



2. Complex PCI II: Bifurcation Intervention

Invited Case Presentation & Focus Review: Bifurcation Intervention



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Curitiba - Brazil



Friday, April 27th, 2012, 9h35 at 9h50

2012 -- Potential conflicts of interest

**Learning Center intracoronary ultrasound
Sponsored by Boston Scientific without medical fees.
Donation to Francisco Costantini Foundation**

Since 2008

(We used IVUS from end of 1994)

Costantino R Costantini, M.D., Ph.D., F.A.A.C.

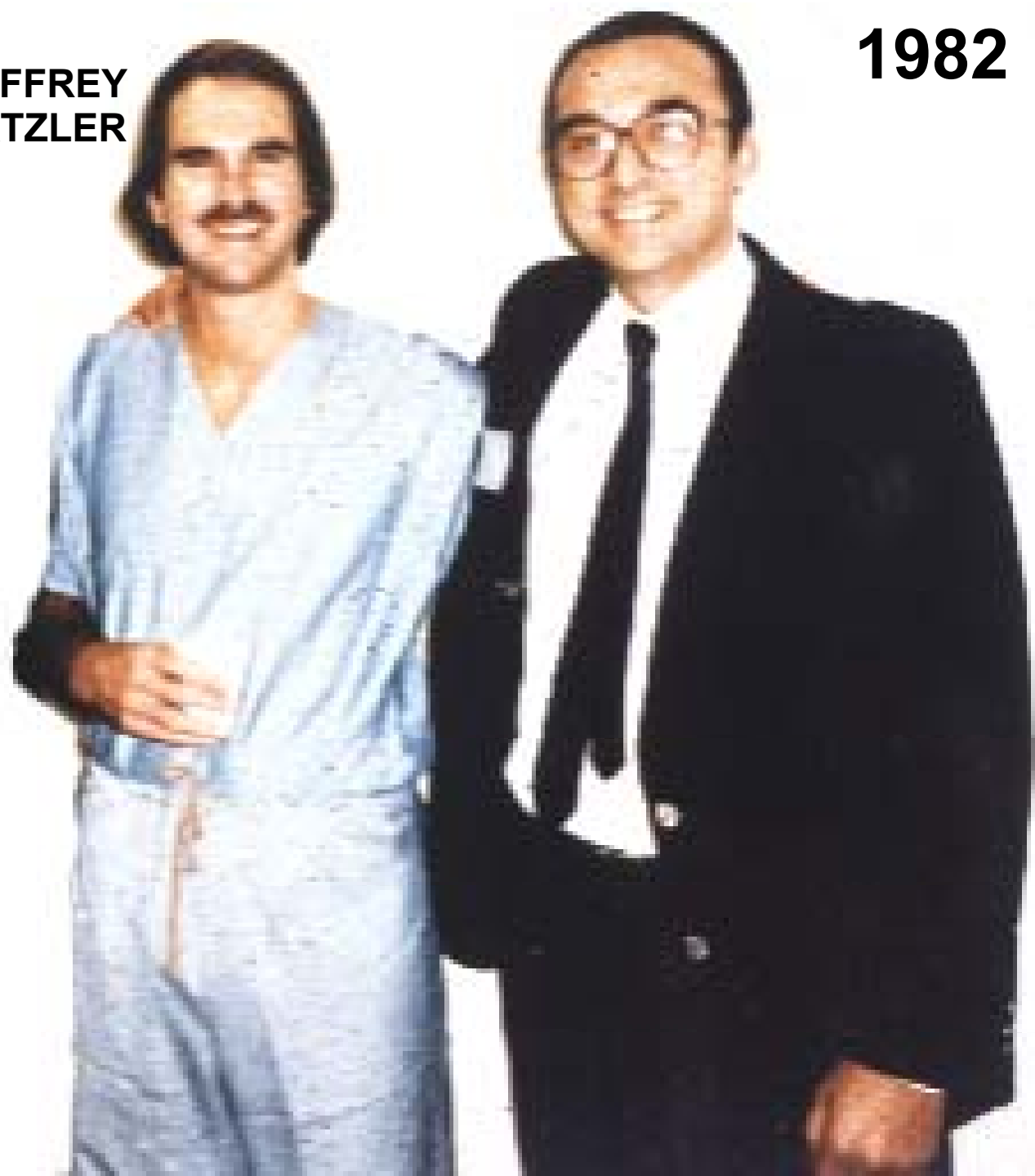
My MENTOR

**GEOFFREY
HARTZLER**

1982

Dead 65 YEAR OLD

(Last April)

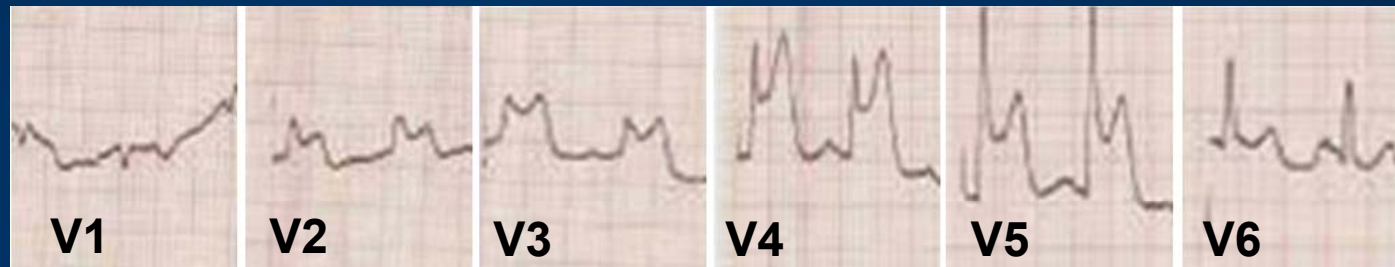
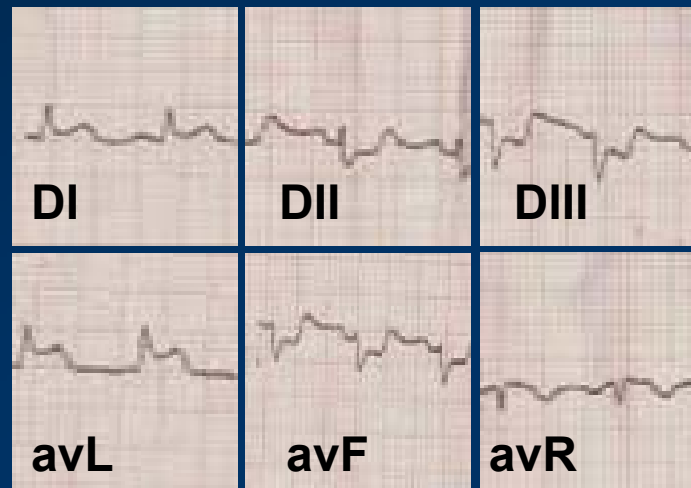


Case Presentation

- 65 yr old Caucasian male,
- Risk factors:
 - Positive family history for CAD
 - Hypertension
 - Dyslipidemia
 - smoking
 - sedentary
- Presented with AMI Anterior wall 40 min on set, KKI, Home Diagnostic Emergency Service...

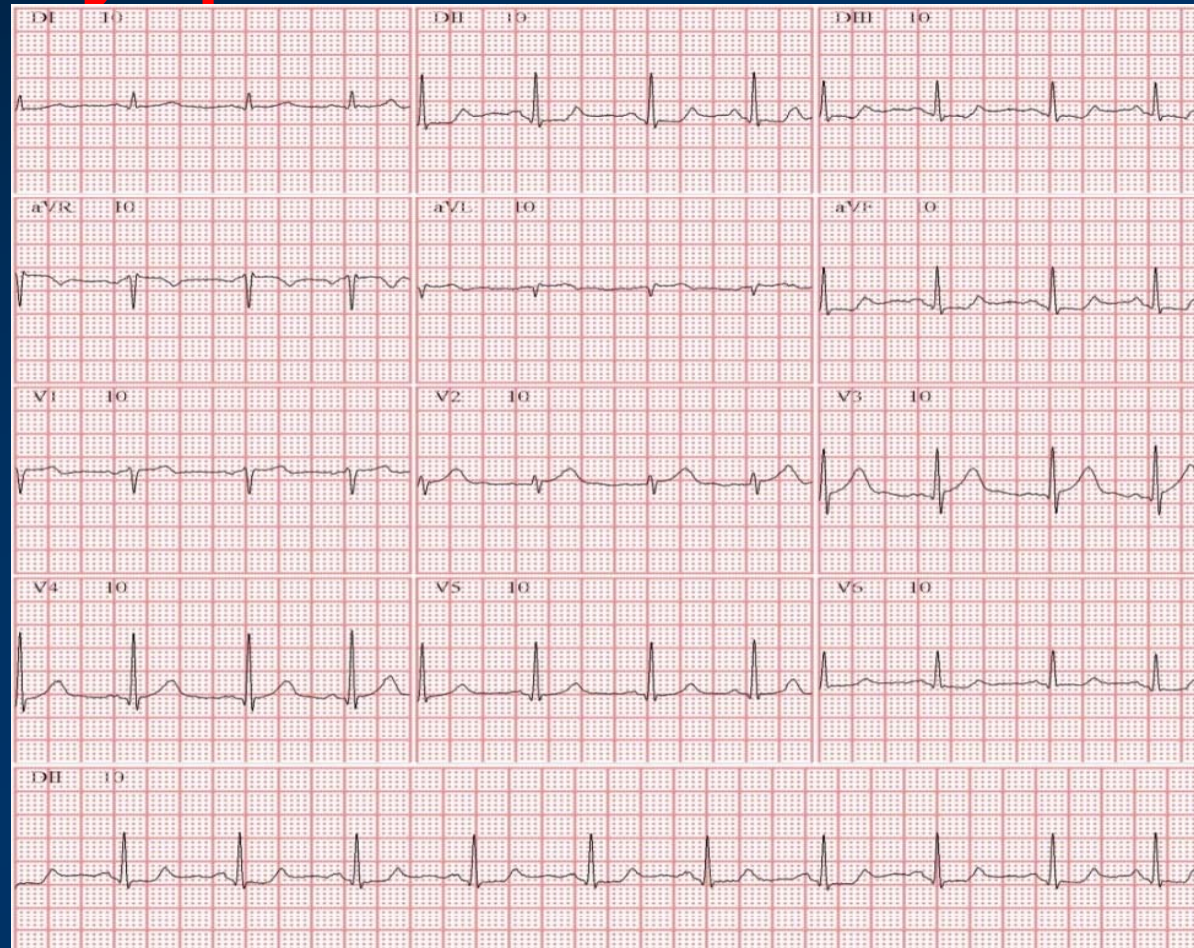
ECG Ambulance, Anterior wall AMI 40 min on set

65 Yrs Old



Hospital admission ECG at the emergency room

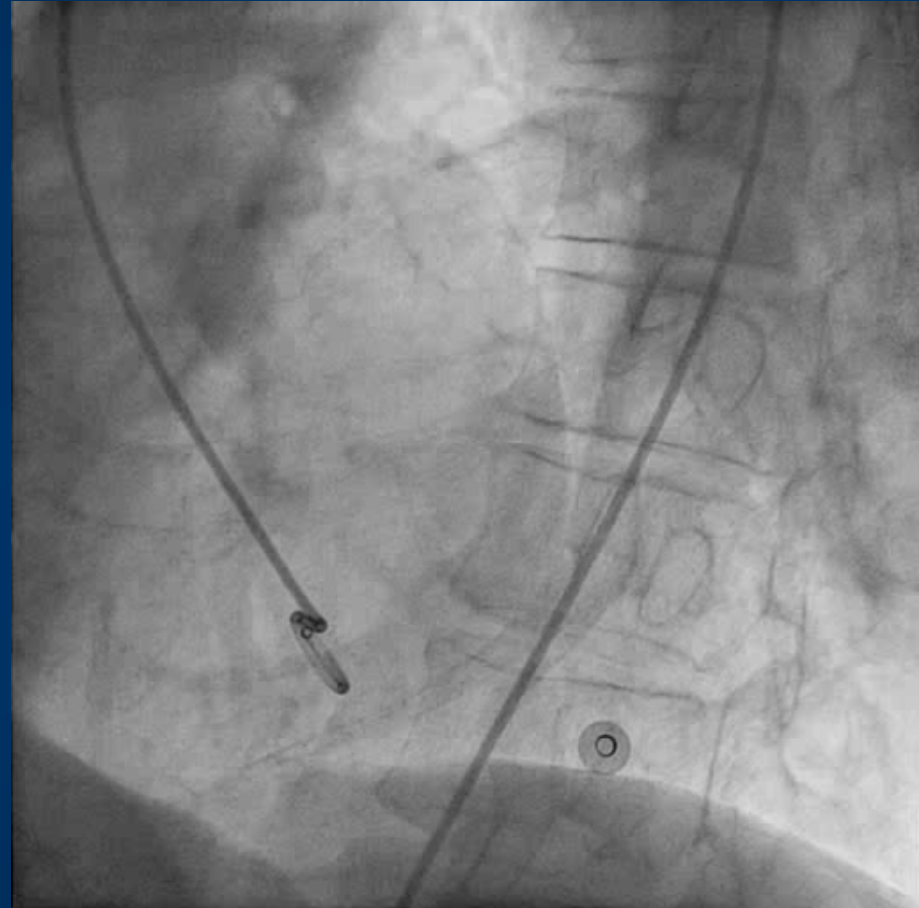
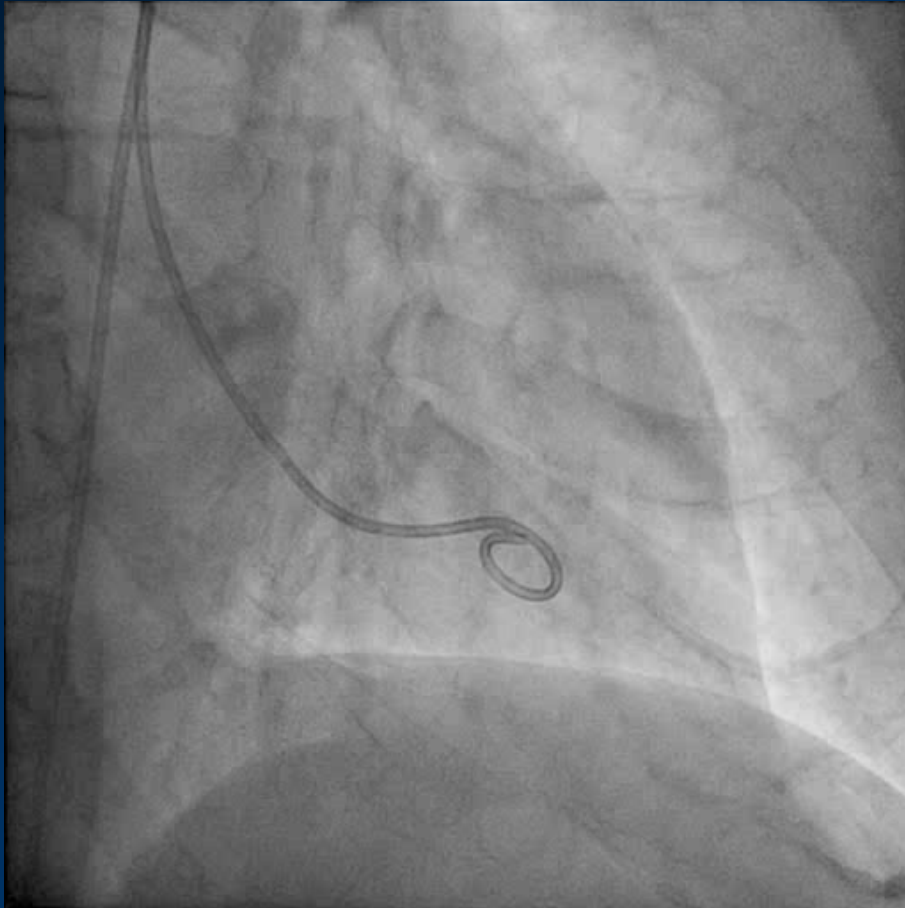
- **Asymptomatic at admssion...**



what should be the Next Step ?

1. C.C.U. Admission -Medical treatment, Enzimas, and Echo, Functional Test ???
2. Cath Lab ???

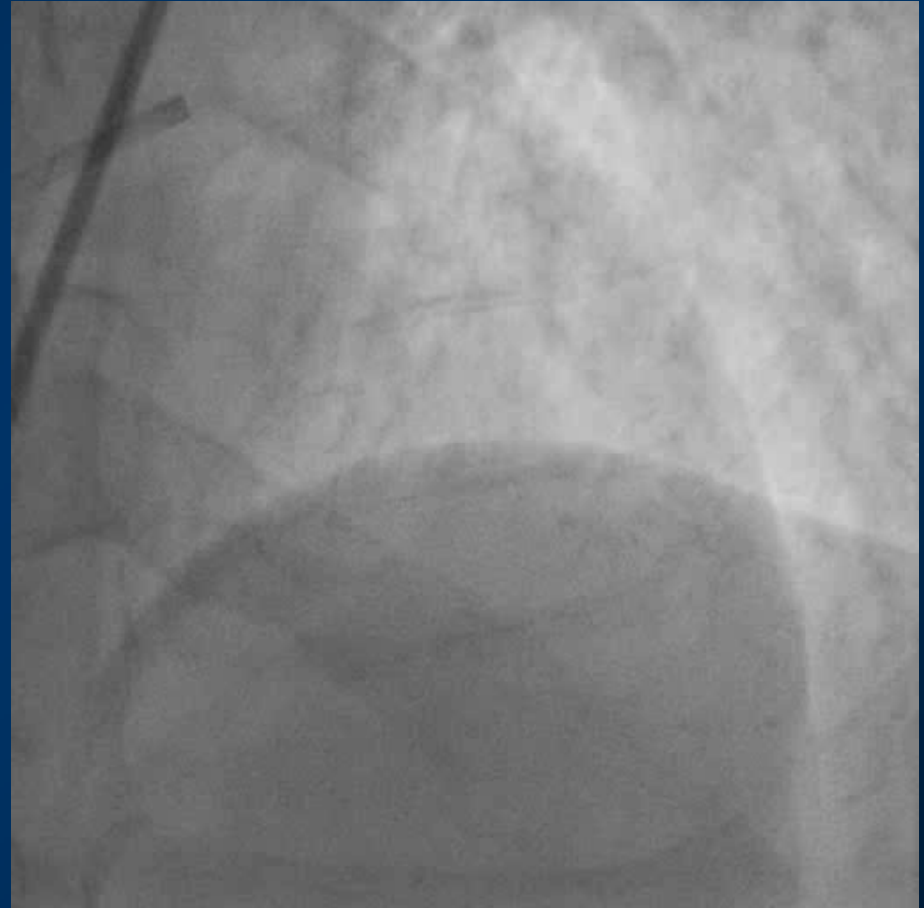
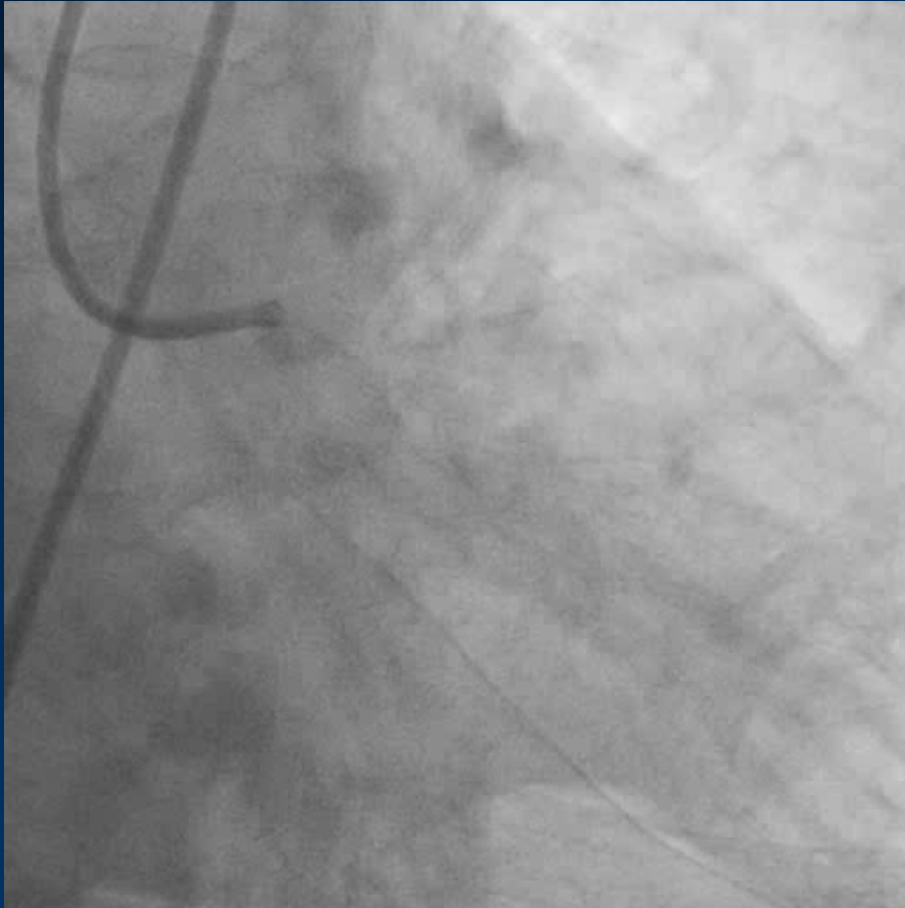
LVEF: 79 %



