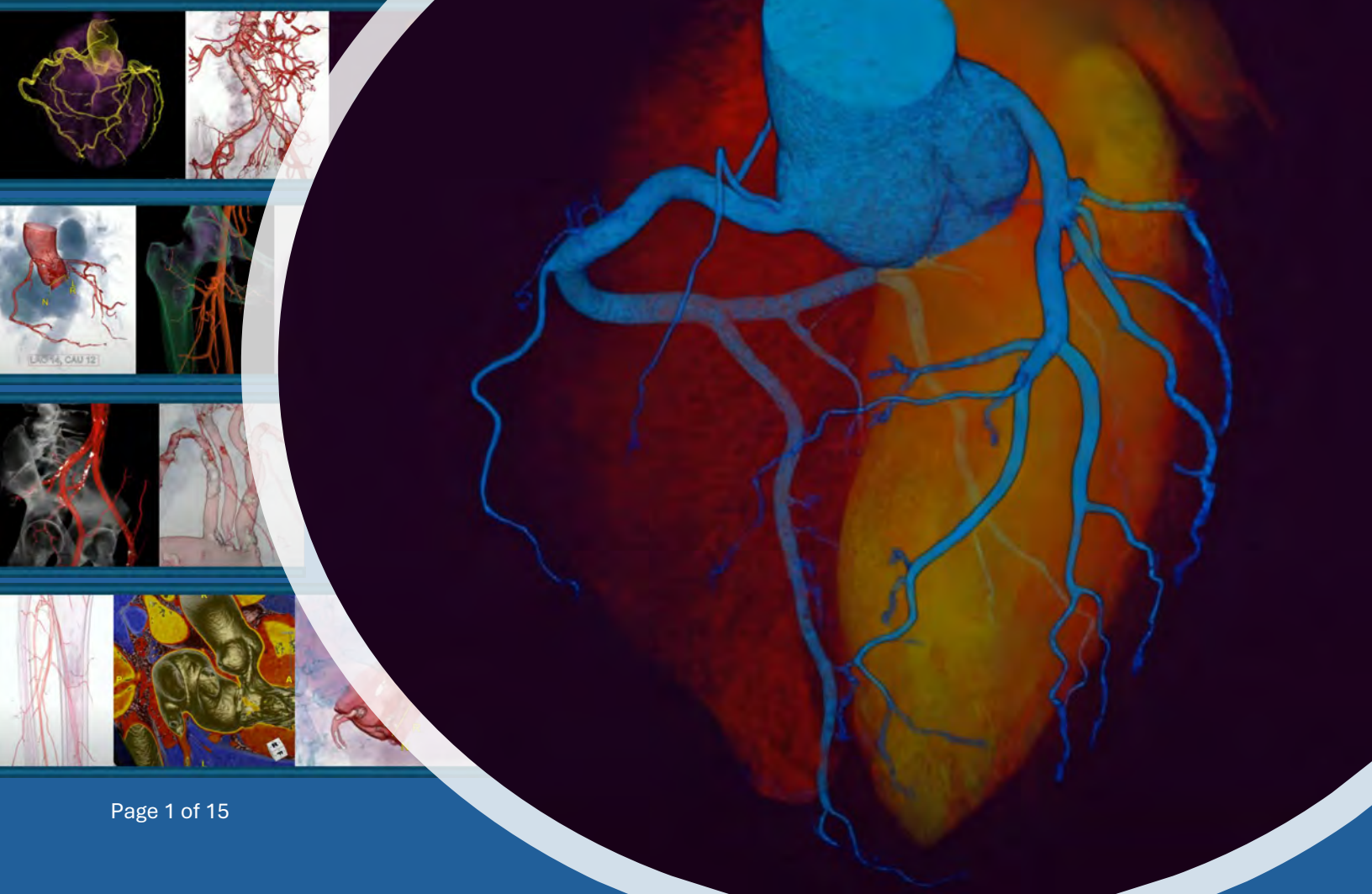
Course Program

2nd Annual All-Georgia Workshop and Board Review for Technologists, Cardiology Fellows, and Radiology Residents

