Infectiousness of pleural tuberculosis without radiological evidence for parenchymal involvement

Radyolojik olarak parankim tutulumu olmayan plevral tüberkülozun bulaştırıcılığı

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Background: Pleural tuberculosis is not always associated with radiologically evident parenchymal disease (PD) and, in clinical practice, patients without radiological evidence for PD are usually deemed noninfectious.

Methods: The study included 77 patients (3 females, 74 males; mean age 23±6 years; range 18 to 52 years) with a definite diagnosis of pleural tuberculosis. Patients with a positive sputum smear or gastric lavage smear for acid-fast bacilli and/or positive sputum culture or gastric lavage culture for *M. tuberculosis* were considered possibly infectious.

Results: When sputum and gastric lavage results were taken together, smear positivity was found in six (7.8%) and culture positivity was found in 21 cases (27.3%). Overall, 21 patients (27.3%) had bacillus-positive pulmonary tuberculosis. Chest X-ray revealed PD in 29 patients (37.7%). High-resolution computed tomography (HRCT) was performed in 55 patients and PD was found in 48 patients (87.3%). Of the patients with PD on chest radiograms, five (17.2%) had positive smears and 13 (44.8%) had positive cultures of sputum or gastric lavage. Of 48 patients without PD on chest radiograms, one (2.1%) had smear positivity and eight (16.7%) had culture positivity. Sputum or gastric lavage samples showed one smear positivity (2.1%) and 12 culture positivity (25%) among 48 patients who were found to have PD by HRCT. Of seven cases in which HRCT did not show PD, two (28.5%) had positive cultures and none had positive smears. Although HRCT was more sensitive to detect PD, infectiousness rate was significantly higher in patients who had PD on chest radiograms (p=0.007).

Conclusion: We suggest that pleural tuberculosis cases may be infectious despite lack of radiological evidence for parenchymal involvement.

Key words: Bronchoalveolar lavage fluid/microbiology; pleura/microbiology; sputum/microbiology; tomography, x-ray computed; tuberculosis, pleural/diagnosis/radiography.

Amaç: Plevral tüberküloza her zaman radyolojik olarak belirgin parankim hastalığı (PH) eşlik etmemekte ve klinik pratikte, radyolojik olarak PH belirtisi olmayan hastalar genellikle bulaştırıcı olarak değerlendirilmemektedir.

Çalışma planı: Çalışmaya plevral tüberküloz tanısı kanıtlanmış 77 hasta (3 kadın, 74 erkek; ort. yaş 23±6; dağılım 18-52) alındı. Balgam yayması (BY) veya mide lavajı yayması (MLY) ile asit-alkole dirençli basil yönünden pozitif bulunan ve/veya balgam kültürü (BK) veya mide lavajı kültüründe M. tuberculosis saptanan hastalar muhtemel bulaştırıcı kabul edildi.

Bulgular: Balgam veya gastrik lavaj sonuçları bir arada değerlendirildiğinde, altı hastada (%7.8) yayma, 21 hastada (%27.3) kültürde pozitifliğe rastlandı. Toplamda 27 hastada (%27.3) basil-pozitif pulmoner tüberküloz saptandı. Göğüs radyografisinde 29 hastada (%37.7) PH izlendi. Elli beş hastada yüksek çözünürlüklü bilgisayarlı tomografi (BT) çekildi ve 48 hastada (%87.3) PH saptandı. Göğüs radyografisinde PH saptanan hastaların beşinde (%17.2) yayma, 13'ünde (%44.8) kültür pozitifliği bulundu. Radyografide PH saptanmayan 48 hastanın balgam veya mide lavajı örneklerinde ise; birinde (%2.1) yayma, sekizinde (%16.7) kültür pozitifliği bulundu. Yüksek çözünürlüklü BT ile PH saptanan 48 olguda, bir hastada (%2.1) yayma, 12 hastada (%25) kültür pozitif bulundu; PH saptanmayan yedi hastanın ikisinin (%28.5) kültürleri pozitif bulunurken, yayma örnekleri tüm hastalarda negatif idi. Parankim hastalığının belirlenmesinde yüksek çözünürlüklü BT daha duyarlı olmakla birlikte, bulaştırıcılık oranı göğüs radyografisinde PH saptanan grupta anlamlı derecede daha yüksekti (p=0.007).

