

# Withdrawal of Cardiac Medications and Devices

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## ABSTRACT

Withdrawal of life-sustaining therapies such as cardiac medications, pacemakers, internal cardioverter defibrillators, and ventricular assist devices occurs in patients with advanced cardiac disease as goals of treatment transition from active to less aggressive. This article defines life-sustaining therapies and describes ethical and legal considerations related to withdrawal of cardiac medications and cardiac devices. Healthcare providers need to anticipate clinical situations in which implantable cardiac devices and medications are no longer desired by patients

and/or are no longer medically appropriate. Discussions are important between patients, families, and healthcare providers that focus on each patient's condition, prognosis, advance directives, goals of care, and treatment options. Critical care nurses support each patient and his or her family and work with other members of the healthcare team to achieve a peaceful death.

**Keywords:** cardiac medications, deactivation, end-of-life, implantable cardiac defibrillators, pacemakers, ventricular assist devices, withdrawal of life-sustaining therapy

Withdrawal of life-sustaining therapies commonly occurs in critical care settings as goals of treatment transition from active to less aggressive. Good palliative care, with emphasis placed on prevention and management of potentially distressing symptoms, is extremely important. The purpose of this article is to discuss considerations related to withdrawal of cardiac medications and cardiac devices.

### Cardiovascular Advances: A Historical Perspective

Advances in cardiovascular technology have evolved steadily. By the late 1950s, external defibrillation was used to treat life-threatening ventricular dysrhythmias and the first pacemaker was implanted. In the 1960s, cardiopulmonary resuscitation was initiated,

the first cardiac intensive care units were developed, and the first heart transplantation was performed. Additional technologies, such as intra-aortic balloon pump therapy, and pharmacological advances such as vasoactive, inotropic, and antidysrhythmic agents were developed throughout the 1970s and 1980s. Advances in the 1980s also included the internal cardioverter defibrillator and insertion of the first total artificial heart.

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These scientific advancements have saved and improved the lives of many patients with cardiovascular disease. (The advancements have, however, added to the complexity of and have important implications for end-of-life care.) Many patients with cardiac disease are active participants in decisions related to withdrawal of cardiac treatments and cardiac devices. It is more common now than ever for patients and families to be actively making decisions that affect life and death.

### **Ethical and Legal Considerations Related to Withdrawal of Life-Sustaining Therapies**

Historically, “cure” has been considered success and “death” has been considered a failure by critical care healthcare providers.<sup>1</sup> Although prevention of death has been an overriding goal for critical care healthcare providers, this goal may not be shared by patients and family members. Ethical and legal issues have surfaced as the practice of withdrawal of life-sustaining therapy (LST) has evolved.

#### ***Life-Sustaining Therapy***

Life-sustaining therapy encompasses “all health care interventions that have the effect of increasing the life span of the patient.”<sup>2(p3)</sup> Traditionally, LSTs have included treatments such as mechanical ventilation, vasoactive agents, dialysis, artificial nutrition, hydration, antibiotics, and blood replacement products. LSTs now also include internal cardioverter defibrillators, pacemakers, and cardiac mechanical assist devices.

Withholding or withdrawing LST involves not giving or not removing interventions with the expectation that death will ensue. Withholding LST is “the considered decision not to institute a medically appropriate and potentially beneficial therapy, with the understanding that the patient will probably die without the therapy in question,” whereas withdrawal of LST is “the cessation and removal of an ongoing medical therapy with the explicit intent not to substitute an equivalent alternative treatment; it is fully anticipated that the patient will die following the change in therapy.”<sup>3(p1164)</sup> There is no moral difference between withholding and withdrawing LST.<sup>2</sup> Thus, there is no moral imperative that once a treatment is started, it cannot be stopped, including cardiac devices. Both the Study of Ethical Problems in

Medicine and Biomedical and Behavioral Research<sup>2</sup> and the Guidelines on the Termination of Life-Sustaining Treatment and the Care of the Dying<sup>4</sup> recommend that treatments should be determined on the basis of the potential benefits versus burdens to the patient. Thus, all therapies should be considered individually and collectively as to their potential benefit versus burden to each individual patient.

