

Pulmonary tuberculosis patient on observed anti tuberculosis therapy with secondary spontaneous pneumothorax: a case study using the Roy adaptation model

Tuberculosis pulmonar en paciente con tratamiento antituberculoso con neumotórax espontáneo secundario: estudio de caso basado en el modelo de adaptación de Roy

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SUMMARY

Introduction: Secondary spontaneous pneumothorax can occur as a complication of several underlying diseases, such as pulmonary tuberculosis (TB). The accumulation of air in the pleural space causes shortness of breath due to inadequate oxygen supply, leading to poor adaptation and reduced quality of life for patients and, potentially, death. Interventions that apply Roy's adaptation model can help patients adapt to changes in physiological needs, self-concept, role function, and interdependence. The aim of this case study was to apply Roy's adaptation model theory to pulmonary TB patients on observed anti tuberculosis therapy (OAT) with secondary spontaneous pneumothorax. **Case Overview:** In this case, an ineffective adaptive

response was identified, with impaired gas exchange emerging as the priority problem, associated with a ventilation-perfusion imbalance. The focal stimulus corresponded to the accumulation of air in the left pleural cavity, while pulmonary tuberculosis was identified as the contextual stimulus. Residual stimuli included a history of pulmonary bullae, left pleural effusion, and exposure to second hand smoke. The nursing interventions implemented were grounded in the coping and control mechanisms described in Roy's Adaptation Model, specifically the regulator and cognator subsystems, with the aim of promoting an adaptive response and optimizing the patient's respiratory function. **Conclusions:** The Roy Adaptation Model is highly applicable to patients with respiratory system disorders, including pulmonary tuberculosis complicated by secondary spontaneous pneumothorax. In clinical practice, it is essential to have nursing professionals who are trained according to established standards of care and who possess the competencies required to apply the Roy Adaptation Model effectively in the management of patients with respiratory alterations.

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RESUMEN

Introducción: *El neumotórax espontáneo secundario puede presentarse como complicación de diversas enfermedades de base, entre ellas la tuberculosis pulmonar (TB). La acumulación de aire en el espacio pleural ocasiona disnea y compromiso de la oxigenación, lo que puede conducir a una adaptación ineficaz, al deterioro de la calidad de vida e incluso a la muerte. Las intervenciones basadas en la teoría del Modelo de Adaptación de Roy pueden favorecer la adaptación del paciente ante cambios en las necesidades fisiológicas, el autoconcepto, la función de rol y la interdependencia. El objetivo de este reporte de caso fue aplicar la teoría del Modelo de Adaptación de Roy en un paciente con tuberculosis pulmonar en tratamiento antituberculoso y con neumotórax espontáneo secundario.*

Presentación del caso: *En el presente caso se identificó una conducta ineficaz de adaptación, destacándose como problema prioritario la alteración del intercambio gaseoso, asociada al desequilibrio ventilación perfusión. El estímulo focal correspondió a la acumulación de aire en la cavidad pleural izquierda, mientras que, como estímulo contextual, se reconoció la presencia de tuberculosis pulmonar. Asimismo, se identificaron como antecedentes residuales las bullas pulmonares, el derrame pleural izquierdo y la exposición al tabaquismo pasivo. Las intervenciones de enfermería implementadas se fundamentaron en los mecanismos de afrontamiento y control descritos en el modelo de Roy, específicamente en los subsistemas regulador y cognador, con el propósito de favorecer una respuesta adaptativa y optimizar la función respiratoria del paciente.* **Conclusiones:** *La teoría del Modelo de Adaptación de Roy resulta especialmente pertinente para la atención de pacientes con trastornos del sistema respiratorio, como los que presentan tuberculosis pulmonar complicada con neumotórax espontáneo secundario. En el ámbito clínico, es fundamental contar con profesionales de enfermería formados conforme a los estándares de calidad del cuidado y con dominio en la aplicación del Modelo de Adaptación de Roy, a fin de garantizar una valoración integral y una intervención eficaz en pacientes con alteraciones respiratorias.*

Palabras clave: *Cuidado de enfermería, tuberculosis pulmonar, Modelo de Adaptación de Roy, neumotórax espontáneo secundario*

