Journal of Advanced Zoology

ISSN: 0253-7214

*Volume **44** Issue **S-2 Year 2023** Page **4180:4188***

Synchronization of Sputum Conversion and Resolution of Intensive Phase Lesion Areas on Thorax X-rays Determinants of Prognosis for Pulmonary Tuberculosis Therapy

Utami Ambarsari[1], Muzaijadah Retno Arimbi[2], Lysa Veterini[3], Yunita Lestari Indrianto[4], Naura Anindya Candini[4], Hari Basuki Notobroto[5] and Nur Sophia Matin[6]

[1]Department of Radiology, Faculty of Medicine, Universitas Nahdlatul Ulama Surabaya
[2]Department of Internal Medicine - Pulmonology, Faculty of Medicine, Universitas Wijaya Kusuma Surabaya
[3]Department of Anatomical Pathology, Faculty of Medicine, Universitas Nahdlatul Ulama Surabaya
[4]Doctor Profession, Faculty of Medicine, Universitas Brawijaya
[5]Department of Public Health, Faculty of Public Health, Universitas Airlangga
[6]UPPM, Faculty of Medicine, Universitas Nahdlatul Ulama Surabaya

Article History

Received: 12 July 2023
Revised: 10 September 2023
Accepted:27 October 2023

Abstract

Background: Pulmonary tuberculosis (TB) is a chronic infectious disease caused by the bacterium Mycobacterium tuberculosis. Diagnosis of TB can be confirmed in two ways, namely bacteriological diagnosis (if AFB sputum is found (+) and clinical diagnosis is (if BTA sputum is found (-), but chest X-ray is (+) TB).

Objective: to determine the alignment of sputum conversion and extensive resolution of intensive phase lesions on chest radiographs which determine the prognosis of pulmonary TB therapy.

Methods: The study design was a retrospective cohort analytic with a retrospective longitudinal study design. Data from medical records of pulmonary TB patients who have undergone therapy for six months or more at the Pulmonary Polyclinic RSI Jemursari Surabaya.

The number of samples was 48 patients aged 41-60 years. All of these pulmonary TB patients were smear positive (BTA+). X-ray examination was done before and after therapy.

Results: analysis using the Wilcoxon Signed Rank test to assess differences in the grade of lung lesions before and after therapy, obtained p = 0.003 (p <0.05) meaning there is a significant difference. Sputum conversion was also carried out after therapy, 89.6% of TB patients in this study experienced sputum conversion (BTA negative). To determine the alignment of sputum conversion with the resolution of lesion area, Kappa coefficient analysis

K=0.033 (p>0.05) was performed with the results of 50% of patients, 47.9% showed improvement in lung lesions and sputum conversion, while 2.1% showed no improvement of lung lesions and no sputum conversion. The rest, 50% showed no congruence in the results of lung lesion repair and sputum conversion.

Conclusion: The results of Kappa coefficient analysis showed that K=-0.110 (p>0.05) showed that there was no congruence between the results of chest x-ray examination of lung lesions before and after therapy (improved or not) with sputum conversion.

Keywords: Pulmonary TB, Thorax Photo, Sputum BTA

BACKGROUND

Pulmonary tuberculosis (pulmonary TB) is a chronic infectious disease that is still a major public health problem in the world, including Indonesia. Pulmonary tuberculosis is an infectious infectious disease caused by the bacterium Mycobacterium tuberculosis. The results of the Household Health Survey (SKRT) in 1995, pulmonary TB became the third cause of death after cardiovascular disease and respiratory disease in all age groups and the number one cause of death from respiratory infectious diseases (Ministry of Health, 2007).

WHO estimates the incidence in 2017 was 842,000 or 319 per 100,000 population while TB-HIV was 36,000 cases per year or 14 per 100,000 population. According to the WHO report, Indonesia is in the list of 30 countries with the highest burden of tuberculosis in the world and ranks third highest in the world regarding the incidence of tuberculosis.

