

# DMS-1602: ECHOCARDIOGRAPHY I

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## Cuyahoga Community College

### Viewing: DMS-1602 : Echocardiography I

#### Board of Trustees:

January 2020

#### Academic Term:

Fall 2020

#### Subject Code

DMS - Diagnostic Medical Sonography

#### Course Number:

1602

#### Title:

Echocardiography I

#### Catalog Description:

Basic theory of echocardiography including study of normal anatomy, anatomic variants, physiology, and pathology of the heart with ultrasound. Includes basic understanding of physical concepts of ultrasound creation and utilization in echocardiography. Visual pathology recognition and identification on transthoracic examination with an understanding of the etiology of cardiovascular disease and affects is included.

#### Credit Hour(s):

4

#### Lecture Hour(s):

4

## Requisites

#### Prerequisite and Corequisite

Concurrent enrollment in DMS-1311 Initial Sonographic Scanning.

## Outcomes

#### Course Outcome(s):

Assess indications for and perform an echocardiogram according to the American Society of Echocardiography.

#### Objective(s):

1. List and describe structures and blood flow within the heart using 2D, M-Mode and Color Doppler.
2. Differentiate between normal and abnormal structures and blood flow within the heart and describe their causes and affects on the cardiovascular system.
3. Evaluate reasons to perform an echocardiogram.
4. Explain correct patient, room and machine preparation in order to obtain the correct imaging planes and views to perform an echocardiogram.
5. Deduce how ultrasound is generated using physical concepts to create real time images M-Mode and color Doppler.
6. List the anatomy, windows, views and transducer locations on the body used in echocardiogram according to the American Society of Echocardiography standards.

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#### Course Outcome(s):

Relate and describe components associated with and affecting the cardiovascular system.

#### Objective(s):

1. List and identify anatomy of the cardiovascular system and its associated components.
2. Describe the electrical conduction system in respect to EKG tracings and recognize common arrhythmias.
3. Relate cardiovascular responses to electrical, mechanical and physiological changes.
4. Explain the histology of cardiac muscle fibers and the events leading to muscle contraction.
5. Describe the anatomy of the different circulatory systems and their associated components.

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**Course Outcome(s):**

Apply knowledge of cardiovascular disease, their etiologies, affects and appearance on an echocardiogram when performing sonographic scans.

**Essential Learning Outcome Mapping:**

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

**Objective(s):**

1. Recognize the presence of various cardiovascular diseases.
  2. List and describe etiology, and affects on a patient with various cardiovascular disease.
  3. Explain appearance on an echocardiogram when various cardiovascular diseases are present.
  4. Describe current methods of treatment for the various cardiovascular diseases.
  5. Describe the effects that transgender hormones have on the cardiovascular system.
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**Methods of Evaluation:**

- A.Quizzes
- B.Mid term and final examinations
- C.Written assignments
- D.Homework

**Course Content Outline:**

1. Concepts
  - a. Protocols
  - b. Preparation
  - c. Cross-sectional anatomy
  - d. Pathophysiology
  - e. Scope of Practice
  - f. Critical thinking
  - g. Hemodynamics
  - h. Disease Process and affects
    - i. Disease Appearance
    - j. Exam preparation techniques
  - k. American Society of Echocardiography standards
    - l. Instrumentation features
  - m. Wigger's Diagram
  - n. Frank-Starling's law
2. Skills
  - a. Preparing patient and room for the exam
  - b. Applying knowledge of physical instrumentation
  - c. Analyzing echocardiogram results/findings
  - d. Identifying normal anatomy of the cardiac system
  - e. Recognizing abnormal pathology of the cardiac system
  - f. Determining normal versus abnormal anatomy and blood flow
  - g. Differentiating between artifact and anatomical variants of circulatory system
3. Issues
  - a. Knowledge retention
  - b. Standards of practice
  - c. Exam Preparation
  - d. Verbal and non-verbal communication limitations
  - e. Critical thinking
  - f. Medical ethics
  - g. Difficult examinations

