

Hazards of Handling

A STUDY OF FLORA IN AN OPEN NEONATAL UNIT

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SUMMARY

A study of the bacterial flora among infants, mothers, staff (nursing and medical), and the environment of a neonatal unit is outlined. On admission to the unit, 60.5% of babies were already infected, presumably from contact with medical staff. By day 15 this number had increased significantly. A large number of mothers (40% on day 1, and 91% on day 15) were found to be carrying pathogenic organisms, providing a significant bacterial reservoir in the unit. Few pathogens were isolated from the environment.

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The indefinable bond between mother and child is probably formed before delivery, and clinical observations have shown that separation of mother and child immediately after delivery adversely affects both.¹ In the infant, detrimental effects on motor and mental development have been described, while a mother who is deprived of handling her infant may subsequently be less attached to the child compared with one who experienced early contact.

There are two further considerations governing admission policies for neonatal units serving lower socio-economic communities in underdeveloped countries. Firstly, the birth rate is high in these groups, necessitating a more rapid turnover, and secondly, the number of available nursing staff handling these neonates is frequently small. As a result of these factors, more neonatal units are now permitting mothers to feed, clean and handle their babies.²⁻⁴ One of the main factors that has previously led to the exclusion of mothers from nurseries has been the fear of the spread of infection. In the developed countries, with the present methods of control, the presence of the mother has not led to an increase in the rate of colonisation or the occurrence of neonatal infection.^{2,3} No studies exist, however, for nurseries in underdeveloped countries, where conditions are often not optimal. Neonatal infections under these circumstances are still common.⁵

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It was thus the purpose of this study to: (a) determine the incidence of infection in a random group of babies, mothers and staff (nursing and medical) in a nursery for the newborn; (b) determine the types of infection present; (c) determine whether, and how much, transfer of bacterial infection from staff/mother to baby occurs; and (d) examine the bacterial flora of the environment.

PATIENTS AND METHODS

A total of 159 pre-term infants weighing less than 2 000 g were admitted to the neonatal unit of Harare Hospital in the 2 separate months during which the study was undertaken (November 1972 and February 1973). Of these, a statistically random sample of 38 babies (24.5%) and 36 mothers (there were two sets of twins), plus all staff, i.e. doctors and nurses, was studied.

During the survey, nasal, umbilical and rectal swabs were taken from the babies on admission, while nasal, throat and rectal swabs were similarly taken from mothers and medical staff. All swabs were repeated on an average of 15 days later (range 3-29 days). Swabs were broth-moistened and plated within 30 minutes onto conventional media, including nutrient, blood, chocolate and MacConkey's agar. After incubation at 37°C for 24 hours, colonies were picked and identified by standard methods. Anaerobic culture was not undertaken.

Swabs were also taken from the environment, which included special care, isolation, transitional and normal pre-term wards, plus the kitchen area. Floors, walls, wall cracks, window sills, lampshades, cots and apparatus of various sorts were similarly examined.

RESULTS

Incidence of Infection

Table I summarises the number of positive swabs obtained from each of the 3 groups studied.

On day 1, 23 (60.5%) of the babies had positive swabs, but of these only 4 (10.5%) showed evidence of clinical infection. By day 15, a further 12 babies had been infected for the first time, and of the first group, 10 had acquired a second organism on culture, making a total of 45 organisms isolated (118.4%). Thirty-one babies (81%) had evidence of clinical infection. Fifteen mothers (41.6%) had positive swabs on admission. This increased to 33 (91.6%) by day 15. Only one mother had clinical infection, and a *Shigella* organism was cultured from her stool.

TABLE I. NEONATAL SURVEY: PRE-TERM INFANTS/MOTHERS, NURSING AND MEDICAL STAFF

	No.	Day 1				Day 15				Comment
		+ve org. on swabs	%	Clinical infection	%	+ve org. on swabs	%	Clinical infection	%	
Babies	38	23	60,5	4	10,5	45	118,4	31*	81,0	10/38 had 2nd organism
Mothers	36	15	41,6	—	—	33	91,6	1	2,1	1 <i>Shigella</i> infection
Staff	44	20	45,4	—	—	25	56,8	—	—	

* 23 (13 + 10) had *Staph. pyogenes* or *E. coli* (74%); conjunctivitis, umbilical sepsis, gastro-enteritis.

