Clinical Application of Integrated Use of FFR and IVUS

Non-Left Main PCI

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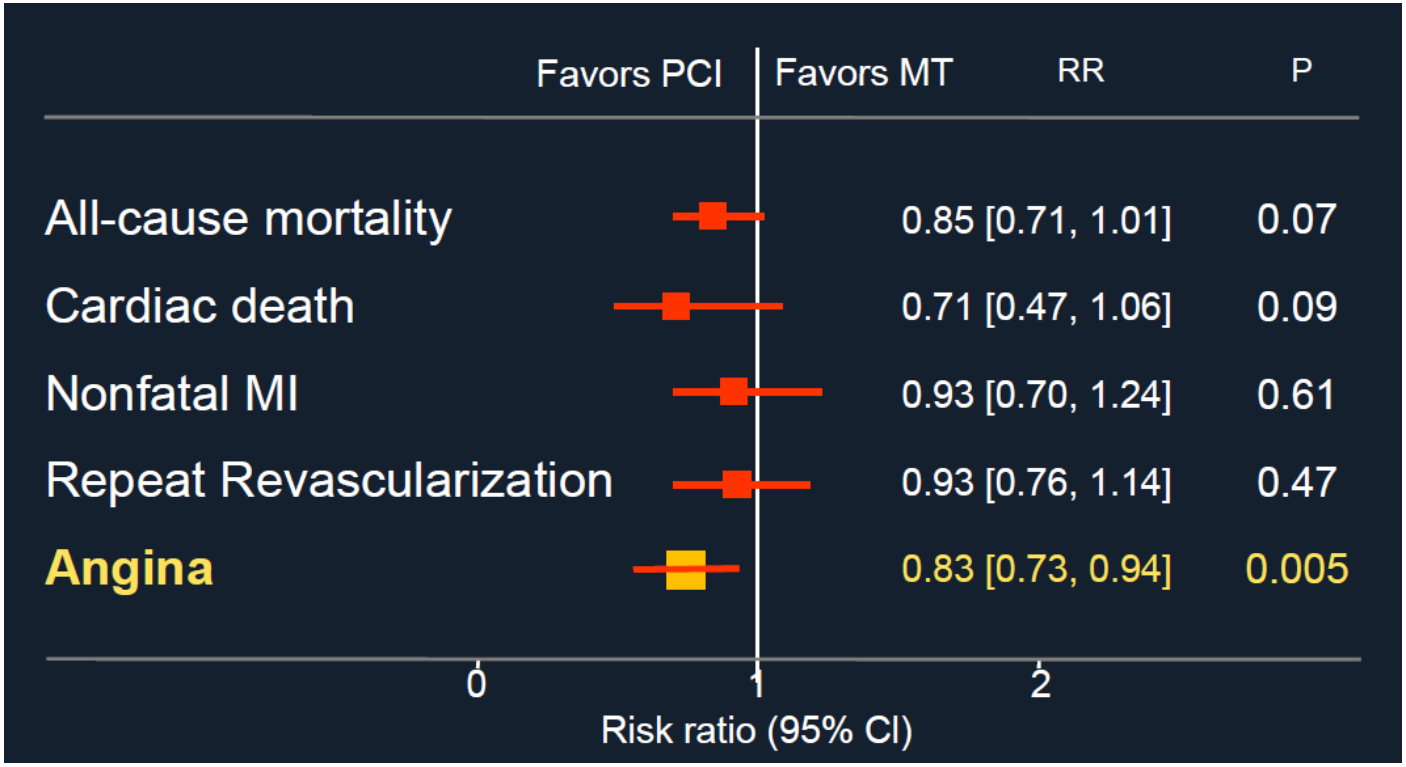
Benefit of stents over medical treatment

- **Stable patients, 12 RCTs, 7182 patients**

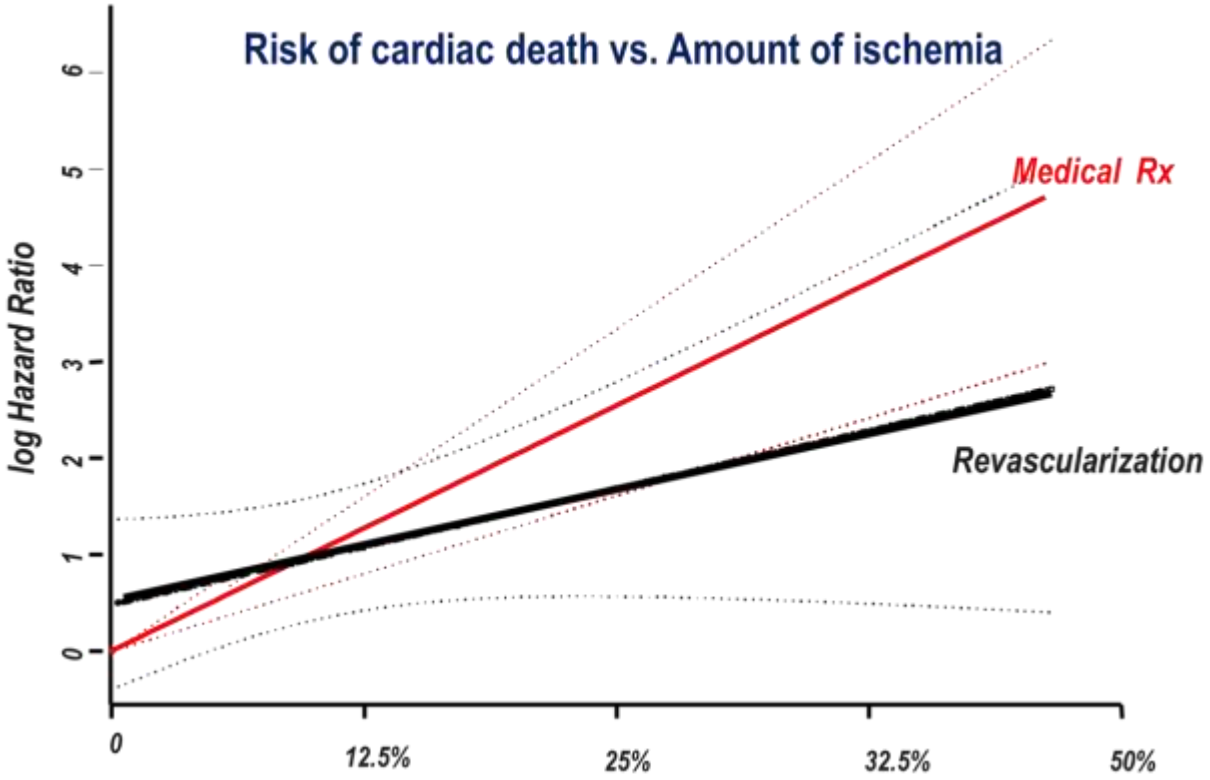


Pursnani, Circ cardiovasc interv 2012

How can we improve the prognosis of our patients?

