Review
(Derleme)

EGEHFD, 2023, 39 (1): 141-148
DOI: 10.53490/egehemsire.1038787

Thoracic Surgery and Nursing Care

Göğüs Cerrahisi ve Hemşirelik Bakımı

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Gönderilme tarihi: 20 Aralık 2021 **Kabul tarihi**: 9 Mayıs 2022

ABSTRACT

Changes in the pathophysiology of the chest after thoracic surgery cause respiratory and heart-related complications. These complications arise in connection with the patient's physiological characteristics and with the type of surgical intervention. Complications which occur and which cannot be brought under control extend the length of hospital stay and cause an increase in the rates of morbidity and mortality. To reduce and prevent complications, holistic nursing care is important throughout the surgical process. In this way, the patient's functional life can recover more quickly. Therefore, we will discuss the pathophysiological changes, complications and evidence-based practices for nursing care after thoracic surgery.

ÖZ

Göğüs cerrahisi sonrası göğüs patofizyolojisindeki değişiklikler solunum ve kalp ile ilgili komplikasyonlara neden olur. Bu komplikasyonlar hastanın fizyolojik özellikleri ve cerrahi müdahalenin tipi ile bağlantılı olarak ortaya çıkmaktadır. Meydana gelen ve kontrol altına alınamayan komplikasyonlar hastanede kalış süresini uzatmakta, morbidite ve mortalite oranlarında artışa neden olmaktadır. Komplikasyonları azaltmak ve önlemek için cerrahi süreç boyunca bütünsel hemşirelik bakımı önemlidir. Böylece hastanın fonksiyonel hayatı daha hızlı toparlanabilmektedir. Bu nedenle göğüs cerrahisi sonrası hemşirelik bakımında patofizyolojik değişiklikler, komplikasyonlar ve kanıta dayalı uygulamalar tartışılacaktır.

Keywords:
Nursing care; thoracic surgery; complication; surgical nursing; postoperative care.

Anahtar Sözcükler:
Hemşirelik bakımı; göğüs cerrahisi; komplikasyon; cerrahi hemşireliği; ameliyat sonrası bakım.

How to cite: Demir Korkmaz, F., Yeşilyaprak,T., Atıcı Sofu, F. (2023). Thoracic Surgery and Nursing Care. *JEUNF*, 39(1), 141-148 DOI: 10.53490/egehemsire.1038787
Kaynak Gösterimi: Demir Korkmaz, F., Yeşilyaprak,T., Atıcı Sofu, F. (2023). Göğüs Cerrahisi ve Hemşirelik Bakımı. *EGEHFD*, *39*(1), 141-148. DOI: 10.53490/egehemsire.1038787

INTRODUCTION

The main illnesses which necessitate thoracic surgery are lung cancer, spontaneous pneumothorax, emphysema, tuberculosis, bronchiectasis, infection, trauma, and sarcoidosis (Akyolcu and Seyhan Ak, 2017; Annesi and Brook-Brunner, 2010; Yang et al., 2014). The most common reason for thoracic surgery is lung cancer. In the USA, there are 39.000 new cases every year, and more than 35.000 people die of lung cancer every year (Crimmons, 2016). According to the World Health Organization (WHO), the rate of new cases of lung cancer in 2018 was 11.6%, and the death rate in the same year was 18.4%. In Turkey, the rate of lung cancer is 225.1/100.000 (World Health Organazition, 2020). According to the Turkish Institute for Statistics, the number of patients dying from cancer of the respiratory system in 2018 was 25.017 (Turkish Institute, 2019). For standard thoracic surgery, thoracotomy is used. However, advances in technology allow video-assisted thoracic surgery (VATS) and robot-assisted thoracic surgery (RATS) to be safely performed in addition to standard surgery. In surgeries which have been performed, single lung ventilation (SLV) has been applied. Although these technological developments have positive effects in patients' lives after surgery, general complications after surgery such as nausea, vomiting or atelectasis can be accompanied by complications specific to thoracic surgery such as mediastinal shift, torsion of the lungs and heart and post pneumonectomy syndrome (Crimmons, 2016; Sengupta, 2015).

