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# Plaque Erosion

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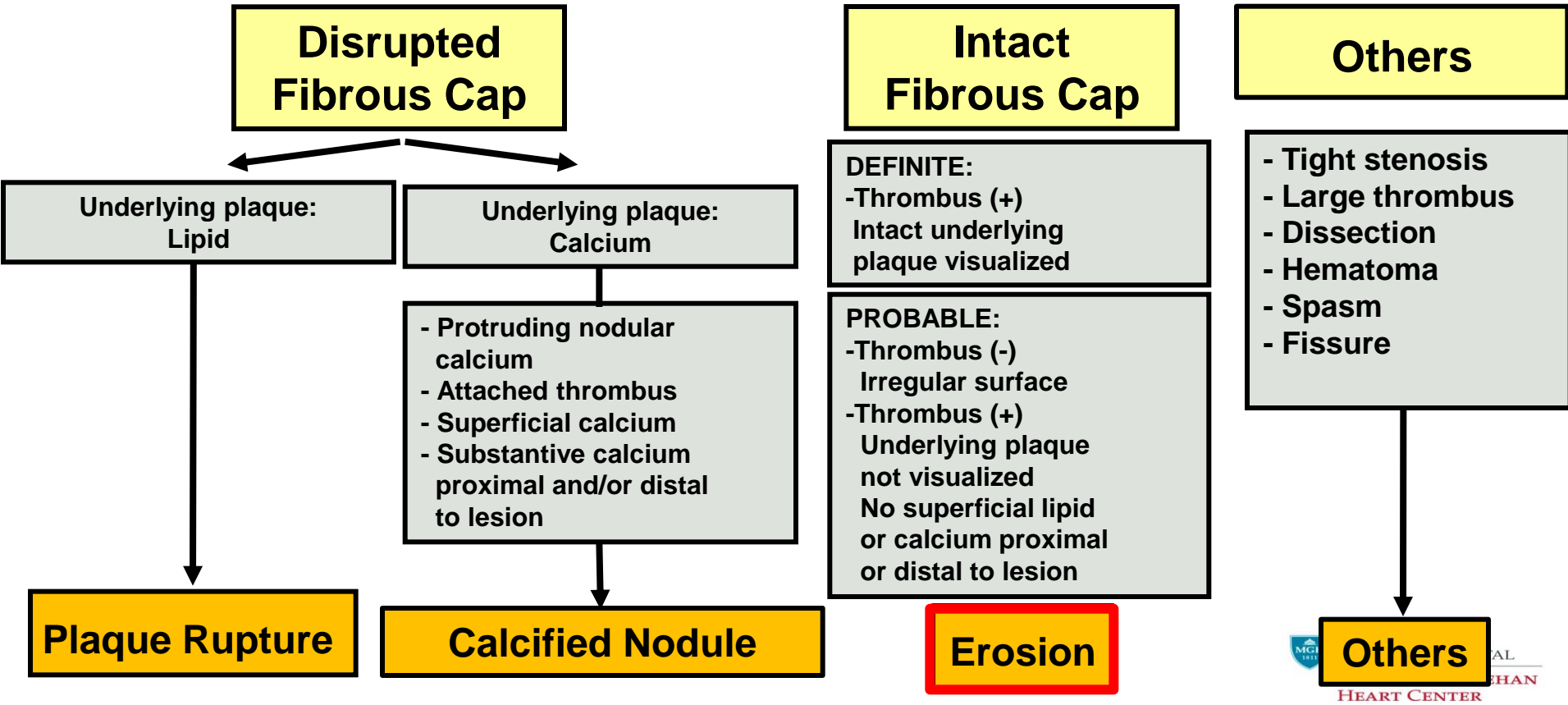
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# Pathology Studies

