

# Nursing Care of Patients with Percutaneous Ventricular Assist Devices (pVAD)

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# Objectives

- Define purpose and clinical indications for percutaneous ventricular assist device (pVAD).
- Describe nursing role and responsibilities in caring for patients with the pVAD device.
- Identify potential complications associated with the pVAD device.
- Review plan of care for the patient with the pVAD device pre- and post-implementation.

# Introduction

- Heart disease is the leading cause of death in the United States.
- Approximately 84 million people in the U.S. suffer from some form of cardiovascular disease.
- More than 600,000 Americans die of heart disease each year.

– Americanheart.org, 2016



# Introduction

- An estimated 15 million U.S. adults have coronary heart disease.
- Heart failure affects more than 5 million adults in the U.S.
- Cardiovascular disease is the cause of more deaths than cancer, chronic lower respiratory diseases, and accidents combined.

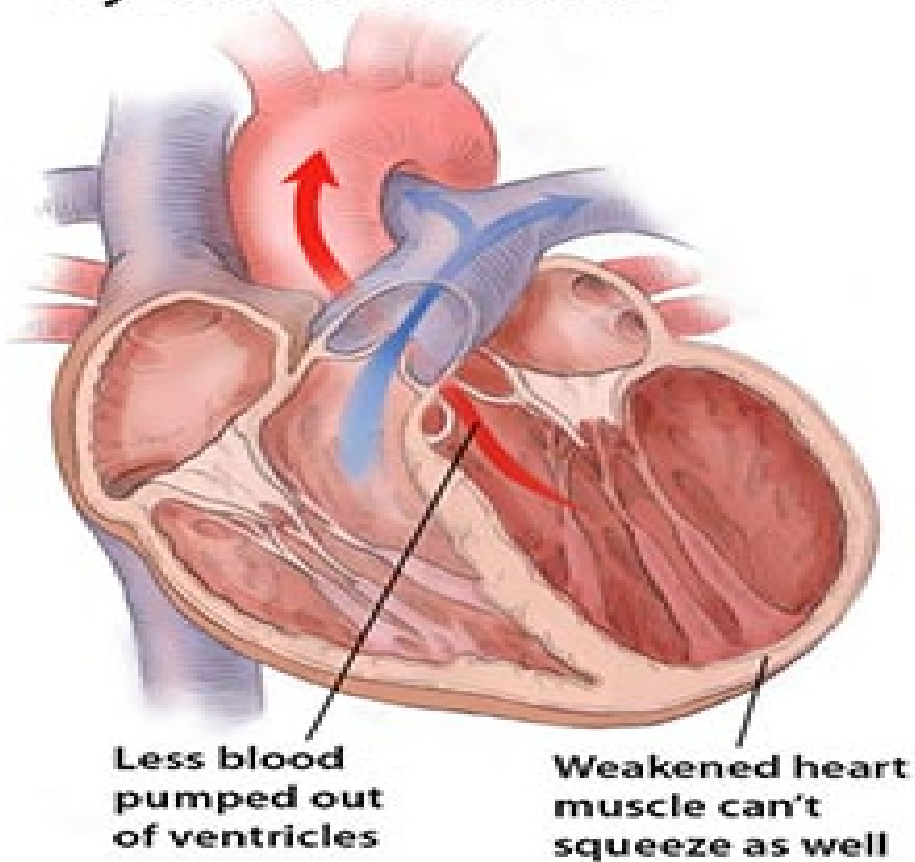
– Americanheart.org, 2016



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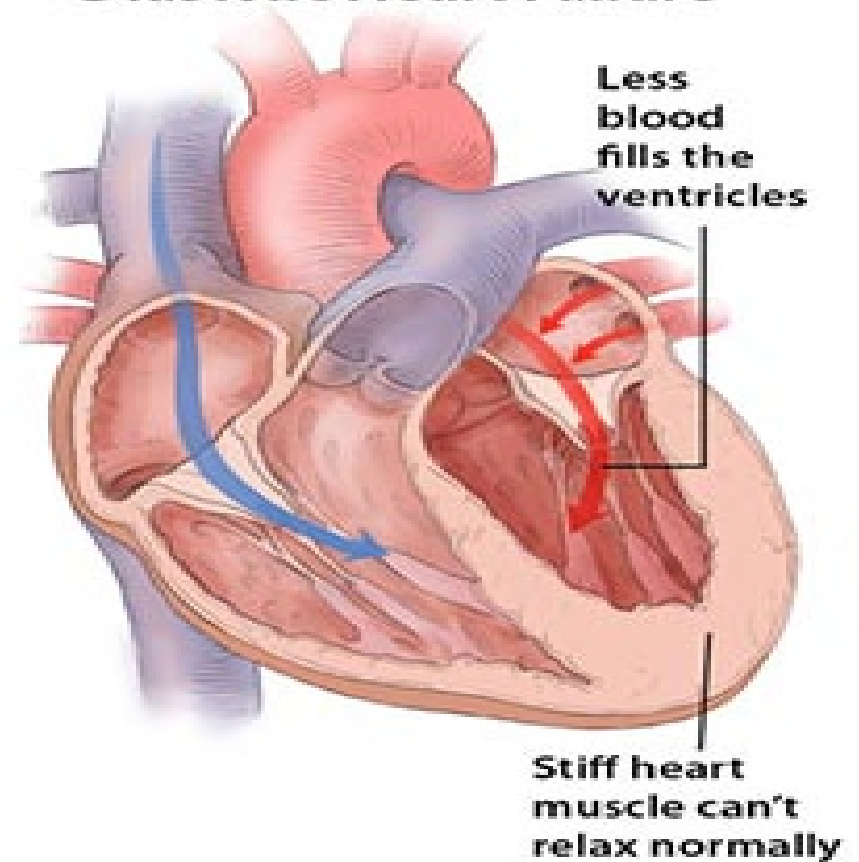
# Abnormal cardiac anatomy and function

