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Clinical Cardiology

Critical analysis of the latest clinical research in cardiovascular medicine [ALERT]

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ABSTRACT & COMMENTARY

NOACs in Patients Requiring Anticoagulation Post-PCI

By Jeffrey Zimmet, MD, PhD

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Dr. Zimmet reports no financial relationships relevant to this field of study.

SYNOPSIS: The PIONEER study of atrial fibrillation patients post-percutaneous coronary intervention showed that regimens of clopidogrel plus reduced-dose regimens of rivaroxaban demonstrated lower bleeding and similar rates of stroke and adverse cardiac events compared with traditional warfarin triple therapy.

SOURCES: Gibson CM, Mehran R, Bode C, et al. Prevention of bleeding in patients with atrial fibrillation undergoing PCI. *N Engl J Med* 2016;375:2423-2434.

Jolly SS, Natarajan MK. Atrial fibrillation and PCI — Do we still need aspirin? *N Engl J Med* 2016;375:2490-2492.

Patients requiring long-term antithrombotic therapy have long presented a safety problem post-percutaneous coronary intervention (PCI). The guideline-directed addition of dual antiplatelet therapy (DAPT) to anticoagulation with either warfarin or one of the new oral anticoagulant (NOAC) drugs carries a significant hazard of serious bleeding that can be several times that posed by the anticoagulant alone. Until recently, strategies to reduce bleeding in this population have received limited attention in clinical trials. In addition, there has been virtually no trial information regarding the safety of NOAC use in the post-PCI setting. The PIONEER AF-PCI trial is the first in a much-anticipated series of trials to tackle this problem.

The trial investigators enrolled 2,124 patients presenting with nonvalvular atrial fibrillation who underwent PCI with stent placement. Patients were randomized 1:1:1 to one of three treatment regimens. In each case, the investigators pre-specified the intended duration of DAPT (one, six, or 12 months) depending on clinical scenario, and patients were distributed evenly among the three groups, depending on DAPT duration. Patients in group one received rivaroxaban at a dose of 15 mg daily, along

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with a single standard-dose P2Y12 inhibitor (of which clopidogrel represented the majority). Aspirin was withheld in all group one patients after randomization. Patients in group two received DAPT in addition to rivaroxaban at a dose of 2.5 mg twice daily, which corresponds to the regimen used in the low-dose arm of the ATLAS2 TIMI 51 trial. Group three patients received full-dose warfarin (international normalized ratio goal, 2-3) in addition to standard DAPT. Both rivaroxaban groups used reduced dosing compared with the approved dose for nonvalvular atrial fibrillation. The standard dosing for such patients with preserved renal function is 20 mg once daily. The primary safety endpoint was the occurrence of clinically significant bleeding during the trial medication period. Major adverse cardiac events (MACE), including cardiac death, myocardial infarction, stroke, and stent thrombosis, were included as secondary endpoints.

The rates of clinically significant bleeding were lower in the two rivaroxaban arms compared with the warfarin group. At 12 months, bleeding rates were 16.8% in group one, 18.0% in group two, and 26.7% in group three (hazard ratio [HR] for group one vs. group three, 0.59; 95% confidence interval [CI], 0.47-0.76; $P < 0.001$; HR for group 2 vs. group 3, 0.63; 95% CI, 0.50-0.80; $P < 0.001$). The majority of these events met criteria for neither TIMI major nor TIMI minor bleeding, but fell under the category of bleeding requiring medical attention. Although early discontinuation rates were > 20% in each group, results were not significantly different in the modified intention-to-treat analysis. MACE rates were low and were not significantly different among the three groups: 6.5% in group one, 5.6% in group two, and 6.0% in group three. Stent thrombosis was rare, occurring in five patients (0.7%) in group one, six patients (0.9%) in group two, and four patients (0.6%) in group three. The authors concluded that in patients with atrial fibrillation post-PCI with stent placement, the studied regimens, including low-dose or very low-dose rivaroxaban, conferred a significantly lower risk of clinically important bleeding compared to standard triple therapy with full-dose warfarin. Although the efficacy endpoints of MACE and stent thrombosis were similar among groups, the authors cautioned that statistical power was insufficient to evaluate these events.

