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# Magnetocardiography Literature Review

## ACUTE CORONARY SYNDROME

### Detection of Coronary Artery Disease in Patients with Chest Pain: A Machine Learning Model Based on Magnetocardiography Parameters

This 200-patient cross-sectional study demonstrated a 90% accuracy (91% sensitivity and 88% specificity) for magnetocardiography (MCG) and machine learning versus a gold standard of percutaneous angiography for detecting significant CAD with stenosis over 50%. This study demonstrates the effective use of magnetocardiography early in the chest pain triage process to accurately rule-out CAD with high negative predictive value and accuracy.

Huang, X., Chen, P., Tang, F., & Hua, N. (2021). Detection of coronary artery disease in patients with chest pain: A machine learning model based on magnetocardiography parameters. *Clinical Hemorheology and Microcirculation*, 78(3), 227–236. <https://doi.org/10.3233/ch-200905>

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### Value of Magnetocardiography in Chronic Coronary Disease Detection: Results of Multicenter Trial

In this trial, MCG showed an accuracy of 94% for grouping patients into severe CAD (stenosis over 80% or FFR < 0.8), mild CAD (50–80% stenosis and FFR > 0.8), and no CAD groups across 133 patients. This study demonstrates MCG's potential use as a stenosis stratification tool with high accuracy and a high negative predictive value of 93%.

Chaikovsky, I., Li, T., Zhang, W., Kazmirchuk, A., Mjasnikov, G., Lutay, M., Lomakovskiy, O., & Wenming, J. (2021). Value of magnetocardiography in chronic coronary disease detection: results of multicenter trial. *European Heart Journal*, 42 (Supplement\_1). <https://doi.org/10.1093/eurheartj/ehab724.1171>

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### Non-invasive Magnetocardiography for the Early Diagnosis of Coronary Artery Disease in Patients Presenting with Acute Chest Pain

This study of 364 patients demonstrates the ability of MCG to detect CAD, even in patient subgroups without specific biomarker or ECG changes. In the overall patient cohort, MCG's sensitivity and specificity were 84% and 85% respectively. In the more challenging patient sub-population that did not display ECG or biomarker changes, MCG displayed a sensitivity and specificity of 73.5% and 82.3% respectively.

Kwon, H., Kim, K., Lee, Y.-H., Kim, J.-M., Yu, K. K., Chung, N., & Ko, Y.-G. (2010). Non-Invasive Magnetocardiography for the Early Diagnosis of Coronary Artery Disease in Patients Presenting With Acute Chest Pain. *Circulation Journal*, 74(7), 1424–1430. <https://doi.org/10.1253/circj.cj-09-0975>

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## CARDIAC RISK FACTORS

### Early Myocardial Repolarization Heterogeneity is Detected by Magnetocardiography in Diabetic Patients with Cardiovascular Risk Factors

This study demonstrates that MCG parameters are associated with cardiovascular risk factors, including metabolic syndrome. In the study, identified risk factors were associated with regional ventricular repolarization heterogeneity in 278 type 2 diabetic patients without overt CAD.

Chang, Y.-C., Wu, C.-C., Lin, C.-H., Wu, Y.-W., Yang, Y.-C., Chang, T.-J., Jiang, Y.-D., & Chuang, L.-M. (2015). Early Myocardial Repolarization Heterogeneity Is Detected by Magnetocardiography in Diabetic Patients with Cardiovascular Risk Factors. *PLOS ONE*, 10(7), e0133192.

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### Resting Magnetocardiography Predicts 3-Year Mortality in Patients Presenting with Acute Chest Pain without ST Segment Elevation

This study demonstrates the use of rest MCG to predict 3-year mortality in patients with acute chest pain. In a cohort of 402 consecutive ICU patients, a multivariate regression analysis revealed the highest mortality risk for patients with diabetes mellitus and an abnormal MCG at admission. MCG seems to be valuable in identifying chest pain patients at highest risk.

Park, J.-W., Leithäuser, B., Hill, P., & Jung, F. (2008). Resting Magnetocardiography Predicts 3-Year Mortality in Patients Presenting with Acute Chest Pain without ST Segment Elevation. *Annals of Noninvasive Electrocardiology*, 13(2), 171-179. <https://doi.org/10.1111/j.1542-474x.2008.00217.x>

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## CARDIAC ALLOGRAFT VASCULOPATHY

### Usefulness of Magnetocardiography to Detect Coronary Artery Disease and Cardiac Allograft Vasculopathy

This study demonstrated the usage of resting MCG to detect cardiac allograft vasculopathy (CAV) in a cohort of 26 post heart transplant patients. MCG is clinically feasible as a non-invasive tool for the diagnosis of CAD and could be used as a surrogate marker of CAV.