Supported by
Educational Grants from
Aidoc, GEHealthcare,
TeraRecon and Heartflow,

Emory School of Medicine
June 7-8, 2025



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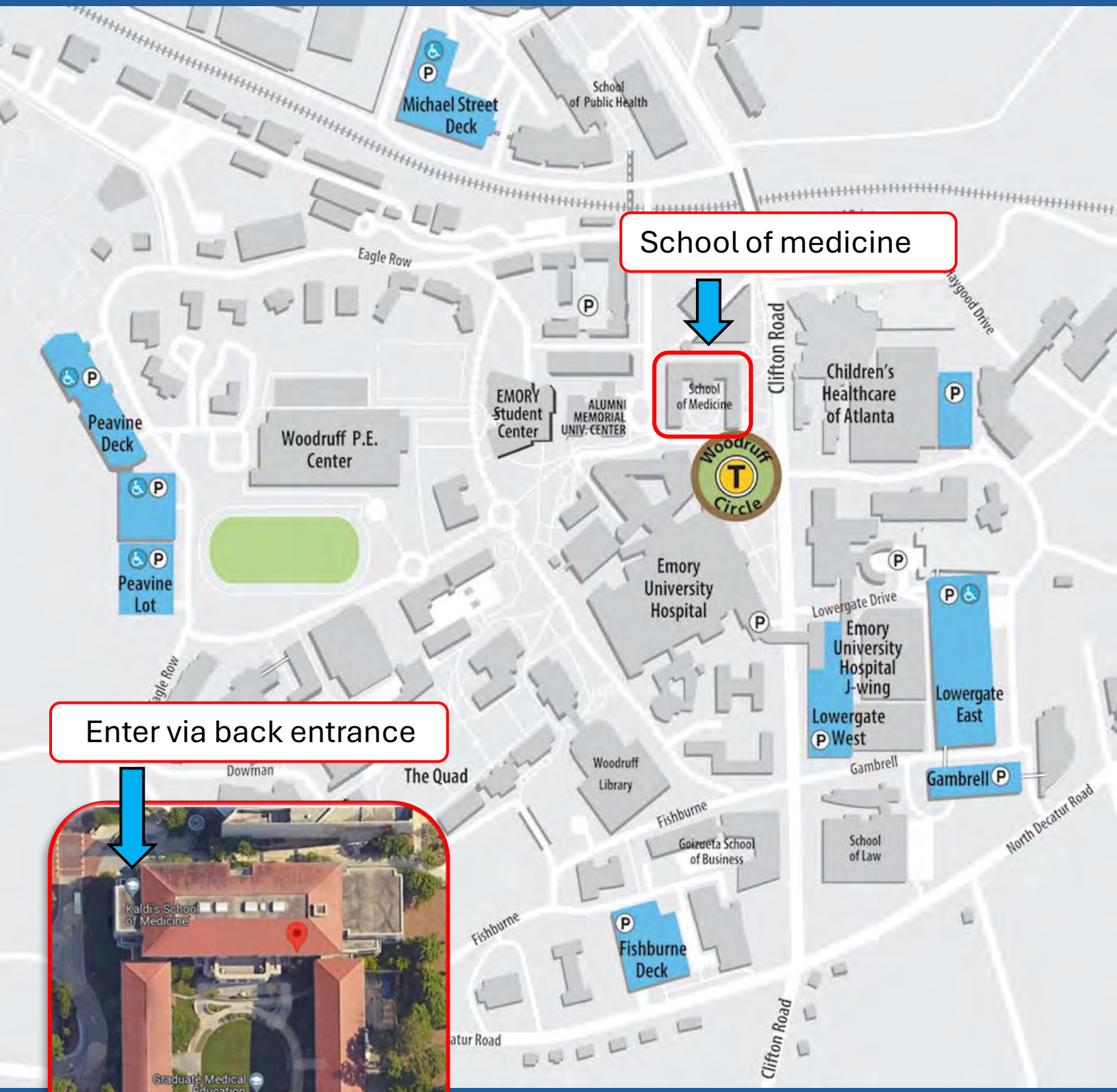
Campus map

For live help with directions you may call one of the course assistants:
David Kulp at 301-466-4762 or David Masotti at 860-899-6736.



