Chronic stable angina limits daily activities and has an adverse impact on quality of life despite the availability of a variety of therapeutic modalities. One in 3 previously employed patients is unable to return to work within 1 year after revascularization.

Stable angina has a staggering societal and economic impact. In the United States, the annual direct and indirect costs of angina, including lost productivity and work days, are measured in tens of billions of dollars.

The direct costs of chronic stable angina from a societal perspective in the year 2000 were estimated by developing a cost-of-illness model based on medical utilization data from National Center for Health Statistics databases, national average Medicare reimbursement rates, International Classification of Diseases, Ninth Revision (ICD-9) codes, and databases of medications valued at average wholesale revenues. Because angina is a manifestation of coronary artery disease (CAD) and estimates based on the ICD-9 code for CAD might overestimate costs but estimates based on the ICD-9 code for narrowly defined chronic angina (NCA) might underestimate costs, a range of estimates was calculated. The lower end of this range was based on the ICD-9 code for NCA, and the upper end of the range was based on the ICD-9 code for CAD. The true cost of chronic angina is thought to lie between the lower and upper ends of this range. Because chronic angina is not always the primary diagnosis and limiting the analysis to primary diagnoses might underestimate costs, separate estimates were made for NCA and CAD when they were listed as any diagnosis as well as when they were the primary diagnosis. Medicare reimbursement rates were used because they are readily available, most patients with angina and CAD are elderly, and Medicare is the primary payer for this age group.

The total direct cost of illness was conservatively estimated at $1.8 million for NCA as a primary diagnosis, with $8.9 million for NCA as any diagnosis. Less conservative estimates of $33 million and $75 million were made for the total direct cost of illness when CAD was the primary diagnosis and CAD was listed as any diagnosis, respectively. The largest components of the direct costs of NCA as the primary diagnosis were outpatient visits (38%), hospitalizations (16%), and prescription medications (15%). By contrast, the largest components of the direct costs of CAD as the primary diagnosis were hospitalizations (74%), nursing home stays (22%), and outpatient visits (10%). Hospitalizations contributed a much larger portion to the direct costs of CAD as a primary diagnosis than NCA as a primary diagnosis (74% versus 16%) largely because of the expense of revascularization and treatment of acute myocardial infarction (MI). The average cost of hospitalization per utilization ranged from $3,744 for NCA as a primary diagnosis to $12,024 for CAD as a primary diagnosis.

**Economic Considerations in Managing Patients With Chronic Stable Angina**

EDITH A. NUTESCU, PharmD

**ABSTRACT**

OBJECTIVE: To quantify the economic burden of chronic stable angina in the United States, characterize recent trends in the use of coronary revascularization, and compare the clinical outcomes and long-term costs of percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), and medical management in patients with stable angina.

SUMMARY: The direct and indirect costs of stable angina are measured in tens of billions of dollars in the United States, with hospitalization contributing a large amount to the costs. The use of coronary revascularization, particularly PCI and insertion of coronary stents, has increased dramatically in recent years. The long-term costs of PCI and CABG are similar and high. Revascularization is sometimes used without an adequate trial of medical management, despite higher costs and a lack of evidence of long-term clinical benefits from revascularization.

CONCLUSION: Chronic stable angina is a costly condition. Medical management should be used before considering costly revascularization, unless medical management is contraindicated.

KEYWORDS: Coronary artery bypass grafting, Cost, Percutaneous coronary intervention, Pharmacotherapy, Stable angina

**J Manag Care Pharm. 2006;12(8):S17-S21**
The costs of multivessel stenting in 100 patients

The initial treatment cost was $2,856 per extrapolation of these figures suggests a 8-10

However, the mean follow-up costs per patient over In one

Revascularization

The use of coronary revascularization (i.e., percutaneous coronary intervention [PCI] or coronary artery bypass grafting [CABG]) has increased markedly in recent years. In 2003, an estimated 664,000 PCI procedures and 467,000 CABG surgeries were performed in the United States at a mean charge of $38,203 and $83,919, respectively. Extrapolation of these figures suggests a total direct cost for revascularization in excess of $64 billion in 2003. The number of PCI procedures increased 326% between 1987 and 2003. PCI is now more commonly performed than CABG. In 2003, 84% of patients undergoing coronary angioplasty received a stent, and the rate of coronary stent insertion increased 147% between 1996 and 2000.7