#### ***Autonomy***

Autonomy is an important factor in decisions to accept, refuse, or withdraw LST. According to the President’s Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, the voluntary choice of a competent and informed patient should determine whether LST will be initiated, continued, or withdrawn, as such choices provide the basis for other decisions about medical treatment.<sup>2</sup> Respect for autonomy is the basis for obtaining informed consent prior to insertion of any cardiac device. Although some cardiac devices used today were not used when the document was released in 1983, the fundamental basis for autonomy is the same.

Judicial precedent has supported an individual’s right to refuse LST. In 1976, the New Jersey Supreme Court supported Karen Quinlan’s family’s right to remove Karen’s ventilator.<sup>5</sup> A few years later, the Cruzan family was supported in their desire to withdraw enteral nutrition from Nancy Cruzan.<sup>6</sup> Numerous cases since then have consistently upheld the right to die.<sup>7</sup>

Patients with decision-making capacity should always be in control of making healthcare decisions. Each patient’s designated surrogate or family should be supported as they make decisions with the healthcare team regarding what the patient would want if or when patients are no longer able to make their own decisions.

#### **Preventative Ethics: Essential Considerations Related to Cardiac Devices**

Ethically complex issues may be avoided at the end of life if essential conversations are held with patients and families early in the course of care. Thus, prior to insertion of a cardiac device, the possibility that the device may be withdrawn or deactivated at a future point should be discussed. “Early discussions serve as an important bridge for later withdrawal or

**Table 1: Informed Consent Prior to Implantation of a Cardiac Device**

The patient knows or understands

- his or her prognosis
- the purpose of the device
- the expected benefits of the device
- the possible risks and burdens of the device
- alternative treatments or options
- that the device can be stopped

The patient completes an advance directive and includes information regarding conditions that the device would be continued or withdrawn.

The patient designates a durable power of attorney for healthcare or a healthcare proxy to make decisions should the patient be unable to speak for himself or herself.

deactivation discussions. Including a discussion about the possibility of deactivating the device in the future improves the quality of the patient's informed consent process.<sup>398(p632)</sup> During the informed consent process, information is provided to the patient and his or her family about alternative treatment options, the device, why it is being indicated, how it works, the expected benefits of the device, the risks of the device, follow-up needed, device maintenance, and the possibility that the device may be deactivated in the future (Table 1).

### **Living Will**

Patients should complete a living will and designate a healthcare proxy prior to insertion of a cardiac device. A living will document includes information related to treatments that patients would or would not want if faced with life-altering changes (eg, coma, permanent unconsciousness, persistent vegetative state, terminal illness, etc). Patients should address the device in the living will and document conditions when the device can be stopped. For example, many patients who participated in early ventricular assist device (VAD) trials "believed that if they became permanently incapable of communicating or participating in relationships with their families, this would be the threshold beyond which further life would not be worthwhile."<sup>399(p561)</sup>

### **Healthcare Proxy**

Prior to insertion of a cardiac device, patients should also designate a healthcare proxy or durable power of attorney for healthcare. Identifying a healthcare proxy is very important as patients with cardiac devices may not be able to make their own decisions at the end of life. Thus, the healthcare proxy would make decisions after reviewing the patient's living will and discussions with the patient about his or her end-of-life wishes.

### **Decisions Regarding Withdrawal of Life-Sustaining Therapies**

Cardiac devices may be withdrawn or deactivated if therapy is ineffective, no longer needed, or not desired. Discussions related to withdrawal of cardiac devices may be initiated by the patient, family, or the healthcare team. The healthcare team may initiate discussions related to withdrawal of cardiac devices based on previously established guidelines. When a patient or surrogate requests withdrawal of a cardiac device, the decision should be informed with time and support provided during the decision-making process (Table 2). Each patient needs to understand his or her condition, prognosis, and other treatment options, and he or she must have a clear understanding of what will happen if the device is withdrawn. For example, patients with an implantable cardioverter defibrillator (ICD) needs to know that if the device is deactivated and a life-threatening ventricular tachycardia occurs, they will likely die.