School of Medicine
Third floor, Room 312 and 313
100 Woodruff Circle
Atlanta, GA 30322

Parking (blue buildings on map) is free on weekends !

Course Chairs

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Associate Program Director – Cardiology Fellowship
Associate Director – Echocardiography Laboratory
Medical College of Georgia at Augusta University

Emory Workstation Login Instructions (Day of course)

Emory learners may log onto the laboratory workstations with their Emory NetIDs and passwords
All learners may use the generic School of Medicine account name *smtexam* and password: *smtex@m!*

Launch Parallel to

Launch Intuition Viewer 6 (the TeraRecon software) using its desktop icon.
Parallels software, which provides the link to the TeraRecon server, will launch automatically.
Use your Intuition account name and password to log into the Intuition server.

You will receive your username and password by email. They will also be available to the learners from the TeraRecon representative the day of the course.

Parallels and Thin Client Installation (for personal laptops)

Case Upload Instructions (Faculty only)

Case file upload links for faculty:

https://terarecon.sharefile.com/r-rcaf5b9e8a38641ab9248625efa410d2b
https://iupload.cloud.terarecon.com/Login.aspx

Important Contact Information

- To RSVP and for general questions email Michael Winkler, course director, at michael.winkler@emory.edu
- For directions the day of the course call David Kulp, course assistant, at 301-466-4762 or David Massoti,course assistant, at 860-899-6736.
- For Intuition (TerareconAI) pre-course virtual machine and remote client installation help email Amanda Jung at ajung@terarecon.com

June 7, 2025

9:30 a.m.	Breakfast
10:00 a.m.	Buttonology: Cases 1-2 Michael Winkler
10:30 a.m.	Patient Selection; Cases 3-4 Scott Jerome and Mariana Garcia
11:00 a.m.	Patient Preparation; Cases 5-6 Mariana Garcia and Scott Jerome
11:30 a.m.	Scanner Technical Factors; Cases 7-8 Shalmali Dharmadhikari & Michael Winkler
Noon	Lunch Panel: Standardized Reporting, ECG, Implantable Devices Scott Jerome, Mariana Garcia, William Bates, Deya Alkhatib
1:00 p.m.	Coronary Arteries & Cardiac Veins; Cases 9-10 Karin Dill
1:30 p.m.	Pulmonary Arteries and Aorta; Cases 11-12 Michael Winkler and J. Jeff Carr
2:00 p.m.	Thoracic Radiology Part 1; Cases 13-14 Cameron Henry and Danny Donovan
2:30 p.m.	Thoracic Radiology Part 2; Cases 15-16 Stefan Tigges and Danny Donovan
3:00 p.m.	Mini Mock Exam and Answer Session 1; Cases 17-20 Stefan Tigges and Cameron Henry
4:00 p.m.	Adjourn/Open Lab Period/Catch-up and Additional Cases
5:00 p.m.	Lab Closes

June 8, 2025

9:00 a.m.	Breakfast/Open Lab Period/Catch-up and Additional Cases
10:00 a.m.	Fractional Flow Reserve Computed Tomography and Plaque Characterization; Cases 21-22 J. Jeff Carr and Cameron Henry
10:30 a.m.	Contrast and Power Injection; Cases 23-24 Scott Jerome and J. Jeff Carr
11:00 a.m.	Image Reconstruction; Cases 25-26 Michael Winkler and J. Jeff Carr
11:30 a.m.	Post-Processing Techniques; Cases 27-28 Michael Winkler and Cameron Henry
Noon	Lunch Panel: Psychometrics of MCQs Michael Winkler and J. Jeff Carr
1:00 p.m.	Artifacts and Problem Solving; Cases 29-30 J. Jeff Carr and Scott Jerome
1:30 p.m.	Valves and Chambers; Cases 31-32 Karin Dill and J. Jeff Carr
2:00 p.m.	TAVR; Cases 33-34 Deya Alkhatib and Joe Xie
2:30 p.m.	TMVR & LAA; Cases 35-36 Joe Xie and Deya Alkhatib
3:00 p.m.	Mini Mock Exam and Answer Session 2; Cases 37-40 J. Jeff Carr and Michael Winkler
4:00 p.m.	Adjourn/Open Lab Period/Catch-up and Additional Cases
5:00 p.m.	Lab Closes

