B-scan Interpretation
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Ultrasound physics
- Frequencies
- Transducers

Ultrasound physics
- Frequency (Hz) = cycles per second
- Penetration decreases as frequency increases
- Resolution increases as wavelength decreases

Ultrasound
- Audible sound 20-20,000 Hz
- Ultrasound > 20,000 Hz
- High Frequency Ultrasound > 1,000,000

Frequencies
- 10 MHz globe and orbit
- 20 MHz cornea to posterior lens
- 35 MHz cornea to lens equator
- 50 MHz cornea to anterior lens
- 100 MHz cornea

Factors Influencing Signal
- Angle of sound beam
- Relative difference between tissues
- Size and shape of interfaces

Transducer Design - Fundamentals

Factors Influencing Signal
- Angle of sound beam
- Relative difference between tissues
- Size and shape of interfaces
Acoustic Interface
• Boundary between two media of different acoustic impedance
  – Reflection, Transmission and Refraction

Exam Techniques
• Kinetic (Dynamic)
  – Probe moves, eye stationary
  – Eye moves, probe stationary
• Static
  – Probe stationary, eye stationary

Exam Techniques
Kinetic (Dynamic)

Exam Techniques
Static

Exam Techniques
Examination Set Up
• Reduce distractions
• Position ultrasound unit
• Explanation of procedure
• Clean probe

Exam Techniques
Coupling Gel
• Disinfect probe tip
• On globe (preferred)
• On Lid (when needed)
• Probe marker = top of display
• Adjust gain to improve resolution
• Place probe opposite area of interest

Exam Techniques
Label images by area examined
• Transverse
  – Center of all clock hours in image
  – Indicator of posterior, equator, anterior
• Longitudinal
  – Clock hour being examined
  – HAX = Horizontal, VAX = Vertical
  – Oblique with clock hour and "AX"
• Patient looks away from probe
  Except axial scans
Exam Techniques

- Transverse
  - Scan plane traverses several clock hours
  - “Quadrant” exams (Superior/Inferior/Nasal/Temporal)
  - Image posterior pole first (Begin with Optic Nerve)
  - Sweep “Acoustic Section” posterior to anterior
  - Observe/Measure lateral extent of pathology
- Labeling
  - Horizontal = 12P, 12PE, 12E, 12EA, same for 6:00
  - Vertical = 3P, 3PE, 3E, 3EA, same for 9:00

Exam Techniques

- Longitudinal (Radial)
  - Image one clock hour at a time
  - Anterior to Posterior orientation of display
    - Top of display = Anterior Periphery
    - Bottom of display = Posterior (Optic Nerve)
  - Probe marker always toward limbus
  - BEST for locating peripheral tears
  - BEST for documentation of macula
  - BEST for differentiation of hyaloid versus hyaloid with heme
  - Observe/Measure anterior-posterior extent

Exam Techniques

- Axial
  - HAX = Horizontal, VAX = Vertical, 10AX, 2 AX
  - Oblique with clock hour and “AX”
    - Patient looks straight ahead
    - Gentle, extra gel
  - Anterior to Posterior orientation of display
    - Left of display = Anterior Segment
    - Right of display = Posterior (Optic Nerve)
  - Probe marker always nasal or UP
  - Observe/Measure anterior-posterior extent
  - Use to recheck A scan measurements

Exam Techniques

- Performing Vertical Transverse Scans
  - 3P
    - Beam Directed Posteriorly
  - 3E
    - Beam Directed Toward Equator
  - 3EA
    - Beam Directed Anteriorly

Exam Techniques

- Performing Longitudinal Scans
  - L9
    - (LMac)
  - L1
  - L3

Exam Techniques

- Probe Orientation
  - Extremely important!
  - Mark on B-scan probe = Top of display

Exam Techniques

- Probe Marker = Top of Image
  - Horizontal Transverse
    - Marker Nasal
  - Vertical Transverse
    - Marker Superior
  - Oblique Transverse
    - Marker as “Up” as possible
  - Longitudinal
    - Marker toward clock hour being examined
  - Axial
    - Center posterior lens echo
    - Horizontal documents visual pathway
The Use of Gain in Exams

- Frequently Adjusted Throughout Exam
  - High Gain = Increased Sensitivity
    - Hemorrhage
    - Synerisis
    - Posterior Hylaoid
    - Inflammatory Cells
  - Low Gain = Increased Resolution
    - Layers of Membranes; Hylaoid, Retina, Choroid
    - Retinal Breaks and Tears
    - Vascularity within Tumors
    - Vascular Edema and Holes

Gain setting

- High (good sensitivity)
  - Hemorrhage
  - Synerisis
  - Posterior Hylaoid
  - Inflammatory Cells
- Low (good resolution)
  - Layers of Membranes; Hylaoid, Retina, Choroid
  - Retinal Breaks and Tears
  - Vascularity within Tumors
  - Vascular Edema and Holes

Probe Positions

- Transverse Scan
- Longitudinal Scan

Screening Procedure

Patient fixates away from Probe

Shift Probe from Limbus to Fornix

Horizontal Transverse

- marker nasal

Horizontal Transverse

- marker nasal

Vertical Transverse

- marker superior

Vertical Transverse

- marker superior

Longitudinal Screening

Evaluate 12:00, 3:00, 6:00, 9:00

Shift: limbus to fornix to get Optic Nerve at bottom
Rock: side to side
Artifacts

- Reverberation
- Reduplication
- Shadowing
- Blocking
- Reflection
- Refraction

20 MHz Anterior B-scan

- Iridectomy
- Anterior Contact Lens
- Posterior Contact Lens
- Anterior Crystalline Lens
- Posterior Crystalline Lens

