ACIN
ASOCIACIÓN COLOMBIANA DE INFECTOLOGÍA

infectio

ARTÍCULO ORIGINAL

Correlation between videothoracoscopy and biopsy in patients with pleural effusion and suspected tuberculosis in a high complexity military hospital

Juan Felipe Vásquez-Rodriguez[1,6], Juan Sebastián Bravo-Ojeda[1,6,*], Luis A. Erazo[2,6], Gustavo Hincapié[3,6], Carlos Rodriguez-Sabogal[4,6], Carlos H Gómez[5,6]

Abstract

Background: In the diagnostic process of pleural tuberculosis, the findings from video-assisted thoracoscopy (VATS) can be highly suggestive for the diagnosis of infection.

Methods: We reviewed VATS records between the years 2012 to 2016 of patients over 16 years of age with pleural effusion and suspected pleural tuberculosis. Symptoms, macroscopic and chemical characteristics of the fluid, surgical descriptions and visual diagnosis of the surgeon were recorded and were compared with the histopathology.

Results: 106 patients were selected, most of them men (71.7%), of whom approximately half were active military (51.3%). The predominant symptoms were dyspnea, pleuritic pain, fever and evolution time greater than 15 days (94.3%, 80.2%, 50% and 46,2%, respectively). These symptoms, in turn, were present more frequently in pleural tuberculosis patients than in non-tuberculosis patients. The fluid was mostly turbid yellow (44%) and lymphocytic cellularity exudate (77.4%). The VATS findings in patients with confirmed TBC included nodules (96.9%), adhesions (87.5%) and thickening (78.1%). The diagnosis made by the surgeon in relation to the histopathological diagnosis showed a sensitivity of 88.6% and a specificity of 98.4%.

Conclusion: There are highly suggestive characteristics of the macroscopic report of VATS that would allow a quicker diagnosis of pleural tuberculosis.

Key Words: Tuberculosis, pleural tuberculosis, videothoracoscopy, pleural effusion.

Correlación entre videotoracoscopia y biopsia en pacientes con derrame pleural y sospecha de tuberculosis en Hospital Militar de alta complejidad

Resumen

Antecedentes: Los hallazgos de toracoscopia asistida por video (VATS) durante el diagnostico de tuberculosis pleural, que son altamente sugestivos de la infección han sido poco descritos.

Metodos: Se revisaron los registros de VATS entre los años 2012 a 2016 of de pacientes mayores de 16 años con efusión pleural y sospechosos de etiología tuberculosa. Se analizaron los síntomas, las características macroscópicas y bioquímicas del líquido, la descripción quirúrgica y el diagnostico visual y se compararon con los resultados de la histopatologia.

Resultados: Se estudiaron los registros de 106 pacientes, la mayoría fueron sexo masculino (71.7%), y aproximadamente la mitad en servicio militar activo (51.3%). Los síntomas predominantes fueron disnea, dolor pleuritico, fiebre y tiempo de evolución mayor a 15 días (94.3%, 80.2%, 50% y 46,2%, respectivamente). Estos sintomas a su vez fueron más frecuentes en tuberculosis pleural que en no tuberculosis. El liquido fue más amarillo turbio (44%) y con exudado de tipo linfocitario (77.4%). Los hallazgos de VATS en pacientes con tuberculosis confirmada incluyeron nodulos (96.9%), adhesiones (87.5%) y engrosamiento (78.1%). El diagnóstico hecho por el cirujano con relación al histopatológico, tuvo una sensibilidad de 88.6% y una especificidad de 98.4%.

Conclusion: Existen características en el VATS altamente sugestivas de tuberculosis pleural.

Key Words: Tuberculosis, tuberculosis pleural, videotoracoscopia, líquido pleural.

