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## **An old off pump coronary artery bypass surgeon’s reflexions: a “retrospective”**

Gianni D Angelini MD, MCh, FRCS, FMed Sci

Bristol Heart Institute, University of Bristol, Bristol Royal Infirmary, Bristol,  
United Kingdom.

Address for correspondence: Professor Gianni D. Angelini, MD, MCh, FRCS, FMed Sci

Level 7, Queen’s Building,

Bristol Heart Institute, Bristol Royal Infirmary, Marlborough St, Bristol,

United Kingdom BS2 8HW (E-mail: [g.d.angelini@bristol.ac.uk](mailto:g.d.angelini@bristol.ac.uk)).

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## **Central message**

After practising OPCAB for 25 years I am reaching the twilight of my surgical career. From this perspective, I reflect on this experience and offer some insights which I hope will be of help to the surgical community, particularly to the young surgeons in training.

## **Introduction**

In 2010 at the height of the off pump coronary artery bypass (OPCAB) surgery controversy, I wrote an editorial for this journal with one of my trainees, the goal of which was critically to evaluate the status of the technique and its future direction (1). We concluded that OPCAB was a safe alternative to on pump coronary artery bypass (ONCAB) surgery and, with proper structured training and supervision and in the right environment, OPCAB was a technique *“for the many and not the few”*.

After practising OPCAB for 25 years I am reaching the twilight of my surgical career. From this perspective, I reflect on this experience and offer some insights which I hope will be of help to the surgical community, particularly to the young surgeons in training.

## **Early stage development**

With colleagues, my journey started in 1994, when the aim was to emulate our fellow general surgeons practising minimally invasive surgery. The goal was to revascularize the left anterior descending (LAD) coronary artery with the left internal mammary artery (LIMA) via a left anterior small thoracotomy (LAST) (2). By default, the restricted access led to the surgery been performed on the beating heart. Although I had practised endoscopic thoracic surgery during my training, I was not accustomed to working in a confined space, and this combined with the lack of dedicated instruments sometimes made the surgery impossible.

To increase the proportion of patients to whom LAST could be applied, the hybrid approach was devised with percutaneous coronary intervention (PCI) plus or minus stenting (2).

However, the *simultaneous* combination, which required using anticoagulation after stenting, was often followed by bleeding from the surgical site. Carrying out PCI *before surgery* did not allow the quality of the surgery to be checked. PCI a few days *after surgery* did not help in the event of a problem with the LIMA-LAD anastomosis. Furthermore, most health service providers charged for two separate procedures, with significant increase in costs.

We soon realised that to revascularize all the ischemic areas of the heart we had to go back to the experience of surgeons like Buffalo and Benetti in the late 1980s, i.e. beating heart coronary surgery via a median sternotomy (3). Ironically, this rejected the quest for a minimally invasive approach and, instead, prioritised the perceived benefits of avoiding the cardiopulmonary bypass (CPB).

In our institution, a dedicated group including anaesthetists, nurses and surgeons embarked on a structured program which resulted in an increase in OPCAB from 8% of CABG operations in 1997 to 72% in 2003 without any increase in procedural morbidity. In relation to the learning curve, after 100 OPCAB operations, performance was the same or better for the residents in training as for the senior consultant (GDA). For all surgeons, performance was the same or better for OPCAB than ONCAB grafting (4). However, together with many other centres during the early phase, we contributed to the main Achilles' heel of OPCAB, i.e. "*incomplete revascularization*". We were in denial, describing vessels we could not graft because of technical difficulty as being too small or not important. Furthermore, the worldwide excitement of doing pioneering work, and the belief that avoiding CPB was the key to all our problems, resulted in an uncritical and excessive use of the technique.

### **The evidence**

Early single-centre both retrospective and randomized clinical studies (RCT) from units who had adopted enthusiastically OPCAB reported no difference between OPCAB and ONCAB in the 30-day composite outcome of death or complications (reoperation, new mechanical support, cardiac arrest, coma, stroke, or renal failure), or at long term follow-up (5-7). These were followed by numerous randomized trials, meta-analyses and retrospective case series which failed to prove a clear superiority of one technique over the other in the short-term. However, in most of these studies there was a reduced incidence of early in hospital complications like atrial fibrillation, renal and respiratory failure and requirement for blood products among patients who had OPCAB compared to those who had ONCAB (5,6,8-12). Conversely, OPCAB patients generally received a lower average number of grafts resulting in a higher incidence of incomplete revascularization and need for repeat revascularization. This is likely to have impacted on long-term survival although contradictory results have been reported (7,11-15).

These findings led to the question: should OPCAB be performed by a dedicated team available in every institution like for mitral valve repair and major aortic surgery, or should it be part of routine clinical practise in the armamentarium of every surgeon?

