

# Clinical Cardiology

## [ALERT]

Critical analysis of the latest clinical research in cardiovascular medicine

### ABSTRACT & COMMENTARY

## Should Catheter Ablation be First-Line Therapy for Patients with Paroxysmal AF?

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:** Morillo CA, et al. Radiofrequency ablation vs antiarrhythmic drugs as first-line treatment of paroxysmal atrial fibrillation (RAAFT-2): A randomized trial. *JAMA* 2014;311:692-700.

**A**trial fibrillation (AF) is common and catheter ablation has become widely available. According to the Heart Rhythm Society consensus statement,<sup>1</sup> catheter ablation of AF should be considered after breaking through one antiarrhythmic drug (AAD). However, use of catheter ablation as first-line therapy is controversial. This multicenter, prospective study randomized patients with recent onset AF ( $\leq 4$  episodes over prior 6 months) to either drug therapy or catheter between January 2006 and February 2012. The primary outcome was the occurrence of the first symptomatic or asymptomatic atrial tachyarrhythmia lasting  $> 30$

seconds. One hundred twenty-seven patients were randomized to either antiarrhythmic therapy ( $n = 61$ ) or radiofrequency catheter ablation ([RFCA],  $n = 66$ ) and followed for up to 24 months. The most common AADs used were flecainide (50.9%) and propafenone (25%). Complete pulmonary vein isolation was achieved in 87% in the ablation group. AADs were all stopped at 90 days in the ablation arm, and anticoagulation with warfarin was continued for at least 3 months after ablation. The primary outcome was reached more often in the AAD group than the RFCA group (72.1% vs 54.5%; hazard ratio [HR], 0.56; 95% confidence interval [CI], 0.35-0.90). The first recurrence of

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symptomatic atrial tachyarrhythmia occurred in 59% in the drug group and 47% in the ablation group (HR, 0.56; 95% CI, 0.33-0.95;  $P = 0.03$ ). There was a 9% incidence of serious adverse events in the ablation group, including four cases of cardiac tamponade. There were no deaths or strokes. There was a significant improvement in quality of life in both groups, with no significant difference. The authors concluded that among treatment-naive patients with paroxysmal AF, RFCA resulted in fewer recurrences of AF as compared to AAD, but recurrences were common in both groups.

#### ■ COMMENTARY

AF remains the most common arrhythmia and management of AF patients remains a significant part of many cardiology practices. Catheter ablation for AF has been increasingly accepted as a therapeutic option for AF, with the potential for AF “cure.” However, while early single-center studies had dramatic success rates, multicenter trials have demonstrated 1-year AF freedom closer to 65%.<sup>2</sup> Complications of AF ablation have also become more widely recognized and include stroke, pulmonary vein stenosis, left-atrial esophageal fistula, and cardiac tamponade. A recent nationwide insurance survey of patients undergoing AF ablation found a striking in-hospital mortality rate of 0.46%, with the majority occurring among low-volume operators (< 25 cases/year).<sup>3</sup> A recent prospective, randomized study in the Netherlands found no difference in cumulative AF burden in the ablation vs drug arms, although the AF burden at 2 years was reduced in the ablation arm.<sup>4</sup> In the Radiofrequency Ablation vs Antiarrhythmic drugs as first-line treatment of paroxysmal Atrial Fibrillation (RAAFT-2) study, there was a clear decrease in recurrent AF in the ablation group, although at 2 years there remained a 50% AF recurrence in the ablation group after a single ablation procedure. Of interest is that pulmonary

vein isolation was achieved in only 87% of patients in the ablation arm, which is quite low. This occurred despite the fact that all the centers in the study were experienced in AF ablation.

So, should catheter ablation be first-line therapy for AF patients? There is little doubt that freedom from AF at 2 years is superior after catheter ablation compared to drug therapy. However, the complication rate in multicenter studies and general practice should not be overlooked. Also, pulmonary vein reconnection and the complexity of AF still leads to significant recurrence rates after a single procedure. Newer advances, such as contact force catheters and rotor-guided ablation, may improve single procedure success rates, but this remains to be tested prospectively. Therefore, at this time, I must agree that the current data support a trial of antiarrhythmic therapy in most patients with paroxysmal AF. However, some patients — often athletes or those already on multiple pharmaceutical agents — are interested in primary ablative therapy without a trial of AADs. I think the RAAFT-2 trial supports this approach as a reasonable option if the ablation is performed at an experienced center and the patient is informed of the anticipated risks and benefits of ablation. ■

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# Is Catheter Ablation Superior to Antiarrhythmic Drugs in Treating Premature Ventricular Contractions?

