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A TC Cardíaca tem um papel no doente com IC ?



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Que papel para a TC na Ins. Cardíaca?

Excluir Doença Coronária...



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Que papel para a TC na Ins. Cardíaca?

Excluir Doença Coronária...

Que mais poderá oferecer ?



Critérios de Apropriação de TC 2010

Ins. Cardíaca “de novo” sem DC documentada

Detection of CAD in Other Clinical Scenarios—New-Onset or Newly Diagnosed Clinical HF and No Prior CAD

• Reduced left ventricular ejection fraction • Low pretest probability of CAD	A (7)
• Reduced left ventricular ejection fraction • Intermediate pretest probability of CAD	A (7)

Avaliação de função e morfologia ventricular

Evaluation of Cardiac Structure and Function—Evaluation of Ventricular Morphology and Systolic Function

• Evaluation of left ventricular function • Following acute MI or in HF patients • Inadequate images from other noninvasive methods	A (7)
• Quantitative evaluation of right ventricular function	A (7)
• Assessment of right ventricular morphology • Suspected arrhythmogenic right ventricular dysplasia	A (7)

• Suspected arrhythmogenic right ventricular dysplasia • Assessment of right ventricular morphology	A (7)
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Critérios de Apropriação de TC 2010

Avaliação de estruturas intra e extra cardíacas

Evaluation of Cardiac Structure and Function—Evaluation of Intra- and Extracardiac Structures

• Characterization of native cardiac valves • Suspected clinically significant valvular dysfunction • Inadequate images from other noninvasive methods	A (8)
• Characterization of prosthetic cardiac valves • Suspected clinically significant valvular dysfunction • Inadequate images from other noninvasive methods	A (8)
• Evaluation of cardiac mass (suspected tumor or thrombus) • Inadequate images from other noninvasive methods	A (8)
• Evaluation of pericardial anatomy	A (8)
• Evaluation of pulmonary vein anatomy • Prior to radiofrequency ablation for atrial fibrillation	A (8)
• Noninvasive coronary vein mapping • Prior to placement of biventricular pacemaker	A (8)
• Localization of coronary bypass grafts and other retrosternal anatomy • Prior to reoperative chest or cardiac surgery	A (8)
• Prior to reoperative chest or cardiac surgery • Localization of coronary bypass grafts and other retrosternal anatomy • Prior to placement of biventricular pacemaker	A (8)



Critérios de Apropriação de TC 2010

Avaliação

Cardíacas

- Characterization of native cardiac valves
- Suspected clinically significant valvular dysfunction
- Inadequate images from other noninvasive methods
- Characterization of prosthetic cardiac valves
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Evaluation of Cardiac

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- Evaluation of pericardial anatomy
- Evaluation of pulmonary vein anatomy
- Prior to radiofrequency ablation for atrial fibrillation
- Noninvasive coronary vein mapping
- Prior to placement of biventricular pacemaker
- Localization of coronary bypass grafts and other retrosternal anatomy
- Prior to reoperative chest or cardiac surgery

A (8)

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Critérios de Apropriação de TC 2010

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• Evaluation of pericardial anatomy

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Critérios de Apropriação de TC 2010

Avaliação

Cardíacas

Evaluation of Cardiac

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- Suspected clinically significant valvular dysfunction
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- Evaluation of cardiac mass (suspected tumor or thrombus)
- Inadequate images from other noninvasive methods

- Evaluation of pericardial anatomy

- Evaluation of pulmonary anatomy

- Prior to radiofrequency ablation

- Noninvasive coronary artery imaging

- Prior to placement of biventricular pacemaker

- Localization of coronary bypass grafts and other retrosternal anatomy

- Prior to reoperative chest or cardiac surgery

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- Noninvasive coronary vein mapping

- Prior to placement of biventricular pacemaker

A (8)

A (8)

A (8)

A (8)

A (8)

A (8)

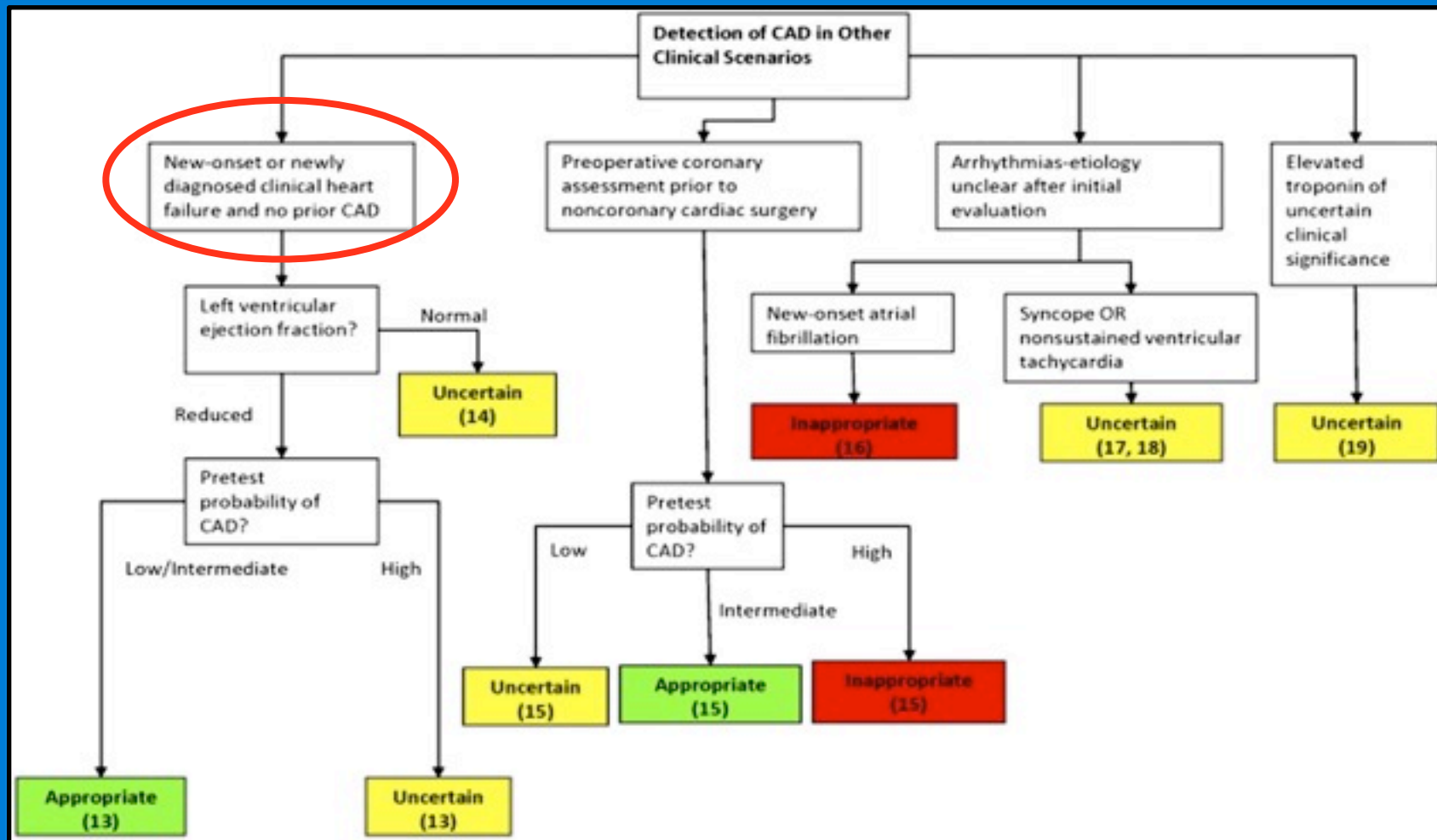
A (8)

A (8)



Critérios de Apropriação 2010

Detecção de DC em doentes com IC “de novo”



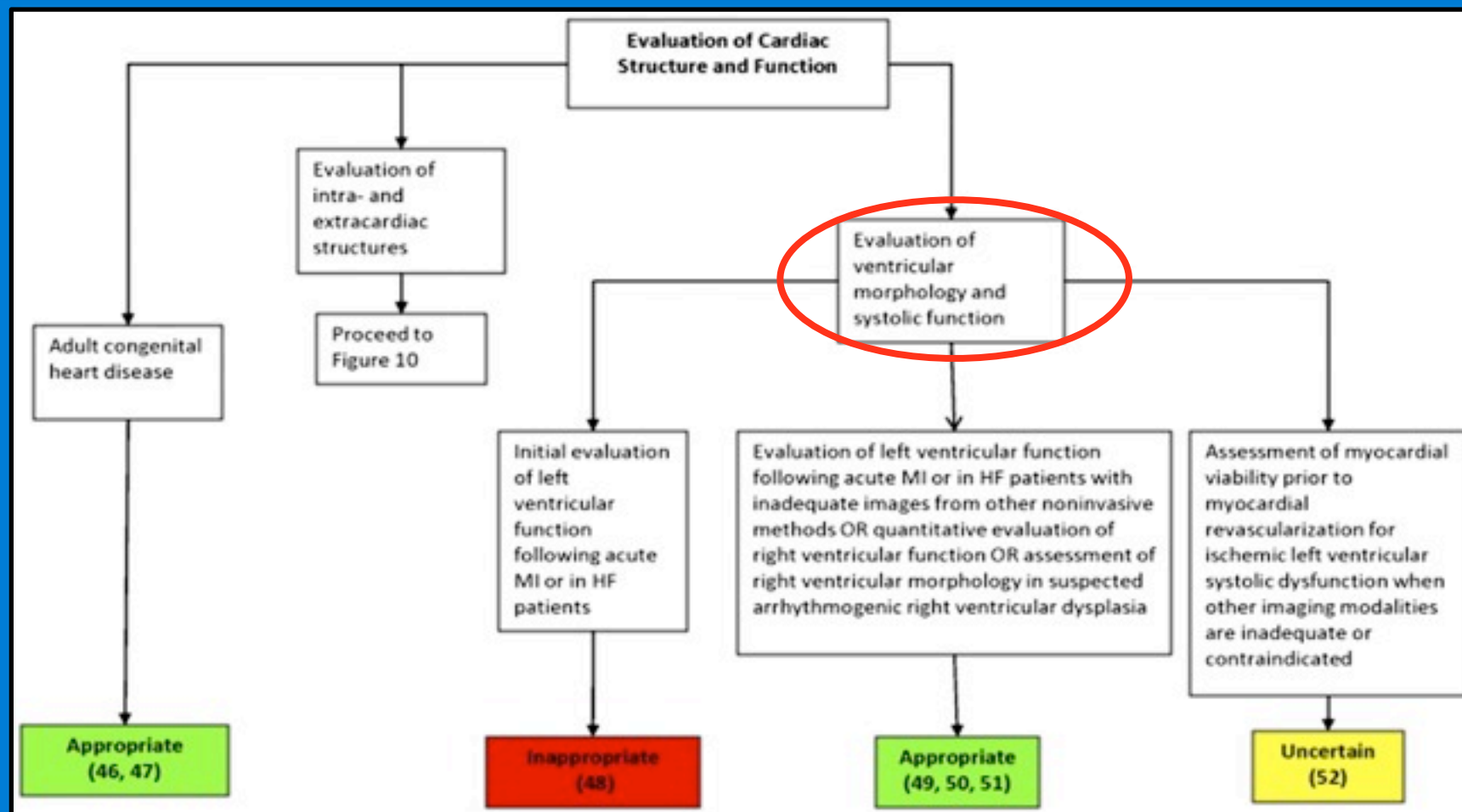
ACCF Appropriate Use Criteria Task Force, Taylor AJ et al
JACC 2010; 56: 1864-94





Critérios de Apropriação 2010

Avaliação de função e morfologia cardíacas



ACCF Appropriate Use Criteria Task Force, Taylor AJ et al
JACC 2010; 56: 1864-94



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Que papel para a TC na Insuf. Cardíaca?



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Que papel para a TC na Insuf. Cardíaca?

 ***Exclusão de DC não documentada***

Que papel para a TC na Insuf. Cardíaca?