■ COMMENTARY

Kudos to the study team for contributing significantly to the knowledge base in this area, and for performing the first randomized study of a NOAC agent in atrial fibrillation patients post-PCI. The studied rivaroxaban regimens, as compared with triple therapy, reduced bleeding without an apparent increase in stroke or myocardial infarction. Warfarin always was slated to lose this contest, and as a matter of trial design was set up to fail. Only warfarin was used at full dose, and on a background of full DAPT. On the other hand, rivaroxaban was used either in a reduced 15 mg dose with aspirin omitted, or at a very low dose on a background of DAPT. There was no WOEST trial-like strategy of omitting aspirin in a warfarin arm. It should come as no surprise that reducing the anticoagulant dose and omitting aspirin from the regimens would reduce bleeding. In this trial, that was powered only for bleeding; therefore, it should come as no surprise that the watered-down rivaroxaban regimens came out on top. The lack of a WOEST-like arm was a significant shortcoming. Notably, WOEST also showed a reduction in MACE and all-cause mortality with warfarin, which was not demonstrated in this trial with rivaroxaban, although WOEST was a smaller trial.

The very low-dose rivaroxaban group was administered on a background of DAPT. It is unclear if the addition of this dose of rivaroxaban produces additional efficacy over DAPT alone for prevention of stroke in atrial fibrillation. As was demonstrated in the ATLAS2 trial, however, it certainly increases bleeding. In this vein, we should note that approximately 10% of the patients were classified as exhibiting CHA_2DS_2-VASc scores of 0 or 1, and typically would not be treated with anticoagulant therapy. The clustering of patients in the lower stroke risk categories again skews the results in favor of lower-intensity and, therefore, lower bleeding risk regimens, with little chance

that a stroke difference will be detected. The authors emphasized that the study was underpowered for efficacy (detection of stroke and cardiac events) endpoints. The authors estimated that a sample size of more than 13,500 patients per group — nearly 41,000 patients total — would be required to reach 90% power to detect a 15% difference between treatment groups in terms of MACE.

Despite these flaws, this trial demonstrates that in average PCI patients, rivaroxaban and clopidogrel without aspirin exhibits an acceptable baseline level of safety. An accompanying editorial asked pointedly whether aspirin is still necessary for atrial fibrillation patients post-PCI. I agree with their assertion that cardiologists should individualize therapy on the basis of each patient's balance of risk for bleeding and stent thrombosis. At least three other NOAC studies are in the works for this population. Of these, the most eagerly anticipated is the AUGUSTUS trial, which is the largest study in this group and pits apixaban against warfarin in a 2x2 design in combination with either aspirin or placebo. Until then, PIONEER has added to the array of options for patients in this challenging group. ■

ABSTRACT & COMMENTARY

Orbiting the Truth of Heart Failure Incidence and Implications in Those with Prevalent Atrial Fibrillation

By Cara Pellegrini, MD

Assistant Professor of Medicine, University of California, San Francisco; Cardiology Division, Electrophysiology Section, San Francisco VA Medical Center

Dr. Pellegrini reports no financial relationships relevant to this field of study.

SYNOPSIS: Patients presenting with atrial fibrillation are at elevated risk for the development of heart failure, typically with preserved ejection fraction, which is associated with increased risk of death and hospitalization.

SOURCE: Pandey A, Kim S, Moore C, et al. Predictors and prognostic implications of incident heart failure in patients with prevalent atrial fibrillation. *JACC Heart Fail* 2017;5:44-52.

Atrial fibrillation (AF) and heart failure (HF) frequently coexist because of shared risk factors and pathophysiological mechanisms. Causality is likely bidirectional and complex. Their concurrence is associated with poor outcomes. Yet, there has not been the same focus of attention on risk stratification and prevention of HF in AF patients, as for other outcomes, such as stroke.