By Edward P. Gerstenfeld, MD

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

SOURCE: Zhong L, et al. Relative efficacy of catheter ablation vs antiarrhythmic drugs in treating premature ventricular contractions: A single-center retrospective study. *Heart Rhythm* 2014;11:187-193.

**F**requent premature ventricular contractions (PVCs) may lead to a cardiomyopathy or worsen a pre-existing cardiomyopathy. Beta-blockers and antiarrhythmic drugs (AADs) have been considered first-line treatment for PVCs; however, catheter ablation has emerged as a reasonable alternative. This study sought to compare radiofrequency catheter ablation (RFCA) and AADs as first-line therapy for treating patients with frequent PVCs. This was a retrospective study from the Mayo Clinic. Patients with frequent PVCs (> 1000/24 hours) on Holter monitor between January 2005 and December 2010 who had baseline and follow-up echocardiograms and Holter monitors were included. Patients who underwent treatment with AADs were compared to those undergoing RFCA. Five hundred ten patients were identified, 215 undergoing RFCA and 295 treated with AADs. The RFCA group was younger than the AAD group ( $47 \pm 16$  vs  $62 \pm 18$ ;  $P < 0.001$ ) and had less coronary artery disease (6% vs 13%;  $P < 0.01$ ). The PVC origin was the outflow tract in 37% and non-outflow tract in 42%, multiple in 5%, and undefined in 16%. The average PVC reduction with AADs was 49%; true AADs including amiodarone, flecainide, mexilitene, sotalol, and propafenone were more effective (82%) than beta-blockers (36%;  $P < 0.001$ ) and calcium channel blockers ([CCBs], 43%;  $P < 0.001$ ). RFCA reduced PVCs by 93%, significantly more than AADs ( $P = 0.04$ ). The acute success rate of PVC ablation was 94%. The left ventricular ejection fraction (LVEF) increased significantly in the RFCA group, but not in the AAD group. Complications occurred in 12 patients (5.6%), and include arterial access complications ( $n = 7$ , including descending aortic dissection in one) and cardiac tamponade requiring pericardiocentesis ( $n = 5$ ). The authors concluded that RFCA was more effective than AAD for reducing PVC burden and improving LVEF.

## ■ COMMENTARY

PVCs in the setting of a structurally normal heart were previously largely considered benign. However, the recognition of frequent PVCs as a cause of cardiomyopathy has increased the recognition and treatment of patients with frequent PVCs. The number of patients referred to our practice with frequent PVCs has dramatically increased in the past 5 years. Treatment options include beta-blockers, CCBs, AADs, or RFCA. In this study, RFCA was significantly more effective than drug therapy for suppressing PVCs (93%) and improving LVEF. It is useful to note that true AADs (Class IC or III) were much better at suppressing PVCs (82%) than beta-blockers (36%) or CCBs (43%). Should all patients with frequent PVCs be referred for catheter ablation? Of concern is the high rate of procedural complications in patients undergoing RFCA (5.6%) in this study, including such complications as aortic dissection (related to retrograde aortic instrumentation), cardiac perforation, and tamponade. In our experience, these complications are quite rare during PVC ablation, particularly for PVCs originating from the right ventricular outflow tract. However, it is a reminder that any procedure has risks. The study found that improvement in ejection fraction occurred mainly in patients with more than 10,000 PVCs over 24 hours (or 10% burden). This supports findings from prior studies.<sup>1</sup>

To summarize, patients who are asymptomatic with < 10% PVCs can be reassured. For patients with symptomatic PVCs, or > 10% PVCs and LV dysfunction, we often start treatment with benign drugs such as beta-blockers. Those patients with continued PVCs on beta-blockers, side effects, or a desire to not be on chronic medical therapy should be offered the option of catheter ablation vs Class I or III antiarrhythmic therapy, after a discussion of the risks and benefits. In patients with frequent PVCs and left ventricular dysfunction, I often move more quickly to catheter ablation because of the

greater efficacy in completely eliminating PVCs. In experienced centers, the success rate of catheter ablation for eliminating PVCs is quite high (> 90%). ■

#### REFERENCE

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## ABSTRACT & COMMENTARY

# New Study Advocates for More Provocative Vasospasm Testing During Routine Cardiac Catheterization

*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:** Ong P, et al. Clinical usefulness, angiographic characteristics and safety evaluation of intracoronary acetylcholine provocation testing among 921 consecutive caucasian patients with unobstructed coronary arteries. *Circulation* 2014; Feb. 26. [Epub ahead of print].