1. **Better concepts**
   - **Treatment of ischemia-causing stenosis**
   - FFR-guided risk assessment
   - IVUS-guided PCI
2. **Better devices**

How to gain the survival benefit with PCI?

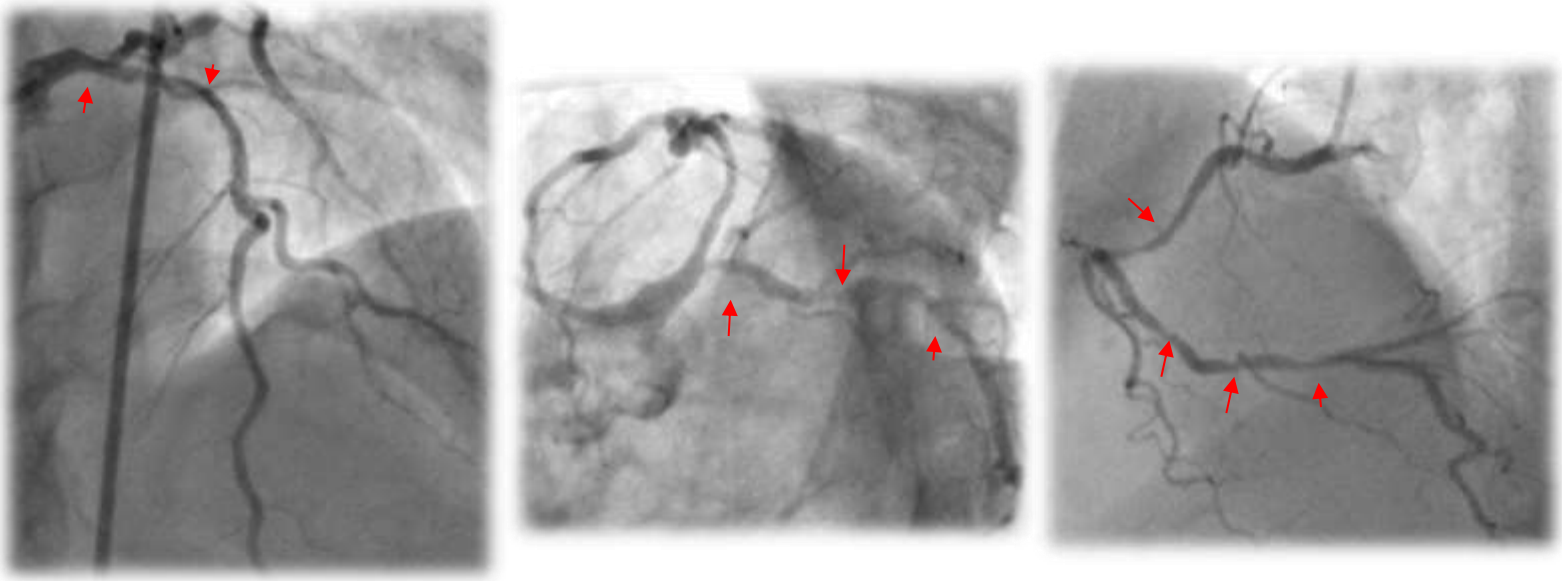


Revascularization (either CABG or PCI) can provide the survival benefit over medical treatment only when the certain amount of ischemia is relieved.

Hachamovitch, Circulation 2003

Which is ischemia causing stenosis?

F/52 Stable angina



Distal left main disease + 3VD, 9 lesions

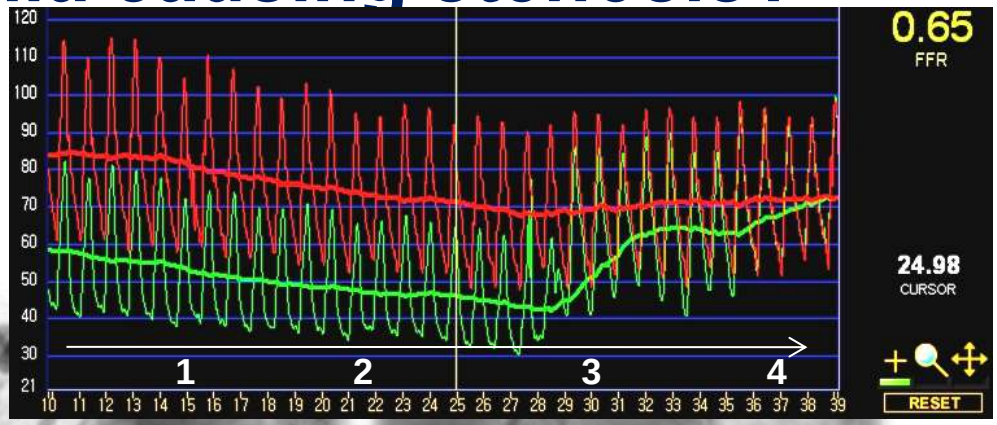
Which is ischemia causing stenosis?