### **OPCAB: for the many or the few?**

OPCAB is a technically demanding and more difficult technique to master than ONCAB. In my opinion (although this may sound controversial and immodest) it requires more than average surgical dexterity. In my career, I have seen trainees and senior surgeons struggling to perform a coronary anastomosis on CPB and on an arrested heart. OPCAB also requires a different state of mind, since the operator does not have the CPB machine to fall back on. A good OPCAB surgeon is one who knows when it is time to convert to ONCAB, giving plenty of warning to the perfusion team, and well before the haemodynamic status deteriorates and

the heart arrests. A similar decision should be taken with no shame when complete revascularization cannot be achieved with OPCAB. Unplanned conversion dramatically increases the risk of peri-operative complications hospital cost and mortality (16-17).

The role of experience is illustrated by the broad simple index of the rate of conversion. In the STS database the conversion rate over 196,000 patients was 5.5% of which 50% were elective (18). In the ROOBY trial (11) the rate of conversion was 12.5% (surgeons took part regardless of their experience and 55% of the procedures were performed by surgeons in training). Even in the CORONARY trial (10) in which surgeons were required to have performed 100 OPCAB procedures before been allowed to recruit, the conversion rate was 7.9%. In a post-hoc analysis of the ART trial including 1260 OPCAB and 1700 ONCAB patients, “sporadic” OPCAB surgeons (1-5 procedures) had a higher rate of conversion (12.9%) than “high volume” OPCAB surgeons, and a higher rate of operative mortality (4.8%) when compared to ONCAB despite a similar distribution of risk factors. OPCAB performed by 3 high-volume OPCAB surgeons (>60) showed very low conversion rate (1%) and the 5-year mortality of OPCAB performed by 95 “OPCAB only” surgeons (outside the trial) was comparable to ONCAB (19).

These observations highlight that one of the reasons for the conflicting results reported in the literature may arise simply because of comparing a well long term established technique, i.e. ONCAB (part of any trainee curriculum and surgeon main practise) with a relatively new procedure, OPCAB, carried out by enthusiastic but insufficiently experienced or “*occasional*” surgeons.

Acquiring proficiency in OPCAB requires a learning curve and experienced trainers in a dedicated institution. Except for a few dedicated units which offer fellowship training to the best of my knowledge there are no national societies which have included OPCAB in the

training curriculum. The perception that success with the technique is limited to more proficient surgeons, and a fear of deleterious patient outcomes, especially during the learning curve is also deterring young surgeons to adopt the technique. This is particularly relevant in the United Kingdom where the results of cardiac surgery units and individual surgeons are published and made available to the public. Furthermore, the fear of name and shame and the potential of negative repercussions on private practice are also important considerations.

The controversy about routine use of OPCAB is not dissimilar from arterial revascularization in CABG; a technique embraced by a few dedicated surgeons, failed to be adopted into routine clinical practice. Is this as often advocated because of lack of clear evidence of superiority or simply because it is a technically demanding technique with all the same potential problems described above for OPCAB?

Currently, in the US and Europe OPCAB is used in roughly 20-25% of patients, whereas in India and Japan is the most common strategy. It has been suggested that in India uptake has been driven by economic considerations whereas in Japan it may be because surgeons have traditionally embraced the most advanced technique like total arterial coronary revascularization. A more hierarchic structure may also play a role in deciding what surgical strategy a unit will adopt, contrary to the United Kingdom where every senior surgeon is to a degree their own master.

## **Conclusion**

When performed by experienced surgeons in centres with the right infrastructure, OPCAB is a safe alternative to ONCAB regardless of the patients' risk profile, and it is associated with reduction of hospital early complications and similar long-term outcomes. OPCAB should always aim to achieve complete myocardial revascularization and be converted to ONCAB if for any technical reason this cannot be achieved. There is a body of evidence in the literature

linking poor outcome in OPCAB to surgeons' limited experience and low volume centres.

OPCAB is a challenging technique requiring a steep "learning curve". To master the learning curve a team approach is of paramount importance. This would be helped by the introduction of specialization in the training curriculum as is the case for mitral valve repair and major aortic surgery. Established recognised OPCAB units should be identified to provide training fellowships. Recognised OPCAB teams could then select trainees with the right dexterity and attitude to facilitate the uptake of OPCAB.

At present OPCAB surgery should be a specialized practise *for the few* with the potential to become *for the many* given the right commitment to training.

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#### Legend to Figure

#### Evolution in stabilization and positioning in 25 years of OPCAB surgery

- A) Stabilisation by means of tapes and snaring of the coronary artery
- B) Pressure stabilizer
- C) Pressure suction stabilizer and heart positioning device