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Clinical Cardiology [ALERT]

Critical analysis of the latest clinical research in cardiovascular medicine

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ABSTRACT & COMMENTARY

Surgical Revascularization and Ischemic MR

By Michael H. Crawford, MD, Editor

SOURCE: Castleberry AW, et al. Surgical revascularization is associated with maximal survival in patients with ischemic mitral regurgitation: A 20-year experience. *Circulation* 2014;129:2547-2556.

The optimal treatment for ischemic mitral regurgitation (MR) is controversial and suffers from a lack of sufficient study data to build a consensus. Thus, these investigators from Duke University Medical Center interrogated their cardiovascular disease database to shed light on this issue by performing a retrospective cohort analysis over 18.5 years of patients with significant coronary artery disease (CAD) and moderate or severe MR by cardiac angiography or echocardiography. Treatment was at the discretion of the attending physician and the patients were kept in the initial treatment category assigned to them for this analysis, which ignored crossovers. The primary outcome was overall survival. After excluding patients who did not meet entry criteria or who had significant cardiac and non-cardiac comorbidities, 4989 patients were included in the study — of which 36% received medical therapy, 26% percutaneous coronary interventions (PCI), 33% coronary artery bypass surgery (CABG) alone, and 5% CABG plus mitral valve (MV) replacement or repair. The majority of patients had three-vessel CAD and moderate MR. Significant differences in the characteristics of the patients assigned to these four treatment categories were found, as would be expected. During the first half of the study, medical management predominated and later CABG alone was most common. After a median follow-up of over 5 years, the median adjusted survival was 5.6 years for medical management, 6.8 years for PCI, 9.7 years for CABG alone, and 8.1 years for CABG+MV repair or replacement. Adjusted hazard ratios showed that CABG alone had the lowest risk of death (0.56; 95% confidence interval [CI], 0.51-0.62; $P < 0.0001$), CABG+MV repair or replacement 0.69, and PCI 0.83. Interestingly, when analyzed based on the severity of MR, the data were not significantly changed. The authors concluded that in patients with moderate or more ischemic MR, CABG alone exhibited the lowest long-term risk of death, and CABG with or without MV surgery showed a lower

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mortality compared to PCI or medical therapy alone.

■ COMMENTARY

The AHA/ACC guidelines recommend medical therapy for ischemic MR (class I), not because of compelling data to support this opinion, but rather due to the perceived high mortality of CABG plus MV repair or replacement.[1] Surgery is recommended if other cardiac surgery is necessary (IIa) and primary mitral surgery with or without CABG can be considered (IIb). The level of evidence for any surgical therapy is C. This paucity of data makes the Duke database study, which includes almost 5000 patients with moderate-to-severe ischemic MR, of interest. Basically, they found the opposite compared to the guidelines recommendation. CABG surgery alone had the best long-term survival and was superior to that of CABG+MV repair or replacement, PCI, or medical therapy after adjustments for differences in the characteristics of the patients in each therapy group. This confirms an old adage that the ischemic myocardium prefers blood to drugs. So if MR is due to ischemia, relieving ischemia should reduce the MR regardless of any MV procedure. PCI, although better than medical therapy, was not superior to CABG, probably because revascularization by PCI is less complete in ischemic MR patients who often have severe three-vessel disease.

These retrospective, observational database studies often are deficient in the kinds of data that would clarify mechanisms in specific patients. In this study, we lack details that may clarify the decision making with the different types of patients. For example, we have no detailed non-invasive data in this study. It could be that if MR was largely due to infarcted and scarred walls and was severe, MV replacement would be the best treatment. On the other hand, MR purely due to ischemia would be expected to benefit from CABG alone. Thus, patient selection may have influenced the results in ways that propensity scoring cannot account for. Also, there is no quality of life or cost data. These considerations could influence treatment choice.

Although for a long-term database study this is fairly contemporary data, it does not reflect the latest developments in this area. We know some patients had mitral valve repair, but did they have the Alfieri technique done? This is a stitching of the two MV leaflet tips together at the center and creating a double orifice valve. Remarkably this reduces MR without causing significant stenosis and doesn't appreciably affect surgical mortality. This concept has now been developed as a percutaneously placed clip (Mitraclip®). In Europe, where the clip has been available for a few years, it is mainly used for ischemic MR, often in combination with PCI. What this area needs are some randomized trials that would include these new technologies. Fortunately several are under way. Until the results of these trials are in, it would appear that more consideration should be given to CABG in patients with ischemic MR. ■

REFERENCE

1. Nishimura RA, et al. 2014 AHA/ACC guidelines for the management of patients with valvular heart disease: Executive summary. *Circulation* 2014;129:2440-2492.

