PHYSIODAY
JOURNÉES DE PHYSIOLOGIE
EN CARDIOLOGIE INTERVENTIONNELLE

FFR pourquoi faire ?

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PCV2I Clinique les Fontaines, Melun / Institut Montsouris, Paris

5&6 AVRIL 2024

HÔTEL SHERATON · NICE

Pas de conflit d’intérêt

- Pourquoi faire de la FFR
- Pourquoi ne pas faire de FFR
- Ça sert à quoi la FFR
- Sur quelles lésions faire la FFR ?

Google

too much coronary stents

Tous | Images | Vidéos | Actualités | Livres | Plus | Outils

Environ 18 000 000 résultats (0,33 secondes)

Lown Institute Hospital Index
https://lownhospitalsindex.org › a... · Traduire cette page

Avoiding Overuse: Coronary Stents

31 oct. 2023 — Medicare wasted as much **as $2.44 billion** on unnecessary stents from 2019-2021. Rates of overuse varied widely: at some hospitals, more than 50 ...

Autres questions

- How many heart stents is too many?
- What is the record for most coronary stents?
- Are heart stents overused?
- What happens to heart stents over time?

Commentaires

USA Today
https://www.usatoday.com › news › health › 2023/10/31

Coronary stent overuse on Medicare patients ... - USA Today

31 oct. 2023 — A widely-cited study in 2007 showed that using stents, **medication and lifestyle changes didn't reduce deaths, heart attacks or hospitalizations** ...

healthcare-in-europe.com
https://healthcare-in-europe.com › ... · Traduire cette page

Too many coronary stent procedures

2 sept. 2014 — Too many coronary stent procedures · In **uncomplicated stable angina cases** no evidence suggests that angioplasty reduces heart attacks or death ...

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 ($P<0.001$).

Stenting Bashing

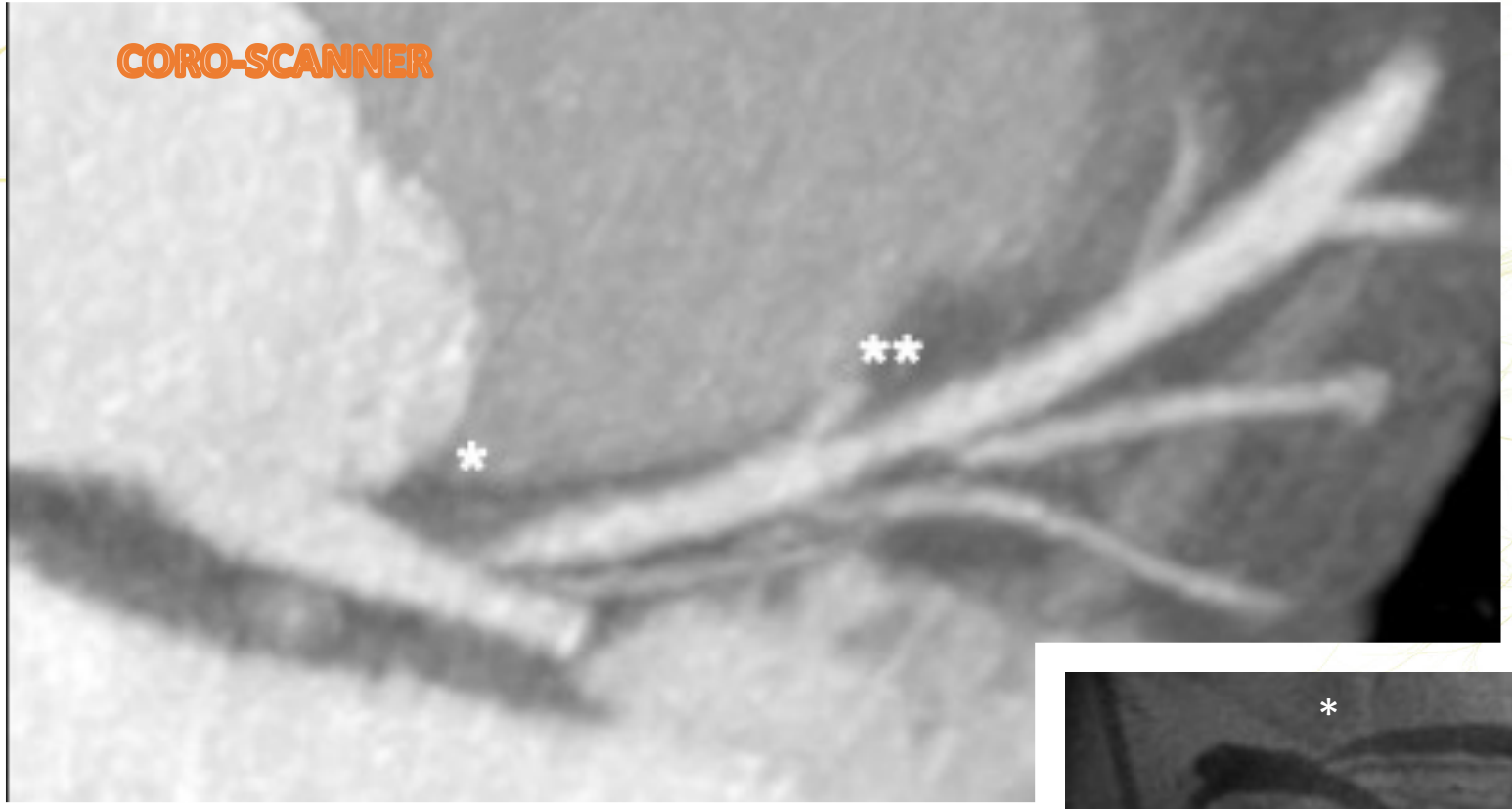
COURAGE 2007

ORBITA 2017

ISCHEMIA 2019

REVIVED 2022

FFR


CORO-SCANNER
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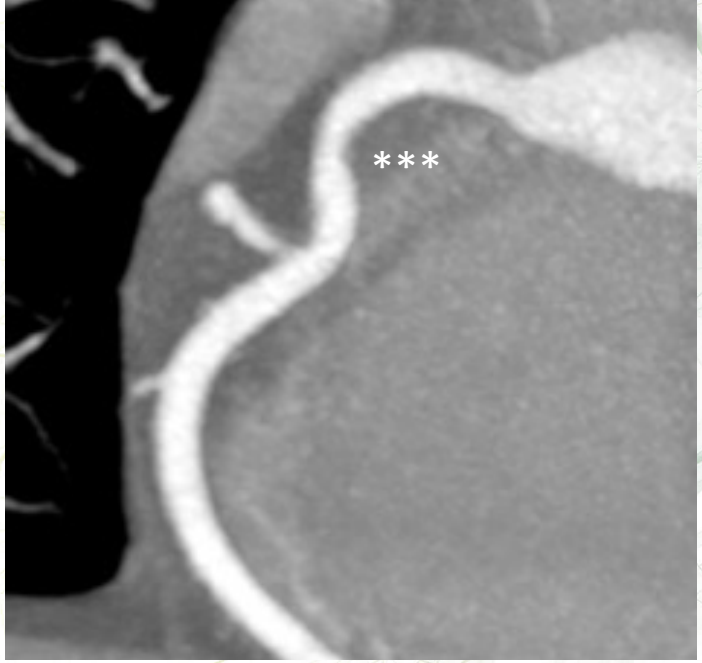
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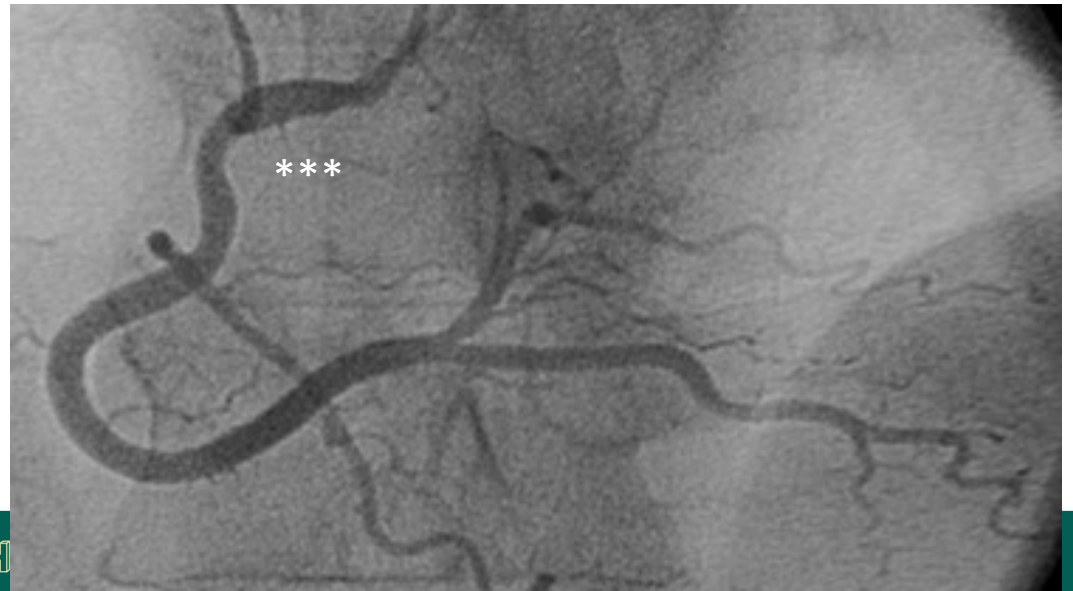
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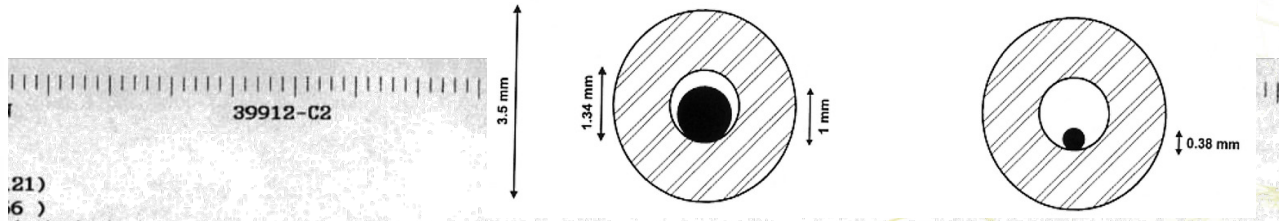
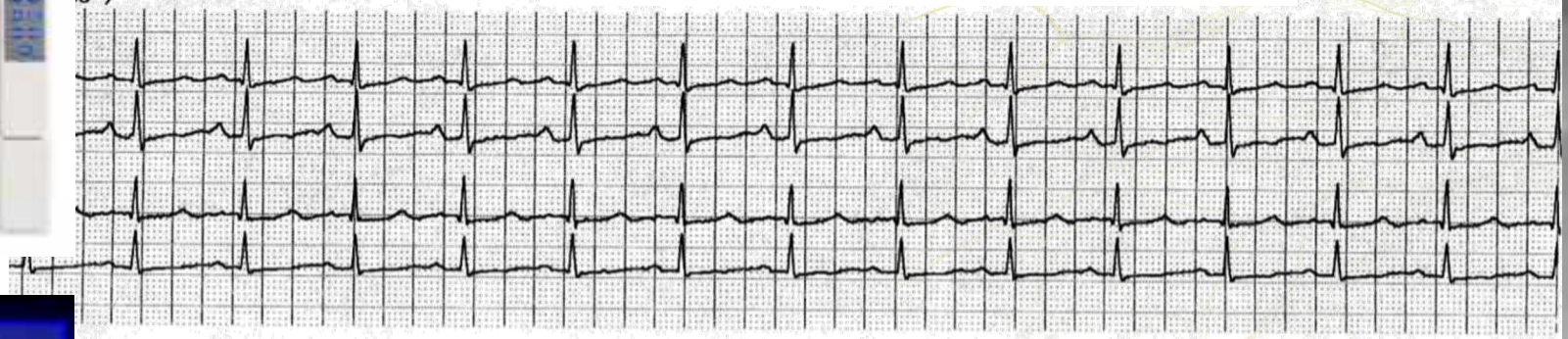
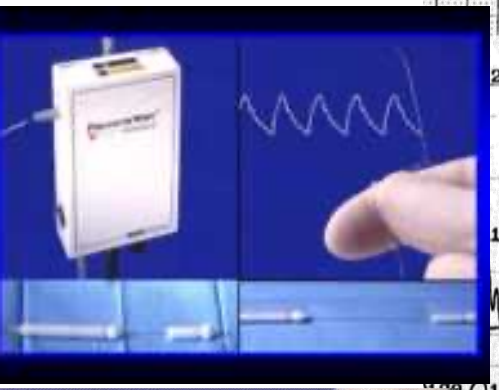
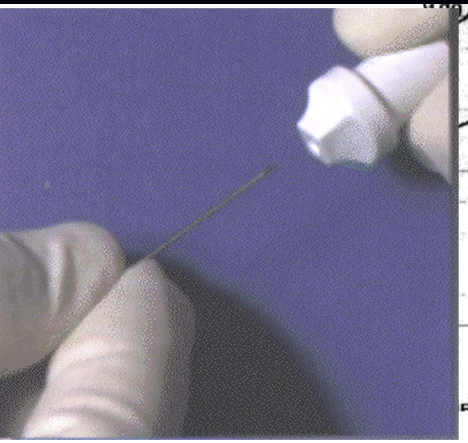
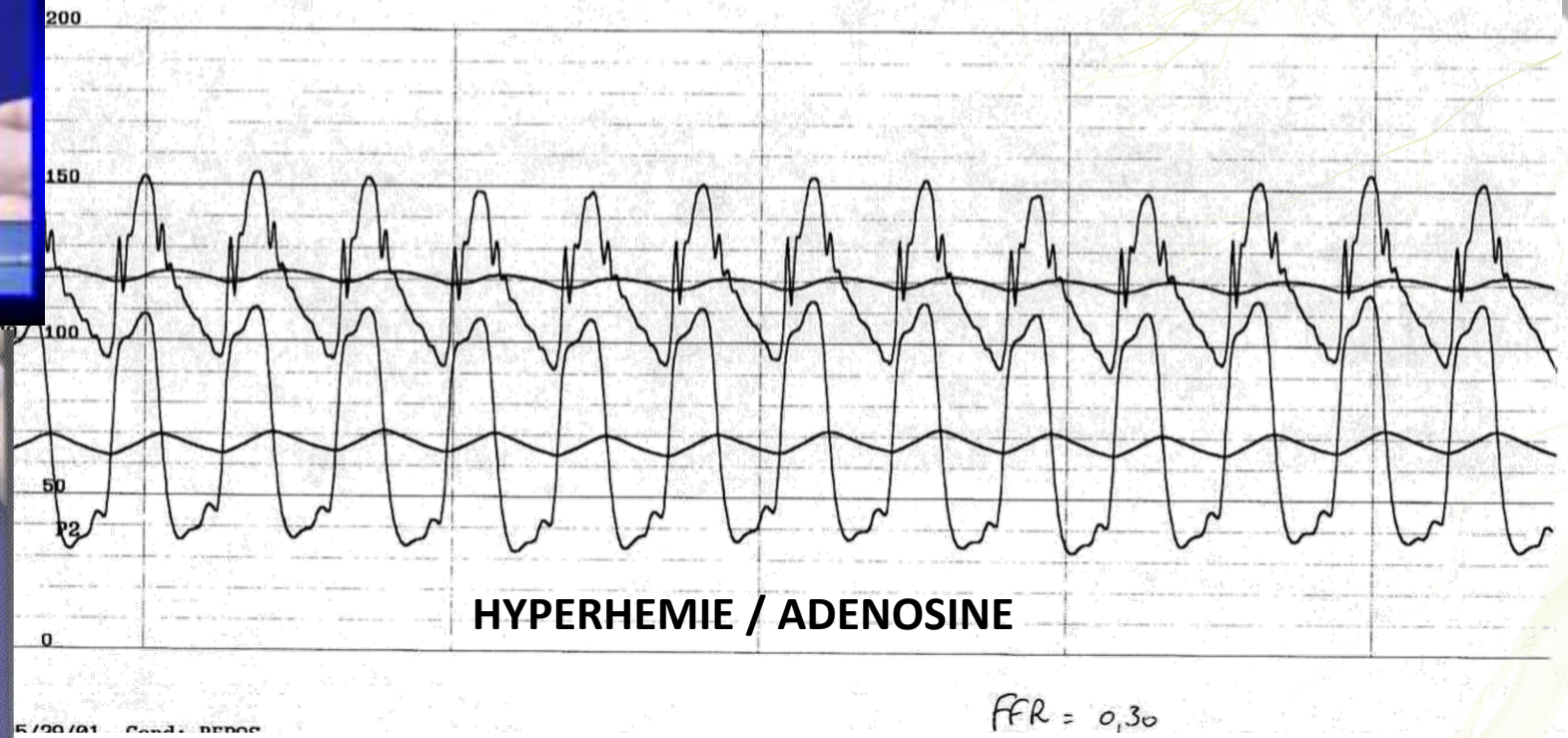