### **Cardiac Medications**

Cardiac medications, such as inotropic and vasoactive agents, are commonly used for patients with advanced cardiac disease. Patients may receive continuous intravenous infusions of cardiac medications in the acute care setting. In the critical care setting, vasoactive agents (eg, phenylephrine [Neo-Synephrine]) are commonly used to reverse hypotension and maintain hemodynamic stability.

Mr Elias was admitted to the cardiac care unit in cardiogenic shock. He was intubated, an intra-aortic balloon pump was emergently inserted, and multiple vasoactive agents were started (inamrinone [Inocor], dobutamine [Dobutrex], and dopamine [Intropin]). He was weaned from the intra-aortic balloon pump 3 days

**Table 2: Informed Decisions Related to Withdrawal of Cardiac Devices**

- The patient understands his or her condition.
- The patient knows his or her prognosis.
- The patient understands the alternative options to withdrawal of the cardiac device.
- The patient understands what will happen if the device is deactivated (eg, anticipated death).
- The decision may be made as above by a surrogate if the patient is unable to participate in the decision-making process.

later and extubated 1 week later. However, the Mr Elias' condition progressively worsened with the onset of sepsis and early signs of renal and liver failure. His level of consciousness vacillated between periods of confusion and periods of lucidity. Several family meetings occurred and a decision was made between the family and the healthcare team to stop aggressive treatments. A morphine drip was started at 2 mg/h and all of his vasoactive agents were stopped. Within minutes, Mr Elias had chest pain that diminished after he received a 5-mg bolus of morphine. His morphine drip was gradually titrated to 10 mg/h until his chest pain was relieved. Mr Elias died 4 hours later.

As the case exemplifies, palliative care interventions are important to consider before and after withdrawal of cardiac medications. Anticipatory dosing of analgesics should be considered, and continuous infusions of analgesics may be needed. Patients need to be assessed and closely monitored after withdrawal of cardiac medications. Stopping cardiac medications may, within minutes, have an effect of reducing cardiac output, causing myocardial ischemia. Conscious patients can communicate angina, whereas patients with impaired cognition may demonstrate physiological symptoms (eg, increased heart rate, increased respiratory rate) or behavioral symptoms (eg, restlessness, grimacing) of discomfort. Analgesic infusions (eg, morphine) are commonly titrated to achieve patient comfort.

The main goal of care before and after withdrawal of treatment(s) is promotion of comfort. Additional distressing symptoms, such as dyspnea and anxiety, can be prevented or quickly managed. Dyspnea can be minimized by reducing intravenous fluids, administering anticholinergic medications (eg, scopolamine) to reduce secretions, and administering morphine. Benzodiazepines (eg, midazolam) are beneficial in preventing and relieving anxiety.

### **Implantable Cardioverter Defibrillators**

Implantable cardioverter defibrillators are used to prevent sudden cardiac death caused by life-threatening dysrhythmias (eg, ventricular tachycardia, ventricular fibrillation). The ICD monitors the patient's inherent cardiac heart rate and rhythm. Based on preprogrammed settings, the ICD responds to dysrhythmias by antitachycardia pacing, cardioversion, or defibrillation. ICDs now also have the capability for back-up cardiac pacing.

Juanita Perez, 74, had an ICD inserted 5 years ago after her first episode of ventricular tachycardia. As her heart disease progressed, the episodes of ventricular tachycardia increased. While at home one afternoon, Juanita's defibrillator shocked her several times and she was admitted to the hospital. Juanita went in and out of consciousness and was hemodynamically unstable for the next 72 hours. After a long family meeting, Juanita's family and cardiologist decided that no further aggressive treatments would be continued and that Juanita's care would focus on comfort. During the night, Juanita's ICD shocked her 10 times, while her nurse tried desperately to contact someone to turn off her ICD. Finally, at 3:00 AM, the cardiologist came in and deactivated the ICD. Juanita died 2 hours later.

In another example, Grassman reported, "We had a patient who went home with home hospice. The defibrillator was never turned off. As a result, the wife reported that the patient died in her arms while the defibrillator jolted him 33 times before the battery ran down."<sup>10(p179)</sup> Thus, not addressing deactivation

of the ICD can cause not only unnecessary suffering for the patient but also distress for the patient's family.

