7 studies demonstrated no statistically significant difference in arterial graft occlusion (RR, 1.01; 95% CI, 0.63–1.60; $P = .98$; P for heterogeneity = .16) between OPCAB and CABG-CPB but a statistically significant increase in venous graft occlusion (RR, 1.29; 95% CI, 1.08–1.54; $P = .006$; P for heterogeneity = .98; Figure 1, A)^{1,3-7} and overall graft occlusion (RR, 1.29; 95% CI, 1.00 [1.0028]–1.42; $P = .05$ [.0465]; P for heterogeneity = .27) with OPCAB relative to CABG-CPB in the fixed-effects model. Two of the 7 studies stated 3-month graft patency, whereas the remaining 5 studies reported ≥ 1 -year patency. In a sensitivity analysis, pooled analysis of the 5 studies reporting ≥ 1 -year graft patency demonstrated no statistically significant difference in arterial graft occlusion (RR, 0.98; 95% CI, 0.58–1.68; $P = .95$; P for heterogeneity = .36) and overall graft occlusion (RR, 1.16; 95% CI, 0.97–1.40; $P = .11$; P for heterogeneity = .83) between OPCAB and CABG-CPB but a statistically significant increase in venous graft occlusion (RR, 1.27; 95% CI, 1.06–1.53; $P = .01$; P for heterogeneity = .94; Figure 1, B)^{1,5-7} with OPCAB relative to CABG-CPB in the fixed-effect model.

The results of our analysis suggest that OPCAB may attenuate venous graft patency over CABG-CPB. Four of the 5 studies included in the sensitivity analysis, however, had merely 1-year follow-up duration as contrasted with 7-year follow-up in the study by Angelini and coworkers.¹ Further long-term follow-up results of randomized controlled trials are needed to confirm our results.

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References

1. Angelini GD, Culliford L, Smith DK, Hamilton MC, Murphy GJ, Ascione R, et al. Effects of on- and off-pump coronary artery surgery on graft patency, survival, and health-related quality of life: long-term follow-up of 2 randomized controlled trials. *J Thorac Cardiovasc Surg*. 2009;137:295-303.
2. Takagi H, Tanabashi T, Kawai N, Kato T, Umemoto T. Off-pump coronary artery bypass sacrifices graft patency: meta-analysis of randomized trials. *J Thorac Cardiovasc Surg*. 2007;133:e2-3.
3. Al-Ruzzeh S, George S, Bustami M, Wray J, Ilesley C, Athanasiou T, et al. Effect of off-pump coronary artery bypass surgery on clinical, angiographic, neuro-cognitive, and quality of life outcomes: randomised controlled trial. *BMJ*. 2006;332:1365.
4. Khan NE, De Souza A, Mister R, Flather M, Clague J, Davies S, et al. A randomized comparison of off-pump and on-pump multivessel coronary-artery bypass surgery. *N Engl J Med*. 2004;350:21-8.
5. Lingaas PS, Hol PK, Lundblad R, Rein KA, Mathisen L, Smith H-J, et al. Clinical and radiologic outcome of off-pump coronary surgery at 12 months follow-up: a prospective randomized trial. *Ann Thorac Surg*. 2006;81:2089-96.
6. Puskas JD, Williams WH, Mahoney EM, Huber PR, Block PC, Duke PG, et al. Off-pump vs conventional coronary artery bypass grafting: early and 1-year graft patency, cost, and quality-of-life outcomes: a randomized trial. *JAMA*. 2004;291:1841-9.
7. Widimsky P, Straka Z, Stros P, Jirasek K, Dvorak J, Votava J, et al. One-year coronary bypass graft patency: a randomized comparison between off-pump and on-pump surgery angiographic results of the PRAGUE-4 trial. *Circulation*. 2004;110:3418-23.

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Reply to the Editor:

In this issue, Takagi and Umemoto¹ report a meta-analysis of patency after coronary artery bypass (CABG) and off-pump CABG (OPCAB) that we and others declined to conduct.^{2,3} We have 4 comments on the appropriateness of both their revised and original analyses.⁴

The authors make the mistake that we described in our article³—that is, they assumed statistical independence of multiple grafts in the same patients. We reiterate that this “could seriously undermine statistical inferences.”³ In our own primary patency analysis, ignoring the dependency between grafts within patients would have narrowed the confidence interval by 40%. Underestimating the standard errors by this amount would make all of their

pooled estimates not statistically significant.

Meta-analysts should write a protocol in advance,⁵ including specifying the planned analyses. Can Takagi and Umemoto confirm that the subgroup analysis by different conduit type was prespecified? In the Beating Heart Against Cardioplegic Arrest Study (BHACAS) follow-up, the 2 groups had very similar overall occlusion rates, but the proportions of vein and arterial grafts occluded in the OPCAB compared with the CABG group happened to be in the directions observed in the original meta-analysis.⁴ We had no prior hypothesis that veins should be more at risk of occlusion with OPCAB and concluded that our nonsignificant findings arose by chance. Did Takagi and Umemoto report the subgroup analyses because it showed statistical significance, without a prior intention to do so?