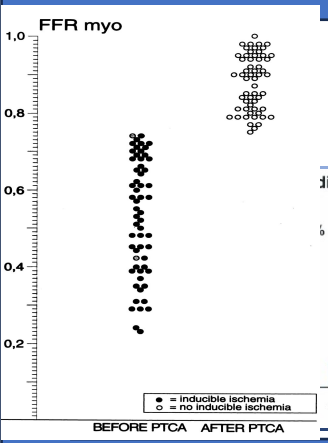




HYPERHEMIE / ADENOSINE

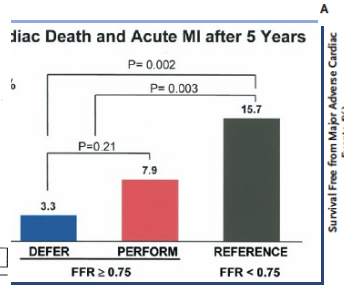
EVALUATION LESIONNELLE

PRONOSTIC



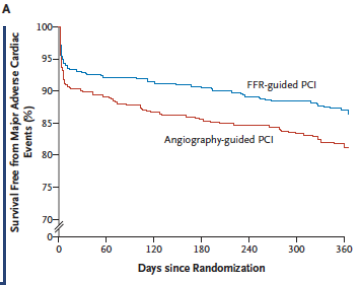
1995

DEFER



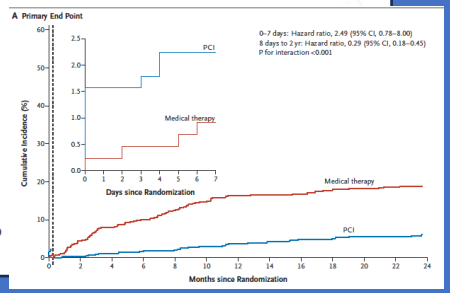
2001

FAME

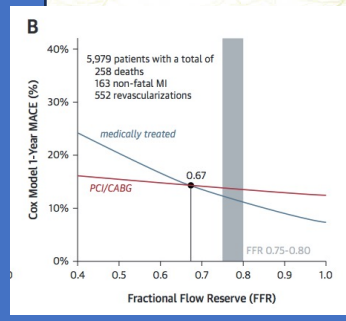


2009

FAME 2

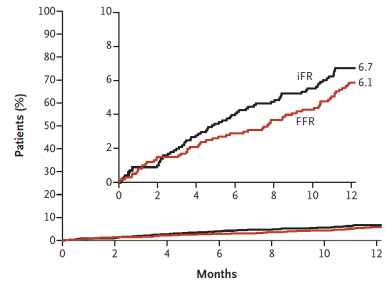


2014



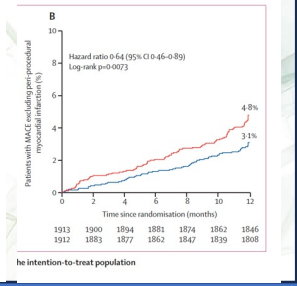
2014

DF SHS



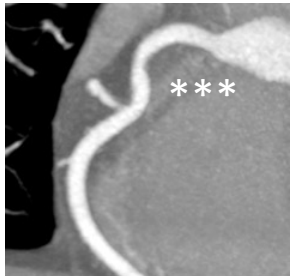
2017

FAVOR III

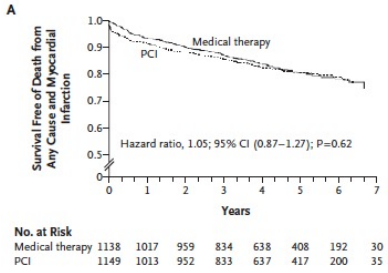


2021

2000-2010

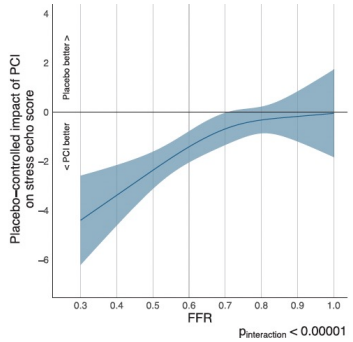


2007



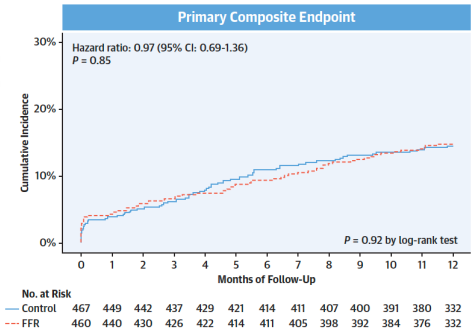
COURAGE

2018



ORBITA

2021



FUTURE

2022

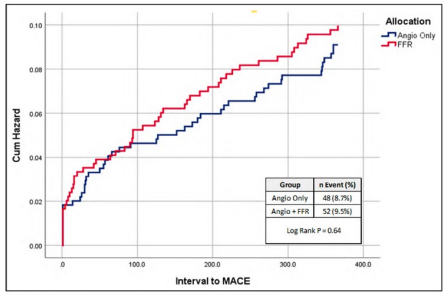


Figure 3. Event curves showing the time to the first MACE from randomization.
Angio indicates angiography; Cum Hazard, cumulative hazard; FFR, fractional flow reserve; and MACE, major adverse cardiovascular event.

RIPCORD 2

2000-2010

ESC European Society of Cardiology

European Heart Journal (2019) **00**, 1–71
doi:10.1093/eurheartj/ehz425

Recommendations for risk assessment		
Risk stratification is recommended based on clinical assessment and the result of the diagnostic test initially employed to make a diagnosis of CAD.	I	B
Resting echocardiography is recommended to quantify LV function in all patients with suspected CAD.	I	C
Risk stratification, preferably using stress imaging or coronary CTA (if local expertise and availability permit), or alternatively exercise stress ECG (if significant exercise can be performed and the ECG is amenable to the identification of ischaemic changes), is recommended in patients with suspected or newly diagnosed CAD.	I	B
In symptomatic patients with a high-risk clinical profile, ICA complemented by invasive physiological guidance (FFR) is recommended for cardiovascular risk stratification, particularly if the symptoms are inadequately responding to medical treatment and revascularization is considered for improvement of prognosis.	I	A
In patients with mild or no symptoms, ICA complemented by invasive physiological guidance (FFR/iwFR) is recommended for patients undergoing medical treatment in whom non-invasive risk stratification indicates a high event risk and revascularization is considered for the improvement of prognosis.	I	A
Symptomatic patients		
Reassessment of CAD status is recommended in patients with deteriorating LV systolic function that cannot be attributed to a reversible cause (e.g. long-standing tachycardia or myocarditis).	I	C
Risk stratification is recommended for patients with new or worsening symptom levels, preferably using stress imaging or, alternatively, exercise stress ECG.	I	B
It is recommended that patients with significant worsening of symptoms be expeditiously referred for evaluation.	I	C
ICA (with FFR/iwFR when necessary) is recommended for risk stratification in patients with severe CAD, particularly if the symptoms are refractory to medical treatment or if they have a high-risk clinical profile.	I	C

Recommendations on functional testing and intravascular imaging for lesion assessment

Recommendations	Class[a]	Level[b]
When evidence of ischaemia is not available, FFR or iwFR are recommended to assess the haemodynamic relevance of intermediate-grade stenosis.[15,17,18,39]	I	A
FFR-guided PCI should be considered in patients with multivessel disease undergoing PCI.[29,31]	IIa	B
IVUS should be considered to assess the severity of unprotected left main lesions.[35–37]	IIa	B

2018 ESC SCC Guidelines

Recommendations for the Use of Coronary Physiology to Guide Revascularization With PCI
Referenced studies that support the recommendations are summarized in Online Data Supplement 5.

COR	LOE	Recommendations
1	A	1. In patients with angina or an anginal equivalent, undocumented ischemia, and angiographically intermediate stenoses, the use of fractional flow reserve (FFR) or instantaneous wave-free ratio (iFR) is recommended to guide the decision to proceed with PCI.[1-6]
3: No benefit	B-R	2. In stable patients with angiographically intermediate stenoses and FFR >0.80 or iFR >0.89, PCI should not be performed.[7-10]

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

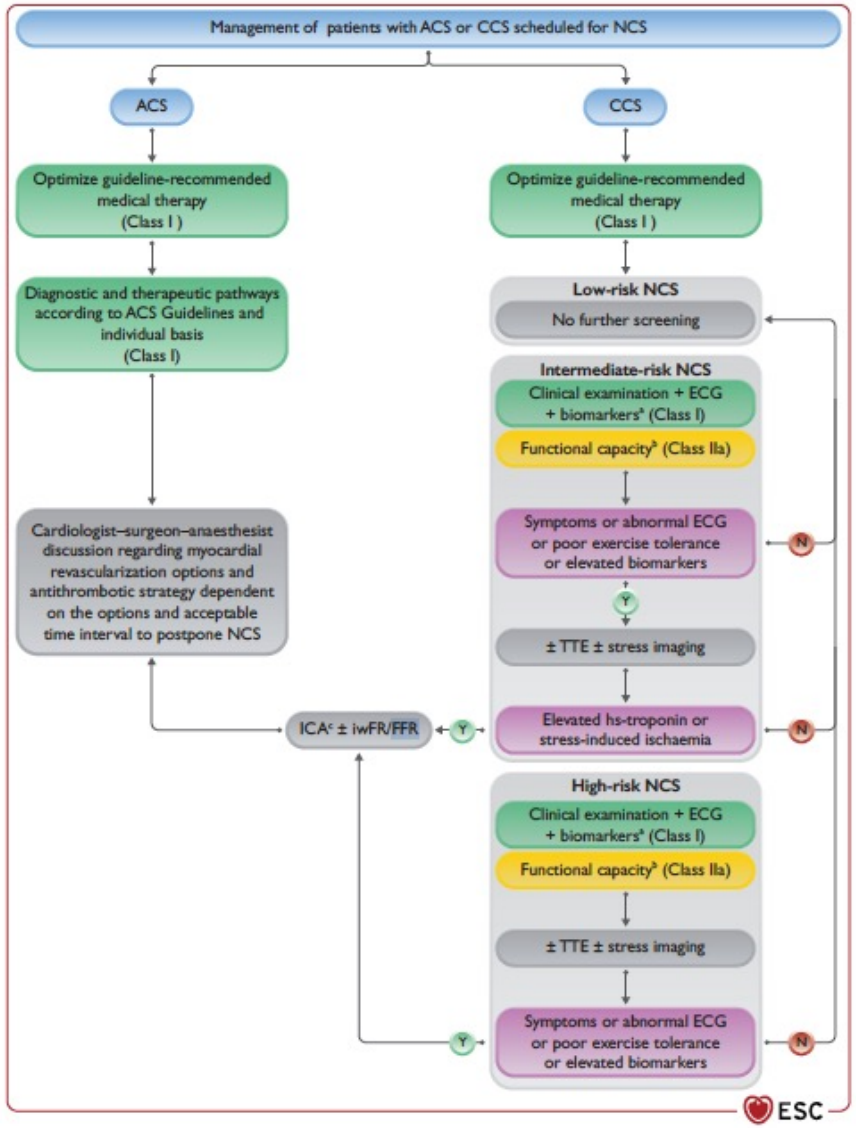
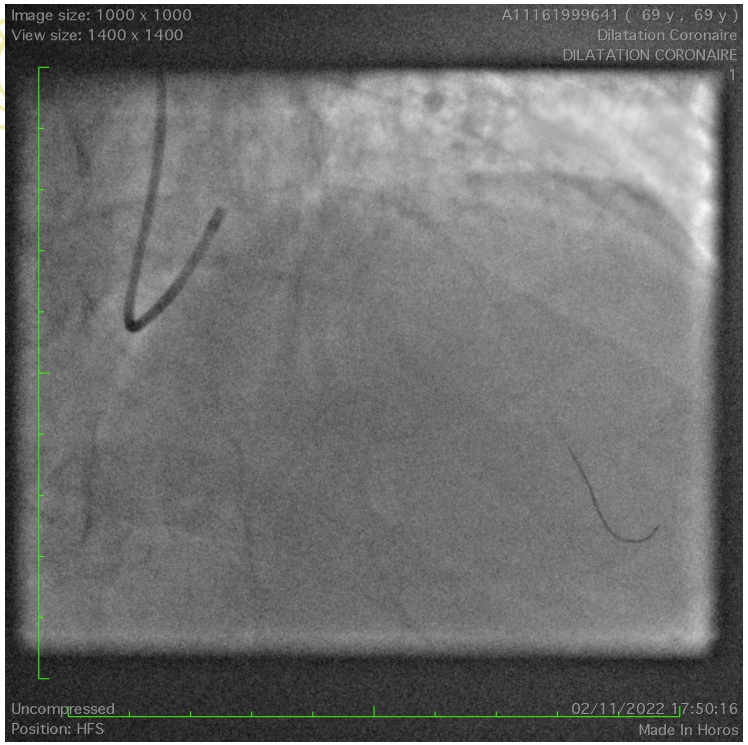


Figure 12 Management of patients with acute or chronic coronary syndrome scheduled for non-cardiac surgery. ACS, acute coronary syndrome; BNP, B-type natriuretic peptide; CABG, coronary artery bypass graft; CAD, coronary artery disease; CCS, chronic coronary syndrome; ECG, electrocardiogram; FFR, fractional flow reserve; hs-cTn, high-sensitivity cardiac troponin; ICA, invasive coronary angiography; iwFR, instantaneous wave-free ratio; N, no; NCS, non-cardiac surgery; NT-proBNP, N-terminal proBNP; PCI, percutaneous coronary intervention; TTE, transthoracic echocardiography. Y, yes; The figure provides a schematic representation of diagnostic tools and therapy to be implemented according to surgical risk and underlying cardiac condition. [a]Biomarkers: hs-cTn T/I (Class I) ± BNP/NT-proBNP (Class IIa). [b]Functional capacity based on Duke Activity Status Index (DASI) or the ability to climb two flights of stairs. [c]ICA ± PCI/CABG on a case-by-case basis according to the Heart Team.

