identify an additional patient with an LVEF <40% was 15. Among the 6 patients newly diagnosed with a low LVEF, 4 (83%) filled a prescription for a recommended beta-blocker, angiotensin-converting enzyme inhibitor, or angiotensin receptor blocker within 6 months of randomization.

Our study found that an electronic reminder (combined with a draft order for echocardiography) to providers of patients with a high BNP level and an LVEF that was not known to be low increased appropriate follow-up of LVEF measurement. Although our study was not powered to determine a difference in health outcomes, we did find a trend toward a greater diagnosis of depressed LVEF that was subsequently treated appropriately with life-prolonging medications. We estimated that for every 15 reminders sent to providers, 1 additional patient would be diagnosed with an LVEF <40% and potentially benefit from treatment.

Such a reminder is inexpensive to implement and can be automated with electronic medical records. Our study had potential limitations, including the male preponderance of the veteran population. We chose a BNP threshold of 200 pg/ml to identify candidates for follow-up echocardiography. The United Kingdom's Chronic Heart Failure Guideline of the National Institute for Health Care Excellence (3) recommends that patients with suspected heart failure and a BNP level between 100 and 400 pg/ml should have echocardiography and specialist assessment within 6 weeks. Thus, health systems may choose to use the more sensitive threshold of 100 pg/ml, although it is unclear if the impact of the reminder would be as strong as the effect observed in this study.

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Myocardial Infarction With Nonobstructed Coronary Arteries

Impact of CMR Early After Presentation

Seven to 15% of patients with acute coronary syndrome (ACS) have nonobstructed coronary arteries, an entity that is known as myocardial infarction with nonobstructed coronary arteries (MINOCA) (1). In these patients, cardiac magnetic resonance (CMR) can identify different underlying etiologies (2). However, the optimum timing and the impact of CMR on clinical management are unknown. We aimed to evaluate the diagnostic and decision-making implications of CMR timing ("early" ≤2 weeks vs. "late" >2 weeks after presentation) in MINOCA.

A total of 204 consecutive patients (56 ± 17 years; 51% men) with troponin-positive ACS (as per the European Society of Cardiology guidelines for ST-segment elevation [STE] or non-STE ACS and the Third Universal definition of myocardial infarction [MI]) and unobstructed coronary arteries (MINOCA) with unclear final diagnoses were referred for CMR and included in the study from September 2011 to July 2014. Nineteen percent presented with ST-segment elevation on the electrocardiogram (ECG) and the remaining patients presented with non-ST-segment elevation myocardial infarction. The mean troponin level was 640 ng/l (normal <14 ng/l). The study was reviewed and approved by local institutional review board. CMR (1.5-T) was performed using a comprehensive protocol (cines, T2-weighted, and late gadolinium enhancement [LGE] sequences). Myocarditis was diagnosed using the Lake Louise Criteria, MI was diagnosed by territorial subendocardial and/or transmural LGE, and Takotsubo cardiomyopathy was diagnosed by modified Mayo Clinic criteria.

Pre-CMR diagnosis was defined per the referring clinician's suspected diagnosis recorded in the CMR referral, based on a composite of clinical, biomarkers, ECG, and echocardiographic and angiographic

FIGURE 1 The Clinical Impact of CMR in MINOCA

A

Post-CMR Diagnosis

Pre-CMR Diagnosis: Total Sample n = 204	Myocarditis	MI	TakoTsubo	Other CM	Normal CMR
Myocarditis	34	23	5	4	7
MI	10	6	8	6	1
TakoTsubo	1	5	3	0	2
Other CM	1	0	1	0	0
Uncertain	8	19	2	8	50

B

Diagnosis	No Change	Change in Management
New Diagnosis	25%	29%
No Change	34%	12%
Clinical Impact Overall (n = 204)		

Management

(A) Comparison of pre-cardiac magnetic resonance (CMR) with post-CMR diagnosis. **Green cells** denote changes in diagnosis, **pink cells** show an agreement between pre- and post-CMR, and **white cells** show if the CMR showed a structurally normal heart. Uncertain was defined when the referring clinician had ≥2 differential pre-CMR diagnoses. **(B)** Overall clinical impact (n = 204). **White cells** denote no change, **green cells** show if there was a new diagnosis or a change in management, and **pink cells** show if both were present. CM = cardiomyopathy; MI = myocardial infarction; MINOCA = myocardial infarction with nonobstructed coronary arteries.

information, which reflects current clinical practice and guideline recommendations.

