

Monterey County EMS System Policy



Policy Number: 4511
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MECHANICAL CIRCULATORY SUPPORT DEVICES

I. PURPOSE

To provide guidance and standardization regarding prehospital management of the patient with a Mechanical Circulatory Support (MCS) device.

II. OVERVIEW OF MCS DEVICES:

A. Ventricular Assist Device (VAD)

1. The VAD assists the native ventricle-pumping action and provides the cardiac output needed to survive.
2. These devices are either pulsatile or continuous-flow (non-pulsatile).
3. They are further divided into Left Ventricular Assist Devices (LVAD), Right Ventricular Assist Devices (RVAD), or Bi-Ventricular Assist Devices (BiVAD).
4. The most common device is a continuous-flow pump located in the patient's thorax or upper abdomen and attached to the patient's left ventricle and aorta (LVAD).
5. VAD patients typically have no pulse because the device is continuously flowing. This will alter your assessments, as pulse oximetry and blood pressure cuffs do not generally work accurately.
6. Properly functioning VADs emit a humming noise that can be auscultated with a stethoscope.
7. The "driveline" or cable connecting the VAD to an external controller usually exits the patient's left upper quadrant of the abdomen and attaches to the controller, which is worn on the patient's belt or in a fanny pack.
8. The controller is attached to a power source (either batteries or a 120-volt power source).

B. Total Artificial Heart (TAH)

1. The TAH is a pulsatile device that replaces both ventricles of the heart. It is attached to a power source called the "Freedom Driver" via two lines running from the chest through the abdomen to an external power source.
2. If the device is functioning, you will hear an audible "gallop" indicating that the device is pumping.
3. TAH patients will have a palpable pulse, so blood pressure and pulse oximetry measurements will be accurate.

C. VAD and TAH

1. Information regarding the type of device, the implanting hospital, and/or the VAD/MCS Coordinator contact telephone/pager number may be on a tag on the device, on the refrigerator, or on a medical alert bracelet.

2. Unless it is absolutely necessary, do not remove the sterile dressing covering the driveline at the abdomen and/or lower chest.

III. ASSESSMENT OF A PATIENT WITH AN MCS

A. Assess the patient prior to assessing the device.

1. VAD Patient

- a. Because these patients likely will have no pulses, use other parameters for assessment (*e.g.*, skin signs, level of consciousness, capillary refill, EtCO₂).

2. TAH Patient

- a. These patients will have a pulse and a blood pressure.

B. Use the AHA's C-A-B recommendations with one addition:

1. Circulation / ***Connections (device)***
2. Airway
3. Breathing

C. Assess to see if the device is working:

1. VAD patient: Auscultate the patient's chest and left upper quadrant of the abdomen. A "humming" noise indicates that the VAD is working.
2. TAH patient: An audible "gallop" indicates that the device is working. The sound can usually be heard without the assistance of a stethoscope.
3. Assess the device for any alarms:
 - a. VAD:
 - 1) The computer controller driving the device will be attached to the driveline. This controller should have a green light or should display the liters per minute of blood flow.
 - 2) The patient will either have the device plugged into batteries worn on his/her person or to a 120-volt power source.
 - b. TAH:
 - 1) The Freedom Driver will display battery status information as well as temperature or fault alarms.
4. Check all connections from the driveline to the device and the power source to ensure that nothing has become disconnected.
5. **Low battery charge is one of the most common reasons for a device to alarm or stop working properly. Always check the charge on the batteries to ensure that they are adequately charged, and replace them with a fully charged battery, if needed.**
6. Continue to assess the patient in conjunction with your VAD/TAH assessment.

IV. CONTACT BASE HOSPITAL

A. Base Hospital contact shall be made as early as possible. Consider establishing base contact while on scene unless transport time is greater than 20 minutes. Be prepared to give the following information to the Base Hospital:

1. Name of implanting hospital
2. Phone number or pager number for the VAD/MCS Coordinator
 - a. The Base Hospital will need to contact the VAD/MCS Coordinator to obtain directions to give to EMS personnel.
 - b. **Orders may only be accepted from the Base Hospital, not from the VAD/MCS Coordinator.**

V. MEDICAL CARE

A. All MCS patients:

1. Standard airway management
2. Administer oxygen as clinically indicated
3. IV initiation – prepare for orders for fluid resuscitation.
4. Full arrest – interventions are device dependent. See below for further details.
5. Pain management medications are appropriate.