PULL BACK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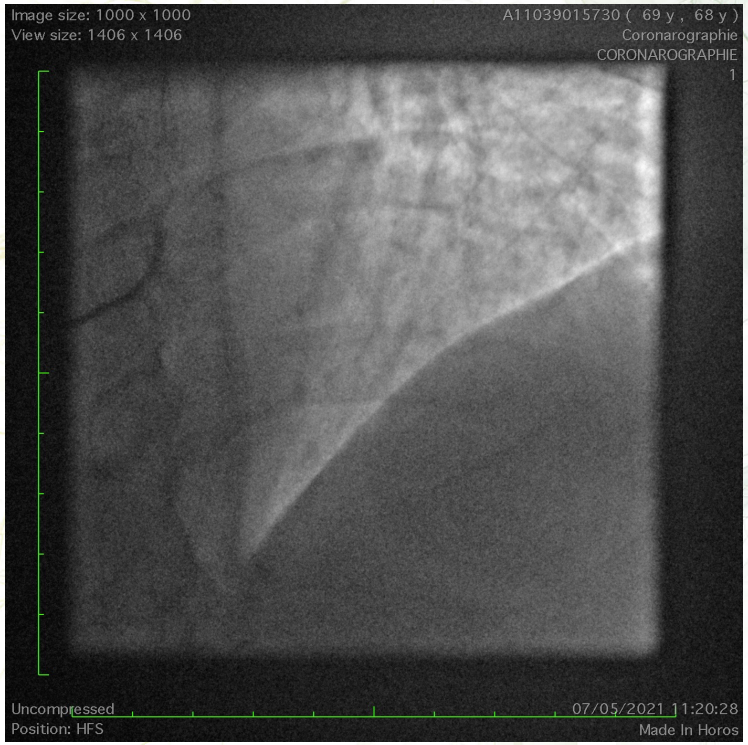
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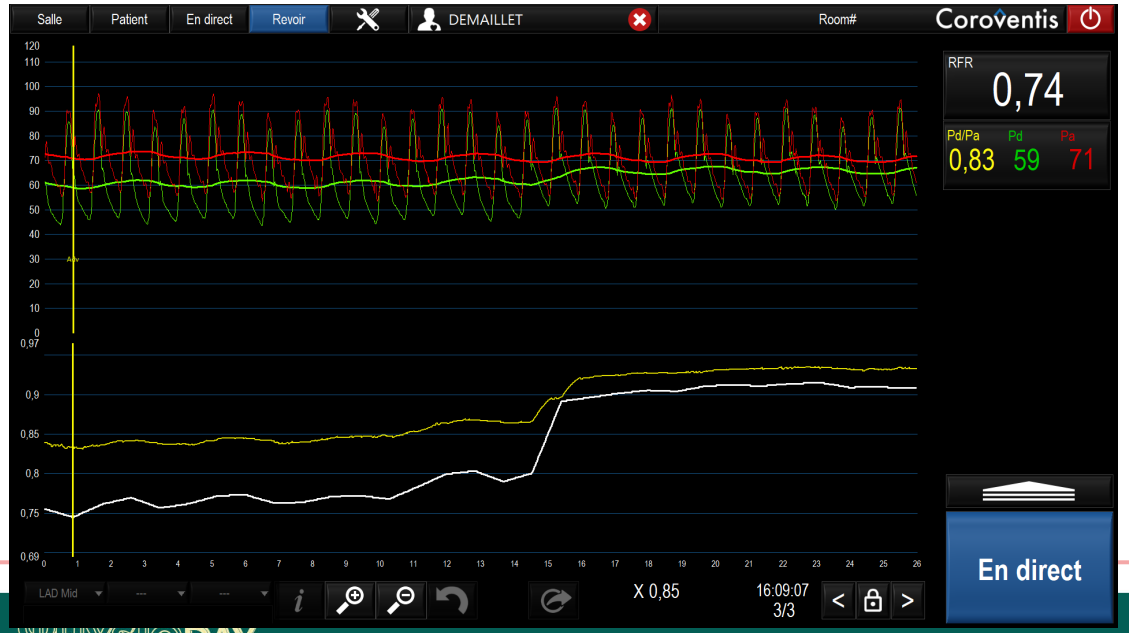
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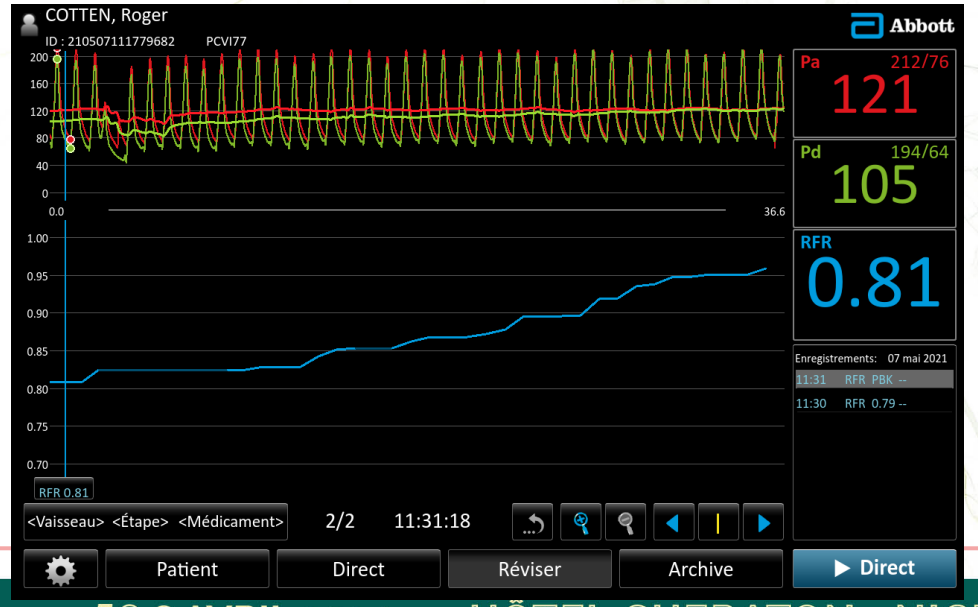
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RFR
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Enregistrements: 07 mai 2021
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<Vaisseau> <Étape> <Médicament>
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Patient
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Réviser
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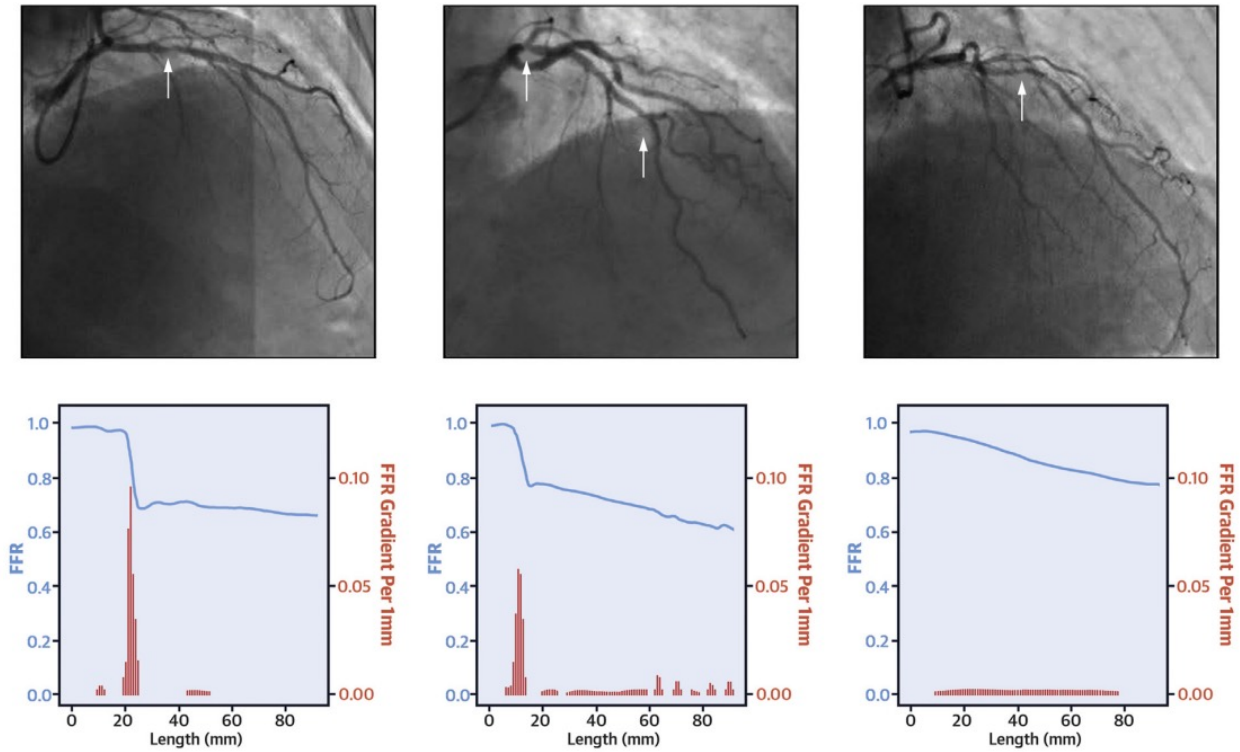
Focal CAD	Combined CAD	Diffuse CAD



Pullback Pressure Gradients Index

$$\{MaxPPG_{20mm}/\Delta FFR_{vessel} + (1\text{-Length with Functional Disease (mm)/Total Vessel Length (mm)})\}/2$$

Focal CAD	Combined CAD	Diffuse CAD
$\frac{MaxPPG_{20mm}}{\Delta FFR_{vessel}} = \frac{0.300}{0.325} = 0.923$	$\frac{MaxPPG_{20mm}}{\Delta FFR_{vessel}} = \frac{0.236}{0.387} = 0.610$	$\frac{MaxPPG_{20mm}}{\Delta FFR_{vessel}} = \frac{0.056}{0.193} = 0.290$
Length CAD $= \frac{20}{100} = 0.200$	Length CAD $= \frac{65}{92} = 0.707$	Length CAD $= \frac{74}{101} = 0.733$
PPG Index $= \frac{0.923 + (1\text{-}0.20)}{2} = 0.86$	PPG Index $= \frac{0.610 + (1\text{-}0.707)}{2} = 0.45$	PPG Index $= \frac{0.290 + (1\text{-}0.733)}{2} = 0.28$

Collet, C. et al. J Am Coll Cardiol. 2019;74(14):1772-84.

