NASAL CARRIAGE OF STAPH. AUREUS BY NEWBORN BABIES

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In recent years attempts have been made in this hospital to prevent the nasal colonization of newborn babies by *Staph. aureus* (Cook *et al.*, 1958; Manfield *et al.*, 1960). Babies who become carriers of staphylococci have been found, like adults, to be more liable to sepsis than those who do not become carriers. We now report the results of applying neomycin cream daily to the babies' noses in addition to the use of hexachlorophane soap and dusting powder. These measures combined have produced a lower carriage rate and sepsis rate than we have achieved before.

Methods

Babies.—The babies were breast-fed. If breast-feeding did not become established the babies were taken to their mothers for a breast-feed with complement or a bottle-feed. Babies and their mothers normally went home on the 12th day.

Nurseries and Staff.—These were as described by Cook *et al.* (1958).

Nursing Procedures.—After delivery the babies were bathed, using 2% hexachlorophane soap; the cord was treated with industrial methylated spirit (95% methyl alcohol), liberally powdered with hexachlorophane powder, and the end sealed with collodion. On the second day the napkin area and face only were washed and the cord was treated with spirit and hexachlorophane powder. On the third and subsequent days the babies were bathed and the cord was similarly treated. Hexachlorophane powder was also applied to the cord and napkin area when the napkins were changed. Neomycin cream (0.5%) was applied each evening to the babies' nostrils. All staff used hexachlorophane soap for hand-washing but did not wear masks or gowns.

Bacteriology.—Noses were examined daily, except on Sundays, by rubbing a dry sterile cotton-wool swab six times round the inside of each nostril. Staphylococci which coagulated plasma in a tube were regarded as *Staph. aureus*.

Results

Nasal Carriage of *Staph. aureus*.—Of the 221 babies examined between May and December, 1960, 38 (17%) were found to be nasal carriers of *Staph. aureus* on at least one day, but 20 of them were carriers on one day only. Eight babies were carriers on two days and only 10 babies had more than two positive swabs. Sixteen babies were carriers at their last examination before going home.

Sepsis.—There were no serious infections. Eleven babies had mild sticky eyes. From five of these pneumococci or α -haemolytic streptococci were isolated. *Staph.*

aureus was isolated from three babies; the eyes of three babies were not swabbed. One baby had a sty and three babies each had a single septic spot, *Staph. aureus* being isolated from the sty and two of the septic spots. The third septic spot was unswabbed. There was thus a known staphylococcal sepsis rate of 2.7%, or of 4.5% if the infection in the unswabbed eyes and unswabbed septic spot was assumed to be staphylococcal. Lesions were first noticed in the babies with known staphylococcal sepsis on the 4th, 5th, 7th, 10th (two babies), and 11th days.

Relationship of Nasal Carriage to Sepsis.—Four of the six babies with known staphylococcal sepsis were nasal carriers, in each of whom *Staph. aureus* had been found in the nose before the appearance of sepsis. There was thus a known staphylococcal sepsis rate of 10.5% among the 38 babies who acquired staphylococci in the nose (13.2% if the unswabbed septic spot is assumed to be staphylococcal) as opposed to a 1.1% sepsis rate for the 183 babies who did not become carriers (2.7% if the three unswabbed eye discharges are assumed to be staphylococcal).

Bacterial Air Counts.—Air sampling with a slit-sampler showed that the number of airborne staphylococci was very low. For 50 samples, each of 108 cu. ft. (3,058 cu. m.), there was a mean of 0.017 particle per cubic foot (0.600/cu. m.) carrying *Staph. aureus*. There were in all 7.14 bacterial particles per cubic foot (252/cu. m.) of air. Samples taken with a size-grading slit-sampler (Lidwell, 1959) showed that the staphylococcal particles had a mean equivalent particle diameter of between 13 and 14 microns, with a size distribution similar to that found in adult surgical wards (Noble, 1961). This size was greater than that of 5 microns reported by Eichenwald *et al.* (1960) for airborne particles carrying staphylococci in his nurseries.

Discussion

It is now clear that babies who become carriers of *Staph. aureus* in hospital run a greater risk of developing staphylococcal sepsis than those who do not become carriers. Among recent measures tried for preventing carriage, Gillespie *et al.* (1958) and Simpson *et al.* (1960), in an extension of the same work, have reported on the use of hexachlorophane powder applied to the umbilical area and to the whole trunk of the baby. They found that these measures greatly reduced staphylococcal colonization of the babies, particularly of the skin and umbilicus. Nasal colonization was reduced by half, but some 40% of the babies left hospital as nasal carriers. There was a greatly diminished incidence of staphylococcal sepsis in infants and mothers. Jennison and Komrower (1961) used combined neomycin-chlorhexidine nasal cream to reduce nasal colonization in newborn babies. They found an appreciable reduction in nasal colonization and in sepsis. Both groups of authors report trials in progress using a hexachlorophane powder and a nasal antibacterial cream.