## Systolic Heart Failure



- emsworld.com

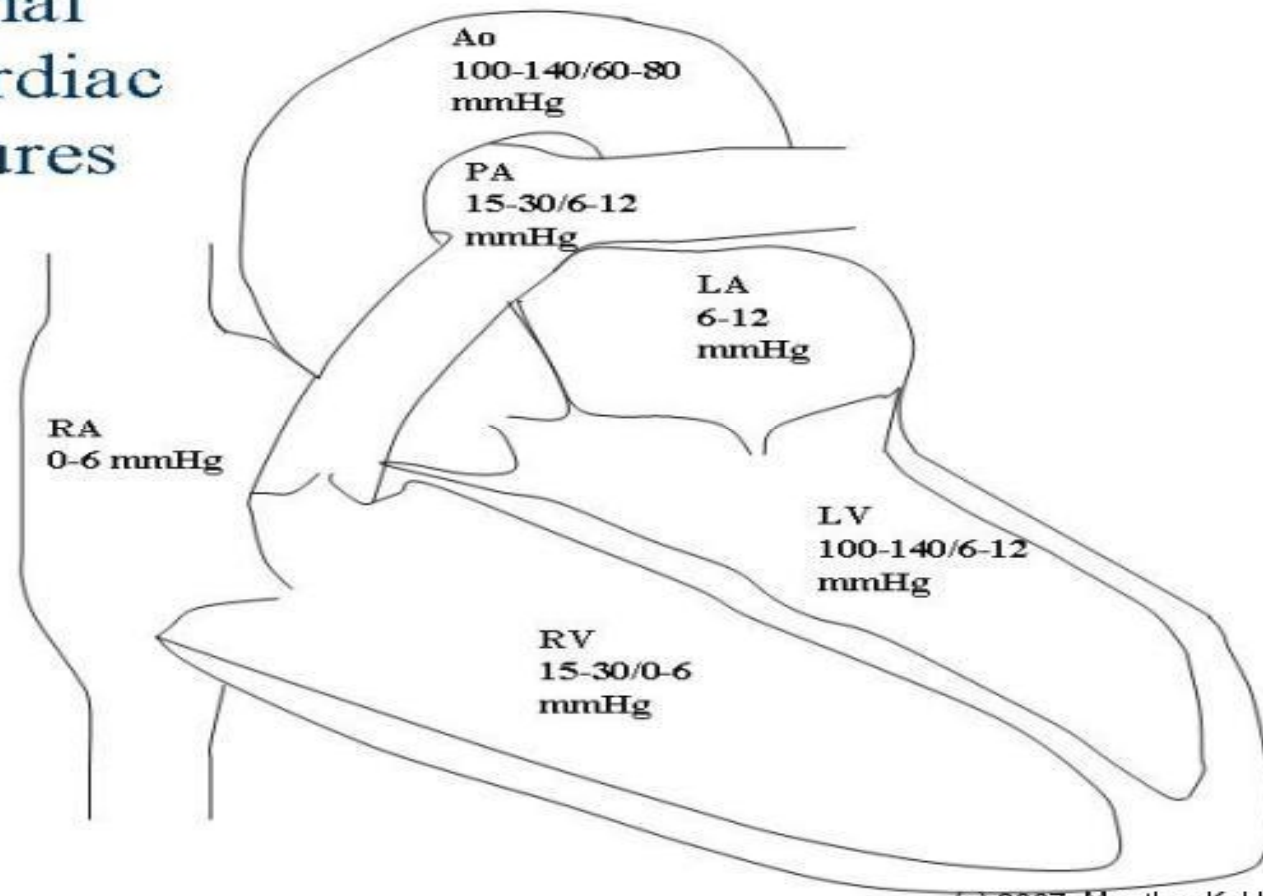
## Diastolic Heart Failure



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# Normal Cardiac Values

## Normal Intracardiac Pressures



Homoud, Munther, K; 2007



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# Background

- In the 1960's the Intra-Aortic Balloon Pump (IABP) was developed for use in patients with cardiogenic shock and/or were unresponsive to traditional therapy.
- It has been shown to reduce infarct size, improve coronary blood flow by reducing left ventricular afterload, and modestly improve cardiac output.

– Topol, 1990



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# IABP Limitations

- The IABP cannot provide total circulatory support.
- IABP effect's are dependent on aortic positioning, blood displacement volume, balloon diameter in relation to aortic diameter, balloon inflation & deflation timing, and intrinsic systemic vascular resistance.
- Patients must have some left ventricular function.

– Parrillo & Dellinger, 2001



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# Ventricular Assist Devices

- The first successful implantation of a left ventricular assist device was completed by Dr. Michael E. DeBakey in 1966 for heart failure.
- Since then these devices have become smaller and more portable for patients.
- There are now minimally invasive, percutaneously inserted, & catheter-based ventricular assist devices.