Global FFR Risk

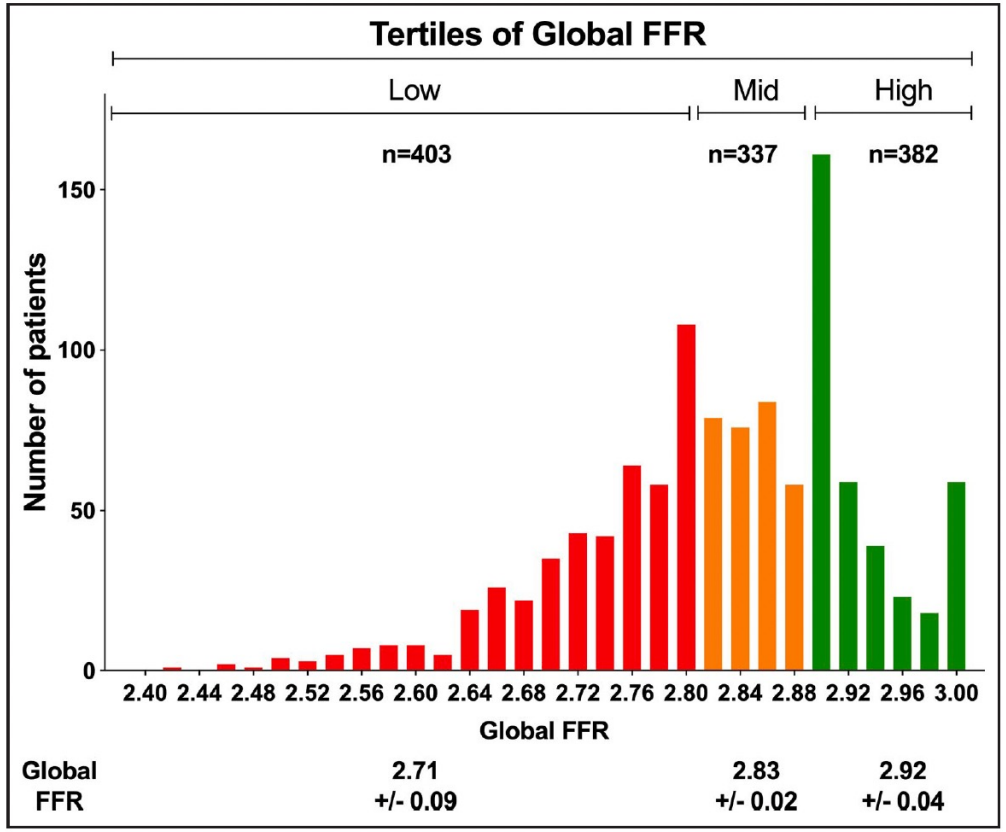
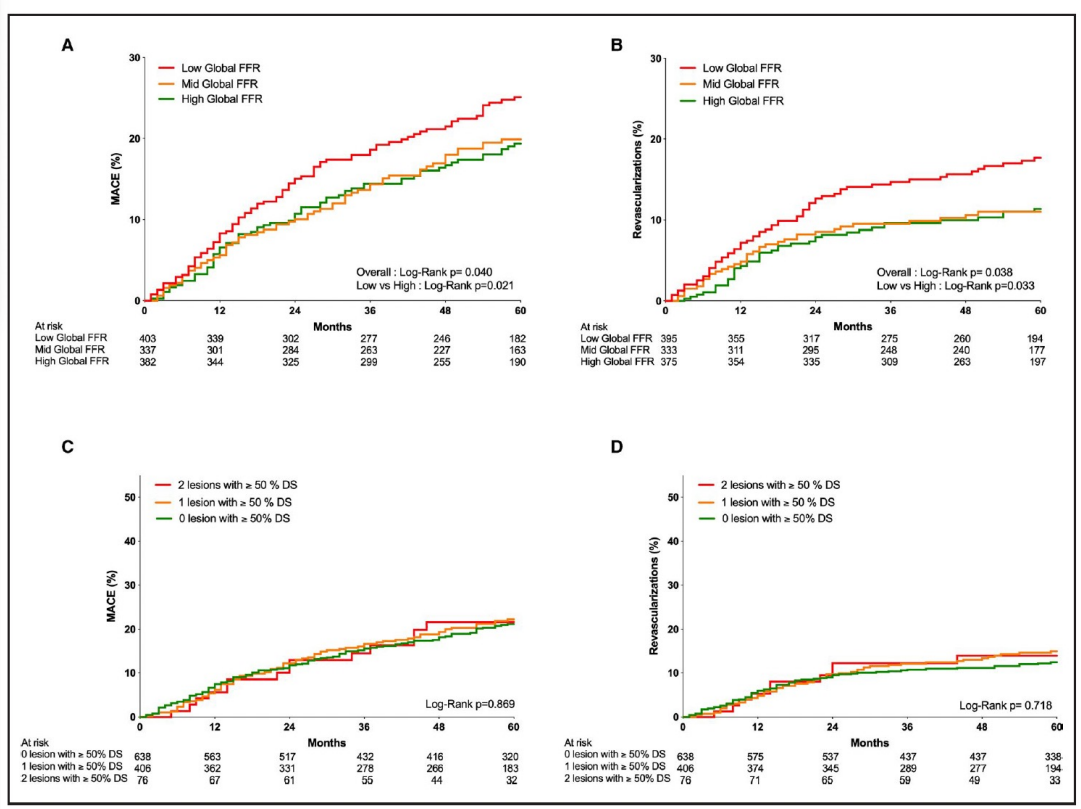
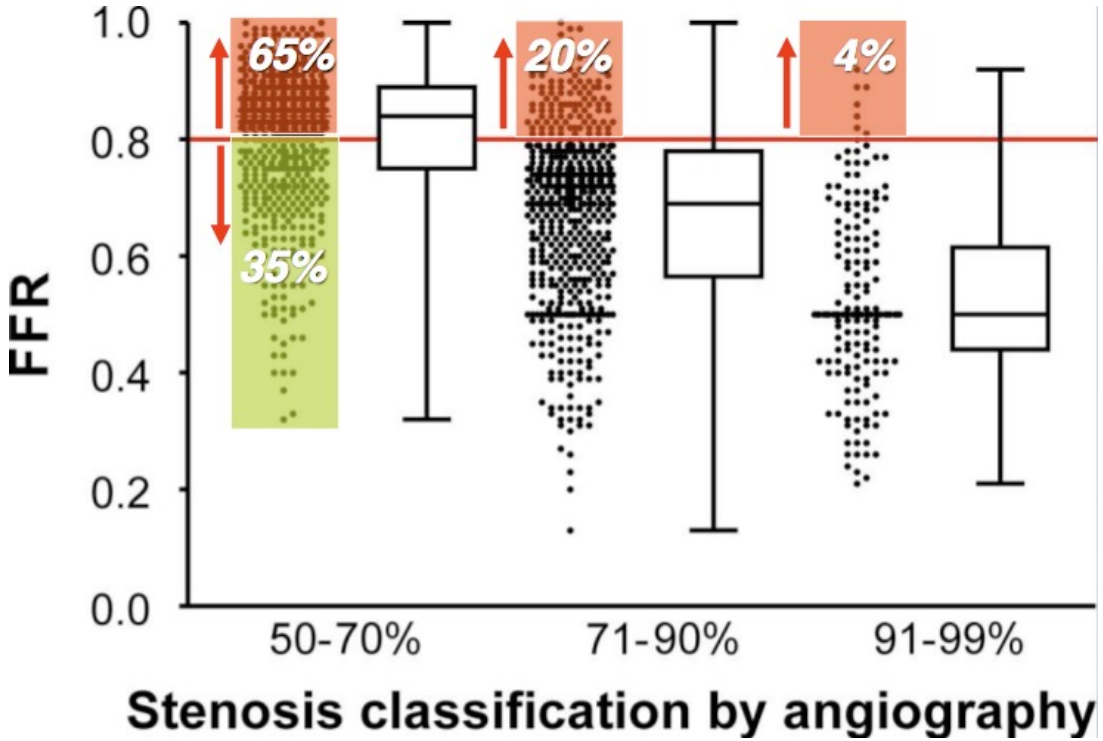


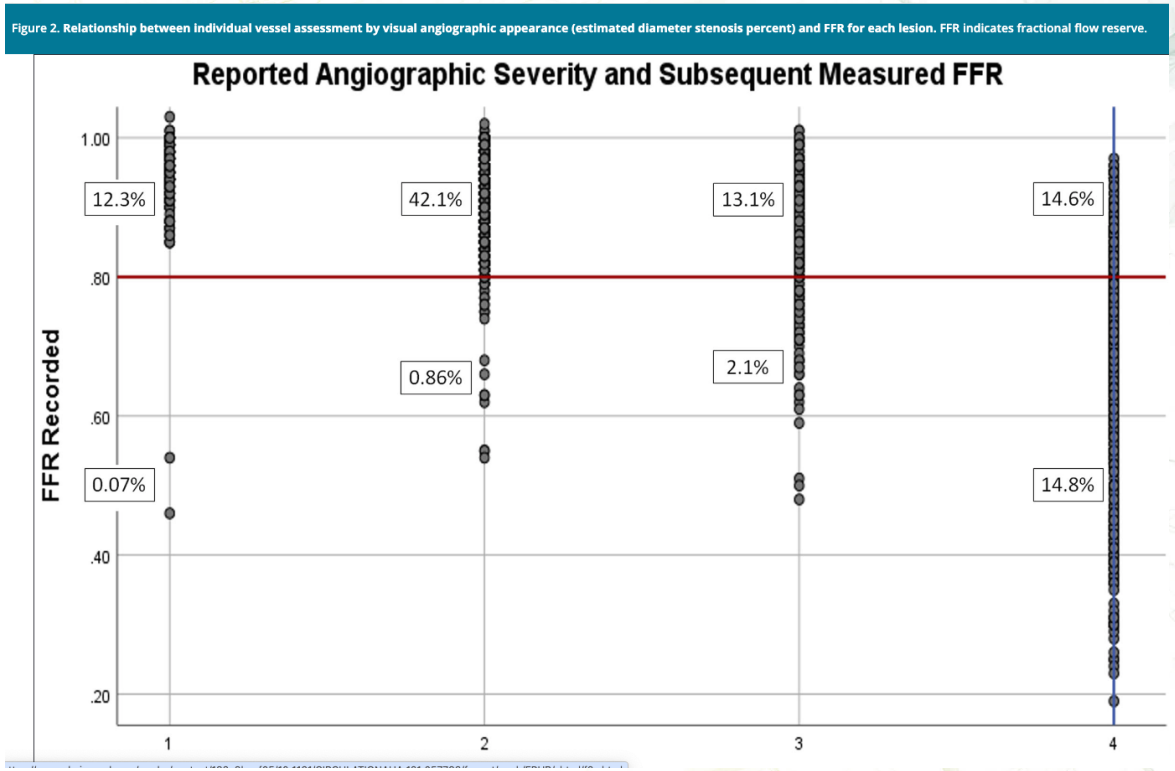
Figure 1. Frequency distribution of global fractional flow reserve (FFR) with classification into 3 tertiles.



