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Clinical Cardiology [ALERT]

Critical analysis of the latest clinical research in cardiovascular medicine

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ABSTRACT & COMMENTARY

Weight Loss to Make You Feel Better, Live Longer, and Lower Your Risk of Atrial Fibrillation

By Joshua D. Moss, MD

Associate Professor of Clinical Medicine, Cardiac Electrophysiology, Division of Cardiology, University of California, San Francisco

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

SYNOPSIS: Significant and sustained weight loss through bariatric surgery reduced the risk of developing new-onset atrial fibrillation in a Swedish cohort of obese individuals.

SOURCE: Jamaly S, Carlsson L, Peltonen M, et al. Bariatric surgery and the risk of new-onset atrial fibrillation in Swedish obese subjects. *J Am Coll Cardiol* 2016;68:2497-2504.

Obesity is an emerging global epidemic and a well-described risk factor for atrial fibrillation (AF), with a 4-5% increased risk of incident AF per unit increase in body mass index (BMI). Given its independent association with stroke and heart failure, AF may play a role in higher morbidity and mortality seen in overweight individuals. In patients with AF, weight loss in the short term is associated with a reduction in symptomatic AF burden, and aggressive weight and risk factor management improves maintenance of sinus rhythm after AF ablation. Long-term sustained weight loss also is associated with significant reduction in AF burden, particularly with a loss of ≥ 10% body weight. Although intensive lifestyle intervention with modest weight loss has not been shown to produce a significant effect on rates of new-onset AF, the effect of more significant weight loss had not been studied previously.

The Swedish Obese Subjects (SOS) study is an ongoing prospective, controlled intervention trial of 4,047 patients between 37 and 60 years of age. Subjects were enrolled between 1987 and 2001 and

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had a BMI ≥ 34 kg/m^2 for men or 38 kg/m^2 for women. An intervention group of 2,010 patients underwent bariatric surgery, while a control group of 2,037 patients who chose conventional therapies was selected via an automatic matching program based on 18 variables. Although incident AF was not a predefined endpoint of the study, AF data were available from the Swedish National Patient Register, allowing 4,021 patients without baseline AF to be identified and analyzed for this study (2,000 undergoing bariatric surgery and 2,021 treated conventionally).

The study groups were not perfectly matched, with a significantly higher baseline BMI in the surgical group as well as more hypertension, diabetes, and smoking. Surgical patients also were on average 18 months younger than conventionally treated patients. Mean weight reduction in the surgical group was 25% by one year and 18% at 20 years, while the control group experienced no significant weight change over two decades. The significant weight loss in the surgical group was independently associated with a 31% reduction in new-onset AF over a median follow-up of 19 years after adjustment for selected baseline variables. Other conditions independently associated with reduced risk included younger age, shorter height, lower BMI, lower blood pressure, lower alcohol intake, and lower thyroxin levels. The effect of bariatric surgery on reducing new-onset AF was conserved largely among subgroups, although patients younger than 47.7 years benefited more than older patients, and patients with diastolic blood pressure (DBP) ≥ 88 mmHg benefited more than those with lower DBP. The authors concluded that sustained weight loss after bariatric surgery compared to usual care reduced the risk of new-onset AF.

■ COMMENTARY

Clearly, not all obese patients will be eligible for or interested in bariatric surgery, but, nevertheless, this study has important implications for patient care and researchers. Under the reasonable assumption that the relevant effect of bariatric surgery is predominantly loss of weight, the ability to achieve and maintain dramatic weight loss is associated with a significant reduction in new-onset AF. Some important questions to consider include: Was the SOS cohort representative of our typical obese patient population? Were the two groups matched well enough in this observational study to correctly attribute the large difference in outcomes to the surgery and attendant weight loss? What nonsurgical strategies can be developed to achieve the weight loss needed to affect arrhythmia burden?

The prevalence of an AF diagnosis at baseline in this cohort patients 37-60 years of age was 26 of 4,047 (0.6%), comparable to that found in prior studies of unselected patients, such as ATRIA. The overall incidence of new AF over a median follow-up of 19 years was 587 of 4,021 (14.6%), a relatively high risk compared to the general population and further supporting the idea that obese patients should be targeted specifically for risk-reduction strategies.

