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Hydrophobic Material in Routine Umbilical Cord Care and Prevention of Infections in Newborn Infants

ALF MEBERG[1] and ROLF SCHØYEN[2]

From the Departments of [1]Paediatrics, [1]Obstetrics and Gynaecology, and [2]Microbiology, Vestfold Central Hospital, Tønsberg, Norway

In a prospective randomized study 2 different regimens for umbilical disinfection in newborn infants were tested: (i) a bandage of hydrophobic material (Sorbact®; $n=1213$), and (ii) daily cleansing with 0.5% chlorhexidine in 70% ethanol ($n=1228$). Infections were registered in the nursery as well as after discharge until 6 weeks of age, and bacterial cultures taken from infected areas. A total of 410 infections were registered in 377 (15.4%) of the 2441 infants. Total infection rates of 16.3 and 14.6% were found in the hydrophobic material group and the chlorhexidine-ethanol group respectively ($p>0.05$). No differences were found between the groups in infection rates in the nursery (8.9 vs. 8.7%), after discharge (7.4 vs. 5.9%), or in rates of different types of infections (conjunctivitis, pyoderma, paronychia, omphalitis) ($p>0.05$). 536 strains were isolated. 498 (92.9%) were gram-positive, 45 (8.4%) gram-negative, and 7 (1.3%) candida strains. 229 (55.9%) were Staphylococcus aureus strains. No differences were found between the two groups concerning distribution of the different strains isolated. Separation of the umbilical cord occurred significantly later in the hydrophobic material group than in the chlorhexidine-ethanol group (6.2 ± 2.2 vs. 5.8 ± 2.1 days; $p<0.05$). Hydrophobic material does not prevent infections more effectively compared to 0.5% chlorhexidine in 70% alcohol.

A. Meberg, MD, Department of Paediatrics, Vestfold Central Hospital, N-3100 Tønsberg, Norway

INTRODUCTION

Newborn infants are rapidly colonized with bacteria in the umbilical area after birth. This area serves as a reservoir for bacterial proliferation through bacterial digestion of the umbilical cord stump (1). The bacteria spread and colonize the infant elsewhere (skin, mucous surfaces), and may act locally as agents for nosocomial infections (pyoderma, conjunctivitis, paronychia, omphalitis) in the neonatal period (1, 2). Different regimens for routine umbilical cord care in the nursery, such as triple-dye, hexachlorophene and chlorhexidine disinfection have been shown to reduce the colonization rate with Staphylococcus aureus and other bacteria (3–5), and also to prevent neonatal infections (2, 6). Recent research has shown pathogenic bacteria to express hydrophobicity, and adhere to hydrophobic material through hydrophobic bindings (7–10). Gauze bandages of hydrophobic material have proven effective in enhancing healing of experimental wounds infected with S. aureus in young animals (10), and clinically in healing of infected wounds in man (11, 12). We put forward the hypothesis that a dressing of hydrophobic material on the umbilical cord stump might absorb bacteria, prevent bacterial colonization from the umbilical area, and through this mechanism prevent local infections. The purpose of the present investigation was to test this hypothesis through registration of infections in the nursery and outside hospital until 6 weeks of age for 2 groups of newborn infants treated with a hydrophobic material or 0.5% chlorhexidine in 70% ethanol, respectively for routine umbilical care in the nursery.

MATERIAL AND METHODS

Patients

The study was undertaken among newborn infants nursed in a maternity ward with modern sanitary facilities. The ward covers on average 2300 deliveries per year, and uses a day-time rooming-in system.

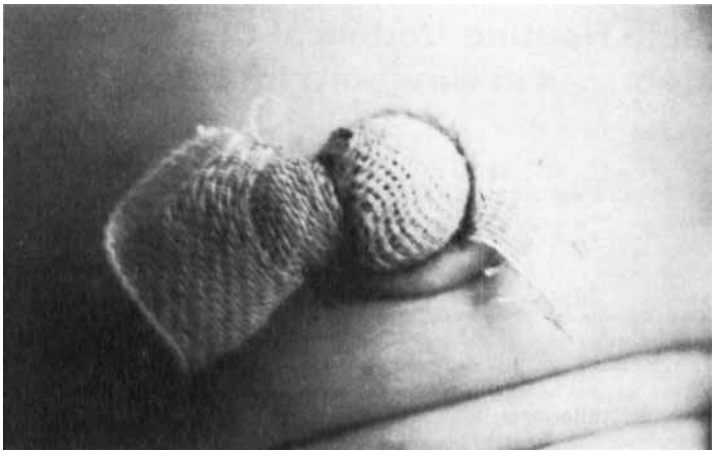

Fig. 1. Hydrophobic gauze material bandage for umbilical cord care.