J Am Heart Assoc. 2020;9:e017729. DOI: 10.1161

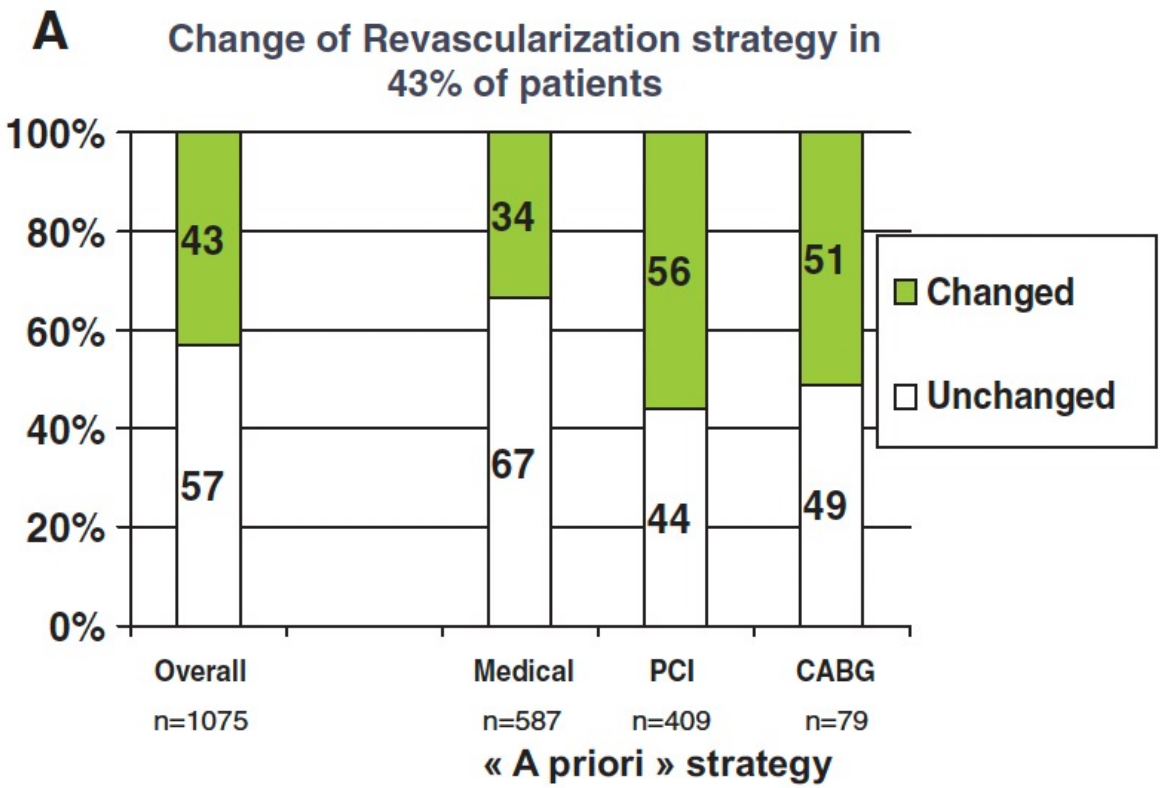


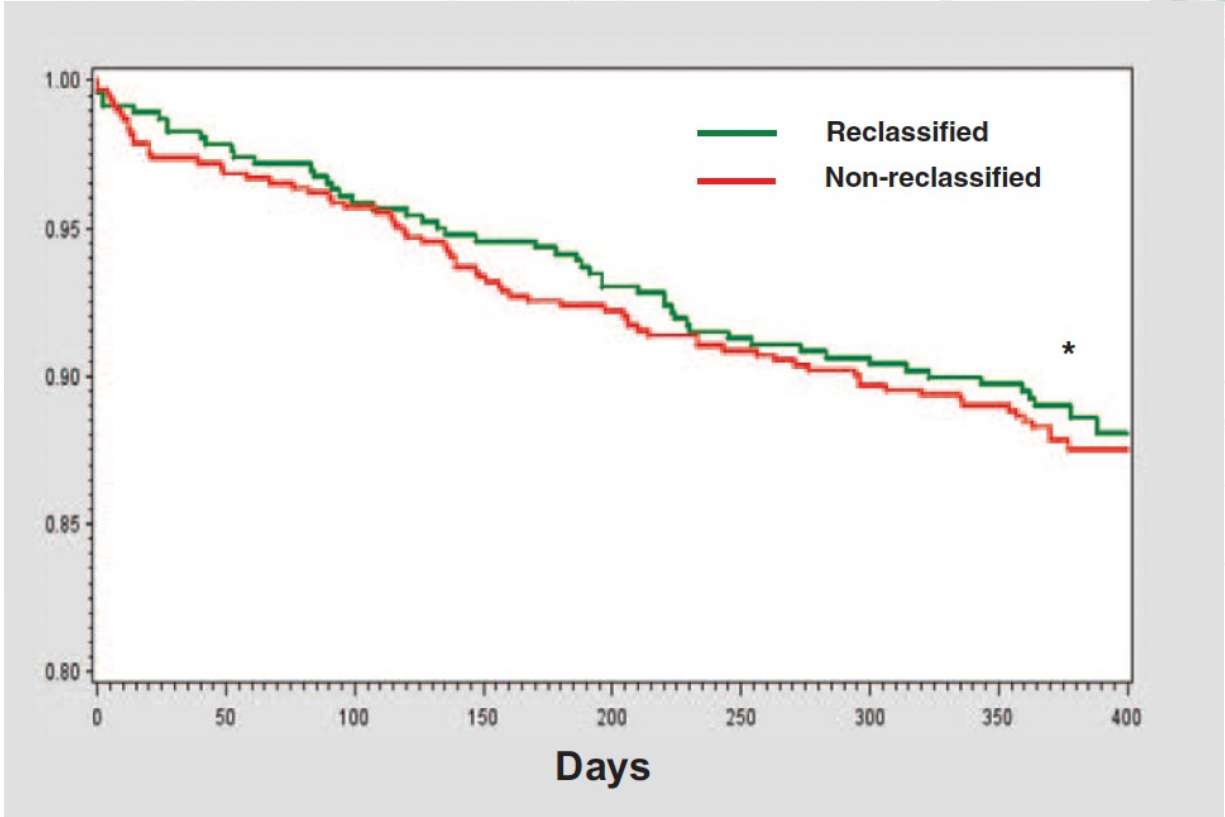
TONINO, JACC Vol. 55, No. 25, 2010



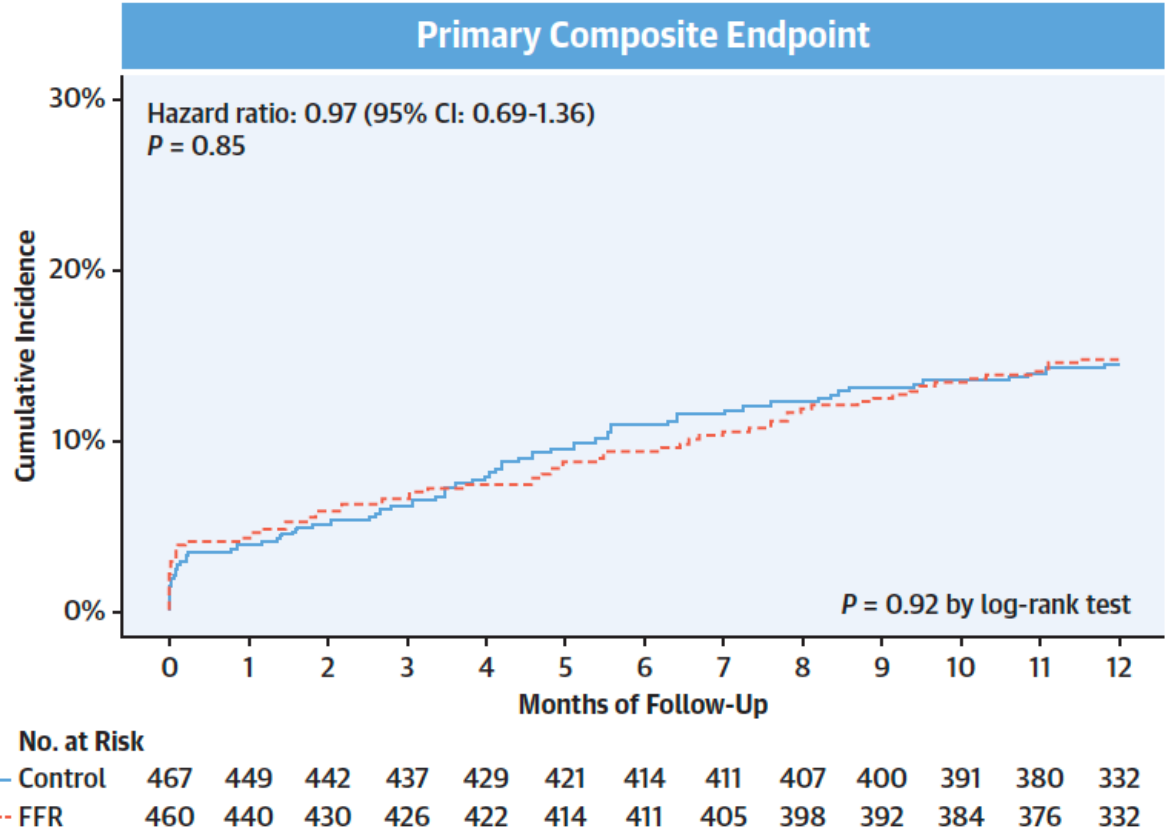
RECLASSIFICATION

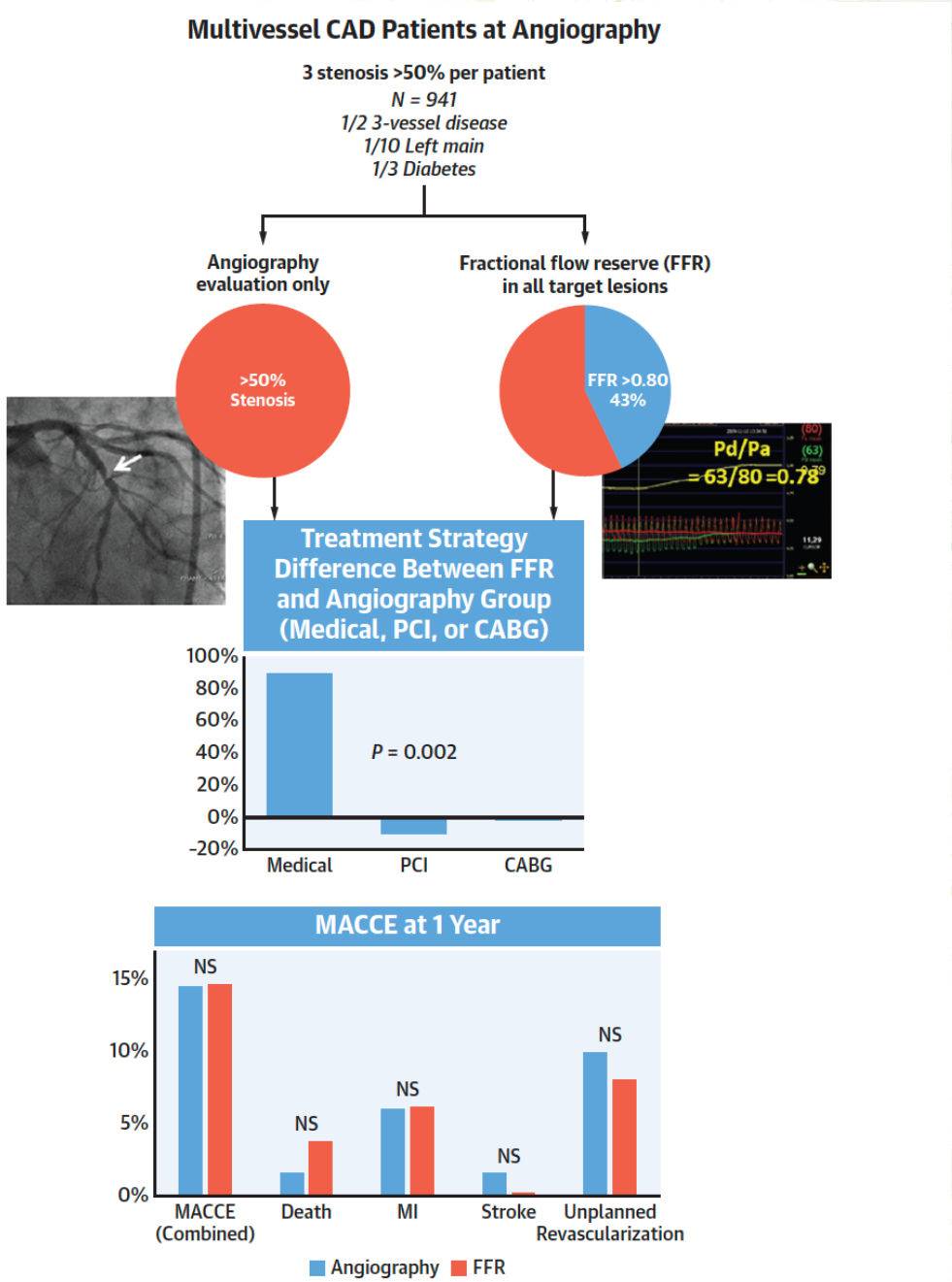
Circulation. 2014;129:173-185



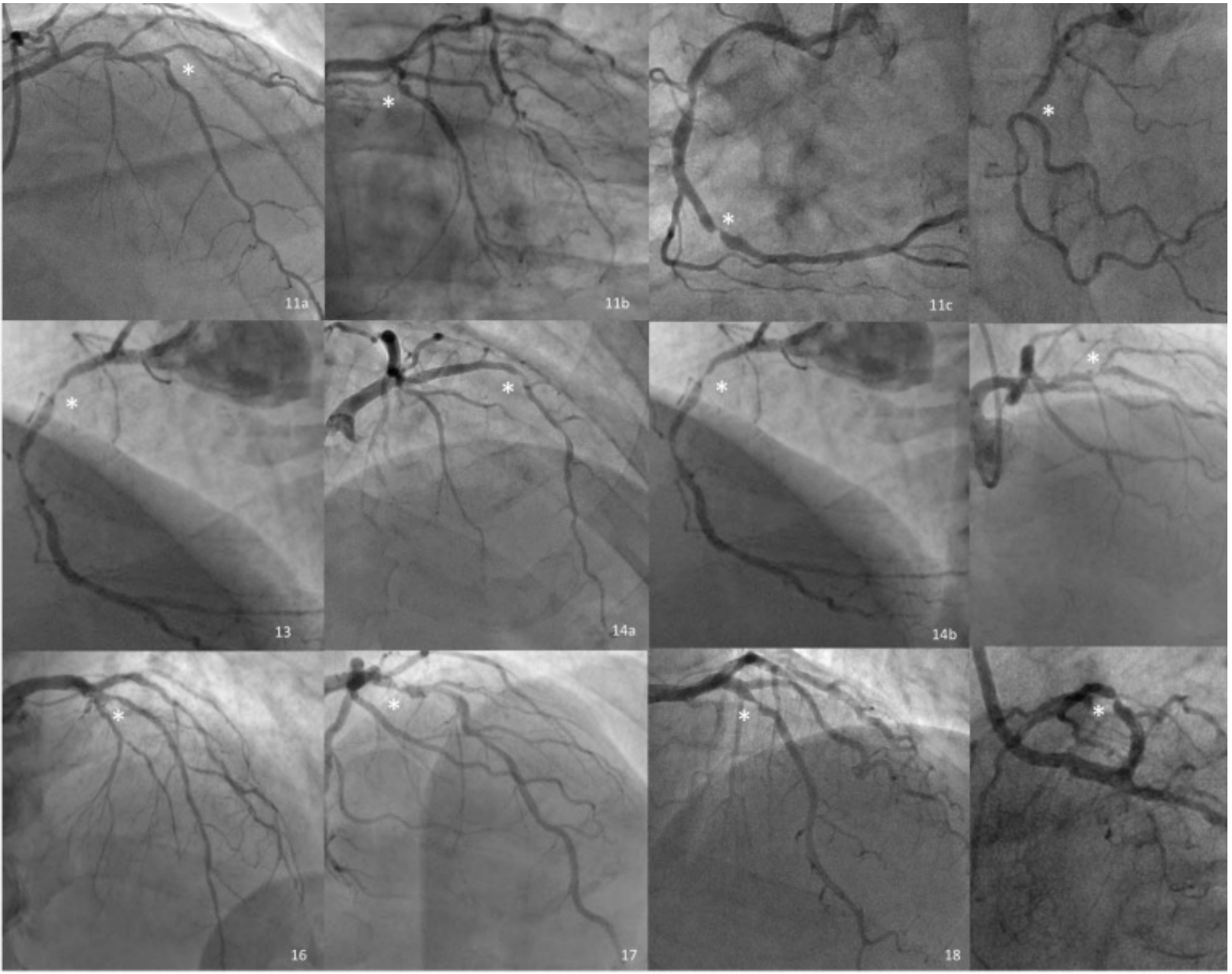


Etude FUTURE





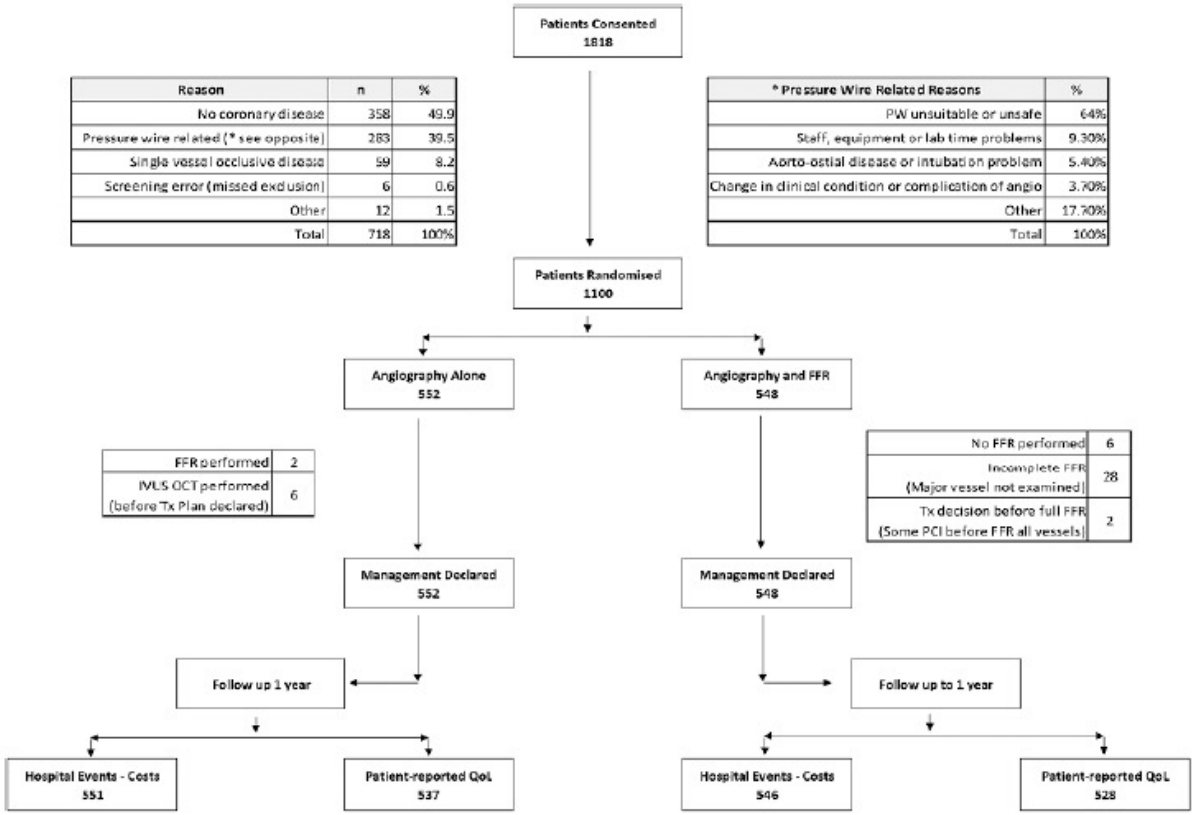
Rioufol, G. et al. J Am Coll Cardiol. 2021;78(19):1875-1885.



