Simulation Based General Cardiology Training Curriculum

Description

In the era of duty hour restrictions and increasing medico-legal pressures, surgical simulation offers a viable alternative to bridge the gap in experience and knowledge of residents[2].

Training within a proficiency-based, virtual-reality training program can increase competency and reduce errors and complications during real surgical procedures[10].

The skills acquired in the simulated environment should be transferable to the real clinical environment[4].

The Simbionix ANGIO Mentor is a virtual reality simulator that provides a safe work environment for a variety of endovascular procedures.

The following curriculum is intended to promote the acquisition of essential skills required for General Cardiology fellows.

Objectives

- To establish the knowledge of coronary artery anatomy, including anatomical variants and bypass grafts.
- To establish knowledge of radial and brachial artery anatomy
- To develop competence in the performance of left heart catheterization including left/right coronary angiography and coronary bypass angiography via femoral or radial approach.
- To develop competence in optimal use of c-arm, imaging techniques, cineangiography, parallax, hand and power contrast injection techniques, in order to minimize patient/team exposure to radiation and minimize the use of nephrotoxic contrast agent.
- To develop competence in interpretation of coronary angiography, with particular attention to the need for tailored views of stenoses
- To develop competence in overcoming anatomical obstacles and complications during transradial coronary angiography
- To develop competence in temporary pacemaker implantation in the right ventricle
- To establish the knowledge of adjunctive pharmacological therapy when appropriate

Specialties

General Cardiology

Target Audience

Individuals or groups interested in following a structured curriculum to promote acquisition of cardiovascular technical skills and procedural performance for coronary angiography and temporary pacemaker implantation.

Assumptions

The following knowledge is assumed:
- Anatomical background
- Properties of wires, catheters and electrodes to be used.

Suggested Time Length

Completing one case successfully in each module should take between 20 minutes to 45 minutes.

Authors

This curriculum is designed by Simbionix to serve as a template for program directors at institutions, who can tailor the curriculum to the individual training needs. Please review references for a detailed review of published studies.

Introduction to Curriculum- Instructors

Before each module is practiced, provide a full demonstration of one case by an experienced operator, with an opportunity for the trainee to ask questions.
Suggested time length for the familiarization period is approximately 30 minutes.

1.1 Coronary Intervention Module

This module provides hands-on practice for transfemoral diagnostic coronary angiography and percutaneous coronary interventions, using a variety of cath lab tools such as diagnostic catheters, wires, guiding catheters, PTA balloons and stents.

During the intervention, the trainee may experience complications such as dissection, perforation or hemodynamic changes. The trainee will be able to treat the complications using a variety of devices and medications.
The module includes 12 cases, presenting left and right dominant coronary anatomy with various stenosis/ infarction locations.

Objectives:

- To establish the knowledge of coronary anatomy, including right and left dominant anatomy.
- To practice safely performing diagnostic coronary angiogram via femoral approach, using standard projections
- To practice c-arm manipulation for visualization of overlapping lesions
- To practice interpretation of the angiographic image
- To practice left and right coronary catheterization techniques and diagnostic catheter positioning
- To practice administration of adjunctive pharmacological therapy for anticoagulation and hemodynamic management

Instructions:

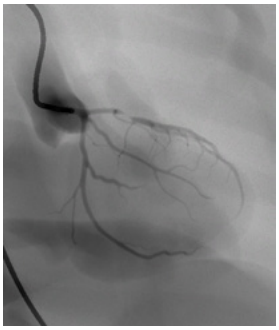
The module enables free-style training using different techniques, alternative approaches, and acquisition of the skill and knowledge necessary to safely cope with possible complications.

Practice left and right coronary diagnostic angiography.

Acquire cineangiograms of standard projections to visualize all vessels and identify lesions.

Fill the trainee report with the lesion findings.

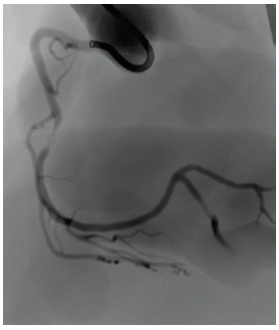
Following performance of the patient case, the trainee is required to analyze his/her performance report and set personal standards for improvement.