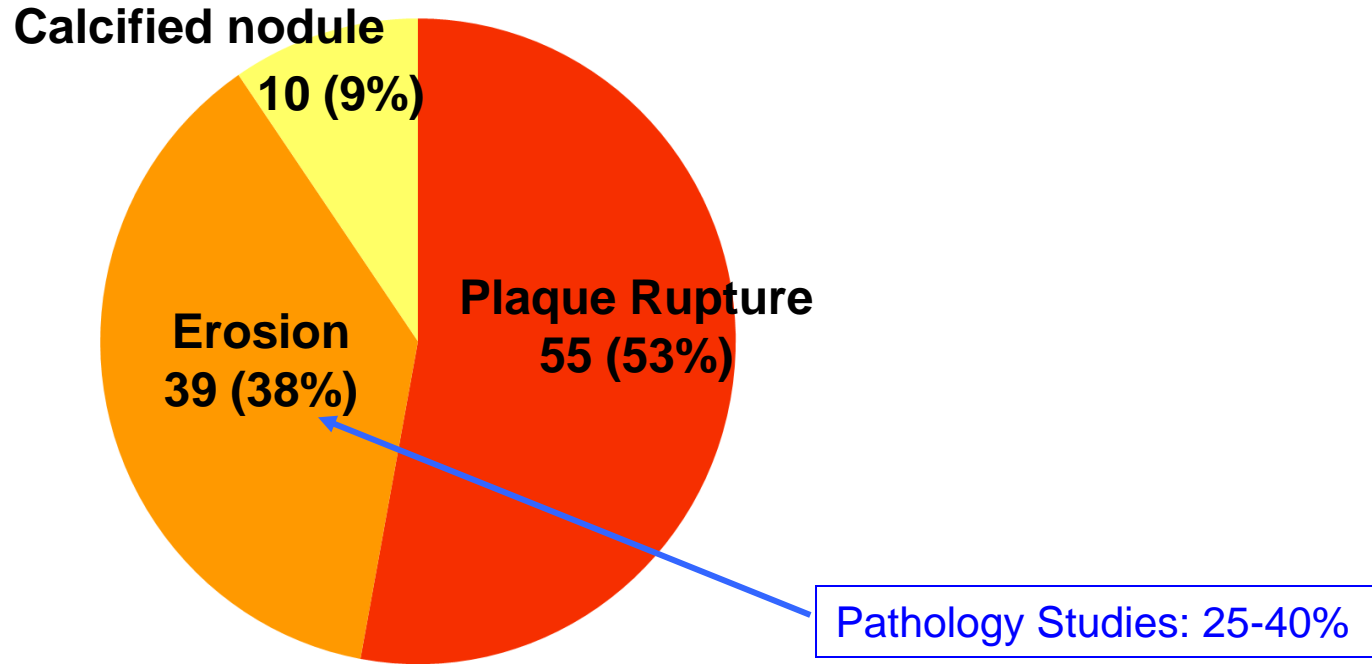
Study	Number of cases	Female	Average age (years)	Rupture (%)	Erosion (%)
<i>van der Wal et al.</i>	20 thrombus	n/r	63	60	40
<i>Farb et al.</i>	96 SCD/50 thrombus	32%	Rupture: 53	56	44
			Erosion: 44		
<i>Burke et al.</i>	113 SCD/59 thrombus	0%	50	69	31
<i>Burke et al.</i>	51 SCD/26 thrombus	100%	Rupture: 58	31	69
			Erosion: 45		
<i>Arbustini et al.</i>					25
<i>Kolodgie et al.</i>		26% (Stable)	Stable: 47		41
<i>Burke et al.</i>	457 SCD/224 thrombus	n/r	n/r	69	31
<i>Sato et al.</i>	31 MI/23 thrombus	13%	Rupture: 70	78	22
			Erosion: 68		
<i>Schwartz et al.</i>	44 SCD	14%	51	57	43
<i>Kramer et al.</i>	345 SCD/181 thrombus	11% (Rupture) 26% (Erosion)	Rupture: 52	71	29
			Erosion: 43		
<i>Tavora et al.</i>	314 SCD/170 thrombus	19%	≈50	70	30

