

**Safety and Efficacy of Ticagrelor versus Clopidogrel  
in Korean Patients with Acute Coronary Syndromes  
Intended for Invasive Management:  
A Randomized Clinical Trial  
*TICAKOREA***

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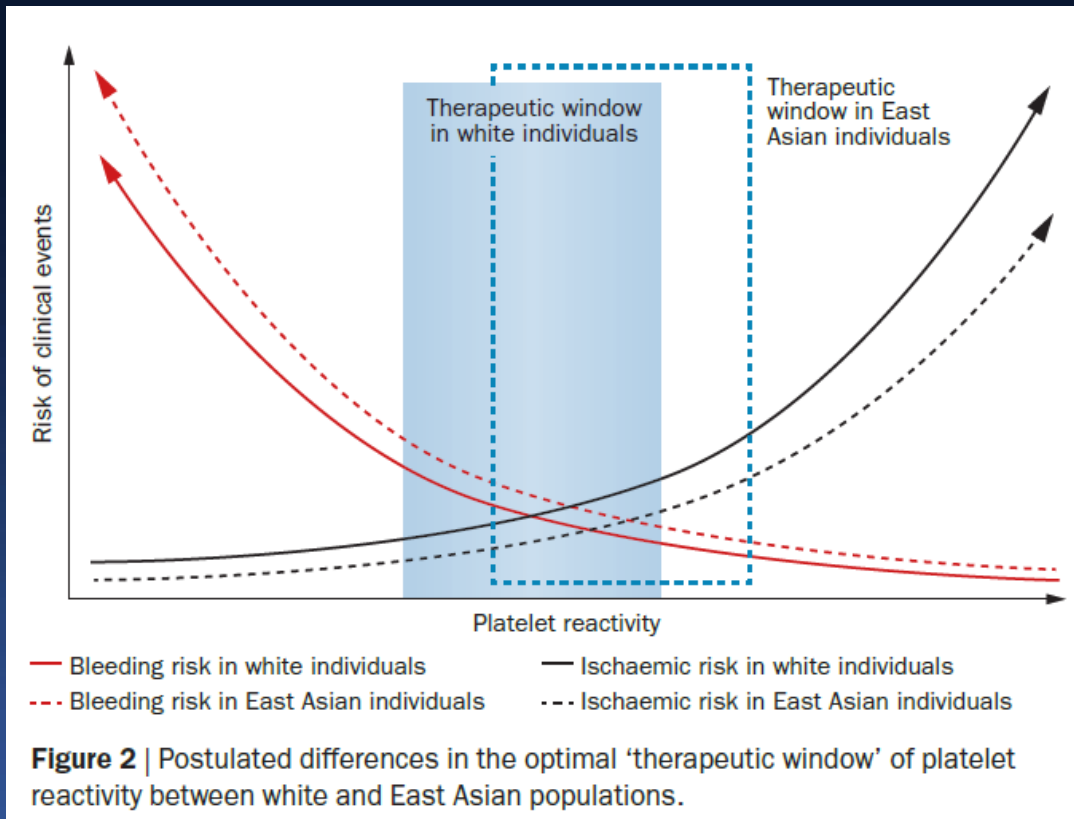
# Disclosure

- I have nothing to disclosure

# Background

- Ticagrelor is an oral, reversible, direct-acting, P2Y12 inhibitor that provides faster, greater, and more consistent P2Y12 inhibition compared to clopidogrel.
- European and U.S. guidelines recommend that ticagrelor should be preferred to clopidogrel as a P2Y12 antagonist in ACS patients with or without PCI.

# East Asian paradox



Compared to Caucasians, East Asian patients are regarded as more susceptible to bleeding events, but relatively resistant to thromboembolic events, even on a higher prevalence of high on-treatment reactivity, a phenomenon that is referred to as “**East Asian paradox.**”

*Levine, G. N. et al. Nat. Rev. Cardiol. 11, 597–606 (2014)*

# PHILO trial with ticagrelor

	Ticagrelor	Clopidogrel	OR (95%CI)	P-value
	N=401	N=400		
Composite end point	43	28	1.60(0.97-2.62)	0.08
Death	10	7	1.44(0.54-4.25)	0.63
Stroke	9	6	1.51(0.54-4.25)	0.60
MI	24	15	1.63(0.85-3.15)	0.19
Bleeding*	92	56	1.83(1.27-2.63)	0.001
Net clinical Benefit**	76	51	1.6(1.09-2.35)	0.02

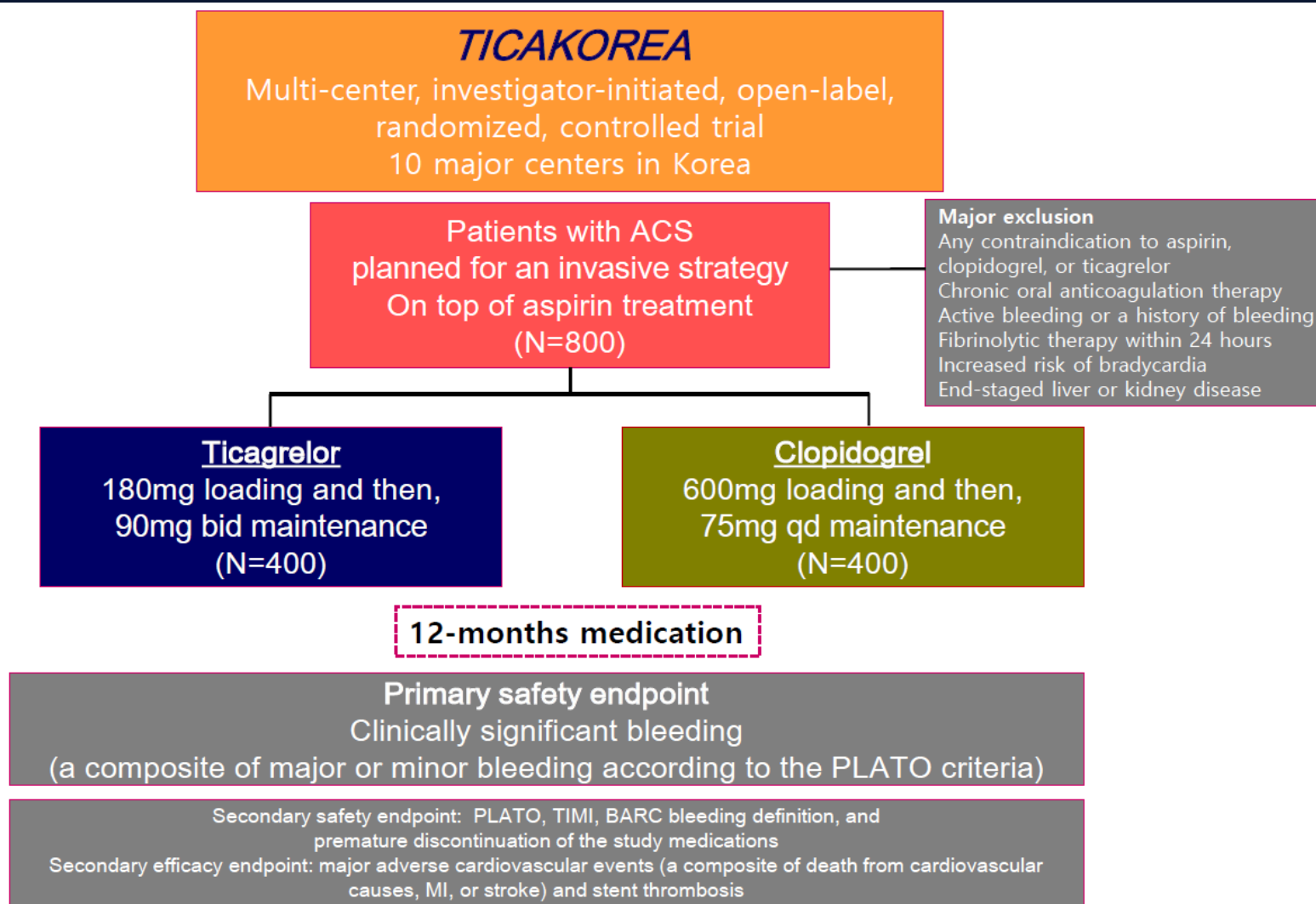
*MI (excluding silent), \* PLATO defined, \*\* PLATO defined as CV death, MI, stroke, or CABG related or non CABG related major bleeding.*

In the PHILO trial targeting East Asian (Japanese, Korean, and Chinese) patients, ticagrelor was associated with a higher rate of bleeding events and a non-significant higher risk of ischemic events compared to clopidogrel.

