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Effect of Topical Application of Human Breast Milk Versus 4% Chlorhexidine Versus Dry Cord Care on Bacterial Colonization and Clinical Outcomes of Umbilical Cord in Preterm Newborns

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Abstract

Introduction: The umbilical cord is one of the routes of entry of microorganisms that can cause infection. Hence, affordable, effective and safe cord care regimens are needed to prevent from such infections.

Methods: The study was conducted in Nehru hospital, PGIMER, Chandigarh with the objective to assess the effect of two cord care regimens-human breast milk, 4% chlorhexidine on bacterial colonization and other clinical outcomes. A total of 105 subjects were enrolled and randomized into three groups (35 subjects in each group) Human breast milk, 4% chlorhexidine and dry cord care group (control group). Information about the baseline data of subjects was collected. Thereafter, the umbilical cord swab baseline sample was taken and cultured from each of the subjects. The first application (either breast milk or 4% chlorhexidine) was done immediately after the baseline cord swab sample was taken. In the dry cord care group (control group), nothing was applied on the cord, it was left dry and exposed to air and the napkin was folded below stump. Cord swab was again taken at 72±12 hours and at 120±12 hours after birth. Umbilical cord separation time was noted.

Results: There was no statistical significant difference in cord colonisation at baseline (p=0.13). At 72±12 hours, 34.3%, 5.7% and 51.4% had colonisation in the breast milk, chlorhexidine and dry cord care respectively (p<0.001). At 120 ±12 hrs, 22.9 % had bacterial colonisation in the breast milk group, 71.4% in the dry cord care group whereas only 2.9% in the chlorhexidine group (p<0.001). The timing of cord separation was 9.09±2.4 days ,12.65± 2.9days and 10.54 ±3.1days in the breast milk, chlorhexidine and dry cord care respectively with maximum separation time with chlorhexidine application and least time taken in the breast milk group (p<0.001).The main microorganisms detected were Klebsiella pneumoniae, E coli, Enterococcus fecalis, Acinatobacter baumanii, Enterococcus faecium, Staphyloccocus hemolyticus, Streptoccoccus. Majority of colonisation was seen with dry cord care as compared to breast milk and chlorhexidine application.

Conclusion: It is concluded that 4% chlorhexidine is very effective in reducing pathogenic bacteria colonisation of the cord. Further, human breast milk, to some extent, can reduce bacterial colonisation in low resource setting and is a better alternative to dry cord care.

Keywords: Umbilical cord care; Cord colonization; Cord separation time

Introduction

The umbilical cord is an excellent medium for bacterial colonization during the intrapartum period while passage through the birth canal and immediate postpartum from the environment [1]. The environmental source includes the hands of the caregivers [2]. The umbilical cord vessel is the direct entry route for invasion of microorganisms into the newborn's circulation. Delay in cord detachment may increase risk of bacterial infection [3]. The tissue of the cord stump can serve as a medium for bacterial growth. This is particularly true in cases where the stump is left moist and certain unclean substances are applied to it. The umbilical stump is a common means of entry for systemic infection in the newborn infant [4]. Umbilical cord infection can either be localized to the cord (omphalitis) or can spread through the blood stream and become systemic causing neonatal sepsis [4]. In hospital settings, *Staphylococcus aurues* is the most common organism being cultured. The other common organisms that have the potential to cause cord infections in hospitals includes group and *E. coli* [4]. Fatima et al. (2011) reported that 80% of all pathogens that caused community acquired omphalitis are *S. aureus* and beta hemolytic streptococci. Cord infection is most prevalent among newborns born in developing countries and it contributes to potential risk of developing life threatening

neonatal sepsis [5]. Preterm babies have immature immune system as compared to term babies; therefore, the chance of infection is increased in preterm babies.

Umbilical cord care after birth until its separation is an important component in newborn care. Usually, the umbilical cord can become colonized with potential pathogenic bacteria during the intra partum or postpartum period. These pathogenic bacteria are likely to invade the umbilical stump, which can lead to omphalitis [6]. Colonization of the cord stump by pathogenic organisms leading to infection can cause morbidity and mortality of newborn especially in the developing countries [7].

