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Drug-eluting stents are here—now what? Implications for clinical practice and health care costs

THE ARTICLE by Drs. Haery, Sachar, and Ellis on page 815 of this issue of the *Cleveland Clinic Journal of Medicine* presents a concise but comprehensive review of current knowledge about the efficacy of drug-eluting stents. Its subtitle, “The beginning of the end of restenosis?” is attention-getting and emphasizes the potential benefit of this new technology in cardiovascular medicine.

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However, the capabilities and current costs of drug-eluting stents raise a number of critical questions for clinical cardiovascular specialists and interventionalists:

- Are drug-eluting stents truly the beginning of the end of restenosis?
- Given the beneficial impact of drug-eluting stents on restenosis, what are the implications for clinical practice—who should receive stents, and how should the procedure be done?
- Should clinical practice be changed on the basis of clinical intuition, or do we require clinical trial data to support standards of care?
- What are the financial implications of drug-eluting stents for health care institutions and for society?

■ HISTORICAL PERSPECTIVE

From the beginning, percutaneous coronary intervention (PCI) has been more attractive than effective as a nonsurgical revasculariza-

tion strategy.

Early conventional balloon PCI, performed with primitive equipment by today's standards, had a combined rate of short-term and long-term failure of approximately 50%. Nonetheless, patients and physicians enthusiastically embraced PCI as an alternative to surgical revascularization, hoping that they would be in the favorable 50%.

To date, no trial has shown that any coronary interventional technique either enhances survival or prevents myocardial infarction except in high-risk subgroups. Furthermore, randomized trials have consistently shown coronary artery bypass graft (CABG) surgery to be superior to PCI in terms of both freedom from need for repeat procedures and in a modest survival benefit.

Although both PCI and CABG have been progressively refined, the efficacy gap between CABG and PCI is narrowing. Bare-metal stents substantially reduced the acute complication rate and moderately reduced the restenosis rate compared with balloon angioplasty, and they had become the standard of care before drug-eluting stents were introduced. Drug-eluting stents are a major next step in improving PCI efficacy.

■ WILL THE NEW STENTS CHANGE CLINICAL PRACTICE?

As Haery et al point out, the promise of eliminating restenosis, while closer, is not yet fully realized. Overall, rates of short-term procedure failure with the new stents range

Will more patients become candidates for stenting?

between 1% and 4%. In-stent restenosis still occurs, although it is rare, and target-vessel failure, which can be due either to in-stent restenosis or to problems elsewhere in the vessel, remains at 8%. Target-lesion revascularization rates, while greatly reduced at 4%, have not reached zero. Diabetes and small-artery stenting may be associated with greater restenosis rates.

Still, these numbers are a big improvement. We clinicians need to consider how this improved capability will change the way we practice: which patient will undergo which treatment?

More PCI, less CABG?

The potential for restenosis has heretofore been an important consideration when selecting patients for PCI. In the era of the bare metal stent, patients whose lesion characteristics predicted a substantial restenosis risk were often preemptively selected for CABG to spare the patient the high likelihood of a late procedure failure. Drug-eluting stents have the potential to shift that boundary.

Preemptive PCI?

Potentially even more important, what are the implications for deciding whether a patient is a candidate for any intervention at all?

Now that there is a highly effective percutaneous treatment for coronary stenoses, to what degree should clinicians screen asymptomatic patients to identify significant coronary obstructions and treat them preemptively? When such patients are identified, is it appropriate to treat them with drug-eluting stents?

What about a patient with a moderately severe but not ischemia-producing coronary stenosis? Current opinion holds that such a lesion should not be treated with a bare-metal stent because of the potential for triggering diffuse in-stent restenosis, a disease far worse than the initial problem. Do drug-eluting stents alter this principle?

Potentially vulnerable plaques that are not sufficiently severe to cause ischemia, but which might degenerate to cause an unstable ischemic syndrome in the future, may present another clinical conundrum. If, in the future, such lesions can be identified, should they be

“fixed” with drug-eluting stents? Does placing a drug-eluting stent in a stenosed coronary segment actually “fix” it?

Longer stents, narrower stents?

Should drug-eluting stents change how the PCI procedure is done? With bare-metal stents, the interventionalist typically tries to use as short a stent as possible, as the risk of in-stent restenosis increases as the length of the stented segment increases. This principle may no longer be valid with drug-eluting stents: perhaps it will be appropriate to employ a generous stent length incorporating adjacent moderately diseased vessel segments.

With bare-metal stents, we try to achieve a final lumen diameter slightly greater than the reference-vessel diameter to allow for the expected 0.7 mm of neointimal growth within the stented segment. With drug-eluting stents, is it more appropriate to achieve a final lumen diameter that is matched to the reference diameter?

Hard data needed

Thus, drug-eluting stents present a number of new challenges to clinicians making management choices for patients. The implications for clinical practice outlined above are complex, but we currently have few data from clinical trials for guidance when making such complex choices. While clinical intuition might suggest some answers, the far-reaching implications of such choices demand that appropriate clinical trials be conducted to answer these complex questions. Mere clinical intuition is inadequate to guide such choices. However, intuition is all that is currently available.

■ COST ISSUES WITH DRUG-ELUTING STENTS

One of the thorniest issues regarding drug-eluting stents is their cost and reimbursement. In the United States, bare-metal stents cost approximately \$900 to \$1,200 each, while drug-eluting stents cost \$3,065 to \$3,195.¹ To compensate in part for the increased cost, the Centers for Medicare and Medicaid Services approved a \$1,800 increase in reimbursement for bare-metal stents.

