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Rehabilitation Nursing for a Patient with Acute Respiratory Failure Combined with Heart Failure and Obesity: A Case Report

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Abstract: This paper summarizes the systematic rehabilitation nursing experience for a patient with acute respiratory failure combined with heart failure and obesity (BMI = 39.1). Key nursing interventions included implementing a sequential respiratory support strategy (high-flow oxygen therapy → non-invasive ventilation → transition to home ventilator), conducting phased exercise rehabilitation training, delivering precise nutritional management (total daily calorie intake controlled at 1500–1800 kcal), enhancing interdisciplinary risk prevention and control, and employing SMART goal setting for behavioral intervention. Following systematic intervention, after 4 days of hospitalization, the patient's SpO2 increased from 80% to 92% while off mechanical ventilator support, and the self-care ability score rose to 85 points. One week after discharge, the patient's body weight had decreased by 2 kg, pulmonary function indices showed improvement, and the patient successfully returned to work.

Keywords: Acute respiratory failure; Heart failure; Obesity; Rehabilitation nursing

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1. Introduction

Acute respiratory failure combined with heart failure represents one of the critical conditions in clinical practice. Patients often experience complex conditions and poor prognosis due to impaired gas exchange and reduced cardiac pump function. Obesity, as a common comorbidity, further aggravates cardiopulmonary load, increases treatment difficulty, and significantly impacts patient rehabilitation process and quality of life. The rehabilitation process for such patients requires comprehensive multi-dimensional strategies including respiratory support, nutritional control, exercise training, and behavioral intervention. Traditional single-specialty nursing models often

fail to meet their comprehensive rehabilitation needs.

In recent years, systematic rehabilitation programs based on multidisciplinary collaboration have demonstrated significant advantages in improving patients' cardiopulmonary function, enhancing exercise tolerance, and promoting the establishment of long-term healthy behaviors. Research indicates that integrating SMART goal management into rehabilitation nursing processes can effectively enhance patient compliance and self-management capabilities, providing new pathways for critically ill obese patients to return to society [1]. This study summarizes the nursing experience of a patient with acute respiratory failure combined with heart failure and obesity (BMI = 39.1), aiming to provide reference for refined nursing care during the rehabilitation period of similar patients.

2. Clinical data

2.1. General information

2.1.1. Patient

This study received approval from the Ethics Committee of Taihe Hospital in Shiyan City (Approval No. 2024XM011). A 39-year-old female of Han ethnicity was enrolled after providing informed consent. She was married, held a college-level education, and worked in an office setting. Her height was 160 cm, weight 100 kg, and Body Mass Index (BMI) 39.1 kg/m^2. She had no history of smoking or alcohol consumption. She was admitted by wheelchair on April 14, 2024, due to chest tightness and dyspnea for 1 week, worsening with decreased oxygen saturation for 1 day.

The patient experienced chest tightness and dyspnea without apparent cause for nearly one week, which significantly worsened with activity, accompanied by fatigue and paroxysmal nocturnal dyspnea. Occasional cough with small amounts of white sticky sputum was present but not given attention. One day prior to admission, symptoms significantly worsened with self-measured pulse oxygen saturation dropping to around 80%, prompting emergency hospital visit. Following emergency assessment, the patient was admitted to the Cardiac Care Unit (CCU) with diagnoses of acute respiratory failure, heart failure.

2.1.2. Past medical history

Hypertension for 3 years with maximum blood pressure of 160/100 mmHg, regularly taking antihypertensive medications (specifics unknown), blood pressure control status unclear. Bilateral total thyroidectomy for thyroid nodules 2 years ago, with long-term postoperative levothyroxine sodium (Euthyrox) replacement therapy. No known drug or food allergies.

2.1.3. Physical examination on admission

Temperature 36.5°C, pulse 102 bpm, respiration 25 bpm, blood pressure 141/92 mmHg, pulse oxygen saturation (SpO_2) 80% on room air. Alert consciousness, lethargic appearance, tachypnea, mild cyanosis of lips and nail beds. No jugular venous distension, diminished breath sounds bilaterally, fine wet rales audible in bilateral lower lungs. Cardiac border enlarged to the lower left, heart rate 102 bpm, regular rhythm, no pathological murmurs heard in any valve area. Abdomen soft and flat, no tenderness, liver and spleen not palpable below costal margins. No pitting edema in bilateral lower extremities.