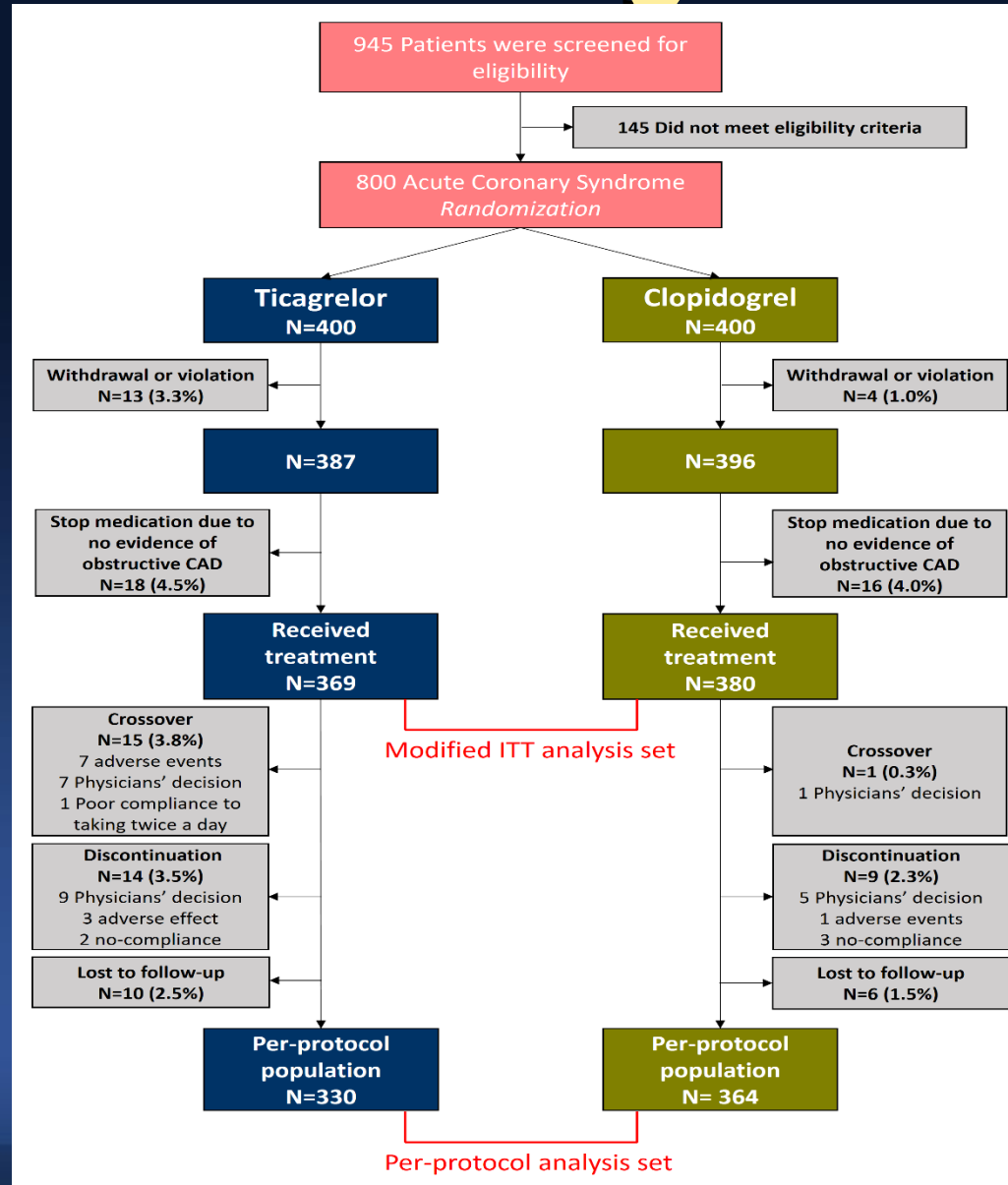
# Background

- The superior efficacy of ticagrelor, as observed in the PLATO trial, was questioned in East Asian patients, and more alarmingly, the pronounced bleeding risk with ticagrelor use was of concern.
- We conducted a practical randomized trial to compare the safety and efficacy of ticagrelor with those of clopidogrel in Korean patients with ACS who were planned for an invasive strategy.

