IVUS-XPL: Five-Year Outcomes From a Randomized Trial of Intravascular Ultrasound-Guided vs Angiography-Guided PCI of Long Coronary Lesions

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Disclosure

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  There are no conflict of interest disclosures.

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IVUS-XPL Trial: 1-year Clinical Outcome

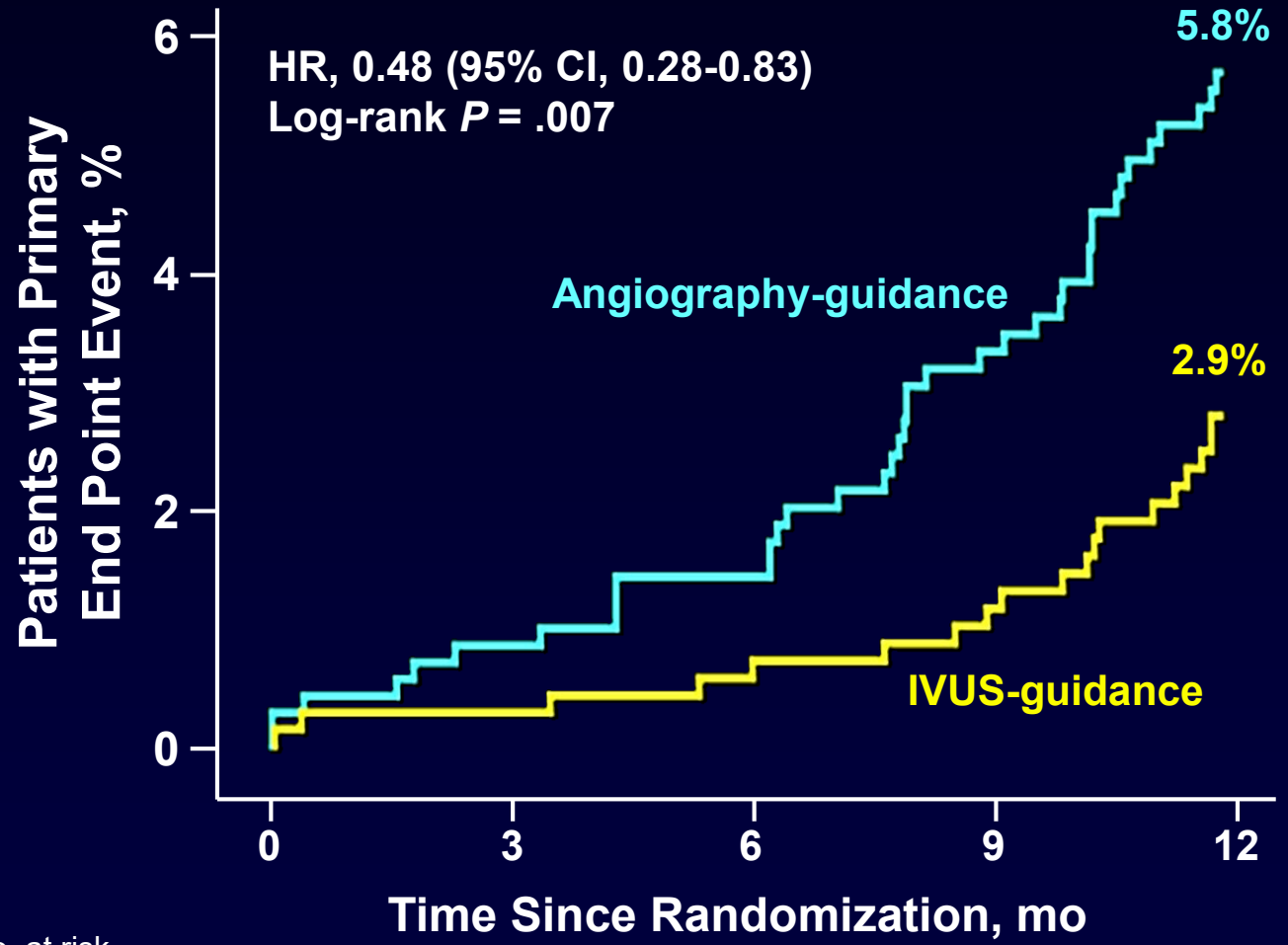
Patients with long coronary lesions
(Implanted stent ≥28 mm in length)
N = 1400

