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Nursing care plans for patients with ventricular assist devices: A holistic evaluation based on clinical observations and practice recommendations

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Abstract

Ventricular assist device (VAD) nursing is a critical specialty in the management of patients with advanced heart failure and cardiomyopathy. VAD nurses play an essential role in the preoperative preparation, intraoperative coordination, and postoperative care of patients receiving mechanical circulatory support, particularly those awaiting heart transplantation. These devices assist in improving cardiac function, but their use carries risks, such as infection, bleeding, thrombosis, device malfunction, and psychological challenges. Therefore, VAD nurses must possess expertise not only in general nursing care but also in infection prevention, anticoagulation management, patient education, and psychosocial support. As integral members of multidisciplinary teams, VAD nurses are responsible for educating patients on device management, ensuring safety, and promoting quality of life. With technological advancements, the role of VAD nurses has become increasingly significant in preventing complications and maintaining patient stability. In conclusion, VAD nursing is vital for improving patient outcomes and enhancing quality of life. Continued education and interprofessional collaboration are essential for advancing expertise and ensuring high-quality patient care.

Keywords: nursing care, advanced nursing practice, ventricular assist devices, artificial organs

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Introduction

Ventricular assist device (VAD) nurses play a crucial role in the care of patients suffering from end-stage heart failure and cardiomyopathy (CMP), who are ineligible for immediate heart transplantation. These nurses are responsible for preoperative, intraoperative, and postoperative care, especially during the implantation of artificial hearts, the most critical stage in cardiovascular surgery [1,2].

According to the World Health Organization (WHO), heart failure is a clinical syndrome characterized by the heart's inability to pump blood effectively due to structural and functional impairments, leading to blood accumulation in the ventricles [2,3]. When the heart muscle fails to function adequately, conditions such as dilated CMP, hypertrophic CMP, and arrhythmogenic right ventricular CMP/dysplasia may be diagnosed. In cases where transplantation is not immediately possible, VADs are used as a life-saving intervention [3,4].

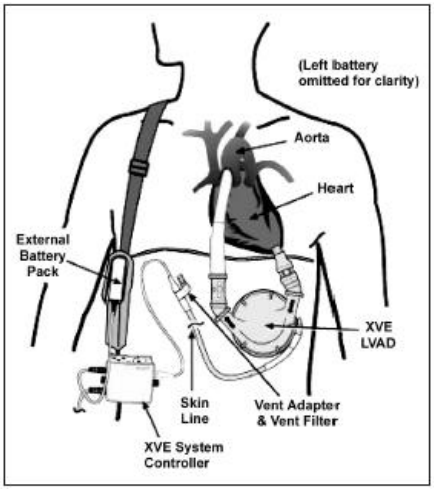
VAD usage involves risks both before and after surgery, including infection, bleeding, thrombus formation, and device malfunction [5]. It is essential to provide patient and caregiver education on wound care, medication administration, and technical aspects of the device [6].

Structure and Function of VAD Devices for Nurses

In severe cases of heart failure, patients are placed on transplant waiting lists with diagnoses such as dilated CMP, hypertrophic CMP, or arrhythmogenic right ventricular CMP. However, when immediate transplantation is not feasible, VADs offer a critical life-support option to prolong survival and improve quality of life [7].

Nurses must possess a clear understanding of the structure and functionality of VADs. As illustrated in Figure 1, the device is typically implanted in the upper left abdomen and connected to the left ventricle via an inflow cannula. The blood-contacting surfaces of the device create a pseudo-endothelial interface, helping to reduce immune rejection. The VAD facilitates forward blood flow through a graft anastomosed to the aorta. A driveline connects the internal pump to an external system controller, which powers and regulates the motor. This system also includes a channel for emergency manual operation in case of pump failure. The system controller receives power from batteries or direct electrical sources, allowing patients to monitor real-time cardiac data via a digital display.

Figure 1: Left ventricular assist device (LVAD) and placement. Reprinted with permission from Thoratec Corp., Pleasanton, CA.



Proper dressing of the driveline site is essential—initially requiring two to three dry dressing changes per day and, as healing progresses, once daily. Dressings must be secure to prevent cable irritation or damage [8].