1 Internal Medicine Department. Hospital Militar Central, Bogotá - Colombia
2 General Surgery Department. Hospital Militar Central, Bogotá - Colombia
3 Internal Medicine and Pulmonology Department. Hospital Militar Central, Bogotá - Colombia
4 General and Thoracic Surgery Department. Hospital Militar Central, Bogotá - Colombia
5 Infectious Diseases Department. Hospital Militar Central, Bogotá - Colombia
6 Universidad Militar Nueva Granada, Bogotá – Colombia

* Autor para correspondencia.
Correo electrónico: jbravoojeda@gmail.com

Recibido: 02/08/2018; Aceptado: 24/10/2018

Cómo citar este artículo: J.F. Vásquez-Rodriguez, *et al*. Correlation between videothoracoscopy and biopsy in patients with pleural effusion and suspected tuberculosis in a high complexity military hospital. Infectio 2019; 23(3): 240-245

Introduction

Tuberculosis is a global health problem. For 2015, the estimated number of new cases in the world was 10.4 million, where 56% were men, 34% women and 10% children. Approximately 60% of cases were seen in India, Indonesia, China, Nigeria, Pakistan and South Africa, with an estimated mortality of 1.4 million[1].

In Colombia, the Public Health Surveillance System (Sistema de Vigilancia en Salud Publica, Sivigila) was notified in 2014 of 12,824 cases, of which 80.4% corresponded to pulmonary involvement and 19.6% to extrapulmonary commitment. The estimated incidence was 24.2 cases per 100,000 inhabitants[2]. During 2016, there were 13,626 reported cases, with an incidence of 27.9 cases per 100,000 inhabitants, showing a significant increase compared with previous records. Epidemiological data on the type of extrapulmonary involvement are controversial in our country. However, publications indicate that pleural tuberculosis is the second form of presentation of extrapulmonary tuberculosis, after lymph node involvement, with prevalence rates ranging from 4% to 10%. In some geographic areas of the country, pleural tuberculosis is a common cause of pleural effusion and may be the first form of extrapulmonary presentation[3].

Currently, the diagnosis of this entity is based on the study of pleural effusion in a patient who may present with all or some of the following symptoms: cough, pleuritic pain, dyspnea, weight loss, fever and diaphoresis. The cytochemical analysis of the fluid usually corresponds to a turbid yellow lymphocytic exudate, with normal to low glycemia, high protein content and the presence of adenosine deaminase (ADA) greater than 40 mg/dl[4–6]. These data, in the appropriate clinical context, allow orienting a diagnosis that is confirmed by the histopathological and/or microbiological demonstration of the bacillus or the presence of case-finding granulomas in the tissue studied[7].

In the diagnostic exercise, the search for the bacillus in pleural fluid stains is positive in less than 10% of cases, and its culture has a performance that ranges between 12% to 70%[4,7]. Therefore, some authors estimate that 15% - 25% of the effusions due to pleural tuberculosis are not diagnosed using conventional methods[8].

The histopathological study of a pleural sample, with demonstration of granulomas or the presence of acid-fast bacilli in the staining or culture of the tissue, allow for a definitive diagnosis, with the presence of granulomas found in 80% of the patients, positive staining in 25% of the samples and culture from 12% to 56%[9].

In most institutions, these histopathological studies take an average of 7 days for their official report, while the cultures take weeks, causing a delay in the diagnosis and initiation of treatment.

In our hospital, despite the low incidence of cases of pleural tuberculosis in general, there is a significant case history because within the attended population (military personnel), there are risk factors for acquiring the tuberculous infection. Special attention has been paid to the macroscopic findings described by the thoracic surgeon after performing diagnostic videothoracoscopy (VATS), with these findings used as a possible diagnostic method. To date, the use of these findings as a diagnostic method of pleural tuberculosis has not been described in the literature.

The present work performed in Central Military Hospital describes the macroscopic findings reported in patients with pleural effusion who were referred for VATS, highlighting the findings suggestive of tuberculous pleurisy to perform an experimental cross study with the results.