Topical Outline

1. Cardiovascular anatomy
  - a. Cardiac muscle layers
  - b. Pericardial layers
  - c. Chambers and septa
  - d. Valves and related apparatus
  - e. Coronary anatomy
  - f. Great vessels
  - g. Relational anatomy
2. Electrophysiology and the conduction system
  - a. Propagation and pathway of electrical activity
    - i. SA node
    - ii. AV node
    - iii. Bundle of His
    - iv. Bundle branches
    - v. Perkinjie fibers
  - b. EKG components and normal values
    - i. Normal sinus rhythm
    - ii. Rhythm disturbances and abnormal electrical activation
    - iii. Sinus arrhythmia
    - iv. Atrial fibrillation
    - v. Supraventricular tachycardia
    - vi. Premature ventricular contractions
    - vii. Ventricular tachycardia
    - viii. Ventricular fibrillation
    - ix. Cardiac arrest
  - c. Mechanical events
    - i. Frank-Starling law (length-tension relationship)
      1. Force-velocity relationship
      2. Muscle contraction
      3. Sliding filament theory
    - ii. Heart Sounds and auscultation (S1 and S2)
    - iii. Phases of the cardiac cycle and events (Wigger"s Diagram)
      1. Passive or rapid filling
      2. Atrial systole
      3. Isovolumic contraction
      4. Systole
      5. Isovolumic relaxation
    - iv. Left ventricular function
      1. Stroke volume
      2. Cardiac output
      3. Ejection fraction and dP/dT
  - d. Exercise Physiology
    - i. Changes in metabolic needs
    - ii. Circulation changes
    - iii. Heart rate changes
    - iv. Cardiac volume changes
    - v. Blood pressure changes
3. Physical principles and instrumentation of ultrasound
  - a. Production of ultrasound waves
  - b. Color Doppler
    - i. Autocorrelation
    - ii. BART
    - iii. Color maps
    - iv. Aliasing
  - c. Power Doppler
  - d. Artifacts due to body habitus
  - e. Echocardiographic probes and frequencies
    - i. Transthoracic adult and pediatric echocardiography
    - ii. Non-imaging pedoff

4. Imaging direction/planes and anatomy
  - a. Parasternal window
    - i. Long axis left ventricle
    - ii. Long axis right ventricle
    - iii. Long axis pulmonic valve (LV-Tilt)
    - iv. Long axis tricuspid valve (RV-Tilt)
    - v. Short axis - aortic level
    - vi. Short axis - mitral valve leaflet level
    - vii. Short axis - chordal level
    - viii. Short axis - papillary level
    - ix. Short axis - apex
  - b. Apical window
    - i. Four chamber
    - ii. Five chamber
    - iii. Two chamber
    - iv. Three chamber (apical long axis)
  - c. Subcostal window
    - i. Long axis (four chamber)
    - ii. Short axis (IVC and hepatics)
    - iii. Short axis (parasternal short axis)
  - d. Suprasternal window
    - i. Long axis (aortic arch)
    - ii. Short axis (LA and pulmonary veins)
5. Diseases of the aorta - echocardiographic findings
  - a. Signs and symptoms
  - b. Aortic aneurysm vs. aortic ectasia
  - c. Aortic atherosclerosis
  - d. Aortic dissection and classifications
  - e. Aortic trauma
  - f. Aortic coarctation
  - g. Sinus of valsalva aneurysm
6. Aortic Valve Diseases
  - a. Aortic sclerosis/stenosis
    - i. Signs and symptoms
    - ii. Etiologies
      1. Primary
      2. Secondary
    - iii. Associated complications and dynamic changes
    - iv. Sonographic appearance by 2D and M-Mode
    - v. Affects on the great vessel
    - vi. Echocardiographic changes following treatment and cardiac medications
  - b. Aortic regurgitation/insufficiency
    - i. Acute vs. chronic
    - ii. Signs and symptoms
    - iii. Etiologies
    - iv. Associated complications and dynamic changes
    - v. Sonographic appearances by 2D, M-Mode and Color Doppler
    - vi. Affects on the great vessel
    - vii. Echocardiographic changes following treatment and cardiac medications
7. Mitral Valve Diseases
  - a. Mitral valve stenosis
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
      1. Primary
      2. Secondary
    - iv. Sonographic appearance by 2D and M-Mode
    - v. Affects on the great vessel
    - vi. Echocardiographic changes following treatment and cardiac medications

- b. Mitral regurgitation/insufficiency
  - i. Acute vs. chronic
  - ii. Signs and symptoms
  - iii. Etiologies
  - iv. Associated complications and dynamic changes
    - 1. Primary
    - 2. Secondary
  - v. Sonographic appearances by 2D, M-Mode and Color Doppler
  - vi. Affects on the great vessel
  - vii. Echocardiographic changes following treatment and cardiac medications
- 8. Pulmonic Valve Diseases
  - a. Pulmonic valve stenosis
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
      - 1. Primary
      - 2. Secondary
    - iv. Sonographic appearance by 2D and M-Mode
    - v. Affects on the great vessel
    - vi. Echocardiographic changes following treatment and cardiac medications
  - b. Pulmonic regurgitation/insufficiency
    - i. Acute vs. chronic
    - ii. Signs and symptoms
    - iii. Etiologies
      - 1. Primary
      - 2. Secondary
    - iv. Associated complications and dynamic changes
    - v. Sonographic appearances by 2D, M-Mode and Color Doppler
    - vi. Affects on the great vessel
    - vii. Echocardiographic changes following treatment and cardiac medications
- 9. Tricuspid Valve Diseases
  - a. Tricuspid valve stenosis
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
      - 1. Primary
      - 2. Secondary
    - iv. Sonographic appearance by 2D and M-Mode
    - v. Affects on the great vessel
    - vi. Echocardiographic changes following treatment and cardiac medications
  - b. Tricuspid regurgitation/insufficiency
    - i. Acute vs. chronic
    - ii. Signs and symptoms
    - iii. Etiologies
    - iv. Associated complications and dynamic changes
      - 1. Primary
      - 2. Secondary
    - v. Sonographic appearances by 2D, M-Mode and Color Doppler
    - vi. Affects on the great vessel
    - vii. Echocardiographic changes following treatment and cardiac medications
- 10. Hypertensive Heart Diseases
  - a. Systemic Hypertension
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
    - iv. Sonographic appearances
    - v. Affects on the great vessel
    - vi. Echocardiographic changes following treatment and cardiac medications
  - b. Pulmonary Hypertension

