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VENTRICULAR FIBRILLATION IN A PATIENT SUPPORTED BY A LEFT VENTRICULAR ASSIST DEVICE: A CASE REPORT ON THE CHALLENGE FOR NURSES

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Abstract

Left ventricular assist devices (LVADs) effectively manage advanced heart failure as a bridge to heart transplantation or as destination therapy. Ventricular arrhythmias remain common after LVAD implantation, and such treatment allows dangerous arrhythmias to be tolerated hemodynamically. The main aim of this study is to report a ventricular fibrillation (VF) episode in a patient supported by a LVAD in terms of nursing care.

A medical document review and review of the literature on VF were carried out. This case report describes the clinical data of a 61-year-old patient who had VF for several days.
Key words: ventricular fibrillation, a left ventricular assist device, nursing care

Introduction

The left ventricular assist device (LVAD) transitioned from the experimental stage to reality during the 1980s, when a growing numbers of patients on heart transplant waiting lists were dying. LVADs effectively manage advanced heart failure as a bridge to heart transplantation or destination therapy. The survival rate improved by 80% in one year; implants in the United States showed a continuous increase, reaching nearly 3000 per year [1]. According to the Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure (REMATCH) study, LVADs resulted in over twice the survival rate and an improved quality of life compared to optimal pharmacological treatment [2].

"Ventricular fibrillation (VF) is a pulseless arrhythmia in which chaotic electrical activity causes absence of ventricular contraction with immediate loss of cardiac output. […] VF is the primary cause of sudden cardiac death in the world. Regular cardiac activity can be restored with mechanical resuscitation or external DC defibrillation" [3:444]. Rapid defibrillation is the most critical survival determinant in VF [3]. Ventricular arrhythmias (VA) are common in patients with advanced heart failure and reduced ejection fraction, which increases mortality. An implantable cardioverter-defibrillator (ICD) helps prevent bradycardia and correct dangerous VA. An ICD is recommended to reduce the risk of sudden death in patients with symptomatic heart failure in primary and secondary prevention [4].

VA is frequent after LVAD implantation, particularly in the first 30 days. The reported prevalence of VAs after LVAD implantation varies depending on the patient population, the definition of the VA, and the arrhythmia surveillance method. VA has been reported in about 20% of LVAD patients, while on the other

hand ICD shocks range from 16% to 42% of LVAD recipients [5–9]. VA occurs more frequently in the early period after LVAD implantation, and a predictor of post-LVAD VA is the fact that the patient suffered from VA before implantation. During a median 126-day follow-up period in a bridge-to-transplant trial, VA requiring cardioversion or defibrillation occurred in 24% of patients who had received LVAD. Similar findings have been seen in single-center observational studies, where VA has been found to appear in 22% to 59% of LVAD recipients [5,7,9].

The engineering advantages of continuous-flow pumps have led to their widespread use in mechanical circulatory support. Using these devices shows that long-term hemodynamic support is possible, even when a clinical "pulse" cannot be detected. Surprisingly, however, VF was discovered by chance in ambulatory patients supported only by a continuous-flow LVAD [10]. VA, as well as atrial arrhythmias, are both highly prevalent in LVAD patients and also are considered poor prognostic factors. Under certain conditions it might be possible to use an LVAD to maintain hemodynamic stability during VA.

The management of VA in LVAD recipients should be similar to non LVAD patients, including ICD or cardiac resynchronization therapy (CRT-D) implantation. It is noticeable that ICD patients with LVAD require postoperative modification of the ICD system due to electromagnetic interference with the LVAD. Routine defibrillation is not recommended after LVAD implantation but can be considered in selected patients with VA burden and a history of failed ICD therapies. Medical management of arrhythmias among LVAD patients followed the recommendations for heart failure with reduced ejection fraction (HFrEF) patients. Firstly, each patient requires oral Vitamin K antagonist (VKA) anticoagulation to reduce the risk of pump thrombosis. The combination of digoxin and β-blockers is an effective strategy for appropriate rate control among patients with Atrial Fibrillation. For ventricular arrhythmias, the combination of amiodarone and β-blockers is more effective than sotalol. In the short-term setting, intravenous amiodarone, lidocaine, and procainamide are preferred [10].

Case presentation

We report the experience of a patient with a continuous flow LVAD who survived sustained and documented VF.