- *Exclusão de DC não documentada*
- *Avaliação da função VE em doentes que não conseguiram obter informação por outros métodos*

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 - *Fístulas*

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- *Anomalias coronárias*
 - *Emergência anómala*
 - *Fístulas*
- *Pericardite constrictiva*



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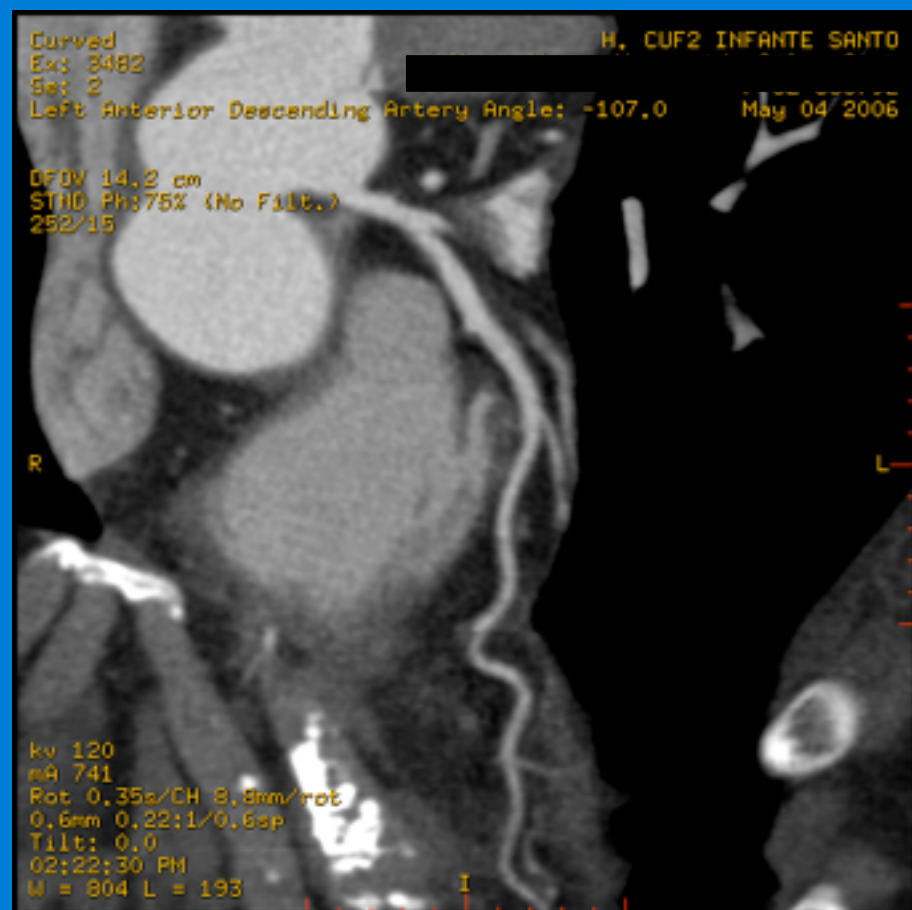
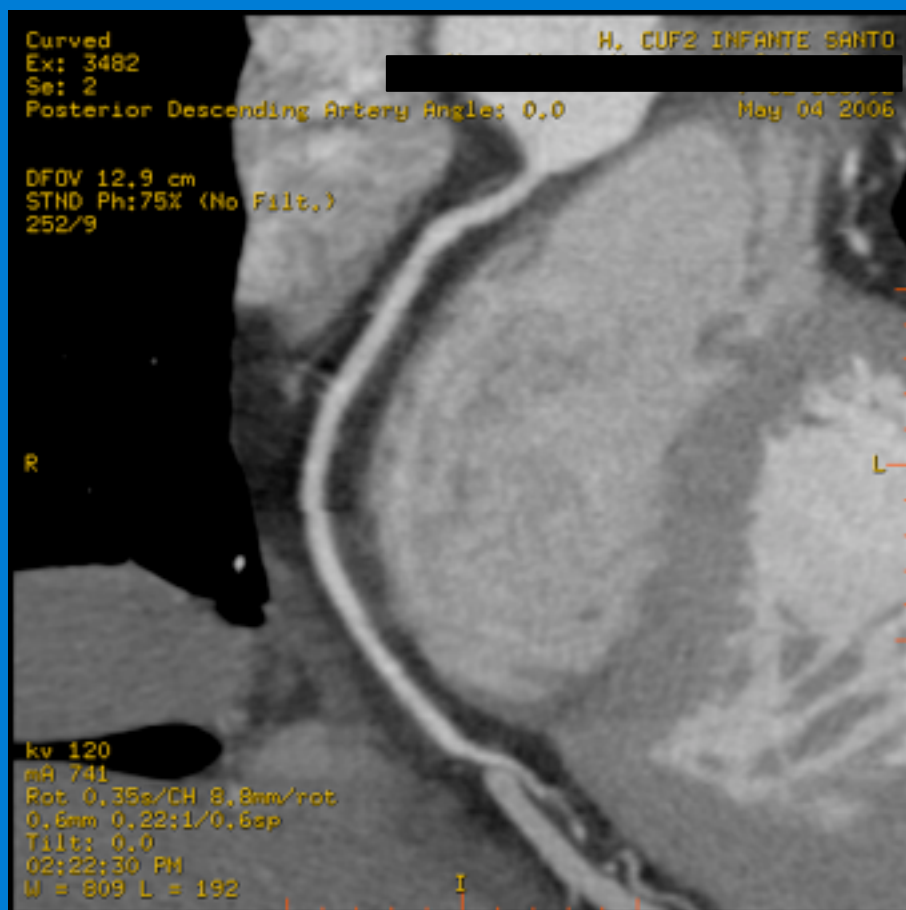
Que papel para a TC na Insuf. Cardíaca?

Exclusão e avaliação de Doença Coronária



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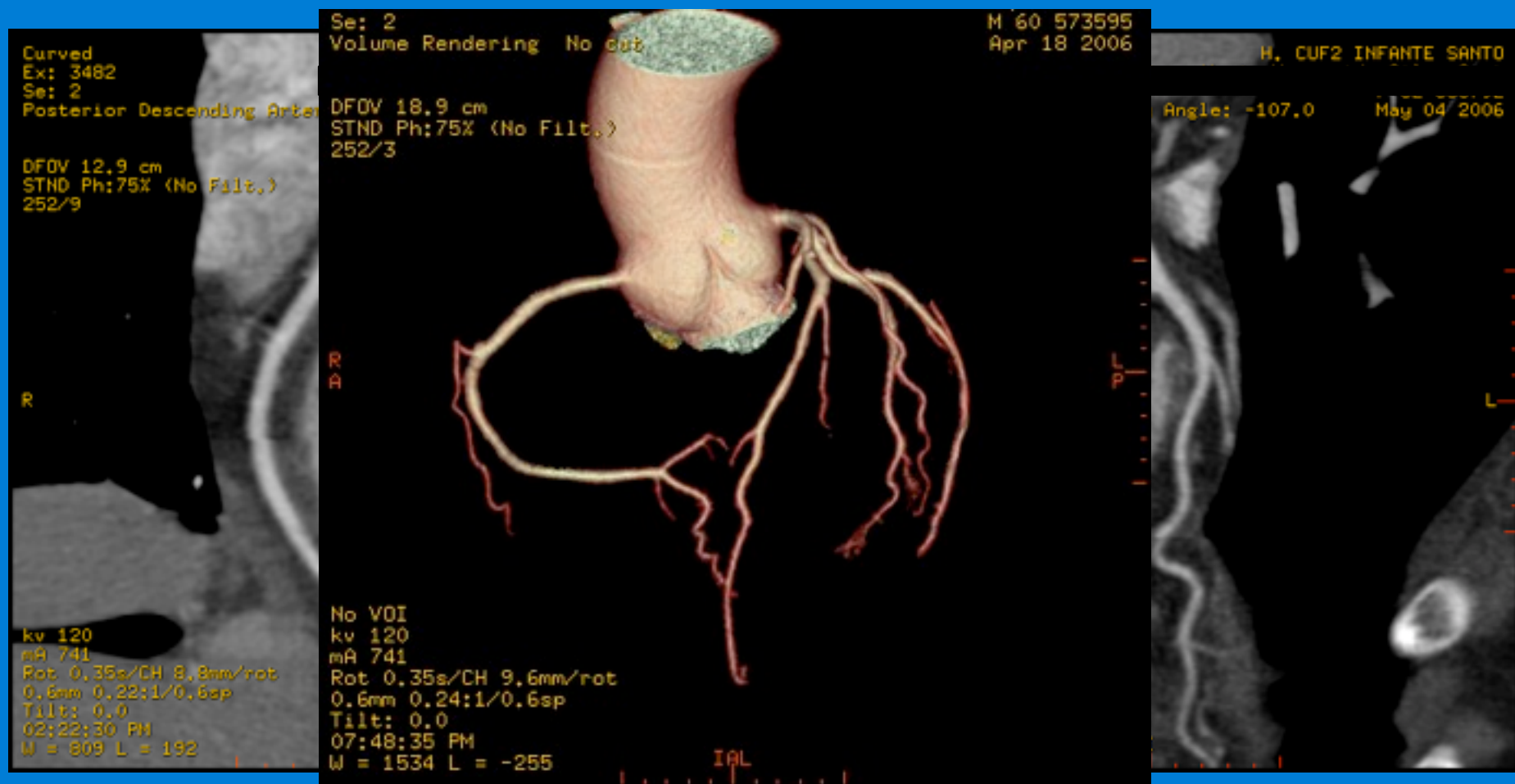
Excluir doença coronária





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Excluir doença coronária





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Angio TC Coronária

Comparação com a coronariografia

ACCURACY Trial

230 doentes
Prevalência DC 25%

Per Patient Analysis

Lesion Grade	Parameters	%	# of subjects by ICA	# of subjects by CCTA
≥50%	Sensitivity	93	55	51
	Specificity	82	174	143
	PPV	62	82	51
	NPV	97	147	143
≥70%	Sensitivity	91	34	31
	Specificity	84	195	163
	PPV	49	63	31
	NPV	98	166	163

≤10%	IBL	38	100	103
	BBL	13	23	31
	Specificity	84	182	183
	NPV	91	171	171

Per Vessel Analysis

Lesion Grade	Parameters	%	# vessels by ICA	# vessels by CCTA
≥50%	Sensitivity	84	88	74
	Specificity	91	824	752
	PPV	51	146	74
	NPV	98	766	752
≥70%	Sensitivity	85	39	33
	Specificity	92	873	805
	PPV	33	101	33
	NPV	99	811	805

≤10%	IBL	23	811	802
	BBL	23	101	33
	Specificity	85	813	802
	NPV	82	78	77

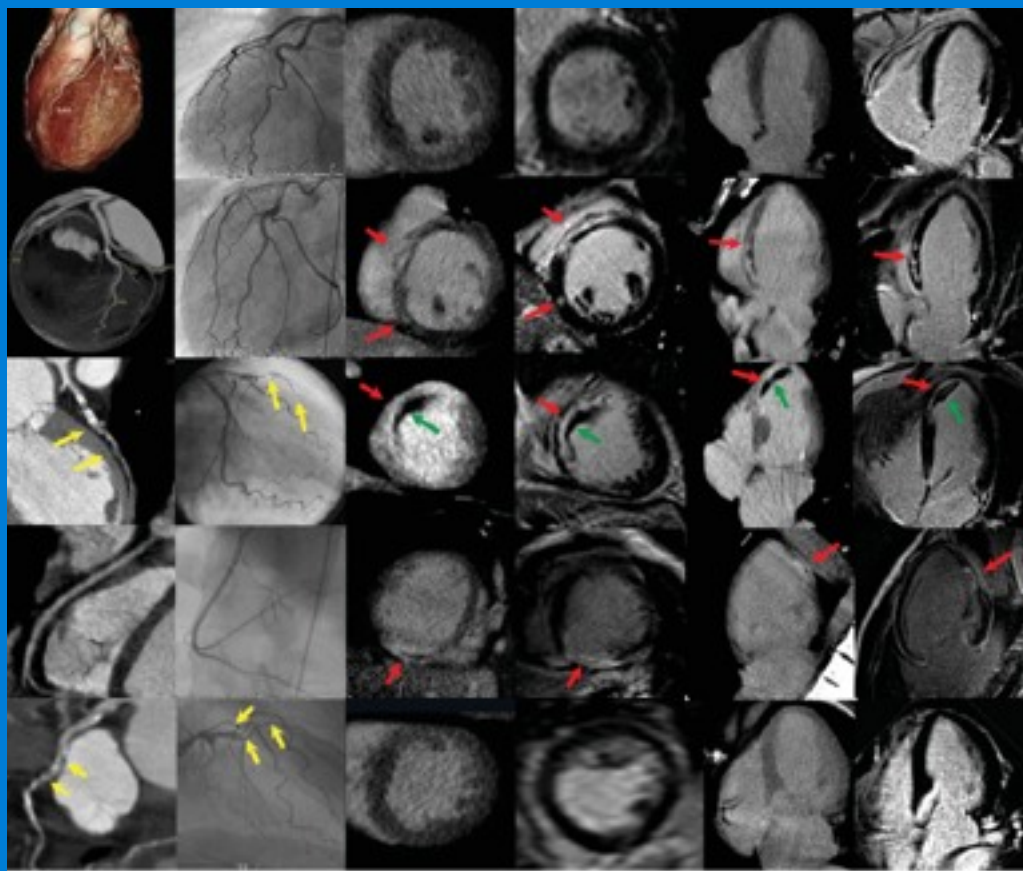
Budoff MJ et al
JACC 2008; 52: 1724-32



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Angio TC Coronária

Comparação com a RM e CAT



Coronary angiography and LGE-CMR

	Group 1	Group 2	Group 3	Group 4	Total
MDCT					
Group 1	24	1	0	1	26
Group 2	0	33	1	0	34
Group 3	0	1	3	0	4
Group 4	0	1	0	6	7
Total	24	36	4	7	71