INTRODUCTION

According to the WHO *Global Tuberculosis Report 2025*, tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide. In 2024, an estimated 10.7 million people developed TB, representing approximately 131 cases per 100,000 population, marking the first global decline in incidence since

the disruptions caused by the COVID-19 pandemic. Despite this modest progress, TB continues to cause more than one million deaths annually, underscoring the persistent global burden of the disease. The distribution of TB remains highly concentrated, with eight countries accounting for roughly two thirds of all cases worldwide: India, Indonesia, the Philippines, China, Pakistan, Nigeria, the Democratic Republic of Congo, and Bangladesh (1). Indonesia continues to rank among the highest burden countries, contributing substantially to global incidence and mortality. Within the Western Pacific Region, where Indonesia is a major contributor, approximately 2.9 million TB cases were reported in 2024, with a regional incidence of 131 per 100,000 population. Although TB affects individuals across all age groups and geographic regions, it remains a preventable and curable disease, and the gradual recovery of TB services post pandemic reflects a positive but insufficient step toward achieving international elimination targets (2). TB is transmitted from person to person through airborne spread. An infected individual releases droplet nuclei—typically 1 to 5 μm in diameter—when speaking, coughing, sneezing, laughing, or singing. Larger droplets settle quickly, whereas smaller particles remain suspended in the air for prolonged periods and can be inhaled by susceptible individuals (3,4). The risk of *M. tuberculosis* transmission is influenced by several factors, including the infectiousness of the source case, the degree of air contamination, the duration of exposure, and the host's susceptibility. The bacterial load in the sputum, the frequency and intensity of coughing, and behaviors such as covering the mouth when coughing directly affect the generation and dispersion of infectious droplet nuclei (4).

Primary risk factors for tuberculosis include close or prolonged contact with individuals who have active TB, as well as conditions that impair immune function, such as HIV infection, malignancies, chronic diseases, and advanced age. Additional risk factors include substance use (drug abuse and alcoholism), cigarette smoking, poor ventilation and high humidity, and living or working in overcrowded or high risk settings, such

as prisons. Low body weight—defined as 10% or more below ideal body weight—also increases susceptibility to infection. Metabolic and chronic conditions, particularly diabetes mellitus, further elevate the risk of developing active TB (5-7).

Classic symptoms of active tuberculosis include persistent cough, weight loss and anorexia, fever, night sweats, dull chest pain, and hemoptysis (3,4,7,8). However, approximately 20% of individuals may remain asymptomatic, particularly those who are immunocompromised or of advanced age (7). Among the most severe complications of pulmonary tuberculosis are tuberculous empyema and bronchopleural fistula. When a tuberculous cavity ruptures, bacilli may enter the pleural space, and the rupture can simultaneously allow air to escape from the lung into the pleural cavity, resulting in a pneumothorax (4). Although uncommon, pneumothorax occurs in approximately 1% of patients with pulmonary TB, with higher frequency among those with cavitory disease (9). TB associated pneumothorax may develop either before the initiation of anti tuberculosis therapy or during the course of treatment (10).

Secondary spontaneous pneumothorax may occur as a complication of several underlying pulmonary diseases, including pulmonary tuberculosis (10). This form of pneumothorax, typically resulting from alveolar overdistension and rupture, is more severe and potentially life threatening than primary spontaneous pneumothorax (9,11). Patients who develop pneumothorax commonly present with acute shortness of breath due to the entry of air into the pleural cavity. As the condition progresses, individuals may appear restless or distressed because of increasing respiratory difficulty. Compensatory physiological responses include tachypnea and tachycardia. The accumulation of air within the pleural space increases intrapleural pressure, compressing the lung parenchyma and leading to partial or complete lung collapse. On physical examination, hyperresonance to percussion is typically noted due to trapped air in the pleural cavity. The collapse of the lung

impairs ventilation and oxygenation, and breath sounds become markedly diminished or absent on auscultation (7,11).

Nurses play a critical role in the management of patients with tuberculosis and pneumothorax. Their responsibilities extend beyond direct clinical care to include education, motivation, and support for patients and their families, all of which are essential to promoting health and well being (12). Evidence indicate that nursing practice grounded in theoretical frameworks yields greater benefits than traditional practice that is not theory based. Consequently, nurses are expected to conduct their assessments, interventions, and evaluations through the lens of established nursing theories, ensuring a systematic, evidence informed, and holistic approach to patient care (13).

One nursing theory frequently applied in clinical practice is Sister Callista Roy's Adaptation Model, which centers on the concept of human adaptation. Within this framework, the concepts of nursing, person, health, and environment are interrelated, with adaptation serving as the unifying construct (14). Humans are continuously exposed to internal and external stimuli, and assessment of these stimuli involves identifying three categories: the focal stimulus, which is the immediate stimulus confronting the individual; the contextual stimuli, which are additional factors that contribute to the effect of the focal stimulus; and the residual stimuli, which consist of environmental or personal factors whose influence on the current situation may be unclear but nonetheless relevant (14). Ultimately, individuals generate responses to these stimuli, leading to either adaptive or ineffective outcomes. Adaptive responses promote human integrity and support the achievement of adaptation goals—namely, survival, growth, reproduction, mastery, and transformation of both self and environment. In contrast, ineffective responses fail to meet these goals or may even threaten their attainment (14,15). According to Roy's model, patients must be regarded as active participants in the care process, with mutually established goals guiding the therapeutic relationship between nurses and patients (15).