The cord care interventions that are followed in both developed and developing countries to help reduce exposure of the cord to pathogens includes use of clean cord cutting device, proper hand washing before and after handling the baby, to bathe the infant with antimicrobial agents and to apply these agents on the cord [3]. WHO recommends application of chlorhexidine daily on the umbilical cord of newborns during the first week of life .This is particular with the newborn born in hospital setting or in other settings where the neonatal mortality rate is high [8].

Current routine cord care in India includes keeping the cord dry. However, findings from the study conducted by Kaur [9] demonstrated 100% positive for pathogenic bacteria with dry cord care [9]. Although the practices of cord care such as applying of harmful substances are reduced but Bhatt et al. [10] reported in their study that oil or ghee including cream, turmeric powder was applied on the umbilical cord [10].

Current protocols for aseptic cord care are based on research studies being done in developed countries. This evidence generated does not provide a clear understanding of the best cord care practices. In developing countries there is a significant difference in availability of resources, social customs and values, environmental cleanliness which serve as a barrier for implementation of research evidence from developed countries [3].

Triple dye, ethyl alcohol, betadine or chlorhexidine was applied at the tip and around the base of the umbilical stump daily to prevent colonization [11]. Antiseptic solutions such as chlorhexidine can decrease the risk of infections as well as bacterial colonisation in health care settings [12]. A randomised controlled trial found that skin cleansing using chlorhexidine is safe and can reduce skin flora in newborns [13].

Human breast milk was applied on the cord which reduced bacterial colonization and cord separation time [2,14]. Human milk contains large amounts of IgA antibodies and antibacterial which can improve the immunity of babies. It promotes growth and repair of musculoskeletal system. The presence of polymorph nuclear leukocytes and other immunologic compounds in the breast milk can decrease the process of cord separation [2]. Colostrum contains large amount of natural antimicrobial agents and can provide specific and non specific passive immunity to the babies [15].

The objective of the study was to compare the effect of topical application of human breast milk versus 4% chlorhexidine versus dry cord care on bacterial colonization, clinical outcomes of umbilical cord in preterm newborns .The clinical outcomes of umbilical cord includes cord separation time and presence of u, nilical cord infection.

Method

An experimental research design was used in the study. A total of 105 preterm newborn ≤34 weeks of gestation born in Nehru hospital, PGIMER, Chandigarh were enrolled in the study. Both healthy and sick preterm neonates were recruited between 3 to 12 hours after birth. Newborn with cord abnormalities such as omphalocele and mothers of newborn who refuse to participate in the study were excluded .The mothers of the newborn were then informed about the aim of the study and written consent was obtained. A structured interview schedule was used to gather information about the baseline data of subjects. After collection of baseline data, baseline umbilical cord swab sample was taken from each of the neonate. Thereafter, each neonate enrolled was randomized to any of the three group's Human breast milk, 4% chlorhexidine or dry cord care group. The first application (either breast milk or 4% chlorhexidine) was done immediately after the baseline cord swab sample was taken. In the dry cord care group (control group) ,the umbilical cord was kept dry and exposed to air and napkin was folded below stump . Topical application of human breast milk or 4% chlorhexidine was done once a day daily till the cord falls off. Cord swab was again taken on the 3rd and 5th day after birth. Umbilical cord separation time was noted and also the presence of any cord infection. Ethical approval for the study was obtained from the Institute Ethics Committee. Mothers were informed about the procedure and written consent was taken. Protocols for topical application of human breast milk, 4% chlorhexidine were developed. The statistical analysis of the data collected was done using Statistical Package for Social Sciences (SPSS version 20.0).Both descriptive and inferential statistics was used for data analysis and interpretation for the 105 subjects. Dichotomous outcomes and categorical data were compared by Chiquare test. Analysis of Variance (ANOVA) was used to compare the mean between groups and Kruskall Wallis was used for comparison of median.

Results

Table 1 describes the distribution of subjects according to baseline data. The mean gestational age and weight was 31 weeks and 1400 grams respectively.

Table 2 shows the distribution of newborn according to time period from birth to the first intervention. In majority of the subjects the time gap of first intervention ranges between 6-12 hours.

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Table 1: Distribution of subjects according to baseline data N=105.

