Atrial Fibrillation and Worse Outcomes in ST-Segment–Elevation Myocardial Infarction

Is It All About Infarct Size, or Do We Need to Look Elsewhere?

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Atrial fibrillation (AF) is a common cardiac arrhythmia in patients admitted to a hospital with myocardial infarction (MI). In a large study looking at 106 780 patients, AF prevalence was 22%, with half of AF patients presenting with and half developing AF during their hospitalization for acute MI.[1] With the use of implantable cardiac monitoring, AF incidence was as high as 39% at 24 months in post-MI patients with left ventricular systolic dysfunction.[2] The relationship between AF and MI is complex and bidirectional, but it is clear that MI patients with AF uniformly have worse outcomes.[3,4] Despite the clear association between AF and poor prognosis in MI, the influence of infarct characteristics on this relationship has remained unclear, mostly because prior studies have lacked the ability to directly assess this important question.

See Article by Reinstadler et al

Cardiac magnetic resonance (CMR) is a noninvasive tool with the ability to provide myocardial tissue characterization. Gadolinium contrast agent has increased extracellular distribution and delayed washout in areas of myocardial infarct or scar, and late gadolinium enhancement CMR imaging has become the gold standard for assessing myocardial infarct size.[5] T2-weighted imaging allows visualization of myocardial edema, and in patients with acute MI, these areas of edema represent the amount of myocardium at risk.[6] Amount of myocardial salvage is then the difference between the volume of myocardium at risk (assessed by T2-weighted CMR) and the volume of myocardial infarct or scar (assessed by late gadolinium enhancement CMR).[7–9] Myocardial salvage index can be calculated by dividing the amount of salvaged myocardium by the volume of myocardium at risk. Both size of infarct and myocardial salvage after ST-segment–elevation myocardial infarction (STEMI) are strong predictors of subsequent major adverse cardiac events, including heart failure and mortality.[10,11]

In this issue of *Circulation: Cardiovascular Imaging*, Reinstadler et al[12] report their findings from a post hoc analysis of data from a CMR substudy of the AIDA STEMI trial (Abciximab Intracoronary Versus Intravenous Drug Application in ST-Elevation Myocardial Infarction). They used CMR data from this large, multicenter STEMI trial to examine the association between the presence of AF during hospitalization and infarct characteristics by CMR and major adverse cardiovascular events at 12 months after primary percutaneous coronary intervention (PPCI). A total of 786 patients with STEMI who underwent CMR were included in the final analysis. Heart rhythm was identified using standard 12-lead ECG before PPCI and then 90 minutes and 24 hours after PPCI. The CMR protocol utilized both T2-weighted and T1-weighted inversion recovery imaging to assess the amount of edema and volume of infarct so that myocardial salvage could be calculated. The primary study outcome was the rate of major adverse cardiovascular events, defined as a composite of all-cause mortality, nonfatal infarction, and new congestive heart failure within 12 months after STEMI.

The overall prevalence of AF was 6.1% (n=48). As expected, patients with AF tended to be those with more comorbid disease. They were older, and they were more likely to have hypertension, diabetes mellitus, a higher heart rate, advanced heart failure on admission (Killip class II and above), and lower left atrial and left ventricular ejection fractions. The median time to CMR scan was 3 days (interquartile range, 2–4 days) after STEMI. In contrast to prior suggestions that AF is associated with a larger amount of myocardial damage and that AF with its rapid and irregular heart rate may result in reduced coronary perfusion and larger infarct size, there was no significant difference in CMR infarct characteristics between patients with or without AF. Major adverse cardiovascular events occurred in 7% (n=53) of all study patients during the 12-month follow-up period, and there was a clear association with AF (odds ratio, 2.41; 95% confidence interval, 1.01–5.76) on multivariable analyses. Although there was no significant difference in CMR infarct characteristics between the 2 groups, patients with AF had more new heart failure (6 [13%] versus 19 [3%]; odds ratio, 5.4; P=0.003) and higher mortality (6 [13%] versus 16 [2%]; odds ratio, 6.4; P<0.001). The investigators make the impactful conclusion that in patients with STEMI treated with PPCI, AF is an independent risk factor for major adverse cardiovascular events and that the heightened risk associated with AF is not explained by differences in PPCI efficacy or more pronounced myocardial damage.

There are a few points in the article by Reinstadler et al that require consideration. First, rhythm identification by 12-lead ECG at only 3 time points (immediately before and then 90

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minutes and 24 hours after PPCI) may introduce an information bias where AF might have been undetected and misclassified. In addition, this approach did not allow for identification of patients with preexisting AF and those with new onset AF at the time of the infarct event. Second, the investigators used T2-weighted Short TI Inversion Recovery (black-blood turbo spin echo) imaging[13] to determine area at risk. This sequence can be susceptible to artifacts mimicking edema from inhomogeneity of the myocardial signal, static blood cavity, and motion-related signal loss.[14] Moreover, there are controversies in area at risk imaging using T2-weighted MRI with a recent study reporting no correlation between the transmural extent of T2 hyperintense regions using T2-weighted black-blood turbo spin echo and area at risk determined using microspheres and histochemical staining.[15] Third, the change in myocardial tissue characteristics after MI is dynamic.[16] Therefore, the timing of CMR after MI is critical for an accurate assessment of area at risk and infarct size. In patients with acute MI and successful reperfusion, the estimated myocardial infarct size by late gadolinium enhancement imaging significantly diminishes over the first week.[17] In this study, the median time to CMR scan was 3 days (interquartile range, 2–4 days). This may result in an overestimation of the infarct size and an underestimation of myocardial salvage.

In this study, patients with AF had a lower left atrial ejection fraction as compared with patients without AF. This could be secondary to an inability to produce an effective atrial contraction because of the AF rhythm disturbance itself or from an underlying atrial myopathy or atrial ischemia. It is plausible that patients develop AF in the setting of acute MI as a result of atrial myocardial injury from ischemia. In animal models, experimental atrial ischemia can cause atrial electrical remodeling and a substrate for AF maintenance.[18] The evidence supporting atrial ischemia is limited to small studies in humans.[19,20] Another possibility is that MI may unmask underlying atrial myopathy and result in AF during an event. Future studies evaluating atrial pathophysiology in the setting of acute MI may be able to determine other possible missing links between AF and MI.

In conclusion, this is an important study from an experienced group, and the authors are to be congratulated for providing valuable data in this area. The increased risk of AF in STEMI is likely not explained by differences in PPCI efficacy (myocardial salvage) or increased myocardial damage. Future studies focused on other pathophysiological questions will help us better understand the relationship between AF and MI.

Disclosures

None.

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