The 4th Revolution in PCI (Bioabsorbable Vascular Scaffolds)

Experience of BVS in Complex Lesions

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Potential conflicts of interest

Speaker's name: Corrado Tamburino

✓ **I have the following** potential conflicts of interest to report:

Research contracts
☑ Consulting Medtronic, Abbott v, Edwards, Boston Sc.
Employment in industry
Stockholder of a healthcare company
Owner of a healthcare company
Other(s)

I do not have any potential conflict of interest

BRS: Predicated Benefits

Vascular restoration therapy (VRT)

▪ Superior conformability and flexibility	→	Improved distribution of the tissue biomechanics and preserved vessel geometry
▪ "Liberation of vessel from a metallic cage"	→	Restoration of physiological vasomotion, adaptive shear stress, late luminal gain, and late expansive remodelling
▪ Absence of any residual foreign material ▪ Restoration of functional endothelial coverage	→	Resolution of malapposition and stent fracture; Reduced inflammation and neoatherosclerosis
▪ Plaque sealing	→	Reduced neoatherosclerosis Passivation of vulnerable plaques
▪ Additional technical benefits	→	No 'jailing' of the side branches; No overhang at ostial lesions; No inability to graft the stented segment; Reduced distal embolization

Expected clinical implications of BRS biological effects

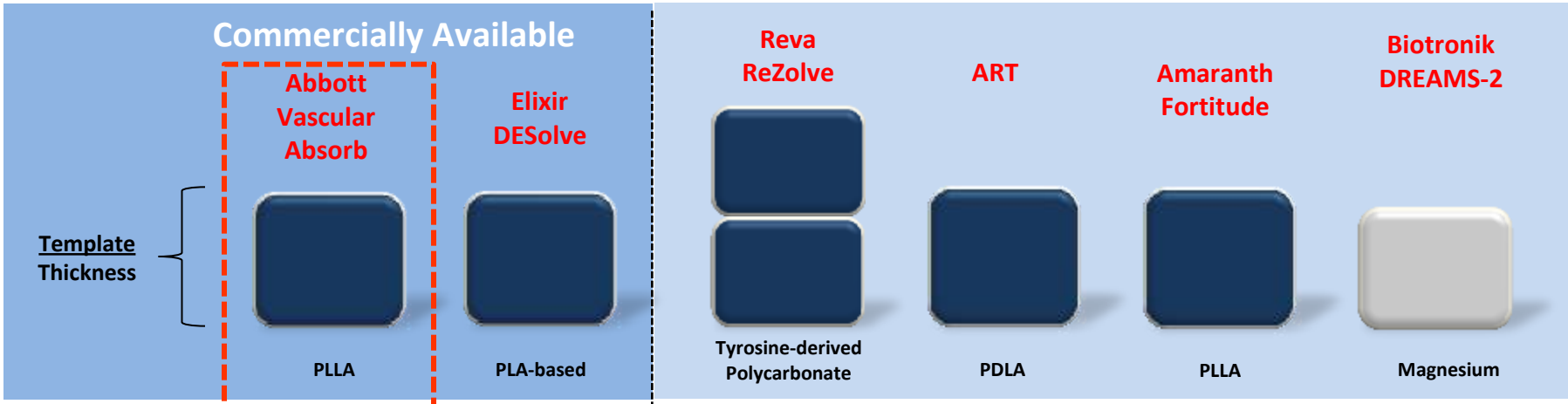
1. Reduction of angina

1. **Prevention of late thrombotic events**

Challenges of BRS

▪ Deliverability and crossing profile	Radial strength versus crossing profile (thick struts: **challenging use in complex lesions and higher thrombogenicity**
▪ Stretchability and strut fracture	Limitations of expansion (risk of malapposition, underexpansion) and potential for breaks with over-dilatation.
▪ Side branch occlusion	Periprocedural myocardial infarctions? Issues with accessibility of side branches
▪ Duration of antiplatelet therapy	Concerns over early discontinuation, further studies are warranted
▪ Use in ACS and complex lesions	Safety and efficacy data in complex lesions not widely available

Absorb BVS versus Other BRS



	Abbott Vascular Absorb	Elixir DESolve	Reva ReZolve	ART	Amaranth Fortitude	Biotronik DREAMS-2
Template Thickness	~150 µm	~150 µm	~122 µm X 2	~160 µm	~150 µm	~125 µm
Support Time	6 months	3 – < 6 months	~6 months	≤ 3 months	3 – 6 months	≤ 3 months
Degradation Products	H_2O & CO_2	H_2O & CO_2	I_2DAT, I_2DT, PCL, Tyrosine	H_2O & CO_2	H_2O & CO_2	Soft Hydroxyapatite
Resorption Time	< 36 months (*slow*)	18 – 24 months (*fast*)	~ 36 months (*slow*)	~18 months (very *fast*)	> 48 months (*very slow*)	9 – 12 months (*very fast*)

•cvPipeline and company presentations

ABSORB experience current status

- According to the IFU, ABSORB is indicated for "de novo native coronary artery lesions". The treated lesion length should be less than the nominal scaffolding length (12 mm,18 mm, 28 mm) with reference vessel diameters ≥ 2.0 mm and ≤ 3.8 mm".
- Current ABSORB experience: moving from simple to complex lesions

Investigator Sponsored Trials - Overview and Status Update

Study Title	S-I	Design	Number of patients enrolled	Primary Endpoint	Patient FU (Years)
Registries (>10,000 Pts) – Funded by Abbott Vascular					
BVS EXPAND	R.J. van Geuns	All – comers Registry (excl STEMI)	300/300	1 – Yr MACE	5
ASSURE	D. Mathey	All – comers Registry	180/180	Safety and Efficacy	3
ABSORB CTO	A. Serra	Feasibility in CTO	35/35	Safety and Performance	2
PABLOS	A. Colombo	Feasibililty in Bifurcations	23/30	Device, Procedural, Main and Side Branch Success	2
IT-DISSAPEARS	F. Bedogni / A.S. Petronio	MVD and Long Lesion Registry	175/1000	Safety and Efficacy	5
GABI-R	H. Nef	All – comers Registry	1417/5000	Safety and Efficacy	5
REPARA	F. Hernandez	All – comers Registry	1000/1500	1- Yr MACE	1
POLAR ACS	D. Dudek	ACS Registry	100/100	Safety, clinical device, procedure success and in-hospital MACE	1
France ABSORB	R. Koning	Feasibility in de novo lesions	160/2000	1 – Yr MACE	1
Registries – w/o Abbott Funding (not all information is available)					
GHOST EU	C. Tamburino	All – comers Registry	1433	Target Vessel Failure (TVF)	1
GHOST-Ferrarotto	C. Tamburino	All – comers Registry	319	Target Vessel Failure (TVF)	1
Prague 19	P. Widimsky	STEMI (STEMI Killip I/II)	98/100	Clinical Outcomes	1

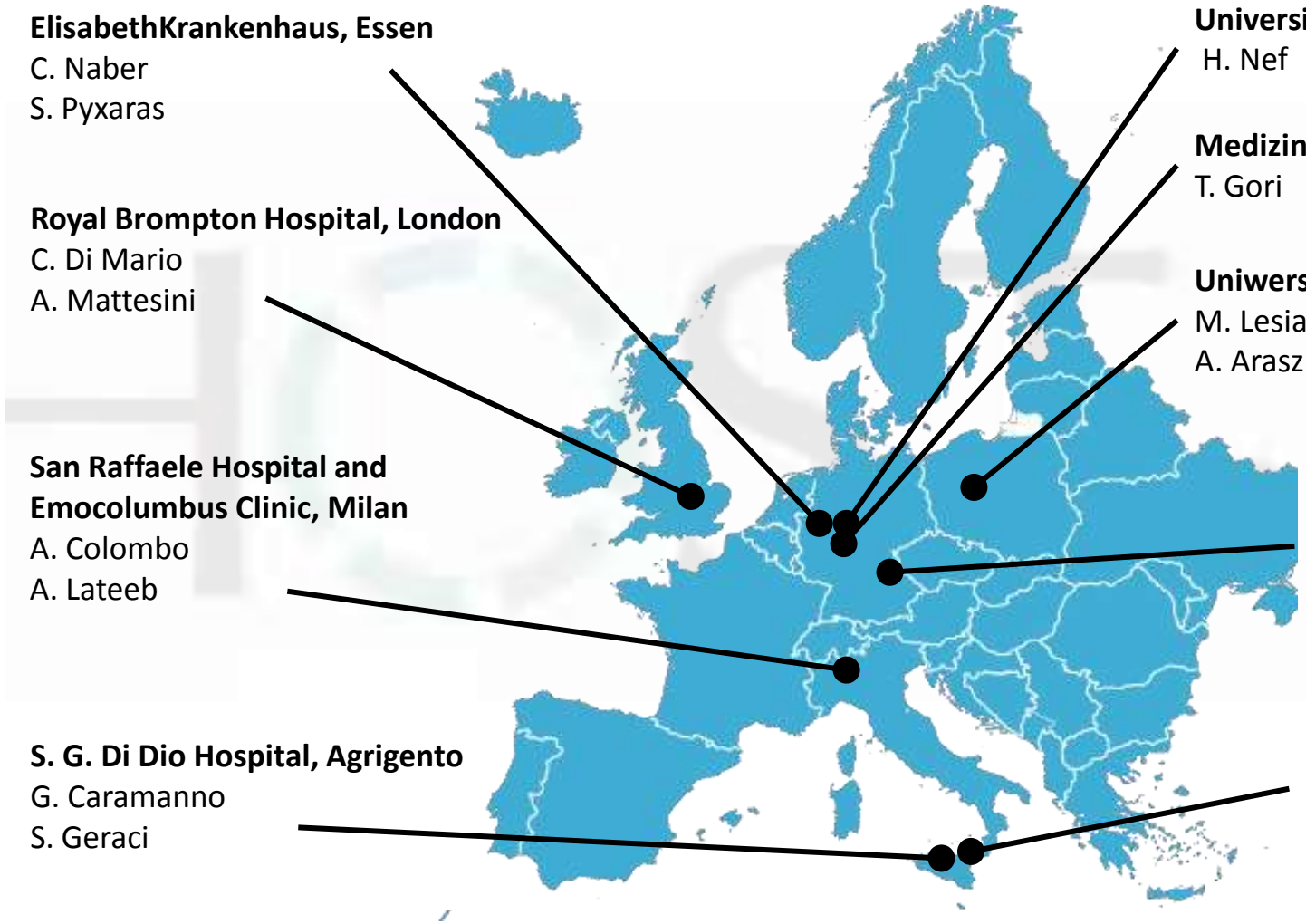
GHOST-EU: Participating centers

ElisabethKrankenhaus, Essen
C. Naber
S. Pyxaras

Royal Brompton Hospital, London
C. Di Mario
A. Mattesini

San Raffaele Hospital and Emocolumbus Clinic, Milan
A. Colombo
A. Lateeb

S. G. Di Dio Hospital, Agrigento
G. Caramanno
S. Geraci



University of Giessen, Giessen
H. Nef

Medizinische Klinik, Mainz
T. Gori

Uniwersytet Medyczny, Poznan
M. Lesiak
A. Araszkiewicz

Klinikum Großhadern, Munich
J. Mehilli

Ferrarotto Hospital, Catania
C. Tamburino (PI)
D. Capodanno (co-PI)
P. Capranzano