This theoretical model is particularly well suited for nursing care because of its emphasis on the patient's adaptive capacity, a factor that significantly influences the healing process. Through this theory's lens, nurses can assess patients' behavioral responses across the four adaptive modes: physiological-physical function, self-concept, role function, and interdependence. The model also enables nurses to identify and evaluate patient stressors, thereby supporting more accurate and precise nursing diagnoses (14).

Common nursing problems observed in patients with tuberculosis undergoing observed anti tuberculosis therapy (OAT) who develop pneumothorax include impaired gas exchange, ineffective breathing patterns, ineffective airway clearance, imbalanced nutrition (less than body requirements), activity intolerance, and anxiety (16-18).

Nursing interventions guided by Roy's Adaptation Model focus on the regulator and cognator coping mechanisms. Nursing goals and actions are aligned with the Nursing Outcomes Classification (NOC) and the Nursing Interventions Classification (NIC) (19,20). The regulatory mechanism encompasses automatic physiological responses mediated through neural, chemical, and endocrine pathways; nursing actions based on this mechanism typically address physical status, physiological stability, and the availability of physical resources (14). In contrast, the cognator mechanism involves cognitive-emotional processes such as perception, learning, judgment, and emotion. Interventions grounded in this mechanism consider factors such as educational level, family knowledge, decision-making resources, openness to new information, and the patient's capacity to process and integrate inputs.

Case overview

A 37 year old woman, a housewife with a high school education, residing in Central Jakarta and identifying as Muslim and Javanese, was brought by her family to the Central General Hospital

Emergency Department on September 15, 2022, at 00:48 WIB. Her medical history included dyspnea, pulmonary tuberculosis under observed anti tuberculosis therapy (OAT), pulmonary bullae, left sided pneumothorax, dyspepsia, and difficulty with oral intake accompanied by electrolyte imbalance.

The patient's chief complaint was worsening shortness of breath and productive cough, accompanied by nausea, vomiting, loss of appetite, and epigastric discomfort for one week prior to hospital admission. She reported no blood in the sputum, which was described as small in volume and greenish in color. The patient stated that she felt more comfortable in a semi sitting position. She had been undergoing observed anti tuberculosis therapy (OAT) since August 30, 2022, and reported experiencing nausea and vomiting since initiating treatment.

On September 15, 2022, at 11:50 WIB, the patient was transferred to Room NB 1 and prepared for the emergency insertion of a water sealed drainage (WSD) system.

Based on the behavioral and stimulus assessment of the patient's oxygenation system, clinical data indicated worsening shortness of breath and productive cough. The patient reported no blood in the sputum, which was greenish in color and produced in small amounts. Episodes of coughing caused significant discomfort, and the patient stated that she felt more at ease in a semi sitting position. She also reported a history of hemoptysis one month earlier, for which she received treatment at the Central General Hospital (RSP). The patient denied any history of smoking or long distance travel. She had been undergoing observed anti tuberculosis therapy (OAT) with Package 3 FDC, 1 × 3 tablets daily, consisting of Rifampicin (R) 150 mg, Isoniazid (H) 75 mg, Pyrazinamide (Z) 400 mg, and Ethambutol (E) 275 mg, since August 30, 2022. Her medical history also included left sided pulmonary bullae and pleural effusion, for which she had previously been treated in the ICU. During that episode, more than 1000 mL of pleural fluid was drained from the left lung on August 13, 2022.

Physical examination

Results of physical examination: Normochemistry, asymmetrical chest wall movement, left chest left behind, no nasal breathing, -/- retractions, use of accessory muscles for breathing. 95% O₂ saturation with 5 liters/minute of oxygen via nasal cannula. Respiratory rate: 28 beats/minute, blood pressure 103/66 mm Hg, pulse: 109 beats/minute, regular and strong rhythm, temperature: 36.7 °C. The patient is attached to the WSD on the 3rd ICS of the left chest, producing 20 cc of reddish fluid, undulation (+), and an expiratory bubble (+). Auscultation: vesicular breath sounds + in the right lung, missing in the upper left lung field, coarse crackles +/-, wheezing -/-. Palpation: tactile fremitus (+) in the right chest and reduced in the left chest, Percussion sonor in the right chest and hyperresonance on the left chest. Chest X-ray results 15/09/2022 10:17 WIB: Cardiomegaly, Bronchopneumonia, Left pneumothorax. MSCT Thorax results September 15, 2022 21:40 WIB: Left pneumothorax with collapse of the superior lobe of the left lung. Consolidation of the inferior lobe of the left lung, suspected pneumonia DD/atelectasis. Pleural thickening with left lung basal split sign, suspected loculated effusion. Laboratory Results September 15, 2022 13:28 WIB: ABG: Respiratory alkalosis pH: 7.52; PO₂: 108.7; PCO₂: 24.2; HCO₃: 19.3; Total plasma CO₂: 20; BE: -3.6; O₂ saturation: 98.5%. Hematology 17/09/2022 03:33 WIB: Hb: 11.6 g/dl; Leukocytes: 7.88 /uL; Platelets: 158,000/μL; Erythrocytes: 4.08 million/μL; MCV 96.1 fl. Hemostasis: PT: 19.6 seconds; APTT: 38 seconds. Stimulus assessment resulted in a focal finding: accumulation of air in the left pleural cavity. Contextual stimulus: Pulmonary TB. Residual stimulus: History of pulmonary bullae (left pleural effusion), passive smoking.