Forty-four staff members were examined. On day 1, 20 (45,4%) were shown to be positive for a pathogenic organism, and the number of positive swabs rose to 25 (56%) by day 15.

Types of Infection

Table II lists the diagnoses and outcome of the babies who were infected. The major pathology was umbilical sepsis, gastro-enteritis and pneumonia. There were 5 deaths (10,3%): two died from necrotising enterocolitis, 2 from pneumonia with gastro-enteritis, and one from recurrent pneumonia with a congenital heart lesion. The remainder recovered and were discharged well.

TABLE II. INFECTIONS FOUND IN BABIES IN THIS SERIES

No.	Infection	Outcome
17*	Umbilical sepsis	Well
15*	Gastro-enteritis	2 died†
6*	Pneumonia	3 died†
2	Pemphigus neonatorum	Well
2	Conjunctivitis	Well
1	Congenital syphilis	Well
—		
43		5 deaths

* 12 babies out of 31 had two infections.

† Postmortem examinations were done on all these cases.

Transfer of Infection

Table III lists the organisms cultured from the babies, mothers and staff. The most common organism isolated was *Staph. pyogenes* and 46% of these organisms were resistant to penicillin. On day 1, *Staph. pyogenes* was found in 16 babies, 7 mothers and 17 staff members. This increased to 25, 17 and 22 respectively by day 15. Pathogenic (typable) *E. coli* was the next most common organism isolated. There were 10 types, of which types 127, 119 and 114 were most frequently found. On admission, 4 infants, 6 mothers and 3 staff members carried these organisms, while 15 days later the total number had increased to 13 and 9 in infants and mothers respectively, no *E. coli* being isolated from staff members at this time. Table III also summarises other organisms found: these included, in order of frequency, *Strep. faecalis*, *Proteus*, *Pseudomonas*, *Shigella*, *Strep. pneumoniae*, *Klebsiella* and *H. influenzae*. It is interesting to note that *Shigella* organisms were isolated from 3 mothers. One was present on day 1, while the other 2 were cultured on subsequent days during the time that the mothers were in hospital nursing their infants. However, only one baby was clinically infected.

The number of concomitant infections in mother and baby is shown in Table IV. On day 1, 8 out of 45 (17,7%) organisms were found in both mother and child. There were 4 *Staph. pyogenes*, 2 *E. coli* and 2 *Pseudomonas* cases. After ± 15 days, 30 out of 94 organisms (31,8%) were present in both mother and baby.

TABLE III. ORGANISMS CULTURED

Organism	Day 1			Day 15		
	Babies	Mothers	Staff	Babies	Mothers	Staff
<i>Staph. pyogenes</i>	16	7	17	25 (+ 9)	17 (+ 10)	22 (+ 5)
<i>E. coli</i>	4	6	3	13 (+ 9)	9 (+ 3)	3 (+ 0)
<i>Strep. faecalis</i>	3	—	—	6 (+ 3)	—	—
<i>Proteus</i>	5	—	1	7 (+ 2)	1 (+ 1)	1 (+ 0)
<i>Pseudomonas</i>	2	1	—	3 (+ 1)	— (- 1)	—
<i>Strep. pneumoniae</i>	—	1	—	1 (+ 1)	— (- 1)	—
<i>Klebsiella</i>	—	—	1	—	—	1 (+ 0)
<i>H. influenzae</i>	—	—	—	1 (+ 1)	3 (+ 3)	—
<i>Shigella</i>	—	—	—	— (- 1)	3 (+ 3)	—
Total	30*	15	22	56	33	27

More than one type of organism found in 7 patients.

