Temporary Mechanical Circulatory Support in Cardiogenic Shock

2024 State of the Heart

2nd Annual Heart and Vascular Symposium

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Disclosures

- **Consultant, Abbott Laboratories, Inc**

Objectives

Overview of temporary MCS in support of cardiogenic shock, with discussion of technique and management, including:

- Axillary IABP
- Peripheral RVAD/LVAD/Bi-VAD
- ECMO, including ambulatory strategies and LV unloading

Axillary IABP

Axillary IABP

CASE REPORT

The Axillary Intra-Aortic Balloon Pump as a Bridge to Recovery Allows Early Ambulation in Long-Term Use

Case Series and Literature Review

Innovations (Phila). 2017 Nov/Dec;12(6):472-478.

EVOLVING TECHNOLOGY/BASIC SCIENCE

Intra-aortic balloon pump inserted through the subclavian artery: A minimally invasive approach to mechanical support in the ambulatory end-stage heart failure patient

J Thorac Cardiovasc Surg. 2012 Oct;144(4):951-5

Benefits of ambulatory axillary intra-aortic balloon pump for circulatory support as bridge to heart transplant

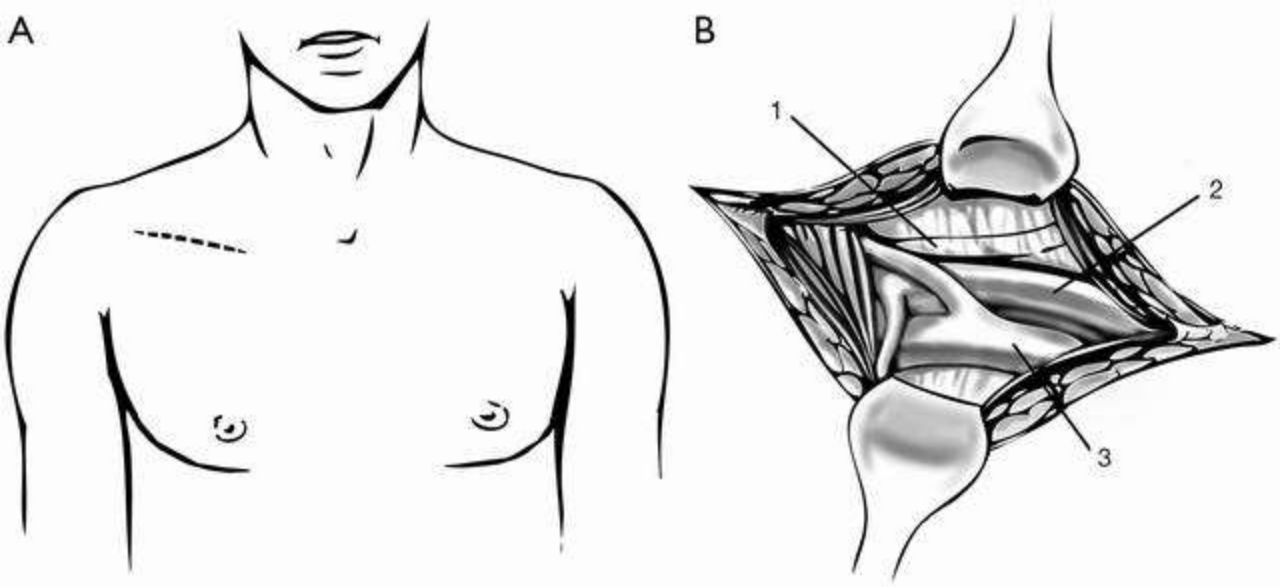
J Thorac Cardiovasc Surg. 2012 May;143(5):1193-7

Axillary IABP

- Allows sitting upright, early ambulation and aggressive physical therapy
- Improved pulmonary status
- Lower infection rate compared to femoral IABP
- Support duration reported as high as 152 days
- Relatively low cost

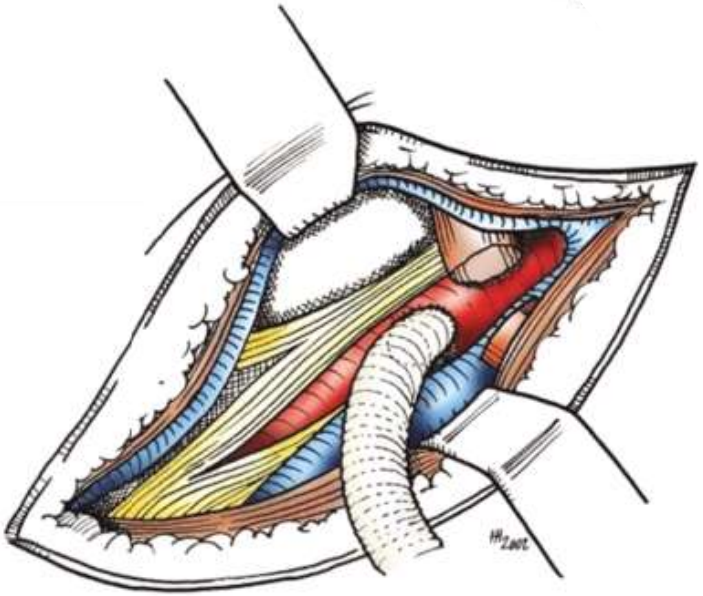
- Malfunction/malpositioning requiring cath lab or operation room
- May not be suitable in emergent setting due to time for cutdown and graft anastomosis
- Increased ICU length of stay

Axillary IABP - Technique



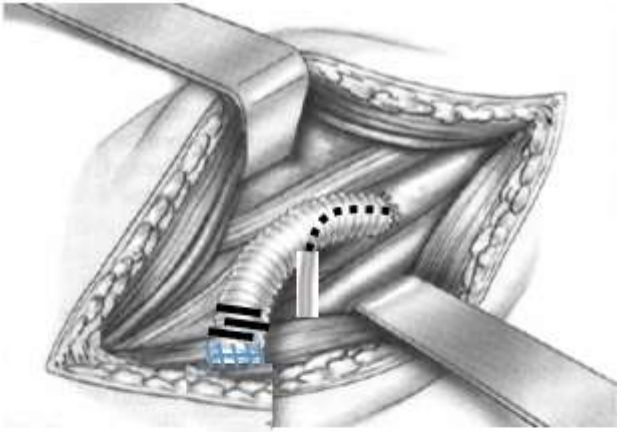
- ~ 4cm cm incision is made 1-2 finger breadths below the lateral 2/3rds of the right clavicle
- Enter the deltopectoral groove and the divide the clavipectoral fascia (avoid dividing the pec major [less pectoral atrophy])
- Partial division of the pectoralis minor

Axillary IABP - Technique

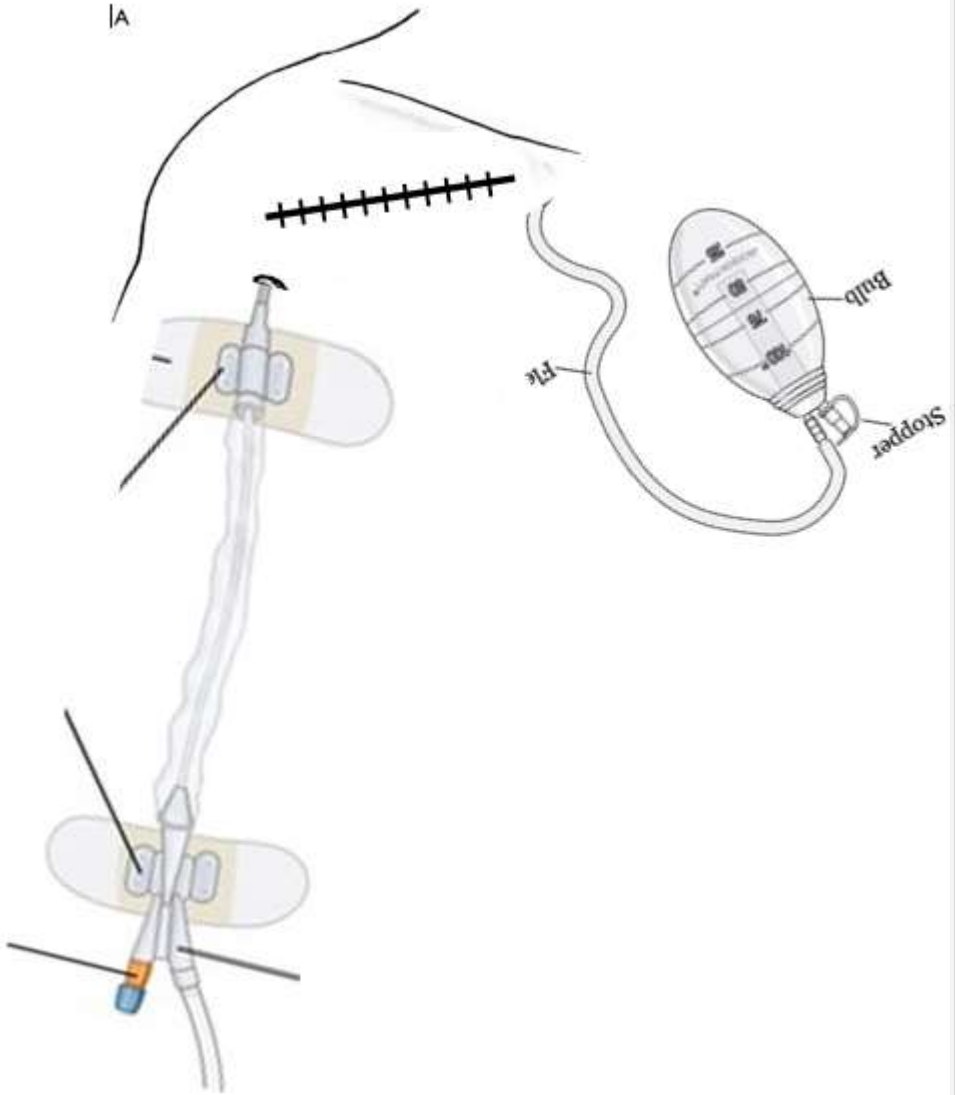


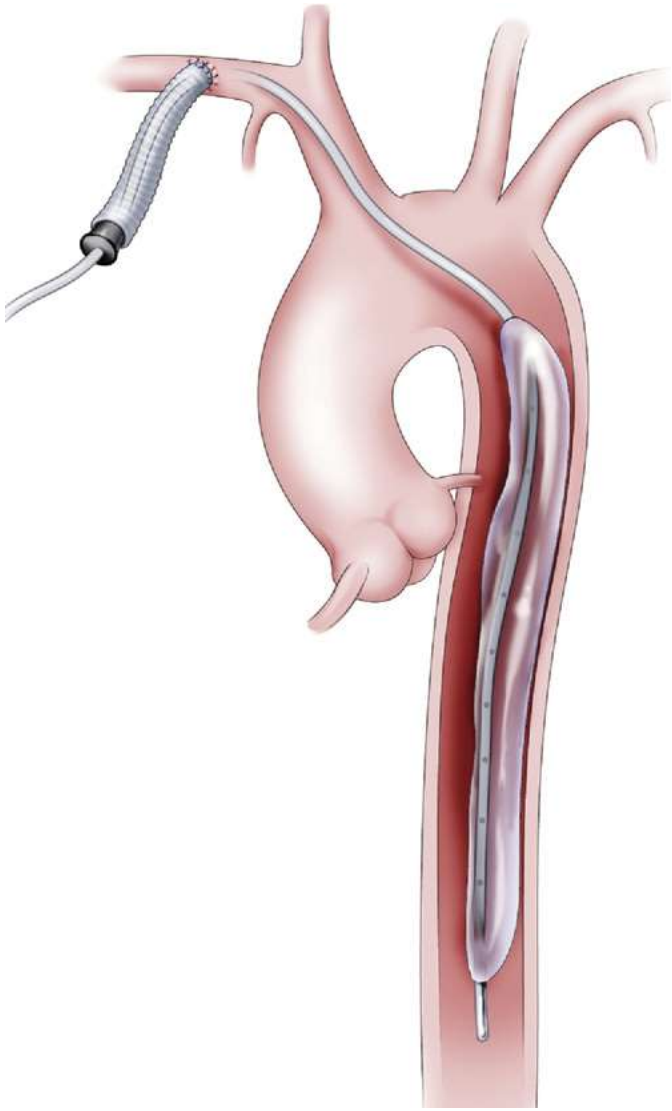
- Administer IV heparin (usualy 5,000 – 8,000 units)
- Clamp the artery and anastomose a 6mm Dacron end-to-side with 5-0 proproplyene suture

