

# Left brachial artery: one more way to percutaneous insertion of IMPELLA 2.5L circulatory support for high-risk percutaneous coronary intervention – a case report

Paolo Sganzerla \*, Francesco Cinelli, Andrea Capoferri , and Mauro Rondi 

Division of Cardiology, Department of Medical Sciences, ASST Bergamo Ovest, Ospedale di Treviglio, Treviglio, Bergamo, Italy

Received 6 April 2020; first decision 5 May 2020; accepted 24 July 2020; online publish-ahead-of-print 21 October 2020

## Background

Percutaneous circulatory support allows the performance of coronary interventions in ever more complex anatomic and clinical situations. The large-bore systems currently available need a suitable vascular calibre to be inserted restricting percutaneous access mainly to the common femoral artery.

## Case summary

We present the case of a 64-year-old man, admitted with an acute coronary syndrome and congestive heart failure, due to triple-vessel coronary artery disease with left main involvement and left ventricular dysfunction. He was successfully treated with percutaneous coronary intervention (PCI) supported through an IMPELLA 2.5L circulatory system. Concomitant severe and diffuse peripheral vascular disease did not allow femoral insertion of the circulatory support which was therefore successfully introduced through a left brachial percutaneous approach.

## Discussion

To the best of our knowledge, this is the first report of a brachial, percutaneous placement of the IMPELLA 2.5L system to support a high-risk PCI procedure. In appropriately selected patients, this approach could be an option when common vascular accesses are not available.

## Keywords

Brachial access • Mechanical circulatory support • Impella • Complex high-risk PCI • Case report

## Learning points

- Mechanical circulatory support systems are still needing vessels of adequate calibre to be inserted.
- Femoral arteries are usually the main entrance port in the arterial tree.
- In selected, adequate body habitus patient, brachial arteries can serve as an alternative point of access.

## Introduction

Percutaneous circulatory support allows the performance of coronary interventions with balloons and stents in ever more complex anatomic and clinical situations such as left main stem coronary artery

stenosis or extensive coronary atherosclerotic involvement with or without left ventricular dysfunction. These anatomical settings are frequently concomitant with obstructive vascular disease in other areas, particularly the lower extremities. This is a potentially limiting factor for the introductions of the large-bore catheters necessary

\* Corresponding author. Tel: +393356810028, Email: [psganzerla@alice.it](mailto:psganzerla@alice.it)

Handling Editor: Kyriakos Dimitriadis

Peer-reviewers: John Kanakakis and Panagiotis Xaplanteris

Compliance Editor: Carlos Minguito Carazo

© The Author(s) 2020. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact [journals.permissions@oup.com](mailto:journals.permissions@oup.com)

to perform circulatory support. In the case of severe stenosis or occlusion of the femoral arteries, the use of the axillary artery has been described, either via a surgical cut down or through a percutaneous approach for the IMPELLA 5L or 2.5L devices placement, respectively.<sup>1,2</sup> Although the axillary arteries are slightly smaller than the corresponding ilio-femoral vessels, they are less frequently diseased and have a mean diameter (6.0 mm)<sup>3</sup> that may tolerate a nearly 18 French outer-diameter catheter introduction and navigation. However, the axillary percutaneous approach needs quite complex manoeuvres to obtain the correct haemostasis at the moment of circulatory support devices withdrawal.<sup>4</sup>

