Patients with end-stage heart failure have little cause for optimism. Despite progress in pharmacological treatment, mortality rates for patients with advanced heart failure remain as high as 50% annually. In 1998, 4.7 million persons in the United States had heart failure, and cardiovascular disease was the leading cause of death for persons more than 65 years old.1

Treatment choices for heart failure include pharmacological therapy and surgical intervention. Clinical trials established that mortality can be reduced with the use of certain medications, such as β-blockers,2 angiotensin-converting enzyme inhibitors,3 and spironolactone.4 These drugs affect the responses of the sympathetic nervous system to heart failure, regulate neurohormonal progression of the disease, and decrease circulating volume.

Other patients with heart failure require surgical intervention to improve ejection fraction and reduce the signs and symptoms of the disease. For example, a patient with ischemic cardiomyopathy may undergo coronary artery bypass grafting to directly increase blood flow to the myocardium. Improved myocardial perfusion leads to better cardiac muscle performance. Repair or replacement of defective cardiac valves may also be used to augment cardiac output.

Heart transplantation has been used to treat patients with end-stage heart failure since 1967. The procedure, as well as management of these patients, has undergone many revisions. Although transplantation is an effective therapy in certain patients, the supply of acceptable donor hearts remains insufficient to meet the demand.5,6 Alternatives to transplantation include cardiac myoplasty and ventricular volume reduction surgery. In cardiac myoplasty, the latissimus dorsi muscle is wrapped around the dilated ventricles. Pacing leads are implanted into the muscle, and during the

Telemetry to Home: Successful Discharge of Patients With Ventricular Assist Devices

Maureen McCafferty, RN, MS
Diana Sorbellini, RN
Pamela Cianci, RN-C, MSN

To purchase reprints, contact The InnoVision Group, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 809-2273 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
next few weeks, the pacemaker stimulates it to contract, providing active support to the dilated ventricle. Ventricular volume reduction surgery, known as the Batista procedure, involves resection of the dilated left ventricle. The decrease in the size of the cavity improves cardiac output.

Myoplasty and the Batista procedure are palliative measures and benefit some patients. However, no single procedure benefits all patients with end-stage heart failure. Consequently, current research focuses on the application and success of mechanical assist devices.

VENTRICULAR ASSIST DEVICES

Ventricular assist devices (VADs) are an option for patients whose hearts are in critical stages of failure. The purpose of a VAD is to provide mechanical circulation when the natural heart cannot maintain adequate cardiac output. The benefits of mechanically unloading the injured ventricle have been described7,8 (Table 1).

All VADs have 3 component parts: the cannula, the blood pump, and the external power source. Blood exits the ailing ventricle via a surgically implanted cannula and flows to the blood pump, which is attached to the power source. When the blood pump is full, the power source directs the pump to eject the stroke volume back into the body through a cannula inserted into the aorta or the pulmonary artery, depending on which ventricle is being unloaded. In this way, the VAD delivers adequate, consistent stroke volumes to the vital organs.

The VAD can be inserted into the right ventricle, the left ventricle, or both ventricles, depending on the patient’s condition. VADs are either fully implantable or the external pulsatile type.7

Fully implantable devices such as the Novacor (Baxter International, Deerfield, Ill) and Heartmate (Thoratec Corporation, Pleasanton, Calif) VADs have an internal pumping chamber in the abdominal wall. These VADs are large and are suited for patients whose body size can accommodate them. The batteries that power the devices can be worn in a harness. In 1998, the Novacor and Heartmate VADs were approved by the Food and Drug Administration for use in patients waiting for cardiac transplantation who are discharged from the hospital. Several patients with these devices have been successfully discharged to outpatient care centers or to home to wait for donor hearts to become available.5,8,9

The external pulsatile VADs are made by Thoratec and Abiomed Cardiovascular Inc (Danvers, Mass). With these VADs, the pumping chamber is on the outside of the body and is attached to the power source (Figure 1).

Clinical research on VADs has been directed at developing better technology, providing for long-term use, and expanding use of outside cardiac transplantation programs. One example of better technology is related to the external power source. Previously, any patient with a VAD was connected to a large, bulky power source that made ambulation difficult. The development of a portable driver addressed this issue. The portable driver is a compact and lightweight external power source. It has 2 rechargeable batteries that are the primary power source for the pump when the patient is ambulating. Figure 2 shows both types of the Thoratec drivers side by side.

