

A Comparative Study of the Rotary Lancet and Bifurcate Needle Techniques of Smallpox Vaccination

L. M. Nath Y. Sree Hari Rao and T. M. V. Prasada Rao

*Department of Preventive and Social Medicine All-India Institute of Medical Sciences
New Delhi*

A group of 173 nurses was re-vaccinated, both by the conventional rotary lancet and by the multiple-puncture method using the newly developed bifurcate needle. The results were read on the third and seventh day. The bifurcate needle technique was found to give a significantly greater number of successful vaccinations, with a three-fold economy of vaccine. No difficulty was experienced by the staff in rapidly acquiring a facility in the technique and the time taken was the same by both the methods. The greater 'take-rate' and substantial economy in vaccine were considered important enough to recommend a change-over to the bifurcate needle technique.

Introduction

Recently several reports have appeared about the advantages of vaccination by multiple puncture method using the bifurcate needle developed in the United States (Anon 1969, WHO 1969). A short preliminary study was conducted to test the needle. The performance of the needle was tested against the traditional rotary lancet.

Material and Methods

One hundred and seventy three nurses at the All-India Institute of Medical Sciences were vaccinated. They were all, of course, revaccinations. The vaccinations were done by postgraduate students of the Department of Preventive and Social Medicine. All the subjects were vaccinated by both methods on the same arm. Except for four or five, all the vaccinations were done on the upper arm near the insertion of the deltoid muscle. The few that insisted on vaccination on the fore-arm were vaccinated there. The nurses came at random and registered their names. Those with odd serial numbers were vaccinated by multiple puncture with the bifurcate needle superiorly and with rotary lancet three inches below. The nurses with even serial numbers were vaccinated with the rotary lancet above and with the needle below.

After registration the subjects moved to the first vaccinator who used the needle on the appropriate site and then went on to the next vaccinator who used the rotary lancet. Thus one insertion was done by each of the two methods on each of the subjects.

After about half the subjects were vaccinated, the vaccinators changed over to each others method.



Bifurcate needle

Immediately after vaccination, the subjects were questioned to determine their opinion on the relative merit of the two methods. The number of vaccinations done from each ampule of freeze-dried vaccine of Russian origin was recorded for both the methods. The lancet and the needle were sterilized by flaming over a spirit lamp. The total time taken for vaccinations by each of the two methods was taken with a stop-watch and recorded. Timing was started as flaming commenced and stopped when the vaccination was completed.

The result of the vaccinations were read both after 72 h and on the seventh or eighth day, though the WHO suggests reading the result on the seventh day (WHO 1964). Some workers feel that in the case of revaccination the results are more meaningful if read after 72 h, before the accelerated reactions have disappeared (Dixon 1962, Patnaik, personal communication).

Results and Discussion

Time taken : No difference was found in the total time taken per vaccination cycle.

Table I. Time per vaccination cycle by two methods

Method	No. of cycles	Time taken second	Standard deviation second
Needle	33	21.8	6.6
Lancet	32	22.3	6.2

Subjects' preference : When the subjects were asked which method they liked or which was preferable, the almost invariable answer was that they liked neither and that both were bad. When they were asked, instead, which method was worse, the replies were more to the point, only about 20% not differentiating between the two methods. There was no real difference in the preference attributable to the vaccinator but a difference showed up when the data were analysed according to the order of vaccination. The tendency to label the second vaccination, whether by lancet or by needle, as the more painful was clearly established. If this factor was taken into account then perhaps the rotary lancet was the less disliked method by a narrow margin. This is contrary to a published claim that the needle was less painful. However because of the small numbers involved, no definite conclusion could be reached on this question.

Vaccinators' preference : The vaccinators, who were postgraduate students of the Department of Preventive and Social Medicine, expressed a slight preference for the rotary lancet. None of them had any difficulty in rapidly acquiring a facility in the use of the needle and neither did the other paramedical staff, in subsequent vaccinations.

During the time this short study was being carried out, and subsequently, many subjects other than the nurses forming the study population, were vaccinated. It was felt that the rotary lancet was simpler to use in the case of frightened and protesting children.

Amount of vaccine used : For the first 112 subjects one ampule of vaccine sufficed for the immunization with the bifurcate needle, application of the vaccine being made with the needle itself, while for the same 112 subjects, three ampules of vaccine were used by the rotary lancet technique.

Reactions : It was possible to examine only 153 vaccinees after 72 h. Reactions as evidenced by swelling and induration at the site were noted. Table II shows the results for the two methods.

Table II. Reactions (take) following vaccination by two techniques after 72 h

Method	Subjects examined	Positive reactions	Negative reactions	% of insertions positive
Needle	153	115	38	75.2
Lancet	153	63	90	41.2

Because both the methods were tested in the same cases, the data are more meaningful when presented as in Table III.

