtain diagnostic images. Sweeps should always be performed before acquiring images.

Ultrasound Scanning Guide for the Abdomen and Male Pelvis, First Edition. Leonardo Faundez and Haleema Rauf. Published 2026 by John Wiley & Sons, Inc.

1.2 Abbreviations Used in This Guidebook

45LLD – refers to a patient position where the patient lies at a 45° angle, halfway between left lateral decubitus and supine
45RLD – refers to a patient position where the patient lies at a 45° angle, halfway between right lateral decubitus and supine
AC – ascending colon
ANT – anterior
Ao – aorta
CA – celiac axis
CBC – common bile duct
CHD – common hepatic duct
CIA – common iliac artery
CIV – common iliac vein
DC – descending colon
FOV – field of view
GB – gallbladder
HVs – hepatic veins
ICS – intercostal space
IDM – image display marker
IHBD – intrahepatic bile duct
INF – inferior
IP – interpolar region
IVC – inferior vena cava
L – patient's left side
LAO – left anterior oblique
LAT – lateral
LK – left kidney
LLD – left lateral decubitus
LLQ – left lower quadrant
LP – lower pole
LPV – left portal vein
LUQ – left upper quadrant
MCL – midclavicular line
MED – medial
ML – midline
MPV – main portal vein
PC – portal confluence
POM – probe orientation marker
POST – posterior
PVs – portal veins
R – patient's right side
RAO – right anterior oblique
RK – right kidney
RLD – right lateral decubitus
RLQ – right lower quadrant
RPV – right portal vein
RUQ – right upper quadrant
SC – sigmoid colon
SMA – superior mesenteric artery
SMV – superior mesenteric vein
SPLV – splenic vein
SUP – superior
SVs – seminal vesicles
TC – transverse colon
UP – upper pole

1.3 Probe Orientation and Image Display Markers

The reader is referred to Table 1.1 and Figures 1.1–1.5 for this section. The probe orientation marker (POM) plays an important role in finding the correct plane to scan. The POM is a small marker or ridge that can be felt and seen on one end of the transducer (the top end). The POM is a guide to help maintain the proper directions and orientation while scanning. These proper directions will then be interpreted on the image display monitor in a correct manner.

The image displayed on the monitor, also referred to as the field of view (FOV), will also have a small marker or icon that is sometimes seen as a letter of the brand name of the ultrasound machine. This image display marker (IDM) must always correspond to the same direction as the POM.

To check if both markers show the correct direction, place a dab of gel on the POM side and check to make sure that the image shows the gel on the same side as the IDM. Another way to check if the scanning direction corresponds to the IDM is to simply place the probe on the body in the sagittal or transverse scan plane and then check if the POM side is moving in the same direction as the IDM side on the image display monitor. The directions on the patient and image display monitor should mirror each other.

Table 1.1 POM and IDM icons used in this guidebook.

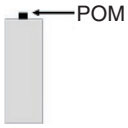
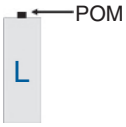
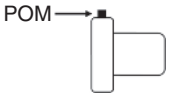
POM icon	POM in long and short axes	POM on the transducer	IDM
			

Figure 1.1 In this guidebook, the POM is represented as a solid black square or circle, which is the POM end. POM, Probe Orientation Marker.

Figure 1.2 Drawing of a transducer icon depicting the long axis (L) of the transducer by having the POM at the top end of the diagram.

Figure 1.3 Drawing of a transducer icon depicting the short axis (S) of the transducer.

Figure 1.4 The long axis of the transducer/probe is shown from the side with the POM in place.

Figure 1.5 Drawing showing the image sector, or FOV, as seen from the operator's perspective, when the sonographer is facing the ultrasound image display monitor. The solid black circle represents IDM. Best practice is to always have the IDM corresponding to the POM side of the probe.

1.4 Scan Plane Directions

The reader is asked to refer to Table 1.2 for this section. The position and direction of the probe when placed on the body determine the scan plane. The position of the long axis of the probe for the sagittal and transverse scan planes on the patient's midline (ML) is shown in Table 1.2, Figures 1.6–1.11.

Table 1.2 Scan plane directions on the image display.

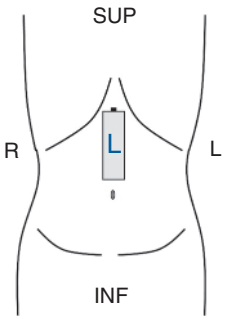
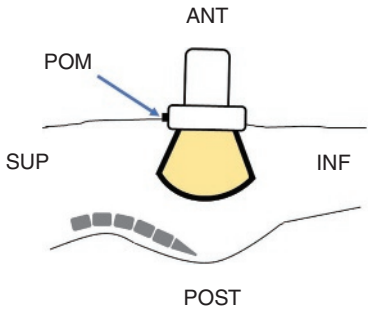
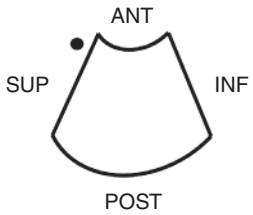
Transducer scan plane	Probe position on the body	Probe on the body in ML (view from a different perspective)	Scan directions as seen on the image display monitor
Sagittal (ML on the body)			

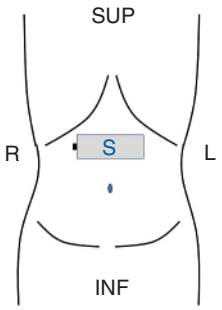
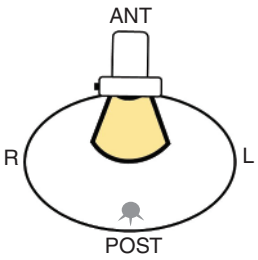
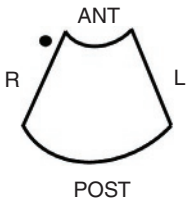
Figure 1.6 Anterior view of the patient. The transducer icon is shown with the POM directed superiorly/cranially (toward the patient's head). INF, inferior; L, left; R, right; SUP, superior.

Figure 1.7 Side view of the patient. The transducer is placed anteriorly on the patient. The POM is shown on the probe directed superiorly/cranially (toward the patient's head). ANT, anterior; INF, inferior; POM, probe orientation marker; POST, posterior; SUP, superior.

Figure 1.8 Image sector or FOV as seen on the image display monitor. IDM is shown as a solid black circle and is on the side of the image sector, which corresponds with the superior end of the patient. ANT, anterior; INF, inferior; POST, posterior; SUP, superior.

(Continued)

Table 1.2 (Continued)

Transducer scan plane	Probe position on the body	Probe on the body in ML (view from a different perspective)	Scan directions as seen on the image display monitor
Transverse (ML on the body)	 **Figure 1.9** Anterior view of the patient. The transducer icon is shown with the POM directed toward the right side of the patient. INF, inferior; L, left; R, right; SUP, superior.	 **Figure 1.10** Axial view of the patient's torso as viewed from the patient's feet when lying on the scanning bed. This is an anterior beam approach. The POM side of the probe is directed toward the patient's right side. ANT, anterior; L, left; POST, posterior; R, right.	 **Figure 1.11** Image sector or FOV as seen on the image display monitor. The IDM is shown as a solid black circle and is on the side of the image sector, which corresponds with the right side of the patient. ANT, anterior; L, left; POST, posterior; R, right.