An important step toward that goal is the development of a greater understanding of what AF population subset is at the highest risk of developing HF. Pandey et al used a national, community-based registry of outpatients with AF (ORBIT-AF) to examine predictors and outcomes of incident HF. In addition to the primary outcome of HF incidence, they examined all-cause death, all-cause hospitalization, stroke/thromboembolism, and bleeding events. They collected demographic and medical history data, as well as insurance status, treatment strategy, and quality-of-life information. Patients presenting with prevalent HF at time of enrollment were excluded, although this did not include patients with asymptomatic systolic or diastolic dysfunction or moderate-to-severe left ventricular hypertrophy (subclinical stage B HF); these patients were excluded in a sensitivity analysis.

The study population was largely elderly (> 70 years of age) and white, nearly half female, and mostly hypertensive with normal left ventricular ejection fraction. Of the 6,545 participants, 236 (3.6%) developed HF over a two-year follow-up period, for a rate of 1.58 per 100 person-years, markedly higher than that reported in the general population (0.2-1 per 100 person-years). Although 64% of those who developed HF had a preserved ejection fraction (HFpEF), only 13.5% exhibited a documented drop in their ejection fraction (HFrEF); and 22.5% could not be classified due to missing ejection fraction information. Not surprisingly, older age, history of coronary artery disease, renal dysfunction, and significant valvular disease were independent predictors of HF incidence. Additionally, permanent AF, AF that is sustained and accepted by physician and patient (more end-stage AF), was associated with a 60% higher risk of HF than paroxysmal AF, and there was

a 7% increased incidence of HF for each beat/minute increase in baseline heart rate. Those who developed HF experienced significantly higher rates of all-cause death, all-cause hospitalization, and bleeding hospitalization specifically. The authors concluded that incident HF in AF is relatively common, more likely HFpEF, predicted by AF-specific clinical characteristics, as well as traditional HF risk factors, and associated with poor long-term outcomes.

■ COMMENTARY

Particularly in the absence of a reduction in ejection fraction, it can be difficult to discern the true onset of heart failure in patients presenting with concomitant AF. AF alone can cause exercise limitation, left atrial enlargement, and elevation of biomarkers, such as NT-proBNP. Given the admitted inclusion of patients with subclinical stage B HF and the one-third to one-half of patients receiving diuretics at baseline, this study may have been identifying those in whom AF aided progression from subclinical to overtly clinical HF more than truly de novo HF cases. Nonetheless, the identification of a vulnerable subset of patients within the larger AF cohort is of value, as the number of people affected by these extremely prevalent conditions continues to increase.

The effect of insufficient ventricular rate control on the development of heart failure in AF patients has been debated. Although the RACE-2 (The Rate Control Efficacy in Permanent Atrial Fibrillation: a Comparison between Lenient versus Strict Rate Control II) trial did not demonstrate an increase in HF incidence in the lenient rate-control arm, there has been ongoing criticism that the study was underpowered and did not allow a long enough follow-up period to detect a potential difference. The current registry-based study cannot ascribe causality, but does raise concerns that in the described setting — elderly patients demonstrating renal dysfunction, coronary artery disease, and more advanced AF — perhaps more stringent rate control should be considered.

There is a growing movement in AF management to treat AF earlier in the disease course and more aggressively. This appears to be all the more true in the HF population, as we have previously discussed, who appear to have all the more to gain with a rhythm control, and, specifically, an ablation-based strategy. In the current study, antiarrhythmic drug use was similar between the two groups, but there was a trend toward more catheter ablation in the group without incident HF. Additional work is needed to determine the effect of risk factor modification, including AF ablation, on HF development, but this study adds to the mounting evidence supporting the idea that halting the process of AF-induced electrical and mechanical atrial remodeling may lead to beneficial effects for mitigating the stressors that cause HF. ■

ABSTRACT & COMMENTARY

A New Risk Score for Stroke in Atrial Fibrillation

By Michael H. Crawford, MD, Editor

SYNOPSIS: A new, simpler score for stroke risk prediction in atrial fibrillation patients uses biomarkers to supplant many clinical variables and outperforms the CHA_2DS_2-VASc score in two large cohorts.

