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Case Report / Olgu Sunumu

Extracorporeal membrane oxygenation support and nursing care in a patient treated for pulmonary artery aneurysm

Pulmoner arter anevrizması nedeniyle ameliyat olan hastada ekstrakorporeal membran oksijenasyonu desteği ve hemşirelik bakımı

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ABSTRACT

Aneurysms are one of the most complex conditions in open heart surgery. In this case, the nursing care of a 39-year-old female patient who was operated due to pulmonary artery aneurysm and left main coronary artery stenosis and who underwent extracorporeal membrane oxygenation was discussed. It is thought that qualified and comprehensive nursing care is important in increasing the success of the treatment and reducing the mortality and morbidity rates in the patient who underwent extracorporeal membrane oxygenation after pulmonary artery aneurysm and coronary artery bypass surgery with high mortality.

Keywords: Aneurysm, extracorporeal membrane oxygenation, nursing care.

ÖZ

Anevrizmalar, açık kalp cerrahisinin en karmaşık durumlarından biridir. Bu olguda pulmoner arter anevrizması ve sol ana koroner arter darlığı nedeniyle ameliyat edilen ve ekstrakorporeal membran oksijenasyonu uygulanan 39 yaşında kadın hastanın hemşirelik bakımı tartışıldı. Yüksek mortalite ile seyreden pulmoner arter anevrizması ve koroner arter baypas cerrahisi sonrası ekstrakorporeal membran oksijenasyonu uygulanan hastada nitelikli ve kapsamlı hemşirelik bakımının tedavi başarısını artırmada ve mortalite ve morbidite oranlarını azaltmada önemli olduğu düşünülmektedir.

Anahtar sözcükler: Anevrizma, ekstrakorporeal membran oksijenasyonu, hemşirelik bakımı.

Pulmonary artery aneurysm (PAA) is a rare type of aneurysm defined by pulmonary artery dilatation of more than 4 cm in diameter.[1] Pulmonary artery aneurysm is a condition with a prevalence of 1 in 14,000 and requires surgery.[2] It is mostly asymptomatic and therefore has a high morbidity and mortality rate.[3] In recent years, conventional treatment methods have been insufficient in cardiothoracic surgery; consequently, mechanical circulation support systems are used to reduce morbidity and mortality in difficult cases.[4]

Extracorporeal membrane oxygenation (ECMO) is a mechanical circulatory support system used in cases where tissue perfusion is impaired, such as with cardiogenic shock and dependence on the cardiopulmonary bypass after cardiac surgery.[5] Indications for the use of ECMO, survival after application, and discharge rates are gradually increasing.[6] There are few studies on the nursing care of patients undergoing ECMO due to different indications.[7,8] The aim of this report was to analyze

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the nursing care of a patient who was treated for PAA and received ECMO support. We believe that high-quality nursing care improves treatment success and decreases morbidity and mortality rates in patients receiving ECMO support for PAA.[9,10]

CASE REPORT

A 39-year-old female who was regularly followed up due to a diagnosis of pulmonary hypertension was admitted to the hospital with complaints of chest pain and dyspnea. The patient recevied left main coranary artery stenting one year ago. The patient was on medical treatment with klopidogrel, metoprolol, succinate, acetylsalicylic acid, and furosemide. According to the echocardiography and thoracic computed tomography, the main and right pulmonary artery diameters were 6.8 cm and 3.8 cm, respectively. Echocardiographic findings showed a 65% ejection fraction, Grade 3 tricuspid valve, Grade 2 mitral valve, and Grade 3 pulmonary valve insufficiency. The ascending aorta was of normal diameter. The right heart cavity dimensions and pulmonary artery dimensions were significantly increased, and the left heart cavity was normal. In addition, the patient had a history of pulmonary hypertension (pulmonary arterial pressure [PAP]: 55 mmHg) for two years.

The patient received coronary angiography. The expanded pulmonary artery compressed on the left main coronary artery, which had a 90% stenosis. The patient was operated on due to these signs and symptoms. In the intraoperative process, total root reconstruction was firstly performed for PAA using the Tirone David method, and the right pulmonary artery graft was anastomosed end to end to the main artery graft (with Teflon felt support). Finally, the left coronary artery was bypassed using a left internal mammary artery. After the patient was removed from the cardiopulmonary bypass, she received positive inotropic agents (dopamine hydrochloride and norepinephrine) due to hypotension and then received peripheral venoarterial (VA)-ECMO to the right femoral artery and femoral vein. Peripheral arterial access was percutaneously established by the modified Seldinger technique.

The patient, connected to VA-ECMO, was transferred from the operating room to the intensive care unit and reoperated due to 2,750 mL of drainage at the 13th postoperative hour. Ten units of red blood cell (RBC) suspension, 8 units of fresh whole blood, and 3 units of platelet concentration were administered to the patients. On the first postoperative day, she had 1,300 mL of drainage; thus, 2 units of RBC suspension, 3 units of fresh whole blood, and 3 units of fresh frozen plasma were administered. She was treated with prophylactic antibiotics (400 mg of intravenous moxifloxacin per day) up to the seventh postoperative day.