Variables	Breast milk group (n_1=35)	Chlorhexidine group(n_2=35)	Dry cord care group(n_3=35)	χ^2 (df) p value ANOVA
Gestational age (in weeks)				
<31	8(22.9)	10(28.6)	7(20)	0.79(4)
31-32	16(45.7)	14(40)	16(45.7)	0.93
33-34	11(31.4)	11(31.4)	12(34.3)	
Mean±SD	31.60±1.70	31.39±2.02	31.41±1.014	p=0.8
Sex of newborn				
Male	12(34.3)	23(65.7)	20(57.1)	7.40(2)
Female	23(65.7)	12(34.3)	15(42.9)	p=0.02
Weight in grams				
<1000	3(8.6)	2(5.7)	2(5.7)	
1000-1249	8(22.9)	9(25.7)	9(25.7)	2.71(6)
1250-1499	13(37.1)	12(34.3)	8(22.9)	p=0.84
>1499	11(31.4)	12(34.3)	16(45.7)	
Mean±SD	1426.4±381.9	1411.1±302.14	1479.89 384.36	p=0.74

Table 2: Distribution of newborn according to time period from birth to the first intervention N=105.

Time gap of first intervention (in hours)	Breast milk group (n_1=35)	Chlorhexidine group(n_2=35)	Dry cord care group(n_3=35)	Chi square , Kruskal wallis test
<6	14(40)	13(37.1)	19(54.3)	χ^2 =2.39,df=2
6-12	21(60)	22(62.9)	16(45.7)	p=0.30
Median	8	9	5	p=0.30
IQR	3-12	3-12	3-11	

Table 3 shows the comparison of newborn colonised with pathogenic bacteria between the three groups. The groups showed statistical significant difference in bacterial colonisation at 72±12 hrs (p<0.001) and at 120±12 hrs (p<0.001) with the highest colonisation in the dry cord care group and the least in the chlorhexidine group.

Table 4 shows the comparison of umbilical cord separation time between the three groups. The maximum cord separation time was in the chlorhexidine group and minimum time in the breast milk group. Cord separation time was statistically significant between the three groups (p<0.001).

Table 3: Comparison of newborn colonised with pathogenic bacteria in different groups N=105.

Culture swab	Breast milk group (n1=35)	Chlorhexidine group(n2=35)	Dry cord care group (n3=35)	Chi square
Baseline culture	5(14.3)	6(17.1)	1(2.9)	χ2=23.95,df=2p=0.13
72±12 hrs	12(34.3)	2(5.7)	18(51.4)	χ2 =17.6,df=2p<0.001**
120 ±12 hrs	8(22.9)	1(2.9)	25(71.4)	χ2=39.75,df=2p<0.001**

Table 4: Comparison of timing of umbilical cord separation in different groups (in days) N=105.

Umbilical Cord separation time(in days)	Human breast milk group (n1=35)	Chlorhexidine group (n2=35)	Dry cord care group(n3=35)	Chisquare, ANOVA
<8	7(20)	1(2.9)	5(14.3)	
8-12	25(71.4)	16(45.7)	20(57.1)	χ2=17.21,df=4p=0.002**
>12	3(8.6)	18(51.4)	10(28.6)	
Mean±SD	9.09 ± 2.44	12.65 ± 2.93	10.54 ±3.13	P=0.001**

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Figure 1 depicts the newborn colonised by pathogenic organisms at baseline. The main microorganisms detected were Klebsiella pneumonia, E.coli, Enterococcus fecalis, Acinatobacter baumanii, Staphylococcus homonis, Enterococcus faecium, Staphyloccocus hemolyticus, Streptoccoccus.

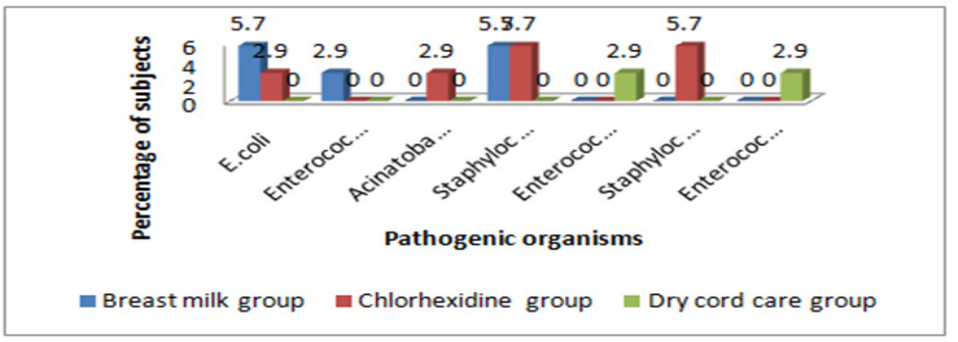

Figure 1: Pathogenic organism's colonization with baseline culture.

