JACC: CASE REPORTS VOL. 26, 2023

CASE REPORT

INTERMEDIATE

CLINICAL CASE SERIES: TECHNICAL CORNER

Placement of Temporary Left Ventricular Assist Device Using Monitored Anesthesia Care and Regional Anesthesia

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ABSTRACT

Patients with advanced cardiogenic shock requiring mechanical circulatory support are uniquely susceptible to clinical deterioration. Limiting physiologic perturbations via avoidance of general anesthesia and endotracheal intubation by awake Impella 5.5 placement is safe and may represent a novel strategy in mechanical circulatory support initiation among patients in cardiogenic shock. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;26:102067)

The Impella 5.5 (Abiomed) is a continuous micro-axial left ventricular assist device (LVAD) that provides temporary ventricular support for the treatment of ongoing cardiogenic shock unresponsive to maximum medical management.[1,2] The device is surgically placed via a cutdown incision over the right axillary artery, although other insertion sites may be considered, and guided through the aortic valve and into the left ventricle with the guidance of both fluoroscopy and echocardiography.[1]

Patients in cardiogenic shock present unique challenges to members of both the surgical and the anesthesia teams during procedures.[3] General anesthetic induction and initiation of positive-pressure ventilation can lead to cardiovascular collapse necessitating high doses of vasoactive medications. Subsequently, patients typically require prolonged sedation and ventilation owing to hemodynamic instability, a well known risk factor for nosocomial infections and further deconditioning.[4,5]

LEARNING OBJECTIVES

- To recognize the safety and feasibility of awake placement of a temporary LVAD, such as the Impella 5.5, and to consider patient criteria to select those who might benefit from avoiding general anesthesia.
- Appreciate the location considerations of regional anesthesia necessary for successful temporary LVAD placement in the absence of general anesthesia.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received July 19, 2023; revised manuscript received September 14, 2023, accepted September 18, 2023.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2023.102067

ABBREVIATIONS AND ACRONYMS

CABG = coronary artery bypass graft

IABP = intra-aortic balloon pump

LVAD = left ventricular assist device

MAC = monitored anesthesia care

MCS = mechanical circulatory support

PECS = pectoral nerve

TTE = transthoracic echocardiography

We discuss 2 cases demonstrating the feasibility of awake placement of a temporary LVAD with the use of a combination of monitored anesthesia care (MAC) and regional anesthesia in patients with cardiogenic shock.

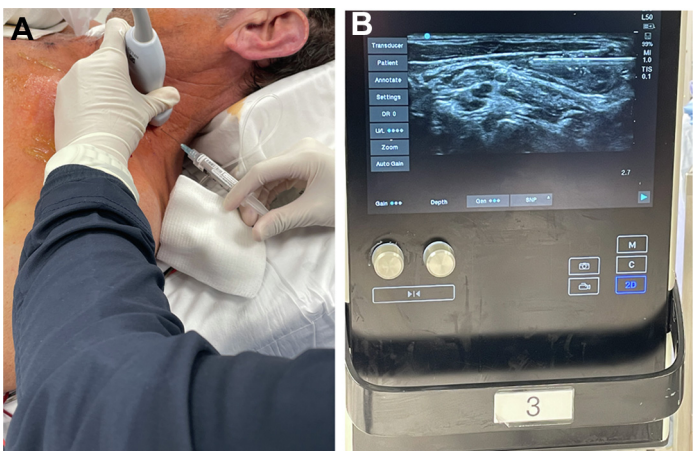
CASE 1

A 54-year-old man with ischemic cardiomyopathy and significant coronary artery disease (CAD) with multiple previous interventions, including coronary artery bypass graft (CABG) 11 years earlier, presented to an outside institution with dyspnea on exertion and evidence of volume overload. Four days after admission, he experienced acute-onset severe chest pain. An anterior ST-segment elevation myocardial infarction was identified. Urgent left heart catheterization revealed limited options for revascularization with 100% chronic total occlusion of mid-left anterior descending artery consistent with previous catheterization, 95% proximal right circumflex artery stenosis, and occluded venous grafts. An intra-aortic balloon pump (IABP) was placed, and he was immediately transferred to our institution for consideration of advanced mechanical circulatory support (MCS).

