IVUS-guided PCI improves patient outcome: The data is clear!

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Disclosure Statement of Financial Interest

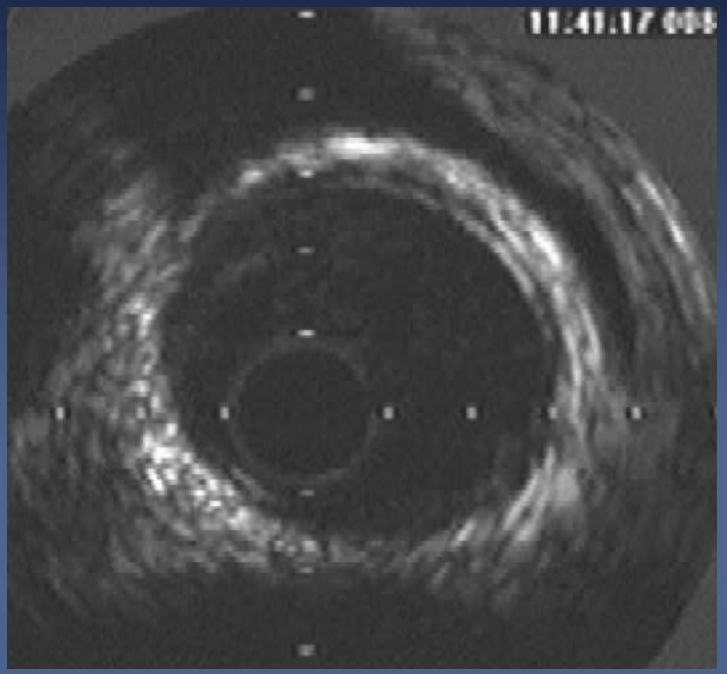
Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship	Company
• Grant/Research Support	Volcano, InfraRedx, BSC
• Consulting Fees/Honoraria	Volcano
• Major Stock Shareholder/Equity	Technology Solutions Group
• Royalty Income	None
• Ownership/Founder	Technology Solutions Group, BioInfo Accelerator Fund
• Intellectual Property Rights	None
• Other Financial Benefit	None

“Evidence”

- Experience
  - Left main evaluation
  - Calcium
  - Real time guidance
- Trial data
  - BMS
  - DES

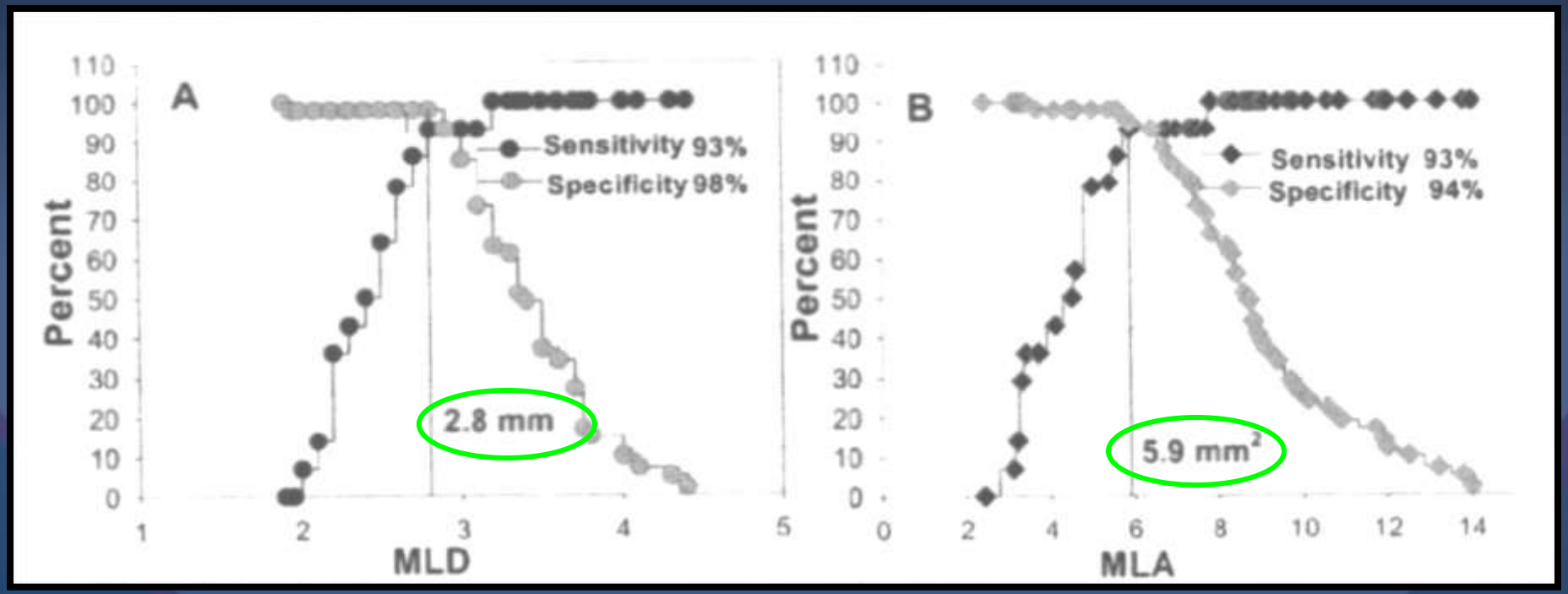
Patient with atypical chest pain referred for CABG: Despite angio appearance, IVUS is normal!



Never assume left main lesion significance by angio only!

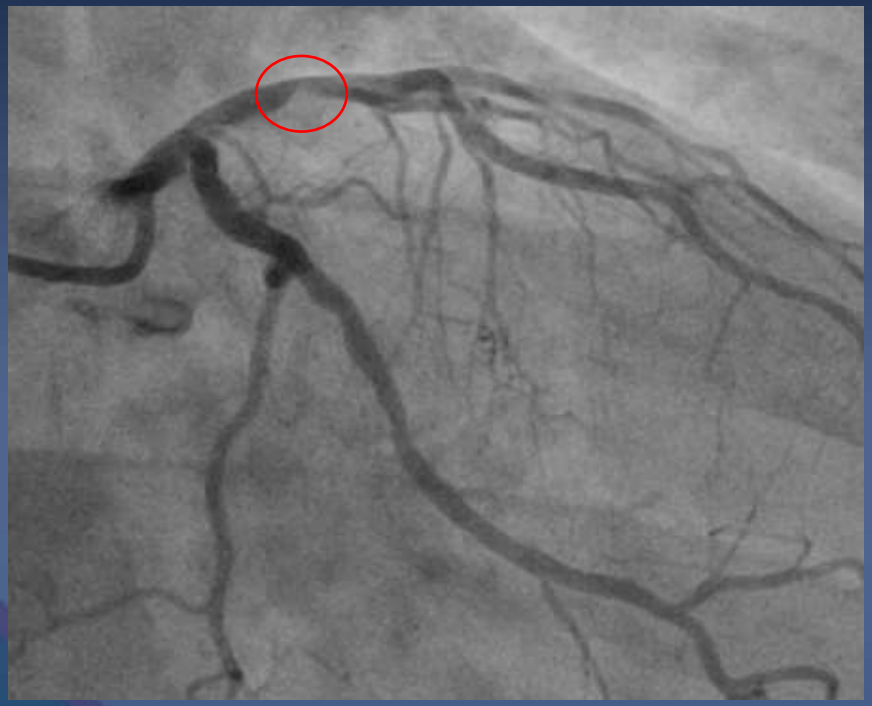
Assessing intermediate left main lesions

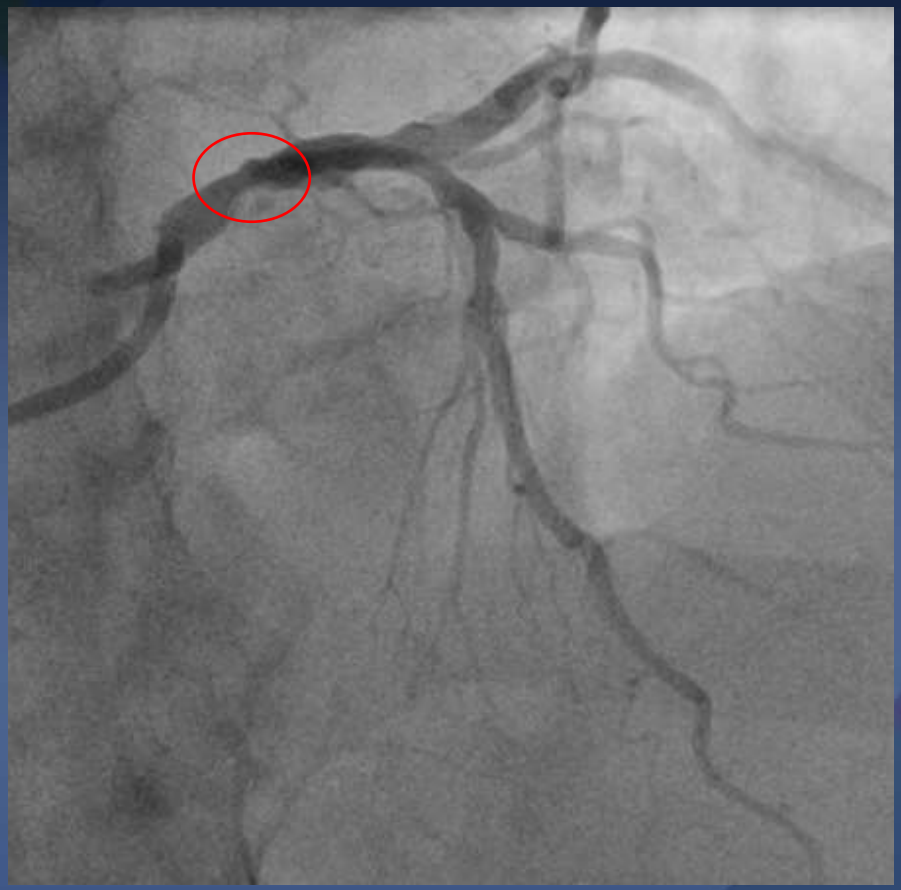
55 patients with ambiguous left main lesion by angiography: IVUS and FFR performed; FFR < 0.75 considered significant



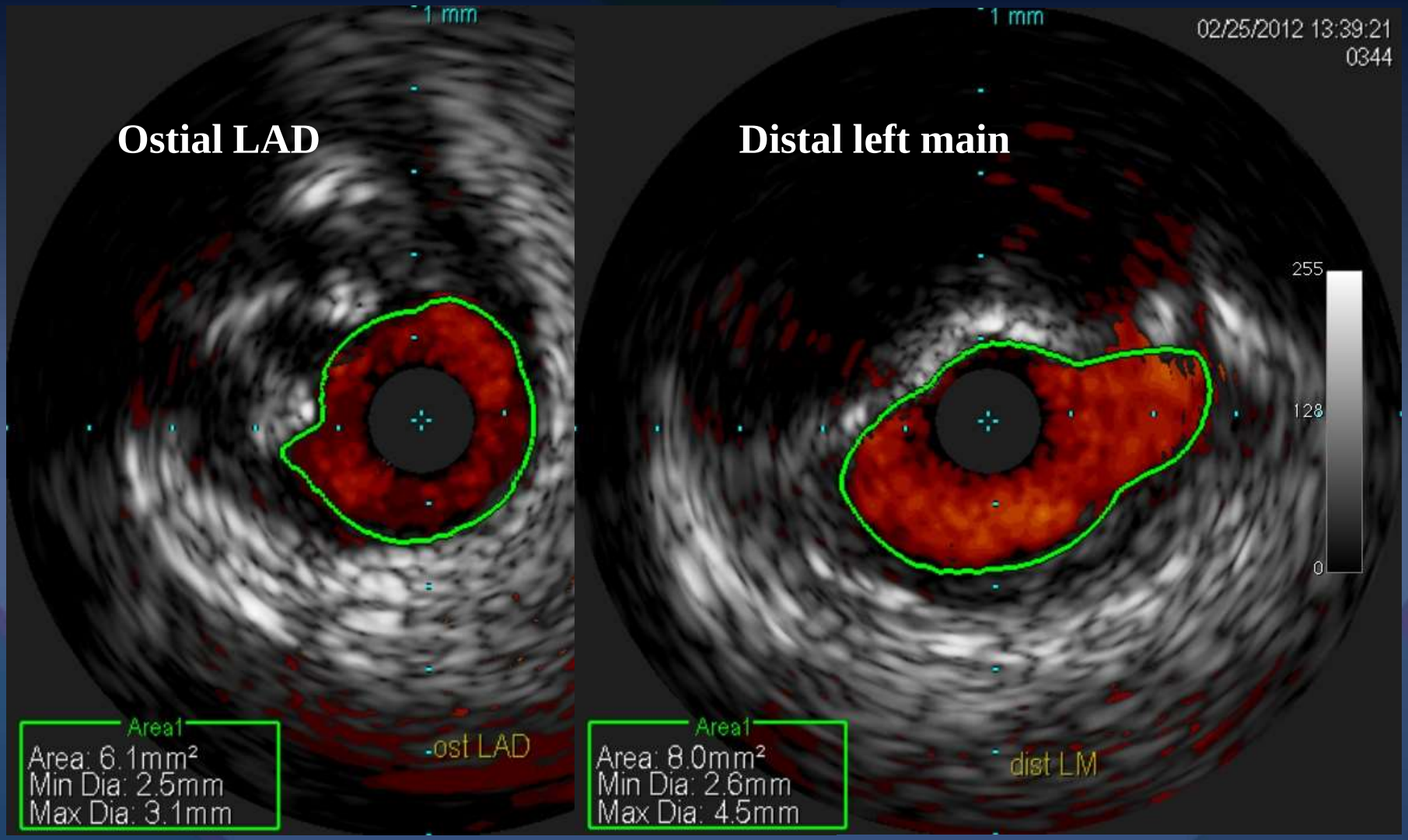
Jasti, *Circulation* 2004;110:2831

Questionable left main and ostial LAD lesions

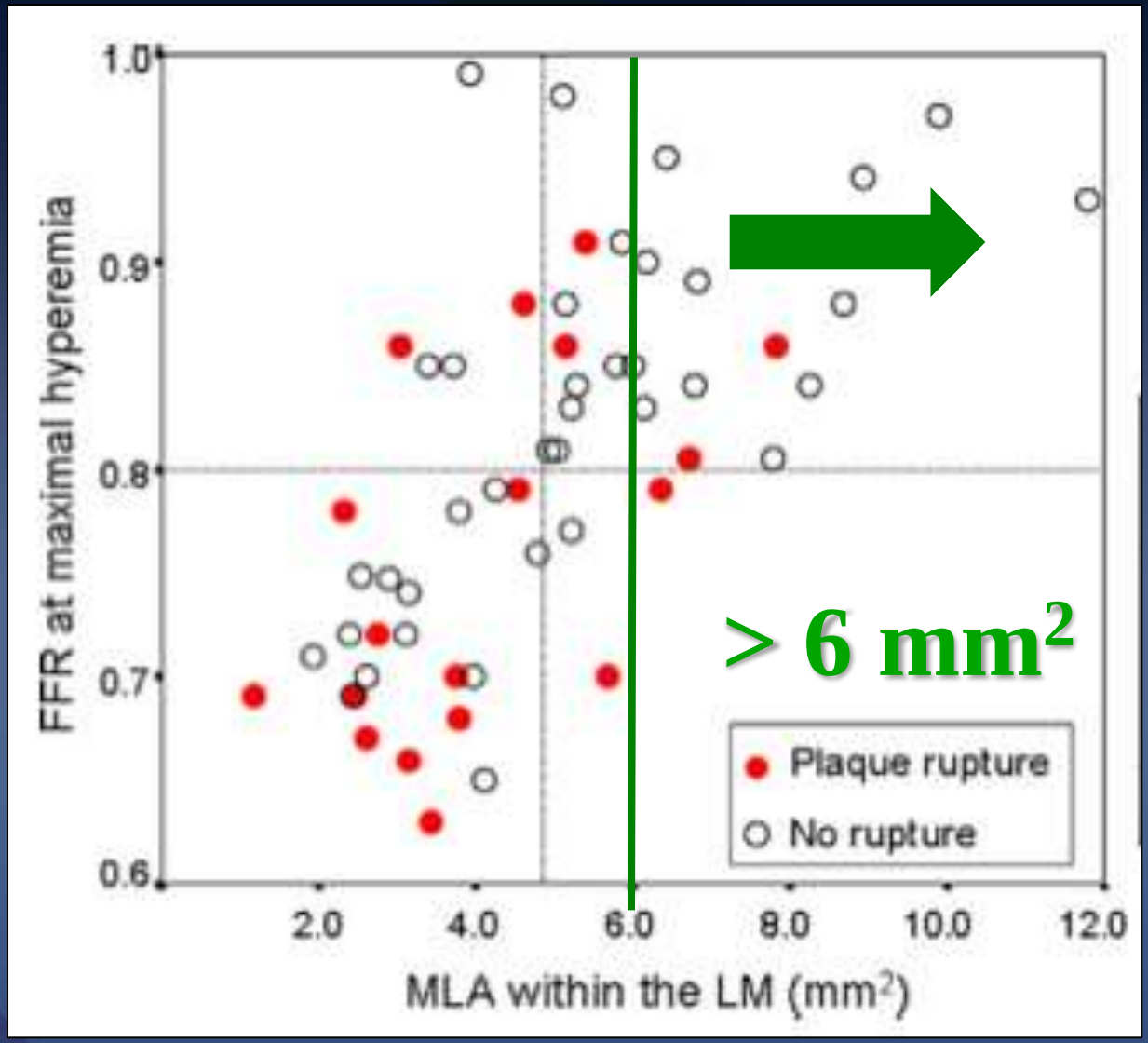




IVUS: adequate MLA in both LAD and left main



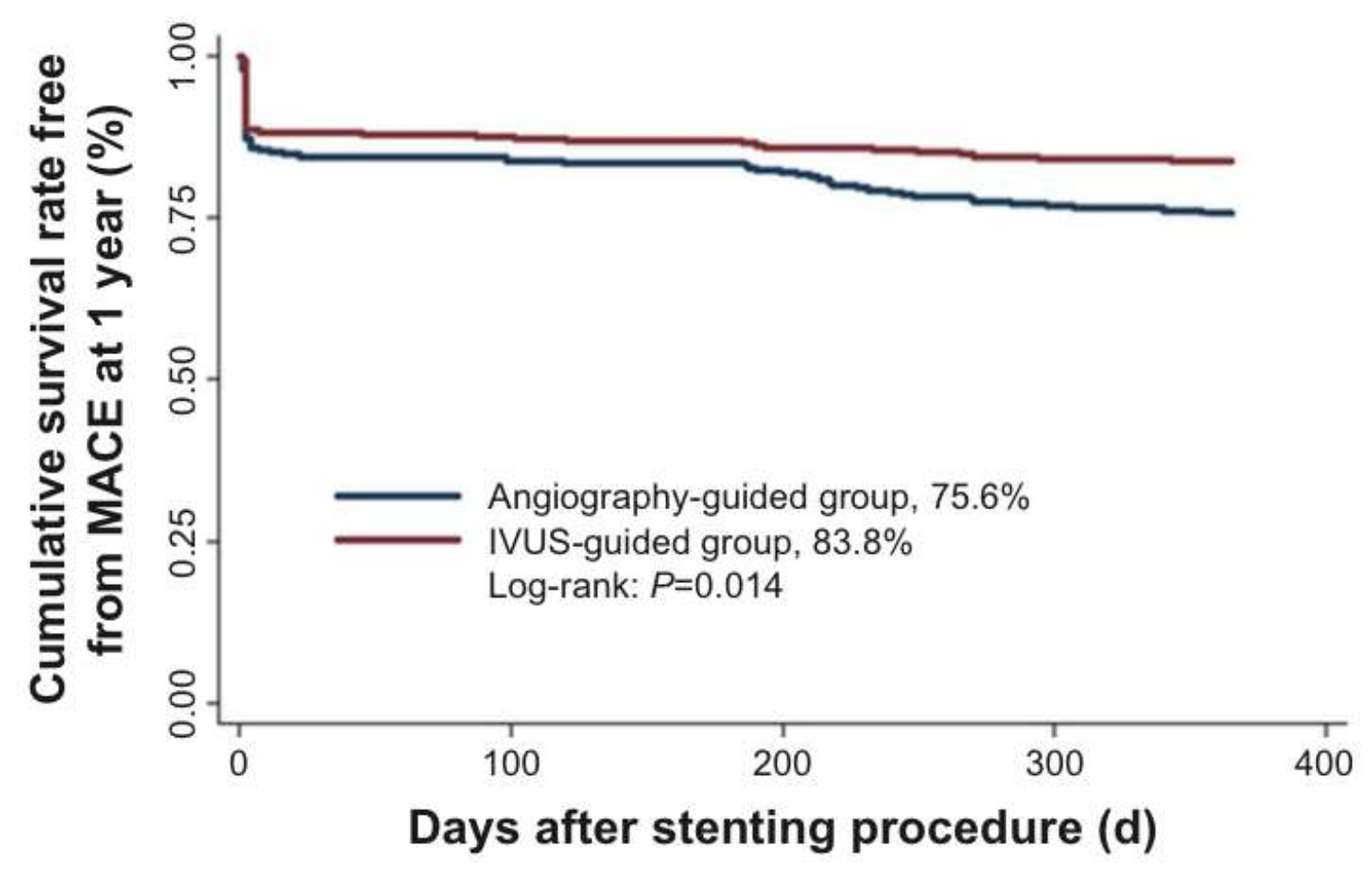
IVUS: Who does NOT need intervention?



J Am Coll Cardiol Intv 2011;4:1168 –74

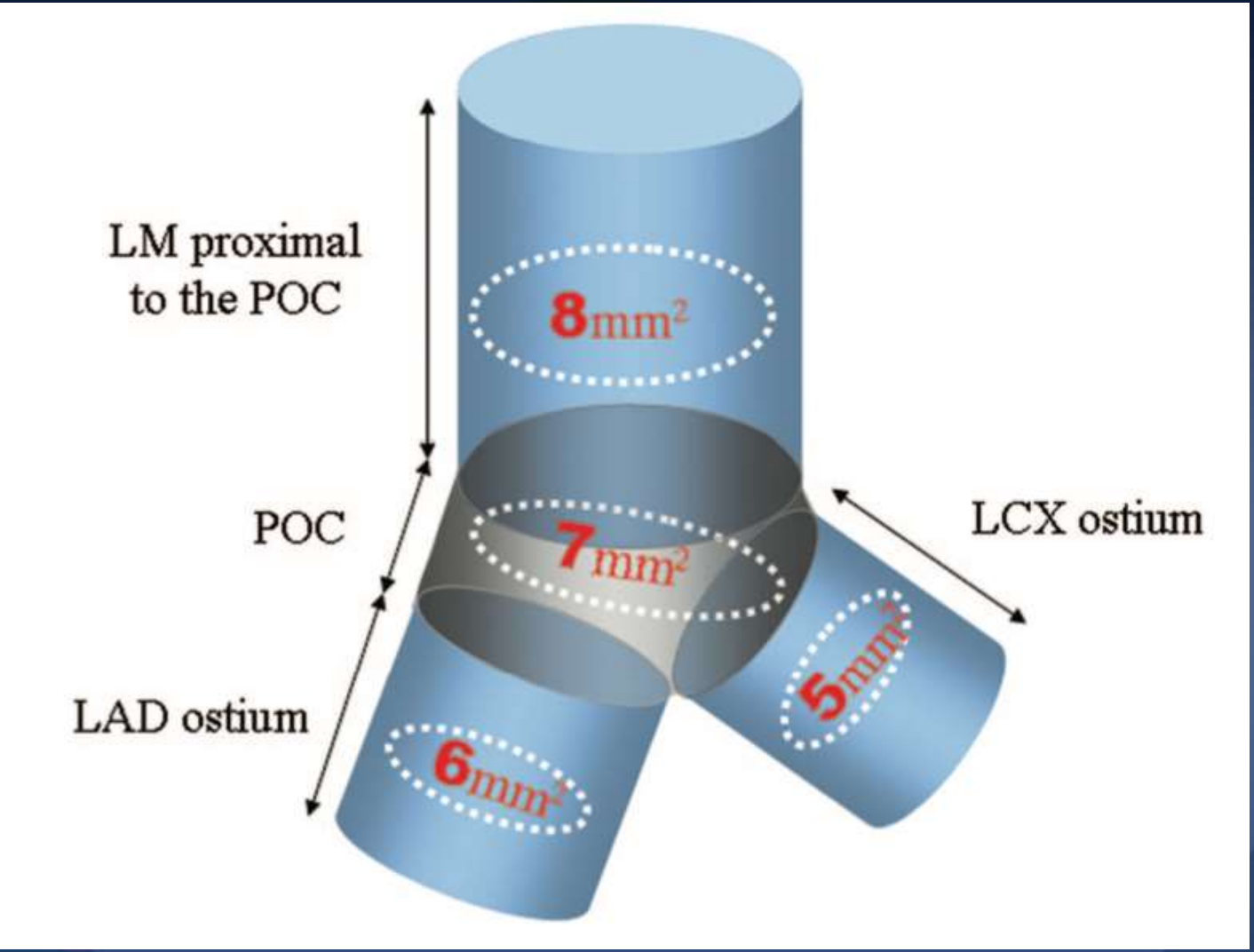
Left Main Stenting with IVUS

Center analysis; propensity matched cohort; n= 291 pairs



Gao. Patient Preference and Adherence 2014:8; 1299-1309

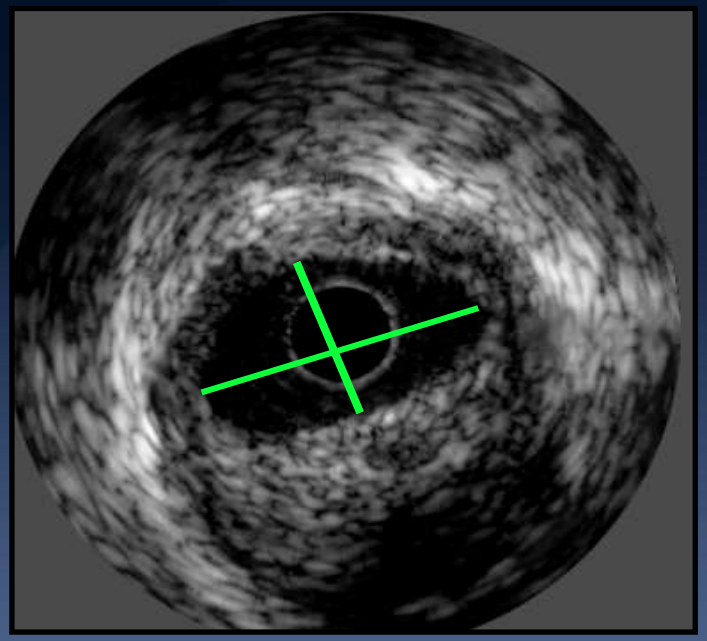
LM: IVUS-based MSA for best outcome



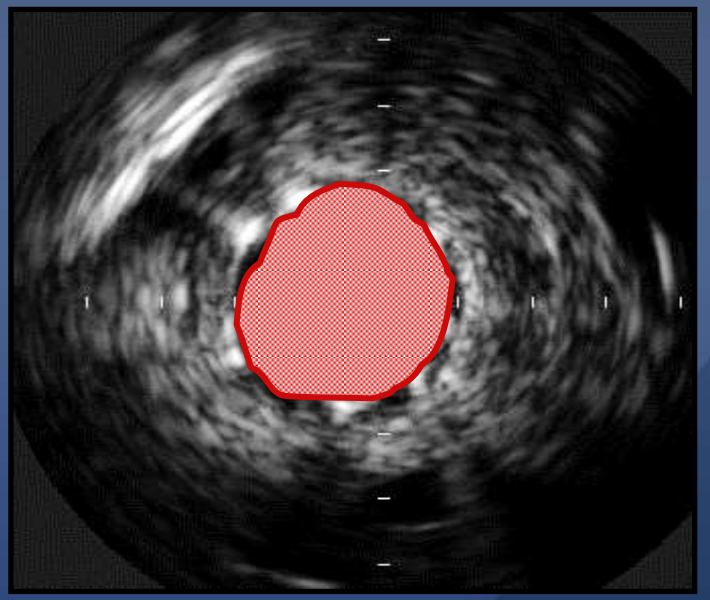
Circ Cardiovasc Interv. 2011;4:562-569

Stent Guidance

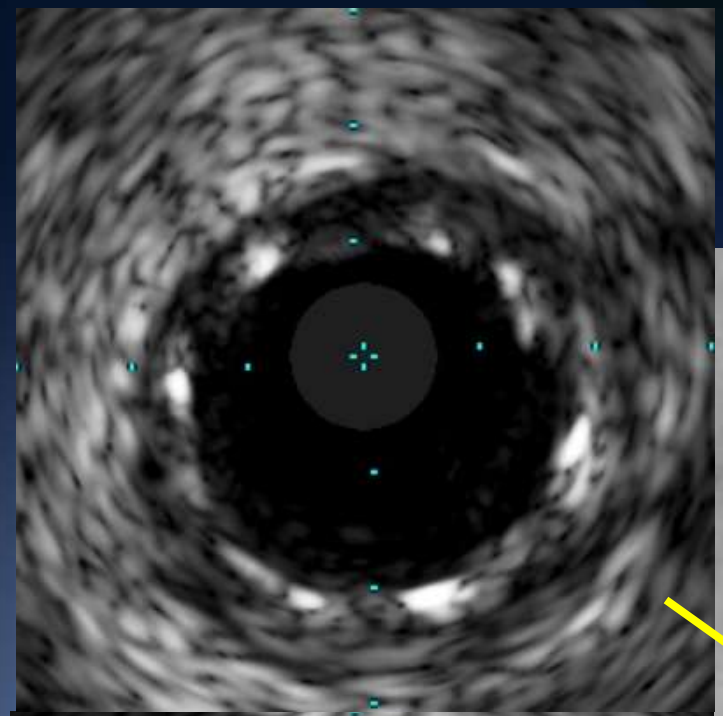
Stent size selection:
Reference lumen diameter
(package size)