ABSTRACT & COMMENTARY

Heart Failure with Recovery of LV Function

By Michael H. Crawford, MD, Editor

SOURCE: Basuray A, et al. Heart failure with recovered ejection fraction: Clinical description, biomarkers, and outcomes. *Circulation* 2014;129:2380-2387.

The clinical implications of the recovery of left ventricular (LV) function after treatment of patients with initial systolic heart failure is poorly understood. Thus,

these investigators from the Penn Heart Failure Study sought to characterize this population, believing them to be different from patients with heart failure with persistently reduced LV function and those with heart failure with preserved LV function. Patients were recruited from three specialized heart failure centers and divided into three groups: heart failure (HF) with reduced LV ejection fraction (EF) < 50% (HFrEF); HF with preserved EF > 50% (HFpEF); and HF with recovered EF (HFrec), meaning it was < 50% and then was > 50% after treatment. Patients with all causes and treatments of HF were included, except those with hypertrophic and infiltrative cardiomyopathies. The final study population included 1821 patients, most of whom had HFrEF (n = 1523); 122 had HFpEF and 176 had HFrec. At baseline the HFrec group was younger and had less comorbidities such as coronary artery or kidney disease. During follow-up for up to 8.9 years (median 3.6), 507 experienced a terminal event (335 death, 129 transplant, 43 ventricular assist device placements). HFrEF had the highest likelihood of reaching the combined endpoint (hazard ratio [HR], 4.1; 95% confidence interval [CI], 2.4-6.8; $P < 0.001$) vs HFrec. HFpEF patients were also more likely to reach this endpoint vs HFrec (HR, 2.3; 95% CI, 1.2-4.5; $P < 0.02$). However, after 8 years nearly 20% of HFrec patients had achieved this endpoint. Hospitalization for HF was more common in the HFrEF group, but not different between the other two groups. The authors concluded that HFrec patients have an increased event-free survival compared to HFrEF and HFpEF patients, but experience similar numbers of subsequent hospitalizations as HFpEF patients.

■ COMMENTARY

I have several patients who had systolic heart failure for a variety of reasons, who responded to therapy and now have a normal LVEF on medical therapy. They keep asking me if they have to keep taking their HF medications. This paper sheds some light on this issue. These investigators propose that this is a unique group with different characteristics than HFrEF and HFpEF patients, and with a different prognosis. Their data show that these patients have a lower mortality than the other two types of heart failure, but they continue to have HF hospitalizations, so they are not cured. Also, they have continued evidence of neurohumeral activity such as elevated brain natriuretic peptide levels and detectable troponin levels. They suggest these data support the rationale for continued medical therapy. However, we have all seen such patients who have self-discontinued their medications and they have done fine. So some must be cured, but how do we tell whom? Perhaps by biomarkers or sophisticated imaging, but this retrospective observation study doesn't address this issue. In this study 88% of the HFrec patients were on beta-blockers, 85% on ACEI, and 69% were on diuretics. Clearly the authors are keeping most of their patients on their HF medications indefinitely.

The investigators raise another interesting issue. Perhaps some patients we are categorizing as HFpEF are really HFrec patients, except we don't have prior echocardiograms or other measures of LV function to determine this. This thought should prompt a more thorough search for outside hospital or other old records in these patients, because the treatment of HFpEF is unknown, but HFrec patients should probably stay on HFrEF therapy indefinitely.

Of course, LVEF is a crude measure of LV performance. Perhaps more sophisticated imaging or hemodynamic studies would discover subtle abnormalities of LV function in the HFrec patients. Also, the use of a 50% LVEF cut point is arbitrary. Some studies have used 45% or 55%. Another limitation of this study is that the deployment of medical therapy and devices was not analyzed further. Also, we don't have an etiologic breakdown. This could be important. For example, I rarely see a CAD patient with HRrEF return to a normal LVEF after revascularization, but post-chemotherapy patients often do. More detailed clinical data will have to come from prospective studies, which hopefully are in the works. ■

ABSTRACT & COMMENTARY

Echo in Acute Pulmonary Embolism

By Michael H. Crawford, MD, Editor

SOURCE: Pruszycyk P, et al. Prognostic value of echocardiography in normotensive patients with acute pulmonary embolism. *J Am Coll Cardiol Img* 2014;7:553-560.

