Journal of Cardiology xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Journal of Cardiology

journal homepage: www.elsevier.com/locate/jjcc

Original article

Long-term outcome of isolated off-pump coronary artery bypass grafting in patients with coronary artery disease and mild to moderate aortic stenosis

Kizuku Yamashita (MD), Tomoyuki Fujita (MD, PhD)*, Hiroki Hata (MD, PhD), Yusuke Shimahara (MD), Yuta Kume (MD), Yorihiko Matsumoto (MD), Junjiro Kobayashi (MD, PhD, FJCC)

Department of Cardiovascular Surgery, National Cerebral and Cardiovascular Center, Osaka, Japan

ARTICLE INFO

Article history:
Received 6 April 2016
Received in revised form 3 October 2016
Accepted 18 October 2016
Available online xxx

Keywords:
OPCAB
AVR
AS
TAVR
TAVI

ABSTRACT

Background: The best management strategy for patients with coronary disease and mild to moderate AS requires the clinician to consider the operative risks of isolated coronary artery bypass grafting (CABG) against the risks of untreated aortic stenosis (AS).

Methods: Between 2000 and 2014, isolated off-pump CABG (OPCAB) was performed in 2023 patients. Of these patients, 103 presented with mild or moderate AS (mean age 72.7 ± 6.3 years; 23 females), 96 (93.2%) presented with mild AS and seven (6.8%) presented with moderate AS. We compared the long-term outcome of these 103 patients undergoing isolated OPCAB with 13 patients who presented with moderate AS and coronary artery disease (CAD) and underwent concomitant aortic valve replacement (AVR) and CABG during the same period.

Results: Mean number of distal anastomoses was 3.7 ± 0.9 per patient, and early graft patency was 98.9% (365 of 369 grafts). No patient required on-pump CABG or concomitant AVR. There were two in-hospital deaths (1.9%). Cumulative 5- and 10-year survival rates were 78.3% and 56.6%, respectively. The respective 5- and 10-year rates of freedom from severe AS were 38.1% and 0.0% in patients with moderate AS, and 73.2% and 65.4% in patients with mild AS (log-rank test, $p < 0.01$). Twelve patients required subsequent AVR, including eight who underwent transcatheter AVR. There were no significant differences between patients undergoing isolated OPCAB and patients undergoing concomitant AVR and CABG according to cumulative survival rate (log rank test, $p = 0.78$) and freedom from major adverse cardiac and cerebrovascular events (log rank test, $p = 0.59$).

Conclusions: Isolated OPCAB is a reasonable staged strategy in coronary disease with mild AS, as the less invasive option of transcatheter AVR is available later if required.

Introduction

Off-pump coronary artery bypass (OPCAB) grafting is a minimally invasive technique that avoids the need for cardiopulmonary bypass (CPB), which may reduce the risk of perioperative stroke or renal injury [1,2]. The Randomized On/Off Bypass (ROOBY) trial found that patients undergoing OPCAB had fewer grafts, higher mortality, and more cardiac events compared with those undergoing coronary artery bypass grafting (CABG) with CPB, indicating that OPCAB was more technically demanding [3]. Other randomized controlled studies have suggested that OPCAB is not inferior to conventional on-pump CABG [4,5], and may have advantages over on-pump surgery in some situations. In experienced hands, OPCAB is a less-invasive alternative to conventional CABG that results in excellent clinical outcomes [6]. The advantages of OPCAB are maximized when arterial grafts are used [7–9].

Concomitant aortic valve replacement (AVR) is a Class IIa recommendation for patients with moderate aortic stenosis (AS) undergoing CABG; despite the greater operative risks, moderate AS is likely to require AVR within 5 years [10]. The role of concomitant AVR in patients with mild AS is controversial [10,11].

* Corresponding author at: Department of Cardiac Surgery, National Cerebral and Cardiovascular Center, 5-7-1, Fujishirodai, Suita, Osaka 565-0873, Japan.
Fax: +81 6 6872 748.
E-mail address: tomofujita@nifty.com (T. Fujita).

http://dx.doi.org/10.1016/j.jjcc.2016.10.007
0914-5087/

In this study, we analyzed the feasibility of isolated OPCAB using arterial grafts without concomitant AVR or transcatheter AVR (TAVR) in patients with CAD and mild to moderate AS. In addition, we compared the long-term outcomes of untreated mild or moderate AS with patients undergoing concomitant AVR and CABG.

Materials and methods

Patient selection

The National Cerebral and Cardiovascular Center Institutional Review Board approved the study. This was a retrospective, observational cohort study of prospectively collected data from consecutive patients with mild or moderate AS who underwent isolated OPCAB or concomitant AVR and CABG at the National Cerebral and Cardiovascular Center between April January 2000 and December 2014. We reviewed the clinical records of 103 consecutive patients with mild or moderate AS among the 2023 patients who underwent OPCAB, and the records of 13 patients with symptomatic moderate AS among the 187 patients who underwent concomitant AVR and CABG. Isolated OPCAB was conducted in seven of the 103 patients with moderate AS because of the patients' preference for low risk surgery in six patients and porcelain aorta in one patient. Individual consent was obtained from each patient. We excluded patients with a history of previous cardiac surgery and those requiring a concomitant procedure.

