

BCG VACCINATION IN MALNOURISHED CHILD POPULATION

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ABSTRACT

The efficacy of BCG vaccination is still a subject of controversy. In the present study the protective role of BCG vaccination, the influence of nutritional status and justification for revaccination in children were investigated. Of the 504 preschool children suffering from tuberculosis who were registered for the study, 345 children did not receive BCG vaccine while the others had it during early infancy. Vaccinated children showed a significantly greater tendency to localise the tubercular lesions while most of the unvaccinated children suffered from progressive forms of the infection. Vaccination had similar effects even when there was associated malnutrition. Age did not seem to influence the severity of the disease in unvaccinated children while older children (>3 yrs) had a greater tendency to localise the lesion in the vaccinated group. These data do not support the proposal of administering a booster dose of BCG to children who were vaccinated during early infancy.

Key words: BCG vaccine, Malnutrition, Tuberculosis.

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Received for publication December 19, 1990;

Accepted August 28, 1991

Among the various vaccines, BCG appears to be unique in being much debated and subjected to vast criticism to several aspects such as its efficacy, age of administration, need for revaccination *etc.*, particularly in children. Much of this debate and controversy is due to the extrapolation to infants and children, of the results obtained from clinical and epidemiological studies carried out in adolescents and adults, the validity of such a procedure being often rightly questioned.

A WHO study group on BCG vaccination policies(1) after a thorough review made a recommendation that "despite the lack of evidence that the risk of infection *per se* is reduced by BCG, the latter should be administered to children with a view to reduce the hematogenous spread which decreases the risk of immediate disease and of disease due to reactivation". Nevertheless, the results of the BCG trial carried out in South India(2) have left doubts among the Indian Pediatricians and Public Health workers about the usefulness of BCG vaccination.

BCG vaccination is now recommended in the newborn period or at the earliest contact of the infant with the health worker. However, it has been observed that the post vaccination tuberculin sensitivity in the newborn is lower than in older children and revaccination at school age is recommended(3). Further, malnutrition in developing countries has been listed as one of the important factors for a faster waning of the immunity in children who received BCG at birth or during early infancy(4).

In the present study the degree and nature of protection conferred by BCG against childhood tuberculosis, the role played by malnutrition in modifying the protection offered by BCG and whether

revaccination is necessary or not were examined.

Material and Methods

Five hundred and four consecutive children, aged 1-5 years and having different forms of childhood tuberculosis, registered over a period of 6 months from April, 1989 to October, 1989 were studied. Diagnosis of tuberculosis was based on the clinical symptomatology, radiological and biochemical evidence in case of tubercular meningitis. In addition, BCG diagnostic test was carried out over right deltoid region and a reaction of 10 mm or more at the end of 72 h was regarded as positive. The presence or absence of BCG scar was noticed and children with positive scar were found to have received BCG within the first 3 months of life and in such children the diagnostic test was given on the right arm. The nutritional status of these children was recorded as percentage weight/age using NCHS standards(5). The type of tuberculosis was diagnosed as localised if it was confined to mediastinal or cervical lymphnodes and severe when there was evidence of pulmonary or extrapulmonary spread.

Results

Of 504 children studied, 345 did not have BCG scar, constituting a significantly higher percentage (68.5%) compared to 31.5% of children who had positive BCG scar. Severity of the infection was compared between the BCG positive and BCG negative groups of children with tuberculosis. Of 159 children who had BCG scar, 73.0% had localised infection while only 7.0% of the unvaccinated children had localised lesions. Twenty seven per cent of the vaccinated children developed severe forms of infection as compared to a highly significant percentage (93.0%) of the unvaccinated children. The profile of the different types of tuberculosis with respect to vaccination status are shown in *Table I*. Nearly 22% of children with progressive pulmonary tuberculosis were vaccinated, 78% were unvaccinated ($p < 0.001$). Extra pulmonary tuberculosis was not commonly seen in the vaccinated children. The other forms like abdominal tuberculosis were not found in the vaccinated group.

The effect of nutritional status on the severity of infection is indicated in *Table II*. In BCG vaccinated group, the percentages

TABLE I—Vaccination Status of Children with Various Forms of Tuberculosis

Severity of tuberculosis	Total No. of cases	BCG vaccination status	
		Positive	Negative
Mediastinal and cervical lymphadenites	140	116*** (82.8)	24 (17.2)
Progressive pulmonary TB	156	34*** (21.8)	122 (78.2)
TB meningitis	186	9*** (4.8)	177 (95.2)
Abdominal TB	16	—	16
Others	6	—	6

Figures in parentheses are percentage.