MDCT

	Group 1	Group 2	Group 3	Group 4	Total
Group 1	24	1	0	1	26
Group 2	0	33	1	0	34
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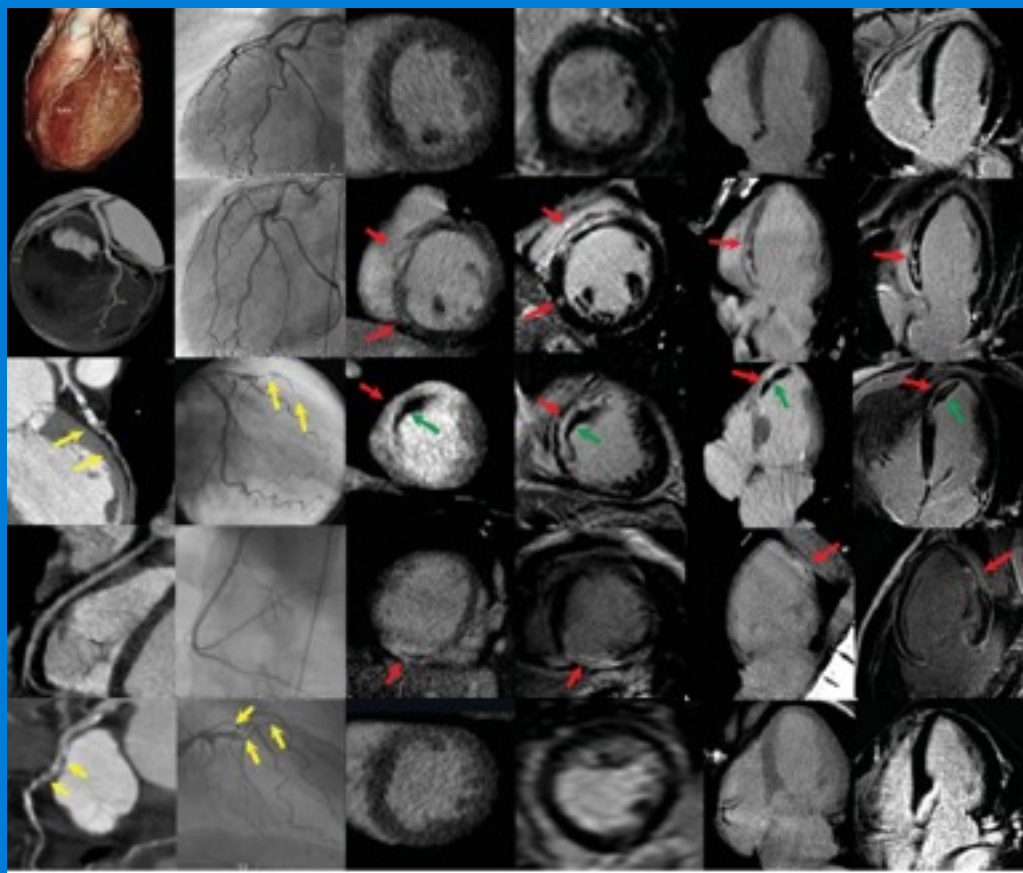
$\kappa = 0.89$; $P < 0.001$.

de Waroux JBP et al
Eur Heart J 2008;29: 2544-51



Angio TC Coronária

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Sens
97

Espec
92

Acurácia
94

de Waroux JBP et al
Eur Heart J 2008;29: 2544-51



DC na IC avaliada por TC

93 doentes com ICC

IC isquémica

TC, DAp, 2 ou + vasos

Classification	n	TP	TN	FP	FN
CAD+	93	43	44	5	1
IHF	93	28	59	3	3

Sensitivity	Specificity	Accuracy	PPV	NPV
98 (88–100)	90 (78–97)	94 (86–98)	90 (77–97)	98 (88–100)
90 (74–98)	95 (87–99)	94 (86–98)	90 (74–98)	95 (87–99)

Ghostine S et al
Eur Heart J 2008;29: 2133-40

Será suficiente ter a informação anatômica?

Quais as lesões funcionalmente importantes?

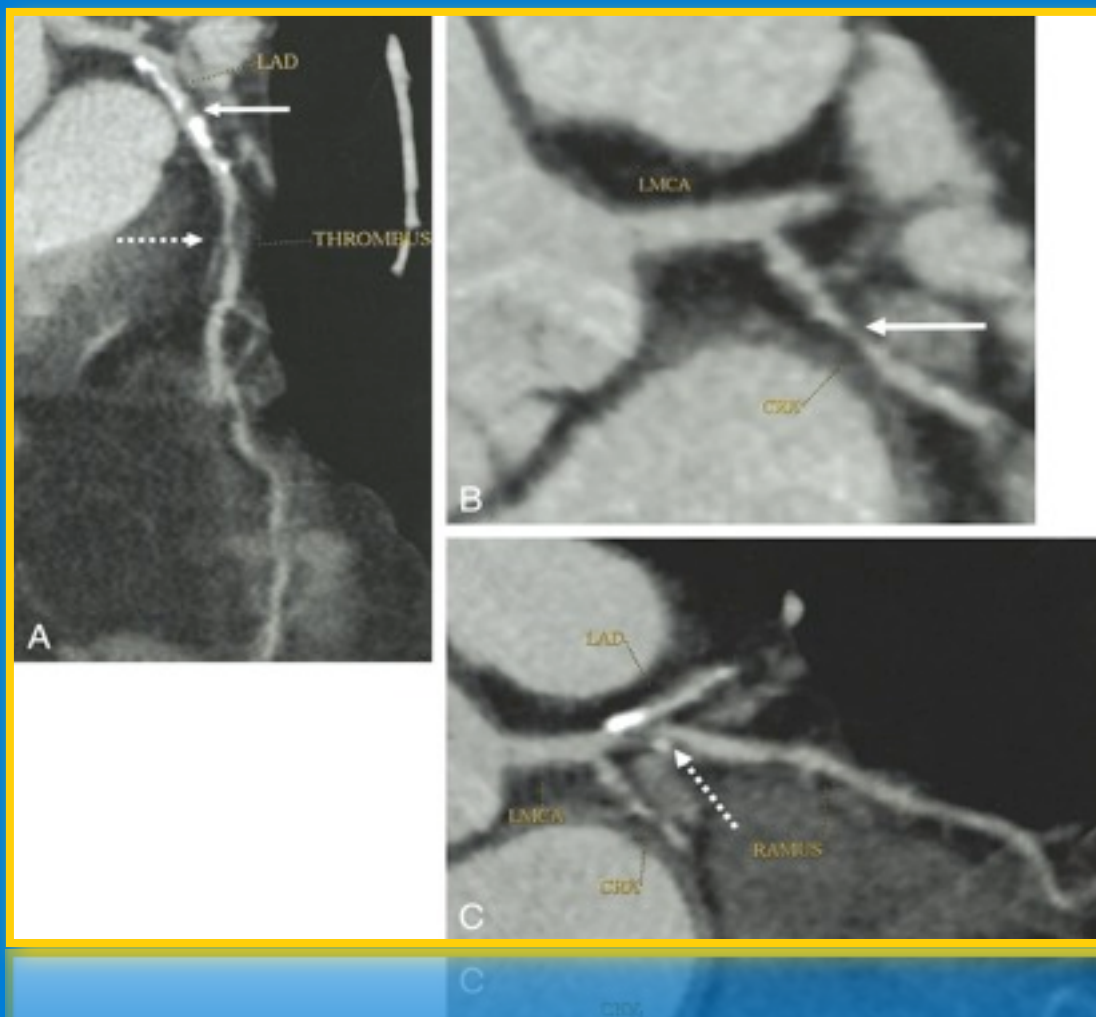
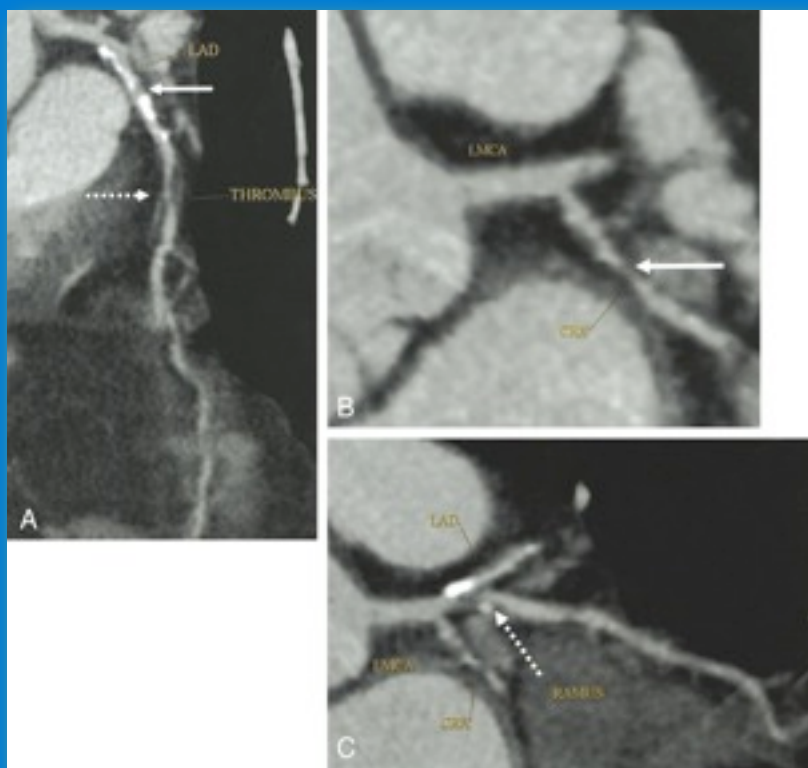


