Coronary Artery Revascularization in Patients With Diabetes Mellitus

David H. Fitchett, MD; Milan Gupta, MD; Michael E. Farkouh, MD, MSc; Subodh Verma, MD, PhD

What Is Coronary Artery Disease?
Atherosclerosis is the disease process that narrows large arteries and limits blood supply to vital organs. Coronary artery disease results from atherosclerosis, may reduce blood supply to the heart muscle, and can lead to angina (chest pain with exertion), heart attack, and possibly sudden death.

Diabetes and Coronary Artery Disease
Patients with diabetes mellitus have more extensive atherosclerosis with more plaques susceptible to the breakdown that causes the artery to block and cause heart attacks.

How Is Coronary Artery Disease Treated?
Coronary artery disease can be stabilized and treated through healthy living and the use of medications to control risk factors and symptoms. In some patients, the coronary arteries become more severely blocked and require a revascularization procedure. The 2 procedures to manage a blocked coronary artery are to implant a stent in the area of the blockage (angioplasty) or to entirely bypass the blocked segment of artery surgically (bypass surgery; Figure).

Percutaneous Coronary Intervention (Angioplasty)
Percutaneous coronary intervention (PCI; angioplasty) is a minimally invasive procedure in which a tube with an associated balloon is introduced via a peripheral artery (either the femoral artery in the groin or the radial artery at the wrist), avoiding the need for surgery and general anesthesia. The balloon is inflated in the area of the blocked artery to stretch it open. In most patients, a coronary stent is then placed. This spring-like looking device helps to keep the artery open and reduces the chance of recurrent narrowing. Approximately 15% to 20% of patients will develop renarrowing of the artery requiring a repeat angioplasty procedure within 6 to 12 months. Stents may be coated with medication that reduces the risk of renarrowing. To prevent clots developing in the stent, 2 medications that inhibit blood platelets are needed for up to 1 year after the procedure (usually aspirin plus an additional blood thinner).

Coronary Artery Bypass Graft Surgery
Coronary artery bypass graft (CABG) surgery is a major surgical procedure requiring general anesthesia. In most patients, the procedure is performed after opening the chest through an incision through the breastbone. Veins taken from the leg and an artery taken from within the chest are used to bypass the coronary artery blockages. The bypass grafts have a high chance of remaining open in the first 5 to 8 years after the operation. However, by 10 years after the operation, about half of vein bypass grafts are either blocked or have developed a severe narrowing. In contrast, arterial bypass grafts are more likely to remain open. Although repeat bypass surgery is possible, many patients with a

The information contained in this Circulation Cardiology Patient Page is not a substitute for medical advice, and the American Heart Association recommends consultation with your doctor or healthcare professional.

From the Division of Cardiology (D.H.F.) and Cardiac Surgery (M.G., S.V.), Li Ka Shing Knowledge Institute (D.H.F., M.G., M.E.F., S.V.), and Keenan Research Centre for Biomedical Science (S.V.), St. Michael’s Hospital, Toronto, Ontario, Canada; Peter Munk Cardiac Centre (M.E.F.), Toronto, Ontario, Canada; Department of Medicine (D.H.F., M.G., M.E.F.) and Surgery (S.V.), University of Toronto, Ontario, Canada; Department of Medicine, McMaster University, Hamilton, Ontario, Canada (M.G.); and the Canadian Cardiovascular Research Network, Brampton, Ontario, Canada (M.G., S.V.).

Correspondence to Subodh Verma, Division of Cardiac Surgery, St. Michael’s Hospital, Suite 8-003, Bond Wing, 30 Bond Street, Toronto, ON, M5B 1W8. E-mail vermasu@smh.ca

(Circulation. 2014;130:e104-e106.)

© 2014 American Heart Association, Inc.

Circulation is available at http://circ.ahajournals.org

DOI: 10.1161/CIRCULATIONAHA.113.007968
blocked vein graft can be treated medically and do not need another operation.

**When Is Angioplasty or Bypass Surgery Needed?**

Improving the coronary blood flow by either angioplasty or bypass surgery may be needed in patients with exertional chest pain not adequately controlled with medical treatment. Either procedure is successful in eliminating pain and improving the quality of life. Patients who have had a recent heart attack have better survival if the blocked artery is opened early after the event. In patients with damaged heart muscle and multiple blockages, bypass surgery can prolong life even in the absence of symptoms.