Case 1 - Stable Angina

Coronary Anatomy: right dominant

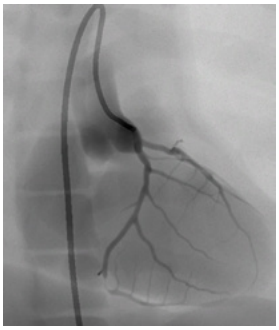
Lesion Location: proximal LAD

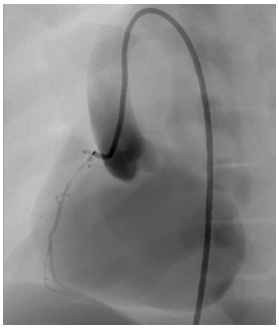


Case 2 - Stable Angina

Coronary Anatomy: right dominant

Lesion Locations: proximal RCA, proximal PDA

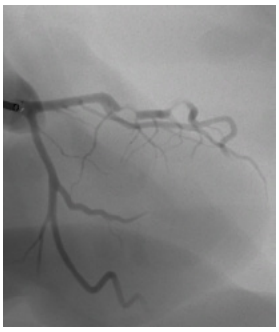




Case 3 - Stable Angina

Coronary Anatomy: left dominant

Lesion Location: proximal RCA, circumflex - proximal PDA



Case 4 - Acute Coronary Syndrome

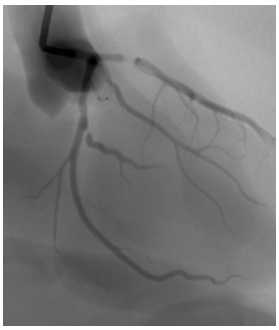
Coronary Anatomy: right dominant, tortuous

Lesion location: 2 LAD lesions

Case 5 - Acute MI

Coronary Anatomy: left dominant

Thrombus and lesion location: left circumflex – proximal PDA

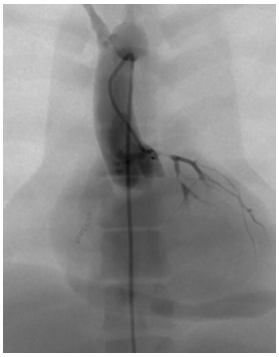


Case 6- Multi-vessel Disease

Coronary Anatomy: right dominant

Lesion location: Left: proximal LAD, proximal OM-1, proximal OM-111, 1st diagonal

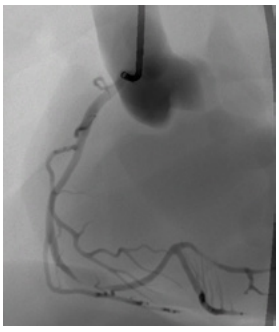
Right: proximal RCA, distal RCA



Case 7 - Acute MI

Coronary Anatomy: right dominant

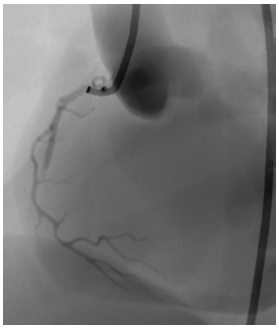
Lesion locations: left main, proximal 2nd diagonal, proximal circumflex



Case 8 - Coronary Intervention

Coronary Anatomy: right dominant

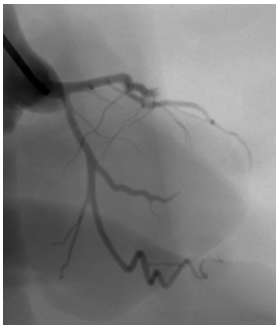
Lesion locations: mid-RCA, proximal right posterolateral



Case 9 - Acute MI

Coronary Anatomy: right dominant

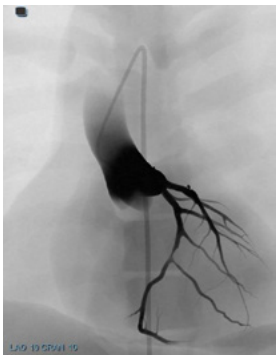
Thrombus location: mid-RCA in-stent thrombosis