Wu, Y.-W., Lee, C.-M., Liu, Y.-B., Wang, S.-S., Huang, H.-C., Tseng, W.-K., Jui, H.-Y., Wang, S.-Y., Horng, H.-E., Yang, H.-C., & Wu, C.-C. (2013). Usefulness of magnetocardiography to detect coronary artery disease and cardiac allograft vasculopathy. *Circulation Journal: Official Journal of the Japanese Circulation Society*, 77(7), 1783-1790. <https://doi.org/10.1253/circj.cj-12-1170>

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## ST ELEVATION MYOCARDIAL INFARCTION

### **An Integrated Maximum Current Density Approach for Noninvasive Detection of Myocardial Infarction**

In this study, MCG demonstrated a sensitivity of 91.2% and specificity of 84.6% in identifying patients with STEMI versus healthy subjects.

Zhao, C., Jiang, S., Wu, Y., Zhu, J., Zhou, D., Hailer, B., Grönemeyer, D., & Van Leeuwen, P. (2018). An Integrated Maximum Current Density Approach for Noninvasive Detection of Myocardial Infarction. *IEEE Journal of Biomedical and Health Informatics*, 22(2), 495–502. <https://doi.org/10.1109/JBHI.2017.2649570>

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## FLOW LIMITING STENOSIS

### **Validation of Magnetocardiography versus Fractional Flow Reserve for Detection of Coronary Artery Disease**

This study demonstrated an accuracy of 91.5% (90.5% sensitive, 92.3% specific) in using MCG to detect functionally significant CAD versus a gold standard of fractional flow reserve in 47 patients. In addition to detecting flow limiting stenosis, MCG also demonstrated the ability to localize stenosis with 92.3% accuracy on a per territory basis.

Park, J.-W., Shin, E.-S., Ann, S. H., Gödde, M., Park, L. Song-I., Brachmann, J., Vidal-Lopez, S., Wierzbinski, J., Lam, Y.-Y., & Jung, F. (2015). Validation of magnetocardiography versus fractional flow reserve for detection of coronary artery disease. *Clinical Hemorheology and Microcirculation*, 59(3), 267–281. <https://doi.org/10.3233/CH-141912>

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## STENOSIS LOCALIZATION

### **Magnetocardiography Based Ischemic Heart Disease Detection and Localization using Machine Learning Methods**

This paper demonstrates the automatic detection and localization of stenosis using MCG for a broad set of 574 subjects (39.5% healthy volunteers, 60.5% with coronary stenosis). MCG paired with machine learning showed an accuracy of 94% and an AUC of 0.98 for detection between these two groups. Additionally for subjects with a known stenosis above 35%, MCG showed localization accuracy ranging from 65-74% depending on the specific artery.

Tao, R., Zhang, S., Huang, X., Tao, M., Ma, J., Ma, S., Zhang, C., Zhang, T., Tang, F., Lu, J., Shen, C., & Xie, X. (2019). Magnetocardiography-Based Ischemic Heart Disease Detection and Localization Using Machine Learning Methods. *IEEE Transactions on Biomedical Engineering*, 66(6), 1658–1667. <https://doi.org/10.1109/tbme.2018.2877649>

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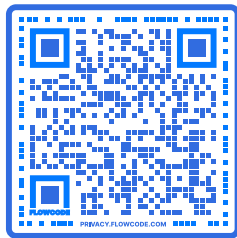
## MCG META ANALYSIS

### Magnetocardiography for the Diagnosis of Coronary Artery Disease: A Systematic Review and Meta-Analysis

This meta-analysis of MCG studies shows a pooled AUC of 0.90 for detection of CAD and suggests the potential use of MCG as an adjunctive or alternative to stress testing in the chest pain workflow.

Agarwal, R., Saini, A., Alyousef, T., & Umscheid, C. A. (2012). Magnetocardiography for the Diagnosis of Coronary Artery Disease- A Systematic Review and Meta-Analysis. *Annals of Noninvasive Electrocardiology*, 17(4), 291–298.  
<https://doi.org/10.1111/j.1542-474x.2012.00538.x>

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