Newborn infants consecutively born at Vestfold Central Hospital during a 16-month period November 1987 to February 1989 and admitted to the ward were randomly selected to one of two groups, one using a hydrophobic gauze material bandage (Sorbact®, LIC-Hygiene, Sweden) for umbilical care, the other using our routine umbilical disinfection regimen with daily cleansing of the cord stump with 0.5% chlorhexidine in 70% ethanol (NAF, Norway). Births were consecutively numbered, and infants with even and uneven numbers enlisted into the two groups respectively. Informed consent was obtained from the parents in every case enlisted. Only 4 infants had to be excluded because the parents rejected participation, all in the hydrophobic material group.

The hydrophobic material was carefully put to cover the whole umbilical stump, and the skin junction around the cord (Fig. 1). The material was changed once daily, and this regimen used as long as the infant stayed in the nursery. Both groups of infants were treated equally concerning severing of the cord (sterile scissor, sterile rubber string around the cord stump), daily bathing (Barnig soap solution, Sterisol AB, Sweden), and all other routines in the nursery. Hand wash with a soap solution (Sterisol AB, Sweden) was used by the staff before each patient contact. Mean stay in the nursery was 6.1 ± 1.6 days (mean $\pm$ SD) (range 3–13 days), and equal for the 2 groups ($p > 0.05$). Infants discharged before full 3 days of age or transferred to our special care baby unit, were excluded from the series.

Infections and microbiological investigations

Infections were carefully registered during the infants' stay in the nursery, and after discharge until 6 weeks of age through cooperation with the Child Health Centers. Samples for bacterial cultures were taken from infected areas. In the nursery the samples were immediately brought to the laboratory for culturing, while samples taken outside the hospital were transported in Stuarts medium. Cultures were performed on blood agar, chocolate agar, salt-mannitol agar and lactose-bromthymol agar using overnight incubation at 37°C. The isolates were identified according to the laboratory's standard procedures.

Statistical methods

χ^2-test, Wilcoxon signed-rank test and 2-tailed t-test were used for statistical analysis. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 2441 infants were included in the study, 1213 in the hydrophobic material group and 1228 in the chlorhexidine-ethanol group. 410 infections were registered in 377 (15.4%) of the infants. Table I gives the distribution of the different types of infections. No differences occurred between the hydrophobic material group and the chlorhexidine-ethanol group concerning total incidence of infections (16.3 vs. 14.6%) as well as distribution of the different types of infections in the hospital or after discharge ($p > 0.05$). The total incidence of infections

(8.8 vs. 6.6%) and the incidence of conjunctivitis (6.1 vs. 2.6%) were significantly higher in the nursery compared to outside hospital ($p<0.01$). Conjunctivitis accounted for 63.9% of the infections in the nursery. Omphalitis was significantly more frequently occurring after discharge than in the hospital (0.6 vs. 0.2%; $p<0.05$).

Table II shows the different bacterial and fungal strains cultured from the 410 infections. A total of 536 strains were isolated. Gram-positives were significantly more frequently occurring than gram-negatives (92.9 vs. 8.4%; $p<0.001$), with S. aureus being the dominant bacteria, accounting for 229 (55.9%) of the strains. No significant differences were found for the distribution of the different strains between the hydrophobic material group and the chlorhexidine-ethanol group ($p>0.05$).

The umbilical cord separated significantly later in the hydrophobic material group than in the chlorhexidine-ethanol group (6.2 ± 2.2 vs. 5.8 ± 2.1 days (mean $\pm$ SD); $p<0.05$). In the hydrophobic material group 252 (20.8%) of the cords separated after more than one week of age, compared to 208 (16.9%) in the chlorhexidine-ethanol group ($p<0.05$).

DISCUSSION

Routine umbilical cord care in the nursery using a hydrophobic material bandage did not prove more effective in prevention of infections during the first 6 weeks of life, neither in the nursery nor after discharge from hospital, than our routine disinfection regimen consisting of daily cleansing with 0.5% chlorhexidine in 70% ethanol. Infection rates and distribution of different bacterial and candida strains isolated from the infections, were equal in the two groups. A total infection rate of 15.4% during the first 6 weeks after birth is in accordance with

Table I. *Infections in newborn infants in the nursery and outside hospital (until 6 weeks of age) after treatment with a hydrophobic material bandage (Sorbact) or 0.5% chlorhexidine in 70% ethanol for umbilical disinfection in the nursery*

