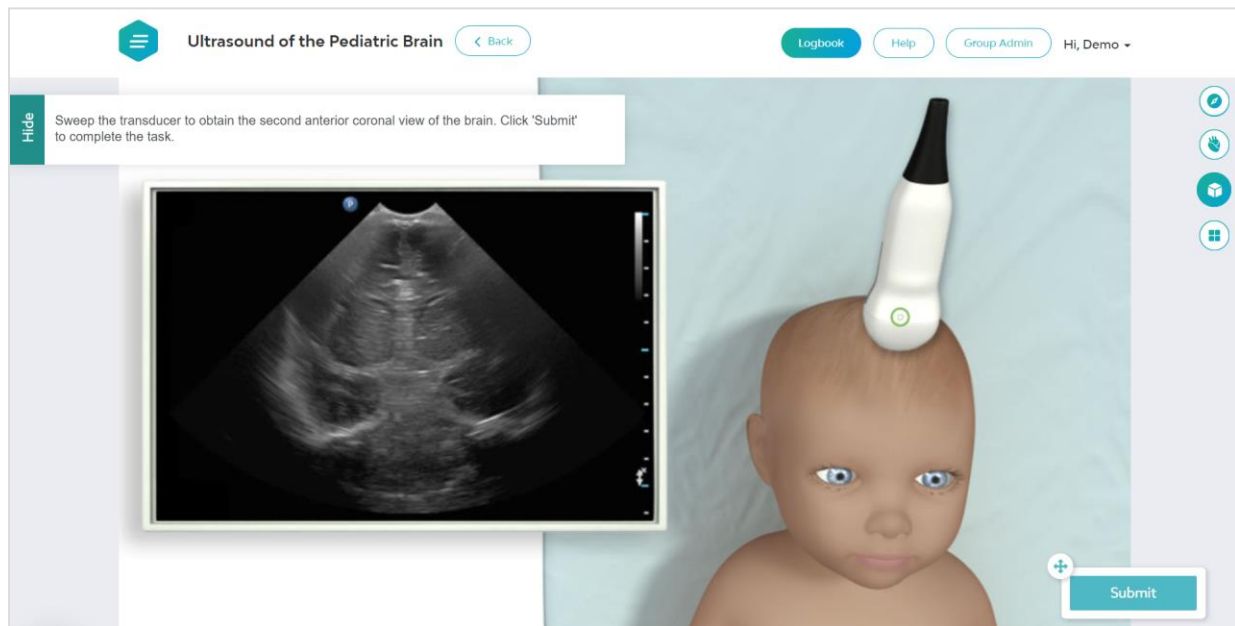


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SIMTICS Sonography Module Outlines

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General Introductory Modules

Basic Ultrasound Scan Techniques

Learning Objectives

- Define and explain related ultrasound terminology
- Identify orientation on the ultrasound image
- Identify and obtain cross-sectional anatomy on ultrasound images
- Identify vascular landmarks used in abdominal imaging
- Describe and explain the significance of obtaining a relevant patient history
- Describe and explain the reason for patient preparation for ultrasound examinations
- Describe and demonstrate the reason for patient positioning for ultrasound examinations
- Manipulate the transducer in sagittal, transverse, and oblique planes
- Demonstrate different transducer approaches and manipulations used to obtain optimum images on different body types
- Describe and explain the reason for patient breathing techniques in order to obtain optimum images
- Identify and utilize acoustic windows in order to obtain optimum ultrasound images
- Describe and explain the requirements for annotation of ultrasound images
- Describe the technique for measuring structures on ultrasound images
- Using a standard format, write a technical impression
- Demonstrate and describe methods for preventing musculoskeletal injury
- Explain the importance of belonging to a professional association.

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1 - Overview

1.1 - Orientation

1.1.1 - Anatomical directions

1.1.2 - Planes or body sections

1.1.3 - On-screen orientation

1.1.4 - Abdominal quadrants and regions

1.2 - Cross sectional anatomy

1.3 - Abdominal vascular landmarks

2 - Preprocedure considerations

2.1 - Patient preparation

2.2 - History

2.3 - Patient position

3 - Procedure

3.1 - Image optimization

3.2 - Transducer manipulation

3.3 - Approaches

3.4 - Breathing

3.5 - Windows

3.6 - Survey scan

3.7 - Protocol

3.8 - Annotation

- 3.9 - Measurement
- 4 - Postprocedure considerations
 - 4.1 - Patient
 - 4.2 - Preliminary report
- 5 - Professional considerations
 - 5.1 - Ergonomics
 - 5.2 - Professional involvement

Ultrasound Physics I

Learning Objectives

- Discuss units and conversions
- Discuss metric system
- Discuss scientific notation, exponents and logarithms
- List and describe the properties of sound waves
- Discuss the parameters of sound waves / speed of sound
- Diagram and compare wave motions
- Diagram and explain mechanisms of attenuation and attenuation coefficients
- Explain acoustic impedance
- Discuss power and intensity
- Explain and diagram the laws of reflection and refraction
- Discuss Snell's Law
- Explain pulse echo principle
- Compare pulse wave to continuous wave
- Discuss crystal diameter and thickness
- Define bandwidth and how it affects an image
- Define Q factor and how it affects an image
- Discuss the types of resolution
- Describe how beam configuration affects image
- Discuss Huygens' Principle and how it relates to phase
- Compare focused and unfocused transducers
- Discuss slice thickness and how it affects the image
- Discuss the role of piezoelectricity in the production and processing of ultrasound
- Diagram and explain transducer construction
- Describe the effects of changing transducer frequency
- Compare types of transducer construction and application
- Discuss the types of transducers
- Apply pulse echo to system design
- Discuss the effect of TGC, gain, and power
- List and describe equipment modes
- Diagram and describe scan converters
- List and describe image recorders
- Discuss parts of ultrasound system
- Explain filters, gates, color maps, pre, and post processing

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Step 1: Basics

- 1.1 Basic mathematics
- 1.2 Units of measurement
- 1.3 Metric system
- 1.4 Relationships and proportionality
- 1.5 Logarithms
- 1.6 Basic trigonometry
- 1.7 Decimal system

Step 2: Waves

- 2.1 Definition
- 2.2 Classification
- 2.3 Propagation of mechanical waves
- 2.4 Acoustic variables
- 2.5 Characteristics and parameters of sound waves
- 2.6 The sound beam
- 2.7 Sound interference
- 2.8 Huygens' Principle
- 2.9 Decibels (dB)

Step 3: Attenuation

- 3.1 Definition
- 3.2 Attenuation coefficient
- 3.3 Half-value layer thickness
- 3.4 Power and intensity
- 3.5 Acoustic impedance
- 3.6 Reflection and transmission coefficient

Step 4: Pulse wave

- 4.1 Pulse echo principle
- 4.2 Pulse wave and continuous wave
 - 4.2.1 Range equation
 - 4.2.2 Parameters for pulse wave ultrasound
- 4.3 Bandwidth and operating frequency
- 4.4 Axial resolution
- 4.5 Frame rate
- 4.6 Temporal resolution

Step 5: Transducers

- 5.1 Transducer construction
- 5.2 Types of transducers
- 5.3 Multifrequency and broadband transducers
- 5.4 Piezoelectric effect
- 5.5 Crystal thickness and operating frequency
- 5.6 Matching layer
- 5.7 Damping layer
- 5.8 Imaging dimensions
- 5.9 Axial resolution
- 5.10 Lateral resolution
- 5.11 Elevational resolution
- 5.12 Blind Doppler probe

5.13 Sequencing

5.14 Steering

5.15 Focusing

Step 6: System operation

6.1 Real-time imaging

6.2 Dynamic range

6.3 Frame averaging techniques

6.4 Preprocessing and postprocessing

6.5 Pulser and beam former

6.6 Receiver

6.7 Contrast resolution

6.8 Analog to digital

6.9 Scan converter

6.10 Display

6.11 Ultrasound modes

6.12 Storage devices

Ultrasound Physics II

Learning Objectives

- Identify and explain artifacts
- Identify testing results that show artifacts from electrical interference
- Discuss methods used to minimize artifacts
- Compare methods and formulae used to measure power
- Discuss the relationship between power and patient exposure
- List and describe bioeffects
- Discuss methods used to minimize bioeffects
- Discuss contrast and harmonics
- Diagram and describe tests for equipment performance
- List and describe the elements of a comprehensive quality assurance program for an imaging lab
- Discuss the importance of preventive maintenance
- Identify, discuss, and describe the proper use of the following: Doppler, color Doppler, power Doppler, and spectral Doppler ultrasound
- Discuss aliasing and explain how to prevent it
- Discuss fluid and hemodynamics

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Step 1: Artifacts

1.1 Definition

1.2 Classification

1.3 Resolution artifact

1.4 Location artifacts

1.5 Attenuation artifacts

1.6 Doppler artifacts

Step 2: Bioeffects

- 2.1 Mechanisms
- 2.2 Thermal bioeffects
- 2.3 Mechanical bioeffects
- 2.4 Intensity
- 2.5 Beam uniformity coefficient (BUC)
- 2.6 Duty factor (DF)
- 2.7 Measurement of sound energy
- 2.8 Dosimetry
- 2.9 Epidemiology
- 2.10 American Institute of Ultrasound in Medicine (AIUM) statements
- 2.11 ALARA

Step 3: Contrast and harmonics

- 3.1 Harmonic imaging
- 3.2 Contrast harmonics
- 3.3 Tissue harmonics
- 3.4 Mechanical index
- 3.5 Future applications

Step 4: Quality Assurance

- 4.1 Definition
- 4.2 Test object
- 4.3 Tissue phantom
- 4.4 Doppler phantom
- 4.5 Slice thickness phantom
- 4.6 Performance measurements
- 4.7 Accreditation of ultrasound practices

Step 5: Hemodynamics

- 5.1 Definitions
- 5.2 Laminar flow
- 5.3 Turbulent flow
- 5.4 Energy gradient
- 5.5 Forms of energy
- 5.6 Energy loss
- 5.7 Pressure flow
- 5.8 Poiseuille's law
- 5.9 Bernoulli's equation
- 5.10 Reynolds number

Step 6: Doppler principles

- 6.1 Ohm's law
- 6.2 Doppler frequency
- 6.3 Doppler equation
- 6.4 Positive and negative Doppler shifts
- 6.5 Continuous wave Doppler
- 6.6 Pulse wave Doppler
- 6.7 Color flow Doppler
- 6.8 Spectral analysis
- 6.9 Power Doppler
- 6.10 Resistivity and pulsatility indices

Abdomen

Ultrasound of the Abdominal Vasculature (also in Vascular category)

Learning Objectives

- List indications for ultrasound of the abdominal blood vessels
- Identify abdominal vascular anatomy on diagrams and sonograms
- List signs and symptoms of abdominal vascular disease
- Describe the abdominal vascular protocol
 - Equipment preparation - transducer and preset selection
 - Patient preparation
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the aorta, abdominal aortic branches, and common iliac arteries
- Identify and obtain sonographic images of the inferior vena cava and its tributaries
- Identify and obtain sonographic images of the portal vein, superior mesenteric vein, inferior mesenteric vein, and splenic vein
- Obtain Doppler spectral traces of the aorta and inferior vena cava
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the blood vessels
- Differentiate normal and abnormal sonographic appearances of the vascular system
- Identify and describe common pathology of the abdominal vasculature
- Explain the important ultrasound characteristics when evaluating an abdominal aortic aneurysm
- Describe the normal and abnormal Doppler patterns of the vascular structures
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

