

EDITORIAL COMMENT

Hybrid Coronary Revascularization

A New Treatment Paradigm for Selected Patients With Multivessel Coronary Artery Disease*



John D. Puskas, MD, MSc, Amit Pawale, MD, Samin K. Sharma, MD

In this issue of *JACC: Cardiovascular Interventions*, Gašior et al. (1), from the Medical Center of Silesia, Poland, are to be congratulated for their landmark contribution of the first randomized, controlled trial of hybrid coronary revascularization (HCR), supporting the safety and efficacy of HCR in patients with multivessel coronary artery disease (MCVD) referred for surgical revascularization (1). The authors cite the “limitations of standard coronary artery bypass grafting (CABG) and unsatisfactory long-term patency of saphenous vein grafts (SVGs)” as the rationale for choosing to randomize surgical referrals for HCR versus CABG. They correctly note that the excellent long-term patency of left internal mammary artery (LIMA) to left anterior descending (LAD) artery grafts, patient preference for avoiding median sternotomy, and improving outcomes with drug-eluting stents in non-LAD coronary arteries are additional factors that have generated increasing interest in HCR.

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According to the guidelines of the joint American societies on percutaneous coronary intervention (PCI) and CABG (2), HCR is defined as planned procedures involving LIMA-to-LAD grafting and PCI of at least 1 non-LAD coronary artery. HCR can be staged (either PCI or LIMA-LAD bypass first and the remaining part

second) or a single stage (both procedures performed under a single anesthesia, typically in a hybrid operating room). The first reported HCR was performed in 1996 (3). Although HCR was performed very infrequently for many years, more recently, an increasing number of these procedures are performed by cardiac surgeons and interventional cardiologists who function on collaborative heart teams and who have mastered advanced techniques in minimally invasive surgery and PCI, allowing them to safely traverse the significant learning curve associated with HCR.

Several previous retrospective, nonrandomized series (4,5) have been published suggesting that HCR can be safe and effective and is associated with less blood use, a very low stroke rate, shortened hospital stay, and so on. However, evidence from well-designed prospective, randomized clinical trials has been lacking. Hence, the present societal guideline recommendations for HCR are not strong. According to the 2011 American College of Cardiology/American Heart Association guidelines for CABG and PCI, HCR is reasonable in patients with ≥ 1 of the following conditions: a calcified proximal aorta, poor targets for surgery that are amenable to PCI, lack of conduits for grafting, or unfavorable LAD anatomy for percutaneous intervention such as chronic total occlusion (Class IIa recommendation) (2).

The present randomized, controlled involved study of staged hybrid procedure, performing LIMA-to-LAD minimally invasive direct CABG (MIDCAB) first and PCI as a second stage after surgery. This procedural strategy allows confirmation of LIMA-to-LAD bypass patency and revision or reintervention if needed. Performing PCI within 36 h postoperatively allows cessation of perioperative bleeding before administration of high-dose dual antiplatelet therapy necessary for PCI. Moreover, PCI to the remaining non-LAD lesions can then safely be performed

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the Icahn School of Medicine at Mount Sinai, Mount Sinai Health System, New York, New York. Dr. Puskas has been a National Principal Investigator of an NHLBI-funded study of Hybrid Coronary Revascularization (#1-RC1-HL100951 09/30/2009-8/31/2011). All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

with the benefit of a revascularized LAD territory. This trial demonstrates that HCR is safe, feasible, and efficacious in selected population of patients with MCVD referred for surgical revascularization.

Stroke has been the Achilles heel of CABG historically. In this small study, there were no strokes in either group. Several authors have advocated a surgical “no-touch technique,” avoiding aortic manipulation to minimize the risk of stroke in patients undergoing surgical coronary revascularization; the HCR strategy naturally lends itself to this technique and thereby holds the hope of a very small stroke risk (6).

This study has several important limitations. Most fundamentally, it is a small, single-center feasibility trial apparently designed without a sample-size calculation or power analysis for either primary or secondary endpoints. As such, all statistical conclusions must be considered hypothesis generating rather than definitive or generalizable.

