Drainage of tuberculous pneumothorax in a northern african country: Characteristics and difficulties

Drainage du pneumothorax tuberculeux dans un pays nord-africain: Caractéristiques et difficultés

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Abstract

Introduction-Aim: Tuberculous pneumothorax (TP) is a serious complication of cavitary pulmonary tuberculosis. The aim of this study was to identify TP drainage characteristics and difficulties.

Methods: This was a retrospective multicenter study of patients hospitalized for TP between 1999 and 2021 in three hospitals from Tunis (Tunisia): Abderahmen Mami, La Rabta, and Charles Nicolle. Clinical, biological, radiological, therapeutic and evolutionary data were collected.

Results: Seventy-three patients were enrolled. The mean±standard-deviation (SD) of age was 37±17 years. The sex ratio was 3.3. TP was isolated in 39 patients (53.4%) and was associated with a purulent effusion in 34 patients (46.6%). It was bilateral in three patients (4.1%). Chest drainage was indicated in 67 patients (91.7%). It was performed with a chest drain in 61 cases, with a pleuro-catheter in one case, and with a pleuro-catheter then a chest drain in five cases. The mean±SD (ranges) duration of drainage was 43±39 (3-175) days. Drainage was prolonged in 36 cases (53.7%). The duration of drainage for pyopneumothorax was significantly longer than for isolated TP (p=0.04). The mean±SD (ranges) number of drains inserted in each patient was 2.02 ±1 (1-7) drains. Spontaneous drain fall was observed in 13 patients. Drainage failure was observed in 16 patients, and was more frequent in cases of pyopneumothorax (p=0.039). Recurrence of pneumothorax was noted in nine patients (13.4%).

Conclusion: The drainage of TP is often extended and requires the use of multiple drains. It is associated with several complications. Failure of thoracic drainage is not negligible.

Key words: Drainage; Mycobacterium Tuberculosis; North Africa; Pleural Effusion; Prognosis; Tunisia

Résumé

Introduction-Objectif: Le pneumothorax tuberculeux (PT) est une complication grave de la tuberculose pulmonaire cavitaire. Le but de ce travail a été de relever les particularités et les difficultés du drainage thoracique du PT.

Méthodes: Il s'agissait d'une étude rétrospective multicentrique de patients hospitalisés pour PT entre 1999 et 2021 dans trois hôpitaux de Tunis (Tunisie): Abderahmen Mami, La Rabta et Charles Nicolle. Les données cliniques, biologiques, radiologiques, thérapeutiques et évolutives ont été colligées.

Résultats: Soixante-treize patients étaient inclus. La moyenne±écart-type (ET) de l'âge était de 37±17 ans. Le sex-ratio était de 3,3. Le PT était isolé chez 39 patients (53,4%) et associé à un épanchement purulent chez 34 patients (46,6%). Il était bilatéral chez trois patients (4,1%). Le drainage thoracique était indiqué chez 67 patients (91,7%), et il était réalisé à l'aide d'un drain thoracique dans 61 cas, d'un pleurocathéter dans un cas, et d'un pleuro-cathéter puis d'un drain thoracique dans cinq cas. La moyenne±ET (range) de la durée du drainage était de 43±39 (3-175) jours. Le drainage était prolongé dans 36 cas (53,7%). La durée du drainage du pyopneumothorax était significativement plus prolongée que celle du PT isolé (p=0,04). La moyenne±ET (range) du nombre de drains insérés chez chaque patient était de 2,02±1 (1-7) drains. La chute spontanée du drain était observée chez 13 patients. L'échec du drainage était retenu chez 16 patients, et il était plus fréquent en cas de pyopneumothorax (p=0,039). Des récidives de pneumothorax étaient notées chez neuf patients (13,4%).

Conclusion: Le drainage du PT est souvent prolongé et nécessite le recours à de multiples drains. Ce drainage est associé à plusieurs complications. L'échec du drainage thoracique n'est pas négligeable.

Mots clés: Afrique du Nord; Drainage; Epanchement Pleural; Mycobacterium Tuberculosis; Pronostic; Tunisie

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INTRODUCTION

Tuberculosis (TB) remains a significant global public health concern [1,2]. In 2019, the World Health Organization (WHO) estimated that around 10 million individuals developed TB, with 1.2 million deaths among people with human immunodeficiency virus infection [1]. Geographically, most TB cases in 2019 were reported in South-East Asia (44%), Africa (25%), and the Western Pacific (18%), with lower incidence percentages in the Eastern Mediterranean (8.2%), the Americas (2.9%), and Europe (2.5%) [1].

In Tunisia, due to the diligent implementation of the National TB Control Program and widespread use of the Bacillus Calmette-Guérin vaccine since the 1960s, the incidence of TB has steadily declined [3]. Currently, Tunisia is classified as having intermediate endemicity, with an incidence rate of 35 cases per 100,000 population in 2018 according to WHO data [4].