DEVELOPMENT OF A TELEMETRY VAD PROGRAM

Advocate Christ Medical Center in Oak Lawn, Ill, has an active cardiovascular surgery program and extensive experience in the management of patients with end-stage heart failure. In 2001, more than 1100 open heart surgeries were performed at the center, 984 patients were discharged with a

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Benefits of the use of ventricular assist devices7,8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease in left ventricular mass</td>
<td></td>
</tr>
<tr>
<td>Regression of left ventricular hypertrophy</td>
<td></td>
</tr>
<tr>
<td>Reversal of ventricular dilatation</td>
<td></td>
</tr>
<tr>
<td>Improved efficiency of myocardial mitochondria</td>
<td></td>
</tr>
<tr>
<td>Reduction in neurohormonal derangements in heart failure such as abnormalities in</td>
<td></td>
</tr>
<tr>
<td>Plasma renin</td>
<td></td>
</tr>
<tr>
<td>Angiotensin II</td>
<td></td>
</tr>
<tr>
<td>Epinephrine</td>
<td></td>
</tr>
<tr>
<td>Norepinephrine</td>
<td></td>
</tr>
<tr>
<td>Arginine vasopressin</td>
<td></td>
</tr>
<tr>
<td>Atrial (type A) and brain (type B) natriuretic peptides</td>
<td></td>
</tr>
</tbody>
</table>
primary diagnosis of heart failure, and the outpatient heart failure clinic logged 4092 patient visits. In an effort to meet the needs of these patients, a program was proposed that would expand the use of VADs to include use of the devices at outside centers as bridges to transplantation and for support after cardiotomy.

Operational issues of the existing VAD program were similar to those described in the transplant literature. Patients with VADs were housed in the intensive care unit (ICU) for the duration of their use of the devices or until they were transferred to another hospital for transplantation. Demand for ICU beds at the medical center is high, and patients with VADs whose conditions were stable occupied beds that were needed for more acutely ill patients. In addition, the length of stay for patients with VADs who are waiting for transplantation is 4 to 6 months.9

To increase the number of patients treated with VADs, we developed a cost-effective program in which the majority of care of patients with these devices is provided on a telemetry unit. A review of the literature, indicating success with telemetry-based VAD programs at transplantation centers,10,11 supported this decision.

Development of the telemetry program included agreements on several criteria. Placement of a VAD was considered suitable for the following:

- patients with severe postoperative cardiogenic shock after cardiotomy who cannot be weaned from the cardiopulmonary bypass machine after a cardiac surgical procedure,
- patients with end-stage cardiomyopathy with New York Heart Association class III or class IV heart failure whose condition has deteriorated acutely into a low cardiac output state despite maximal medical therapy, and
- survivors of myocardial infarction who remain in cardiogenic shock or refractory heart failure.

Patients are transferred to the telemetry unit if they

- are extubated,
- have been weaned from vasoressors,
- have no active bleeding,
- have no evidence of sepsis,
- have stable vital signs,
- have stable cardiac rhythm,
- can be cared for by staff who have completed VAD competency assessment, and
- have a peripherally inserted central catheter.

Table 2 gives the policies and procedures of the medical center for the care of patients with VADs. The cardiac surgical team chose the Thoratec VAD as the device to be used. At the time this article was written, the Thoratec device was the only one approved by the Food and Drug Administration for both use as a bridge to transplantation and support after cardiotomy.12

Our goal was to provide care for up to 4 patients with VADs on the telemetry unit at the same time.

The telemetry program had many benefits. For the hospital, ICU beds and staff were used more appropriately, and the costs of providing high-level care were reduced. Benefits for the patients were more open visitation, improved outcomes because of a structured rehabilitation program, the potential to leave the hospital for short trips, and a focus on recovery. The nurses received an opportunity to acquire additional critical care skills, participate in clinical research, and develop long-term nurse-patient relationships.