When the transducer face is placed on an area of the body, the sound beam will enter from that point of contact, thereby providing a two-dimensional image on the display monitor. The area of the transducer contact on the patient will then help to identify the directions on each side of the image sector/FOV. Accordingly, the scan plane direction of the near field of the beam sector will represent the sound beam entry, or beam approach, to the patient as well.

1.5 The Relationship Between the Sagittal and Transverse Scanning Planes

The sagittal and transverse planes are always 90° from one another. Each of these planes is defined below.

1.5.1 Sagittal Plane

For learning purposes, the reader is asked to consider the POM end of the transducer as pointing to a clock position. For example, to start an examination in the ML of the abdomen in the sagittal scanning plane, the POM is directed toward 12 o'clock, which also indicates the superior end of the patient.

To change the scanning plane from sagittal to transverse, the probe will be rotated 90° counterclockwise, as shown in Figure 1.12.

1.5.2 Transverse Plane

To start an examination in the ML of the abdomen in the transverse scanning plane, the POM is directed toward 9 o'clock (toward the right side of the patient). To change the scanning plane from transverse to sagittal, the probe will be rotated 90° clockwise, as shown in Figure 1.13.

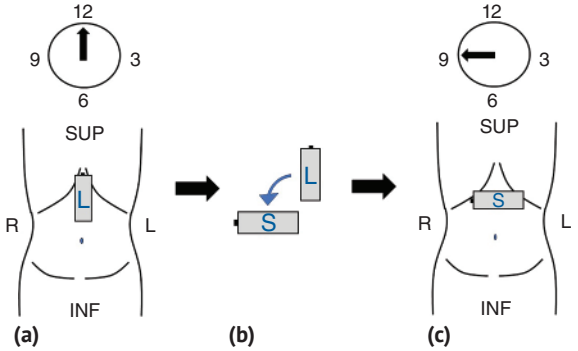


Figure 1.12 Changing the scanning plane from sagittal to transverse. (a) The transducer icon in the sagittal plane is placed anteriorly in the ML of the body; (b) The curved arrow indicates the direction of the rotation of the probe from sagittal to transverse; (c) The transducer icon is shown in the transverse scan plane in the ML of the body. INF, inferior; L, left; R, right; SUP, superior.

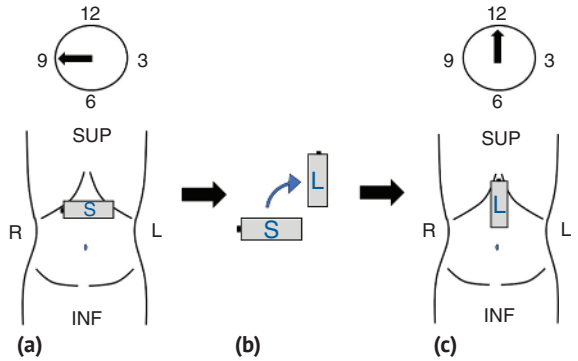


Figure 1.13 Changing the scanning plane from transverse to sagittal. (a) The transducer icon in the transverse plane is placed anteriorly in the ML of the body; (b) The curved arrow indicates the direction of the rotation of the probe from transverse to sagittal; (c) The transducer icon is shown in the sagittal plane in the ML of the body. INF, inferior; L, left; R, right; SUP, superior.

1.5.3 Oblique Scan Planes

These oblique planes are commonly utilized in ultrasound scanning. Most of the organs and structures within the body do not lie in straight lines; therefore, the transducer needs to be rotated in an oblique plane to find the long or short axis of such an organ or structure.

The following examples demonstrate how to find the sagittal and transverse planes of the gallbladder (GB). Please refer to the accompanying drawings following each example (Figures 1.14 and 1.15).

Example 1: The GB lies in a straight line in the sagittal plane (Figure 1.14a). The exam is started in the sagittal plane in the ML of the body with the POM at 12 o'clock (Figure 1.14b). The probe is rotated 90° counterclockwise for the transverse scan plane of the GB (Figure 1.14c).

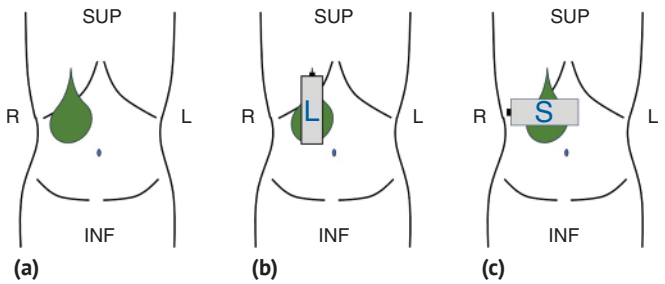


Figure 1.14 The GB lies in a straight line in the sagittal plane of the body. (a) Anterior view of the abdomen shows the GB in a straight line in the sagittal plane. The GB is shown to be much larger than the actual size for clarity; (b) Probe position sagittal to the body and GB; (c) Probe position transverse plane to the body and GB. INF, inferior; L, left; R, right; SUP, superior.

Example 2: The fundus of the GB points to the patient's ML (Figure 1.15a). The exam is started in the sagittal plane in the ML of the body with the POM directed cranially at 12 o'clock (Figure 1.15b). To find the long axis of the GB, the probe must be rotated slightly clockwise, then counterclockwise to determine which direction elongates the GB. In this case, the rotation is counterclockwise. The degree of rotation will depend on the position of the GB. Once the long axis is seen, stop any further rotation of the probe. The probe position in Figure 1.15c is technically sagittal oblique to the body; however, the plane is also sagittal to the GB and would be labeled as sagittal on images. From this sagittal plane to the GB, rotate 90° counterclockwise to find the short axis. This will technically be a transverse oblique plane to the body; however, the plane is also transverse to the GB (Figure 1.15d) and would be labeled as transverse on images.

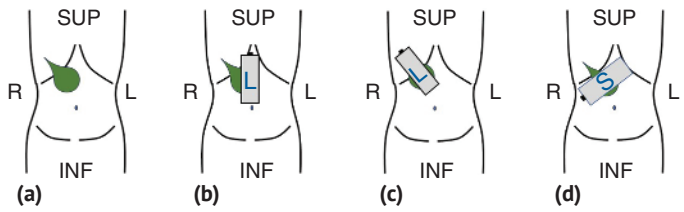


Figure 1.15 The fundus of the GB points to the patient's ML. (a) Anterior view showing the GB fundus tilted toward patient's ML. The GB is shown to be much larger than the actual size for clarity; (b) Probe position in the sagittal plane to the patient's body; (c) Probe position sagittal to the GB; (d) Probe position transverse to the GB. INF, inferior; L, left; R, right; SUP, superior.