Sonuç: Plevral tüberkülozlu hastalarda radyolojik olarak parankimal tutulum saptanmasa bile bulaştırıcılık olabileceği sonucuna varıldı.

Anahtar sözcükler: Bronkoalveoler lavaj sıvısı/mikrobiyoloji; plevra/mikrobiyoloji; balgam/mikrobiyoloji; bilgisayarlı tomografi; tüberküloz, plevral/tanı/radyografi.

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Tuberculosis (TB) is a disease, which has social and economical burdens. Despite being a treatable disease, it is still a major health problem in the world as the seventh cause of death, which is estimated to keep the same position in the coming 15 years.[1] One third of the world's population is infected with *Mycobacterium tuberculosis (M. tuberculosis)*, of which 3-5% develops the disease each year.[2] In the 2005 Global Tuberculosis Control Report of the World Health Organization (WHO), it was reported that, in the year 2003, there were 8.8 million recorded new tuberculosis patients, of whom 3.9 million were sputum smear positive. Each year 8-10 million new cases are being diagnosed with active disease and more than two million patients die from tuberculosis.[2]

The most frequent causes of pleural effusion are tuberculosis and malignancy.[3,4] Pleural involvement is the most common form of extrapulmonary tuberculosis.[5] Histopathological examination of specimens obtained by closed pleural biopsy yields diagnosis in 50-80% of the cases and microorganism could be detected in 33-80% of them.[3,6-8] Pleural fluid staining for acid-fast bacilli (AFB) and culture of *M. tuberculosis* are reported to have a poor yield, and sputum or bronchial sampling via bronchoscopy can diagnose only a minority of cases with pleural tuberculosis.[9] With both histological and microbiological studies of pleura, diagnostic yields as high as 86% have been reported.[10] Pleural TB may occur in the presence or absence of pulmonary parenchymal disease on the chest radiograph and when there is no apparent parenchymal lesion the patients are usually deemed not infectious. However, patients with tuberculous pleural effusion (TPE) almost invariably have a small subpleural nidus of tuberculosis showing granulomatous inflammation and signs of leakage into the pleural space.[11] Hence, the presence of *M. tuberculosis* in the respiratory specimen of patients with a pleural effusion may be diagnostic of pleural TB and also suggests a possibility of transmission of the microorganism to others, which is quite rare in other forms of extrapulmonary tuberculosis. Anyway, smear-negative pulmonary TB cases may account for as much as 17% of *M. tuberculosis* transmission.[12]

Involvement of lung parenchyma has been investigated by many studies via high-resolution computed tomography (HRCT) or plain chest radiography in pleural TB. In this study, we aimed to determine the utility of HRCT in demonstrating parenchymal disease as a possible source of infection, especially in case of a normal plain chest radiograph, and sought relations between radiological findings and infectiousness, defined by the presence of AFB/ *M. tuberculosis* in the sputum or gastric lavage in patients with pleural TB.

PATIENTS AND METHODS

This study was carried out prospectively in GATA Haydarpaşa Training Hospital between June 2003 and December 2004. Seventy-seven non-AIDS patients who were admitted to the hospital with clinical and radiographic findings suspicious of, and with a final diagnosis of, pleural TB were enrolled in the study. There were three (3.9%) females and 74 (96.1%) males, with a mean age of 23±6 years (range 18 to 52 years). Patients with a systemic disease other than TB were excluded.