To effectively manage this process, surgical nurses must have a wide accumulation of knowledge of thoracic surgery, and to achieve an increase in the effectiveness of care, they must closely follow nursing care which includes evidence-based practices. Therefore, this review covers diagnostic methods relating to thoracic surgery, pathophysiologic changes following surgery, surgical techniques, and nursing care.

Pathophysiology of Thoracic Surgery

Following resection in thoracic surgery, changes occur in the pneumonectomy area, which is reduced by the rising diaphragm (Paone, Rose and Giudice, 2018). The space which forms after pneumonectomy is called the postoperative pleural space. The size of the pleural space depends on the lung before the surgery and the lymphatic vessel structure of the lung. In the early period after the surgery, this space is filled with air (Paone et al., 2018; Patella, Saporito, Mongelli, Pini, Inderbitzi and Cafarotti 2018; Wolfe and Lewis, 2002). The volume of the gas in the space is reduced by reabsorption of carbon dioxide, oxygen and nitrogen by the body. After than bleeding which can be seen from lung radiography occurs in this space. In this way, a low-protein liquid formed by bleeding and chylothorax begins to take the place of the gas in the pneumonectomy area (Paone et al., 2018; Wolfe and Lewis, 2002). For this reason, chest drainage is kept closed for the first 24 hours after the surgery to regulate the liquid level in the postoperative pleural space (Paone et al., 2018; Patella et al., 2018). The liquid begins to change with time from a fluid to a solid; a part of it is reabsorbed by the body, and the organs move into the pneumonectomy space. Negative pressure occurs by a slight shift in the center of mediastinum. (Paone et al., 2018; Wolfe and Lewis, 2002). This pathophysiologic change negatively affects the patient's respiratory functions. For this reason, various approaches have been developed to closing the pleural space which forms after thoracic surgery.

Closing the Pleural Space After Thoracic Surgery

In closing the pleural space after thoracic surgery, plombage was used in the first period. Also, muscle flaps are employed for this purpose (Shen, Wain, Wright, Grillo and Mathisen, 2008). The most frequently used muscle flaps are the dorsal muscle, the transverse rectus abdominis myocutaneous flap, the extra thoracic muscles, the latissimus dorsi and the pectoralis major flap (Huang, Lin, Wu and Tsai, 2017; Seify et al., 2007). However, these methods are no longer used, because they cause pressure on the bronchi and have negative effects on breathing. Today, tissue dilators containing saline have begun to be used for this purpose (Birdi, Baghai and Wells, 2001; Jung et al., 2016).

Nursing Management in Thoracic Surgery

The prevention of complications which may be seen after thoracic surgery can be assured with holistic nursing care given perioperative period.

Pre-Operative Nursing Care

Preparing the patient well before the surgery is important in the prevention of complications. Evaluation of the patient before the surgery focuses on the respiratory and cardiovascular systems. The patient's breathing rate and breathing sounds must be checked. Dyspnea, coughing, exercise intolerance, digital clubbing, obesity, posture disorder and use of alcohol and cigarettes must be checked (Saqib, 2016). ERAS and ESTS state that in the good preparation of a patient for thoracic surgery, the following are necessary;

- Evaluation of the patient's nutrition and elimination of malnutrition
- Use of oral nutrition support in malnourished patients

- Determination of patient's nutrition risk by a nurse using the NRS2002 evaluation instrument within 24 hours of admission to hospital; if the score is three or more, communication should be established with the nutrition support team and if necessary, 5-7 days of nutrition supplement should be applied
- For four weeks before the surgery, no alcohol or cigarettes should be used
- Regulation of lung function and exercise capacity
- In order to reduce postoperative lung infections, the teeth should be brushed once every six hours until the surgery with a non-alcoholic antiseptic mouth solution
- Evaluation of patients' venous thromboembolism risk using the Caprini Risk Score Evaluation instrument developed for thoracic surgery; if the risk score is five or above, exclusion of bleeding risk and use of low molecular weight heparin until 12 hours before the surgery
- Identification of anemia (Batchelor et al., 2019).

