JOJ Nursing & Health Care
ISSN: 2575-8551

Case Report
Volume 14 Issue 2 - November 2025
DOI: 10.19080/JOJNHC.2025.14.555885

JOJ Nurse Health Care

Nursing Cooperation of 32 Cases of Ventricular Assist Device Implantation Assisted by Cardiopulmonary Bypass

Minwei Shen* , Yue Yang and Wanjun Cha

Zhongshan Hospital, Fudan University, 200032, Shanghai, China

Submission: October 24, 2025; **Published:** November 03, 2025

***Corresponding author:** Minwei Shen, Zhongshan Hospital, Fudan University, 200032, Shanghai, China

Abstract

Objective: To summarize the key nursing coordination points for 32 cases of left ventricular assist device (LVAD) implantation.

Methods: A retrospective analysis was conducted on the clinical data of 32 patients who underwent open-heart LVAD implantation surgery with cardiopulmonary bypass (CPB) support between January 2024 and February 2025.

Results: All 32 procedures were successfully completed with CPB support. The mean operative time was (333.69±85.68) minutes, and the mean CPB time was (104.72±28.81) minutes. No intraoperatively acquired pressure injuries occurred in any patient.

Conclusion: LVAD implantation with CPB support is characterized by long duration, high risk, and complex procedural steps. Operating room nurses must not only possess skills for assisting in CPB-assisted open-heart surgeries but also master specific knowledge related to LVAD implantation. Familiarity with the key coordination points for LVAD implantation, building upon traditional open-heart surgery protocols, is essential to ensure safe and successful procedure completion.

Keywords: Cardiopulmonary Bypass; Ventricular Assist System; Surgical Nursing Coordination; Perfusionists; Anesthesiologists; Echocardiographers; Cardiac Apex

Preface

Heart failure (HF) is a cardiovascular disease with high treatment difficulty and risk, featuring high mortality and readmission rates [1]. While heart transplantation is often the optimal treatment for end-stage HF, the availability of organ donors is severely limited. Ventricular assist devices (VADs) serve as a crucial therapeutic option for these patients [2,3] and have become a primary choice either as a bridge to transplantation or as permanent destination therapy [4].

The left ventricular assist device (LVAD) operates by using a rotating impeller within its blood pump to generate force. This force propels blood from the left ventricle through the pump and into the ascending aorta, thereby assisting circulation. Breakthroughs in key technologies like magnetic levitation bearings and optimized fluid dynamics [5,6] have shifted their clinical application from traditional mechanical support towards more intelligent and miniaturized systems. Surgical coordination for VAD implantation is a critical factor for success, where its level of specialization directly impacts patient safety and outcomes. Clinical studies indicate that standardized nursing coordination can reduce operative time by 15-20% and lower device-related complication rates to below 3% [7].

Research Purpose

Current research in nursing coordination reflects a trend towards multidisciplinary integration. The combination of monitoring engineering parameters with clinical nursing observations is driving innovation in traditional cardiac surgery coordination models [8]. This study collected clinical data from patients who underwent VAD implantation at our hospital and retrospectively analyzed perioperative nursing coordination strategies, aiming to provide a reference for future related research.

Clinical Data

General Information

A total of 32 patients were included in this study, comprising 5 females and 27 males. The age of the patients ranged from 30 to 71 years, with a mean age of 53.69 ± 11.20 years. Among them, 17 patients (53.15%) had a body mass index (BMI) between 18.5 and

23.9. Preoperative cardiac function assessment revealed that 28 patients (87.5%) were classified as New York Heart Association (NYHA) class IV, and left ventricular ejection fraction ranged from 11% to 37%. Seven patients had previously implanted cardiac pacemakers. These findings indicate that the study population primarily consisted of individuals with end-stage heart failure.

All 32 patients underwent elective surgery, and the types of procedures performed did not significantly impact nursing resource allocation. In terms of device selection, 21 patients received the Corheart6 (Shenzhen Core Medical), 10 received the CH-VAD (Suzhou Tongxin Medical), and 1 received the Abbott (106524 US) device. All implanted devices were fully magnetically levitated left ventricular assist systems.