Imagem Híbrida

Fusão SPECT-CT

Angio TC

Lesões na DA, Cx e R Int



Rispler S et al

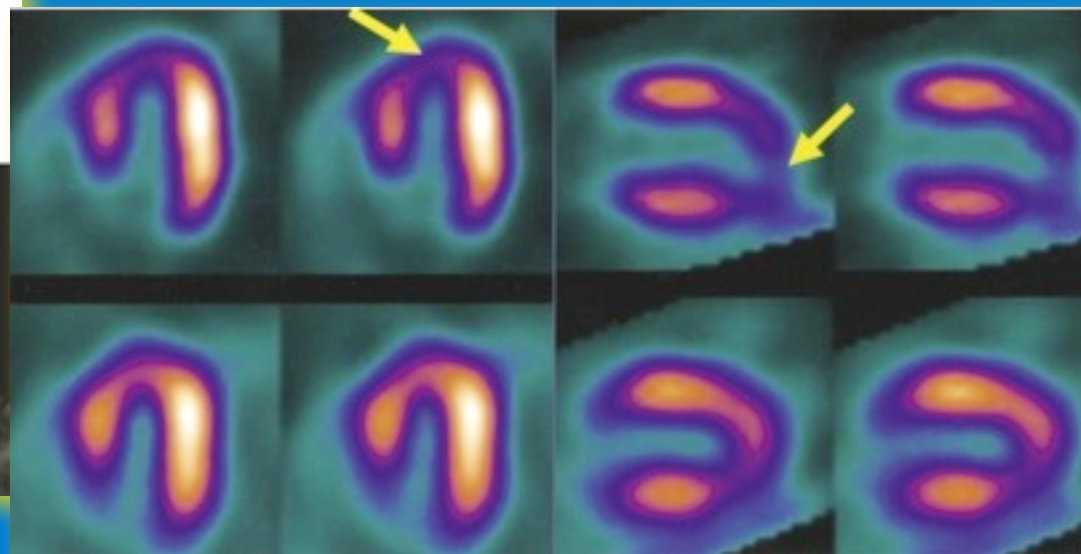
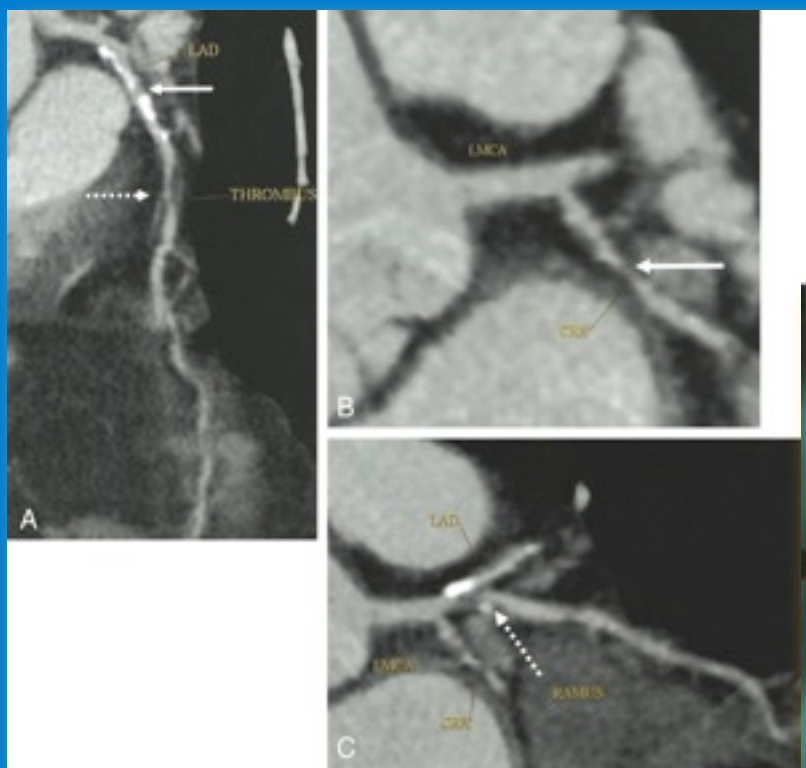
J Am Coll Cardiol 2007; 49: 1059-1067

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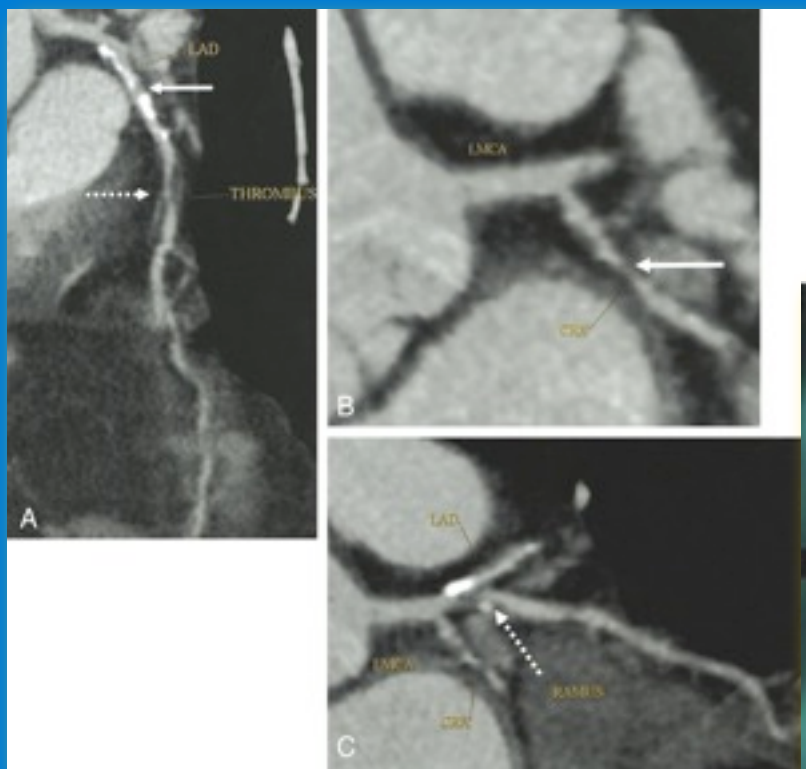
JACC
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

Imagem Híbrida

Fusão SPECT-CT

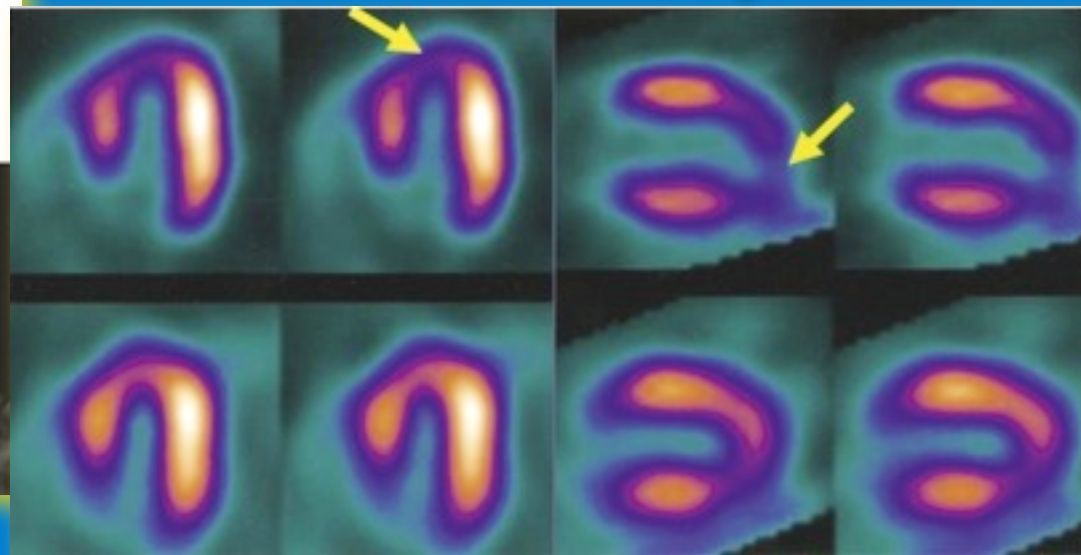
Angio TC

Lesões na DA, Cx e R Int



SPECT

Isquemia septo-apical e antero-apical



Rispler S et al

J Am Coll Cardiol 2007; 49: 1059-1067



JACC
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

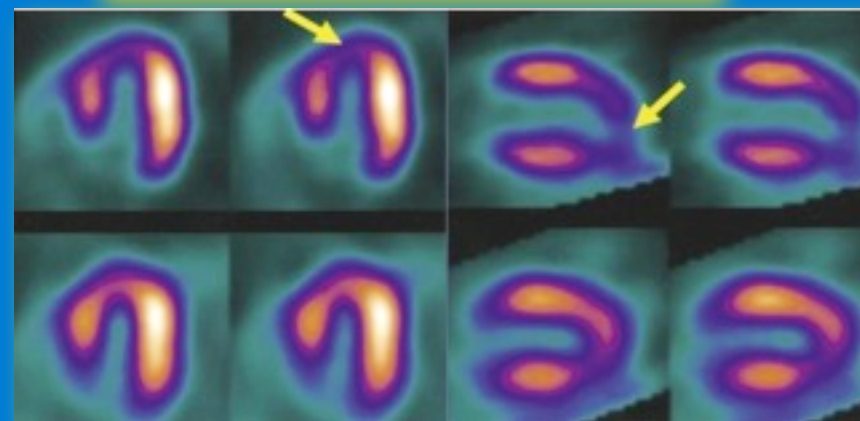


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Imagem Híbrida

Fusão SPECT-CT

	CT	SPECT CT
Sens	96	96
Espec	63	95
PPV	31	77
NPV	99	99



Rispler S et al

J Am Coll Cardiol 2007; 49: 1059-1067

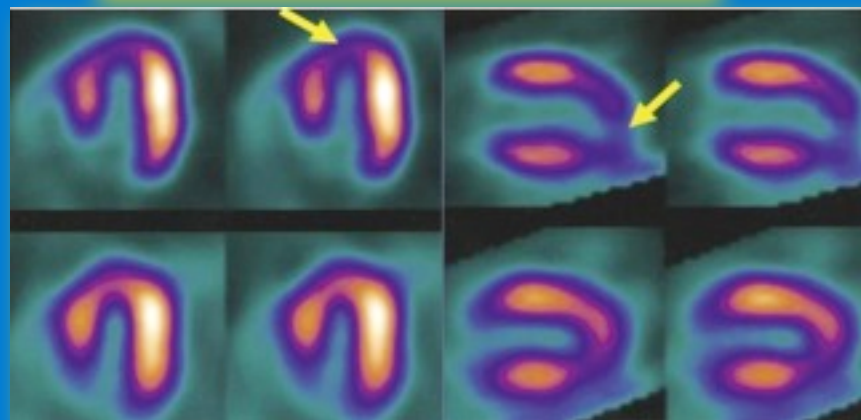
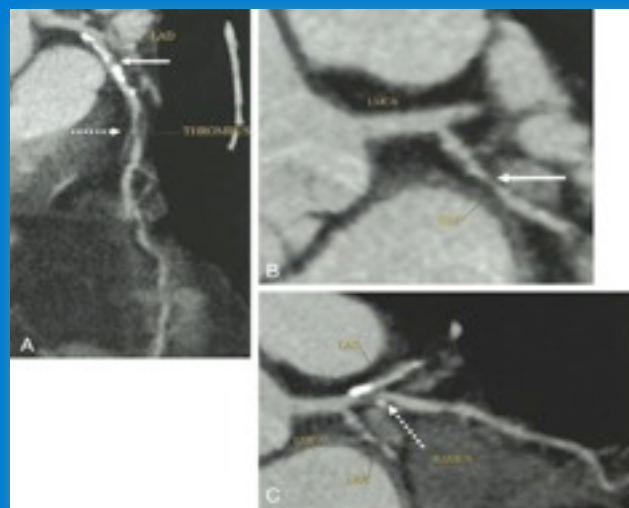


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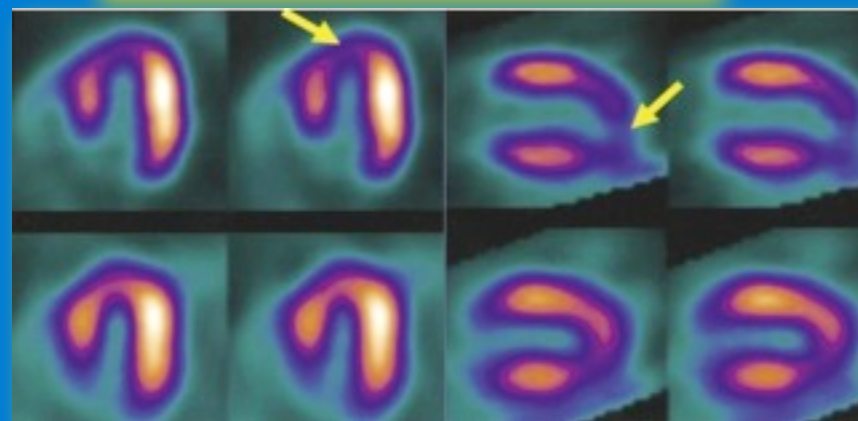
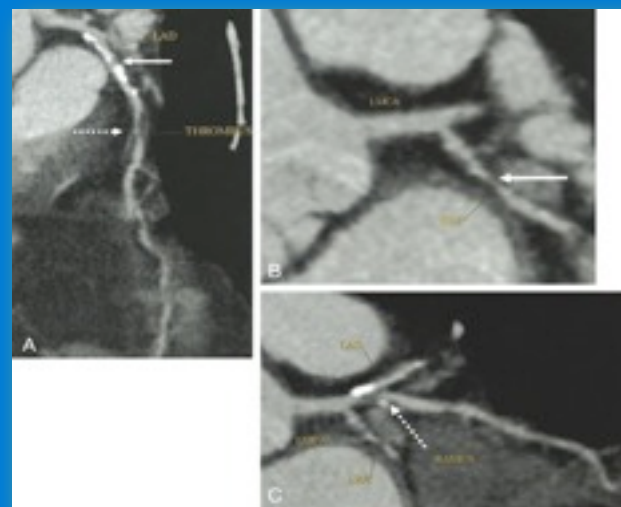


Imagem Híbrida

Fusão SPECT-CT

	CT	SPECT CT
Sens	96	96
PPV	31	77
NPV	99	99

Dose Radiação ~ 41.5 mSV



Rispler S et al

J Am Coll Cardiol 2007; 49: 1059-1067



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Imagem sequencial - TC e RM

Doença coronária e avaliação funcional

55 doentes

Risco intermédio
TC 64 e RM

CTA < 30%
(n=15)