GHOST-EU Extended Use* 1.189 patients

Clinical

Angiographic

NSTEMI/STEMI, N=406/1,189(34.1%)

LVEF<30%, N=32/980 (3.3%)

CKD (eGFR<60), N=111/743 (14.9%)

ISR, N=49/1,440 (3.4%)

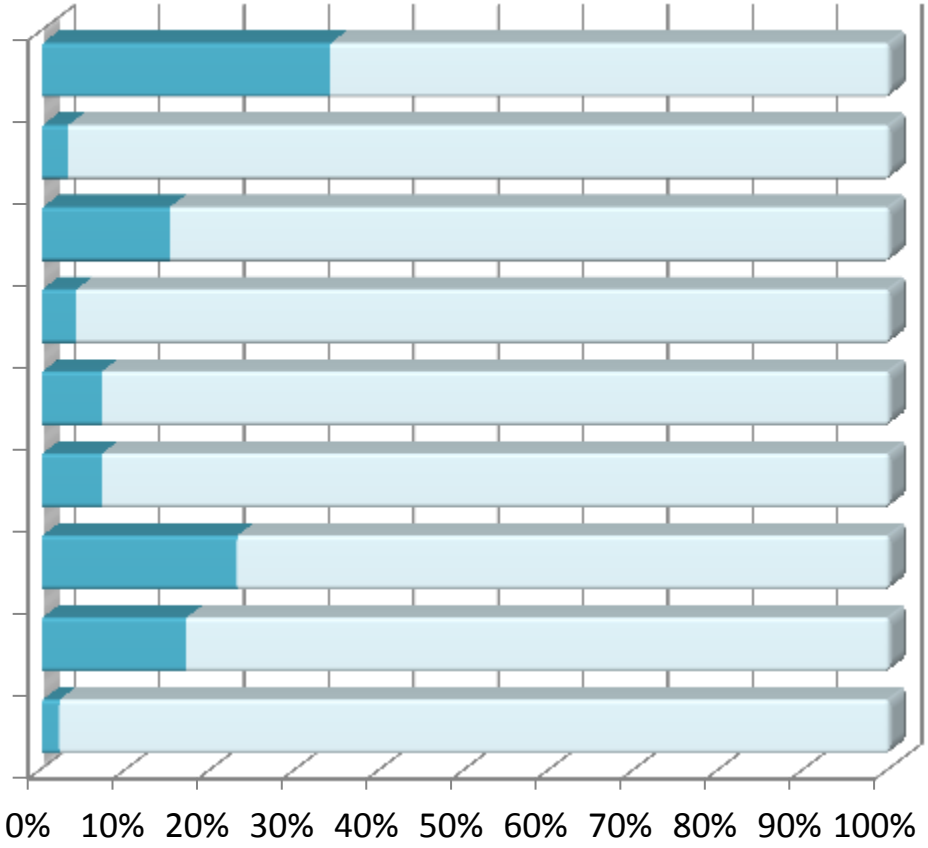
Ostial, N=90/1,282 (7.0%)

CTO, N=96/1,440(6.7%)

Bifucations, N=333/1,440(23.1%)

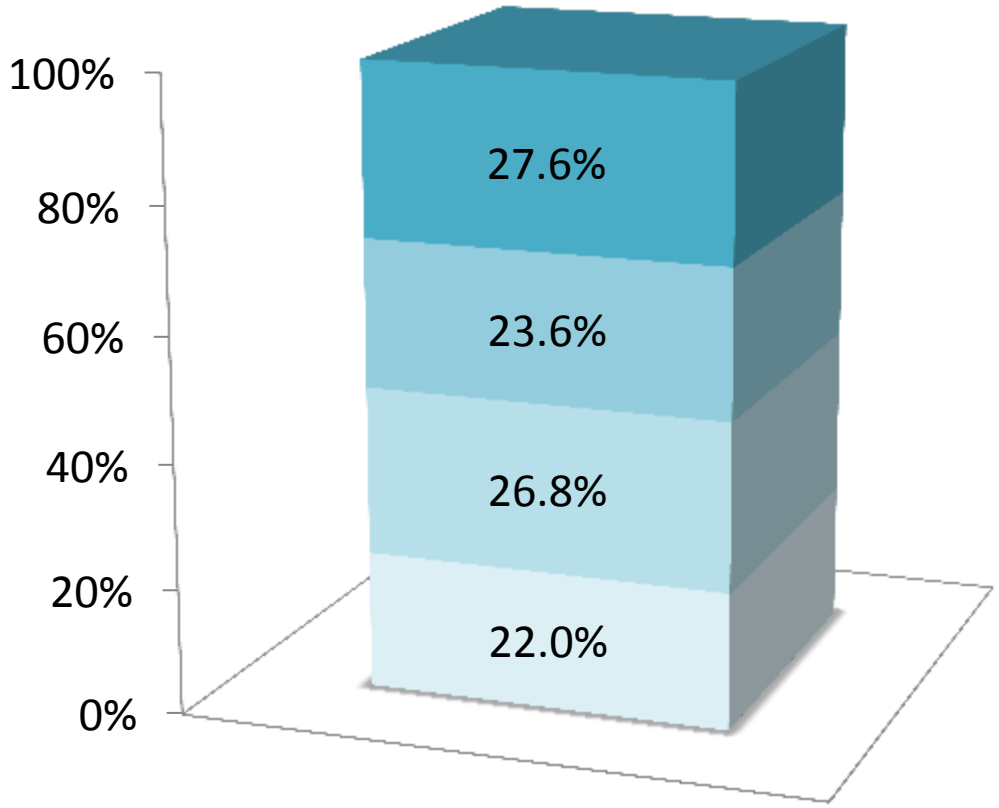
Thrombus, N=242/1,440(16.8%)

Left main, N=17/1,427(1.2%)



***Compared to ABSORB II eligibility (Diletti et al. Am Heart J. 2012;164:654-63)**

ACC/AHA Lesion Complexity



ACC/AHA B2/C
N= 687/1,343 (51.2%)*

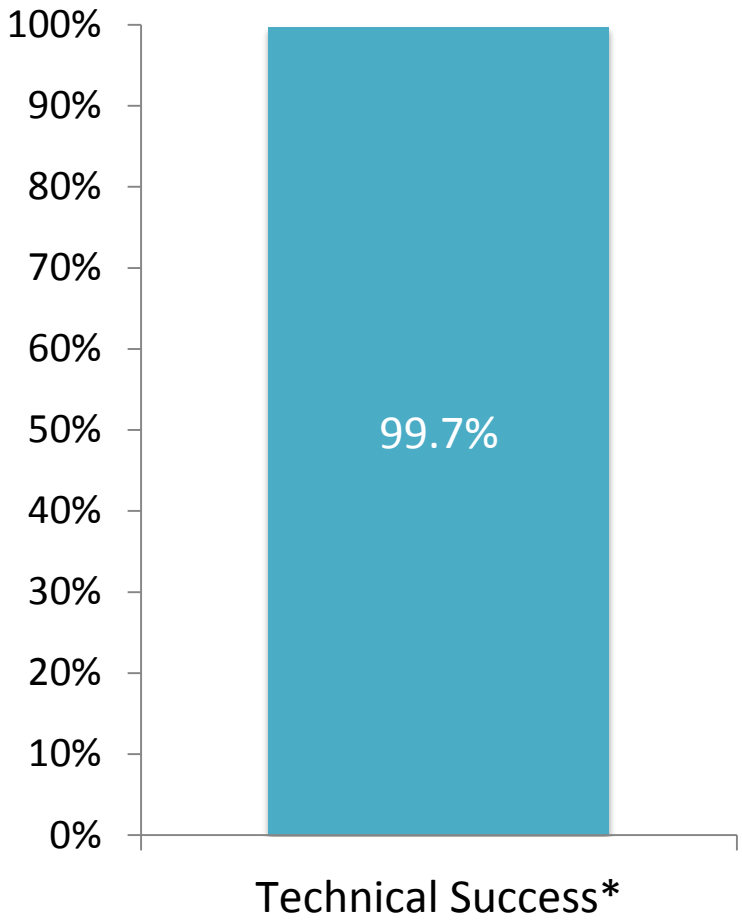
- ACC/AHA type C (N=370)
- ACC/AHA type B2 (N=317)
- ACC/AHA type B1 (N=360)
- ACC/AHA type A (N=296)

*Vs. 40% in the ABSORB EXTEND
Whitbourn et al. – TCT 2013

GHOST-EU Procedural Details :1189 patients

Lesion-based	
Pre-Dilatation	1,405/1,440 (98%)
Post-Dilatation	712/1,1440 (49%)

