International Research Journal of Public and Environmental Health Vol.3 (2),pp. 20-27, February 2016
Available online at http://www.journalissues.org/IRJPEH/
http://dx.doi.org/10.15739/irjpeh.16.004

ISSN 2360-8803

Original Research Article

Risk factors analysis for bacteria discharge of pulmonary tuberculosis

Received 8 January, 2016 Revised 26 January, 2016 Accepted 30 January, 2016 Published 12 February, 2016

Jiangnan Zhao[1], Xiaoqi Zhang[2], Wenge Xin[2], Wenyu Liu[2], Dezhi Sun[2] and Guoru Yang*[3]

[1]Department of Respiratory Medicine, The First Hospital of Jiaxing, Jiaxing, China.
[2]Department of Tuberculosis Medicine, Second People's Hospital of Weifang, Weifang, China.
[3]Department of Respiratory and Critical Care Medicine, Second People's Hospital of Weifang, Weifang, China.

*Corresponding Author
E-Mail: zjn911016@126.com

Tel: 0536-8233405
Fax:0536-8233405

TB patients with bacteria discharge have higher risk of infectivity and spread of TB, but little is known of risk factors for bacteria discharge in the China border region. We aimed to discuss the predictors for bacteria discharge in pulmonary TB (PTB) patients. Over 47-month period a retrospectivestudy was done on 3669 consecutive PTB patients. Predictors of bacteria discharge in PTB were identified by univariate and multivariate logistic regression analysis. The *c* statistic was calculated to assess the discriminatory ability of the multivariate logistic regression model to predict bacteria discharge. The overall incidence of bacteria discharge in PTB was 32.24%. Underweight (OR 5.14, 95% CI 1.56-16.28), smoking history (OR 2.00, 95% CI 1.12-3.56), cavity (OR 2.57, 95% CI 1.22-8.56), low BMI (OR 1.51, 95% CI 1.05-2.16) and hypoproteinemia (OR 1.58, 95% CI 1.06-2.35) were positively associated and pleural effusion (OR 0.30, 95% CI 0.18-0.48) was negatively associated with bacteria discharge in PTB patients. Underweight, smoking history, cavity, low BMI and hypoproteinemia are the independent factors for TB bacterial discharge. Early identification of PTB patients that susceptible to bacteria discharge may contribute to controlling source of infection in time and reduce the spread of TB.

Keywords: Tuberculosis (TB),bacteria discharge, risk factor

Abbreviation

TB: tuberculosis; PTB: pulmonary TB; BMI: body mass index; COPD: chronic obstructive pulmonary disease; PPD: purified protein derivative; RBC: red blood cell count; HGB: hemoglobin; WBC: white blood cell count; CRP: C-reaction protein; ESR: erythrocyte sedimentation rate.

INTRODUCTION

Tuberculosis (TB) is the leading infectious cause of death worldwide. Nowadays, more than nine million people still develop active TB each year and nearly two million die worldwide (Wang et al., 2014). In developing countries such as India, China, Bangladesh, Indonesia and Brazil, where TB is still highly endemic. China accounts for nearly 17% of the world's TB burden, with an estimated 1.5 million new cases and approximately 270,000 deaths each year (Wang et al., 2013).

Exclusively transmitted by the airborne route, the TB disease cycle begins when a human host inhales infectious aerosols containing viable Mycobacterium tuberculosis (MTB). An untreated sputum positive patient can infect approximately 10 individuals per year, and each smear positive case can lead to two new cases of TB, at least one of which will be infectious (Jones-Lopez et al., 2013). Patients with sputum smear or culture positive are at high risk of TB transmission (Mekonnen, 2014). Therefore, assessment of the risk factors for bacteria discharge in TB patients, effective intervention and early detection of smear positive TB patients are the key to control the disease.

Previous studies have shown that human

immunodeficiency virus (HIV)/AIDS, diabetes, cancer, malnutrition, alcoholism, smoking cigarette, active TB contact, extreme poverty, homelessness, and being in prison were the commonly identified risk factors of TB in most developing countries(Mekonnen, 2014 ; Narasimhan et al.,2013; Inghammar et al., 2010).However, few studies have elucidated the predictors of bacteria discharge in PTB patients. Second People's Hospital of Weifang (Weifang City thoracic hospital) as the Weifang area the most authoritative organization of tuberculosis prevention and control, the number of TB patients admitted to the hospital is very large. Therefore, we initiated this large scale retrospective epidemiologic study using primary data to evaluate the risk factors of bacteria discharge in PTB patients and to achieve effective prevention and control of the spread of TB.