SOURCE: Oldgren J, Hijazi I, Lindback J, et al. Performance and validation of a novel biomarker based stroke risk score for atrial fibrillation. *Circulation* 2016;134:1697-1707.

Current guidelines recommend the use of the CHA_2DS_2-VASc score to risk stratify patients with atrial fibrillation (AF) for stroke risk. This score is composed entirely of clinical variables. A newer score, ATRIA, also includes a measure of renal function. Since certain biomarkers have been shown to be powerful risk predictors, investigators derived a new risk score that included biomarkers from the almost 15,000 patients in the ARISTOTLE trial (apixaban vs. warfarin in AF). This new score was called ABC for Age, Biomarkers (NT-proBNP and high-sensitivity troponins), and Clinical history of prior stroke. In this population, it outperformed the CHA_2DS_2-VASc score. The purpose of this study was to validate that the ABC score in the RE-LY trial (dabigatran vs. warfarin), which included more than 8,000 patients at 951 sites in 44 countries who had AF and at least one clinical risk factor for stroke. Baseline patient characteristics for RE-LY and ARISTOTLE were similar, except that median age (72 years) was higher in RE-LY. There were 219 adjudicated strokes or systemic embolism events, or 1.36 per 100 patient years. Stroke risk groups were predefined as low (0-1% per year), medium (1-2%), or high (> 2%). Stroke rate for the low-risk group was 0.76 per 100 patient years, 1.48 for medium risk, and 2.6 for high risk.

These results were similar when troponin I or T were used. The ABC score outperformed CHA_2DS_2-VASc (C index 0.65 vs. 0.60) and ATRIA (0.61). Also, the ABC score identified patients at higher and lower risk within each risk category in the CHA_2DS_2-VASc and ATRIA scores, including those with a CHA_2DS_2-VASc scores of 0-2. The authors concluded that the biomarker-based ABC score should be considered a superior tool for decisions regarding anticoagulant use in AF.

■ COMMENTARY

It was hard enough to remember what $CHADS_2$ stood for, and then the newer and better CHA_2DS_2-VASc came along. So if for no other reason, this new ABC score is much easier to remember; however, it is not a simple 1-2 points each, add them up kind of score. It is a complicated nomogram that cannot be stored in your head unless you are some kind of savant. There is an online calculator (http://bit.ly/2jgavO1), but it only uses troponin T, so if your hospital uses troponin I, like mine does, you are out of luck. Also, the website offers a calculator for the ABC bleeding score, which has been shown to be superior to the HAS-BLED and the ORBIT-AF bleeding scores, but it requires growth differentiation factor-15 or cystatin blood levels, which are not routine tests in many laboratories, including mine.[1] In addition, the ABC risk score for stroke uses NT-proBNP, and my hospital uses BNP. Thus, I can't use either score conveniently. Perhaps in the future these, and other less common biomarkers will be available more readily as the clinical utility of so-called proteomics catches on. Analyzing DNA has been a major disappointment clinically, and current risk prediction researchers now focus on proteins. This study clearly showed that by just measuring two biomarkers, the clinical predictors of sex, hypertension, diabetes, and other cardiovascular disease no longer provide incremental value.

The strengths of this study included the large derivation and validation cohort sizes. Also, the score is well-calibrated, as the prediction of events was similar in both cohorts. The major weakness of this study is that all the patients in RE-LY and half the patients in ARISTOTLE were on anticoagulants. How do you apply the score clinically? Will it be as accurate in a population that has not been started on anticoagulants? If someone exhibits a low-risk score on anticoagulants, can you stop them? If someone demonstrates a high score on anticoagulants, do you do something else, such as left atrial exclusion? Another issue is that biomarkers can change over time. Should you calculate the score periodically and adjust treatment accordingly? Further study seems to be necessary to use the ABC score clinically. However, the authors noted that placebo-controlled trials of oral anticoagulants in AF are no longer ethical, so any new knowledge gained will be limited by this constraint. At this point, I'm going to stick with CHA_2DS_2-VASc until something clearly better clinically and easier to use comes along. Thank goodness for online and smartphone applications to calculate these scores. ■

REFERENCE

1. Hijazi Z, Lindbäck J, Alexander JH, et al. The ABC (age, biomarkers, clinical history) stroke risk score: A biomarker-based risk score for predicting stroke in atrial fibrillation. *Eur Heart J* 2016;37:1582-1590.

