

**Ten-Year Outcomes of Stents vs.  
Coronary-Artery Bypass Grafting for  
Left Main Coronary Artery Disease  
From the MAIN-COMPARE Registry**

***Seung-Jung Park, MD, PhD***

*Professor of Medicine, University of Ulsan College of Medicine,  
Heart Institute, Asan Medical Center, Seoul, Korea*

# Disclosure Statement of Financial Interest

- I, (Seung-Jung Park,MD) DO NOT have a financial interest/ arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.
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# MAIN-COMPARE Registry

## Wave 1 (BMS era)

LM disease treated with BMS (n=318) and concurrent CABG (n=448) btw 2000~2003

## Wave 2 (DES era)

LM disease treated with DES (n=784) and concurrent CABG (n=690) btw 2003~2006

From January 2000 through June 2006

Total  
2240

Stent (N=1102)

CABG (N=1138)



Clinical follow-up every 12 months  
Death, Composite of Death/MI/Stroke, TVR

# Enrollment Criteria

## Inclusion Criteria

*Patients with unprotected left main disease (defined as stenosis of more than 50%) who underwent stenting or isolated CABG (“Unprotected” is defined as no coronary artery bypass grafts to the LAD or the LCX artery)*

## Exclusion Criteria

- *Prior CABG*
- *Concomitant valvular or aortic surgery*
- *ST-elevation MI*
- *Cardiogenic shock at presentation*

# *Revascularization Procedures*

- The choice of revascularization strategy was at the discretion of the treating physicians and/or patients after consideration of several clinical and anatomic factors or surgical risk for CABG.
- PCI was performed exclusively with bare-metal stents (BMS) between January 2000 and May 2003 and exclusively with DES between May 2003 and June 2006.

# *Primary Outcome Measures*

- **Death**
- **Composite of death, Q-wave MI, or stroke**
- **Target-vessel revascularization**

# Outcome Definitions

- Death was defined as death from any cause
- Q-wave myocardial infarction was defined as the documentation of a new pathologic Q-wave after index treatment.
- Stroke, as detected by neurological deficits, was confirmed by a neurologist and imaging modalities.
- Target-vessel revascularization was defined as repeat revascularization of the treated vessel, including *any* segments of the LAD and/or LCX.

# *Follow-up and National DB Linkage*

- Clinical follow-up was recommended at 1 month, 6 months, and 1 year, and then annually up to 10 years.
- In this report, the follow-up period was extended through December 31, 2016, to ensure that all patients had the opportunity for at least 10-year follow-up evaluation.
- For validation of complete follow-up data on mortality, information about vital status was obtained from the National Population Registry of the Korea National Statistical Office with the use of a unique personal identification number up to December, 31, 2016.



# *Statistical Analysis*

- All comparative analyses were performed in the overall cohort, wave 1 (BMS era), and wave 2 (DES era) cohort.
- To adjust baseline characteristics between PCI and CABG, propensity analyses using (1) the inverse-probability-of-treatment weighting (IPTW) and (2) propensity-score matching were performed.
- To characterize the time-dependent nature of the relative treatment effects and to compensate for the violation of the proportional-hazards assumption, we performed weighted piecewise Cox regression models with robust standard errors according to a prespecified time point at 5 years after index treatment.

# Participating Centers

## *Investigating centers (12 Major Cardiac Centers in Korea)*

Asan Medical Center

Kangnam St Mary's Hospital

Yoido St Mary's Hospital

Kyungpook National University Hospital

Gachon University Gil Medical Center

Seoul National University Hospital

Seoul National University Bundang Hospital

Samsung Medical Center

Ajou University Hospital

Yonsei University Medical Center

Chonnam National University Hospital

Chung-Nam University Hospital

***P.I.*** : Seung-Jung Park, MD, Duk-Woo Park, MD, Asan Medical Center

***Sponsors:*** CardioVascular Research Foundation (CVRF)

***Data analysis and management:*** Clinical Research Center in CVRF, AMC.

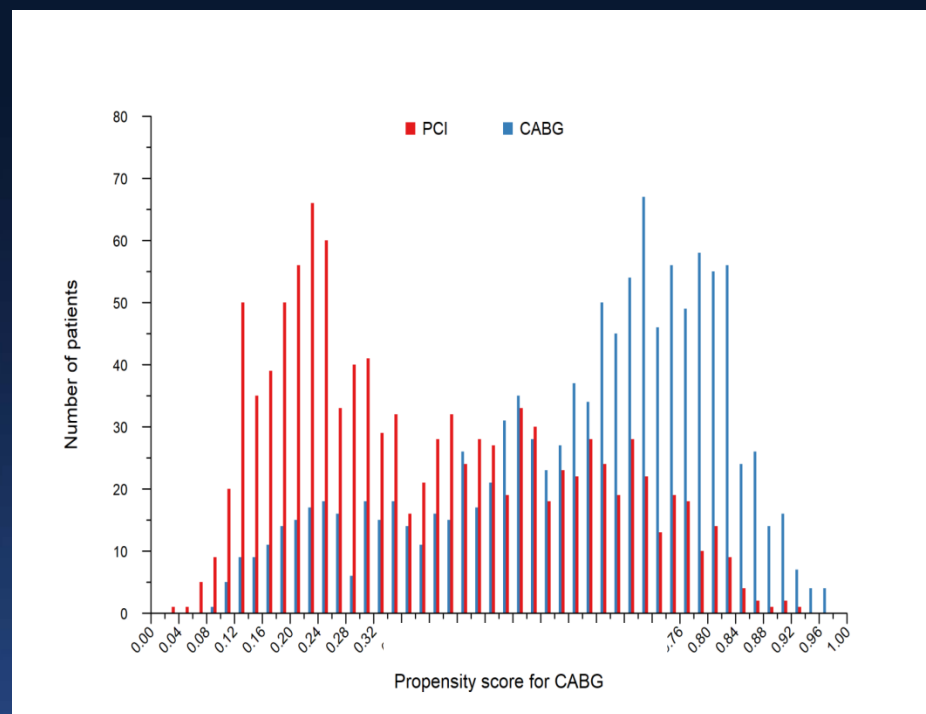
***Local independent event committee:*** Clinical Research Center in CVRF, AMC.

# RESULTS

# Baseline Characteristics

	Unadjusted Data		
	PCI (N = 1102)	CABG (N = 1138)	P Value
Age (yr)	61.3±11.7	62.9±9.4	<0.001
Male gender	779 (70.7)	830 (72.9)	0.24
Diabetes mellitus			
Any diabetes	327 (29.7)	395 (34.7)	0.01
Requiring insulin	75 (6.8)	93 (8.2)	0.22
Hypertension	546 (49.5)	562 (49.4)	0.94
Hyperlipidemia	315 (28.6)	371 (32.6)	0.04
Current smoker	282 (25.6)	339 (29.8)	0.03
Previous PCI	200 (18.1)	125 (11.0)	<0.001
Previous MI	89 (8.1)	132 (11.6)	0.005
Previous CHF	27 (2.5)	38 (3.3)	0.21
Chronic lung disease	22 (2.0)	23 (2.0)	0.97
Cerebrovascular disease	78 (7.1)	83 (7.3)	0.84
PVD	16 (1.5)	62 (5.4)	<0.001
Renal failure	30 (2.7)	34 (3.0)	0.71
Ejection fraction (%)	60.6±10.8	57.2±11.9	<0.001