- 0.1 Principles of Doppler ultrasound
- 0.2 Basic physiology of the abdominal blood vessels
 - 0.2.1 Signs and symptoms of abdominal vascular disease

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the abdominal blood vessels

Step 4: Commence the scanning protocol for the abdominal blood vessels

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Images required
- 4.4 Annotations required

- 4.5 Sonographic features of normal abdominal vessels
 - 4.5.1 Sonographic features of the normal abdominal aorta
 - 4.5.2 Sonographic features of the normal celiac axis
 - 4.5.3 Sonographic features of the normal common hepatic artery
 - 4.5.4 Sonographic features of the normal splenic artery
 - 4.5.5 Sonographic features of the normal superior mesenteric artery (SMA)
 - 4.5.6 Sonographic features of the normal renal arteries
 - 4.5.7 Sonographic features of the normal inferior mesenteric artery (IMA)
 - 4.5.8 Sonographic features of the normal inferior vena cava (IVC)
 - 4.5.9 Sonographic features of the normal renal veins
 - 4.5.10 Sonographic features of the normal superior mesenteric vein (SMV)
 - 4.5.11 Sonographic features of the inferior mesenteric vein (IMV)
 - 4.5.12 Sonographic features of the splenic vein
 - 4.5.13 Sonographic features of the normal portal vein

4.6 Variants

4.7 Troubleshooting

Step 5: Scan the aorta

- 5.1 Scan the proximal aorta in the longitudinal plane
- 5.2 Scan the mid aorta in the longitudinal plane
- 5.3 Scan the distal aorta in the longitudinal plane
- 5.4 With the patient in the supine position scan the aorta in the transverse plane
- 5.5 Obtain a Doppler spectral trace of the aorta
- 5.6 Scan celiac artery in the longitudinal plane
- 5.7 Scan the celiac artery in the transverse plane
- 5.8 Pathology of the celiac axis
- 5.9 Scan the SMA in the longitudinal plane
- 5.10 Scan the SMA in the transverse plane
- 5.11 Pathology of the SMA

Step 6: Scan the inferior vena cava

- 6.1 Scan the proximal inferior vena cava (IVC) in the longitudinal plane
- 6.2 Scan the distal inferior vena cava (IVC) in the longitudinal plane
- 6.3 Scan the inferior vena cava (IVC) in the transverse plane
- 6.4 Obtain a Doppler spectral trace of the inferior vena cava

Step 7: Scan the portal venous system

- 7.1 Obtain longitudinal images of the main portal vein (MPV)
- 7.2 Obtain a Doppler spectral trace of main portal vein (MPV)
- 7.3 Obtain longitudinal images of the superior mesenteric vein (SMV)
- 7.4 Obtain a Doppler trace of the SMV
- 7.5 Obtain a longitudinal image of the splenic vein
- 7.6 Obtain a Doppler trace of the splenic vein
- 7.7 Obtain a longitudinal image of the inferior mesenteric vein (IMV)
- 7.8 Obtain a Doppler trace of the IMV

Step 8: Complete the procedure

Ultrasound of the Gallbladder

Learning Objectives

- List indications for ultrasound of the gallbladder
- Identify gallbladder anatomy
- Explain gallbladder physiology
- List clinical symptoms of gallbladder disease
- Describe and apply the gallbladder protocol
 - Patient preparation
 - Transducer selection and preset selection
 - Patient positioning
 - Transducer positions and scan planes
- Identify and obtain sonographic images of the gallbladder, bile ducts, and portal triad
- Identify and obtain sonographic images of the extrahepatic biliary system
- Obtain measurements of the gallbladder and related structures
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the gallbladder
- Differentiate normal and abnormal sonographic appearances of the gallbladder
- List and identify common neoplasms of the gallbladder
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the gallbladder

Step 4: Commence the biliary system scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard biliary protocol image requirements
- 4.4 Annotations required
- 4.5 Sonographic features of a normal gallbladder
 - 4.5.1 Sonographic features of a prominent gallbladder
 - 4.5.2 Sonographic features of a contracted gallbladder
- 4.6 Sonographic features of gallbladder variants
- 4.7 Troubleshooting

Step 5: Scan the gallbladder in the longitudinal and transverse planes

- 5.1 Scan the body and fundus of the gallbladder in the longitudinal plane
- 5.2 Scan the body and neck of the gallbladder in the transverse plane

Step 6: Measure the gallbladder wall in the transverse plane

Step 7: Assess the bile ducts and measure the common hepatic duct (CHD) and common bile duct (CBD)

Step 8: Complete the procedure

Ultrasound of the Liver

Learning Objectives

- List indications for ultrasound of the liver
- Identify the liver anatomy
- Explain liver physiology and laboratory findings
- List clinical symptoms of liver disease
- Describe and apply the liver ultrasound scan protocol
 - Patient preparation
 - Transducer selection and preset selection
 - Patient positioning
 - Transducer positions
 - Scan plane
- Identify and obtain sonographic images of liver, vascular structures, ligaments, and fissures of the liver
- Obtain measurements of the liver
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the liver
- Differentiate normal and abnormal sonographic appearances of the liver
- Differentiate and describe common pathologies of the liver on sonographic images
- Identify and obtain images in hepatic trauma
- Identify and obtain images in hepatic transplantation
- Identify and obtain images of vascular flow abnormalities
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

- 0.1 Basic physiology of the liver
- 0.2 Signs and symptoms of liver disease

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the liver

Step 4: Commence the liver system scanning protocol

- 4.1 Patient Position
- 4.2 Scan Plane
- 4.3 Standard liver protocol image requirements and observations
- 4.4 Annotations required
- 4.5 Sonographic features of the normal liver
- 4.6 Sonographic features of liver variants
- 4.7 Troubleshooting

Step 5: Scan the liver in the longitudinal and transverse planes

- 5.1 Scan the liver in the longitudinal plane
- 5.2 Measure the liver in the longitudinal plane
- 5.3 Scan the liver in the transverse plane
- 5.4 Describe any findings from the longitudinal and transverse images:

Step 6: Hepatic vascular imaging and Doppler

6.1 Hepatic veins

6.2 Portal veins

6.3 Hepatic arteries

Step 7: Complete the procedure

Ultrasound of the Pancreas

Learning Objectives

- List indications for ultrasound of the pancreas
- Identify pancreas anatomy
- Explain pancreas physiology
- List clinical symptoms of pancreatic disease
- Identify laboratory data relevant to the pancreas
- Describe and apply the pancreas protocol
 - Patient preparation
 - Transducer and preset selection
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the pancreas
- Identify and obtain sonographic images of the vascular and ductal landmarks of the pancreas
- Obtain measurements of the pancreas and related structures
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the pancreas
- Differentiate normal and abnormal sonographic appearances of the pancreas
- List and identify common neoplasms of the pancreas
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

0.1 Basic physiology of the pancreas

0.2 Signs and symptoms of pancreatic disease

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the pancreas

Step 4: Commence the pancreas system scanning protocol

4.1 Patient position

4.2 Scan Plane

4.3 Standard pancreas protocol image requirements

4.4 Annotations required

4.5 Sonographic features of a normal pancreas

4.6 Trouble shooting

Step 5: Scan the pancreas in the transverse and longitudinal planes

5.1 Scan the head, neck, body, and tail of the pancreas in the transverse plane

5.2 Scan the head, neck, body, and tail of the pancreas in the longitudinal plane

5.3 Pathology of the parenchyma of the pancreas

Step 6: Assess and measure the pancreatic duct

6.1 Measure the pancreatic duct in its long axis

Step 7: Complete the procedure

Ultrasound of the Gastrointestinal Tract

Learning Objectives

- List indications for ultrasound of the gastrointestinal tract
- Identify the gastrointestinal tract anatomy
- Explain gastrointestinal physiology
- List clinical symptoms of gastrointestinal tract disease
- Describe and apply the gastrointestinal tract protocol:
 - Patient preparation
 - Transducer and preset selection
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the gastrointestinal tract
- Explain and demonstrate the use of breathing techniques and graded compression to obtain optimal sonographic images of the gastrointestinal tract
- Differentiate normal and abnormal sonographic appearances of the gastrointestinal tract
- Describe and identify pathologies of the gastrointestinal tract
- Describe and identify abnormalities of the gastrointestinal tract
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer, and obtain images of the gastrointestinal tract

Step 4: Commence the gastrointestinal tract scanning protocol

4.1 Patient position

4.2 Scan plane

4.3 Standard gastrointestinal tract protocol image requirements

4.4 Annotations required

4.5 Sonographic features of a normal gastrointestinal tract

4.6 Troubleshooting

Step 5: Scan gastrointestinal tract in longitudinal and transverse planes

5.1 Scan the segment of bowel in the longitudinal plane

5.2 Scan the segment of bowel in the transverse plane

5.3 Scan the segment of bowel using color or spectral Doppler

Step 6: Complete the procedure

Ultrasound of the Retroperitoneum, Peritoneal Cavity & Abdominal Wall

Learning Objectives

- List indications for ultrasound of the retroperitoneum, peritoneal cavity, and abdominal wall
- Identify the anatomy of the retroperitoneum, peritoneal cavity, and abdominal wall
- Explain the basic physiology of the retroperitoneum, peritoneal cavity, and abdominal wall
- Distinguish potential spaces for fluid collections in the abdominal and pelvic retroperitoneum
- List clinical symptoms of retroperitoneal, peritoneal, and abdominal wall disease
- Describe and apply the retroperitoneum, peritoneal cavity, and abdominal wall protocol
 - Patient preparation
 - Transducer and preset selection
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the retroperitoneum, peritoneal cavity, and abdominal wall
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the retroperitoneum, peritoneal cavity, and abdominal wall
- Identify and obtain images of the retroperitoneum, peritoneal cavity, and abdominal wall
- Describe and identify pathologies of the retroperitoneum
- Describe and identify abnormalities of the peritoneal cavity and abdominal wall
- Explain sonography occupational health and safety issues (see references)
- Explain Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the abdomen

Step 4: Commence retroperitoneum and peritoneal cavity scanning protocol

4.1 Patient position

4.2 Scan plane

4.3 Retroperitoneum and peritoneal cavity image requirements

- 4.4 Annotations required
- 4.5 Sonographic features of a normal retroperitoneum
- 4.6 Sonographic features of a normal peritoneal cavity
- 4.7 Troubleshooting

Step 5: Scan the retroperitoneum and peritoneal cavity

- 5.1 Scan the subphrenic space
- 5.2 Scan the perirenal space (also called the perinephric space) and pararenal spaces
- 5.3 Scan the lesser sac
- 5.4 Scan the right and left lower quadrants
- 5.5 Scan the pelvic cul-de-sac (Pouch of Douglas)