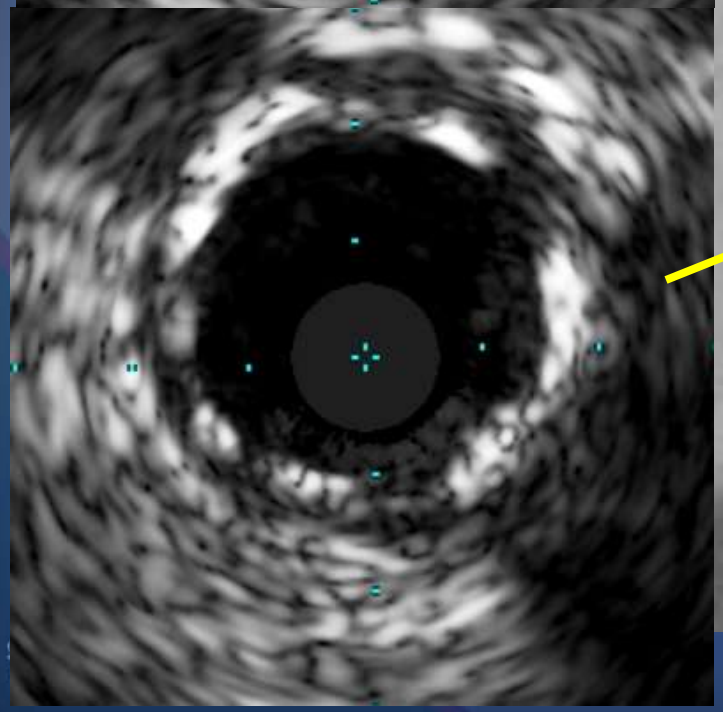


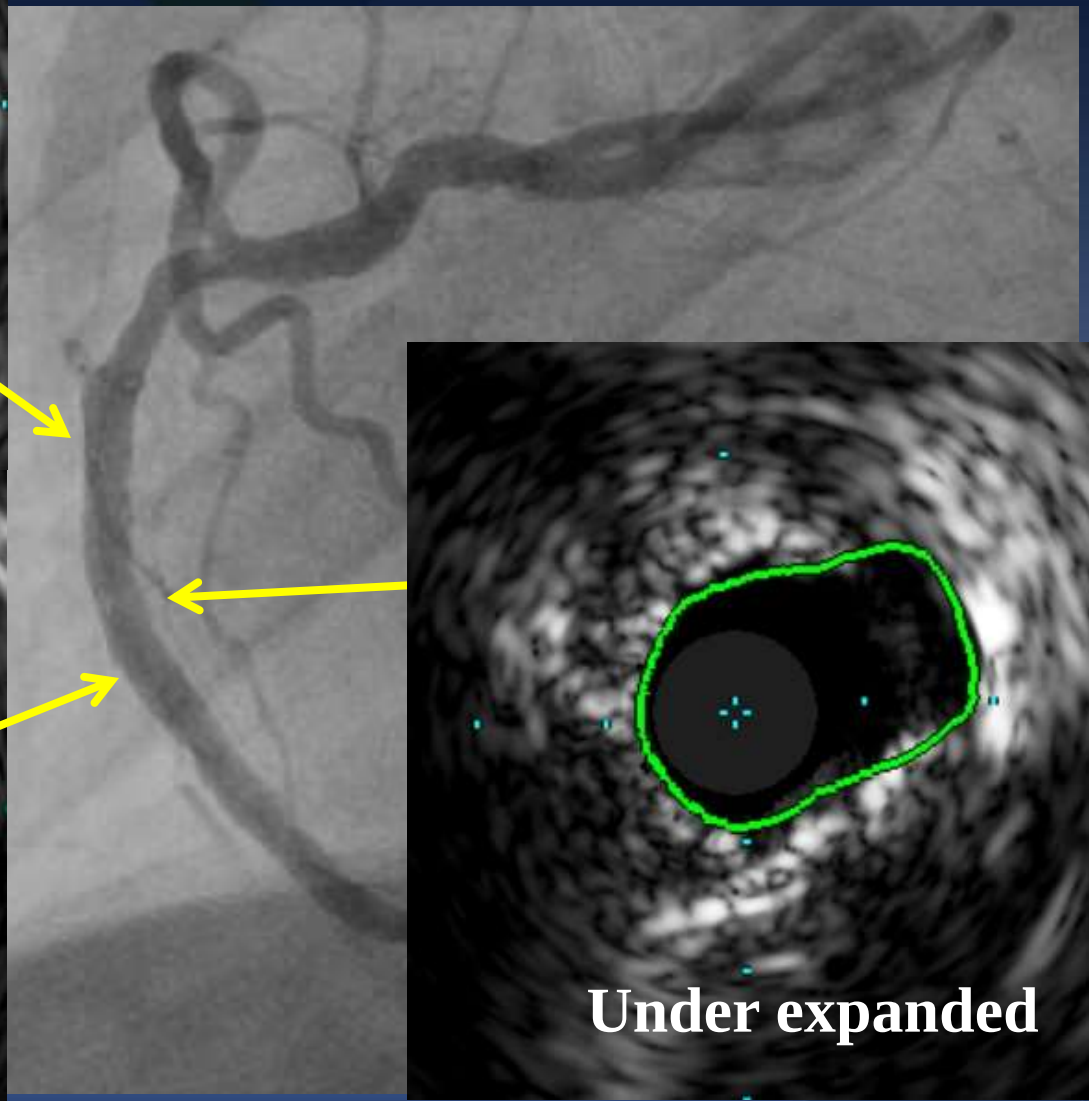
Result optimization:
Stent lumen
cross sectional area
> 80% of reference
(Bernoulli)



Post 3.0 mm stent @ 22 atm

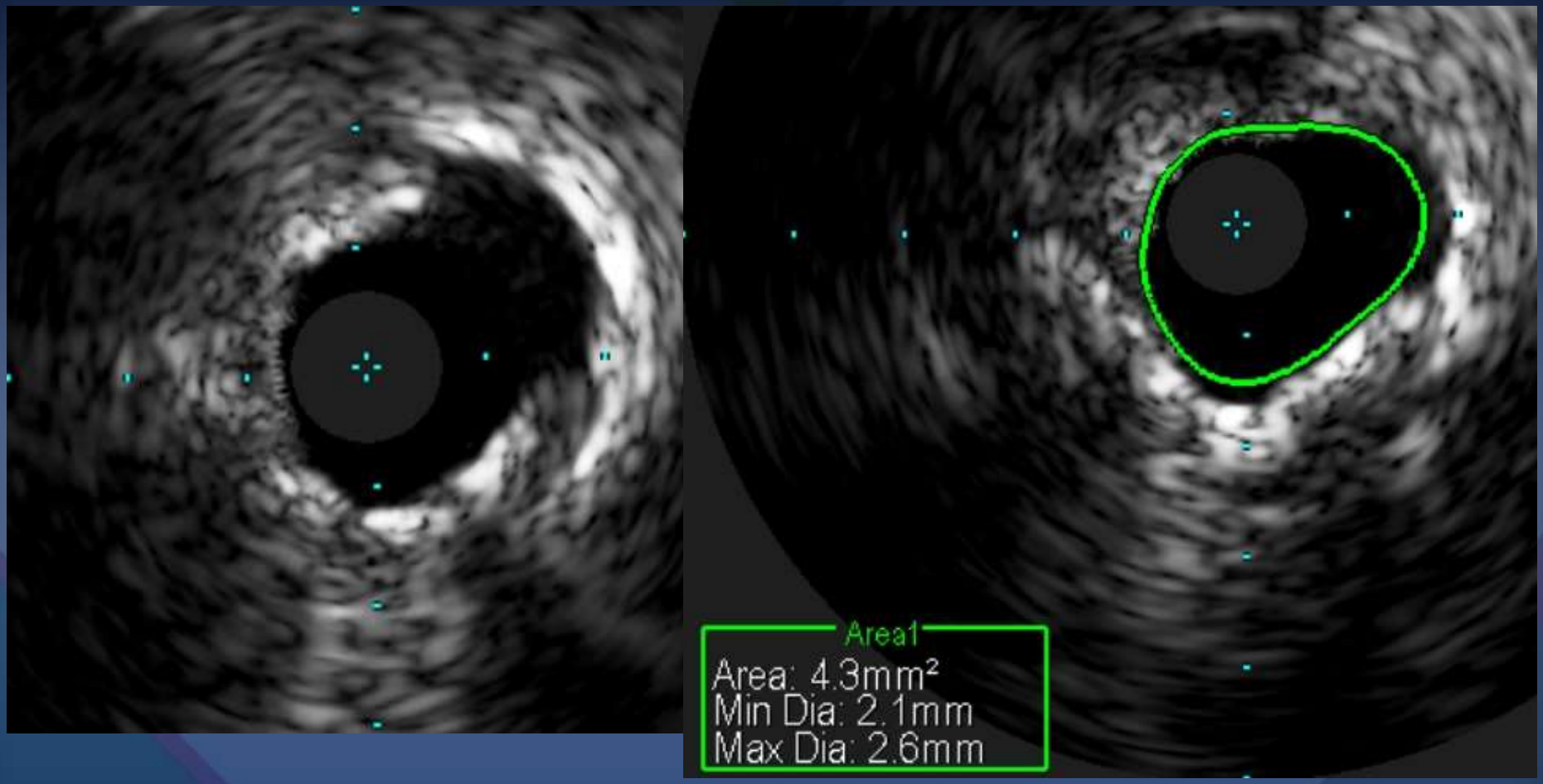


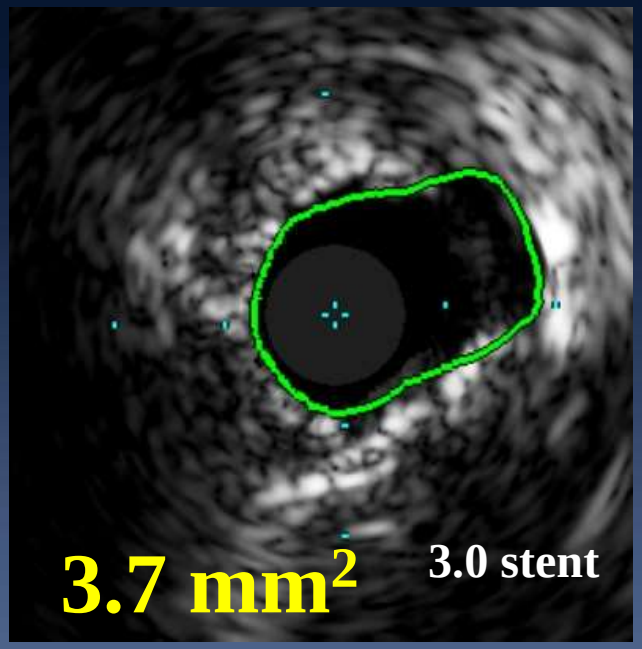


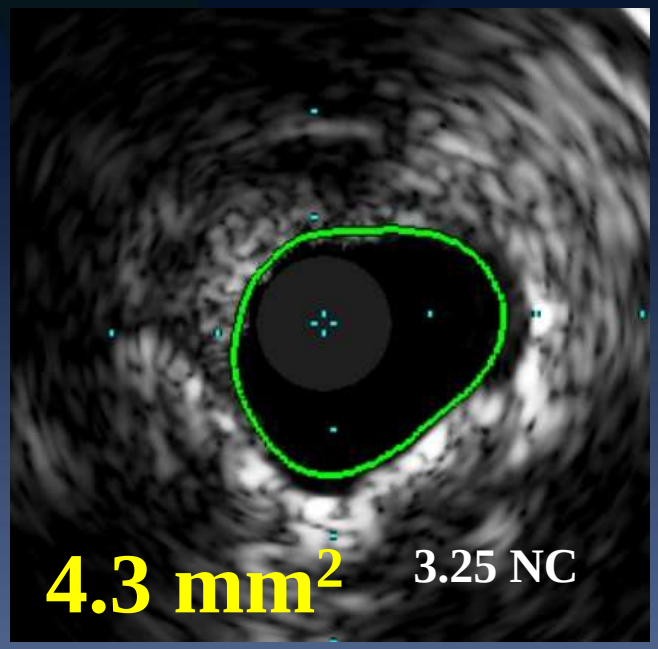


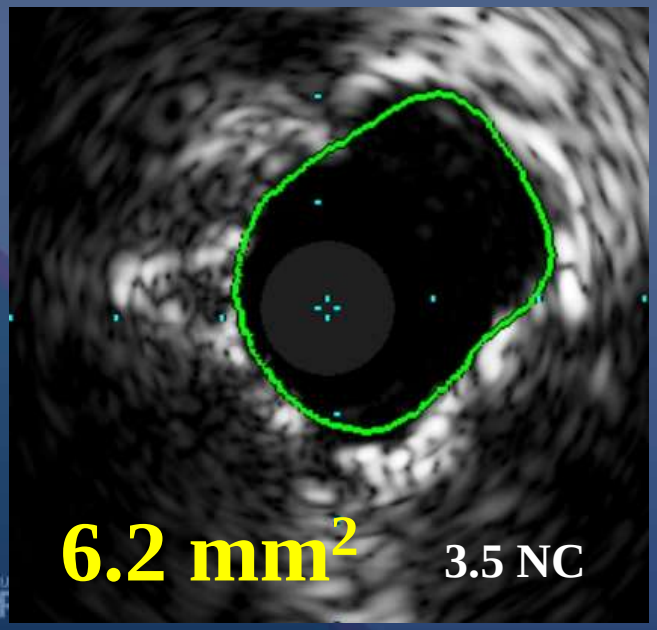
Under expanded

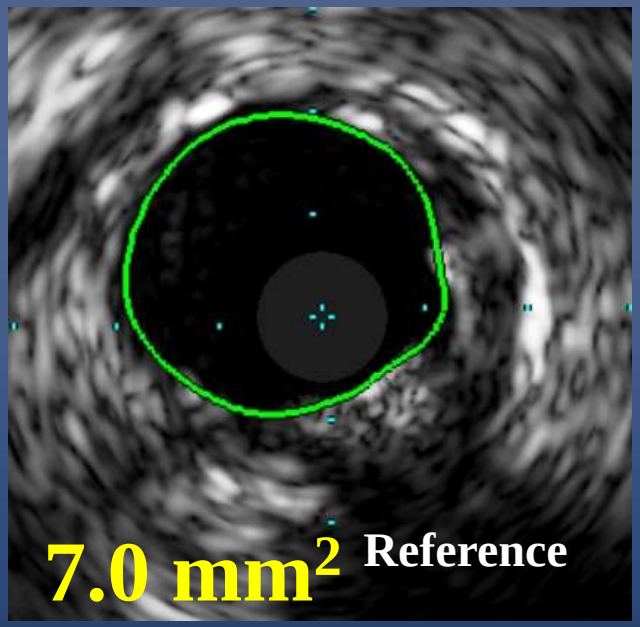
After 3.25 mm post-dilation @ 24 atm











3.0 mm stent should be 7.1 mm^2

Expansion is 89%

IVUS guidance results in larger lumens

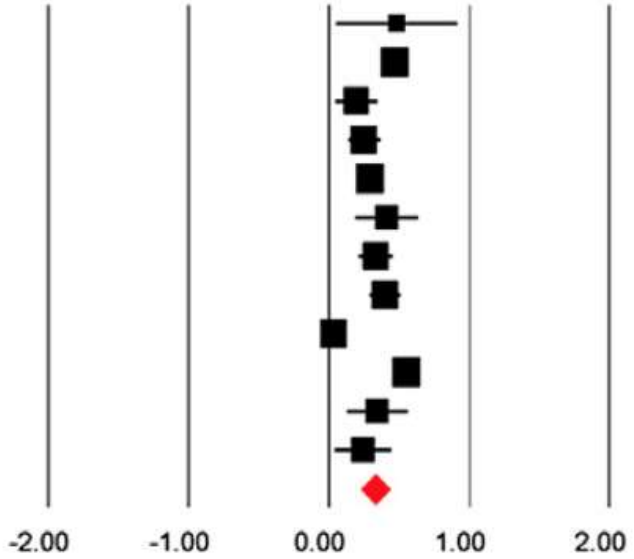
Mean Stent Diameter

0.33 mm

Author Name (Year)	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Ahn SG et al. (2013)	0.484	0.223	0.050	0.048	0.920	2.174	0.030
Ahn JM et al. (2013)	0.467	0.036	0.001	0.398	0.537	13.134	0.000
Chen SL et al. (2012)	0.195	0.080	0.006	0.038	0.352	2.439	0.015
Claessen BE et al. (2011)	0.250	0.061	0.004	0.131	0.369	4.122	0.000
Hur SH et al. (2012)	0.291	0.030	0.001	0.231	0.350	9.579	0.000
Kim SH et al. (2010)	0.411	0.116	0.013	0.184	0.638	3.547	0.000
Kim JS et al. (2011)	0.333	0.065	0.004	0.207	0.460	5.166	0.000
Park KW et al. (2012)	0.400	0.057	0.003	0.288	0.512	6.985	0.000
Roy P et al. (2008)	0.031	0.048	0.002	-0.063	0.124	0.645	0.519
Witzenbichler B et al. (2012)	0.553	0.023	0.001	0.509	0.597	24.557	0.000
Youn YJ et al. (2011)	0.343	0.113	0.013	0.122	0.565	3.034	0.002
Chieffo A et al. (2013)	0.243	0.105	0.011	0.037	0.449	2.311	0.021
Random Effect Model	**0.328**	**0.054**	**0.003**	**0.221**	**0.435**	**6.015**	**<0.001**

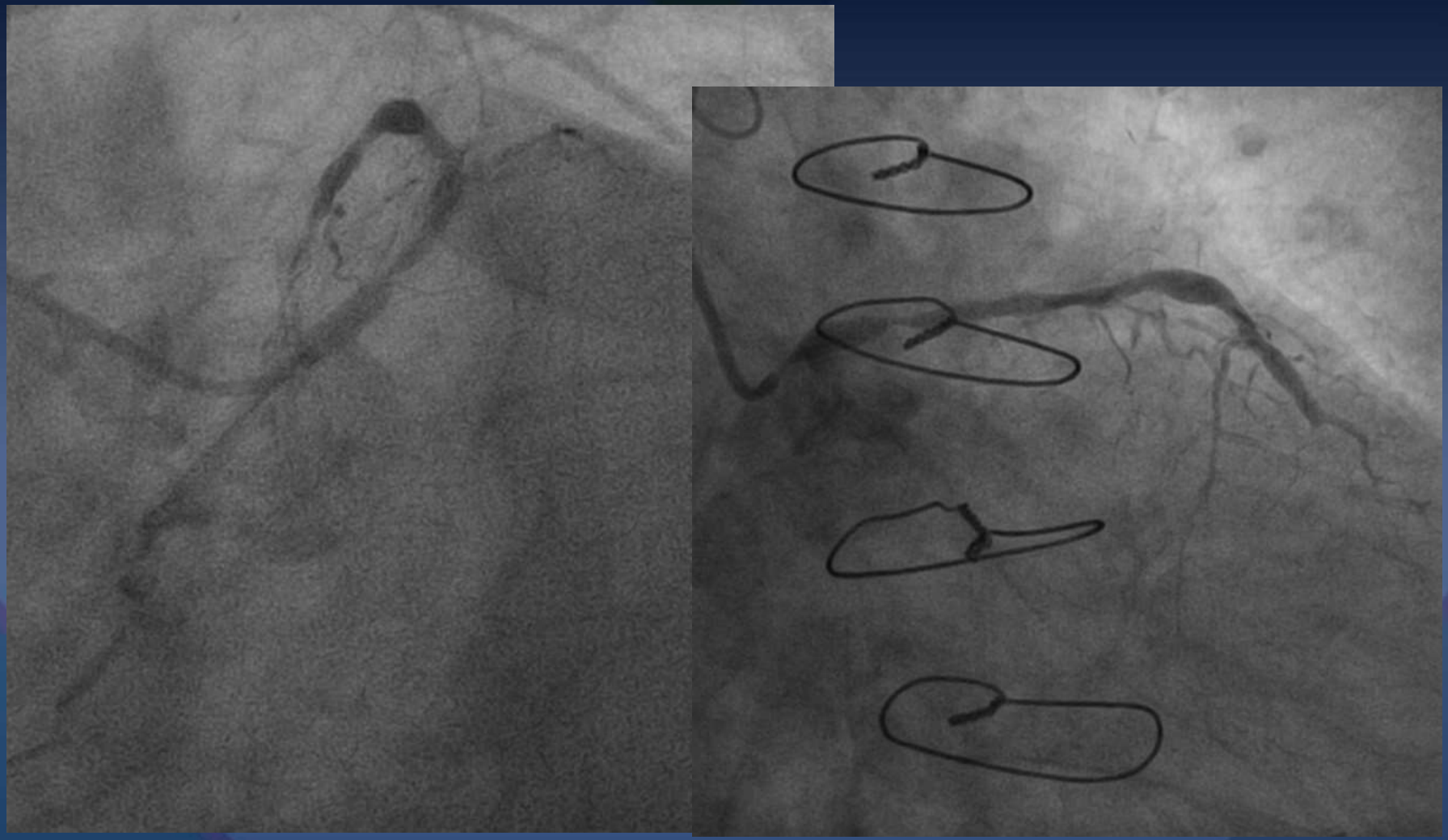
Test for Heterogeneity Q=139.2, df=11, p<0.001, I^2=92.1

