



## Quality of Care in Myocardial Revascularization Procedures

This short review refers to the quality of care after coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty, the two procedures for myocardial revascularization in coronary artery disease (after acute myocardial infarction, unstable or stable angina pectoris or chronic ischemic disease). As in other fields of practice, the quality of care in the two procedures can be improved through the study of process or outcome elements of care, or both.

### Outcome Elements

Outcome elements are operative mortality, adverse outcomes, survival following surgery, and quality of life following surgery.

#### *Mortality*

Death is a sentinel event that mandates the search for causes and their modification in an effort to improve quality of care and reduce mortality. Data on surgical mortality by procedure may be used as a valid outcome indicator, but require adjustment for differences in case of mix and other external factors to ensure fair comparison among surgeons and settings (1). Such data have been used to study the volume/quality relationship (2,3) and differences in mortality attributable to differences in the quality of care in coronary artery bypass graft surgery (4). Comparison between observed and predicted mortality rate also allows quality assessment among surgeons and settings and was used more than twelve years ago in a study involving 15 different hospitals (5). A new method was proposed in 1989 and designed to find new risk factors for predicting the possible cardiac operative mortality risk (6). Two studies that used the comparison between predicted and observed mortality among settings reported a decrease in mortality as a result of continuous efforts to identify outlier providers (7,8). With the purpose of identifying outliers, two other studies surveyed the mortality in all settings in which the coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty were done (9,10). Sharing the findings with surgeons concerned may lead to improvement.

#### *Adverse Outcomes*

The review of adverse outcomes may serve as an alternative measure of the quality of care (11). Readmission to the intensive care unit or the department of

heart surgery is an adverse event and its rate is used as an indicator of clinical performance. Its value as a quality of care indicator in coronary artery bypass graft surgery is debated. One important aspect concerns the degree to which readmission could be predicted, which is difficult since the reasons for readmission may vary from true emergencies to non-specific causes, such as lack of appropriate services in the community. It has been suggested that cause-specific readmission could be a better outcome element for assessment of the quality of care (12). Other adverse outcomes of coronary artery bypass graft surgery are atrial fibrillation and flutter, renal impairment, cerebrovascular event, endocarditis, bowel bleeds or necrosis, and pancreatitis. In percutaneous transluminal coronary angioplasty, in addition to the above possibilities, adverse outcomes also include the requirement for an intra-aortic balloon pump, ventricular arrhythmia, and need to be on a respirator for more than 48 h. The need for coronary artery bypass graft surgery because of complications of percutaneous transluminal coronary angioplasty may also be regarded an adverse outcome of the latter method. Certain surgical practices increase the risk of postoperative complications, ie, of adverse outcomes; modifying these practices may reduce the occurrence of adverse outcomes and improve the quality of care (13). However, complication rates are poorly correlated with rankings that use death rates for assessing hospital's quality of care. Therefore, complication rates should be used with great caution and in combination with other parameters if the quality of care in two or more settings is to be compared (14).

#### *Survival Following Surgery*

Several studies comparing early coronary artery bypass graft surgery and initial medical therapy were conducted in the 1970s and early 1980s. Their results were disparate, probably because of variations in the study design, as well as the type and number of patients enrolled. In the early 1990s, a meta-analysis used data from seven randomized trials that compared a strategy of initial coronary artery bypass graft surgery with one of initial medical therapy to assess the effect on survival in patients with stable coronary heart disease (15). It concluded that the coronary artery bypass graft surgery group had significantly higher survival than the medical group at 5 years; also, the initial surgery was found to be associated

with higher survival than one of the medical managements with delayed surgery, when necessary, particularly in high and medium risk patients. In low-risk patients limited data showed a non-significant trend towards reduced survival in coronary artery bypass graft surgery (15).

