

Original Articles

Chlorhexidine Cleansing of the Umbilical Cord for Prevention of Umbilical Infection: A Hospital based Study in Bangladesh

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Abstract

Background: The umbilical cord is an important site for bacterial colonization. A possible consequence of bacterial colonization is cord stump infection, a factor that can greatly increase morbidity and mortality for infants in developing countries. Chlorhexidine cleansing of the cord can reduce neonatal mortality among newborns infants in low-resource settings with high risk of infection. This objective of this study was to determine the effect of cord cleansing with chlorhexidine in reduction of umbilical infection among newborns in hospital settings.

Methodology: Between April 2013 to July 2014, 510 newborns were randomly assigned within a tertiary level hospital in Bangladesh to receive 1 of 3 cord care regimens: single cord cleansing with 4% chlorhexidine (Group-1), multiple cord cleansing with 4% chlorhexidine (Group-2) and clean and dry cord care (Group-3 : control).

Results: The risk of umbilical cord infection (omphalitis) was significantly reduced in both the single (Relative risk [RR] 0.15 [95% CI] 0.008-0.93) and multiple chlorhexidine cleansing group (RR 0.37 [95% CI] 0.04- 0.99) compared to the dry cord care group. The risk of omphalitis was not significantly different between multiple and single chlorhexidine cleansing group (RR 3.14 [0.13-76.54]).

Conclusion: 4% chlorhexidine significantly reduce the risk of umbilical infection in both single and multiple cord cleansing groups as compared to clean and dry cord care group.

Keywords: Chlorhexidine, Umbilical Cord, Prevention of infection.

Introduction

Neonatal mortality rate in Bangladesh is still high (28/1000 live births) and 20% of which are due to sepsis.¹ The umbilicus is regarded as key entry point for invasive

pathogens, consequence of which is a cord stump infection, a factor that can greatly increase neonatal morbidity and mortality due to systemic sepsis.²⁻⁵ Pathogens can enter the bloodstream through the patent vessels of the newly cut cord even in the absence of overt signs of cord infection.⁵ Infection risk is greatest in countries like Bangladesh where most deliveries (>70%) take place at home, often attended by unskilled traditional birth attendants (TBAs) with suboptimal conditions and delivery places.⁶⁻⁷ Application of potentially harmful substances to the umbilical stump are still common (52%) in Bangladesh and are associated with a high risk of umbilical infection⁸. Chlorhexidine use substantially reduces bacterial colonization on the cord stump and may be associated with reduced superficial skin infections.^{2,9-11} Chlorhexidine has

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broad spectrum activity against gram-positive and gram-negative organisms, an extensive safety record, strong binding potential that results in residual effectiveness and low cost¹². Three communities-based randomized controlled trials in Nepal, Bangladesh and Pakistan identified safety aspects of chlorhexidine use in newborn infants¹³⁻¹⁵. A meta-analysis from three recent trials revealed application of 7.1% chlorhexidine digluconate (delivering 4% chlorhexidine) on cord reduce newborn mortality risk by 23% and eliminates two-thirds to three-quarters of serious umbilical infections.¹⁶ The objectives of the study were to determine the effect of cord cleansing with chlorhexidine in reduction of umbilical infection among newborns in hospital settings.

Materials and Methods

This was a randomized controlled trial carried out in the department of Neonatology and department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from April 2013 to July 2014. The study protocol was approved by the Institutional Review Board (IRB), BSMMU. All term and preterm healthy newborns delivered during the study period were included. Preterm or any sick newborns who needed NICU admission, newborns with congenital malformations and newborns with risk factors for sepsis were excluded. A total of 510 both term and preterm healthy newborns were enrolled and divided into three study groups using a simple randomization method. Each study group was assigned to one of three cord care regimens. **Group 1** was assigned for single cord cleansing group and 7.1% chlorhexidine digluconate solution (delivering 4% chlorhexidine) was applied as soon as possible after birth or within 24 hours of birth. **Group 2** was assigned for multiple cord cleansing group and same chlorhexidine solution was applied to the cord as soon as possible after birth or within 24 hours of birth and then repeat application once daily for up to 7 days. **Group 3** was assigned for clean and dry cord care and promoted dry cord care messages recommended by WHO and did not apply chlorhexidine to the cord. After proper hand washing with soap and water, two sterile cotton balls were soaked with 7.1% chlorhexidine digluconate solution. One cotton ball was used to gently cleanse the umbilical cord stump and another cotton ball was used to gently cleanse the base of the stump and the skin immediately around the base from center to periphery^{13, 15}. During the hospital stay, chlorhexidine was applied to the cord by the investigator in either OPD of department of