Methods

A systematic convenience sample was taken of the registry of interventions of the thoracic surgery group in the hospital, applying search filters according to procedures and diagnoses. Once the patients were identified, the study variables were searched in the electronic medical records. We excluded patients with known paraneoplastic pleural effusion, patients with procedures for therapeutic purposes, patients with hemopneumothorax of traumatic or postsurgical causes and patients in whom the information was not in the electronic records, which have been in use since 2012. All data extracted were included in a database for study purposes in *Excel* (Microsoft Office 2016). An audit of the data was performed, looking for erroneous, extreme and lost values, obtaining an error of less than 1%, for which reason it was considered that the quality of the data was adequate for the purposes of the study.

The following variables were included: age, gender, origin (distribution according to 5 regions of the national territory), occupation, symptoms (cough, dyspnea, fever, weight loss and pleuritic pain), findings of the pleural fluid study, macroscopic diagnosis by the thoracic surgeon and description of findings in 6 patterns: no lesions, plaque, pleural hyperemia, nodules, pleural thickening and pleural adhesions. The descriptive analysis of the data was performed as follows: quantitative variables by means or medians according to the distribution of the variable initially evaluated with the Shapiro-Wilk test, with its respective dispersion measure, standard deviation or interquartile range; the categorical variables were expressed in relative and absolute frequencies. As part of the exploratory purpose of the study, bivariate analyses were performed for the following variables: sex and presence or not of confirmed tuberculosis. These analyses were performed with Fisher's exact test for categorical variables and the Mann-Whitney test for continuous variables given the low number of patients, seeking more stringent tests for samples of this type. The results were analyzed in the *STATA 14.0* statistical package.

Results

During the study period, 106 patients with pleural effusion under study and suspected pleural tuberculosis undergoing diagnostic VATS were systematically included for the analysis. The average age of the population studied was 48 ± 23 years. Women had a higher average age than men, with this difference being statistically significant (p = 0.008). Regarding origin by regions of national territory, cases from the Andean region were more frequent, followed by the Pacific and Orinoquia regions. Regarding the occupation of the patients in the study, 49.1% of the patients were unemployed at the time of the procedure, with a greater proportion of women with respect to men in this group (76.7% *vs.* 38.2%). In the group of active military men, the majority was men (51.3%), and a smaller proportion performed different tasks. (p = 0.000). Table 1 describes the general characteristics of the population studied. Regarding the symptoms, 35.8% (38/106) of the patients presented 4 symptoms at the time of the procedure, 31.1% (22/106) 3 symptoms and 15.1% (16/106) 2 symptoms. Table 2 describes the frequency of each symptom, with dyspnea being the most frequent symptom in patients, followed by pleuritic pain and fever, with more than half of the cases.

Table 1. General characteristics

AGE (Full years)	48 ± 23
Men	34 (23 – 27)
Women	58 (43 – 70)
GENDER	
Male	76 (71.7%)
Female	30 (28,3%)
ORIGIN BY REGION	
Andean	75 (70,7%)
Pacific	14 (13,2%)
Orinoquia	11 (10,4%)
Caribbean	3 (2,8%)
Amazonia	3 (2,8%)
OCCUPATION BY GENDER (%) MEN	
Active military	51,3%
Off duty	38,2%
Other	10,5%
WOMEN	
Active military	0%
Off duty	76,7%
Others	23,3%

Table 2. Documented symptoms

	No.	%
Dyspnea	100	94.3%
Pleuritic pain	85	80.2%
Fever	53	50.0%
Cough > 15 days	49	47.6%
Cough < 15 days	54	52.4%
Weight loss	31	29.2%
NUMBER OF SYMPTOMS		
4 symptoms	38	35.8%
3 symptoms	33	31.1%
2 symptoms	16	15.1%

The macroscopic aspect of the most prevalent pleural fluid was the presence of turbid yellow fluid (44%), followed by turbid (26%), clear (21%) and hematic fluid (9%) (Figure 1).

Regarding the macroscopic findings of VATS, the most frequent finding was pleural adherence in more than 70% of patients, followed by pleural thickening, nodular pattern and pleural plaques (Figures 2 and 3).

