CLINICAL CHARACTERISTICS AND TREATMENT OUTCOMES AMONG PATIENTS WITH TUBERCULOSIS IN BANGKOK AND NONTHABURI, THAILAND

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Abstract. Tuberculosis (TB) is a public health problem in many large cities. We retrospectively studied the clinical characteristics and treatment outcomes of patients with active TB at 6 hospitals in Bangkok and Nonthaburi, Thailand during 2008-2009. Eight hundred thirteen patients were included in the study. The mean age of subjects ±SD was 41±14 years and mean body weight ±SD was 53±11 kilograms. The three leading co-morbid conditions were HIV infection (40%), diabetes (6%) and chronic liver disease (2%). Two-thirds of subjects had isolated pulmonary TB. Isoniazid, rifampicin and multi-drug resistance were seen in 13, 7 and 5%, respectively. After 1 year, 52% were cured or completed treatment, 19% transferred out, 12% defaulted, 9% were still on-going TB treatment, 7% had died and 1% had failed treatment. Survival rates at 2, 6 and 12 months were 93, 85 and 81% among HIV seropositive subjects; 96, 94 and 92% among HIV seronegative subjects and 98, 97 and 97% among subjects with unknown HIV status (p <0.001). On multivariate analysis, death was associated with: TB/HIV co-infection (HR 2.8; 95%CI 1.6-5.0), low body weight (HR 1.6; 95%CI 1.2-2.3), being elderly (HR 1.4; 95%CI 1.1-1.8) and having extrapulmonary/disseminated TB (HR 2.2; 95%CI 1.1-4.2). HIV infection and diabetes were the most common co-morbidities among TB subjects in our study. The percent of patients with unfavorable outcomes was relatively high, particularly among HIV co-infected and elderly subjects. Further effort needs to be made to improve these unfavorable TB outcomes in Nonthaburi and Bangkok, Thailand.

Keywords: tuberculosis, treatment outcome, survival rate, HIV, Thailand

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INTRODUCTION

Tuberculosis (TB) is a major public health problem in both resource-rich and resource-limited countries, including Thailand (Chiang *et al*, 2007; Trebucq, 2007). The World Health Organization

(WHO) estimates the global incidence of TB in 2009 was 9.4 million cases. Two billion people are estimated to have latent TB, and 3 million people worldwide die from TB annually (WHO, 2010). Most TB cases occur in Asia and Africa (WHO, 2010). Urban areas usually have a variety of health care services, such as public and private hospitals, teaching hospitals and non-profit organizations. The number of inhabitants living in major cities is often large in resource-limited countries. Bangkok is the capital of and the largest city in Thailand. In 2009, Bangkok had a registered population of 5.7 million individuals (Department of Provincial Administration, 2010). Nonthaburi is a large suburb city located directly northwest of Bangkok. Due to the large number of contacts, duration of infectiousness, absence of adequate TB healthcare services, TB transmission may be greater in large cities. Early detection and appropriate treatment of TB are important for its control.

The current WHO recommended regimen for the treatment of TB is isoniazid, rifampicin, pyrazinamide, and ethambutol for the first 2 months followed by isoniazid and rifampicin for an additional 4 months (WHO, 2009). Multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) are increasing worldwide (WHO, 2009). The WHO recommends performing drug susceptibility testing (DST) at the commencement of therapy, especially in all previously treated patients (WHO, 2009), so appropriate therapy can be given to individuals with resistance. The global HIV pandemic over the past three decades has had a dramatic impact on the epidemiology of TB (Raviglione, *et al*, 1995; Corbett *et al*, 2003). The risk of TB is dramatically increased in HIV-TB co-infected patients due to the higher probability of progression to active disease from latent infection and rapid progression of the disease (Jon, 2004). Systematic studies of the magnitude, treatment outcomes and resistance to TB drugs are essential to guide public health policies. The present study was conducted to investigate clinical characteristics and treatment outcomes of patients with TB at 6 hospitals in Bangkok and Nonthaburi, Thailand.