Case 10 - Acute MI

Coronary Anatomy: right dominant, tortuous

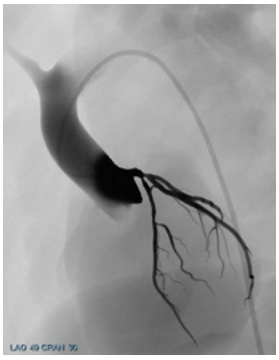
Thrombus and lesion locations: proximal LAD, proximal RCA lesion



Case 11 – Bifurcation Lesion

Coronary Anatomy: left dominant

Lesion Location: LCx bifurcation lesion



Case 12 – Bifurcation Lesion

Coronary Anatomy: right dominant

Lesion Locations: LMCA-LAD and LAD-D2 bifurcation lesions

1.2 Transradial Coronary Intervention Module

This module provides hands-on practice of transradial approach for diagnostic coronary angiography and percutaneous coronary interventions, using a variety of cath lab tools such as diagnostic catheters, wires, guiding catheters, PTA balloons and stents.

The cases included present anatomical variations which feature technical challenges, such as tortuous subclavian, CABG and brachial loop. Complications include radial/brachial artery spasm and perforation.

The module includes 5 cases, presenting left and right dominant coronary anatomy with various stenosis locations.

Objectives:

- To establish the anatomical knowledge of coronary anatomy and transradial pathway to the aortic sinus
- To practice techniques and devices required to overcome challenging anatomies (tortuous subclavian, CABG and brachial loop).
- To practice management of radial artery complications (spasm and perforation)
- To practice safely performing diagnostic coronary angiogram via transradial approach, using standard projections
- To practice c-arm manipulation for visualization of overlapping lesions
- To practice interpretation of the angiographic image
- To practice c-arm manipulation for visualization of overlapping lesions
- To practice interpretation of the angiographic image
- To practice left and right coronary catheterization techniques and diagnostic catheter positioning
- To practice administration of adjunctive pharmacological therapy for anticoagulation and hemodynamic management

Instructions:

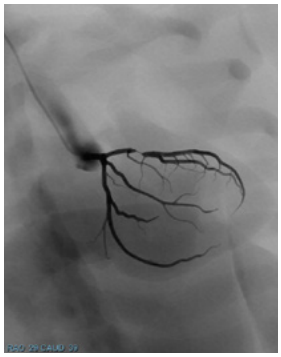
The module enables free-style training using different techniques, alternative approaches, and acquisition of the skill and knowledge necessary to safely cope with possible complications.

Practice left and right coronary diagnostic angiography via transradial approach.

Acquire cineangiograms of standard projections to visualize all vessels and identify lesions.

Fill the trainee report with the lesion findings.

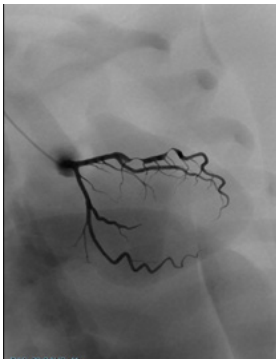
Following performance of the patient case, the trainee is required to analyze his/her performance report and set personal standards for improvement.



Case 1 - Left and Right Transradial Approach

Coronary Anatomy: right dominant

Lesion Location: LAD



Case 2 - Tortuous Subclavian

Coronary Anatomy: right dominant

Lesion Location: 2 LAD lesions

Case 3 - CABG

Coronary Anatomy: Right Dominant, RCA VG and LIMA

Lesion Location: distal LAD

Case 4 - Standard Radial Anatomy

Coronary Anatomy: Right Dominant

Lesion Location: 2 RCA lesions

Complications: radial/brachial spasm

Treatment: drug adminstration

Case 5 - Brachial Loop

Coronary Anatomy: Left Dominant

Lesion Location: LCx and RCA lesions

Complications: perforation at the loop

Treatment: pass an 0.014" wire and continue

1.3 CRM Module

This module provides significant training and practice in the placement of three electrode leads (LV, RV and RA). The simulation, designed to help develop competence in electrophysiology interventions, includes real-life sensing and pacing measurements and enables clinicians to cope with procedural arrhythmia complications such as A.V. Block, VF and VT.
The CRM module provides a variety of realistic anatomies based on real patient data including variations in the Coronary Sinus ostium (e.g. Thebesian valve) and vasculature.

Objectives:

- To practice and develop proficiency in temporary pacemaker implantation in the right ventricle.
- To practice and develop proficiency in complete electrical measurements by providing realistic simulations of sensing and pacing measurements.

