Graft Patency After Off-Pump Coronary Artery Bypass Surgery

Vinod H. Thourani, MD; Robert A. Guyton, MD

For the past few decades, coronary artery bypass grafting (CABG) using cardiopulmonary bypass and cardioplegic arrest (ONCAB) has been considered the standard for surgical coronary revascularization. Since the mid-1990s, there has been increased interest in avoiding the use of extracorporeal circulation and the bypass circuit during construction of the distal anastomoses. This interest in off-pump coronary artery bypass grafting (OPCAB) has, in large part, been because of the detrimental effects of cardiopulmonary bypass; specifically the inflammation response, adverse neurological outcomes, and the multi-system organ injury that may occur. Importantly, OPCAB has been associated with reduced myocardial enzyme release, lower transfusion requirement, reduced pulmonary and renal complications, shorter length of stay, and lower cost.1,2

The most noted limitation of the ROOBY trial revolves around the level of expertise in performing the OPCAB surgical distal anastomoses. In this trial, bypass grafting was morbidity and mortality than ONCAB.8–10 Results of all these studies have consistently shown that OPCAB is a safe and effective method for performing coronary revascularization. However, none of these prospective randomized trials, typically enrolling low-risk patients, has shown an in-hospital mortality advantage for OPCAB. In a meta-analysis of 37 randomized trials11 and large multi-center randomized trials to date comparing OPCAB versus ONCAB, there was no difference in 30-day mortality.3,7

In this edition of Circulation, Hattler and colleagues12 specifically address the outcomes of graft patency in those patients undergoing CABG in the Department of Veterans Affairs–funded Randomized On/Off Bypass (ROOBY) trial. The investigators in 18 Veterans Affairs hospitals from February 2002 to May 2007 randomized 2203 patients to ONCAB or OPCAB.3 The initial 1-year outcomes have been published by Shroyer et al12 in 2009, in which the investigators reported OPCAB in this setting to be significantly inferior to ONCAB with regard to composite end point of death, new myocardial infarction, or need for revascularization (9.9 versus 7.4%). In the study by Hattler et al,12 the authors eloquently delineate arterial and venous conduit patency among the 3 major coronary beds in 685 patients (62%) in each group. This led to an evaluation of 1998 distal anastomoses in the OPCAB group and 2094 in the ONCAB group.12 They noted an overall worse graft patency at 1 year in the OPCAB group (82.6% versus 87.8%; P<0.001). Overall, they report a lower overall patency in OPCAB saphenous vein grafts (76.6% versus 83.8%; P<0.001). However, there was no statistically significant difference in left internal mammary artery grafts to the left anterior coronary artery between groups (OPCAB, 95.0% versus ONCAB 96.4%; P=0.27). With respect to coronary beds, there was no statistical difference between OPCAB and ONCAB graft patency in anterior wall or right coronary artery bypasses. However, patency by conduit to the circumflex (OPCAB: 78.1% versus ONCAB, 85.5%; P=0.002) and posterior descending coronary artery (OPCAB: 74.1% versus ONCAB, 82.8%; P=0.003) territory was significantly less with OPCAB. In comparison, 1-year graft patency by an experienced surgeon facile in OPCAB in a single-institution randomized trial reveals left internal mammary artery to left anterior coronary artery patency of 97.2% in OPCAB group compared with 98.7% in ONCAB (P>0.99).13 Moreover, saphenous vein graft patency to the circumflex artery was similar between OPCAB and ONCAB (89.7% versus 93.4%, P=0.52, respectively).13

The most noted limitation of the ROOBY trial revolves around the level of expertise in performing the OPCAB surgical distal anastomoses. In this trial, bypass grafting was...
performed in a majority of cases by surgical trainees under supervision of attending surgeons who were relatively inexperienced in OPCAB and much more experienced in ONCAB. Off-pump CABG is a more technically demanding operation and requires a skilled, coordinated perioperative team; the experience and skill of the intraoperative assistants and the anesthesia team is critical. The 53 surgeons in this study performed an average of only 3.3 OPCAB cases per year in this study in these Veterans Affairs hospitals. Furthermore, there was an 18% failure to bypass the intended targets in the OPCAB group, compared with 11% (P<0.001) in the ONCAB group and a staggering 12.4% conversion rate from OPCAB to ONCAB. This trial reveals to the surgical community that OPCAB performed by occasional off-pump teams is inferior to ONCAB surgery.

