# Percutaneous Coronary Revascularization in Elderly Patients: Impact on Functional Status and Quality of Life

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**Background:** Percutaneous coronary intervention (PCI) is frequently performed in elderly patients, but little is known about its impact on overall health and quality of life.

**Objective:** To examine changes in health-related quality of life among elderly patients after PCI.

**Design:** Observational study.

**Setting:** 75 U.S. hospitals.

**Patients:** Participants in two clinical trials of PCI.

**Measurements:** Health-related quality of life was assessed by using the Medical Outcomes Study Short Form (SF-36) survey and the Seattle Angina Questionnaire at baseline, 6 months, and 1 year.

**Results:** Serial data on health-related quality of life were available for 295 elderly (≥70 years) and 1150 nonelderly (<70 years) patients. At 6 months, physical health had improved in 51% of elderly patients and mental health had improved in 29%. Cardiovascular-specific health status had improved in 58% to 75% of elderly patients. Improvement did not significantly differ between elderly and nonelderly patients at 6 months or 1 year.

**Conclusions:** Elderly patients selected for participation in a trial of PCI had substantial improvements in health-related quality of life after PCI that were similar to those in younger patients.

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Ischemic heart disease affects more than 25% of persons older than 65 years of age in the United States. Although elderly patients with coronary artery disease tend to be treated less aggressively than nonelderly patients, the use of percutaneous coronary intervention (PCI) in the elderly is increasing rapidly; it more than doubled between 1979 and 1986 (1). Previous studies have examined the risks for PCI-related complications among elderly patients and found that elderly patients have a higher risk for vascular complications and in-hospital death than younger patients (2). Nonetheless, little is known about the critical outcomes of these procedures from the patient's perspective. Although short- and long-term mortality rates are important outcomes to consider, PCI is generally done to improve the patient's quality of life by relieving the signs and symptoms of myocardial ischemia. Improvement in quality of life may be particularly germane to older patients, for whom competing risks tend to limit any potential gains in longevity (3). We examined changes in health-related quality of life among elderly patients after PCI and compared these changes with those in nonelderly patients.

## Methods

### Study Sample

Patients in this study had PCI as part of two randomized multicenter clinical trials: the Balloon versus Optimal Atherectomy Trial (BOAT; $n = 989$), which compared directional atherectomy with balloon angioplasty (4), and the Advanced Cardiovascular System Multi-Link-Stent System Trial (ASCENT; $n = 1040$), which compared the ACS Multi-Link stent to the Palmaz–Schatz stent (5). Only patients enrolled in U.S. hospitals who completed a baseline health-related quality-of-life survey ($n = 1789$) were eligible for our substudy.

Inclusion and exclusion criteria for the trials were similar. All patients had symptomatic coronary artery disease that required percutaneous revascularization of a single native coronary artery. Patients with a myocardial infarction within 5 days of treatment, stroke within the preceding 3 months, bifurcation lesions, or severe proximal tortuosity were excluded. The institutional review boards of each institution approved the studies, and all patients provided informed consent before participation.

### Quality-of-Life Assessment

Health-related quality of life was assessed by using the physical and mental health summary scales of the Medical Outcomes Study Short-Form Survey (SF-36) (6, 7). These summary scales are standardized such that the mean (± SD) for the U.S. population is $50 \pm 10$. Higher scores indicate better health. Patients in ASCENT also completed the Seattle Angina Questionnaire (SAQ), a validated disease-specific instrument that measures five health-related quality-of-life domains specific for coronary artery disease (physical functioning, anginal stability, anginal frequency, disease perception, and treatment satisfaction) (8, 9). The SAQ scores range from 0 to 100, and higher scores indicate better levels of functioning (that is, less physical limitation and less frequent angina).

Baseline health-related quality of life was assessed by using self-administered questionnaires that were completed immediately before the index revascularization procedure. Follow-up measurements were obtained by surveys mailed to participants 6 months and 1 year after initial treatment. Patients who did not respond to the mailed survey within 2 weeks were administered the same instrument by telephone when possible.

### Statistical Analysis

Baseline patient characteristics of elderly (≥70 years of age) and nonelderly (<70 years of age) patients were compared by using *t*-tests and Wilcoxon rank-sum tests for continuous variables and Fisher exact tests for categorical variables. Logistic regression was used to determine whether the likelihood of substantial improvement in health-related quality of life after PCI differed between elderly and nonelderly patients (10). For each health-related quality-of-life scale, each patient was classified as improved or not improved according to the level of change at which patients in previous studies had reported substantial improvement. Previous studies involving the SF-36 have demonstrated that changes in the physical component score of 3.8 points or more and changes in the mental component score of 7.2 points or more were meaningful to patients (6). For the SAQ subscales, an improvement of 10 or more points has been found to correlate with clinically meaningful changes (9) and was used to classify patients as improved or not improved for our analysis. Each regression model adjusted for patient demographic characteristics (sex, marital status, education, race or ethnicity) and medical conditions (previous myocardial infarction, congestive heart failure, diabetes, chronic obstructive pulmonary disease, peripheral vascular disease, arthritis, vision problems, number of comorbid conditions, smoking status). Standardized predicted probabilities derived from these models were used to estimate the percentage of patients in each age group who were expected to demonstrate substantial improvement after PCI. We also calculated standardized risk differences and associated confidence intervals (11). The main results were not altered in analyses that adjusted for clustering (data not shown).

