Journal of Hospital Infection 80 (2012) 173–175

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Short report

Five-year prospective study of tuberculin skin testing among new healthcare personnel at a university hospital in Thailand☆

S. Kiertiburanakul[a], S. Suebsing[a], P. Kehachindawat[b], S. Apivanich[b], S. Somsakul[b], B. Sathapatayavongs[a], K. Malathum[a,*]

[a] Department of Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
[b] Department of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

ARTICLE INFO

Article history:
Received 17 June 2011
Accepted 29 November 2011
by J.A. Child
Available online 20 December 2011

Keywords:
Healthcare personnel
Tuberculin skin test
Tuberculosis

SUMMARY

We determined the prevalence of a positive tuberculin skin test (TST) and the incidence of TST conversion among new healthcare personnel (HCP) in a hospital in Thailand. During 2005–2008, TST was performed on 1438 HCP and the prevalence of positive TST was 66.3%. Age, male gender, and the presence of Bacille Calmette–Guérin (BCG) scar were associated with odds of positive TST (all $P < 0.05$). The incidence of TST conversion was 4.8 per 100 HCP-years. Nine (0.6%) HCP were diagnosed with active tuberculosis. The annual surveillance programme is important for the early diagnosis and prevention of tuberculosis among HCP in Thailand.

Introduction

Tuberculosis (TB) is an important infection worldwide. According to a World Health Organization (WHO) report in 2010, the incidence of TB in Thailand was 93,000 cases per year and the prevalence was 189 cases per 100,000 population per year.[1] Nosocomial transmission of TB may occur either from patients to healthcare personnel (HCP) or from HCP to patients. Several studies have confirmed that HCP are at increased risk of acquiring TB from patients.[2,3] The annual incidence of TB in HCP in low and middle income countries ranges from 69 to 5780 per 100,000.[4]

Tuberculin skin testing (TST) is used to determine the prevalence and incidence of latent tuberculosis infection (LTBI), especially in healthcare settings. The prevalence of LTBI in HCP varies depending on the background TB burden in the relevant population and the criteria used for diagnosis. The prevalence of LTBI among HCP in low and middle income countries was reported to be an average of 54% (range: 33–79%).[4] Estimates of the annual risk of LTBI ranged from 0.5% to 14.3%.[4] Long-term studies to assess the occupational risk among HCP are lacking.

The transmission of TB from HCP to patients is a concern in our hospital and screening of HCP for LTBI and active TB is an important component of the hospital's infection control programme.[5] An annual surveillance programme commenced in 2005. We aimed to determine the prevalence of TST prior to the start of clinical employment among new HCP and the

☆ Presented in part at the 51st Annual Interscience Conference on Antimicrobial Agents and Chemotherapy, Chicago, Illinois, USA, 17–20 September 2011.

* Corresponding author. Address: Department of Medicine, Faculty of Medicine, Ramathibodi Hospital, 270 Rama VI Rd, Bangkok 10400, Thailand. Tel.: +662 201 1581; fax: +662 201 2232.
E-mail address: kmalathum@hotmail.com (K. Malathum).

0195-6701/$ – see front matter
doi:10.1016/j.jhin.2011.11.017

incidence of TST conversion during clinical employment, including the detection of TB cases among HCP.

Methods

A prospective study was conducted from April 2005 to December 2009 at Ramathibodi Hospital, Mahidol University (a 1000-bed university hospital), Bangkok, Thailand. Consecutive new HCP were enrolled into the annual surveillance programme, which consisted of TST and a chest X-ray prior to the start of clinical employment. The study was reviewed and approved by the institutional review board.

TST was performed using the Mantoux method. For those with a negative reaction, a two-step TST was performed to avoid misinterpretation due to the anamnestic response.[5] HCP with <10 mm induration were asked to enrol in the surveillance programme in the subsequent year and were followed up annually until they developed TST conversion or the end of data collection in December 2009. TST conversion was defined as a positive Mantoux test following a documented negative test or an increase of ≥6 mm over the previous year's test to ≥10 mm induration.[5]

HCP with an abnormal chest X-ray (reported by radiologists, who were blinded to the results of the TST) underwent further management. All HCP who did not have active TB at the initial evaluation were advised to observe themselves. No treatment was offered to those who had a positive TST at the baseline evaluation. Those who had TST conversion but had no evidence of active TB by history, chest X-ray, and physical examination, were advised to undergo a nine-month regimen of isoniazid (INH) as preventive therapy.

Logistic regression was used to determine the risk factors associated with prevalence of TST at baseline and the odds ratio (OR) and its 95% confidence interval (CI) were estimated. Poisson regression was used to determine the factors associated with cumulative incidence of TST conversion and the risk ratio (RR) and its 95% CI were estimated. $P < 0.05$ was considered statistically significant. All statistical analyses were performed using Stata statistical software version 10.0 (Release 10.0, Stata Corporation, College Station, TX, USA).

