

1,000 units per cc. of normal saline were administered as local drops every one to two hours. Erythromycin was used as the drug of choice.

2. Eleven cases not receiving the enzymes were lost.

3. All the cases treated with these agents were saved.

4. With the use streptokinase and streptodornase the average hypopyon resorption

time, the average slough-clearance time, and the average healing time were reduced.

5. The therapy had no effect on the density of the scar formed but, in view of the initial hopeless prognosis of the cases, the results are encouraging.

6. The use of these agents in doses described is recommended as a routine in sloughing hypopyon corneal ulcers.

*Medical College.*

#### REFERENCES

- Agarwal, L. P., and Adhaulia, H. N.: *Ophthalmologica*, **128**:6, 1954.  
 ———: *Am. J. Ophth.*, **38**:110, 1954.  
 Agarwal, L. P., and Datt, K.: *Am. J. Ophth.*, **37**:764, 1954.  
 Friedman, M. W.: *Am. J. Ophth.*, **35**:1184, 1952.  
 Jukofsky, J. L.: *Am. J. Ophth.*, **34**:1692, 1951.  
 Portfolio, A. G.: *Arch. Ophth.*, **52**:557, 1954.

#### OPHTHALMIC USE OF NEOSPORIN®\*

JOSEPH W. HALLETT, M.D., MICHAEL I. WOLKOWICZ, M.D.,  
 AND IRVING H. LEOPOLD, M.D.  
*Philadelphia, Pennsylvania*

Neosporin® is a combination of antibiotics designed for topical therapy of bacterial infections. It contains polymixin B for control of gram-negative bacterial infections,<sup>1,2</sup> bacitracin<sup>3</sup> (in the ointment preparation), or gramicidin<sup>4</sup> (in the liquid preparation) for gram-positive infections, and neomycin for specific elimination of *Proteus vulgaris*, which is highly resistant to most other agents.<sup>5</sup>

The aim of this study is to evaluate topical therapy with Neosporin® in external ocular infections. In most instances, an ophthalmic ointment consisting of polymixin B sulfate 0.5 mg., bacitracin 400 units, and neomycin sulfate 5.0 mg. per gm. of ointment base was used four times daily. In approximately one sixth of the cases, usually because of the

patient's preference for drops over an ointment, an ophthalmic solution was instilled four times daily. The solution contained in each cc.—polymixin B sulfate, 0.5 mg.; neomycin sulfate 2.5 mg.; gramicidin 0.025 mg., in a saline vehicle. No difference was noted in tolerance or effect no matter which preparation was employed.

A total of 214 private and clinic patients was treated. To help corroborate the clinical diagnoses free use of bacterial cultures and conjunctival scrapings was made. The absence of adequate controls would make a statistical analysis of the results meaningless, consequently only a descriptive report of the results follows:

#### ACUTE AND SUBACUTE CATARRHAL CONJUNCTIVITIS

Thirty-five cases were included in this diagnostic group. Pathogenic staphylococci were cultured in 10 cases, nonpathogenic staphylococci in 10, B. xerosis in three, H.

\* From the Research Department, Wills Hospital. Generous supplies of Neosporin® ophthalmic ointment and solution were made available to us through the courtesy of Stanley T. Bloomfield, M.D., Medical Department, Burroughs Wellcome and Company.

influenzae in two, pneumococci in one, *Streptococcus viridans* in one, nonhemolytic streptococci in one, *S. marcescens* in one, no growth in six. In two cases two different organisms were cultured. Thirty-two cases were cured or very much improved, in most instances within five to seven days. One case due to pathogenic *Staph. aureus* and another, with negative culture, were worse after four and seven days of treatment, respectively; the former was switched to topical Chloramphenicol therapy with resultant cure in one more week, the latter was cured in two more weeks by topical sulfonamide treatment. The one case due to nonhemolytic streptococci showed no change in culture or clinical appearance after two weeks of treatment; the subsequent addition of hydrocortisone also had no effect, but erythromycin ointment eventually succeeded. Both *H. influenzae* cases (in one of which *Staph. albus* was also found) were made bacteriologically sterile and clinically cured in seven days.