"Intuition Buttonology" (i.e. Keyboard Shortcuts and Mouse Controls)

Keyboard Shortcuts for Volume Dataset Positions & Projections:

- A = Anterior
- P = Posterior
- R = Right Lateral
- L = Left Lateral
- F = Axial (From Foot)
- H = Axial (From Head)
- G = Perpendicular view (will be on anatomy in the center of crosshairs)
- Q=Cube View

Mouse Controls:

- W/L = Right +Left mouse
- Zoom In = Middle mouse depress & hold + push entire mouse forward
- Zoom Out = Middle mouse depress & hold + pull entire mouse back
- Pan = right mouse hold and drag
- Slice or page through volume data set = middle + right mouse
- Page through MPR's = left mouse
- Isocenter from 2D: Alt + left click on area of interest & will center all planes
- Isocenter on 3D view = Alt + left click OR middle mouse depress and release on area of interest

Keyboard Window/Level Presets
(Presets 1-5 can be edited to site or user specific WW/WL settings)

- 1-2 = Abd
- 3 = Head
- 4 = Lung
- 5 = Bone
- 6-9 = CTA

Changing the Main View:

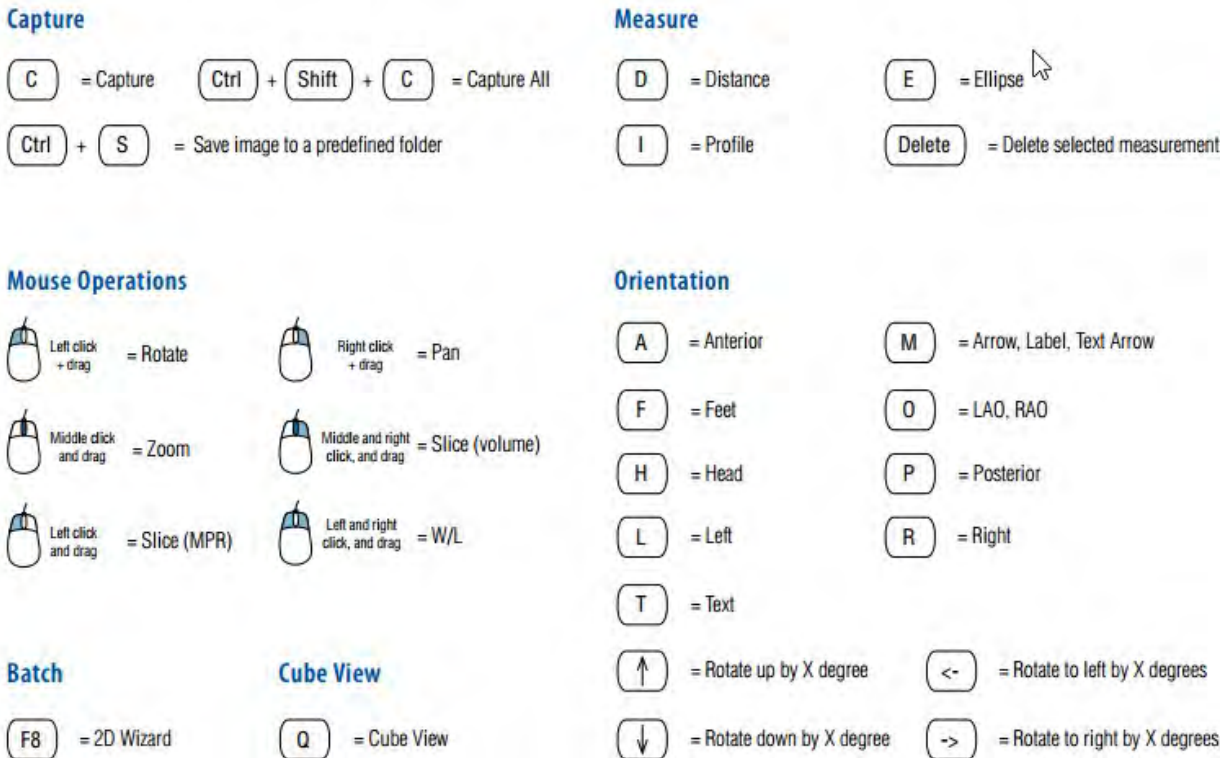
- F2 = 3D VR
- F3 = MPR
- F4 = MIP

Tool Short Cuts:

- F5 = Dynamic Region Grow Tool
- F6 = Free ROI Tool
- F7 = CPR Tool
- F8 = Batch Wizard Tool

Measurements & Captures:

- D = Distance
- E = Ellipse (ROI)
- C = Capture
- X = Crosshairs on/off



Syllabus

- **Patient Selection:**
    - **Chest Pain Guidelines,**
    - **Contraindications,**
    - **Alternative Examinations,**
    - **Calcium Scoring**
- **Patient Preparation:**
    - **Pharmacological Preparation** (Beta Blockers, Ivabradine, Calcium Channel Blockers, Nitroglycerin, Benzodiazepines, Drug Contraindications),