TB pneumothorax (TP) is a severe complication commonly associated with cavitary pulmonary TB [5-7]. It is considered a form of secondary spontaneous pneumothorax [8,9]. Chest drainage is a cornerstone in managing TB complicated by TP [10]. The primary objective of drainage is to remove pleural effusion and facilitate lung re-expansion [10]. However, numerous challenges arise during the procedure and subsequent monitoring, owing to the chronic nature of the disease, extensive pleural inflammation, and frequent occurrence of large broncho-pleural fistulas (BPF) [11].

The aim of this study was to investigate the characteristics and challenges of TP drainage in a North African country, Tunisia.

METHODS

Study Design

We conducted a multicenter retrospective study spanning from 1999 to 2021, involving patients from seven pneumology departments across three Tunisian hospitals (Abderrahmen Mami, La Rabta, and Charles Nicolle).

Patient Selection

Inclusion Criteria

This study included all patients with pneumothorax or pyopneumothorax associated with active and confirmed pulmonary or pleural TB. TB diagnosis was based on the following criteria [10]:

- Bacteriological evidence: positive acid-fast bacilli in sputum, positive cultures in analyzed samples (sputum, bronchial fluid, pleural fluid, and pleural biopsy), or molecular biology; and/or
- Histological evidence: presence of epithelioid and giganto-cellular granuloma with caseous necrosis in pleural and/or lung biopsy fragments.

TP was defined by the presence of a pneumothorax accompanied by purulent pleural effusion [10]. Purulent fluid was confirmed based on its appearance or the predominance of neutrophils in cytologic analysis of the pleural fluid.

Chronic pneumothorax was defined as the persistence of air in the pleural space after 30 days of proper thoracic drainage. The choice of the 30-day duration was based on the experience of pneumologists and surgeons in our hospital, as there is no consensus definition for chronic pneumothorax.

Drainage failure was defined as the failure of lung re-expansion despite appropriate drainage for at least 60 days. The choice of the 60-day duration was based on the experience of pneumologists and surgeons in our hospital due to the absence of a consensus definition for drainage failure in TB pneumothorax.

Pleural sequelae were defined as the presence of persistent pleural opacity resulting from pleural thickening after two years of follow-up.

Exclusion Criteria

Patients with incomplete medical records were excluded from the final analysis.

Data Collection

Patient medical records were retrieved from the medical databases of each respiratory department, using the keywords «tuberculous pneumothorax» and «tuberculous pyopneumothorax.» The following data were extracted from the patients' files while ensuring patient name confidentiality:

i) Socio-demographic characteristics (e.g., age, sex)
ii) TB risk factors (e.g., tobacco or narghile use, alcohol consumption, substance abuse, previous incarceration)
iii) Comorbidities (e.g., diabetes mellitus, cardiovascular diseases, chronic respiratory diseases, systemic diseases, hepatitis B, and immunodeficiency)
iv) Clinical presentation (e.g., fever, asthenia, weight loss, anorexia, cough, sputum, hemoptysis, chest pain, dyspnea, shock, acute respiratory failure, cachexia, pleuroparietal fistula)
v) Radiological findings (e.g., excavations, nodules, infiltrates, military opacities, hydrous level)
vi) Methods of TB confirmation (e.g., bacteriological or histological methods)
vii) Details of thoracic drainage for TP (e.g., chest drainage, number of chest tubes per patient, duration of drainage in days, extended drainage, drain removal, drainage failure)
viii) Types of drainage ix) Patient outcomes (e.g., infection, pneumothorax recurrence after drain removal, indwelling drain, sequelae).

Statistical Analysis

A descriptive analysis was performed, including means ± standard deviations (SD) (ranges) for quantitative data, and numbers (frequencies) for categorical data. A comparative analysis was conducted to compare the characteristics of isolated TP and tuberculous pyo-pneumothorax. The Student's t-test was used for quantitative variables, while the chi-square test was used for categorical variables. In cases where the chi-square test was not applicable, Fisher's exact test was used. A significance level of $p = 0.05$ was applied to all statistical tests. Data analysis was carried out using SPSS software (version 25).

RESULTS

Patient characteristics

In this study, a total of seventy-three patients were enrolled, including three with bilateral pneumothorax and eight (11%) who had multifocal TB. The mean age±SD was 37 ± 17 years, ranging from 12 to 80 years, and the male-to-female ratio was 3.3. General and respiratory symptoms dominated the clinical presentation. The mean time from symptom onset to TB confirmation was 19.7 ± 35 days, with a range of 1 to 210 days. Isolated TP was present in 39 patients (53.4%), while pyopneumothorax was observed in 34 patients (65.8%). Excavation and nodular lesions were detected in 51 patients (69.9%).