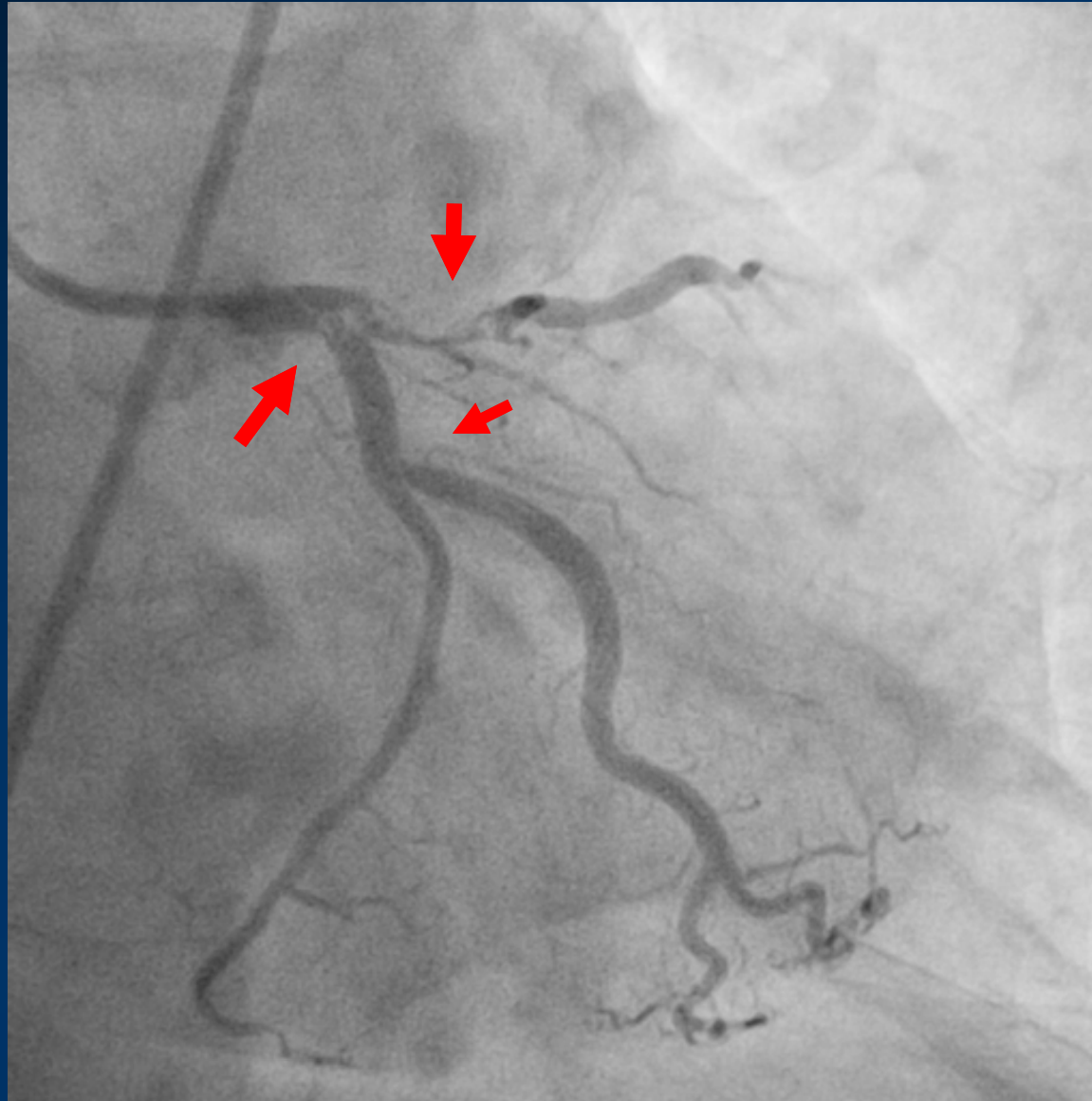
RCA



LCx / LAD



LM > LAD / LCx



Unprotected Left Main PCI in STEMI and NSTEMI

✓ ULM-lesions are responsible for 4-6% of the ACS (STEMI and NSTEMI)

✓ 70% of the ACS-lesions affect the distal left main, the preferred PCI strategy is provisional stenting

✓ PCI is the current strategy for LM associated STEMI (particularly in case of cardiogenic shock), for NSTEMI CABG still remains the main alternative

✓ In-hospital mortality for ULM PCI varies between 8-40% (lower for NSTEMI, higher for STEMI)

GRACE LM-Registry (2009), Lee (2009), Hurtado (2009), Pappalardo (2011), AMIS Plus LM-Registry (2011)

what should be the Next Step ?

1. No revascularization, med tx ?
2. CABG ??
3. PCI ???

(CARDIAC SURGEON in the FAMILY-EEUU)

(Real Heart team)

Indications for CABG versus PCI in stable patients with lesions suitable for both procedures and low predicted surgical mortality

Subset of CAD by anatomy	Favours CABG	Favours PCI
Left main (isolated or IVD, ostium/shaft)	I A	IIa B
Left main (isolated or IVD, distal bifurcation)	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≤ 32	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≥ 33	I A	III B

- In the most severe patterns of CAD, CABG appears to offer a survival advantage as well as a marked reduction in the need for repeat revascularisation.

Wijns W, Kolh P, et al. Eur Heart J 2010

HCC LEFT MAIN Clinical Outcomes

Follow Up 950 ± 795 days

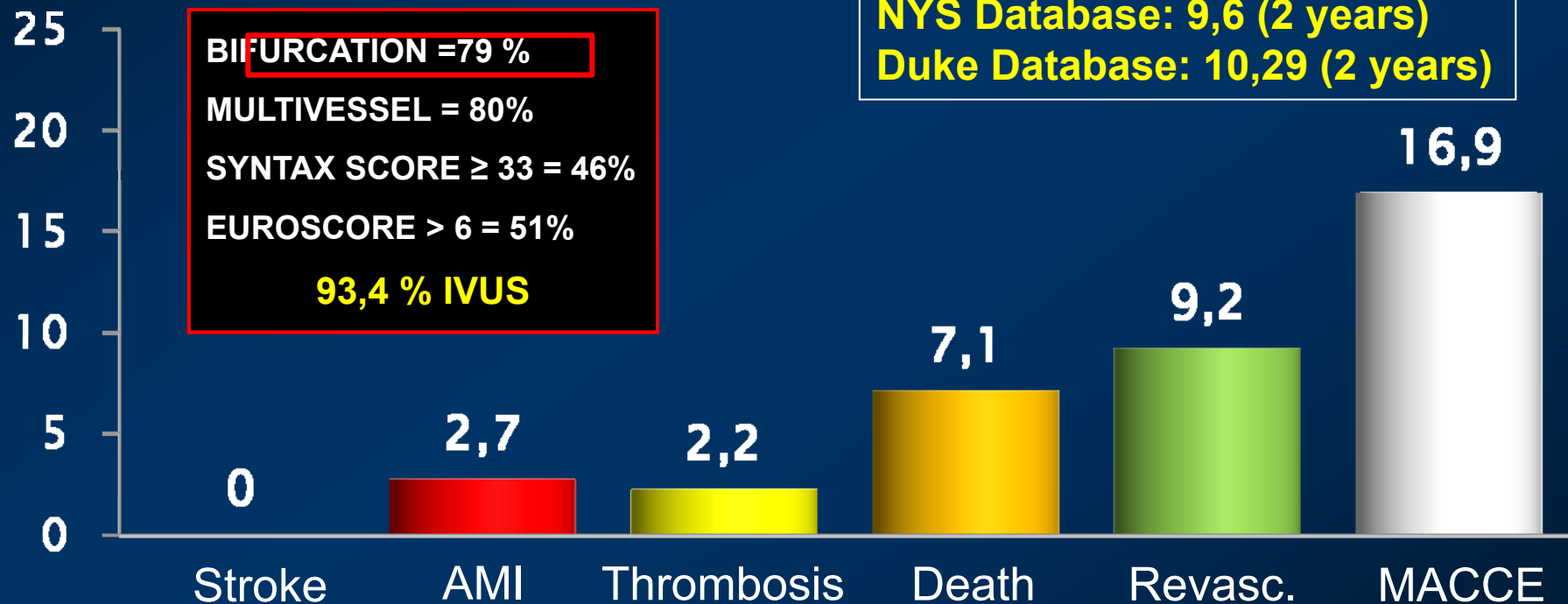
(n = 183 pts)

CABG Results (F/U mortality)

Cleveland: 11,3 (1 year)

NYS Database: 9,6 (2 years)

Duke Database: 10,29 (2 years)

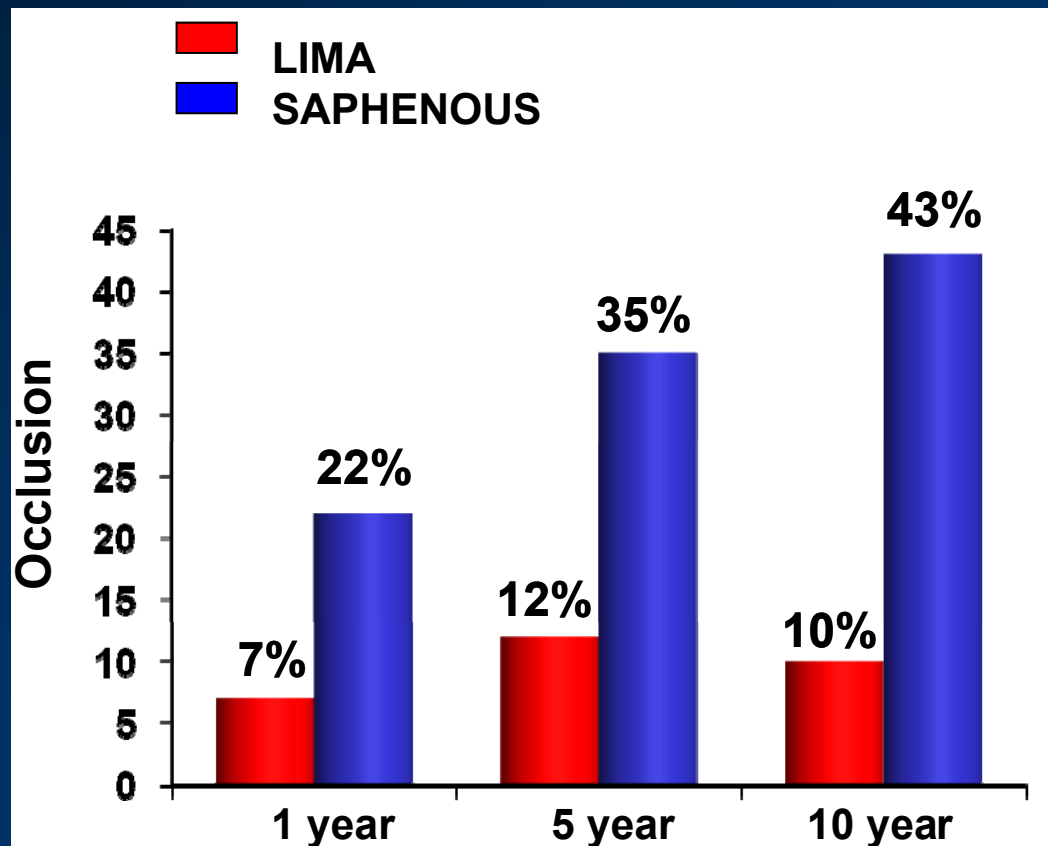


Hospital Costantini Registry LM PCI

Comparison of Saphenous Vein and Internal Thoracic Artery Graft Patency by Coronary System

Joseph F. Sabik III, MD, Bruce W. Lytle, MD, Eugene H. Blackstone, MD,
Penny L. Houghtaling, MS, and Delos M. Cosgrove, MD

Departments of Thoracic and Cardiovascular Surgery, and Biostatistics and Epidemiology, The Cleveland Clinic Foundation,
Cleveland, Ohio



Results. Unadjusted 1-, 5-, and 10-year patency was 93%, 88%, and 90% for internal thoracic arteries and 78%, 65%, and 57% for saphenous veins. At 10 years, internal thoracic arteries were more likely than saphenous veins to be patent to left anterior descending in 99.1% of cases, to diagonals in 98.3%, to circumflex in 98.3%, to posterior descending artery in 98.5%, and to right coronary arteries

ANN THORAC SURG 2005;79:544-51

Coronary Artery Bypass Graft Failure After On-Pump and Off-Pump Coronary Artery Bypass: Findings From PREVENT IV

Mitchell J. Magee, MD, John H. Alexander, MD, MHS, Gail Hafley, MS, T. Bruce Ferguson, Jr, MD, C. Michael Gibson, MD, Robert A. Harrington, MD, Eric D. Peterson, MD, MPH, Robert M. Califf, MD, Nicholas T. Kouchoukos, MD, Morley A. Herbert, PhD, and Michael J. Mack, MD, for the PREVENT IV Investigators

Cardiopulmonary Research Science and Technology Institute, Dallas, Texas; Duke University Medical Center and Duke Clinical Research Institute, Durham, North Carolina; East Carolina Cardiovascular Institute, Greenville, North Carolina; PERFUSE Angiographic Core Laboratory, Boston, Massachusetts; Missouri Baptist Medical Center, St. Louis, Missouri; and Medical City Dallas Hospital, Dallas, Texas

FU @ 12 months

Failure of LIMA and Vein Graft

	Off Pump	On Pump
Vein Graft	25,3%	25,7%
IMAs	8,0%	8,6%

Ann Thorac Surg 2008;85:494 –500

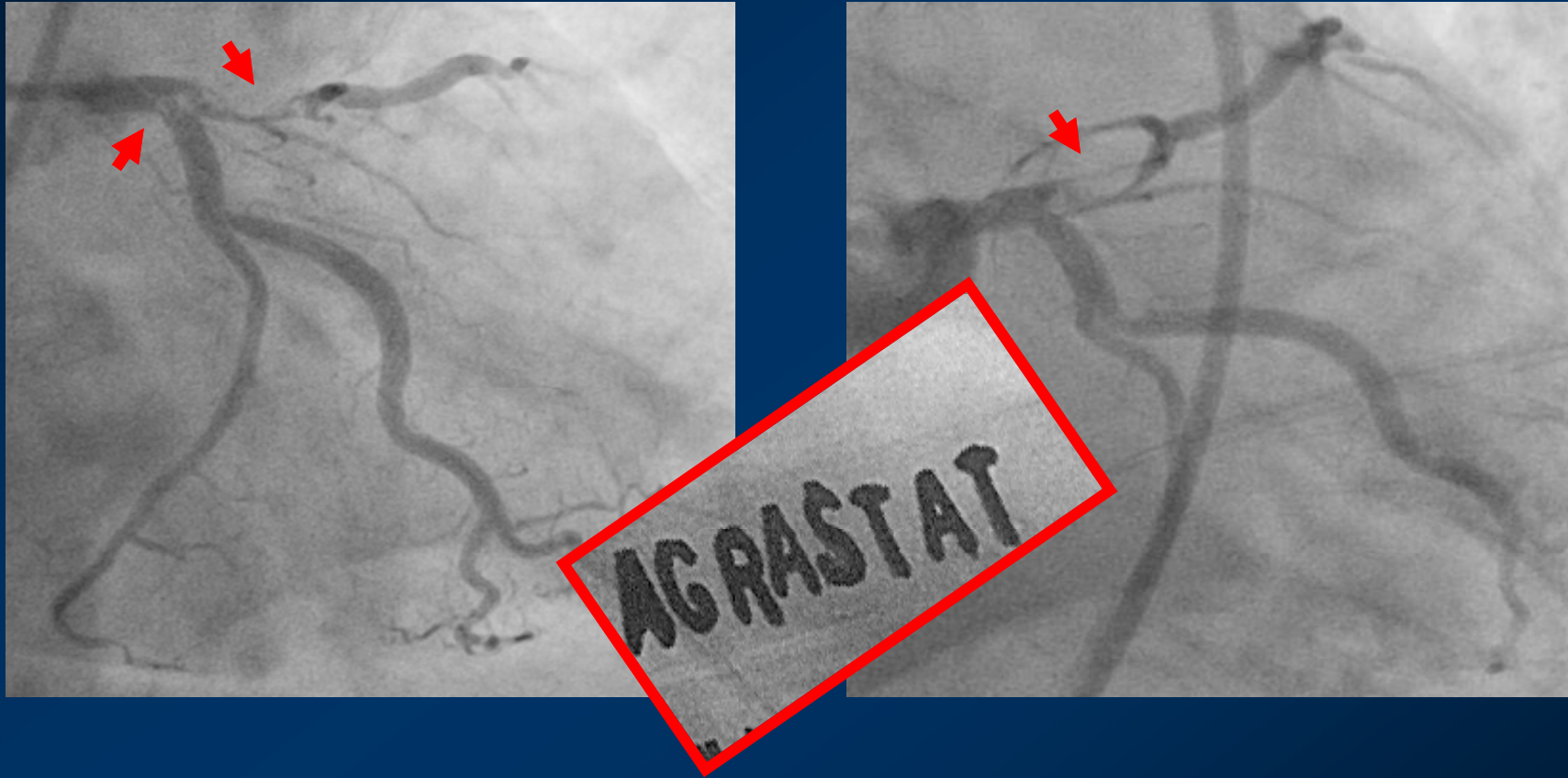
what should be the Next Step ?

