Le cath-lab du Futur frappe à notre porte

Ma Vision du Futur

Patrick Dupouy

PCVI Antony - Melun

DÉCLARATION DE LIENS D'INTÉRÊT AVEC LA PRÉSENTATION

Intervenant : Patrick DUPOUY, Antony

☑ Je n'ai pas de lien d'intérêt à déclarer

Functional testing and intravascular imaging for lesion assessment

Recommendations	Class	Level
When evidence of ischaemia is not available, FFR or iwFR are recommended to assess the haemodynamic relevance of intermediate-grade stenosis.	I	A
FFR-guided PCI should be considered in patients with multivessel disease undergoing PCI.	IIa	B
IVUS should be considered to assess the severity of unprotected left main lesions.	IIa	B

2018 ESC/EACTS Guidelines on myocardial revascularisation
European Heart Journal (2018) 00, 1-96 - doi:10.1093/eurheartj/ehy394

Adhésion modeste dans la pratique de tous les jours

Décrets, arrêtés, circulaires

TEXTES GÉNÉRAUX

MINISTÈRE DES AFFAIRES SOCIALES, DE LA SANTÉ ET DES DROITS DES FEMMES

Décision du 10 septembre 2015 de l'Union nationale des caisses d'assurance maladie relative à la liste des actes et prestations pris en charge par l'assurance maladie

NOR : *AFSU1523152S*

Le collège des directeurs,

Vu le code de la sécurité sociale, notamment les articles L. 162-1-7 et R. 162-52 ;

Vu l'avis de la Haute Autorité de santé en date du 8 avril 2015 ;

Vu l'avis de l'Union nationale des organismes complémentaires d'assurance maladie en date du 30 juillet 2015 ;

Vu la décision de la commission de hiérarchisation des actes et prestations des médecins en date du 9 juillet 2015,

Décide :

De modifier le livre II de la liste des actes et prestations, adoptée par décision de l'UNCAM du 11 mars 2005 modifiée, comme suit :

Art. 1er. – Le livre II est ainsi modifié :

I. – A la subdivision 18.02.04.02 « Autres gestes complémentaires diagnostiques sur l'appareil circulatoire » inscrire l'acte suivant :

CODE	LIBELLÉ	ACTIVITÉ	PHASE	REMBT. SS conditions	ACCORD préalable
DDQF202	**Mesure du flux de réserve coronarien [FFR] au cours d'une artériographie coronaire** *Indications : en situation de coronaropathie stable, en cas de lésions pluritronculaires ou en cas de lésion monotronculaire avec une sténose intermédiaire lorsque les tests d'ischémie myocardiques préalables n'ont pas été contributifs ou été contre-indiqués selon avis de la HAS du 8 avril 2015.*	1	0		

II. – Modifications d'actes :

a) A la subdivision 04.01.04.01 « Artériographie coronaire [Coronarographie] », mentionner le code du geste complémentaire DDQF202 sous les actes suivants :

CODE	LIBELLÉ	ACTIVITÉ	PHASE	REMBT. SS conditions	ACCORD préalable
DDQH009 [A, F, P, S, U, 7]	**Artériographie coronaire sans ventriculographie gauche, par voie artérielle transcutanée** *(DDQJ001, DDRH001, YYYY260, YYYY300, DDQF202)*	1	0		
DDQH012 [A, F, P, S, U, 7]	**Artériographie coronaire avec ventriculographie gauche, par voie artérielle transcutanée** *(DDQJ001, DDRH001, YYYY260, YYYY300, DDQF202)*	1	0		

REPUBLIQUE FRANCAISE

HAS
HAUTE AUTORITÉ DE SANTÉ

Avis n°2015.0037/AC/SEAP du 8 avril 2015 du collège de la Haute Autorité de santé relatif à l'inscription sur la Liste des actes et prestations mentionnée à l'article L.162-1-7 du code de la sécurité sociale de la mesure de la fraction de flux de réserve coronarien (FFR) lors d'une coronarographie

Le collège de la Haute Autorité de santé, ayant valablement délibéré en sa séance du 8 avril 2015,

Vu les articles L.161-37 et L. 162-1-7 du code de la sécurité sociale,
Vu la demande de l'Union nationale des caisses d'assurance maladie du 2 mai 2011,
Vu la demande de la Société française de cardiologie du 10 septembre 2012,

ADOPTE L'AVIS SUIVANT :

La HAS a réalisé une évaluation du rapport bénéfice/risque de la mesure de la FFR lors d'une coronarographie présentée dans l'argumentaire ci-joint.

La HAS considère qu'en situation de coronaropathie stable la mesure de FFR présente un rapport bénéfice/risque favorable en cas de lésions pluritronculaires ou en cas de lésions intermédiaires pour lesquelles les examens préalables n'ont pas été contributifs ou n'ont pu être réalisés.

La HAS rappelle que la mesure de la FFR est réalisée dans les mêmes conditions d'environnement que la coronarographie.

En conséquence, la HAS estime que :

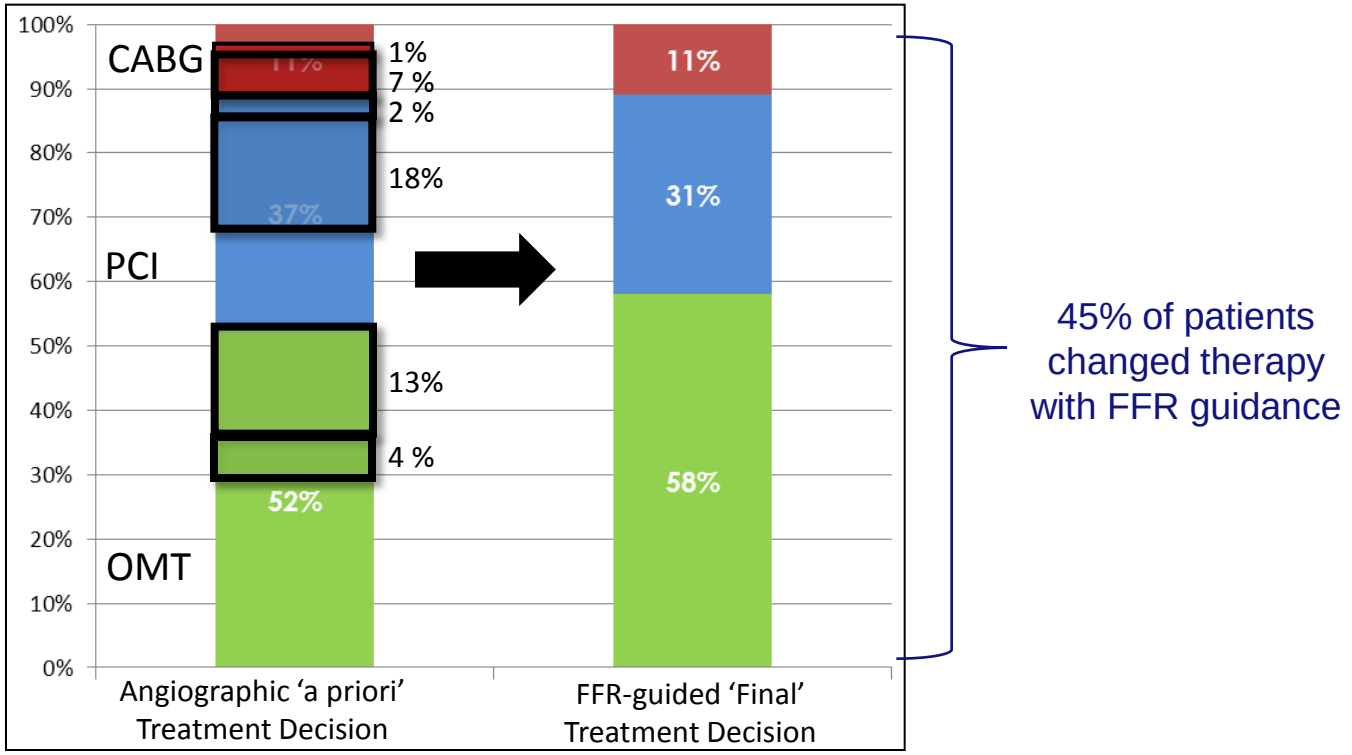
- le service attendu de la mesure fraction de flux de réserve coronarien (FFR), en situation de coronaropathie stable, en cas de lésions pluritronculaires ou en cas de lésions intermédiaires pour lesquelles les examens préalables n'ont pas été contributifs ou n'ont pu être réalisés, est suffisant ;
- l'amélioration du service attendu est III (modérée), compte tenu du bénéfice observé sur la survenue des événements cardiaques graves en comparaison à une stratégie basée sur les résultats de coronarographie sans mesure de FFR, à un an de suivi.

La population cible estimée par la CNAMTS se situe entre 26 000 et 31 000 patients par an en France.

Fait le 8 avril 2015

Pour le collège,
le Président,
Jean-Luc HAROUSSEAU

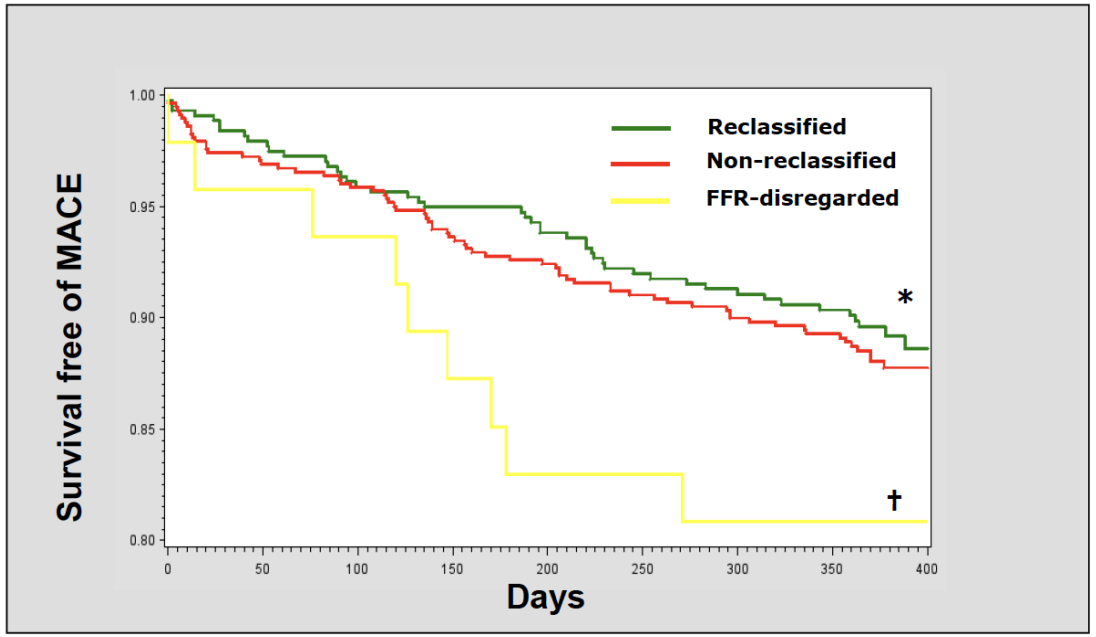
La Physiologie permet de reclassifier 45% des lésions

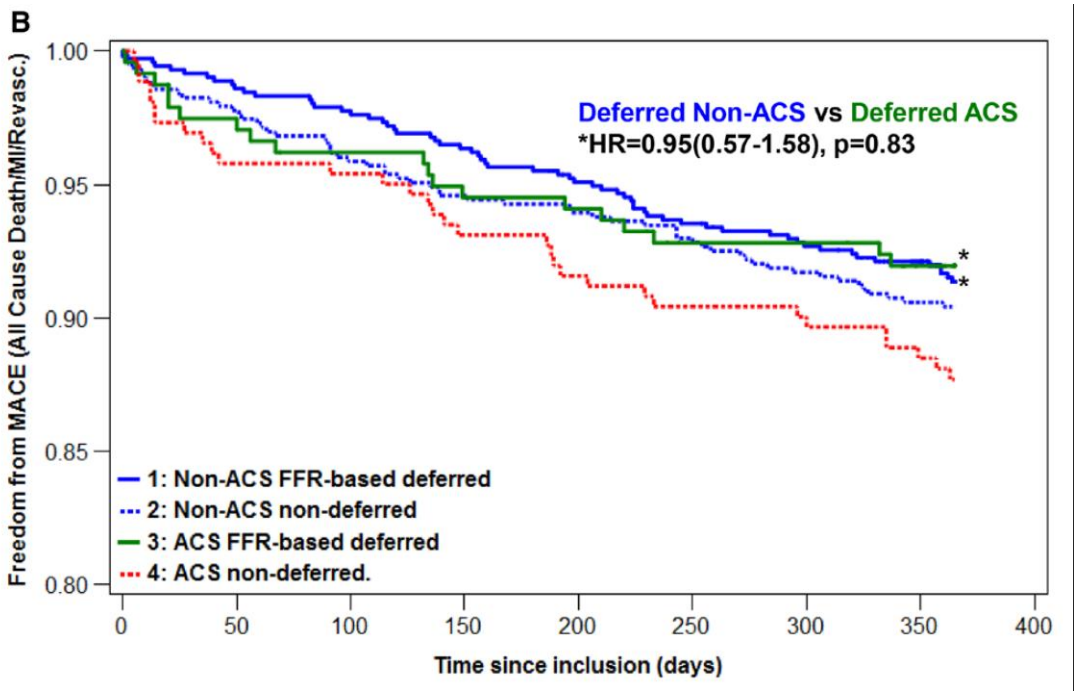


- 945 patients evaluated at diagnostic angio then FFR for final treatment decision
- FFR guidance reduced PCIs by 6%, but **changed the treatment for 45% of patients**

Van Belle, Dupouy et al. Circulation 2014

Les patients récusés FFR ont un excellent pronostic

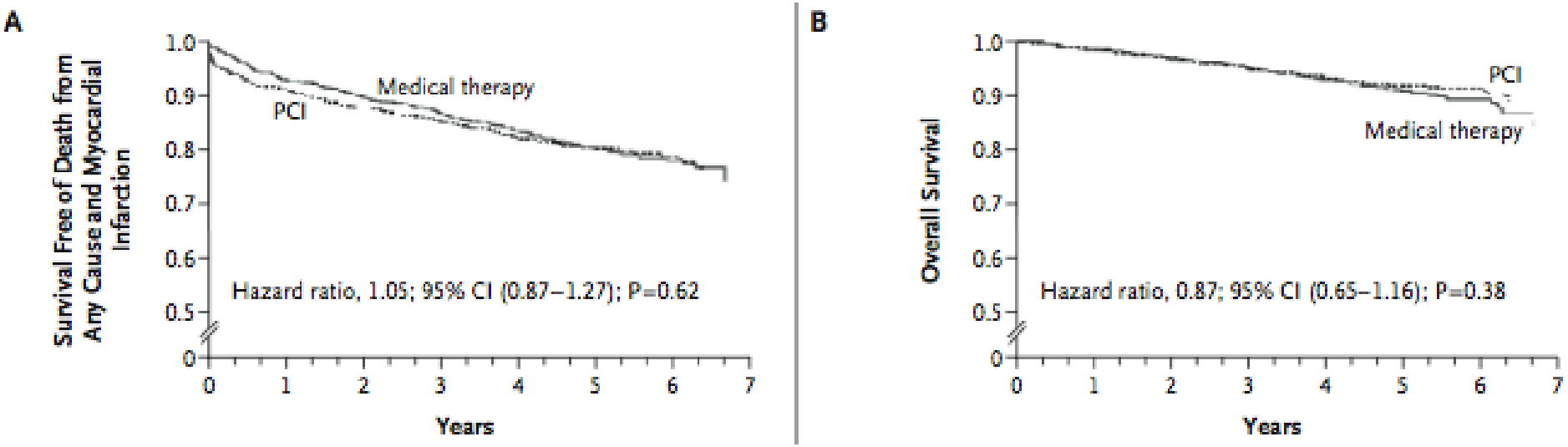




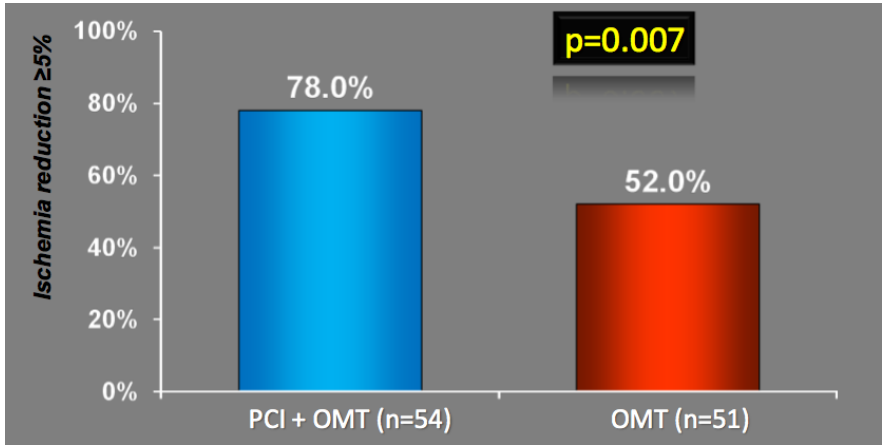
Van Belle, Dupouy et al. Circulation 2014