#### *Quality of Life*

Quality of life is increasingly used as an outcome measure in clinical trials, effectiveness research, and quality of care improvement activities. There is evidence that this measure is valid, reliable, and responsive to important clinical stages. Because measures of quality of life describe what the patient has experienced as the result of care, they are useful and important supplements to traditional biological and physiological measures of health status (16). Improvement in the survival of patients who underwent coronary artery bypass graft surgery, compared with those who received other treatment, is greatest for the severe types of coronary artery disease. For milder cases, the improvement in quality of life is an important outcome of this operation, since it results almost immediately in improvement in quality of life variables, with the effects in some end-points that persist for 5 years and are superior to those of drug treatment (17,18). A prospective questionnaire study surveyed 100 patients aged < 60 years at the time of operation before coronary artery bypass graft surgery and at 3 months and 1 year afterwards (19). The questionnaires reflected patients' assessment of their health state in terms of functional capacity and aspects of distress according to the Nottingham Health Profile before surgery and outcome of operation in terms of change of symptoms, working life and daily activities after it. Improvement following the operation was evident. Significant positive factors affecting return to work and home activities were short wait for surgery, absence of breathlessness, and working before the operation (19). Patients participating in cardiac rehabilitation evaluated their quality of life as better, were more satisfied with care received, and had a higher rate of return to work (19,20). Thus, interventions likely to influence outcomes and improve quality of care are reduction in waiting time as well as the promotion and funding of rehabilitation.

The impact of angina pectoris on the quality of life and absence from work may be alleviated by coronary artery bypass graft surgery or percutaneous transluminal coronary angioplasty (18,21). Angina is avoided more successfully with coronary artery bypass graft surgery, whereas percutaneous transluminal coronary angioplasty offers a speedier return to work, with both procedures producing the benefits over several years (18,21).

#### **Process Elements**

Process elements for quality of care improvement are the appropriateness of the procedure (in relation to symptoms and signs, as well as results of investigation) and length of hospital stay.

#### *Appropriateness*

This is a new process measure based on the evidence of effectiveness and expert judgment of probable outcomes. It relates to the adherence of the use of procedures to pre-determined criteria. Coronary artery bypass graft surgery has been the subject of many randomized controlled trials resulting in evidence about the risks and benefits for many indications. Hence, when appropriateness was used to assess the quality of care of this procedure, a low rate of inappropriateness (16%) was found both in the USA and UK (22-24). Since its introduction in 1977, percutaneous transluminal coronary angioplasty is becoming ever more common and advocated as the procedure of choice for single- and two-vessel coronary artery disease, but has been less evaluated than the procedure it can replace, ie, coronary artery bypass graft surgery. The inappropriateness rate of coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty is very similar (25,26). As the fraction of patients receiving coronary artery bypass graft surgery for one- or two-vessel disease decreased from 51% to 24%, its appropriateness increased to 91% and the inappropriateness dropped to 2.4% (24). Rates of inappropriate use of the two procedures were low both in Canada and New York State (27). This may suggest that the regionalization of the procedures, which characterizes the health care systems of both states, contributes to better clinical decision making and improved quality of care of the two procedures.

#### *Length of Hospital Stay*

This process element is regarded an important measure in quality improvement activities after coronary revascularization procedures (28). However, the relationship between length of stay and quality of care is problematic. The optimum length of stay for any condition depends on individual patient's sociodemographic and clinical profile and needs, as well as the availability of relevant community services and local supply and demands (29). The median hospital stay in coronary artery bypass graft surgery was 7 days, but it could have been underestimated (30). Factors associated with long length of stay after coronary artery bypass graft surgery are comorbidity, diminished left ventricular function, advanced age, female sex, malnutrition, and also postoperative neurological events, prolonged intubation, extended cardiopulmonary bypass times, prolonged hemodynamic support, and nosocomial infections (28). Valve surgery requires longer length of stay than coronary artery bypass graft surgery, probably because of the need for anticoagulation, higher incidence of postoperative atrial fibrillation, and presence of advanced structural heart disease (31). Length of stay should not be reduced without consideration of care pathways and appropriate treatment patterns. Ensuring these is crucial for quality of care, whereas length of stay itself may be irrelevant to this process.

