**CARDIOVASCULAR SURGERY
OUTCOMES OF PATIENTS
WITH HIV: NEW DATA IN THE
ERA OF COMBINATION
ANTIRETROVIRAL THERAPY
Reply to the Editor:**

We thank Sullivan and colleagues for their interest in our article regarding cardiovascular surgical outcomes of patients with human immunodeficiency virus (HIV). The advantage of using a large administrative data set such as the Nationwide Inpatient Sample is the ability to examine a relatively rare clinical situation. In our study, we were able to examine the outcomes of a large number of HIV-seropositive patients undergoing cardiac operations. One significant limitation, however, is the lack of clinical data. Clearly, understanding the status of the patients' disease would be beneficial, especially with regard to CD4⁺ T-cell counts. We agree that the degree to which HIV is controlled or the development of acquired immunodeficiency syndrome would significantly impact the outcome.

The etiology of the heart disease is not easy to discern, and we appreciate that the treatment for HIV has evolved significantly with time. We found it interesting that patients with HIV were seen significantly earlier (49 years old vs 66 years old). It is not entirely clear why this was the case, but it may be due to the HIV or the treatment. It is likely that many of the patients who were operated on during our study period were treated with early-generation antiretroviral regimens, and that may have contributed to cardiac disease progression. It will be interesting to see how the trend in cardiac operations changes in the future in response to the newer protease inhibitors.

The article by Hsu and coworkers cited in the letter of Sullivan and colleagues offers an excellent look at the de novo development of atrial fibrillation and flutter in a large cohort of HIV-seropositive patients. Hsu and

coworkers noted that not only did traditional risk factors such as age, race, coronary artery disease, and congestive heart failure play a role, but HIV severity also had a significant impact. Adding the stress and inflammatory response to cardiac surgery and cardiopulmonary bypass further complicates the situation. It is not well understood how the immunodeficient HIV-seropositive patient responds to these stressors. In our article, we comment on the fact that in the article of Hsu and coworkers atrial fibrillation was higher in HIV-seropositive patients, but in our own study arrhythmia was less common in the HIV-seropositive patients (Table 2 in our original article). The fact is, we really do not know why HIV-seropositive patients had a lower incidence of stroke, and a lower rate of postoperative atrial fibrillation was one supposition. It could also be that HIV-seropositive patients are younger and do not have the same burden of aortic atherosclerotic disease.

We read the recent article by Longenecker and colleagues with great interest, as this review sought to clarify the relationship of HIV and the treatment regimens with regard to development of cardiovascular disease. This thoughtful article concludes that treatment of HIV should be started earlier, at higher CD4⁺ counts, because uncontrolled viral replication is likely an important contributor to the development of cardiovascular disease, and modern treatments are safer in this regard.

We fully agree that more robust studies of the topic are needed to further our understanding of the interplay between HIV and antiretroviral therapy. We look forward to the results of the Strategic Timing of Anti-Retroviral Treatment (START) trial, which will examine cardiovascular disease as a secondary outcome. In summary, we were encouraged to see that patients with HIV can have excellent outcomes of

cardiac operations, and we hope that as more of these patients live longer and healthier lives, we can provide the appropriate care.

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**THE CASE FOR MULTIPLE
ARTERIAL CORONARY
ARTERY BYPASS GRAFT: NO
LONGER A LEAP OF FAITH
To the Editor:**

We wholeheartedly agree with the assertion of Halkos and Guyton that the time has come for a "palpable shift in our practice of coronary revascularization" away from the traditional left internal thoracic artery (LITA)-based single arterial coronary artery bypass graft (SABG) to either radial artery (RA) or right internal thoracic artery (RITA)-based multi-arterial coronary artery bypass graft (MABG).¹ We applaud and fully support the authors' impassioned plea for the adoption of MABG into routine everyday practice. Although their reservations regarding MABG are well articulated, they may be overstated and do not fully convey the current evidence supporting MABG. We contend that, in the absence of any meaningful data substantiating a survival disadvantage associated with MABG compared with SABG, the evidence in favor of MABG as the superior technique can no longer be ignored, and that waiting for the complete and unambiguous resolution of these reservations through randomized trials before the wider adoption of MABG represents a disservice to our patients. In the face of the current MABG utilization rate of 9% among the Society of

Thoracic Surgeons cohort, this technique is woefully underused, thus arguably depriving our patients of an enhanced life expectancy: the *raison d'être* of coronary surgery. We are unaware of any peer-reviewed published data suggesting that SABG, in any setting, is better than MABG, with the exception of the evidence on the short-term risk of mediastinitis associated with bilateral internal thoracic artery grafts. Uniformly, in all hands, survival is always better or equivalent with MABG compared with SABG. Thus, based on all the currently available data, the worst case scenario that can be envisioned with a shift to MABG is equivalent long-term survival. At best, this technique results in substantially improved survival.