    - **Nonpharmacological Preparation** (Oxygen, Hydration, Warm Blankets, Positioning, Coaching, Desensitization to Scanner),
    - **Contrast Reactions**
- **Coronary Arteries and Cardiac Veins:**
    - **Coronary Arteries (**Segmental Anatomy, Common and Significant Branches, Vascular Territories, Anomalies)
    - **CAD-RADS 2.0** (Stenoses, Plaque, Remodeling, Occlusions, Stents, Bypass Grafts)
    - **Cardiac Veins** (Nomenclature, Variants, Relevance)
- **FFRCT and Plaque Characterization:**
    - **Science**
    - **Implementation**
    - **Interpretation**
- **Valves and Chambers:**
    - **Valves** (anatomy, pathology, planimetry)
    - **Chambers** (anatomy, pathology, cardiac function)
    - **Septa**
    - **Myocardium**
    - **Cardiac Tumors**
- **Pulmonary and Systemic Vessels:**
    - **Pulmonary Arteries** (Anatomy, Pulmonary Hypertension, Pulmonary Embolus, AI Analysis)
    - **Pulmonary Veins** (Anatomy, Anomalies, Pathology)
    - **Aorta** (Anatomy, Aneurysm, Dissection, Hematoma, AI Analysis)
    - **Great arteries** (Variants, Pathology)
    - **Central veins** (Variants, Pathology)
- **Thoracic Radiology:**
    - **Mediastinum** (Adenopathy, Esophageal Thickening And Dysmotility, Aortic Aneurysm, Dissection, and Hematoma)
    - **Fleischner Society Guidelines** (solid, ground glass, atypical nodules)
    - **Lungs**(Atelectasis, Small Airway Disease, Infarcts, Pneumonia, Pleural Thickening and Effusion)
    - **Abdomen** (Cirrhosis, Varices, Adrenal and Renal Masses, Pancreatitis)

Syllabus (cont.)

