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Clinical Cardiology [ALERT]

Critical analysis of the latest clinical research in cardiovascular medicine

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ABSTRACT & COMMENTARY

Management of Cardiac Arrest Patients Without STEMI

By Michael H. Crawford, MD, Editor

SYNOPSIS: An analysis of the COACT trial for one-year outcomes continues to confirm the original 90-day outcomes, namely that there is no difference in mortality or morbidity in the immediate vs. the delayed coronary intervention groups of patients who are successfully resuscitated after cardiac arrest and do not show evidence of STEMI or cardiogenic shock.

SOURCE: Lemkes JS, Janssens GS, van der Hoeven NW, et al. Coronary angiography after cardiac arrest without ST segment elevation: One-year outcomes of the COACT Randomized Clinical Trial. *JAMA Cardiol* 2020; Sept. 2. doi: 10.1001/jamacardio.2020.3670. [Online ahead of print].

Immediate coronary angiography and percutaneous intervention in appropriate patients is the standard of care for resuscitated cardiac arrest patients with evidence of ST elevation myocardial infarction (STEMI). However, the treatment of non-STEMI patients is controversial since the Coronary Angiography After Cardiac Arrest (COACT) trial of such patients failed to show reduced mortality at 90 days. Since it is possible there would be long-term benefits of an invasive approach, the investigators from the COACT trial analyzed the one-year follow-up data.

COACT was a multicenter, randomized, open-label study of immediate vs. delayed (until neurologic recovery) coronary intervention in successfully resuscitated (but unconscious) patients without ECG evidence of STEMI. Patients were excluded if they had cardiogenic shock, severe renal dysfunction, or had an obvious non-cardiac cause of arrest. Immediate coronary interventions were initiated within two hours. In most patients with delayed intervention, such interventions occurred after discharge from the ICU. All patients underwent temperature management and other guideline-directed therapy.

Investigators acquired one-year follow-up data by phone calls to the patient, family, or primary physician and through an examination of medical records and death registries. The primary endpoints were death, myocardial infarction since the index hospitalization, repeated revascularization since the index hospitalization, hospitalization for heart

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failure, and implantable cardioverter-defibrillator (ICD) shock.

At 90 days, there were 538 patients. At one year, there were 522 patients because of attrition of consent for the one-year follow-up (264 in the immediate group, 258 in the delayed group). In total, 79% were men, with a mean age of 65 years. Coronary intervention was performed in 97% of the immediate group at a median time of one hour. Such interventions were performed in 65% of the delayed group at a median time of 120 hours.

An acute thrombotic occlusion was found in < 10% of patients (3% immediate group, 8% delayed group). In about one-third of both groups, a chronic total occlusion was found, and about one-third exhibited no significant coronary artery lesions. Percutaneous coronary interventions were performed in about one-third of the immediate group and one-quarter of the delayed group. Fewer than 10% underwent coronary bypass surgery (6% and 8%, respectively).

One-year survival was 61% in the immediate group and 64% in the delayed group (odds ratio [OR], 0.90; 95% confidence interval [CI], 0.63-1.28). The composite endpoint of death, myocardial infarction, or repeat revascularization since the index hospitalization was 43% in the immediate group and 41% in the delayed group (OR, 1.10; 95% CI, 0.77-1.56). Researchers did not observe any significant differences between the groups for any other outcomes at one year.

The authors concluded that since there were no significant differences in outcomes at 90 days or one year, coronary interventions in successfully resuscitated cardiac arrest patients without evidence of STEMI or cardiogenic shock can be delayed until neurologic recovery is evident.

■ COMMENTARY

Although this study was powered only for the 90-day endpoint and the results are technically hypothesis-generating, I believe it will finally put this debate to rest. Also, the results are consistent with the many other studies of an early invasive vs. a selective delayed invasive approach for non-STEMI. In non-STEMI, an immediate invasive approach is not necessary unless there are other indications, such as cardiogenic shock.

Despite the negative results, there are several interesting findings in this study. Unlike the more general management studies of non-STEMI, in this study of cardiac arrest survivors, one-third showed no significant coronary artery lesions while one-third exhibited chronic total occlusions. Among the remaining one-third, the authors found thrombotic coronary artery occlusions in only 5% of the total study population.

[This study is quite compelling and supports a selective and delayed approach to coronary interventions in unconscious cardiac arrest survivors without ECG evidence of STEMI.]