Results

From April 2005 to August 2008, 1438 new HCP were enrolled in the programme, 82% were females and the mean (SD) age was 20.7 (1.7) years. Of these, 579 (40.3%), 486 (33.8%), 272 (18.9%) and 101 (7%) were third-year nursing students, third-year medical students, nursing assistants, and registered nurses, respectively (Table I). The prevalence of positive TST was 66.3%. HCP who had a positive TST at baseline were slightly older, more likely to be male, and were more likely to have a Bacillus Calmette–Guérin (BCG) scar (Table II). Twenty-one HCP had an abnormal screening chest X-ray and seven HCP were diagnosed with active TB.

Although the annual prevalence of positive TST decreased from 70.5% in 2005 to 53% in 2008, this was not statistically significant (P for trend = 0.166). By multiple logistic regression analysis, age, male gender, BCG scar, and calendar year of TST were associated with odds of positive TST at baseline (Table II).

The 485 (33.7%) HCP who had negative TST results were followed up annually from 2006 to December 2009. Of these, 116 (23.9%) were lost to follow-up. The overall cumulative incidence of TST conversion was 11.4% among HCP who were at risk. The annual cumulative incidence of TST conversion decreased from 14% in 2006 to 3.6% in 2009, but there was no statistical difference by cohort year (P for trend = 0.166). The incidence rate of TST conversion was 4.79 per 100 HCP-years. By univariate Poisson regression, only the calendar year of TST was associated with TST conversion (RR: 0.63; 95% CI: 0.49–0.82; $P = 0.001$).

Table I
Baseline characteristics of new healthcare personnel (HCP) defined by the status of tuberculin skin test (TST) at screening

Characteristics	TST status at screening		*P*-value
	Positive ($N = 953$)	Negative ($N = 485$)	
Mean (SD) age (years)	20.8 (2.0)	20.4 (1.6)	0.002
Female gender, *N* (%)	756 (79.3)	423 (87.2)	<0.001
Positive BCG scar, *N* (%)	774 (81.4)	354 (73.8)	0.003
Type of HCP, *N* (%)			0.004
3rd year medical students	332 (34.8)	154 (31.8)	NS
3rd year nursing students	363 (38.1)	216 (44.5)	0.018
Registered nurses	81 (8.5)	20 (4.1)	0.002
Nursing assistants	177 (12.3)	95 (19.6)	<0.001
Cohort year, *N* (%)			<0.001
2005	278 (29.2)	116 (23.9)	0.035
2006	244 (25.6)	65 (13.4)	<0.001
2007	246 (25.8)	140 (28.9)	NS
2008	185 (19.4)	164 (33.8)	<0.001

BCG; Bacillus Calmette–Guérin; NS, non-significant.

Of 42 HCP with TST conversion, two were diagnosed with active TB. Sputum culture revealed *Mycobacterium tuberculosis* that was susceptible to first-line anti-TB drugs. They were treated with a six-month regimen. Of 31 HCP who received preventive therapy for LTBI, 30 received nine months of INH. One patient received INH for three months followed by rifampicin for six months because of peripheral neuropathy associated with INH. No serious adverse effects were found. Eight HCP refused preventive therapy and data were not available for one HCP. No HCP developed TB afterwards.

Discussion

We believe that this study is one of the largest cohorts and longitudinal TST studies among HCP, especially in Thailand and Asia where TB is endemic. We found the overall high prevalence of positive TST at baseline prior to commencing clinical employment comparable to other studies conducted either in Thailand or in other resource-limited settings.[3,4,6] The crude incidence of TST conversion was up to 11.4% or an incidence rate of 4.79 per 100 HCP-years. The programme detected active TB in 0.6% HCP by screening chest X-ray.

The cumulative incidence of TST conversion in this study was similar to other reports. Most converters had TST conversion within the first year after commencing clinical employment.[4,7] This observation may reflect a lack of compliance with standard precautions which in turn may reflect less clinical experience among these HCP. The TST conversion decreased over time in the present study, which may reflect improved compliance with

Table II
Univariate and multivariate logistic regression determining factors associated with positive tuberculin skin test (TST) at baseline

Characteristics	Univariate logistic regression		Multivariate logistic regression	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Age	1.12 (1.03–1.21)	0.008	1.07 (1.00–1.15)	0.043
Male gender	1.78 (1.30–2.42)	<0.001	1.82 (1.33–2.49)	<0.001
Positive BCG scar	1.56 (1.20–2.02)	0.001	1.46 (1.12–1.91)	0.005
Year of TST	0.74 (0.68–0.82)	<0.001	0.76 (0.69–0.84)	<0.001
Type of HCP	0.99 (0.90–1.10)	NS		

BCG, Bacillus Calmette–Guérin; OR, odds ratio; CI, confidence interval; NS, non-significant.

precautions and/or the implementation of effective infection control strategies in the hospital. A number of infection prevention and control measures were implemented in the hospital during the study period including the building of two isolation rooms with negative-pressure ventilation and an upgrade of the ventilation systems of the intermediate (so-called 'step-down' unit), the medical intensive care unit and the coronary care unit so that air will flow from nurse station to patient then exhaust through a high efficiency particulated (HEPA) filter system.

