Echocardiography Program Knowledge Goals

(with written exam category weight)

This document is very comprehensive, and appears overwhelming, but there is extensive overlap between categories.

1. **Physics / Instrumentation 11%**
    - 1.1. Transducers – types and uses
    - 1.2. Cycles wavelengths and frequency
    - 1.3. Resolution and frequency
    - 1.4. Artifacts appearance and causes
    - 1.5. Speed of sound and image generation
    - 1.6. Acoustic impedance
    - 1.7. Attenuation and frequency
    - 1.8. Types of Doppler and uses (color, spectral, tdi)
    - 1.9. Aliasing
    - 1.10. Nyquist limit
    - 1.11. Bernoulli equation
    - 1.12. Doppler equation and accuracy
    - 1.13. Doppler shift
    - 1.14. Advantages and disadvantages of CW and PW
    - 1.15. Info from a spectral display (velocity direction timing density)
    - 1.16. PRF
    - 1.17. Frame rate
    - 1.18. Laminar vs turbulent blood flow
    - 1.19. 2D and M-Mode
        - 1.19.1. Gain
        - 1.19.2. TGC
        - 1.19.3. Sector width
        - 1.19.4. Focus
        - 1.19.5. Depth
        - 1.19.6. Grey map
        - 1.19.7. Dynamic range
        - 1.19.8. Smoothing
        - 1.19.9. Frame rate
        - 1.19.10. Frame averaging
        - 1.19.11. Harmonics
        - 1.19.12. Zoom
        - 1.19.13. Sweep speed
    - 1.20. Doppler
        - 1.20.1. Scale (Nyquist limit)
        - 1.20.2. Frequency
        - 1.20.3. Baseline
        - 1.20.4. Threshold/priority
        - 1.20.5. Wall filter

1.20.6. B-Pause/Update
1.20.7. Sample volume
1.20.8. Sweep speed
1.20.9. Layout

2. Cardiac Structure and Function 19%

2.1. Cardiac Anatomy –
2.1.1. coronary arteries, include pulmonary and systemic veins, coronary sinus, great cardiac vein
2.1.2. cardiac chambers
2.1.3. valves and valve structure
2.1.4. pericardium (visceral and parietal)

2.2. Cardiac physiology
2.2.1. Phases of the cardiac cycle
2.2.2. Pressure changes and valvular function (including Wigger's diagram)
2.2.3. Hemodynamic factors

2.3. Cardiac Remodeling
2.3.1. Concentric hypertrophy and causes of
2.3.2. Eccentric hypertrophy and causes of
2.3.3. Maladaptive remodeling and causes of

3. Disease Sequelae 17%

3.1. Natural history of common acquired and congenital diseases
3.1.1. Myxomatous valve disease
3.1.2. DCM
3.1.3. HCM/HOCM
3.1.4. Non-specific CM
3.1.5. Restrictive CM
3.1.6. ARVC – dogs and cats
3.1.7. Pulmonary hypertension
3.1.8. Systemic hypertension
3.1.9. Masses and effusions
3.1.10. Endocarditis
3.1.11. VSD
3.1.12. ASD
3.1.13. AVSD
3.1.14. PDA
3.1.15. SAS
3.1.16. PS
3.1.17. Valvular dysplasia
3.1.18. Double chamber RV
3.1.19. Tetralogy of Fallot
3.1.20. Cor triatriatum dexter and sinister
3.1.21. Persistent left cranial vena cava

4. Basic Arrhythmia detection (ECG) 9%

4.1. Ventricular
4.1.1. VPCs

- 4.1.1.1. Ventricular tachycardia
- 4.1.1.2. Bigeminy
- 4.1.1.3. Trigeminy
- 4.1.1.4. Couplets and triplets

4.1.2. Idioventricular rhythm

4.2. Atrial

4.2.1. Atrial fibrillation

4.2.2. Atrial flutter

4.2.3. Atrial tachycardia

4.2.4. APCs

4.3. Blocks

4.3.1. 2nd and 3rd degree AV blocks

5. Basic embryology 3%

5.1. Fetal circulation

5.2. Development of the aortic arch

5.3. Development of the interatrial and ventricular septa

5.4. Development of the endocardial cushion

6. Echocardiographic Images 2%

6.1. Structure identification

6.1.1. All standard right and left-sided imaging planes

6.1.2. Non-standard or modified views

- 6.1.2.1. Vena cava
- 6.1.2.2. Great cardiac vein and coronary sinus
- 6.1.2.3. Coronary arteries
- 6.1.2.4. Pulmonary veins