1. No revascularization, med tx ?
2. CABG ??
3. PCIOK

(CARDIAC SURGEON in the FAMILY)

(Real Heart team)

Tirofiban Used



Tirofiban

Tirofiban as adjunctive therapy for acute coronary syndromes and percutaneous coronary intervention: a meta-analysis of randomized trials

Methods and results

We searched for randomized trials comparing tirofiban vs. placebo or any active control. Odds ratios (OR) were computed from individual studies and pooled with random-effect methods. Thirty-one studies were identified involving 20 006 patients (12 874 comparing tirofiban vs. heparin plus placebo or bivalirudin alone, and 7132 vs. abciximab). When compared with placebo, tirofiban was associated at 30 days with a significant reduction in mortality [OR = 0.68 (0.54–0.86); $P = 0.001$] and death or myocardial infarction (MI) [OR = 0.69 (0.58–0.81); $P < 0.001$]. The treatment benefit persisted at follow-up but came at an increased risk of minor bleedings [OR = 1.42 (1.13, 1.79), $P = 0.002$] or thrombocytopenia. When compared with abciximab, mortality at 30 days did not differ [OR = 0.90 (0.53, 1.54); $P = 0.70$], but in the overall group tirofiban trended to increase the composite of death or MI [OR = 1.18 (0.96, 1.45); $P = 0.11$]. No such trend persisted at medium-term follow-up or when appraising studies testing tirofiban at 25 $\mu\text{g}/\text{kg}$ bolus regimen.

Conclusion

Tirofiban administration reduces mortality, the composite of death or MI and increases minor bleedings when compared with placebo. An early ischaemic hazard disfavouring tirofiban was noted when compared with abciximab in studies based on 10 but not 25 $\mu\text{g}/\text{kg}$ tirofiban bolus regimen.

Thrombus Aspiration During PCI for STEMI



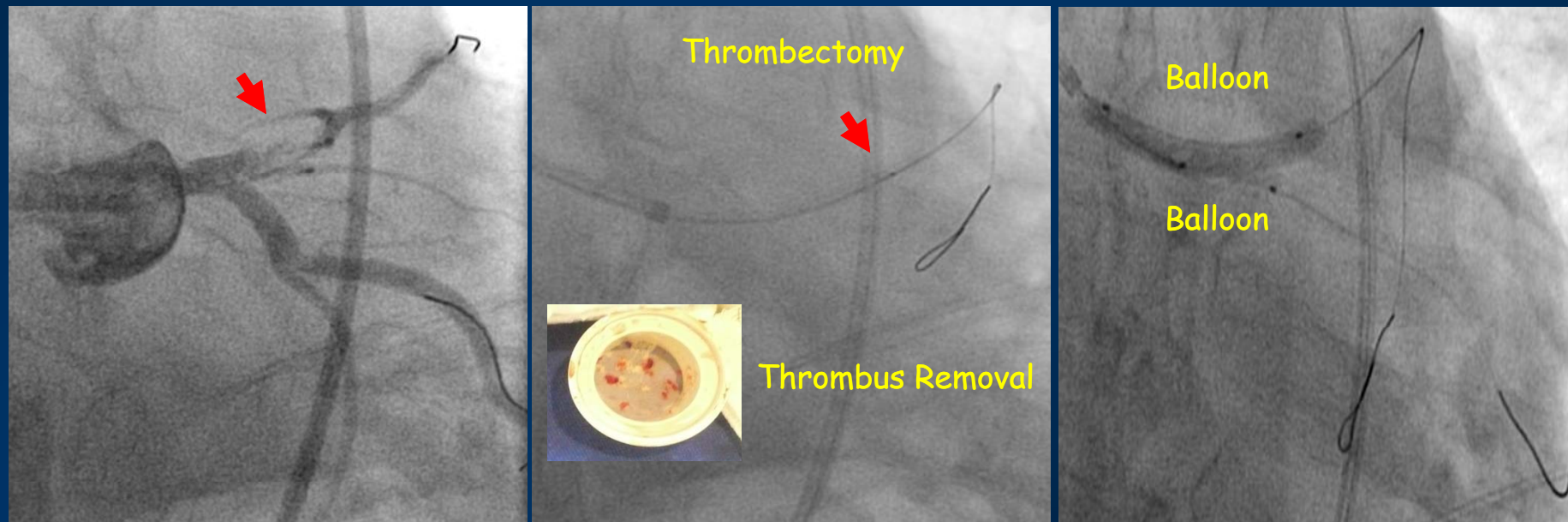
2011 ACCF/AHA/SCAI -- 2008 SBC/SBHCI Guideline



Device	Recommendation	COR	LOE
Thrombectomy	Aspiration thrombectomy for patients undergoing primary PCI	Ia	B

2008 Arq Bras Cardiol 2008;91

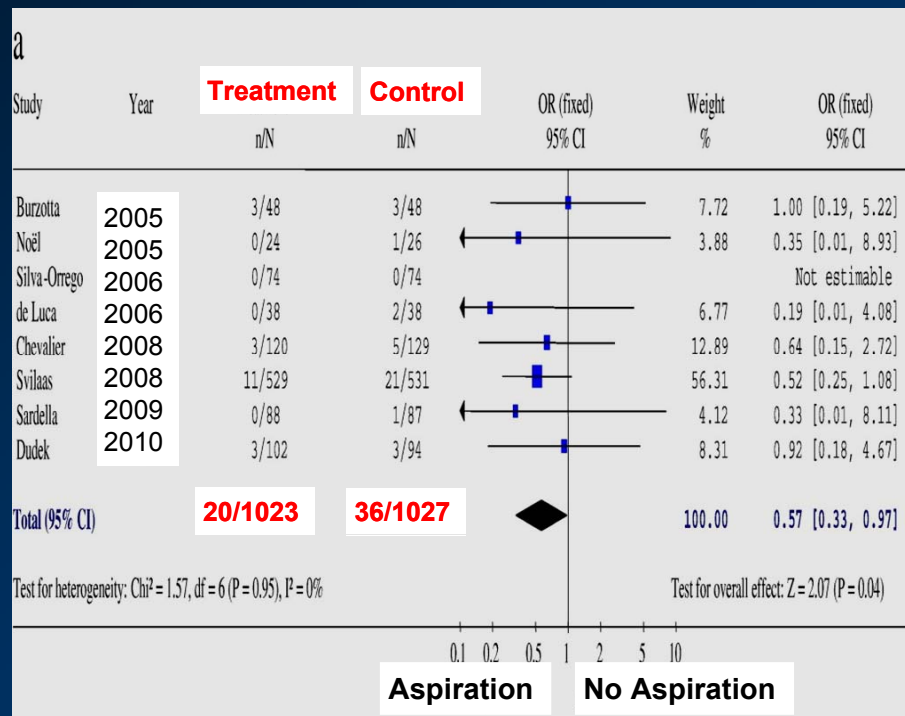
2011 ACCF/AHA/SCAI Guideline for PCI and Coronary Revascularization



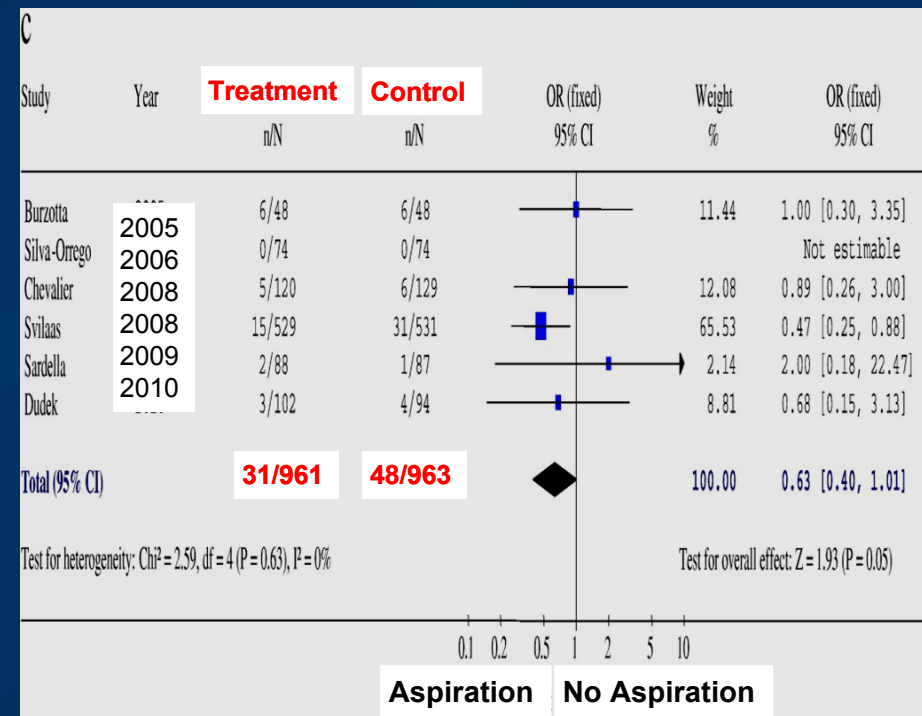
Use of thrombectomy devices in primary percutaneous coronary intervention: A systematic review and meta-analysis

Charis Costopoulos^a, Diana A. Gorog^{a,b}, Carlo Di Mario^{b,c}, Neville Kukreja^{a,*}

Mortality



MACE

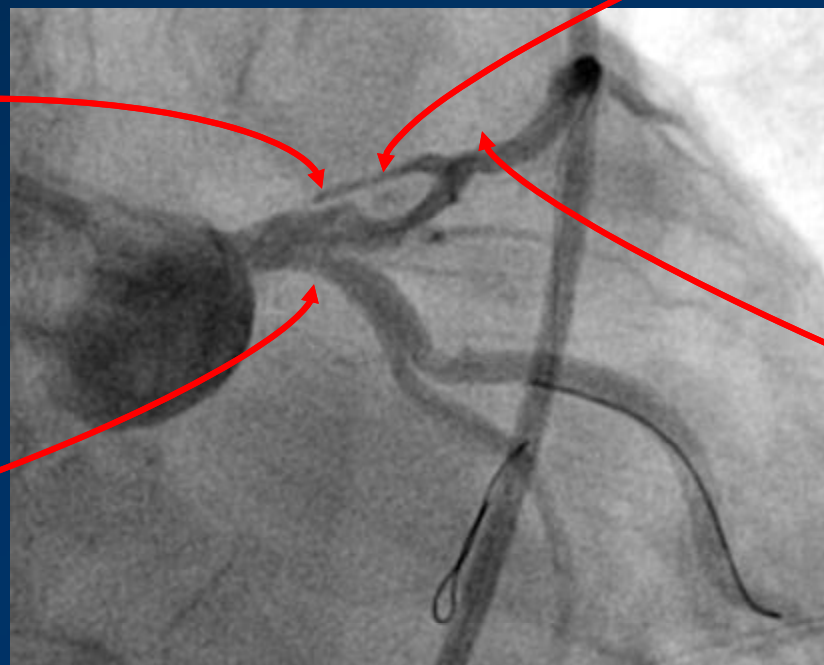
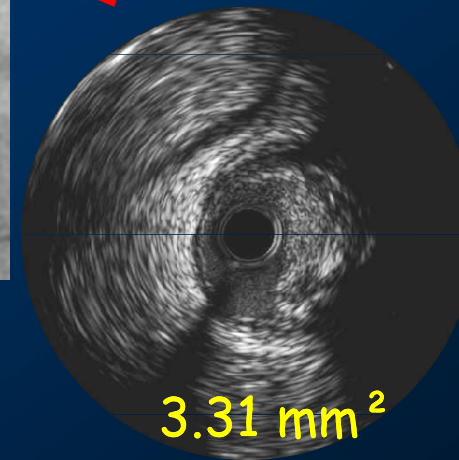
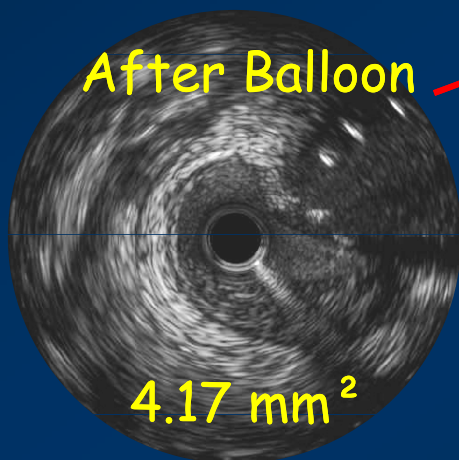
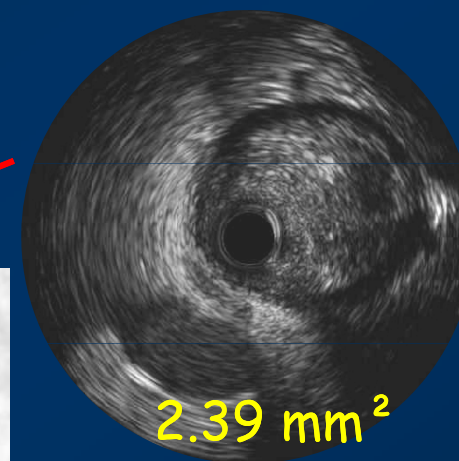
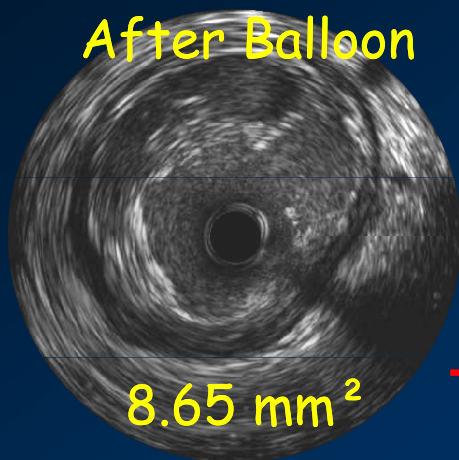


Conclusion: Current evidence advocates the routine use of manual thrombectomy devices in PCI. Mechanical thrombectomy may have a role in selected PCI patients with large caliber vessels and heavy thrombus burden although their routine use is not presently supported.

C. Costopoulos, Int J Cardiol. 2011

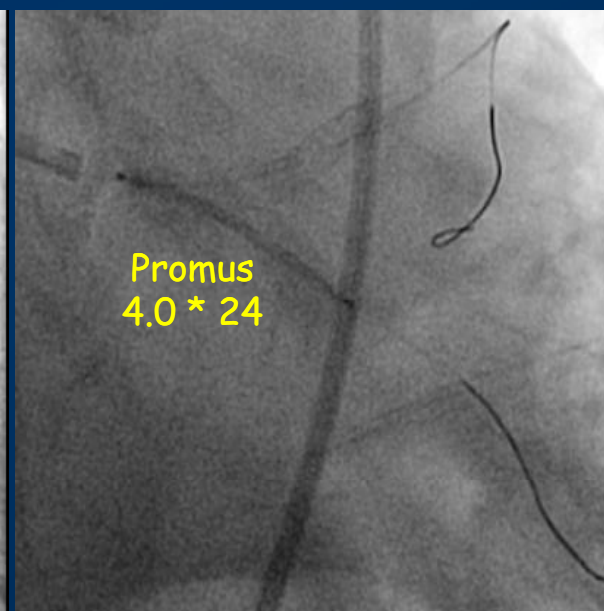
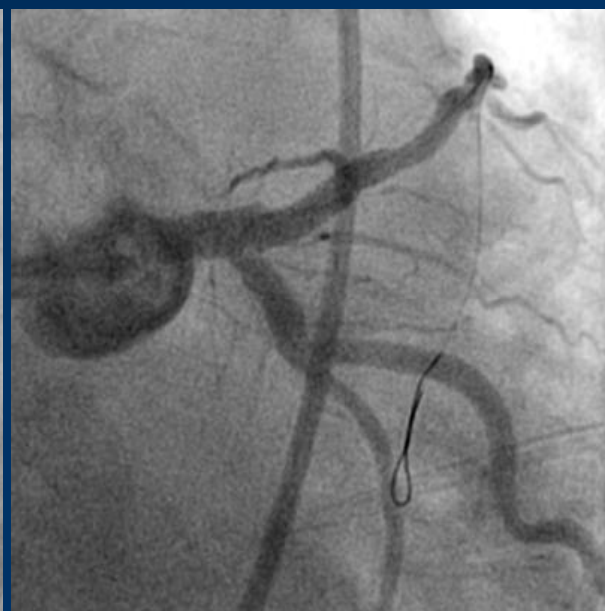
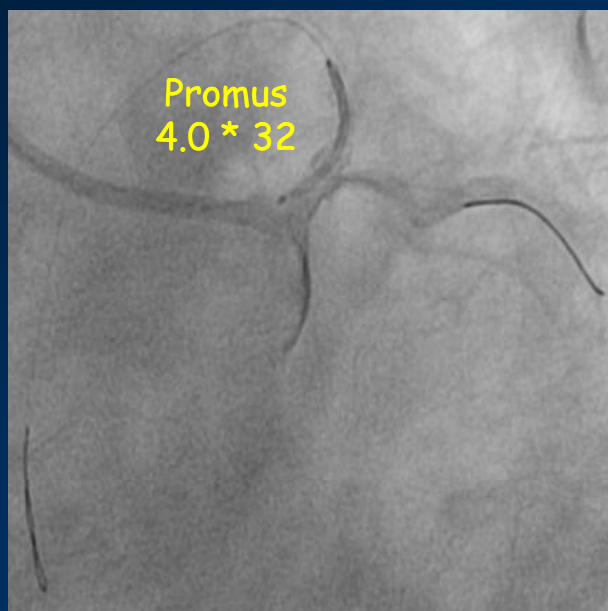
After Thrombus Removal and Kissing Balloon