The incidence of tuberculosis in Indonesia in 2018 was 316 per 100,000 population or it is estimated that around 845,000 people suffered from tuberculosis in 2018. WHO said there were around 1.7 million people who died from tuberculosis in the world, while in Indonesia it was estimated that 92,700 people died from tuberculosis, or about 11 people die of TB per hour. TB is not only experienced by adults, but people who have low immunity and have comorbidities, such as the elderly, children, diabetic patients PLWHA (People with HIV AIDS) are very at risk of being infected with TB (Indonesian TB)

The Indonesian Ministry of Health released the latest data on estimated cases of tuberculosis (TB) in Indonesia, the number of which fell by around 200 thousand, from around 1,020,000 cases in 2017 to 842,000 cases in 2018 (Ministry of Health, 2019).

Establishing the main TB diagnosis according to WHO is AFB sputum with results (+), (-) or no material (phlegm-), if sputum is not found, then it is diagnosed as TB based on chest X-ray supported by clinical symptoms (TB triad).

Establishing the diagnosis of TB in 2 ways, namely by establishing a bacteriological diagnosis (if BTA (+) sputum is found), and clinical diagnosis (if AFB sputum is found (-), but chest x-ray (+)

TB). TB therapy (according to WHO 2 category) category I (new case) and category 2 (relapse, tx failure, default), category 1 TB therapy takes 6 months.

Is the harmony between sputum conversion and extensive resolution of intensive phase lesions can be a determinant of the prognosis of pulmonary TB therapy, which is a measure of the success of complete healing on time in patients with pulmonary TB. This is done by analyzing the conversion of AFB sputum in the intensive phase and analyzing the resolution results of serial chest X-rays obtained in the 2-month intensive phase.

Serial photo resolution is by looking at 2 photos to compare, namely the first chest photo obtained at the beginning of therapy and the second photo obtained at the end of the 2-month intensive phase and followed by the development of pulmonary TB infection healing for 6 months in order to find out how the prognosis of the patient's recovery after therapy for 2 months. 6 months ended. The conversion of BTA sputum (change in AFB sputum (+) to sputum BTA (-) that occurs in the intensive phase.

METHODS

The study design was a retrospective analytic cohort with a retrospective longitudinal study design. Data from medical records of pulmonary TB patients who have undergone therapy for six months or more at the Pulmonary Polyclinic RSI Jemursari Surabaya. The number of samples was 48 patients aged 41-60 years. All of these pulmonary TB patients were smear positive (BTA+). X-ray examination was done before and after therapy.

RESULTS

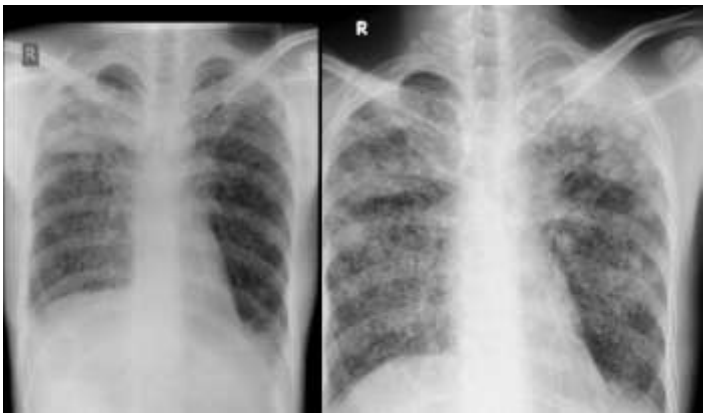

Figure 1. Patients with steady condition between before and two months after therapy