B. VAD patients

1. An ECG will show the patient's native heart rhythm, which may not be indicative of their current circulatory status.
 - a. The patient could potentially be in a lethal heart rhythm, such as VT or VF while conscious.
2. Chest compressions, external pacing, cardioversion, and defibrillation are permissible.
 - a. Mechanical CPR devices should not be utilized unless cleared by the Base Hospital or MCS Coordinator.
3. Avoid Nitroglycerin and aspirin in VAD patients.

C. TAH Patients

1. An EKG will show asystole as these patients do not have ventricles.
2. DO NOT perform chest compressions, external pacing, cardioversion, or defibrillation.
3. TAH patients are instructed to take nitroglycerin SL if their systolic blood pressure is >140 mmHg. Contact the Base Hospital for orders.

D. For treatment questions, contact the Base Hospital.

VI. TRAUMA PATIENTS WITH AN MCS DEVICE

A. These patients are likely on anticoagulants. Maintain an elevated index of suspicion for internal hemorrhage.

- B. Let the Trauma Center know that the patient has an MCS device.
- C. Treat the trauma per protocol. Do not let the MCS guide the treatment.

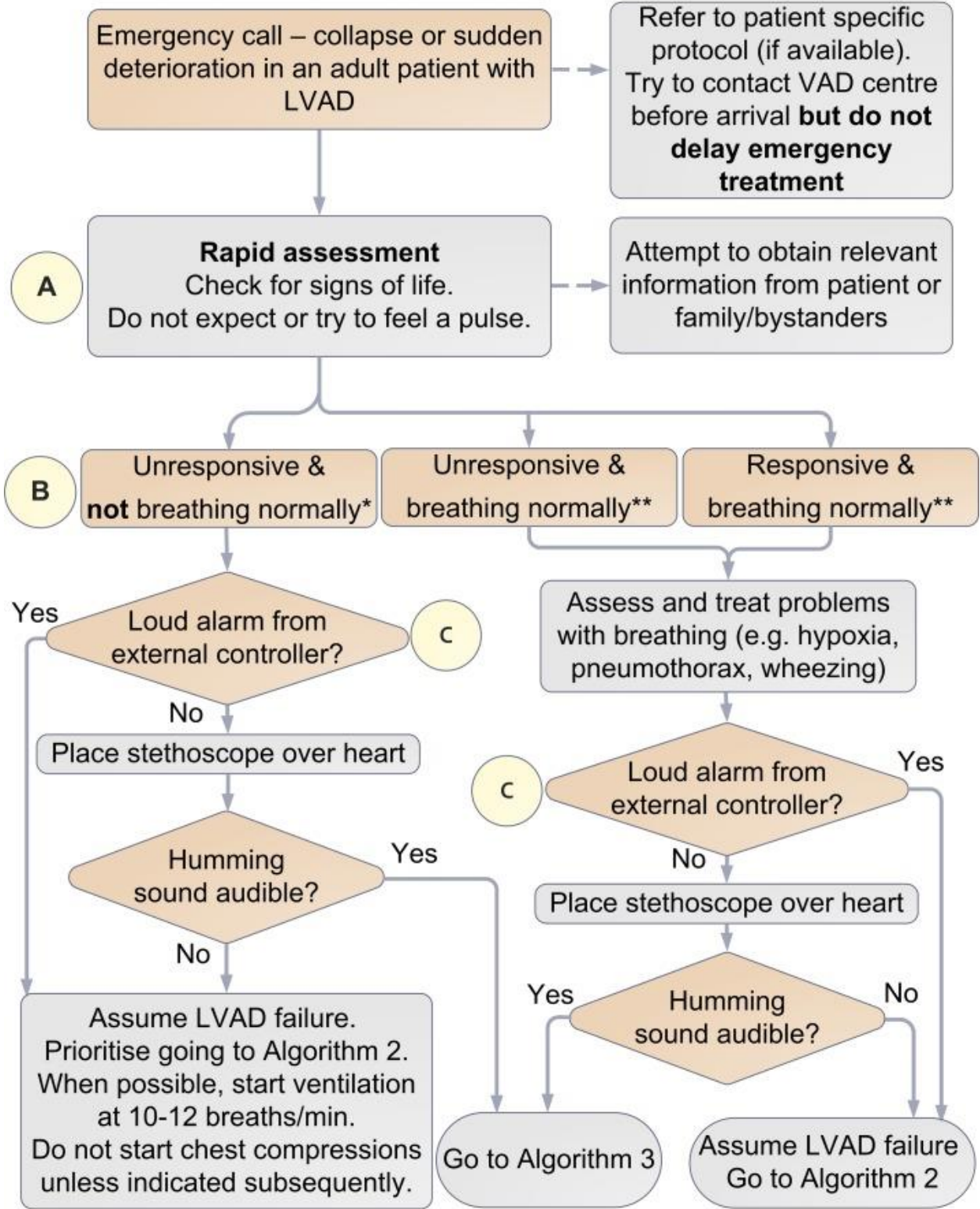
VII. TRANSPORT

- A. When possible, MCS patients should be transported to the implanting hospital.
- B. Follow Base Hospital order for transport.
 - 1. If the patient is in-extremis (*e.g.*, if CPR is indicated or if the patient is unconscious / unresponsive with poor skin signs or decreased capillary refill), transport to the closest emergency department.
- C. Always take all the patient’s additional equipment for the MCS with you to the hospital.
- D. Bring the patient’s caregiver with you to the hospital if they are present. They have been trained in the device and are important resources during the patient’s care.

VAD and TAH Differences

Ventricular Assist Device	Total Artificial Heart
Usually pulseless	Pulsatile
ECG shows native heart rhythm	ECG is meaningless since there are no ventricles
Pulse oximetry is inaccurate or absent	Pulse oximetry is accurate
