Physiologie et Imagerie: La réconciliation

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FACULTE DE MEDECINE

Instituts thématiques

Inserm

Institut national de la santé et de la recherche médicale

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

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American Heart Association.

Editorial

Routine Pressure Wire Assessment at Time of Diagnostic Angiography

Is It Ready for Prime Time?

Eric Van Belle, MD, PhD; Gilles Rioufol, MD, PhD; Patrick Dupouy, MD

Editorial

Routine Fractional Flow Reserve Combined to Diagnostic Coronary Angiography as a One-Stop Procedure

Episode 3

Eric Van Belle, MD, PhD; Patrick Dupouy, MD; Gilles Rioufol, MD, PhD

Van Belle et al. Circ Cardiovasc Interv 2014
Van Belle et al. Circ Cardiovasc Interv 2016

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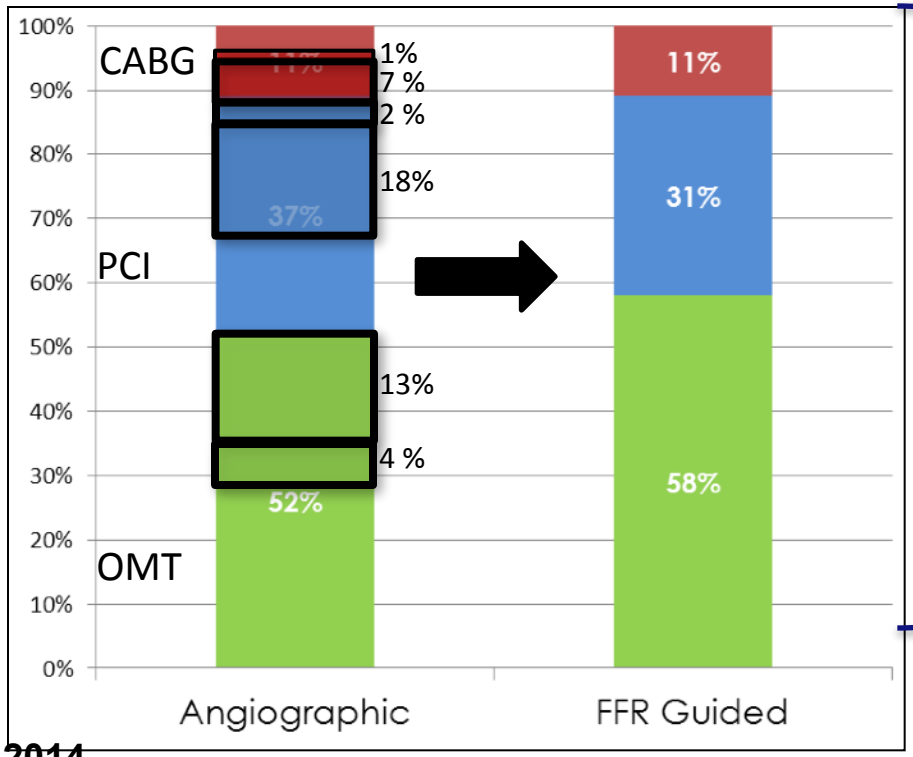
R3F

American Heart Association

Outcome Impact of Coronary Revascularization Strategy Reclassification With Fractional Flow Reserve at Time of Diagnostic Angiography

Insights From a Large French Multicenter Fractional Flow Reserve Registry

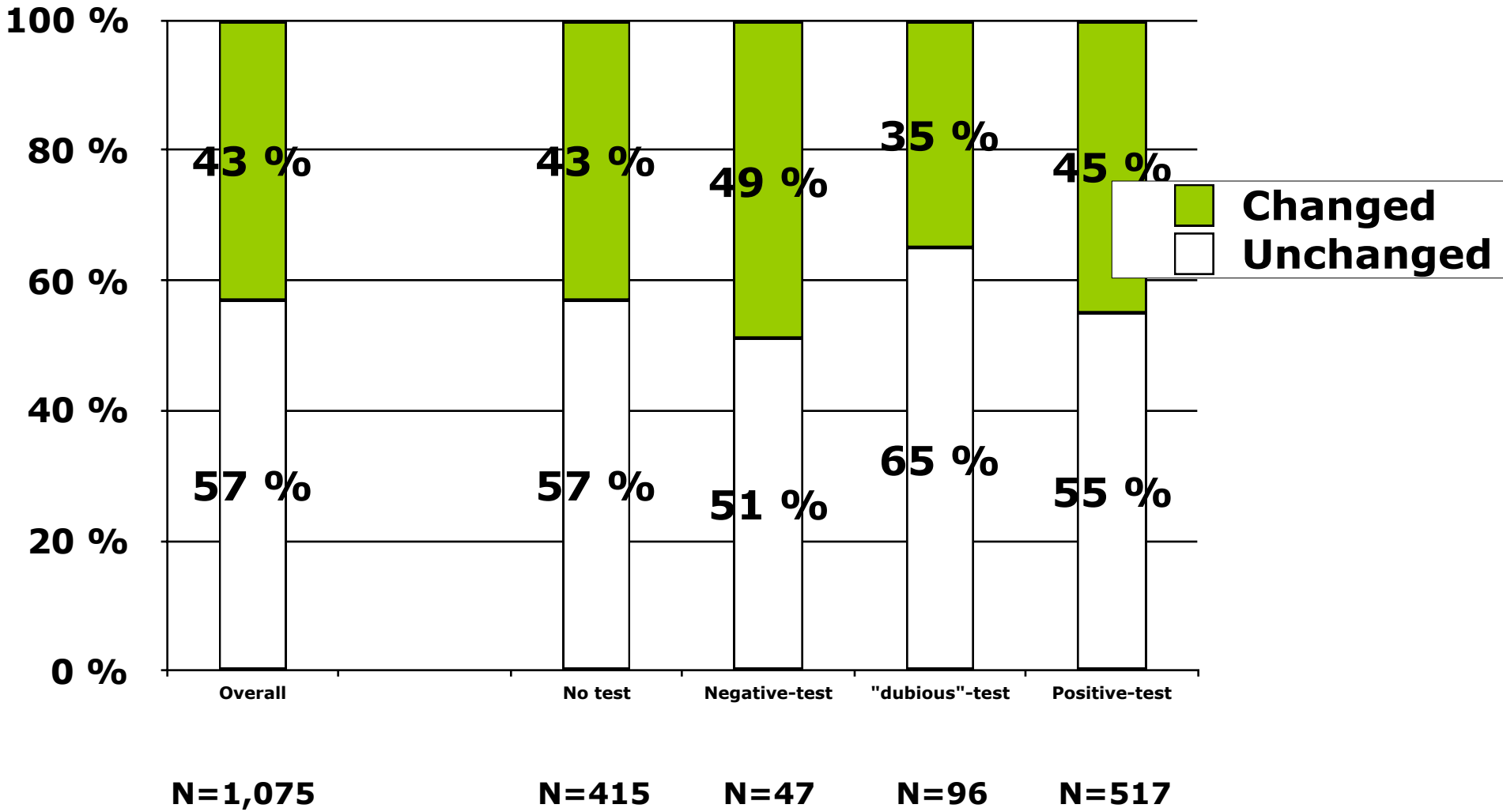
Eric Van Belle, MD, PhD; Gilles Rioufol, MD, PhD; Christophe Pouillot, MD;

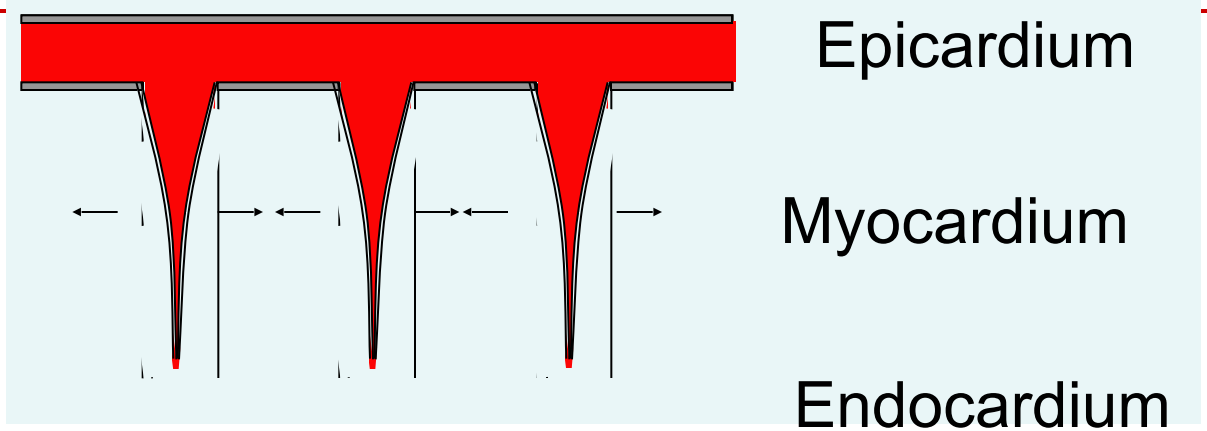


43% of patients changed therapy with FFR guidance

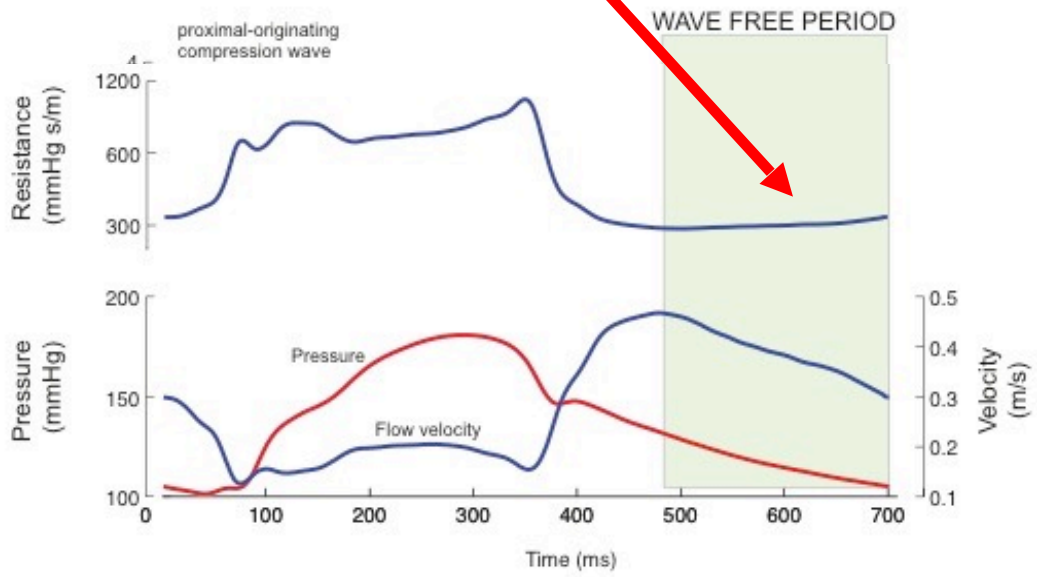
Van Belle et al. Circulation 2014

Change of the Revascularization strategy according to the results of non-invasive tests

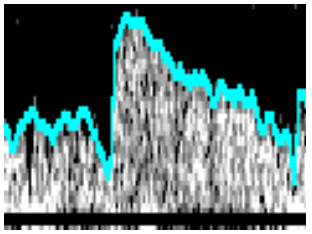




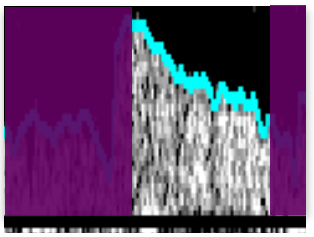
Distal pressure falling

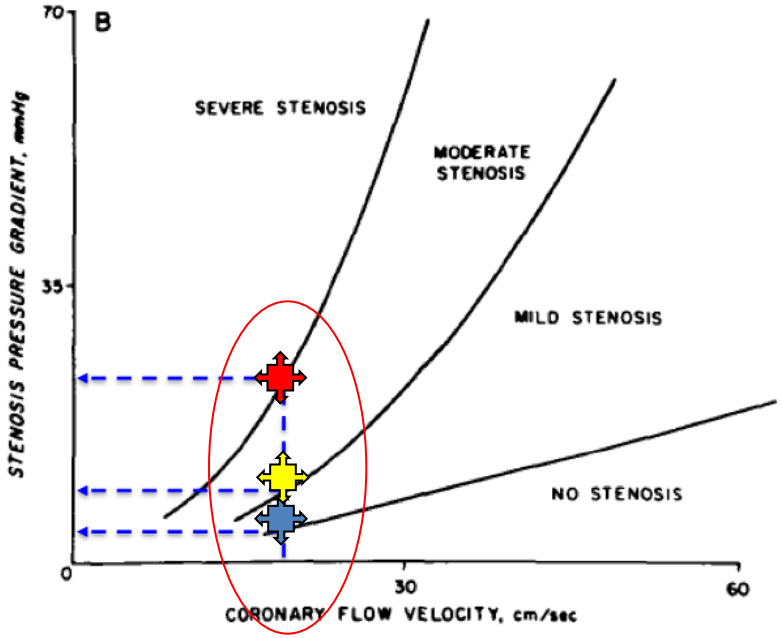


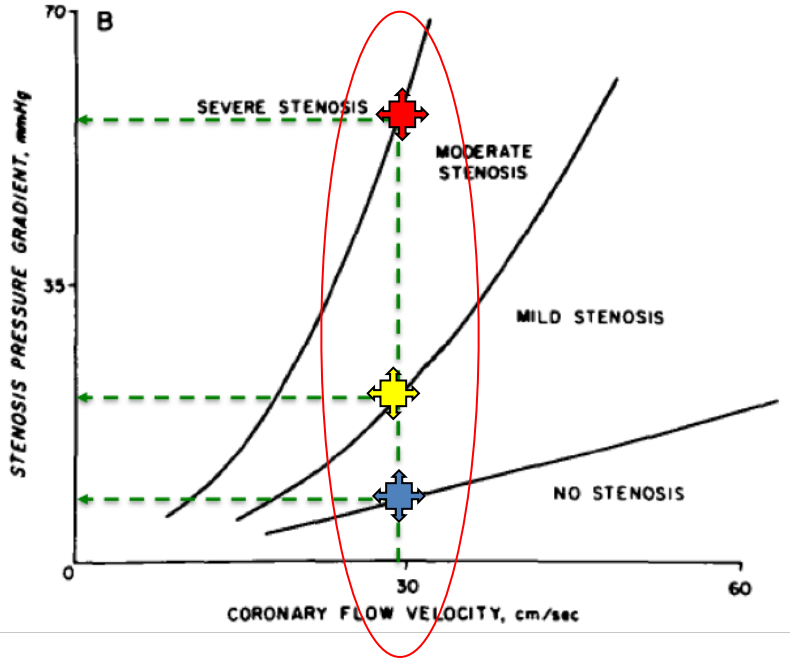
Complete cycle flow



Wave-free flow







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JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

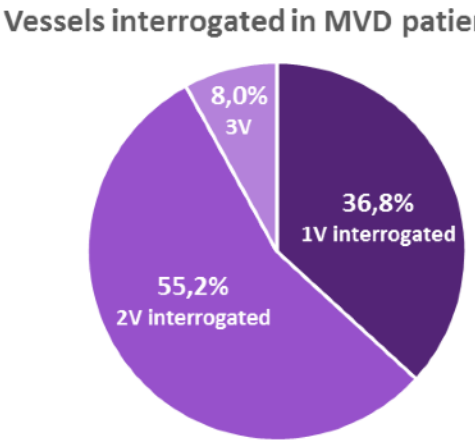
Impact of Routine Invasive Physiology at Time of Angiography in Patients With Multivessel Coronary Artery Disease on Reclassification of Revascularization Strategy

Results From the DEFINE REAL Study

Eric Van Belle, MD, PhD,[a] Robert Gil, MD, PhD,[b] Volker Klauss, MD,[c] Mohammed Balghith, MD,[d] Martijn Meuwissen, MD, PhD,[e] Jérôme Clerc, MD,[f] Bernhard Witzenbichler, MD,[g] Miha Cercek, MD,[h] Marios Vlachojannis, MD,[i] Irene Lang, MD,[j] Philippe Commeau, MD,[k] Flavien Vincent, MD,[a] Luca Testa, MD, PhD,[l] Wojciech Wasek, MD, PhD,[m] Nicolas Debry, MD,[a] Stephan Kische, MD, PhD,[n] Gabriele Gabrielli, MD,[o] Gennaro Sardella, MD, PhD[p]

JACC: CARDIOVASCULAR INTERVENTIONS VOL. 11, NO. 4, 2
FEBRUARY 26, 2018:354–65

Reclassification according to the number of vessels investigated



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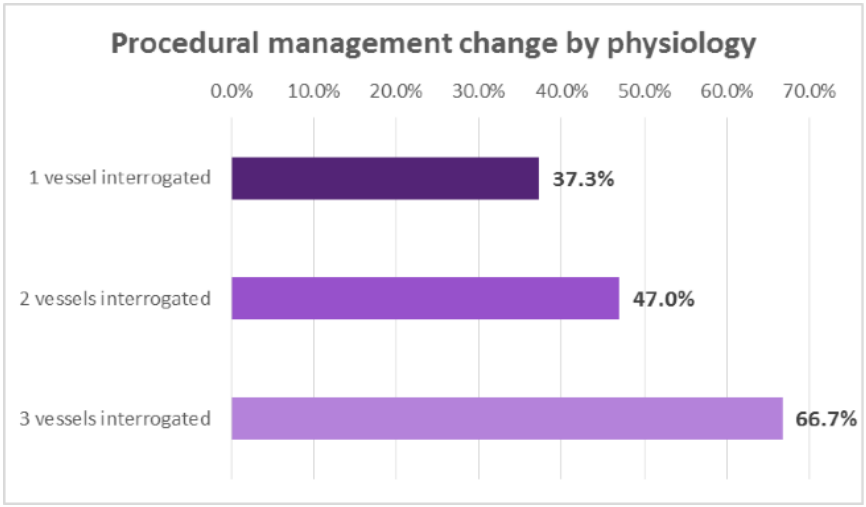
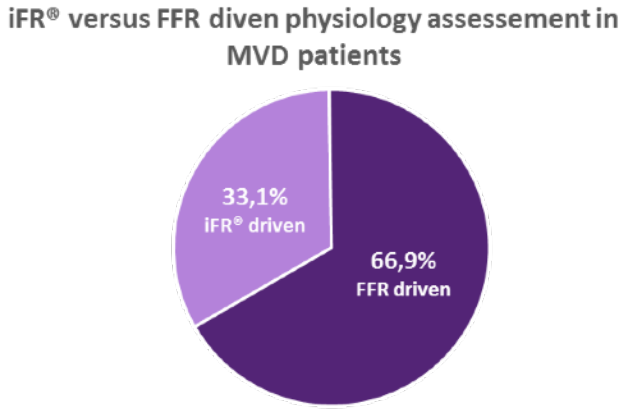
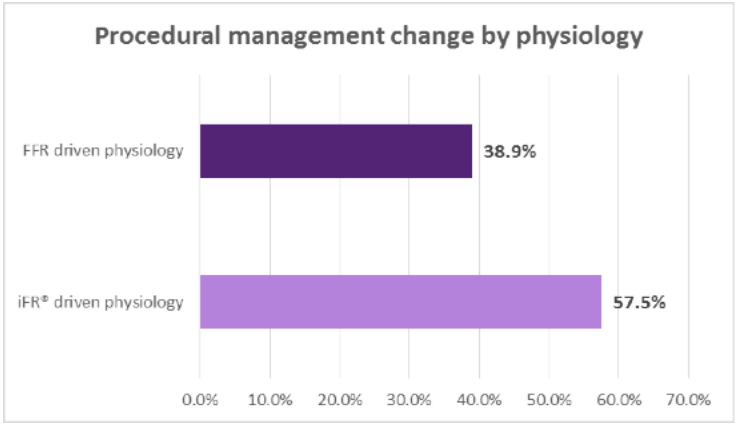