A 61-year-old man, who had undergone LVAD implantation (April 23, 2018), was admitted to the Transplant and Mechanical Support Ward from an ambulatory outpatient clinic due to significant fatigue, decreased exercise tolerance and shortness of breath that had lasted seven days. One week before he had been subjected to ICD therapy due to recurrent VA. The LVAD was working correctly. The laboratory test results on the day of admission and after the event are presented in Table 1.

Table 1. Laboratory results before, on the day of admission, and after the VF event

Variable	Before the event (12 days before the event)	On the day of admission (during the event)	After the event	Norms
Lactate dehydrogenase [U/L]	232	407	277	120–240
Nt-proBNP [pg/mL]	2095	5676	Not available	68–112
C Reactive Protein (CRP) [mg/L]	3.3	49.1	Not available	<5
White blood count [mcL/10^9/l]	5	8.93	5.14	4–10.8
Hemoglobin [gm/dL]	12.7	13.3	12.6	For men 12.5–18
Hematocrit [%]	39.3	40	38.5	For men 42–52
Potassium [mmol/L]	4.4	4.2	4.1	3.5–5.1
Magnesium [mmol/L]	0.68	0.73	0.68	0.8–1
Creatinine [µmol/L]	112	145	115	53–115
Urea [mmol/L]	5.3	10.8	Not available	2.5–67
Aspartate aminotransferase [U/L]	50	42	42	For men 19
Alanine aminotransferase [U/L]	39	50	20	For men <45
Total Bilirubin [µmol/L]	82	109.9	57.9	3.42–20.6
International Normal Ratio	2.18	2.62	1.63	For LVAD therapy 2.5–3
Gamma-glutamyl transferase (GGT) [U/L]	107	53	Not available	For men 18–100
Haptoglobin [g/l]	<10	32	Not available	0.3–2

The patient did not present symptoms of end-organ dysfunction. However, we observed a significant increase in total bilirubin. In *electrocardiogram* (ECG), VF was seen (*torsade de pointes*) (Fig. 1). Interrogation of the ICD revealed VF in the memory of the device lasting for 12 days. Two internal defibrillation attempts with energy of -35 J had no effect, and multiple ramp stimulation also had no effect. The absence of left ventricular ejection fraction was documented using echography. An intravenous infusion of amiodarone and magnesium was administered immediately. Then, the patient was rapidly transferred to the Intensive Care Unite (ICU), and an external shock of 300 J was given. The patient successfully reverted to sinus rhythm (Fig. 2). Due to thyroid dysfunction after amiodarone therapy, he was prescribed rythmonorm and sotalol. During the hospitalization process, coronarography was performed. There were no changes in the coronary arteries. After 24 hours ECG monitoring revealed complex ventricular tachycardia (VT) and Accelerated Ventricular Rhythm/_Idioventricular rhythm (AIVR/IVR) arrhythmias. The rest of the hospitalization was uneventful. The patient was successfully discharged home after 14 days in hospital.