- **Scanner Technical Factors:**
    - **Injector**(Contrast Media, Venous Access, Injection Protocols)
    - **Scanner** (kVp, mAs, Pitch, Mode, detector types and geometries)
- **Gating and Triggering:**
    - **Explanation**
    - **Mode Selection**
    - **Dose Reduction**
- **Image Reconstruction:**
    - **Filtered Back Projection**
    - **Contrast Resolution**
    - **Spatial Resolution** (Storage Matrix, DisplayedField of View, Slice Thickness, Slice Interval)
    - **Noise** (Signal to Noise Ratio, Noise Spectrum, Kernels, Iterative Reconstruction, AI Reconstruction)
- **Post-Processing Techniques:**
    - **Imagine Enhancement** (Interpolation, Noise Reduction, Frame Averaging)
    - **Two Dimensional Reformats** (MPR, MIP, minIP, avMPR, Stretched CPR, Straightened CPR, MAR)
    - **Three Dimensional Reformats** (Surface Rendering, Ray Casting, Ray Tracing)
- **Artifacts and Problem Solving:**
- **Motion Artifacts** (Gross Motion, Breathing, Arrythmia)
    - **Technical Artifacts** (Beam Hardening, Streak, Photon Starvation, Detector Element)
    - **Signal Processing Artifacts** (Interpolation, Noise Reduction, Reformatting)
- **Transcatheter Aortic Valve Repair:**
    - **Pre and Post TAVR Scanning Protocols**
    - **TAVR planning workflow**
- **Transcatheter Mitral Valve Repair and Left Atrial Appendage Exclusion:**
    - **TMVR** (Scanning Protocol, planning workflow)
    - **LAA (**Scanning Protocol, Planning Workflow)
- **Psychometrics of Multiple Choice Question Examinations:**
    - **CBCCT Exam (**the Certification Board of Cardiovascular Computed Tomography)
    - **EACVI-CCT Online Certification Exam (**the European Association of Cardiovascular Imaging Cardiac Computed Tomography)

Important References (open access)

Coronary Computed Tomographic Angiography

- Koweek et al. Standardized medical terminology for cardiac computed tomography 2023 update. J Cardiovasc Comput Tomogr. 2023. https://www.journalofcardiovasculararct.com/action/showPdf?pii=S1934-5925%2823%2900389-1

- Gulati et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation 2021. https://www.ahajournals.org/doi/epub/10.1161/CIR.0000000000001030

- Cury et al. CAD-RADS™ 2.0 - 2022 Coronary Artery Disease - Reporting and Data System An Expert Consensus Document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Cardiology (ACC), the American College of Radiology (ACR) and the North America Society of Cardiovascular Imaging (NASCI). Radiol Cardiothorac Imaging 2022. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9627235/pdf/ryct.220183.pdf

- Hecht et al. CAC-DRS: Coronary Artery Calcium Data and Reporting System. An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT). JCCT 2018. https://www.journalofcardiovasculararct.com/action/showPdf?pii=S1934-5925%2818%2930058-3

- Nieman et al. Standards for quantitative assessments by coronary computed tomography angiography (CCTA): An expert consensus document of the society of cardiovascular computed tomography (SCCT). J Cardiovasc Comput Tomogr. 2024. https://cdn.ymaws.com/scct.org/resource/resmgr/docs/guidelines/Garcia-Garcia-Nieman_QA_Expe.pdf

- Gentile et al. Coronary Artery Anomalies. Circulation. 2021 https://www.ahajournals.org/doi/epub/10.1161/CIRCULATIONAHA.121.055347

- Boppana et al. Atrial Coronary Arteries: Anatomy And Atrial Perfusion Territories. J Atr Fibrillation. 2011 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5153018/pdf/jafib-04-00375.pdf

Important References cont. (open access)

Cardiac CT for Planning of Structural Heart Interventions and Surgeries

- Achenbach et al. SCCT expert consensus document on computed tomography imaging before transcatheter aortic valve implantation (TAVI)/transcatheter aortic valve replacement (TAVR). JCCT 2012. https://cdn.ymaws.com/scct.org/resource/resmgr/Docs/Fellows&Residents_of_SCCT/Guidelines_TAVI_TAVR.pdf

- Cheung A, Webb JG. Multislice computed tomography for prediction of optimal angiographic deployment projections during transcatheter aortic valve implantation. JACC Cardiovasc Interv. 2010. https://www.sciencedirect.com/science/article/pii/S1936879810006461

