

ORIGINAL ARTICLE

A Study on BCG Vaccination Using Bifurcated Needle in Babies*

by

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Abstract

Investigation was done on 527 babies comparing BCG vaccination by bifurcated needle and intradermal method. For this study Japanese and Biofarma BCG vaccines were used. Tuberculin reaction produced did not show any significant difference between the two methods. On the other hand, vaccination lesions produced by bifurcated needle were significantly larger than the intradermal method, however the mean lesion size were below the 7 mm limit. Complication were not found with both methods.

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Introduction

The use of bifurcated needle for BCG vaccination in children has been studied abroad. The results have been unsatisfactory as the tuberculin reaction was inferior to that of the intradermal method (Vaughan et al., 1972).

A similar study was conducted in 1973 in Indonesia. It was found that complication was rare and the scar was substantially smaller than that resulting from the standard intradermal method. However, the tuberculin reaction was also inferior to the standard method (Handojo et al., 1974).

The merits of WHO bifurcated needles in smallpox eradication was well known. Its method was very simple and easily accepted by a layman.

In 1974/1975 a study on the use of the bifurcated needle for BCG vaccination was conducted among a number of babies with the objective to test whether similar results could be produced in babies as in schoolchildren, particularly regarding complication, scar size and tuberculin reaction.

Materials and method

685 babies were collected from various MCH-centres in Tangerang, Jakarta, Bogor and Bandung. Babies of civilian families as well as Armed Forces fulfilling the following criteria were included in the study.

- No BCG scar on both upper arms.
- Tuberculin reaction 5 mm, which was considered as non-reactor.
- Under 12 months of age.

They were divided into 6 groups according to the type of BCG vaccination, concentration and technique, and 1 placebo group (Table 1); 527 babies have terminated the study.

Japanese and Biofarma BCG vaccines were used in this study: A higher concentration for bifurcated needle whereas normal concentration for the standard intradermal method (Table 2). Saline solution being the solvent for Japanese BCG vaccine, was used as placebo.

Copenhagen PPD RT 23 Tween 80 at a concentration of 2 TU per 0.1 ml, was used for tuberculin testing.

Two well trained nurses were assigned as tuberculin tester and reader. An experienced smallpox vaccinator and another well trained nurse used bifurcated intradermal method respectively.

All vaccines were kept in a refrigerator and, under field condition, in ice box, reconstituted vaccines were protected from sunlight with black carbon paper, and was not recommended to be used after 2 hours, while in a syringe not after 15 minutes.

BCG vaccine and placebo solution were prepared by the investigator and distributed by the vaccinators who remained not to know about the concentration of the content as a double blind method.

The application of vaccine with the bifurcated needle was done as follows: The needle was inserted into the reconstituted vaccine and the first drop was spread over 1 cm² of the skin; a

second drop was taken out from the ampule to be punctured 15 times on the same skin area. For intradermal vaccination, Omega syringe was used, BCG vaccine was applied according to the usual technique.

Tuberculin testing and BCG vaccination were done simultaneously on all babies, respectively on the lower dorsal part (WHO, 1963) of the left lower arm and 3 cm below the shoulder at the right upper arm.

TABLE 1: *Grouping of babies according to BCG vaccine, concentration and method*

Code	Number of babies	Method of application	Concentration	Vaccine
01	45	Intradermal	Placebo	—
02	81	Intradermal	0,375 mg/ml	Biofarma
03	92	Intradermal	0,25 mg/ml	Japan
04	70	Intradermal	0,50 mg/ml	Japan
05	73	Percutaneous	160 mg/ml	Japan
06	79	Percutaneous	80 mg/ml	Japan
07	87	Percutaneous	80 mg/ml	Biofarma