The cases above and several additional reports exist specific to ICDs' increasing burden during the dying process.<sup>11–13</sup> Even when the dying process is expected and discussions have occurred regarding focusing on comfort care, the topic of deactivating the ICD is not routinely discussed.<sup>12</sup>

Goldstein et al conducted telephone surveys with the family members of 100 patients who died with an ICD, and found that only 27% of the family members reported that physicians discussed deactivation of the ICD. Most of these discussions occurred just days, hours, or minutes before the patient died.<sup>14</sup>

Lewis et al<sup>15</sup> followed patients with ICDs and monitored each patient's noncardiac history to identify patients entering the terminal state of a comorbid illness. An interdisciplinary team worked with each patient to address individual goals of treatment and discussed and planned for deactivation of the ICD. This approach prevented ICD shocks as the end of life neared.<sup>15</sup>

### **Withdrawal of Implantable Cardiovascular Defibrillator Discussions**

Prior to insertion of an ICD, a general discussion should occur regarding the possibility that the device may be deactivated at a future point in time if therapy is ineffective, no longer needed, or not desired. During the informed consent process, information is provided to the patient about the ICD, including why it is indicated, how it works, the expected benefits, the risks of use, required follow-up, device maintenance (eg, battery changes), and the possibility that the ICD may be deactivated in the future. A statement such as the following introduces the topic: "A time may come in the future when the ICD may not work as we had anticipated, or you may decide that you no longer want the ICD. If that time comes, we will talk about deactivating the device." When having end-of-life "discussions with patients and their families facing the last chapter, it is easier if they have heard previously of the potential circumstances for turning the defibrillator off."<sup>16(p410)</sup>

As discussed earlier, patients should be encouraged to complete advance directives before insertion of the ICD, designate a health-care proxy, and address the ICD in their advance directives.

### **Resources for Patients with Implantable Cardiovascular Defibrillators**

Patients with ICDs are asked to carry an identification card that has important ICD information (eg, manufacturer, model number, treatment settings). Patients need to know the primary person to contact regarding the ICD and what they should do if the ICD is activated and they receive shocks. Patients and their family members are given a telephone number for a contact person that they can call if they have any ICD questions or problems where someone is readily available 24 hours a day.

The primary person responsible for the ICD (eg, the cardiology service, the electrophysiology service) needs to know how to access the programmer to adjust settings or to deactivate the ICD. The ICD programmer and the personnel trained to use the programmer need to be available 24 hours a day. Resources are usually more readily available in a hospital setting than in a long-term care facility, a home setting, or a hospice or palliative care setting. However, a system needs to be in place so that the programmer is accessible if needed.

An overpenetrated radiograph of the ICD generator will show a radiopaque marker allowing identification of the ICD model and manufacturer.<sup>17</sup> This may be necessary if an emergency situation occurs and the patient or family is unable to locate the ICD information card or the emergency contact information is not available.

Basta described a woman who asked for her ICD to be deactivated because she "would rather die than endure this fate which is worse than death."<sup>18(p326)</sup> Her physician recommended a comprehensive process that included consulting psychiatric assistance to help the woman deal with her anxiety, sleeplessness, and depression; adjusting the patient's antidysrhythmic medication and ICD settings in an attempt to reduce the number of activations and the intensity of the energy released during shocks; encouraging the patient to participate in a support group; assuring the patient that she has the option of deactivating the ICD if the quality of her life could not be improved through the other measures.

### **Withdrawal of ICD Therapy: ICD Deactivation**

Withdrawal of the ICD after a thorough, thoughtful process is considered withdrawal of treatment—treatment that is no longer

wanted. The patient may want the ICD withdrawn in the home, office, clinic, or the hospital setting (Table 3).

The ICD can be deprogrammed by personnel trained in using the ICD programmer. A pacemaker magnet can be placed on the skin above the ICD generator to deactivate the generator if the ICD programmer is not available. However, manufacturer guidelines should be closely followed. For example, some ICDs are deactivated when the magnet is placed on the skin above the ICD generator

and then the magnet can be removed, but other ICDs are deactivated only when the magnet remains on the skin over the ICD generator.

The pacemaker magnet will deactivate the tachydysrhythmia recognition and treatment functions of the ICD but will not turn off the pacemaker function of the ICD. In most cases, the pacemaker magnet changes the sensing function so that the heart is paced at a preset rate. Again, it is important to follow manufacturer guidelines.