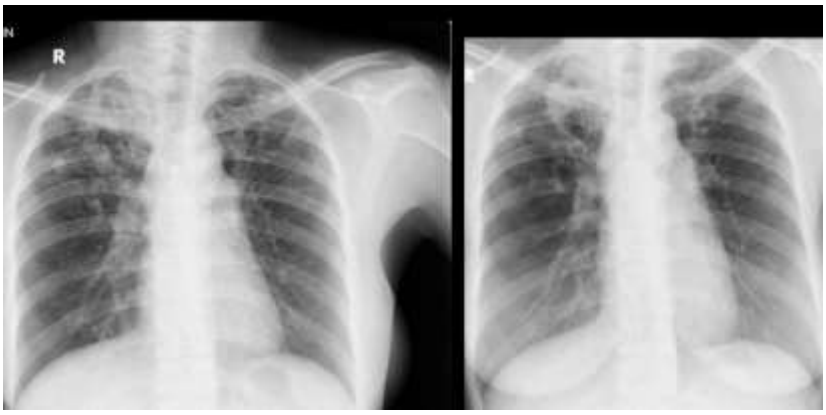

Figure 2. Patients with improved condition between before and two months after therapy

The picture above is 2 of the 48 samples used in this study. The first image represents a patient with a steady state between before and two months after therapy. In the second image, the patient's condition remained between before and two months after therapy. Several aspects examined in this study include the characteristics of patients with pulmonary TB, the description of the results of the chest x-ray examination, the results of the sputum examination (sputum conversion), and the alignment of the sputum conversion with the resolution of the extent of the lesion.

1. Characteristics of Pulmonary TB Patients

Characteristic	**Category**	**Frequency (%)**	**∑x ± SD (Min-Max)**
Age	21-40 years	17 (35,4%)	48,19 ± 15,24 (21 – 80) tahun
	41-60 years	20 (41,7%)	
	>60 years	11 (22,9%)	
Gender	Man	23 (47,9%)	
	Woman	25 (52,1%)	

Table 1. Characteristics of patients with pulmonary TB

Most of the pulmonary TB patients in this study were female and were in the 41-60 year age group. From the results of sputum examination before therapy, it was found that all patients with pulmonary TB (100%) in this study were BTA positive (BTA+).

2. Overview of Thorax X-ray Examination Results

Lung Lesion	**Chest X-ray Examination Time**	
	Before Therapy	After Therapy
Negative	0 (0,0%)	6 (12,5%)
Minimal	14 (29,2%)	23 (47,9%)
Moderate	32 (66,7%)	14 (29,2%)
Far advance	2 (4,2%)	5 (10,4%)
Total	48 (100,0%)	48 (100,0%)

Table 2. Results of Thorax Photo Examination before and after therapy

The results of the chest x-ray examination showed that before therapy, most of the lung lesions were of moderate grade (66.7%) while after therapy, most of the lesions were minimal (47.9%) and only 12.5% were negative.

If you look at the changes in the chest radiograph that occur before and after therapy, the distribution is as shown in the following table.

Lung Lesion Before Therapy	**Lung Lesion After Therapy**				**Total**
	Negative	Minimal	*Moderate*	*Far advance*	
Minimal	6 (12,5%)	3 (6,3%)	5 (10,4%)	0 (0,0%)	14 (29,2%)
Moderate	0 (0,0%)	20 (41,7%)	8 (16,7%)	4 (8,3%)	32 (66,7%)
Far advance	0 (0,0%)	0 (0,0%)	1 (2,1%)	1 (2,1%)	2 (4,2%)
Total	6 (12,5%)	23 (47,9%)	14 (29,2%)	5 (10,4%)	48 (100,0%)

Table 3. Changes in the picture of changes in lung lesions on chest X-ray examination before and after therapy

In Table 3, the results of the analysis using the Wilcoxon Signed Ranks test showed that there were differences in the grade of lung lesions before and after therapy, p=0.003 (p<0.05). The data in Table 3 shows that most patients (56.3%) experienced improvement in the appearance of pulmonary lesions, 25.1% remained, and 18.7% experienced worsening.