In the diagnosis by macroscopic findings of pleural tuberculosis, the thoracic surgeon established tuberculous pleurisy in 35 patients, which was corroborated by microbiology or histopathology in 32 cases; of this group, 4 patients had positive culture and biopsy, 2 patients had positive culture only and 26 patients had positive biopsy described as granulomas with caseation necrosis related to a mycobacteria infection After the exploratory analysis, a sensitivity and specificity of 89% and 98%, respectively, were determined.

For these analysis eight patients were excluded because histopathology was either not processed or it was lost; all eight patients excluded belongs to a non-tuberculosis group. Other calculated results are described in Table 3.

A bivariate analysis was conducted, taking into account the patients with and without tuberculosis diagnoses to describe the characteristics between the groups (Table 4). Within the group of patients with pleural tuberculosis, the most relevant findings were predominance in male gender, active military, symptoms greater than 15 days of evolution and the presence of yellow liquids, with lymphocytosis in the pleural fluid. Regarding the macroscopic findings, nodularity was the most common finding (96.9%), followed by pleural adhesions (87.5%) and pleural thickening (78.1%).

Discussion

For the present work, we reviewed some clinical, paraclinical and surgical descriptions of patients with pleural effusion with suspected pleural tuberculosis that would have required the realization of diagnostic VATS.

The population studied includes not only military but also civilian personnel, family members of the military with access to health services in the Central Military Hospital. Thus, approximately half of the population of the sample is active military and half is unemployed or has other occupations. In the group that was diagnosed with pleural tuberculosis, the majority was active military men, a result that may be related to a higher risk of acquiring this disease due to crowded conditions in military quarters and while serving active duty, explaining the greater frequency in the male gender.

Regarding the symptoms, dyspnea and pleuritic pain were predominantly observed, with these two symptoms being a reflection of the involvement of the pulmonary mechanics and the pleural irritation as a result of the effusion. When eva-

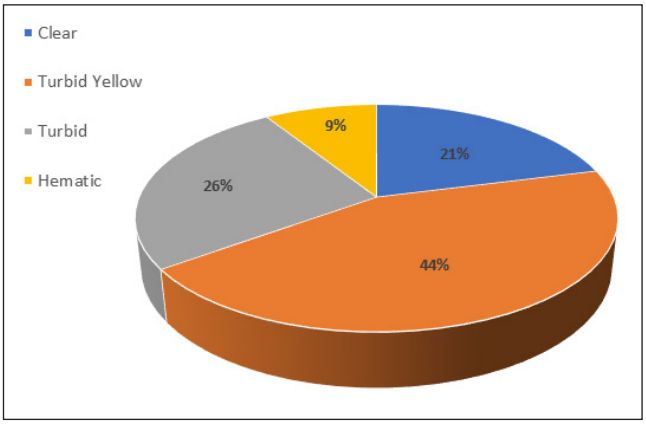

Figure 1. Macroscopic characteristics of the liquid.

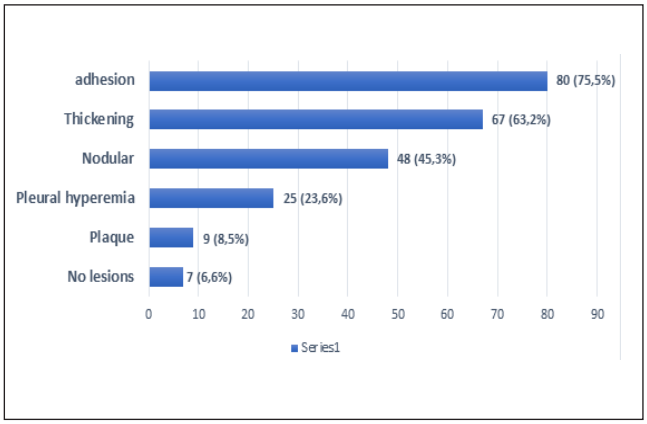

Figure 2. Lesions described in video-assisted thoracoscopy

luated by groups, there was a percentage difference between the tuberculosis group and the non-tuberculosis group with respect to the presence of pleuritic pain (96.9% *vs.* 72.2%, respectively). Fever and evolution greater than 15 days were very frequent characteristics in the group with pleural tuberculosis, according to descriptions in the literature[10].