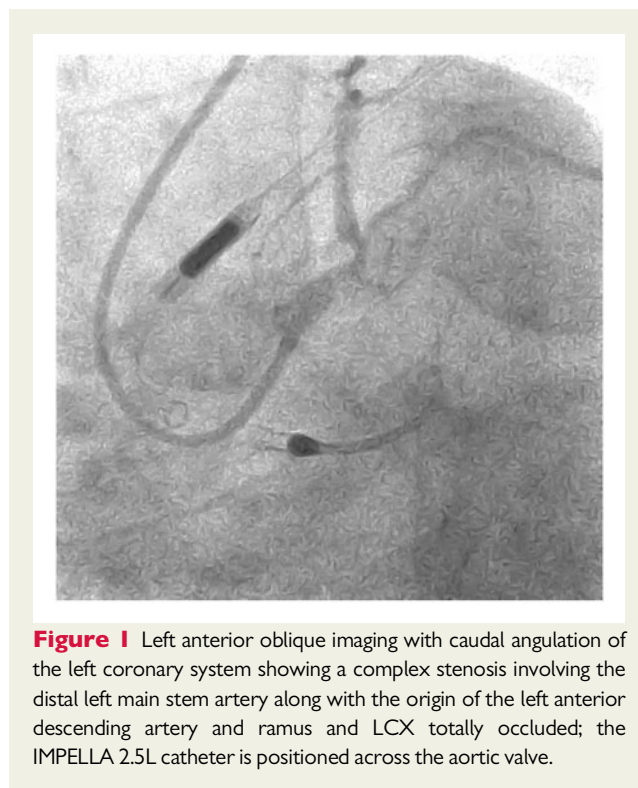
We describe the use of the left brachial arterial percutaneous approach for positioning an IMPELLA 2.5L support in a left main stem coronary artery stenting procedure.

## Timeline

Time	Events
2001	Acute inferior ST-elevation myocardial infarction ; no coronary angiography; residual (echo) left ventricular ejection fraction (LVEF): 50%
2013–14	Repeated, percutaneous ilio-femoral bilateral stenting because of intermittent claudication
Day 1	Hospital admission due to unstable angina and heart failure
Days 1–3	Heart failure treatment with IV diuretics and nitroglycerine
Day 3	Cardiac catheterization: three-vessel coronary artery disease with left main stenosis and left ventricular dysfunction
Days 4–6	Heart and vascular teams consultations; patient and relatives counselling; IV hydration for acute kidney injury prophylaxis
Day 7	PCI with mechanical circulatory support: rotational atherectomy of left main and ramus with multiple stenting
Day 8	Doppler ultrasound evidence of left brachial pseudo-aneurism with no sign of distal limb ischaemia
Day 9	5 mm diameter, self-expanding covered stenting of the left brachial artery with complete pseudo-aneurism exclusion
3 months after discharge	New York Heart Association functional Class I, neither angina nor symptoms or sign of upper limb ischaemia; LVEF: 48%

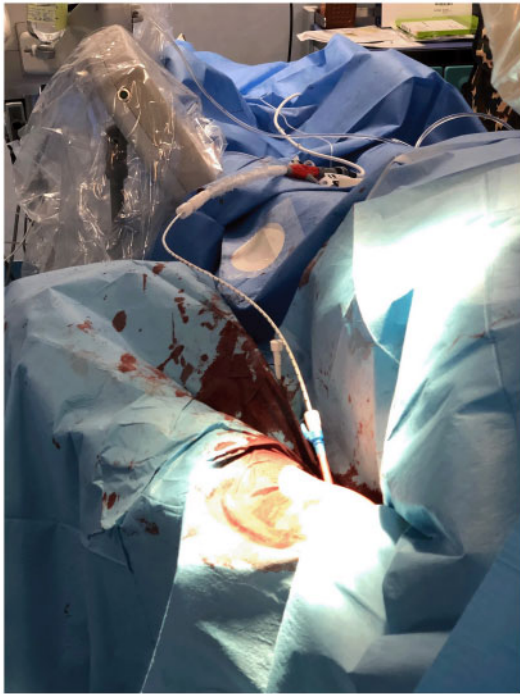
## Case presentation

A 64-year-old obese male [weight 138 kg, height 180 cm, body mass index (BMI) 43] was admitted with unstable angina and congestive heart failure; blood pressure was normal and bilateral pulmonary



**Figure 1** Left anterior oblique imaging with caudal angulation of the left coronary system showing a complex stenosis involving the distal left main stem artery along with the origin of the left anterior descending artery and ramus and LCX totally occluded; the IMPELLA 2.5L catheter is positioned across the aortic valve.

