Comparing the Impacts of Topical Chlorhexidine and Dry Cord Care on Umbilical Cord Separation Time among Neonates

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Department of Midwifery, Kashan University of Medical Sciences, Kashan, Iran. They were assigned to chlorhexidine and dry cord care groups. In the first group, 4% chlorhexidine solution was applied to the cord stump 3 h after birth and then every 12 h until 2 days after cord separation. The mothers of neonates in the dry cord care group were recommended to avoid using any material on the cord stump. The signs of cord stump infection were assessed by mothers on a daily basis and also by the second author at four-time points, namely, 3 h after birth (in hospital), 3 and 7 days after birth (through home visits), and 2 days after cord separation (through home visits). UCS time was documented by mothers. The Chi-square and the independent-samples t-tests were used to analyze the data. Results: UCS time in the chlorhexidine group was significantly longer than the dry cord care group (13.28 ± 6.79 vs. 7.85 ± 2.51 days; P < 0.001). The longest separation time in these groups was 53 and 17 days, respectively. There were no significant differences between the groups with regard to infection signs, namely, discharge, redness, foul odor, inflammation, and swelling (P > 0.05). Conclusion: Dry cord care not only is as effective as topical use of chlorhexidine in preventing cord stump infection but also is associated with shorter cord separation time.

**KEYWORDS:** Chlorhexidine, Infection, Neonatal care, Umbilical cord

**INTRODUCTION**

Umbilical cord separation (UCS) normally occurs in the first 2 weeks after birth. Delayed UCS, particularly after 1 month, is associated with different complications such as bacterial infection, neutrophil chemotaxis disorders, and unnecessary postpartum care and visits. Necrotic tissue of the cord is a good environment for bacterial growth and in case of delayed UCS and poor umbilical cord care; it can become rapidly infected. Infection, in turn, is among the leading causes of neonatal mortality. For example, tetanus causes around 300,000 neonatal deaths per year in the world, while one of the most common sources of tetanus infection is umbilical cord infections.

Umbilical cord care is performed through different antiseptic powders and solutions. The most commonly used powders are zinc oxide, talcum, starch, alum, hexachlorophene, and chlorhexidine, while the most commonly used solutions are alcohol, triple sulfa, tincture of iodine, silver sulfadiazine, and chlorhexidine. However, there is no consensus over the most effective agent for cord care. The World Health Organization recommended dry cord care.

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care, while there are great controversies about this method.[6]

Chlorhexidine is one of the most commonly used solutions for cord care. It substantially reduces bacterial colonization and infection of the cord stump.[7] According to the World Health Organization, in case of the need for antiseptic use for cord care, chlorhexidine is the agent of choice.[1] Evidence indicates that cord care using 4% chlorhexidine may reduce the risks of omphalitis, sepsis, and mortality rate in low-resource settings.[8,9‑12] A study also reported that compared with the dry cord care method, cord care using chlorhexidine was associated with shorter UCS time.[13] However, other studies showed that chlorhexidine prolonged UCS time.[14‑16] Given these controversies, it is still unknown whether chlorhexidine can decrease UCS time.

**Objectives**

This study aimed to compare the impacts of topical chlorhexidine and dry cord care on UCS time.

**Methods**

**Design and participants**

This was a quasi-experimental study. Study participants were 174 neonates recruited from two teaching hospitals affiliated to Kashan University of Medical Sciences, Kashan, Iran. Inclusion criteria were a gestational age of 37–42 weeks, 1- and 5-min Apgar scores of more than seven, residence in Kashan, intact membranes or membrane rupture for <12 h at birth, and no perinatal asphyxia, respiratory distress, metabolic disease, congenital disease or deformity, and any other problem requiring immediate hospitalization in neonatal Intensive Care Unit. Neonates were excluded if they or their mothers developed any disorder or disease that interfered with cord care according to the study protocol or their mothers did not adhere to the recommended cord care method.

Sample size was calculated using the findings of a study by Sharma and Gathwala, who examined the effects of chlorhexidine on UCS time and reported that the means of UCS times in their control and chlorhexidine groups were 10.31 ± 3.23 and 8.92 ± 2.77 days, respectively.[17] Then, considering Type I and II errors of, respectively, 0.05 and 0.2 and $S_1 = 3.23$, $S_2 = 2.77$, $\mu_1 = 10.31$, $\mu_2 = 8.92$, sample size for each group was estimated to be 74. However, given the potential withdrawal of participants from the study, sample size was expanded to 87.

