



Introdução à AngioTC de coronárias e RM cardíaca

1702104 - Sistema Cardiocirculatório

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Anatomia coronariana

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Anatomia coronariana

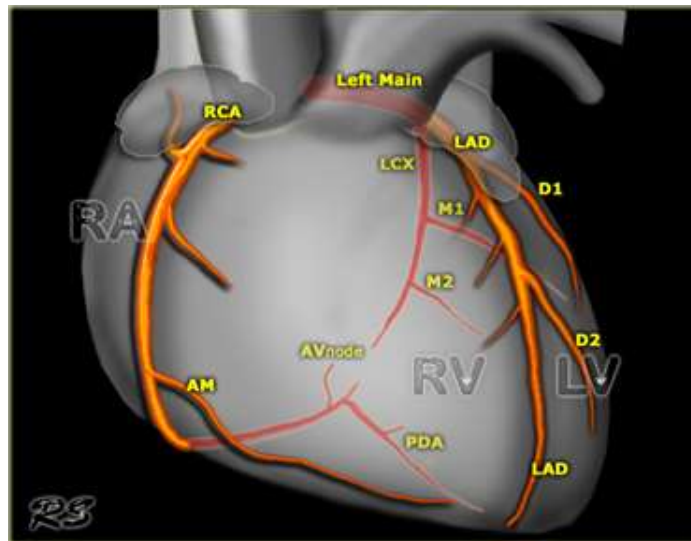


Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

3



Anatomia coronariana

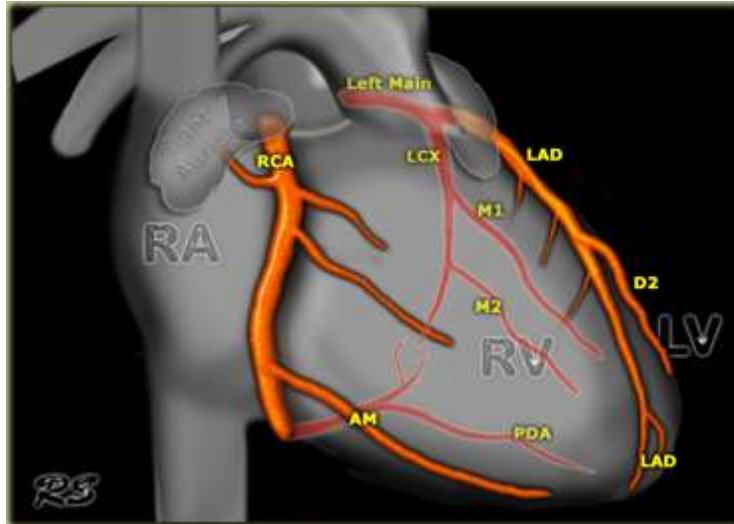


Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/anatomy/coronary-anatomy-and-anomalies> (acesso em 18/02/2024)

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Anatomia coronariana

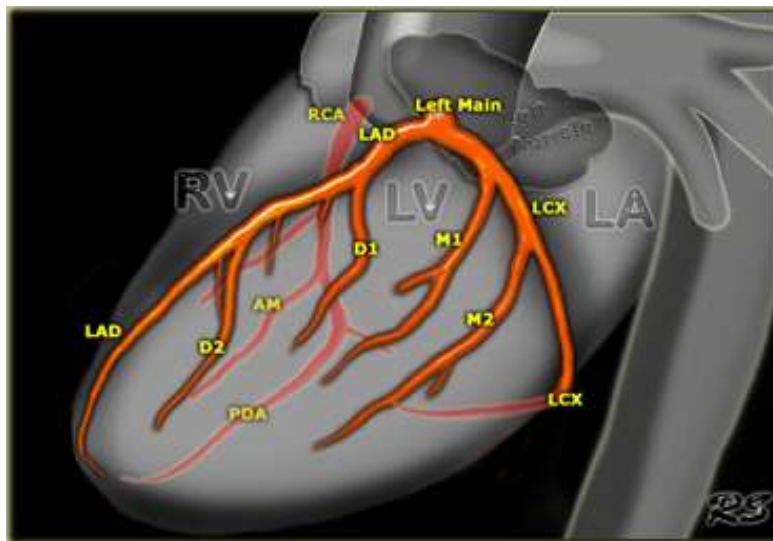


Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/anatomy/coronary-anatomy-and-anomalies> (acesso em 18/02/2024)

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Anatomia coronariana

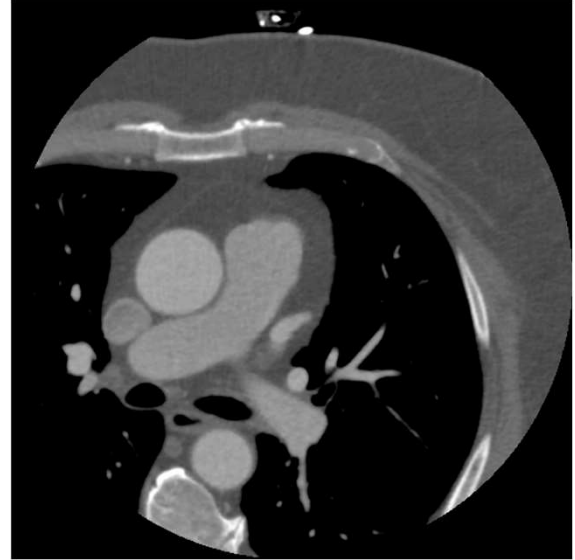
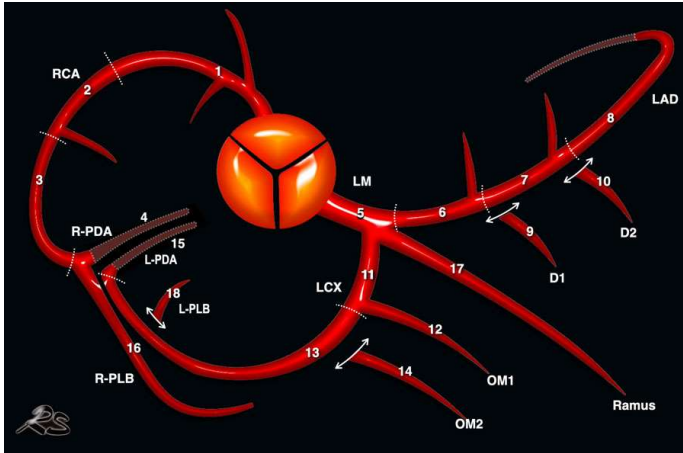


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Anatomia coronariana



Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

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Anatomia coronariana

Segment	Abbreviation	Description
Proximal RCA	pRCA	Ostium of the RCA (right coronary artery) to one-half the distance to the acute margin of heart
Mid RCA	mRCA	End of proximal RCA to the acute margin of heart
Distal RCA	dRCA	End of mid RCA to origin of the PDA (posterior descending artery)
PDA-RCA	R-PDA	PDA from RCA
PLB-RCA	R-PLB	PLB (posterior-lateral branch) from RCA
LM	LM	Ostium of LM (left main) to bifurcation of LAD (left anterior descending artery) and LCx (left circumflex artery)
Proximal LAD	pLAD	End of LM to the first large septal or D1 (first diagonal), whichever is most proximal
Mid LAD	mLAD	End of proximal LAD to one-half the distance to the apex
Distal LAD	dLAD	End of mid LAD to end of LAD
Diagonal 1	D1	First diagonal branch D1
Diagonal 2	D2	Second diagonal branch D2
Proximal LCx	pCx	End of LM to the origin of the OM1 (first obtuse marginal)
OM1	OM1	First OM1 traversing the lateral wall of the left ventricle
Mid and distal LCx	LCx	Traveling in the AV groove, distal to the first obtuse marginal branch to the end of the vessel or origin of the L-PDA (left posterior descending artery)
OM2	OM2	Second marginal OM2
PDA-LCx	L-PDA	PDA from LCx
Ramus intermedius	RI	Vessel originating from the left main between the LAD and LCx in case of a trifurcation
PLB-L	L-PLB	PLB from LCx

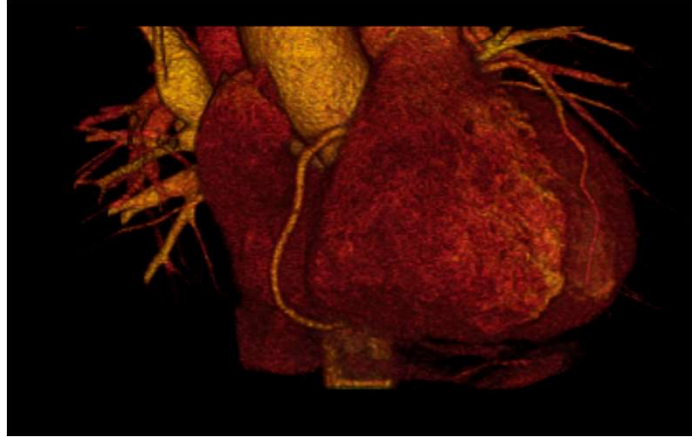
Dashed lines represent division between RCA, LAD, and LCx and the end of the LMPLB = PLV (posterior left ventricular branch) Additional nomenclature may be added for example: D3, R-PDA2, SVG (saphenous vein graft) mLAD

Raff GL, Abidov A, Achenbach S, Berman DS, Boxt LM, Budoff MJ, Cheng V, DeFrance T, Hellinger JC, Karlsberg RP; Society of Cardiovascular Computed Tomography. SCCT guidelines for the interpretation and reporting of coronary computed tomographic angiography. *J Cardiovasc Comput Tomogr.* 2009 Mar-Apr;3(2):122-36. doi: 10.1016/j.jcct.2009.01.001. Epub 2009 Jan 29. PMID: 19272853.

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Anatomia coronariana



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Anatomia coronariana



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Anatomia coronariana

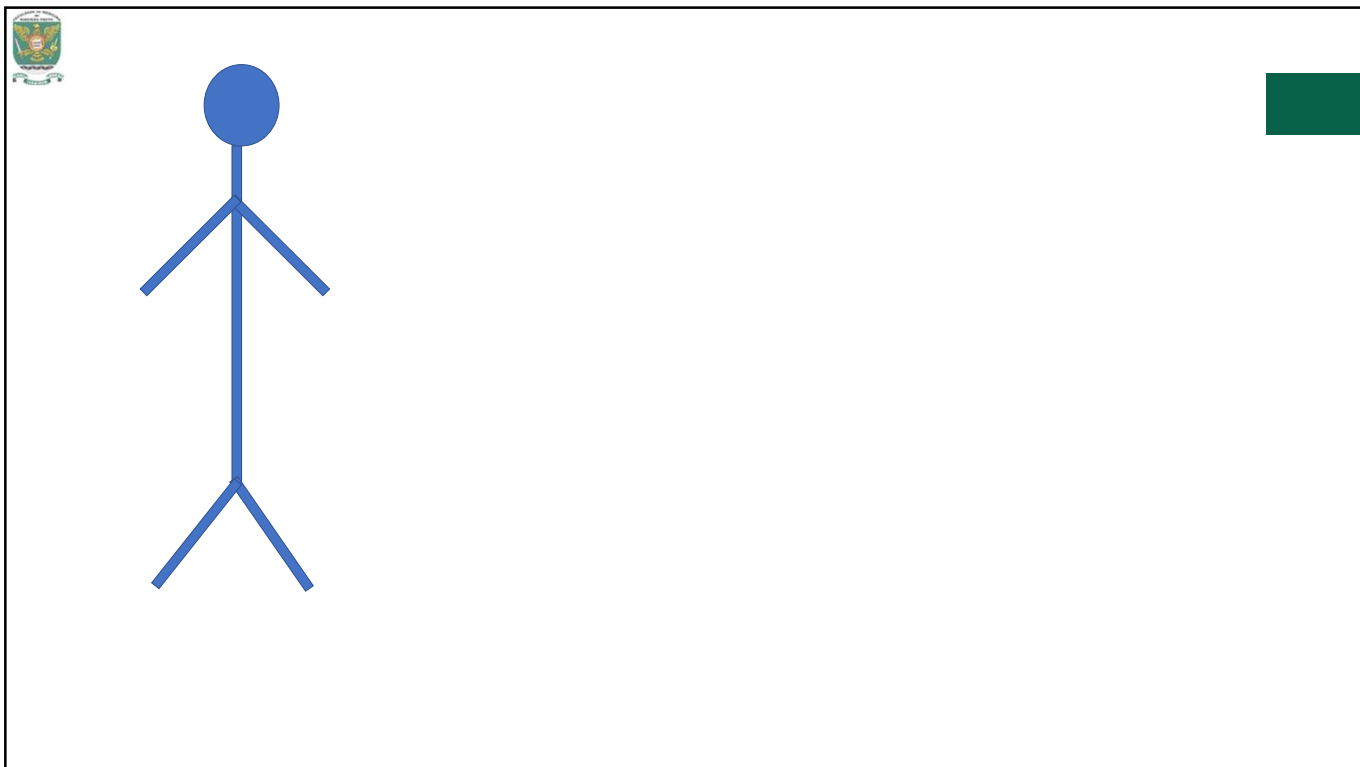


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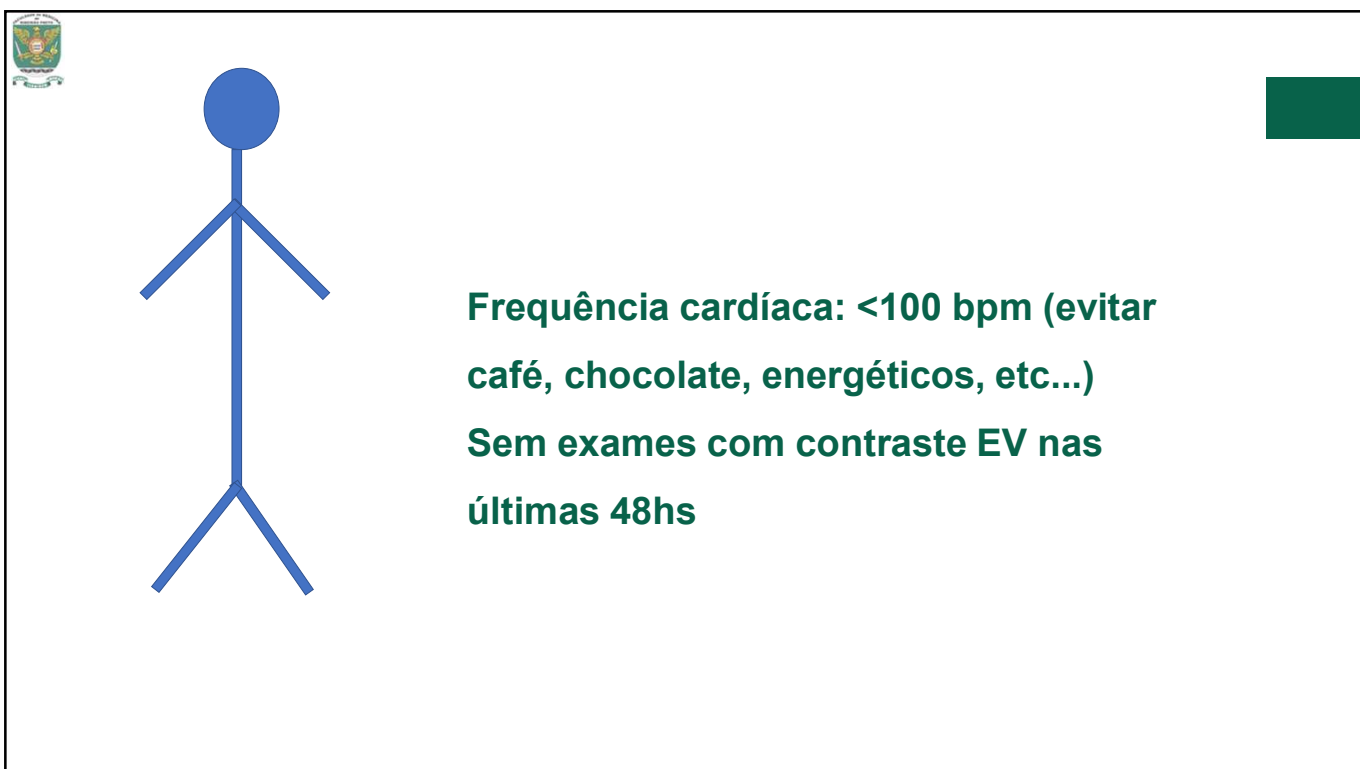


Escore de cálcio coronariano

12



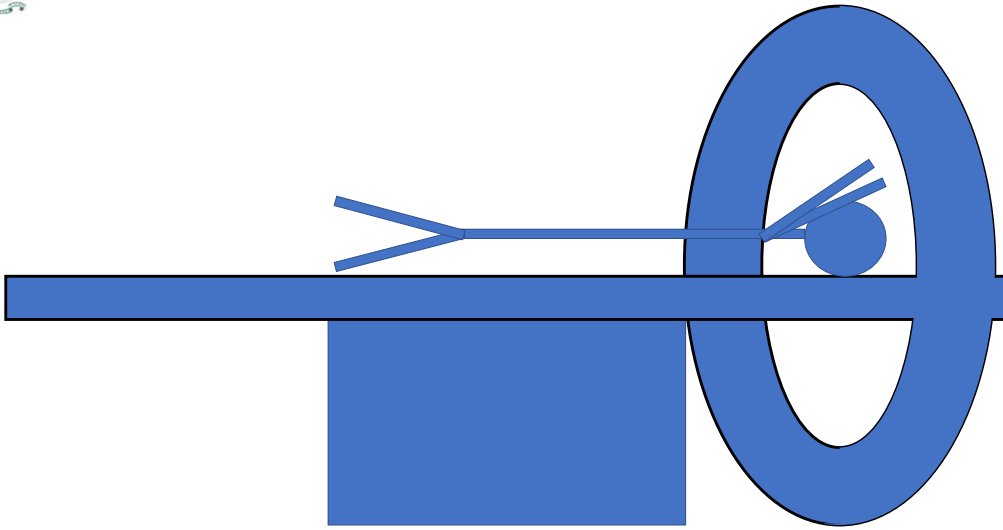
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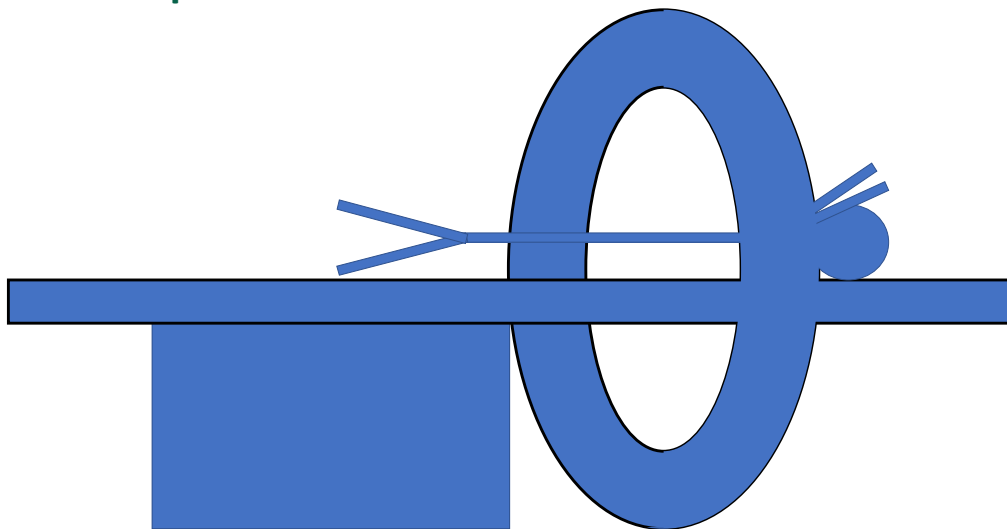
Tomografia computadorizada



15



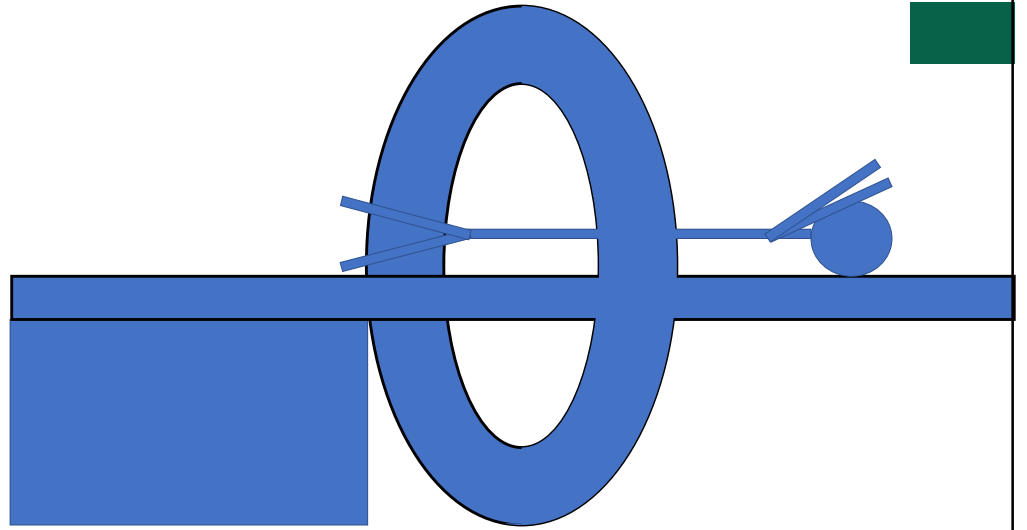
Tomografia computadorizada



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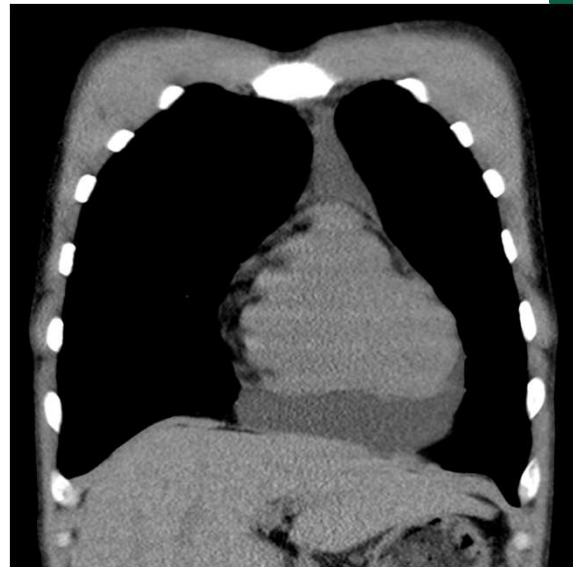
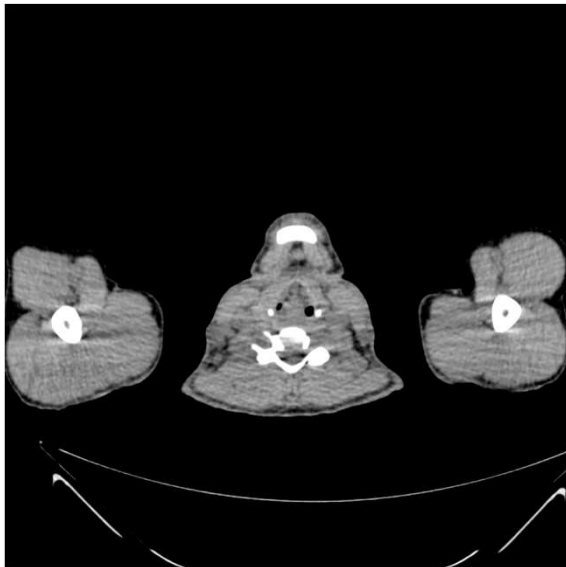
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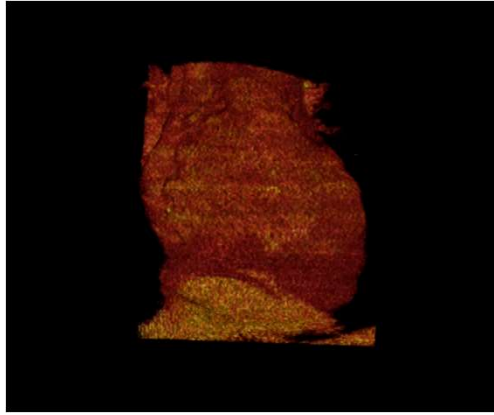
Tomografia computadorizada



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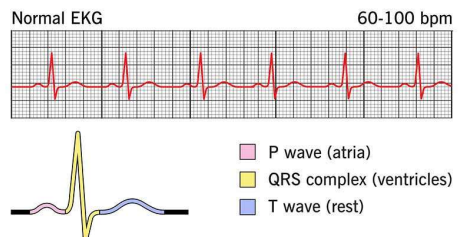
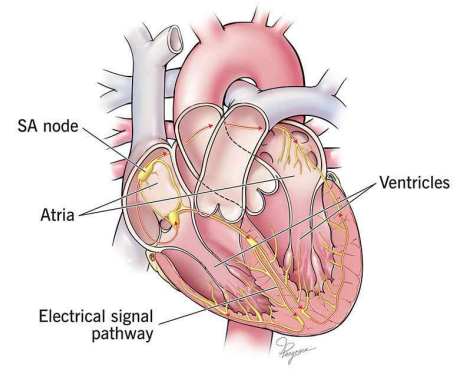
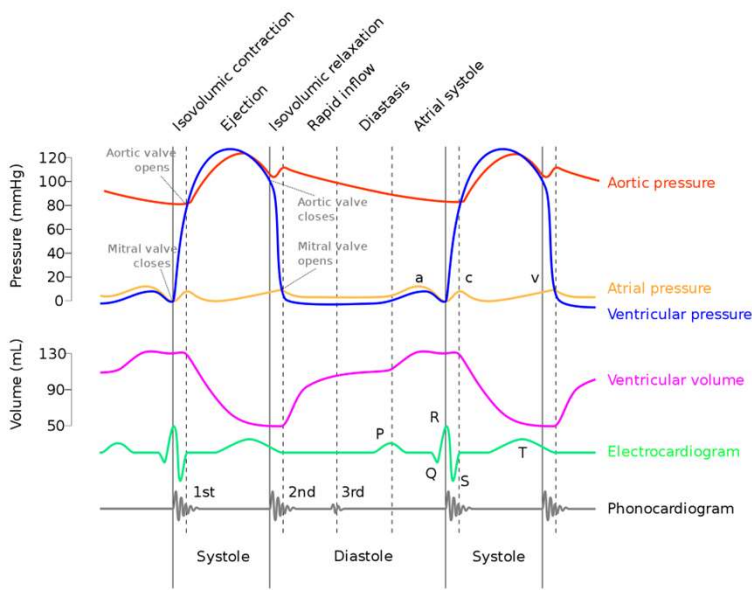