**Plaque Erosion: 25-40%**

# OCT Plaque Classification

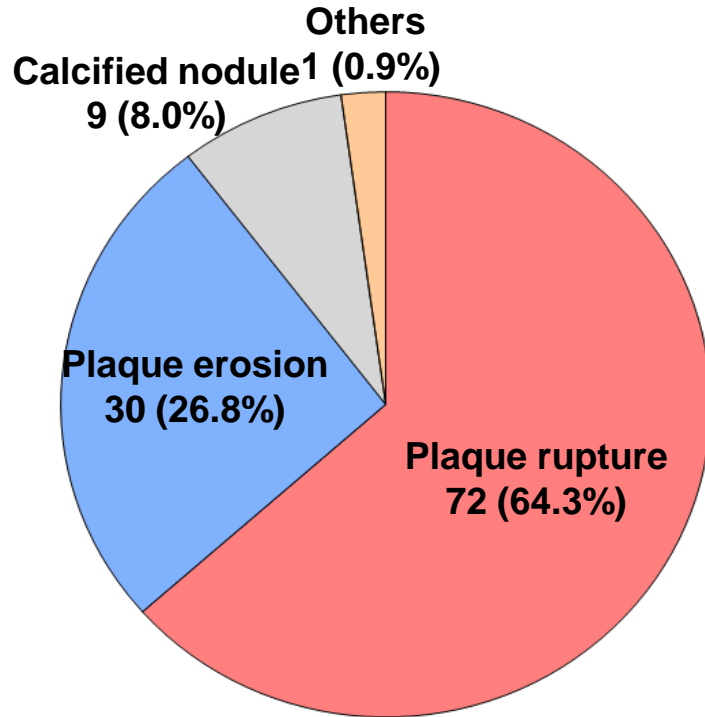


# Incidence of Rupture, Erosion, and Calcified nodule in ACS



**n = 104**

# Underlying Pathology of STEMI



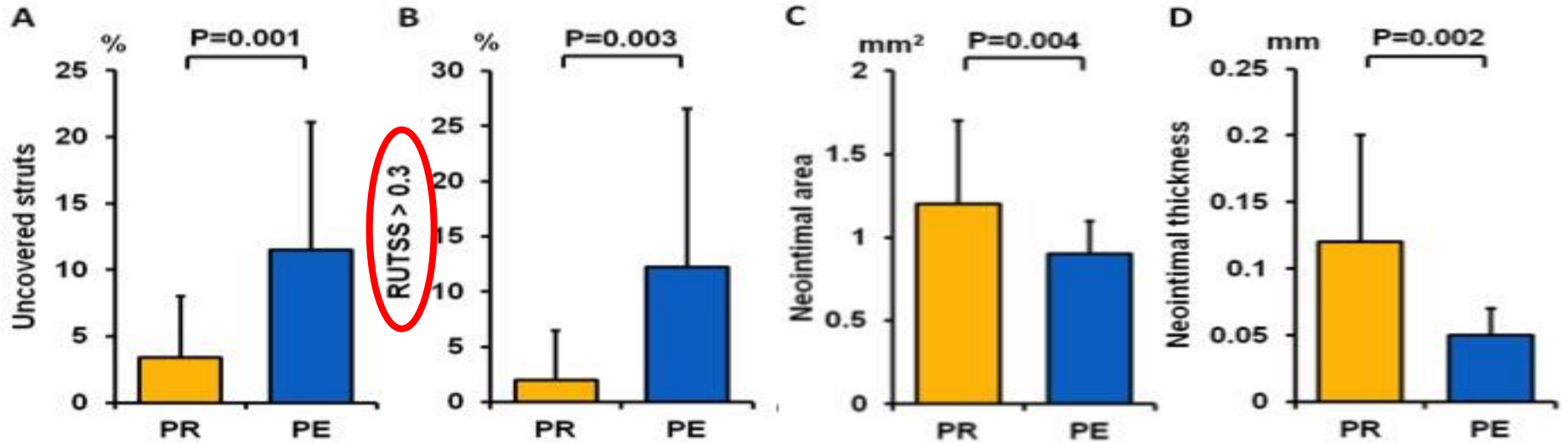
Higuma, Jang. JACC Intv 2015

Total 112 STEMI

# Conclusions

1. The prevalence of erosion was 26.8% in STEMI.
2. Erosion was associated with lower degree of plaque vulnerability (OCT).
3. Erosion had more eccentric plaques with more constrictive remodeling (IVUS).
4. Erosion had better acute outcome after PCI in patients with STEMI.

# OCT findings at 6 months



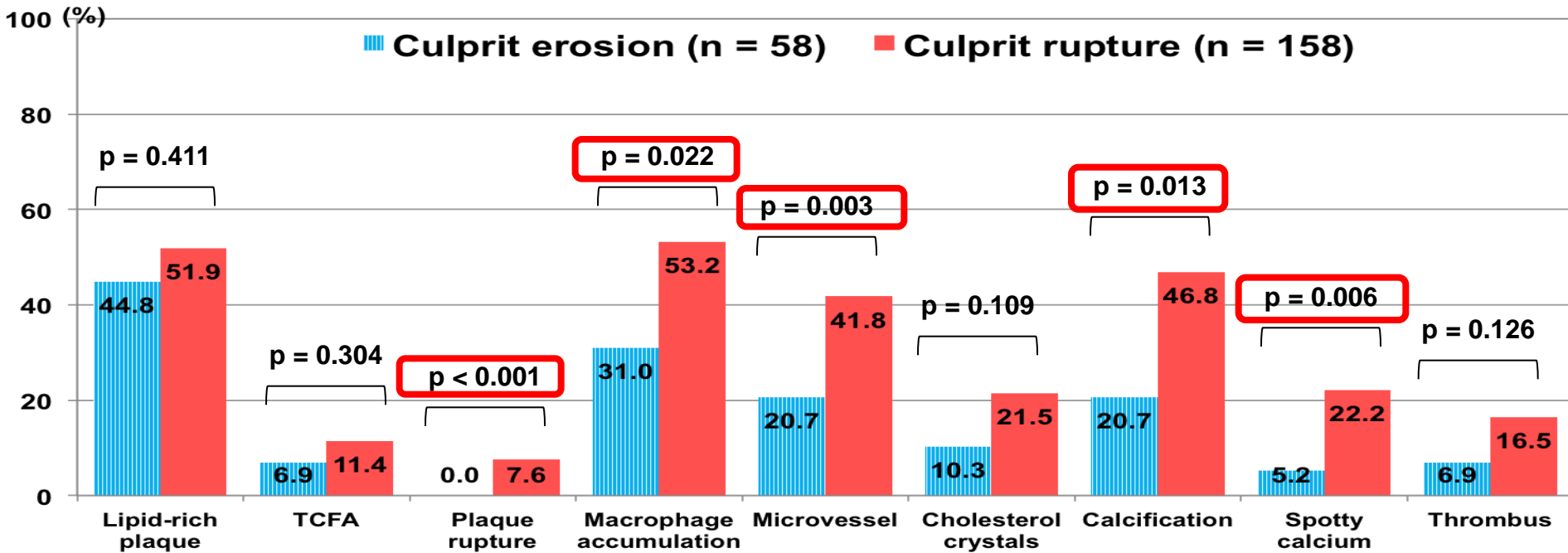
Hu, Jang. CCI 2017

# Predictors for RUTTS>30%

	Univariate Models			Multivariate Models		
	OR	95%CI	<i>p</i>	OR	95%CI	<i>p</i>
Stent length	0.95	0.86-1.06	0.395			
Plaque erosion	7.5	1.87-30.16	0.005	6.92	1.37-37.78	0.025
Thrombus score	0.68	0.96-1.003	0.096	0.99	0.97-1.02	0.579
Intrastent thrombus volume	0.72	0.44-1.18	0.194			
Diabetes mellitus	1.30	0.39-4.33	0.669			
Current smoking						
Hs-CRP	0.99	0.84-1.17	0.912			
Statin	1.81	0.15-21.54	0.639			
ACEI/ARB	0.94	0.28-3.14	0.920			