Each patient underwent a thorough physical examination and a detailed history taking, including contact with a TB patient and previous TB infection. A biochemical profile was obtained by automated analysis (R-A 1000, RA-XT autoanalyser, Technicon, Tarrytown, Newyork, USA). A Coulter MD II device (Coulter MD II Series Analyzer, Coulter Corporation, Miami, FL, USA) was used for whole blood count. Tuberculin skin test (TST) by intracutaneous injection of 0.1 ml of 5 tuberculin units of PPD was performed in each patient once and the size of induration was measured after the 48th hour but no later than 72 hours. A tuberculin reaction of ≥10 mm of induration was classified as positive.

Parenchymal involvement (infiltration, cavitation, nodule, fibrotic sequelae, and parenchymal bands were considered TB-related lesions), the affected side (right, left or both), and the extent of pleural fluid were evaluated with posteroanterior plain chest radiographs. Most of the cases (55 patients) were also evaluated with thoracic HRCT. The pleural effusion was considered an exudate according to the criteria described by Light et al.[13] Thoracentesis, as much as possible but not more than 1500 ml at a time, and pleural tissue sampling were performed before radiological evaluation in order to obtain specimens for histological, biochemical, and microbiological examinations and to improve the visibility of parenchyma. We did not insist further when flow was not freely coming. A sample of pleural fluid was drawn and 3-5 pieces of pleural biopsy were taken from each subject under local anesthesia by means of an Abrams needle. Five milliliters of sample fluid was sent for bacteriological, biochemical, and cytological testing. Pleural biopsy specimens were also sent for bacteriological and histopathological examination. For microbiological examination, pleural biopsy specimens were grounded in sterile 0.9% saline and then inoculated concurrently in Lowenstein-Jensen and BACTEC 12B media. Pleural fluid samples were digested and decontaminated by the N-acetyl-L-cysteine-sodium hydroxide method, then concentrated by centrifugation at 3,000 g for 15 minutes.

Three samples of sputum or fasting gastric lavage, when sputum could not be obtained, were taken for smear examination for AFB and microbiological culture

for *M. tuberculosis*. Sampling of gastric lavage was performed via a Levin-type 14 Fr or nasogastric catheter in the morning, after a fasting night, before getting up, and sent to laboratory immediately. Sputum and gastric lavage samples were concentrated in the same way as described above and sediments were inoculated on Lowenstein-Jensen and BACTEC 12B. The inoculated media were incubated at 37 °C up to six weeks for BACTEC 12B and eight weeks for Lowenstein-Jensen. The latter was incubated for an additional four weeks if a smear of inoculated material was positive and the culture was negative at eight weeks. Culture results in BACTEC 12B medium were evaluated with appropriate equipment (BACTEC 460, Becton-Dickinson, Sparks, Maryland, USA). Smears of sputum, gastric lavage, pleural biopsy, and pleural fluid were stained with the Ziehl-Neelsen and evaluated microscopically.

The diagnosis of pleural TB was established when examination of pleural fluid or pleural biopsy samples revealed the presence of *M. tuberculosis* by culture or when pleural biopsy specimens yielded granulomatous inflammation with caseous necrosis on histology. In this particular group of patients with the definite diagnosis of pleural TB, bacillus-positive pulmonary TB was defined as the observation of AFB in the smear of sputum or gastric lavage specimens or microbiological culture positivity for *M. tuberculosis* in these specimens.

High-resolution computed tomography was performed after tapping, by spiral computed tomography (Siemens Plus 4-Power Spiral CT, Forgenheim, Germany) with a collimation of 1 mm. The window level was set to -450 Hounsfield units (HU) with a window width of 1500 HU. Patients were in the supine position and at the end of quiet inspiration during the procedure. Lesions visible with HRCT were described as lymphadenopathy, consolidation, fibrotic changes, pulmonary nodule, parenchymal band, linear atelectasis, and cavity. We ignored passive atelectasis due to compression by pleural fluid as a parenchymal abnormality. The same radiologist performed radiological evaluation in all cases.

