

Coronary OCT and Cardiac MRI to Determine Underlying Causes of MINOCA in Women

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on behalf of the HARP Investigators:

AHA SFRN Funded Research

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Women's Cardiovascular Research

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Myocardial infarction with non-obstructive coronary arteries (MINOCA)

- **MINOCA defined as:**
 - MI meeting the universal definition
 - < 50% stenosis in all major epicardial arteries on angiography
 - Normal appearance or mild-moderate atherosclerosis
 - No specific alternate diagnosis for the clinical presentation (e.g., PE, sepsis, myocarditis)
- Occurs in 6-15% of MI, disproportionately affects women
- 4-year rate of MACE: 24%, 5-year mortality: 11%
- Pathogenesis is varied, leading to uncertainty about treatment



AHA Go Red for Women Strategically Focused Research Network Sarah Ross Soter Center for Women's Cardiovascular Research **Women's Heart Attack Research Program (HARP)**

Objectives - to determine frequency of:

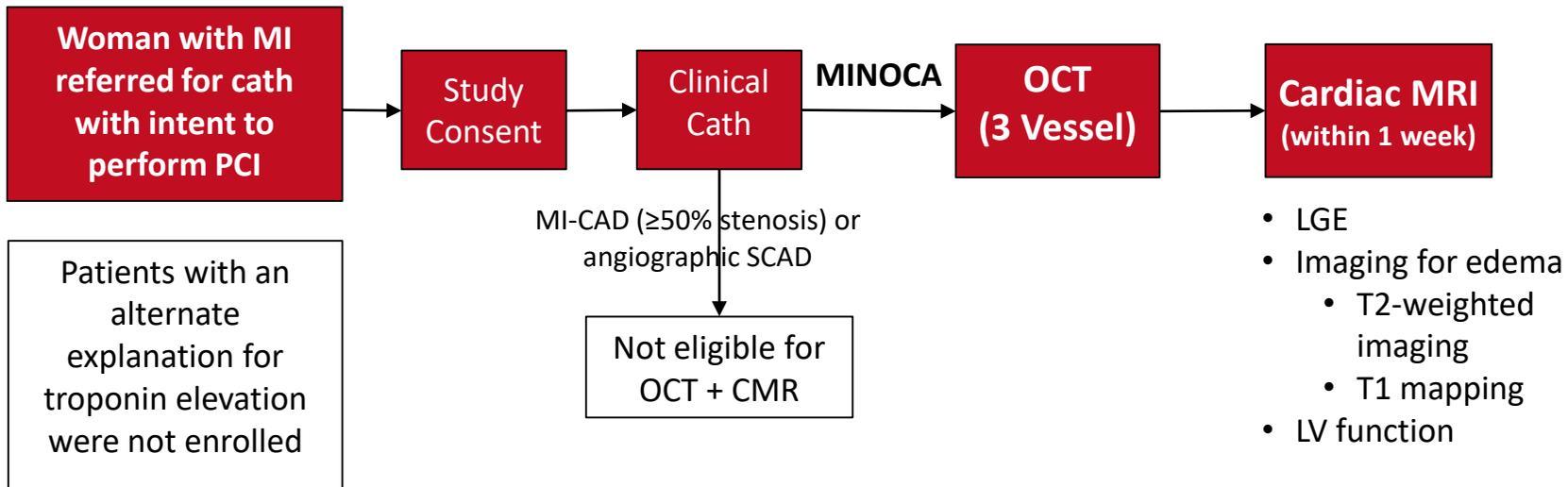
- Vascular causes of MINOCA on optical coherence tomography (OCT)
- Myocardial abnormalities on cardiac MRI (CMR) - ischemic or non-ischemic
- Various underlying etiologies identified based on OCT + CMR

Core laboratories blinded to detailed clinical information, results of other imaging tests.

OCT Core Lab
Dr. Akiko Maehara,
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CMR Core Lab
Dr. Raymond Kwong,
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Angiography Core Lab
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Demographics and Presentation

301 women with clinical diagnosis of MI, 16 sites ⇨ 170 MINOCA ⇨ ²³ OCT contraindications, 2 not interpretable ⇨ 145 OCT ⇨ 116 CMR