Step 6: Commence the abdominal wall scanning protocol

- 6.1 Patient position
- 6.2 Scan Plane
- 6.3 Abdominal wall image requirements
- 6.4 Annotations required
- 6.5 Sonographic features of the normal abdominal wall
- 6.6 Troubleshooting

Step 7: Scan the abdominal wall

- 7.1 Scan the anterior abdominal wall in the transverse plane
- 7.2 Scan the anterior abdominal wall in the longitudinal plane
- 7.3 Scan the inguinal canal/groin

Step 8: Complete the procedure

Ultrasound of the Spleen

Learning Objectives

- List indications for ultrasound of the spleen
- Identify spleen anatomy
- Explain splenic physiology and laboratory findings
- List clinical symptoms of splenic disease
- Describe and apply the spleen protocol
 - Patient preparation
 - Transducer and preset selection
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the spleen and vascular structures
- Obtain measurements of the spleen
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the spleen
- Differentiate normal and abnormal sonographic appearances of the spleen
- Differentiate and describe common pathologies of the spleen on sonographic images
- Identify and obtain images of vascular flow of the splenic artery and vein
- Identify and discuss the physiology of congestion of the spleen
- Compare and contrast focal and diffuse disease of the spleen

- Explain Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the spleen

Step 4: Commence the spleen scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard spleen protocol image requirements
- 4.4 Annotations required
- 4.5 Sonographic features of the normal spleen
- 4.6 Sonographic features of spleen variants
 - 4.6.1 Accessory spleen or splenunculus
 - 4.6.2 Ectopic or wandering spleen
 - 4.6.3 Agenesis of the spleen
- 4.7 Troubleshooting

Step 5: Scan the spleen in the longitudinal and transverse planes

- 5.1 Scan the spleen in the longitudinal plane
- 5.2 Assess the direction of flow in splenic vessels with color Doppler
- 5.3 Scan the spleen in the transverse plane

Step 6: Complete the procedure

Ultrasound of the Urinary Tract & Adrenal Glands

Learning Objectives

- List indications for ultrasound of the urinary tract and adrenal glands
- Identify the anatomy of the urinary tract and adrenal glands
- Explain the basic physiology of the urinary tract and adrenal glands
- Identify laboratory data relevant to the urinary tract
- Identify laboratory data relevant to the adrenal glands
- Describe and apply urinary tract protocol
 - Patient preparation
 - Transducer and preset selection
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the urinary tract
- Identify and obtain sonographic images of the adrenal gland
- Obtain measurements of the kidneys and related structures

- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the urinary tract and adrenal glands
- Differentiate normal and abnormal sonographic appearances of the urinary tract and adrenal glands
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the kidneys, bladder, and adrenal glands

Step 4: Commence the urinary tract and adrenal gland scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard urinary tract and adrenal gland protocol image requirements
- 4.4 Annotations required
- 4.5 Sonographic features of the normal urinary tract and adrenal glands
- 4.6 Sonographic features of renal variants
- 4.7 Troubleshooting

Step 5: Scan the kidneys in the longitudinal and transverse planes

- 5.1 Scan the right kidney in the longitudinal plane
- 5.2 Scan the right kidney in the transverse plane
- 5.3 Scan the left kidney in the longitudinal and transverse planes

Step 6: Scan the urinary bladder in the longitudinal and transverse planes

- 6.1 Scan the urinary bladder in the longitudinal plane
- 6.2 Scan the urinary bladder in the transverse plane
- 6.3 Scan the ureteric jets using color Doppler
- 6.4 Measure the post void volume of the urinary bladder

Step 7: Scan the renal arteries and veins

- 7.1 Scan the renal arteries
- 7.2 Scan the renal veins
- 7.3 Scan the renal segmental arteries in the longitudinal plane

Step 8: Scan the adrenal glands in the longitudinal and transverse planes

- 8.1 Scan the right adrenal gland in the longitudinal and transverse planes
- 8.2 Scan the left adrenal gland in the longitudinal and transverse planes

Step 9: Complete the procedure

Abdomen 1 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Abdominal Vessels
- Gallbladder
- Liver

- Pancreas

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Abdomen 2 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Gastrointestinal Tract
- Retroperitoneum, Peritoneal Cavity & Abdominal Wall
- Spleen
- Urinary Tract & Adrenal Glands

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Obstetrics

Ultrasound Assessment during First Trimester

Learning Objectives

- List and describe the sequence of embryonic development.
- Identify the anatomy of early intrauterine pregnancy on diagrams and sonograms.
- Describe how to obtain a patient history and correlate the information with laboratory results.
- Recognize and differentiate between intrauterine, ectopic, heterotopic, and multiple pregnancies, including signs, symptoms, and locations.
- Describe and demonstrate methods for calculating gestational age during the first trimester of pregnancy.
- Describe and recognize on images the features of various types of failed pregnancy in the first trimester.
- Describe and recognize on images embryonic abnormalities in the first trimester.
- Describe and recognize on images normal and abnormal amniotic fluid in the first trimester.
- Describe and recognize on images normal and abnormal placental anatomy in the first trimester.
- Explain the sonographic features of fetal demise of the first trimester.
- Describe and recognize on images first trimester abnormalities of the uterus and adnexae.
- Describe a nuchal translucency measurement.
- Follow relevant protocols when scanning.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the lower abdomen and apply the gel

Step 3: Select the transducer

Step 4: Commence the first trimester scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
 - 4.2.1 Transabdominal scan plane
 - 4.2.2 Endovaginal scan plane
- 4.3 Standard first trimester protocol image requirements
 - 4.3.1 Maternal uterus, ovaries, and adnexae
 - 4.3.2 Gestation sac
 - 4.3.3 Embryo
 - 4.3.4 Placenta

4.4 Annotations required

4.5 Troubleshooting

Step 5: Scan the pregnant pelvis transabdominally

- 5.1 Scan the uterus in longitudinal and transverse planes
- 5.2 Scan the ovaries and adnexae in longitudinal and transverse planes

- 5.3 Scan the gestation sac and yolk sac
 - 5.3.1 Scan the gestation sac
 - 5.3.2 Scan the yolk sac
 - 5.3.3 Multiple pregnancy and chorionicity
- 5.4 Scan the embryo in longitudinal and transverse planes
 - 5.4.1 Scan for crown-rump length and gestational age
 - 5.4.2 Scan the embryonic heart
 - 5.4.3 Scan the embryonic abdomen and pelvis
 - 5.4.4 Scan the fetal cranium
 - 5.4.5 Scan the embryonic spinal column
 - 5.4.6 Multiple pregnancy: scan for chorionicity

Step 6: Scan the pregnant pelvis endovaginally

- 6.1 Scan the uterus in longitudinal and coronal planes
- 6.2 Scan the adnexae and ovaries in coronal and longitudinal planes
- 6.3 Scan the gestation sac and yolk sac in longitudinal and coronal planes
- 6.4 Scan the embryo/fetus in longitudinal and transverse planes
 - 6.4.1 Scan for crown-rump length and gestational age
 - 6.4.2 Scan the embryonic heart
 - 6.4.3 Scan the embryonic abdomen and pelvis
 - 6.4.4 Scan the fetal cranium
 - 6.4.5 Scan the embryonic spinal column
 - 6.4.6 Multiple pregnancy

Step 7: Complete the procedure

Ultrasound Assessment during Second & Third Trimesters

Learning Objectives

- Identify on diagrams and sonograms normal fetal anatomy of the second and third trimesters.
- Describe and demonstrate gestational age assessment in the second and third trimesters, including multiple pregnancies.
- Describe fetal presentation and position.
- Identify on diagrams and sonograms normal fetoplacental anatomy of the second and third trimesters.
- Compare and contrast the advantages of 3D/4D imaging with those of conventional 2D imaging.
- Follow relevant protocols when scanning.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the lower abdomen and apply the gel

Step 3: Select the transducer

Step 4: Commence the second and third trimester pregnancy scanning protocol

4.1 Patient position

4.2 Scan plane

4.3 Standard second and third trimester protocol image requirements

4.3.1 Fetal lie, life, number, presentation and situs

4.3.2 Maternal uterus and adnexae

4.3.3 Amniotic fluid and placental location

4.3.4 Fetal biometry

4.3.5 Fetal anatomy

4.4 Annotations required

4.5 Troubleshooting

Step 5: Scan for fetal viability, number, presentation, and situs

5.1 Determine fetal lie and presentation

5.2 Scan the fetus for fetal viability

5.3 Determine fetal number

5.4 Determine fetal organ situs

Step 6: Scan the maternal uterus and adnexae

Step 7: Scan for amniotic fluid and placental location

7.1 Scan for amniotic fluid

7.1.1 Calculate amniotic fluid volume

7.2 Determine placental location

Step 8: Assess fetal biometry

8.1 Calculate the biparietal diameter

8.2 Head circumference

8.3 Abdominal circumference

8.4 Femur length

8.5 Transcerebellar diameter

8.6 Cephalic index

Step 9: Scan fetal anatomy relevant to gestational age

9.1 Scan the fetal head and face

9.1.1 Cranium

9.1.2 Orbits

9.1.3 Lips and nostrils

9.1.4 Fetal profile

9.2 Scan the fetal spine

9.3 Scan the fetal thorax

9.3.1 Diaphragm

9.3.2 Fetal heart four-chamber view

9.3.3 Fetal heart left ventricular outflow tract, or aortic outflow tract

9.3.4 Fetal heart right ventricular outflow tract or pulmonary outflow tract.

9.3.5 Fetal ductal arch and aortic arch views

9.4 Scan the fetal abdomen

9.4.1 Fetal stomach

9.4.2 Fetal liver, spleen, and gallbladder

9.4.3 Fetal kidneys and adrenals

9.4.4 Fetal bowel

9.4.5 Fetal cord insertion and umbilical cord

9.4.6 Fetal bladder

9.4.7 Fetal umbilical vein, aorta, and inferior vena cava

9.5 Scan the fetal limbs/extremities

9.5.1 Fetal lower limbs

9.5.2 Fetal upper limbs

9.6 Scan fetal gender

Step 10: Sonographic examination of the fetus in 2D, 3D, and 4D

Step 11: Complete the procedure

Ultrasound Assessment of Fetal Growth (& High Risk Pregnancies)

Learning Objectives

- Describe and demonstrate how to evaluate normal and abnormal findings relating to the amniotic fluid, placenta, and umbilical cord.
- Describe the use of Doppler in evaluating fetoplacental circulation.
- Give the criteria and demonstrate the testing of fetal well-being, including the biophysical profile.
- Describe techniques for the sonographic evaluation of high-risk pregnancies including multiple gestations.
- List and describe peri- and post-pregnancy maternal diseases and complications and be able to compare immune and non immune hydrops.
- Explain how intrauterine growth restriction is evaluated by ultrasound.
- Describe and recognize on images abnormalities that may occur with multiple pregnancies.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