CTA 30-50%
(n=24)

CTA > 50%
(n=16)

RM normal
(n=34)

41%

44%

15%

RM anormal
(n=21)

5%

43%

52%

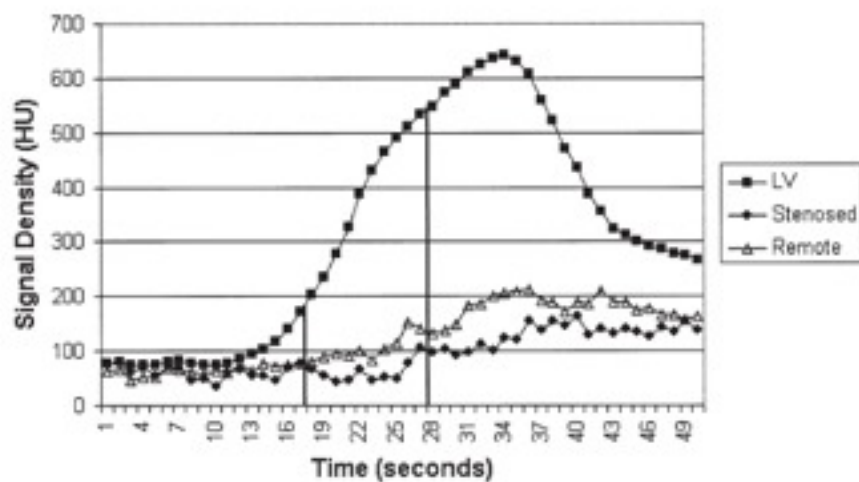
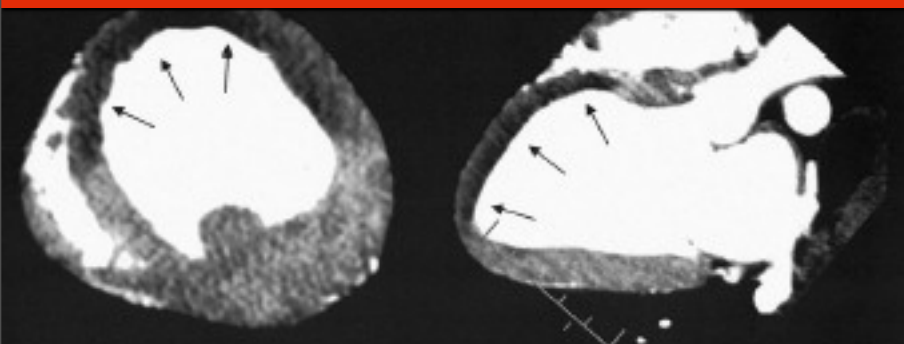
Van Werkhoven et al
ESC 2008; Abstr 2244



Perfusão com TC na avaliação funcional ?

Estudo animal

Perfusão por TC vs Microsf



George RT et al
JACC 2006;48: 153-60

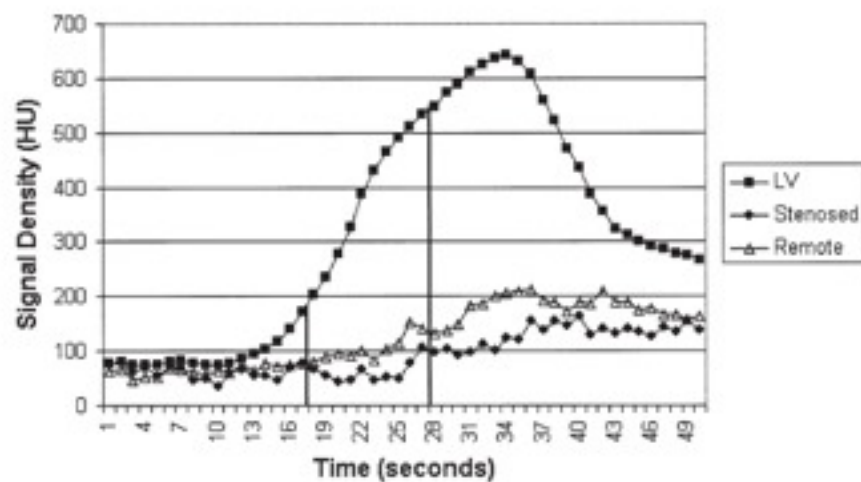
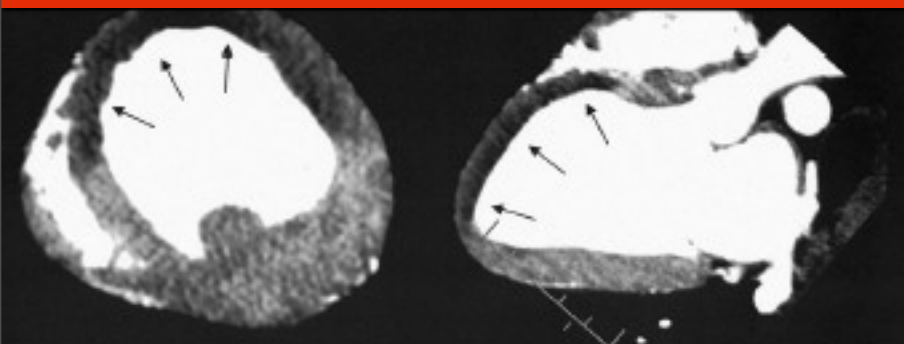
George RT et al
Circ 2008;118 Suppl: 936



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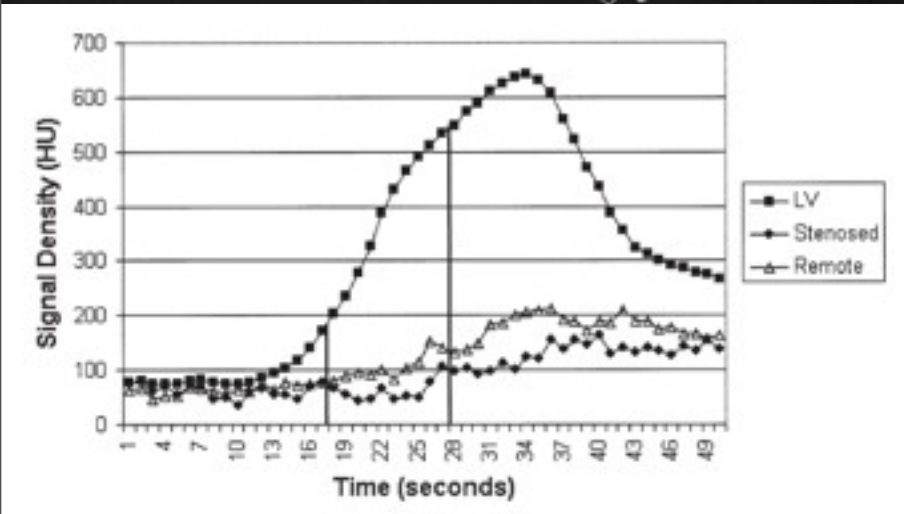
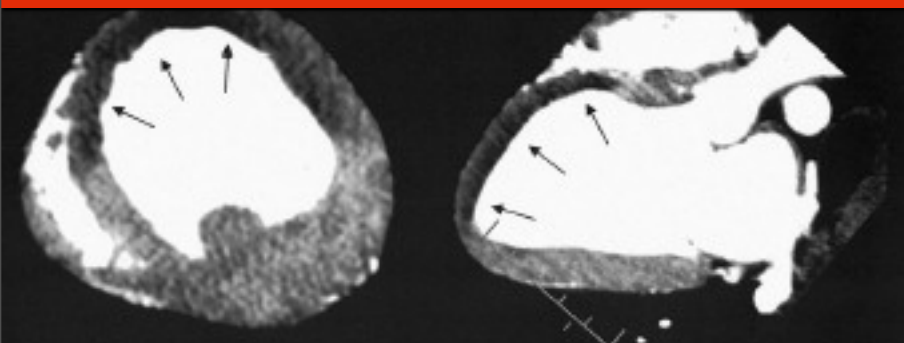
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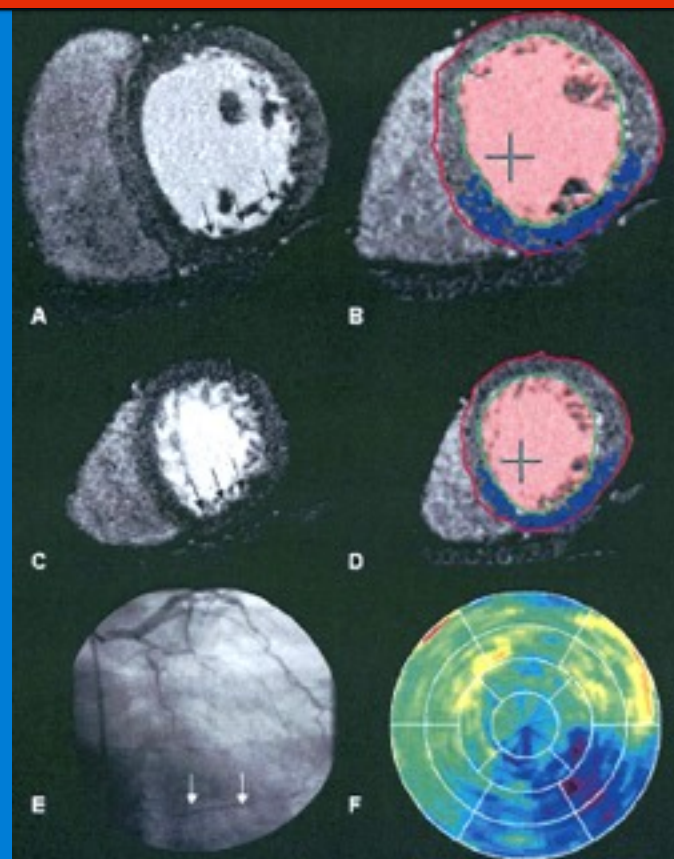
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Estudo preliminar vs SPECT 18 doentes



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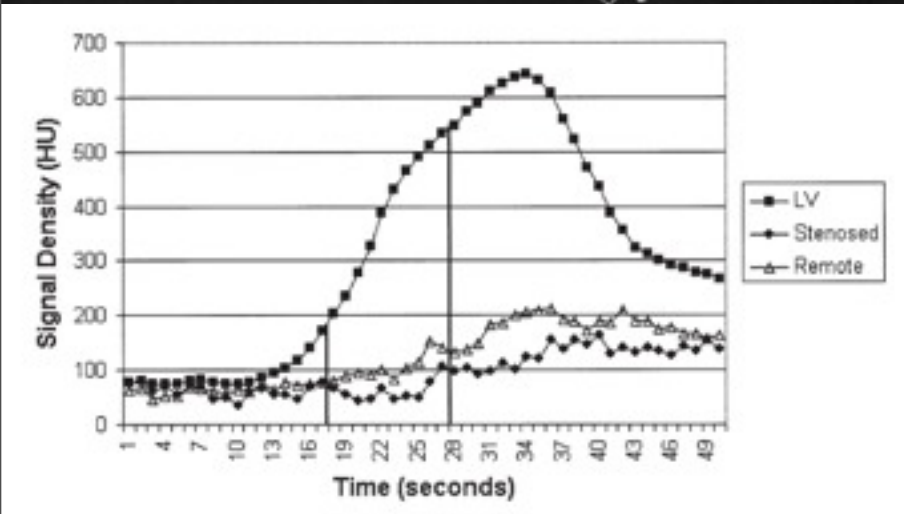
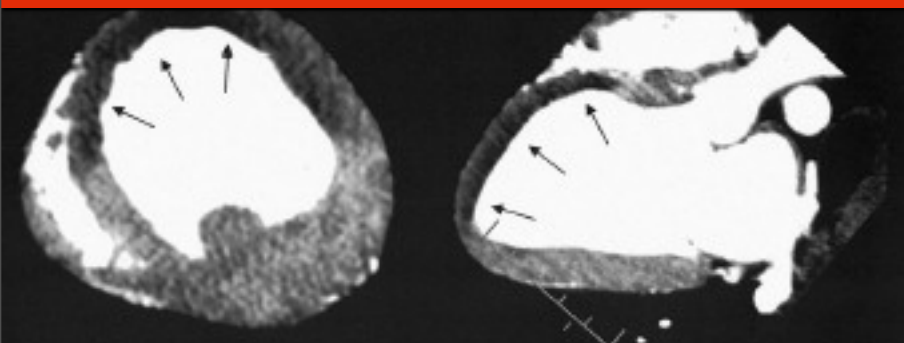
George RT et al
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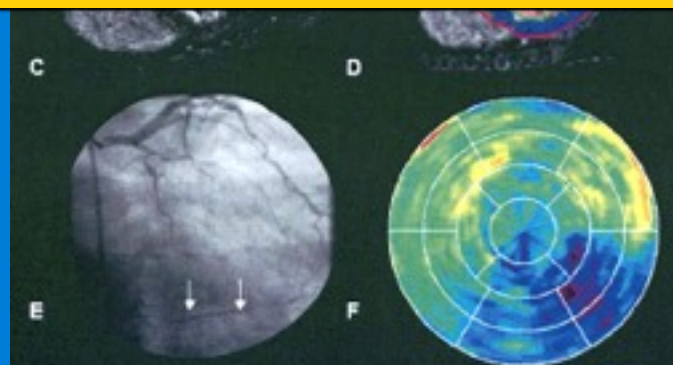


Estudo preliminar vs SPECT 18 doentes



Sens	Espec	PPV	NPV
89	94	89	94

13.4 mSV



George RT et al
JACC 2006;48: 153-60

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Circ 2008;118 Suppl: 936



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Que papel para a TC na Ins. Cardíaca?