## Distribution of Propensity-Score



# Baseline Characteristics

	Unadjusted Data			Data Adjusted with IPTW			After Propensity Matching	
	PCI (N = 1102)	CABG (N = 1138)	P Value	PCI (N = 1102)	CABG (N = 1138)	P Value	PCI (N=659)	CABG (N=659)
Age (yr)	61.3±11.7	62.9±9.4	<0.001	62.1±11.0	62.1±10.1	0.89	62.6±11.2	63.2±9.7
Male gender	779 (70.7)	830 (72.9)	0.24	797 (72.3)	820 (72.1)	0.90	472 (71.6)	457 (69.4)
Diabetes mellitus								
Any diabetes	327 (29.7)	395 (34.7)	0.01	338 (30.6)	356 (31.3)	0.73	338 (30.6)	197 (29.9)
Requiring insulin	75 (6.8)	93 (8.2)	0.22	84 (7.6)	89 (7.9)	0.82	84 (7.6)	44 (6.7)
Hypertension	546 (49.5)	562 (49.4)	0.94	525 (47.7)	551 (48.4)	0.71	525 (47.7)	335 (50.8)
Hyperlipidemia	315 (28.6)	371 (32.6)	0.04	340 (30.8)	339 (29.8)	0.60	340 (30.8)	201 (30.5)
Current smoker	282 (25.6)	339 (29.8)	0.03	313 (28.4)	330 (29.0)	0.76	313 (28.4)	188 (28.5)
Previous PCI	200 (18.1)	125 (11.0)	<0.001	165 (15.0)	172 (15.1)	0.93	165 (15.0)	99 (15.0)
Previous MI	89 (8.1)	132 (11.6)	0.005	99 (9.0)	111 (9.8)	0.54	99 (9.0)	67 (10.2)
Previous CHF	27 (2.5)	38 (3.3)	0.21	32 (2.9)	33 (2.9)	0.95	32 (2.9)	17 (2.6)
Chronic lung disease	22 (2.0)	23 (2.0)	0.97	25 (2.3)	20 (1.7)	0.36	8 (1.2)	10 (1.5)
Cerebrovascular disease	78 (7.1)	83 (7.3)	0.84	71 (6.5)	74 (6.5)	0.96	48 (7.3)	48 (7.3)
PVD	16 (1.5)	62 (5.4)	<0.001	46 (4.2)	43 (3.9)	0.66	15 (2.3)	10 (1.5)
Renal failure	30 (2.7)	34 (3.0)	0.71	34 (3.1)	35 (3.1)	0.98	16 (2.4)	21 (3.2)
Ejection fraction (%)	60.6±10.8	57.2±11.9	<0.001	59.8±11.0	59.0±11.2	0.12	59.7±11.1	59.4±11.5

# Baseline Characteristics

	Unadjusted Data			Data Adjusted with IPTW			After Propensity Matching	
	PCI (N = 1102)	CABG (N = 1138)	P Value	PCI (N = 1102)	CABG (N = 1138)	P Value	PCI (N=659)	CABG (N=659)
ECG findings			0.53			0.92		
Sinus rhythm	1078 (97.8)	1105 (97.1)		1076 (97.7)	1109 (97.4)		644 (97.7)	641 (92.3)
Atrial fibrillation	22 (2.0)	31 (2.7)		24 (2.2)	28 (2.5)		15 (2.3)	17 (2.6)
Other	2 (0.2)	2 (0.2)		1 (0.1)	1 (0.1)		0 (0.0)	1 (0.2)
Clinical indication			<0.001			0.96		
Silent ischemia	33 (3.0)	25 (2.2)		30 (2.7)	32 (2.8)		23 (3.5)	19 (2.9)
Chronic stable angina	353 (32.0)	226 (19.9)		289 (26.1)	296 (26.0)		166 (25.2)	173 (26.3)
Unstable angina	608 (55.2)	775 (68.1)		677 (61.4)	692 (60.1)		401 (60.9)	402 (61.0)
NSTEMI	108 (9.8)	112 (9.8)		107 (9.7)	118 (10.4)		69 (10.5)	65 (9.9)
LM disease location			0.04			0.87		
Ostium or shaft	557 (50.6)	526 (46.2)		522 (47.3)	543 (47.7)		316 (48.0)	321 (48.7)
Distal bifurcation	545 (49.5)	612 (53.8)		580 (52.7)	595 (52.3)		343 (52.0)	338 (51.3)
Extent of disease			<0.001			0.98		
LM only	278 (25.2)	71 (6.2)		175 (15.9)	186 (16.4)		81 (12.3)	71 (10.8)
LM plus 1-VD	264 (24.0)	119 (10.5)		192 (17.4)	201 (17.6)		114 (17.3)	112 (17.0)
LM plus 2-VD	287 (26.0)	299 (26.3)		288 (26.1)	291 (25.6)		212 (32.2)	223 (33.8)
LM plus 3-VD	273 (24.8)	649 (57.0)		448 (40.1)	460 (40.4)		252 (38.2)	253 (38.4)
RCA disease	396 (35.9)	804 (70.7)	<0.001	584 (53.0)	597 (52.5)	0.81	350 (53.1)	353 (53.6)
Restenotic lesion	32 (2.9)	14 (1.2)	0.005	22 (2.0)	22 (1.9)	0.88	17 (2.6)	12 (1.8)

# Procedural Characteristics

	CABG (n = 1138)	PCI (n = 1102)
<b>CABG Group</b>		
Off-pump surgery (%)	42	-
At least one arterial conduit (%)	98	-
IMA to LAD Graft (%) in patients with arterial conduits	98	-
Grafts / Patients (Mean ± SD)	2.9±1.0	-
<b>PCI Group</b>		
Bare-metal stents(%)	-	29
Drug-eluting stents (%)	-	71
Sirolimus stents of DES (%)	-	77
Paclitaxel stents of DES (%)	-	23
Number of stents at LMCA lesions	-	1.2±0.5
Total length of stents at LMCA (mm)	-	28±21
Average stent diameter at LM site	-	3.5±0.4
Number of stents per patients	-	1.9±1.1

# *Unadjusted Kaplan-Meier Curves*

- The median duration of follow-up among all patients was 12.0 years (IQR, 10.7 to 13.5); the maximum follow-up was 17.6 years.
- The follow-up status for major clinical events was ascertained for 2,211 patients (98.7%) of the overall population