It is believed that right ventricular (RV) performance in acute pulmonary embolism patients is of prognostic value, but specific RV function parameters are not agreed upon and there are little outcome data in this area. Thus, these investigators from Poland studied 411 consecutive patients with

symptomatic acute pulmonary embolism (APE) who were hemodynamically stable on admission (systemic systolic blood pressure > 90 mm Hg). Echocardiograms were done as soon as possible after admission (immediately in 193, within 24 hours in 159, and in < 72 hours in 59). RV dysfunction was defined as: 1) RV free wall hypokinesis and an RV/LV diastolic diameter ratio of >0.9; or 2) an elevated systolic pressure gradient across the tricuspid valve of > 30 mm Hg and a pulmonary flow velocity acceleration time of < 80 msec. Patients without these findings were considered low risk. The primary endpoint was a combination of 30-day APE-related mortality or rescue thrombolysis in patients with cardiac arrest or shock.

Fifty-nine percent of the patients had RV dysfunction (sub-massive APE); the rest were low risk. Only nine in the sub-massive group received thrombolysis and seven of them survived. The primary endpoint was observed in 21 patients (5%). These patients had higher heart rates, troponins, and brain natriuretic peptide values. Many of the RV functional parameters on echocardiogram were significantly different in those who exhibited the primary endpoint vs those who didn't. Also, these patients had lower LV ejection fractions as well. However, multivariate analysis showed that tricuspid annulus plane systolic excursion (TAPSE) was the only independent predictor of the primary endpoint (hazard ratio [HR], 0.64; 95% confidence interval [CI], 0.54-0.7; $P <$ 0.0001). A TAPSE < 1.6 cm had a HR of 27.9 (95% CI, 6.2-124.6; $P < 0.0001$), a positive predictive value of 21%, and a negative predictive value of 99%. Also, the receiver operating curve (ROC) area for TAPSE was the highest of any parameter (0.9 at < 1.6 cm). The authors concluded that TAPSE is superior to other measures of RV and LV performance for predicting 30-day mortality or rescue thrombolysis.

■ COMMENTARY

Initially, normotensive patients with APE usually do well on anticoagulant therapy. However, there is a reluctance to discharge them from the hospital because some deteriorate and APE is commonly found at autopsy in hospitalized patients. It is known that RV dysfunction is associated with a worse outcome, but there is little agreement on which parameters are the most useful in risk prediction. If a low-risk group of APE patients could be identified, perhaps they could be discharged from the hospital earlier. Obviously, hypotensive patients would not be candidates for early discharge, so this group from Warsaw, Poland, studied 411 patients with APE who were normotensive on admission and performed echocardiography on them as soon as feasible (86% in 24 hours and all by 72 hours). They analyzed 15 RV and LV performance parameters to determine their ability to predict mortality or need for rescue thrombolysis. There was one clear winner, TAPSE. It was the only independent predictor by multivariate analysis and it had the highest ROC area of any parameter (0.9 at < 1.6 cm). At a TAPSE < 1.6, the HR for mortality or rescue thrombolysis was an astonishing 28. The nearest competitor was RV/LV diameter in the four-chamber view at HR = 7.3 and a ROC area of 0.6. Other findings, such as McConnell's sign, had much lower HRs. However, the positive predictive value of TAPSE was only 21% at < 1.6 cm with a negative predictive value of 99%. In fact, at a TAPSE > 2 cm, there were no complications from APE with a negative predictive value 100%. Thus, TAPSE is better at defining the low-risk group among normotensive patients with APE.

Could we use TAPSE to decrease length of stay in APE? In this study, about half the patients with normotensive APE had no RV abnormalities on echo and no events, so perhaps they could go home earlier. In those with some signs of RV dysfunction, if the TAPSE was > 2.0 cm, perhaps they could go early as well. Of course, this would have to be tested in a large clinical trial. In those with a TAPSE < 1.6, perhaps earlier consideration of thrombolytic therapy is reasonable; of course, any clinical decisions would have to consider other factors such as comorbidities, bleeding risk, etc.