– Arroyo & Cook, 2011

# IABP vs. pVAD

## IABP

- Short term use: hours to days
- Blood volume displacement
- Requires cardiac rhythm or arterial pressure for trigger
- Requires intermittent timing to ensure optimal inflation & deflation of balloon

## pVAD

- Short term use: hours to days
- Increases cardiac output more than IABP
- Works independently of cardiac rhythm or arterial pressure
- No timing required because it is continuous flow



# IABP vs. pVAD

## IABP

- Decreases afterload
- Augments cardiac output modestly
- Physiological impact on moderate to severe aortic insufficiency, abdominal, or aortic aneurysm
- Contraindications include moderate to severe peripheral arterial disease, moderate to severe aortic disease

## pVAD

- Increases forward flow
- Unloads left ventricle
- Augments cardiac output
- Increases mean arterial pressure
- Contraindications include mechanical heart valve, moderate to severe aortic disease, left ventricular thrombus, & moderate to severe peripheral arterial disease



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# IABP vs. pVAD

## IABP

- Cost - \$800 - \$1200 for cost of device & associated supplies plus cost of console
- Potential complications include limb ischemia, bleeding, hematoma at access site, vascular injury, embolization of thrombus or plaque, infection, balloon rupture

## pVAD

- Cost - \$20,000 - \$25,000 for cost of device & associated supplies; console provided with catheter purchase
- Potential complications include limb ischemia, bleeding, hematoma at access site, vascular injury, hemolysis, embolization of thrombus or plaque, infection, device failure

- Arroyo & Cook 2011



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# Benefits

- pVAD demonstrate increased cardiac output versus IABP.
- Improves cardiac pressures
- Decreases oxygen consumption.
- Decrease hospital length of stay.
- Provides support post cardiac arrest.

– McCulloch, 2011



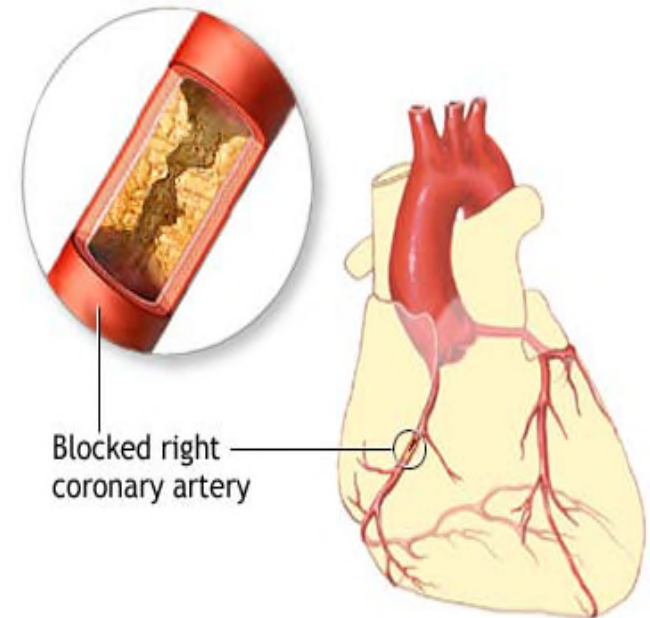
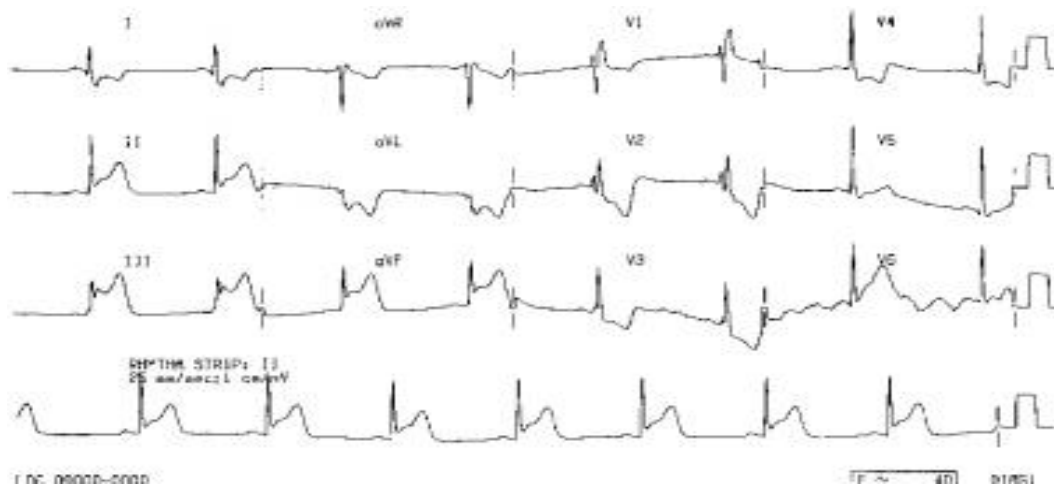
-indigopreciousmetal.com

# Benefits

- In a recent study by Anusionwu, Fischman, & Cheriyaath, 2012 statistical significance was reported on decreased length of stay with the use of a pVAD.
- Another study, Mukku, Cai, Gilani, et al. 2012 suggested that earlier implantation of pVAD after cardiac arrest might provide cardiac support and tissue perfusion until recovery or high risk PCI.

# Clinical Indications

- Support during high-risk (PCI).
- Support of patients with myocardial infarction.



-heart-disease-and-prevention.com

- Abiomed, 2016



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# Clinical Indications

- Cardiomyopathy w/ acute decompensation.
- Postcardiotomy shock.
- Off-pump coronary artery bypass grafting surgery.
- Heart transplant rejection.
- Bridge to the next decision.

– McCulloch, 2011



# Contraindications

- Mechanical heart valve or heart constrictive device.
- Aortic valve stenosis/calcification.
- Moderate to severe aortic insufficiency.
- Severe peripheral arterial obstructive disease that would preclude pVAD device placement.
- Angiography of aorta, iliac, and femoral vessels is mandatory.

