

One-stop hybrid coronary revascularization versus off-pump coronary artery bypass in patients with diabetes mellitus

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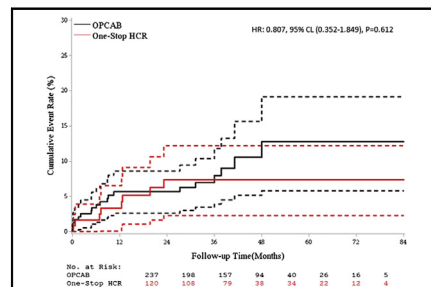
ABSTRACT

Objectives: To compare in-hospital and midterm outcomes after one-stop hybrid coronary revascularization (HCR) and off-pump coronary artery bypass (OPCAB) in patients with diabetes mellitus (DM).

Methods: The series included 120 patients with DM who underwent one-stop HCR at Fuwai Hospital between June 2007 and September 2014. These patients were 1:2 matched with 240 patients who underwent OPCAB using propensity score matching. The primary endpoint was a major adverse cardiac or cerebrovascular event (MACCE) over midterm follow-up, and secondary endpoints were in-hospital outcomes. Accounting for matched-pairs design, the survival analysis was evaluated with a marginal Cox model, and the continuous and dichotomous variables of in-hospital outcomes were compared with the Wilcoxon signed-rank test and a logistic regression model using generalized estimating equations, respectively.

Results: Compared with OPCAB, one-stop HCR was associated with less chest tube drainage (median, 748 mL [interquartile range (IQR), 540-1080 mL] vs 990 mL [IQR, 730-1250 mL]; $P < .001$), a lower packed red blood cell transfusion rate (18.3% vs 29.6%; $P = .032$), shorter mechanical ventilation time (median, 13.7 hours [IQR, 10.3-16.9 hours] vs 16.8 hours [IQR, 13.0-19.6 hours]; $P < .001$), and shorter stay in intensive care unit (median 21.7 hours [IQR, 19.0-44.3 hours] vs 46.7 hours [IQR, 24.3-72.7 hours]; $P < .001$). Over 30 months of follow-up, one-stop HCR and OPCAB had a similar rate of MACCE (7.4% vs 8.0% at 3 years; hazard ratio, 0.807; 95% confidence limit, 0.352-1.849; $P = .612$), but one-stop HCR had a lower stroke rate (0% vs 3.6% at 3 years; $P = .046$).

Conclusions: For selected patients with DM, one-stop HCR provided safe and reproducible revascularization, with less perioperative invasiveness and similar and favorable midterm outcomes compared with OPCAB. (*J Thorac Cardiovasc Surg* 2016; ■:1-7)



MACCE Kaplan-Meier curves, with number of patients at risk and 95% confidence limits.

Central Message

For selected patients with DM, one-stop hybrid coronary revascularization provided a safe and reproducible revascularization option.

Perspective

Hybrid coronary revascularization (HCR) combines the advantage of both CABG and PCI to achieve complete revascularization. In selected patients with DM and multivessel CAD, the results of this study show that one-stop HCR decreased perioperative invasiveness and incurred similar and favorable midterm outcomes compared with OPCAB.

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One-quarter of coronary revascularization procedures are performed in patients with diabetes mellitus (DM). These patients present with accelerated atherosclerotic progression and increased platelet aggregation, which result in suboptimal outcomes compared with patients without

Scanning this QR code will take you to supplemental tables for this article.

Abbreviations and Acronyms

| | |
|-------|--------------------------------------------------|
| ACT | = activated clotting time |
| CABG | = coronary artery bypass grafting |
| CAD | = coronary artery disease |
| CL | = confidence limit |
| DES | = drug-eluting stent |
| DM | = diabetes mellitus |
| HCR | = hybrid coronary revascularization |
| HR | = hazard ratio |
| IQR | = interquartile range |
| LAD | = left anterior descending artery |
| LIMA | = left internal mammary artery |
| MACCE | = major adverse cardiac or cerebrovascular event |
| OPCAB | = off-pump coronary artery bypass |
| PCI | = percutaneous coronary intervention |
| SV | = saphenous vein |

DM.^{1,2} A recent randomized clinical trial reported better survival with coronary artery bypass grafting (CABG) compared with percutaneous coronary intervention (PCI) for these patients.³ It is generally believed that the survival superiority of CABG is due mainly to the left internal mammary artery (LIMA) to left anterior descending artery (LAD) graft, based on its favorable long-term patency rate (>90% at 10 years).^{4,5} However, the patency rate of saphenous vein (SV) grafts decreases year by year, from approximately 80% at 1 year to an average of 70% at 5 years.^{6,7} In addition, the use of drug-eluting stents (DES) has a lower target lesion revascularization rate compared with bare metal stents (approximately 5% vs 20% at 1 year and 10% vs 25% at 5 years).^{8,9} Thus, PCI with DES is hypothesized to be a promising treatment for non-LAD lesions.¹⁰