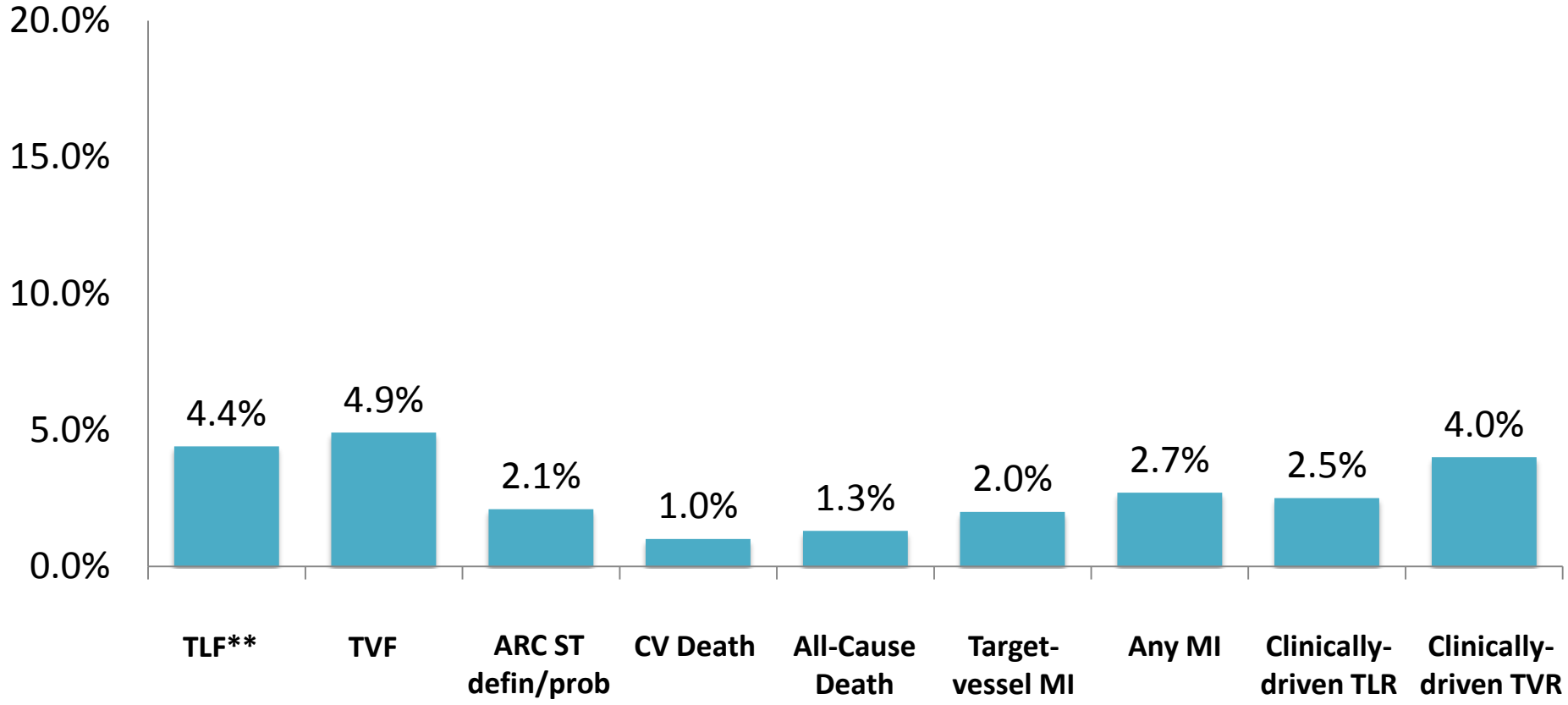
Patient-based	
No. Target Lesion/Pt	1.2±0.5
Multivessel Disease	485/1,186 (40.9%)
SYNTAX Score	11.3±7.9 (820)
Hybrid (BVS plus non-BVS)	219/1,189 (18.4%)
IVUS-guided	171/1,184 (14.4%)
OCT-guided	163/1,184 (13.8%)
Tot. Scaffold Length (mm)	32.6±23.0 (1,189)
Aver. Scaffold Diameter (mm)	3.0±0.5 (1,189)
Tot. Scaffold Implanted (n)	1731



*** Residual in-scaffold diameter stenosis < 30%**

Capodanno D et at. EuroIntervention 2015;10:1144-53.

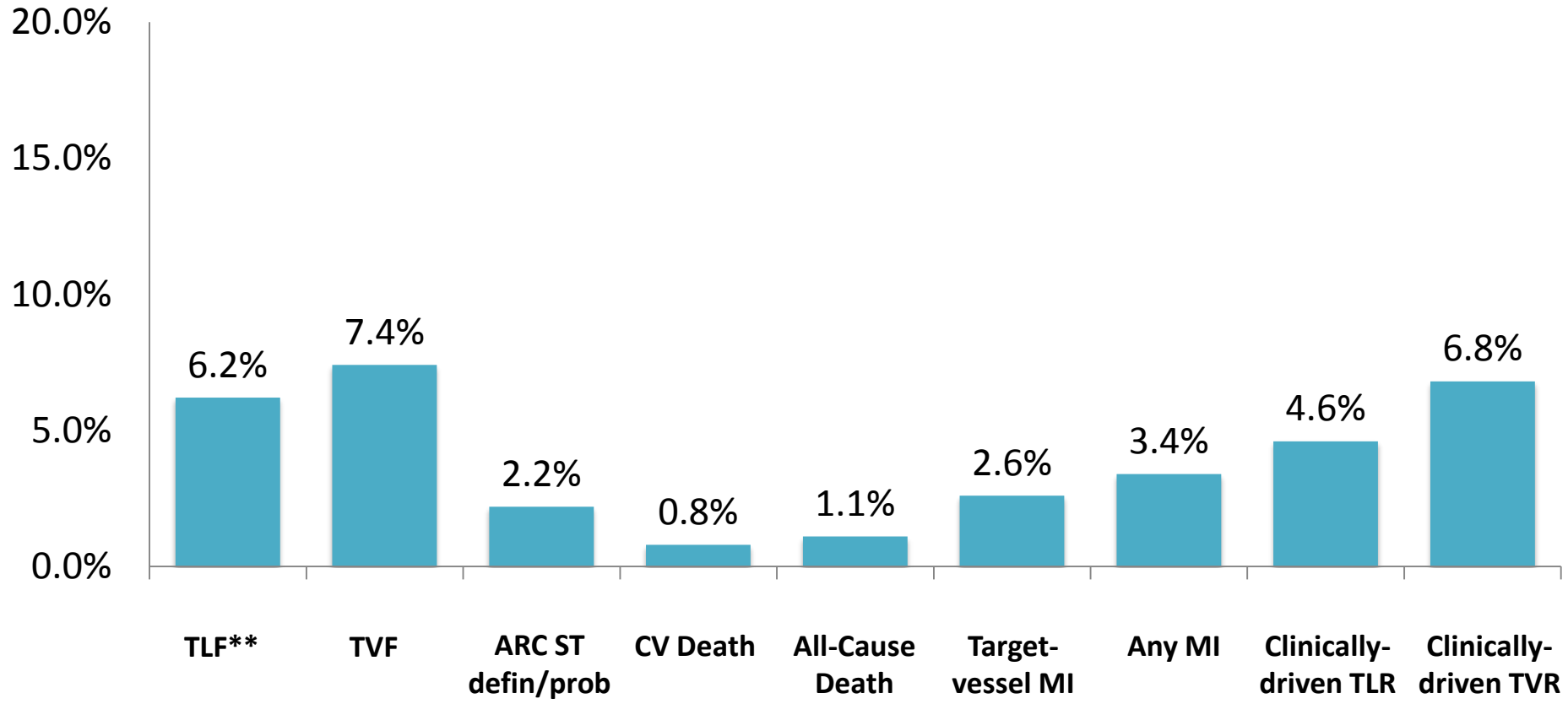
6-Month Outcomes* 1189 patients
6-month follow-up available in 76%



*Event rates are expressed as Kaplan Meier estimates
** Device-Oriented composite primiry endpoint

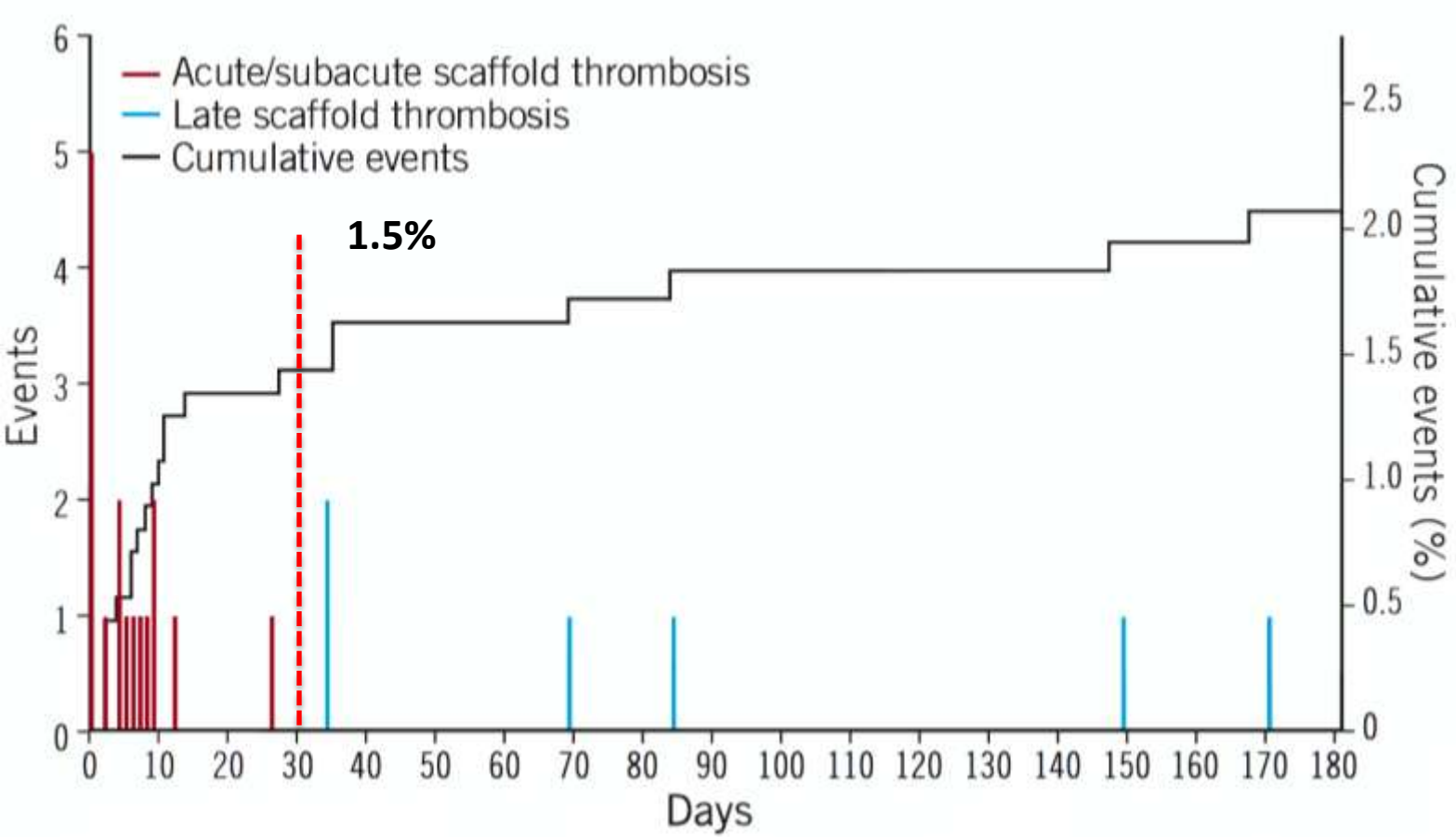
Capodanno D et at. EuroIntervention 2015;10:1144-53.