2.1.4. Laboratory tests

Arterial blood gas analysis (on oxygen) showed pH 7.30, PaO_2 52 mmHg, $PaCO_2$ 55 mmHg, lactate 3.5 mmol/L. B-type natriuretic peptide (BNP) 1250 pg/mL. Complete blood count, liver and kidney function, and electrolytes within normal ranges.

2.1.5. Auxiliary examinations

Bedside chest X-ray showed decreased bilateral lung field transparency with patchy infiltrates, enlarged cardiac silhouette, suggesting possible pulmonary edema with pulmonary infection. Echocardiography showed left ventricular end-diastolic diameter 58 mm, left ventricular ejection fraction (LVEF) 40%, global cardiac enlargement with left heart predominance, generalized wall motion hypokinesis. Chest CT scan with 3D reconstruction showed bilateral interstitial pneumonia with partial lung consolidation and bilateral pleural effusion. Non-invasive hemodynamic monitoring showed cardiac output (CO) 4.1 L/min, cardiac index (CI) 2.2 L/(min·m^2), increased peripheral vascular resistance.

2.2. Treatment and outcomes

The patient was declared critically ill upon admission, requiring intensive care with continuous cardiac, blood pressure, and oxygen saturation monitoring, and strict 24-hour intake and output recording. The medical team immediately initiated a multidisciplinary collaborative treatment approach and developed a comprehensive treatment plan [2].

The primary goal was to correct hypoxemia and improve cardiac function. High-flow nasal oxygen therapy was immediately initiated (flow rate 50 L/min, FiO_2 60%), but oxygenation improvement was inadequate. The patient was transitioned to non-invasive positive pressure ventilation (S/T mode, IPAP 12 cmH_2O, EPAP 6 cmH_2O, FiO_2 50%), alternating with high-flow oxygen therapy.

2.2.1. Pharmacological treatment

Ceftriaxone sodium for anti-infection; sacubitril/valsartan sodium tablets to inhibit neuroendocrine activation and improve ventricular remodeling; bisoprolol fumarate to control ventricular rate and reduce myocardial oxygen consumption; supplemented with nebulized ipratropium bromide compound solution for bronchodilation and antispasmodic effects, rabeprazole enteric-coated tablets for acid suppression and gastric protection, while continuing Euthyrox replacement therapy.

After 4 days of intensive treatment, the patient's dyspnea significantly improved, with arterial blood gas analysis showing PaO_2 increased to 78 mmHg and $PaCO_2$ decreased to 45 mmHg. The patient was successfully weaned from non-invasive ventilation, with SpO_2 stable above 92% without mechanical support. Early rehabilitation was initiated during hospitalization, including respiratory function training, bedside passive to active exercise, progressive endurance training, and strict adherence to a balanced nutrition plan of 1500–1800 kcal daily.

The patient was discharged after 4 days of stable condition, with discharge weight of 99 kg and self-care ability score of 85 points. One-week post-discharge follow-up showed weight reduction to 98 kg, improved pulmonary function indices, cardiac function recovery to NYHA Class II, and successful return to daily work activities.

3. Nursing care

3.1. Construction and implementation of multidisciplinary collaborative treatment system

Given the patient's critical and complex condition involving cardiopulmonary failure and obesity, a multidisciplinary team was immediately established upon admission, led by the CCU and including cardiovascular medicine, respiratory therapists, clinical nutritionists, rehabilitation therapists, and specialist nurses. The team conducted daily bedside handoffs and case discussions, jointly assessing the condition and developing bundled, individualized treatment and nursing plans, ensuring homogeneous and continuous care measures, providing solid team support for successful patient treatment.

3.2. Systematic oxygenation management with respiratory support as the core

3.2.1. Sequential respiratory support strategy

For the patient's acute respiratory failure, a graduated respiratory support approach was adopted. Initially, when high-flow nasal oxygen therapy (flow rate 40–50 L/min, FiO_2 50–60%) failed to achieve satisfactory oxygenation improvement, non-invasive positive pressure ventilation was immediately initiated. ST mode was used with inspiratory positive airway pressure (IPAP) 10–12 cmH_2O and expiratory positive airway pressure (EPAP) 4–6 cmH_2O, alternating with high-flow oxygen therapy to maintain airway patency and improve ventilation/perfusion ratio. Dedicated monitoring to ensure mask seal and comfort; regular skin assessment to prevent equipment-related pressure injuries; close monitoring of arterial blood gas changes with timely parameter adjustments [3].