ABSTRACT & COMMENTARY

Utility of Serial Coronary Calcium Scores

By Michael Crawford, MD, Editor

SYNOPSIS: Researchers determined recently that if serial scans are performed, the most recent scan should be used for risk assessment, and the degree of CT calcium score progression adds no further prognostic information.

SOURCES: Radford NB, DeFina LF, Barlow CE, et al. Progression of CAC score and risk of incident CVD. *JACC Cardiovasc Imaging* 2016;9:1420-1429.

Shah PK. Temporal change in CAC score and prognosis: Follow-up score is simpler and as good as a change in score. *JACC Cardiovasc Imaging* 2016;9:1430-1431.

Hecht H, Chandrashekhar Y, Narula J. Coronary artery calcium progression and residual risk. *JACC Cardiovasc Imaging* 2016;9:1477-1479.

The clinical utility of repeat coronary CT calcium scores (CAC) in patients at risk of coronary heart disease (CHD) is unclear. Thus, investigators from the Cooper Clinic in Dallas evaluated the prospective Cooper Center Longitudinal Study database to answer this question. Since 1998, CAC was included in the clinical evaluation of patients enrolled in this study. Because the CT equipment

changed significantly in 2007, only CAC data to that time are included in this analysis. Among these patients, more than 8,000 underwent at least two visits with CAC; follow-up information was available on 80% of them. Patients were excluded if they experienced revascularization within 90 days of their CT scan or between CT scans, if they suffered a cardiovascular event before their scan, or if CAC regressed by > 50 Agatston units. The final population studied was 5,933 prevention patients who were largely white and well-educated. In addition to clinical data and basic blood tests, each patient was subjected to a maximum Balke-type treadmill exercise test. Deaths were determined by the National Death Index Service and Medicare data. Other cardiovascular (CV) events were ascertained by a mailed survey, and nonresponders were contacted by phone. Hospital records were then obtained and the events adjudicated by two independent cardiologists. A CAC score > 0 was found in 48% of the subjects. The average time to the second scan was 3.5 years. Those with a CAC score were older, had a higher blood pressure and lower cardiorespiratory fitness, and were more often on a statin. After a mean follow-up of seven years after their second scan, 161 of those with CAC experienced a cardiovascular event. This rate was higher than observed in those without baseline CAC (7.7 vs. 1.4 events/1,000 patient years; $P < 0.001$). In those without CAC at baseline who developed CAC at the second scan, CV event rates were no different than those who maintained a 0 score. Progression of CAC was associated with CV events (hazard ratio [HR], 1.14; 95% confidence interval [CI], 1.01-1.3; P = NS) in the model that included baseline CAC, but the incremental contribution of CAC progression was small relative to the baseline CAC (chi-square 4.2 vs. 66.0). Also, CAC progression was not associated with CV events in the model using the second CAC score (HR, 1.05; 95% CI, 0.92-1.21; P = NS). The model using follow-up CAC alone predicted CV events as well as the model using baseline and progression. Adjustment for other clinical variables did not change these results. The authors concluded that if serial scans are performed, the most recent scan should be used for risk assessment, and the degree of CAC progression adds no further prognostic information.