Single-Vessel Disease

In a 2004 review of several studies of the costs of revascularization published between 2000 and 2004, Nagle and Smith expressed the costs in 2003 dollars, which allows comparisons.8,10 In one study, the median cost of the initial hospitalization for PCI with planned stent insertion for coronary heart disease involving a single vessel was $10,452 in 2003 dollars.8,9 Another study compared the costs of routine stent implantation (i.e., primary stenting) with those of provisional stenting (i.e., the insertion of stents during balloon angioplasty only if the results of angioplasty were less than optimal) in patients with single-vessel disease.8,9 The mean cost of the initial hospitalization was higher ($11,694) for primary stenting than for provisional stenting ($10,681). However, the mean total cost after 6 months was lower ($12,925) for primary stenting than for provisional stenting ($13,285). The investigators concluded that primary stenting improved clinical outcomes at a cost comparable to or slightly less than that of provisional stenting in patients with single-vessel disease.8,9

Multivessel Disease

The 2004 review by Nagle and Smith also compared the costs of PCI and CABG in 3 studies of patients with multivessel disease, in 2003 dollars.8,11-13 The costs of multivessel stenting in 100 patients and CABG in 200 patients who were followed for a median of 2.8 years were compared in a retrospective, matched cohort study.8,11 The mean initial hospitalization cost was significantly lower (P < 0.001) in the multivessel stenting group ($13,454) than in the CABG group ($23,438). The mean total cost after 2 years remained significantly lower in the multivessel stenting group than in the CABG group ($20,088 vs. $27,669), despite a significantly higher need for at least one repeat revascularization procedure in the multivessel stenting group.

Two other longer studies comparing the costs of PCI and CABG in patients with multivessel disease suggest that the cost gap between PCI and CABG narrows over time because of the need for repeat revascularization after PCI.8,12,13 In a randomized, controlled study, the mean initial hospitalization cost was $6,627 lower in patients undergoing PCI than in patients undergoing CABG.12 The difference between PCI and CABG in the mean total cost was $5,153 after 3 years, and it decreased to $2,605 after 8 years. In 2003 dollars, the mean total 8-year cost was $56,343 in the PCI group and $58,948 in the CABG group, a difference that is not significant.

The total lifetime costs for initial angioplasty with primary stenting, initial angioplasty with provisional stenting, CABG with primary stenting, CABG with provisional stenting, and CABG without stenting in patients with multivessel disease were modeled using data from a substudy of the Bypass Angioplasty Revascularization Investigation.13 The total lifetime costs were similar, ranging from $154,018 to $163,587 in 2003 dollars.8

Drug-Eluting Stents

The initial treatment costs, follow-up costs, and total 1-year costs were compared in 1,058 patients with complex stenoses in a single coronary vessel who planned to undergo PCI and were randomly assigned to implantation of a drug-eluting stent or a bare-metal stent after PCI.14 The initial treatment cost was $2,856 per patient higher in the drug-eluting stent group compared with the bare-metal stent group, a difference that is significant. (P = 0.001) However, the mean follow-up costs per patient over the subsequent 12 months were $2,371 lower in the drug-eluting stent group than in the bare-metal stent group, largely because of a lower need for repeat revascularization. The total 1-year cost was $309 higher in the drug-eluting stent group than in the bare-metal stent group. The difference is not significant.

The economic impact, from a hospital perspective, over a 5-year period of a proposed change in Medicare reimbursement policy for drug-eluting stents and converting from bare-metal stents to drug-eluting stents was simulated by a computer model.15 An annual patient volume of 3,112 and the use of drug-eluting stents in 85% of stent implants during the first year were assumed in the model.15 In 2003 dollars, the model predicted a shift from a $2.01 million annual profit to a $5.41 million loss in the first year and a $6.38 million annual loss in subsequent years.8,15 Thus, more than $28 million in revenue would be diverted from the hospital over a 5-year period under the conditions of the model (i.e., adoption of the Medicare reimbursement policy for drug-eluting stents). The potential for loss of revenue may, in part, explain lower rates of use of drug-eluting stents in some hospitals than in others.
Justifying the Costs

In summary, both PCI and CABG are costly procedures. The costs of PCI for single-vessel disease are less than the costs of PCI for multivessel disease.\(^2\) In patients with multivessel disease, the initial costs of PCI with or without stenting are lower than the initial costs of CABG, but the long-term costs of PCI and CABG are similar. Drug-eluting stents have the potential to greatly affect the economics of revascularization, but additional data are needed to quantify the impact.