MATERIALS AND METHODS

We conducted a retrospective cohort study of all patients diagnosed with active TB between January 2008 and December 2008 at 6 hospitals in Bangkok and Nonthaburi, Thailand: Bamrasnaradura Infectious Diseases Institute (a tertiary HIV and infectious diseases health care center), the King Chulalongkorn Memorial Hospital (a teaching hospital), the Royal Irrigation Hospital (a general hospital) and three private hospitals in Bangkok and Nonthaburi. The hospitals ranged in size from 105 to 1,500 beds. Patients with a diagnosis of TB were selected from the registrars and the data were obtained from the patients' medical records. Inclusion criteria were: 1) all TB-infected patients older than 15 years with 2) newly clinically diagnosed active tuberculosis, positive acid-fast staining of TB or a positive culture for *Mycobacterium tuberculosis*. Patients with culture-proven nontuberculous mycobacteria or without clinical findings consistent with tuberculosis were excluded. All the patients' records were reviewed until December 2009. The medical records were reviewed to determine their clinical characteristics, a history of delay in treatment, drug resistance and treatment outcomes. The patients were categorized into: HIV seropositive, HIV seronegative and undetermined HIV serostatus.

The primary outcome of interest was the one year TB treatment outcome. Treatment outcome was categorized based on WHO criteria (WHO, 2009) as follows: 1) cure, 2) treatment completed, 3) treatment failure, 4) defaulted on treatment, 5) death, and 6) transfered out. Favorable outcomes with TB treatment were cure and completed treatment, the rest were classified as having an unfavorable outcome. Patients still undergoing treatment in December 2009 were not included in an outcome category. We determined the survival in December 2009. The survival period for each patient was calculated by subtracting the date of death, last visit, transferred out or end of the study from the date on which the patient was diagnosed with TB. Patients were right censored at the date of last visit if they were cured, completed treatment for TB, were lost to follow-up or transfered-out. The secondary outcomes were: 1) rate of voluntary counseling and testing for HIV, 2) rate of performing DST, 3) rate of anti-TB drug resistance, 4) duration from first presentation to TB diagnosis, 5) risk factors related to death at the end of the study and 6) a comparison of the frequencies of death among patients with different HIV serostatuses during the study period, *ie*, seropositive, seronegative and undetermined serostatus. Possible predictive factors were determined and other data were collected and studied. These included patient demographics, co-morbid conditions, sites of tuberculosis, duration of time from TB diagnosis to commencement of TB treatment, direct observed therapy program to treat TB, location obtaining TB treatment, test used to diagnose TB, and susceptibility to anti-TB drugs. Extrapulmonary TB was defined as a case of TB involving organs other than the lungs, such as the lymph nodes, pleura, gastrointestinal tract, central nervous system, skeletal tissue, genitourinary tract or skin. CD4 cell counts obtained 3 months before until 3 months after TB diagnosis were collected.

Mean (± standard deviation, SD), median (interquartile range at 25th and 75th, IQR) and frequencies (%) were used to describe patient characteristics. The chi-square and Kruskal-Walis tests were used to compare categorical and continuous variables, respectively. Death-free curves were calculated using the Kaplan-Meier method and compared among groups with the Log rank test. The Cox proportional hazard model was used to determine the probability of death after TB diagnosis by adjusting for confounding factors. Factors with a p-value <0.05 on univariate analysis were included in the multivariate analysis. Patients were divided into age categories as follows: 15-25, 26-35, 36-45, 46-55, 56-65 and ≥66 years. Body weights were categorized into <40, 40-49, 50-59, 60-69, 70-79, and ≥80 kilograms. The hazard ratio (HR) for death and its 95% confidence interval (CI) were estimated. All statistical analyses were conducted using SPSS version 15.0. A two sided p-value <0.05 was considered statistically significant. This study was reviewed and approved by the ethics committees of the Department of Disease Control, Ministry of Public Health and by the institutional review boards of the public sector and appropriate authorities of the private hospitals.

RESULTS

Eight hundred fifty-one TB patients were identified by review of the registry. Thirty-eight were excluded because of culture-proven non-TB mycobacterial infection. Eight-hundred thirteen cases

Table 1
Baseline characteristics of 813 patients with tuberculosis.