1-Year Outcomes* 1189 patients
1-year follow-up available in 86%



*Event rates are expressed as Kaplan Meier estimates
** Device-Oriented composite primary endpoint

GHOST-EU Scaffold Thrombosis : 1189 patients



Capodanno D et at. EuroIntervention 2015;10:1144-53.

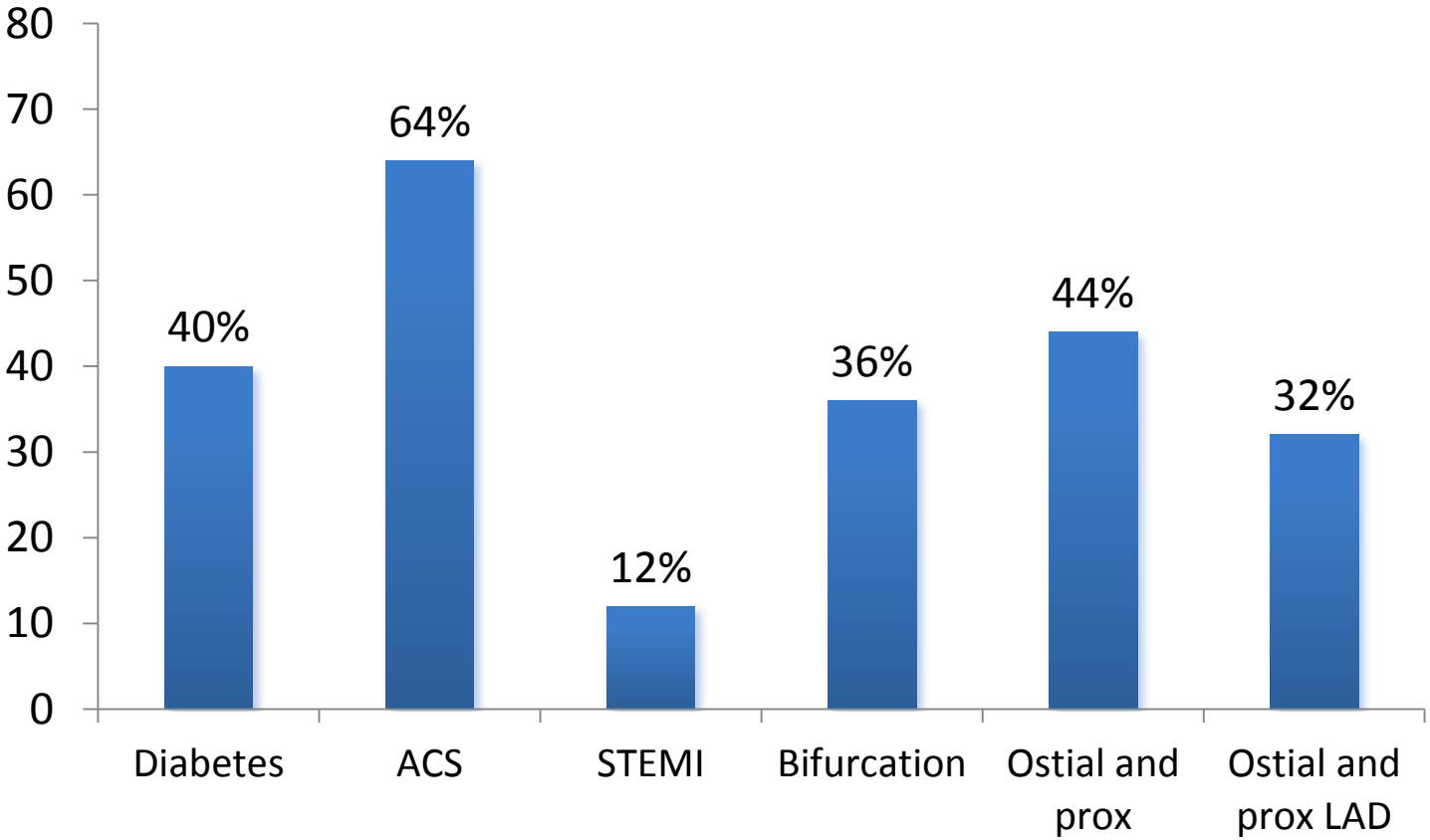
Scaffold Thrombosis GHOST-EU: 1189 patients

- There were 20 cases of angiographically confirmed ST and three of probable ST.
- 70% occurred in the first month after PCI, **at a median of 5 days,** suggesting the need for scrupulous lesion selection and PCI techniques when using BVS.
- Intravascular imaging was performed in only 4 of 23 patients who experienced ST, of whom 2 discontinued DAPT.
- 18 of 23 were on clopidogrel.
- 20 of 23 patients were on DAPT at the time of ST.

Capodanno D et al. Eurointervention 2014. In press

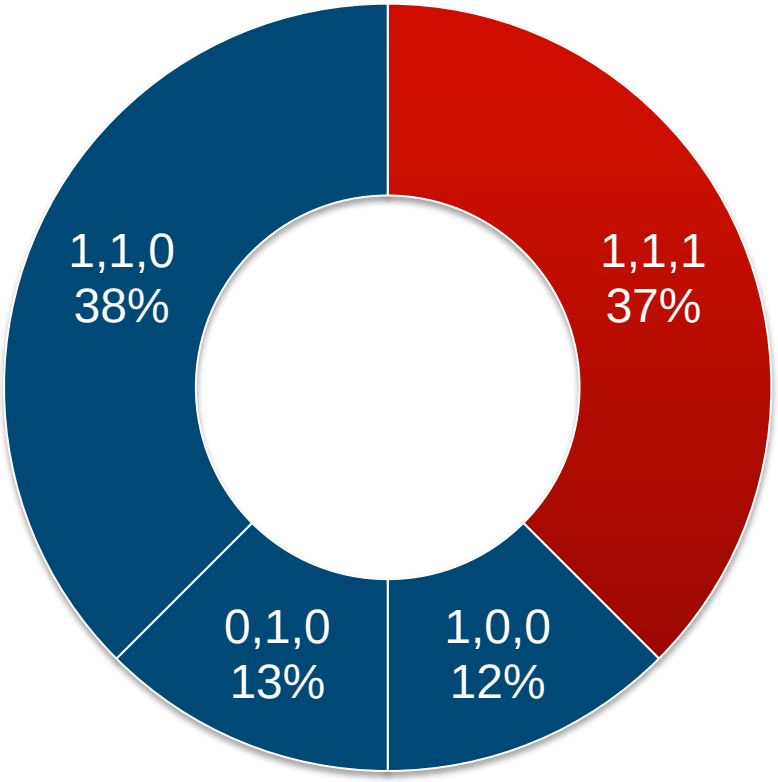
Scaffold Thrombosis GHOST-EU: 1189 patients

Prevalence of clinical and angiographic factors among 25 patients with scaffold thrombosis