Example 3: The fundus of the GB points to the patient's right (Figure 1.16a). The exam is started in the sagittal plane in the ML of the body with the POM directed cranially at 12 o'clock (Figure 1.16b). To find the long axis of the GB, the probe must be rotated slightly clockwise, then counterclockwise to determine which direction elongates the GB. The degree of rotation will depend on the position of the GB. In this case, the rotation is in a clockwise direction. This plane is now a sagittal oblique plane to the body; however, it is also a sagittal plane to the GB and would be labeled as sagittal GB on images. Figure 1.16c shows the probe position sagittal to the GB. From this probe position, rotate the probe 90° counterclockwise to show the short axis of the GB. This is technically a transverse oblique plane to the body; however, the plane is also transverse to the GB (Figure 1.16d) and would be labeled as transverse GB on images.

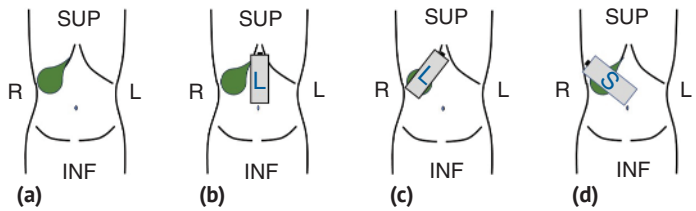


Figure 1.16 The fundus of the GB is pointing to the patient's right. (a) Anterior view of the abdomen. The fundus of the GB is pointing to the patient's right. The GB is shown to be much larger than the actual size for clarity; (b) the probe is positioned in the sagittal plane to the patient's body; (c) the probe is positioned sagittal to the GB; and (d) the probe is positioned transverse to the GB. INF, inferior; L, left; R, right; SUP, superior.

1.6 Annotations or Image Labeling

By labeling the scan plane or view, the knowledgeable viewer will be able to identify the directions or orientation of the images. In addition, labeling the anatomy also allows for quick identification of the area being imaged. This provides a more efficient way to view and report ultrasound imaging and is especially important in cases

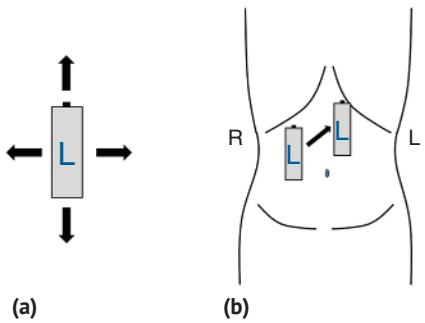
of follow-up of pathology. The labeling of images may vary to some extent, as this will depend on the facility protocol. The general guideline is to label the plane or view and the body part that is being shown in the image. Generally, abbreviations are often used. For example, long-axis views of the GB may be labeled as "SAG GB" (sagittal gallbladder) or "LONG GB." Similarly, short-axis views may be labeled as "TRX GB" (transverse gallbladder) or "Short GB."

It is important to label sides correctly. For example, when acquiring images of one of the two kidneys, it is crucial to identify the right and left sides by labeling them as such. In addition, some protocols may ask for arrows to point out pathology.

1.7 Transducer Manipulation Techniques

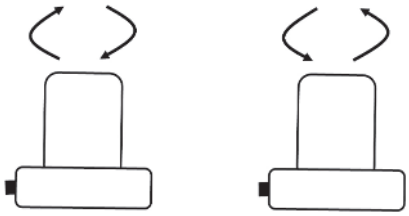
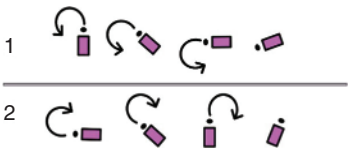
The reader is asked to refer to Table 1.3 and Figures 1.17–1.29 for this section. Transducer manipulation techniques refer to different methods of handling the probe to direct the sound beam in a particular direction. This allows for the interrogation of the organs and structures in the body. At the start of each examination, the user must always make sure that the POM end on the transducer corresponds to the same direction as the IDM. Always maintain proper directions or orientation during scanning.

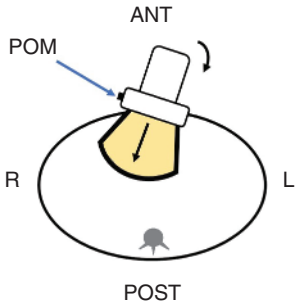
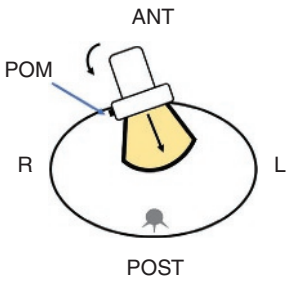
Table 1.3 Examples of transducer manipulation techniques.

Probe movement	Explanation of method
Slide or move	 **Figure 1.17** Slide or move probe movement. The transducer is positioned in one location on the body and moved to another location in any scan plane. The central point of contact of the probe face changes. (a) The transducer icon is shown with arrows indicating some examples of directions the transducer may be moved or slid; (b) anterior view of the patient. The probe moves or slides from one point to another. The arrow indicates the direction in which the transducer was moved. L, left; R, right.

(Continued)

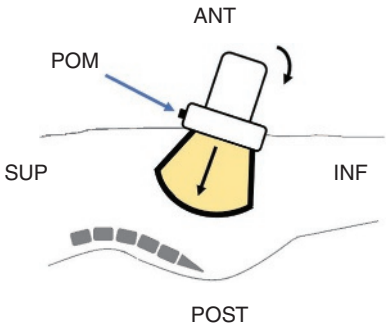
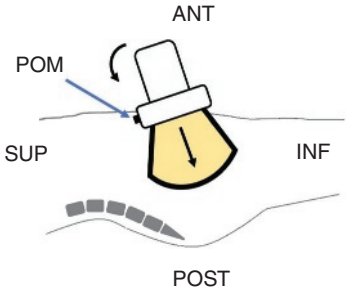
Table 1.3 (Continued)

Probe movement	Explanation of method
Rotate	 **Figure 1.18** Rotate probe movement. When rotating the probe, the central point of contact of the probe face is fixed. The probe is positioned in a location on the body, and the probe handle is rotated in a clockwise or counterclockwise direction. (a) The transducer is shown with arrows indicating a clockwise rotation of the probe handle; (b) the transducer is shown with arrows indicating a counterclockwise rotation of the probe handle. Rotating the probe to any degree will change the scan plane. This allows for the initial scan plane to be changed to, for example, that of an oblique scan plane that is relative to the anatomy in order to assess a structure in long or short axis. The direction of rotation of the probe handle will depend on the way the organ/structure being assessed lies within the body. It is also important to note that there is a limit to the degree of rotational movements of the probe.  **Figure 1.19** Transducer face, shown as purple rectangles, in varying degrees of rotation in a counterclockwise and clockwise direction. Row 1 shows the POM's end of the probe rotating in a counterclockwise manner from the initial sagittal plane start point. Row 2 shows the POM's end of the probe rotating in a clockwise manner from the initial transverse plane start point. The degree of rotation is technically limited for two important reasons: 1. When the POM end of the transducer is rotated past a certain point with a large degree of rotation, the image will be reversed. The POM will then not correspond correctly with the IDM on the image display monitor. This will cause confusion as the scanning orientation will then be reversed and may be interpreted incorrectly, not only by the operator but also by the reporting physician. 2. Over time, scanning with a large degree of over-rotation of the probe may also cause strain and/or injury to the operator's scanning wrist/hand.