# Non-culprit plaque characteristics (plaque-based)



Sugiyama, Jang. *JAMA Cardiol* 2018

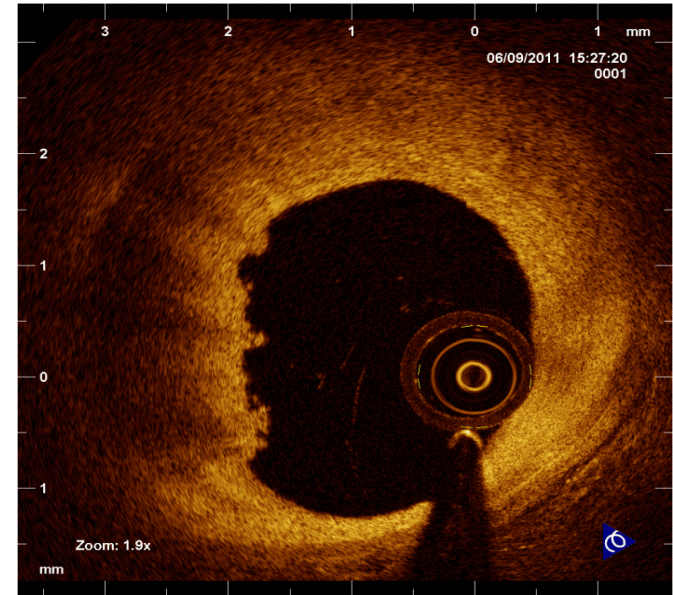
# Clinical Presentations of Plaque Erosion

	STEMI (%)	NSTE-ACS/UAP (%)
Jia et al.	38.5	61.5
Niccoli et al.	29.8	70.2
Yonetsu et al.	16	84
Kwon et al.	35	65

*Partida, Libby, Crea, Jang. EHJ 2018*

# Erosion (vs. Rupture)

1. Larger lumen CSA
2. Preserved vascular integrity
3. Platelet-rich thrombus





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# Effective Anti-thrombotic Therapy without Stenting: Intravascular OCT-based Management in Plaque Erosion (the EROSION study)

*Eur Heart J* 2017



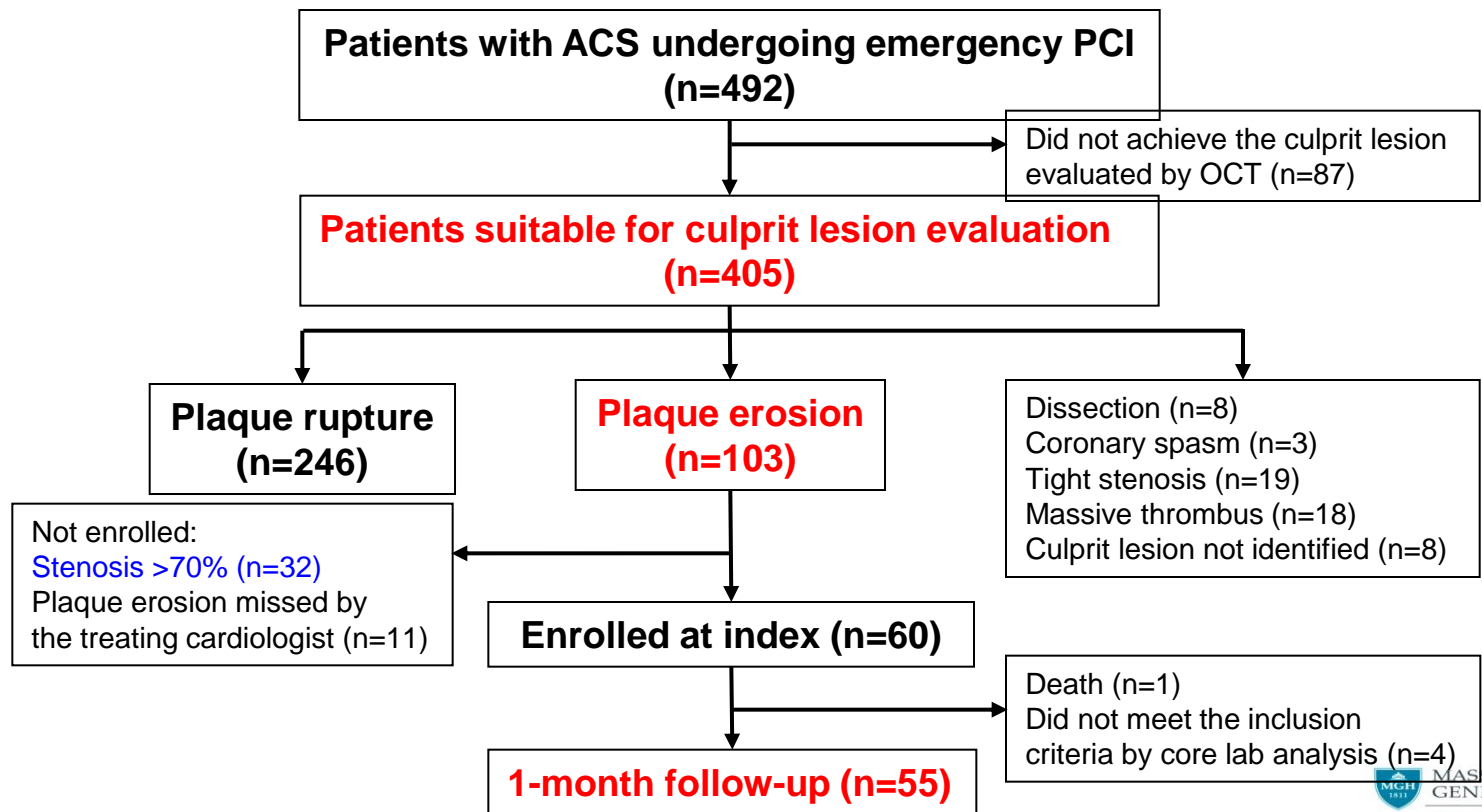
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# Hypothesis

- Patients with plaque erosion may be stabilized by effective anti-thrombotic treatment without stent implantation.