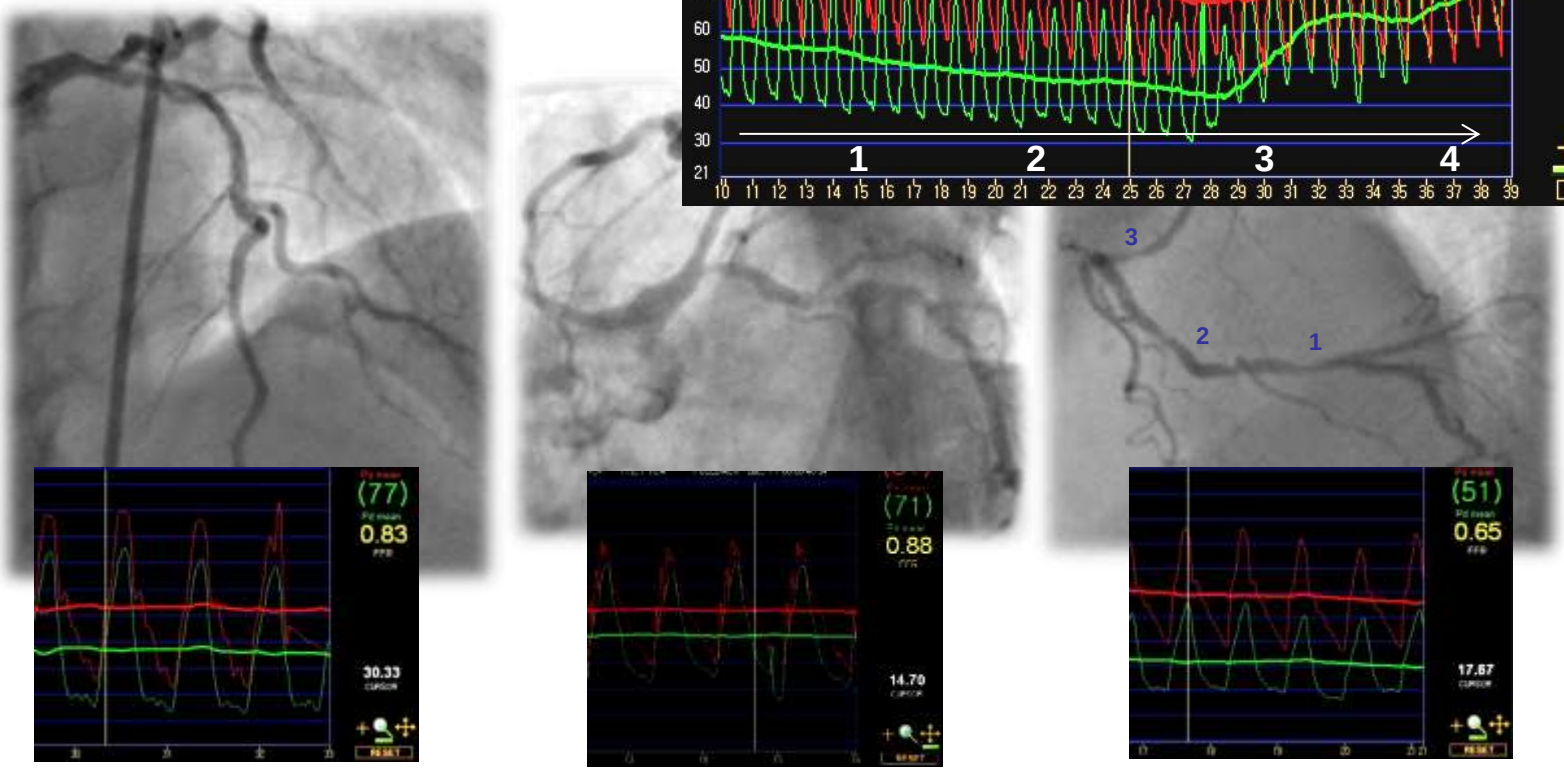
Different world, from different view

Proportions of functionally diseased (ischemia+) coronary arteries in patients with angiographic 3 vessel disease

Tonino P, JACC 2010

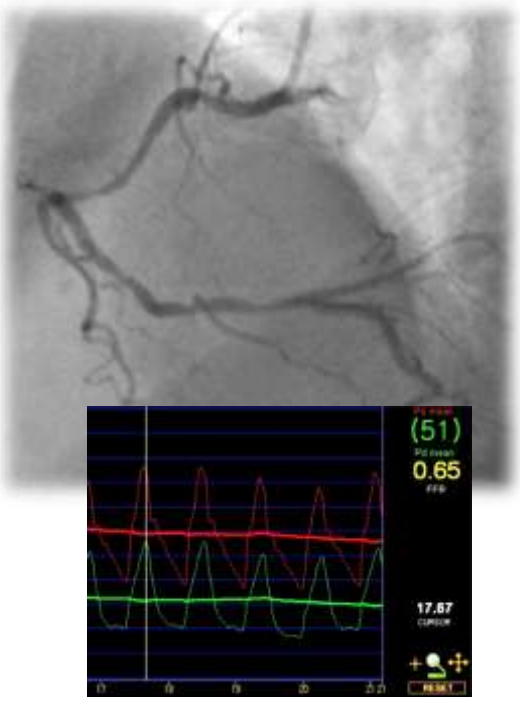
Which is ischemia causing stenosis?

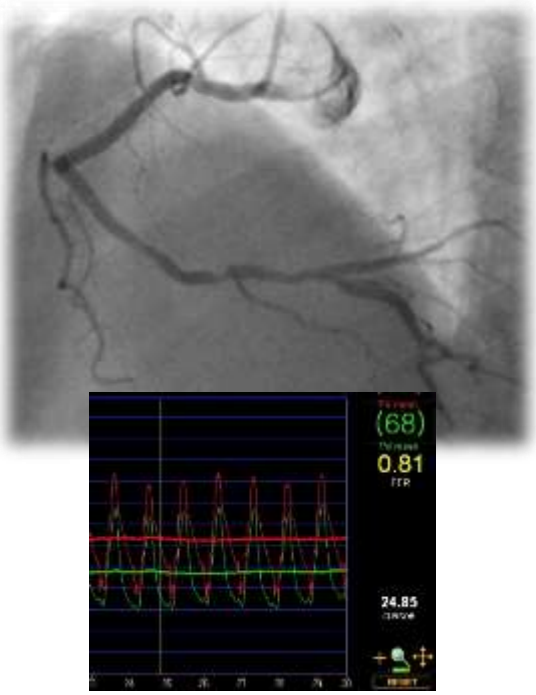




Distal left main disease + 3VD, 9 lesions

Patient with multi-vessel, multi-lesion disease???





LM+3VD, 9 significant lesions by coronary angiography

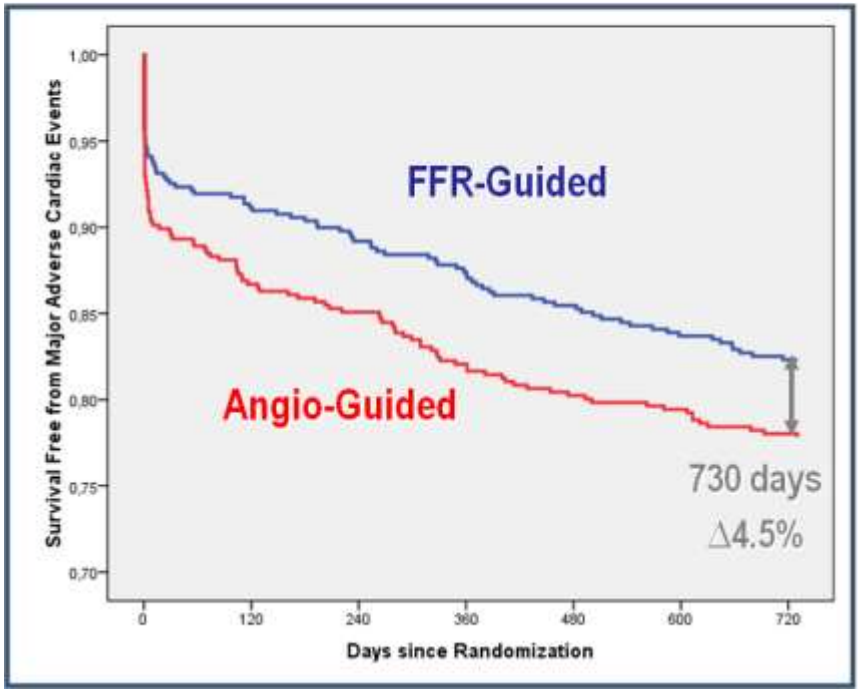
→ **1VD, single lesion by FFR, treated with one DES**

