

Clinical Impact of Periprocedural Myocardial Injury After TAVR

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Conflict of Interest Statement

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

Consulting Fees/Honoraria

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Company

Edwards LifeSciences

Medtronic Inc

Boston Scientific

Definition of Peri-procedural MI

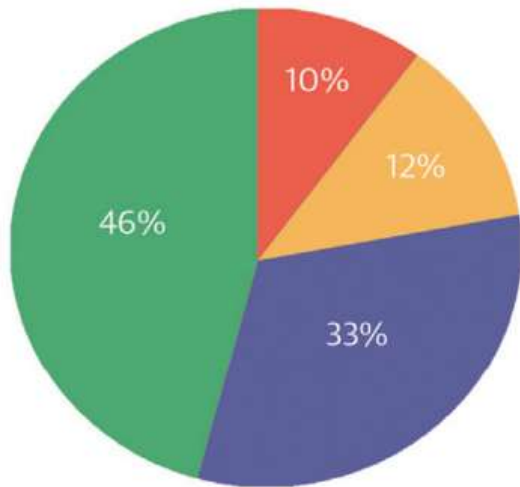
- **≤ 72 h** after the index procedure
- **New ischemic symptoms** or **new ischemic signs AND**
- **Elevated Cardiac biomarker** (preferable CK-MB)

CK-MB $\geq 5 \times$ Upper normal limit (UNL)

Troponin $\geq 15 \times$ Upper normal limit (UNL)

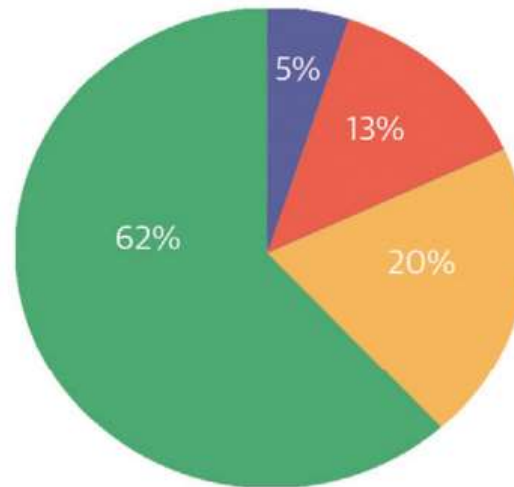
Incidence of Peri-procedural MI By CK-MI