**Table 3: Deactivation of a Cardiac Device**

1. Ensure informed consent for deactivation.
2. Follow institution policy or guidelines regarding who is responsible for deactivating the cardiac device.
3. Prepare the patient and the family.
4. Initiate palliative care interventions to address symptoms; provide patient and family support.
5. Deactivate the device.

**A. Implantable Cardiovascular Defibrillator**

Trained personnel should deactivate the device using the ICD programmer.

In the absence of the ICD programmer, a pacemaker magnet can be placed over the ICD generator (follow manufacturer guidelines regarding removing the magnet or taping the magnet in place).

The magnet will not turn the pacemaker off (the magnet may initiate asynchronous pacing, thus the pacemaker will pace the heart at a preset rate without the ability to sense the patient's inherent rate).

Considerations:

The backup pacing function of the ICD can be turned off only by the ICD programmer.

Some ICDs have audible tones that are emitted when the ICD is initially deactivated.

**B. Pacemaker**

Trained personnel should interrogate the pacemaker with the pacemaker programmer.

If the patient is pacemaker dependent:

Prepare the patient and the family for a rapid death.

Adjust the pacemaker settings (eg, rate and output) so that pacing does not occur.

If the patient is not pacemaker dependent:

Prepare the patient and the family.

Adjust the pacemaker settings (eg, rate, output) gradually and assess patient response.

**C. Cardiac Assist Device**

Trained personnel should stop the assist device.

Silence the assist device alarms.

Stop the assist device (stop the pump, disconnect the equipment, and turn the power unit off).

6. Continue palliative care interventions to treat symptoms; provide patient and family support.

### **Additional Considerations**

After death, patients can be buried with the ICD, but they cannot be cremated with the ICD in place. Removal of the ICD is necessary only if it is an investigational device or if the body is to be cremated; if the body is to be buried, removal of the ICD is the prerogative of the patient's family.<sup>19</sup>

### **Cardiac Pacemakers**

Jillian Snyder, 67, was admitted to the hospital with chest pain and dyspnea. She had a history of chronic obstructive pulmonary disease, cardiomyopathy, chronic renal insufficiency and advanced type I diabetes. She was hospitalized 5 times in the past year, where attempts were made to control new onset, rapid atrial fibrillation. Multimodal pharmacological agents did not control Mrs Snyder's atrial fibrillation. Two months ago, she had an atrioventricular node ablation with insertion of a permanent pacemaker. Mrs Snyder's chest pain was treated with nitroglycerin and morphine infusions. Her dyspnea worsened, along with worsening renal failure and marked heart failure. Three days later, Mrs Snyder stated that she wanted to die. After several discussions between Mrs Snyder and her family, her wish to stop additional treatments was honored. Within 24 hours, Mrs Snyder developed delirium, and her family requested withdrawal of all life-sustaining therapies, including the pacemaker. The cardiology service declined to stop the pacemaker, but was, however, open to withdrawal of pacemaker support after review by the ethics committee. Mrs Snyder died before the ethics committee reviewed the family's request.

Cardiac pacemakers are usually implanted to treat bradycardia. Pacemaker systems consist of a pulse generator and a lead system that delivers energy to the atrium or ventricle. In the asynchronous mode, the pacemaker stimulates an impulse at a preset rate, whereas in the synchronous mode, the pacemaker stimulates an impulse only when the patient's heart rate falls below a preset rate. Pacemaker settings (eg, pacing mode, rate, output) can be adjusted by an external programmer.

Another type of a pacemaker is the biventricular pacemaker. Biventricular pacemakers

may be indicated for patients with heart failure. Biventricular pacemakers simultaneously pace both the right and left ventricles. The goal of biventricular pacing is to improve hemodynamic function by restoring ventricular synchrony for patients with intraventricular conduction delays.