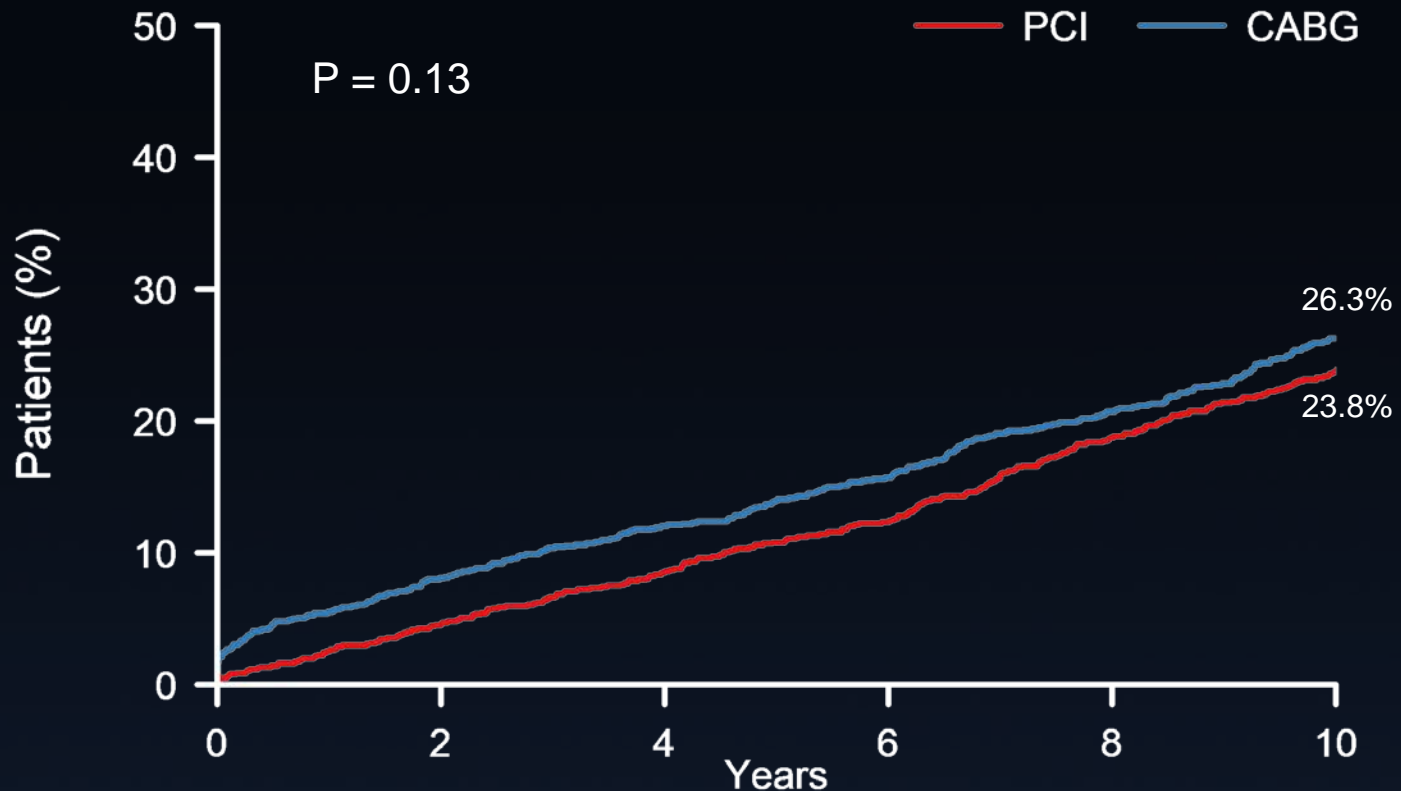
# Overall Cohort Death



Number at risk

PCI	1102	1056	1017	978	919	869
CABG	1138	1062	1024	986	933	872

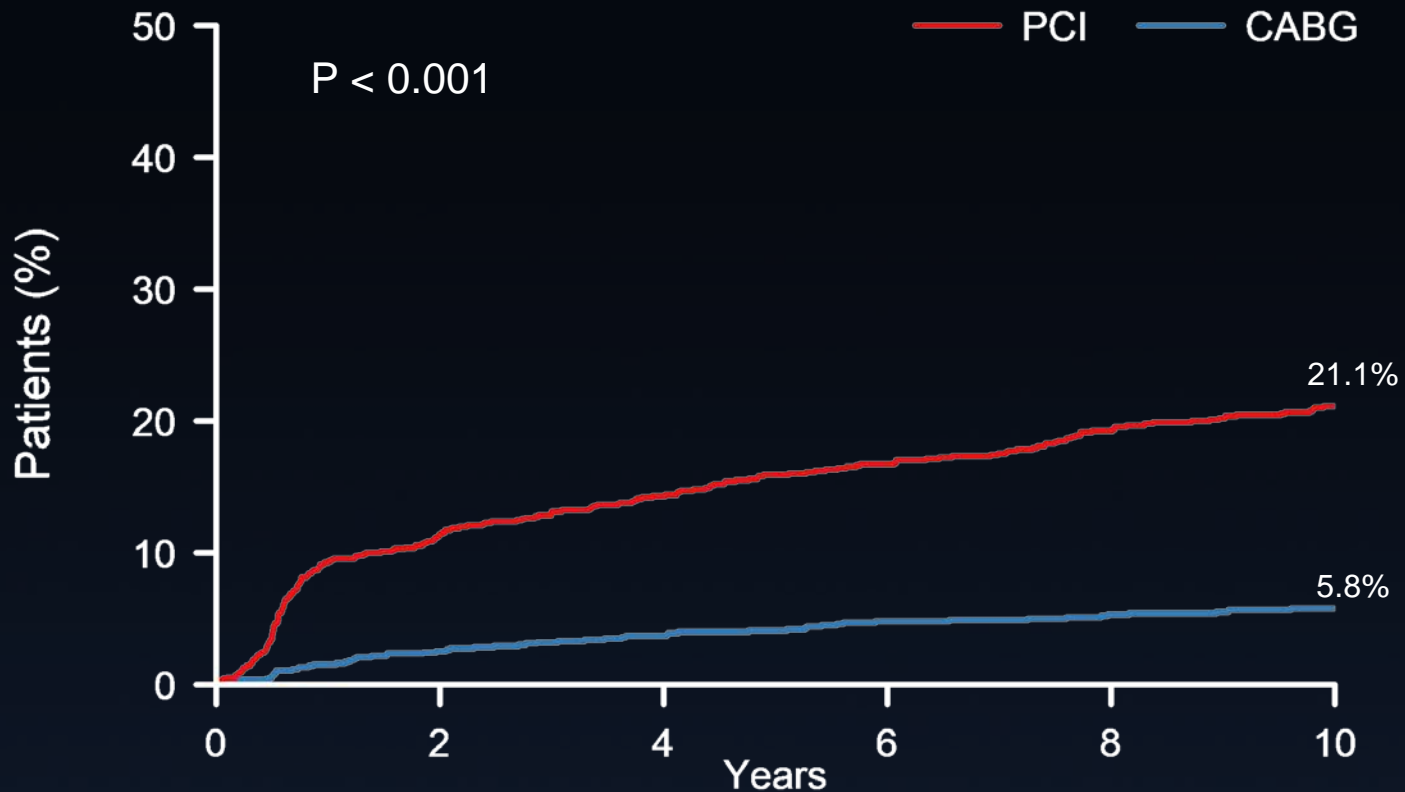
# Overall Cohort Death, Q-MI, or Stroke



Number at risk

PCI	1102	1051	1008	966	895	840
CABG	1138	1046	1001	959	902	837

# Overall Cohort TVR



Number at risk

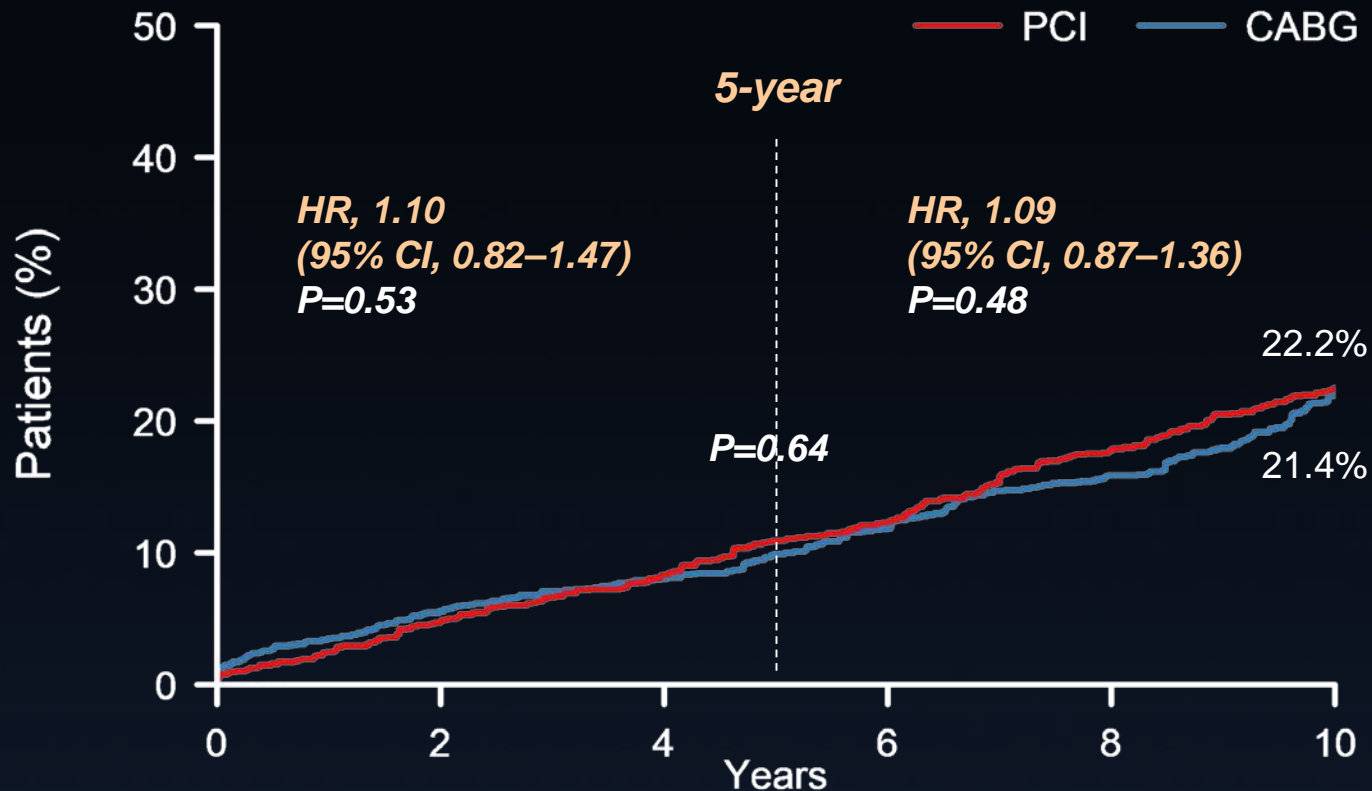
PCI	1102	937	872	817	747	693
CABG	1138	1035	986	937	885	824

# Hazard Ratios for Clinical Outcomes Before and After 5-Year of Follow-up

Outcome	Overall Cohort		Wave 1* (BMS)		Wave 2* (DES)	
	Hazard Ratio† (95% CI)	P value	Hazard Ratio† (95% CI)	P value	Hazard Ratio† (95% CI)	P value
<b>Analyses with IPTW</b>	N = 2240 patients (PCI 1102, CABG 1138)		N = 766 patients (BMS 318, CABG 448)		N = 1474 patients (DES 784, CABG 690)	
<b>Death</b>		0.64		0.05		0.15
0~5 years	1.10 (0.82–1.47)	0.53	1.65 (0.91–2.98)	0.10	1.02 (0.71–1.46)	0.91
>5 years	1.09 (0.87–1.36)	0.48	0.68 (0.46–1.02)	0.06	1.35 (1.00–1.81)	0.05
<b>Composite outcome (death, Q-wave MI or stroke)</b>		0.43		0.06		0.03
0~5 years	0.98 (0.75–1.29)	0.91	1.46 (0.84–2.53)	0.18	0.91 (0.66–1.27)	0.59
>5 years	1.16 (0.93–1.43)	0.19	0.67 (0.46–1.00)	0.05	1.46 (1.10–1.94)	0.009
<b>TVR, All period</b>	4.07 (3.43–6.44)	<0.001	4.45 (2.81–7.05)	<0.001	5.82 (3.77–9.01)	<0.001