Overall



■ <1-fold

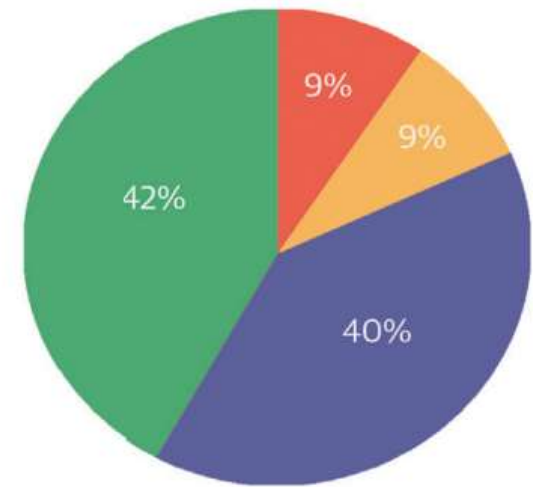
Transapical



■ 1-3-fold

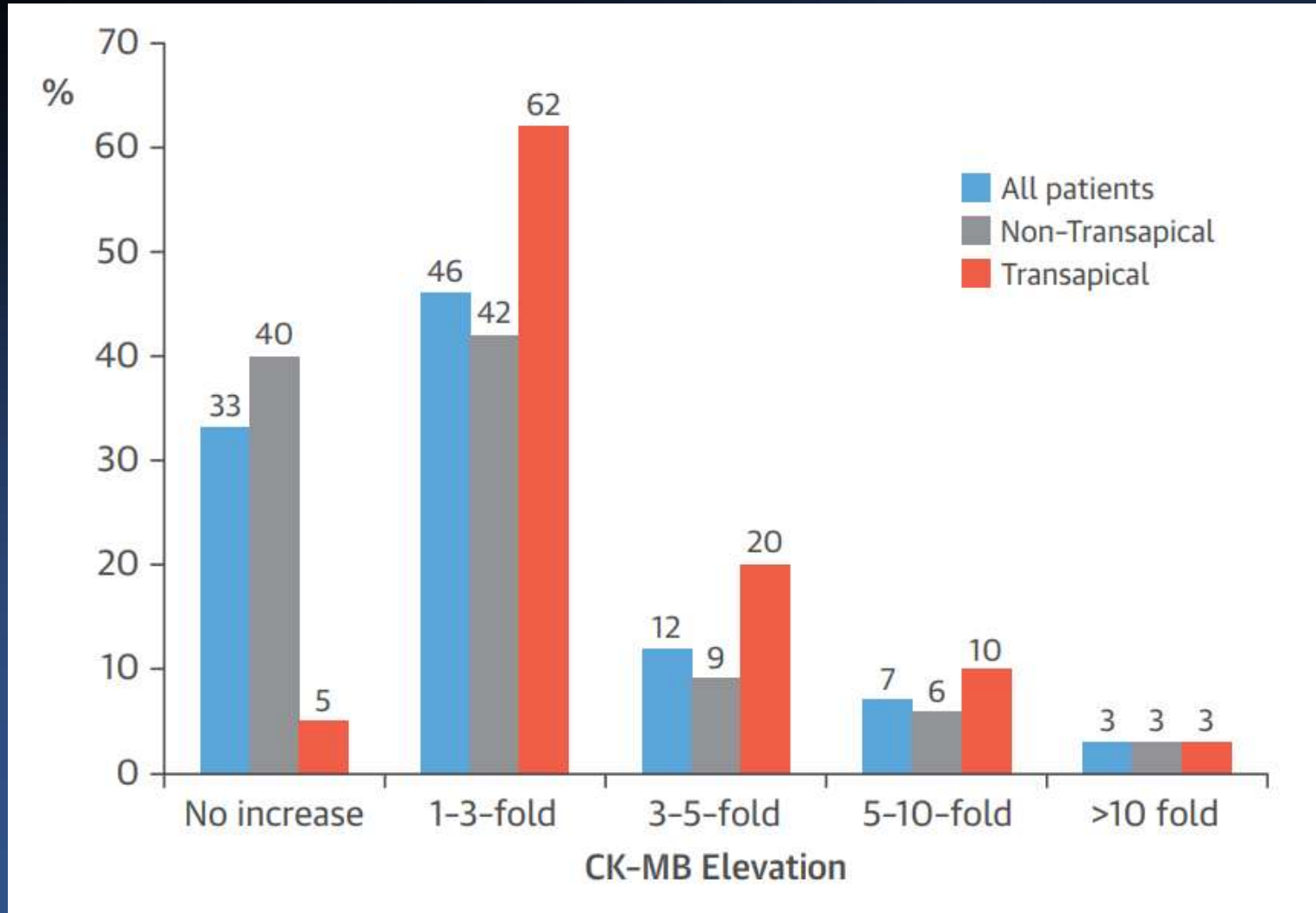
■ 3-5-fold

Non-Transapical

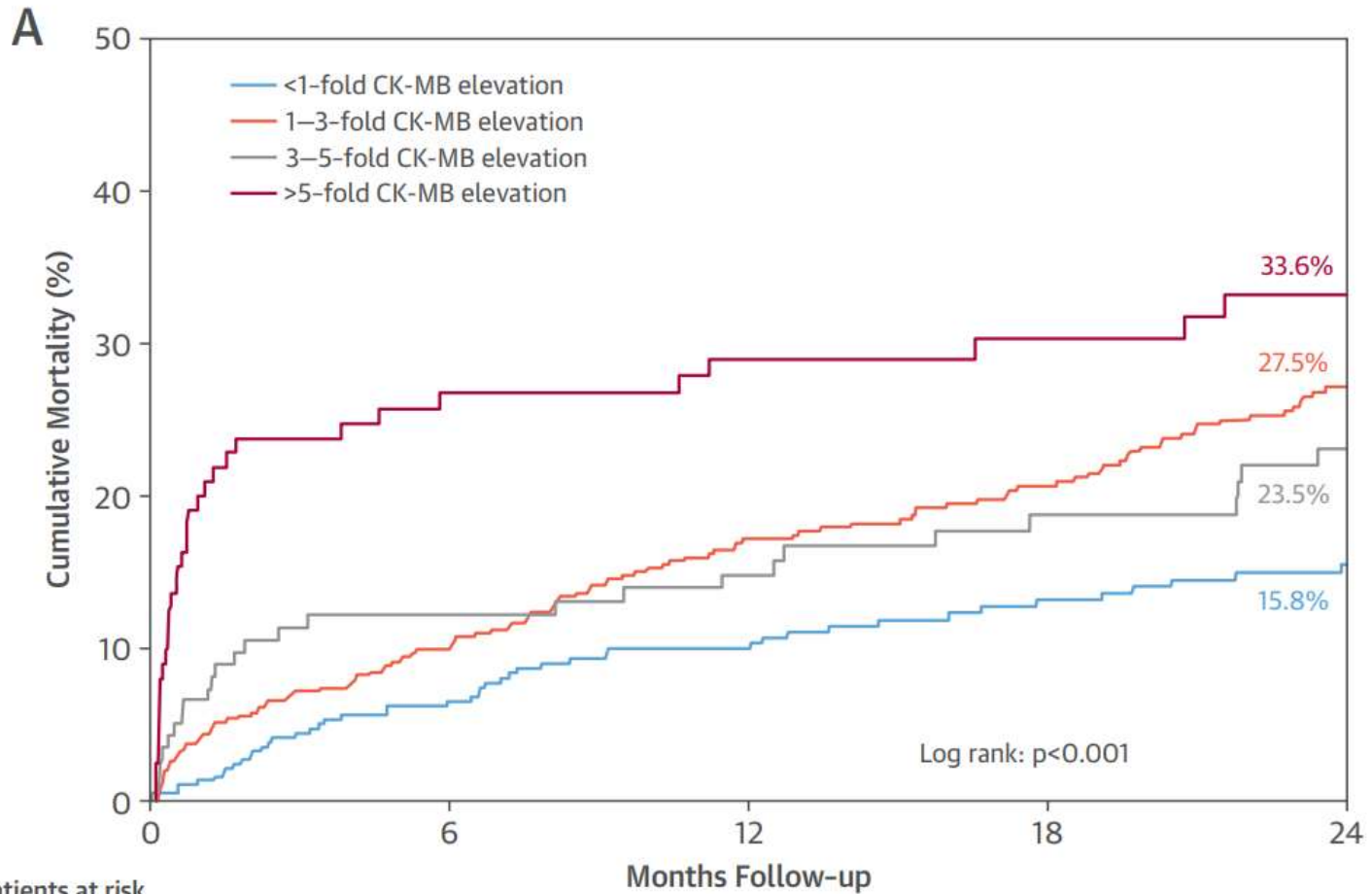


■ >5-fold

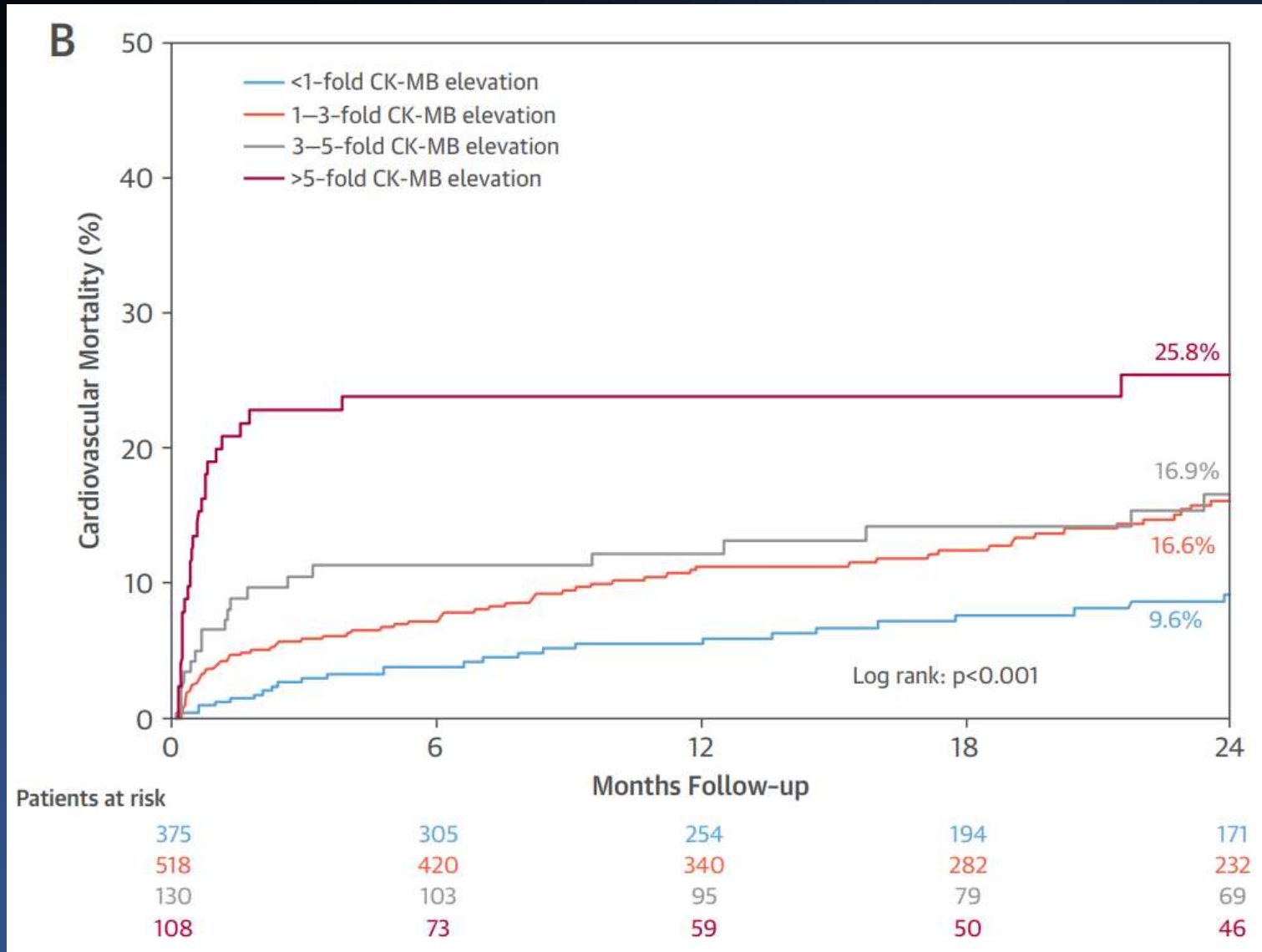
Degree of Increase in CK-MB after TAVR



