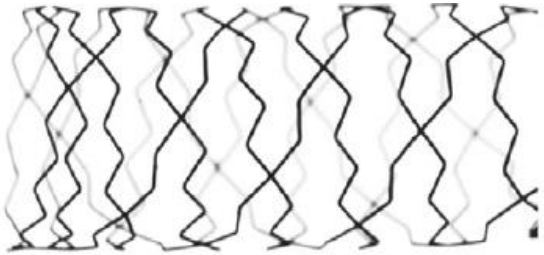
TCTAP 2019

Delivering More Innovation of the Interventional Portfolio, Further Together

Seoul, Korea, 29 April 2019

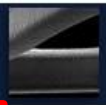
The Way to Be More Familiar with Onyx: Lessens from BIONYX & KAMIR



Yongcheol Kim

Chonnam National University Hospital, Gwangju, Korea

Thin composite wire strut, durable polymer-coated (Resolute Onyx) versus ultrathin cobalt–chromium strut, bioresorbable polymer-coated (Orsiro) drug-eluting stents in allcomers with coronary artery disease (BIONYX): an international, single-blind, randomised non-inferiority trial

	Resolute Onyx 	Orsiro 
Coating characteristics	**Durable**	**Bioresorbable**
Bare strut thickness, µm	**81 / 91** (≤ 4.0 / ≥ 4.5 mm stents)	**60 / 80** (≤ 3.0 / ≥ 3.5 mm stents)
Coating thickness, µm	**5.6** (conformal)	**7.4 / 3.5** (ab-/luminal)
Coated strut thickness*, µm	**92**	**71**
Stent platform	**swaged shape core wire from platinum-iridium surrounded by cobalt-chromium alloy** 	**cobalt-chromium alloy**
Polymer	**BioLinx®**, a blend of hydrophobic C10, hydrophilic C19, and poly-vinyl pyrolidone	**PLLA** (poly [L-lactide] acid) (**BIOlute®**), on thin amorphous silicon carbide (proBIO®)
Drug	**Zotarolimus**	**Sirolimus**
Drug release time, months	**6**	**3.3**
Degradation time, months	**–**	**< 24**
Available stent diameters	**2.0 – 5.0**	**2.25 – 4.0**

Lancet 2018;392:1235-1245

BIONYX: Trial Design

All-comer patients (2015.10.07~2016.12.23)

- Inclusion criteria: Pat. ≥ 18 yrs.; PCI with DES required; informed consent; ability and willingness to comply with study procedures and follow-up
- Exclusion criteria: Participation in RCT of CV devices, DAPT, anti-thrombotics or anticoagulants before reaching primary EP; life expectancy < 1 y ear; planned surgery <3 mo. preventing maintenance of DAPT; known pregnancy; known intolerance to DES, anticoagulants or antiplatelet drugs, preventing DAPT

2,488 patients were 1:1 randomized

Zotarolimus-eluting	Sirolimus-eluting
RESOLUTE ONYX	ORSIRO
(N = 1243)	(N = 1245)

1-year clinical outcomes

- Primary endpoint: Target Vessel Failure (CD, TV-MI, or ID-TVR)
- Secondary endpoints: individual component of the primary outcomes, all death, all MI, any revascularization, major bleeding, stent thrombosis
- Additional composite endpoints: TLF (CD, TV-MI, or ID-TLR), MACE (all death, all MI, emergent CABG, ID-TLR) POCE (all death, all MI, any revascularization)

*** Equally funded by Medtronic and Biotronik ***

Baseline Characteristics

	All patients n = 2,488	Resolute Onyx n = 1,243	Orsiro n = 1,245
Age (yrs.)	64.0 ± 11.0	64.1 ± 10.9	63.9 ± 11.2
Women	23.9 %	23.9 %	23.9 %
BMI (kg/m²)	27.9 ± 4.4	27.9 ± 4.4	28.0 ± 4.4
Current smoker	30.6 %	30.6 %	30.7 %
Family history of coronary artery disease	43.5 %	44.7 %	42.2 %
Diabetes, medically treated	20.5 %	20.9 %	20.1 %
Hypertension	51.5 %	49.8 %	53.2 %
Hypercholesterolemia	45.9 %	45.4 %	46.4 %
Previous myocardial infarction	16.1 %	15.6 %	16.5 %
Previous percutaneous revascularization	21.7 %	21.1 %	22.3 %
Previous coronary bypass surgery	7.1 %	6.4 %	7.8 %
Acute coronary syndrome ★	70.9 %	70.8 %	71.1 %
Acute myocardial infarction ★	51.2 %	50.4 %	52.1 %
STEMI ★	25.0 %	22.7 %	27.2 %
NSTEMI	26.3 %	27.7 %	24.9 %
Unstable angina	19.7 %	20.4 %	19.0 %
Stable angina or silent ischemia	29.1 %	29.2 %	28.9 %

Lesion Characteristics

	All lesions n = 3,239	Resolute Onyx n = 1,646	Orsiro n = 1,593
Target lesion coronary artery			
Left main	1.5 %	1.5 %	1.4 %
Left anterior descending	41.4 %	41.2 %	41.6 %
Left circumflex	23.8 %	24.3 %	23.4 %
Right coronary artery	33.1 %	32.9 %	33.3 %
Bypass graft	1.4 %	1.2 %	1.6 %
ACC/AHA lesion class	3,235	1,644	1,591
A/B1	30.3 %	30.4 %	30.2 %
B2/C ★	69.7 %	69.6 %	69.8 %
Bifurcation ★	31.9 %	31.3 %	32.5 %
Severe calcification	15.5 %	15.0 %	16.0 %
In-stent restenosis	2.3 %	2.9 %	1.8 %
Chronic total occlusion	3.5 %	3.1 %	4.0 %
Number of stents per lesion	1.26 ± 0.56	1.27 ± 0.55	1.26 ± 0.57
Implantation of assigned stents only	98.3 %	98.6 %	98.0 %

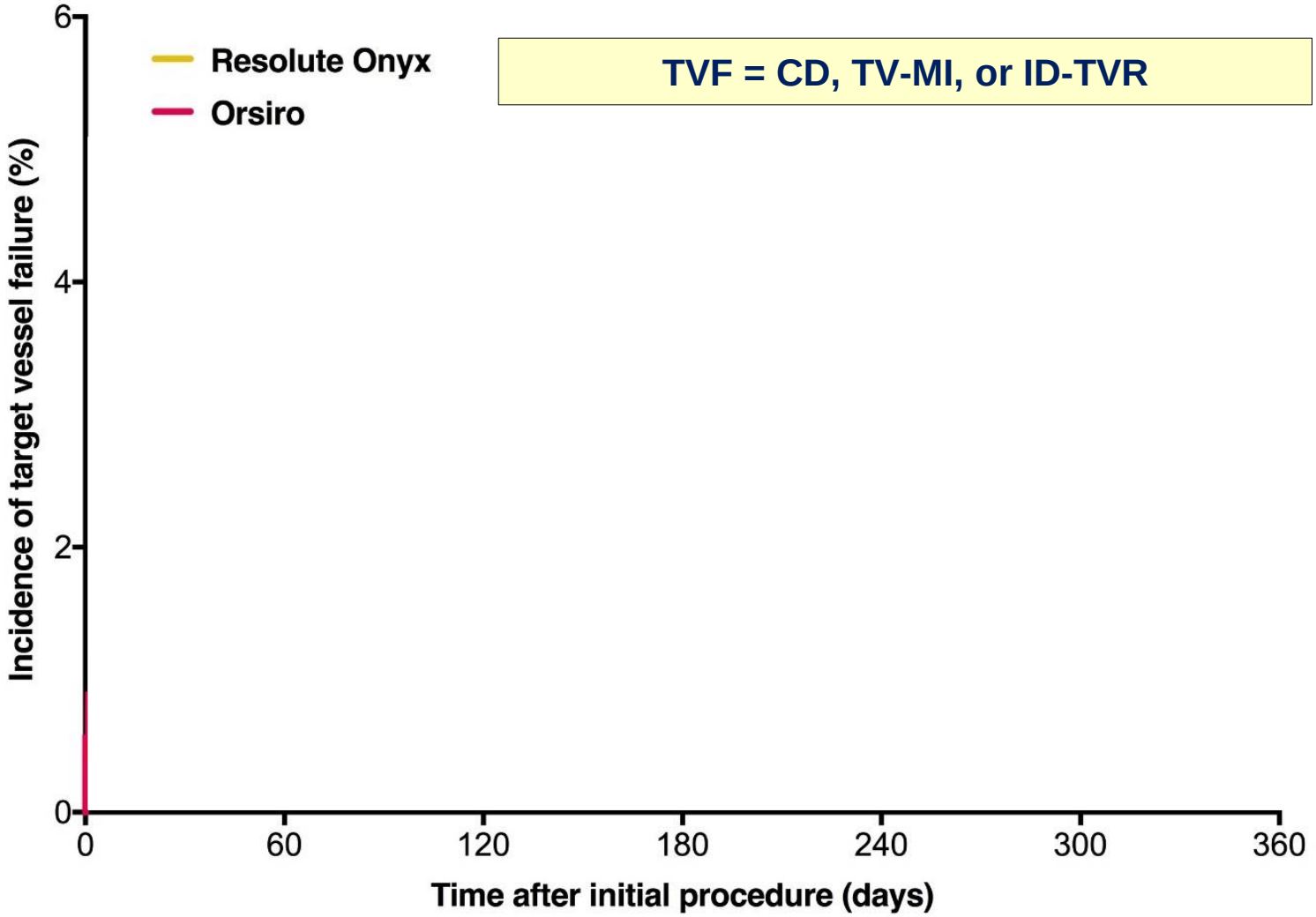
Procedural Data (1)

	All lesions n = 3,239	Resolute Onyx n = 1,646	Orsiro n = 1,593
Total number of lesions treated per patient			
1 lesion	75.2 %	73.5 %	76.9 %
2 lesions	20.1 %	21.2 %	19.1 %
3 or more lesions	4.7 %	5.4 %	4.0 %
Multivessel treatment ★	17.7 %	19.0 %	16.5 %
At least one chronic total occlusion	4.5 %	4.0 %	5.0 %
At least one bifurcation lesion	39.4 %	39.0 %	39.8 %
At least one in-stent restenosis	2.9 %	3.5 %	2.2 %
At least one small-vessel (RVD < 2.75 mm)	52.3 %	54.3 %	50.3 %
At least one long lesion (> 27 mm)	21.0 %	19.7 %	22.3 %
Total stent length (mm) per patient ★	30 (18-48)	30 (18-49)	30 (18-48)
Radial approach	73.1 %	73.5 %	72.6 %
Total number of lesions treated per patient			
1 lesion	75.2 %	73.5 %	76.9 %
2 lesions	20.1 %	21.2 %	19.1 %

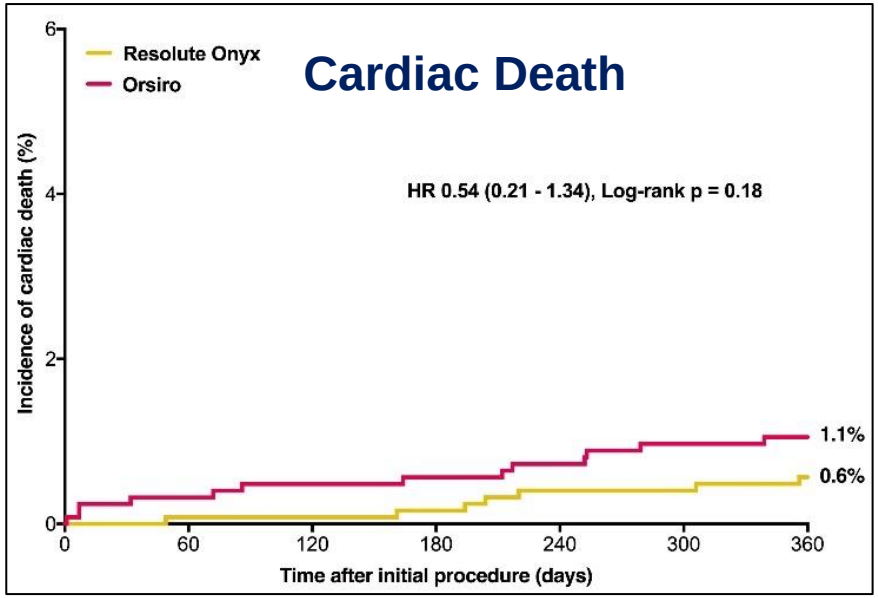
Procedural Data (2)