Even though this was a randomized, controlled, multicenter trial, there were some weaknesses. It was powered for the 90-day mortality outcome, and almost all the mortality occurred in the first 90 days. From day 90 to day 365, the mortality rate was 2%, and the rates of all the other outcomes explored also were low. Thus, it could be said this study was underpowered to find any differences in one-year outcomes. Further, this study was not blinded, but that would have been difficult. However, the core lab that looked at all the data was blinded. In addition, there are no data on medical therapy during follow-up.

Despite these weaknesses, I believe this study is quite compelling and supports a selective and delayed approach to coronary interventions in unconscious cardiac arrest survivors without ECG evidence of STEMI. The first selection criterion should be cardiogenic shock. After that, neurologic recovery. ■

ABSTRACT & COMMENTARY

Perioperative Atrial Fibrillation: Is It Important?

By Michael H. Crawford, MD, Editor

SYNOPSIS: A large epidemiologic study with validated endpoints of patients with atrial fibrillation after non-cardiac surgery demonstrated such patients experience a higher incidence of subsequent atrial fibrillation, stroke, transient ischemic attacks, and all-cause mortality over five years of follow up.

SOURCE: Siontis K, Gersh BJ, Weston SA, et al. Association of new-onset atrial fibrillation after non-cardiac surgery with subsequent stroke and transient ischemic attack. *JAMA* 2020;324:871-887.

Atrial fibrillation (AF) after non-cardiac surgery may be an isolated phenomenon or a harbinger of future adverse events. Investigators from the Mayo Clinic employed the Rochester Epidemiology Project to ascertain the risk of stroke or transient ischemic attack (TIA) in patients with postoperative AF compared to similar patients without postoperative AF from 2000 to 2013.

From this population, patients with first-ever AF during or within 30 days after non-cardiac surgery were selected and matched with a comparator group by age, sex, year of surgery, and type of surgery. This resulted in 452 matched pairs. In those who developed AF, it occurred a median of two days after surgery; 90% occurred within 14 days. The median age of participants was 75 years, and 52% were men. Patients with AF had higher comorbidity indices and a mean CHA_2DS_2-VASc score of 4 vs. 3 for those without AF ($P < 0.001$). Over a median follow-up of five years, all adverse outcomes were more prevalent in those developing AF.

After adjustment for age and comorbidities, the risk of stroke or TIA was 10.7% (95% confidence interval [CI], 7.1-14.2) in the AF group vs. 6.0% (95% CI, 3.5-8.4) in the no AF group. The hazard ratio (HR) was 2.69 (95% CI, 1.35-5.37). Subsequent AF also was more common in the AF group: 51.4% (95% CI, 45.8-56.4) vs. 12.1% (95% CI, 9.0-15.1) for the no AF group. The HR was 7.94 (95% CI, 4.85-12.98). There was a significant difference in all-cause mortality in the AF group (HR, 1.66; 95% CI, 1.32-2.09), but not in cardiovascular mortality.

Anticoagulation therapy was prescribed in 49% of those with AF, and the median time on anticoagulants was 60 days. At one year, 35% were on anticoagulants, which did not appear to be related to the development of stroke or TIA. The authors concluded patients who developed AF after non-cardiac surgery had a higher incidence of subsequent stroke, TIA, AF, and all-cause mortality. However, the implications for the management of these patients cannot be ascertained from this observational study.

■ COMMENTARY

Previous studies that relied heavily on administrative databases and were of shorter duration than this analysis have shown that subsequent AF and stroke are more common in those who develop AF postoperatively. This study confirms and strengthens these findings in three important ways. First, all outcomes were manually verified in the patients' charts rather than relying on coding alone. Second, there was a matched control group, so the effect of the type of surgery and other factors were balanced between the groups. Third, the follow-up was for five years. Thus, the results are perhaps not surprising, but serve to continue to cast doubt on the theory that postoperative AF is an isolated phenomenon caused by the stress of surgery and probably can be ignored for most patients. It seems more likely, as the authors noted, that surgery is a "stress test for AF." Also, these could be patients with pre-existing paroxysmal AF that was undetected until the prolonged monitoring after surgery.