The components of the implant, which are both functionally and symbolically significant, must be stored in secure, sterile containers post-implantation. The entire surgical team shares responsibility for the secure handling and storage of these parts. Following any procedure involving artificial heart components, the items must be placed in locked boxes and appropriately recorded. As shown in Table 1, nurses are responsible for safeguarding all components of the device [9].

To minimize error, all implants removed from sterile packaging must be supervised by the lead cardiac surgeon and device technician. The artificial heart nurse plays a vital role in ensuring sterilization protocols are followed. Before placing materials on the surgical table, all packaging must be double-checked, and serial numbers and expiration dates verified. Contaminated or questionable materials must be rejected and properly sterilized to maintain patient safety. Barcodes of all implanted parts must be documented and stored in the patient's medical file [10-12].

A spare pump kit should always be available, and artificial heart nurses must conduct monthly maintenance checks to ensure functionality and readiness [13].

Operating room and circulating nurses must conduct sponge, needle, and instrument counts at the start of the procedure, after explantation of the native heart, post-implantation of the VAD, and prior to sternum closure. In high-flow situations, additional counts are advised as needed [14]. Antibiotic prophylaxis initiated at device placement is another critical component of care [15]. Monitoring anticoagulation therapies such as heparin, aspirin, dextran, or warfarin is essential to prevent thromboembolic complications, especially during hypotensive episodes [16].

Following implantation, lactate dehydrogenase levels may increase, indicating heightened bleeding risk. In such cases, Ringer's lactate solution should be avoided unless prescribed. Administering fluids without proper evaluation can lead to serious nursing errors [16].

Intensive care unit nurses, operating room staff, caregivers, and technicians require competence in sterile dressing changes, device monitoring, documentation, and emergency procedures in case of device malfunction. Most alerts are related to battery status or connection issues. In the rare event of pump failure, patients or caregivers must be able to switch to manual pumping until professional help arrives [8–16].

Research Methods

This study employed a systematic review approach to synthesize existing literature in the field of VAD nursing. The research included peer-reviewed articles and relevant resources published between 2009 and 2025. The literature review was conducted using the CINAHL, Scopus, and Web of Science databases. Keywords used for the search included "VAD nursing," "vascular access," "nursing practices," and "vascular nursing." The selected studies were evaluated based on predefined inclusion and exclusion criteria. Inclusion criteria encompassed original

research articles, reviews, and clinical guidelines related to VAD nursing. Studies were excluded if they were duplicates, pre-printed publications, or subject to language restrictions. As a result, 32 studies were deemed eligible for inclusion, and a detailed content analysis was conducted. Thematic analysis was applied to classify findings under relevant categories. This methodological approach aimed to provide a comprehensive perspective on VAD nursing practices and education, as well as to identify knowledge gaps in the field.

The Role of the VAD Nurse and the Care Plan

Patient refusal of treatment is not considered sufficient grounds for nurses to terminate the care process. In such cases, referral to a psychiatric evaluation is required. The compassionate approach of the nursing staff and the demeanor of the surgical team are essential during this period. The patient's relationship with psychiatric services must be supported. If decisions regarding the continuation or termination of care are to be made, multidisciplinary meetings between psychiatry and surgery teams—along with patient statements and the involvement of family members—play a significant role [19]. A more complex and demanding process begins after VAD implantation, and the quality of nursing care is critical to successful outcomes [5,18,19].

Waiting for transplantation or for a suitable donor heart is an emotionally taxing experience. Patients may become discouraged and refuse care after prolonged waiting periods. At such times, it is crucial to establish supportive communication addressing the patient's psychological state in order to maintain compliance with treatment.

Patient safety is the highest priority during all surgical interventions [19]. One of the nurse's essential responsibilities is to ensure effective communication within the healthcare team and to facilitate coordination when necessary.