6.2. Assessment for normal and abnormal

6.2.1. Subjective assessment of all 2D imaging planes

6.2.2. Normal and abnormal color flow

6.2.3. Normal and abnormal spectral Doppler velocities and PG

6.3. Usefulness of imaging planes

6.3.1. Color flow

6.3.2. Valve evaluation

6.3.3. Spectral Doppler alignment

6.3.4. Masses

7. Standard Measurements 4%

7.1. 2D

7.1.1. LV

7.1.2. LA (LA:Ao)

7.1.3. LA 4chamber/ AO annulus

7.1.4. LA FS

7.1.5. PA/Ao ratio

7.1.6. RMPA distensibility

7.1.7. Ejection fraction

7.1.8. LV area fractional change

7.2. MM
    7.2.1. LV
    7.2.2. MV
    7.2.3. LA FS
    7.2.4. TAPSE
    7.2.5. RMPA distensibility
7.3. Doppler
    7.3.1. AO valve and LVOT
    7.3.2. PA valve and RVOT
        7.3.2.1. Ejection time
        7.3.2.2. Acceleration time
    7.3.3. MV inflow
        7.3.3.1. E
        7.3.3.2. A
        7.3.3.3. E deceleration time
    7.3.4. TDI (RV and LV)
    7.3.5. E/E'
    7.3.6. IVRT
    7.3.7. E/IVRT
    7.3.8. MR velocity and PG if present
    7.3.9. TR velocity and PG if present
    7.3.10. PI if present
        7.3.10.1. Mean and diastolic pressures
    7.3.11. AI if present
        7.3.11.1. PHT

Diagnostics and evaluation – Acquired Heart Diseases 21%

8. 2D MM and Doppler evaluation of

8.1. Degenerative valve disease
    8.1.1. Anatomic pathology and hemodynamic consequences
        8.1.1.1. Chamber enlargement
        8.1.1.2. LV and LA Function
        8.1.1.3. RV and RA involvement
        8.1.1.4. Valve appearance and movement
    8.1.2. Doppler Evaluation
        8.1.2.1. Abnormal flow dynamics
            8.1.2.1.1. Color flow area
            8.1.2.1.2. MV inflow
            8.1.2.1.3. Presence of valvular regurgitation
            8.1.2.1.4. MR and or TR regurgitant velocities
        8.1.2.2. Presence or absence of pulmonary hypertension
    8.1.3. Staging (A, B1-2, C, D)
    8.1.4. Filling pressures
        8.1.4.1. E/IVRT
8.2. Endocarditis (appearance, Doppler assessment)

8.2.1. Anatomic pathology and hemodynamic significance
8.2.1.1. affected valve(s) appearance
8.2.1.1.1. potential underlying pathology
8.2.1.2. affected chamber remodeling
8.2.1.3. LV and LA Function
8.2.2. Doppler and Hemodynamic significance
8.2.2.1. Color flow assessment of severity of insufficiencies if any
8.2.2.2. PHT if AI
8.2.2.3. E/IVRT if MR
8.2.2.4. E wave velocity of MV inflow
8.2.2.5. AO valve velocity if AO valve affected
8.3. Dilated cardiomyopathy
8.3.1. Overt
8.3.1.1. Echocardiographic features
8.3.1.1.1. Chamber sizes
8.3.1.1.2. LV and RV Function
8.3.1.1.3. EPSS
8.3.1.1.4. EF
8.3.1.1.5. E/IVRT
8.3.1.1.6. Color Doppler findings
8.3.1.2. Electrocardiographic findings
8.3.2. Subclinical
8.3.2.1. Echocardiographic features
8.3.2.1.1. Chamber sizes
8.3.2.1.2. LV Function
8.3.2.1.3. EPSS
8.3.2.1.4. Sphericity
8.3.2.1.5. EF
8.3.2.1.6. E/IVRT
8.3.2.1.7. Ejection time and PEP
8.3.2.2. Electrocardiographic findings
8.3.2.3. Doberman DCM
8.3.2.3.1. Breed specific findings
8.3.2.4. Other causes of phenotypic changes
8.3.2.4.1. Thyroid disease
8.3.2.4.2. Volume contraction
8.3.2.4.3. Tachy-arrythmia
8.3.2.4.4. Diet
8.3.2.4.5. Infectious
8.3.2.4.6. Drug toxicity
8.4. Hypertrophic cardiomyopathy
8.4.1. Obstructive and non-obstructive
8.4.1.1. 2D Echocardiographic features
8.4.1.1.1. Locations and patterns of hypertrophy