#### CHRONIC CATARRHAL CONJUNCTIVITIS

This group was made up of 16 cases. On primary culture, eight cases were negative, nonpathogenic staphylococci were cultured in six cases, *B. xerosis* in three, nonhemolytic streptococci in one, pathogenic staphylococci in one, and *Ps. aeruginosa* in one. In four cases, two different types of bacteria were found in the primary cultures. In 12 of the 16 cases, repeat cultures were obtained after treatment and all were rendered bacteriologically sterile except one originally negative culture which changed to nonhemolytic streptococci. After treatment for an average duration of seven days, five cases were not improved and 11 cases were improved or cured. The one case due to gram-negative bacterial infection (*Ps. aeruginosa*) occurred in an anophthalmic socket and was listed as cured in seven days.

#### MARGINAL BLEPHARITIS AND BLEPHAROCONJUNCTIVITIS

A total of 12 cases was treated in this group. Of four due to pathogenic staphylo-

cocci three were cured in seven, 14, and 14 days, respectively, and one was worse at the end of seven days. The latter case was associated with a seborrhea of the scalp and face which later responded satisfactorily to topical sulfonamide treatment. One case due to nonpathogenic staphylococci was cured in five days. Another case due to the same bacteria plus *B. xerosis* did not improve after 10 days but, when local cortisone drops were added, was cured in another week. A third case in which nonpathogenic staphylococci were found also yielded pneumococci and *Proteus vulgaris* and was associated with a chronic meibomitis; it was much improved after seven days of treatment at which time only pneumococci were cultured. Four cases with negative cultures were all improved in seven, seven, 10, and 14 days, respectively.

#### ACUTE HORDEOLUM

This category comprises 12 cases of acute hordeolum, either internal or external, that were encountered. In no case did treatment exceed seven days. In six cases nonpathogenic staphylococci were cultured, in five, pathogenic staphylococci, and in one, the culture was negative. Local applications of heat were ordered as adjuvant therapy in all cases. Eleven cases were very much improved or cured within the treatment period of one week. The one resistant case was associated with chronic meibomitis and went on to chalazion formation; primary culture yielded nonpathogenic staphylococci which disappeared from culture after seven days even though clinical improvement was lacking.

#### SUPERFICIAL PUNCTATE KERATITIS AND MARGINAL CORNEAL ULCER

In 19 cases with this diagnosis nonpathogenic staphylococci were cultured in eight, pathogenic staphylococci in four, alpha hemolytic streptococci in one, *Proteus vulgaris* in one, *B. xerosis* in one, and negative culture in seven. Two different types of bacteria were found in each of three cases.

Sixteen cases reverted to or maintained negative or innocuous cultures and were clinically improved after an average of eight days of treatment. Two cases with negative cultures and one case with nonhemolytic *Staph. aureus* showed no change after two weeks of treatment and were, consequently, listed as failures. Of particular interest was the one case in which *Proteus vulgaris* and alpha hemolytic streptococci were cultured; in seven days complete clinical and laboratory cure was effected.

#### CHRONIC DACRYOCYSTITIS

This group included two congenital and four adult cases. In addition to topical therapy digital expression of the tear sacs was ordered for the congenital cases. From the first of these was cultured nonhemolytic streptococci and staphylococci and from the second nonhemolytic staphylococci. Both cases were clinically and bacteriologically clear in 22 and six days respectively. Two adult cases had negative cultures and were improved in five and seven days, respectively. One adult case, from which were cultured nonhemolytic streptococci and staphylococci, showed no improvement clinically or in cultures after 10 days of treatment and was eventually obliged to undergo surgical correction of the accompanying dacryostenosis. In the final adult case beta hemolytic streptococci were found and prophylactic surgery prior to cataract extraction was refused; drop treatment for seven days, aided by several lavages of the lacrimal passages with the same solution, resulted in sterile cultures and uneventful cataract surgery.

#### ACUTE FOLLICULAR CONJUNCTIVITIS

Of four cases treated in this category, two of the Beal type with negative bacterial cultures showed no improvement after 10 and 14 days respectively. A third case, from which pathogenic staphylococci were cultured, was improved in seven days. The last case yielded a culture of nonpathogenic staphylococci and, after five days, developed

a severe conjunctival reaction. Treatment was then switched to Chloramphenicol and cortisone drops which effected a definite improvement in two more days.

#### EPIDEMIC KERATOCONJUNCTIVITIS

One patient with this disease came for the first time two weeks after onset of symptoms and showed remarkable improvement after five days of treatment with the drops.