Nutritional examination

A behavioral assessment of the patient's nutritional system revealed that nausea had decreased, vomiting was absent, and appetite remained poor. The patient consumed only half of the meals provided by the hospital. She reported

that nausea occurred particularly after taking her OAT medication, and she occasionally ingested the medication before eating, which further contributed to gastrointestinal discomfort. Patients with TB on OAT since August 30, 2022 (already two weeks). Physical examination: oral cavity and tongue: state of dry lip mucosa. Inspection of the abdomen: Symmetrical, no masses, dilated veins, surgical scars. Auscultation: Bowel sounds heard, peristalsis 12 times per minute. palpation: There is tenderness in the epigastric area, the pain is sharp and sore with a scale of 2, there is no enlargement of the liver and spleen, Percussion: tympani. Nutritional Assessment: A (Anthropometry): BB: 65 kg, TB: 150 cm, BMI: 28.9 Kg/m², Nutritional status: obese 1, B (Biochemistry): Hb: 11.6 g/dL, GDS: 118 mg/dL, SGOT/SGPT: 50/21 U/L, C (Clinical sign): nausea and no appetite, dry lip mucosa, D (Diet): TKTP diet per oral 1700 kcal with a menu of three main meals and two snack times. Currently, the patient is on IVFD, RL 1500 mL/24 hours. Therapy: Ranitidine 50 mg Intravenous, Metoclopramide HCL 10 mg Intravenous, Sucralfate 3x 1 PO, Lansoprazole 2 x 1 tab PO, OAT drugs continue and be taken after meals. Stimulus assessment resulted in a focal stimulus: OAT therapy. Contextual stimulus: Inadequate nutritional intake. Residual stimulus: Lack of knowledge regarding nutrition and the side effects of OAT drugs.

Elimination examination

A review of the patient's elimination system revealed no abnormalities. In the activity and rest system, assessment data indicated generalized weakness, with dyspnea contributing to easy fatigability and excessive sweating. The patient experienced limitations in performing activities of daily living, requiring assistance from family members and nursing staff for tasks such as eating, bathing, and dressing. She reported poor sleep quality, primarily due to coughing, shortness of breath, and discomfort associated with diaphoresis. Episodes of dyspnea and coughing made the patient more comfortable in a sitting or semi Fowler's position, and these symptoms worsened when lying supine.

Physical examination demonstrated normal muscle tone, full range of motion, no muscle atrophy, and normal muscle coordination, with upper and lower extremity muscle strength documented as 5555/5555. Functional assessment using the Barthel Index indicated a moderate level of dependency (score: 11), while the Morse Fall Scale classified the patient as low risk (score: 45). Stimulus assessment identified: Focal stimulus: shortness of breath and coughing, Contextual stimuli: pulmonary tuberculosis under OAT and pneumothorax and Residual stimulus: history of pulmonary bullae.

Protection Assessment

Behavioral assessment of the protection system, sensation, and endocrine function found no nursing problems. In the fluid and electrolyte system, patient data showed no restrictions on fluid intake. Calculation of fluid balance, namely fluid intake of 2700 mL/24 hours (consisting of 1200 mL of oral fluids, and 1500 mL parenteral fluids) minus the amount of urine, namely 1600 mL/24 hours, WSD output of 20 mL/24 hours, and IWL 770 mL/24 hours, obtained +150 mL/24 hours. The results of the physical examination found dry lip mucous membranes, elastic skin turgor, no pitting edema, CRT less than 2 seconds, no elevation of jugular vein pressure (JVP), and no shifting dullness. The patient's blood pressure is 104/66 mmHg, and pulse is 109 beats/minute. The patient was given 1500 mL of RL fluid per 24 hours. Laboratory September 16, 2022 03:33 WIB: Kidney function: Ur/Cr: 28/1.3 mg/dL, eGFR: 46 mL/minute/1.73m². Electrolytes: Sodium (Na): 133 mmol/L, Potassium (K): 4.8 mmol/L, Chloride (Cl): 97 mmol/L. Stimulus assessment found focal symptoms: nausea and vomiting. Contextual stimulus: Pulmonary TB on OAT, Pneumothorax. Residual stimulus: none.

