# A Study of Bacterial Skin Colonization Among Newborn Infants Using Lactic Acid and Hexachlorophene*

Teresita B. Naval,** Gemiliano L. Aligui** and Esperanza F. Rivera**

*(*PSMID-UNILAB Junior Awardee, 1985; **Dept. of Pediatrics, MCU-F.D. Tanchoco Memorial Medical Foundation Hospital, Caloocan City, Metro Manila, Philippines)*

## ABSTRACT

A study was made comparing the efficacy of lactic acid and hexachlorophene on bacterial skin colonization in newborn infants. Term infants (37-42 weeks) of normal spontaneous vaginal deliveries were allocated into two treatment groups viz., lactic acid group and hexachlorophene group. Excluded were pre-term, post-term, and potentially infected infants. Routine bathing procedures were done after delivery. Cultures were obtained 24 hours after bathing. Swabs were taken from the armpit. Bacterial growth reporting was done after 48 hours.

A total of 20 infants were included in the lactic acid group and 20 in the hexachlorophene group. The results of the two groups showed no significant difference between the two groups on the frequency of single and mixed isolates. A higher proportion of coliform organisms were noted in the hexachlorophene group, though not statistically significant. No significant difference in the magnitude of growth in both groups were noted.

The trial shows that lactic acid is comparable to hexachlorophene for neonatal skin care. *[Phil J Microbiol Infect Dis 1985; 14(2):55-57]*

*Key Words:* lactic acid, hexachlorophene, neonates, colonization

## INTRODUCTION

Neonatal infections have been known to occur following skin colonization by bacterial pathogens. Studies on the routine use of hexachlorophene in nurseries show that the bacterial composition of the environment can significantly change with the use of the cleansing agent. The common practice has led to the emergence of gram-negative infections. The same compound was also proven to be potentially dangerous because of its ability to penetrate the intact infant skin. Lactic acid, an acidifying skin cleanser, was reported to keep the skin at its acid ph, thus maintaining the physiochemical property of the epidermis. This property keeps the integrity of the upper layer of the skin, therefore maintaining the physiological and mechanical barrier against offending chemical and biological agents.

Owing to the technical difficulty of preparing physically identical preparations, the study was conducted as an open trial with the objective of determining the effects of the hexachlorophene and lactic acid in the bacteriology of the infant skin. Two groups of newborn infants were separately bathed with hexachlorophene and lactic acid preparations. Skin swab bacterial cultures from both groups were compared to determine any difference. We have reason to believe that lactic acid is comparable to hexachlorophene in its effect on the bacteriological characteristics of the infant's skin.

## MATERIAL AND METHODS

Infants delivered at MCU-FDTMF Hospital were entered in the study. These were term (37-42 weeks by Dubowitz) normal spontaneous vaginal deliveries covering the period from October to December 1984. The subjects were allocated at random into 2 treatment groups: Group 1, hexachlorophene and Group 2, lactic acid.

Excluded were pre-term infants (less than 37 weeks), post-term infants (more than 42 weeks), those with prolonged rupture of membranes (more than 12 hours), and those with history of maternal infections prior to delivery.

The subjects were bathed as in the routine procedure of the hospital. Both hexachlorophene (3%), and lactic acid were used without further dilution and each infant was supplied with individual cleaning preparations. The head, face and body was first wiped with a sterile gauze to remove mucus, blood and vemix caseosa. The head was shampooed with the assigned agent and with the same preparation; the face was washed, taking care that the agent did not get into contact with the eyes, followed by downward washing of the chest, upper extremities, the abdomen, back, and lower extremities. After rinsing, the infant was dried by a clean towel, clothed and placed in the crib.