Axillary IABP - Technique



Axillary IABP - Technique





Axillary IABP - Management

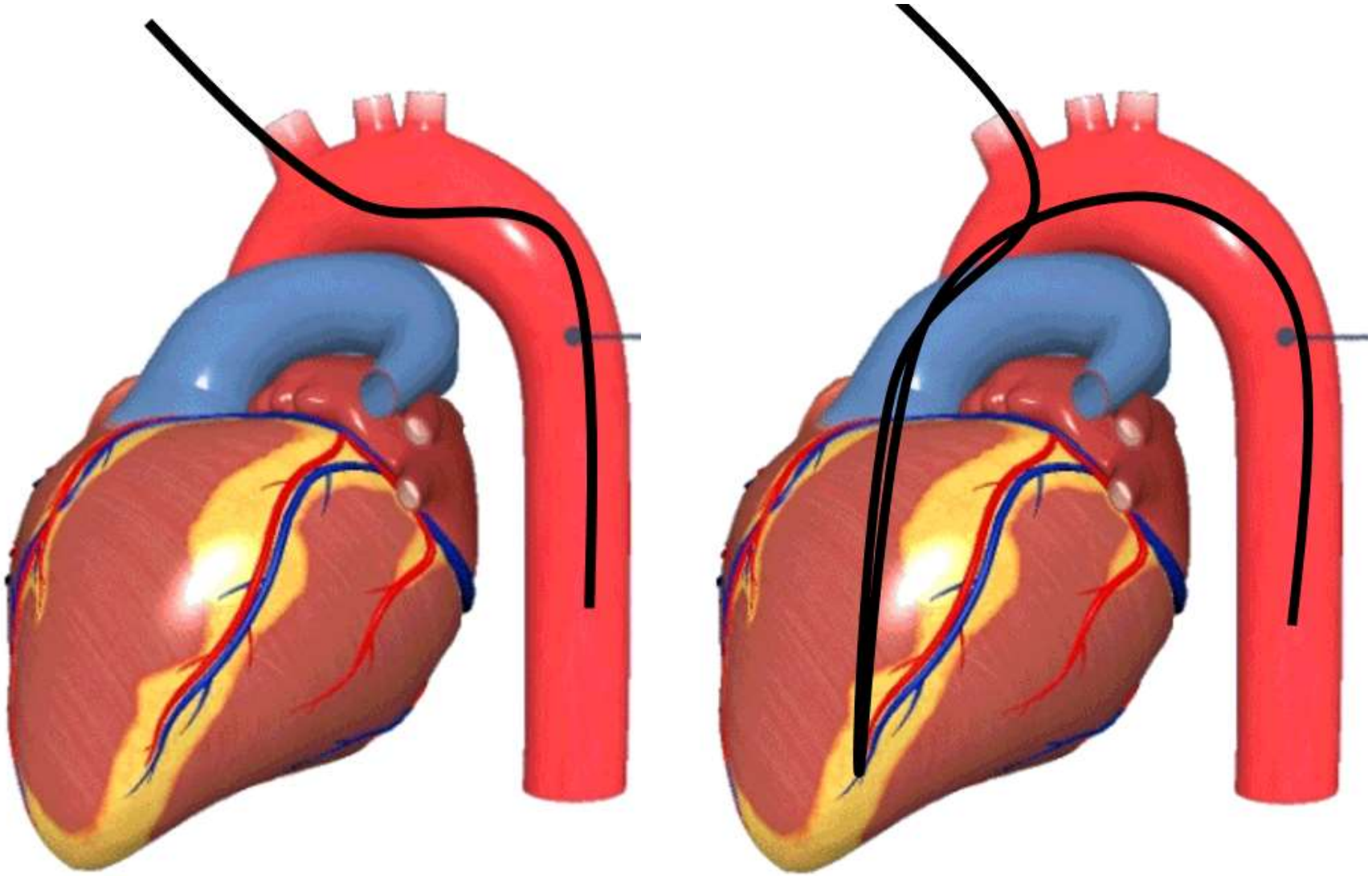
CLINICAL IMAGES

Migration of Intraaortic Balloon Pump Placed Via the Axillary Artery

Yaron D. Barac, MD, PhD[1]; Hazim Alwair, MD[1]; David F. Kong, MD, AM, DMT[2]; Chetan B. Patel, MD[2]; Mani A. Daneshmand, MD[1]; Carmelo A. Milano, MD[1]; Jacob N. Schroder, MD[1]

J INVASIVE CARDIOL 2018;30(1):E11.
KEY WORDS: cardiac imaging, intraaortic balloon pump, migration, PCI, complications

Axillary IABP - Management

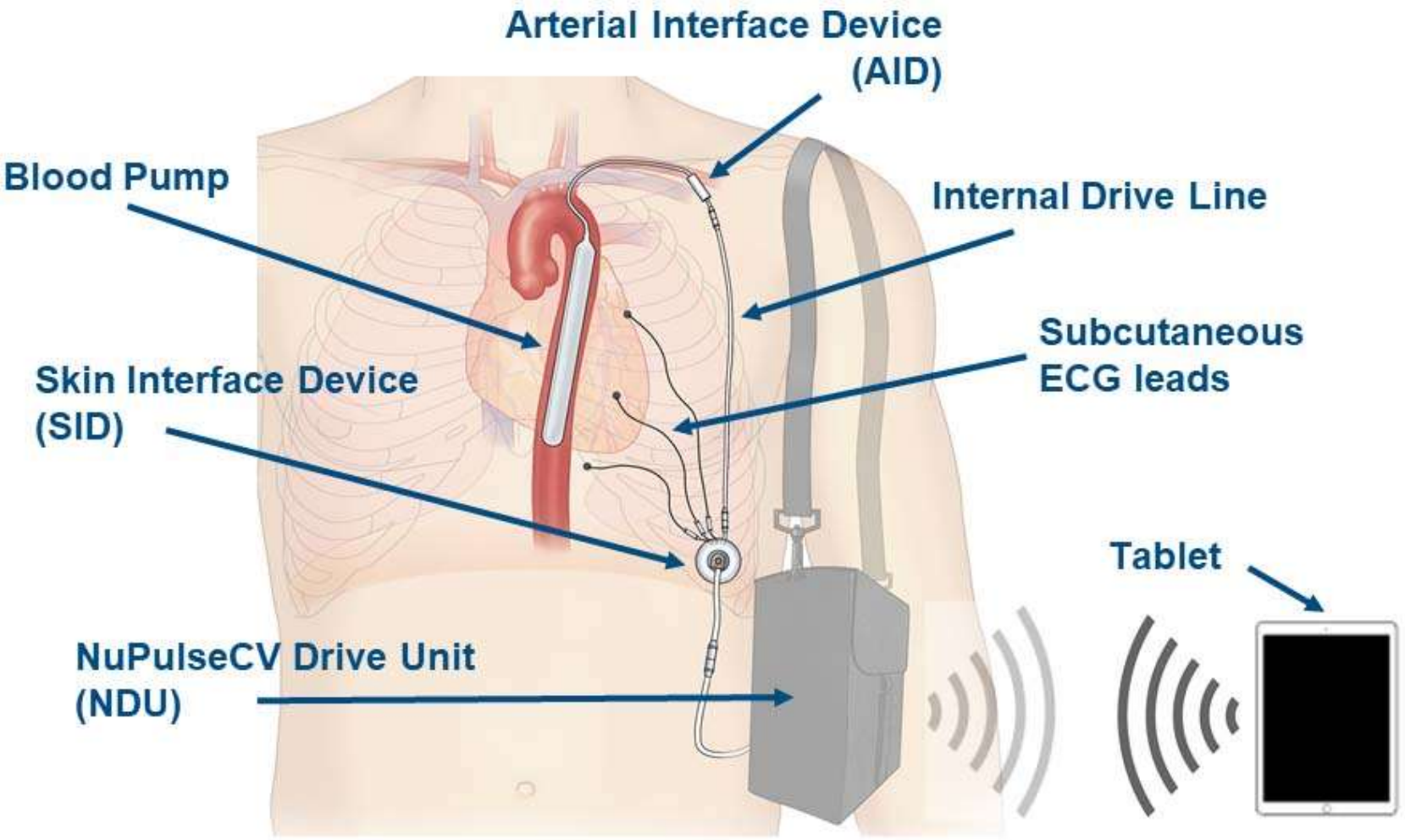


Axillary IABP - Management

Axillary IABP - Management

- Care must be taken to avoid having the tip of the balloon curve into an abdominal vessel and cause ischemia
- Augmentation waves will not look the same as when the pressure sensor tip was at the aortic arch because it will now sense the volume being pushed to the distal aorta rather than the proximal aorta
- Ax-IABP promotes ambulation, which increases the risk of balloon migration, so daily chest x-rays are recommended;
- The left axillary may be theoretically safer than the right SC to avoid potential neurological consequences of passing the right carotid at the innominate artery, but no significant differences in neurological events have been shown

Axillary IABP – iVAS/NuPulse



Peripheral/Percutaneous RVAD

Percutaneous RVAD

ASAIO Journal 2018 Brief Communication

Outcomes with the Tandem Protek Duo Dual-Lumen Percutaneous Right Ventricular Assist Device

ASAIO J. 2018 Jul/Aug;64(4):570-572.