Postoperative Outcomes

All 32 patients successfully underwent the surgical procedure. Among them, 9 patients underwent concomitant procedures, including coronary artery bypass grafting, aortic valve replacement, and/or tricuspid valvuloplasty. The mean operative time was 333.69 ± 85.68 minutes, and the mean cardiopulmonary bypass time was 104.72 ± 28.81 minutes. The average hospital stay was 26.34 ± 12.02 days, with a mean intensive care unit stay of 12.69 ± 10.87 days. Two patients died postoperatively due to severe multiple organ failure. The remaining 30 patients showed improvement or were cured and were discharged successfully.

Preoperative Management

Forming a Multidisciplinary Team and Developing a Surgical Plan

The multidisciplinary team approach proves highly valuable in VAD implantation, focusing on integrating knowledge and skills from various specialties to manage the procedure's complexity. Preoperatively, a collaborative team comprising cardiac surgeons, perfusionists, anesthesiologists, echocardiographers, and specialized nurses participates in case discussions.

During the preoperative phase, the team conducts a comprehensive assessment of the patient's cardiac function, coagulation status, and device characteristics. Detailed communication is established regarding the surgical approach, specific intraoperative steps, potential risks, and possible emergencies. Furthermore, the team develops a thorough understanding of anesthesia-related risks and key perioperative management points, formulating a corresponding nursing care plan. This process aims to enhance the success rate, mitigate risks, and ensure a prompt response to any urgent situations.

Equipment consumables configuration

The operating room nursing team should thoroughly assess potential contingencies and prepare the necessary equipment and supplies accordingly [9]. Coordination with the supply management department is essential before surgery to confirm the delivery of the VAD and any specialized instruments requiring sterilization. These dedicated instruments should be sent to the central sterile supply department one day in advance to ensure availability for the next day's surgery.

Basic instrument sets must also be secured, typically including one set for cardiopulmonary bypass procedures and one set for coronary artery bypass grafting. Additional specific items are required, such as fastener coils for securing apical sutures, a sterile marker for labeling positions, an arthroscopy sleeve to protect the pump connectors and driveline from contamination, plus specific clamps, occlusion clamps, and other device-dedicated tools.

Environmental preparation

Rational planning of the operating room space is crucial for ensuring a smooth procedure. The flow of non-essential personnel should be strictly controlled to minimize infection risks [10]. Given the large number of devices used, careful placement is necessary. All cables and tubing should be organized neatly to prevent contamination of the sterile instrument field.

Intraoperative management

Surgical position

After the induction of general anesthesia, the patient is placed in the supine position. A transesophageal echocardiography probe is inserted. The planned exit site for the driveline is marked on the right abdomen, approximately 2-3 fingerbreadths below the costal margin at the midclavicular line. Due to the use of electrosurgical equipment during the procedure, potential interactions with existing pacemakers or implantable cardioverter-defibrillators (ICDs) must be addressed. A magnet is typically placed over the device to suspend its therapies, and it should be programmed off before using electrocautery to prevent interference. External defibrillation pads must be placed on the patient while the permanent device is deactivated [11,12].

Medication Preparatio

Pump Testing Solution: Prepare a solution of 2000ml 0.9% sodium chloride injection with 12,500 units/2ml of heparin in a basin. The blood pump is submerged in this solution for a test run. After confirming performance and adjusting speed, the pump is wrapped in a sterile gauze pad and placed on the sterile table for later use. In a separate measuring cup, prepare 500ml 0.9% sodium chloride injection with 12,500 units/1ml of heparin (used with a 50ml syringe to flush the pump's conduits).

Antibiotics: Administer antibiotics intravenously as prescribed, 30 minutes before skin incision. If the procedure duration exceeds 3 hours or twice the drug's half-life, an intraoperative redosing is required [13].

Anticoagulation: Prepare a full systemic heparinization dose of 3mg/kg based on patient body weight. The patient's coagulation status is monitored in real-time during surgery using the Activated Clotting Time (ACT).