3. Sputum Examination Results (Sputum Conversion)

Conversion	**Frequency**	**Percentage (%)**
Yes	43	89,6
No	5	10,4
Total	48	100,0

Table 4. Sputum conversion after therapy

Table 4 shows that most of the TB patients (89.6%) in this study experienced sputum conversion (BTA negative).

4. Alignment of Sputum Conversion with Resolution of Lesion Area

The analysis to determine the alignment of sputum conversion with the resolution of the lesion area obtained the following results.

Lung Lesion Repair	**Sputum Conversion**		**Total**
	Yes	No	
Yes	23 (47,9%)	4 (8,3%)	27 (56,3%)
No	20 (41,7%)	1 (2,1%)	21 (43,8%)
Total	43 (89,6%)	5 (10,4%)	48 (100,0%)

Kappa = -0,110 p = 0,258

Table 5. Results of alignment analysis of lung lesion repair with sputum conversion

The data in Table 5 shows that the concordance of results was obtained in 50% of patients, where 47.9% of patients showed improvement in lung lesions and sputum conversion, while 2.1% of patients showed no improvement in lung lesions and no sputum conversion. The rest, as many as 50% of patients showed no alignment of the results of lung lesion repair and sputum conversion.

The results of Kappa coefficient analysis showed that K = -0.110 (p>0.05) indicated that there was no congruence between the results of chest x-ray examination of lung lesions before and after therapy (improved or not) with sputum conversion.

If the results of the chest x-ray examination are positive and negative, the results of the analysis of the alignment of the resolution of the lesion area with the conversion of sputum are as follows.

Lung Lesion	Sputum Conversion		Total
	Yes	No	
Negative	6 (12,5%)	0 (0,0%)	6 (12,5%)
Positive	37 (77,1%)	5 (10,4%)	42 (87,5%)
Total	43 (89,6%)	5 (10,4%)	48 (100,0%)

Kappa = 0,033 p = 0,372

Tabel 5. Hasil analisis keselarasan hasil pemeriksaan foto thoraks dengan konversi sputum

The data in Table 6 shows that concordance of results was obtained in 22.9% of patients, where 12.5% of patients showed negative lung lesions and sputum conversion, while 10.4% of patients showed positive lung lesions and no sputum conversion occurred. The rest, as many as 77.1% of patients showed no congruence between the presence of lung lesions and sputum conversion.
The results of Kappa coefficient analysis showed that K=0.033 (p>0.05) indicated that there was no harmony between the results of chest x-ray examination (positive or negative lesions) after therapy with sputum conversion.

DISCUSSION

Inconsistency between the results of chest x-ray examination of lung lesions before and after therapy (improved or not) with sputum conversion. From the Sputum BTA factor of conversion patients (89.6%), from the chest x-ray factor 47.9% of patients with resolution experienced a reduction in lesions in general indicating the healing process, as well as 2.1% of patients with fixed lesions compared to the initial 2 months of therapy, but it can be concluded (47.9% + 2.1% = 48.8%) Radiological improvement. Broadly speaking, 50% of TB patients with AFB (+) experience conversion in their sputum, this is in line with TB patients with wider initial radiological features experiencing resolution, marked by infiltrates on radiological images, the area is narrowed and shows signs of the healing process.

Meanwhile, the remaining 50% of patients who experienced conversion of their sputum were statistically inconsistent with the resolution on the chest radiograph. It is suspected that 50% of patients with pulmonary TB with smear (+) who are not in harmony with the development of the reduction in the number of infiltrates on the radiographic picture of the chest radiograph have an X factor. From the point of view of TB patients who come with sputum smear examination (+) after intensive phase therapy for 2 months it appears on examination of sputum smear (-) as many as 89.6%, it is suspected that the number of pulmonary TB patients with sputum smear examination (-) after intensive therapy is caused by several things:

1) . BTA (-) at the end of the Intensive Phase therapy, there were no TB germs found in the lungs anymore, because there was no AFB in the sputum sample, so the sputum samples did not find TB germs and smear staining results (-)