Reclassification according to the use of iFR/FFR

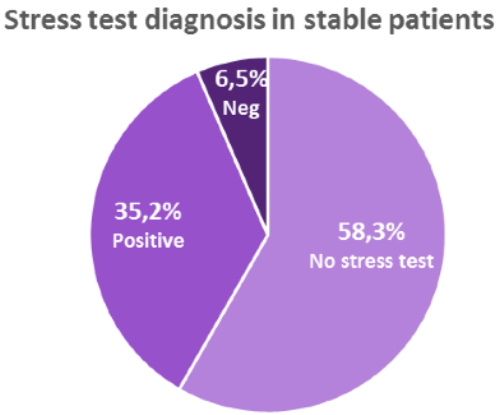


iFR : 1.9 vessels
FFR: 1.6 vessels

P=0.0001



Reclassification according to the results of non-invasive tests



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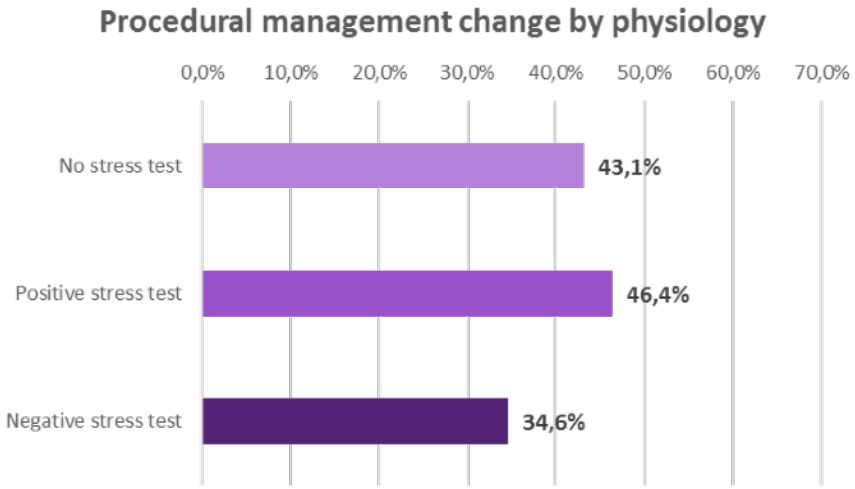

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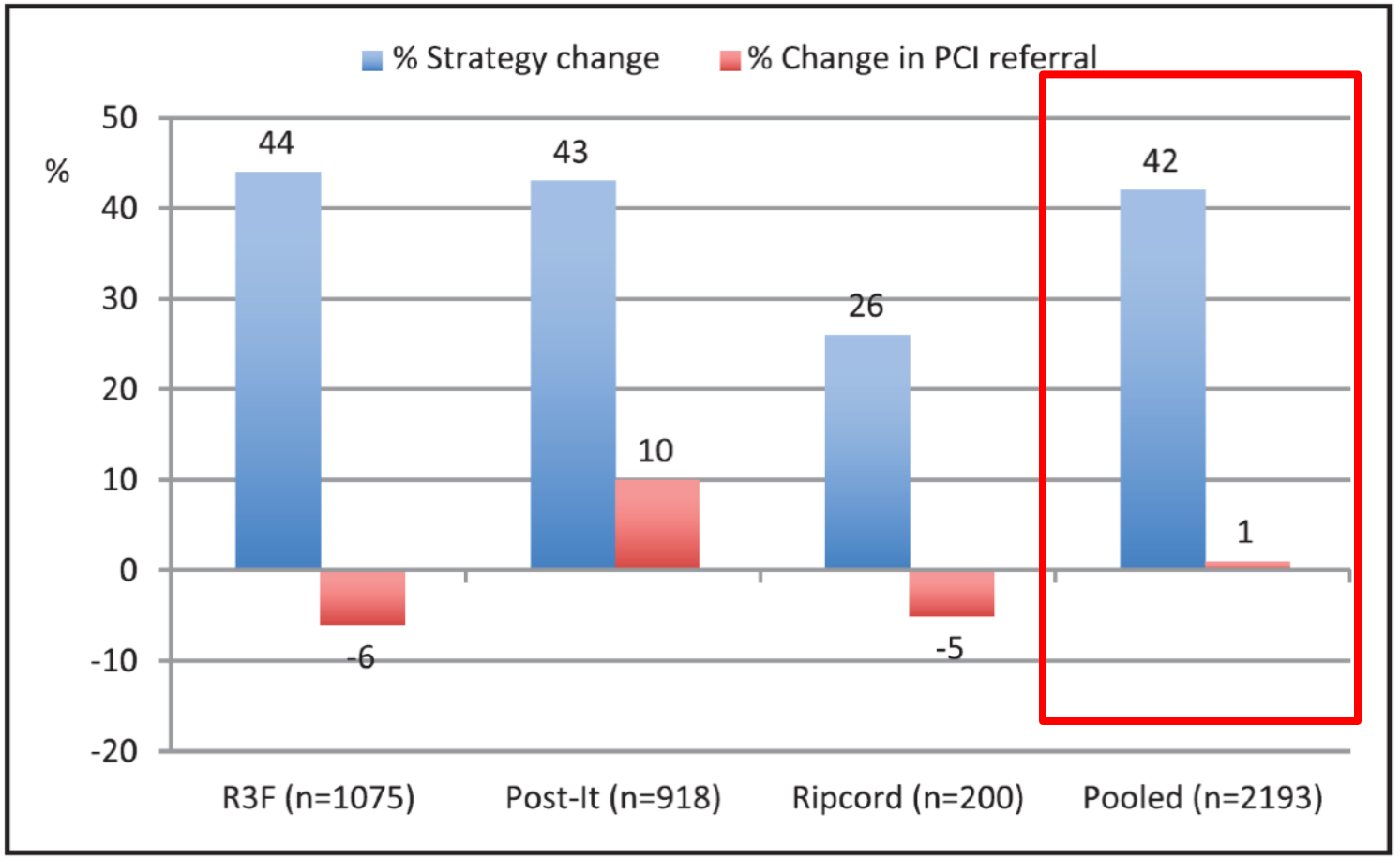
Autre



Van Belle et al. Circ Cardiovasc Interv 2016

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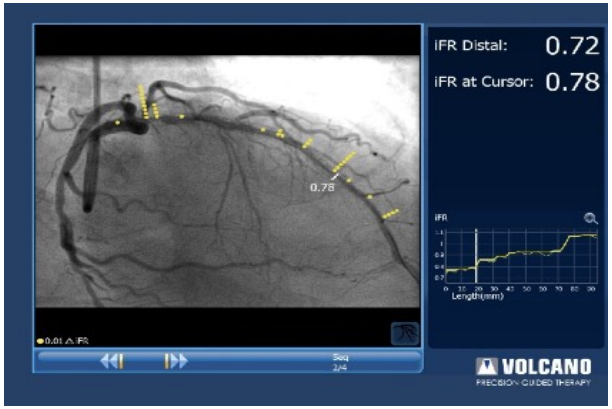
TABLE 1 Studies Evaluating Reclassification of the Treatment Strategy by Routine Coronary Pressure Assessment and Its Impact on Revascularization Rates

Study	Number of Patients	Target Population	Patients Considered for Revascularization Based on Angiography†	Reclassification Rate	Gain/Loss in Patients Undergoing Revascularization Following Pressure Wire	Number of Patients With 1-Year Clinical Outcome
Episode 1: R3F	1,075	Mostly stable	488 (45%)	43%	−32 (−6%)	1,075
Episode 2: RIPCORD	200	Stable	113 (56%)	27%	−3 (−1%)	0
Episode 3: POST-IT	918	Mostly stable	357 (39%)	44.2%	+123 (+34%)‡	918
Episode 4: FAMOUS-NSTEMI	176	ACS	158 (90%)	22%	−22 (−12%)	176
Episode 5: PRIME-FFR	533*	ACS	206 *(39%)	38%	+42* (+24%)	533*
Episode 6: DEFINE-REAL	484	MVD	346 (71%)	45%	−39 (−11%)	0
Episode 7: iFR-SWEDEHEART	2,013	Mostly stable Including 722 with MVD	1,282 (64%) 648 (89%)	40% 49%	−177 (−14%) −64 (−9%)	2,013
Total	4,866*		2,744 (56%)		−150 (−5%)	4,182*

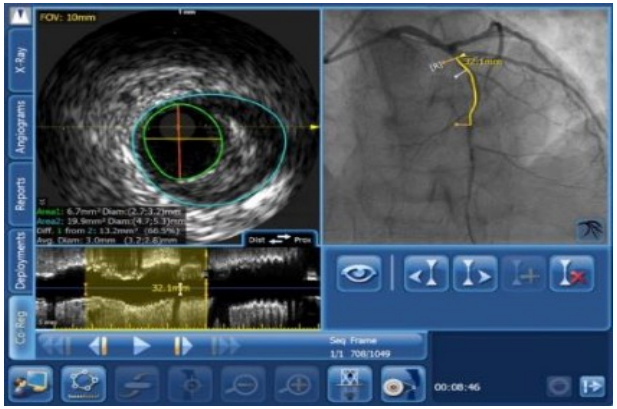
Role of iFR in serial lesions

Co-registration of imaging and physiology tools

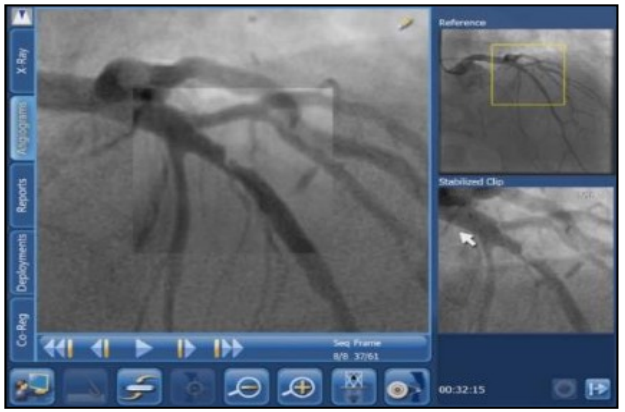
iFR Co-Registration



IVUS Co-Registration



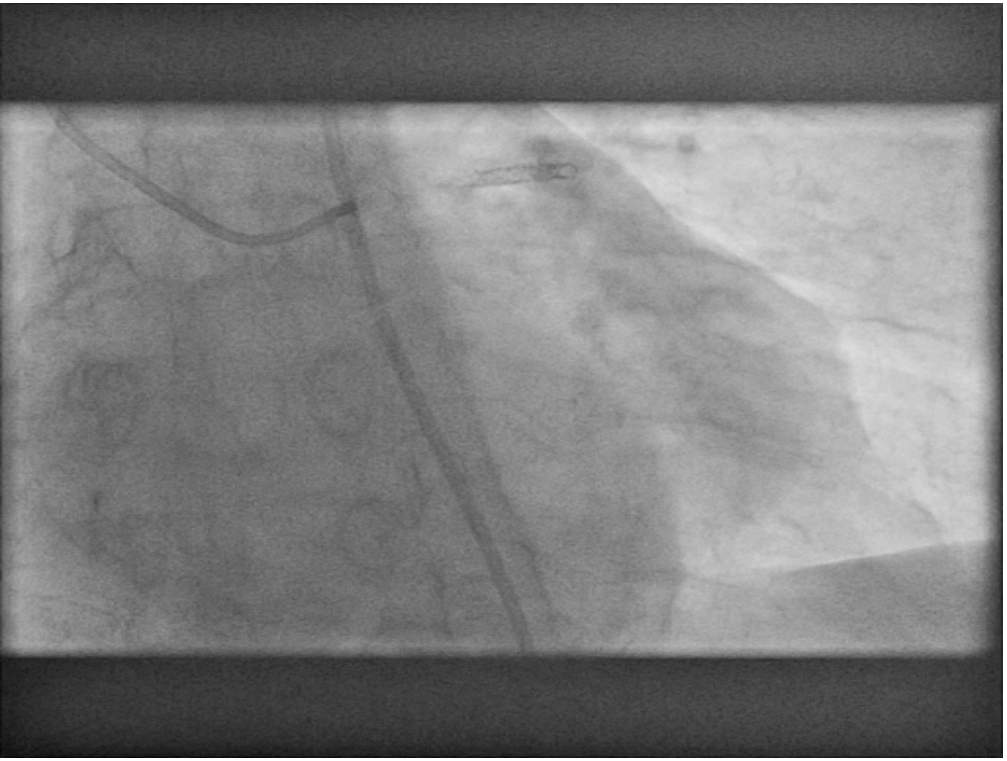
Enhanced Angiography



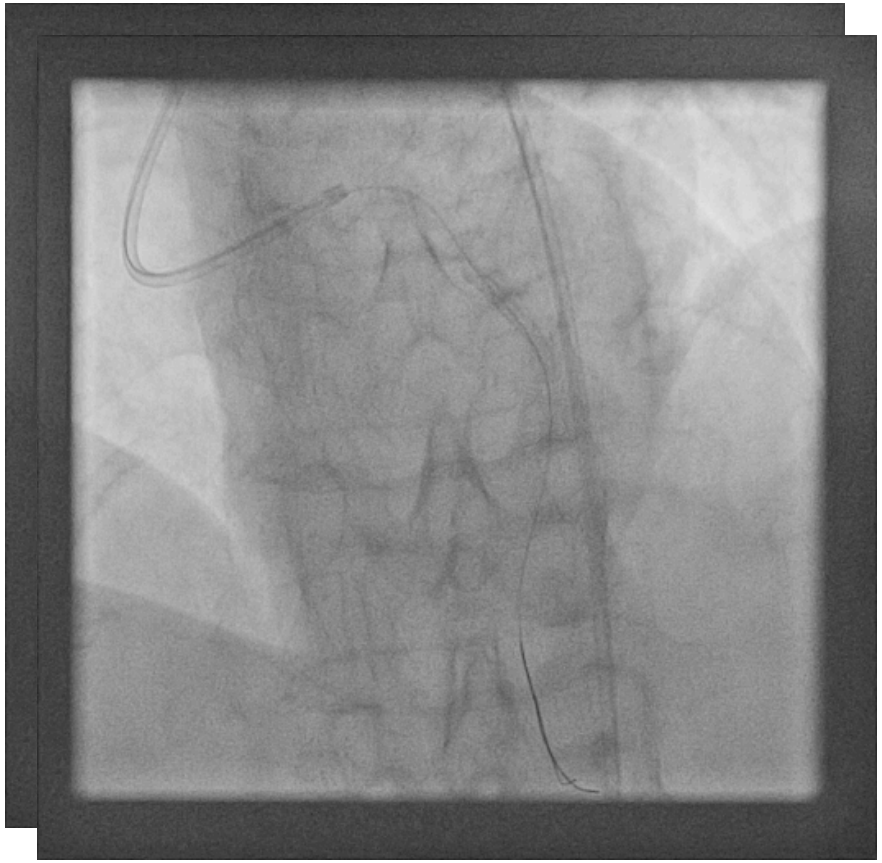
OCT / OFDI Co-Registration

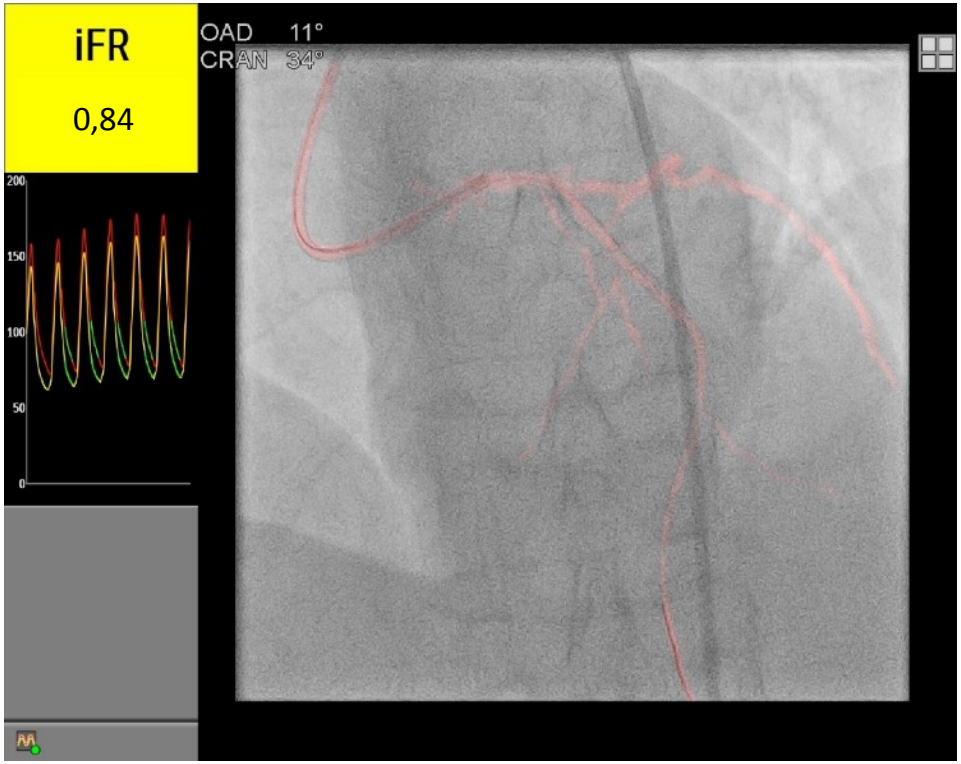
Cas clinique N°1

- Patiente de 76 ans.
- Antécédent de coronaropathie stentée sur l'IVA en 2011.
- Hospitalisée pour angor instable dans un Centre partenaire
- ETT : FEVG conservée
- Coronarographie : Découverte d'une sténose du TC distale
- Adressée pour angioplastie TC distale.