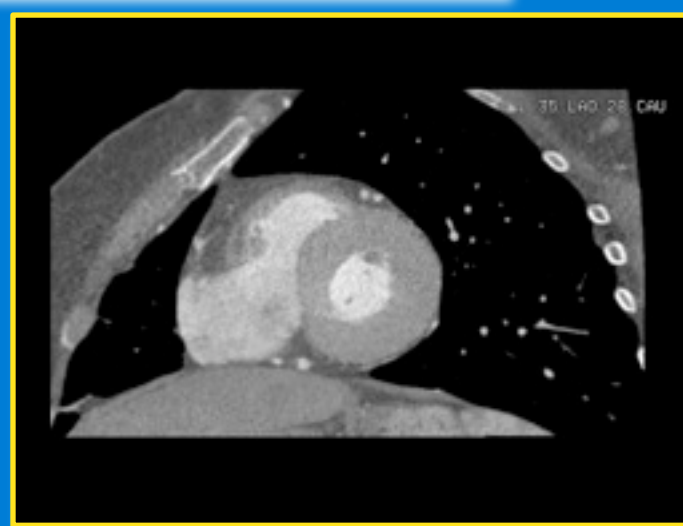
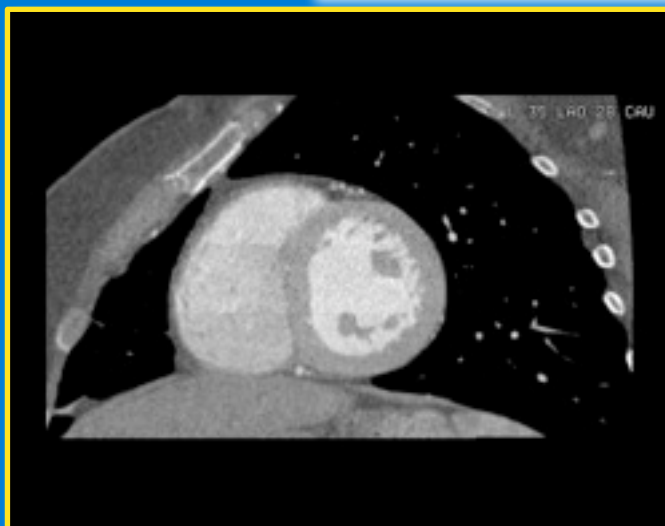
Avaliação de Função VE e VD



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Função VE

Cálculo de volumes e F. ejeção

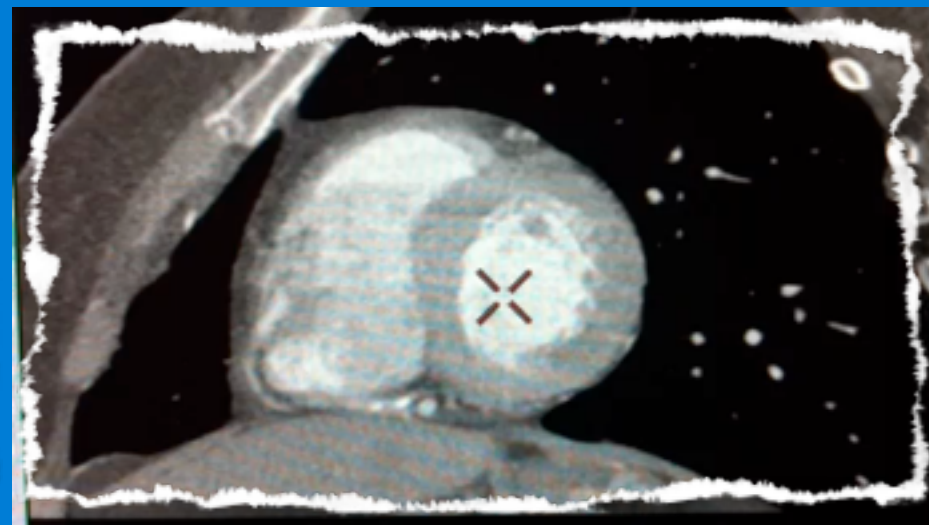
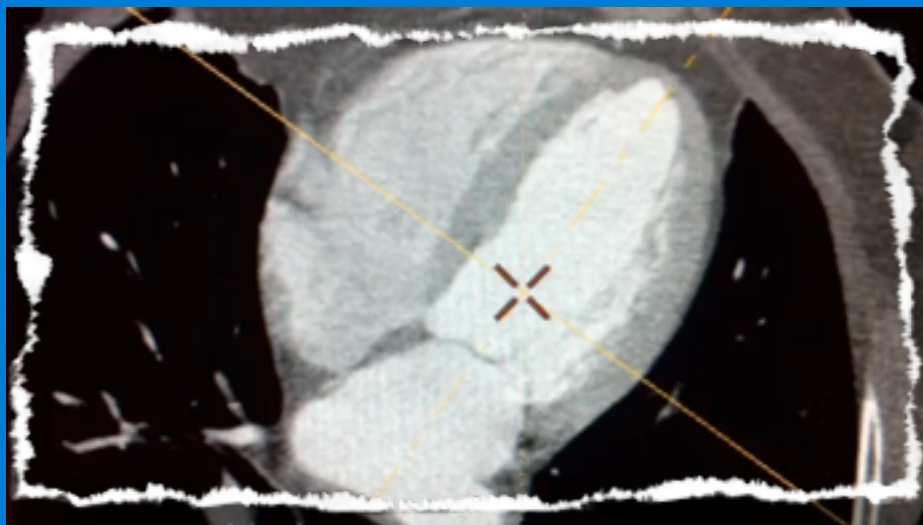




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Função VE

Análise segmentar





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Que papel para a TC na Ins. Cardíaca?

Anatomia venosa



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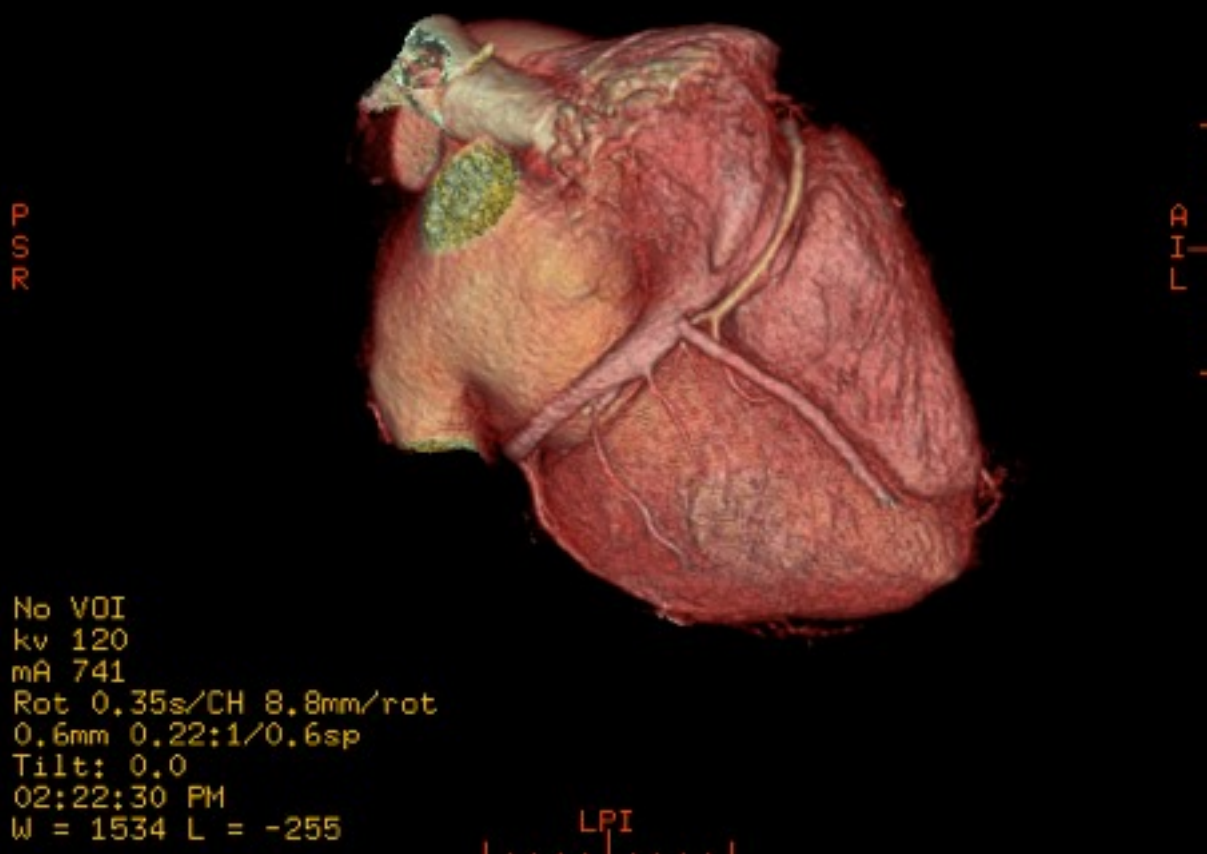
Anatomia venosa no doente para resincronização

Se: 2
Volume Rendering No cut

F 62 856792
May 04 2006

DFOV 25.0 cm
STND Ph:75% (No Filt.)
252/34

0 L 129 RAO 43 CAU





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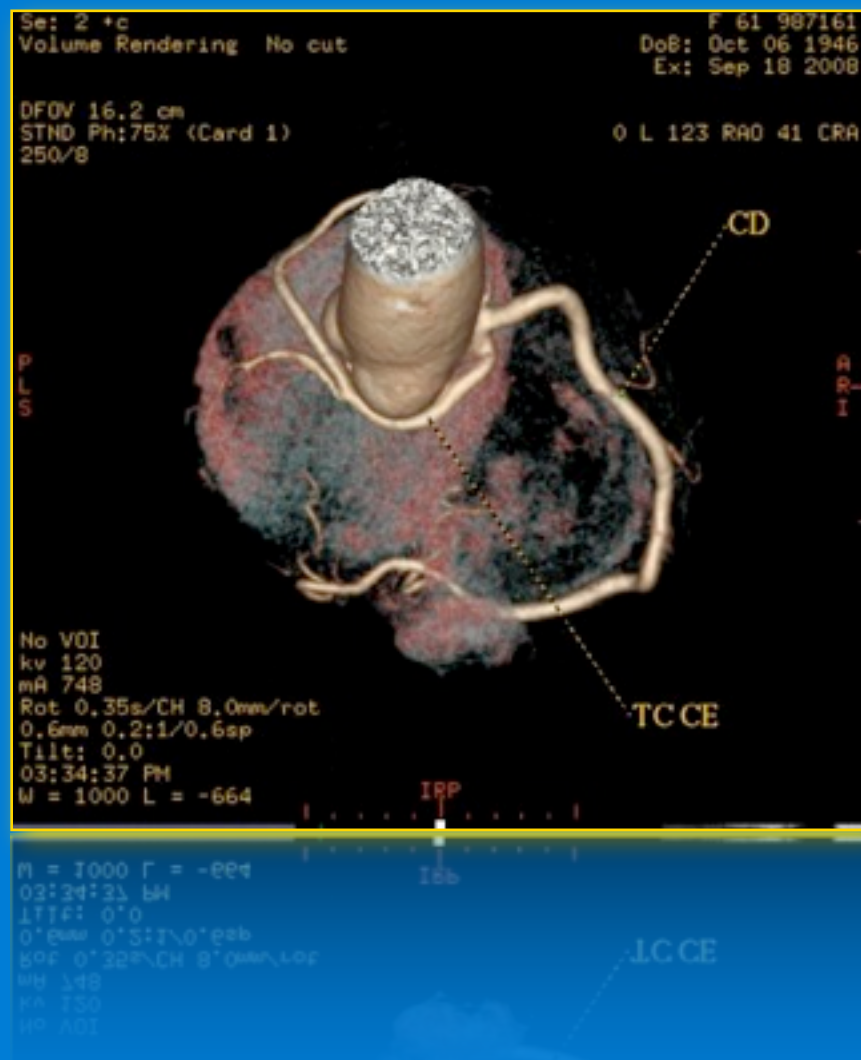
Que papel para a TC na Ins. Cardíaca?