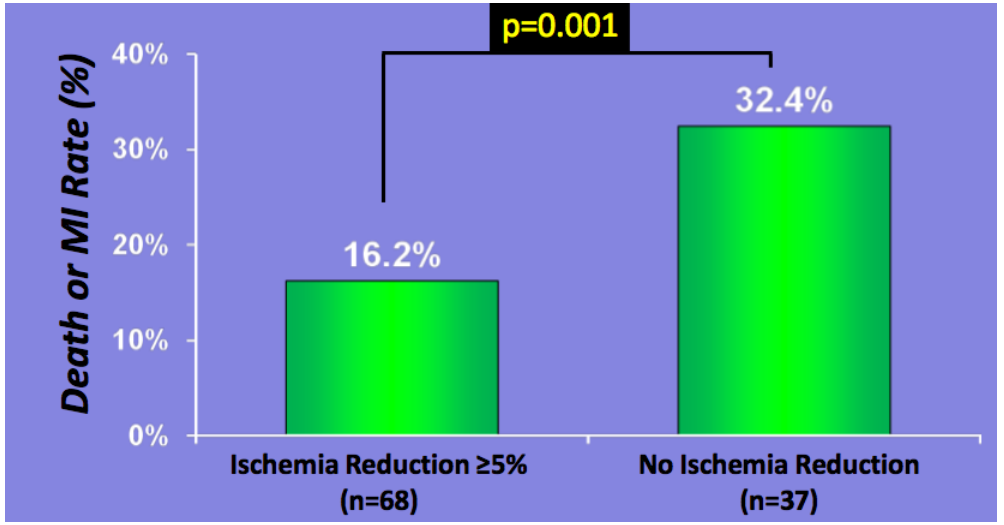
Circ Cardiovasc Interv. 2017

Courage Study



N Engl J Med 2007;356:1503-16





ORBITA study

	PCI n = 105
Drug eluting stents	138 (100%)*
Stent length (mm)	24 (IQR 18-33)
Stent diameter (mm)	3.1 (SD 0.5)
Post-dilatation	103 (75%)*
FFR post-PCI	0.90 (SD 0.06) p<0.0001
iFR post-PCI	0.95 (SD 0.04) p<0.0001

Peak stress wall motion index score	PCI n = 91	Placebo n = 70
Pre-randomization	1.08 (0.12)	1.07 (0.11)
Follow-up	1.02 (0.05)	1.09 (0.14)
Δ (Pre-randomization to follow-up)	-0.05 (0.12)	0.02 (0.10)
Difference in Δ between arms	-0.07 (-0.11 to -0.04) **P<0.0001**	

Al-Lamee et al Lancet 2018;391:31-40

La disparition du réflexe oculo-sténotique

Indian Heart Journal 70 (2018) 191–193

Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Opinion Piece

Palliative treatment of coronary "atherosclerotic cancer" by drug-eluting or bare-metal stents: From oculo-stenotic reflex period to age of precision medicine

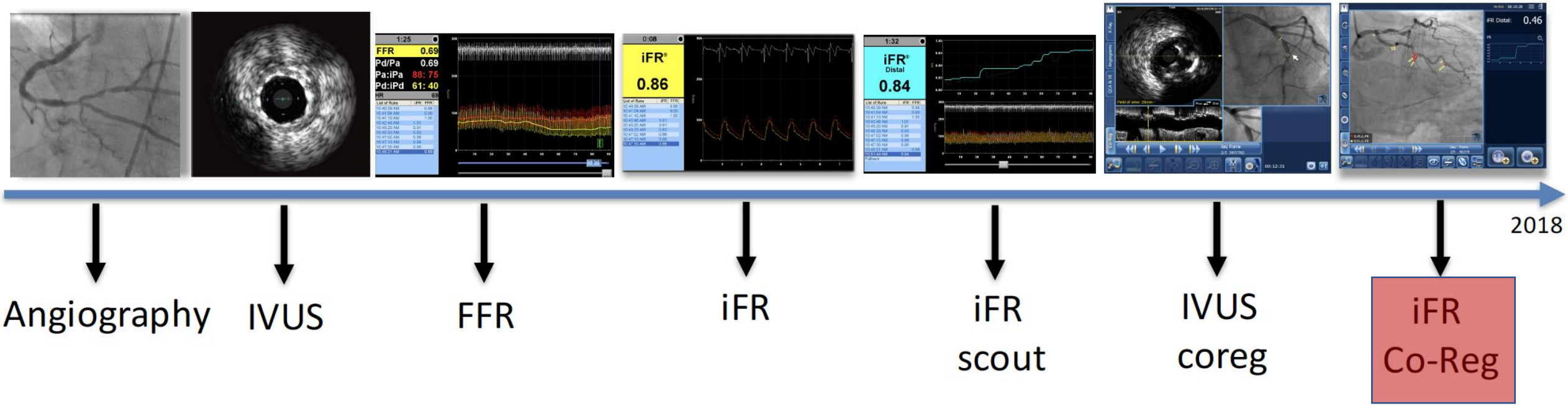
Elif Hande Ozcan Cetin, Ozcan Ozeke*, Erdogan Ilkay, Dursun Aras, Serkan Topaloglu, Zehra Golbasi, Sinan Aydogdu, Can Ozer

Health Sciences University, Turkiye Yuksek Ihtisas Training and Research Hospital, Department of Cardiology, Ankara, Turkey

Les outils anti « réflexe oculo-sténotique ». La nouvelle ère de la « physiologie » coronaire

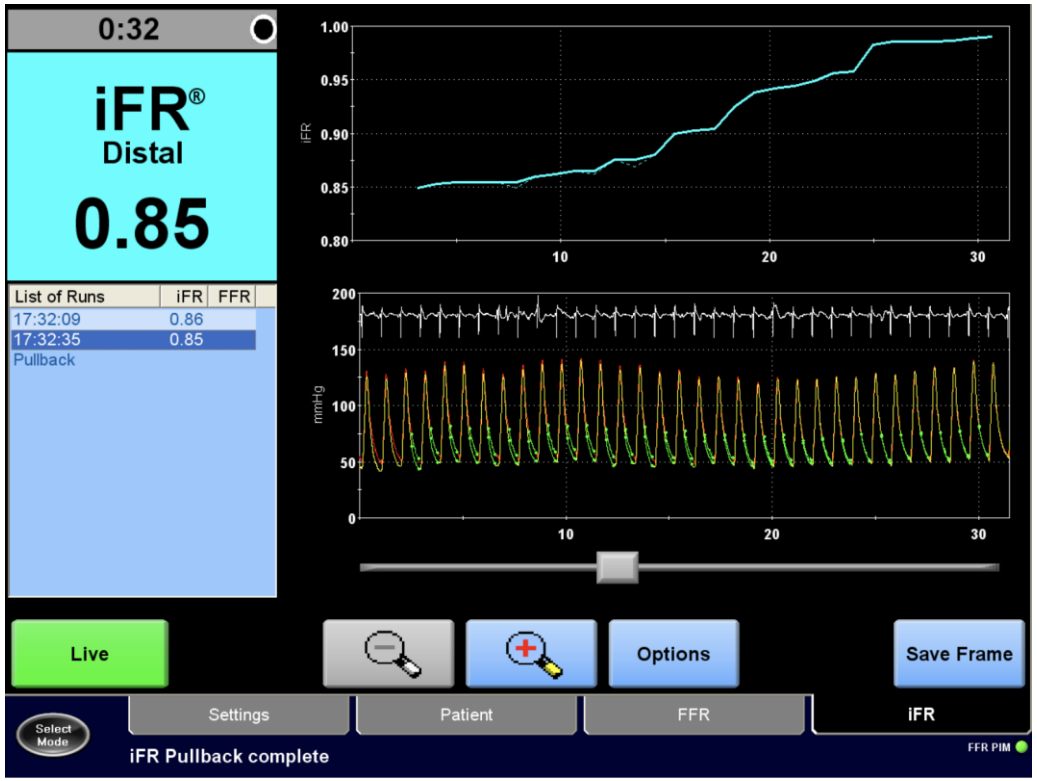
- Co-registration
  - iFR
  - IVUS
- Q FR angio
- FFR CT

Co-Registration : pull back iFr-Angio ou IVUS - Angio



Mieux anticiper l'impact du stenting ?

ATHEROME DIFFUS



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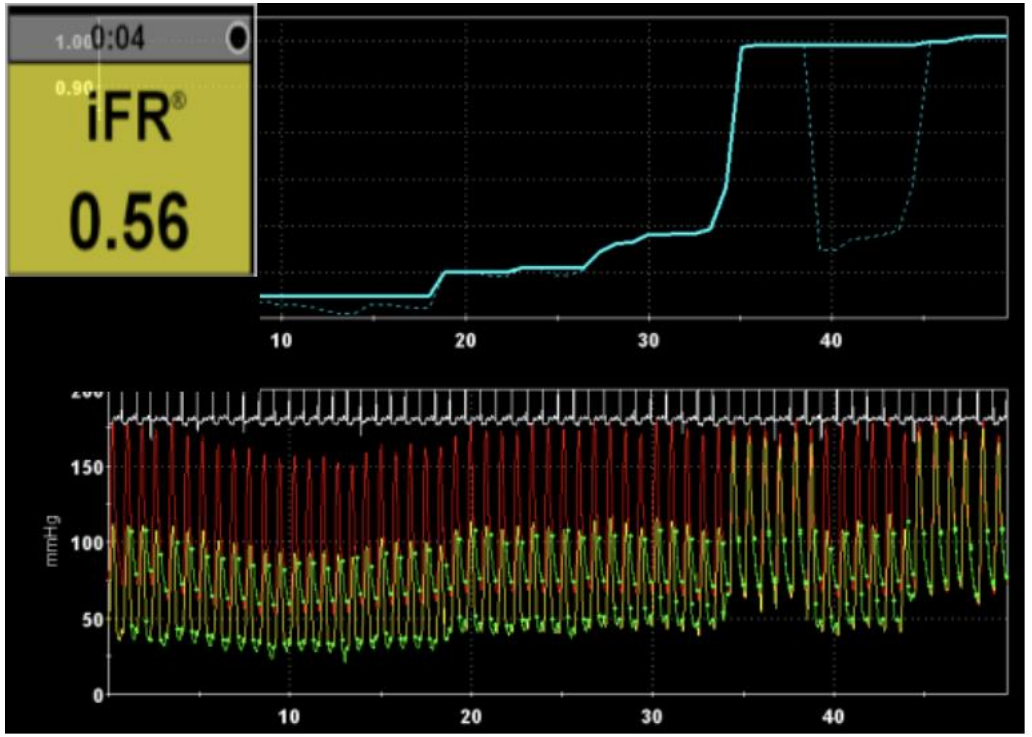
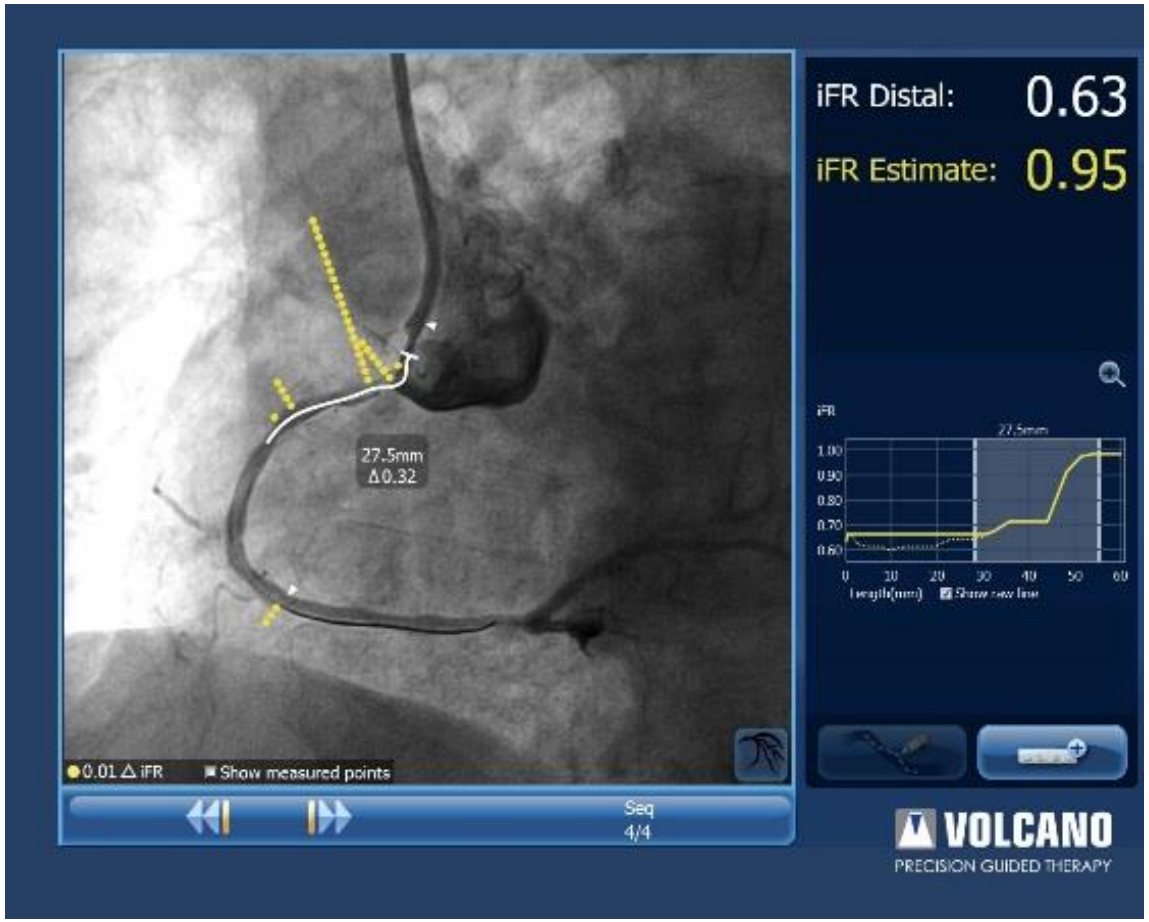
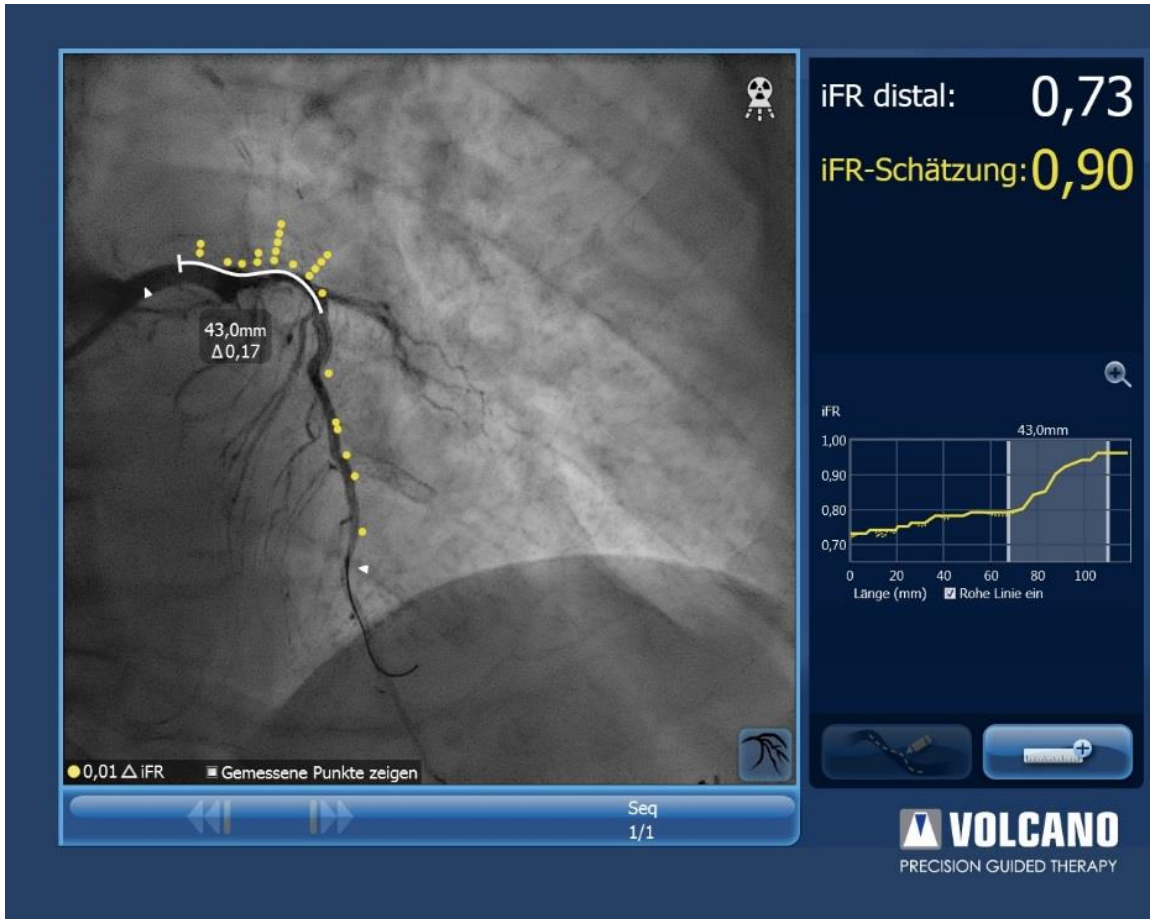
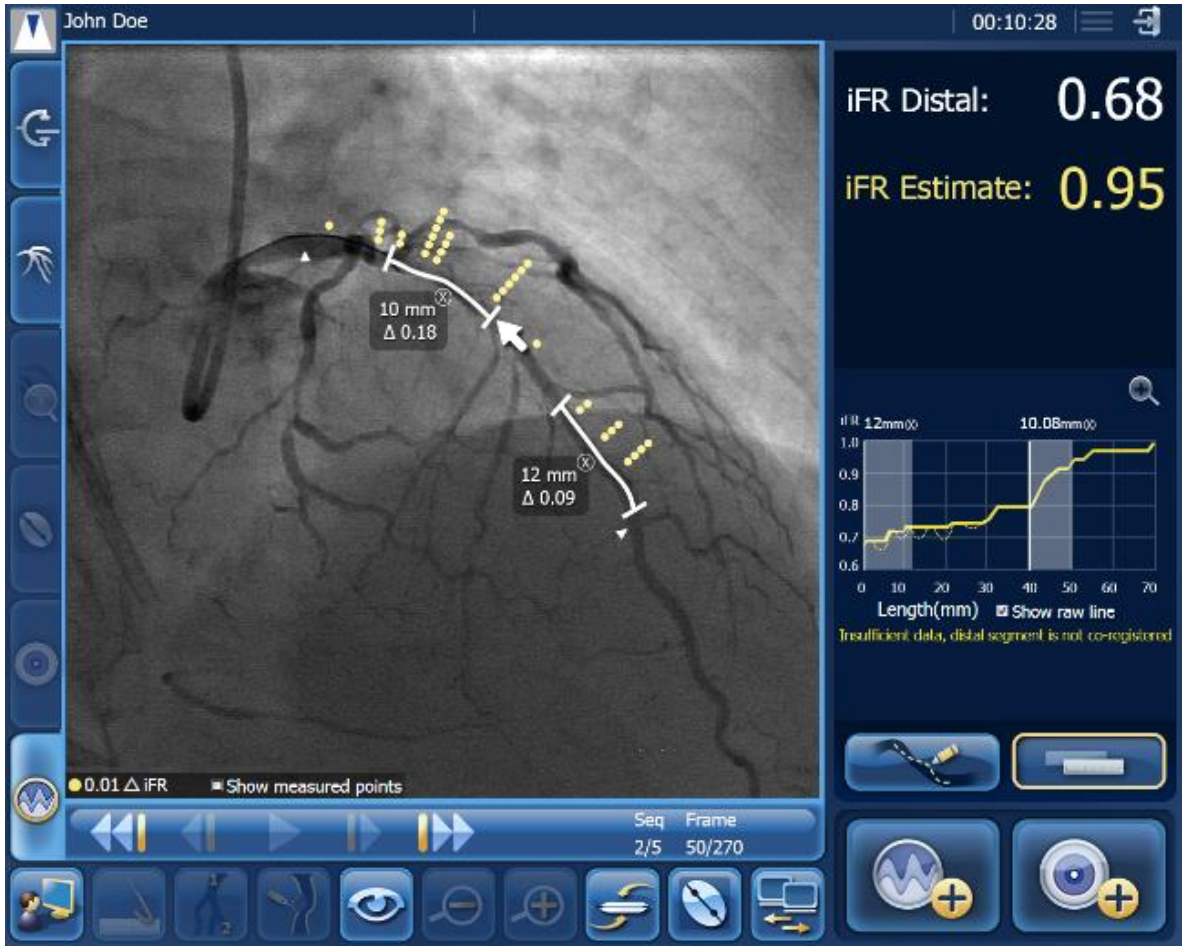