Table of Contents

Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.3 Operator preparation

Step 2: Expose the lower abdomen and apply the gel

Step 3: Select the transducer

Step 4: Commence the growth and high-risk pregnancy scanning protocol

4.1 Patient position

4.2 Scan plane

4.2.1 Transabdominal scan plane

4.2.2 Endovaginal scan plane

4.3 Standard second and third trimester protocol image requirements

4.3.1 Fetal lie, life, number, presentation, and situs

4.3.2 Maternal uterus and adnexae

4.3.3 Amniotic fluid and placental location

4.3.4 Fetal biometry

4.3.5 Fetal anatomy

4.4 Annotations required

4.5 Troubleshooting

Step 5: Overview of second and third trimester routine ultrasound examination

Step 6: Perform targeted scan relevant to clinical condition of fetus and/or mother

6.1 Scan for multiple pregnancy

Step 7: Scan for intrauterine growth restriction

7.1 Fetal biometry, growth, and weight

7.2 Doppler studies

Step 8: Scan for amniotic fluid and membranes

8.1 Calculate the amniotic fluid volume

Step 9: Scan for placenta and umbilical cord abnormalities

9.1 Placenta

9.2 Umbilical cord

Step 10: Scan for fetal biophysical profile

Step 11: Scan for fetal complications of maternal disease

11.1 Fetal hydrops

11.2 Maternal diabetes

11.3 Maternal hypertension and pre-eclampsia

11.4 Other maternal diseases

Step 12: Scan for premature labor

12.1 Cervical assessment

Step 13: Complete the procedure

Ultrasound Assessment of Fetal Anomalies

Learning Objectives

- Describe and recognize on images abnormalities of the following: cranium, face, neck, vertebral column, thorax, lungs, anterior abdominal wall, hepatobiliary system, gastrointestinal tract, abdomen, urinary tract, genitalia, extremities, skeleton, umbilical cord, circulatory system.
- Describe congenital heart abnormalities and fetal abnormalities associated with the fetal thorax.
- Discuss the use of genetic testing in pregnancy, including amniocentesis, chorionic villus sampling (CVS), and nuchal translucency.
- Explain procedures related to fetal therapies.
- Describe and recognize on images abnormalities of chromosomes.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act

Table of Contents

Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.3 Operator preparation

Step 2: Expose the lower abdomen and apply gel

Step 3: Select the transducer

Step 4: Commence the targeted fetal anomaly scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Targeted fetal anomaly protocol image requirements
 - 4.3.1 Fetal lie, life, number, presentation, and situs
 - 4.3.2 Maternal uterus and adnexae
 - 4.3.3 Amniotic fluid and placental location
 - 4.3.4 Fetal biometry
 - 4.3.5 Fetal anatomy
- 4.4 Annotations required
- 4.5 Troubleshooting
- Step 5: Perform targeted fetal anomaly evaluation
 - 5.1 Scan the fetal head and face
 - 5.2 Scan the fetal spine
 - 5.3 Scan the fetal thorax and heart
 - 5.4 Scan the abdomen and pelvis
 - 5.5 Scan the fetal limbs and extremities
- Step 6: Genetic testing techniques and common genetic conditions identified by ultrasound
 - 6.1 Maternal serum markers
 - 6.2 Nuchal translucency
 - 6.3 Chorionic villus sampling
 - 6.4 Amniocentesis
- Step 7: Fetal therapies under ultrasound guidance
 - 7.1 Cordocentesis
 - 7.2 Umbilical cord therapies
 - 7.3 Fetal shunting procedures
 - 7.4 Embryo reduction and selective fetocide
- Step 8: Complete the procedure

Obstetrics 1 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- First Trimester
- Second and Third Trimesters

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Obstetrics 2 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Fetal Anomalies
- Fetal Growth and High Risk Pregnancies

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Pediatrics

General Pediatric Ultrasound Protocols and Ultrasound of the Pediatric Abdomen

Learning Objectives

- List, demonstrate, and discuss methods for effectively communicating with children of various ages.
- Describe additional considerations when imaging patients in the neonatal intensive care unit.
- Identify and describe differences between adult and neonatal abdominal anatomy on diagrams and sonograms.
- Identify and describe sonographic images of common pediatric pathologies, including hypertrophic pyloric stenosis, appendicitis, and intussusception.
- Identify the anatomy of the neonatal kidney and adrenal gland on diagrams and sonograms.
- Identify and describe sonographic images of pathologies of the kidney and adrenal gland.
- Describe and demonstrate the protocols for sonographic scanning of the pediatric abdomen.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select transducer

Step 4: Commence the pediatric abdomen scanning protocol

- 4.2 Scan plane
- 4.1 Patient position
- 4.3 Standard pediatric abdomen protocol image requirements
 - 4.3.1 Pylorus protocol
 - 4.3.2 Appendix protocol
 - 4.3.3 Bowel protocol
 - 4.3.4 Kidney protocol
 - 4.3.5 Adrenal glands protocol
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the pylorus in longitudinal and transverse planes

- 5.1 Scan the pylorus in the transverse plane
- 5.2 Scan the pylorus in the longitudinal plane

Step 6: Scan the appendix in transverse and longitudinal planes

- 6.1 Scan the appendix in the transverse plane
- 6.2 Scan the appendix in the longitudinal plane

Step 7: Scan the bowels in longitudinal and transverse planes

- 7.1 Scan the segment of bowel in the longitudinal plane

- 7.2 Scan the segment of bowel in the transverse plane
- Step 8: Scan the kidneys in longitudinal and transverse planes
 - 8.1 Scan the right kidney
 - 8.1.1 Scan the right kidney in the longitudinal plane
 - 8.1.2 Scan the right kidney in the transverse plane
 - 8.2 Scan the left kidney
- Step 9: Scan the adrenal glands in longitudinal and transverse planes
 - 9.1 Scan the right adrenal gland
 - 9.1.1 Scan the right adrenal gland in the longitudinal plane
 - 9.1.2 Scan the right adrenal gland in the transverse plane
 - 9.2 Scan the left adrenal gland
- Step 10: Complete the procedure

Ultrasound Assessment of the Pediatric Brain

Learning Objectives

- Identify on diagrams and sonograms the anatomy of the neonatal brain.
- Describe the protocol for ultrasound evaluation of the neonatal brain.
- List and describe developmental defects in the neonatal brain.
- Describe and recognize on images neural tube defects of the neonate.
- Describe and recognize on images neonatal brain lesions.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the head and apply gel

Step 3: Select transducer

Step 4: Commence the neonatal head scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard neonatal head protocol image requirements
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the neonatal head in the coronal and sagittal planes

- 5.1 Scan the neonatal head in the coronal plane
 - 5.1.1 Obtain the first anterior coronal view
 - 5.1.2 Obtain the second anterior coronal view
 - 5.1.3 Obtain the first midcoronal view
 - 5.1.4 Obtain the second midcoronal view
 - 5.1.5 Obtain the first occipital coronal view

- 5.1.6 Obtain the second occipital coronal view
- 5.2 Scan the neonatal head in the sagittal and parasagittal planes
 - 5.2.1 Obtain a midline view
 - 5.2.2 Obtain the first parasagittal view on the right
 - 5.2.3 Obtain the second parasagittal view on the right
 - 5.2.4 Obtain the third parasagittal view on the right
 - 5.2.5 Obtain the left parasagittal views
- 5.3 Scan the superficial aspect of the neonatal head in the coronal and sagittal planes
 - 5.3.1 Scan the superficial aspect of the neonatal head in the coronal plane
 - 5.3.2 Scan the superficial aspect of the neonatal head in the sagittal plane

Step 6: Complete the procedure

Ultrasound Assessment of the Pediatric Hip and Spine

Learning Objectives

- Identify on diagrams and sonograms the anatomy of the neonatal hip and spine.
- Describe the protocol for ultrasound evaluation of the neonatal hip and spine.
- List and describe developmental defects in the neonatal hip and spine.
- Describe and recognize on images defects of the neonatal spine.
- Describe and recognize on images neonatal hip anomalies.
- List steps for relevant protocols.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the hip or spine and apply gel

Step 3: Select transducer

Step 4: Commence the hip and spine scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard hip and spine protocol image requirements
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the hips in coronal and transverse planes

- 5.1 Scan the right neonatal hip in the coronal plane
 - 5.1.1 Neutral view
 - 5.1.2 Flexion view
- 5.2 Scan the right neonatal hip in the transverse plane
 - 5.2.1 Neutral view
 - 5.2.2 flexion view

5.3 Scan the left neonatal hip in the coronal and transverse planes

5.4 Scan the pediatric hip with an anterior approach

5.4.1 Scan the pediatric hip in the longitudinal plane

5.4.2 Scan the pediatric hip in the transverse plane

Step 6: Scan the neonatal spine in sagittal and axial planes

6.1 Scan the neonatal spine in the sagittal plane

6.2 Scan the neonatal spine in the axial plane

Step 7: Complete the procedure

Pediatrics – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the 3 Pediatrics modules above.

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Reproductive Systems & Small Parts

Ultrasound Assessment of the Female Breast

Learning Objectives

- Identify the anatomy and explain the physiology of the breast on diagrams and sonograms.
- Describe and demonstrate the protocol for sonographic scanning of the breast, including the clock and quadrant methods, and targeted examinations based on mammographic findings.
- Describe the various diagnostic pathways that may lead to a sonographic breast examination, and explain how the ultrasound findings are correlated with other imaging modalities.
- Identify and describe sonographic images of benign and malignant features and common breast pathologies.
- Explain biopsy techniques for breast tumors.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act (see reference).

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the chest and apply gel

Step 3: Select the transducer

Step 4: Commence the breast scanning protocol

- 4.1 Patient position
- 4.2 Scan planes
 - 4.2.1 Radial scan plane
 - 4.2.2 Anti-radial scan plane
 - 4.2.3 Transverse scan plane
 - 4.2.4 Longitudinal (sagittal) scan plane
- 4.3 Standard breast protocol image requirements
 - 4.3.1 Clock method
 - 4.3.2 Quadrant method
 - 4.3.3 Targeted breast examination
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the breast

- 5.1 Clock method
 - 5.1.1 Scan the breast in the radial plane
 - 5.1.2 Scan the breast in the anti-radial plane
- 5.2 Quadrant method
 - 5.2.1 Scan the breast in the longitudinal plane
 - 5.2.2 Scan the breast in the transverse plane
 - 5.2.3 Obtain representative images from each quadrant

- 5.3 Targeted examination
 - 5.3.1 Scan the quadrant in the longitudinal plane
 - 5.3.2 Scan the quadrant in the transverse plane

- 5.4 Sonographic features of a normal breast
- 5.5 Sonographic features of breast variants

Step 6: Scan the nipple and sub-areolar tissue

- 6.1 Scan the nipple and areola in the longitudinal and transverse planes
- 6.2 Sonographic features of the nipple and sub-areolar tissue

Step 7: Scan the axilla

- 7.1 Scan the axilla in the longitudinal plane
- 7.2 Scan the axilla in the transverse plane

Step 8: Biopsy techniques

- 8.1 Preparation
 - 8.1.1 Equipment
 - 8.1.2 Patient
 - 8.1.3 Operator
- 8.2 Techniques
 - 8.2.1 Aspiration of cysts
 - 8.2.2 Fine-needle aspiration cytology
 - 8.2.3 Drainage procedures
 - 8.2.4 Large-core needle biopsy
 - 8.2.5 Vacuum-assisted needle biopsy
 - 8.2.6 Pre-operative needle (wire) localization
 - 8.2.7 Open (surgical) biopsy
 - 8.2.8 Sentinel node biopsy

Step 9: Complete the procedure

Ultrasound Assessment of the Female Reproductive Organs

Learning Objectives

- Describe and demonstrate the protocol for sonographic scanning of the female pelvis, including transabdominal and endovaginal scanning.
- Identify and explain the anatomy and physiology of the female pelvis on diagrams and sonograms.
- Describe and demonstrate Doppler evaluation of the female pelvis, including uterus and ovaries.
- Identify on images, common abnormalities and pathologies of the uterus and adnexa, including fallopian tubes, ovaries, and the appearance and locations of the various types of intrauterine contraceptive devices.
- Describe the sonographic evaluation and follow-up of the infertile patient.
- Describe the interventional and post-operative uses of ultrasound.
- Differentiate the sonographic appearances of the female reproductive organs in relation to the menstrual cycle, the use of contraceptives and hormone replacement, and following chemotherapy.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act (see reference).