DES implantation with IVUS guidance
n = 700

DES implantation with angiography guidance
n = 700

Clinical follow-up at 12 months
Primary end point: MACE

Cardiac death, target-lesion related MI, and ischemia-driven TLR



Hong et al. *JAMA* 2015;314:2155-2163

Background

Limitation of the IVUS-XPL trial

- Short-term follow-up, while the TLR still has been continued to occur beyond 1 year even in the era of new-generation DES.
- There is no randomized trial evidence evaluating the long-term effect of IVUS guidance beyond 2 years.

Usefulness of IVUS beyond 1 year

IVUS usage during PCI → **?** → **Is the beneficial effect sustained up to 5 years?**

Objective

We report the 5 year clinical outcomes of the randomized IVUS-XPL trial in order to determine **whether the beneficial 1-year effect of IVUS guidance is sustained up to 5 years** when patients are treated with contemporary DES.

Study Design

- **IVUS-XPL trial:**

A prospective, randomized, multi-center trial at 20 centers in Korea

- **Enrollment period: Oct 2010 and July 2014**

- **Key inclusion criteria**
  - Age 20 years or older
  - Patients with typical chest pain or evidence of myocardial ischemia
  - Non-emergent conditions
  - Stent length ≥ 28 mm based on angiographic estimation
  - Significant coronary artery stenosis (>50% based on visual estimate) considered for coronary revascularization with stent implantation

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Study Design

- **Extended 5-year Follow-up of IVUS-XPL trial:**

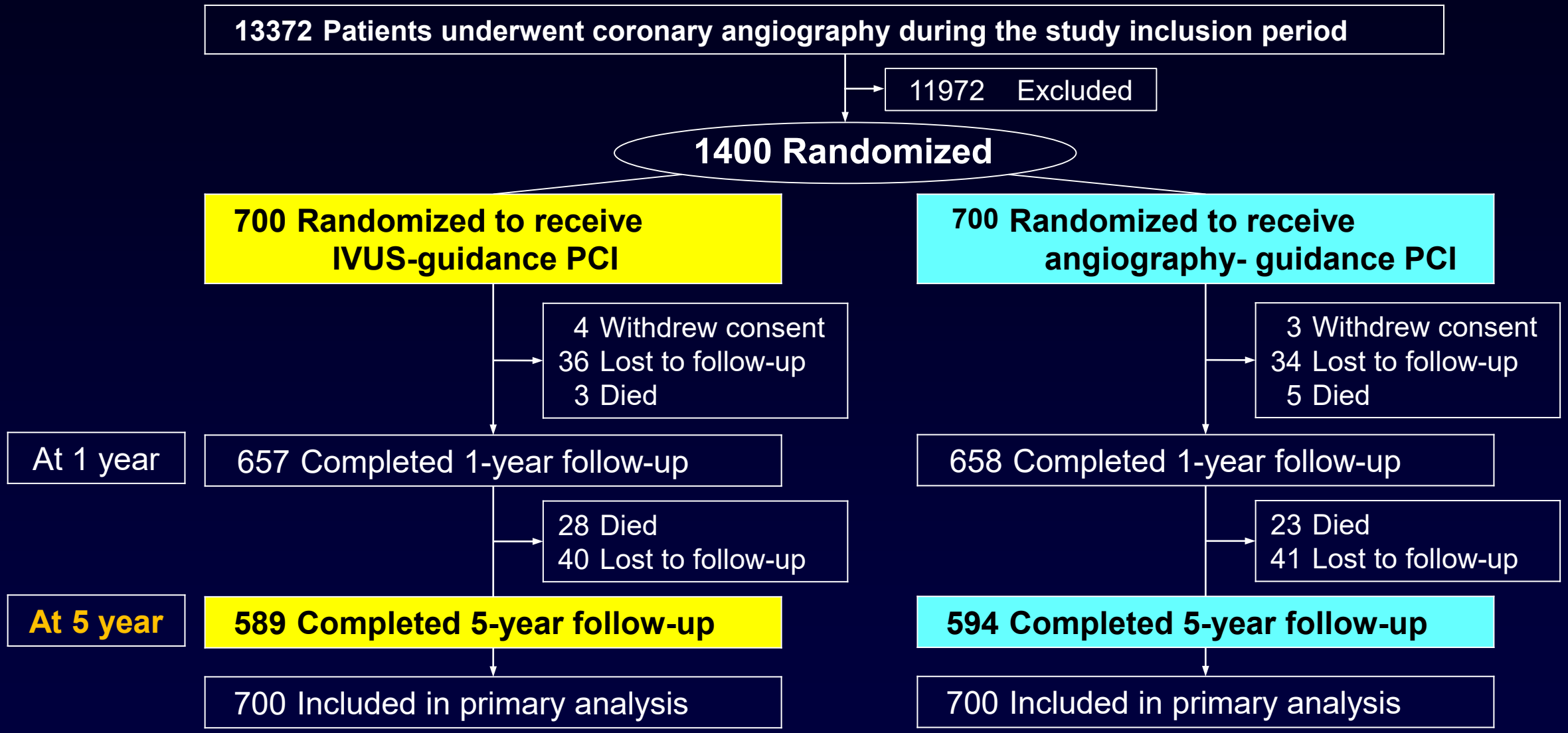
  - ✓ Clinical assessment, including the evaluation of cardiac symptoms and compliance with medications, was performed at the physician office visit every 3-6 months during the 5 year follow-up period.