FAME I: FFR-guided PCI > Angio-guided PCI

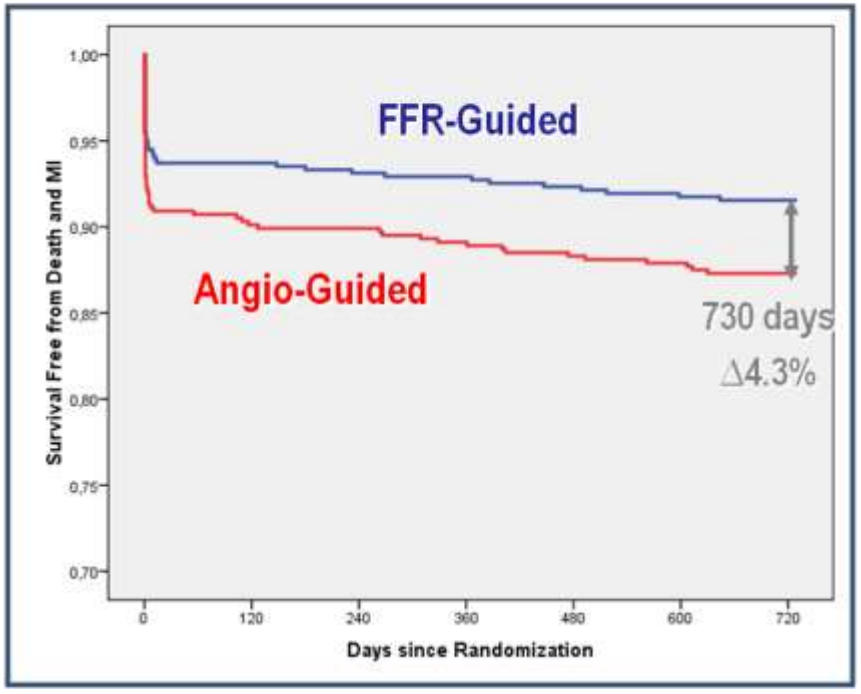
Patient with ≥ 2 vessel disease
(N=1005)

- **Angiography-guided PCI** (N=496)
- **FFR-guided PCI** (N=509)

2 Year MACE-free Survival



2 Year Death/MI-free Survival



Tonino, et al. NEJM 2009; Pijls, et al. JACC 2010

FAME II: FFR-guided PCI > Medical treatment

The NEW ENGLAND JOURNAL of MEDICINE

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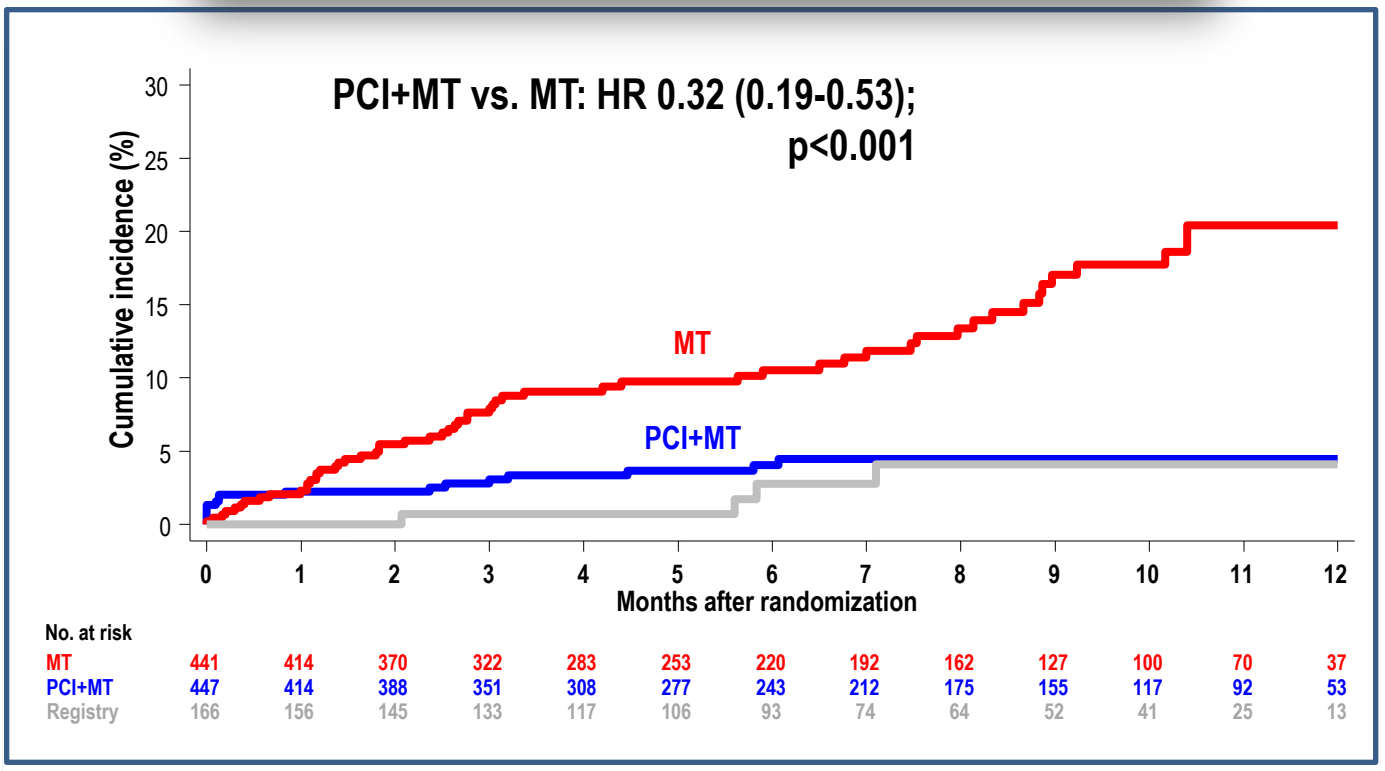
Fractional Flow Reserve–Guided PCI versus Medical Therapy in Stable Coronary Disease



How can we improve the prognosis of our patients?