# Study Flowchart

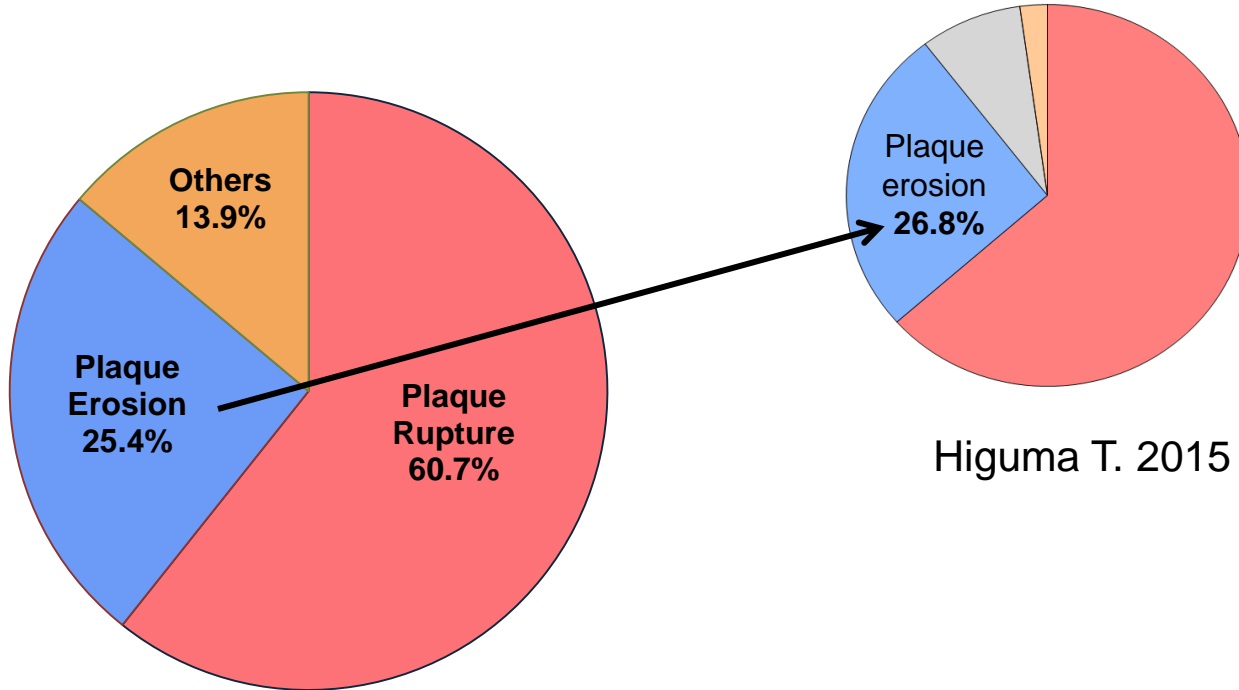


# Baseline Characteristics

Variables	Completers (n=55)
Age, years	52.4 ± 10.4
Male	48 (87.3)
Smoking	41 (74.5)
Diabetes mellitus	7 (12.7)
Hypertension	17 (30.9)
Prior-MI	2 (3.6)
Prior-PCI	2 (3.6)
<b>Presentation</b>	
STEMI	53 (96.4)
NSTEMACS	2 (3.6)
<b>Laboratory data</b>	
LDL-C, mg/dl	110.2 ± 38.5
hs-CRP, mg/l	7.3 (2.9, 12.0)
TnI, µg/l	1.6 (0.1, 11.0)
<b>Procedure characteristics</b>	
Manual thrombectomy	46 (83.6)
Glycoprotein IIb/IIIa inhibitor	35 (63.6)
DAPT to procedure, min	44 (28, 78)
Symptom onset to OCT, h	4.8 (3.3, 9.0)
Aspirin	55 (100.0)
Ticagrelor	55 (100.0)
Statins	55 (100.0)
Beta-blockers	32 (58.2)
ACE inhibitors or ARB	38 (69.1)