METHODOLOGY

Ethical approval

The study was approved by the Ethic Committee of Second People's Hospital of Weifang, China. Patient records were anonymized and de-identified prior to analysis. All the patient information was routinely collected and recorded by trained research coordinators over the entire study period.

Data collection

The study was conducted in a tuberculosis medical department with more than 1000 admissions (aged 18 years or older) per year at Second People's Hospital of Weifang, a tertiary-care, university-affiliated hospital. All data were extracted from the electronic medical record (EMR) system. All adult (≥18 years) newly-diagnosed PTB patients who treated by Directly Observed Treatment Short Course (DOTS) in the hospital from January 2010 to November 2013 were included. HIV-positive patients were excluded because HIV infected tuberculosis patients are not admitted to our hospital. HIV-positive patients will be transferred to HIV specialized hospital immediately in China.

The diagnosis of PTB was made within the existing TB prevention and control system in China, in which clinical manifestations, sputum smear microscopy and chest radiography were the central component: (1) typical clinical symptoms of PTB and chest X-ray manifestation, (2) anti-tuberculosis therapy is effective, (3) other non-tuberculosis pulmonary diseases can be excluded clinically, (4) PPD (5TU) is strong positive; serum antituberculous antibody is positive, (5) sputum tubercle bacillus polymerase chain reaction (PCR) probe detection appeared positive, (6) pathology of extrapulmonary tissues are confirmed as tuberculosis lesion, (7) anti-acid mycobacteria are tested in bronchoalveolar lavage fluid (BALF), (8) pathology of bronchus or pulmonary tissue proved to be tuberculosis lesion. A definite diagnosis could be made in case of conforming to 3 items among (1)-(6) or any item between (7) and (8). Suspected PTB person was investigated by sputum smear examination. The patient was diagnosed as smear-positive PTB if sputum specimens were smear positive. If sputum smears were negative and chest radiograph was compatible with active PTB, the patient was diagnosed as smear-negative PTB after discussion by clinical and radiographic doctors Caliskan et al., (2014). The results of blood parameters and biochemical parameters collected after the diagnosis of PTB were reviewed and analyzed.

Each patient's medical records were reviewed to collect the clinical characteristics and laboratory results. Information were recorded regarding socio-demographics, personal and family disease history, and lifestyle risk factors including smoking, alcohol consumption, main symptoms and signs, imaging manifestation and laboratory test. Anthropometric measurements including height and weight by standard procedure were measured by trained investigators. Body mass index (BMI, kg/m^2) was calculated by using the formula: BMI=Weight (kg)/Height^2 (m^2). Underweight, normal weight, overweight, and obesity were defined by using the modified criteria for Chinese population (Wang et al., 2013). The BMI cut-off value for underweight (severe underweight, moderate underweight, mild underweight), normal weight, overweight, and obesity was 18.5 kg/m^2 (<16 kg/m^2, 16-16.9 kg/m^2, 17-18.4 kg/m^2), 18.5-23.9kg/m^2, 24.0- 27.9 kg/m^2 and ≥28.0 kg/m^2, respectively.

Sputum samples were obtained by spontaneous morning expectoration, saline solution induction, or bronchoscopy with BALF.All sputum specimens were concentrated and examined by trained microbiology technicians. Different parts were chosen from the same sputum specimen as sputum smear and culture respectively. Results of sputum smear were reported according to the following standards (Bolursaz et al., 2014): (1) acid-fast bacillus negative: 300 different fields of views were observed consecutively but acid-fast bacillus was not found. (2) acid-fast bacillus suspected (±): 1-2 acid-fast bacillus/300 fields of view. (3) acid-fast bacillus positive (1+): 3-9 acid-fast bacillus/100 fields of view. (4) acid-fast bacillus positive (2+): 1-9 acid-fast bacillus/10 fields of view. (5) acid-fast bacillus positive (3+): 1-9 acid-fast bacillus/each field of view. (6) acid-fast bacillus positive (4+): ≥ 10 acid-fast bacillus/ each field of view. Sputum culture results (Shao et al., 2011 ; Tang et al.,2013). Each sputum sample was decontaminated with 4% sodium hydroxide (NaOH), centrifuged, and then cultured on Lowenstein-Jensen (L-J) culture media. The L-J culture media was incubated at 37°C. The growth situation of cultured TB was observed on the third and seventh days, subsequently once a week at least eight weeks. Those with colony growth, which were identified as acid fast bacteria by conducting acid fast staining, were reported to be culture positive.