#### **Conclusions**

The recommended outcome measures for assessing the quality of care can be obtained from the

comparison between predicted and observed mortality among settings (used to identify outlier settings and surgeons) and the quality of life following the procedures. Patient satisfaction is also an important outcome measure and includes patients' reception of adequate information of their condition and treatment (32). The recommended process measure is the appropriateness of performance of the two procedures, with the information about it presented to surgeons in a meaningful, patient-specific, clinical context so that the need for changes in practice can be recognized. As in other medical fields, the improvement of quality of care of the two procedures will be more effective and successful with multiple interventions rather than with single ones. Guidelines are available for both coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty (33,34). These aim to reduce unintended and unwanted variations thus having the potential to improve the quality of care. Their use could be promoted as part of a multiple intervention, along with providing surgeons and heads of hospital with feedback information regarding findings of outcome and process studies.

Reuben Eldar

## References

- 1 Iezzoni LI, Ash AS, Shwartz M, Daley J, Hughes JS, Mackiernan YD. Judging hospitals by severity-adjusted mortality rates: the influence of the severity-adjustment method. *Am J Publ Health* 1996;86:1379-87.
- 2 Luft HS, Bunker JP, Enthoven AC. Should operations be regionalized? The empirical relation between surgical volume and mortality. *New Engl J Med* 1979;301:1364-9.
- 3 Flood AB, Scott WR, Ewy W. Does practice make perfect? Part I: The relation between hospital volume and outcomes for selected diagnostic categories. *Med Care* 1984;22:98-114.
- 4 Landon B, Iezzoni LI, Ash AS, Shwartz M, Daley J, Hughes JS, et al. Judging hospitals by severity-adjusted mortality rates: the case of CABG surgery. *Inquiry* 1996;33:155-66.
- 5 Kennedy JW, Kaiser GC, Fisher LD, Maynard C, Fritz JK, Myers W, et al. Multivariate discriminant analysis of the clinical and angiographic predictors of operative mortality from the Collaborative Study in Coronary Artery Surgery (CASS). *J Thorac Cardiovasc Surg* 1980;80:876-87.
- 6 Parsonnet V, Dean D, Bernstein AD. A new method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. *Circulation* 1989;79(6 Pt 2):3-12.
- 7 Hannan EL, Kilburn H Jr, Racz M, Shields E, Chassin MR. Improving the outcomes of coronary artery bypass surgery in New York State. *JAMA* 1994;271:761-6.
- 8 O'Connor GT, Plume SK, Olmstead EM, Morton JR, Maloney CT, Nugent WC, et al. A regional intervention to improve the hospital mortality associated with coronary artery bypass graft surgery *JAMA* 1996;275:841-6.
- 9 Ghali WA, Ash AS, Hall RE, Moskowitz MA. Statewide quality improvement initiatives and mortality rate after cardiac surgery. *JAMA* 1997;277:379-82.
- 10 Mozes B, Olmer L, Galai N, Simchen E. A national study of postoperative mortality associated with coronary artery bypass grafting in Israel. IS CAB Consortium. Israel Coronary Artery Bypass Study. *Ann Thorac Surg* 1998;1254-62; discussion 1263.
- 11 Hartz AJ, Kuhn EM, Kayser KL, Pryor DP, Green R, Rimm AA. Assessing providers of coronary revascularization: a method for peer review organizations. *Am J Public Health* 1992;82:1631-40.
- 12 Zitser-Gurevich Y, Simchen E, Galai N, Braun D. Prediction of readmissions after CABG using detailed follow-up data: the Israeli CABG Study (ISCAB). *Med Care* 1999;37:625-36.
- 13 Mathew JP, Parks R, Savino JS, Friedman AS, Koch C, Mangano DT, et al. Atrial fibrillation following coronary artery bypass graft surgery: predictors, outcomes, and resource utilization. MultiCenter Study of Perioperative Ischemia Research Group. *JAMA* 1996;276:300-6.
- 14 Silber JH, Rosenbaum PR, Schwartz JS, Ross RN, Williams SV, et al. Evaluation of the complication rate as a measure of quality of care in coronary artery bypass graft surgery. *JAMA* 1995;274:317-23.
- 15 Yusuf S, Zucker D, Peduzzi P, Fisher LD, Takaro T, Kennedy JW, et al. Effect of coronary artery bypass graft surgery on survival: overview of 10-year results from randomized trial by the Coronary Bypass Graft Surgery Trialists Collaboration. *Lancet* 1994;344:563-70.
- 16 Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. *JAMA* 1995;273:59-65.
- 17 Booth DC, Deupree RH, Hultgren HN, DeMaria AN, Scott SM, Luchi RJ. Quality of life after bypass surgery for unstable angina: 5-year follow-up results of a Veterans Affairs Cooperative Study. *Circulation* 1991;83:87-95.
- 18 Coronary angioplasty versus coronary artery bypass surgery: the Randomized Intervention Treatment of Angina (RITA) trial. *Lancet* 1993;341:573-80.
- 19 Caine N, Harrison SC, Sharples LD, Wallwork J. Prospective study of quality of life before and after coronary artery bypass grafting. *BMJ* 1991;302:511-6.
- 20 Simchen E, Naveh I, Zitser-Gurevich Y, Brown D, Galai N. Is participation in cardiac rehabilitation programs associated with better quality of life and return to work after coronary artery bypass operation? The Israeli CABG study. *Isr Med Assoc J* 2001;3: 399-403.
- 21 Pocock S, Henderson RA, Seed P, Treasure T, Hampton JR. Quality of life, employment status, and anginal symptoms after coronary angioplasty or bypass surgery. 3-year follow-up in the Randomized Intervention Treatment of Angina (RITA) Trial. *Circulation* 1996;94:135-42.
- 22 Winslow CM, Koscoff JB, Chassin M, Kanouse DE, Brook RH. The appropriateness of performing coronary artery bypass surgery. *JAMA* 1988;260:505-9.
- 23 Gray D, Hampton JR, Bernstein SJ, Koscoff J, Brook RH. Audit of coronary angiography and bypass surgery. *Lancet* 1990;335:1317-20.
- 24 The appropriateness of use of percutaneous transluminal coronary angioplasty in New York State. *JAMA* 1993;269:761-5.
- 25 Bernstein SJ, Lazaro P, Fitch K, Aguilar MD, Kahan JP. Effect of specialty and nationality on panel judgments of the appropriateness of coronary revascularization: a pilot study. *Med Care* 2001;39:513-20.