Parenchymal lesions were present in two-thirds of the lung fields in 20.8% of cases (n=10) and in all lung fields in 16.7% of cases (n=8). Clinical and radiological findings of the study population are summarized in Table 1.

Table 1. Characteristics of the study population (n=73).

	Frequency	%
Risk factors for TB		
Tobacco use	49	67.1
Narghile use	7	9.6
Alcohol consumption	22	30.1
Substance abuse	8	11
Previous incarceration	11	15.1
Comorbidities		
Diabetes mellitus	13	17.8
Cardiovascular diseases	1	1.4
Chronic respiratory diseases	2	2.7
Systemic diseases	1	1.4
Hepatitis B	3	4.1
Human immunodeficiency virus infection	3	4.1
Clinical presentation		
Fever	50	68.5
Asthenia	59	80.8
Weight loss	57	78.1
Anorexia	55	75.3
Cough	61	83.6
Sputum	51	69.9
Haemoptysis	10	13.7
Chest pain	57	78.1
Dyspnoea	50	68.5
Shock	1	1.3
Acute respiratory failure	18	24.7
Cachexia	13	17.8
Pleuroparietal fistula	3	4.1
Radiological findings		
Excavations	51	69.9
Nodules	51	69.9
Infiltrates	46	63
Miliary	3	4.1
Hydrous level	48	65.7

The confirmation of TB was based mainly on bacteriological evidence. Mycobacterium TB was isolated in all patients. Table 2 summarizes means of TB confirmation.

Table 2. Means of tuberculosis confirmation (n=73).

Bacteriological methods		Frequency	%
Positive acid fast bacillus	Sputum	57	78.0
	Bronchial fluid	5	6.8
	Pleural fluid	20	27.4
	Pleural biopsy	4	5.5
GeneXpert mycobacterium tuberculosis DNA and resistance to rifampicin	Sputum	2	2.7
	Pleural fluid	1	1.4
Culture for tuberculosis mycobacteria	Sputum	12	16.4
	Pleural fluid	7	9.6
Histological methods			
Pleural biopsy		2	2.7

Antibiotic susceptibility testing was requested in 19 patients (26%), and revealed resistance to first-line anti-TB drugs in five patients: three cases of multidrug resistance, one case of isoniazid resistance and one case of rifampicin resistance.

Chest drainage

Chest drainage was performed by pulmonologists and thoracic surgeons in 67 patients (91.8%), of whom 20 (29.8%) had poorly tolerated TP: 17 patients had TP associated with acute respiratory failure, 2 patients had compressive effusion, and one patient had both. Drainage was indicated in 92.3% of TP cases and in 91.2% of TB pyopneumothorax cases. Six cases of well-tolerated minimal TP were not drained and responded well to anti-TB therapy combined with strict bed rest.

Drainage was performed with a pleuro-catheter in two patients and with a drain in 67 patients. The mean ± SD (range) of the number of inserted drains was 2.02±1 (1-7 drains per patient).

The drainage duration's mean ± SD (range) of was 43±39 (3 - 175) days. The three-day drainage duration was for a patient who died on the third day of drainage. Chronic pneumothorax was observed in 36 patients (53.7% of all drainage cases). Chest drainage resulted in total lung re-expansion in 42 patients (62.7%). One case of nosocomial pleural infection with Pseudomonas aeruginosa (1.5%) occurred following prolonged drainage. Recurrence of pneumothorax after drain removal was observed in 9 patients (13.4%).

Two patients were discharged from the hospital with an indwelling drain. After an average follow-up of 4 years, pleural sequelae were observed in 20 patients (27.4%). Drainage failure was statistically higher in TB pyopneumothorax compared to TB pneumothorax. Particularities of thoracic drainage depending on the type of TP are summarized in Table 3.

Table 3. Particularities of thoracic drainage of TP

	All population n=73)	TB pneumothorax (n=39)	TB pyopneumothorax (n=34)	P-value
Chest drainage N(%)	67 (91.8)	36 (92.3)	31 (91.2)	0.86
Number of chest tubes per patient (mean +/-DS)	2.02±1.4	1.7±1.2	2.39±1.6	0.05
Duration of drainage (days) mean+/-DS	43 ±39	33.9±36.0	53.5±40.0	0.04
Extended drainage N(%)	36 (53.7)	17 (43.6)	19 (55.9)	0.25
Drain fall N(%)	10 (19.4)	6 (15.4)	7 (20.5)	0.99
Drainage failure N(%)	16 (23.9)	5 (12.8)	11 (32.3)	0.039

Data were mean±standard deviation, and frequency (%), for quantitative and categorical data, respectively. p-value: TB pneumothorax vs. TB pyopneumothorax.

