Postprint of Perioperative Nursing Care Coordination in Transcatheter Aortic Valve Replacement

Authors: Lu Jianfa, He Jing, Wang Xiaoping, Huang Zhuqiu

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Abstract

Transcatheter Aortic Valve Replacement (TAVR) is a multidisciplinary collaborative procedure, and close cooperation between physicians and nursing staff is the key to successful surgery. This paper summarizes perioperative nursing experiences in preoperative nursing preparation, intraoperative cooperation, and postoperative nursing care for TAVR, aiming to provide guidance and reference for clinical TAVR perioperative nursing care.

Full Text

Preamble

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Perioperative Nursing Cooperation for Transcatheter Aortic Valve Replacement

LU Jianfa, HE Jing, WANG Xiaoping, HUANG Zhuqiu
(Department of Cardiovascular Diseases, Shenzhen Traditional Chinese Medicine Hospital, Shenzhen, Guangdong)

Abstract

Transcatheter aortic valve replacement (TAVR) is a multidisciplinary collaborative procedure in which close coordination between physicians and nursing staff is critical to surgical success. This article summarizes perioperative nursing

experiences in preoperative preparation, intraoperative cooperation, and postoperative care for TAVR, aiming to provide guidance and reference for clinical nursing practice during the TAVR perioperative period.

Keywords: TAVR; aortic stenosis; perioperative nursing; complications; cardiac pacing; perivalvular leakage; cardiac rehabilitation

Introduction

Aortic stenosis refers to abnormal aortic valve structure resulting from congenital anomalies or acquired disease, leading to reduced aortic valve orifice area. The normal aortic valve orifice area in adults is cm^2; a valve orifice area of $<$ cm^2 indicates moderate stenosis, cm^2 indicates severe stenosis, and cm^2 indicates mild stenosis. With the aging of China' s population, degenerative valvular disease is increasing. Current reports indicate that the prevalence of aortic stenosis is approximately %, while the prevalence of aortic regurgitation is about %. In clinical practice, approximately % of patients with severe aortic stenosis report no symptoms at initial diagnosis [1], and the annual sudden death rate among asymptomatic severe aortic stenosis patients is substantial. Aortic stenosis is currently the most common primary valvular disease requiring surgical or catheter-based intervention [2].

TAVR was first successfully performed in France in 2007, and subsequently, Shanghai Zhongshan Hospital and other institutions in China began to adopt this technique. With rapid advances in medical technology, significant breakthroughs have been achieved in evaluation methods, device selection, and complication prevention. The latest expert consensus both domestically and internationally has expanded the relative indications for TAVR [3]. The TAVR procedure offers advantages of minimal trauma and rapid recovery, gradually becoming the mainstream treatment for aortic stenosis patients [4]. TAVR is a multidisciplinary collaborative surgery, and close cooperation between physicians and nurses is the key to successful outcomes. This places higher demands on interventional nursing professionals, who must not only fully understand the patient' s preoperative condition and potential surgical adverse reactions but also master the characteristics of the stent valves used in TAVR and the specific surgical procedure, while anticipating possible complications to provide higher quality and safer nursing care.

Transcatheter aortic valve replacement (TAVR) involves delivering a preassembled aortic valve via catheter to the aortic root to replace the native aortic valve. This article summarizes relevant data on preoperative nursing preparation, intraoperative cooperation, and postoperative nursing care for TAVR, aiming to provide guidance and reference for clinical nursing practice during the TAVR perioperative period.

1 Preoperative Nursing Preparation

1.1 Comprehensive Patient Assessment

TAVR treatment requires consideration of anatomical features, surgical strategy, and complication prevention to develop individualized surgical plans based on patient characteristics, thereby ensuring the safety, effectiveness, and long-term outcomes of TAVR in this special population [5]. For patients with severe aortic stenosis and poor preoperative circulatory and hepatic-renal function, ECMO-assisted therapy can ensure hemodynamic stability during the TAVR perioperative period and provide effective cardiopulmonary support [6]. For younger patients, on one hand, the proportion of concomitant coronary artery disease is higher than reported in existing RCT results, with risk of coronary disease progression over time postoperatively, and the proportion of bicuspid aortic valve is higher; on the other hand, their longer life expectancy places greater demands on prosthetic valve durability and the incidence of permanent pacemaker implantation caused by TAVR [7]. Although TAVR has certain safety and effectiveness in low-risk aortic stenosis patients, a cautious attitude is still required regarding its application in this population [8]. Among asymptomatic patients with severe aortic stenosis, clinical predictors for requiring TAVR treatment mainly include advanced age, frailty, chronic heart failure, chronic renal insufficiency, and sedentary lifestyle. Early TAVR treatment in these patients can improve survival and long-term prognosis [9].