- 26 Leape LL, Hilborne LH, Park RE, Bernstein SJ, Kamberg CJ, Sherwood M, et al. The appropriateness of use of coronary artery bypass graft surgery in New York State. *JAMA* 1993;269:753-60.
- 27 McGlynn EA, Naylor CD, Anderson GM, Leape LL, Park RE, Hilborne LH, et al. Comparison of the appropriateness of coronary angiography and coronary artery bypass graft surgery between Canada and New York State. *JAMA* 1994;272:934-40.
- 28 Katz NM, Hannan RL, Hopkins RA, Wallace RB. Cardiac operations in patients aged 70 years and over: mortality, length of stay, and hospital charge. *Ann Thorac Surg* 1995;60:96-100.
- 29 Clarke A. Length of in-hospital stay and its relationship to quality of care. *Qual Saf Health Care* 2002;11:209-1.
- 30 In-hospital audit underestimates early postoperative morbidity after cardiac surgery. *Br Heart J* 1995;74: 556-8.
- 31 Tripp HF, Obney JA, Febinger DL, Lisagor PG, Cohen DJ. Differences in length of stay between coronary bypass and valve procedures. *Mil Med* 2002;167:109-12.
- 32 Sorlie T, Sexton HC, Busund R, Sorlie D. Predictors of satisfaction with surgical treatment. *Int J Qual Health Care* 2000;12:31-40.
- 33 Guidelines and indications for coronary artery bypass graft surgery. A report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures (Subcommittee on Coronary Artery Bypass Graft Surgery). *J Am Coll Cardiol* 1991;17:543-89.
- 34 Guidelines for percutaneous transluminal coronary angioplasty: a report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures (Committee on Percutaneous Transluminal Coronary Angioplasty). *J Am Coll Cardiol* 1993;22: 2033-54.