Self-Concept Assessment

In the self concept mode, assessment data showed that the patient felt unable to carry out her usual activities due to her illness and expressed

fear that her condition might worsen, potentially requiring a longer period of hospitalization. She stated that she wished for her physical condition to stabilize so she could resume her normal activities; however, the recurrent nature of her symptoms caused anxiety, leading her to feel resigned. The stimulus assessment identified anxiety as the focal stimulus, the patient's perception of her illness as a serious and threatening condition as the contextual stimulus, and no residual stimulus was identified. In the role function mode, the patient is a wife and mother of two children and works as a housewife. At present, she is unable to perform her domestic responsibilities due to her health condition. Despite this, she expressed confidence that she would recover soon and return to her usual roles and activities. In the interdependence mode, the patient reported receiving continuous care and support from her family during her illness. She also actively communicates her symptoms and concerns to healthcare professionals—including physicians, nurses, nutritionists, and pharmacists—who are involved in her care. The patient stated that she accepts her current health condition and surrenders the outcome to Allah SWT.

Nursing Diagnoses

Based on the results of the behavioral and stimulus assessment, several nursing problems were found, including (1) Impaired gas exchange related to ventilation-perfusion imbalance characterized by complaints of shortness of breath (SpO₂ 95% with 5 lpm oxygen via nasal cannula), tachypnoea (RR 28 times/minute), complaints of shortness of breath making the patient more comfortable in a semi-sitting position, asymmetric chest wall movement, left chest left behind, there was use of accessory muscles for breathing, decreased tactile fremitus on the left chest, hyperresonant percussion on the left chest, breath sounds not heard in the left upper lung field, respiratory alkalosis pH: 7.52; PO₂: 108.7; PCO₂: 24.2; HCO₃: 19.3; Total plasma CO₂: 20; BE: -3.6; O₂ saturation: 98.5%, Thorax MSCT results found left pneumothorax with left lung superior lobe collapse (Domain 4, class 4, diagnosis code

00030). (2) Decreased activity tolerance related to an imbalance between oxygen supply and demand which is characterized by complaints of feeling weak in the body, congested conditions making the patient tired and sweating easily, not sleeping well at night due to coughing and shortness of breath, feeling uncomfortable due to excessive sweating, feeling comfortable in a sitting or semi-Fowler's position while resting or sleeping, and complaints of shortness of breath or increasing cough if the patient sleeps on his back, the patient experiences limitations in daily activities, where activities such as eating, bathing, dressing with the help of family and nurses, Barthel Index: Moderate level of dependence (score 11), BP: 103/66 mmHg, pulse: 109 beats/minute, RR: 28 beats/minute, SPO₂ 95% (Domain 4, class 2, diagnosis code 00298). (3) Imbalanced nutrition less than body requirements related to lack of interest in food which is characterized by nausea, vomiting, no appetite, only half the portion of food from the hospital is used up, current weight is 65 kg, height: 150 cm, BMI: 28.9 Kg/m², Nutritional status: obese 1, Hb: 11.6 g/dL (Domain 2, class 1, diagnosis code 00002). (4) Risk for electrolyte imbalance with risk factors for nausea, vomiting associated with side effects of TB treatment programs, which are characterized by abnormal electrolyte values: Sodium (Na): 133 mmol/L, Potassium (K): 4.8 mmol/L (Domain 2, class 5, Diagnostic code 00195). (5) Anxiety related to changes in health status, which is marked by the patient saying anxious and afraid if his condition worsens and requires longer hospital care (Domain 9, class 2, diagnosis code 00146).

Nursing Care Plan

The goals and intervention plans were aligned with the patient's identified nursing problem of impaired gas exchange related to ventilation-perfusion imbalance. 1. The expected outcomes included maintaining arterial blood gases (PaO₂, PaCO₂, and pH) and oxygen saturation within normal limits, achieving balanced ventilation-perfusion, demonstrating normal respiratory rate and rhythm, absence of accessory muscle use, reduced or absent dyspnea at rest and during