The most impressive result of this study is more than half of the postoperative AF patients experienced subsequent AF during follow-up. This raises the issue of whether these patients should be anticoagulated, starting when and for how long. Of course, postoperative bleeding concerns would delay the start of anticoagulants if they are considered necessary. In this analysis, few patients were started on anticoagulants, so these data cannot inform such decisions. A randomized trial would be necessary. However, it is interesting that 15% of patients who suffered a subsequent stroke were on anticoagulants. Perhaps these patients with more comorbidities than the patients who did not develop AF suffered stokes that were not thromboembolic. Unfortunately, the investigators could not fully categorize the mechanism of stroke in all patients. The fact that all-cause mortality was higher in the AF group supports

the theory that they were more prone to adverse outcomes for a variety of reasons.

There were several limitations. The study population was largely white, so the results may not apply to other groups. The type of AF (paroxysmal, persistent, permanent) could not be determined. Postoperative AF patients may have been monitored more, so there may be an ascertainment bias toward finding AF subsequently. In addition, few patients in this study underwent vascular surgery, which would be expected to be a higher risk group for AF. Despite the matched control group, there always is the possibility of residual confounding in an observational study.

Since there are no randomized, controlled trials, watchful waiting may be one option. Or cardiologists could consider anticoagulant therapy in appropriate candidates for one to three months, and then conduct a monitoring study for a few weeks and base further therapy on the results. Perhaps in some patients, a loop recorder would make sense, with monthly interrogation. Perhaps anticoagulating appropriate candidates indefinitely if their CHA_2DS_2-VASc score was > 2 is the right approach. Unfortunately, a solid solution to this problem does not exist yet. Until then, cardiologists should act in a manner that seems most reasonable to us and patients. ■

ABSTRACT & COMMENTARY

When Aortic Stenosis Is Almost Severe: What Happens Next?

By Michael H. Crawford, MD, Editor

SYNOPSIS: A study of patients with normal flow, low gradients, normal left ventricular systolic function but with calculated aortic valve areas < 1.0 cm^2 showed that about half of them progressed to severe aortic stenosis during the 25-month median follow-up period. This suggests considering such patients to be at an intermediate stage between moderate and severe aortic stenosis.

SOURCE: Chadha G, Bohbot Y, Lachambre P, et al. Progression of normal flow low gradient "severe" aortic stenosis with preserved left ventricular ejection fraction. *Am J Cardiol* 2020;128:151-158.

Patients with aortic stenosis (AS) who have normal left ventricular (LV) ejection fraction (EF), normal flow (stroke volume index > 35 mL/m^2 measured at the LV outflow tract), a mean pressure gradient < 40 mmHg, but a calculated aortic valve area (AVA) of < 1.0 cm^2 often are referred to as normal flow, low gradient, severe AS (NF-LG-SAS). Their management is controversial. Researchers from three academic medical centers in Belgium and France performed a retrospective observational study that included such patients who also had undergone a second follow-up echocardiogram after at least six months between 2005 and 2015.

The authors excluded patients with more than mild aortic or mitral regurgitation and patients who underwent aortic valve replacement (AVR) between the two echocardiographic examinations. The resulting study group consisted of 96 patients (mean age, 79 years; 38% men) with a Charlson Comorbidity Index score averaging 3 and a EuroSCORE II averaging 2.01. The median time between the two echoes was 25 months (interquartile range, 15-52 months). As expected, the severity of AS progressed. Mean aortic pressure gradient increased from 28 to 39 mmHg, peak aortic jet velocity increased from 3.46 to 4.01 m/s, and calculated AVA decreased from 0.87 to 0.72 cm^2 (all $P < 0.001$), but there was no significant change in LVEF. During follow-up, 48% of patients exhibited the parameters of SAS, with mean pressure gradients of > 40 mmHg. The authors concluded NF-LG-SAS with preserved LVEF is an intermediate stage between moderate and SAS and requires close follow up.

■ COMMENTARY

Current American guidelines recognize six levels of AS: mild, mild to moderate, moderate, moderate to severe, severe, and very severe. Chadha et al concluded NF-LG-SAS is moderate to severe AS, and they recommended watchful waiting for such patients.

The study population was highly selected, in that it was mainly elderly women, 83% of whom had class I-II symptoms, and the remainder had class III-IV symptoms. One could argue that symptomatic patients with NF-LG-SAS should have AVR, unless the symptoms were thought to be caused by something else.