# Study design



# Flow Diagram





# Baseline Characteristics

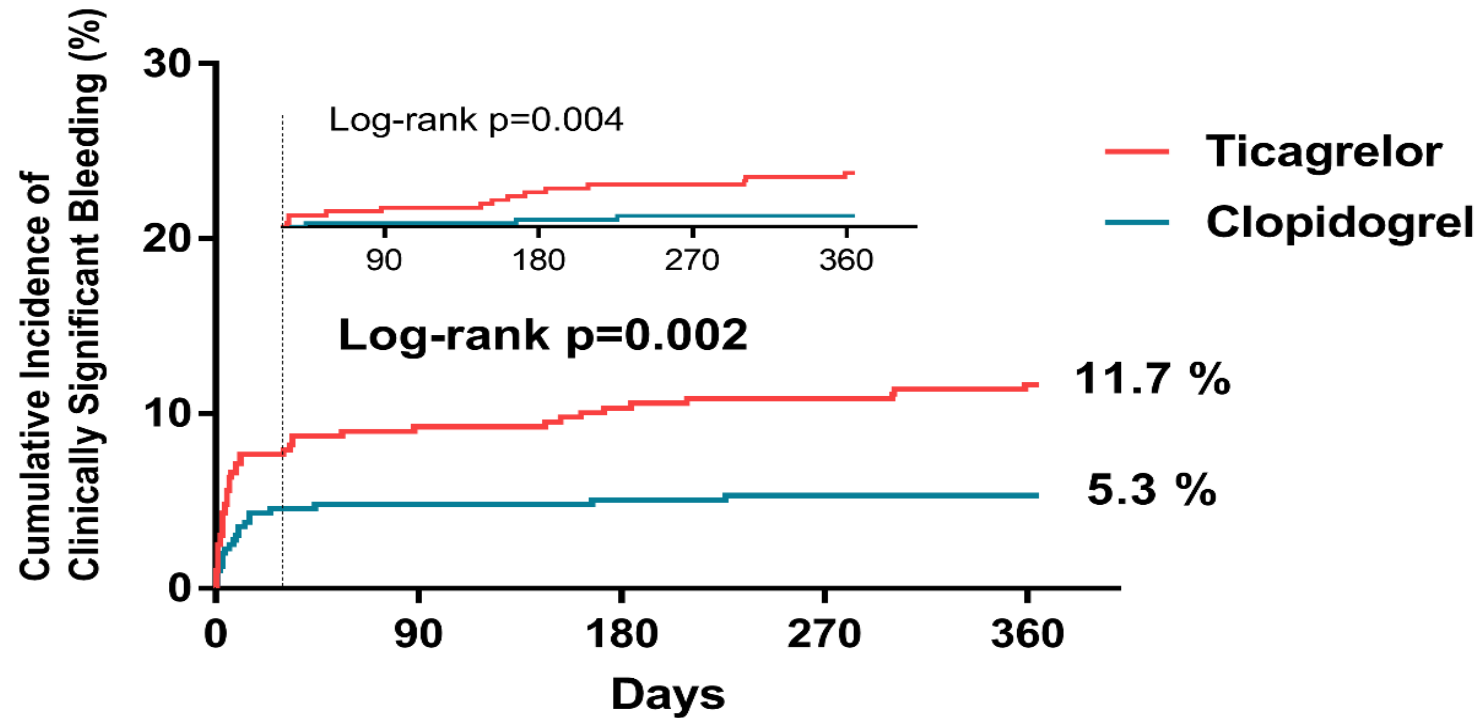
Characteristic	All population (N=800)	Ticagrelor (N=400)	Clopidogrel (N=400)	P value
Age, years	62.4 ± 11.	62.5 ± 11.3	62.3 ± 11.5	0.86
Age ≥ 75 years	122 (15.3)	64 (16.0)	58 (14.5)	0.55
Male sex	599 (74.8)	297 (74.2)	302 (75.5)	0.74
Body mass index, kg/m <sup>2</sup>	24.7 ± 3.1	24.6 ± 3.0	24.9 ± 3.2	0.33
Body mass index < 20 kg/m <sup>2</sup>	41 (5.1)	20 (5.0)	21 (5.3)	0.87
Hypertension	416 (51.9)	223 (55.8)	193 (48.2)	<b>0.04</b>
Diabetic mellitus	216 (27.0)	116 (29.0)	100 (25.0)	0.23
Insulin use	16 (2.0)	8 (2.0)	8 (2.0)	>0.99
Current smoker	285 (35.6)	146 (36.5)	139 (34.8)	0.61
Hyperlipidemia	402 (50.2)	208 (52.0)	194 (48.5)	0.36
History of myocardial infarction	45 (5.6)	25 (6.2)	20 (5.0)	0.54
Prior PCI	72 (9.0)	41 (10.2)	31 (7.8)	0.27
Prior CABG	7 (0.9)	4 (1.0)	3 (0.8)	>0.99
History of stroke	40 (5.0)	24 (6.0)	16 (4.0)	0.26
History of heart failure	16 (2.0)	10 (2.5)	6 (1.5)	0.45
Peripheral artery disease	6 (0.7)	4 (1.0)	2 (0.5)	0.68
Chronic renal disease	7 (0.9)	6 (1.5)	1 (0.2)	0.13
Chronic lung disease	15 (1.9)	12 (3.0)	3 (0.8)	<b>0.04</b>
History of gout	9 (1.1)	5 (1.2)	4 (1.0)	>0.99
Previous GI bleeding	1 (0.1)	1 (0.2)	0 (0.0)	>0.99

# Baseline Characteristics

Characteristic	All population (N=800)	Ticagrelor (N=400)	Clopidogrel (N=400)	P value
<b>Clinical presentation</b>				0.59
Unstable angina	171 (21.3)	82 (20.5)	89 (22.2)	
NSTEMI	303 (37.8)	148 (37.0)	155 (38.8)	
STEMI	326 (40.7)	170 (42.5)	156 (39.0)	
Killip class > 2	21 (2.6)	10 (2.5)	11 (2.8)	0.83
Positive Troponin I or T at inclusion	671 (83.9)	338 (84.5)	333 (83.3)	0.63
<b>Final treatment</b>				0.32
PCI with stenting	620 (77.5)	300 (75.0)	320 (80.0)	
PCI with ballooning	48 (6.0)	26 (6.5)	22 (5.5)	
CABG	17 (2.1)	11 (2.8)	6 (1.5)	
Medical treatment only	115 (14.4)	63 (15.8)	52 (13.0)	
Glycoprotein IIb/IIIa inhibitors	22 (2.8)	8 (2.0)	14 (3.5)	0.20
<b>Discharge medications</b>				
β-blocker	572 (71.5)	275 (68.8)	297 (74.2)	0.10
Calcium channel blocker	180 (22.5)	90 (22.5)	90 (22.5)	>0.99
ACE inhibitor or ARB	334 (41.8)	163 (40.8)	171 (42.8)	0.62
Statin	723 (90.4)	354 (88.5)	369 (92.2)	0.09
Proton-pump inhibitors	20 (2.5)	12 (3.0)	8 (2.0)	0.50

# Primary Safety Endpoint

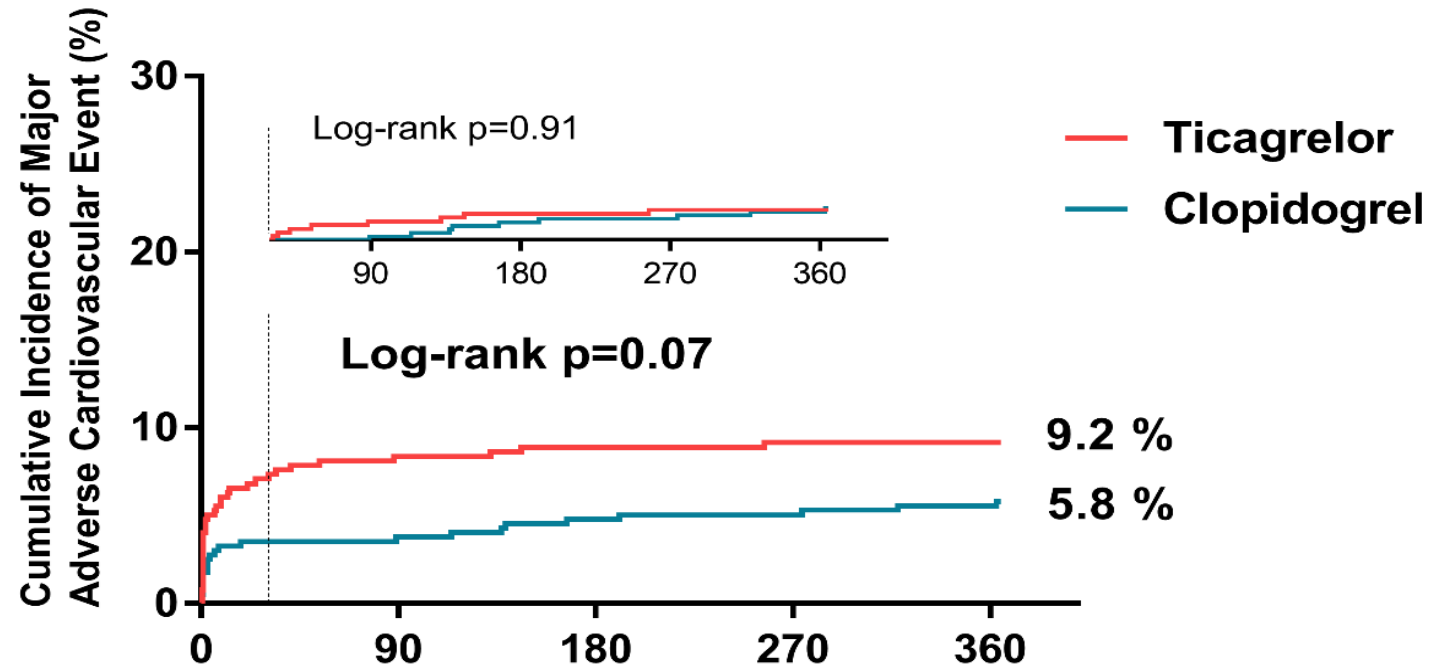
PLATO major or minor bleeding



No. at risk	0	90	180	270	360
Ticagrelor	400	341	337	334	324
Clopidogrel	400	372	371	369	361

