Despite marked improvements in the management of acute coronary syndromes, complete atrioventricular (AV) block can still complicate acute myocardial infarction (MI) (1). In the pre-thrombolytic era, second- or third-degree AV block was recorded in 5% to 7% of patients presenting with acute MI (2,3), and reached 28% in those with inferior MI (4). In the thrombolytic era, Meine et al. (5) reported that the overall incidence was little changed at 6.9% with inferior MI; age, worse Killip class at presentation, female sex, smoking, hypertension, and diabetes were all risk factors for its occurrence. In that study, adjusted 1-year mortality was significantly higher in patients with than in those without AV block (odds ratio [OR]: 1.5; 95% confidence interval [CI]: 1.3 to 1.6), and when subdivided by location, the ORs for death were 2.4 (95% CI: 2.2 to 2.6) and 3.3 (95% CI: 3.0 to 3.7) for inferior and anterior MI, respectively. One problem with both older and more recent data is that a distinction is not made between second- and third-degree AV block.

In this issue of JACC: Clinical Electrophysiology, Harikrishnan et al. (6) examine the association of third degree or complete heart block (CHB) with outcomes and the temporal trends and incidence of CHB complicating acute ST-segment elevation myocardial infarction (STEMI) in the current era. Using data from the National Inpatient Sample for 2003 to 2012, of 2,273,853 patients with STEMI, 49,882 (2.2%) had CHB. The incidence of CHB increased from 2.1% in 2003 to 2.3% in 2012 (adjusted OR per year: 1.02; 95% CI: 1.01 to 1.03). In-hospital mortality was higher in those with than in those without CHB (20.4% vs. 8.7%, respectively). Although the association was independent of the location of STEMI, the association was the greatest in patients with anterior STEMI. Interestingly, the rate of permanent pacemaker (PPM) implantation declined (adjusted OR per year: 0.96), and in-hospital mortality remained unchanged during the study period. As expected, the rate of PPM implantation was lower for patients with CHB complicating inferior MI compared with anterior MI.

Why is CHB with STEMI increasing when cardiac care has improved and mortality decreased (7)? There are several possible explanations. First, the time point of reference must be considered: despite the increasing trend of CHB in the current study, the rate is still much less than that in the pre-thrombolytic era (3-5,8), and as discussed by Harikrishnan et al. (6), this likely reflects overall improvement in MI care. Second, if patients are now seeking care and being treated earlier after symptoms develop, they may present with acute coronary syndromes or non-STEMI rather than STEMI. Thus, those with STEMI may be sicker and more likely to have an arrhythmia or other complication in their hospital course. As a consequence, when those “late presenters” develop CHB, it is in combination with greater myocardial damage that may lead to more serious consequences. In keeping with this hypothesis, in the current study,
Compared with STEMI patients without CHB, those with CHB were older and had more underlying comorbidities. Third, the definition of MI has undergone evolution. It is possible that with changes in definition, patients identified as having STEMI or non-STEMI may have been different depending on the definition in use at the time of presentation. Notably in the current study, the investigators point out that the National Inpatient Sample from which their data were derived redesigned its structure during the study to reduce errors in classification and improve statistical estimations. In addition, they point out that hospital documentation may have evolved to maximize reimbursement, leading to an artificial increase in the incidence of CHB. In short, the classification of STEMI was not static during the years the study was done.

This study led me to think about several related issues. The investigators did not provide information about the prediction of CHB in patients who present with first- or second-degree AV block, right or left bundle branch block, with or without a hemiblock, or a combination of these. Melgarejo-Moreno et al. (9) reported that in the thrombolytic era, right bundle branch block complicating acute MI remained predictive of mortality, but that it was associated with a lower rate of bifascicular block, possibly representing a beneficial effect of thrombolysis. For those with second- or third-degree AV block post-MI, what is the time course of progressing from some AV or intraventricular conduction disturbance to complete AV block? How long should patients be monitored in the hospital or intensive care unit? Is there a group who should be monitored after discharge if they had CHB that resolved and no PPM was implanted, or had a transient or persistent conduction disturbance? We have no answers to these important clinical questions.