# Prevalence of Plaque Erosion



Higuma T. 2015

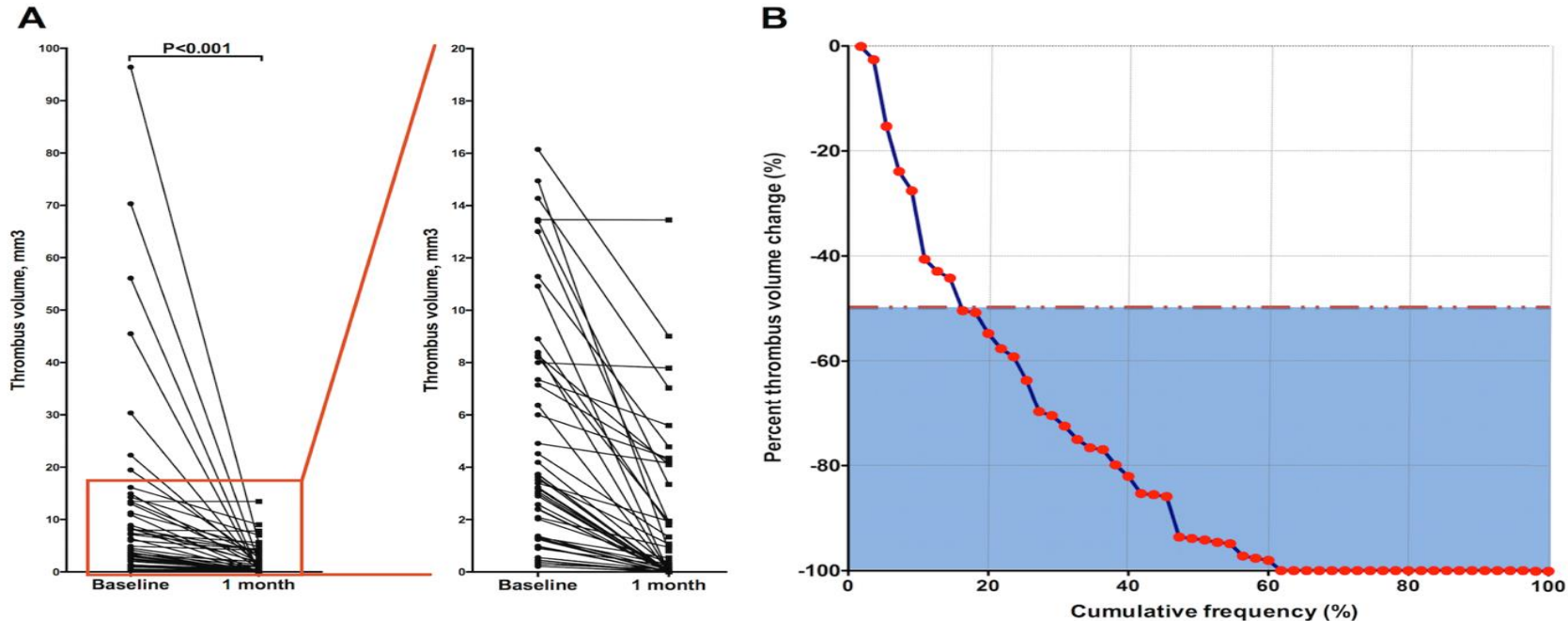


# OCT Analysis

Variables	Baseline (n=60)	Follow-up (n=55)	Percent change (%)	P
<b>Thrombus type</b>				<0.001
White	44 (73.3)	29 (52.7)		
Red	16 (26.7)	4 (7.3)		
No thrombus	0 (0.0)	22 (40.0)		
<b>Thrombus volume, mm<sup>3</sup></b>				
<b>Median (IQR)</b>	<b>3.7 (1.3, 10.9)</b>	<b>0.2 (0.0, 2.0)</b>	<b>-94.2 (-100.0, -63.7)</b>	<b>&lt;0.001</b>
<b>Mean (SD)</b>	<b>10.0 (17.4)</b>	<b>1.7 (2.8)</b>	<b>-79.2 (27.7)</b>	<b>&lt;0.001</b>
<b>Thrombus burden, %</b>				
Median (IQR)	16.0 (8.9, 21.5)	2.9 (0.0, 9.2)	-85.4 (-100.0, -9.0)	<0.001
Mean (SD)	16.8 (11.4)	6.4 (9.0)	-58.2 (48.3)	<0.001
<b>Mean thrombus area, mm<sup>2</sup></b>				
Median (IQR)	0.5 (0.3, 1.0)	0.2 (0.0, 0.5)	-82.5 (-100.0, -14.2)	<0.001
Mean (SD)	0.8 (0.9)	0.3 (0.4)	-57.2 (48.5)	<0.001
<b>Max thrombus area, mm<sup>2</sup></b>				
Median (IQR)	1.0 (0.6, 2.2)	0.3 (0.0, 1.0)	-83.8 (-100.0, -25.0)	<0.001
Mean (SD)	1.7 (1.8)	0.6 (0.8)	-61.0 (44.9)	<0.001
<b>Thrombus length, mm</b>				
Median (IQR)	7.7 (5.4, 12.8)	1.5 (0.0, 4.9)	-79.7 (-100.0, -54.8)	<0.001
Mean (SD)	9.1 (5.4)	3.2 (4.5)	-70.8 (33.4)	<0.001
<b>Thrombus score</b>				
Median (IQR)	53 (37, 88)	7 (0, 27)	-87.5 (-100.0, -60.0)	<0.001
Mean (SD)	66 (49)	18 (24)	-75.8 (30.8)	<0.001
<b>Minimal flow area, mm<sup>2</sup></b>				
<b>Median (IQR)</b>	<b>1.7 (1.4, 2.4)</b>	<b>2.1 (1.5, 3.8)</b>	<b>15.0 (-8.6, 40.5)</b>	<b>0.002</b>
<b>Mean (SD)</b>	<b>2.3 (1.9)</b>	<b>2.9 (2.2)</b>	<b>27.4 (56.4)</b>	<b>0.001</b>