Parameters	Total *N*=813	HIV seropositive *n*=325	HIV seronegative *n*=271	Undetermined HIV serostatus *n*=217	*p*-value
Age, years, mean±SD	41 ± 14	37 ± 9	44 ± 15	42 ± 16	<0.001 N, U > *p**
Gender					ns
Male	505 (62.1%)	218 (67.1%)	162 (59.8%)	125 (57.6%)	
Female	308 (37.9%)	107 (32.9%)	109 (40.2%)	92 (42.4%)	
Body weight, kg, mean±SD	53 ± 11	51 ± 10	53 ± 11	54 ± 11	0.01 N, U > *p**
Other co-morbid conditions					
Diabetes mellitus	52 (6.4%)	7 (2.1%)	25 (9.2%)	20 (9.2%)	<0.001
Chronic liver disease	17 (2.1%)	3 (0.9%)	12 (4.4%)	2 (0.9%)	0.004
Chronic lung disease	9 (1.1%)	1 (0.3%)	4 (1.5%)	4 (1.8%)	ns
Receiving steroid	9 (1.1%)	1 (0.3%)	7 (2.6%)	1 (0.5%)	0.017
Chronic kidney disease	8 (9.8%)	1 (0.3%)	4 (1.5%)	3 (1.4%)	ns
Site of TB					
Pulmonary	533 (65.6%)	153 (47.1%)	205 (75.6%)	175 (80.7%)	<0.001
Extrapulmonary	184 (22.6%)	108 (33.2%)	42 (15.5%)	34 (15.6%)	N, U > *p**
Both	96 (11.8%)	64 (19.7%)	24 (8.9%)	8 (3.7%)	
Duration from first visit to TB diagnosis (excluding transferred-in patients), days, median (IQR)	3 (0-10) *n* = 764	1 (0-8) *n* = 289	4 (0-17) *n* = 261	3 (0-9) *n* = 214	0.002 N, U > *p**
Category of TB cases					<0.001
New	666 (81.9%)	242 (74.5%)	239 (88.2%)	185 (85.2%)	N, U > *p**
Retreatment	147 (18.1%)	83 (25.5%)	32 (11.8%)	32 (14.8%)	
Performed AFB smear (%)	747 (91.9%)	307 (94.4%)	242 (89.2%)	198 (91.2%)	ns
Positive AFB smear (%)	413 (55.3%)	178 (58.0%)	140 (57.9%)	95 (48.0%)	0.054
Culture positive for *M. tuberculosis* (%)	240/350 (68.6%)	134/190 (70.5%)	77/113 (68.1%)	29/47 (61.7%)	ns
Directly observed treatment					<0.001
Performed	131 (16.1%)	23 (7.1%)	54 (19.9%)	54 (24.9%)	N, U > *p**
Not performed	574 (70.6%)	265 (81.5%)	178 (65.7%)	131 (60.4%)	
No report	108 (13.3%)	37 (11.4%)	39 (14.4%)	32 (14.7%)	
Anti-TB drug resistance					
INH resistant	17/133 (12.8%)	15/79 (19.0%)	1/43 (2.3%)	1/11 (9.1%)	ns
Rifampicin resistant	10/133 (7.5%)	8/79 (10.1%)	2/43 (4.7%)	0/11 (0%)	ns
Ethambutol resistant	7/129 (5.4%)	6/76 (7.9%)	1/43 (2.3%)	0/10 (0%)	ns
Streptomycin resistant	21/128 (16.4%)	14/75 (18.7%)	6/43 (14.0%)	1/10 (10.0%)	ns
MDR	7/133 (5.3%)	6/79 (7.6%)	1/43 (2.3%)	0/11 (0%)	ns
Anti-TB drug resistance among re-treated patients					
INH resistant	6/26 (23.1%)	6/18 (33.3%)	0/5 (0%)	0/3 (0%)	ns
Rifampicin resistant	5/26 (19.2%)	5/18 (27.8%)	0/5 (0%)	0/3 (0%)	ns
Ethambutol resistant	4/24 (16.7%)	4/17 (23.5%)	0/5 (0%)	0/2 (0%)	ns
Streptomycin resistant	6/24 (25.0%)	4/17 (23.5%)	2/5 (40.0%)	0/2 (0%)	ns
MDR	3/26 (11.5%)	3/18 (16.7%)	0/5 (0%)	0/3 (0%)	ns

Table 1 (Continued).