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   - IVUS-guided PCI
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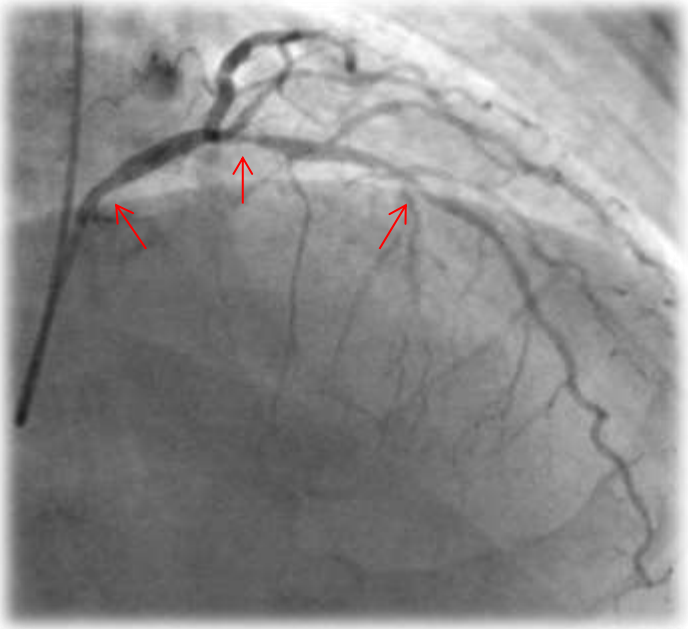
SYNTAX score

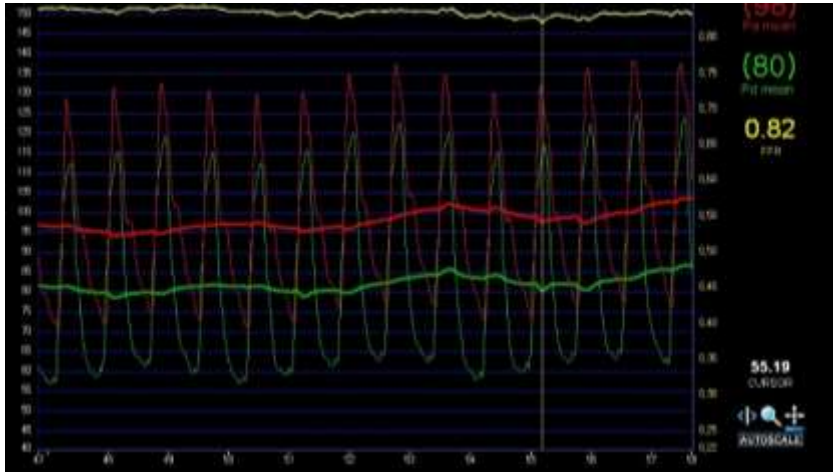
Counting angiographically signficant stenosis