IVUS

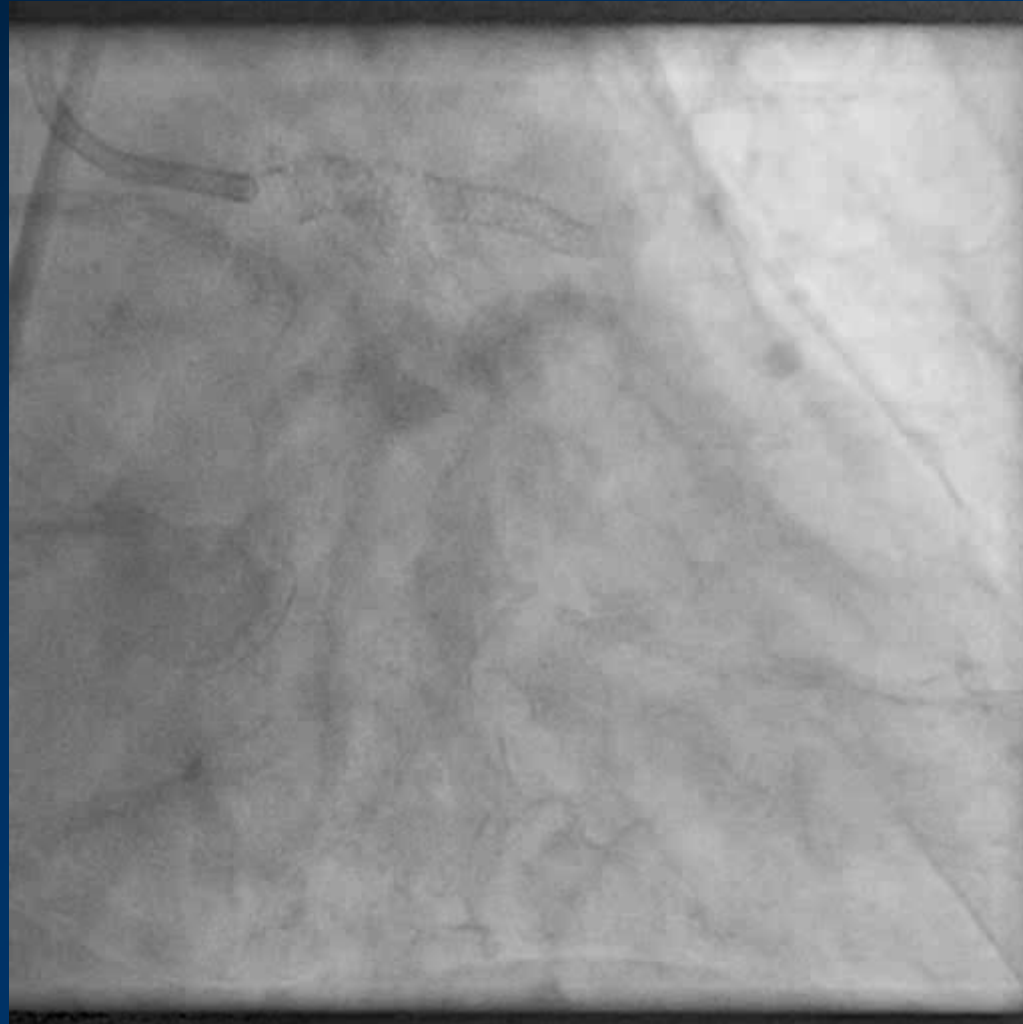


One Stent or Two Stents

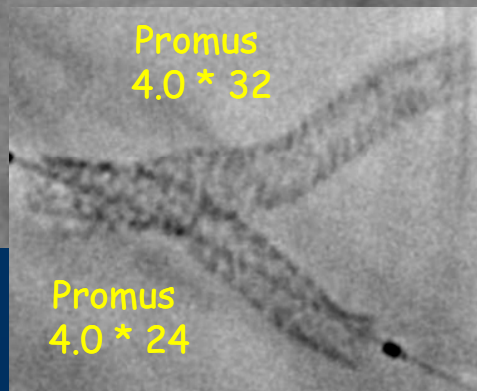
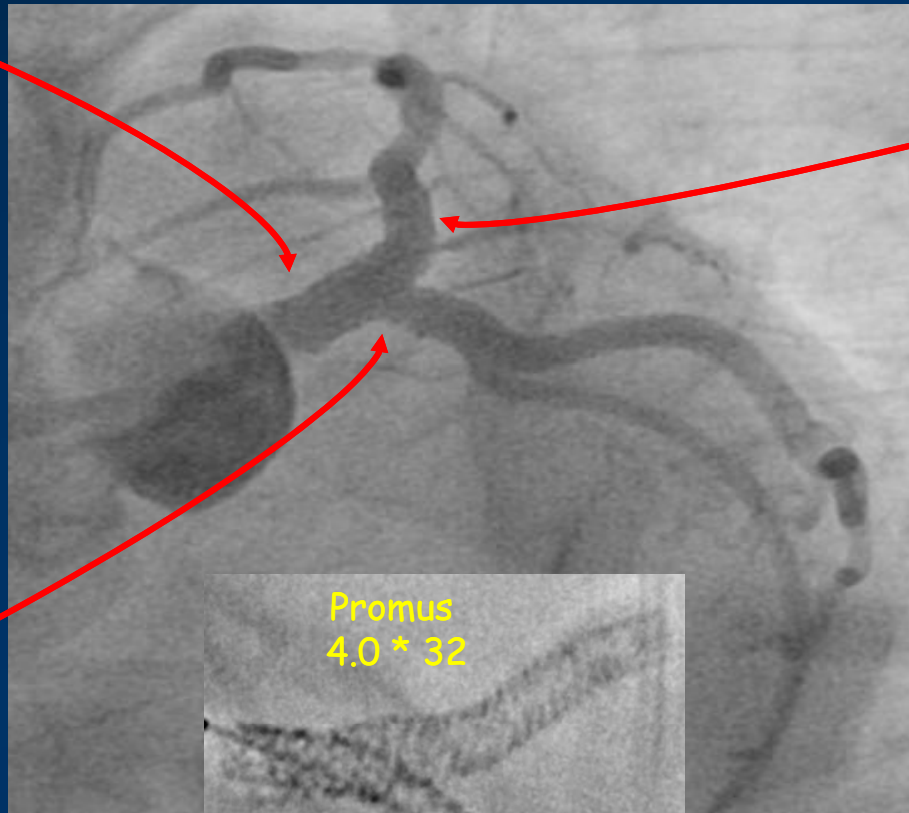
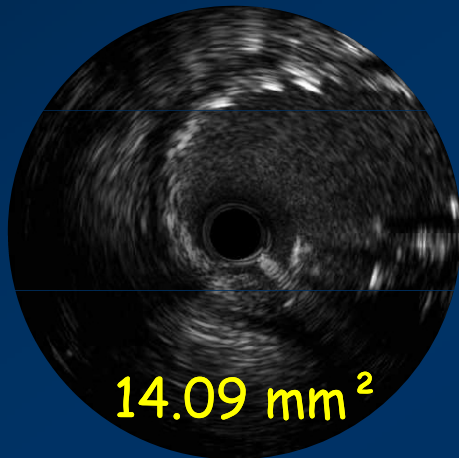
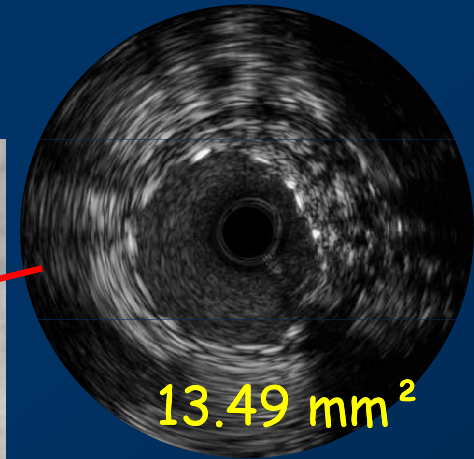
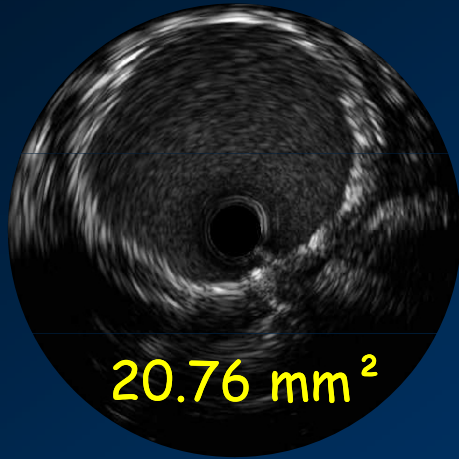
Stent LM > LAD & LM > LCx Culotte Technique



Final Result



Final Result



And now ??



QCA Diameter Stenosis 76 %

what should be the Next Step ?

1. No revascularization, med tx ?

2. CABG ?? (LIMA ???)

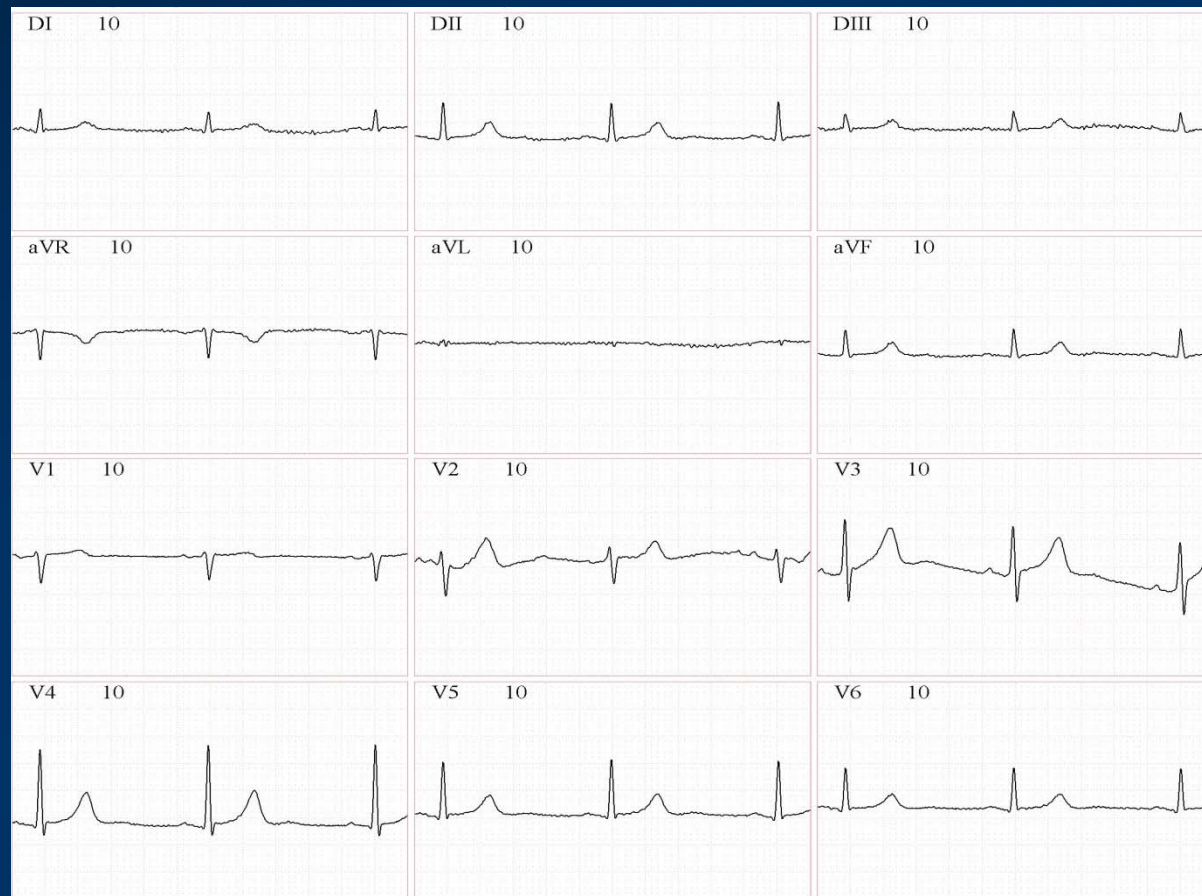
3. PCI ??? (PROVISIONAL STENT ???)

(CARDIAC SURGEON in the FAMILY-EEUU)

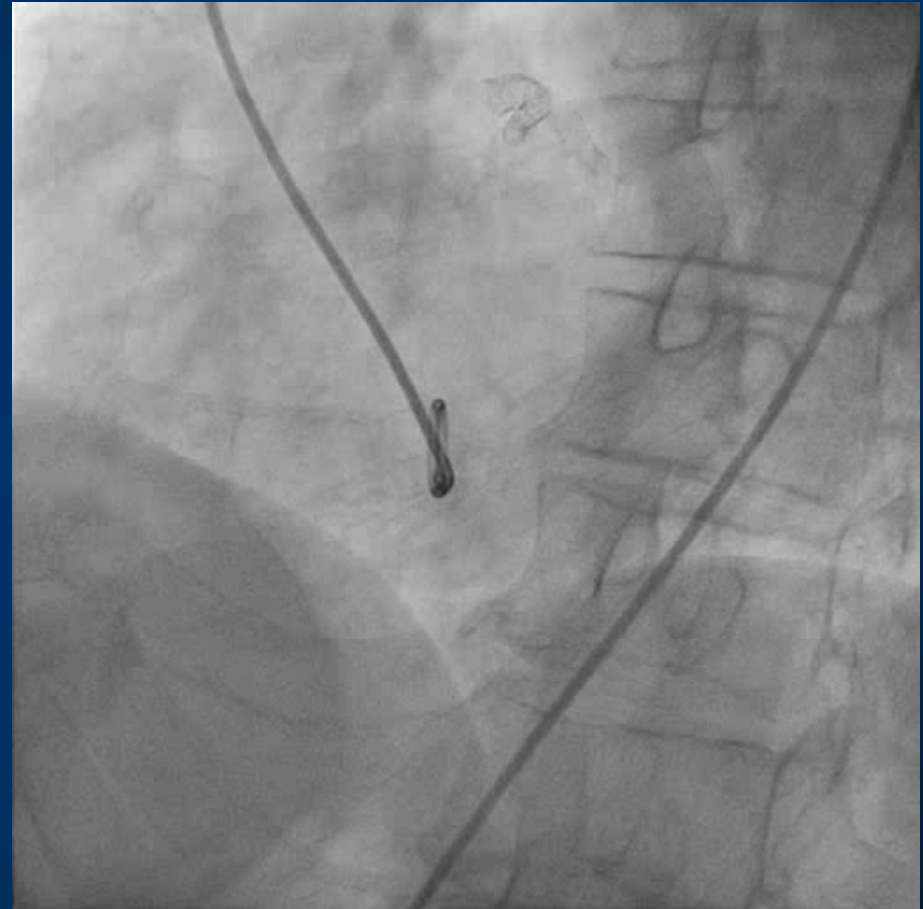
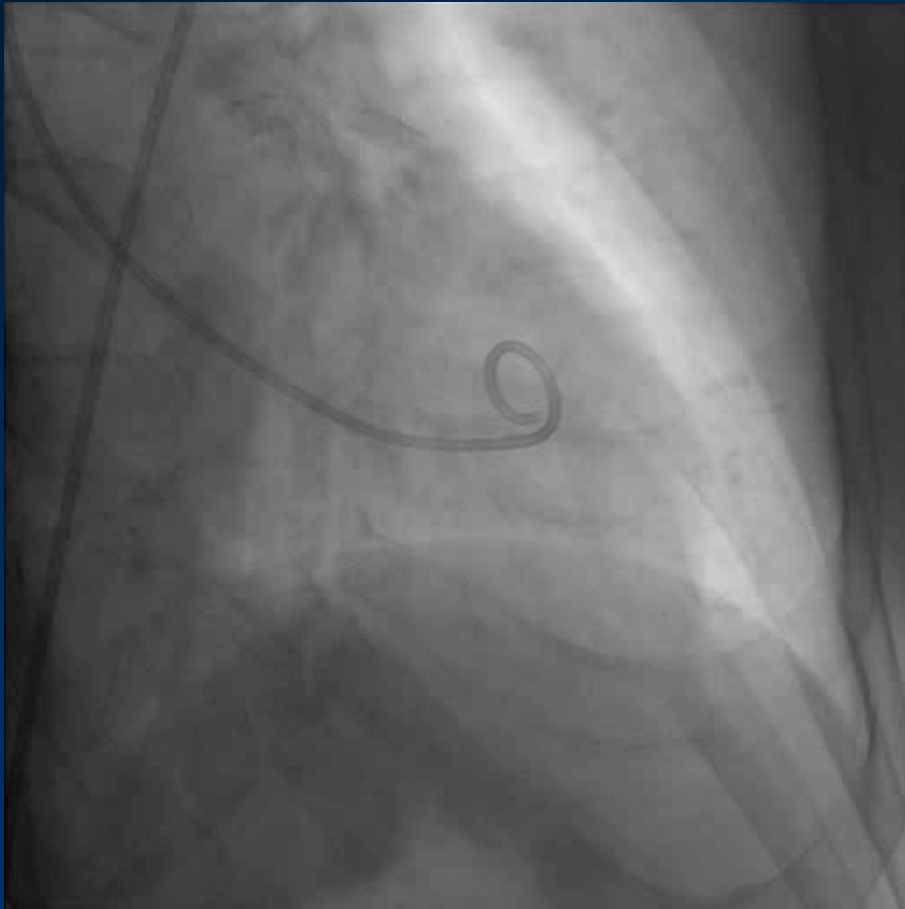
(Real Heart team)

Hospital Re-admission After 2 months ECG at the emergency room

- Re-admission (Recurrent Chest Pain)



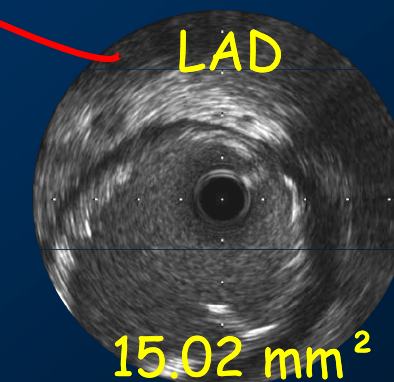
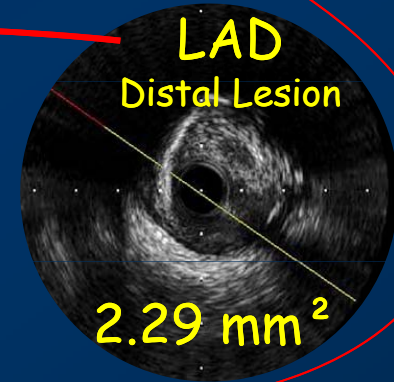
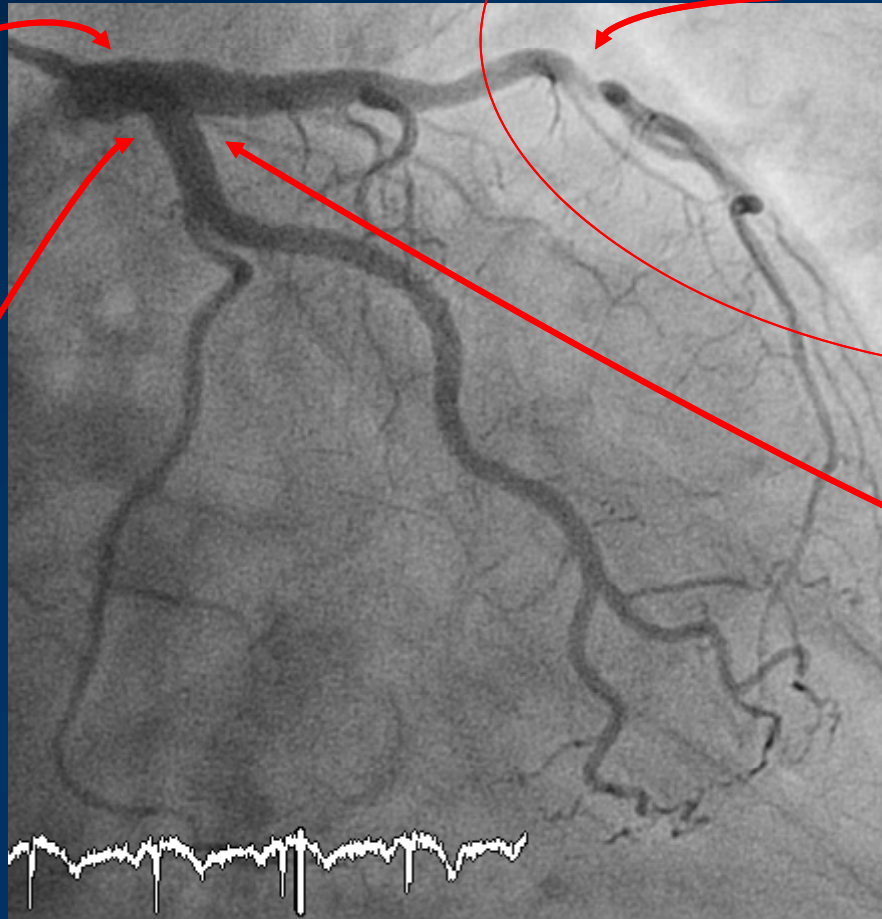
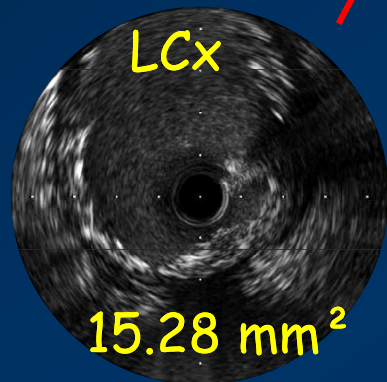
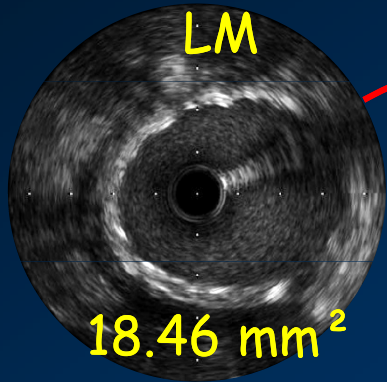
Follow up @ 2 months