Tomografia computadorizada

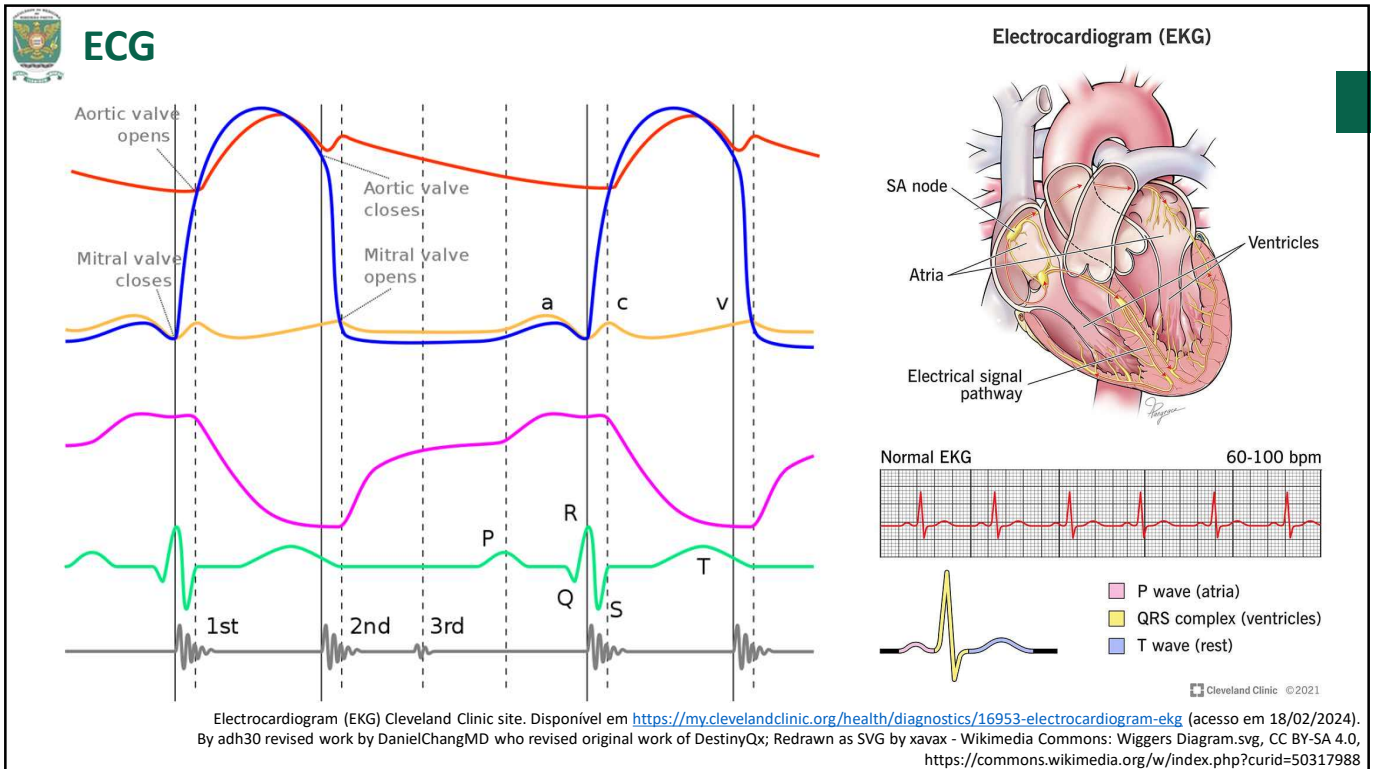


ECG

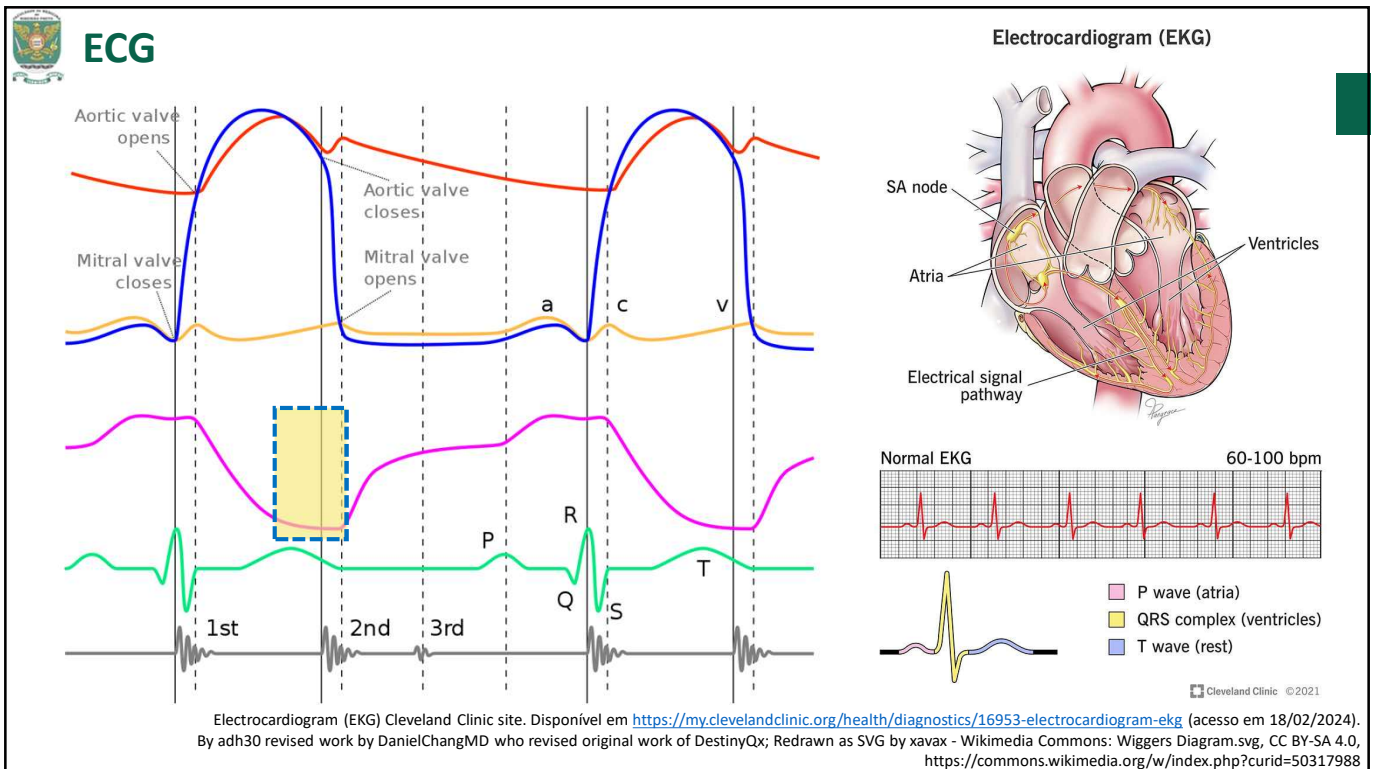
Electrocardiogram (EKG)



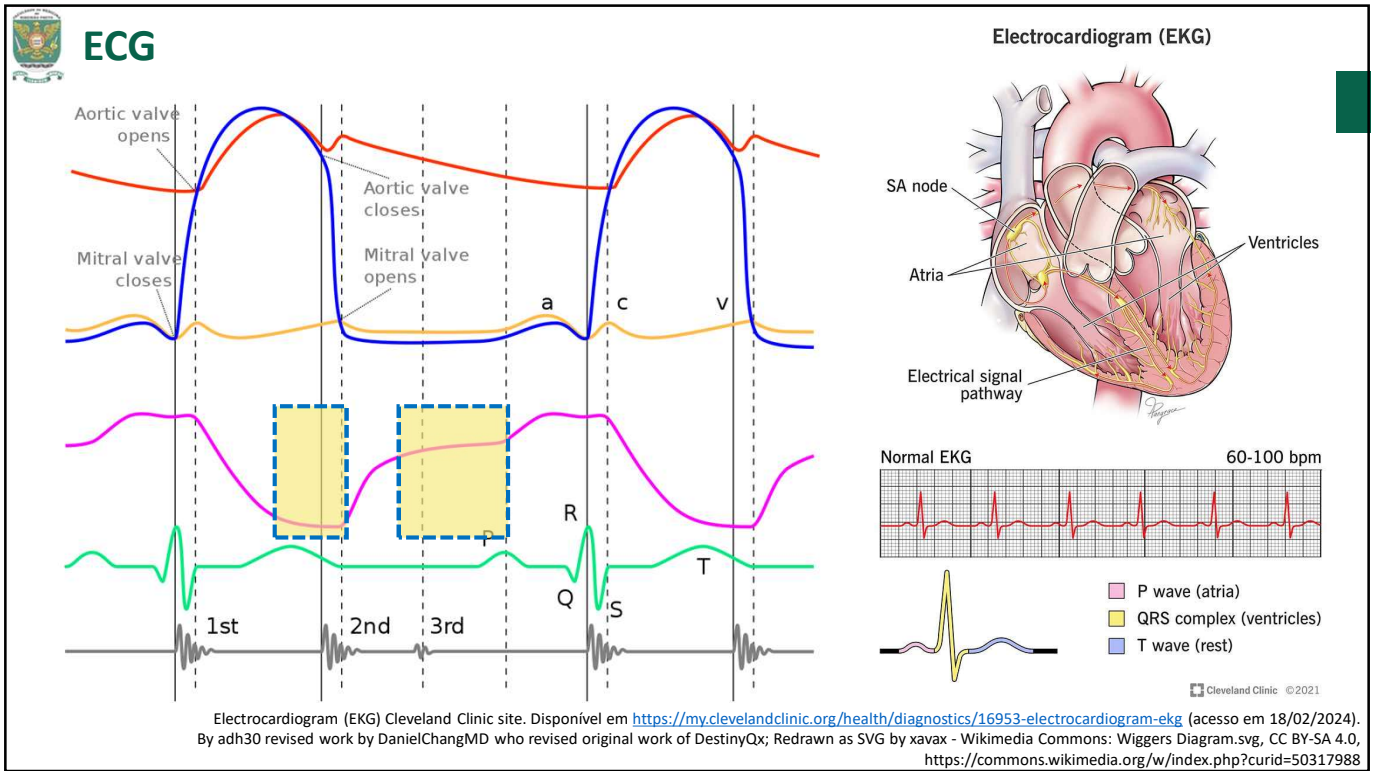
Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).
 By adh30 revised work by DanielChangMD who revised original work of DestinyQx; Redrawn as SVG by xavax - Wikimedia Commons: Wiggers Diagram.svg, CC BY-SA 4.0,
<https://commons.wikimedia.org/w/index.php?curid=50317988>



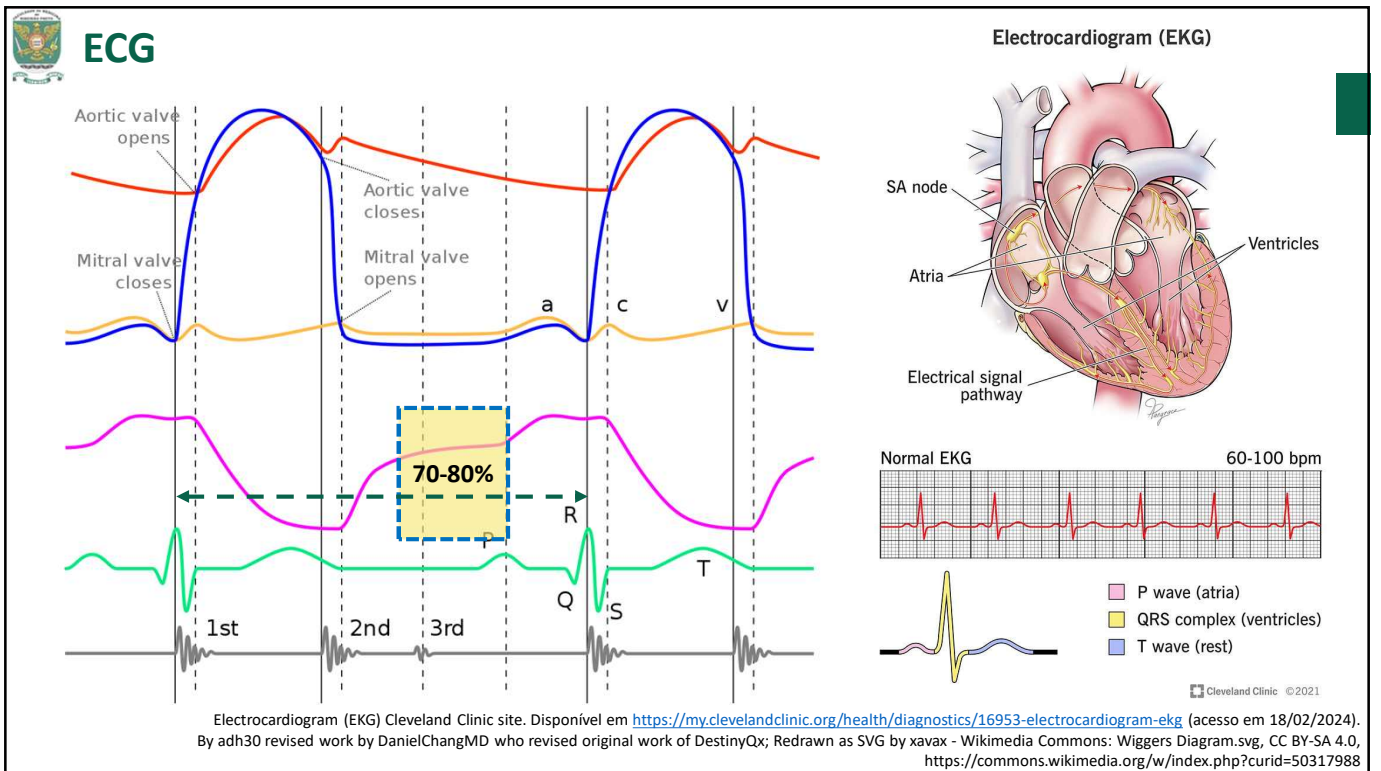
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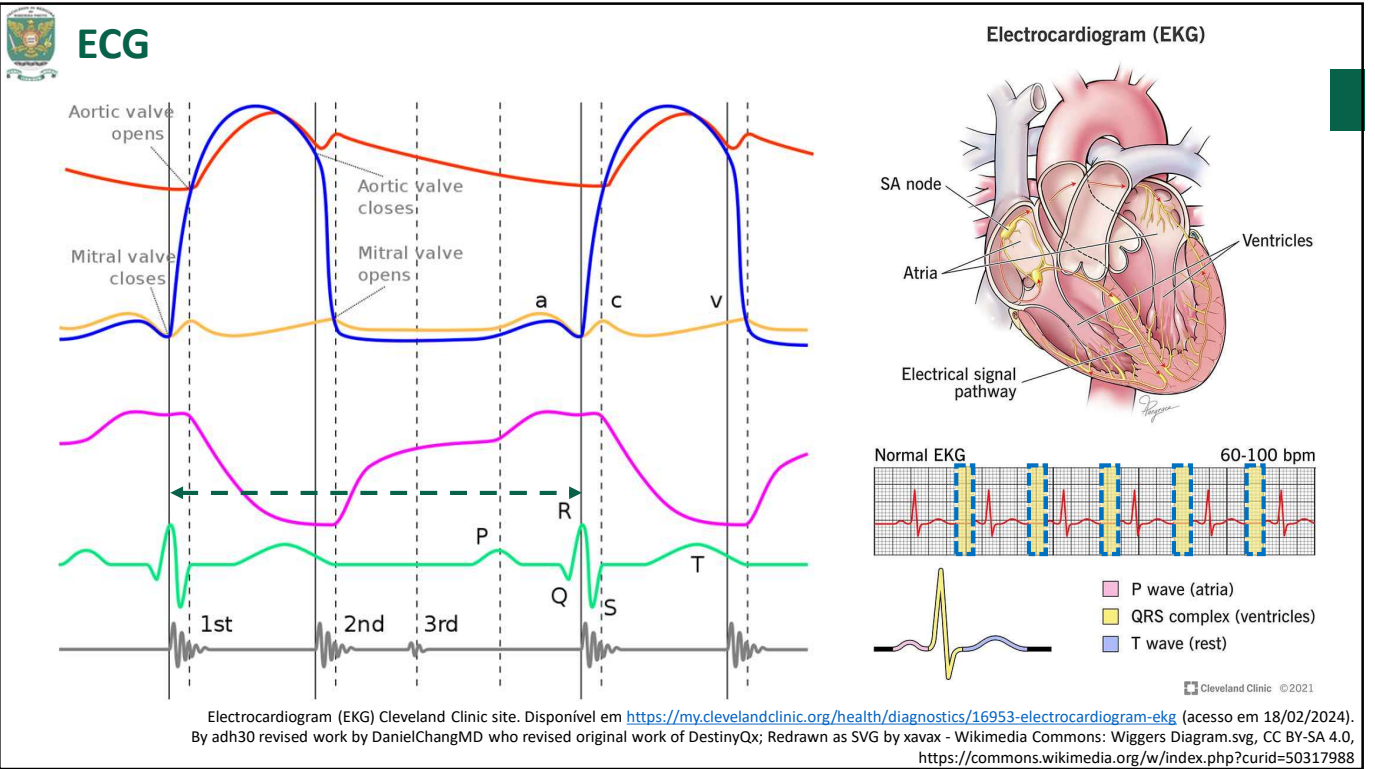
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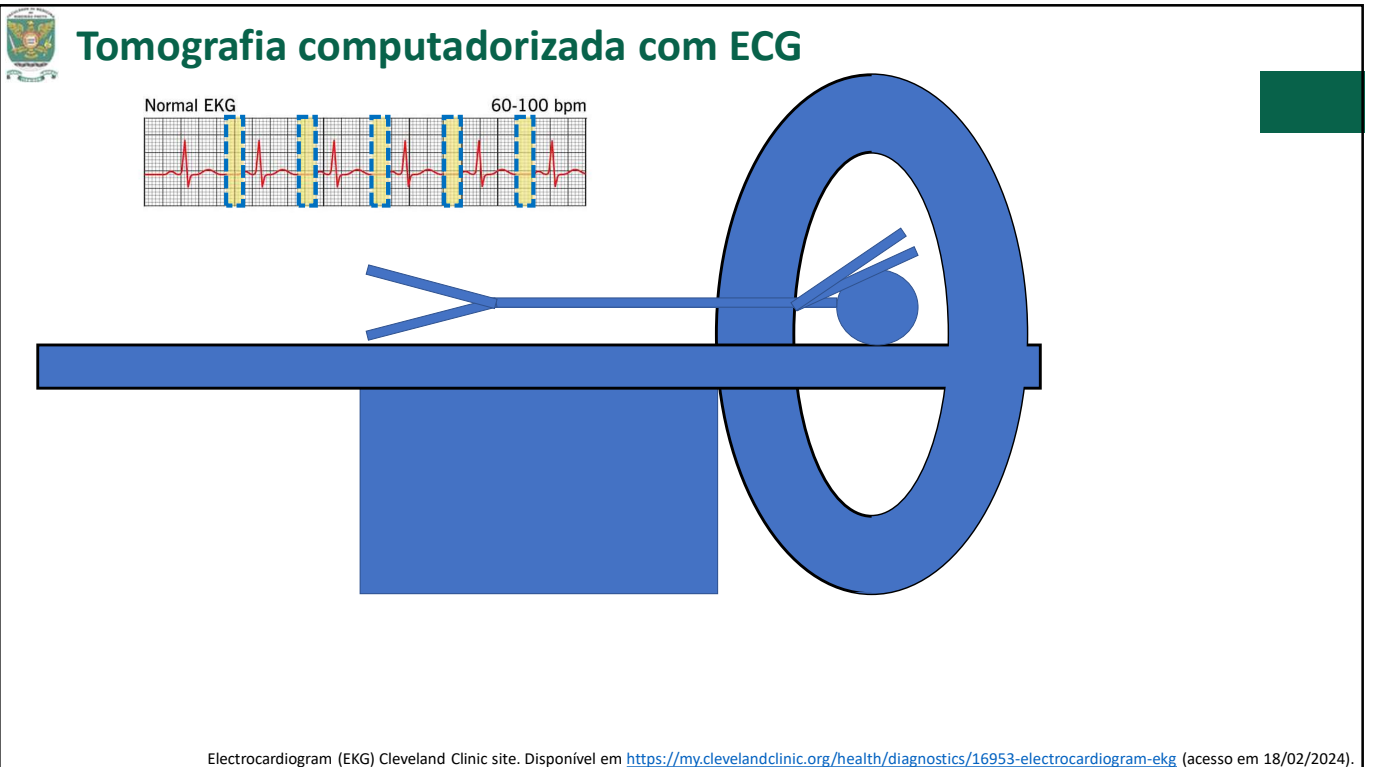
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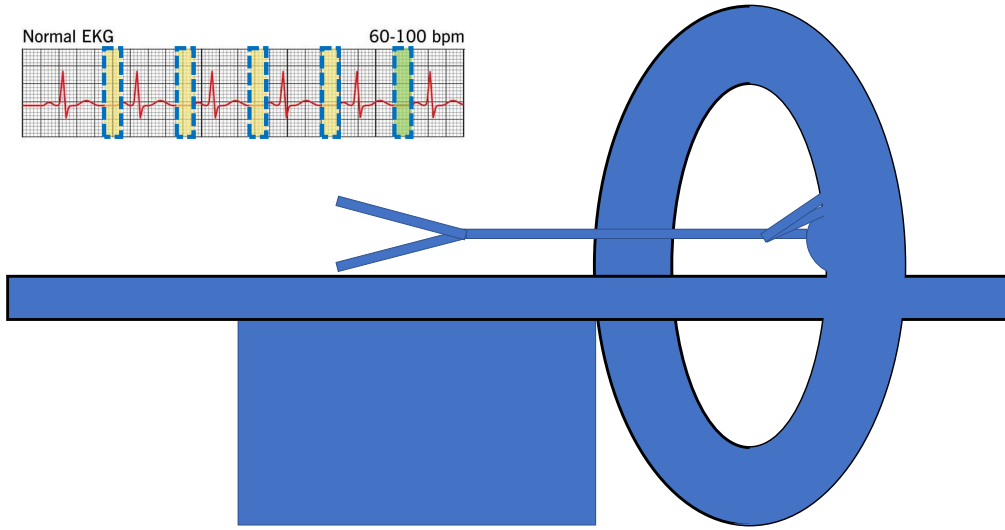
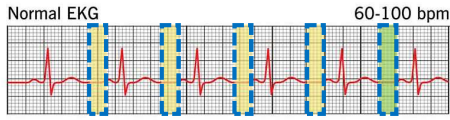
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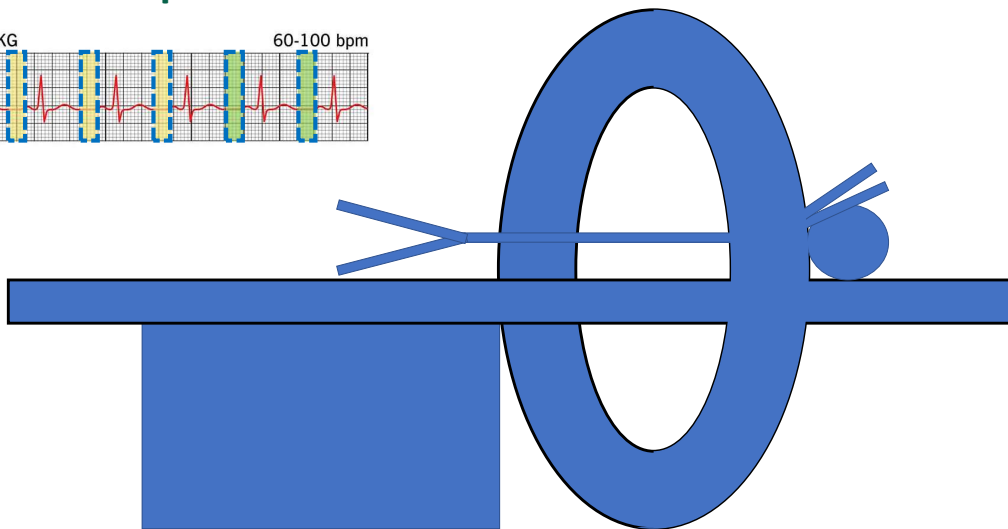
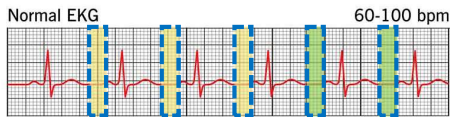
Tomografia computadorizada com ECG



Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).



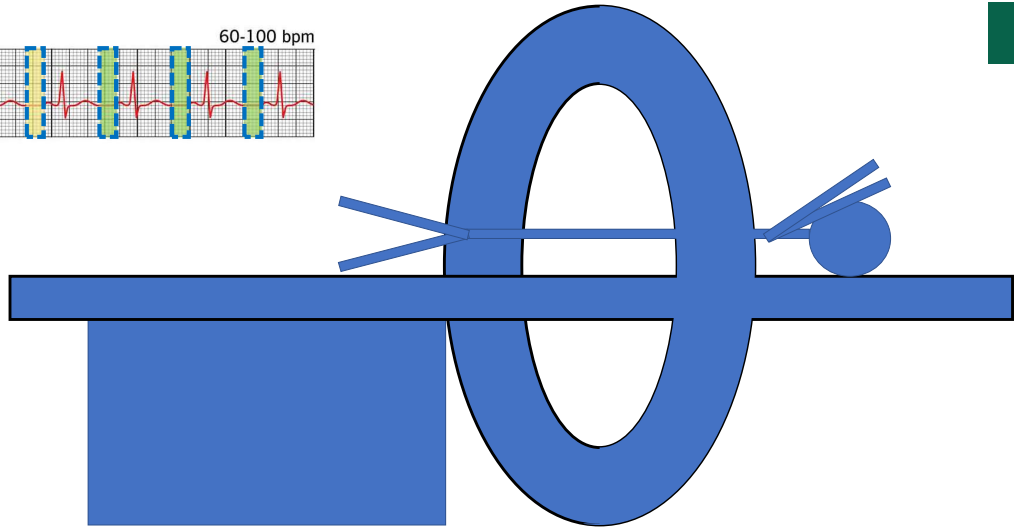
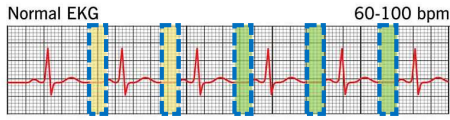
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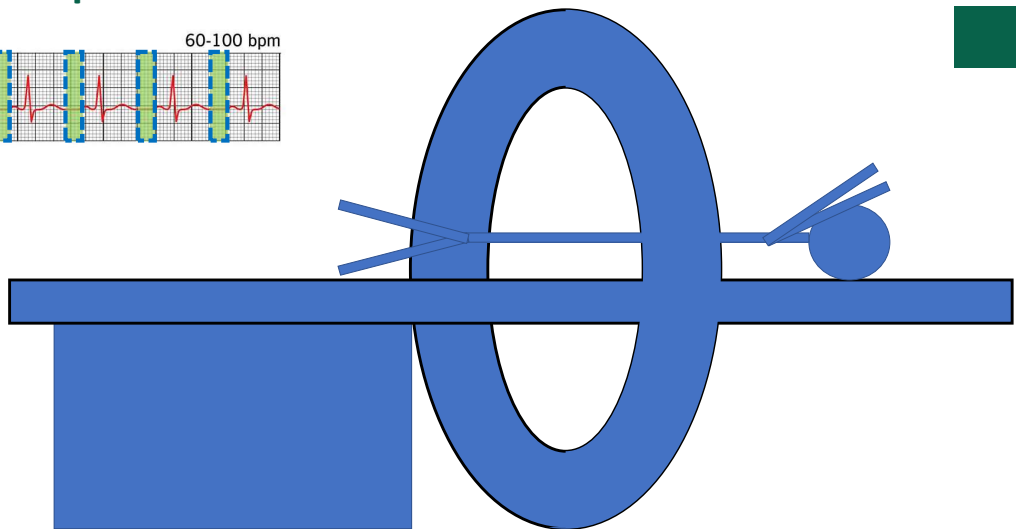
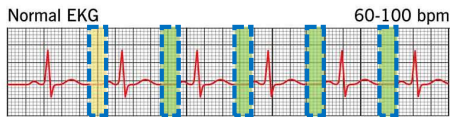
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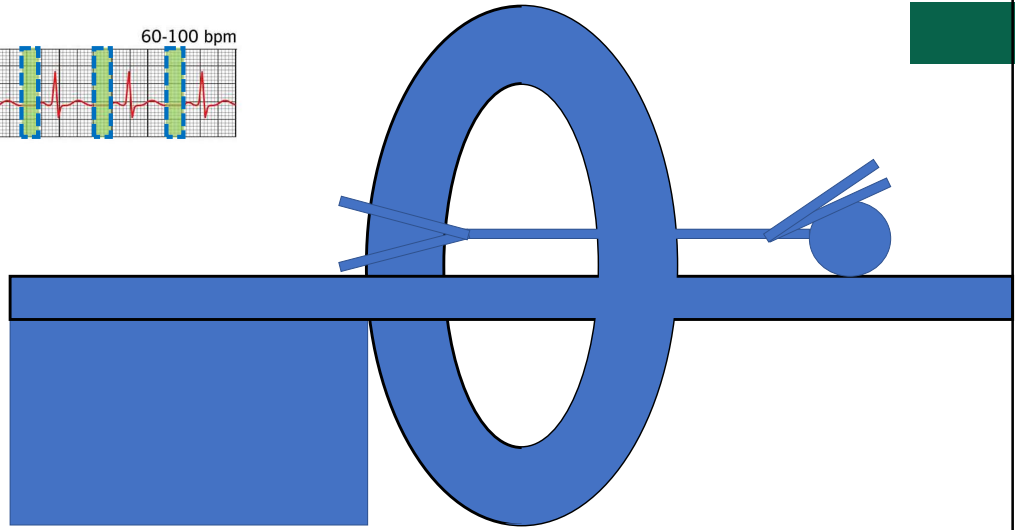
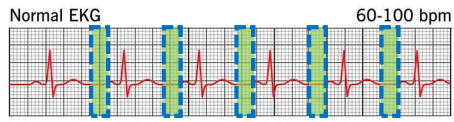
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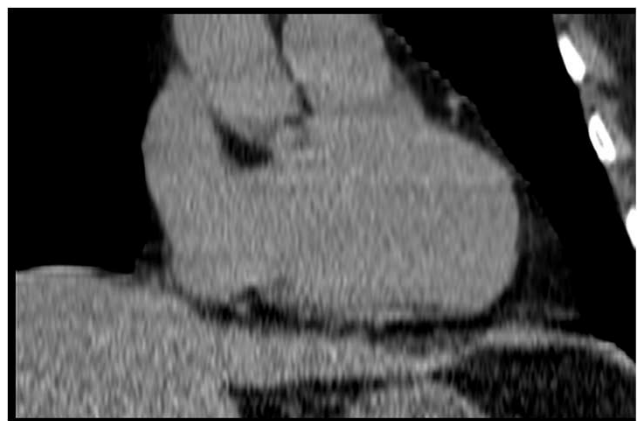
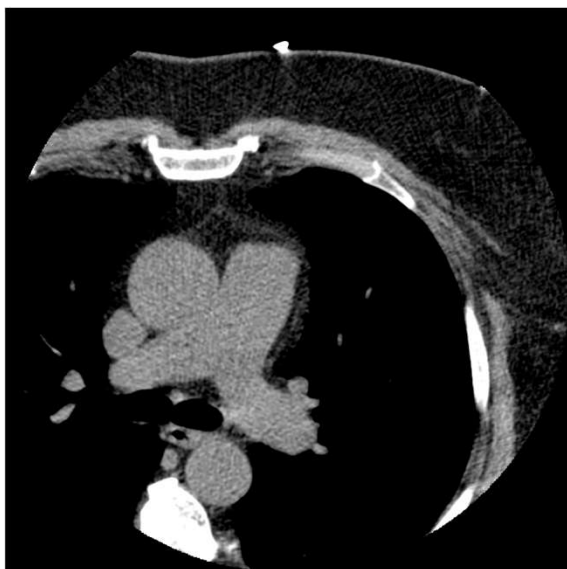
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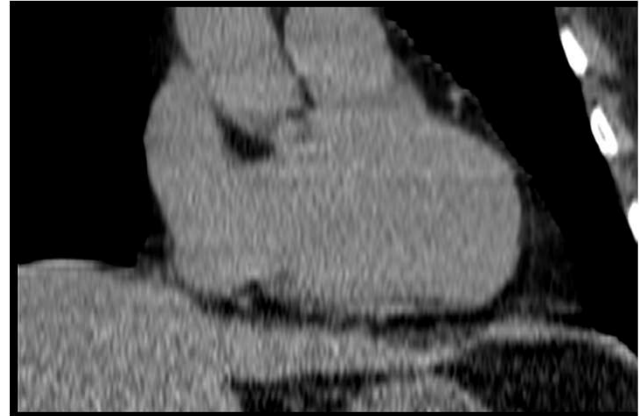
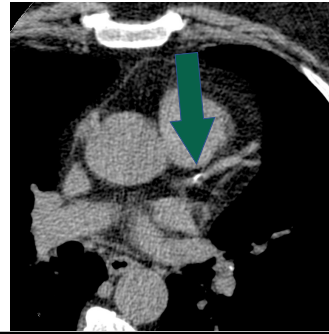