Parameters	Total *N*=813	HIV seropositive *n*=325	HIV seronegative *n*=271	Undetermined HIV serostatus *n*=217	*p*-value
Anti-TB drug resistance among new cases					
INH resistant	11/107 (10.3%)	9/61 (14.8%)	1/38 (2.6%)	1/8 (12.5%)	ns
Rifampicin resistant	5/107 (4.7%)	3/61 (4.9%)	2/38 (5.3%)	0/8 (0%)	ns
Ethambutol resistant	3/105 (2.9%)	2/59 (3.4%)	1/38 (2.6%)	0/8 (0%)	ns
Streptomycin resistant	15/104 (14.4%)	10/58 (17.2%)	4/38 (10.5%)	1/8 (0%)	ns
MDR	4/107 (3.7%)	3/61 (4.9%)	1/38 (2.6%)	0/8 (0%)	ns
TB service sites					
Public hospital	574 (70.6%)	293 (90.1%)	171 (63.1%)	110 (50.7%)	<0.001
Private hospital	239 (29.4%)	32 (9.9%)	100 (36.9%)	107 (49.3%)	*p* >N >U*

**p*, HIV sero-positive; N, HIV sero-negative; U, Undetermined HIV sero-status; ns, not significant

were included in the study. The mean (±SD) age was 41 (±14) years and 62% were males. Forty-two percent (129 of 307) had a positive AFB smear. DST was conducted in 15.9%. The patient characteristics, diagnostic test results, and DST results by HIV serostatus are shown in Table 1. There were no XDR-TB cases. Five hundred seventy-four patients (70.6%) received treatment at public hospitals and 239 (29.4%) received treatment at private hospitals. Seventy-three percent had voluntary counseling and testing for HIV. Forty percent of patients were HIV seropositive, 33% were HIV seronegative and 27% had an undetermined HIV serostatus. Sixteen percent of all patients and 7% of HIV-infected patients received directly observed therapy. Table 2 shows the baseline characteristics of the 325 patients co-infected with TB and HIV. The overall median (IQR) CD4 count was 55 (22-169) cells/mm^3.

Seventy-eight patients were not included in the evaluation of treatment outcomes because they were undergoing treatment. The one year treatment outcomes for TB are shown in Table 3. The treatment outcomes of the 284 patients newly diagnosed with pulmonary TB and pulmonary with extrapulmonary TB having a positive AFB smear are shown in Table 4. The one year TB treatment outcomes among new smear positive pulmonary TB and new pulmonary with extrapulmonary TB cases compared with retreated cases are shown in Table 5. Of the 52 diabetic patients, by one year, 52% were on treatment, cured or had completed treatment, 15% were undergoing treatment, 14% transferred out, 11% defaulted on treatment, and 8% died.

The TB survival rates using the Kaplan-Meier method are shown in Fig 1. The 2, 6, 12 and 24 month survival rates were 93, 85, 81 and 81% in the HIV seropositive group; 96, 94, 92 and 92% in the HIV seronegative group; and 98, 97, 97 and 97% in the undetermined HIV serostatus group (log rank test, p <0.001). Twenty percent of patients in the HIV seropositive group died within 12 months of TB diagnosis. The Cox proportional hazard model was used to compare the

Table 2
Baseline characteristics of 325 TB-HIV coinfected patients.

Parameters	Number
CD4 count, cells/mm^3, median (IQR), *n*=257	55 (22-169)
Received antiretroviral therapy (ART) during the study period	203 (62.5%)
Initiated ART after TB diagnosis	127/203 (62.6%)
Duration from TB diagnosis to commencing ART, days, median (IQR)	80 (34-142)
CD4 cell count, median (IQR)	49 (22-129)
Simultaneously initiated ART and TB treatment	5/203 (2.4%)
CD4 cell count, median (IQR)	35 (17-85)
Initiated ART before TB diagnosis	71 (35.0%)
Duration from ART to TB, days, median (IQR)	160 (34-764)
CD4 cell count, median (IQR)	91 (21-248)

ART, antiretroviral therapy

Table 3
Treatment outcomes among 735 TB patients 1 year after diagnosis.

