

## Effectiveness of Chest Physiotherapy toward Tuberculosis (TBC) Patient to Overcome Ineffective Airway Clearance in Dieng Inpatient Room of dr. Abdoer Rahem Hospital Situbondo: A Case Report

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### Abstract:

Tuberculosis is an infectious and potentially fatal disease in worldwide, caused by lungs inflammation due to Mycobacterium bacteria infection. Tuberculosis patient experiences coughing with phlegm, shortness of breath or dyspnea, accumulation of exudate or sputum. Excessive of sputum accumulated can lead to obstruction of breath way and increase lungs infection that related to ineffective airway clearance. Chest physiotherapy can be intervention of nursing to overcome ineffective airway clearance that helps in clearing accumulated sputum and improving oxygen saturation. This scientific work uses a case report method that describes the case of Tuberculosis patient with main problem of nursing that was called ineffective airway clearance. The sampling was consecutive sampling but only one patient included in the case. The sample of study was Mrs. M, 32 years old who had Tuberculosis patient with ineffective airway clearance. The research was conducted twice daily for 3 days began from December 21st, 2023, to December 23rd, 2023, in the Dieng Inpatient Room of dr. Abdoer Rahem Hospital Situbondo. Intervention was done in two sessions, that were morning and afternoon. Based on observations, there was no significant difference on blood pressure level, but there were decreasing pulse rate, decreasing respiratory rate, increasing oxygen saturation value, and improving ability of sputum production post intervention Chest Physiotherapy on the third day. The application of Chest Physiotherapy quietly helped in expelling phlegm and improving respiratory status.

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## INTRODUCTION

Tuberculosis (TB) remains the world's second deadliest infectious disease after COVID-19 despite ongoing efforts to develop safe and effective preventive measures. Tuberculosis (TB) is an infectious disease that mainly attacks the lung parenchyma (National Institute of Allergy and Infectious Diseases, 2024). This disease can also be transmitted to other body parts, including the meninges, kidneys, bones, and lymph nodes. The main infectious agent of Tuberculosis is Mycobacterium Tuberculosis, an acid-resistant aerobic rod that grows slowly and is sensitive to heat and ultraviolet light. Exposure to Tuberculosis is very dangerous and can result in serious situations, including death (Hinkle & Cheever, 2018).

According to data from World Health Organization (2023) the global epidemiological situation of tuberculosis (TB) in 2022. According to estimates, around 10.6 million people were diagnosed with TB worldwide in that year, with the majority of cases occurring in countries -developing country. Of this number, approximately 5.8 million are men, 3.5 million are women, and 1.3 million

are children. People living with HIV account for approximately 6.3% of total TB cases. The TB incidence rate (the number of new cases per 100,000 population per year) increased by 3.9% between 2020 and 2022, reversing a downward trend of around 2% annually for most of the last two decades. This shows there are challenges in TB control efforts, especially in dealing with factors such as transmission of infection, drug resistance, and access to health care.

Tuberculosis spreads quickly through the air. Transmission occurs when a patient with active TB releases bacteria into the air, especially droplets or saliva, when coughing, sneezing, or talking. When another person is infected, the bacteria can attack the person's lungs and other body organs, causing an inflammatory process and impaired immune response (Richard et al., 2023). Tuberculosis patients can experience symptoms such as coughing with excess sputum, coughing up blood and blood, chest pain, night sweats, and decreased appetite accompanied by crackles/wheezing, minor symptoms such as shortness of breath, fatigue, cyanosis, changes in breathing patterns (PPNI SDKI Working Group Team, 2017). Sputum that is not removed effectively can cause obstruction of the airways, worsening symptoms and increasing the risk of lung infection, which can result in respiratory syndrome. This condition is related to the problem of ineffective airway clearance nursing (Herdman & Kamitsuru, 2018). Chest physiotherapy techniques can overcome patients with ineffective airway clearance and help expel excess sputum (Bulechek et al., 2013).