SYNTAX score: LM ostial + proximal LAD + mid LAD bifurcation lesions = 28

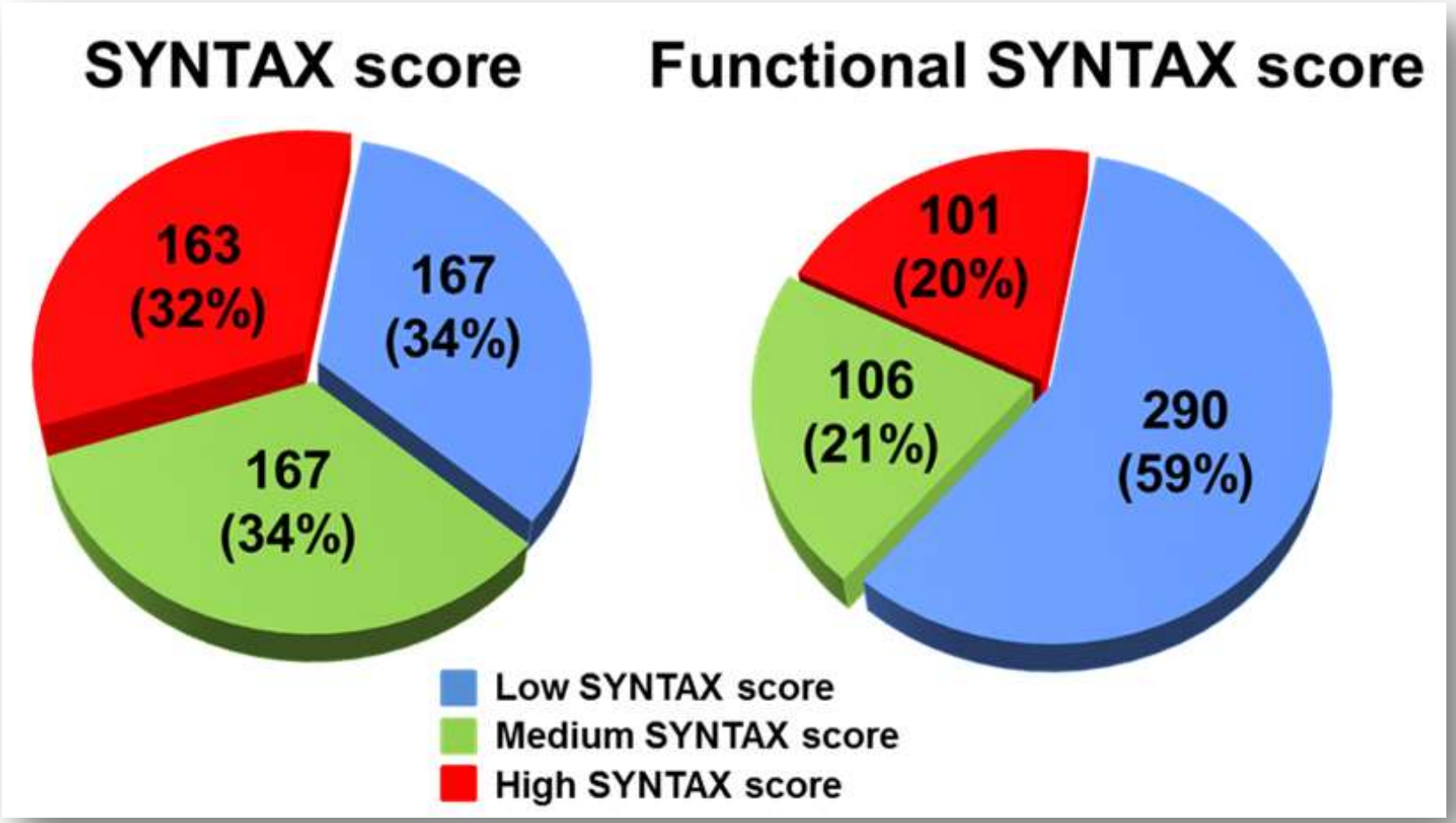
Functional SYNTAX score

Counting ischemia-causing stenosis



Functional SYNTAX score = 0

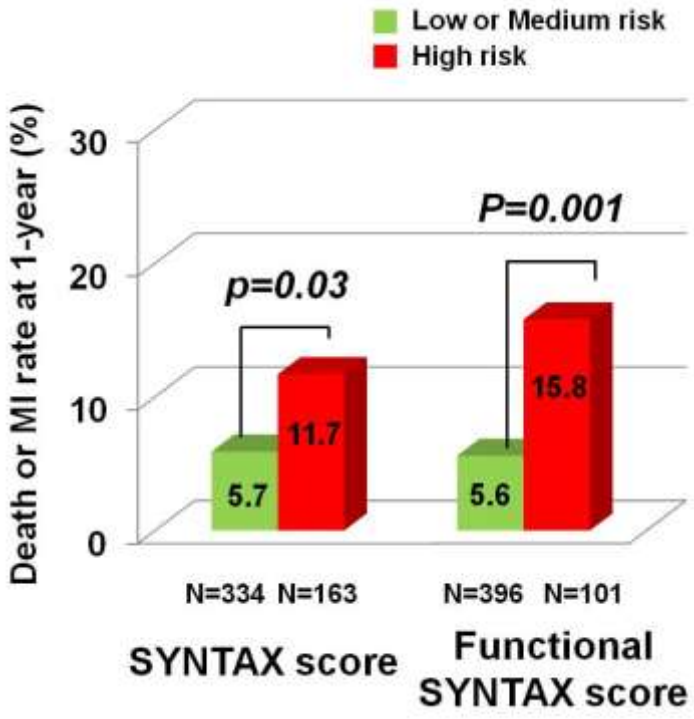
SYNTAX score vs. Functional SYNTAX score

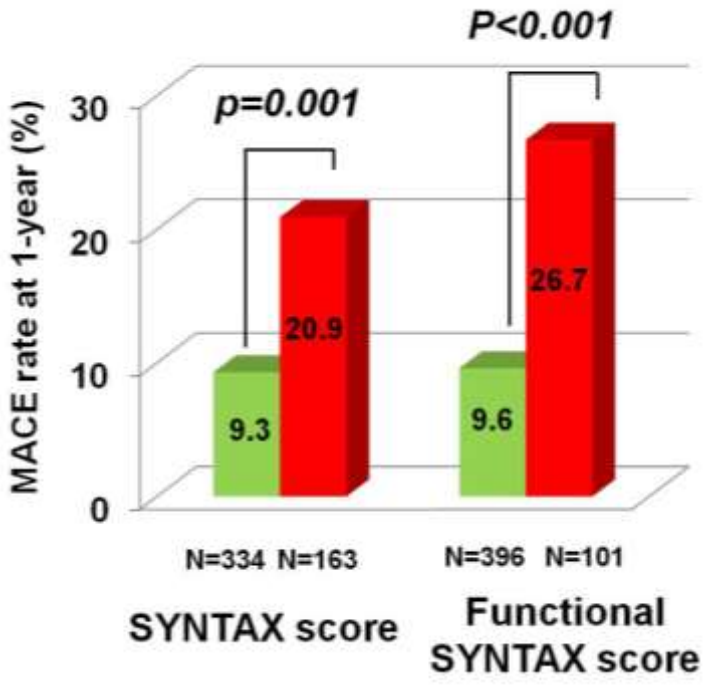


Nam CW, et al. JACC 2011;58:1211

SYNTAX score vs. Functional SYNTAX score

Outcomes after PCI in FAME study





Functional SYNTAX score decreases the number of higher-risk patients and better discriminates risk for adverse events in patients with multivessel PCI.

Nam CW, et al. JACC 2011;58:1211

How can we improve the prognosis of our patients?

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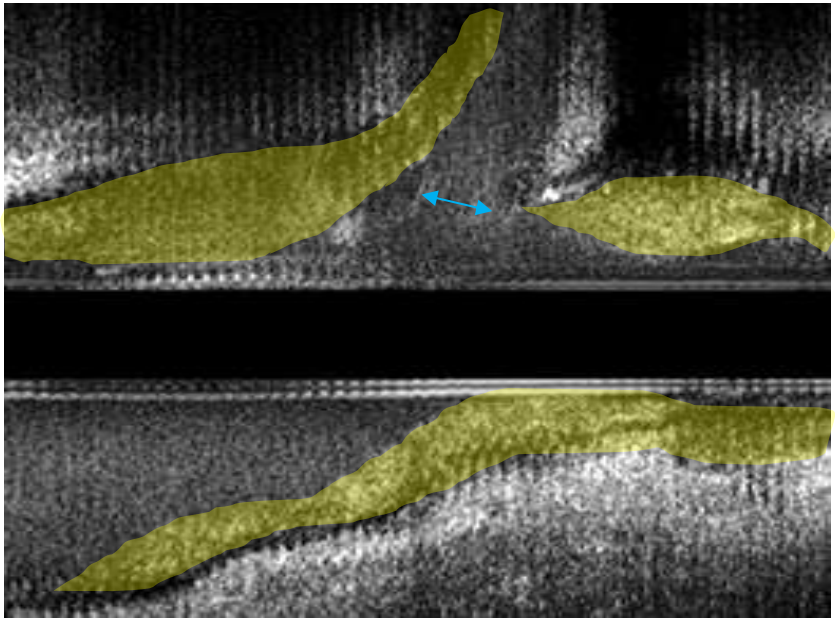
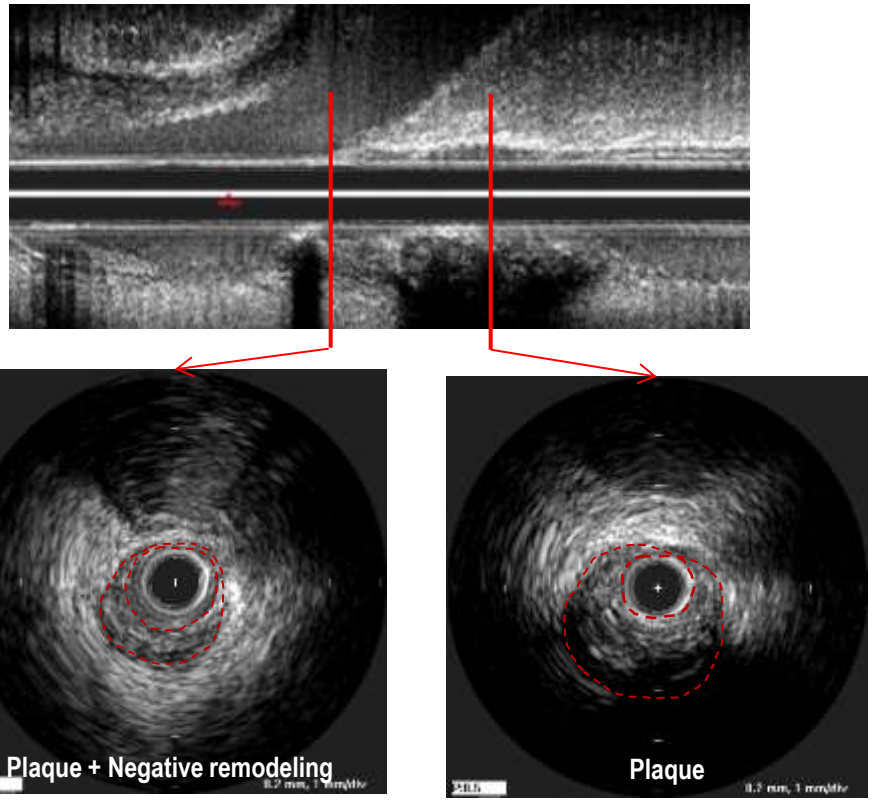
Before PCI, IVUS can provide….