LVEF: 85 %

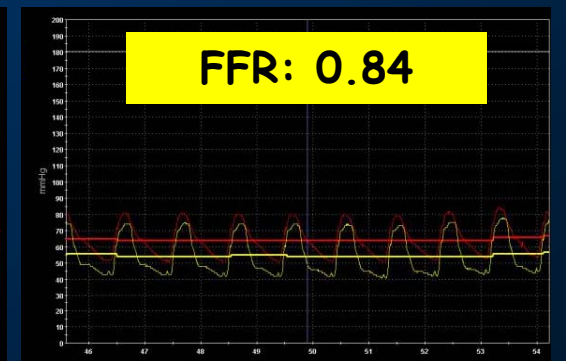
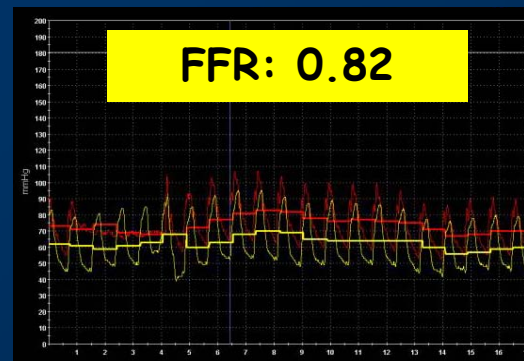
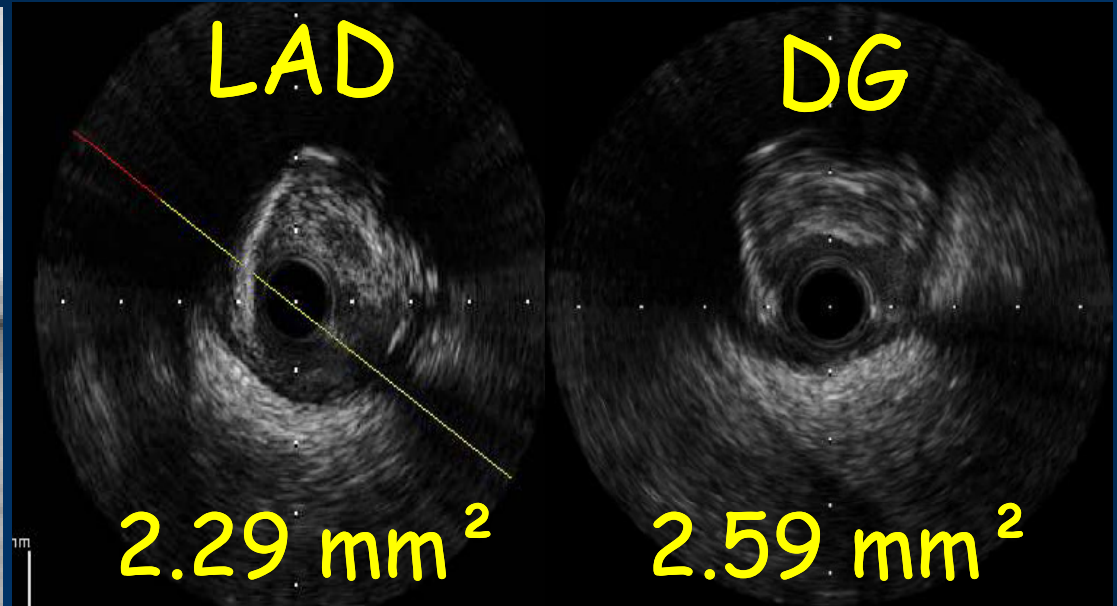
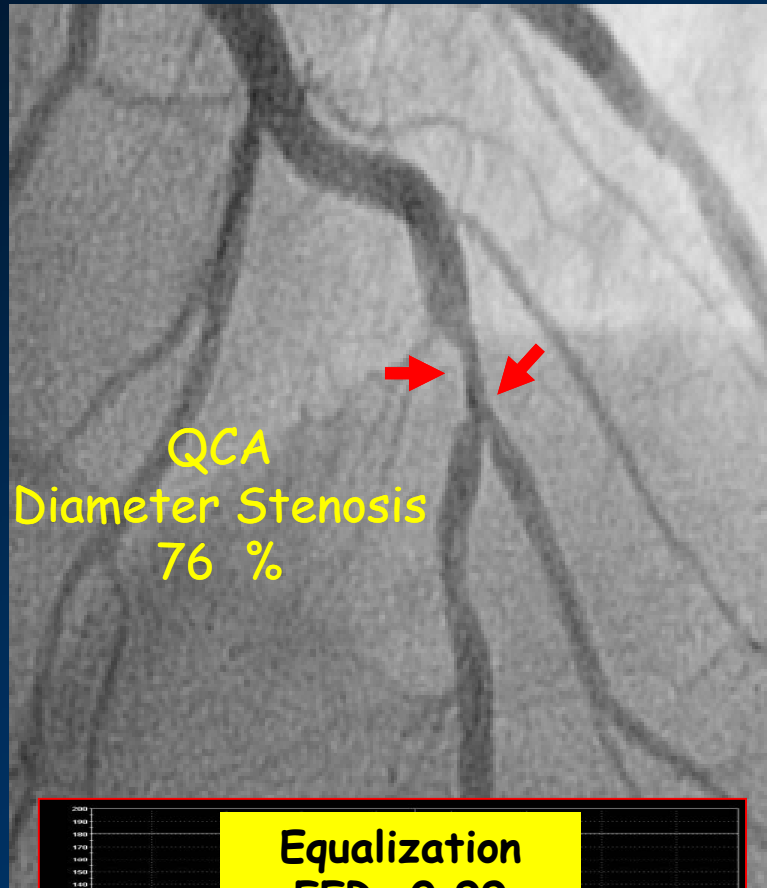
Follow up @ 2 months

ANGIO and IVUS EVALUATION



FFR Vs. IVUS Vs. ???

Continuous Intravenous Infusion 180 $\mu\text{g}/\text{kg}/\text{min}$



• 1979 , first PTCA of Latin America

Costantino R. Costantini
Lázaro C. Garcia
Donaldo Pereira Garcia
Ramon Rojas
Pedro V. Michelotto
Flávio Nogueira.

Angioplastia coronariana
transluminal. Aspectos
cineangiográficos e metabólicos.
Relato de um caso.

Os autores apresentam um caso de arterioplastia coronária pela técnica de Grüntzig e col. Paciente masculino, de 55 anos de idade, com história de insuficiência coronária, mostrava à cinecoronariografia, lesão crítica de 75-80%, única, localizada no terço proximal da coronária direita.

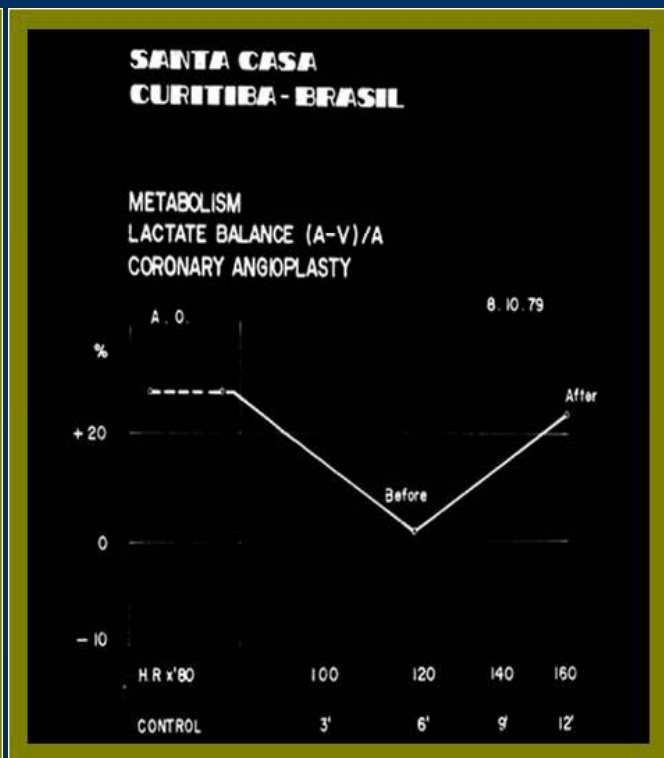
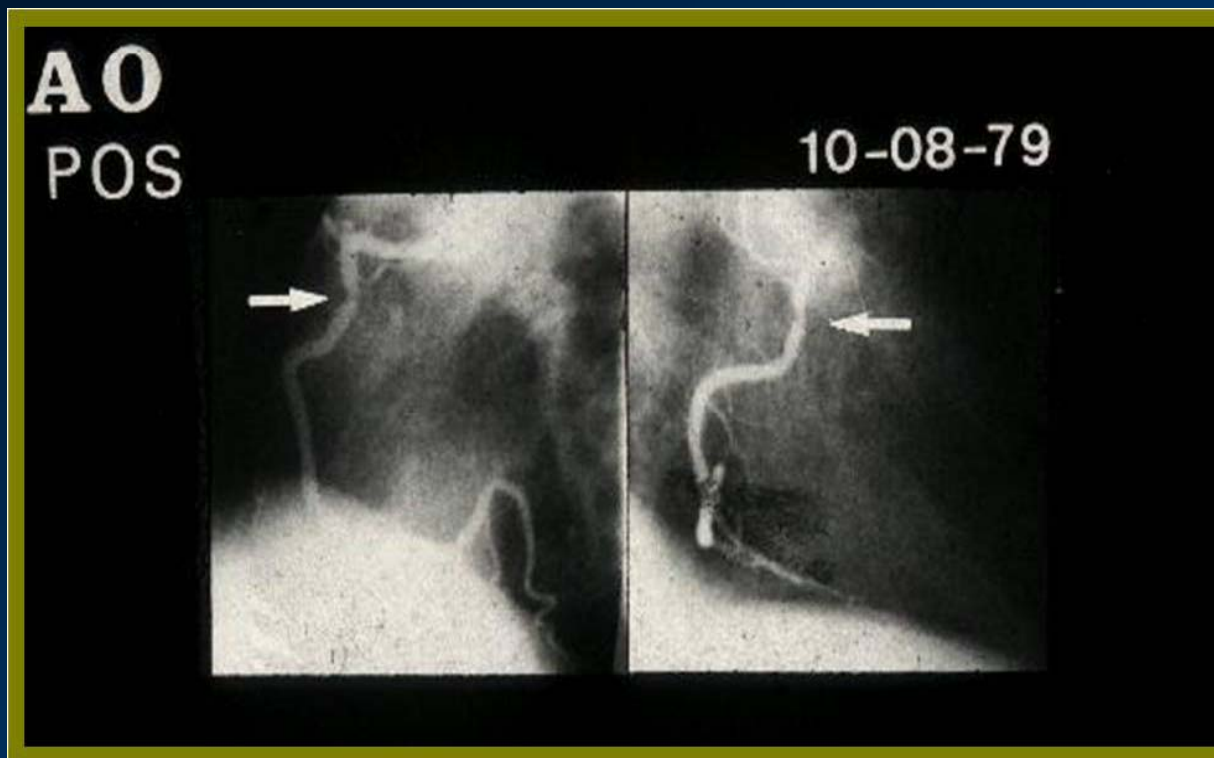
Realizou-se dilatação da artéria coronária, com balão, pela técnica acima. Após o procedimento, a obstrução diminuiu para 15-20% e a ventriculografia demonstrou acentuada melhora da contratilidade da parede inferior do ventrículo esquerdo.

Outrossim, a análise da extração de lactato no sangue do seio coronário, que era anormal com frequência cardíaca de 120 bpm, resultou normal após a dilatação coronária, mesmo com frequência de 160 bpm.

Esse método, se bem indicado e realizado com êxito, pode abrir nova perspectiva no tratamento da doença coronária.

Costantini, C. et al Arq Bras Cardiol.1980;34(4):307-10.

- 1979 , first PTCA of Latin America



Estudo do metabolismo miocárdico = extração de lactato normal em repouso.
 Diminuição da extração (+ 2%) com freqüência cardíaca de 120 bpm.
 Após angioplastia, a freqüência cardíaca atingida foi de
 160 bpm e a extração de lactato normal.

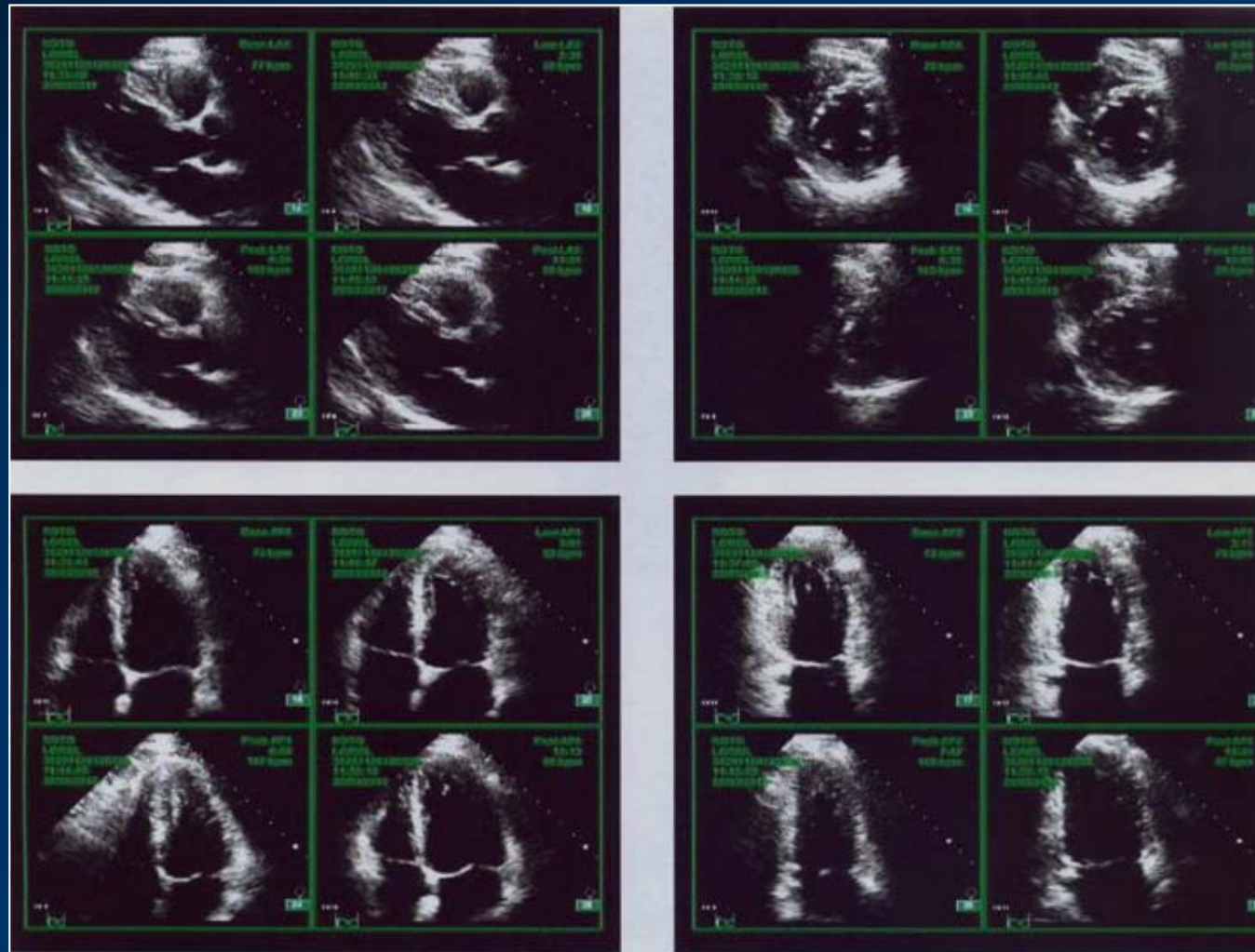
Costantini, C. et al Arq Bras Cardiol.1980;34(4):307-10.

what should be the Next Step ?