Regarding the macroscopic and cytochemical characteristics of pleural fluid, in the total evaluated population, a greater proportion of liquids described as *"turbid yellow"* was observed, followed by *"turbid", "clear"* and *"hematic"* liquids. When the samples were divided into groups with and without tuberculosis, the presence of "cloudy yellow" liquid was the main characteristic of tuberculous effusions. This characteristic is described in studies conducted by Whang et al. (11) and Vorster et al[10].

The presence of lymphocytes in pleural fluid was a common finding in patients with pleural tuberculosis, as previously described by cytochemical analysis of tuberculous pleurisy[4,6,12], and has a basis according to the pathophysiology, where it is noteworthy that the effusion is likely the manifestation of a paucibacillary infection in the pleural space, generating a rapid inflammatory response of neutrophilic predominance (first 24 hrs), with a subsequent peak of macrophages (96 hours) and finally replacement by lymphocytes. This progression is the result of the predominant *T-Helper 1 (Th1)* response, which favors high levels of interferon gamma, activating macrophages for the destruction of phagocytized mycobacteria[10].

The description of the macroscopic findings documented by VATS was grouped into 5 types given their frequency of presentation in all of the registers according to these fundamental findings: adherence, thickening, nodules, pleural hyperemia and plaques. Of these, the presence of adhesions was the most commonly described finding and is recorded in both infectious and non-infectious processes. The second finding is the presence of thickening, equally common in patients with tuberculosis; their percentage differences do not exceed 20% (71.2% *vs.* 87.5% for adhesions and 62.1% *vs.* 78.1% for thickening).

The third finding was the presence of nodular lesions, with positive results for the majority of patients with pleural tuberculosis (96.9%) and occasionally identified in the group without tuberculosis, in which case the finding was mainly related to the presence of tumor lesions.

In the differentiation of these conditions, the thoracic surgeon describes "typical" tuberculous nodules as multiple, of *"rice grain"* appearance, whitish on the pleural and visceral

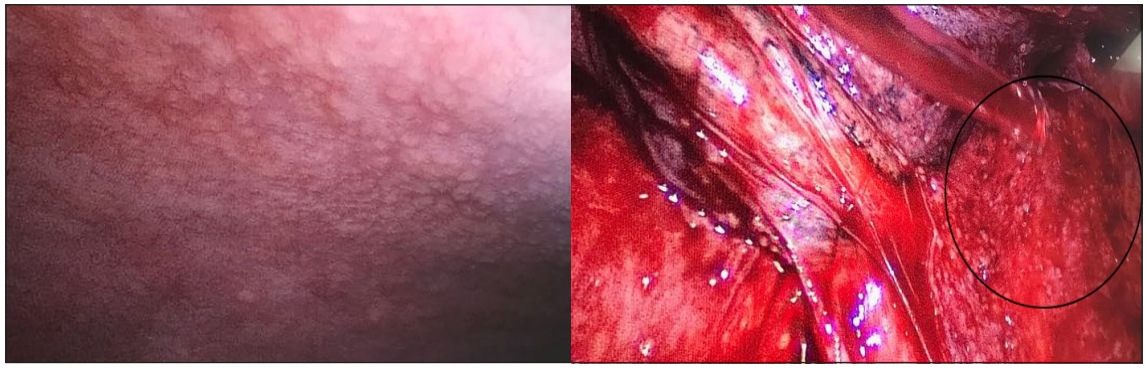

Figure 3. "Typical" pleural nodules.
Image obtained from the parietal pleura, where multiple homogenous, whitish nodular lesions with a rice appearance are observed. **B.** Whitish nodular lesions on visceral pleura, some punctate. Findings in relation to granulomas in pleural tuberculosis. Courtesy Dr. Carlos Rodriguez Sabogal.

Table 3. Sensitivity and specificity of the diagnosis of tuberculosis by video-assisted thoracoscopy (VATS).

