

## Off-Pump Coronary Bypass Surgery: Is it a Surgical Technique Worth Performing Usually or Should it be Only Used by Experts in Some Specific Cases? The Never-Ending Dilemma

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The debate whether which technique is better in coronary artery bypass surgery (CABG), concerning on-pump (CCAB) or off-pump (OPCAB) coronary surgery, is still controversial, despite there have been published numerous articles dealing with this topic [1-3].

OPCAB was developed in order to avoid some of the major adverse events associated with cardiopulmonary bypass (CPB), nevertheless it's a proven fact that OPCAB is a more skill demanding technique.

There have been published thousands of observational studies comparing both alternatives, but one of the first randomized trials comparing on and off-pump coronary surgery, the Veterans Affairs Randomized On/Off Bypass (ROOBY) Study, pointed that there was no statistically significant differences regarding mortality or adverse events at 30 days after surgery but. Furthermore, patients who underwent OPCAB had worse outcomes and lower graft patency at 1-year follow-up [4]. But this work has been seriously criticized, as there are many factors related to OPCAB that have to be taken into account before making any conclusion whether any surgical technique is better than other: the surgeon's experience and a proper surgical technique, which are the main keys for surgical success.

Most of the published literature agree with the fact that either 30-day or follow-up mortality is quite similar between OPCAB and CCAB. But, in the other hand, there is one important advantage that benefits OPCAB surgery: the lower incidence of some major adverse events [5].

One of the most discussed and representative benefits attributed to OPCAB surgery has been the significant reduction in the incidence of stroke, especially if a "no touch aorta technique" is employed [6]. OPCAB surgery can be performed without clamping or cannulating the aorta and, therefore, there is no need of manipulation of a widely calcified ascending aorta, reducing the risk of embolism of calcified plaques. It is interesting to point out that, even some studies that have not found a big difference in the incidence of stroke, state that the lack of benefit could be due to the partial clamping of the aorta when the proximal anastomosis of venous grafts are performed. This drawback could be completely solved by the "no-touch" aortic techniques [7,8].

Moreover, the reduction in the need of blood transfusion, in the incidence of atrial fibrillation, or in the use of hemodialysis (mostly due to the preservation of the renal blood flow), are some other of the major advantages that have been associated to OPCAB [9,10].

But all this reduction in postoperative complications open the way to one of the main pillars of the OPCAB technique: There is a general recommendation for the use of OPCAB in high risk patients. Puskas., *et al.* [11] demonstrated that, when calculating predicted surgical risk by STS score, high-risk patients presented a lower mortality compared to CCAB, with an increasing benefit with the increasing predicted risk. Other studies state that the real benefit of OPCAB can be seen in only in high-risk patient groups, such as 80 years or older, those with peripheral vascular disease, or patients with preoperative renal failure [9,12,13].

Therefore, it could seem reasonable to perform OPCAB surgery exclusively in selected groups of patients, especially those with high surgical risk or those with intense calcification of the ascending aorta, which makes aortic manipulation less advisable [14]. In fact, in some of the studies mentioned, there was a crossover from patients of the CCAB group with calcified aorta to OPCAB, in order to avoid embolism and stroke.

One intermediate alternative has been proposed, the on-pump beating-heart technique, which has showed some promising results, but still, offers the technical difficulties to perform the distal anastomosis on a beating heart, without the complete avoidance of the complications associated to the extracorporeal circulation [15]. Nevertheless, on-pump beating-heart technique could be used in hemodynamically unstable patients, that could benefit from the absence of aortic manipulation, and could not safely be performed with the OPCAB technique.

But not everything concerning OPCAB has been positive. One of the most negative facts attributed to OPCAB has always been the lower number of grafts performed [16,17]. Even though, some studies claim that specialized on-pump surgeons tend to perform more grafts than those initially planned [9]. Most of the published evidence claims that, despite getting a complete revascularization with both techniques, the number of grafts has always been inferior in OPCAB surgery. But again, this subject is still opened to debate. As we mentioned before, OPCAB surgery is more skill demanding, and it requires experienced cardiac surgeons. It may seem clear that, obviously, high volume centres with a large number of off-pump cases have a great advantage on this field. Some of the latest developments, such as the intracoronary shunt, a proper heart stabilization or the assessment of the graft function by the intraoperative Doppler blood flow measurement, have improved the results of OPCAB in the recent years. Still, long term graft patency, especially in venous grafts, is still inferior to those grafts performed on-pump.

Long-term patency of grafts performed on-pump has always been a subject to debate. Even though first studies published affirm that during follow-up, there is a higher percentage of occluded grafts in the OPCAB group [18], actually, long-term results in high volume centres and with experienced surgeons are, at least, comparable with those obtained with CCAB [16].

Considering graft patency and incidence of cardiovascular adverse events during follow-up, we may find some studies recommending a higher intraoperative heparine dose [19], or a postoperative double antiplatelet treatment [20,21], with better reported results. Of course, the question about complete revascularization and total arterial revascularization is still present in this debate, with similar recommendations to those existing for CCAB: it is compulsory to get a total revascularization with as many arterial grafts as possible in order to get better long-term results.

So, after analysing all these facts, and summing up for answering the main question of this editorial “is it a surgical technique worth performing usually or should it be only used by experts in some specific cases?”, we may say that there are some cases where OPCAB has proved a real benefit, such as extensive aortic calcification or high risk patients, avoiding some adverse events like stroke, and reducing mortality [22]. Nevertheless, the lack of experience in this technique may lead to an important technical disadvantage: grafts could be fewer and worse. We think that this is a technique to be learnt and developed by specialized surgeons in order to use it for the mentioned cases, were it could provide a real benefit in perioperative and long-term results.

What offers no doubt is the fact that the main goal in coronary surgery is complete revascularization, and it should be done regardless the technique used, according to the surgeon’s criteria.

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