GHOST-EU : 8/23 ST were in bifurcations

Kaplan-Meier 30-day and 6-mo ST in bifurcations: 1.5% and 3.1%, respectively

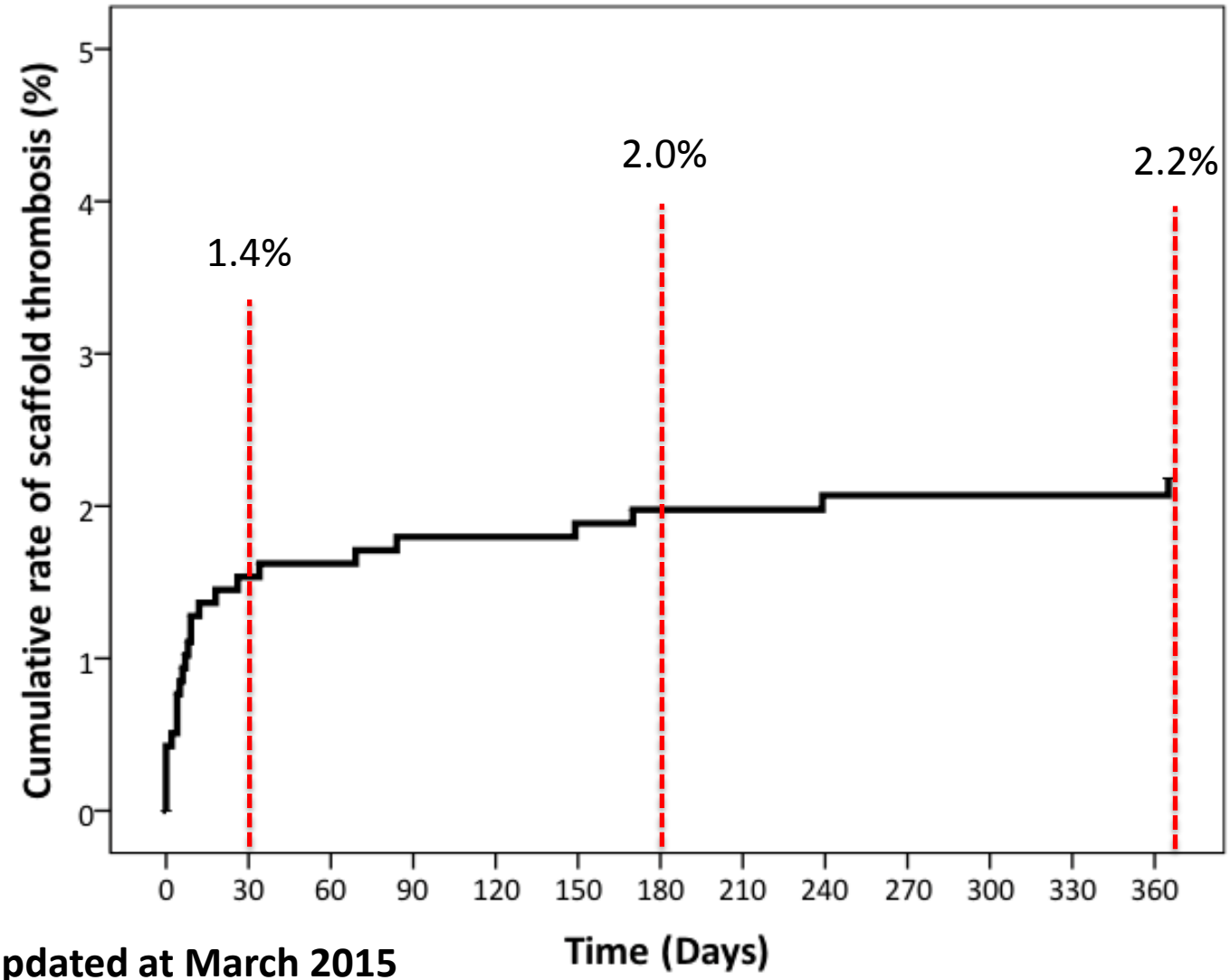


Medina classes in 8 bifurcations ST

Case	Days	ACS	Strategy	PD	KBI	IG	DAPT
#1	149	No	Single	Yes	No	Yes	No
#2	69	No	Single	No	No	No	Yes
#3	2	Yes	Single	No	No	Yes	Yes
#4	0	Yes	Single	No	No	No	Yes
#5	34	Yes	Single	No	No	No	Yes
#6	34	Yes	Double	Yes	No	No	No
#7	0	Yes	Single	No	No	No	Yes
#8	12	Yes	Single	No	No	No	Yes

ACS = acute coronary syndromes; PD = main branch post-dilatation;
IG = intravascular guidance; DAPT = on dual antiplatelet therapy

Scaffold Thrombosis GHOST-EU: 1189 patients



Follow-up updated at March 2015

GHOST | Ferrarotto Population

Patients enrolled N=319; lesions N = 406

From 1/3/2013 to 30/06/2014

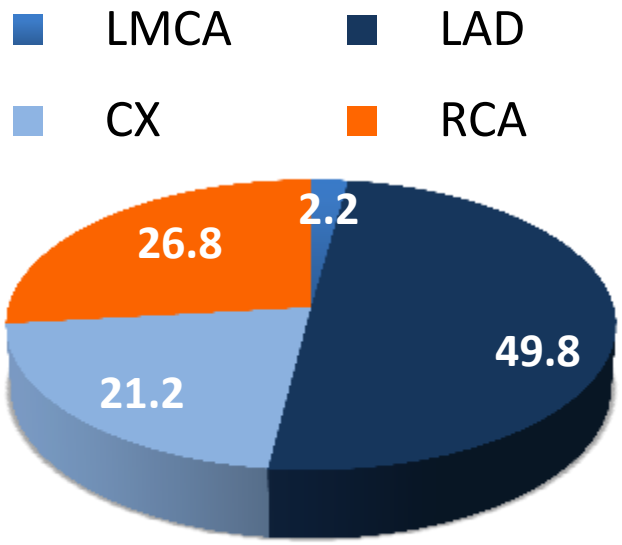
- **6-months FU in 305 patients 95.6%**
- **1-year FU in 281 patients: 88.1% of overall population and 95% of those eligible (n=296)**

GHOST

Ferrarotto Population Clinical characteristics

Variable	Patient-based (N = 319)
Age, years±SD	60.7 ± 9.6
Male	272 (85.3%)
Diabetes mellitus	**79 (24.8%)**
On insulin	32 (10.0%)
Dyslipidemia	187 (58.6%)
Hypertension	221 (69.3%)
Smoker	117 (36.7%)
Previous PCI	102 (32.0%)
Prior CABG	10 (3.1%)
ACS	**158 (49.5%)**
NSTEMI	**46 (14.4%)**
STEMI	**58 (18.2%)**

Ferrarotto Population
Lesions and procedural characteristics



Lesions B2/C: 51.2%
Bifurcations: 16.7%
CTO: 8.4%

*per patient

Variable	Lesions (N = 406)
Lesion Lenght	21.2 ± 16.8
Lesion length >34 mm	55 (13.5%)
Reference vessel diameter (mm)	2.9 ± 0.5
Total scaffold length (mm)	32.8 ± 21.6
Average scaffold diameter (mm)	3.1 ± 0.4
Average of scaffolds implanted (n)	1.9 ± 1.2*
Post-dilatation	**289 (71.2%)**
Post-dilation balloon pressure, atm	**16.6±4.3**
Scaffold implantation pressure, atm	**13.5±3.4**
Overlapping	132 (32.5%)
Optical coherence tomography use	80 (25.1)*
Intravascular ultrasound use	37 (11.6)*

GHOST

Ferrarotto Population
1-year outcomes

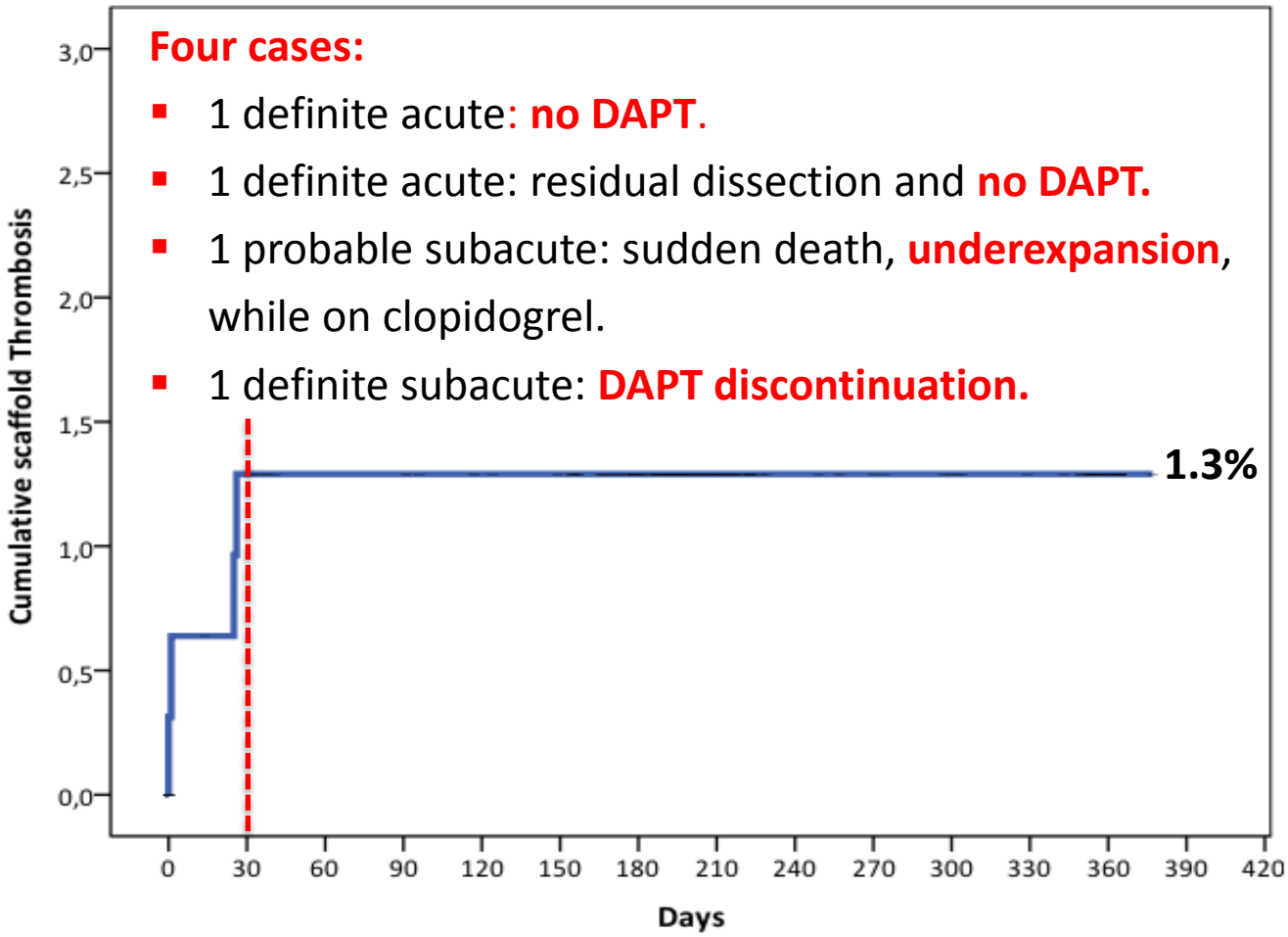
TLF (cardiac death, target-vessel MI, or clinically-driven TLR)	5.2%
TVF (cardiac death, target-vessel MI, or clinically-driven TVR)	5.6%
All Death	1.7%
Non-Cardiac Death	1.0%
Cardiac Death	0.3%
Any MI (all target vessel)	1.3%
TVR	5.3%
TLR	4.9%

Event rates are expressed as Kaplan Meier estimates.