The intervention and control groups had several significant differences in baseline characteristics, which the authors believed were probably explained by disparate weight changes in the two groups during the sometimes-long period between matching and baseline measurements. When controlling for these characteristics statistically, weight loss remained independently associated with lower incidence of AF. However, it might be expected that other characteristics for which the authors did not control could have influenced the results — both behavioral (such as motivation to exercise and follow medical recommendations) and clinical (such as likelihood for caregivers to recommend and encourage surgical management). Nevertheless, the effect of weight loss was profound, particularly among younger patients for whom there was perhaps a better chance of significant reverse atrial remodeling.

The major challenge raised by this study is how to achieve the kind of weight loss necessary to affect AF risk without committing all patients to bariatric surgery. In the meantime, this is another strong motivator for clinicians to highlight for patients who want to lose weight. ■

ABSTRACT & COMMENTARY

ECG Screening of Athletes

By Michael H. Crawford, MD, Editor

SYNOPSIS: This study of almost 15,000 young caucasian subjects that included 32% women and 20% athletes showed that T-wave inversion in ECG leads V1 and 2 is a normal variant. T-wave inversions extending beyond V2 are rare and may warrant further evaluation, but in this study no such individuals exhibited cardiac abnormalities.

SOURCES: Malhotra A, Dhutia H, Gati S, et al. Anerior T-wave inversion in young white athletes and nonathletes prevalence and significance. *J Am Coll Cardiol* 2017;69:1-9.

Kirchhof P, Fabritz L. Anterior T-wave inversion does not convey short-term sudden death risk: Inverted is the new normal. *J Am Coll Cardiol* 2017;69:10-12.

ECG T-wave inversions (TWI) in the anterior precordial leads generally are considered abnormal, but precise criteria are lacking. Investigators from England analyzed a convenience population of 14,646 young (16-35 years of age), Caucasian, apparently healthy adults (32% women), which included 2,950 (20%) athletes. Although not sponsored by the National Health Service, several elite sporting organizations in England underwrote annual medical testing of their member athletes through the charitable organization CRY (cardiac risk in the young). The CRY also tested any young adult who desired testing. The evaluation included history, physical examination, ECG, and referral for further testing in those with abnormal findings or designated as research controls. Subjects with cardiac symptoms and a history or family history of cardiac disease or premature sudden cardiac death or complete right bundle branch block were excluded. All subjects in this population underwent echocardiography, and those with abnormal ECGs were subjected to ambulatory ECG monitoring, exercise testing, signal averaged ECG, or cardiac MRI. Those with TWI in two or more contiguous anterior precordial leads (V1-4) were considered abnormal, and this was discovered in 338 (2.3%) subjects. It was more common in women (4.3%) than men (1.4%; $P < 0.0001$) and in athletes compared to nonathletes (3.5% vs. 2%; $P < 0.0001$). In athletes, it was more common with endurance athletes than strength athletes. It was confined to leads V1-V2 in 77% of all cases, with only 78 (0.5%) showing TWI beyond V2. Echocardiography in 338 of the abnormal TWI subjects (103 athletes, 235 nonathletes) were compared to 1,848 (1,079 athletes) without anterior TWI. No differences in cardiac structure or function were detected. Cardiac MRI was performed in 250 with anterior TWI. No evidence of arrhythmogenic right ventricular cardiomyopathy (ARVC), hypertrophic cardiomyopathy (HCM), dilated cardiomyopathy, or myocardial scar were detected. During the mean follow-up of 23 months, no one with anterior TWI experienced a cardiac event. The authors concluded that TWI confined to ECG leads V1-V2 is a normal variant, but TWI beyond V2 is rare and may warrant further investigation.

■ COMMENTARY

ECG anterior precordial TWI has been suggested as a screening tool for the further evaluation of otherwise healthy adults because it is common in ARVC, HCM, and other cardiomyopathies. Since the European Society of Cardiology (ESC) recommended ECG screening in all pre-participation sports health examinations, it is a trigger finding for further testing. However, it is known to be more common in athletes, especially those of Afro-Caribbean origin and, thus, its value is questionable. Also, there are little data in Caucasians about this finding. Therefore, this study from the United Kingdom is of interest. The strength of the study is its large size (almost 15,000), reasonable proportion of women (32%) and athletes (20%), and the liberal use of further testing in those with anterior TWI (echo 100%), cardiac MRI (74%), signal-averaged ECG (93%), ambulatory ECG monitoring (87%), and exercise ECG testing (81%). Also, the anterior TWI group was followed for two years. In addition, the ECGs were performed correctly using the American Heart Association-recommended submammary lead placement in women, rather than the often-performed placement of V3-6 below the brassiere. It was not a randomized trial and may have suffered from selection bias, but the large size partially mitigates this limitation. Finally, ARVC is believed to be accelerated by exercise, so we cannot exclude that the anterior TWI is not an early sign of disease that cannot be confirmed by imaging yet. Although no events occurred during two years of follow-up, this was a cross-sectional study and no further imaging was conducted after the baseline testing.