Neonatology or in operation theater room of department of Obstetrics and Gynecology, BSMMU. After discharge from hospital, chlorhexidine was applied to the cord once daily by parents or family members at home to complete a total of 7 days. Parents and family members of the group 2 newborns were trained about the application of chlorhexidine to the cord during the time of hospital stay¹⁵. Sufficient sterile cotton balls and chlorhexidine solution in 25 ml opaque bottle were supplied to caregivers for application at home. Chlorhexidine solution (7.1% chlorhexidine digluconate delivered 4% chlorhexidine) used in the trial was prepared by diluting a 20% stock solution of aqueous chlorhexidine digluconate (ACI Limited, Dhaka, Bangladesh) with distilled water. The prepared chlorhexidine solution was packaged into 250 ml and 25 ml opaque bottles and were supplied to NICU, BSMMU with free of cost only for research purpose after ensuring 6 months stability test.

Caregivers of all newborns in all groups were received educational messages about clean and dry cord care practice according to WHO and also advised to follow it after application of chlorhexidine during the total neonatal period. Newborns of all 3 groups were followed up for 7 times in assigned date (Day 1, 3, 5, 7, 14, 21 and 28) by the concerned physician for signs of umbilical cord infection and features of sepsis during the total neonatal period. Mother was oriented about the signs of umbilical infection during the hospital stay with colored photograph of umbilical cord infection and report to concerned physician if any. Researcher was communicated with the parents or other family member over mobile phone in assigned date. If any signs of cord infection were observed by the parents or other family members, parents were requested to bring their baby to NICU, BSMMU for umbilical cord swab culture and treatment. In each follow up during hospital stay or after discharge at home, findings were observed by the researcher or information's reported by parents or other family members were recorded. Umbilical cord swab culture and septic screening were done in all babies who developed signs of umbilical infection. Treatment was given to all babies who developed umbilical infection according to NICU, BSMMU protocol. Omphalitis was defined as the presence of signs of inflammation such as redness and swelling, foul smelling from the cord or pus either in the cord stump or in the skin at the base of stump¹³. Omphalitis was graded into mild, moderate and severe¹³. Mild omphalitis was defined as redness and swelling, foul smelling from the cord or pus restricted to the cord stump. Moderate omphalitis was defined as

redness and swelling, foul smelling from the cord or pus extending to the skin at the base of cord stump < 2 cm. Severe omphalitis was defined as inflammation extending > 2 cm from the cord stump, with or without pus¹³.

An informed written consent was obtained from parents or legal guardians of the babies. All demographic information and detailed history relevant to the research work were collected from the parents or other family members and from obstetrics record by a structured questionnaire and data collection sheet. Collected data were compiled and analyzed with the help of SPSS (Statistical package for social sciences) Version 20.0. Quantitative data were expressed as mean and standard deviation and comparison were done by ANOVA test and independent unpaired student's t-test. Qualitative data were expressed as frequency and percentage and comparison were carried out by chi-square (X²) test. P value < 0.05 was considered statistically significant. Variable like umbilical infection was analyzed according to above plan.

Results

A total of 510 newborn babies were included (170 in each group), 47 of them were dropped out from different groups due to incomplete follow up, needed

NICU admission, application of local antibiotics/antiseptics or other harmful substances and parents having no interest to continue the research. Finally 463 newborns (single chlorhexidine cleansing 153, multiple chlorhexidine cleansing 146 and dry cord care 164) were completed the study. Demographic characteristics of mother, household and babies were comparable in newborns of all 3 groups.

The risk of umbilical cord infection (omphalitis) was significantly reduced in both the single (Relative risk [RR] 0.15 [95% CI] 0.008-0.93) and multiple chlorhexidine cleansing group (RR 0.37 [95% CI] 0.04-0.99) compared to the dry cord care group. The risk of omphalitis was not significantly different between multiple and single chlorhexidine cleansing group (RR 3.14 [0.13-76.54]). The risk of mild omphalitis was significantly low in single (RR 0.34 [95% CI] 0.014-8.70)) but not in multiple chlorhexidine cleansing group (RR 1.12 [95% CI] 0.07-17.79) as compared to dry cord care group. The risk of moderate omphalitis was significantly low both in single (RR 0.21 [95% CI] 0.01 - 0.97) or multiple (RR 0.22 [95% CI] 0.01 – 0.98) chlorhexidine cleansing groups as compared to dry cord care group. No severe omphalitis was found in our study. Out of 4 omphalitis cases, 3 babies had growth on umbilical swab culture (1-Acinetobacter, 1-Staph. Aureus and 1-pseudomonas).