	Surgeon n (%)		
Histological	**Yes**	**No**	**Total**
Yes	31 (88.6)	1 (1.6)	32 (32.6)
No	4 (11.4)	62 (98.4)	66 (67.4)
Total	35 (100)	63 (100)	98 (100)*

*8 patients without histological confirmation excluded

Sensitivity	Specificity	PPV	PVN	LR (+)	LR (-)
89%	98%	97%	94%	44.5	0.11

sides of the pleura and homogeneous, as shown in Figure 3. This description was registered by Wang et al. in a study conducted to evaluate the safety of biopsy guided by VATS for diagnosis. There, the nodular pattern was seen in 69.4% of patients[11].

A study published by Kumar et al., aimed at assessing the accuracy of different diagnostic methods, including thoracoscopy in pleural effusions of patients with kidney disease, found pleural tuberculosis in 6 of 26 patients (23.07%) who underwent the procedure. In turn, 5 patients had pleural nodules, indicating a sensitivity of 83% and a specificity of 100% for the diagnosis of pleural tuberculosis[13].

Regarding nodular involvement by tumor lesions, the lesions are described as large, heterogeneous formations of irregular morphology, as shown in Figure 4[14].

Confirmation of the diagnosis of pleural tuberculosis was made as indicated by the guidelines, with histopathological and/or microbiological evidence of mycobacterial infection[7,15,16]. These reports were mostly recorded as *"granulomas with caseation necrosis suggestive of mycobacterial infection"*. The positivity of direct stains and cultures was scarce, bearing in mind that the physiopathological theories of the disease include that it may be the product of either a hypersensitivity reaction in the pleural space, which does not allow the presence of the bacillus in sufficient quantities for visualization or culture, or the presence of a paucibacillary infection, as previously commented, that is rapidly neutralized by the immune system, resulting in a low probability of positivity in direct staining or culture[17,18]. This observation, in turn, is consistent with findings in previous studies where direct examination negativity is indicated in almost all pleural fluid samples, along with low positivity in cultures of pleural fluid and pleura samples (8.5% and 11.7%, respectively)[9].

Regarding the usefulness of thoracoscopy as a diagnostic method through the identification of macroscopic findings, no studies have been found that evaluate the percentage of correlation between the visual assessment of the thoracic surgeon and the histopathological diagnosis of pleural TB. Based on the recognition of bias on the type of study performed and the evaluation of the diagnostic method, an exploratory cross-sectional analysis was conducted to determine the sensitivity and specificity of the diagnosis made by the surgeon compared with the histopathological report. The calculated results were 88.6% (sensitivity) and 98.4% (specificity). The positive LR result (44.5) is striking, increasing the probability of pleural tuberculosis, if such macroscopic findings are found by VATS.

Table 4. Characteristics of patients with or without tuberculosis.

Characteristic	Without *Tuberculosis* *N = 66*	With *Tuberculosis* *N = 32*	*P value*
Average age	55.0 ± 24.3	36.1 ± 18.7	0.005
Male gender n (%)	43 (65.1)	28 (87.5)	0.0005
Origin n (%)			0.06
Amazonia	1 (1.5)	1 (3.1)	
Caribbean	2 (3.0)	1 (3.1)	
Andean	52 (78.8)	17 (53.1)	
Pacific	8 (12.1)	6 (18.7)	
Orinoquia	3 (4.5)	7 (21.9)	
Occupation n (%)			0.002
Active military	15 (22.8)	21 (65.6)	
Off duty	41 (62.1)	6 (18.8)	
Other	10 (15.1)	5 (15.6)	
Symptoms > 2 n (%)	48 (72.7)	31 (96.9)	0.002
Dyspnea, n (%)	62 (93.9)	32 (100)	0.155
Pleuritic pain, n (%)	48 (72.7)	31 (96.9)	0.005
Fever, n (%)	25 (42.4)	21 (65.6)	0.03
Cough greater 15 days, n (%)	26 (40)	21 (67.7)	0.011
Cough less than 15 days, n (%)	24 (36.6)	9 (29.0)	0.447
Weight loss, n (%)	15 (22.7)	15 (45.8)	0.015
Lymphocytes	52.8 ± 35.8	77.4 ± 25.9	
pleural fluid picture, n (%)			0.0001
Clear	16 (27.6)	1 (3.2)	
Turbid yellow	15 (25.9)	25 (80.6)	
Turbid	17 (29.3)	3 (9.7)	
Purulent	2 (3.4)	0	
Hematic	7 (12.1)	0	
Diagnosis by surgeon, n (%)			
Adherence	47 (71.2)	28 (87.5)	0.07
Thickening	41 (62.1)	25 (78.1)	
Nodular	9 (13.6)	31 (96.9)	0.0001
Pleural hyperemia	20 (30.3)	1 (3.1)	0.002