■ COMMENTARY

Frequently, I see patients who have undergone a CAC in the past and now want to know if they should undergo another one to assess their progress. Since we know atherosclerosis is dynamic and often progressive, this would seem to make sense. However, current guidelines do not recommend serial CAC studies. In fact, performing CAC is a IIb recommendation in those whom the new pooled risk equation shows borderline risk. CAC clearly predicts CV events as well or better than any other approach, but unless it will change management, there is little reason to conduct a relatively expensive test with some radiation exposure, when there are other less expensive and less invasive ways to accomplish the same thing. The value of repeat or serial testing also has been explored in other studies, with mixed results. It has been concluded that atherosclerotic disease progression is inevitable, genetic, and related to the initial CAC. Several studies have shown an increase in CAC, but a paradoxical decrease in CV events. Other studies have shown that high-dose statins can reduce CAC and presumably events. These interstudy differences may relate to the stage of the disease process. It could be that in some situations, increasing CAC actually represents plaque healing and stabilization, which could be a good thing. Thus, the interpretation of changes over time in the CAC is unclear.

This study further reduces enthusiasm for serial studies. It shows that an increase in CAC over time increases risk compared to the first CAC, but not enough to overcome the predictive accuracy of the second scan alone. This result stood up no matter which of the several methods of measuring a change in CAC was used. Also, the authors considered all CV events, not just coronary events. The robust conclusion was that if your patient receives a second scan, you need only consider those results, and you don't need to consider changes from the first scan.

There are weaknesses in this study. It involved a homogeneous population that was not randomly selected. There was a relatively short interval between the two scans (mean 3.5 years). There was no information on the details of risk factor reduction therapy. Electron beam CT was used, not the current multidetector CT. There was no follow-up in 20% of subjects. The authors excluded patients with large reductions in CAC between scans. There were a few hard endpoints observed (coronary death, myocardial infarction, and stroke; n = 55), and although the same trends were seen, CAC prediction of hard events was not statistically significant. Finally, there are no details on plaque morphology, which may be an important determinant of outcomes.

This leaves us with the question of how to measure the results of the risk-reduction therapy besides waiting for events since CAC does not seem to be the answer, and the jury is still out on low-density lipoprotein cholesterol levels. ■

ABSTRACT & COMMENTARY

Troponin Highly Prognostic in Decompensated Heart Failure with Preserved Ejection Fraction

By Van Selby, MD

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Dr. Selby reports no financial relationships relevant to this field of study.

SYNOPSIS: Among patients with acute decompensated heart failure and preserved ejection fraction, elevated troponin is associated with worse in-hospital outcomes and long-term survival, independent of other predictors.

SOURCE: Pandey A, Golwala H, Sheng S, et al. Factors associated with and prognostic implications of cardiac troponin in decompensated heart failure with preserved ejection fraction: Findings from the American Heart Association Get With The Guidelines-Heart Failure Program. *JAMA Cardiol* 2016;Dec 28. [Epub ahead of print].

Serum troponin is a well-established biomarker in both ischemic heart disease and heart failure with reduced ejection fraction (HFrEF). The prognostic significance of elevated troponin in patients presenting with decompensated heart failure with preserved ejection fraction (HFpEF) is not well studied.

In a retrospective analysis of the Get With The Guidelines-HF registry, Pandey et al evaluated all participants admitted for decompensated HFpEF (defined as an ejection fraction ≥ 50%) who exhibited at least one troponin level (either troponin T or I) measured from January 2009-December 2014. The primary outcome was in-hospital, all-cause mortality. Secondary outcomes included post-discharge mortality and readmission rates.

Of 96,769 patients hospitalized for decompensated HFpEF, 34,233 (35.0%) submitted to troponin level measurements and were included in the analysis. Of those, 7,732 (22.6%) demonstrated elevated troponin. Predictors of elevated troponin included higher serum creatinine, black race, older age, and ischemic heart disease. In adjusted analyses, elevated troponin was associated with increased in-hospital mortality (odds ratio [OR], 2.19; $P < 0.001$), longer than four-day hospital stay (OR, 1.38; $P < 0.001$), and eventual discharge to home (OR, 0.65; $P < 0.001$). Post-discharge outcomes also were worse among those with elevated troponin, with increased 30-day (OR, 1.59; $P < 0.001$) and one-year mortality (OR, 1.35; $P > 0.001$). The prognostic significance of troponin was independent of serum B-type natriuretic peptide (BNP) level and remained significant among patients without coronary artery disease. The authors concluded that troponin elevation is associated with poor in-hospital and long-term clinical outcomes among patients hospitalized for decompensated HFpEF, suggesting a role for early troponin assessment in this patient population.