  - ✓ Therefore, follow-up data were collected from medical records by the dedicated clinical research coordinators from each of the participating centers.

Statistical Analysis

- Primary analysis
  - Intention-to-treat analysis with cumulative incidences of MACE at 5 year using the Kaplan-Meier estimates.
  - Comparison using the log-rank test.
  - Land-mark analyses between 1 and 5 year
  - Subgroup analyses for 5-year MACE

Study Flow


13372 Patients underwent coronary angiography during the study inclusion period
11972 Excluded
1400 Randomized
700 Randomized to receive IVUS-guidance PCI
700 Randomized to receive angiography- guidance PCI
4 Withdrew consent
36 Lost to follow-up
3 Died
3 Withdrew consent
34 Lost to follow-up
5 Died
At 1 year
657 Completed 1-year follow-up
658 Completed 1-year follow-up
28 Died
40 Lost to follow-up
23 Died
41 Lost to follow-up
At 5 year
589 Completed 5-year follow-up
594 Completed 5-year follow-up
700 Included in primary analysis
700 Included in primary analysis

Baseline Clinical Characteristics

	End of trial at 1 year		
	IVUS-guidance	**Angiography-guidance**	**P-value**
No. of patients	**657**	**658**	
Age, y	63±9	64±9	0.413
Male sex	452 (69)	455 (69)	0.890
Body mass index, kg/m^2	24.6±2.9	24.7±3.1	0.537
Hypertension	425 (65)	419 (64)	0.702
Diabetes mellitus	211 (32)	235 (36)	0.168
Dyslipidemia	445 (68)	434(66)	0.494
Current smoker	144 (22)	168 (26)	0.123
Prior myocardial infarction	33 (5)	29 (4)	0.599
Prior percutaneous coronary intervention	73 (11)	68 (10)	0.649
Prior coronary artery bypass graft	18 (3)	16 (2)	0.725
Left ventricular ejection fraction, %	63.0±9.8	62.3±10.2	0.244
Clinical presentation			0.252
Stable angina	335 (51)	340 (52)	
Unstable angina	231 (35)	209 (32)	
Acute myocardial infarction	91 (14)	109 (17)	
No. of treated lesions per patients	1.31±0.55	1.36±0.56	0.128
Duration of dual antiplatelet treatment, days	365 (180, 365)	365 (180, 365)	0.864