TABLE 2: *BCG Vaccine used*

Origin	Strain	Property	Content each amp.	Batch number	Date		Application	Dissolved into
					Manuf.	Expired		
Japan	Tokyo	Heatstable Freeze dr.	80 mg	K.1327 G	Sept. 73	Sept. 75	Percutaneous	160 mg/ml 80 mg/ml
Japan	Tokyo	Heatstable Freeze dr.	2.5 mg	5386 G	April 74		Intradermal	0.50 mg/ml 0.25 mg/ml
Biofarma	Paris	Freeze dr.	80 mg	B 10	May 74		Percutaneous	80 mg/ml
Biofarma	Paris	Freeze dr.	3.75 mg	USP 76		June 75	Intradermal	0.375 mg/ml

Notes :

Japanese BCG vaccine, Tokyo strain 172, concentration 0.050/0.1 ml was half adult dosage.

For application in the field, the adult dosage was also given to newborns. Biofarma BCG vaccine, Paris strain 1173 P2, concentration 0.0375 mg/0.1 ml was half adult dosage. Routinely only $\frac{1}{4}$ adult dosage is given to babies nowadays.

Tuberculin reading was done 3 days thereafter; results and pathologic find-

ings of lymphnodes prior to vaccination were recorded in individual cards. A second tuberculin test was performed 10 weeks later on to assess the results of the vaccinations.

Results*Tuberculin Reaction*

Mean induration of tuberculin reaction was larger than 5 mm in all groups, except for the placebo group which was much less (Table 3).

TABLE 3: *Tuberculin reaction and vaccination lesion 10 weeks after vaccination*

Method	Vaccine	Number	Tuberculin reaction		Vaccination lesion	
			mean (mm)	standard deviation	mean (mm)	standard deviation
Intradermal	Placebo	45	0.09	0.60	0	0
	Biofarma 0.375 mg/ml	81	7.11	3.89	4.78	2.15
	Japan 0.25 mg/ml	92	7.16	3.80	4.51	1.71
	Japan 0.50 mg/ml	70	7.87	3.60	5.06	1.75
Percutaneous	Japan 160 mg/ml	73	7.58	3.75	6.57	1.51
	Japan 80 mg/ml	79	6.78	3.98	5.58	1.52
	Biofarma 80 mg/ml	87	7.32	4.79	6.34	2.32

As shown in Table 4, different vaccines and methods used did not result in any significant difference of mean induration, except for the percutaneous Japanese vaccine with a concentration of 80 mg/ml, which showed a smaller induration than the intradermal one.

TABLE 4: Student's Test Comparing Mean Induration and Mean Lesion

C o m p a r i s o n				Mean In- duration	Mean Lesion
Biofarma	0.0375 mg	Intradermal : Japan	0.025 mg Intradermal	-0.09	1.04
Japan	0.050 mg	Intradermal : Biofarma	0.0375 mg Intradermal	1.24	0.87
Japan	0.050 mg	Intradermal : Japan	0.025 mg Intradermal	1.20	2.39**
Japan	160 mg	Percutan. : Biofarma	0.375 mg Intradermal	0.76	5.95**
Japan	160 mg	Percutan. : Japan	0.025 mg Intradermal	0.71	9.90**
Japan	160 mg	Percutan. : Japan	0.050 mg Intradermal	-0.47	5.55**
Japan	160 mg	Percutan. : Japan	80 mg Percutan.	1.28	4.04**
Japan	160 mg	Percutan. : Biofarma	80 mg Percutan.	0.38	3.91**
Japan	80 mg	Percutan. : Biofarma	0.0375 mg Intradermal	-0.28	2.71**
Japan	80 mg	Percutan. : Japan	0.025 mg Intradermal	-0.64	5.19**
Japan	80 mg	Percutan. : Japan	0.050 mg Intradermal	-1.74*	1.94*
Japan	80 mg	Percutan. : Biofarma	80 mg Percutan.	-0.79	0.78
Biofarma	80 mg	Percutan : Biofarma	0.0375 mg Intradermal	0.51	1.62
Biofarma	80 mg	Percutan : Japan	0.025 mg Intradermal	0.25	3.05**
Biofarma	80 mg	Percutan : Japan	0.050 mg Intradermal	-0.80	0.84

* Significant at 0.05 level

** Significant at 0.01 level

Japanese vaccine with a concentration of 0.050 mg/0.1 ml.