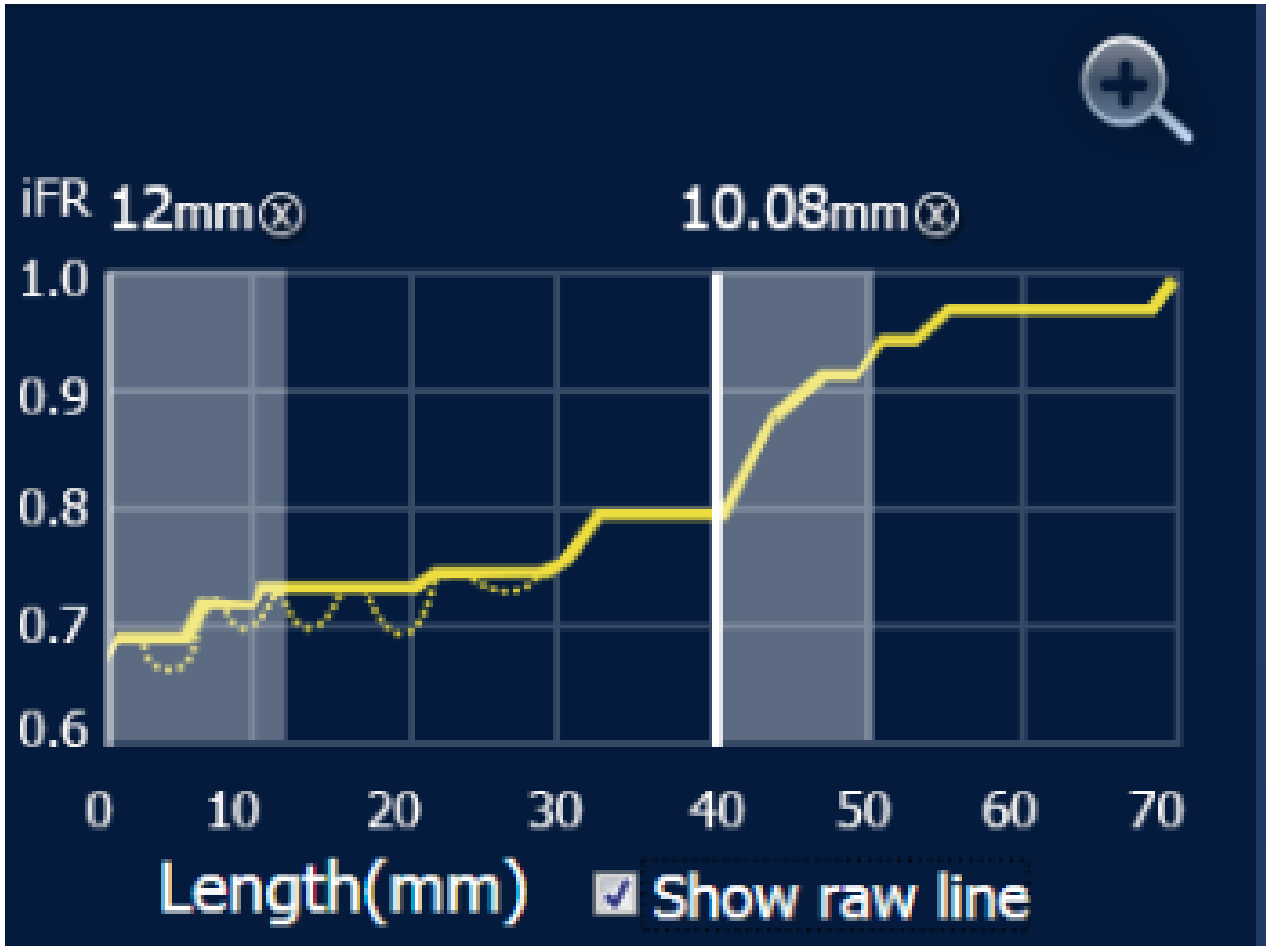
Maladie diffuse vs focale





Mesure des Longueurs sans pull back répétés / Procédure guidée par la physiologie/Estimation résultat physiologique post procédure





The NEW ENGLAND JOURNAL of MEDICINE

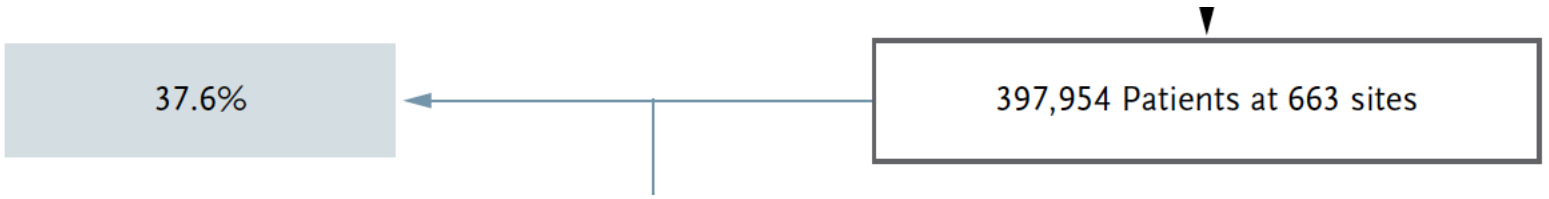
ORIGINAL ARTICLE

Low Diagnostic Yield of Elective Coronary Angiography

Manesh R. Patel, M.D., Eric D. Peterson, M.D., M.P.H., David Dai, M.S., J. Matthew Brennan, M.D., Rita F. Redberg, M.D., H. Vernon Anderson, M.D., Ralph G. Brindis, M.D., and Pamela S. Douglas, M.D.

NONINVASIVE TESTING

Noninvasive testing (resting electrocardiography, echocardiography, computed tomography [CT], or a stress test) was performed in 83.9% of the patients before invasive angiography. A positive test result was recorded in the case of 68.6% of all the patients in the cohort. A noninvasive test was not performed before angiography in 17.1% of low-risk patients, 15.9% of intermediate-risk patients, and 15.0% of high-risk patients (P<0.001).



N Engl J Med 2010;362:886-95

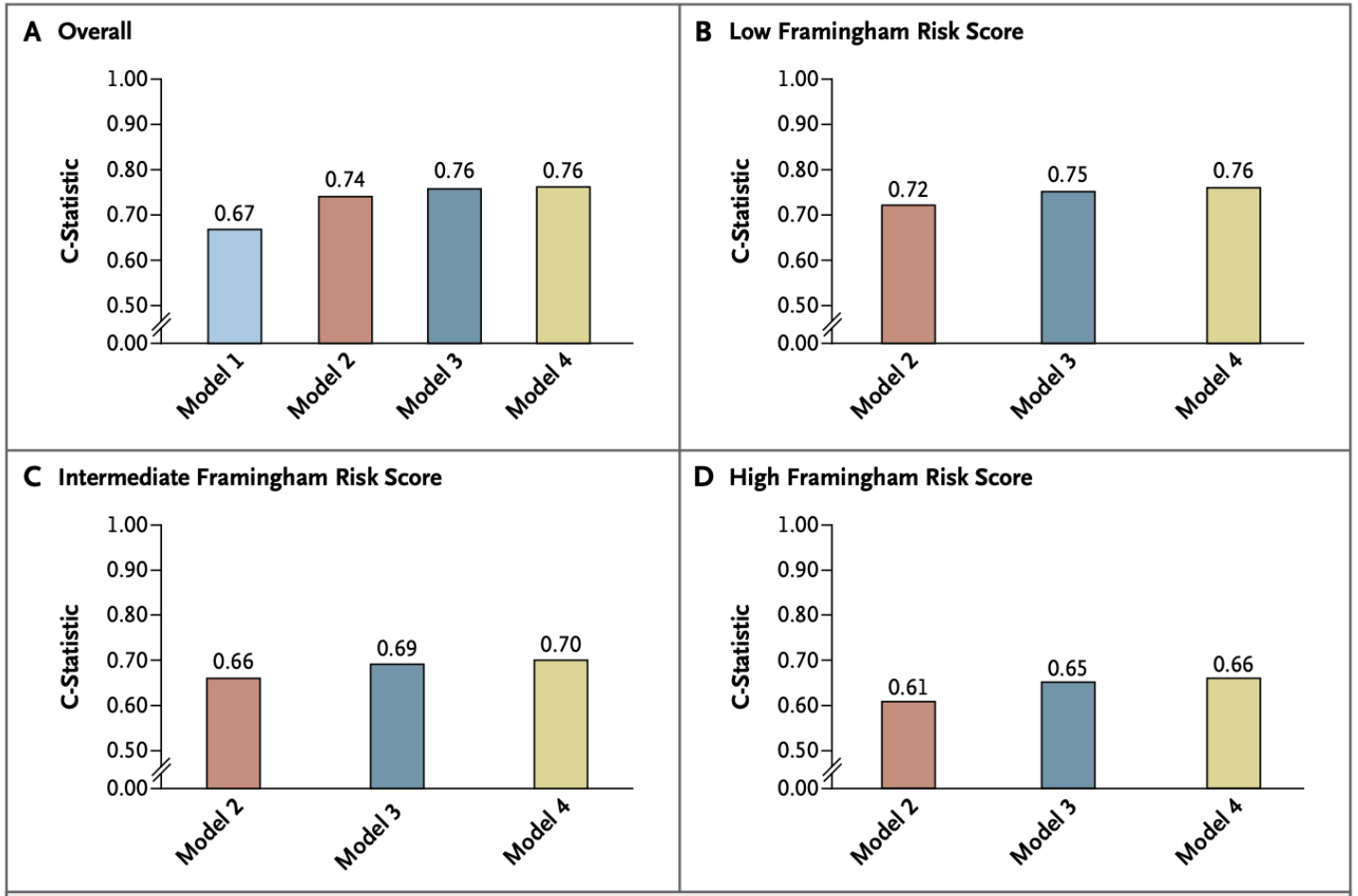
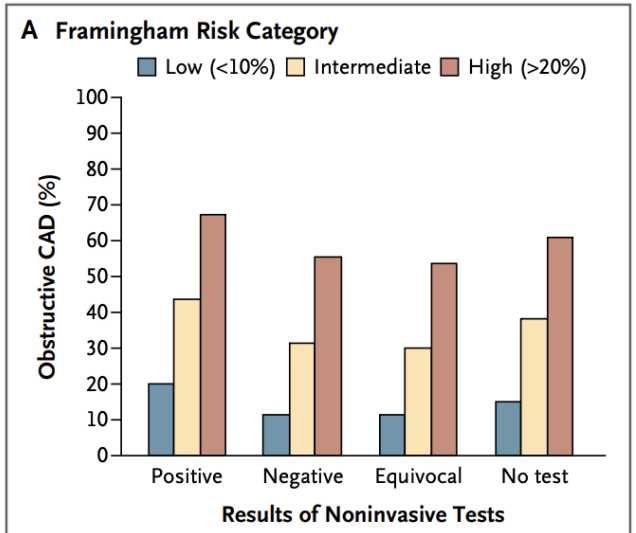


Figure 3. Ability of Information Obtained before Angiography to Predict Obstructive Coronary Artery Disease in the Overall Study Population and within Framingham Risk Categories.