Escore de cálcio





Escore de cálcio



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Escore de cálcio

Calcium scoring

CT

- Multislice (Threshold: 90HU)
- Electron Beam (Threshold: 130HU)

Left Anterior Descending Artery

Starting Point: (Click in the image)

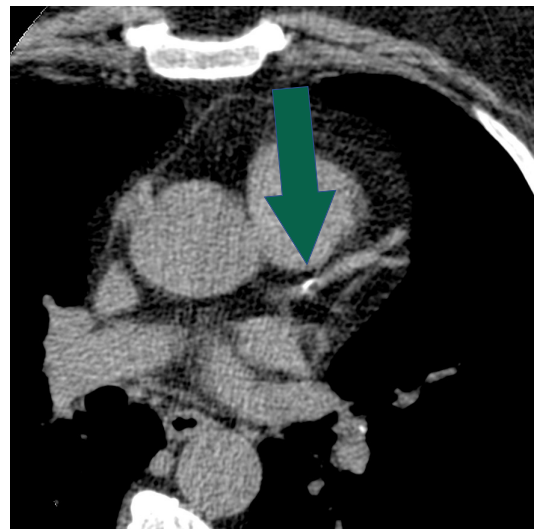
px: x:249 y:280

mm: x:29.88 y:-5.25 z:178.6

value: 260.00

Vessel	Score	Volume	Mass
Left Coronary Artery	0	0	0
Left Anterior Descending Artery	23	23	19
Left Circumflex Artery	0	0	0
Right Coronary Artery	0	0	0
Total	23	23	19

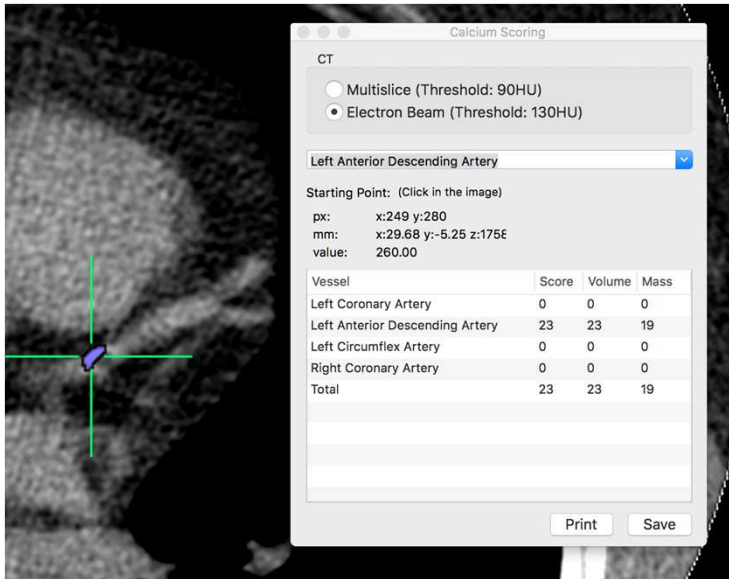
Print Save



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Escore de cálcio



The Multi-Ethnic Study of Atherosclerosis

[Back to MESA CAC](#)

Input your age, select your gender and race/ethnicity, input (optionally) your observed calcium score and click "Calculate".

Age (45-84):

Gender:

Race/Ethnicity:

Observed Agatston Calcium Score (optional):

The estimated probability of a non-zero calcium score for a white male of age 63 is **74 %**.

Percentiles and Calcium Scores for: white male of age 63

25th	50th	75th	90th
0	51	235	641

The observed calcium score of **23** is at percentile **39** for subjects of the same age, gender, and race/ethnicity who are free of clinical cardiovascular disease and treated diabetes.

Chart 1: Percentiles



McClelland RL et al. Distribution of coronary artery calcium by race, gender, and age: results from the Multi-Ethnic Study of Atherosclerosis (MESA). *Circulation*. 2006;113(1):30-37. Disponível em <https://www.mesa-nhlbi.org/Calcium/input.aspx> (acesso 28/02/2024).

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Técnica

Posicionamento: decúbito dorsal com braços acima da cabeça

Voltagem do tubo: fixo em 120 kVp

mAs: variável pelo IMC

-IMC <30: 40mAs

-IMC 30-34: 50 mAs

-IMC >34: 60 mAs

Aquisição em inspiração

Reconstruções de 2,5 mm com FOV de 25 cm

Gupta A et al. Coronary Artery Calcium Scoring: Current Status and Future Directions. *Radiographics*. 2022 Jul-Aug;42(4):947-967. doi: 10.1148/rg.210122.

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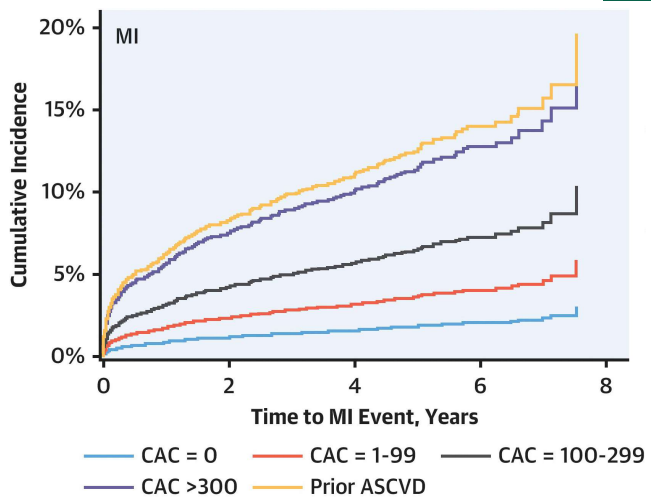
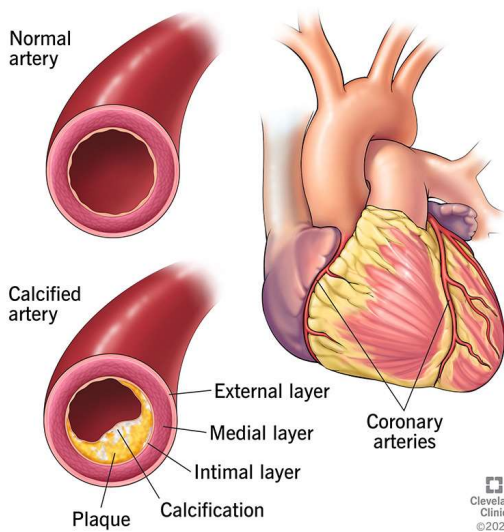


Para que serve?



Escore de cálcio

Coronary artery calcification



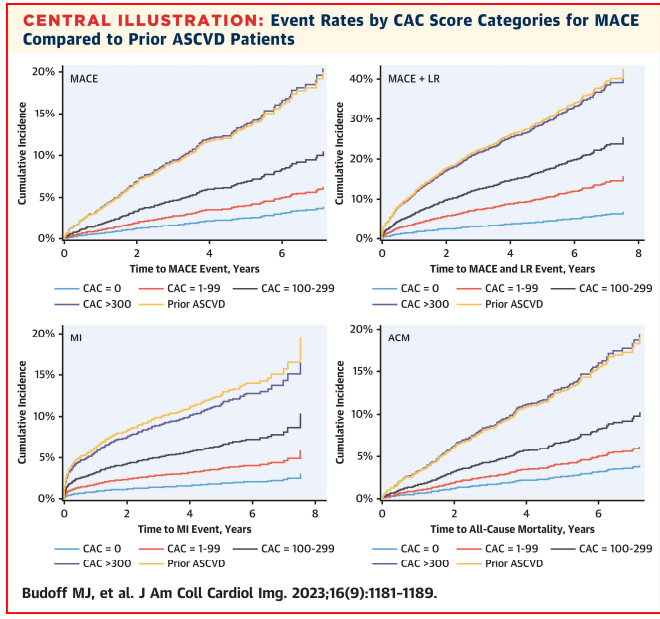
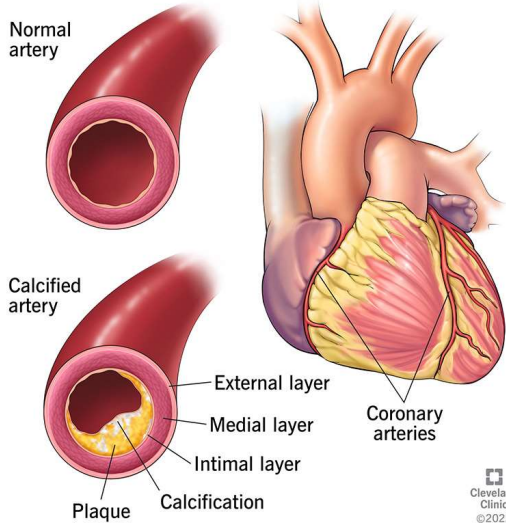
Budoff MJ et al. CONFIRM Investigators. When Does a Calcium Score Equate to Secondary Prevention?: Insights From the Multinational CONFIRM Registry. JACC Cardiovasc Imaging. 2023 Sep;16(9):1181-1189. doi: 10.1016/j.jcmg.2023.03.008.

Coronary Artery Calcification. Cleveland Clinic web site. Disponível em <https://my.clevelandclinic.org/health/diseases/22953-coronary-artery-calcification> (acesso em 18/02/2024).



Escore de cálcio

Coronary artery calcification



Budoff MJ et al. CONFIRM Investigators. When Does a Calcium Score Equate to Secondary Prevention?: Insights From the Multinational CONFIRM Registry. JACC Cardiovasc Imaging. 2023 Sep;16(9):1181-1189. doi: 10.1016/j.jcmg.2023.03.008.

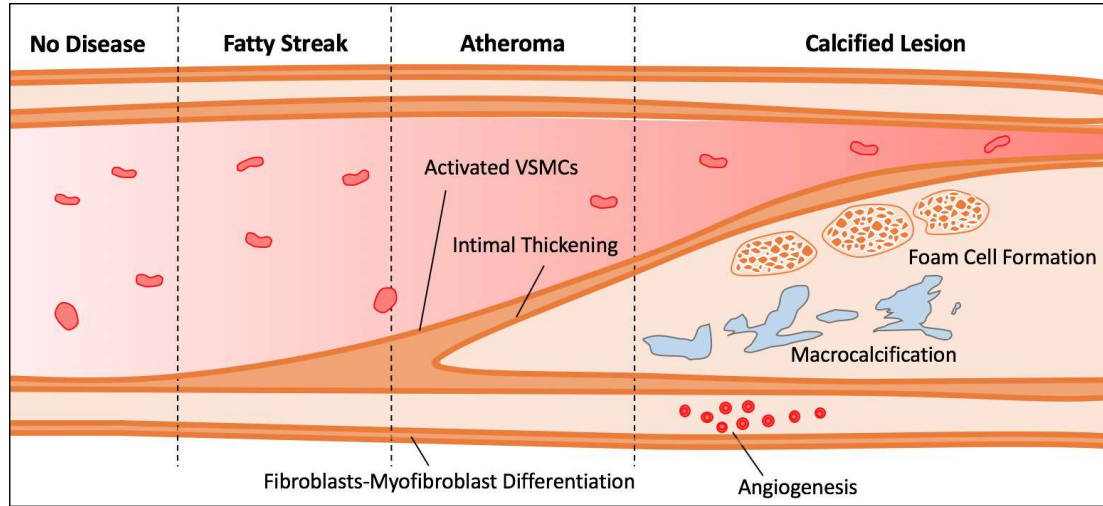
Coronary Artery Calcification. Cleveland Clinic web site. Disponível em <https://my.clevelandclinic.org/health/diseases/22953-coronary-artery-calcification> (acesso em 18/02/2024).



Porém...



Escore de cálcio



Albanese I, Khan K, Barratt B, Al-Kindi H, Schwertani A. Atherosclerotic Calcification: Wnt Is the Hint. J Am Heart Assoc. 2018 Feb 8;7(4):e007356. doi: 10.1161/JAHA.117.007356. PMID: 29437603; PMCID: PMC5850186.

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O que o escore de cálcio muda?

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Escore de cálcio

CENTRAL ILLUSTRATION: Proposed Decision-Making Approach to Selective Use of Coronary Artery Calcium Measurement for Risk Prediction

Using 10-year ASCVD risk estimate plus coronary artery calcium (CAC) score to guide statin therapy

Patient's 10-year atherosclerotic cardiovascular disease (ASCVD) risk estimate:	<5%	5–7.5%	>7.5–20%	>20%
Consulting ASCVD risk estimate alone	Statin not recommended	Consider for statin	Recommend statin	Recommend statin
Consulting ASCVD risk estimate + CAC				
If CAC score =0	Statin not recommended	Statin not recommended	Statin not recommended	Recommend statin
If CAC score >0	Statin not recommended	Consider for statin	Recommend statin	Recommend statin
Does CAC score modify treatment plan?	✗ CAC not effective for this population	✓ CAC can reclassify risk up or down	✓ CAC can reclassify risk up or down	✗ CAC not effective for this population

Greenland, P. et al. J Am Coll Cardiol. 2018;72(4):434–47.

Greenland P, Blaha MJ, Budoff MJ, Erbel R, Watson KE. Coronary Calcium Score and Cardiovascular Risk. J Am Coll Cardiol. 2018 Jul 24;72(4):434–447. doi: 10.1016/j.jacc.2018.05.027. PMID: 30025580; PMCID: PMC6056023.

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Para quem solicitar escore de cálcio?

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Escore de cálcio

Table 1
SCCT CAC expert consensus recommendations.

1. It is appropriate to perform CAC testing in the context of shared decision making for asymptomatic individuals without clinical ASCVD who are 40–75 years of age in the 5–20% 10-year ASCVD risk group and selectively in the <5% ASCVD group, such as those with a family history of premature coronary artery disease.
2. In patients for whom the development or progression of CAC would support intensification or alteration in preventive management, it may be appropriate to consider repeat CAC scanning at an interval of 5 years for patients with 0 CAC and a 3–5-year interval for patients with >0 CAC.
3. As an alternative to filtered back projection and 120 kVp acquisition, iterative and model based reconstruction and 100 kVp acquisition may be utilized with caution after site-based or literature-based validation for each scanner vendor, with documented <10% difference in mean CAC scores and risk group classification compared to filtered back projection and 120 kVp studies.
4. Consistent with a prior guideline from the SCCT/STR, CAC scoring of noncontrast chest CT scans is appropriate in all lung cancer screening patients and patients greater than 40 years of age without established ASCVD. The presence of CAC should be noted in the report of all NCCT studies.
5. The presence of BAC on mammography should be discussed with the patient and detailed in the final report. Shared decision making regarding dedicated CAC scanning may be considered for patients with BAC.
6. It may be appropriate to include CAC scanning in CCTA protocols in symptomatic patients without established CAD undergoing CTA, and in high risk asymptomatic individuals for whom the CCTA appropriateness criterion is uncertain, as well as in asymptomatic patients referred for preoperative evaluation prior to major surgery.
7. It is appropriate to incorporate CAC scanning in SPECT and PET MPI protocols in patients who are free of known clinical coronary artery disease.

Hecht H, Blaha MJ, Berman DS, Nasir K, Budoff M, Leipsic J, Blankstein R, Narula J, Rumberger J, Shaw LJ. Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. *J Cardiovasc Comput Tomogr.* 2017 Mar-Apr;11(2):157-168. doi: 10.1016/j.jcct.2017.02.010. Epub 2017 Feb 24. PMID: 28283309.

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Escore de cálcio para quem?

Age	Typical Angina		Atypical		Non-anginal		Dyspneu	
	Men	Women	Men	Women	Men	Women	Men	Women
30-39	3%	5%	4%	3%	1%	1%	0%	3%
40-49	22%	10%	10%	6%	3%	2%	12%	3%
50-59	32%	13%	17%	6%	11%	3%	27%	9%
60-69	44%	16%	26%	11%	22%	6%	27%	6%
70+	52%	27%	34%	19%	24%	10%	32%	12%

**Probabilidade pré-
teste de DAC >15%**

Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

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Escore de cálcio para quem?



Dor retroesternal

Com piora ao esforço ou estresse

Com melhora com nitrato ou repouso

Angina pectoris

Collection of Medical Illustrations, Heart - Volume 5. Author: Frank H. Netter, MD Chapter: Acquired Diseases of the Heart Page: 223. Pharmacology - Raffa 1E

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Escore de cálcio para quem?

Age	Typical Angina		Atypical		Non-anginal		Dyspneu	
	Men	Women	Men	Women	Men	Women	Men	Women
30-39	3%	5%	4%	3%	1%	1%	0%	3%
40-49	22%	10%	10%	6%	3%	2%	12%	3%
50-59	32%	13%	17%	6%	11%	3%	27%	9%
60-69	44%	16%	26%	11%	22%	6%	27%	6%
70+	52%	27%	34%	19%	24%	10%	32%	12%

Probabilidade pré-teste de DAC >15%

Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

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Escore de cálculo

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US Preventive Services Task Force | Recommendation FREE

Statement

July 17, 2018

Risk Assessment for Cardiovascular Disease With Nontraditional Risk Factors

US Preventive Services Task Force Recommendation Statement

US Preventive Services Task Force

Article Information


JAMA. 2018;320(3):272-280. doi:10.1001/jama.2018.8359

Conclusions and Recommendation The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of adding the ABI, hsCRP level, or CAC score to traditional risk assessment for CVD in asymptomatic adults to prevent CVD events. (I statement)

Ainda não é universalmente aceito

US Preventive Services Task Force; Curry SJ, Krist AH, Owens DK, Barry MJ, Caughey AB, Davidson KW, Doubeni CA, Epling JW Jr, Kemper AR, Kubik M, Landefeld CS, Mangione CM, Silverstein M, Simon MA, Tseng CW, Wong JB. Risk Assessment for Cardiovascular Disease With Nontraditional Risk Factors: US Preventive Services Task Force Recommendation Statement. JAMA. 2018 Jul 17;320(3):272-280. doi: 10.1001/jama.2018.8359. PMID: 29998297.

49



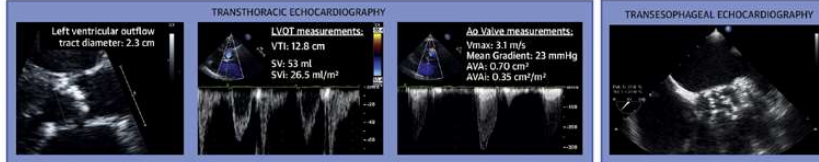
Outros empregos

50



Escore de cálcio

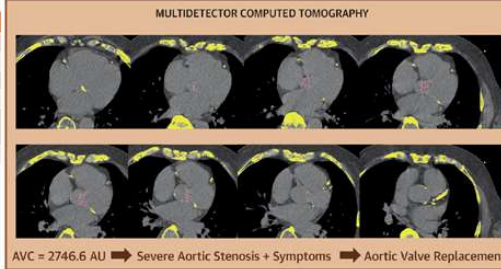
CENTRAL ILLUSTRATION: Usefulness of Aortic Valve Calcification Score in Patient With Discordant Echocardiographic Markers of Aortic Stenosis Severity



Symptomatic 84-year-old man with low-flow low-gradient aortic stenosis – Preserved Ejection Fraction – Unknown stenosis severity

Computed Tomography Scan protocol	
kV	120-140
mAs	30-80 according to patient body weight
Acquisition	Spiral or volumetric
Pitch	0.15-0.25 according to scanner
Reconstruction placement on R-R interval	60%-80%
Slice Thickness	3 mm

Rounded threshold identifying severe aortic stenosis	
Women	AVC >1,300 AU
Men	AVC >2,000 AU



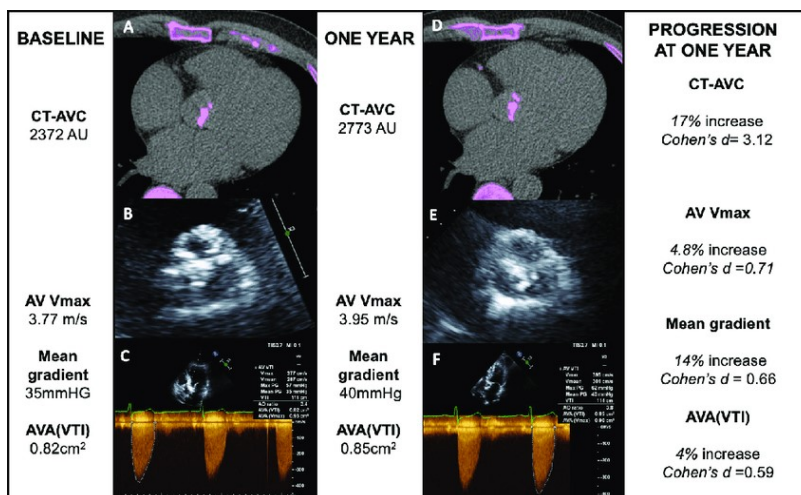
Pawade, T. et al. J Am Coll Cardiol Img. 2019;12(9):1835-48.

Hecht H, Blaha MJ, Berman DS, Nasir K, Budoff M, Leipsic J, Blankstein R, Narula J, Rumberger J, Shaw LJ. Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. J Cardiovasc Comput Tomogr. 2017 Mar-Apr;11(2):157-168. doi: 10.1016/j.jcct.2017.02.010. Epub 2017 Feb 24. PMID: 28283309.

51



Escore de cálcio



Guzzetti E, Clavel MA. Measuring progression of aortic stenosis: computed tomography versus echocardiography. Heart. 2020 Dec;106(24):1873-1875. doi: 10.1136/heartjnl-2020-317340. Epub 2020 Oct 9. PMID: 33037021.

52



Casos

53



Escore de cálcio: 0



Calcium Scoring

CT

- Multislice (Threshold: 90HU)
- Electron Beam (Threshold: 130HU)

Left Coronary Artery

Starting Point: (Click in the image)

px: x:179 y:243
mm: x:-2.46 y:94.04 z:-14E
value: 15.00

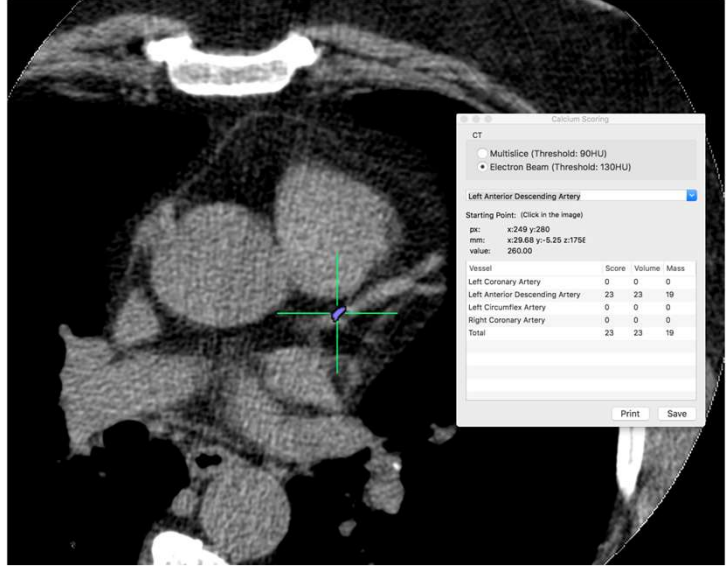
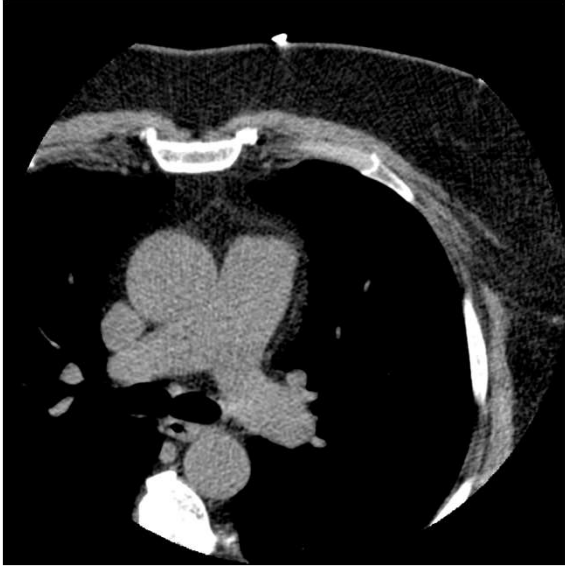
Vessel	Score	Volume	Mass
Left Coronary Artery	0	0	0
Left Anterior Descending Artery	0	0	0
Left Circumflex Artery	0	0	0
Right Coronary Artery	0	0	0
Total	0	0	0

Print Save

54



Escore de cálcio: 10-99



55



Escore de cálcio: 100-299



56



Escore de cálcio: ≥ 300



Calcium Scoring

CT

- Multislice (Threshold: 90HU)
- Electron Beam (Threshold: 130HU)

Starting Point: (Click in the image)

px: x:-463 y:559
 mm: x:-327.82 y:61.00 z:-1:
 value: 0.00

Vessel	Score	Volume	Mass
Left Coronary Artery	128	86	84
Left Anterior Descending Artery	737	578	632
Left Circumflex Artery	200	170	168
Right Coronary Artery	1346	938	1023
Total	2410	1773	1907

Print Save

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Questionário 1

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Angiotomografia de coronárias

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Indicações

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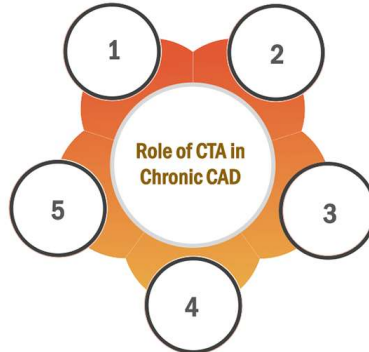
Indicações

First line test for evaluating patients with:

- No known CAD and Stable Typical or Atypical Chest Pain, or Anginal Equivalent

Reasonable test for evaluating patients with:

- Known CAD and Stable Typical or Atypical Chest Pain, or Anginal Equivalent



First line test for evaluating patients with:

- Coronary Anomalies
- Prior CABG, particularly if graft patency or location of LIMA is the primary objective

Reasonable test for evaluating patients with:

- A non-conclusive functional test; to obtain more precision regarding diagnosis and prognosis

Reasonable test for evaluating patients with:

- Coronary Stents > 3.0 mm
- Proximal, Non Bifurcation thin strut Stents < 3.0 mm
- Prior to Non Cardiac Surgery in younger patients with low-intermediate probability of CAD
- Evaluating Coronary Anatomy in patients with suspected Dissection of the Aorta

Narula J, Chandrashekhar Y, Ahmadi A, Abbara S, Berman DS, Blankstein R, Leipsic J, Newby D, Nicol ED, Nieman K, Shaw L, Villines TC, Williams M, Hecht HS. SCCT 2021 Expert Consensus Document on Coronary Computed Tomographic Angiography: A Report of the Society of Cardiovascular Computed Tomography. J Cardiovasc Comput Tomogr. 2021 May-Jun;15(3):192-217. doi: 10.1016/j.jcct.2020.11.001.



