

**LOW-FLOW STATE INDUCED LIMB ISCHEMIA
INCREASING INCIDENCE IN THE ERA OF ECMO, IMPELLA, LVAD
AND HEART TRANSPLANTION**

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UNAPPRECIATED CAUSE OF LIMB ISCHEMIA – LOW FLOW STATE

In 1990s, our group reported a small number of patients who developed lower extremity ischemic symptoms from a variety of causes like severe acute dehydration, hypovolemia or sudden cardiac decompensation. We termed this

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and highlighted the fact that this entity portended poor prognosis, this was marker of limb loss and death

Frank Veith had described this scenario in one of his papers and called it "**pseudo-embolic obstruction**"

LOW FLOW STATE INDUCED LIMB ISCHEMIA

Unappreciated causes of ischemia in the leg
Babu SC, Shah PM, Clauss RH

Am J Surg. 1982 Aug;144(2):225-7

LOW FLOW STATE INDUCED LIMB ISCHEMIA

In the late 90s, significant strides were made in knowledge and technology about cardiovascular hemodynamics

An entirely new generation of drugs became available to treat cardiac dysfunction – Calcium channel & Beta blockers, Ace inhibitors, ARBS, and drugs to correct rate and rhythm disturbances

This remarkable progress did indeed see a decreased incidence of Low Flow State conditions

UNAPPRECIATED CAUSE OF LIMB ISCHEMIA – LOW FLOW STATE

Recently we have seen an increase in number of patents with low-flow induced limb ischemia

This is seen selectively in high-risk cardiac patients who present with cardiovascular collapse and are resuscitated, maintained on high dose vaso-active drugs (pressors) for many days

A significant number of these patients are maintained on mechanical circulatory assist devices like IABP, ECMO, IMPELLA, etc to optimize for Heart transplantation or LVAD as bridge to transplantation or destination therapy

INTRA AORTIC BALLOON PUMP (IABP) AORTIC COUNTERPULSATION

Impella 2.5 and 5.0

- Utilized for LV support only; not appropriate to use with RV failure
- Impella 2.5 can be inserted through the femoral artery during a standard catheterization procedure; provides up to 2.5 L of flow
- Impella 5.0 inserted via femoral or axillary artery cut down; provides up to 5L of flow
- The catheter is advanced through the ascending aorta into the left ventricle
- Pulls blood from an inlet near the tip of the catheter and expels blood into the ascending aorta
- FDA approved for support of up to 6 hours

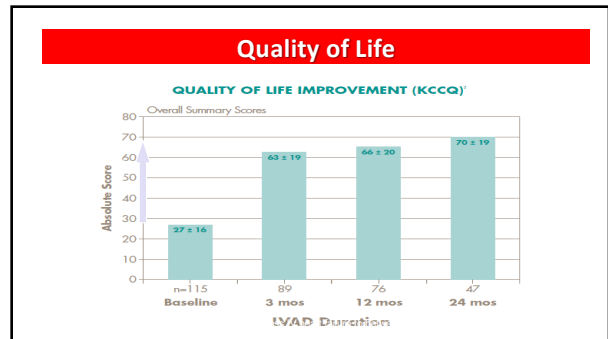
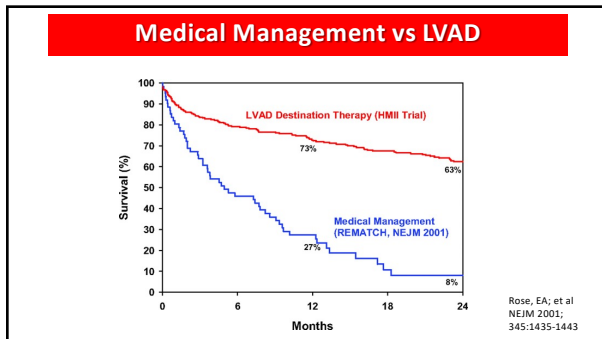
TandemHeart pVAD

- Used for LV support; not appropriate in RV failure
- Cannulas are inserted percutaneously through the femoral vein and advanced across the interatrial septum into the left atrium
- The pump withdraws oxygenated blood from the left atrium and returns it to the femoral arteries via arterial cannulas
- Provides up to 5L/min of flow
- Can be used for up to 14 days

ECMO (VA)

- Used for patients with a combination of acute cardiac and respiratory failure
- A cannula takes deoxygenated blood from a central vein or the right atrium, pumps it past the oxygenator, and then returns the oxygenated blood, under pressure, to the arterial side of the circulation
- Can be used for days to weeks

VA ECMO: Dual Cannula Circuit Model



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MECHANICAL CIRCULATORY SUPPORT DEVICES (MCS)


Review of literature on complications of MCSs list device malfunction, loss of battery function, bleeding and clotting events, embolic strokes, hemolysis and sepsis

There are no large reports of the lower or upper extremity complications

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- Patient presented with cardiogenic shock
- Maintained on ECMO
- High dose vasopressors
- Eventually survived
- Bilateral TMA

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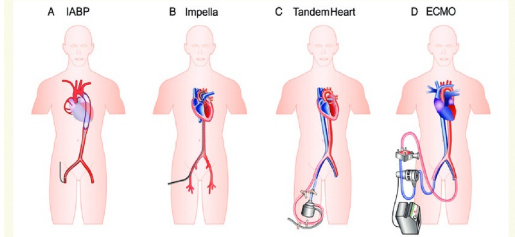


- Acute MI, cardiogenic shock
- Resuscitated, sustained dose of pressors
- Maintained on ECMO
- Heart transplant
- Palpable pedal pulses

LOW FLOW STATE INDUCED LIMB ISCHEMIA
YOUNG WOMAN WITH MYOCARDITIS, CARDIOGENIC SHOCK MAINTAINED ON ECMO & IMPELLA, PRESSORS



PERCUTANEOUS CIRCULATORY ASSIST DEVICES FOR CARDIOGENIC SHOCK
LOW PROFILE INSERTION CANNULAS & DEVICES TO DECREASE COMPLICATIONS



A IABP B Impella C TandemHeart D ECMO

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- There has been a significant surge of these mechanical circulatory support devices
- We have seen a number of patients with upper and lower extremity ischemic events resulting in amputations
- There has been no large reports in the literature about the extremity amputations in this group of critically ill patients
- While these devices are life saving as BTT and DTs, more attention needs to be focused on how to prevent these serious life altering events



Thank You