The results support the Seattle consensus recommendations to consider further evaluation only if the TWI goes beyond V2, rather than the ESC recommendation of beyond V1. However, ARVC is more common in continental Europe, especially Italy, than

in the United Kingdom or the United States, which may justify more sensitive criteria. The trade-off is lower specificity, which is a problem because of the unnecessary anxiety, delay of participation, and cost of pursuing further testing. In fact, these investigators do not even strongly recommend further testing when the TWI is beyond V2, because no one with anterior TWI in their study was found to have a cardiomyopathy. Of course, those with symptoms or signs or a family history of cardiac disease were excluded.

Thus, one could argue that these criteria are worthless. In fact, this very lack of specificity is why the American Heart Association still does not recommend ECG screening for pre-participation evaluation of asymptomatic athletes without a family history or physical exam findings suggestive of heart disease. The accompanying editorial concludes that we need better tools to exclude these rare cardiomyopathies. I agree. ■

ABSTRACT & COMMENTARY

Mechanical Circulatory Support in Cardiogenic Shock: Can Any Device Move the Mortality Needle?

By Jeffrey Zimmet, MD, PhD

Associate Professor of Medicine, University of California, San Francisco; Director, Cardiac Catheterization Laboratory, San Francisco VA Medical Center

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

SYNOPSIS: In a small randomized trial of patients with cardiogenic shock secondary to acute myocardial infarction, the Impella heart pump failed to improve mortality compared with intra-aortic balloon counterpulsation.

SOURCE: Ouweneel DM, Eriksen E, Sjauw KD, et al. Percutaneous mechanical circulatory support versus intra-aortic balloon pump in cardiogenic shock after acute myocardial infarction. *J Am Coll Cardiol* 2017;69:278-287.

Despite major advances in coronary revascularization techniques and medical therapy, mortality rates for cardiogenic shock complicating acute myocardial infarction have not changed substantially over more than a decade. Indeed, 30-day mortality in the original SHOCK trial (published in 1999) averaged approximately 50%, and this remains a fairly accurate estimate today. The failure of intra-aortic balloon counterpulsation to change mortality in the 2012 IABP-SHOCK II trial has led to increased interest in potentially more effective mechanical support devices.

The Impella device is a minimally invasive ventricular support device that sits across the aortic valve, resting in the left ventricle and providing positive forward flow. The currently available Impella CP has a maximum output of 3.7 L/minute, and in most cases can be inserted from the femoral arterial approach. Prior trials have demonstrated that the Impella can be implanted safely in cardiogenic shock patients and that it gives significantly greater levels of hemodynamic support compared with the intra-aortic balloon pump (IABP). Earlier trials primarily were conducted using the less-powerful Impella 2.5 system and did not target mortality as an outcome measure.

The IMPella versus IABP Reduces mortality in STEMI patients treated with primary PCI in Severe cardiogenic SHOCK (IMPRESS) trial randomized patients with severe cardiogenic shock due to ST-segment elevation myocardial infarction to treatment with either IABP or the Impella CP device. This was a modest-sized trial and was intended to be enriched for very sick patients. To that end, only mechanically ventilated patients were included. Among the 48 patients included in the trial, 44 (92%) had suffered cardiac arrest before randomization. All patients received pressor medications, 31% received renal replacement therapy, and 75% were treated with therapeutic hypothermia.

Twenty-four patients were randomized to each group. The infarct-related artery was the left anterior descending (LAD) in 65% of patients, and 98% were revascularized successfully by percutaneous coronary intervention with stenting. The majority of patients received the assigned mchanical support. At 30 days, mortality was not significantly different between the two groups: 50% with IABP, and 46% in the Impella group (hazard ratio, 0.96; 95% confidence interval, 0.42-2.18; $P = 0.92$). Mortality at six months was 50% in each group.

The authors termed this an "explorative" randomized trial and concluded that routine use of mechanical circulatory support in patients with severe cardiogenic shock did not improve survival, compared with IABP.