Right heart catheterization on arrival showed a pulmonary capillary wedge pressure of 35 mm Hg and cardiac index of 1.82 L/min/m^2 despite inotropic support, deemed as Society for Cardiovascular Angiography and Interventions (SCAI) class D. Transthoracic echocardiography (TTE) demonstrated a mildly dilated left ventricle with an ejection fraction (EF) of 34% and extensive regional wall motion abnormalities. Orthotopic heart transplant evaluation was initiated with temporary LVAD placement as bridge therapy. The patient's tenuous clinical status and his desire to avoid intubation made him a candidate for placement under MAC and regional anesthesia.

He was initially sedated with 0.5 μg/kg/h dexmedetomidine and 0.05 μg/kg/min remifentanil. Minimal phenylephrine was used for hemodynamic support. Regional anesthesia was performed with an ultrasound-guided right superficial cervical plexus block along the lateral neck (**Figure 1**) with the use of 5 mL 0.5% ropivacaine, a right interscalene block along the anterolateral neck (**Figure 2**) with the use of 5 mL of 0.5% ropivacaine, and a right pectoral nerve (PECS) II block along the lateral chest (**Figure 3**) using a total of 25 mL 0.5% ropivacaine (15 mL between the pectorales major and minor, and 10 mL below the pectoralis minor). After confirmation of adequate anesthetic plane, an incision and cutdown were performed over the right axillary artery. A 10-mm graft was sewn to the axillary artery and temporary LVAD inserted in standard fashion under fluoroscopy and sterile surface TTE guidance. Therapy was initiated at P8 with improved hemodynamics and the IABP was removed in the operating room. The device remained in place until postoperative day 19 when the patient received an orthotopic heart transplant without any interval complications and complete avoidance of mechanical ventilation before transplantation. He had an uncomplicated post-transplantation course and was discharged on postoperative day 29.

FIGURE 1 Anatomic Landmarks for Ultrasound-Guided Cervical Plexus Block



(A) Ultrasound placement and (B) ultrasound image demonstrating the anatomic landmarks for cervical plexus block in the lateral neck between the posterior sternocleidomastoid and levator scapuli muscles.

CASE 2

A 58-year-old man with severe peripheral vascular disease and previous iliofemoral stenting was admitted to an outside hospital with complaints of worsening dyspnea on exertion. Left heart catheterization revealed 3-vessel coronary artery disease, and TTE showed significant left ventricular dilation with an ejection fraction of 18% and a dilated right ventricle with moderate dysfunction. He was taken to the operating room at that outside facility, where a 4-vessel CABG was performed with post-bypass right axillary temporary LVAD bridge to recovery. His course was complicated by postoperative hemorrhage requiring washout and right axillary/radial artery thrombosis with threatened right upper extremity

necessitating thrombectomy and device removal on postoperative day 4. He was maintained on epinephrine and milrinone for inotropic support, with significant peripheral vascular disease precluding femoral MCS. Worsening shock and clinical deterioration prompted transfer to our facility for further management.

Advanced progressive cardiogenic shock (SCAI class D) with a worsening lactic acidosis and liver function tests despite maximal inotropy was evident on arrival. Temporary femoral MCS was not feasible, owing to occluded left femoral artery and right common femoral stenting. The degree of shock was considered to be so advanced that general anesthesia for MCS would culminate in cardiovascular collapse and arrest. Therefore, awake axillary temporary LVAD placement was pursued.

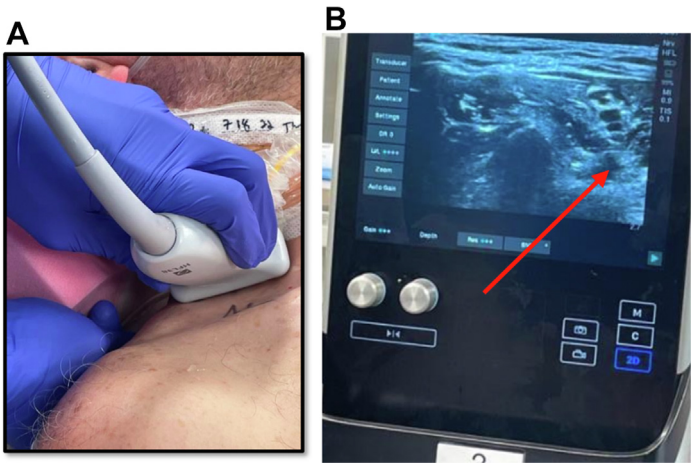
Dexmedetomidine (0.5 μg/kg per hour) and remifentanil (0.04 μg/mg per minute) were initiated for sedation. A left PECS I block was performed (**Figure 3**) with 20 mL 0.5% ropivacaine followed by a left cervical plexus block (**Figure 1**) with 10 mL ropivacaine. An interscalene block of the brachial plexus was avoided owing to a large left pleural effusion and risk of hemidiaphragmatic paralysis. An incision and cutdown were performed over the left axillary artery. A 10-mm graft was sewn and temporary LVAD inserted in standard fashion under fluoroscopy and sterile surface TTE guidance and initiated at P6 with improved hemodynamics. His end-organ perfusion improved, and he avoided general anesthesia until he received a destination Heartmate 3 LVAD on postoperative day 18, and he was discharged home on postoperative day 60.