Cultures were done 24 hours from bathing: two simultaneous skin swabs were done, each taken from both armpits. The skin swabs were inoculated into two separate media: brain-heart infusion for aerobes and thioglycollate for anaerobes. The cultures were incubated at.37°C for 24-48 hours. Positive growth was examined for staining characteristics, and morphology. Gram-positive cocci were subcultured into chocolate agar with 10% $CO_2$ and oxidase disc. Gram-negative bacilli were subcultured into either MacConkey or EMB agar and were further subcultured on TSI, sulfide-indole-motility, and Simon Citrate agar. Gram-positive cocci were tested for coagulase by the slide and tube methods, and subcultured into BAP plus optochin disc.

Statistical analysis was done using the z test.

## RESULTS

A total of 40 infants were included in the trial: 20 were in the hexachlorophene group and 20 in the lactic acid group. Table 1 shows the number of infants with single isolate and those with mixed isolate. No culture grew more than 2 kinds of organisms. There was no significant difference between the two groups (p = 0.8414) as regards single isolates.

**Table 1. Single and Mixed Isolates Among 20 Infants Washed with Hexachlorophene and Among 20 Infants Washed with Lactic Acid**

| | Hexachlorophene | | Lactic Acid | | |
|---|---|---|---|---|---|
| Characteristic of Isolates | No. of Infants | % | No. of Infants | % | p value |
| Single isolate | 18 | 90 | 16 | 80 | 0.8414 n.a |
| Mixed isolate | 2 | 10 | 4 | 20 | 0.3628 n.a |
| Total | 20 | | 20 | | |

Table 2 shows the microorganisms isolated from both groups. No anaerobes were isolated from either group: There is a higher yield of enterobacter and *E. coli* in the hexachlorophene group while the lactic acid group yielded a higher number of enterobacter and *Bacillus subtilis*.

**Table 2. Bacterial Isolates from 20 Infants given Hexachlorophene Bath and 20 Infants given Lactic Acid Bath**

| | Hexachlorophene | | Lactic Acid | |
|---|---|---|---|---|
| | No. of Isolates | % | No. of Isolates | % |
| Bacteria | 6 | 27.3 | 7 | 29.2 |
| Enterobacter | 1 | 4.5 | 0 | |
| Proteus vulgaris | 6 | 27.3 | 5 | 20.8 |
| E. coli | 1 | 4.5 | 0 | |
| Paracolon bacilli | 0 | | 1 | 4.2 |
| Alcaligenes sp. | 3 | 13.6 | 9 | 37.5 |
| Bacillus subtilis | 1 | 4.5 | 0 | |
| Sarcinae | 1 | 4.5 | 1 | 4.2 |
| Acinetobacter | 3 | 13.6 | 0 | |
| Staphylococcus epidermidis | 0 | | 1 | 4.2 |
| Streptococcus, non-hemolytic | 22 | | 24 | |

A review of the bacterial isolates indicates more coliforms in the hexachlorophene group (64%) compared to the lactic acid group (54%), though they were not statistically significant (p=0.4778).

Single and mixed cultures were determined for each type of bacterium (Table 3). There was a higher proportion of single isolates, which occurred in the hexachlorophene group (82%) compared to the lactic acid group (67%). This however did not show any statistical difference (10=0.2502).

**Table 3. Occurrence of Single Cultures by Type of Bacteria Isolated in both Hexachlorophene and Lactic Acid Groups**

| | Hexachlorophene | | Lactic Acid | |
|---|---|---|---|---|
| | No. of Single Culture | % | No. of Single Culture | % |
| Bacteria | 5 | 28 | 3 | 19 |
| Enterobacter | 1 | 5 | 0 | |
| Proteus vulgaris | 5 | 28 | 5 | 31 |
| E. coli | 0 | | 0 | |
| Paracolon bacilli | 0 | | 1 | 6 |
| Alcaligenes sp. | 3 | 17 | 7 | 44 |
| Bacillus subtilis | 1 | 5 | 0 | |
| Sarcinae | 1 | 5 | 0 | |
| Acinetobacter | 2 | 10 | 0 | |
| Staphylococcus epidermidis | 0 | | 0 | |
| Streptococcus, non-hemolytic | 18 | | 16 | |

Classification as to staining characteristics was made (Table 4) for both groups: No statistical difference was noted. The hexachlorophene group yielded 68.2% gram-negative bacteria while the lactic acid group yielded 62.5% gram negatives (13=0.7188).