activity, symmetrical chest expansion, resonant percussion sounds, effective cough, and clear vesicular breath sounds. Interventions focused on continuous respiratory monitoring, including observation of respiratory rate, rhythm, depth, and effort; assessment of chest wall symmetry and accessory muscle use; evaluation of breathing patterns such as tachypnea or hyperventilation; monitoring oxygen saturation; palpation of lung expansion; percussion of the chest; and auscultation to identify decreased ventilation or adventitious sounds. The nurse also assessed the need for suctioning, monitored for signs of restlessness or air hunger, evaluated the effectiveness of the cough and sputum characteristics, identified factors that worsened dyspnea, and positioned the patient to optimize breathing. Oxygen therapy included monitoring flow and device function, educating the patient on proper use, ensuring correct oxygen concentration, and administering oxygen during mobilization. Chest tube care involved identifying the drainage system, monitoring for signs of pneumothorax, ensuring WSD patency, recording drainage characteristics, securing the tube, maintaining the system below chest level, observing for infection, encouraging coughing and deep breathing, repositioning every 2 hours, and performing dressing changes as indicated. Cognator focused interventions included education on effective coughing, breathing exercises, and active cycle of breathing techniques (ACBT) to reduce dyspnea and facilitate sputum clearance, as well as instruction on WSD function and general care. Collaborative actions included monitoring diagnostic results, administering oxygen and pharmacologic therapy, and assisting with the insertion and management of the WSD.

2. Decreased activity tolerance related to an imbalance between oxygen supply and demand. Objective (NOC): Activity Tolerance (0005), Indicators: Oxygen saturation, heart rate, respiratory rate, blood pressure within the normal range during activity, ease of breathing during activity, and able to perform daily activities (ADLs) independently. Intervention (NIC) regulatory activities include Energy Management (0180), encourage patients to express about limitations in activities; observation of patient restrictions

in carrying out activities; Assess for factors that cause fatigue; Monitor for excessive physical and emotional fatigue; Monitor cardiovascular response to activity: blood pressure, pulse, and respiration during and after activity; Note adverse response to increased activity level, increased heart rate and blood pressure, dysrhythmias, dizziness, dyspnea, tachypnea; Monitor the patient's sleep pattern and length of sleep/rest; Help the patient to perform activities (ambulation, self-care) if necessary; Instruct the patient for physical activity (ambulation, self-care) according to the energy sources they have; elevate the head of the bed, according to tolerance; Instruct the patient to change position slowly; Increase tolerable activity level; Instruct patient to stop activity if palpitations, chest pain, shortness of breath, weakness, or dizziness occurs. Cognator activities include education on periods of rest or bed rest; help the patient to prioritize ADL and desired activities; recommend assistance with activities and ambulation as necessary, if possible; Plan the progress of activities with the patient, including activities in the patient's view as important; educational organization of activities and time management techniques to prevent burnout. The collaborative activities include monitoring laboratory tests, such as Hb/Hct, RBC count, and arterial blood gas (AGD), administering additional oxygen as indicated, and administering medications as indicated.

3. Imbalanced nutrition was less than body requirements related to a lack of interest in food. Objectives (NOC): Nutritional Status (1004), Indicators: Nutritional intake within normal limits, food intake within normal limits, fluid intake within normal limits, adequate energy, ratio of body weight/height within normal limits. Intervention (NIC) regulatory activity namely Nutrition Management (1100) with independent activities including Documenting the patient's nutritional status at admission, record skin turgor, current body weight and degree of weight loss, integrity of the oral mucosa, ability to swallow, presence of intestinal tone, and history of nausea, vomiting, or diarrhea; Determine the patient's ability and willingness to address nutritional problems; Assess the patient's usual dietary patterns and favorite or

disliked foods; Monitor intake and output (I&O) and body weight regularly; investigate anorexia, nausea, and vomiting. Note possible correlation with drugs; Monitor side effects of drugs given. Cognator activities include encouraging small, frequent meals or snacks with high-protein and carbohydrate foods, encouraging families to bring food from home, and sharing food with patients unless it is inappropriate or contraindicated. Inform the patient and family about the benefits of nutrition. Collaborative activities, namely referral to a dietitian/nutritionist to adjust the diet, monitoring laboratory tests, administering anti-emetics and other pharmacological therapies, and collaborating on fluid therapy.

4. Risk of electrolyte imbalance. Objective (NOC): Electrolyte Balance (0606), Indicator: Increase in serum sodium (sodium) within the normal range (134-146 mmol/L), Decrease in serum potassium (Potassium) within the normal range (3.4 -4.5 mmol/ L). Intervention (NIC) regulatory activities include Electrolyte Management (2000), Independent Activities, including monitoring abnormal serum electrolyte levels; monitoring symptoms of electrolyte imbalance; maintaining patent intravenous access; monitoring fluid intake and output; monitoring loss of fluids and electrolytes from the presence of WSD fluids, diarrhea, or diaphoresis; controlling excessive electrolyte loss. Electrolyte Monitoring (2020) with the activity of monitoring electrolyte serum levels; Identify possible causes of electrolyte imbalances; Monitor for nausea, vomiting, or diarrhea; Identify medications that can change electrolyte status, such as administration of diuretics, and monitor symptoms of electrolyte imbalance. Cognator activities include teaching the patient how to prevent or minimize electrolyte imbalances and instructing the patient and family on specific dietary modifications, as appropriate. Collaborative Activities: Collaborating on treatment based on the underlying cause; Consult a nutritionist/nutritionist to educate the patient/significant other and to recommend or provide balanced nutrition, using the best route, and provide an appropriate diet to balance electrolytes; laboratory tests to monitor changes in fluid or electrolyte levels.