Ferrarotto Population
1-year scaffold thrombosis

Four cases:

- 1 definite acute**: no DAPT**.
- 1 definite acute: residual dissection and **no DAPT.**
- 1 probable subacute: sudden death, **underexpansion**, while on clopidogrel.
- 1 definite subacute: **DAPT discontinuation.**



Ferrarotto Population
Lesions characteristics

Variable	Absorb II inclusion Patient N = 89 Lesions N = 110	Absorb II exclusion Patient N = 230 Lesions N = 296	P values
Lesion type			0.01
A	20.0%	11.8%	
B1	41.8%	32.1%	
B2	17.3%	22.6%	
C	20.9%	33.4%	
Bifurcation	**10.9%***	**18.9%**	0.07
CTO	**-**	**11.5%**	
Lesion Length	16.4 ± 7.9	22.9 ± 18.7	<0.0001
Lesion length >34 mm	**5.5%**	**16.6%**	**0.006**
Reference vessel diameter (mm)	2.9 ± 0.5	2.9 ± 0.5	0.32

*side branch <2 mm

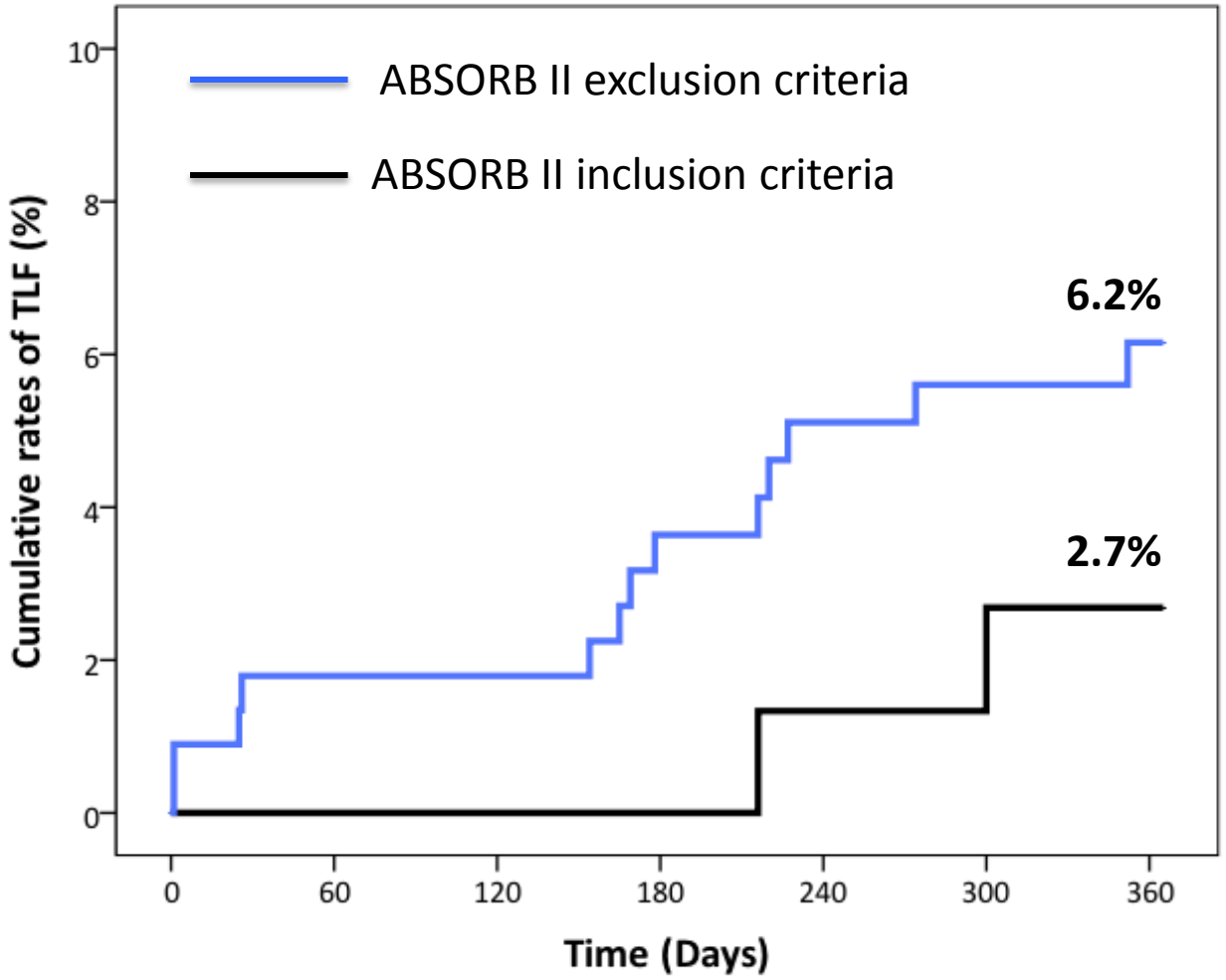
Ferrarotto Population
Procedural characteristics

Variable	Absorb II inclusion Patient N = 89 Lesions N = 110	Absorb II exclusion Patient N = 230 Lesions N = 296	P values
Total scaffold length (mm)	25.8 ± 11.5	35.3 ± 23.8	<0.001
Average scaffold diameter (mm)	3.1 ± 0.4	3.2 ± 0.4	0.11
Avarage of scaffolds implanted (n)	1.5 ± 0.7 *	2.0 ± 1.3*	<0.001
Post-dilatation	**59.1%**	**75.7%**	**0.002**
Overlapping	21.5%	36.5%	0.005
Optical coherence tomography use	9.0%*	31.3%*	<0.001
Intravascular ultrasound use	11.2%*	11.7%*	1.00

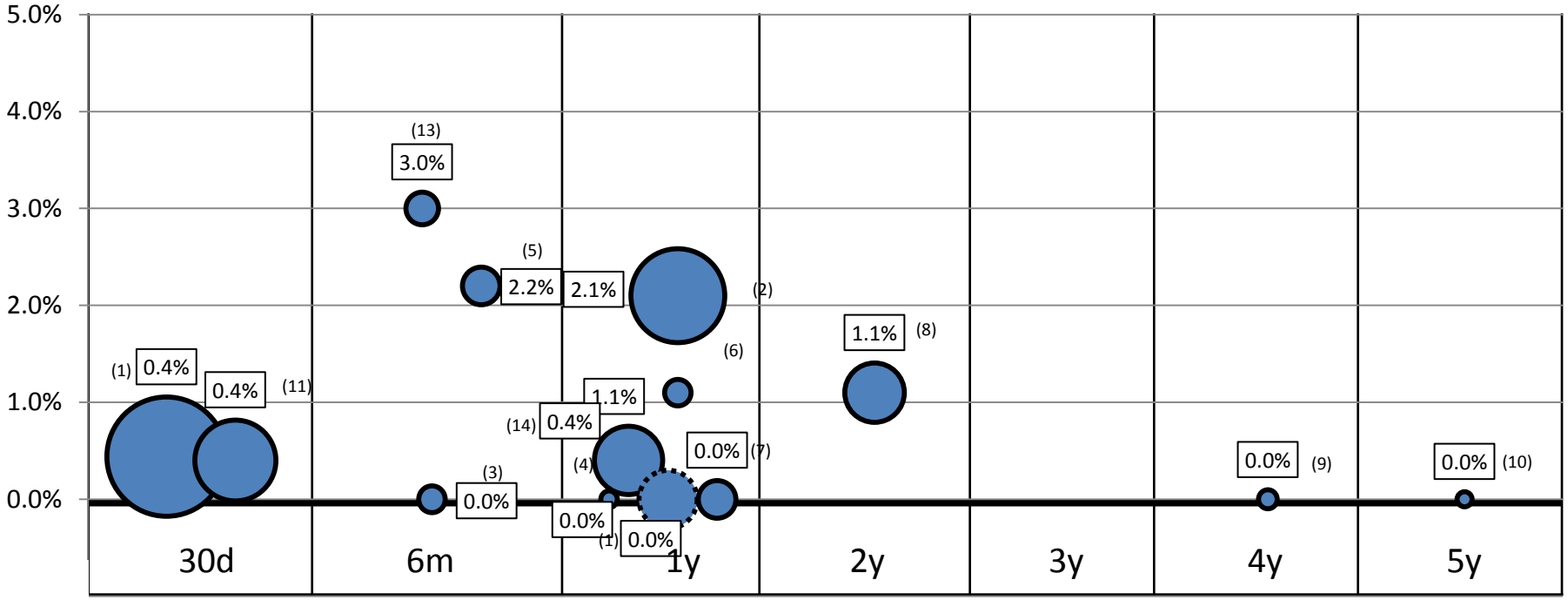
*per patient

GHOST

Ferrarotto Population
1-year TLF



ABSORB Data
Scaffold Thrombosis (Longest Available FU)



(1) ABSORB FIRST: **All Comers (@AsiaPCR2015)**

(2) GHOST-EU: **All Comers** (@JIM2015)

(3) Dr. Costopoulos on CCI: **All Comers (in CCI2014)**

(4) CTO (Dr. Serra): **CTO (on Eurointervention2014)**

(5) ABSORB EXPAND: **All Comers (@EuroPCR2014)**

(6) POLAR ACS: **ACS (@ EuroPC2014)**

(7) ASSURE: **All Comers (on Eurointervention2014)**

(8) ABSORB EXTEND: **selected (@ EuroPCR2014)**

(9) ABSORB Cohort B: **simple (@ EuroPCR2014)**

(10) ABSORB Cohort A: **simple @ EuroPCR2011)**

(11) GABI-R: **All Comers (@Germand congress2014)**

(12) ABSORB II**: selected (in Lancet 2014)**

(13) AMC Registry**: AC (in Eurointervention 2014)**

(14) Polish BVS registry: **all comers (@NFIC2014)**

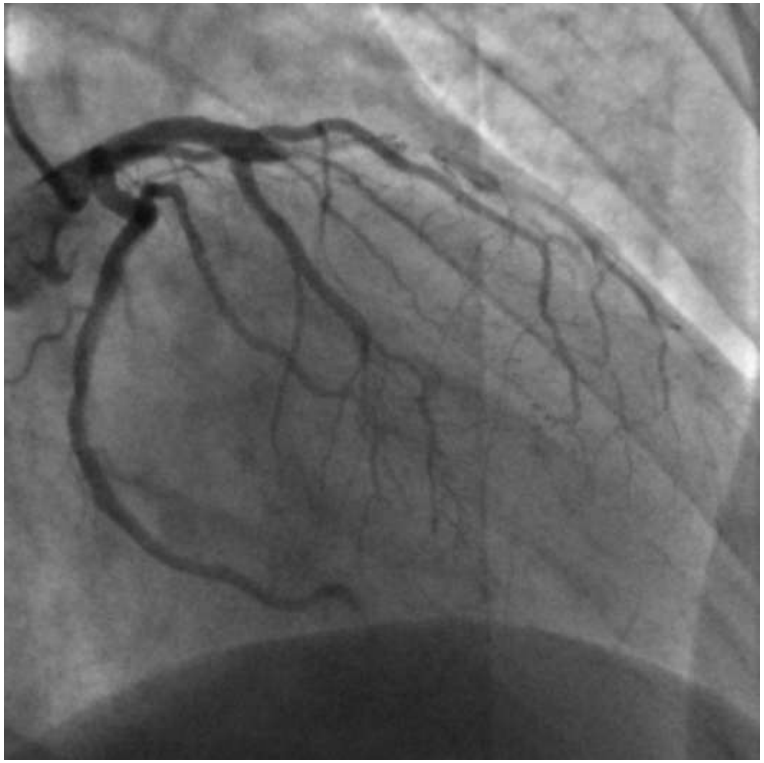
Lessons from Absorb all-comers registries