**Table 4. Classification of Bacteria as to Staining Characteristics Isolated from Infants Bathed with Hexachlorophene and Infants Bathed with Lactic Acid**

| | Hexachlorophene | | Lactic Acid | | |
|---|---|---|---|---|---|
| Staining Characteristics | No. of isolates | % | No. of Isolates | % | p value |
| Gram Negative | 15 | 68.2 | 15 | 62.5 | 0.7188 |
| Gram Positive | 7 | 31.8 | 9 | 37.5 | |
| Total | 22 | | 24 | | |

The magnitude of bacterial, growth after 48 _hours incubation was also analyzed (Table 5) for both groups to determine any difference. There was no significant statistical difference in terms of bacterial growth characteristics. The hexachlorophene-bathed infants yielded 82% of bacteria showing moderate to heavy growth while the lactic acid-bathed infants yielded 62% moderate to heavily growing bacteria.

**Table 5. Growth Characteristics of Bacteria Isolated from Infants Given Hexachlorophene Bath and Infants Given Lactic Acid Bath**

| | Hexachlorophene | | Lactic Acid | | |
|---|---|---|---|---|---|
| Growth Characteristics | No. of Cultures | % | No. of Cultures | % | p value |
| Light | 4 | 18.2 | 9 | 37.5 | |
| Moderate- Heavy | 18 | 81.8 | 15 | 62.5 | 0.1236 |
| Total | 22 | | 24 | | |

During the first 5 days of life about 40-90% infants are colonized by staphylococcus mostly in the nares, umbilicus and skin. These colonized infants contaminate the hands of nursery

personnel. If these personnel do not practice hand washing between patients, then spread of staphylococci will result.

Neonatal staphylococcal infections may occur in periodic epidemics and are partially explained by difference in the capacity of a variety of staphylococci strains to colonize and cause disease. To reduce the incidence of skin infections particularly colonization by *Staphylococcus aureus*, bathing of babies and hand washing of nursery personnel with antibacterial preparations containing hexachlorophene has been recommended. It has been reported, however, that rats given oral doses of 25 mg/kg/day of hexachlorophene produced edema of the white matter and paralysis. Subsequent studies likewise showed that hexachlorophene may be absorbed through an n i tact skin as demonstrated by a rise in concentration of hexachlorophene in the blood of infants washed with 3% hexachlorophene during their stay in the hospital nursery.

The epidermis has been found to be more protective in an acid medium. When exposed to prolonged alkaline medium the epidermis loses its protective effect. Many trials were done to decrease skin ph using acids. Dilute citric acid was found to be broken down faster while boric acid could be absorbed in the skin and may cause bone marrow changes. Lactic acid has been used successfully to acidify the skin. It has been found to be effective in both local treatment and preventive skin care.

A comparison of the efficacy of hexachlorophene and lactic acid in the prevention of bacterial colonization showed no statistical difference in the frequency of single and mixed isolates between the two groups. However, this study showed a higher proportion of coliform organisms in the hexachlorophene group.

By reducing staphylococcal population of the skin, hexachlorophene may in effect increase gram negative organisms to grow. This may be brought about by the reduction of gram positive organisms. In this study both groups were comparable in terms of the proportion of gram negative and gram positive bacteria. Likewise, the magnitude of growth for both groups were not significant.

Experiments using lactic acid preparations (Lactacyd) have shown a relative bactericidal effect. Most of the organisms did not recover their vitality after being treated with lactic acid preparation.

## CONCLUSIONS

On the basis of the Z test, we failed to demonstrate a significant difference between the proportions of single and mixed isolates, number of coliforms, frequency of gram negative and gram-positive organisms, and the number of moderate to heavy growth for both the hexachlorophene and the lactic acid groups.

For these reasons, it appears that lactic acid is comparable to hexachlorophene as a skin-cleaning agent.

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