Since the initial description of variant angina by Prinzmetal in the late 1950s and the later confirmation of coronary artery spasm as its cause, clinicians have sought a means of reliably testing for this entity. The ergoline derivative ergonovine, which causes vasoconstriction of smooth muscle, causes severe focal epicardial coronary spasm with ST elevation in a majority of patients with typical variant angina. Intravenous and intracoronary administration of ergonovine, which is a relatively long-acting agent, is associated with common unpleasant side effects including nausea and headache, and has infrequent risks of myocardial infarction, ventricular fibrillation, or refractory spasm. Acetylcholine, which has a shorter half-life and fewer side effects, is considered a safer agent for diagnostic purposes, and has been characterized as an effective diagnostic agent primarily in studies performed in Japanese populations. Provocative testing is rarely used today in Western countries due to concerns over the safety of the practice, as well as a perceived lack of specificity.

In this study, Ong and colleagues performed intracoronary acetylcholine testing (ACH-test) on 847 consecutive Caucasian patients with chest pain syndromes who were found to have non-obstructive disease (no lesions  $\geq 50\%$ ) at the time of cardiac catheterization. Their aims were to determine the frequency of coronary spasm in this group of patients, to describe the angiographic and clinical characteristics of acetylcholine-induced spasm, and to determine the safety of this approach. Patients with severe chronic obstructive pulmonary disease,

creatinine  $> 2.0$ , or spontaneous spasm were excluded. The ACH-test was considered “positive” if the patient developed coronary narrowing of  $\geq 75\%$  compared with the baseline post-NTG angiogram, in combination with reproduction of the patient’s symptoms and ECG changes. Epicardial spasm was further characterized in terms of proximal or distal location, and as focal vs diffuse. The test was also considered positive for “microvascular spasm” when the patient developed ischemic ST changes and typical symptoms in the absence of  $\geq 75\%$  reduction in vessel diameter.

Of the patients studied, epicardial spasm was seen in 283 patients (33.4%), and microvascular spasm in an additional 205 (24.3%). Only 117 patients had fully negative tests, while 242 patients were considered inconclusive due to developing only angina or ECG changes or angiographic vasospasm in isolation. Of those with epicardial spasm, the majority were of the diffuse and distal type. Overall, patients with positive tests were more often older and female and presented with exertional symptoms. Among the positive patients, however, those with epicardial as opposed to microvascular spasm were more likely to be male with a history of smoking and obstructive coronary artery disease. Only nine patients (3.2%) developed proximal and focal vasospasm of the type traditionally associated with variant angina. There were no serious complications during the study, with only nine patients experiencing less-serious events, including NSVT, self-terminating atrial fibrillation, and transient bradycardia and

hypotension. The authors concluded that the ACH-test using their protocol is a safe and effective test for coronary spasm, and suggest that interventional cardiologists become familiar with its use.

#### ■ COMMENTARY

Several points about this study may strike the reader as surprising. First, nearly 58% of patients studied in this consecutive non-selected group had “positive” ACH-tests. Is this a true estimate of the frequency of vasospastic angina? All subgroups of spasm were grouped together in defining a totality of positive acetylcholine responses. It is worth noting that the authors’ definition of epicardial spasm differed from prior studies in requiring a lesser degree of differential narrowing. The dose of acetylcholine used, up to 200 µg injected intracoronary, was relatively high. Some would argue that epicardial coronary narrowing seen at these concentrations is as much a marker of endothelial dysfunction as of spasm; vasoconstriction even in angiographically normal arteries is well-described with sufficient dose. “Microvascular spasm” was defined by the combination of symptoms and ischemic ECG changes, but coronary blood flow was not directly measured.

On the other hand, tests were only considered positive with both objective criteria (either angiographic or ECG) and recrudescence of what the authors considered typical symptoms. This gives some credence to the statement that a positive test

“...leads to reassurance of the patient that a cause for symptoms is found.” I admit to some skepticism that an abnormal test indicates an ironclad diagnosis in most patients, however.