Finally, the study has significant limitations as the authors acknowledge. It is an observational study from one center and the causes of death were not adjudicated. Also, there was considerable delay in obtaining echocardiograms in about 15% (24-72 hours). In addition, there was a low incidence of events in this subgroup of APE; 5% for the primary combined endpoint and 3.4% mortality. Thus, extended hospital stays for any APE patient who does well initially may not make much sense. ■

ABSTRACT & COMMENTARY

What is the Utility of Implantable Loop Recorders for Evaluating Patients with Cryptogenic Stroke?

By Edward P. Gerstenfeld, MD

Professor of Medicine, Chief, Cardiac Electrophysiology, University of California, San Francisco

Dr. Gerstenfeld does research for Biosense Webster, Medtronic, and Rhythmia Medical.

SOURCE: Sanna T, et al. Cryptogenic stroke and underlying atrial fibrillation. *N Engl J Med* 2014;370:2478-2486.

The cause of ischemic stroke remains uncertain despite a complete diagnostic evaluation in many cases. Detection of atrial fibrillation (AF) after cryptogenic stroke would have important therapeutic implications. This study was a randomized, controlled study of 441 patients to assess whether long-term monitoring with an implantable cardiac monitor (ICM) was more effective than conventional follow-up for detecting AF in patients with cryptogenic stroke. Patients 40 years of age or older classified as cryptogenic stroke after extensive testing and with no evidence of AF during at least 24 hours of ECG monitoring underwent randomization within 90 days after stroke. The primary endpoint was the time to first detection of AF (lasting > 30 seconds). By 12 months, atrial fibrillation had been detected in 12.4% of patients in the ICM group (29 patients) vs 2.0% of patients in the control group (4 patients) (hazard ratio, 7.3; 95% CI, 2.6-20.8; $P < 0.001$). The authors concluded that ECG monitoring with an ICM was superior to conventional follow-up for detecting AF after cryptogenic stroke.

■ COMMENTARY

Undiagnosed ischemic stroke remains a difficult problem. Despite costly evaluation with carotid Doppler, echocardiography, and Holter monitoring, many patients remain without a clear diagnosis. Most patients are treated empirically with antiplatelet agents. AF is common and it is well known that the initial presentation may be a stroke. Diagnosing AF in stroke patients is important, because treatment with systemic anticoagulation (warfarin, Factor Xa, or direct thrombin inhibitors) can prevent future strokes. Yet, there is significant cost and some risk associated in treating all stroke patients with systemic anticoagulants. Twenty-four or 48-hour Holter monitors are often used to detect asymptomatic AF, but we know these are of limited value. ICMs are now smaller, can be placed in an outpatient setting, and can record ECG data for up to 3 years. Automatic algorithms can detect asymptomatic AF. The main downside is the cost (~$10,000). However, the utility of these devices in detecting asymptomatic AF was impressive in this study, with 12% of cryptogenic stroke patients having AF detected compared to only 2% undergoing standard Holter monitoring. Of course, there remains some debate about the significance of brief AF episodes detected with prolonged monitoring; brief AF may simply be a marker of patients with high stroke risk factors rather than the cause of stroke. Also, we don't know if AF is causally related to the strokes in these patients. In addition, the effectiveness of anticoagulant therapy in patients with frequent brief episodes of AF is unclear. Current clinical practice suggests that you have to be in AF for > 48 hours before the stroke risk increases significantly. Nevertheless, this study will likely change the paradigm for the workup of cryptogenic stroke. Many neurologists will now refer patients with cryptogenic stroke for ICM implantation. Future studies should examine the clinical benefit of treating these patients with anticoagulants. ■

ABSTRACT & COMMENTARY

Why Is the Hospitalization Rate for Patients with Atrial Fibrillation Increasing?

By Edward P. Gerstenfeld, MD

Professor of Medicine, Chief, Cardiac Electrophysiology, University of California, San Francisco

SOURCE: Patel NJ, et al. Contemporary trends of hospitalization for atrial fibrillation in the United States, 2000 through 2010: Implications for healthcare planning. *Circulation* 2014;129:2371-2379.