Model 1 included the Framingham risk score only. Clinical risk factors were added in model 2, symptoms in model 3, and the results of noninvasive testing in model 4.



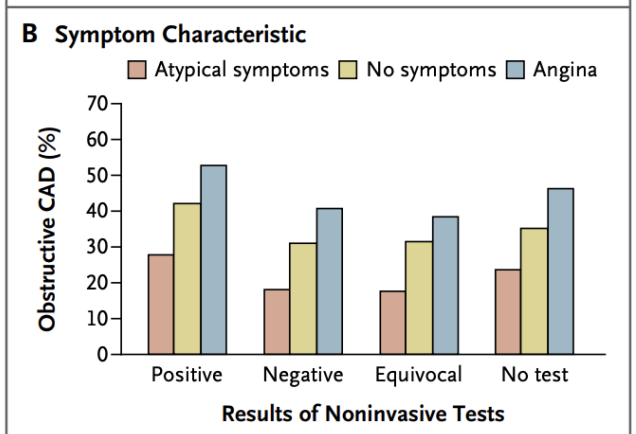


Figure 2. Patients with Obstructive Coronary Artery Disease, According to Noninvasive Test Result.

Results are presented according to the level of the Framingham risk score (low, intermediate, or high) (Panel A) and symptom category (no symptoms, atypical symptoms, or angina) (Panel B). CAD denotes coronary artery disease.

N Engl J Med 2010;362:886-95

Efficacy of Patient Selection for Diagnostic Coronary Angiography in Suspected Coronary Artery Disease

Francisco Flávio Costa Filho, Áurea Jacob Chaves, Lourenço Teixeira Ligabó, Eduardo Moreira dos Santos, Danillo Taiguara da Silva, Marcelo Aguiar Puzzi, Sérgio Luiz Braga, Alexandre Abizaid, Amanda GMR Sousa

Instituto Dante Pazzanese de Cardiologia, São Paulo, SP – Brazil

Conclusions: In this study, less than a quarter of the patients referred for coronary angiography with suspected CAD had the diagnosis confirmed. A better clinical and non-invasive assessment is necessary, to improve the efficacy of patient selection for coronary angiography. (Arq Bras Cardiol. 2015; 105(5):466-471)

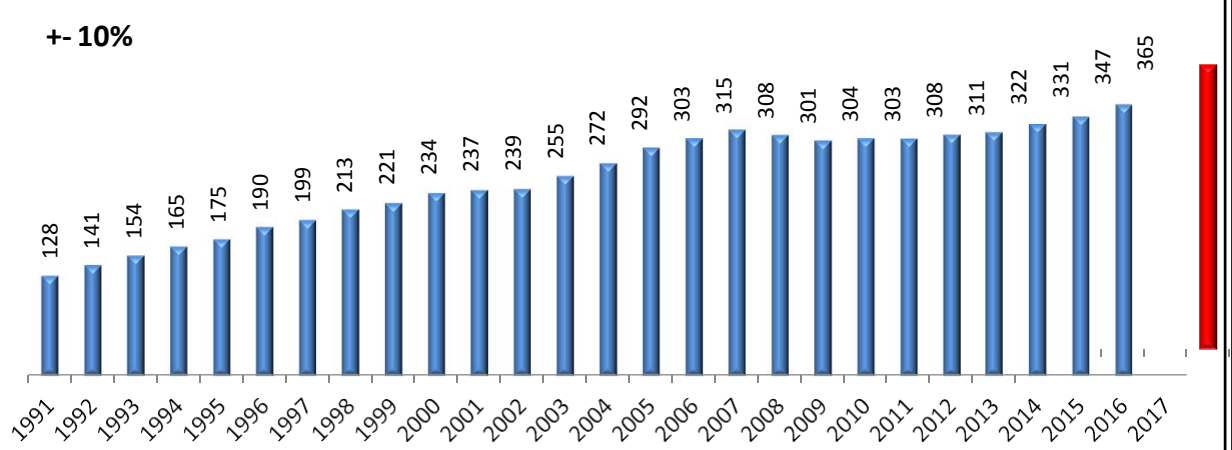
Table 2 – Predictors of obstructive CAD (stenosis ≥ 50% in left main coronary artery or ≥ 70% any epicardial vessels)

Variable	Odds Ratio	Confidence interval 95%	p Value
Age, every 5 years increase	1.15	1.06-1.26	0.002
Male gender	3.95	2.70-5.77	< 0.001
Diabetes	2.01	1.40-2.90	< 0.001
Dyslipidemia	2.02	1.32-3.07	0.001
Typical angina*	2.92	1.77-4.83	< 0.001
Non-invasive diagnostic test†	1.54	1.05-2.27	0.027

Non-invasive diagnostic test§, n (%)	538 (64.8)
ECG Stress testing	270 (32.5)
Myocardial radionuclide imaging	182 (21.9)
Stress echocardiography	12 (1.4)
Computed tomography coronary angiography	9 (1.1)
Resting electrocardiogram	30 (3.6)
Resting echocardiography	33 (4.0)

ACTIVITÉ CORONAROGRAPHIE

+ 5.3%

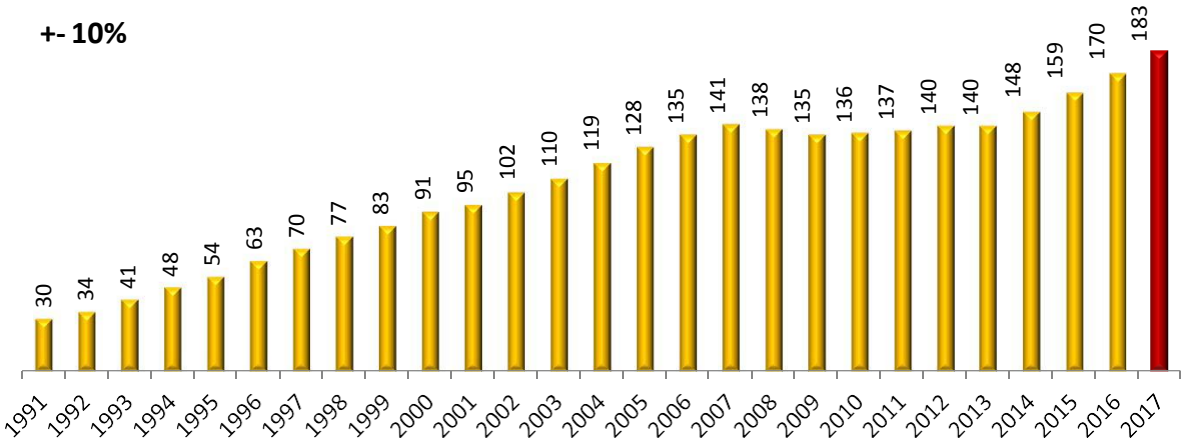


x 10^3

Source Enquête

ACTIVITÉ ANGIOPLASTIE

+ 7.8%

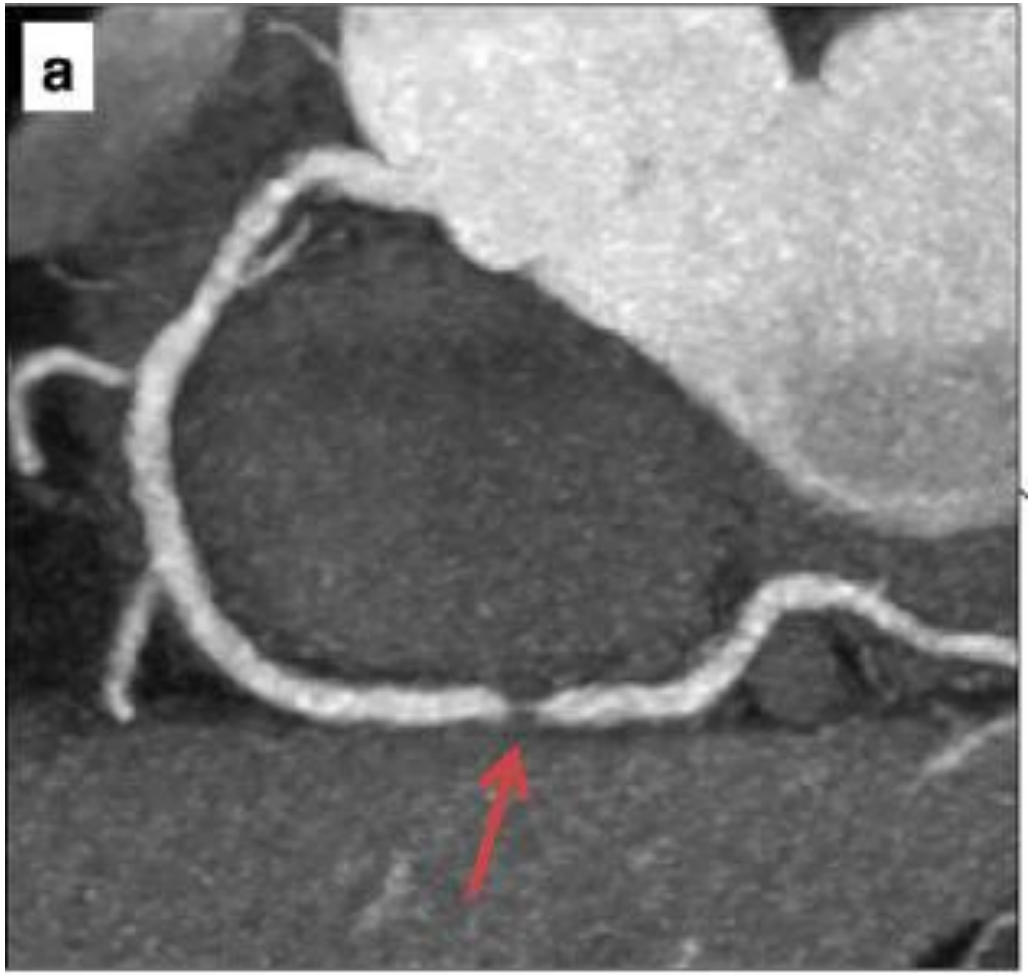


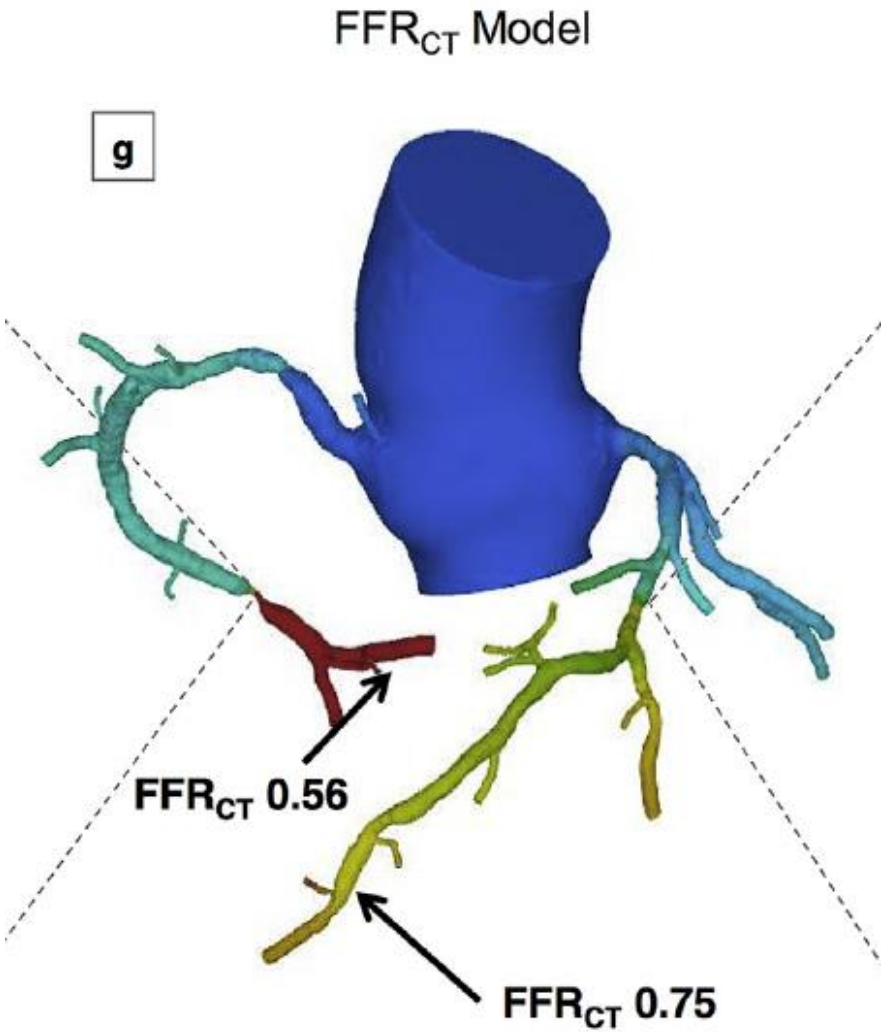
x 10^3

Source Enquête

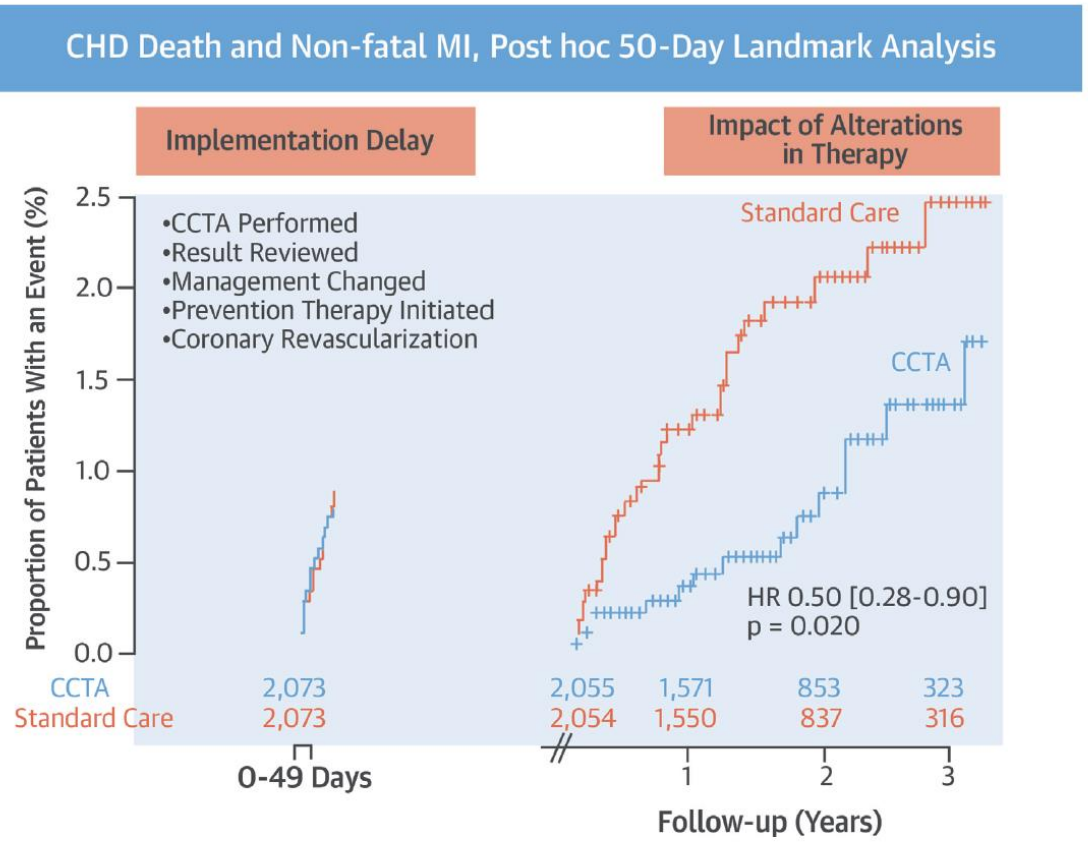
Blanchard D, HTC 2018

L’espion aux pattes de velours : le coro-scanner





CENTRAL ILLUSTRATION **Clinical Effect of CCTA in Suspected Angina Pectoris: Coronary Heart Disease Death and Nonfatal Myocardial Infarction**



Williams, M.C. et al. J Am Coll Cardiol. 2016;67(15):1759-68.