The result of research done by Manurung et al. (2021) showed the important role of chest physiotherapy as an intervention to improve respiratory function in individuals with respiratory disorders. Chest physiotherapy is a therapeutic method that aims to facilitate the removal of secretions that accumulate in the tracheobronchial tract, as often occurs in diseases such as cystic fibrosis, pneumonia, or chronic obstructive pulmonary disease (COPD). Chest physiotherapy techniques can help remove sputum from the airways and increase oxygen saturation in patients with ineffective airway clearance problems. Based on these considerations, researchers are interested in implementing chest physiotherapy interventions to address ineffective airway clearance in Tuberculosis patient at the Dieng Inpatient Room, dr. Abdoer Rahem Situbondo Regional General Hospital.

## STUDY DESIGN

The research method used a quasi-experimental design focused on nursing care for patients with Tuberculosis (TBC) in the Dieng Inpatient Room of dr. Abdoer Rahem Hospital Situbondo began on December 21-23, 2023. The population in the study was adult patients who were treated in the Dieng Inpatient Room at RSUD dr. Abdoer Rahem Situbondo. The sample used in the study was a female patient with a medical diagnosis of Tuberculosis who met the characteristics of the inclusion and exclusion criteria. Research inclusion includes adult patients aged 18-64 years with respiratory problems, cough with phlegm, and willing to be respondents. Meanwhile, research exclusions are members of the population who cannot be used as research samples, such as patients with tension pneumothorax, chest fractures, and patients using mechanical ventilation who are unwilling to be respondents and sign informed consent. This method uses Evidence-Based Nursing (EBN) following Standard Operating Procedures (SOP) Chest Physiotherapy and observation sheet to determine pulse rate, blood pressure level, breath sound, respiratory rate, oxygen saturation value, and sputum production ability before and after chest physiotherapy.

The informed consent process began with the researcher introducing themselves to the patient and explaining the purpose of the study. The researcher provided comprehensive information about the intervention to be carried out and clarified their responsibilities towards the

patient. Once the information had been conveyed, the researcher allowed the patient to ask questions and ensured that the patient fully understood the study's details. The patient was then allowed to decide whether to participate in the study or decline, which was documented on the informed consent approval sheet provided. After the patient had consented by signing the approval sheet, the researcher proceeded with the intervention as planned. This process was carried out in collaboration with the patient and the nurse in charge of the patient's care.

### **PATIENT INFORMATION**

The patient under this management is Mr. S a 71-year-old man. The family said that 10 days before entering the hospital, the patient suddenly fell at home feeling weak, suddenly sluggish, unable to connect when spoken to, and unable to walk on his own. Then, the patient was rushed to the nearest health service, the community health center, referred to RSUD Dr. Abdoer Rahem Situbondo on October 17, 2023, and advised to undergo inpatient treatment in the Raung Room. The family said the patient had a long history of hypertension and no previous history of stroke, no family history of similar illnesses to the patient, and the patient had no history of hospitalization.

The study's assessment of the patient managed was Mrs. M from Kp. Bukkolan, Paowan, Panarukan, Situbondo, 32 years old, Muslim, and a housewife. The patient was diagnosed with active pulmonary tuberculosis on November 20, 2023. Active pulmonary tuberculosis and initial symptoms were fever for 3 months, cough with phlegm, shortness of breath, decreased appetite, and weakness. The patient came back to RSUD dr. Abdoer Rahem on Wednesday, December 20th, 2023, in the morning. The patient wanted to continue OAT treatment, which had been interrupted for 12 days at home. The patient assessment showed that the patient complained of a cough that never subsides, inability to expel phlegm, shortness of breath, weakness, and decreased appetite. The physical assessment was obtained that blood pressure level was 95/65 mmHg, pulse rate was 92 x/minutes, respiratory rate was 26 x/minutes, Ronchi (+/+) in both lung fields that were in the right medial lobe and left superior lobe, oxygen saturation was 93% without breath apparatus.