The British Thoracic Society and the Society for Cardiothoracic Surgery in Great Britain and Ireland published Guidelines on the Radical Management of Patients with Lung Cancer (Warner and Weiskopf, 2000). According to this guide, patients should be given a 400-meter walking test and cardiopulmonary exercise tests before the surgery, and pulmonary functions should be evaluated (Lim et al., 2010). In the preoperative period, the FEV should be >1.5 L for lobectomy patients and >2.0 L for pneumonectomy patients. Also, a sputum sample should be taken from these patients, and arterial blood gases should be examined (Lim et al., 2010; Warner and Weiskopf, 2000). The Turkish Thoracic Society also recommends that before chest surgeries, lung function tests, blood gas analyses and exercise tests should be carried out on patients (Ozkan, 2014). It was stated in a study on the topic by Iyer and Yadav that before an surgery, patients should quit smoking, and their breathing functions should be kept at an optimal level by physiotherapy (Iyer and Yadav, 2013).

Before the surgery, general patient instruction should be ensured (Refai et al., 2018). This instruction should cover deep breathing and coughing exercises, respiratory hygiene, smoking, early mobilization, postoperative pain control, contact addresses, wound and drain care and the surgical process (Gao et al., 2019; Kavaklı and Tarhan, 2020; Whyte and Grant, 2005).

Nursing Care During the Surgery

Measures to be applied during the surgery recommended by ERAS to prevent complications after thoracic surgery are as follows:

- Administration of routine intravenous antibiotic prophylaxis 60 minutes before the surgery
- Removal of body hair if necessary
- Use of chlorhexidine gluconate to clean the skin
- Maintenance of normothermia
- Monitoring core temperature to monitor the patient's body temperature in ensuring normothermia (Batchelor et al., 2019).

Postoperative Nursing Care

Maintaining respiratory functions

The incidence of complications relating to the respiratory system of patients following thoracic surgery is between 5-80% (Sengupta, 2015). As in all surgery, pulmonic regurgitation and atelectasis are complications which may also be seen after thoracic surgery. Pulmonic regurgitation is more commonly seen in patients with low FEV1 (Iyer and Yadav, 2013). After the surgery, respiratory functions should be checked at 15-minute intervals, the bed head should be elevated to an angle of 35-40 degrees and breathing exercises should be given by nurses to prevent pulmonic regurgitation and atelectasis (Crimmons, 2016; Iyer and Yadav, 2013). Postoperative aspiration and postural drainage also prevent atelectasis (Iyer and Yadav, 2013). Placing patients in a suitable position and helping to change their position at intervals plays a key role in preventing of complications. The positions given may vary according to the type of surgery (Annesi and Brook-Brunner, 2010). When changing position, the head and the healthy side of the chest should be supported, and the operated side should not be held by the chest or the arm (Tahiri et al., 2020). To prevent the development of thrombus in relation to prevention of blood flow from the lungs, the patient should not always be placed in the same position. Suitable position change causes an increase in ventilation, perfusion and gas exchange, and enables the removal of bronchial secretions (Kavaklı et al., 2020; Li et al., 2020; Refai et al., 2018; Tahiri et al., 2020).

To prevent atelectasis, mobilization should be achieved in the first 24 hours after the surgery (Batchelor et al., 2019). Before recovery from anesthesia, passive movements of the upper and lower extremities should be started with the support of the nurse. After the patient regains consciousness, participation in physical activities should be ensured (Annesi and Brook-Brunner, 2010). The activity level should be increased progressively. Before mobilization, the patient's ability to follow instructions should be assessed, their sitting balance and particularly in patients with a spinal block, sensory and motor functions of the lower extremities should be tested (Li et al., 2020).

