Differences in CMRI-Confirmed Cardiac Structure Between Patients with Angina with Non-obstructive Coronary Artery Disease (ANOCA) and Ischemia with Non-obstructive Coronary Artery Disease (INOCA)

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Background

- Around 40% of patients that undergo coronary angiography for stable angina have no evidence of obstructive coronary artery disease (NOCAD)
- Angina without evidence of ischemia on prior stress testing (ANOCA) and with evidence of ischemia on stress imaging (INOCA) are the most common NOCAD conditions
- Ischemia is associated with adverse structural remodeling in the heart, presenting as abnormalities in cardiac architecture, size, and function
- Cardiac magnetic resonance imaging (CMRI) is the gold standard for visualizing cardiac structure, and is critical for evaluating the relatively unstudied remodeling differences between ANOCA and INOCA patients

Purpose

To explore differences in CMRI measures of cardiac structure between patients with angina with no obstructive coronary artery disease (ANOCA) and with ischemia with no obstructive coronary artery disease (INOCA)

Methods

- Prospective cohort study of NOCAD patients (<50% stenosis of epicardial arteries) with a history of a CMRI
- Patients categorized based on prior stress test results (ANOCA v. INOCA)
- Patients' clinical characteristics, self-reported angina, and coronary functional angiography-confirmed CMD diagnosis were also assessed

Results

Table 1. Demographics	**ANOCA (N=96)**	**INOCA (N=81)**	**P-value**
Clinical Characteristics			
Age, mean ± SD	57.3 ± 11.3	59.4 ± 12.6	0.254
Female, N (%)	86 (91)	79 (99)	0.040
Hypertension, N (%)	59 (61)	50 (62)	0.971
Hyperlipidemia, N (%)	84 (88)	76 (94)	0.203
Validated Questionnaire Scores			
CCS Class, N (%)			0.604
1	19 (32)	13 (24)	
2	14 (24)	14 (26)	
3	15 (25)	19 (35)	
4	11 (19)	8 (15)	
[1]SAQ7, median (IQR)	38.5 (16.1, 55.0)	45.8 (30.0, 65.6)	**0.018**
[1]DASI, mean ± SD	34.8 ± 14.6	34.2 ± 13.7	0.821
[2]PSS, median (IQR)	13 (9, 16)	12 (9, 16)	0.431
[2]UCSD SOB, median (IQR)	35 (15, 53)	31 (14, 47)	0.468
CFA Outcomes (N, %)			
Endothelial Dependent CMD	24 (57)	14 (67)	0.466
Endothelial Independent CMD	26 (62)	16 (67)	0.699
Epicardial Spasm	13 (30)	2 (8)	**0.037**

1=Lower score indicates adverse condition; 2=Higher score indicates adverse condition
CCS Class indicates Canadian Cardiovascular Society angina class; SAQ7, Seattle Angina Questionnaire; PSS, Perceived Stress Scale; DASI, Duke Activity Status Index; USCDSOB, University of California, San Diego Shortness of Breath Questionnaire. Proportion data was compared via chi-square, displayed as N, %. Means were compared via t-test and displayed as the group mean, standard deviation (SD). Non-normally distributed data was compared via Wilcoxon-rank sum test, represented as median (interquartile range, IQR).

- The mean ages of the ANOCA and INOCA patients are 57.3 ±11.3 and 59.4±12.6 years, respectively, and INOCA patients are more proportionately female (p=0.04)
- ANOCA patients had a lower median SAQ-7 score (38.5, p=0.018), consistent with more severe angina, and higher proportion of epicardial spasm (30%, p=0.037) than INOCA patients

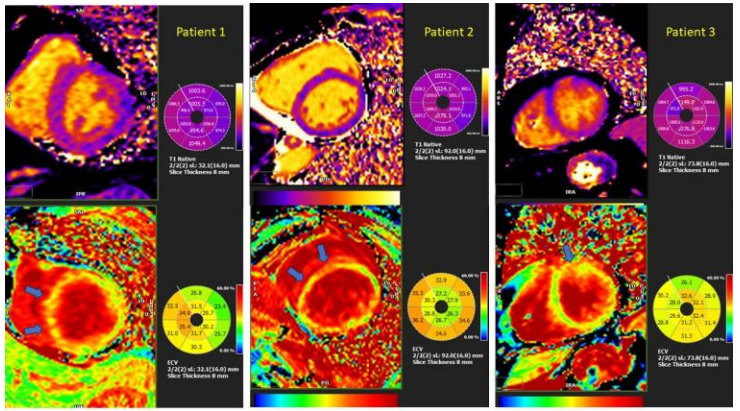
Table 2. CMRI Results	**ANOCA (N=96)**	**INOCA (N=81)**	**P-value**
CMRI Characteristics (Median, IQR)			
LV End Diastolic Volume Indexed (LVEDVi)	71.7 (62.7, 83.6)	66.5 (56.5, 78.6)	**0.035**
LV End Systolic Volume Indexed (LVESVi)	31.1 (25.3, 37.3)	28.6 (22.8, 34.7)	**0.044**
LV Ejection Fraction % (LVEF)	57.9 (53.5, 60.2)	57.5 (52.6, 62.0)	0.891
LV Cardiac Output (LVCO)	5.2 (4.4, 6.2)	4.8 (4.1, 5.5)	**0.025**
LV Mass Index (LVMI)	37.7 (31.3, 44.0)	38.7 (33.5, 44.8)	0.512
Global Peak Wall Thickness (GPWT)	9.98 (8.59, 11.78)	10.25 (8.86, 12.15)	0.193
LV long-axis strain	-18 (-19, -16)	-16 (-18, -14)	0.076
Global Native T1	1027 (1004, 1047)	1038 (1019, 1074)	**0.012**
Global Native T2, ms	51 (49, 53)	51 (49, 53)	0.457
Global ECV, ms	27 (26, 30)	28 (26, 31)	0.475
Myocardial Perfusion Reserve Index (MPRI)	2.20 (1.70, 2.53)	2.03 (1.67, 2.30)	0.151
LGE Present, n (%)	4 (5)	3 (4)	1.00

LV indicates left ventricle; Global ECV, global extracellular volume; LGE present, late gadolinium enhancement present

- ANOCA was significantly associated with a higher LVEDVI (p=0.035), LVESVI (p=0.044), and LVCO (p=0.025)
- INOCA patients displayed elevated global native T1 (p=0.012) levels compared to ANOCA patients
- Non-significant, yet notable results include more severe LV long-axis strain (p=0.076), increased GPWT (p=0.193), and decreased MPRI in INOCA patients (p=0.151)

CMRI Imaging

Figure 1: CMRI Visualization of Native T1 and Extracellular Volume (ECV)



Conclusions

- Both ANOCA and INOCA patients had significant alterations to their cardiac structure, which emphasizes the importance of approaching these patients with similar clinical treatment and testing plans
- ECV and LGE, established CMRI indicators of ischemia, were not elevated in INOCA patients, demonstrating a need for further studies of CMRI characteristics of INOCA patients
- The increases to LVEDVI, LVESVI, and LVCO experienced by ANOCA patients are suggestive of early-stage heart failure, warranting further investigation
- Future studies should explore the relationship between epicardial spasm and its contribution to adverse cardiac remodeling