# Secondary Efficacy Endpoint

## Major adverse cardiac event



No. at risk	0	90	180	270	360
Ticagrelor	400	354	352	351	345
Clopidogrel	400	380	375	373	362

# Primary Safety Endpoint and Its Components

End point number (%) <sup>*</sup>	Ticagrelor (N=400)	Clopidogrel (N=400)	Hazard Ratio for Ticagrelor Group (95% CI)	P value <sup>†</sup>
<b>Clinically significant bleeding (PLATO major or minor bleeding)</b>	45 (11.7)	21 (5.3)	2.26 (1.34–3.79)	<b>0.002</b>
Procedure-related	11 (2.8)	7 (1.8)	1.59 (0.62–4.11)	0.34
CABG-related	11 (2.8)	4 (1.0)	2.85 (0.91–8.94)	0.07
Non-procedure or CABG-related	23 (6.0)	10 (2.5)	2.39 (1.14–5.02)	<b>0.02</b>
<b>PLATO major bleeding</b>	29 (7.5)	16 (4.1)	1.89 (1.03–3.48)	<b>0.04</b>
Procedure-related	4 (1.0)	5 (1.3)	0.81 (0.22–3.01)	0.75
CABG-related	11 (2.8) <sup>‡</sup>	4 (1.0)	2.85 (0.91–8.94)	0.07
Non-procedure or CABG-related	14 (3.7)	7 (1.8)	2.07 (0.84–5.13)	0.12
<b>PLATO minor bleeding</b>	20 (5.2)	5 (1.3)	4.16 (1.56–11.1)	<b>0.002</b>
Procedure-related	8 (2.0)	2 (0.5)	4.05 (0.86–19.07)	0.06
CABG-related	0 (0.0)	0 (0.0)	NA	NA
Non-procedure or CABG-related	12 (3.2)	3 (0.8)	4.17 (1.18–14.79)	<b>0.02</b>
<b>Fatal bleeding</b>	4 (1.0) <sup>§</sup>	0 (0.0)	NA	<b>0.04<sup>¶</sup></b>

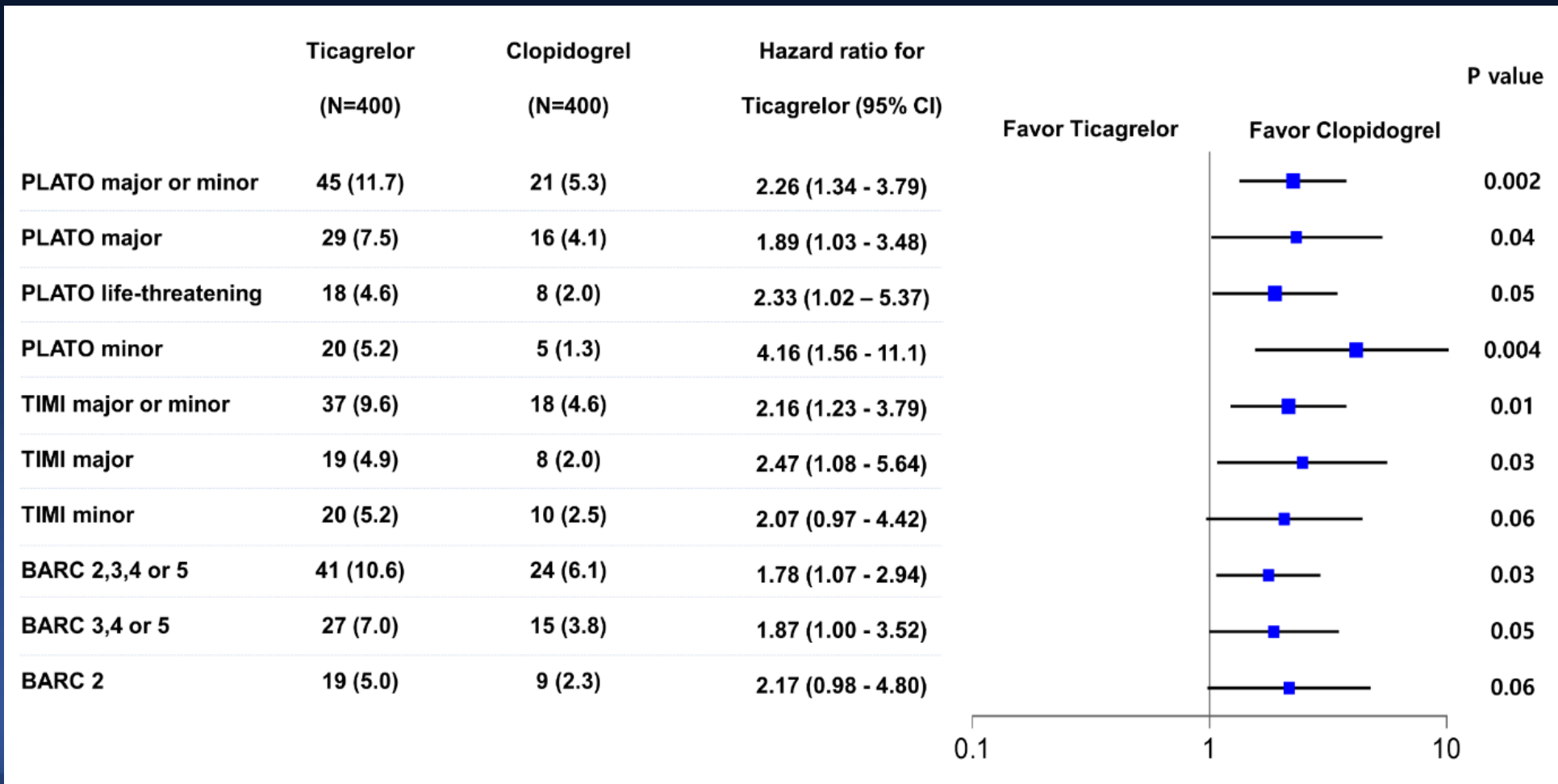
Data are presented as number (%). The percentages are Kaplan-Meier estimates of the rates of the events at 12 months. <sup>†</sup>P values are based on the results of Cox regression analysis.

<sup>‡</sup>Two cases of CABG were electively performed during the follow-up period after the index treatment of balloon angioplasty.

<sup>§</sup>Fatal bleeding included 1 GI bleeding, 1 hemorrhagic pericarditis, 1 fatal bleeding, and 1 aortic dissection.

<sup>¶</sup>P value was calculated with the use of the log-rank test. Abbreviation: CI, confidence interval; HR, hazard ratio; MI, myocardial infarction; NA, not available.