**Intervention and data collection**

Neonates were alternatively allocated to chlorhexidine and dry cord care groups. Accordingly, in the 1st week of the study, all newly-born eligible neonates were allocated to the chlorhexidine group while in the 2nd week all neonates were allocated to the dry cord care group. This weekly alternation process was repeated until 87 neonates were recruited to each group. This type of allocation was used to prevent the communication of neonates’ mothers in the dry cord care group with those in the chlorhexidine group.

The primary outcome of the study was UCS whereas the secondary outcomes were the signs of infection, namely, redness, discharge, foul odor, inflammation, and swelling. A demographic and perinatal characteristics questionnaire and a cord stump assessment checklist were used for data collection. The questionnaire contained six items on neonate’s gender, mothers’ age, educational and employment status, vaccination against tetanus, and route of delivery. The checklist was used for the daily assessment of the signs of umbilical cord infection such as discharge, redness, foul odor, inflammation, and swelling. Moreover, it contained an item on the exact times of topical application of chlorhexidine. The content validity of the questionnaire and the checklist were assessed and confirmed by ten nursing and midwifery faculty members.

During the first 3 h after birth, a training session was held for each mother to inform her about the importance of umbilical cord care and the signs of cord stump infection. Moreover, mothers in the chlorhexidine group were taught to provide cord care using 4% chlorhexidine solution (Hydrex, Ecolab Co., Germany) as follows:

1. Soak a cotton swab in chlorhexidine through placing it in the orifice of the chlorhexidine bottle and inverting the bottle
2. Rub the soaked swab thoroughly on the skin surrounding the cord stump
3. Soak another swab in chlorhexidine in the same way and clean the tip of the stump (if the cord has not yet been separated) or the center of the cord stump (if the cord has been separated).

Mothers in both groups were asked to use the infection assessment checklist for daily assessment of the cord stump for the signs of infection until 2 days after UCS. Besides mothers, the second author also performed infection assessments, either in hospital or through home visits, at four time points, namely, during the first 3 h after birth (in hospital), three and 7 days after birth (through home visits), and 2 days after UCS (through home visits). Neonates were immediately visited by a neonatologist in case of any delay in UCS (i.e., a UCS time longer than 2 weeks) and any cord-related problems such as blood leakage, mucoid discharge, and granuloma formation. Mothers in the
chlorhexidine group were also taught to document the exact time of daily application of chlorhexidine. Moreover, during the first 3 h after birth, a swab sample was collected from the stump for microbial culture.

**Ethical considerations**

This study gained the approval of the Ethics Committee of Kashan University of Medical Sciences, Kashan, Iran (the approval code: 8922). It was also registered in the Iranian Registry of Clinical Trials (the registration number: IRCT201010285038N1). We informed the participating mothers about the aim and the process of the study, their absolute right to voluntarily withdraw from the study, and the confidential management of their personal information. Then, we obtained their written informed consents.

**Data analysis**

The SPSS software (v. 13.0; SPSS Inc., Chicago, IL, USA) was used to analyze the data. The Kolmogorov–Smirnov test revealed that the distribution of all variables was normal. The Chi-square and the independent-sample t-tests were used to compare the groups respecting demographic characteristics and UCS time. \( P < 0.05 \) was regarded as statistically significant.

**RESULTS**

A total of 174 neonates were recruited. Five neonates from the chlorhexidine and four from the dry cord care groups were excluded due to reasons such as respiratory distress, perinatal asphyxia, use of other cord care agents, or nonadherence to study protocol [Figure 1]. All neonates were born in baby-friendly hospitals with rooming-in policy. The umbilical cords of all neonates had been cut using sterile technique in the delivery room without the use of any antiseptic agent on the stump. Moreover, all mothers had received complete vaccination against tetanus. No significant differences were found between the groups respecting mothers’ and neonates’ characteristics (\( P > 0.05 \), [Table 1], the signs of cord stump infection (\( P > 0.05 \), [Table 2], the frequency of medical visits (\( P = 0.325 \)), and the presence of microorganisms in the cord stump in the first 3 h after birth (\( P = 0.281 \)). However, compared with the dry cord care group, UCS time in the chlorhexidine group was significantly longer (\( P < 0.001 \), [Table 3]).