rales, increased jugular venous pressure, and pretibial oedema were detectable; electrocardiogram (ECG) showed sinus tachycardia with complete left bundle branch block; high sensitivity TnT was 135 mg/L [upper levels normal (ULN) <50 mg/L], with normal CK-Mb and total CK values. He was on treatment with aspirin, rosuvastatin, Lisinopril + HCTZ, lacidipine, metformin, and insulin. In 2001, he suffered from an inferior-wall acute myocardial infarction, and in 2013 and 2014 had several percutaneous revascularization procedures to his iliac and femoral arteries because of bilateral claudication. Comorbidities were type 2 diabetes mellitus (on insulin), Stage IV chronic kidney disease and obstructive sleep-apnoea syndrome. Coronary angiography via left radial approach revealed severe three-vessel coronary artery disease with critical involvement of the left main stem (*Figure 1*), total occlusion of right and circumflex arteries (*Supplementary material online, Videos S1A,B*) (Syntax I score: 54.5) and the left ventricular angiogram showed an ejection fraction of 42% with global hypokinesis. An echocardiographic evaluation detected also moderate, post-ischaemic mitral regurgitation and estimated pulmonary artery systolic hypertension (48 mmHg). As per our institutional policy in patients with multi-vascular involvement, particularly in those with chronic kidney disease, a selective angiography of the iliac-femoral axes was performed (at least 50% contrast medium sparing vs. angio computed tomography scan) during diagnostic cardiac catheterization; it showed a 100% ostial left common iliac (CI) artery and a 99% right CI and femoral arteries stenosis (*Supplementary material online, Figure S1*) due to under expansion of previously implanted stents in severely calcified vessels. Cardiac surgery consultation concluded that the patient was too high risk for surgical revascularization (Euroscore II: 14.52%). Therefore, left main stenting with provisional rotational atherectomy was planned. Due to a 'last remaining vessel' situation with depression of left ventricular function, circulatory support with



**Figure 2** Percutaneous introduction of the circulatory support at the brachial level; sheath *in situ*.

IMPELLA 2.5L was judged necessary. Surgical axillary access for the circulatory support device was not recommended by the vascular surgeon in consultation with the anaesthesiologist. Furthermore, percutaneous access was deemed too complex due to the body habitus of the patient, in particular regarding end-procedural haemostasis. Because an angiographic evaluation showed a 5.5 mm diameter left brachial artery with no atherosclerotic disease (Supplementary material online, Figure S2), we decided to insert, percutaneously, an IMPELLA 2.5L in the left brachial artery (Figure 2). The circulatory support device was easily navigated in the upper limb arterial system and was placed across the aortic valve (Supplementary material online, Video S2); the introducer was peeled away in order to reduce vascular luminal obstruction and minimize potential limb ischaemic problems. There was no bleeding or oozing during the entire procedure. Unfractionated heparin bolus (10 000 IU) was administered and subsequent doses were given to maintain activated coagulation time (ACT)  $\geq$  250 s. Through a 7 Fr right radial approach, left main stenosis was pre-treated with rotational atherectomy (1.75 mm burr) (Boston Scientific Europe, Galway, Ireland) and multiple inflations of a 3.0 mm Flextome cutting balloon (Boston Scientific Europe, Galway, Ireland); an Ultimaster Tansei 4.0 mm  $\times$  18 mm stent (Terumo Europe NV, Leuven, Belgium) was deployed at 14 ATM from the left main to the proximal left anterior descending artery. In order to obtain the most complete percutaneous revascularization, two Ultimaster Tansei stents (3.0 mm  $\times$  24 mm and 3.0 mm  $\times$  8 mm) were deployed at 14 ATM in the ramus artery with a T-stenting technique. Proximal optimization treatment was obtained with inflation a NC Euphora 4.0 mm  $\times$  9 mm balloon (Medtronic Inc., Galway,



**Figure 3** Unsuccessful wiring of the IMPELLA catheter: the wire does not enter the inlet port correctly and takes an extravascular pathway.