# *Adjusted Curves with the Use of IPTW Method*

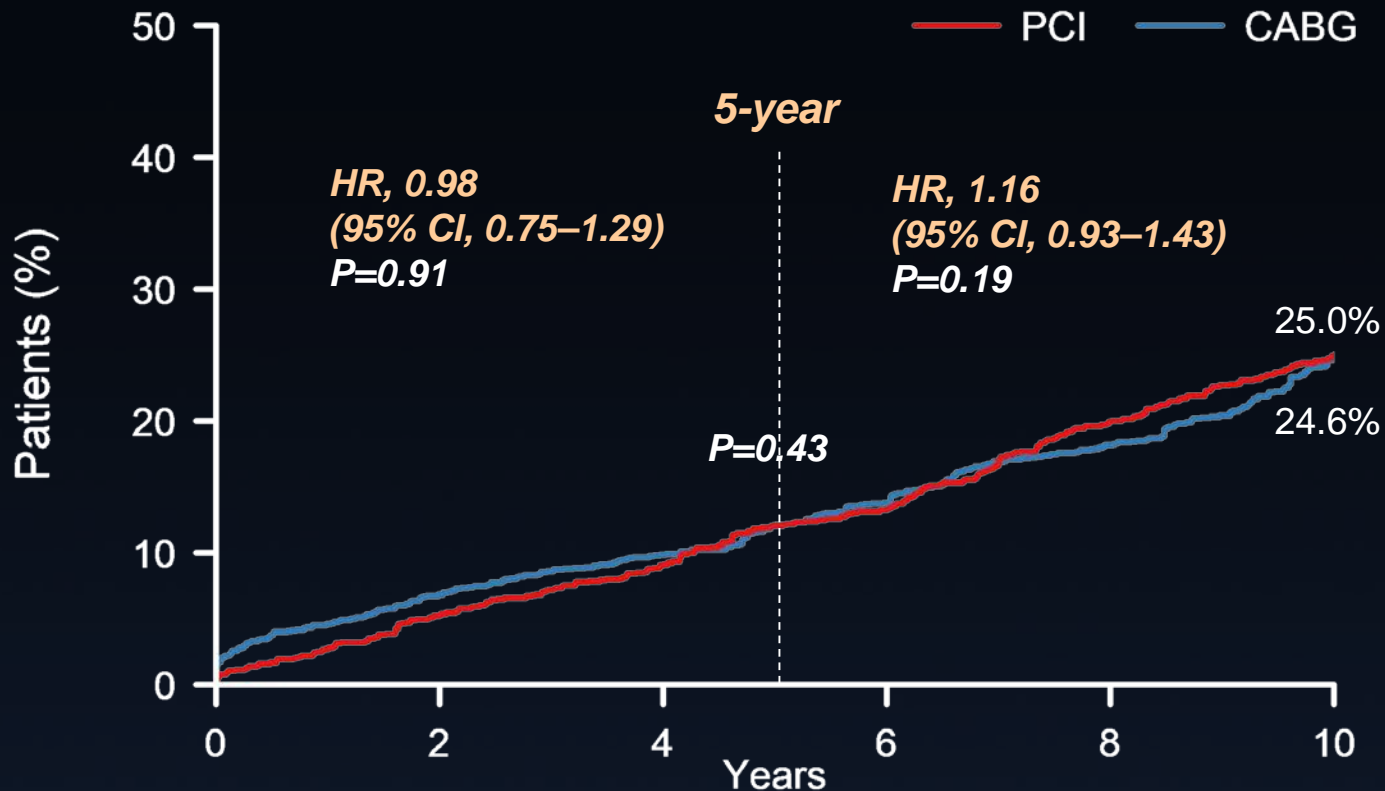
# Overall Cohort Death



Number at risk

PCI	1102	1049	1010	966	906	854
CABG	1138	1074	1046	1003	957	887

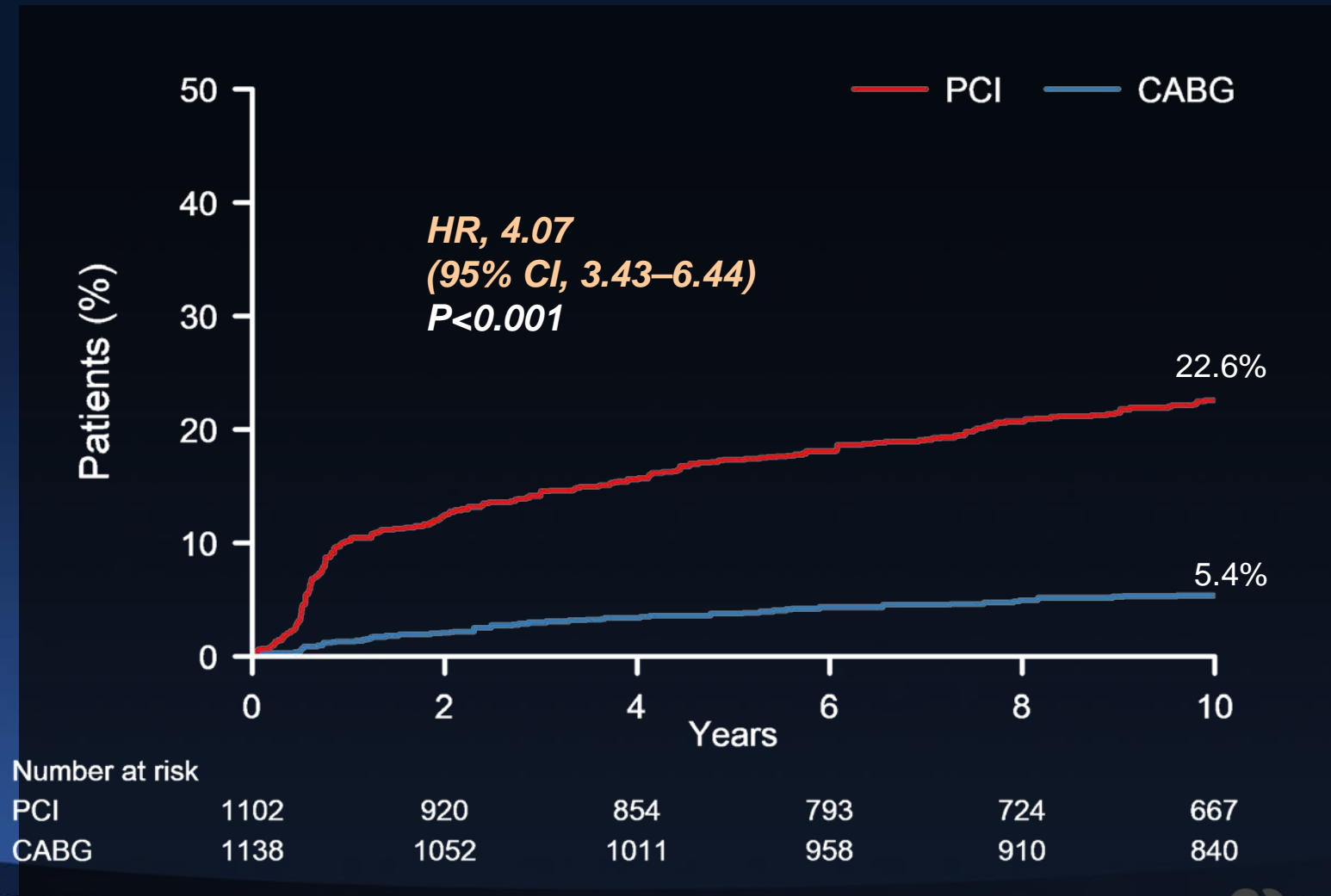
# Overall Cohort Death, Q-MI, or Stroke



Number at risk

PCI	1102	1044	1002	956	882	827
CABG	1138	1060	1026	981	931	857

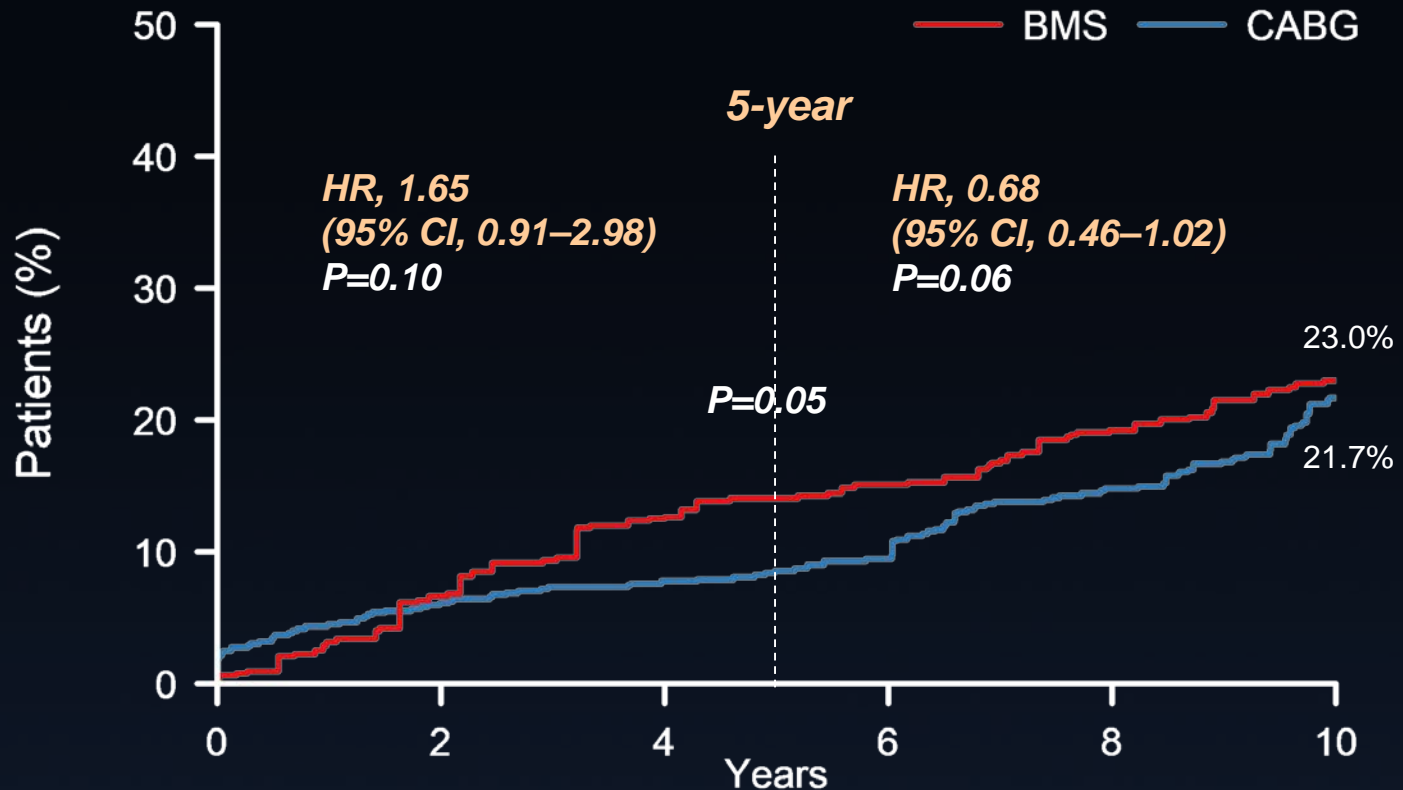
# Overall Cohort TVR





# Wave 1 (BMS vs. CABG)

## Death

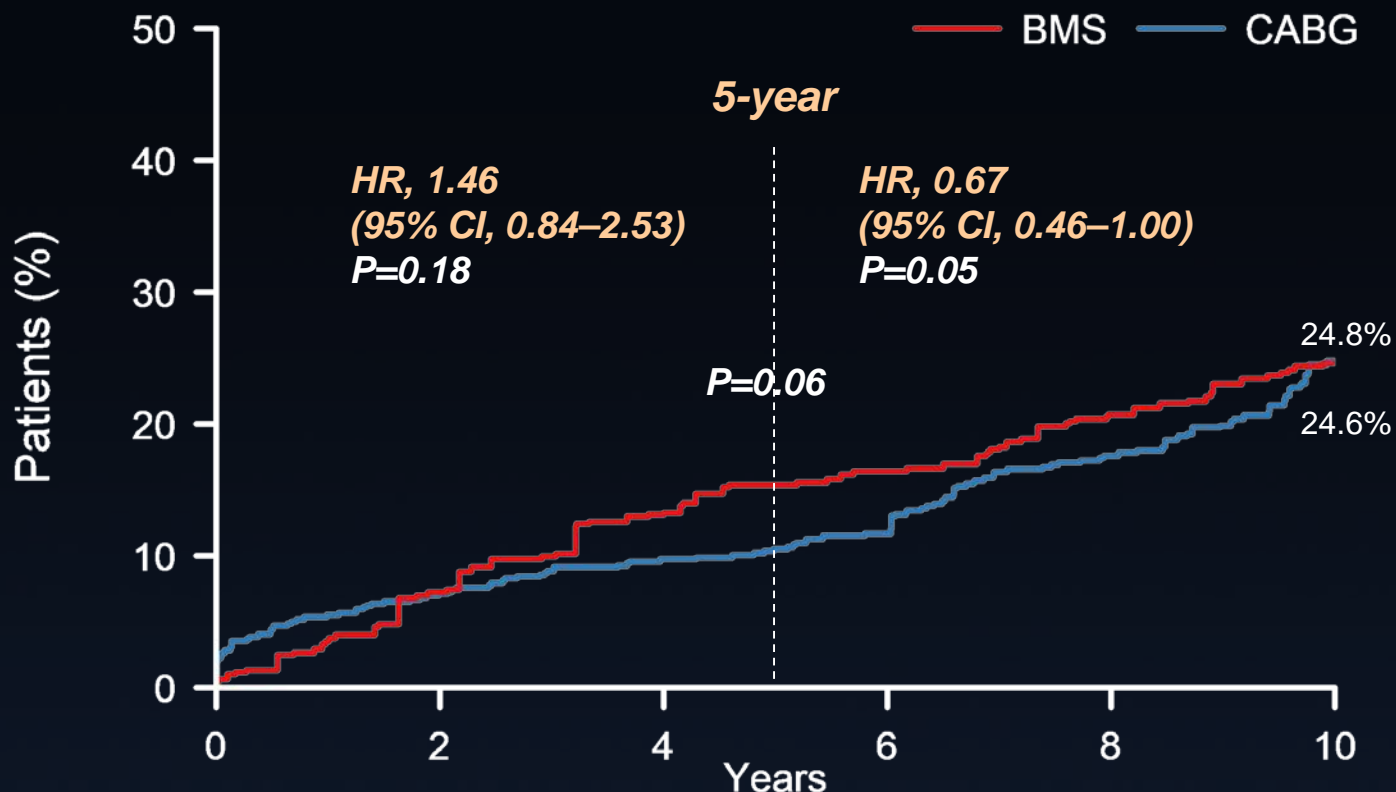


Number at risk

BMS	318	297	278	270	257	245
CABG	448	421	413	406	382	351

# Wave 1 (BMS vs. CABG)

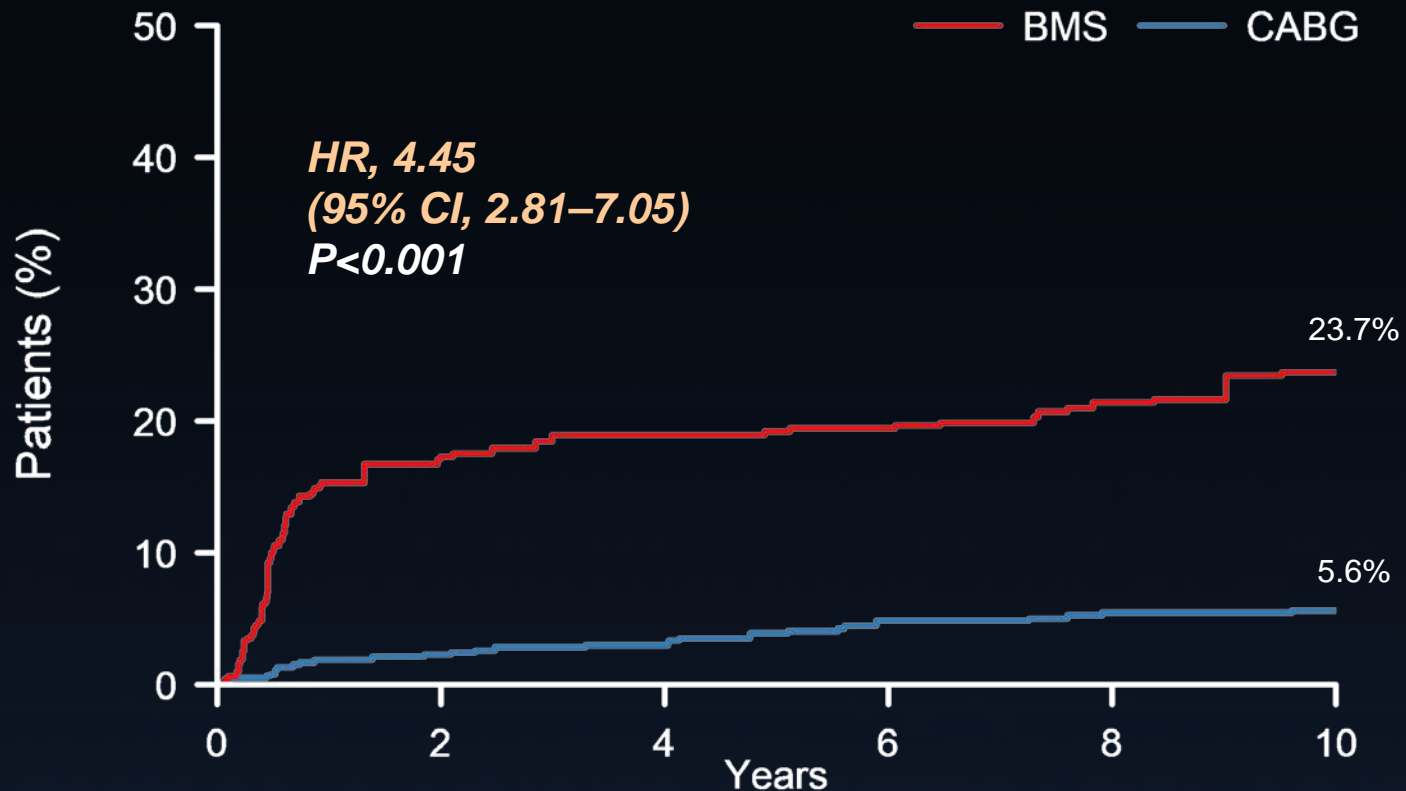
## Death, Q-MI, or Stroke



Number at risk

BMS	318	295	276	266	252	240
CABG	448	416	404	396	369	337

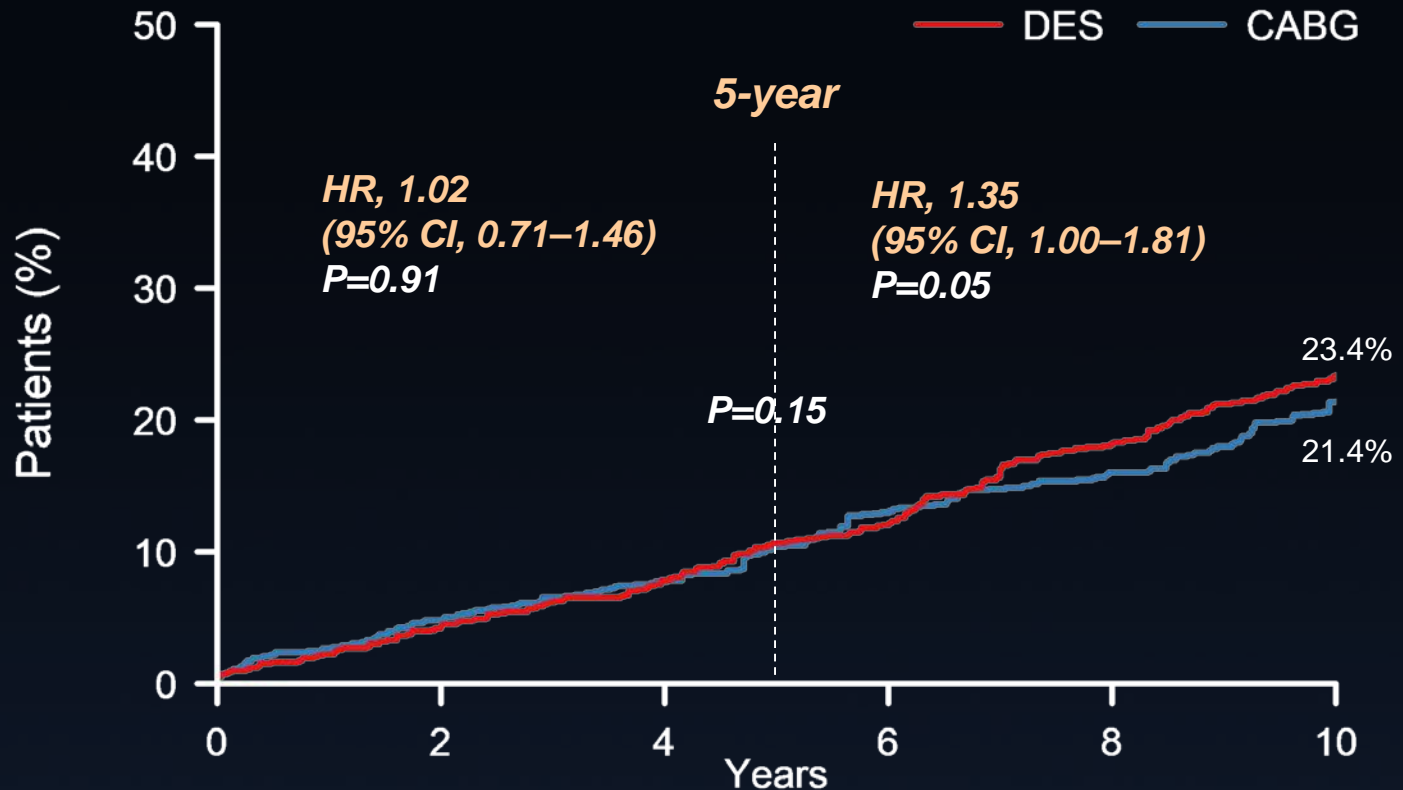
# Wave 1 (BMS vs. CABG) TVR



Number at risk

BMS	318	246	227	218	203	189
CABG	448	411	400	385	362	331

# Wave 2 (DES vs, CABG) Death

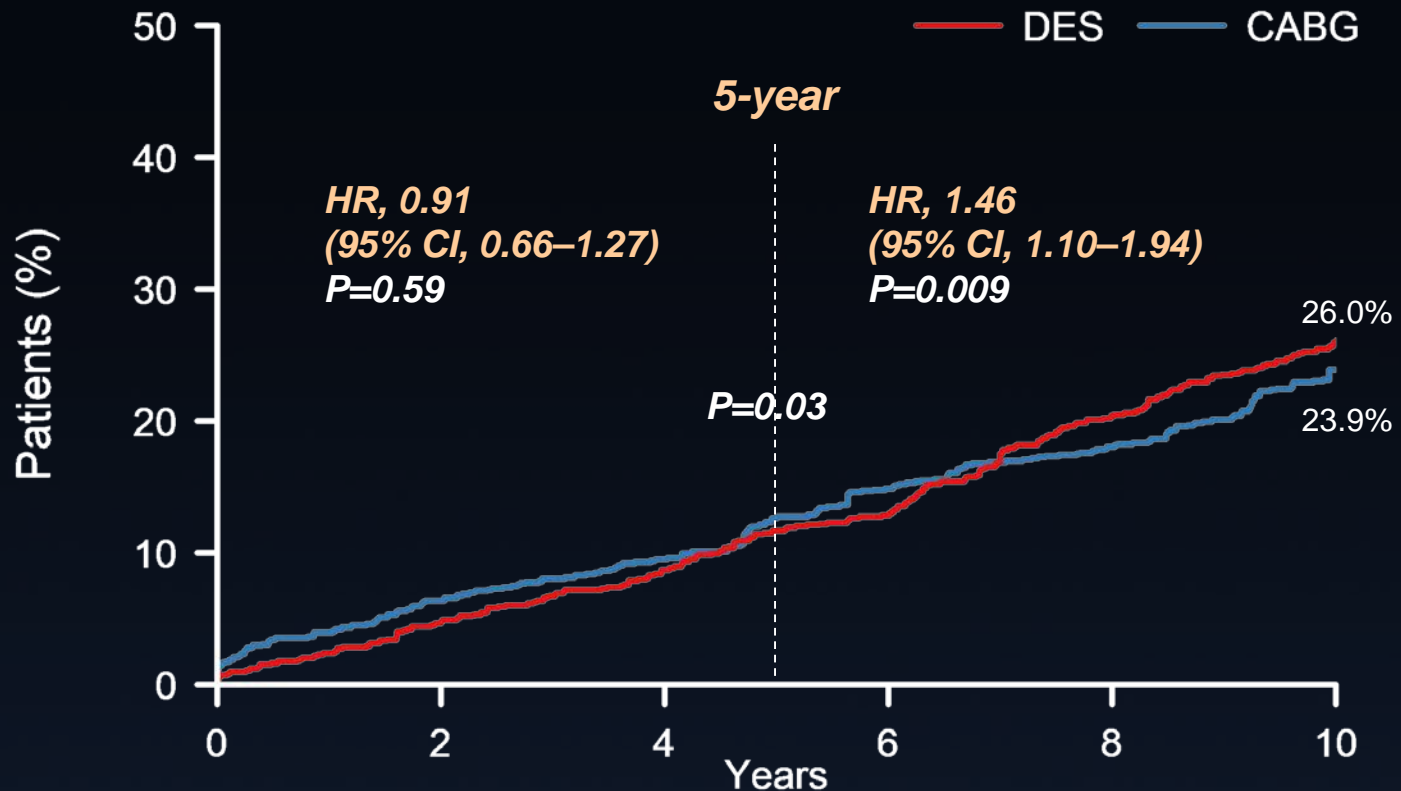


Number at risk

DES	784	750	723	689	641	601