■ COMMENTARY

"Explorative" is an interesting choice of words to use in a paper's conclusion, and it is worthwhile for a moment to delve into what this means. First, this was a small trial, with only 24 patients per group. To select a group with high mortality, and to increase the odds that the intervention would be able to significantly change outcomes, the investigators selected only patients who were intubated, and included primarily patients who had been resuscitated from cardiac arrest. The power calculation assumed a baseline 30-day mortality of 95% in the IABP group, which, of course, turned out to be unrealistic. However, the predictable result was the selection of a significant number of patients who had no genuine opportunity to be salvaged. Indeed, the cause of death in nearly half of patients was listed as anoxic brain injury, while only 29% died due to refractory cardiogenic shock or multi-organ failure. Although inclusion of such post-resuscitation, brain-damaged patients "resembles a real-life cohort," in the words of the authors, it does not provide much of an opportunity to demonstrate a survival advantage from a mechanical support device.

This trial highlights some disadvantages of using the Impella device. For example, bleeding was more frequent with the Impella (33% of patients) compared with IABP, and this is logical given the relatively large vascular access required (14F) and the need for continued heparin anticoagulation while the device is in place. Hemolysis was noted in 8%, which is comparable to prior reports of the device. The issue of cost is not discussed, but at more than $25,000 per catheter, it cannot be ignored, especially in the absence of a positive outcome.

So what are we to learn from these new data? Cardiogenic shock remains a major scourge, with high mortality and few proven therapies beyond percutaneous revascularization. Although mechanical circulatory support with devices like the Impella holds intuitive appeal for treatment of these patients, for now we are left without supporting data. Ultimately, larger trials with more careful patient selection will be needed to answer this question with any certainty. ■

ABSTRACT & COMMENTARY

Hemoconcentration Associated with Lower Mortality in Acute Heart Failure

By Van Selby, MD

Assistant Professor of Medicine, University of California, San Francisco, Cardiology Division, Advanced Heart Failure Section

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

SYNOPSIS: Among patients hospitalized for acute heart failure, hemoconcentration was associated with reduced 90-day mortality and may be a useful marker for guiding therapy.

SOURCE: Breidthardt T, Weidmann ZM, Twerenbold R, et al. Impact of haemoconcentration during acute heart failure therapy on mortality and its relationship with worsening renal function. *Eur J Heart Fail* 2017;19:226-236.

Decongestion is a primary goal in the management of acute heart failure (AHF), and hemoconcentration has been identified as a potential marker of decongestion. Breidthardt et al sought to evaluate the association between hemoconcentration, worsening renal function (WRF), and mortality in patients hospitalized for AHF. In a prospective cohort of 1,019 patients hospitalized for AHF at a single academic center in Switzerland, serial measurements of hematocrit, hemoglobin, total protein, creatinine, and albumin levels were made. Hemoconcentration was defined as a simultaneous increase in at least three of the four markers above admission values at any point during hospitalization. Patients with hemoconcentration were further subdivided into those achieving early (day 1-4) vs. late (day 5 or beyond) hemoconcentration. Worsening renal function (WRF) was defined as any increase of at least 0.3 mg/dL in serum creatinine at any time during hospitalization. The primary outcome was 90-day mortality.

Overall, 38.5% of patients met criteria for hemoconcentration during their hospitalization, and the median time until the occurrence of hemoconcentration was 6.3 days. There were no significant baseline clinical or demographic differences between those with and with-

out hemoconcentration. Patients with hemoconcentration had greater evidence of successful decongestion during their hospitalization as measured by change in B-type natiuretic peptide level and weight loss. After adjusting for other predictors of death, hemoconcentration was associated with reduced 90-day mortality (hazard ratio [HR], 0.59; $P = 0.01$). However, the mortality reduction was only observed in patients with late hemoconcentration (late vs. early hemoconcentration HR, 0.41; $P = 0.03$). Patients with hemoconcentration were more likely to develop WRF (37.1 vs. 30.8%; $P = 0.04$). However, patients with hemoconcentration and WRF still had lower 90-day mortality than patients without hemoconcentration. The authors concluded that hemoconcentration is an inexpensive and easily accessible measure of adequate decongestion in AHF and is associated with lower mortality.