Case Report

Current Status of Percutaneous Right Ventricular Assist Devices: First-In-Man Use of a Novel Dual Lumen Cannula

Catheter Cardiovasc Interv. 2016 Sep;88(3):390-6

Original Article

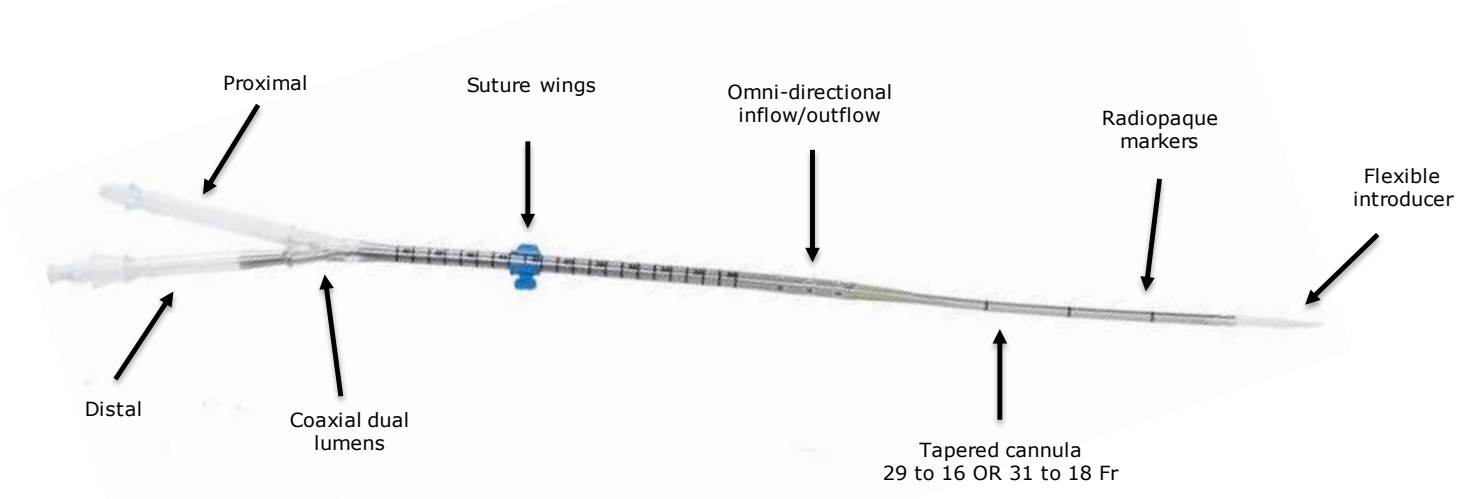
Results of concomitant groin-free percutaneous temporary RVAD support using a centrifugal pump with a double-lumen jugular venous cannula in LVAD patients

J Thorac Dis. 2019 Apr;11(Suppl 6):S913-S920.

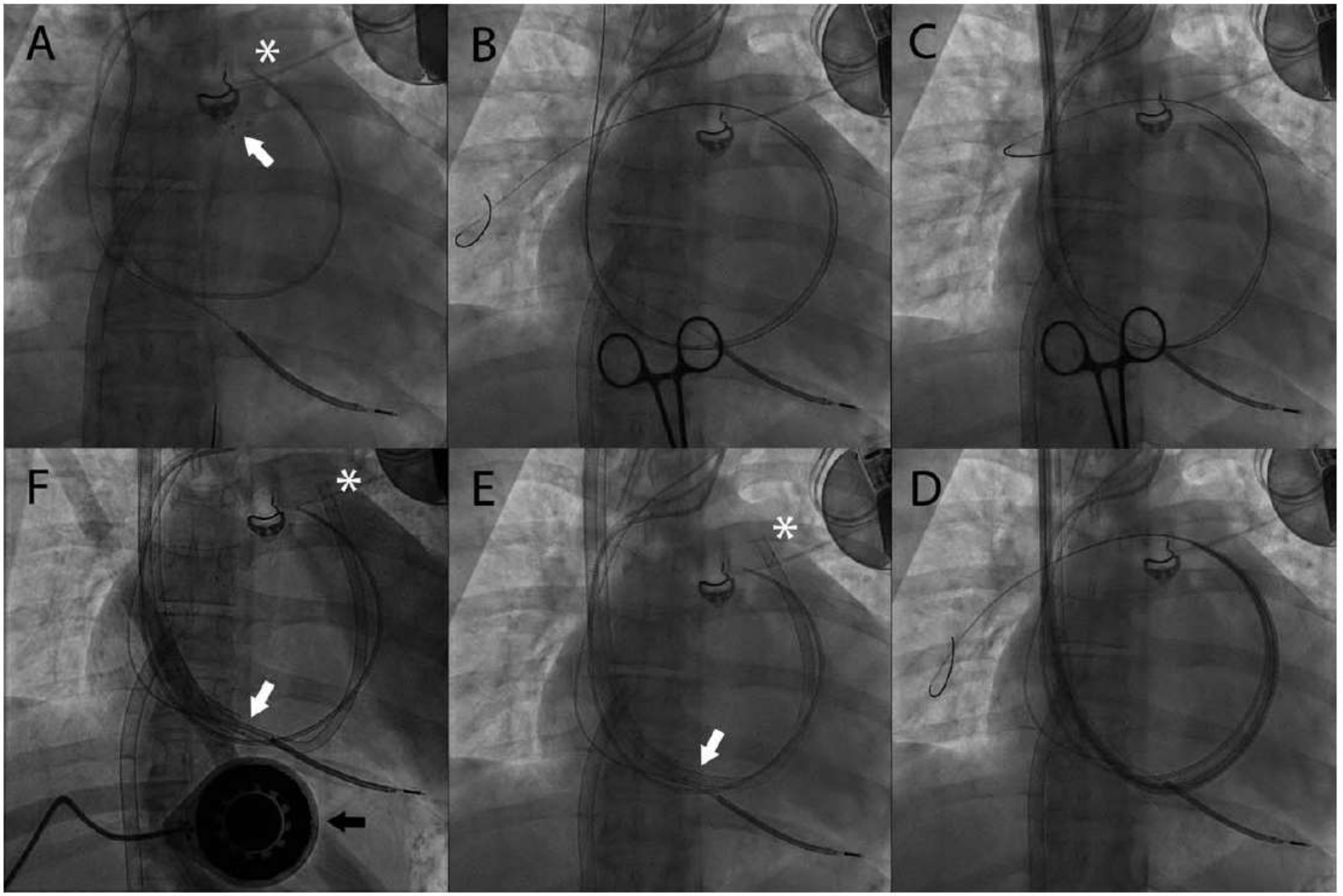
Percutaneous RVAD - ProTek Duo

- Placed in the Right IJ (or Left IJ, or Left SC)
- Allows for sitting upright and ambulation
- Easy implantation
- Bedside removal
- Duration of support of weeks or more

