

Percutaneous coronary intervention or bypass surgery: Which to choose?

The debate over stents versus surgery is longstanding and unlikely to resolve soon. What is clear is that patients receiving stents have an increased rate of revascularization.

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Approximately 500,000 coronary artery bypass graft (CABG) surgeries are performed yearly in the United States.¹ In addition, 750,000 percutaneous intervention (PCI) procedures for coronary artery disease (CAD) are also conducted.² Although these numbers are impressive, they should not be surprising to anyone because the number one cause of death in men and woman in the United States is cardiac disease. Given these statistics, it is not hard to imagine the physical and monetary burden caused by such an epidemic. Our nation's population of older citizens is growing larger, and heart disease-related statistics are expected to increase with it.



CT reconstruction shows a stent in the left coronary artery.

With such a demand for cardiac-related treatments, funding for research in this arena has flourished. In 1968, the first bypass surgery was conducted. Today, CABG procedures are often being done without the aid of a bypass machine (off-pump coronary artery bypass graft, or OPCABG). Minimally invasive surgery (MIDCAB) is also becoming more popular, including anastomosis of the left internal mammary artery (LIMA) to the left anterior descending coronary artery through a small incision in the chest. The use of robotics is finding a niche in cardiac surgery (totally endoscopic coronary artery bypass, or TECAB). Pioneers are using robotic technology to expose the LIMA and suture it to a diseased target vessel.

PCI has its own evolution. In 1977, balloon angioplasty was first reported. In this procedure, a wire with a balloon attached is inserted into an artery, often through a groin approach, where the wire then is manipulated to a diseased portion of a coronary vessel. Inflating the balloon opens the restricted part of the artery. By 1994, the bare metal stent was introduced in the United States. Stents are similar to a scaffold tube; they are slipped over a balloon, which, when inflated, deploys the stent to keep the vessel open. Since 2002, the drug-eluting stent has become the standard for this type of PCI. A drug-eluting stent is coated with a medication that increases the time until restenosis occurs.

These devices are continually being revised. And, in addition to mechanical developments, antiplatelet drugs have helped to improve outcomes in patients who receive stents. The glycoprotein IIb/IIIa inhibitors IV are an example of such medications.

RESEARCH

CABG and PCI procedures have been in a constant state of development since 1968, so it is not surprising that both the medical community and patient populations have been at odds over which option is preferable.³ The debates range from whether to choose one procedure or the other to whether a combination approach can be used. A review of the current literature might clarify the debate, but, unfortunately, data that clearly define which procedure is superior have been difficult to capture. To begin with, it has been hard to achieve similar patient populations during clinical trials. The variability among patients who undergo revascular-

ization is extensive and significantly affects the outcome of the procedure^{4,5} (see Table 1).

In past trials, strict exclusion criteria were used to minimize the variations in the populations identified for study. Table 2 (page 38) lists some of these criteria. However, the exclusion criteria have also kept out of trials the types of cardiac patients who really should be studied,⁶ particularly because these patients typically have a greater risk for morbidity and mortality. With the development of better cardiac medications, the time period before patients are referred for revascularization has increased. This older, sicker population is now a more significant percentage of those being treated. For this reason, omitting them from studies has been a concern.

Other variations in trials have included measurable outcomes. The term *major adverse cardiac and cerebral events* (MACCE) is often used as a quantifiable end point. MACCE includes death, stroke, documented nonfatal MI, and repeat revascularization by either PCI or CABG. This criterion is not conclusive, however, and researchers have used a variety of outcomes that may include MACCE but also examine others as well⁷ (see Table 3, page 38).

Clinicians who try to use the current literature for decision making may also be uncertain how to interpret results because many of the studies have not been randomized. Patients selected for surgery often have greater amounts of diffuse disease and more comorbid conditions. As a result, some members of the medical community are again questioning study results and suggesting that the selection process has favored patients who receive stents.^{8,9} It is true, however, that patients at too high a risk to undergo an open-heart procedure have been treated with PCI if their anatomy permitted it.

TRIALS

Although many variables affect the adequacy of the existing studies of CABG versus stenting, this should not deter continuing research and examinations of the data presented, particularly data from landmark trials. The list of such trials includes, but is not restricted to, the Arterial Revascularization Therapies Study (ARTS),¹⁰ the Stent or Surgery (SoS) trial,¹¹ the multicenter ERACI II study,¹² and the Medicine, Angioplasty, or Surgery Study (MASS II).¹³

Continued on page 38

TABLE 1. Factors that affect patient populations for revascularization studies

Age
Amount of disease and location
Angina (stable or unstable)
Concomitant medical conditions
Coronary anatomy
Current coronary disease
Diagnosis of heart failure
Family history
General health
Hepatic disease
History of MI
Hyperlipidemia
Hypertension
Involvement of the left anterior descending coronary artery
Low left ventricular ejection fraction
Medical treatments after the procedure
Medications taken before the procedure
Obesity
Patient adherence
Peripheral vascular disease
Previous bypass surgery
Previous percutaneous intervention
Previous stroke
Pulmonary function
Race
Renal disease
Risk of anticoagulation
Severity of previous MI
Smoking
Type 1 or type 2 diabetes

KEY POINTS

- Coronary artery bypass graft (CABG) and percutaneous intervention procedures have been in a constant state of development since 1968, so it is not surprising that which to choose remains unclear. A review of the current literature might clarify the debate; however data that clearly define which procedure is superior have been difficult to capture.
- Although many variables affect the adequacy of the existing studies of CABG versus stenting, this should not deter continuing research and examinations of the data presented.
- The occurrence of restenosis in patients with multivessel disease has been shown to decline when drug-eluting stents instead of bare metal stents are used.
- The choice of stents versus CABG for the treatment of cardiovascular disease is complex for a number of reasons. Future studies and reports, although welcomed, may continue to be contested by those favoring either technique.