Técnica



Técnica

Posicionamento: decúbito dorsal com braços acima da cabeça

Voltagem do tubo: fixo em 120 kVp

mAs: variável pelo IMC

-IMC <30: 40mAs

-IMC 30-34: 50 mAs

-IMC >34: 60 mAs

Aquisição em inspiração

Reconstruções de 2,5 mm com FOV de 25 cm

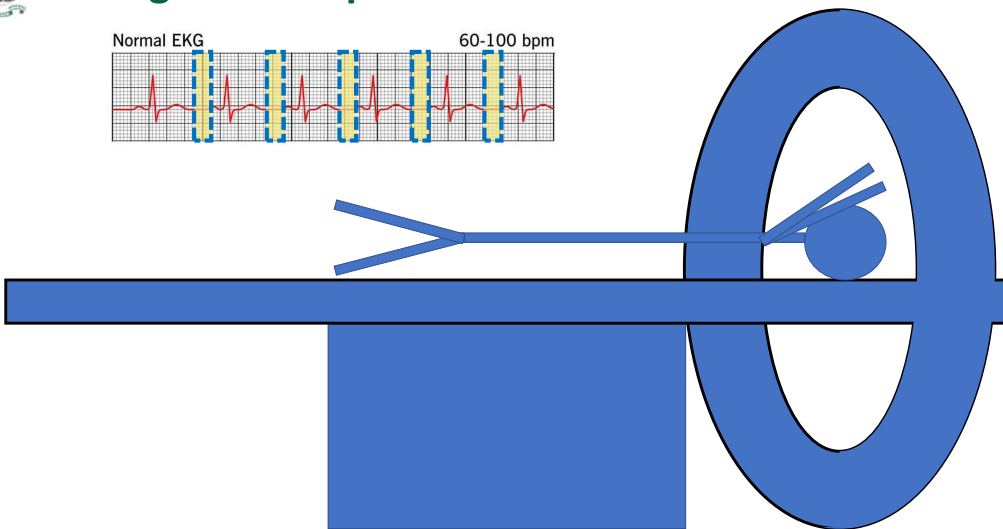
FC: <60 bpm

Gupta A et al. Coronary Artery Calcium Scoring: Current Status and Future Directions. Radiographics. 2022 Jul-Aug;42(4):947-967. doi: 10.1148/rg.210122.

63




Tomografia computadorizada com ECG



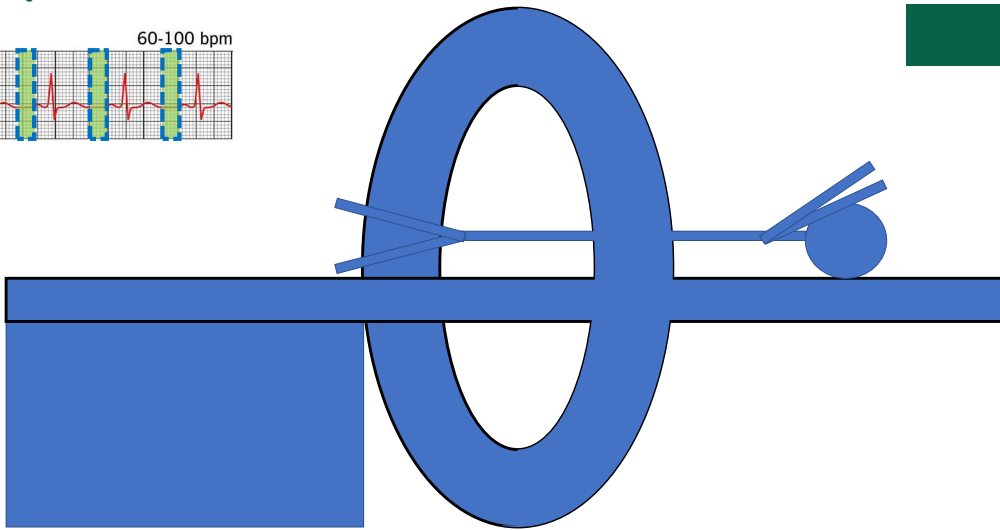
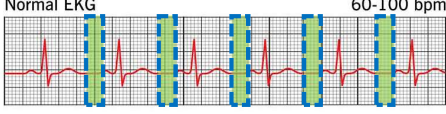
Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).

64



Tomografia computadorizada com ECG


Normal EKG 60-100 bpm



TC de pelo menos 64 canais

Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).

65



Preparo

66



Preparo

Controle de FC com beta-bloqueadores (*atenolol)

Controle de FC com outras medicações (*ivabradina)

Dilatação das coronárias com nitrato (*dinitrato de isossorbida)

Término do controle de FC com o paciente na sala de TC com complemento de beta-bloqueadores (*metoprolol)

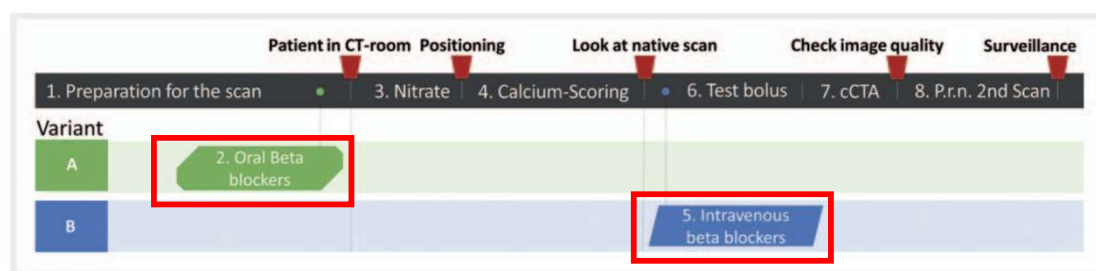
!!!Atenção para contraindicações!!!

Abbara S et al. SCCT guidelines for the performance and acquisition of coronary computed tomographic angiography: A report of the society of Cardiovascular Computed Tomography Guidelines Committee: Endorsed by the North American Society for Cardiovascular Imaging (NASCI). J Cardiovasc Comput Tomogr. 2016 Nov-Dec;10(6):435-449. doi: 10.1016/j.jcct.2016.10.002. Soschynski M et al. Update for the Performance of CT Coronary Angiography - Evidence-Based Application and Technical Guidance According to Current Consensus Guidelines and Practical Advice from the Clinical Routine. Rofo. 2022 Jun;194(6):613-624. English, German. doi: 10.1055/a-1747-3554.

67



Indicações



Narula J, Chandrashekhar Y, Ahmadi A, Abbara S, Berman DS, Blankstein R, Leipsic J, Newby D, Nicol ED, Nieman K, Shaw L, Villines TC, Williams M, Hecht HS. SCCT 2021 Expert Consensus Document on Coronary Computed Tomographic Angiography: A Report of the Society of Cardiovascular Computed Tomography. J Cardiovasc Comput Tomogr. 2021 May-Jun;15(3):192-217. doi: 10.1016/j.jcct.2020.11.001.

68



Dificuldades

69



Dificuldades

Apneia insatisfatória

Ritmo cardíaco irregular (fibrilação atrial, bigeminismo, etc)

Extrassístoles

Pacientes obesos

Meios de contraste de baixa concentração de iodo

Equipamentos mais antigos

Abbara S et al. SCCT guidelines for the performance and acquisition of coronary computed tomographic angiography: A report of the society of Cardiovascular Computed Tomography Guidelines Committee: Endorsed by the North American Society for Cardiovascular Imaging (NASCI). J Cardiovasc Comput Tomogr. 2016 Nov-Dec;10(6):435-449. doi: 10.1016/j.jcct.2016.10.002. Soschynski M et al. Update for the Performance of CT Coronary Angiography - Evidence-Based Application and Technical Guidance According to Current Consensus Guidelines and Practical Advice from the Clinical Routine. Rofo. 2022 Jun;194(6):613-624. English, German. doi: 10.1055/a-1747-3554.

70

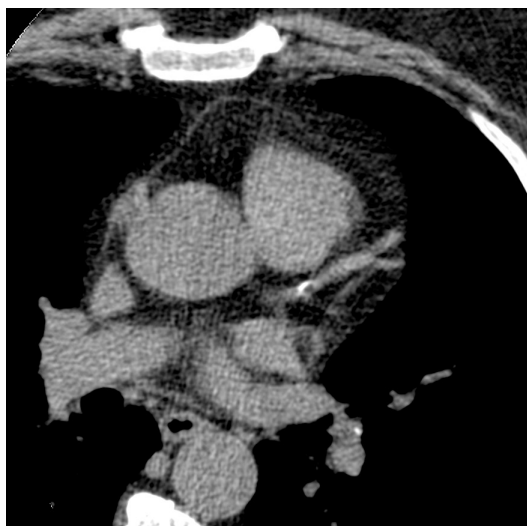


Aquisição

71



AngioTC de coronária



72

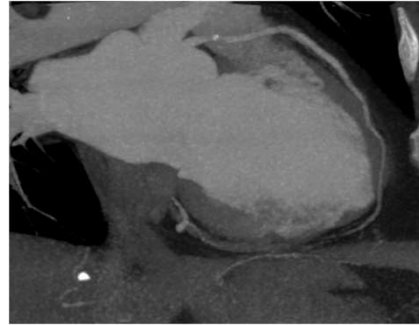


AngioTC de coronária

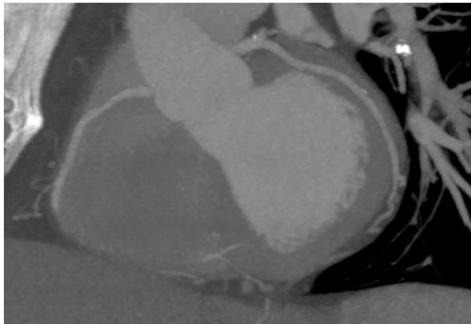
Tronco E



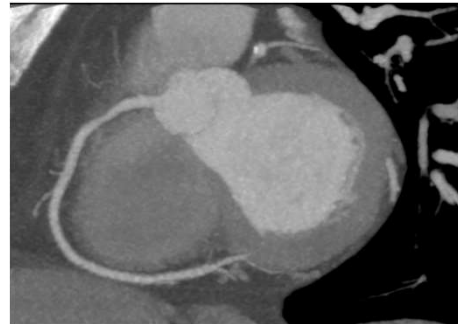
DA



Cx



CD



73



Grau de estenose

CAD-RADS categories

Score	Stenosis	Interpretation	Further investigation
0	0%	Absence of CAD	None
1	1–24%	Minimal non-obstructive CAD	None
2	25–49%	Mild non-obstructive CAD	None
3	50–69%	Moderate stenosis	Consider functional assessment
4A	70–99% single or 2- vessel	Severe stenosis	Consider ICA or functional assessment
4B	Left main >50% or 3- vessel ≥70%		ICA
5	100%	Total coronary occlusion	Consider ICA and viability assessment
CadRads N	Non-diagnostic study	Obstructive CAD cannot be excluded	Additional evaluation needed

Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

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Grau de estenose

CAD-RADS categories			
Score	Stenosis	Interpretation	Further investigation
0	0%	Absence of CAD	None
1	1–24%	Minimal non-obstructive CAD	None
2	25–49%	Mild non-obstructive CAD	None
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4A	70–99% single or 2- vessel	Severe stenosis	Consider ICA or functional assessment
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Grau de estenose

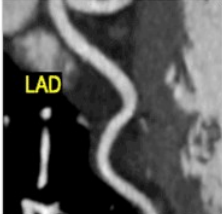
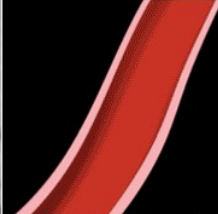

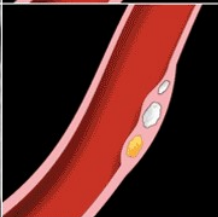
Cad-Rads	Stenosis	CT imaging	Illustration	Additional Tests
Cad-Rads 0	0% No stenosis			None
Cad-Rads 1	1-24% Minimal stenosis			None
Cad-Rads 2	25-49% Mild stenosis			None
Cad-Rads 3	50-70% Moderate stenosis			Consider functional assessment
Cad-Rads 4	A: 70-99% stenosis in 1 or 2 vessels B: >50% stenosis in the left main or >70% stenosis in 3-vessels			A: Consider functional assessment or ICA B: ICA is recommended
Cad-Rads 5	100% total occlusion			ICA and/or viability assessment
Cad-Rads N	Non-diagnostic study			Additional evaluation

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Grau de estenose


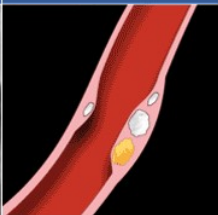

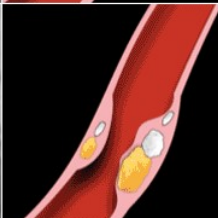
Cad-Rads	Stenosis	CT imaging	Illustration	Additional Tests
Cad-Rads 0	0% No stenosis			None
Cad-Rads 1	1-24% Minimal stenosis			None

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Grau de estenose


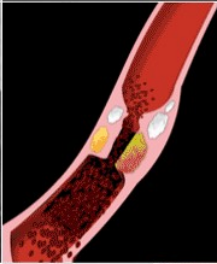
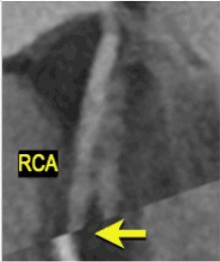
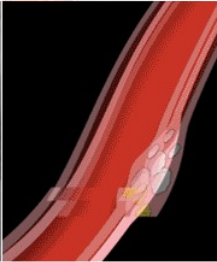
Cad-Rads	Stenosis	CT imaging	Illustration	Additional Tests
Cad-Rads 2	25-49% Mild stenosis			None
Cad-Rads 3	50-70% Moderate stenosis			Consider functional assessment

Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

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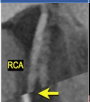

Grau de estenose

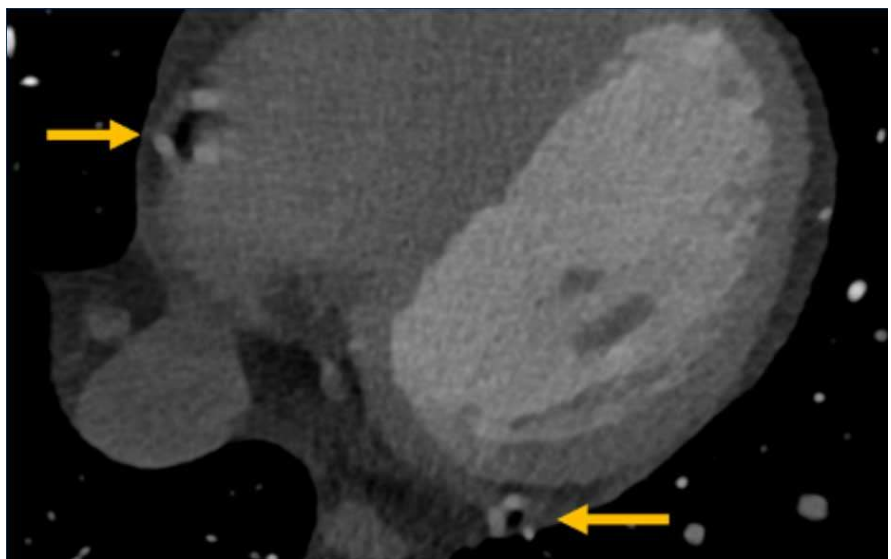
Cad-Rads	Stenosis	CT imaging	Illustration	Additional Tests
Cad-Rads 5	100% total occlusion	 RCA		ICA and/or viability assessment
Cad-Rads N	Non-diagnostic study	 RCA		Additional evaluation

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Grau de estenose

Cad-Rads	Stenosis	CT imaging	Illustration	Additional Tests
Cad-Rads N	Non-diagnostic study	 RCA		Additional evaluation



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Burden de placa (por escore de cálcio)

Coronary Plaque Burden				
	Amount of plaque	Calcium score	SIS*	Visual
P1	Mild	1-100	≤2	1-2 vessels with mild amount of plaque
P2	Moderate	101-300	3-4	1-2 vessels with moderate amount; 3 vessels with mild amount of plaque
P3	Severe	301-999	5-7	3 vessels with moderate amount; 1 vessel with severe amount of plaque
P4	Extensive	>1000	≥8	2-3 vessels with severe amount of plaque

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Manejo dos resultados

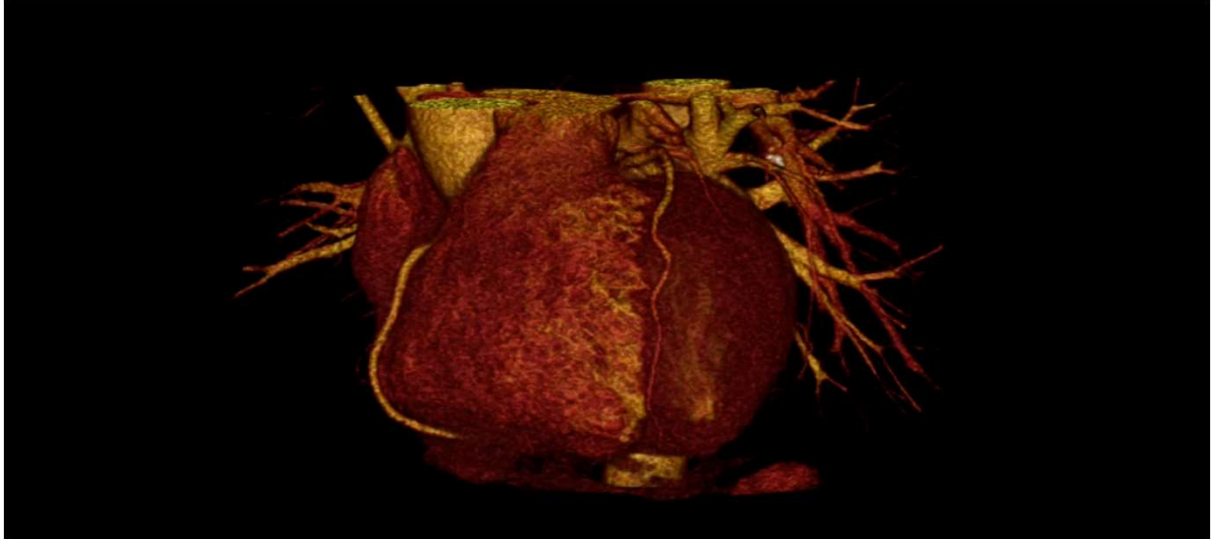
Management considerations based on plaque burden	
CAD-RADS 1	Consider non-atherosclerotic causes P1: Consider risk factor modification and preventive pharmacotherapy P2: Risk factor modification and preventive pharmacotherapy P3/P4: Aggressive risk factor modification and preventive pharmacotherapy
CAD-RADS 2	Consider non-atherosclerotic causes P1/P2: Risk factor modification and preventive pharmacotherapy P3/P4: Aggressive risk factor modification and preventive pharmacotherapy
CAD-RADS 3	P1/P2/P3/P4: Aggressive risk factor modification and preventive pharmacotherapy Other treatments (including anti-anginal therapy) should be considered per guideline When modifier I+, consider ICA, especially if frequent symptoms persist after guideline-directed medical therapy
CAD-RADS 4A/B	P1/P2/P3/P4: Aggressive risk factor modification and preventive pharmacotherapy Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline
CAD-RADS 5	P1/P2/P3/P4: Aggressive risk factor modification and preventive pharmacotherapy Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline

Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system> (acesso em 18/02/2024)

