



Myocardial Infarction with Nonobstructive Coronary Arteries (MINOCA)

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When I (JSA) first heard the term *MINOCA*, it made me think that perhaps it referred to an ancient civilization in Greece resembling the Minoans on Crete. For example, “Archeologists had just unearthed the remains of one of the cities of Minoca in northern Greece.” Of course, for cardiologists, MINOCA has nothing to do with ancient Greece. Rather, it refers to the 5%-10% of acute myocardial infarction patients with minimal to no discernable high-grade critical coronary arterial stenoses (Myocardial Infarction with Nonobstructed Coronary Arteries). The majority of these patients are postmenopausal females, and the appropriate therapy for these individuals remains unclear despite vigorous discussion. Clearly, angioplasty was not a viable therapeutic intervention for a patient with MINOCA because there were no detectable, high-grade coronary arterial stenoses or occlusions. However, despite the lack of clinically significant coronary artery disease, patients with MINOCA frequently had manifestations of atherosclerotic disease in other territories (eg, peripheral vascular disease).¹ Moreover, mortality rates were substantial in the years following the MINOCA event. In the nationwide Swedish Web-system for Enhancement and Development of Evidence-based care in Heart disease Evaluated According to Recommended Therapies (SWEDEHEART) registry, 14% died during a 4.5-year follow-up.¹

Although not termed MINOCA at the time, this entity had been known for many years² with a number of possible pathophysiologic mechanisms suggested, including transient coronary arterial spasm, coronary arterial embolization, endothelial dysfunction, coronary arterial dissection, and even occlusion of a small coronary arterial branch that

was overlooked on angiography. A number of clinical observers have even suggested that some of these individuals had had a takotsubo event, resulting in injury of the myocardium in the absence of clinically significant coronary artery disease. Patients with takotsubo syndrome were excluded in the analysis of Nordenskjöld et al.¹ Recently, the fourth edition of the Universal Definition of Myocardial Infarction devoted a separate section to MINOCA.³ Because the underlying pathophysiology and optimal therapy for these patients remains unclear, investigators have universally called for additional research involving this interesting yet confusing entity.

The majority of patients with MINOCA are older women with a substantial burden of atherosclerotic risk factors such as diabetes mellitus, hypertension, and hyperlipidemia. In a subsequent investigation published in this issue of *The American Journal of Medicine*, the SWEDEHEART investigators queried the registry concerning patients with MINOCA who had suffered a recurrent myocardial infarction. They observed that approximately 6% of patients with MINOCA subsequently suffered a second myocardial infarction.⁴ Coronary angiography at the time of the second myocardial infarction revealed that half of the patients with MINOCA had developed clinically important coronary arterial stenoses. In other words, there had been progression of the atherosclerotic disease process in half the patients. The second myocardial infarction occurred approximately 2 years after the initial MINOCA event. As noted above, the prognosis for patients with MINOCA was not benign and worsened with the second myocardial infarction. Twenty-two percent of the patients with MINOCA in the SWEDEHEART registry who developed a reinfarction died during a 2.3-year follow-up, and half of the deaths were cardiovascular.

Recently, Opolski and colleagues⁵ studied 38 patients with MINOCA with optical coherence tomography and magnetic resonance. Optical coherence tomography is a technique that enables visualization of the coronary arterial lumen. These investigators observed that MINOCA was often associated with atherosclerotic plaque disruption, thrombosis, and evidence for ischemic injury of the

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myocardium. To date, there have been no randomized, double-blind trials of therapy in patients with MINOCA. However, the SWEDEHEART investigators did note that patients who received evidence-based therapy for myocardial infarction (ie, beta blockers, renin-angiotensin system blockade, and statins) had a better long-term prognosis compared with patients with MINOCA who did not receive evidence-based therapy.⁶ There are a number of large retrospective and prospective trials underway studying this enigmatic syndrome. Hopefully, these studies will increase our understanding of the pathophysiology of MINOCA and thereby lead to effective therapy.

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