# Safety Endpoints according to the different Bleeding Criteria

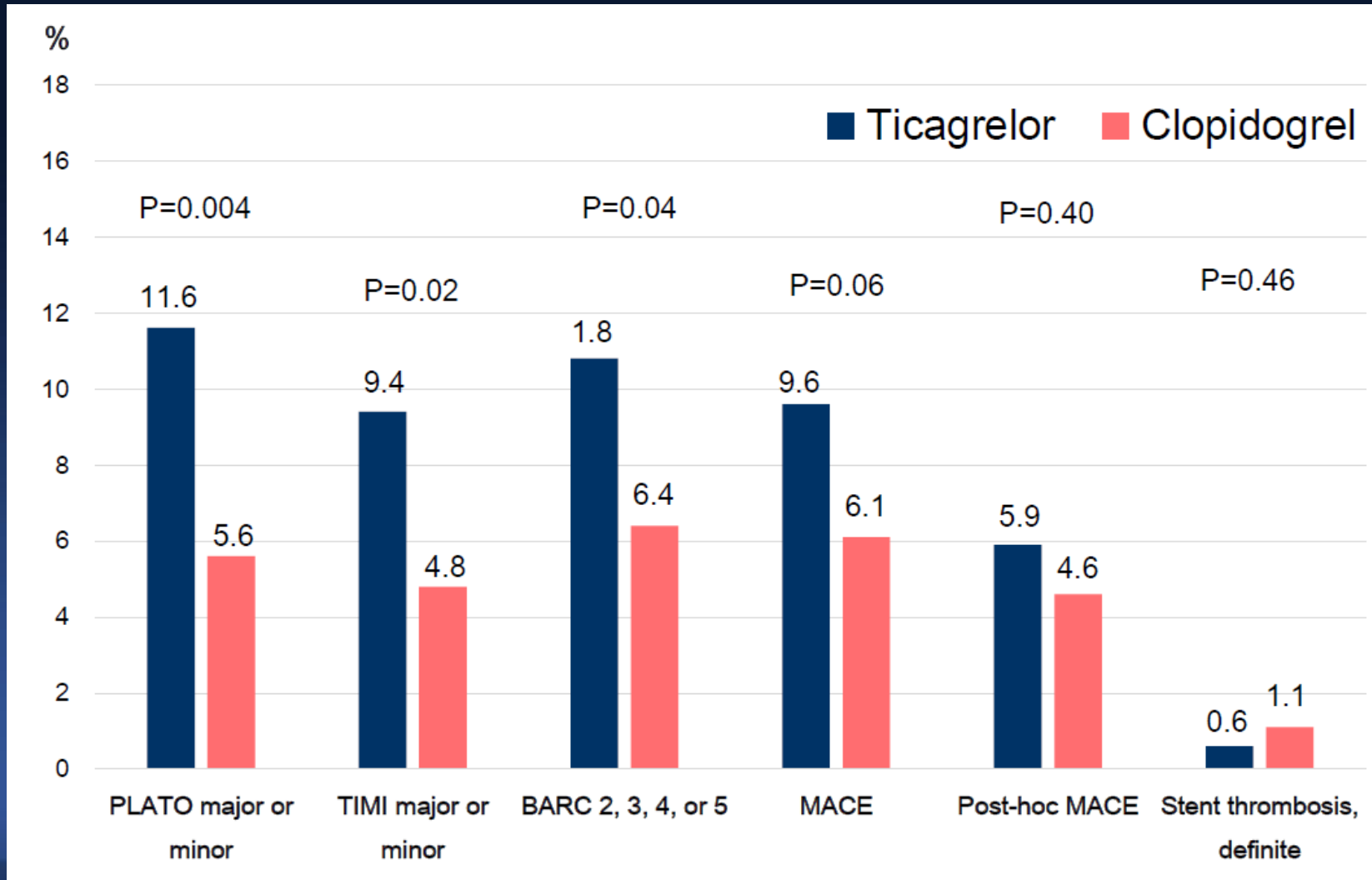


# Secondary Efficacy Endpoint and Its Components

End point number (%)*	Ticagrelor (N=400)	Clopidogrel (N=400)	Hazard Ratio for Ticagrelor Group (95% CI)	P value†
<b>Major adverse cardiovascular event</b>				
Composite of cardiovascular death, MI or stroke	36 (9.2)	23 (5.8)	1.62 (0.96–2.74)	0.07
Post-hoc: composite of cardiovascular death, spontaneous MI, or stroke	21 (5.4)	17 (4.3)	1.27 (0.67–2.40)	0.47
<b>Other secondary efficacy endpoints</b>				
Composite of all-cause death, MI or stroke	37 (9.4)	27 (6.8)	1.42 (0.86–2.33)	0.17
<b>All-cause death</b>	16 (4.1)	10 (2.5)	1.65 (0.75–3.63)	0.22
Cardiovascular death	15 (3.8)	6 (1.5)	2.61 (1.01–6.72)	<b>0.05</b>
Non-cardiovascular death	1 (0.3)	4 (1.0)	0.26 (0.03–2.31)	0.23
<b>Myocardial infarction</b>	20 (5.1)	16 (4.0)	1.28 (0.66–2.47)	0.46
Periprocedural MI	16 (4.0)	7 (1.7)	2.30 (0.95–5.60)	0.07
Spontaneous MI	4 (1.1)	9 (2.3)	0.45 (0.14–1.47)	0.19
<b>Stroke</b>	6 (1.6)	5 (1.3)	1.25 (0.38–4.09)	0.72
<b>Repeat revascularization</b>	10 (2.7)	12 (3.1)	0.86 (0.37–2.00)	0.73
Target-vessel	5 (1.3)	8 (2.0)	0.65 (0.21–1.97)	0.44
Target-lesion	4 (1.1)	4 (1.0)	1.03 (0.26–4.13)	0.96
Non-target vessel	6 (1.6)	3 (0.8)	2.09 (0.52–8.35)	0.30
<b>Stent thrombosis, definite</b>	2 (0.5)	4 (1.0)	0.51 (0.09–2.79)	0.44

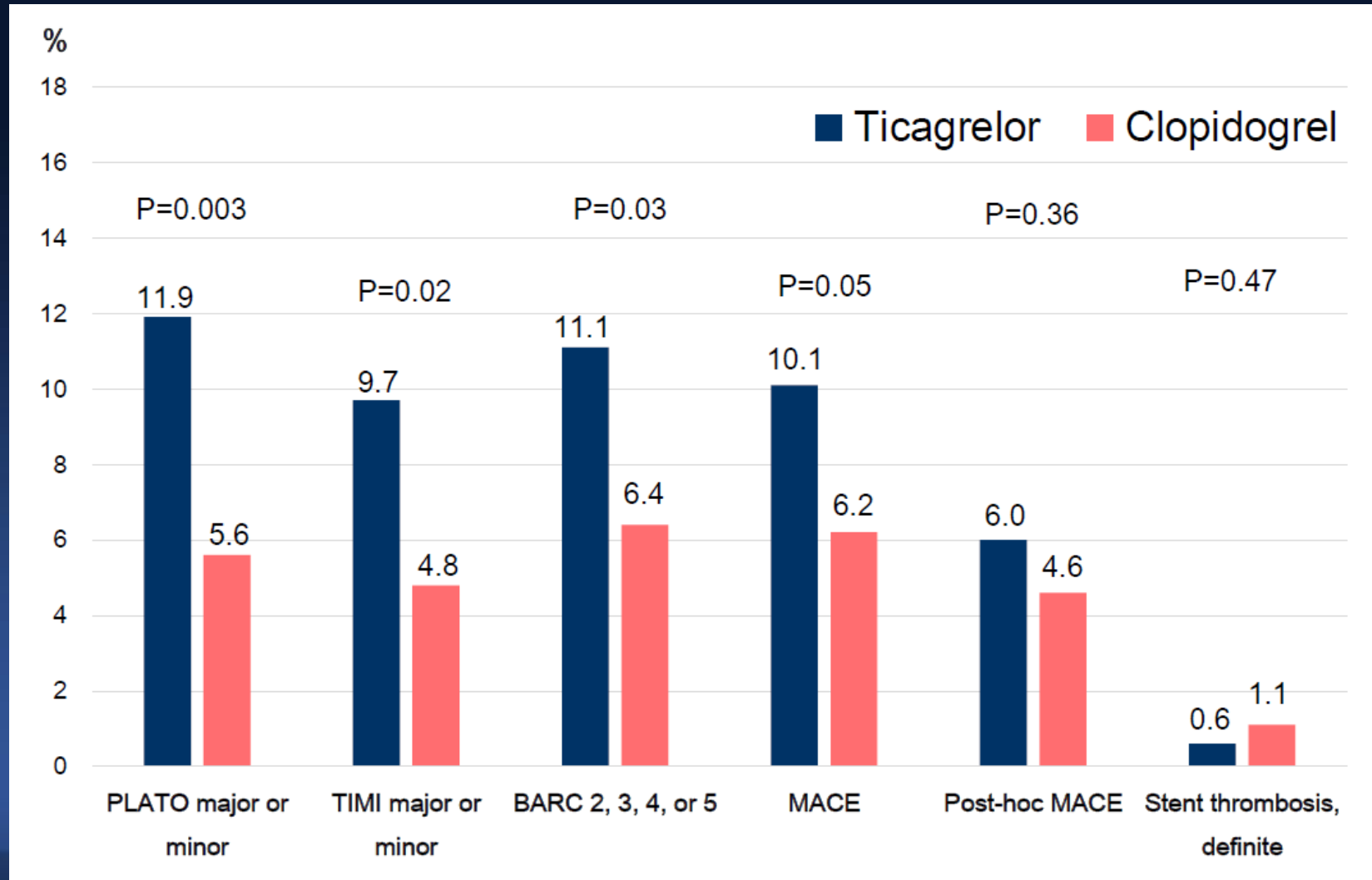
Data are presented as number (%). \*The percentages are Kaplan-Meier estimates of the rates of the end points at 12 months. †P values were calculated by means of Cox regression analysis  
Abbreviations: CI, confidence interval; HR, hazard ratio; MI, myocardial infarction

