Usefulness of the Mantoux test in screening for active pulmonary tuberculosis in the Hong Kong elderly

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From October to December 1985, 78 patients with active pulmonary tuberculosis (mean age, 73.4 years) were given the Mantoux test (1 unit). Non-reactors were rechallenged with 10 units. The results of the test group were compared with those of 108 controls. Fifty-three patients with radiologically inactive tuberculosis (mean age, 71.4 years) were included in the control group. Twenty-one had radiologically inactive tuberculosis without prior treatment and 32 had radiologically inactive tuberculosis with a mean interval of 11.9 years from previous treatment. The remaining 55 controls had no radiological or clinical evidence of tuberculosis (mean age, 72.0 years). The Mantoux test in either strength showed either low sensitivity or specificity for active tuberculosis. Although both showed good positive predictive value of over 80% in indicating an abnormal chest X-ray, further investigations were required to establish disease activity. We concluded that the Mantoux test has limited usefulness as a screening or diagnostic tool for active pulmonary tuberculosis in the elderly population of Hong Kong, where the prevalence of tuberculosis is high.

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Introduction

The tuberculin skin test has long been used as an aid in the diagnosis of and in epidemiological studies of tuberculosis (TB).[1,2] However, a decline in sensitivity with advancing age is a recognised phenomenon, as are other causes of anergy.[3-6] Previous clinical or subclinical pathogenic tuberculous infection and cross-reactions from non-tuberculous mycobacteria also vary the pattern of tuberculin sensitivity in different geographic locations.[7] Our study looked at the usefulness of one of the tuberculin skin tests, the Mantoux test, as a diagnostic and screening test for active pulmonary TB in a Hong Kong elderly population where the disease is prevalent.

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Materials and methods

Test subjects

Pulmonary TB patients aged 65 years or more who were attending three chest hospitals in Hong Kong, were given skin tests during the period October to December 1985. All patients included in the study had either positive bacteriological results by smear or culture, serial radiologically active lesions in the chest, or histological findings of typical granulomata. All were receiving treatment for active pulmonary TB as inpatients.

Control subjects

Controls were drawn from two patient groups (Table 1). One group comprised elderly subjects with serial radiologically inactive TB on chest radiograph, and with negative bacteriology studies. These were selected from the geriatric units at two general hospitals in Hong Kong. Any history of previous antituberculous treatment and time-lapse from the treatment were recorded. Skin tests were performed as in the test subjects.

The second group included patients from the above two geriatric units who had no clinical or radiological evidence of pulmonary TB.

All control subjects were admitted for the management of unrelated medical conditions. All study subjects had no previous history of BCG vaccination and had been Hong Kong residents for at least 40 years.

Table 1. Sex and age profile of study and control subjects

	No. of males (Mean age: y)	No. of females (Mean age: y)	Total
Active TB	59 (72.4) *	19 (76.4) *	78
Inactive TB without prior treatment	11 (69.0) *	10 (74.7) *	21
Inactive TB with prior treatment*	27 (70.4) *	5 (75.4) *	32
No TB	22 (70.2) *	33 (73.2) *	55

* Mean interval from prior treatment = 11.9 y

The skin test technique

The technique used for skin testing followed the standard Mantoux test procedure.[1] One tuberculin unit (MT1) of purified protein derivative (tuberculin [PPD]; Virus Unit, Queen Mary Hospital, Pokfulam, Hong Kong) stabilised with Tween 80 (Virus Unit, Queen Mary Hospital, Pokfulam, Hong Kong) was given to all study subjects initially. The resulting induration response (mm) was read at 48 hours. A negative reaction was judged as being induration of less than 10 mm. Non-reactors were rechallenged with 10 tuberculin units of PPD (MT10) within seven days of the initial MT1 test. The subsequent reaction was again read at 48 to 72 hours. The results of the skin tests were all read by the first author. Prior consent was obtained in all study subjects.

Results

From October to December 1985, 186 individuals were tested with MT1 and non-responders were rechallenged with MT10. There were 78 study patients with active pulmonary TB. The control group included 21 individuals with radiologically inactive TB without prior treatment, 32 with radiologically inactive TB who had received prior treatment, and 55 with no radiological or clinical evidence of TB. In all study subjects, MT10 increased the proportion of positive responders, particularly in the group without clinical disease. In those with active TB, MT10 increased the proportion of positive responders from 50.0% to 83.3%; inactive TB, 56.6% to 92.4%; and those without evidence of TB, from 18.2% to 50.9% (Tables 2 to 5).

Discussion

Tuberculosis remains an important disease in Hong Kong. The notification rate in 1984 was 146.2 per 100 000 population,[8] which was considerably higher than that for developed countries such as the United Kingdom and the United States.[9,10] Almost 15% of those notified were aged 65 years or more. As the elderly tend to report their illnesses at a later stage, and often less readily than does the general population,[11] a sizeable proportion of those with TB might have escaped diagnosis. A simple skin test that aids the screening and diagnosis of active TB in such a population would be useful.

As a screening test for active TB, the MT1 was neither sensitive nor specific (Table 3a). Although MT10 has a reasonable sensitivity of 83.3%, treatment based on a

Table 2. Positive response to Mantoux test using 1U (MT1) and 10U (MT10) purified protein derivative (tuberculin)

TB Activity	No. of subjects	MT1		MT10	
		Frequency	%	Frequency	%
Active TB (t)	78	39	50.0	65	83.3
Inactive TB without prior treatment (a)	21	10	47.6	20	95.2
Inactive TB with prior treatment (b)	32	20	62.5	29	90.6
Inactive TB (a + b)	53	30	56.6	49	92.4
No TB (c)	55	10	18.2	28	50.9
Total	186				

positive response will result in overtreatment because of the low specificity of 28.7% (Table 3b).