Interestingly, 48% progressed to NF-high gradient-SAS in a median of 25 months, but only 27%

underwent AVR after the second echo. There may be several explanations for this, but the authors did not include any reasons. The average EuroSCORE II was only 2 and the Charlson Comorbidity Index score was 3. Many patients should have at least been candidates for TAVR, which was available in Europe during the study period.

Perhaps the most interesting finding was the mortality rate was 32%. Thus, some patients may have died before AVR could be considered or actuated. Could earlier AVR have mitigated this high mortality rate? The results of some prior studies have suggested this, but others have supported the watchful waiting approach. I hate to think that elderly women are treated less aggressively compared to men in Europe.

During follow up, 15% of patients progressed to low flow-LG-SAS, and one-third developed reduced LVEF (< 50%). These patients may have benefited from earlier AVR if they could be identified from the start.

Faced with one of these patients, I believe the priority is to be sure the gradient measurement is correct. Unless continuous wave Doppler from many angles is employed, the peak gradient may be underestimated. Despite the fact cardiologists conducted this study in academic centers, there could have been true high gradient patients who were missed. Second, it would be wise in such patients to employ other less-often-performed measures of AS severity to be certain severe AS was not missed. There is considerable literature supporting the use of the extent of calcium in the valve on CT imaging as a measure of severity that is directly associated with outcome. Also, BNP levels have been shown to correlate with outcomes. More sophisticated echo measures, such as global longitudinal strain, could be conducted to identify those with subtler LV dysfunction. Finally, cautious exercise testing to identify symptoms likely caused by AS can be performed. Patients whose initial echo shows moderate to severe AS require additional scrutiny to be sure true SAS is not missed before embarking on a course of watchful waiting. ■

ABSTRACT & COMMENTARY

Pulmonary Artery Denervation: A Promising Treatment Option for CTEPH

By Jamie L.W. Kennedy, MD, FACC

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

SYNOPSIS: A trial of patients with residual chronic thromboembolic pulmonary hypertension following pulmonary endarterectomy showed pulmonary artery denervation is superior to medical management with riociguat.

SOURCE: Romanov A, Cherniavskiy A, Novikova N, et al. Pulmonary artery denervation for patients with residual pulmonary hypertension after pulmonary endarterectomy. *J Am Coll Cardiol* 2020;76:916-926.

Chronic thromboembolic pulmonary hypertension (CTEPH) is an uncommon but severe complication of pulmonary embolism, leading to exercise intolerance, right heart failure, and death. Pulmonary endarterectomy (PEA) is the treatment of choice for appropriate surgical candidates and can be curative, although it is only available at a few centers. Many patients do not undergo surgery for a variety of reasons. Some are not referred for surgery, some decline surgical evaluation or intervention, some are not surgical candidates because of comorbid conditions, and some lesions are not amenable to PEA. In addition, a few patients experience residual pulmonary hypertension after surgery. Clinical trials have revealed modest benefit from pulmonary vasodilators (riociguat, macitentan, bosentan, sildenafil, and prostacyclins) for inoperable or residual CTEPH. Balloon pulmonary angioplasty also has been explored as an option for inoperable or residual disease, often requiring multiple sessions over weeks or months and offered at a few centers.

Pulmonary artery denervation (PADN) has been studied in small trials over the last few years as an intervention for pulmonary hypertension of various etiologies. It is based on the theory that the autonomic nervous system plays a role in pulmonary vasoconstriction. In animal PH models, PADN results in an immediate decrease in pulmonary artery pressure. TROPHY 1, a pilot study in the

United States and Europe, showed the addition of intravascular ultrasound PADN to medical management in PAH patients resulted in mean reduction in pulmonary vascular resistance (PVR) of 94 ± 151 dyn-s-cm^{-5} after four to six months.

Romanov et al screened 278 patients with CTEPH who had undergone PEA for residual pulmonary hypertension by echo, followed by right heart catheterization for confirmation. They identified 50 patients with mean pulmonary artery pressure > 25 mmHg and PVR > 400 dyn-s-cm^{-5}. The average age was 48 years, half were men, and average six-minute walk distance was 380 m. Half of patients had NYHA class II symptoms (one-quarter each were class I and III). On average, patients had CTEPH for four years before PEA and were diagnosed with residual CTEPH 29 months after PEA. Twenty-five patients were randomized to PADN and placebo medication, and 25 patients were randomized to sham procedure and medical management with riociguat.