Outras indicações



Coronárias anómalas

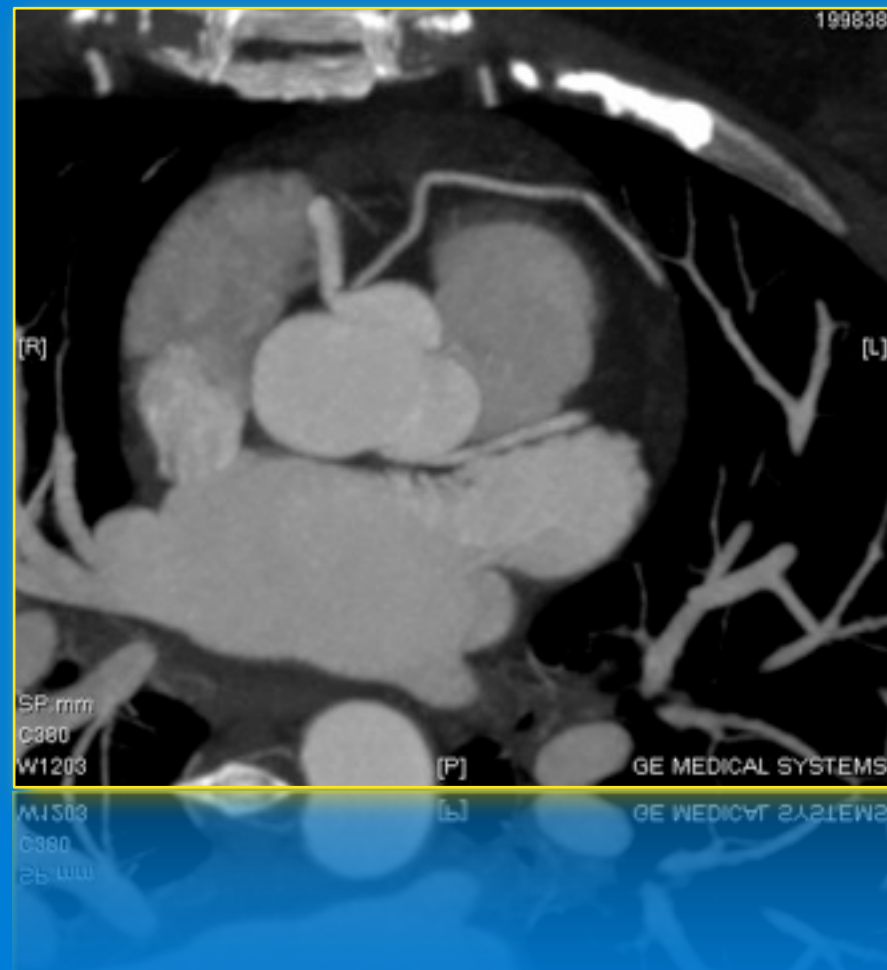
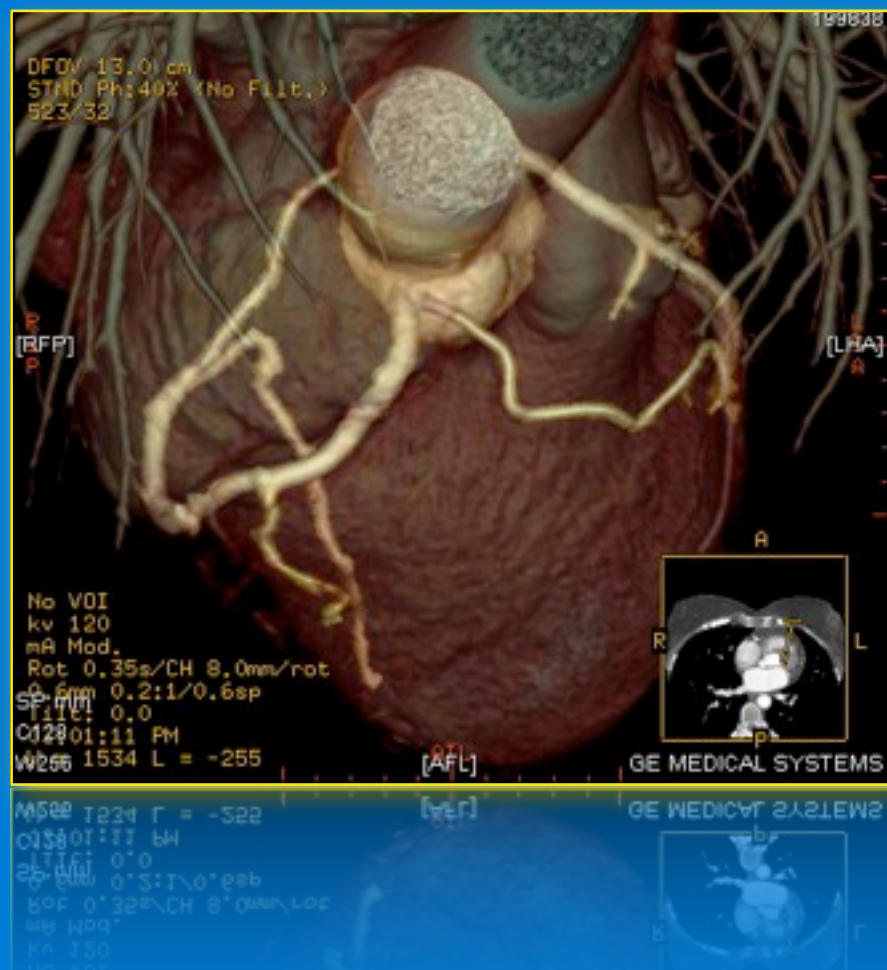
Coronária esq. sai do S.Valsava direito





Coronárias anómalas

DA sai do S.Valsava direito





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Fístulas Coronárias



MIP No cut Inverse

DoB: Nov 22 1991
Ex: Jul 03 2008

DFOV 20,5 cm
STND Ph:75% (No Filt.)
251/13

0 L 65 RAO 35 CRA

P
R
S

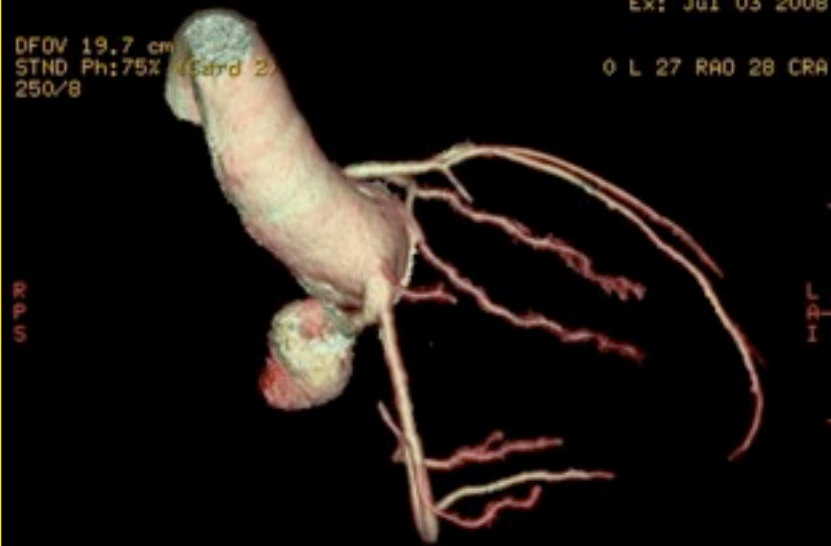
A
I
L

Se: 2 +c
Volume Rendering No cut

F 16 9/7/956
DoB: Nov 22 1991
Ex: Jul 03 2008

DFOV 19,7 cm
STND Ph:75% (Sard 2)
250/8

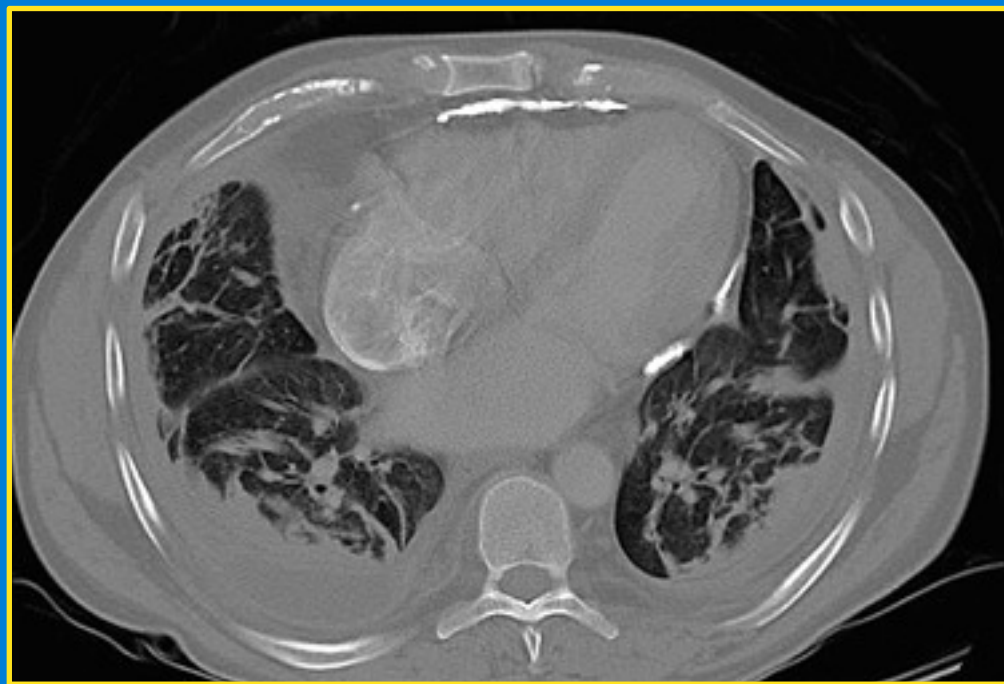
0 L 27 RAO 28 CRA





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Pericardite constrictiva



Wang Z J et al.
Radiographics 2003;23:S167-S180



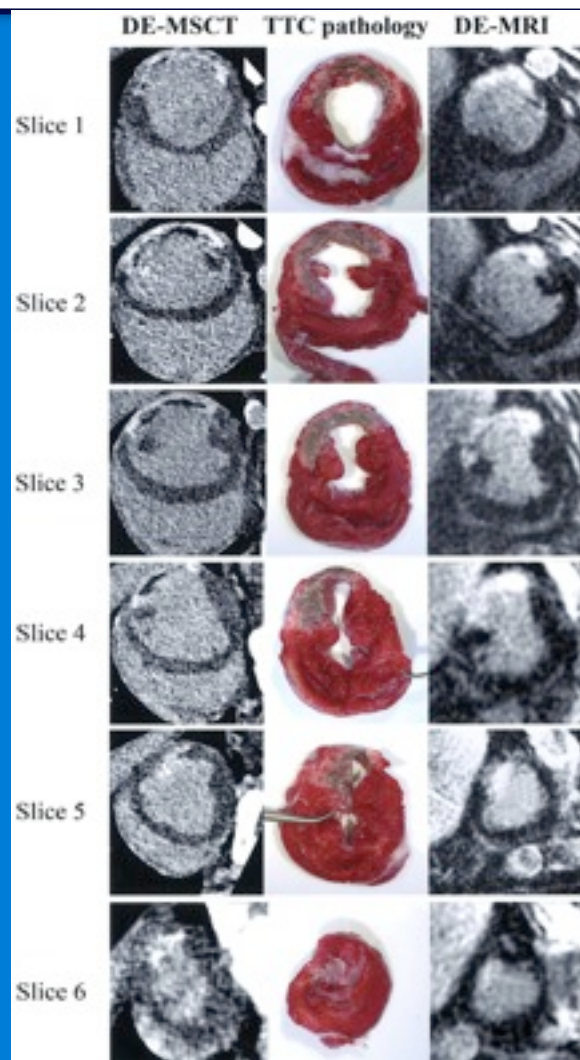
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Que papel para a TC na Ins. Cardíaca?

