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Reliability of mantoux in diagnosis of tuberculosis and Factors affecting it

Abstract

This study was conducted to determine the frequency of infected children cohabiting with sputum-positive and negative tuberculous adults for grounding the authenticity of the Montoux test in diagnosing tuberculosis among these groups. It was inferred from the study that a significant figure of the children with positive tuberculin skin test was not found to be diseased with tuberculosis and those with negative test results were diagnosed tuberculous based on chest X-ray, sputum examination, and FNAC of enlarged lymph nodes. Therefore, despite its widespread use, a large proportion of children remain undiagnosed yet are infected. Therefore, the Montoux test solely is not worth reliable for the diagnosis of tuberculosis and hence confirmation of the disease by more sophisticated tests is mandatory.

Keywords: Montoux test, tuberculin skin test, sputum smear-positive TB, sputum smear-negative TB

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Introduction

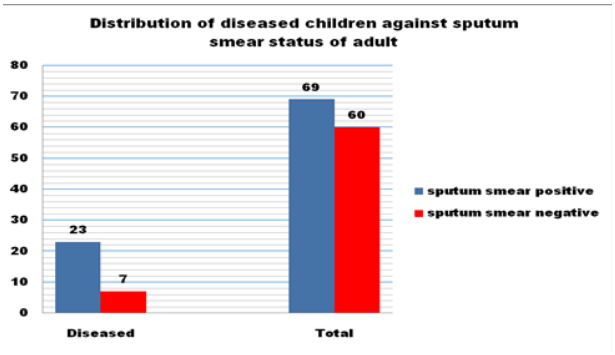
The Montoux test has been one of the commonest screening investigations to diagnose tuberculosis, particularly in the pediatric population for decades and is considered to be a powerful tool for determining latent TB infection in TB endemic areas.[1,2] It generates a delayed hypersensitivity response to 0.1 ml of 5 TU of purified protein derivative administered intradermally[3] which is a common crude blend of various mycobacterial antigens such as *M.tb, M. Bovis*, BCG, and *non-tuberculous mycobacteri*a. Furthermore, several factors inherent in the test and those related to the host such as prior BCG exposure, immunity of the patient, age, socioeconomic status, contact with tuberculous adults, local infection at the site, unskilled observer, other illnesses, etc. yield a wide range of variations in the test results with the expression of reaction in uninfected children to complete absence of reaction in confirmed TB cases,[4] thus steeping down the reliability of the test to several folds. This study had been conducted on children cohabiting with tuberculous adults. It was inferred from the study that a significant figure of the children with positive tuberculin test was not found to be diseased with tuberculosis and those with negative test results were diagnosed tuberculous based on chest X-ray, sputum examination, and FNAC of enlarged lymph nodes. Therefore, despite its widespread use, a large proportion of children remain undiagnosed yet are infected. Therefore, the Montoux test solely is not worth reliable for the diagnosis of tuberculosis and hence confirmation of the disease by more sophisticated tests is mendatory.[5]

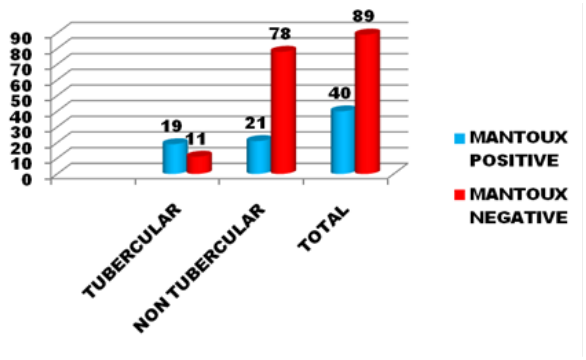
Materials and methods

This study had been conducted in the department of Pediatrics in Jawaharlal Nehru

Medical College, AMU, Aligarh, during the year 2008-2009 on 129 children <12 yrs of age, of which 69 children were cohabiting with 25 sputum positive and 60 children with 23 sputum negative tuberculous adults registered under DOTS of JNMCH, AMU Aligarh with no previous history of ATT, HIV, hematological or reticuloendothelial malignancies and immunosuppressive therapy. Each child underwent a sputum examination, Montoux test, X-ray chest, FNAC of lymph nodes, USG abdomen, and CT head. The Montoux test was done by administering 5 TU of PPD and the results were observed after 72 hrs of administration considering 10 mm or greater induration as a positive tuberculin test.

Observation and result





Discussion

Montoux or Tuberculin Skin Test is one of the few conventional tests which have been employed to date for diagnosing TB. Despite its widespread application across the world, there persists debate regarding the interpretation and authenticity of the test result.[4] The cut-off values for Montoux to be considered positive are variable among different individuals and highly influenced by age, immunity, socioeconomic status, and associated medical conditions ranging from < 5mm in severe immunodeficiency to > 15mm in otherwise healthy individuals harboring latent TB infection.[6] Considering 10 mm induration to be the cut-off value for the positive test, the sensitivity and specificity of the tuberculin skin test are 94% and 88% respectively.[7]

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It is evident from table 1 of the above study that age <3 yrs, low socioeconomic status, symptomatic children, and those in close congruity with sputum smear-positive adults remarkably influenced the test outcome. Table 2 depicts that, 38.64% of children were in close contact with sputum smear-positive adults and 14.29% with sputum negative out of 55% of total Montoux-positive vaccinated children. Furthermore, in comparison to normal and moderately malnourished children, the Mantoux positivity is less frequent in severely malnourished children among sputum-positive contacts. The symptomatic individuals belonging to sputum-positive contacts show Montoux positivity of 68.89 % as compared to sputum-negative contacts in which this value is 31.03%.