### **CLINICAL FINDINGS**

Based on laboratory results showed that the hemoglobin level was 11.4 – 17.57 g/dL, leukocytes 4.30 – 11.30 x 10<sup>3</sup> /uL, erythrocytes 4.00 – 5.50 x 10<sup>6</sup> /uL, hematocrit 38 – 47%, platelets 142 – 424 x 10<sup>3</sup> /uL. This was interpreted that the client has a low complete blood count (CBC). Therefore, patient was recommended to have blood transfusion 1 kolf per day. There were no signs of redness, itching, and fever chills during administering blood transfusion. This therapy was about to help increase the patient's complete blood requirement.

While the results of an X-ray examination of the lungs showed that the Cor was not enlarged, the sinuses and diaphragm were normal, the Pulmo: hills were normal, the bronchovascular pattern was increased, infiltrates were visible in the upper fields of the left and right lungs. AP and lateral views of white spots in the left and right lung fields. Positive Effects of Pulmonary Tuberculosis.

### **THERAPEUTIC INTERVENTION**

The patient was recommended to be treated in the Dieng Inpatient Room at RSUD dr. Abdoer Rahem Situbondo and advised to start OAT treatment from the initial dose. The patient

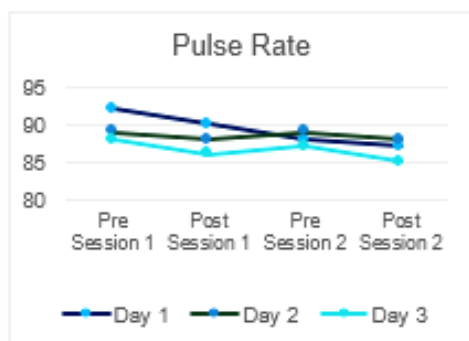
was given an OAT dose of 2 tablets once a day and the patient complained of nausea on the first day of therapy. The patient stated that he had a history of hypertension. and still receiving OAT medication and nebulizer therapy. The following is the medical treatment therapy received by Mrs. M in the form of Hydromal infusion 14 tpm, pantoprazole injection 1 x 40 mg, ondansetron injection 3 x 4 mg, santagesic 1 g if necessary, TB OAT 1 x 2 4FDC or Rifastar, Nebulizer combivent UDV every 8 hours. The assessment was carried out in a conscious or compos mentis condition with GCS E4V5M6 and the patient was coughing up phlegm, crackles in the right and left lung fields, excess sputum, and weakness. The presence of excess sputum results from the response of the body's phagocytes and lymphocytes. Phagocytes suppress and lymphocytes destroy bacterial cells. This reaction causes a buildup of exudate or sputum in the alveoli (Luiez and Preez, 2020).

Chest physiotherapy intervention was done before the Nebulizer and OAT had been given to the patient. This therapy was given in two continuous sessions (morning and afternoon) for 15-20 minutes over 3 days. The intervention of Chest physiotherapy began with an auscultation test with a stethoscope on both lung lobes. Based on the auscultation test, a Ronchi sound was heard in the right medial lobes and left superior lobes. Then, the postural drainage step was performed by positioning the patient according to the location of the ronchi sound. In this case study, the patient was positioned at 15 degrees and sitting in the Fowler position with the back bent slightly instead of lying on his back and tilted on his left side or face down. This condition occurred because the patient felt pain and difficulty in sleeping position on her side to the right and left.

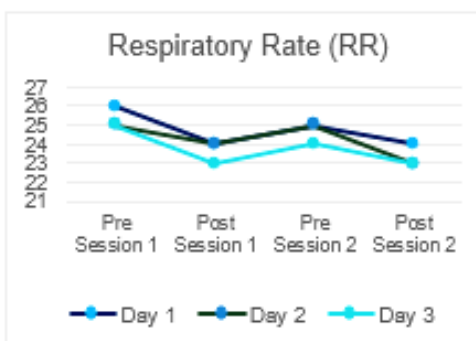
Furthermore, percussion was performed by tapping slowly and softly on both chest and back sides with hands, forming a bowl according to the location of the Ronchi, which was the right medial lobe and left superior lobe. Hereafter, the patient was encouraged to exhale; simultaneously, vibration was given by vibrating both hands slowly and softly on both sides of the chest and back. Last, the patient was encouraged to lean over and coughed once.