**DISCUSSION**

The findings of this study showed that UCS time in the chlorhexidine group was significantly longer than the dry cord care group. The longest UCS time in the chlorhexidine and the dry cord care groups was 53 and

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**Table 1: Between-group comparisons of mother’s and neonate’s characteristics**

| Characteristics                  | Group             | \( P^a \) |
|----------------------------------|-------------------|-----------|
| Maternal age (years)             |                   |           |
| 15-24                            | Chlorhexidine \( n=82 \) | 0.693     |
|                                  | Dry cord care \( n=83 \)  |           |
| 25-29                            | 27 (32.9)         | 24 (28.9) |
|                                  | 29 (35.4)         | 26 (31.3) |
| 30-34                            | 16 (19.5)         | 18 (21.7) |
| 35 and more                      | 10 (12.2)         | 15 (18.1) |
| Mean ± SD                        | 27.20 ± 5.14      | 28.29 ± 5.35 |
| Mother’s educational status      |                   |           |
| Illiterate and primary           | Chlorhexidine \( n=82 \) | 0.595     |
|                                  | Dry cord care \( n=83 \)  |           |
| Guidance school                  | 12 (14.6)         | 13 (15.7) |
| High school                      | 16 (19.5)         | 15 (18.1) |
| University                       | 39 (47.6)         | 33 (39.7) |
|                                  | 15 (18.3)         | 22 (26.5) |
| Mother’s employment status       |                   |           |
| Unemployed                       | Chlorhexidine \( n=82 \) | 0.161     |
|                                  | Dry cord care \( n=83 \)  |           |
| Employed                         | 75 (91.5)         | 70 (84.3) |
|                                  | 7 (8.5)           | 13 (15.7) |
| Neonate’s gender                 |                   |           |
| Male                             | Chlorhexidine \( n=82 \) | 0.185     |
|                                  | Dry cord care \( n=83 \)  |           |
|                                  | 46 (56.1)         | 38 (45.8) |
| Female                           | 36 (43.9)         | 45 (54.2) |
| Route of delivery                |                   |           |
| Vaginal delivery                 | Chlorhexidine \( n=82 \) | 0.121     |
|                                  | Dry cord care \( n=83 \)  |           |
|                                  | 42 (51.2)         | 34 (41.0) |
| Cesarean section                 | 40 (48.8)         | 49 (59.0) |

\( ^a\)The results of the Chi-square test, \(^b\)Result of t-test. SD: Standard deviation.

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**Table 2: Between-group comparisons of the signs of local infection at cord stump site**

| Infection signs                  | Group  | \( P^b \) |
|----------------------------------|--------|-----------|
|                                  | Chlorhexidine \( n=82 \) |           |
|                                  | Dry cord care \( n=83 \)  |           |
| Discharge                        | 34 (41.5) | 33 (49.3) | 0.342     |
| Redness                          | 17 (20.7) | 15 (22.4) | 0.807     |
| Foul odor                        | 1 (1.2)  | 2 (3)     | 0.445     |
| Inflammation and swelling        | 9 (11)  | 7 (10.4)  | 0.918     |

\( ^b\)Some of the infants had no sign. \(^c\)The results of the Chi-square test.
Topical applications of chlorhexidine to the umbilical cord stump site among both full- and pre-term neonates.

Study findings also indicated no statistically significant between-group differences respecting the signs of infection. In contrast, Kapellen et al. found that the rate of cord-related problems among neonates who were treated with chlorhexidine was significantly lower than neonates who received dry cord care. The rate of cord-related problems in our study was much lower than that reported by Kapellen et al. because all neonates in our study were born in baby-friendly hospitals with rooming-in policy, their mothers had been vaccinated against tetanus, and they were breastfed immediately after birth. None of the neonates experienced granuloma formation and sepsis, and none of them needed hospitalization.

This study was done solely on full-term neonates. It is worthy to note that preterm neonates are more susceptible to infections and thus, studies are needed to determine the impacts of the topical use of chlorhexidine on UCS time among preterm neonates. The group allocation of the participants was not randomized in this study. Therefore a randomized controlled trial is suggested to be conducted. Moreover, future studies might evaluate the effects of topical use of chlorhexidine on the growth of pathogenic bacteria and normal skin flora at umbilical cord stump site among both full- and pre-term neonates.

**Conclusion**

Compared to dry cord care, topical use of chlorhexidine significantly prolongs UCS time. Moreover, there is no significant difference between the effects of these two techniques on cord stump infection. In other words, topical use of chlorhexidine not only has no advantage over dry cord care but also is associated with longer UCS time.

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**Conflicts of interest**

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