We have gradually transitioned to RA-based MABG over the last 2 decades such that RA use is now routine (approximately 73% of our patients undergoing coronary artery bypass grafting (CABG) receive more than 1 arterial graft) with excellent angiographic and clinical outcomes.²⁻¹¹ In our experience, we have yet to find a subcohort of CABG patients in which RA-facilitated MABG did not result in improved intermediate- to long-term survival.^{5,6,8} The RA-mediated survival advantage is realized early postoperatively. The MABG and SABG survival curves diverge as early as the first postoperative year. This is an important consideration among patients such as the elderly, diabetics, or those with diminished ejection fraction who have a limited life expectancy and heretofore have rarely been offered MABG. We must respectfully take exception with the authors' contention that "it is often unclear which patients will truly benefit and what coronary anatomy is suitable" in MABG. We have successfully used the RA routinely in the right and left coronary artery systems, and with a judicious grafting strategy, the dreaded "string sign," indicating competitive flow-mediated premature graft failure, can be avoided with excellent long-term RA patency.^{10,11} RA patency

rates equivalent to RITA have been observed.^{11,12} In our hands, the RA artery is a versatile graft able to reach any coronary target. It is easily harvested, concurrently rather than consecutively, with other grafts and thus does not incur additional operative complexity or operative cost. The cost of an additional surgical assistant required for RA harvesting is trivial. By avoiding excessive chest devascularization, we have avoided the complications of both increased sternal wound dehiscence and mediastinitis. In our practice, hand complications and infections are truly a never event. Clinically significant vasospasm is rarely seen.

The shift toward MABG is a necessary and long overdue transition from a quality standpoint and represents an increasingly necessary validation of the value of surgical myocardial revascularization in an era of increasing sophistication and effectiveness of percutaneous approaches to coronary disease. Since the inception of SABG in the 1990s, there has been no substantive modification in conduit selection, whereas our cardiology colleagues have progressed from balloon angioplasty to bare metal stents and finally to several generations of drug-eluting stents (DES) with incrementally improved outcomes. We recently presented a comparative outcomes study of CABG and coronary stenting at the 2014 Annual Meeting of The American Association for Thoracic Surgery noting a survival advantage only in MABG patients compared with DES. There was no difference in long-term survival between SABG and DES in patients with multivessel coronary artery disease.¹³ If confirmed by larger studies, SABG will become a historical curiosity and perhaps rightfully so in light of the sobering results of the PREVENT IV study.¹⁴

The authors correctly point out that there are no randomized prospective studies supporting the improved outcomes of MABG versus SABG

reported from numerous retrospective observational studies. Considering the current status of health care economics as well as the lack of a substantial financial stake of industry in CABG, it is unlikely that any such studies will be forthcoming in the near future. Given this reality, surgeons must ask themselves if this is not the right time for a palpable shift toward MABG? Change is hard, but perhaps our professional societies can facilitate such a pragmatic transition by establishing MABG as a quality metric. As in the case of the transition from SVG-only CABG to LITA-based SABG, a similar debate ensued with passionate views for and against these competing grafting strategies. It was only after the establishment of the LITA CABG as a quality metric that it was widely adopted in clinical practice. We now need such similar boldness and conviction from our leadership to facilitate this shift toward MABG by the multidisciplinary Heart Team that increasingly guides therapeutic strategies. Given the growing and consistently aligned decades-old data supporting clinically important improved end points associated with MABG, clinicians should take comfort in the fact that such a transition is evidence based and no longer requires a leap of faith.

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References

1. Halkos ME, Guyton RA. Coronary bypass: is it time to take the next step—the routine use of second arterial graft? *J Thorac Cardiovasc Surg*. 2014;148:1149-51.
2. Zacharias A, Habib RH, Schwann TA, Riordan CJ, Durham SJ, Shah A. Improved survival with radial artery versus vein conduits in coronary bypass surgery with left internal

