

Sex Differences in MINOCA Causes Identified by OCT and CMR Imaging

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Myocardial infarction with no obstructive coronary arteries (MINOCA) presents a diagnostic challenge, as conventional angiography fails to identify the underlying pathology. This often leads to empirical treatment and suboptimal outcomes. Advanced imaging with optical coherence tomography (OCT) and cardiac magnetic resonance (CMR) imaging provides critical insights into the specific etiologies, revealing significant sex differences in the prevalence of these causes.

KEY TAKEAWAYS

- **The Pivot:** OCT and CMR imaging are essential for identifying the specific causes of MINOCA, moving beyond angiography alone.
- **The Data:** Women with MINOCA show a higher prevalence of myocarditis and takotsubo syndrome, while men have more plaque rupture and coronary spasm.
- **The Action:** Clinicians should consider sex-specific diagnostic pathways and tailored management strategies for MINOCA patients based on advanced imaging findings.

Myocardial infarction with no obstructive coronary arteries (MINOCA) is a clinical syndrome defined by the presence of myocardial infarction criteria in the absence of obstructive coronary artery disease (CAD) on angiography, typically defined as 1 This diagnosis accounts for approximately 5% to 15% of all myocardial infarctions.² Despite the absence of obstructive CAD, MINOCA patients are not benign; they experience adverse cardiovascular events, including recurrent myocardial infarction and death, at rates comparable to patients with obstructive CAD.³ The heterogeneity of MINOCA's underlying causes necessitates a precise diagnostic approach to guide effective treatment. Without identifying the specific etiology, management often remains empirical, leading to potentially inadequate or inappropriate therapies.⁴

What the study did

This analysis, reported from ACC.26, focused on the utility of advanced cardiac imaging, specifically optical coherence tomography (OCT) and cardiac magnetic resonance (CMR) imaging, to determine the underlying causes of MINOCA and to identify potential sex differences in these etiologies. The study cohort comprised patients presenting with MINOCA who underwent both OCT and CMR imaging as part of their diagnostic workup. OCT provides high-resolution intracoronary imaging, allowing for the detection of subtle plaque rupture, erosion, or dissection that might be missed by angiography.⁵ CMR imaging, on the other hand, is crucial for identifying myocardial pathologies such as myocarditis, stress-induced cardiomyopathy (takotsubo syndrome), and myocardial infarction with normal coronaries.⁶ The diagnostic protocol involved initial coronary angiography to confirm the absence of obstructive CAD. Subsequently,

patients underwent OCT of the culprit vessel (if identified or suspected) and comprehensive CMR imaging within a predefined timeframe, typically within 14 days of presentation. The images were interpreted by experienced readers blinded to patient characteristics and initial clinical diagnosis. The primary objective was to classify the underlying cause of MINOCA based on a hierarchical algorithm integrating findings from both imaging modalities. Secondary objectives included comparing the prevalence of these etiologies between male and female patients.⁷

Key Findings

The study enrolled a total of N=1,250 MINOCA patients who completed both OCT and CMR imaging. A definitive cause of MINOCA was identified in 92% of the cohort. The most common etiologies identified were plaque rupture/erosion (35%), myocarditis (28%), and takotsubo syndrome (12%). Other causes included coronary artery spasm (8%), spontaneous coronary artery dissection (SCAD) (5%), and other rare conditions (4%).⁸

Significant sex differences were observed in the distribution of these underlying causes. Among female MINOCA patients (N=580), myocarditis was identified in 38%, and takotsubo syndrome in 20%. Plaque rupture/erosion accounted for 25% of cases in women. In contrast, male MINOCA patients (N=670) showed a higher prevalence of plaque rupture/erosion (43%) and coronary artery spasm (12%). Myocarditis was present in 20% of men, and takotsubo syndrome in 5%. The difference in the prevalence of myocarditis and takotsubo syndrome between sexes was statistically significant (P 0.001 for both). Similarly, plaque rupture/erosion and coronary artery spasm were significantly more prevalent in men (P 0.001 for both).⁹

These findings underscore the importance of a comprehensive diagnostic approach using both OCT and CMR in MINOCA patients. The ability to identify specific etiologies, particularly the sex-specific patterns, allows for more targeted therapeutic interventions. For instance, patients with plaque rupture may benefit from intensive antiplatelet and statin therapy, while those with myocarditis require immunosuppression or supportive care. Patients with takotsubo syndrome typically require supportive management and stress reduction strategies.¹⁰

Limitations & Next Steps

While the study provides robust data on sex differences in MINOCA etiologies, it is important to acknowledge certain limitations. The study was conducted at specialized centers, which may limit the generalizability of the findings to all clinical settings, particularly those without routine access to OCT and CMR. The sequential nature of imaging, where angiography precedes OCT and CMR, might introduce selection bias if certain patients were deemed unsuitable for advanced imaging. Future research should focus on prospective, multicenter trials to validate these findings in broader populations and to evaluate the impact of etiology-guided therapy on long-term patient outcomes. Further investigation into the pathophysiological mechanisms contributing to these sex differences is also warranted.¹¹

CLINICAL IMPLICATIONS

The clear demonstration of sex-specific etiologies in MINOCA, elucidated by OCT and CMR, should fundamentally alter how clinicians approach these patients. No longer can MINOCA be considered a monolithic entity. The higher prevalence of myocarditis and takotsubo syndrome in women, versus plaque rupture and coronary spasm in men, demands a tailored diagnostic algorithm. Relying solely on angiography for MINOCA is now demonstrably insufficient; it is akin to diagnosing a fever without identifying the infection.

The implication is that every MINOCA patient, particularly women, should be considered for advanced imaging to avoid misdiagnosis and inappropriate treatment. This will require significant investment in imaging infrastructure and training, particularly in community hospitals.

From an industry perspective, this data highlights a critical unmet need for diagnostic tools and perhaps even sex-specific therapeutic strategies. Pharmaceutical companies developing anti-inflammatory agents for myocarditis or novel therapies for microvascular dysfunction might find a more defined target population. Furthermore, the increased utilization of OCT and CMR will undoubtedly drive demand for these imaging technologies and the expertise to interpret them. Guideline bodies like the ESC and ACC must rapidly integrate these findings into updated MINOCA management guidelines, providing clear recommendations for the sequence and interpretation of advanced imaging. Failure to do so risks perpetuating empirical treatment and suboptimal patient outcomes.

For patients, this means a move towards precision medicine in MINOCA. Instead of a generic diagnosis, they can expect a specific explanation for their myocardial infarction and a treatment plan tailored to that underlying cause. This shift should lead to improved prognosis and quality of life, reducing the burden of recurrent events. However, access to these advanced imaging modalities remains a significant barrier, particularly in underserved areas. Ensuring equitable access will be paramount to translating these research findings into real-world patient benefit, preventing a two-tiered system of care for MINOCA.

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