### Structural Issues

Our next priority was to upgrade selected physical features

---

**Table 2** Content of policies and procedures developed for care of patients with a ventricular assist device on the telemetry unit at Advocate Christ Medical Center

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile dressing change</td>
<td></td>
</tr>
<tr>
<td>Physical therapy and exercise plan</td>
<td></td>
</tr>
<tr>
<td>Administration of blood products</td>
<td></td>
</tr>
<tr>
<td>Documentation of ventricular assist device operations</td>
<td></td>
</tr>
<tr>
<td>Routine monitoring protocol (includes vital signs and plan for routine laboratory and radiology tests)</td>
<td></td>
</tr>
<tr>
<td>Protocol for outside excursions off hospital property with safety plan</td>
<td></td>
</tr>
<tr>
<td>Protocol for walking outside on hospital property</td>
<td></td>
</tr>
</tbody>
</table>

on the existing telemetry unit. Structural issues included designation of specific private rooms for the care of patients with VADs and the purchase of some new equipment. Stationary bikes and a treadmill were added to an available room for unit-based exercise. A small charting station with a computer was created for the nurses. Overall, the physical changes to the existing care area were minimal.

Development of the Nursing Staff

Upgrading the skills of the telemetry nursing staff to include management of patients with VADs was of utmost importance. Experienced telemetry nurses were eligible for VAD certification if they had successfully completed the critical care course, a requirement for the unit. In addition, leadership skills such as being in charge, acting as a preceptor, and participating on unit committees were required. Involvement in the program was voluntary, and nurses were recruited from all shifts. A core group of 3 to 4 nurses per shift served as unit-based preceptors and experts.

The learning needs of the telemetry staff were ascertained (Table 3), and an instructional program of 4 hours of classroom time was set up to meet those needs. Each nurse then spent a minimum of 8 hours providing direct care to a patient with a VAD in the ICU. The nurses were required to successfully complete a VAD competency assessment (Table 4). The competency assessment is completed annually to ensure continued proficiency. The standards of care are available on the unit for nurses to review at any time.

**NURSING CARE OF PATIENTS WITH VADs**

When medically indicated, patients with VADs are extubated, and intravenous pharmacological support is discontinued. A peripherally inserted central catheter replaces the invasive catheters. The patients are assessed to determine whether they are candidates for the Thoratec TLC-II portable driver (Table 5), because this driver is used on the telemetry unit. The patients are then prepared for transfer out of the ICU.

Early in the implementation phase, a recurrent issue related to patients’ care was identified. The first request that many patients have after implantation is for a shower. This option was not available in the ICU, so the following technique was developed on the basis of the product guidelines:

1. The VAD pumps and the electric and pneumatic lines are covered in towels and wrapped in large plastic bags.
2. The dressing covering the insertion site is covered completely with plastic and tape.
3. The peripherally inserted central catheter is secured.
4. After the shower, a sterile dressing change is performed.

Several patients have described the ability to shower as being a major turning point in their recovery.

Fatigue is common in the recovery phase, so periods of uninterrupted rest and relaxation are essential. Once their condition is stable, the patients are not routinely awakened from 10 PM to 6 AM for monitoring of vital signs. Blood cell counts are done weekly and as needed. Treatment of symptomatic anemia is required to combat fatigue. Weekly laboratory tests include assays of serum levels of electrolytes, urea nitrogen, creatinine, and albumin; liver function tests; and prothrombin time. The Thoratec blood pump has mechanical valves, so patients are given warfarin to prevent formation of thrombus. A chest radiograph is obtained each week, and any additional testing is based on patients’ individual needs.

---

**Table 3** Learning needs of telemetry nurses before implementation of a ventricular assist device program

<table>
<thead>
<tr>
<th>Equipment related</th>
<th>Purpose of device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function of device</td>
<td>Troubleshooting alarms</td>
</tr>
<tr>
<td>Patient care issues</td>
<td>Sterile dressing changes</td>
</tr>
<tr>
<td>Signs and symptoms of infection</td>
<td>Nutritional needs</td>
</tr>
<tr>
<td>Psychosocial challenges</td>
<td>Policies and procedures</td>
</tr>
<tr>
<td>Pharmacological challenges</td>
<td>Patient teaching needs</td>
</tr>
<tr>
<td>Physical therapy and exercise plan</td>
<td>Cardiac testing</td>
</tr>
</tbody>
</table>