Intra Ocular Contact Lens – Correcting Hyperopia

PMMA IOL

20 MHz Anterior B-scan

- IOL Optic (appears large because of slow velocity of sound in silicone)
- Plate Haptics

Silicone Plate Haptic IOL

B-scan Echo Patterns

- Comet's Tail Reverberation Echo

BB Imbedded in Sclera

Dislocated IOL

6PE (Horizontal Transverse of 6:00 Posterior to Equator)
Dislocated Crystalline Lens

Phthisis — The End of the Line for this Patient

Medial Opacities

- Vitreous hemorrhage
  - Blood cells
  - Recent
  - Clot
- Cataract
- Inflammatory cells
  - Endophthalmitis
  - Asteroid Hyalosis
  - Calcium soap particles

B-scan Echo Patterns

- Sub Hyaloid Hemorrhage
- Vitreous Heme, PVD, Shallow RD
- PVD, Vitreous Heme

B-scan Echo Patterns

- PVD, Clot
- Cataract
- Inflammatory Cells
B-scan Echo Patterns

Asteroid Hyalosis
L9 (Longitudinal of 9:00)

B-scan Echo Patterns

Detachments

- Vitreous
  - Weiss ring
- Retina
  - Exudative
  - Rhegmatogenous
  - Tears

Detachments (cont’d)

- Choroid
  - Scallop shape
- Ciliary body

Detachments

Weiss Ring - Usually shown best in Longitudinal position

Weiss Ring

Weiss Ring

Weiss Ring
Detachments

Traction Retinal Detachment

Subhyloid Hemorrhage

Exudative Detachments

Exudative Detachments

Exudative Detachments

Exudative Detachments

Post Dropped Nucleus (3 of 3)

L10 (Longitudinal of 10:00, very anterior)

Giant Retinal Tear

NOTE: Sound beam directed so anteriorly that optic nerve is off display.
RD with Cyst (4 of 4)
L1 (Longitudinal of 1:00)
- Retinal Detachment
- Orbital Bone
- Shallow Choroidal

Serous Choroidal
L3MAC (Longitudinal of 3:00 Macula)
- Sharp angle of detachment
- Optic Nerve

Serous Choroidal
- Vortex Vein Pulling on Choroid
- Bridging Membrane

Choroidal + Total RD
- Retina and Choroid
- Vortex Vein
- Choroid
- Retina
- Optic Nerve
- Hyaloid

Choroidal Detachments

B-scan Echo Patterns
- Retinal Detachment with Macro Cyst

B-scan Echo Patterns
- Diabetic Traction Retinal Detachment
- Hyaloid with adherent blood cells
- Retina

Diabetic Traction RD
1EP (Transverse of 1:00 Posterior to Equator)

Macula
- Edema
- Holes
- Detachment
- Tumor
Longitudinal Scans of Macula
Macular Hole with Pseudo Operculum

B-scan Echo Patterns
Macular Hole with Pseudo-Operculum

B-scan Echo Patterns
Macular Edema Caused By Vitreomacular Traction

Longitudinal Scans of Macula
Macular Edema without Traction

Macular Tumor

Diabetic Traction
L3MAC (Longitudinal of 3:00 OS Macula)

Optic Nerve
- Edema
- Drusen
- Fluid
- Colobomas

Optic Nerve

Optic Nerve
Coloboma

Optic Nerve
Coloboma
Optic Nerve

Optic Nerve

Optic Nerve

Optic Nerve

Optic Nerve

Optic Nerve

Tumors

- Choroidal
- Collar button
  - Extrascleral extension
- Ciliary body
- Orbital

Tumor Evaluation (1 of 4)

Diagnostic B-scan for location, lateral extent, extra-scleral extension

Diagnostic A-scan for differentiation, height measurements, extra-scleral extension

Tumor Evaluation (2 of 4)

Lower gain on B-scan for better definition

Tissue Sensitivity for this instrument = 67 dB

Tumor Evaluation (3 of 4)

Choroidal Melanoma

Extra-Scleral Extension?

Serous RD

Bruch's Membrane
B-scan Echo Patterns

Dislocated IOL

6PE (Horizontal Transverse of 6:00 Posterior to Equator)

Dislocated Crystalline Lens

Post Dropped Nucleus (1 of 3)

9EA (Vertical Transverse of 9:00 Anterior to Equator)

Tissue sensitivity
- Probe to tissue model

Internal reflectivity
- High
- Medium
- Low

Diagnostic A-scan

Foreign Bodies

Intraocular
- Metallic
- Glass
- Plastic
  - Intraocular lenses
  - Organic matter

Orbital
- Buckle
- Plaque

Choroidal Melanoma

Tumor Evaluation (4 of 4)

Tumor Surface Bruch's Membrane

BB Imbedded in Sclera

Comet's Tail

Reverberation Echo

Dislocated IOL

Reduplication artifact in orbit
Post Dropped Nucleus (2 of 3)
9EA (Vertical Transverse of 9:00 Anterior to Equator)

Sub Retinal Space
Where Retina + Choroid Split
Sub Choroidal Space

Scleral Buckle
VAX (Vertical Transverse Axial)

Artifacts from buckle
Buckle
Buckle
Optic Nerve

Scleral Sponge
L9 (Longitudinal of 9:00)

Sponge
Hyaloid

B-Biometry
• Used when confirming A-scan biometry measurements
  – Difficult to measure eyes due to:
    • Staphyloma
    • Silicone oil