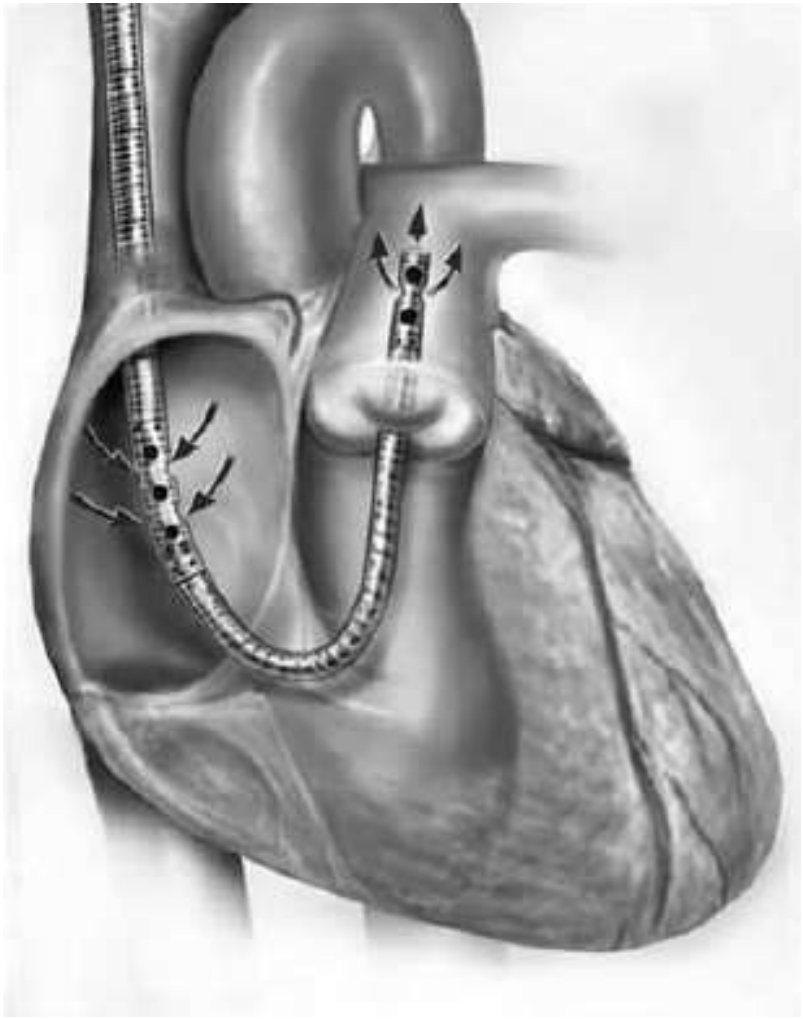
ProTek DUO - Technique



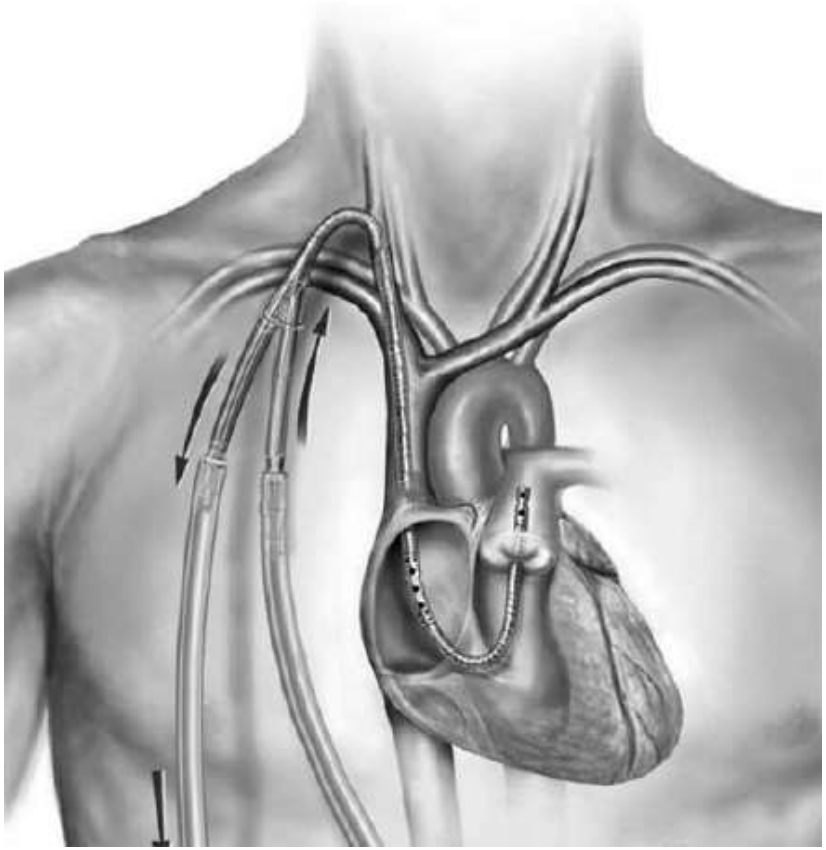
ProTek DUO - Technique

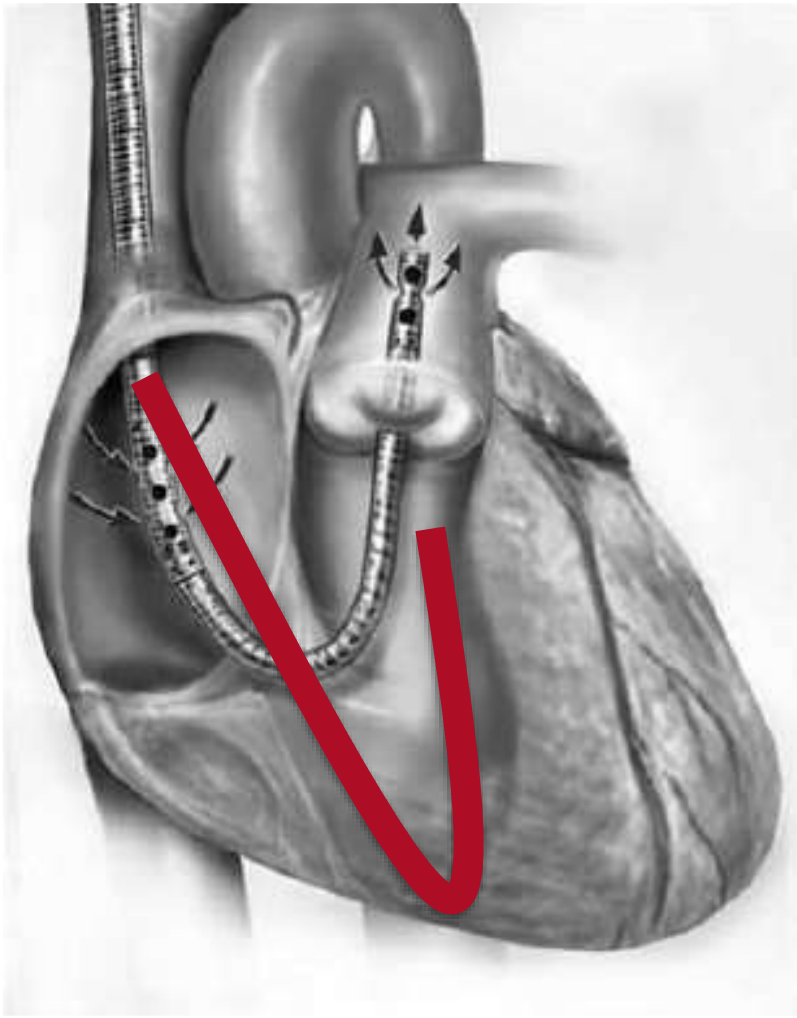


ProTek DUO - Technique



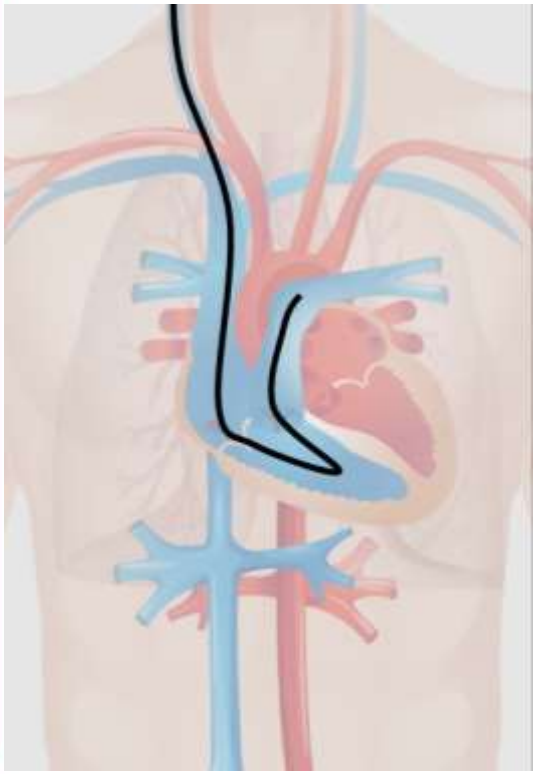
ProTek DUO - Technique





ProTek DUO - Technique

 # 1



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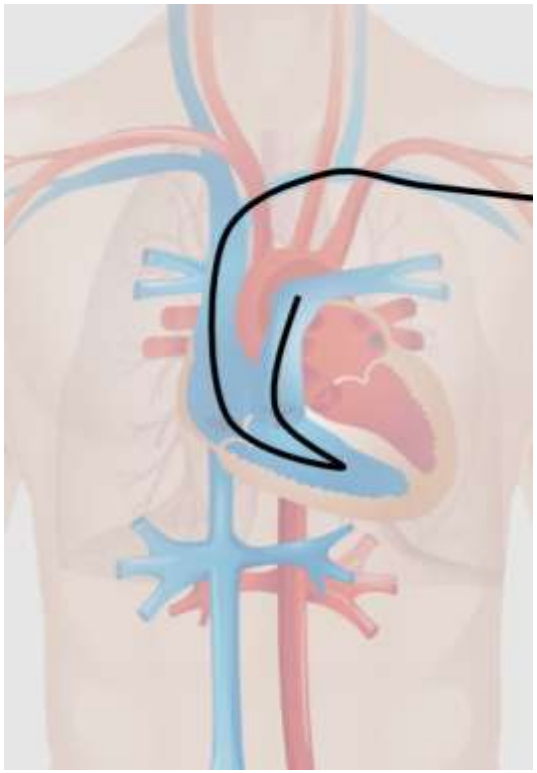
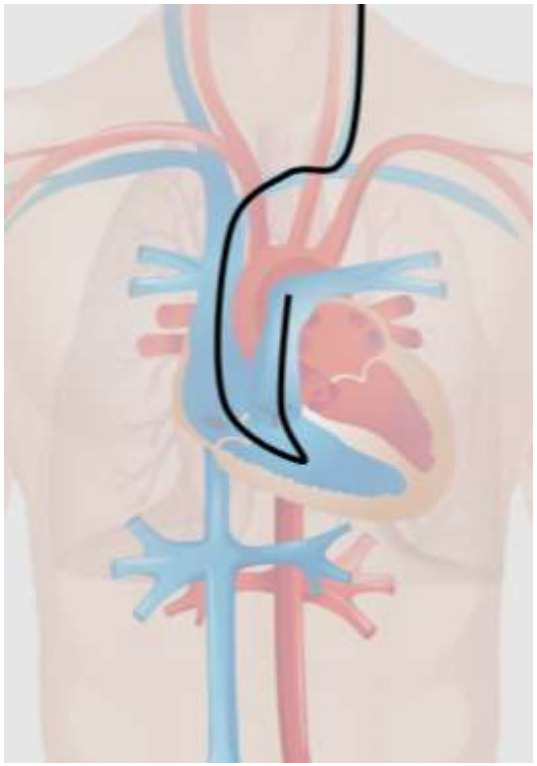
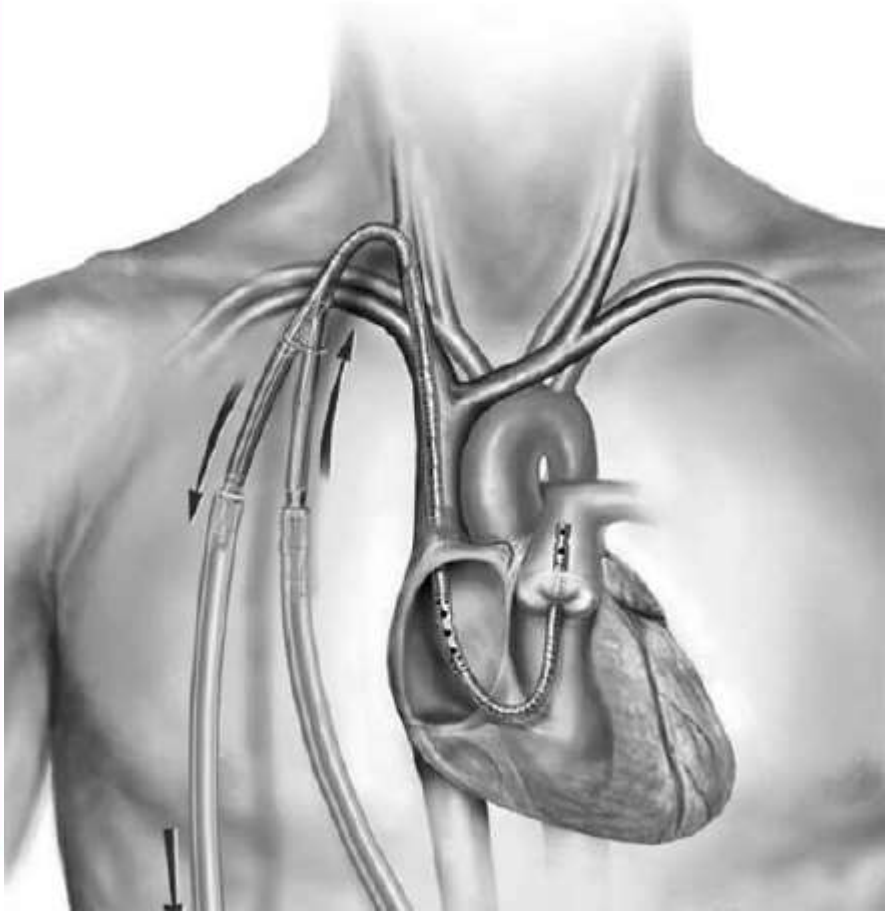