Table 1. Result of Pre and Post-intervention of Chest Physiotherapy

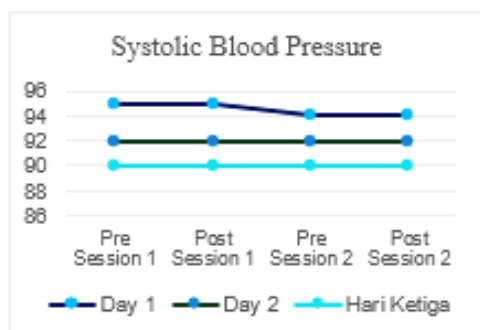
Day	Date	Indicator	Pre	Post	Pre	Post
Day 1	21/12/2023	Pulse Rate	92 x/minutes	90 x/minutes	88 x/minutes	87 x/minutes
Day 2	22/12/2023		89 x/minutes	88 x/minutes	89 x/minutes	88 x/minutes
Day 3	23/12/2023		88 x/minutes	86 x/minutes	87 x/minutes	85 x/minutes
Day 1	21/12/2023	Blood Pressure	95/65 mmHg	95/65 mmHg	90/60 mmHg	90/60 mmHg
Day 2	22/12/2023		90/60 mmhg	90/60 mmHg	90/50 mmHg	90/50 mmHg
Day 3	23/12/2023		90/60 mmHg	90/60 mmHg	90/50 mmHg	90/50 mmHg
Day 1	21/12/2023	Breath Sound	Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)
Day 2	22/12/2023		Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)
Day 3	23/12/2023		Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)	Ronkhi (+/+)
				minimal	minimal	minimal
Day 1	21/12/2023	Respiratory Rate	26 x/minutes	24 x/minutes	25 x/minutes	24 x/minutes
Day 2	22/12/2023		25 x/minutes	24 x/minutes	25 x/minutes	23 x/minutes
Day 3	23/12/2023		25 x/minutes	23 x/minutes	24 x/minutes	23 x/minutes
Day 1	21/12/2023	SPO <sub>2</sub>	93%	93%	93%	94%
Day 2	22/12/2023		94%	95%	94%	95%
Day 3	23/12/2023		94%	95%	95%	95%
Day 1	21/12/2023	Ability of Sputum Production	-	-	-	-
Day 2	22/12/2023		-	-	-	thick cloudy white
Day 3	23/12/2023		thick cloudy white 0.5 mL	thick cloudy white 1.5 mL	thick cloudy white 0.5 mL	2 mL thick cloudy white 1 mL



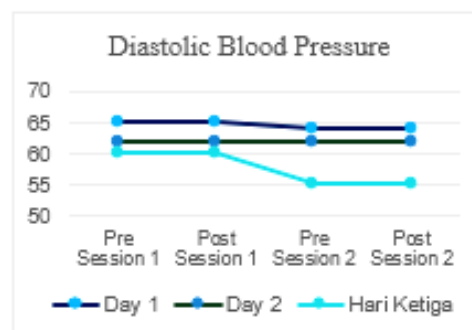
**Figure 1.** Pulse Rate Pre and Post Intervention



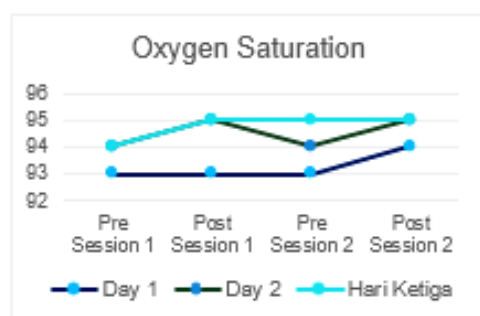
**Figure 2.** Respiratory Rate Pre and Post Intervention