Patients enrolled in the present trial had coronary disease of intermediate complexity. With a mean SYNTAX score of ~23, and a mean of 4.0 significant coronary lesions per patient, the patients enrolled in this RCT received a mean of 2.3 stents in the HCR group and 2.7 conduits in the CABG group. Despite intervention of relatively high complexity, patients in both groups had a similarly concerning 78% rate of complete revascularization. One-year angiographic assessment of LIMA-LAD patency (obtained in ~85% of patients) found a 94% patency rate in the HCR group and a 93% patency rate in the CABG group, with 1 narrowed LIMA in the HCR group and 5 in the CABG group. Moreover, the proportion of grafted or stented vessels free of stenosis/occlusion was reportedly significantly higher in the HCR group than in the CABG group, despite more frequent need for percutaneous reintervention in the HCR group. No explanation is offered for these surgical patency results. The authors accomplished all-arterial revascularization in ~25% of the CABG group; although this exceeds the rate of all-arterial revascularization in either the U.S. or European databases, it can be argued that a

suitable comparator CABG group would include a higher rate of all-arterial revascularization to be considered state-of-the-art.

It may be more appropriate and impactful to study the safety and efficacy of HCR in patients with less extensive, hybrid-eligible coronary anatomy referred for either multivessel PCI or surgical coronary revascularization. Any patient with proximal LAD stenosis and significant lesion(s) in 1 or at most 2 other non-LAD vessels could be eligible for randomization to HCR versus multivessel PCI. Such a trial would address selected patients in the ambiguous zone of the SYNTAX (TAXUS Drug-Eluting Stent Versus Coronary Artery Bypass Surgery for the Treatment of Narrowed Arteries) trial who may have better outcomes with CABG than with PCI, but who are often treated with PCI rather than the more invasive option of CABG via sternotomy. HCR, by combining the lesser invasiveness of PCI to non-LAD lesions with the durability and longevity of minimally invasive LIMA grafting to the LAD, may be the procedure of choice for many such patients and may be more easily recommended by their cardiologists.

Left main stenosis was an exclusion criterion in the present study, despite the publication of non-randomized series demonstrating the safety of HCR for isolated LM stenosis (7). Indeed, HCR may be a preferred treatment for isolated LM distal/bifurcation stenosis in patients with limited other coronary disease.

In conclusion, Gąsior et al. (1) have contributed importantly to our evidence base supporting the safety and efficacy of HCR. We look forward to their report of the quality of life assessment and longer term clinical follow-up as well as the cost-effectiveness analysis from this important trial.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. John Puskas, Icahn School of Medicine at Mount Sinai Surgical Coronary Revascularization Center of Excellence, Mount Sinai Health System, 1190 Fifth Avenue, Box 1028, New York, New York 10029. E-mail: john.puskas@mountsinai.org OR jpuskas@chpnet.org.

REFERENCES

1. Gąsior M, Zembala MO, Tajstra M, et al. Hybrid revascularization for multivessel coronary artery disease. *J Am Coll Cardiol Intv* 2014;7: 1277-83.
2. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2012;60:e44-164.
3. Angelini GD, Wilde P, Salerno TA, Bosco G, Calafiore AM. Integrated left small thoracotomy and angioplasty for multivessel coronary artery revascularisation. *Lancet* 1996;347: 757-8.

4. Shen L, Hu S, Wang H, et al. One-stop hybrid coronary revascularization versus coronary artery bypass grafting and percutaneous coronary intervention for the treatment of multivessel coronary artery disease: 3-year follow-up results from a single institution. *J Am Coll Cardiol* 2013;61:2525-33.
 5. Halkos ME, Vassiliades TA, Douglas JS, et al. Hybrid coronary revascularization versus off-pump coronary artery bypass grafting for the treatment of multivessel coronary artery disease. *Ann Thorac Surg* 2011;92:1695-701.
 6. Emmert MY, Seifert B, Wilhelm M, Grunenfelder J, Falk V, Salzberg SP. Aortic no-touch technique makes the difference in off-pump coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 2011;142:1499-506.
 7. Halkos ME, Rab ST, Vassiliades TA, et al. Hybrid coronary revascularization versus off-pump coronary artery bypass for the treatment of left main coronary stenosis. *Ann Thorac Surg* 2011;92:2155-60.
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- KEY WORDS** coronary artery bypass grafting, hybrid revascularization, multivessel coronary artery disease, percutaneous coronary intervention