# Safety and Efficacy Endpoints According to the Lag-Censoring Analysis

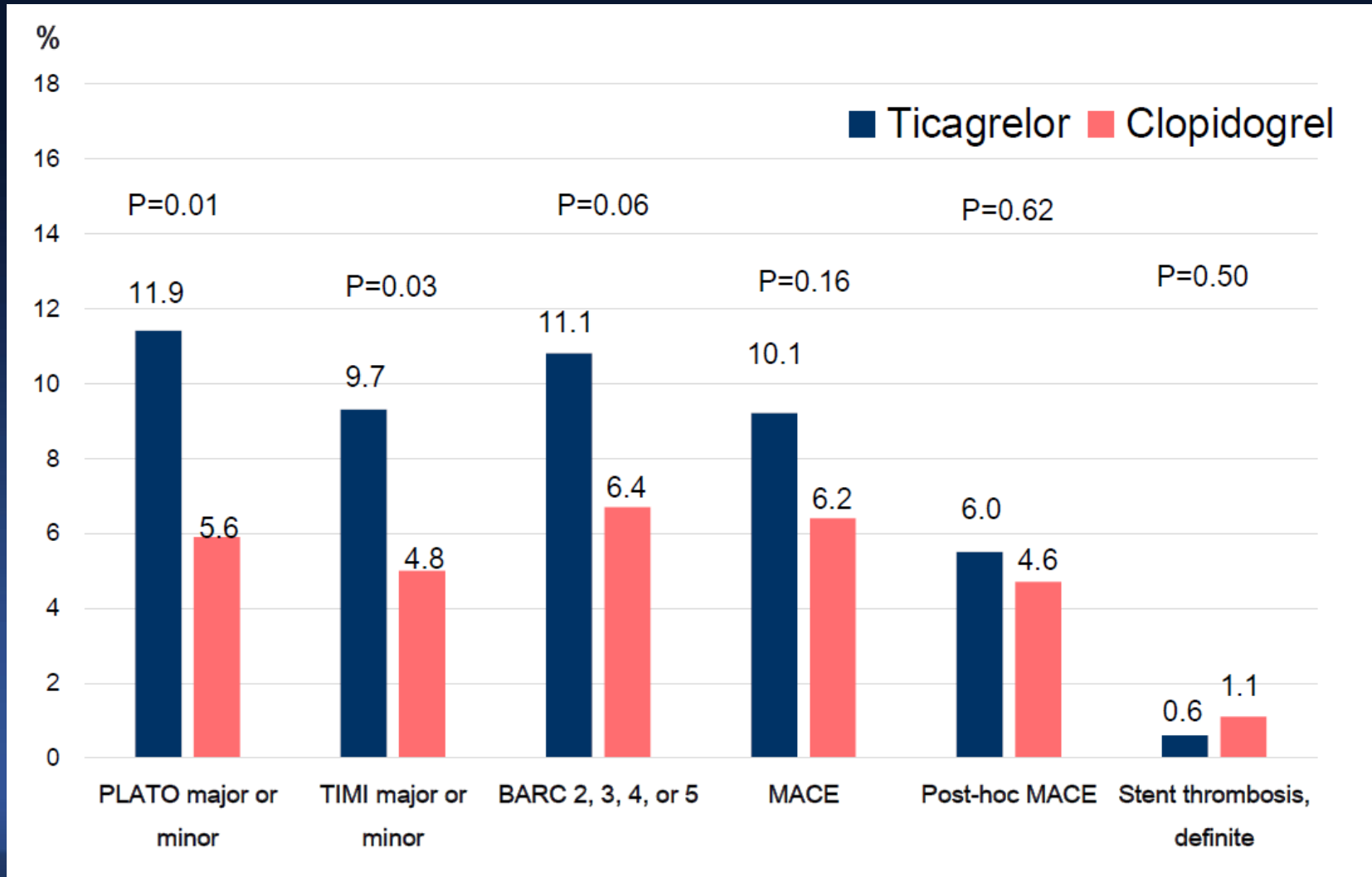




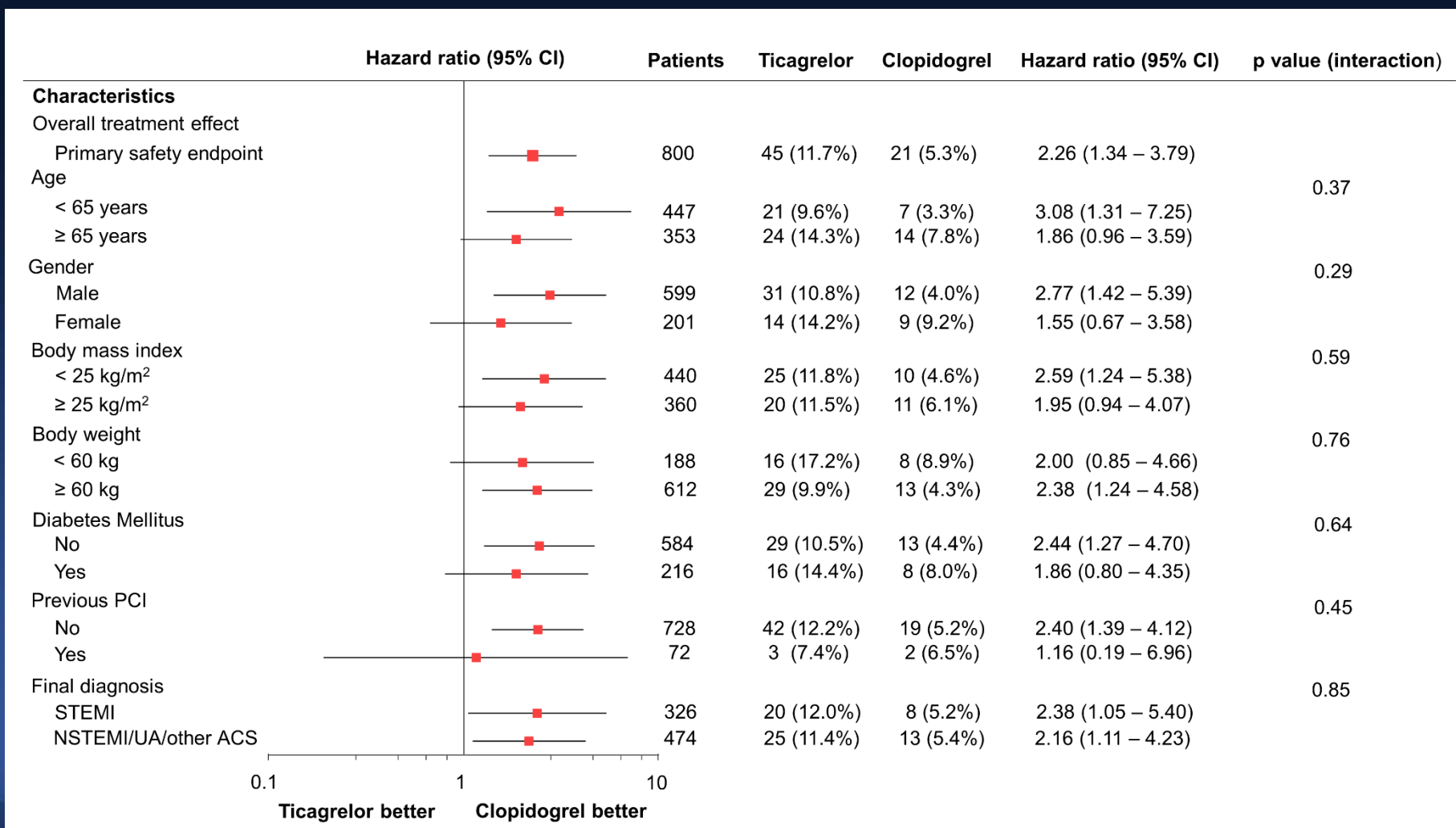
# Safety and Efficacy Endpoints According to **the Modified Intention-to-Treat Analysis** and its **Lag-Censoring Analysis**