She had 550 mL of drainage on the second postoperative day and 50 mL of drainage on the third postoperative day. When her hemodynamics stabilized, inotropic drug infusions were reduced, and she was removed from ECMO support (60th postoperative hour) and extubated. She was mobilized on the fourth postoperative day and transferred to the ward without any problem on the fifth postoperative day.

In the intensive care unit, hemodynamic monitoring was performed by nursing care. Cardiac parameters were invasively monitored. Pulmonary artery pressure was measured using a Swan-Ganz catheter, central venous pressure was measured using a central venous catheter applied to the right jugular vein for fluid volume balance and fluid intake, and urinary output was followed on an hourly basis. Blood circulation was maintained by ECMO, and skin color and temperature were monitored for tissue perfusion. Blood flow was monitored using a Doppler flow probe attached to the dorsalis pedis and posterior tibial arteries in the right extremity. Body temperature was monitored using the heat regulator of ECMO. Pain was assessed using the behavioral pain scale and was treated with pharmacological methods. Heparin infusion required by ECMO was terminated due to hemorrhage, and heparin was replaced by enoxaparin sodium (6000 anti-Xa IU/ 0.6 mL), administered subcutaneously. Activated clotting time (ACT) was monitored hourly to assess the risk of hemorrhage and thromboembolism in the patient. Neurological functions were assessed hourly. In neurological evaluation, Glasgow Coma Scale, pupillary light reflex, evaluation of the pupil size and equality, and extremity motor examination were used.

For oxygenation and tissue perfusion, partial pressure of oxygen (pO_2), partial pressure of carbondioxide (pCO_2), serum electrolytes (calcium [Ca], potassium [K], magnesium [Mg]), and lactate values were assessed hourly through blood gas monitoring. In addition, the patient's hemogram and basic biochemical parameters were followed, and no abnormal finding was found (sodium [Na]: 141; potassium [K]: 4.01; hemoglobin [HGB]: 12; hematocrit [HTC]: 28.8; white blood cell [WBC]: 5.61; aspartate aminotransferase [AST]: 22; alanine aminotransferase [ALT]: 20; blood urea nitrogen [BUN]: 5, creatinine: 0.46, low density lipoprotein [LDL]: 98; international normalized ratio [INR]: 1.04; activated partial thromboplastin time [aPTT]: 33.4; glucose: 126; C-reactive protein [CRP]: 73.3).

The cannula insertion site and drains were monitored hourly for hemorrhage, and the insertion site was dressed daily according to the aseptic technique. The patient was informed of movement restrictions required to maintain the position of the cannula. Initially, the patient's risk of pressure injury was determined to prevent the development of pressure injury in the patient, and mobilization was targeted at the earliest possible stage. The Braden Scale was used to assess pressure injury risk, and the patient was mobilized in the early period after ECMO support. No pressure injury was observed during her stay in the intensive care unit.

DISCUSSION

Pulmonary artery aneurysm is a rare disease with life-threatening complications. Patients undergoing surgery for PAA may suffer from both cardiac and respiratory problems. Therefore, both cardiac and respiratory parameters should be monitored in nursing care.[11] In our case, medical treatment was inadequate for the patient who underwent surgery for PAA; therefore, ECMO was used. The guidelines of the Extracorporeal Life Support Organization highlight the importance of early detection and prevention of complications in the care of patients with ECMO.[9] Nursing care plays a key role in early detection and prevention of ECMO complications.[12] In this case, a systematic assessment was conducted to determine the nursing care needs of the patient who undergoing PAA surgery and receiving ECMO support. One of the major ECMO complications is bleeding, with an incidence of 10 to 30%.[13] The most common causes of bleeding in ECMO patients are anticoagulant therapy and thrombocytopenia. Bleeding generally occurs in the cranial area, gastrointestinal area, or ECMO cannula insertion sites.[14,15] Activated clotting time, coagulation parameters (prothrombin time [PT], aPTT, INR, platelet count), hemoglobin, and hematocrit levels, incisions, cannulation sites, and drains should be monitored hourly to prevent bleeding.[16,17] In this case, the patient had heparin infusion-related bleeding, which was primarily addressed and intervened during nursing care. Bleeding symptoms and drains were monitored in the patient. Activated clotting time and coagulation parameters were monitored hourly. Blood and blood products were transfused. Furthermore, in place of heparin infusion, enoxaparin sodium was subcutaneously administered in the anticoagulant treatment. Heparin infusion is recommended for the prevention of thromboembolic events in patients receiving VA-ECMO support.[18,19] In this case, discontinuation of heparin infusion due to bleeding required close monitoring to prevent thromboembolic events in nursing care. The incidence of thromboembolic events in ECMO patients is 8%. Thromboembolic events are mostly reported as leg ischemia, stroke, deep vein thrombosis, and circulating clots.[16,17] It is recommended that temperature, color, and peripheral pulse should be monitored in the limb for ischemia.[20] In this case, assessment of neurological functions and symptoms of thromboembolic events was performed regularly. The cannulation was performed on the patient's right femoral artery, and the right leg of the patient was monitored hourly for temperature, color, and pulse. Blood flow was monitored using a Doppler flow probe attached to the dorsalis pedis and posterior tibial arteries in the right extremity. There was no sign of thromboembolic events or peripheral ischemia in this case. A primary goal of nursing care in ECMO is to monitor and maintain hemodynamic balance. It is therefore recommended that the cardiovascular system parameters (arterial blood pressure, pulse, central venous pressure, and pulmonary artery pressure), hemorrhagic and ischemic complications, respiratory system, mechanical ventilator parameters (oxygen fraction [FiO_2], positive expiratory pressure [PEEP]), anticoagulation, hemostasis, fluid volume balance, and tissue perfusion be monitored.[21,22] Hemodynamic balance monitoring became more important in the nursing care of our patient, who received ECMO support after PAA surgery. The cardiac functions of the patient (echocardiography, heart rate, blood pressure, right atrial pressure, and pulmonary artery pressure) were invasively monitored hourly. While the patient received mechanical ventilator support, the tidal volume, PEEP, respiratory rate, and respiration mode were monitored. The pO_2, pCO_2, oxygen saturation pressure (SpO_2), and lactate values were monitored using arterial blood gas.

