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Successful use of the Impella Recover LP 5.0 device for circulatory support during off-pump coronary artery bypass grafting



Paolo Pepino^a, Germano Coronella^a, Piermario Oliviero^a, Mario Monaco^b,
Vincenzo Schiavone^a, Filippo Finizio^{c,d}, Giuseppe Biondi-Zoccai^e, Giacomo Frati^e,
Arturo Giordano^{d,*}

^a Unità Operativa di Cardiocirurgia, Presidio Ospedaliero Pineta Grande, Castel Volturno, Italy

^b Unità Operativa di Chirurgia Vascolare, Presidio Ospedaliero Pineta Grande, Castel Volturno, Italy

^c Unità Operativa di Cardiologia, Presidio Ospedaliero Pineta Grande, Castel Volturno, Italy

^d Unità Operativa di Interventistica Cardiovascolare, Presidio Ospedaliero Pineta Grande, Castel Volturno, Italy

^e Dipartimento di Scienze e Biotecnologie Medico-Chirurgiche, Sapienza Università di Roma, Latina, Italy

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ABSTRACT

INTRODUCTION: Surgical coronary revascularization is being performed with ever increasing frequency in patients at high surgical risk. Off-pump coronary artery bypass grafting (OPCABG) is particularly appealing in such subjects, but may limit the options for concomitant mechanical circulatory support.

PRESENTATION OF CASE: We hereby report an original case of mechanical circulatory support with the Impella Recover LP 5.0 device during OPCABG in a 61-year-old gentleman with multiple comorbidities and severe left ventricular systolic dysfunction. Specifically, the soft tipped device did not impede surgical manipulation of the heart during the surgical procedure, providing uninterrupted circulatory support to the patient.

DISCUSSION: This clinical vignette supports the feasibility, safety and efficacy of the Impella Recover LP 5.0 device in patients undergoing OPCABG.

CONCLUSION: Pending further studies, use of the Impella Recover LP 5.0 device can be envisioned safely for OPCABG.

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1. Introduction

Given the increased life expectancy of patients with coronary artery disease (CAD) and the aging population, cardiac surgery is being increasingly performed in older and sicker patients. Accordingly, means to reduce the risk of short-term complications are being actively sought. Off-pump coronary artery bypass grafting (OPCABG) is a typical paradigm, as it may reduce peri-procedural adverse events (e.g. stroke).

However, the fact that OPCABG is favored in high-risk patients poses a clinical conundrum, as often the very same patients who are ideal candidates for OPCABG may not tolerate cardiac surgery without additional mechanical circulatory support. Among the several mechanical circulatory support strategies currently available, the most effective ones are typically also more invasive than the least effective ones. In this scenario, the recently developed

Impella device (Abiomed, Danvers, MA, USA) might represent a favorable compromise between effective circulatory support and limited invasiveness.¹ However, the cardiac manipulations typically required during off-pump CABG have to date considered a major contraindication to the use of the Impella device in such operative setting, as they may conceivably lead to device malfunction, damage, valve dysfunction, or thrombosis.^{2,3} Accordingly, only minimal experience has been accrued so far on this indication for the Impella device.^{4,5}

We report a patient who successfully and safely underwent OPCABG with concomitant mechanical circulatory support accomplished by the Impella device.

2. Presentation of case

A 61-year-old gentleman was admitted to our institution for ischemic cardiomyopathy. Because of long-standing dyspnea and recent onset of angina for mild efforts, the patient had undergone echocardiography which showed severely depressed left ventricular ejection fraction (LVEF, 25%) and mild mitral regurgitation. Subsequent coronary angiography disclosed three-vessel CAD. Several comorbidities were present, including non-insulin-dependent

* Corresponding author at: Unità Operativa di Interventistica Cardiovascolare, Presidio Ospedaliero Pineta Grande, Strada Statale Domiziana Km 30, 81030 Castel Volturno, Italy. Tel.: +39 0823854381; fax: +39 0823854143.

E-mail address: arturogiordano@tin.it (A. Giordano).

diabetes mellitus, chronic obstructive pulmonary disease, renal failure, and hypothyroidism. Accordingly, a 10.5% in-hospital mortality risk was computed with the EuroSCORE II model.