**Choosing Between Angioplasty and Bypass Surgery**

The heart has 3 major coronary arteries, each supplying a different area of the heart muscle. When a single artery is blocked, angioplasty is often preferred over surgery, because it is less invasive and allows faster recovery. When multiple arteries are blocked, a decision must be made between angioplasty to the multiple blockages or bypass surgery. Sometimes arteries are blocked in such a way that only 1 revascularization choice is possible. For example, arteries that have been 100% occluded for years may not be amenable to

---

**Figure.** A. Individuals with diabetes mellitus typically present with diffuse atherosclerosis that may be treated by percutaneous coronary intervention (B) or coronary artery bypass graft surgery (C). D. Coronary angiogram of a patient with diabetes mellitus showing the typical diffuse nature of the atherosclerotic disease with narrowings in multiple locations (i, ii, iii).
angioplasty, and in this case, surgery may be the only option. In other cases, patients may be too frail to withstand surgery, but may be able to more safely undergo multivessel angioplasty.

In many patients with multivessel coronary disease, both angioplasty and bypass surgery are technically feasible. There has long been a debate as to which procedure is best for such patients.

Which Is Best? PCI or CABG?
There have been several studies comparing angioplasty and bypass surgery in patients with multivessel coronary artery disease who were good candidates for either procedure. For such patients, without diabetes mellitus, angioplasty and surgery provide similar control of chest pain and comparable survival over 5 years after the procedure. However, angioplasty-treated patients have a greater need for repeated procedures.

An early study comparing PCI with CABG suggested that in patients with diabetes mellitus, CABG was associated with better long-term survival than PCI. Since that time, there has been considerable debate as to whether surgery truly is better for patients with diabetes mellitus.¹ Recently, this initial observation was confirmed in the largest ever study comparing PCI and CABG in patients with diabetes mellitus.² This study showed that in patients with diabetes mellitus, CABG improved survival by one third over 5 years, compared with PCI. The need for a repeat procedure was almost 3-fold greater in those who had PCI. The benefits of CABG came with the cost of an increased risk of stroke (5% versus 2.5%) that usually occurred during or shortly after the operation.

Why Should CABG Be Better Than PCI?
Neither CABG nor PCI completely eliminate heart attacks in patients with stable coronary artery disease. However, CABG will often restore blood flow to a larger amount of heart muscle, because not all coronary blockages are accessible to PCI. Recurrent narrowing of the artery is also more likely to occur after PCI. Bypass surgery also likely protects the heart, and prevents heart attack or sudden death, even if a coronary artery suddenly blocks.

Should All Patients With Diabetes Mellitus Needing Coronary Revascularization Only Have CABG?
For the patient with diabetes mellitus needing a revascularization procedure for multivessel coronary disease, CABG should usually be considered the procedure of choice. However, individualization of treatment needs to take into account the risk of CABG and patient preferences (Table). After carefully weighing the evidence, PCI may be the choice for frail patients and those with a higher risk of stroke.

Table. Comparison of Angioplasty (PCI) and Bypass Surgery in Patients With Diabetes Mellitus and Multi-Vessel Coronary Disease Who Are Candidates for Both Procedures

<table>
<thead>
<tr>
<th>Factor</th>
<th>PCI</th>
<th>CABG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Recovery time</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Procedural risk</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Bleeding risk</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Ability to treat most blockages</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Need for repeat interventions</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Symptom control</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Reduces risk of death</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Reduces risk of heart attack</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Risk of stroke</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Need for dual antiplatelet treatment</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Cost</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Need for long-term medications</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

CABG indicates coronary artery bypass graft; and PCI, percutaneous coronary intervention.

After Revascularization, Medical Treatment Remains Essential
Revascularization with either PCI or CABG does not change the atherosclerotic process. Progressive atherosclerosis may cause blockage of coronary arteries, stents, or bypass grafts in patients who have had a revascularization procedure, and cause a heart attack or recurrence of angina. In all patients with coronary artery disease, especially those with diabetes mellitus, measures are required to reduce the risk of progression of the atherosclerosis. Protection of the arteries includes strategies such as implementing a heart-healthy lifestyle, with smoking cessation, increased physical activity, and weight loss, as well as cholesterol and blood pressure control.

Disclosures
None.

References
Coronary Artery Revascularization in Patients With Diabetes Mellitus
David H. Fitchett, Milan Gupta, Michael E. Farkouh and Subodh Verma

Circulation. 2014;130:e104-e106
doi: 10.1161/CIRCULATIONAHA.113.007968
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2014 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/130/12/e104

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/