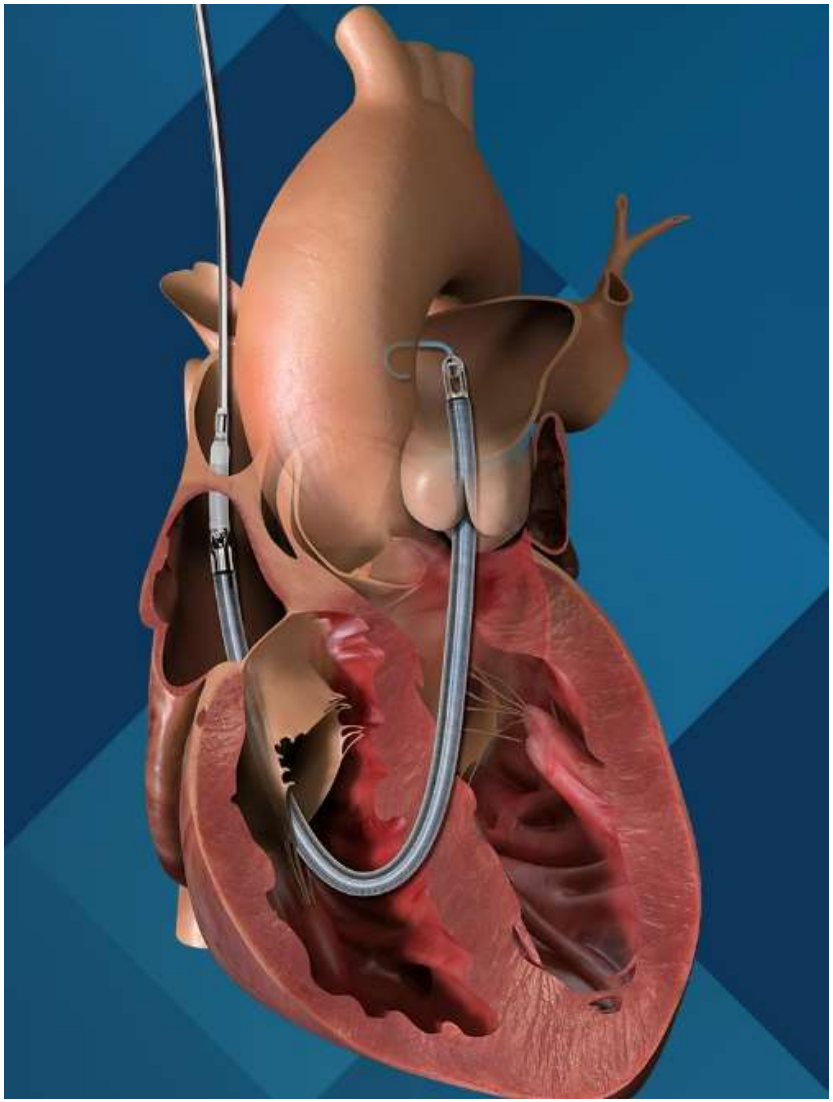
 # 3



ProTek DUO - Technique



Percutaneous RVAD – Impella RP Flex



Peripheral/Percutaneous LVAD

Axillary Impella – temp LVAD

Effectiveness and Safety of the Impella 5.0 as a Bridge to Cardiac Transplantation or Durable Left Ventricular Assist Device

Am J Cardiol. 2016 May 15;117(10):1622-1628

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Review

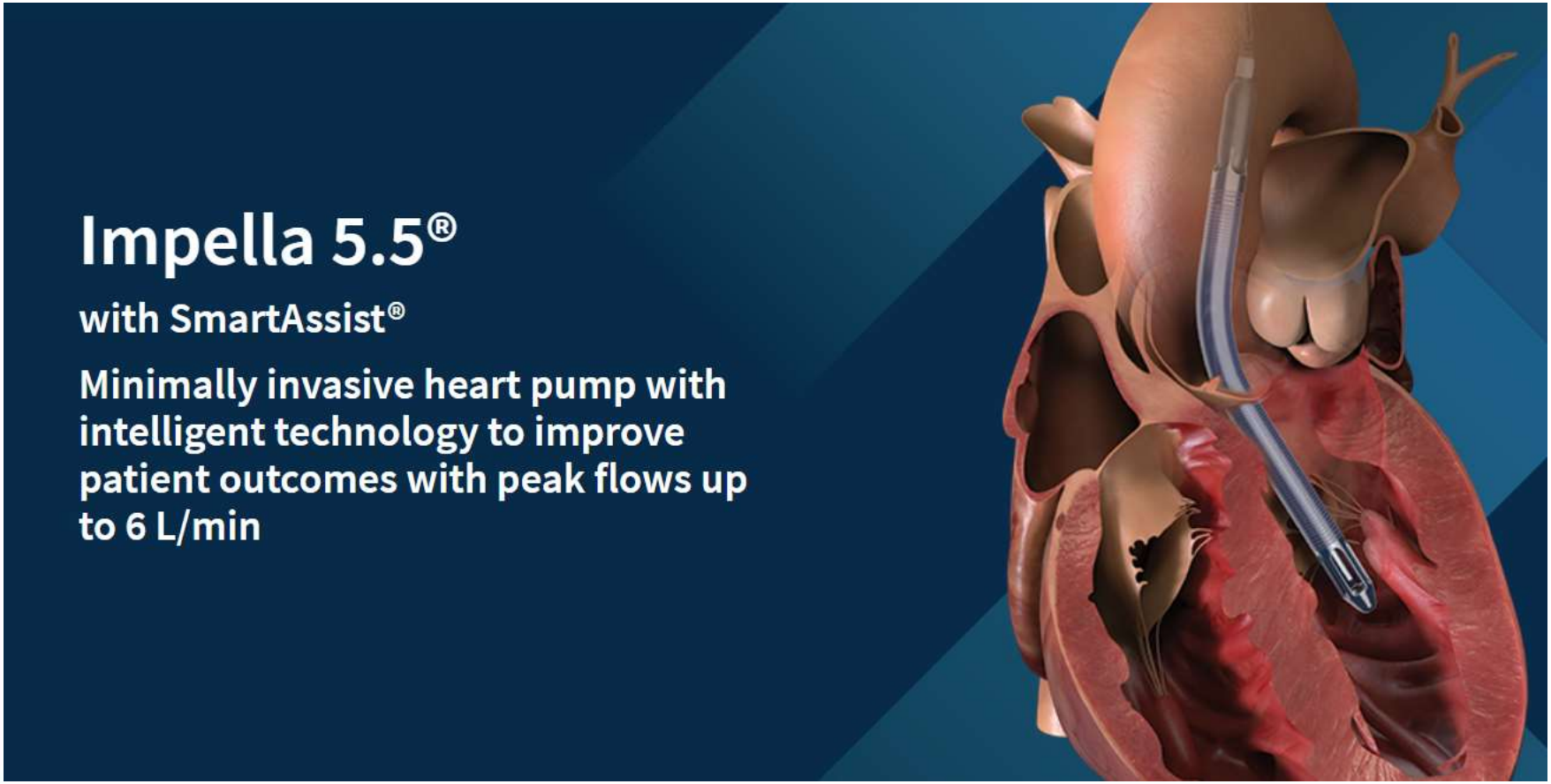
Impella ventricular support in clinical practice: Collaborative viewpoint from a European expert user group

ASAIO Journal 2018

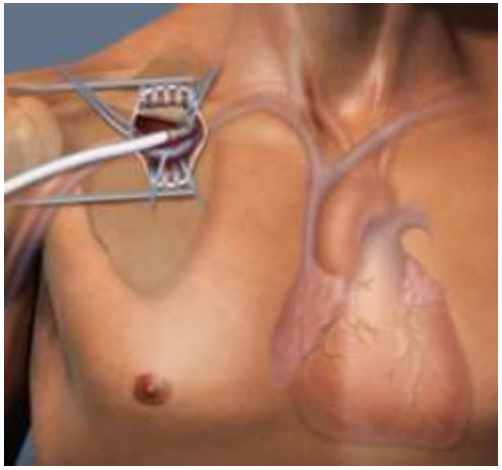
Adult Circulatory Support

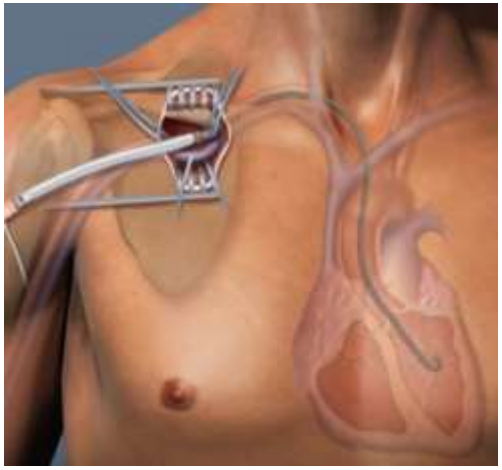
Clinical Outcomes of Impella Microaxial Devices Used to Salvage Cardiogenic Shock as a Bridge to Durable Circulatory Support or Cardiac Transplantation