#### HERPES-SIMPLEX CONJUNCTIVITIS

The one patient with this diagnosis had a follicular conjunctivitis in association with two herpes-simplex lesions of the skin of the upper lid. There was a grossly visible but not tender preauricular adenopathy. No keratitis was present. Nonhemolytic streptococci and *B. xerosis* were found in the culture. The conjunctivitis cleared in four days on drop treatment. The lid lesions cleared in about 10 days.

#### VACCINIA

A 15-month-old child developed vaccinal lesions of the skin of one upper lid soon after the appearance of a primary vaccination on the arm. There was no involvement of the conjunctiva or cornea. Neosporin® ointment was applied liberally and chlor-tetracycline (125 mg. every six hours) was ordered. A complete cure resulted in seven days.

#### CENTRAL CORNEAL ULCERS

This group includes two infected cases and nine clean posttraumatic ulcers. One of the infected ulcers yielded nonpathogenic staphylococci and was cured in two weeks. The other case was due to hemolytic staphylococci, beta hemolytic streptococci, and *H. influenzae*; after one week of treatment, it was much improved, although *H. influenzae* was still present. Of the nine clean posttraumatic ulcers, five resulted from fingernail abrasions and the others from miscellaneous objects. All received Neosporin® prophylactically and obtained uncomplicated prompt healing.

## ALKALI BURNS OF CORNEA AND CONJUNCTIVA

Seven cases with varying amounts of corneal and conjunctival involvement were kept free of infection and were healed in an average of five days, the extremes being three and 14 days.

## IMPETIGO

One case of impetigo of the lids with conjunctivitis from which *Proteus vulgaris* was cultured was much improved after seven days of treatment; culture then showed *B. subtilis*.

## INFECTIOUS ECZEMATOID DERMATITIS

One such case previously resistant to local Chloramphenicol therapy was associated with marginal corneal infiltrates and negative culture. It cleared in seven days but relapsed in two weeks only to disappear permanently after two more weeks of renewed treatment.

## PHLYCTENULAR CONJUNCTIVITIS

Two cases of phlyctenular conjunctivitis were treated. The culture in one case was negative and this case was much improved after four days of treatment. Nonpathogenic staphylococci were found in the other case, which was cured after five days of treatment.

## PROPHYLACTIC TREATMENT

In 63 eyes, the ointment was used after removal of corneal or conjunctival foreign bodies, after minor lid or conjunctival sur-

gical procedures and after lacrimal probing. All these eyes remained free of unusual irritation or secondary inflammation. Eleven cataracts (not including the one case reported above in the chronic dacryocystitis group), seven glaucoma, and four strabismus patients received the local treatment for varying periods of time (two days to one week) prior to surgery. None of these cases developed a postoperative infection.

## LOCAL REACTIONS

Five cases out of the grand total of 214 experienced mild to moderate burning of the eyes after application of the ointment but none of them was obliged to stop treatment because of this reaction. Only one other case (described in the acute follicular conjunctivitis group) developed severe conjunctival hyperemia and edema which necessitated termination of the treatment. This constitutes a low reaction rate of 0.5 percent.

## SUMMARY

Neosporin® ointment or solution was used in 214 cases of actual or potential external ocular infections. It was successful in most instances of gram-positive infections and in all seven cases of gram-negative infection. Most viral infections encountered improved during the course of therapy. The local reaction rate was 0.5 percent.

*1601 Spring Garden Street (30).*

## REFERENCES

1. Brounlee, G., Bushby, S. R. M., and Short, E. J.: The pharmacology of polymixin A, B, and D. *Ann. New York Acad. Sc.*, **51**:952, 1949.
2. White, H. J., Alverson, C. M., Baker, M. J., and Jackson, E. R.: Comparative biological studies of polymixin and "Aerosporin." *Ann. New York Acad. Sc.*, **51**:879, 1949.
3. Wrong, N. M., Smith, R. C., Hudson, A. L., and Hair, H. C.: The treatment of pyogenic skin infections with bacitracin ointment. *Canad. M. A. J.*, **64**:395, 1951.
4. Wong, W. W.: Penicillin and gramicidin as ocular chemotherapeutic agents. *Arch. Ophth.*, **31**:165, 1944.
5. Livingood, C. S., Nilasena, S., King, W. C., Stevenson, R. A., and Mullins, J. F.: Pyogenic infections treated with neomycin. *J.A.M.A.*, **148**:334, 1952.