82



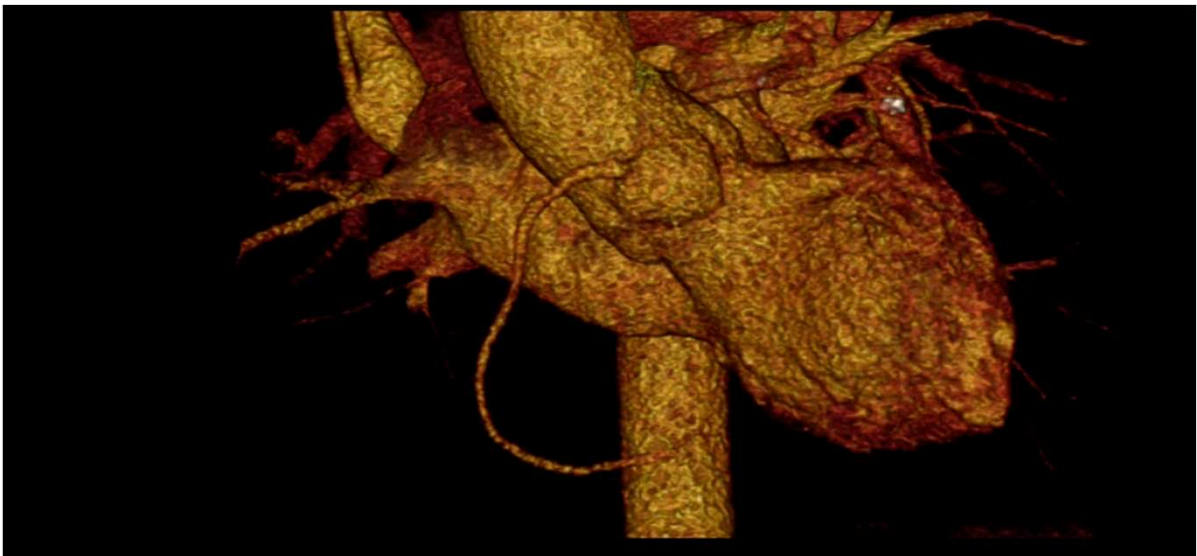
Volume rendering



83



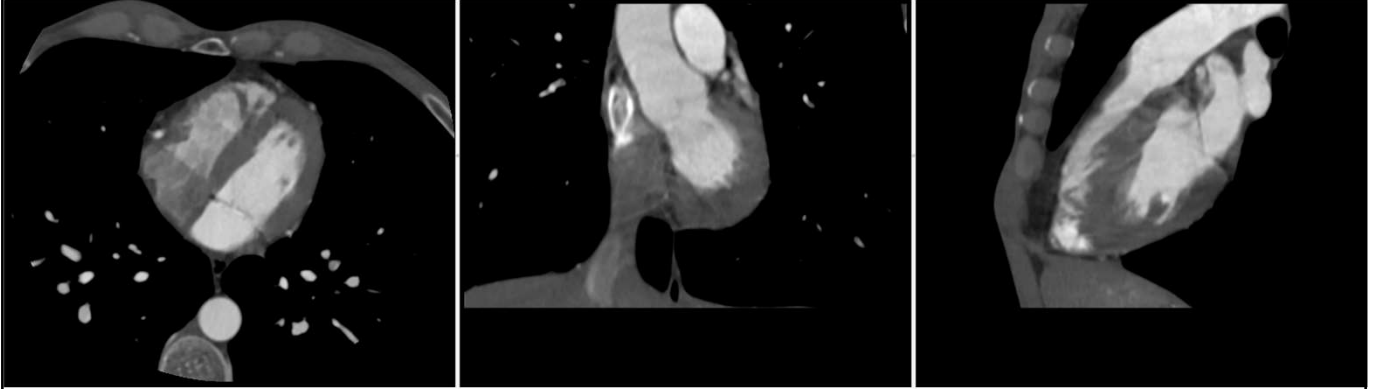
Volume rendering



84



Avaliação 4D



85



Avaliação 4D



86

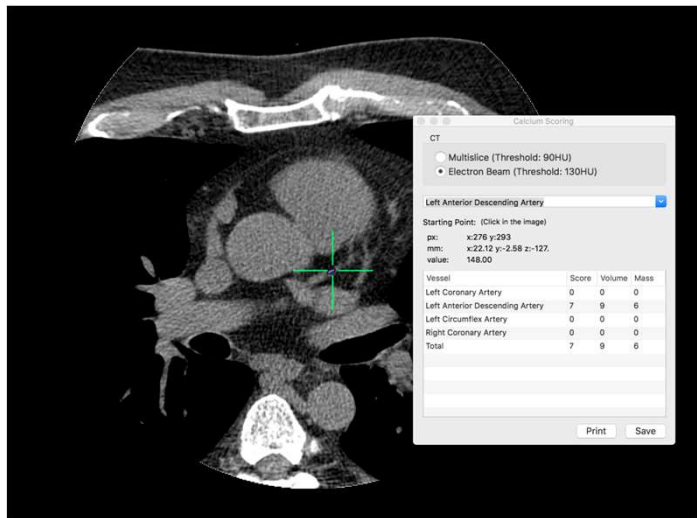


Casos

87



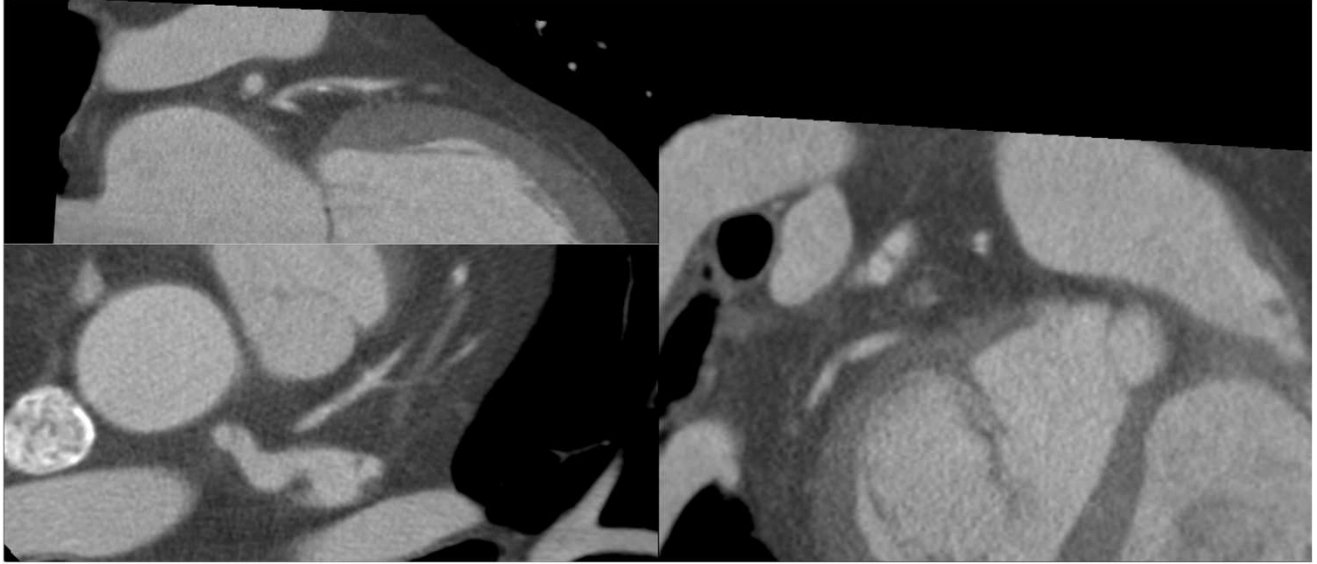
Escore de cálcio: <100



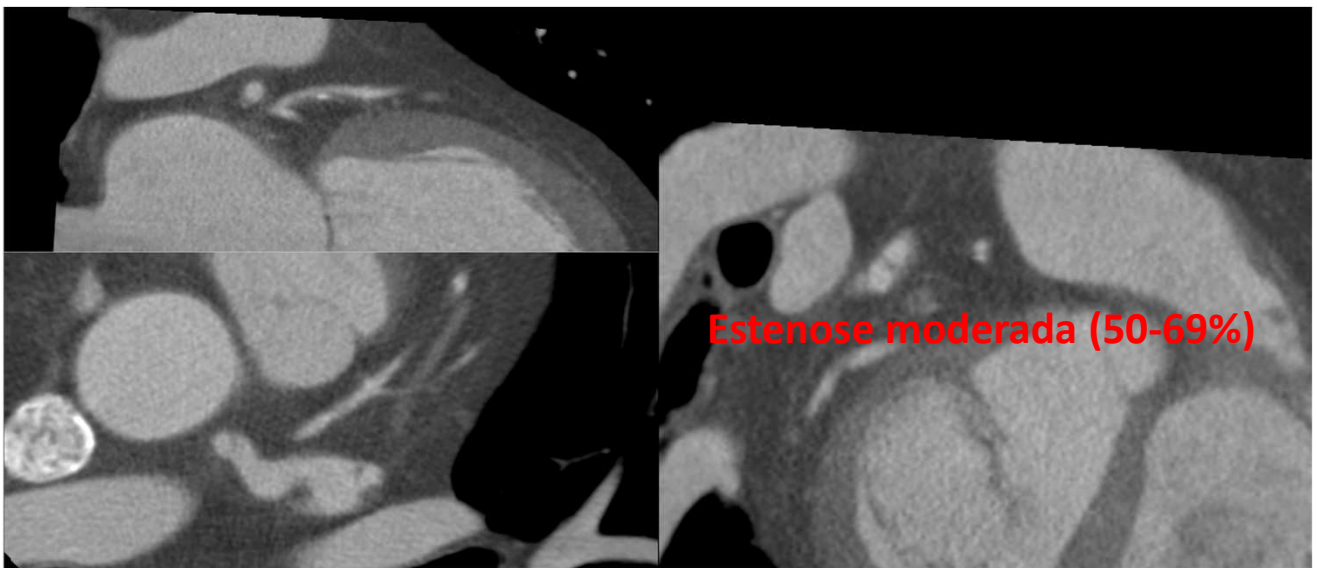
88



Escore de cálcio: <100

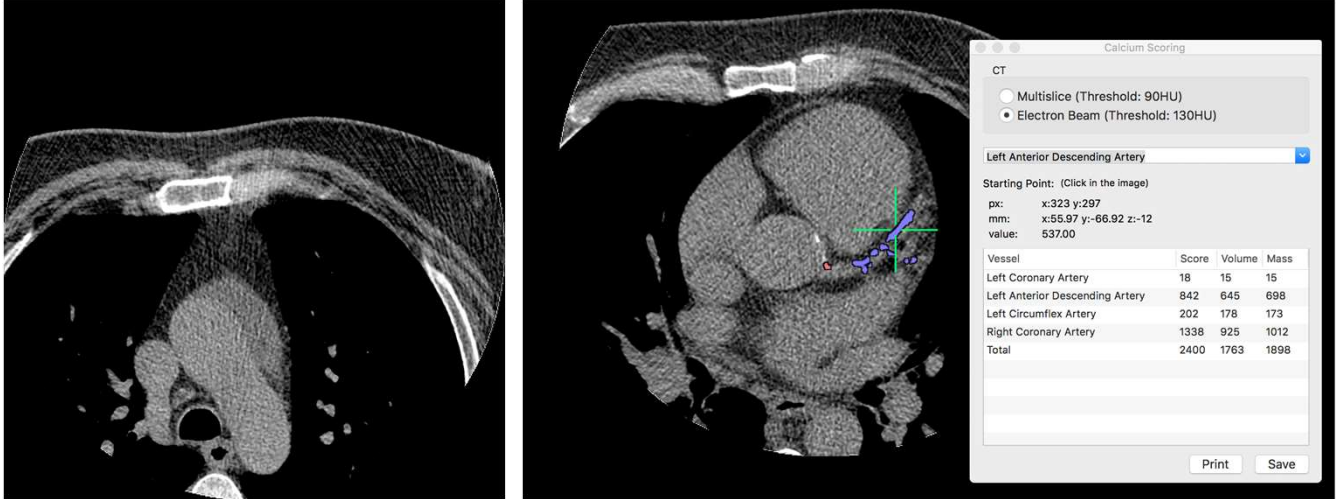


Escore de cálcio: <100

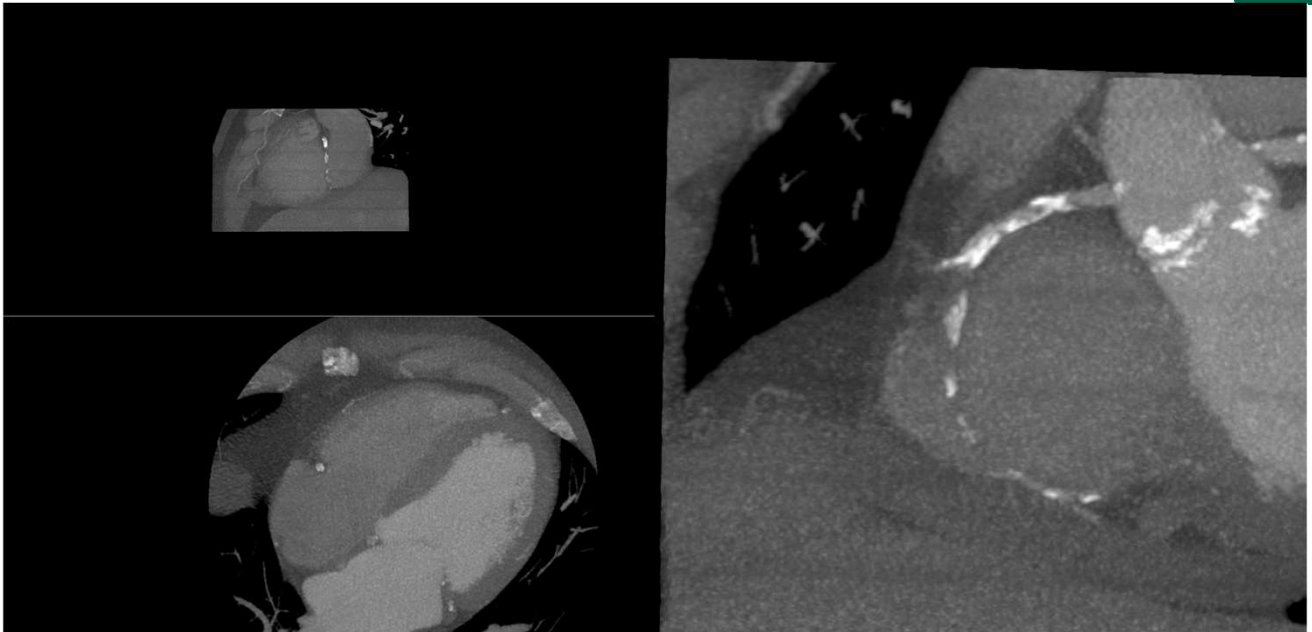




Escore de cálcio: >300

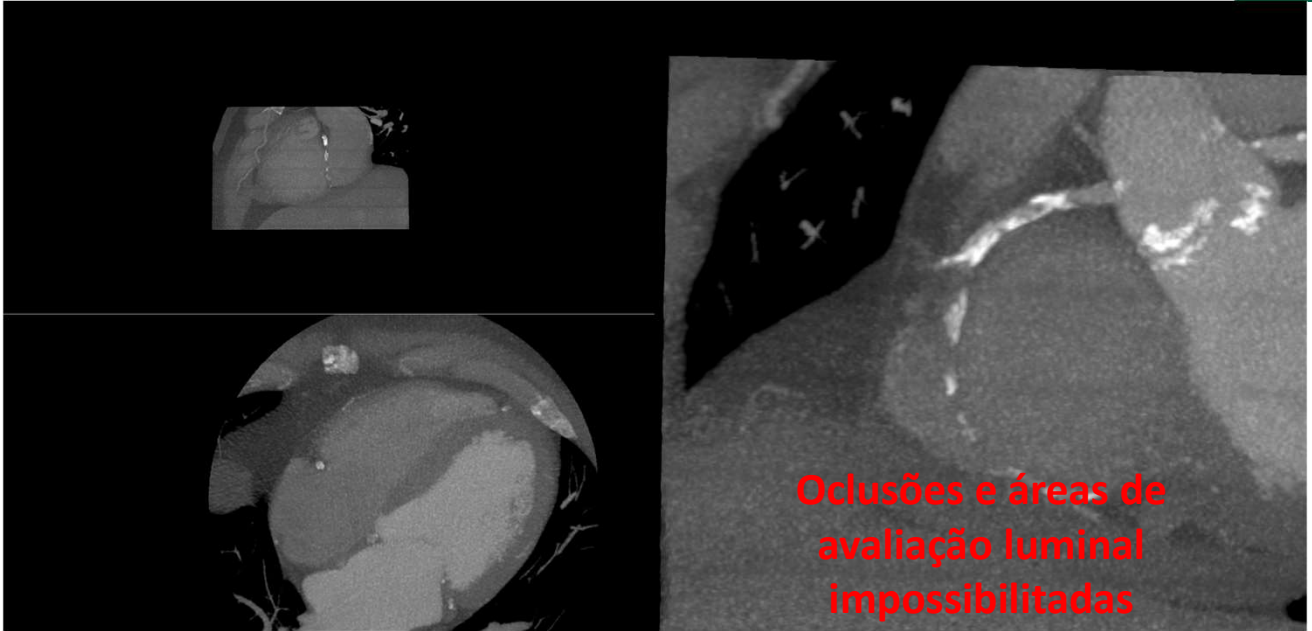


Escore de cálcio: >300

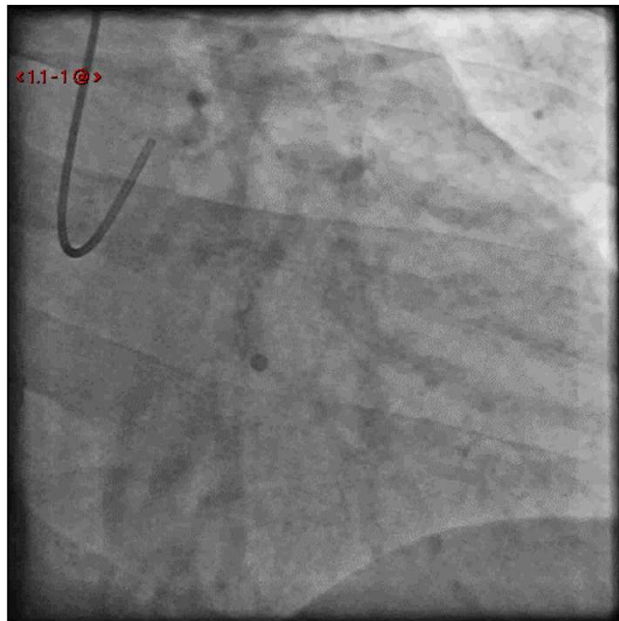




Escore de cálcio: >300



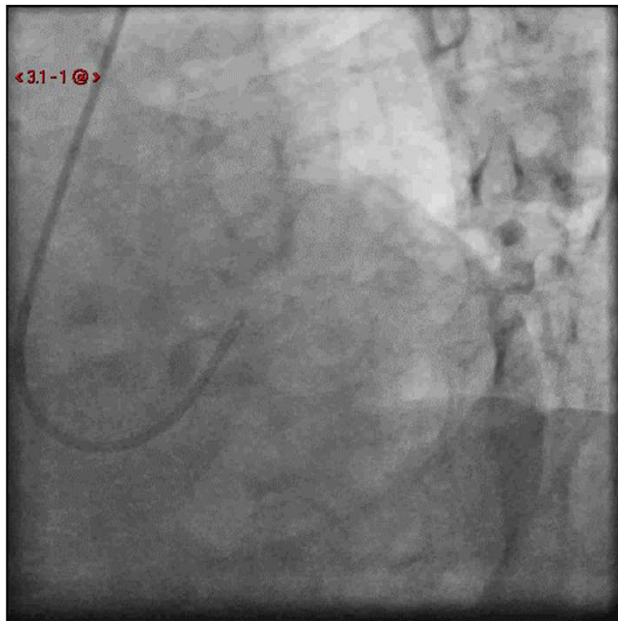
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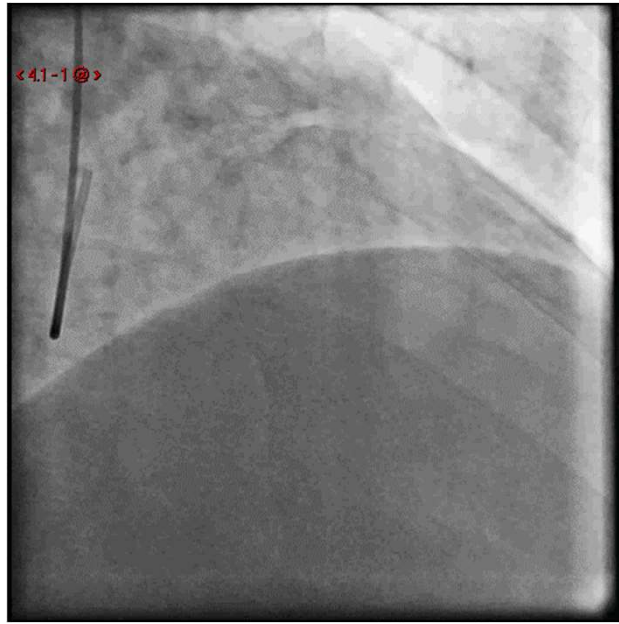
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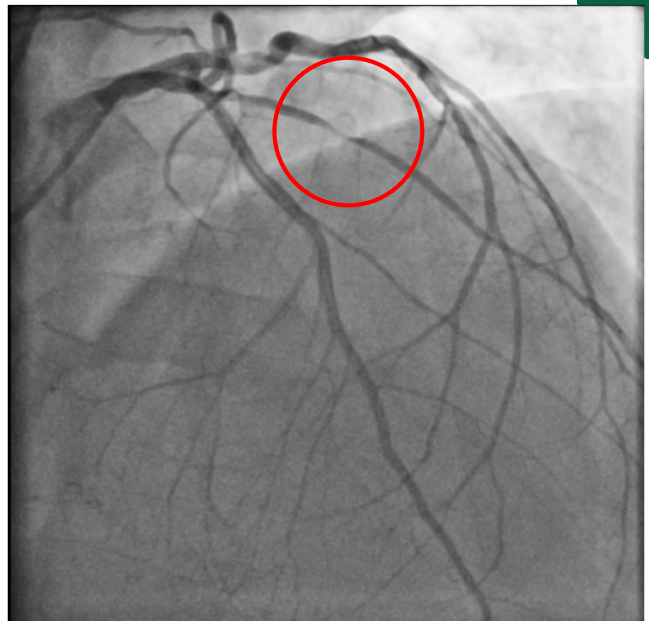
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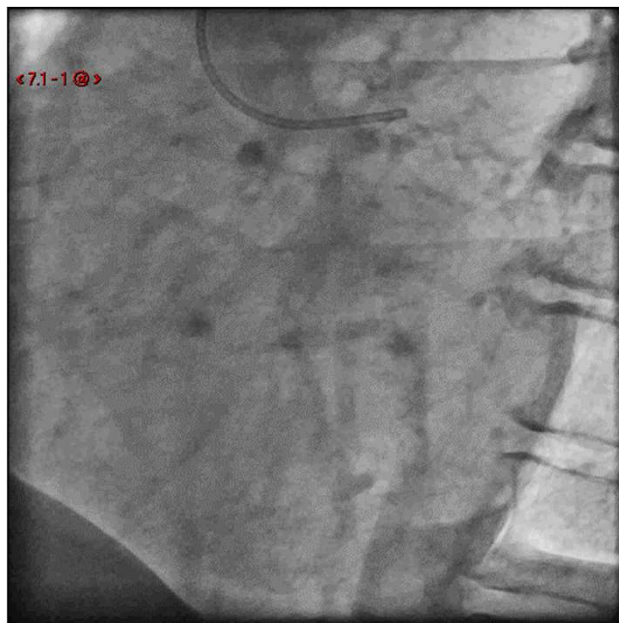
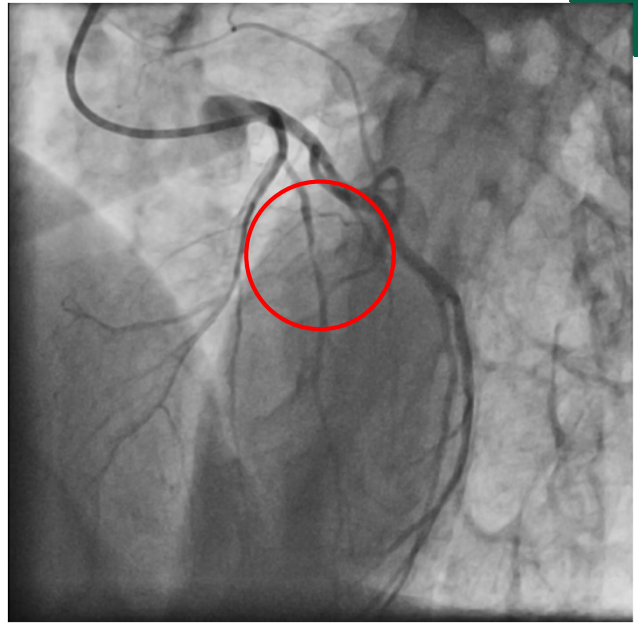
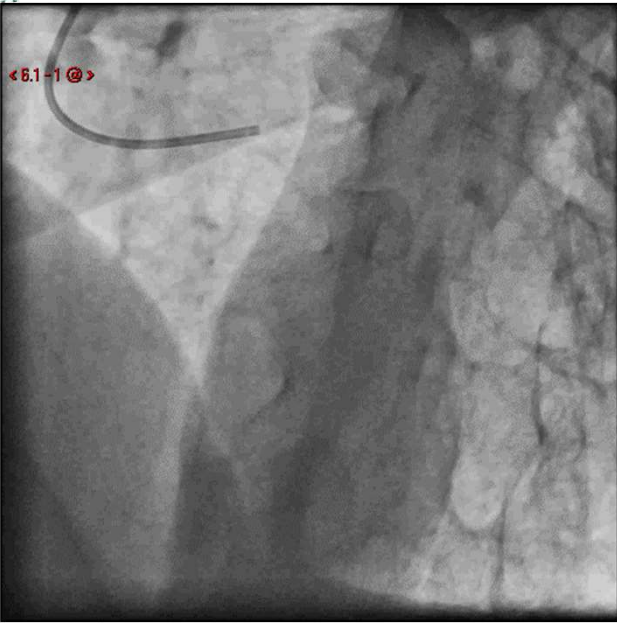
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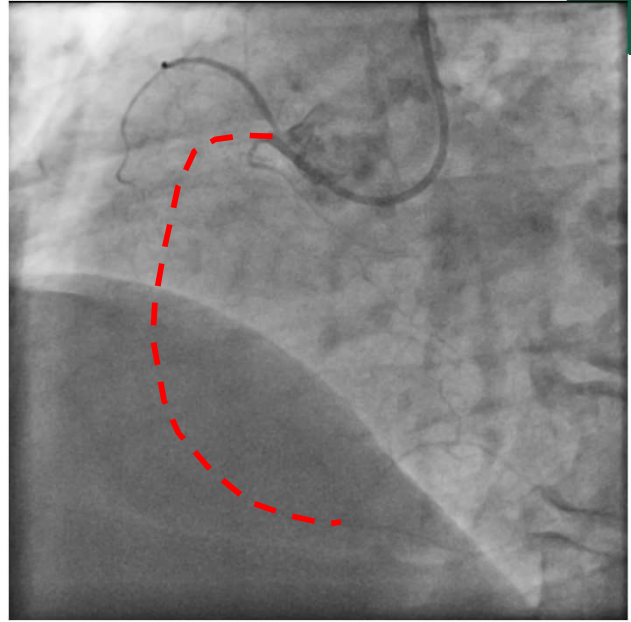
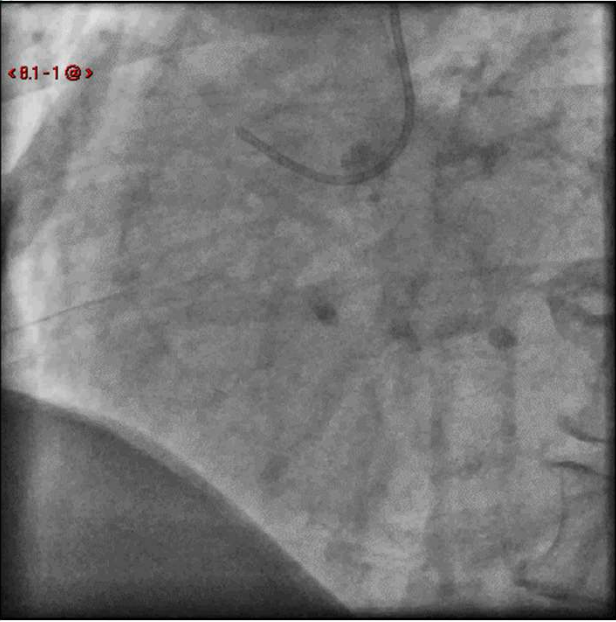


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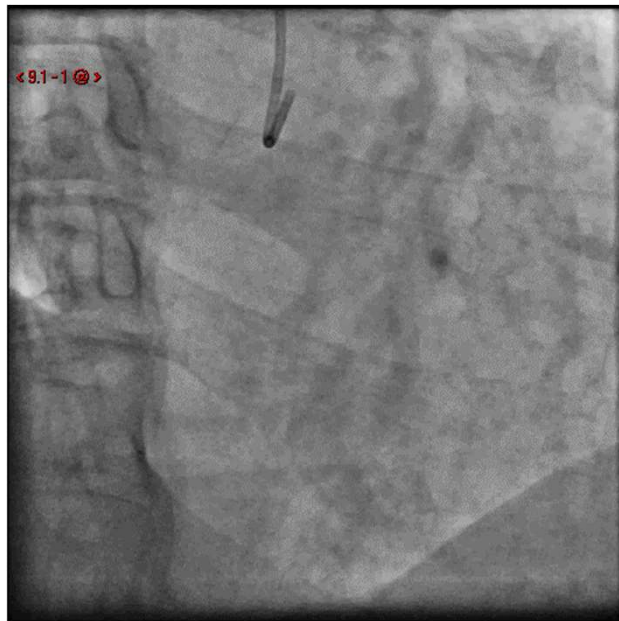


98

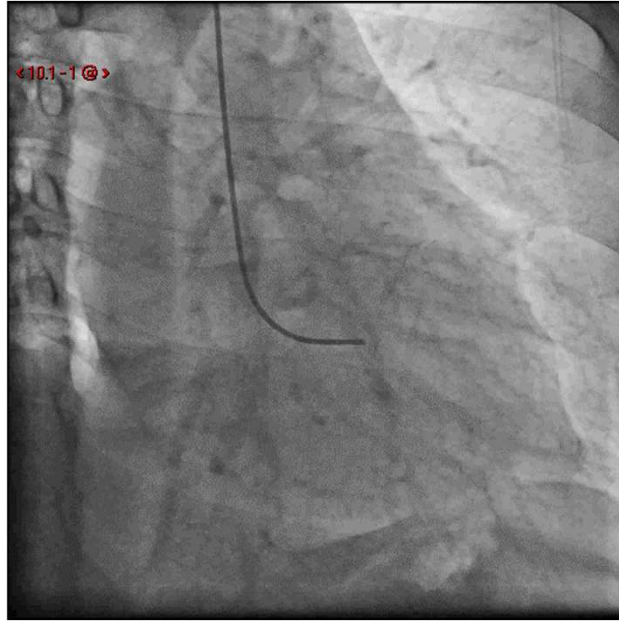




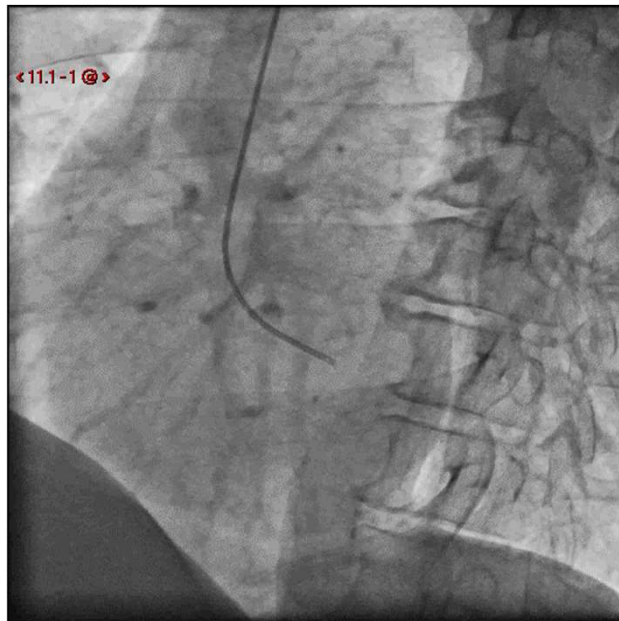
101



102



103



104



Questionário 2

105



Ressonância magnética cardíaca

106



Técnica

107



Técnica

Posicionamento: decúbito dorsal com braços acima da cabeça

Bobina superficial de corpo

Aquisições de sequências em expiração

Aquisições nos planos do coração

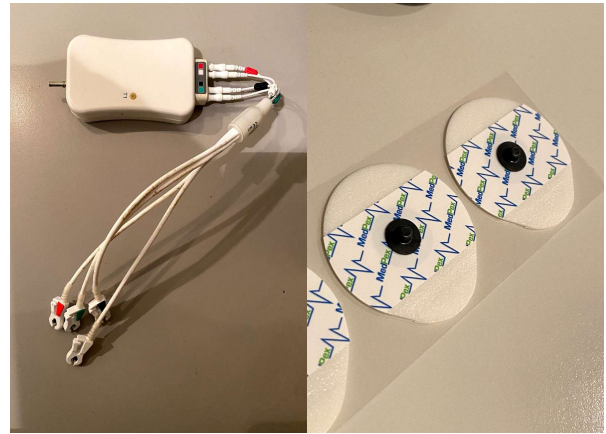
Tempo de exame: 25-60 min

Ref

108



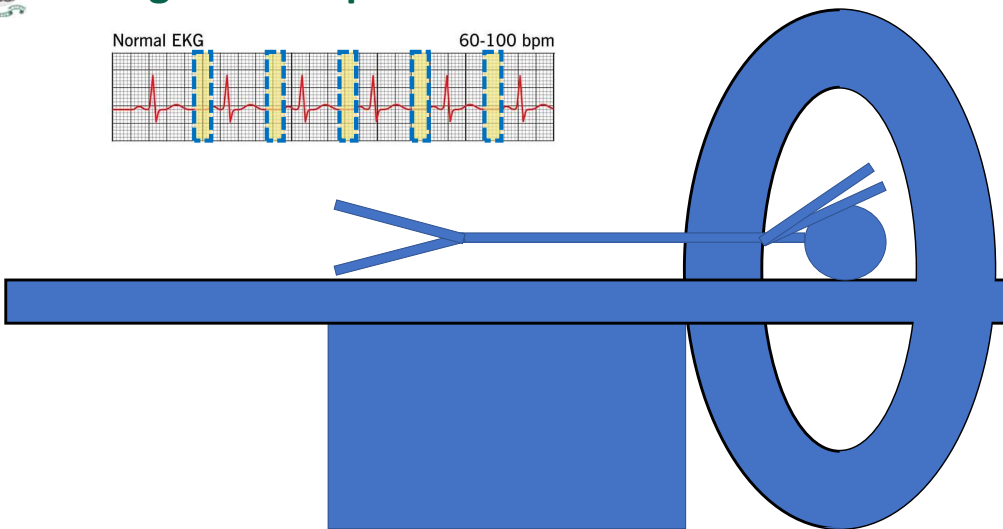
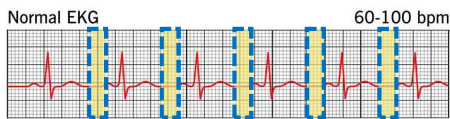
O exame



109



Tomografia computadorizada com ECG

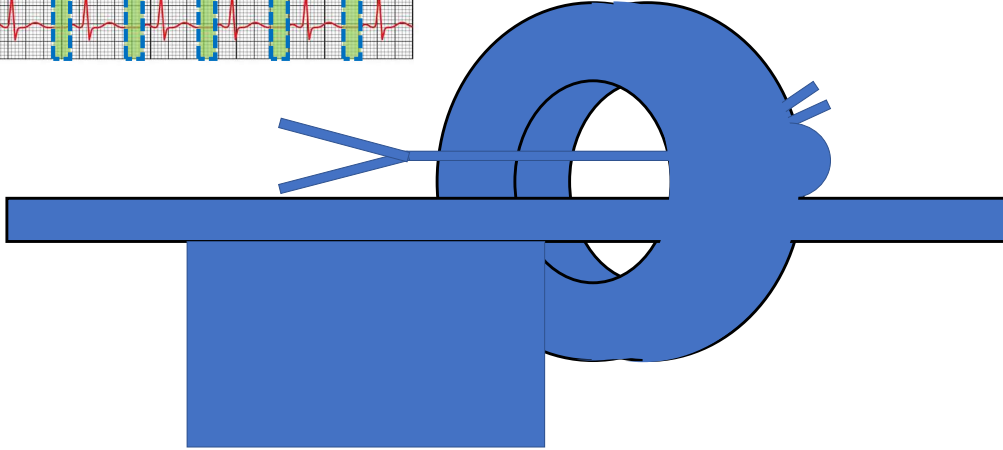
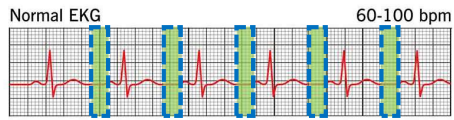


Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).