	All lesions n = 3,239	Resolute Onyx n = 1,646	Orsiro n = 1,593
Preprocedural			
Lesion length (mm)	15.4 (11.3-23.2)	15.3 (10.9-22.9)	15.6 (11.2-23.7)
Minimum lumen diameter (mm)	0.75 (0.46-1.05)	0.75 (0.48-1.04)	0.74 (0.43-1.06)
Reference vessel diameter (mm)	2.81 (0.56)	2.79 (0.57)	2.83 (0.56)
Stenosis (lumen diameter, %)	72.3 (61.5-83.0)	72.0 (61.2-82.1)	72.7 (61.8-84.4)
Procedural			
Implantation of study stents only	98.3 %	98.6 %	98.0 %
Number of stents implanted per lesion	1.26 (0.56)	1.27 (0.55)	1.26 (0.57)
Postdilatation	64.0 %	63.5 %	64.5 %
Postprocedural			
Minimum lumen diameter (mm)	2.41 (0.53)	2.41 (0.54)	2.41 (0.52)
Stenosis (lumen diameter, %)	12.7 (8.2-18.3)	12.4 (8.1-17.8)	13.0 (8.5-18.9)
Acute gain in segment (mm)	1.67 (0.63)	1.65 (0.62)	1.68 (0.64)
Device success★	98.1 %	98.4 %	97.8 %
Lesion success	99.7 %	99.7 %	99.6 %

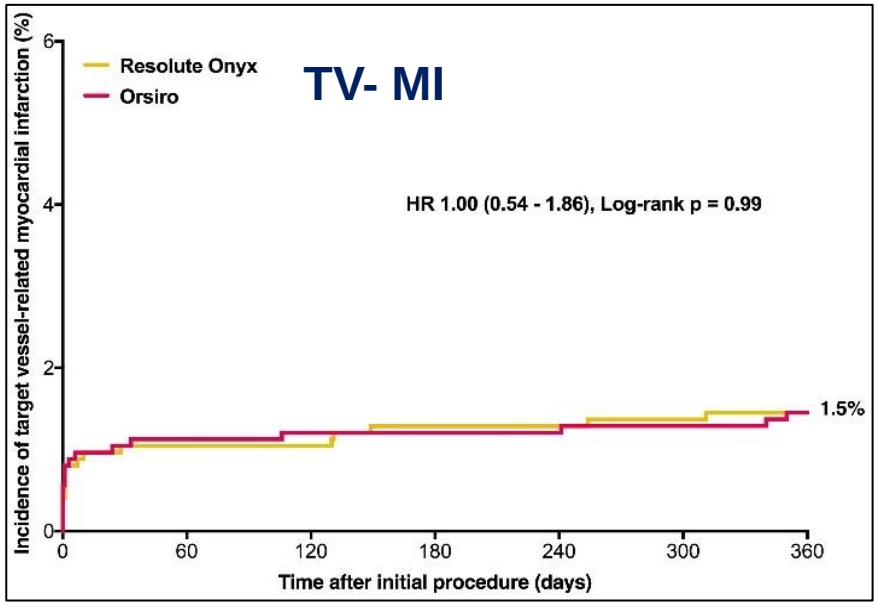
Primary Endpoint (TVF)

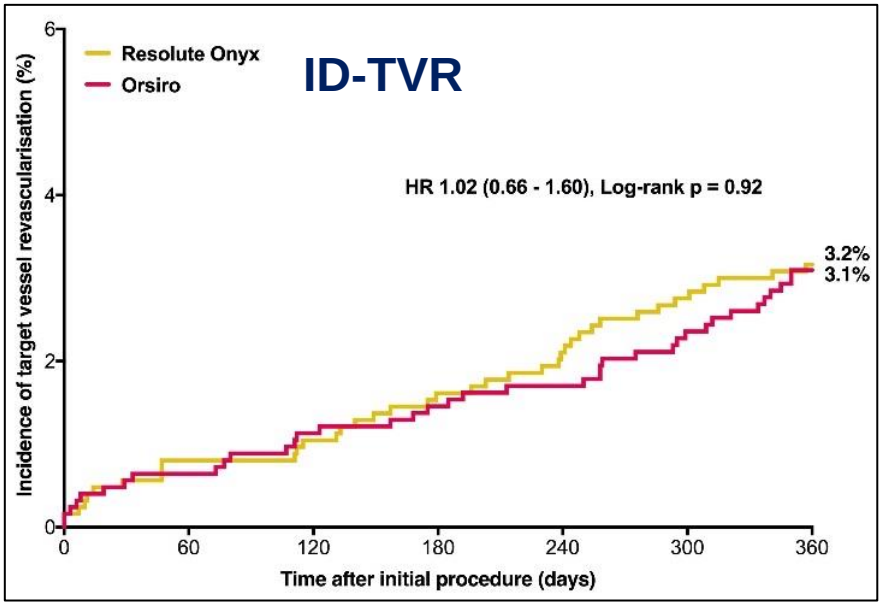


Components of TVF

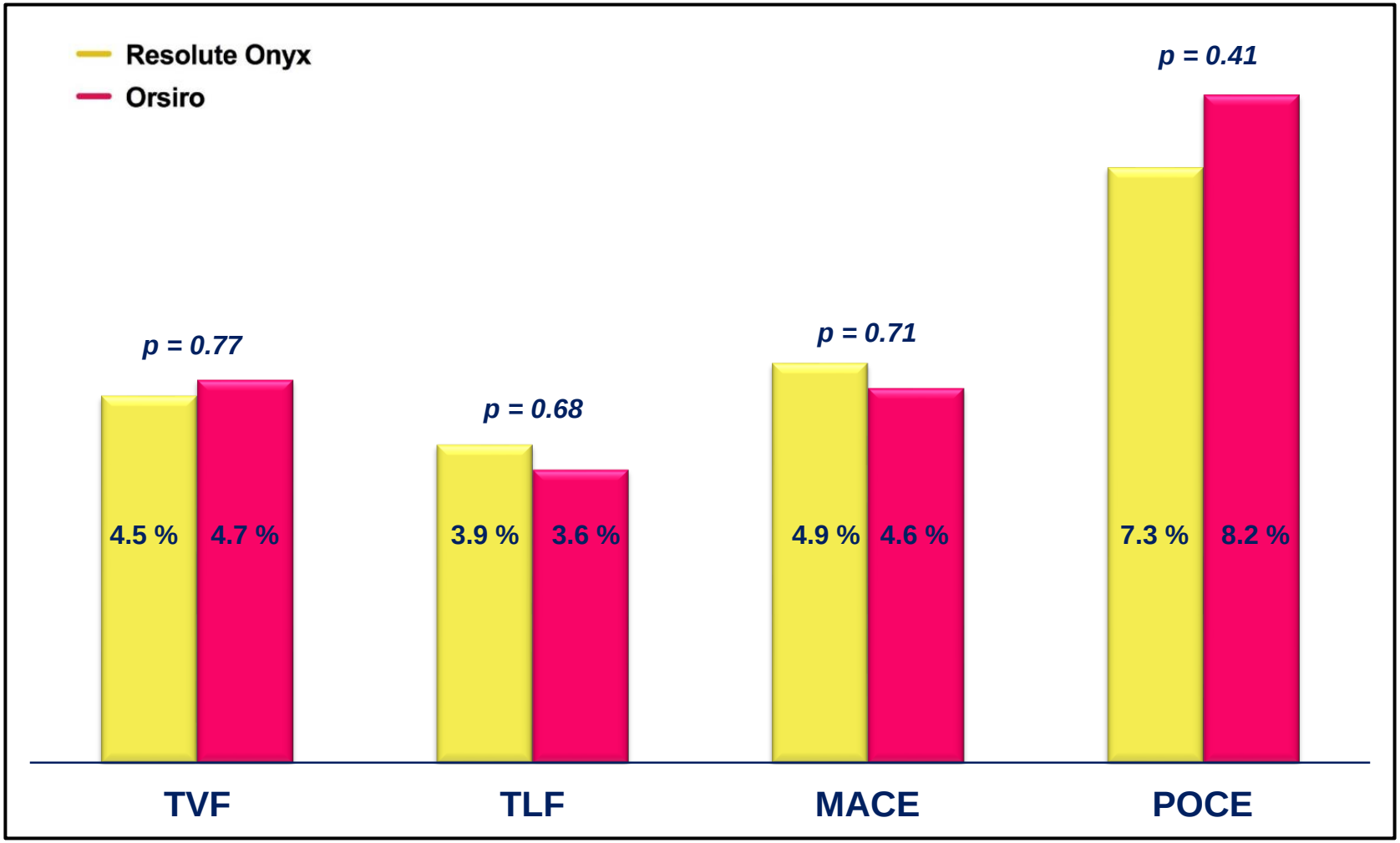


At 1-year follow-up, there was no statistically significant difference between stent groups in the components of TVF.