- i. Signs and symptoms
  - ii. Etiologies
    - 1. Primary
    - 2. Secondary
  - iii. Associated complications and dynamic changes
  - iv. Sonographic appearances
  - v. Affects on the great vessel
  - vi. Echocardiographic changes following treatment and cardiac medications
- 11. Coronary Artery Disease - Ischemic heart disease
  - a. Risk factors and indications
  - b. Wall motion abnormalities
  - c. Ejection fraction and other parameters of systolic performance
  - d. Myocardial infarction
  - e. Complications of myocardial infarction
  - f. Echocardiographic changes following treatment and cardiac medications
- 12. Cardiomyopathies
  - a. Dilated or Congestive
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Effects on chamber sizes and pressures
    - iv. Sonographic appearance
    - v. Ventricular systolic performance
    - vi. Associated complications and dynamic changes
    - vii. Echocardiographic changes following treatment and cardiac medications
  - b. Hypertrophic
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Obstructive and non-obstructive
    - iv. Associated complications and dynamic changes
    - v. Sonographic appearance
    - vi. Diagnostic maneuvers
    - vii. Echocardiographic changes following treatment and cardiac medications
  - c. Infiltrative or Restrictive
    - i. Signs and symptoms
    - ii. Types
    - iii. Etiologies including transgender hormone treatments
    - iv. Associated complications and dynamic changes
    - v. Sonographic appearance
    - vi. Echocardiographic changes following treatment and cardiac medications
- 13. Pericardial Diseases
  - a. Pericarditis
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
    - iv. Sonographic appearance
    - v. Treatments
    - vi. Echocardiographic changes following treatment and cardiac medications
  - b. Constrictive Pericarditis
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes
    - iv. Sonographic appearance
    - v. Treatments
    - vi. Echocardiographic changes following treatment and cardiac medications
  - c. Pericardial Effusion
    - i. Signs and symptoms
    - ii. Etiologies
    - iii. Associated complications and dynamic changes

- iv. Sonographic appearance
- v. Treatments
- vi. Echocardiographic changes following treatment and cardiac medications
- d. Cardiac Tamponade
  - i. Signs and symptoms
  - ii. Etiologies
  - iii. Associated complications and dynamic changes
  - iv. Sonographic appearance
  - v. Treatments
  - vi. Echocardiographic changes following treatment and cardiac medications
- 14. Prosthetic Valves
  - a. Indications for replacement
  - b. Prosthetic failure by type
  - c. Mechanical
    - i. Types
    - ii. Sonographic appearance
  - d. Bioprosthetic
    - i. Types
    - ii. Sonographic appearance
- 15. Tumors, Masses and Missiles
  - a. Primary vs. Benign
  - b. Secondary
  - c. Anomalies
  - d. Foreign bodies/Missiles
  - e. Artifacts
- 16. Pharmacology
  - a. Diuretics
  - b. Vasodilators
  - c. Vasopressors
  - d. Antagonists
  - e. Inotropic
  - f. Chronotropic
  - g. Calcium channel blocking agents
  - h. Antiarrhythmic agents

## Resources

Otto, Catherine. *Textbook of Clinical Echocardiography 6th ed.. 7th ed.* Philadelphia, PA: Elsevier, 2018.

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Harry, M. and Behrends, T. (2013) *Essentials of Echocardiography and Cardiac Hemodynamics: An Illustrative Guide*, Mark Harry Cardiac Ultrasound, LLC.

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Pai, R., Varadarajan, P., Chandraratna, P. and Malik, S. (2013) *Echocardiography, A Case Based Approach*, Burlington, MA: Jones Bartlett.

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Silverman, D. and Manning, W. (2012) *The Complete Guide to Echocardiography*, Sandbury, MA: Jones Bartlett Learning.

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McLaughlin, M. (2014) *Cardiovascular Care Made Incredibly Easy*, Philadelphia, PA: Wolters Kluwer.

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Armstrong, William F. and Thomas Ryan. *Feigenbaum's Echocardiography*. 8th ed. Wolters Kluwer, 2019.

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