The decision to turn off a pacemaker is not without controversy.<sup>20–23</sup> Some argue that a pacemaker should not be discontinued for a patient who is pacemaker dependent.<sup>17,18</sup> As Basta describes, "In a pacemaker-dependent patient, disabling or removing the pacemaker represents an active intervention, the intent of which is to cause death."<sup>18(p327)</sup>

Pellegrino supports discontinuance of the pacemaker if the intention is to remove a futile treatment.<sup>22</sup> In comparison, Paola and Walker suggest that prior to deactivating the pacemaker one would need clear and convincing evidence that the patient did not regard the pacemaker as a biofixture (a permanent part of the patient), but rather as a LST that could be withdrawn.<sup>24</sup>

Ballentine notes that there is more support for deactivating ICDs than stopping pacemakers, yet there is no "meaningful fundamental or conceptual distinction between the devices or, for that matter, between these and other technological life-supporting devices."<sup>25(p18)</sup> It is a mistake to assume that a pacemaker will prolong life or suffering in an otherwise terminally ill patient. On the contrary, it is unlikely that a pacemaker alone could interrupt progression of end-stage physiologic events in a palliative care patient, who typically dies of multiorgan failure at an advanced disease state.<sup>11</sup> On the other hand, ICDs, by their design alone, prompt concerns that are generally the direct opposite of those raised by pacemakers. ICDs are capable of converting some unstable cardiac rhythms and may, therefore, deprive a terminal patient of a timely, mercifully rapid, and "peaceful death." Other than ICD discharges, unlike pacer impulses, are both emotionally and physically distressing to most patients and families and may impose an additional symptom burden.

Although Lewis et al assisted terminally ill patients by planning end-of-life care that included ICD deactivation, they did not discontinue pacing therapy for the same patients.<sup>15</sup> As they described, "Pacing therapy is a comfort care measure in that discontinuation of pacing therapy may worsen heart failure because of

complete atrioventricular block or lead to syncope.<sup>15(p896)</sup> The important principle for clinicians to consider, prior to withdrawal or deactivation of pacemakers or ICDs, is to approach each case individually, based on patients' preferences, diagnosis, and goals of therapy.

Mueller et al support the right of a patient or designated family member to withdraw pacemakers and ICDs.<sup>26</sup> They reported on 6 cases (5 with permanent pacemakers and 1 with an ICD) at one hospital where patients (or their family members) requested withdrawal of the pacemaker or defibrillator device at the end of life. Two of the 5 patients with pacemakers were not supported by the healthcare team in their preference to have pacing therapy stopped. One of the patients expressed to her family members that "she did not want efforts to prolong her life, including a functioning pacemaker, if there was no reasonable hope for functional recovery."<sup>26(p960)</sup> Her advance directive was consistent with her wishes. Despite the clear evidence of her wishes, the cardiology pacemaker consultation service refused to turn off her pacemaker. A second patient did not have the pacemaker addressed in his advance directive, but he did state that he did not want treatment prolonging the dying process and that he did not want cardiopulmonary resuscitation or artificial nutrition. Morphine was started to promote comfort during his dying process, yet the cardiology pacemaker consultation service refused to turn off the pacemaker.

Three of the 5 requests were supported for withdrawal of pacing therapy.<sup>26</sup> One of the patients requested comfort measures only, and the families of the other 2 patients requested withdrawal of the pacemaker per previously stated patient wishes. An ethics consultation was sought for one of the patients. The cardiology pacemaker service reprogrammed the pacemakers in such a way that no effective pacing was present for 2 patients, and they reprogrammed the biventricular pacemaker so that it was no longer effective for the third patient. Morphine was initiated to prevent dyspnea and pain. Mueller et al reported that withdrawal of the pacemakers was neither "painful nor burdensome" in the patients described above.<sup>26(p962)</sup>

### **Withdrawal of Pacemaker Therapy: Pacemaker Deactivation**

Stopping a cardiac pacemaker may lead to death within minutes or may not be a factor in

the final cause of death.<sup>27</sup> The patient will die soon after the pacemaker is discontinued if a pacemaker is stopped for a patient who is pacemaker dependent. If the patient is not pacemaker dependent, the dying process is unpredictable and patients will need to be assessed closely for symptoms of distress.