The patient should sit up in bed 3.5 hours after the surgery and should maintain the sitting position for 30 minutes. In the fourth hour after the surgery, the patient should sit in a chair. Before mobilization, it is necessary to patients' clinical stability in a suitable way (Li et al., 2020; Refai et al., 2018; Tahiri et al., 2020). When the patients can sit for five minutes beside the bed without support and can completely perform bilateral knee extension, they can progress to standing and ambulation (Ahmad, 2018). After the surgery, every patient should sit beside the bed four times on the first day and should walk 80m on the second day and 100m on the third day (Annesi and Brook-Brunner, 2010; Grondell, Holleran, Mintz and Wiesel, 2018; White and Dixon, 2015; Yeung, 2016). However, patients do not want to walk after a surgery, because of pain and drainage. For successful mobilization of patients, pain management with analgesics must be successful. Because of the risk of postural hypotension, patients must be helped by at least two people when they first stand or walk. Also, equipment such as wheeled walkers, mechanical raising devices or thoracic walkers can be used (Grondell et al., 2018; White and Dixon, 2015; Yeung, 2016). During all mobilization activities, attention must be paid to keeping the patient's drainage system upright and at least 0.5m below the level of their chest tube (Bertani et al., 2018; Forster et al., 2021). Patients should be encouraged to record their activities in the diary section of the information handbook which specifies what they should succeed in doing every day after the surgery (Bertani et al., 2018).

In the prevention and treatment of pulmonary edema, arterial blood pressure must be monitored, 24-hour positive fluid balance should not exceed 20cc/kg, and sufficient nutrition and oxygenation should be ensured (Iyer and Yadav, 2013). In the late stages, post pneumonectomy syndrome may occur in the respiratory system. The findings are difficulty breathing, dyspnea and dysphagia. Patients should be given instruction on post pneumonectomy syndrome (Sengupta, 2015).

Maintenance of cardiovascular system functions

The loss of negative pressure in the lungs and the accumulation of fluid in the pneumonectomy area after thoracic surgery puts pressure on the heart. For this reason, AF is seen in patients following thoracic surgery (Al Sawalhi et al., 2021; Chae et al., 2006; Grondell et al., 2018; Iyer and Yadav, 2013). Also, in a retrospective examination by Rena et al., it was reported that 86.7% of patients undergoing lung resection developed AF (Rena et al., 2001). It is recommended in guides and studies that in order to prevent postoperative AF, the use of beta-blocker should be started before the surgery, magnesium deficiency should be corrected and if necessary, calcium canal blocker should be administered (Batchelor et al., 2019; Fernando et al., 2011; Iyer and Yadav, 2013). Keshava and Boffa have also published an algorithm on the management of atrial fibrillation after thoracic surgery (Keshava and Boffa, 2015).

Cardiac herniation seen postoperatively causes disruption of the blood flow in the vena cava inferior (Iyer and Yadav, 2013; Keshava and Boffa, 2015). For this reason, ischemia in the heart, right to left shunt and cardiac insufficiency are seen in patients after thoracic surgery (Chae et al., 2006; Grondell et al., 2018; Iyer and Yadav, 2013). Measuring pulmonary arterial and central venous pressure values, monitoring blood gases, monitoring ECG, raising the bed head to an elevation of 30-45 degrees, and changing horizontal position as much as the patient can tolerate are nursing interventions which should be performed to prevent cardiac complications (Crimmons, 2016; Grondell et al., 2018). In left lobectomy patients, cardiac tamponade may be seen. An increasing in pulmonary artery diastolic pressure and central venous pressure are frequently signs of cardiac tamponade. For this reason, reduction in cardiac output, Beck's triad, pulmonary artery pressure and ECG should be monitored (Iyer and Yadav, 2013).