Table 1 Probable risk factors influencing the prevalence of infection among children in household contact with adult tuberculous patients

Variables	Infection	No infection	P Value	Odd ratio	chi-square	95% CI
Age < 3 yrs (N=30)	14	16	< 0.05	2.457	4.5	1.055-5.714
Contact with sputum-positive adults(N=69)	27	42	< 0.05	2.324	4.6	1.063-5.078
Low socioeconomic status (N=59)	25	34	<0.01	2.696	6.6	1.248-5.284
Symptomatic children(N=65)	32	33	<0.001	6.787	20.3	6.246-7.367

Table 2 Demographic characteristics of Mtx +ve children viz a viz sputum smear status of the source

Variables		Sputum +ve		Sputum -ve		Total N=40	p Value
		total	Mtx +ve	total	Mtx +ve		
Age	0-3 YRS N=30	17	6 (35.29)	13	2(15.38)	8 (20.00)	NS
	3-6 YRS N=48	23	8 (34.78)	25	3 (12.00)	11 (27.50)	NS
	6-12 YR N=51	29	13 (44.83)	22	8 (36.36)	21 (52.50)	NS
Gender	Male N=69	38	18 (47.37)	31	7 (22.58)	25 (62.50)	0.05
	Female N=60	31	9 (29.03)	29	6 (20.69)	15 (37.50)	NS
BCG status	Vaccinated N=79	44	17 (38.64)	35	5 (14.29)	22 (55.00)	0.05
	Unvaccinated N=50	25	11 (44.00)	25	7 (28.00)	18 (45.00)	NS
Nutritional status	Normal N=35	21	4 (19.05)	14	1 (7.14)	5 (12.50)	NS
	Mod Undernutrition N=72	36	18 (50.00)	36	8 (22.22)	26 (65.00)	0.05
	Severe Undernutrition N=22	12	5 (41.67)	10	4 (40.00)	9 (22.50)	NS
Socio-economic background	Low Socio-Economic Status N=59	38	18 (47.37)	21	8 (38.10)	26 (65.00)	NS
	Above Low Socio-Economic Status N=70	31	9 (29.03)	39	5 (12.82)	14 (35.00)	NS

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Variables		Sputum +ve		Sputum -ve		Total N=40	p Value
		total	Mtx +ve	total	Mtx +ve		
Clinical features	Symptomatic N=65	36	23 (63.89)	29	9 (31.03)	32 (80.00)	0.05
	Asymptomatic N=64	32	4 (12.90)	32	4 (12.90)	8 (20.00)	NS

The figure in parenthesis indicates the percentage.

Table 3 reflects that out of the total diseased children, 63.33% were Montoux-positive. However, a considerable fraction of 36.67% was tested Montoux negative yet tuberculous, diagnosed on the grounds of chest X-ray, sputum examination, FNAC of enlarged lymph nodes, USG abdomen, and CT head. This is regarded as one of the greatest demerits of the Montoux test as these cases when remain undetected will act as a reservoir from whom new TB cases will arise. Therefore, for unerring recognition of the disease, the evaluation must not be confined to negative TST results and efforts ought to be made in the direction of more advanced and authentic investigations so that there should be no possibility of inaccuracy in the correct diagnosis.

Table 3 Mantoux status in relation to tuberculosis in children

Montoux status	Tubercular	Non-tubercular	Total
Montoux Positive	19(63.33)	21(21.21)	40(31.00)
Montoux Negative	11(36.67)	78(78.79)	89(69.00)
Total	30	99	129

Tuberculin skin test and immunity

The Tuberculin Skin Test is mediated by T-cells sensitized by prior infection and clustered to the skin site producing lymphokines. The absence of cell-mediated immunity following tuberculous infection may be due to a lack of prior sensitization, non-functional T-cells, or anergy resulting from immunosuppression. As a result, immunodeficient states influencing T-cells primarily lower the percentage of the positive Tuberculin test result. On the other hand, conditions associated with a hyperactive immune response such as autoimmune diseases yield the highest percentage of positive tuberculin skin tests.[8]

Tuberculin skin test and low socioeconomic status

Since children belonging to low socioeconomic status are malnourished and tend to

have feeble immunity, the probability of acquiring tuberculosis is relatively high in comparison to those adequately fed and belonging to upper socioeconomic groups. However, the possibility of a false negative value of the Montoux test is more frequent in children of low socioeconomic status and very few among them yield the correct value of TST.[9]

Tuberculin skin test and infection with atypical mycobacteria

As already mentioned that PPD is a combination of various mycobacterial antigens, and children previously sensitized to non-tuberculous mycobacteria (atypical mycobacteria) generate false positive results in the TST. Hence, for more precise diagnosis, screening by other advanced techniques like IGRA can successfully minimize the dilemma in the diagnosis and irrelevant exposure to chemoprophylaxis of tuberculosis.[10]

Conclusion

The above study infers that despite the widespread application, easy accessibility, and cost-effectiveness, the tuberculin skin test is associated with ambiguity in the correct diagnosis of tuberculosis, and confirmation with more sensitive and specific investigations is necessary to rectify the uncertainty associated with Montoux results. Only then, the latent tuberculous cases will be spotted which is essential to minimize the burden of tuberculosis in the country.

Acknowledgments

None.

Conflict of interest

The authors declare there is no conflict of interest.

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