Std diff in Means and 95% CI

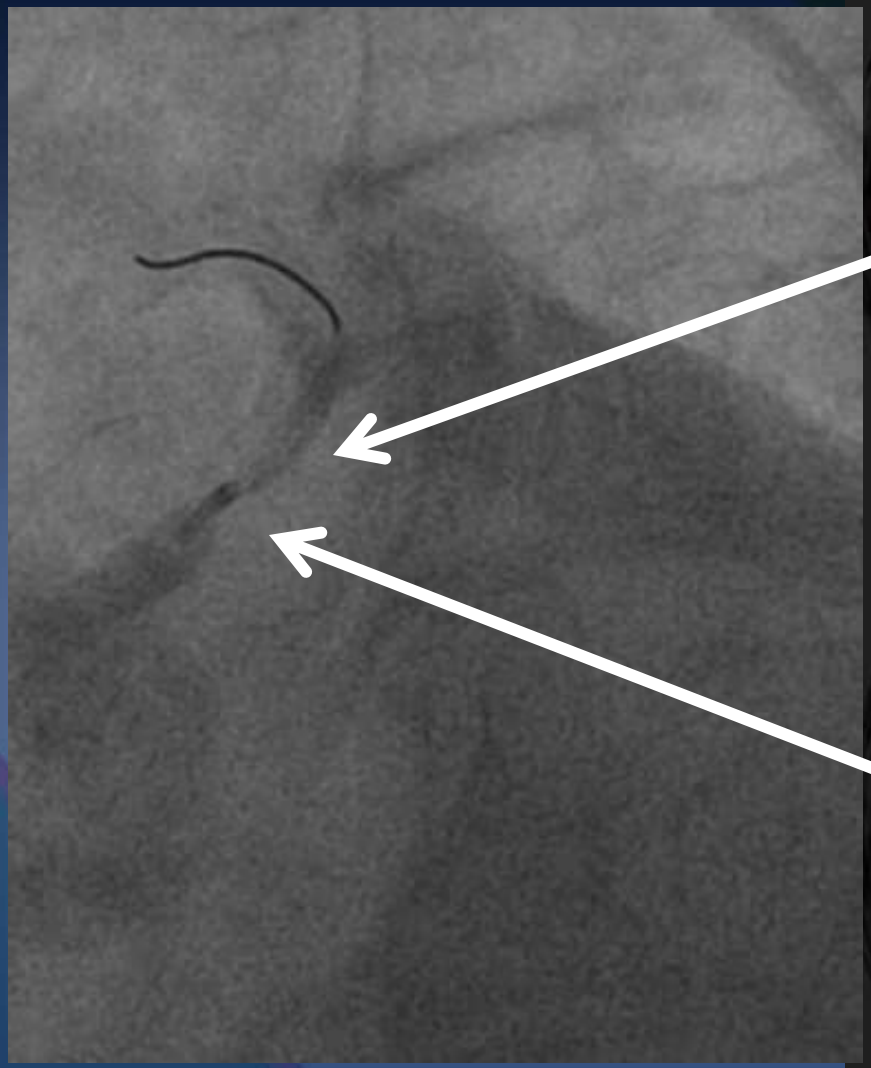


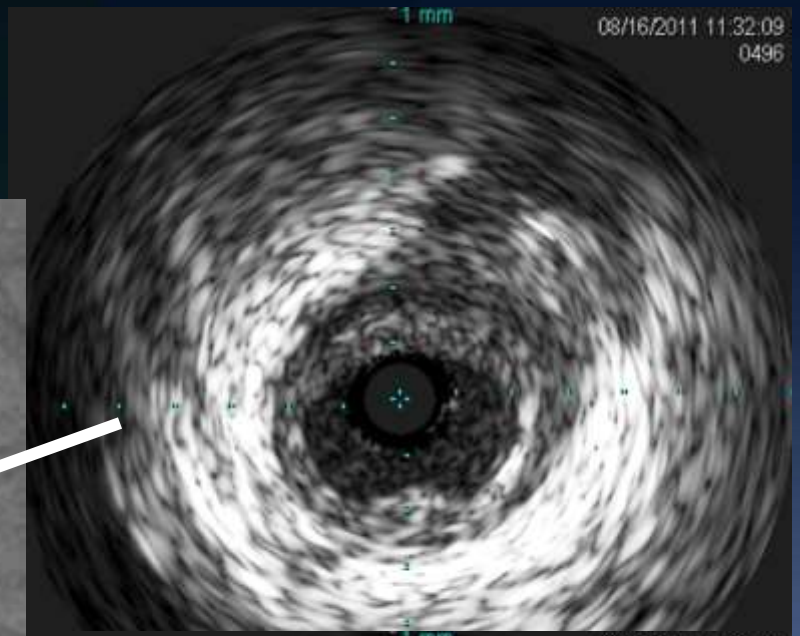
Am J Cardiol 2014;113:1338-1347

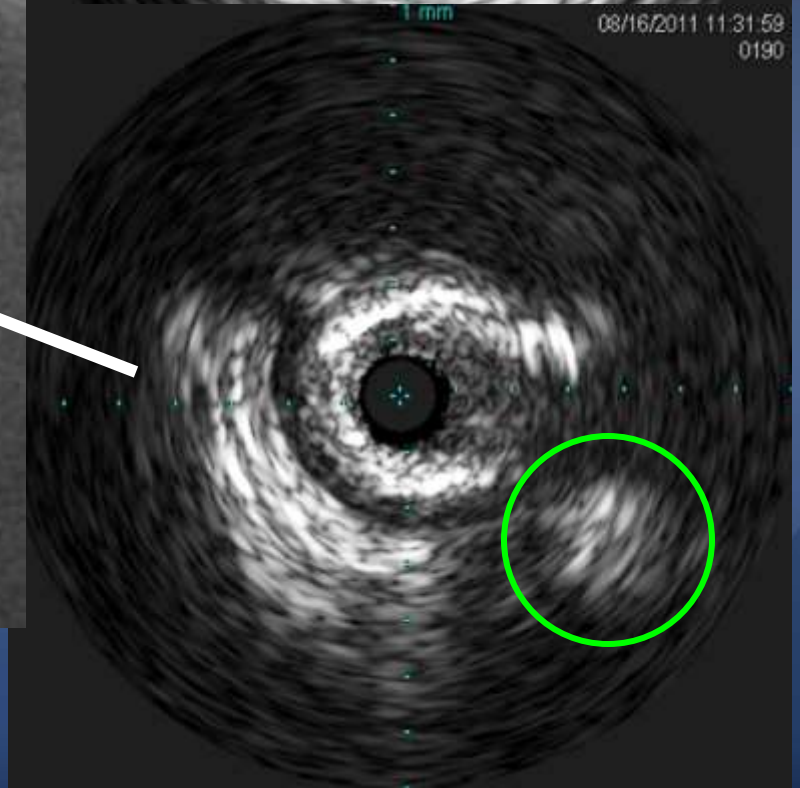
Complex left main stenting: CTO; culottes



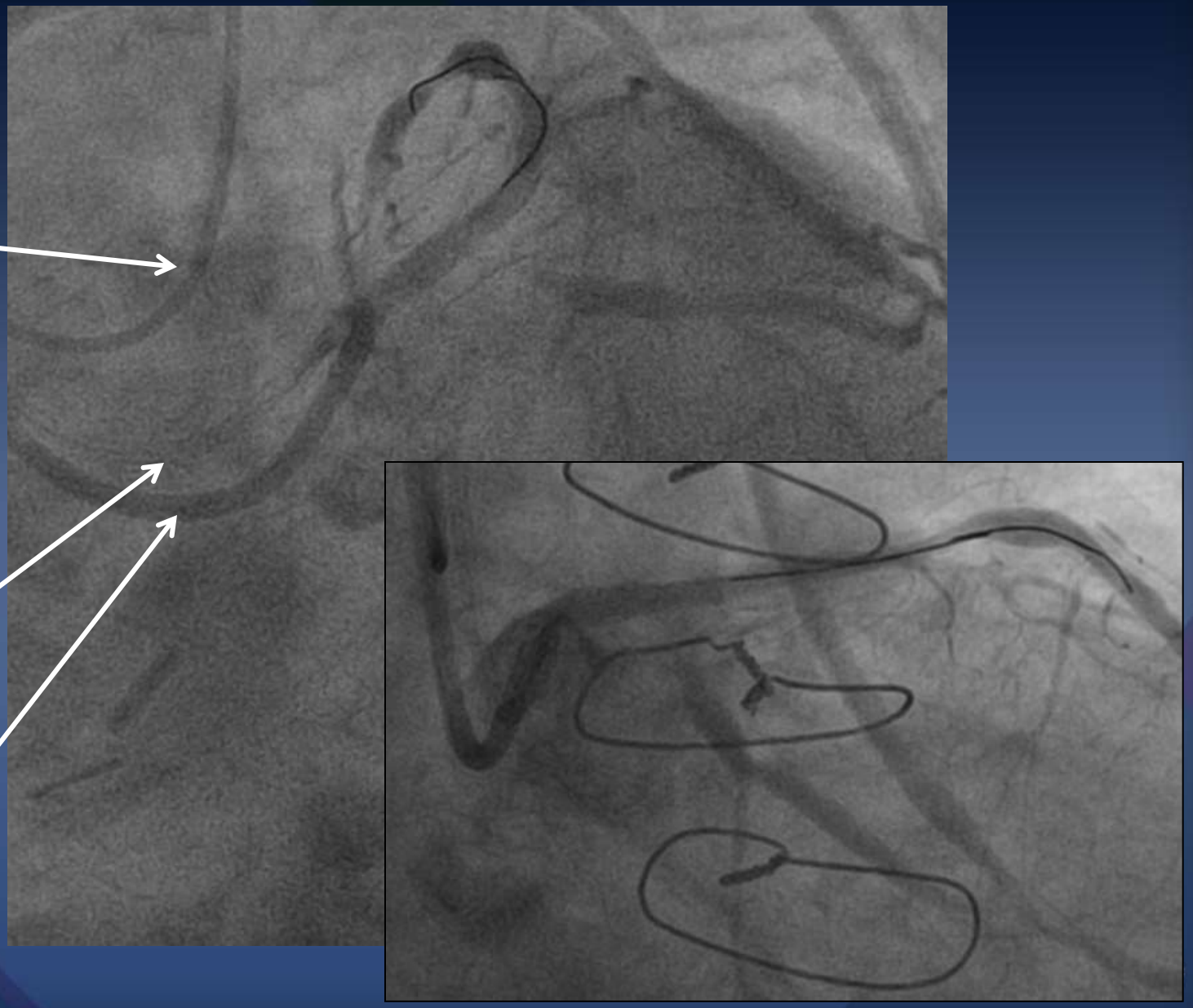
Step 1: find LCX



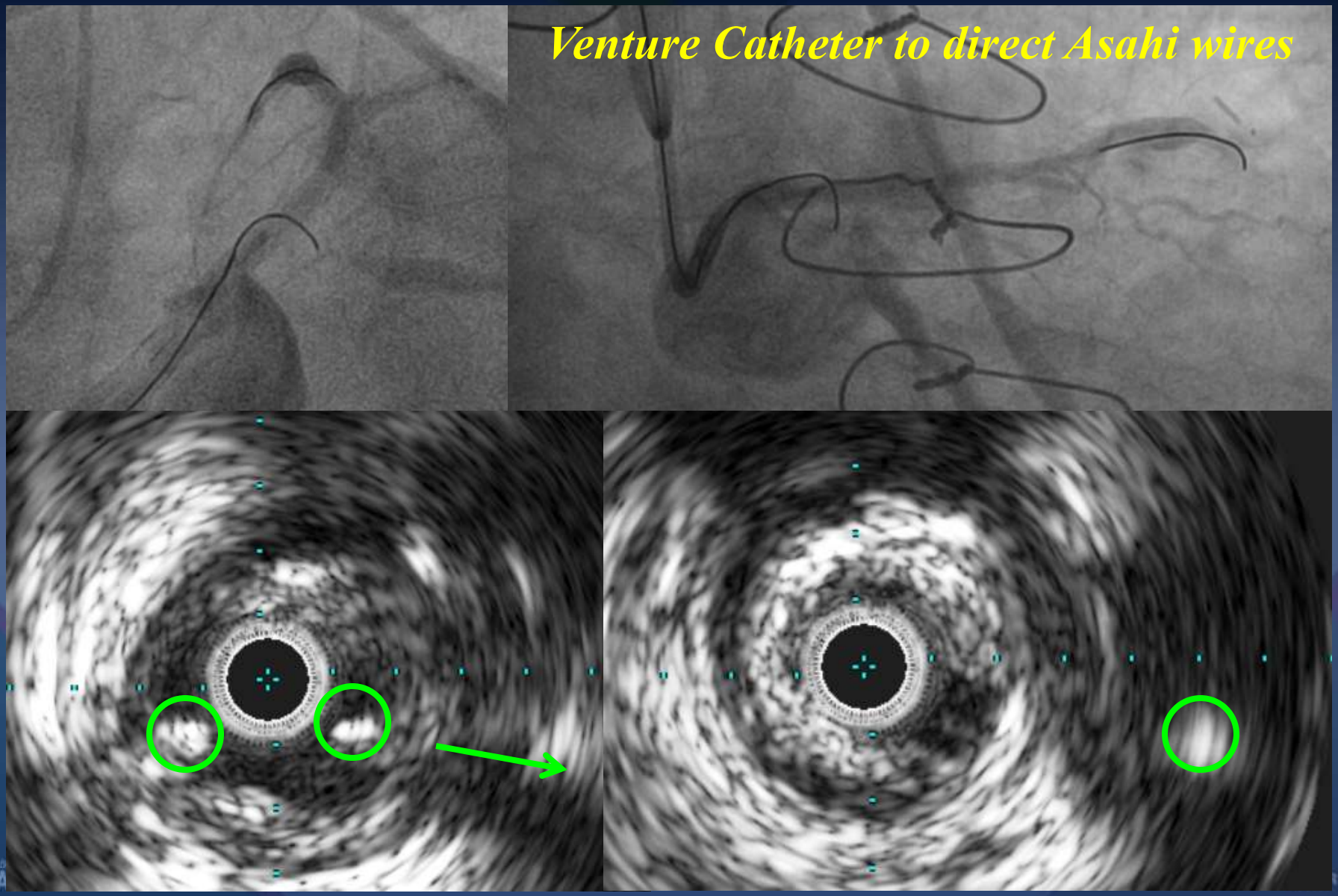




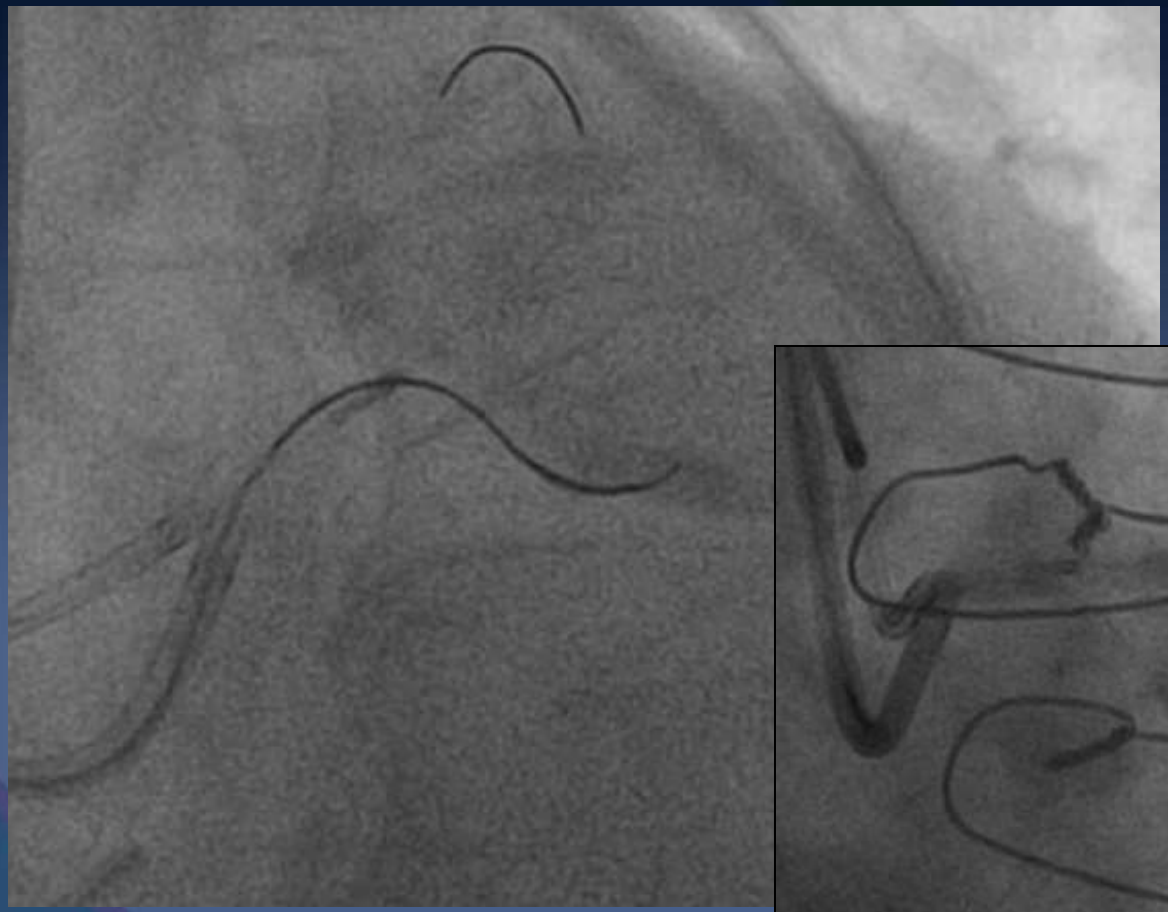
Step 2: Set up for IVUS-guided cap penetration