Outcomes	Total *N*=735	HIV seropositive *n*=287	HIV seronegative *n*=243	Undetermined serostatus *n*=205	*p*-value
Favorable outcome	412 (56.1%)	111 (38.7%)	154 (63.4%)	147 (71.7%)	<0.001
Cured	87 (11.9%)	19 (6.6%)	40 (16.5%)	28 (13.7%)	
Completed treatment	325 (44.2%)	92 (32.1%)	114 (46.9%)	119 (58.0%)	
Unfavorable outcome	164 (22.3%)	81 (28.2%)	60 (24.7%)	23 (11.2%)	<0.001
Failed	9 (1.2%)	4 (1.4%)	4 (1.6%)	1 (0.5%)	
Defaulted	89 (12.1%)	33 (11.5%)	39 (16.1%)	17 (8.3%)	
Died	66 (9.0%)	44 (15.3%)	17 (7.0%)	5 (2.4%)	
Transferred out	159 (21.6%)	95 (33.1%)	29 (11.9%)	35 (17.1%)	<0.001

probability of death among patients by their HIV serostatus. The final factors in this model included age, baseline body weight, HIV serostatus and site of TB infection. All these factors were associated with a higher probability of death (Table 6) (p <0.05). The adjusted hazards ratio for death among HIV seropositive patients without antiretroviral therapy was 13.7 (95%CI 4.5-41.8) and among HIV seropositive patients receiving ART was 2.4 (95%CI 1.0-6.1) when compared to HIV seronegative patients.

DISCUSSION

The treatment outcome, particularly among new sputum smear positive pulmonary TB patients, is an important indicator of the quality of a TB treatment program. In the present study, the overall treatment success rate was 57%

Table 4
Treatment outcomes among 255 newly diagnosed TB patients with smear positive pulmonary TB and pulmonary/extrapulmonary TB at 1 year.

Outcomes	Total	HIV seropositive	HIV seronegative	Undetermined serostatus	*p*-value
	N=255	*n*=78	*n*=110	*n*=67	
Favorable outcome	142 (55.7%)	30 (38.5%)	65 (59.1%)	47 (70.2%)	<0.001
Cured	63 (24.7%)	14 (18.0%)	29 (26.4%)	20 (29.9%)	
Completed treatment	79 (31.0%)	16 (20.5%)	36 (32.7%)	27 (40.3%)	
Unfavorable outcome	62 (24.3%)	23 (29.5%)	30 (27.3%)	9 (13.4%)	<0.001
Failed	3 (1.2%)	1 (1.3%)	2 (1.8%)	0 (0%)	
Defaulted	34 (13.3%)	9 (11.5%)	19 (17.3%)	6 (8.9%)	
Died	25 (9.8%)	13 (16.7%)	9 (8.2%)	3 (4.5%)	
Transferred out	51 (20.0%)	25 (32.0%)	15 (13.6%)	11 (16.4%)	<0.001

Table 5
Comparison of outcome among new and retreated smear positive pulmonary TB and pulmonary/extrapulmonary TB cases at 1 year.

Outcomes	New cases	Retreated cases	*p*-value
	n = 255	*n* = 52	
Favorable outcome	142 (55.7%)	21 (40.4%)	0.048
Cured	63 (24.7%)	13 (25.0%)	
Completed treatment	79 (31.0%)	8 (15.4%)	
Unfavorable outcome	62 (24.3%)	12 (23.1%)	1.000
Failed	3 (1.2%)	2 (3.8%)	
Defaulted	34 (13.3%)	7 (13.5%)	
Dead	25 (9.8%)	3 (5.8%)	
Transferred out	51 (20.0%)	19 (36.5%)	0.017

