

THE JET INJECTION APPARATUS (PED-O-JET) FOR USE IN MASS VACCINATION AGAINST MEASLES — AN EFFECTIVE PROCEDURE FOR ITS DISINFECTION

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SUMMARY

A procedure was investigated for the decontamination of the jet injection apparatus (Ped-O-Jet) used in mass vaccination against measles, with a germicide (brand name Germekil), used as is, and with the purpose of avoiding the inactivation of the virus present in the vaccine, diluted at 1:50 and 1:100. It was shown that employing 10 water rinsings, traces of the disinfectant still present were able to inactivate the virus particles up to the 8th dose dispensed, whereas 20 rinsings thoroughly eliminated the chemical, preventing viral inactivation. According to our studies, the disinfection of Ped-O-Jets should be carried out as follows:

- 1) Calibrate the injector for its full volume (1 ml) and fill it up with Germekil (1:50 ou 1:100) for four consecutive times; 2) Allow the chemical of the 5th aspiration to remain in contact with the inner parts for at least 20 min; 3) Rinse the injector by 20 aspirations of sterile distilled water; 4) Recalibrate the Ped-O-Jet to 0.5 ml and adapt the vial of reconstitute vaccine to it; 5) Start administering the doses.

INTRODUCTION

Measles infection determines a high mortality usually due to complications, mostly among infants less than 3 years of age, and undernourished children. Intense and continuous vaccination of the susceptible population is the most effective procedure for the control of the disease and consequent reduction of its incidence to minimum levels, in order to eliminate the risk of epidemics. In areas where health programs carry out routine vaccination, the decrease of the number of susceptible children to measles is attainable. However, in areas where adverse conditions prevail, there is a mandatory need for an intensification of the immunization programs. When such situation has to be faced, jet injectors are likely to replace disposable needle-syringes since they speed up the rhythm

of the vaccination¹. They allow the injection of metered quantities of vaccine without the conventional use of needle-syringes and operate by ejecting the liquid at high pressure and velocity through a jet tip, in a way that the liquid makes its own opening into the skin and penetrates to a suitable depth for immunization⁵.

Vaccines such as typhoid and paratyphoid, poliomyelitis (Salk's), cholera, smallpox, yellow fever, influenza, adenovirus, tetanus and diphtheria toxoids combined, and more recently, live attenuated vaccine against measles, have been administered with injectors on mass basis⁵. Before use, some parts of the injector should be sterilized (front end including piston, the feed needle fitted with cotton packed nylon

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adapter, and the protective cap) in an autoclave for 15-20 min at 121°C to avoid damage to the plastic parts. Since this is difficult to be carried out in distant regions, a thorough previous disinfection with the use of iodine, Merthiolate, or more recently, with a germicide (brand name "Germekil") was established to replace sterilization. Should the use of injectors be officially preconized in the intensification of the vaccination against measles, three questions arise: a) is the presently used germicide effective in the disinfection of the Ped-O-Jets?; b) is the water rinsing prescribed capable of eliminating traces of the chemical?; c) if not, to what extent would it affect the viability of the live measles present in the vaccine?

In this paper, the Authors try to answer these questions and to establish a safe and effective procedure for the disinfection of the Ped-O-Jets, especially when these are to be used in mass campaigns, in the administration of biologicals containing live organisms, like vaccine against measles.

MATERIAL AND METHODS

Vaccine — Fifty dose vials of live attenuated vaccine against measles, Schwarz strain, titer $10^{4.20}$ TCID₅₀ per dose, were used throughout the study, being reconstituted just prior to the tests.

Disinfection — Germekil, a chemical sterilizing agent with synergistic action of formaldehyde solution and a quaternary ammonium compound, exhibiting surfactant and antioxidant actions, manufactured by Darrow Laboratórios S.A., Rio de Janeiro, Brazil, recently adopted for the disinfection of jet injectors, was used throughout the study.

Routine procedure for disinfection — Disinfection followed earlier regulations using Germekil as is: four consecutive aspirations of the germicide with the apparatus adjusted to its full capacity (1 ml) were followed by a 5th that remained in contact with the inner parts for 20 min. The liquid was then eliminated and the injector rinsed out with 10 aspirations of sterile distilled water. At this point, it was considered as disinfected and ready to have the vaccine vial plugged in. In this study the germicide was tested as is, and diluted at 1:50 and 1:100, as well.