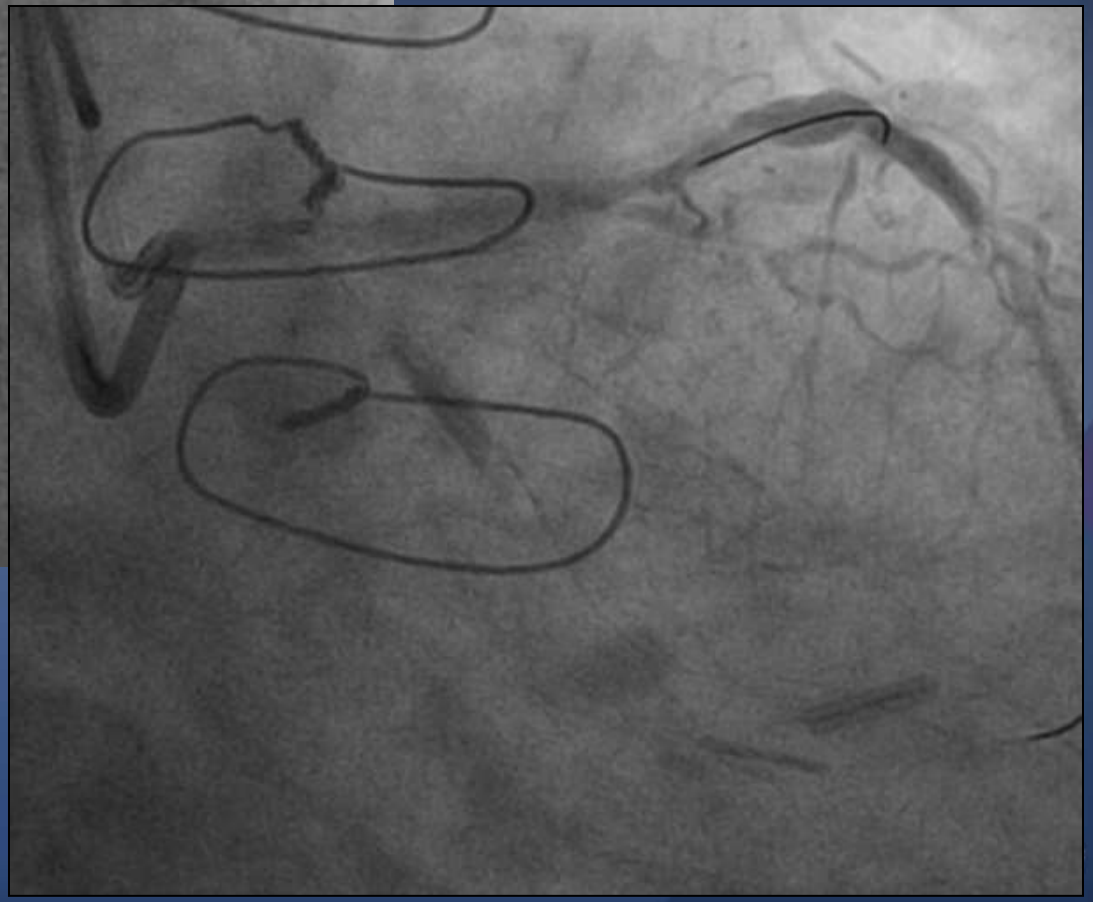


Step 3: use IVUS to “watch” wire penetrate cap

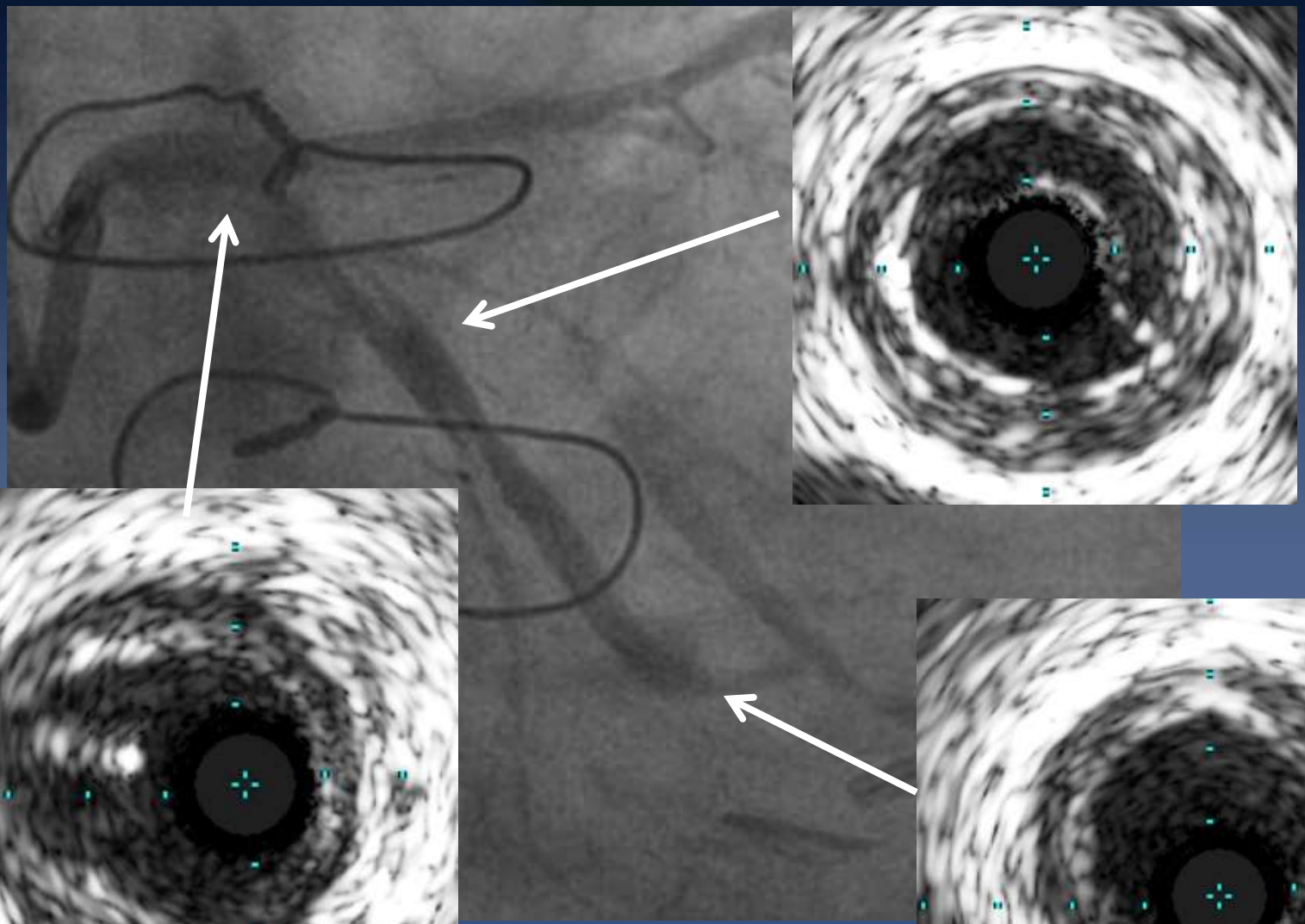


Step 4: cross into distal LCX

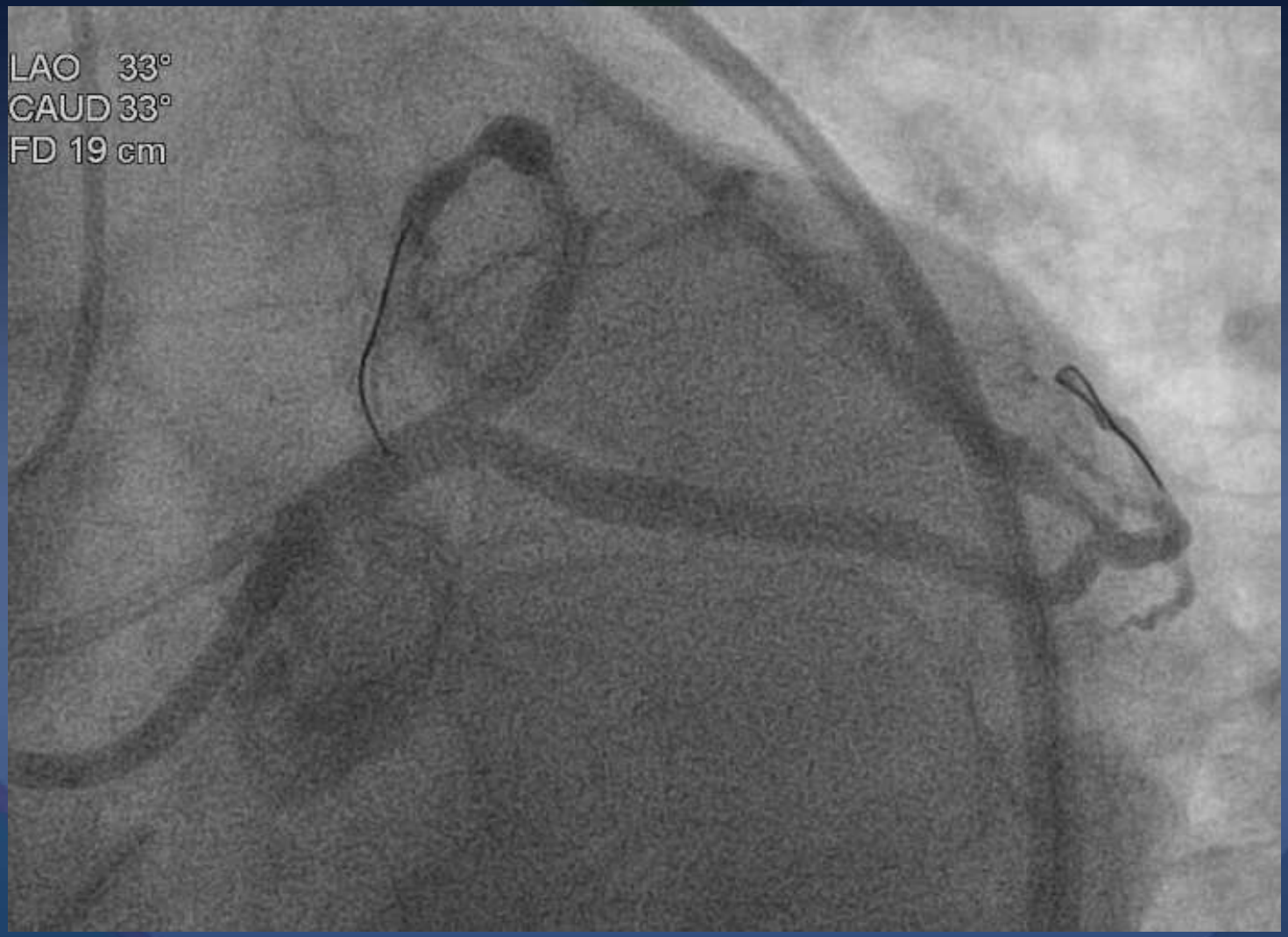




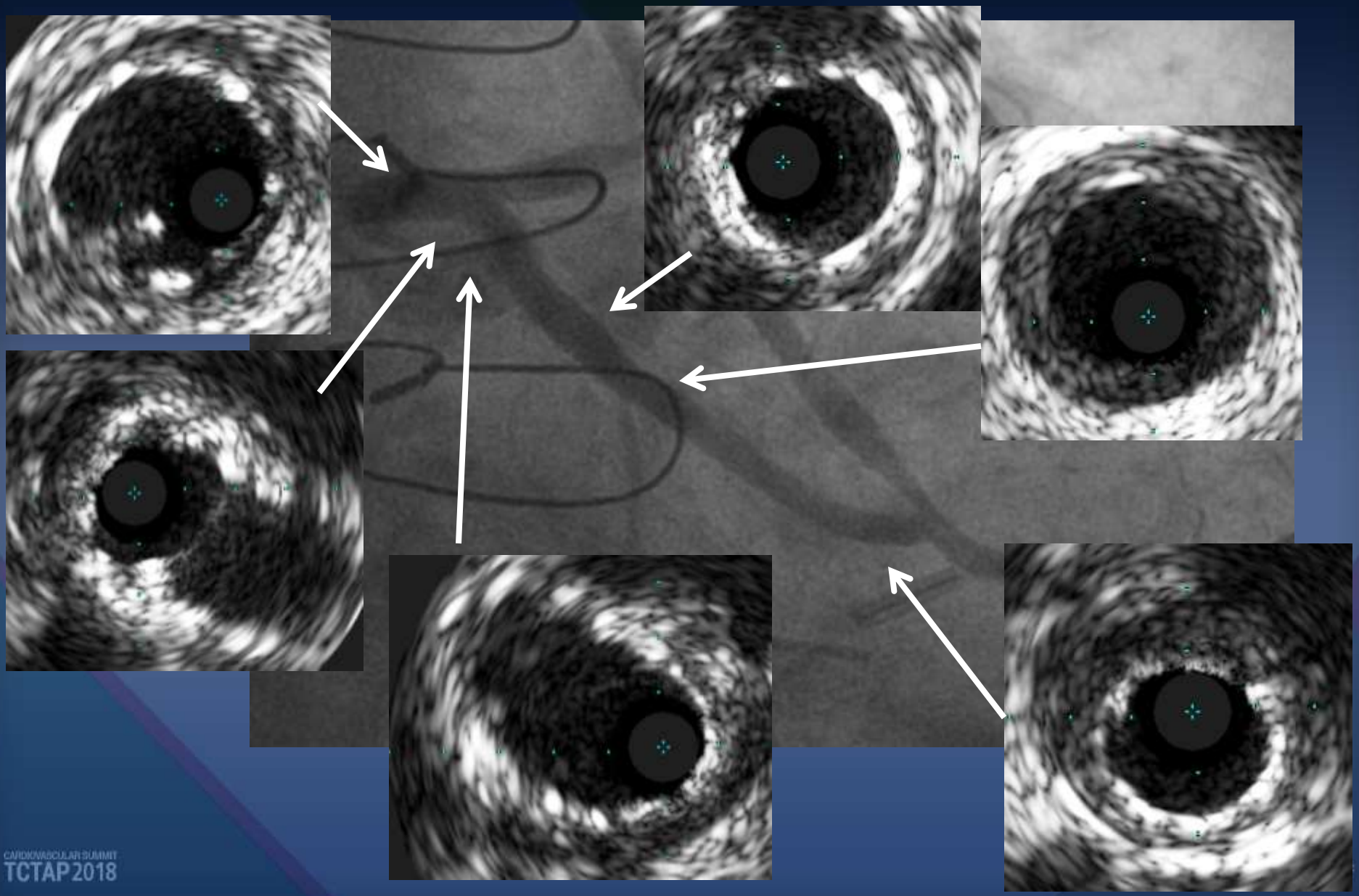
Step 5: Confirm with IVUS; size stents



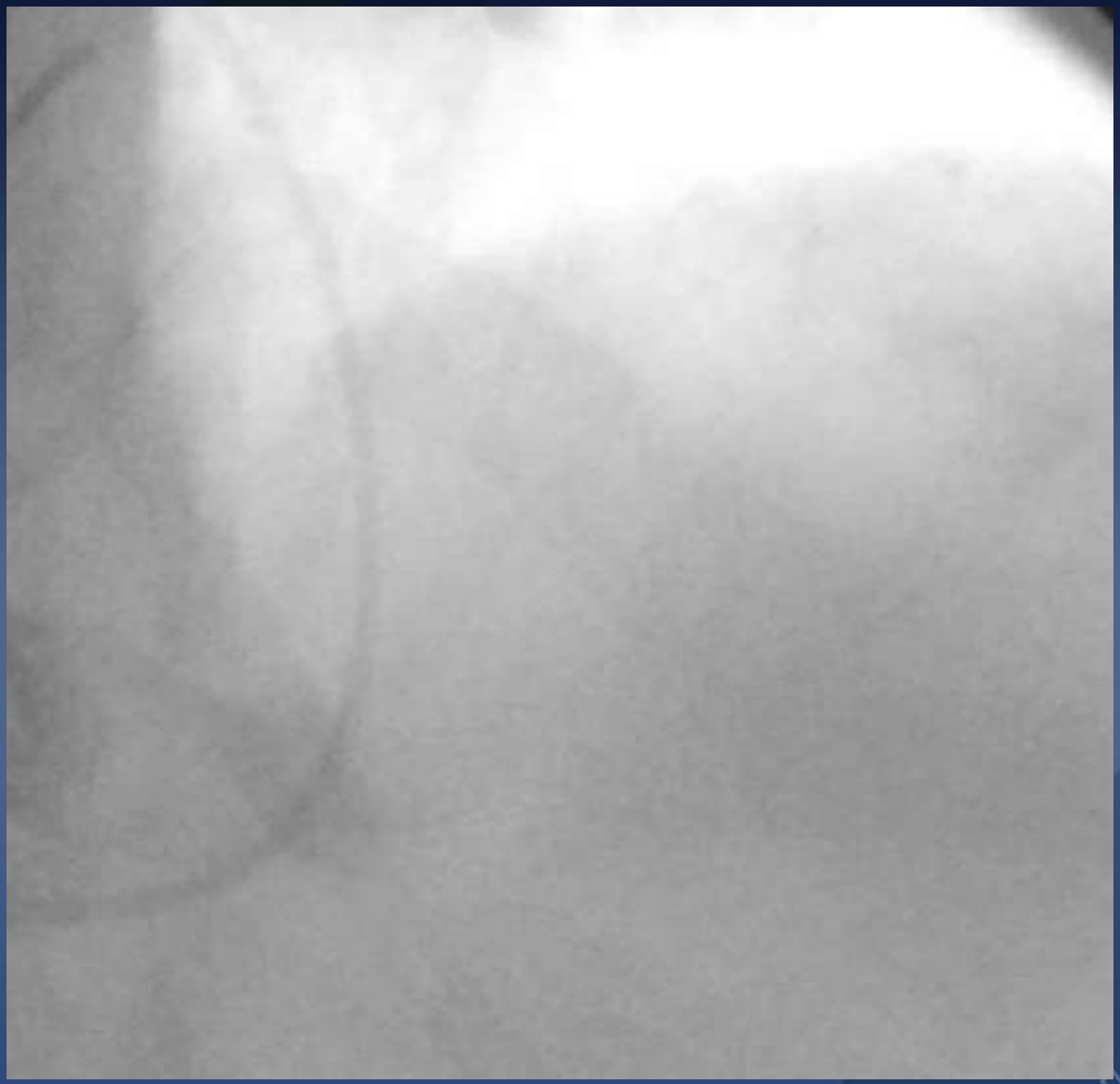
Step 6: stent LCX to LM; culottes to LAD



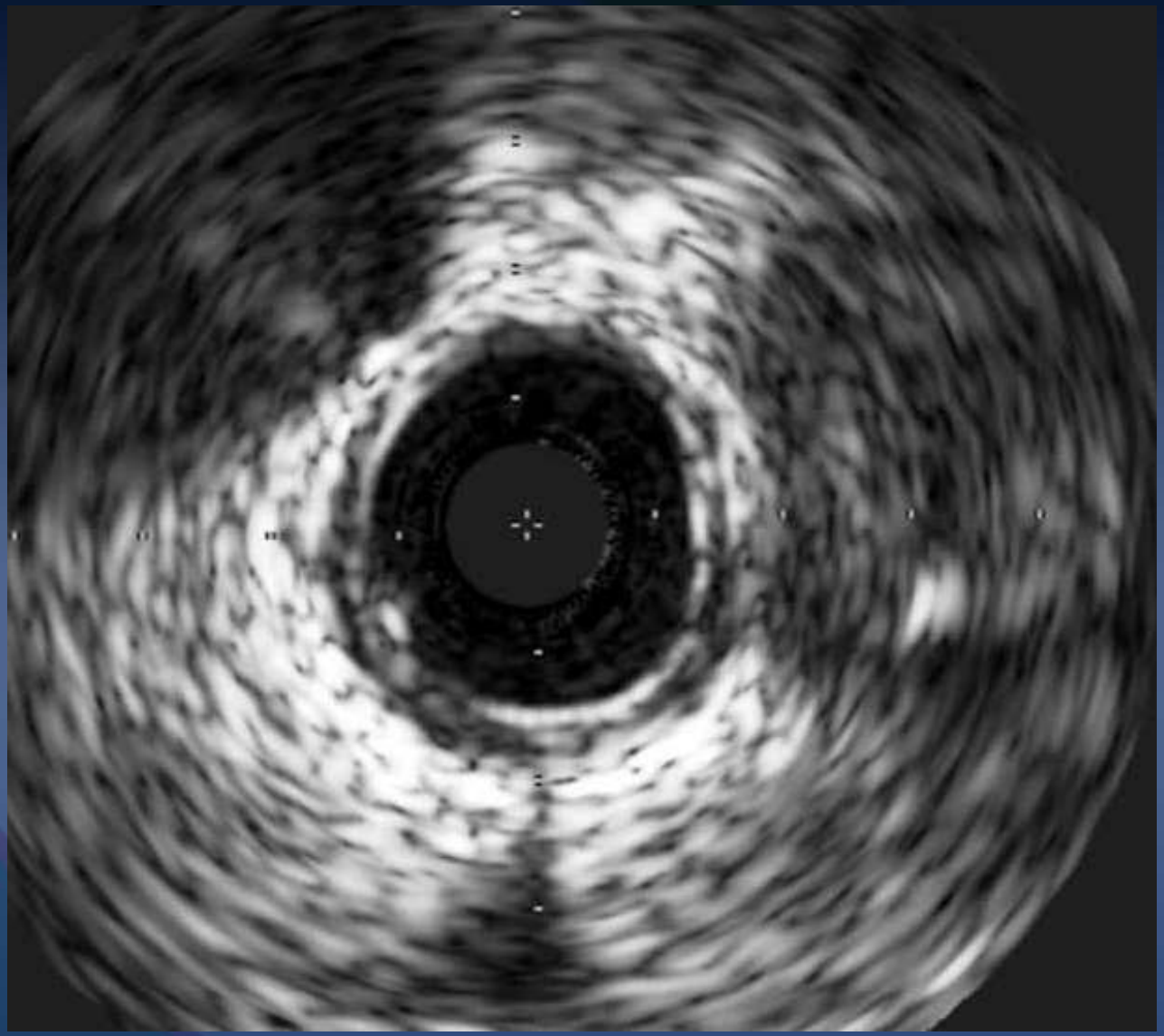
Step 7: Confirm with IVUS



JP: CTO of LAD



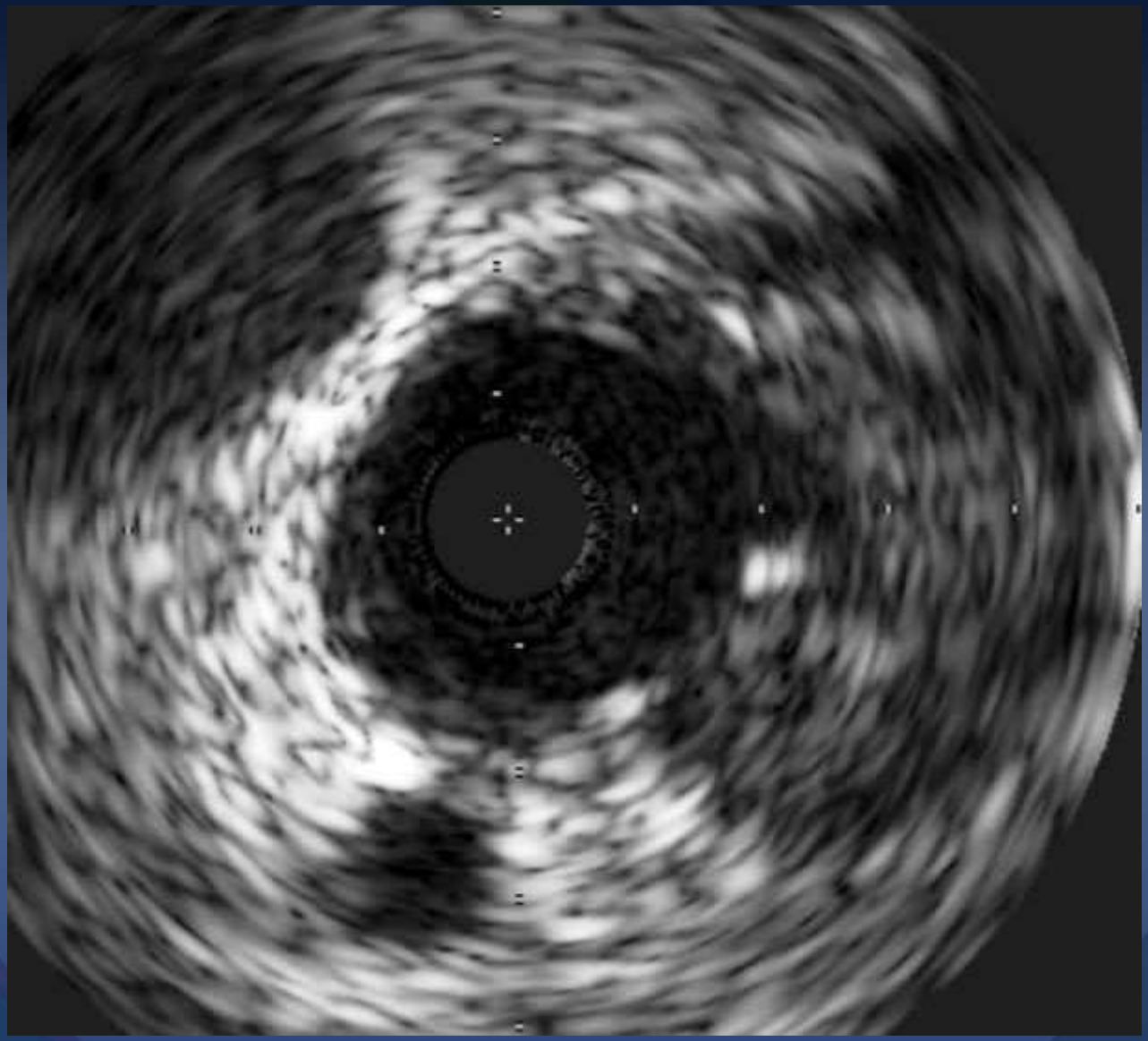
JP: IVUS to guide proximal cap penetration



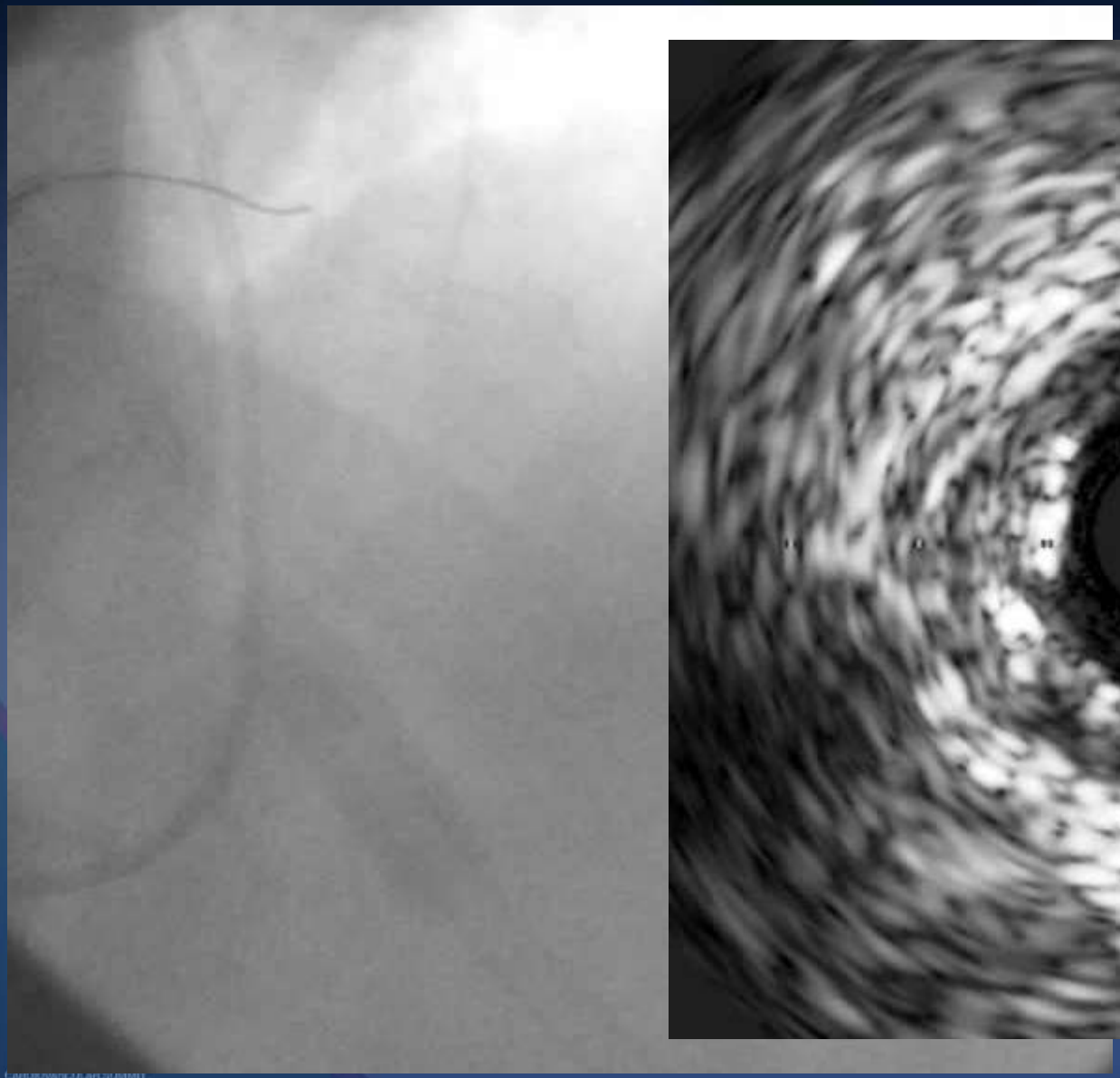
IVUS in diagonal

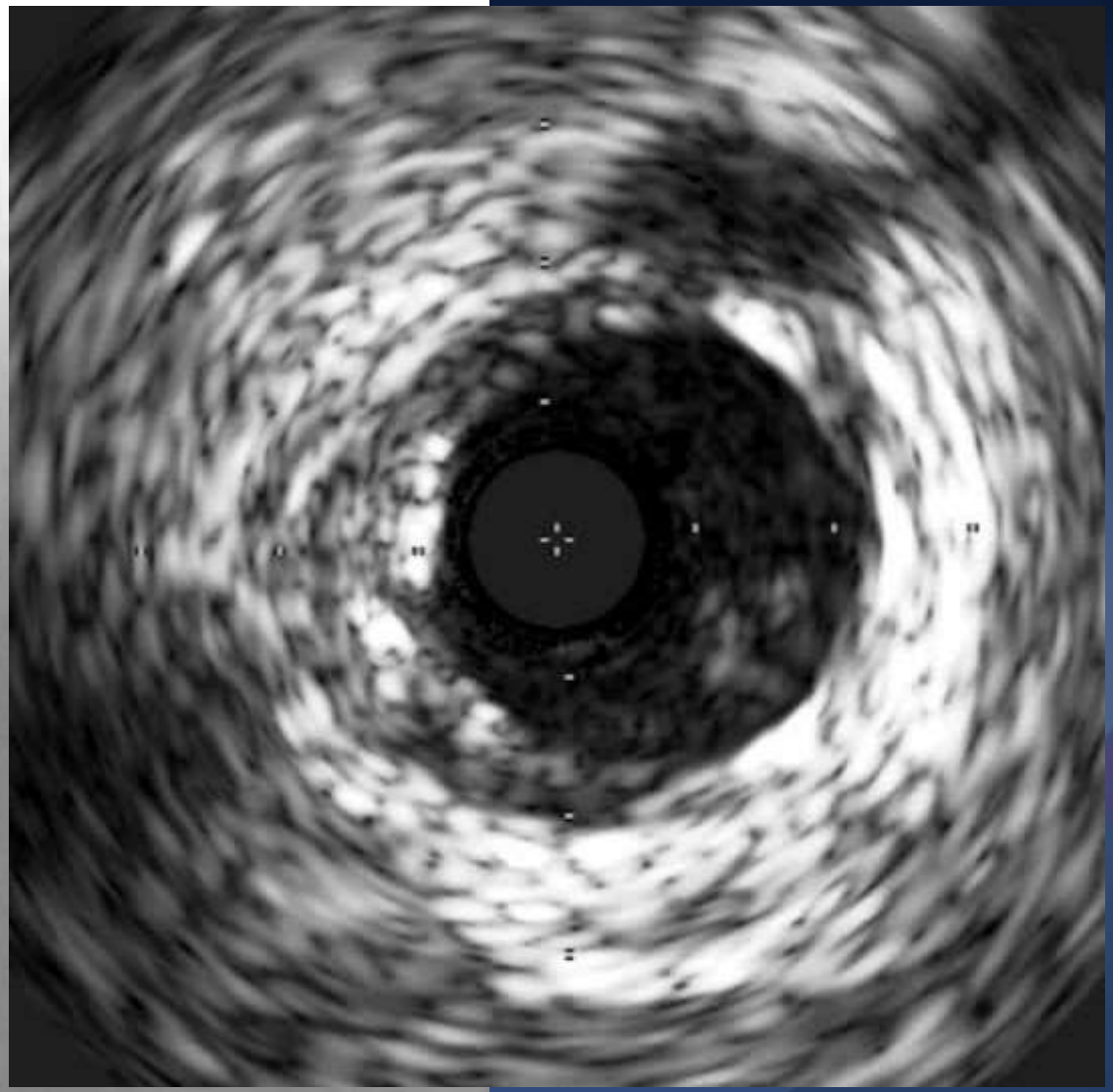
Park, et.al. Int J Cardiol. 2011 Apr 14;148(2):174-8