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select transducer

Step 4: Commence the female reproductive system scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
 - 4.2.1 Scan plane transabdominal
 - 4.2.2 Scan plane endovaginal
- 4.3 Standard female pelvis image requirements
 - 4.3.1 Transabdominal protocol
 - 4.3.2 Endovaginal protocol
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the uterus with the transabdominal approach

- 5.1 Scan the uterus in the longitudinal plane
- 5.2 Scan the uterus in the transverse plane
- 5.3 Sonographic features of the normal uterus
- 5.4 Sonographic features of uterine variants

Step 6: Scan the ovaries and adnexa with the transabdominal approach

- 6.1 Scan the ovaries and adnexae in the longitudinal and transverse planes
- 6.2 Sonographic features of the normal ovaries and adnexa
- 6.3 Sonographic features of variants of the ovaries and adnexa

Step 7: Scan the uterus with the endovaginal approach

- 7.1 Scan the uterus in the longitudinal plane
- 7.2 Scan the uterus in the coronal plane

Step 8: Scan the ovaries and adnexa with the endovaginal approach

- 8.1 Scan the ovaries and adnexae in the coronal and longitudinal planes

Step 9: Procedures and examinations of the female reproductive organs

- 9.1 Infertility assessment
- 9.2 Sonohysterography assessment

Ultrasound Assessment of the Male Reproductive System

Learning Objectives

- Identify the anatomy and explain the physiology of the scrotum on diagrams and sonograms.
- Describe and demonstrate the protocol for sonographic scanning of the scrotum.
- Identify and describe sonographic images of congenital abnormalities of the scrotum.
- Identify and describe sonographic images of pathologies of the scrotum.
- Identify and describe sonographic images of extratesticular disease processes.

- Identify the anatomy and explain the physiology of the prostate on diagrams and sonograms.
- Describe and demonstrate the protocol for transabdominal and endorectal sonographic scanning of the prostate.
- Identify and describe sonographic images of benign and malignant pathologies of the prostate, including benign hyperplasia, prostatitis, carcinoma, and calculi.
- Explain the technique for prostate biopsy.
- Define the criteria for an ultrasound appearance of prostate tumor staging.
- Explain the technique for radiation seed implantation.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act (see reference).

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the region of interest, and apply gel

Step 3: Select the transducer

Step 4: Commence the male reproductive system scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
 - 4.2.1 Scan plane of the scrotum and testes
 - 4.2.2 Scan plane of the transabdominal prostate
 - 4.2.3 Scan plane of the endorectal prostate
- 4.3 Standard male reproductive system protocol image requirements
 - 4.3.1 Scrotum and testes protocol
 - 4.3.2 Transabdominal prostate protocol
 - 4.3.3 Endorectal prostate protocol
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan the scrotum and testes in longitudinal and transverse planes

- 5.1 Scan the scrotum and testes in the longitudinal plane
- 5.2 Scan the scrotum and testes in the transverse plane
- 5.3 Sonographic features of a normal scrotum
- 5.4 Sonographic features of scrotum variants

Step 6: Scan the prostate in longitudinal and transverse planes

- 6.1 Scan the prostate, using the transabdominal protocol
 - 6.1.1 Scan the prostate in the longitudinal plane
 - 6.1.2 Scan the prostate in the transverse plane
- 6.2 Scan the prostate using the endorectal protocol
 - 6.2.1 Scan the prostate in the longitudinal plane
 - 6.2.2 Scan the prostate in the axial plane
- 6.3 Sonographic features of a normal prostate
- 6.4 Sonographic appearance of prostate variants

Step 7: Biopsy technique

- 7.1 Technique for prostate biopsy
- 7.2 Technique for radiation seed implantation

Step 8: Complete the procedure

Ultrasound Assessment of the Thyroid & Parathyroid Glands

Learning Objectives

- Define and use related medical terminology.
- Describe and demonstrate techniques for imaging the thyroid gland.
- Discuss functional abnormalities of the thyroid gland.
- Correlate laboratory data relevant to the thyroid and parathyroid glands.
- Describe, and recognize on images, pathologies of the thyroid gland.
- Identify the anatomy of the parathyroid glands on diagrams and sonograms.
- Describe and demonstrate techniques for imaging the parathyroid glands.
- Describe, and recognize on images, pathologies of the parathyroid glands.
- List and describe other neck masses.
- Follow relevant protocols when scanning.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act (see reference).

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the neck and apply the gel

Step 3: Select the transducer and obtain images of the thyroid and parathyroid

Step 4: Commence the thyroid and parathyroid scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Standard thyroid and parathyroid protocol image requirements
- 4.4 Annotations required
- 4.5 Troubleshooting

Step 5: Scan and measure the thyroid in the transverse and longitudinal planes

- 5.1 Scan and measure the thyroid in the transverse plane
- 5.2 Scan and measure the thyroid in the longitudinal plane

Step 6: Scan and measure the parathyroid glands in the transverse and longitudinal planes

Step 7: Scan the neck region in the longitudinal and transverse planes

Step 8: Complete the procedure

Human Reproduction – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Breast
- Female Reproductive Systems
- Male Reproductive Systems

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Vascular

Ultrasound Assessment of the Carotid, Subclavian, & Vertebral Arteries

Learning Objectives

- Describe the principles of Doppler ultrasound
- Perform ultrasound scans of the carotid, vertebral, and subclavian arteries to include 2D anatomy, color flow, and Doppler analysis
- Scan and identify:
 - Common carotid artery
 - Internal carotid artery
 - External carotid artery
 - Vertebral artery
 - Subclavian artery
- Describe various methods of carotid interpretation
- Differentiate normal and abnormal sonographic appearances of the carotid, vertebral, and subclavian arteries
- Differentiate and describe common pathologies of the carotid, vertebral, and subclavian arteries on sonographic images
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

Table of Contents

Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the neck and apply gel

Step 3: Select the transducer and obtain images of the carotid arteries

Step 4: Commence the carotid, subclavian, and vertebral vessel scanning protocol

- 4.1 Patient Position
- 4.2 Scan Plane
- 4.3 Images required
- 4.4 Annotation
- 4.5 Sonographic features of the normal neck vessels
- 4.6 Variants
- 4.7 Troubleshooting

Step 5: Scan and identify the branches of the carotid artery in the longitudinal and transverse planes

- 5.1 Perform a survey scan
- 5.2 Identify the branches of the CCA
- 5.3 Pathology of the carotid arteries

- Step 6: Scan the vertebral arteries
 - 6.1 Evaluate vertebral artery flow
 - 6.2 Pathology of vertebral arteries
- Step 7: Scan the subclavian arteries
 - 7.1 Pathology of subclavian arteries
- Step 8: Carotid interpretation
- Step 9: Complete the procedure

Ultrasound Assessment of the Lower Limb Arteries

Learning Objectives

- Discuss arterial anatomy, physiology, and hemodynamics
- Describe the effects of atherosclerosis
- Describe physiologic arterial testing of the lower limbs:
 - Ankle-Brachial Index (ABI)
 - Segmental pressures
 - Exercise stress testing
 - Toe pressure
 - Treadmill exercise
- Discuss color duplex imaging of the lower limb arteries:
 - Aorto-iliac segment
 - Femoral-popliteal arterial segment
 - Popliteal artery
 - Tibial artery
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the limb and apply gel

Step 3: Select the transducer

Step 4: Commence the lower limb arterial scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Images required
- 4.4 Annotation
- 4.5 Sonographic features of the normal lower limb arteries
- 4.6 Variants
- 4.7 Troubleshooting

Step 5: Scan the femoropopliteal segment in the longitudinal and transverse planes

- 5.1 Interrogate the distal external iliac and common femoral artery

- 5.2 Interrogate the length of the femoral artery
- 5.3 Pathology of the femoral artery
- Step 6: Scan the popliteal arteries in the longitudinal and transverse planes
 - 6.1 Pathology of the popliteal artery
- Step 7: Scan the tibial arteries in the longitudinal and transverse planes
 - 7.1 Obtain images of the posterior tibial and peroneal arteries
 - 7.2 Obtain images of the anterior tibial artery
 - 7.3 Pathology of the tibial arteries
- Step 8: Scan the aorto-iliac segment in the longitudinal and transverse planes
 - 8.1 Obtain images of the distal abdominal aorta
 - 8.2 Obtain images of the common iliac arteries
 - 8.3 Obtain images of the external iliac arteries
 - 8.4 Pathology of the aorto-iliac segment
- Step 9: Scan arterial bypass grafts and stents
 - 9.1 Obtain images of grafts or stents
 - 9.2 Pathology of bypass grafts and stents
- Step 10: Complete the procedure

Ultrasound Assessment of the Lower Limb Veins

Learning Objectives

- Discuss venous anatomy and hemodynamics
- Perform an ultrasound scan of the lower extremity venous vessels to include 2D anatomy, color flow, and Doppler analysis (valve competency and vessel patency)
- Scan and identify
 - Common femoral vein (CFV)
 - Saphenofemoral junction (SFJ)
 - Superficial femoral vein (SFV)
 - Saphenous vein, popliteal vein
- Compress with probe frequently to determine compressibility
- Evaluate for thrombus
- Evaluate for flow with distal augmentation
- Evaluate valve competence with proximal compression
- Continue the evaluation for posterior tibial and peroneal veins
- Explain Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the limb and apply gel

Step 3: Select the transducer and obtain images of the lower limb veins

Step 4: Commence the lower limb venous scanning protocol

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Images required
- 4.4 Annotation
- 4.5 Sonographic features of normal lower limb veins
- 4.6 Variants
- 4.7 Troubleshooting

Step 5: Scan and identify the common femoral vein, femoral vein, and popliteal vein

Step 6: Compress with probe frequently to determine compressibility

Step 7: Evaluate for thrombus

- 7.1 Pathology of venous thrombosis

Step 8: Valve competence with Valsalva, augmentation, and photoplethysmography (PPG)

- 8.1 Pathology of venous incompetence

Step 9: Continue evaluation of posterior tibial and peroneal veins

Ultrasound of the Abdominal Vasculature (also in Abdomen category)