8.4.1.1.2. Presence or absence of SAM
8.4.1.1.3. LA size
8.4.1.2. Color flow and Spectral Doppler
8.4.1.2.1. LVOT obstruction
8.4.1.2.2. Mid ventricular
8.4.2. Staging (A, B1-2, C, D)
8.4.3. Filling pressure
8.4.3.1. E/E'
8.4.3.2. LA function
8.4.4. Diastolic Function measurements
8.4.4.1. Pulmonary venous flow
8.4.4.2. Trans MV flow
8.4.4.3. IVRT
8.4.4.4. TDI E'
8.4.4.5. Stages of diastolic dysfunction
8.4.5. Electrocardiographic findings
8.5. Dynamic Right Ventricular Outflow Tract Obstruction (DRVOTO)
8.5.1. Echocardiographic Features
8.5.1.1. 2D and Doppler
8.5.2. Hemodynamic Significance
8.6. Non-specific cardiomyopathy
8.6.1. Color flow Doppler
8.6.2. Staging (A, B1-2, C, 2D Echocardiographic features
8.6.2.1. Ventricular appearance
8.6.2.2. LA size
8.6.2.3. Stage D
8.6.3. Filling pressure
8.6.3.1. E/E'
8.6.3.2. LA function
8.6.4. Diastolic Function measurements
8.6.4.1. Pulmonary venous flow
8.6.4.2. Trans MV flow
8.6.4.3. IVRT
8.6.4.4. TDI E'
8.6.4.5. Stages of diastolic dysfunction
8.6.5. Electrocardiographic findings
8.7. Restrictive cardiomyopathy/physiology
8.7.1. Forms
8.7.2. 2D Echocardiographic features
8.7.2.1. Ventricular appearance
8.7.2.2. LA size
8.7.3. Staging (A, B1-2, C, D)
8.7.4. Filling pressure
8.7.4.1. E/E'

8.7.4.2. LA function
8.7.5. Diastolic Function measurements
8.7.5.1. Pulmonary venous flow
8.7.5.2. Trans MV flow
8.7.5.3. IVRT
8.7.5.4. TDI E'
8.7.5.5. Stages of diastolic dysfunction
8.7.6. Electrocardiographic findings
8.8. ARVC
8.8.1. Canine
8.8.1.1. Echocardiographic features (2D, Doppler)
8.8.1.2. Electrocardiographic findings
8.8.2. Feline
8.8.2.1. Echocardiographic features (2D, Doppler)
8.8.2.2. Electrocardiographic findings
8.9. Neoplasia
8.9.1. Echocardiographic features and possible rule outs
8.9.1.1. Location and appearance of mass and surrounding structures
8.9.1.2. Flow abnormalities and hemodynamic consequences of the mass
8.9.1.3. Presence of pericardial effusion and tamponade?
8.9.1.4. Types
8.9.1.4.1. Chemodectoma
8.9.1.4.2. Hemangiosarcoma
8.9.1.4.3. Lymphoma
8.9.1.4.4. Mesothelioma
8.9.1.4.5. Other
8.10. Pulmonary hypertension
8.10.1. Echocardiographic Features of Primary and Secondary Etiologies
8.10.1.1. 2D
8.10.1.2. Spectral Doppler
8.10.1.3. M-mode
8.10.2. Additional echocardiographic findings when PG not available
8.10.2.1. AT/ET
8.10.2.2. PA flow appearance
8.10.2.3. Tissue Doppler
8.10.2.4. Tei index
8.10.2.5. RMPA distensibility index
8.11. Systemic Hypertension
8.11.1. Echocardiographic features
8.11.1.1. 2D and M-Mode
8.11.1.2. Spectral Doppler
8.11.1.2.1. AI if present
8.11.1.2.2. MR if present
8.12. Pericardial Effusion