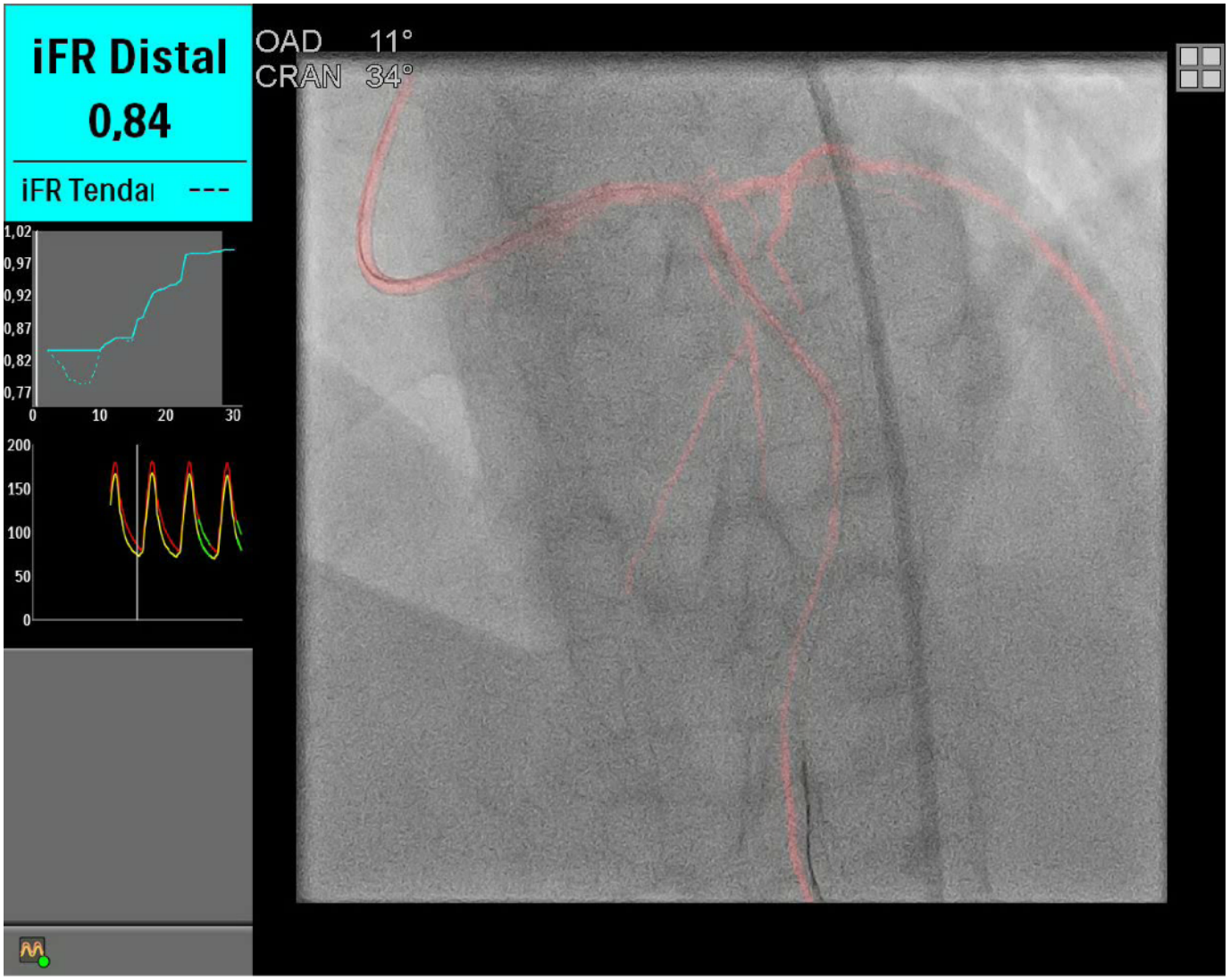


iFR en distalité





iFR Roadmap


iFR Distal
0,84
iFR Tendal ---
1,02
0,97
0,92
0,87
0,82
0,77
0
10
20
30
200
150
100
50
0
OAD 11°
CRAN 34°

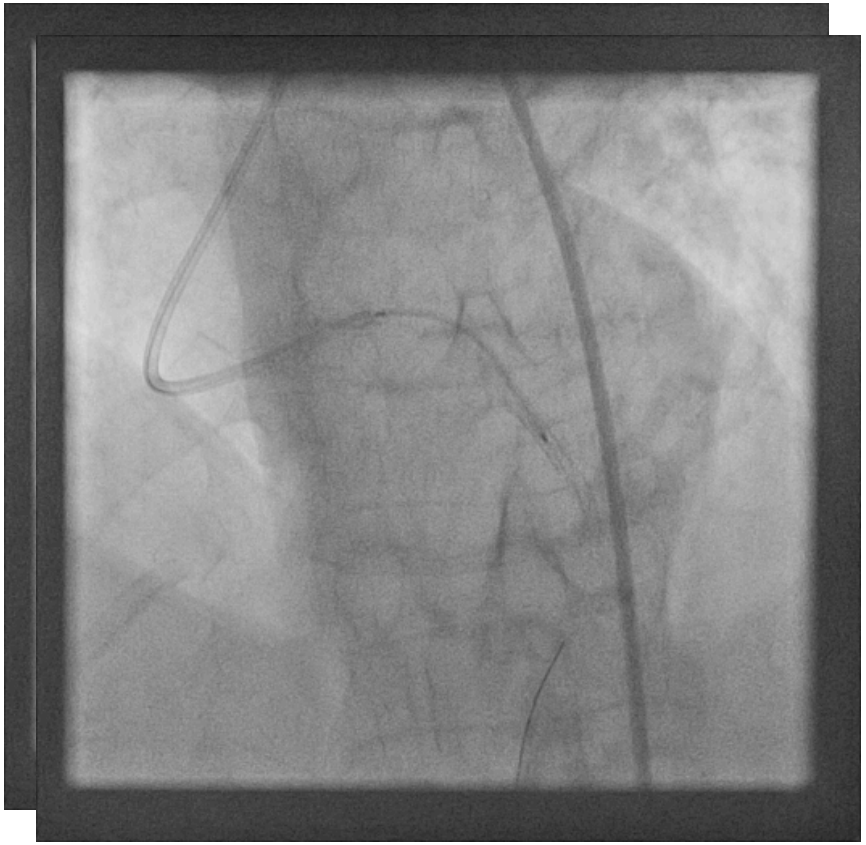
Perte de charge diffuse sur TC distale et RIS IVA Moyenne :

- Prédilatation au ballon NC

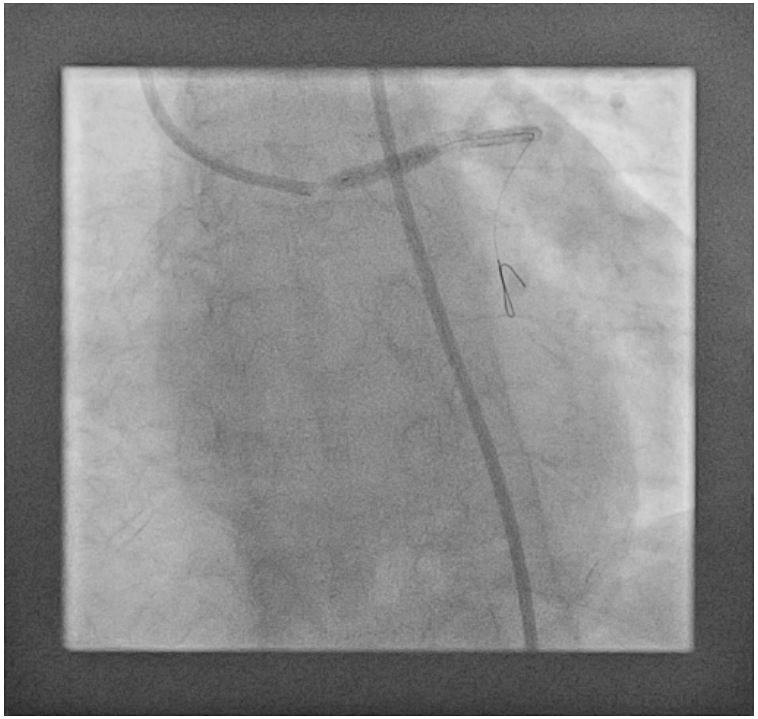
- Décision angioplastie par long stent TC-IVA en overlap sur stent IVA moyenne

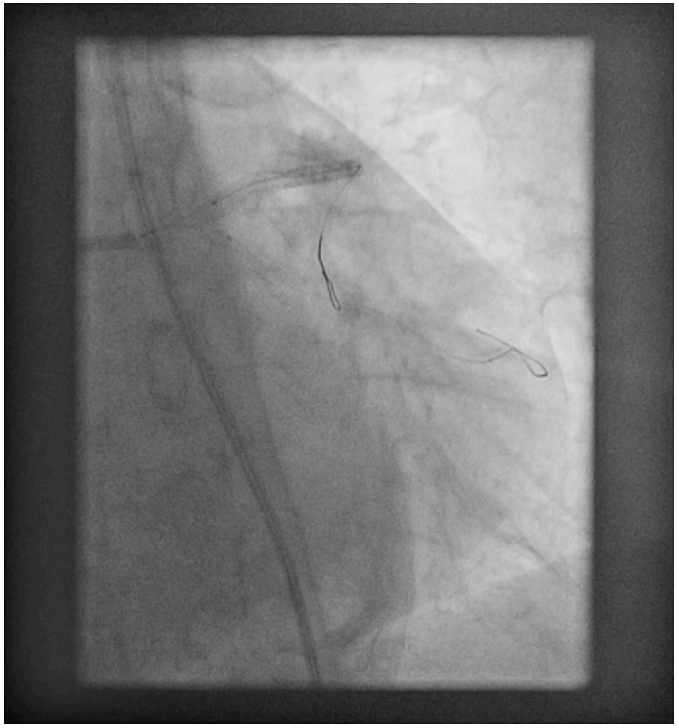
Stent actif Resolute ONYX 3,5*38mm TC-IVA en overlap

