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Increased Incidence of Neonatal Staphylococcal Pyoderma in Males

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A prospective study was performed to evaluate neonatal staphylococcal pyoderma. Significantly more males returned with staphylococcal colonization and skin disease after discharge from the nursery. Additionally. colonization at some time during the stay in the newborn nursery places an infant at increased risk for staphylococcal skin disease. MILITARY MEDICINE. 149. 7:408. 1984

Direct application of agar plates to skin is an effective method of detecting skin colonization.[1-3] In addition. direct contact may make pos sible semiquantitative colony counts, as the agar surface is a replica of the organism distribution on the cultured skin.[4] Utilizing Rodac plates, Brown et al[5] demonstrated the superiority of direct contact over dry swab methods for monitoring colonization of infant skin by *Staphylococcus aureus*. Their data suggested that infants having quantitatively higher colony counts on direct agar-skin contact plates might be at a higher risk of developing staphylococcal skin disease.

A prospective study was designed to evaluate the predictive value nf semiquantitative Rodac plate cultures to determine colonization of the newborn skin by *S. aureus* prior to discharge from the nursery.

Materials and Methods

Patients (infants). A birth cohort of 158 infants, 79 males and 79 females, was cultured by direct contact plate technique twice prior to discharge from the nursery. Informed consent was obtained from the parents of newborns prior to admission to the

newborn nursery. The mean ages of infants at time of culture were one day and two and one-half days, corresponding to release from the nursery to rooming-in and discharge to home, respectively. A culture was taken at 72 hours for all infants not ready for discharge on the third day of life. At the time of the second culture. all infants were assigned a return appointment for 10-14 days of age (mean time for follow-up cultures: 12.5 days). One-hundred-eighteen infants completed the entire protocol, 56 males and 62 females.

Direct Contact culture plates. The nursery cultures were obtained by the direct agar-skin contact method, using Rodac plates containing five per cent sheep red blood cells (Clinical Standards Laboratories, Carson, Calif.). The agar surface of the plate was applied directly to the skin surface just to the right of the umbilicus. The agar surface was pressed down with even pressure and slight rocking motion to insure even distribution of agar-skin contact. Care was taken not to twist or slip the agar to prevent smudging the culture inocula on the agar surface. Follow-up swabs. Cultures were obtained from infants returning to the follow-up clinic, using dry cotton swabs to sample the skin just to the right of the umbilicus, Swabs were used since qualitative and not quantitative culture were desired. Swabs were cultured on blood agar and mannitol salt agar plates. Any disease lesions detected during this period were cultured by the same swab method.

Staphylococcal isolates. Organisms were identified on plates by colonial morphology and confirmed microscopically. Direct contact plates were counted after 24 and 48 hours, and all staphylococcal isolates were tested for catalase, DNAase, and coagulase. All coagulase-positive staphylococci, except those isolated from disease lesions were phage typed by the Department of Health, State of Hawaii.

During the study, the names of the patients were not known to the laboratory. All laboratory evaluations were done by culture numbers and reported back to the physician by number. The follow-up examinations were performed by physicians in the Well-Baby Clinic, or by staff pediatricians when infants presented with skin infections before their scheduled appointments. The physicians performing these examinations were unaware of previous culture findings.

Statistics. The statistical significance of the results was evaluated using the chi-square distribution with one degree of freedom. Results

Colonization data. Results of the first culture established an overall 5.7 per cent colonization rate. Overall colonization rate after the second cultures was 9.5 per cent. The nursery colonization rate determined by an infant having at least one positive nursery culture was 13.3 per cent (Table I).

TABLE I

S AUREUS CULTURE RESULTS FOR INFANTS BEGINNING

THE STUDY (n = 158)

Sex	Number of Infants Number of In-fants	Colonized in the Nurs-ery
Male	79	11(13.9%)

Female	79	10 (12.7%)
Total	158	21 (13.3%)

Of the original 158 infants cultured in the nursery, 118 (75 per cent) returned for follow-up culture and examination by a physician. Of the 118 infants completing the study. the nursery colonization rates was 16 per cent (Table II). with 5.9 per cent positive on first culture and 11.9 per cent positive on second culture.

TABLE II
S. AUREUS CULTURE RESULTS FOR INFANTS COMPLETING THE STUDY (n = 118)

Sex	Number of Infants	Number of Infants Colonized In The Nursery	Infants Colonized Diagnosed	Number Colonized With Pyoderma At Follow-up
Male	56	9(16.1%)*	13(23.2%)**	9 (16,1%)**
Female	62	10(16.1%)	3 (4.8%)	2 (3.2%)
Total	118	19(16.1%)	16(13.8%)	11 (9.3%)

* Eight of nine were circumcised
** All males were circumcised

Sixteen of the 118 (13.5 per cent) infants completing the study had evidence of staphylococcal colonization on return visit. Five infants were culture-positive on return visit without evidence of disease. Ten infants had culture-proven staphylococcal pyoderma. One additional infant was treated at an outlying dispensary for bullous impetigo: however. no culture was taken. All pyoderma observed occurred after discharge from the nursery.