JP: IVUS guided wire penetration

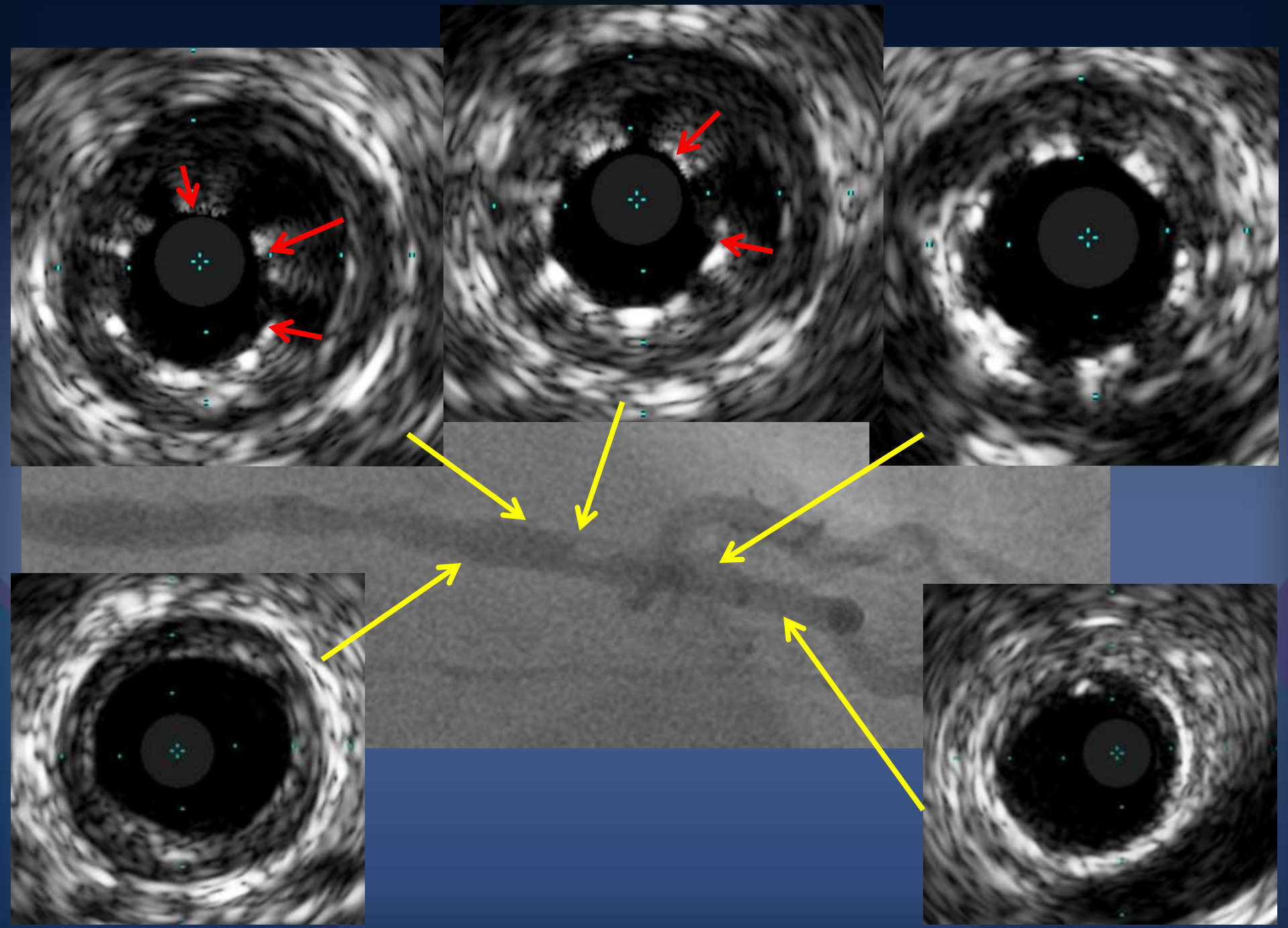


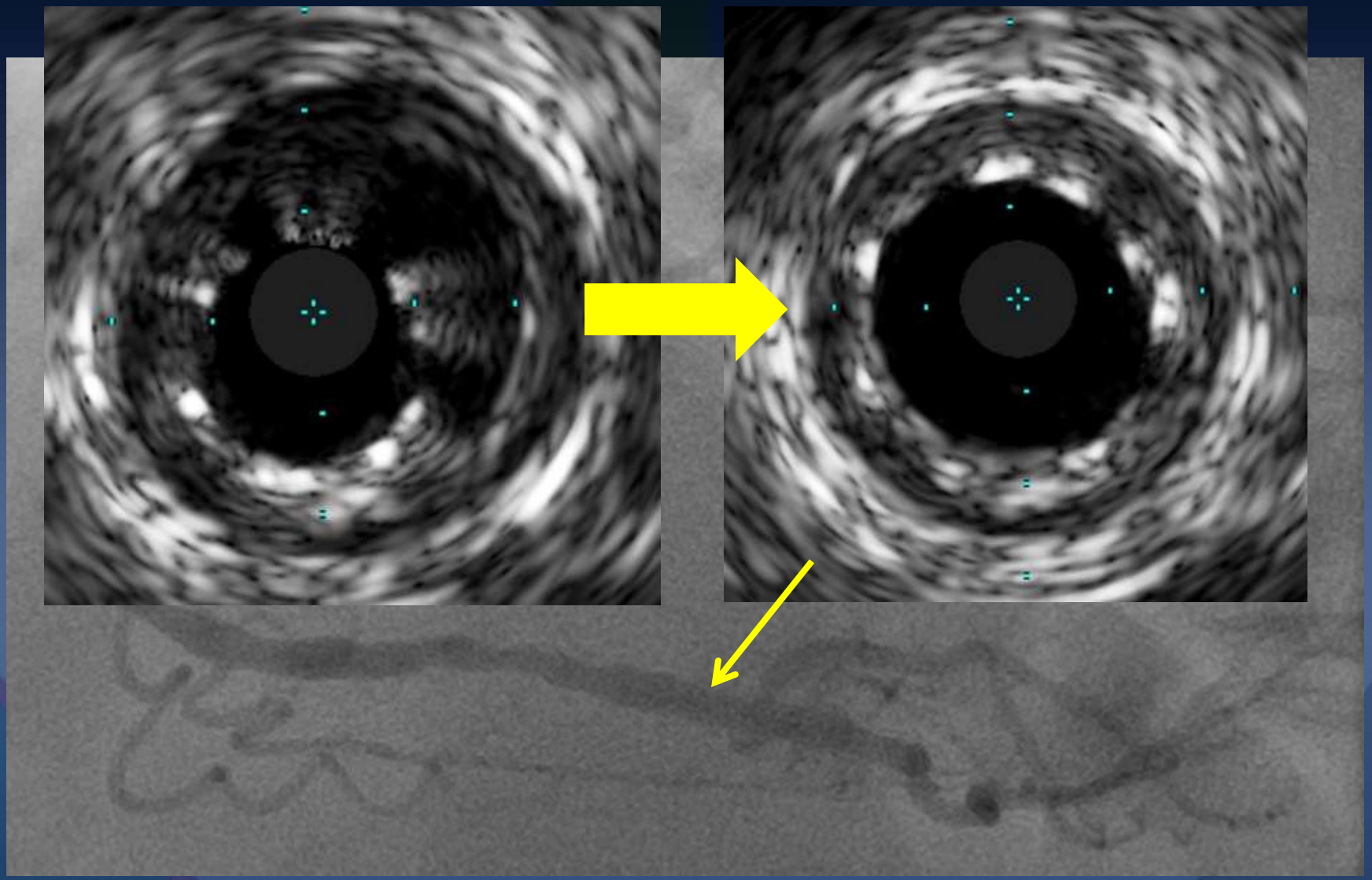
JP: Final post stenting





Mal apposition resulting in SAT

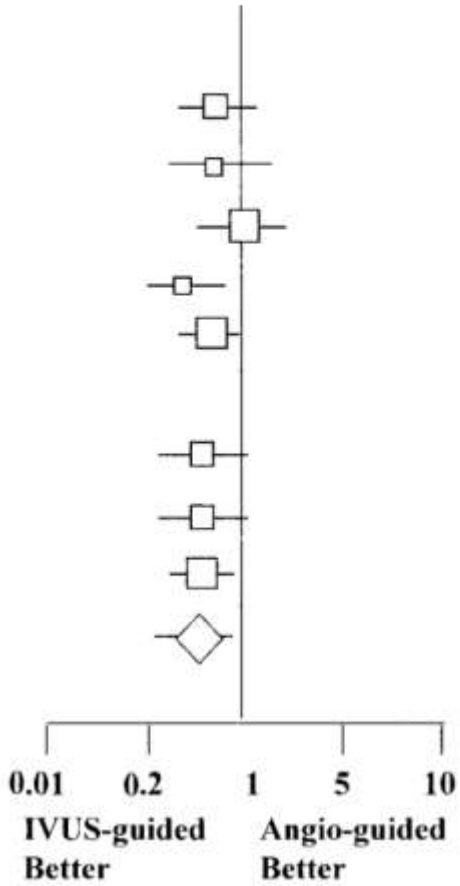




Early PCI, BMS studies: IVUS vs Angio Restenosis

TABLE IV. Binary Restenosis*

Study	IVUS-guided	Angio-guided	Odds ratios and 95% CI fixed
Randomized			
SIPS, 1996	48/166 (29%)	66/190 (34.7%)	0.76 (0.49–1.20)
RESIST, 1997	16/71 (22.5%)	21/73 (28.7%)	0.72 (0.34–1.53)
OPTICUS, 1998	56/229 (24.4%)	52/228 (22.8%)	1.10 (0.71–1.69)
TULIP, 2001	15/73 (20.5%)	28/77 (36.4%)	0.45 (0.22–0.94)
Subtotal	135/539 (25%)	167/568 (29%)	0.81 (0.62–1.06)
Registries			
Albiero et al., 1995	29/158 (18.3%)	40/154 (26%)	0.64 (0.37–1.10)
Blasini et al., 1995	22/105 (20.9%)	32/107 (29.9%)	0.62 (0.33–1.16)
Subtotal	51/263 (19%)	72/261 (27.5%)	0.63 (0.42–0.95)
Total	186/802 (23%)	239/829 (28.8%)	0.75 (0.60–0.94)

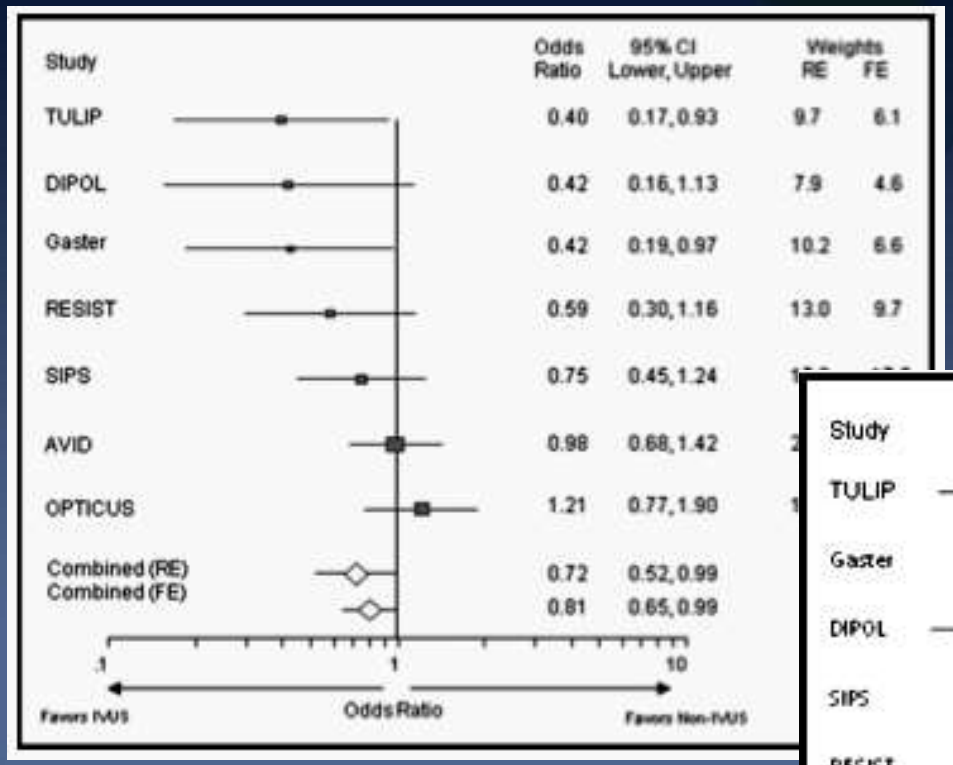


Chi-square heterogeneity: 0.36; $P = 0.01$

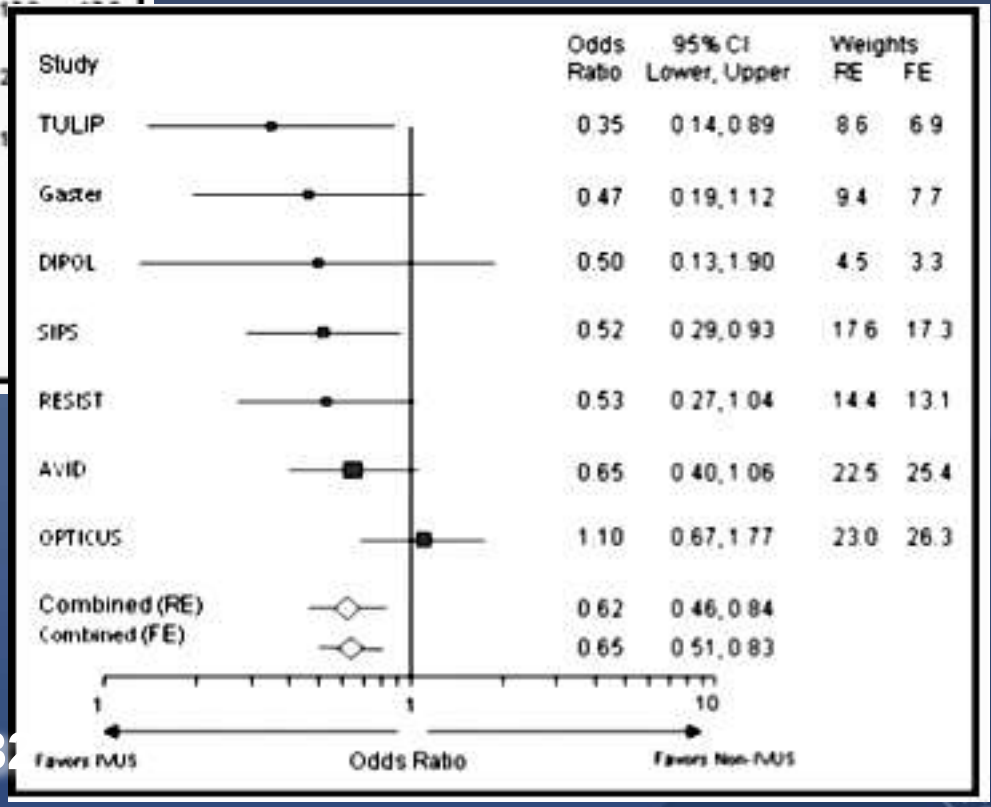
25%

CCI 2003;59:314

IVUS-guided BMS: meta-analysis



TLR 38%



MACE 28%

Am J Cardiol 2011;107:374-382

Asan & Dongsan: IVUS vs Angio

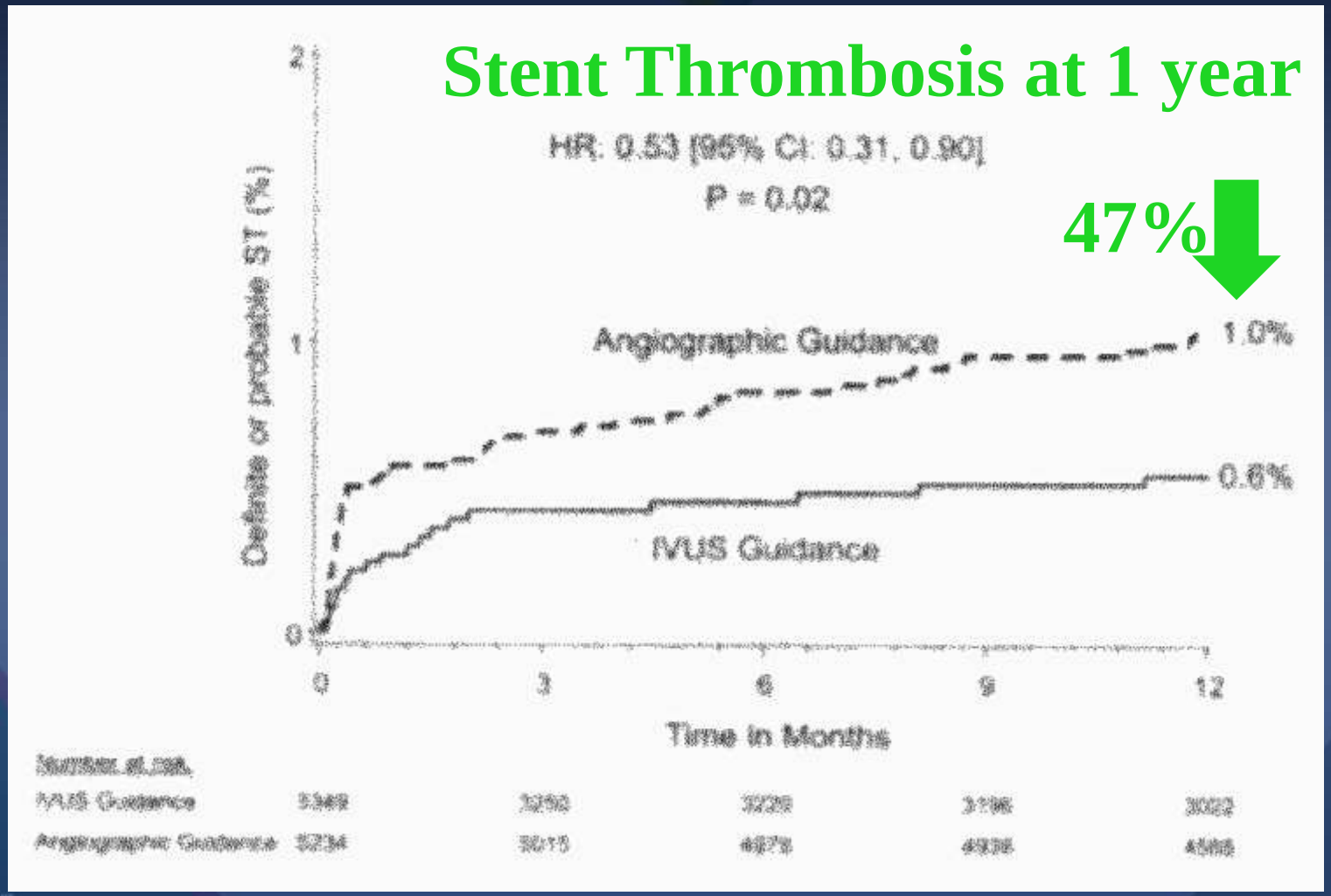
1998 to 2006; all PCI pts n=8,371; 55% IVUS guided
DES: 4,581; crude, adjusted, propensity matched analyses

3 Year Mortality	Hazard ratio (95% CI)		*P* value
DES population			
IVUS guided PCI	0.52 (0.37–0.73)	48% ↓	<0.01
Age (year)	1.04 (1.02–1.05)		<0.01
Renal failure	2.8 (1.76–4.51)		<0.01
LV EF, (%)	0.98 (0.97–1.00)		0.02
Bifurcation lesion	1.71 (1.08–2.70)		0.02
Multivessel PCI	1.78 (1.21–2.63)		<0.01

CCI 2013;81:407

ADAPT DES: IVUS study; >75% 2nd gen DES

Multicenter all comer study; 39% IVUS use; n= 3349
76% of pts with IVUS had a change in PCI strategy

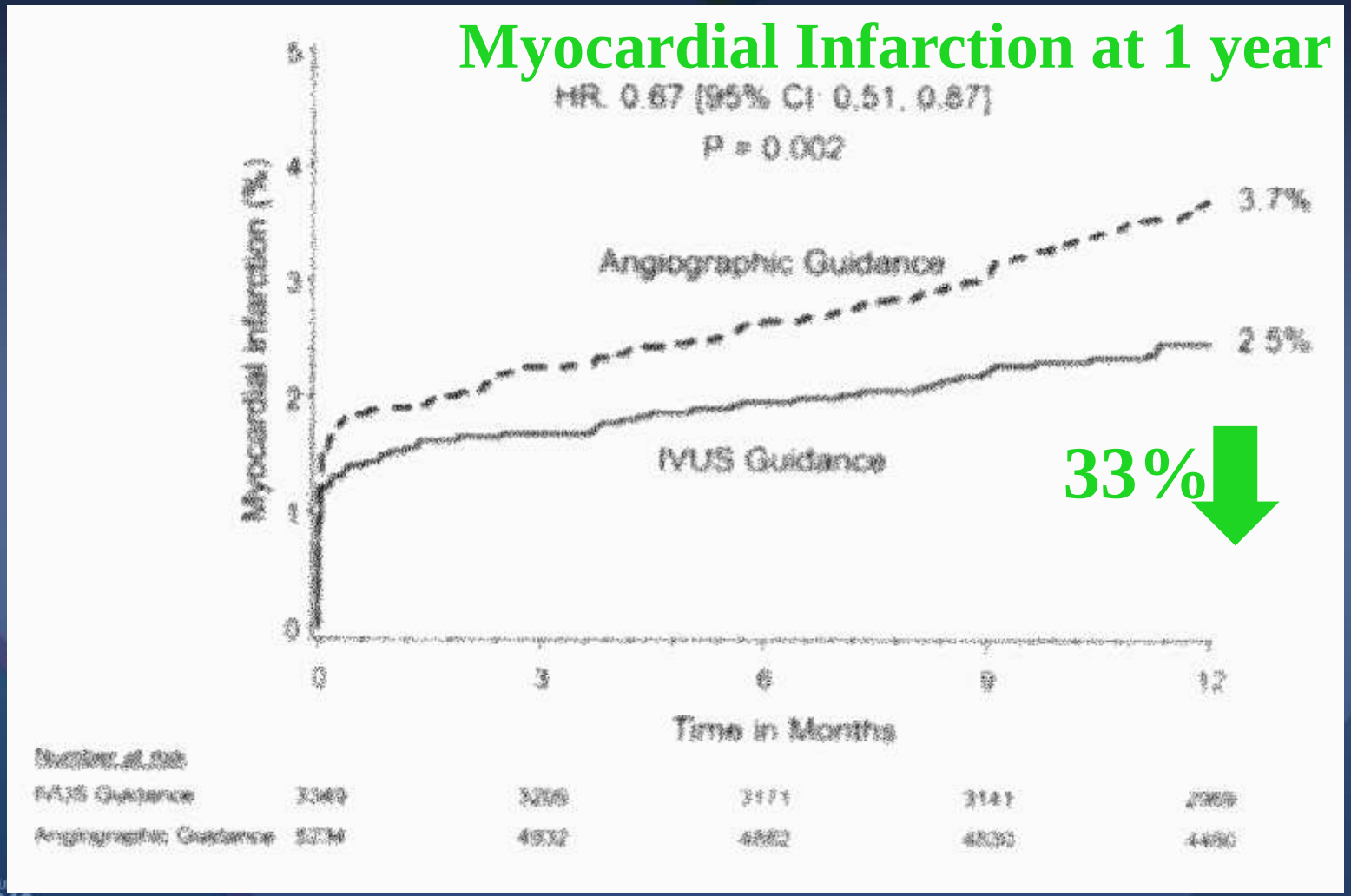


Circulation 2014;129:463

ADAPT DES: IVUS substudy

Multicenter all comer study; 39% IVUS use; n= 3349

76% of pts with IVUS had a change in PCI strategy



Circulation 2014;129:463

DES: IVUS vs Angio guidance

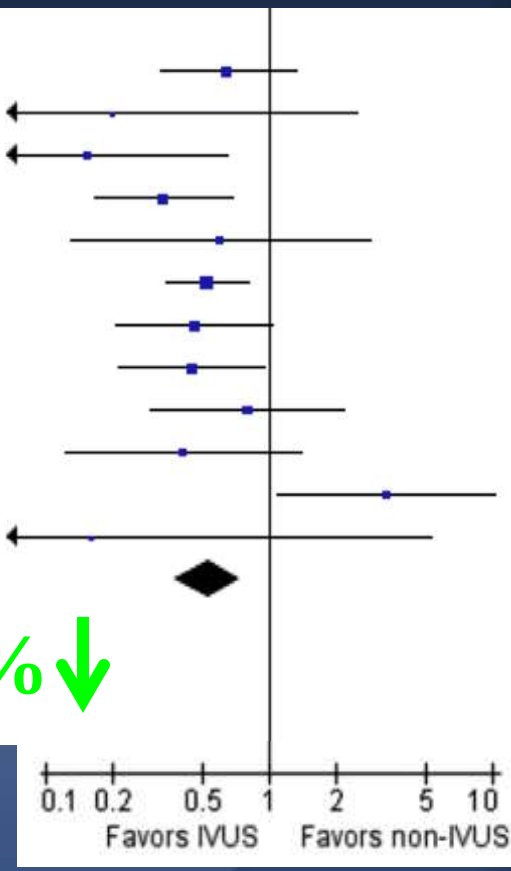
Meta analysis

N= 24,849 (13 studies) odds of Myocardial Infarction

1.2.2 Myocardial infarction							
Roy	18	884	26	884	12.7%	0.69 [0.37, 1.26]	2008
HOME DES IVUS	1	105	4	105	1.8%	0.24 [0.03, 2.21]	2010
COBIS	3	487	15	487	4.8%	0.20 [0.06, 0.68]	2011
MATRIX	13	631	45	873	12.3%	0.39 [0.21, 0.72]	2011
Youn	3	125	8	216	4.2%	0.64 [0.17, 2.46]	2011
ADAPT-DES	40	3349	109	5234	19.0%	0.57 [0.39, 0.82]	2012
Hur	14	2765	18	1816	10.9%	0.51 [0.25, 1.02]	2013
Chen	15	324	27	304	11.8%	0.50 [0.26, 0.96]	2013
AVIO	10	142	12	142	8.2%	0.82 [0.34, 1.97]	2013
IRIS-DES	5	1616	11	1628	6.2%	0.46 [0.16, 1.32]	2013
EXCELLENT	13	619	6	802	7.1%	2.85 [1.08, 7.53]	2013
RESET	0	269	2	274	1.0%	0.20 [0.01, 4.23]	2013
Subtotal (95% CI)		**11316**		**12765**	**100.0%**	**0.57 [0.42, 0.78]**	
Total events	135		283				

Heterogeneity: $Tau^2 = 0.09$; $Chi^2 = 17.32$, df = 11 (P = 0.10); $I^2 = 37\%$

Test for overall effect: Z = 3.61 (P = 0.0003)



JACC INT 2014
http://dx.doi.org/10.1016/j.jcin.2013.09.013

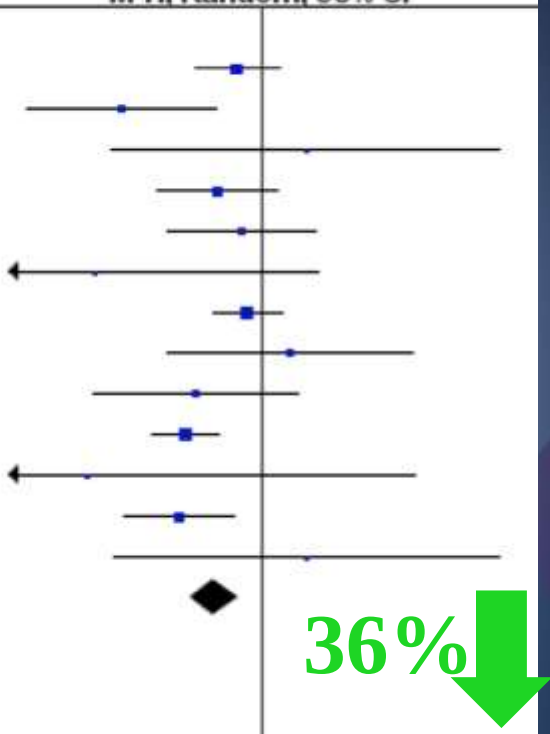
DES: IVUS vs Angio guidance

N= 24,849 (13 studies) odds of All Cause Death

Study or Subgroup	IVUS Events	IVUS Total	Angiography Events	Angiography Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
1.2.1 All-cause death							
Roy	50	884	62	884	15.4%	0.79 [0.54, 1.17]	2008
MAIN-COMPARE	7	145	23	145	5.5%	0.27 [0.11, 0.65]	2009
HOME DES IVUS	3	105	2	105	1.5%	1.51 [0.25, 9.26]	2010
MATRIX	19	631	39	873	10.5%	0.66 [0.38, 1.16]	2011
COBIS	15	487	18	487	7.8%	0.83 [0.41, 1.66]	2011
Youn	1	125	8	216	1.2%	0.21 [0.03, 1.70]	2011
ADAPT-DES	58	3349	103	5234	17.5%	0.88 [0.63, 1.21]	2012
EXCELLENT	6	619	6	802	3.6%	1.30 [0.42, 4.05]	2012
Chen	7	324	12	304	4.9%	0.54 [0.21, 1.38]	2013
Hur	75	2765	98	1816	18.2%	0.49 [0.36, 0.66]	2013
AVIO	0	142	2	142	0.6%	0.20 [0.01, 4.14]	2013
IRIS-DES	22	1616	47	1628	11.6%	0.46 [0.28, 0.77]	2013
RESET	3	269	2	274	1.6%	1.53 [0.25, 9.25]	2013
Subtotal (95% CI)		**11461**		**12910**	**100.0%**	**0.64 [0.51, 0.81]**	
Total events	266		422				

Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 18.67$, df = 12 (P = 0.10); $I^2 = 36\%$

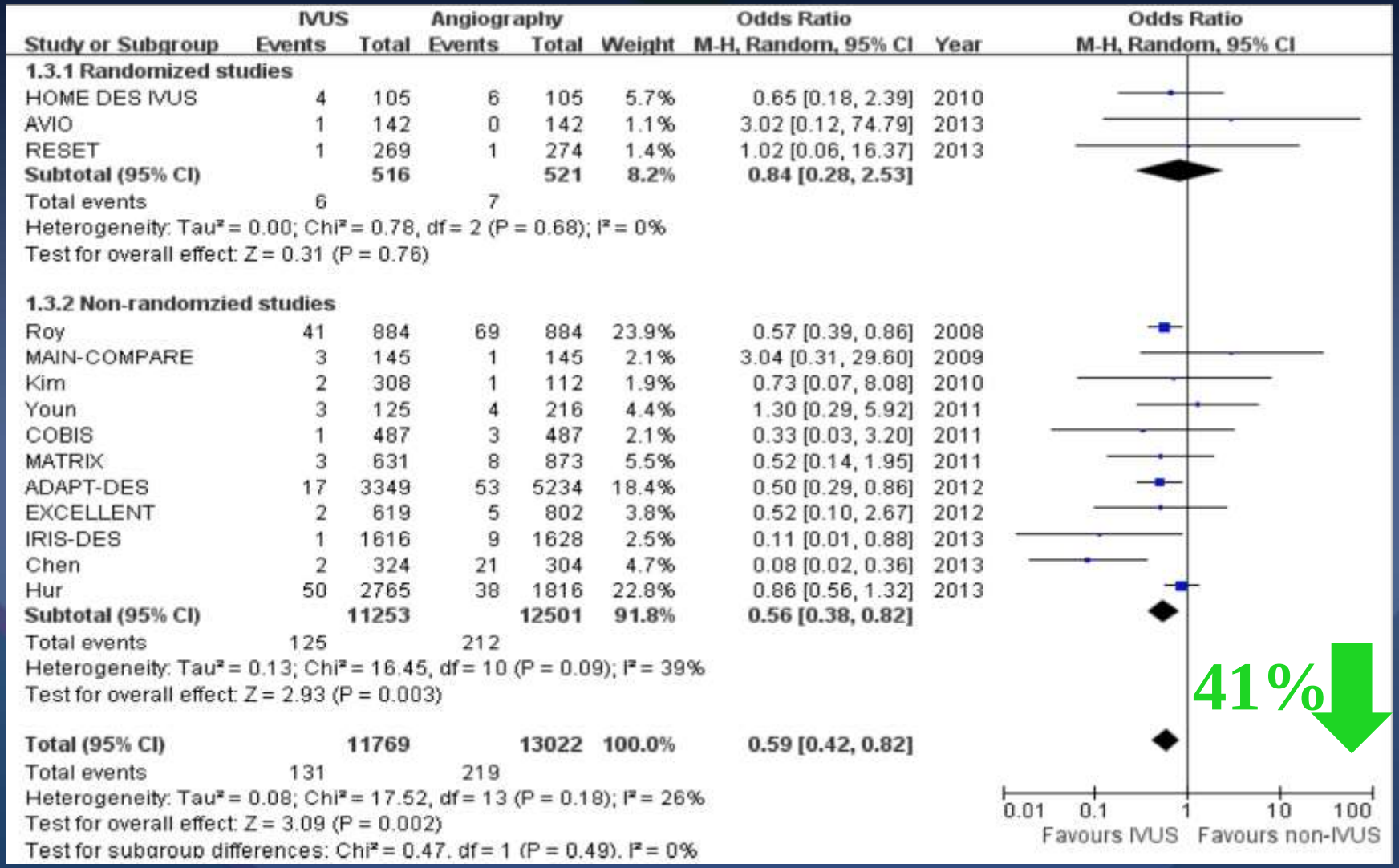
Test for overall effect: Z = 3.75 (P = 0.0002)



Jang, et al JACC Int 2014 (epub)

DES: IVUS vs Angio guidance

N= 24,849 (13 studies) odds of Stent Thrombosis



Study or Subgroup	IVUS Events	IVUS Total	Angiography Events	Angiography Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
1.3.1 Randomized studies							
HOME DES IVUS	4	105	6	105	5.7%	0.65 [0.18, 2.39]	2010
AVIO	1	142	0	142	1.1%	3.02 [0.12, 74.79]	2013
RESET	1	269	1	274	1.4%	1.02 [0.06, 16.37]	2013
Subtotal (95% CI)		**516**		**521**	**8.2%**	**0.84 [0.28, 2.53]**	
Total events	6		7				
Heterogeneity: Tau² = 0.00; Chi² = 0.78, df = 2 (P = 0.68); I² = 0%							
Test for overall effect: Z = 0.31 (P = 0.76)							
1.3.2 Non-randomzied studies							
Roy	41	884	69	884	23.9%	0.57 [0.39, 0.86]	2008
MAIN-COMPARE	3	145	1	145	2.1%	3.04 [0.31, 29.60]	2009
Kim	2	308	1	112	1.9%	0.73 [0.07, 8.08]	2010
Youn	3	125	4	216	4.4%	1.30 [0.29, 5.92]	2011
COBIS	1	487	3	487	2.1%	0.33 [0.03, 3.20]	2011
MATRIX	3	631	8	873	5.5%	0.52 [0.14, 1.95]	2011
ADAPT-DES	17	3349	53	5234	18.4%	0.50 [0.29, 0.86]	2012
EXCELLENT	2	619	5	802	3.8%	0.52 [0.10, 2.67]	2012
IRIS-DES	1	1616	9	1628	2.5%	0.11 [0.01, 0.88]	2013
Chen	2	324	21	304	4.7%	0.08 [0.02, 0.36]	2013
Hur	50	2765	38	1816	22.8%	0.86 [0.56, 1.32]	2013
Subtotal (95% CI)		**11253**		**12501**	**91.8%**	**0.56 [0.38, 0.82]**	
Total events	125		212				
Heterogeneity: Tau² = 0.13; Chi² = 16.45, df = 10 (P = 0.09); I² = 39%							
Test for overall effect: Z = 2.93 (P = 0.003)							
Total (95% CI)		**11769**		**13022**	**100.0%**	**0.59 [0.42, 0.82]**	
Total events	131		219				
Heterogeneity: Tau² = 0.08; Chi² = 17.52, df = 13 (P = 0.18); I² = 26%							
Test for overall effect: Z = 3.09 (P = 0.002)							
Test for subgroup differences: Chi² = 0.47, df = 1 (P = 0.49), I² = 0%							

Jang, et al JACC Int 2014 (epub)

DES: IVUS vs Angio guidance

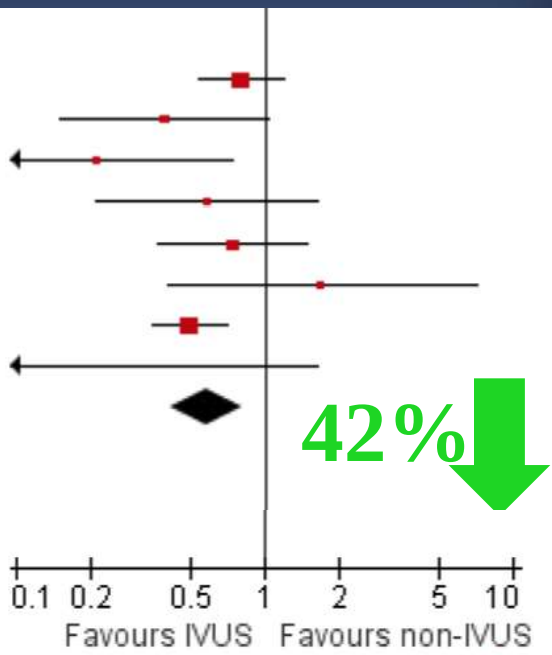
N= 13,545 (9 Propensity studies) odds of All Cause Death

2.1.2 All-cause death

Roy	-0.2296	0.1963	26.8%	0.79 [0.54, 1.17]	2008
MAIN-COMPARE	-0.93865868	0.48901986	9.2%	0.39 [0.15, 1.02]	2009
Kim	-1.56406073	0.63743518	6.0%	0.21 [0.06, 0.73]	2010
COBIS	-0.54220678	0.51962228	8.4%	0.58 [0.21, 1.61]	2011
MATRIX	-0.30449494	0.35192348	14.8%	0.74 [0.37, 1.47]	2011
EXCELLENT	0.51266225	0.72907104	4.7%	1.67 [0.40, 6.97]	2012
Hur	-0.70324853	0.17682651	28.8%	0.49 [0.35, 0.70]	2013
Chen	-2.4392	1.4827	1.2%	0.09 [0.00, 1.59]	2013
Subtotal (95% CI)			**100.0%**	**0.58 [0.42, 0.81]**	

Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 10.74$, df = 7 (P = 0.15); $I^2 = 35\%$

Test for overall effect: Z = 3.22 (P = 0.001)



Jang, et al JACC Int 2014 (epub)

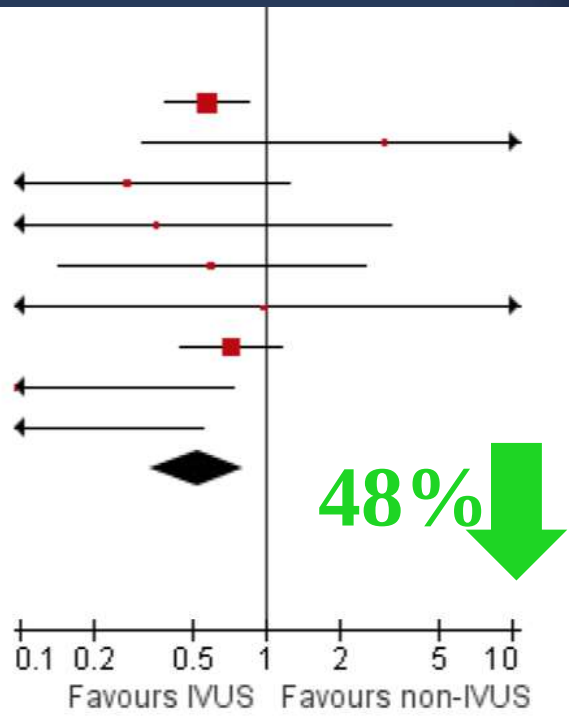
DES: IVUS vs Angio guidance

N= 13,545 (9 Propensity studies) odds of Stent Thrombosis

2.1.6 Stent thrombosis					
Roy	-0.5543	0.2032	35.6%	0.57 [0.39, 0.86]	2008
MAIN-COMPARE	1.1126	1.1607	3.5%	3.04 [0.31, 29.59]	2009
Kim	-1.29513358	0.77464543	7.3%	0.27 [0.06, 1.25]	2010
COBIS	-1.02630244	1.11868044	3.8%	0.36 [0.04, 3.21]	2011
MATRIX	-0.5145	0.7328	8.0%	0.60 [0.14, 2.51]	2011
EXCELLENT	-0.02072359	1.42486655	2.4%	0.98 [0.06, 15.99]	2012
Hur	-0.33628027	0.2473006	31.2%	0.71 [0.44, 1.16]	2013
Chen	-2.3792	1.0569	4.2%	0.09 [0.01, 0.74]	2013
IRIS-DES	-2.71307537	1.07922308	4.0%	0.07 [0.01, 0.55]	2013
Subtotal (95% CI)			**100.0%**	**0.52 [0.34, 0.82]**	

Heterogeneity: Tau² = 0.10; Chi² = 11.06, df = 8 (P = 0.20); I² = 28%

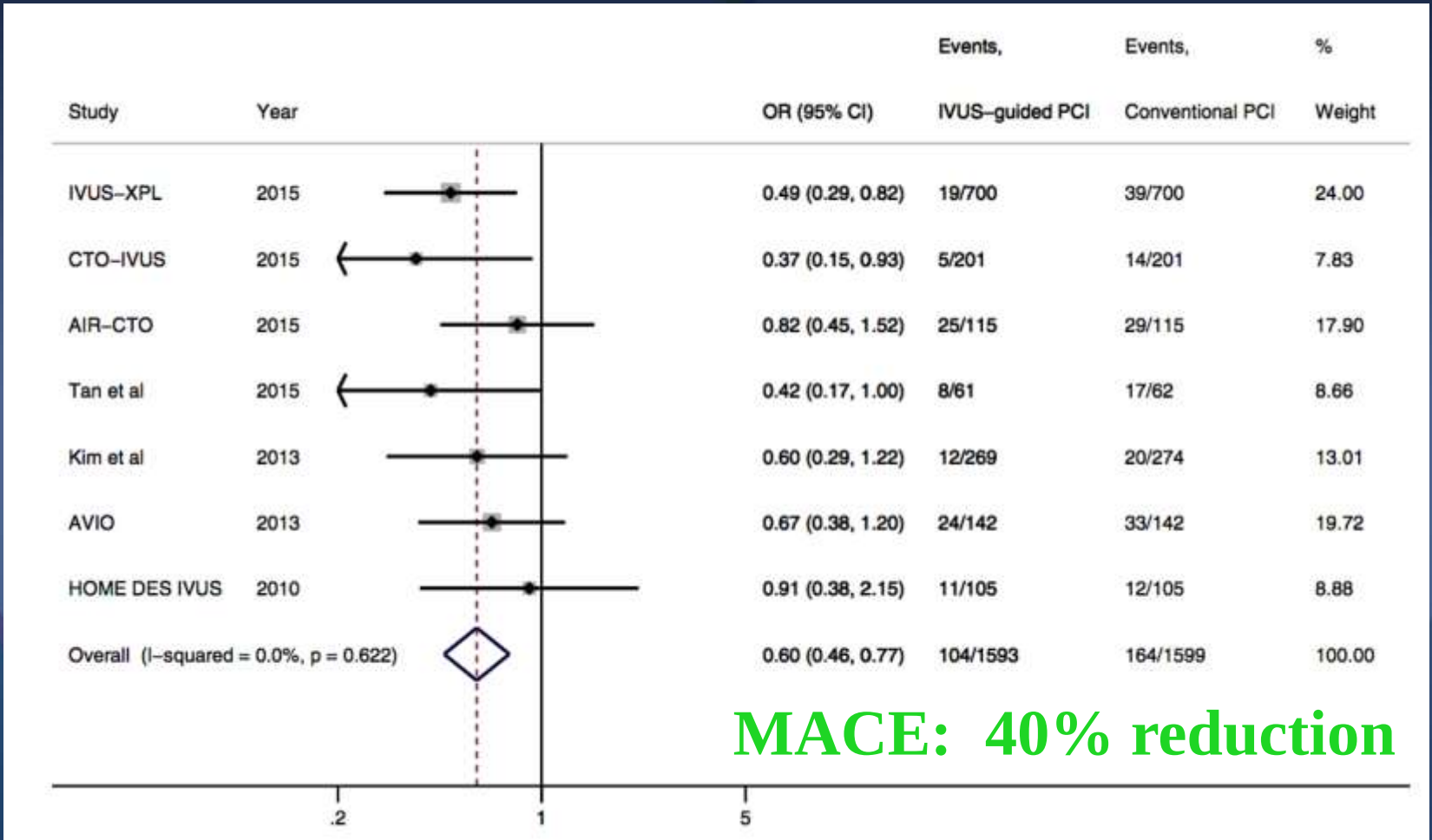
Test for overall effect: Z = 2.86 (P = 0.004)



Jang, et al JACC Int 2014 (epub)

Meta-analysis of Randomized DES trials

7 trials with 3192 patients including left main, CTO and long lesions

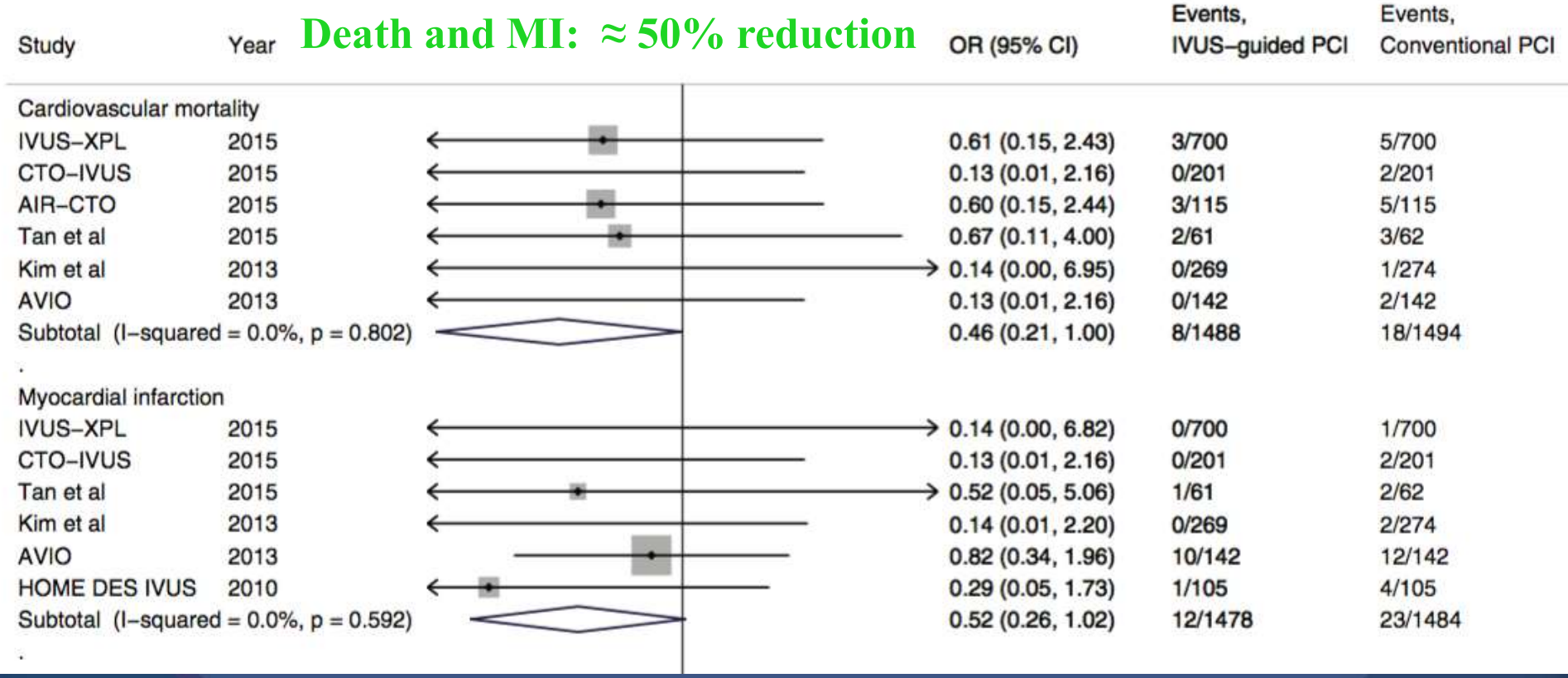


Circ Cardiovasc Interv. 2016;9:e003700

Meta-analysis of Randomized DES trials

7 trials with 3192 patients including left main, CTO and long lesions

Death and MI: ≈ 50% reduction

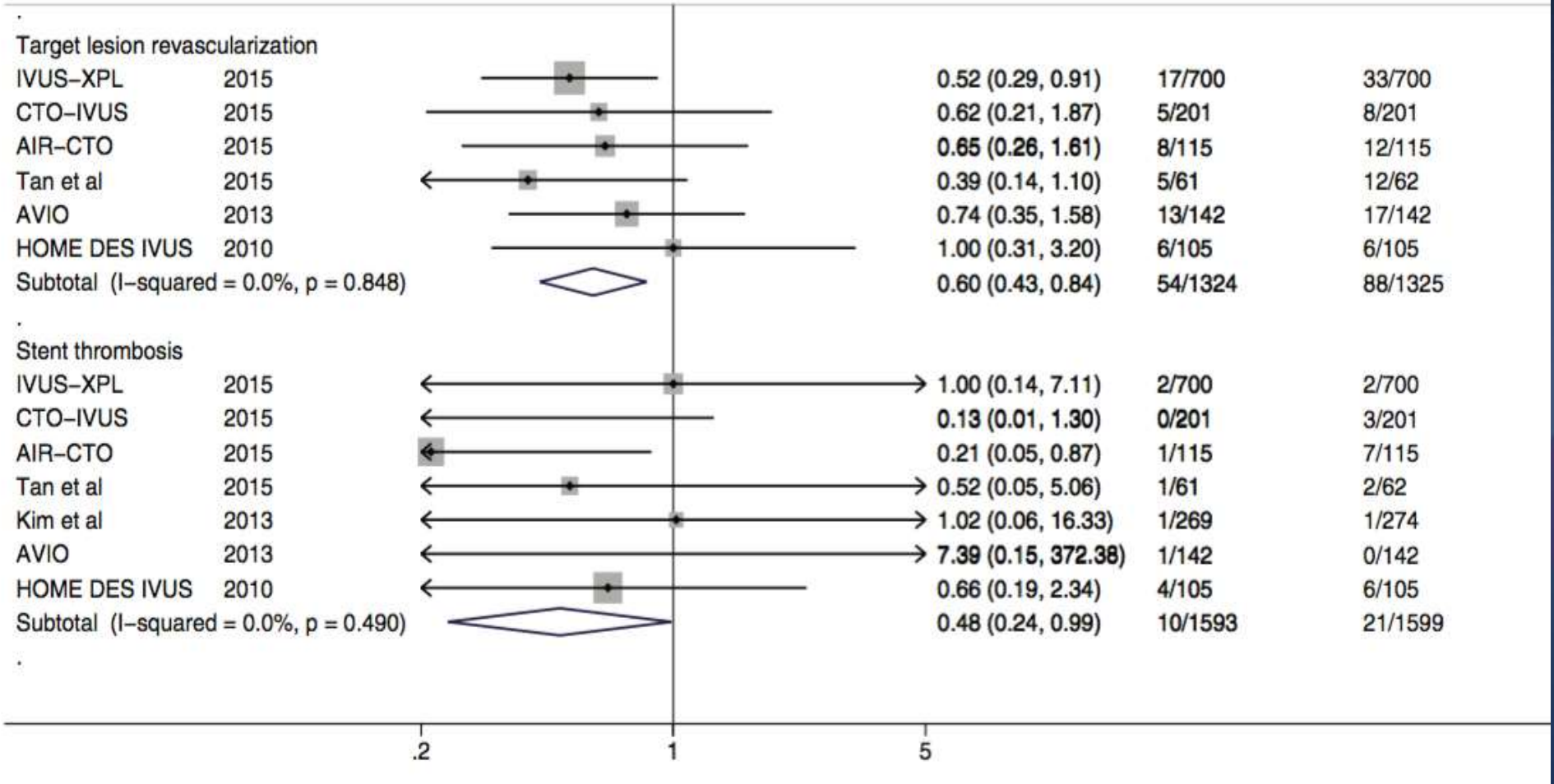


Study	Year	OR (95% CI)	Events, IVUS-guided PCI	Events, Conventional PCI
Cardiovascular mortality				
IVUS-XPL	2015	0.61 (0.15, 2.43)	3/700	5/700
CTO-IVUS	2015	0.13 (0.01, 2.16)	0/201	2/201
AIR-CTO	2015	0.60 (0.15, 2.44)	3/115	5/115
Tan et al	2015	0.67 (0.11, 4.00)	2/61	3/62
Kim et al	2013	0.14 (0.00, 6.95)	0/269	1/274
AVIO	2013	0.13 (0.01, 2.16)	0/142	2/142
Subtotal (I-squared = 0.0%, p = 0.802)		0.46 (0.21, 1.00)	8/1488	18/1494
Myocardial infarction				
IVUS-XPL	2015	0.14 (0.00, 6.82)	0/700	1/700
CTO-IVUS	2015	0.13 (0.01, 2.16)	0/201	2/201
Tan et al	2015	0.52 (0.05, 5.06)	1/61	2/62
Kim et al	2013	0.14 (0.01, 2.20)	0/269	2/274
AVIO	2013	0.82 (0.34, 1.96)	10/142	12/142
HOME DES IVUS	2010	0.29 (0.05, 1.73)	1/105	4/105
Subtotal (I-squared = 0.0%, p = 0.592)		0.52 (0.26, 1.02)	12/1478	23/1484

Circ Cardiovasc Interv. 2016;9:e003700

Meta-analysis of Randomized DES trials

7 trials with 3192 patients including left main, CTO and long lesions



Circ Cardiovasc Interv. 2016;9:e003700

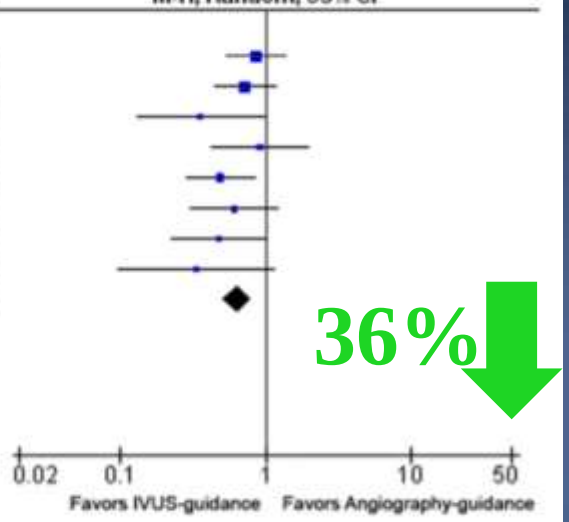
Randomized Trials: complex lesions

N=16 trials: MACE

Study or Subgroup	IVUS guided PCI Events	Total	Angiography guided PCI Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
1.1.1 MACE						
AIR-CTO, 2015	25	115	29	115	23.2%	0.86 [0.54, 1.38]
AVIO, 2013	24	142	33	142	22.9%	0.73 [0.45, 1.17]
CTO-IVUS, 2015	5	201	14	201	5.1%	0.36 [0.13, 0.97]
HOME DES IVUS, 2010	11	105	12	105	8.5%	0.92 [0.42, 1.98]
IVUS-XPL, 2015	19	700	39	700	17.6%	0.49 [0.28, 0.83]
RESET, 2013	12	269	20	274	10.5%	0.61 [0.30, 1.23]
Tan et al, 2015	8	61	17	62	8.8%	0.48 [0.22, 1.03]
Zhang et al, 2016	3	42	9	42	3.3%	0.33 [0.10, 1.15]
Subtotal (95% CI)		**1635**		**1641**	**100.0%**	**0.64 [0.51, 0.80]**
Total events	107		173			