Instructions:

The module enables training using different techniques, alternative approaches, and acquisition of the skill and knowledge necessary to safely cope with possible complications.

Select and position an RV electrode in the right ventricle.

Press the Sense/pace button, set the amplitude and impedance values and then determine the pacing threshold.

Upon completion, the trainee is required to analyze his/her performance report and set personal standards for improvement.

Case 1 – Simple RV Anatomy

Standard ventricle size. Active and passive electrode fixations are possible, both pacing and ICD leads are available.

Complication: VF

Treatment: Defibrillation

Case 3 – Dilated ventricles

Both apex and septal active fixations are possible using different stylet shapes.

Complication: VT & VF

Treatment: either defibrillation or Pacing using either RV lead or external defibrillator.

ANGIO Mentor Studies

1. **Training with simulation versus operative room attendance.**
Desender LM, Van Herzeele I, Aggarwal R, Vermassen FE, Cheshire NJ. Department of Thoracic and Vascular Surgery, University Hospital Ghent, Ghent, Belgium. J Cardiovasc Surg (Torino). 2011 Feb;52(1):17-37.
2. **Simulation in Neurosurgical Residency Training: A New Paradigm** Alejandro M. Spiotta, MD Richard P. Schlenk, MD The Cleveland Clinic Foundation, Cleveland, Ohio, USA The Congress of Neurological Surgeons(CNS) Quarterly 2010 page 18-20.
3. **The Utility of Endovascular Simulation to Improve Technical Performance and Stimulate Continued Interest of Preclinical Medical Students in Vascular Surgery** Jason T. Lee , Mary Qiu , Mediget Teshome, Shyam S. Raghavan, Maureen M. Tedesco, and Ronald L. Dalman Division of Vascular Surgery, Stanford University School of Medicine, Stanford, California Journal of Surgical Education Volume 66, Issue 6, November-December 2009, Pages 367-373 Available online 30 January 2010.
4. **Results from endovascular skills training for surgical residence.** Jason T. Lee, Division of Vascular Surgery, Stanford University School of Medicine, Stanford, California.
5. **Virtual Reality Simulation in the Endovascular Field** Aggarwal Rajesh , Herzeele Isabelle Van European Virtual Reality Endovascular Research Team (EVEREST) US Cardiology, 2008;5(1):41-5.
6. **Experienced endovascular interventionalists objectively improve their skills by attending carotid artery stent training courses.** S. Neequaye, I. Van Herzeele, R. Aggarwal, M. Hamady, A. Darzi, T. Cleveland, P. Gaines, N. Cheshire Department of Biosurgery and Surgical Technology, Imperial College London, U.K. *presented in the prize session of the European Society for Vascular Surgery (ESVS) Annual Meeting September 20 - 23, 2007 in Madrid, Spain.*
7. **Analysis of simulated angiographic procedures. Part 2: extracting efficiency data from audio and video recordings.** Duncan JR, Kline B, Glaiberman CB.Mallinckrodt Institute of Radiology, Washington University School of Medicine, 510 S. Kingshighway Blvd., St. Louis, MO 63110, USA. *J Vasc Interv Radiol. 2007 Apr;18(4):535-44*
8. **The use of interventional cardiovascular simulation to evaluate operator performance: The carotid Assessment of operator performance by the Simbionix carotid StEnting Simulator Study (ASSESS)** Giora Weisz, Jacque Devaud, Stephen Ramee, Mark Reisman, William Gray Cardiovascular Research Foundation, and Center for Interventional Vascular Simulation, New-York Presbyterian Hospital, Columbia University, New York, NY *Journal of the Society for Simulation in Healthcare 2007, Volume2, Issue 1*
9. **Preliminary Results of Construct Validity of an Endo Vascular Simulator** Giora Weiss, Colombia University, New York The abstract was *accepted and presented **at the 2006 TCT meeting** October 22- 26, 2006 in Washington DC J Vasc Surg. 2012 Jun 26. [Epub ahead of print]*
10. **Development of a Virtual Reality Training Curriculum for Laparoscopic Cholecystectomy** Aggarwal, P. Crochet, A. Dias, A. Misra, P. Ziprin and A. Darzi *British Journal of Surgery 2009; 96: 1086–1093.*