PADN was performed by radiofrequency ablation lesion sets in the main pulmonary artery 2-3 mm proximal of the bifurcation, and in both the left and right pulmonary arteries 2-3 mm distal from the bifurcation. The procedure was guided by a combination of fluoroscopy and remote magnetic navigation. The most significant complications were transient bradycardia, chest pain, cough, and access site hematoma.

The primary endpoint was pulmonary vascular resistance at 12 months. The PADN group demonstrated a mean reduction of 258 ± 135 dyn-s-cm^{-5} vs. 149 ± 73 dyn-s-cm^{-5} in the medical management group (P = 0.001). Several secondary endpoints also were reported. Mean pulmonary artery pressure improved in the PADN group, from 35 ± 9 mmHg at baseline to 26 ± 7 mmHg at 12 months. In the medical management group, there was minimal change, from 36 ± 9 mmHg to 34 ± 6 mmHg (P < 0.001). Echo showed both tricuspid annular plane systolic excursion (TAPSE) and right ventricular (RV) fractional area change improved significantly in the PADN group, but did not change in the medical management group. The six-minute walk distance improved substantially (470 ± 84 m), while the medical management group improved marginally (399 ± 116 m; P = 0.03).

In the PADN arm, one patient was hospitalized, and one died of worsening heart failure. In the medical management arm, seven patients were hospitalized, and two died of worsening heart failure. NT-pro-BNP improved an average of 632 pg/mL in the PADN arm and 176 pg/mL in the medical management arm (P = 0.04). The authors concluded PADN is a promising new intervention for residual pulmonary hypertension after PEA.

■ COMMENTARY

To date, trials of PADN have been heterogeneous in terms of patient populations, concomitant medical management, and PADN technique, making comparisons difficult. The Romanov et al study is an advance in that it was a randomized, sham-controlled, placebo-controlled trial focused on a single patient population. The PADN technique demonstrated significant benefit compared to standard of care medical management. Future studies of the CTEPH population also may include patients deemed inoperable. The primary role of PEA in the treatment of CTEPH remains unchanged, as does the importance of evaluating every PH patient for CTEPH and every CTEPH patient for PEA. The relative roles of medical management, balloon angioplasty, and PADN for residual and inoperable CTEPH remain to be clarified. Other patient populations may benefit from PADN, particularly those with PH caused by left heart disease, in which trials to date have struggled to demonstrate benefit from treatments directed at the pulmonary vasculature. ■

ABSTRACT & COMMENTARY

Does BAMI Spell the End for Cell-Based Therapy After Acute Myocardial Infarction?

By Jeffrey Zimmet, MD, PhD

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

SYNOPSIS: Investigators tested the mortality benefit of intracoronary bone marrow cells in patients with successfully reperfused acute myocardial infarction. They observed no effect on mortality.

SOURCE: Mathur A, Fernández-Avilés F, Bartunek J, et al. The effect of intracoronary infusion of bone marrow-derived mononuclear cells on all-cause mortality in acute myocardial infarction: The BAMI trial. *Eur Heart J* 2020; Aug 30;ehaa651. doi: 10.1093/eurheartj/ehaa651. [Online ahead of print].

Using a patient's own bone marrow mononuclear cells as therapy for ischemic myocardial injury has been a recognized area of study for longer than 20 years. Although small proof-of-concept trials, such as TOPCARE-AMI, made headlines in the early 2000s, no large-scale, Phase III trial had been completed to bring this therapy into the mainstream.

Based in part on the promising results of the Phase II REPAIR AMI study, (*N Engl J Med*, 2006), the Phase III BAMI trial was designed to demonstrate the safety and efficacy of intracoronary autologous bone marrow mononuclear cells (BM-MNC) in post-MI patients. To this end, patients with ejection fraction < 45% after successful primary PCI for acute MI were enrolled. The treatment group received intracoronary infusion of autologous bone marrow mononuclear cells between two and eight days after the MI event, in addition to standard medical therapy. The control group received medical therapy alone in an open-label design. The trial was powered to detect a 25% reduction in all-cause mortality at a follow-up of two years. It was designed in 2011, and enrollment took place between September 2013 and October 2017. The authors planned to enroll 3,000 patients from at least 17 sites in 11 European countries. The European Commission partly funded the trial, and work was coordinated from the BAMI trial office in London.