Heterogeneity: Tau² = 0.00; Chi² = 6.67, df = 7 (*P* = .46); I² = 0%

Test for overall effect: Z = 3.88 (*P* = .0001)

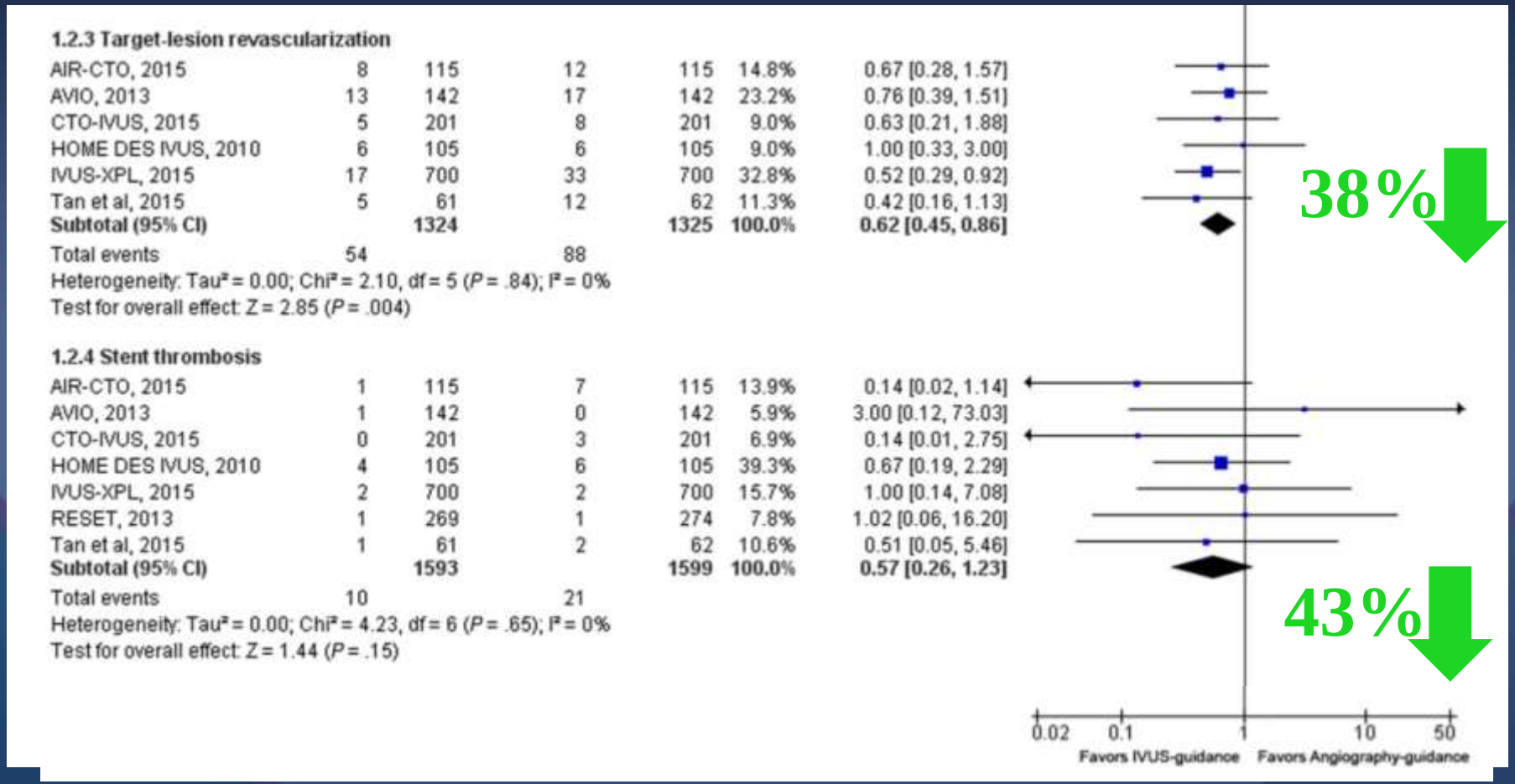


In meta-regression analysis, IVUS-guided PCI was of greatest benefit in reducing MACE in patients with acute coronary syndromes, diabetes, and long lesions

Am Heart J 2017;185:26-34.)

Randomized Trials: complex lesions

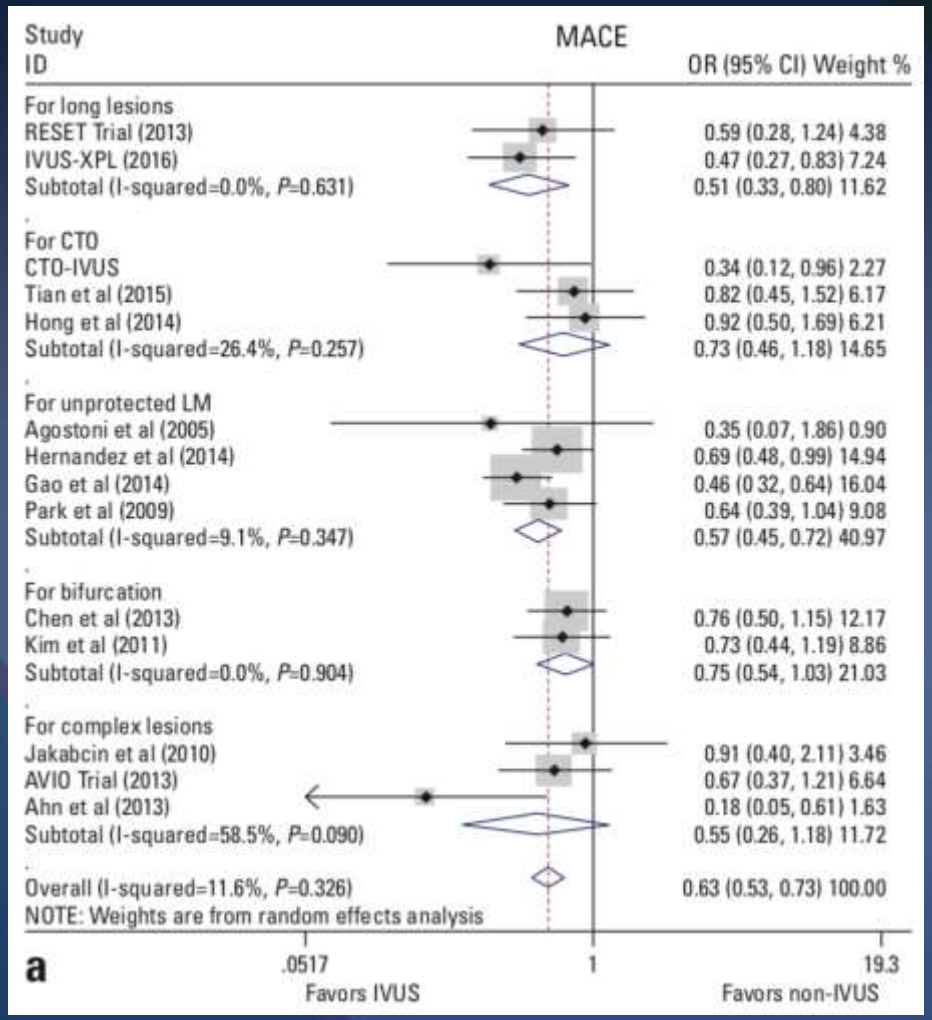
N=16 trials: TLR and ST

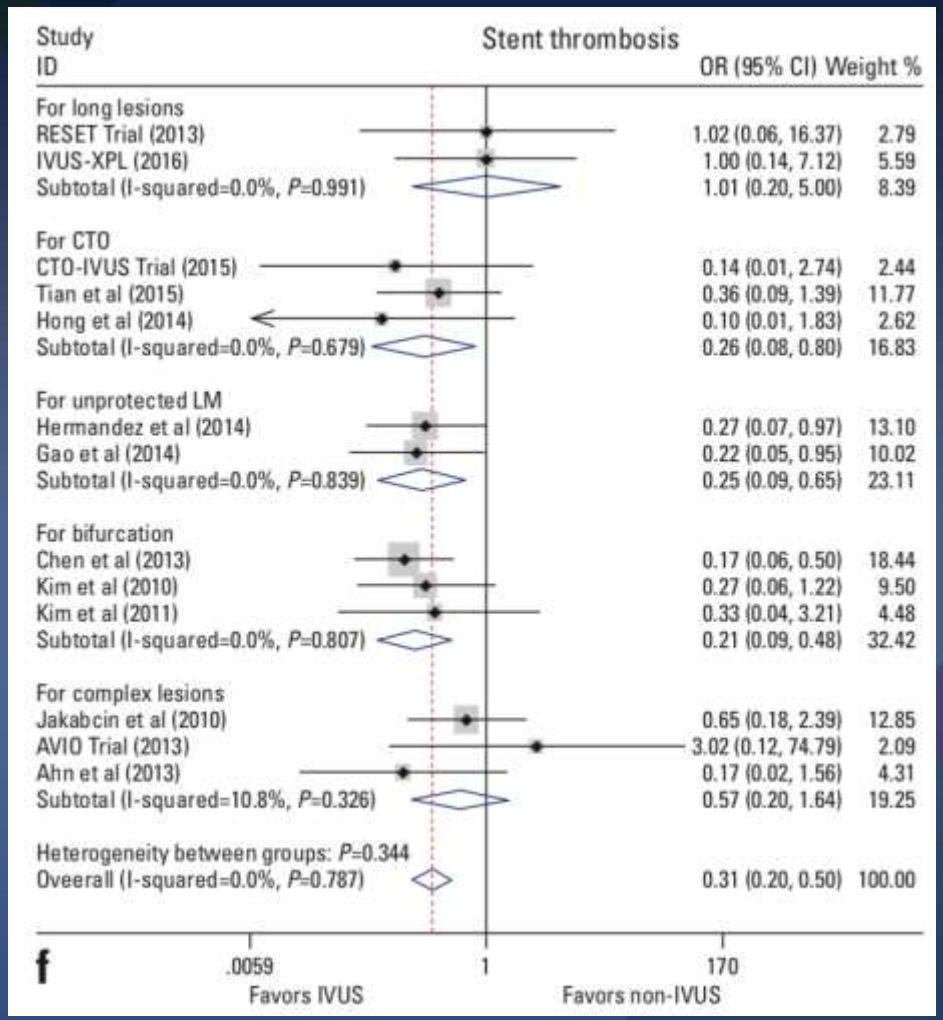


Am Heart J 2017;185:26-34.)

Complex lesions: long, CTO, LM, Bifurcations

Fifteen clinical trials involving 8,084 patients





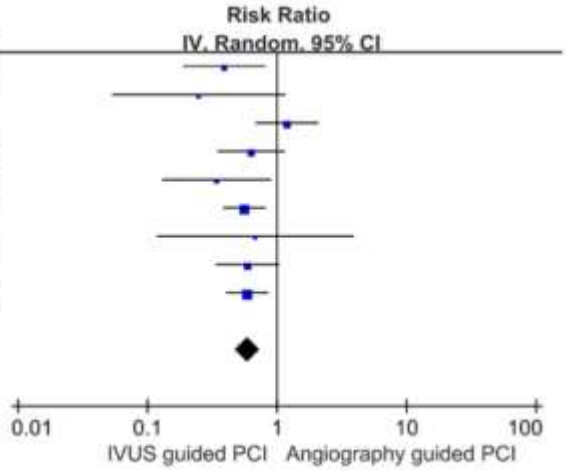
JG Fan, et al. Anatol J Cardiol 2017; 17: 258-68

Left Main: IVUS guidance reduces death

10 studies with 6480 patients

Study or Subgroup	IVUS guided PCI Events	Total	Angiography guided PCI Events	Total	Weight	Risk Ratio IV, Random, 95% CI	Year
Park SJ, et al. 2009	9	145	23	145	8.3%	0.39 [0.19, 0.82]	2009
Kinoshita N, et al. 2010	2	228	8	226	2.1%	0.25 [0.05, 1.15]	2010
Jama A, et al.2011	18	111	25	184	13.1%	1.19 [0.68, 2.09]	2011
Narbute I, et al. 2012	13	294	47	671	11.7%	0.63 [0.35, 1.15]	2012
Park SH, et al. 2012	5	90	15	92	5.1%	0.34 [0.13, 0.90]	2012
De La Torre Hernandez JM, et al.2014	37	505	66	505	22.3%	0.56 [0.38, 0.82]	2014
Tan Q, et al. 2015	2	61	3	62	1.6%	0.68 [0.12, 3.91]	2015
Tang Y, et al. 2016	16	713	45	1186	12.9%	0.59 [0.34, 1.04]	2016
Andell P, et al. 2017	37	340	63	340	22.8%	0.59 [0.40, 0.86]	2016
Total (95% CI)		**2487**		**3411**	**100.0%**	**0.60 [0.47, 0.75]**	
Total events	139		295				

Heterogeneity: Tau² = 0.02; Chi² = 9.89, df = 8 (P = 0.27); I² = 19%
Test for overall effect: Z = 4.45 (P < 0.00001)



B

Study or Subgroup	IVUS guided PCI Events	Total	Angiography guided PCI Events	Total	Weight	Risk Ratio IV, Random, 95% CI	Year
Park SH, et al. 2012	2	90	12	92	5.4%	0.17 [0.04, 0.74]	2012
Narbute I, et al. 2012	9	294	42	671	23.3%	0.49 [0.24, 0.99]	2012
De La Torre Hernandez JM, et al.2014	17	505	30	505	34.4%	0.57 [0.32, 1.01]	2014
Gao XF, et al. 2014	5	291	15	291	11.7%	0.33 [0.12, 0.91]	2014
Tan Q, et al. 2015	2	61	3	62	3.8%	0.68 [0.12, 3.91]	2015
Tang Y, et al. 2016	9	713	31	1186	21.5%	0.48 [0.23, 1.01]	2016
Total (95% CI)		**1954**		**2807**	**100.0%**	**0.47 [0.33, 0.66]**	
Total events	44		133				

Heterogeneity: Tau² = 0.00; Chi² = 2.87, df = 5 (P = 0.72); I² = 0%
Test for overall effect: Z = 4.35 (P < 0.0001)

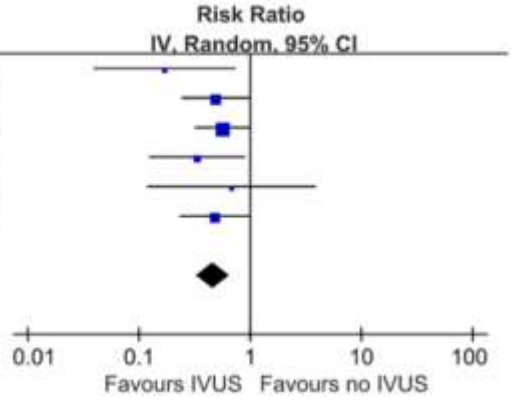


Fig 2. Forest plot of primary outcomes; (A) all-cause death; (B) cardiac death.

Y Ye, PLoS ONE 2017: 12(6): e0179756.

Review of the Meta-analyses

Table 1 Meta-analyses of registries and randomized-controlled trials of intravascular ultrasound versus angiography-guided drug-eluting stent

References	Follow-up (mean) (months)	RCT (*n*)	Non-RCT (*n*)	Patients	MACE	Death	MI	ST	TLR	TVR
Zhang *et al.* [40]	20.7	1 [1]	10 [10–20]	19 619	0.87 (0.78–0.96) *P*=0.008	0.59 (0.48–0.72) *P*<0.001	0.82 (0.63–1.06) *P*=0.13	0.58 (0.44–0.77) *P*<0.001	0.90 (0.73–1.11) *P*=0.3	0.90 (0.77–1.05) *P*=0.2
Klersy *et al.* [41]	20	3 [1–3]	15 [10–12,14,16,17,19–26]	18 707	0.80 (0.71–0.89) *P*<0.001	0.60 (0.48–0.74) *P*<0.001	0.59 (0.44–0.80) *P*=0.001	0.50 (0.32–0.80) *P*=0.007	0.95 (0.82–1.09) *P*=0.8	
Jang *et al.* [42]		3 [1–3]	12 [10–14,16–19,22,28,29]	24 869	0.79 (0.69–0.91) *P*=0.001	0.64 (0.51–0.81) *P*<0.001	0.57 (0.42–0.78) *P*<0.001	0.59 (0.42–0.82) *P*=0.002	0.76 (0.64–0.94) *P*=0.01	0.81 (0.68–0.95) *P*=0.01
Ahn *et al.* [43]	29	3 [1–3]	14 [10–14,16–19,22,28–31]	26 503	0.74 (0.64–0.85) *P*<0.001	0.61 (0.48–0.79) *P*<0.001	0.57 (0.44–0.75) *P*<0.001	0.59 (0.47–0.75) *P*<0.001	0.81 (0.66–1.00) *P*=0.046	0.82 (0.70–0.97) *P*=0.022
Zhang *et al.* [44]	20.8	3 [1–3]	17 [10–14,16–19,22,28–34]	29 068	0.77 (0.71–0.83) *P*<0.001	0.62 (0.54–0.71) *P*<0.001	0.64 (0.55–0.75) *P*<0.001	0.59 (0.47–0.73) *P*<0.001	0.81 (0.69–0.94) *P*=0.005	0.86 (0.77–0.97) *P*=0.012
Alsidawi *et al.* [45]	20	3 [1–3]	9 [10–14,16–19]	11 406	0.81 (0.71–0.91) *P*<0.01	0.65 (0.47–0.92) *P*<0.01	0.55 (0.36–0.84) *P*<0.01	0.65 (0.50–0.85) *P*<0.01		
Nerlekar *et al.* [46]		6 [1–4,6,7]	9 [10–14,17,19,33,35]	9313	0.73 (0.64–0.85) *P*<0.001	0.55 (0.36–0.83) *P*=0.005	0.67 (0.50–0.90) *P*=0.01	0.52 (0.38–0.72) *P*<0.001	0.66 (0.52–0.84) *P*<0.001	0.79 (0.64–0.98) *P*=0.04
Steinvil *et al.* [47]		7 [1–7]	18 [10–14,16–19,22,28–34, 36]	31 283	0.76 (0.70–0.82) *P*<0.001)	0.62 (0.54–0.72) *P*<0.001	0.67 (0.56–0.80) *P*<0.001	0.58 (0.47–0.73) *P*<0.001	0.77 (0.67–0.89) *P*=0.005	0.85 (0.76–0.95) *P*=0.005

Data presented as relative risk of events after IVUS versus angiographic guidance and 95% confidence intervals.
IVUS, intravascular ultrasound; MACE, major adverse cardiovascular events; MI, myocardial infarction; RCT, randomized clinical trial; TLR, target lesion revascularization; TVR, target vascular revascularization.

Note: all of the relative risks are <1.0: favoring IVUS guidance

Mintz, Coronary Artery Disease 2017, 28:346–352

Updated Bayesian Network Meta-analysis

31 studies:17,882 patients

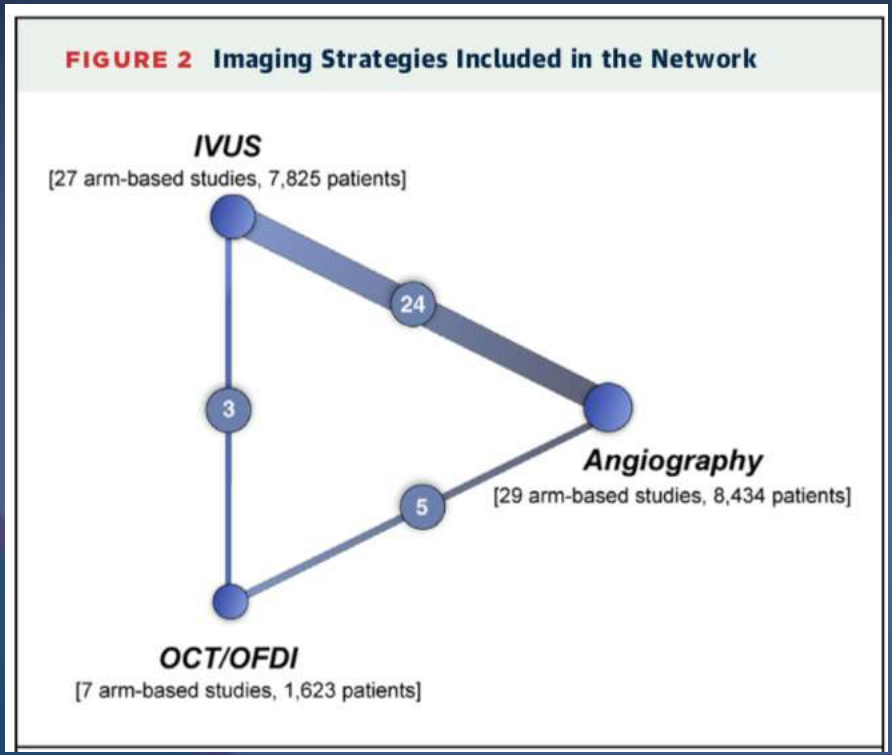


TABLE 3 Main Analysis for Secondary Endpoints

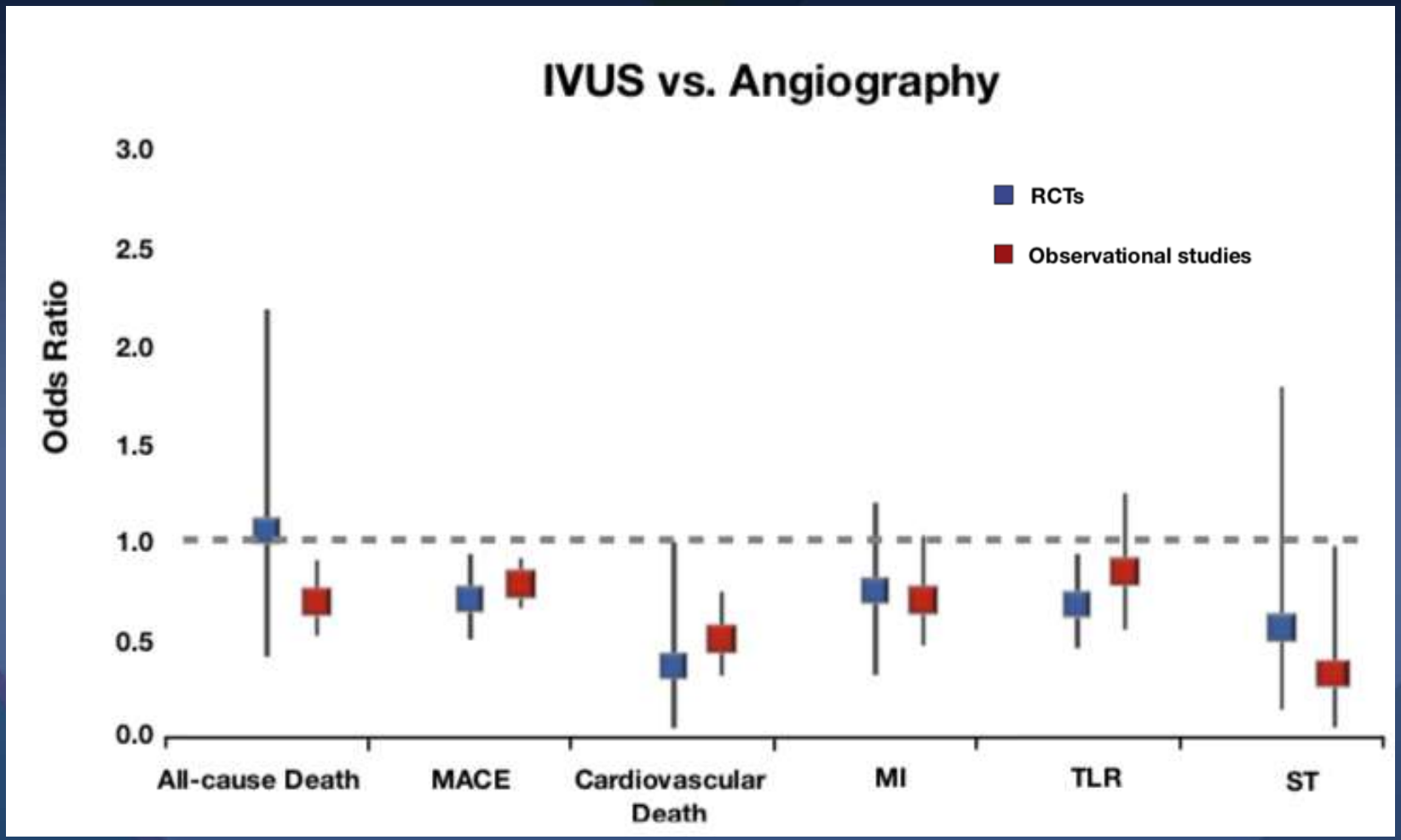
	Angiography	IVUS	OCT/OFDI
MACE			
Angiography	–	0.79 (0.67-0.91)	0.68 (0.49-0.97)
IVUS	1.30 (1.10-1.50)	–	0.87 (0.61-1.30)
OCT/OFDI	1.50 (1.00-2.00)	1.10 (0.78-1.60)	–
Cardiovascular death			
Angiography	–	0.47 (0.32-0.66)	0.31 (0.13-0.66)
IVUS	2.10 (1.50-3.10)	–	0.66 (0.27-1.50)
OCT/OFDI	3.20 (1.50-7.60)	1.50 (0.66-3.70)	–
Myocardial infarction			
Angiography	–	0.72 (0.52-0.93)	0.79 (0.44-1.40)
IVUS	1.40 (1.10-1.90)	–	1.10 (0.60-2.10)
OCT/OFDI	1.30 (0.72-2.30)	0.90 (0.47-1.70)	–
Target lesion revascularization			
Angiography	–	0.74 (0.58-0.90)	0.66 (0.35-1.20)
IVUS	1.40 (1.10-1.70)	–	0.88 (0.47-1.60)
OCT/OFDI	1.50 (0.83-2.90)	1.10 (0.61-2.10)	–
Stent thrombosis			
Angiography	–	0.42 (0.20-0.72)	0.39 (0.10-1.20)
IVUS	2.40 (1.40-5.10)	–	0.93 (0.24-3.40)
OCT/OFDI	2.60 (0.80-10.0)	1.10 (0.29-4.20)	–

Orange cells indicate a significant increased risk for the outcome of interest, whereas **blue cells** indicate a significant reduction in the risk of experiencing an adverse event.