Post hoc landmark analysis at 50 days to account for the implementation and treatment delay consequent on the conduct, reporting, and communication of the coronary computed tomography angiography (CCTA) findings. HR = hazard ratio.

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 67, NO. 15, 2016

ISSN 0735-1097
http://dx.doi.org/10.1016/j.jacc.2016.02.026

ORIGINAL INVESTIGATIONS

Use of Coronary Computed Tomographic Angiography to Guide Management of Patients With Coronary Disease

Michelle C. Williams, MD,[a] Amanda Hunter, MD,[a] Anoop S.V. Shah, MD,[a] Valentina Assi, PhD,[b] Stephanie Lewis, PhD,[b] Joel Smith, PhD,[c] Colin Berry, MD,[d] Nicholas A. Boon, MD,[a] Elizabeth Clark,[a] Marcus Flather, MD,[e] John Forbes, PhD,[f] Scott McLean, PhD,[g] Giles Roditi, MD,[d] Edwin J.R. van Beek, MD,[a] Adam D. Timmis, MD,[h] David E. Newby, MD,[a] on behalf of the SCOT-HEART Investigators

JAMA Cardiology | Review

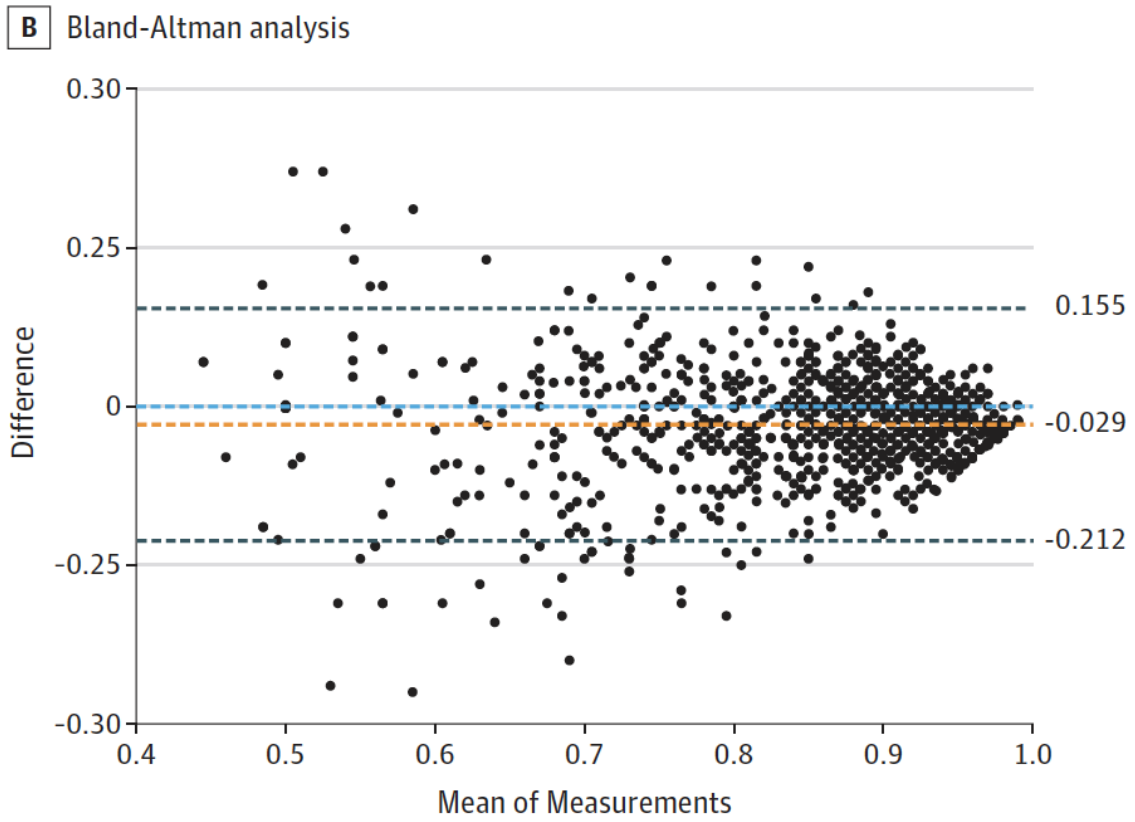
Diagnostic Accuracy of Computed Tomography-Derived Fractional Flow Reserve

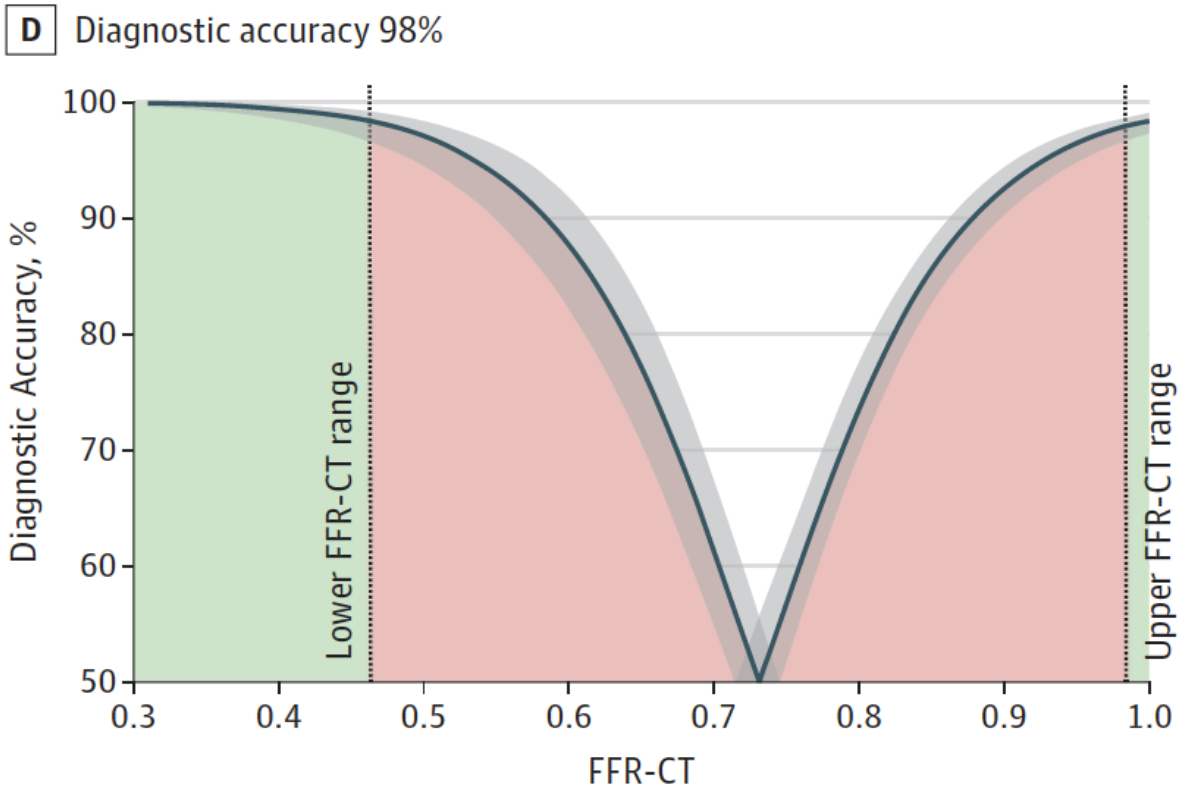
A Systematic Review

Christopher M. Cook, MBBS; Ricardo Petraco, MD, PhD; Matthew J. Shun-Shin, MBBS; Yousif Ahmad, MBBS; Sukhjinder Nijjer, MBChB; Rasha Al-Lamee, MBBS; Yuetsu Kikuta, MD; Yasutsugu Shiono, MD; Jamil Mayet, MBChB, MD, MBA; Darrel P. Francis, MB, BChir, MA, MD; Sayan Sen, MBBS, PhD; Justin E. Davies, MBBS, PhD

JAMA Cardiol. 2017;2(7):803-810.

Précision FFR CT





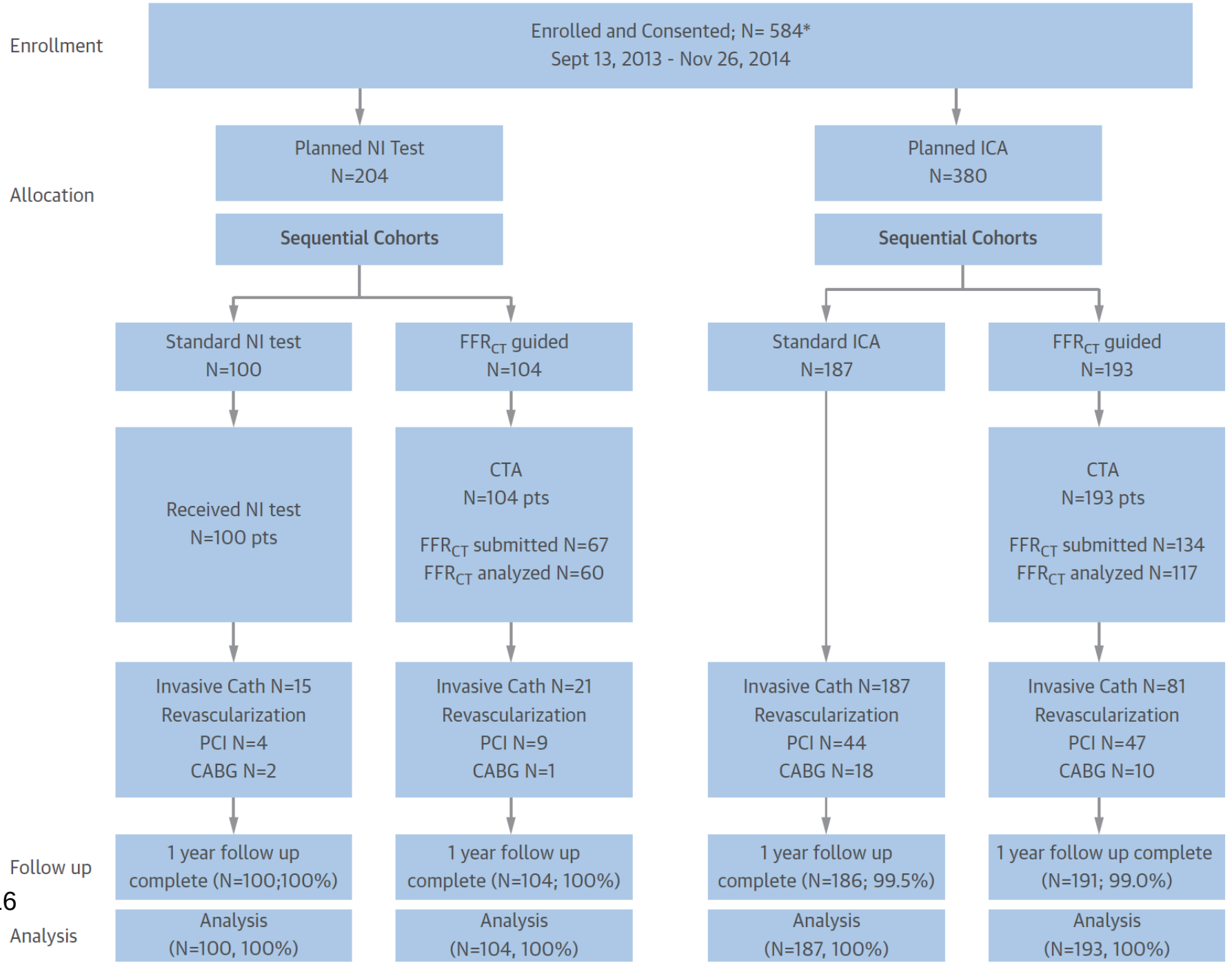
JAMA Cardiol. 2017;2(7):803-810.

1-Year Outcomes of FFR_{CT}-Guided Care in Patients With Suspected Coronary Disease

The PLATFORM Study

Pamela S. Douglas, MD,[a] Bernard De Bruyne, MD,[b] Gianluca Pontone, MD,[c] Manesh R. Patel, MD,[a] Bjarne L. Norgaard, MD,[d] Robert A. Byrne, MB BCh,[e] Nick Curzen, BM,[f] Ian Purcell, MD,[g] Matthias Gutberlet, MD,[h] Gilles Rioufol, MD,[i] Ulrich Hink, MD,[j] Herwig Walter Schuchlenz, MD,[k] Gudrun Feuchtner, MD,[l] Martine Gilard, MD,[m] Daniele Andreini, MD,[c] Jesper M. Jensen, MD,[d] Martin Hadamitzky, MD,[e] Karen Chiswell, PhD,[a] Derek Cyr, PhD,[a] Alan Wilk, BS,[n] Furong Wang, MD,[n] Campbell Rogers, MD,[n] Mark A. Hlatky, MD,[o] on behalf of the PLATFORM Investigators