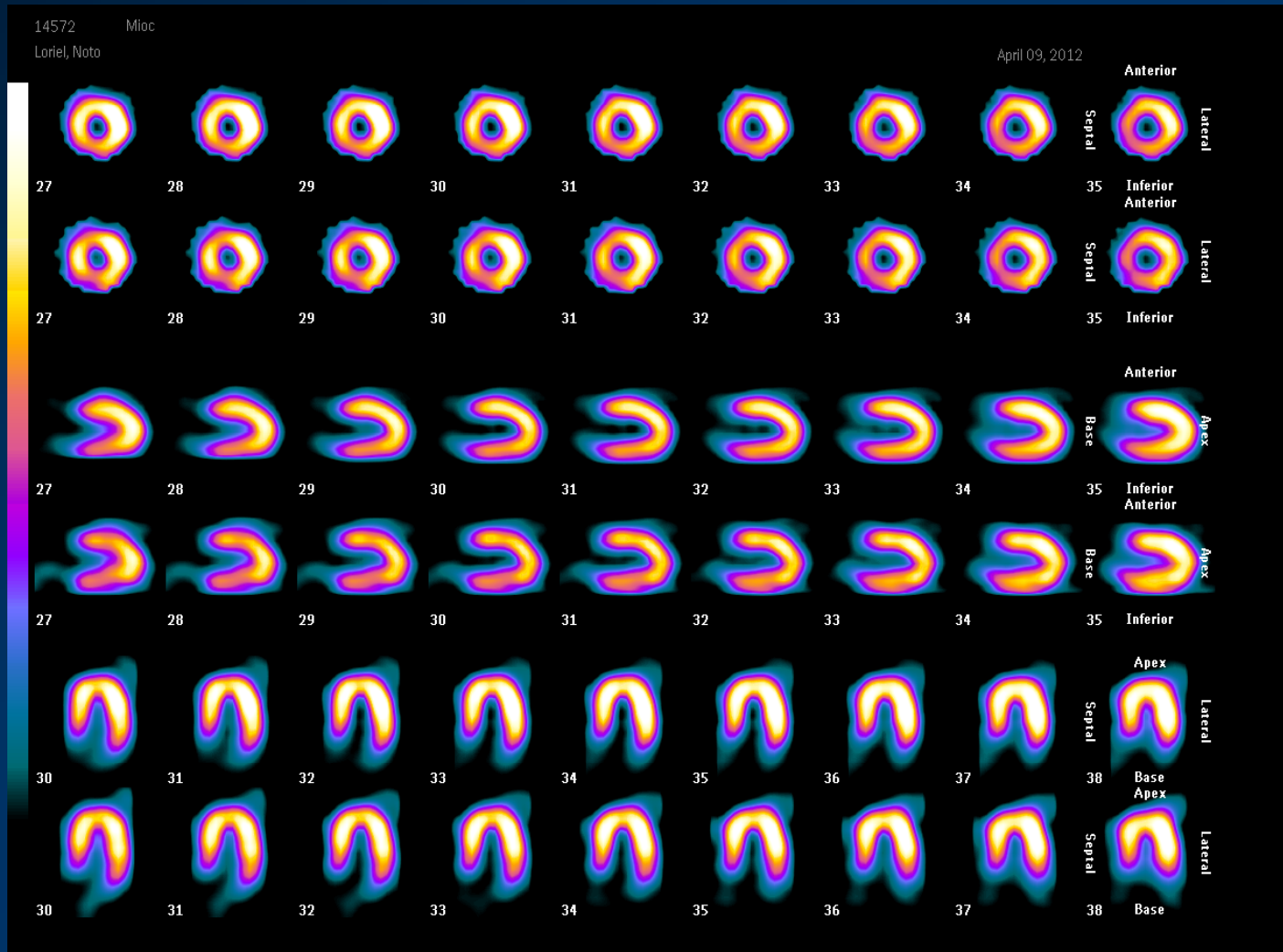
1. No revascularization, med tx

Tallium Spect or Echo

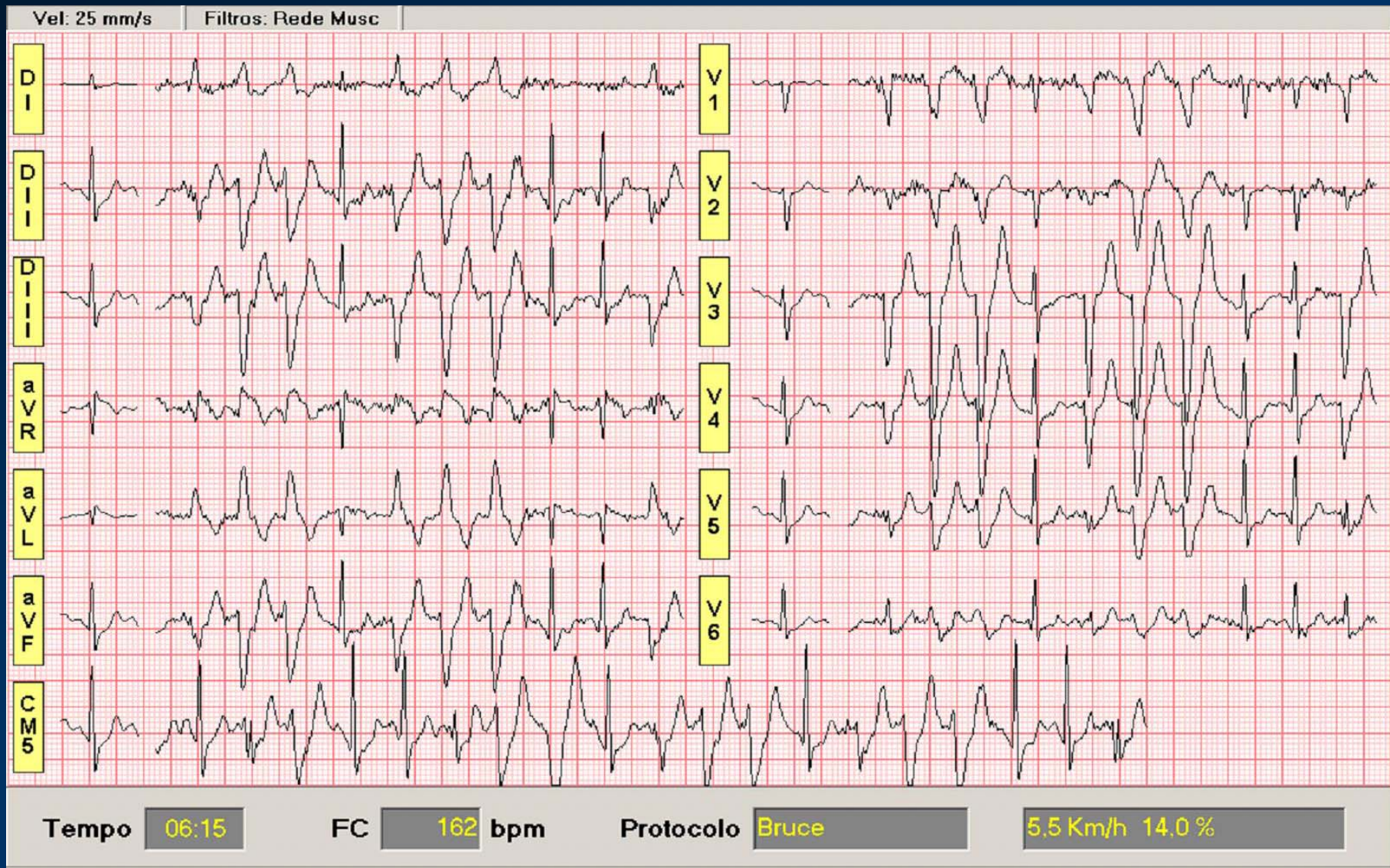
Dobutamine Echo Stress; Normal After 3 months



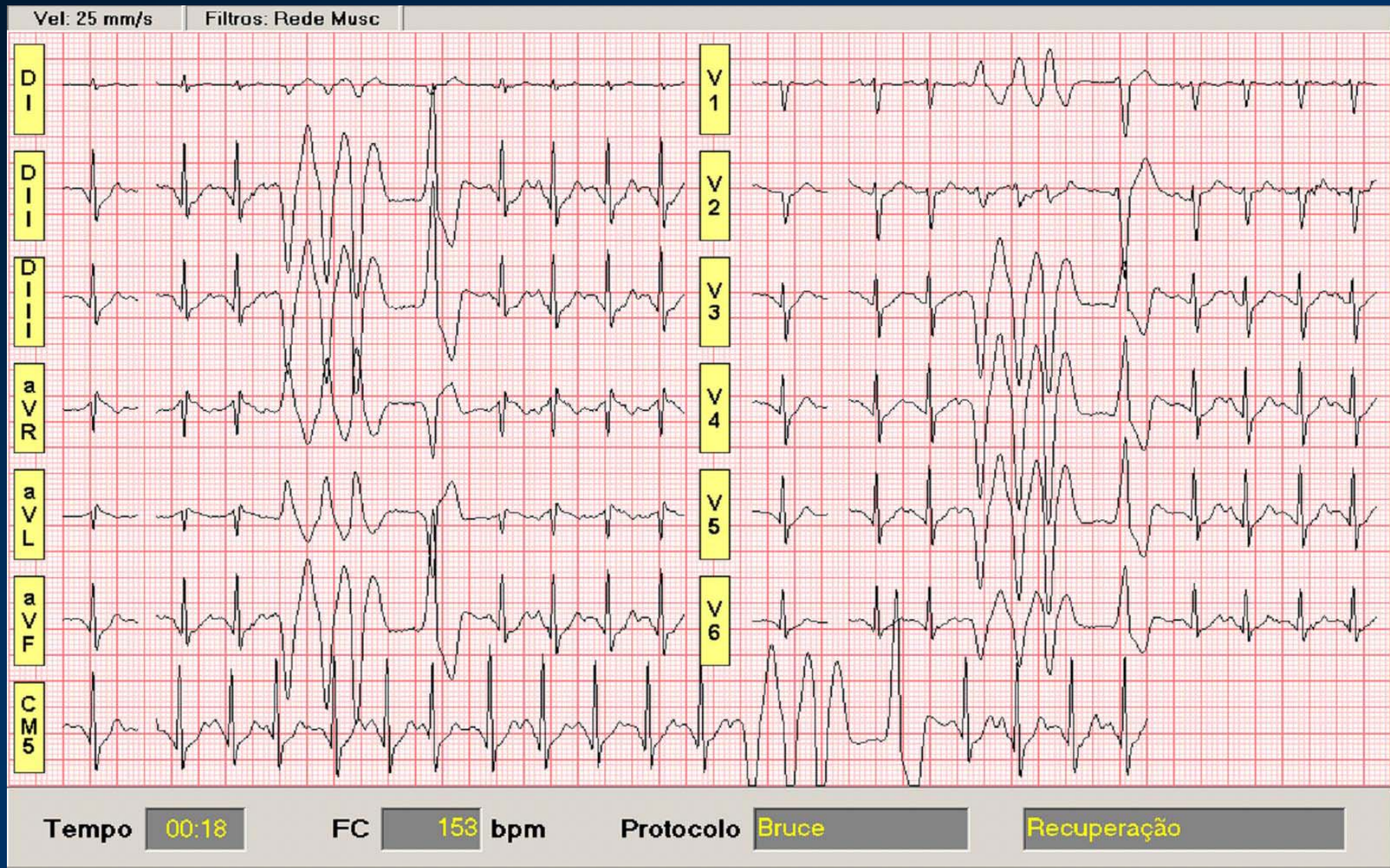
Thallium Spect; Normal After 3 months



TMT After 3 months



TMT After 3 months



RECUPERATION

LN ♂ - 65 Yrs
09/04/2012

And Now ?

1. Conservative , med tx ?
2. CABG (LIMA NOW ??)
3. PCI !!! PATIENT DECISION !!!

(CARDIAC SURGEON in the FAMILY)

(Real Heart team)

BIFURCATION

CHALLENGING DECISION

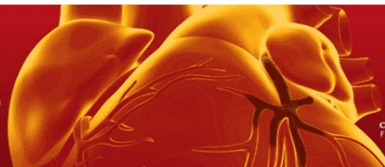
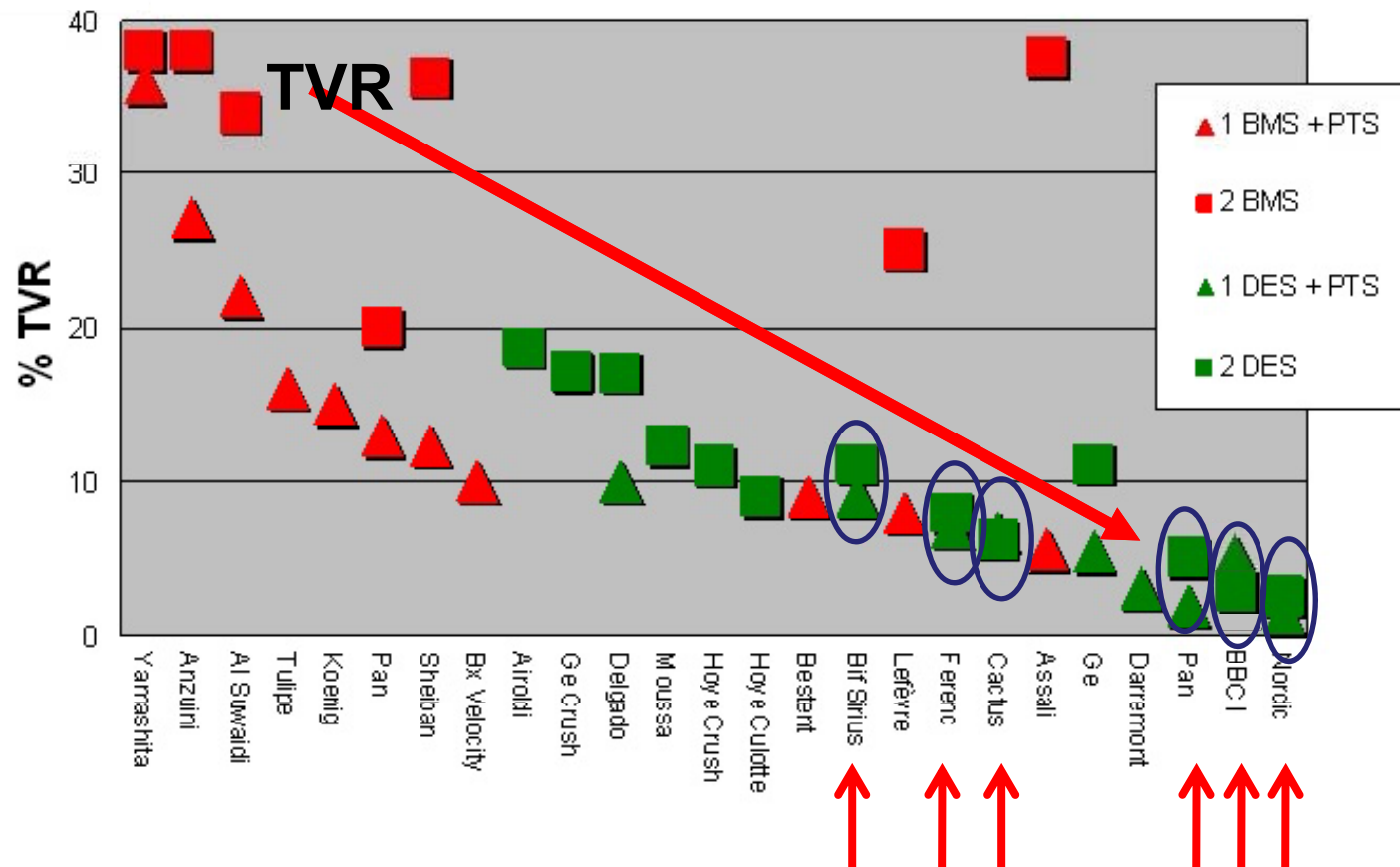
One Stent or Two Stents

(THESE IS THE QUESTION)

Bifurcation Lesions

Remain a challenge to today's interventionalist.

TVR in Bifurcation lesions (BMS vs DES)

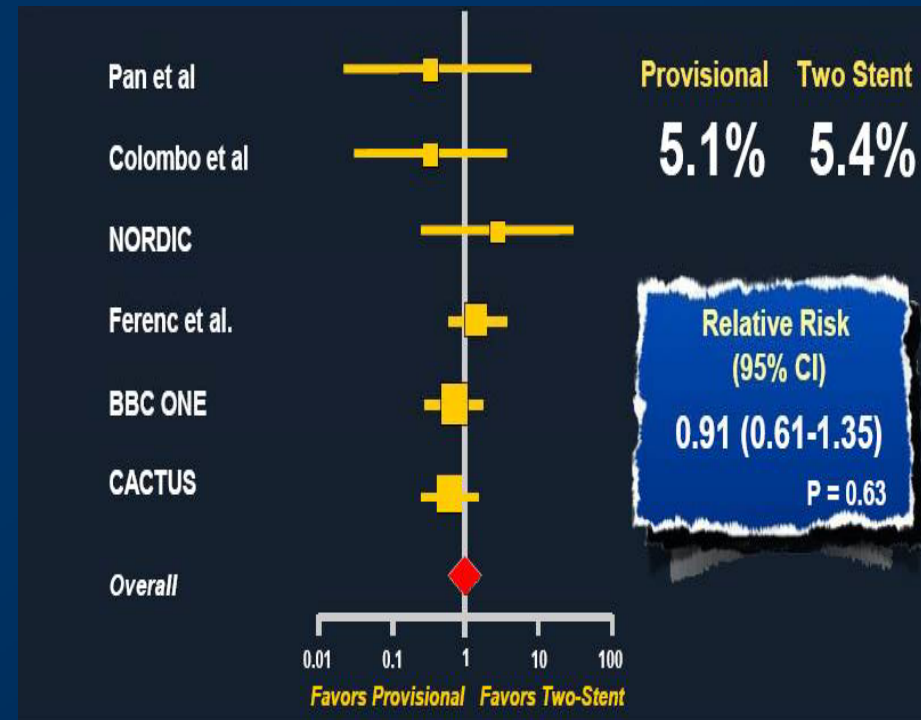
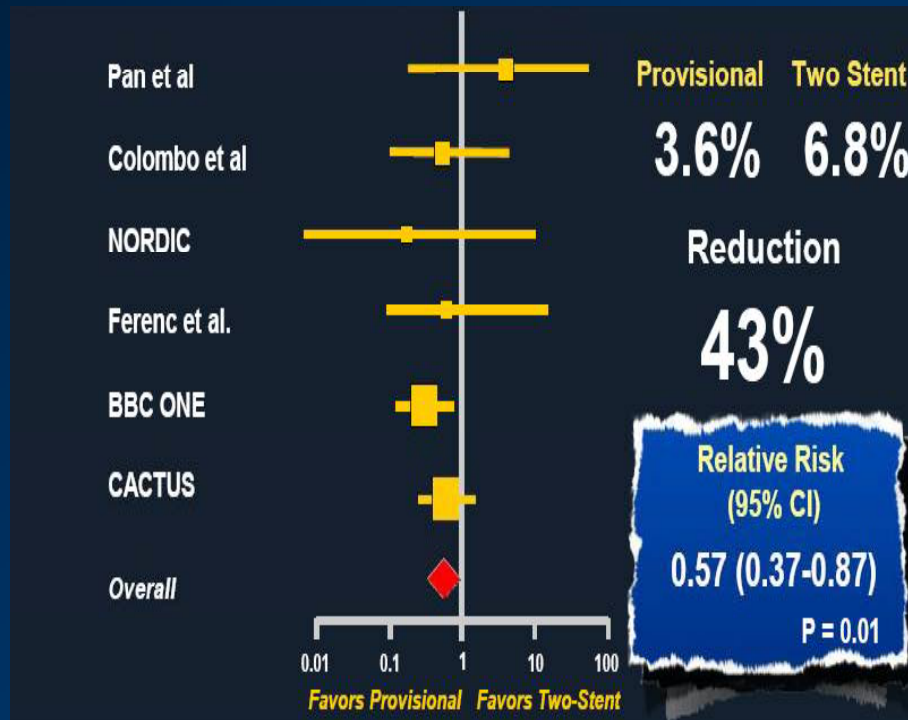


Bifurcation Stenting Meta-Analysis

Provisional vs two Stents Strategies (1641 pts)

MI
Provisional -> Significantly lower

TLR
Clinical outcome -> No difference

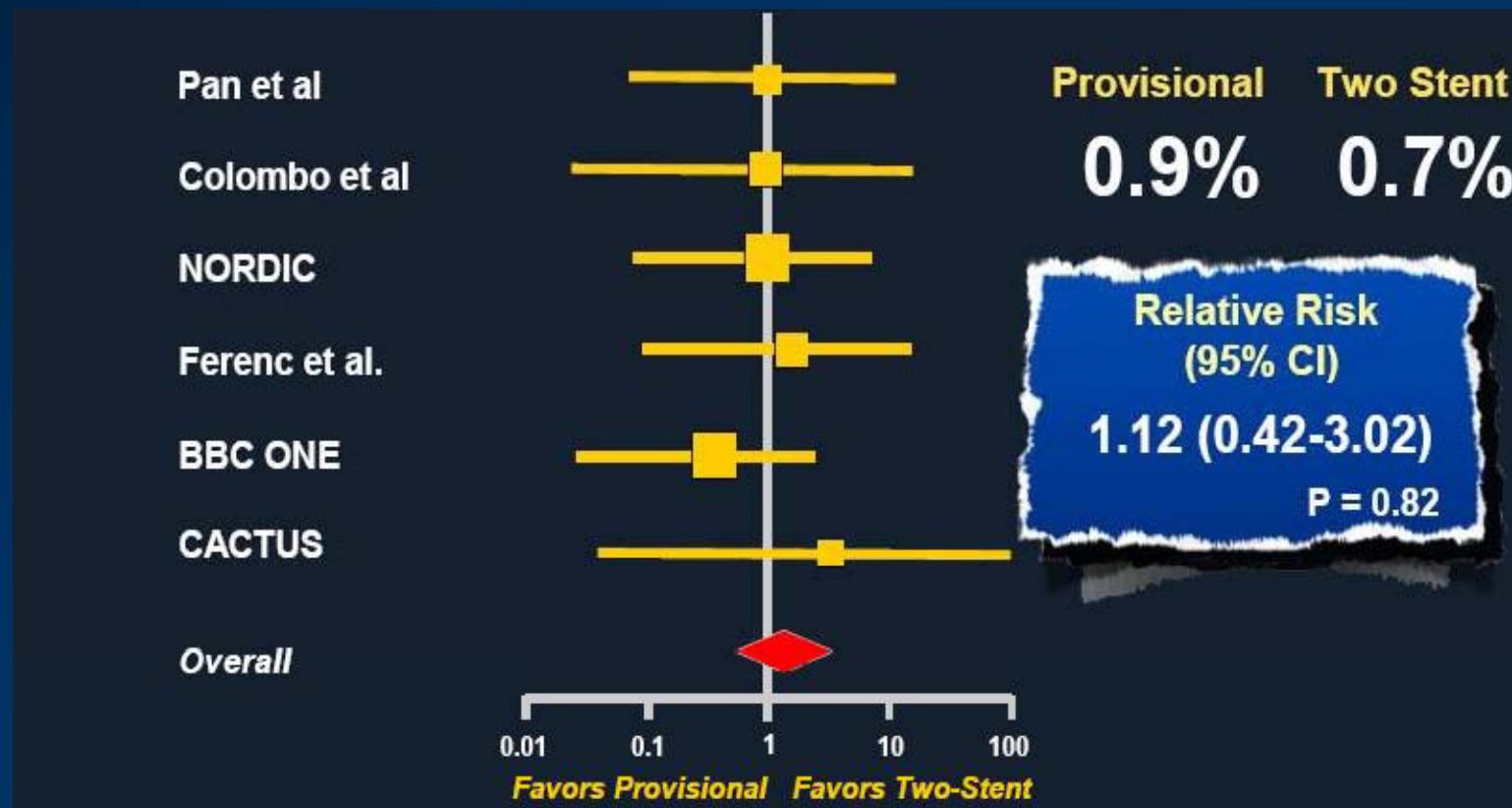


Brar SS et al. Eurointervention 2009;5:475:84.