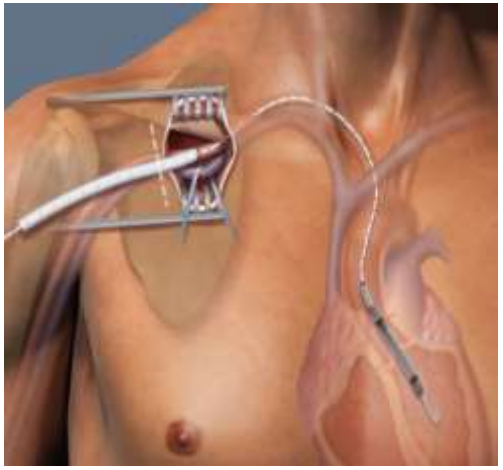
Axillary Impella – temp LVAD

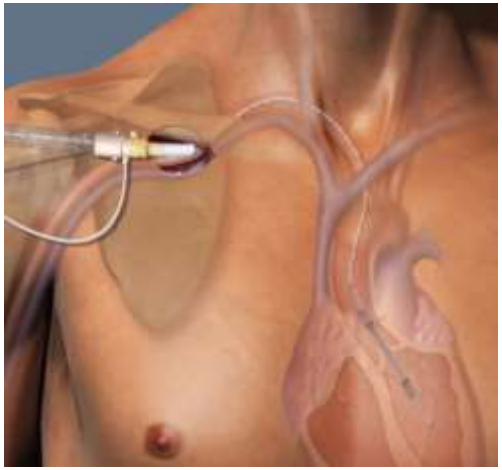


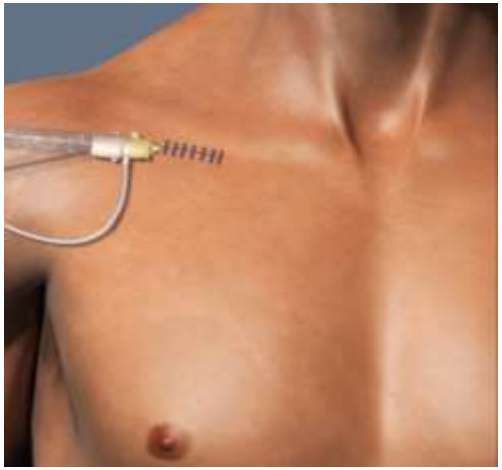
Axillary Impella - Technique

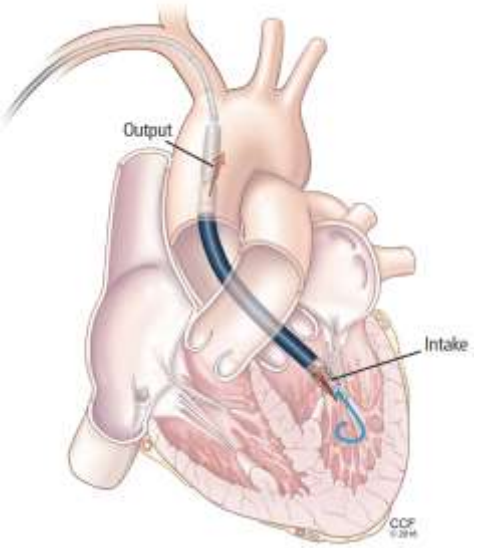




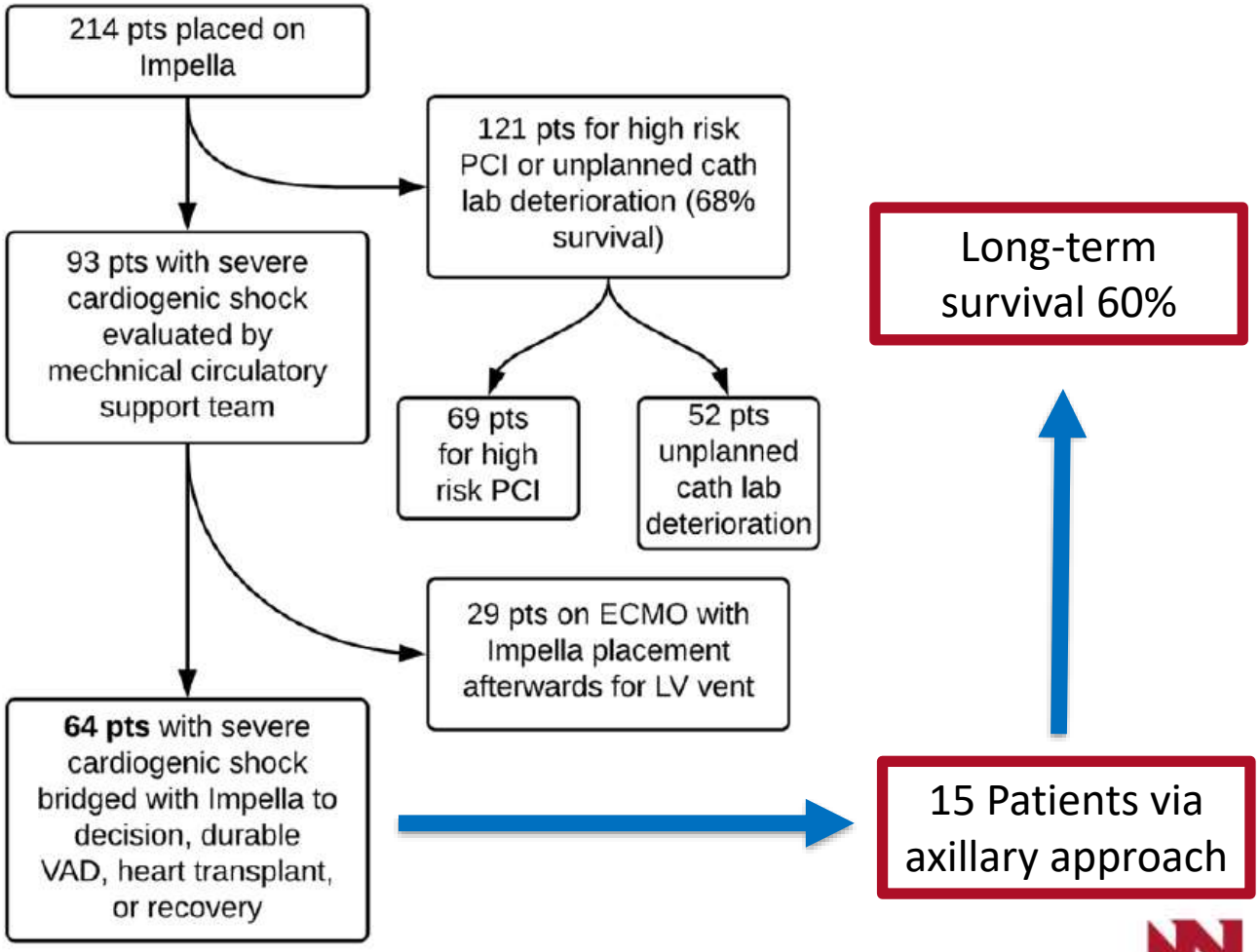








Axillary Impella – Bridging Strategy



ASAIO J. 2018 Sep 28.

Axillary Impella – Bridging Strategy

75% Axillary
n = 30

Table 3
In-hospital complications

Complication	N = 40
Stroke	0%
Aortic Valve injury	3%
Limb Ischemia	3%
Vascular complication requiring surgery	0%
Vascular complication without surgery	0%
Bleeding requiring surgery	0%
Bleeding requiring transfusion	28%
Acute Renal Dysfunction	33%
Hemolysis	8%
Device Malfunction	10%

Am J Cardiol. 2016 May 15;117(10):1622-1628

Axillary Impella – Bridging Strategy

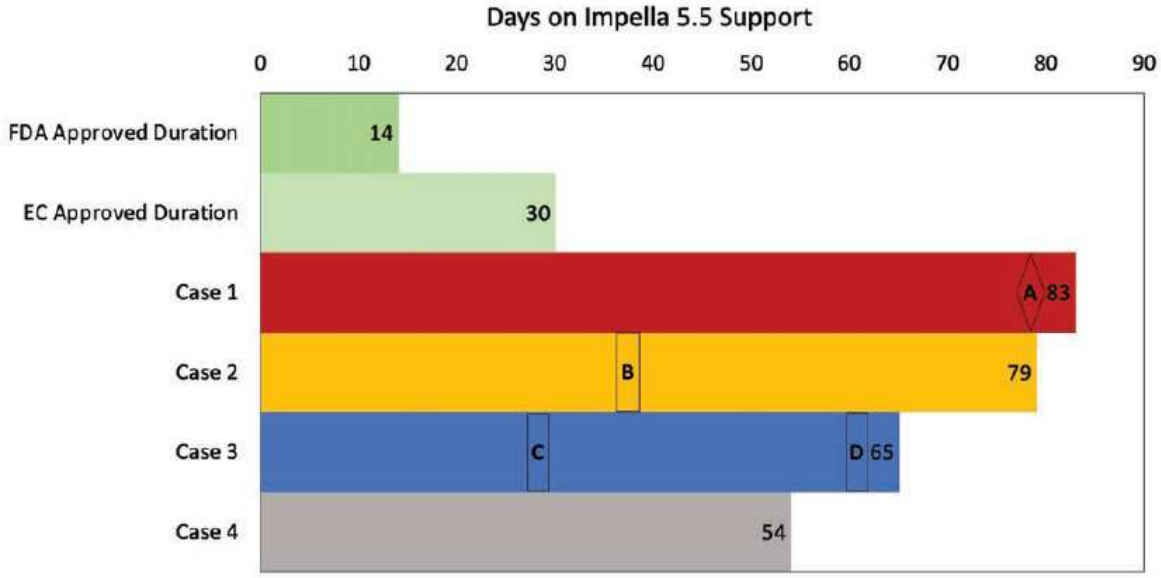
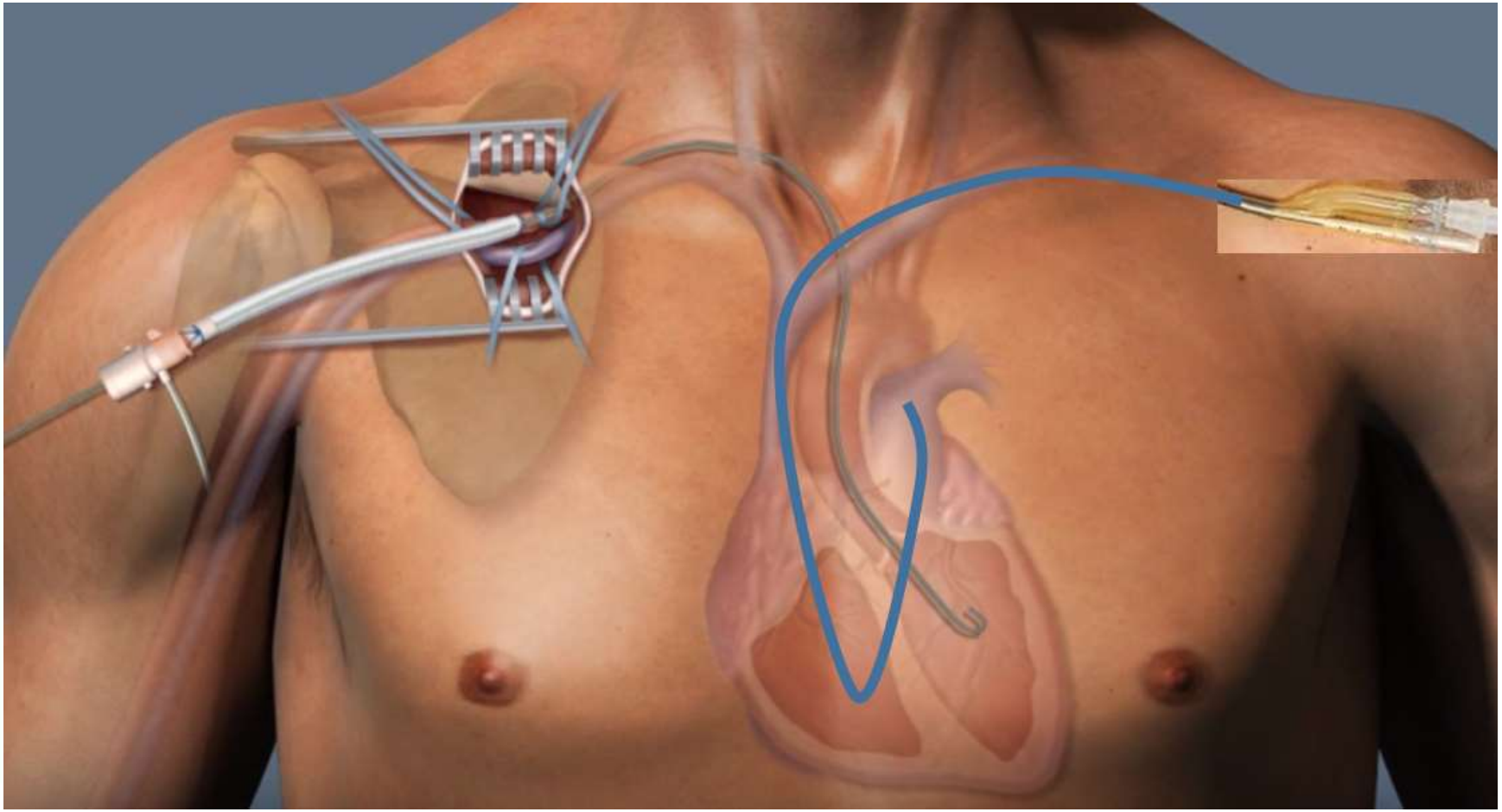


Figure 1. The current US Food and Drug Administration (FDA) and European Conformity (CE Marking) approved durations for the Impella device 5.5 system as well as the duration of Impella support in cases 1, 2, 3, and 4. In case 1, the diamond labeled "A" marks day 81 of Impella support, the day of patient 1's heart transplantation (HTx). The same Impella device was left in place for continued support for 2 days following HTx. In case 2, the rectangle labeled "B" marks day 38 of Impella support, indicating the day of fiber-optic malfunction. In case 3, the rectangle labeled "C" and "D" marks days 30 and 62 of Impella support indicating the days the patient experiences a left posterior cerebral artery (PCA) infract and right PCA infract, respectively.