Table III. Comparative take rate following vaccination by two methods after 72 h

		Multiple puncture by needle			
		Positive	Negative	Total	%
Rotary lancet	Positive	56	7	63	41.2
	Negative	59	31	90	58.8
	Total	115	38	153	100.0
	Per cent	75.2	24.8	100.0	

The most immediately striking fact that emerged from Table III is the great difference in the rate of reactions between the multiple puncture and the rotary lancet methods when the results were read after 72 h ($p < .001$). This difference may possibly have been due to causes other than a true difference in the effectiveness of the two techniques such as the greater amount of trauma with the needle. This seemed unlikely in view of the fact that the vaccination with the needle almost never, if ever, produced frank bleeding in this series. The area of induration required to give a positive interpretation to the test was also considerably bigger than the area actually covered by the vaccination, and it was felt that the reaction produced by the slight trauma caused by the needle would have subsided in 72 h.

This hypothesis was tested by trial vaccinations outside the study population only with the bifurcated needle, both with normal, fresh live vaccine and killed vaccine from the same ampule. It was found that the needle did not produce any false reactions or induration in the absence of the viable vaccine.

We found it difficult to apply vaccine by touching the needle perpendicular to the skin as suggested by the W.H.O. It was found that the transfer of vaccine to the skin was easier and better achieved by touching the loaded needle to the skin at an angle of between 15° and 20° .

Take rate : Only 122 of the 153 cases examined at 72 h could be re-examined for the presence of a take, i.e. the presence of a major reaction as defined by the World Health Organisation (1964). The major reaction was taken to mean the presence of one or more of the following :—

- (a) Palpable induration of one centimeter or more
- (b) Vesicle and/or
- (c) Pustule.

The findings are presented in Table IV.

Table IV. Take rate after vaccination by two methods (7 days)

Method	Number of subjects	Number positive	Number negative	% positive
Needle	121	17	104	14.2
Lancet	121	10	111	8.3

As before these results too are better presented in Table V :—

Table V. Take rate after vaccination by two methods

		Multiple puncture by needle			
		Positive	Negative	Total	%
Rotary lancet	Positive	3	7 (5.8%)*	10	8.3
	Negative	14 (11.7)*	97	111	91.7
	Total	17	104	121	100.0
	Per cent positive	14.2	85.8	100.0	

(*% computed out of the total of 121 insertions followed up)

As seen from Table V, 3 cases were positive with both methods ; 14 (11.7%) had positive reactions with the multiple puncture method only, while 7 (5.8%) had positive reaction with the rotary lancet only. This difference is not statistically significant, possibly because of the small numbers of positive cases. In a group such as the nurses who were the subjects of this study, it is not unexpected that only about 15% successful takes were recorded after a week, as they are revaccinated every year.

The rotary lancet has one disadvantage that has perhaps not been adequately emphasized. Because of the relative cost of the lancet and its own substantial nature, it is all too often treated as a permanent non-consumable piece of equipment. The lancet is, therefore, likely to remain in use long after it is blunt and past its prime, requiring increased force and effort to successfully vaccinate. The bifurcated needle is not only sufficiently durable to be inexpensive (in our series over 150 vaccinations were done with one needle with no diminution in efficacy) but because of its very nature is likely to be classified as a consumable item and thus replaced from time to time.

The much smaller mass of the tip of the bifurcate needle makes it very much quicker to heat up and cool down than the rotary lancet. This has the obvious advantage of not only effective sterilization by flaming but also of minimising the chances of thermal damage to the vaccine.

Besides the few cases enumerated in this study, we have vaccinated well over a thousand individuals with the bifurcate needle and the multiple puncture technique. The experience gained from this work and the study indicate that the bifurcate needle method has distinct advantages over the rotary lancet. Not only is it more effective but also has the advantage of economy without being more time consuming.

Though further trials on a large scale are indicated, we feel the evidence available is conclusive enough to warrant the recommendation of the needle for general use in the country, even pending the availability of more complete information.

Acknowledgment

We would like to acknowledge our gratitude to the many people who helped us in

our work, specially the SEARO office of the W.H.O. for supplying the needles, the Matron Mrs Pudussery and Assistant Matron Mrs Abraham and their staff and Mrs Shanta Amar, our Social Worker.

References

- Anon, 1969. Less painful type of vaccination. **J Indian Med Ass** **52**, 93.
Dixon, C.W. 1962. Textbook on Smallpox. J & A. Churchill Ltd (Publisher), London.
WHO 1964. Technical Report Series, No. 283.
WHO 1969. **Chronicle** **23**, 10, 475.