110



Ressonância magnética com ECG



Espaço menor

Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).

111



O exame



112



Preparo

113



Preparo

Nenhum específico

**Exceto: casos de indução farmacológico de estresse para
pesquisa de isquemia miocárdica**

Gupta A et al. Coronary Artery Calcium Scoring: Current Status and Future Directions. Radiographics. 2022 Jul-Aug;42(4):947-967. doi: 10.1148/rg.210122.

114



Contraindicações

115



Contraindicações

Aparelhos médicos incompatíveis (dispositivos eletrônicos cardíacos incompatíveis, alguns componentes de marcapassos, implantes cocleares, etc.)

Outros objetos metálicos no corpo

***Claustrofobia**

REF

116



Contraindicações

The screenshot shows the MRIsafety.com website. On the left is a 'Menu' with links to 'HOME PAGE', 'THE LIST AND SAFETY TOPICS', 'INFO & TERMINOLOGY', 'SCREENING FORM', 'PRODUCT TESTING', 'LECTURES', 'DISCLAIMER', 'ABOUT DR. SHELLOCK', and 'PRIORITY EMAIL'. Below the menu is an 'Accidents' section with a photo of an office chair in an MRI room and the text 'An office chair was in the wrong place - at ANY time!'. The main content area features the text 'Welcome to MRIsafety.com!' and 'YOUR RESOURCE FOR MRI SAFETY, BIOEFFECTS, & PATIENT MANAGEMENT'. It also includes a promotional message for a book: '** MRI BIOEFFECTS, SAFETY, AND PATIENT MANAGEMENT: SECOND EDITION book available at Amazon.com ** (PDF version is available at MRIsafetybook.com)'. The BRACCO logo is visible at the bottom of the main content area.

MRi Safety. Web site disponível em <https://www.mrisafety.com/> (acesso 18/02/2024).

117



Contraindicações

This screenshot is identical to the one above, but with a red circle highlighting the 'THE LIST AND SAFETY TOPICS' menu item in the left-hand navigation menu.

MRi Safety. Web site disponível em <https://www.mrisafety.com/> (acesso 18/02/2024).

118



Contraindicações

Research:

This site is Exclusively Sponsored by BRACCO

Displaying 1 - 20 of 4036

Object Description ↑	Object Status	Safety Topic / Subject
20 Intra-30 Fiberoptic Platinum Coil Boston Scientific, www.bostonscientific.com	1,5,3 Conditional 5 More...	Cable, Fibers, Beams, and Grafts More...
3/4" Socket Wrench 3/4" x 1/2 inch Newmatic Medical, www.newmaticmedical.com	3 Conditional 7 More...	Miscellaneous Implants and Devices More...
30 Caliber, 762 x 38, Copper Jacketed Round, Armor Piercing, Non-toxic	1,5 Unsafe 1 More...	Miscellaneous Implants and Devices More...
357 Magnum Revolver Model 66-3 M&C Smith and Wesson Springfield, MA	1,5 Unsafe 1 More...	Miscellaneous Implants and Devices More...
30 Intraoral Ring Applicator 90° with Plastic Needles Varian Medical Systems, www.varian.com	1,5,3 Conditional 8 More...	Miscellaneous Implants and Devices More...
30 Intraoral Ring Applicator with Plastic Needles Varian Medical Systems, www.varian.com	1,5,3 Conditional 5 More...	Miscellaneous Implants and Devices More...
30 Intraoral Silicone/Soft Sule Aesthetic Spine, Inc., www.aestheticspine.com	1,5,3 Safe More...	Orthopedic Implants, Materials, and Devices More...
3M Kind Remove Silicone Tape 3M, www.3m.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
3M PICOVIC Securement Device - Tegaderm LV Advanced Securement Dressing 3M, www.3m.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
3M Tegaderm CHG Chlorhexidine Gluconate LV Securement Dressing 3M, www.3m.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
3M Tegaderm Silicone Foam Border Dressing 3M, www.3m.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
4 Leg Steel IV Stand, Stainless Steel Plyer Products Oceanside, CA	3 Conditional 7 More...	Miscellaneous Implants and Devices More...
40 Dome Semi-resorbable Paratral Reinforcement Implant Cousin Biotech, www.cousin-biotech.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
40 Mesh Semi-resorbable Paratral Reinforcement Implant Cousin Biotech, www.cousin-biotech.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
40 Vertical Semi-resorbable Paratral Reinforcement Implant Cousin Biotech, www.cousin-biotech.com	1,5,3 Safe More...	Miscellaneous Implants and Devices More...
4 Leg Steel IV Stand, Aluminum Plyer Products Plyer Products, PA	3 Conditional 7 More...	Miscellaneous Implants and Devices More...

MRI Safety. Web site disponível em <https://www.mrisafety.com/> (acesso 18/02/2024).

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Contraindicações

Research:

This site is Exclusively Sponsored by BRACCO

Displaying 1 - 5 of 5

Object Description ↑	Object Status	Safety Topic / Subject
Alpha (M) Magnetic Implant, Bone Conduction Hearing System Sophono, Inc., www.sophono.com	1,5,3 Conditional 5 More...	Cochlear Implants More...
Esteem System, which includes a Model 2001 Sound Processor with the 7002/7004/7010 Sensors and 7502/7504/7510 Drivers, Hearing Implant . Envoy Medical www.envoymedical.com MR Conditional labeling - htt More ...	1,5,3 Conditional 5 More...	Miscellaneous Implants and Devices More...
Lyric Hearing Device InSound Medical Newark, CA	1,5 Unsafe 1 More...	InSound XT Series and Lyric Hearing Device More...
MAXUM System, MAXUM Hearing Implant Ototronix, www.ototronix.com	1,5 Unsafe 1 More...	Otologic Implants More...
Ponto Wide Implant, Used With Bone Conduction Hearing System Oticon Medical, www.oticonmedical.com	3 Conditional 6 More...	Miscellaneous Implants and Devices More...

Shellock R & D Services, Inc. email: Frank.Shellock@MRIsafety.com.
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MRI Safety. Web site disponível em <https://www.mrisafety.com/> (acesso 18/02/2024).

120

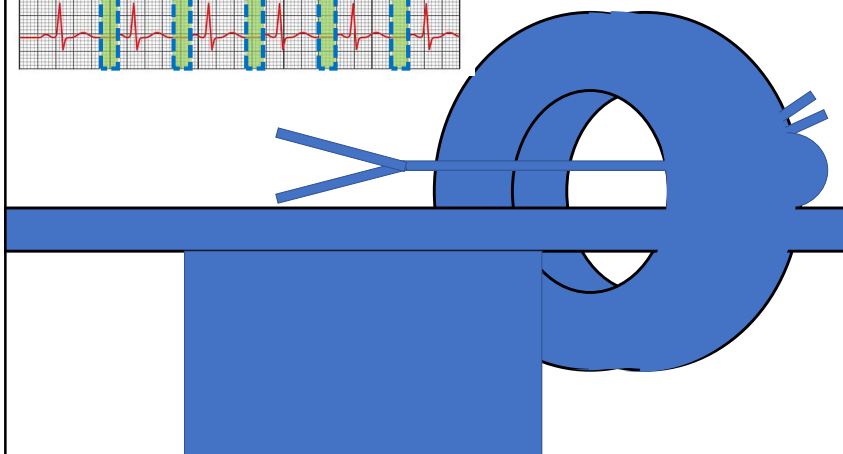
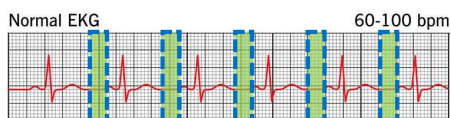


Como são as imagens de um exame?

121



Ressonância magnética com ECG



Encha o peito de ar
Solte todo o ar
Pare de respirar
zzzzzzzzzzzzzzzzzzzz (aquisição)
Relaxe

~51 apneias num exame

Electrocardiogram (EKG) Cleveland Clinic site. Disponível em <https://my.clevelandclinic.org/health/diagnostics/16953-electrocardiogram-ekg> (acesso em 18/02/2024).

122

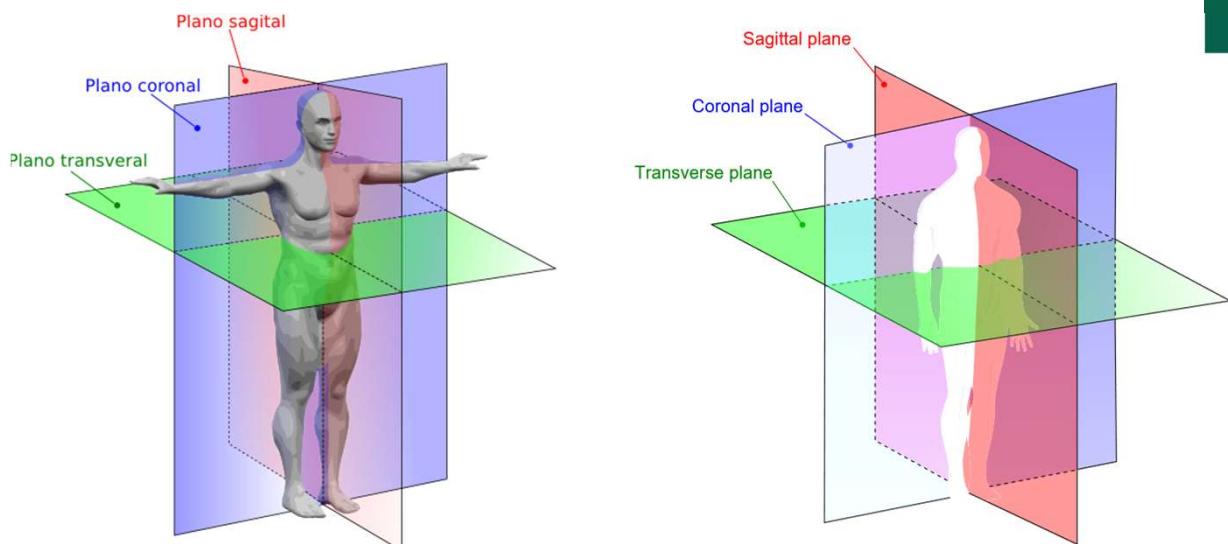


Planos cardíacos (exemplos pela angioTC de coronárias)

123



Planos anatômicos



GYassineMrabetTalk This W3C-unspecified vector image was created with Inkscape ., CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

124



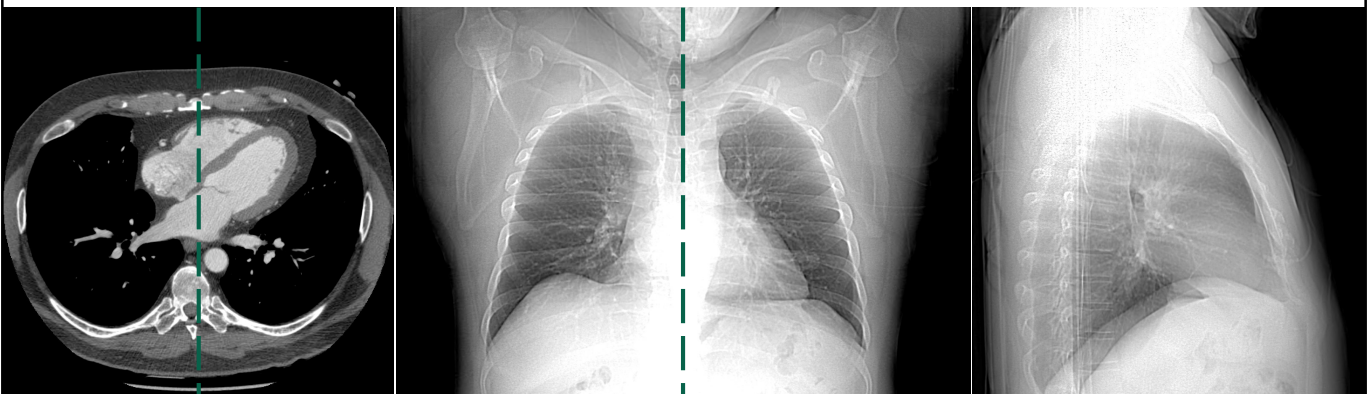
Planos anatômicos



125



Planos anatômicos

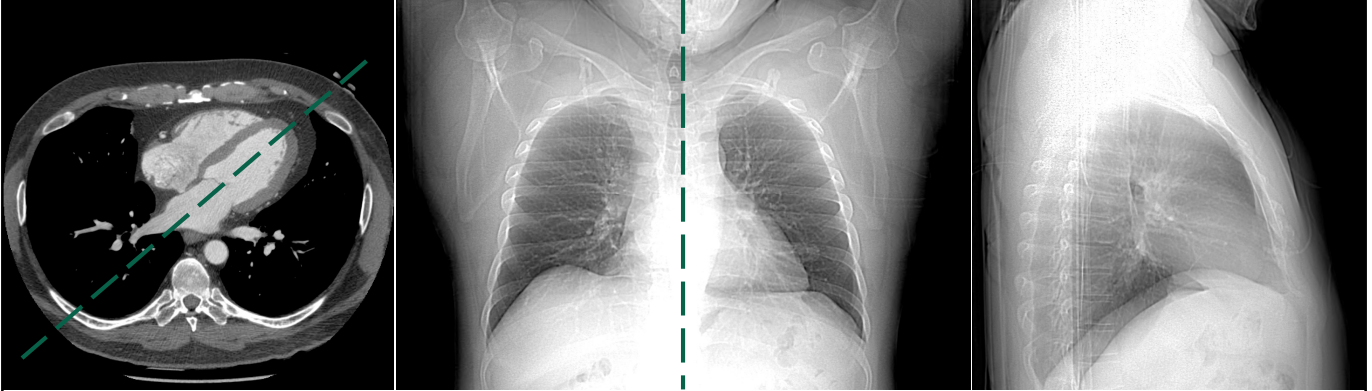


Sagital

126



Planos anatômicos



**Loc eixo longo do ventrículo
esquerdo (ELVE)**

127

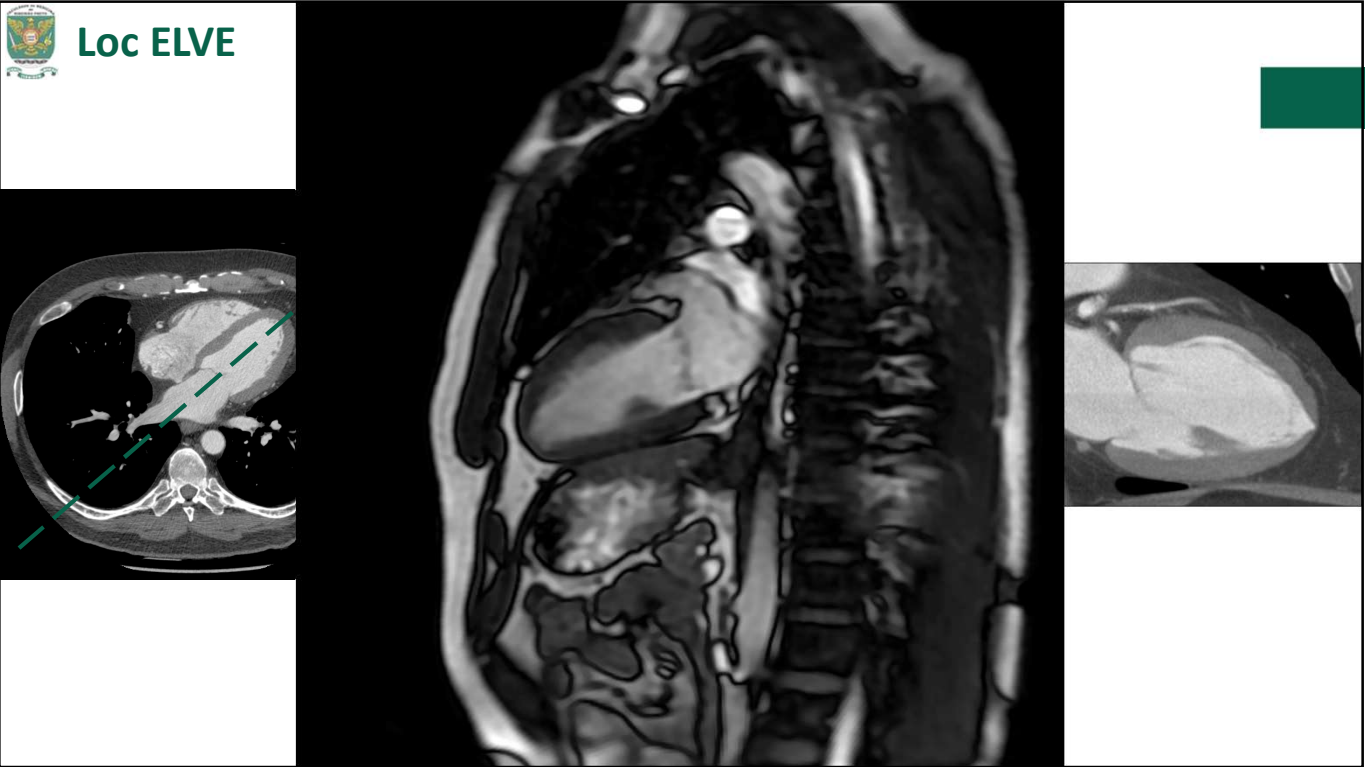


Loc ELVE

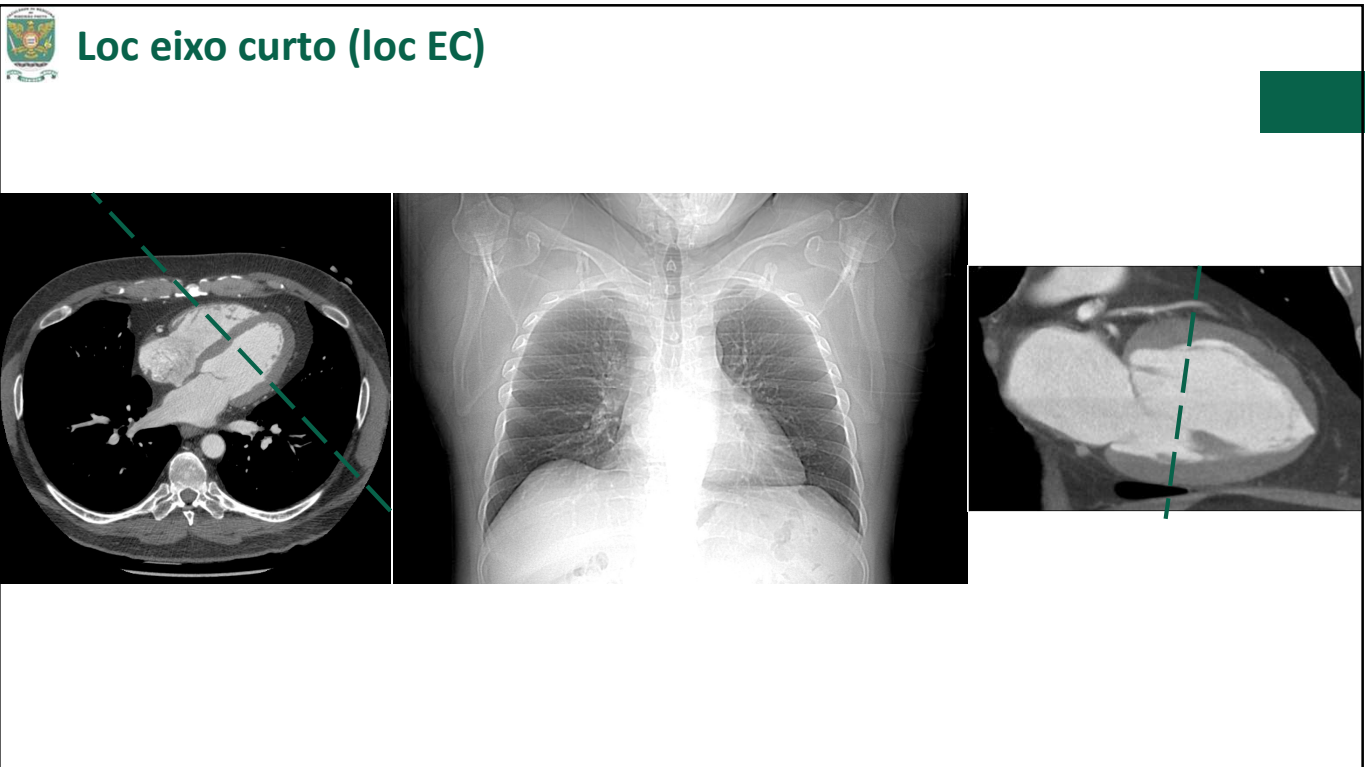


**Loc eixo longo do ventrículo
esquerdo (ELVE)**

128



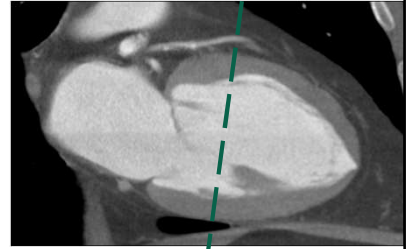
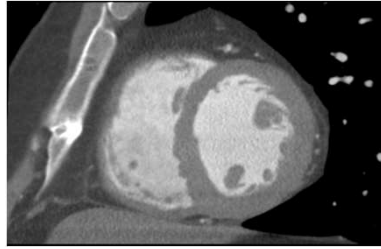
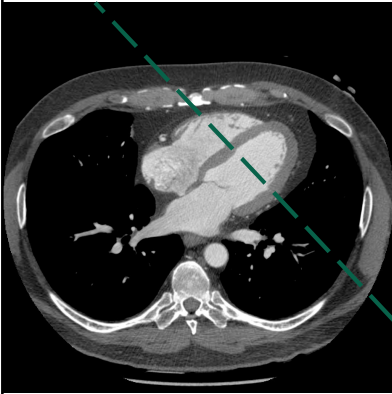
129



130



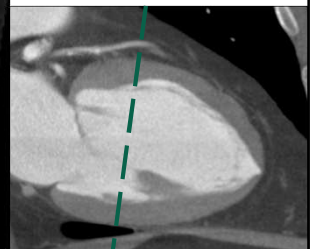
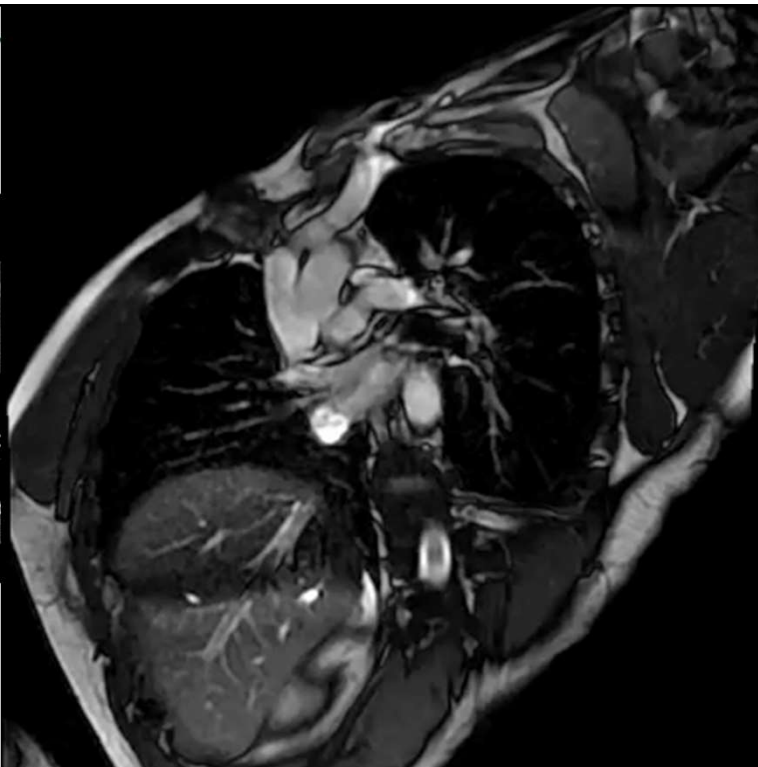
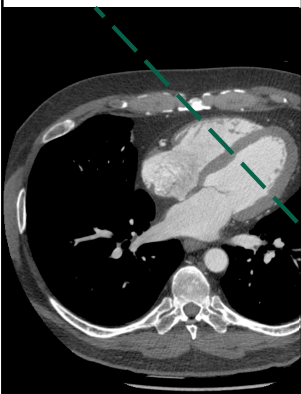
Loc eixo curto (loc EC)



131



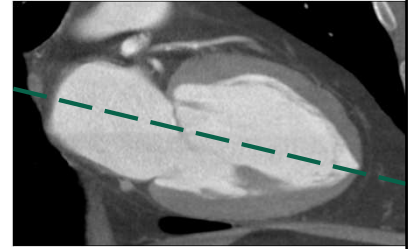
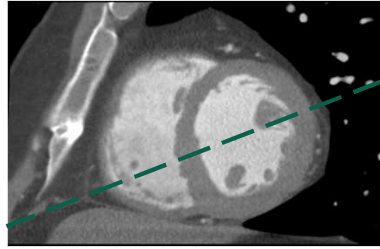
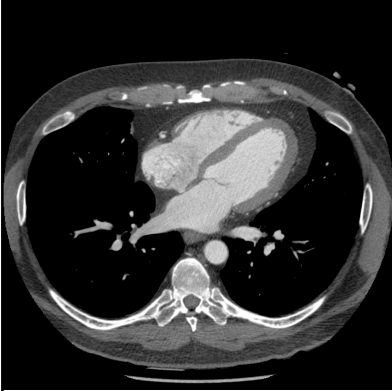
Loc eixo cur