*** $p < 0.001$ compared with the unvaccinated group.

TABLE III—Effect of Vaccination, Nutritional Status and Age on Severity of Tuberculosis

% Nutritional status and age groups	BCG +ve			BCG -ve		
	Localised	Severe	Total	Localised	Severe	Total
<3 years						
>75	17 (70.8)	7 (29.2)	24 (100)	5 (9.8)	46 (90.2)	51 (100)
75-61	18 (62.1)	11 (37.9)	29 (100)	5 (8.1)	57 (91.9)	62 (100)
≤60	2 (22.2)	7 (77.8)	9 (100)	2 (3.6)	53 (96.4)	55 (100)
>3 years						
>75	33 (89.2)	4 (10.8)	37 (100)	5 (13.2)	33 (86.8)	38 (100)
75-61	27 (79.4)	7 (20.6)	34 (100)	5 (6.1)	77 (93.9)	82 (100)
≤60	19 (73.1)*	7 (26.9)	26 (100)	2 (3.5)	55 (96.5)	57 (100)

Figures in parentheses are the percentages.

Nutritional status is based on weight for age as percentage of standard.

* $p < 0.025$, compared to severely malnourished group > 3 years.

Discussion

The protection offered by BCG vaccine has always been a matter of debate and the controversy(3,6). Several epidemiological studies showed highly variable results, the protection ranging from 0-80%(2,7). The reasons for such results are not clear but could be due to both environmental and microbial factors. The recent long term follow up study from India pointing out the failure of BCG vaccine to protect from bacillary pulmonary tuberculosis in adults has added more confusion to the controversy(2). The WHO expert group clearly expressed that the results of a study in one part of the globe cannot be extrapolated to those carried out in other parts of the world and as the Indian study had not provided adequate information regarding the protective role of BCG in infants and children, the vaccination should continue in order to protect children from progressive forms of the disease, if not to prevent the disease totally(1). Despite this clear recommendation, doubts have been raised

by pediatricians and public health workers regarding the protective role of BCG.

The present study demonstrates a protective role played by BCG vaccine in children confirming some of the earlier experimental and clinical reports(9,10). The study also clearly demonstrates that in BCG vaccinated children, the infection tends to be localised and hematogenous spread, which leads to progressive forms, minimised. However, the protection offered appears to be greater for extra pulmonary forms compared to progressive pulmonary forms. The reasons for this phenomenon are not clear. The fact that considerable number of children with tuberculosis in this study are vaccinated shows that BCG vaccination does not prevent infection, when the individual is exposed to tubercle bacilli. However, the protection offered by BCG is only partial and should not be mistaken for absolute prevention from the disease.

The occurrence of tuberculosis inspite of BCG immunization has also led to speculation of several reasons, one of them

being malnutrition which is prevalent among preschool children of the developing countries. However, the present study shows that the percentage of vaccinated and malnourished children with severe forms of the disease is significantly lower than that of the children who did not receive vaccination and the tendency to localize the lesion by even malnourished children is comparable with that of the well nourished in the vaccinated group suggesting that BCG prevents the spread of infection even in presence of associated malnutrition.

It is now recommended in most of the developing countries that BCG vaccine should be administered during the early infancy or in the neonatal period(11). Doubts have been expressed about the long lasting effects of single vaccination at birth or in early infancy and hence the need for revaccination suggested(12). Further, Seth *et al.* reported less number of undernourished children showing positive Mantoux test after BCG vaccination compared to the younger age group of similar nutritional status thus implying that in malnourished and older children the protection offered by BCG might have waned off earlier than in the well nourished group(4).

The results of the present study showed that age played no role in determining the severity of the disease in unvaccinated children. But interestingly greater percentage of children above 3 yrs of age and who received primary BCG vaccination in infancy showed significantly greater tendency to localise the lesion. The same was true in relations to a given plane of nutritional status also. This observation is in line with the results reported by the tuberculosis Vaccination Clinical Trials Committee to the Medical Research Council(13). Though the exact mechanism for this

phenomenon is not clear, it is possible that the primarily protected child tends to improve the immune status due to repeated exposures to the infection in the community while the unvaccinated child being susceptible, develops the disease with such exposure.

In view of this, it is perhaps appropriate to stress the need for compulsory primary immunization and effective measures of eliminating open cases of pulmonary tuberculosis as measures for prevention and control of tuberculosis in developing countries.

Acknowledgements

The authors are thankful to Dr. Vinodini Reddy, Director, National Institute of Nutrition, for her keen interest in the study and Mr. P. Ajay Kumar for his help in the analysis of the data.

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NOTES AND NEWS

UPDATE-CUM-WORKSHOP ON HEMATO-ONCOLOGY

An Update-cum-Workshop on Hemato-Oncology sponsored by the Department of Pathology, Lady Hardinge Medical College; Department of Hematology & Blood Bank, All India Institute of Medical Sciences and Department of Pathology, Maulana Azad Medical College in collaboration with Delhi Society of Hematology is being held at Department of Pathology, Lady Hardinge Medical College, New Delhi on 16-17 February, 1992.

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