Statistical analysis

Continuous variables were summarized with mean and standard deviation (SD) ; categorical variables were

Table 1. Socio-demographicscharacteristics of study participants

	All patients N=3669(%)	Bacteria discharge group N=1183(%)	Non-bacteria discharge group N=2486(%)	OR Value	95%CI	P value
Age(year)(mean±SD)	43.6±19.8	46.4±19.5	42.2±19.9	1.01	1.00-1.01	<0.001
Male	2576(70.2)	881(74.5)	1695(68.2)	1.36	1.17-1.59	<0.001
Occupation						
Student	352(9.6)	78(6.6)	274(11.0)	1.49	1.32-2.17	0.035
Cadre	170(4.6)	46(3.9)	124(5.0)	1.30	0.86-1.99	0.218
Worker	674(18.4)	213 (18.0)	461(18.5)	1.62	1.20-2.19	0.002
Farmer	2342(63.8)	821(69.4)	1521(61.2)	1.90	1.45-2.47	<0.001
Migrant worker	43(1.2)	18(1.5)	25(1.0)	2.53	1.31-4.87	0.006
Others	88(2.4)	7(0.6)	81(3.3)	0.30	0.14-0.68	0.004
Residence						
Urban residents	1043(28.4)	309(26.1)	734(29.5)	1.08	0.92-1.48	0.452
Rural residents	2626(71.6)	874(73.9)	1752(70.5)	1.18	1.01-1.39	0.03

summarized as proportions. In univariate analysis, X^2 test was used to compare categorical variables, and *t* test was used to compare continuous variables. Multivariate logistic regression analysis was used to identify independent factors that were associated with bacteria discharge in PTB patients. The odds ratios (OR) and the 95% confidence interval (CI) and p-values for individual variables were obtained using a logistic regression model, and P < 0.05 is considered to be statistically significant. Statistical analysis was performed using SPSS software, version 17.0.

RESULTS

Demographic and clinical characteristics in the study patients

A total of 3699 patients with PTB who conformed to the diagnostic criteria were enrolled. The majority of the study participants were male, 2576 (70.2%). Maleswere more likely being affected by PTB than females. The mean age of the study population was 44±19.8 years.The detail socio-demographics information were shown in Table 1.

PTB patients with bacteria discharge include sputum smear and/or culture positive. The overall prevalence rate of bacteria discharge in PTB was 32.24% (1183 patients). Almost 29.1% (1066 patients) of the sputum smear and 12.4% (454 patients) of the sputum culture were positive in PTB patients. Among patients with bacteria discharge, 337 (9.2%) patients were both positive in sputum smear and culture, while 729 (19.9%) patients were single smear positive and 117 (3.2%) patients were single culture positive.

Demographic and clinicalcharacteristics of bacteria discharge patients

The Socio-demographics characteristics of patients with bacteria dischargewere showed in the Table 1. For all bacteria discharge patients, there were 821 farmers (69.4%), 213 workers (18%) and 78 students (6.6%). A total of 309 patients resided in cities (26.1%), and rural residents, 874(73.9%).

Clinical symptoms and comorbidities of patients with bacteria discharge were presented in Table 2. The most common symptom of bacteria discharge patients was cough (97.1%) followed by expectoration (95.3%), night sweat (30.6%), hemoptysis (28.1%) and underweight (8.9%). There was considerable variation in the severity of the signs and symptoms.The most common complications were diabetes (18.2%) successively followed by chronic obstructive pulmonary disease (COPD) (11.1%), coronary heart disease (3.9%) and hypertension (3.5%). Patients with smoking history were accounted for 19.3%, and drinking history, 11.1%.