A programmer is needed to adjust the functions of a cardiac pacemaker (Table 3). Interrogation of the patient's pacemaker may provide useful information that will help the patient, family, and healthcare providers prepare for the dying process. However, most pacemaker generators cannot be turned off; the rate and output voltage can be adjusted downward to such a level as to make the pacemaker essentially nonfunctional.<sup>11</sup> Balentine suggests that the pacemaker should be deactivated in stages for patients who are not pacemaker dependent to see if distressing symptoms result.<sup>25</sup> Palliative care interventions such as anticipatory dosing of analgesics (eg, morphine), continuous infusion of analgesics, and administration of anxiolytics (eg, Ativan) can be provided throughout the withdrawal process to promote patient comfort.

### **Additional Considerations**

Similar to patients with ICDs, patients who die with pacemakers can be buried, but they cannot be cremated with the pacemaker in place. The funeral home usually removes the pacemaker to avoid the risk of explosion of the pacemaker battery if a patient is to be cremated.<sup>11,28,29</sup>

### **Ventricular Assist Devices**

Ventricular assist devices are mechanical pumps that are surgically implanted to improve function of the left (LVAD), right (RVAD), or both (BiVAD) ventricles. Ventricular assist devices are used for patients in cardiogenic shock and for postcardiotomy support to allow for myocardial recovery, for bridge to transplantation and more recently for destination therapy. Destination therapy describes when the VAD is inserted because it is expected that the patient will need the VAD the rest of his or her life, thus the VAD is considered a final treatment. Different assist device systems are available with some designed for short-term use and others designed for long-term use. Technological advances have made VADs more compact and portable

providing freedom for some patients to be discharged home from the hospital with complex follow-up. Portable assist devices contain the thoracic unit to pump blood, a rechargeable battery, a small computer to monitor and control the heart, and a transcutaneous energy transmission coil. Devices such as this have established the role of mechanical circulatory assistance as a destination therapy for patients with end-stage heart disease.<sup>30,31</sup>

John Jarel was 25 years old and healthy. He developed a viral infection with flu-like symptoms. He spent a week in bed and then went to the physician as he was not regaining strength. He was very short of breath and extremely weak. His physician recommended hospitalization where he was diagnosed with viral myocarditis. John's condition continued to worsen. An intra-aortic balloon pump and a LVAD were inserted to improve contractility of his failing ventricle. Five weeks later, John developed an overwhelming sepsis not responsive to antibiotic therapy followed by multiple organ dysfunction. As his condition continued to deteriorate, the decision was made between the healthcare team and John's family to stop the LVAD. John died 10 hours later with his mother, father, and sister at his side.

MacIver and Ross reported on 22 patients with VADs implanted as a bridge to transplant.<sup>32</sup> Seven of the 22 patients (32%) died following device withdrawal. Three of the patients were in multisystem organ failure, 2 patients had coagulopathies, 1 patient had primary graft dysfunction, and 1 patient was septic. Discussions regarding VAD withdrawal were initiated by families for 4 of the patients and by the healthcare team for 3 of the patients.

### **Ventricular Assist Device Deactivation Discussions**

A comprehensive informed consent process is important prior to insertion of a VAD. An abbreviated process is often necessary when a VAD is inserted emergently in an extremely unstable patient. VADs inserted in emergent situations are usually short-term treatments for acutely ill patients with severely compromised ventricular function. Consent for use of the VADs is usually given by the patient's family due to the critical nature of the patient's illness.

A more thorough, thoughtful informed consent process is conducted when a VAD insertion is considered as a bridge to transplantation or as destination therapy. During the informed consent process, information should be provided to the patient about the VAD, including why it is being indicated, how it works, the expected benefits, the potential risks, the required care, device maintenance (eg, potential device changes), alternative treatment options, and the possibility that the VAD may be withdrawn in the future. "Engaging in a discussion about the potential for device withdrawal prior to device implantation allows the team and family to understand the patient's wishes and serves to direct decision making, should it need to occur."<sup>32(p154)</sup>

In an effort to prepare for an uncertain future, Dudzinski recommends discussing possible scenarios with the patient and family. For example, the physician may review situations in which the VAD would be deactivated (eg, profound neurologic injury or irreversible hepatic and renal dysfunction requiring indefinite intensive care).<sup>33</sup> Morreim described seriously ill patients who participated in early VAD trials.<sup>9</sup> As Morreim stated these patients

could end up in a state they might consider worse than death, an important part of the informed consent process involved careful conversations about personal values regarding quality of life and end-of-life. The decision to stop can be at least as important as the decision whether to begin, and it was important to elicit these patients' views at a time when they were still capable of reflection.<sup>9(p561)</sup>