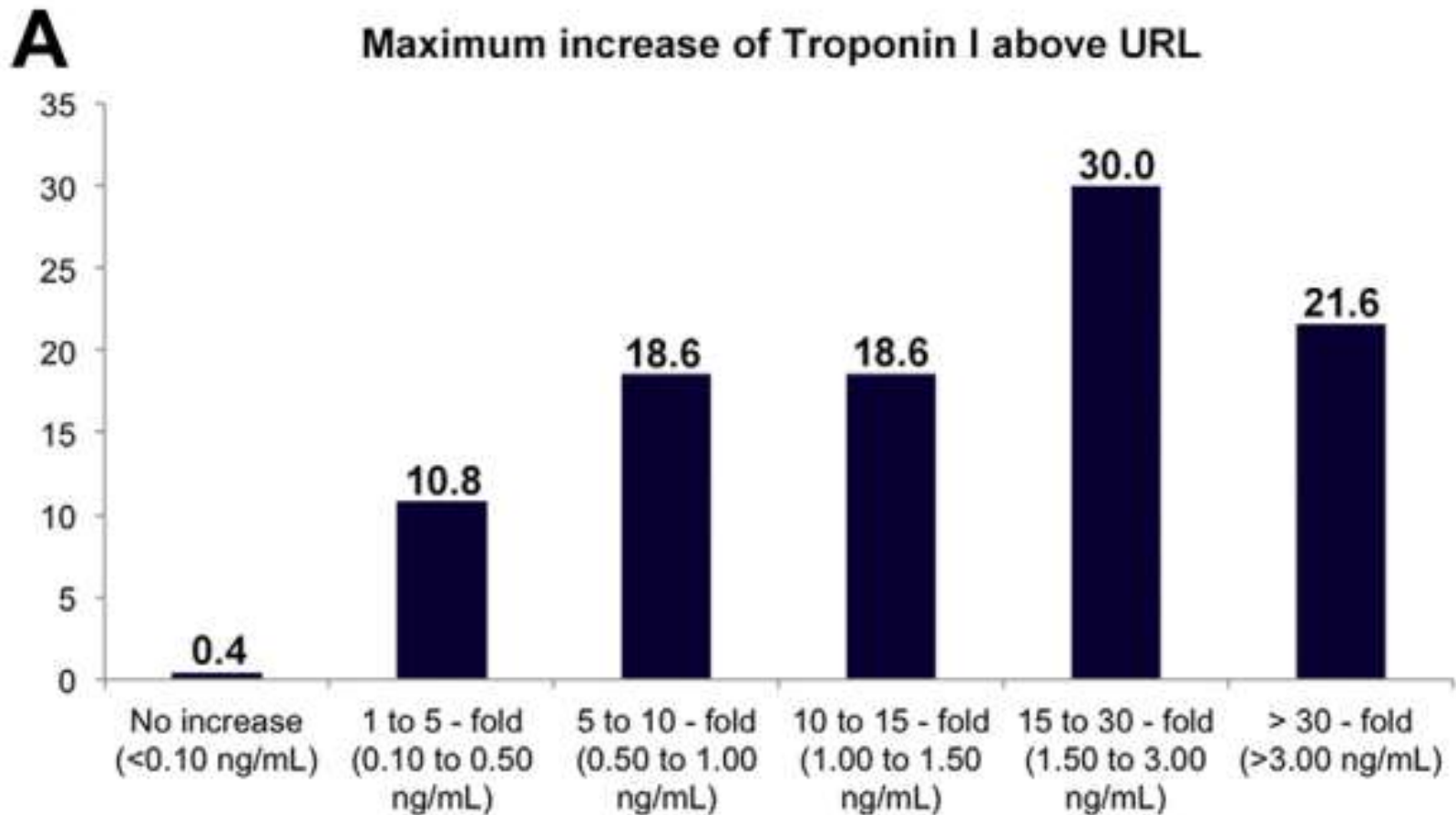
Peri-procedural MI on All-cause Death



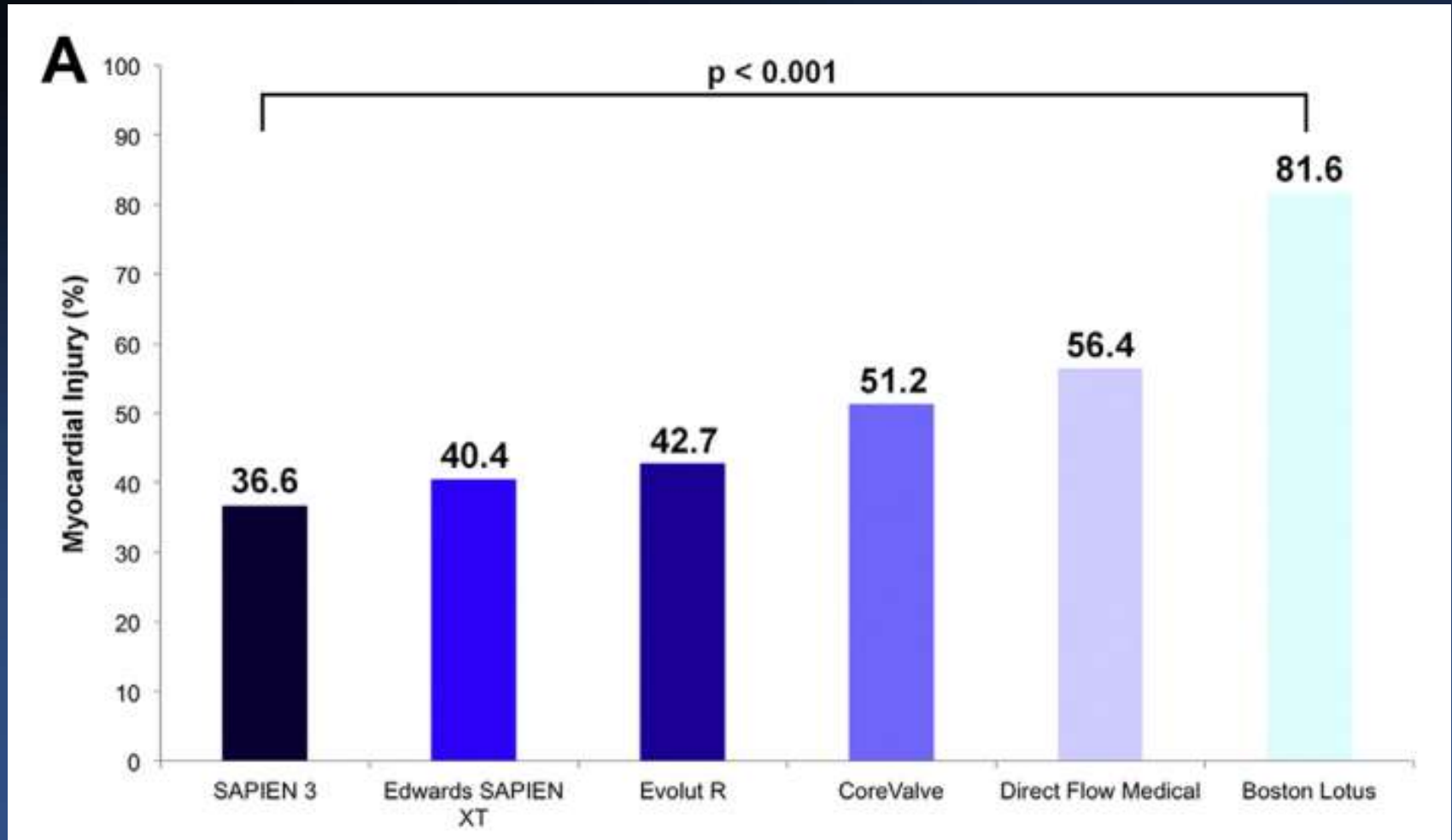
Peri-procedural MI on CV death



Degree of Increase in Troponin I after TAVR



Incidence of Peri-procedural MI By Troponin-I



Clinical outcome and Periprocedural MI (Troponin I $\geq 15 \times$ UNL)