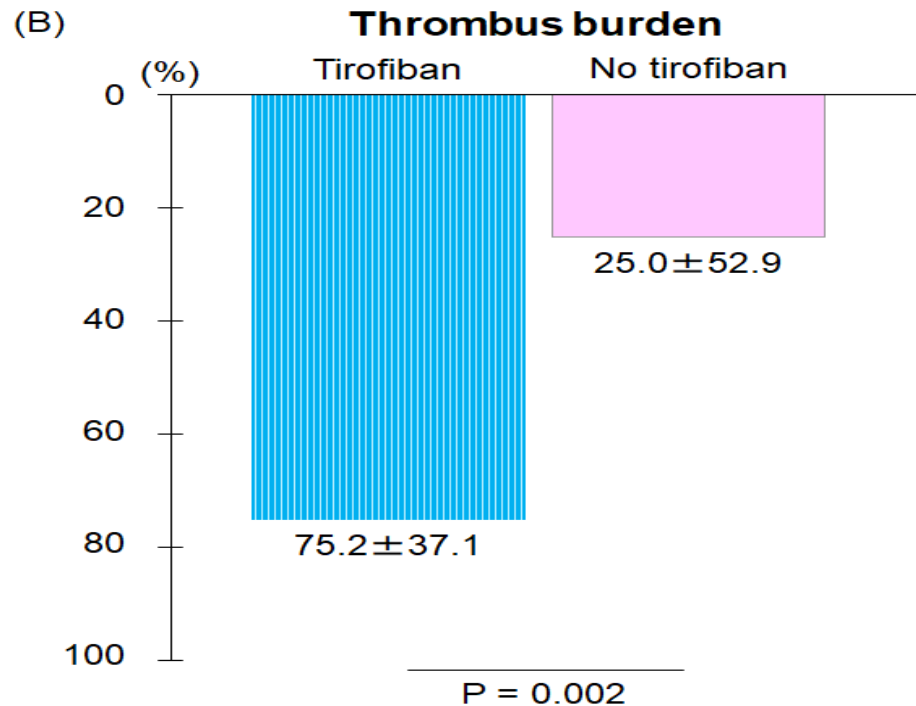
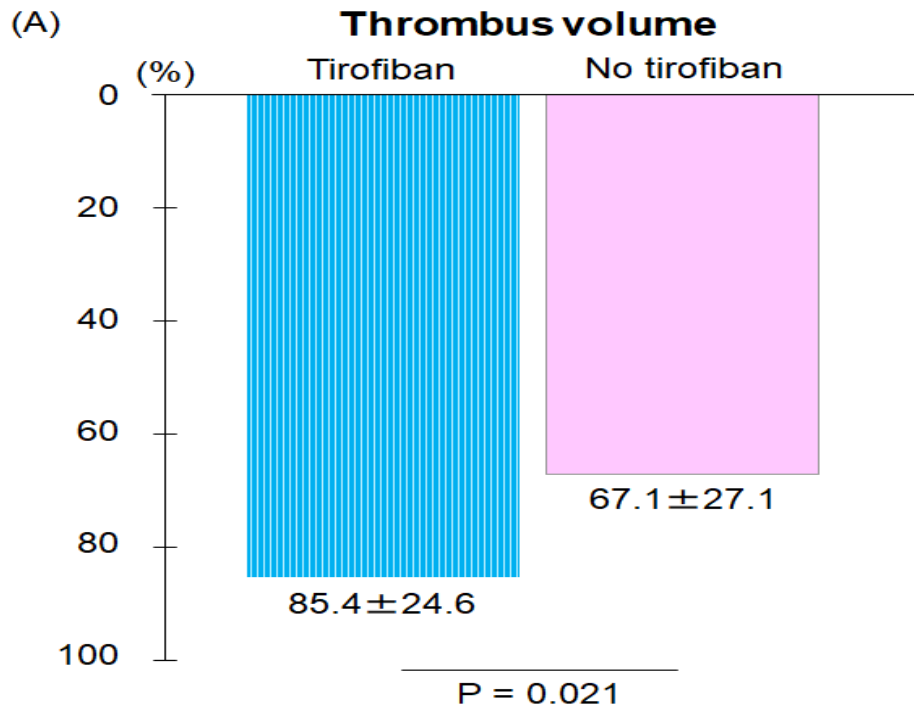


