Editorial comment

"Hybrid" myocardial revascularization: "The best of two worlds?" May be, but for a small number of selected patients

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In this issue of the *Italian Heart Journal*, Presbitero et al.[1] present their results with integrated ("hybrid") coronary revascularization of patients with multivessel coronary artery disease. This approach is believed to offer "the best of both worlds", minimally invasive direct coronary artery bypass (MIDCAB) surgery and percutaneous transluminal coronary angioplasty (PTCA), and to optimize acute and long-term clinical outcome. There are few doubts about the need to enhance safety, efficacy, and shortcomings of conventional bypass surgery: neurologic deficits from cardiopulmonary bypass[2,3] and invasive maneuvers on the aorta[4], and complications due to median sternotomy[5], graft harvesting techniques[6] and graft occlusion[7] leave substantial room for improvement. MIDCAB offers several benefits. It eliminates the extracorporeal circulation (off-pump intervention), avoiding the aforementioned deleterious effects, provides direct, albeit "minimal", access to the heart through tiny incisions in the left chest without the obvious trauma, pain and recovery time associated with sternotomy, and allows graft to be performed without additional incisions[8,9]. A practical weakness is that MIDCAB may be applicable only to patients with disease confined to the left anterior descending coronary artery (LAD). This limitation stimulated the appealing concept of "hybrid" coronary revascularization, which has attracted strong interest from innovators seeking to combine the superior clinical outcome of left internal mammary artery (LIMA)-to-LAD grafting with the least invasive nature of the percutaneous catheter-based approach to the other coronary vessels[10-12]. The aim is to minimize invasiveness and healthcare resource consumption while maximizing clinical results in multivessel disease patients, which represent the majority of surgical candidates. However, as minimally invasive approaches to cardiac surgery have expanded, a significant number of limitations have become apparent, particularly the lack of adequate accuracy in performing coronary anastomoses[13]. Despite the increasing use of stabilization techniques, early anastomotic failures, requiring reoperation or PTCA, have been reported[14,15]. In MIDCAB surgery, accurate suturing may be hampered by coronary target site motion and site view may be obscured by collateral blood flow. These difficulties are increased with extremely small, calcified and intramyocardial LAD vessels. It is noteworthy that this type of coronary anatomy is very often the reason favoring the surgical approach over PTCA. Moreover, mobilization of the full length of the LIMA graft may be technically demanding and the risk of its damage during harvesting is increased. Finally, MIDCAB has an extensive learning curve for which vulnerable patients may pay a high price. In their series, Presbitero et al. report a 12.2% in-hospital complication rate, with an early anastomotic failure of 7.7%. Their graft patency rate appears lower than that observed for LIMA-to-LAD anastomosis after conventional on-pump coronary artery bypass[16,17]. These results stress again the issue of arterial conduit compromise by the desire of minimized invasiveness and the need of good, randomized studies that compare minimally invasive surgery with the standard

operation. Interestingly, two of the described complications had some relationship with the angioplasty procedure: pericardial effusion and cardiac tamponade, eventually favored by anticoagulation and antiplatelet treatment, and atheroembolic syndrome due to catheterization. These observations raise another important and debated question: the temporal sequence of the two combined procedures[18,19]. The strategy in which PTCA is the first step may be troubled with the risk of bleeding due to adjunctive pharmacotherapy, such as ticlopidine, aspirin, and especially IIb/IIIa inhibitors[20]. Presbitero et al. state that their current approach is to perform MIDCAB followed by PTCA after 48-72 hours during the same hospital stay, suggesting that this strategy allows immediate protection of the LAD and assessment of the LIMA-to-LAD graft patency during the interventional procedure. However, also this approach is not without risks. MIDCAB surgery as first approach may create serious difficulties in case PTCA fails and emergency surgical revascularization is required. Moreover, it does not fully protect the patient from bleeding, particularly when IIb/IIIa inhibitors are used. Alternatively, MIDCAB can be followed by PTCA after few months, reducing the risk of bleeding but not that of ischemia of non-revascularized territories. The latest is the preferred strategy applied in those few patients undergoing "hybrid" revascularization at our Institute.

The strongest competitor of "hybrid" revascularization is off-pump coronary artery bypass, which offers the same benefits as MIDCAB, except that it is done through a midline incision (ministernotomy or full sternotomy)[21]. Avoiding cardiopulmonary bypass morbidity, this procedure achieves the same major goal as that of MIDCAB. In addition, it provides surgeons the ability to perform complete revascularization on a beating heart, since it allows greater visualization of and direct access to all three major coronary vessels and internal mammary arteries, along with other important advantages: freedom to lift and rotate the heart, careful management of unexpected circumstances and uncompromised selection of anastomosis sites. Safety and effectiveness of off-pump coronary artery bypass has been further increased by several advancements in techniques of cardiac elevation, coronary artery exposure, and mechanical epicardial stabilization[22]. Interestingly, these improvements represent the evolution of instrumentations and techniques used in MIDCAB procedures. In addition, new operative strategies that completely avoid aortic manipulation and instrumentation ("no-touch" techniques) may prevent dislodgment of atherosclerotic material and cerebrovascular embolization, reducing the risk of neurologic complications in patients with severe atherosclerotic disease of the ascending aorta[23].

Finally, we should not forget that these are rapidly changing times for catheter-based coronary interventions, which undoubtedly represent a less invasive approach than minimally invasive surgery. Success of angioplasty and stent implantation has reduced the number of surgical candidates (or at least delayed their first bypass operation). Moreover, the advent of vascular radiation therapy[24] and stent antiproliferative coatings[25] have the potential to further increase the number and improve the long-term outcome of multivessel coronary disease patients undergoing percutaneous revascularization.

In conclusion, although there is ample evidence that the overall bypass growth will be low (1 to 2.5% per year), I do believe there will be considerable increase in the number of "off-pump" surgical revascularizations performed on a beating heart through full or partial sternotomy. However, I doubt that "hybrid" revascularization will be the major way multivessel coronary artery disease will be treated in the future. In my view, it will continue to have a niche role for few selected patients.

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