Bifurcation Stenting Meta-Analysis

Provisional vs two Stents Strategies (1641 pts)

Mortality

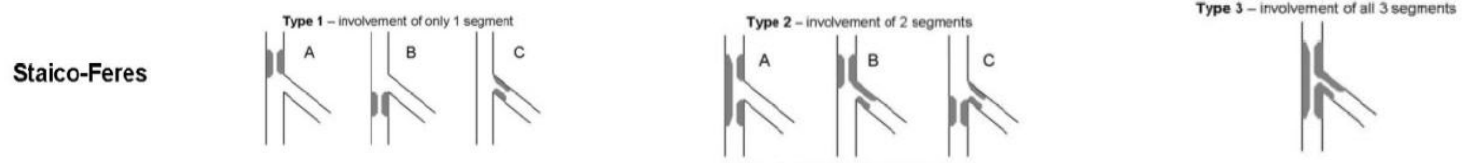
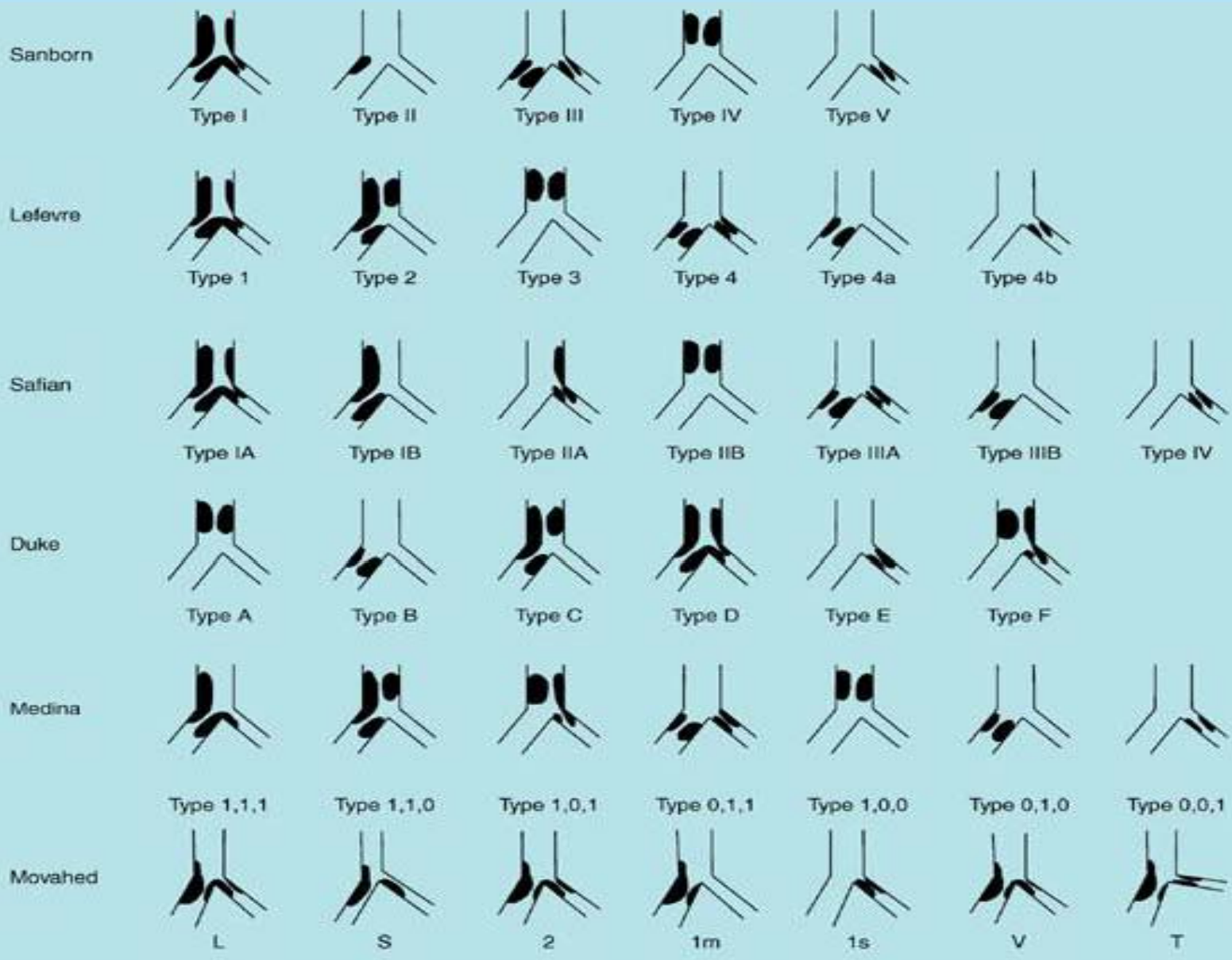


Brar SS et al. Eurointervention 2009;5:475:84.

SIDE BRANCH



IS DIFFERENT PATIENT TO PATIENT



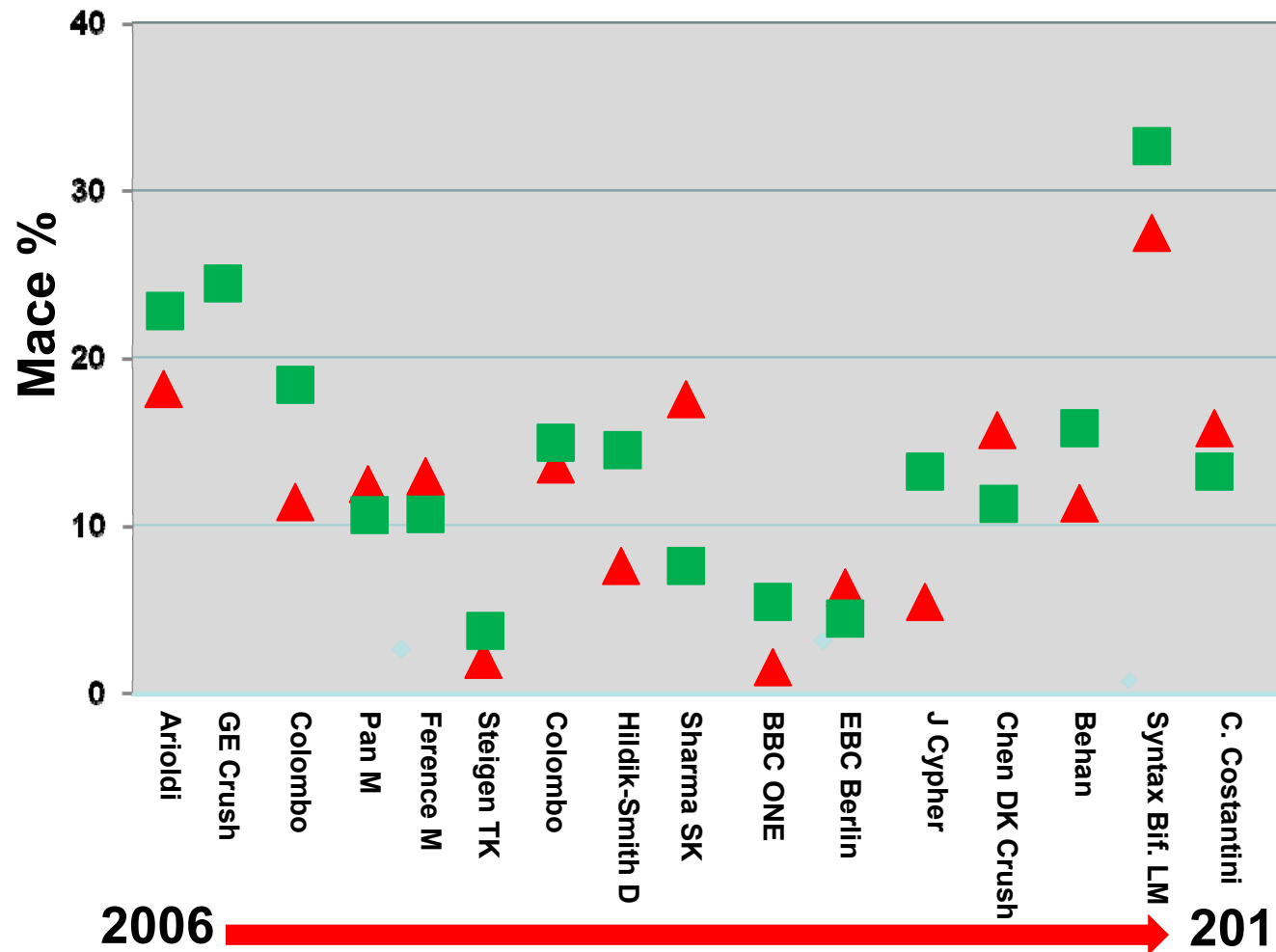
1. Colombo. Randomized study of the crush technique versus provisional side-branch stenting in true coronary bifurcations: the CACTUS Study. *Circulation* 2009;119(1):71-8.
2. Brar. Bifurcation stenting with drug-eluting stents: a systematic review and meta-analysis of randomised trials. *EuroIntervention*. 2009 Sep;5(4):475-84.
3. Zamani. Long-term risk of clinical events from stenting side-branches of coronary bifurcation lesions with drug-eluting and bare-metal stents: An observational meta-analysis. *Catheter Cardiovasc Interv*. 2010 Sep 7.
4. Athappan. True coronary bifurcation lesions: meta-analysis and review of literature. *J Cardiovasc Med (Hagerstown)*. 2010 Feb;11(2):103-10.
5. Hildick-Smith. Randomized Trial of Simple Versus Complex Drug-Eluting Stenting for Bifurcation Lesions: The British Bifurcation Coronary Study: Old, New, and Evolving Strategies. *Circulation* 2010;121:1235-43.
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11. Francesco Burzotta, . Prospective Randomized Comparison of Sirolimus- or Everolimus-Eluting Stent to Treat Bifurcated Lesions by Provisional Approach. . *J Am Coll Cardiol Intv* 2011;4:327–35.

Bifurcation Lesions

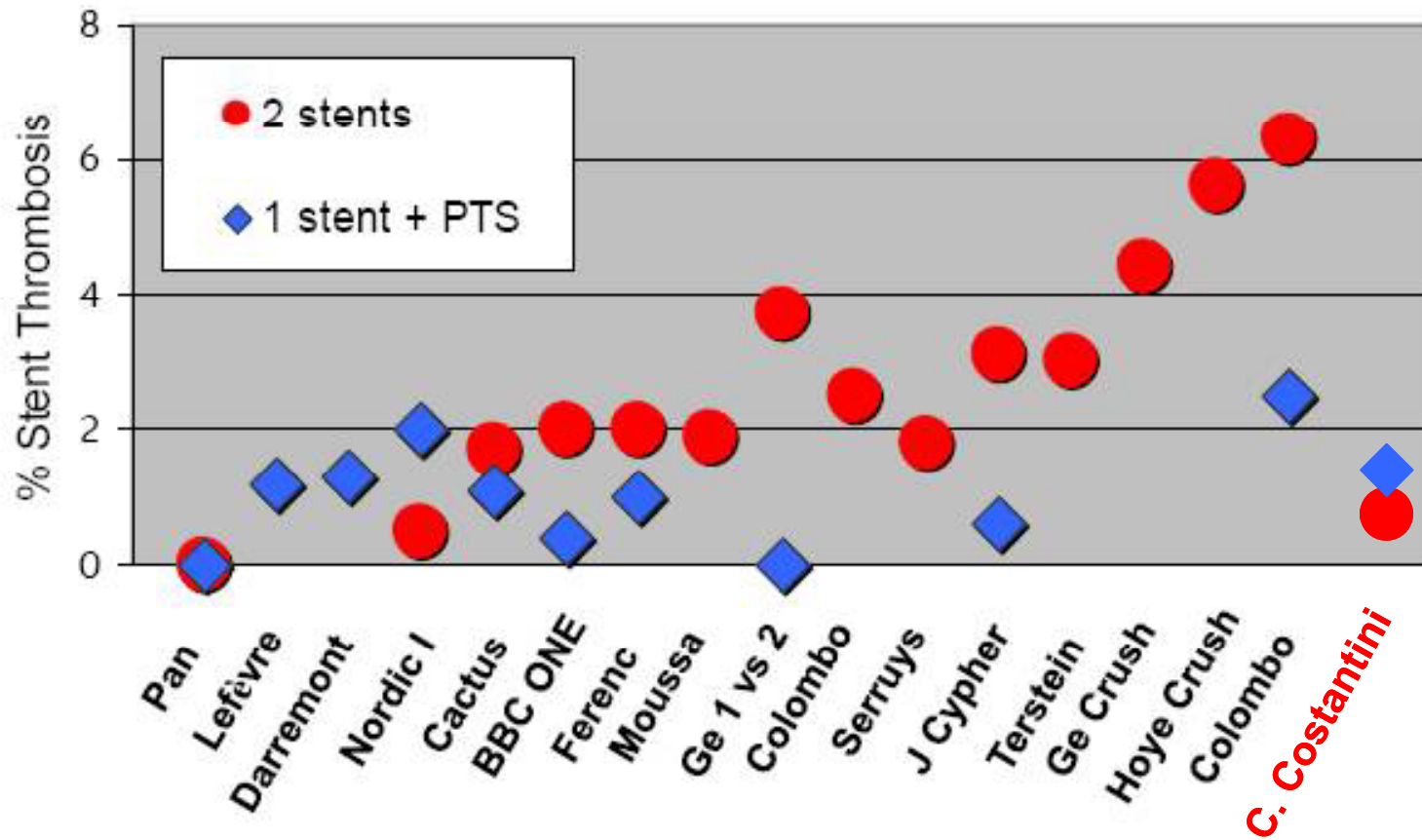
Remain a challenge to current practice.

MACE in Bifurcation Lesion 1S vs 2S

▲ 1 Stent ■ 2 Stents



DES in Bifurcation Lesions

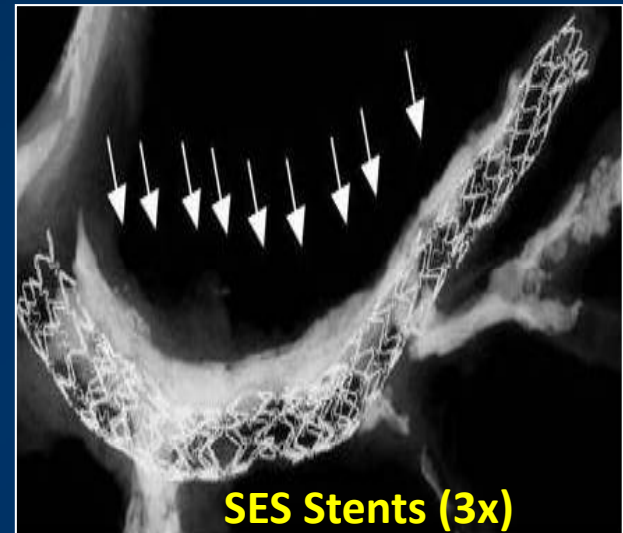
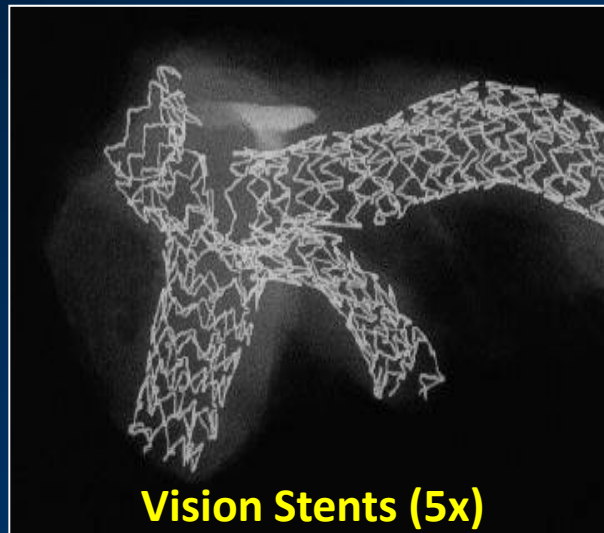
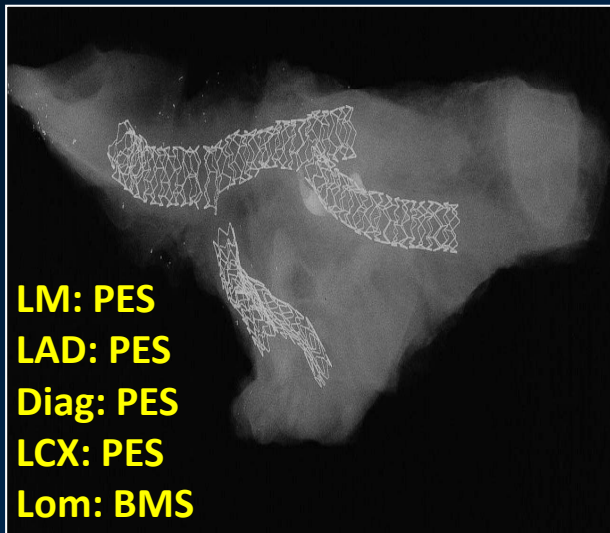


2006



2011

THROMBOSIS DES AFTER CLOPIDOGREL DISCONTINUOS !!!!!!!!!!!!!!!!



Vorpahl M, Virmani R. presented ACC 2010

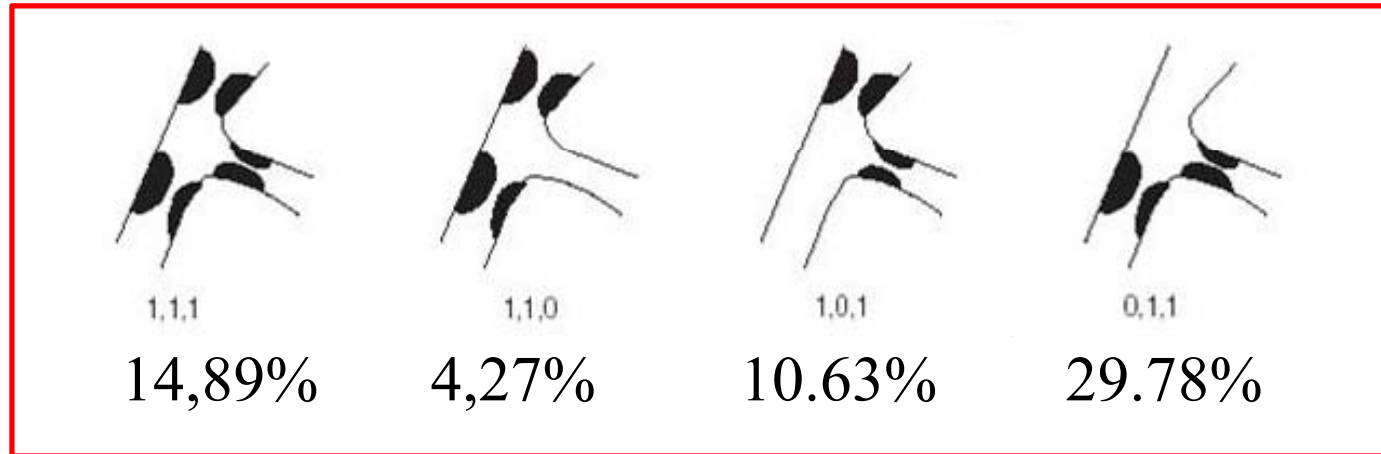
!!!!!! 1995 !!!!!