Statistical analysis. The chi-square (Fischer's exact test as needed) test was used to show the relations of plain chest radiography and HRCT findings with bacillus positivity. Agreement between plain chest radiography and HRCT in showing parenchymal lesions was evaluated by the Cohen's kappa coefficient. Spearman's correlation analysis was used to assess the relationship between the type of lesion in HRCT and the number of lesion types with bacillus positivity. We took $p<0.05$ as the level of significance.

RESULTS

Of 77 patients, 61 (79.2%) had granulomatous inflammation with caseous necrosis on histology, 32 (41.6%) had positive culture of pleural biopsy sample, and 19 (24.7%) had positive culture of pleural fluid sample for *M. tuberculosis*. In 15 cases (19.5%), both pleural fluid and/or tissue culture and histological examination were diagnostic for pleural TB. Smear of pleural fluid, which was not considered a criterion for definite diagnosis, revealed AFB in three patients (3.9%).

Three samples of sputum were obtained from each of 59 patients and gastric lavage samples were taken from 18 patients who could not give adequate sputum sample. Sputum smear was positive in five (8.4%) and sputum

Table 1. Biochemical results of pleural fluid and some other relevant findings

	All patients	Infectious patients	Non-infectious patients	*p**
Pleural adenosine deaminase (U/L)	67.5±20.0	64.8±20.8	68.16	NS
Serum adenosine deaminase (U/L)	42.4±21.1	42.4±8.6	43.0±24.7	NS
Pleural glucose (mg/dL)	77.6±31.7	71.9±34.1	78.5±31.6	NS
Serum glucose (mg/dL)	93.2±13.8	91.9±9.7	93.0±12.8	NS
Pleural protein (g/dL)	5.9±1.7	5.9±1.4	6.0±1.8	NS
Serum protein (g/dL)	7.4±0.8	7.2±0.6	7.4±0.8	NS
Pleural albumin (g/dL)	3.15±1.32	3.3±1.4	3.2±1.2	NS
Serum albumin (g/dL)	3.91±0.54	3.8±0.4	3.9±0.6	NS
Pleural lactate dehydrogenase (U/L)	1263.1±1210.8	1221.9±1199.7	1324.0±1302.2	NS
Serum lactate dehydrogenase (U/L)	469.8±168.6	389.0±72.6	456.0±142.1	NS
Erythrocyte sedimentation rate (mm/hr)	63.6±31.4	67.7±33.5	62.4±31.9	NS
White blood cell count (/mL)	6807.8±1439.8	6673.3±1483.0	6869.1±1430.5	NS
Thrombocyte (/mL)	333.3±106.7	370.7±129.6	320.8±98.4	0.079
Hemoglobin (g/dL)	13.1±2.0	12.3±1.4	13.3±2.2	0.041
Hematocrite (%)	38.4±4.2	36.4±4.5	38.9±4.2	0.062
Tuberculine skin test (mm)	10.8±7.4	8.2±7.2	11.9±7.2	0.055

*: Infectious patients compared to non-infectious patients; NS: Non significant.

culture was positive in 15 patients (25.4%). Smears were found to be positive for AFB in the gastric lavage in one (5.5%) and culture for *M. tuberculosis* was positive in six patients (33.3%). When sputum and gastric lavage results were taken together, smear was positive in six (7.8%) and culture was positive in 21 cases (27.3%). In other words, 21 patients (27.3%) had bacillus-positive pulmonary TB.

Biochemical examination results of the pleural fluid and some other clinically relevant findings are shown in Table 1. Blood hemoglobin levels were significantly (p=0.041) and hematocrit levels were almost significantly (p=0.06) lower in patients who had bacillus positive, so called infectious, pulmonary TB. In the infectious group, thrombocyte counts tended to be higher than the noninfectious group. The mean TST reaction was also lower in the infectious group, which was close to significance (Table 1). Tuberculin skin test was negative in 27 patients (35.1%) and, of them, 12 were infectious and 15 were noninfectious. The proportion of TST-negative cases was higher in the infectious group (57.1% *vs* 26.8%, p=0.042). Previous contact history with a TB patient was reported in 12 patients (15.6%) and three patients (3.9%) had a previous diagnosis of TB. The frequency of bacillus-positive pulmonary TB was higher in patients who had a previous contact with a TB patient (7/12 *vs* 14/65, p=0.014). There was no relation between bacillus-positive pulmonary TB and previous TB history.