Disease data. Eleven infants (9.3 per cent) completing the study developed staphylococcal skin infection (Table II). Infants who were colonized at some time in the nursery developed pyoderma more often than culture negative infants ($p < 0.01$) (Table III).

TABLE III
STAPHYLOCOCCAL SKIN DISEASE AS A FUNCTION OF NEWBORN NURSERY COLONIZATION

	Culture Positive Nursery Infants	Culture Negative Infants	Total
Disease	4	7	11
No Disease	15	92	107
Totals	19	99	118

Phage type results. Phage typing was completed for 25 *S. aureus* isolates from the 21 infants who were positive in the nursery. Six phage type patterns were observed for 20 *S. aureus* isolates: the remaining five were non-typable (Table IV). One infant had two different *S. aureus* isolates from the first nursery culture as determined by phage type. Four infants with previous positive nursery cultures returned with disease (Table IV). Phage typing was available on follow-up culture isolates from eight infants. Five of these infants were previously culture-positive for *S. aureus* in the nursery. One infant had the same phage type, while four infants had different phage types. Phage types were not obtained from disease lesion isolates.

TABLE IV
PHAGE TYPES OF S. AUREUS ISOLATES

Number of Culture >From Culture Positive	Numher of Isolates Infants Who Later Developed Disease	Positive Infants Phage Type
10	1	95
4	1	53/83A
2	1	96
2	0	79
1	0	81
1	0	83/95
5	1	Nontypable
4	10	Increase

Results by sex. Of 118 infants completing the protocol, 56 were males and 62 were females (Table II). Completing the study were 19 infants previously culture-positive in the nursery, nine males and ten females. At the time of follow-up examination. 16 of the 118 infants had evidence of staphylococcal colonization (positive cultures or disease). **Thirteen of the 16 colonized infants were, males (S. $p < 0.005$), all circumcised. Nine of 56 males (16 per cent) completing the study developed pyoderma, compared with two of 62 (three per cent) females (S, $p < 0.025$). All nine males were circumcised.** Four of the nine males previously positive in the nursery by direct contact culture, returned with pyoderma (S. $p < 0.025$). Neither of the two females with disease had positive cultures in the nursery.

Results of colony count. Significant overgrowth of skin flora Gram-negative organisms on the Rodac culture plates made quantitation of *S. aureus* colonies technically difficult. Probably as a consequence, there was no relationship between the actual semiquantitative colony counts of *S. aureus* and subsequent skin disease.

Discussion

This study did not confirm any superiority of quantitative culture over simple qualitative culture. However, colonization at some time during the stay in the newborn nursery place an infant at increased risk for staphylococcal skin disease. The phage typing data suggest that the source of the staphylococci is multiple rather than single.

There was a difference between the colonization rate in the nursery and the disease rate when infants were compared according to sex. Although there was no statistical difference in the colonization rate while in the nursery, significantly more male infants returned with staphylococcal colonization and skin disease after discharge from the nursery.

A larger study involving more infants is required to validate the finding of increased neonatal staphylococcal skin disease in males. That study should employ a more selective culture medium to enhance growth Gram-positive cocci and inhibit Gram-negative rods, facilitating quantitative colony counts of S. aureus.

The disparity between the disease and colonization rates of male and female infants after discharge from the nursery was not foreseen. Circumcision, which is performed on approximately 90 per cent of male infants born in our hospital, may be a factor. Circumcision, by its very nature. requires more staff-patient "hands-on" contact, both during the procedure and during preoperative and postoperative care.

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References

1 Brown, J., Wannamaker. L. W., and Ferrieri, P.: Enumeration of B-haemolytic streptococci on normal skin by direct agar contact. *J. Med. Microbiol.*, 8:503. 1975.

2 Brvte, L., Gillquist, J.. and Tdrnvik, A.: Wound infections in general surgery. Wound contamination. rates of infection and some consequences. *Acta Chir. Scand.*, 142:99. 1976.

3 Raahave, D.: Agar contact plates in evaluation of skin-dis infection. *Dan. Med. Bull.*, 20:204, 1973.

4 Dotson, C. R., Brown, J., and Leonard, T.: A comparison of mannitol salt agar and blood agar Rodac plates to monitor colonization of newborn skin by staphylococci. *Abst. Ann. Meet. Am. Soc. Microbiol.*, C-79. 1980, p. 287.

5 Brown. J.. Bowen. F. W., and Cheldelin, L. V.: Direct skin agar contact. Indicator of Staphylococcus aureus colonization and subsequent disease of neonatal skin. *Abst. Ann. Meet. Am. Soc. Microbiol.*, C-122. 1975.

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