Inflaté à 12 Bar

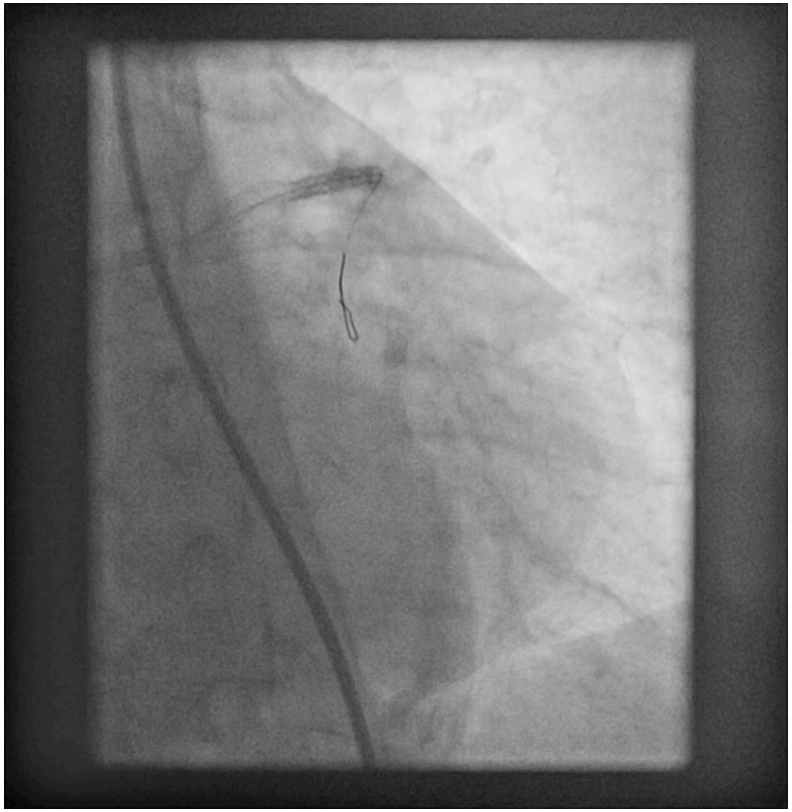


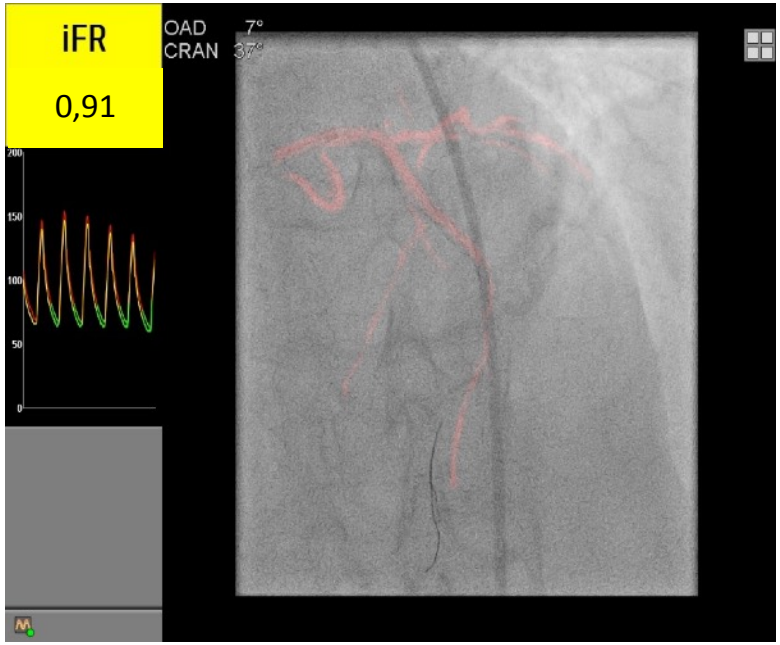
Optimisation



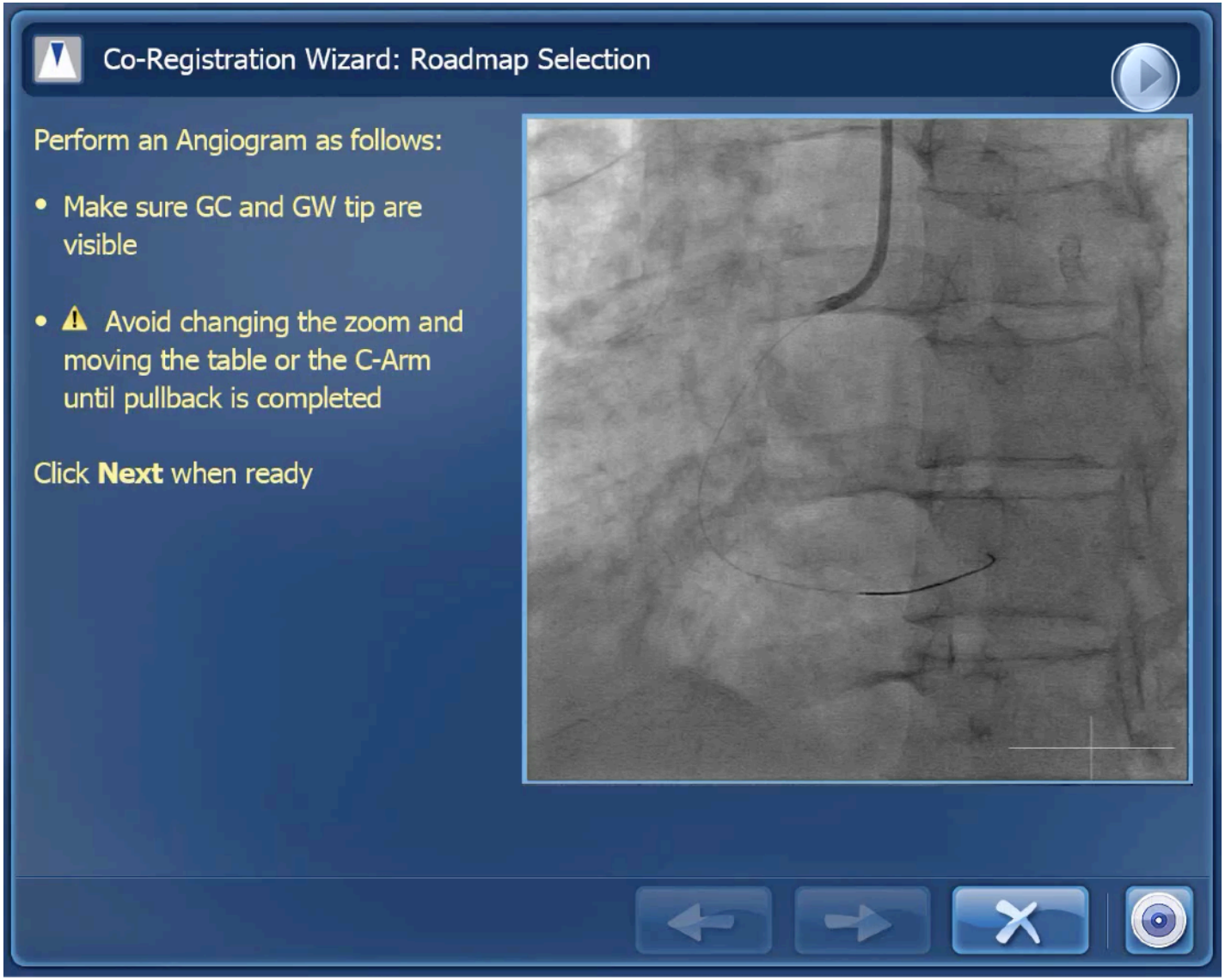


Résultat final

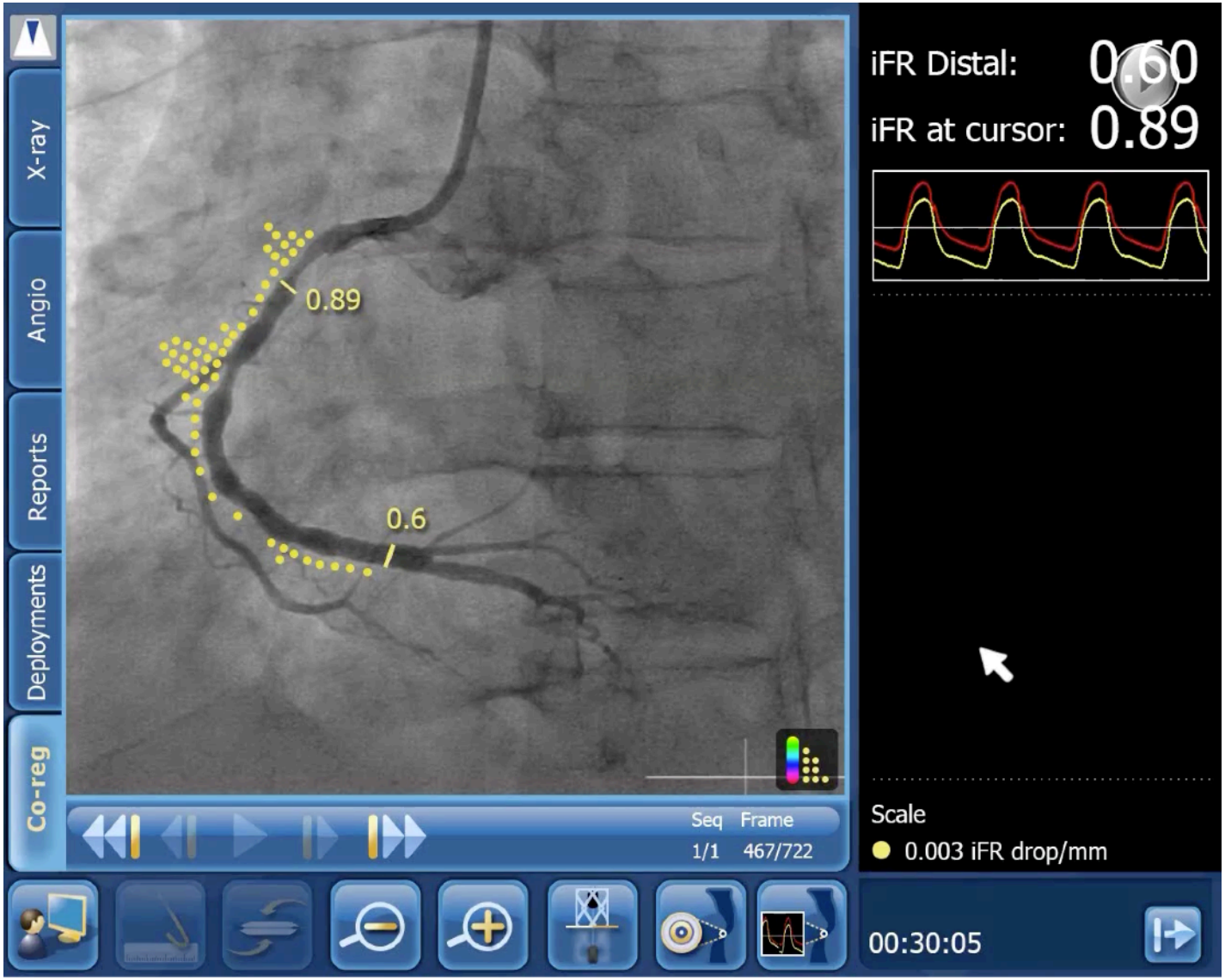




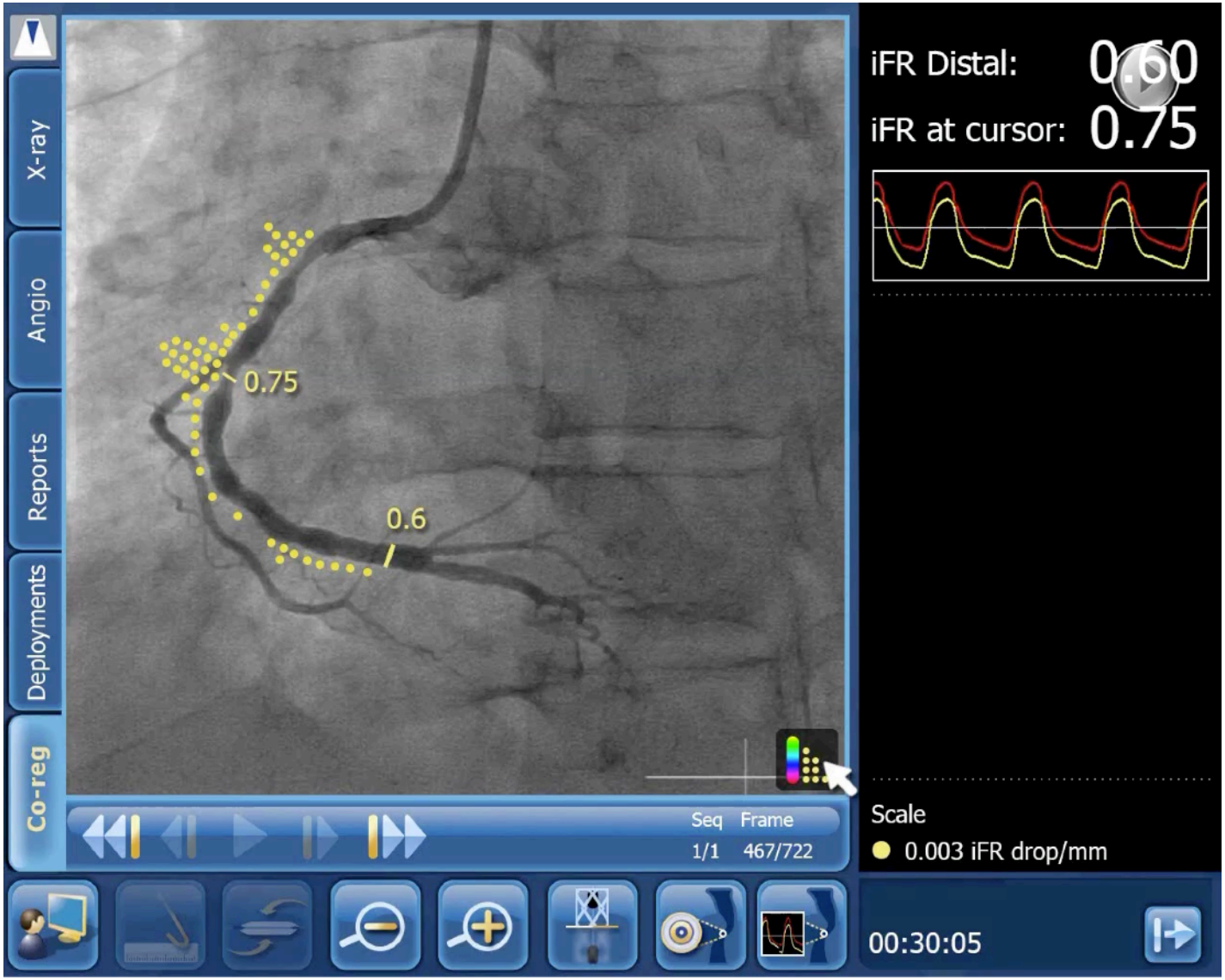
iFR Co-registration



iFR Co-registration

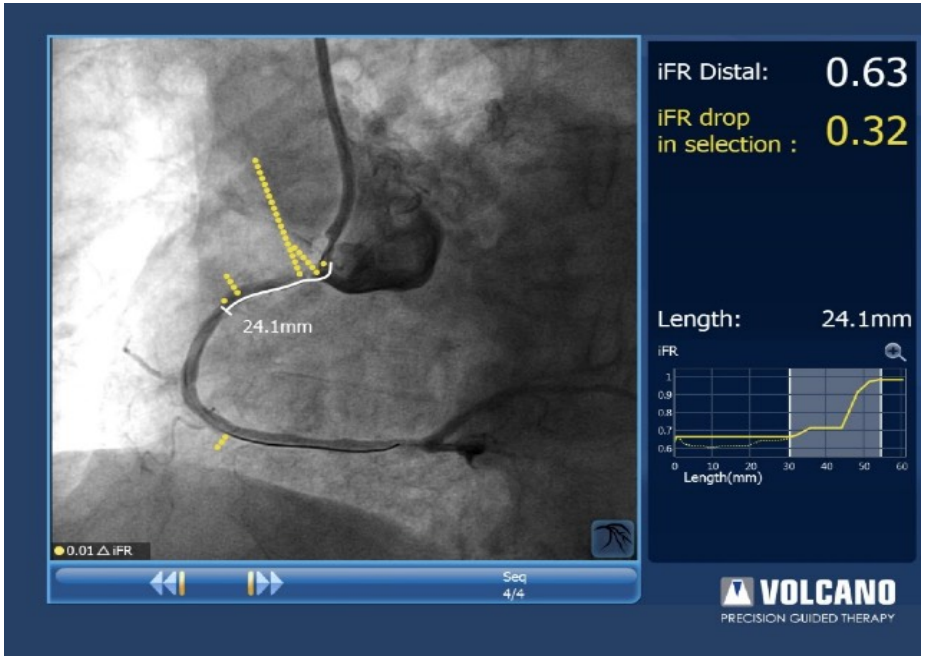


iFR Co-registration

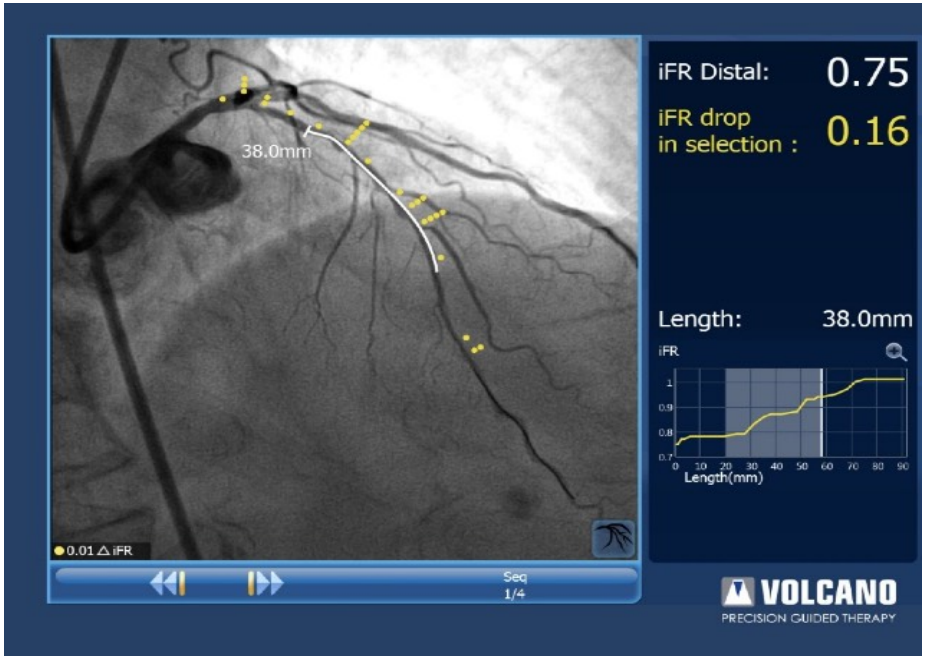


iFR Co-registration

Focal stenosis



Diffuse disease



Combining imaging and local detection of ischemia

For the best possible decision

Conclusions

- ✓ Invasive detection of ischemia by FFR/iFR (IP) has become the gold standard for the evaluation of epicardial vessel related ischemia.
- ✓ PCI guided by local invasive detection of ischemia is associated with an improved clinical outcome (FAME and FAME 2)
- ✓ Routine use of FFR/iFR during diagnostic angiography is associated with change of the treatment decision (Reclassification) in > 40%
- ✓ Combining angiography with iFR pullback to perform a coronary physiology mapping (diagnostic) and virtual PCI (therapeutic) is a major step forward at the time Coronary-CT and FFR-CT
- ✓ 100% of patient should be discharged from coronary angiography with a clear plan of revascularization (non-invasive test before or FFR/iFR during angio)

Thank you for your attention!

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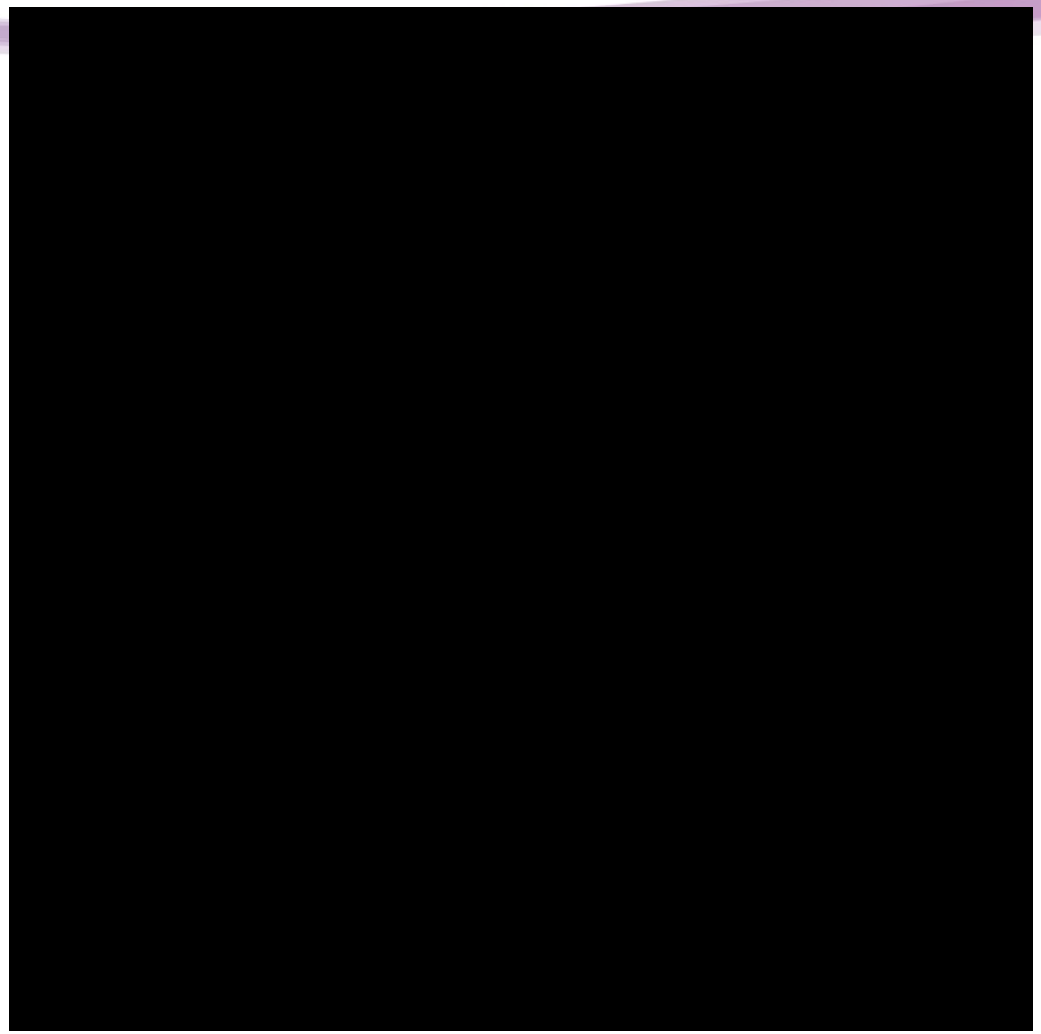
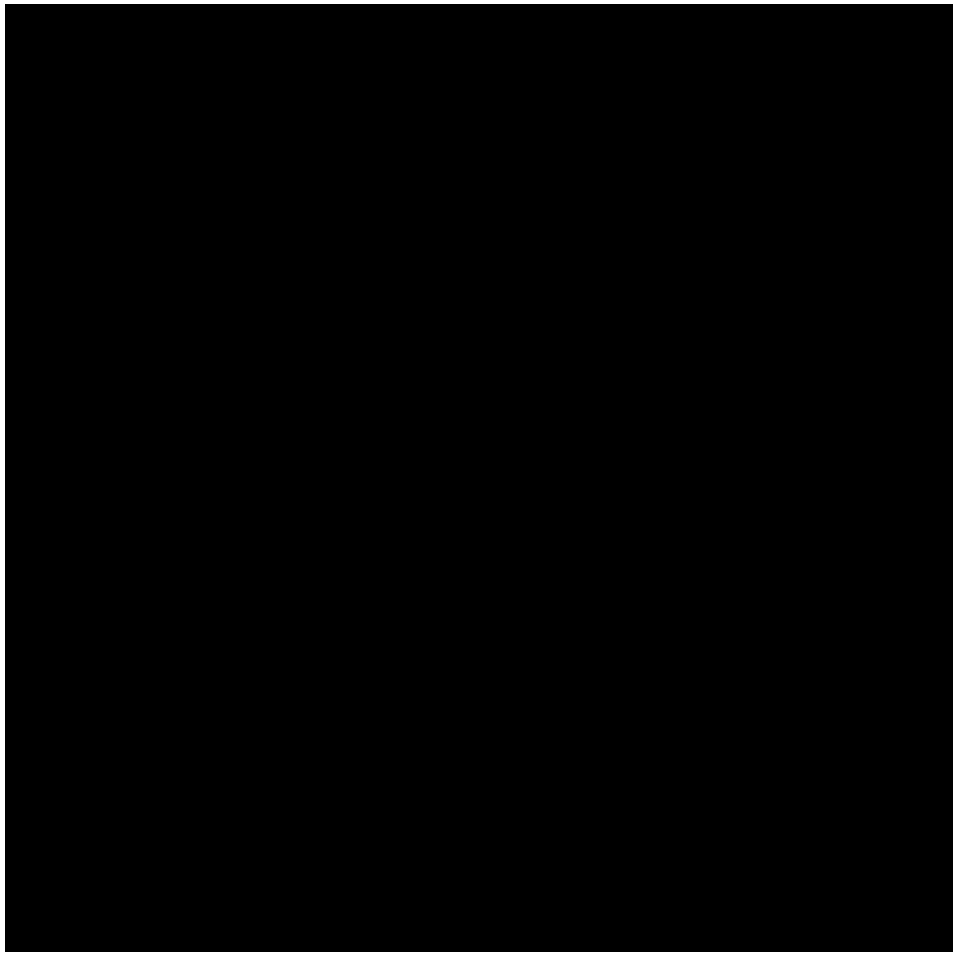
Institut Coeur et Poumon - CHU Lille, France
University of Lille - School Of Medicine Henri Warembourg

Coordonner l'imagerie et la physiologie

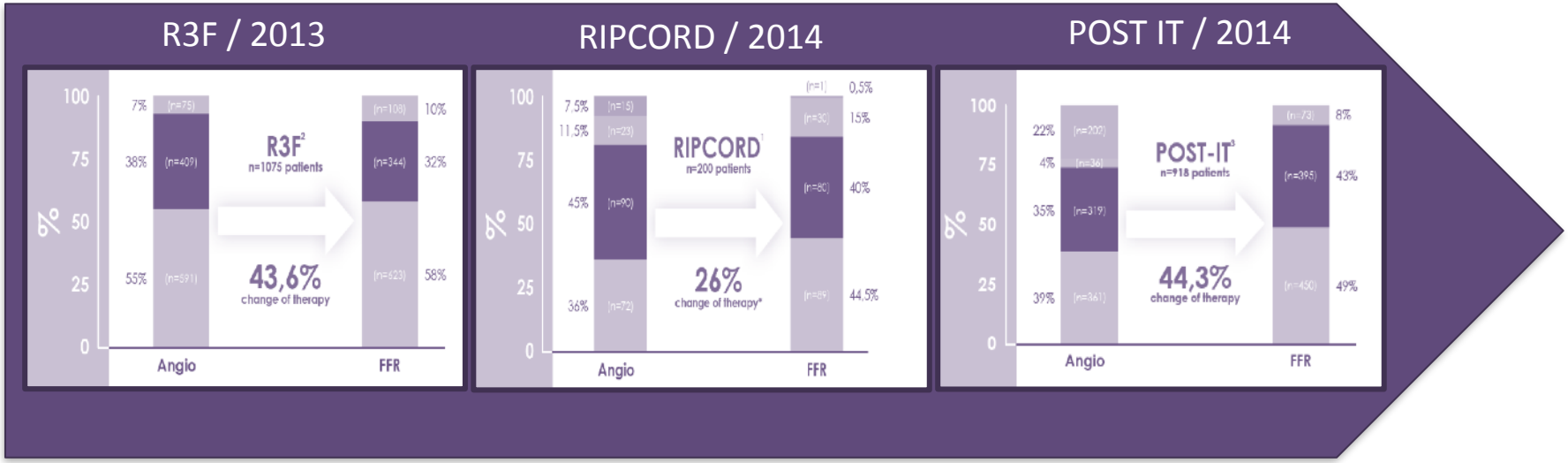
Pour la meilleure decision possible





Background

- Results from national studies have shown that FFR evaluation during diagnostic angiography impacts the coronary revascularization strategy on a range of 26 to 44% of patients.
- There is limited data on utilization of coronary physiology and reclassification in Multi-Vessel Disease (MVD) population



Van Belle E, et. al. Outcome impact of coronary revascularization strategy reclassification with FFR at time of diagnostic angiography: insights from a large French multicenter FFR registry. Circulation. Published online 19 Nov 2013

Curzen N, et al. RIPCORD: Does Routine Pressure Wire Assessment Influence Management Strategy at Coronary Angiography for Diagnosis of Chest Pain? Circ Cardiovasc Interv.2014;7:248-255.