Pleural effusion involved the right side in 39 (50.6%), left side in 36 (46.7%), and both sides in two cases (2.6%). On plain chest radiograms, lung parenchymal lesion was present in 29 patients (37.7%), and absent in 48 cases (62.3%). In patients with parenchymal involvement, the lesion was on the same side with pleurisy in 23 cases (79.3%), bilateral in two cases (6.9%), and on the contralateral side in four cases (13.8%).

High-resolution computed tomography performed in 55 patients (71.4%) showed parenchymal lesions in 48 patients (87.3%). Findings of HRCT are shown in Table 2. The most frequent HRCT findings were consolidation, parenchymal band, and nodule, respectively. Nodules were located in the subpleural region in five cases (9.1%). There were also six (10.9%) centrilobular lesions and three (5.5%) solitary pulmonary nodules.

Of 29 patients who were found to have a parenchymal lesion by plain radiography, HRCT could be performed in 19 patients and all were shown to have parenchymal lesions with HRCT. Of 48 patients in whom plain radiography did not show parenchymal involvement, 36 patients underwent HRCT examination, which revealed parenchymal lesions in 29 patients (80.6%). In other words, of 48 patients with abnormal HRCT findings, 29 patients (60.6%) had a normal plain radiogram, and both plain radiography and HRCT were normal in seven

Table 2. High-resolution computed tomography findings in 55 patients

	n	%
Nodule	14	25.5
Atelectasis	7	12.7
Consolidation	31	56.4
Fibrotic changes	9	16.4
Lymphadenopathy	12	21.8
Bronchiectasis	2	3.6
Parenchymal band	18	32.7
Cavity	1	1.8

patients. There was a weak agreement between HRCT and plain chest radiography (κ=0.143, p=0.040).

Of 29 patients (37.7%) with an abnormal chest X-ray, five (17.2%) had positive smears and 13 (44.8%) had positive cultures of sputum or gastric lavage. Of 48 patients (62.3%) with a normal chest X-ray, one (2.1%) had smear positivity and eight (16.7%) had culture positivity in either sputum or gastric lavage. Of 48 patients with abnormal HRCT findings, one (2.1%) had a positive smear, 12 (25%) had positive cultures in either sputum or gastric lavage. Of seven patients with normal HRCT, two patients (28.5%) had positive cultures, but all smears were negative. The frequency of bacillus-positive pulmonary TB was higher in patients with an abnormal chest X-ray than in those with normal radiography (p=0.007), but we could not find a significantly higher rate of infectiousness in patients with an abnormal HRCT.

High-resolution computed tomography findings in bacillus-positive pulmonary TB cases were as follows: nodules (n=4; 28.6%), linear atelectasis (n=2; 14.3%), consolidation (n=9; 64.3%), fibrotic changes (n=2), hilar/mediastinal lymphadenopathy (n=3; 21.4%), bronchiectasia (n=2), and parenchymal band (n=6; 42.9%). In 34 patients who had parenchymal lesions with HRCT but found to have negative sputum/gastric lavage smears and cultures, the lesions included nodules (n=10; 27%), linear atelectasis (n=5; 13.5%), consolidation (n=20; 54.1%), fibrotic changes (n=6; 16.2%), hilar/mediastinal lymphadenopathy (n=9; 24.3%), and parenchymal band formation (n=11; 29.7%).

The type of the lesion was not related to bacillus positivity. There was a weak and insignificant relationship between the number of various types of HRCT-detected lesions and bacillus positivity (r=0.259, p=0.056). Smear/culture results of patients with or without lesions detected by plain chest X-ray and HRCT are given in Table 3 and 4.