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and has been the leading arrhythmic cause for hospitalization. With an increasing trend toward outpatient care of subacute illness, it is possible that the AF hospitalization rate is stable or decreasing despite the aging population. This study identified AF-related hospitalizations during the years 2000-2010 using CPT code 427.31 as the principal discharge diagnosis. Overall AF hospitalizations increased by 23% from 2000 to 2010. The most frequent coexisting conditions were hypertension (60.0%), diabetes mellitus (21.5%), and chronic pulmonary disease (20.0%). Overall in-hospital mortality was 1%. In-hospital mortality rate decreased significantly from 1.2% in 2000 to 0.9% in 2010 (29.2% decrease; $P < 0.001$). The mean cost of AF hospitalization increased significantly from $6410 in 2001 to $8439 in 2010 (24.0% increase; $P < 0.001$). The authors concluded that hospitalization rates for AF have increased exponentially among U.S. adults from 2000 to 2010, as have the costs to care for these patients.

■ COMMENTARY

AF remains the most common cardiac arrhythmia, and makes up a large part of any outpatient cardiology practice. Management consists of ventricular rate control, stroke prophylaxis, and, if symptomatic, restoration and maintenance of sinus rhythm. Yet it is rare that AF episodes, even new-onset AF, require acute hospitalization. Newer anticoagulants, including Factor Xa inhibitors or direct thrombin inhibitors, can be started orally and reach therapeutic effect in 1-2 hours. Ventricular rate control can often be achieved with oral beta-blockers or calcium-channel blockers quickly. Myocardial ischemia, acute coronary syndrome, or pulmonary embolus are rarely causes of AF. Most AF patients can be evaluated, treated, and discharged from an emergency department (ED) or managed in an outpatient clinic. The 23% increase in AF hospitalization from 2000 and 2010 is striking and represents a potential crisis in health care dollars. AF ablation is becoming more common, but these procedures are typically performed as outpatient procedures and should not be contributing to the increase in hospitalizations. How do we deal with this crisis moving forward? It is unlikely that ED physicians will have the expertise to manage AF on an outpatient basis. Many hospitals have established chest pain centers to deal efficiently with patients presenting with chest pain and allow rapid evaluation and discharge. General cardiologists will have to take an active role in evaluating and treating AF patients in the ED in order to reverse this trend, which will otherwise only increase as the population continues to age. Perhaps we should be considering "AF centers" or programs to allow these patients to be rapidly evaluated and treated in the ED by cardiologists. Such a study examining the cost effectiveness of cardiology-driven AF treatment in the ED would be of great interest. ■

ABSTRACT & COMMENTARY

Are Newer Drug-Eluting Stents Really Safer? Swedish Registry Data Says Yes

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.

SOURCE: Sarno G, et al. Stent thrombosis in new-generation drug-eluting stents in patients with STEMI undergoing primary PCI: A report from SCAAR. *J Am Coll Cardiol* 2014;64:16-24.

Coronary artery stents are implanted in the vast majority of coronary revascularization procedures, owing to improvements in both restenosis and acute vessel occlusion vs balloon angioplasty alone. Drug-

eluting stents (DES), by virtue of their well-demonstrated ability to reduce clinical restenosis and target lesion revascularization compared with bare metal stents (BMS), have captured a large proportion of the market since their introduction in Europe in 2002 and in the United States in 2003. The same drug and polymer combination in DES that staves off restenosis also delays endothelialization and vessel healing, however. And while dual antiplatelet therapy has reduced the rate of stent thrombosis (ST) to relatively low levels, late (after 1 month) and very late (after 1 year) ST remains a significant concern with these devices. Patients presenting with acute coronary syndrome, particularly those with ST elevation myocardial infarction (STEMI), are known to be at increased risk of ST. This has led to significant uncertainty regarding DES use in STEMI. Randomized trials comparing DES and BMS in acute MI generally involve the older first-generation DES and are relatively underpowered for rare events such as ST. Newer DES, with thinner struts, reduced or more-biocompatible polymers, and in some cases novel drugs, have the potential to both endothelialize more quickly and to cause less inflammation compared with earlier devices.

The Swedish Coronary Angiography and Angioplasty Registry (SCAAR) reports on ST rates out to 3 years in patients with STEMI treated with primary PCI between January 2007 and January 2013. Patients were treated with a mix of stent types and, for the purposes of the study, DES were subdivided into older first-generation models and newer second-generation stents. Among the 34,147 patients with STEMI tracked in the national registry, 25,065 were treated with BMS, 4811 with newer DES, and 4271 with older, first-generation DES. When looking at events out to 1 year ("early" + "late" ST) using adjustment by propensity scoring, both first- and second-generation DES showed significantly lower rates of ST compared with BMS. (*See Table.*)

Table.