- Precise quantitative assessment and lesion geometry
- Amount, character and distribution of plaque
- Mechanism of stenosis and Treatment planning

After PCI, IVUS can provide….

Procedural results after PCI

Angiographically excellent, but…..

JACC Vol. 46, No. 4, 2005
August 16, 2005:599–605

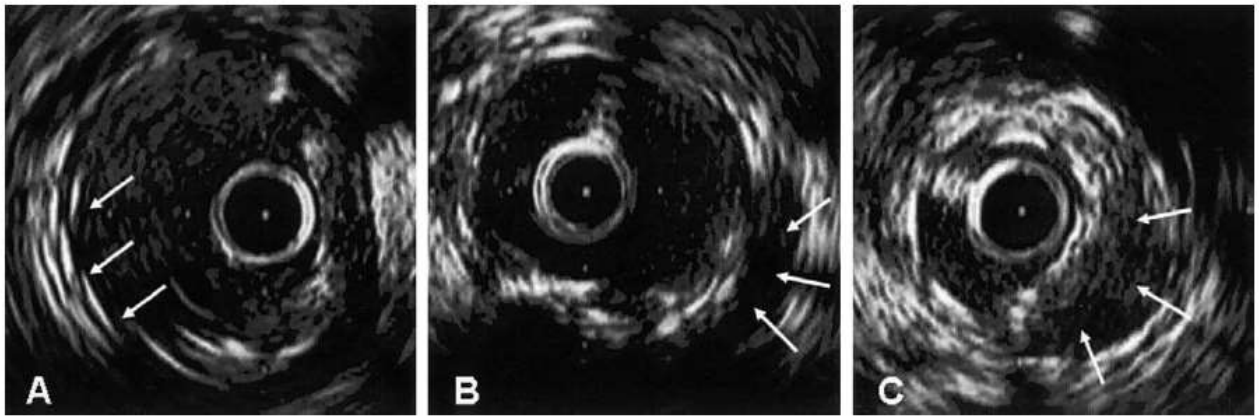


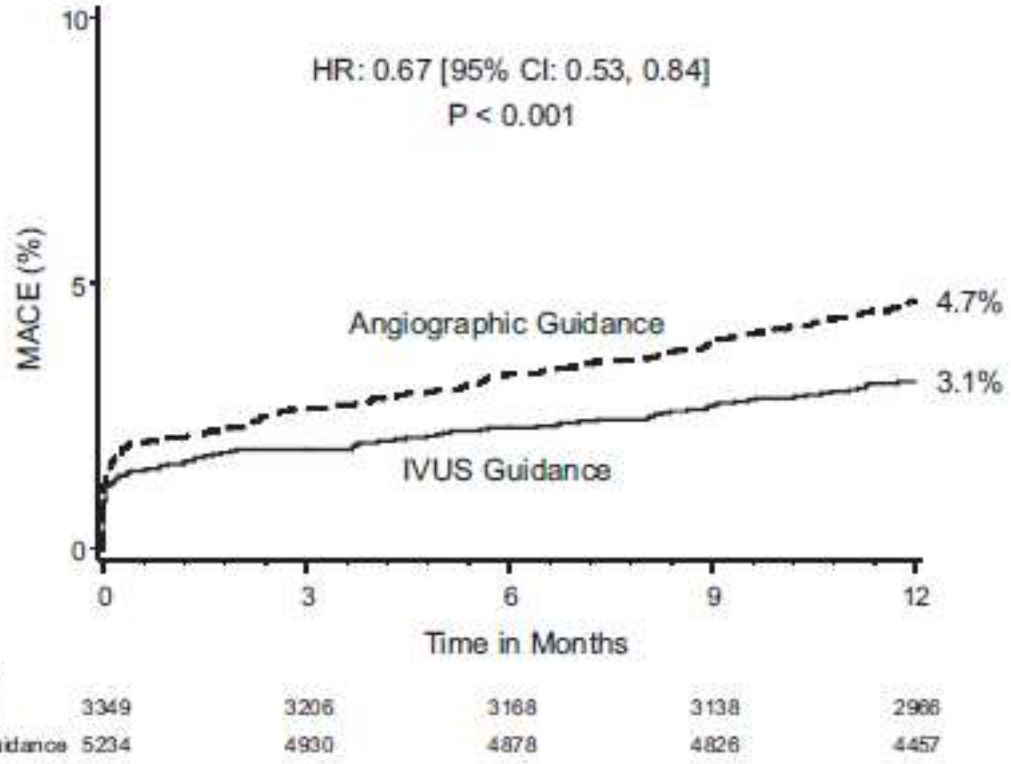
Figure 4. **(A)** Intravascular ultrasound image showing complete crush (apposition) of the side branch (SB) stent; **arrows** indicate the three layers of stent struts. **(B, C)** Intravascular ultrasound images showing incomplete crush (apposition) of the SB stent struts **(arrows)**.

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association.

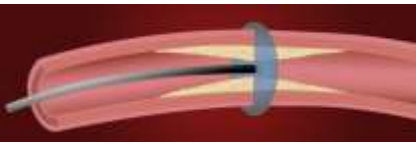
Relationship Between Intravascular Ultrasound Guidance and Clinical Outcomes After Drug-Eluting Stents: The Assessment of Dual Antiplatelet Therapy With Drug-Eluting Stents (ADAPT-DES) Study

Bernhard Witzenbichler, Akiko Maehara, Giora Weisz, Franz-Josef Neumann, Michael J. Rinaldi, D. Christopher Metzger, Timothy D. Henry, David A. Cox, Peter L. Duffy, Bruce R. Brodie, Thomas D. Stuckey, Ernest L. Mazzaferri, Jr, Ke Xu, Helen Parise, Roxana Mehran, Gary S. Mintz and Gregg W. Stone



IVUS-guidance was associated with a reduction in stent thrombosis, myocardial infarction, and major adverse cardiac events within 1 year after DES implantation