Should the ACH-test be added to our catheterization lab repertoire? Perhaps. The procedure, once learned, could easily be put into place alongside existing lab protocols. Notably, all patients in the study discontinued cardiac medications, including beta-blockers, calcium channel blockers, and nitrates, at least 48 hours before the test; this provision seems neither realistic nor wise for a significant proportion of patients coming to the catheterization lab. While I don’t foresee acetylcholine testing becoming too commonplace, there is surely a population of patients for whom the additional information may change management. In the accompanying editorial in the same issue of *Circulation*, Dr. Scott Kinlay puts it well: “... the need for routine provocative testing is uncertain as it is unlikely to change clinical practice in most patients with coronary artery disease. Its value probably lies in a smaller group of patients with non-obstructive disease and recalcitrant symptoms or unexplained sudden cardiac death. Coronary spasm in the former may lead to more intensive vasodilator therapy and the latter an implantable cardioverter defibrillator.”<sup>1</sup> ■

#### REFERENCE

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## ABSTRACT & COMMENTARY

# The Allen’s Test Prior to Transradial Access: A Necessary Precaution or a Waste of Time?

*Jeffrey Zimmet, MD, PhD*

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

**SOURCE:** Valgimigli M, et al. Trans-radial coronary catheterization and intervention across the whole spectrum of Allen’s test results. *J Am Coll Cardiol* 2014; Feb. 14. [Epub ahead of print].

**T**he transradial approach to cardiac catheterization has been steadily gaining ground over the past several years due to advantages over the femoral approach in terms of bleeding risk, vascular injury, procedural cost, and patient comfort. In many countries around the world, the transradial technique has become the dominant method for cardiac catheterization. The forearm in most patients has a dual blood supply, with the radial and ulnar arteries anastomosing

in the palmar arch of the hand. The procedural sheath is often occlusive to antegrade flow for the duration of the procedure. In addition, every published study has demonstrated some risk of occlusion of the radial artery, with frequencies over a wide range as low as 0.8% and as high as 30%. The modified Allen’s test (AT) has classically been used to evaluate the patency of the dual blood supply and palmar arch prior to transradial catheterization, despite its well-described issues

with subjectivity and reproducibility (patients excluded based on the AT range from 1-25%). Multiple centers have reported that they no longer assess the blood supply to the hand prior to cardiac catheterization, proceeding with transradial access without the AT.

Valgimigli and colleagues sought to more fully characterize the safety of transradial access in patients across the full range of AT results — normal, intermediate, and abnormal. A total of 203 patients were enrolled between 2007 and 2009 at a single center, and were grouped according to the AT result: 83, 60, and 60 presented a normal, intermediate, and abnormal AT result, respectively. The primary endpoint was the thumb capillary lactate measured at six time points during and after the procedure. The Barbeau modified AT was performed on each subject, with test results reported as A, B, C, or D as per the original description (with pattern D describing no return of pulse tracing within 2 minutes of radial artery compression). Blood flow to the hand at radial sheath insertion and removal was measured semi-quantitatively by ulnar artery angiographic frame counting. Discomfort and handgrip strength were assessed, and each patient also underwent assessment of radial artery patency and plethysmography at follow-up. In the reported cohort of patients, capillary thumb lactate did not differ among the groups immediately after the procedure or at any time point. Likewise, the handgrip strength and discomfort ratings did not differ among groups. Both plethysmography and ulnar frame count readings suggested an improvement in ulnar collateral flow following transradial catheterization, specifically in those with abnormal AT at baseline. The authors concluded that the patency of collateral circulation of the hand is highly dynamic, and that collaterals may be recruited during and after transradial procedures, especially in those with baseline deficiency in said testing. They take this as evidence that the

transradial approach should not be denied to appropriate patients based on the AT.

#### ■ COMMENTARY

Transradial access for cardiac catheterization is increasingly common, and reported ischemic complications to the hand are rare. Of the few reported cases in the literature, several describe such difficulties in the setting of small vessel disease of the hand, such as CREST syndrome or severe Raynaud's disease. It is unlikely that tests of ulnar collateral patency would predict these complications.

It is certainly reassuring that thumb capillary lactate, the very measurement that resulted in some early recommendations against transradial access in patients with abnormal AT, did not differ among the groups studied. Other concerns over differential hand strength and discomfort also seem to be laid to rest. The hypothesis of collateral recruitment during and after radial access in patients with baseline abnormal testing is certainly supported by their results, and appears to be a reasonable conclusion.

On the other hand, the number of cases studied here was small. The authors reported that 40% of the abnormal AT group had Barbeau type D patterns (the only pattern for which most labs would exclude the transradial approach) on plethysmography; this corresponds to only 24 patients in the study. At 1 day post-procedure, only five patients had documented radial artery occlusion, and only one of these was even from the abnormal AT group. All five had documented collateral flow by doppler ultrasound. Does this prove that all patients with abnormal AT (Barbeau type D) will remain asymptomatic if they develop radial artery occlusion? It is certainly suggestive, but I for one would like to see more evidence of follow up in the type D population before discarding this test entirely. In the meantime, we would all do well to follow established means for reducing the incidence of radial artery occlusion in our transradial patients. ■

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## ABSTRACT & COMMENTARY

# Value of the Physical Examination in Heart Failure

*By Michael H. Crawford, MD, Editor*

SOURCE: Caldentey G, et al. Prognostic value of the physical examination in patients with heart failure and atrial fibrillation: Insights from the AF-CHF Trial (Atrial Fibrillation and Chronic Heart Failure). *JACC Heart Fail* 2014;2:15-23.

These investigators from the Montreal Heart Institute asked the question of whether the physical examination was still of value in the modern era of heart failure management that includes the use of biomarkers and echocardiography. They employed the patient population in a trial of heart failure and non-permanent atrial fibrillation (AF) randomized to a rhythm control vs rate control strategies. The study showed no differences in outcome between the two groups. The physical examination findings were evaluated retrospectively and four signs were studied: peripheral edema, jugular venous distention (JVD), third heart sound, and pulmonary rales. The patients were followed for up to 6 years and the primary outcome was cardiovascular (CV) mortality. Secondary outcomes included all-cause mortality, heart failure-related mortality, sudden death, and heart failure hospitalizations. Of the 1376 patients enrolled, all but seven had data on all four of the physical exam findings. At enrollment, 31% had peripheral edema, 22% had JVD, 15% a third sound, and 13% had rales. Over a mean follow-up of 37 months, 32% died and 25% had at least one heart failure hospitalization. In the univariate analysis, all four of the physical findings were associated with increased CV mortality (hazard ratios [HRs], 1.5-1.9; all  $P < 0.004$ ). On multivariate analysis up against laboratory tests and echocardiographic parameters, peripheral edema (HR, 1.25; 95% confidence interval [CI], 1.00-1.57;  $P < 0.05$ ) and rales (HR, 1.4; 95% CI, 1.08-1.86;  $P < 0.02$ ) remained predictive of CV mortality. Peripheral edema was independently associated with all-cause mortality and heart failure-related death. Rales were independently associated with heart failure-related death and hospitalization. JVD or a third heart sound were not independently associated with any CV outcome. The authors concluded that physical examination signs of congestion are important prognostic indicators in the modern therapeutic milieu of congestive heart failure.

## ■ COMMENTARY

In the current era where the serial use of echocardiography, brain natriuretic peptide levels, and measures of renal function are often the drivers of therapeutic decisions in heart failure management, it is interesting to see that signs of congestive heart failure on physical examination are still useful predictors of outcome. This study involved patients with left ventricular ejection fractions  $< 35\%$  and heart failure symptoms within 6 months of enrollment. They were on modern therapy: 86% on angiotensin-converting enzyme inhibitors, 79% on beta-blockers, and 45% on aldosterone antagonists. However, it is not known how many had ventricular pacing. Also, the patients all had a history of non-permanent atrial fibrillation and some were on antiarrhythmic drugs such as amiodarone. Whether the results would apply to other less sick or less well treated populations is unknown, but previous studies would suggest that they would.

The major limitation of this study is that it is observational and cannot be adjusted for unknown confounders. For example, rales can be caused by lung disease; a third sound may be due to marked mitral regurgitation; and edema can be due to venous insufficiency. Also, this is a retrospective analysis of a study designed for another purpose, so it is difficult to know how well the physical examination was conducted. Unless each patient is put in the left lateral position and the bell of the stethoscope used, third heart sounds can be missed. In addition, JVD is notoriously hard to determine. Perhaps this is why rales and edema were more predictive than the third sound and JVD.

The new Accreditation Council for Graduate Medical Education mandated resident evaluation system emphasizes the attainment of milestones. At my institution, we are including the mastery of identifying these four physical findings as milestones that the residents should achieve. ■

## ABSTRACT & COMMENTARY

# Who Should be Referred for Advanced Heart Failure Care?

By Michael H. Crawford, MD, Editor

SOURCE: Thorvaldsen T, et al. Triage of patients with moderate to severe heart failure: Who should be referred to a heart failure center? *J Am Coll Cardiol* 2014;63:661-671.