Do not use nitroglycerin	Patients are ordered to use nitroglycerin for systolic blood pressure >140 mmHg
Chest compressions may be performed if needed	No chest compressions
May perform transcutaneous pacing, cardioversion, or defibrillation if indicated	Do NOT pace, cardiovert, or defibrillate
Auscultate the left upper quadrant of the patient’s abdomen for the “hum” of the VAD	The TAH’s Freedom Driver is audible without a stethoscope, and makes a “galloping” sound.
Usually have an ICD	Do not have an ICD
Obtaining a blood pressure measurement using a BP cuff and stethoscope is not possible. Use a non-invasive blood pressure device if available. A normal MAP is 70 – 90 mmHg.	Blood pressure is obtainable utilizing a normal sphygmomanometer.

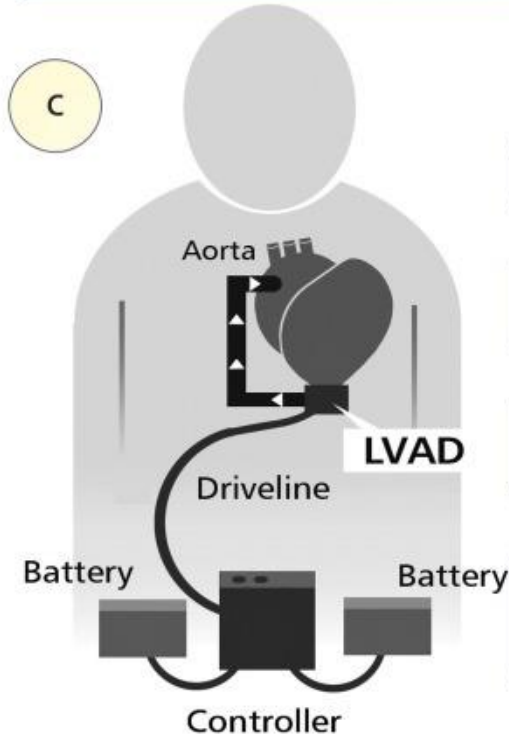
**Initial Assessment
of the Left Ventricular Assist Device (LVAD) Patient : Algorithm 1**



**'Not breathing normally' means not breathing or making only agonal gasps
 **'Breathing normally' includes breathlessness, rapid breathing and wheezing

LVAD troubleshooting : Algorithm 2

Use when directed from Algorithm 1



Diagrams of the four current LVAD systems are provided with these algorithms and show how to disconnect and reconnect the external components

No humming sound heard in chest or loud alarm from LVAD

Assume LVAD not working - try to restart

Expose controller, power source and driveline

Ensure driveline is firmly attached to controller

Ensure that all connections between the controller and a working power source (charged battery or mains power) are secure

Assess battery charge by pressing charge indicator button on battery. Replace discharged batteries with charged battery or mains power adaptor.

Attach a charged battery (or mains power) to spare controller. Detach driveline from old controller and connect it to new controller.

LVAD Restarted?
Humming sound audible?

No

Consider cable fracture. Quickly but gently manipulate driveline to try to restore broken contact. If successful, stabilise driveline with tape.