Nbre de lesions/Vx évalués

	Lésions/Vx	MonoTronc
Defer lesion	1,1	100%
FAME	2,7 Vx	
FAME 2	1,87 Lésions	60%
DefineFlair	1,5 Lésions	60%
Swedeheart	1,5 Lésions	44%
FUTURE	1,4/3Lésion	2% (98% triT)
RIPCORD 2	2-5/pts	40% 30% 0 lesions
FlowerMi	1,7 Lésions	70%
Favor III China	1,4 Vx	45%
R3F	1,3 Lésions	38%

RIPCORD 2



Reason	n	%
No coronary disease	358	49.9
Pressure wire related (* see opposite)	283	39.5
Single vessel occlusive disease	59	8.2
Screening error (missed exclusion)	6	0.6
Other	12	1.5
Total	718	100%

* Pressure Wire Related Reasons	%
PW unsuitable or unsafe	64%
Staff, equipment or lab time problems	9.30%
Aorto-ostial disease or intubation problem	5.40%
Change in clinical condition or complication of angio	3.70%
Other	17.70%
Total	100%

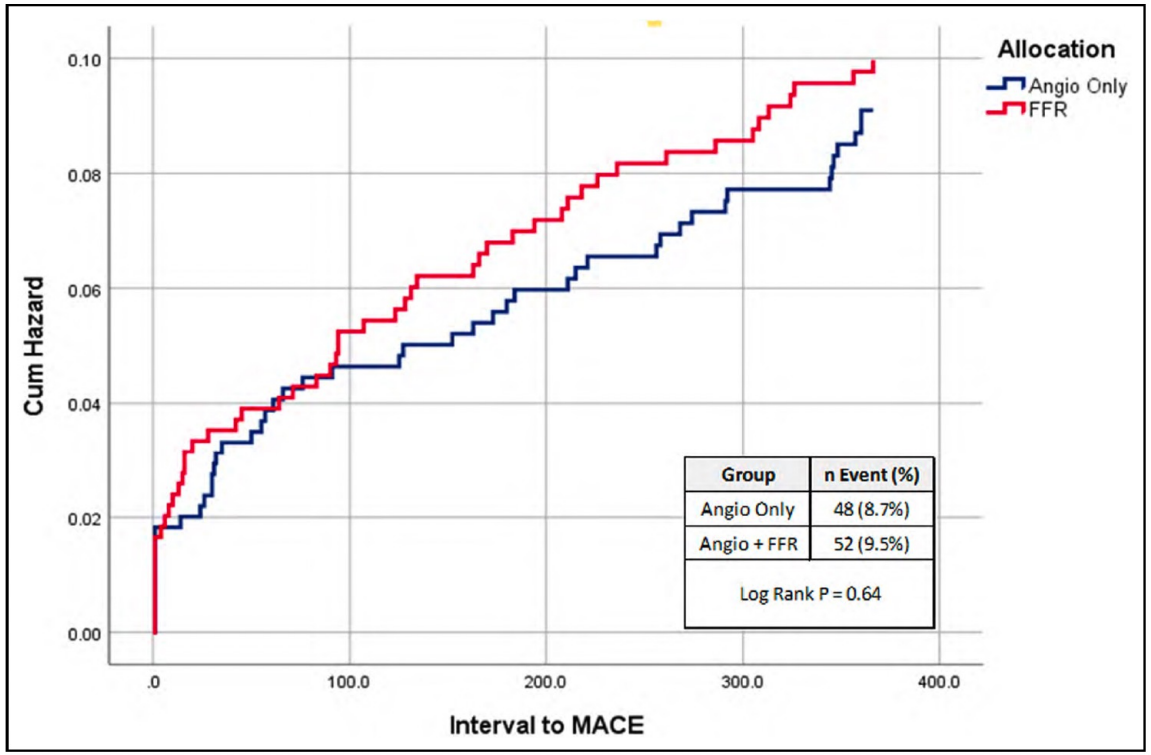


Figure 3. Event curves showing the time to the first MACE from randomization.
Angio indicates angiography; Cum Hazard, cumulative hazard; FFR, fractional flow reserve; and MACE, major adverse cardiovascular event.

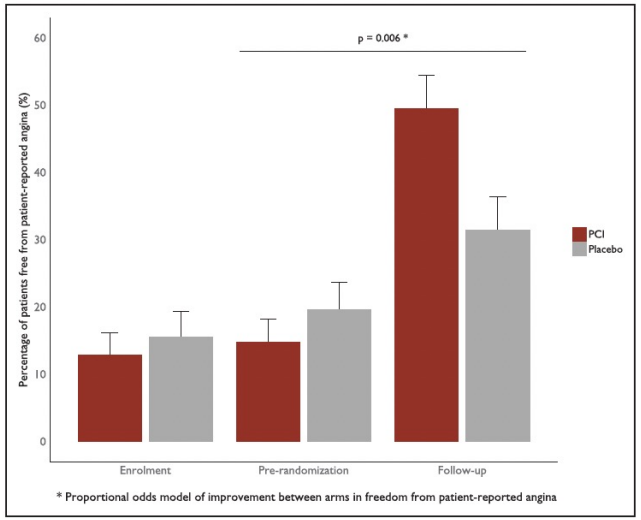
Circulation. 2022;146:687–698. DOI: 10.1161/CIRCULATIONAHA

ORBITA

Table 2. **Procedural Demographics**

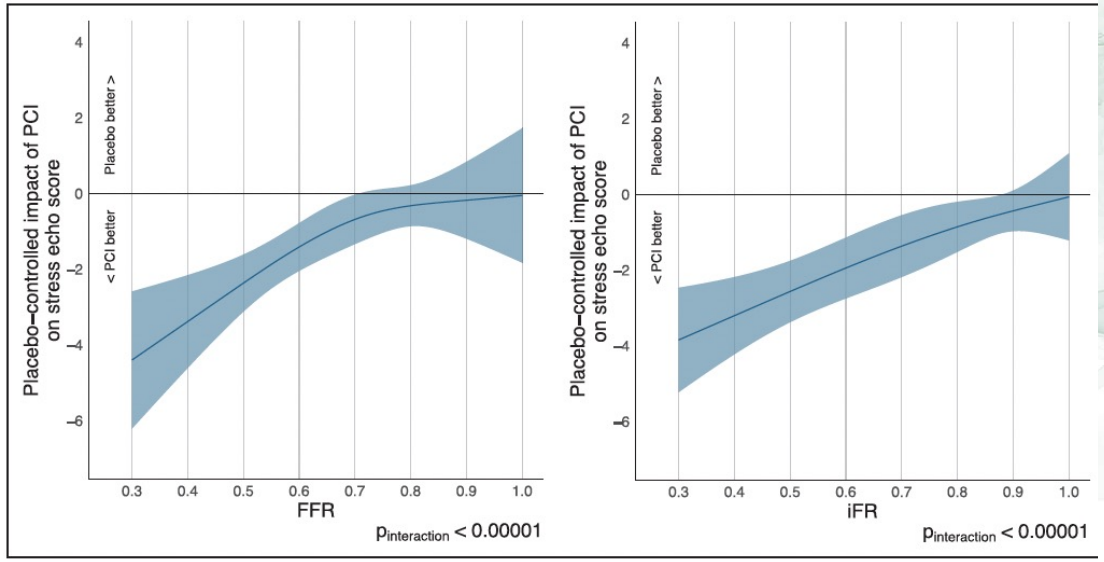
	Percutaneous Coronary Intervention (n=103)	Placebo (n=93)	Complete Group (n=196)
Vessel			
Left anterior descending	72 (69.9)	65 (70.0)	137 (69.9)
Ostial/proximal	46 (44.7)	30 (32.3)	76 (38.8)
Mid	33 (32.0)	38 (40.9)	71 (36.2)
Distal	4 (3.9)	8 (8.6)	12 (6.1)
Right coronary	16 (15.5)	15 (16.1)	31 (15.8)
Circumflex	9 (8.7)	9 (9.7)	18 (9.1)
First obtuse marginal	3 (2.9)	–	3 (1.5)
First diagonal	2 (1.9)	2 (2.2)	4 (2.0)
Intermediate	1 (1.0)	2 (2.1)	3 (1.5)
Serial lesions	17 (16.5)	12 (12.9)	29 (14.8)
No. of patients with diameter stenosis ≥50% by quantitative coronary angiography	87 (84.4)	79 (85.0)	166 (84.7)
Diameter stenosis by quantitative coronary angiography	64.1±13.7	63.7±13.6	63.9±13.6
Area stenosis by quantitative coronary angiography	84.4±10.1	84.0±10.2	84.2±10.1
FFR Median (IQR)	0.69±0.16 0.72 (0.25)	0.69±0.16 0.73 (0.21) (n=91)	0.69±0.16 0.72 (0.24) (n=194)
iFR Median (IQR)	0.76±0.22 0.85 (0.24)	0.76±0.21 0.85 (0.21)	0.76±0.22 0.83 (0.22)
No. of patients with FFR ≤0.80	76 (73.8)	69 (75.8) (n=91)	145 (74.7) (n=194)
No. of patients with iFR ≤0.89	68 (66.0)	68 (73.1)	136 (69.4)
Stent length, mm Median (IQR)	28.4±14.8 24 (15)	–	–
Stent diameter, mm Median (IQR)	3.07±0.46 3 (0.75)	–	–
FFR post-PCI (n=101) Median (IQR)	0.90±0.06 0.9 (0.06)	–	–
iFR post-PCI Median (IQR)	0.95±0.04 0.95 (0.05)	–	–
No. of patients with post-FFR>0.80	95 (94.1) (n=101)	–	–
No. of patients with post-iFR>0.89	98 (95.1) (n=103)	–	–

Values indicate n (%) or mean±SD.
FFR indicates fractional flow reserve; iFR, instantaneous wave-free ratio; and IQR, interquartile range.

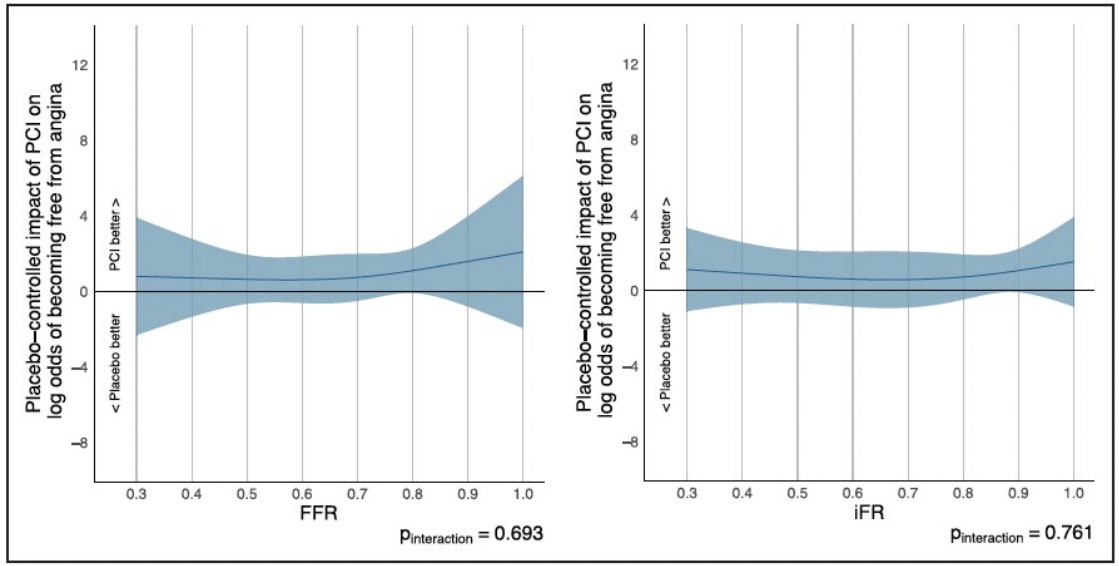


* Proportional odds model of improvement between arms in freedom from patient-reported angina

Circulation. 2018;138:1780–1792.
DOI: 10.1161/CIRCULATIONAHA.118.033801

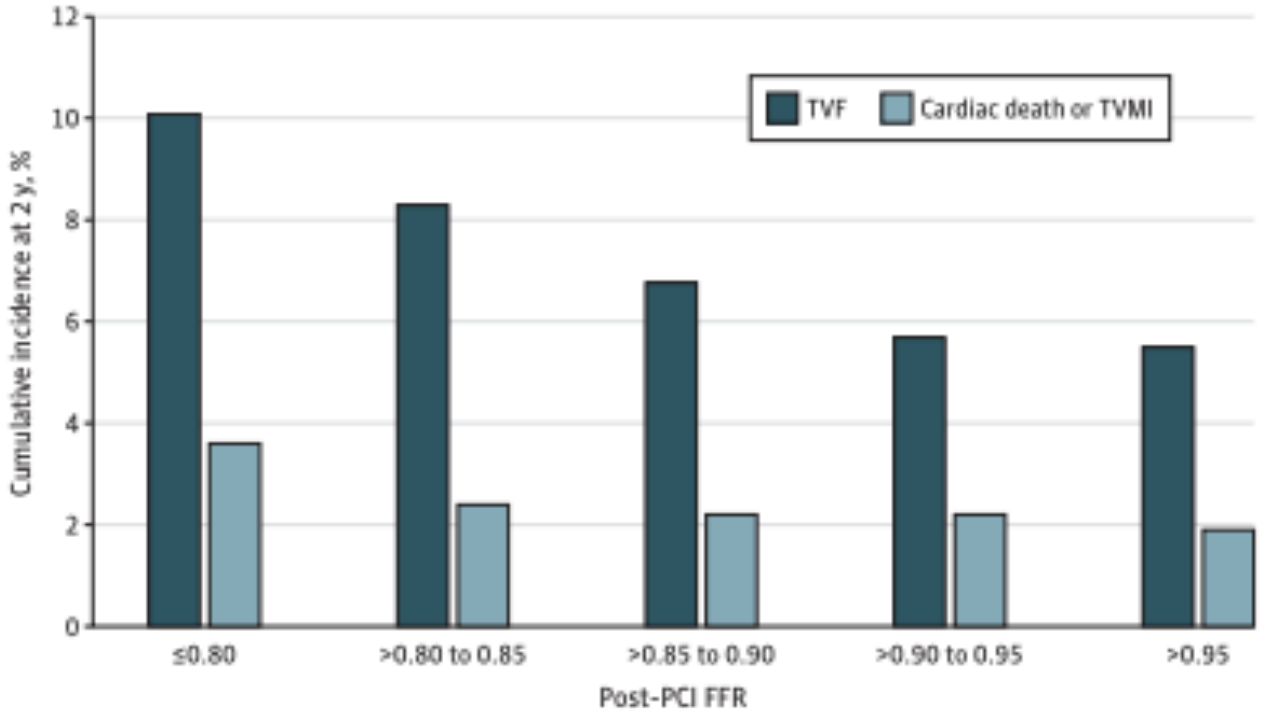


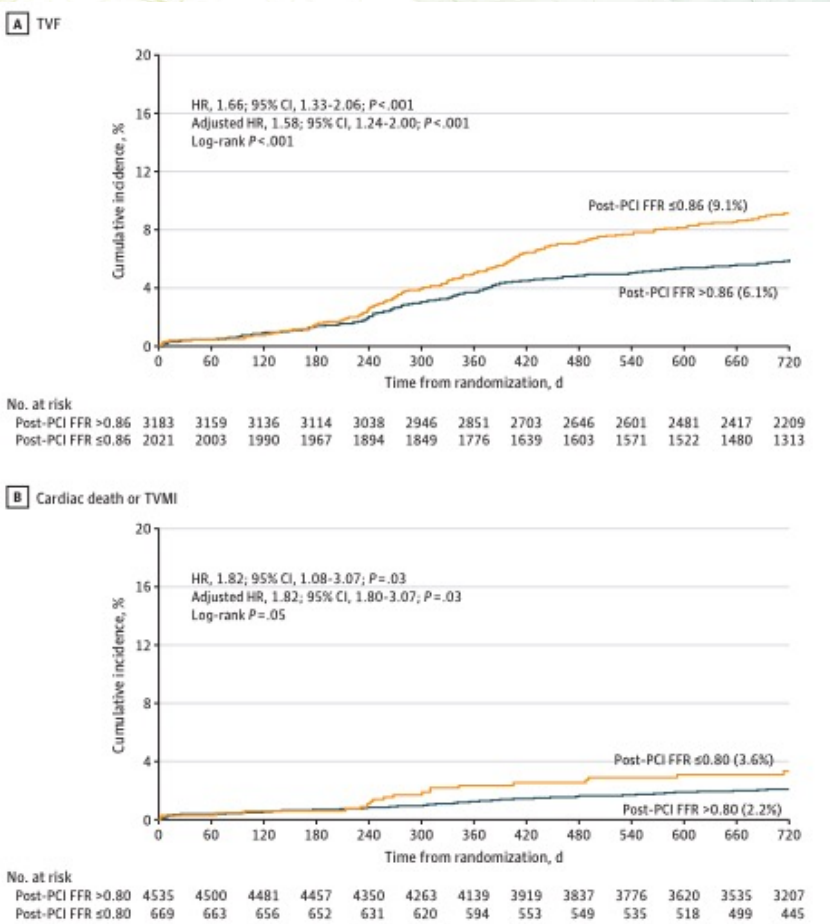
e 2. **Relationship of treatment difference in stress echo score and prerandomization FFR and iFR by randomization arm.**



ionship of treatment difference in patient-reported freedom from angina from Seattle Angina Questionnaire at follow-
R and iFR by randomization arm.