After thoracic surgery, bleeding, shock and deep vein thrombosis can also occur. In order to ensure postoperative hemodynamics, bleeding and shock findings should be monitored by the nurse (Crimmons, 2016) . Fluid accumulation of 1000mL/24h in the chest tube is a sign of bleeding, and a surgery is necessary to control bleeding, and therefore, the chest tube must be monitored (Iyer and Yadav, 2013). Also, if the patient's hemodynamic condition is stable but the amount of chest tube drainage is excessive, hematocrit values must be monitored to assess active bleeding from the lymphatic space (Batchelor and Ljungqvist, 2019; Forster et al., 2021; Iyer and Yadav, 2013). One week before the surgery, it is necessary to cease the use of anticoagulants to prevent bleeding (Batchelor et al., 2019). Interventions to prevent venous thromboembolism are risk assessment, the use of low molecular weight heparin, ensuring fluid volume, the use of elastic bandages, early mobilization, raising the feet, performing range of motion exercises, the periodic use of pneumatic equipment, and providing patient instruction (Batchelor et al., 2019; Crimmons, 2016; Iyer and Yadav, 2013; Yeung, 2016).

Ensuring fluid volume

Following thoracic surgery, hydration must be ensured to prevent pulmonary insufficiency (Iyer and Yadav, 2013). In ensuring fluid management, 0.9% saline solution should be used (Batchelor et al., 2019). However, to prevent Acute Respiratory Distress Syndrome during fluid replacement, excessive hydration should be avoided, and the amount of fluid should be adjusted to 1-2mg/kg/h (Iyer and Yadav, 2013). Also, if the patient has an electrolyte deficiency, this should be replaced with suitable fluids (Batchelor et al., 2019). Hypovolemia should be

monitored because a fall in volume during fluid treatment can be an indicator of bleeding. If the threshold limits of hydration have been reached, inotrope support should be considered, and urine output should be monitored (Iyer and Yadav, 2013).

Control of pain

After thoracic surgery, pain is experienced in the thoracotomy area, and if sufficient pain management is not provided, post-thoracotomy pain syndrome (PTPS) can develop. This is defined as pain at the incision site continuing or repeating for at least two months, and it is seen in 21-61% of patients (Blichfeldt-Eckhardt, Andersen, Ørding, Licht and Toft, 2017; Odejobi, Maneewat and Chittithavorn, 2019). Pain disrupts the patient's ability to draw a deep breath or to cough effectively, and this leads to reintubation by reducing lung volume and causing retention of mucus (Grondell et al., 2018; Iyer and Yadav, 2013). Inadequate pain control causes an increase in breathing rate, heart rate and blood pressure by increasing sympathetic stimulation, negatively affecting hemodynamic stability (Ahmad, 2018). Pain control can be achieved with a combination of paracetamol and NSAIDs. Another method of pain control is patient-controlled analgesia (Batchelor et al., 2019; Iyer and Yadav, 2013). Opioid group drugs are not to be preferred because they depress the respiratory system (Crimmons, 2016). In patients with chronic pain, ketamine may be used. If the patient has been given epidural anesthesia, a paravertebral block may be given to control pain (Batchelor et al., 2019; Iyer and Yadav, 2013). Multiple analgesia management is generally preferred for pain management. Before the surgery is completed, long-term effect local anesthetic and an intercostal nerve block are administered. Also, in the clinic, at first day hourly and later daily pain assessment should be made. NSAIDs are used over the first twelve hours after an intravenous injection (Li et al., 2020). If the patient's pain score is four or less, oral acetaminophen is given, and relaxation techniques may be applied to the patient. If the pain score is between four and seven, pain management should be performed with in intercostal nerve block including long-term effect local anesthesia and weak opioids. If the pain score is eight or above, more powerful opioids are used (Forster et al., 2021; Piccioni et al., 2018). Removing chest tubes after surgery also reduces the patient's pain. To reduce patients' pain and prevent wound opening during deep breathing and coughing exercises, the wound area should be supported with a towel or pillow (Li et al., 2020; Piccioni et al., 2018).