– Arroyo & Cook, 2011

# Potential Adverse Events

- Aortic insufficiency
- Aortic valve injury
- Arrhythmia
- Limb ischemia
- Bleeding
- Cardiogenic Shock
- Cardiac tamponade
- Stroke
- Hemolysis
- Insertion site infection
- Perforation
- Renal failure
- Sepsis
- Hepatic failure
- Thrombocytopenia
- V-fib/V-tach/Death

Abiomed, 2016

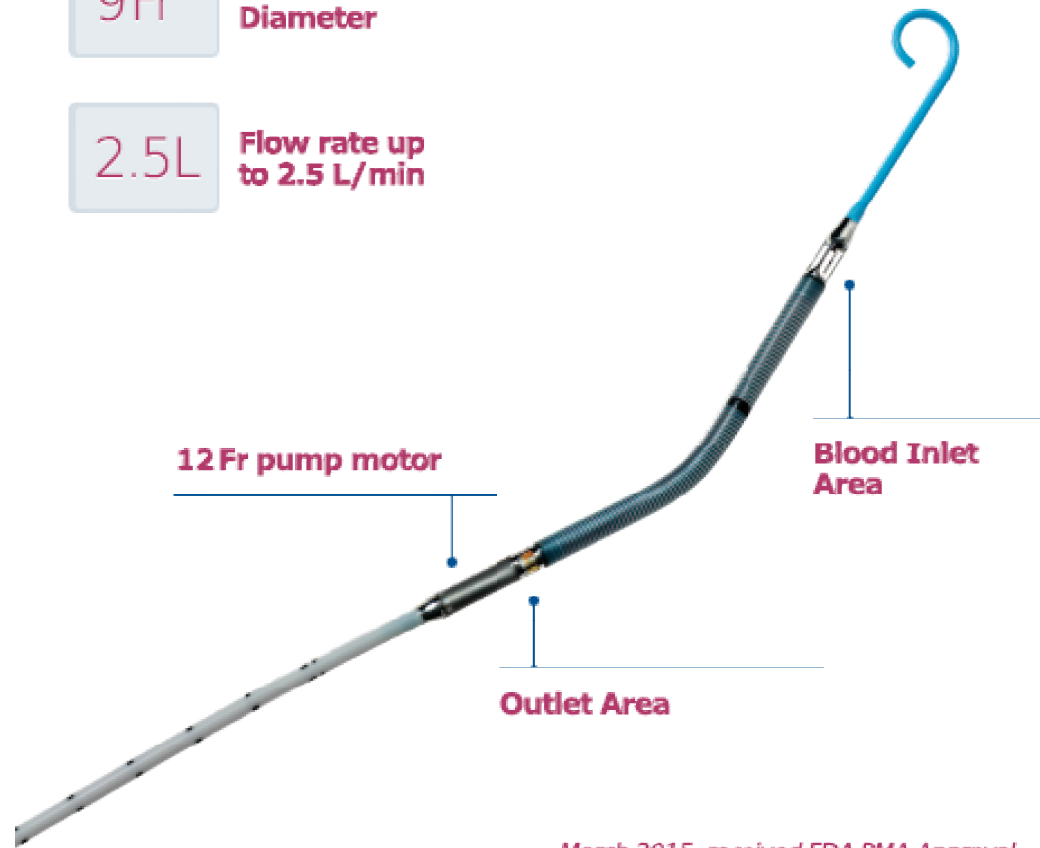


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# pVAD

9Fr Catheter Diameter

2.5L Flow rate up to 2.5 L/min

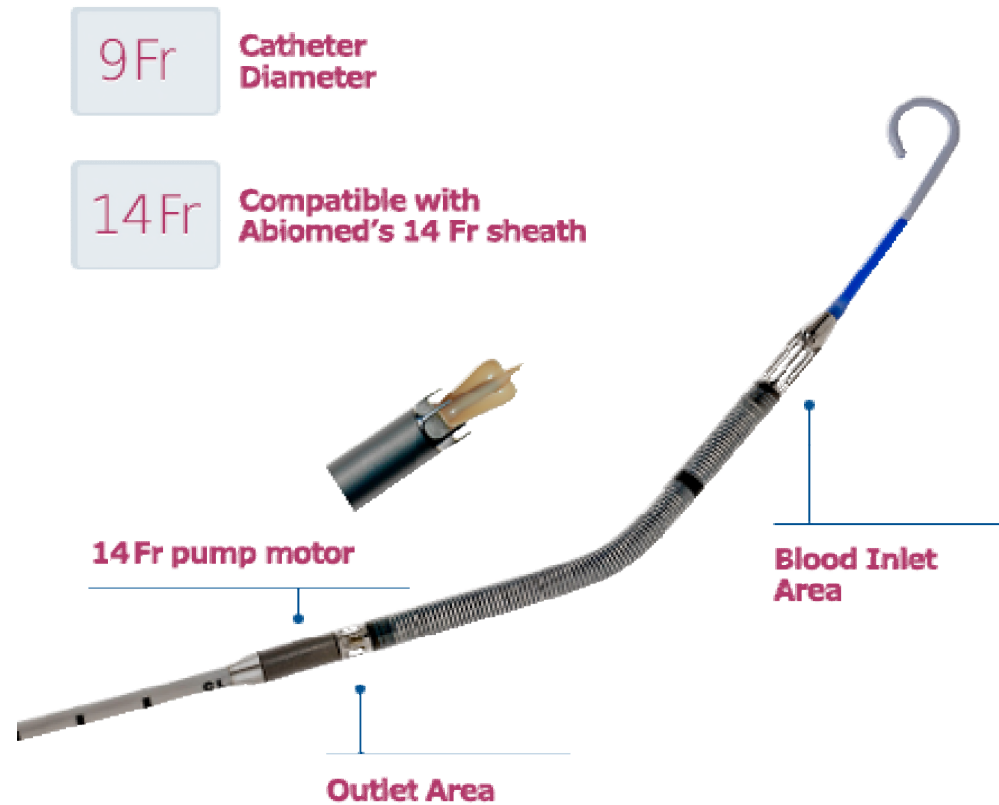


March 2015, received FDA PMA Approval