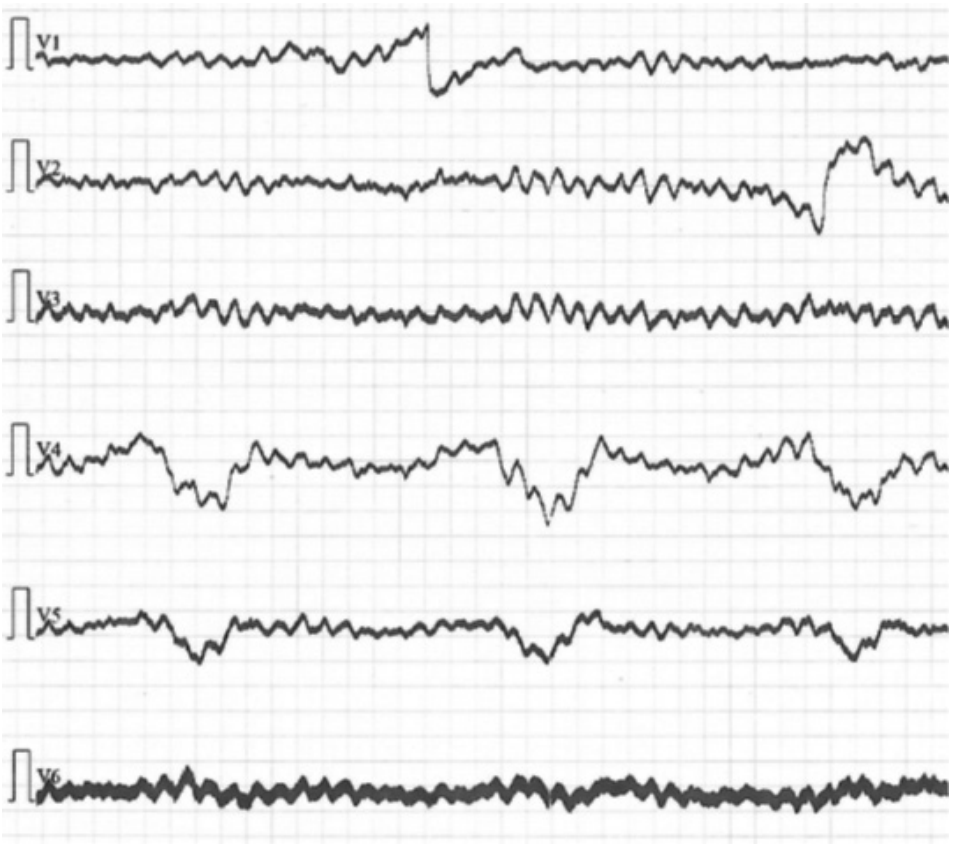

Figure 1. ECG on the day of admission – ventricular fibrillation

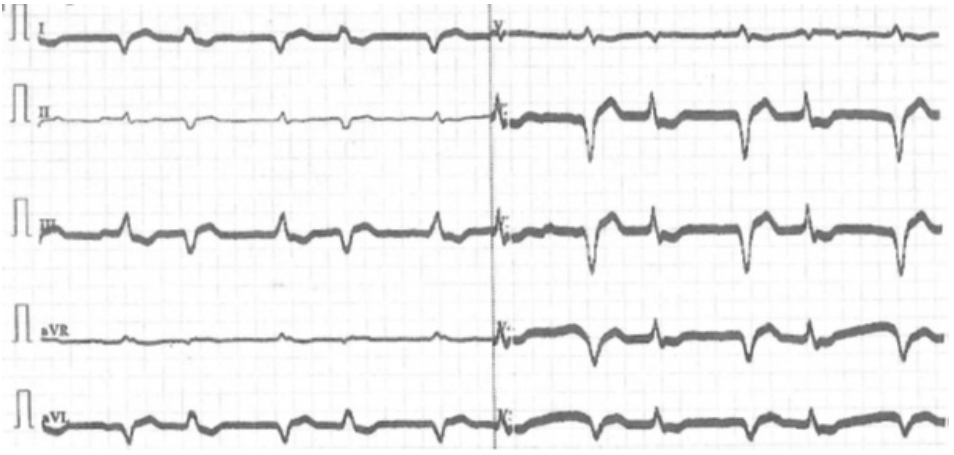

Figure 2. ECG after defibrillation – sinus rhythm

Summary

Our experience shows that patients with continuous-flow LVAD can remain hemodynamically efficient in order to survive prolonged episodes of VF. Despite the complete absence of cardiac contractility revealed in echography, the patient was conscious and exhibited no end-organ impairment. Our findings correspond to the reports of other authors who observed similar clinical results of prolonged ventricular tachyarrhythmia [11]. Salzberg et al. describe the case of a patient with an LVAD who survived seven hours of VF. The patient had an implantable pacemaker. During the incident of VF, he suffered a sudden onset of light-headedness and nausea. No failure or loss of alertness was noted. External defibrillation and intravenous lidocaine were necessary to restore the sinus rhythm [3]. Baldwin et al. describe six clinically stable patients with prolonged fibrillation events without evidence of hemodynamic collapse. They reported only mild symptoms [10]. Makki et al. carried out a meta-analysis to evaluate the association between post-LVAD Vas and all-cause mortality at 60, 120 and 180 days. Only a VA history was found to be a risk factor for mortality after LVAD implantation [12].

Galand et al., in their study, evaluated the incidence, clinical impact, and predictors of late VAs in LVAD recipients aiming to standardize the ICD indications. The authors proposed the VT-LVAD score, which may help identify patients at risk of late VAs and guide ICD indications in previously nonimplanted patients [13]. An additional investigation is needed to determine whether defibrillator settings for these patients should be adjusted to limit shock therapy. A multidisciplinary approach is mandatory for LVAD recipients. Close collaboration between the VAD team, specialist nurse, an electrophysiology team, and a caregiver are critical for quick decision-making in order to manage in cases of serious arrhythmia. Advanced practice nurses working with LVAD patients can rapidly recognize an abnormality in ECGs and closely collaborate with the team. Also, they can provide the necessary education and support for LVAD recipients and their caregivers.