Angiographic and Procedural Characteristics

	IVUS-guidance	Angiography-guidance	P-value
No. of lesions	**657**	**658**	
Coronary arteries			0.109
Left anterior descending artery	431 (66)	395 (60)	
Left circumflex artery	85 (13)	102 (16)	
Right coronary artery	141 (22)	161 (25)	
Baseline quantitative coronary angiographic data			
Reference vessel diameter, mm	2.89±0.46	2.84±0.45	0.105
Minimum lumen diameter, mm	0.83±0.43	0.82±0.43	0.563
Diameter stenosis, %	71.2±14.4	71.4±14.4	0.859
Lesion length, mm	34.9±10.8	35.2±10.5	0.562
Adjunct post-dilatation	498 (76)	375 (57)	<0.001
Final balloon size, mm	3.15±0.43	3.05±0.42	<0.001
Maximal inflation pressure, atmosphere	16.5±4.1	15.9±4.1	0.048
Post-intervention quantitative coronary angiographic data			
Total stented length, mm	39.3±10.8	35.2±10.5	0.738
Reference vessel diameter, mm	3.04±0.44	2.97±0.44	0.003
Minimum lumen diameter, mm	2.64±0.42	2.56±0.40	0.001
Diameter stenosis, %	12.9±8.6	13.5±8.1	0.216

Clinical outcomes at 5 years

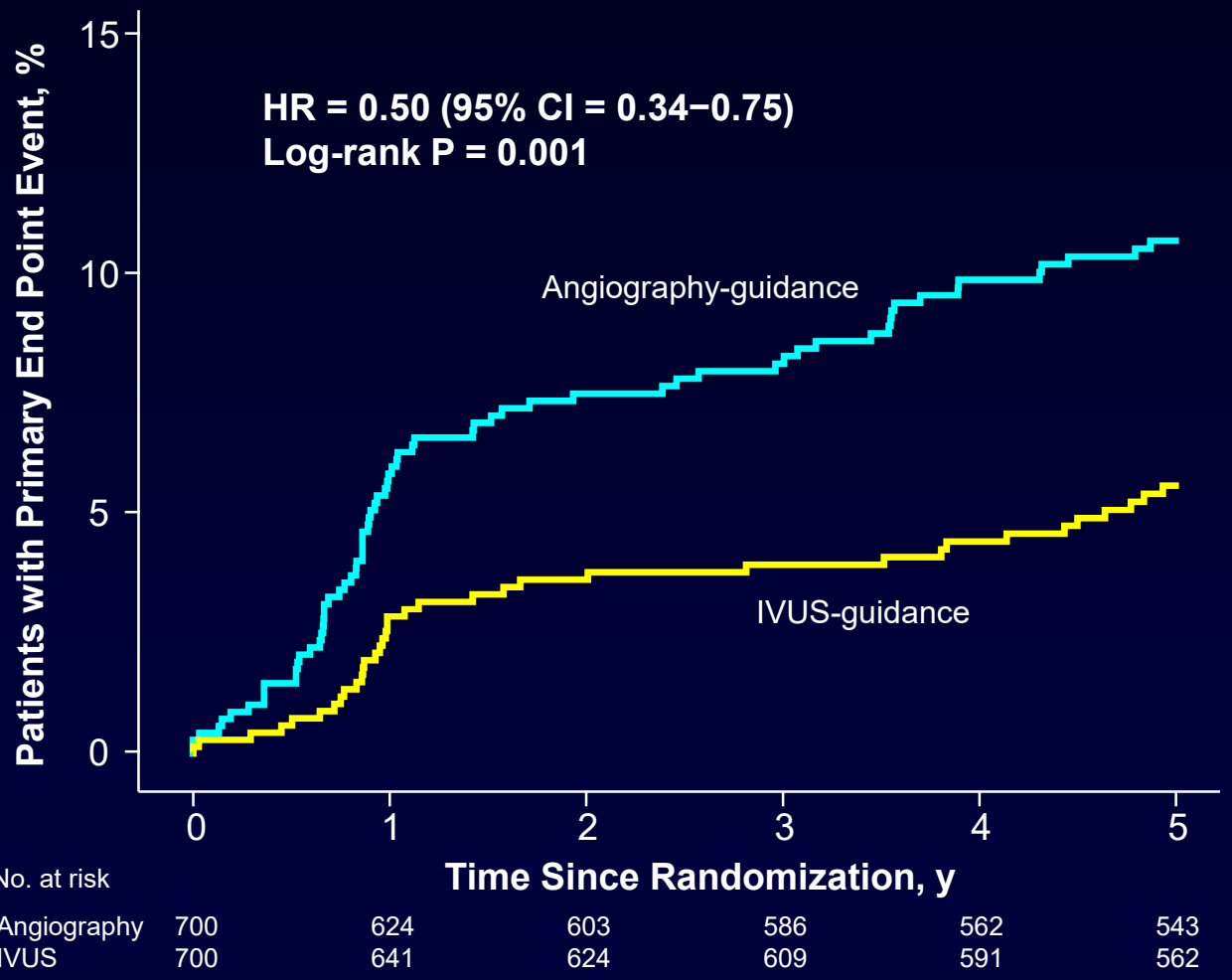
	IVUS-guidance (n=700)	Angiography-guidance (n=700)	Hazard ratio (95% CI)	Log-Rank *P* value
Primary End Point				
MACE	36 (5.6%)	70 (10.7%)	0.50 (0.34–0.75)	0.001
Secondary End Point				
Cardiac death	6 (0.9%)	14 (2.2%)	0.43 (0.17–1.12)	0.074
Target lesion related MI	4 (0.6%)	6 (0.9%)	0.67 (0.19–2.36)	0.525
Ischemia-driven TLR	31 (4.8%)	55 (8.4%)	0.54 (0.33–0.89)	0.007
Stent thrombosis	2 (0.3%)	2 (0.3%)	1.00 (0.14–7.10)	1.000
Acute	1 (0.1%)	1 (0.1%)		
Sub-acute	1 (0.1%)	0		
Late	0	1 (0.1%)		