**Table 4** Content of competency assessment for care of patients with ventricular assist devices at Advocate Christ Medical Center

Candidates for assist devices
Indications
Machine function
Modes of operation
Troubleshooting alarms
Battery changes
Postoperative patient management
Postoperative complications and their management
Documentation
Emergency procedures

Nutritional support is crucial. Placement of a VAD can leave patients with feelings of early satiety. Frequent, small meals are sometimes helpful. A dietician is consulted to plan a diet that ensures proper amounts of sodium, fat, protein, and carbohydrates. Determinations of caloric energy intake are done during phases of poor appetite. Patients’ family members are encouraged to bring in favorite foods. Weight control is also addressed when indicated.

Fluid balance is monitored closely because VAD function is correlated with volume status. Patients are taught to chart their own intake and output and daily weight. Patients with heart failure traditionally are treated with fluid restriction combined with aggressive diuresis. Once the VAD is implanted, cardiac output and stroke volume improve, and the need for diuretics can actually decrease. In fact, many patients need to increase fluid intake to maintain adequate flow through the VAD. Alarms on the VAD may be triggered by hypovolemia and decreased cardiac output. Educating patients about fluid volume management is essential, but understanding such management can be difficult for patients with chronic heart failure.

**REHABILITATION**

Many VAD patients have been ill for a long time and are deconditioned. They must be returned to the best possible physical condition before transplantation or weaning from the VAD is attempted. The patients need motivation and encouragement as they progress through the program.

Before any ambulation, the blood pump must be secured. The standard telemetry pouch provides sufficient support and prevents migration of the cannula. Initial physical therapy is done at the bedside every day for the first week. Patients then travel to the physical therapy department 3 to 5 times a week. Each patient participates in an individualized structured program designed to build strength and endurance. This program is supplemented with exercise on the unit. Patients are encouraged to use the treadmill or stationary bike twice a day, working up to 30-minute sessions. Additionally, patients use free weights and rubber bands and do leg-strengthening and stretching exercises. Patients document their own progress; their goal is to surpass the previous day’s achievement.

The patients are expected to progress from ambulation on the unit to excursions outside the hospital. Once a patient is making progress in physical therapy, an excursion wish list is developed. Examples of successful excursions include going to a movie, dining in a restaurant with a spouse, and attending family functions and church services. Every effort is made to accommodate patients’ requests. The excursion checklist (Table 6) is reviewed before each outing to ensure patients’ safety.

**PSYCHOLOGICAL RECOVERY**

The long hospital stay typically leaves plenty of time for the patients to consider all the changes in their lives. Their next step may be cardiac transplantation, discharge home, and/or limited life expectancy. Patients need to learn the coping skills necessary to face whatever lies ahead. Common fears include the following:

- loss of independence,
- dependence on machinery,
- fear of incompetence,
- financial issues,
- fear of being a burden to family members,
- fear of dying,
- body image issues,
- fear of loss of control, and
- dependence on nursing staff.

Psychiatrists, psychiatric clinical nurse specialists, and clergy are used to assist the patients as needed. Former VAD patients have returned to provide support and answer questions for prospective VAD patients. Successful

---

**Table 5** Inclusion and exclusion criteria for use of the TLC-II portable driver

<table>
<thead>
<tr>
<th>Inclusion</th>
<th>Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed consent</td>
<td>Continuous cardiac monitoring required</td>
</tr>
<tr>
<td>Currently supported with the Thoratec ventricular assist device dual driver</td>
<td>Active clinical infection</td>
</tr>
<tr>
<td>Hemodynamically stable</td>
<td>Chronic liver disease</td>
</tr>
<tr>
<td>No need for blood volume replacement or titration of vasopressors</td>
<td>End-stage renal disease requiring hemodialysis or hemofiltration</td>
</tr>
<tr>
<td>Surgical wounds healed sufficiently to allow ambulation without assistance</td>
<td>Increased plasma-free hemoglobin</td>
</tr>
<tr>
<td>Emotionally and mentally stable</td>
<td>Concurrent support from other mechanical assist devices</td>
</tr>
</tbody>
</table>

---

*Critical Care Nurse* Vol 22, No. 3, JUNE 2002 47

Downloaded from http://ccn.aacnjournals.org/ by AACN on September 26, 2017
Excursions outside the hospital are a psychological boost for the patients and their families. Other strategies include visits from family pets and attendance at religious services. Finally, antianxiety and antidepressant medications are used when warranted.