132



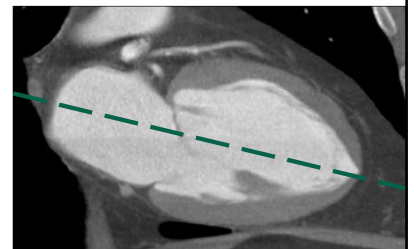
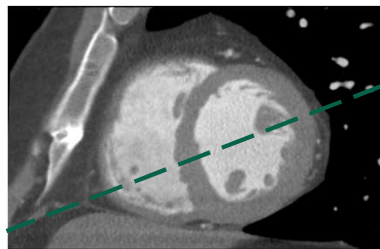
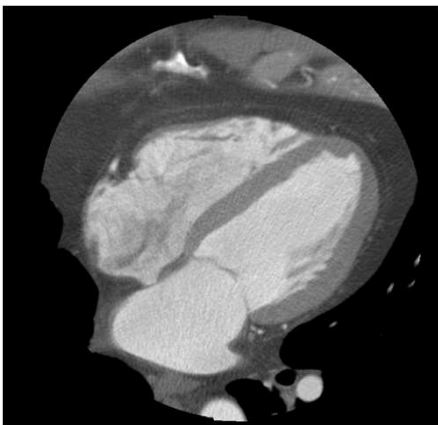
4 câmaras (4C)



133



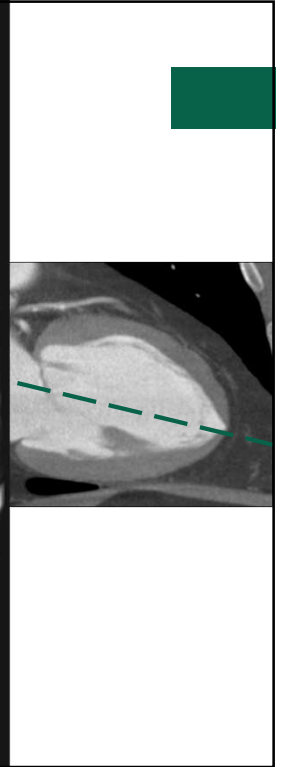
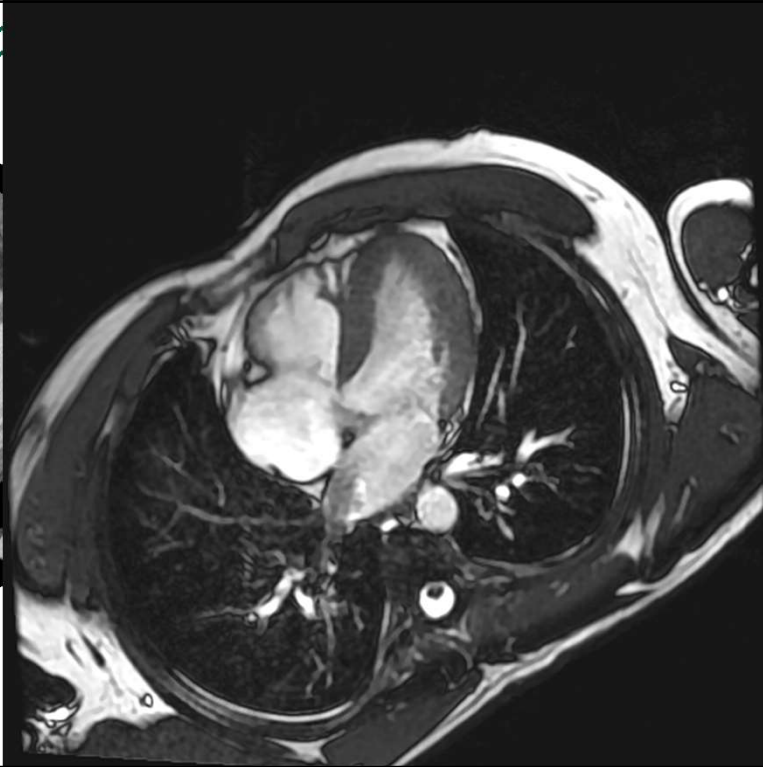
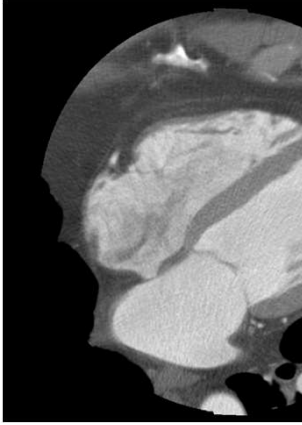
4 câmaras (4C)



134



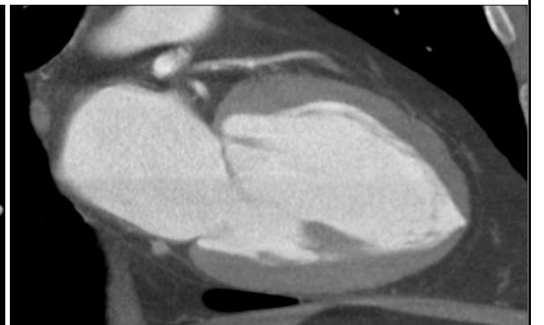
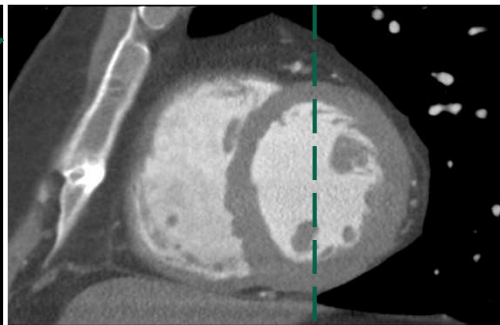
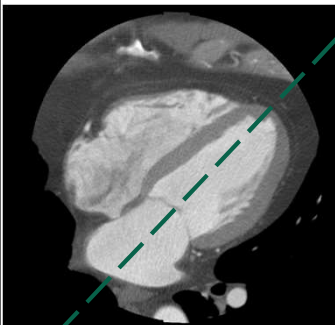
4 câmaras (4C)



135



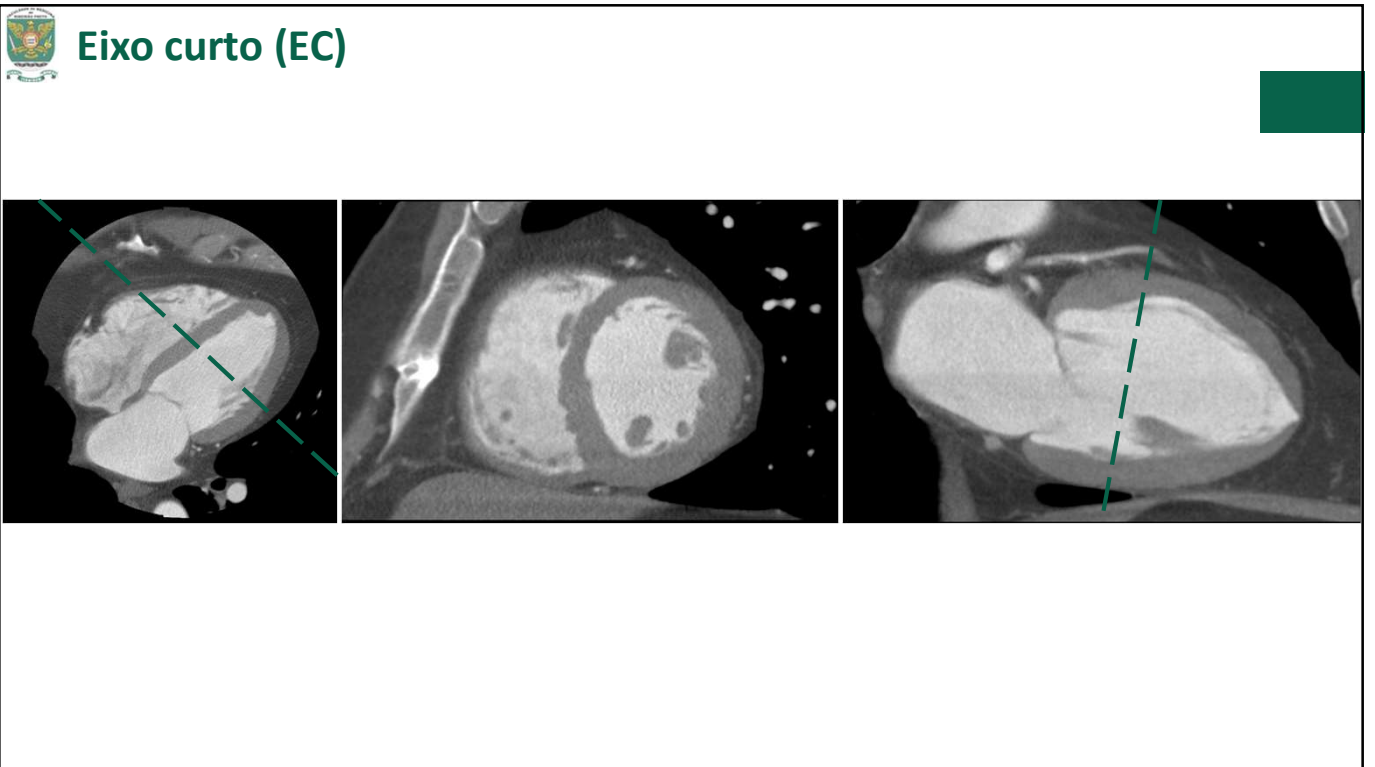
Eixo longo do ventrículo esquerdo (ELVE)



136



137



138



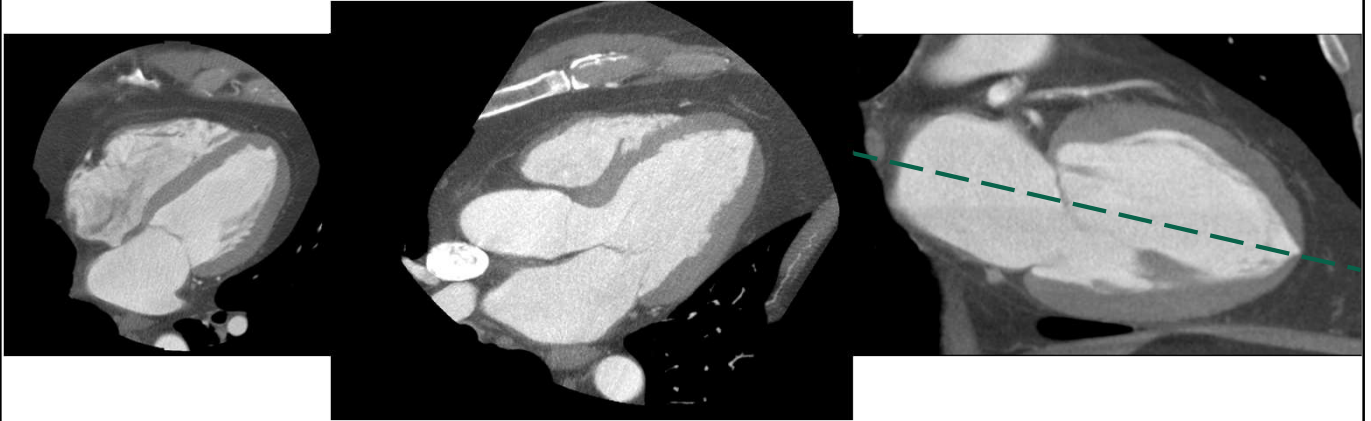
139



140



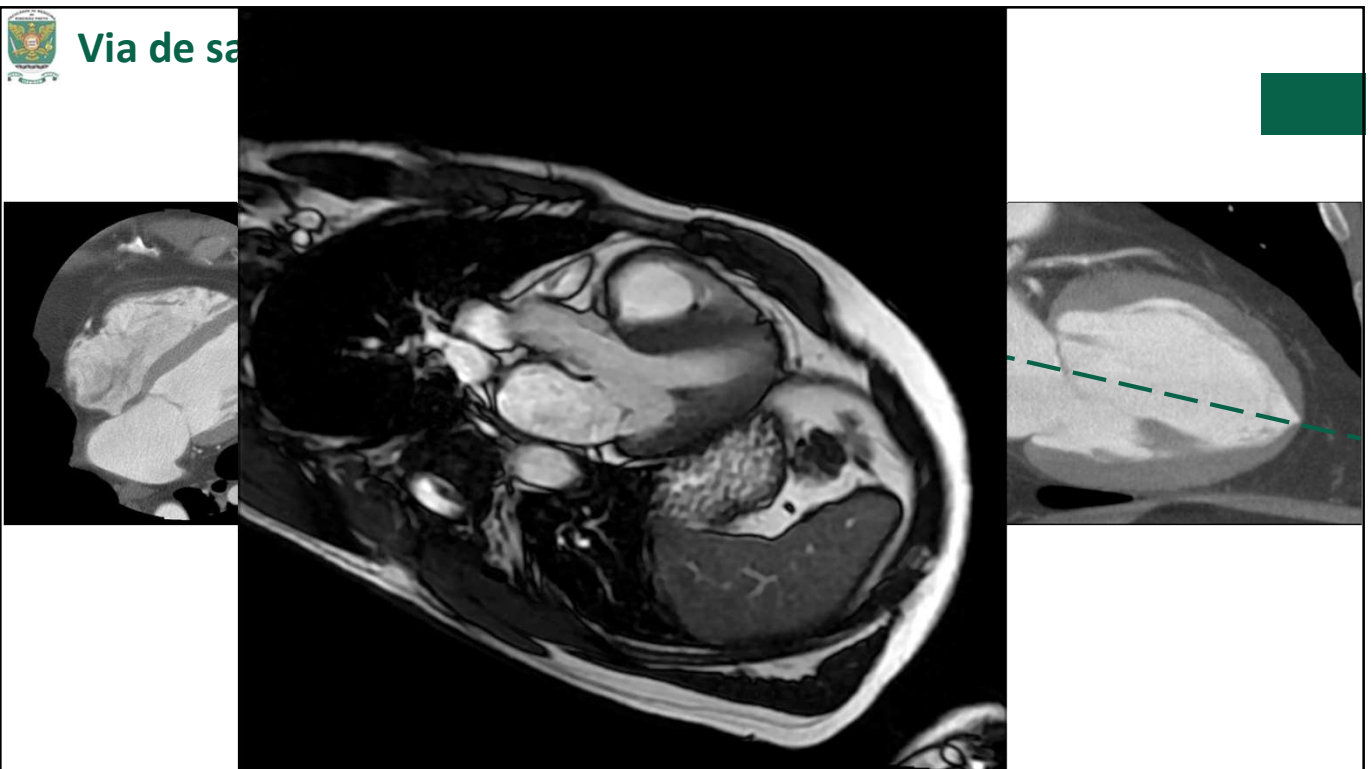
Via de saída do ventrículo esquerdo (VSVE)



141



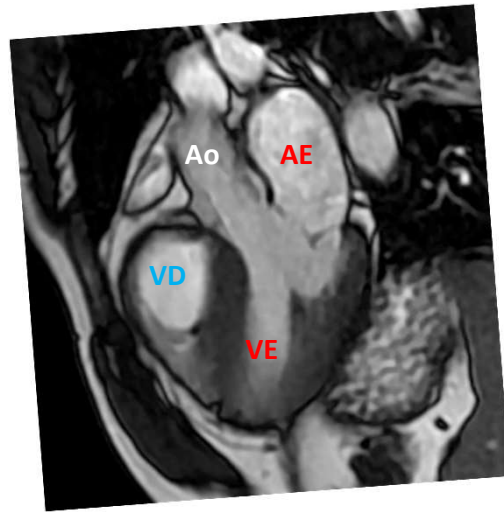
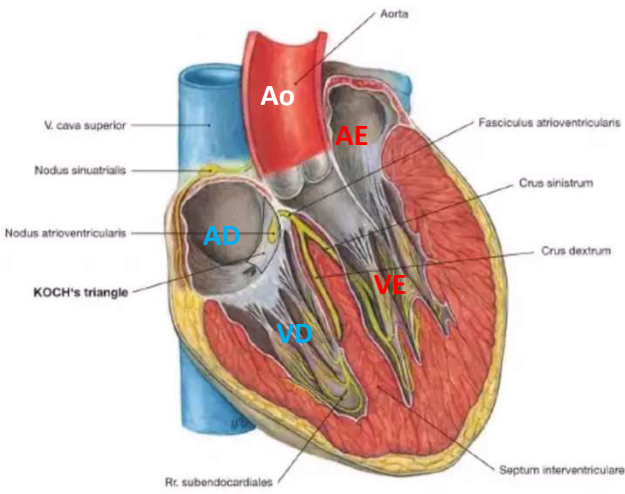
Via de sa



142



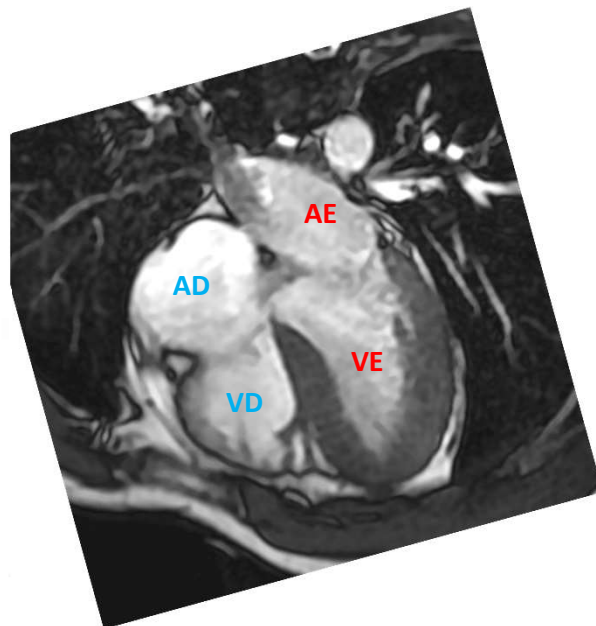
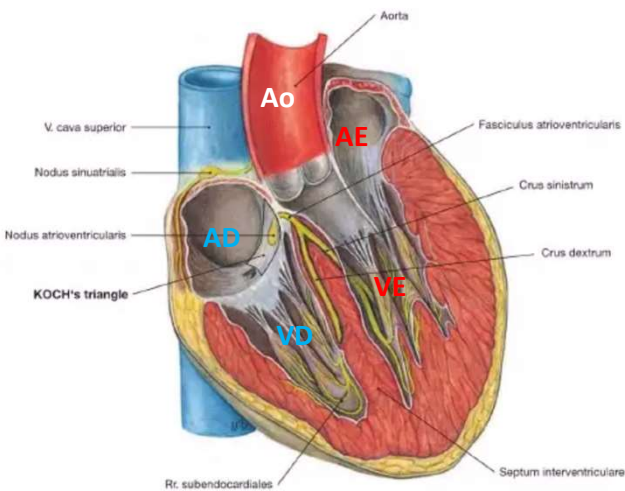
Coração



Paulsen Friedrich and J Waschke. 2011. Sobotta Atlas of Human Anatomy 15th edition English version. Munich: Elsevier.



Coração



Paulsen Friedrich and J Waschke. 2011. Sobotta Atlas of Human Anatomy 15th edition English version. Munich: Elsevier.

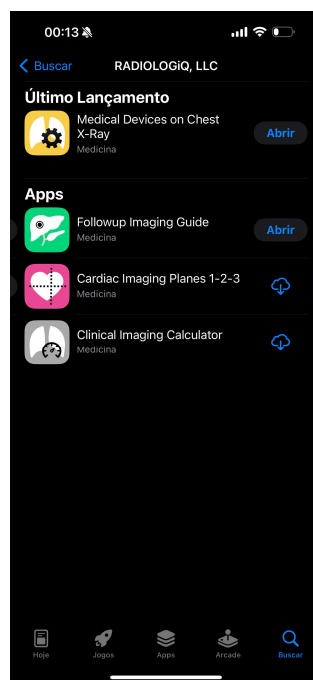
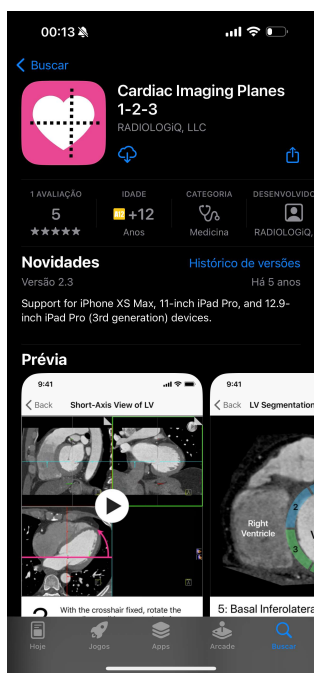


Atividade extra

145



Planos cardíacos



RADIOLOGIQ, LLC

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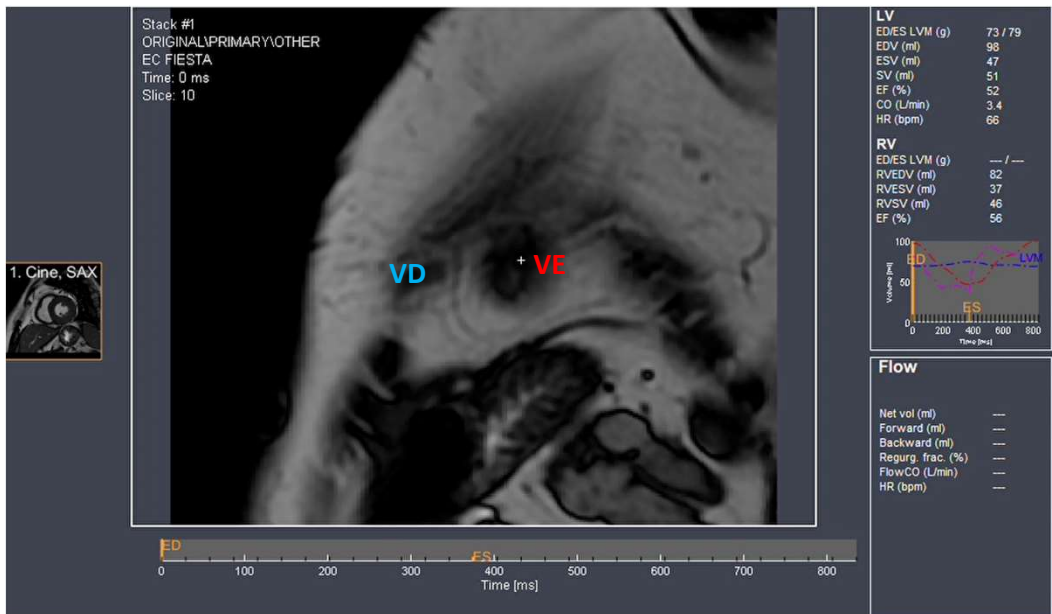


Segmentação

147



Coração



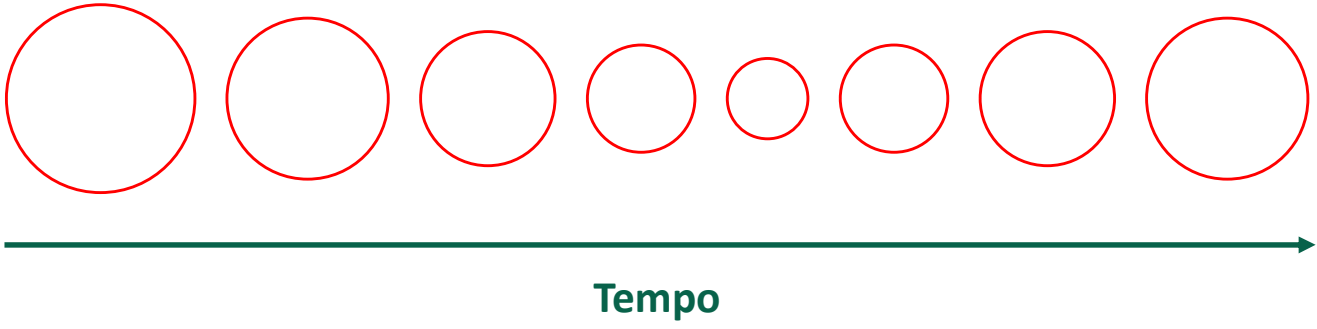
Paulsen Friedrich and J Waschke. 2011. Sobotta Atlas of Human Anatomy 15th edition English version. Munich: Elsevier.

148



Coração

Contorno endocárdico do VE

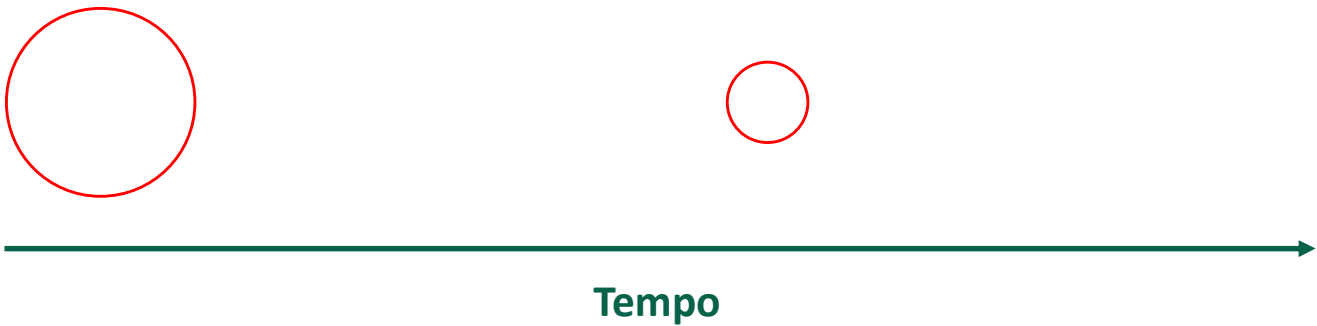


149



Coração

Contorno endocárdico do VE

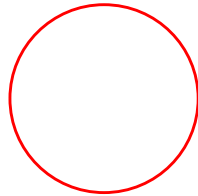


150



Coração

Contorno endocárdico do VE



Diástole



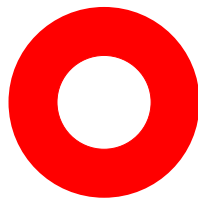
Sístole

151



Coração

Contorno endocárdico do VE



Diástole



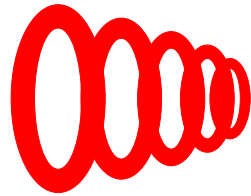
Sístole

152



Coração

Contorno endocárdico do VE



Volume diastólico
final do VE



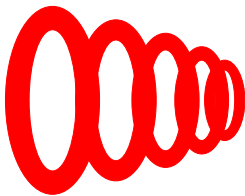
Volume sistólico
final do VE

153



Coração

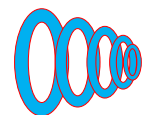
Contorno endocárdico do VE



Volume diastólico
final do VE



Volume sistólico
final do VE



Volume
sistólico do VE

-

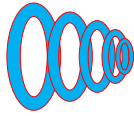
=

154



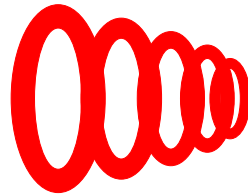
Coração

Contorno endocárdico do VE



**Volume
sistólico do VE**

-



**Volume diastólico
final do VE**

=

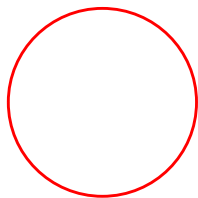
**Fração de ejeção
do VE (FEVE%)**

155



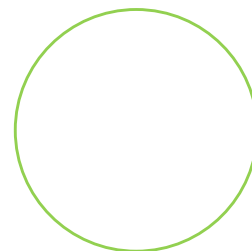
Coração

Contorno endocárdico do VE



Diástole

Contorno epicárdico do VE



Diástole

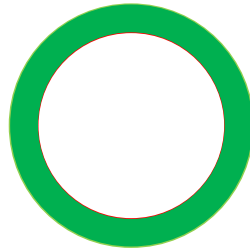
156



Coração

Contorno endocárdico do VE

Contorno epicárdico do VE



Diástole

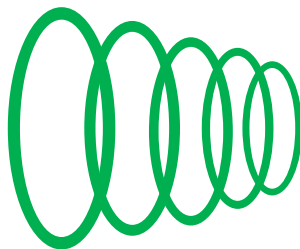
Diástole

157



Coração

Volume miocárdico do VE



Densidade
miocárdio:
1,05 g/ml

Diástole

158

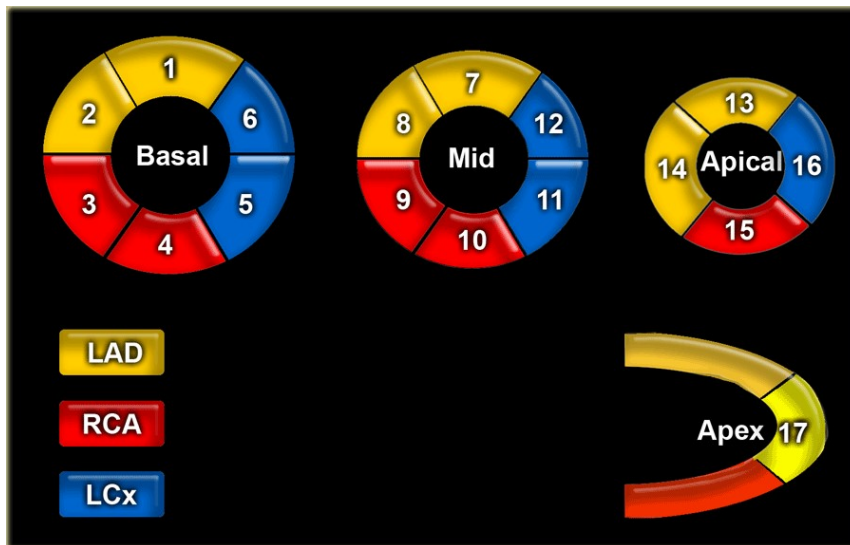


Anatomia miocárdica

159



Segmentos

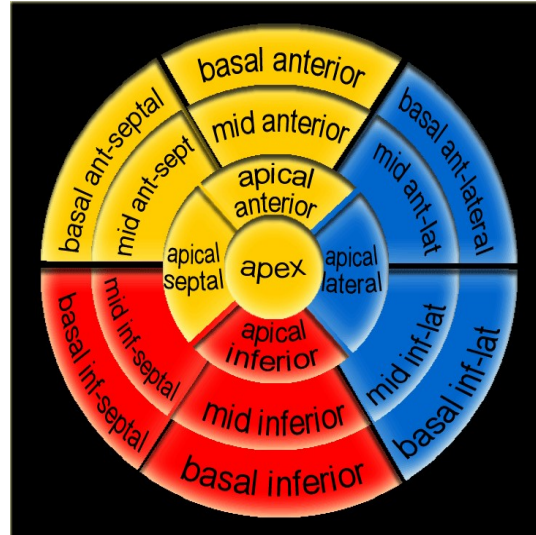


Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cardiomyopathy/ischemic-and-non-ischemic-cardiomyopathy> (acesso em 18/02/2024)

160



Segmentos



Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cardiomyopathy/ischemic-and-non-ischemic-cardiomyopathy> (acesso em 18/02/2024)

161

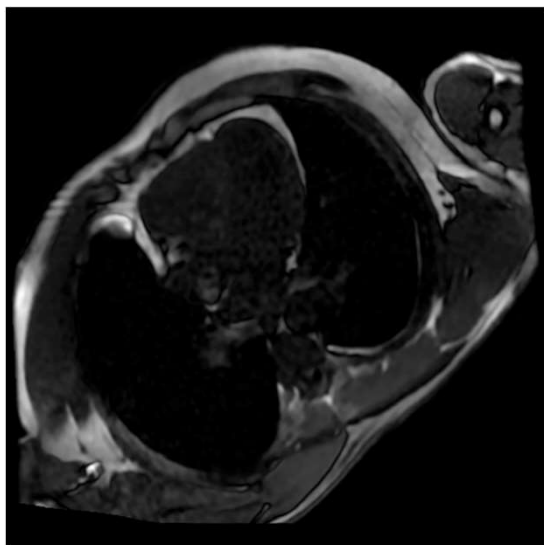


Avaliação perfusão

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Perfusão miocárdica



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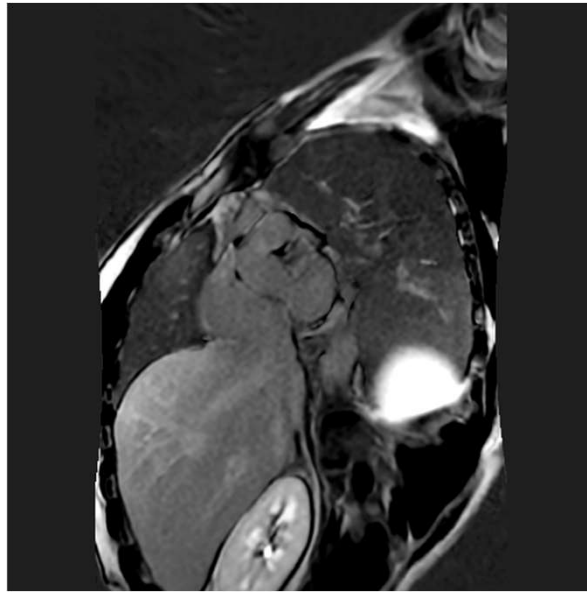


Avaliação realce tardio

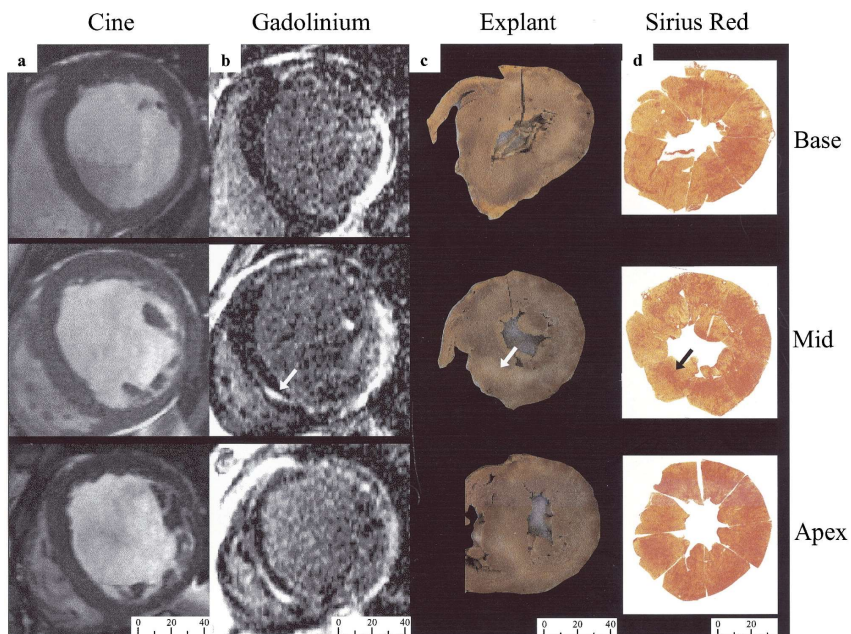
164



Realce tardio



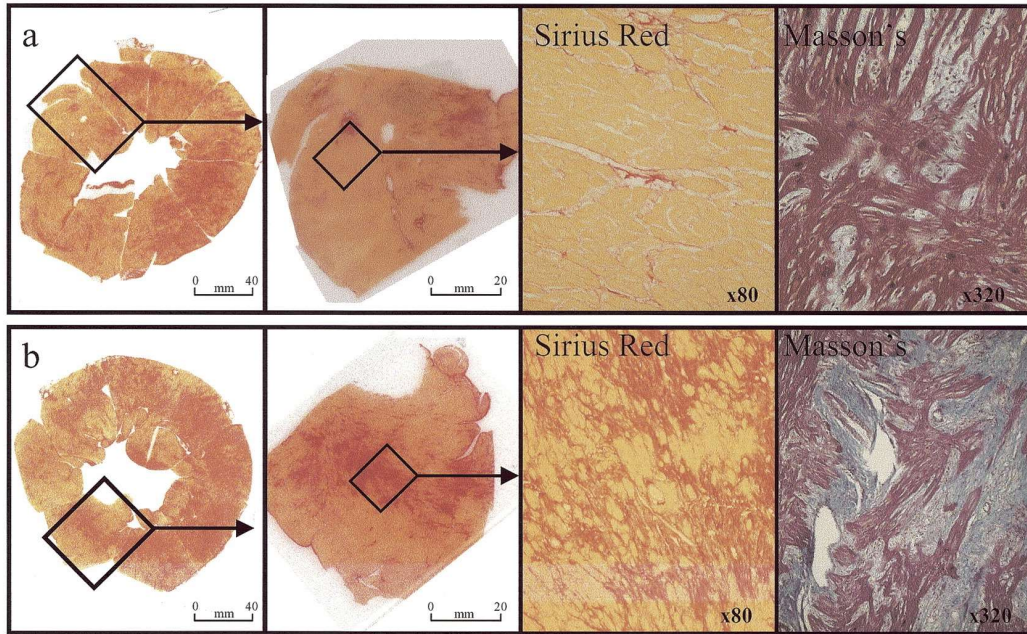
Realce tardio



Moon JC, Reed E, Sheppard MN, Elkington AG, Ho SY, Burke M, Petrou M, Pennell DJ. The histologic basis of late gadolinium enhancement cardiovascular magnetic resonance in hypertrophic cardiomyopathy. *J Am Coll Cardiol.* 2004 Jun 16;43(12):2260-4. doi: 10.1016/j.jacc.2004.03.035. PMID: 15193690.



Realce tardio

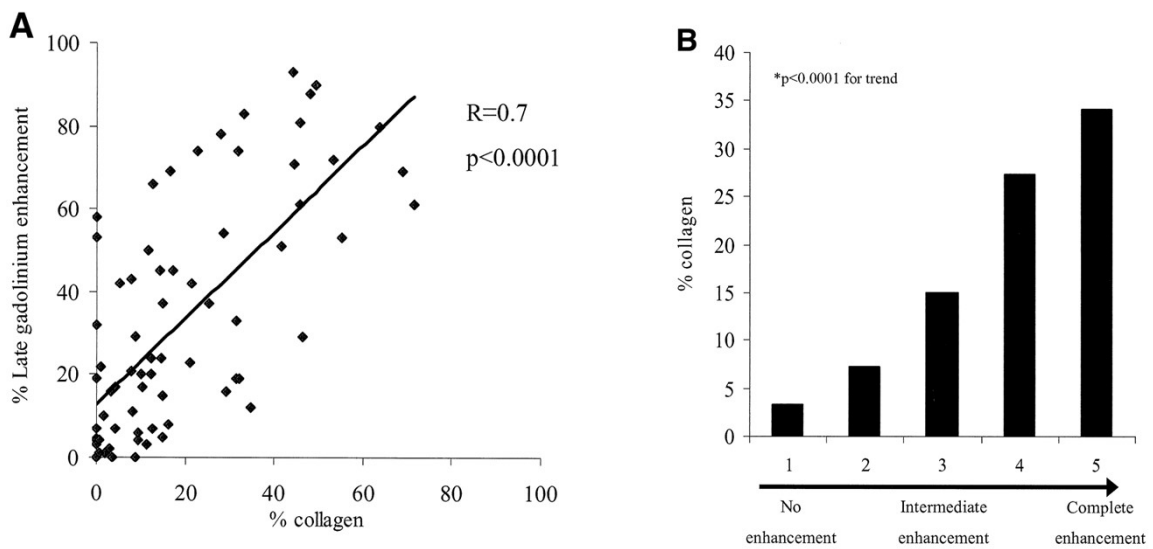


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167



Realce tardio

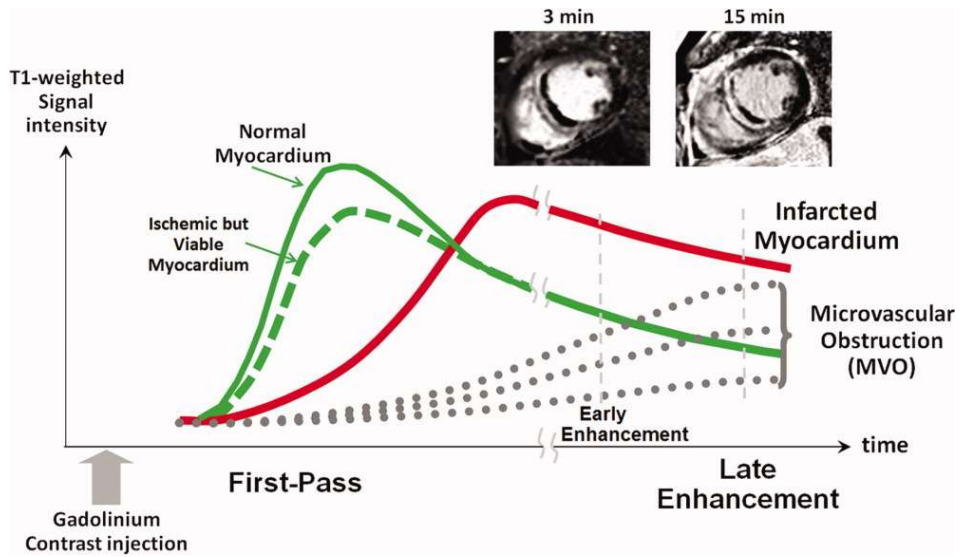


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Realce tardio

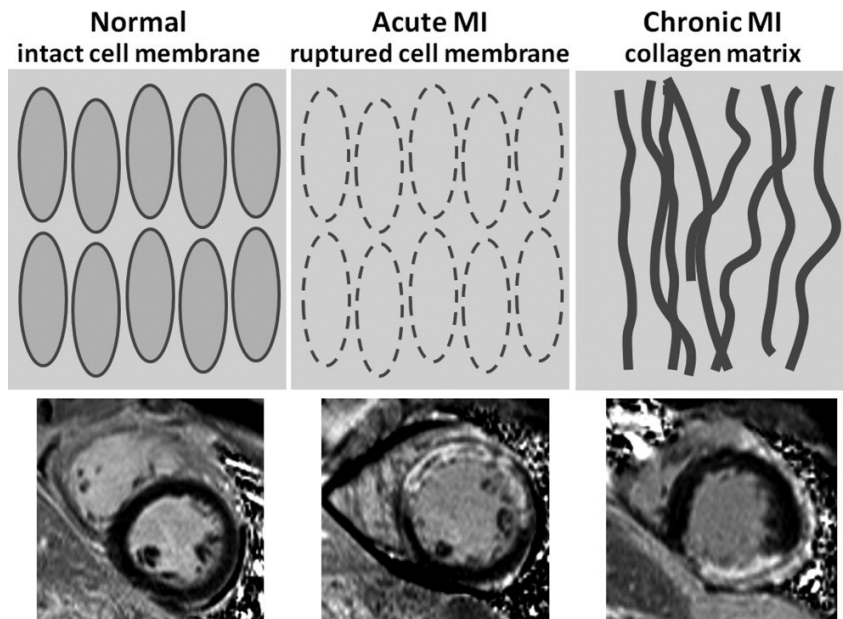


Kellman P, Arai AE. Cardiac imaging techniques for physicians: late enhancement. *J Magn Reson Imaging*. 2012 Sep;36(3):529-42. doi: 10.1002/jmri.23605. PMID: 22903654; PMCID: PMC3428749.

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Realce tardio

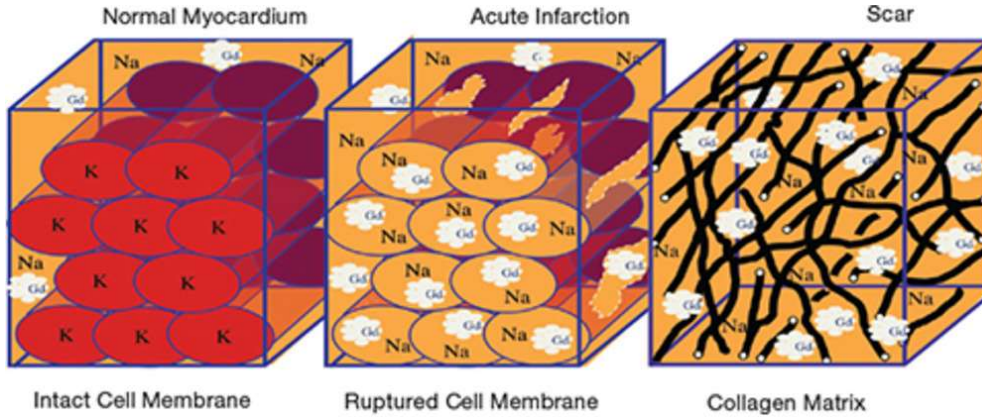


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Realce tardio

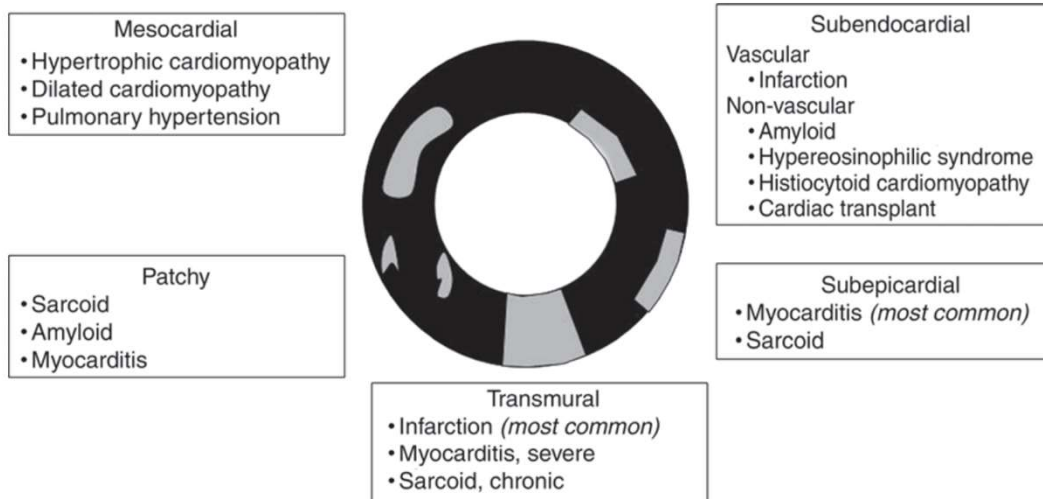


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Realce tardio

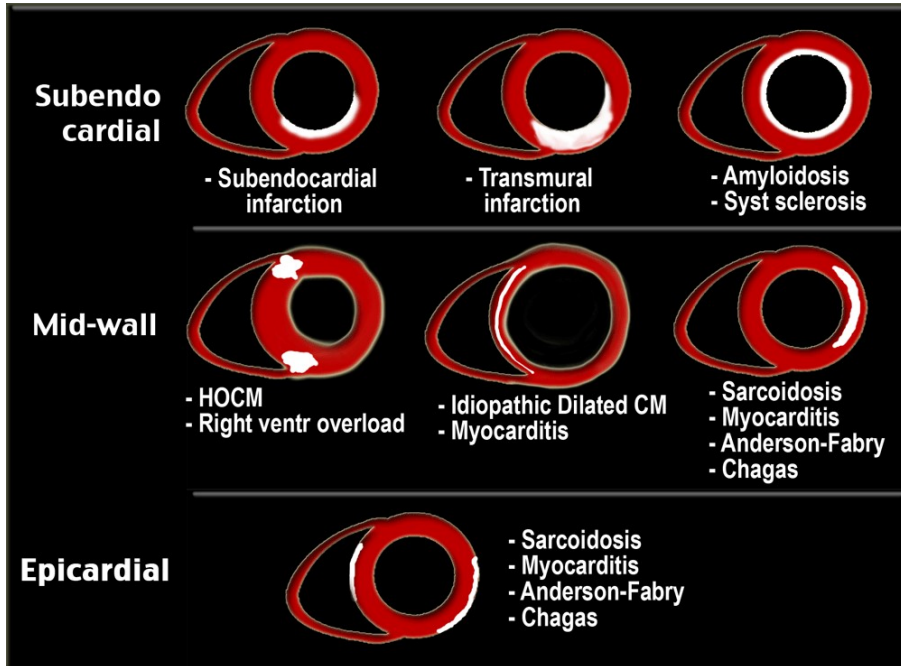


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Segmentos

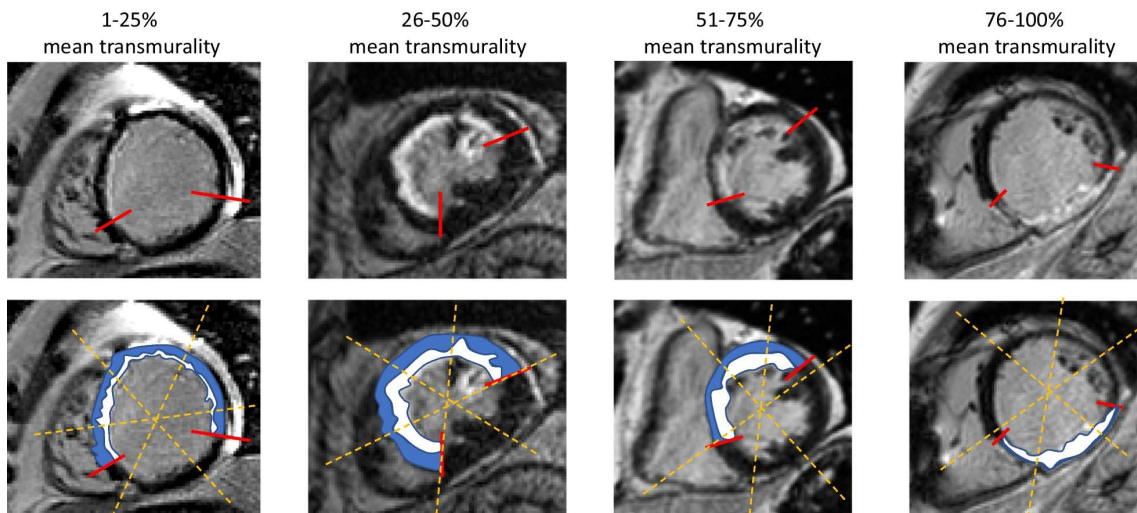


Radiology Assistant. Web site disponível em <https://radiologyassistant.nl/cardiovascular/cardiomyopathy/ischemic-and-non-ischemic-cardiomyopathy> (acesso em 18/02/2024)

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Realce tardio



Increasing likelihood of improved contractile function with revascularization



Jenista ER, Wendell DC, Azevedo CF, Klem I, Judd RM, Kim RJ, Kim HW. Revisiting how we perform late gadolinium enhancement CMR: insights gleaned over 25 years of clinical practice. J Cardiovasc Magn Reson. 2023 Mar 16;25(1):18. doi: 10.1186/s12968-023-00925-0. PMID: 36922844; PMCID: PMC10018965.

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Questionário 1

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Referências para estudo

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Radiology Assistant Abdomen Breast Cardiovascular Chest Head/Neck Musculoskeletal Neuroradiology Pediatrics More Q

Coronary anatomy and anomalies

Robin Smithuis and Tineke Willems
Radiology department of the Rijnland Hospital Leiderdorp and the University Medical Centre Groningen, the Netherlands.

Publicationdate 2008-10-14

In this article we describe the anatomy of the coronary arteries of the heart and some of the anomalies with illustrations and CT-images. This article is an update of an article that appeared earlier in *the Radiology Assistant*.

- Overview
- Left Coronary Artery (LCA)
- Left Anterior Descending (LAD)
- Circumflex (Cx)
- Right Coronary Artery (RCA)
- Coronary Anomalies
 - Interarterial LCA
 - ALCAPA
 - Myocardial bridging
 - Fistula

<https://radiologyassistant.nl/cardiovascular/anatomy/coronary-anatomy-and-anomalies>



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Radiology Assistant Abdomen Breast Cardiovascular Chest Head/Neck Musculoskeletal Neuroradiology Pediatrics More Q

Coronary Artery Disease-Reporting and Data System 2.0

Examples for the different Cad-Rads categories

Silla Celeng, Richard Takx, Robin Smithuis and Tim Leiner
University Medical Center Utrecht, Amsterdam University Medical Center, Mayo Clinic, Rochester, USA and Alrijne hospital Leiden

Publicationdate Update 2023-05-05

CAD-RADS is the Coronary Artery Disease-Reporting and Data System. CAD-RADS is developed to standardize reporting of coronary CTA, to improve communication and to guide therapy. The original article was published in 2016 by the Society of Cardiovascular Computed Tomography (SCCT), the American College of Radiology (ACR) and the North American Society for Cardiovascular Imaging (NASCI) and it has been endorsed by the American College of Cardiology (ACC)(1).

CAD RADS 2.0
In 2022 CAD RADS was updated to version 2.0 (2). Similar to the original CAD-RADS version, stenosis severity determines the CAD-RADS score (from 0 to 5). New in the current version is the incorporation of plaque burden (from P1 to P4) and an update of the modifiers.

- Understanding Chest pain
 - Stable angina
 - Unstable angina
 - NSTEMI
 - STEMI
- Target population for coronary CTA
- CAD-RADS
 - Assessment of stenosis degree
 - P1-Overall plaque burden sub-classification
- Cad-Rads Modifiers
 - Modifier N - nondiagnostic
 - Modifier HSP - high-risk plaque
 - Modifier I - ischemia
 - Modifier S - stent
 - Modifier G - graft
 - Modifier S - stents/pops
- CTA features of stable and high risk plaque
 - Low-attenuation plaque
 - Plaque remodeling
 - Spotty calcification
 - Nipkowring sign
- Coronary CTA protocol
- Extra cardiac findings
- Examples
 - Case 1 - CAD-RADS 2P1
 - Case 2 - CAD-RADS 5P2S
 - Case 3 - Calcium score 0 and severe stenosis.
 - Case 4 - CAD-RADS 3P1P4 - thrombus left ventricle
 - Case 5 - CTA overestimates stenosis due to calcium

<https://radiologyassistant.nl/cardiovascular/cad-rads/coronary-artery-disease-reporting-and-data-system>



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Radiology Assistant Abdomen Breast Cardiovascular Chest Head/Neck Musculoskeletal Neuroradiology Pediatrics More Q

Ischemic and non-ischemic cardiomyopathy

Wouter van Es, Hans van Heeswijk, Benno Rensing, Jan van der Heijden and Robin Smithuis
Radiology and Cardiology department of the St. Antonius Hospital in Nieuwegein and the Rijnland hospital in Leiderdorp, the Netherlands

Introduction

- 17 segments model
- Enhancement patterns
- Ischemic versus non-ischemic

Ischemic Cardiomyopathy

- Infarction and delayed enhancement
- No reflow phenomenon
- Stunning
- Hibernation

Non Ischemic cardiomyopathy

- Hypertrophic cardiomyopathy
- Restrictive cardiomyopathy - Amyloidosis
- Constrictive cardiomyopathy
- Dilated cardiomyopathy
- ATAC
- Myocarditis
- Tako-Tsubo cardiomyopathy

Publicationdate 2009-11-12

In this presentation we will discuss the MRI features of ischemic cardiomyopathy and non-ischemic cardiomyopathies and the role of late enhancement imaging in differentiating between the various types of cardiomyopathy.

Images can be enlarged by clicking on them.
If a video doesn't work, just click the stop button and then the play button once more.
For proper printing you may have to adjust the print settings of your internet browser.

<https://radiologyassistant.nl/cardiovascular/cardiomyopathy/ischemic-and-non-ischemic-cardiomyopathy>



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Journal of Cardiovascular Computed Tomography (2009) 3, 122-136

Journal of
Cardiovascular
Computed Tomography

Guidelines

SCCT guidelines for the interpretation and reporting of coronary computed tomographic angiography

Gilbert L. Raff, MD*, Chair, Aiden Abidov, MD, PhD, Stephan Achenbach, MD, Daniel S. Berman, MD, Lawrence M. Boxt, MD, Matthew J. Budoff, MD, Victor Cheng, MD, Tony DeFrance, MD, Jeffrey C. Hellinger, MD, Ronald P. Karlsberg, MD

Society of Cardiovascular Computed Tomography, 2400 N Street NW, Washington, DC 20037, USA

[https://www.journalofcardiovascularct.com/article/S1934-5925\(09\)00070-7/fulltext](https://www.journalofcardiovascularct.com/article/S1934-5925(09)00070-7/fulltext)



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