How to cite this article: Minwei S, Yue Y, Wanjun C. Nursing Cooperation of 32 Cases of Ventricular Assist Device Implantation Assisted by Cardiopulmonary Bypass. JOJ Nurse Health Care. 2025; 14(2): 555885. DOI: 10.19080/JOJNHC.2025.14.555885

Implant Device Preparation

On a separately set up sterile back table, a 10mm x 60cm vascular graft is connected to the blood pump's outlet. A graft protection cover is placed over the external part of the graft and secured by tightening the screws. The sterile driveline extension cable is connected to the pump, and its distal end is passed off the field, taking care to avoid contamination.

The prepared pump assembly is then completely submerged in a basin filled with heparinized saline (20 units/ml). The pump is started for a test run, initially set at 2200 RPM, increased to 3000 RPM, and then returned to 2200 RPM. This test run lasts 30-60 seconds, during which parameter readings and flow curves are observed to confirm proper pump function. The distal end of the vascular graft is clamped, allowing the pump outlet to be raised above the fluid surface. The previous speed adjustment sequence is repeated while observing the connection between the pump outlet and the graft for any signs of leakage, thereby assessing the security and seal of the connection. After confirming normal pump operation and the absence of leaks, the pump is stopped.

Once the rotor comes to a complete stop, the pump is removed from the heparinized saline, and the connection to the controller is disconnected. Protective caps are placed on the pump ports. The driveline connector is covered with its protective seal. The driveline itself is covered with an antibiotic-soaked saline gauze. The entire pump assembly is then wrapped in a sterile drape and kept in the sterile field for later implantation.

Driveline Tunneling

A small incision was made approximately two fingerbreadths below the right costal margin along the midclavicular line, marking the exit site for the driveline. A tunneling needle was introduced through this incision and advanced through the abdominal wall into the thoracic cavity. The needle was then connected to the protective cap on the driveline connector. By holding the needle handle, the driveline was pulled back along the established subcutaneous tunnel. The velour portion of the driveline was positioned subcutaneously, ensuring the leading edge remained 1.5–2.0 cm inside the skin exit site. The driveline was then secured with sutures. Care was taken to protect the connector from moisture by covering it with a sterile plastic sheath and drapes.

Establishment of Cardiopulmonary Bypass

A median sternotomy was performed. After systemic heparinization and confirmation of adequate anticoagulation (activated clotting time >480 seconds), cardiopulmonary bypass was established via cannulation of the aorta and both the superior and inferior venae cavae. Carbon dioxide was continuously insufflated into the surgical field. The ascending aorta was cross-clamped, and cardioplegia was administered to induce cardiac arrest. Intraoperative transesophageal echocardiography was used to assess for a patent foramen ovale, evaluate valvular function, and detect any intracardiac thrombi, with appropriate interventions performed as necessary.

Device Implantation

The cardiac apex was fully exposed. Saline-soaked gauze pads were placed around the heart to elevate the apex, and copious ice slush was applied for myocardial protection. The coring site on the apex was marked using a sterile pen along the border of the apical cuff. Approximately 12–15 pledgeted 3-0 polypropylene everting sutures, reinforced with felt and bovine pericardial strips, were preplaced around the apical cuff. A stabilizer was used to hold the cuff in position. A cruciate incision was made at the apex with a No. 11 blade, penetrating the endocardium. An apical coring device was inserted vertically into the ventricle, activated with a twisting motion to excise the myocardial core, and then removed. The ventricular chamber was inspected, and any thrombus or tissue debris was cleared to ensure an unobstructed inflow path.

The pump was inserted vertically into the apical cuff and adjusted to achieve optimal positioning, ensuring a secure fit between the pump and the cuff and verifying that the outflow graft was free of kinks or twists. The suture ring was tightened and inspected for bleeding, with additional sutures placed if needed. Following initial de-airing, a soft clamp was applied near the distal end of the outflow graft. The aortic cross-clamp was removed to allow cardiac reperfusion and resumption of heartbeat. The gauze pads and ice slush were removed, and the heart was returned to its anatomical position.

A side-biting clamp was applied to partially occlude the ascending aorta. The outflow graft was trimmed to an appropriate length, and an opening was created. Approximately 50 mL of heparinized saline (50 U/mL) was injected retrograde through the graft to fill the pump and left ventricular apex, minimizing the risk of pump thrombosis before activation. An end-to-side anastomosis between the outflow graft and the ascending aorta was performed using a 5-0 polypropylene suture. After completing the anastomosis and releasing the side-biting clamp, a 5 mL syringe needle was inserted into the graft to assist in venting residual air.