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# pVAD



September 2012, received FDA 510(k) clearance



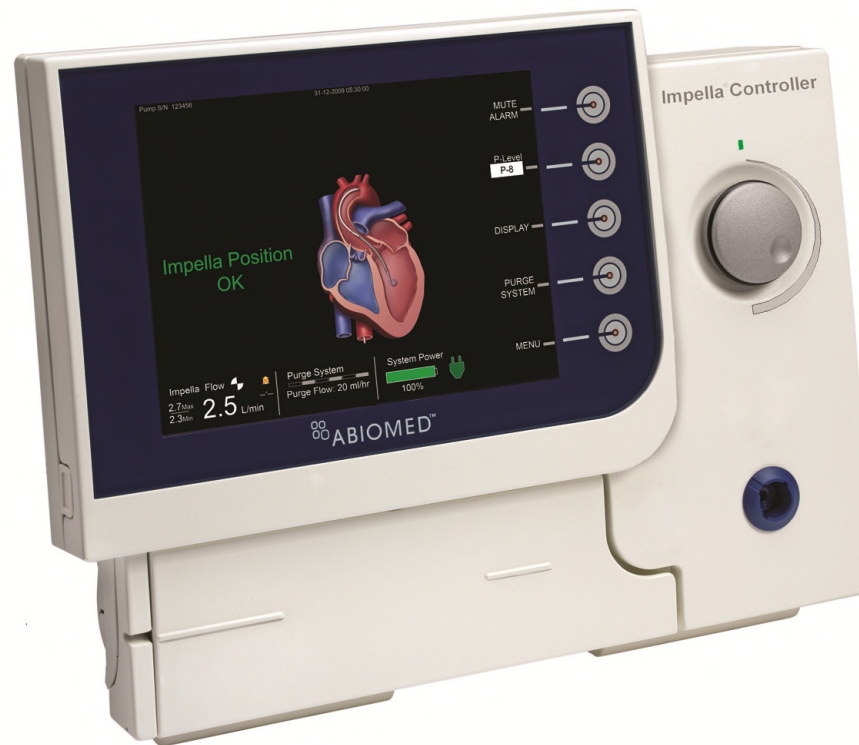
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# Equipment Set-up

- Equipment:
  - Automated Controller
  - pVAD catheter
  - Diagnostic catheter
  - 500ml. Bag of dextrose (20% recommended; 5%-40% acceptable) w/ 50 units heparin/mL.
  - Back-up Automated Controller, purge cassette, connector cable, and pVAD catheter.



# Abiomed Automated pVAD Controller

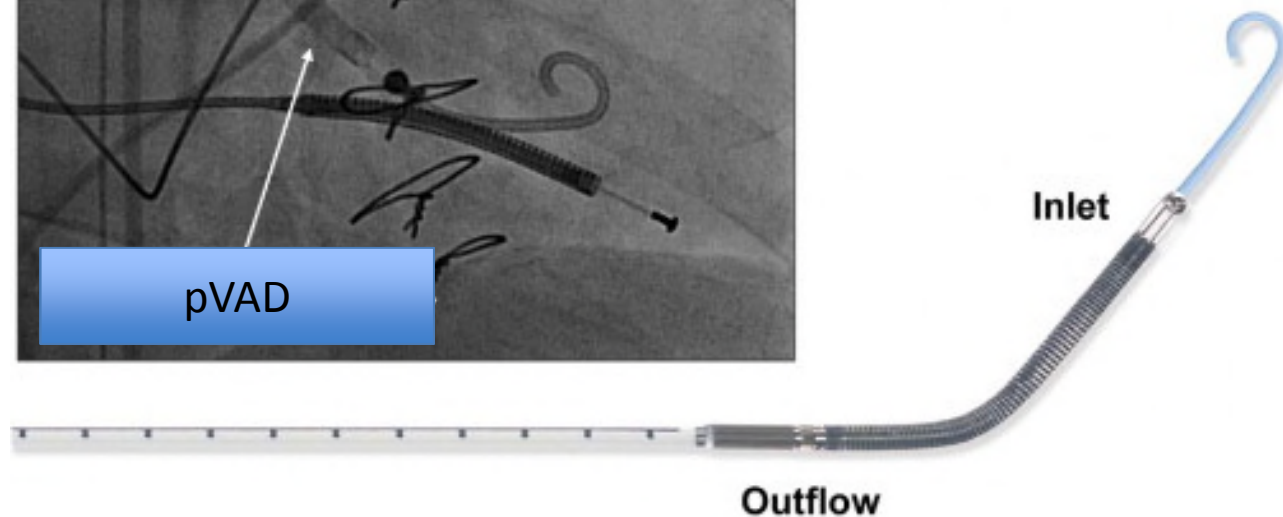
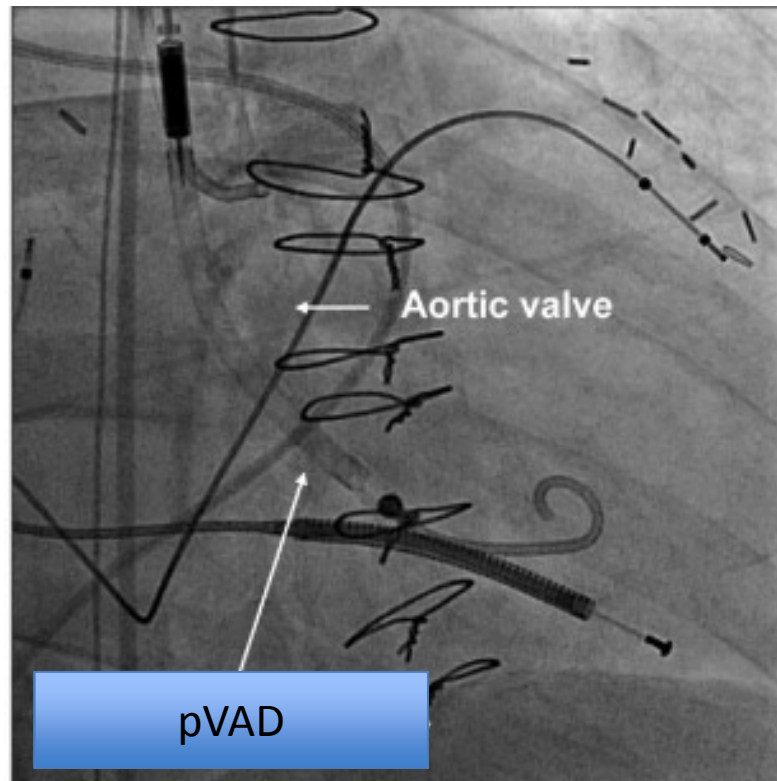


