

Regionalized approach to emergency medical services training for the care of patients with mechanical assist devices

Advances in mechanical circulatory assist device technology have allowed dozens of patients with different types of devices to live in any community in the United States. Some of the newer devices pump blood continuously, resulting in patients without pulses. The mechanical circulatory assist device teams and emergency medical services providers in the mid-Atlantic region wondered how best to prepare the community to respond appropriately to emergencies in patients with these mechanical devices. (*Progress in Transplantation*. 2010;20:129-133)

Todd J. Van de Bussche, NREMT-P, FP-C, Lori G. Edwards, RN, MSN, Tonya Elliott, RN, MSN, CCTC, Suzie Harton, RN, MS, CCTC, Dennis Rivard, MA, CCP, Allen C. Wolfe Jr, RN, MSN, CCRN, CFRN, TNATC

Life Evac of Virginia, Glen Allen, VA (TJVdB), Inova Fairfax Hospital, Falls Church, VA (LGE, TE), Virginia Commonwealth University Health System, Richmond, VA (SH), The Johns Hopkins Hospital, Baltimore, MD (DR), MedSTAR Transport, Lanham, MD (ACW)

Corresponding author: Todd J. Van de Bussche, NREMT-P, FP-C, Clinical Educator, Life Evac of Virginia, 11207 D Nuckols Road, Glen Allen, VA 23059 (e-mail: tvandebussche@airmethods.com)

To purchase electronic or print reprints, contact:

The InnoVision Group
101 Columbia, Aliso Viejo, CA 92656
Phone (800) 809-2273 (ext 532) or
(949) 448-7370 (ext 532)
Fax (949) 362-2049
E-mail reprints@aacn.org

Notice to CE enrollees:

A closed-book, multiple-choice examination after this article tests your ability to accomplish the following objectives:

1. Differentiate between first-, second-, and third-generation mechanical assist devices that are used for heart failure patients
2. Evaluate the use of mechanical assist devices in destination therapy and bridge to transplantation
3. Describe the process for developing and educating emergency medical services about caring for patients with mechanical assist devices in emergency situations

Ventricular assist device (VAD) coordinators and emergency medical services (EMS) responders in the mid-Atlantic region recognized that the increasing numbers of patients with a VAD necessitated regionalization of the EMS response to VAD patients in the community. The VAD coordinators from 5 centers and EMS providers in Maryland, Virginia, and Washington, DC, met monthly for more than 18 months to create education materials for EMS providers to use in the field, to develop a patient identification alert system, and to provide classes for EMS responders. The team faced several challenges that provided opportunities

for streamlining the development of the training program; that experience may facilitate replication of our system for training EMS responders about VADs in other areas of the country. Addressing these challenges at the beginning of a program may make implementation of the program more efficient. In this article, we describe the creation of a task force to address the education of first responders and the rationale for our work.

Background and History of Mechanical Assist Devices

Mechanical circulatory assist devices, also known as VADs, are now an acceptable treatment for heart failure. The first of these devices were placed in the early 1980s.¹ The external hardware needed to run this early heart pump was so large that it prevented patients from being mobile. The developers of these “first-generation” devices thought that mimicking the heart’s pulsatile action was important, so these devices created a pumping action. The first generations of VADs are known as volume-displacement or pulsatile devices. These devices automatically fill a blood sac or chamber that can be compressed so that blood is ejected into the native circulation. Patients with first-generation devices always had a pulse. In the past 25 years, the devices and accessory components have become smaller and are considered wearable. With the more advanced devices, patients have become increasingly mobile and independent in their care.

Devices Approved for Discharge

September 1998 marked the date that the Food and Drug Administration (FDA) approved 2 models of first-generation VADs for use at home.² These devices allowed a small number of patients to leave the hospital. This important milestone meant that patients moved from the hospital setting into the community with VAD technology.³ Historically, VAD coordinators have provided education sessions for EMS providers at their training centers and/or fire stations. Albeit resource intensive, such training has been considered essential to ensuring that VAD patients have a safe transition to home. VAD coordinators across the country have worked with EMS providers to respond to emergencies related to the patient and the environment in the home setting.⁴

Devices Approved for Nontransplant Patients: Destination Therapy

The first major indication for the implantation of a VAD is called “bridge to transplant.” Devices were implanted into patients with heart failure who were waiting for a transplant but were so sick that they might die before a suitable donor was found. Because these patients did so well with an implanted VAD, physicians wondered if VADs could be implanted in patients who

were not considered good transplant candidates but needed mechanical support to treat heart failure.