Before activating the pump, the patient was placed in a Trendelenburg position to reduce the risk of cerebral air embolism. The echocardiographer confirmed the position of the inflow cannula and the absence of residual air in all cardiac chambers. The device specialist verified correct parameter settings. The pump was initiated at the lowest recommended speed. Under parallel support from the left ventricle, cardiopulmonary bypass, and the LVAD, the surgical, anesthesia, and perfusion teams collaboratively adjusted the pump speed based on continuous transesophageal echocardiographic monitoring of right ventricular function, septal position, and hemodynamic status. Cardiopulmonary bypass flow was gradually weaned while the LVAD speed was incrementally increased, ultimately allowing for safe discontinuation of bypass.

How to cite this article: Minwei S, Yue Y, Wanjun C. Nursing Cooperation of 32 Cases of Ventricular Assist Device Implantation Assisted by Cardiopulmonary Bypass. JOJ Nurse Health Care. 2025; 14(2): 555885. DOI: 10.19080/JOJNHC.2025.14.555885

Hemostasis and Chest Closure

Protamine sulfate was administered to reverse heparinization. Meticulous inspection was performed for potential bleeding sites, particularly along the apical cuff sutures and myocardial needle holes, with hemostatic agents applied as needed. Pericardial and mediastinal drainage tubes were placed. Before closure, an anti-adhesion barrier was applied over the pump and outflow graft to facilitate potential future reoperation. All surgical instruments and supplies were counted and verified. The chest was then closed in layers.

Postoperative Patient Transfer

Upon completion of the procedure, the intensive care unit was notified to prepare for patient arrival. A structured handover was prepared, summarizing the surgical procedure, hemodynamic status, infusion lines and therapies, ventilator settings, and other critical information. Roles were clearly assigned among the surgeon, anesthesiologist, nursing staff, and assistants for patient transfer. All catheters and lines were checked for patency, and monitoring equipment was securely positioned. Patient warmth was maintained throughout the transfer. Care was taken to prevent dislodgement or dropping of the system controller, monitor, or driveline during movement.

Summary

The decision to implant an LVAD with CPB support requires a multi-faceted evaluation, centered on balancing procedural safety against clinical benefit. The choice of surgical technique must consider the specific characteristics of the device used [14]. These numerous factors place greater demands on the operating room nurse [15].

The multidisciplinary team model demonstrates significant value in VAD implantation, with its core strength being the integration of expertise from different specialties to manage the procedure's complexity. Ensuring the availability of the LVAD itself and all necessary specialized instruments is a fundamental prerequisite for initiating the surgery.

Having a dedicated device specialist or engineer involved intraoperatively to monitor parameters like magnetic levitation bearing stability is highly beneficial. Efficiently organizing the limited operating room space, properly positioning all equipment to minimize clutter, and clearly defining the core responsibilities of nursing staff at different surgical stages are crucial. A standardized operational framework helps reduce team acclimatization time, enhances patient safety, optimizes resource use, and improves overall procedural efficiency.

Strict aseptic technique is paramount to reduce infection risk. Identifying key nursing coordination points during VAD implantation and establishing a risk warning indicator system are important. Developing standardized response protocols for potential emergencies, such as hemodynamic instability during CPB or device malfunction, enables the team to manage crises methodically and effectively.

As a bridge therapy to heart transplantation [16], the LVAD can effectively prevent further clinical deterioration in patients with advanced heart failure while they await a suitable donor. It can also make some patients, initially ineligible for transplant, become potential candidates for the waiting list.

Although the application of LVAD technology in China started relatively late, its development has been rapid, and the technology is gradually gaining recognition among healthcare professionals and the public [17]. Mastering the coordination process for LVAD implantation and summarizing perioperative nursing management pathways and strategies will contribute significantly to saving lives, extending survival, and improving the quality of life for a greater number of heart failure patients.