Post-CMR diagnosis was also recorded and was subsequently compared with the pre-CMR diagnosis to investigate whether the results confirmed the pre-CMR diagnosis or identified a new diagnosis.

Significant clinical impact was defined as identification of a new diagnosis or a change in management. For changes in management, we recorded: 1) changes in length of hospital stay (shorter and/or longer); 2) changes in discharge medications (introduction and/or discontinuation); or 3) introduction and/or avoidance of additional invasive procedures.

To identify the correlates of clinical and CMR indexes with a significant clinical impact, we performed univariate and multivariate regression analysis for age, sex, troponin T, indexed left ventricular (LV) end-diastolic volume, LV ejection fraction, regional wall motion abnormality, myocardial edema, and LGE. Propensity matching, using a nonparsimonious multivariable logistic regression model, was performed to minimize any selection bias between early and late CMR groups. SPSS version 23 (IBM, Armonk, New York) was used for statistical analysis.

Overall, CMR provided a final diagnosis in 70% (n = 143) of patients (myocarditis: 27%; MI: 26%; Takotsubo cardiomyopathy: 9%; and other cardiomyopathies: 9%). In 30% (n = 61) of patients, CMR demonstrated a structurally normal heart (no RWMA, edema, or scarring). The diagnostic yield of CMR was significantly higher when performed early (84% vs. 57%; $p < 0.0001$). Myocarditis (33%) was the most common diagnosis in the early group, whereas MI was the most common diagnosis in the

late group (26%). The detection of myocarditis (33% vs. 21%; p = 0.04) and Takotsubo cardiomyopathy (16% vs. 3%; p = 0.002) was also significantly higher in patients who underwent early CMR, whereas no change was observed for MI (26% vs. 26%; p = 1).

Overall, CMR had a significant clinical impact in 66% (n = 134) of patients (new diagnosis: 54%; change in management: 41%) (Figure 1). CMR led to subsequent invasive procedures in 5% (myocardial biopsy: n = 5; implantable cardiac defibrillator: n = 3; ventricular assist device: n = 2); 4% of patients avoided an invasive procedure. Age (odds ratio [OR]: 1.024; 95% confidence interval [CI]: 1.006 to 1.041; p = 0.008), myocardial edema (OR: 1.765; 95% CI: 0.938 to 3.323; p = 0.078), and LGE (OR: 2.393; 95% CI: 1.318 to 4.345; p = 0.004) were significant univariate predictors of clinical impact (p < 0.1, considered significant for univariate analysis). In a multivariate model, only age (OR: 1.035; 95% CI: 1.013 to 1.058; p = 0.002) and LGE (OR: 2.411; 95% CI: 1.17 to 4.968; p = 0.017) remained significant.

Propensity score matching identified 58 pairs of early and late subjects. The results confirmed the significantly higher diagnostic yield in the propensity-matched early group versus late group (88% vs. 50%; p < 0.0001). The clinical impact also improved significantly in the propensity-matched early CMR group (76% vs. 51%; p = 0.01).

The study demonstrated the importance of performing CMR early in MINOCA, which provides a window of opportunity to image myocardial damage before healing occurs, thereby maximizing the diagnostic yield. This is particularly relevant in potentially reversible conditions (acute myocarditis and Takotsubo cardiomyopathy).

The timing of CMR was partly based on the referring physician's discretion or scanner availability. However, with propensity scoring, we matched the early CMR group with the late CMR group, thereby reducing the selection bias. CMR-guided diagnosis was assumed to be correct based on previous literature (2).

In conclusion, in consecutive patients with MINOCA, CMR established a definitive diagnosis in 70% of patients and made a significant additive impact on diagnosis and/or clinical management in 66% of patients, with LGE being the best independent predictor of clinical impact more than the traditional clinical and diagnostic markers. Moreover, the diagnostic value and the clinical impact of CMR were highest when performed within 2 weeks from presentation.

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Coronary Computed Tomography Angiography to Predict Successful Percutaneous Coronary Intervention for Chronic Total Occlusion

Ready for Prime Time?

We read with interest the paper by Fujino et al. (1) evaluating the accuracy of the computed tomography angiography (CTA)-derived J-CTO (Multicenter CTO Registry of Japan) score for predicting successful percutaneous coronary intervention (PCI) for chronic total occlusion (CTO). We congratulate the authors on their elegant study; however, several aspects of the presented results need more in-depth reflection before major implications can be conveyed to the clinical community.

First, it is important to note that there are 2 distinct ways to obtain CTA before PCI for CTO (2).