Preoperative checklists help minimize mistakes and prevent erroneous events in regard to the patient, the site, the procedure, or the implant [20]. The informed consent specific to the artificial heart system must be signed by the patient [21]. According to hospital protocol, the surgeon must be present or confirmed to be on site before the patient is transferred to the operating room [22,23]. The patient is expected to demonstrate understanding of the procedure and express personal expectations [20–23]. Preoperative care orders issued by the surgeon—including administration of prophylactic intravenous antibiotics—must be followed precisely [20–23]. The nurse should work collaboratively with the anesthesia team and document the timing of prophylaxis [20–23].

On the morning of surgery, blood group and antibody verifications must be repeated. All blood products prepared for transfusion during surgery should be double-checked; if there is uncertainty, the anesthesia technician must be notified [20–23]. Hair from the chest and bilateral groin areas should be removed using battery-operated clippers, avoiding razors to prevent infection [21]. A preoperative shower and surgical site cleaning with chlorhexidine wipes are also required [23]. Patient transfer to the operating room must adhere strictly to established protocols [20–23].

At the beginning of the intraoperative period, all relevant units—including the nursing unit, anesthesia department, recovery room, and intensive care unit—must be notified and prepared for support [20]. Particularly during the transfer to intensive care, the patient should be moved promptly to a bed and allowed to rest without delay [23].

Plan of Nursing Care

VAD nurses must be fully cognizant of their legal responsibilities, duties, and scope of practice in the surgical setting [24]. Although there are currently no specific regulations exclusively for VAD nurses, their roles are generally governed by the standard regulations for operating room nurses in accordance with national nursing legislation [24].

The scrub (sterile) nurse works in the sterile field and is responsible for preparing all surgical instruments and materials, applying aseptic techniques, and ensuring proper infection control. This role involves maintaining patient safety through strict adherence to hand antisepsis and the correct donning of sterile gowns and gloves [24].

During surgery, the scrub nurse organizes instruments for accessibility and anticipates the surgeon's needs based on the procedure. In collaboration with the circulating (non-sterile) nurse, they conduct at least four counts of all surgical items—prior to surgery, during the procedure, and after closure—to ensure no materials are retained. The counted items are then handed over to the sterilization team [24].

The circulating nurse supports the surgical team by providing necessary materials before, during, and after the operation. Upon the patient's entry into the operating room, the nurse logs the procedure code and attempts to reduce patient anxiety. The circulating nurse is also responsible for controlling access to the operating room to ensure the safety of both the patient and the surgical team and remains present throughout the surgery. They ensure that sterile items are opened correctly and that the tissue specimens are handled, labeled, and sent to the laboratory appropriately [24].

A personalized nursing care plan should be developed for patients undergoing VAD implantation, particularly during the perioperative period. This plan should be based on established nursing diagnoses, interventions, and expected outcomes. As presented in Table 2, this process includes specific nursing activities tailored to the unique needs of VAD patients.

Education of Patients and Their Relatives

Educating patients with VAD implants is primarily the responsibility of nurses, who spend the most time with them [32]. A key aspect of this education is emphasizing the importance of proper device use and emergency preparedness [16,32]. One of the most common concerns patients express—often hesitantly—is, "What happens if the device suddenly shuts down or I go outside without realizing the battery is dead?" [29]. Through effective communication, patients are reassured that the device is designed to be safe even in emergencies. They are informed that the equipment can still be controlled even when the battery is depleted and that they should go to the hospital immediately if such a situation arises [27]. Patients are advised to stay calm to help their body adapt to the change in heart rhythm during such events [10,27,32].

A comprehensive written guide is given to the patient. It covers such topics as the system controller, alarms, external power sources, batteries, travel equipment, and maintenance tools. This

Table 1: Basic implant parts of the artificial heart

Basic Implant Parts of the Artificial Heart	
During implantation:	**Post-implantation:**
○ **Heart pump (HeartWare Pump)** ○ **Outflow graft** ○ Closed graft implant kit (sealed implant kit) ○ Pocket controller ○ Implant accessory kit ○ Closed inlet pipe (Sealed inflow conduit) ○ Sealed grafts with anti-kink closed exit Outflow grafts with bend relief ○ Sealed outlet pipe (sealed outflow bend relief collar) ○ Apical suture ring (Apical sewing ring)	○ Battery ○ Charger (battery charger) ○ Heart pump control kit (HeartWare control kit) ○ Transfer cable within the system (driveline extension cable) ○ Surgical tool kit