- thoracic artery to left anterior descending artery grafting. *Circulation*. 2004;109:1489-96.
3. Schwann TA, Zacharias A, Riordan CJ, Durham SJ, Shah AS, Habib RH. Sequential radial artery grafts for multivessel coronary artery bypass graft surgery: 10-year survival and angiography results. *Ann Thorac Surg*. 2009;88:31-9.
 4. Zacharias A, Schwann TA, Riordan CJ, Durham SJ, Shah AS, Habib RH. Late results of conventional versus all-arterial revascularization based on internal thoracic and radial artery grafting. *Ann Thorac Surg*. 2009;87:19-26.
 5. Zacharias A, Schwann TA, Riordan CJ, Durham SJ, Shah AS, Engoren M, et al. Late outcomes after radial artery versus saphenous vein grafting during reoperative coronary artery bypass surgery. *J Thorac Cardiovasc Surg*. 2010;139:1511-8.
 6. Schwann TA, Zacharias A, Riordan CJ, Durham SJ, Shah AS, Habib RH. Survival and graft patency after coronary artery bypass grafting with coronary endarterectomy: role of arterial versus vein conduits. *Ann Thorac Surg*. 2007;84:25-31.
 7. Schwann TA, Tranbaugh RF, Dimitrova KR, Engoren MC, Kabour A, Hoffman DM, et al. Time-varying (0-15 years) survival benefit of radial artery versus saphenous vein grafting: a multi-institutional analysis of 9852 patients. *Ann Thorac Surg*. 2014;97:1328-34.
 8. Schwann TA, Al-Shaar L, Engoren M, Habib RH. Late Effects of radial artery versus saphenous vein grafting for multivessel coronary bypass surgery in diabetics—a propensity matched analysis. *Eur J Cardiothorac Surg*. 2013;44:701-10.
 9. Schwann TA, Zacharias A, Riordan CJ, Durham SJ, Shah AS, Habib RH. Does radial artery use as a second arterial graft improve coronary artery bypass surgery long-term outcomes in diabetics? *Eur J Cardiothorac Surg*. 2008;33:914-23.
 10. Tranbaugh RF, Dimitrova KR, Friedmann P, Geller CM, Harris LJ, Stelzer P, et al. Radial artery conduits improve long-term survival after coronary artery bypass grafting. *Ann Thorac Surg*. 2010;90:1165-72.
 11. Tranbaugh RF, Dimitrova KR, Lucido DJ, Hoffman DM, Dincheva GR, Geller CM, et al. The second best arterial graft: a propensity analysis of the radial artery versus the free right internal thoracic artery to bypass the circumflex artery. *J Thorac Cardiovasc Surg*. 2014;147:133-42.
 12. Hayward PAR, Hare DL, Gordon IR, Matalanis G, Buxton BF. Which arterial conduit? Radial artery versus free right internal thoracic artery: six year clinical results of a randomized controlled trial. *Ann Thorac Surg*. 2007;84:493-7.
 13. Habib RH, Dimitrova KR, Yammine MB, El-Hage-Sleiman AM, Hoffman DM, Geller CM et al. Increased late benefit of multi arterial CABG compared to intra-coronary stenting in multi-vessel left anterior descending coronary artery disease. Presented at the 94th Annual Meeting of The American Association for Thoracic Surgery, Toronto, Ontario, Canada, April 26-30, 2014. Available at: <http://www.aats.org/annualmeeting/Program-Books/2014/38.cgi>.

14. PREVENT IV Investigators. Efficacy and safety of edifoligide, an E2F transcription factor decoy, for prevention of vein graft failure following coronary artery bypass graft surgery: PREVENT IV: a randomized controlled trial. *JAMA*. 2005;294:2446-54.

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THE ROSS PROCEDURE: UNDERUSE OR UNDER-COMPREHENSION?

To the Editor:

Yacoub and colleagues¹ elegantly discussed the underuse of the Ross procedure in a recent comment in *The Lancet*. Technical difficulties and risks of the procedure, especially at issue if it is not performed by experienced practitioners, have conspired against the widespread use of this life-saving operation. Additionally, the advancing technologies of bioprosthesis manufacturing, the reports on their prolonged life, along with the increasingly available option of percutaneous valve-in-valve implantation, have discouraged the majority of surgeons from undertaking a technically challenging operation. The procedure carries augmented surgical risk, may negatively affect a surgeon's reputation, and potentially burdens cardiac units economically. We think that a miscomprehension of the intrinsic value of this procedure additionally played a role in its underutilization. In other words, we believe that in the face of the technical difficulties of the procedure, its biological significance and clinical advantage for the patient may have been overlooked in surgical practice.

As Yacoub and colleagues¹ point out, along with Ross himself, the inventor of the procedure,² its real keystone is the possibility of maintaining the viability of the aortic valve and preserving the biological activity of the valve leaflets. As pointed out recently, cells populating the

leaflets guarantee an adequate coagulative balance and favorable tissue homeostasis.³ Compared with the glutaraldehyde fixed bioprostheses, the active function of a living leaflet is reflected by the absence of calcific degeneration and anticoagulation.³ More importantly, when applied to pediatric or young adult cases, the Ross procedure's advantage is the possibility of providing an aortic root substitute that can be harmoniously integrated into the vascular system during progressive somatic growth of the aortic structures. However, reports of the need for reoperation for neoroot dilation must be taken into account and are another major deterrent to use of the procedure, especially with young patients.⁴ Such dilation is mainly a result of the anatomic and histologic features of the native pulmonary artery (PA), which is normally subjected to pulmonary pressures and behaves as a venous conduit. Horer and colleagues⁵ elegantly examined the hemodynamic loads on a PA autograft and reported the differential potential for dilation at the various regions of the neo-aorta: the annulus, the Valsalva sinuses (0.5 mm per year) and the sinutubular junction (0.7-0.9 mm per year). They point out that root enlargement may be a pivotal problem, affecting the reimplanted coronaries in the long term.

Attempts to reinforce PAs using synthetic materials such as polyethylene terephthalate and polytetrafluoroethylene have been performed, but though they are effective in preventing dilation, the poor elastomechanical properties and deleterious inflammatory reactions caused by the artificial nature of the materials undermined the effectiveness of this approach.⁶ The biological consequences of surgical procedures should not be neglected, and these 2 materials, which are normally used to reinforce the PA, fail to meet the demanding needs of growing tissue. The strong foreign-body reaction