References

1. National Center for Cardiovascular Quality Control, Heart Failure Expert Working Group (2021) 2020 China Heart Failure Medical Quality Control Report. Chinese Circulation Journal 36(3).
2. Chen M, Wang YX, Xu Li, Fei Li (2023) Current status and progress in ventricular assist devices. Organ Transplantation 14(1): 62-67.
3. Li P, Xu BL, Wu TT, Nianguo D (2021) Clinical application of extracorporeal ventricular assist therapy in cardiogenic shock. Journal of Clinical Cardiology 37(6): 500-507.
4. Albert CL, Estep JD (2019) How to Optimize Patient Selection and Device Performance of the Newest Generation Left Ventricular Assist Devices. Curr Treat Options Cardiovasc Med 21(9): 45.
5. Li YT, Liu Y, Ren JR, Shen B, Zhanling G (2024) Research progress on ventricular assist devices. China Medical Devices 39(3): 160-169.
6. Zhu PX, Guan X, Li QG (2023) Research progress of magnetically levitated ventricular assist devices. International Journal of Cardiovascular Disease 50(5): 274-277.
7. Hu SS, Wang XQ, Zhou XT (2023) Ventricular assist device for heart failure: current status and future considerations. Chinese Circulation Journal 38(8): 791-793.
8. Chinese Society of Mechanical Circulatory Support, Chinese Expert Committee on Ventricular Assist Devices, Hu SS, et al. (2024) Chinese expert consensus on early intensive care management after left ventricular assist device implantation (2024). Chinese Circulation Journal 39(8): 729-750.
9. Wei KJ, Liu Y, Wang SM, et al. (2021) Surgical cooperation of left ventricular assist device artificial heart implantation. Journal of Nurses Training 36(5): 443-445.
10. Lin LX, Chen SS, Chen SS (2020) Impact of intraoperative personnel flow on air quality and patients in laminar flow operating rooms. Hospital Management Forum 37(10): 64-66.
11. Kirklin JK, Naftel DC, Kormos RL, pagani FD, Myers SL et al. (2013) Quantifying the effect of cardiorenal syndrome on mortality after left ventricular assist device implant. J Heart Lung Transplant 32(12): 1205-1213.

How to cite this article: Minwei S, Yue Y, Wanjun C. Nursing Cooperation of 32 Cases of Ventricular Assist Device Implantation Assisted by Cardiopulmonary Bypass. JOJ Nurse Health Care. 2025; 14(2): 555885. DOI: 10.19080/JOJNHC.2025.14.555885

12. Ben Gal T, Avraham BB, Milicic D, Crespo-Leiro MG, Coats AJS, et al. (2021) Guidance on the management of left ventricular assist device (LVAD) supported patients for the non-LVAD specialist healthcare provider: executive summary. Eur J Heart Fail 23(10): 1597-1609.

13. Jiangsu Provincial Pharmaceutical Association, Infectious Pharmacy Committee, Shao H (2025) Expert consensus on prophylactic use of antibiotics in common invasive diagnostic and therapeutic procedures. China Pharmacy 36(10): 1153-1160.

14. Wang Q, Li S, Li JG (2023) Basic performance study of ventricular assist devices. China Medical Devices 38(8): 6-10.

15. Niu DD, Gao XL, Li X, Wei S (2022) Surgical cooperation for MP-EX fully magnetically levitated short-term extracorporeal ventricular assist device implantation. Journal of Nursing Science 37(4): 57-58.

16. Dong NG, Yu SZ (2024) Reflections on the development of biventricular assist devices. Chinese Journal of Thoracic and Cardiovascular Surgery 40(8): 449-450.

17. Sichuan Professional Committee on Cardiac Critical Care and Assist Support, et al. (2024) Expert consensus on whole-process management of left ventricular assist device implantation (2023). Practical Journal of Clinical Medicine 21(1): 43-55.

How to cite this article: Minwei S, Yue Y, Wanjun C. Nursing Cooperation of 32 Cases of Ventricular Assist Device Implantation Assisted by Cardiopulmonary Bypass. JOJ Nurse Health Care. 2025; 14(2): 555885. DOI: 10.19080/JOJNHC.2025.14.555885