Probe movement	Explanation of method
Angle to patient's right in the transverse plane	 **Figure 1.20** Axial view of the patient's abdomen as viewed from the patient's feet, showing angling of the probe in the transverse plane to the patient's right. The probe is shown in the patient's ML. The central point of contact of the probe face is fixed. The curved arrow indicates the pressure is applied opposite to the POM's side to angle the probe, and thus, direct the sound beam toward the patient's right within the body (straight arrow). This allows for the extension of the FOV toward the patient's right side. ANT, anterior; L, left; POM, probe orientation marker, POST, posterior; R, right.
Angle to patient's left in the transverse plane	 **Figure 1.21** Axial view of the patient's abdomen as viewed from the patient's feet, showing angling of the probe in the transverse plane to the patient's left. The probe is shown in the patient's ML. The central point of contact of the probe face is fixed. The curved arrow indicates the pressure is applied to the POM's side to angle the probe, and thus, direct the sound beam toward the patient's left within the body (straight arrow). This allows for the extension of the FOV toward the patient's left side. ANT, anterior; L, left; POM, probe orientation marker; POST, posterior; R, right.

(Continued)

Table 1.3 (Continued)

Probe movement	Explanation of method
Angle cranially in the sagittal plane	 **Figure 1.22** Sagittal view of the abdomen as seen from the patient's side, showing angling of the probe cranially in the sagittal plane. The probe is placed on the body in the sagittal scan plane, and the central point of contact of the probe face is fixed. The curved arrow indicates the pressure is applied opposite to the POM's side to angle the probe, and thus, direct the sound beam toward the patient's cranial end (straight arrow). This allows for the extension of the FOV in a cranial direction toward the patient's head. ANT, anterior; INF, inferior; POM, Probe Orientation Marker; POST, posterior; SUP, superior.
Angle caudally in the sagittal plane	 **Figure 1.23** Sagittal view of the abdomen as seen from the patient's side, showing angling of the probe caudally in the sagittal plane. The probe is placed on the body in the sagittal scan plane, and the central point of contact of the probe face is fixed. The curved arrow indicates the pressure is applied to the POM side to angle the probe, and thus, direct the sound beam toward the patient's caudal end. This allows for the extension of the FOV in a caudal direction. ANT, anterior; INF, inferior; POM, probe orientation marker; POST, posterior; SUP, superior.

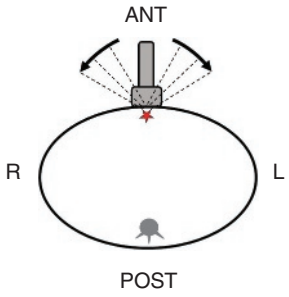
Probe movement	Explanation of method
Angle/tilt in the sagittal plane	

Figure 1.24 Axial view of the patient's abdomen as viewed from the patient's feet, showing angling/tilting the probe. The probe is placed on the body in the sagittal plane, and the central point of contact of the probe face is fixed. The probe handle start position (star symbol) is perpendicular to the skin. From this position, the probe handle can be tilted to either the right side or left side of the patient in varying degrees. The degree of the tilt angle will depend on where the sound beam is to be directed within the body. The curved arrows show the tilting directions from the center. Dotted lines represent varying degrees of tilting angles. ANT, anterior; L, left; POST, posterior; R, right.

1. Focused angling/tilting in the sagittal scan plane:
   By tilting the probe handle from the start position, the sound beam can be angled/tilted to either side. For example, in Figure 1.25, if the probe handle is moved from the start position 1 to 3, the sound beam will be directed to the patient's right to position 3 within the body.

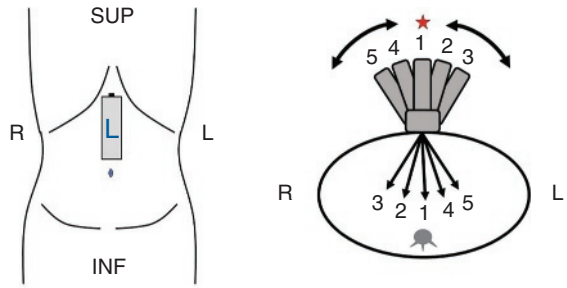
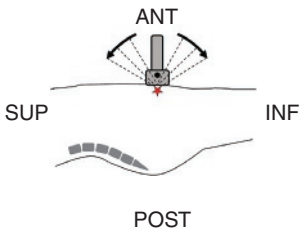


Figure 1.25 Angling/tilting in the sagittal scan plane. (a) Anterior view of the patient shows the transducer icon positioned in the sagittal scan plane in the ML of the body; (b) axial view of the patient's abdomen seen from the patient's feet shows a different perspective with the same ML start point (star symbol). The numbers indicate the different tilting positions of the probe handle. The straight arrows indicate the direction of the sound beam relative to the numbered probe handle positions. The curved arrows indicate the tilting directions from the center. INF, inferior; L, left; R, right; SUP, superior.

(Continued)

Table 1.3 (Continued)

Probe movement	Explanation of method
	2. Serial angling/tilting (sweeping beam) in the sagittal scan plane: This method of angling/tilting the probe handle in a continuous serial motion is called sweeping the beam. It is a method to interrogate a structure in a series of sectional planes. Figure 1.25b helps illustrate this technique by using the probe handle as a reference. Position 1 is the starting point (star symbol). When the probe handle is angled from position 1 to 2 to 3, the sound beam is directed from ML to the patient's right. When the angle is reversed by tilting the probe handle from position 3 to 2 to 1, the sound beam moves back medially to the start point at position 1. The probe handle motion then continues from position 1 to 4 to 5 to direct the sound beam toward the patient's left. When the probe handle's direction is reversed from position 5 to 4 to 1, the sound beam will then be directed medially back to the center start point. By angling/tilting the probe handle in a continuous motion, this "sweeping" motion of angling or tilting the beam back and forth will allow us to interrogate an area/structure in the sagittal plane. This serial motion can be captured in a video clip.
Angle/tilt in transverse plane	 **Figure 1.26** Sagittal view from the patient's side showing angling/tilting the probe in the transverse plane. POM is indicated by the solid black circle. The probe is placed on the body in the transverse scan plane, and the central point of contact of the probe face is fixed. The probe handle start position is perpendicular to the skin with a 0° tilt angle (star symbol). From this position, the probe handle can be tilted to either the cranial or caudal direction in varying degrees. The degree of the tilt angle will depend on the area or structure that is to be examined within the body. The sound beam will follow the same path as the probe handle. The curved arrows indicate the tilting from the center. The dotted lines indicate varying degrees of the tilting angles. ANT, anterior; INF, inferior; POST, posterior; SUP, superior.