**PATIENTS’ EDUCATION**

Patients in the telemetry-based program are encouraged to become experts in their own care. Becoming an expert is an important way to decrease their feelings of dependency on the staff; it is also a challenge. Because patients with VADs have variable levels of formal education and learning styles, a combination of methods such as one-on-one teaching, printed materials, videos, and having the patients demonstrate certain procedures is used. Self-tests are administered throughout the recovery phase, and educational efforts are refocused according to each patient’s knowledge deficits.

The patients are taught to change the VAD power source and batteries and to troubleshoot problems with the equipment. They also must be able to change their dressings. Initially, dressing changes require use of sterile technique. Over time, if evidence of good wound healing without signs of infection is apparent, the physician may order a modification to use of clean technique.

**DISCHARGE OF A PATIENT WITH A VAD**

The institutional review board at Advocate Christ Medical Center approved our participation in a clinical trial to evaluate patients who are discharged to home with the Thoratec TLC-II portable driver. Potential candidates for discharge with a VAD must meet certain criteria (Table 7). Patients who qualify for this trial are independent in their care and have a designated caregiver.

The role of the caregiver varies depending on the ability of the patient to provide self-care. Having a caregiver is desirable but not essential. The caregiver does not have to be with the patient 24 hours a day if the patient can provide self-care, allowing the patient to have autonomy and decreasing the caregiver’s potential for stress. However, the caregiver must be available, be competent in an emergency, and be willing to take an active role if necessary.

At our hospital, the VAD nurse specialist provides training and support for the caregivers. Like the patients, caregivers learn about common alarms and troubleshooting, dressing changes, role of exercise, medications, emergency plans, and changing the VAD batteries. The trial requires each caregiver to attend 3 outside excursions with the patient and nurse. Before discharge, the caregiver and the patient must complete 2 independent outside trips of at least 3 hours each for the purpose of demonstrating competence.

**CONCLUSION**

The future management of patients with end-stage heart

---

**Table 6** Excursion checklist for patients with ventricular assist devices

- Physician’s order
- Informed consent
- Fully charged batteries
- Backup TLC-II portable driver
- Extra batteries
- Electrical hookup cord
- Two emergency hand pumps
- Flashlight
- Water
- Cellular phone
- One certified registered nurse
- Vital signs stable
- Pain adequately controlled
- Two-way radio if ambulating on hospital grounds
- No active alarms on the portable driver
- Functional external power supply available
- Optimal settings selected by using the system computer

**Table 7** Criteria for selection of patients for potential discharge with a ventricular assist device

- Independence in activities of daily living
- Identification of a competent caregiver
- Stable hemodynamic status
- Demonstrated ability to perform dressing change
- Competence in the following areas:
  - Signs and symptoms of infection
  - Battery changes
  - Responses to machine alarms
  - Machine function
  - Indicators of fluid balance
  - Medication and follow-up protocols
  - Emergency responses
failure promises to be exciting. The use of VADs is a viable adjunct to medical therapy. The program at Advocate Christ Medical Center has been successful in providing care to these patients on a telemetry unit and in discharging patients with VADs when the patients are able. Use of VADs as long-term therapy, also known as destination therapy, was recently evaluated. In the Randomized Evaluation of Mechanical Assistance in the Treatment of Heart Failure trial, patients selected for

CASE STUDY

The VAD telemetry program has been under way for more than 2 years. The following case study is an example of a patient who was successfully discharged to home with a VAD in place in the left ventricle and a TLC-II portable driver.

P.U., a 45-year-old woman, was admitted to the hospital because of increasing shortness of breath. Her medical history included asthma, obesity, and smoking 1/2 pack of cigarettes per day for 20 years. She had quit smoking 6 months before this admission. Both of her parents had died of coronary artery disease at an early age. She did not drink alcohol, had never married, and had no children.