3.2.2. Artificial airway management and ventilator weaning

As cardiac function improved, weaning from non-invasive ventilation was attempted on the third day of admission. Prior to weaning, the patient was instructed in diaphragmatic breathing and pursed-lip breathing techniques. During the weaning process, vital signs and SpO_2 were closely monitored, using a strategy of gradually extending weaning time, ultimately achieving successful complete daytime weaning. To ensure nighttime ventilation safety and address obesity-related hypoventilation syndrome, home non-invasive ventilator training was introduced early, with simulation of home environment for machine training, establishing a foundation for long-term post-discharge management.

3.3. Circulation management and fluid balance monitoring based on precise assessment

3.3.1. Hemodynamic monitoring and volume management

The patient was at risk for cardiogenic pulmonary edema and fluid overload. Nursing care included strict 24-hour intake and output recording, using precision urine bags to monitor hourly urine output. Daily weight measurements were taken at the same time, using the same scale, in fasting condition, providing objective data for volume assessment. Through monitoring central venous pressure (CVP), blood pressure, heart rate, and pulmonary rales changes, volume status was comprehensively assessed, with appropriate use of diuretics as prescribed to achieve negative fluid balance and effectively reduce cardiac preload.

3.3.2. Medication nursing and monitoring

Core medications including sacubitril/valsartan sodium and bisoprolol fumarate were administered as prescribed. After the first dose of sacubitril/valsartan sodium, blood pressure changes were closely monitored to prevent first-dose hypotension. During bisoprolol administration, heart rate was carefully observed, with physician notification

if heart rate dropped below 55 bpm. Drug interactions were monitored, including patient education to avoid concurrent use of NSAIDs and high-potassium foods, ensuring medication safety.

3.4. Development and implementation of individualized cardiac rehabilitation program

3.4.1. Graduated exercise rehabilitation training

Based on the patient's cardiac function, obesity, and muscle strength status, rehabilitation therapists and nurses jointly developed a four-stage progressive exercise program.

(1) Phase 1 (Bed Rest Period)

Primarily passive range-of-motion exercises combined with respiratory training and respiratory muscle training to prevent muscle atrophy and joint stiffness while improving respiratory function. Respiratory Training: Pursed-lip breathing, 10–15 min/session, 3 times/day; combined with positional management, head of bed elevated 90°, turning every 2 hours to improve ventilation efficiency, reduce respiratory muscle compensation, and enhance oxygenation; monitoring indicator SpO_2 (target ≥ 92%), reducing work of breathing. Respiratory Muscle Training: External diaphragmatic pacing therapy, 2 times/day, 20 min/session, to enhance respiratory muscle strength. Flexibility Training: Bedside passive joint activities performed by nurses or therapists, 10–20 min/session, 3 times/day, to prevent muscle atrophy and joint stiffness while maintaining range of motion; simultaneously preventing deep vein thrombosis (DVT), monitoring Borg Rating of Perceived Exertion scale maintaining at 11–13 level. Precautions: ECG/blood pressure monitoring during exercise, ensuring heart rate increase ≤ 20 bpm, blood pressure < 160/100 mmHg; immediately terminate training if SpO_2 < 88%, Borg RPE > 14, chest pain, or dizziness occurs.

(2) Phase 2 (Bedside Activity Period, Post-Weaning)

Supervise bedside sitting and bilateral lower extremity dependent training, adding low-intensity resistance exercises and bedside cycling, with intensity maintained at Borg score ≤ 13. Respiratory Training: Diaphragmatic breathing, 10 min/session, 3 times/day; combined with Active Cycle of Breathing Technique (ACBT), 2 times/day (performed after nebulization), continuously improving ventilation efficiency; monitoring SpO_2 (target ≥ 92%), reducing work of breathing.

Respiratory Muscle Training

(a) External diaphragmatic pacing therapy 20 min/session, 2 times/day

(b) Resistance training based on muscle strength, 10 min/session, 2 times/day (starting with 0.5 kg sandbag, gradually increasing weight)

(c) Threshold loading training: inspiratory threshold 30% MIP = 16.5 cmH_2O, expiratory training 30% MEP = 18 cmH_2O, 5–10 min/session, 1 time/day.