DISCUSSION

Pleural TB constitutes 10% of all tuberculosis cases. If not diagnosed timely and treated adequately, tuberculous pleurisy is followed by an active pulmonary TB within

Table 3. Bacteriological findings of patients with or without chest X-ray abnormality

	With lesion (n=29)		No lesion (n=48)		
Sputum+gastric lavage	n	%	n	%	*p*
Smear positive	1	17.2	1	2.1	0.016
Culture positive	13	44.8	8	16.7	0.007
Total	13	44.8	8	16.7	0.007

Table 4. Bacteriological findings of patients with or without abnormality in high-resolution computed tomography

	With lesion (n=48)		No lesion (n=7)		
Sputum+gastric lavage	n	%	n	%	*p*
Smear positive	1	2.1	0	0	>0.05
Culture positive	12	25	2	28.5	>0.05
Total	12	25*	2	28.5	>0.05

five years in the 30-50% of the cases.[3] The diagnosis of pleural TB is established when *M. tuberculosis* is demonstrated in pleural fluid or pleural biopsy samples or when pleural biopsy specimens yield granulomatous inflammation with caseous necrosis on histology.[7,14-16] For the diagnosis of tuberculous pleurisy, sensitivity rates of pleural fluid culture, closed needle pleural biopsy, and needle pleural biopsy culture are 10-35%, 56-82%, and 39-65%, respectively.[10,17,18] Histological and microbiological examinations together bring the sensitivity up to 86%.[10] Our results were in accordance with previous reports.

Plain chest X-ray is a useful tool in the evaluation of parenchymal lesions in TB patients. Pleural effusion is associated with pulmonary lesions detected by chest X-ray in 17-38% of the pleural TB cases, but some 25% of the parenchymal lesions cannot be adequately evaluated with this method.[9,17,19,20] High-resolution computed tomography has allowed visualization of lung parenchyma with greater detail than conventional computed tomography and plain radiography. In our study, HRCT detected lung parenchymal lesions in the majority of cases (87.3%), but chest X-ray missed many patients (37.7%) with lesions. We found that bacillus positivity rate in the sputum/gastric lavage was significantly higher (p=0.007) in patients with lesions in the chest X-ray (n=29) than patients with a normal radiograph, but we could not show this relationship for lesions detected by HRCT. Whether the ability of HRCT to detect less disseminated, less productive and/or clinically unimportant lesions is responsible for this discrepancy deserves further investigation.

Sputum smear is positive in 50% and culture is positive in 70% of active pulmonary TB patients.[21] Detection of *M. tuberculosis* in the sputum smears and cultures of patients with pleural TB varies widely (0-60%).[4,7,22-26] Valdes et al.[9] studied 254 pleural TB cases and found that 48 patients (18.9%) had pulmonary lesions associated with pleurisy, of which, 30 cases (62.5%) were smear positive and 48 cases (100%) were culture positive for *M. tuberculosis*. Apparently, selection of patients with radiological evidence for parenchymal involvement for sputum examination was responsible for these high rates. Ferrer[7] stated that sputum culture was positive in 4% of the cases with pleural effusion without pulmonary TB. Conde et al.[22] reported that, in patients with pleural TB, sputum cultures yielded a positive result in 55% of the cases, higher than our results, even if there was no radiographic evidence for pulmonary parenchymal disease. However, their study differed from ours in that they examined induced sputum, they did not look at the yield of gastric lavage and did not perform HRCT examination. Besides, 13 of the 84 patients in their study were HIV seropositive, which might have affected local and systemic response to the disease. In that study, induced sputum revealed a positive culture for *M. tuberculosis* in HIV-positive patients more frequently than non-HIV patients (77% *vs* 48%). In fact, it has been reported that tuberculous pleurisy is more common in AIDS patients than in non-AIDS patients with tuberculosis[25] and *M. tuberculosis* is more frequently isolated from sputum cultures of AIDS patients with tuberculous pleurisy.[27] Berger and Mejia[17] reported that 30% of patients with pleural TB had *M. tuberculosis* isolated from sputum culture or gastric contents, 10 out of 40 patients had parenchymal lesions (25%), and only 9% of the patients with no evidence for parenchymal lesions on the chest radiography had a positive sputum or gastric aspirate culture. Antoniskis et al.[23] studied 59 tuberculous pleurisy patients with a definite diagnosis and reported that all of the sputum smears were negative and 23% of the sputum cultures were positive in those without parenchymal infiltrates. This wide range of differences in the results of the studies may arise from factors such as variations in the number of cases, the methods used for diagnosis, and comorbid conditions.