After heart team consensus, OPCABG was chosen as revascularization strategy. In addition, we perused several of the typical possible alternatives for ancillary mechanical circulatory support, as the patient had required prolonged levosimendan therapy after coronary angiography and was not likely to face a successful operative outcome without circulatory support. While the intra-aortic balloon pump (IABP) is most commonly used for mechanical support in high-risk patients undergoing cardiac surgery, it is less likely to improve tissue perfusion in comparison to the Impella, which is well known for its superior mechanical support,⁶ especially when the Impella LP 5.0 version is used. Accordingly, we finally chose the Impella device. Despite the potential untoward effects on the device itself related to the manipulations required during off-pump surgery, we felt indeed that the soft-tipped device could provide continuous and interrupted support to the patient while not impeding the surgical procedure.

After preliminary lower limb duplex ultrasound to exclude peripheral artery disease, an Impella Recover LP 5.0 device was deployed via surgical cutdown of the right femoral artery and successfully deployed in the left ventricle, with anticoagulation obtained with weight adjusted doses of unfractionated heparin (aiming to an activated clotting time between 200 and 150s). Subsequently, OPCABG was performed preparing a left internal mammary artery (LIMA) graft to the left anterior descending, and a sequential radial artery jump graft from the LIMA graft to the first diagonal branch and the ramus intermedius, using the Octopus stabilizer and the Urchin retractor (Medtronic, Minneapolis, MN, USA). No bypass was prepared for the obtuse marginal branches and the distal right coronary artery as these vessels were too diseased and thus unsuitable for grafting. Ongoing peri-procedural monitoring was achieved with transesophageal echocardiography. The procedure could be performed safely and effectively, without any undue interference from the Impella device, which was subsequently left in place for an additional time of 24 h.

The patient fared well and was discharged home 9 days after admission. PredischARGE transthoracic echocardiography showed a mild improvement in LVEF (30%). One month later the patient was asymptomatic for dyspnea or angina, with satisfactory effort tolerance, and control echocardiography showed additional improvement in LVEF (40%).

3. Discussion

Several options are available for cardiac surgeons wishing to minimize the risk of peri-operative complications in patients undergoing cardiothoracic surgery. There is however a typical trade-off between the degree of invasiveness and the ability of any given approach or strategy to provide durable and effective results. In other words, minimally invasive surgical options typically offer slightly lower chances of long-term success than more invasive approaches.

Another important limitation of minimally invasive cardiac surgical procedures is that they limit the options for several ancillary tools and devices. OPCABG represents a paradigmatic example of minimally invasive cardiac surgery. It offers good long-term results and reduces the risk of short-term complications. Yet, the very same fact that OPCABG is typically reserved to higher risk patients means that this procedure may often be considered in patients also concomitantly requiring mechanical circulatory support.

Mechanical circulatory support for patients undergoing OPCABG may be provided by different means, but of course approaches requiring substantially invasiveness appear counterintuitive in

combination with the logic of reduced invasiveness inherent in the choice of OPCABG. Accordingly, use of the Impella device in this specific setting could be particularly appealing.^{4,5} This device provides substantial circulatory support up to 5.0 L/min while requiring only the vascular insertion of a 21 French sheath. Despite its remarkable hemodynamic performance and suitability for short as well as mid-term usage, there has been so far no extensive experience with use of the Impella device in patients undergoing OPCABG. Given our favorable experience to date with the Impella device for percutaneous coronary intervention and the fact that the device ends with a soft-tipped section, and two anecdotal reports from the literature,^{4,5} we hypothesized that it could be used safely and effectively even for OPCABG. The case hereby reported supports this hypothesis and warrants further exploration of the role and larger series of Impella use in the setting of OPCABG.

Despite the favorable outcome of this case, complications might have ensued and could occur with similar off-label use of the Impella device, including device malfunction, device damage, high purge pressure, valve dysfunction, device thrombosis, coronary, cerebral, visceral or peripheral embolization, ventricular perforation, bleeding, and vascular complications spanning from dissection to thrombosis or bleeding.³ In addition, we did not bypass the obtuse marginal branch or the posterior descending artery in this case, but we believe this could have still been feasible and safe using Impella. Accordingly, caution should be exercised when envisioning the use of this type of mechanical circulatory support, as well as a high index of suspicion to timely recognize and address potentially life-threatening complications.

4. Conclusion

Use of the Impella Recover LP 5.0 device for patients undergoing OPCABG is feasible and safe, and appears a promising strategy to improve short- and long-term outcomes of patients undergoing surgical coronary revascularization.

Conflict of interest statement

The authors report no conflict of interest pertinent to this work.

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None declared.

Ethical approval

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Drs. Pepino and Giordano designed the work and drafted the manuscript, while the other authors provided critical suggestions for data interpretation and manuscript improvement.

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