■ COMMENTARY

HFpEF is a heterogenous disease. Recent studies have attempted to categorize HFpEF into distinct subgroups based on clinical characteristics, pathophysiology, and outcomes. Hopefully, this work will lead to individualized management of HFpEF based on a patient's particular phenotype. For now, this phenotypic diversity has made it difficult to identify effective treatments for HFpEF. Similarly, there are few tools for prognostication in HFpEF. For this reason, the findings of Pandey et al are important. Serum troponin appears to be highly prognostic in acute HFpEF, regardless of the exact phenotype, making it a potentially useful test that is easy to implement in routine clinical care.

Current practice guidelines assign a Class I recommendation to measuring serum troponin levels in patients admitted for decompensated heart failure. In this study, only 35% of patients submitted to a troponin level check at any time during hospitalization, meaning the recommendation is not widely followed in practice. This study increases the evidence base supporting this recommendation and expands the demonstrated prognostic utility of troponin to include patients with preserved EF. It is also important to note the prognostic utility of troponin was independent of BNP, which is more commonly used in the acute heart failure setting. Checking troponin levels could help clinicians identify acute HFpEF patients who require more aggressive monitoring and treatment during hospitalization, as well as closer follow-up after discharge.

There are important limitations to this study. Unmeasured confounding is a significant concern in a retrospective, registry-based study. The study authors only could evaluate patients in whom troponin was measured, and these patients may have differed from the broader acute HFpEF population in unmeasured ways. Also, it is possible some troponin elevations were actually due to acute coronary syndromes (although these patients should have been excluded from this registry). Therefore, some of the increased morbidity and mortality in patients with elevated troponin may have been related to ischemic disease rather than HFpEF.

In light of these findings and the current Class I recommendation to measure troponin levels in patients hospitalized for acute heart failure, is it time to start checking troponin in all patients presenting with decompensated HFpEF? The authors concluded their findings "suggest a role of early troponin assessment as an important risk stratification tool during the initial evaluation" of acute HFpEF. Although better early risk stratification theoretically may lead to improved patient care and outcomes, it is important to remember this study did not specifically demonstrate the utility of this strategy. Routine measurement of troponin will increase costs and potentially could lead to increased use of diagnostic testing such as coronary angiography in patients found to exhibit elevated troponin. Whether this strategy ultimately will improve outcomes remains to be seen. For now, measurement of serum troponin in acute HFpEF is appropriate when improved risk stratification would influence clinical decision-making. ■

CME/CE QUESTIONS

1. **In patients with two CT calcium score determinations, which of the following is the most valuable prognostically?**
   a. The score on the first test
   b. The score on the second test
   c. The difference in scores between the two tests
   d. The first score and the difference

2. **New research suggests which of the following tests may add significantly to the estimation of stroke risk in atrial fibrillation?**
   a. NT-proBNP
   b. High-sensitivity troponin
   c. Both
   d. Neither

3. **Heart failure in atrial fibrillation patients is usually associated with:**
   a. a rapid heart rate.
   b. preserved left ventricular ejection fraction.
   c. permanent atrial fibrillation.
   d. All of the above

4. **A recent trial of rivaroxaban and single or dual antiplatelet therapy vs. warfarin with dual antiplatelet therapy after percutaneous coronary intervention in patients with atrial fibrillation showed that the rivaroxaban arms reduced:**
   a. major bleeding events.
   b. stent thrombosis.
   c. major adverse cardiac events.
   d. All of the above

5. **In patients hospitalized for heart failure with preserved left ventricular ejection fraction, troponin levels predicted:**
   a. a longer length of stay.
   b. higher hospital mortality.
   c. higher long-term mortality.
   d. All of the above