Chest radiological imaging abnormalities were recorded and included into statistical analysis, which were shown in Table 3. Out of the 1183 bacteria discharge patients, 703(76.9%), 157(24.2%), 58(9.3%) and 27(4.5%) were cavity, pleural effusion, mediastinal adenopathy and miliary tuberculosis, respectively. And encapsulated pleural effusion was accounted for 2.3% (15 patients). The detail information of laboratory inspection of study participants were presented in Table 4.

Risk factors

The mean age of the bacteria discharge patients was 46.4±19.5 and of the non-discharge patients 42.2±19.9 (P<0.001). There was significant sex difference between bacteria discharge and non-discharge patients (P<0.001). Occupation and resident had significant association with bacteria discharge: worker (P=0.002), farmer (P<0.001), migrant worker (P=0.006), rural residents (P=0.03). Mean BMI of non-discharge cohort was significantly higher than that of the discharge cohort (P<0.001). Cough (P<0.001), expectoration (P<0.001), hemoptysis (P=0.048) and night sweat (P<0.001) were more common in discharge patients.

Table 2. Clinical symptoms and Comorbiditiesof study participants

	All patients N=3669 (%)	Bacteria discharge group N=1183 (%)	Non-bacteria discharge group N=2486 (%)	OR Value	95%CI	P value
Clinical symptoms						
Cough	3038 (91.8)	1121 (97.1)	1917 (89.0)	4.22	2.91-6.12	<0.001
Expectoration	2812 (88.2)	1083 (95.3)	2812 (88.2)	3.83	2.84-5.17	<0.001
Hemoptysis	586 (25.6)	225 (28.1)	361 (24.3)	1.22	1.00-1.48	0.048
Body temperature (mean±SD)	37.9±0.7	38.1±0.6	37.8±0.8	1.24	0.87-1.58	0.231
Night sweat	554 (25.1)	235 (30.6)	319 (22.2)	1.55	1.27-1.88	<0.001
BMI(kg/m^2)	20.91±2.97	17.86±3.06	21.99±2.72	2.22	1.90-2.58	<0.001
Underweight	1046 (28.5)	437 (36.9)	609 (24.5)	4.01	2.98-5.56	<0.001
Normal	1999(54.5)	564(47.7)	1434(57.7)	2.1	0.52-3.1	0.320
Overweight and obesity	624(17.0)	182(15.4)	442(17.8)	1.6	0.8-2.6	0.086
Comorbidities						
Hypertension	109(4.4)	29(3.5)	80(4.9)	0.69	0.45-1.07	0.098
Diabetes	279(11.1)	159(18.2)	120(7.3)	2.81	2.19-3.63	<0.001
Coronary heart disease	115(4.7)	33(3.9)	82(5.1)	0.77	0.51-1.16	0.211
Cerebrovascular disease	54(2.2)	12(1.4)	42(2.6)	0.55	0.29-1.05	0.069
Chronic liver disease	30(1.2)	12(1.4)	18(1.1)	1.29	0.62-2.70	0.495
Connective tissue diseases	29(1.2)	9(1.1)	20(1.2)	0.87	0.39-1.91	0.721
Bronchiectasis	34(1.4)	12(1.5)	22(1.2)	1.06	0.52-2.15	0.872
Asthma	13(0.5)	4(0.5)	9(0.6)	0.86	0.26-2.80	0.801
COPD	211(8.5)	95(11.1)	116(7.1)	1.63	1.23-2.17	0.001
HIV positive	3(0.1)	1(0.1)	2(0.1)	0.98	0.09-10.64	0.963
Smoking	447(13.6)	211(19.3)	236(10.8)	1.98	1.62-2.42	<0.001
Alcohol consumption	230(7.3)	117(11.1)	113(5.4)	2.18	1.66-2.85	<0.001

Abbreviation: BMI, body mass index; COPD, chronic obstructive pulmonary disease.

