Commentary: We have mastered off-pump coronary artery bypass grafting technique, but not the indications for it

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Off-pump coronary artery bypass grafting (OPCAB) has been associated with reductions in bleeding complications,^{1,3} acute kidney injury (AKI),^{1,3} and stroke⁴ relative to on-pump coronary artery bypass grafting, but these reductions come at the cost of more incomplete revascularization,^{1,2,4} lower graft patency,² and greater need for repeat revascularization,^{1,4} with no difference in survival.^{1,2,4} It has been suggested that the lack of a mortality benefit in these studies is a result of their inclusion of a population of patients at low² to intermediate¹ risk. Puskas and associates⁵ stratified patients by Society of Thoracic Surgeons predicted risk of mortality score and found that OPCAB was associated with significant reductions in operative mortality in higher-risk patients with a Society of Thoracic Surgeons score greater than 2.5 (3.2% vs 6.7%; $P < .001$), whereas no difference was noted in lower risk patients. The question remains, should OPCAB be looked at as a less invasive revascularization option for patients at high risk, even at the cost of less complete revascularization? Studies assessing the benefits of OPCAB in patients at particular risk for certain postoperative complications are therefore warranted.

In this issue of the *Journal*, Rocha and colleagues⁶ used the CorHealth Ontario Cardiac Registry to identify retrospectively 7782 patients with “moderate” renal failure, defined as estimated glomerular filtration rate of 30 to 59 mL/min, who were undergoing OPCAB versus on-pump coronary artery bypass grafting. After propensity matching, OPCAB was associated with a lower rate of in-hospital renal failure requiring hemodialysis (1.2% vs 2.9%; $P < .01$), but this effect was lost by 30 days. There were no differences in perioperative mortality, 8-year mortality, or progression to permanent dialysis (7% vs 7%; $P = .74$).⁶ Strengths of the current study include its use of a large multicenter registry with adequate powering to allow a robust propensity analysis including socioeconomic variables such as income and location of residence, likely surrogates for degree of preoperative medical optimization. Limitations include a lack of data on surgeon experience,

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Central Message

The potential benefits of off-pump coronary artery bypass grafting for patients with preoperative renal dysfunction remain to be determined.

See Article page 1297.

which has been clearly demonstrated to correlate with outcomes after OPCAB.⁷ A major limitation is a lack of granular data, including individual patient creatinine levels, allowing assessment of more subtle degrees of AKI. In addition, the definition of “moderate” renal failure, with an average creatinine of 126 $\mu\text{mol/L}$ (1.43 mg/dL), included mainly patients at low risk for significant postoperatively renal dysfunction regardless of CABG strategy. This likely explains the very short-lived difference in in-hospital renal outcomes.

A potential reduction of the risk of renal failure with the use of OPCAB has been suggested, but not proved. In the randomized Coronary Artery Bypass Surgery Off or On Pump Revascularization Study,¹ OPCAB was associated with a reduced incidence of 30-day AKI, as defined by the Acute Kidney Injury Network criteria (stage 1, increase in creatinine $\times 1.5$ from baseline or increase of >0.3 mg/dL within 48 hours; hazard ratio 0.87; $P = .01$). In a substudy of the Coronary Artery Bypass Surgery Off or On Pump Revascularization Study that assessed short- and long-term effects on renal function,⁸ no difference was noted at 1 year, even in the subgroup with preoperative chronic renal insufficiency (estimated glomerular filtration rate <60 mL/min/ 1.73 m²). In the randomized German Off-Pump Coronary Artery Bypass Grafting in Elderly Patients Study, which included only patients older than 75 years,⁴ no differences in 30-day or 1-year rates of renal failure requiring

hemodialysis were noted between the OPCAB and on-pump coronary artery bypass grafting groups. In a substudy of the German Off-Pump Coronary Artery Bypass Grafting in Elderly Patients Study that assessed short-term effects of OPCAB on renal function,³ no difference was noted in 30-day rates of AKI, as defined by the Acute Kidney Injury Network criteria, regardless of CABG strategy, even in the subgroup with preoperative chronic renal insufficiency (estimated glomerular filtration rate <60 mL/min/1.73 m²). In the Department of Veteran Affairs Randomized On/Off Pump Bypass Study,² no difference was noted in 30-day rates of renal failure requiring hemodialysis. A smaller trial that randomly allocated only patients with preoperative renal insufficiency (glomerular filtration rate <60 mL/min/1.73 m²) demonstrated reduced rates of short-term (5 days) AKI with OPCAB,⁹ with no assessment of longer-term outcomes. In a retrospective study of more than 2000 patients from 2 hospitals in Taiwan,¹⁰ OPCAB was associated with a reduced incidence of short-term (in-hospital) renal failure requiring dialysis in patients with severe renal insufficiency (glomerular filtration rate <30 mL/h), although this effect was lost after controlling for preoperative renal function. No difference was seen in long-term (4-year follow-up). Interestingly, in a much larger retrospective study of more than 38,000 patients from the Japanese Cardiovascular Surgery Database,¹¹ OPCAB was associated with a reduced incidence of short-term (30 day/in-hospital) renal failure requiring dialysis and reduced mortality in patients with severe renal insufficiency (glomerular filtration rate <30 mL/min/1.73 m²), and this relationship held after risk adjustment, including inverse probability of treatment weighting.

The current study of Rocha and colleagues⁶ suggests that for patients with “moderate” renal dysfunction, immediate postoperative renal function is improved with OPCAB, but this effect is lost by 30 days, with no detectable difference in the long term. It therefore seems rational to hypothesize that in a group of patients with more

significant renal dysfunction, OPCAB will demonstrate greater long-term benefits. In the last 3 decades, the pendulum has swung to and fro with regard to OPCAB, and it is still swinging. It is clear that mastery of this more challenging technique may be achieved by dedicated surgeons. What is not clear is what group of patients this mastery may benefit the most.

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