5. Anxiety related to changes in health status. Objectives (NOC): Anxiety Level (1211), Indicators: demonstrate appropriate range of feelings and appear relaxed and rested appropriately; Anxiety Self-Control (1402), Indicators: acknowledging and discussing fears and worries, Expressing accurate knowledge of the situation, reporting the early use of effective coping strategies individually; Spiritual Health (2001), Indicators: increased quality of faith, hope, meaning of life goals, spiritual attainment, feelings of calm, ability to pray, spiritual satisfaction. Intervention (NIC) regulatory activities include Anxiety Reduction (5820). Independent activity Independent: Encourage patient to express feelings; Listen attentively; Identify the level of anxiety; Help the patient recognize situations that cause anxiety; Evaluation of the patient's and family's level of understanding regarding health conditions; Give the opportunity to ask questions and answer honestly; Ensure that the patient and care provider have an understanding of the same terms being used; Involve patients and loved ones in treatment planning; Take time to prepare for action and treatment; Provide physical comfort to the patient. Aromatherapy (1330): Choose or mix the right essential oils to enhance relaxation; Involve the patient in choosing the preferred essential oil; Monitor vital signs, response, and patient discomfort before and after administration of therapy. Cognator activities include practicing diversion activities to reduce anxiety, practicing relaxation techniques, and teaching meditation and guided imagery. Spiritual Support (5420): Use therapeutic communication to build trust and empathic care; Provide privacy and quiet time for spiritual activities; Pray with individuals; Encourage participation in interactions with family members, friends, and others.

DISCUSSION

Roy's Adaptation Model provides a suitable and effective framework for collecting patient information, as its application enhances nurses' concentration, organization, clinical reasoning, and decision making (14,21). Guided by this model, nurses conduct systematic assessments

through interviews, observations, and precise measurements. They then identify maladaptive behaviors—representing the patient's problems—across the four adaptive modes, along with the associated stimuli (21,22). Based on this analysis, nurses design targeted educational and therapeutic interventions to address maladaptive responses. Evidence shows that applying this model improves patient adaptation, and studies in individuals with chronic obstructive pulmonary disease have demonstrated positive outcomes when care is guided by Roy's framework (22).

Tuberculosis may present as either an acute or chronic infection, and one of its recognized complications is pneumothorax (23). Although spontaneous pneumothorax is rare, occurring in fewer than 5% of patients with severe cavitary disease, it can develop when a tuberculous cavity ruptures and forms a bronchopleural fistula, when a bleb ruptures into the pleural space, or as a result of liquefactive pleural necrosis secondary to caseous infiltration (24,25). In the present case, the patient developed pneumothorax due to a previously ruptured bleb, and management included the placement of a water sealed drainage (WSD) chest tube. The accumulation of air in the pleural cavity increases intrapleural pressure, compresses the lung parenchyma, and leads to collapse, resulting in shortness of breath that can become life threatening if untreated (9,23). As part of the body's compensatory response to impaired ventilation, the patient exhibited tachypnea and an increased pulse rate (23).

The Multislice Computed Tomography (MSCT) results revealed a left sided pneumothorax accompanied by collapse of the superior lobe of the left lung, as well as consolidation in the inferior lobe suggestive of pneumonia or, alternatively, atelectasis. Additional findings included pleural thickening and a basal split sign, indicating a likely loculated effusion. These structural abnormalities contributed directly to the patient's impaired gas exchange due to a ventilation-perfusion imbalance. In pneumothorax, the accumulation of air in the pleural cavity reduces the available alveolar surface area, decreases the number of functional alveoli through collapse or damage,

and limits the amount of oxygen reaching the alveoli (25,26). Consequently, oxygen diffusion into the bloodstream is diminished, hemoglobin binds less oxygen, and carbon dioxide removal becomes impaired because collapsed alveoli cannot effectively receive CO₂ from the blood. This pathophysiological process was reflected in the patient's arterial blood gas results, which showed a low PaCO₂ of 24.2 mmHg, an SpO₂ of 95%, and a respiratory rate of 28 breaths per minute. To address impaired gas exchange, the patient received oxygen therapy at 5 L/min via nasal cannula and underwent insertion of a water-sealed drainage (WSD) chest tube to evacuate intrapleural air and facilitate lung re-expansion. The patient also exhibited an acid-base imbalance consistent with respiratory alkalosis, characterized by decreased PaCO₂ and elevated pH, a pattern commonly associated with tachypnea as a compensatory response to hypoxemia and dyspnea. In this state, the kidneys increased bicarbonate excretion as part of the compensatory mechanism (23). Together, these findings illustrate the physiological consequences of pneumothorax and underscore the importance of timely interventions to restore adequate ventilation, correct gas exchange abnormalities, and stabilize acid-base balance.