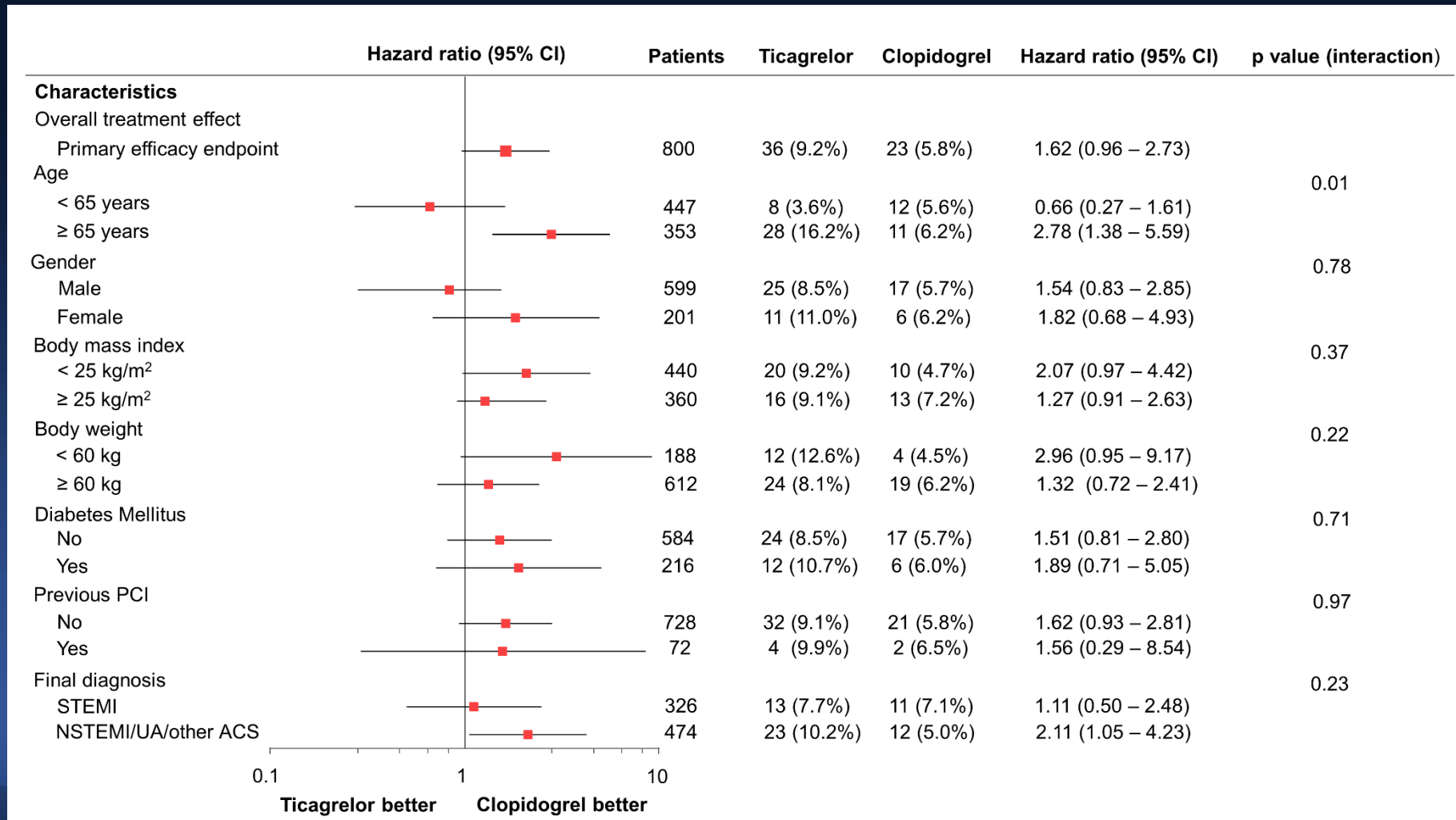
# Safety and Efficacy End Points According to the Per-Protocol Analysis and its Lag-Censoring Analysis



# Primary Safety Endpoint According to Patient Key Subgroups



# Secondary Efficacy Endpoint According to Patient Key Subgroups



# Premature Discontinuation of the Medications

	All population (N=800)	Ticagrelor (N=400)	Clopidogrel (N=400)	P value*
Bleeding events	9 (1.1)	8 (2.0)	1 (0.3)	0.02
Adverse event other than bleeding	10 (1.3)	9 (2.3)	1 (0.3)	0.01
Dyspnea†	7 (0.9)	7 (1.8)	0 (0.0)	0.02
Gout	1 (0.1)	1 (0.3)	0 (0.0)	>0.99
Impotence	1 (0.1)	1 (0.3)	0 (0.0)	>0.99
GI trouble	1 (0.1)	0 (0.0)	1 (0.3)	>0.99
Physicians' decision	24 (3.0)	16 (4.0)	8 (2.0)	0.15
High bleeding risk†	7 (0.9)	7 (1.8)	0 (0.0)	0.02
High thrombotic burden‡	1 (0.5)	0 (0.0)	1 (1.0)	>0.99
Thrombotic event (MI)‡	2 (0.3)	0 (0.0)	2 (0.5)	0.50
Short duration of DAPT	11 (1.4)	6 (1.5)	5 (1.3)	>0.99
Requiring concomitant anticoagulation	3 (0.4)	3 (0.8)	0 (0.0)	0.25
Poor compliance to taking twice a day†	1 (0.1)	1 (0.3)	0 (0.0)	>0.99
Non-compliance	5 (0.6)	2 (0.5)	3 (0.8)	>0.99
Lost to follow-up	16 (2.0)	10 (2.5)	6 (1.5)	0.45

DAPT, dual antiplatelet therapy; GI, gastrointestinal; MI, myocardial infarction. †The study medication was switched from clopidogrel to ticagrelor. ‡The study medication was switched from ticagrelor to clopidogrel.