The long-term benefits of PCI and CABG are unclear and controversial.\(^16\)\(^19\) Although short-term improvements in anginal symptoms and quality of life have been demonstrated with revascularization, these improvements may subside over time.\(^20\) One in 4 patients has recurrence of angina within 1 year after revascularization, and many of these patients require antianginal medications.\(^20\)\(^21\) Twenty-three percent of patients undergoing PCI or CABG report their health as poor or fair 5 years after the procedure.\(^3\)

Comparison with Medical Management

Evidence suggests that revascularization often is considered before medical therapy has been given an adequate trial.\(^22\) Guidelines of the American College of Cardiology and American Heart Association for the treatment of chronic stable angina call for the use of medical therapy unless contraindicated before considering revascularization (see the article by Trujillo in this supplement).\(^7\)

Meta-Analysis

A meta-analysis of 11 randomized trials comparing PCI with conservative medical treatment in a total of 2,950 patients with stable CAD found no significant difference between the 2 groups in mortality (n = 95 vs. n = 101, respectively), a composite of cardiac death or MI (n = 126 vs. n = 109, respectively), nonfatal MI (n = 87 vs. n = 66, respectively), the need for CABG (n = 109 vs. n = 106, respectively), or the need for PCI during follow-up (n = 219 vs. n = 243, respectively).\(^23\) There was an increase in relative risk of nonfatal MI by approximately 30% in the PCI group compared with the conservative medical treatment group, largely related to the PCI procedure. The difference between the 2 groups was not significant. A possible survival benefit was seen for PCI in trials of patients with a recent MI. Thus, in the absence of a recent MI, PCI did not offer any benefit in terms of reduced risk of death, MI, or need for repeat revascularization compared with conservative medical treatment.

Randomized Intervention Treatment of Angina (RITA-2)

The costs of PCI and medical management were compared in several studies. In the second, the RITA-2 trial, 1,018 patients with stable CAD were randomly assigned to undergo PCI or receive continued medical management.\(^24\) Health service resource use data were collected prospectively over a 3-year follow-up period.

At the end of the 3 years, the incidence of the composite end point of death or MI was significantly higher (P=0.025) in the PCI group (7.3%) than in the medical management group (4.1%), largely due to procedure-related nonfatal MI.\(^24\) The incidence of grade 2 or worse angina was significantly lower (P<0.001) in the PCI group (17%) than in the medical management group (27%) after 1 year of follow up, but there was no significant difference (P=0.43) between the 2 groups in this end point after 3 years of follow up (20% versus 22%, respectively).

After the initial treatment strategy in the RITA-2 study, the number of subsequent PCI procedures was higher in the medical management group than in the PCI group (118 PCI procedures in 102 patients in the medical management group versus 73 PCI procedures in 62 patients in the PCI group), but the number of coronary angiograms was higher in the PCI group than in the medical management group (171 coronary angiogram procedures in 131 patients in the PCI group versus 110 coronary angiogram procedures in 93 patients in the medical management group).\(^24\) The number of CABG procedures was similar in the 2 groups (37 CABG procedures in 37 patients in the medical management group and 38 CABG procedures in 37 patients in the PCI group).

As expected, the use of antianginal medications (beta-blockers, calcium channel blockers, and long-acting nitrates) was higher in the medical management group than in the PCI group. The use of community-based resources (general practitioner visits, district nurse visits, and trial research assistants) was similar in the 2 groups.

The average hospital unit cost, which includes medical and nursing staff, standard procedure-related drugs and anesthetics, equipment, consumables, and overhead, was nearly twice as high in the PCI group as in the medical management group.\(^24\) The

![FIGURE 1 Total Costs Over Time by Treatment Group (Mean and CI)](chart.png)
difference between the total costs of the 2 therapeutic approaches did not diminish over time (Figure 1). The cost of PCI as an initial strategy exceeded the cost of medical management as an initial strategy by 74% over 3 years.