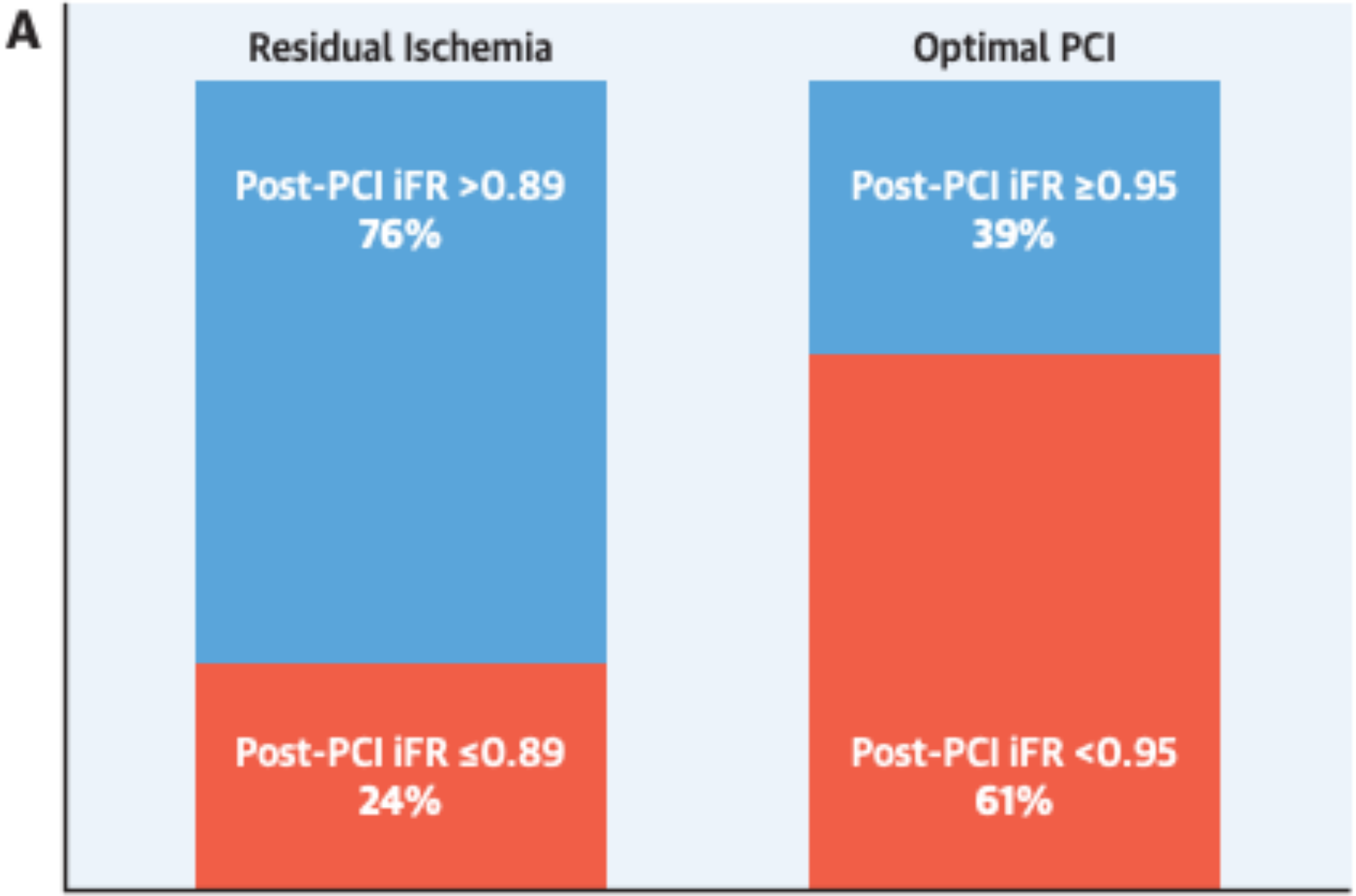
Post PCI FFR





JAMA Network Open. 2022;5(9):e2232842

CENTRAL ILLUSTRATION Rate of Residual Ischemia Post-PCI and Clinical Outcomes



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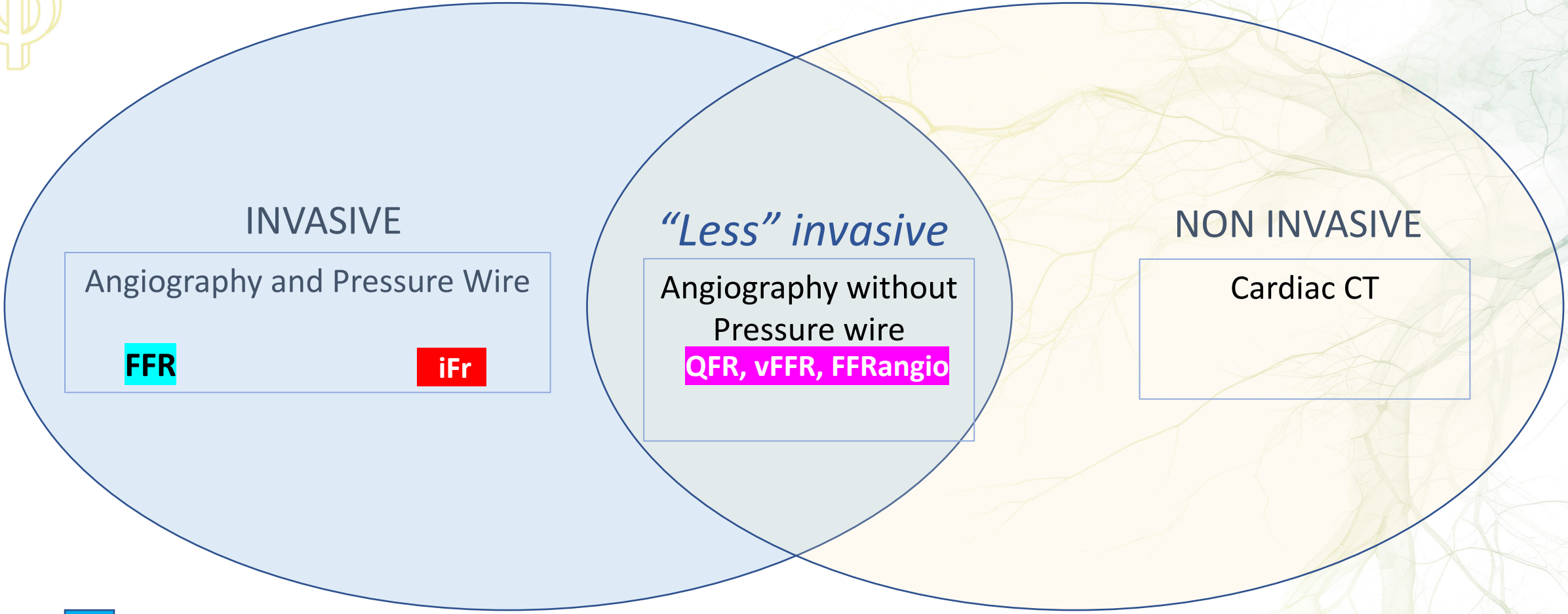
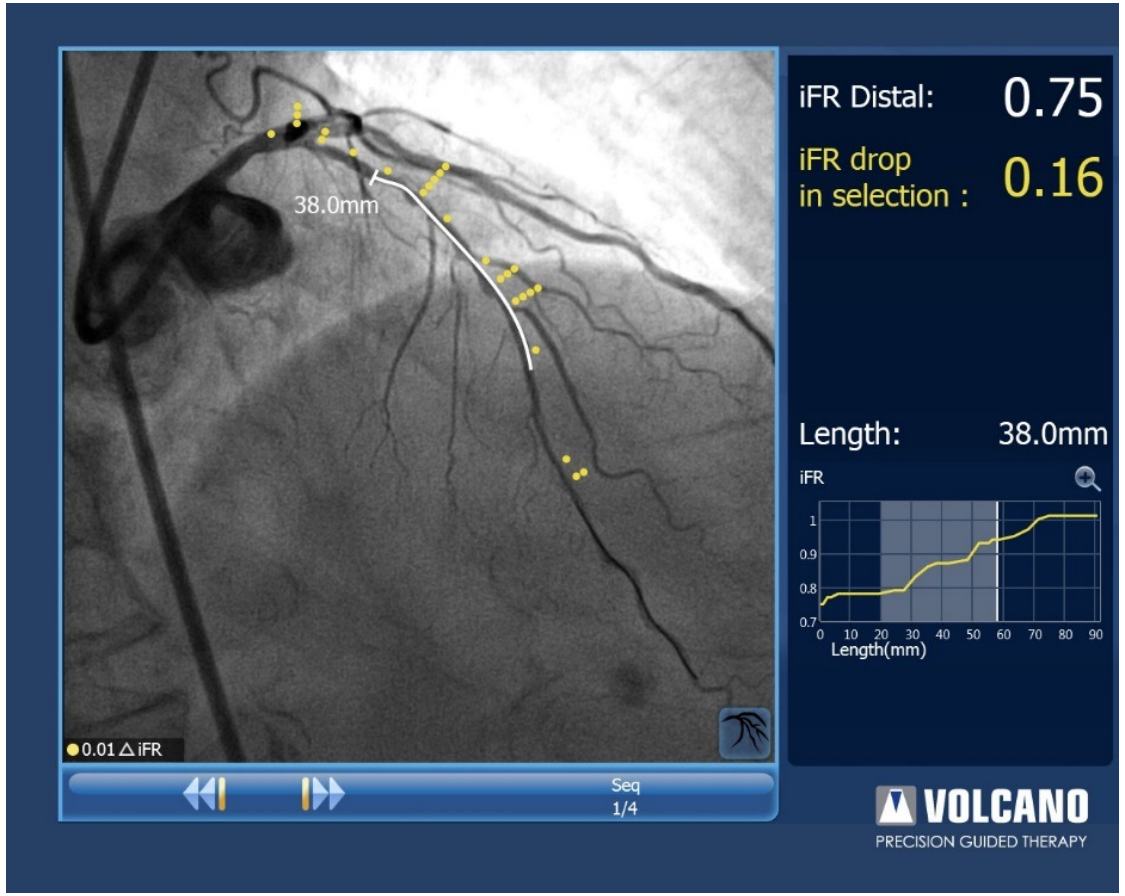