Go to Algorithm 3

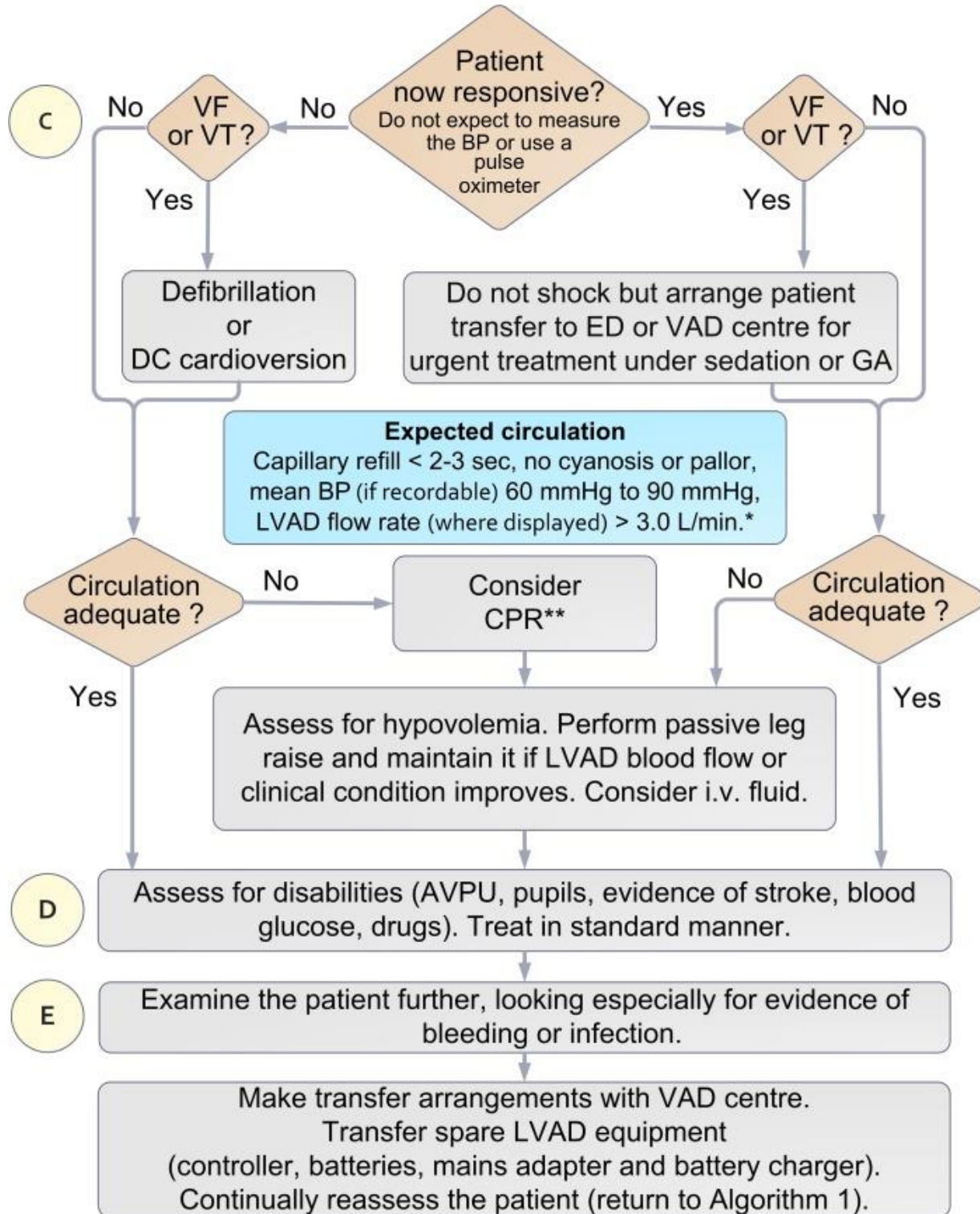
No

LVAD Restarted?
Humming sound audible?

Yes

Yes

**Ensuring adequate circulation
to sustain life : Algorithm 3**
Use when directed from Algorithm 1 or 2



* Persistently low LVAD flow or a "high power" alarm message on controller can indicate LVAD thrombosis

** Adrenaline may be given during CPR according to standard ALS guidelines

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Bowles CT, Hards R, Wrightson N, et al
Algorithms to guide ambulance clinicians in the management of emergencies in patients with implanted rotary left ventricular assist devices. *Emergency Medicine Journal* 2017;**34**:842-850

END OF POLICY