Adequate blood flow is extremely important to achieve ECMO goals. Adequate blood flow indicators are normal cardiac parameters (mean arterial pressure, central venous pressure), tissue oxygenation, a normal lactate level, negative P1 pressure in the ECMO circuit, and the absence of mechanical obstruction.[23] In this case, fluid volume balance for adequate blood flow during nursing care was addressed. The symptoms and signs of fluid-electrolyte imbalance, central venous pressure, blood gas, electrolyte-fluid intake, and urinary output were monitored in the nursing care, and adequate fluid infusion was achieved.

The cannula position should be maintained for circulatory continuity and adequate perfusion during ECMO support.[9,24] The dislocation of the cannula during ECMO support is a major complication. This leads to an interruption in ECMO support and requires decannulation; therefore, the movements of ECMO patients should be restricted.[25,26] During ECMO support, our patient was kept informed, the movements of the patient were restricted, and the cannula insertion site was checked hourly. Although the movement restriction is necessary to maintain cannula position and safety during ECMO support, it increases the risk of pressure injury.[27] The risk assessment for pressure injury, early mobilization, position change, skin assessment, and the prevention of predisposing factors, such as malnutrition and incontinence, protein-rich nutritional support, the use of special beds to reduce tissue, and interface pressure are recommended for the prevention of pressure injury in ECMO patients.[28] In this case, the Braden Scale was used to determine the pressure injury risk of the patient. The patient with a high risk of pressure injury was evaluated every 2 h for pressure injury. The skin was protected from pressure and moisture exposure, and an air mattress was used to prevent pressure injury. The patient, who received ECMO support for four days, was hemodynamically unstable. Therefore, frequent position changes in the bed could not be achieved. Parenteral nutrition support was provided to the patient during the ECMO support. On the fourth postoperative day, the patient was removed from ECMO and mobilized early. No pressure injury was observed in the patient during ECMO support.

Extracorporeal membrane oxygenation is an invasive procedure that can cause pain.[9] Sedation is recommended in the first 24 h to reduce physiological stress and pain.[26] At the end of 24 h, the amount of sedation is consistently decreased based on the patient's alertness, restlessness, and pain status.[9] Regular pain assessment, adequate sleep, emotional support, and nonpharmacological and pharmacological methods, such as opioids, are recommended for pain management.[29] During ECMO, the pain status of our patient was evaluated using the behavioral pain scale, and pharmacological methods were used in pain management in the case of severe pain.

Prolonged ECMO support is related to a higher rate of infection.[30] Nosocomial infection is observed in 11.7% of patients with ECMO.[31] Symptoms and signs of infection should be monitored, and culture samples should be taken if necessary to diagnose infections. Invasive procedures should be performed in accordance with aseptic principles, and unnecessary catheters should be removed to prevent infections in ECMO patients. A transparent dressing and 5% chlorhexidine gluconate should be used for the care of the cannula insertion site.[8,13] In this case, the patient was monitored for the infection signs and symptoms. The cannula insertion site was dressed daily according to the aseptic technique with chlorhexidine gluconate. Prophylactic antibiotic treatment was started at the first day of hospitalization and stopped on the seventh postoperative day. No infection was observed in the patient during ECMO support.

In conclusion, high-quality and comprehensive nursing care improves treatment success and decreases morbidity and mortality rates in patients receiving ECMO support who underwent PAA surgery. In this case, the patient was provided systematic nursing care to prevent complications related to the ECMO support and the surgery.

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