Sterility tests — Three Ped-O-Jets disinfected respectively with Germekil as is, 1:50 and 1:100 were used to carry out six sterility tests, in which three sets of 10 tubes containing 15 ml of each of three culture media (soybean casein (TSB)³, thioglycollate Brewer (TB)², and Sabouraud-NIH (S)⁷) were inoculated with a 0.5 ml dose of vaccine each, dispensed with the injector subjected to disinfection. Incubation was carried out at 23°C and 36.5°C for TSB and TB, and at 23°C for S, during 14 days. Five tubes of each non-inoculated medium were kept as controls, and incubated as already mentioned.

Virus viability tests — Each vaccine dose dispensed by the disinfected Ped-O-Jets was collected in a sterile test tube to which 4.5 ml of Eagle's maintenance medium⁴ were added. Despite the caution observed in this step, part of each volume was usually lost either as a fine aerosol, or by adsorption to the inner walls of the collection tube. Thus each dose consisted of less than the expected 0.5 ml. Each such tube was considered as a starting virus suspension from which $10^{-2.0}$ to $10^{-5.0}$ dilutions were prepared to be inoculated in confluent culture tubes of Vero cells (African Green Monkey) growing in minimum Eagle (0.17% NaHCO₃) with 10% calf serum and 25 mcg/ml Neomycin. Before inoculation supernatants were discarded and each of eight Vero culture tubes were inoculated with 0.5 ml of each virus dilution. After 60 min at 36.5°C for virus adsorption, the inoculated tubes received 1.5 ml of maintenance Eagle (0.22% NaHCO₃) plus 2% calf serum, 25 mcg/ml Neomycin, and were held at 36.5°C for 7 days. The cytopathogenic effect (CPE) observed microscopically was recorded on the 4th, 6th and 7th days, and the titer (TCID₅₀) calculated by the Reed & Muench method. All titrations were performed in parallel to a measles reference virus (titer $10^{3.05} \pm 0.5$ TCID₅₀/ml).

RESULTS

When the problem of checking the effectiveness of Germekil in decontaminating jet-injectors emerged — as the potency and the safety requirements of the biologicals administered must be maintained — preliminary tests with Ped-O-Jets disinfected with Germekil as is were carried out. Results indicated that the appara-

tuses had been actually disinfected by the chemical. To confirm data from these tests, six additional experiments for sterility testing were performed using the disinfectant as is, diluted 1:50 and 1:100, in parallel, as shown in Table I. As expected, Germekil as is was active in preserving the sterility of the product dispensed by the injectors submitted to disinfection; however, all tests with 1:50 and 1:100 dilutions proved that both of them were as effective as the undiluted product in providing the disinfection of the injectors.

T A B L E I

Sterility tests performed with live measles virus vaccine dispensed with Ped-O-Jet submitted to disinfection by Germekil

Number of tests	Disinfection by Germekil		
	as is	1:50	1:100
2	Positive	N.D.	N.D.
2	Positive	Positive	N.D.
1	Positive	N.D.	Positive
1	N.D.	Positive	Positive

N.D.: not done

In a further step, a possible effect of traces of the germicide upon the live attenuated virus particles contained in the vaccine was investigated. To verify if the 10 prescribed rinsings with distilled sterile water were capable of eliminating the disinfectant, in a comparative test, two Ped-O-Jets were disinfected as usual by Germekil as is but one was rinsed 10 and the other, 20 times with distilled water, corresponding to 10 and 20 ml, respectively. Vials containing reconstituted live attenuated vaccine against measles were adapted to them and 10 consecutive individual doses (0.5 ml) were collected for tests on virus viability. Results from Table II indicate that considerable amounts of virus particles were inactivated by passing through the injector treated with 10 rinsings, especially from the 1st to the 8th dose, whereas doses collected from the Ped-O-Jets that had been water-rinsed 20 times did not fall below the minimum titer of 1,000 TCID₅₀ (Table II).

DISCUSSION

All lots of live attenuated measles vaccines must comply with an international regulation

T A B L E II

Viability of live measles virus present in vaccine dispensed by Ped-O-Jet disinfected by Germekil

Vaccine doses titrated	Titer of live measles vaccine dispensed by Ped-O-Jet treated with Germekil as is and water rinsed	
	10 times	20 times
1st	< 1.0	3.50
2nd	2.50	3.50
3rd	2.50	3.50
4th	N.D.	3.50
5th	2.50	3.83
6th	2.50	3.62
7th	2.83	N.D.
8th	2.83	3.83
9th	3.16	N.D.
10th	3.16	3.62
Measles reference virus	3.13 ± 0.5 TCID ₅₀ /ml	