Although updating a meta-analysis is always worthwhile, one should not expect the addition of a single new result to overturn a previous conclusion unless the new trial contributes an overwhelming amount of new information (depicted by the size of a “blob” in a forest plot) or a substantially different estimate (which might cause concern about heterogeneity). Neither was the case here.

Inspection of the blobs does, however, show that one trial contributes most of the statistical weight.⁶ Interestingly, the PRAGUE-4 trial reported patency findings for a similar number of patients (255) as the BHACAS trials (199), highlighting that the large weight is due to a high rate of overall occlusion (45%) compared with the other trials (7%–17%). Meta-analysts need to judge whether it makes sense to pool data.⁵ We question whether the PRAGUE trial should be pooled with the others, even in the absence of statistical heterogeneity and without obvious major design differences between studies. Moreover, there are other important sources of heterogeneity between trials,

such as duration of follow-up and susceptibility to attrition bias.

We conclude that there is no current evidence that the patency rates are statistically significantly different for OPCAB and CABG. The pooled point estimate is unaffected by the flawed data analysis, so the risk of a vein graft occlusion using the OPCAB technique may be $\approx 25\%$ higher. However, even if future data confirm that the risk is higher, the best answer to the question “Dare we perform OPCAB... to merely improve [these] selected clinical and resource outcomes?”⁴ is provided by analyses of outcomes that are more relevant to patients and less susceptible to attrition (survival free from major adverse cardiac-related events and health-related quality of

life). There is no hint from a systematic review⁶ or the BHACAS trials² that these outcomes are better after CABG than OPCAB, either in the short or long term.

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References

1. Takagi H, Umemoto T. Graft patency in coronary artery bypass versus off-pump coronary artery bypass. *J Thorac Cardiovasc Surg.* 2009;138:792-3.
2. Cheng DC, Bainbridge D, Martin JE, Novick RJ. Evidence based perioperative clinical outcomes research group. Does off-pump coronary artery bypass reduce mortality, morbidity, and resource utili-

zation when compared with conventional coronary artery bypass? A meta-analysis of randomized trials. *Anesthesiology.* 2005;102:188-203.

3. Angelini GD, Culliford L, Smith DK, Hamilton MCK, Murphy GJ, Ascione R, et al. Effects of on- and off-pump coronary artery surgery on graft patency, survival and quality of life: long term follow-up of 2 randomized controlled trials. *J Thorac Cardiovasc Surg.* 2009;137:295-303.
4. Takagi H, Tanabashi T, Kawai N, Kato T, Umemoto T. Off-pump coronary artery bypass sacrifices graft patency: meta-analysis of randomized trials. *J Thorac Cardiovasc Surg.* 2007;133:e2-3.
5. Higgins JPT, Green S, editors. Chapters 4 and 9. Cochrane Handbook for Systematic Reviews of Interventions Version 5.0.1 [updated September 2008]. The Cochrane Collaboration, 2008. Available from www.cochrane-handbook.org.
6. Widimsky P, Straka Z, Stros P, Jirasek K, Dvorak J, Votava J, et al. One-year coronary bypass graft patency: a randomized comparison between off-pump and on-pump surgery angiographic results of the PRAGUE-4 trial. *Circulation.* 2004;110:3418-23.

doi:10.1016/j.jtcvs.2009.05.043

Notices of Correction

Re: Hypoxic reoxygenation during initial reperfusion attenuates cardiac dysfunction and limits ischemia-reperfusion injury after cardioplegic arrest in a porcine model. *J Thorac Cardiovasc Surg.* 2009;137:978-82.

In the above-noted article, the spelling of Dr Behjati's surname was incorrect. The corrected author list is printed below.

U. Abdel-Rahman, MD, P. Risteski, MD, K. Tizi, S. Kerscher, MD, PhD, S. Behjati, K. Zwicker, MD, M. Scholz, MD, PhD, U. Brandt, MD, PhD, and A. Moritz, MD, PhD

Re: Long-term results of percutaneous management of malperfusion in acute type B aortic dissection: Implications for thoracic aortic endovascular repair. *J Thorac Cardiovasc Surg.* 2009;138:300-8.

In the above-noted article, the spelling of Dr Meerkov's surname and his degree were incorrect. The corrected author list is printed below.

Himanshu J. Patel, MD, David M. Williams, MD, Meir Meerkov, MSE, Narasimham L. Dasika, MD, Gilbert R. Upchurch, Jr, MD, and G. Michael Deeb, MD