■ COMMENTARY

Correction of hypervolemia is a mainstay of treatment for AHF. However, accurate assessment of volume status can be challenging, and often is made based on a combination of physical exam, symptoms, imaging studies, and laboratory results. Studies have found that many AHF patients ultimately leave the hospital without adequate fluid removal, contributing to high observed rates of readmission and adverse outcomes after hospital discharge. Accurate, reliable assessment of congestion has been referred to as the Holy Grail of heart failure management, and additional tools to guide treatment of AHF are needed. The concept of hemoconcentration as a clinical marker is based on the idea that successfully reducing intravascular volume must lead to an increased concentration of large intravascular molecules such as hemoglobin and albumin. Several prior studies have identified a correlation between hemoconcentration and improved outcomes after hospitalization for AHF. However, these studies often were performed in highly selected populations, without rigorous definitions for hemoconcentration. This study is among the largest to date, evaluating hemoconcentration prospectively in a real-world AHF cohort. The findings strengthen the association between hemoconcentration and reduced mortality following hospitalization for AHF. In this study, there was a clear distinction between patients who achieved early vs. late hemoconcentration. Survival among patients who achieved hemoconcentration within the first four days of hospitalization was no better than among those who did not achieve hemoconcentration. The authors suggested that patients achieving later hemoconcentration may be more likely to experience persistent hemoconcentration, and, therefore, a slow and steady approach to diuretics may be preferable.

The finding that patients with hemoconcentration are more likely to develop worsening renal failure during hospitalization has been reported previously. WRF often prompts clinicians to de-escalate diuretic therapy, and may explain why many of the "early hemoconcentrators" in this study regressed to "no hemoconcentration" by the time of discharge, and, therefore, had higher mortality compared to those with a late, sustained hemoconcentration. The authors showed the benefits of decongestion (and hemoconcentration) outweigh the risks associated with WRF, suggesting clinicians should not let a small rise in creatinine prevent them from achieving adequate diuresis in patients admitted for AHF.

The primary limitation of this study is its observational design. Although there is a clear association between hemoconcentration and improved outcomes, we cannot conclude that incorporating hemoconcentration as a therapeutic target in AHF management protocols will improve mortality. Hopefully, future studies will address this. This study adds to a growing body of literature demonstrating the prognostic value of hemoconcentration in AHF. No measurement of volume status is perfect, and hemoconcentration cannot replace other measures completely. Rather, it should be viewed as another tool to complement the current options for assessing congestion. It is a low-cost, practical, noninvasive test, and given the clear association with outcomes, clinicians should strongly consider incorporating hemoconcentration into the management of AHF. ■

ABSTRACT & COMMENTARY

High-sensitivity Cardiac Troponin

By Michael H. Crawford, MD, Editor

SYNOPSIS: In patients with new-onset chest pain without ECG evidence of an ST-elevation myocardial infarcition, conversion to the use of a high-sensitivity troponin T assay with three-hour retesting in three hospitals was compared to maintaining the fourth-generation troponin T assay with six-hour retesting in three other hospitals. The use of high-sensitivity troponin T resulted in lower ED length of stay and costs, without increasing the use of coronary angiography or stress testing.

SOURCES: Twerenbold R, Jaeger C, Rubini Gimenez M, et al. Impact of high-sensitivity cardiac troponin on use of coronary angiography,

cardiac stress testing, and time to discharge in suspected acute myocardial infarction. *Eur Heart J* 2016;37:3324-3332.

Crea F, Jaffe AS, Collinson PO, et al. Should the 1h algorithm for rule in and rule out of acute myocardial infarction be used universally? *Eur Hear J* 2016;37:3316-3323.

Januzzi JL. Troponins in equipoise. *Eur Heart J* 2016;37:3333-3334.

Although the introduction of high-sensitivity troponin assays in some health systems has decreased the time necessary to accurately diagnose an acute myocardial infarction (MI), there has been concern that its use would lead to an increase in inappropriate coronary angiography. Investigators from the Advantageous Predictors of Acute Coronary Syndromes Evaluation (APACE) study assessed the effect of switching from fourth-generation troponin T assays to high-sensitivity troponin T(hsTnT) on use of coronary angiography, cardiac stress testing, and time to ED discharge in three hospitals in Europe. Three hospitals in APACE who did not switch were used as controls. Patients in the ED with chest pain for less than 12 hours that was suggestive of acute MI were recruited. Those with ECG ST elevation MI or end-stage renal disease on dialysis were excluded. The troponin T protocol required repeat testing at six hours and the hsTnT protocol after three hours. Of the 2,544 patients entered over about six years, 57% were enrolled before and 43% after the switch. There were baseline characteristic differences in the patients between the two study periods, and there was an increase in the diagnosis of acute MI in the second period (14% vs. 10%; $P < 0.001$). Also, there was a corresponding decrease in the diagnosis of unstable angina from 14% to 9%, but the overall acute coronary syndrome (ACS) rate was unchanged (24% vs. 23%; P = NS). In addition, the discharge diagnosis of chest pain of unknown origin decreased from 48% to 38% ($P < 0.001$). The rate of coronary angiography was identical between the two phases (23%), and the rate of stress testing was similar (12% vs. 10%). Finally, ED length of stay was reduced in the hsTnT group by 79 minutes ($P < 0.001$), and costs were reduced 20% ($P = 0.002$). There were no significant changes in these parameters in the control group over the same two time periods. The authors concluded that the use of hsTnT did not increase the use of coronary angiography or stress testing, but did reduce ED length of stay and costs.