Ireland) in the left main stem with the good angiographic result (Supplementary material online, Video S3) and no complications. The circulatory support duration was 105 min. The IMPELLA 2.5L catheter, which repositioning sheath does not have a wire access port, was then retracted out of the body at the left elbow level until the outlet port was exposed in order to insert a wire to the vessel and obtain a protected manual or a mechanical haemostasis, as described by Omran *et al.*<sup>5</sup> Unfortunately, the wiring was not successful because of the deviation of the wire at the inlet port (Figure 3) and haemostasis was obtained with prolonged manual compression. The day after the procedure, no ECG changes were registered, hs-TnT rose, from normal values, to 222 mg/L with no change in CK-Mb or total CK. A Doppler ultrasound scan of the brachial–radial axis, while documenting normal distal perfusion at the radial level, revealed a brachial pseudo-aneurysmatic dilatation. Through a 6 Fr radial sheath, a 5 mm diameter, self-expanding covered stent was placed in the brachial artery with complete exclusion of the pseudo-aneurysm (Supplementary material online, Videos S4 and S5). The patient slowly recovered with no cardiac and/or limb ischaemic problem and was discharged on pantoprazole, aspirin, ticagrelor, bisoprolol, rosuvastatin, furosemide, and insulin treatment.

At a 3 month follow-up, he was in functional New York Heart Association Class I, free from angina and from symptoms or sign of upper limb ischaemia; left ventricular ejection fraction was 48%. A lower limbs revascularization procedure has been scheduled in the next weeks.

## Discussion

The above case highlights the feasibility of left brachial artery access for the use of an IMPELLA 2.5L circulatory support device for high-

risk percutaneous coronary intervention (PCI) in patients in whom severe aorto-iliac disease precludes device insertion via the standard femoral artery approach. To the best of our knowledge, this is the first published report of the use of the brachial artery for the percutaneous insertion of an IMPELLA 2.5L device. In this case, the patient's body habitus may have even facilitated the brachial approach; it has been shown that, at least with regard to the axillary artery, BMI is correlated to the vascular lumen size and higher BMI values are associated with larger luminal diameters (0.02 mm per 1-unit increase in BMI).<sup>3</sup> A 5.5 mm minimum lumen diameter artery accepted percutaneous insertion of the 13 Fr IMPELLA 2.5L introducer sheath without any problem; the straight brachial-axillary-subclavian axis, no subclavian tortuosity and a smooth subclavian artery take-off angle from the ascending aorta allowed a straightforward navigation of the circulatory support device to the correct trans-valvular position. This was particularly important since tortuosity is a well-established risk factor for increased vascular and procedural complications.<sup>6</sup> Moreover, because the vessel calibre appears to be the most important factor in predicting vascular complications following large-bore catheter access,<sup>7</sup> the introducer was peeled away in order to reduce the mechanical obstruction of the vascular lumen. At the end of the procedure, this negatively influenced the closure of the 13 Fr arteriotomy hole given both that the artery was not 'pre-lassoed' with a suture-mediated closure device. Moreover, the IMPELLA 2.5L does not have a wire access port and rewiring through outlet-port exposition out of the skin is not easily performable and was unsuccessful in our case. Although the use of mechanical circulatory support has not been linked to clear, favourable clinical outcomes compared to intra-aortic balloon pump during high-risk PCI,<sup>8</sup> it trended toward a reduction in the incidence of major adverse events in patients with triple-vessel coronary artery disease and reduced left ventricular systolic function.<sup>9</sup> Moreover, an increase in bleeding and access site complications, such as the one we had to face, has been reported.<sup>10</sup> Routinely obtaining additional radial access on the ipsilateral side should be considered in order to proximally advance a haemostatic balloon or to allow placement of a covered stent, as later we did, should the haemostasis fail and/or injury occur to the artery. It should be considered that, in this case of high-risk PCI, the circulatory support was of limited duration. It is difficult to advocate prolonged support, such in case of cardiogenic shock, through such a percutaneous approach.