To address the aspect of limited surgical experience, Lamy et al have reported the short-term outcomes of a large multi-institutional trial comparing ONCAB versus OPCAB with experienced surgeons in each technique. The CABG Off or On Pump Revascularization Study (CORONARY) was a randomized, controlled trial with blinded adjudicated outcome assessments in patients undergoing isolated CABG surgery. The trial randomized 4752 patients from 79 hospitals and 19 countries: 2375 were assigned to OPCAB and 2377 to ONCAB. The major advantage for this study, in comparison with the ROOBY trial, remains the assurance that CABG was performed by a surgeon with expertise in the specific type of surgery that the patient was assigned to receive. Expertise was defined as having 2 years of experience and having completed 100 procedures involving the specific technique. Unlike the ROOBY trial, trainees were not allowed to be the primary surgeon for any procedure. In CORONARY there was no difference between groups with regard to short-term mortality, stroke, myocardial infarction, or new renal failure. They do report that in OPCAB patients, when compared with ONCAB, there was a reduced rate of blood-product transfusion, reoperation for bleeding, acute kidney injury, and respiratory complications. However, this potentially comes at a cost. Those patients undergoing OPCAB did have a higher early repeat revascularization rate (0.7%–0.2%; hazard ratio, 4.01; 95% confidence interval, 1.34–12.0; P = 0.01); including 16 patients (0.7%) in the OPCAB group and 4 in the ONCAB group (0.2%, P = 0.01) requiring early repeat CABG or percutaneous coronary intervention. Furthermore, in those undergoing OPCAB, incomplete revascularization was significantly higher (11.8% versus 10.0%, risk ratio, 1.18; 95% confidence interval, 1.0–1.39; P = 0.05) and the number of total of distal anastomoses were statistically less (3.0±0.95 versus 3.2±0.92, P<0.001). A major limitation of the CORONARY trial remains the lack of routine postoperative angiograms in their patient groups. The findings by Lamy et al are similar to the short-term results from the ROOBY trial. However, the main differences between these 2 contemporary trials includes that the CORONARY trial randomized more than twice as many patients from a more diverse array of clinical settings and a more defined and potentially higher level of surgical expertise when compared with the ROOBY trial. Further long-term analysis of the patients in the CORONARY trial will allow more clarity, specifically if coronary angiograms are performed to allow a more detailed analysis for the graft patency.

An aspect that neither study has addressed lies in the more aggressive postoperative pharmacological management of CABG patients with dual antiplatelet therapy. Currently, it is routine for patients undergoing OPCAB to have dual platelet therapy (aspirin and clopidogrel); while this was not well controlled or documented in the ROOBY of CORONARY trials. Studies incorporating the most effective strategy are warranted.

In conclusion, the study by Hattler et al should stimulate discussion among physicians regarding the management of multivessel coronary artery disease. First, coronary artery disease remains a very complex and challenging disease process and similar to the model of transcatheter aortic valve therapies; cardiologists and cardiac surgeons should develop a heart team approach to the most optimal management scheme. This would include patient-level discussions of percutaneous coronary intervention versus CABG, hybrid CABG and concomitant or staged percutaneous coronary intervention, and discussions of OPCAB versus ONCAB.

Second, in light of the data by Hattler and colleagues, we would be remiss if we did not advocate enhanced monitoring of individual surgical outcomes with progressive improvement as the primary goal. Although mortality has been the cornerstone of most outcomes research in the treatment of coronary artery disease, it may be for graft patency to be given a higher priority. This would be analogous to a transesophageal echocardiogram after a mitral valve repair for confirmation of adequate surgical outcomes. Would it be feasible, for each surgeon, to perform completion angiograms in 20 consecutive CABG procedures annually so that graft visualization by postoperative imaging studies could provide a similar feedback about surgical technical quality, a feedback that might be the trigger needed for more effective quality improvement? Although it would be most efficient to perform a completion angiogram immediately after CABG in a hybrid room, resource limitations may preclude such a process. Regardless, the patients could undergo angiograms before discharge. Third, for those surgeons with an interest in initiating an OPCAB program, technical proficiency with simulators or proctoring should be performed with experienced surgical operators before the initiation of an independent program. Coronary artery bypass grafting still remains one of the most successful operations for the treatment of multivessel coronary artery disease. Intricacies revolving around the techniques for the performance of CABG remain debated. Off-pump coronary artery bypass surgery may offer disproportionate benefit to patients at high risk for morbidity and mortality with cardiopulmonary bypass and should remain part of the heart team’s repertoire for patient-specific and pathology-focused coronary revascularization.

Disclosures
Dr Thourani has received compensation from Maquet Medical’s advisory board (<$10 000/year).
References


Key Words: Editorials • coronary artery bypass
Graft Patency After Off-Pump Coronary Artery Bypass Surgery
Vinod H. Thourani and Robert A. Guyton

Circulation. 2012;125:2806-2808; originally published online May 16, 2012;
doi: 10.1161/CIRCULATIONAHA.112.108514
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2012 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/125/23/2806

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/