Second, although the numbers reported in this study are statistically significant, are they clinically so? Yes, the percentage of patients with STEMI developing CHB increased 0.2% over a decade, and as discussed previously, the reasons for that are likely more related to behavior and definition, rather than something intrinsically different about MI now compared with previous years. However, I do not think we are going to change our practice of implanting pacemakers in patients with CHB after STEMI (or non-STEMI), especially if it is anterior. They will be will receive pacemakers.

A third point for discussion is that because CHB continues to be a problem, how should it be managed in an era when implantable cardioverter-defibrillators (ICDs) are recommended for survivors of MI who have persistent left ventricular dysfunction? The later years of the current study included years during which it became known that the Department of Justice (DOJ) was investigating inappropriate ICD implantation, with a focus on implantation of these devices before expiration of a waiting period of 1 month if no revascularization had been undertaken or 3 months if there was revascularization (10). These waiting periods were and are mandated by both the American College of Cardiology/American Heart Society/Heart Rhythm Society device-based therapy guideline (11) and the National Coverage Determination (NCD) (12), of which the latter is the legal basis of reimbursement eligibility for ICD implantation (for both hospitals and providers) by Medicare/Centers for Medicare & Medicaid Services (CMS). These documents are based on the results of well-done randomized, controlled clinical trials. Importantly, there are no data that support early ICD implantation to improve outcomes (13,14). However, for the patient with CHB post-MI, implanting a PPM is not elective and cannot wait. It is conceivable that cognizance or fear of the Department of Justice investigation influenced the balance of PPMs versus ICDs implanted for CHB complicating MI confounded the National Inpatient Sample data. Although we now have Appropriate Use Criteria that list scenarios in which an ICD can be implanted within the waiting period (e.g., CHB complicating STEMI), these criteria were published in 2013, after the study ended (15). Even with this document, providers are still left with the uncomfortable understanding that CMS coverage for implantation is not assured because the NCD has never been updated. Although we might find comfort that there is now precedent that in the DOJ inquiry physicians who implanted a device in patients such as previously described were not cited for false claims (16), the so-called resolution model does not constitute policy for the future. We need an updated NCD in which situations like this are addressed so that any ambiguity regarding appropriate patient management is removed.

Because CHB has not gone away, Harikrishan et al. (6) have given us new information, food for thought, for which we should be grateful. In the "old days" it was said that although patients with inferior MI who developed AV block had poor in-hospital outcomes, long-term prognosis was similar irrespective of its occurrence (17), even for those with CHB (18). However, patients with anterior MI and CHB did not fare as well in the past (3), or today as in the current study. As the investigators point out, CHB with STEMI was associated with a 20.4% increase in mortality, twice that seen in patients without CHB. New initiatives can be envisioned to identify high-risk subsets with a
high risk for CHB and prophylactically treat those patients to protect the AV conduction system. For those who require pacing, would His bundle pacing, when feasible, be beneficial? Unfortunately, for anterior MI complicated by CHB, this may be precluded because the level of AV block is more likely to be distal in the His-Purkinje system than at the AV node. Would septal pacing be better than apical pacing, and does the MI location matter? How could biventricular pacing be applied in this population? For patients with large MIs and no indication for pacing, biventricular pacing was anticipated to hold promise (19), but larger trials did not show improved remodeling (20,21) or quality of life, functional class, rate of hospitalization, or mortality (21) even when peri-infarct locations were targeted for lead placement. Would the outcome be different if biventricular pacing was done for patients post-MI who have a requirement for pacing? Might stem cell therapy be useful in the acute or chronic setting? We also need to be at the table if and when the NCD is updated to ensure that the majority of patients with pacing and ICD indications are covered without fear of nonpayment or legal reprimand. The investigators of this study should be commended for reminding us of our humility, the enduring problem of (complete) heart block in STEMI, and how future therapies may further affect a distressing and persistently high mortality.

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