During TAVR procedures, patients' conditions can change rapidly, and complications such as circulatory collapse, vascular access injury, severe perivalvular leakage, or even emergency thoracotomy may occur during manipulation. Therefore, close collaboration among cardiovascular medicine, interventional cardiology, cardiac surgery, imaging, and anesthesiology is key to successful surgery.

1.2 Complete Imaging Examinations

Preoperative ultrasound can evaluate cardiac morphology, function, valvular function, and aortic root anatomy. Preoperative coronary angiography can assess coronary artery conditions. Preoperative CT should measure the annulus diameter in multiple planes and observe annulus shape to calculate its dimensions, which is extremely valuable for evaluating concomitant coronary artery disease, valvular calcification degree, peripheral vascular access, and measuring coronary ostium height. Intraoperative combination of multiple imaging modalities evaluates vascular access and aortic root structure, providing references for vascular access selection and valve size choice. Combined with angiography and balloon measurement, this guides selection of surgical instruments and strategies. Additionally, appropriate projection angles for aortic root angiography and valve implantation must be selected to provide reliable information for surgeons during the procedure [10].

1.3 Preoperative Patient Preparation

Indwelling catheterization not only facilitates intraoperative urine output observation but also enables postoperative volume control. Nurses assist physicians in establishing central venous access and temporary pacemaker placement for intraoperative drug administration and cardiac pacing. Peripheral venous access is established to assist anesthesiologists with endotracheal intubation and invasive peripheral arterial monitoring under general anesthesia. Patients may require cardioversion and defibrillation during surgery, so defibrillation pads should be applied preoperatively while avoiding interference with the surgical field. Routine preoperative skin preparation and psychological guidance and health education are provided.

Most TAVR procedures in China (approximately %) use transfemoral artery access, which requires routine skin preparation. Although the surgical path is straightforward, it is relatively distant from the heart, resulting in longer procedural time and unpredictable events. During vascular puncture or large-bore arterial sheath insertion, unexpected events such as stent displacement or detachment may occur. Interventional nurses should closely monitor vital signs and overall patient response, communicate with operators and technicians at all times, accurately deliver consumables, cooperate with pacemaker pacing during stent release and assist with medication administration, while maintaining relevant records.

The transapical approach is a hybrid procedure combining surgical and interventional techniques. In addition to interventional nurses, scrub nurses are required for intraoperative cooperation. This approach has a shorter delivery distance and relatively easier positioning, avoiding peripheral vascular disease-related accidents. However, because it involves thoracotomy, more precise nursing cooperation and heightened attention are required, with perfusionists prepared for emergencies. In addition to observing the overall patient condition, interventional nurses should anticipate the local surgical field to deliver instruments promptly and accurately to complete surgical cooperation [11].

TAVR is a complex and high-risk procedure, and nurses must prepare all emergency equipment and supplies, such as thoracotomy kits, cardiopulmonary bypass machines, snares, and IABP.

2 Intraoperative Cooperation

2.1 Vascular Access Protection

TAVR puncture requires selecting larger-diameter, straight vascular access routes to avoid hematomas from repeated puncture attempts. The incidence of vascular complications correlates with sheath size; larger sheaths are associated with higher complication rates.

2.2 Intravenous Channel Management

TAVR procedures typically use multiple vasoactive drugs to enhance myocardial contractility and cardiac output while reducing cardiac load. With numerous intravenous medication lines, proper fixation is essential. Use brightly colored label stickers at syringe and extension tube connections to indicate dosages and avoid mixing different drugs, which could reduce efficacy. Use infusion pumps to accurately control drug infusion rates. When changing medications, use a pump-to-pump method to avoid sudden changes in infusion speed that could affect circulatory stability. When changing drugs, pay special attention to removing all air from connecting tubing to prevent air embolism. If blood clots block the tubing, use a syringe to aspirate; do not forcefully inject to prevent clot entry into the left atrium causing arterial embolism.

2.3 Valve Cleaning

Prepare sterile normal saline and ice-cold saline intraoperatively. Set up a sterile instrument table, open valve washing basins and bowls. Pour room-temperature saline into small bowls and ice-cold saline into basins to clean the valves.

2.4 Item Delivery and Temporary Pacemaker Use

Strictly deliver items according to sterile requirements and physician instructions. Correctly record pressures in each chamber. Implement rapid ventricular pacing as ordered (heart rate of 180-220 beats/min for 5-10 seconds) and promptly manage any arrhythmias occurring after pacing [12].