Figure 2 shows the percentage of newborn colonised by pathogenic organisms at 72±12 hours. The most common microorganisms found were *Klebsiella pneumonia, E. coli, Enterococcus fecalis, Acinatobacter baumanii, Staphylococcus aureus, Staphylococcus homonis, Enterococcus faecium, Staphyloccocus hemolyticus, Streptoccoccus* and *Enterococcus gallinarum.*

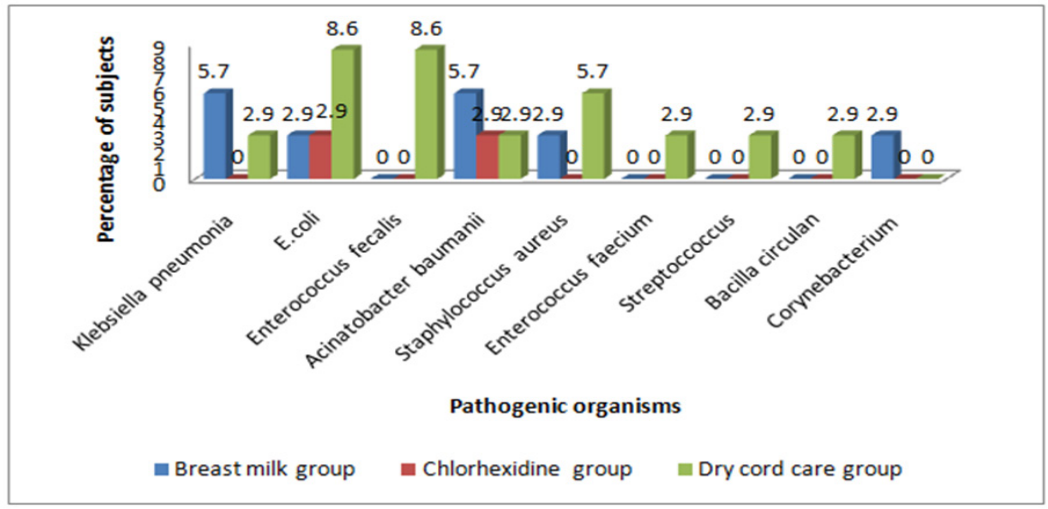

Figure 2: Pathogenic organism's colonization at 72±12 hours.

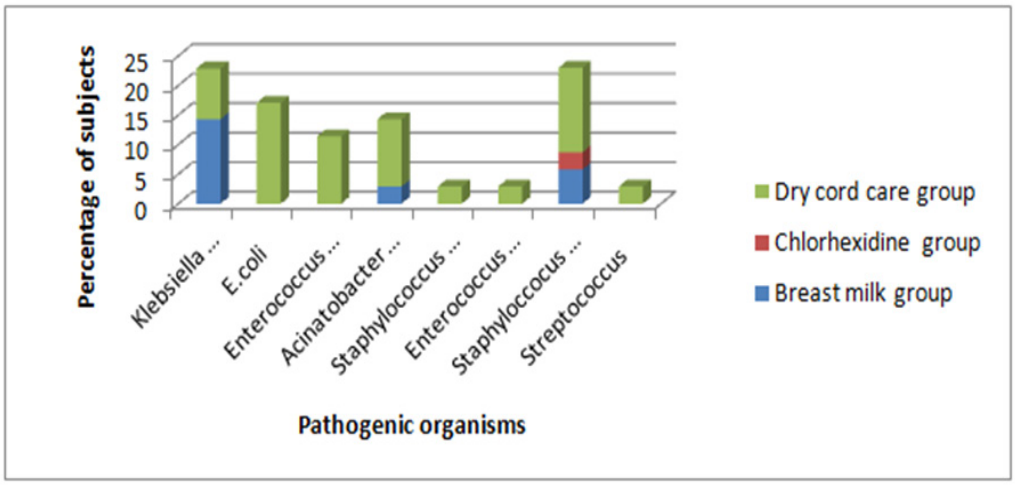

Figure 3: Pathogenic Organisms colonization at 120 ±12 hours.