# Insertion

- Accessed through femoral artery in the cardiac catheterization lab or the OR.
- Fluoroscopy is required to guide placement of the pVAD catheter.
- After inserting the pVAD and until explant, maintain ACT at 160-180 seconds.
- Abiomed Controller, catheter, and accessories are 100% latex free.



# pVAD X-Ray Placement



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# How it Works

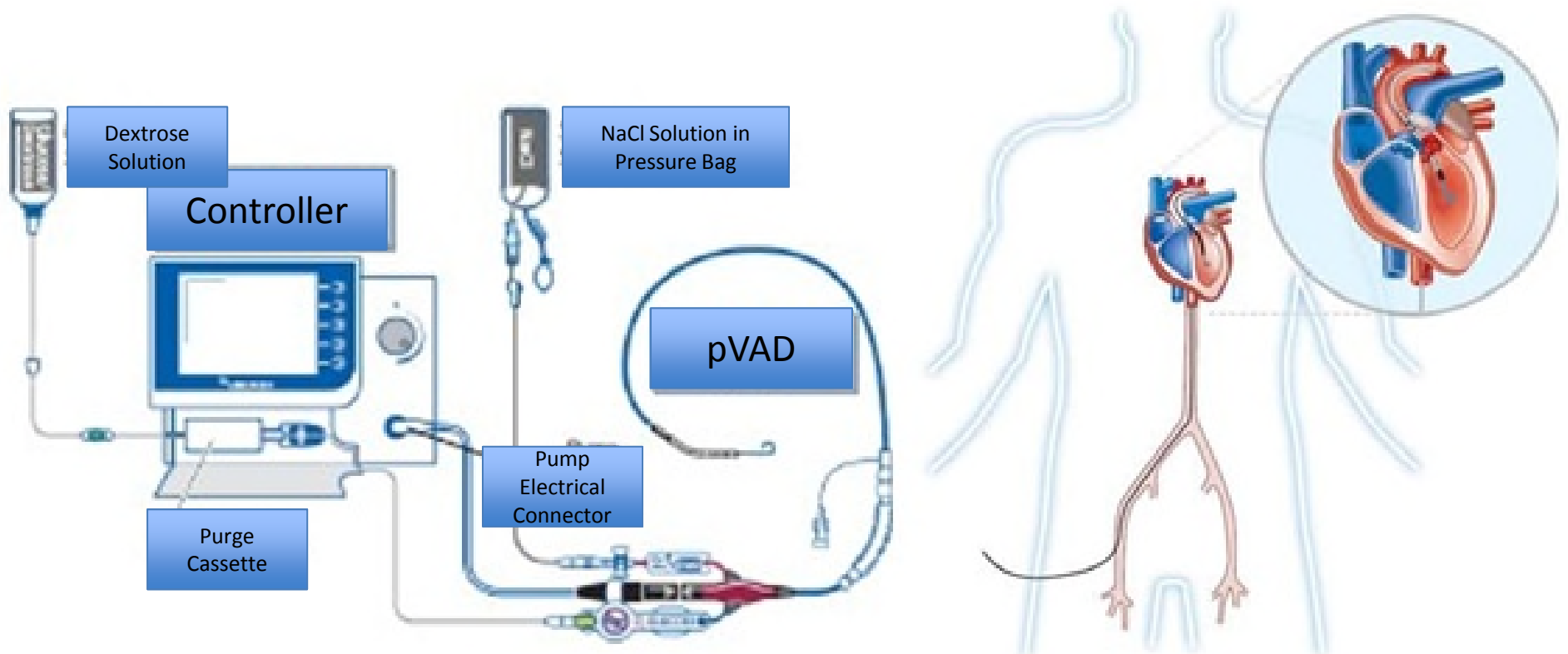
- pVAD's aspirate pre-determined L/min. of blood from the left ventricle through an inlet area near the tip and expel blood from the catheter into the ascending aorta rapidly unloading the left ventricle and increasing forward flow.
- Duration of support extends from hours to days.
- Stepwise weaning process should be done before discontinuance.

- Arroyo & Cook, 2011



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# Standard Configuration for pVAD



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# Nursing Considerations

- Care of patients with a pVAD are low volume, high risk process.
- All patients need to be cared for in an intensive care environment.
- In addition, all health care personnel caring for these patients must have specialized education and training.
- Vendor access must be 24/7 for troubleshooting/questions.