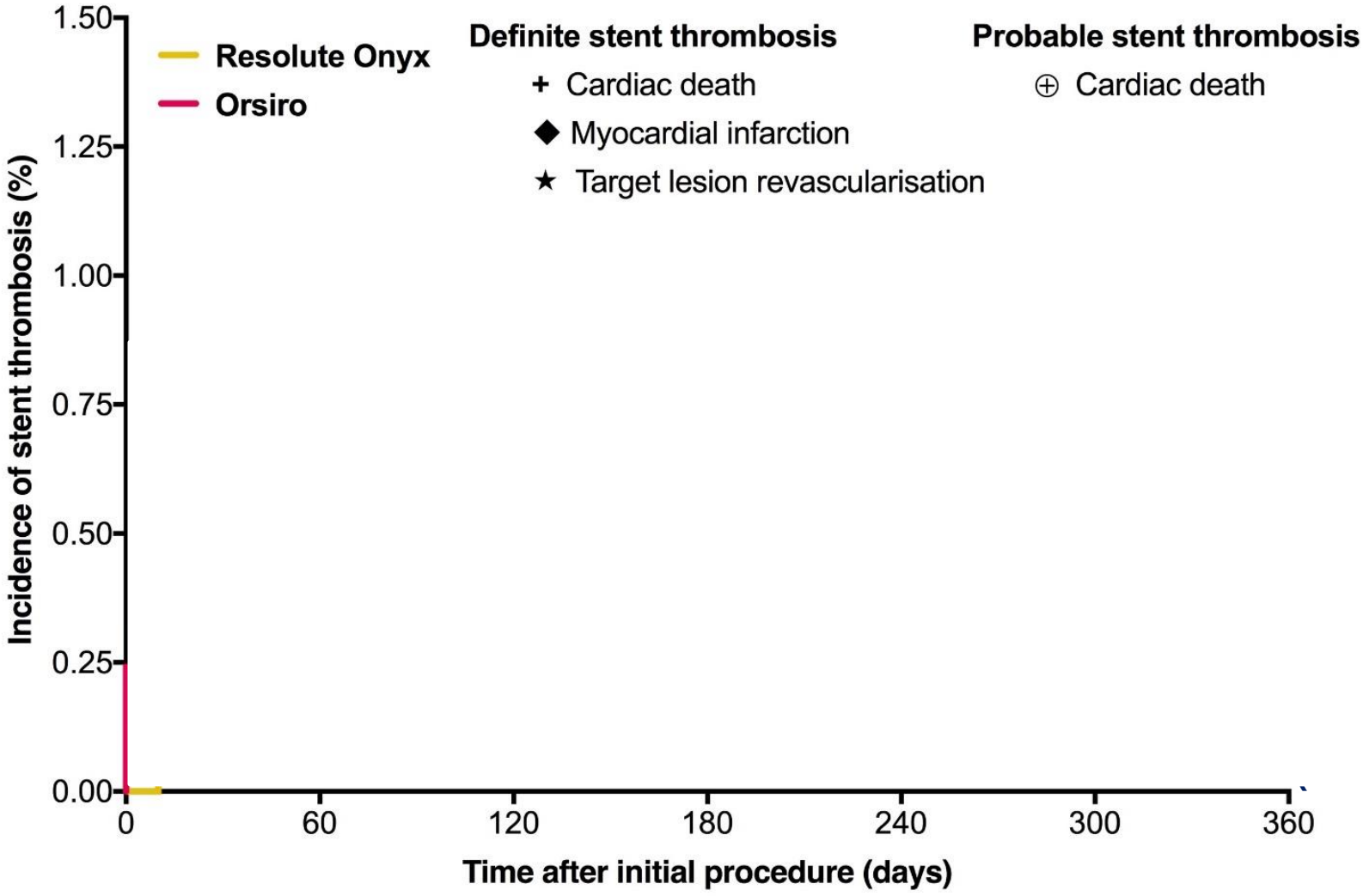




Composite Clinical Endpoints



Definite or Probable Stent Thrombosis



What we learned from BIONIX trial

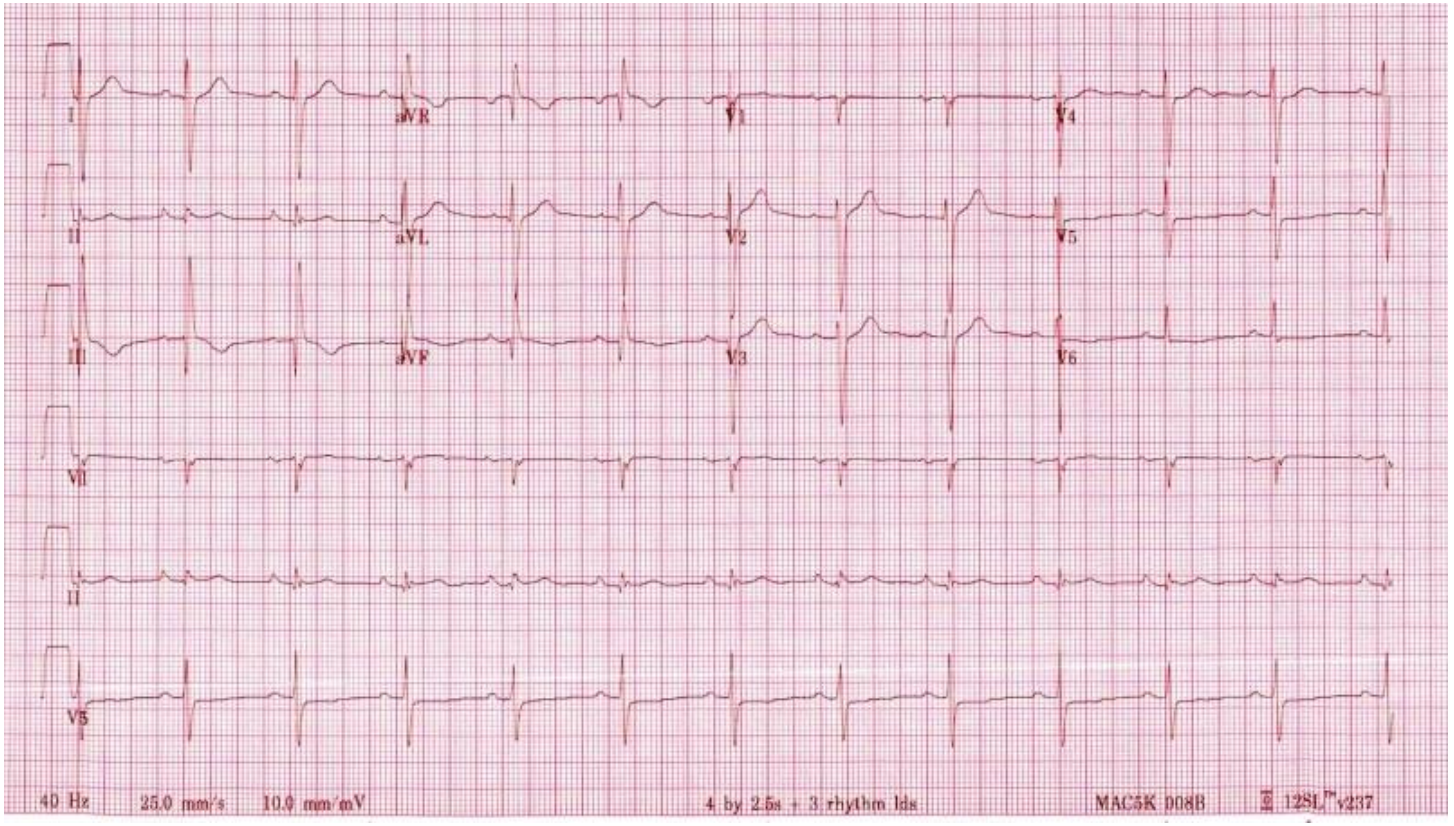
- **Regarding BIONIX trial, it can reflects well the wide spectrum of patients treated in routine daily practice as study population included 30% bifurcation lesion, 18% MVD, 70% ACS including 25% STEMI, 26% NSTEMI.**

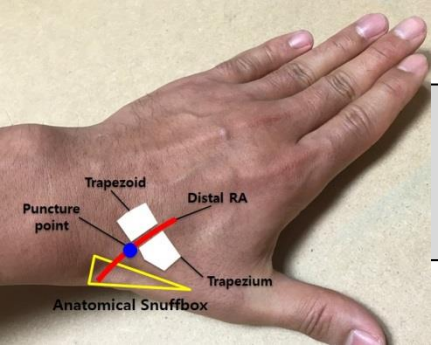
- **The Resolute Onyx demonstrated safety and efficacy at 1-year follow-up in allcomers.**

- **The rate of stent thrombosis was very low (0.1%) in the Resolute Onyx group.**

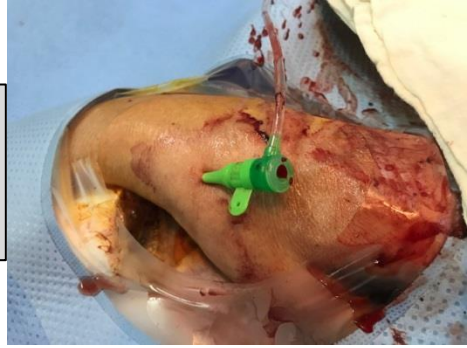
Ahn OO (85/M)

- Resting chest pain 6-hour ago
- Known Diabetes, NTN
- s/p PCI for p-to-mLAD d/t NSTEMI 8-month ago
- Interruption of medication including for 3-day DAPT d/t the loss of his wife
- Initial TnI: 15.1 ng/dL

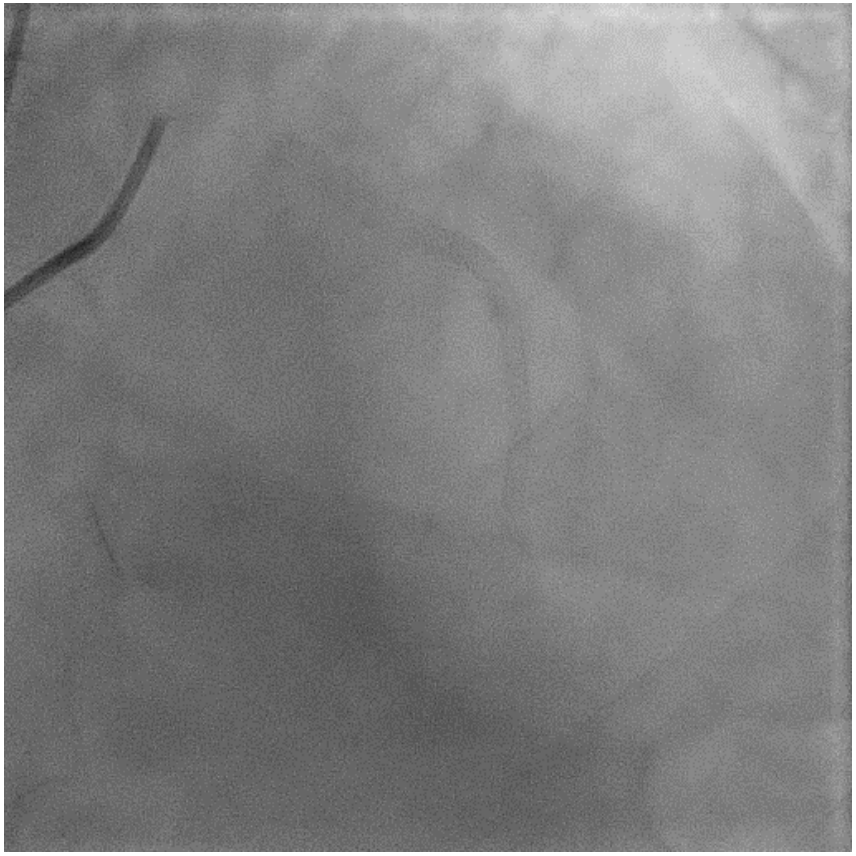




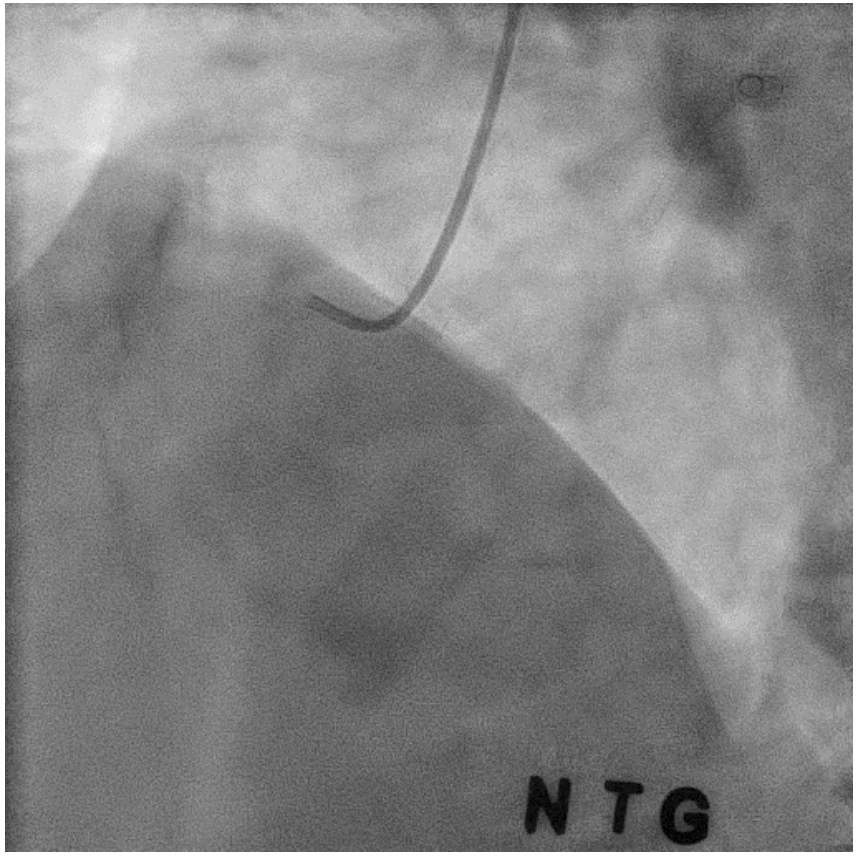
Urgent CAG
Lt.snuffbox approach



(2018.03.17) 2.75x28mm & 2.5x33mm DES implantation in p-to-mLAD

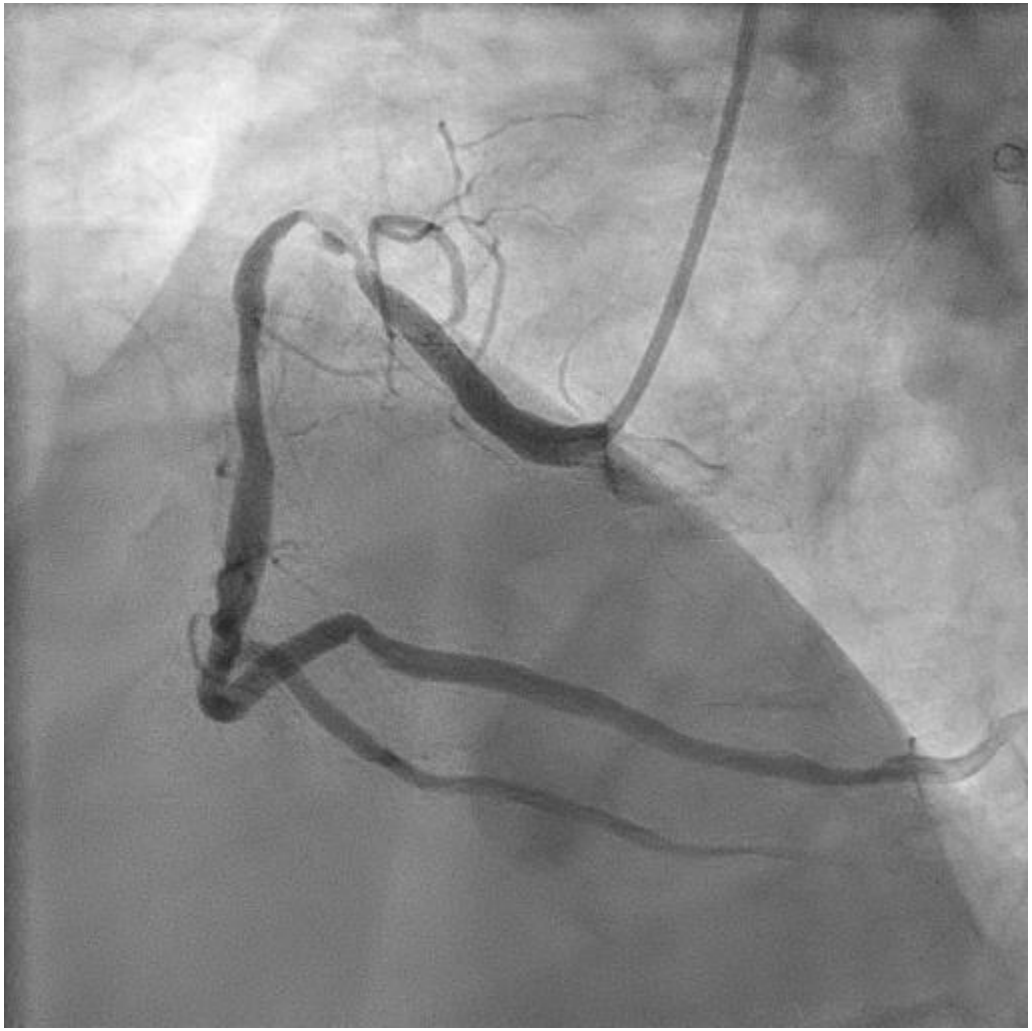


2018.11.15
No ISR of implanted stent in LAD



Severe stenosis in ectatic pRCA, suspicious ruptured plaque, with TIMI 2 flow

stent optimization in the setting of AMI



The factor of stent optimization (① Intravascular image guidance)