Probe movement	Explanation of method
	1. Focused angling/tilting in the transverse scan plane. By tilting the probe handle from the start position (star symbol), the sound beam can be angled/tilted in either direction. For example, by using the probe handle as a reference, if the probe handle is moved from the start position 1 to 3, the sound beam will be directed superiorly (cranially) on the patient to position 3 within the body (Figure 1.27b).

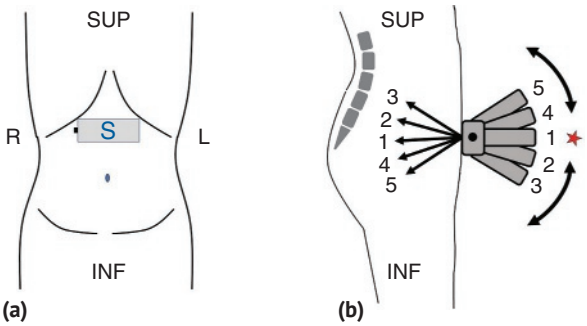
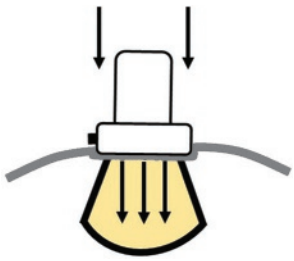
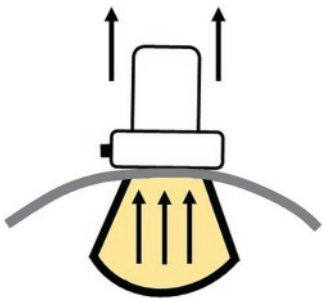


Figure 1.27 Focused angling/tilting in the transverse scan plane. (a) Anterior view of the patient. The transducer icon is positioned in the transverse scan plane in the ML of the body; (b) side view of the body shows the start point (star symbol). The probe is viewed in the short axis, where the POM is indicated by the solid black circle. The numbers indicate the different positions of the probe handle tilt. The straight arrows indicate the direction of the sound beam location relative to the numbered probe handle positions. The curved arrows indicate the directions for motion of superior-inferior and inferior-superior sweeps of the probe angling/ tilting technique from the center start point. INF, inferior; L, left; R, right; SUP, superior.

	2. Serial angling/tilting in the transverse scan plane. This method of angling/tilting the probe handle in a continuous serial motion is called sweeping the beam. Figure 1.27b helps illustrate this technique by using the probe handle as a reference. The handle position 1 is the start point (star symbol). When the probe handle is angled from position 1 to 2 to 3, the sound beam is directed superiorly (cranially). When the angle is reversed by tilting the probe handle from position 3 to 2 to 1, the sound beam moves inferiorly back to the 0° tilt start point at position 1. Then, when the probe handle motion continues from position 1 to 4 to 5, the sound beam is directed inferiorly (caudally). Subsequently, when the probe handle's direction is reversed (from position 5 to 4 to 1), the sound beam will be directed back to the start point. By angling/tilting the probe handle in a continuous motion in the directions along the short axis of the probe, this "sweeping" motion of angling the beam back and forth will allow us to interrogate an area/structure in the transverse scan plane. This serial motion can be captured in a video clip.

(Continued)

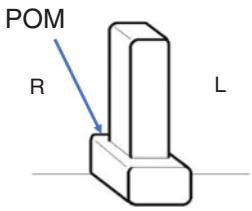
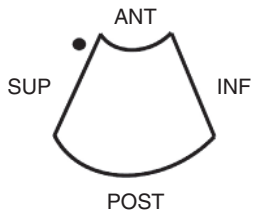
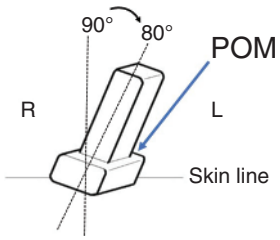
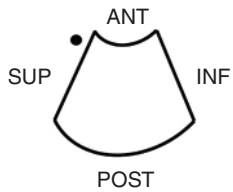
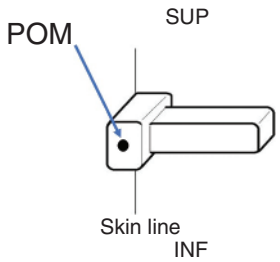
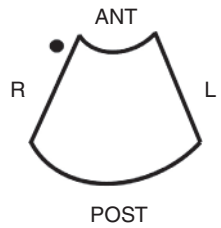
Table 1.3 (Continued)

Probe movement	Explanation of method
Compression technique	In this method, the probe face is entirely in contact with the skin surface. Pressure is applied to the transducer handle toward the skin surface. This technique can be done in any scan plane (Figure 1.28). This technique allows to: • push bowel gas away from the FOV. • observe the compressibility of a structure when used in conjunction with the release pressure technique. • observe if a lesion or mass moves with an organ/structure, or if it just slides against it.  **Figure 1.28** Compression technique. Arrows show the motion of the probe toward the patient.
Release pressure	In this method, the probe face is in contact with the surface of the skin. Pressure is released from the transducer. This technique can be done in any scan plane (Figure 1.29). This technique allows for: • the near field structures to be seen. • more accurate measurements of superficial anatomy. For example, if an abdominal mass is close to the surface of the abdominal wall, it may be compressed by the pressure from the probe held by the sonographer. By releasing pressure, more accurate measurements can be taken. • assessment of the compressibility of a structure when used in conjunction with the compression technique.  **Figure 1.29** Releasing pressure. Arrows show the motion of the probe away from the patient for the release of some pressure.

1.8 Transducer Placement on the Patient's Skin and Corresponding Orientation in the FOV

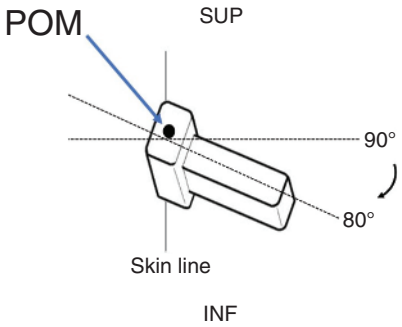
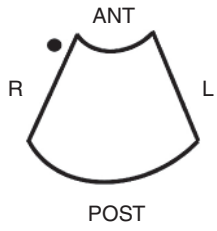
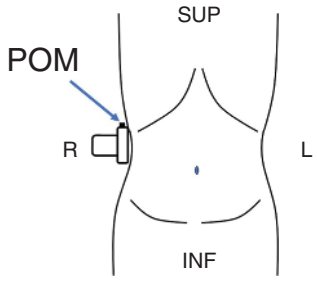
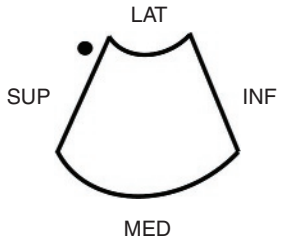
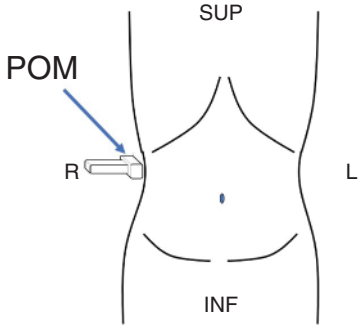
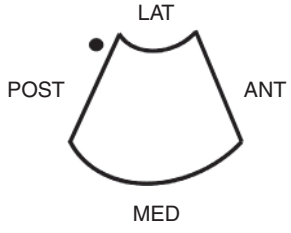
When using the different windows to scan organs and structures in the body, it is crucial to consider the scan plane and thus, the orientation in the FOV, based on the location of the POM. As mentioned before, both POM and IDM must match to ensure the standard orientation used for sweeps and images (Table 1.4 and Figures 1.30–1.45).