A 12-lead electrocardiogram showed sinus rhythm with nonspecific S-T changes and a left bundle branch block. No prior electrocardiograms were available for comparison, so it was not known if the left bundle branch block was a new finding. An echocardiogram revealed severe systolic dysfunction consistent with cardiomyopathy. The results of cardiac catheterization confirmed the presence of severe, multivessel coronary artery disease. The left main artery had minor amounts of plaque. Blockage of other arteries was as follows: left coronary artery, 90%; ramus branch, 90%; septal branch, 100%; circumflex artery, 100%; and right coronary artery, 100%. Some collateral flow was present. The ventriculogram showed a grossly enlarged left ventricle with an ejection fraction of 0.10. The anterobasal and anterolateral segments were severely hypokinetic, with apical dyskinesia. Coronary artery bypass grafting to all these arteries was recommended.

The following day P.U. underwent coronary artery bypass grafting.

Initially, discontinuation of the cardiopulmonary bypass pump was without difficulty, but P.U.’s condition deteriorated during the next 50 minutes. Cardiopulmonary bypass was reintiated, and an intra-aortic balloon pump was placed. P.U. was transferred to the ICU in critical condition. The immediate postoperative period continued to be turbulent. She had several episodes of ventricular tachycardia requiring cardioversion, and her cardiac index (calculated as cardiac output in liters per minute divided by body surface in square meters) was less than 2.0 despite maximal inotropic support. Renal and liver dysfunction associated with hypoperfusion developed (Table 8).

The consensus of the medical team was that P.U. would not survive without continued aggressive intervention. After discussion with her aunt (legal next of kin) and cousin, it was decided to place a Thoratec VAD in the left ventricle as a bridge to cardiac transplantation. After placement of the VAD, P.U. was extubated and weaned from the vasopressors. She met the criteria for transfer to the telemetry unit with the VAD in place.

P.U. participated in the telemetry VAD program and showed signs of incremental improvement. After 3 months of VAD support, her chest radiograph showed no evidence of heart failure. Her body weight had decreased by 11.3 kg (25 lb). However, cardiopulmonary exercise stress testing revealed that her maximal oxygen intake was 10 to 12 mL/min per kilogram, indicating a moderate-to-severe functional impairment in aerobic capacity. At this point, a family conference was held, and all possible options were presented to P.U. and her family members. It was her wish that weaning from the VAD be attempted and that transplantation be considered as a last resort. The following day P.U. went to the cardiacl catheterization laboratory, where baseline pressures in the right side of the heart were obtained. She was carefully monitored as she was weaned from the VAD. Chest pain and evidence of acute cardiac decompensation developed immediately (Table 9).

A transesophageal echocardiogram was obtained. With VAD support, the decrease in left ventricular systolic function was moderate to severe, mitral regurgitation was moderate to severe, the right-sided chambers were slightly dilated, and tricuspid regurgitation was moderate. When the VAD was turned off, the left ventricle dilated, and the mitral regurgitation worsened. These results were disappointing. P.U. appeared to be totally dependent on the VAD, and her name was placed on the list of candidates for transplantation at a local center.

During the next 2 months, with continuous VAD support, P.U.’s condition improved. She was accepted into the home discharge clinical trial because she was independent in her care and that of the VAD. Her cousin agreed to be her primary caregiver. Her rehabilitation included daily excursions off the unit with the TLC-II portable driver. One of these outings was to her local polling center to cast her vote in the 2000 presidential election (Figure 5). P.U. and her cousin successfully completed the training program, and P.U. was discharged to her cousin’s home with the VAD in place. She attended the clinic weekly for follow-up, and her outpatient course was uneventful. Two weeks after discharge, she received a donor heart, and the VAD was removed. At the time this article was written, she was at home, doing well, 1 year after transplantation.
inclusion had New York Heart Association class IV heart failure and were not considered candidates for heart transplantation. The patients were randomized to optimal medical therapy or long-term support with the Heartmate implantable VAD. Overall survival, functional status, and quality of life were better in the VAD group. However, the patients in this group did experience more complications than did the patients treated with medical therapy.15

Another surgical trial under way is the evaluation of the Acorn cardiac support device (Acorn Cardiovascular Inc, St Paul, Minn). This device is a mesh socklike device that is surgically sewn onto the impaired ventricle. Use of the device can reverse remodeling of the ventricle, improve cardiac function, and reduce ventricular volume.16

The results of studies such as the Randomized Evaluation of Mechanical Assistance in the Treatment of Heart Failure trial and use of the Acorn device will shape the future care of patients with heart failure. The implications for nurses are many. Nurses working outside of cardiac transplantation programs must be able to provide care for these patients. In the future, most of the care of these patients may be provided on telemetry units or in the patients’ homes. Shorter stays in the hospital will require that home healthcare nurses, emergency medical response personnel, and emergency department nurses be familiar with the care of patients with VADs.