J Am Coll Cardiol 2016;68:435–45

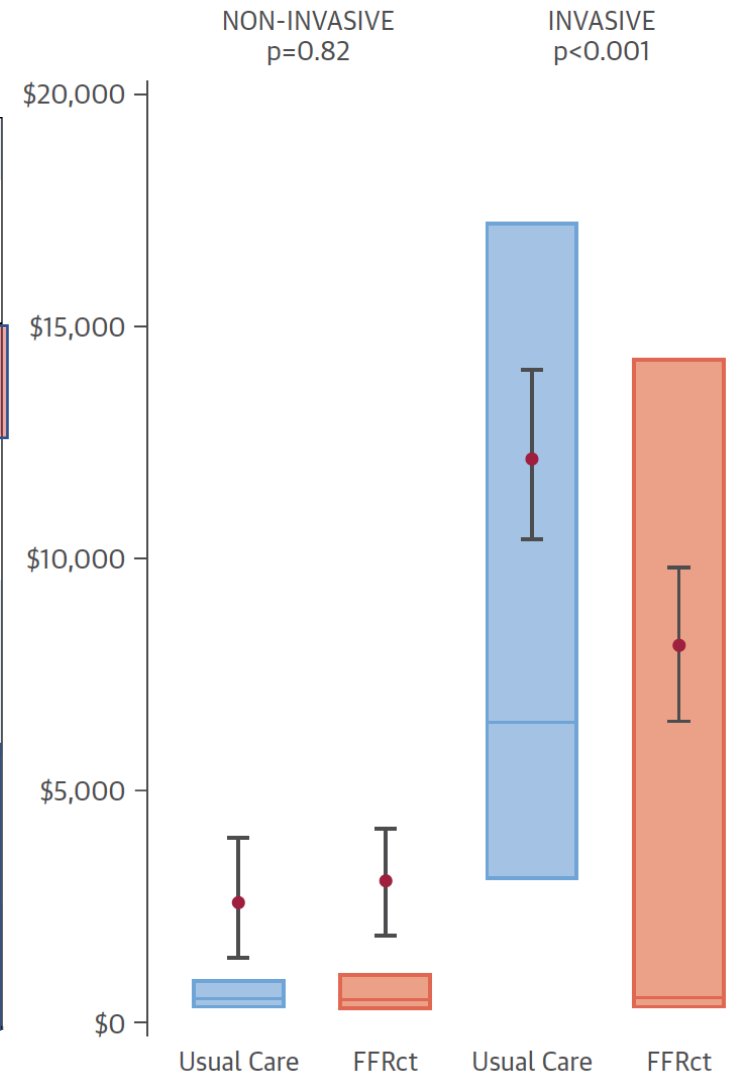


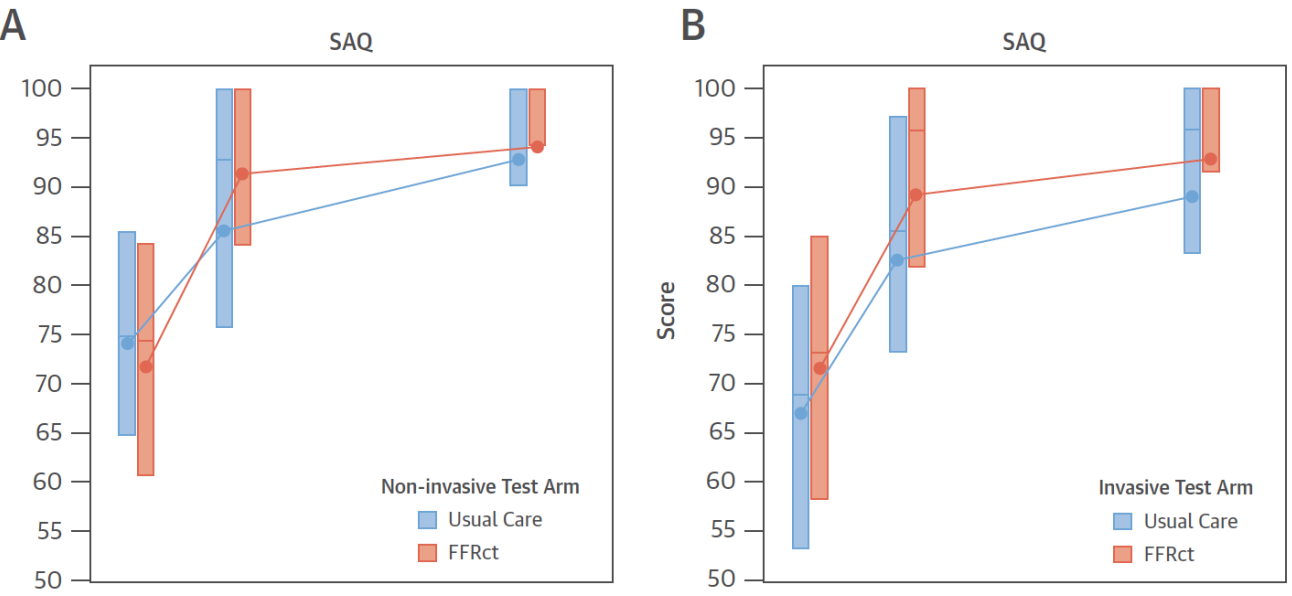
J Am Coll Cardiol 2016

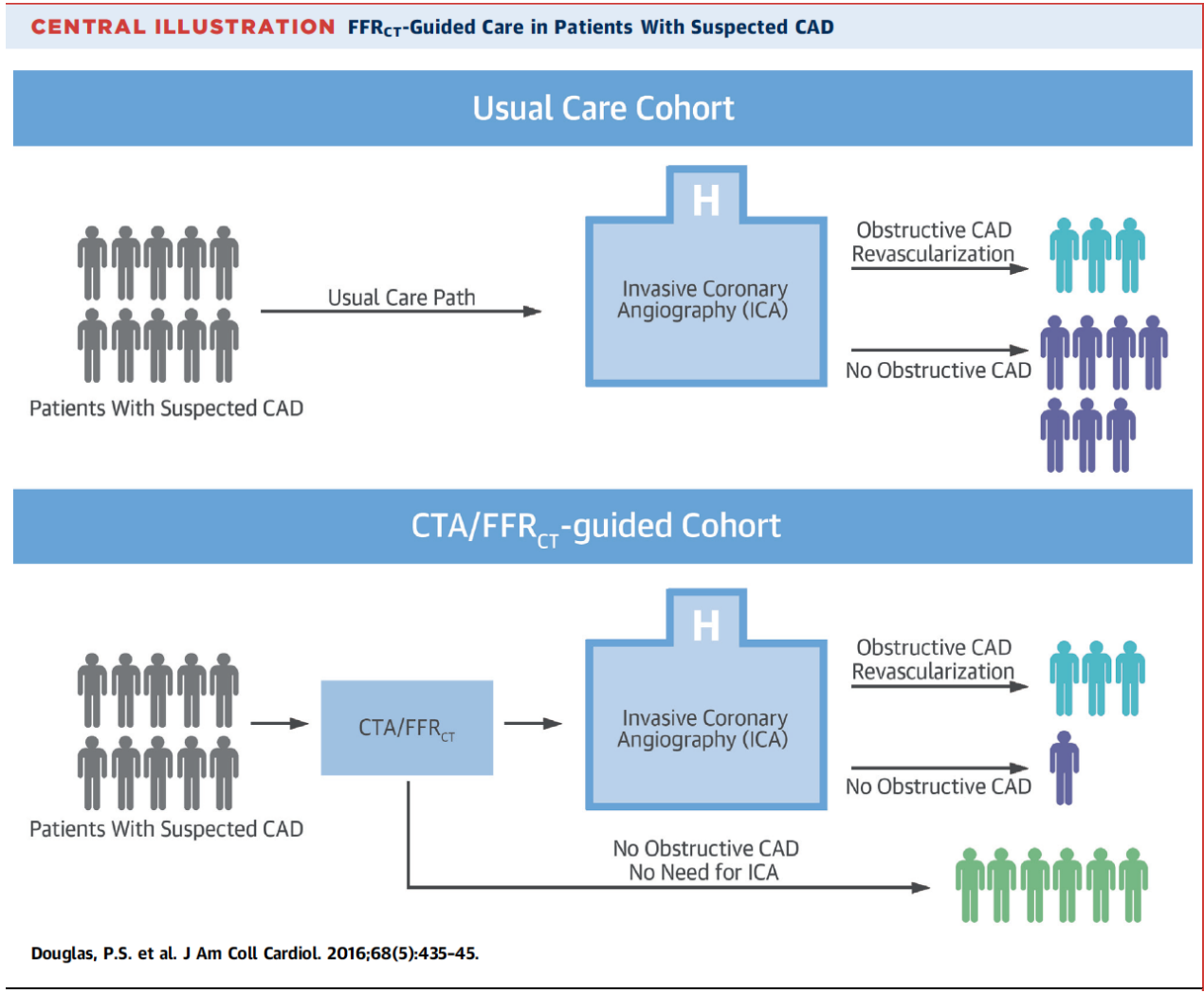
TABLE 1 1-Year Clinical Outcomes

	Planned Noninvasive Test (n = 204)			Planned Invasive Test (n = 380)		
	Usual Care Strategy (n = 100)	FFR_{CT}-Guided Strategy (n = 104)	p Value	Usual Care Strategy (n = 187)	FFR_{CT}-Guided Strategy (n = 193)	p Value
Invasive catheterization without obstructive CAD*						
Patients	6 (6.0)	13 (12.5)	0.95	137 (73.3)	24 (12.4)	<0.001
Risk difference, %	-6.5 (-14.4 to 1.4)†			60.8 (53.0 to 68.7)†		
MACE						
Patients	1	0		2	2	
Percentage	1.00 (0.03-5.45)†	0.00 (0.00-3.48)†		1.07 (0.13-3.81)†	1.04 (0.13-3.69)†	
Risk difference, %	-1.00 (-12.67 to 10.68)‡			-0.03 (-8.55 to 8.47)‡		
MACE components						
All-cause death	0 (0.0)	0 (0.0)		1 (0.5)	0 (0.0)	
Nonfatal MI	1 (1.0)	0 (0.0)		1 (0.5)	1 (0.5)	
Hospitalization with urgent revascularization	0 (0.0)	0 (0.0)		0 (0.0)	1 (0.5)	
MACE or vascular complications						
Patients	1	1		4	7	
Percentage	1.00 (0.03-5.45)†	0.96 (0.02-5.24)†		2.14 (0.59-5.39)†	3.63 (1.47-7.33)†	
Risk difference, %	-0.04 (-11.73 to 11.62)‡			1.49 (-7.05 to 9.95)‡		
Cumulative radiation exposure			<0.001			0.21
Mean ± SD, mSv	6.42 ± 7.47	9.55 ± 10.56		10.36 ± 6.69	10.72 ± 9.62	
Median (IQR), mSv	2.57 (0.00-10.58)	4.91 (2.49-12.37)		7.00 (7.00-15.00)	7.94 (2.67-17.32)	

FIGURE 2 1-Year Costs by Stratum and Evaluation Strategy







Douglas, P.S. et al. J Am Coll Cardiol. 2016;68(5):435–45.

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Clinical Use of Coronary CTA–Derived FFR for Decision-Making in Stable CAD

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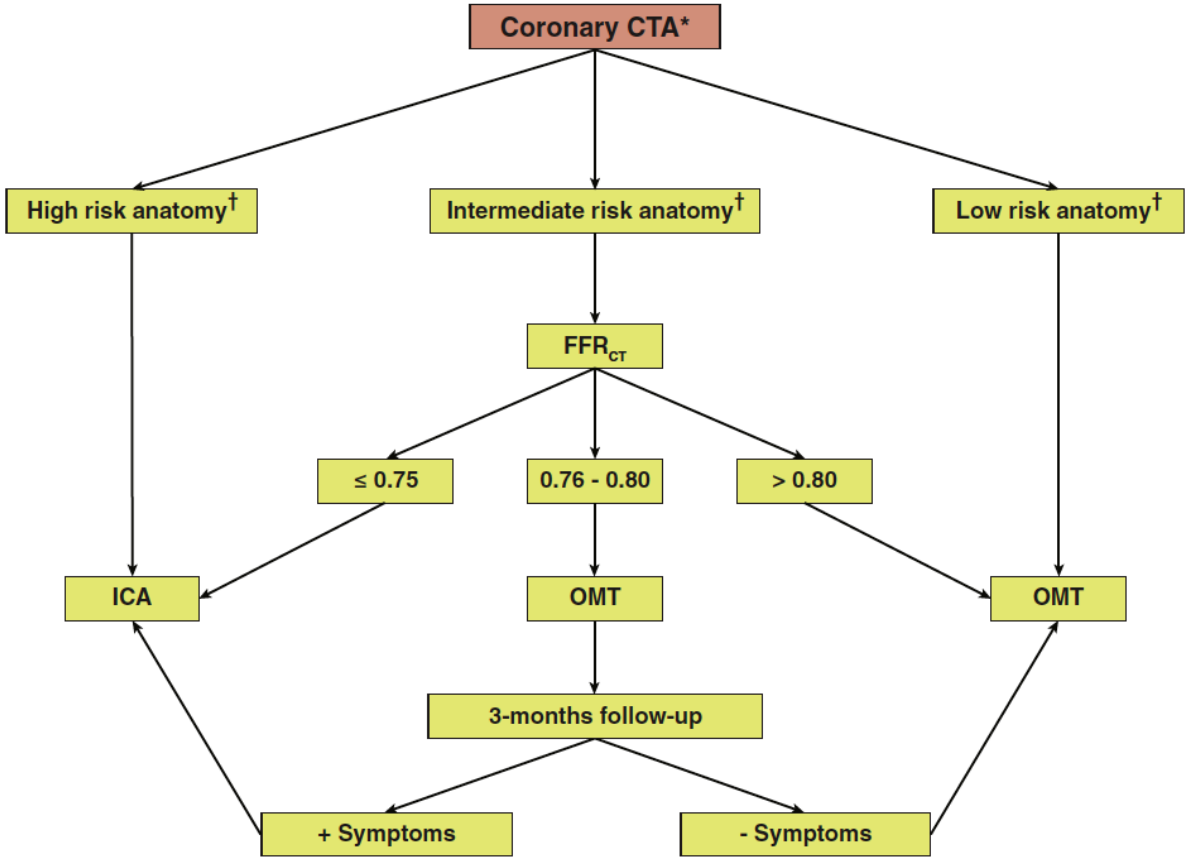
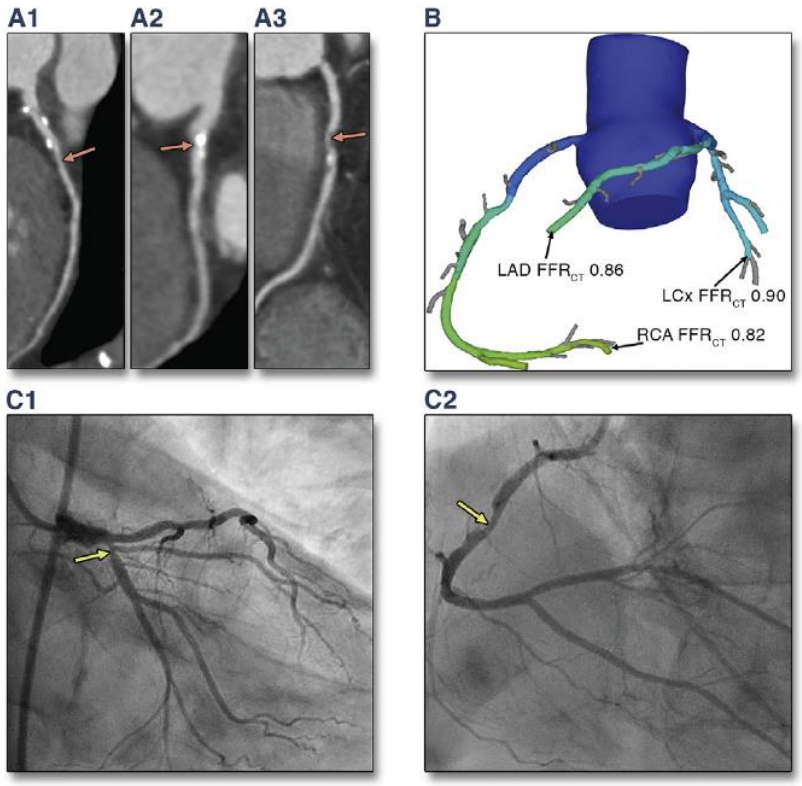
FIGURE 6 The "Aarhus" FFR_{CT} Decision-Rule Algorithm



*Patients with new-onset chest pain without known coronary artery disease, low to intermediate pre-test probability of disease, and in whom a diagnostic coronary CTA result can be expected. †"High risk anatomy" is defined as the presence of left main, 3-vessel and/or high-grade left anterior descending artery stenosis; "intermediate risk anatomy" as 1 or 2 intermediate stenoses (30% to 70%); and "low risk anatomy" as normal or stenosis <30%. Abbreviations as in Figures 2 and 4.