All analyses were done by using Stata software, version 6.0 (Stata Corp., College Station, Texas). *P* values less than 0.05 were considered statistically significant. Significance tests were not adjusted for multiple comparisons. All data were collected and analyzed by an independent data coordinating center (Cardiovascular Data Analysis Center, Boston, Massachusetts), without direct input from the study sponsor.

Twenty percent of the data were missing because of patient nonresponse at follow-up. To examine whether our results were sensitive to differences between respondents and nonrespondents, we imputed the change scores of nonrespondents by using multiple imputation techniques (12) and re-estimated the models for the full study sample. Because the results of these sensitivity analyses were similar to our primary results, we report only the primary results.

## Results

Of the patients who completed the baseline survey, 1445 (80%) completed the 6-month follow-up survey. These patients made up our analytic cohort. Compared with nonrespondents, respondents were more likely to be nonwhite and unmarried and were less likely to have congestive heart failure.

Among respondents, the median age of the nonelderly group was 57 years (range, 38 to 69 years) and the median age of the elderly group was 74 years (range, 70 to 89 years). Compared with nonelderly patients, elderly patients were more likely to be female, white, and unmarried and were less well-educated. Elderly patients were less likely to smoke cigarettes but were more likely to have hypertension and congestive heart failure and had more comorbid conditions (data not shown).

### Clinical Events

During the initial hospitalization and 1-year follow-up period, the incidence of major adverse cardiac events, including myocardial infarction, bypass surgery, and repeated PCI, was low in both groups. However, during the initial hospitalization, older patients were more likely than younger patients to sustain a major vascular complication (3.7% compared with 1.7%; $P = 0.04$).

### Effect of Percutaneous Coronary Intervention on Health-Related Quality of Life

At baseline, both elderly and nonelderly patients had substantial impairments in physical health and

**Table. Distribution of Health-Related Quality-of-Life Scores at Baseline, 6 Months, and 1 Year***

| Variable | Nonelderly Patients | | | | Elderly Patients | | | |
|---|---|---|---|---|---|---|---|---|
| | 25th Percentile | Median | 75th Percentile | Ceiling | 25th Percentile | Median | 75th Percentile | Ceiling |
| | | | | % | | | | % |
| Baseline ($n$ = 1445) | | | | | | | | |
| SF-36 physical health | 31.2 | 40.1 | 49.5 | 0 | 28.6 | 36.0 | 45.6 | 0 |
| SF-36 mental health | 38.9 | 49.0 | 57.0 | 0 | 40.1 | 50.6 | 58.2 | 0 |
| SAQ physical function | 44.4 | 66.7 | 88.9 | 15.3 | 36.1 | 61.1 | 83.3 | 12.4 |
| SAQ anginal frequency | 40.0 | 60.0 | 80.0 | 13.8 | 40.0 | 60.0 | 80.0 | 13.0 |
| SAQ disease burden | 25.0 | 41.7 | 58.3 | 2.5 | 29.2 | 41.7 | 58.3 | 1.6 |
| 6 months ($n$ = 1445) | | | | | | | | |
| SF-36 physical health | 39.7 | 50.6 | 55.5 | 0 | 33.1 | 44.6 | 53.1 | 0 |
| SF-36 mental health | 44.1 | 53.1 | 57.6 | 0 | 48.0 | 54.9 | 59.4 | 0 |
| SAQ physical function | 72.2 | 91.7 | 100 | 42.5 | 55.6 | 81.9 | 100 | 31.8 |
| SAQ anginal frequency | 80.0 | 100 | 100 | 58.3 | 80.0 | 100 | 100 | 57.8 |
| SAQ disease burden | 58.3 | 75.0 | 91.7 | 15.3 | 66.7 | 83.3 | 91.7 | 18.2 |
| 1 year ($n$ = 1182) | | | | | | | | |
| SF-36 physical health | 40.3 | 51.4 | 55.7 | 0 | 32.6 | 45.0 | 52.7 | 0 |
| SF-36 mental health | 46.0 | 54.3 | 58.2 | 0 | 47.2 | 54.8 | 58.8 | 0 |
| SAQ physical function | 70.8 | 91.7 | 100 | 41.2 | 55.6 | 81.9 | 100 | 30.7 |
| SAQ anginal frequency | 80.0 | 100 | 100 | 60.1 | 80.0 | 100 | 100 | 64.5 |
| SAQ disease burden | 58.3 | 83.3 | 91.7 | 16.5 | 58.3 | 83.3 | 91.7 | 23.3 |

* Values in table are unadjusted. SAQ = Seattle Angina Questionnaire; SF-36 = Medical Outcomes Study Short-Form Survey.

modest impairments in mental health relative to the overall U.S. population (**Table**). The SAQ subscales also demonstrated substantial physical limitations and impaired quality of life due to angina in both age groups. At 6-month follow-up, both elderly and nonelderly patients demonstrated substantial improvement in each quality-of-life domain, and these gains persisted at 1 year (**Table**). At both 6 months and 1 year, approximately 60% of patients reported no angina.