Baptista SB, et al. POST.IT: Presented at late breaking trial at PCR 2014.
Market Model data on file at Volcano Corporation.

Objectives

As systematic FFR multi-vessel assessment is time consuming and therefore rarely performed in routine practice, the iFR® index may help to simplify the physiology assessment of MVD patient population.

The DEFINE REAL objectives are:

- To assess prospectively the impact of physiology on revascularization strategy of MVD patients compared to diagnostic angiogram only.
- To analyze how FFR and iFR® are used in routine practice during physiology evaluation of MVD patients.

Methodology

ANGIOGRAPHY

PHYSIOLOGY

CHANGE(S) ?

Patient with Lesion DS% >40 in 2 or 3 different major vessels

Patient Eligible should be for Physiology Evaluation

Initial Treatment Strategy based on **Angiography (and clinical information)**

➔ CABG, PCI or OMT

Final treatment strategy based on **Physiology**

➔ CABG, PCI or OMT

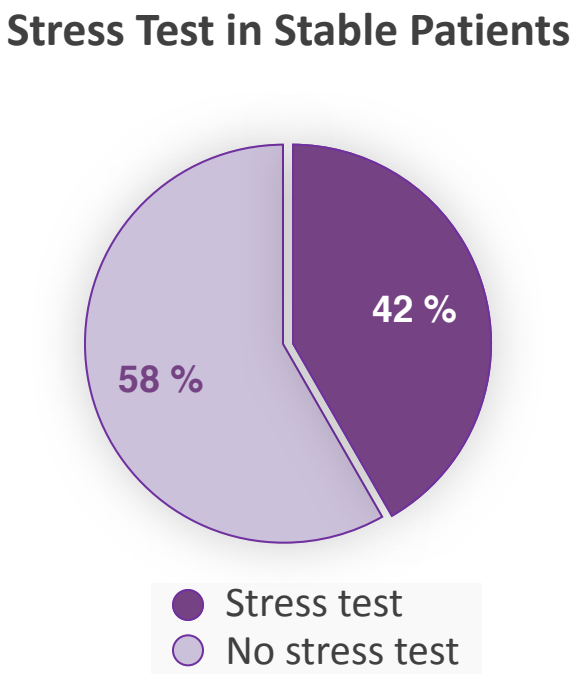
Change of Treatment Strategy based on the Difference between Initial and Final Treatment:

➔ At Vessel level

➔ At Patient level

Patient Demographics

Patient Demographics	n = 484
Gender (male)	80%
Age (mean)	66.7 yr
Previous MI	36%
ACS	17.8%
Diabetes	26.7%
Normal LVEF	62.8.%
Non-invasive stress test	26.7%



Baseline Characteristics

Patients population	**484**
• Patient with LM involved	9.1%
Vessels diseased	**1107**
• Average per patient	**2.29**
Vessels assessed by physiology	**830 (75%)**
• Average per patient	**1.71**

3VD

Lesion severity Median **DS 60%**

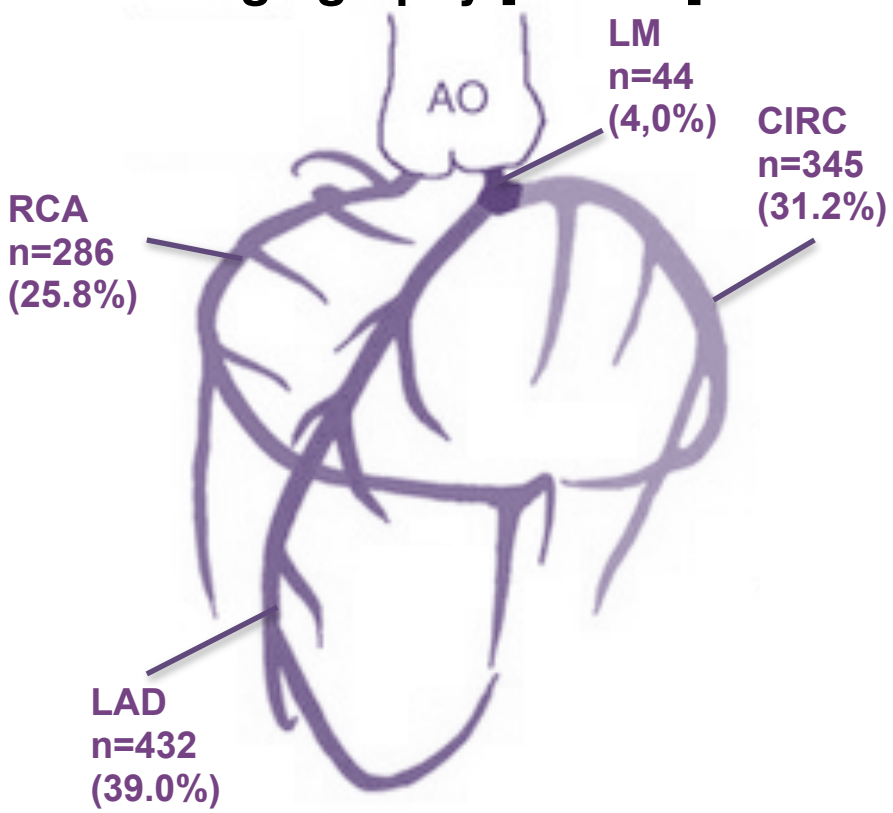
Results of FFR/iFR®

Median FFR Value: 0,85
n = 608

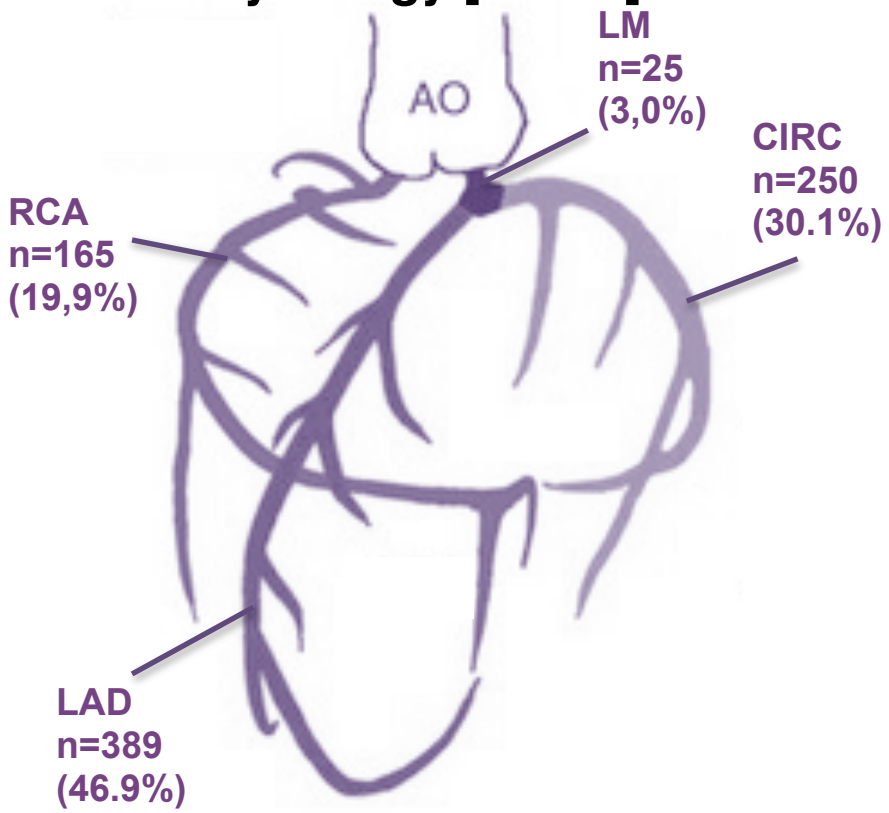
Median iFR® Value: 0,92
n = 793

Baseline Characteristics

Diseased Vessels by Angiography [n=1107]

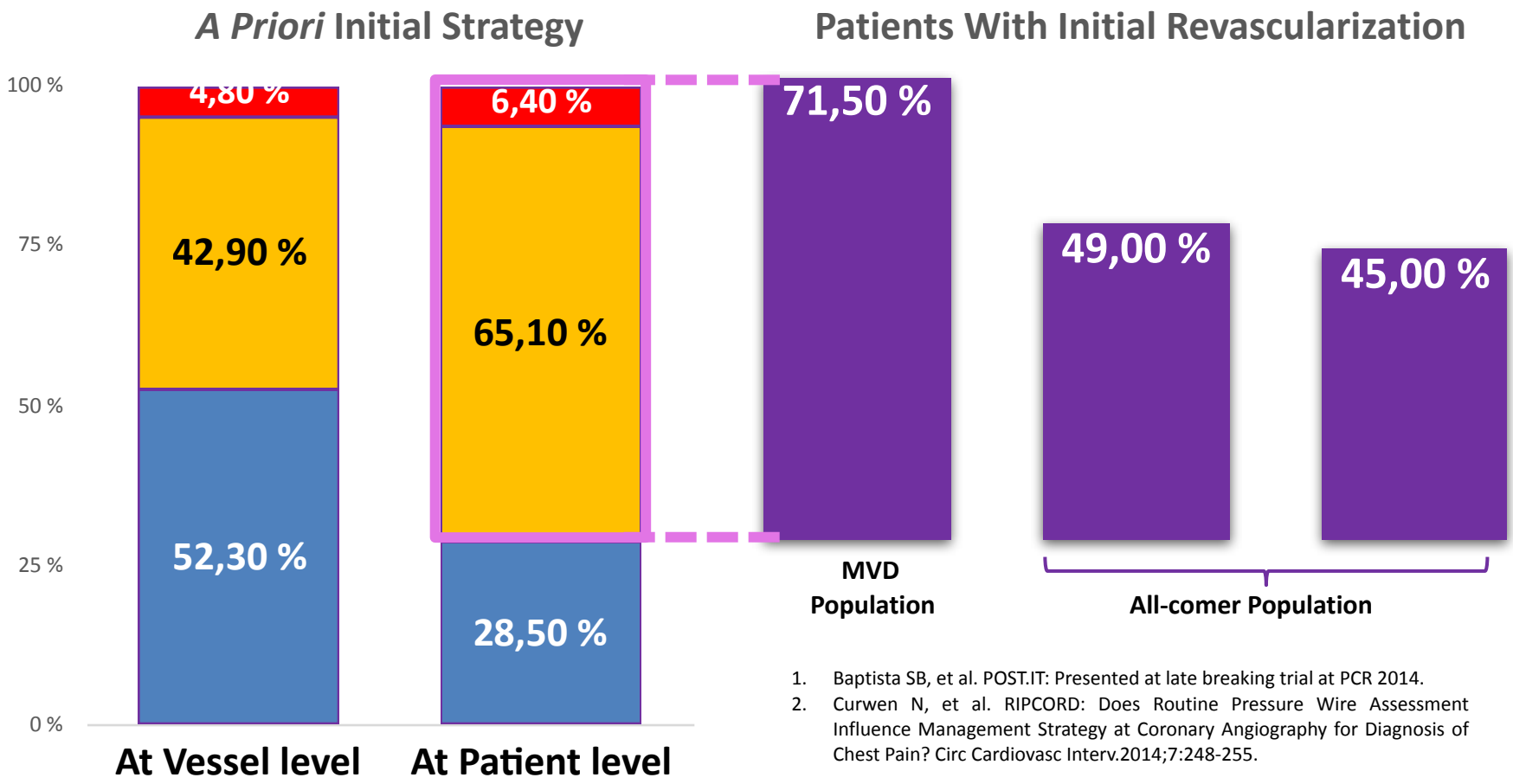


Vessels Interrogated with Physiology [n=830]



In this MVD population, 75% of diseased vessels were interrogated by Physiology

Initial Treatment Strategy By Angiography



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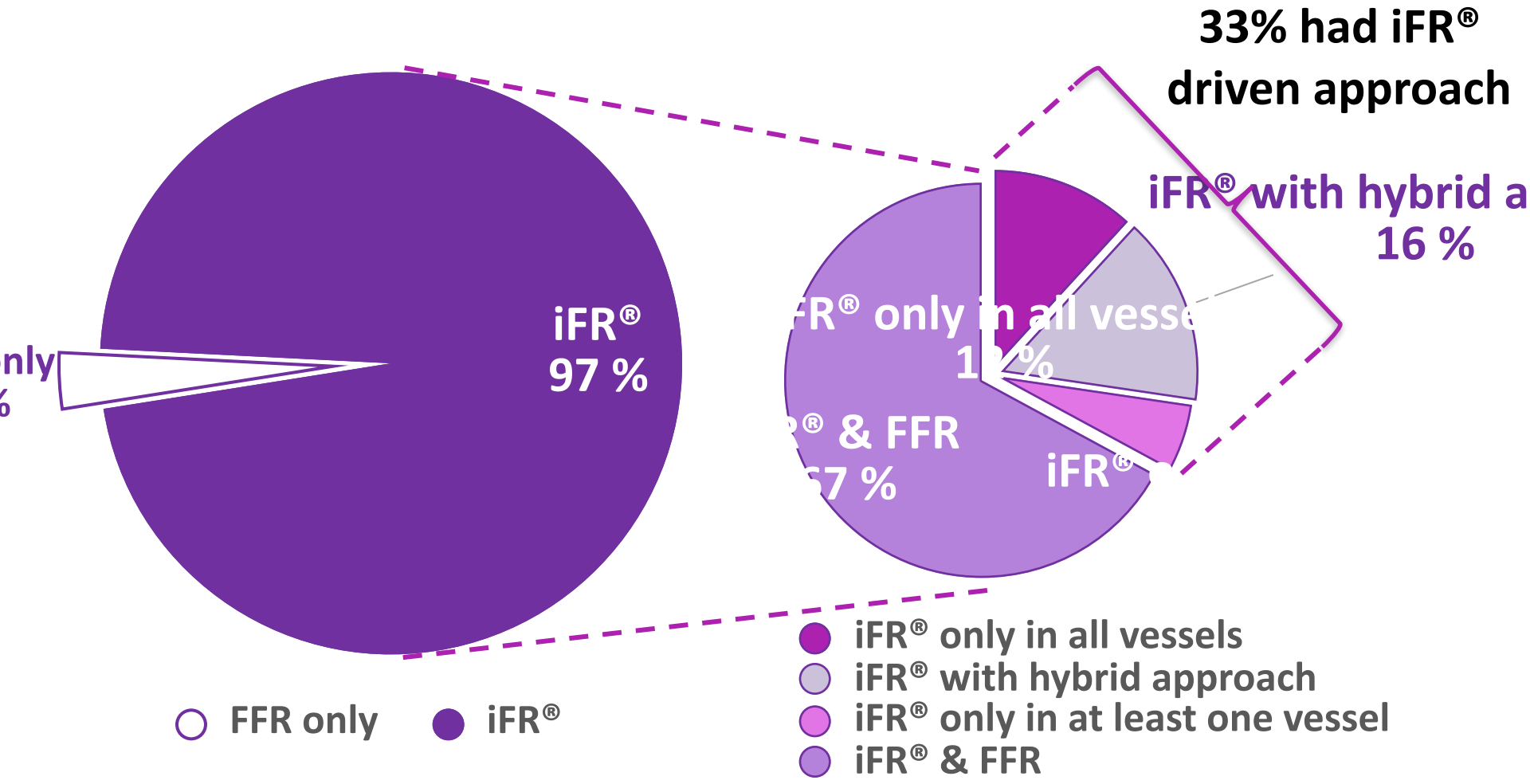
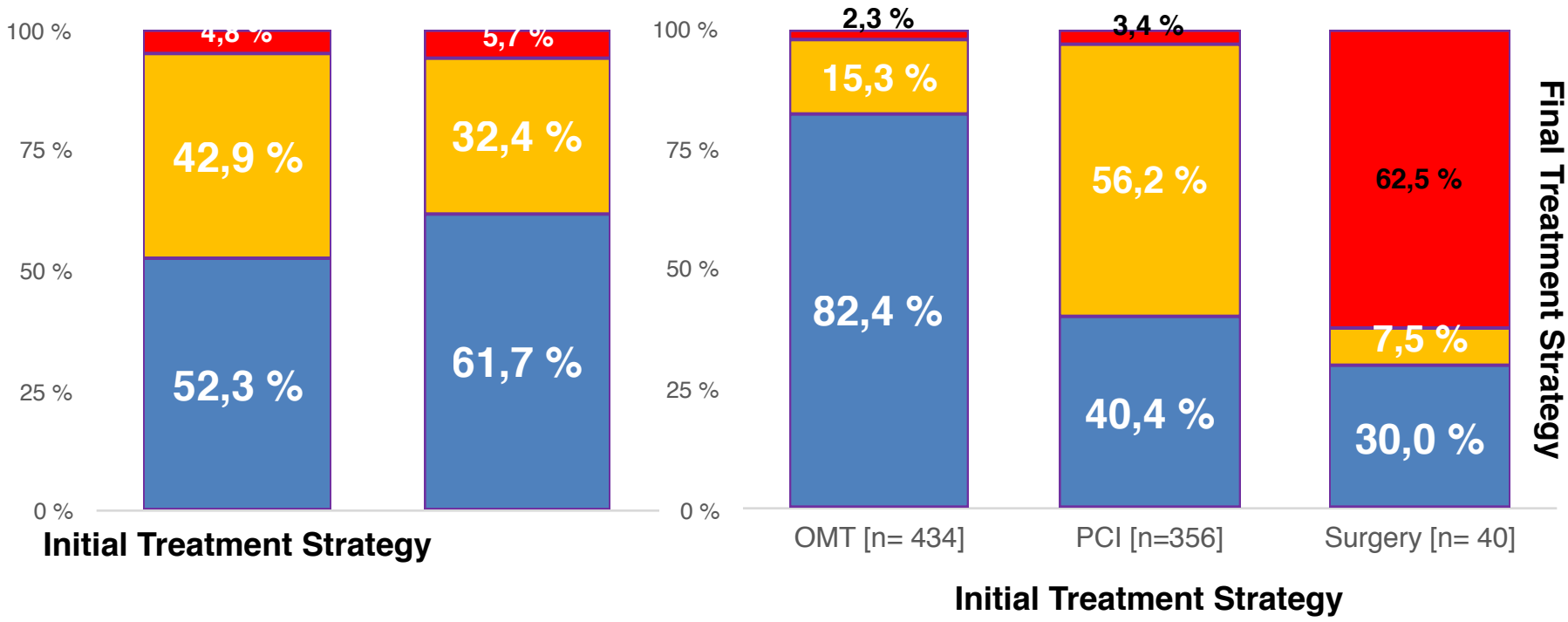
Physiology Approaches