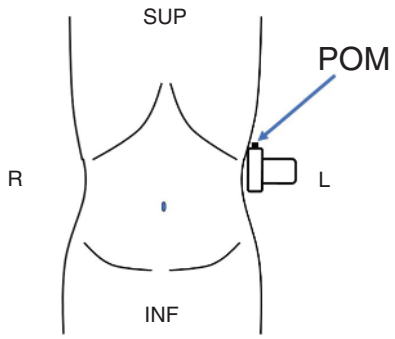
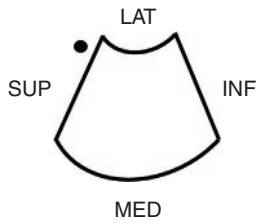
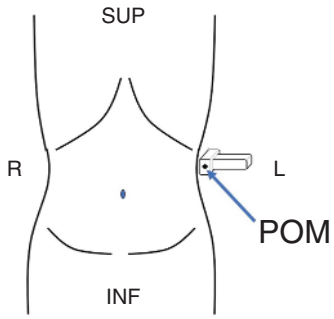
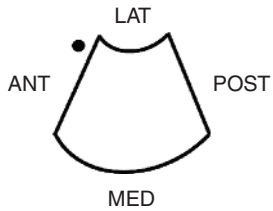
Table 1.4 Examples of transducer placement and corresponding orientation in the FOV.

Plane	Transducer placement	Corresponding orientation in FOV
Sagittal	 **Figure 1.30** Viewing perspective from the patient's feet. Transducer in the sagittal scan plane is placed anteriorly on the abdomen with the handle upright and at 90° to the skin surface. POM is facing superiorly, as shown by the arrow. L, left; POM, probe orientation marker; R, right.	 **Figure 1.31** Orientation and IDM (solid black circle) correspond to Figure 1.30. ANT, anterior; INF, inferior; POST, posterior; SUP, superior.
Sagittal – angling the probe	 **Figure 1.32** Viewing perspective from the patient's feet. The angle between the transducer and skin surface is shown to range from 90° to 80°, directing the sound beam to the patient's right in the sagittal plane. POM is facing superiorly, as shown by the arrow. L, left; POM, probe orientation marker; R, right.	 **Figure 1.33** Orientation and IDM (solid black circle) correspond to Figure 1.32. ANT, anterior; INF, inferior; POST, posterior; SUP, superior.
Transverse	 **Figure 1.34** Viewing perspective from the patient's side. Transducer in the transverse scan plane with the probe handle at 90° to the skin surface. POM faces patient's right, as shown by the arrow. INF, inferior; POM, probe orientation marker; SUP, superior.	 **Figure 1.35** Orientation and IDM (solid black circle) correspond to Figure 1.34. ANT, anterior; L, left; POST, posterior; R, right.

(Continued)

Table 1.4 (Continued)

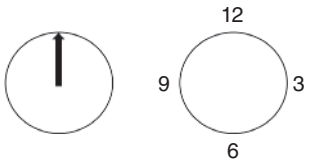
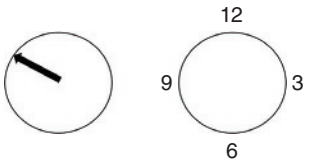
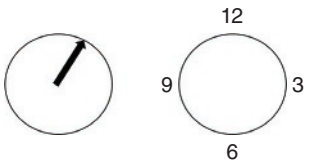
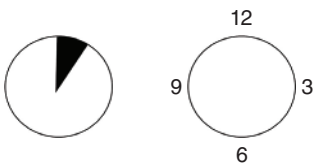
Plane	Transducer placement	Corresponding orientation in FOV
Transverse – angling the probe	 **Figure 1.36** Viewing perspective from the patient's side. Angle between the transducer and skin surface is shown ranging from 90° to 80°, directing the sound beam superiorly in the transverse plane. POM faces toward the patient's right, as shown by the arrow. INF, inferior; POM, Probe Orientation Marker; SUP, superior.	 **Figure 1.37** Orientation and IDM (solid black circle) correspond to Figure 1.36. ANT, anterior; L, left; POST, posterior; R, right.
Sagittal – right coronal	 **Figure 1.38** Anterior view of the abdomen. Transducer in the coronal scan plane, from the patient's right flank. POM faces the patient's head as shown by the arrow. INF, inferior; L, left; POM, Probe Orientation Marker; R, right; SUP, superior.	 **Figure 1.39** Orientation and IDM (solid black circle) correspond to Figure 1.38. INF, inferior; LAT, lateral; MED, medial; SUP, superior.
Transverse – right coronal	 **Figure 1.40** Anterior view of the abdomen. Transducer in the transverse scan plane, coronal approach/window, from patient's right flank. POM faces the patient's back, as shown by the arrow. INF, inferior; L, left; POM, Probe Orientation Marker; R, right; SUP, superior.	 **Figure 1.41** Orientation and IDM (solid black circle) correspond to Figure 1.40. ANT, anterior; LAT, lateral; MED, medial; POST, posterior.

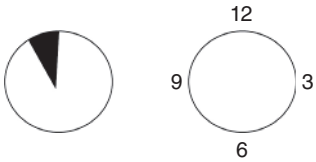
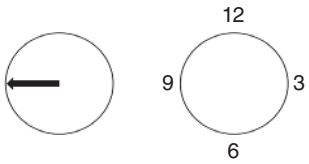
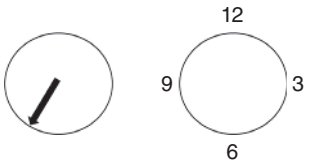
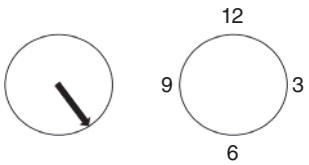
Plane	Transducer placement	Corresponding orientation in FOV
Sagittal – left coronal	 **Figure 1.42** Anterior view of the abdomen. Transducer in the coronal scan plane, from the patient's left flank. POM faces the patient's head, as shown by the arrow. INF, inferior; L, left; POM, probe orientation marker; R, right; SUP, superior.	 **Figure 1.43** Orientation and IDM (solid black circle) corresponding to Figure 1.42. INF, inferior; LAT, lateral; MED, medial; SUP, superior.
Transverse – left coronal	 **Figure 1.44** Anterior view of the abdomen. Transducer in the transverse scan plane, coronal approach/window, from patient's left flank. POM faces the patient's front, as shown by the arrow. INF, inferior; L, left; POM, probe orientation marker; R, right; SUP, superior.	 **Figure 1.45** Orientation and IDM (solid black circle) corresponding to Figure 1.44. ANT, anterior; LAT, lateral; MED, medial; POST, posterior.

