Implantable Ventricular Assist Devices

Aliases

Ventricular assist device (VAD), left ventricular assist device (LVAD), right ventricular assist device (RVAD), biventricular assist device (BiVAD)

Patient Care Goals

1. Rapid identification of, and interventions for, cardiovascular compromise in patients with VADs
2. Rapid identification of, and interventions for VAD-related malfunctions or complications

Patient Presentation

Inclusion Criteria

1. Adult patients that have had an implantable ventricular assist device (VAD), including a left ventricular assist device (LVAD), right ventricular assist device (RVAD), or biventricular-assist device (BiVAD), and have symptoms of cardiovascular compromise
2. Patients with VADs that are in cardiac arrest
3. Patients with VADs that are experiencing a medical or injury-related event not involving the cardiovascular system or VAD malfunction

Exclusion Criteria

Adult patients who do not have a VAD in place

Patient Management

Assessment

1. Assess for possible pump malfunction.
    a. Assess for alarms.
    b. Auscultate for pump sound "hum."
    c. Look for signs of hypoperfusion including pallor, diaphoresis, or altered mental status.
2. Assess the functionality of the VAD pump. If it has malfunctioned:
    a. Utilize available resources to troubleshoot potential VAD malfunctions and to determine appropriate corrective actions to restore normal VAD function:
        i. Contact the patient's VAD-trained companion, if available.
        ii. Contact the patient's VAD coordinator, using the phone number on the device.
        iii. Check all the connections to system controller.
        iv. Change VAD batteries, and/or change system controller if indicated.
        v. Have patient stop all activity and assess for patient tolerance.
        vi. Follow appropriate cardiovascular condition-specific protocol(s) as indicated.
3. Assessment Variations
    a. May not have a palpable pulse, utilize EKG to determine heart rate
    b. Blood pressures will have a narrow pulse pressure or may be undetectable by automatic cuffs.
        i. BPs should be obtained using a doppler and a manual cuff. BPs are referred to as MAPs and will only be one number. Goal MAP range is 60-80.
    c. Pulse Oximetery may be inaccurate

Treatment and Interventions

1. Manage airway as indicated.
2. Apply ECG cardiac monitoring
3. Establish IV access **[AEMT]**
4. Acquire 12-lead ECG
5. Assess patient for VAD-related complications or cardiovascular problems.
    1. VAD Malfunction -OR- Cardiovascular-related problem with functioning VAD: If the

patient's clinical condition and time allow, expedite transport to the medical facility where the VAD was placed or a hospital with a VAD program. If not able to transport to the hospital with VAD program, prefer transport to the highest-level cardiac facility.
    2. Non-cardiovascular-related problems with functioning VAD -AND- condition will likely require admission: If the patient's clinical condition and time allow, expedite transport to the medical facility where the VAD was placed or a hospital with a VAD program. Otherwise, transport to a facility that is appropriate for the patient's main presenting problem without manipulating the device
    3. Non-cardiovascular-related problem with functioning VAD -AND- condition will likely not require admission: Transport to a facility that is appropriate for the patient's main presenting problem without manipulating the device
    4. Consider consulting with the patient's VAD Coordinator AND/OR **Medical Control Consultation** to help determine the most appropriate destination.
        a. Transport to a local hospital with anticipated urgent inter-facility transport to a hospital with VAD program may be appropriate given time/distance factors.
        b. Hospitals with VAD programs: UW Hospital- Madison, Froedtert Hospital-Milwaukee, Aurora St. Lukes Hospital-Milwaukee, Mayo-Rochester, University of Minnesota-Minneapolis, Abbott Northwestern Hospital-Minneapolis
6. Hypoperfusion with functioning VAD:
    1. Administer normal saline bolus 20ml/kg IV/IO ***[AEMT]*** maximum of 1 liter) over less than 15 minutes, using a pressure bag.
    2. Repeat up to 3 times based on patient's condition and clinical impression for a total cumulative dose not to exceed 3 L.
7. If patient is in full cardiac arrest:
    1. Do not perform CPR if there is any evidence the pump is still functioning, the decision whether to perform CPR should be made based upon best clinical judgment in consultation with the patient's VAD-trained companion and the VAD coordinator (or on-line medical control if VAD coordinator unavailable)
    2. Initiate CPR **only** where:
        a. You have confirmed the pump has stopped and troubleshooting efforts to restart it have failed, **and**
        b. The patient is unresponsive and has no detectable signs of life, **and**
        c. Patient is a full code.
    3. CPR extremely likely not to be successful at resuscitating patient

Notes and Educational Pearls

- You do not need to disconnect the controller or batteries in order to:
    - Defibrillate or cardiovert
    - Acquire a 12-lead ECG.
- Automatic non-invasive cuff blood pressures may be difficult to obtain due to the narrow pulse pressure created by the continuous flow pump.
- Flow through many VAD devices is not pulsatile and patients may not have a palpable pulse or accurate pulse oximetry.
- The blood pressure, if measurable, may not be an accurate measure of perfusion.
- Ventricular fibrillation, ventricular tachycardia, or asystole/PEA may be the patient's "normal" underlying rhythm. Evaluate clinical condition and provide care in consultation with VAD coordinator.
- The patient's travel bag should accompany them at all times with back-up controller and spare batteries.
- If feasible, bring the patient's power module, cable, and display module to the hospital.
- All patients should carry a spare pump controller with them.
- The most common cause for VAD alarms are low batteries or battery failures.
- Although automatic non-invasive blood pressure cuffs are often ineffective in measuring systolic and diastolic pressure, if they do obtain a measurement, the MAP is usually accurate.
- Other VAD complications:

- Infection
- Stroke/TIA
- Bleeding
- Arrhythmias
- Cardiac tamponade
- CHF
- Aortic insufficiency

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914069—General-Medical Device Malfunction
- 9914065—General-Indwelling Medical Devices and Equipment

Key Documentation Elements

- Information gained from the VAD control box indicating any specific device malfunctions
- Interventions performed to restore a malfunctioning VAD to normal function
- Time of notification to and instructions from VAD-trained companion and/or VAD coordinator

Performance Measures

- Identify and mitigate any correctable VAD malfunctions.
- Perform CPR for patients in cardiac arrest when indicated.

References

1. Garg S, Ayers CR, Fitzsimmons C, et al. In-hospital cardiopulmonary arrests in patients with left ventricular assist devices. *J Card Fail*. 2014;20(12):899-904.
2. Mabvuure NT, Rodrigues JN. External cardiac compression during cardiopulmonary resuscitation with left ventricular assist devices. *Interact Cardiovasc Thorac Surg*. 2014;19(2):286-9.
3. Mechem M. Prehospital assessment and management of patients with ventricular-assist devices. *Prehosp Emerg Care*. 2013;17(2):223-9.
4. Shinar Z, Bellezzo J, Stahovich M, Cheskes S, Chillcott S, Dembitsky W. Chest compressions may be safe in arresting patients with left ventricular assist devices (LVADs). *Resuscitation.* 2014;85(5):702-4.