At current prices, drug-eluting stents may not be cost-effective



However, while the increase provides full reimbursement for the incremental cost of placing one stent, it does not cover the cost of two or more stents. In most series the number of stents placed per procedure averaged 1.7, and some patients received as many as 4 or 5 stents in a single procedure. Furthermore, there will be no Medicaid reimbursement until 2005.

Are drug-eluting stents worth the added cost? To answer this question, we need to compare the increased initial cost of the device with the expected later savings from not having to treat restenosis. The issue can be examined from the perspective of society as a whole, hospitals, or patients.

Overall societal costs

The costs to society as a whole may actually be higher with drug-eluting stents.

In an analysis of the Randomized Comparison of a Sirolimus-Eluting Stent with a Standard Stent for Coronary Revascularization (RAVEL) trial cited by Lemos et al,² van Hout calculated that the use of sirolimus-eluting stents in the Netherlands increased the overall cost per patient over the ensuing year by 54 euros (approximately \$65), even assuming that the new stents would reduce the incidence of major clinical events (primarily restenosis) from 28.8% to 5.8%.

Lemos et al estimated that if all 800,000 patients each year who currently receive stents in the United States received drug-eluting stents, if the average number of stents implanted per patient were 1.5, and if each drug-eluting stent cost \$2,000 more than a bare-metal stent, then procedural costs per year would increase by \$2.4 billion. The expected 15% reduction in restenosis resulting from universal use of drug-eluting stents would decrease postimplant costs by \$1.5 billion per year, leaving a net societal cost of \$0.9 billion.

Greenberg et al³ calculated an approximate \$2,800 cost increase per procedure, assuming an average of 1.4 stents per patient and a \$2,000 increase in cost per stent. Even if drug-eluting stents completely eliminated restenosis (they don't), the downstream savings would be only approximately \$2,500 per patient. Hence, the initial cost increment of the drug-eluting stents would not be completely offset.

Greenberg et al also developed a decision-analytic model that projected that universal use of drug-eluting stents would increase overall medical care costs by approximately \$900 per patient. However, in their model, the use of drug-eluting stents in patients with an anticipated restenosis rate of more than 20% with bare-metal stents (for example, diabetic patients with smaller vessels or longer lesions, or nondiabetic patients with vessel diameters smaller than 2.5 mm requiring stents longer than 30 mm) would be cost-saving.

These analyses do not consider the potential cost savings achieved by avoiding the need for CABG surgery in some patients. It is possible that, overall, the use of drug-eluting stents might be "cost-neutral," since the additional cost of the drug-eluting stents might be offset by combined savings from the decreased need for repeat interventional procedures and the decreased need for surgery.⁴

Health care institutional costs

A study performed at William Beaumont Hospital in Michigan modeled the overall financial impact on a health care institution using the following assumptions: 1.43 stents per procedure, an increase in Medicare reimbursement of \$1,800, a stent cost of \$3,500, a 10% reduction in the number of cardiac surgical procedures, and a 50% reduction in coronary restenosis. The net annual monetary loss to the hospital was calculated to be \$3.8 million.⁵

Value depends on perspective

Whether the value of the greater efficacy of drug-eluting stents in reducing restenosis is worth the cost depends on one's perspective.

From the patient's perspective, the extra cost is likely justifiable if the device decreases the likelihood of requiring additional procedures (including bypass surgery) to treat restenosis.

From the physician's perspective, it is attractive to be able to offer patients the newest technology and spare them the frustration of additional revascularization procedures.

From the hospital's perspective, drug-eluting stents are a money-loser since their universal use increases procedural costs while reducing revenue from repeat revascularization procedures.

**For hospitals,
the new stents
are a money-
loser**



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From society's perspective, drug-eluting stents likely will increase the overall costs of care unless they substantially reduce the need for CABG surgery. The societal cost implications will be further modulated by whatever changes in case finding, case selection, and the procedure itself occur as a result of the enhanced capabilities of drug-eluting stents. If the availability of drug-eluting stents actually triggers either greater numbers of procedures or a greater number of stents implanted per procedure, then the societal cost will increase commensurately.

■ THE PHYSICIAN'S DILEMMA

Drug-eluting stents enhance physicians' ability to care for patients and hopefully will result in more effective care and better clinical outcomes for patients with coronary heart disease. However, many clinical questions remain to be answered concerning how to apply this new capability appropriately and optimally to the universe of patients with coronary heart disease.

In addition, the current high price of drug-eluting stents places physicians and health care institutions in a conflict between their responsibilities to their patients to provide the best possible medical care and their responsibilities to society to provide optimal care in a cost-effective manner. These prices are also depriving society of a potential opportunity to realize substantial overall health care cost savings combined with a major enhancement in quality of care. 

■ REFERENCES

1. **Anonymous.** Drug-eluting stents boost prices. *Hosp Mater Management* 2004; 29:1.
2. **Lemos PA, Serruys PW, Sousa JE.** Drug-eluting stents: cost versus clinical benefit. *Circulation* 2003; 107:3003-3007.
3. **Greenberg D, Bakhai A, Cohen DJ.** Can we afford to eliminate restenosis? Can we afford not to? *J Am Coll Cardiol* 2004; 43:513-518.
4. **Holmes DR, Firth BG, Wood DL.** Paradigm shifts in cardiovascular medicine. *J Am Coll Cardiol* 2004; 43:507-512.
5. **O'Neill WW, Leon MB.** Drug-eluting stents. Costs versus clinical benefit. *Circulation* 2003; 107:3008-3011.

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