■ COMMENTARY

Current troponin assays used in the United States are imprecise at low values where the risk of missing an early non-ST segment myocardial infarction is highest. In addition to the usual clinical and ECG data, the six-hour troponin retest has been advanced to overcome this problem. The advent of high-sensitivity troponin tests has allowed for a three-hour retest protocol to perform similarly to the six-hour protocol. However, there has been resistance to adopting the three-hour test protocol because of concerns that it would generate considerable false positives and would increase costs and inappropriate coronary angiography. The adoption of the hsTnT with a three-hour protocol in three hospitals in the APACE research consortium allowed the investigators to compare their experience to experiences of the hospitals still using the standard troponin T six-hour protocol. Although not a randomized trial, the results are compelling. Coronary angiography and stress testing rates remained constant, and ED length of stay decreased significantly. There were no changes in these parameters over the same time frame in the control hospitals. The authors argued that adoption of the three-hour retest in the hsTnT protocol improved the precision of allocating patients for further testing or discharge home.

There are limitations to the study. There were baseline differences between the patients before and after the switch in the test hospitals, which the investigators adjusted for, but a propensity analysis was not performed. Also, only troponin T was studied, so the results may not be applicable to troponin I. In addition, patients with end-stage renal disease on hemodialysis were excluded. It is well known that troponin T levels are higher in such patients, which adds complexity to the use of the three-hour protocol, were it to be used more widely. Finally, there are no outcome data, so we don't know if the three-hour protocol resulted in better care.

The most recent European Society of Cardiology guidelines recommend a one-hour retest protocol with high-sensitivity troponin, which wasn't tested in this study, but there are other data supporting its use. The expected changes in high-sensitivity troponin over one hour usually will be less than that seen with three- or six-hour retest protocols, raising the concern that specificity will be less due to the difficulty in interpreting small rises in troponin. If this is the case, the one-hour protocol could increase angiography and other costs. Clearly, the barriers to high-sensitivity troponin testing are falling, and I would anticipate adoption of these tests in the United States in the near future. In appropriate patients where non-ST elevation acute MI is highly likely clinically, these tests could increase the rapidity of diagnosis and appropriate treatment. However, we know from our experience with fourth-generation troponin testing that the test will be applied widely to largely inappropriate patients, worsening the current troponimania we are dealing with now. ■

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CME/CE QUESTIONS

1. **Converting to the use of a high-sensitivity troponin T assay with a three-hour retest protocol resulted in:**
   a. more coronary angiography.
   b. fewer stress tests.
   c. higher costs.
   d. lower ED lengths of stay.

2. **In young people, ECG anterior T-wave inversion may be abnormal when present:**
   a. in V1.
   b. in V1 and V2.
   c. in V1-V3.
   d. only in V3.

3. **Sustained weight loss from bariatric surgery has been shown to decrease the incidence of new atrial fibrillation in obese patients:**
   a. < 48 years of age.
   b. with a body mass index > 40 kg/mg^2.
   c. with a diastolic blood pressure > 88 mmHg.
   d. Both a and c

4. **A comparison of Impella vs. an intra-aortic balloon pump support in post-arrest, post-percutaneous coronary intervention, intubated, cardiogenic shock patients showed that Impella use:**
   a. improved survival.
   b. increased bleeding.
   c. reduced anoxic brain injury.
   d. reduced costs.

5. **Evidence of hemoconcentration in patients treated for acute heart failure is associated with:**
   a. reduced mortality.
   b. greater reductions in weight.
   c. worsening renal function.
   d. All of the above

CME/CE OBJECTIVES

Upon completion of this educational activity, participants should be able to:

- discuss the most current information related to cardiac illness and the treatment of cardiac disease;
- explain the advantages and disadvantages, as well as possible complications, of interventions to treat cardiac illness;
- discuss the advantages, disadvantages, and cost-effectiveness of new and traditional diagnostic tests in the treatment of cardiac illness; and
- discuss current data regarding outpatient care of cardiac patients.