We detected nine HCP with active pulmonary TB. We found seven HCP with active pulmonary TB at baseline screening, which comprised about 487 per 100,000 population. This is higher than the national estimate published in the WHO Report.[1] About 5% of converters had active pulmonary TB diagnosed, which is consistent with statistics.[8] Our surveillance programme detected active TB cases among HCP and could be implemented as a national strategy.

We note that TST may not be the gold standard for the diagnosis of LTBI in HCP because of limited diagnostic accuracy and the association of TST and BCG vaccination.[9] In this study, the presence of a BCG scar was associated with positive TST at baseline but not TST conversion. Several studies evaluated the utility of TST and interferon-gamma diagnosis assays among HCP.[10] However, TST remains the only readily, inexpensive, and affordable test for diagnosis of LTBI in resource-limited settings.

There were other limitations of our study, namely, two-step TST was not carried out during the follow-up visit and the incidence of TST conversion may have been underestimated. A significant proportion of HCP was lost to follow-up. We did not have information about compliance with preventive therapy and could not assess the effect of preventive therapy among converters because of the small sample size. There was no further information about the *M. tuberculosis* strains isolated from HCP who developed active TB and patients who were suspected to be the source.

In conclusion, a high prevalence of TST among HCP was found and may represent high rates of TB in the community in Thailand. The high incidence of TST conversion may reflect nosocomial transmission. We suggest that the surveillance programme described here should be implemented in other healthcare units. These strategies facilitate the prompt diagnosis and prevention of TB among HCP to help reduce nosocomial TB transmission and contribute to global TB control.

Acknowledgements

The authors would like to thank all staff of the Infection Control Unit, Department of Nursing for surveillance data collection. Assistance from the medical chart service staff is acknowledged. We also would like to thank M.M. Broughton for reviewing the manuscript.

Conflict of interest statement
None declared.

Finding support
None.

References

1. Thailand. Country profile. In: *Global tuberculosis control: epidemiology, strategy, financing. World Health Organization Report 2010*. Geneva: WHO Press; 2010. p. 149–152.
2. Alonso-Echanove J, Granich RM, Laszlo A, *et al.* Occupational transmission of *Mycobacterium tuberculosis* to health care workers in a university hospital in Lima, Peru. *Clin Infect Dis* 2001;33:589–596.
3. Cuhadaroglu C, Erelel M, Tabak L, Kilicaslan Z. Increased risk of tuberculosis in health care workers: a retrospective survey at a teaching hospital in Istanbul, Turkey. *BMC Infect Dis* 2002;2:14.
4. Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health-care workers in low- and middle-income countries: a systematic review. *PLoS Med* 2006;3:e494.
5. Jensen PA, Lambert LA, Iademarco MF, Ridzon RCDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR Recomm Rep* 2005;54(RR-17): 1–141.
6. Tippayachai J, Jiamjarasrangsi W, Hiransuttikul N, Ekpanyaskul C, Udompanich V, Sittipunt C. Prevalence rate and factors associated with *Mycobacterium tuberculosis* infection among health care workers in King Chulalongkorn Memorial Hospital. *Chula Med J* 2006;50:303–318.
7. Chaiear N, Buapeun J, Saejiw N, Reechaipichitkul W, Boonsawas W. Tuberculin skin test positive conversion rate in health care personnel and health science students in a Srinagarind hospital, Thailand [abstract]. *Occup Environ Med* 2004;61:e29.
8. Small PM, Fujiwara PI. Management of tuberculosis in the United States. *N Engl J Med* 2001;345:189–200.
9. Girardi E, Angeletti C, Puro V, *et al.* Estimating diagnostic accuracy of tests for latent tuberculosis infection without a gold standard among healthcare workers. *Eurosurveillance* 2009;14(43): pii=19373.
10. Khawcharoenporn T, Apisarnthanarak A, Sungkanuparph S, Woeltje KF, Fraser VJ. Tuberculin skin test and isoniazid prophylaxis among health care workers in high tuberculosis prevalence areas. *Int J Tuberc Lung Dis* 2011;15:14–23.