Table 2: Artificial heart support provided by nurses

Nursing Interventions for Patients with Artificial Heart Support		
Nursing Diagnosis	**Nursing Initiative**	**Evaluation Conclusion**
During the first three postoperative days, all critical nursing diagnoses, such as risk of bleeding, risk of infection, risk of fluid and electrolyte imbalance, and risk of impaired airway patency are thoroughly assessed, and corresponding interventions are implemented with the highest priority.		
Risk of Bleeding	Observe early signs of bleeding, such as petechiae, ecchymosis, nosebleeds, hematuria. Maintain drainage tubes below heart level. Monitor blood pressure, tachycardia, central venous pressure, anemia, PT, PTT, platelet count, ACT; vital signs hourly or thrice daily if not ordered by physician. Monitor hourly drainage. Administer platelet, erythrocyte suspension, fresh frozen plasma as needed. Adjust heparin infusion with physician. Inspect incision and device exit sites for bleeding.	Normal drainage without excessive bleeding. Blood gas and laboratory values within normal ranges. No visible bleeding observed.
Risk of Infection **Risk of Skin Integrity** **Disruption**	Care is planned to be minimally invasive to reduce procedure duration, limiting interventions to essential areas only. Prior to providing care, thorough hand washing is performed, gloves are worn, and appropriate protective clothing is used, especially when full isolation is required. Isolation protocols are strictly followed for surgical wound infections. The patient's susceptibility to infection is continuously assessed. Culture samples are collected upon physician request. The surgical incision site is classified and monitored regularly. Sterile techniques are employed when necessary to prevent contamination. Measures are taken to protect the patient from cross-contamination. Prophylactic treatments are administered according to the physician's orders. The patient is closely monitored for signs and symptoms of infection; any occurrence of high fever prompts immediate communication with the surgical team. Continuous observation of the patient's condition is maintained. The patient is positioned correctly and repositioned every two hours to prevent complications. Signs and symptoms of physical injury to the skin and underlying tissues are evaluated, including assessment of tissue perfusion. Daily dry sterile dressings are applied to all surgical wounds, and the wound healing process is regularly assessed. Postoperative factors increasing infection risk are evaluated following the procedure. Perioperative monitoring includes evaluation for infection signs and symptoms for up to 30 days after surgery.	The patient exhibits no signs or symptoms of infection at the incision site upon hospital discharge, including absence of pain, redness, swelling, drainage, or delayed wound healing. ▪ The surgical wound is covered with a dry sterile dressing upon transfer from the operating room. ▪ The patient remains afebrile and shows no clinical evidence of infection. ▪ Preoperative and postoperative antibiotic therapies administered according to established guidelines, with no subsequent signs or symptoms of infection observed. ▪ Any hyperemia observed resolved within 30 minutes. ▪ The patient reports no pain or numbness related to surgical positioning and shows no signs or symptoms of positioning-related injury. ▪ Skin assessment reveals smooth, intact skin free from cuts, abrasions, lacerations, rashes, or blisters. ▪ Neuromuscular evaluation confirms that the patient can flex and extend extremities independently and denies any numbness or tingling sensations.
Risk of Fluid – Electrolyte Imbalance	Identify factors associated with an increased risk of bleeding or fluid and electrolyte imbalance. (If lactate dehydrogenase levels are elevated, Ringer's lactate is avoided unless specifically requested by the physician for fluid replacement.) Report any deviations in diagnostic test results and repeat urine-specific gravity measurements every two hours. Monitor central venous pressure hourly. Evaluate and document the amount and characteristics of fluid draining from chest tubes. Apply appropriate hemostatic techniques as needed. Maintain hourly records of the patient's fluid intake and output, document occurrences of vomiting, diarrhea, fever, and additional fluid losses from tubes and drains. Continuously monitor physiological parameters. Review arterial blood gas results regularly. Administer electrolyte replacement therapy as prescribed. Assess the patient's response to fluid and electrolyte administration.	The patient's vital signs remain within the expected range for discharge from the operating room. The patient maintains hemodynamic stability during positional changes while being transferred to the postoperative intensive care unit. Urine output is closely monitored and maintained within normal limits. The patient's fluid, electrolytes, and acid-base balances are preserved at baseline levels or show improvement.
