Intra-Aortic Balloon Pump Placement in the Axillary Artery: Where are We?

Gustavo André Boeing Boros,[1] Claudia Yanet San Martin de Bernoche,[1] Pedro Felipe Gomes Nicz[1,2,3,4]
Instituto do Coração do Hospital das Clínicas da Universidade de São Paulo – InCor/HCFMUSP,[1] São Paulo, SP – Brazil
Hospital Sírio-Libanês,[2] São Paulo, SP – Brazil
Hospital de Clínicas da Universidade Federal do Paraná – HC/UFPR,[3] Curitiba, PR – Brazil
Instituto de Neurologia e Cardiologia de Curitiba – Hospital INC,[4] Curitiba, PR – Brazil

The prevalence of patients with heart failure (HF) in Brazil is high, with an increasing number of hospitalizations for advanced HF in tertiary care services. This suggests that patients' conditions are persistently more severe, with recurrent episodes of pulmonary congestion or low cardiac output requiring frequent hospitalization. Multidisciplinary clinical support and optimized medical therapy are fundamental in the treatment of these patients. However, in refractory cases, bridge or destination therapies such as circulatory or ventricular assist devices (VADs) and heart transplantation may be indicated.[1,2]

Patients with decompensated INTERMACS 2 or 1 HF may have an indication for mechanical circulatory support (MCS) during hospital stay. Devices currently available in Brazil include intra-aortic balloon pump (IABP), Impella CP, venoarterial extracorporeal membrane oxygenation, and Centrimag.[2] The IABP is the most used device in Brazil and worldwide due to easy access, cost-effectiveness, and simple implant procedure and management. Despite having a modest effect on cardiac output, the IABP has a significant impact on circulatory hemodynamics, is simpler to use, and has an equal or superior safety profile compared with more modern devices.[3-5]

Complete or partial patient immobilization is inherent in critical HF and in the use of MCS and thus may be required. The development of additional complications due to immobilization is a risk factor for worse in-hospital outcomes, and complications such as sarcopenia and cachexia are more frequent and often progressive.[6,7]

Aiming at reducing immobility and its consequences while still providing the necessary hemodynamic support, McBride et al. first described in 1989 a technique for surgical placement of an IABP through the axillary artery.[8] In the early 2000s, two case series were published. The first series described the outcomes of 13 patients over a 3-year period who had received IABP support for a mean duration of 37 days. Of these, 10 underwent a heart transplant.[9] The second series reported the outcomes of 4 patients with ischemic cardiomyopathy on the heart transplant waiting list. Support duration ranged from 12 to 70 days, and all patients underwent successful transplants.[10]

In 2012, a series of 18 patients surgically implanted with an axillary IABP between 2007 and 2010 was published. Median support duration was 19 days, and 72% of patients underwent a heart transplant. Three patients developed device-related complications, ie, IABP displacement, rupture, or kinking. These complications were not associated with worse outcomes. There were no vascular complications or stroke.[11]

The first series of patients treated with an axillary IABP using only percutaneous access was published in 2013. Fifty patients referred for heart transplantation or VAD evaluation received a left axillary IABP between 2007 and 2012. Mean support duration was 18 days, and 84% of patients underwent a heart transplant. Complications requiring intervention included one case of significant bleeding and two cases of left upper extremity ischemia. IABP repositioning was required in 44% of patients, whereas 20% of patients required IABP replacement due to malfunction. There were no IABP-related deaths, strokes, or infections.[12]

In 2020, the same group of researchers expanded on previous experience and published a series of 195 patients who had received an axillary IABP between 2007 and 2018. Patients were divided into two groups according to therapeutic success, which was defined as destination therapy. Success rate was 68%; 120 patients underwent a heart transplant, and 13 patients received a long-term VAD. Among the remaining 62 patients (31.8%), 16 (8%) died, 18 (9.2%) required support escalation, and 28 (14%) underwent IABP removal (22 due to complications and 6 due to contraindications to destination therapy). The 1-year survival rate was 87% for heart transplantation and 62% for VAD implantation. Median support duration was 19 days. IABP replacement or repositioning was common (37%), with a mean number of IABP exchanges per patient of 0.68. Left upper extremity ischemia occurred in 3.5% of patients, but no patient suffered limb loss. Stroke, mesenteric ischemia, and bacteremia rates were 2.5%, 3%, and 9.2%, respectively. Among patients who developed bacteremia, 16.6% required IABP removal due to infection. Implant site-related bleeding occurred in 2.5% of patients, whereas 96 (49%) patients required IABP repositioning at least once.[13]

More recently, another study described 38 patients treated percutaneously between 2017 and 2020. IABP failure or migration requiring replacement occurred in 21.4% of patients. There were no major complications, and 81.6% of patients

Keywords

Intra-Aortic Balloon Pumping; Heart Failure; Axillary Artery.