DISCUSSION

Our study revealed that TP drainage is often an extended process (average duration = 43 days) and requires the use of multiple drains (average of 2.02 drains per patient). It is associated with several complications, including recurrence, nosocomial infection, and pleural sequelae. Drainage failure is not negligible (12.8% of cases) and was statistically higher in pyopneumothorax. Our multicenter study, which included patients from seven of the most prominent Tunisian respiratory departments, provides valuable insights into the management of severe TB forms. However, it is important to note that our study has the limitation of a retrospective design.

Managing TP is a complex endeavor that necessitates a multidisciplinary approach. Treatment strategies encompass anti-TB chemotherapy, evacuation of the pleural cavity, physical therapy to soften pleura, and improving the patient's nutritional and psychological status. Surgical intervention may become necessary if thoracic drainage fails.

While the British Thoracic Society recommends exsufflation as the primary treatment for minimal spontaneous pneumothorax

without associated pleural fluid effusion in patients under 50 years old with minimal dyspnea, TP presents different challenges [14]. Some authors advocate for systematic drainage in TP cases, emphasizing the importance of effusion nature in therapeutic decisions [15].
In our study, the frequency of thoracic drainage was comparable between patients with pyopneumothorax (91.1%) and patients with isolated TP (92.3%). When drainage was indicated, various drain types, including the Joly drain, the Monod drain, the Fuhrman drain, and the pleuro-catheter, were used [14].
The nature of the effusion plays a crucial role in therapeutic decision-making [14].It is imperative to differentiate between two distinct radio-clinical patterns: isolated TP and TB pyopneumothorax. In cases where a patient with active TB presents a mixed effusion, characterized by both liquid and gas in the pleural cavity, it strongly suggests the presence of a broncho-pleural fistula (BPF), even if the latter cannot be identified through radiological imaging [13]
In our study, the frequency of thoracic drainage was similar among patients with pyopneumothorax (91.1%) and those with isolated TP (92.3%). The options for drainage included the Joly drain, the Monod drain, the Fuhrman drain, and the pleuro-catheter [14]. The latter two, being of smaller caliber, offer the advantage of causing less discomfort and trauma, with immediate effectiveness when oriented upwards [16].
Until 2023, it is recommended to consider ultrasound or scan-guided drainage for empyema (evidence level B) [17].This approach, utilizing non-irradiating ultrasound detection, enhances the precision of drain placement and reduces drainage duration (18). In cases of minimal and encapsulated empyema, especially in patients ineligible for surgery, the use of a pleuro-catheter is recommended (evidence level C) [17].However, it is worth noting that different authors have reported the use of large-bore drains for TB empyema [19].This choice may be justified by the need to optimize the drainage of thick pleural fluid that could potentially obstruct smaller drains, as observed in our study.
In our study, the choice of large-bore drains aimed to optimize pleural fluid drainage, which can be viscous and obstruct small-bore drains.
The duration of TP drainage in our study was prolonged, averaging six weeks. This aligns with findings from other studies where the mean duration of drainage ranged from 15 to 77 days [12,13,15,20-22]. The extended drainage period in TP is significantly longer than non-TB pneumothorax, emphasizing the unique challenges of managing this form of TB [15].
In our study, prolonged drainage (> 30 days) occurred in comparable proportions for isolated pneumothorax and pyopneumothorax (43.6% vs. 55.9%; p=0.25). The longer the drainage duration, the greater the potential damage to the chest wall, suture loosening, and accidental drain falls. Nearly one fifth of our drained patients experienced drain falls.
Well-tolerated minimal TB pneumothorax can be managed clinically and radiologically without the need for drainage, as demonstrated in our study with three patients who responded well to anti-TB treatment combined with strict bed rest.
The extended thoracic drainage in TP and TB pyopneumothorax can be attributed to several factors, including the challenge of lung re-expansion, pleural thickening, septations, superinfection of the pleural cavity, and the presence of broncho-pleural fistulas (BPF). BPF is a significant factor associated with drainage failure and is often present in patients with active pulmonary TB complicated by pneumothorax [13].
To enhance the management of TP, it may be advantageous to consider the following recommendations:

i) Consider multiple and simultaneous drainage in cases of persistent air leaks, especially within the first week of treatment.
ii) Explore echo or scan-guided drainage in the presence of pleural fluid or radiological evidence of pleural partitioning for improved drainage efficiency.
iii) Optimize the patient's nutritional status to promote BPF healing, reduce chest wall damage, and prevent drain falls.

CONCLUSION

In conclusion, managing TP presents a significant challenge for healthcare professionals. Developing specific guidelines for the treatment of this severe form of TB could address the numerous therapeutic difficulties encountered and improve patient prognosis. Early TB diagnosis remains a key strategy to reduce the incidence of cavitary TB and TP.

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