The number of patients with heart failure is increasing. Clearly, a single standard therapy does not work for all patients. The challenge for the healthcare team will be to tailor medical and surgical interventions according to each patient’s individual needs. ✗

**Table 8** Laboratory evidence of renal and liver dysfunction in P.U. before placement of a ventricular assist device

<table>
<thead>
<tr>
<th>Laboratory test</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanine transferase, U/L</td>
<td>45</td>
<td>9-52</td>
</tr>
<tr>
<td>Aspartate aminotransferase, U/L</td>
<td>16</td>
<td>8-39</td>
</tr>
<tr>
<td>Bilirubin, µmol/L (mg/dL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>8.6 (0.5)</td>
<td>0-5.1 (0-0.3)</td>
</tr>
<tr>
<td>Total</td>
<td>10 (0.6)</td>
<td>0-17 (0-1.0)</td>
</tr>
<tr>
<td>Serum urea nitrogen, mmol/L (mg/dL)</td>
<td>4.3 (12)</td>
<td>2.5-6.1 (7-17)</td>
</tr>
<tr>
<td>Serum creatinine, µmol/L (mg/dL)</td>
<td>80 (0.9)</td>
<td>53-88 (0.6-1.0)</td>
</tr>
</tbody>
</table>

**Table 9** Hemodynamic parameters during attempt to wean P.U. from the ventricular assist device

<table>
<thead>
<tr>
<th>Parameter</th>
<th>With device</th>
<th>Without device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right atrial pressure, mean, mm Hg</td>
<td>21</td>
<td>Not available</td>
</tr>
<tr>
<td>Pulmonary artery pressure, mean, mm Hg</td>
<td>32</td>
<td>63</td>
</tr>
<tr>
<td>Pulmonary artery wedge pressure, mm Hg</td>
<td>22</td>
<td>50</td>
</tr>
<tr>
<td>Cardiac output, L/min</td>
<td>5.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Acknowledgments**

The authors thank Mark Slaughter, MD, and Marc Silver, MD, for their visionary leadership in the development of this program. We also acknowledge the efforts of our professional colleagues, who are responsible for the success of the program.

**References**


**Table 9** Hemodynamic parameters during attempt to wean P.U. from the ventricular assist device

<table>
<thead>
<tr>
<th>Parameter</th>
<th>With device</th>
<th>Without device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right atrial pressure, mean, mm Hg</td>
<td>21</td>
<td>Not available</td>
</tr>
<tr>
<td>Pulmonary artery pressure, mean, mm Hg</td>
<td>32</td>
<td>63</td>
</tr>
<tr>
<td>Pulmonary artery wedge pressure, mm Hg</td>
<td>22</td>
<td>50</td>
</tr>
<tr>
<td>Cardiac output, L/min</td>
<td>5.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Figure 3** An example of a successful excursion of a patient with a ventricular assist device: P.U. casting her vote in the 2000 presidential election at her local polling place.

Reprinted with permission of P.U. Photograph courtesy of Jill McCain, RN.


Telemetry to Home: Successful Discharge of Patients With Ventricular Assist Devices
Maureen McCafferty, Diana Sorbellini and Pamela Cianci

Crit Care Nurse 2002;22 43-51
Copyright © 2002 by the American Association of Critical-Care Nurses
Published online http://ccn.aacnjournals.org/

Personal use only. For copyright permission information:
http://ccn.aacnjournals.org/cgi/external_ref?link_type=PERMISSIONDIRECT

Subscription Information
http://ccn.aacnjournals.org/subscriptions/

Information for authors
http://ccn.aacnjournals.org/misc/ifora.xhtml

Submit a manuscript
http://www.editorialmanager.com/ccn

Email alerts
http://ccn.aacnjournals.org/subscriptions/etoc.xhtml