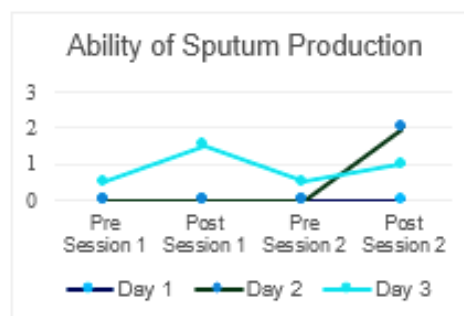
**Figure 3.** Systolic Blood Pressure Pre and Post Intervention



**Figure 4.** Diastolic Blood Pressure Pre and Post Intervention



**Figure 5.** Oxygen Saturation Pre and Post Intervention



**Figure 6.** Ability of Sputum Production Pre and Post Intervention

Complications of Tuberculosis that often occurs are reduced surface alveoli, inability to clear excessive of sputum accumulation, and obstructions from the respiratory tract so that there will be a nursing diagnosis ineffective airway clearance was related to infection process that was indicated by cough ineffectively, excessive of exudate or sputum, shortness of breath, ronchi (+/+) in both of lungs that were right lobe medialis and left superior lobe, respiratory rate increased that was 26 x/minutes, oxygen saturation decreased that was 93% without breathing apparatus (SDKI DPP PPNI, 2017).



Based on the result of the observation sheet and measurements using an oximeter, it was found that during the 3 days of intervention, there was no significant difference in blood pressure level. There was a decrease in the pulse rate between pre and post-intervention of Chest Physiotherapy, which began from the first until the third day after being given intervention. Patients have low blood pressure and tend to remain stable pre- and post-intervention, both from the first to the third day. The patient's breath sounds were obtained as a result of crackles in the lung fields of the dextra or right medial lobe and sinistra or left superior lobe.

Ronchi in the right lung field were heard minimally during the first post-intervention session on the third day until the second post-intervention session on the third day. Furthermore, the patient's RR results decreased pre and post-intervention from the first to the third day. Then, the oxygen saturation results increased to 95% on the second pre- and post-intervention on the third day. Lastly, there is an increase in the patient's ability to expel phlegm or sputum. The patient was able to expel sputum in session two of 2nd-day post-intervention as much as 2 mL, session one of 3rd-day pre- and post-intervention from 0.5 mL to 1.5 mL, and session two of 3rd-day pre and post-intervention from 0.5 mL to 1 mL.

## DISCUSSION

Patients with airway clearance issues often face challenges such as thick secretions that make coughing difficult. To address these nursing problems, observation, therapy, and collaboration are essential. Observations aim to track changes in clinical signs and identify any new issues. According to the Indonesian Nursing Intervention Standards, key observations include the patient's breathing patterns (including frequency and depth), respiratory effort, additional breath sounds, and sputum produced. Therapeutic interventions are implemented as part of independent nursing actions, including procedures such as chest physiotherapy to aid in clearing the airways (SIKI DPP PPNI, 2018).

According to physiological theory, chest physiotherapy clears the airways, including a collection of mechanical techniques to non-invasively clear excessive secretions or inhaled material from the airways. One indication for performing chest physiotherapy is increased sputum accumulation. Chest physiotherapy can release retained secretions, which are loose, watery and easy to clean. This results in a clean airway, good ventilation, and increased binding of hemoglobin to oxygen, as indicated by oxygen saturation values moving towards normal. Regular and effective airway clearance through chest physiotherapy is crucial for managing respiratory conditions, preventing severe complications, and ensuring optimal lung function (Tripathi & Sankari, 2024).

Nursing evaluation of managed patients was grounded in clinical conditions following a blend of the Indonesian Nursing Outcome Standards. The goal set for patients with airway clearance issues is to enhance airway clearance, with evaluation criteria encompassing sputum production, presence of rhonchi, shortness of breath, respiratory pattern, and breathing rate (SLKI DPP PPNI, 2019). Therapeutic interventions are performed as independent nursing actions. Chest physiotherapy is a therapeutic technique aimed at mobilizing pulmonary secretions (Potter & Perry, 2016). The intervention of chest physiotherapy includes postural drainage, percussion, and vibration, ending with one cough (SPO DPP PPNI, 2021).