TABLE IV. MOTHER AND BABY CORRELATION

Organism	Day 1	%	Day 15	%
<i>Staphylococcus</i>	4	8,8	24	25,5
<i>E. coli</i>	2	4,4	2	2,1
<i>Shigella</i>	0	—	2	2,1
<i>Proteus</i>	0	—	2	2,1
<i>Pseudomonas</i>	2	4,4	—	—
Total	8	17,7	30	31,8

Environment

The organisms recovered from the environment were chiefly non-pathogens, and included spore-bearing bacilli, micrococci, diphtheroids and *Neisseria catarrhalis*. Of the few pathogens isolated, most were *Staph. pyogenes* (57% penicillin-resistant) cultured from the floor.

DISCUSSION

There are 3 main sites from which bacterial colonisation of the newborn arises: nasopharyngeal spread of the organisms, contaminated handling, and an infected environment. In normal circumstances (i.e. excluding respirators, etc.) the most important method of bacterial transmission is by handling.^{6,7} This study outlines the importance of medical staff in the aetiology of early infection of the newborn. In spite of all the babies having been removed from their mothers directly after birth, precluding maternal contact as a source of infection, 60,5% of the babies were infected by the end of the first day. These organisms could only have come from contact with medical staff. By 2 weeks of age, though maternal staphylococci did not increase significantly in number, 25 babies (an increase of 56%) were found to be infected. These data strongly suggest that the increase in infection rate came mostly from the medical staff.

Though the help of mothers in the nursery has many advantages, avoiding as it does the separation of mother from child and providing much-needed 'manpower', the data demonstrate the high percentage of mothers carrying pathogenic organisms. On day 1 over 40% of mothers had pathogenic organisms isolated, which increased to 91% by day 15. The potential hazard of babies being exposed to this significant maternal bacterial reservoir requires to be stressed, while the absolute increase in the numbers of babies becoming infected during their stay in hospital, as compared with other units,^{3,8} emphasises the need for careful monitoring of mothers from the lower socio-economic groups, and medical staff, before they are freely admitted to the neonatal unit.

All members of staff working in the neonatal unit either roll their sleeves, remove jewellery, wash their hands and use a 0,04% Hibitane solution before handling any baby, or wear theatre-type shirts, similarly washing their hands as above. Caps, boots and masks are not worn. Mothers are allowed freely into the unit but all are required to remove their normal hospital-issued blouse, wash their hands and breasts, and put on a clean gown

and overshoes. A Hibitane solution is applied to their hands before handling their babies. Any ill mother or staff member is excluded from the unit until she or he has recovered.

Although the wearing of masks and gowns does not reduce the infection rate,⁹ encouraging the mothers to go through the motions of aseptic techniques reinforces the image of 'cleanliness in the unit' which is so desirable. In addition, these mothers do not usually wear shoes; thus the wearing of canvas overshoes reduces significantly the amount of dust brought into the unit.

Neonates are not bathed. After birth, babies are simply dried and all blood, vernix, etc. gently wiped away, while their cords are treated with a 0,04% Hibitane-in-spirit solution. No prophylactic antibiotics are used, nor are cords dressed. Though bathing infants with 3% hexachlorophene reduces the colonisation rate of staphylococci,¹⁰ Forfar *et al.*¹¹ have shown that the use of this agent increases infection caused by Gram-negative organisms and there is evidence that this substance gives rise to neurotoxic complications in both animals and man.¹² Artificial colonisation of infants with selected strains of *Staph. aureus* of low resistance has resulted in termination of hospital outbreaks of infection.¹³ However, this method can only be used in the face of an epidemic and cannot be recommended as a routine. As the umbilical cord is readily colonised at birth and is a direct portal of entry of organisms into the blood, and since umbilical sepsis was the most common clinical condition present, many might advocate the use of daily prophylactic Polybactrin-spray until the cord falls off.¹⁴ If no topical antibiotics are used, an occlusive dressing has been found to be preferable to leaving the cord exposed.¹⁵ As nasal carriage and infection rate by *Staph. aureus* have been found to be reduced by the use of Naseptin nasal cream,¹⁶ this too might be beneficial and worth a trial.

Though some pathogens were isolated from the nursery environment, these were surprisingly few in number and insignificant in type. This tends to diminish environmental factors, but rather underlines the importance of staff and mothers as the major source of infant contamination in this, a neonatal unit in an underdeveloped country.

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