(4, 5, or 6 mm), position in relation to neoaorta (right or left of the aorta), and anastomosis both proximally either with ventricular fixation or epicardial fixation as well as distally with Gore-Tex or biologic patch or direct anastomosis. A review of controlled trials²⁻⁵ is given in Table 1. Each of these technical modifications can behave as a confounder at the time of the RV to PA conduit reconstruction. Furthermore, they can have long-term effects on the PA architecture, whether central or branch pulmonary artery stenosis. The PAs are essential for healthy Fontan circulation.

This lack of a standardized surgical technique for the RV to PA shunt construction in itself allows for error-generating boundaries. All of the entities in Norwood procedures are essential but have limitations inherent in the surgeon's cognition that is worthy of appraisal and understanding. These are difficult to measure with existing tools. We should not, however, underestimate the role of variable surgical technique in contributing to increased rate of reinterventions.

Simple randomization in the trial of Ohye and colleagues¹ to 2 different shunts does not mean that these shunts were constructed in the same exact manner at each surgery and by every surgeon. In particular, the RV to PA shunt more often can be constructed in different ways given the modifications, predetermined patient sample selection, and unweighted confounding. For example, surgeons elect not to place RV to PA shunts if there is a crossing coronary artery or presence of an important papillary muscle.

With regard to the modified Blalock-Taussig shunt, the major variations are limited to length and diameter. The number of variable boundaries in the RV to PA shunt construction is thus far greater than that in the Blalock-Taussig shunt. The blood flow patterns vary in each shunt as well as each reconstruction. Although the RV to PA shunt has been popular among the sur-

gical community, attention to the details in its construction is needed. Material-compliance mismatch (eg, Gore-Tex to PA or Gore-Tex to pericardial patch to pulmonary artery) at the distal anastomosis is another boundary that could be associated with further reinterventions in the RV to PA conduit.

If we were to revisit our techniques critically and systematically and reinterpret the intricate boundaries for each surgical variable, we could provide a quality improvement initiative and reduce the rate of reintervention after the Norwood procedure.

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CONVENTIONAL RATHER THAN OFF-PUMP CORONARY ARTERY BYPASS GRAFTING SHOULD BE PERFORMED FOR NON-HIGH-RISK PATIENTS

To the Editor:

We read with great interest an editorial by Patel and Angelini,¹ which

cited 2 meta-analyses^{2,3} of randomized controlled trials of off-pump coronary artery bypass grafting without cardiopulmonary bypass (OPCAB) versus conventional coronary artery bypass grafting with cardiopulmonary bypass (ONCAB) that demonstrated similar late mortality. The meta-analysis (published in 2008) by Møller and associates² of 18 trials (2864 patients) showed no significant difference in late (>30 day) mortality (3.1% in OPCAB vs 2.7% in ONCAB; $P = .55$). In the meta-analysis (published in 2009) by Feng and colleagues³ of 10 trials (2018 patients), late (≥ 1 year) mortality was not significantly reduced (odds ratio, 1.00; 95% confidence interval [CI], 0.56–1.77; $P = 1.00$). More recently (published in 2010), we⁴ performed a meta-analysis of 11 results of 12 trials (4326 patients) including the Randomized On/Off Bypass (ROOBY) trial.⁵ Despite the results of previous meta-analyses,^{2,3} our pooled analysis demonstrated a statistically significant increase in late (≥ 1 -year) mortality by a factor of 1.37 with OPCAB relative to ONCAB (risk ratio, 1.373; 95% CIs, 1.043–1.808; $P = .024$).⁴ Furthermore, our updated meta-analysis of 15 results of 16 trials (by a comprehensive search current through September 2010) (4865 patients) also demonstrated a statistically significant increase in late (≥ 1 -year) mortality by a factor of 1.39 with OPCAB relative to ONCAB (risk ratio, 1.39; 95% CIs, 1.07–1.80; $P = .01$; Figure 1). This result was robust in sensitivity analyses: exclusion of any single result (including the result of the ROOBY trial⁵) from the analysis did not substantively alter the overall result of our analysis. Therefore, on the basis of the best evidence of our newest meta-analyses of randomized controlled trials, ONCAB rather than OPCAB should be considered for patients at least who meet the criteria for enrollment in the randomized trials (typically not high-risk but low- to moderate-risk patients),

FIGURE 1. Late (≥ 1 -year) mortality among patients randomized to off-pump coronary artery bypass grafting without cardiopulmonary bypass (OPCAB) versus conventional coronary artery bypass grafting with cardiopulmonary bypass (ONCAB). BBS, Best Bypass Surgery trial; BHACAS, Beating Heart Against Cardioplegic Arrest Study; CI, confidence interval; MASS, Medicine, Angioplasty, or Surgery Study; M-H, Mantel-Haenszel; PROMISS, Prospective Randomized Comparison of Off-Pump and On-Pump Multi-vessel Coronary Artery Bypass Surgery trial; ROOBY, Randomized On/Off Bypass trial; SMART, Surgical Management of Arterial Revascularization Therapies trial; df , degrees of freedom.

because late mortality reduction must imply the greatest clinical benefit among patients undergoing coronary artery bypass grafting.

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Reply to the Editor:

Supplemental material is available online.

We read with interest the letter by Takagi and colleagues, who suggest that coronary artery bypass graft surgery without cardiopulmonary bypass (OPCAB) is associated with adverse long-term outcomes based on a recent systematic review they¹ have performed and recommend that the preferred technique for non-high-risk patients should be coronary artery bypass graft surgery with cardiopulmonary bypass (ONCAB).

We, however, question the validity of their systematic review, which included 11 randomized controlled trials (RCTs) evaluating long-term outcomes in more than 4000 low-risk patients for the following reasons. First, 7 of the 11 RCTs (please see references E1-E7) included in the meta-analysis carry moderate to high risk of bias according to the Cochrane system for the evaluation of the methodologic quality of studies. Removal of

these studies reveals comparable mortality rates (risk ratio, 1.276; 95% confidence intervals, 0.858–1.898; $P = .229$) between OPCAB and ONCAB surgery. Second, the meta-analysis is heavily weighted by the Randomized On/Off Bypass (ROOBY) trial, which we have already critically analyzed and have shown to have several flaws. Removal of this trial from the meta-analysis demonstrates no difference between the 2 surgical techniques (odds ratio, 1.344; 95% confidence intervals, 0.952–1.896).¹

Conversely and more fundamentally, though, if we consider the findings of Takagi and colleagues to be robust, we may conclude that OPCAB is not for all surgeons and patients. Numerous observational studies from centers specializing in OPCAB demonstrate trends toward or significant reductions in mortality in all groups of patients.²⁻⁵ OPCAB surgeons achieved anastomotic numbers comparable with ONCAB surgeons in these studies,⁴ and this is in contrast to RCTs performed to date. Results of the CRISP trial (Coronary artery grafting in high RISK patients randomized to off Pump or on pump