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# Nursing Plan of Care

- Potential for psychosocial issues for patients and families related to the intensive physical care, nursing, and psychological support.
  - Body and self – shock, restrictions, scarring, & infection.
  - Trust – machinery (keeping them alive, device failure, & staff knowledge).
  - Language barriers.
    - Chapman, Parameshwar, Jenkins, et al, 2007.



# Nursing Plan of Care

- Knowledge deficit patient and family.
  - Need for pVAD device in assisting the heart.
  - Understanding the need for the restriction in movement, bedrest, repositioning, frequency of assessments, daily equipment/tubing changes, nutritional needs, visitation, infection prevention, medication, & equipment/alarm monitoring.
  - Language barriers.
    - McCulloch, 2011

# Nursing Plan of Care

- Decreased cardiac output related to decreased cardiac contractility.
- Outcomes/goals:
  - Hemodynamic stability,
  - Warm & dry skin,
  - Urinary output,
  - Alert & oriented,
  - Arrhythmia stability.
    - McCulloch, 2011

# Nursing Plan of Care

- Potential for bleeding related to device placement and anticoagulation.
- Outcomes/goals:
  - Arterial access site dry without evidence of bleeding,
  - PTT between 45 & 55 seconds
  - Baseline Hgb, Hct, & platelet levels maintained.
    - McCulloch, 2011



# Nursing Plan of Care

- Potential for limb ischemia related to device placement.
- Outcomes/goals:
  - Maintenance of baseline circulation to affected extremity,
  - Distal pulses presence & quality maintained,
  - Sensation & movement maintained.
    - McCulloch, 2011



# Nursing Plan of Care

- Potential for hemolysis related to device placement.
- Outcomes/goals:
  - Maintenance of red blood cell integrity,
  - Maintenance of urine without red blood cells,
  - Plasma levels without hemoglobin, haptoglobin.
    - McCulloch, 2011

# Nursing Plan of Care

- Potential for infection related to device placement.
- Outcomes/goals:
  - No signs or symptoms of infection,
  - Strict aseptic technique utilized with dressing changes,
  - Adequate nutrition to promote healing,
  - Removal of device as soon as possible.
    - McCulloch, 2011



# Nursing Plan of Care

- Potential of device malfunction/device failure.
- Outcomes/goals:
  - No device failure,
  - Head of bed not elevated more than 30 degrees,
  - Assessed/documentated exact device placement at least once per shift.
  - Successfully troubleshoot alarms.
    - McCulloch, 2011

# Nursing Plan of Care

- Potential for discomfort related to pain, anxiety, bedrest.
- Outcomes/goals:
  - Comfortable,
  - Decreased anxiety,
  - Prompt administration of ordered analgesics & sedatives,
  - Repositioning as indicated.
    - McCulloch, 2011

# Care of the Patient w/ pVADs

- Initially and throughout pVAD support; assess and document:
  - Vital signs (every 15 minutes first hour, every 30 minutes second hour, and hourly, if stable).
  - Hemodynamic measurements.
  - Access site.
  - Distal pulses.
  - pVAD placement.
    - McCulloch, 2011

# Care of the Patient w/ pVADs

- Trace all tubing from the patient to its point of origin to make sure that the system is set up properly and all tubing is attached to its proper port.
- Label the tubing at the distal (near the patient connection) and proximal (near the source container) ends to reduce risk of misconnection.

– McCulloch, 2011

# Care of the Patient w/ pVADs

- Confirm the device's performance level setting with the physician's orders.
- The pVAD's performance level setting determines the number of times the pump rotates per minute and the rate of blood flow.
- Performance levels range from P0 to P9.

– Lippincott, Williams & Wilkins, 2016

# Care of the Patient w/ pVADs

- Monitor placement signal (catheter placement).
- Assess pressure bag over the flush solution every 1-3 hours to make sure the pressure is maintained at 300-350 mmHg.
- Assess vasoactive medications, as needed and prescribed.

– Lippincott, Williams & Wilkins, 2016



# Care of the Patient w/ pVADs

- Initiate pVAD flowsheet.
- Document parameters hourly:
  - Flow rate
  - Mean motor current
  - Purge flow rate
  - Purge pressure
  - Purge infusion volume
  - Heparin dosing
  - Purge dextrose dose.

– Abiomed, 2016



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# Care of the Patient w/ pVADs

- Document location of catheter at insertion site.
- Cardiopulmonary assessment every 2 hours.
- Document ACT and heparin dose
  - In cath lab, maintain ACT at 250-260 seconds.
  - Outside of cath lab, in ICU, maintain ACT between 160-180 seconds on a stable dose of heparin.
    - Abiomed, 2016



# Care of the Patient w/ pVADs

- Vascular assessments via Doppler or palpable pulse
  - Pre-insertion
  - Upon arrival to unit
  - Every hour when in place and after removal.
- Labwork should include:
  - PTT
  - CBC, platelets
  - CMP
  - Abiomed 2016

# Care of the Patient w/ pVADs

- Monitor urinary output hourly.
- Turn patient at least every 2 hours, as tolerated – to reduce risk of pressure ulcers.
- Provide nutritional support – orally, enterally, or parenterally.
- If patient transport is necessary within facility – confirm that the battery capacity is at 100%.

– Lippincott, Williams & Wilkins, 2016



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# Alarm Monitoring

- Alarms are divided into three levels of severity.
  - Advisory – white – notification.
  - Serious – yellow – may become harmful or life-threatening if not addressed immediately.
  - Critical – red – immediately harmful or life-threatening.
- Sound pressure of audible alarm indicators is  $>80\text{dBA}$

– Abiomed, 2016

# Special Considerations

- Complete bedrest.
- Head of the bed  $\leq$  30 degrees.
- Moving the patient:
  - Use care when moving the patient to prevent the catheter from moving out of position. This will cause a position alarm.
  - Patient may be log-rolled carefully side-to-side.
  - Do not twist chest or hips.
    - Lippincott, Williams & Wilkins, 2016

# Special Considerations

- Immobilize the affected leg.
- Bladder catheter is recommended for all patients unless contraindicated.
- Dressing changes at the site:
  - Sterile dressing changes immediately if damp or soiled.
  - Use chlorhexidine and transparent non-gauze dressings.
  - Use additional staff to stabilize catheter during changes.

