

Controversies in cardiac surgery: do multivessel arterial revascularization and beating heart bypass operations improve prognosis?

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Coronary artery bypass grafting (CABG), was introduced in clinical practice in 1964, and has rapidly become the ‘gold standard’ for the treatment of coronary atherosclerosis.

In 2014, the 5-year results of the SYNTAX (SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery) trial have been published.

The study validated the SYNTAX score, which assigns a score of increased risk of mortality or adverse events based on the complexity of the coronary lesions and the clinical characteristics of the patient.

The results of the trial attested for a superiority of CABG over Percutaneous Coronary Angioplasty (PTCA) in patients with higher SYNTAX score, both in term of myocardial infarction and need for reinterventions (26.7% for PTCA vs. 15.5% for CABG).^{1,2} During the last 30 years two new techniques have been introduced: multivessel total arterial revascularization, and off-pump coronary bypass (OP-CAB), both designed to optimize the results of surgery, but both still controversial.

Presently the most common, and widely supported surgical procedure involves the use of the left internal mammary artery (LIMA) for revascularization of the left anterior descending coronary artery (‘Gold Standard’), and one or more saphenous vein bypasses for the other coronaries.

Arterial grafts seem to have a protective effect on the progression of atherosclerosis. The effect is probably due to the release of vaso-active compounds, such as nitric oxide, which also enhance LIMA patency.³

Recently, more attention has been devoted to the revascularization with both internal mammary arteries, LIMA, and right internal mammary artery (RIMA).

Despite a wealth of data supporting the use of double mammary, RIMA is seldom considered as potential graft (0.6% as a single graft, 4.1% as double graft). The reason

could be the complexity and lack of confidence in performing the procedure, as well as the risk of sternal wound infections.

The radial artery is an alternative conduit used in an attempt at total arterial revascularization. This vessel has a more prominent muscular layer than the mammary artery and is thus more susceptible to vasospasm.

The radial artery appears to have the same patency characteristics of the mammary artery.⁴

Multivessel total arterial revascularization is not better than the standard single arterial graft in achieving good mid-term results, but its use is technically more challenging. Furthermore, there is no standardization as to the best grafts configuration to be used.

The beating heart bypass operation has grown in popularity in the Western Countries during the 90’, for the perceived advantage of avoiding the systemic inflammatory response and microembolization of extracorporeal circulation (ECC).

In 2009, the results of the first large randomized study (ROOBY, Randomized On/Off Bypass) demonstrated that OP-CAB was associated with inferior conduit patency and higher rate of incomplete revascularization. Furthermore, after 1 year (but not at 30 days) the composite outcome (death, non-fatal myocardial infarction, and repeated revascularization) was worst for the operation without ECC (9.9% vs. 7.4%; $P=0.04$).

In 2012, the CORONARY (CABG Off or On Pump Revascularization Study)⁵ enrolling high-risk patients ($n=4752$) operated by surgeons who had at least 2-year experience and more than 100 procedure performed, provided results similar to the ROOBY study, while the recently published ROOBY-FS,⁶ the 5 years follow-up of the ROOBY study, reported significantly worse results.

Various meta-analyses demonstrated that patients after OP-CAB had less respiratory and wound infections, as well as shorter post-operative hospital stay and need for transfusions, but also a lower conduits patency, particularly of the venous grafts⁷ OP-CAB was associated with up to 30% reduction of neurologic events. The reduction of neurologic damages is further enhanced by specific technical measures which allow dealing with 'porcelain' atherosclerotic ascending aorta without manipulations. These include off-pump operation and the 'no-touch aortic technique' or 'anaortic surgery', in which both internal mammary arteries are used, thus avoiding the need for proximal anastomoses.

Patient's selection process. It is becoming apparent that the OP-CAB technique for high-risk patients [Society of Thoracic Surgeons (STS) Predicted Risk Score >3%] is associated with decreased mortality, whether for low-risk patients the mid-term to long-term outcome is similar between the two techniques. Vice versa, when the patients are haemodynamically compromised, the on-pump technique is preferable.

The 2014 ESC/EACTS (European Society of Cardiology/ European Association of Cardio-Thoracic Surgery) guidelines for myocardial revascularization recommend OP-CAB and/or ON-CABG without aortic manipulation when ascending aortic atherosclerosis is present, and OP-CAB in high-risk patients in high volume centres (recommendation I and IIa respectively, level of evidence B).

Multivessel total arterial revascularization does not appear to offer particular advantages over the classical coronary revascularization with only one arterial graft, in terms of mid-term results. The choice to select off-pump procedure should be based on appropriate selection of the patients, better when considering specific scoring systems. Patients older than 75 years of age could probably benefit from this technique, avoiding aortic manipulations in presence of extensive aortic calcifications, while patients with STS score lower than 3% would probably be best served

with conventional ON-CABG. The selection of the most appropriate operation for the individual patient should be taken by the Heart Team, and should be based his/her specific characteristics.

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