FIGURE 1 Patient Example



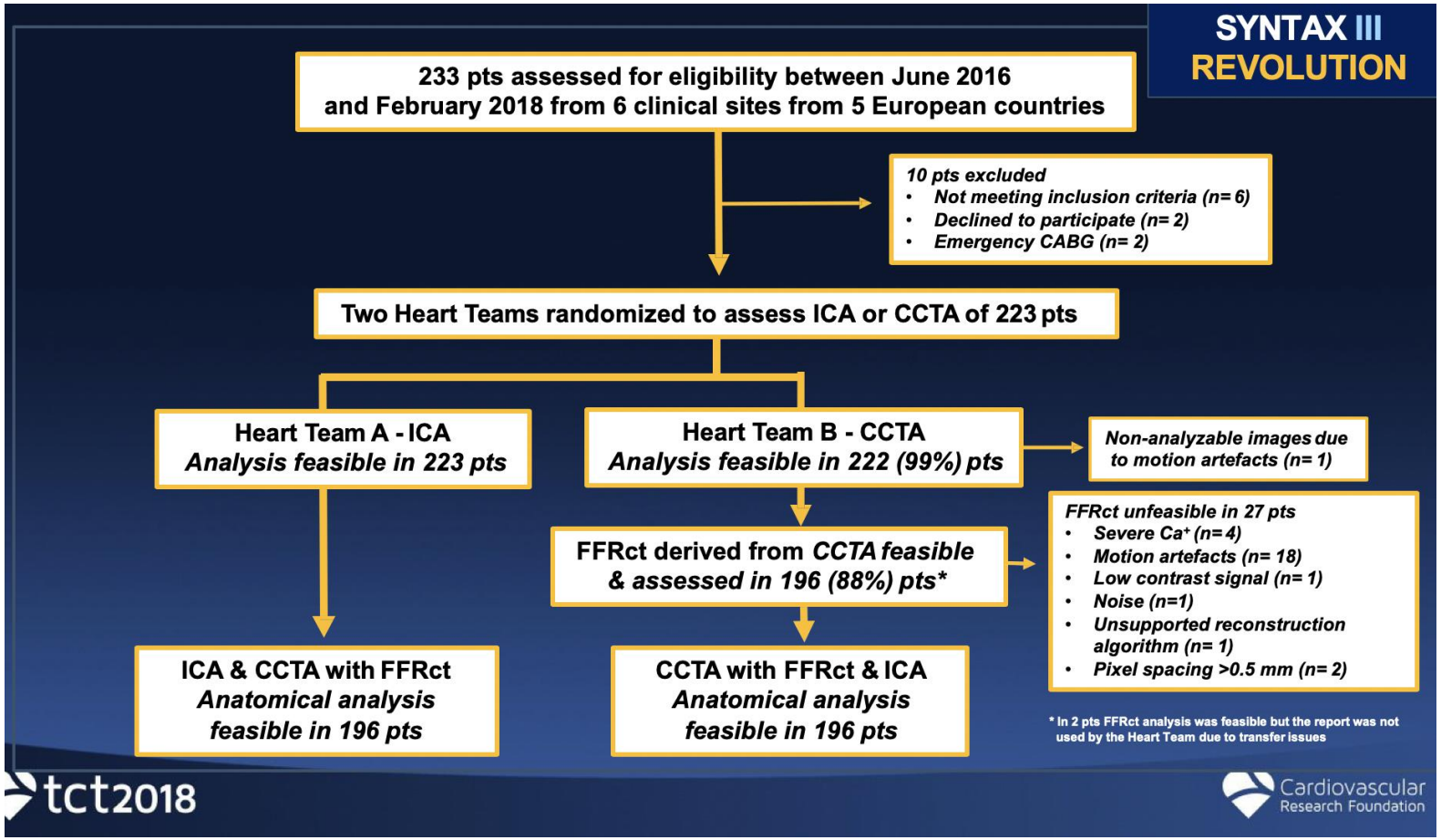
A 51-year-old man presented with new-onset atypical chest pain. **(A)** Coronary computed tomography angiography (curved multiplanar reconstructions) showed 50% to 70% stenoses **(pink arrows)** in the left anterior descending (LAD) **(A1)**, circumflex (LCx) **(A2)**, and right coronary (RCA) **(A3)** arteries, respectively. **(B)** Coronary computed tomography angiography-derived fractional flow reserve (FFR_{CT}) indicated that lesions were not hemodynamically significant. **(C)** Invasive coronary angiography demonstrated 2 50% to 60% stenoses **(yellow arrows)** in the **(C1)** LCx and the **(C2)** RCA, and mild luminal irregularities in LAD. FFR_{CT} values in LCx and RCA were 0.92 and 0.88, respectively; distally measured FFR in the LAD was 0.88.

Syntax III Revolution Trial

- **The *SYNTAX III REVOLUTION* trial sought to determine the agreement between separate *Heart Teams* on treatment recommendation based either on coronary *CCTA* or *invasive coronary angiography (ICA)* in patients with three-vessel CAD with or without left main stenosis.**
- **Moreover, the impact of *FFRct* on heart team treatment decision and procedural planning was evaluated.**

Antonio L. Bartorelli, TCT 2018

Syntax III Revolution Trial



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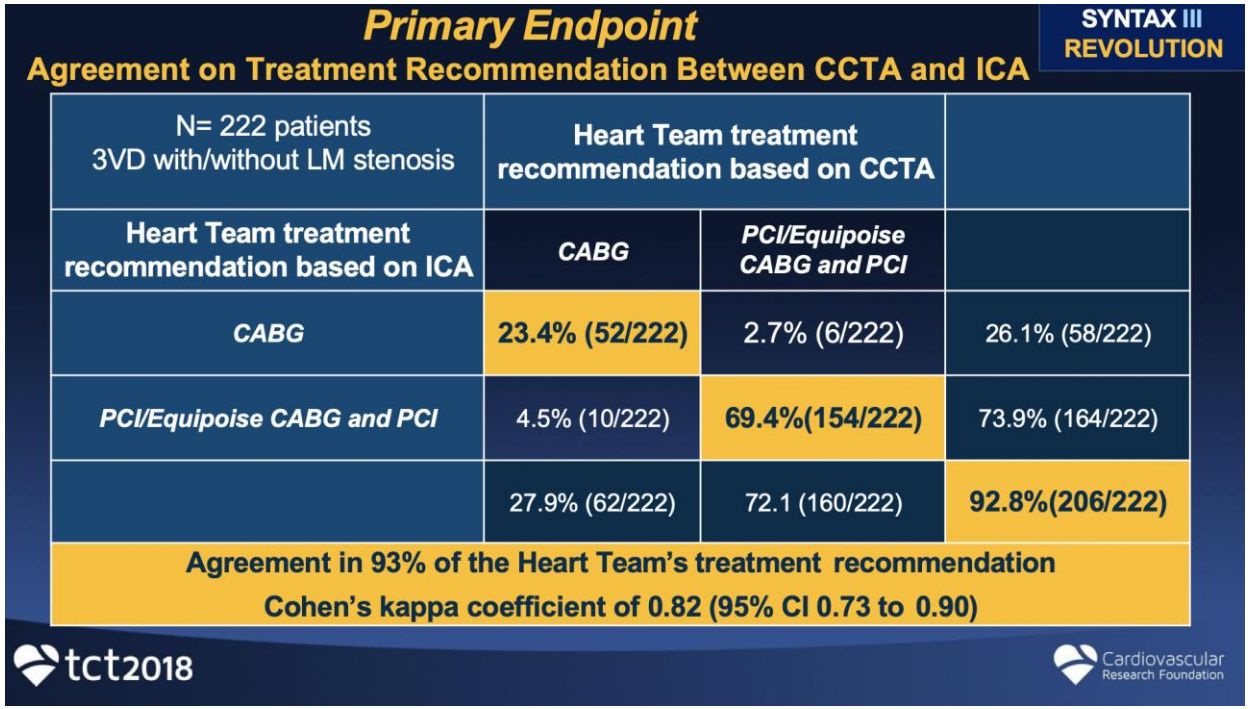
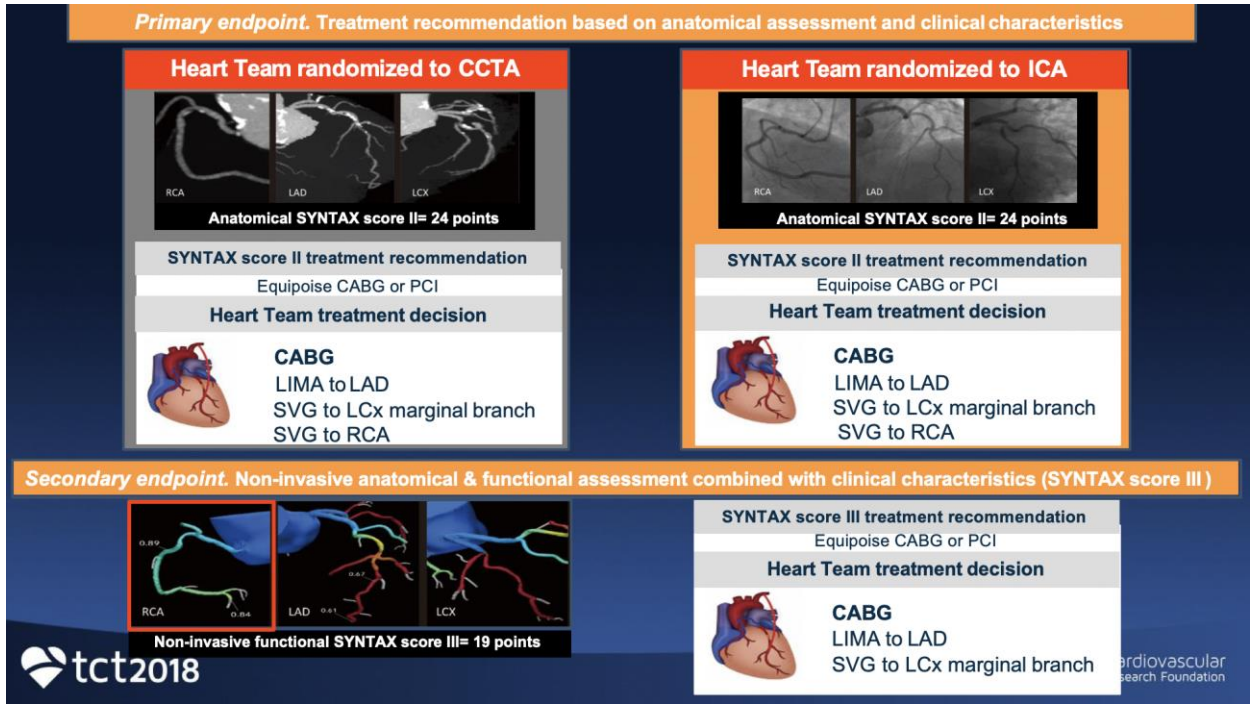
Syntax III Revolution Trial

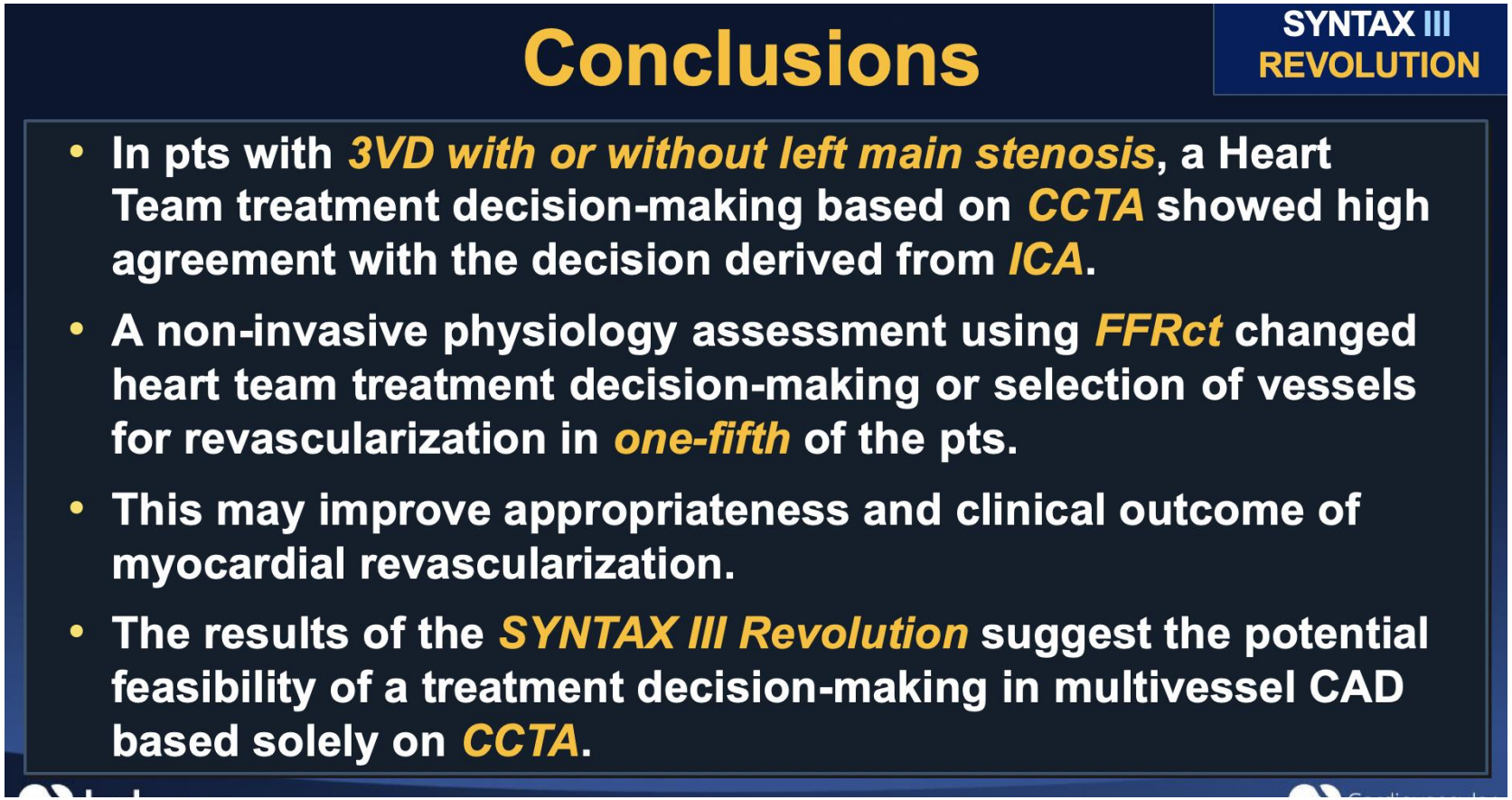




Antonio L. Bartorelli, PCR-TCT 2018

…. when you know in advance that it is a multivessel disease, you can immediately discuss with the surgeon based on the non-invasive imaging alone and go immediately to the operating room or the interventional suite to perform the intervention".

P Serruys



ESC European Society of Cardiology

European Heart Journal - Cardiovascular Imaging (2018) **19**, 405–414
doi:10.1093/ehjci/jex068

Computed tomography derived fractional flow reserve testing in stable patients with typical angina pectoris: influence on downstream rate of invasive coronary angiography

Jesper Møller Jensen[1]*, Hans Erik Bøtker[1], Ole Norling Mathiassen[1], Erik Lerkevang Grove[1], Kristian Altern Øvrehus[1], Kamilla Bech Pedersen[1], Christian Juhl Terkelsen[1], Evald Høj Christiansen[1], Michael Maeng[1], Jonathon Leipsic[2], Anne Kaltoft[1], Lars Jakobsen[1], Jacob Thorsted Sørensen[1], Troels Thim[1], Steen Dalby Kristensen[1], Lars Romer Krusell[1], and Bjarne Linde Nørgaard[1]

Table I Local recommendation for diagnostic work-up in patients referred for coronary CTA or ICA between 1 January 2016 and 30 June 2016

Frontline coronary CTA	Test outcome	Diagnostic consequence
Conclusive	High risk anatomy[a]	OMT and ICA ($\pm FFR_{CT}$[d])
	Intermediate risk anatomy[b]	OMT and FFR_{CT}[e]
	Low risk anatomy[c]	OMT
Inconclusive		OMT, MPI or ICA
FFR_{CT}	**Test outcome**	**Clinical recommendation**
Conclusive	>0.8	OMT
	0.75–0.8	OMT and follow-up[f]
	<0.75 diffuse disease[g]	OMT and follow-up[f]
	<0.75 focal stenosis[h]	OMT and ICA
Inconclusive		OMT or ICA

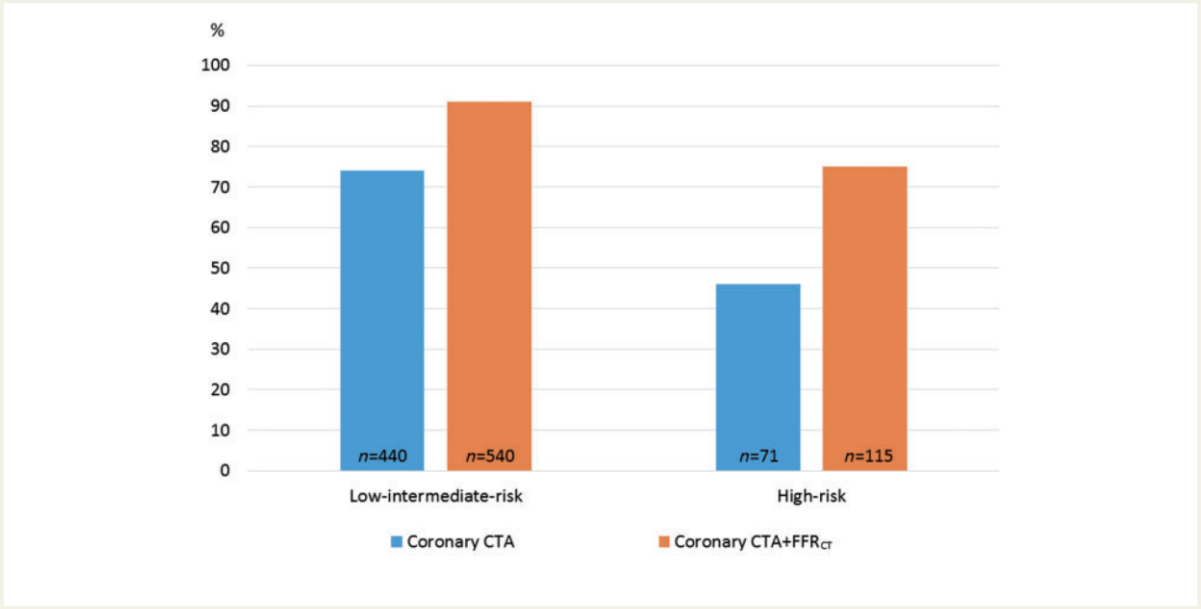


Figure 2 Effect of FFR_{CT} testing on cancellation of ICA. The Y-axis shows percentage in each risk group. CTA, CT angiography; FFR_{CT}, prescribed coronary CTA derived fractional flow reserve.