– Lippincott, Williams & Wilkins, 2016



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# Nursing Implications

- Do **NOT** subject a patient who has been implanted with a pVAD to magnetic resonance imaging (MRI). The strong magnetic energy produced may cause the components to stop working.
- An MRI may also damage the electronics of the pVAD system.

– Abiomed 2016



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# Nursing Implications

- Monitor for hemolysis due to:
  - Pumping forces may damage blood cells and urine may turn dark or blood-colored.
  - Catheter position.
  - Pre-existing medical conditions.
  - Current procedures or treatments.
  - Small left ventricular volumes.
    - Abiomed 2016



# Nursing Implications

- Cardiopulmonary support (CPR) should be initiated immediately per hospital protocol if indicated.
- When initiating CPR, reduce the pVAD flow rate.
- When cardiac function has been restored, return flow rate to the previous level and assess placement signals on the controller.

– Abiomed 2016

# Nursing Implications

- During defibrillation, do **NOT** touch the pVAD Catheter, cables, or Automated Controller.
- Do **NOT** bend, pull, or place excess pressure on the catheter or mechanical components at any time.

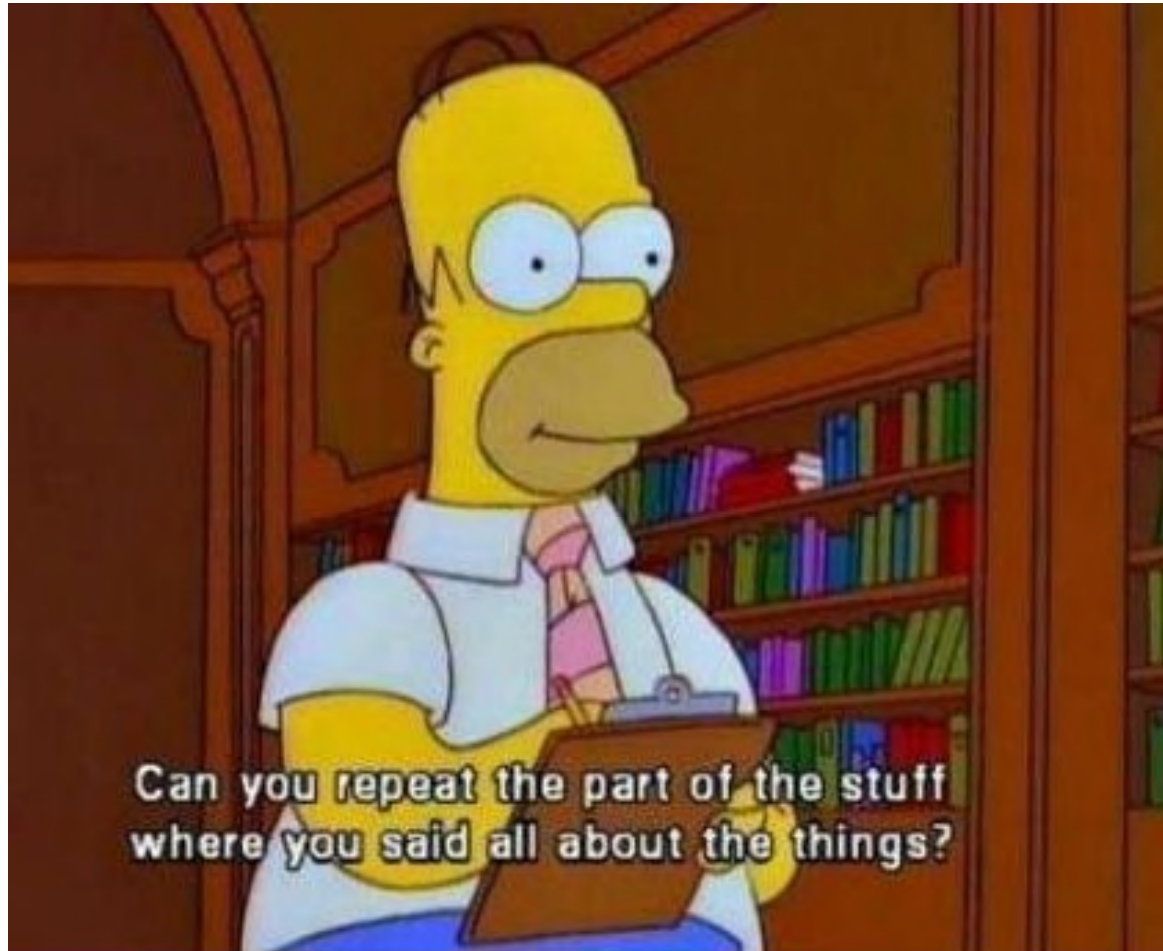
– Abiomed 2016

# Post Catheter Removal Care

- Although manual pressure is applied to the arteriotomy site for at least 40 minutes; monitor for rebleeding, hematoma, pseudoaneurysm.
- Follow-up per individual hospital protocol.
- Document site, cardiovascular status of affected limb, vital signs, and patient tolerance to procedure and education provided.

– Abiomed 2016

# Questions??



[www.UShumor.com](http://www.UShumor.com)



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# Case Study

- Discussion

# References

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