	All Patients (N = 756)	Δ Troponin I $< 15 \times$ URL (n = 366)	Δ Troponin I $\geq 15 \times$ URL (n = 390)	p Value
30-day mortality	22 (2.9)	10 (2.7)	12 (3.1)	0.778
1-yr mortality	128 (16.9)	63 (17.2)	65 (16.7)	0.841
3-yr mortality	194 (25.7)	93 (25.4)	101 (25.9)	0.878
5-yr mortality	228 (30.2)	110 (30.1)	118 (30.3)	0.952
Stroke	17 (2.2)	4 (1.1)	13 (3.3)	0.038
Myocardial infarction	1 (0.1)	0 (0.0)	1 (0.3)	0.332
Minor vascular complications	148 (19.6)	64 (17.5)	84 (21.5)	0.161
Major vascular complications	24 (3.2)	8 (2.2)	16 (4.1)	0.133
Major bleeding	24 (3.2)	6 (1.6)	18 (4.6)	0.020
Pacemaker implantation	111 (14.7)	44 (12.0)	67 (17.2)	0.102
More than mild AR	44 (5.8)	18 (4.9)	26 (6.7)	0.305
AR index < 25	201 (26.6)	108 (29.5)	93 (23.8)	0.078
Acute kidney injury	114 (15.1)	41 (11.2)	73 (18.7)	0.004

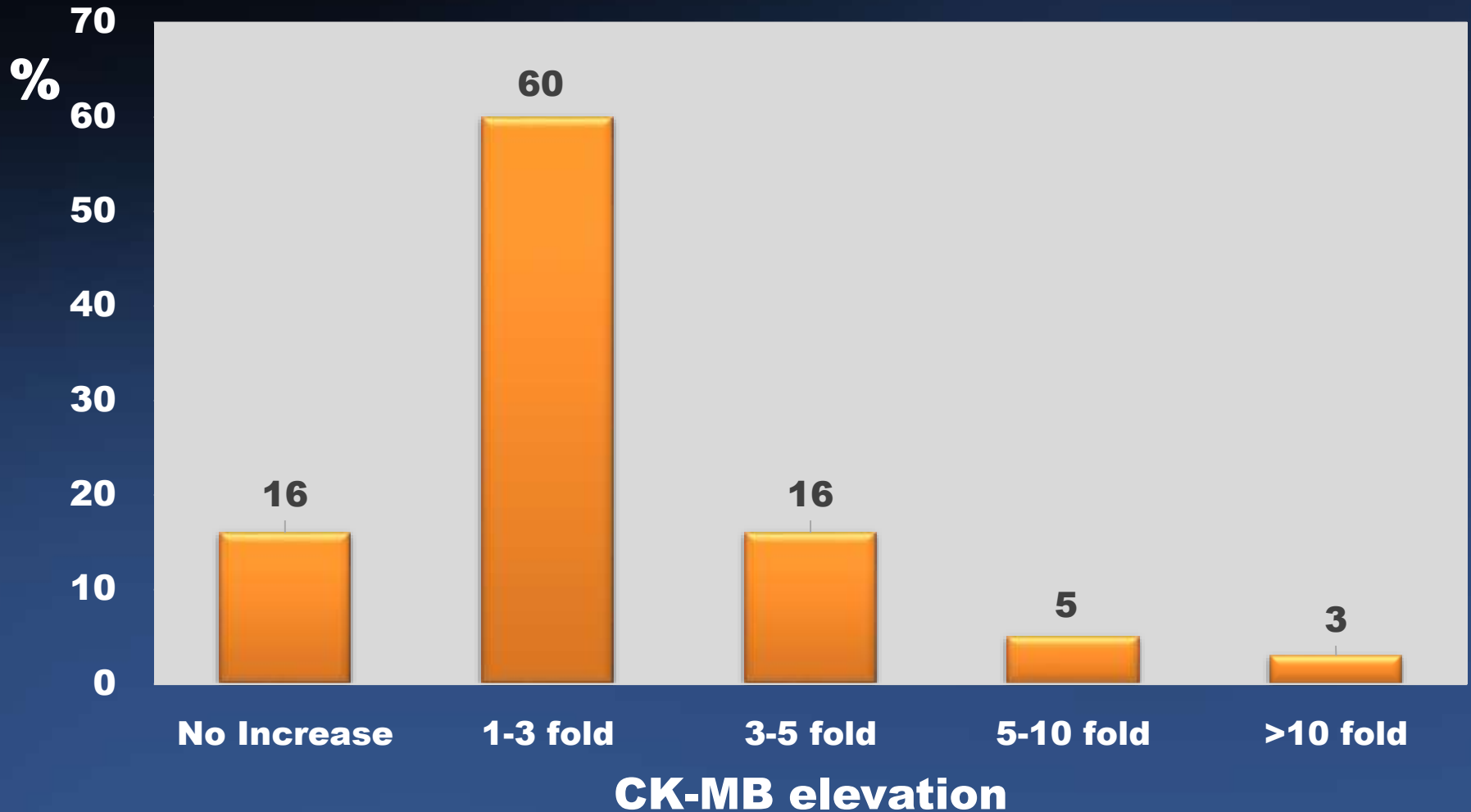
- Periprocedural MI according to troponin I is not associated with adverse short- and long-term after TAVR