As previously described, patients should develop advance directives that address the VAD. For example, it would be extremely helpful to know that a patient would not want to continue VAD support if they were unable to live at home or if they suffered severe and lasting cognitive damage.<sup>34</sup> MacIver and Ross described, "In our experience, patients usually want their families to know that it's alright to withdraw support if they have no reasonable chance of recovery."<sup>32(p154)</sup>

It is also important to address what would happen if a patient is on a VAD as a bridge to transplant, yet a transplant does not become available or the patient's condition changes making the patient ineligible for a transplant.<sup>33,35</sup>

Powel and Oz<sup>34</sup> stress the importance of learning as much as possible about the patient's objectives in seeking medical treatment as early in the treatment as possible; as many patients will go on to lose decision-making capacity. MacIver and Ross<sup>32</sup> have both the patient and the patient's surrogate sign a document addressing the potential for future VAD removal (Table 4).

### **Withdrawal of Ventricular Assist Device Therapy: Ventricular Assist Device Deactivation**

Dudzinski recommends developing guidelines to guide VAD deactivation, including a description of how the patient's pain and symptoms will be prevented and managed before, during, and after deactivation.<sup>33</sup> MacIver and Ross also recommend establishing a process for VAD withdrawal.<sup>32</sup>

The device should be stopped when the patient or family is ready (see Table 3). The VAD can be disconnected from the power source in the context of excellent comfort care.<sup>33</sup> If patients are alert, last wishes should be honored. Promotion of patient comfort and family support is essential.

### **Conclusion**

Death will come to each and every one of us despite using or not using technology.

Does the use of the LVAD and other technologies radically change end-of-life decision-making? Yes and no. The hallmark of good medical decisions in any era is the appropriate blend of medical opinion and expertise with the patient's values and wishes. The introduction of new

technology does not change this fact. However, new devices do force us to re-examine our practices, and to ask when and how it is wise to employ or withdraw a treatment. The use of advance directives may serve as a useful starting point for discussions but cannot substitute for in-depth efforts to learn how patients assess benefits and burdens. We do not believe that a treatment, once initiated, needs be maintained once its burdens to the patient outweigh its benefit.<sup>34(p1224)</sup>

The first artificial heart recipient was a gentleman named Barney Clark. Mr Clark's physician gave him a key that he could use if he wanted to turn off the compressor of the artificial heart.<sup>36</sup> The key that was given to Mr Clark was both functional and symbolic of Mr Clark being in charge of his life.<sup>37</sup>

Withdrawal of cardiac devices at the end of life is complex. There is little evidence to guide care for patients when cardiac medications and devices are withdrawn. Asking the right questions is important. Does a cardiac device improve not only the length of a person's life but also the quality of living, or does the device lengthen the person's life, decrease the quality of living, and prolong the dying process? Do patients know that cardiac devices can be removed if they want them to be? Are patients informed about their treatment options, including the option of palliative care? Asking the right questions will facilitate the wise use of technology and ensure that each patient is in charge of his or her life.

**Table 4: Addendum to Consent for Treatment for Ventricular Assist Device**

The goal of mechanical circulatory support is to support the failing ventricle(s) to allow patients to recover end organ function and improve physical conditioning while waiting either for recovery or a donor heart to become available. If, despite all efforts, the patient has no reasonable chance of receiving a heart transplant or surviving to leave the hospital, or if continued use will no longer be serving the purpose for which it was originally placed, the device will be discontinued. This will occur only after the transplant team caring for the patient is in agreement that the goals for mechanical circulatory support cannot be met and after consulting with the patient or, if the patient is too ill, with the family or substitute decision maker.

My signature herewith confirms that I have read and understood the contents of this message and I voluntarily agree to be bound by its terms. I also acknowledge that I have been afforded an opportunity to ask any questions I might have related to the use of the ventricular assist device and that all my questions have been answered to my satisfaction.

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