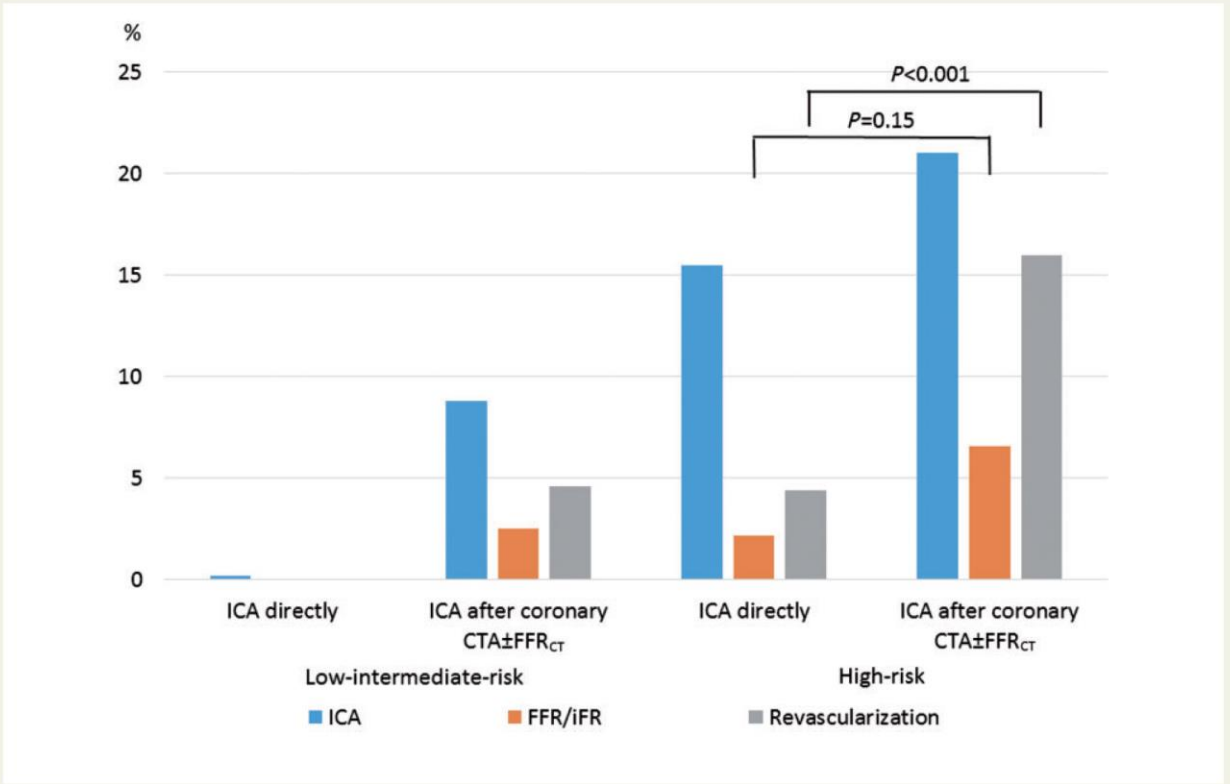


Figure 5 Use of FFR and revascularization following ICA. Numbers refer to percentage in each risk group. In patients referred to coronary CTA revascularization was performed more frequently in high-risk as compared with low-intermediate risk ($P = 0.03$) without significant difference in use of FFR/iFR ($P = 0.78$). Of the 56 patients in whom coronary revascularization was performed after coronary CTA with optional FFR_{CT}, 59% (33/56) had FFR_{CT} performed, 21% (12/56) had FFR_{CT} plus FFR and/or iFR, and 20% (11/56) had neither performed. ICA, invasive coronary angiography;

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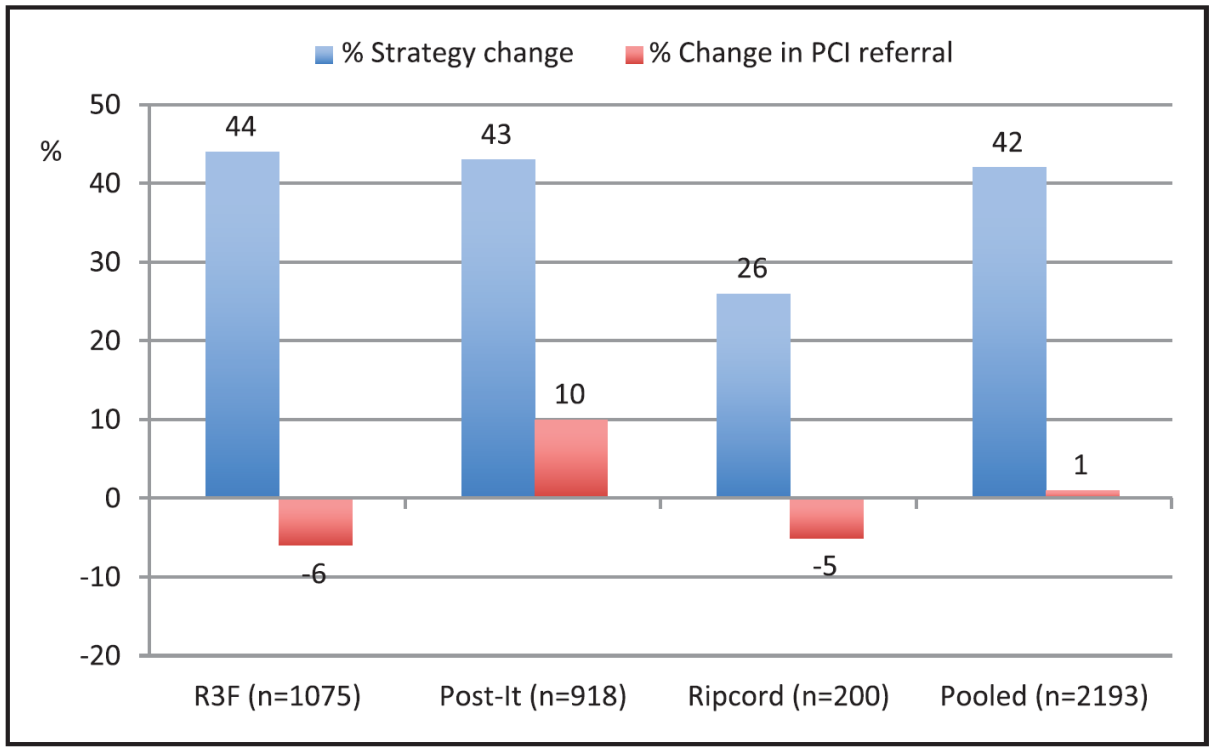
Quel Impact sur l'activité de revascularisation ?



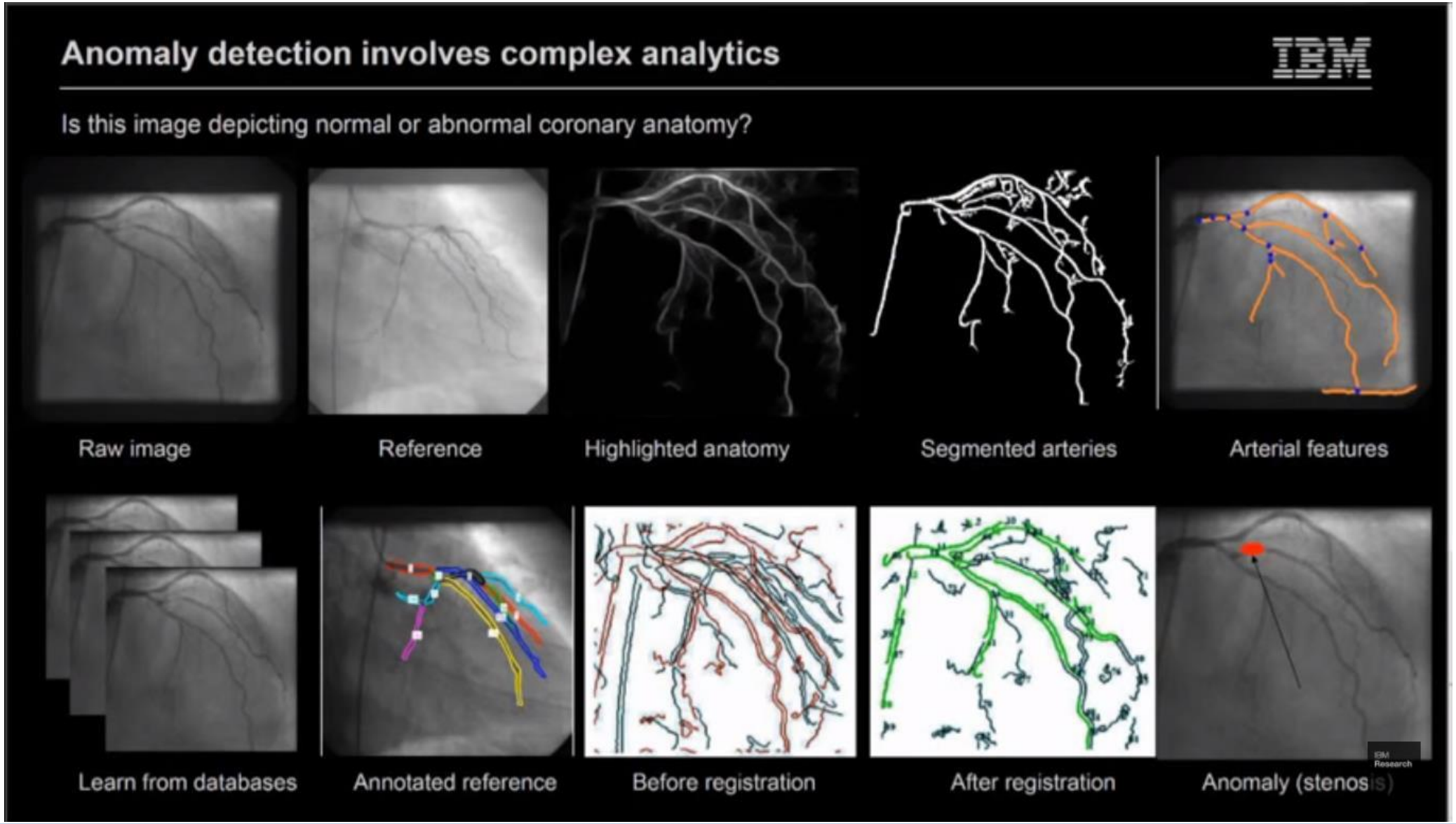
Van Belle; Dupouy et al. Circ Cardiovasc Interv 2016

TABLE 2 Resource Use Over 12 Months After Enrollment

	Planned Noninvasive Test (n = 204)		Planned Invasive Test (n = 380)	
	Usual Care Strategy (n = 100)	FFR_{CT}-Guided Strategy (n = 104)	Usual Care Strategy (n = 187)	FFR_{CT}-Guided Strategy (n = 193)
Noninvasive tests				
Stress electrocardiography	11	9	17	19
Stress echocardiography	29	2	5	6
Stress nuclear	17	8	6	3
Magnetic resonance imaging	3	3	6	3
Coronary CT angiography	62	104	1	194
FFR_{CT}	0	60	0	117
Invasive procedures				
Diagnostic ICA	11	13	159	44
ICA with PCI	5	9	44	55
FFR_{INV}	0	5	12	29
Intravascular ultrasound	3	2	8	5
Optical coherence tomography	0	0	3	1
Coronary revascularization				
PCI	5	9	49	55
Bypass surgery	2	1	18	10
Total hospital days	43	57	514	283
Clinic visits	56	48	162	111

J Am Coll Cardiol 2016;68:435–45

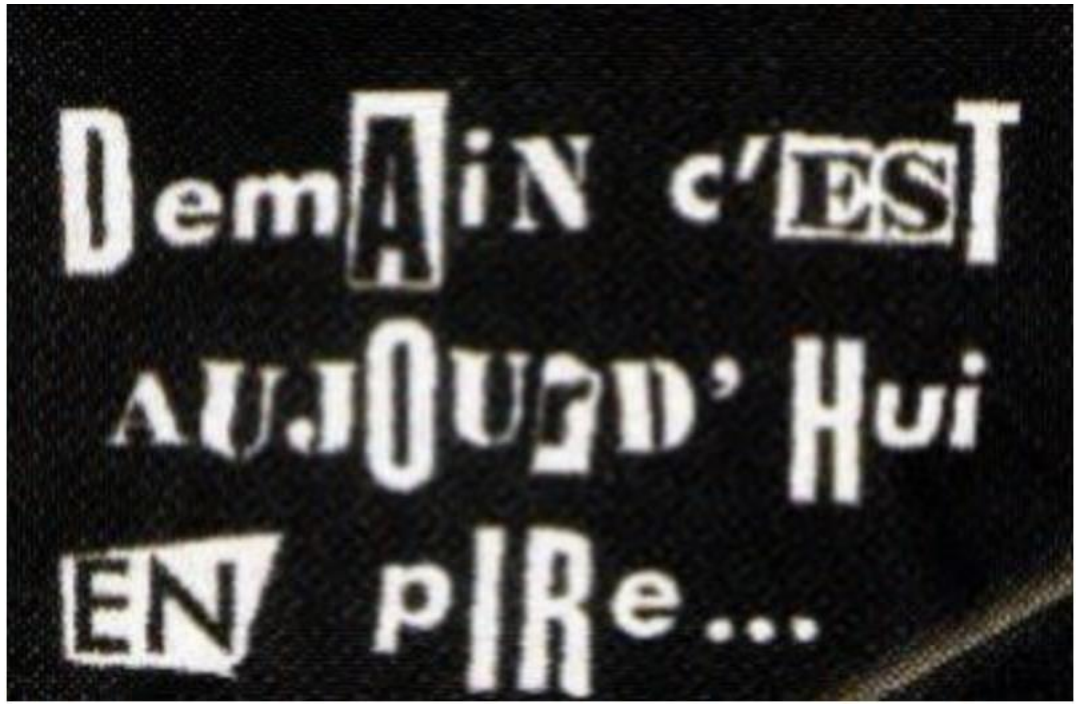
Intelligence Artificielle



SAN FRANCISCO (Reuters) - Amazon a mis au point en 2014 un programme informatique secret basé sur l'intelligence artificielle (IA) pour le recrutement de ses effectifs mais le géant informatique y a renoncé trois ans plus tard après avoir découvert une faille majeure dans le système : il n'aimait pas les femmes.

Conclusions

- Vers la fin du réflexe oculo sténotique
- Vers une angioplastie mieux préparée
- Vers la disparition de la coronarographie diagnostique ?



Le meilleur moyen de prédire l’avenir est de le créer
Peter Drucker