In November 2001, the REMATCH study⁵ was published and showed a 48% reduction in the risk of death from any cause in patients who received left ventricular assist devices (LVADs) as compared with patients who received medical therapy. Survival rates at 1 year were 52% in the device group and 25% in the medical-therapy group, and the rates at 2 years were 23% and 8%, respectively. The conclusion was that use of an LVAD in patients with advanced heart failure resulted in a clinically meaningful survival benefit and an improved quality of life. An LVAD is an acceptable alternative therapy in selected patients who are not candidates for heart transplant.⁵ In November 2002, the FDA approved the use of VADs to treat patients who are not candidates for a transplant, calling it destination therapy.⁶ VADs are now used to treat end-stage heart failure that has not responded to optimal medical therapy.⁷

Next-Generation Devices

The first-generation devices have 2 major barriers to widespread use. The first issue is that the moving parts within the motor of the VAD cause device failure after a few years. The second issue is the size of the pump. In order to create pulsatile flow, the pump has to have a blood chamber that fills and empties. The pump housing must accommodate this blood chamber, making the housing several inches in diameter. Many women, children, and small-framed men are too small to be considered candidates for these first-generation devices.

Second- and third-generation devices were developed to address these problems. Unlike the volume displacement devices, which produce pulsatile flow, axial or centrifugal flow pumps generate continuous flow. These devices use a small shaft that rotates at high speeds and can provide up to 10 L of flow. The patients will not have palpable pulses unless their own heart is functional. The devices are smaller with fewer issues related to wear and tear; therefore, they can be implanted into more people and last longer.⁸ The trade-off is that these pumps use spinning parts to move blood, thereby creating continuous blood flow, resulting in a pulseless state.

In 2008, 2 major advancements for VAD devices were achieved: devices became smaller (thus smaller patients could use the devices) and the continuous-flow device was developed (which lasts longer than the first-generation devices). These developments mean that more people with heart failure can have a VAD implanted, which in turn means that more people with a VAD are living in the community without pulses for years. The number of patients with such implants is growing rapidly. The practice of relying on VAD

coordinators to train EMS providers and reach all members of a fire station has become an immense task because of the sheer number of patients who now are supported by mechanical circulatory assist devices. The VAD coordinators from hospitals and EMS providers in the mid-Atlantic Region (Maryland, Washington, DC, and Virginia) recognized the need for a formalized, cooperative approach to educating EMS providers. We created a task force that meets monthly to standardize educational materials and discuss strategies for providing in-service training.

Mid-Atlantic Regional Prehospital Task Force

The concept of meeting as a regional group was conceived by the chief flight nurse from one VAD facility and the VAD coordinator from another facility who shared the common responsibility for in-service training of EMS providers. The new paradigm that they were trying to foster was one of regional, cooperative, standardized education for prehospital care of VAD patients. The helicopter crews, the county EMS medical director, EMS providers who transported VAD patients, and the VAD coordinators from 2 hospitals were invited to attend a kickoff meeting. The initial goals of the group were to have uniform VAD policies for EMS providers, to provide standardized training opportunities for EMS providers, and to initiate dialogue with medical directors to facilitate approvals of policies and processes.

Challenges

Thirteen people from 2 states attended the first meeting. A challenge that presented itself during this initial dialogue was that although everyone agreed that the community must be prepared for VAD patients, the depth, scope, and format of the information to be provided was debatable. Several meetings focused on trying to build consensus around ideas being generated. In retrospect, some time designing program outlines and VAD policies for review may have limited the wide range of comments from the group and focused our efforts from the first meeting.

The group still meets at the facility most central to the other hospitals. A drawback to a physical meeting with attendees from miles away is that not everyone can attend every meeting. This results in a change in the focus at every meeting depending on who is present. Changing attendees with new dialogue is not necessarily bad, but it did prolong the resolution and completion of projects. The group is now considering teleconferencing. Group members do communicate between meetings via e-mails.

Collaboration

The news of the existence of the group spread and the attendees have expanded to include VAD coordi-

nators and EMS responders from Baltimore, Maryland, to Richmond, Virginia. The cooperation between centers and facilities has been a key to the success of the task force. Some of the task force members have attended training sessions at the other facilities. The exchange of ideas regarding teaching strategies and patient management has been invaluable.

Projects

Color Coding VAD Systems. As the regional VAD coordinators compared notes on the types of devices that each center was currently discharging, we realized that an EMS responder might encounter 7 different devices in this region. One dilemma was how to alert the first responders to the needs of this unique type of patient in the event that the patient was unable to speak for himself or herself. We developed a tagging system that provides emergency contact information that would provide a link from the EMS provider to the VAD coordinator. All major pieces of equipment are tagged with a sticker, and all carrying accessories (fanny pack and travel case) are tagged with traditional luggage tags.