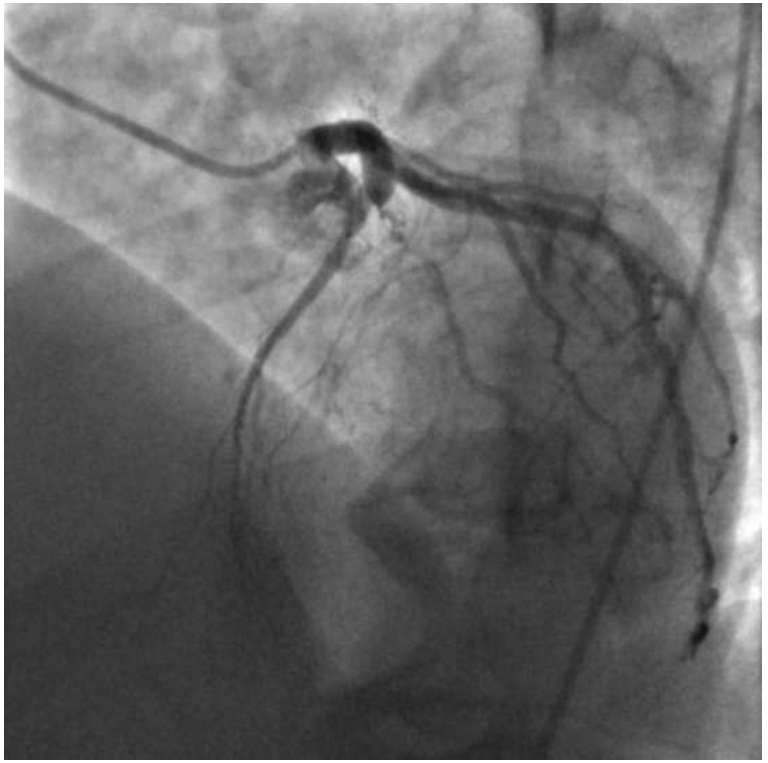
- **Accurate Patient and Lesion selection:** more data are needed to define the best candidate for BVS;
- **Lesion preparation:** RVD:balloon 1:1; aim to stent-like result.
- **Accurate sizing:** Use IC nitro, imaging if necessary, predilatation balloon sizing; tend to slight oversizing
- **Adeguate Scaffold Implantation and result optimization:** 2 atm every 5 seconds. Keep inflated 30 seconds, at high pressure; post-dilatation (NC balloon + 0.5 nominal size) at high pressure; Meticulous ovelapping.
- **More Liberal Imaging use especially in complex setting**.
- **Optimal antiplatelet therapy.**

Clinical Case – FPJ

L.M. male, 52 yrs old
Prior smoking and Dyslipidemia

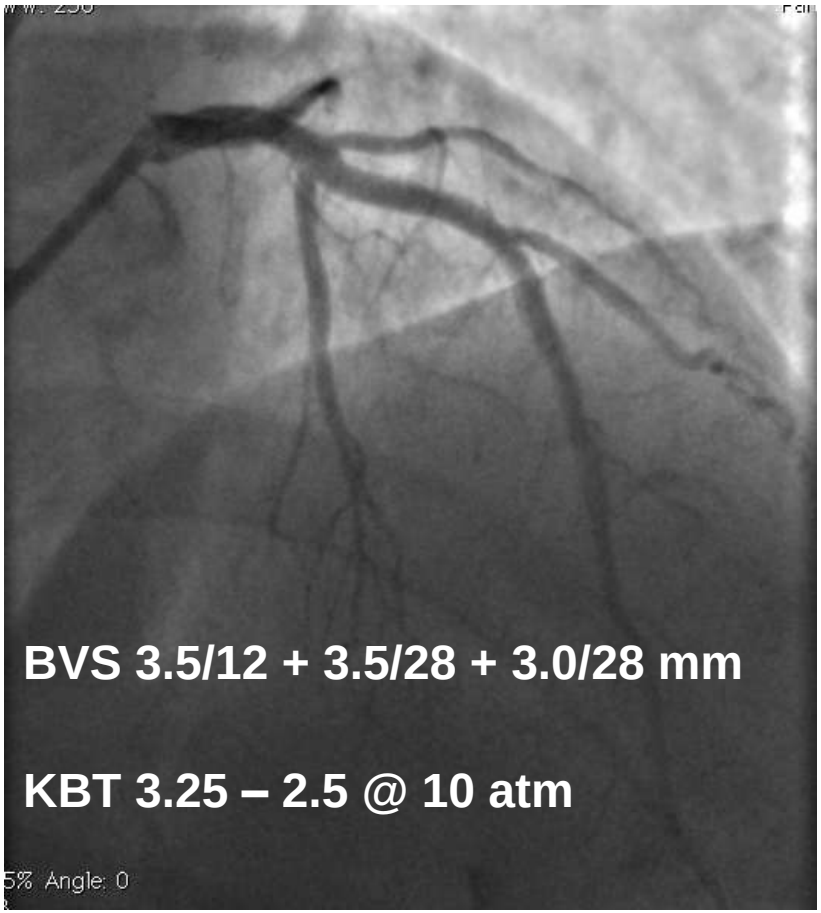
Clinical Case – Full Polymer Jacket





Baseline Angio

Clinical Case – Full Polymer Jacket



Final Angio

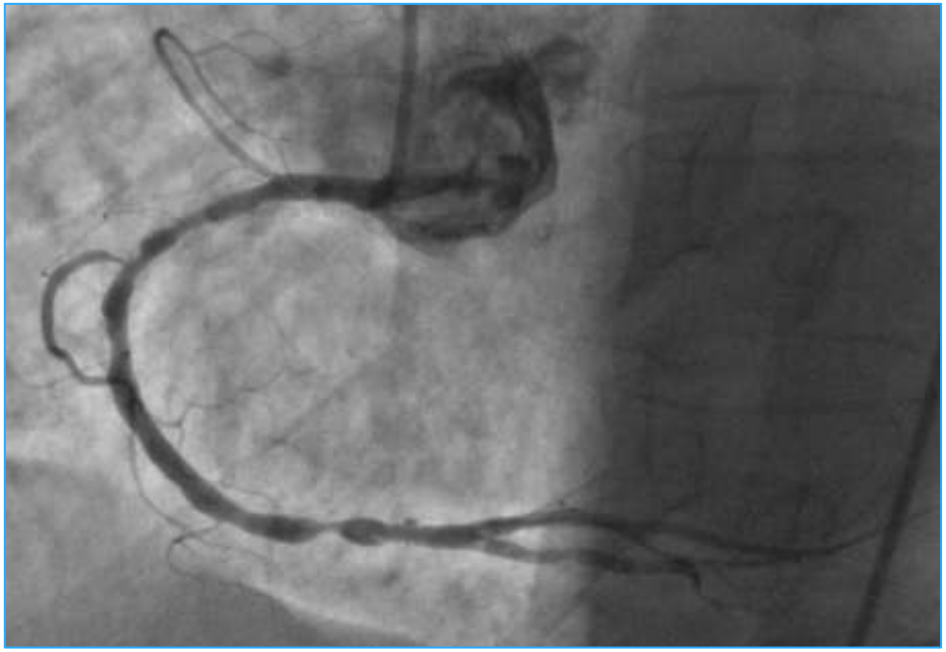
Clinical Case – Full Polymer Jacket

Index procedure

1-y

BVS in calcified RCA multiple lesions

- T. G., male, 73 yrs old, family history of CAD
- History of atrial fibrillation and flutter *and* since Jan 2014: toracic oppression and stress test with runs of ventricular tachicardia
- Feb 2014 → coronary angiography