DISCUSSION

Significant morbidity and mortality risks accompany a diagnosis of cardiogenic shock, with estimates of in-hospital mortality ranging from 27% to 51% despite significant advances in clinical care.[6] The Impella 5.5 represents an advancement in minimally invasive LVAD therapy, providing up to 5.5 L/min transaortic flow, while preserving the potential of patient mobility and limiting risk of infection.[7] However, previous reports of temporary LVAD therapy describe the need for general anesthesia for surgical placement, with ventilation times often exceeding 5 days,[7] leading to increased risk of nosocomial infections and patient deconditioning.

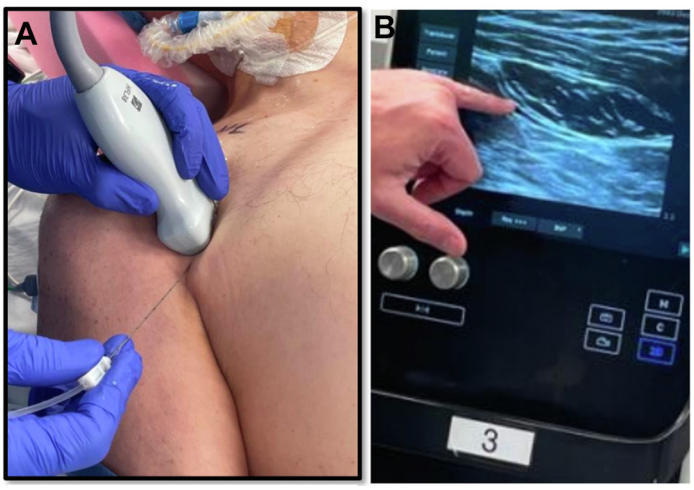
The cases presented here demonstrate that peripheral nerve blocks that cover the anterolateral chest wall and shoulder in combination with MAC can facilitate surgical temporary LVAD placement. Awake temporary LVAD placement can avoid the deleterious effects of general anesthesia, endotracheal intubation, and positive-pressure ventilation in a patient population at significantly increased risk for acute

FIGURE 2 Anatomic Landmarks for Ultrasound-Guided Interscalene Block



(A) Ultrasound placement and (B) ultrasound image demonstrating the anatomic landmarks for interscalene block of the brachial plexus between the anterior and middle scalene muscles (red arrow pointing to brachial plexus).

FIGURE 3 Anatomic Landmarks for Ultrasound-Guided Pectoral Nerve I or II Block



(A) Ultrasound and needle placement and (B) ultrasound image of the anatomic landmarks for a pectoral nerve I block that injects local anesthetic between the pectoralis major and pectoralis minor muscles, and a pectoral nerve II block that includes a pectoral nerve I in addition to between the pectoralis minor and serratus anterior muscles.

clinical deterioration. Furthermore, advanced peripheral vascular disease, similar to case 2 above, can limit other platforms for emergency temporary MCS, such as extracorporeal membrane oxygenation. In such cases, awake temporary LVAD placement as described may represent a significant change in the treatment options for patients in cardiogenic shock requiring MCS, especially among patients most vulnerable to clinical decline.

We have described 2 successful cases of temporary LVAD placement under a combination MAC and regional anesthesia, demonstrating the feasibility and safety of this novel strategy.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr DePaolo is supported by the American Heart Association (23POST1011251). Dr Spelde is funded by the National Institutes of Health (T32GM112596). Dr Usman is funded by the National Institutes of Health (T32GM112596, HL159698). Dr Cevasco consults for Abiomed. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS cardiogenic shock, Impella 5.5, mechanical circulatory support, monitored anesthesia care, regional anesthesia, temporary LVAD