2014 ESC/EACTS Guidelines

Recommendations	Class[a]	Level[b]	Ref.[c]
FFR to identify haemodynamically relevant coronary lesion(s) in stable patients when evidence of ischaemia is not available.	I	A	50,51,713
FFR-guided PCI in patients with multivessel disease.	IIa	B	54
IVUS in selected patients to optimize stent implantation.	**IIa**	**B**	702,703,706
IVUS to assess severity and optimize treatment of unprotected left main lesions.	IIa	B	705
IVUS or OCT to assess mechanisms of stent failure.	IIa	C	
OCT in selected patients to optimize stent implantation.	**IIb**	**C**	

2018 ESC/EACTS Guidelines

UPGRADES

For PCI of bifurcation lesions, stent implantation in the main vessel only, followed by provisional balloon angioplasty with or without stenting of the side branch

Immediate coronary angiography and revascularization, if appropriate, in survivors of out-of-hospital cardiac arrest and an ECG consistent with STEMI

Assess all patients for the risk of contrast-induced nephropathy

OCT for stent optimization

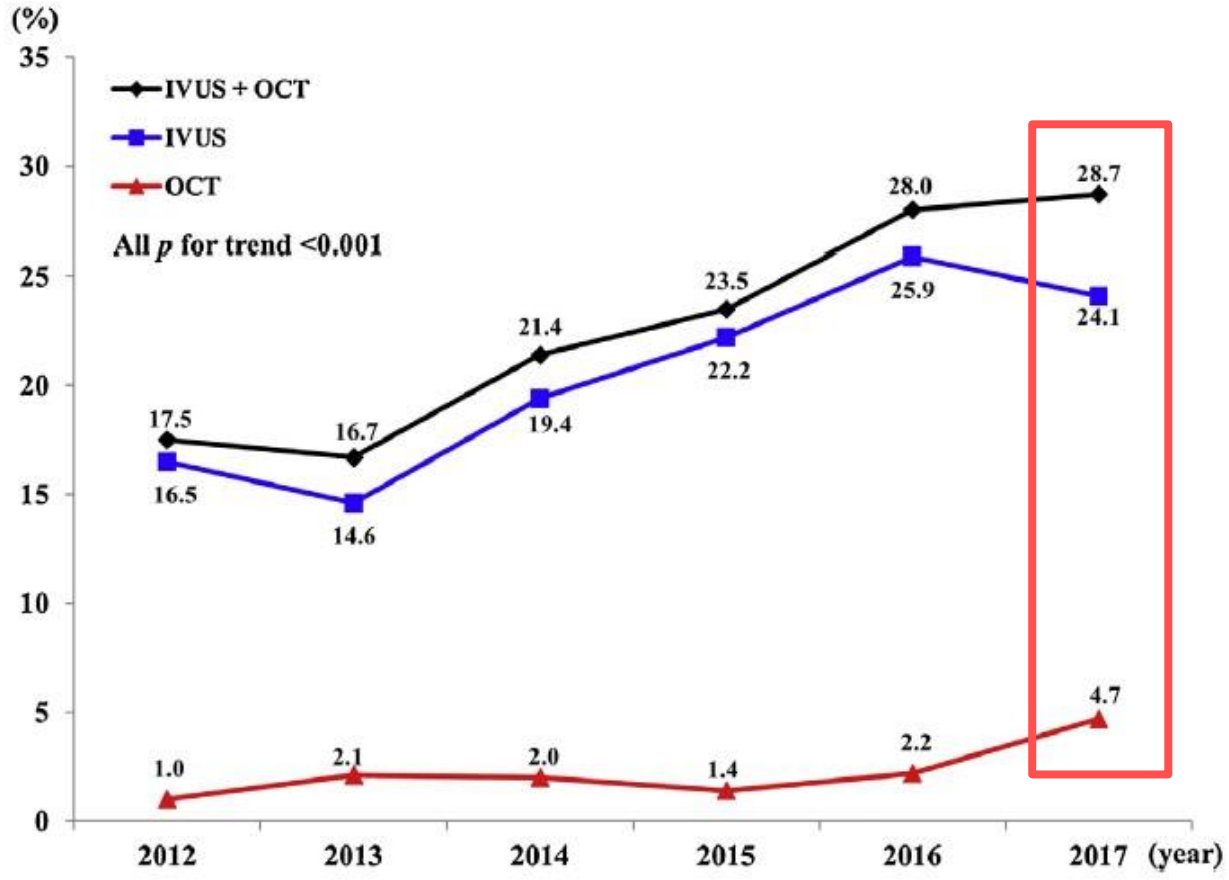
Recommendations	Class[a]	Level[b]
IVUS or OCT should be considered in selected patients to optimize stent implantation.[603,612,651–653]	**IIa**	**B**
IVUS should be considered to optimize treatment of unprotected left main lesions.[35]	IIa	B

Intravascular imaging for procedural optimization should be considered

Review

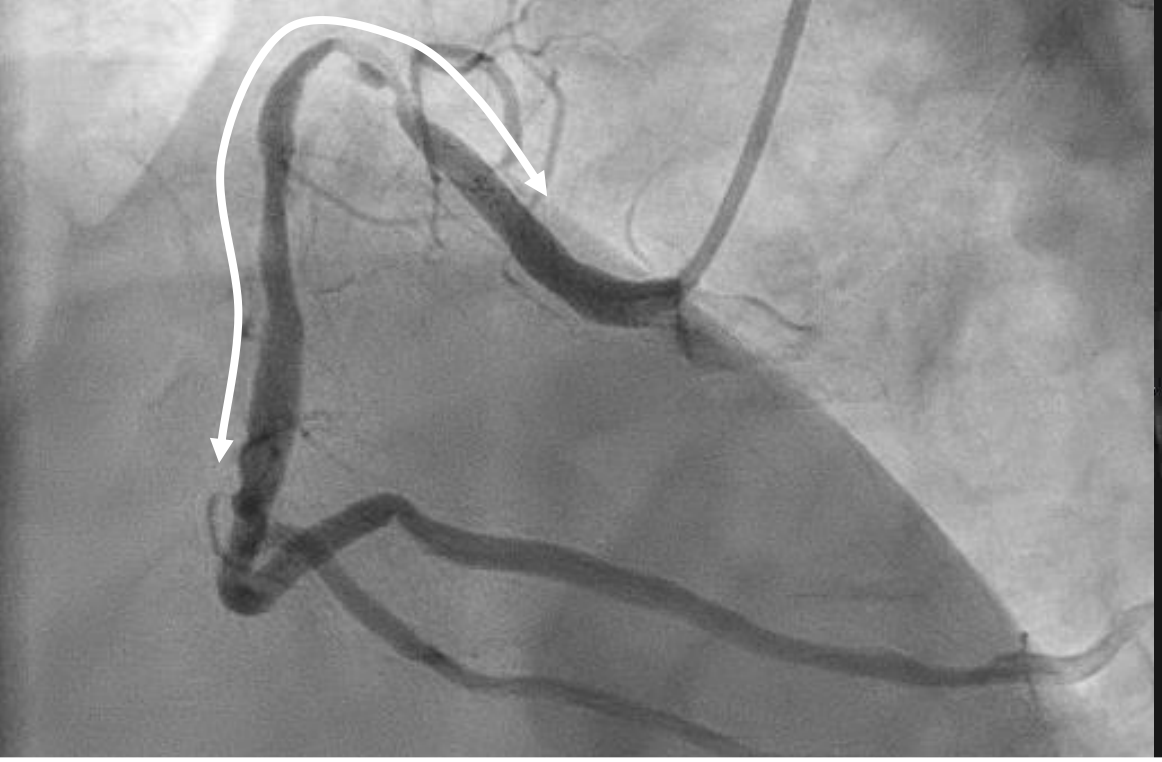
The role of optical coherence tomography in the setting of acute myocardial infarction

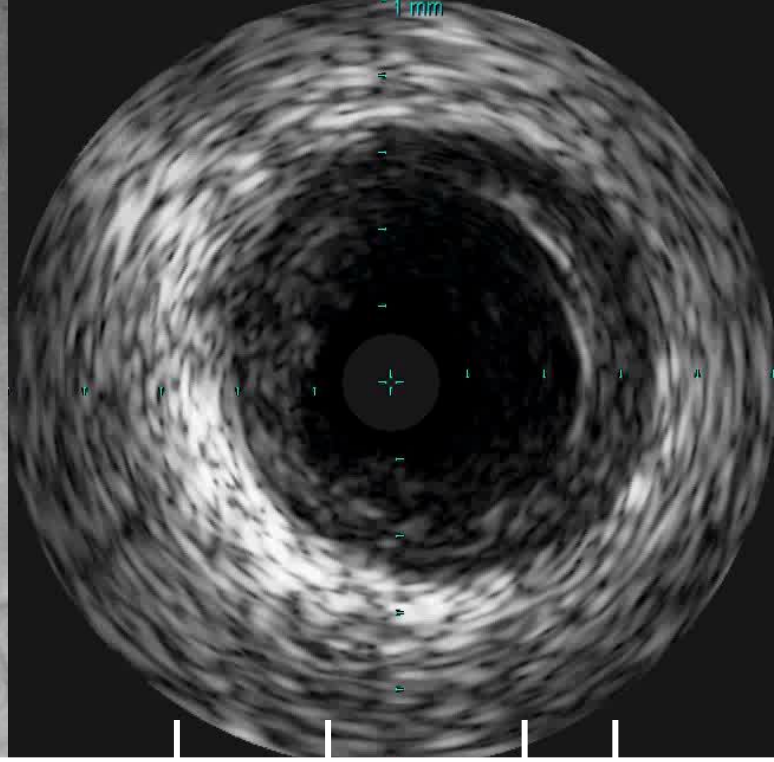
Yongcheol Kim (MD)[a], Thomas W. Johnson (MD)[b], Takashi Akasaka (MD)[c], Myung Ho Jeong (MD)[a,*]

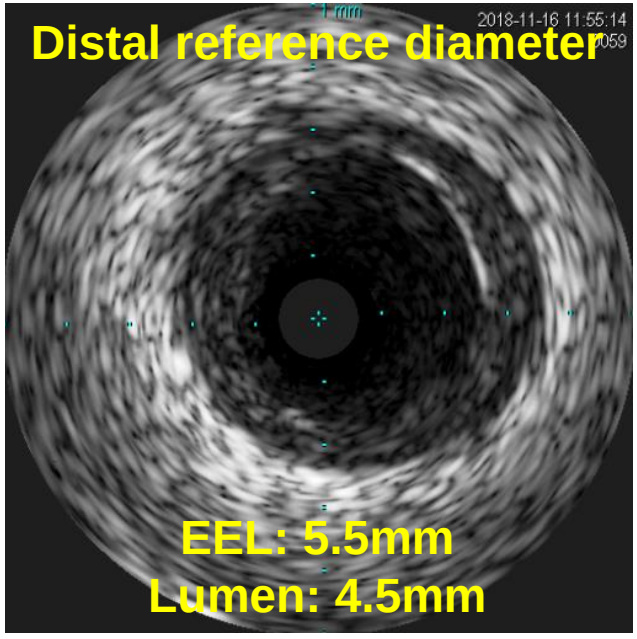


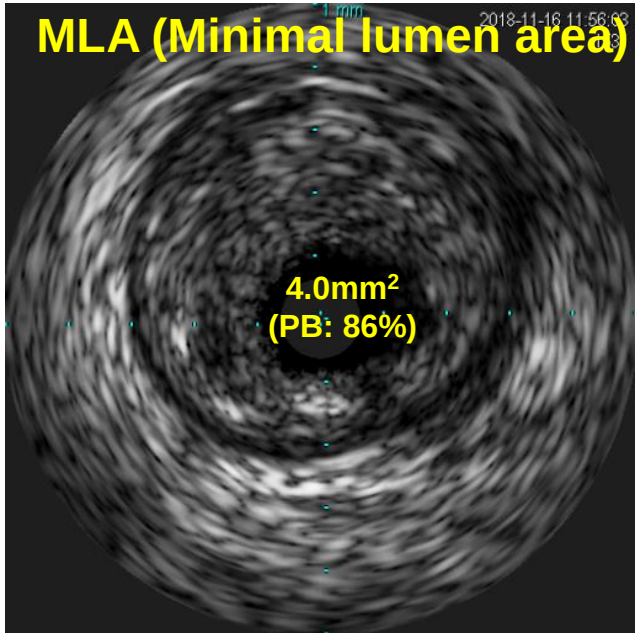
Annual trend of image-guided PCI in patients with AMI (data from KAMIR)