after excluding on-going treatment cases. For new sputum smear positive cases of pulmonary TB, the treatment success rate was 56%. This is markedly below the WHO recommended target of 85%. A review of European countries revealed an overall success rate of 74% (Faustini *et al*, 2005). Several factors contributed to the low success rate in this study including a high referral rate to other hospitals with no documented outcomes (nearly one-third of patients with TB-HIV coinfection), low rate of directly observed treatment (DOT), a significant percentage of mortality among TB- HIV coinfected patients, and the high default rate among HIV seronegative patients. Our results suggest to improve TB outcomes in the study area, a number of modalities need to be employed: strengthening the referral system to be able to trace back treatment outcomes, implementing a comprehensive TB-HIV treatment program and implementing DOT. Implementing DOT in large

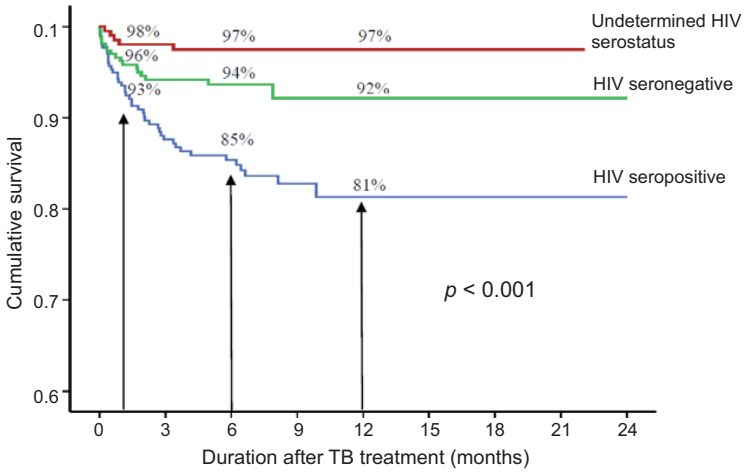

Fig 1–Cumulative survival by HIV serostatus after TB treatment at the end of the study.

cities is a challenge due to population size and transportation problems.

The cumulative survival rate was substantially lower among TB-HIV co-infected patients. Most TB-HIV co-infected patients in this study presented with a CD4 count <200 cells/mm^3 (median <50 cells/mm^3) indicating advanced HIV disease; these findings are similar to previous studies (Manosuthi *et al*, 2006; Akksilp *et al*, 2007; Mankatittham *et al*, 2009; Varma *et al*, 2009). Severely immunocompromised HIV-infected patients have a higher risk of opportunistic infections and death, especially if highly active antiretroviral therapy (HAART) is not being used (Manosuthi *et al*, 2006). One-third of TB-HIV coinfected patients in this study had not received HAART. A recent study from South Africa demonstrated initiation of antiretroviral therapy during TB therapy reduced mortality by 56% (Abdool *et al*, 2010). One of the major strategies for improving survival is early initiation of HAART. In addition to HIV coinfection, we found older age, lower body weight and disseminated/extra-pulmonary TB were associated with a higher mortality rate. A previous study showed an increased mortality rate among elderly persons with tuberculosis (Zevallos and Justman, 2003). A study from the European Union found old age and resistance to isoniazid and rifampicin were strong determinants of death (Lefebvre and Falzon, 2008). Risks for death may vary by country, presumably reflecting differences in patient profiles and medical infrastructure.

One of the primary steps for controlling TB is to identify individuals at risk for TB. In the present study 40% of TB patients had HIV co-infection. This number may be biased because one of the 6 hospitals is an infectious disease hospital that serves as a tertiary care center for treating HIV. If we exclude this hospital in the analysis, the rate of TB-HIV co-infection was approximately 20% (data not shown). This number is still high. In our study, approximately 30% of TB patients had not been tested for HIV; the WHO recommends HIV screening should be performed in all TB patients irrespective of HIV prevalence in the population. These findings reflect a weakness in the management of TB patients in our health care system. Patients with an undetermined HIV serostatus had a greater survival rate than HIV-seronegative patients. This finding may be explained by the fact that an HIV test may not be performed in patients with an apparent low risk for HIV infection or in cases of less severe disease with a better prognosis.

Diabetes was the second most common associated co-morbid disease in this

Table 6
Cox's regression analysis of possible risk factors for death at the end of the study.