Insights from AMC registry

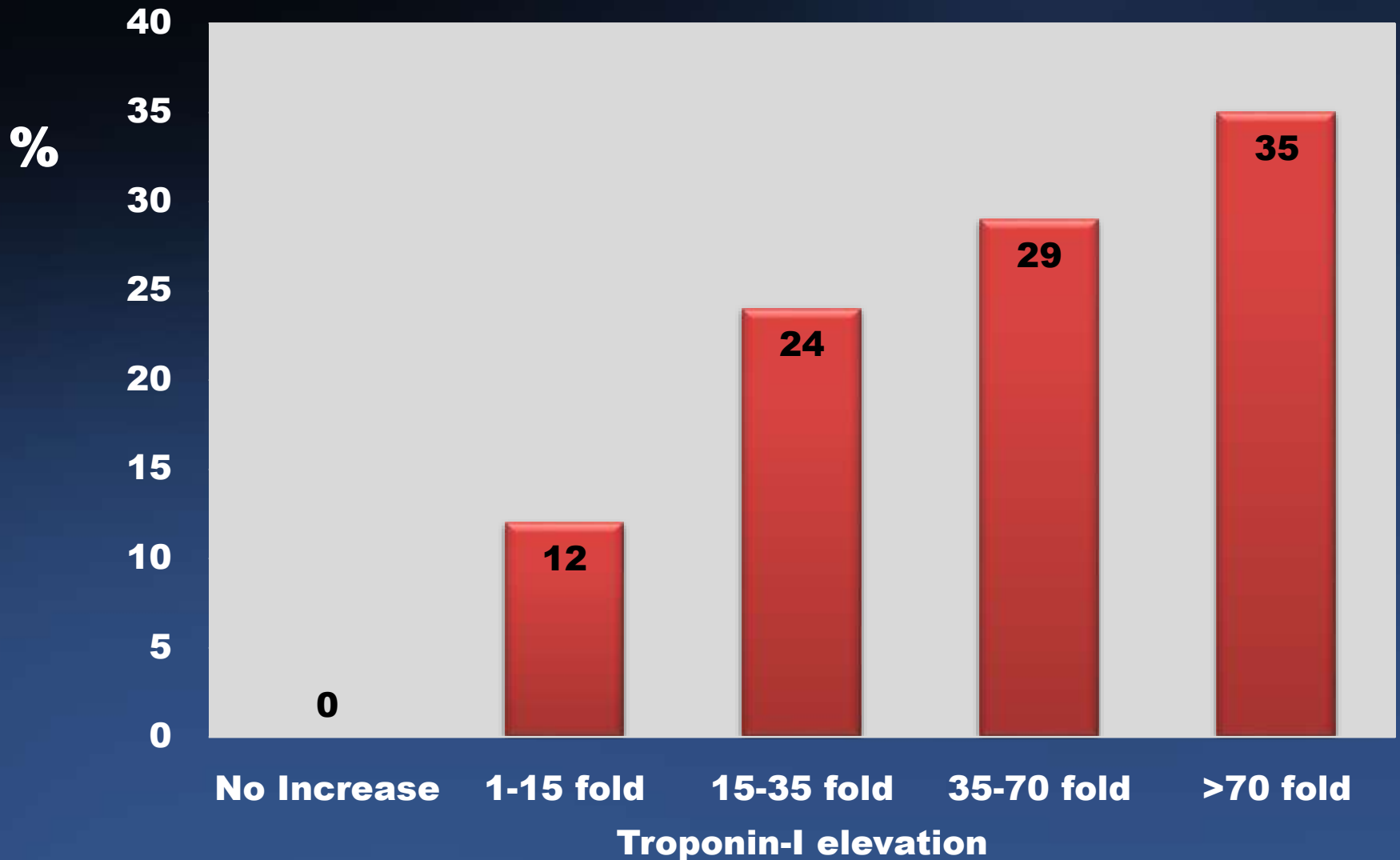
Methods

- **From 2010 to 2017 at Asan Medical Center**
- 99 percentile value (Upper normal limit) of Cardiac biomarker at Our institution
 - CK-MB 5 ng/mL
 - Highly sensitive Troponin-I 0.04 ng/mL

