Role of Coronary Artery Bypass Grafting (CABG) in Coronary Artery Disease

The treatment of coronary artery disease includes medication, percutaneous catheter intervention (PCI) and coronary artery bypass grafting (CABG), and an indication of these treatments is dependent on its severity, mainly number of diseased vessels. Multiple vessel disease is now considered as an indication of intervention, and severe coronary artery disease such as three-vessel disease and left main disease is considered as a good indication of CABG.\textsuperscript{1, 2} Although an indication for PCI is expanding especially since the introduction of drug-eluting stent, CABG is still considered superior to PCI among patients with complex coronary artery disease, diabetes mellitus, and old age, due to its less frequency of major adverse cardiac events (MACE), in large part because of a reduced rate of repeat revascularization.\textsuperscript{1, 2}

Innovation of Operative Technique in CABG

On-pump cardiac arrest CABG has been the golden standard in CABG for a long time, however, off-pump CABG (OPCAB) has been developed along with the advancements in devices\textsuperscript{3} to avoid deleterious effects of extracorporeal circulation.\textsuperscript{4} Enthusiasm for OPCAB stimulated cardiac surgeons to perform OPCAB as a standard technique of CABG, especially in Japan. The proportion of OPCAB in CABG dramatically increased up to 63\% of CABG in 2008 according to the annual report from the Japanese association for thoracic surgery,\textsuperscript{5} while it remains 20\%–30\% in the world.

Comparison between OPCAB and On-pump Cardiac Arrest CABG

OPCAB is considered to be less invasive compared with on-pump CABG because OPCAB can eliminate aortic cannulation maneuver, aortic clamping, contact of blood to the foreign materials which induces inflammatory responses and destruction of blood components, dilution of blood due to priming of extracorporeal circuits, and so on. Many reports have been published to show the superiority of OPCAB against on-pump CABG concerning the requirement of blood transfusion, incidence of postoperative atrial fibrillation, incidence of stroke, length of stay at the intensive care unit (ICU) and hospital, in-hospital mortality, and so on.\textsuperscript{6–11}

However, many recent reports including the analysis of randomized control studies have evoked the controversial arguments against the superiority of OPCAB including mortality and morbidity such as incidence of stroke, perioperative myocardial infarction and renal failure.\textsuperscript{12–21} In addition, less complete revascularization rate\textsuperscript{12, 13} and poor graft patency in OPCAB\textsuperscript{16, 18} are suspected the main cause of high incidence of repeat revascularization compared with conventional CABG.\textsuperscript{9, 16, 17} Even with the hands of Japanese experts for OPCAB, early graft patency without stenosis was inferior to that of on-pump CABG.\textsuperscript{22} As mentioned above, because reduced rate of repeat revascularization is the key of superiority of CABG to PCI, meticulous attention should be paid for the application of OPCAB, especially to patients with low risk.
Situation in the Real World

In Japan, isolated CABG was performed in 17764 cases in 2008 according to the most recent report from the Japanese association for thoracic surgery. The proportion of OPCAB, on-pump arrest CABG and on-pump beating CABG was 63.2%, 26.7% and 10.1%, respectively. The primary elective case occupies 86.4% of OPCAB, while it remained 84% in on-pump arrest CABG and 70% in on-pump beating CABG. On the contrary, primary emergency case occupies 11.7% in OPCAB, 14.7% in on-pump arrest CABG, and 26.9% in on-pump beating CABG. Differences of hospital mortality between these three groups (1.0%, 1.2% and 2.5% in primary elective cases, and 4.5%, 7.3% and 15.7% in primary emergency cases, respectively) are suspected partially due to the bias of patients’ selection among these groups. There might be a tendency for common cardiac surgeons (not for experts of OPCAB) to choose on-pump arrest CABG or on-pump beating CABG in high risk patients, especially in patients with hemodynamic instability. This bias might be the cause of different conclusion between observational studies and randomized control studies in comparison of OPCAB and on-pump CABG, because most of randomized control studies select patients with low or low-to-medium risk during the randomization process.

In addition, attention has to be paid for high mortality and morbidity in conversion from OPCAB to on-pump CABG (for example, 6.3% operative mortality in primary elective cases and 12.5% operative mortality in primary emergency cases from the 2008 annual report). Because the conversion cases are often excluded from the clinical results of OPCAB except for the randomized control study with the intention to treat policy, clinical results of OPCAB may have a tendency to be overestimated.

Algorithm for CABG Selection

Appropriate selection criteria for OPCAB, on-pump arrest CABG and on-pump beating CABG has not been established yet. Not only advantages and disadvantages of each operative technique but also characteristics of patients should be included this selection. I suggest making an algorithm for CABG selection in this editorial. The concept is as follows. On-pump arrest CABG is recommended for patients who do not have a risk for cardiopulmonary bypass. OPCABG is recommended for patients with high risk for cardiopulmonary bypass. On-pump beating CABG is recommended for patients with high risk of stroke and with hemodynamic instability, despite having a spot for safe cannulation. From my personal experience at Kyushu University Hospital, six surgeons could perform CABG with quite an acceptable early mortality (predicted mortality by logistic EuroSCORE and observed mortality were 6% and 0.5% in on-pump CABG, 7.1% and 2.1% in OPCAB, and 13.5% and 1.9% in on-pump beating CABG, respectively, presented at the 11th annual meeting of the Japanese Association for Coronary Artery Surgery and un-published data) using this algorithm. A further refined algorithm is expected to be established.

References