As a diagnostic test to detect active TB in an abnormal chest X-ray (Tables 4a and 4b), the MT1 was neither sensitive nor specific. The low specificity of MT10 at 7.5% also rendered it useless for such a purpose.

However, the χ^2 statistics revealed a significant difference in the response of MT1 and MT10 to abnormal chest X-ray, including active and inactive disease (Tables 5a and 5b). Both MT1 and MT10 showed good positive predictive values for an abnormal chest X-ray in clients in more than 80% of instances. Hence, MT1s which yielded a positive response were followed by a chest X-ray. Since the Mantoux test cannot distinguish between active and inactive disease states, the discovery of an abnormal chest X-ray requires further investigations for activity, such as clinical correlation, sputum or bronchoscopic aspiration for acid-fast bacilli, and serial monitoring for any radiological changes.

Our study did not analyse the effect of any coexisting medical conditions on the response to the Mantoux test. While these skin tests continue to be a recognised tool in the screening and diagnosis of TB in more affluent countries,[1,2] its usefulness in the elderly remains limited in areas with a high prevalence of the disease such as Hong Kong.

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References

1. American Thoracic Society Committee on Diagnostic Skin Testing. The tuberculin test. Am Rev Respir Dis 1971;104:769-75.
2. Katz S, Duvall RC, Ryan TJ, et al. Intermediate-strength purified protein derivative: its diagnostic significance in active tuberculosis. Am Rev Respir Dis 1960;81:196-9.
3. Holden M, Dubin RD, Diamond PH. Frequency of negative intermediate strength tuberculin sensitivity in patients with

Table 3a. Response to MT1 observed in those with active TB

	Active TB (t)	**Inactive TB or no TB (a + b + c)**	
MT1 +	39	40	Positive predictive value 49.4%
MT1 -	39	68	Negative predictive value 63.6%
	Sensitivity 50.0%	Specificity 63.0%	
$\chi^2 = 3.1$ P = 0.08			

Table 3b. Response to MT10 observed in those with active TB

	Active TB (t)	**Inactive TB or no TB (a + b + c)**	
MT10 +	65	77	Positive predictive value 45.8%
MT10 -	13	31	Negative predictive value 70.5%
	Sensitivity 83.3%	Specificity 28.7%	
$\chi^2 = 3.6$ P = 0.06			

active tuberculosis. N Engl J Med 1971;285:1506-9.
4. Johnston RN, Ritchie RT, Murray IH. Declining tuberculin sensitivity with advancing age. BMJ 1963;21:720-4.
5. Kent DC, Schwartz R. Active pulmonary tuberculosis with negative tuberculin skin reactions. Am Rev Respir Dis 1967;95:411-8.
6. Nash DR, Douglas JE. Anergy in active pulmonary tuberculosis Chest. 1980;77:32-7.
7. Palmer CE, Edwards LB, Hopwood L, et al. Experimental and epidemiologic basis for the interpretation of tuberculin sensitivity. J Paediatr 1959;55:413-28.
8. Tuberculosis and Chest Services: Departmental Report, 1984-85. Hong Kong: Hong Kong Medical and Health Services; 1985.
9. Davies B. The respiratory system. In: Pathy MS, editor. The principle and practice of geriatric medicine. Chichester: John Wiley & Sons, 1985:519-21.
10. Grazybowki S. Tuberculosis: a look at the world situation. Chest 1983;84:756-61.
11. Williamson J, Stokoe IH, Gray S, et al. Old people at home: their unreported needs. Lancet 1964;i:1119-20.

Table 4a. Response to MT1 according to radiological status

	Chest X-ray Active (t)	**Chest X-ray Inactive (a + b)**	
MT1 +	39	30	Positive predictive value 56.5%
MT1 -	39	23	Negative predictive value 37.1%
	Sensitivity 50.0%	Specificity 43.3%	
$\chi^2 = 0.55$ P = 0.46			

Table 4b. Response to MT10 according to radiological status

	Chest X-ray Active (t)	**Chest X-ray Inactive (a + b)**	
MT10 +	65	49	Positive predictive value 57.0%
MT10 -	13	4	Negative predictive value 23.5%
	Sensitivity 83.3%	Specificity 7.5%	
$\chi^2 = 2.31$ P = 0.13			

Table 5a. Abnormal radiological result found: response to MT1

	Chest X-ray Abnormal (t + a + b)	**Chest X-ray Normal (c)**	
MT1 +	69	10	Positive predictive value 87.3%
MT1 -	62	45	Negative predictive value 42.1%
	Sensitivity 52.7%	Specificity 81.8%	
$\chi^2 = 18.76$ P = 0.00001			

Table 5b. Abnormal radiological result found: response to MT10

	Chest X-ray Abnormal (t + a + b)	**Chest X-ray Normal (c)**	
MT10 +	114	28	Positive predictive value 80.3%
MT10 -	17	27	Negative predictive value 61.4%
	Sensitivity 87.0%	Specificity 49.1%	
$\chi^2 = 27.82$ P = 0			