Virus titer: log₁₀ TCID₅₀/0.5 ml dose

Original titer of tested measles vaccine: 4.20 TCID₅₀/0.5 ml dose

N.D.: not done

stating that an individual human immunizing dose shall be no less than 1,000 TCID₅₀ (10^{3.0} TCID₅₀) in terms of the assigned titer of a reference measles virus³. Potency tests of the vaccines used in routine basis or in mass vaccinations are performed with all lots available for the purpose. After their release, storage conditions must be adequate to avoid titer losses due to temperature raising or to exposure of vaccine to light. Reconstitution of the freeze-dried vaccine, as well as its administration, play an important role within the immunization process. Vaccines against measles are usually administered with needle-syringes. However, in mass vaccinations, Ped-O-Jets are the most convenient devices to speed-up the rhythm of vaccination. Since they are devised to dispense bacteriologically sterile products, they must be submitted to a previous process of sterilization or disinfection. Whenever sterilization by autoclavation is not possible, it has to be replaced by a strict disinfection procedure with chemicals which, on the other hand, if not thoroughly

washed out, may lead, through virus inactivation, to a decrease in the immunological potency of the vaccine.

In the present work, some aspects of the procedure routinely used for the disinfection of the Ped-O-Jets used in mass vaccinations with live measles vaccine were studied to test its effectiveness, as far as decontamination is concerned, along with the preservation of the virus titer.

The sterility tests have shown that both the disinfection and the method adopted for the disinfection of the Ped-O-Jets were effective. Furthermore, lower concentrations of the germicide (1:50 and 1:100) were shown to exhibit similar performance.

When injectors disinfected with Germekil as is were used to dispense the vaccine doses to be checked for potency, there was a remarkable virus inactivation (Table II). This effect ceased and all doses were shown to comply with the minimum requirements of potency for live measles vaccine when rinses were increased to 20, whereas with ten water rinsings only the 9th and the 10th doses dispensed titrated accordingly. Traces of the chemical employed in the disinfection affected the viability of the virus particles present in the first eight aliquots of the vaccine.

The difference noted between the original titer of the vaccine used in all tests ($10^{4.20}$ TCID₅₀ per 0.5 ml dose) and the titers registered in the tests carried out after 20 rinsings of the Ped-O-Jets (3.50 through 3.83 TCID₅₀) is due to the evident loss of part of the doses in the form of fine aerosol at the moment of collection, besides the usual adsorption of minimal amounts to the inner walls of the tube, in spite of careful pipetting. This titer loss is not bound to occur during vaccination programs since the tip of Ped-O-Jet is closely applied to the recipient's arm.

In conclusion, besides showing that the injector should be water-rinsed 20 times after disinfection to suffer no effect upon the virus particles, it was shown that the disinfectant diluted at 1:50 and 1:100 is as effective as in its original concentration. Our studies would thus stress another aspect to be taken into account in any mass vaccination program with Ped-O-

Jets, namely, the economical one, as theoretically, the studied dilutions of the germicide, for instance, would result in a substantial reduction of the operational costs, besides minimizing the dangers of deficient rinsing procedures.

RESUMO

O aparelho injetor (Ped-O-Jet) para uso em vacinações em massa contra o sarampo — um processo efetivo para sua desinfecção

Padronizou-se um processo para a desinfecção de rotina do aparelho injetor (Ped-O-Jet) empregado nas vacinações em massa contra o sarampo, com vacina viva atenuada. Foi estudado o desinfetante de nome comercial Germekil, usado em sua concentração original e também, diluído a 1:50 e a 1:100, com o objetivo de prevenir a inativação das partículas de vírus presentes na vacina devida a traços residuais do germicida nas partes internas do aparelho, se a lavagem se processar com volume insuficiente de água destilada estéril. Ficou demonstrado que 10 enxagues sucessivos com água não são suficientes para eliminar o desinfetante: há inativação das partículas virais da 1.ª à 8.ª dose, apenas a 9.ª e 10.ª doses satisfazendo ao limite mínimo de potência. Verificou-se, entretanto, que 20 enxagues sucessivos eliminam o risco de inativação do vírus pelo desinfetante. Com base nos estudos desenvolvidos, sugere-se o seguinte procedimento para a desinfecção de Ped-O-Jet: 1) Calibrar o aparelho para sua capacidade máxima (1 ml) e aspirar com ele o desinfetante (diluído a 1:50 ou a 1:100) por quatro vezes consecutivas; 2) Deixar o desinfetante da 5.ª aspiração permanecer em contacto com as partes internas por, no mínimo, 20 minutos; 3) Lavar o injetor com 20 enxagues de água destilada estéril; 4) Recalibrar o Ped-O-Jet para 0,5 ml e adaptar a ele o frasco de vacina reconstituída; 5) Iniciar a administração das doses.

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