## Conclusion

When the luminal diameter is adequate, and no other vascular access is available, the brachial artery could be a suitable entry port for a large-bore circulatory support device such as IMPELLA 2.5L. The straightness of the upper limb arterial axis is particularly appropriate for simple navigation of the system. Due to the lack of a wire access port on the IMPELLA 2.5L, if it is not wise to leave in place the 13 Fr sheath during the entire procedure, pre-positioning of a suture-mediated closure device and an additional ipsilateral radial access may be advisable in order to promote efficient haemostasis and complete procedural success.

## Lead author biography



Paolo Sganzerla, MD, is Head of Medical Sciences Department and Cardiology Division, ASST Bergamo Ovest-Treviglio Hospital, in Treviglio, Italy. As interventional cardiologist, he is involved, since many years ago, in the percutaneous management of any type of arterial (coronary and peripheral) disease, of septal cardiac defects, in left atrial appendage occlusion and in valvular disease treatment, with a particular interest in intracardiac echography. When not at work, his main hobby is cycling.

## Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

## Acknowledgements

Dr Benjamin Gupta, MD, kindly assisted in revising the text. Mr Marco Meroni and Stefano Bombardieri created the figures and videos.

**Slide sets:** A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

**Consent:** The authors confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidelines.

**Conflict of interest:** none declared.

## References

- Sassard T, Scalabre A, Bonnefoy E, Sanchez I, Farhat F, Jegaden O. The right axillary artery approach for the Impella<sup>®</sup> recover LP 5.0 microaxial pump. *Ann Thorac Surg* 2008;**85**:1468–1470.
- Lotun K, Shetty R, Patel M, Arain S. Percutaneous left axillary artery approach for Impella 2.5 circulatory support for patients with severe aortoiliac arterial disease. *J Intervent Cardiol* 2012;**25**:210–213.
- Arnett DM, Lee JC, Harms MA, Kearney KE, Ramos M, Smith BM, et al. Caliber and fitness of the axillary artery as a conduit for largebore cardiovascular procedures. *Catheter Cardiovasc Interv* 2018; **91**:150–156.
- Mathur M, Hira RS, Smith BM, Lombardi WL, McCabe JM. Fully percutaneous technique for transaxillary implantation of the Impella<sup>®</sup> CP. *J Am Coll Cardiol Interv* 2016;**9**:1196–1198.
- Omran J, Reeves R. Techniques of Impella removal while preserving arterial access. *Cardiovasc Revasc Med* 2019;**20**:167–170.
- Dato I, Burzotta F, Trani C, Crea F, Ussia GP. Percutaneous management of vascular access in transfemoral transcatheter aortic valve implantation. *World J Cardiol* 2014;**6**:836–846.
- Genereux P, Webb JG, Svensson LG, Kodali SK, Satler LF, Fearon WF, et al.; PARTNER Trial Investigators. Vascular complications after transcatheter aortic valve replacement: insights from the PARTNER (Placement of Aortic Transcatheter Valve) trial. *J Am Coll Cardiol* 2012;**60**:1043–1052.

8. O'Neill WW, Kleiman NS, Moses J, Henriques JPS, Dixon S, Massaro J, et al. A prospective, randomized clinical trial of hemodynamic support with Impella 2.5 versus intra-aortic balloon pump in patients undergoing high-risk percutaneous coronary intervention the PROTECT II study. *Circulation* 2012;**126**:1717–1727.
9. Kovacic JC, Kini A, Banerjee S, Dangas G, Massaro J, Mehran R, et al. Patients with 3-vessel coronary artery disease and impaired ventricular function undergoing PCI with Impella 2.5 hemodynamic support have improved 90-day out-comes compared to intra-aortic balloon pump: a sub-study of the PROTECT II trial. *J Int Cardiol* 2015;**28**:32–40.
10. Schreiber T, Htun WW, Blank N, Telila T, Mercado N, Briasoulis A, et al. Real-world supported unprotected left main percutaneous coronary intervention with impella device; data from the USpella Registry. *Catheter Cardiovasc Interv* 2017;**90**:576–581.