Medical, Angioplasty, or Surgery Study (MASS-II)

The clinical outcomes and effective costs of medical management, PCI with stenting, and CABG were compared after 1 year in the MASS-II, a randomized study of 611 patients with multivessel CAD and preserved left ventricular function.23 The baseline characteristics of the 3 treatment groups were similar, except for a higher incidence of previous acute MI in the PCI plus stenting group than in the other 2 groups and a higher incidence of class III or IV angina pectoris in the CABG group than in the other 2 groups.

The incidence of death during 1 year of follow-up was similar in the 3 groups: 1.9% with medical management, 4.4% with PCI plus stenting, and 3.9% with CABG.24 However, significantly larger percentages (P < 0.0001) of patients in the PCI plus stenting group (79%) and CABG group (88%) remained angina-free after 1 year than patients in the medical management group (49%). The need for angioplasty was significantly higher (P = 0.0003) in the PCI plus stenting group (8.3%) than in the medical management group (3.5%) and the CABG group (0.5%). The average time to first event (acute MI, need for revascularization procedure, or death) was similar in the 3 groups: 4.6 months in the medical management group and PCI plus stenting group and 3.7 months in the CABG group.

The analysis of effective costs was performed taking into consideration clinical outcomes as well as the costs of treatment over a 1-year period.25 Expected costs, costs per event-free year of life gained from treatment, and costs per angina- and event-free year of life gained from treatment were determined for all 3 interventions. The expected costs were lowest for medical management, higher for PCI plus stenting, and highest for CABG. The event-free cost of 1 year of life gained with medical management, PCI plus stenting, and CABG was $2,454, $10,348, and $12,404, respectively. The cost per angina- and event-free year of life gained from medical management, PCI plus stenting, and CABG was $5,006, $13,099, and $14,095, respectively. Thus, medical management presented the lowest cost but at the greatest increment increase. The effective costs of PCI plus stenting and CABG were similar when clinical outcomes were considered in the cost analysis. The most stable costs were presented by the CABG group.

Trial of Invasive Versus Medical Therapy in Elderly Patients With Chronic Angina (TIME) Study

In the TIME study, the costs and benefits of using either PCI or CABG were compared with those of medical therapy over a 1-year period in 188 elderly patients (aged 75 years or older) with chronic CAD and angina.26 The primary end point was quality of life and freedom from major adverse clinical events (death, nonfatal MI, or hospitalization for uncontrolled symptoms or acute coronary syndrome, with or without the need for revascularization).

The incidence of major adverse clinical events over the 1-year study period was significantly lower (P < 0.0001) in the invasive therapy group (0.38 events per patient) than in the medical therapy group (1.0 event per patient).26 Angina severity decreased and quality of life improved from baseline in both treatment groups, with no significant differences between the 2 groups after 1 year.

The average cost was significantly higher (P < 0.0002) with invasive therapy than with medical therapy during the first 30 days, but the cost in the subsequent 11 months was significantly higher (P = 0.004) with medical therapy than with invasive therapy.26 The total cost over the 1-year study period was slightly lower in the medical therapy group compared with the invasive therapy group, but the difference was not significant (P = 0.08).

Analysis of the incremental cost to prevent a major adverse clinical event favors the use of invasive therapy instead of medical therapy in this patient population.26 However, little improvement in quality of life is associated with substitution of medical therapy with invasive therapy.

Conclusion

Chronic stable angina is associated with large direct and indirect costs, with a large share of the costs associated with hospitalization and revascularization. Revascularization is sometimes used without an adequate trial of medical management, despite higher costs and a lack of clear evidence of long-term clinical benefits.

DISCLOSURES

This article is based on a presentation given by the author at a symposium entitled “Emerging Therapies for Management of Patients with Stable Angina: Focus on Clinical Efficacy and Outcomes” at the Academy of Managed Care Pharmacy’s 18th Annual Meeting and Showcase in Seattle, Washington, on April 5, 2006. The symposium was supported through an educational grant from CV Therapeutics, Inc. The author received an honorarium from CV Therapeutics, Inc. for participation in the symposium. She discloses no potential bias or conflict of interest relating to this article.

REFERENCES