1.9 Clockface Symbols

Clockface symbols are used in this guidebook to indicate the position of the POM in relation to a clock. For example, when the POM is at 12 o'clock, it means that the POM is pointing superiorly, toward the patient's head. When the POM is at 10 o'clock, it means that the POM is pointing slightly off the ML, toward the patient's right shoulder, in a sagittal oblique plane (Table 1.5 and Figures 1.46–1.55).

Table 1.5 Examples of clockface symbols used in this guidebook.

Plane	Clockface indicating the position of POM
Sagittal, arrow	 **Figure 1.46** Clockface symbol indicating that the POM needs to be pointing to 12 o'clock (arrow), that is, superiorly, toward the patient's head, in the sagittal plane.
Sagittal oblique – arrow	 **Figure 1.47** Clockface symbol indicating that the POM needs to be pointing to ten o'clock (arrow), that is, toward the patient's right shoulder in a sagittal oblique plane.  **Figure 1.48** Clockface symbol indicates that the POM needs to be pointing to 1 o'clock (arrow), that is, toward the patient's left shoulder in a sagittal oblique plane.
Sagittal Oblique – range	 **Figure 1.49** Clockface symbol indicating that the transducer rotation ranges from 12 to 1 o'clock, where 1 o'clock means having the POM pointing toward approximately the patient's left shoulder, in the sagittal plane. This transducer rotation maneuver allows changing the scan plane from sagittal to sagittal oblique or vice versa.

Plane	Clockface indicating the position of POM
	 **Figure 1.50** Clockface symbol indicating that the transducer rotation ranges from 11 to 12 o'clock, where 11 o'clock means having the POM pointing toward approximately the patient's right shoulder in a sagittal oblique plane. This transducer rotation maneuver allows changing the scan plane from sagittal to sagittal oblique or vice versa.
Transverse – arrow	 **Figure 1.51** Clockface symbol indicating that the POM needs to be pointing to 9 o'clock (arrow), that is, toward the patient's right, in the transverse plane.
Transverse Oblique – arrow	 **Figure 1.52** Clockface symbol indicating that the POM needs to be pointing to 7 o'clock (arrow), that is, toward approximately the patient's right hip in an oblique plane.  **Figure 1.53** Clockface symbol indicating that the POM needs to be pointing to 5 o'clock (arrow), that is, toward approximately the patient's left hip, in an oblique plane.

(Continued)

Table 1.5 (Continued)

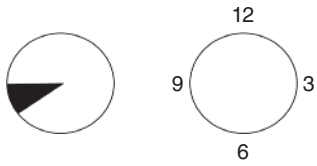
Plane	Clockface indicating the position of POM
Transverse Oblique – range	

Figure 1.54 Clockface symbol indicating that the transducer rotation ranges from 8 to 9 o'clock where 9 o'clock means having the POM pointing toward the patient's right in the transverse plane. This transducer rotation maneuver allows changing the scan plane from transverse to transverse oblique and vice versa.

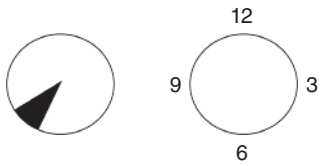


Figure 1.55 Clockface symbol indicating that the transducer rotation ranges from 7 to 8 o'clock where 7 o'clock means having the POM pointing toward approximately the patient's right hip. This transducer rotation maneuver allows changing the scan plane from transverse to transverse oblique and vice versa.

1.10 Guidebook Chapters

Each chapter of this guidebook contains the following content:

1.10.1 Introduction

Each chapter starts with a few points to consider for the specific organ/structure. These points are presented so that the reader is aware of them at the start of each chapter because they provide insights which help to further understand the scanning of that particular organ/structure.

1.10.2 Window Diagrams

Window diagrams include specific locations of common acoustic windows used to visualize an organ/structure or a portion of an organ/structure. A "window" is the place on the body where the transducer is to be placed to image a specific organ/structure or part of an organ/structure. In this guidebook, each window is identified with a number and a name. Please refer to the window number in the scanning table for scanning techniques when using that specific scan window. Below are examples of window diagrams (Figures 1.56 and 1.57):

Gallbladder
Anterior windows

MCL = mid clavicular line

1 = epigastric, slightly to the patient's right
2 = subcostal at MCL
3 = first intercostal space superior to costal margin, along MCL

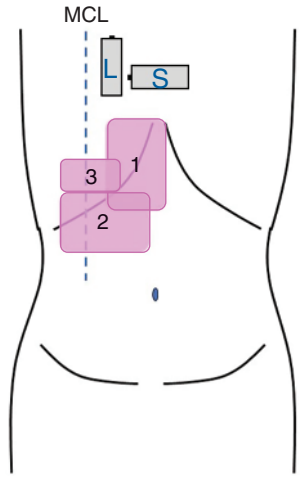


Figure 1.56 Anterior view of the body. Pink areas represent windows used to scan the specific organ/structure, in this case, the GB. Each window is identified by a number and further described by a name. For example, window 2 is also referred to as "subcostal at midclavicular line." Transducer icons for long and short axes are also shown, pointing to the correct orientation. In this figure, the transducer icon in the long axis is shown in line with the long axis of the body for the sagittal scan plane. The transducer icon in the short axis is shown perpendicular to the long axis of the body for the transverse scan plane. MCL, midclavicular line.

Aorta and common iliac arteries
anterior windows

1 = epigastric
2 = midpoint between xiphoid and umbilicus
3 = umbilical
5 = right common iliac artery
6 = left common iliac artery

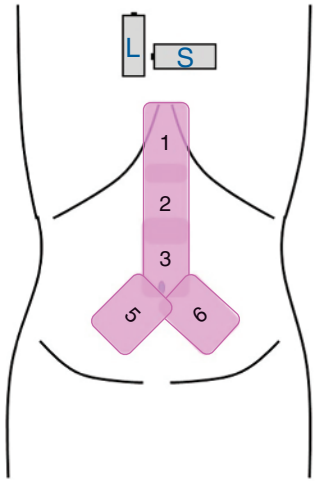


Figure 1.57 Anterior view of the body. Pink areas represent windows used to scan the specific organ/structure, in this case, the abdominal aorta (Ao) and common iliac arteries (CIAs). Each window is identified by a number and further described by a name. For example, window 1 is also referred to as "epigastric." Transducer icons for long and short axes are also shown, pointing to the correct orientation for the specific scan planes required for the assessment of the organ/structure. In this figure, the transducer icon in the long axis is shown in line with the long axis of the body for the sagittal scan plane. The transducer icon in the short axis is shown perpendicular to the long axis of the body for the transverse scan plane.