The initial intervention is carried out by auscultation with a stethoscope to determine the position of the sputum in the lungs. Next, body positioning or postural drainage relies on gravity through body position. Positioning the body aims to drain secretions according to the area of the infected lung segment. Then, gently tap the chest and/or back area (percussion) to stimulate the movement of mucus in the lungs and make it easier to remove the mucus through coughing

(Warnock & Gates, 2023). The next action is to provide vibrations as a form of kinetic energy (vibration) to increase the mobilization of secretions. Vibration can provide hand muscle vibration impulses to relax and shift airway secretions (Susanto et al., 2022); Tripathi & Sankari, 2024). Lastly, the huff cough stage. This technique is a method used to help expel mucus from the airways by taking a deep, slow breath before performing a strong cough. The huff cough technique helps prevent mucus from sticking to the walls of the airways and facilitates the removal of accumulated mucus or phlegm (Putri et al., 2024).

Based on research results from observation tables and graphs, there were no significant differences in systolic and diastolic blood pressure. Chest Physiotherapy intervention does not affect the client's blood pressure. Systolic blood pressure is in the range of 90-95 mmHg and diastolic in the range of 55-65 mmHg. The client's blood pressure tends to be low, which is related to the client's condition being infected with Tuberculosis. Some studies suggest that individuals with tuberculosis may experience decreased blood pressure as a manifestation of Millier Tuberculosis in the early stages of the disease, or during anti-Tuberculosis treatment. Miliary tuberculosis is caused by Mycobacterium infection which spreads seriously and systemically and affects blood circulation (Vohra & Dhaliwal, 2024). However, there was a decrease in the client's pulse rate between pre and post chest physiotherapy intervention. In line with research by Polapa et al. (2022) found that a decrease in pulse rate is inversely proportional to SaO<sub>2</sub>, meaning that when the oxygen level in the blood increases (SaO<sub>2</sub> increases), the pulse rate tends to decrease. This occurs because the body does not need to pump blood as quickly as before to meet lower oxygen requirements, or because increased oxygenation reduces the body's need to increase cardiac output.

Results showed that decrease in respiratory rate values and an increase in oxygen saturation after chest physiotherapy. The average RR value decreased to 23 x/minute, and oxygen saturation or SpO<sub>2</sub> increased from 93% to 95% post-intervention on 3rd day. This proves conformity with the results achieved; that is, the respiratory rate becomes normal. Patient's ability of sputum production also increased. The rhonchi sound reduced to minimal audibility in the right medial lobe. Alfarizi et al. (2024) also, chest physiotherapy and postural drainage could be carried out according to the patient's clinical condition. This combination of interventions could improve the patient's clinical condition by increasing sputum production, reducing ronchi and dyspnea, and improving breathing patterns and respiratory frequency.

Based on the graphic diagram, the patient's ability to produce sputum increased, especially on the 2nd day and 3rd day of post-intervention chest physiotherapy. Mobilization of phlegm from the airways after chest physiotherapy will expand the alveolar cavity, so that pressure decreases, resulting in maximum alveolar expansion. Maximal development of the alveoli will support adequate ventilation to increase more oxygen absorption into the lungs, thereby reducing complaints of shortness of breath in patients (Manurung et al., 2021; Tripathi & Sankari, 2024). The technique has been proven to be safe and quietly effective, reducing the level of shortness of breath (Windiastroni et al., 2023).

## CONCLUSION

Tuberculosis is the second deadliest infectious disease in the world after COVID-19. Tuberculosis or TB is caused by infection with the bacteria *Mycobacterium tuberculosis* and most often attacks the lungs. Physical examination, such as breath sounds, revealed wet, fine, and loud rales, which could result in ineffective airway clearance. Chest physiotherapy is applied to diseases that interfere with the airway, such as tuberculosis so that no buildup of secretions

causes obstruction of the airway. After implementing chest physiotherapy in this final scientific work 2 times a day for 3 days and each session was carried out for 15 minutes. There are gradual changes that are monitored through the sound of crackles which gradually decrease over time. This action is quite easy and practical so that the client's family can do it independently and can be implemented at home

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