Operative procedures and graft evaluation

Our CABG technique aimed to achieve all-arterial grafts with in situ internal thoracic artery (ITA) to left anterior descending artery (LAD) grafting without using the aorta. Selection of bilateral or single ITA grafting was determined by age, severity of diabetes mellitus, bypass target on the LAD, and surgeon's preference. Composite arterial Y- or I-grafts were made using single or bilateral ITA and/or a free radial artery (RA) graft for targets in the circumflex artery and right coronary artery. The I-composite graft we commonly used was a linear extension of in situ ITA with the RA or free ITA. A sequential bypass technique was used for multiple targets in the circumflex artery and right coronary artery. When arterial composite grafts were not available due to RA disease or a deficit of arterial grafts for all targets, saphenous vein grafts (SVG) were used for aorto-coronary bypass.

All cases of concomitant AVR and CABG were performed via median sternotomy using standard CPB. Distal anastomoses were performed with an on-pump beating heart. Consequently, AVR was performed with tepid-blood cardioplegic arrest. Proximal anastomoses were then performed if required.

The grafts undertaken are shown in Table 1. The total number of distal anastomoses in the 103 patients undergoing isolated OPCAB was 378; mean number of distal anastomoses was 3.7 ± 0.9 per patient.

Early postoperative coronary angiography (CAG) or enhanced computed tomography (eCT) was performed routinely, except for patients with a considerable risk of renal dysfunction as a result of these examinations. Graft occlusion was defined as a lack of evidence of flow in the anastomosed grafts on eCT or CAG.

Definitions

We used the joint American College of Cardiology/American Heart Association Task Force Guidelines for Management of Patients with Valvular Heart Disease [12] to define the severity of AS. Briefly, patients were diagnosed with mild AS if the peak aortic jet velocity measured by echocardiography was <3 m/s, moderate AS if the peak aortic jet velocity was 3–4 m/s, and severe AS if peak aortic jet velocity was >4 m/s and/or the aortic valve area index was <0.6 cm^2/m^2.

Table 1
Graft design.

Variables	OPCAB	AVR + CABG	*p*-Value
Conduits			
BITA [*n* (%)]	50 (48.5)	3 (23.1)	0.08
SITA [*n* (%)]	53 (51.5%)	3 (23.1)	0.08
GEA [*n* (%)]	1 (1.0%)	0	0.72
SVG [*n* (%)]	16 (15.5%)	3 (23.1)	0.49
Graft shape			
In situ ITA in individual fashion [*n* (%)]	35 (34.0)	5 (38.5)	0.75
Y-composite graft [*n* (%)]	73 (70.9)	9 (69.2)	0.90
I-composite graft [*n* (%)]	25 (24.3)	1 (7.7)	0.18
Aorta no touch technique [*n* (%)]	92 (89.3)	12 (92.3)	0.24

OPCAB, off-pump coronary artery bypass grafting; AVR, aortic valve replacement; CABG, coronary artery bypass grafting; BITA, bilateral internal thoracic artery; SITA, single internal thoracic artery; GEA, gastroepiploic artery; SVG, saphenous vein graft; ITA, internal thoracic artery.

Endpoints and follow-up

Operative data, including the presence of mild AS or moderate AS and in-hospital complications, were extracted from the hospital records. The primary endpoint was a composite of overall death, cardiac death, or a major adverse cardiac and cerebrovascular event (MACCE) including myocardial infarction, stroke, coronary revascularization, or heart failure after CABG. Cardiac death was defined as death caused by myocardial infarction, heart failure, or sudden death. Coronary revascularization was defined as CABG or percutaneous coronary intervention after OPCAB. Secondary endpoints included early graft patency of OPCAB, freedom from severe AS, and freedom from AVR.

Patients were followed-up by direct contact, telephone, or a postcard survey each year. The duration of follow-up was measured from the date of the operation to death or the last contact by telephone or personal interview. Transthoracic echocardiography for the follow-up of AS was performed every 1–2 years for moderate AS, and every 3–5 years for mild AS according to accepted guidelines [13]. Aortic jet velocity and aortic valve area were calculated for all patients. If there was confirmed progression of mild or moderate AS to severe AS, follow-up transthoracic echocardiography was performed every 6 months to 1 year and subsequent treatment of severe AS was considered.

Statistical analysis

Pre- and post-operative data are expressed as the median (range) or mean $\pm$ standard deviation, as appropriate. The Wilcoxon test was used for data that were not normally distributed. The chi-squared test or Fisher's exact test was used to compare categorical variables. Actuarial survival rate, freedom from severe AS, and freedom from AVR were calculated using the Kaplan–Meier method, and comparisons of the two groups were made using the log-rank test. Data were analyzed using JMP (Version 10; SAS institute Inc., Cary, NC, USA) and differences were considered statistically significant at $p < 0.05$.

Results

Patient characteristics

The patients' demographic and clinical characteristics are shown in Table 2. In the isolated OPCAB group, mean age was

Please cite this article in press as: Yamashita K, et al. Long-term outcome of isolated off-pump coronary artery bypass grafting in patients with coronary artery disease and mild to moderate aortic stenosis. J Cardiol (2016), http://dx.doi.org/10.1016/j.jjcc.2016.10.007