*8 patients without histological confirmation excluded

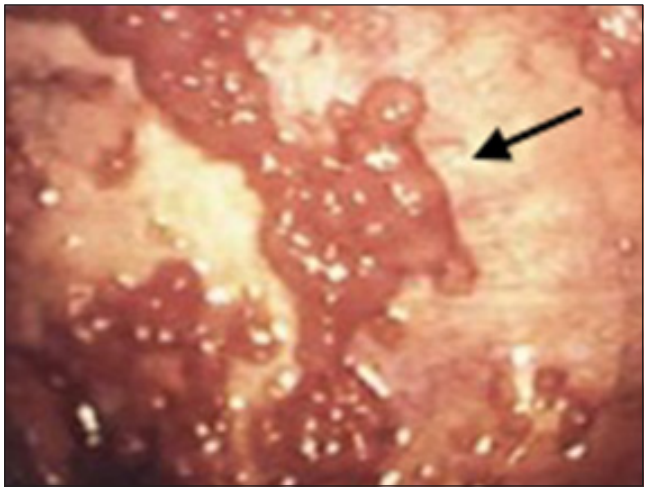

Figure 4. Pleural carcinomatosis nodule. Costal parietal pleura infiltrated by tumor-like tissue. The non-homogeneous distribution of carcinomatosis can be observed (black arrow). *Oyonarte WM. Módulo pleuroscopía Toracoscopía [Pleoroscopy Thoracoscopy module] Rev Chil enfermedades Respir.* 2008;24(1):35–9. Reference 14.

Based on all findings, it could be concluded that tuberculous effusion is likely defined in a patient with symptoms greater than 20 days (fever, dyspnea and pleuritic pain), with pleural fluid of turbid yellow and cytochemical appearance with lymphocytic exudate, with "typical" multiple nodular lesions, adhesions and pleural thickening.

The biases identified in the study correspond to the methodological design, sample size (performed for convenience), possible underreporting (quality of clinical history) and lack of molecular tests and cultures (yield is unknown).

The present study raises the need for studies that allow the construction of a predictive model of homogenous and rapid diagnosis of pleural tuberculosis, which would provide tools to the clinician for the early initiation of treatment, given the current context of our country.

Conclusion

Pleural tuberculosis constitutes a frequent form of extrapulmonary involvement, with consequences of delayed diagnosis and treatment.

In the diagnostic exercise, a process is followed that starts with a lymphocyte exudate in an adequate clinical context (sub-acute febrile syndrome, pleuritis, diaphoresis and weight loss) that requires histopathological study of pleural tissue by VATS. The macroscopic findings of this procedure describe highly suggestive patterns that can lead to a more agile, simple and reproducible diagnostic method.

Ethical disclosures

Confidentiality of data. The authors declare to have followed the reccomendations of its institution to keep the confidenciality of patient´s data.

Right to privacy and informed consent. No data that permit to identify identity of patients is published, the authors have obtained the informed consent from patients

Conflict of interest and Funding. The authors declare, have no conflicts of interest associated with this publication and there has been no financial support for this work.

Protection of human and animal subjects. The work was carried out under the supervision and approval of the Institutional Ethics Committee of the Central Military Hospital and adheres to the international guidelines for that purpose.