- Tang et al. "Cusp-Overlap" View Simplifies Fluoroscopy-Guided Implantation of Self-Expanding Valve in Transcatheter Aortic Valve Replacement. JACC Cardiovasc Interv 2018. https://www.sciencedirect.com/science/article/pii/S1936879818307416

- Cardiac Interventions Today 2021 Cusp Overlap Special Supplement https://assets.bmctoday.net/citoday/pdfs/cit0121_Supp_MDT_combined.pdf

- Nai et al. Anatomical Predictors of Pacemaker Dependency After Transcatheter Aortic Valve Replacement. Circ Arrhythm Electrophysiol 2021. https://www.ahajournals.org/doi/full/10.1161/CIRCEP.120.009028

- Khalique et al. Quantity and location of aortic valve complex calcification predicts severity and location of paravalvular regurgitation and frequency of post-dilation after balloon-expandable transcatheter aortic valve replacement. JACC Cardiovasc Interv 2014. https://www.sciencedirect.com/science/article/pii/S1936879814008462

- Ranganath et al. CT for Pre- and Postprocedural Evaluation of Transcatheter Mitral Valve Replacement. Radiographics 2020. https://pubs.rsna.org/doi/10.1148/rg.2020200027

- Yoon et al. Predictors of Left Ventricular Outflow Tract Obstruction After Transcatheter Mitral Valve Replacement. JACC Cardiovasc Interv 2019. https://www.sciencedirect.com/science/article/pii/S1936879818324233

- Rajiah et al. Pre- and Postprocedural CT of Transcatheter Left Atrial Appendage Closure Devices. Radiographics 2021. https://pubs.rsna.org/doi/epdf/10.1148/rg.2021200136

Important References cont. (open access)

Artificial Intelligence for Cardiovascular Imaging

- Wu et al. Non-invasive imaging innovation: FFR-CT combined with plaque characterization, safeguarding your cardiac health. JCCT 2025. https://www.journalofcardiovasculartct.com/action/showPdf?pii=S1934-5925%2824%2900433-7

- Langius-Wiffen et al. Retrospective batch analysis to evaluate the diagnostic accuracy of a clinically deployed AI algorithm for the detection of acute pulmonary embolism on CTPA. Insights into imaging 2023. https://insightsimaging.springeropen.com/articles/10.1186/s13244-023-01454-1

Certification Examinations and Psychometrics

- Certification Board of Cardiovascular Computed Tomography (CBCCT) Cardiovascular Computed Tompgraphy Examination Content Outline Summary. https://www.apca.org/wp-content/uploads/pdf/CCT-Content-Outline-1.pdf

- EACVI Cardiac CT Core Syllabus. https://www.escardio.org/static-file/Escardio/Education-Subspecialty/Certification/EACVI/Certification/CT/EACVI_CCT_Core_Syllabus.pdf

Contrast Media

- ACR Manual on Contrast Media 2024. https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Contrast-Manual

- Davenport et al. Use of Intravenous Iodinated Contrast Media in Patients With Kidney Disease: Consensus Statements from the American College of Radiology and the National Kidney Foundation. Kidney Med. 2020. https://www.kidneymedicinejournal.org/article/S2590-0595(20)30002-9/fulltext

Miscellaneous References

- Kassem et al. Cardiac veins, an anatomical review. Translational Research in Anatomy, 2021 https://www.sciencedirect.com/science/article/pii/S2214854X20300352

- MacMahon et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017. Radiology. 2017 https://pubs.rsna.org/doi/epdf/10.1148/radiol.2017161659

Recommended Texts (low cost!)

Beginner Cardiovascular CT

- Cardiac CT Made Easy: An Introduction to Cardiovascular Multidetector Computed Tomography 3rd Edition Paul Schoenhagen, Frank Dong

Board Review

- EACVI Handbook of Cardiovascular CT (The European Society of Cardiology Series), Oliver Gaemperli, Pál Maurovich- Horvat, Koen Nieman, Gianluca Pontone, Francesca Pugliese