Vaccination lesion

Mean lesions produced by different vaccines and methods are shown in Table 3.

In general, percutaneous BCG vaccination showed a significant larger mean lesion than the intradermal method (Table 4).

Complications

Within 4 months follow up no pathological findings were observed in any

group, such as enlargement of regional lymph nodes, keloid formation and development of a large ulcer at the vaccination site.

Discussion

Vaughan et al., (1975) and Handojo et al., (1973) reported that the results of the multiple puncture method using bifurcated needle for BCG vaccination in schoolchildren were unsatisfactory. The same was also reported by Sawada (1970) and Azuma et al., (1971) using needle planted cylinder, because the tuberculin reaction produced was inferior to that of intradermal method, whereas in babies, multiple punctures with needle planted cylinder produced comparable tuberculin reaction as the intradermal method (Sawada, 1979).

In this investigation, Japanese BCG vaccine at the concentration of 160 mg/ml was given to babies with bifurcated needle. The tuberculin reaction produced was comparable to that of the intradermal method at 0.5 mg/ml, which could fulfill the expectation of WHO. The same applies to Biofarma BCG vaccine at 80 mg/ml with bifurcated needle compared to 0.375 mg/ml using the intradermal method.

Such findings may be due to the increased number of bacilli entering the body as a result of the 'modification' in applying BCG vaccine by giving 2 drops.

It has been reported that tuberculin reaction using bifurcated needle would

be larger if higher concentration is used, or by 2-3 times insertion of the needle into the vaccine when applying multiple punctures (Sawada, 1973).

Three factors may have contributed to this findings :

1. Thicker coverage of skin by 2 drops of vaccine, therefore more BCG bacilli were found at the same area.
2. Bifurcated needle puncture enables more bacilli to enter the body.
3. The possibility of a kind of sucking process due to empty spaces in the skin covered by vaccine. More vaccines are absorbed into the body. The wider the coverage of skin, the bigger the chance for the vaccine to be absorbed.

It has been reported that both in schoolchildren and babies (Sawada, 1979) multiple punctures with needle planted cylinder produced smaller lesion than the intradermal method. Similar results were found in schoolchildren using multiple punctures with bifurcated needle in East Java, where the mean BCG scar was smaller (Handojo et al., 1974). In this investigation, lesions were found significantly larger compared with results of intradermal method.

Nevertheless, the mean scar size still lies within the acceptable limit. The explanation may probably be due to a correlation between the bigger increase of number of bacilli entering the body resulting from modified application method.

Complications which might occur with intradermal method were not observed in both groups using Japanese as well as Biofarma BCG vaccines. Also no complications occurred when bifurcated needle technique was used.

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REFERENCES

1. AZUMA, Y.; SUNAKORU, B. and BUMRUNGTAGOON, T. : A Trial of a Multiple Puncture Method of BCG Vaccination, WHO/TB/71.89. (1971).
2. HANDOJO, R.A.; LIUNANDA, S. and SUSILO, A.W. : BCG Vaccination with the Bifurcated Needle Technique. Seminar Epidemiologi Lit Bang Kes. Departemen Kesehatan 1974.
3. SAWADA, T. : BCG Vaccination by Multiple Puncture Method employed in Japan, International Symposium on BCG Vaccine, Frankfurt (Main), 1979.
4. SAWADA, T. : Vaccination using Bifurcated Needle, Additional Report. The XXIIInd International Tuberculosis Conference I.U.A.T. Tokyo, 1973.
5. VAUGHAN, J.P.; LINDQVIST, K.; BROOKS, D. and DOYLE, R.F. : Combined BCG and Smallpox Immunization, a Preliminary Report on a Method using the WHO Bifurcated Needle, East African med. 49 (1972).
6. World Health Organization : The WHO Standard Tuberculin Test, WHO/TB/Tech.Guide/3, 22 February 1965.