Along with incision pain, shoulder pain is also seen in patients after thoracic surgery (Odejobi et al., 2019). During the surgery, patients are placed in the LDP, and when the upper arm is brought into flexion of more than 90 degrees, pain occurs in the ipsilateral shoulder in connection with tension in the muscles and ligaments. The rate of occurrence of shoulder pain is 37-97% (Blichfeldt-Eckhardt et al., 2017). Wanting to keep the arm immobile because of pain causes the shoulder opening to be reduced (Blichfeldt-Eckhardt et al., 2017; Odejobi et al., 2019). In reducing shoulder pain, early mobilization and the use of oral analgesics should be ensured, and shoulder exercises should be taught (Annesi and Brook-Brunner, 2010; Blichfeldt-Eckhardt et al., 2017). Also, other nursing interventions such as listening to music, massage and attracting the attention elsewhere can be applied in postoperative pain control. Studies have shown that patients' pain has been significantly reduced using non-pharmacological procedures for pain management after thoracic surgery such as breathing exercise, prayer, listening to music, cold application, meditation and massage (Dion et al., 2011; Liu and Petrini, 2015; Odejobi et al., 2019; Reeve et al., 2010).

Chest tube drainage

After surgery, chest tubes are placed in the patient to monitor fluid, bleeding and air, and to prevent mediastinal shift. To prevent mediastinal shift, the chest tube must be kept closed for the first 24 hours (Grondell et al., 2018). However, the routine use of chest tubes is a subject which is debated. In the guide published by ERAS, chest tubes are recommended to be single entry and to be used if needed (Batchelor et al., 2019). In a study by Grondell et al., it was stated that in order to prevent infection, chest tubes should be taken out within one or two days of the surgery if the patient is stable (Grondell et al., 2018). Also, if chest tubes were used for more than two days, they should be changed for a flexible waterproof drainage system (Mehran, Martin, Baker, Mena and Rice, 2016).

Another debatable topic concerning chest tubes is classic closed underwater drainage. It has been found that classic underwater drainage is limited in assessing pleural air escape. Digital chest tubes on the other hand allow evaluation of minimal air escape and the regulation of pleural pressure (Wang, Hu, Ma and Zhang, 2019). Studies have found that in patients using digital chest tubes after thoracic surgery, chest tubes were used for a shorter time, pleural air escapes could be significantly monitored, pleural pressure could be monitored, patients' quality of life improved, and postoperative complications were reduced (Baringer and Talbert, 2017; Wang et al., 2019). In patients with chest tubes, fluid and air monitoring must be performed hourly, the amount coming must be monitored for blockages and the color of the fluid must be observed. Also the tube clamping and effleurage must not be performed, the tube must be held 90cm below, the closed drainage system must not be disrupted, and non-traumatic clamping should only be performed when tubes are changed (Crimmons, 2016).

Wound care and healing

In order to achieve wound healing after surgery, blood glucose should be monitored at 2-4-hour intervals. The wound should be cleaned with saline solution, the non-touch method should be used in dressing. Hydrocolloid wound closing products should be used in obese patients, and if necessary, vacuum-supported wound closing should be used (Li et al., 2020). In ensuring wound healing, nutrition is as important as wound care. Before the surgery, the patient's nutrition or malnutrition status must be assessed, and if necessary, oral nutrition products should be used (Batchelor et al., 2019). Also, patients' postoperative weight loss and body mass index should be monitored (Batchelor et al., 2019; Forster et al., 2021; Refai et al., 2018). In assessing nutrition and the healing process postoperatively, albumin levels must be monitored. In a study by Kaya et al., it was found that postoperative wound healing of patients without malnutrition was fast and that their albumin levels were normal (Kaya, Akcam, Ceylan, Samancılar, Ozturk and Usluer, 2016).

CONCLUSION

After thoracic surgery, complications relating to respiration and the heart may occur. Nursing interventions to prevent postoperative complications include giving breathing exercises, monitoring bleeding, shock and cardiovascular findings, monitoring vital signs, pain control.

Author Contributions

Concept and design: F.D.K., T.Y., F.A.S. Supervision: F.D.K. Literature search: T.Y., F.A.S. Writing manuscript: T.Y., F.A.S. Critical review: F.D.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study has received no financial support.

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