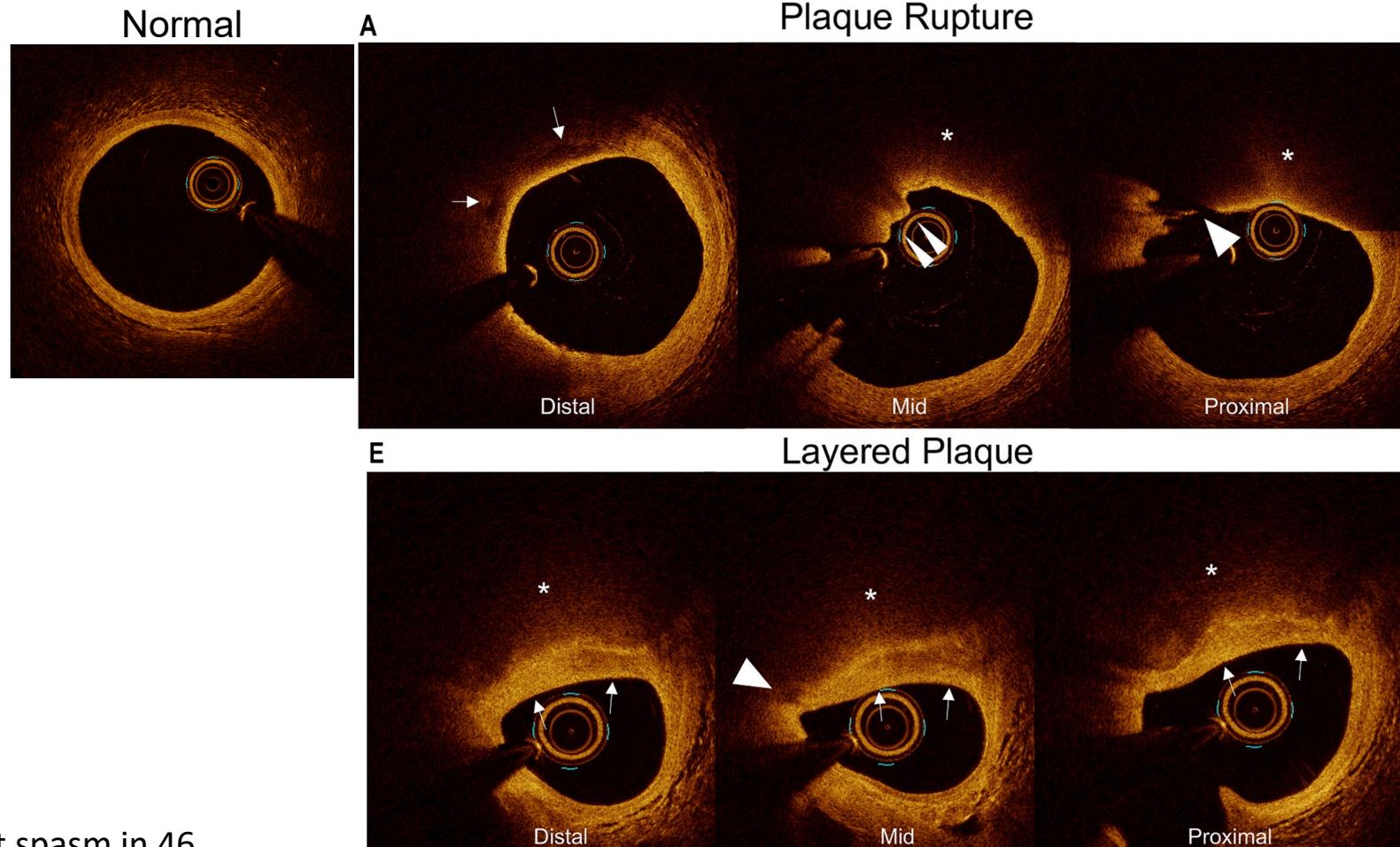
Demographics and History	Women with MINOCA (n=145)	MI Presentation	Women with MINOCA (n=145)
Age, years (median, IQR)	60 [52, 69]	Peak troponin, median (IQR)	0.94 ng/mL [0.34, 4.38]
Race/ethnicity other than white, non-Hispanic, %	50%	Peak troponin as multiple of local upper limit of normal, median (IQR)	17 x ULN [7x, 61x]
Hypertension, %	46%	STEMI presentation	3.5%
Diabetes mellitus, %	16%	Segmental wall motion abnormality on echocardiogram (N=111)	44%
		Coronary angiogram reported as normal by site	54%
		Maximal % stenosis by core laboratory, median (IQR)	30% [26%, 37%]

OCT Findings

OCT N=145

Culprit Lesion n=67 (46%)

Plaque Rupture	n=8 (6%)
Thrombus without plaque rupture	n=5 (3%)
Intra-Plaque Cavity	n=31 (21%)
Layered Plaque	n=19 (13%)
Intimal Bump (Spasm)	n=3 (2%)
SCAD	n=1 (1%)



No major complications of OCT; transient spasm in 46

Multivariable analysis: culprit associated with age, abnormal angiography per site, diabetes, but not troponin or angiographic stenosis severity per core laboratory

