Diagnosis of coronary microvascular dysfunction using magnetocardiography


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Background: In patients with ischemia and non-obstructive coronary artery disease (INOCA), diagnosing coronary microvascular dysfunction (CMD) is limited to invasive, expensive, and/or difficult to access methods. Magnetocardiography (MCG) is a rest-based scan that measures weak magnetic fields generated by cardiac ionic currents and has been validated for diagnosing ischemia secondary to obstructive coronary artery disease (CAD).

Objectives: The goal of this study was to validate MCG for diagnosing CMD in patients with INOCA as compared to invasive coronary functional angiography (CFA), the gold-standard for evaluation of CMD by coronary flow reserve (CFR).

Methods: Forty-eight patients with INOCA (58 ± 10.5 years of age) underwent both CFA and a noninvasive 36-channel MCG scan. CFA diagnosed 21 patients with CMD (CFR <2 by Doppler wire method or CFR <2.5 by thermodilution method) and 27 patients were confirmed as negative for CMD. Using MCG, patients were classified as either CMD positive or CMD negative using an adaptive rules-based system, originally developed for evaluating ischemia secondary to obstructive coronary artery disease. These rules based on 5 features involve the analysis of depolarization and repolarization to observe regions where electrophysiological heterogeneity exists and action potentials in affected tissue are altered in amplitude and/or rate.

Results: Of the 21 patients confirmed positive for CMD by CFA, 15 had at least one abnormal finding on the MCG. Of the 27 patients confirmed negative for CMD by CFA, 19 had no abnormal findings in the MCG. Using gold standard invasive CFR as reference, MCG had a mean accuracy of 71%, sensitivity of 71% and specificity of 70% for the detection of CMD. Figure 1 shows an example of CMD negative and CMD positive patient. In patients that exhibited more than one abnormal finding on the MCG rules (n=5), accuracy was 80%, with 4 patients correctly characterized as CMD positive, and one patient being characterized as falsely positive.

Conclusions: In INOCA patients, MCG demonstrates ability to noninvasively assess for CMD. An MCG-based diagnostic pathway for CMD merits further clinical evaluation.

Abbreviations and Acronyms: CMD, coronary microvascular dysfunction; MCG, magnetocardiography; CFR, coronary flow reserve; INOCA, ischemia and non-obstructive coronary artery disease; CFA, coronary functional angiography

Figure 1: CMD negative patient (CFR 3.7) with no abnormal findings (Left) vs. CMD positive patient (CFR 1.4) with abnormal multipolarity findings during repolarization (Right)