Who Was Thrombogenic: The Stent or the Doctor?

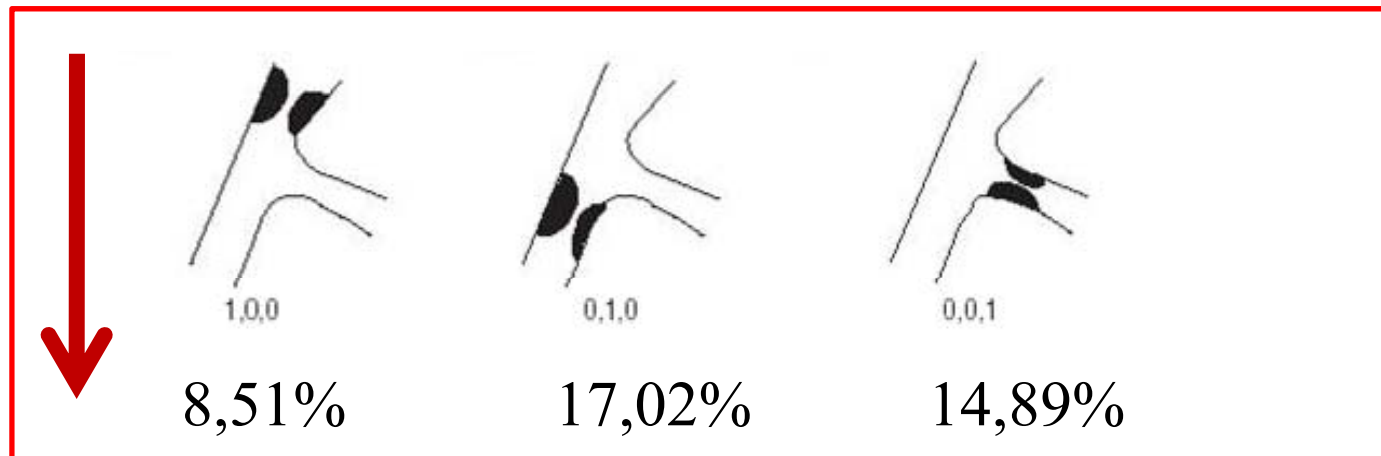
Patrick W. Serruys, MD, PhD; Carlo Di Mario, MD, PhD

Patrick Serruys. Circulation. 1995;91:1891-1893

47 BIFURCAÇÕES TRATADAS FORAM AVALIADAS COM IVUS PRE IMPLANTE EM AMBOS OS RAMOS



IVUS	↑ 34,04%	↑ 6,38%	10,63%	25,53%
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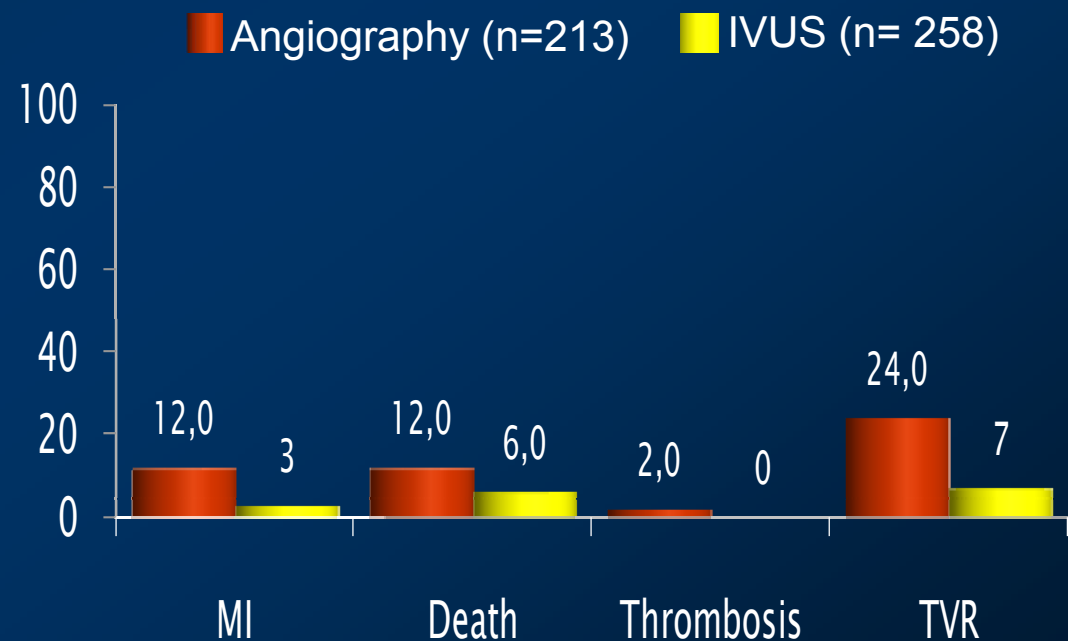
IVUS	4,27%	12,76%	6,38%
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Long-Term Outcomes With Use of Intravascular Ultrasound for the Treatment of Coronary Bifurcation Lesions

Yogesh Patel, MD, Jeremiah P. Depta, MD, Eric Novak, MS, Michael Yeung, MD, Kory Lavine, MD, PhD, Sudeshna Banerjee, MD, C. Huie Lin, MD, PhD, Alan Zajarias, MD, Howard I. Kurz, MD, John M. Lasala, MD, PhD, Richard G. Bach, MD, and Jasvinder Singh, MD*

Follow Up @ 2.5 ± 2 yrs

In conclusion, IVUS-guided treatment of complex bifurcation lesions was associated with significantly lower rates of adverse cardiac events at late follow-up. Further study is warranted to evaluate the role of IVUS guidance in improving long-term outcomes after PCI of bifurcation lesions.

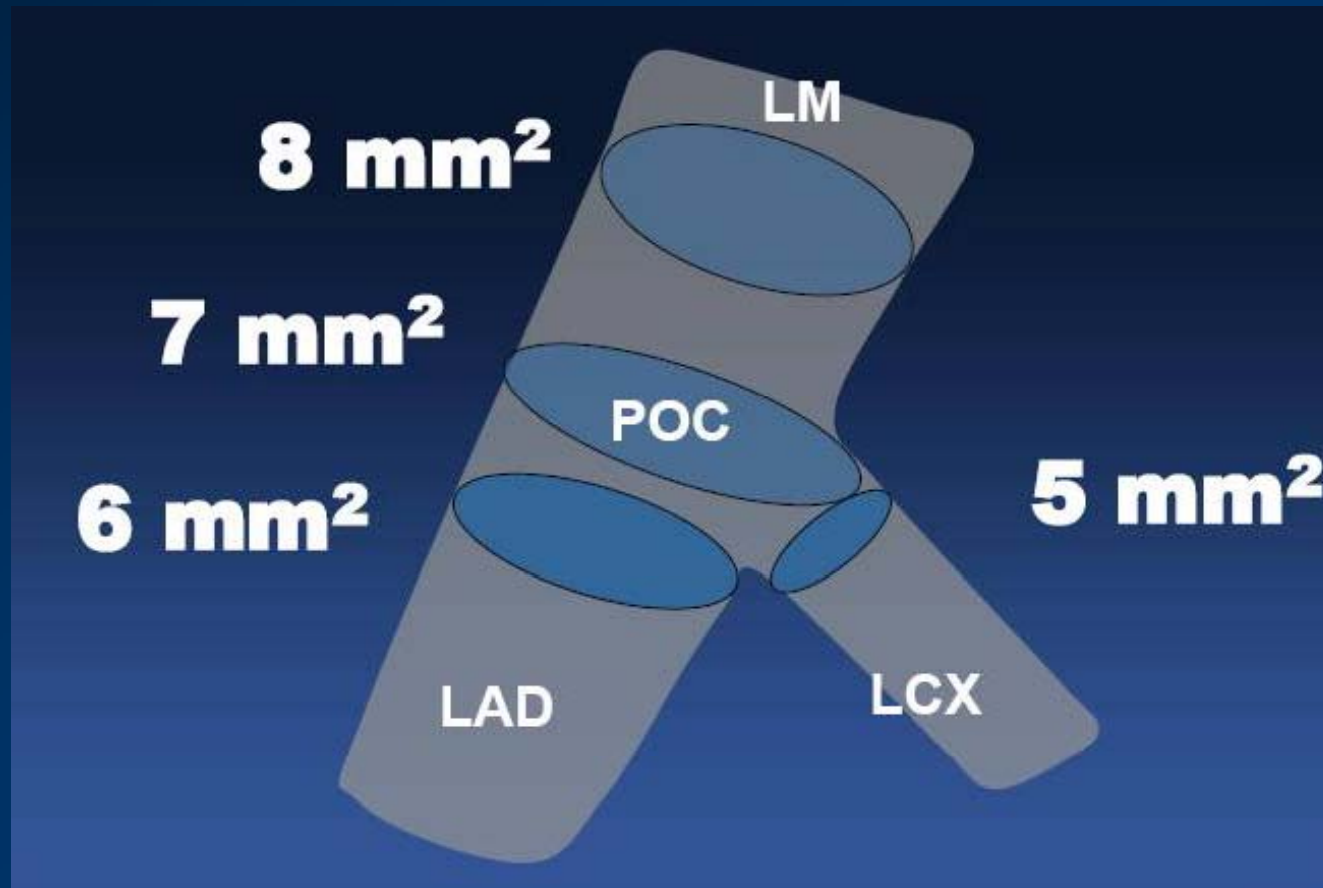


Am J Cardiol 2012;109:960 –965

Non-LM bifurcation studies in 2011

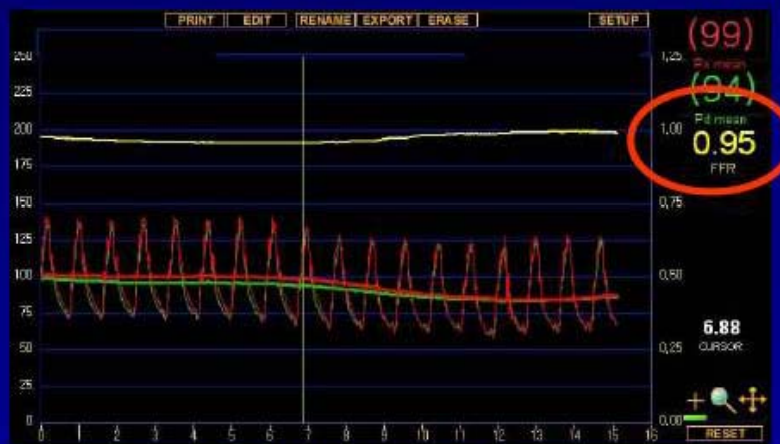
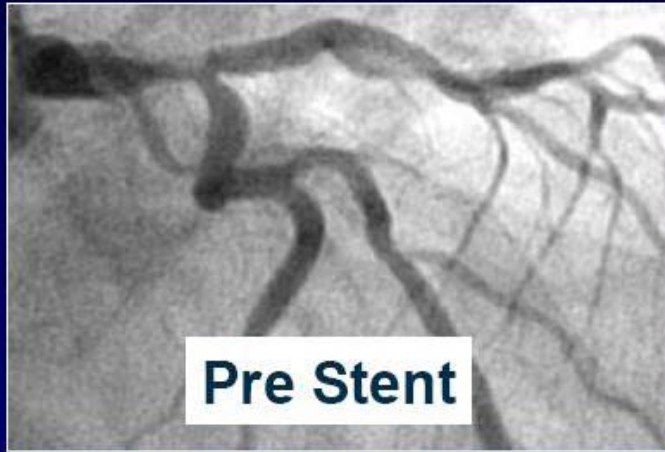
	MI (%)	Death (%)	TVR (%)	Mace (%)	IVUS (%)	FU months
HCC 2011						
1 Stent (n=242)	1,2	6,2	7,4	17	92	48 mo
2 Stents (n=542)	1,4	3,3	11,8	16,6		
S.L Chen 2011						
DK Group (n=185)	3,2	1,1	6,5	10,3	45,9	12 mo
PS Group (n=185)	2,2	1,1	14,6	17,3	47,6	
Behan 2011						
Simple (n=457)	4,8	1,0	5,3	10,1	0	9 mo
Complex (n=456)	12,3	1,0	4,4	17,3		
Burzota 2011						
SES (n=75)	2,0	2,7	4,0	9,3	0	12 mo
EES (n=75)	4,0	1,3	5,3	10,7	0	
Pan 2011						
No Kissing Final (n=116)	1,0	2,0	2,0	6,0	65	12 mo
Kissing Final (n=118)	1,0	2,0	4,0	9,0	64	
Niemelä 2011						
No FKBD (n=239)	1,3	0	3,8	2,9	0	6 mo
FKBD (n=238)	0,4	0,8	3,0	2,9		

IVUS Stent Optimization (Stent Cross-sectional Area)



Kang, Park et al. Circulation. Cardiovascular Interventions. 2011 Dec 1;4(6):562-9.

FFR of "jailed" Circumflex



Courtesy of Chang-Wook Nam, MD

Stanford

*FAME Results 1 Year

FAME Vs. HCC ** Taxus Experience

	*ANGIO-group N=496	*FFR-group N=509	** HCC TAXUS N= 643
<i>Events at 1 year, No (%)</i>			IVUS 91%
MACE	(18.3)	(13.2)	(5.3)
MI	(8.7)	(5.7)	(0.2)
Death	(3.0)	(1.8)	(1.3)
repeat PCI	(9.5)	(6.5)	(3.5)

Real World
Mult Vessel = 66 %
Single Vessel = 34%

*FAME study: Adverse Events at 1 year ; NEJM 2009;360:213-24

** HCC TAXUS: Adverse Events at 1 year

Fractional Flow Reserve

Methodology What has changed ???

0.75 ----- 0.80

1995 to 2011

Protocol for IC adenosine or ATP administration recommends doses of 15–20 μg in the right coronary artery (RCA) and 18–24 μg in the left coronary artery (LCA)

Pijls NHJ, N Engl J Med 1996;334:1703–8.

ADENOSINE: 24 μg Left Coronary artery, 18 μg Right Coronary artery

Costantino Costantini; SOLACI 1998

(140 g/kg/min) or intracoronary (15 μg in RCA or 20 μg in the left coronary artery).

DEFER Study // Circulation 2001, 103:2928-2934

After complete hyperemia has been achieved with intravenous adenosine,
administered at 140 $\mu\text{g}/(\text{kgd min})$ via a central vein.

FAME Study // Am Heart J 2007;154:632-6

FFR Vs QCA Vs IVUS

Costantini Hospital

During almost 15 years we were using IVUS to guide PCI

According, Abizaid and Col. (*Circulation* 1999, 100:256-261)
the reference was 4.0 mm²

But.....

Today no one know which is the REAL AREA !!!

WHAT HAVE CHANGED ??? IVUS ??? ADENOSINE ??? FFR ??? DOPPLER ???

Therefore

We are conducting a local PILOT study in CURITIBA BRAZIL to know the appropriate IVUS cut-off, in relation to QCA – FFR and ischemia provocative testing.

And preliminary data are confused

Summary of Bifurcation CAD

PERSONAL POINT of VIEW

- ❖ Complexity of Bifurcations depends on several factors, some of them not visualized by angiography
- ❖ In true bifurcations with large side branches 2 stents technique will give the best results.
- ❖ The best stent technique (T, V, Culotte, Crushing, Mini Crushing, TAP ...) is the one that the operator has the greatest expertise. However kissing balloon should always be performed at the end
- ❖ IVUS assessment should be performed before and after bifurcation intervention.

Bifurcation is....TIME !!!!!!!

T echnique

I mage

M aterial

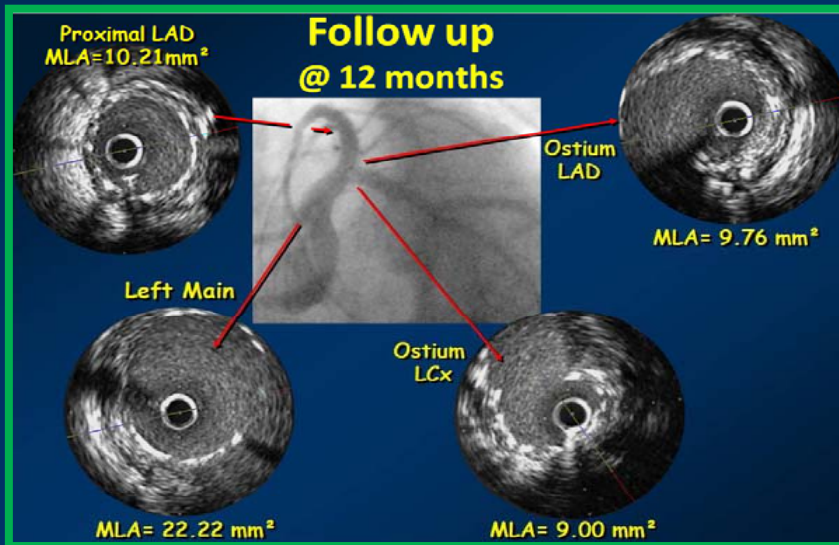
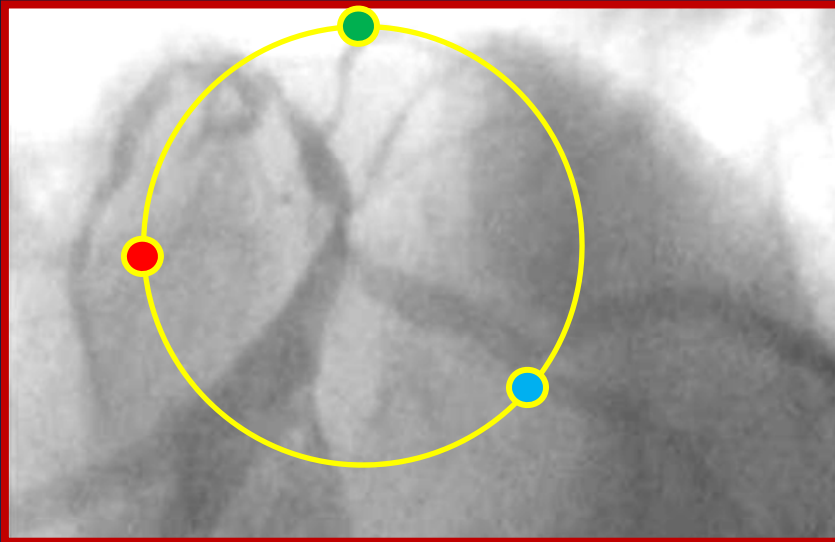
E xperience

and.... PACIENCE

Costantino Costantini

Stent Bifurcation Today.....

PERSONAL POINT of VIEW



- Experience
- Technology
 - ✓ IVUS
 - ✓ Stent Boost
 - ✓ OCT
 - ✓ FFR
- Judgment
- Honesty