Clinical outcomes between 1 and 5 years

	IVUS-guidance (n=700)	Angiography-guidance (n=700)	Hazard ratio (95% CI)	Log-Rank *P* value
Primary End Point				
MACE	17 (2.8%)	31 (5.2%)	0.53 (0.29–0.95)	0.031
Secondary End Point				
Cardiac death	3 (0.5%)	9 (1.4%)	0.33 (0.90–1.23)	0.083
Target lesion related MI	4 (0.6%)	5 (0.8%)	0.80 (0.21–2.97)	0.736
Ischemia-driven TLR	14 (2.3%)	22 (3.7%)	0.61 (0.31–1.20)	0.150
Stent thrombosis	0	0	–	–

Primary End Point

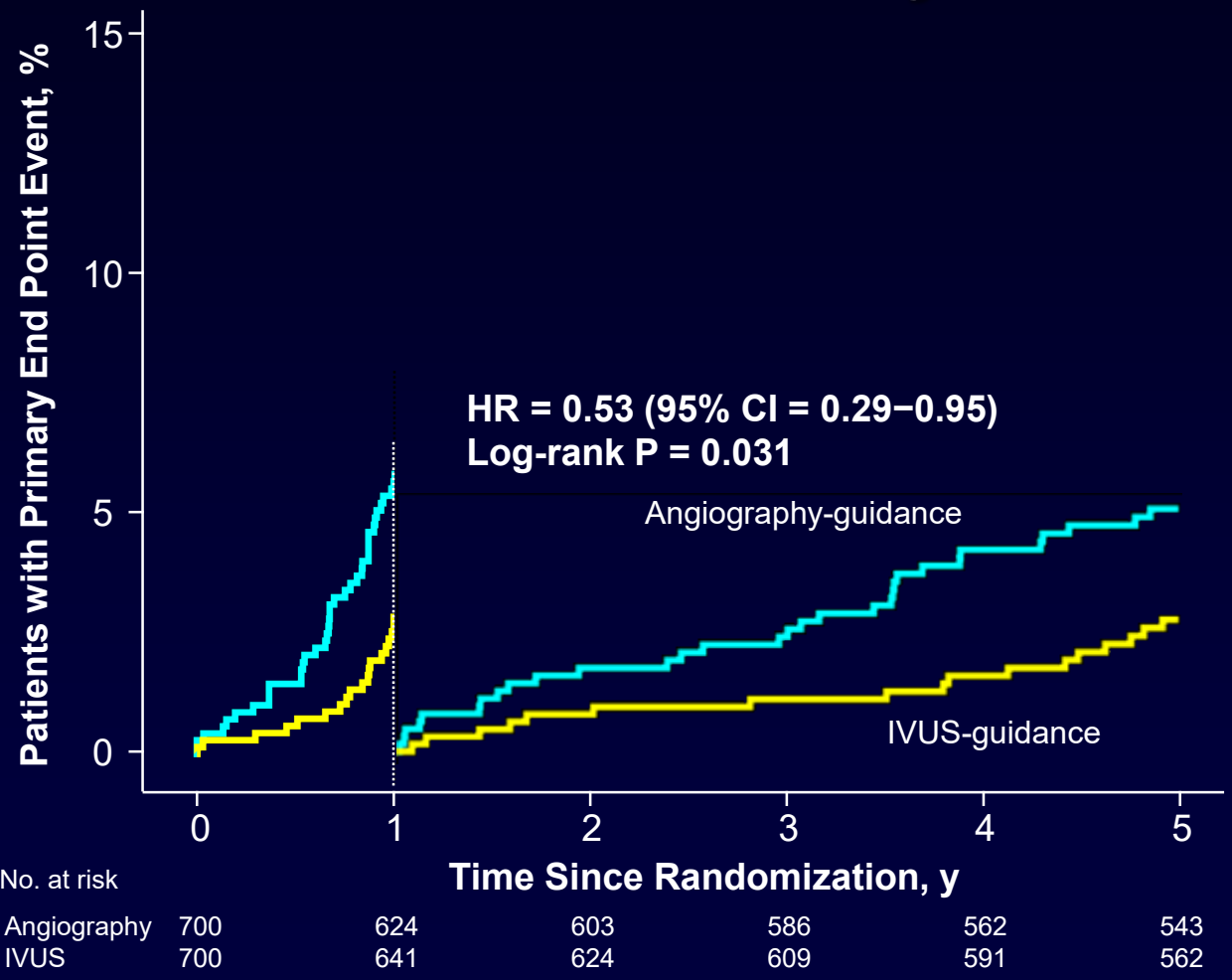
At 5 years



No. at risk

Angiography	700	624	603	586	562	543
IVUS	700	641	624	609	591	562

Between 1 and 5 years



No. at risk

Angiography	700	624	603	586	562	543
IVUS	700	641	624	609	591	562

Subgroup analyses of 5-year rates of MACE

Subgroup	IVUS-guidance No. of events	IVUS-guidance No. of patients	Angiography-guidance No. of events	Angiography-guidance No. of patients	Hazard Ratio (95% CI)	*P* Value for interaction
All patients	36	700	70	700	0.50 (0.34–0.75)	
Age, y						
<65	17	350	36	345	0.44 (0.25–0.79)	0.548
≥65	19	350	34	355	0.57 (0.32–0.99)	
Sex						
Male	24	483	50	481	0.47 (0.29–0.76)	0.592
Female	12	217	20	219	0.59 (0.29–1.21)	
Hypertension						