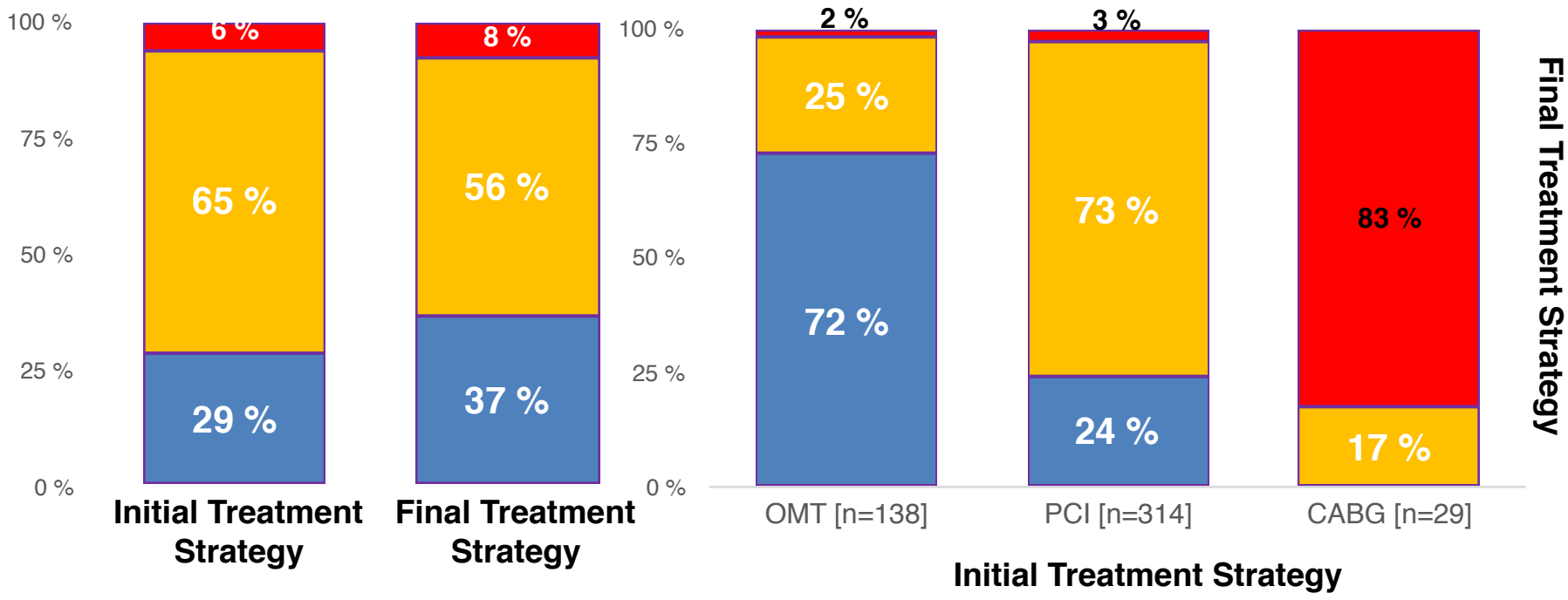
Changes of Treatment Strategy

At Vessel Level, treatment decision was changed after physiology assessment for **30.0% of Vessels**



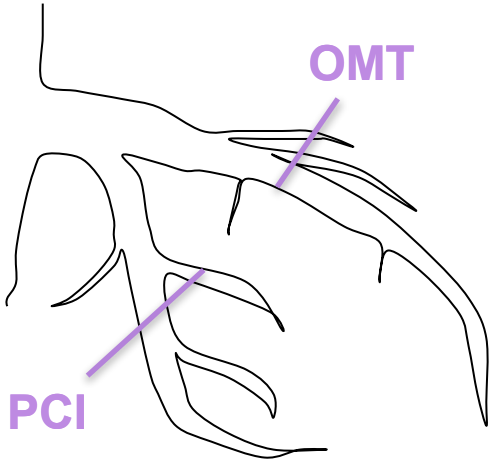
Changes of Treatment Strategy

At Patient Level (Macro Strategy), treatment decision changed after physiology assessment **for 27%** of Patients



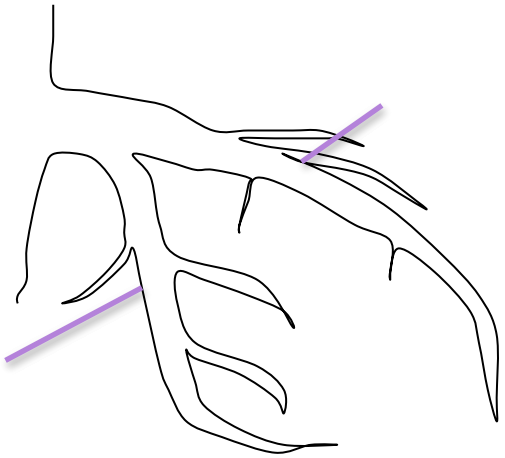
Changes of Treatment Strategy

Initial Treatment
by Angiography

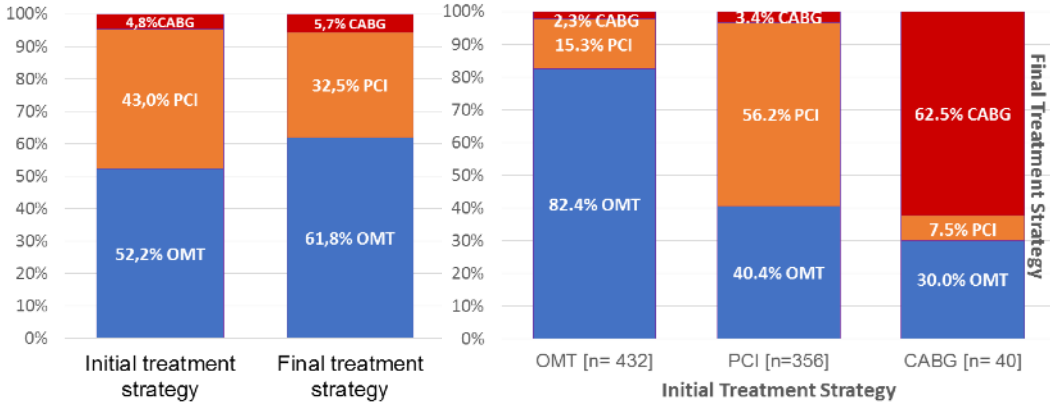


Physiology
iFR/FFR

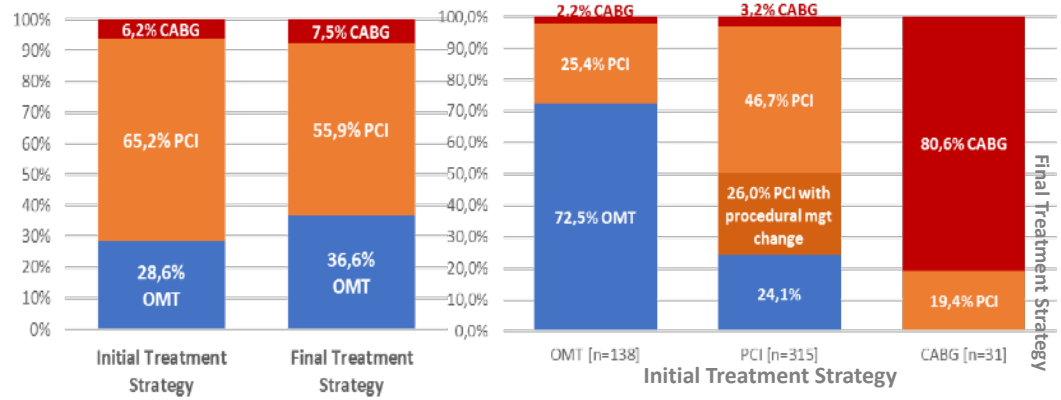
Final Treatment
by Physiology



Reclassification of the revascularization strategy at vessel level (n=828) is 29.6%



Reclassification of the revascularization strategy at patient level (n=484) is 26,9%



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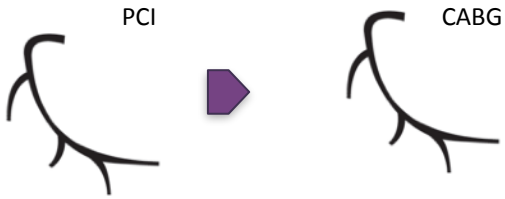
RECLASSIFICATION OF TREATMENT ?

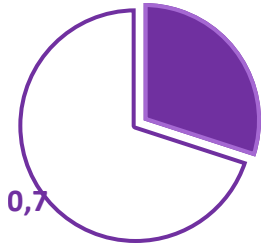
2A

VESSEL LEVEL



Change:
PCI → CABG

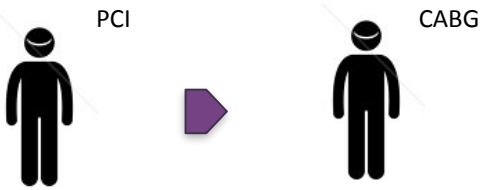
Vessel Management
At Vessel Level



Vessel management change in **29.6%** of vessels

2B

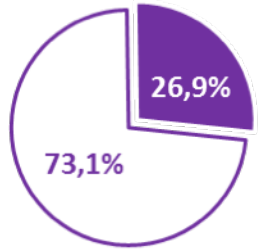
PATIENT LEVEL



Change:
PCI → CABG

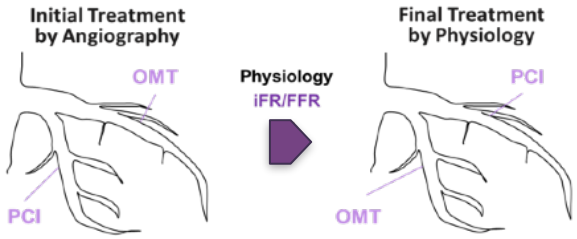
No Change:
PCI → PCI

Patient Management
At Patient Level
Patient Point of View



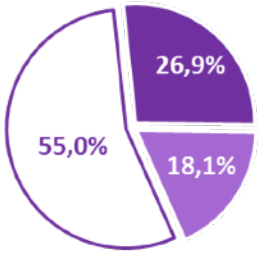
Patient management change in **26.9%** of patients

2C



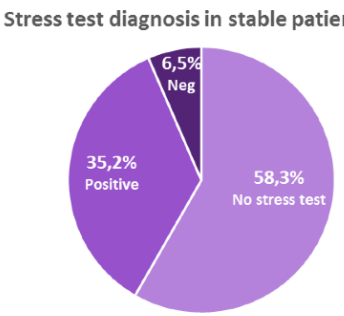
Change:
PCI → PCI of other vessel

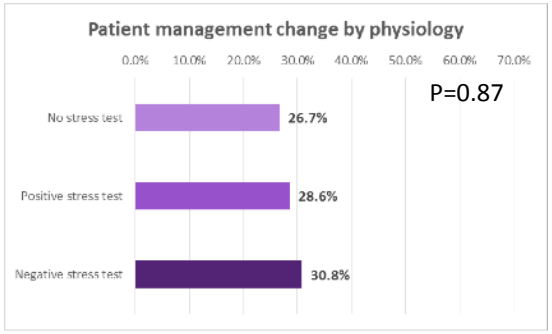
Procedural Management
At Patient Level
Physician Point of View

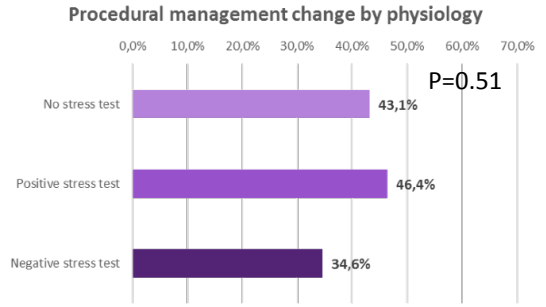


Procedural management change in **45.0%** of patients

A







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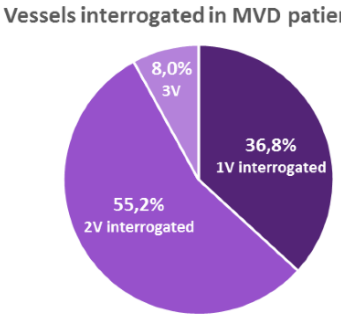

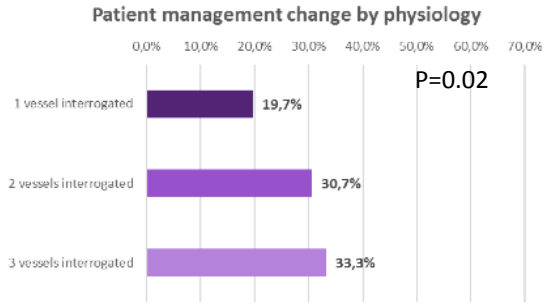

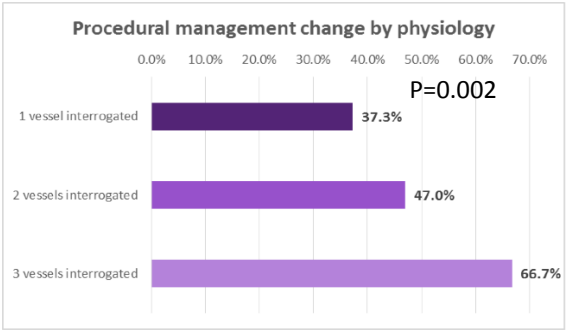

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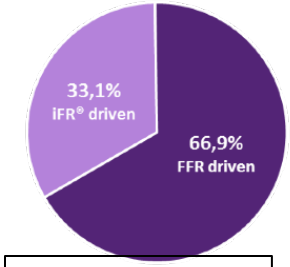
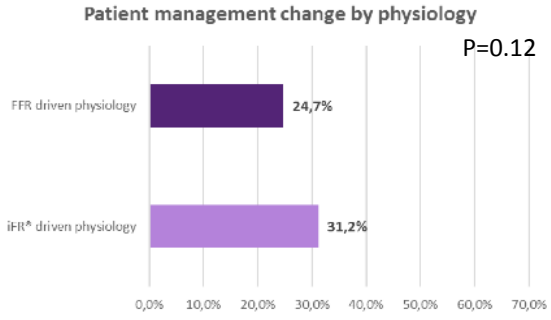
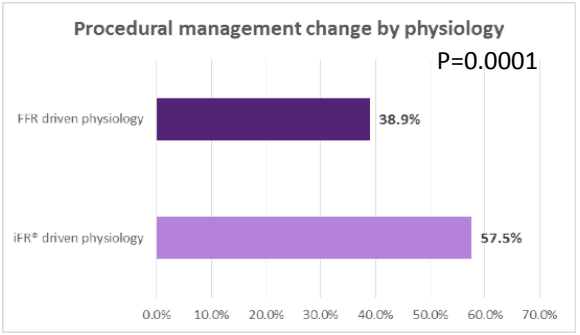


iFR : 1.8 vessels
FFR: 1.6 vessels





Extra time for Physiology in >1 vessel

2 Vessels Interrogated

Conclusions

- ✓ Routine use of invasive physiology in patients with MVD, on-going UA/ NSTEMI or recent ACS is associated with a high rate of reclassification of management strategy (>30%).

- ✓ In ACS, Integrating FFR on clinical decision making and pursuing a treatment strategy divergent from angiography (including revascularization deferral) was as safe as in stable CAD patients.

- ✓ In MVD patient, implementation of iFR is safe and allows evaluation of more vessels which in turn leasd to a higher of reclassification.

Perspective

- PRIME-FFR and DEFINE REAL reinforces the observation made in previous national prospective physiology studies;

- They extends those previous findings to ACS and MVD patients and also to iFR® use;

- DEFINE FLAIR, Swedeheart, and Syntax II will provide clinical outcome data of the use of routine physiology in MVD patients.