# Change in Thrombus Volume

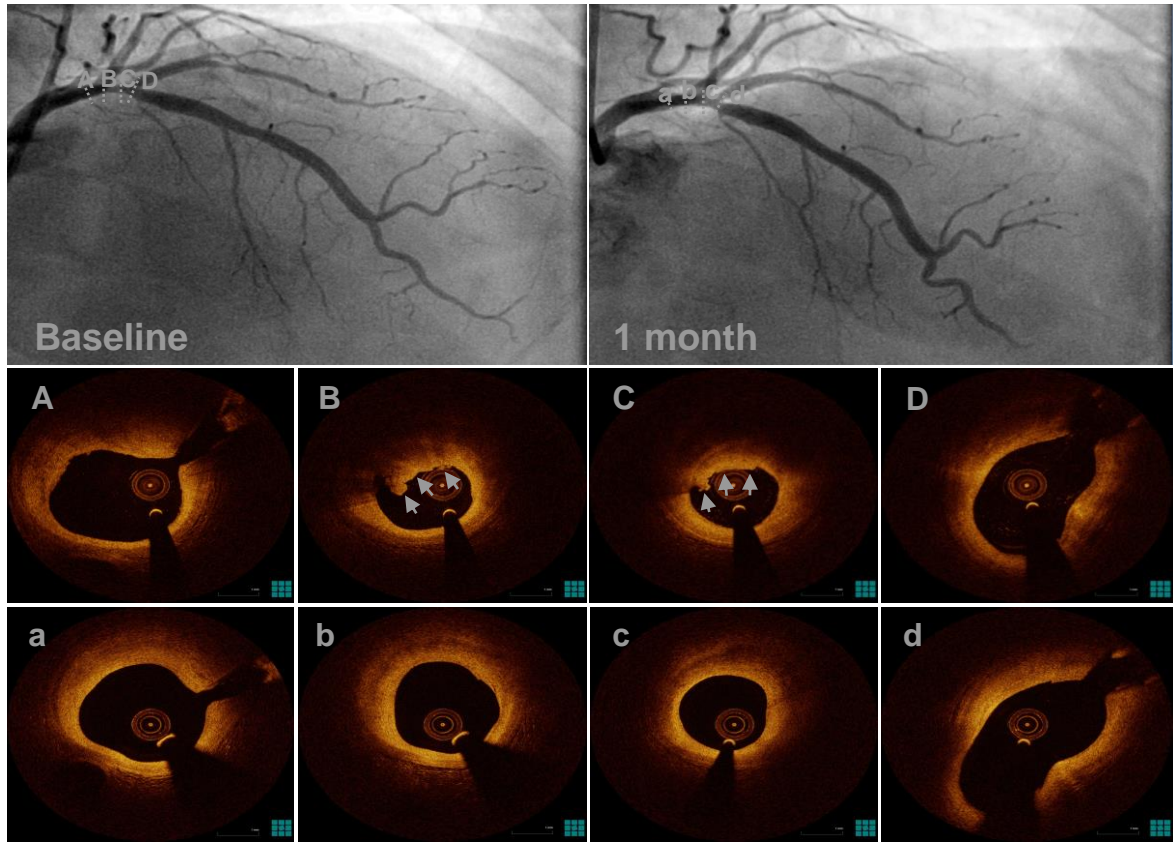


(A) Absolute change of thrombus volume from baseline to 1 month. (B) Cumulative distribution curves of percent thrombus volume reduction in all 55 patients. **Forty-seven (47/55, 85%)** patients met the primary endpoint (blue area) and **twenty-two (22/55, 40%)** patients had **no** residual thrombus at 1 month (100.0% reduction).

# GP IIb/IIIa inhibitor



# Representative Case



A 65-year-old man presented with STEMI. Baseline angiogram (upper left) shows a 55% stenosis in the proximal LAD. Serial OCT images of the culprit lesion demonstrate plaque erosion with white thrombus (arrows). One month F/U angiogram (upper right) shows a 45% stenosis, and serial OCT images (a-d) show no visible thrombus overlying a fibrous plaque. The minimal flow area increased from 2.4mm<sup>2</sup> to 4.0mm<sup>2</sup>.



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# The EROSION study: A 1-Year Follow Up

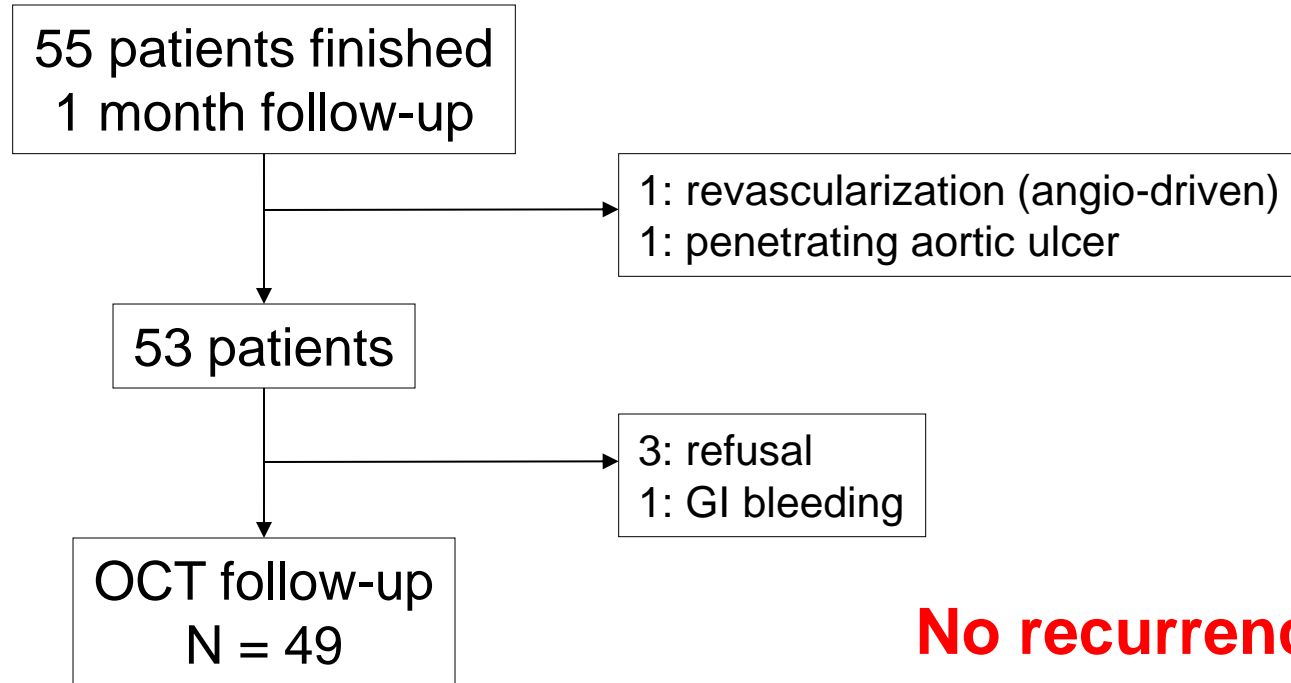
*Xing, Jang. Circ Intv 2017*



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# Study flow diagram



**No recurrence !**

# Summary

- Erosion is responsible for 25-38% of ACS (more frequent in NSTEMI).
- Erosion is associated with lower degree of panvascular instability.
- Vascular healing after DES is impaired in erosion.
- Conservative management with aspirin and ticagrelor may be an option for patients with ACS caused by erosion.

# Collaborators

## **Registry**

20 sites

## **MIT**

James Fujimoto, PhD

## **Mt. Sinai**

Valentin Fuster, MD, PhD

## **BWH**

Peter Libby, MD

## **TMDU, Japan**

Taishi Yonetsu, MD

## **Nara Medical Univ. Japan**

Tsunenari Soeda, MD, PhD

## **Hirosaki Univ. Japan**

Takumi Higuma, MD, PhD

## **Leuven Univ. Belgium**

Tom Adriaenssens, MD, PhD

## **Univ. of Melbourne, Australia**

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Andrew Ooi, PhD

## **Catholic Univ. Italy**

Filippo Crea, MD

Luigi Biasucci, MD, PhD



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