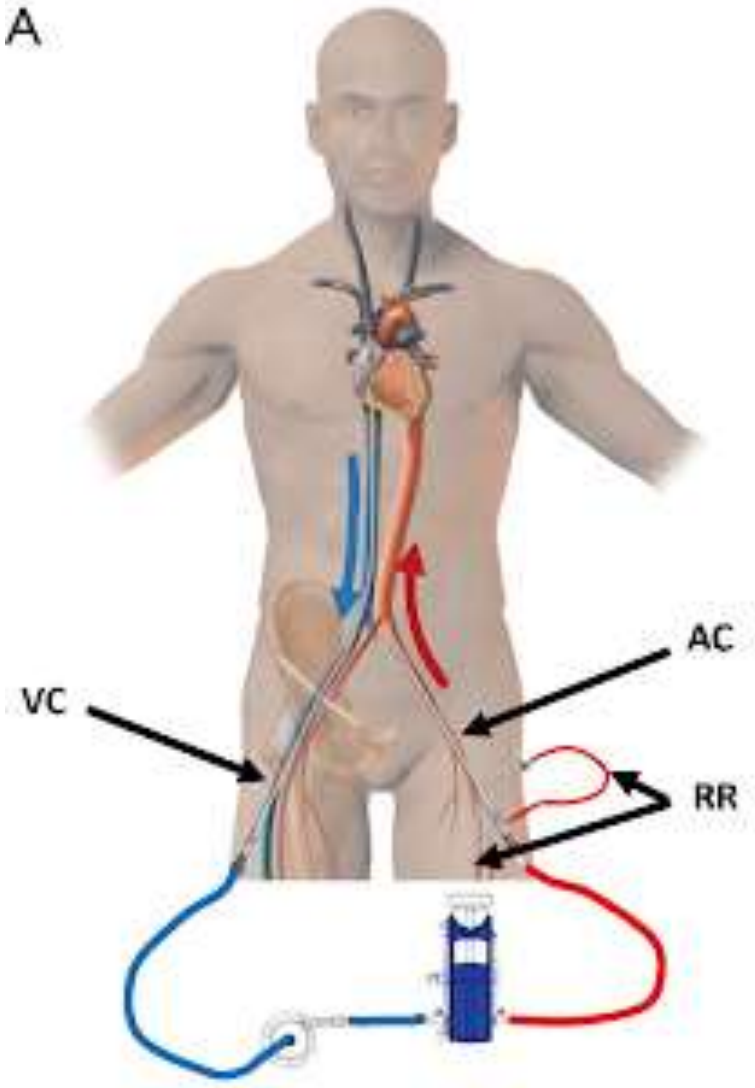
ASAIO Journal 2023; 69;e158–e162

Peripheral Biventricular Support

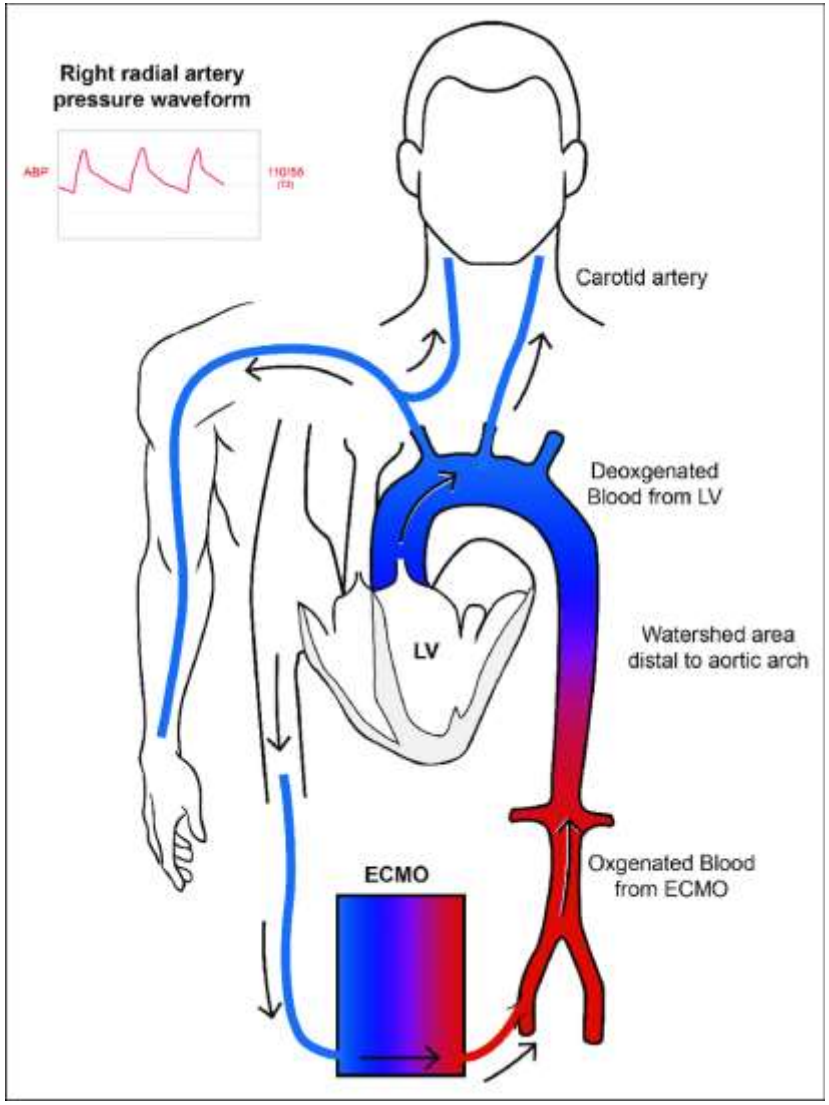


Veno-Arterial Extracorporeal Membrane Oxygenation

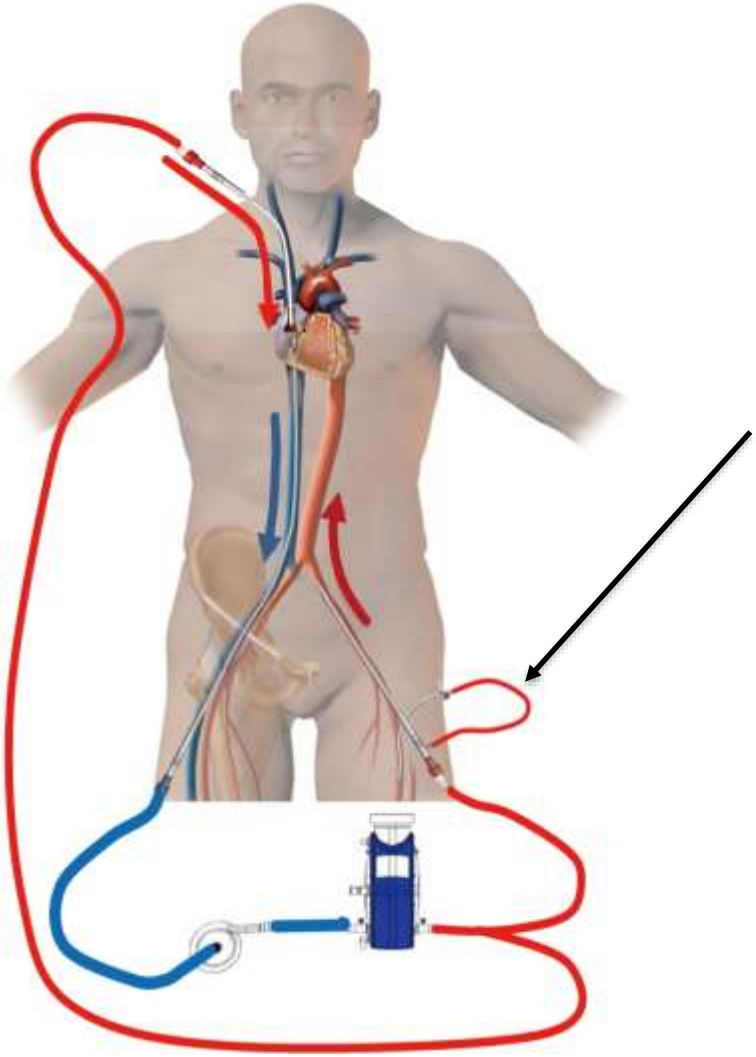
Veno-Arterial (VA) ECMO



VA-V ECMO – Harlequin Syndrome ("North-South Syndrome")



VA-V ECMO – Harlequin Syndrome ("North-South Syndrome")