8.12.1. Pleural vs Pericardial fluid
8.12.2. Etiology
8.12.3. Echocardiographic Features
8.12.3.1. 2D and Doppler if other than neoplasia or idiopathic
8.12.4. Presence of Tamponade
8.13. LV Systolic function
8.13.1. Methods of evaluation
8.13.1.1. Ejection fraction (Simpson's)
8.13.1.2. Fractional shortening
8.13.1.3. Fractional area change
8.13.1.4. Systolic Chamber Size
8.13.1.5. Factors that affect function evaluation
8.13.1.5.1. Preload
8.13.1.5.2. Afterload
8.13.1.5.3. Contractility
8.14. RV systolic function
8.14.1. Methods of evaluation
8.14.1.1. Area fractional change
8.14.1.2. TDI
8.14.1.3. TAPSE
8.14.2. Evidence of Right Heart Failure
8.14.2.1. Ascites
8.14.2.2. Hepatic Veins Appearance
8.14.2.3. Vena Cava Distensibility
8.15. LA function
8.15.1. Methods of evaluation
8.15.1.1. Ejection fraction
8.15.1.2. Area fractional change
8.15.1.3. LA FS
8.15.1.4. LAA flow velocities

Diagnostics and evaluation –Congenital Heart Diseases 13%

9. 2D MM and Doppler evaluation of

9.1. Pulmonary stenosis and Double Chamber RV
9.1.1. Breed predilections
9.1.2. Phenotypes including branch PA stenosis
9.1.3. Double Chamber RV (and infundibular stenosis)
9.1.4. Echocardiographic features
9.1.4.1. 2D, Doppler
9.1.5. Coronary artery anatomy
9.1.5.1. Normal vs abnormal
9.1.6. Hemodynamic significance
9.2. Subaortic and aortic stenosis (including bicuspid Aortic Valve)
9.2.1. Breed predilections
9.2.2. Phenotypes

- 9.2.3. Echocardiographic features
  - 9.2.3.1. 2D, Doppler
- 9.2.4. Hemodynamic significance

9.3. Patent Ductus Arteriosus
- 9.3.1. Breed predilections
- 9.3.2. Phenotypes
- 9.3.3. Echocardiographic features
  - 9.3.3.1. 2D, Doppler
- 9.3.4. Hemodynamic significance

9.4. Ventricular Septal Defect
- 9.4.1. Phenotypes
- 9.4.2. Echocardiographic features
  - 9.4.2.1. 2D, Doppler
- 9.4.3. Hemodynamic significance

9.5. Atrial Septal Defect
- 9.5.1. Phenotypes including AVSD (complete and incomplete)
- 9.5.2. Echocardiographic features
  - 9.5.2.1. 2D, Doppler
- 9.5.3. Common associated congenital diseases
- 9.5.4. Hemodynamic significance

9.6. Tricuspid Valve Dysplasia/Stenosis
- 9.6.1. Breed predilections
- 9.6.2. Phenotypes
- 9.6.3. Echocardiographic features
  - 9.6.3.1. 2D, Doppler
  - 9.6.3.2. Pressure Half Time
- 9.6.4. Common associated congenital diseases

9.7. Mitral Valve Dysplasia/Stenosis
- 9.7.1. Breed predilections
- 9.7.2. Phenotypes
- 9.7.3. Echocardiographic features
  - 9.7.3.1. 2D, Doppler
  - 9.7.3.2. Pressure Half Time

9.8. Tetralogy of Fallot
- 9.8.1. Echocardiographic features
  - 9.8.1.1. 2D, Doppler
- 9.8.2. Acyanotic vs cyanotic

9.9. Cor triatriatum
- 9.9.1. Species - canine vs feline
- 9.9.2. Echocardiographic features
  - 9.9.2.1. 2D, Doppler
  - 9.9.2.2. Differentiate from mitral stenosis

Topic and number on knowledge list	importance	% of questions # of questions TBD
8. Echo in Acquired Heart Disease	1	21
2. Cardiac Structure and Function	2	19
3. Disease Sequellae	3	17
9. Echo in Congenital Heart Disease	4	13
1. Physics / Instrumentation	5	11
4. Arrhythmia Recognition	6	9
5. Basic Embryology	7	3
7. Standard Measurements	8	4
6. Echocardiographic Images	9	2