References

1. OMS. Informe mundial sobre la tuberculosis 2016 [Internet]. Organización Mundial de la Salud. 2016. p. 1–5. Available from: http://www.who.int/tb/publications/global_report/gtbr2016_executive_summary_es.pdf?ua=1
2. INS. Protocolo De Vigilancia En Salud Publica Tuberculosis. Inst Nac Salud [Internet]. 2016;42. Available from: http://www.ins.gov.co:81/lineas-de-accion/Subdireccion-Vigilancia/sivigila/Protocolos SIVIGILA/PRO Tuberculosis.pdf
3. Porcel JM. Tuberculous pleural effusion. Lung. 2009;187(5):263–70.
4. Jeon D. Tuberculous pleurisy: An update. Tuberc Respir Dis (Seoul). 2014;76(4):153–9.
5. Light RW. Update on tuberculous pleural effusion. Respirology. 2010;15(3):451–8.
6. Porcel-Pérez JM, Vives Soto M, Esquerda Serrano A, Jover Sáenz A. Puntos de corte de los parámetros bioquímicos del líquido pleural: Su utilidad en el diagnóstico diferencial de 1.040 pacientes con derrame pleural. An Med Interna [Internet]. 2004;21(3):113–7. Available from: http://www.scopus.com/inward/record.url?eid=2-s2.0-1942423640&partnerID=tZOtx3y1
7. Gopi A, Madhavan SM, Sharma SK, Sahn SA. Diagnosis and Treatment of Tuberculous Pleural Effusion in 2006. Chest [Internet]. 2007; 131(3):880–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17356108
8. Cozma G, Tudorache V, Burlacu O, Tunea C, Voiculescu V, Vancea D, et al. [Our experience in the thoracoscopic surgery of the tuberculous pleural effusions]. Pneumologia [Internet];56(2):73–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18019751
9. Valdés L, Alvarez D, San José E, Penela P, Valle JM, García-Pazos JM, et al. Tuberculous pleurisy: a study of 254 patients. Arch Intern Med [Internet]. 1998;158(18):2017–21. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9778201
10. Vorster MJ, Allwood BW, Diacon AH, Koegelenberg CFN. Tuberculous pleural effusions: Advances and controversies. J Thorac Dis. 2015;7(6):981–91.
11. Wang Z, Xu LL, Wu YB, Wang XJ, Yang Y, Zhang J, et al. Diagnostic value and safety of medical thoracoscopy in tuberculous pleural effusion. Respir Med. 2015;109(9):1188–92.
12. Ruan S-Y, Chuang Y-C, Wang J-Y, Lin J-W, Chien J-Y, Huang C-T, et al. Revisiting tuberculous pleurisy: pleural fluid characteristics and diagnostic yield of mycobacterial culture in an endemic area. Thorax [Internet]. 2012;67(9):822–7. Available from: http://thorax.bmj.com/lookup/doi/10.1136/thoraxjnl-2011-201363
13. Kumar S, Agarwal R, Bal A, Sharma K, Singh N, Aggarwal AN, et al. Utility of adenosine deaminase (ADA), PCR & thoracoscopy in differentiating tuberculous & non-tuberculous pleural effusion complicating chronic kidney disease. Indian J Med Res [Internet]. 2015;141(3):308–14. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25963491
14. Ferreiro L, San José E, Valdés L. Derrame pleural tuberculoso. Arch Bronconeumol. 2014;50(10):435–43.
15. Diacon AH, Van de Wal BW, Wyser C, Smedema JP, Bezuidenhout J, Bolliger CT, et al. Diagnostic tools in tuberculous pleurisy: A direct comparative study. Eur Respir J. 2003;22(4):589–91.
16. Seibert AF, Haynes J, Middleton R, Bass JB. Tuberculous pleural effusion. Twenty-year experience. Chest [Internet]. 1991; 99(4):883–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1901261
17. Leibowitz S, Kennedy L, Lessof MH. The tuberculin reaction in the pleural cavity and its suppression by antilymphocyte serum. Br J Exp Pathol [Internet]. 1973;54(2):152–62. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4700698