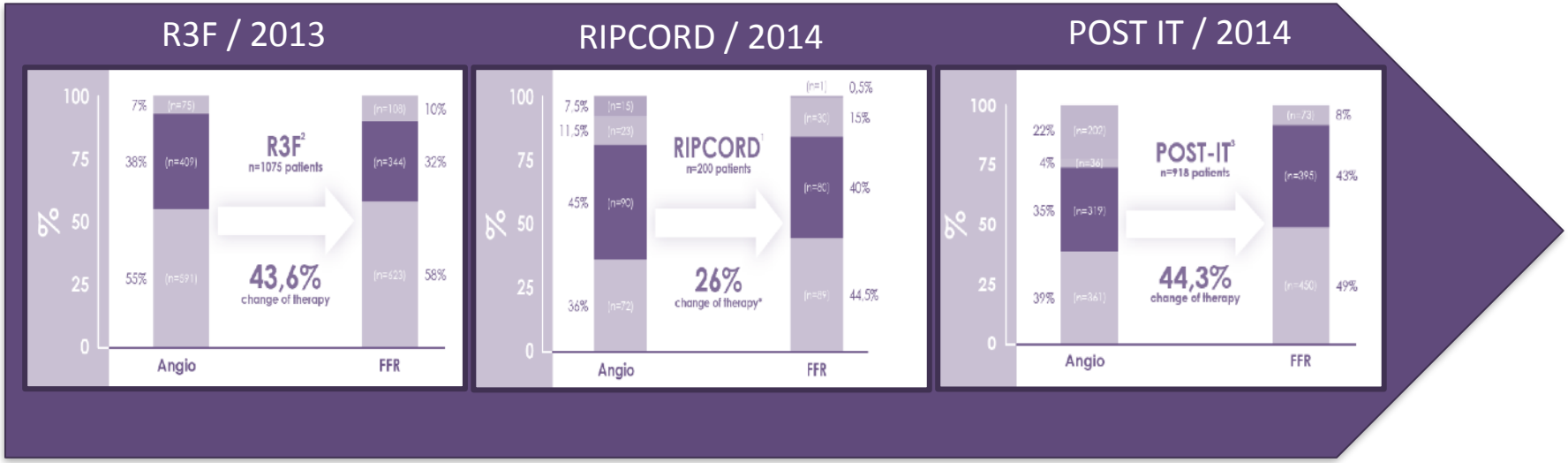
A prospective, observational, European, multi-center registry, collecting REAL-life information on the utilization of instantaneous wave-free ratio™ (iFR®) in the multi-vessel disease patients population

Prof. Eric Van Belle on behalf of the DEFINE REAL Investigators

DEFINE REAL

Background

- Results from national studies have shown that FFR evaluation during diagnostic angiography impacts the coronary revascularization strategy on a range of 26 to 44% of patients.
- There is limited data on utilization of coronary physiology and reclassification in Multi-Vessel Disease (MVD) population



Van Belle E, et. al. Outcome impact of coronary revascularization strategy reclassification with FFR at time of diagnostic angiography: insights from a large French multicenter FFR registry. Circulation. Published online 19 Nov 2013

Curzen N, et al. RIPCORD: Does Routine Pressure Wire Assessment Influence Management Strategy at Coronary Angiography for Diagnosis of Chest Pain? Circ Cardiovasc Interv.2014;7:248-255.

Baptista SB, et al. POST.IT: Presented at late breaking trial at PCR 2014.
Market Model data on file at Volcano Corporation.

Objectives

As systematic FFR multi-vessel assessment is time consuming and therefore rarely performed in routine practice, the iFR® index may help to simplify the physiology assessment of MVD patient population.

The DEFINE REAL objectives are:

- To assess prospectively the impact of physiology on revascularization strategy of MVD patients compared to diagnostic angiogram only.
- To analyze how FFR and iFR® are used in routine practice during physiology evaluation of MVD patients.

Methodology

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PHYSIOLOGY

CHANGE(S) ?

Patient with Lesion DS% >40 in 2 or 3 different major vessels

Patient Eligible should be for Physiology Evaluation

Initial Treatment Strategy based on **Angiography (and clinical information)**

➔ CABG, PCI or OMT

Final treatment strategy based on **Physiology**

➔ CABG, PCI or OMT

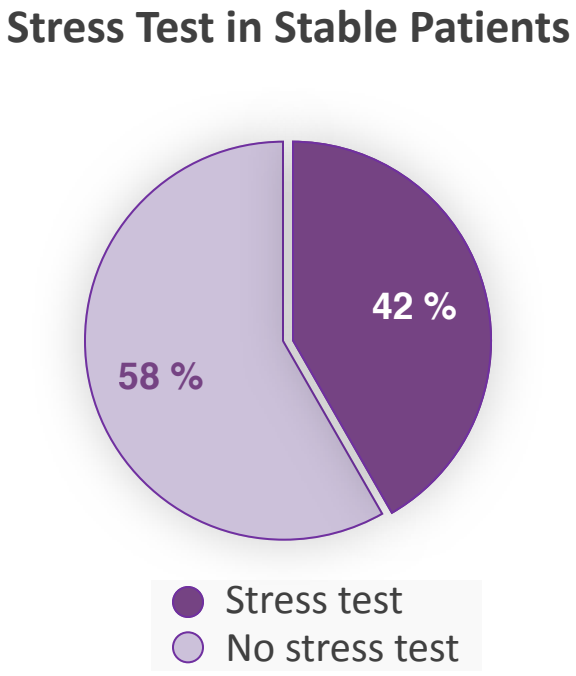
Change of Treatment Strategy based on the Difference between Initial and Final Treatment:

➔ At Vessel level

➔ At Patient level

Patient Demographics

Patient Demographics	n = 484
Gender (male)	80%
Age (mean)	66.7 yr
Previous MI	36%
ACS	17.8%
Diabetes	26.7%
Normal LVEF	62.8.%
Non-invasive stress test	26.7%



Baseline Characteristics

Patients population	**484**
• Patient with LM involved	9.1%
Vessels diseased	**1107**
• Average per patient	**2.29**
Vessels assessed by physiology	**830 (75%)**
• Average per patient	**1.71**

3VD

Lesion severity Median **DS 60%**

DEFINE REAL

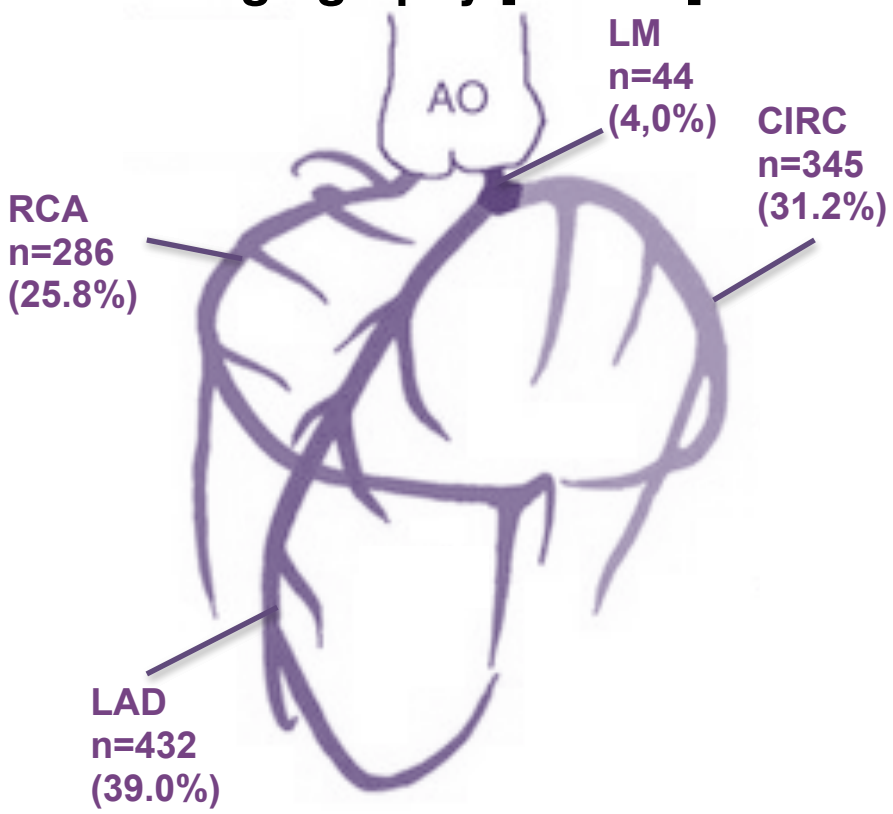
Results of FFR/iFR®

Median FFR Value: 0,85
n = 608

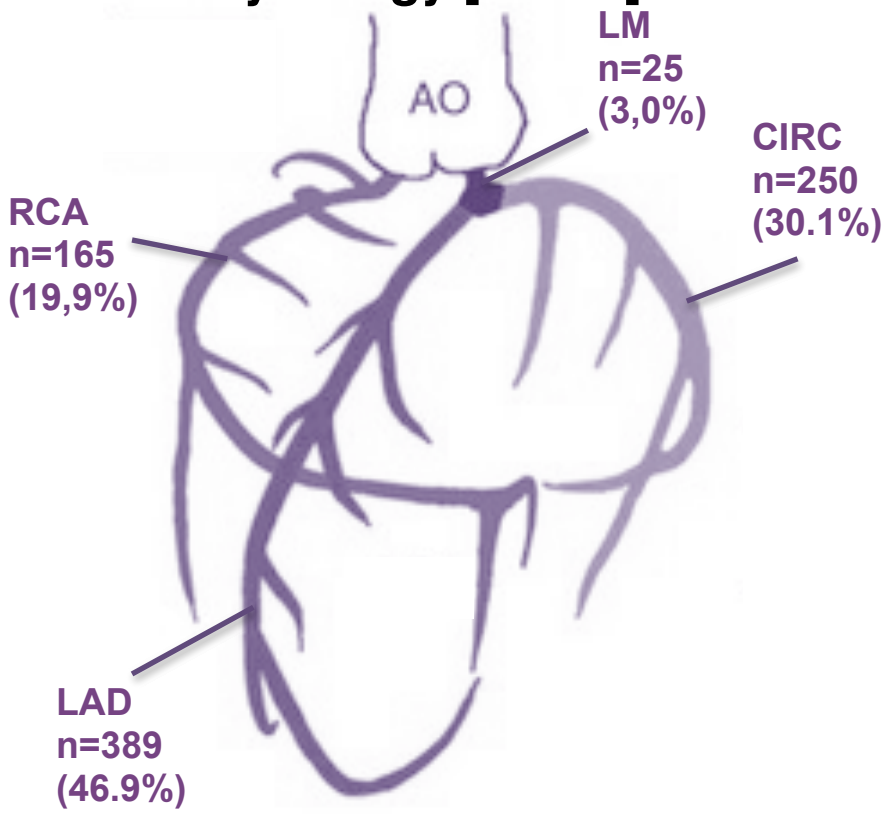
Median iFR® Value: 0,92
n = 793

Baseline Characteristics

Diseased Vessels by Angiography [n=1107]



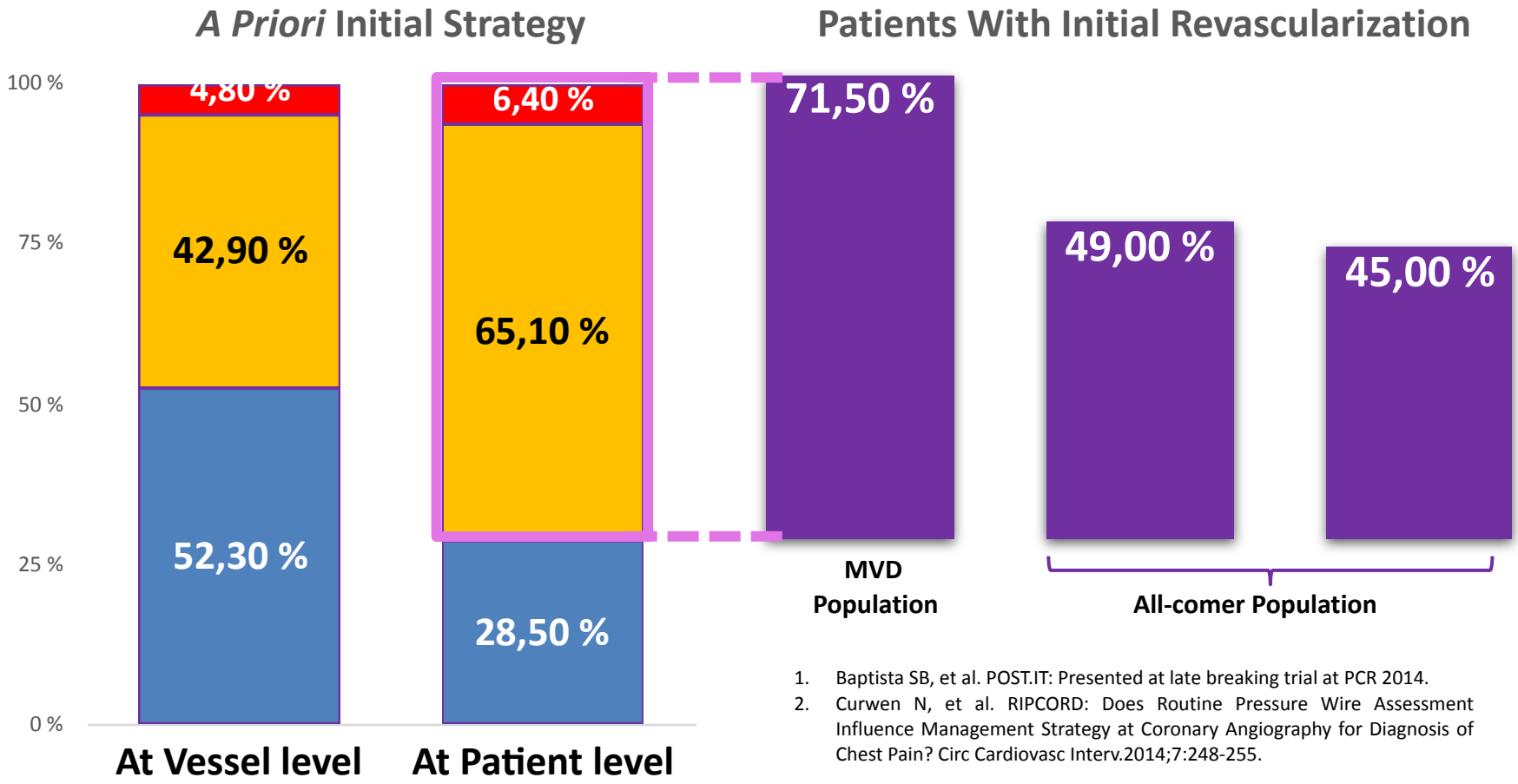
Vessels Interrogated with Physiology [n=830]



In this MVD population, 75% of diseased vessels were interrogated by Physiology

DEFINE REAL

Initial Treatment Strategy By Angiography



1. Baptista SB, et al. POST.IT: Presented at late breaking trial at PCR 2014.
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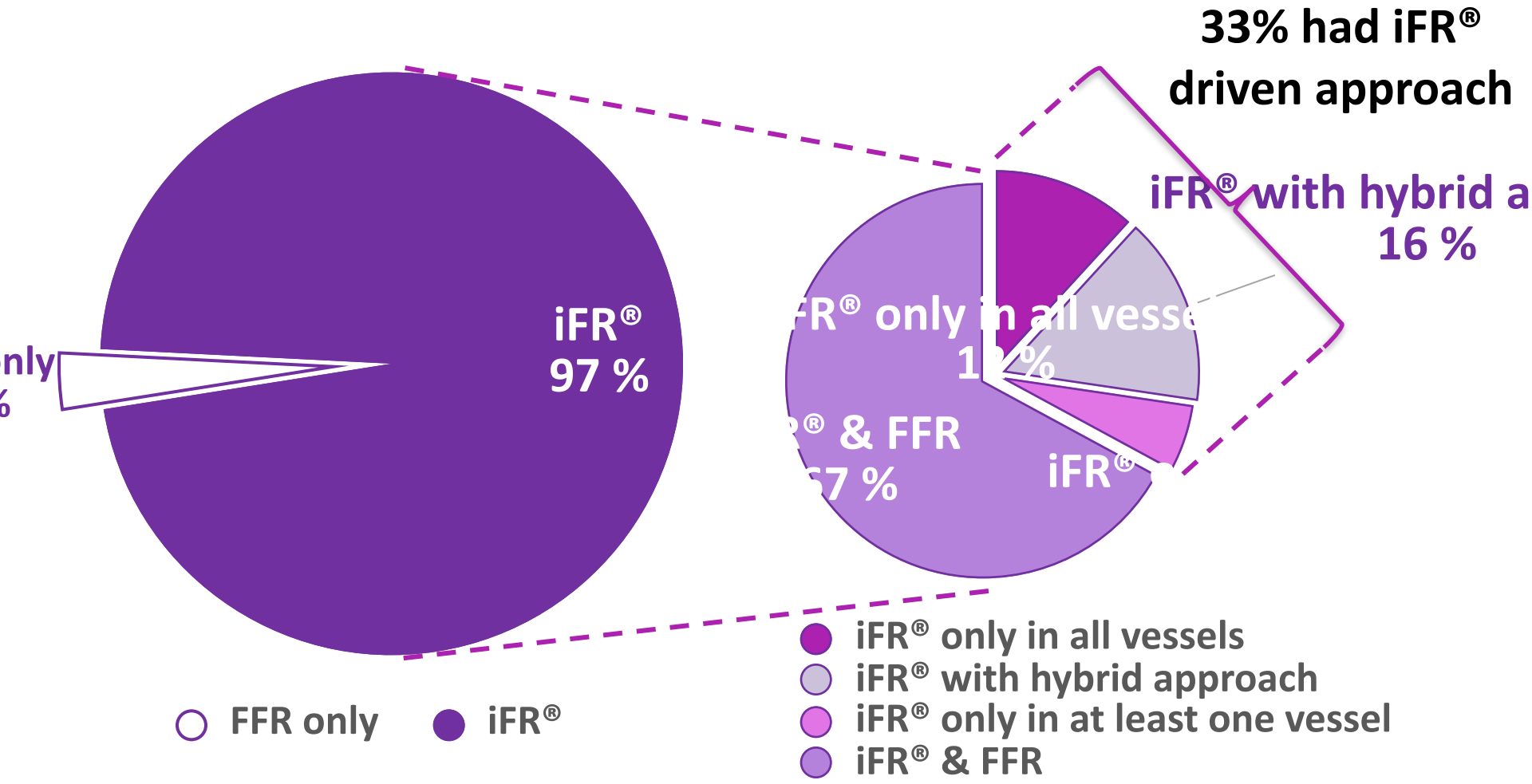
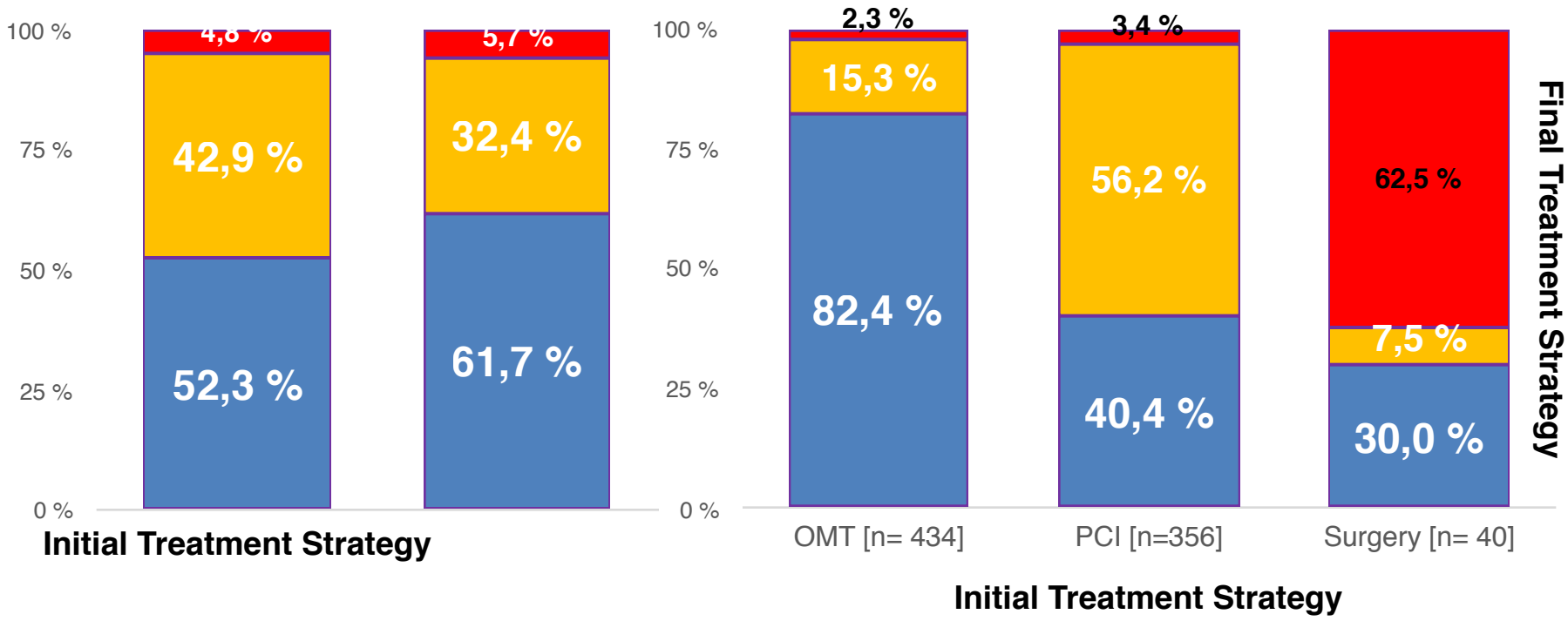
Physiology Approaches