2) BTA (-) at the end of the Intensive Phase therapy, there were no TB germs found in the lungs in a dormant state, so that the sputum samples were not found to have TB germs and smear staining results (-)

3) BTA (-) at the end of the Intensive Phase therapy, TB germs were not found in the lungs, but the number of TB germs in the respiratory tract/lungs was relatively small, so that the sputum samples did not find TB germs and smear staining results (-)

4) BTA (-) at the end of the Intensive Phase therapy was evident in the lungs where TB germs were not found dormant, but the location of TB germs was far from the central airway/large channel, so that the sputum samples did not find TB germs and smear staining results (-)

Temporary conclusions from the results of Sputum Painting: reasons number 1) and 2) cannot be denied because logically there are no TB germs that are excreted through sputum, so the results of smear smear staining (-)

However, for reasons number 3) and 4) there are still things that need to be revealed, namely why AFB germs cannot come out with phlegm. Sputum sample collection is influenced by several things:

1) . The cough method for removing phlegm is good and correct in patients so that the coughed up phlegm can carry TB germs that are located far from the central airway / large channel or the number of TB germs in the respiratory tract / lungs is relatively small

2) The method of stimulating the production of good and correct phlegm in patients, so that more and more phlegm is produced, it is expected that the relatively small number of TB germs in the respiratory tract/lungs will accumulate and be carried along with the discharge of phlegm whose production is increasing.

3) The method of increasing the concentration of TB germs in the respiratory tract is less effective (ie collecting phlegm in the morning after waking up, without brushing teeth, without drinking, before bathing/ablution) is not carried out properly, so that TB germs accumulate in the respiratory tract in small numbers or there is not any

4) The method of increasing the frequency of sputum collection in one container for 24 hours as a one-time sample is not carried out properly, so the number of TB germs in the respiratory tract/lungs is relatively small. more and more

Temporary conclusions from the results of the collection of phlegm

Methods 1 to 4 should be applied to ensure that non-dormant TB germs can be expelled with sputum.

This is the reason why out of 100% of TB patients with AFB (+) found 89.6% experienced conversion.

Of the 89.6% of patients who underwent conversion, a chest X-ray was found 47.9% experienced resolution / experienced a reduction in lesions at the end of the 2-month intensive phase of therapy generally showing a healing process, as well as 2.1% of patients with persistent lesions at the end of the intensive phase 2 therapy. months generally show that TB germs in a

stagnant position (Dorman) indicate a good body defense process. Temporary conclusions (47.9% + 2.1% = 48.8%) indicate the process leads to improvement.

Several references that also investigated the alignment of AFB sputum with chest X-rays, among others, in the first literature the samples studied were 200 samples of pulmonary TB patients. There were 100 samples of patients with positive smear results and 100 samples of patients with negative smear results. In the second literature, the samples studied were 147 samples of pulmonary TB patients. The number of samples with positive smear test results were 38 samples and samples with negative smear results were 109 samples. Where in the third literature, the number of samples studied were 159 samples of pulmonary TB patients with negative smear results.

The research action carried out in the first literature was a chest X-ray examination and AFB examination, the results of the chest X-ray obtained were interpreted by two radiology doctors independently. In the second literature, only a chest X-ray was performed. The results of the chest X-ray examination were interpreted by two radiology doctors who were not aware of the results of the AFB examination in each patient. In the third literature, sputum culture was repeated and chest X-ray was repeated in all samples. The results obtained from the chest x-ray examination were interpreted by two senior radiology doctors.

CONCLUSION

The reason why the Sputum Conversion occurs faster than the resolution of radiological photos, is presumably because the detection tool for the presence of lesions in the lungs is not influenced by mechanisms in the body, but is influenced by the sensitivity of the radiology tool and the experience of the radiographer, so radiology is a very sensitive and very detailed detection tool in detecting the presence of infiltrates or other features that indicate active lung lesions. Thus, the accuracy of radiology photos can detect the presence of an active disease process, so that it can be distinguished between severe, moderate, mild, and undetected lesions. Meanwhile, the detection of germs in the patient's sputum is strongly influenced by many factors.