Factors	Univariate analysis[a]			Multivariate analysis		
	HR[b]	95% CI[c]	*p*-value	HR[b]	95% CI[c]	*p*-value
HIV seropositive	2.387	1.647-3.448	<0.001	2.801	1.570-5.000	<0.001
Decrement for every 10 kilograms of body weight	1.626	1.159-2.283	0.005	1.637	1.250-2.304	0.005
Increment for every 10 years of age	1.310	1.112-1.543	0.001	1.439	1.118-1.853	0.005
Extrapulmonary/disseminated TB *vs* pulmonary TB	2.252	1.404-3.612	0.001	2.184	1.127-4.235	0.021
Not performed directly observed therapy (DOT)	2.238	0.969-5.172	0.059	-	-	-
INH resistance	3.712	0.789-17.464	0.097	-	-	-

[a]Univariate analysis showed variable with $p < 0.01$ only
[b]Hazards ratio, [c]95% confidence interval

study. Diabetes increases the risk for TB infection because of its association with immunosuppression (Jeon and Murray, 2008). Public health policy should therefore include diabetes screening and care in the national TB program. One of the major challenges for TB control is delay in diagnosis. In the present study, the length of time to diagnosis after onset of symptoms was 3 days, which is acceptable. The time to diagnosis was shorter in the HIV seropositive group than in the other groups (1 day in HIV seropositive patients, 4 days in HIV seronegative patients and 3 days in patients with undetermined HIV status, p=0.002). The symptoms of TB overlap with those of other HIV-related illnesses. Smear-negative and extra-pulmonary TB are common among HIV patients. A strong index of suspicion for diseases in endemic areas and a higher yield with acid-fast stains in extra-pulmonary specimens from advanced HIV-infected patients (Shriner *et al*, 1992; Golden and Vikram, 2005) may contribute to the shorter time-to-diagnosis for TB in our study.

Drug resistant TB (DR-TB), in particular multidrug resistant (MDR-TB), is a threat to TB prevention and treatment globally. MDR-TB increases the risk of death in both HIV seropositive and seronegative populations (Chaisson *et al*, 1987; Pablos-Mendez, *et al*, 1996; Quy *et al*, 2006). Based on a national Thai drug resistance survey in 2007, MDR-TB was found in 1.7% of newly diagnosed TB patients and 35% of previously treated TB patients. In this study we found a high prevalence of DR-TB and MDR-TB in both newly diagnosed and previously treated patients. A previous study among Thais with TB but without HIV showed a high death rate among patients infected with MDR-TB (Amnuaiphon *et al*, 2009). Our results show DR-TB and MDR-TB were more common among HIV-seropositive patients than among other groups, similar to a previous Thai study (Akksilp *et al*, 2009) but the difference was not significant. The lack of significance may be explained by the small sample size; less than one-fifth of the patients in this study had drug

sensitivity testing. The rate of performing TB culture and drug sensitivity testing in this study was low. The laboratory plays a critical role in identifying MDR-TB and XDR-TB cases. This study shows the need to educate physicians to request drug sensitivity testing more frequently.

There were some limitations in the present study. First, the retrospective study makes some aspects difficult to assess, such as social characteristics and mortality rate. A cohort analysis needs to be prospective to study treatment outcomes. Second, this study was limited to only two large cities in Thailand; the results may not reflect other parts of the country. Third, the study population was relatively small. Fourth, the study sites were not chosen randomly but by their willingness to participate in the study. These hospitals may not be representative of other hospitals in Thailand. Fifth, many treatment outcomes were missing, especially among HIV-infected patients who transferred to other hospitals.

In summary, this study provides clinical data and treatment outcomes of TB patients from two large cities in Thailand. HIV infection was the most common co-morbidity among the study population. Unfavorable treatment outcomes were relatively high, particularly among patients with HIV co-infection. Elderly status, low body weight, and extra-pulmonary/disseminated TB were also factors independently associated with high mortality. The current TB prevention and treatment programs need to be improved to reach WHO guidelines and an integrative TB-HIV management programs is needed in Thailand.

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