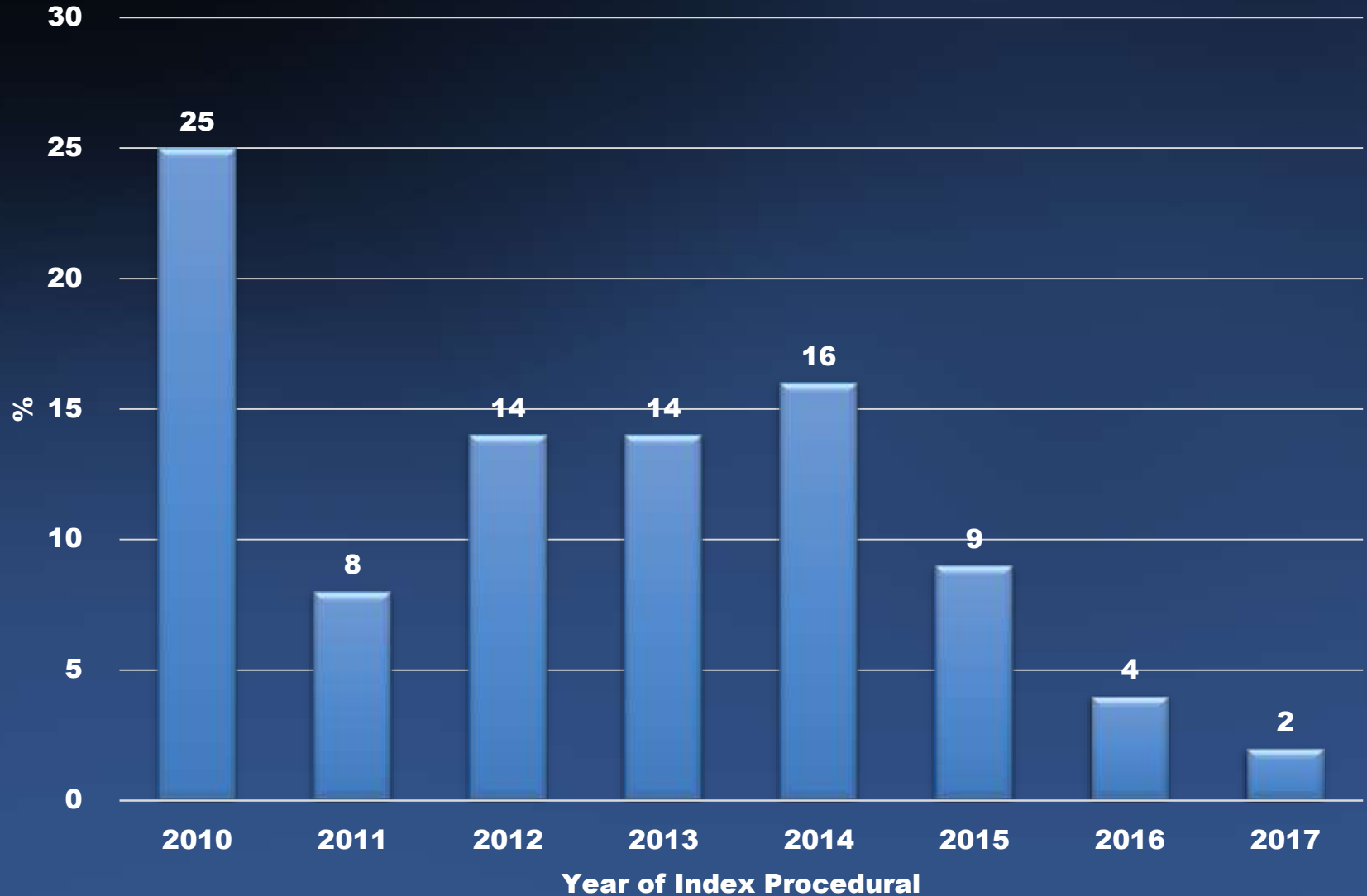
Degree of Increase in CK-MB after TAVR



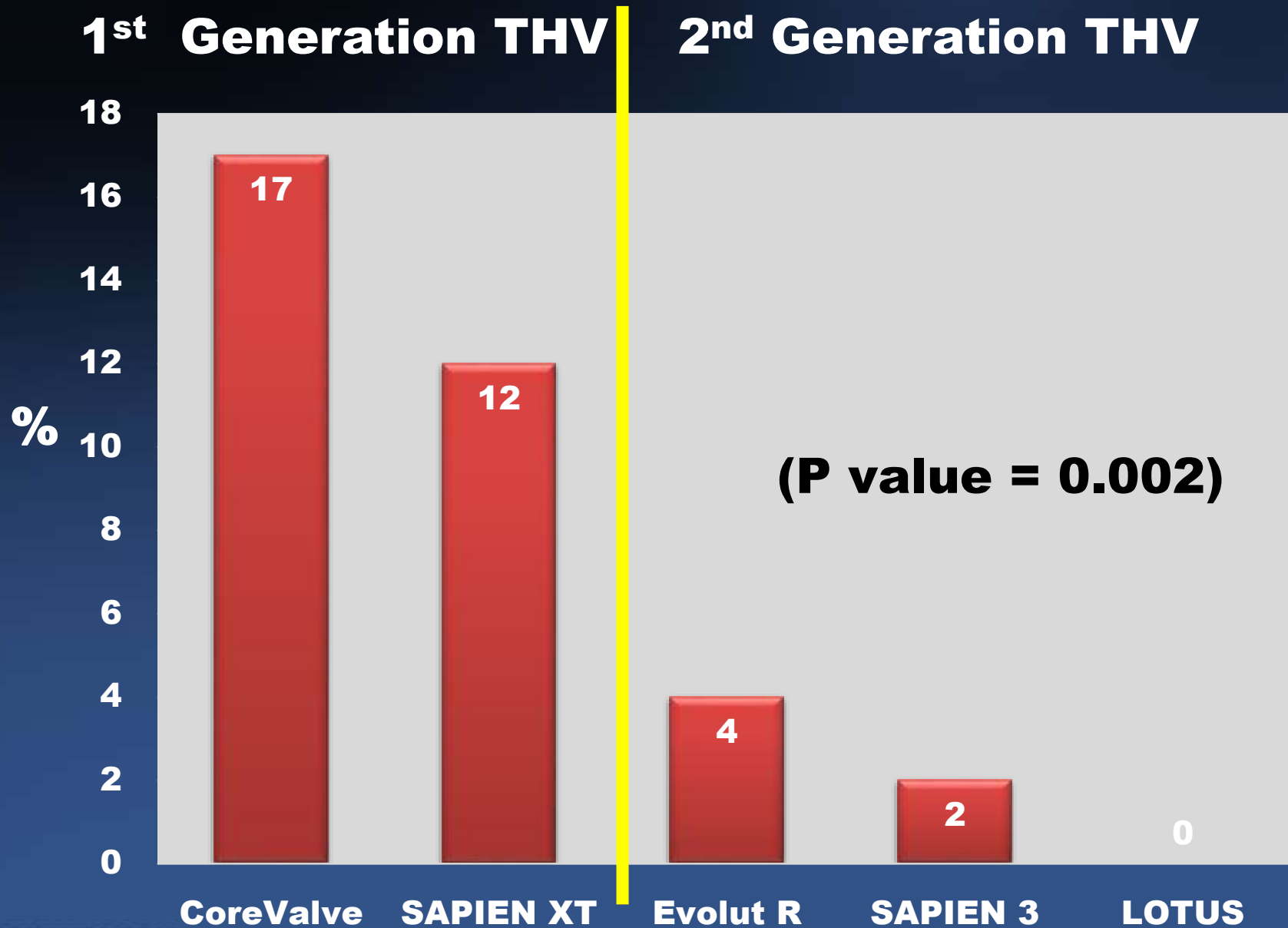
Degree of Increase in Troponin-I after TAVR



Incidence of periprocedural MI (CK-MB)



Incidence of periprocedural MI and Type of THV



Peri-procedural MI and Concomitant CAD status



(P value = 0.77)

**Etiology of Periprocedural MI(CK-MB)

Etiology	N (%)
LV rupture/Cardiac tamponade	5 (17)
Need for second valve	2 (7)
BP drop during procedure	1 (3)
Coronary obstruction	2 (7)
AV block (requiring PPM insertion)	3 (10)
Systemic embolism	2 (7)
Atrial fibrillation	1 (3)
Major/Life-threatening bleeding	2 (7)
Trans-apical TAVR	4 (14)
Concurrent PCI	1 (3)
Unknown	6 (21)

Baseline Characteristics (CK-MB)

	All patients (N=363)	CK-MB \geq 5 x URL (N=29)	CK-MB<5 x URL (N=334)	P value
Age, years	78.8 \pm 5.1	77.0 \pm 5.0	79.0 \pm 5.1	0.053
Male, N (%)	173 (47.7)	11 (37.9)	162(48.5)	0.37
BMI, kg/m2	23.9 \pm 3.4	24.1 \pm 3.8	23.9 \pm 3.4	0.72
Logistic EuroSCORE(%)	15.6 \pm 12.1	16.5 \pm 8.0	15.5 \pm 12.3	0.52
STS mortality score(%)	4.3 \pm 4.5	3.8 \pm 2.2	4.4 \pm 4.7	0.27
Current smoker	37 (10.2)	1 (3.4)	36 (10.8)	0.35
HTN	311 (85.7)	23 (79.3)	288 (86.2)	0.46
DM	117 (32.2)	6 (20.7)	111 (33.2)	0.24
Hyperlipidemia	243 (66.9)	18 (62.1)	225 (67.4)	0.71
Previous CHF	71 (19.6)	11 (37.9)	60 (18.0)	0.02
Coronary artery disease	147 (40.5)	13 (44.8)	134 (40.1)	0.77
Previous MI	22 (6.1)	1 (3.4)	21 (6.3)	0.83
Previous PCI	109 (30.0)	8 (27.6)	101 (30.2)	0.93

Baseline Characteristics (CK-MB)

	All patients (N=363)	CK-MB \geq 5 x URL (N=29)	CK-MB<5 x URL (N=334)	P value
Previous CVA	41 (11.3)	3 (10.3)	38 (11.4)	0.99
Atrial fibrillation	50 (13.8)	2 (6.9)	48 (14.4)	0.40
Peripheral vascular disease	21 (5.8)	1 (3.4)	20 (6.0)	0.88
Chronic kidney disease	106 (29.2)	7 (24.1)	99 (29.6)	0.68
Chronic liver disease	17 (4.7)	1 (3.4)	16 (4.8)	0.99
Chronic pulmonary disease	56 (15.4)	9 (31.0)	47 (14.1)	0.031
Previous CABG	22 (6.1)	3 (10.3)	19 (5.7)	0.55
Bicuspid AV	32 (8.8)	7 (24.1)	25 (7.5)	0.007
LV ejection fraction	59 \pm 11	58 \pm 12	59 \pm 11	0.70
EF<40	28 (7.7)	2 (6.9)	26 (7.8)	0.99
Moderate to Severe Atherosclerosis on aorta	81 (22.3)	9 (31.0)	72 (21.6)	0.35
Peak CK-MB	14.7 \pm 26.3	69.7 \pm 72.0	9.9 \pm 5.3	<0.001
Peak Troponin-I	5.2 \pm 25.5	36.3 \pm 85.0	2.5 \pm 2.3	0.04

Procedural Characteristics (CK-MB)