REFERENCES

1. Abdelaziz MM, Bakr WM, Hussien SM, Amine AE. 2016. Diagnosis of pulmonary tuberculosis using Ziehl-Neelsen stain or cold staining techniques? J Egypt Public Health Assoc. Mar;91(1):39-43. doi: 10.1097/01.EPX.0000481358.12903.af. PMID: 27110859.
2. Agarwal, Shradha & Caplivski, Daniel & Bottone, Edward. 2005. Disseminated tuberculosis presenting with finger swelling in a Patient with tuberculous osteomyelitis: A case report. Annals of clinical microbiology and antimicrobials. DOI: 10.1186/1476-0711-4-18.
3. Alzayer Z, Al Nasser Y. Primary Lung Tuberculosis. 2021. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.
4. Asmar, Shady & Drancourt, Michel. (2015). Rapid culture-based diagnosis of pulmonary tuberculosis in developed and developing countries. Frontiers in Microbiology. 6. 10.3389/fmicb.2015.01184.
5. Kementerian Kesehatan Republik Indonesia. 2017. Petunjuk Teknis Pemeriksaan TB Menggunakan Tes Cepat Molekuler. Gerakan Masyarakat Hidup Sehat.

6. Keputusan Menteri Kesehatan Republik Indonesia. 2019. Pedoman Nasional Pelayanan Kedokteran Tata Laksana Tuberkulosis.
7. Lewinsohn DM, Leonard MK, LoBue PA, Cohn DL, Daley CL, Desmond E, Keane J, Lewinsohn DA, Loeffler AM, Mazurek GH, O'Brien RJ, Pai M, Richeldi L, Salfinger M, Shinnick TM, Sterling TR, Warshauer DM, Woods GL. Official American Thoracic Society/Infectious Diseases Society of America/Centers for Disease Control and Prevention Clinical Practice Guidelines: Diagnosis of Tuberculosis in Adults and Children. Clin Infect Dis. 2017 Jan 15;64(2):111-115. doi: 10.1093/cid/ciw778. PMID: 28052967; PMCID: PMC5504475.
8. Nachiappan, Arun C.; Rahbar, Kasra; Shi, Xiao; Guy, Elizabeth S.; Mortani Barbosa, Eduardo J.; Shroff, Girish S.; Ocazionez, Daniel; Schlesinger, Alan E.; Katz, Sharyn I.; Hammer, Mark M. (2017). *Pulmonary Tuberculosis: Role of Radiology in Diagnosis and Management. RadioGraphics, 37(1), 52–72.* doi:10.1148/rg.2017160032
9. Pedoman Penatalaksanaan TB (Konsensus TB). 2021. Pedoman Diagnosis & Penatalaksanaan Tuberkulosis Di Indonesia. PDPI.
10. Shah, Maunank & Reed, Caitlin. (2014). Complications of tuberculosis. Current opinion in infectious diseases. 27. 10.1097/QCO.0000000000000090.
11. Singh, Saurabh & Tiwari, Kamlesh. (2015). Clinicoradiological Profile of Lower Lung Field Tuberculosis Cases among Young Adult and Elderly People in a Teaching Hospital of Madhya Pradesh, India. Journal of tropical medicine. 2015. 230720. 10.1155/2015/230720.
12. Suryawati B, Saptawati L, Putri AF, Aphridasari J. 2018. Sensitivitas Metode Pemeriksaan Mikroskopis Fluorokrom dan Ziehl-Neelsen untuk Deteksi Mycobacterium tuberculosis pada Sputum. Smart Medical Journal Vol. 1 No. 1. eISSN : 2621-0916.
13. Yang, N. Advanced pulmonary tuberculosis. Case study, Radiopaedia.org. DOI: 10.53347/rID-8599. Diakses 29 November 2021.