Table-I
Umbilical cord infections (omphalitis) in different groups (n=463).

Group	No of live births	No of Omphalitis Case	Risk per 100 live birth	Relative Risk (95%CI)
Group 1	153	0	0	0.15 (0.008 -0.93)
Group 2	146	1	6.85	0.37 (0.04- 0.99)
Group 3 (control)	164	3	18.29	1.0
Group 2	146	1		3.14 (0.13 -76.54)
Group 1	153	0		1.0

RR reached from Chi-square test

Table-II
Grading of omphalitis in different groups (n=463)

	No of live births	No of omphalitis cases	Relative risk(95% CI)
Mild omphalitis			
Group 1	153	0	0.34 (0.014-8.70)
Group 2	146	1	1.12 (0.07-17.79)
Group 3 (control)	164	3	1.0
Moderate omphalitis			
Group 1	153	0	0.21 (0.01 – 0.97)
Group 2	146	0	0.22 (0.01 – 0.98)
Group 3 (control)	164	2	1.0

RR reached from Chi-square test

Discussion

In this study, 7.1% chlorhexidine significantly reduce umbilical cord infection in the single (RR 0.15 [95% CI] 0.008-0.93) and multiple (RR 0.37 [95% CI] 0.04-0.99) chlorhexidine cleansing group as compared to the dry cord care group but there was no significant difference in reduction of omphalitis between the single and multiple chlorhexidine cleansing group (RR 3.14 [0.13-76.54]) (Table I). These findings were consistent with another 3 community based studies; in Nepal¹³, Bangladesh¹⁴ and Pakistan¹⁵ though the intervention groups were slight different in Nepal and Pakistan's studies. In our study, in single cord cleansing group 7.1% chlorhexidine was applied to the cord as soon as possible after birth or within 24 hours of birth, in multiple cord cleansing group 7.1% chlorhexidine was applied to the cord as soon as possible after birth or within 24 hours of birth and repeat application once daily for up to 7 days and control group was assigned for clean and dry cord care recommended by WHO and did not apply chlorhexidine to the cord. In Nepal study, Mullany and colleagues reported a 32-75% reduction in the incidence of omphalitis in infants receiving cord cleansing with 4% chlorhexidine on days 1-4, 6,8 and 10 compared with those receiving dry cord care. In Pakistan Study, the total clusters were randomly allocated to one of four groups (group A to D). Group A received chlorhexidine to the cord just after birth by TBA and then once daily for 14 days along with hand washing. Group B received hand washing only, group C received chlorhexidine to the cord only similar to group A and group D received dry cord care only. Chlorhexidine acts by binding to the bacterial cell wall and disrupting its membrane, leading to increased permeability and cell content leakage. It has broad spectrum activity against gram-positive and gram-negative organisms and strong binding potential that results in residual effectiveness. Chlorhexidine binds to the umbilical cord and continues to exert antimicrobial effect for several days¹². Therefore its use reduces bacterial colonization and infection on the umbilical cord stump².

In our study, chlorhexidine significantly reduce mild omphalitis in single chlorhexidine group (RR 0.34[0.014-8.70]) and moderate omphalitis both in single (RR 0.21[0.01-0.97] and multiple (RR 0.22 [0.01-0.98]) chlorhexidine cleansing group as compared to dry cord care group (Table II). Our study finding was consistent with the findings of a meta-analysis from 3 randomized controlled trials in Nepal, Bangladesh and

Pakistan¹⁶. Organisms isolated in umbilical swab culture were *Acinetobacter*, *Staphylococcus aureus* and *Pseudomonas* species which was similar to locally isolated organism from blood and other culture in our hospital wards and nurseries. The organism pattern in our study is slightly different from the previous hospital & community based studies¹⁷⁻¹⁸. The isolated organisms of these studies were *S. Aureus*, group A streptococcus, group B streptococcus, *E coli*, *klebsiella* and anaerobic bacteria. This difference in organism patterns was probably due to different local organism patterns in the hospital nurseries of the study areas.

Conclusion

Application of 7.1% chlorhexidine digluconate (delivering 4% chlorhexidine) to the umbilical cord significantly decrease the risk of omphalitis(mild to moderate) and markedly decrease in single chlorhexidine cleansing group than the multiple chlorhexidine cleansing group.

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