The goal is to keep it simple. Information on the tag includes

- the implanting hospital
- what type of heart device patient has
- emergency contact number for the VAD coordinator

Having this information readily available has been valuable to us in numerous situations. The information is used by EMS responders and by our patients when they need to contact us. If all their equipment is tagged, patients always have our emergency contact information.

In addition, each device is color coded to enable visual recognition of the type of pump implanted. This color coding can be expanded to pre-discharge to assist the hospital staff in recognizing each device, as all centers in our area implant various types of devices. Hospital staff know the color code systems and can recognize the patient's pump and the options available for the particular device. Pumps, tags, and emergency information sheets are all color coded. This way, clinicians can access important information quickly by using the color coding system.

Because our patients travel throughout the area and many hospitals in the Mid-Atlantic region implant pumps, members of this task force all agreed to use the same color coding system. Thus local, county, and statewide emergency groups can use the same color coding system. Emergency field guides that have color tabs that correspond to the patient's tags would make it easier for emergency personnel to access information.

Quick Reference Guide for EMS Responders. These guides were developed to give EMS providers

a quick reference in case they have to treat a patient with a VAD implanted. The design of the reference guides used the same colors as the coding system. They also included the 10 questions to ask when treating a VAD patient and the correct answers.⁹

1. Can I do external CPR (cardiopulmonary resuscitation)?
2. If not, is there a “hand pump” or external device to use?
3. If the device slows down (low flow state), what alarms will go off?
4. How can I speed up the rate of the device?
5. Do I need to heparinize the patient if it slows down?
6. Can the patient be defibrillated while connected to the device?
7. If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?
8. Does the patient have a pulse with this device?
9. What are acceptable vital sign parameters?
10. Can this patient be externally paced?

The guides also described how to interpret basic alarms and corrective actions to take. All printed materials developed for training included the instruction “Never replace manufacturer’s recommendations.”

Presentation to the EMS Community

Finally, a plan was devised on how to present the information to the EMS community. A 4-hour program was developed that provides an overview of mechanical assist devices, explains the color coding system, presents the reference guides, and offers a hands-on demonstration. The large group is broken down during this session into smaller groups for the hands-on instruction given by a mechanical device coordinator who works with that device at their institution. This arrangement gives each person who attends these classes the needed time to ask what questions they may have for each device currently being discharged from the local institutions.

Conclusion

In the ever-changing environment of mechanical circulatory assist devices, a regional approach to providing VAD education to the health care providers

working on the front line appears to be effective and well received. With the increasing numbers of patients being discharged with such devices and the work load being placed on mechanical assist coordinators to educate EMS providers, this regional approach is a more economical way of providing this education.

This information was presented to a regional group once in June 2009 and the response was overwhelming. Requests have come from all realms of front line providers, from physicians working in emergency departments to EMS groups across the mid-Atlantic region. We have also worked directly with the manufacturers of mechanical circulatory assist devices to adopt the color coding system that we currently use with these devices. Consequently, the color coding system has started being used in other parts of the country as well.

Financial Disclosures

None reported.

References

1. Frazier OH, Rose EA, Macmanus Q, et al. Multicenter clinical evaluation of the HeartMate 1000 IP left ventricular assist device. *Ann Thorac Surg.* 1992;53(6):1080-1090.
2. Food and Drug Administration approval of VAD for home use. http://www.accessdata.fda.gov/cdrh_docs/pdf/P980012a.pdf. Accessed November 1, 2009.
3. Holmes E. Outpatient management of long-term assist devices. *Cardiol Clin.* 2003;21:93-99.
4. Bartell LA. Ventricular assist devices: preparing for catastrophic environmental events. *Prog Transplant.* 2005;15(3):264-270.
5. Rose EA, Gelijns AC, Moskowitz AJ, et al. Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure (REMATCH) Study Group. Long-term mechanical left ventricular assistance for end-stage heart failure. *N Engl J Med.* 2001;345(20):1435-1443.
6. Food and Drug Administration approval for use of ventricular assist devices for destination therapy. http://www.accessdata.fda.gov/cdrh_docs/pdf/P920014S016a.pdf. Accessed November 1, 2009.
7. Stahovich M, Chilcott S, Dembitsky WP. The next treatment option: using ventricular assist devices for heart failure. *Crit Care Nurs Q.* 2007;30(4):337-346.
8. Aggarwal S, Cheema F, Oz MC, Naka Y. *Long-Term Mechanical Circulatory Support.* New York, NY: McGraw-Hill; 2008:1609-1628.
9. Sweet L, Wolfe AC. Mechanical circulatory devices in transport. In: Holleran R, ed. *Patient Transport Principles and Practice.* 4th ed. St. Louis, MO: Mosby; 2010.