Learning Objectives

- List indications for ultrasound of the abdominal blood vessels
- Identify abdominal vascular anatomy on diagrams and sonograms
- List signs and symptoms of abdominal vascular disease
- Describe the abdominal vascular protocol
 - Equipment preparation - transducer and preset selection
 - Patient preparation
 - Patient positioning
 - Transducer positions
 - Scan planes
- Identify and obtain sonographic images of the aorta, abdominal aortic branches, and common iliac arteries
- Identify and obtain sonographic images of the inferior vena cava and its tributaries
- Identify and obtain sonographic images of the portal vein, superior mesenteric vein, inferior mesenteric vein, and splenic vein
- Obtain Doppler spectral traces of the aorta and inferior vena cava
- Explain and demonstrate the use of breathing techniques to obtain optimal sonographic images of the blood vessels
- Differentiate normal and abnormal sonographic appearances of the vascular system
- Identify and describe common pathology of the abdominal vasculature
- Explain the important ultrasound characteristics when evaluating an abdominal aortic aneurysm
- Describe the normal and abnormal Doppler patterns of the vascular structures
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act (see reference)

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Introduction

- 0.1 Principles of Doppler ultrasound
- 0.2 Basic physiology of the abdominal blood vessels
 - 0.2.1 Signs and symptoms of abdominal vascular disease

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the abdomen and apply gel

Step 3: Select the transducer and obtain images of the abdominal blood vessels

Step 4: Commence the scanning protocol for the abdominal blood vessels

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Images required
- 4.4 Annotations required
- 4.5 Sonographic features of normal abdominal vessels
 - 4.5.1 Sonographic features of the normal abdominal aorta
 - 4.5.2 Sonographic features of the normal celiac axis
 - 4.5.3 Sonographic features of the normal common hepatic artery
 - 4.5.4 Sonographic features of the normal splenic artery
 - 4.5.5 Sonographic features of the normal superior mesenteric artery (SMA)
 - 4.5.6 Sonographic features of the normal renal arteries
 - 4.5.7 Sonographic features of the normal inferior mesenteric artery (IMA)
 - 4.5.8 Sonographic features of the normal inferior vena cava (IVC)
 - 4.5.9 Sonographic features of the normal renal veins
 - 4.5.10 Sonographic features of the normal superior mesenteric vein (SMV)
 - 4.5.11 Sonographic features of the inferior mesenteric vein (IMV)
 - 4.5.12 Sonographic features of the splenic vein
 - 4.5.13 Sonographic features of the normal portal vein
- 4.6 Variants
- 4.7 Troubleshooting

Step 5: Scan the aorta

- 5.1 Scan the proximal aorta in the longitudinal plane
- 5.2 Scan the mid aorta in the longitudinal plane
- 5.3 Scan the distal aorta in the longitudinal plane
- 5.4 With the patient in the supine position scan the aorta in the transverse plane
- 5.5 Obtain a Doppler spectral trace of the aorta
- 5.6 Scan celiac artery in the longitudinal plane
- 5.7 Scan the celiac artery in the transverse plane
- 5.8 Pathology of the celiac axis
- 5.9 Scan the SMA in the longitudinal plane
- 5.10 Scan the SMA in the transverse plane
- 5.11 Pathology of the SMA

Step 6: Scan the inferior vena cava

- 6.1 Scan the proximal inferior vena cava (IVC) in the longitudinal plane
- 6.2 Scan the distal inferior vena cava (IVC) in the longitudinal plane
- 6.3 Scan the inferior vena cava (IVC) in the transverse plane
- 6.4 Obtain a Doppler spectral trace of the inferior vena cava

Step 7: Scan the portal venous system

- 7.1 Obtain longitudinal images of the main portal vein (MPV)

- 7.2 Obtain a Doppler spectral trace of main portal vein (MPV)
- 7.3 Obtain longitudinal images of the superior mesenteric vein (SMV)
- 7.4 Obtain a Doppler trace of the SMV
- 7.5 Obtain a longitudinal image of the splenic vein
- 7.6 Obtain a Doppler trace of the splenic vein
- 7.7 Obtain a longitudinal image of the inferior mesenteric vein (IMV)
- 7.8 Obtain a Doppler trace of the IMV

Step 8: Complete the procedure

Ultrasound Vessel Mapping

Learning Objectives

- Discuss preoperative vein-artery mapping for the following procedures:
 - Sclerotherapy
 - Perforator veins and varicosities
 - Radial artery harvest
 - Arteriovenous fistula for dialysis
 - Suitability for venous bypass graft and harvest
- Discuss venous imaging of the upper extremity for deep venous thrombosis
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Expose the limb and apply gel

Step 3: Select the transducer and obtain images of the upper or lower limb vessels as required

Step 4: Commence the scanning protocol for upper limb veins, or the appropriate mapping procedure

- 4.1 Patient position
- 4.2 Scan plane
- 4.3 Images required
- 4.4 Annotation
- 4.5 Sonographic features of normal veins
- 4.6 Variants
- 4.7 Troubleshooting

Step 5: Scan the upper limb veins in the longitudinal and transverse planes to exclude deep venous thrombosis

- 5.1 Pathology of upper limb venous thrombosis

Step 6: Upper limb mapping procedure for arteriovenous fistula (AVF)

Step 7: Sclerotherapy mapping

Step 8: Perforator veins and varicosity marking

Step 9: Radial artery harvest

Step 10: Venous bypass graft suitability and harvest

Step 11: Complete the procedure

Neck & Duplex Imaging – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Thyroid and Parathyroid
- Cerebrovascular System
- Lower Limb Veins

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Vascular 1 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Cerebrovascular System
- Lower Limb Veins

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Vascular 2 – Integrated Clinical (Simulations and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Lower Limb Arteries
- Vessel Mapping

In test mode the scenarios are presented at random from any of these modules, with the goal of helping students prepare for a clinical situation where each patient is different.

Echocardiography

Cardiovascular Pathology for Sonographers

Learning Objectives

- Define and use medical terminology related to cardiovascular pathology
- Describe cell injury and repair
- Explain the mechanisms of inflammation
- Explain the importance of obtaining a full clinical history of the patient
- Describe cellular changes that result in neoplasia
- Differentiate between benign and malignant tumors, and give examples of each
- Describe mechanisms of fluid disorders, and give examples
- Describe mechanisms of hemodynamic disorders, and give examples
- Describe disorders and possible treatments of the venous system
- Describe disorders and possible treatments of the arterial system
- Differentiate between common signs and symptoms of cardiovascular and venous diseases
- Describe diagnostic tests used to diagnose cardiovascular disease, and their application to certain diseases
- Describe cardiac catheterization and interventional procedures for coronary artery disease
- Describe acute cardiac conditions and emergency procedures
- Discuss techniques and benefits of cardiac rehabilitation

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Introduction

Step 1: Cell pathology

- 1.1 Normal cell function
- 1.2 Cell injury and repair
- 1.3 Inflammation

Step 2: Neoplasia

- 2.1 Benign neoplasms
- 2.2 Malignant neoplasms
- 2.3 Cardiac tumors

Step 3: Fluid and hemodynamic disorders

- 3.1 Body fluids
- 3.2 Edema
- 3.3 Hyperemia
- 3.4 Hemorrhage
- 3.5 Thrombosis
- 3.7 Infarction
- 3.6 Embolism
- 3.8 Shock

Step 4: Diseases of the arterial system

- 4.1 Atherosclerosis
- 4.2 Coronary artery disease
 - 4.2.1 Angina
 - 4.2.2 Myocardial infarction or heart attack (MI)

- 4.3 Peripheral Vascular Disease
- 4.4 Arteritis
- Step 5: Diseases of the venous system
 - 5.1 Varicose veins
 - 5.2 Deep vein thrombosis (DVT)
- Step 6: Hypertension
- Step 7: Congestive heart failure
- Step 8: Cardiomyopathy
 - 8.1 Dilated cardiomyopathy
 - 8.2 Hypertrophic cardiomyopathy
 - 8.3 Restrictive cardiomyopathy
- Step 9: Inflammatory heart disease
 - 9.1 Infective endocarditis
 - 9.2 Myocarditis
 - 9.3 Pericarditis
 - 9.4 Rheumatic heart disease
- Step 10: Heart valve disorders
 - 10.1 Mitral valve
 - 10.1.1 Mitral stenosis
 - 10.1.2 Mitral regurgitation
 - 10.2 Aortic Valve
 - 10.2.1 Aortic stenosis
 - 10.2.2 Aortic regurgitation
- Step 11: Congenital heart disease

Basic Echocardiography Techniques

Learning Objectives

- Define and explain ultrasound terminology
- Identify orientation on the ultrasound image
- Identify and obtain echocardiographic views
- Identify cardiac landmarks
- Describe the reason for, and demonstrate, patient positioning for cardiac ultrasound examinations
- Manipulate the transducer in various planes
- Describe patient breathing techniques in order to obtain optimum images and explain the reason for the techniques
- Describe the technique for measuring structures on ultrasound images
- Write a technical impression using a standard format
- Demonstrate and describe methods for preventing musculoskeletal injury
- Explain the importance of belonging to a professional organization

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- Step 1: Anatomical overview
 - 1.1 Orientation
 - 1.1.1 Anatomic directions

- 1.1.2 Scanning planes
- 1.1.3 On-screen orientation
- 1.2 Cross-sectional anatomy of the heart
- 1.3 Anatomical landmarks
 - 1.3.1 Thoracic landmarks
 - 1.3.2 Cardiac landmarks
- 1.4 Scanning windows
- Step 2: Introduction to echocardiography
 - 2.1 Basic cardiac physiology
 - 2.2 Signs and symptoms of cardiac disease
 - 2.3 Types of echocardiography (TTE, TEE, Stress echo)
 - 2.3.1 Transthoracic echocardiography
 - 2.3.2 Transesophageal echocardiography
 - 2.3.3 Stress echocardiography
- Step 3: Preprocedure considerations
 - 3.1 Patient preparation
 - 3.2 History
 - 3.3 Patient position
 - 3.4 Equipment
- Step 4: Basic techniques
 - 4.1 Transducer selection
 - 4.2 Transducer manipulation
 - 4.2.1 Sweeping
 - 4.2.2 Rotating
 - 4.2.3 Rocking
 - 4.3 Transducer pressure
 - 4.4 Transmission gel
 - 4.5 Breathing
- Step 5: Two-dimensional imaging
 - 5.1 Image optimization
 - 5.1.1 Sector size
 - 5.1.2 Focal zones
 - 5.1.3 Time gain compensation
 - 5.1.4 Lateral gain compensation
 - 5.1.5 Zoom
 - 5.1.6 Gain
 - 5.1.7 Dynamic range
 - 5.1.8 Harmonics imaging
- Step 6: M-mode
 - 6.1 Image optimization
 - 6.1.1 Cursor alignment
 - 6.1.2 Sweep speed
 - 6.1.3 Gain
- Step 7: Doppler
 - 7.1 Principles of Doppler ultrasound
 - 7.1.1 Spectral Doppler
 - 7.1.2 Color Doppler
- Step 8: Standard echocardiography procedure
 - 8.1 Protocol