Mailing Address: Pedro Felipe Gomes Nicz •
Setor de Hemodinâmica e Cardiologia Intervencionista - Rua Dr. Enéas de Carvalho Aguiar, 44, Bloco 3. Postal Code 05403-900, Cerqueira César, São Paulo, SP – Brazil
E-mail: pedronicz@cardiol.br
Manuscript received April 14, 2022, revised manuscript April 14, 2022, accepted May 05, 2022

DOI: https://doi.org/10.36660/abchf.20220034

received the intended therapy.[14] Nishida et al. reported their experience with 241 patients implanted with an IABP, of whom 58.9% underwent axillary insertion. Ambulation was possible in 90% of patients, and 86.7% received the intended therapy.[15] Vascular complications occurred in 3% of patients who underwent percutaneous IABP placement, and one third of these patients required surgical treatment.[16]

Some Brazilian hospitals perform percutaneous IABP placement in the left upper extremity, but data on MCS implantation and advanced HF treatment are scarce (Figures 1 and 2). Knowledge is essential to better understand the risk factors involved in complications and unfavorable outcomes, as well as to precisely define the role of axillary IABP in the current setting of MCS. Although these approaches have not been directly compared, the positive impact on adequate physical therapy and motor rehabilitation favors IABP placement via the axillary artery compared with the femoral artery. By allowing ambulation and greater mobility, the processes of sarcopenia and cachexia are also likely to be attenuated.

According to the available data, percutaneous axillary IABP placement is a viable and safe alternative for the implantation of an IABP in patients who require long-term support. The data suggest that placement via the axillary artery requires careful attention for correct device positioning, with increased rates of IABP repositioning and exchange compared with the femoral artery. Prospective and randomized clinical trials involving multidisciplinary teams are needed to provide hemodynamic support and comprehensive care according to the demands and risk profile of each patient in this complex setting of advanced HF.

Author Contributions

Conception and design of the research and Critical revision of the manuscript for intellectual content: Boros GAB, Bernoche CYSM, Nicz PFG; Writing of the manuscript: Boros GAB, Nicz PFG.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

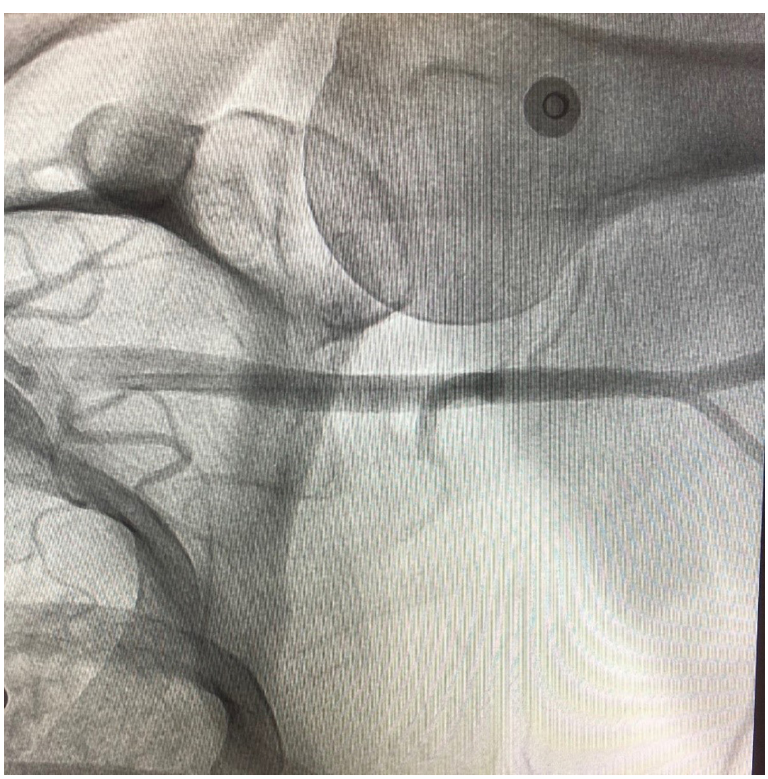

Figure 1 – *Arteriography performed with a 5F introducer to confirm puncture positioning.*

Figure 2 – *Final position of the intra-aortic balloon pump after percutaneous implantation.*

References

1. Marcondes-Braga FG, Moura LAZ, Issa VS, Vieira JL, Rohde LE, Simões MV, et al. Emerging Topics Update of the Brazilian Heart Failure Guideline - 2021. Arq Bras Cardiol. 2021;116(6):1174-212. doi: 10.36660/abc.20210367.