ST out to 1 year	Hazard Ratio	95% CI	*P* Value
2nd-gen DES vs BMS	0.65	0.43-0.99	0.04
1st-gen DES vs BMS	0.60	0.41-0.89	0.01
2nd- vs 1st-gen DES	0.73	0.44-1.21	0.22

When looking at events beyond 1 year in the category known as very late ST, the only significant difference was a higher risk of ST in the older DES group compared with BMS. There was no significant difference between BMS and newer DES, nor did the two DES groups differ significantly. The authors concluded that patients treated with DES have a lower risk of early/late ST than patients treated with BMS. The risk of very late ST is low and comparable between the newer DES and BMS, whereas the older DES are associated with an increased risk of very late ST.

■ COMMENTARY

The authors propose several major findings from this study: 1) a higher risk of ST in the first year in patients receiving BMS compared with both older and newer DES; 2) a higher risk of very late ST in patients receiving first-generation DES compared with BMS; and 3) a similar risk of very late ST in BMS vs second-generation DES patients. Are these results plausible, and what do they mean?

We should first note that procedural characteristics were not strictly similar among groups. This is to be expected in such an "all-comers" registry analysis. For example, bivalirudin was used more frequently in DES groups compared with BMS, whereas glycoprotein IIb/IIIa inhibitor use was more common among patients receiving BMS. Ticagrelor, which in ACS patients has on its own demonstrated a lower event rate (including ST) compared with clopidogrel, was used more frequently in first-generation DES patients. More importantly, the SCAAR database lacks information regarding the duration and dose of dual antiplatelet therapy in the three groups. Given the known associations between antiplatelet drugs and ST, this is a significant shortcoming.

In addition, while we are provided with common baseline characteristics of the patients in each group and that these appear to be similar, we have to remember that these patients were not randomly assigned. No mention is made of the fact that patients may be treated with BMS rather than DES for a variety of reasons including greater comorbidities, propensity for bleeding, and the need to limit the duration of dual antiplatelet therapy. Clearly this may have an effect on downstream ST in at least a subgroup of BMS patients.

The idea that the polymer in DES might have opposite, time-dependent effects on ST is not new and is supported by other data. This hypothesis suggests that the polymer has a protective effect early on, but that this is later overtaken by a proinflammatory effect that increases the risk for very late ST. The results of this study support the idea that the newer DES have at least partially overcome this late detrimental effect. DES with fully biodegradable polymers, which are already available in many parts of the world outside the United States, take this idea to the next level. For now, these data provide reassurance that the newer, durable polymer stents are relatively safe for use in the STEMI arena. ■

QUESTIONS & COMMENTS:
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CME INSTRUCTIONS

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CME QUESTIONS

1. Newer drug-eluting coronary stents (DES) have shown which of the following results vs the older DES?

a. Reduced early stent thrombosis
b. Reduced late stent thrombosis
c. Higher early stent thrombosis
d. Higher late stent thrombosis

2. In the last decade, hospitalization rates for atrial fibrillation have increased:

a. 5%.
b. 12%.
c. 23%.
d. 33%.

3. In cryptogenic stroke patients, implantable ECG monitors detect atrial fibrillation in:

a. 1%.
b. 6%.
c. 12%.
d. 24%.

4. Follow-up of patients with systolic heart failure who recover LV function on medical therapy often reveals:

a. no further cardiac problems.
b. recurrent heart failure hospitalizations.
c. the development of diastolic dysfunction.
d. sudden death.

5. A recent large database study shows that the treatment for ischemic mitral regurgitation with the best long-term survival is:

a. medical therapy.
b. percutaneous coronary intervention.
c. CABG.
d. CABG plus MV replacement or repair.

6. Which of the following echo findings best predicts 30-day mortality or need for thrombolysis in normotensive acute pulmonary embolus patients?

a. RV/LV diameter in the 4-chamber view
b. Moderate-to-severe tricuspid regurgitation
c. McConnell sign
d. TAPSE (tricuspid annular plane systolic excursion)

CME 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.