CMR Findings (N=116)

Infarction n=38 (33%)

Regional Injury n=24 (21%)

Non-Ischemic n=24 (21%)

Myocarditis n=17 (15%)

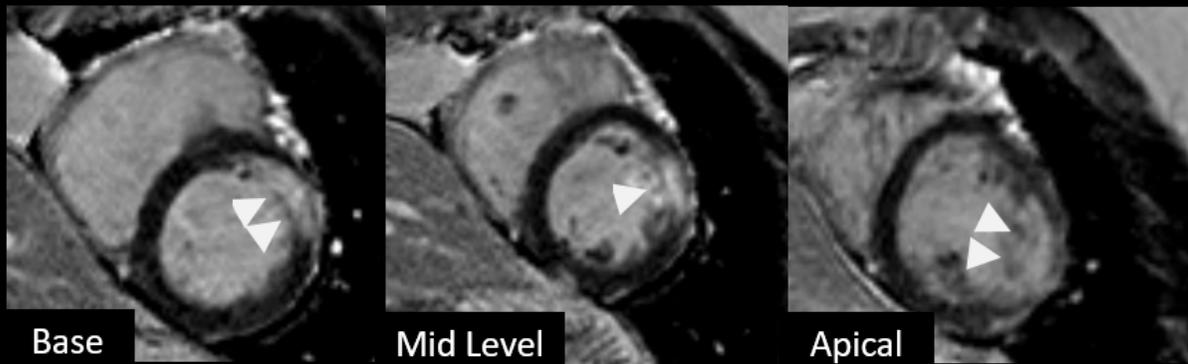
Takotsubo Syndrome n=4 (3%)

Other Cardiomyopathy n=3 (3%)

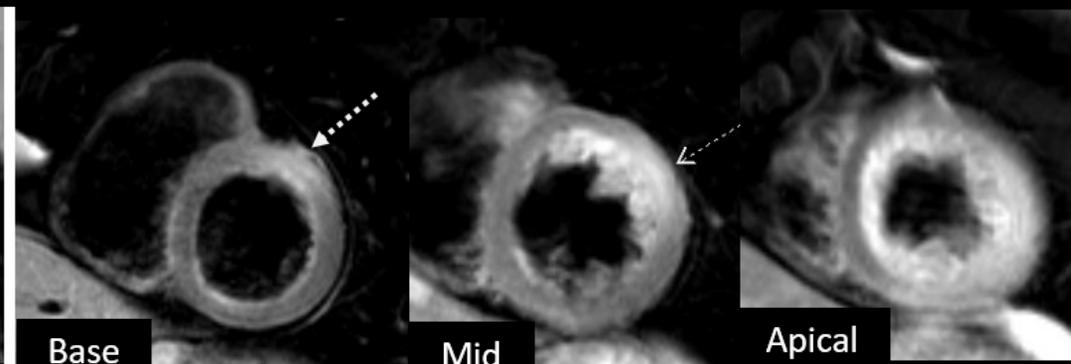
Normal
n=30 (26%)

Myocardial Infarction

Late Gadolinium Enhanced Imaging



T2-Weighted Imaging



Subendocardial to Transmural Late Gadolinium Enhancement with T2 Signal Hyperintensity indicating Acute MI

Multivariable analysis: abnormal CMR associated with higher peak troponin, creatinine and diastolic BP but not OCT culprit lesion or angiographic stenosis severity

No troponin threshold below which abnormal CMR unlikely



Integration of OCT and CMR N=116

Cause Identified n=98 (85%)

Myocardial infarction n=74 (64%)

Myocarditis n=17 (15%)

Takotsubo Syndrome n=4 (3%)