The presence of *M. tuberculosis* in pulmonary specimens in the setting of an otherwise normal chest radiograph can be explained by the presence of subpleural foci of the disease. These lesions have been documented in histological studies and through computed tomography.[11,28] Positivity of sputum AFB smear and mycobacterial culture positivity have the potential risk for *M. tuberculosis* transmission to contacts. Unlike other forms of extrapulmonary tuberculosis, pleural TB can result in transmission to others. Behr et al.[12] studied 1574 sputum smear-negative and culture-positive patients and found that smear-negative cases might account for

17% of *M. tuberculosis* transmission. Moreover, we demonstrated that these patients could be infectious despite lack of radiological evidence, even with HRCT, for pulmonary involvement. We suggest that pleural TB be handled like smear-negative pulmonary TB and, probably, reclassified in a combined pleuropulmonary TB category, as in the United Kingdom, instead of extrapulmonary TB. However, the limited number of our cases with normal HRCT makes it difficult to draw firm conclusions.

Pulmonary TB is mainly transmitted to others by way of respiratory system. We asked whether our patients had a previous contact with a TB patient and found a contact rate of 15.6%. Conde et al.[22] reported a contact rate of 40%. This high rate may be related to the high proportion of HIV-positive patients in their group. The relation between bacillus positivity in the sputum/gastric lavage and previous contact with TB patient(s) has not been well-defined. We found that the rate of bacillus positivity in the sputum/gastric lavage was significantly higher in patients with a contact history compared with the rest of the patients (58.3% vs 21.5%, p=0.014).

We previously reported that, in patients with active pulmonary TB, there was a hypercoagulable state associated with thrombocytosis and decreased hemoglobin levels, which improved after anti-TB treatment.[29] In the current study, blood hemoglobin levels were significantly (p=0.041) and hematocrit levels were almost significantly (p=0.06) lower in patients with infectious disease and thrombocyte counts tended to be higher. Whether infectiousness is related to a worse hematological state needs to be clarified.

There are conflicting results on the relation of the size of TST reaction to the radiological extensiveness of pulmonary TB. Antoniskis et al.[23] and Teklu and al-Wabel[30] independently suggested that extensive pulmonary involvement was associated with increased rate of negative TST reactions, while some others claimad that the size of tuberculin reaction did not matter.[31] However, there is no doubt that intact cellular immunity is crucial to give an appropriate response and wall-off mycobacterial infection and invasion. Supporting this idea, AFB is more frequently isolated from sputum cultures of AIDS patients with tuberculous pleurisy than non-AIDS cases.[27] We could not show any relationship between TST reaction size and radiological findings, but the mean TST reaction was almost significantly lower in the infectious group (Table 1) and the rate of TST-negative cases was significantly higher in the infectious group (57.1% *vs* 26.8%, p=0.042), which might have clinical implications.

We conclude that sputum and gastric lavage examinations may significantly contribute to the diagnosis of PTB even in patients without apparent parenchymal involvement and the infectiousness of PTB cases should not be underestimated. However, the number of our patients with normal parenchyma on HRCT scanning was very low, preventing us from making stronger comments. In the current study, plain chest radiography seemed to be more useful in detecting possibly infectious cases compared with HRCT, but given that we could not perform HRCT in all the patients, this point needs to be better defined.

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