CABG	690	657	636	600	579	541

# Wave 2 (DES vs. CABG)

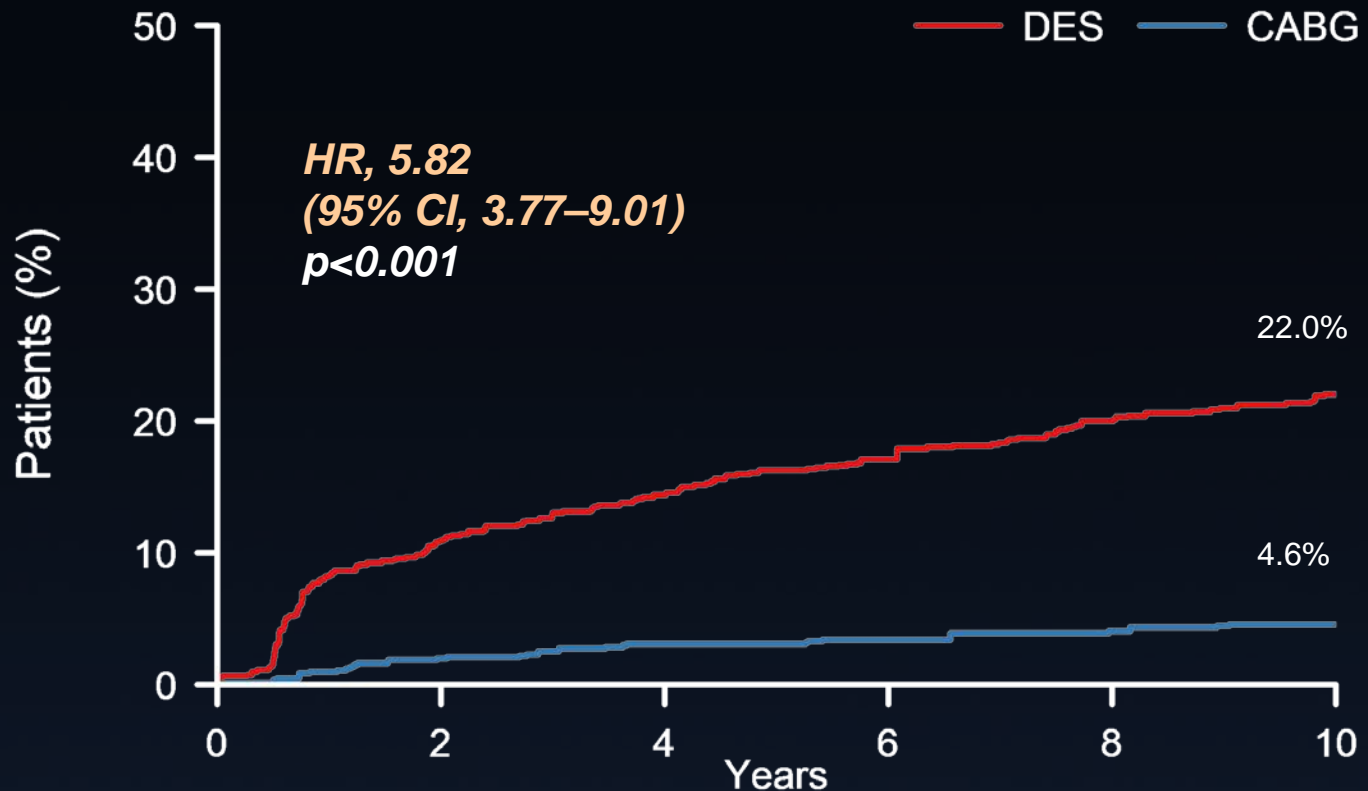
## Death, Q-MI, or Stroke



Number at risk

DES	784	747	716	683	624	580
CABG	690	646	624	587	565	524

# Wave 2 (DES vs. CABG) TVR



Number at risk

DES	659	628	602	580	542	506
CABG	690	644	617	579	556	518

# Hazard Ratios for Clinical Outcomes Before and After 5-Year of Follow-up

Outcome	Overall Cohort		Wave 1* (BMS)		Wave 2* (DES)	
	Hazard Ratio <sup>†</sup> (95% CI)	P value	Hazard Ratio <sup>†</sup> (95% CI)	P value	Hazard Ratio <sup>†</sup> (95% CI)	P value
<b>Analyses with IPTW</b>	N = 2240 patients (PCI 1102, CABG 1138)		N = 766 patients (BMS 318, CABG 448)		N = 1474 patients (DES 784, CABG 690)	
<b>Death</b>		0.64		0.05		0.15
0~5 years	1.10 (0.82–1.47)	0.53	1.65 (0.91–2.98)	0.10	1.02 (0.71–1.46)	0.91
>5 years	1.09 (0.87–1.36)	0.48	0.68 (0.46–1.02)	0.06	1.35 (1.00–1.81)	0.05
<b>Composite outcome (death, Q-wave MI or stroke)</b>		0.43		0.06		0.03
0~5 years	0.98 (0.75–1.29)	0.91	1.46 (0.84–2.53)	0.18	0.91 (0.66–1.27)	0.59