Table 3. Chest radiological imagingof study participants

Chest radiological imaging	All patients N=3669 (%)	Bacteria discharge group N=1183 (%)	Non-bacteria discharge group N=2486 (%)	OR Value	95%CI	P value
Aspergilloma	12(0.6)	4(0.6)	8(0.6)	0.99	0.30-3.31	0.992
Pneumothorax	31(1.6)	12(1.9)	19(1.5)	1.26	0.61-2.61	0.536
Encapsulated pleural effusion	75(3.9)	15(2.3)	60(4.6)	0.49	0.27-0.86	0.013
Miliary tuberculosis	80(4.6)	27(4.5)	53(4.7)	0.96	0.60-1.55	0.875
Mediastinal adenopathy	143(8.0)	58(9.3)	85(7.4)	1.28	0.90-1.82	0.163
Pleural effusion	736(36.6)	157(24.2)	579(42.4)	0.43	0.35-0.53	<0.001
Cavity	1191(55.2)	703(76.9)	488(39.2)	5.17	4.27-6.26	<0.001

Diabetes (P<0.001), COPD (P<0.001), smoking (P<0.001) and alcohol consumption (P<0.001) were more common in discharge patients than in non-discharge cohort. Cavity was more common in discharge patients than non-discharge patients (P<0.001), while pleural effusion (P<0.001) and encapsulated pleural effusion (P=0.013) were more common in non-discharge patients. White blood cell (WBC) level(P<0.001), neutrophil (N) percentage (P<0.001), ESR (P<0.001) and serum creatinine (P=0.039) were higher in bacteria discharge patients compared to non-discharge cohort, while hemoglobin concentration (P<0.001), serum albumin (P<0.001) and serum sodium (P<0.001) were higher in non-discharge cohort.

On multivariate logistic regression analysis, significant risk factors for bacterial discharge are shown in Table 5. The independent risk factors (P <0.05) for bacteria discharge of PTB patients were underweight (OR 5.14, 95% CI 1.56-16.28), smoking history (OR 2.00, 95% CI 1.12-3.56),

Table 4. Laboratory inspection of study participants

Laboratory inspection	**All patients N=3669(%)**	**Bacteria discharge group N=1183(%)**	**Non-bacteria discharge group N=2486(%)**	**OR Value**	**95%CI**	**P value**
PPD test						
Negative	266(8.7)	103(10.3)	163(8.0)	1.00		
Weak positive	99(3.3)	26(2.6)	73(3.6)	0.67	0.34-1.05	0.061
Positive	1466(48.2)	435(43.9)	1031(50.3)	0.87	0.51-1.09	0.084
Strong positive	1210(39.8)	428(43.1)	782(38.2)	0.88	0.67-1.15	0.338
RBC($\times10^{12}$/L) (mean±SD)	4.67±2.12	4.43±2.62	4.54±2.15	0.84	0.69-1.38	0.465
HGB concentration (mean±SD)(g/L)	117.24±35.05	105.43±36.62	132.43±22.78	2.15	1.79-2.60	<0.001
WBC ($\times10^{9}$/L) (mean±SD)	9.60±6.12	12.53±6.91	8.54±5.15	1.70	1.37-2.10	<0.001
Neutrophil percentage (%)	68.2±15.3	75.2±14.8	62.1±30.5	1.73	1.50-2.01	<0.001
CRP (mg/L) (mean±SD)	10±17	11±19	9±16	1.01	1.00-1.02	0.174
ESR (mm/h) (mean±SD)	31±23	39±23	27±21	1.02	1.02-1.03	<0.001
Serumbilirubin (μmol/L) (mean±SD)	16.3±11.7	17.2±11.0	10.9±9.6	0.81	0.64-1.02	0.077
Serum albumin (g/L) (mean±SD)	30.3±21.2	21.5±17.6	34.4±25.7	2.01	1.73-2.34	<0.001
Serum creatinine (μmol/L) (mean±SD)	88.2±43.3	109.1±33.4	89.5±48.6	1.68	1.47-1.98	0.039
Serum potassium (mmol/L) (mean±SD)	3.9±0.3	3.7±0.6	4.2±0.4	1.13	0.75-1.72	0.553
Serum sodium (mmol/L) (mean±SD)	142.2±6.4	130.3±9.5	147.7±4.6	1.99	1.48-2.68	<0.001
Blood glucose level（mmol/l）(mean±SD)	5.4±7.8	5.8±9.0	5.2±7.2	1.01	0.99-1.03	0.191

Abbreviation: PPD, purified protein derivative; RBC, red blood cell count; HGB, hemoglobin; WBC, white blood cell count; CRP, C-reaction protein; ESR: erythrocyte sedimentation rate.