Shortfalls in funding and enrollment became evident early. In particular, numbers of acute MI patients with ejection fraction ≤ 45% were markedly less than anticipated. The steering committee reimagined the trial as an observational study. Although 37 sites were enrolled in the study, only 28 contributed patients, and 23 actually delivered the experimental therapy. Ultimately, the authors enrolled 375 patients, of whom 185 received BM-MNC and 190 were randomized to control. Average age was 59 years, more than 80% were men, and more than 90% were white. The mean ejection fraction was 39%, as measured by a core echo laboratory. More than 97% of patients had Killip class I or II MI.

The original power calculations assumed a 12% mortality rate, based on early data from the primary PCI era. Among enrolled patients at two years, there were only six deaths in the BM-MNC group, and seven deaths in the control group, which was not statistically different. Among the secondary endpoints, only rehospitalization due to heart failure demonstrated an advantage among the treated patients, with five BM-MNC patients and 15 control patients recording an event (2.7% vs. 8.1%; hazard ratio, 0.332; 95% confidence interval, 0.12-0.88). The remaining secondary endpoints were not different between the groups, including rehospitalization due to MI, revascularization, ICD implant, and stroke.

The authors concluded the sample sizes and event rates were too low to make any meaningful group comparisons. They estimated future trials would need a prohibitively large number of patients (> 10,000) to demonstrate a treatment effect at the observed average mortality rate of 3.5%.

■ COMMENTARY

With two decades and a multitude of clinical trials, what have we to show for these investigations into BM-MNC after acute MI? The authors of earlier trials all have used surrogate endpoints, such as LV function and infarct size, and have shown disparate results. TOPCARE-AMI (*Clin Res Cardiol*, 2011), BOOST (*Eur Heart J*, 2009), BONAMI (*Eur Heart J*, 2017), and REPAIR AMI authors all reported improvements in LVEF, while no significant changes were observed in LEUVEN-AMI (*Lancet*, 2006), ASTAMI (*N Engl J Med*, 2006), REGENT (*Eur Heart J*, 2009), or HEBE (*Eur Heart J*, 2011). The largest of these, REPAIR AMI, included 202 patients. Those authors reported intracoronary infusion of progenitor cells led to an improvement in LV function as well as a reduction in the composite of death, recurrence of MI, and subsequent revascularization.

The Mathur et al trial was nearly twice as large, and yet did not demonstrate any such benefits. One lesson appears to be that the landscape of acute MI has changed over time. With aggressive use of primary PCI, and current medical therapy, mortality after AMI is significantly lower than it used to be. Even identifying significant numbers of post-MI patients with ejection fraction ≤ 45% turned out to be challenging.

For now, the writing appears to be on the wall: Subsequent trials of BM-MNC in post-MI patients who have undergone successful reperfusion are impractical and are unlikely to be successful. Further trials of cell-based therapies are likely to focus on sicker HFrEF patients who continue to have high rates of clinical endpoints and for whom demonstration of benefit (or lack thereof) is more likely. ■

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CME/CE QUESTIONS

1. **Bone marrow-derived mononuclear stem cells infused after successful reperfusion in acute myocardial infarction patients with ejection fraction < 45% resulted in a reduction in:**
   a. mortality rate.
   b. rehospitalization because of heart failure.
   c. repeat revascularization.
   d. stroke rate.

2. **A small study of patients with residual pulmonary hypertension (PH) after pulmonary artery endarterectomy for chronic thromboembolic PH showed a reduction in PH with:**
   a. sildenafil.
   b. riociguat.
   c. pulmonary artery angioplasty.
   d. pulmonary artery denervation.

3. **An observational follow-up study of patients with normal stroke volume and ejection fraction, and calculated aortic valve area < 1.0 cm^2, but low gradients (< 40 mmHg), after two years showed:**
   a. a high mortality rate.
   b. no change in aortic valve gradient.
   c. a decline in ejection fraction.
   d. no change in calculated valve area.

4. **A large, five-year follow-up study of patients who developed atrial fibrillation after non-cardiac surgery showed which endpoint was most common?**
   a. All-cause mortality
   b. Subsequent atrial fibrillation
   c. Stroke
   d. Transient ischemic attack

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.