The nursing actions implemented to support the patient's adaptation to impaired gas exchange involved both regulator and cognator mechanisms. Regulator-focused interventions included continuous monitoring of respiratory status, positioning the patient in Fowler's position to optimize ventilation, collaborating in administering oxygen therapy, and providing comprehensive chest tube care. Cognator-focused interventions emphasized patient education, including instruction in effective coughing techniques, breathing exercises, and the Active Cycle of Breathing Techniques (ACBT) to reduce dyspnea and facilitate sputum clearance, as well as education on overall care and the function of the water-sealed drainage (WSD) system. Another nursing problem identified in the patient was activity intolerance, a condition characterized by insufficient physiological or psychological energy to perform or complete required or desired

daily activities. This intolerance may result from generalized weakness, an imbalance between oxygen supply and demand, or a sedentary lifestyle, and is manifested by abnormal blood pressure, heart rate, or respiratory responses during activity, discomfort following exertion, and patient reports of fatigue and weakness (18). Interventions addressing this problem aim to help the patient adapt her activity level to her current capabilities, thereby improving functional tolerance and overall quality of life (27).

In this patient, malnutrition below body requirements was attributed to poor appetite, nausea, and vomiting following OAT administration, as well as the patient's inability to finish more than half of the meals provided. This is particularly concerning because individuals with tuberculosis experience hypermetabolism due to the infectious process, increasing their nutritional requirements. Adequate nutrition is essential for effective TB treatment, and patients must understand the importance of sustained nutritional support throughout therapy. Evidence indicates that interventions to improve nutritional intake, combined with strong support from family members and healthcare providers, play a critical role in helping TB patients meet their nutritional needs (28,29). Another nursing problem identified in the patient was the risk of electrolyte imbalance. Electrolyte disturbances in TB patients may result from vomiting, diarrhea, and excessive sweating. In this case, hyponatremia was likely caused by vomiting and dehydration, while hypokalemia may have resulted from urinary potassium loss and repeated vomiting. Hypocarbonemia observed in pulmonary tuberculosis can be explained by compensatory physiological mechanisms aimed at maintaining electrochemical neutrality, influenced by plasma sodium and chloride levels. Given that electrolyte disturbances occur in approximately 20–40% of patients with tuberculosis, close monitoring of electrolyte levels is essential to prevent complications and guide appropriate management (17).

Another nursing problem identified in this patient was anxiety related to changes in health status. Evidence from Ethiopia reports a high

prevalence of anxiety among individuals with tuberculosis, reaching 41.5%, while a study conducted in Mexico found a wide prevalence range of 7.14% to 74%, indicating that anxiety is a frequent and significant comorbidity in TB patients (29,30). Factors such as perceived stigma, high levels of stress, being in the intensive phase of treatment, and low body mass index have been shown to be significantly associated with both anxiety and depression in this population (31). These psychological conditions can negatively influence treatment adherence and overall well being. Early identification of risk factors and the development of targeted interventions to reduce anxiety in TB patients are essential, as improving psychological adaptation can enhance disease control, reduce transmission, and help prevent the emergence of drug resistant strains. Ultimately, addressing anxiety contributes to a better prognosis and improved quality of life for individuals living with this chronic condition (30,31).

CONCLUSIONS AND RECOMMENDATION

Nursing care planning for pulmonary tuberculosis patients undergoing OAT who develop left secondary spontaneous pneumothorax, when approached through Roy's Adaptation Model, begins with a comprehensive assessment of patient behaviors across the four adaptive modes—physiological, physical function, self concept, role function, and interdependence—in response to internal and external stimuli, including focal, contextual, and residual factors. Based on this assessment, the nurse analyzes the data to identify maladaptive behaviors and formulate nursing diagnoses, then develops intervention strategies to promote adaptive responses. The effectiveness of these interventions depends on the nurse's ability to accurately interpret the patient's situation and collaborate with all members of the healthcare team involved in patient care. Applying this theoretical model enables nurses to deliver more holistic, structured care, thereby enhancing the patient's ability to adapt to internal and external changes that threaten physical and psychological well-being.

Roy's Adaptation Model is particularly applicable to patients with respiratory system disorders, including those with pulmonary tuberculosis complicated by secondary spontaneous pneumothorax. Effective implementation requires nurses who are proficient in the standards of nursing care and skilled in applying the model within clinical settings. By integrating Roy's framework into practice, nurses can better support adaptive processes, improve patient outcomes, and enhance the overall quality of care for individuals with complex respiratory conditions.

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Ethical statement. Not Applicable

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