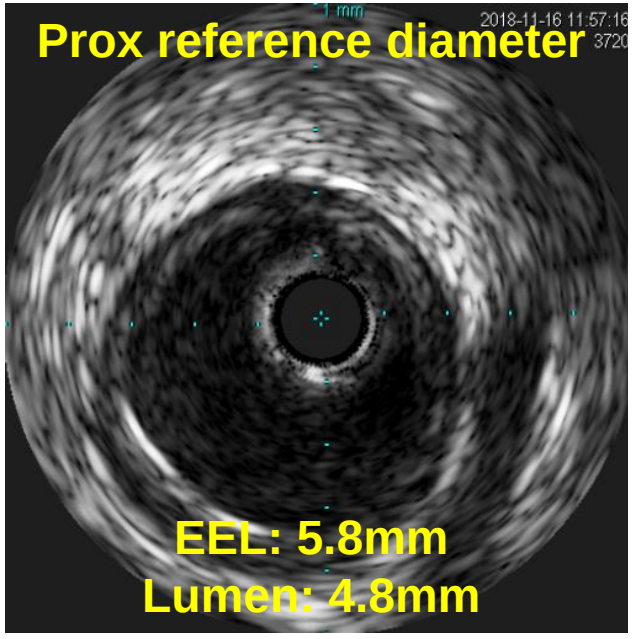
J Cardiol 2018;72:186-192






Distal reference diameter
EEL: 5.5mm
Lumen: 4.5mm


MLA (Minimal lumen area)
4.0mm²
(PB: 86%)


Prox reference diameter
EEL: 5.8mm
Lumen: 4.8mm

The factor of stent optimization (② appropriate DES selection)

2018 ESC/EACTS Guidelines on myocardial revascularization

2.1 What is new in the 2018 Guidelines?

- Calculation of the Syntax Score, if left main or multivessel revascularization is considered
- Radial access as standard approach for coronary angiography and PCI
- DES for any PCI
- Systematic re-evaluation of patients after myocardial revascularization
- Stabilised NSTE-ACS patients: revascularization strategy according to principles for SCAD
- Use of the radial artery grafts over saphenous vein grafts in patients with high-degree stenosis
- Myocardial revascularization in patients with CAD, heart failure, and LVEF ≤35%
  - CABG preferred
  - PCI as alternative to CABG

Recommendations on choice of stent and access site

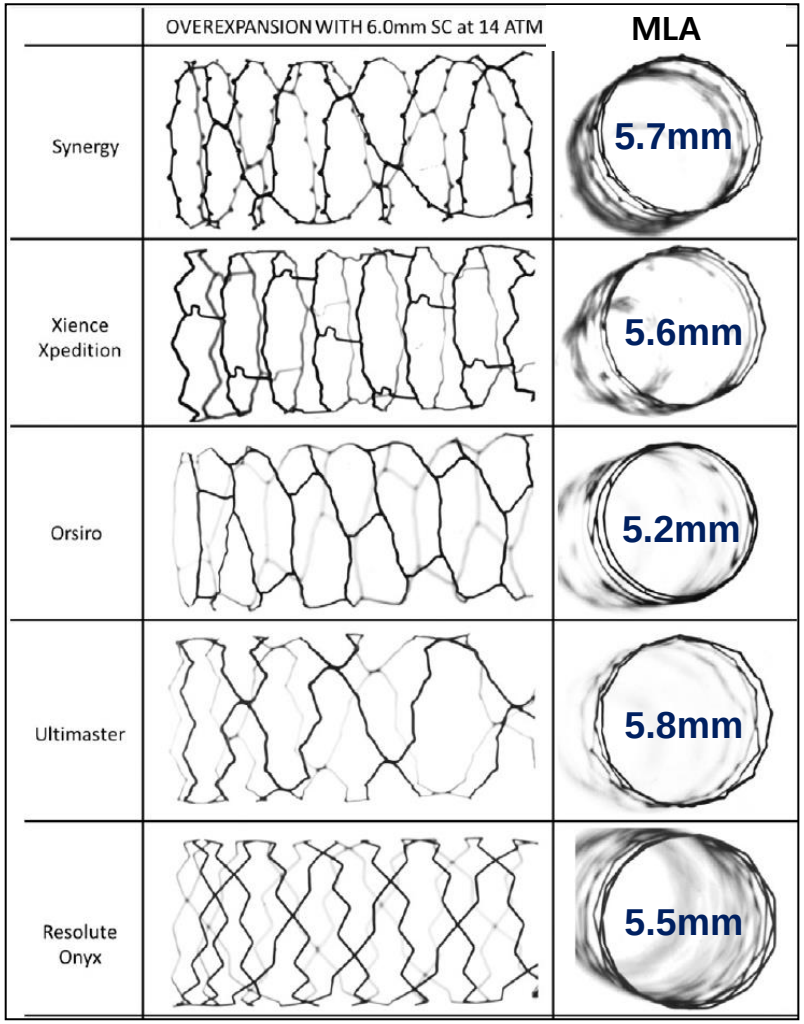
Recommendations	Class[a]	Level[b]
DES are recommended over BMS for any PCI irrespective of: • clinical presentation • lesion type • planned non-cardiac surgery • anticipated duration of DAPT • concomitant anticoagulant therapy.[100,578,579,640]	I	A
Radial access is recommended as the standard approach, unless there are overriding procedural considerations.[172,638,641]	I	A
BRS are currently not recommended for clinical use outside of clinical studies.[642–650]	III	C

BMS = bare-metal stents; BRS = bioresorbable scaffolds; DAPT = dual antiplatelet therapy; DES = drug-eluting stents; PCI = percutaneous coronary intervention.
[a]Class of recommendation.
[b]Level of evidence.

Over-expansion capacity and stent design model: An update with contemporary DES platforms

Jaryl Ng [a,1], Nicolas Foin [a,*,1], Hui Ying Ang [a], Jiang Ming Fam [a], Sayan Sen [b], Sukhjinder Nijjer [b], Ricardo Petraco [b], Carlo Di Mario [c], Justin Davies [b], Philip Wong [a]

[a] National Heart Research Institute Singapore, National Heart Centre Singapore, Singapore
[b] International Centre for Circulatory Health, NHLI, Imperial College London, UK
[c] Biomedical Research Unit, Royal Brompton & Harefield NHS Trust, London, UK



4.0mm DES

↓

Deployment at NP

↓

Postdilation

↓

4.0x12mm NC balloon @ 14 atm

↓

5.0x12mm NC balloon @ 14 atm (5.02mm)

↓

6.0x15mm balloon @ 14 atm (6.46mm)

No guarantee of

1. strut fracture
2. polymer damage
3. Clinical data

International Journal of Cardiology 2016;221:171-179

Dedicated stent for dilated coronary artery

RESOLUTE ONYX™

Drug-Eluting Stent

BROADEST
DES SIZE MATRIX EVER

No Patient Anatomy Is the Same

5.75 mm

Maximum expansion for **4.5- and 5.0-mm sizes**[1]

FIRST 4.5- AND 5.0-mm DES SIZES EXPAND TREATMENT OPTIONS FOR YOUR PATIENTS

BROADEST SIZE MATRIX

Stent length (mm)

Stent diameter (mm)											
2.25	8	12	15	18	22	26	30	34	38	3.25
2.50	8	12	15	18	22	26	30	34	38	3.25
2.75	8	12	15	18	22	26	30	34	38	3.75
3.00	8	12	15	18	22	26	30	34	38	3.75
3.50	8	12	15	18	22	26	30	34	38	4.75
4.00	8	12	15	18	22	26	30	34	38	4.75
4.50	-	12	15	18	22	26	30	-	-	5.75
5.00	-	12	15	18	22	26	30	-	-	5.75

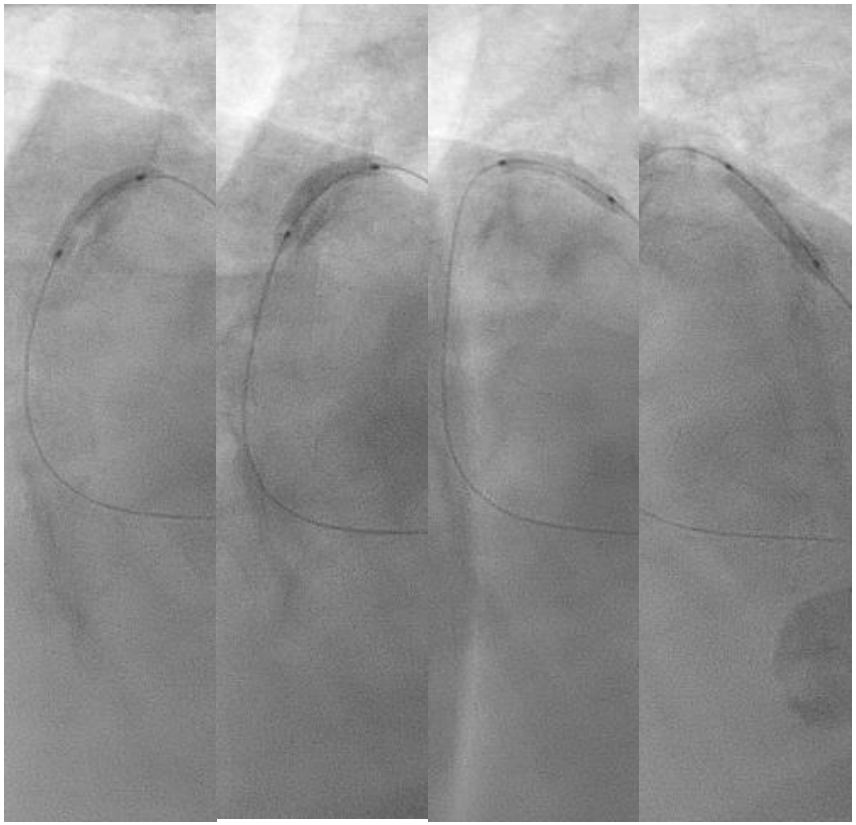
New sizes

Maximum overexpansion (mm)