‡The study medication was switched from clopidogrel to ticagrelor

Abbreviations: DAPT, dual antiplatelet therapy; GI, gastrointestinal; MI, myocardial infarction

# Conclusion

- Among Korean ACS patients with or without ST-elevation who are intended for an invasive strategy, use of ticagrelor was associated with a higher rate of clinically significant bleeding at 12 months than was clopidogrel therapy.
- A non-significant higher rate of MACE was observed with ticagrelor use, although the present trial was underpowered to draw any conclusion regarding efficacy.
- A larger, adequately powered trial would be required to definitively assess the efficacy and safety of potent P2Y12 inhibitor ticagrelor in East Asian population.

# Thank you for your attention.



24<sup>th</sup> CARDIOVASCULAR SUMMIT  
**TCTAP 2019** April 27-30, 2019  
Coex, Seoul, Korea

# The PLATO trial

End Point	Ticagrelor Group	Clopidogrel Group	Hazard or Odds Ratio for Ticagrelor Group (95% CI) <sup>†</sup>	P Value
Primary safety end points — no./total no. (%)				
Major bleeding, study criteria	961/9235 (11.6)	929/9186 (11.2)	1.04 (0.95–1.13)	0.43
Major bleeding, TIMI criteria <sup>‡</sup>	657/9235 (7.9)	638/9186 (7.7)	1.03 (0.93–1.15)	0.57
Bleeding requiring red-cell transfusion	818/9235 (8.9)	809/9186 (8.9)	1.00 (0.91–1.11)	0.96
Life-threatening or fatal bleeding, study criteria	491/9235 (5.8)	480/9186 (5.8)	1.03 (0.90–1.16)	0.70
Fatal bleeding	20/9235 (0.3)	23/9186 (0.3)	0.87 (0.48–1.59)	0.66
Nonintracranial fatal bleeding	9/9235 (0.1)	21/9186 (0.3)		0.03
Intracranial bleeding	26/9235 (0.3)	14/9186 (0.2)	1.87 (0.98–3.58)	0.06
Fatal	11/9235 (0.1)	1/9186 (0.01)		0.02
Nonfatal	15/9235 (0.2)	13/9186 (0.2)		0.69
Secondary safety end points — no./total no. (%)				
Non-CABG-related major bleeding, study criteria	362/9235 (4.5)	306/9186 (3.8)	1.19 (1.02–1.38)	0.03
Non-CABG-related major bleeding, TIMI criteria	221/9235 (2.8)	177/9186 (2.2)	1.25 (1.03, 1.53)	0.03
CABG-related major bleeding, study criteria	619/9235 (7.4)	654/9186 (7.9)	0.95 (0.85–1.06)	0.32
CABG-related major bleeding, TIMI criteria	446/9235 (5.3)	476/9186 (5.8)	0.94 (0.82–1.07)	0.32
Major or minor bleeding, study criteria	1339/9235 (16.1)	1215/9186 (14.6)	1.11 (1.03–1.20)	0.008
Major or minor bleeding, TIMI criteria <sup>‡</sup>	946/9235 (11.4)	906/9186 (10.9)	1.05 (0.96–1.15)	0.33

# The PHILO trial

**Table 3. Adverse Events for All Patients**

	Ticagrelor 90 mg b.i.d.	Clopidogrel 75 mg o.d.	HR for ticagrelor (95% CI)
<b>Major bleeding (PLATO-defined)</b>	40 (10.3)	26 (6.8)	1.54 (0.94–2.53)
CABG-related	8 (2.1)	5 (1.3)	1.57 (0.51–4.81)
Non-CABG-related	32 (8.3)	22 (5.8)	1.45 (0.84–2.50)
Coronary procedural	14 (3.6)	11 (2.9)	1.25 (0.57–2.77)
Non-coronary procedural	2 (0.5)	3 (0.8)	0.66 (0.11–3.93)
<b>Minor bleeding (PLATO-defined)</b>	59 (15.2)	35 (9.2)	1.75 (1.15–2.67)
CABG-related	0	1 (0.3)	
Non-CABG-related	59 (15.2)	34 (8.9)	1.81 (1.18–2.76)
Coronary procedural	31 (8.0)	22 (5.8)	1.43 (0.82–2.48)
Non-coronary procedural	10 (2.6)	4 (1.1)	2.51 (0.79–8.01)
<b>Composite of major and minor bleeding</b>	92 (23.8)	56 (14.7)	1.72 (1.23–2.40)
CABG-related	8 (2.1)	5 (1.3)	1.57 (0.51–4.81)
Non-CABG-related	85 (22.0)	52 (13.7)	1.71 (1.20–2.41)
Coronary procedural	44 (11.4)	31 (8.2)	1.44 (0.91–2.29)
Non-coronary procedural	12 (3.1)	7 (1.8)	1.72 (0.68–4.36)
<b>Any adverse event (excluding bleeding)</b>	327 (84.5)	337 (88.7)	
Mild	321 (82.9)	322 (84.7)	
Moderate	67 (17.3)	83 (21.8)	
Severe	30 (7.8)	38 (10.0)	
<b>Dyspnea</b>	22 (5.7)	9 (2.4)	
<b>Bradycardia</b>	11 (2.8)	8 (2.1)	
<b>Ventricular extrasystoles</b>	7 (1.8)	6 (1.6)	
<b>Ventricular pauses ≥3 s on Holter monitoring</b>	0	1 (1.9)	
<b>Increase in serum creatinine &gt;30% (on treatment)</b>	75 (19.4)	60 (15.8)	
<b>Increase in serum uric acid from baseline to end of treatment (μmol/L)</b>	34±87	9±80	
<b>Any uric acid adverse event<sup>†</sup></b>	26 (6.7)	20 (5.3)	

Data given as mean±SD or n (%). <sup>†</sup>Includes hyperuricemia, blood uric acid increase, gout, blood urine present, calculus ureteric, joint swelling. CI, confidence interval; HR, hazard ratio. Other abbreviations as in Table 1.



End point number (%)*	Ticagrelor (N=400)	Clopidogrel (N=400)	Hazard Ratio for Ticagrelor Group (95% CI)	P value†
<b>Clinically significant bleeding (PLATO major or minor bleeding)</b>	45 (11.7)	21 (5.3)	2.26 (1.34–3.79)	0.002
Procedure-related	11 (2.8)	7 (1.8)	1.59 (0.62–4.11)	0.34
CABG-related	11 (2.8)	4 (1.0)	2.85 (0.91–8.94)	0.07
Non-procedure or CABG-related	23 (6.0)	10 (2.5)	2.39 (1.14–5.02)	0.02
<b>PLATO major bleeding</b>	29 (7.5)	16 (4.1)	1.89 (1.03–3.48)	0.04
Procedure-related	4 (1.0)	5 (1.3)	0.81 (0.22–3.01)	0.75
CABG-related	11 (2.8)‡	4 (1.0)	2.85 (0.91–8.94)	0.07
Non-procedure or CABG-related	14 (3.7)	7 (1.8)	2.07 (0.84–5.13)	0.12
Intracranial	4	1		
Gastrointestinal	6	1		
Genitourinary	0	1		
Pulmonary	1	2		
Surgery-related	0	2		
Skin	2	0		
Pericarditis, hemorrhagic	1	0		
<b>PLATO minor bleeding</b>	20 (5.2)	5 (1.3)	4.16 (1.56–11.1)	0.002
Procedure-related	8 (2.0)	2 (0.5)	4.05 (0.86–19.07)	0.06
CABG-related	0 (0.0)	0 (0.0)	NA	NA
Non-procedure or CABG-related	12 (3.2)	3 (0.8)	4.17 (1.18–14.79)	0.02
Gastrointestinal	5	1		
Genitourinary	2	1		
Pulmonary	1	0		
Genitourinary	2	1		
Epistaxis	2	0		
<b>Fatal bleeding</b>	4 (1.0)§	0 (0.0)	NA	0.04¶