Risk of Inadequate Airway Patency **Aspiration Risk**	Due to the presence of an endotracheal tube, suctioning is performed every two hours based on the patient's condition. In cases of obstruction, suctioning is conducted using 2–3 cc of sterile saline. This procedure should be brief, with continuous monitoring of oxygen saturation via pulse oximetry. Respiratory rate is recorded four times per hour. Any abnormalities in arterial blood gas results are promptly reported. Physiological parameters are continuously monitored. If tidal volume decreases, the physician is notified immediately. The patient is encouraged to perform deep breathing and coughing exercises, in collaboration with the respiratory therapist. The patient's respiratory status is maintained at baseline or shows improvement.	The patient's arterial oxygen saturation (SaO2) remains within the expected range; the rate, depth, and symmetry of respirations are stable or improved compared to preoperative assessments. Cognitive status: The patient responds appropriately to questions, and memory function is intact. Vital signs: Blood pressure, temperature, oxygen saturation measured by pulse oximetry (SpO2), and pulse rate are all within expected ranges.
Risk of Injury	Prior to the initiation of surgery, the patient's identity is confirmed, and the surgical site is clearly marked in advance. The correct patient and surgical site are verbally confirmed by the entire surgical team. The planned VAD procedure is announced aloud in the operating room. Scrub and circulating nurses perform and document counts of all surgical materials before the intervention; if discrepancies arise, corrective measures must be taken immediately after the procedure. Patient privacy is rigorously maintained throughout the process. Patient information is disclosed only to healthcare personnel directly involved in the patient's care. Nurses serve as patient advocates by protecting them from inadequate, unethical, or unlawful practices. The patient's initial skin condition is thoroughly assessed prior to surgery.	The surgical team confirms that the intervention was performed at the correct anatomical site, side, and level. The patient receives competent and ethical care in accordance with established legal and professional standards.
Risk of Body Temperature Imbalance	▪ The risk of normothermia dysregulation is assessed. Both hypothermia and hyperthermia are closely monitored. ▪ Any deviations in diagnostic test results are reported immediately. ▪ Thermoregulation interventions are implemented, and the patient's response is evaluated continuously. ▪ Body temperature is frequently monitored, specifically every 15 minutes during the first 24 hours postoperatively. ▪ Physiological parameters are continuously observed.	▪ The patient's body temperature is maintained above 36°C (96.8°F) upon discharge from the operating room. ▪ The patient is in the immediate postoperative phase and has returned to, or is returning to, normothermia by the end of the monitoring period.
Cardiac Insufficiency Output	The patient's initial cardiac status is thoroughly documented. Vascular conditions and any previous surgical or invasive procedures are reviewed through detailed patient interviews. Supporting data is gathered from available technological devices to facilitate a comprehensive evaluation. Renal function is carefully assessed to ensure homeostasis is maintained. The presence of any implantable cardiac devices is identified and duly reported. Any abnormalities or deviations observed in diagnostic test results are promptly communicated.	Cardiovascular status: The patient's heart rate and blood pressure are within expected limits; peripheral pulses are present and symmetrical bilaterally; the skin is warm to the touch; no cyanosis or pallor is observed; capillary refill time is less than three seconds. Respiratory status: The patient's arterial oxygen saturation (SaO2) is within normal range. Skin condition (general): The conjunctiva and mucous membranes appear pink, with no signs of cyanosis or pallor. Renal status: Urine output exceeds 30 mL/hour, with specific gravity ranging between 1.010 and 1.030.
Fear **Anxiety** **Lack of Information** **Inadequacy in Communication** **Ineffective Family Management of the Therapeutic Regimen**	Assesses the patient's psychosocial status and collaborates with the healthcare team to evaluate neurological function. Evaluates the patient's coping mechanisms and implements interventions to provide psychological support. Screens for signs and symptoms of anxiety and fear. Creates a calm and supportive environment to address home care needs and alleviate anxiety when present. Identifies sensory impairments and potential communication barriers. Determines the educational needs of both the patient and their family. Explains the expected sequence of events related to the surgical and recovery process. Monitors the patient's response to interventions and develops a personalized care plan accordingly. Explores the patient's perceptions and concerns regarding surgery. Verifies patient allergies to prevent adverse reactions. Documents the psychosocial status comprehensively. Assesses patient-specific challenges related to medication management. Provides perioperative education to the patient and/or their caregiver. Evaluates the effectiveness of educational interventions. Supplies information regarding prescribed medications.	▪ Patients and their relatives are informed about the potential feelings of anxiety, fear, and worry that may arise before and immediately after surgery. ▪ Psychological support is provided to both patients and their family members. ▪ Patients are guided to verbalize realistic expectations regarding the effects of medications on postoperative recovery prior to hospital discharge. ▪ They are educated about the possible side effects of medications prescribed at discharge. ▪ Patients and/or their relatives are able to accurately identify the correct dosage, frequency, and purpose of each medication.