COMPETENCIES

- Medical knowledge
- Interpersonal & communication skills
- Patient care
- Professionalism
- Practice-based learning and improvement
- Systems-based practice

ARTS-1 This 5-year study compared bare metal stents to CABG in patients with multivessel disease.¹⁰ Subjects randomized to receive stents (n = 600) or CABG (n = 605) were examined, with a final end point being freedom from MACCE at 1 and 5 years. The results of ARTS-1 demonstrated no statistical benefit to either group for mortality, stroke, or MI. However, overall MACCE rates were higher in the patients who received stents—an increase attributed to the need for repeat revascularization (stent group, 30.3%; CABG group, 8.8%).¹⁰

SoS The SoS randomized trial compared stenting (n = 488) to surgery (n = 500) 2 years after the procedure in patients with multivessel disease.¹¹ The major end point was the need for revascularization because of restenosis. The SoS investigators reported that 21% of patients who received stents required another procedure, versus 6% of those who underwent CABG.¹¹

ERACI II This randomized trial followed 450 patients, 225 of whom received stents and 225 of whom underwent CABG.¹² Follow-up evaluations were conducted at 30 days, 1 year, 3 years, and 5 years. There was no significant difference between groups in survival benefits or freedom from nonfatal acute MI at 5 years. At the conclusion of the study, however, 28.5% of patients who received stents had required revascularization, versus 7.6% of those who underwent CABG.¹²

MASS-II In this study, medical therapy (n = 203), angioplasty/stent placement (n = 205), and CABG (n = 203) were compared in patients with multivessel coronary disease.¹³

Patients were followed for 5 years, and end points included recurrent ischemia requiring revascularization, nonfatal MI, and death. Revascularization was required in 9.4% of those receiving medical therapy, 11.2% of those who underwent PCI, and 8.3% of those who underwent CABG. The percentages of those experiencing nonfatal MI were 15.3% for medical therapy, 11.2% for PCI, and 8.3% for CABG. All three interventions produced low rates of cardiac-related death.¹³

These trials demonstrated that except for the need for revascularization, which was consistently higher in patients receiving stents, outcomes were not greatly different for patients undergoing PCI or CABG. This should not be surprising. In patients with diffuse multivessel disease, treatment with a strategically placed stent—instead of with a vein or arterial graft with relatively 0% disease—would lead us to expect such outcomes. Similar results have occurred in patients with diabetes, who are even more likely to have diffuse multivessel disease.⁵

NEW DEVELOPMENTS

Drug-eluting stents are still a relatively new product. Long-term studies have not been quantified, but the occurrence of restenosis in patients with multivessel disease has been shown to decline when drug-eluting stents instead of bare metal stents are used.¹⁴ Although these results appear promising, the FDA has outlined possible links between drug-eluting stents and an increased risk of late stent thrombosis.¹⁵ In addition, reports have described allergic reactions to this type of stent, including some deaths.¹⁶ The number of patients experiencing complications has been small; however, the number of drug-eluting stents being used is great enough that the adverse effects are a concern. Some lawsuits have already been filed against manufacturers. The FDA still maintains that coronary drug-eluting stents are safe and effective when used for approved indications. The

TABLE 2. Exclusion criteria used in revascularization studies

>4 bypass grafts during procedure
Advanced age
History of chest wall trauma or irradiation
History of stroke
Left anterior descending coronary artery <1.5 mm in diameter and calcified
Left main coronary artery stenosis
Left ventricular ejection fraction <20%, <30%, <40%
Length of lesion
MI within previous 24 h
Need for concomitant major surgery
Pathology of the heart valves, great vessels, or aorta
Previous coronary revascularization
Previous thoracotomy
Severe lung disease
Severe renal or hepatic disease
Transmural MI within the preceding wk
Use of bypass machine

TABLE 3. End points used in revascularization studies

Atrial fibrillation
Death
Major cerebral event
MI
Need for repeat revascularization
Permanent pacemaker
Pneumonia
Post-procedural bleeding
Recurrence of angina
Renal failure requiring hemodialysis
Required medications
Thoracentesis
Ventricular tachycardia or fibrillation

FDA has also pledged to continue to monitor the new devices for additional risks.

CONCLUSION

The choice of stents versus CABG for the treatment of cardiovascular disease is complex. The population of patients with CAD is large and is expected to grow still larger. With the development of newer and more effective medications, patients are first presenting for procedures at older ages and with increased health risks. Techniques and devices are continually being refined, which in turn continually changes our criteria for determining which technique may be superior. Additionally, conclusive data concerning which treatment option might be best have historically been difficult to find. Future studies and reports, although welcomed, may continue to be contested by those favoring either technique. [JAAPA](#)

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