MACE = major adverse cardiac event(s); other abbreviations as in Figure 1.

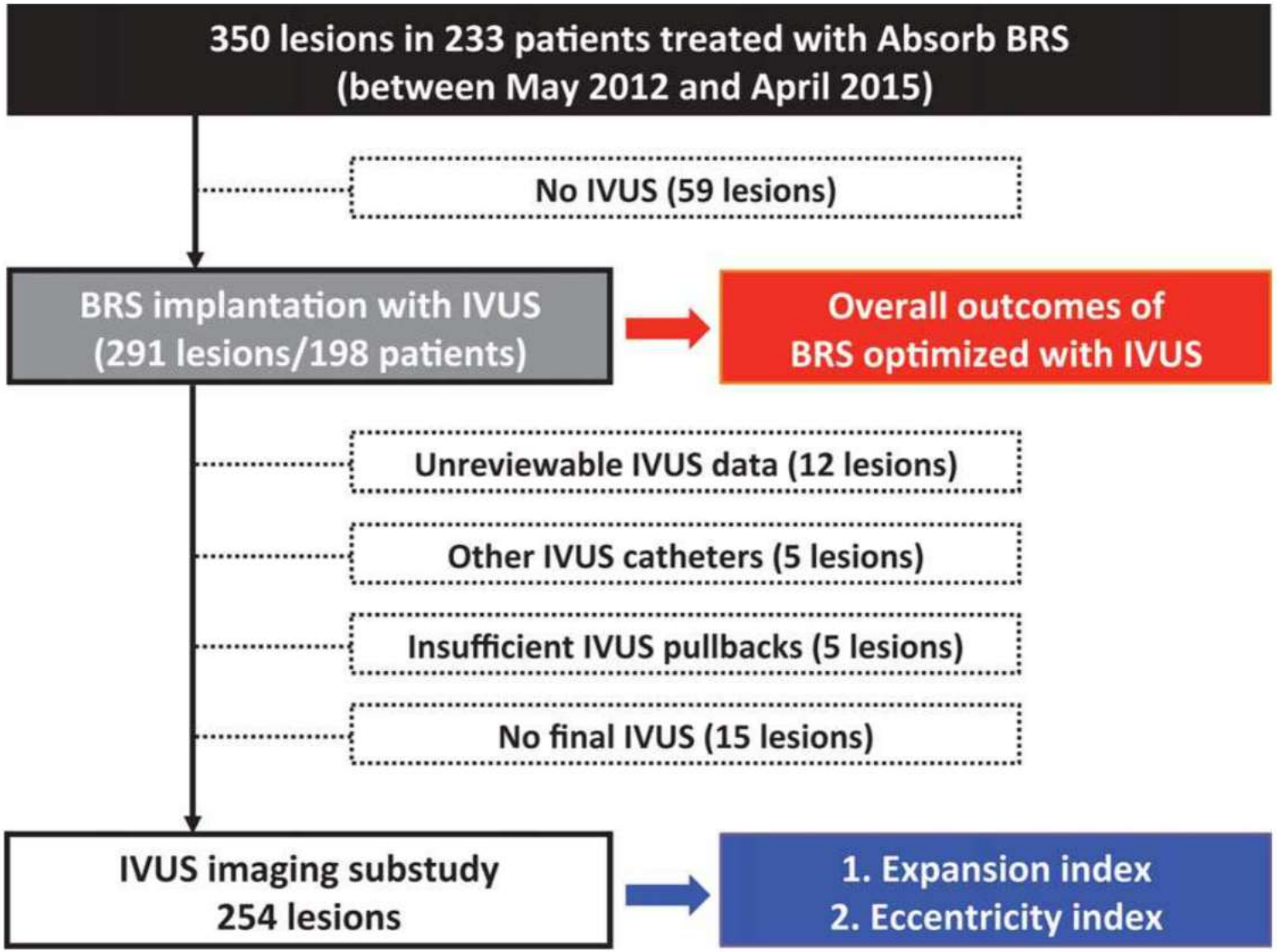
J Am Coll Cardiol Intv 2017;10:2488–98

Consistent results



J Am Coll Cardiol Intv 2017;10:2488–98

Original Studies



CCI 2017;89:789–797

Original Studies

Expansion in Calcific Lesions and Overall Clinical Outcomes following Bioresorbable Scaffold Implantation Optimized With Intravascular Ultrasound

Hiroyoshi Kawamoto,[1,2,3] MD, Neil Ruparelia,[1,2,4] DPHIL, MRCP, Azeem Latib,[1,2] MD, Tadashi Miyazaki,[5] MD, Katsumasa Sato,[6] MD, Akihito Tanaka,[1,2] MD, Toru Naganuma,[3] MD, Alessandro Sticchi,[1] MD, Alaide Chieffo,[1] MD, Mauro Carlino,[1] MD, Matteo Montorfano,[1] MD, and Antonio Colombo,[1,2*] MD

Mean Atm: 20.9
Repeat PCI post IVUS: 30%

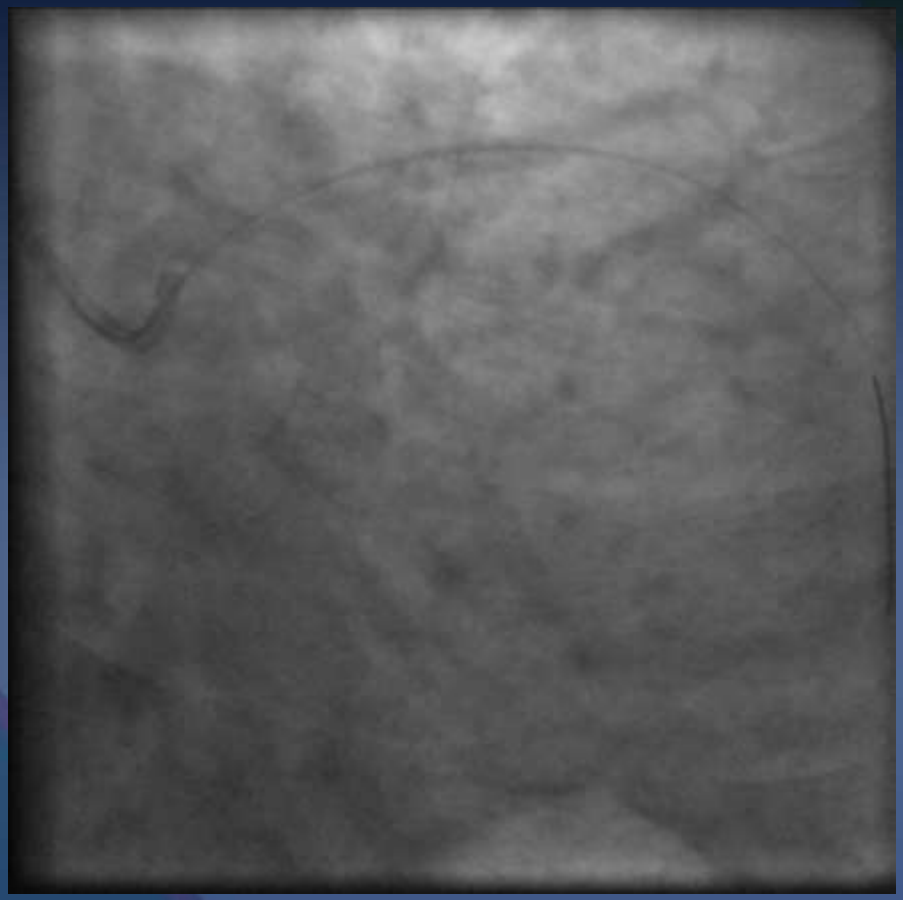
1 year TLR: 7.5% (7.8%)
Stent thrombosis: 0.5% (1.5%)

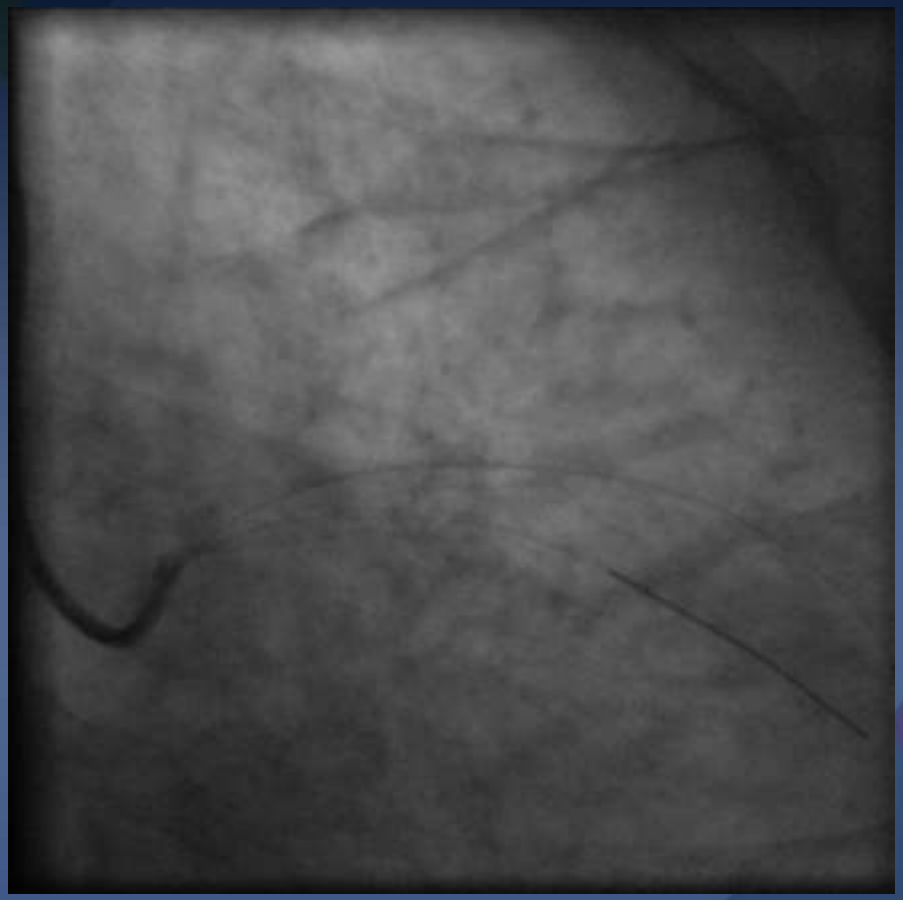
ABSORB III

CCI 2017;89:789–797

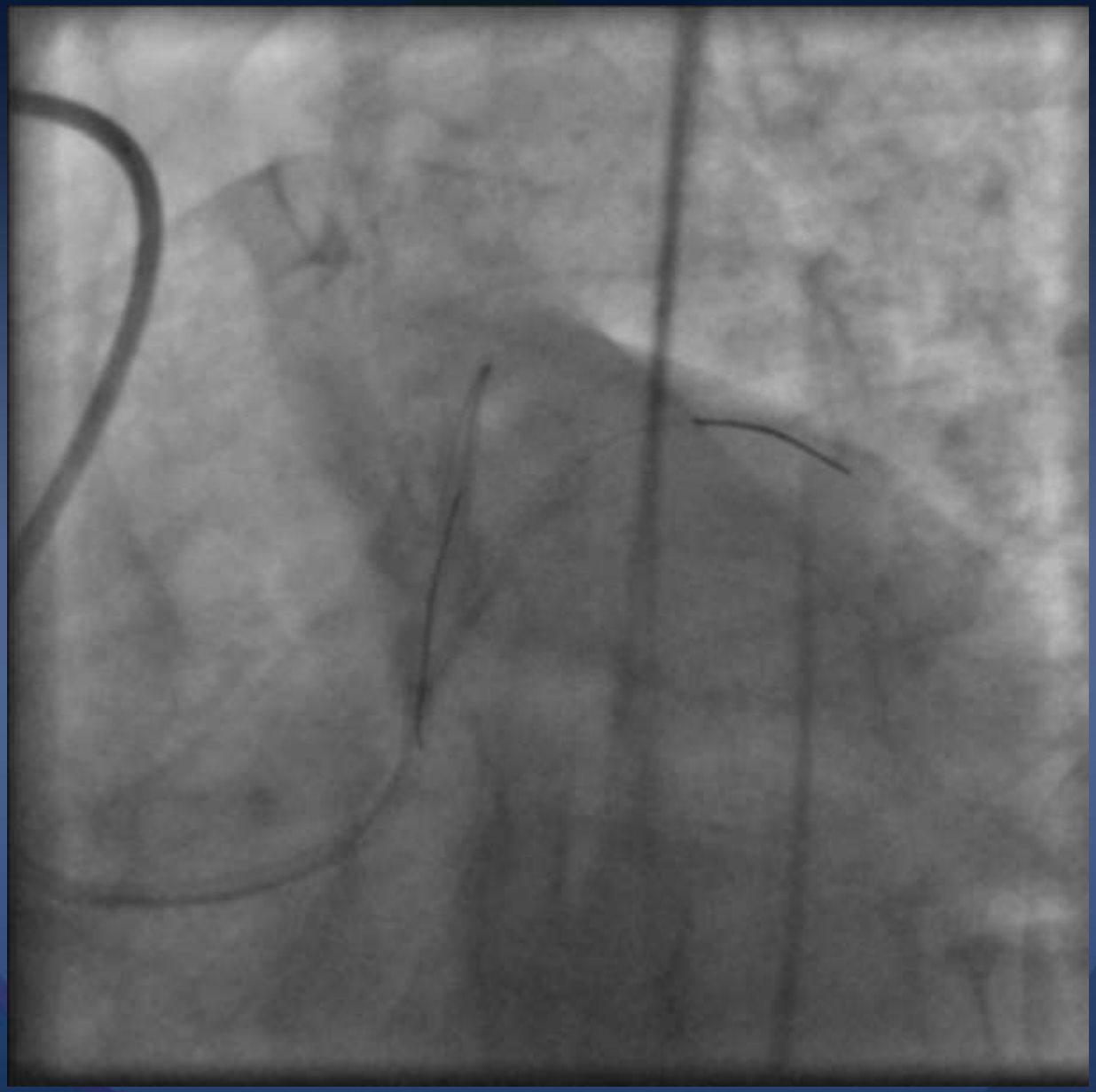
2018, academic center, STEMI PCI

Culprit LAD fixed; elected to do Diagonal

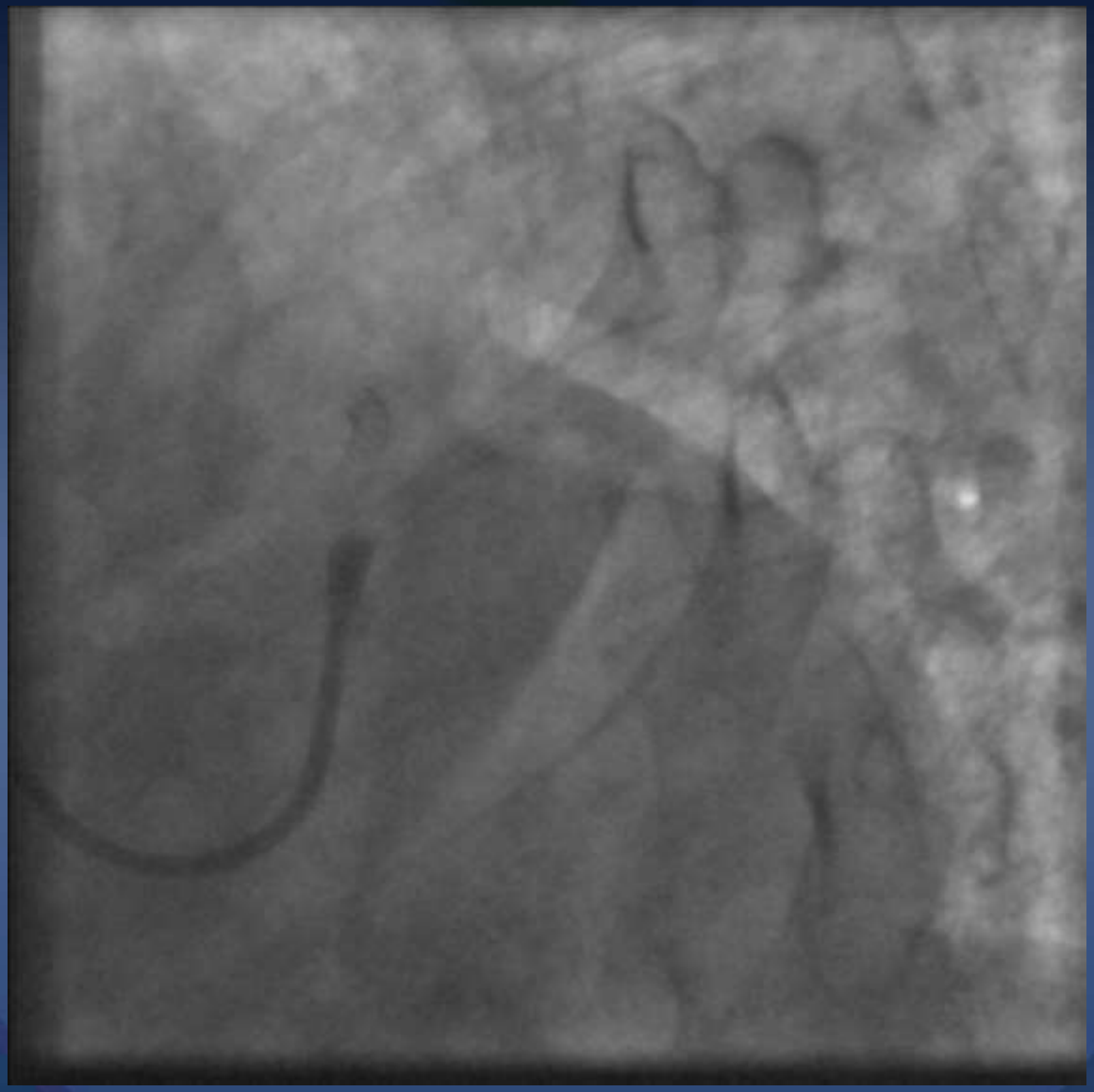




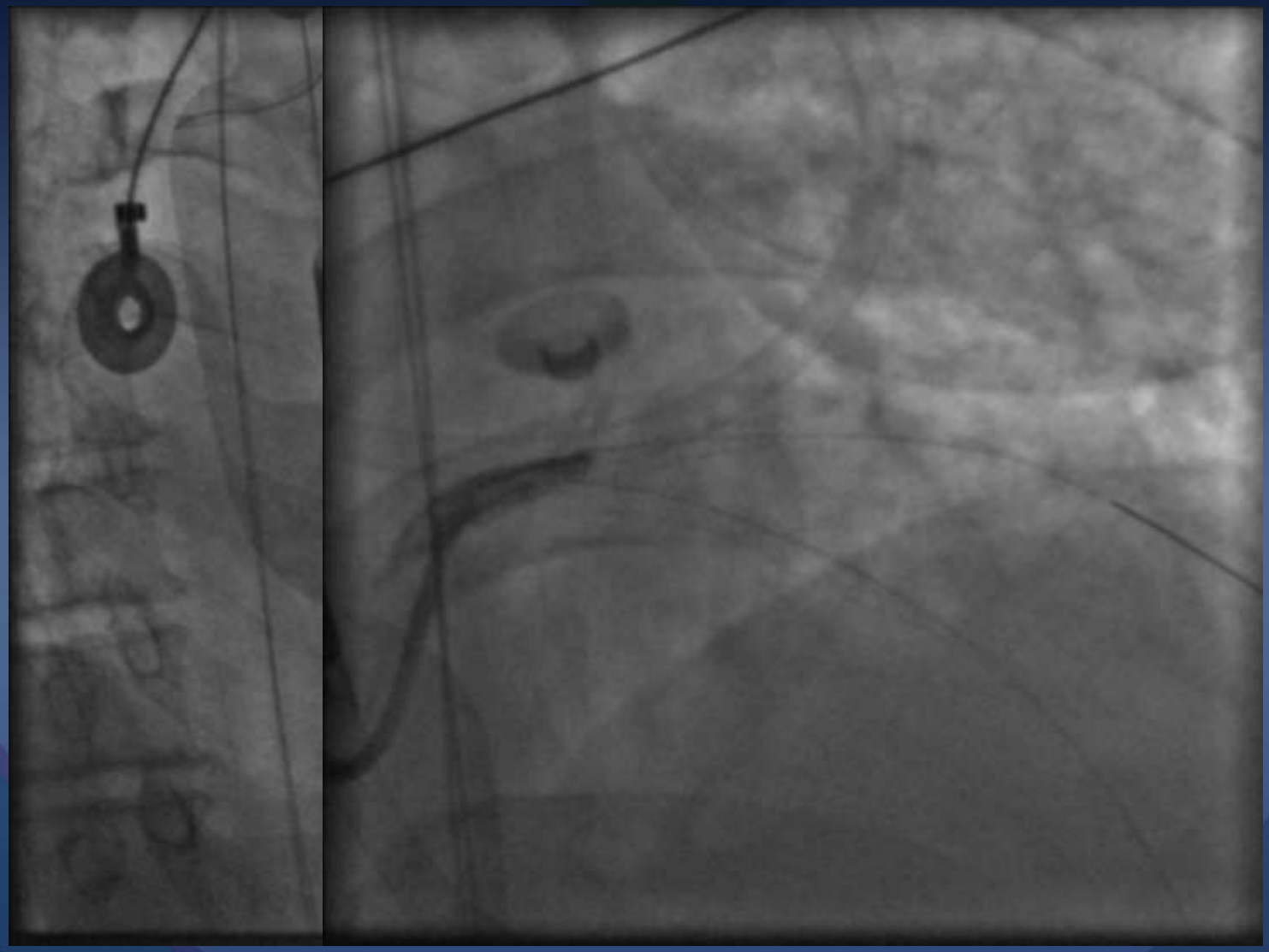
Post LAD and Diag stents at 14atm



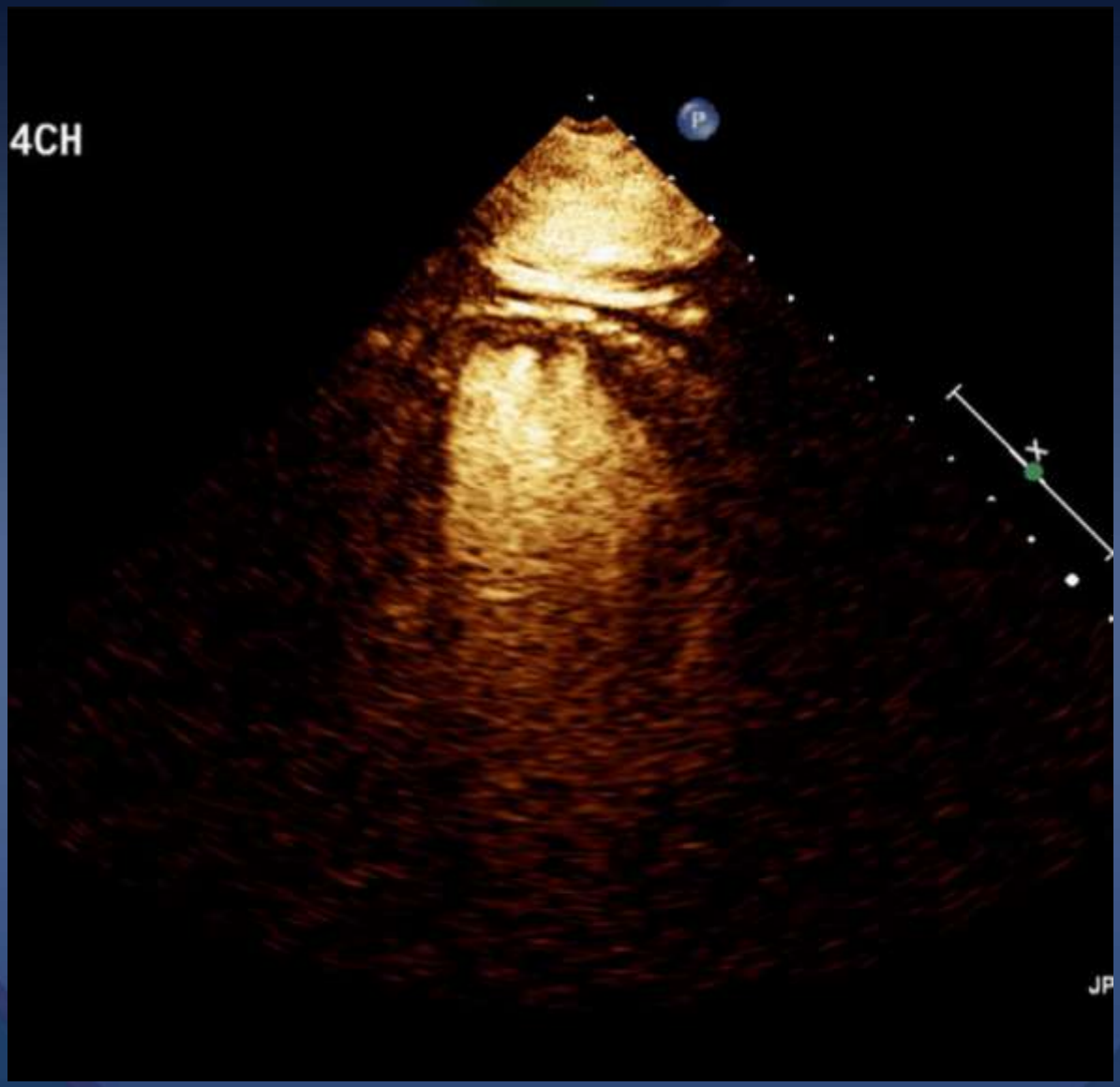
3 hours later



Shock, Impella, IVUS guidance



10 days on VAD support, awaiting transplant



Summary

- IVUS guidance of BMS, DES improves hard outcomes of MI, TLR, SAT and Death.
- IVUS facilitates LM stenting, CTO PCI, complication management.
- Despite these data, IVUS use by interventional physicians is appallingly low.

PCI without IVUS: