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Effect of Bypass Surgery on LV Performance

ABSTRACT & COMMENTARY

Synopsis: *Successful myocardial revascularization may improve LV performance under stress.*

Source: Elhendy A, et al. *Am J Cardiol* 2000;86:490-494.

Previous studies of the effect of coronary artery bypass graft (CABG) surgery have used resting left ventricular ejection fraction (LVEF) as the gold standard for determining myocardial viability, yet little is known about LV perfusion and contractile reserve after CABG. Thus, Elhendy and colleagues studied 57 patients with EF less than 40% referred for CABG, by dobutamine thallium stress testing before and three months after the CABG. Patients who suffered perioperative myocardial infarction (MI) or had incomplete revascularization were excluded. All patients had a previous MI and underwent CABG for angina. There was no change in EF overall post-CABG. In 12 patients, resting EF increased post-CABG (group A), whereas no change was observed in the remaining 45 (group B). A significant increase in rest to low-dose dobutamine EF occurred in patients in both groups after CABG (13% after vs 7% before; $P < 0.001$). Both groups showed a reduction in myocardial ischemia perfusion scores after CABG, but was greater in group A (60%) vs. group B (30%; $P < 0.01$). Elhendy et al concluded that CABG produces significant improvements in resting myocardial perfusion and the EF response to low-dose dobutamine in the absence of an overall increase in the resting EF. These results suggest that successful myocardial revascularization may improve LV performance under stress.

COMMENT BY MICHAEL H. CRAWFORD, MD

Studies of the results of CABG surgery in patients with reduced EF have shown modest improvements in postoperative EF. This study is consistent with these findings in that about 20% of their patients showed an increase in resting EF postoperatively, despite increases in myocardial perfusion in all patients. The magnitude of increase in perfusion was roughly related to return

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of LV function since the 12 patients with EF increases more than 5% did have the largest increase in perfusion. This suggests that it may take very large increases in perfusion to increase resting EF. Other studies have also shown that improvements in segmented wall motion may not always translate to increases in global EF. This could be because the improved areas are relatively small or that compensatory hyperfunction of normal walls may decrease as regional wall motion abnormalities improve.

Previous studies have demonstrated that mortality is reduced after CABG in patients with symptoms, three-vessel disease, and low EF. Several reasons have been suggested: First, EF may increase—a powerful marker of survival; Second, long-term remodeling may be reduced (unfortunately, there is no echo data to analyze LV structure in this study); Third, ventricular arrhythmia may be reduced; Fourth, myocardial ischemia is probably reduced and LV contractile reserve improved as shown in this study. This study was not designed to evaluate mortality and the follow-up was rather short. A larger, longer study would be necessary to assess the prognostic significance of improved LV contractile reserve. Regardless, this study suggests that revascularization of patients with ischemic cardiomyopathy may be beneficial even if resting EF is unchanged. ❖

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Prosthetic Valve Choice

ABSTRACT & COMMENTARY

Synopsis: *A 15-year survival rate was better with a mechanical aortic valve replacement because primary valve failure was virtually absent.*

Source: Hammermeister K, et al. *J Am Coll Cardiol* 2000;36:1152-1158.

Previous studies comparing mechanical to tissue valves have shown no difference in overall survival for up to 12 years. Thus, the 15-year report of the Veterans Affairs randomized trial is of interest. From 1977 to 1982, 575 men were randomized to either a Bjork-Shiley mechanical valve or a porcine bioprosthesis for single-valve aortic or mitral replacements. The primary end points of the long-term follow-up were death and valve-related complications. Follow-up was 97% complete at the 18th year since randomization. Operative mortality was 8% and did not differ between the two valve types. Aortic valve replacement (AVR) with a mechanical valve resulted in a significantly lower 15-year mortality vs. a bioprosthetic valve (66 vs 79%; $P = 0.02$), but there was no difference with mitral valve replacement (MVR). The cause of death was prosthesis related in 37-57% of cases of AVR and MVR with both valve types. Primary valve failure was more common with bioprosthetic valves in both positions: AVR, 23 vs. 0%, $P < 0.001$; MVR 53 vs. 31%, $P = 0.01$. In MVR, perivalvular regurgitation was more common with mechanical valves; 17 vs. 7%, $P = 0.05$. In AVR, reoperation was more common with a bioprosthetic valve; 29 vs. 10%, $P = 0.004$. The incidence of other complications such as systemic embolism, endocarditis, and valve thrombosis was not different between the two valve types. Hammermeister and colleagues concluded that 15-year survival was better with a mechanical AVR because primary valve failure was virtually absent. Primary valve failure was more common with a bioprosthesis in either position and was more prevalent in those younger than 65 years old.

COMMENT BY MICHAEL H. CRAWFORD, MD

The previous large, long-term comparative studies were inconclusive regarding survival of patients with mechanical vs. bioprosthetic valves. The five and 11-year reports from the VA trial showed no difference in survival for the two valve types in either position. The Edinburgh trial showed a trend for increased survival with mechanical valves at 12 years ($P = 0.08$). Thus,

this 15-year VA follow-up study is of interest.

Ideally, valve replacement should be a one-time event, consequently, this type of long-term data is important for selecting the right valve for each patient. Unfortunately, the two valves used in this study are no longer the most widely used and concern would be reasonable that these results are not applicable to modern valves. On the other hand, there is no data suggesting that current valves are superior to the older designs in any way that would effect major outcomes. Also, one mechanical valve is probably more similar to another mechanical valve than it is to a bioprosthetic valve and vice versa. Currently, this is the best data available and several major clinical points are made.

Overall mortality was high in this series ranging from 66% to 81% over the 15-year follow-up. The majority of deaths were due to factors other than the valve replacement per se; about 25% were other cardiac causes, 20% noncardiac, and 10% undetermined. This is not surprising given the comorbidities reported in this male, veteran population. However, about 45% of the deaths were valve related and with AVR the lower primary valve failure rate resulted in a better survival with a mechanical valve. This advantage for mechanical AVR was greatest in those younger than age 65 because virtually all the primary valve failures in porcine valves occurred in the younger patients. Thus, in patients younger than age 65, AVR should be with a mechanical valve unless chronic anticoagulation is not feasible or desirable.

The major drawback to mechanical valves is the need for anticoagulation and the subsequent risk of bleeding that was demonstrably higher for mechanical valves in both positions in this study. Clinically, significant bleeds occurred in about half the patients with mechanical valves over 15 years. However, the incidence of bleeding with bioprosthetic valves in both positions was substantial at about 30%. Hammermeister et al speculate that many of the bioprosthetic valve patients were on anticoagulants for other reasons, such as atrial fibrillation. If one analyses VA trial data on atrial fibrillation patients treated with anticoagulants, the bleeding rate over 15 years would calculate to 23%. The high bleeding rates with both types of valves may be related to the fact that INRs were not used during the early part of this study and thus, anticoagulant control may have been suboptimal. Bleeding rates in the INR era are probably lower.

In patients older than age 65, no advantage to a mechanical valve was demonstrated, so such patients may be good candidates for bioprosthetic valves especially if they do not need anticoagulants for other reasons. Also of interest is the fact that thromboembolic events were uncommon (< 20%) and were equal between the two valve types. Thus, the concept that there are fewer embolic events with bioprosthetic valves is disproven by this study. In addition, valve thrombosis was rare (1-2%) and was not more common with mechanical valves.

In summary, with AVR, a mechanical valve makes sense for those younger than age 65 and a porcine valve for those older than age 65, provided that they do not need anticoagulation for some other reason. Patients who need anticoagulation for other reasons should get mechanical valves in either position at any age. With MVR, there is no survival advantage of one valve type over the other, so patient-related factors become more important. On the other hand, for MVR, primary valve failure was significantly lower with mechanical valves (5% vs 44%). MVR freedom from re-operation has to be weighed against freedom from anticoagulation. ❖

Ross Procedure in Older Patients

ABSTRACT & COMMENTARY

Synopsis: *The Ross procedure may be performed in selected patients older than 60 years without increased risks or complications.*

Source: Schmidtke C, et al. *J Am Coll Cardiol* 2000; 36:1173-1177.

The pulmonary autograft for aortic valve replacement (Ross procedure) has mainly been used in young patients because the complexity of the surgery makes perioperative risk higher in older patients; however, the age limit is controversial. Thus, Schmidtke and colleagues compared the results of the Ross procedure in 27 patients older than 60 years of age to 84 patients younger than age 60, followed for a mean of 26 months. Perioperative mortality was zero in the older group and less than 1% in the younger group. Echocardiographic measures of left ventricular and valve function were not significantly different between the two groups except that the gradient across the homograft pulmonic valve was higher in the younger group. The New York Heart Association Functional class was

less than class I in almost all the patients and was not different between the two groups. Schmidtke et al concluded that the Ross procedure may be performed in selected patients older than age 60 without increased risks or complications.

COMMENT BY MICHAEL H. CRAWFORD, MD

The use of a pulmonary autograft to replace the aortic valve and a homograft for the pulmonic valve was originated by Donald Ross of London in the 1960s, but it was rapidly eclipsed by the development of mechanical and biological prosthetic valves, which were simpler alternatives for most surgeons. When the long-term results of the Ross procedure were published in the late 1980s, renewed interest in this operation was sparked. The Ross procedure registry now suggests that more than 600 are performed a year at more than 100 centers worldwide. The major indications for the procedure are: isolated aortic valve pathology; prior prosthetic valve failure; endocarditis of the aortic valve only; and athletic young adults where anticoagulation is not desirable, but optimal hemodynamics are important. The Ross procedure results in a better hemodynamic outcome than a bioprosthesis and does not require anticoagulation. Also, long-term durability is excellent with reported 20-year freedom from re-operation rates of 75-80%.

These attractive features would make the Ross procedure ideal for older patients were it not for the complexity of the surgery. In order to avoid the need for anticoagulation, older individuals are often given bioprostheses, but then they face the possibility of replacement at an advanced age if the tissue valve fails before they die of other causes. Re-operation at ages older than 70 years have a 15-25% reported mortality. These considerations prompted the present study.

Their outstanding results with zero perioperative mortality and excellent functional class in patients aged 61-71 years with about equal numbers of men and women, is remarkable. Such results speak to their experience with this operation, but also to their patient selection. Patients with extensive three-vessel coronary disease were excluded, as were patients with multivalve disease, ejection fraction less than 40%, disease of the pulmonic valve, severe aortic root calcification, and reduced general health. Most of their patients had aortic stenosis and were NYHA functional class II. Although no data on cognitive state are given, it is noteworthy that bypass time averaged more than 200 minutes in both groups, but was not different between the older and younger patients.

The only clinical or echocardiographic measurement difference between the young and older patients was the gradient across the pulmonic homograft—it was greater in the young group and was weakly correlated with years since operation. This suggests that in the younger patients a more profound immune reaction may be mounted against the homograft. Although in most long-term data, re-operation because of aortic autograft problems is more common than re-operation for pulmonic homograft problems. Thus, this reaction to the homograft may be of little clinical consequence.

In summary, the advantages of the Ross procedure—autologous tissue, long-term viability of the graft, optimal hemodynamics, resistance to infection, no valve noise, low primary failure rate, no anticoagulation and very low thromboembolic rates—make it an ideal operation for isolated aortic valve disease if the patient is otherwise robust and meets the inclusion/exclusion criteria. Based upon this study, ages 50-70 would not seem to be a contraindication alone. ❖

Measuring Ejection Fraction

ABSTRACTS & COMMENTARY

Synopsis: *Ejection fraction by gated single photon emission computed tomography is unpredictably inaccurate. Mitral annular motion on echocardiography can estimate ejection fraction, but they are not linearly related.*

Sources: Vallejo E, et al. *J Nucl Cardiol* 2000;7: 461-470; Emission K, et al. *J Am Soc Echocardiogr* 2000;13:896-901.

Left ventricular ejection fraction (ef) is a powerful predictor of mortality and an important guide to many therapies in heart disease. Thus, techniques for easily measuring or estimating EF are of interest. The latest generation of quantitative ECG gated single photon emission computed tomography (GSPECT-QGS) software is widely used for computation of EF from SPECT images. However, its accuracy in clinical situations remains undefined. Vallejo et al selected 990 patients from 1694 SPECT myocardial perfusion studies who also had first-pass radionuclide angiograms (FPRNA), but 279 FPRNAs had to be excluded for technical reasons. Also, 311 SPECT studies were excluded for technical problems. Therefore, the final study population was 400 patients. The overall

correlation between GSPECT-QGS and FPRNA EFs was r = 0.66, SEE = 11.85%, and the mean QGS EF was lower (52 vs 58%; $P < 0.001$). Also, at low EFs the QGS EF was lower, but at high EFs it tended to be higher than the FPRNA EF. However, if only EFs less than 50% were considered, the correlation was better: r = 0.77, SE = 6.4%, and mean EF was similar by both methods (37 vs 34%; $P = 0.07$). In addition, agreement between QGS and FPRNA was better in hearts with large end-diastolic volumes. Vallejo and colleagues concluded that EF by GSPECT-QGS is often lower than with FPRNA and accuracy is adversely affected by technical and anatomic factors.

COMMENT BY MICHAEL H. CRAWFORD, MD

In a time where hype and exaggeration seem to be the norm, it is nice to see the nuclear cardiologists publicly admitting they have a problem. However, the group from Yale has always been appropriately critical. Due to the underestimation of EF and the unpredictable inaccuracies caused by high extra cardiac activity, low count densities, and small left ventricles, which could not be reliably corrected with the automated program, Vallejo et al caution against using GSPECT-QGS for serial EF measurements to guide clinical decisions such as chemotherapy doses. On the other hand, they believe it is accurate enough for prognostication in coronary disease patients if one considers 0.45 the lower limit of normal.

The reason they provide such strong conclusions is the perceived strength of the study. They studied a large unselected group with a wide range of EFs (12-84%). Some of their patients had perfusion defects and ventricular enlargement. I was amazed at the technical difficulties they had—590 patients (60%) were excluded due to various technical factors that they thought would adversely affect the results. If a less experienced laboratory did not recognize some of these difficulties, their results could be even more inaccurate. The major limitation of this study was using FPRNA as the gold standard since it has its own problems. However, in their laboratory, FPRNA has a 5% variance and their results with QGS agree with experimental studies. Thus, GSPECT-QGS to estimate EF should be used with these limitations in mind.

In patients with technically inadequate echocardiograms for analyzing endocardial motion ordered for evaluation of LV function, inspection of mitral annular excursion in the apical four-chamber view has been suggested as a surrogate for estimating EF. Although originally the relationship between M-mode excursion of the mintral annulus and EF was thought to be linear, recent studies have cast doubt on this construct. Thus, Emisson et al studied 182 patients with excellent echocardiograms and no conduction abnormalities or arrhythmias. They performed a meta-analysis with their data and 252 patients from the literature, resulting in a total of 434 patients. EF was determined by the biplane Simpson's rule technique. Use of a linear model showed an r^2 of 0.74 for the correlation between mitral annular motion (MAM) and EF. Use of a curvilinear model had a higher r^2 of 0.79. Also, at lower EF levels MAM overestimates EF using the linear model. As an example; a MAM of 4 mm would correspond to an EF of 23% with the linear model and 14% with a curvilinear model. In addition, the relationship between MAM and EF is negatively influenced by heart size. Thus, the larger heart sizes of the patients with lower EFs may contribute to the overestimation of EF in this range by the linear model. Vallejo et al present a new regression equation that takes LV size into consideration so one can calculate EF from a MAM measure, but they suggest that MAM be used alone as a measure of LV function.

Although the use of MAM alone as a measure of LV function makes sense theoretically, it is a tough sell to physicians used to the EF measure. Other indices of LV function, such as fractional shortening and fractional area change, have been suggested over the years, but none have caught on and supplanted EF. Despite the observation that MAM is not linearly related to EF especially at lower EFs, the commonly used clinical cut point of a MAM of 10 mm corresponds to an EF of 50% is validated by this study. Thus, a MAM less than 10 mm indicates an abnormally low EF in general. However, keep in mind that a MAM of 5 mm does not indicate an EF of 25% (linear) but rather an EF of 15%. ❖

Ultrasound Ablation for Recurrent Atrial Fibrillation

ABSTRACT & COMMENTARY

Synopsis: *Results with the ultrasound ablation catheter are promising and this ablation system allows isolation of pulmonary vein ectopic foci in a significant proportion of patients.*

Source: Natale A, et al. *Circulation* 2000;102: 1879-1882.

Natale and associates report on the use of a new ultrasound ablation catheter for pulmonary vein isolation in patients with recurrent paroxysmal atri-

al fibrillation. The ablation system consists of a 0.035 in diameter luminal catheter with a distal balloon, which houses an ultrasound transducer. A guide wire is used for placement of the ablation catheter in the target pulmonary vein using a transseptal approach. Delivery of ultrasound produces tissue heating and, when successful, circumferential electrical isolation.

Data from 15 patients are included in this report. These patients all had markedly symptomatic atrial fibrillation that had been resistant to two or more antiarrhythmic drugs. The patients ranged in age from 30 to 69 years with a mean age of 59 ± 10 years. In 13 patients, only paroxysmal atrial fibrillation had been observed while in two patients atrial fibrillation episodes had required cardioversion. Nine patients had no known structural heart disease, four patients had a history of hypertension, one patient had reduced ventricular function, and one patient had valvular heart disease. Mapping of atrial premature contraction foci was performed using an octapolar recording catheter placed in the pulmonary veins. A site of origin for triggering beats that initiated atrial fibrillation was identified in nine of the 15 patients. In these nine patients, 12 atrial foci were observed. In five patients, no spontaneous premature contractions were recorded and in one patient a right atrial tachycardia was noted but was not mapped or ablated during this procedure. In the nine patients who underwent ablation, ablation was performed in the right superior, left superior, and left inferior pulmonary veins. In five patients, however, the right inferior veins were too small to accept the balloon ultrasound ablation catheter. A median of four ultrasound applications were required to isolate each vein. In one patient, in whom the target pulmonary vein was larger than the ablation balloon, radiofrequency lesions were used to complete the ablation. The ultrasound applications produced an adequate interface temperature of greater than 55ºC in 86% of lesions. Four of the nine patients had significant complications. One patient suffered a peri-procedural embolic stroke, one patient developed transient ST segment elevation, one patient had entry into the pericardial space by the transseptal needle, and one patient developed phrenic nerve paralysis that only partially resolved after three months. During a follow-up of 35 ± 6 weeks, nine patients remained in sinus rhythm off drugs, four patients had atrial fibrillation recurrence, and two patients had atrial tachycardia. Four of the six who suffered recurrences responded to drugs that had previously been ineffective. Natale et al concluded that these results with the ultrasound ablation catheter are promising and that this ablation system allows isolation of pulmonary vein ectopic foci in a significant proportion of patients.

COMMENT BY JOHN P. DiMARCO, MD, PhD

The observation by Haissaguerre and his colleagues that ectopy originating in the pulmonary vein sites was frequent precursor of paroxysmal atrial fibrillation has led to widespread interest in the development of new approaches for electrically isolating the pulmonary veins. Circumferential ablation at or near the ostia is difficult to achieve with currently available radiofrequency ablation catheters and several different devices that produce circumferential lesions more rapidly are now in clinical trials. The ultrasound ablation catheter has the advantage that one system allows the pulmonary vein to be occluded and visualized. Another potential advantage is that this catheter should produce uniform heating around the edge of the balloon, which is in direct contact with the entire circumference of the vein. As might be expected in an initial clinical trial, the overall results in this study are not overwhelming. Since only nine patients underwent ablation, it appears that the success rate in those undergoing ablation is less than the rate based on "intention-to-treat" quoted by Natale et al. Five of the nine patients with ectopic foci appear to have experienced recurrences while recurrence was noted in only one of six who did not undergo the ablation procedure. However, these are merely the first pilot results with a new device in an exciting area. As new tools are developed for electrophysiologists who produce electrical isolation of the pulmonary veins with a low rate of complications and a short procedure time, we can expect to see a revolution in the way patients with paroxysmal atrial fibrillation are handled. ❖

Reference

1. Haissaguerre M, et al. *N Engl J Med* 1998;339: 659-666.

Beneficial Effects of a Statin vs. an ACE Inhibitor on Coronary Atherosclerosis

ABSTRACT & COMMENTARY

Synopsis: *Patients with coronary atherosclerosis and normal lipids should be treated with statins.*

Source: Teo KK, et al. *Circulation* 2000;102:1748-1754.

Simvastatin/enalapril coronary atherosclerosis Trial (SCAT) tested the hypothesis that an ACE inhibitor would contribute to the proven benefits of a

statin on coronary atherosclerosis. This four-center Canadian trial initiated in the early 1990s is a study of 394 patients who had quantitative coronary angiograms (QCA) at baseline and at study conclusion. The average follow-up was four years (range, 3-5 yrs). Patients had coronary atherosclerosis as documented by coronary angiography as well as preserved left ventricular function. The qualifying lipid levels included a total cholesterol of 146-236 mg/dL and HDL cholesterol less than 42 mg/dL; the patients had essentially normal lipids with baseline mean of 198 for total cholesterol; 125 for LDL cholesterol, and 38 for HDL. Patients were placed on a NCEP-ATP Step I or Step II diet. All medications were allowed other than lipid-lowering drugs and ACE inhibitors. Study end points were standard quantitative coronary angiographic measures as well as prespecified clinical events, including all major CAD end points. Angiographic end points were average per patient change in mean and minimum diameters and maximum percent stenosis in analyzed segments. Qualifiers had to have coronary disease in greater than three major coronary segments. Progression/regression was defined by appropriate criteria, with an absolute mean or minimum diameter change of greater than 0.4 mm or a 15% in baseline diameter in one or more sections. Patients were randomly assigned to simvastatin, enalapril, the combination, or double-placebo. Target doses were 40 mg of simvastatin and 20 mg/d of enalapril; average daily doses achieved were 29 ± 15 mg for simvastatin, 7 ± 3 mg b.i.d. for enalapril. Compliance was very high. The primary end point was positive for the statin and neutral for enapril. Thus, the average per-patient mean absolute diameter, minimum absolute diameter, and maximum percent diameter stenosis was favorably affected by simvastatin vs. placebo, with slowing of disease progression. Angiographic changes and change in lipid levels were correlated for simvastatin, which also produced more regression in stable patients without angiographic change compared to placebo for all QCA end points. There were no differences in any angiographic end point for the enalapril patients compared to placebo; furthermore, the combination of simvastatin and enalapril did not differ from simvastatin alone. Clinical end points were positive only for revascularization, which was reduced by greater than 50% ($P = 0.02$) by simvastatin. Enalapril (alone or with simvastatin), but not simvastatin alone, compared to placebo resulted in a decrease in a combined end point of death, MI, and stroke (7% vs 13%; $P = 0.04$). The drugs were well tolerated; there were no significant laboratory abnormalities. Teo and colleagues concluded that "long-term lipid lowering therapy…resulted in significant slowing of CAD progression in normocholesterolemic patients…related to changes in lipid levels during treatment...long-term ACE inhibition with enalapril had a neutral effect." Clinical end points were uncommon, but less with the ACE inhibitor; revascularization end points were less with the statin. The benefits with simvastatin were believed to be due to plaque shrinkage and stabilization of plaque. Teo et al could not explain why the hypothesis that the ACE inhibitor would have an additional benefit was not supported; they stress that there may be favorable vascular mechanisms with enalapril that might not be detected by the QCA techniques. This study differs from most other CAD regression trials in that the baseline lipid levels were relatively normal. They concluded that patients with coronary atherosclerosis and normal lipids should be treated with simvastatin.

COMMENT BY JONATHAN ABRAMS, MD

This study supplies more evidence that sustained LDL cholesterol lowering alone with a statin in patients with CAD inparts benefit. While not powered as a randomized clinical trial that would be able to detect clinical event reduction, there was a clear-cut decrease in need for revascularization in the lipid-lowering group. The unique feature of SCAT compared to prior regression trials using a statin is that the baseline lipid levels were unremarkable. The previously published Harvard Atherosclerosis Reversibility Project (HARP) trial was negative and included normal cholesterol level patients. However, that was a small study. These data are consistent with the earlier Multicenter Anti-Atheroma Study (MAAS) trial, which showed benefit from lovastatin at four years. The ACE inhibitor results in subjects with unremarkable lipids are not surprising, in that there is little evidence from animal models that coronary atherosclerosis can be attenuated with ACE inhibition. Nevertheless, the enalapril clinical results, while modest in this small trial, do resonate with the recently published HOPE trial, with reduction of composite clinical end points in those patients taking enalapril, although individual end points of death, MI, and stroke were not significantly reduced. Simvastatin treatment did not affect this combined end point.

Both lipid lowering as well as ACE inhibition appear to be beneficial, particularly the statin. ACE inhibitors have a more poorly explained effect on clinical events, which cannot be readily explained by coronary angiographic end points or studies of vascular function. While some endothelial function trials, including Trendelenburg (TREND), have been positive for ACE inhibitors, the aggregate data are not particularly robust. Many mechanisms have been hypothesized to explain long-

term vascular benefits with ACE inhibitors. The robust reduction of a wide variety of cardiovascular end points in the HOPE trial in more than 9000 high-risk patients treated with ramipril, is similar to the reduction of clinical events in SCAT. It is likely that with both a statin and an ACE inhibitor, major benefits accrue only after a period of years, and not months. The data from SCAT clearly support the use of a statin and probably an ACE inhibitor as well in individuals who may not qualify for conventional lipid-lowering therapy or for an ACE inhibitor, using conventional clinical criteria. ❖

CME Questions

26. Mechanical valves are generally preferred for which one of the following?
a. Aortic valve replacement
b. Mitral valve replacement
c. Double valve replacement
d. None of the above

27. The Ross procedure:
a. avoids anticoagulation.
b. has excellent hemodynamics.
c. has a low thromboembolic rate.
d. All of the above

28. Ejection fraction cannot be reliably estimated by which one of the following?
a. Gated SPECT software
b. First-pass radionuclide angiography
c. Biplane echocardiography
d. Mitral annular motion

29. Which of the following are beneficial in CAD patients?
a. Statins
b. ACE inhibitors
c. Both a & b
d. All of the above

30. Coronary bypass surgery in patients with LVEF less than 40% did what?
a. Increased EF
b. Increased myocardial perfusion
c. Improved the EF response to dobutamine
d. b & c

Readers are Invited. . .

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