	All patients (N=363)	CK-MB \geq 5 x URL (N=29)	CK-MB<5 x URL (N=334)	P value
Valve Type				0.002
Core Valve	66 (18.2)	11 (37.9)	55 (16.5)	
Evolut R	49 (13.5)	2 (6.9)	47 (14.1)	
Lotus	5 (1.4)	0 (0.0)	5 (1.5)	
SAPIEN XT	120 (33.1)	14 (48.3)	106 (31.7)	
SAPIEN 3	123 (33.9)	2 (6.9)	121 (36.2)	
Second generation THV	177 (48.8)	4 (13.8)	173 (51.8)	<0.001
Type of expansion				0.17
Balloon-expandable	248 (68.3)	16 (55.2)	232 (69.5)	
Self-expandable	115 (31.7)	13 (44.8)	102 (30.5)	
Valve size	26.0 \pm 2.2	25.8 \pm 2.3	26.0 \pm 2.2	0.67

Peri-procedural MI and Clinical Outcome

	CK-MB \geq 5 x URL (N=29) N (Cumulative incidence, %)	CK-MB<5 x URL (N=334) N (Cumulative incidence, %)	Log-rank P
30-day mortality	6 (20.7)	4 (1.2)	<0.001
30-day stroke	5 (17.2)	9 (2.7)	<0.001
30-day death or stroke	10 (34.5)	12 (3.6)	<0.001
1-year mortality	7 (24.5)	23 (7.9)	<0.001
1-year stroke	5 (19.0)	16 (5.4)	0.002
1-year death or stroke	10 (34.5)	36 (12.2)	<0.001

Peri-procedural MI and Clinical Outcome

	Troponin \geq 15 x URL (N=318) N (Cumulative incidence, %)	Troponin<15 x URL (N=45) N (Cumulative incidence, %)	Log-rank P
30-day mortality	10 (3.1)	0 (0.0)	0.23
30-day stroke	13 (4.1)	1 (2.2)	0.55
30-day death or stroke	21 (6.6)	1 (2.2)	0.26
1-year mortality	26 (9.1)	4 (9.4)	0.99
1-year stroke	19 (6.5)	2 (5.2)	0.63
1-year death or stroke	40 (13.7)	6 (14.3)	0.95

Peri-procedural MI and 30-day All-cause Death



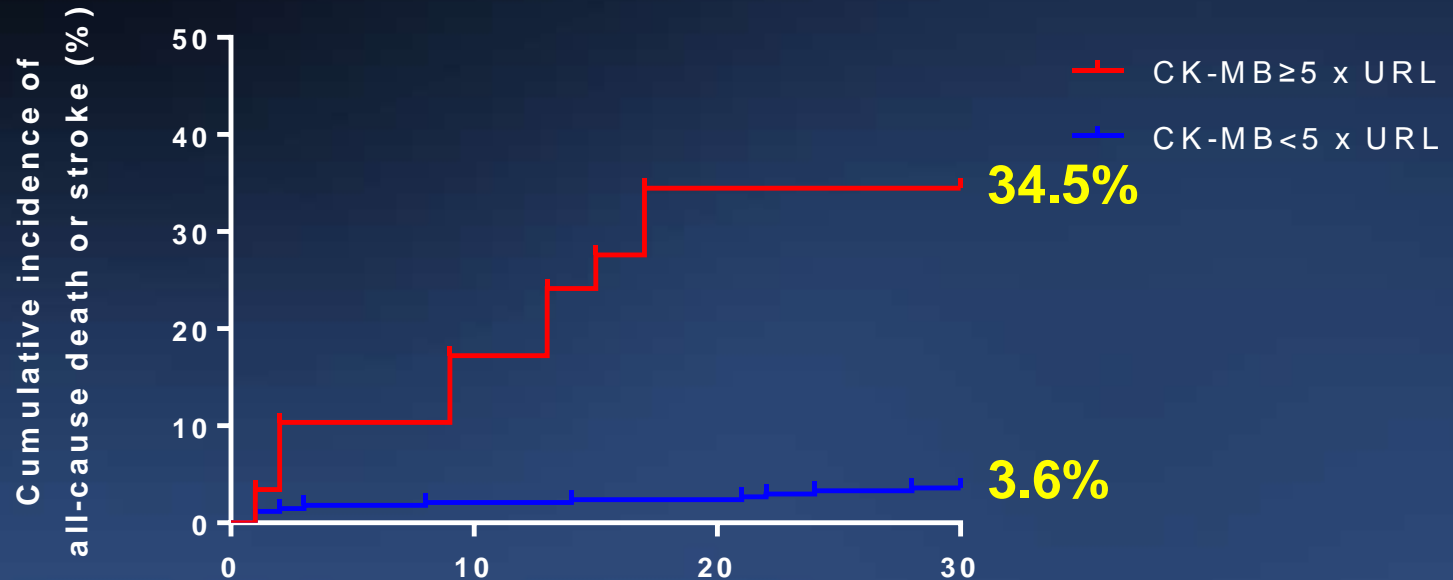
Log-rank $P < 0.001$

No. of at risk

	0	10	20	30
CK-MB \geq 5 x URL	29	27	24	23
CK-MB < 5 x URL	334	334	334	330

Peri-procedural MI and 30-day All-cause Death or Stroke

(C)