Hybrid coronary revascularization (HCR), involving minimally invasive LIMA-LAD grafting and PCI for non-LAD lesions, combines the advantage of both strategies to achieve complete revascularization.¹¹ In initial experiences, HCR has produced favorable outcomes in selected patients with multivessel coronary artery disease (CAD).^{12,13} However, there are few published studies on the integrated revascularization strategy in patients with DM. In the present study, using propensity score matching, we compared in-hospital and midterm outcomes after one-stop HCR and off-pump coronary artery bypass (OPCAB) in patients with DM.

METHODS

Patient Selection

Between June 2007 and September 2014, 120 patients with DM underwent one-stop HCR at Fuwai Hospital. During the same period, 1905 DM patients underwent OPCAB with LIMA-LAD grafting and SV to non-LAD grafting. After screening these patients with the exclusion criteria, the remaining patients (n = 1658) were subjected to propensity

score matching (original data presented in Table E1). The patients undergoing one-stop HCR were then 1:2 matched with those undergoing OPCAB (Figure 1). This study was approved by the institutional Ethical Committee of Fuwai Hospital.

The inclusion criteria for one-stop HCR were (1) multivessel CAD involving LAD lesion (eg, chronic total occlusion, excessive tortuosity, severely diffuse lesion) or left main coronary artery lesion (unprotected) not favorable for PCI, with non-LAD lesions suitable for PCI, and (2) multivessel CAD with traditional CABG contraindications (eg, heavily calcified ascending aorta, lack of available graft conduits, non-LAD lesions impracticable to anastomosis but feasible for PCI, high-risk status for traditional CABG, such as dysfunction of vital organs). The exclusion criteria for one-stop HCR were (1) minimally invasive LIMA-LAD grafting contraindications (eg, previous sternotomy; LIMA or left subclavian artery stenosis; distal LAD impracticable to anastomosis, such as intramyocardial LAD; significantly unstable hemodynamics, such as mechanical support) and (2) concurrent with other cardiac surgery, for example, valve replacement.

Since 2007, a heart team consisting of 2 experienced interventional cardiologists and 2 experienced cardiac surgeons, had been set up in a cardiology ward at Fuwai Hospital. If a patient met the foregoing criteria, decisions regarding the optimal revascularization strategy were made by the heart team considering the patient's clinical condition, coronary anatomy, and individual needs.

For the patients who underwent OPCAB, the criteria for entering propensity score matching were (1) multivessel CAD involving LAD lesion or left main coronary artery lesion and (2) completion of a LIMA-LAD graft and an SV to non-LAD graft. Exclusion criteria were (1) concurrent with other cardiac surgery, (2) previous sternotomy, and (3) significantly unstable hemodynamics.

Procedures

One-stop HCR was performed in a hybrid operation room, involving minimally invasive LIMA-LAD grafting and consecutive PCI for non-LAD lesions. The procedure and the protocol for antiplatelet and anticoagulation therapy are outlined below.

Using a lift retractor, the LIMA pedicle was harvested under direct vision through reversed-L inferior sternotomy, and its distal end was anastomosed to LAD in situ with off-pump techniques. Transit time flow measurement was routinely performed when the anastomosis was completed. After the surgical operation, instant angiography to confirm the LIMA-LAD graft patency and PCI for non-LAD lesions was performed by an interventional cardiologist with a standardized technique through the femoral artery.

Before the procedure, clopidogrel was stopped for at least 7 days, whereas aspirin 100 mg/day was maintained. During the surgery, unfractionated heparin was administered intravenously before LIMA harvesting to achieve a kaolin-based activated clotting time (ACT) >300 seconds, and reversed with protamine sulfate when the LIMA-LAD anastomosis was successfully completed. For PCI, a loading dose of 300 mg clopidogrel was supplied through a nasogastric tube after confirming the LIMA-LAD graft patency with angiography, and additional unfractionated heparin was administered to achieve an ACT >250 seconds. After the procedure, clopidogrel 75 mg/day was administered for at least 12 months, and aspirin 300 mg/day for 1 month and 100 mg/day thereafter for life was prescribed.

OPCAB was performed through median sternotomy, and the graft conduits were obtained by conventional methods. The distal anastomoses were performed on a beating heart with the aid of a coronary stabilizer, and the proximal anastomoses were performed using partial aortic occlusion clamps. During the surgery, unfractionated heparin was administered intravenously before the LIMA harvest to maintain an ACT >300 seconds throughout the entire procedure, and protamine sulfate was used to reverse heparin when all anastomoses were completed. After the procedure, aspirin 100 mg/day for life was prescribed.

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