document is intended to reduce anxiety and promote self-confidence in managing the device.

The dressings around the driveline—the tubes connecting the internal and external components—should be changed daily using a sterile, dry technique [32]. Although surgical site infections can be treated under hospital conditions with full sterility, failure to perform proper dressing changes at home may lead to serious infections that affect the device's output line [28]. Therefore, patients must be taught how to apply dressings in a simple, clear, and hands-on manner [26].

Patients can generally continue their activities of daily living (ADLs), but they are advised to avoid strenuous or emotionally intense activities [27]. The ability to resume ADLs is determined by the surgeon and based on specific postoperative criteria [29–32]. If the cardiac output displayed on the device monitor falls below 3.5 liters, patients are instructed to contact the clinical team immediately [30–32]. It is recommended that patients check the device's battery status every two hours using alarms or reminders [31,32]. Additionally, once a suitable donor heart becomes available, patients are informed that they must arrive at the hospital within two hours [32].

Conclusion

In addition to providing direct patient care, VAD nurses support the surgical team throughout the entire treatment process—from the patient's hospital admission for artificial heart implantation to the heart transplantation itself. Successful implantation requires detailed planning, interdisciplinary collaboration, coordinated efforts, and clinical competence.

In the preoperative phase, the VAD nurse ensures open communication with the patient, answers questions to reduce anxiety, and thoroughly prepares the patient for surgery—steps essential to the success of the procedure. During surgery, the VAD nurse actively participates in teamwork, identifies potential complications in advance, and implements contingency plans to deliver high-quality, safe care.

With the continuous evolution of VAD technologies, ongoing annual training for VAD nurses and relevant hospital staff is a necessity. Beyond the responsibilities of operating room nursing, VAD nurses must also focus on improving the quality of life for patients through empathy, patient education, communication, and crisis management. Managing a device that supports a vital organ like the heart demands the dedication and expertise of highly trained nurses. VAD nursing is thus a cornerstone in the treatment of advanced heart failure.

Suggestions

Based on the findings of this study, several recommendations can be made to enhance the quality of VAD nursing. VAD nurses should be encouraged to participate regularly in case conferences and interdisciplinary training programs, as such collaboration strengthens both patient care and teamwork among healthcare professionals. Continuing education must be supported through simulation-based training, and evidence-based clinical guidelines to ensure up-to-date knowledge and skill development. Additionally, it is essential to adopt and routinely update national and international care protocols, which help maintain consistent and effective practices during the perioperative period. Providing nurses with training in emergency scenarios is also crucial, as it improves their ability to respond competently to complications that may arise during surgical procedures. Furthermore, educational materials tailored to patients and their families should be developed to facilitate their adaptation to life with a ventricular assist device. Finally, considering the high workload and emotional stress associated with this role, supportive working environments should be fostered, and institutional policies should be implemented to promote the well-being and job satisfaction of VAD nurses.

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