3 Postoperative Nursing Guidance

3.1 Puncture Vessel Management

Nurses assist physicians in managing puncture vessels by first suturing the femoral artery puncture site, then applying sterile sandbags and elastic bandages for compression dressing. After returning to the ward, use sandbag compression and observe the operative limb. Observe the patient' s consciousness and inquire about symptoms after anesthesia recovery; if abnormalities occur, promptly manage and inform physicians. Monitor continuously for 30 minutes until the condition stabilizes before escorting the patient back to the ward.

ECG monitoring should focus on two time periods: first, during delivery of the "transapical interventional device," closely observe ECG changes for arrhythmias such as supraventricular tachycardia, ventricular tachycardia, atrial fibrillation, or atrial flutter; second, during prosthetic valve release, observe for ST-T segment changes compared with preoperative status. Monitor arterial blood pressure changes to prevent hypotension from intraoperative cardiac tamponade while also avoiding excessive arterial pressure that could cause puncture site bleeding [13].

3.2 Ward Rehabilitation Guidance

TAVR has lower incidence of acute renal failure, new-onset atrial fibrillation, and major bleeding events compared with open-chest surgery, but higher rates of permanent pacemaker implantation, perivalvular leakage, and major vascular complications. Therefore, temporary pacemakers are brought to the ward postoperatively. Secure pacing leads properly and instruct patients to assume left lateral or supine positions. If patients are conscious, instruct them to avoid vigorous head movement. Record the length of exposed catheters, particularly observing the sterile condition near the proximal end and external electrodes, and monitor skin condition at catheter insertion sites to prevent complications such as puncture site bleeding, myocardial perforation, and electrode displacement.

Monitor central venous pressure every 2-4 hours; if the patient is hemodynamically unstable, shorten the monitoring interval. When patients experience coughing, suctioning, or restlessness, wait until they are calm before monitoring. Simultaneously monitor arterial blood pressure to observe fluctuations and closely monitor urine output using a precision urine bag to record hourly urine volume.

Pay attention to intraoperative fluid infusion speed, which should be adjusted according to patient age and cardiac function to avoid increased circulatory load from excessive speed. Closely monitor urine output to maintain water, electrolyte, and acid-base balance. Intraoperative bleeding may reduce systemic perfusion and urine output, potentially leading to acute kidney injury. If massive bleeding occurs that cannot be completely controlled by interventional surgery, emergency median sternotomy should be performed.

3.3 Cardiac Rehabilitation Training

Early postoperative cardiac rehabilitation can improve physiological function, enhance activities of daily living, improve psychological status, and increase quality of life, particularly for frail and elderly patients. Currently, cardiac rehabilitation is well-developed abroad, but started relatively late in China, with incomplete development of relevant cardiac rehabilitation institutions and no unified standards for cardiac rehabilitation protocols [14].

Perivalvular leakage is a common post-TAVR complication, occurring in approximately % of cases. The main causes include improper valve positioning, preoperative imaging deviations, severe native valve annulus calcification, and valve-size mismatch preventing effective apposition to the aortic annulus. Therefore, surgeons must accurately measure the aortic root and annulus size, ensuring full apposition to the aortic root during intraoperative balloon dilation for accurate measurement to reduce perivalvular leakage incidence. Intraoperative 3D echocardiography is needed for precise perivalvular leakage assessment [15].

Coronary artery obstruction and myocardial infarction are the most severe

TAVR complications, which can be life-threatening if not managed promptly. The main cause is the native calcified valve flipping upward after valve implantation and obstructing the coronary ostium. Therefore, to avoid coronary ostium blockage, surgeons should promptly perform balloon dilation or stent implantation when small coronary artery obstruction is detected on imaging [16].

Discussion

In the TAVR perioperative period, integrated medical care is central to the entire process. Integrated medical care has become an advanced nursing concept that optimizes traditional nursing perspectives through effective utilization of medical knowledge and nursing experience [17]. High-quality perioperative nursing can effectively ensure successful surgery completion, shorten hospital stays, ensure prognostic outcomes, and prevent severe complications. Preoperative psychological nursing can effectively improve patient confidence, alleviate negative emotions, and promote active treatment cooperation [18]; intraoperative nursing can promptly detect and rapidly manage abnormal situations during surgery; postoperative nursing can dynamically observe patient conditions, promptly manage adverse symptoms, prevent complications, and promote patient recovery through proper guidance, thereby improving prognostic outcomes and patient satisfaction.

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Note: Figure translations are in progress. See original paper for figures.