2. Rohde LEP, Montera MW, Bocchi EA, Clausell NO, Albuquerque DC, Rassi S, et al. Diretriz Brasileira de Insuficiência Cardíaca Crônica e Aguda. Arq Bras Cardiol. 2018;111(3):436-539. doi: 10.5935/abc.20180190.

3. Amione-Guerra J, Elizondo KJ, Cruz-Solbes AS, Kostick K, Loza L, Bhimaraj A, et al. Cost-Effectiveness Comparison of Intra Aortic Balloon Pump versus Left Ventricular Assist Devices as Bridge to Heart Transplant (BTT) Strategies. J Heart Lung Transplant. 2016;35(4):S272-3. doi: 10.1016/j.healun.2016.01.774.

4. Parissis H, Graham V, Lampridis S, Lau M, Hooks G, Mhandu PC. IABP: History-evolution-pathophysiology-indications: What we Need to Know. J Cardiothorac Surg. 2016;11(1):122. doi: 10.1186/s13019-016-0513-0.

5. White JM, Ruygrok PN. Intra-aortic Balloon Counterpulsation in Contemporary Practice - Where are We? Heart Lung Circ. 2015;24(4):335-41. doi: 10.1016/j.hlc.2014.12.003.

6. Akan B. Influence of Sarcopenia Focused on Critically Ill Patients. Acute Crit Care. 2021;36(1):15-21. doi: 10.4266/acc.2020.00745.

7. Tavares LCA, Lage SHG, Bocchi EA, Issa VS. Undernutrition and Cachexia in Patients with Decompensated Heart Failure and Chagas Cardiomyopathy: Occurrence and Association with Hospital Outcomes. Arq Bras Cardiol. 2022;118(1):3-11. doi: 10.36660/abc.20200644.

8. McBride LR, Miller LW, Naunheim KS, Pennington DG. Axillary Artery Insertion of an Intraaortic Balloon Pump. Ann Thorac Surg. 1989;48(6):874-5. doi: 10.1016/0003-4975(89)90694-2.

9. H'Doubler PB Jr, H'Doubler WZ, Bien RC, Jansen DA. A Novel Technique for Intraaortic Balloon Pump Placement via the Left Axillary Artery in Patients Awaiting Cardiac Transplantation. Cardiovasc Surg. 2000;8(6):463-5. doi: 10.1016/s0967-2109(00)00052-1.

10. Cochran RP, Starkey TD, Panos AL, Kunzelman KS. Ambulatory Intraaortic Balloon Pump Use as Bridge to Heart Transplant. Ann Thorac Surg. 2002;74(3):746-51. doi: 10.1016/s0003-4975(02)03808-0.

11. Umakanthan R, Hoff SJ, Solenkova N, Wigger MA, Keebler ME, Lenneman A, et al. Benefits of Ambulatory Axillary Intra-aortic Balloon Pump for Circulatory Support as Bridge to Heart Transplant. J Thorac Cardiovasc Surg. 2012;143(5):1193-7. doi: 10.1016/j.jtcvs.2012.02.009.

12. Estep JD, Cordero-Reyes AM, Bhimaraj A, Trachtenberg B, Khalil N, Loebe M, et al. Percutaneous Placement of an Intra-aortic Balloon Pump in the Left Axillary/subclavian Position Provides Safe, Ambulatory Long-term Support as Bridge to Heart Transplantation. JACC Heart Fail. 2013;1(5):382-8. doi: 10.1016/j.jchf.2013.06.002.

13. Bhimaraj A, Agrawal T, Duran A, Tamimi O, Amione-Guerra J, Trachtenberg B, et al. Percutaneous Left Axillary Artery Placement of Intra-Aortic Balloon Pump in Advanced Heart Failure Patients. JACC Heart Fail. 2020;8(4):313-23. doi: 10.1016/j.jchf.2020.01.011.

14. Rosenbaum AN, Jain CC, Shadrin IY, El Hajj SC, El Sabbagh A, Behfar A. Percutaneous Axillary Intra-aortic Balloon Pump Insertion Technique as Bridge to Advanced Heart Failure Therapy. ASAIO J. 2021;67(4):81-5. doi: 10.1097/MAT.0000000000001259.

15. Nishida H, Ota T, Onsager D, Grinstein J, Jeevanandam V, Song T. Ten-year, Single center Experience of Ambulatory Axillary Intra-aortic Balloon Pump Support for Heart Failure. J Cardiol. 2022;79(5):611-7. doi: 10.1016/j.jjcc.2021.11.010.

16. Nishida H, Song T, Onsager D, Nguyen A, Grinstein J, Chung B, et al. Significant Vascular Complications in Percutaneous Axillary Intra-aortic Balloon Pump. Ann Vasc Surg. 2022:S0890-5096(21)01052-9. doi: 10.1016/j.avsg.2021.12.078.