Monitoring indicators: respiratory rate (target ≤ 20 bpm), SpO2 (target ≥ 92%), heart rate increase (≤ 20% resting value), Borg RPE maintained at 11–13, to enhance diaphragmatic strength and improve respiratory muscle strength and ventilation efficiency.

(3) Phase 3 (Standing and Walking Period, Post-Muscle Strength Recovery)

Focus on balance training and bedside short-distance walking while maintaining respiratory and muscle strength training.

(4) Phase 4 (Consolidation Period, Pre-Discharge)

Assess exercise capacity through 6-minute walk test, develop post-discharge aerobic exercise prescription to consolidate rehabilitation outcomes.

3.5. Nutritional management and behavioral intervention

3.5.1. Precise nutritional prescription

According to the Obesity Nutrition Treatment Guidelines, a daily calorie target of 1500–1800 kcal was set [4]. The nutritionist developed a specific meal plan with principles of low sodium (< 3 g/day), low fat, appropriate high-quality protein, and high dietary fiber. Patients were guided to maintain food diaries and avoid sweets and sugar-containing beverages.

3.5.2. Behavioral intervention and health education

Simple charts were used to explain the pathophysiology of acute heart failure and respiratory failure along with treatment goals, emphasizing the necessity and safety of home ventilators, guiding patients in purchasing home ventilators. Daily 10–15-minute bedside psychological interviews were conducted using open-ended questions (such as What concerns do you have about current treatment?) to assess potential anxiety or adjustment disorders. Distress Thermometer visual analog scale (0–10 points, 0 = no distress, 10 = extreme distress) was used for rapid screening of patient mood fluctuations. When scores ≥ 4, specialized psychological consultation was immediately initiated. Patients to establish SMART goals, such as independently complete 10-minute bedside cycling training within 3 days was collaborated, providing daily progress feedback and positive reinforcement through verbal praise and progress charts [5]. Motivational Interviewing (MI) techniques was employed with open-ended questions, affirmations, reflective listening, and summarizing to enhance patient compliance with weight reduction and rehabilitation exercise.

3.6. Skin care and complication prevention

3.6.1. Skin integrity protection

The patient was at high risk for skin breakdown due to obesity and need for non-invasive ventilator mask. Foam dressings were preemptively applied to pressure points such as nasal bridge and cheekbones for pressure relief. Facial skin was assessed every 4 hours, with intermittent ventilator breaks based on tolerance to relieve local pressure. Skin was kept clean and dry, especially in skin folds of neck and axillae. Regular turning was assisted to prevent pressure ulcer development. During hospitalization, skin integrity was maintained without pressure injuries.

3.6.2. Thrombosis and fall prevention

Patient had a Padua score of 4, indicating intermediate risk for venous thromboembolism. In addition to early mobilization, intermittent pneumatic compression devices were used as prescribed, twice daily for 20 minutes each. Patient had a fall/bed fall score of 45, indicating intermediate risk. Non-slip shoes were provided, activity area floors were kept dry, and medical staff or family members assisted with all patient ambulation, effectively preventing adverse events.

4. Conclusion

For this patient with acute respiratory failure combined with heart failure and obesity, excellent outcomes were achieved through constructing a multidisciplinary collaborative treatment system and implementing systematic nursing interventions centered on respiratory support, integrating graduated exercise rehabilitation, precise

nutritional management, and behavioral intervention.

The nursing practice demonstrates that for such complex critically ill patients, early identification of pathophysiological characteristics and implementation of sequential respiratory support strategies are key to stabilizing vital signs. Individualized cardiac rehabilitation and nutritional management based on precise assessment are core components for improving cardiopulmonary function and controlling weight.

Furthermore, integrating SMART goal management and motivational interviewing techniques throughout the nursing process effectively enhanced patient treatment compliance and self-management capabilities, establishing a solid foundation for smooth transition from inpatient treatment to home management and successful return to society [6]. This case suggests that for cardiopulmonary failure patients with obesity, systematic rehabilitation nursing models that break down specialty barriers are more capable of comprehensively addressing clinical challenges and improving patient long-term prognosis compared to traditional single-disease nursing approaches.

Disclosure statement

The authors declare no conflict of interest.

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