Table 5. Independent risk factors of bacteria discharge for TB patients through multivariate logistics regression analysis

Variables	**OR value**	**95%CI**	**P value**
Underweight	5.04	1.56-16.28	0.007
Smoking history	2.00	1.12-3.56	0.019
Cavity	2.57	1.22-8.56	<0.001
BMI(kg/m^2)	1.51	1.05-2.16	0.027
Pleural effusion	0.30	0.18-0.48	<0.001
Hypoproteinemia	1.58	1.06-2.35	0.026

intrapulmonary cavity (OR 2.57, 95% CI 1.22-8.56), low BMI(OR 1.51, 95% CI 1.05-2.16) and hypoproteinemia (OR 1.58, 95% CI 1.06-2.35), while pleural effusion (OR 0.30, 95% CI 0.18-0.48) in chest imaging was an independent factor correlated with low bacteria discharge rate.

DISCUSSION

Only a few reports concerning the prevalence of bacteria discharge in PTB patients in China are available until now. This study aims to propose an alternative indicator of infection in terms of prevention of disease transmission through selective isolation policy in PTB patients whose clinical conditions are highly suggestive of bacteria discharge in PTB patients(Figure 1).

Our analysis comprehensively presented novel findings regarding risk factors for bacteria discharge involving a cohort of PTB patients. The results demonstrated that underweight, smoking, intrapulmonary cavity, low BMI and serum albumin can be used to indentify PTB patients with a high risk of bacteria discharge, while pleural effusion is

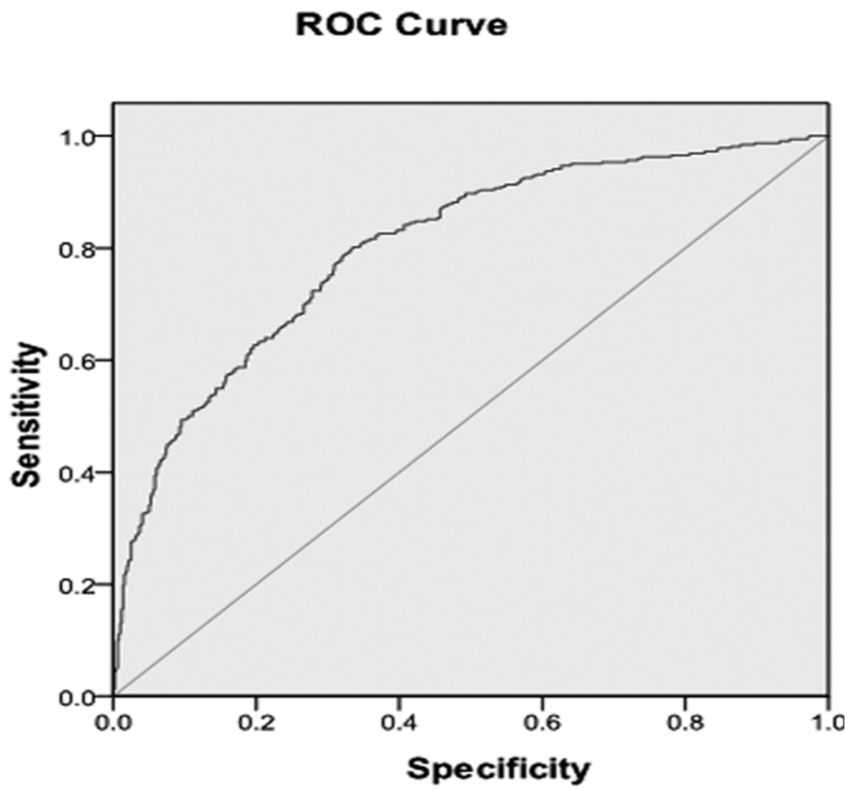

Figure 1: ROC curve to assess the discriminatory ability of the model predicting bacteria discharge in pulmonary TB patients.

associated with decreased risk of bacteria discharge.

