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).

Specifically, CTA may be performed for better characterization of CTO when the decision to perform PCI is already made or is at least considered. In this scenario, the referral patterns for CTA usually include CTO with previously failed PCI or challenging visualization in invasive coronary angiography (ICA) (e.g., ambiguous proximal cap, poor distal target, long occlusion). Alternatively, CTO may be initially identified on diagnostic CTA in patients with suspected coronary artery disease, and these patients may be subsequently scheduled for percutaneous recanalization attempts (2). Whereas the latter scenario should favor relatively "straightforward" CTO lesions, the former is usually associated with difficult occlusions resisting effortless guidewire (GW) crossing. Thus outstanding questions informing the most accurate use of coronary CTA to predict successful PCI for CTO will likely require better-defined patient populations in future clinical trials.

Second, that coronary CTA outweighs ICA in visualization and characterization of CTO has been consistently established in several clinical trials (2,3). Importantly, the more complex the appearance of the CTO lesion in ICA, the more valuable is the information that can be derived from the noninvasive CTA scan. Conversely, with a median J-CTO score of 1 (and less than one-third of lesions with calcification, bending, and occlusion length >20 mm), the sample included in the study by Fujino et al. (1) represents a rather simple CTO population, particularly when compared with the prior J-CTO and CT-RECTOR (Computed Tomography Registry of Chronic Total Occlusion Revascularization) registries (3,4). As such, the true diagnostic yield of CTA over ICA in more complex CTO lesions may have been underestimated, and yet it gains momentum to be fully elucidated in future clinical trials.

Third, although one may be impressed with the overall high success rate of PCI for CTO (almost 83%) reported by Fujino et al. (1), the relatively low percentage of 30-min GW crossing (29%) in essentially noncomplex CTO is surprising. This finding contrasts with prior studies (with 30-min GW crossing rates ranging from 47% to 55%) (3,4), and it may represent a function of differing PCI techniques as well as a wide variability between operators' speed and control of GW manipulations. Thus, until the results of Fujino et al. (1) are replicated in a prospective trial with a refined GW crossing rate, the clinical utility of the noninvasive J-CTO score should be viewed with caution.

Finally, in 2015 the CT-RECTOR score was introduced as a robust and easy-to-remember CTA-based calculator to predict 30-min GW crossing through CTO (3). It was derived from 240 consecutive CTO lesions from 4 European centers by assigning 1 point for each of the independent predictors (multiple occlusions, blunt stump, calcification ≥50% of the vessel cross-section, bending ≥45°, CTO age ≥12 months, previously failed PCI). Contrary to the J-CTO score, the CT-RECTOR score is a 6-grade classification system with multiple occlusions (instead of the lesion length) and CTO duration. By relevance, multiple occlusion sites are clearly seen on CTA but are usually missed with ICA, and they have the potential to exceed the discriminatory accuracy of the lesion length for predicting GW passage (3). Hence a head-to-head comparison between CTA-derived J-CTO score and CT-RECTOR score makes intuitive sense to establish the most accurate noninvasive prediction rule for time-efficient GW crossing through a CTO.

To sum up, clinicians may find the CTA-derived scores particularly useful to better estimate the time and resources required for the interventional treatment of CTO when compared with the angiographic J-CTO score (3). Whether coronary CTA will build on the optimal approach to the interventional treatment of CTO remains to be observed, but what is certain is that it is already a "moving target" that is too good to ignore.

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THE AUTHORS REPLY:

We thank Dr. Opolski and colleagues for their interest in our study (1). Compared with the study by Dr. Opolski and associates (2), our study (1) had a lower 30-min wire crossing rate (29% vs. 55%), but a much higher procedural success rate (83% vs. 62%) when treating chronic total occlusions (CTOs) with percutaneous coronary intervention (PCI). A possible reason for the lower prevalence of 30-min wire crossing in our study was that we began each procedure with a soft to intermediate guidewire and were not quick to switch to a stiffer wire, and we often used a parallel wire technique to optimize the frequency of intraplaque versus subintimal tracking.

The main reason for this approach was to reduce short-term complications. Moreover, we were concerned that stent implantation into a subintimal space could have a negative impact on long-term patency of the treated vessel. In addition, true lumen re-entry devices were not available in our institution. Thus our goal was not to cross a CTO as soon as possible, but to be methodical and minimize vessel trauma. This methodical approach, along with the possibility of a population of patients with simpler CTOs, may explain the much higher success rate because the lesions in our study (1) did have a lower J-CTO (Multicenter CTO Registry Japan) score than in the study by Dr. Opolski and colleagues (2). Furthermore, the prevalence of the retrograde approach in our study was 3 times higher than in the study by Dr. Opolski and colleagues (2) (33% vs. 11%, respectively); consequently, we had more fluoroscopy time (74 min vs. 30 min, respectively) and more contrast volume (327 ml vs. 213 ml, respectively). Finally, physicians are less interested in predicting 30-min wire crossing times than previously, whereas predicting the final procedural success rate has become a more important endpoint for operators. Predicting procedural success may be more challenging than predicting 30-min wire crossing because procedural success can be influenced by many factors other than lesion morphology; it indeed depends on the indication for PCI for of CTO, the procedure strategy, and allocation of resources, especially in difficult CTO lesions. Nevertheless, we agree with Dr. Opolski and colleagues (2) that as an adjunctive strategy for comparing PCI for CTOs including morphological features and success rates, computed tomography angiography should be used more universally.

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Exercise Echocardiography in Aortic Stenosis

A Happy End?

We read with interest the paper from Messika-Zeitoun et al. (1), which showed that neither the increase in mean pressure gradient (MPG) nor the systolic pulmonary hypertension at exercise were predictive of aortic stenosis (AS)-related events in patients with asymptomatic AS and a normal exercise test. A small proportion of the patients (24%) examined had an abnormal exercise test. Thirty-four percent of those with a normal test had a MPG increase >20 mm Hg and/or systolic pulmonary artery pressure at peak exercise >60 mm Hg, which occurred at a lower rate than in previous studies (2). Intriguingly, only 2 patients had both criteria at exercise. The inclusion of patients with moderate AS might have contributed to this observation. Noteworthy would be to know the impact of each parameter taken separately on the outcome of patients with severe AS. Interestingly, MPG changes during exercise were higher in patients with an abnormal exercise test, indicating a more advanced disease stage. However, the rate of changes in MPG was particularly high, with values reaching a delta of more than 120 mm Hg. To avoid any