1.10.3 Scanning Tables

Scanning tables contain details of the scanning techniques for each organ/structure. In these tables, the reader can find how to scan each organ/structure using each window described in the Windows Diagram section. These tables will outline the patient position, transducer rotation, angle between the transducer and the skin, and representative images to acquire. Additional scanning tips are listed after every scanning table.

In each table, the reader will find specific information on:

- Transducer placement regarding the plane (sagittal, transverse, oblique, etc.).
- Transducer rotation which describes the position of the transducer's POM relative to the hands on a clock-face. For example, on the patient's body, rotate the transducer so that the POM is pointing to 12 o'clock.
- The angle between the transducer and the skin, which describes the direction in which the transducer needs to be pointed or tilted with respect to the patient's skin (Figures 1.30–1.36). For example, when directing the sound beam to the patient's left side, with the transducer in the sagittal plane, an angle range of 90–80° means that the transducer needs to be in a range from perpendicular to the skin (90°) to slightly tilted toward the patient's left side (80°).
- Heel-toeing maneuvers (Figures 1.22–1.23) pertaining to the scanning of an organ/structure. Basically, the transducer is angled to direct the sound beam in a different direction. A lot of times, heel-toe is in reference to probe manipulation with Doppler and interventional procedures, where the ultrasound user has to heel-toe the transducer in order to get a better angle of insonation or see the needle tip, respectively.

1.10.4 Ultrasound Images

In each chapter, the reader is referred to several ultrasound images using a figure number. Each image has an orientation diagram next to it, which assists the reader to understand the anatomical orientation of the ultrasound image. This orientation diagram also includes IDM for further clarity.

Annotation or labeling of images can sometimes be relative to the patient, and sometimes relative to the anatomy, depending on the facility protocol. For the purposes of this guidebook, the views of anatomy will be described in long and short-axis planes. Planes in the tables will also be referred to sometimes as long and short axes, relative to the anatomical part being evaluated.

Sequence, protocol, and examples of images may vary depending on the organization or facility. The sequence, protocol, and examples of images described in this guidebook come from the authors' extensive clinical experience.

To ensure ease in understanding the content for the reader, the ultrasound images in the figures have been edited with the intention to help facilitating ease of understanding the visual elements pertaining to ultrasound scanning. Ultrasound image editing included the following:

- cropping of the image
- the addition of text and/or symbols to identify key anatomical structures
- highlighting areas for clarity
- multipart figures which have an image placed with another image, or the placement of an image with an illustration

The drawings and all images in this guidebook will depict the correct anatomical orientation corresponding to that when viewing the patient from a specific approach. Always refer to the POM and/or the IDM indicated in the figures for further clarity.

1.11 Transducers and Transducer Frequency

In this guidebook, curvilinear and linear transducers are mentioned, as these are used for abdominal ultrasound. A combination of low and high-frequency curvilinear transducers is recommended to scan the abdominal organs and structures. The higher frequency curvilinear transducer is necessary when assessing the surface of the liver or the bowel, for example, as it is explained in the corresponding chapters. In addition, a linear transducer, which also has a higher frequency range, is useful to further assess the bowel.

1.12 Image Optimization

Although this guidebook focuses on scanning techniques, it is important to mention a few points about image optimization.

When the harmonics function is used, resolution improves, and noise is eliminated or minimized from cystic structures such as vessels, GB, and biliary ducts, for example. This facilitates determining whether these structures are indeed cystic in nature and so they can be optimally displayed. By the same token, harmonics also help improve image optimization when imaging pathologies. Nowadays, most, if not all, ultrasound systems have harmonics as part of the default presets.

Dynamic range involves the number of shades of gray being used. That is, when the dynamic range is decreased, contrast increases because fewer shades of gray are applied. This also helps eliminating or minimizing noise within cystic structures. Furthermore, this improvement in contrast helps with identifying lesions that may have a similar echogenicity compared with the surrounding tissue.

1.13 Ergonomics

Adjustable beds, chairs, and stools are helpful in finding the best position for the ultrasound operator to perform the ultrasound examination. The ultrasound machine, ultrasound operator, and the patient should be in close proximity to each other to prevent any undue strain to the operator. Thus, it is important to have the patient move closer to the edge of the bed, when lying on a stretcher, to avoid hyperextension or potential strain of the scanning arm. The ultrasound operator must be cognizant of their posture while scanning to avoid any repetitive strain injuries. In addition, using either the 4th and 5th digits or the side of the scanning hand to assist with anchoring the transducer to the patient's skin (See Figure 3.20) helps with stabilizing the scanning hand and thus allows for a more stable holding of the transducer.

1.14 Patient Preparation and Care

Although patient preparation and care are not included in this guidebook, it is important to highlight that patients need to be fasting prior to an abdominal ultrasound examination. Filling the bladder is required for those male patients having an ultrasound examination of the pelvis. In addition, proper care, such as explaining the procedure, obtaining consent, among others, must be provided before, during, and after the ultrasound examination.

1.15 Using This Guidebook

Please follow the steps below to use this guide:

- Spend a significant amount of time to become familiar with Chapter 1. This chapter lays out the foundation for the next chapters.
- Familiarize yourself with the abbreviations used throughout the guidebook. The abbreviations are listed in Chapter 1 for easy reference.
- It is crucial to spend time becoming familiar with the content in each chapter before you attempt to scan. For each chapter:
  - Study the Window Diagrams referring to the numbered windows and the transducer position.
  - Read the content in the Scanning Table for each window as well as the additional scanning tips.
  - Review the examples of images provided.

The learner may want to bring this guidebook to the scanning lab to refer to while scanning. Making notes as needed is also highly recommended, as well as asking questions to the clinical instructor or sonography mentor.

It is strongly recommended for the learner to read this guide often, such as in between labs, for example, to further consolidate what has been learned during the scanning lab.

Bibliography

Bahner DP, Blickendorf JM, Bockbrader M, Adkins E, Vira A, Boulger C, et al. Language of transducer manipulation: codifying terms for effective teaching. Journal of Ultrasound Medicine [Internet]. 2016;35(1): 183–188. Available from: https://doi.org/10.7863/ultra.15.02036.

De Jong, Jr MR. Craig's Essentials of Sonography and Patient Care. 4th ed. MO: Elsevier; 2018.

Kremkau FW. Sonography Principles and Instruments. 10th ed. MO: Elsevier; 2023.

Professional Practice Guidelines [Internet]. Sonography Canada (accessed 2023 June 23). Available from: https://sonographycanada.ca/membership/professional-practice-guidelines.

Rumack CM, Wilson SR, Charboneau JW, et al. Diagnostic Ultrasound. 3rd ed. Vol. 1. MO: Elsevier; 2005.