Cardiac nurses are poised to offer clinical expertise and supportive care for LVAD patients and outpatient clinics. Recognition by nurses of the signs and symptoms of arrhythmias is essential for positive patient outcomes. An early consultation with a cardiologist for timely diagnosis and to facilitate a well-rounded care plan is vital. Nurses must also coordinate robust, interdisciplinary, family-centered care, including providing patient-family education to support informed decision-making, promoting coping within families, providing emotional support, and allocating inpatient and community resources as needed. A prevalence of ventricular dysrhythmias of between 22% and 52% has been reported among patients with LVAD [14]. Most patients with an LVAD have an ICD inserted before surgery. Nurses and other medical professionals need to know the current device's settings and ensure that the device settings are changed if

dysrhythmias are suspected. The ICD may terminate the ventricular dysrhythmias with anti-tachycardia pacing or internal defibrillation. Frequent electric shocks of ICD, regardless of their type – adequate or inadequate – cause anxiety-depressive disorders reminiscent of post-traumatic stress disorder (PTSD). A basic form of therapy for patients who have had an ICD implanted is cognitive behavioral therapy (CBT), which consists in interpreting the events that cause negative feelings. Drug treatment includes administration of amiodarone – the most frequently used medication. The nurse should monitor LVAD parameters, mainly the PI (Pulse Index), to assess how the patient tolerates dysrhythmias. Low PIs can lead to "suction events," which means the left ventricle is underfilled and is being "sucked" into the LVAD. Also, reducing the speed of the device allows the ventricles to fill adequately and reduces the risk of arrhythmia. Administering fluid can help improve this temporarily, but a VAD coordinator or physician should be contacted [15].

The challenge for nurses and all LVAD team members is to recognize and administer proper treatment of arrhythmias. Potential difficulties that can be present in daily practice with LVAD recipients are as follows [3,6–17]:

- mild symptoms: fatigue, dyspnea, new exertional dyspnoea, lethargy;
- it is a properly working LVAD system;
- very often, normal laboratory tests;
- absence of ICD detection;
- the possible complications due to VF are:
  - frequent ICD shocks in LVAD patients have been shown to harm the long-term outcome,
  - right ventricular failure,
  - post amiodarone hyperthyroidism.

Patients with continuous-flow LVADs can remain hemodynamically stable if they have VF. The LVAD allows VAs to be tolerated well in the acute setting. However, there are numerous long-term complications related to VAs, such as ventricular remodeling, right ventricular failure in patients with LVADs, and possibly increased mortality. Also, the appropriate use of ICD technology is required in this group of patients. Close collaboration between the VAD team, the specialist nurse, the electrophysiology team, and the caregiver is critical for quick decision-making and arrhythmia care. The VT-LVAD score might help identify patients at risk of late VA.

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Migotanie komór u pacjenta z mechanicznym wspomaganiem układu krążenia. Opis przypadku dotyczący wyzwania dla pielęgniarek

Streszczenie

Urządzenia wspomagające lewą komorę (LVADs) skutecznie radzą sobie z zaawansowaną niewydolnością serca jako metoda pomostowania do przeszczepienia serca lub jako terapia docelowa. Komorowe zaburzenia rytmu pozostają częstym zjawiskiem po wszczepieniu LVAD, a takie leczenie może umożliwić

hemodynamiczną tolerancję niebezpiecznych zaburzeń rytmu. Głównym celem pracy było przedstawienie opisu przypadku migotania komór (VF) u pacjenta z mechanicznym wspomaganiem układu krążenia w odniesieniu do opieki pielęgniarskiej.

Dokonano przeglądu dokumentacji medycznej i przeglądu piśmiennictwa dotyczącego VF u pacjentów z LVAD. W niniejszym opisie przypadku przedstawiono dane kliniczne 61-letniego pacjenta, u którego przez kilka dni występowały objawy VF.

Słowa kluczowe: migotanie komór, urządzenie wspomagające lewą komorę, opieka pielęgniarska