Yes	27	454	43	444	0.37 (0.37–0.98)	0.182
No	9	246	27	256	0.33 (0.16–0.70)	
Diabetes mellitus						
Yes	16	250	28	256	0.62 (0.33–1.14)	0.419
No	20	450	72	444	0.44 (0.26–0.75)	
Dyslipidemia						
Yes	20	471	45	458	0.43 (0.25–0.72)	0.316
No	16	229	25	242	0.64 (0.34–1.21)	
Current smoker						
Yes	12	155	18	181	0.76 (0.36–1.57)	0.218
No	24	545	52	519	0.43 (0.27–0.70)	
Clinical presentation						
Stable angina	15	358	32	356	0.47 (0.26–0.87)	0.813
Acute coronary syndrome	21	342	38	344	0.52 (0.31–0.89)	
No. of diseased vessels						
One	11	230	17	210	0.55 (0.26–1.18)	0.784
Two or three	25	470	53	490	0.49 (0.30–0.79)	
Coronary arteries						
LAD	26	455	37	419	0.64 (0.39–1.05)	0.149
LCX or RCA	10	245	33	281	0.34 (0.17–0.68)	
Reference vessel diameter, mm						
<3.00	21	417	53	451	0.42 (0.25–0.70)	0.189
≥3.00	15	283	17	249	0.75 (0.37–1.50)	

Conclusion

- Compared with angiography-guided stent implantation, IVUS-guided stent implantation resulted in a significantly lower rate of major adverse cardiac events up to 5 years.

- Sustained 5-year clinical benefits resulted from both within 1 year and from 1 to 5 years post-implantation even in the current DES implantation era.


Dreams will
come true