8.2 Annotation

Step 9: 2D (B-mode) imaging

9.1 Parasternal long axis

9.2 Parasternal survey scan

9.3 Parasternal short axis views

9.4 Apical views

9.4.1 Apical four-chamber view

9.4.2 Apical five-chamber view

9.4.3 Apical two-chamber view

9.4.4 Apical long axis view

9.5 Subcostal views

9.5.1 Subcostal four-chamber view

9.5.2 Subcostal interatrial septal view

9.5.3 Subcostal view

9.5.4 Subcostal descending aorta view

9.6 Suprasternal views

9.7 Measurement

9.7.1 Example of 2D measurement in parasternal long axis view

Step 10: M-mode

10.1 M-mode parasternal long axis

10.1.1 M-mode images of the right and left ventricles

10.1.2 M-mode images of the mitral valve

10.1.3 M-mode images of the aortic root and the left atrium

10.2 Parasternal short axis M-mode

Step 11: Postprocedure considerations

11.1 Integration of test results with clinical findings

11.2 Patient

11.3 Preliminary report

Step 12: Professional considerations

12.1 Ergonomics

12.2 Professional involvement

Basic Echocardiography Views

Learning Objectives

- Describe and explain heart anatomy
- Describe and explain heart physiology
- List indications for ultrasound of the heart
- Review and apply the echocardiography protocol
- Describe and explain the reason for patient preparation for echocardiography
- Describe and explain transducer and preset selection
- Describe and demonstrate the reason for patient positioning for echocardiography
- Describe and demonstrate the use of scanning planes and the echocardiography protocol
- Demonstrate different transducer positions to obtain optimal images
- Describe and explain the reason for patient breathing techniques in order to obtain optimum images
- Identify and obtain images of heart, ascending aorta, main pulmonary arteries, and great veins

- Obtain measurements of various structures within the heart
- Differentiate normal and abnormal sonographic appearances of the heart
- Explain the Patient's Bill of Rights, HIPAA Privacy Rule, and Patient Safety Act

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.3 Operator preparation
- 1.2 Patient preparation
 - 1.2.1 Position the patient
 - 1.2.2 Apply ECG electrodes

Step 2: Select the transducer

Step 3: Obtain left parasternal 2D views

- 3.1 Locate the parasternal window
- 3.2 Obtain measurements of the left ventricle
 - 3.2.1 Obtain M-mode images of the right and left ventricles
- 3.3 Obtain images of the mitral valve
 - 3.3.1 Obtain M-mode images of the mitral valve
- 3.4 Obtain images of the aortic valve
 - 3.4.1 Obtain M-mode images of the aortic root and the left atrium
- 3.5 Obtain images of the right ventricular inflow tract
- 3.6 Obtain images of the right ventricular outflow tract

Step 4: Obtain left parasternal short axis views

- 4.1 Obtain images at mitral valve level
- 4.2 Obtain images of the myocardium at the papillary muscles
- 4.3 Obtain images of the myocardium at the apex
- 4.4 Obtain images of the aortic valve
- 4.5 Obtain images of the tricuspid valve
- 4.6 Obtain images of the right ventricular outflow tract

Step 5: Apical views

- 5.1 Locate the apical window
- 5.2 Apical four-chamber view
 - 5.2.1 Obtain zoomed images of the mitral valve
 - 5.2.2 Obtain zoomed images of the tricuspid valve
- 5.3 Apical five-chamber view
 - 5.3.1 Obtain zoomed images of the aortic valve
- 5.4 Apical two-chamber view
- 5.5 Apical long axis view

Step 6: Subcostal views

- 6.1 Locate the subcostal window
- 6.2 Subcostal four-chamber view
- 6.3 Subcostal interatrial septal view
- 6.4 Subcostal inferior vena cava and hepatic veins view
- 6.5 Subcostal descending aorta view

Step 7: Suprasternal views

- 7.1 Locate the suprasternal aortic arch window

Step 8: Complete the procedure

Perform Electrocardiogram (ECG) - 12 Lead

Learning Objectives

- Describe the anatomy and physiology of the heart
- Identify the basic electrophysiology of the heart
- Describe the sinus mechanisms
- Describe atrial rhythms
- Describe junctional rhythms
- Describe ventricular rhythms
- Describe atrioventricular (AV) blocks
- Describe pacemaker rhythms
- Explain and demonstrate the 12-lead ECG
- Describe stress testing and Holter monitoring

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Introduction

Step 1: Preparation

- 1.1 Tray preparation
- 1.2 Patient preparation
- 1.3 Operator preparation

Step 2: Place electrodes

- 2.1 Place the limb electrodes
 - 2.1.1 Unipolar limb leads: augmented leads
 - 2.1.2 Bipolar limb leads
- 2.2 Place the chest electrodes
 - 2.2.1 Unipolar leads: Chest leads

Step 3: Record the ECG

- 3.1 Enter the patient's details into the machine
- 3.2 Check the machine is calibrated
- 3.3 Record the ECG
- 3.4 Annotate the presence of symptoms on the ECG tracing

Step 4: Analyze the rhythm strip (2 lead)

- 4.1 Assess the rate
 - 4.1.1 The 6-second ECG count
 - 4.1.2 Count large squares
 - 4.1.3 Count small squares
 - 4.1.4 Sequence method
- 4.2 Assess the rhythm
 - 4.2.1 Ventricular rhythm
 - 4.2.2 Atrial rhythm
 - 4.2.3 Regularity
- 4.3 Identify and assess the P wave
- 4.4 Assess the intervals (conduction)
 - 4.4.1 PR interval
 - 4.4.2 QRS duration
 - 4.4.3 QT interval

4.5 Evaluate overall appearance

Step 5: Sinus rhythms

- 5.1 Features of sinus rhythms
- 5.2 Sinus bradycardia
- 5.3 Sinus tachycardia
- 5.4 Sinus arrhythmia
- 5.5 Sinoatrial block
- 5.6 Sinus arrest

Step 6: Atrial arrhythmia

- 6.1 Premature atrial complexes (PACs)
- 6.2 Wandering atrial pacemaker
- 6.3 Multifocal atrial tachycardia
- 6.4 Supraventricular tachycardia
 - 6.4.1 Atrial tachycardia
 - 6.4.2 AVNRT
 - 6.4.3 AVRT
- 6.5 Atrial flutter
- 6.6 Atrial fibrillation

Step 7: Junctional arrhythmia

- 7.1 Premature junctional complexes (PJC)s
- 7.2 Junctional escape beats/rhythm
- 7.3 Accelerated junctional rhythm
- 7.4 Junctional tachycardia

Step 8: Ventricular arrhythmia

- 8.1 Premature ventricular complexes
 - 8.1.1 Types of PVC
- 8.2 Ventricular escape beats
- 8.3 Idioventricular rhythm
- 8.4 Accelerated idioventricular rhythm (AIVR)
- 8.5 Ventricular tachycardia (VT)
 - 8.5.1 Types of VT
- 8.6 Ventricular fibrillation (VF)
- 8.7 Asystole
- 8.8 Pulseless electrical activity

Step 9: AV blocks

- 9.1 First-degree AV block
- 9.2 Second-degree AV block
 - 9.2.1 Second-degree AV block type I (Wenckebach, or Mobitz type I)
 - 9.2.2 Second-degree AV block type II (Mobitz type II)
 - 9.2.3 Second-degree AV block, 2:1 conduction (2:1 AV block)
- 9.3 Third-degree/complete AV block

Step 10: Pacemaker rhythms

- 10.1 Pacemaker terminology
- 10.2 Pacemaker systems
 - 10.2.1 Single-chamber pacemakers
 - 10.2.2 Dual-chamber pacemakers
 - 10.2.3 Transcutaneous pacing
- 10.3 Pacemaker malfunction and complications
- 10.4 Analyzing pacemaker function with an ECG

Step 11: Interpret the 12-lead ECG

11.1 Normal 12-lead ECG

11.1.1 Leads

11.1.2 Layout of the 12-lead ECG

11.2 Axis

11.2.1 Vectors

11.2.2 Einthoven's triangle/Hexaxial reference system

11.2.3 Two-lead method of axis determination

11.3 Myocardial ischemia

11.3.1 ST segment changes

11.3.2 T wave changes

11.4 Myocardial infarction

11.4.1 ST changes

11.4.2 T wave changes

11.4.3 Q waves

11.5 Pericarditis

11.6 Pericardial effusion

11.7 Electrolyte imbalance

11.7.1 Imbalance of sodium ions

11.7.2 Imbalance of calcium ions

11.7.3 Imbalance of magnesium ions

11.7.4 Imbalance of potassium ions

11.8 Conduction abnormalities

11.8.1 Right bundle branch block

11.8.2 Left bundle branch block

11.9 Analyzing an ECG

11.9.1 Systematic method

Step 12: Stress testing and Holter monitoring

Doppler Techniques and Instrumentation

Learning Objectives

- Review normal cardiac anatomy.
- Describe and demonstrate the use of spectral Doppler and color Doppler instrumentation.
- Identify and describe anatomy represented on spectral Doppler tracings.
- Differentiate between normal and abnormal anatomy represented on color images.
- Describe and demonstrate tissue Doppler.
- Describe and identify tissue Doppler wave forms.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.2.1 Position the patient

1.2.2 Apply ECG electrodes

1.3 Operator preparation

Step 2: Select the transducer and apply the gel

Step 3: Obtain the left parasternal long axis view

3.1 Scan the mitral valve, using color

3.2 Scan the aortic valve, using color

Step 4: Obtain the left parasternal short axis view

4.1 Scan the aortic valve, using color

4.2 Scan the tricuspid valve, using color

4.3 Scan the tricuspid valve, using pulsed wave Doppler

4.4 Scan the tricuspid valve, using continuous wave Doppler

4.5 Scan the pulmonary valve, using color

4.6 Scan the pulmonary valve, using pulsed wave Doppler

4.7 Scan the pulmonary artery, using continuous wave Doppler

4.8 Scan the right ventricular outflow tract, using pulsed wave Doppler

4.9 Scan the right ventricular outflow tract, using continuous wave Doppler

Step 5: Obtain the apical four-chamber view

5.1 Scan the mitral valve, using color

5.2 Scan the mitral valve orifice, using pulsed wave Doppler

5.3 Scan the mitral valve, using continuous wave Doppler

5.4 Scan the tricuspid valve, using color

5.5 Scan the tricuspid valve orifice, using pulsed wave Doppler

5.6 Scan the tricuspid valve, using continuous wave Doppler

5.7 Scan the pulmonary vein, using pulsed wave Doppler

5.8 Perform tissue Doppler imaging of the septal annulus, using pulsed wave Doppler

5.9 Perform tissue Doppler imaging of the lateral annulus, using pulsed wave Doppler

Step 6: Obtain the apical five-chamber view

6.1 Scan the left ventricular outflow tract, using color

6.2 Scan the left ventricular outflow tract, using pulsed wave Doppler

6.3 Scan the aortic valve, using color

6.4 Scan the aortic valve, using continuous wave Doppler

Step 7: Obtain the subcostal view

7.1 Scan the inferior vena cava and hepatic veins, using color

7.2 Scan the abdominal aorta, using pulsed wave Doppler

7.3 Obtain a four-chamber view of the interatrial septum, using color

Step 8: Obtain the suprasternal view

8.1 Scan the aorta long axis, using color

8.2 Scan the aorta long axis, using pulsed wave Doppler

8.3 Scan the aorta long axis, using continuous wave Doppler

8.4 Scan the main pulmonary artery, using color

8.5 Continuous wave Doppler of the ascending aorta, with Pedoff probe

Step 9: Obtain the right parasternal long axis view

9.1 Scan the thoracic aorta, using continuous wave Doppler with Pedoff probe

Step 10: Complete the procedure

Embryology & Echocardiography Assessment of Congenital Heart Disease

Learning Objectives

- Define and use related medical terminology.
- Understand and discuss cardiac embryology.
- List and describe common congenital abnormalities.
- Identify and describe the sonographic appearance of common congenital abnormalities.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Step 1: Fetal heart development