CE Test Test ID 4000-141: Regionalized approach to emergency medical services training for the care of patients with mechanical assist devices

Learning objectives: 1. Differentiate between first-, second-, and third-generation mechanical assist devices that are used for heart failure patients
2. Evaluate the use of mechanical assist devices in destination therapy and bridge to transplantation 3. Describe the process for developing and educating emergency medical services about caring for patients with mechanical assist devices in emergency situations

1. Which of the following is another name for a mechanical assist device?

- a. Ventricular assist device
- b. Aorta assist device
- c. Atrium assist device
- d. Coronary assist device

2. Which of the following is another name for first-generation mechanical assist devices?

- a. Pulse flow devices
- b. Volume displacement
- c. Center flow device
- d. False heart flow device

3. Who has primarily provided education to emergency services providers in the past?

- a. The patient's family members
- b. Emergency services (self-learning)
- c. The patient
- d. Ventricular assist device coordinators

4. First-generation mechanical assist devices have failed in patients because of which of the following problems?

- a. Moving parts within the device failed
- b. Drive line failure
- c. Batteries were too small to maintain the patient for longer than 2 hours
- d. Controller computer failure

5. Second-generation devices can flow how many liters of blood?

- a. 5
- b. 6
- c. 10
- d. 25

6. Which of the following describes how a color coding system was used to identify the equipment?

- a. Patients were tattooed
- b. Luggage tags were placed on all equipment
- c. Information cards were kept by the patient
- d. No further identification was needed

7. What information was included on the patient identification?

- a. Hospital where implant of the device took place
- b. Name of the patient's heart pump
- c. Emergency contact number for the ventricular assist device coordinator
- d. All the above

8. Axial flow pumps provide the patient with an improved cardiac output through which of the following?

- a. Volume displacement
- b. Centrifugal flow
- c. Pulsatile flow
- d. A blood chamber that fills and empties

9. The patient's pulse is not palpable when using which of the following mechanical assist devices?

- a. Syncardia's total artificial heart
- b. Volume replacement pumps
- c. Axial flow pumps
- d. Pulsatile flow pumps

10. The REMATCH trial demonstrated which of the following outcomes?

- a. Increased risk of infection with axial flow pumps versus volume displacement pumps
- b. Increased risk of mechanical failure with axial flow pumps versus volume displacement pumps
- c. Decreased risk of death with volume displacement pumps versus medically managed patients with heart failure
- d. Decreased risk of death with axial flow pumps versus medically managed patients

Test answers: Mark only one box for your answer to each question. You may photocopy this form.

- | | | | | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| 1. <input type="checkbox"/> a | 2. <input type="checkbox"/> a | 3. <input type="checkbox"/> a | 4. <input type="checkbox"/> a | 5. <input type="checkbox"/> a | 6. <input type="checkbox"/> a | 7. <input type="checkbox"/> a | 8. <input type="checkbox"/> a | 9. <input type="checkbox"/> a | 10. <input type="checkbox"/> a |
| <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b | <input type="checkbox"/> b |
| <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c | <input type="checkbox"/> c |
| <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d | <input type="checkbox"/> d |

Test ID: 4000-141 Form expires: June 1, 2012 Contact hours: 1.0 ABTC CCTC Fee: NATCO members, \$0; nonmembers, \$35 Passing score: 7 correct (70%)

NATCO,
 The Organization for
 Transplant Professionals

 P.O. Box 15384
 Lenexa, KS 66285-5384
 Fax: (913) 895-4652

Program evaluation

	Yes	No
Objective 1 was met	<input type="checkbox"/>	<input type="checkbox"/>
Objective 2 was met	<input type="checkbox"/>	<input type="checkbox"/>
Objective 3 was met	<input type="checkbox"/>	<input type="checkbox"/>
Content was relevant to my nursing practice	<input type="checkbox"/>	<input type="checkbox"/>
My expectations were met	<input type="checkbox"/>	<input type="checkbox"/>
This method of CE is effective for this content	<input type="checkbox"/>	<input type="checkbox"/>
The level of difficulty of this test was:		
<input type="checkbox"/> easy <input type="checkbox"/> medium <input type="checkbox"/> difficult		
To complete this program, it took me _____ hours/minutes.		

Name _____

Address _____

City _____ State _____ ZIP _____

NATCO ID (if applicable) _____ Phone () _____

If applicable: State(s) of licensure _____

License number(s) _____

ABTC certification number _____

CPTC, expiration _____

CCTC, expiration _____

CCTN, expiration _____

CTP, expiration _____

E-mail address: _____