In multivariate logistic regression analysis, underweight (BMI less than 18.5kg/m^2) (OR 5.14, 95% CI 1.56-16.28, P<0.001) remained the strongest predictor of bacteria discharge. Furthermore, decreased levels of serium albumin were associated with bacteria discharge. China is a developing country, and its economic development is uneven. In our study, most patients with TB bacteria discharge are farmers and workers, some of whom have under-nutrition due to lack of money. Underweight and low serum albumin indicate poor nutritional status, reduce immunity of human body and impaire cellular immune function(Tang et al., 2013), which are susceptible to aggravate the disease. Malnutrition and hypoproteinemia can impair host immunity (Koromath et al., (2008) against TB, subsequently progress to deterioration. The extent of pulmonary involvement has been proposed to be a major predictor of bacteria discharge in PTB.

Inhalation of tobacco can biologically impair pulmonary immune response (Lam et al., 2010). In the recent, Shang and coworkers in their animal study demonstrated that exposure of mice to cigarette followed by infection with MTB result in a decline in the adaptive immunity, which leading to a significant increase in the number of viable MTB isolated from the lungs and spleen (Jee et al., 2009). The early symptoms of TB infections in smokers, such as cough and expectoration, are frequently mistaken as airway response to the smoking. Chronic exposure to tobacco impairs the normal clearance of secretions on the tracheobronchial mucosal surface and allow the causative organism MTB to escape the first level of host defenses, which prevent bacilli from reaching the alveoli. Smoking also notably limit the ability of alveolar AMs, which are not only the cellular target of MTB infection but also constitute an important early defense mechanism against the bacteria. Evidence has shown that the substances in tobacco can inhibit tumor necrosis factor and restrict the function of AMs. Therefore, smokers have a weak immunity against MTB, which is likely to be one of the mechanisms to the deterioration of the disease. With disease worsen, TB lesion is inclined to infringe respiratory tract and increase the risk of bacteria discharge.

We evaluated the radiographic presentation of tuberculosis in bacterial discharge patients and found some significance. The association of cavity with bacteria discharge in TB patients was similar to what has been reported earlier (Mixides et al., 2005); Kanaya, 2001). The study demonstrated that the most prevalent abnormality observed on chest imaging in bacteria discharge was cavity, which is also significantly associated with bacteria discharge tuberculosis. The absorption, repair, deterioration and progress of lesions occurred alternatively and formed chronic fibrocavernous PTB. Patients with tuberculotic cavity often have bronchial disseminated lesions (Kwon et al., 2013).Ultimately lesions drain into the airways and deliver bacillus to the sputum. The study showed that pleural effusion in chest imaging was negatively associated with bacteria discharge. It is an independent factor correlated with low bacteria discharge rate. The prevalence of pleural effusion was 24.2% in cases with bacteria discharge versus 42.4% in the bacteria non-discharge patients, and the difference was statically significant. It is advisable that performing chest CT as early as possible may indentify bacteria discharge patients early and isolate them to prevent transmission.

Our study has several limitations. First, only one hospital participating in this study, thus the findings cannot fully represent the clinical characteristic and current situation of TB bacteria discharge in China, and the findings may represent TB in specialized TB hospitals, but not in the population as a whole. Second, this study was limited by the relatively small number of TB bacteria discharge cases. A larger sample can better reflect the predictors of TB bacteria discharge. Third, MTB infection was not confirmed by sputum smear and culture results in a substantial number of participants in the clinical settings in our study. However, according to the recent national TB epidemiological survey in China, sputum smear and culture positive is documented in only 26.4% of the active TB patients (TB Epidemiological Survey, 2012), which means that nearly three quarter of the active TB may be missed if we would take the MTB smear and culture result as the gold standard. As with most TB centres, clinical manifestations, sputum smear and culture results and chest radiographs were the central component for TB diagnosis in our study.

Conclusions

Based on the above statement, bacteria discharge is related with the extent and severity of pulmonary lesion. Strengthening the nutrition, quitting smoking and standardizing the treatment to control the diseases could reduce the risk of bacteria discharge of patients. As a chronic infectious disease, TB is one of the main causes of death for infectious diseases in China, which is of great harmful to patients, patient contacts and community. Given the growing huge burden and high rate of TB in China, systematic screening of all TB patients for bacteria discharge through the infrastructure for TB control could serve to improve the early prevention of disease spread.

Acknowledgments

Financial support. This work was supported by Science and technology development plan of Shandong Province (Grant Number: 2009GG10002054).

Potential conflicts of interest. All authors report no potential conflicts.

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