Ambulatory VA ECMO

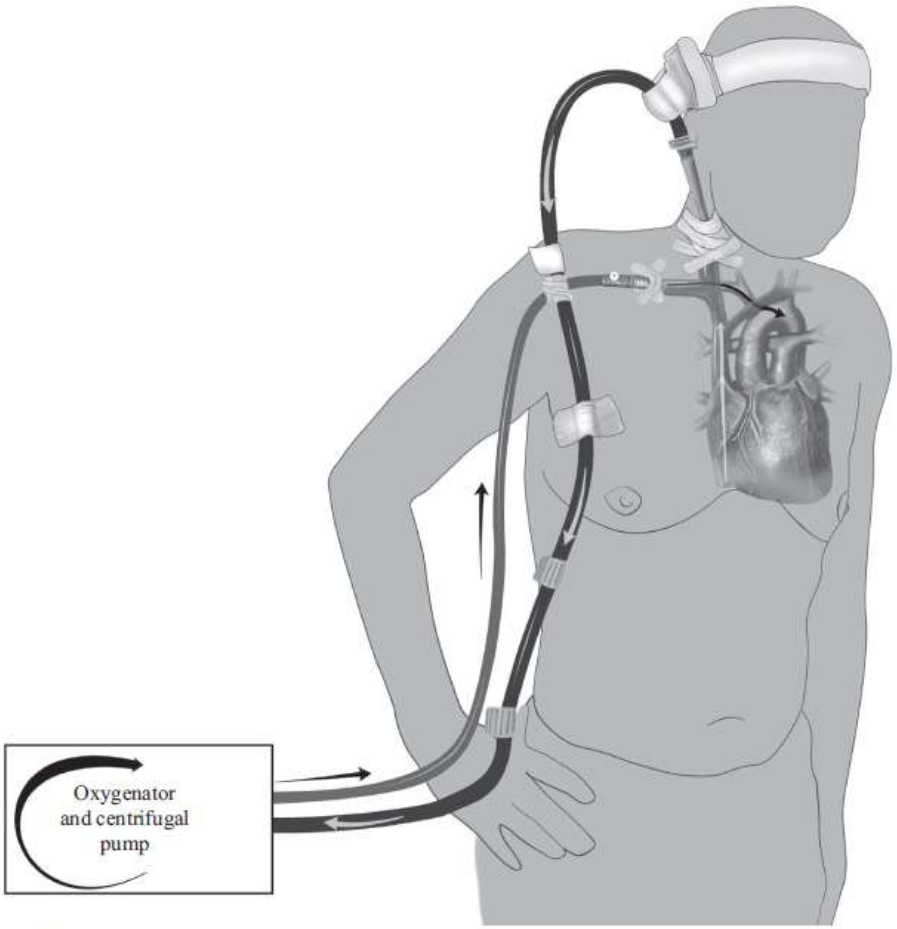
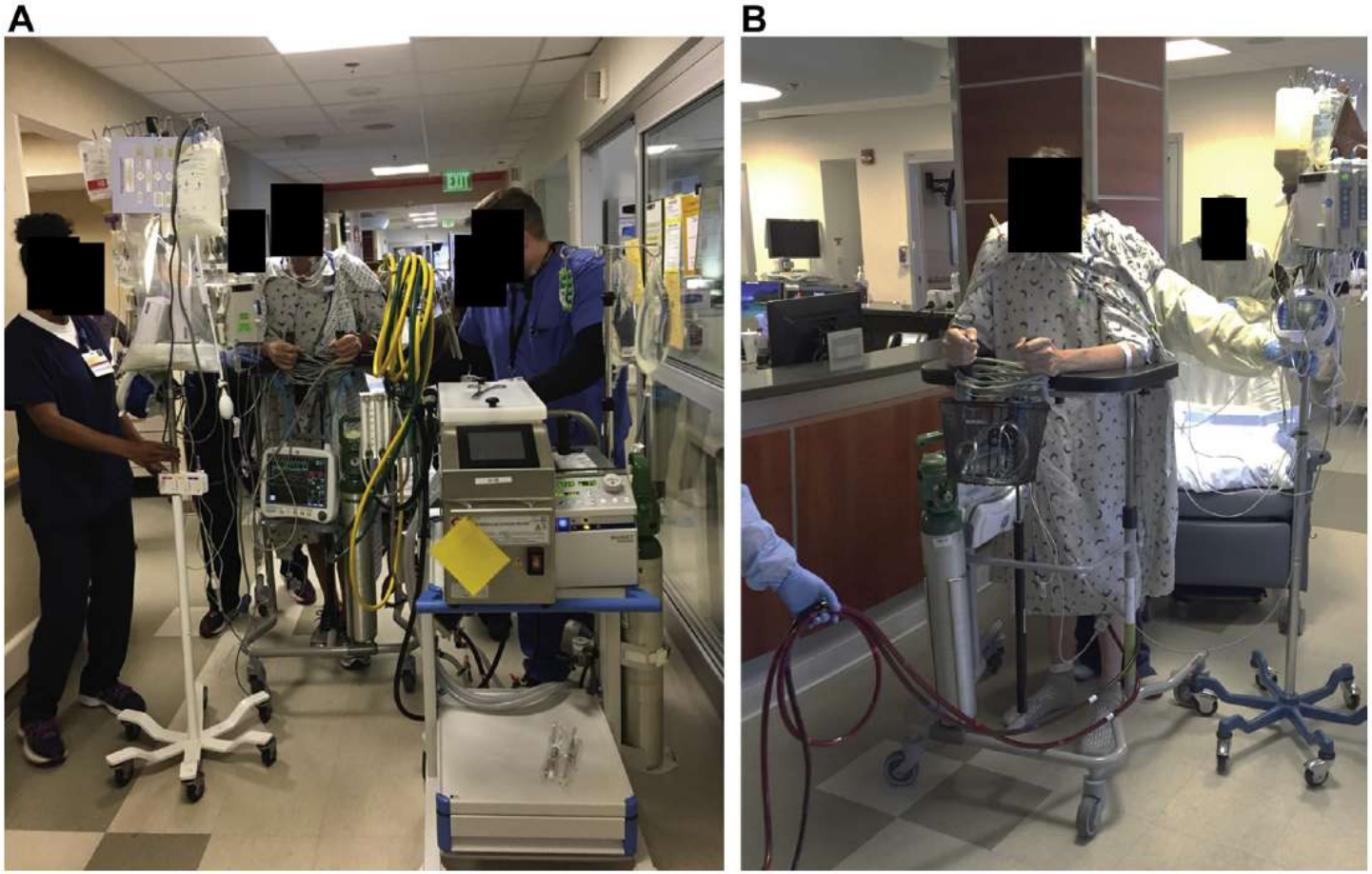
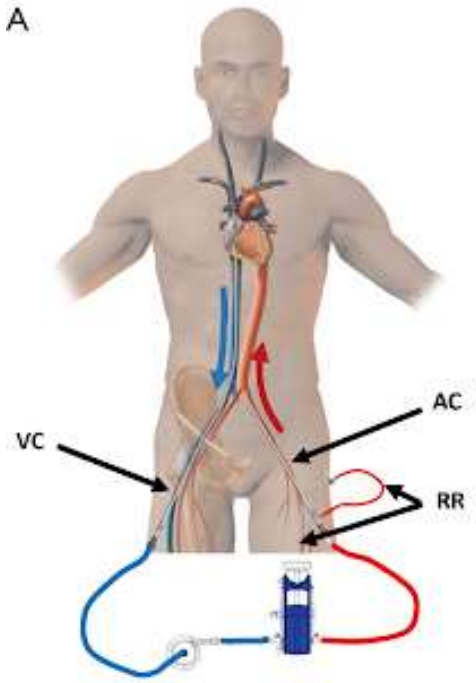


Figure 3 "Partial bypass" walking ECMO. Venous drainage from percutaneous right IJ access via a 20 Fr EOPA CAP arterial cannula (Medtronic). Postoxygenator arterial inflow is via the right axillary approach as described in Figure 2. Venous drainage limits full hemodynamic support but patients with mixed cardiopulmonary disease can effectively ambulate with 3-4 L/min of flow.

Ambulatory VA ECMO



VA ECMO with Impella (ECPELLA) for LV Unloading



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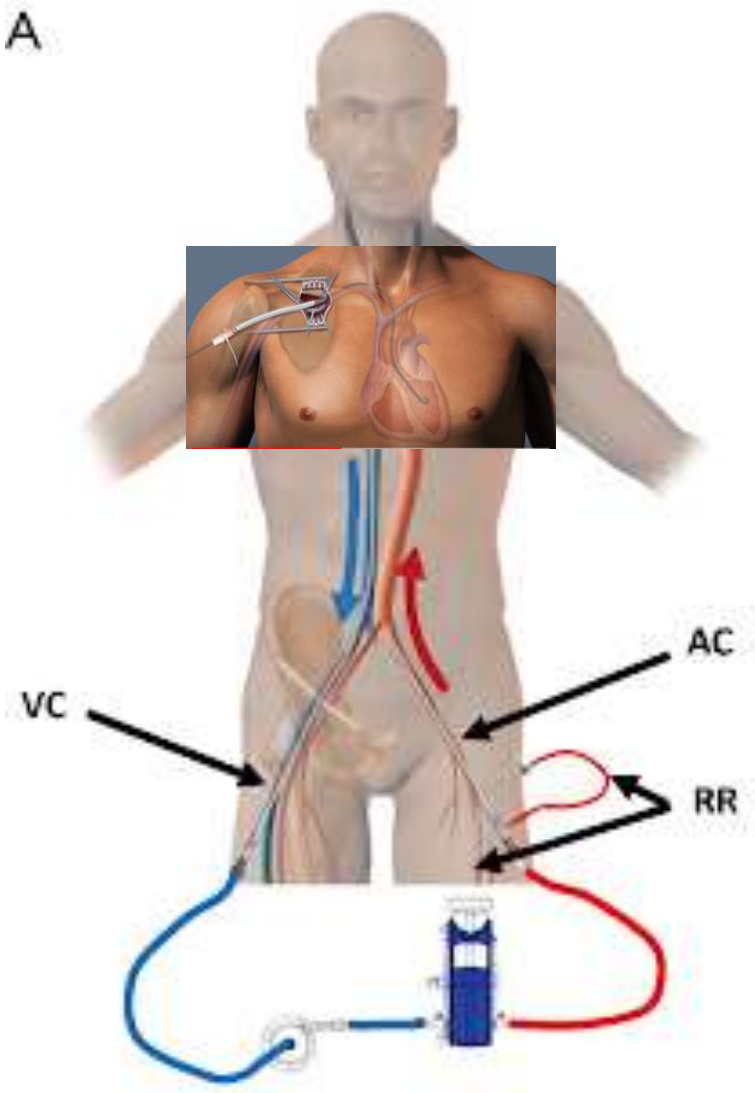
VA ECMO with Impella (ECPELLA) for LV Unloading



VA ECMO with Impella (ECPELLA) for LV Unloading

Circulation

ORIGINAL RESEARCH ARTICLE

Left Ventricular Unloading Is Associated With Lower Mortality in Patients With Cardiogenic Shock Treated With Venoarterial Extracorporeal Membrane Oxygenation

Results From an International, Multicenter Cohort Study

Editorial, see p 2107

Benedikt Schrage, MD
⋮
Dirk Westermann, MD

BACKGROUND: Venoarterial extracorporeal membrane oxygenation (VA-ECMO) is increasingly used to treat cardiogenic shock. However, VA-ECMO might hamper myocardial recovery. The Impella unloads the left ventricle. This study aimed to evaluate whether left ventricular unloading in patients with cardiogenic shock treated with VA-ECMO was associated with lower mortality.

METHODS: Data from 686 consecutive patients with cardiogenic shock treated with VA-ECMO with or without left ventricular unloading using an Impella at 16 tertiary care centers in 4 countries were collected. The association between left ventricular unloading and 30-day mortality was assessed by Cox regression models in a 1:1 propensity score–matched cohort.

VA ECMO with Impella (ECPELLA) for LV Unloading

Circulation

ORIGINAL RESEARCH ARTICLE

Conclusions

In this large, international, multicenter cohort study of patients with cardiogenic shock treated with VA-ECMO, LV unloading with an Impella was associated with lower mortality, but also with more bleeding and ischemic complications, compared with VA-ECMO alone. Although this study supports the use of an Impella for LV unloading in patients with cardiogenic shock treated with VA-ECMO, it also calls for appropriate patient selection and very strict vascular access management to optimize the benefit/risk ratio. This study supports performance of randomized controlled trials evaluating LV unloading in patients with cardiogenic shock supported with VA-ECMO.

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