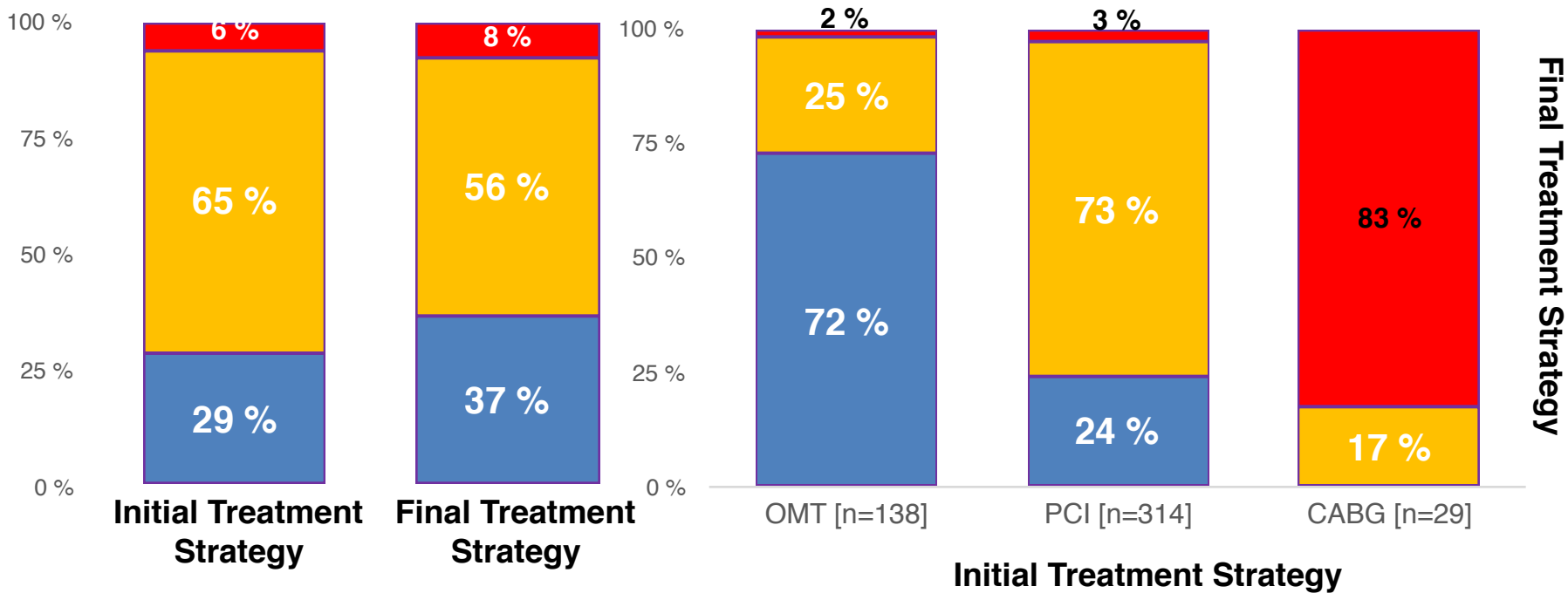
Changes of Treatment Strategy

At Vessel Level, treatment decision was changed after physiology assessment for **30.0% of Vessels**



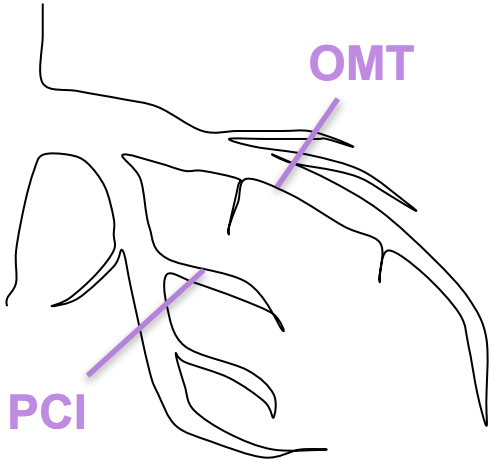
Changes of Treatment Strategy

At Patient Level (Macro Strategy), treatment decision changed after physiology assessment **for 27%** of Patients



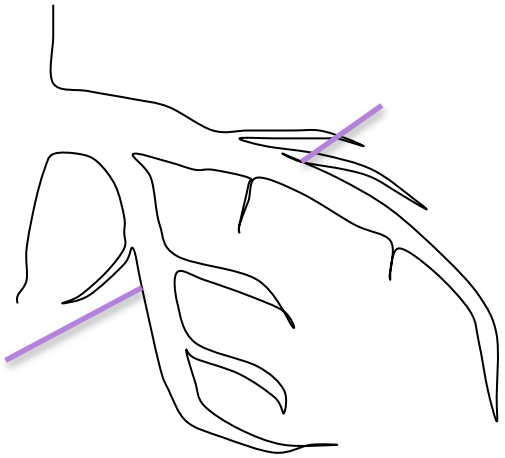
Changes of Treatment Strategy

Initial Treatment
by Angiography

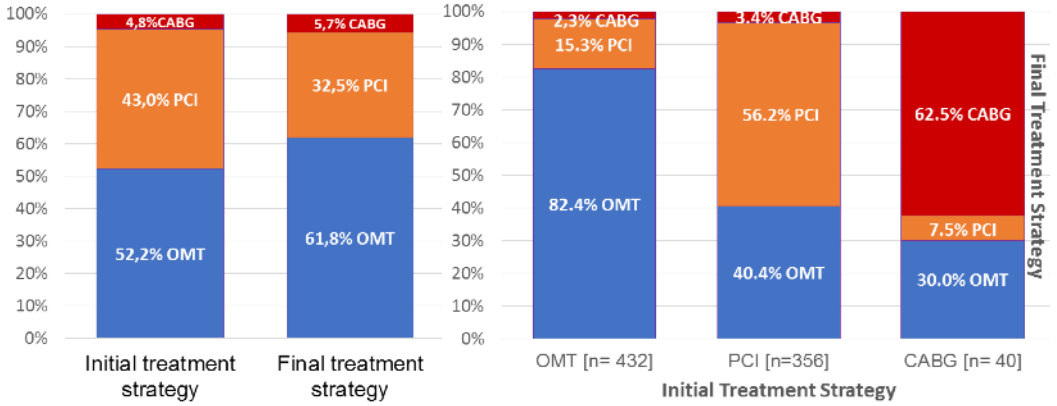


Physiology
iFR/FFR

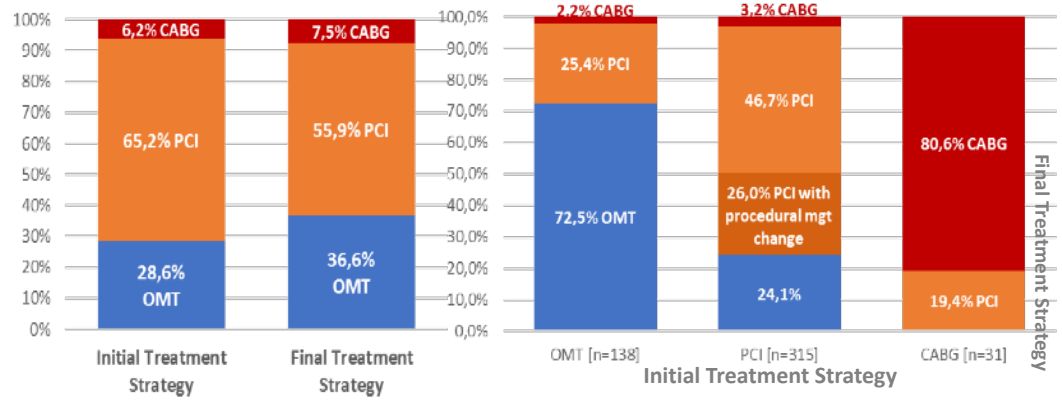
Final Treatment
by Physiology



Reclassification of the revascularization strategy at vessel level (n=828) is 29.6%



Reclassification of the revascularization strategy at patient level (n=484) is 26,9%



2016 euro PCR

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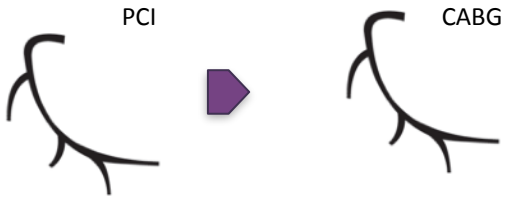
RECLASSIFICATION OF TREATMENT ?

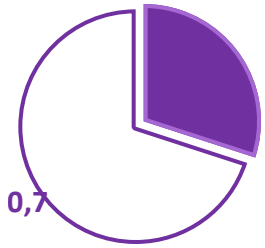
2A

VESSEL LEVEL



Change:
PCI → CABG

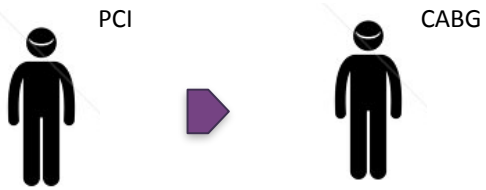
Vessel Management
At Vessel Level



Vessel management change in **29.6%** of vessels

2B

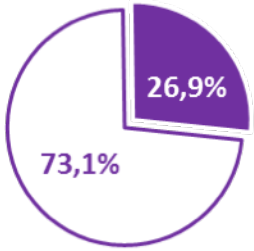
PATIENT LEVEL



Change:
PCI → CABG

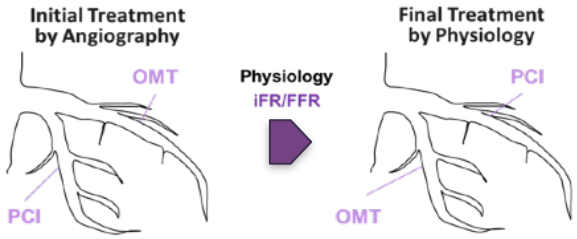
No Change:
PCI → PCI

Patient Management
At Patient Level
Patient Point of View



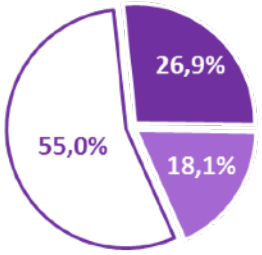
Patient management change in **26.9%** of patients

2C



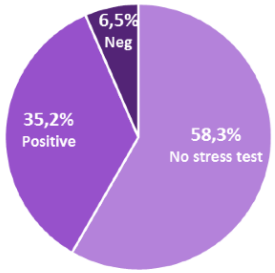
Change:
PCI → PCI of other vessel

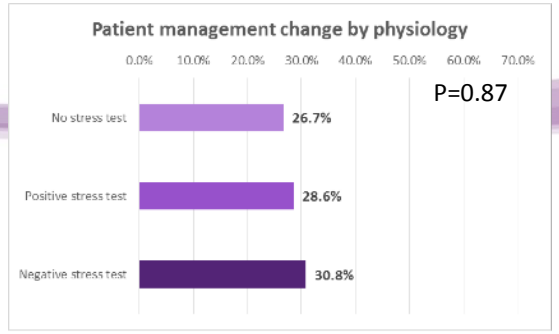
Procedural Management
At Patient Level
Physician Point of View

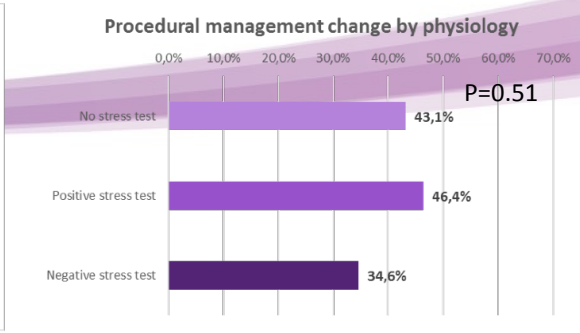


Procedural management change in **45.0%** of patients

A







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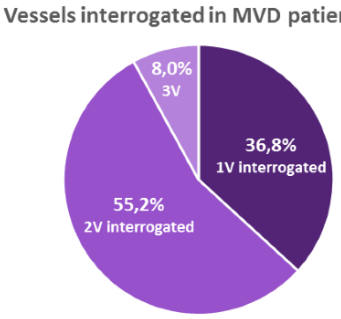
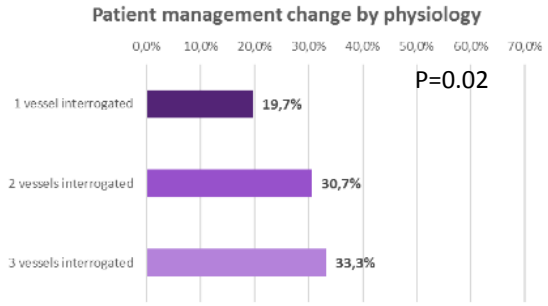
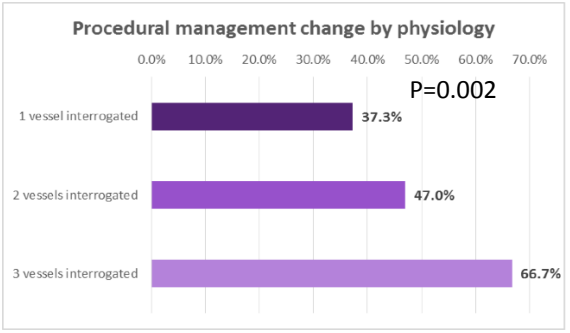
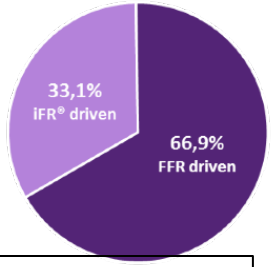






C



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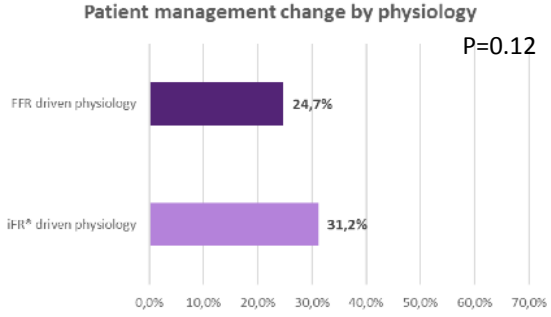
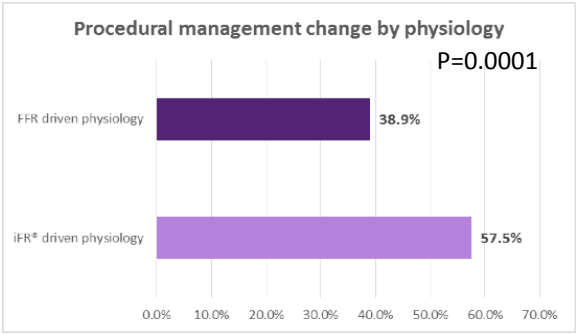
FFR: 1.6 vessels





Extra time for Physiology in >1 vessel

2 Vessels Interrogated

Conclusions

- ✓ Routine use of invasive physiology in patients with MVD, on-going UA/ NSTEMI or recent ACS is associated with a high rate of reclassification of management strategy (>30%).

- ✓ In ACS, Integrating FFR on clinical decision making and pursuing a treatment strategy divergent from angiography (including revascularization deferral) was as safe as in stable CAD patients.

- ✓ In MVD patient, implementation of iFR is safe and allows evaluation of more vessels which in turn leasd to a higher of reclassification.

Perspective

- PRIME-FFR and DEFINE REAL reinforces the observation made in previous national prospective physiology studies;

- They extends those previous findings to ACS and MVD patients and also to iFR® use;

- DEFINE FLAIR, Swedeheart, and Syntax II will provide clinical outcome data of the use of routine physiology in MVD patients.

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