	Sorbact *n* (%)	Chlorhexidine-ethanol *n* (%)	Total *n* (%)
Total no. of patients	1 213	1 228	2 441
No. infected	198 (16.3)	179 (14.6)	377 (15.4)
In nursery			
No. of patients infected	108 (8.9)	107 (8.7)[a]	215 (8.8)[a]
Conjunctivitis	73 (6.0)[a]	75 (6.1)[a]	148 (6.1)[a]
Pyoderma	35 (2.9)	33 (2.7)	68 (2.8)
Paronychia	7 (0.6)	5 (0.4)	12 (0.5)
Omphalitis	1 (0.1)[a]	3 (0.2)	4 (0.2)[a]
Outside hospital			
No. of patients infected	90 (7.4)	72 (5.9)	162 (6.6)
Conjunctivitis	34 (2.8)	29 (2.4)	63 (2.6)
Pyoderma	47 (3.9)	31 (2.5)	78 (3.2)
Paronychia	12 (1.0)	10 (0.8)	22 (0.9)
Omphalitis	7 (0.6)	8 (0.7)	15 (0.6)

[a] $p<0.05$; statistically significant differences from infection rates outside hospital.

earlier investigations from our hospital (13), and with other investigations (6, 14). The infection rate was higher in the nursery than outside hospital, with conjunctivitis most frequently occurring in the nursery. Umbilical infections were more frequent after discharge. S. aureus, for years a dominant pathogen in nosocomial infections in nurseries (14), also dominated in the present investigation (55.9% of the infections). S. aureus strains possess high surface hydrophobicity (7) and bind to hydrophobic material (10). Such material is in experimental and clinical studies shown effective in accelerating healing of wounds infected with these bacteria (10, 12). Used prophylactically in this study, hydrophobic material did not prove more effective than chlorhexidine-ethanol in preventing infections.

Different regimens for routine umbilical disinfection are shown to inhibit bacterial colonization of the newborn (3–5), and some also to prevent neonatal infections. Seeberg et al. (2, 6) found a 4% chlorhexidine soap detergent to be effective in prevention of neonatal pyoderma and omphalitis. In our department we have earlier tested umbilical disinfection combined with whole body wash with the same 4% chlorhexidine soap detergent, as well as umbilical disinfection with benzine solution and 0.05% chlorhexidine aqueous solution, and not been able to document significantly preventive effects against infections during the first 6 weeks of life from any of these regimens, compared to daily soap wash alone (13). The infection rates found in the present investigation were nearly identical to those found in our earlier study, and

Table II. *Distribution of bacterial and candida strains, with no regards to etiologic significance, cultured from infections during the first 6 weeks of life in infants treated with a hydrophobic material (Sorbact) or 0.5% chlorhexidine in 70% ethanol for umbilical disinfection in the nursery*

	Sorbact *n* (%)	Chlorhexidine-ethanol *n* (%)	Total *n* (%)
No. of infections	216	194	410
Gram-positives			
Staph. aureus	120 (55.6)	109 (56.2)	229 (55.9)
Staph. epidermidis	66 (30.6)	63 (32.5)	129 (31.5)
Strept. viridans	38 (17.6)	35 (18.4)	73 (17.8)
Diphtheroids	1 (0.5)	5 (2.6)	6 (1.5)
Beta hemolyt. strept.	8 (3.7)	8 (4.1)	16 (3.9)
Group A	1 (0.5)	0	1 (0.2)
Group B	5 (2.3)	7 (3.6)	12 (2.9)
Group C	2 (0.9)	1 (0.5)	3 (0.7)
Non-hemolyt. strept.	3 (1.4)	3 (1.5)	6 (1.5)
Strept. pneumoniae	6 (2.8)	3 (1.5)	9 (2.2)
Enterococci	6 (2.8)	9 (4.6)	15 (3.7)
Peptostreptococci	0	1 (0.5)	1 (0.2)
Gram-negatives			
Haemophilus influenzae	3 (1.4)	4 (2.1)	7 (1.7)
E. coli	10 (4.6)	8 (4.1)	18 (4.4)
Proteus	2 (0.9)	1 (0.5)	3 (0.7)
B. catarrhalis	1 (0.5)	1 (0.5)	2 (0.5)
Bacteroides sp.	2 (0.9)	1 (0.5)	3 (0.7)
Acinetobacter	1 (0.5)	1 (0.5)	2 (0.5)
Coliforms	6 (2.8)	2 (1.0)	8 (2.0)
Alcaligenes	1 (0.5)	0	1 (0.2)
Enterobacter	1 (0.5)	0	1 (0.2)
Candida sp.	4 (1.9)	3 (1.5)	7 (1.7)

questions the effectiveness of the two present regimens tested. Colonization of the skin and mucous surfaces of the newborn with pathogenic bacteria does not only occur from the umbilical area, but also through contact with the mother during and after delivery, by hand contact from the nursery staff (15), and from air-transferred bacteria from carriers in the hospital (16). Bacteria aquired these ways may later on cause infections in the infant.

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