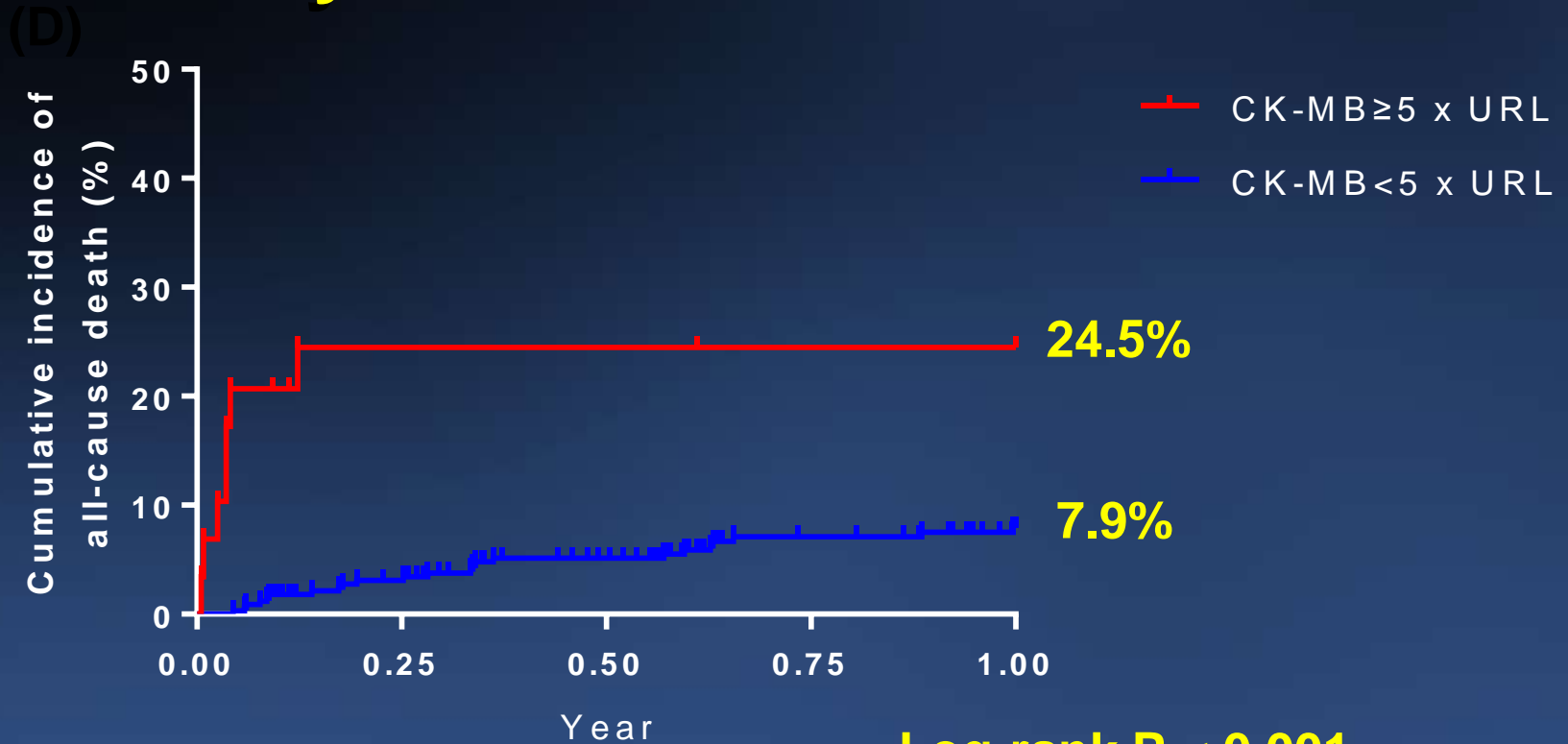
Log-rank P < 0.001

No. of at risk

Days

CK-MB $\geq 5 \times$ URL	29	26	21	19
CK-MB $< 5 \times$ URL	334	328	327	322

Peri-procedural MI and 1-year All-cause Death



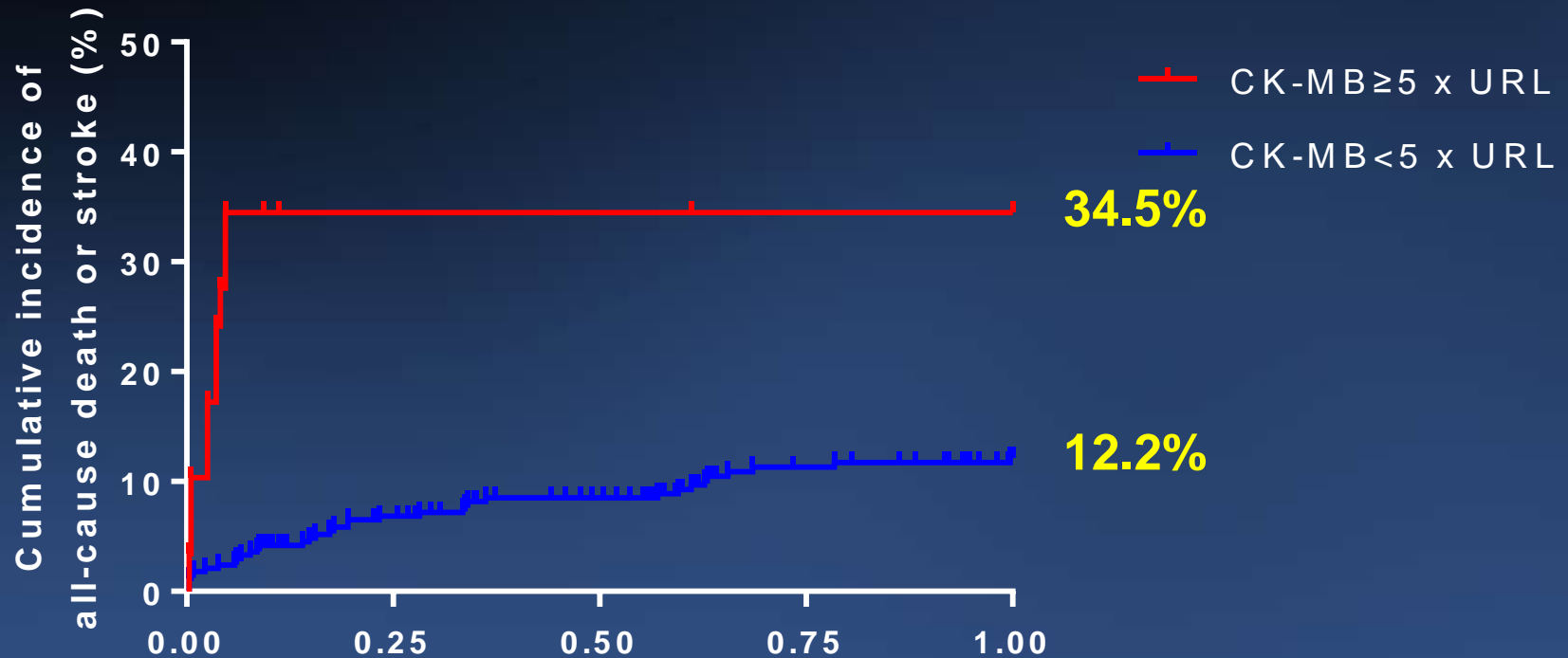
Log-rank P < 0.001

No. of at risk

CK-MB $\geq 5 \times$ URL	29	21	21	20	19
CK-MB $< 5 \times$ URL	334	293	272	228	212

Peri-procedural MI and 1-year All-cause Death or Stroke

(F)



Log-rank P < 0.001

No. of at risk

	0.00	0.25	0.50	0.75	1.00
CK-MB $\geq 5 \times$ URL	29	18	18	17	16
CK-MB $< 5 \times$ URL	334	281	262	216	200

Adjusted HR of Peri-procedural MI (CK-MB) on Clinical Outcomes

	Univariate HR (95% CI)	P value	Multivariate HR* (95% CI)	P value
30-day mortality	19.93 (5.62-70.71)	<0.001	25.82 (5.84-114.14)	<0.001
30-day stroke	6.69 (2.24-19.97)	<0.001	5.84 (1.80-18.96)	0.003
30-day death or stroke	11.21 (4.83-26.01)	<0.001	10.90 (4.31-27.59)	<0.001
1-year mortality	4.09 (1.76-9.55)	0.001	5.77 (2.24-14.87)	<0.001
1-year stroke	4.24 (1.55-11.59)	0.005	3.78 (1.30-11.02)	0.02
1-year death or stroke	4.00 (1.98-8.06)	<0.001	4.54 (2.12-9.72)	<0.001

*Multivariate model was adjusted by year of index procedure, chronic kidney disease, second THV, mode of anesthesia, and moderate to severe atherosclerosis on aorta

Predictors of Peri-procedural MI (CK-MB)

	Univariate OR (95% CI)	P value	Multivariate OR (95% CI)	P value
Congestive heart failure	2.79 (1.25-6.21)	0.01	2.60 (1.05-6.43)	0.04
Chronic pulmonary disease	2.75 (1.18-6.40)	0.02	2.66 (1.06-6.71)	0.04
Bicuspid AV	3.93 (1.53-10.10)	0.004	5.82 (2.03-16.70)	0.001
Second generation THV	0.15 (0.05-0.44)	0.001	0.22 (0.07-0.70)	0.01
Trans-apical approach	6.52 (1.84-23.15)	0.004	7.40 (1.83-29.93)	0.005
General anesthesia	5.35 (1.99-14.35)	0.001		

Summary: Peri-MI after TAVR

- Periprocedural MI according to CK-MB level was associated with poor short-term and long-term outcome.
- However, the incidence of periprocedural MI has substantially decreased with evolvement of TAVR devices.
- Because highly sensitive Troponin-I assay is too sensitive to define periprocedural MI and periprocedural MI according to Troponin-I level was not associated with short-term and long-term clinical outcome.