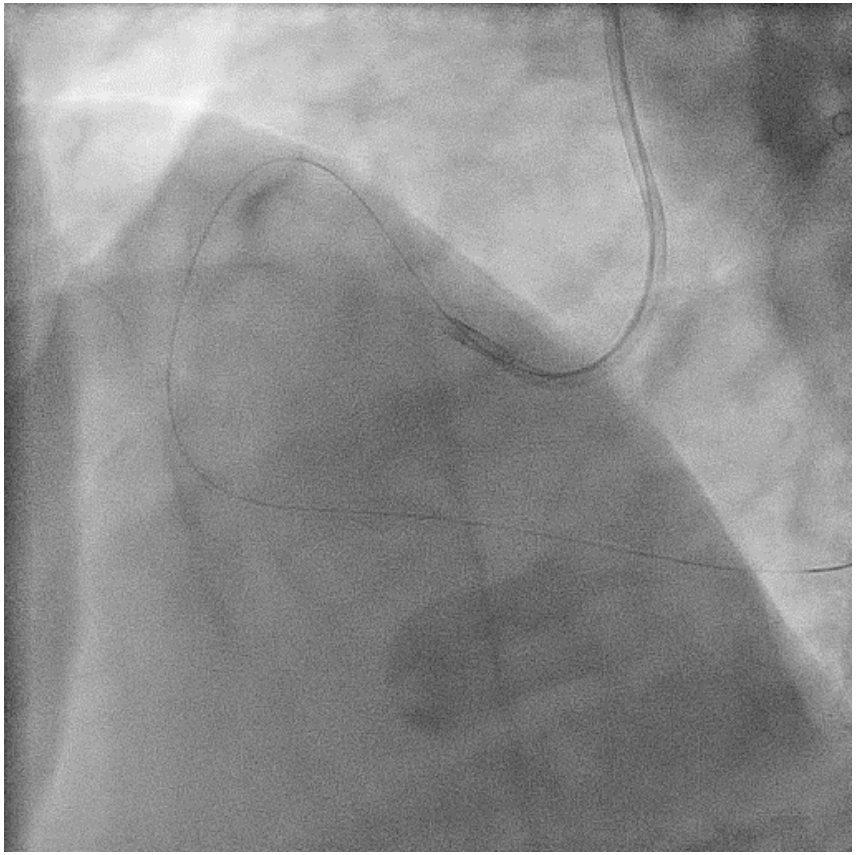
All sizes
5F
compatibile

2.25–5.00 mm

IVUS-guided stent optimization for dilated coronary artery with Resolute Onyx™

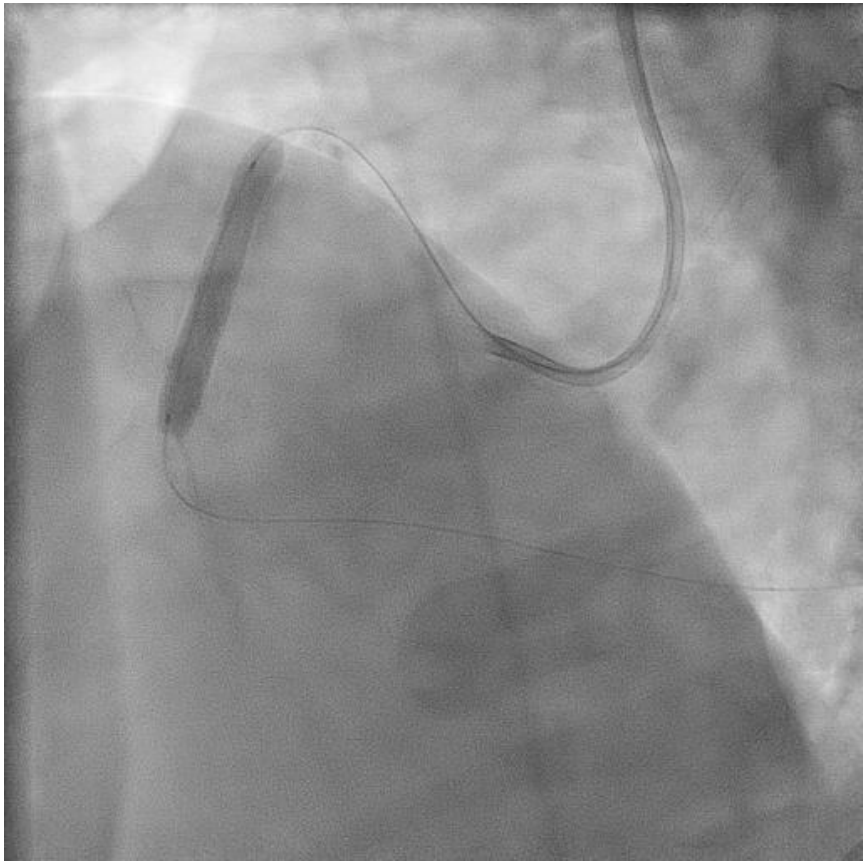


Predilation with 3.0x15mm compliance balloon

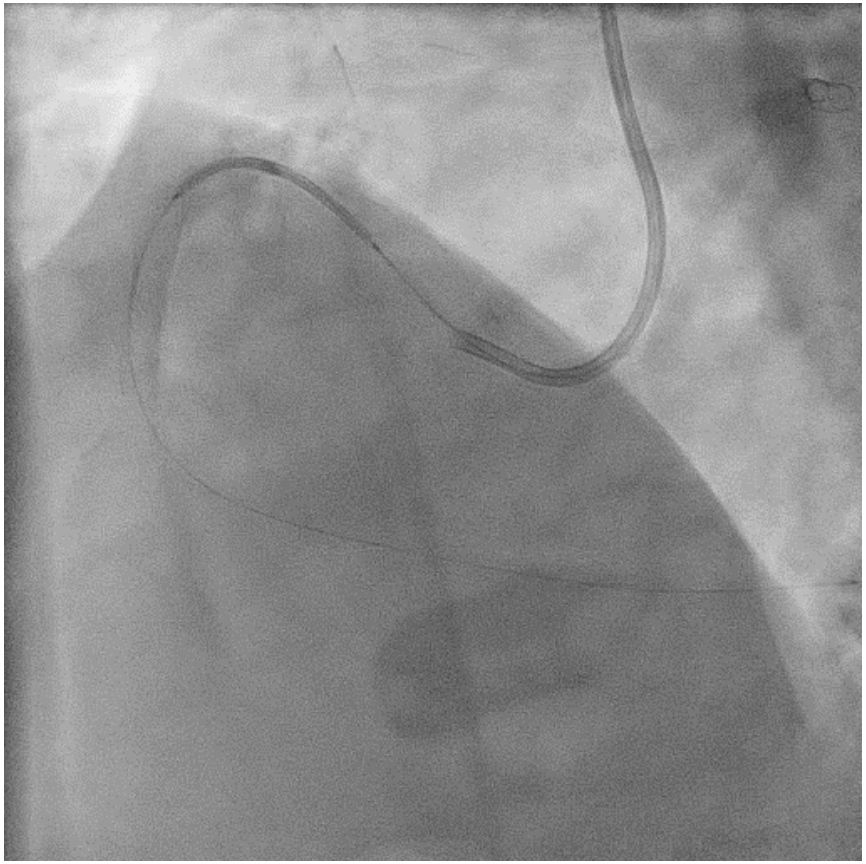


FU CAG after predilation

IVUS-guided stent optimization for dilated coronary artery with Resolute Onyx™

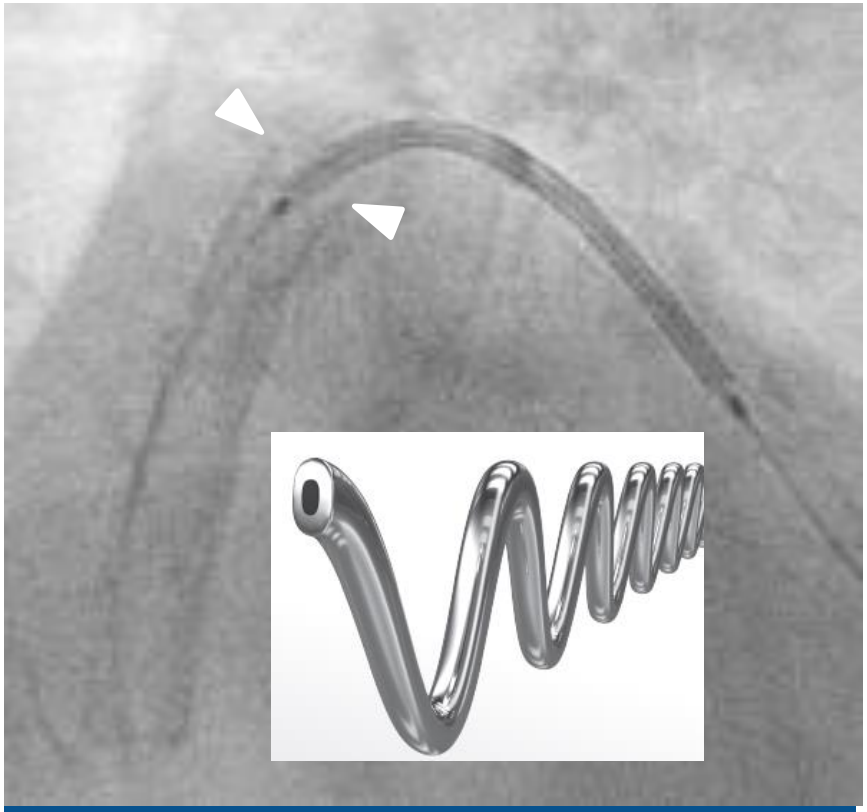


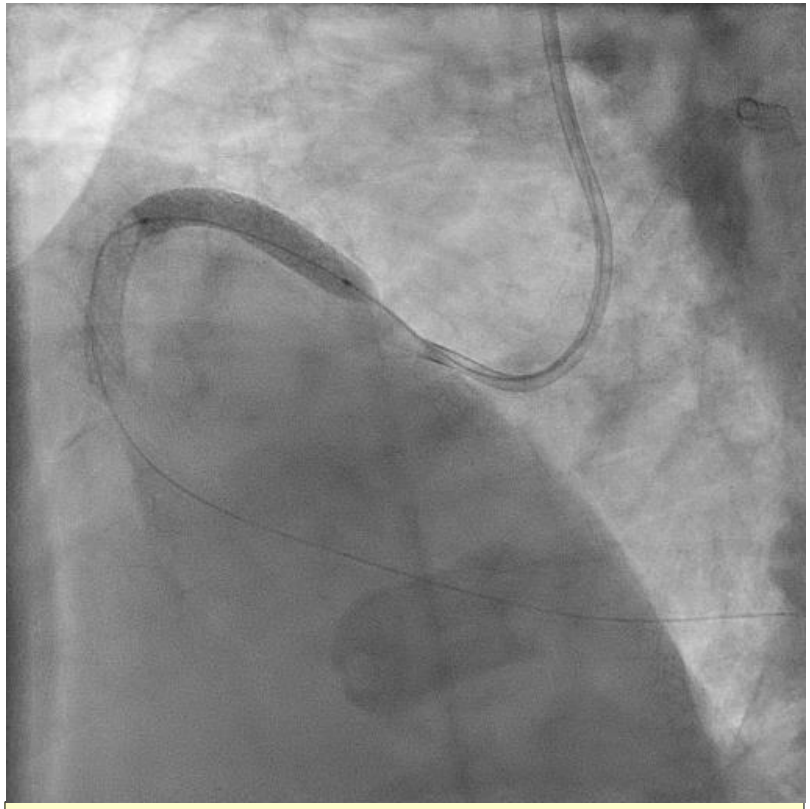
4.5x30mm Onyx™ implantation in mRCA @ 16atm (upto 4.7mm)



Positioning of 5.0x30mm Onyx™ for implantation with overlapping

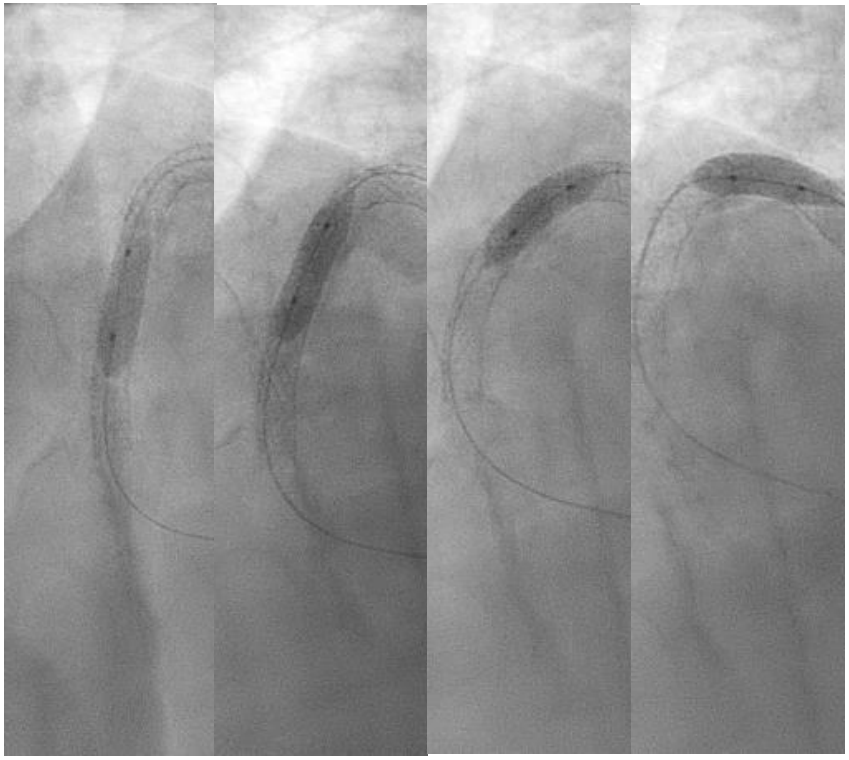
CORE WIRE TECHNIQUE of Resolute Onyx™



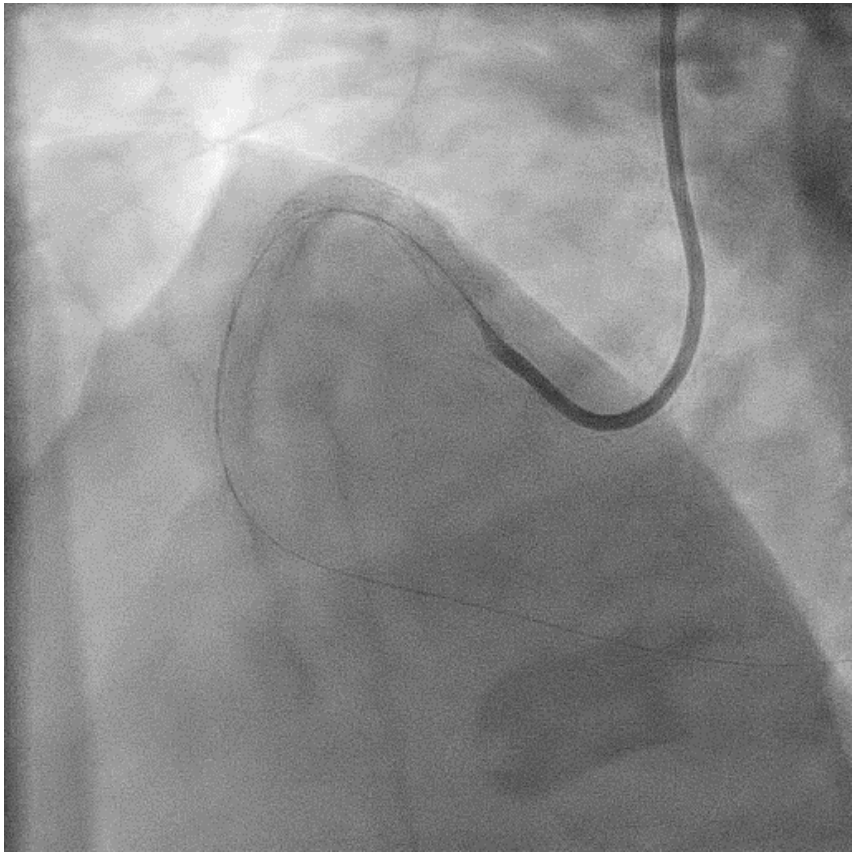


5.0x30mm Onyx™ implantation in pRCA with overlapping @ 18 atm (upto 5.35mm)