E o futuro pode ser...?

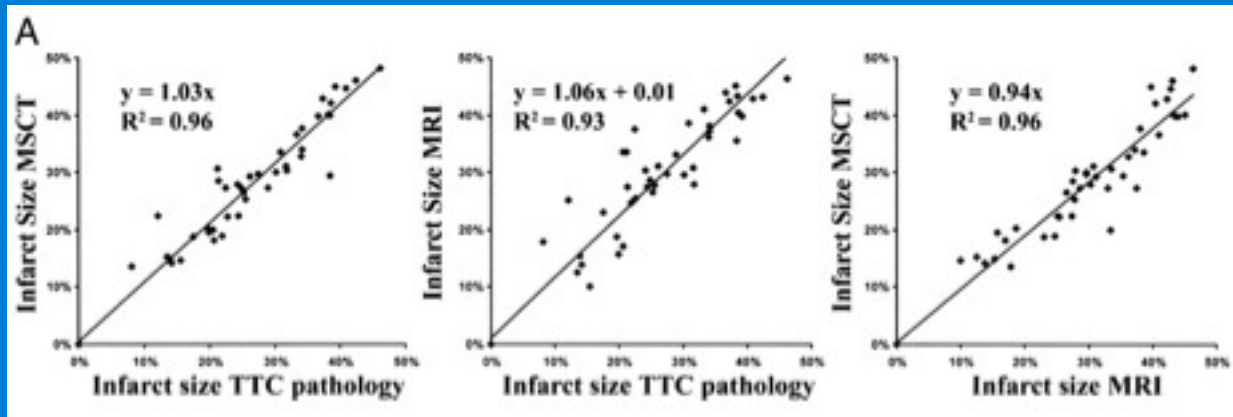


Haverá futuro para a avaliação de viabilidade com TC após EAM ?



Estudo animal 3-7 dias após EAM

Realce Tardio por TC vs RM após EAM
Correlação anatomo-patológica (TTC)

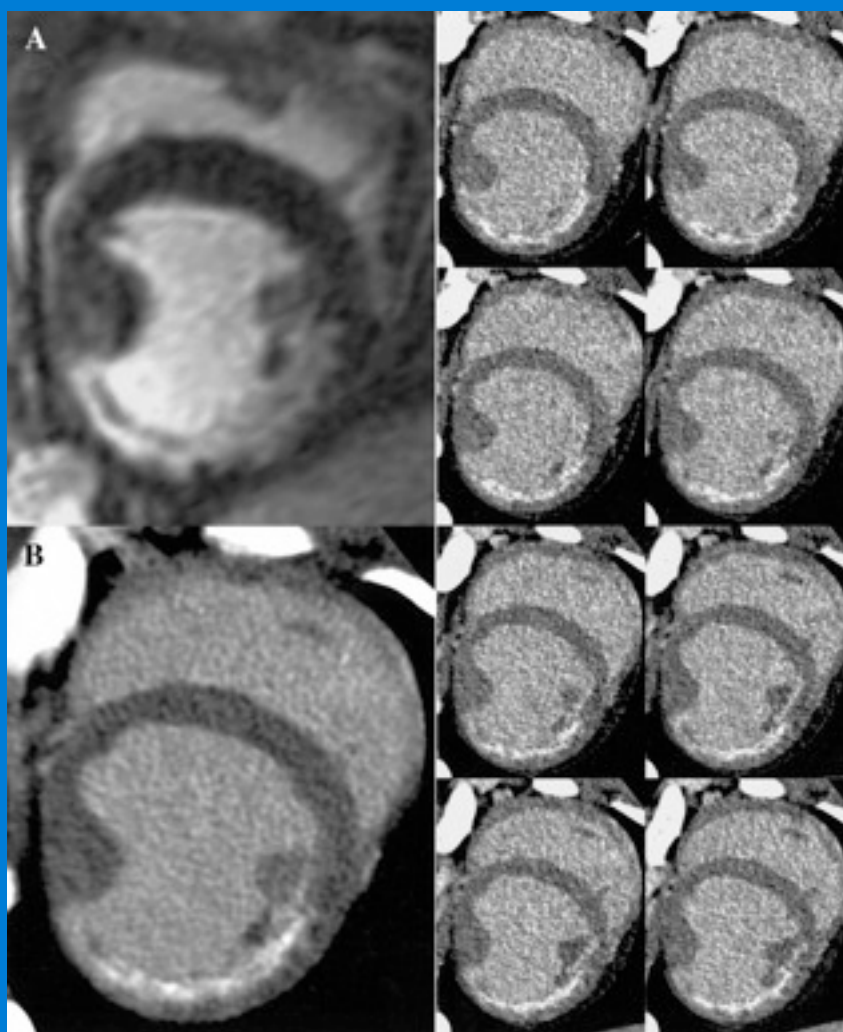


Baks, T. et al.
J Am Coll Cardiol 2006;48:144-152



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Realce por TC tem maior resolução espacial que a RM



Mas menos resolução temporal...

Baks, T. et al.
J Am Coll Cardiol 2006;48:144-152

Volume CT

Dos 256 para os 320 cortes

Aquisição numa só rotação

256* Slice MDCT

*WIP

Capturing an entire organ in a single rotation at one instance in time.



256* Slice MDCT

*WIP

"Heart in a Heartbeat"



- The exposure is over one single heart beat.
- Dose will be approximately 1/4 of 64 slice system.

Approximately 3 – 4 mSv

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Perfusão e viabilidade num só exame?

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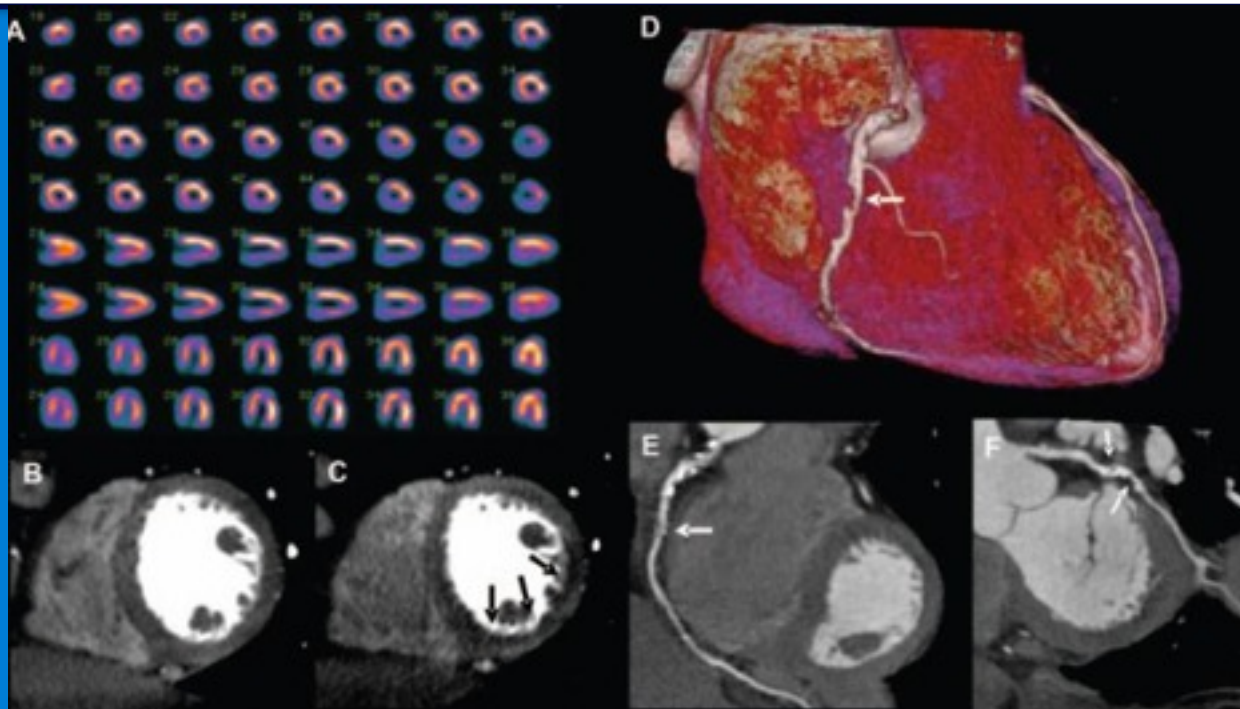
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Volume CT - 256 cortes

Perfusão vs SPECT



	With Nonevaluable Vessels Categorized as Negative (n=27)	With Nonevaluable Vessels Categorized as Positive (n= 27)	Evaluable Vessels Only (n=26)
Prevalence	15/27, 56%	16/27, 59%	14/26, 54%
Sensitivity	12/15, 80% (51–95)	14/16, 88% (60–98)	12/14, 86% (57–97)
Specificity	11/12, 92% (60–100)	10/11, 91% (57–100)	11/12, 92% (61–98)
PPV	12/13, 92% (62–100)	14/15, 93% (66–100)	14/15, 92% (62–100)
NPV	11/14, 79% (49–94)	10/12, 83% (51–97)	11/13, 85% (54–97)
AUC	0.84 (0.77–0.90)	0.89 (0.71–0.97)	0.88 (0.70–0.97)

George RT et al
Circ Cardiovasc Imag May 2009;2 (3):174-82



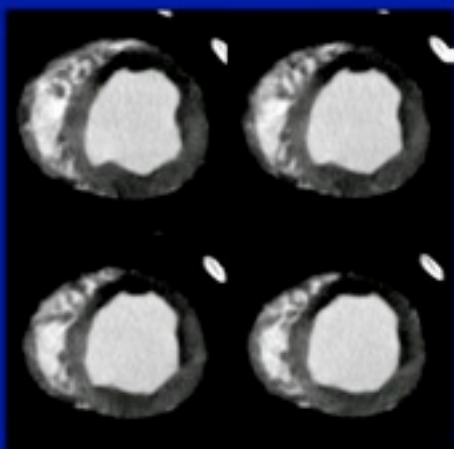
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Volume CT - 320 cortes

Perfusão e viabilidade com TC ?

Helical MDCT Perfusion Imaging

Wall Motion and Perfusion



George RT, et al. SCCT, 2006.

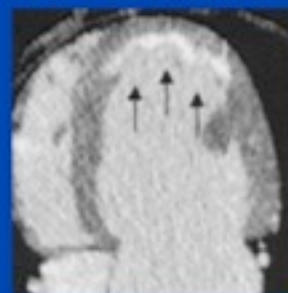
George RT, et al. SCCT, 2006.

256*-Slice MDCT

*WIP

One exam.....One scanner

- Calcium
- Coronaries
- Wall motion and EF
- Perfusion
- Viability



All for ~12 mSv
in ~15 min



0.2mSv

0.2mSv

All for ~12 mSv
in ~15 min





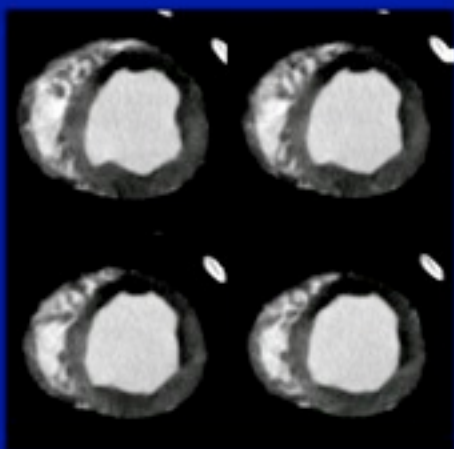
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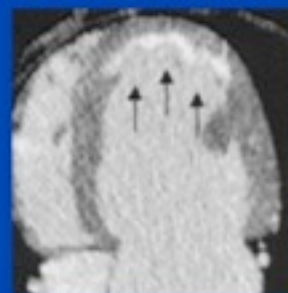
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Ensaio CORE-320
Perfusão TC vs SPECT
450 doentes - 15 centros

João AC Lima
Publ 2012



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Que papel para a TC na Insuf. Cardíaca?



Que papel para a TC na Insuf. Cardíaca?

■ Método possível para excluír DC em doentes de risco baixo/moderado



Que papel para a TC na Insuf. Cardíaca?

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- *Bom para ver calcificações pericárdicas*
- *Possibilidades de informação anatomo-funcional num só exame*