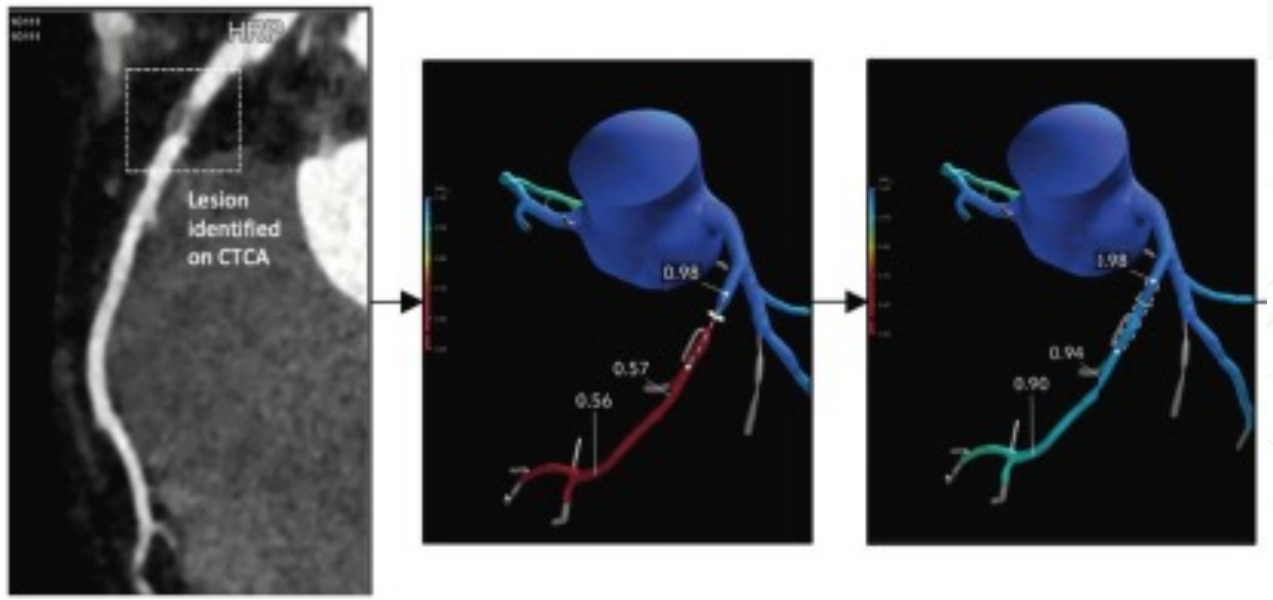
Pharmacological Hyperhemia

No Hyperhemia

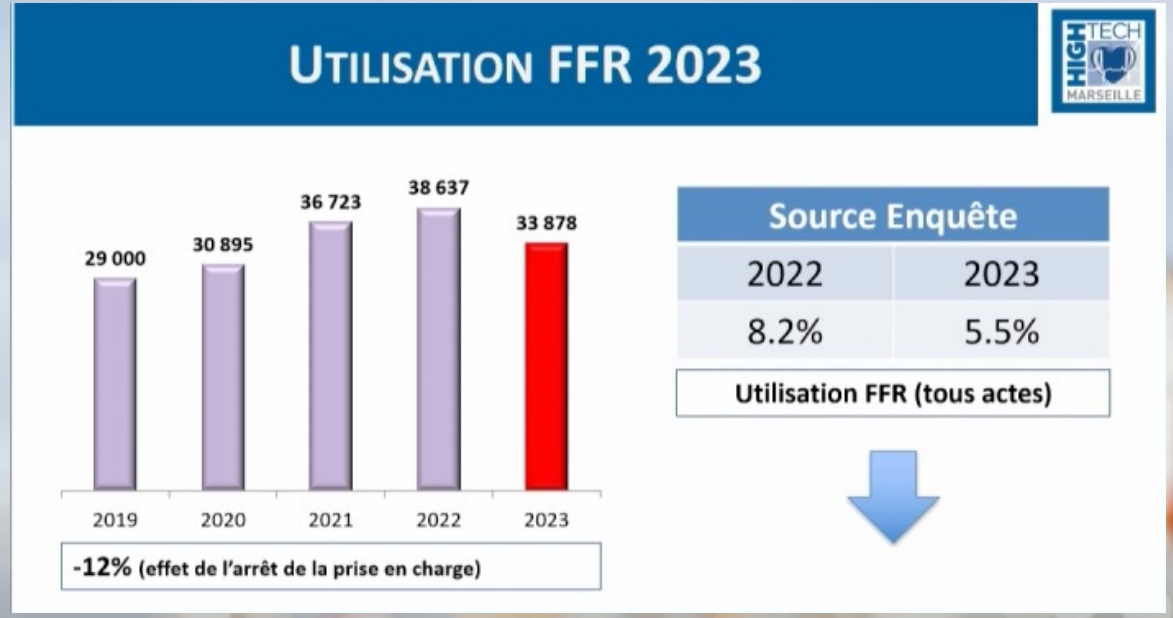
Virtual Hyperhemia

Stenting Virtuel





La FFR il faut La FR



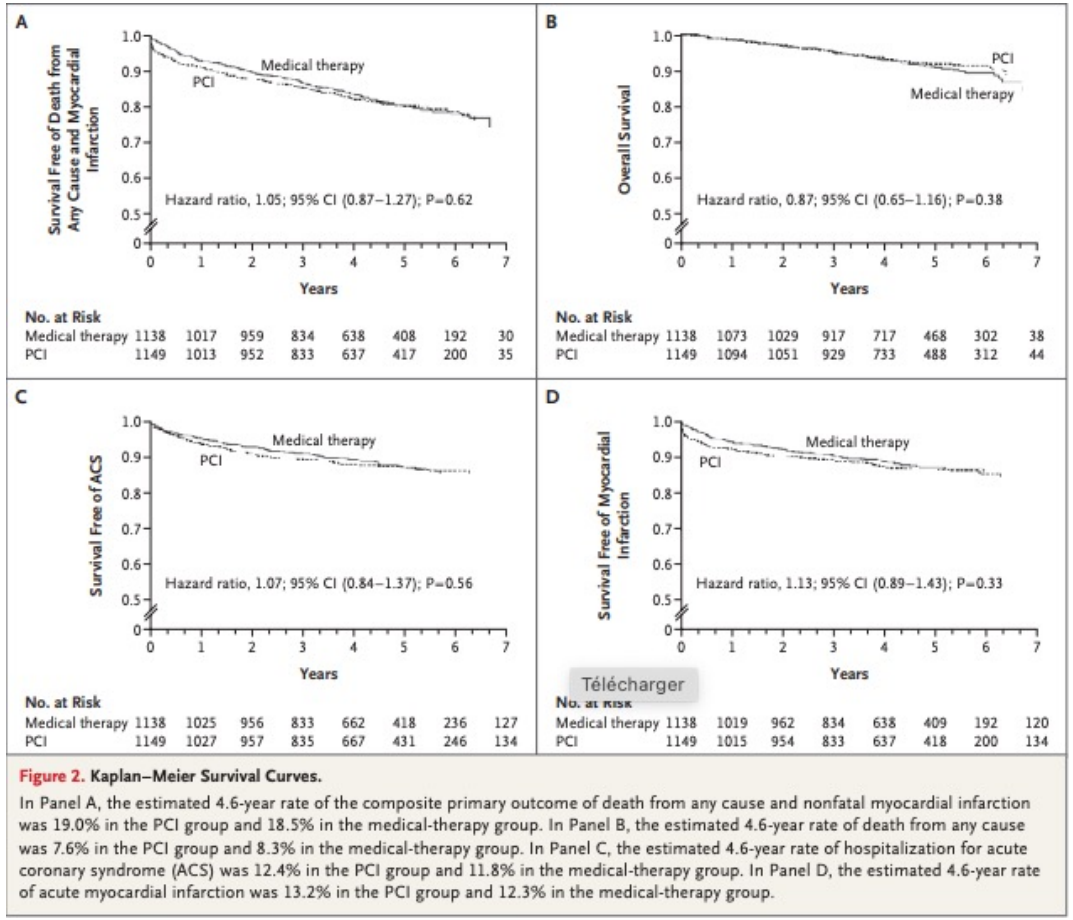
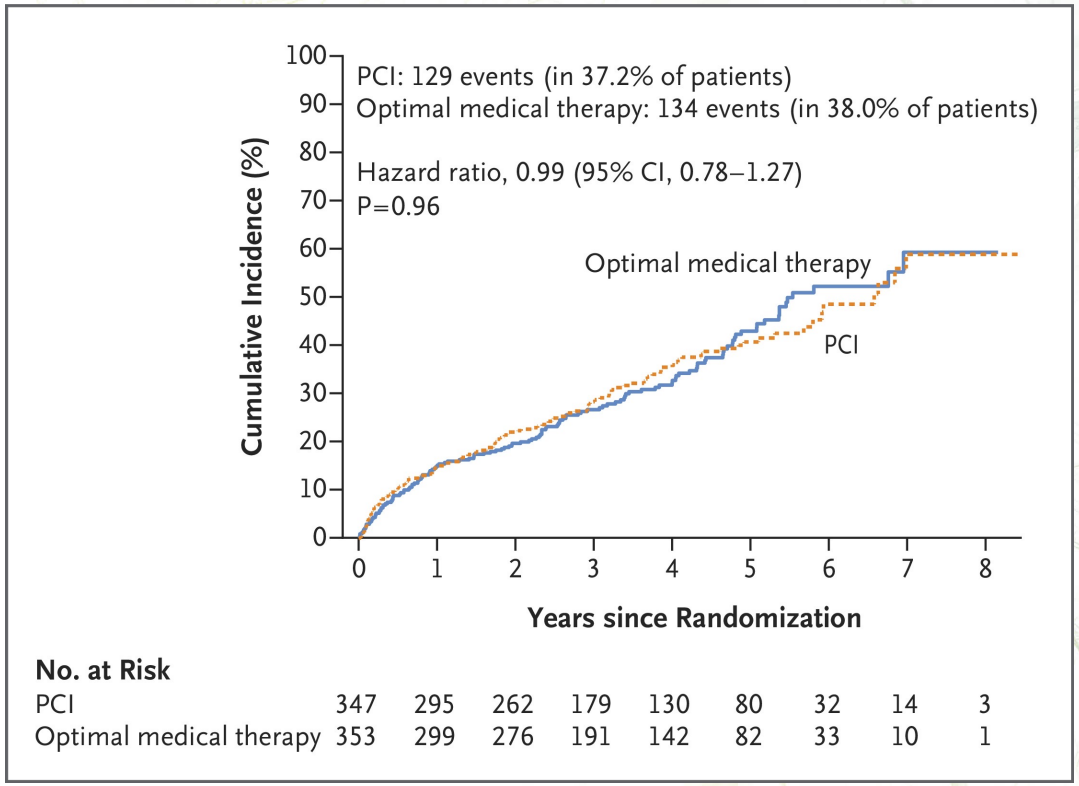


Figure 2. Kaplan–Meier Survival Curves.

In Panel A, the estimated 4.6-year rate of the composite primary outcome of death from any cause and nonfatal myocardial infarction was 19.0% in the PCI group and 18.5% in the medical-therapy group. In Panel B, the estimated 4.6-year rate of death from any cause was 7.6% in the PCI group and 8.3% in the medical-therapy group. In Panel C, the estimated 4.6-year rate of hospitalization for acute coronary syndrome (ACS) was 12.4% in the PCI group and 11.8% in the medical-therapy group. In Panel D, the estimated 4.6-year rate of acute myocardial infarction was 13.2% in the PCI group and 12.3% in the medical-therapy group.



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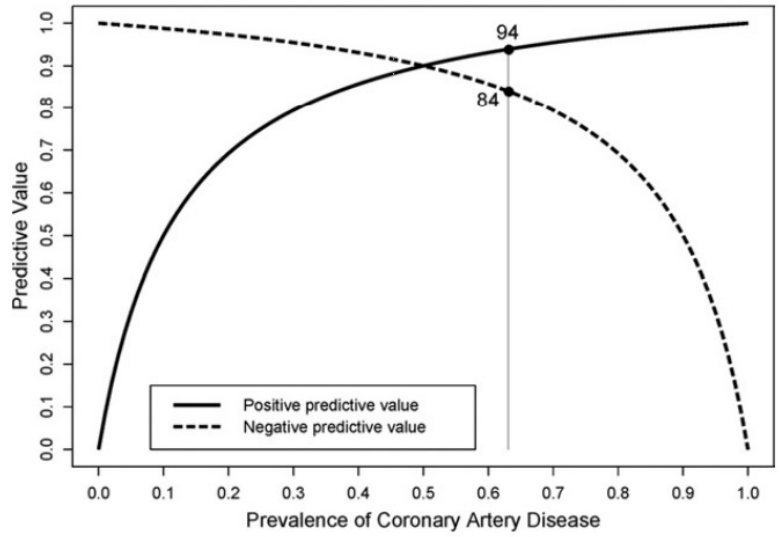


Figure 3 **Predictive Values of a Diagnostic Test According to Disease Prevalence**

Shown are positive predictive values **(solid line)** and negative predictive values **(dashed line)** as a function of disease prevalence, ranging from 0% to 100% for a diagnostic test with a sensitivity and specificity of 90%, chosen as arbitrary but typical values. The **reference line** indicates the disease prevalence observed in this study (63%). One can appreciate the large shifts in predictive values according to low versus high disease prevalence.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Low Diagnostic Yield of Elective Coronary Angiography

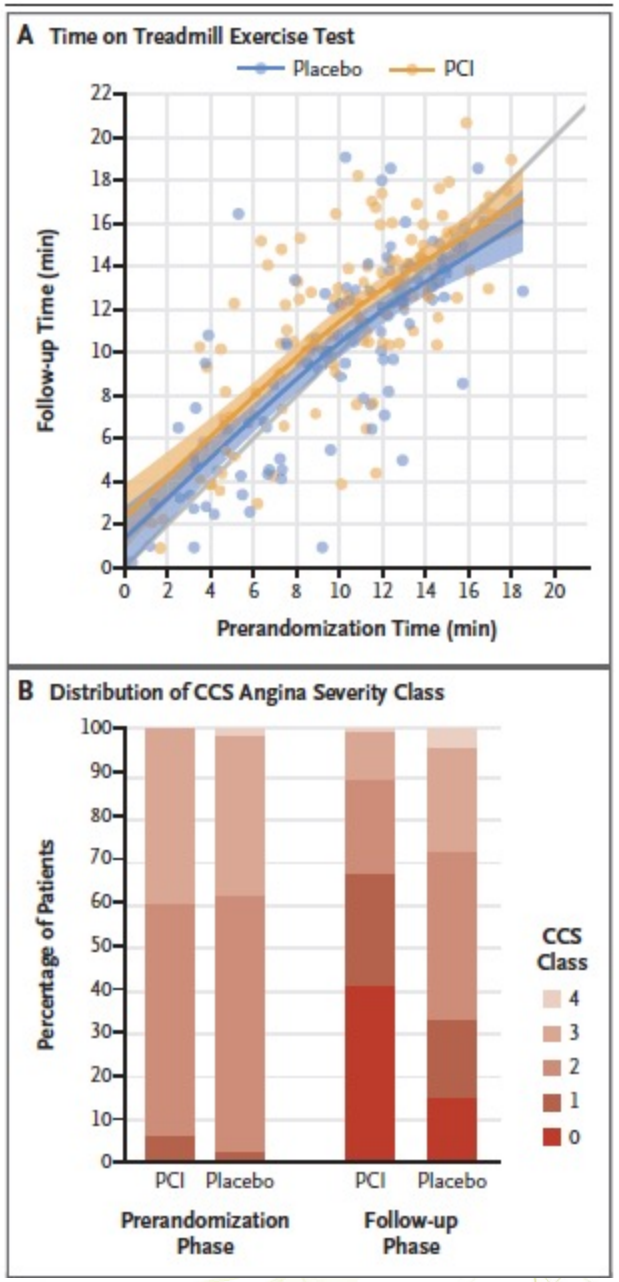
Manesh R. Patel, M.D., Eric D. Peterson, M.D., M.P.H., David Dai, M.S., J. Matthew Brennan, M.D., Rita F. Redberg, M.D., H. Vernon Anderson, M.D., Ralph G. Brindis, M.D., and Pamela S. Douglas, M.D.

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).

Table 3. Primary and Secondary End Points.*

End Point	PCI (N=151)		Placebo (N=150)		Odds Ratio or Difference (95% CI)†
	value	*no. of patients with data*	*value*	*no. of patients with data*	
Primary end point: angina symptom score — mean score‡	2.9	151	5.6	150	2.21 (1.41 to 3.47)§
Mean daily angina episodes — no.	0.3	151	0.7	150	3.44 (2.00 to 5.91)
Mean daily antianginal medication use — units¶	0.2	151	0.3	150	1.21 (0.70 to 2.10)
Secondary end points					
Mean treadmill exercise time — sec	700.9	123	641.4	112	59.5 (16.0 to 103.0)
CCS class — mean	0.9	147	1.7	146	3.76 (2.43 to 5.82)
End points assessed with the use of the SAQ‖					
Frequency of angina	80.6	146	66.2	145	14.4 (9.5 to 19.4)
Physical limitation	82.7	139	73.9	144	8.8 (4.7 to 12.9)
Angina stability	61.8	145	55.3	145	6.5 (0.5 to 12.5)
Quality of life	62.8	145	51.6	145	11.2 (6.2 to 16.1)
Freedom from angina	40	146	15	145	3.69 (2.10 to 6.46)
EQ-5D-5L descriptive system — mean score**	0.82	145	0.73	144	0.09 (0.05 to 0.13)
EQ-VAS — mean score**	73.1	146	66.9	143	6.2 (2.4 to 10.0)
Stress echocardiography score — mean score††	0.79	119	1.95	111	−1.17 (−1.56 to −0.78)



n engl j med 389;25 nejm.org December 21, 2023