Some patients with heart failure (HF) due to systolic left ventricular (LV) dysfunction may benefit from advanced therapies such as heart

transplantation, left ventricular assist devices (LVAD), or palliative care, but criteria for referring patients to advanced HF centers are lacking. Thus, these

#### EDITOR

Michael H. Crawford, MD  
Professor of Medicine  
Chief of Clinical Cardiology  
University of California,  
San Francisco

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**AHC Media**

investigators from Sweden interrogated their country's HF registry to ascertain variables that independently predict survival and can be used as triggers for referral to advanced HF care. Between 2000 and 2013, more than 10,000 patients with New York Heart Association (NYHA) class III-IV heart failure and LV ejection fraction < 40% were registered. At baseline, 46 clinically relevant variables were analyzed with regard to mortality and compared to the overall Swedish population (expected mortality) in three age groups: < 65 years (n = 2247), 66-80 years (n = 4632), and > 80 years (n = 3183). In those < 80 years, based on previous data, five risk factors for all-cause mortality were studied: systolic blood pressure < 90 mmHg, creatinine > 1.9 mg/dL, hemoglobin < 12 g/dL, absence of renin angiotensin antagonist, or absence of beta-blocker therapy. The observed and expected survival for those < 65 years was 90% vs 99%; 66-80 years was 79% vs 97%; and > 80 was 61% vs 89%. In those < 80 years, the presence of 1, 2, or 3-5 risk factors increased mortality with HRs of 1.4, 2.3, and 4.1, and 1-year survivals of 79%, 60%, and 39%, respectively. The authors concluded that more than one of these five simple risk factors for death would be an indication to explore advanced therapies in systolic HF patients < 80 years of age. Above age 80, palliative care should be considered.

#### ■ COMMENTARY

The thesis of this study is that there are

patients being managed by primary care doctors and perhaps cardiologists who may benefit from referral to a HF center. The authors point out that in Sweden, 50% of patients with HF are cared for by primary care doctors. They believe that the various HF scores and exercise peak VO<sub>2</sub> are too complex for most busy practitioners to consider. Thus, they sought simple criteria for referral to a HF specialist, based on previous studies. They did not prospectively validate the risk factors they chose, but they did analyze their ability to predict all-cause mortality in a HF database. The presence of one of their five risk factors dropped 1-year survival lower than that expected with LVAD or heart transplant therapy (79% vs 80% for LVAD and 90% for transplant). The presence of more than one risk factor progressively decreased survival further. They emphasize that their risk factors are useful for deciding on referral, not selection for advanced therapy. Not all referred patients may be suitable for advanced therapies; especially those over 80 years who may be better candidates for palliative care, which is used less frequently in HF as compared to cancer. Perhaps all high-risk HF patients deserve one consultation with an advanced care specialist. Thus, in NYHA class III or IV patients with HF and EF < 40%, the presence of systolic blood pressure < 90 mmHg, creatinine > 1.9 mg/dL, hemoglobin < 12 g/dL, or the absence of ACEI/ARB or beta-blocker therapy (for whatever reason), should be referred to an advanced HF therapy center. ■

#### CME Questions

- The modified Allen's test should *not* be used:**
  - to determine circulatory adequacy in patients with hand pain.
  - to demonstrate the palmar arch blood flow to medical students.
  - to exclude patients from transradial cardiac catheterization.
  - All of the above
- A relatively safe test for provoking coronary artery spasm is an intracoronary infusion of:**
  - ergonovine.
  - acetylcholine.
  - phenylephrine.
  - vasopressin.
- Current randomized trial data in patients with symptomatic non-valvular paroxysmal atrial fibrillation support which of the following initial approaches?**
  - A trial of antiarrhythmic drug therapy
  - Catheter ablation
  - The rate control, oral anticoagulant approach
  - Lifestyle modifications
- Which of the following approaches is most likely to significantly reduce PVC burden and improve LVEF?**
  - Antiarrhythmic drug therapy
  - Beta-blocker therapy
  - Catheter ablation
  - ACEI or ARB therapy
- Which physical examination findings are most predictive of cardiovascular mortality in heart failure patients?**
  - An enlarged apical impulse and a systolic murmur
  - Hepatojugular reflux and a fourth heart sound
  - Jugular venous distention and a third heart sound
  - Pulmonary rales and peripheral edema
- Simple risk factors for reduced mortality in systolic heart failure patients include all *but* which of the following?**
  - Hemoglobin < 12 g/dL
  - Serum chloride < 100
  - Systolic blood pressure < 90 mmHg
  - Absence of beta-blocker or ACEI/ARB therapy

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# Clinical Cardiology

## [ALERT]

Critical analysis of the latest clinical research in cardiovascular medicine

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**Volume 32**

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