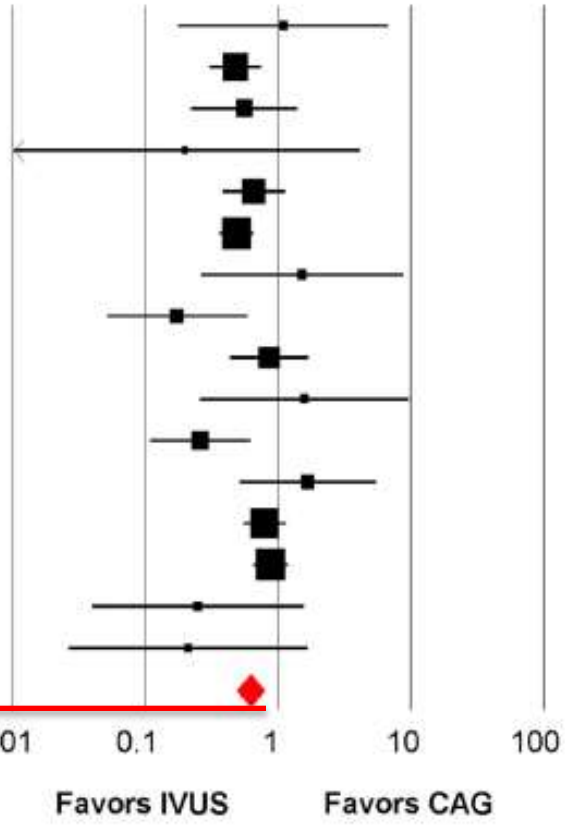
Survival benefit of Intravascular Ultrasound usage for DES implantation



Death

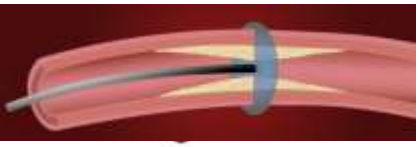
Author Name (Year)	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Ahn SG et al. (2013)	1.095	0.174	6.898	0.097	0.923
Ahn JM et al. (2013)	0.477	0.301	0.756	-3.152	0.002
Chen SL et al. (2012)	0.554	0.216	1.422	-1.227	0.220
Chieffo A et al. (2013)	0.198	0.009	4.170	-1.041	0.298
Claessen BE et al. (2011)	0.656	0.376	1.147	-1.478	0.139
Hur SH et al. (2012)	0.486	0.358	0.661	-4.604	0.000
Jakabcin J et al. (2010)	1.515	0.259	8.874	0.461	0.645
Kim SH et al. (2010)	0.172	0.050	0.590	-2.802	0.005
Kim JS et al. (2011)	0.857	0.425	1.725	-0.433	0.665
Kim JS et al. (2013)	1.578	0.254	9.784	0.490	0.624
Park SJ et al. (2009)	0.259	0.107	0.629	-2.982	0.003
Park KW et al. (2012)	1.673	0.506	5.533	0.844	0.399
Roy P et al. (2008)	0.791	0.539	1.160	-1.200	0.230
Witzenbichler B et al. (2013)	0.875	0.636	1.204	-0.818	0.413
Yoon YW et al. (2013)	0.248	0.039	1.587	-1.472	0.141
Youn YJ et al. (2011)	0.210	0.026	1.698	-1.463	0.143
Random Effect Model	**0.613**	**0.478**	**0.786**	**-3.861**	**<0.001**
Test for Heterogeneity	**Q=25.9, df=15, p=0.039, I^2=42.2**				

Odds Ratio and 95% CI



Ahn JM, Am J Cardiol 2014

Survival benefit of Intravascular Ultrasound usage for DES implantation

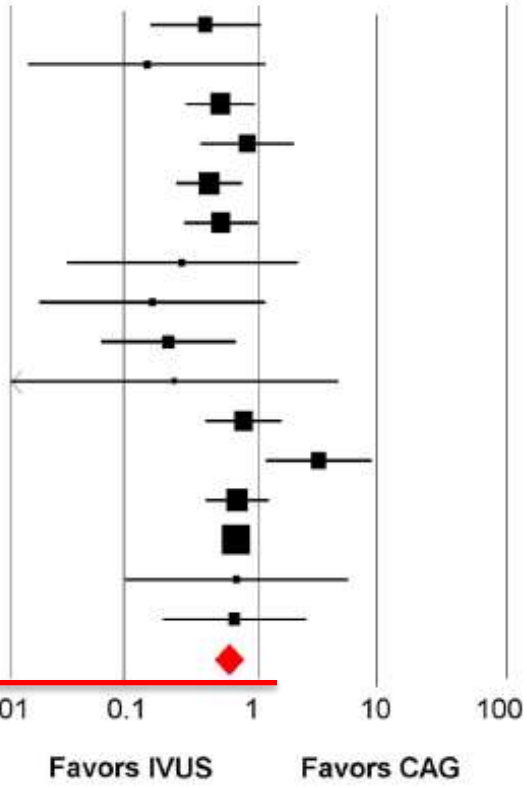


Myocardial Infarction

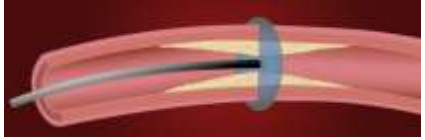
Author Name (Year)	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Ahn JM et al. (2013)	0.373	0.131	1.061	-1.849	0.064
Ahn SG et al. (2013)	0.126	0.014	1.154	-1.833	0.067
Chen SL et al. (2012)	0.494	0.257	0.948	-2.120	0.034
Chieffo A et al. (2013)	0.810	0.338	1.941	-0.472	0.637
Claessen BE et al. (2011)	0.399	0.214	0.744	-2.893	0.004
Hur SH et al. (2012)	0.497	0.247	1.004	-1.949	0.051
Jakabcin J et al. (2010)	0.242	0.028	2.094	-1.288	0.198
Kim SH et al. (2010)	0.139	0.017	1.150	-1.830	0.067
Kim JS et al. (2011)	0.189	0.054	0.665	-2.596	0.009
Kim JS et al. (2013)	0.209	0.010	4.414	-1.006	0.315
Park SJ et al. (2009)	0.757	0.369	1.550	-0.762	0.446
Park KW et al. (2012)	3.043	1.125	8.234	2.191	0.028
Roy P et al. (2008)	0.670	0.369	1.218	-1.313	0.189
Witzenbichler B et al. (2013)	0.660	0.508	0.858	-3.110	0.002
Yoon YW et al. (2013)	0.666	0.083	5.317	-0.383	0.701
Youn YJ et al. (2011)	0.640	0.167	2.458	-0.650	0.516
Random Effect Model	**0.571**	**0.435**	**0.751**	**-4.011**	**<0.001**
Test for Heterogeneity	**Q=22.9, df=15, p=0.086, I^2=34.5%**				

Statistics for Each Study

Odds Ratio and 95% CI



Ahn JM, Am J Cardiol 2014



Integrated use of FFR and IVUS enables us to do…

- Functionally complete revascularization with PCI for ischemia-causing stenosis and medical treatment for the other stenoses.
- Proper treatment strategy selection with ischemia-guided risk stratification.
- Imaging-guided treatment planning and PCI adjustment.

→ Improve the patients' symptom and prognosis