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Figure 3 depicts the colonization of newborn with pathogenic bacteria at 120 ±12 hours. The pathogenic microorganisms that were cultured include *Klebsiella pneumonia, E. coli, Enterococcus fecalis, Acinatobacter baumanii, Staphylococcus homonis, Enterococcus faecium, Staphyloccocus hemolyticus, Streptoccoccus.* Majority of colonisation was seen in the dry cord care group as compared to the breast milk and chlorhexidine group.

Discussion

In the present study, preterm newborn ≤34 weeks gestation were recruited with majority of the newborn's birth weight <2500 grams. This is similar to Pezzati et al. [16] whereby preterm newborns <34 weeks and birth weight of <2500g were included in the study to compare salicylic sugar vs. chlorhexidine.

In the present study baseline culture was taken just before the interventions. Similar protocol was followed by Mahrous et al. [7] where baseline umbilical cord swab was taken after birth and before interventions [17]. The umbilical cord swab sample for bacterial colonization was taken by using sterile cotton swab stick and single stroke was made at the umbilical cord base .This protocol is matched with that of Abd El Hamid AA et al where the first cord swab was taken from the umbilical cord stump after delivery 2.Three cord swab sampling were taken –baseline cord swab, 2nd culture at 72±12 hours and 3rd sample at 120 ±12 hours which is in contrast with that of Abd El Hamid AA et al whereby two cord swab sample were taken immediately at birth and after 3 days2. 40% of the neonates' baseline culture was taken within 6 hours of birth in the breast milk group while 37% and 54% in the chlorhexidine and dry cord care group respectively. Abd El Hamid et al. [15] in their study comparing different cord care regimens took the first swab 3 hours after birth. Single or multiple cleansing with 4% chlorhexidine to the cord sump using cotton swabs was done 19 which was also done in the present study where application of 4% chlorhexidine using sterile cotton swabs once a day till cord separates.

Findings of this research showed no statistical significant difference in colonization rate with baseline culture(p=013). At 72±12 hours ,34.3% of the neonates in the breast milk group were colonised with pathogenic bacteria as compared to 5.7% in the chlorhexidine group and 51.4% in the dry cord care group. Statistical analysis of the findings showed a highly significant difference in the bacterial colonisation between the three groups at 72±12 hours of life (p<0.001).High percentage of pathogenic organisms (71.4%) was found in the dry cord care group at 120 ±12 hours whereas it is an interesting finding that only 2.9% of the neonates in the chlorhexidine group had bacterial colonization. Highly significant difference in bacterial colonization was reported at 120 ±12 hours (p<0.001).This study is comparable to findings by Mahrous ES where there was a significant difference in bacterial colonisation during the follow up visits [9].

The mean cord separation time in chlorhexidine group was 12 days as compared to 10 days in dry cord care group and 9 days in breast milk group. The mean cord separation time had significant difference among the three groups (p<0.001). Study of Abbaszadeh et al. [14] also reported shorter cord separation in human milk group (7.15±2.15days) than in chlorhexidine group (13.28±6.79 days) [18].

The different pathogenic microorganisms that colonised the umbilical cord were *Klebsiella pneumonia, E. coli, Enterococcus fecalis, Acinatobacter baumanii, Staphylococcus homonis, Enterococcus faecium, Staphyloccocus hemolyticus, Streptoccoccus* and is in accordance with findings reported in various studies where the most common pathogenic microorganisms were E. coli, Klebsiella pneumonia, Pseudomonas, Staphyloccocus [7,19].

Conclusion

The objective of the study is to compare the effect of topical application of human breast milk versus 4% chlorhexidine versus dry cord care on bacterial colonization, clinical outcomes of umbilical cord in preterm newborns. The findings of the study show that there was statistical significant difference in the bacterial colonisation and umbilical cord separation time between the three groups (p value <0.005). It can be concluded that 4% chlorhexidine is very effective in reducing bacterial colonisation of the umbilical cord. Further, human breast milk to some extent can reduce bacterial colonisation in low resource setting and is a better alternative to dry cord care.

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