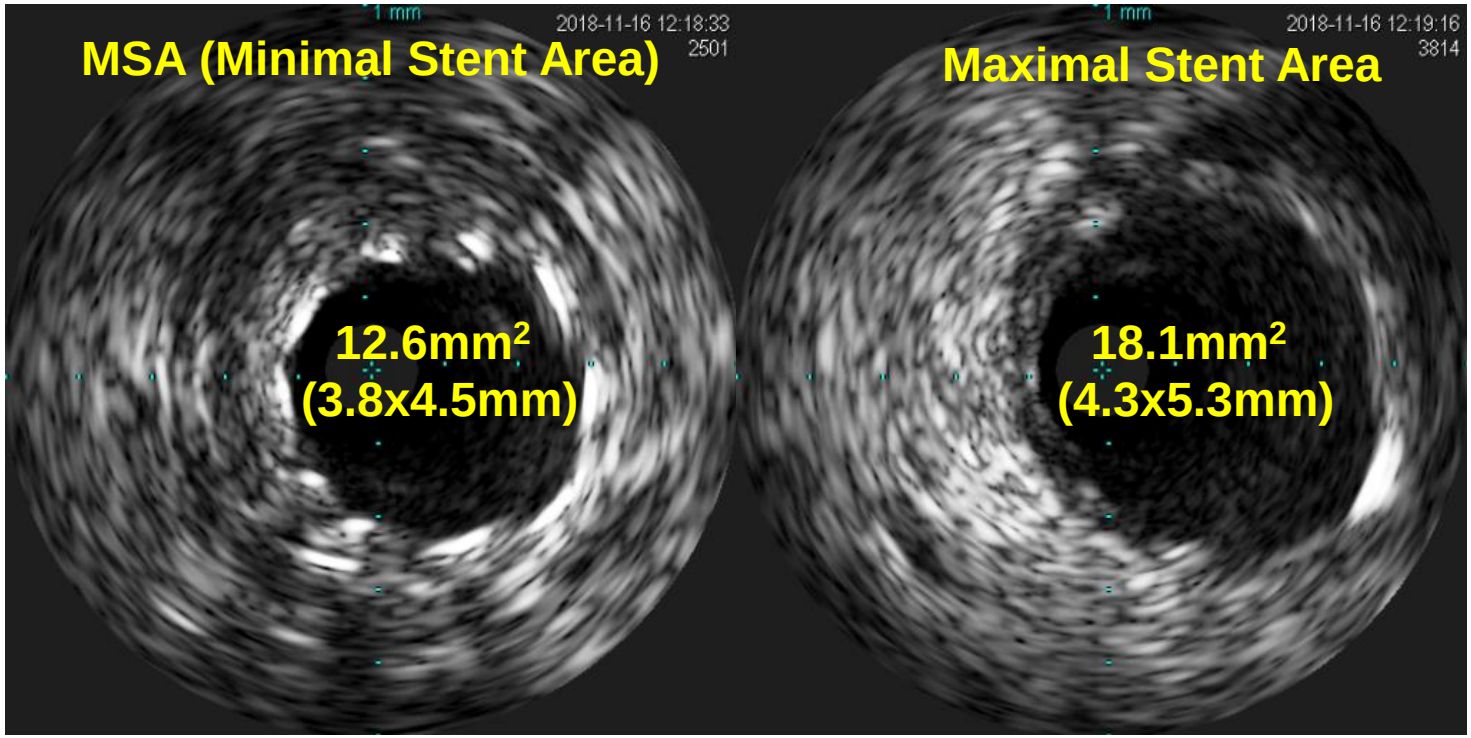
IVUS-guided stent optimization for dilated coronary artery with Resolute Onyx™



Postdilation with 4.5x12mm NC balloon @ upto 22atm



FU CAG after postdilation



Box 4 Criteria to assess optimal stent result

- A relative stent expansion of >80% (MSA divided by average reference lumen area) should be obta ctice.
- An MSA of >5.5 mm^2 by IVUS and > 4.5 mm^2 by OCT should be achieved in non-left main lesions.
- The clinical relevance of acute malapposition is uncertain. Nonetheless, extensive malapposition after stent implantation should be avoided and corrected, if anatomically feasible. Early strut coverage may be promoted by full apposition.
- Acute malapposition of <0.4 mm with longitudinal extension <1 mm or malapposition should not be corrected as spontaneous neointimal integration is anticipated. This cut-off requires prospective validation.
- Late acquired malapposition represents an established cause of late an
- Tissue prolapse in ACS as compared with stable CAD is adversely related to outcomes, likely because of differences in the composition of the protruding tissue.
- Large dissections detected by IVUS or OCT are independent predictors of MACE. Presence of residual plaque burden, extensive lateral (>60°), and longitudinal extension (>2 mm), involvement of deeper layers (medial or adventitia) and localization distal to the stent increase the risk for adverse events.
- Stent edge haematoma may e of a residual stent edge stenosis.

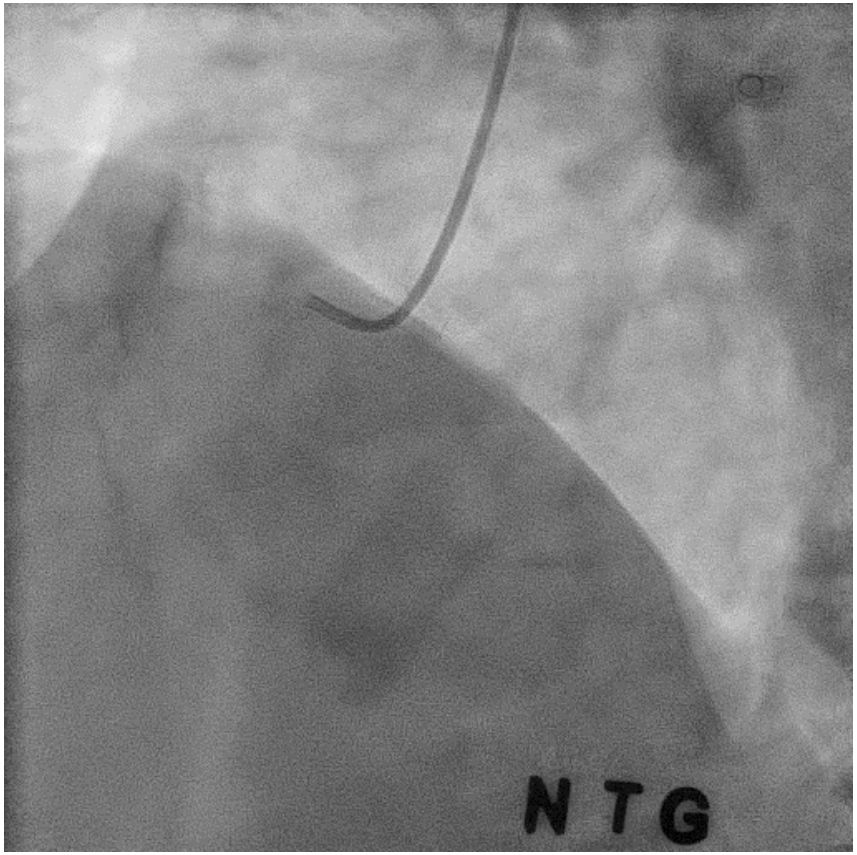
① MSA

② No Severe malapposition

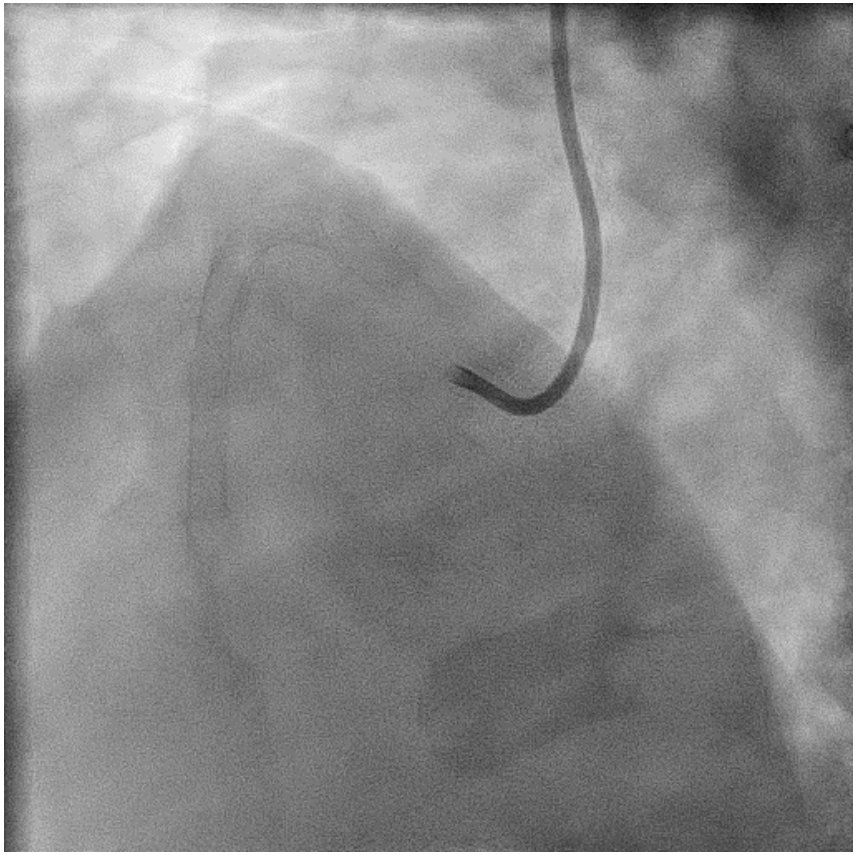
③ No Stent edge dissection

Expert consensus of the EAPCI, Eur Heart J May 16, 2018

Successful IVUS-guided Resolute Onyx™ implantation in the stenotic lesion of dilated coronary artery



Initial CAG



Final CAG after 4.5x30mm & 5.0x30mm Onyx™ implantation

ONLINE FIRST

This is a provisional PDF only. Copyedited and fully formatted version will be made available soon.