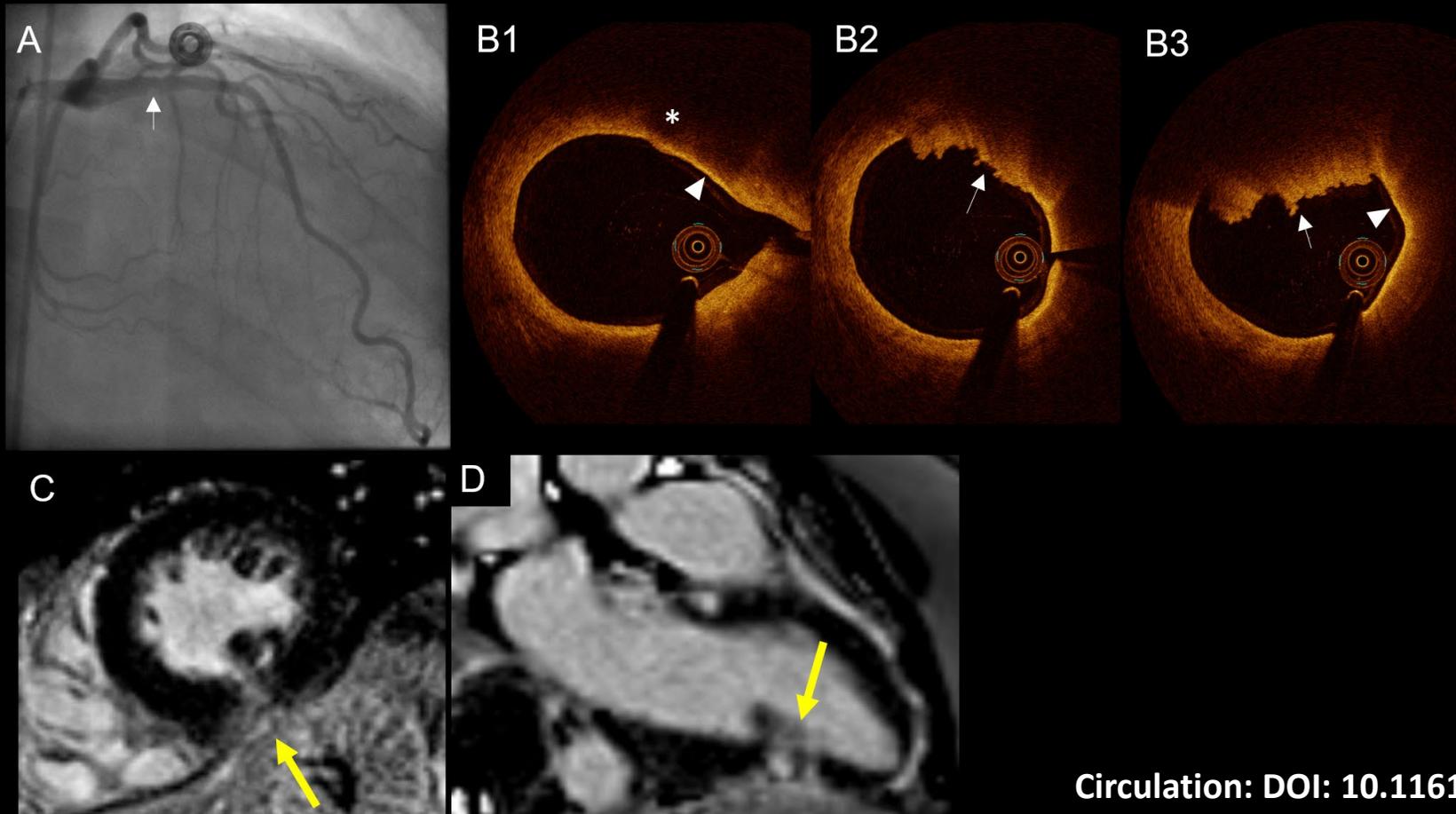
Non-Ischemic Cardiomyopathy n=3 (3%)

No cause identified n=18 (15%)

- OCT culprit → CMR evidence of infarction or regional ischemic injury in 69%
- Ischemic CMR findings (LGE or regional injury) → 44% no OCT culprit
 - Suspect coronary artery spasm, thromboembolism (or missed culprit lesion)
- Multi-modality imaging (OCT+CMR) → 85% with cause identified
 - OCT alone: 46% (p<0.001)
 - CMR alone: 74% (p=0.001)

44-year-old woman with no CAD risk factors, chest pain and heavy menstrual bleeding, hemoglobin 7, peak troponin 3.25 ng/mL

LAD Plaque Rupture in Thin Cap Fibroatheroma Causing Small, Transmural Infarction at the Terminus of the LAD





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Limitations

- Relatively small sample size, very few STEMI cases
- Myocardial edema in a single coronary territory considered to be evidence of ischemic injury, but regional myocarditis cannot be excluded
- No spasm testing, No control group, not all women had 3-vessel OCT and CMR
- Limited to women



- **Multi-modality imaging (OCT + CMR) abnormal in 85% of women with MINOCA**
- OCT and CMR provided useful diagnostic information, independently and in combination
- CMR findings correlated well with OCT culprit lesions, demonstrating that non-obstructive culprit lesions frequently cause MINOCA
- Coronary artery spasm or thromboembolism likely caused MI/regional ischemic injury in cases without OCT culprit
- Mechanisms of MINOCA in women were often similar to mechanisms of MI-CAD: atherothrombosis with possible contribution of coronary artery spasm
- These findings have implications for secondary prevention treatment after MINOCA

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