In adjusted analyses, the change in health-related quality of life associated with PCI did not significantly differ between elderly and nonelderly patients (**Figure**). At 6-month follow-up, physical health improved substantially for 51% of elderly patients and 58% of nonelderly patients (difference, 7 percentage points [95% CI, −15 to 1 percentage point]). Similarly, mental health improved substantially for 29% of elderly patients and 30% of nonelderly patients (difference, −1 percentage point [CI, −9 to 6 percentage points]). At 6-month follow-up, most patients demonstrated substantial improvement in all three aspects of disease-specific quality of life, with nearly identical benefits regardless of age. Physical limitations related to angina improved substantially for 58% of elderly patients and 54% of younger patients (difference, 4 percentage points [CI, −7 to 13 percentage points]). Elderly and nonelderly patients demonstrated similar rates of improvement in frequency of angina (75% compared with 74% [difference, 1 percentage point; CI, −6 to 10 percentage points]) and in disease burden (77% compared with 71% [difference, 6 percentage points; CI, −6 to 10 percentage points]). Only 4% to 13% of patients reported meaningful declines in cardiovascular-specific quality of life, and the proportion did not vary with age. Similar changes were observed at 1-year follow-up as well (data not shown).

## Discussion

We found that PCI resulted in substantial population-level benefits for elderly patients with regard to both physical and mental health as well as reductions in physical limitations due to angina, frequency of angina, and the perceived burden of coronary artery disease. During 6- to 12-month follow-up, the SF-36 physical health scale improved by more than 6 points on average and the mental health scale improved by 3 to 4 points. These changes are similar to those previously described for younger patients undergoing percutaneous translu-

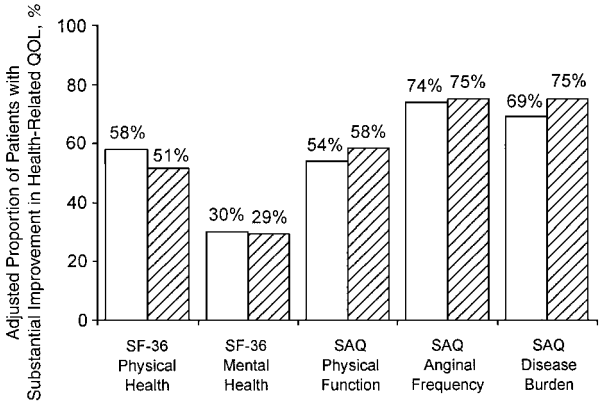


**Figure. Standardized estimates of the percentage of patients expected to have improvements in health-related quality of life (*QOL*) 6 months after percutaneous coronary intervention, according to age**. The probability of clinically meaningful improvement was not significantly associated with age. White bars represent patients younger than 70 years of age; striped bars represent patients 70 years of age or older. SAQ = Seattle Angina Questionnaire; SF-36 = Medical Outcomes Study Short-Form Survey.

minal coronary angioplasty (8, 13) and to those seen in symptomatic patients undergoing cardiac valve replacement (14) or total hip arthroplasty (6). Moreover, on an individual level, most elderly patients in our series experienced improvements in physical health and in each disease-specific measure that exceeded thresholds previously defined as "clinically meaningful" (6, 9). After adjustment for baseline differences in comorbid conditions and other factors, the proportion of elderly and nonelderly patients who demonstrated substantial improvement in any generic or disease-specific health-related quality-of-life measure did not significantly differ.

Our study has several limitations. First, patients included in our study were participants in two multicenter clinical trials, and our results may not be generalizable to other populations. In general, patients enrolled in clinical trials tend to be healthier than unselected patients undergoing the same procedures. Consequently, comparable improvements in health-related quality of life may not be attainable in an unselected elderly population. Second, we did not examine the impact of alternative treatments, such as bypass surgery or medical therapy, on health-related quality of life. Although our results thus do not prove that elderly patients should undergo PCI (rather than alternative treatments for symptomatic coronary artery disease), the consistency of the benefits across age groups suggests that PCI is as beneficial for selected elderly patients as it is for younger patients—a group for whom the benefits of PCI relative to medical therapy are well established (15–17). Finally, because only 2 patients in the elderly group were older than 85 years of age, we could not examine health-related quality-of-life gains of the "old-old."

In this study, elderly patients demonstrated improvements in health-related quality of life after PCI that are similar in magnitude to those of nonelderly patients. These findings suggest that age alone should not influence the decision to perform PCI.

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