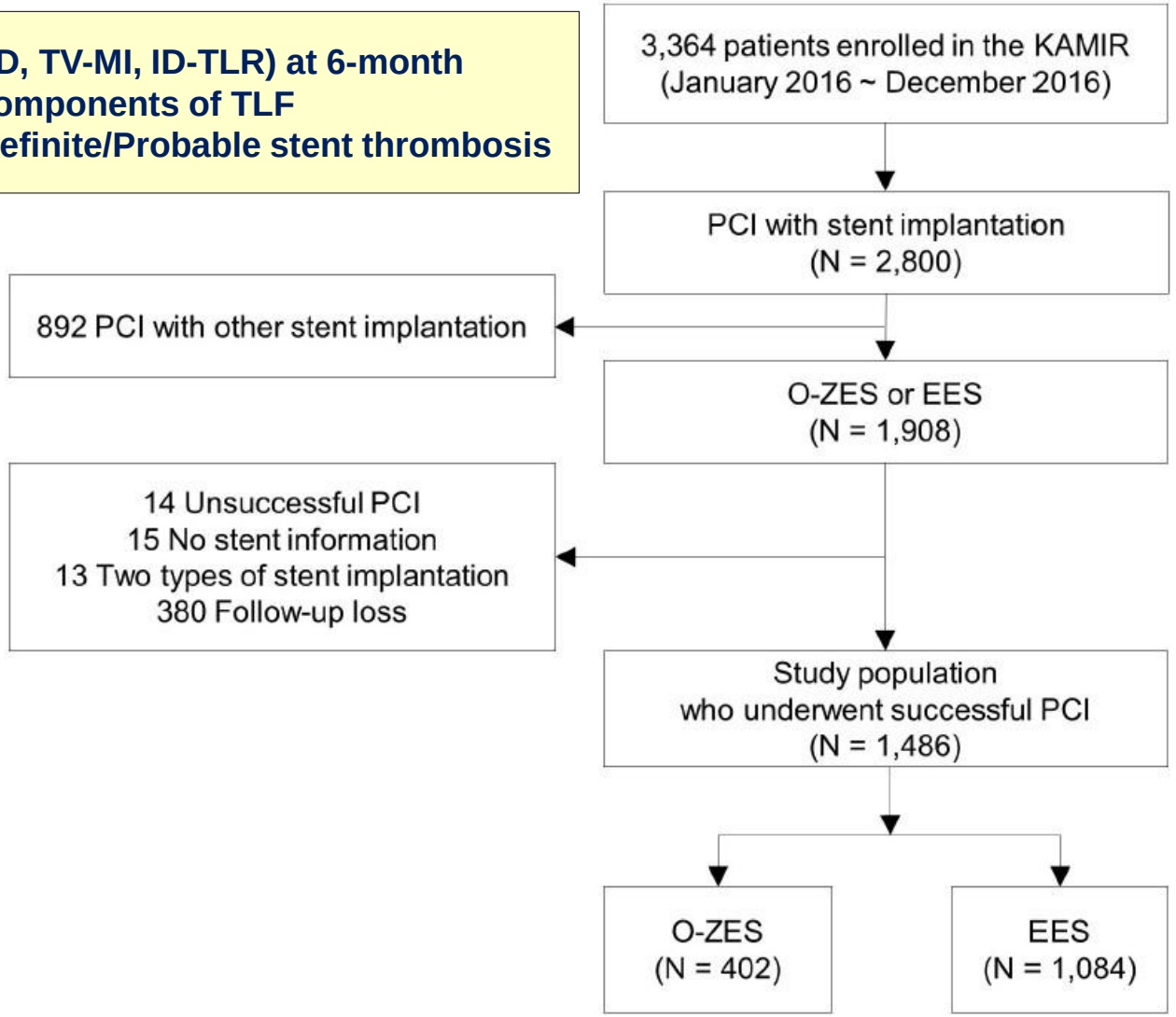
CARDIOLOGY JOURNAL

Comparison of short-term clinical outcomes between Resolute Onyx zotarolimus-eluting stents and everolimus-eluting stent in patients with acute myocardial infarction: Results from the Korea Acute Myocardial infarction Registry (KAMIR)

Authors: Yongcheol Kim, Sung Sik Oh, Myung Ho Jeong, Youngkeun Ahn, Ju han Kim, Young Joon Hong, Doo Sun Sim, Min Chul Kim, Hyo-Soo Kim, Kyeong Ho Yun, Seok Kyu Oh, Chong Jin Kim, Myeong Chan Cho

Study Flowchart

- **Primary outcomes: TLF (CD, TV-MI, ID-TLR) at 6-month**
- **Secondary outcomes: 1) components of TLF**
  2) Definite/Probable stent thrombosis



Cardiol J 2018 [Epub ahead of print]

Baseline Characteristics

	Onyx™ (n=402)	Xience™ & Synergy™ (n=1,084)	*p*-value
Demographic			
Age [kg/m^2]	64.0 ±12.4	64.2 ± 12.2	0.802
Male sex	305 (75.9%)	816 (75.3%)	0.813
CV risk factors			
HTN	206 (51.2%)	541 (49.9%)	0.647
Diabetes	122 (30.3%)	294 (27.1%)	0.218
Dyslipidemia	52 (12.9%)	128 (11.8%)	0.554
Current smoking	158 (39.3%)	446 (41.1%)	0.521
F/Hx of IHD	35 (8.7%)	106 (9.8%)	0.531
Medical history			
Angina	36 (9.0%)	70 (6.5%)	0.097
MI	30 (7.5%)	45 (4.2%)	0.010
HF	5 (1.2%)	11 (1.0%)	0.704
CVA	24 (9.0%)	73 (6.7%)	0.596
STEMI ★	207 (51.5%)	566 (52.2%)	0.805
Killip III/IV	58 (14.5%)	151 (14.5%)	0.997
LVEF, %	52.3	52.8	0.388

Cardiol J 2018 [Epub ahead of print]

Angiographic and procedural Characteristics

	Onyx™ (n=402)	Xience™ & Synergy™ (n=1,084)	*p*-value
Transradial approach	189 (47.0%)	498 (46.3%)	0.802
Image-guided PCI	123 (30.6%)	359 (33.1%)	0.305
Culprit vessel			0.532
LAD	186 (46.3%)	528 (48.8%)	
LCx	65 (16.2%)	180 (16.6%)	
RCA	140 (34.8%)	337 (31.1%)	
Left main	11 (2.7%)	38 (3.5%)	
Left main or MVD ★	228 (56.7%)	530 (49.0%)	0.008
B2/C lesion ★	354 (90.1%)	952 (89.3%)	0.670
Implanted stent			
Stent number	1.25 ± 0.46	1.20 ± 0.45	0.077
Stent diameter	3.12 ± 0.46	3.15 ± 0.43	0.222
Stent length	31.0 ± 14.8	30.4 ± 15.2	0.498

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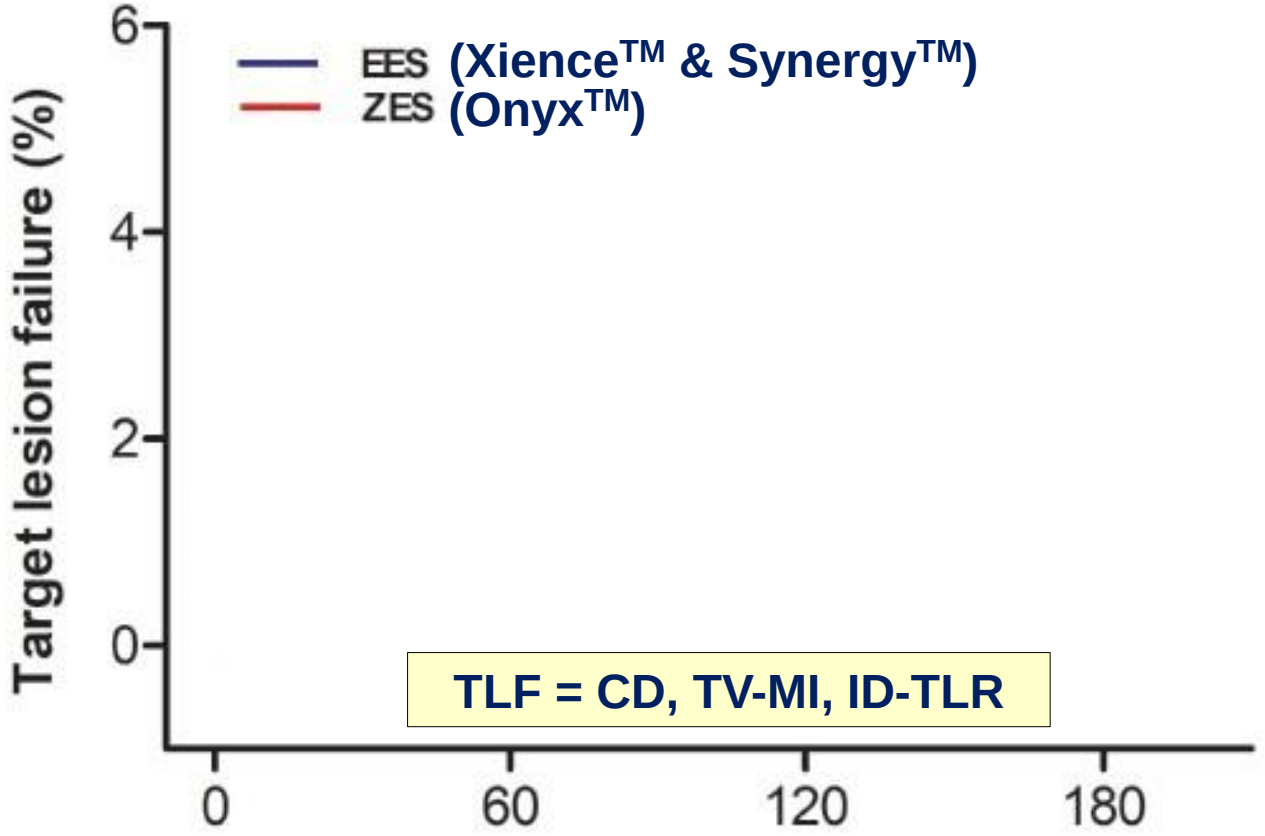
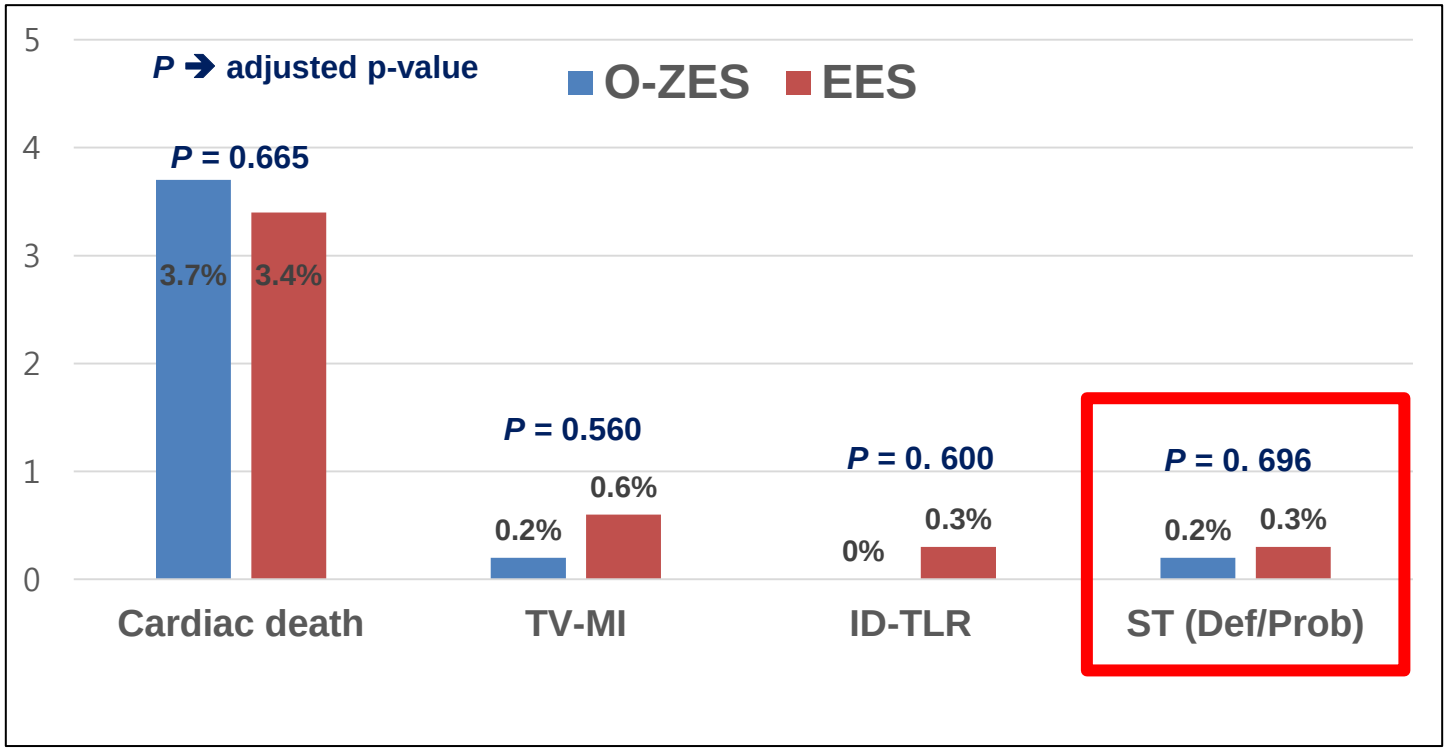
Target Lesion Failure (TLF) at 6-month



No. at risk				
EES	1084	1049	1029	578
ZES	402	388	380	205

Composite clinical outcomes 6-month



implantation of Resolute Onyx™ or EES including Xience and Synergy provided similar clinical outcomes in patients with AMI undergoing successful PCI.

Cardiol J 2018 [Epub ahead of print]

Take Home Message

- When you performed PCI with Onyx™, you don't have to worry about stent thrombosis in 99.8~99.9% of the patients including AMI.
- For stent optimization for the dilated coronary artery, dedicated large size Onyx™ is good option, especially with intravascular image-guidance.
- Don't try to change the name, Onyx!

Thank you for your attention