- 1.1 Early heart development
- 1.2 Completion of heart development
 - 1.2.1 Atrial septation
 - 1.2.2 Truncus arteriosus and bulbus cordis septation
 - 1.2.3 Sinus venosus remodeling
 - 1.2.4 Ventricular septation
 - 1.2.5 Cardiac valve development
 - 1.2.6 Development of the heart wall
- 1.3 Development of the conduction system
- 1.4 The primitive circulation
- 1.5 Fetal circulatory system
 - 1.5.1 Vascular remodeling
 - 1.5.2 Fetal circulation
- 1.6 Postnatal circulation

Step 2: Congenital abnormalities

- 2.1 Atrial septal defect
- 2.2 Ventricular septal defect
- 2.3 Patent foramen ovale
- 2.4 Patent ductus arteriosus
- 2.5 Transposition of the great arteries
- 2.6 Marfan's syndrome
- 2.7 Coarctation of the aorta
- 2.8 Tetralogy of Fallot
- 2.9 Ebstein anomaly
- 2.10 Pulmonary stenosis

Echocardiography Assessment of Endocarditis & Pericarditis

Learning Objectives

- Describe and demonstrate the sonographic appearance of subacute bacterial endocarditis, common cardiac tumors, and thrombus.
- Describe and demonstrate the hemodynamics and pathophysiology associated with pericardial diseases.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
 - 1.2.1 Position the patient
 - 1.2.2 Apply ECG electrodes
- 1.3 Operator preparation

Step 2: Select the transducer and apply the gel

Step 3: Obtain a parasternal long axis view

- 3.1 Scan the aortic valve, using 2D
- 3.2 Scan the mitral valve, using 2D
- 3.3 Scan the aortic valve, using color Doppler
- 3.4 Scan the mitral valve, using color Doppler

Step 4: Obtain the apical four-chamber view

- 4.1 Scan the mitral valve, using 2D
- 4.2 Scan the tricuspid valve, using 2D
- 4.3 Scan the mitral valve, using pulsed wave Doppler
- 4.4 Scan the mitral valve, using continuous wave Doppler
- 4.5 Scan the tricuspid valve, using pulsed wave Doppler
- 4.6 Scan the tricuspid valve, using continuous wave Doppler
- 4.7 Scan the pulmonary vein, using pulsed wave Doppler
- 4.8 Perform tissue Doppler imaging of the lateral mitral annulus, using pulsed wave Doppler
- 4.9 Perform tissue Doppler imaging of the septal mitral annulus, using tissue Doppler
- 4.10 Scan the left ventricle and obtain the volume
- 4.11 Scan the left atrium and obtain the volume
- 4.12 Scan the right ventricle for dimension
- 4.13 Scan the right atrium and obtain the volume

Step 5: Obtain the apical five-chamber view

- 5.1 Scan the aortic valve, using 2D
- 5.2 Scan the aortic valve, using continuous wave Doppler
- 5.3 Scan the left ventricular outflow tract, using pulsed wave Doppler

Step 6: Obtain the apical two-chamber view

- 6.1 Scan the left ventricle to obtain the volume

Step 7: Obtain the subcostal view

- 7.1 Obtain the four-chamber view, in 2D
- 7.2 Obtain the inferior vena cava and hepatic veins view, in 2D

7.3 Scan the inferior vena cava and hepatic veins, using color

Step 8: Complete the procedure

Transesophageal & Stress Echocardiography

Learning Objectives

- Describe and discuss transesophageal echocardiography (TEE).
- Discuss the indications and protocols for TEE, and identify standard TEE views.
- Describe and discuss stress echocardiography.
- Evaluate normal and abnormal stress echocardiography images.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Introduction

Step 1: Preparation

1.1 Equipment preparation

1.2 Patient preparation

1.2.1 Position the patient

1.2.2 Apply ECG electrodes

1.3 Operator preparation

Step 2: Select the transducer and apply the gel

Step 3: Obtain the four primary views

3.1 Obtain the 0 degree view

3.2 Obtain the 45 degree view

3.3 Obtain the 90 degree view

3.4 Obtain the 135 degree view

Step 4: Obtain the longitudinal TEE views

4.1 Obtain the 90 degree counterclockwise (slight leftward tip placement) rotation view

4.2 Obtain the 90 degree clockwise (slight rightward tip placement) rotation view

4.3 Obtain the 100 degree view (neutral tip position)

Step 5: Obtain the transgastric multiplane views

5.1 Obtain the 0 degree view

5.2 Obtain the 90 degree view

5.3 Obtain the 120 degree view

Step 6: Obtain the pulmonary artery bifurcation views

6.1 Obtain the 0 degree view

Step 7: Obtain the left atrial appendage views

7.1 Obtain the 90 degree view

Step 8: Obtain the thoracic aorta views

8.1 Obtain the 0 degree view

8.2 Obtain the 90 degree view

Step 9: Remove probe

Step 10: Complete the procedure

Step 11: Stress echocardiography

- 11.1 Types of stress echocardiography
- 11.2 Scanning protocol for stress echocardiography
 - 11.2.1 Clinical indications
 - 11.2.2 Protocol
- 11.3 Normal stress echocardiography
- 11.4 Abnormal stress echocardiography
- 11.5 Regional wall motion analysis
- 11.6 Comparison of stress echocardiography with nuclear imaging

Echocardiography Assessment of Valvular Disease

Learning Objectives

- Review normal cardiac anatomy.
- Identify and describe the appearance of valve replacements on echocardiograms.
- List and describe pathology that may affect the heart valves.
- Identify and describe the sonographic appearance of mitral, aortic, tricuspid, and pulmonary valve pathology.
- Identify and explain the mechanisms of various types of prosthetic valve replacements.
- Discuss the use of proximal isovelocity surface area (PISA).
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act.

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Introduction

Step 1: Mitral valve

- 1.1 Basic physiology
- 1.2 Pathology
 - 1.2.1 Mitral stenosis
 - 1.2.2 Mitral regurgitation
 - 1.2.3 Mitral valve prolapse
 - 1.2.4 Flail mitral valve
 - 1.2.5 Mitral annulus calcification
 - 1.2.6 Proximal isovelocity surface area
 - 1.2.7 Mitral valve replacement

Step 2: Aortic valve

- 2.1 Basic physiology
- 2.2 Pathology
 - 2.2.1 Aortic stenosis
 - 2.2.2 Aortic regurgitation
 - 2.2.3 Bicuspid aortic valve
 - 2.2.4 Aortic valve prolapse
 - 2.2.5 Idiopathic hypertrophic subaortic stenosis (IHSS)
 - 2.2.6 Aortic valve replacement

Step 3: Tricuspid valve

- 3.1 Basic physiology
- 3.2 Pathology
 - 3.2.1 Tricuspid stenosis
 - 3.2.2 Tricuspid regurgitation

Step 4: Pulmonary valve

- 4.1 Basic physiology
- 4.2 Pathology
 - 4.2.1 Pulmonary regurgitation
 - 4.2.2 Pulmonary stenosis

Echocardiography Assessment of Wall Motion & Diastolic Function

Learning Objectives

- Review cardiac anatomy.
- List and describe pathology that may affect the cardiac chambers.
- Calculate linear and volume measurements of the cardiac chambers.
- Evaluate the wall motion of the left ventricle.
- Describe and demonstrate special measurements used in echocardiography.
- Define and use related medical terminology.
- Explain the Patient Privacy Rule (HIPAA) and Patient Safety Act (see reference).

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Introduction

Step 1: Preparation

- 1.1 Equipment preparation
- 1.2 Patient preparation
 - 1.2.1 Position the patient
 - 1.2.2 Apply ECG electrodes
- 1.3 Operator preparation

Step 2: Select the transducer and apply the gel

Step 3: Obtain the parasternal long axis view in 2D

- 3.1 Scan the aorta
- 3.2 Scan the left ventricle and myocardium
- 3.3 Scan the left ventricle in M-mode
- 3.4 Scan the aortic root and left atrium in M-mode

Step 4: Obtain the parasternal short axis view in 2D

- 4.1 Evaluate the basal left ventricle
- 4.2 Evaluate the mid left ventricle
- 4.3 Evaluate the left ventricular mass
 - 4.3.1 Left ventricular mass measurements
- 4.4 Evaluate the apical left ventricle

Step 5: Obtain the apical four-chamber view in 2D

- 5.1 Scan the ventricles and atria

- 5.2 Scan the mitral valve, using pulsed wave Doppler
- 5.3 Scan the mitral valve, using color M-mode Doppler
 - 5.3.1 Color M-mode flow propagation velocity measurements
- 5.4 Perform tissue Doppler imaging of the lateral mitral annulus, using pulsed wave Doppler
- 5.5 Perform tissue Doppler imaging of the septal mitral annulus, using pulsed wave Doppler
- 5.6 Scan the pulmonary vein, using pulsed wave Doppler
- 5.7 Scan the left ventricle and obtain the volume
 - 5.7.1 Biplane Simpson's method for left ventricle volume measurement
- 5.8 Scan the left atrium and obtain the volume
 - 5.8.1 Biplane area-length measurements of the left atrium
- 5.9 Scan the right ventricle for dimension
 - 5.9.1 Right ventricle basal diameter measurement
- 5.10 Scan the right atrium and obtain the volume
 - 5.10.1 Biplane area-length of the right atrium

Step 6: Obtain the apical two-chamber view

- 6.1 Scan the left ventricle to evaluate the myocardium
- 6.2 Scan the left ventricle to obtain the volume
 - 6.2.1 Biplane Simpson's method for measuring left ventricle volume

Step 7: Obtain the apical long axis view

- 7.1 Scan the left ventricle in apical long axis to evaluate the myocardium

Step 8: Complete the procedure

Echocardiography 1 – Integrated Clinical (Sims and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Basic Echocardiography Techniques
- Basic Echocardiography Views

Echocardiography 2 – Integrated Clinical (Sims and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Doppler Techniques and Instrumentation
- Valvular Disease
- Wall Motion & Diastolic Function

Echocardiography 3 – Integrated Clinical (Sims and Quizzes only)

Contains all simulation scenarios and quizzes from the following modules:

- Embryology & Congenital Heart Disease
- Endocarditis & Pericarditis
- TEE & Stress Echo

NOTE: In test mode the scenarios in these integrated clinical modules are presented at random, with the goal of helping students prepare for a clinical situation where each patient is different.