>5 years	1.16 (0.93–1.43)	0.19	0.67 (0.46–1.00)	0.05	1.46 (1.10–1.94)	0.009
<b>TVR, All period</b>	4.07 (3.43–6.44)	<0.001	4.45 (2.81–7.05)	<0.001	5.82 (3.77–9.01)	<0.001
<b>Analyses with Propensity-score Matching</b>	N = 1318 patients (PCI 659, CABG 659)		N = 386 patients (BMS 193, CABG 193)		N = 864 patients (DES 432, CABG 432)	
<b>Death</b>		0.27		0.29		0.25
0~5 years	0.91 (0.66–1.24)	0.55	1.29 (0.67–2.46)	0.45	1.04 (0.70–1.54)	0.86
>5 years	1.21 (0.94–1.55)	0.14	0.74 (0.48–1.14)	0.17	1.30 (0.95–1.78)	0.09
<b>Composite outcome (death, Q-wave MI or stroke)</b>		0.03		0.17		0.03
0~5 years	0.85 (0.63–1.14)	0.27	1.18 (0.65–2.12)	0.59	0.92 (0.63–1.34)	0.66
>5 years	1.34 (1.06–1.70)	0.02	0.67 (0.44–1.04)	0.07	1.48 (1.10–2.00)	0.01
<b>TVR, All period</b>	4.70 (3.26–6.76)	<0.001	6.05 (3.12–11.8)	<0.001	5.07 (3.11–8.27)	<0.001

# Conclusions

- In this large-scale, multi-center cohort of patients with LMCA disease, there was no significant difference in the rates of death and a composite end point of death, Q-wave MI, or stroke between the PCI and the CABG groups up to 10 years.
- However, in the cohort comparing DES and concurrent CABG, DES was associated with higher risks of death and serious composite outcomes compared to CABG after 5 years: the treatment benefit of CABG has diverged over time during continued follow-up.
- The rate of target-vessel failure was consistently higher in the PCI group.



# *Study Limitations*

- This was a nonrandomized, observational study and thus potential selection and ascertainment bias should be acknowledged.
- Although rigorous adjustment was performed, hidden bias may remain due to the influence of unmeasured confounders (i.e., frailty or detailed information of concomitant atherosclerotic burden).
- We evaluated the first-generation of DES. However, previous our reports did not find any meaningful difference in outcomes among several types of first- and second-generation DES for LMCA disease.

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