In our nurseries the present regime has been the most successful so far tested. When no special steps were taken all our babies became nasal carriers of *Staph. aureus* by the 12th day (Cook *et al.*, 1958). The application of triple dye to the umbilical cord and washing the babies with a hexachlorophane preparation resulted in 46% of the babies reaching the 12th day free from nasal staphylococci. Staphylococcal sepsis occurred in 7.7% of the babies (Manfield *et al.*, 1960).

In the present series 83% of the babies remained free from nasal staphylococci, and when nasal colonization did occur it was seen on only one day in more than half of the carrier babies. Staphylococcal sepsis occurred in between 2.7% and 4.5% of the babies. It was of some interest that all the staphylococcal sepsis occurred on the fourth day or later, and perhaps might not have occurred in babies discharged from hospital within three days of birth.

Summary

A reduced incidence of nasal carriage of *Staph. aureus* and of sepsis has been achieved in a newborn nursery by the use of hexachlorophane soap for bathing, treatment of the cord with spirit and hexachlorophane powder, and daily application of neomycin cream to the babies' noses. Only 38 of 221 babies (17%) were nasal carriers of *Staph. aureus*, and only 10 of these had more than two positive swabs. The sepsis rate in carriers was 10.5%–13.2% as opposed to 1.1%–2.7% in non-carriers. Sepsis was not recorded in any baby before the fourth day.

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NASAL DISINFECTION IN PREVENTION OF POST-OPERATIVE STAPHYLOCOCCAL INFECTION OF WOUNDS

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Considerable emphasis has recently been laid on the part played by nasal carriage of staphylococci in leading to post-operative wound infection and on various other aspects of hospital cross-infection. Elek and Fleming (1960) postulate: "High nasal carriage rates in normal people combined with confined conditions in a hospital lead to a build-up of staphylococci in the surroundings; the noses of fresh individuals then become colonized in turn and void more staphylococci into the air and dust. . . . It is our belief that the crux of the problem lies in nasal carriage." Other observations point in the same direction. Williams *et al.* (1959), in a survey of

nasal staphylococci and sepsis in surgical patients, found that patients who were or became nasal carriers of staphylococci had three times as much post-operative staphylococcal wound sepsis as those who were never carriers, and that in roughly half the cases the sepsis was due to a staphylococcus of the same type as was found in the nose. Since many of the patients apparently became nasal carriers before they developed wound sepsis, it seemed possible that self-infection from the nose was important in the aetiology of septic lesions.

If this were true then there would be sense in attempting to prevent the colonization by staphylococci of the noses of patients admitted to surgical wards of a hospital, and one might reasonably expect to find a lowering of the sepsis rate where such an attempt had been successful. Gillespie *et al.* (1959) included nasal disinfection as one of the measures examined in their attempts to prevent wound infection and considered that it had value, but they made several modifications in the ward routine during their studies. This paper describes an experiment in which nasal prophylaxis was the only control measure tried.

Methods

The patients were men and women admitted to the general surgical wards of two hospitals in a provincial town, the hospitals being combined and operated as a group hospital. Both routine waiting-list and emergency cases were included, but patients with open fractures or operations on the rectum, anus, or genito-urinary tract were excluded, it being felt that the nature of these cases might predispose to sepsis.

On admission or as soon after as possible each patient's nose was swabbed, the swab being previously moistened with broth, and then a tube of nasal disinfectant cream† was given to patients whose hospital number ended with an even digit, and a tube of control cream to those where it was odd. The tubes were identical in appearance and were labelled by a piece of adhesive tape on which "even" or "odd" had been printed. The identity of the odd and even tubes was not disclosed to the sister or nursing staff on the wards, and in fact was known only to the hospital pharmacist and bacteriologist until the study was over.

A real attempt was made to apply either cream into the nostrils as soon as possible after admission, and this was usually done on the same day as admission. At week-ends, especially with emergencies, this was not possible, and patients admitted on Saturday afternoon or Sunday were not swabbed nor did they have the cream applied until Monday morning. In the case of waiting-list patients who were admitted in the afternoon, swabbing and application of cream took place next morning.

The first few patients were given the tubes of cream and told what to do; but it soon became obvious that further instruction was required, and the routine adopted was to swab the nose, squeeze some cream on to the patient's finger-tip, and then ask the patient to insert the finger in each nostril in turn and to spread the cream round the inside of the alae nasi. The patient was then instructed to insert the cream four times daily and if necessary to ask for a second tube. A second nasal swab was taken 10 days or so later, usually at the same time as a swab was taken from the wound.

†The cream was "naseptin," containing chlorhexidine hydrochloride 0.1% w/w, neomycin sulphate B.P. 0.5% w/w, supplied together with the tubes of inert base by Imperial Chemical Industries Ltd.

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