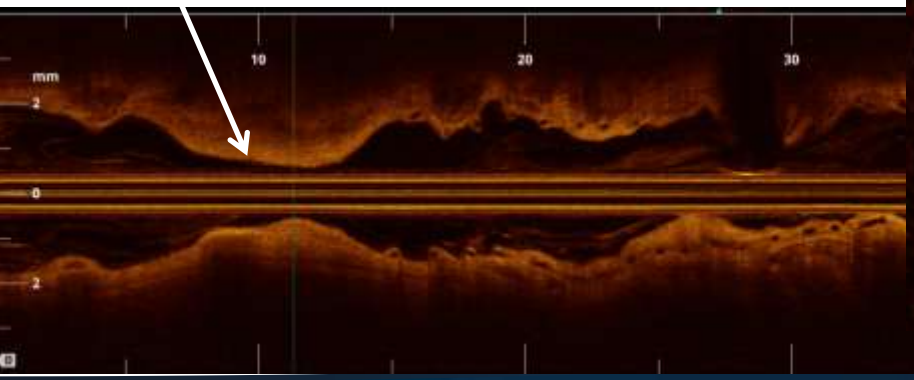
CUTTING, ANGIOSCULPT,
HIGH ATM (30) NC BALLOON
ROTABLATOR, CUTTING, BVS

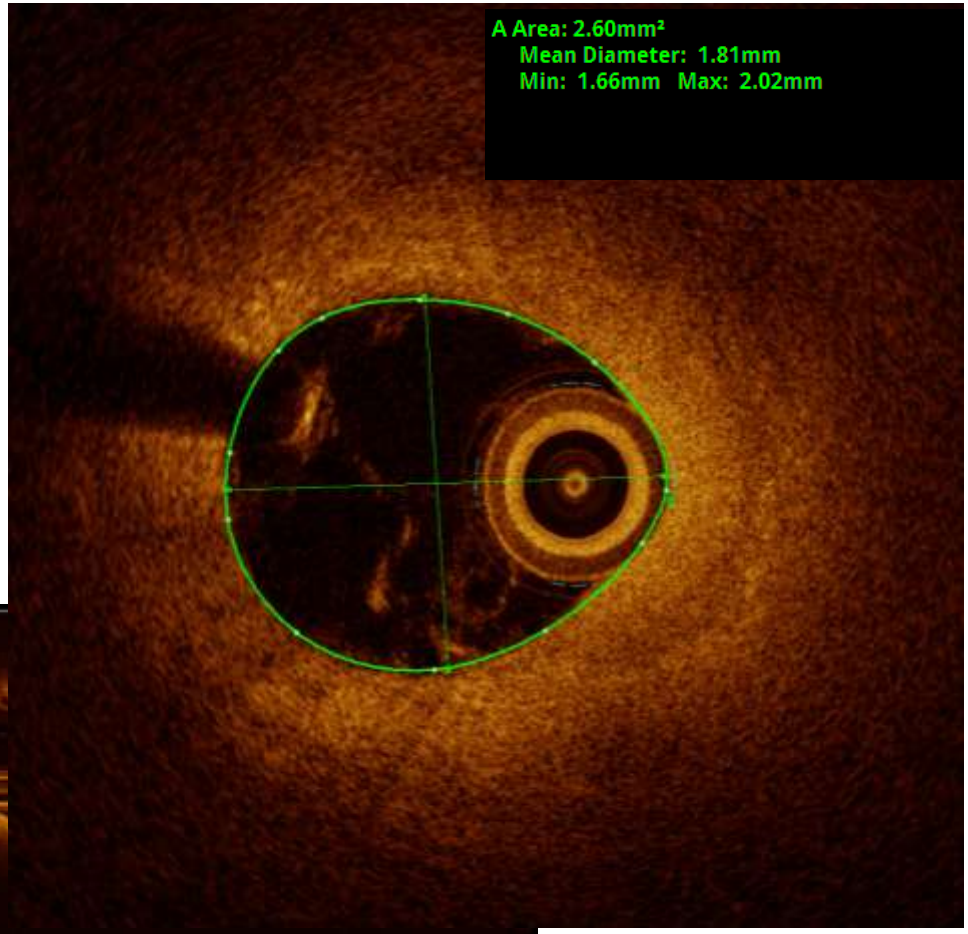
BVS in calcified RCA multiple lesions

Final result after 3 BVS (3/28-3.5/28-3.5/12 mm) and overlap post-dilatation

BVS in calcified RCA multiple lesions

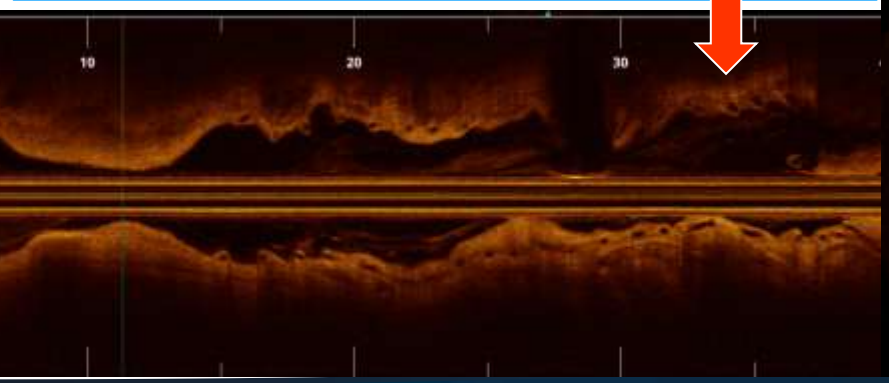
6-Month Angiography-FU for positive Treadmill test

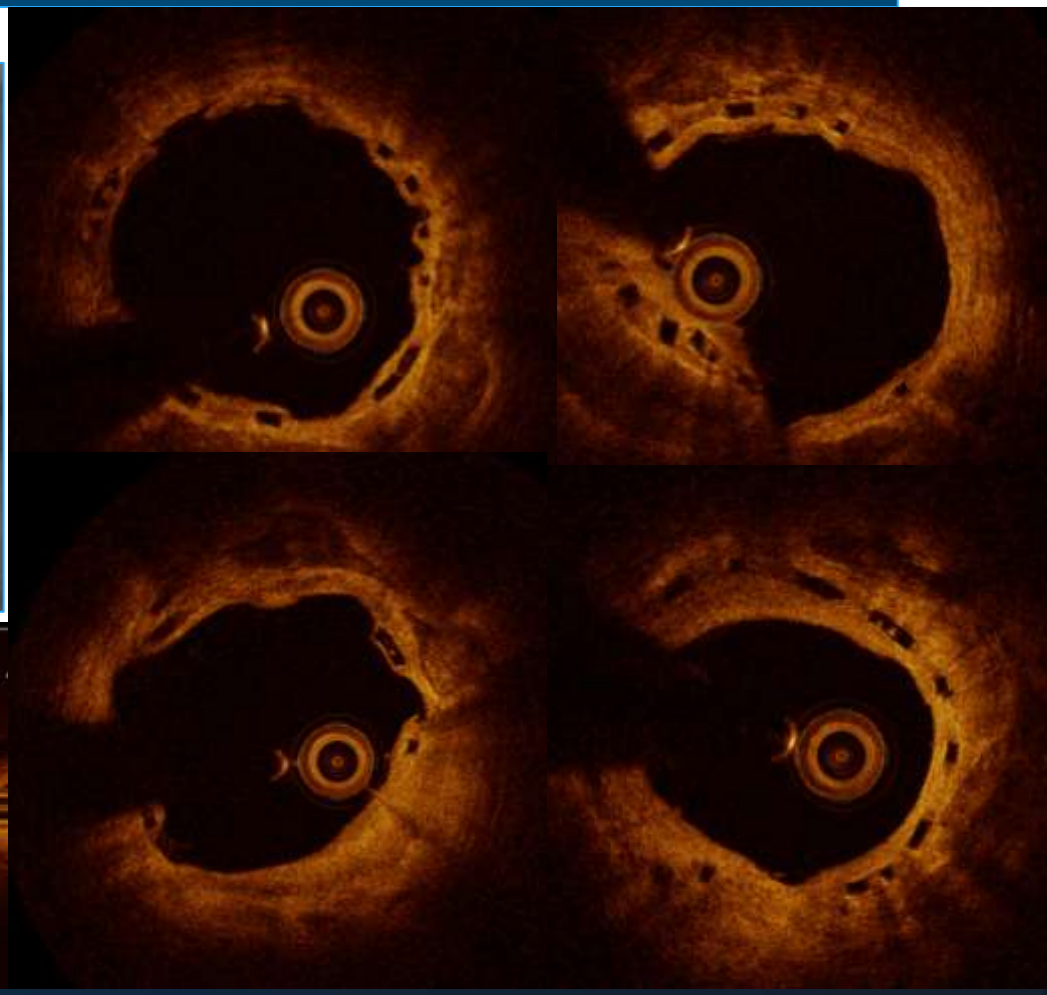




BVS in calcified RCA multiple lesions

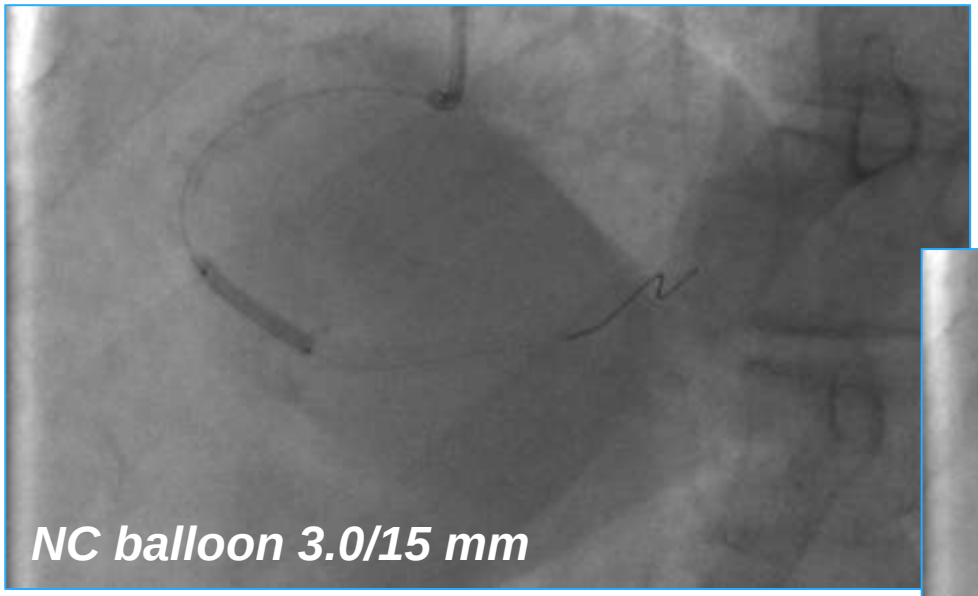
6-Month Angiography-FU for positive Treadmill test

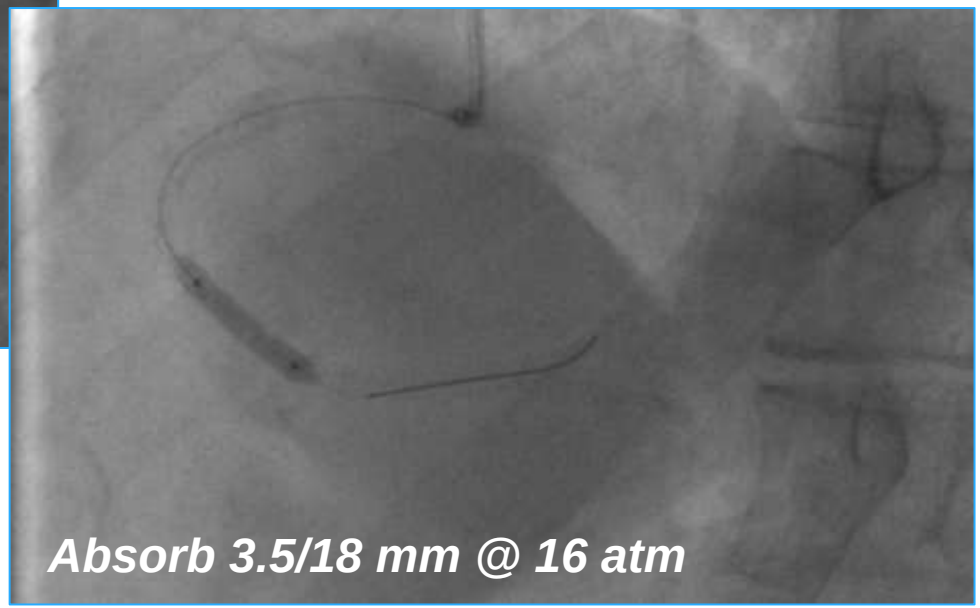




BVS in calcified RCA multiple lesions

Predilatation and BVS implantation





BVS in calcified RCA multiple lesions

Final result after BVS